The Ranch Plan Planned Community
Planning Areas 3 and 4 Runoff Management Plan

Final Report (Approved November 2019)
Revision 1

Rancho Mission Viejo

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November 2019

Revised September 2023

JN 134519

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Project Manager:

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In Coordination with PACE:

Rebecca Kinney, PE (PACE)

Entitlement Compliance

The PA-3&4 ROMP Revision 1, submitted on September 15, 2023, is approved effective as of the signature date below, in compliance with the Ranch Plan Final Environmental Impact Report #589 Mitigation Measures 4.5-1 (Items 19, 21, 22, 25, 26, 27), 4.5-5 (Items 36-38), and 4.5-8 (Items 80-83 and 92-97), and the Ranch Plan Planned Community Program Text (Zoning) Condition of Approval 4 (Items 247-249). Upon approval, the PA-3&4 ROMP revision shall supersede any prior ROMPs approved for Ranch Plan Planned Community Planning Areas 3 and 4.

APPROVED:

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Nov 17, 2023

Date

Kevin Onuma, P.E.

County Engineer

OC Public Works

box SIGN 19YVXX81-4L2KXV5X

Nov 15, 2023

Nardy Khan, P.E., P.M.P

Date

Deputy Director, Infrastructure Programs

OC Public Works

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Nov 15, 2023

Justin Kirk, AICP

Date

Deputy Director, OC Development Services

OC Public Works

Foreword

The purpose of the PA-3 & 4 ROMP Revision 1 (Revision 1) is to update the mitigation analysis presented in the previously approved PA-3 and 4 ROMP (2019) based on the changes to the C-Complex Basins in PA-3. The Basis of Design Report for the C-Complex Basins (BoDR) provides the preliminary design for the C-Complex Basins including verification of appropriate basin volume and definition of the outlet structure rating curve. Revision 1 updates the last remaining basin system tributary to San Juan Creek from PA-3, therefore, Rancho Mission Viejo (RMV) is seeking approvals for the BoDR and Revision 1 focusing on the Phase-1, -2, and -3 developed condition. The Phase PA-1, -2, -3 and -4 developed condition and Ultimate condition presented in this document will be updated again in the future as PA-4 and PA-5 design details become more refined. RMV will provide additional revisions for review and approval as required to support the other proposed basins intended to mitigate runoff flows (expected value flows for all nodes included in the ROMP). In the case that another basin meets the criteria to be owned, maintained, and operated by OCFCD, the design flows (100-year high confidence flows) will be included in the Basis of Design Report for that basin system. The high confidence analysis will verify that the flowrates from Table 13 of the approved 2008 San Juan Creek Watershed Hydrology Study are not exceeded due to the proposed mitigation basin.

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1 Introduction

The Ranch Plan Planned Community Planning Area 3 and Planning Area 4 Runoff Management Plan that was approved on November 2019 (approved 2019 PA-3&4 ROMP) provided an update of the hydrology, hydraulics, water quality and stream stability analyses included in the "Comprehensive Regional Stormwater Plan for The Ranch Plan Planned Community Runoff Management Plan (Ranch Plan ROMP)" dated April 2013 prepared by Pacific Advanced Civil Engineering, Inc (PACE). This report will focus in detail on supporting the planning and design efforts of Planning Area 3 (PA-3) and Planning Area 4 (PA-4) within Rancho Mission Viejo (RMV).

The RMV Planning Areas are located within the San Juan Creek (SJC) watershed, which is approximately 176 square miles at the ocean outlet. The Ranch Plan regional vicinity map is shown in Figure 1-1.

The PA-3&4 ROMP Revision 1 consists of updating the flood and water quality design and mitigation for Planning Area 3 (PA-3), integrating the new Subwatershed C concept and verifying the overall regional integration with the Ranch Plan ROMP. All pertinent data from the approved 2019 PA-3&4 ROMP that is still applicable to the PA-3&4 ROMP Revision 1 will remain in place and will continue to be a part of this document. Revision 1 will focus on the updated flood and water quality design and mitigation for Planning Area 3 (PA-3) Subwatershed C and verify the overall regional integration with the Ranch Plan ROMP. Herein the term "C-Complex Basins" encompasses both the water quality and flood control basins, unless specified otherwise. The C-Complex Basin design considers the ultimate condition, with fully developed land uses from the PA-3 tributary areas.

1.1 Background

The Ranch Plan ROMP included five development Planning Areas: PA-1, PA-2, PA-3, PA-4, and PA-5, as shown in Figure 1-2. A description of each area, as described in the Ranch Plan ROMP, follows:

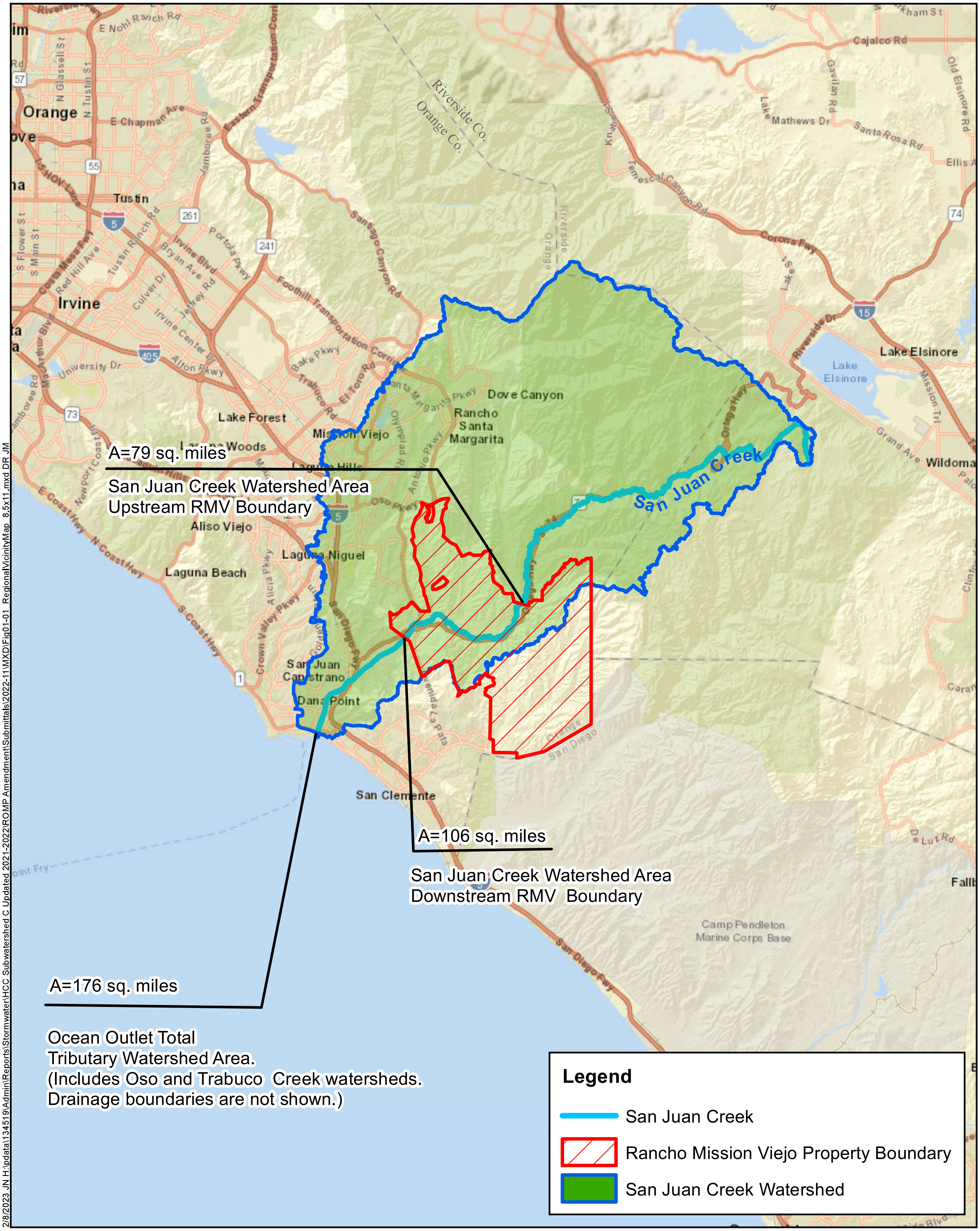
- PA-1 is located primarily in the Narrow Canyon watershed sub-basin. PA-1 is also referred to as the Sendero. Development in PA-1 consists of 704 Planning Area gross acres and 464 gross development acres. Planning Area 1 has been constructed per a planning level ROMP previously prepared and approved by the County.
- PA-2 is primarily located within the Chiquita Canyon sub-basin. Development in PA-2 consists of 1,680 Planning Area gross acres and 824 gross development acres. Planning Area 2 has been constructed per a planning level ROMP previously prepared and approved by the County.
- PA-3, the focus of this Planning Area Runoff Management Plan, is located within the Gobernadora and Central San Juan Creek regional watershed sub-basin. PA-3 includes 2,185 gross acres (Limits of PA Boundary). Figure 1-3 shows the portion of PA-3 that is being included as part of this ROMP.
- PA-4, another focus of this Planning Area Runoff Management Plan, is located within the Verdugo and Central San Juan Creek watershed sub-basins. PA-4 currently includes 1,127 gross acres (Limits of PA Boundary). The actual limits of the proposed development within PA-4 are significantly less than the gross acreage. Figure 1-3 shows the portion of PA-4 that is being included as part of this ROMP.
- PA-5 is located within the Central San Juan Creek and Trampas regional watershed sub-basins. Development in PA-5 would consist of 1,191 gross acres. This planning area will ultimately contain the large Santa Margarita Water District (SMWD) recycled water reservoir (Trampas

Reservoir); however, for this study the land uses, assumed grading and regional detention basins are the same as what was used in the approved Ranch Plan ROMP.

1.2 Previous Studies

The approved Ranch Plan ROMP (PACE, 2013), and the Ranch Plan Planned Community PA-2 Runoff Management Plan Update (PA-2 ROMP), prepared by Michael Baker International (formerly RBF Consulting) and approved in April 2014, were the primary background studies used in this PA-3&4 ROMP.

- **The Ranch Plan ROMP** document is a comprehensive watershed planning tool that was developed to support the planning and design efforts for future development within RMV. The document provides planning guidance that implements the specific mitigation measures required in the Final Environmental Impact Report No. 589 (FEIR), to address flood protection, surface hydrology, water quality, and stream stability for future RMV development. The guidelines and requirements in the Ranch Plan ROMP and the PA-2 ROMP were used to establish the studies for this focused PA-3&4 ROMP and provided the base models for the hydrology, hydraulic and stream stability analyses. This study used Geographic Information System (GIS) data, land use tables and base hydrology and hydraulic models developed as part of the Ranch Plan ROMP and PA-2 ROMP.
- **The PA-2 ROMP** (Michael Baker International [formerly RBF Consulting], 2014), updated the Ranch Plan ROMP models to incorporate the final PA-2 stormwater management plan. This document provided local and regional hydrology analysis of the SJC watershed, master plan storm drain hydraulics, water quality management and stream stability studies specific to the overall effects of the development of PA-2. This PA-3&4 ROMP update incorporates the final PA-2 ROMP models as needed and follows the future submittal requirements of Section 6.2 of the final PA-2 ROMP.



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RANCHO MISSION VIEJO PA-3&4 ROMP Revision 1

Regional Vicinity Map

Figure 1-1

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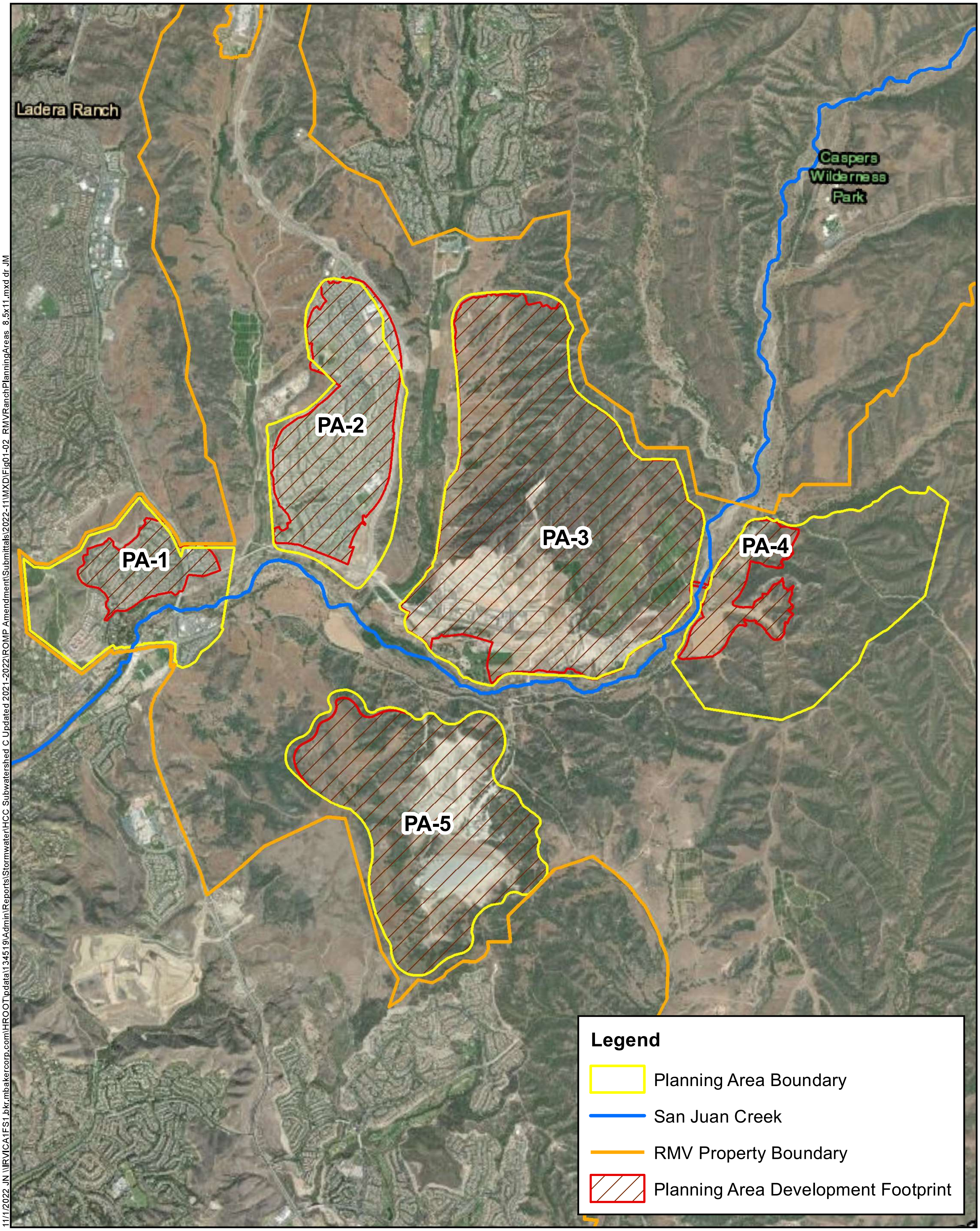

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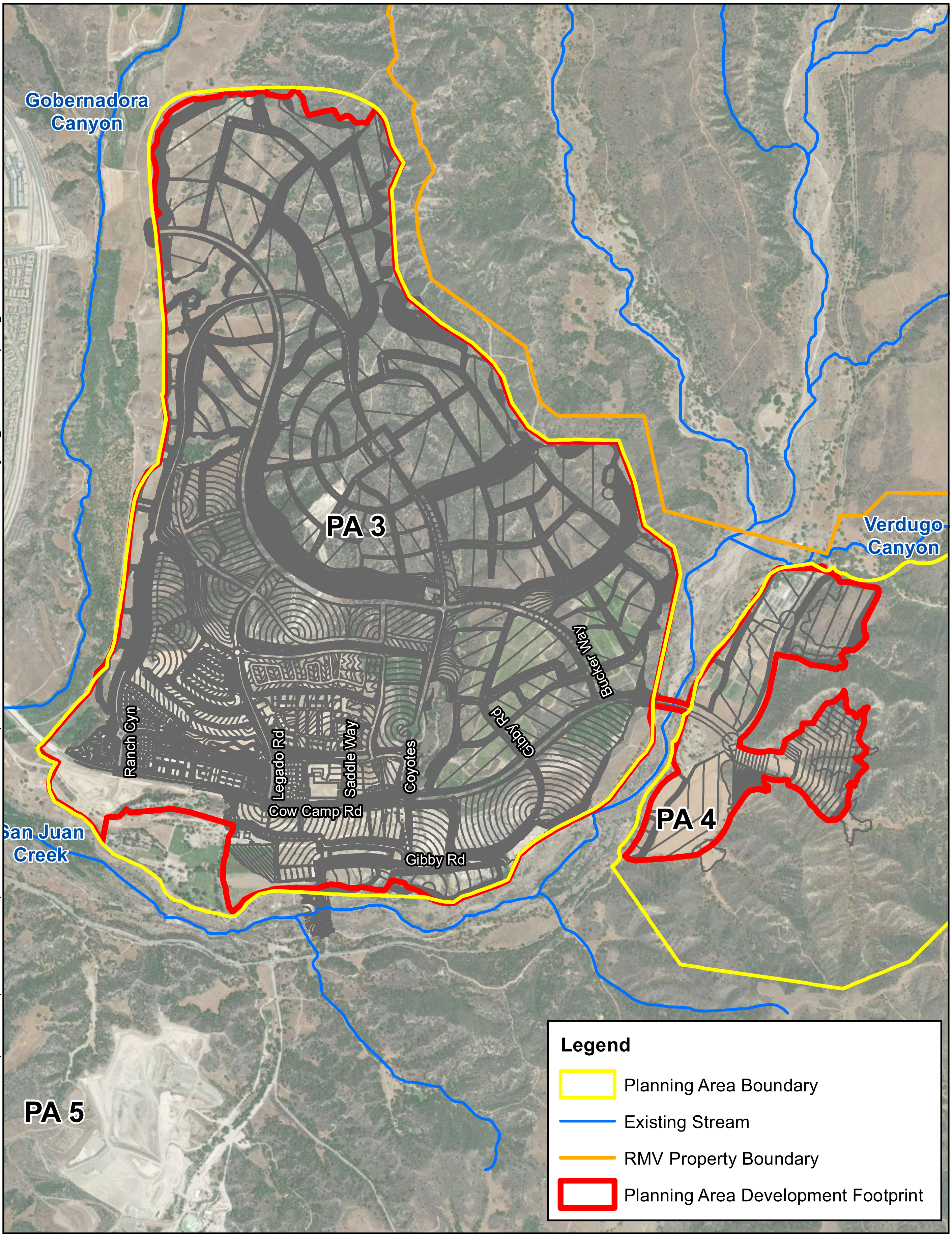
RMV PA-3&4 ROMP Revision 1

RMV Ranch Plan Development Areas

Figure 1-2



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RMV PA-3&4 ROMP Revision 1

PA-3 and PA-4 Study Areas

Figure 1-3

1.3 Study Purpose

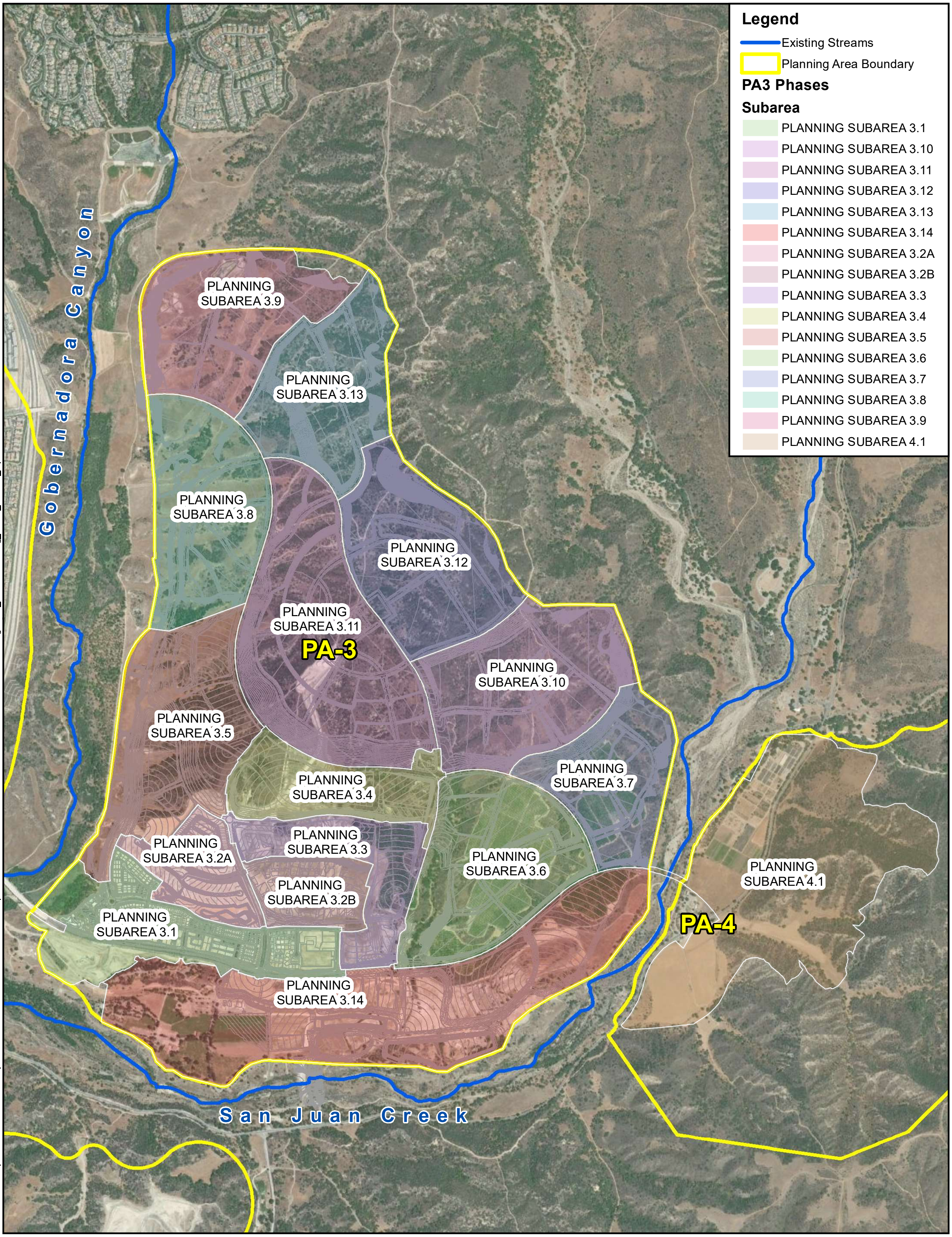
The PA-3&4 ROMP Revision 1 consists of updating the flood and water quality design and mitigation for Planning Area 3 (PA-3), integrating the new Subwatershed C concept and verifying the overall regional integration with the Ranch Plan ROMP. All pertinent data from the approved 2019 PA-3&4 ROMP that is still applicable to the PA-3&4 ROMP Revision 1 will remain in place and will continue to be a part of this document. A concurrent Basis of Design Report (BoDR) is being prepared by MBI and reviewed by OCPW that details the site plan and land use changes within the PA-3 development, specifically within Subwatershed C (i.e., previously Subwatershed C and D in the approved 2019 PA-3&4 ROMP). The BoDR provides the preliminary design for the Heritage Cow Camp (HCC) C-Complex Basins.

The purpose of the PA-3&4 ROMP is to provide a focused study with additional details in the PA-3 and PA-4 areas for the hydrology, hydraulics, water quality, and stream stability studies that were prepared as part of the Ranch Plan ROMP. The PA-3&4 ROMP will serve as both a Master Plan of Drainage and a Runoff Management Plan as detailed in Chapter 19 of the Ranch Plan ROMP. This PA-3&4 ROMP Revision 1 updates the approved 2019 PA-3&4 ROMP document to verify mitigation is still achieved with the updated drainage plan. Phase condition PA-1, -2 & -3 constructed is the subject of the approval of the PA-3&4 ROMP Revision 1 because the revision focuses on the C Basin Complex. Other phase scenarios are presented to provide updates to the C Basin Complex for reference but the studies and ROMPs will be updated again as basin planning progresses on future regional basins. Chapter 19 indicates that there are 63 Mitigation Measures related to water resources/stormwater management in the Ranch Plan FEIR. The overall approach to address those mitigation measures are outlined in the Ranch Plan ROMP. This study will show how the refined details of the PA-3 and PA-4 development are consistent with the Ranch Plan ROMP and satisfy the requirements of the mitigation measures in FEIR 589. Appendix A provides a detailed description of these measures.

Prior to this study, several documents and analysis for related projects have already been approved by the County. This PA-3&4 ROMP was developed in accordance with the following approved documents:

1. Comprehensive Regional Stormwater Plan for The Ranch Plan Planned Community Runoff Management Plan (Ranch Plan ROMP)" dated April 2013 prepared by PACE.
2. The Ranch Plan Planned Community PA-2 Runoff Management Plan Update approved April 4, 2014 prepared by Michael Baker International (formerly RBF Consulting).
3. "PA-1 Development Area and the Ranch Development Plan San Juan Creek Watershed Stream Monitoring Program" dated 2011 prepared by PACE.
4. Gobernadora Multipurpose Basin Design Report dated August 2014 prepared by PACE.
5. Sediment Transport and Scour Analysis Report of Gobernadora Canyon for Cow Camp Road Bridge dated September 2017 prepared by Michael Baker International.
6. Gibby Road Bridge Hydraulics & Scour Analysis of San Juan Creek dated March 2018 prepared by PACE.
7. The approved 2019 Planning Areas 3 and 4 Runoff Management Plan (approved 2019 PA-3&4 ROMP) dated October 2019 prepared by Michael Baker International.
8. The 2022 Conceptual Planning Area 3&4 Water Quality Management Plan (2022 Conceptual PA-3&4 WQMP), approved in December of 2022.

The approved 2019 PA-3&4 ROMP study was also being prepared to support the extension of Cow Camp Road and the rough grading plans for Planning Area 3 phase subareas 3.1, 3.2, 3.3, 3.4, and 3.5 shown in Figure 1-4. Cow Camp Road currently extends from Antonio Parkway to Horton Way in PA-3 and is a major infrastructure facility that will provide access to the future development of PA-3 and PA-4. The Cow Camp Road extension through the south of PA-3 consists of a bridge over Gobernadora Canyon that connects PA-2 and PA-3, and the road extension within PA-3. The extension through PA-4 consists of a bridge over San Juan Creek that will connect PA-3 and PA-4. Refer to Cow Camp Road Improvements Phase 2B (2019) for basis of design for Cow Camp Road storm drain. Currently, the major effort is to verify the revised Subwatershed C basin is adequately sized for mitigation purposes. The PA-3&4 ROMP is a general document that supports the PA-3&4 Master Area Plan. A separate Basis of Design Report is being prepared concurrently for preliminary design of the Subwatershed C basin. Additionally, a FEMA Conditional Letter of Map Revision (CLOMR) Request for Gibby Road Bridge/RMV Planning Area 3 – San Juan Creek was prepared in June 2023 by PACE.



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RANCHO MISSION VIEJO PA-3&4 ROMP Revision 1

PA-3 Phasing Areas

Figure 1-4

2 Hydrology

This section details the onsite local Planning Area 3 and Planning Area 4 hydrology, including discussion on land use, local and regional hydrology, preliminary flood control basins, and water quality basins.

The hydrology analyses for the local and regional studies were completed using the same criteria and methodology as outlined in detail in the Ranch Plan ROMP. Modification or additions to the studies in that document are described in the following sections. In order to show conformance with both the Ranch Plan ROMP and the Ranch FEIR, several additional hydrology analyses were completed. The analyses include updated local analysis and regional studies, and integrated local and regional models. The regional analysis provides the following: an update to the existing condition regional analysis from the Ranch Plan ROMP, ultimate condition analysis, and a phased condition analysis. The ultimate condition assumes full build out of the Ranch. This study will comply with the requirements of the FEIR.

The Ranch Plan ROMP addressed local basins and regional impacts separately (local basins were not considered in the Regional Models). To comply with Mitigation Measure 4.5-5, this PA-3&4 report includes the integration of local basins and regional stream hydrology in the regional models. Mitigation analysis of the subregional Gobernadora models includes the local water quality basins from PA-3 subwatershed A for the 2- through 10-year storm events and includes the Gobernadora Multipurpose Basin for the 25- through 100-year storm events. This approach is consistent with the approach the local hydromodification basins along Chiquita Canyon were modeled in the approved PA-2 ROMP.

2.1 Approach

The FEIR expressed concern that the detention basins could affect the timing of the hydrograph peaks within the overall watershed stream network (MM4.5-5) and result in adverse impacts to the regional hydrology. An integrated local and regional hydrology analysis is included in this study for the evaluation of the PA-3&4 development impacts and for the identification of the detailed mitigation measures. The evaluation will balance the local and regional concerns to develop a detailed approach to mitigate impacts to the watershed. The PA-3&4 development area drains to two different streams, San Juan Creek, and Gobernadora Canyon. Gobernadora is a tributary of San Juan Creek, and confluences with the creek within the Ranch property between PA-2 and PA-3.

The PA-3&4 stormwater infrastructure in the Ranch Plan ROMP includes six outfalls to San Juan Creek (2013 Ranch Plan ROMP outfall Nos. 11, 13, 14, 17, 20, and 22) and one outfall to Gobernadora Canyon (2013 Ranch Plan ROMP outfall No. 9). In Spring 2018, the 2013 Ranch Plan ROMP outfall locations were revised to be consistent with the grading plan in this 2019 PA-3&4 ROMP, this resulted in the addition of three new outfall locations 12.1, 13.1, and 14.1. The outfall locations are shown in Figure 2-3 and Figure 2-4. This report will specify which set of outfalls are referred to when outfalls are mentioned.

In the Ranch Plan ROMP, each of the outfalls for the development area has a tributary storm drain system and proposed local flood control and water quality basins. Offsite Area O (outfall 17) has a tributary area consisting solely of existing land use and will not have basins. The Ranch Plan ROMP developed basins to mitigate the local drainage area and did not consider the effects of the local basins on the regional channel systems. Six regional flood control basins were proposed and included in the Ranch Plan ROMP regional models but the attenuation from the local basins were not assessed in conjunction with these. This evaluation was delegated to the PA ROMPs where more detail on the facilities could be established. The overall goal of the PA ROMPs is to meet or exceed peak flow mitigation results previously established in the 2013 Ranch Plan ROMP.

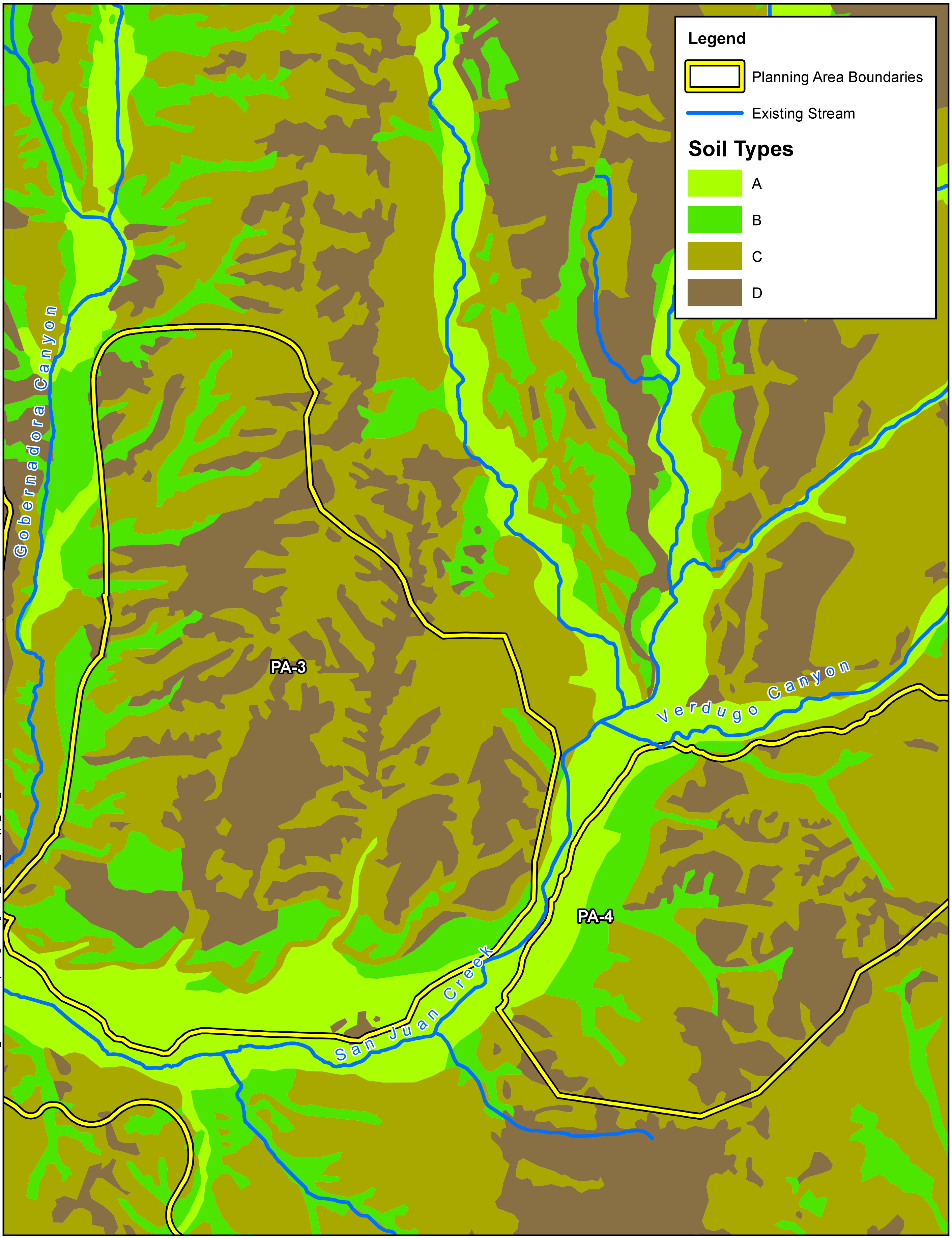
The hydrologic analysis and basin flood routing were developed to document that the ultimate and phased improvements will conform to the mitigation goals along Gobernadora Canyon and San Juan Creek in conformance with the results from the Ranch Plan ROMP and subsequent white papers.

2.2 Local Planning Area Analysis

The local hydrology consists of the rational method analysis, loss rate calculations, small area hydrograph, single area, and complex unit hydrograph analysis. Local subwatershed hydrology is included in Appendix B. The hydrology models were prepared using the Advanced Engineering Software Version 2013 (AES). All models were performed in conformance with the Orange County Hydrology Manual (OCHM) (OC Public Works, 1986), including Addendum no. 1 (OC Public Works, 1996), which requires expected value analyses to use antecedent moisture condition (AMC) II and soil type B. The 2-, 5-, 10-, 25-, 50-, and 100-year expected value storm events and the 25- and 100-year high confidence storm events hydrology models were prepared. The 100-yr High Confidence analysis was used to size preliminary storm drain facilities. The Expected Value models were created for mitigation analysis. The local hydrology analysis steps are shown below:

1. Based on the proposed Master Area Grading plan from September 2017, the PA-3 and PA-4 land use maps were developed. Land uses have been updated from the approved 2019 PA-3&4 ROMP to include the approved tract land uses and the land plan for Subwatershed C and B as of December 2021 (shown in Figure 2-2). The GIS soils data from the Ranch Plan ROMP was used (shown in Figure 2-1).
2. The watershed hydrology map was developed in CADD and GIS.
3. Items 1-3 were intersected in GIS to generate input into the local hydrology.
4. The rational method was developed using the results from item #4. To reduce rounding errors produced by subdividing the data, the GIS intersect results were adjusted to match the subarea area by changing the value of the largest land use-soil-area combination. This adjusted data was copied into the loss rate spreadsheets.
5. The rainfall data for the local area high confidence models is based on the Orange County Hydrology Manual for areas below 2,000 feet. The expected value rainfall numbers are based on Addendum No. 1 to the Hydrology Manual.
6. The loss rates for each subwatershed (subwatersheds described in Section 2.2.3) were calculated using a spreadsheet, which implements the County Hydrology loss rate procedures and deviations in the Ranch Plan ROMP.
7. The expected value hydrographs for the subwatersheds were calculated. Small area hydrographs were used for subwatersheds with areas of less than 640 ac, and single area unit hydrographs were used for area C, which has an area of greater than 640 ac.
    a. These local expected value single area hydrographs use the rational method Tc.
    b. Local event (EV) hydrographs use local rainfall depths, no depth area reductions (unless the watershed is greater than 640 ac), and AMC II for loss rate calculations. This is consistent with the methodology used in the PACE 2013 Ranch Plan ROMP.

The local existing hydrology included in this analysis is a truncated version of the existing condition from the 2013 Ranch Plan ROMP. Boundaries were truncated to the development boundary to provide a better comparison because the ultimate local analysis only extends to the outlet location.



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Michael Baker INTERNATIONAL

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RANCHO MISSION VIEJO - PA3&4 ROMP

PA-3 and PA-4 Soil Type Map

Figure 2-1

2.2.1 Land Use

Multiple grading plans were used for the study. For Cow Camp Road and the development north of Cow Camp Road, the hydrology study referenced the grading plan by Huitt-Zollars dated July 2022, the approved tract grading for phases 3.1 and 3.2, and the Cow Camp Road roadway grading. South of Cow Camp Road, the grading plan is based on the Cow Camp Road Phase 2B B Basins and the PA-3.14 Rough Grading plan which is currently being reviewed by the County. The exhibits show the grading files combined.

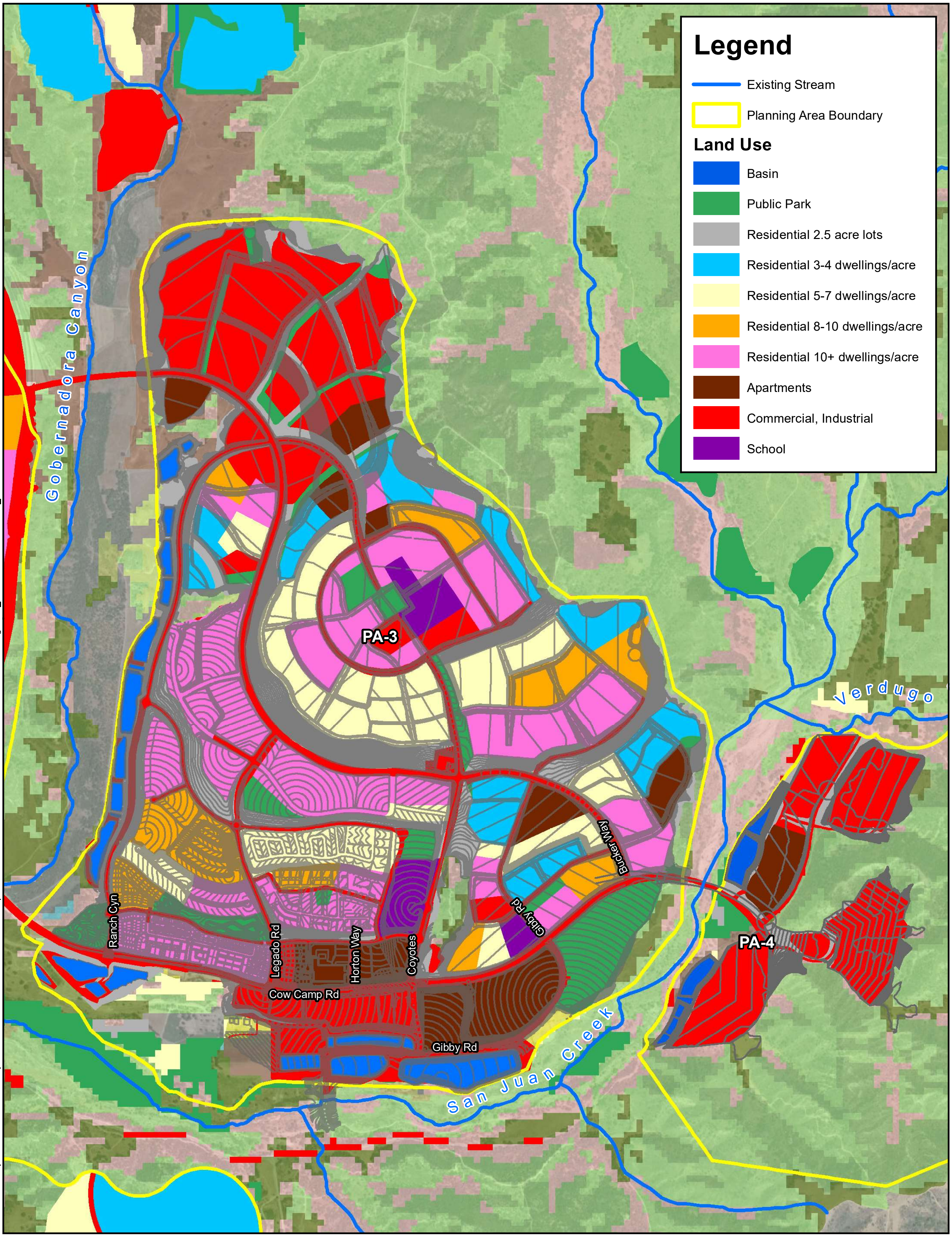
The approved 2019 PA-3&4 ROMP used the latest land use from SWA Group to create a GIS land use file with land uses consistent with the Orange County Hydrology Manual. In order to be consistent with the OCHM, some land uses from the SWA Group were modified to reflect land uses specific for the hydrology analysis. Figure 2-2 shows the PA-3 and PA-4 land use used in the local hydrologic analysis. Table 2-1 and Table 2-2 summarize the hydrology land uses in PA-3 and PA-4 respectively and compare them to the Ranch Plan ROMP. The current land use plan proposes a total developed area for PA-3 of 1953.6 acres, which includes graded hillside on the outside of the development footprint. In the Ranch Plan ROMP, the total developed area was 1,909.5 acres. The increase in developed area is due to changes in the grading plan and proposed land uses. The PA-3&4 ROMP Revision 1 does not propose any changes to the land use categories in Subwatershed A, compared to what was included in the approved 2019 PA-3&4 ROMP.

The PA-4 footprint was significantly reduced compared to the Ranch Plan ROMP. The current studies have a total developed area of 218.7 acres, versus the Ranch Plan ROMP which had 540 acres. Detailed grading studies found that the natural conditions within PA-4 create challenges to develop most of the area that was proposed in the Ranch Plan ROMP. Thus, current plans reduced the total developed footprint to include only the areas where it will be feasible to develop the land. Current plans also maintain the Ranch Plan ROMP proposed 86% imperviousness within the PA-4 planning area boundary.

In both PA-3 and PA-4, graded hillslopes within and adjacent to the development were changed to "residential 2.5 acre lots" (10% impervious) to account for concrete v-ditches that will be installed to collect hillside runoff. It is important to also note that small slopes (less than 60 feet wide) use the adjacent land use for the hydrology analysis. These adjustments affect the total land use density when compared to the SWA Group land use plan, therefore the two plans will not match exactly.

However, the land use plans are in substantial conformance. A comparison of the land plan (from the approved 2019 PA-3&4 ROMP) has been updated, as needed. The hydrology land uses are summarized in Tables 2-1 and 2-2. Land uses listed in Tables 2-1 and 2-2 list all land use within the planning area boundaries.

The water quality analysis uses a separate land use plan, which maintains a land use designation for the graded hillslopes as graded hillslopes. Additionally, the water quality analysis differentiates between graded hillside slopes that are greater than and less than 60 feet wide. Slopes greater than 60 feet wide (large slopes) have been determined to need concrete v-ditches. The 10% imperviousness is accounted for in this hydromodification analysis, but not for Low Impact Development (LID) analysis. The imperviousness of the concrete v-ditches was removed for the LID analysis to eliminate treatment of areas used as drainage conveyance.



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PA-3 and PA-4 Land Use

Figure 2-2

Table 2-1: Ranch Plan ROMP Versus PA-3 Ultimate Land Use Data Comparison

Ranch Plan ROMP				PA-3&4 Ultimate Conditions			
Land Use	Soil Type	Area (ac)	A_p	Land Use	Soil Type	Area (ac)	A_p
Commercial, Industrial	A	6.9	10%	Commercial, Industrial	A	95.6	10%
Commercial, Industrial	B	28.1	10%	Commercial, Industrial	B	101.7	10%
Commercial, Industrial	C	83.5	10%	Commercial, Industrial	C	220.9	10%
Commercial, Industrial	D	78.3	10%	Commercial, Industrial	D	144.9	10%
Apartments	A	0.6	20%	Apartments	A	25.4	20%
Apartments	B	1.5	20%	Apartments	B	31.7	20%
Apartments	C	16.1	20%	Apartments	C	32.4	20%
Apartments	D	45.9	20%	Apartments	D	45.5	20%
Residential 1 acre lots	A	4.5	80%	Residential 10+ dwellings/acre	A	1.6	20%
Residential 1 acre lots	B	47.1	80%	Residential 10+ dwellings/acre	B	27.5	20%
Residential 1 acre lots	C	151.2	80%	Residential 10+ dwellings/acre	C	181.6	20%
Residential 1 acre lots	D	109.6	80%	Residential 10+ dwellings/acre	D	170.6	20%
Residential 2 dwellings/acre	A	0.8	70%	Residential 8-10 dwellings/acre	B	20.5	40%
Residential 2 dwellings/acre	B	16.6	70%	Residential 8-10 dwellings/acre	C	78.8	40%
Residential 2 dwellings/acre	C	391.7	70%	Residential 8-10 dwellings/acre	D	22.7	40%
Residential 2 dwellings/acre	D	316.4	70%	Residential 5-7 dwellings/acre	A	4.6	50%
Residential 5-7 dwellings/acre	A	50.4	50%	Residential 5-7 dwellings/acre	B	15.6	50%
Residential 5-7 dwellings/acre	B	25.5	50%	Residential 5-7 dwellings/acre	C	85.4	50%
Residential 5-7 dwellings/acre	C	6.9	50%	Residential 5-7 dwellings/acre	D	117.9	50%
Residential 5-7 dwellings/acre	D	6.3	50%	Residential 3-4 dwellings/acre	B	5.3	60%
Residential 3-4 dwellings/acre	A	6.6	60%	Residential 3-4 dwellings/acre	C	52.9	60%
Residential 3-4 dwellings/acre	B	94.1	60%	Residential 3-4 dwellings/acre	D	52.0	60%
Residential 3-4 dwellings/acre	C	104.5	60%	School	A	0.0	60%
Residential 3-4 dwellings/acre	D	128.0	60%	School	B	3.0	60%
Residential 8-10 dwellings/acre	B	24.2	40%	School	C	18.2	60%
Residential 8-10 dwellings/acre	C	20.5	40%	School	D	19.2	60%
Residential 8-10 dwellings/acre	D	11.1	40%	Public Park	A	36.2	85%
Public Park	A	25.2	85%	Public Park	B	34.5	85%
Public Park	B	1.4	85%	Public Park	C	40.9	85%
Public Park	C	2.6	85%	Public Park	D	55.1	85%
Public Park	D	2.5	85%	Residential 2.5 acre lots	A	8.5	90%
School	A	1.4	60%	Residential 2.5 acre lots	B	45.6	90%
School	B	30.0	60%	Residential 2.5 acre lots	C	135.9	90%
School	C	43.2	60%	Residential 2.5 acre lots	D	97.0	90%
School	D	26.3	60%	Barren	A	12.5	100%
Barren	A	14.2	100%	Barren	B	1.4	100%
Barren	B	0.1	100%	Barren	C	0.0	100%
Chaparral, Broadleaf, Fair	A	0.2	100%	Barren	D	0.8	100%
Chaparral, Broadleaf, Fair	B	0.7	100%	Chaparral, Broadleaf, Fair	A	0.5	100%

Table 2-1: Ranch Plan ROMP Versus PA-3 Ultimate Land Use Data Comparison

Ranch Plan ROMP				PA-3&4 Ultimate Conditions			
Land Use	Soil Type	Area (ac)	A_p	Land Use	Soil Type	Area (ac)	A_p
Chaparral, Broadleaf, Fair	C	5.3	100%	Chaparral, Broadleaf, Fair	B	0.0	100%
Chaparral, Broadleaf, Fair	D	0.6	100%	Chaparral, Broadleaf, Fair	C	5.0	100%
Chaparral, Narrowleaf, Fair	B	0.0	100%	Chaparral, Broadleaf, Fair	D	2.2	100%
Chaparral, Narrowleaf, Fair	C	3.5	100%	Chaparral, Narrowleaf, Fair	B	0.1	100%
Chaparral, Narrowleaf, Fair	D	2.7	100%	Chaparral, Narrowleaf, Fair	C	4.5	100%
Grass, Annual or Perennial, Fair	A	32.8	100%	Chaparral, Narrowleaf, Fair	D	4.5	100%
Grass, Annual or Perennial, Fair	B	5.3	100%	Fallow	B	1.8	100%
Grass, Annual or Perennial, Fair	C	14.3	100%	Fallow	C	0.9	100%
Grass, Annual or Perennial, Fair	D	0.1	100%	Fallow	D	0.5	100%
Meadows or Cienegas, Fair	A	2.4	100%	Grass, Annual or Perennial, Fair	A	13.0	100%
Open Brush, Fair	A	8.0	100%	Grass, Annual or Perennial, Fair	B	1.0	100%
Open Brush, Fair	B	6.7	100%	Grass, Annual or Perennial, Fair	C	5.9	100%
Open Brush, Fair	C	43.1	100%	Grass, Annual or Perennial, Fair	D	0.3	100%
Open Brush, Fair	D	5.0	100%	Meadows or Cienegas, Fair	A	1.2	100%
Woodland, Grass, Fair	A	6.3	100%	Open Brush, Fair	A	7.6	100%
Woodland, Grass, Fair	B	7.7	100%	Open Brush, Fair	B	7.7	100%
Woodland, Grass, Fair	C	18.9	100%	Open Brush, Fair	C	39.5	100%
Woodland, Grass, Fair	D	1.0	100%	Open Brush, Fair	D	5.2	100%
Orchards, Evergreen, Fair	B	1.5	100%	Orchards, Evergreen, Fair	B	0.7	100%
Orchards, Evergreen, Fair	C	1.8	100%	Orchards, Evergreen, Fair	C	0.0	100%
Orchards, Evergreen, Fair	D	0.2	100%	Orchards, Evergreen, Fair	D	0.2	100%
Row Crops, Good	D	0.1	100%	Row Crops, Poor	A	0.4	100%
Row Crops, Poor	A	50.5	100%	Row Crops, Poor	B	6.3	100%
Row Crops, Poor	B	18.6	100%	Row Crops, Poor	C	6.4	100%
Row Crops, Poor	C	15.7	100%	Row Crops, Poor	D	2.5	100%
Row Crops, Poor	D	8.5	100%	Woodland, Grass, Fair	A	3.6	100%
				Woodland, Grass, Fair	B	4.6	100%
				Woodland, Grass, Fair	C	13.5	100%
Total Area[1]		**2185.3**	**65%**	**Total Area[1]**		**2185.0**	**44%**
Total Developed Area[2]		**1909.5**		**Total Developed Area[2]**		**1953.6**	

[1]Total Area is the Gross PA area.

[2]Total Developed Area is all graded development area, including basins and outside hillslopes. There is some impervious existing land use within the PA boundaries, such as the houses in Cow Camp.

Table 2-2: Ranch Plan ROMP Versus PA-4 Ultimate Land Use Data Comparison

Ranch Plan ROMP				PA-3&4 Ultimate Conditions			
Land Use	**Soil Type**	**Area (ac)**	**Ap**	**Land Use**	**Soil Type**	**Area (ac)**	**Ap**
Commercial, Industrial	A	8.5	10%	Commercial, Industrial	A	36.5	10%
Commercial, Industrial	B	9.3	10%	Commercial, Industrial	B	70.8	10%
Residential 1 acre lots	A	4.3	80%	Commercial, Industrial	C	23.3	10%
Residential 1 acre lots	B	24.0	80%	Commercial, Industrial	D	21.1	10%
Residential 1 acre lots	C	74.7	80%	Apartments	A	5.6	20%
Residential 1 acre lots	D	77.7	80%	Apartments	B	12.3	20%
Residential 2 dwellings/acre	A	4.3	70%	Residential 5-7 dwellings/acre	A	0.3	50%
Residential 2 dwellings/acre	B	38.7	70%	Public Park	A	6.1	85%
Residential 2 dwellings/acre	C	72.0	70%	Public Park	B	0.3	85%
Residential 2 dwellings/acre	D	108.8	70%	Residential 2.5 acre lots	A	11.1	90%
Residential 5-7 dwellings/acre	A	6.0	50%	Residential 2.5 acre lots	B	16.0	90%
Residential 5-7 dwellings/acre	B	14.7	50%	Residential 2.5 acre lots	C	7.4	90%
Residential 5-7 dwellings/acre	C	1.4	50%	Residential 2.5 acre lots	D	7.9	90%
Residential 3-4 dwellings/acre	B	17.5	60%	Chaparral, Broadleaf, Fair	A	0.3	100%
Residential 3-4 dwellings/acre	C	17.2	60%	Grass, Annual or Perennial, Fair	A	0.6	100%
Residential 3-4 dwellings/acre	D	4.8	60%	Open Brush, Fair	A	1.6	100%
Residential 8-10 dwellings/acre	A	6.8	40%	Row Crops, Poor	A	3.3	100%
Residential 8-10 dwellings/acre	B	12.1	40%	Woodland, Grass, Fair	A	4.8	100%
Public Park	A	22.9	85%	Chaparral, Broadleaf, Fair	B	16.0	100%
Public Park	B	14.3	85%	Grass, Annual or Perennial, Fair	B	7.7	100%
Chaparral, Broadleaf, Fair	A	0.5	100%	Open Brush, Fair	B	21.5	100%
Chaparral, Broadleaf, Fair	B	8.3	100%	Row Crops, Poor	B	0.5	100%
Chaparral, Broadleaf, Fair	C	194.2	100%	Woodland, Grass, Fair	B	13.6	100%
Chaparral, Broadleaf, Fair	D	29.5	100%	Chaparral, Broadleaf, Fair	C	256.8	100%
Grass, Annual or Perennial, Fair	A	0.4	100%	Grass, Annual or Perennial, Fair	C	12.6	100%
Grass, Annual or Perennial, Fair	B	0.0	100%	Open Brush, Fair	C	271.4	100%
Grass, Annual or Perennial, Fair	C	8.7	100%	Woodland, Grass, Fair	C	45.8	100%
Grass, Annual or Perennial, Fair	D	6.3	100%	Chaparral, Broadleaf, Fair	D	90.6	100%
Open Brush, Fair	A	0.8	100%	Grass, Annual or Perennial, Fair	D	8.5	100%
Open Brush, Fair	B	9.1	100%	Open Brush, Fair	D	134.4	100%
Open Brush, Fair	C	221.0	100%	Woodland, Grass, Fair	D	19.1	100%
Open Brush, Fair	D	50.9	100%				
Woodland, Grass, Fair	A	8.3	100%				
Woodland, Grass, Fair	B	10.5	100%				
Woodland, Grass, Fair	C	28.0	100%				
Woodland, Grass, Fair	D	3.4	100%				
Orchards, Evergreen, Fair	A	1.0	100%				
Row Crops, Poor	A	6.4	100%				
Total Area[1]		**1127**	**86%**	**Total Area[1]**		**1127**	**86%**
Total Developed Area[2]		**540.0**		**Total Developed Area[2]**		**218.7**	

[1] Total Area is the Gross PA area (area of the PA boundary)

[2] Total Developed Area is all graded development area within the PA boundary which includes imperviousness, including basins and outside hillslopes. There is some impervious existing land use within the PA boundaries, such as the houses in Cow Camp.

2.2.2 Rainfall

For the local analysis, the 2013 Ranch Plan ROMP used the user-defined option for the rainfall intensity in the Rational Method. The user-defined ordinates are from the regression equation on Figure B-3 per the OCHM. AES follows the OCHM and is approved by the county. Therefore, the user defined rainfall intensity input is not required for the 10-, 25-, and 100-year expected value storm events. The 2-, 5-, and 50-year expected value storm events require user-defined input. See the local hydrology appendix in the 2013 Ranch Plan ROMP.

2.2.3 Subwatershed Descriptions

As part of this study, the PA-3&4 onsite subwatershed areas were updated from the areas in the Ranch Plan ROMP. In the approved Ranch Plan ROMP, within PA-3 there were six storm drain outfalls: 9, 10, 12, 13, 15, and 17 (see Figure 2-3). Within PA-4 there were five storm drain outfalls: 18, 19, 20, 21, and 22 (see Figure 2-4). Preliminary grading and hydrology studies concluded that to achieve the hydrologic mitigation requirements for the ultimate condition the following modifications were appropriate.

- PA-3 areas tributary to Gobernadora Canyon at outfall 9 (subwatershed A) will be treated through infiltration basins and several biofiltration basins. Hydromodification mitigation will be provided through a series of hydromodification detention basins which will detain the hydromodification volume per Section 5 of this report. These basins will also serve as a mitigation device for local flood control for the 2-, 5- and 10-year storm events. Properly sized energy dissipation will be implemented during final design and construction at the outfall locations, per Section 15.2.3 of the 2013 Ranch Plan ROMP. The existing Gobernadora Multipurpose Basin will mitigate 25-, 50- and 100-year storm events. Section 2.2.5 provides a detailed discussion of the Gobernadora Canyon modeling.
- PA-3 areas tributary to San Juan Creek were divided into three subwatersheds: B, C, and O. Subwatersheds B, and C will be treated and mitigated through a series of basins located in the most downstream portions of each subwatershed tributary to 2018 outfalls 11, 13, and 13.1 respectively. The offsite (O) subwatershed will drain to outfall 17. The outlet for each basin will be extended into the 10-year floodplain within San Juan Creek. Properly sized energy dissipation will be implemented during final design and construction at the outfall locations, per Section 15.2.3 of the 2013 Ranch Plan ROMP. Therefore, hydromodification is not required. These basins will provide local and regional mitigation for PA-3.
- PA-4 development areas will be tributary to San Juan Creek. This development area was significantly reduced in size compared to the Ranch Plan ROMP. There are two subwatershed areas: E and F, which will be treated and mitigated through basins at outfalls 20 and 22 (2013 outfalls) respectively. The outlet for each basin will be extended into the 10-year floodplain within San Juan Creek. Properly sized energy dissipation will be implemented during final design and construction at the outfall locations, per Section 15.2.3 of the 2013 Ranch Plan ROMP. Therefore, hydromodification basins are not required.
- Outfall 8 is not considered a proposed storm drain outfall, because this outfall will not be used for flood control mitigation, nor will it receive peak flows from the 2- through 100-year storm events. Discharges at outfall 8 will be low flows controlled by the diversion structures and will maintain the existing flows to Gobernadora Ecological Restoration Area (GERA).

The PA-3&4 ROMP Revision 1 watersheds include subwatersheds: A, B, C, O, E and F. Detailed description of each watershed is provided below. The PA-3 and PA-4 Ultimate Hydrology Maps are shown on Exhibit 1 and Exhibit 2, respectively. Exhibit 3a shows the preliminary PA-3 and PA-4 grading, storm drains, proposed basins and outlet locations.

Subwatershed A is located in the northern portion of the PA-3 development and it is tributary to 2018 outfall 9, which is the exact same location as the 2013 Ranch Plan ROMP outfall 9. It has a total drainage area of 510.2 acres, and outlets to a tributary drainage that confluences with Gobernadora Canyon. This subwatershed contains several basins that provide water quality, hydromodification, and local flood control mitigation benefits for the 2-, 5- and 10-year expected value storm events. In an effort to protect the habitat adjacent to Gobernadora Canyon known as the GERA, a series of small basins that will receive water quality storm flows, dry weather runoff and nuisance flows are proposed. These small basins will provide water quality treatment following LID requirements and will receive and discharge low flows to irrigate the existing habitat along the Gobernadora Canyon overbank. More detailed information is provided in Section 5, Water Quality Program.

Subwatershed B is located in the southwest portion of the PA-3 development and it is tributary to 2018 proposed outfall 11. It has a total drainage area of approximately 213.7 acres. Basin B has been constructed and receives runoff flows from subwatershed B. This facility provides flood control mitigation prior to discharging to San Juan Creek. The Ranch Plan ROMP had a large proposed basin for this subwatershed, as well as portions of subwatershed C. The PA-3&4 ROMP reduces the area tributary to this basin and proposes two smaller flood control basins south of Cow Camp Road for subwatershed B. The basin B system also consists of water quality treatment basins consisting of pretreatment basins and an infiltration basin (3B-5) south of Cow Camp Road. Grading constraints also require a small portion of subwatershed B to be treated by biofiltration basin (3A-12) in the subwatershed A on the west side of the development. Basins 3B-1, 3B-2, and 3B-4 provide flood control mitigation prior to discharging to San Juan Creek.

Subwatershed C (C1 and C2) is approximately 1,292.3 acres in size and is the largest in the PA-3 development. The updated Subwatershed C (C1 and C2) encompasses the south-center and south-east portion of the PA-3 development, previously Subwatershed C and Subwatershed D in the approved 2019 PA-3&4 ROMP and is tributary to 2018 outfall 13.1. The previously approved Outfall 13, in the ultimate condition will be reserved for emergency overflow from the water quality infiltration basins. Outlet 13 currently conveys interim condition flows through the constructed outlet structure.

Runoff from this subwatershed is conveyed in four mainline storm drain systems, each of which will include appropriate diversions to convey first flush flows to pretreatment systems, a settling basin and an infiltration basin. The northern offsite area of Subwatershed C1 (OC1-1, OC1-2, OC1-3, OC1-4, OC1-5 of Exhibit 1) is routed through a separate pipe system that outlets to the natural canyon in Subwatershed C (OC1-6), where flows will be treated with a debris basin, and then conveyed under Cow Camp Road into a storm drain those confluences with the development flows and ultimately discharges to the flood control basin.

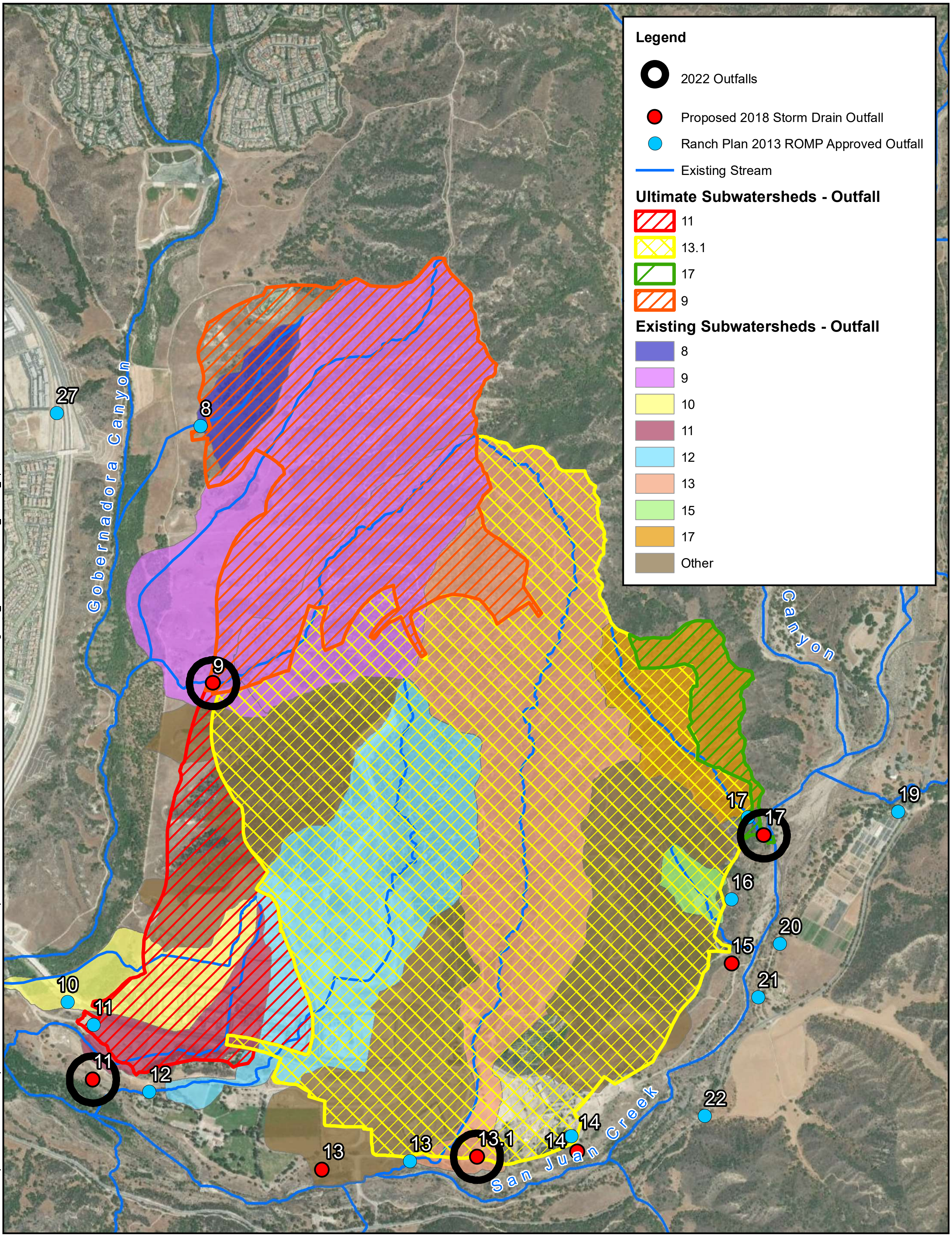
Flood control in Subwatershed C will be provided by the C-Complex Basins. All mainlines (from the development) will first divert the design capture volume (DCV)/water quality flow into the water quality basins before discharging into the flood control basin system. Development flows are mitigated in basin 3C-3 and discharge to outlet 13.1.

Subwatershed O is located on the eastern portion of PA-3. The total drainage area is 51.1 acres. It consists of natural areas with small drainages around the development that will not be disturbed by the proposed development. Subwatershed O will be maintained as a separate watershed from the developed areas in order to maintain natural drainage patterns and minimize impacts to the existing regional watershed S26. Some of the flows from this drainage area will be collected through a separate storm drain system and discharged into San Juan Creek at 2018 outfall 17, which is the exact same location as the 2013 Ranch Plan ROMP outfall 17. The natural runoff flows will be routed through an oversized pipe to deliver flow and sediment to San Juan Creek. Other flows will be routed to the same location through ditches that will only receive the undeveloped area runoff flows.

Subwatershed E is located in the northern-west portion of PA-4. It has a total drainage area of 171 acres. This subwatershed will collect off-site runoff through the storm drain system and comingle with runoff flows from the developed areas. The off-site runoff originates from natural hills that will not be developed. The two basins in subwatershed E will be located in the most downstream portion of this subwatershed and will be sized to accommodate the entire watershed, not only the developed areas. A flood control and pretreatment forebay will provide flood mitigation and pretreatment for the infiltration basin. An infiltration basin directly downstream will treat the water quality volume. The flows will be discharged to San Juan Creek through storm drain outfall 20.

Subwatershed F is located in the southern-east portion of PA-4. It has a total drainage area of 553.8 acres. This subwatershed will collect off-site runoff flow through the storm drain system and comingle with runoff flows from the developed areas. The off-site runoff originates from natural hills that will not be developed. A flood control and pretreatment forebay will provide flood mitigation and pretreatment for the infiltration basin. The two basins in subwatershed F will be located in the most downstream portion of this subwatershed. The flood control basin will provide flood mitigation for the entire watershed, not only the developed areas but the infiltration basin directly downstream will treat the water quality volume of only the developed areas. The flows will be discharged to San Juan Creek through storm drain outfall 22.

The 2018 Outfalls 12.1, 14.1, and 15 are not currently used in the ultimate PA-3 and PA-4 storm drain plan; however, they may be used in future planning efforts.



2/9/2023 JN H:\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2023-02\MXD\Fig02-03_PA3-Outfall Location_8.5x11P_Update.mxd

Michael Baker INTERNATIONAL

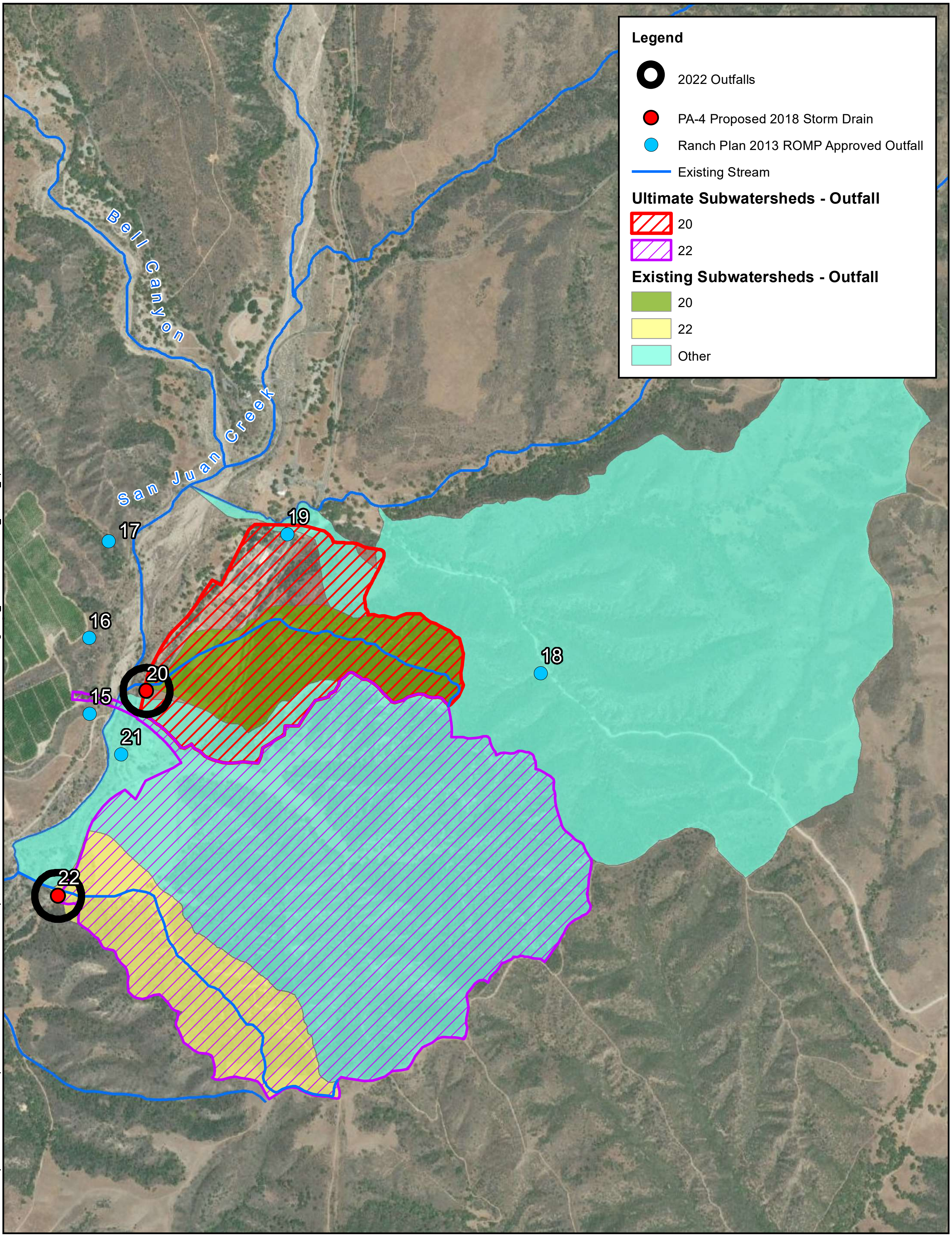
0 500 1,000 2,000 Feet

Source: ArcGIS Online

RANCHO MISSION VIEJO PA-3&4 ROMP Revision 1

PA-3 Outfall Location

Figure 2-3



2/8/2023 JN H:\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2023-02\MXD\Fig02-04_PA4-Outfall Location_8.5x11P_Update.mxd

Michael Baker INTERNATIONAL

0 500 1,000 2,000 Feet

Source: ArcGIS Online

RANCHO MISSION VIEJO PA-3&4 ROMP REVISION 1

PA-4 Outfall Location

Figure 2-4

2.2.4 Hydrology Results

The results of the local analysis are summarized in the tables below as required by item 4.4 of Table 19-1 of the Ranch Plan ROMP. The proposed discharges in Table 2-3 represent the unmitigated condition. Table 2-4 provides existing, proposed unmitigated and mitigated values. The local ultimate condition flows are in some cases larger than the existing condition tributary but due to the location of the San Juan Creek outlets to the floodplain, increases are acceptable for mitigation given there are no other adverse effects to San Juan Creek. The outlets proposed to San Juan Creek are protected up to the 10-year floodplain. Appropriate energy dissipation will be provided at final design to mitigate for local scour. The regional analysis of hydrologic, hydraulic, and stream stability are included in Sections 2.4, 3.2, and 4.1 respectively.

Table 2-3: Proposed Condition Local Rational Method Hydrology Results

Description				Expected Value (cfs)						High Confidence (cfs)	
Planning Area	Sub-watershed	2013 Ranch Plan Outfall # (2018)	Area (ac)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	100-yr	25-yr
3	A	9 (Gobernadora) (9)	510.2	214.0	387.7	636.6	831.1	949.3	1020.7	1356.2	1032.9
3	B	11 (San Juan) (11)	213.7	79.0	147.0	252.0	330.0	374.0	408.0	539.0	411.0
3	C	13.1 (San Juan) (13.1)	1292.3	437.0	814.0	1412.0	1855.0	2109.0	2296.0	3060.0	2325.0
N/A	O	17 (San Juan) (17)	51.1	5.0	26.0	59.0	79.0	90.0	99.0	134.0	101.0
4	E	20 (San Juan) (20)	171.0	94.5	167.2	274.2	358.2	408.3	435.8	573.5	438.6
4	F	22 (San Juan) (22)	553.8	162.3	345.8	646.8	865.7	991.4	1081.3	1468.8	1110.8

Table 2-4: Local Discharge Existing Versus Proposed PA-3&4 ROMP Revision 1 | 2023

Existing Condition Subwatershed[1]	Tributary to	Existing Condition (PA3&4 ROMP)							Planning Area	2018 Outfall # (2018)[7]	Proposed Condition Subwatershed (Tributary to)	Ultimate Condition (PA3&4 ROMP)												
													Unmitigated						Mitigated					
		Area	2	5	10	25	50	100				Area	2	5	10	25	50	100	2	5	10	25	50	100
		ac		cfs								ac	cfs						cfs					
3	Gobernadora	8.5	0.8	3.1	8.2	11.2	12.8	14.1		-		-	-	-	-	-	-	-	-	-	-	-	-	-
4A	Gobernadora	24.4	8.6	20.8	39.3	51.9	58.6	63.7		-		-	-	-	-	-	-	-	-	-	-	-	-	-
4B	Gobernadora	42.0	8.2	28.2	58.0	77.6	89.5	96.3		8	A[1,3] (Gober-nadora)	-	-	-	-	-	-	-	-	-	-	-	-	-
5A	Gobernadora	152.9	14.0	69.0	163.6	220.9	253.8	277.3	3	-		-	-	-	-	-	-	-	-	-	-	-	-	-
5D	Gobernadora	57.1	8.0	33.6	72.8	97.8	111.7	121.8		-		-	-	-	-	-	-	-	-	-	-	-	-	-
5B	Gobernadora	61.5	9.6	37.0	79.1	105.7	120.6	131.5		-		-	-	-	-	-	-	-	-	-	-	-	-	-
5C	Gobernadora	187.2	9.0	68.0	183.0	249.9	286.7	316.5		9		510.2	214.0	387.7	636.6	831.1	949.3	1020.7	13.8	77.8	233.5	350.8	465.3	579.7
6	Gobernadora	9.9	2.5	7.1	13.9	18.4	21.0	22.6		-		-	-	-	-	-	-	-	-	-	-	-	-	-
7	Gobernadora	74.0	8.3	37.2	85.8	115.8	132.6	145.1		-		-	-	-	-	-	-	-	-	-	-	-	-	-
8	Gobernadora	49.3	6.5	28.2	61.0	81.7	92.5	101.7		-		-	-	-	-	-	-	-	-	-	-	-	-	-
9A	Gobernadora	31.2	5.1	18.8	39.7	52.9	60.1	68.4	3	-	B[1,2] (SJC)	-	-	-	-	-	-	-	-	-	-	-	-	-
9B	Gobernadora	12.3	2.2	7.6	16.0	21.2	24.2	26.3		-		-	-	-	-	-	-	-	-	-	-	-	-	-
10	Gobernadora	48.7	6.3	27.8	60.2	80.6	91.3	100.4		-		-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-		10		-	-	-	-	-	-	-	-	-	-	-	-	-
11	SJC	52.8	2.9	21.2	53.3	72.2	82.4	91.1		11		213.7	78.8	146.9	251.9	330.0	374.2	407.9	8.4	16.8	35.4	47.3	67.4	88.4
											TOTAL													
12	SJC	283.8	10.7	81.7	233.2	321.9	371.2	412.3		-		-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-		12	C[4,2,6] (SJC)	-	-	-	-	-	-	-	-	-	-	-	-	-
13[5]	SJC	103.0	5	37.0	98.0	133.0	153.0	168.0	3	13														
14[5]	SJC	499.0	6	92	323.0	454.0	531.0	592.0		13.1		1292.3	470.5	812.7	1384.5	1810.8	2046.9	2253.2	153.3	463.9	826.6	996.8	1077.9	1134.3
15	SJC	47.0	5.5	21.1	46.3	62.0	70.9	77.7				-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-		14														
16	SJC	191.6	5.9	56.7	164.5	226.2	260.7	288.7		-		-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	3	15	C[4,2,6] (SJC)	-	-	-	-	-	-	-	-	-	-	-	-	-
17A	SJC	18.3	2.9	10.8	22.8	30.4	34.3	37.6		-		-	-	-	-	-	-	-	-	-	-	-	-	-
17B	SJC	25.2	2.8	13.5	29.6	39.5	45.1	49.2		-		-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-		16		-	-	-	-	-	-	-	-	-	-	-	-	-
	TOTAL										TOTAL													
18	SJC	118.8	9.1	48.9	116.4	157.7	180.9	198.3	3	17	O[1] (SJC)	51.1	5.2	25.9	58.8	79.0	90.3	98.7	5.2	25.9	58.8	79.0	90.3	98.7
-	-	-	-	-	-	-	-	-		18		-	-	-	-	-	-	-	-	-	-	-	-	-
2	SJC	33.5	6.1	20.9	44.0	58.7	67.1	72.8	4	19	E[1,2,6] (SJC)	-	-	-	-	-	-	-	-	-	-	-	-	-
3	SJC	130.9	6.3	57.8	138.2	186.7	213.8	234.8		20		171.0	94.5	167.2	274.2	358.2	408.3	435.8	1.7	3.9	101.3	176.4	208.2	232.5
4	SJC	394.6	37.9	176.6	414.0	561.8	647.2	708.0		21		-	-	-	-	-	-	-	-	-	-	-	-	-
5	SJC	78.0	13.8	43.4	93.6	125.7	143.5	156.6	4	-	F[1,2,6] (SJC)	-	-	-	-	-	-	-	-	-	-	-	-	-
6	SJC	105.9	6.4	42.4	107.7	146.2	167.0	184.5		22		553.8	162.3	345.8	646.8	865.7	991.4	1081.3	19.6	206.5	538.1	720.3	824.9	912.7

[1]Rational method discharges were used for the existing condition and unmitigated ultimate condition less than 640 acres.
[2]Complex unit hydrograph peak discharges were used for the mitigated ultimate condition
[3]Subwatershed A mitigated peak discharges are from PCSWMM as the PCSWWM results are more conservative than the AES results. Additionally, there were instability issues in AES pipe routing (peak Q increased), which were removed in the models.
[4]Single area hydrograph peak discharges were used for the unmitigated ultimate condition for areas greater than 640 acres.
[5]Flows are from the PA-3.1 Rough Grade Condition analysis.
[6] Due to the location of the outlet, within the San Juan Creek Floodplain, flows higher than the existing condition are acceptable given that there are no other adverse effects to San Juan Creek.
[7] The outfalls are labeled 2018 due to the year they were permitted.

2.3 Gobernadora Canyon Hydrology Analysis

The northern portion of PA-3, Subwatershed A, will discharge into Gobernadora Canyon at outfall 9. The Gobernadora Multipurpose Basin (GMB) is located upstream of this outfall. This basin was designed to provide flood control mitigation for the 25-, 50-, and 100-year storm events. As part of this PA-3&4 ROMP, infiltration basins, biofiltration basins, and hydromodification basins are proposed at outfall 9. These basins will provide water quality treatment and hydromodification control (see Section 5) and flood control mitigation for the 2-, 5- and 10-year storm events. A diversion structure located in the storm drain master plan facility will collect the runoff flows from Subwatershed A and divert the 2-, 5- and 10-year storm event runoff flows into the basins. A schematic of hydrograph routing through the Gobernadora Basin is shown on Figure 2-5, and the schematic of the 2-year through 10-year hydrograph routing for subwatershed A at node 13305 is shown in Figure 2-6. Figure 2-7 shows the configuration of the A basins.

2.3.1 Local Analysis

2.3.1.1 Subwatershed A Basins

The Ranch Plan ROMP includes local and regional basins. Per the Ranch Plan ROMP, local basins are for mitigation of flow along San Juan Creek tributaries and regional basins are for mitigation along San Juan Creek (see Ranch Plan ROMP, Section 11.1.3). The Subwatersheds A Basins volumes were designed using South Orange Hydrology Model (SOHM) from Clear Creek Solutions, Inc. SOHM is a tool that optimizes stormwater and water quality impacts due to land use changes on local streams. A Personal Computer Storm Water Management Model (PCSWMM) model from Computational Hydraulics International (CHI) was used to supplement the hydraulics throughout the A basin system and to model the water discharged from each basin into Gobernadora Canyon.

The diversion structures located in the storm drain master plan facility will collect the runoff flows from Subwatershed A and divert the flow simultaneously to the basin 3A-2, 3A-5, 3A-6, 3A-7, and 3A-9. Runoff from basin 3A-2 are distributed to basin 3A-3 and 3A-4 for infiltration. Basins are designed to have a 1-foot of freeboard to the crest of the spillway structure in the 100-yr event. Basin 3A-5, 3A-6, and 3A-7 are biofiltration basins, and basins 3A-9, 3A-10, and 3A-11 are detention basins in series. Flows from the biofiltration basins and detention basins are discharged into Gobernadora Canyon. For a detailed schematic, see Figure 2-7.

Unit hydrographs for 2-, 5-, and 10-year storm events were generated for the developed and offsite areas of subwatershed A in the local hydrology analysis and added to the PCSWWM basin routing model. The developed area hydrograph was applied at Junction 1 and the hydrograph for the offsite area was added at the outfall location. Continuous flow is used to determine if the basins meet the hydromodification requirements. Time series for continuous simulation was exported from SOHM. Continuous simulation was completed with time series from 1958 to 2005 for every 15 minutes increment.

Biofiltration basins are modeled with 1.2-feet of equivalent water depth and 5-feet of available depth above the gravel. A 6-inch underdrain is located at the bottom of each biofiltration basin to discharge flows to Gobernadora Canyon. The hydromodification basins were connected in series and have outlet pipes to simulate the flows outletting to Gobernadora Canyon.

2.3.1.2 Local Gobernadora Results

Table 2-5 shows the local flows out of each basin compared to the existing rational method flows. The cumulative proposed discharge from the basins is less than the existing condition.

Table 2-5: Existing and Basin Outflow Comparison

2019 Outfall #	Existing Condition Watershed	Existing Condition (PA3&4 ROMP)							Ultimate Mitigated[1]						
		Area	2	5	10	25	50	100	Basin	2	5	10	25	50	100
		ac	cfs							cfs					
-	3	8.5	0.8	3.1	8.2	11.2	12.8	14.1	-	-	-	-	-	-	-
-	4A	24.4	8.6	20.8	39.3	51.9	58.6	63.7	-	-	-	-	-	-	-
8	4B	42.0	8.2	28.2	58.0	77.6	89.5	96.3	-	-	-	-	-	-	-
-	5A	152.9	14.0	69.0	163.6	220.9	253.8	277.3	-	-	-	-	-	-	-
-	5D	57.1	8.0	33.6	72.8	97.8	111.7	121.8	-	-	-	-	-	-	-
-	5B	61.5	9.6	37.0	79.1	105.7	120.6	131.5	3A-5	3.6	36.3	42.3	43.0	43.5	43.8
9	-	-	-	-	-	-	-	-	-	0.0	0.0	0.0	112.6	185.2	264.3
	5C	187.2	9.0	68.0	183.0	249.9	286.7	316.5	3A-6	2.9	28.9	70.1	70.1	70.8	71.4
-	6	9.9	2.5	7.1	13.9	18.4	21.0	22.6	3A-7	2.0	2.2	4.5	14.9	19.8	21.6
-	7	74.0	8.3	37.2	85.8	115.8	132.6	145.1	3A-9	1.2	2.5	43.2	74.9	81.8	84.4
-	8	49.3	6.5	28.2	61.0	81.7	92.5	101.7	3A-10	1.0	2.5	45.1	80.4	96.1	103.4
-	9A	31.2	5.1	18.8	39.7	52.9	60.1	68.4	3A-11	1.3	10.4	77.8	104.4	117.4	123.3
-	9B	12.3	2.2	7.6	16.0	21.2	24.2	26.3	-	-	-	-	-	-	-
-	10	48.7	6.3	27.8	60.2	80.6	91.3	100.4	-	-	-	-	-	-	-

[1]Basin peak discharges are from PCSWMM.

2.3.2 Subregional Analysis

A subregional analysis was created to assess the effects of discharging the post-development runoff flows from Subwatershed A into Gobernadora Canyon and the GERA at node 13305 along Gobernadora Canyon. Node 13305 is an intermediate node in the Ranch Plan ROMP. The use of node 13305 allows a hydrology analysis comparison that better captures the differences between the existing and ultimate condition runoff flows within Gobernadora Canyon, which is immediately adjacent to the basins in Subwatershed A. This Gobernadora subregional hydrology analysis consists of the existing and ultimate condition rational method and unit hydrographs for the area tributary to node 13305. This analysis includes the single area, free draining and complex with basin hydrograph models. A description of these hydrographs is below.

The unit hydrographs for the local Gobernadora analysis, in accordance with Section K of the Orange County Hydrology Manual, included:

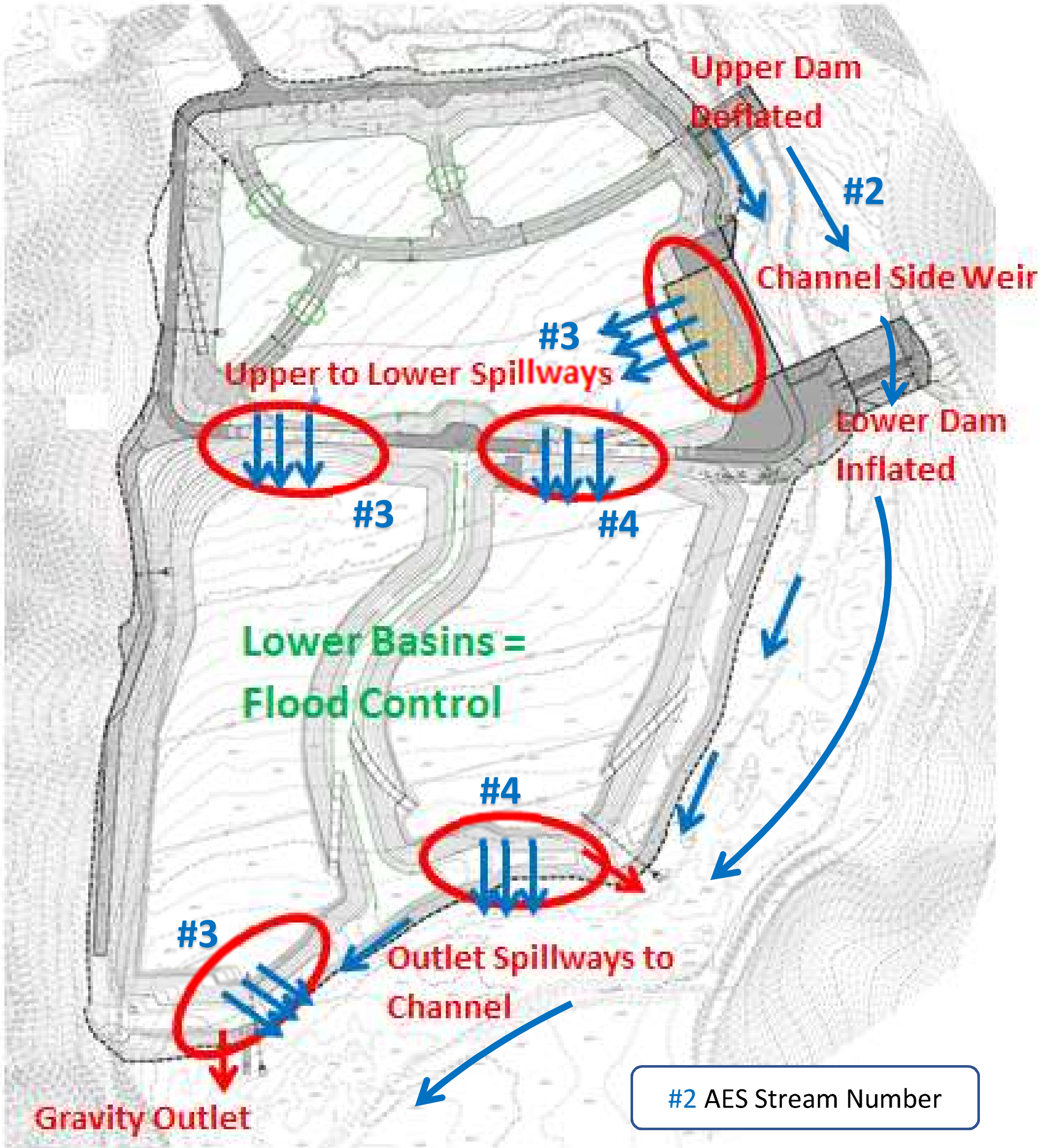
1. Single Area Model: single hydrograph to a concentration point
2. Free Draining Model: multiple hydrographs (due to watershed division into subwatersheds) that are linked together by routing processes to the same concentration point as the single area runoff hydrograph

3. Calibrated Free Draining: free draining model with increased rainfall so that the free draining model is equal to or greater than the single area model. Free draining models with flows within 2% of the single area model were not calibrated
4. Complex with Basin Model: free draining or calibrated free draining model with proposed basins inserted in the model

The Gobernadora Multipurpose Basin routing used the final design rating curves from the Gobernadora Basin Report (PACE, 2014). The local basin stage-storage-outflow curve is based on the PCSWMM model. The diversion flows into the local basins are also based on the water quality models described in Section 5 of this report. The existing condition unit hydrograph model for Node 13305 is based on the approved Ranch Plan ROMP rational method models. It consisted of modifying the unit hydrograph models to use the time of concentration (T_c) at node 13305 and excluding all areas downstream of 13305. The unit hydrograph model was then run following the Orange County methodology and the unique considerations for areas within San Juan Creek Watershed per Chapter 5 of the Ranch Plan ROMP including modeling of the development with AMC II and undeveloped areas with AMC I for more frequent storms (2-, 5-, and 10-year). Appendix C provides the rational method and unit hydrograph hydrology models. The ultimate condition watershed tributary to node 13305 is shown on Exhibit 9. Table 2-6 provides a summary of the hydrology results for the existing and ultimate conditions.

Table 2-6: Local Node 13305 Discharge Results

Storm Event	Existing Condition Model	Ultimate Condition			
		Single Area Model	Free Draining Model	Calibrated Model	Complex Model
100	3826	3859	3828	-	2849
50	3399	3435	3329	3423	2611
25	2845	2874	2815	2882	2289
10	1868	1941	1856	1895	1659
5	813	882	845	878	781
2	368	409	386	407	393



Citation: PACE August 2014 Design Report: Gobernadora Multipurpose Basin

Figure 2.5: Gobernadora Multipurpose Basin Routing

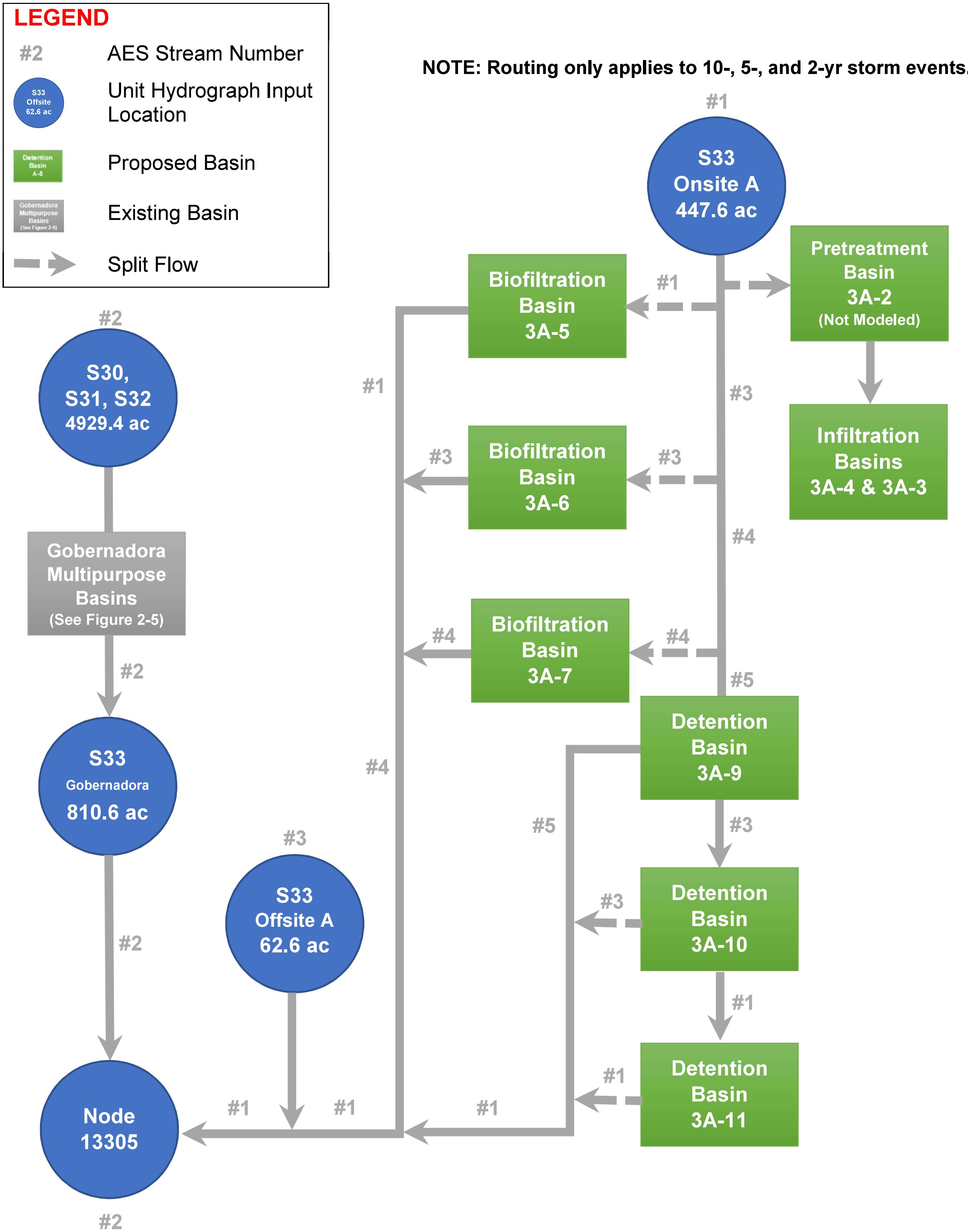
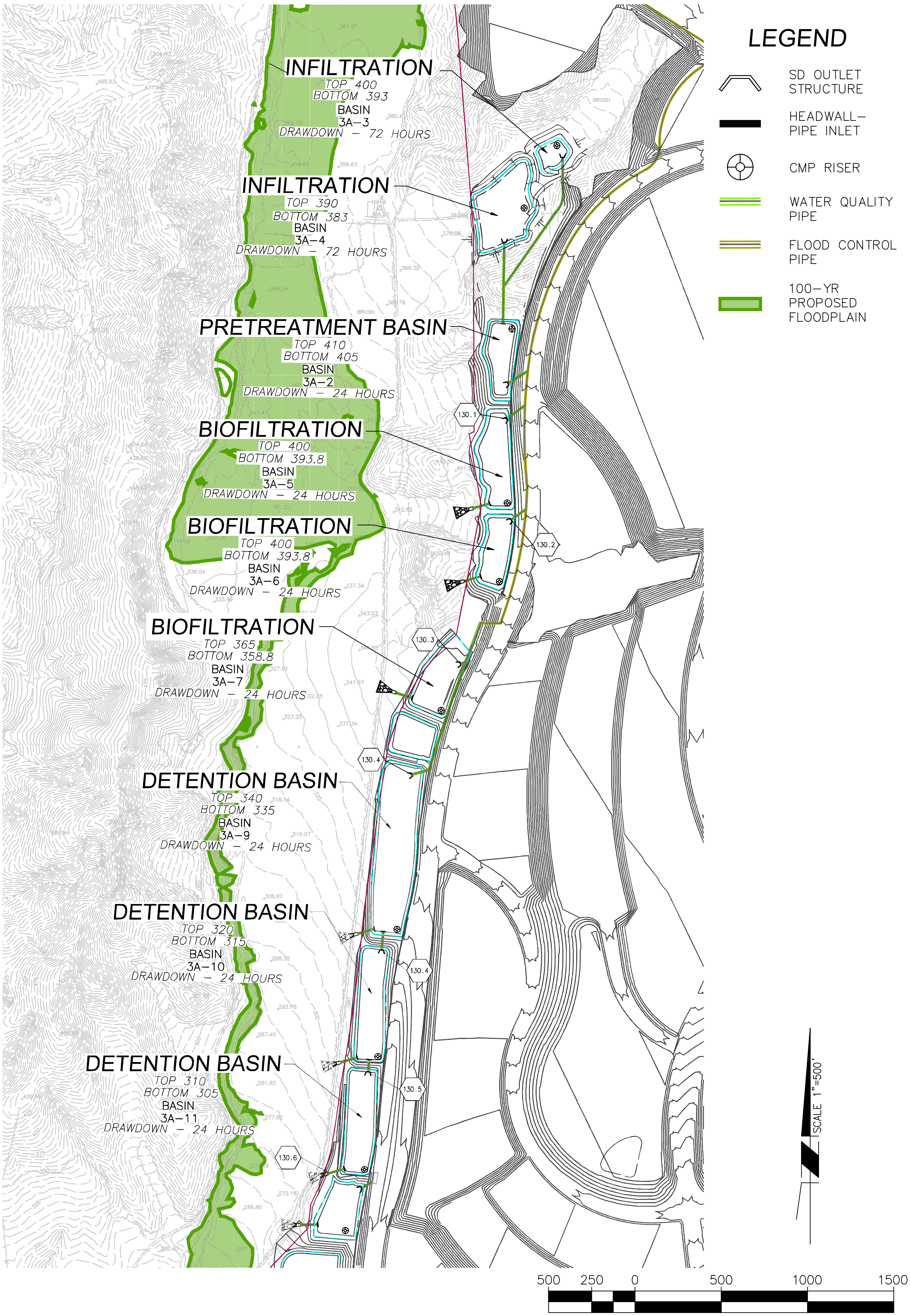


Figure 2-6: Proposed Subwatershed A Basin Routing to Node 13305 PCSWWM Routing



RANCHO MISSION VIEJO PA3&4 ROMP
PROPOSED SUBWATERSHED A BASIN MAP
FIGURE 2-7

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2.4 Regional Analysis

In order to address the Ranch Plan ROMP Chapter 19 requirements and Mitigation Measure 4.5-5, the regional hydrology analysis includes the following:

- Revised existing conditions analysis;
- Sub-regional analysis for Gobernadora Canyon;
- Phased condition regional hydrology;
- Ultimate condition regional hydrology; and
- Final Recommendations.

The hydrology methods used in the regional analysis are consistent with the methods used in the Ranch Plan ROMP including the use of AMC I for undeveloped areas and AMCII for developed areas for the higher frequency storms. A complete discussion of the regional hydrology methods can be found in the Ranch Plan ROMP Chapter 5. Unit Hydrograph Parameter Development is included in Appendix H. The following summarizes the hydrologic inputs to the various models.

2.4.1 Regional Rational Method

The rational method was used in the regional study to determine lag times for use in the unit hydrograph models according to the Orange County Hydrology Manual Equation E.1 Lag= 0.8 Tc except for the 2-year and 5-year. The 2-year and 5-year analysis required the use of the unit yield method in natural areas (0% impervious) where the rainfall intensity becomes less than the loss rate. The unit yield calculations are included in Appendix H.6 through H.8.

The rainfall intensity for the regional rational method required the use of both non-mountainous and mountainous weighted average depending on the location of the concentration point in the watershed. The rainfall data used in this updated PA-3&4 ROMP is included in Appendix D.4, E.7, F.7, and G.7 for the Existing, Phase and Ultimate Conditions, respectively.

The regional rational method model includes the use of .DNA files for concentration points upstream of the studied concentration points. For this update the only regional areas studied are: S19 (existing area northeast of PA-4), S26 (PA-4 and San Juan Creek), S27 (PA-3 and San Juan Creek), S29 (PA-5 and San Juan Creek), and S33 (Gobernadora Canyon and San Juan Creek confluence). Exhibit 9 shows the rational method regional watershed basins. For the phased and ultimate analysis, a regional rational method with embedded basins (complex model) is included in Appendices E.6 and F.6 for Phased and G.6 for Ultimate Conditions. These models are developed with the basin outflow to estimate lag time for complex models (with basins). The basins mitigate outflow and decrease the velocity and increase the travel time for the stream segments downstream of the basin. The outflow is simulated by re-inputting the max outflow into the free draining rational method model. The calculation of effective area for basin outflow uses the local rainfall unit hydrograph for the area directly tributary to that basin (Appendix B.8). Time of concentration and intensity for the areas tributary to proposed mitigation basins are from the Local Rational Method longest flow path.

2.4.2 Basins

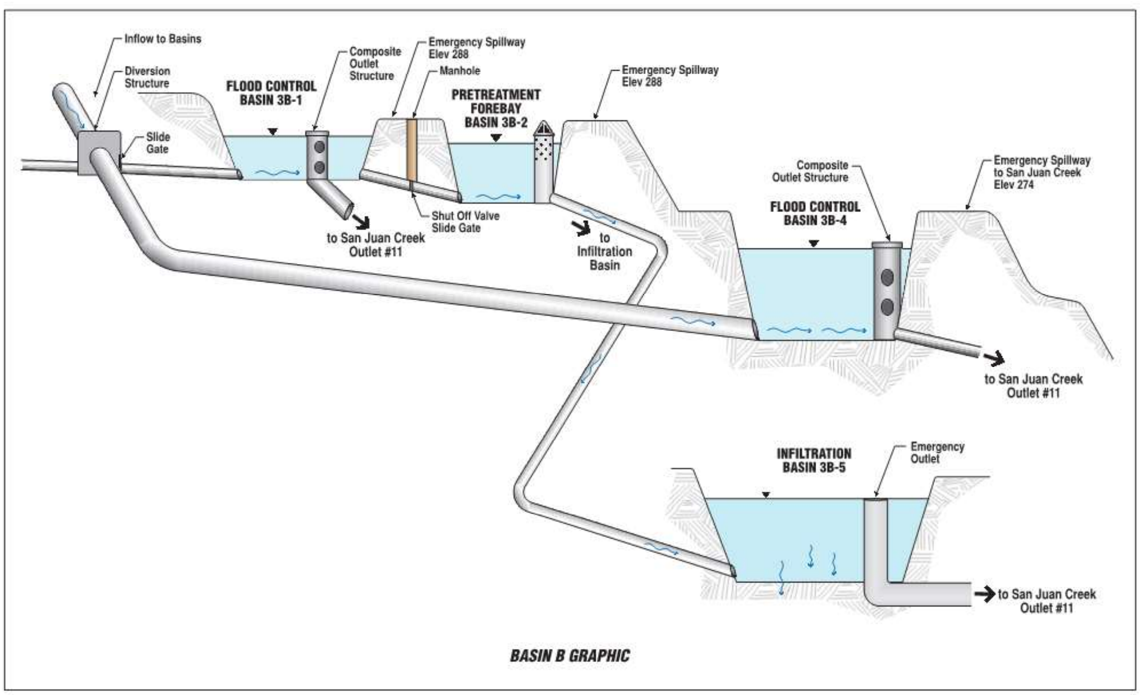
Four (4) regional basin systems are proposed within the PA-3&4 development. Basins in subwatersheds B, C E, and F provide regional mitigation and are included in the regional hydrology models. These basins have been sized for local watershed requirements. They are able to detain the local multiday storms and provide the required two (2) feet of freeboard to the crest of the emergency spillways. Basin design conforms with the County Design Criteria and Division of Safety of Dams (DSOD) requirements.

Basins in subwatershed A provide subregional mitigation and are only included in subregional Gobernadora models. Proposed basins are shown on Exhibit 3a. The basin systems will provide water quality treatment, hydromodification mitigation, and flood control for the planning areas. Regional basins outside of PA-3&4 include Gobernadora Basin in regional area S33 (see Plans for Construction of Facility L07B01 Canada Gobernadora Detention Basin dated July 2014) and the proposed basin in PA-5, which is unchanged from the 2013 Ranch Plan ROMP. This ROMP provides a programmatic evaluation of the storm drains, bypasses, and preliminary footprints of all the basins. Detail for each facility will be provided with final design.

Basin System A will provide water quality treatment and hydromodification mitigation for local flows through approximately the 10-year event in subwatershed A. Basins in System A are located on the north and northwestern portion of PA-3. The basin system will outlet into Gobernadora Canyon and is included in the subregional analysis at Node 13305 2-, 5-, and 10-year models. The Basin System A, which is primarily for LID, water balance and hydromodification, is discussed in detail in Section 5.

Basin System B has been constructed based on the approved 2019 PA-3&4 ROMP and Basis of Design for Cow Camp Road Phase 2B. This basin provides water quality treatment and flood control for Subwatershed B Basins. The system is located south of Cow Camp Road just east of the Gobernadora Canyon. Subwatershed B basins include two flood control basins, a pretreatment forebay, and an infiltration basin for water quality. Water quality features are discussed in Section 5.3.2. The lower flows are directed to the easterly flood control basin 3B-1, which is also connected to the pretreatment forebay and infiltration basins (3B-2 and 3B-5). The remaining flows are conveyed to the larger westerly flood control basin (3B-4) and outlet directly to San Juan Creek at Outlet 11 (tributary to regional hydrology node 129). A graphic of the B basin system is shown in Figure 2-8. A schematic of Basin System B functions is shown in Figure 2-9, and a map of the Basin System B layout is shown in Figure 2-10. The Basin System B final design was included on the Cow Camp Road Phase 2B plans.

Figure 2-8: Proposed Subwatershed B Basin Graphic



Basin System C includes Pretreatment Forebays (Basin 3C-1A and 3C-1C), Settling Basin (Basin 3C-1B), open infiltration basin (Basin 3C-2), open infiltration basin (Basin 3C-5) and flood control basin (Basin 3C-3). The infiltration basin 3C-5 is proposed to be a supplemental/backup part of the stormwater infiltration system. Water Quality basin is included in Section 5 and additional information is included in a separate report titled "Rancho Mission Viejo Ranch Plan – Planning Area 3 Conceptual Level: Water Quality Management Plan (WQMP) 2022 Update Summary & C-Complex Basins." The basins have been sized to consider the flow from the entire watershed, not only the developed area. Outflows from Flood Control Basin System C will enter San Juan Creek at outlet 13.1 (tributary to regional hydrology node 127). A schematic of how Basin System C functions is included in Figure 2-11, and a map of the Basin System C layout is included in Figure 2-12. Basin System E consists of a flood control basin and a water quality basin located on the western side of PA-4 subwatershed E. The flood control basin (4E-1) will serve as a sediment forebay for the water quality infiltration basin (4E-2). The basins have been sized to consider the flow from the entire watershed, not only the developed area. Low flows will enter the water quality basin, and higher flows will discharge into San Juan Creek at outlet 20 (regional hydrology node 126). A plan view of the configuration for Basin System E is included in Figure 2-15.

Basin System F consists of a flood control basin and a water quality basin located on the northwestern side of PA-4 subwatershed F. The flood control basin (4F-1) will serve as a sediment forebay for the water quality infiltration basin (4F-2). The basins have been sized to consider the flow from the entire watershed, not only the developed area. Low flows will enter the water quality basin, and higher flows will discharge into San Juan Creek at outlet 21 (tributary to regional node 126). A plan view of the configuration for Basin System F is included in Figure 2-16.

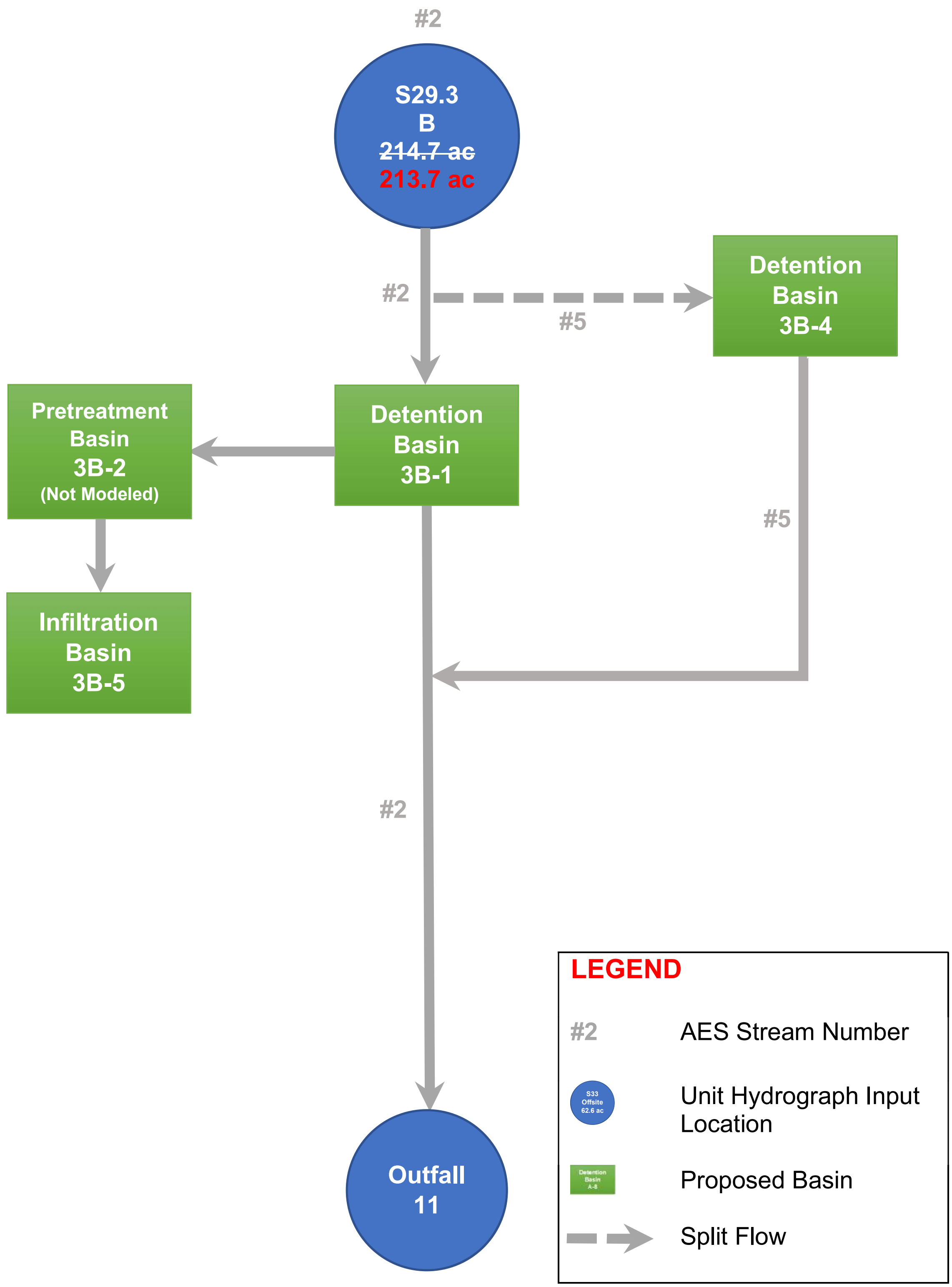
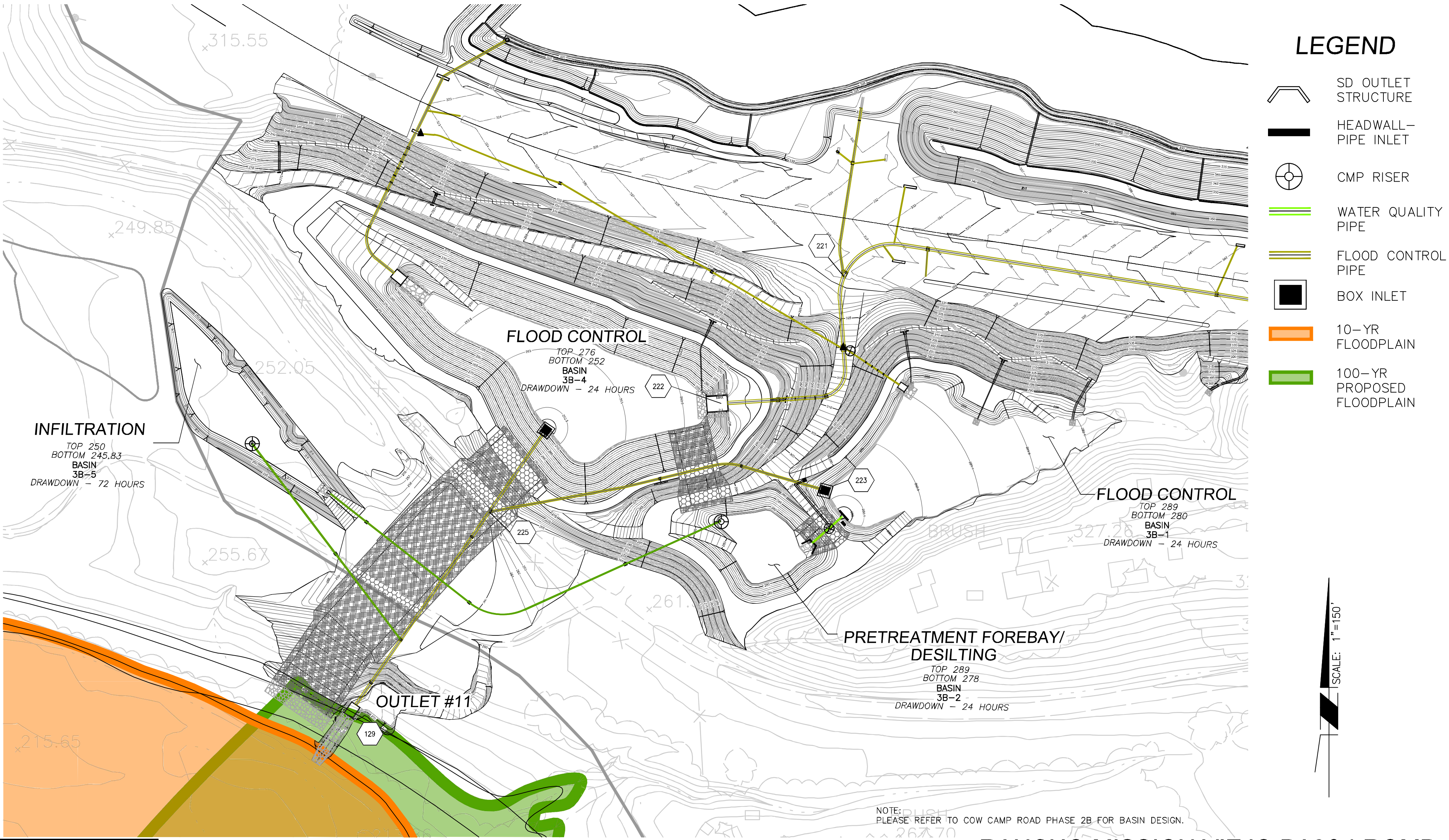


Figure 2-9: Proposed Subwatershed B Basin Routing



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RANCHO MISSION VIEJO PA3&4 ROMP
PROPOSED SUBWATERSHED B BASIN MAP
FIGURE 2-10

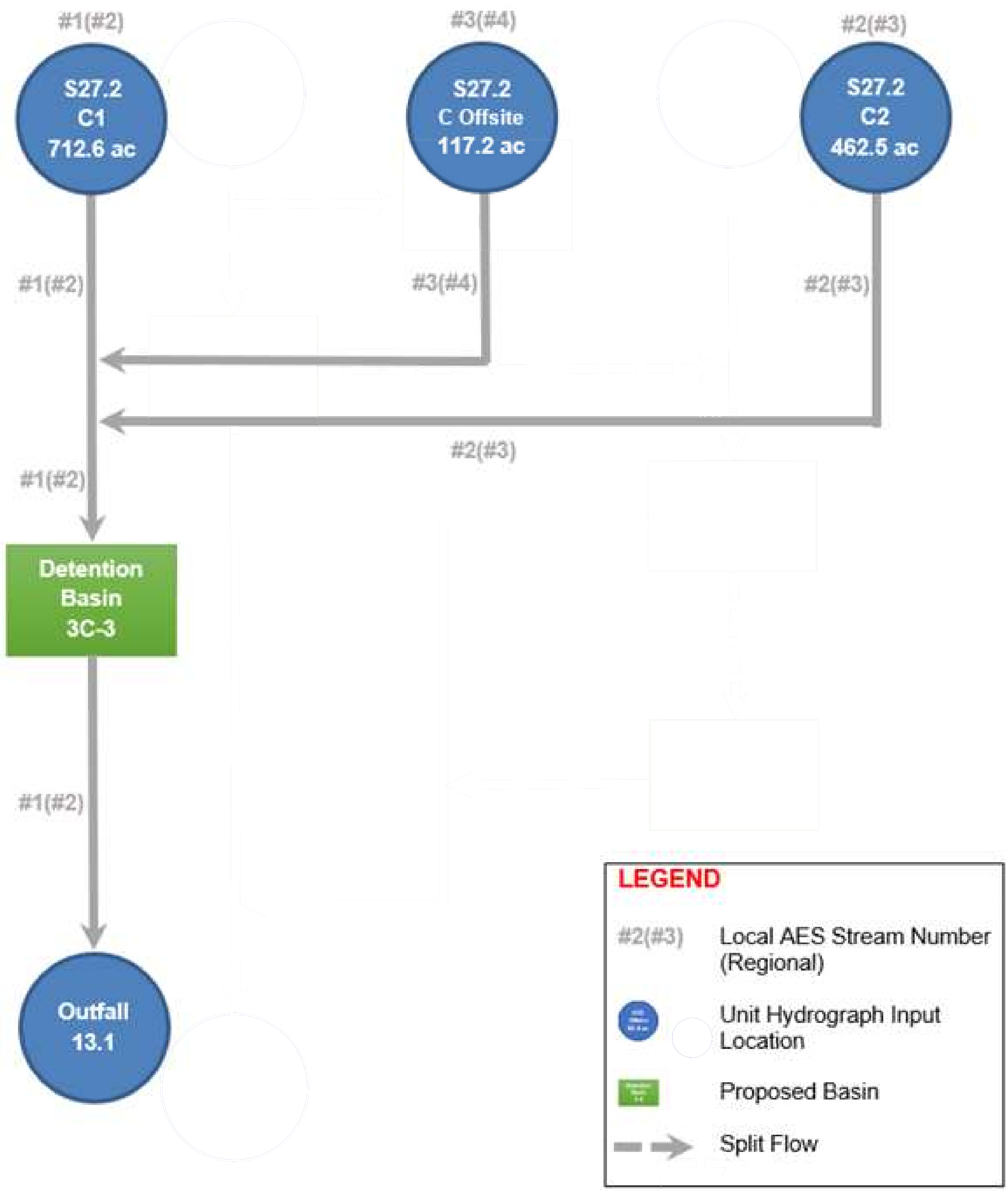
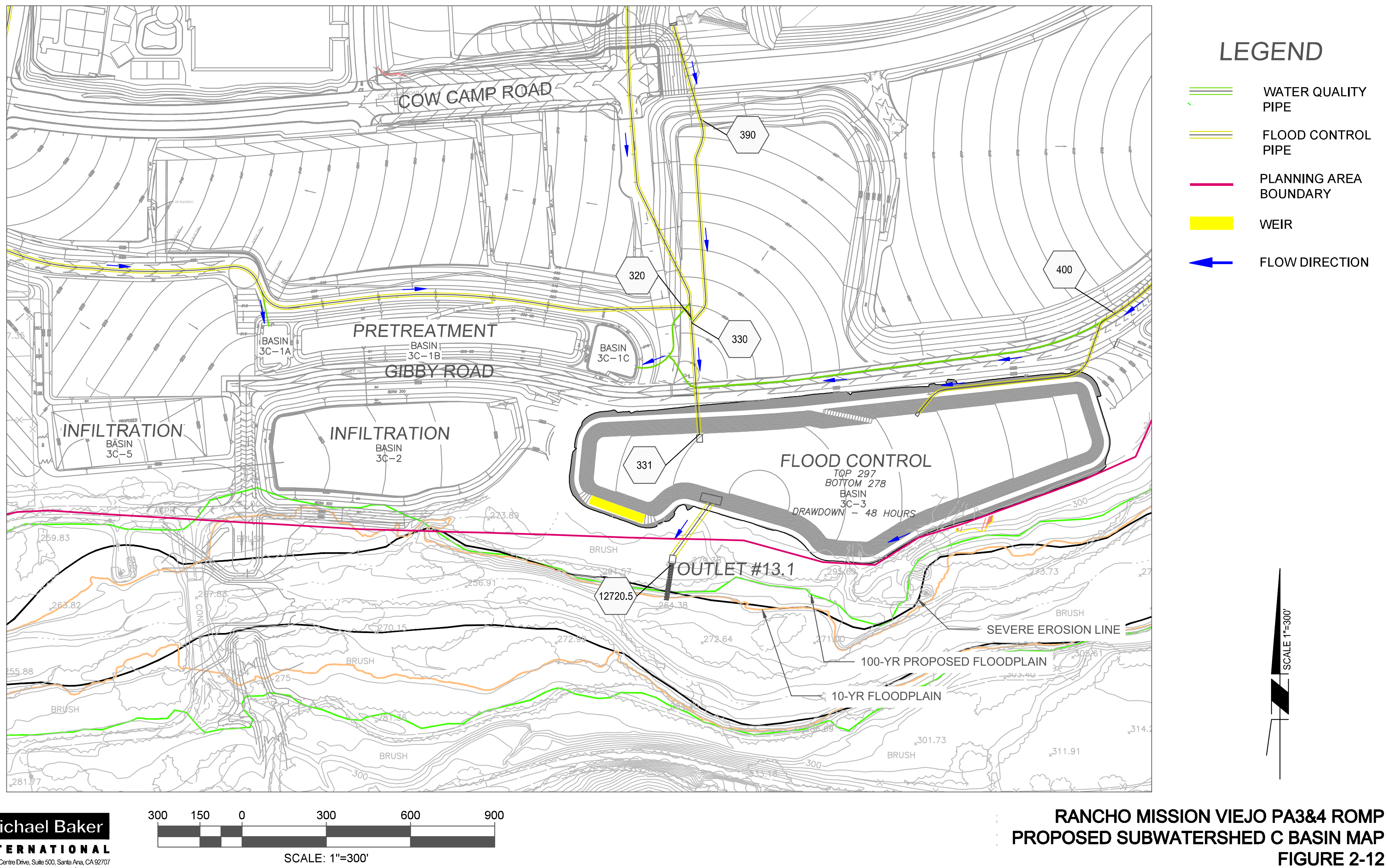


Figure 2-11: Proposed Subwatershed C Basin Routing



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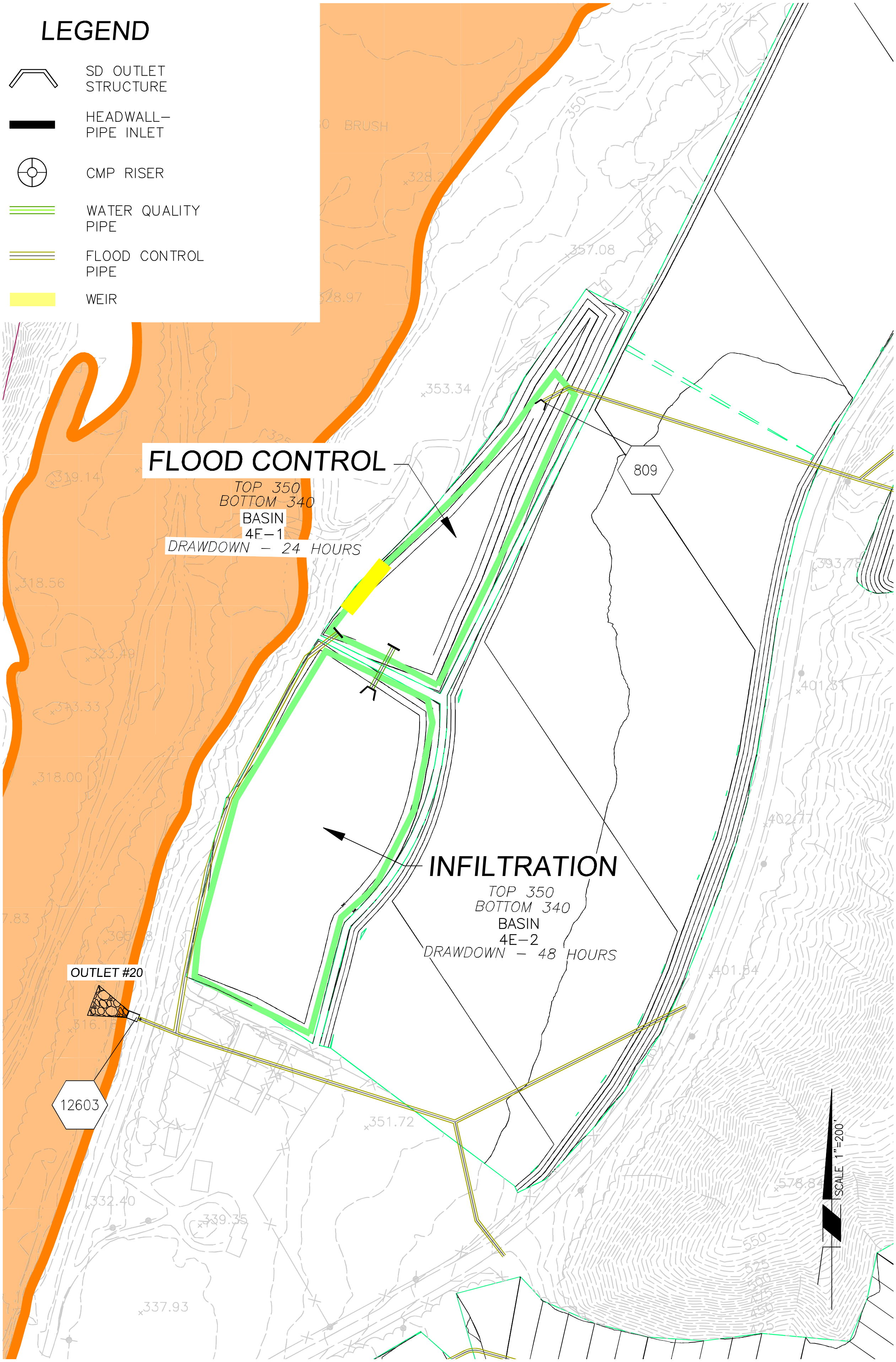
RANCHO MISSION VIEJO PA3&4 ROMP
PROPOSED SUBWATERSHED C BASIN MAP
FIGURE 2-12

~~Figure 2-13: Proposed Subwatershed D Basin Routing~~ REMOVED

~~Figure 2-14: Proposed Subwatershed D Basin Map~~ REMOVED



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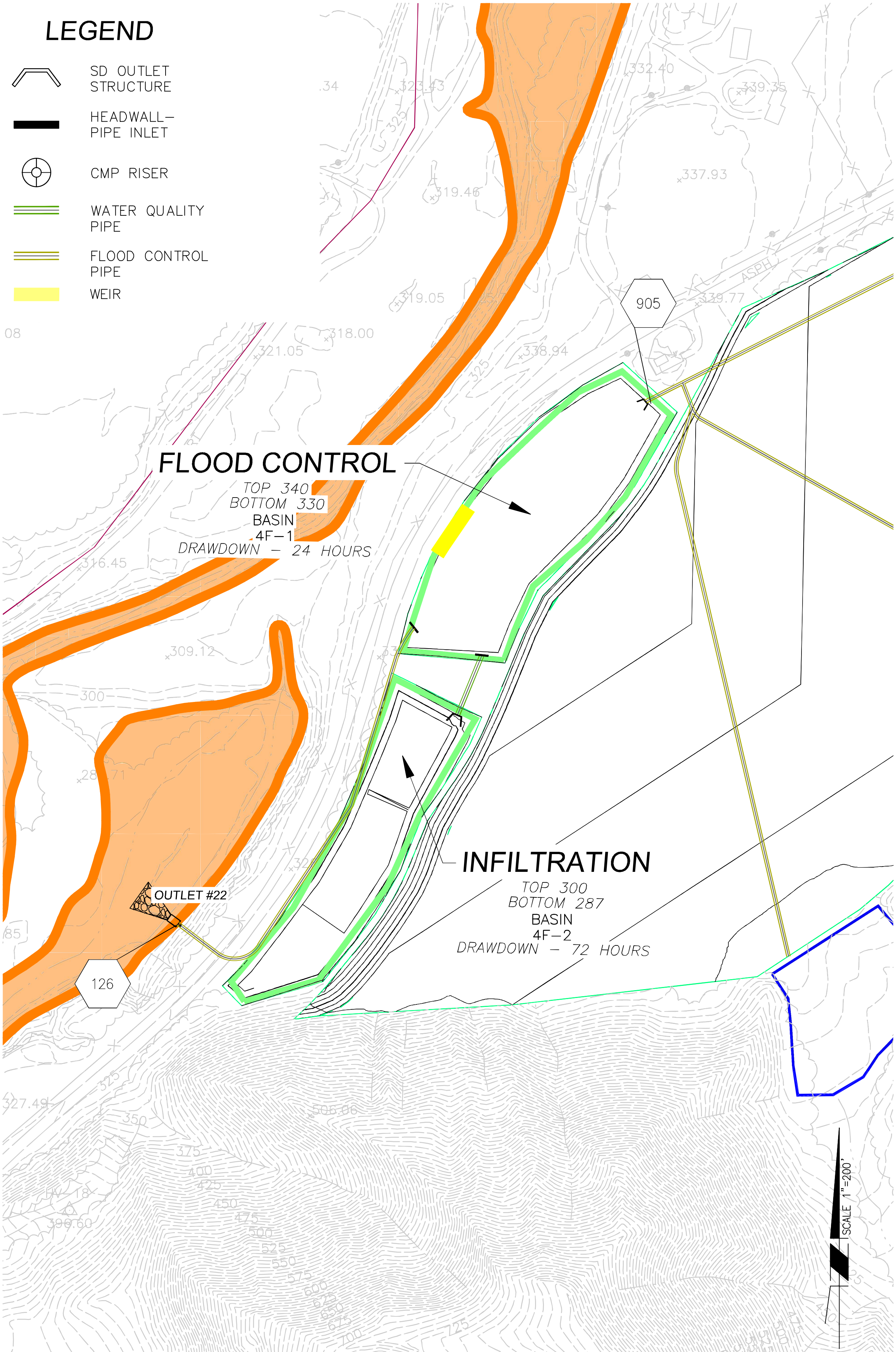
200 100 0 200 400 600
SCALE: 1"=200'

RANCHO MISSION VIEJO PA3&4 ROMP
PROPOSED SUBWATERSHED E BASIN MAP
FIGURE 2-15



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SCALE: 1"=200'

RANCHO MISSION VIEJO PA3&4 ROMP
PROPOSED SUBWATERSHED F BASIN MAP
FIGURE 2-16

2.4.2.1 Debris Basins

Debris basins will be included in the planning areas to capture debris from the natural area tributary to the development. Preliminary sizing was conducted for the large offsite areas tributary to the planning areas but will be analyzed in greater detail in future design efforts. The potential debris volume was determined based on the US Army Corps of Engineers LA District procedure for the *Prediction of Debris Yield* (regression equations) per the County of Orange guidelines for detention basins. These calculations were performed for offsite areas that would ultimately drain through the basin systems as explained in Section 2.4.2 above. Debris volumes were estimated for offsite areas for Subwatersheds C, E, and F, the results are shown in Table 2-7. From the Army Corps of Engineers (ACOE) manual, the equation shown below, was used to determine the potential debris volume for watersheds from 0.1 to 3.0 square miles.

$$\text{Log (Dy)} = 0.65(\text{Log P}) + 0.62(\text{Log RR}) + 0.18(\text{Log A}) + 0.12(\text{FF})$$

Where:

- Dy = Unit Debris Yields (yd^3/mi^2)
- P = Maximum 1-hour precipitation (OC Hydrology Manual values were used to the hundredths place and converted to percentages)
- RR = Relief Ratio (ft/mi)
- A = Drainage Area (ac)
- FF = Non-dimensional Fire Factor

Table 2-7: 100-year Debris Volume Calculation

Watershed Debris Basin	Total Drainage Area (ac)	Undeveloped Drainage Area (A)	100-year - 1-hour Precipitation (P)	Relief Ratio (slope) (ft/mile) (RR)	Fire Factor (FF)	Dy Unit Debris Yield (yd^3/mi^2)	Dy Unit Debris Yield (ac-ft)	Parent Material	Soils	Channel Morphology	Hillslope Morphology	A-T Factor	Computed 100-year Debris Production (ac-ft)
C1 Debris Basin	829.8	117.2	145	430	4.5	8915	7.1	0.15	0.15	0.25	0.15	0.7	5.0
E Debris Basin 1	171.0	34.1	145	853	4.5	10913	1.8	0.15	0.15	0.25	0.15	0.7	1.3
E Debris Basin 2	171.0	20.8	145	815	4.5	9707	1.6	0.15	0.15	0.25	0.15	0.7	1.1
E Debris Basin 3	171.0	17.8	145	796	4.5	9303	1.5	0.15	0.15	0.25	0.15	0.7	1.1
F Debris Basin 1	553.8	23.6	145	1185	4.5	12521	6.7	0.15	0.15	0.25	0.15	0.7	4.7
F Debris Basin 2	553.8	269.2	145	580	4.5	12462	6.7	0.15	0.15	0.25	0.15	0.7	4.7
F Debris Basin 3	553.8	5.7	145	1947	4.5	13192	7.1	0.15	0.15	0.25	0.15	0.7	5.0
F Debris Basin 4	553.8	18.5	145	1823	4.5	15656	8.4	0.15	0.15	0.25	0.15	0.7	5.9
F Debris Basin 5	553.8	120.7	145	897	4.5	14140	7.6	0.15	0.15	0.25	0.15	0.7	5.3
F Debris Basin 6	553.8	1.2	145	314	4.5	14140	7.6	0.15	0.15	0.25	0.15	0.7	0.9

The different watershed parameters using in the debris production analysis following the ACOE procedures were based on the following background for their selection:

Watershed Drainage Area = Only the debris producing portions of the watershed are included in the analysis, consistent with recommendations in the ACOE guidance document. The drainage area would include the natural area excluding the development area.

Maximum 1-hour Precipitation = The 100-year 1-hour precipitation from the *Orange County Hydrology Manual* will utilize the high confidence since this is debris volume is used in the "design" of the basin storage. This high confidence value is 1.45 inches, so this value is multiplied by 100 for the equation of a value of 145.

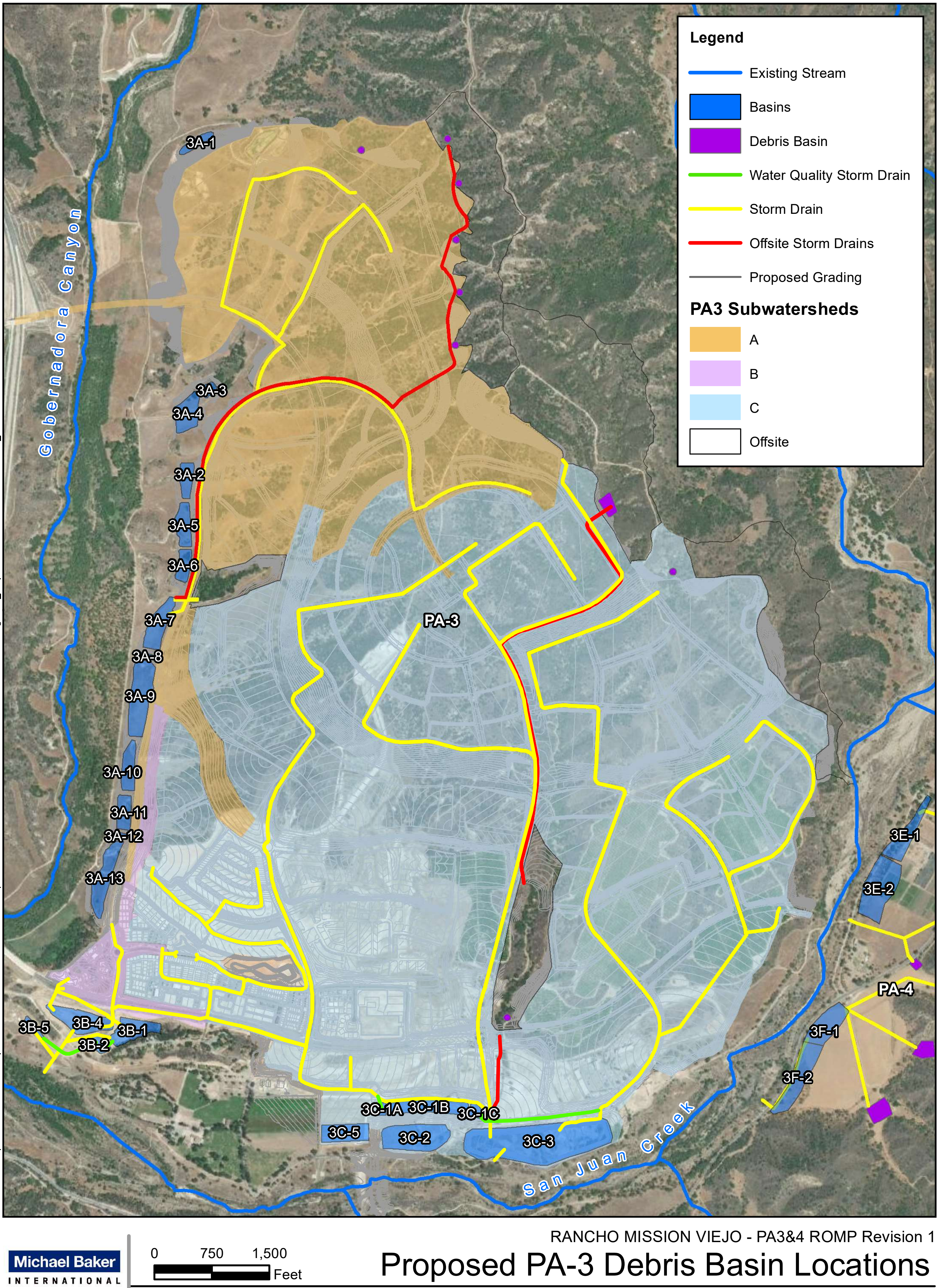
Relief Ratio = This is the slope measured from the digital watershed topography tributary to the detention basin location from the upstream most remote point in the watershed to the downstream basin. The slope units are in feet/mile.

Fire Factor = The *Orange County Draft Detention Basin Design Criteria* indicates a 4-year after burn in the County's guidelines for the time period of the burn within the watershed. Refer to the 2013 ROMP *Chapter 14 – Regulatory Requirements and Design Criteria* under Section 4.3 and the category "sediment and debris criteria".

Adjustment-Transposition Factor (A-T Factor) = The estimation of the AT factor was based on the summing of the four different factors. These watersheds all fall within the moderate range of all the different descriptors except for the "Morphology" indicated in values of 0.15 for each of the factors except the morphology that is 0.25. The total average AT factor would be 0.7 for the different watersheds. This is consistent with the ACOE guidance document which indicates that "watershed areas of less debris yield potential than the San Gabriel Mountains, such as the Peninsular Ranges of San Diego and Orange Counties would have A-T factors less than 1.0".

Proposed debris basin locations are shown on Figure 2-17 and Figure 2-18 for PA-3 and PA-4 respectively. The debris basins will be designed per the Los Angeles County Sedimentation Manual 2nd Edition dated March 2006.

Minimum pipe size shall be 36-inches for debris producing watersheds within Categories 3 or 4 per the latest edition of the Orange County Flood Control District Design Manual per the Orange County Local Drainage Manual 2nd Edition. Final design of debris basins shall be in conformance with the OCLDM 2nd Edition Chapter 9.



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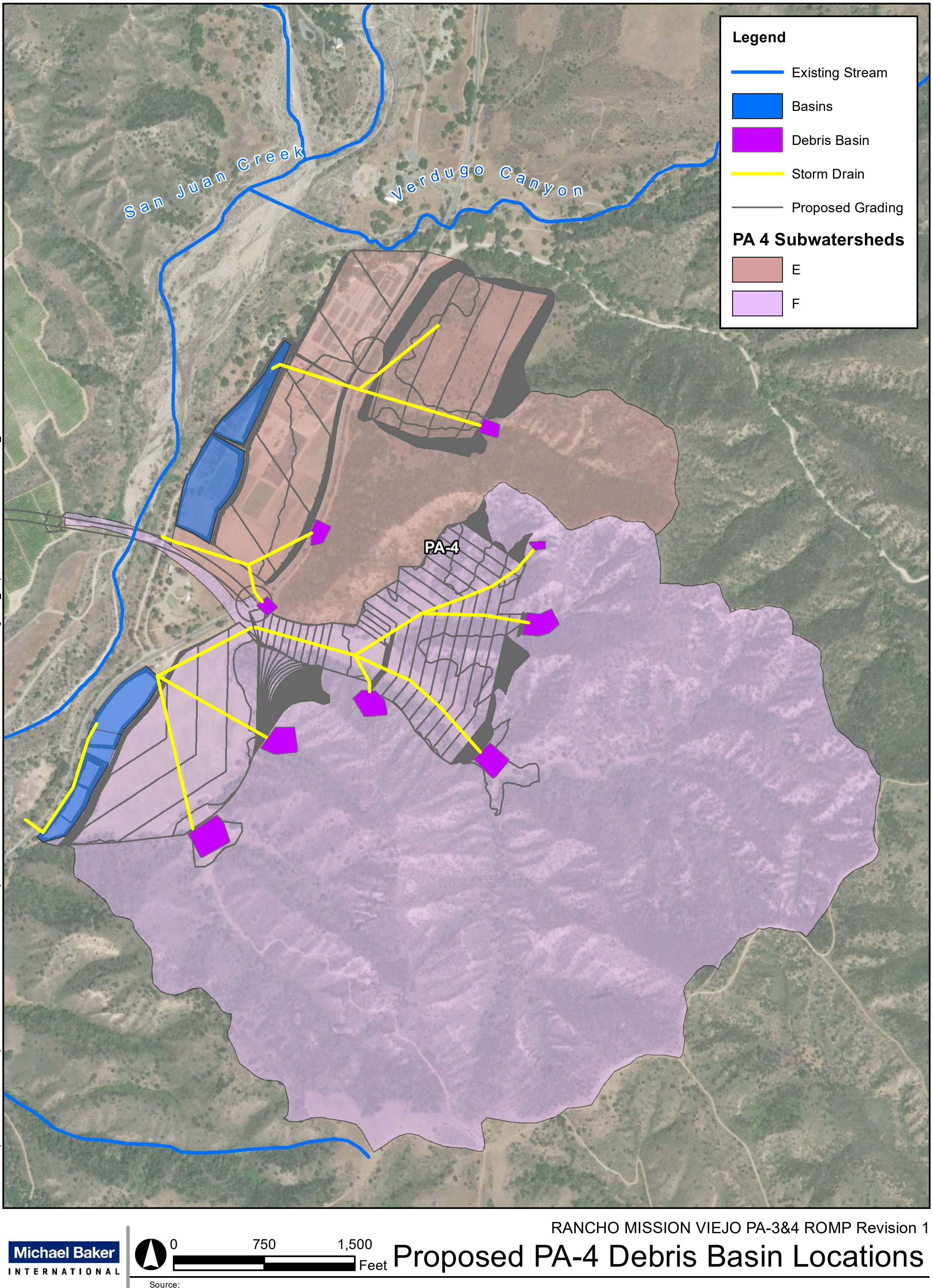
Proposed PA-3 Debris Basin Locations

Figure 2-17



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Proposed PA-4 Debris Basin Locations

Source:

Figure 2-18

2.4.3 Unit Hydrograph Models

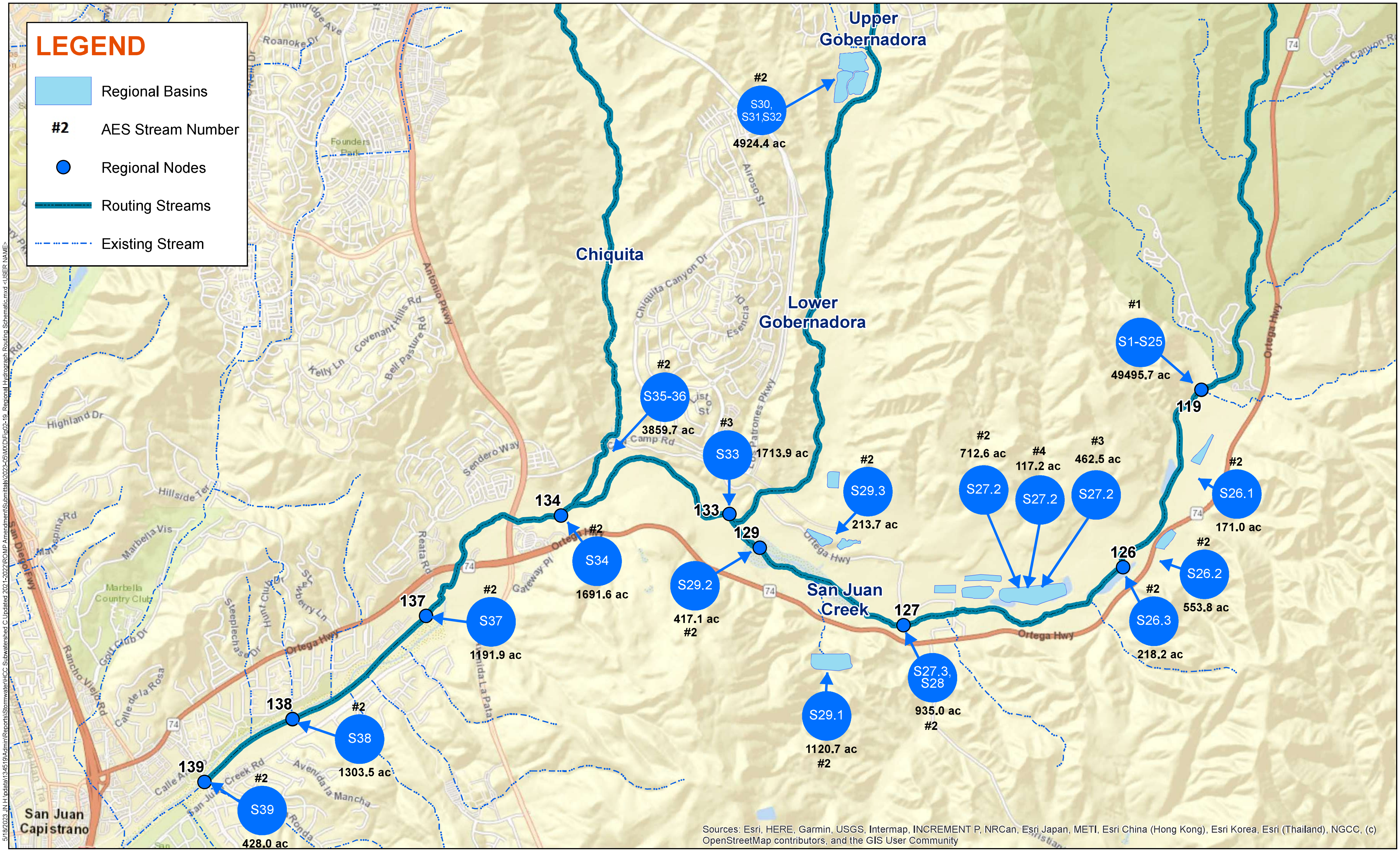
The unit hydrographs for the regional analysis, in accordance with Section K of the Orange County Hydrology Manual included:

1. Single Area Model: single hydrograph to a concentration point (see Appendices D.2, E.3, F.3, and G.3)
2. Free Draining Model: multiple hydrographs representing the same concentration point as the single area (Appendices D.3, E.4, F.4, and G.4)
3. Calibrated Free Draining: free draining model with increased rainfall so that the free draining model is equal to or greater than the single area model. Free draining models with flows within 2% of the single area model were not calibrated (see Appendices E.5, F.5, and G.5)
4. Complex Model: free draining or calibrated free draining model with proposed basins (see Appendices E.6, F.6, and G.6).

The models were run for the concentration points (nodes) that are impacted by the PA-3&4 development and Gobernadora Basin. An exhibit with all the regional nodes is included as Exhibit 6, and a simplified routing schematic of the ultimate condition is shown in Figure 2-19. The nodes studied in this update include:

- 119: San Juan Creek upstream of PA-3 and PA-4
- 126: San Juan Creek downstream of PA-4
- 127: San Juan Creek downstream of PA-3 local subwatershed C (formerly C and D)
- 132c: Gobernadora Canyon downstream of Gobernadora Basin
- 133t: Gobernadora Canyon upstream of confluence with San Juan Creek
- 133u: San Juan Creek upstream of Gobernadora Canyon
- 133c: San Juan Creek downstream of the confluence with Gobernadora Canyon
- 134t: Chiquita Canyon upstream of confluence with San Juan Creek
- 134u: San Juan Creek upstream of confluence with Chiquita Canyon
- 134c: San Juan Creek downstream of confluence with Chiquita Canyon
- 137: San Juan Creek at the RMV boundary
- 138: San Juan Creek downstream of the RMV boundary
- 139: San Juan Creek at La Novia Bridge

The area weighted regional rainfall used at each node is presented in Appendix D.4, E.7, F.7 and G.7 for the Existing, Phased and Ultimate conditions, respectively. Depth area reduction factors are based on the total tributary area to node according to the Orange County Hydrology Manual. Loss rates were based on the methods used in the Ranch Plan ROMP and the Orange County Hydrology Manual and are included in Appendix H. S-graphs were selected based on the Valley Developed S-graph consistent with the Ranch Plan ROMP.



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Regional Hydrograph Routing Schematic

Figure 2-19

2.4.4 Area Discussion

There are area discrepancies between the rational method, the loss rate calculations, and the unit hydrograph method models in the Approved Ranch Plan ROMP. This PA-3&4 update revises the areas within S26, S27, S29, and S33 to eliminate these inconsistencies. Table 2-8 and Table 2-9 show the discrepancies in total tributary area at each of the regional nodes. Changes in total tributary area at each of the regional nodes from the 2013 Ranch Plan ROMP can be attributed to revised grading and delineation of watershed areas. Inconsistencies within PA-5 of the Ranch ROMP will be addressed with the future PA-5 ROMP submittals.

Table 2-8: Existing and Phase Area Comparison

Existing Condition				Phase Condition 1 (PA-1, -2 & -3)				Phase Condition 2 (PA-1, -2, -3 & -4)			
Regional Node	Subarea ID	Area (ac)	Total Area (ac)	Subarea Area (ac)	RM (ac)	Loss Rate (ac)	Differences (ac)	Subarea Area (ac)	RM (ac)	Loss Rate (ac)	Differences (ac)
119	S19	3358	49512	3358	49511.8	49511.8	0.0	3342	49495.7	49495.7	0.0
126	S26	1006	50518	894.3	50438.7	50438.6	0.1	910.1	50438.7	50438.7	0.0
127	S27	1562	52080	2031.0	52442.9	52442.8	0.1	2031.0	52442.8	52442.8	0.0
-	S28	1066	53147	1066.4	53506.2	53506.2	0.0	1066.4	53506.2	53506.2	0.0
133u	S29	966	54113	851.7	54354.0	54354.1	0.1	851.7	54354.0	54354.0	0.0
-	S30	2016	-	2016.1	-	-	-	2016.1	-	-	-
-	S31	1781	-	1780.7	-	-	-	1780.7	-	-	-
-	S32	1128	-	1127.6	-	-	-	1127.6	-	-	-
133c	S33	2190	61227	1716.1	60992.4	60992.4	0.0	1716.1	60992.3	60992.3	0.0
134u	S34	1244	62471	1705.5	62697.9	62698.0	0.1	1705.5	62697.9	62698.0	0.1
-	S35	1580	-	1579.8	-	-	-	1579.8	-	-	-
134c	S36	2503	66554	2279.9	66557.7	66557.7	0.1	2279.9	66557.6	66557.6	0.0
137	S37	1239	67793	1240.9	67798.3	67798.2	0.1	1240.9	67798.3	67798.3	0.0
138	S38	1333	69125	1303.7	69102.0	69102.0	0.0	1303.7	69102.0	69102.0	0.0
139	S39	428	69553	427.8	69529.8	69529.8	0.0	427.8	69529.8	69529.8	0.0

Table 2-9: Ultimate Approved and PA-3 Ultimate Area Comparison

Ranch Plan Ultimate Condition				PA-2 Ultimate Condition		PA-3&4 Ultimate Condition			
Regional Node	**Subarea ID**	**Area (ac)**	**Total Area (ac)**	**Area (ac)**	**RM (ac)**	**Area (ac)**	**RM (ac)**	**Loss Rate (ac)**	**Differences (ac)**
119	S19	3413.6	49567.3	3413.6	49567.3	3342.0	49495.7	49495.7	0.0
126	S26	969.1	50536.4	969.1	50536.4	910.1	50438.7	50438.7	0.0
127	S27	1414.5	51950.9	1414.5	51950.9	2031.0	52442.8	52442.8	0.0
-	S28	223.2	52174.1	223.2	52174.1	223.2	53666.0	53666.0	0.0
133u	S29	2166.6	54340.7	2166.6	54340.7	1755.4	54417.5	54417.5	0.0
-	S30	2015.8	-	2015.8	-	2016.2	-	-	-
-	S31	1780.7	-	1780.7	-	1780.7	-	-	-
-	S32	1127.5	-	1127.6	-	1127.6	-	-	-
133c	S33	2022.5	61291.2	1787.8	61052.6	1716.1	61055.8	61055.8	0.0
134u	S34	1186.0	62477.3	1691.6	62744.2	1691.6	62747.4	62747.4	0.0
-	S35	1579.0	-	1579.8	-	1579.8	-	-	-
134c	S36	2549.9	66602.0	2279.9	66603.8	2279.9	66607.1	66607.1	0.0
137	S37	1191.6	67794.0	1191.9	67795.7	1191.9	67799.0	67799.0	0.0
138	S38	1303.5	69097.0	1303.7	69099.4	1303.7	69102.6	69102.7	0.1
139	S39	427.8	69524.1	427.8	69527.2	427.8	69530.5	69530.5	0.0

2.4.5 Basin Footprint Discussion

A comparison of the estimate footprint area size identified in the 2013 Ranch Plan ROMP for the regional detention facilities to the footprint size provided in the PA-3&4 ROMP Revision 1 is summarized in Table 2-10 and Table 2-11 below as required by item 1.6 of Table 19-1 of the Ranch Plan ROMP. The comparison was prepared to ensure that adequate area was provided in the land plan for regional mitigation. It should be noted that in the comparison for PA-4, the footprint provided in the PA-3&4 ROMP is less than the identified footprint due to the drastic reduction in development area and proposed developed land.

Table 2-10: PA-3 Basin Footprint Comparison

Flood Control Basin	Tributary Area	Outlet	Basin Area at Top	Max. Depth	Max. Storage
Name	**(ac)**	**#**	**(ac)**	**(ft)**	**(ac-ft)**
S29.2 Basin*	710	12	12.6	8.1	95.5
S27.1 Basin*	736	13	14.0	8.3	110.8
3B-1	213.7	11	1.4	9	12.5
3B-4			4.0	24	53.8
	1292.3	13.1			
3C-3			16.1	19	169.5
Total Storage Identified for PA-3 in 2013 Ranch Plan ROMP				206.3 ac-ft	
Total Storage Provided for PA-3				235.8 ac-ft	

* Denotes basins from 2013 Ranch Plan ROMP

Table 2-11: PA-4 Basin Footprint Comparison

Flood Control Basin	Tributary Area	Outlet	Basin Area at Top	Max. Depth	Max. Storage
Name	**(ac)**	**#**	**(ac)**	**(ft)**	**(ac-ft)**
S26.2 Basin*	442	21	10.9	4.8	47.7
S19.2 Basin*	742	19	10.9	9.2	94.7
4E-1	171	20	2.8	10	21.1
4F-1	553.8	21	3.5	10	29.3
Total Storage Identified for PA-4 in 2013 Ranch Plan ROMP				142.4 ac-ft	
Total Storage Provided for PA-4				50.4 ac-ft	

* Denotes basins from 2013 Ranch Plan ROMP

2.4.6 Existing Condition Regional Hydrology

The existing condition regional models were approved as part of the Ranch Plan Planned Community Runoff Management Plan (Ranch Plan ROMP) dated April 2013. However, discrepancies, including area inconsistences up to 51 acres, between the loss rates calculations and the hydrology models were discovered during the PA-2 ROMP and updated for nodes downstream of Gobernadora Canyon for the AES hydrograph runs. The 2019 PA-3&4 ROMP updated the remaining area differences for nodes upstream of Gobernadora. The updates upstream of Gobernadora Canyon are contained in Appendix D. Appendix D includes the following existing condition models: regional rational method free draining model from the Ranch Plan ROMP for reference (Appendix D.1), single area unit hydrographs (Appendix D.2), and free draining unit hydrographs (Appendix D.3). Loss Rates are included in Appendix H. In accordance with the Ranch Plan ROMP (Table 9-18), the higher discharge between the single area UH and free draining UH was selected for comparison in the ultimate condition. Exhibits 4 and 5 show the rational method map from the Ranch Plan ROMP for reference. Exhibit 6 shows the watershed unit hydrograph map from the Ranch Plan ROMP. Table 2-12 describes the results of the single area, free draining, and complex ultimate condition models.

Table 2-12: Regional Existing Condition Hydrology

Node	Area	100-year Expected Value Storm Event (cfs)					50-year Expected Value Storm Event (cfs)					25-year Expected Value Storm Event (cfs)					10-year Expected Value Storm Event (cfs)					5-year Expected Value Storm Event (cfs)					2-year Expected Value Storm Event (cfs)				
		Baseline 2008[1]	Ranch Plan ROMP[2]	PA-3&4 ROMP			Baseline 2008[1]	Ranch Plan ROMP[2]	PA-3&4 ROMP			Baseline 2008[1]	Ranch Plan ROMP[2]	PA-3&4 ROMP			Baseline 2008[1]	Ranch Plan ROMP[2]	PA-3&4 ROMP			Baseline 2008[1]	Ranch Plan ROMP[2]	PA-3&4 ROMP			Baseline 2008[1]	Ranch Plan ROMP[2]	PA-3&4 ROMP		
	(ac.)	Single Area	Existing Flow	Single Area	Free Draining	Existing Flow[3]	Single Area	Existing Flow	Single Area	Free Draining	Existing Flow[3]	Single Area	Existing Flow	Single Area	Free Draining	Existing Flow[3]	Single Area	Existing Flow	Single Area	Free Draining	Existing Flow[3]	Single Area	Existing Flow	Single Area	Free Draining	Existing Flow[3]	Single Area	Existing Flow	Single Area	Free Draining	Existing Flow[3]
119	49512	20221	20304	20326	20326	20326	17815	17836	17844	17844	17844	14999	14923	14939	14939	14939	7159	7195	7239	7238	7239	2462	2404	2403	2403	2403	538	525	534	534	534
126	50518	20284	20302	20352	20249	20352	17854	17810	17828	17767	17828	14798	14897	14924	14866	14924	7024	7101	7114	7145	7145	2340	2349	2380	2346	2380	531	516	514	525	525
127	53147	18254	20598	20460	20273	20460	17896	18013	17925	17779	17925	15014	15055	14964	14872	14964	6917	7076	6972	6990	6990	2331	2319	2303	2314	2314	456	513	494	514	514
133t	7115	3935	3982	3986	3926	3986	3430	3492	3500	3403	3500	2900	2937	2942	2856	2942	1846	1871	1875	1781	1875	776	796	781	786	786	329	364	354	350	354
133u	54113	20274	20362	20361	20213	20361	17849	17894	17911	17719	17911	14986	14923	14948	14829	14948	6769	6874	6908	6914	6914	2345	2287	2308	2298	2308	452	512	483	515	515
133c	61228	25162	21839	21636	21828	21828	18930	19145	19018	19143	19143	15936	15954	15882	15972	15972	7117	7148	7150	7172	7172	2464	2466	2458	2412	2458	576	586	583	568	583
134t	4083	2383	2409	2415	2415	2415	2110	2121	2124	2124	2124	1776	1787	1792	1792	1792	1024	1034	1039	1039	1039	385	381	329	329	329	124	148	121	121	121
134u	62471	21655	22026	21792	22000	22000	19068	19304	19119	19284	19284	15736	16077	15932	16080	16080	7123	7115	7015	7148	7148	2420	2413	2415	2409	2415	575	578	582	569	582
134c	66554	22515	22964	22661	22933	22933	19800	20143	19841	20118	20118	16390	16774	16536	16770	16770	7175	7247	7066	7275	7275	2504	2473	2470	2525	2525	601	605	610	600	610
137	67793	22575	23098	22728	23080	23080	19929	20253	19864	20237	20237	16424	16865	16526	16869	16869	7107	7236	7076	7267	7267	2531	2496	2501	2496	2501	600	608	617	604	617
138	69125	22752	23260	22878	23249	23249	20038	20388	19985	20380	20380	16567	16972	16654	16983	16983	7031	7219	7056	7270	7270	2529	2510	2510	2505	2510	598	622	625	612	625
139	69553	22846	23309	22805	23299	23299	20119	20429	19930	20423	20423	16507	17009	16621	17013	17013	7042	7224	7041	7270	7270	2516	2523	2531	2512	2531	597	635	640	617	640

[1] Approved 2008 Single Area Hydrology Analysis.

[2] April 2013 Ranch Plan ROMP (Table 9-18 in the Approved ROMP). Q is selected from the higher discharge between Single Area and Free-draining model.

[3] Existing flow used for mitigation comparison from PA-3&4 ROMP for the 100-, 50-, and 25-year storms. Q is selected from the higher discharge between Single Area and Free-draining model.

2.4.7 Phase Condition Regional Hydrology

Two phase conditions were analyzed as part of the PA-3&4 ROMP. The first phase condition assumes that PA-1, PA-2, and PA-3 are constructed. Phase condition PA-1, -2 & -3 constructed is the subject of the approval of the PA-3&4 ROMP Revision 1 because the revision focuses on the C Basin Complex. The following phase is included for reference only and will be updated in future ROMP revisions that update the PA-4 basins. The second phased condition regional models assume that PA-1, PA-2, PA-3, and PA-4 are constructed. Appendices E and F include the following models: regional rational method free draining model, regional rational method complex model, single area unit hydrographs, free draining unit hydrographs, calibrated free draining unit hydrographs, and complex unit hydrographs. Appendix H shows the loss rate calculations. Phased condition hydrology maps are included as Exhibits 7 and 8.

2.4.7.1 Model Development

In order to develop the phased condition model, a combination of the existing condition hydrology, PA-1 hydrology, and PA-2 hydrology was used in conjunction with the updated hydrology for PA-3&4 presented in Section 2.2. The analysis used a combination of the Ranch Plan ROMP land use tables (for both existing and proposed conditions), the PA-2 ROMP, and current PA-3&4 land use. See Figure 2-20 and Figure 2-21 for the revised phased land uses.

For the rational method, the existing condition Ranch Plan ROMP models were used for areas S19, S26, S28, S30, S31, S32 and S35 in the phase condition where PA-1, PA-2 and PA-3 are developed. The existing condition Ranch Plan ROMP models were used for areas S19, S28, S30, S31, S32 and S35 in the phase condition where it is assumed only PA-1, PA-2, PA-3 and PA-4 are constructed. Areas S27 and S29 were modified to reflect the drainage patterns for PA-3. The PA-2 ROMP models were used for S34 and S36. Area S33 is a hybrid of PA-2 ROMP and proposed Subwatershed A in PA-3. Areas S37, S38, and S39 were the proposed condition models from the Ranch Plan ROMP.

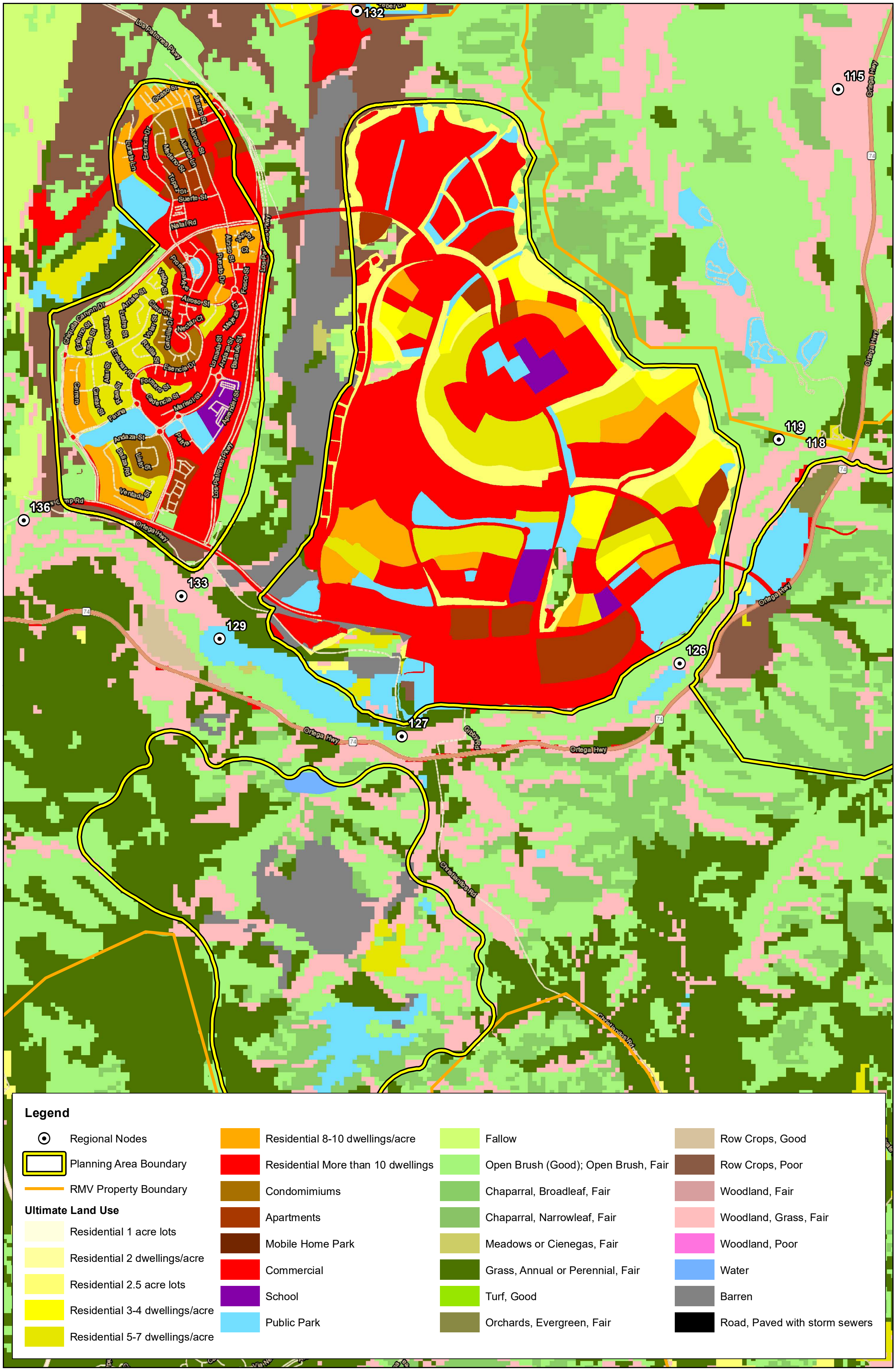
The loss rates were calculated by using the Ranch Plan ROMP land use data, and replacing PA-2, PA-3 and PA-4 revised land uses.

Calibration was required for the 2-, 5-, and 10-year events. The calibration was performed by increasing the rainfall in the free draining unit hydrograph models. Free draining models which underestimate the single area flow by less than 2% where not calibrated.

The following regional node points were analyzed: 119, 126, 127, 129, 132c, 133t, 134t, 133c, 134c, 133u, and 134u, 137, 138, and 139. The analyses were run for the following storms: 2, 5, 10, 25, 50, and 100-year expected value storm events.

2.4.7.2 Phased Condition Results

To meet mitigation requirements, the 25-, 50-, and 100-yr complex models need to be less than or equal to the existing values and the target 10-, 5-, and 2-yr peak discharges are the 2013 Ranch Plan value. Based on the analysis, Table 2-13, Table 2-14, Table 2-15, and Table 2-16 describe the results of the single area, free draining, and complex phased condition models. Results of the 2023 regional analysis shows a minor increase in peak flow for the 50- and 25-year Phased Condition PA-1, -2, -3, & -4 Constructed (No PA-5), less than 0.5% increase, as well as the smaller more frequent events in both conditions. The phased condition PA-1, -2, & -3 Constructed (No PA-4 &-5) also showed an insignificant increase in flow for a few nodes for the 50-year and 25-year. The increase for the smaller events is acceptable because the flow does not impact flood protection and stream stability analysis shows no adverse impacts to San Juan Creek. Results of the ROMP Revision 1 regional analysis are listed in the following Tables.



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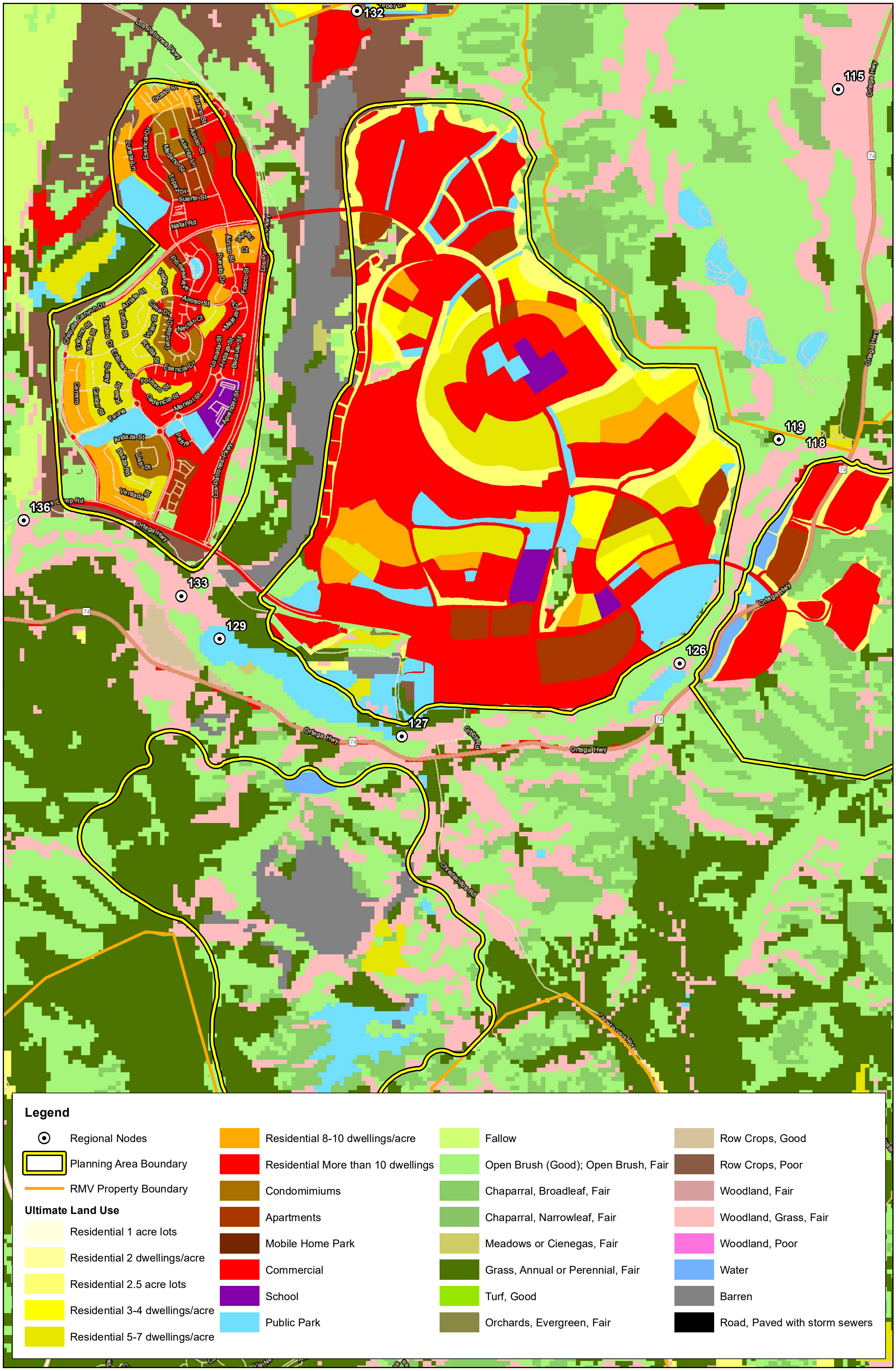
0 2,250 4,500 Feet

Source: ArcGIS Online

RANCHO MISSION VIEJO - PA3&4 ROMP REVISION 1

Phased Condition PA-1, -2 and -3 Developed

Figure 2-20



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0 2,250 4,500 Feet

Source: ArcGIS Online

RANCHO MISSION VIEJO - PA3&4 ROMP REVISION 1

Phased Condition PA-1, -2, -3 and -4 Developed

Figure 2-21

Table 2-13: Phased Condition PA-1, -2 and -3 Developed Regional Hydrology San Juan Creek

Node	Area (ac)	100-year Expected Value Storm Event				50-year Expected Value Storm Event				25-year Expected Value Storm Event				10-year Expected Value Storm Event				5-year Expected Value Storm Event				2-year Expected Value Storm Event			
		Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model
119	49512	20326	20326	-	-	17854	17854	-	-	14919	14919	-	-	7197	7197	-	-	2407	2407	-	-	527	525	-	-
126	50439	20308	20080	-	20080	17785	17708	-	17683	14872	14798	-	14798	7095	7101	-	7101	2344	2345	-	2345	510	518	-	518
127	53506	20370	20203	-	20271	17807	17790	-	17838	14911	14825	-	14929	7346	6990	7429	7083	2441	2346	2436	2457	575	535	593	611
133t	6638	3876	3888	-	2921	3412	3401	-	2690	2868	2848	-	2300	1905	1869	-	1639	865	857	-	842	403	451	-	403
133u	54354	20539	20239	-	20280	18077	17822	-	17859	15128	14827	-	14904	7096	6933	- 7125	7033	2446	2340	2443	2469	588	534	598	614
133c	60992	21745	21855	-	21704	19135	19234	-	19102	16012	16017	-	15941	7465	7349	-	7374	2687	2557	2683	2734	736	662	729	732
134t	3860	2323	-	-	-	2048	-	-	-	1726	-	-	-	1021	-	-	-	348	-	-	-	131	-	-	-
134u	62698	22058	22086	-	21935	19329	19429	-	19301	16174	16176	-	16101	7383	7365	-	7391	2749	2576	2725	2763	758	693	739	724
134c	66558	22841	22996	-	22830	20052	20251	-	20098	16749	16858	-	16768	7475	7525	-	7544	2827	2679	2824	2859	825	736	806	746
137	67798	22983	23146	-	22988	20083	20373	-	20227	16721	16962	-	16875	7528	7548	-	7563	2838	2706	2825	2852	826	766	806	775
138	69102	23082	23308	-	23151	20183	20500	-	20354	16810	17055	-	16977	7506	7550	-	7565	2836	2725	2840	2873	825	789	824	774
139	69530	22959	23378	-	23185	20115	20532	-	20391	16801	17077	-	16992	7482	7551	-	7566	2856	2733	2805	2846	841	802	825	774

Table 2-14: Phased Condition PA-1, -2 and -3 Developed Regional Hydrology San Juan Creek Mitigated Flow Comparison Table

Node	Area (ac)	100-year Expected Value Storm Event				50-year Expected Value Storm Event				25-year Expected Value Storm Event				10-year Expected Value Storm Event				5-year Expected Value Storm Event				2-year Expected Value Storm Event			
		Target Value (CFS)	Post Development (CFS)	Variance %	Variance CFS	Target Value (CFS)	Post Development (CFS)	Variance %	Variance CFS	Target Value (CFS)	Post Development (CFS)	Variance %	Variance CFS	Target Value (CFS)	Post Development (CFS)	Variance %	Variance CFS	Target Value (CFS)	Post Development (CFS)	Variance %	Variance CFS	Target Value (CFS)	Post Development (CFS)	Variance %	Variance CFS
119	49512	20326	-	-	-	17844	-	-	-	14939	-	-	-	7239	-	-	-	2403		-	-	524	-	-	-
126	50439	20352	20080	-1.3	-272	17828	17683	-0.8	-145	14924	14798	-0.8	-126	7178	7101	-1.1	-77	2429	2345	-3.5	-84	533	518	-3.0	-16
127	53506	20460	20271	-0.9	-189	17925	17838	-0.5	-87	14964	14929	-0.2	-35	7159	7083	-1.1	-76	2414	2457	1.8	43	560	611	9.3	51
133u	54354	20361	20280	-0.4	-81	17911	17859	-0.3	-52	14948	14904	-0.3	-44	7221	7033	-2.7	-188	2575	2469	-4.3	-106	638	614	-3.8	-24
133c	60992	21828	21704	-0.6	-124	19143	19102	-0.2	-41	15972	15941	-0.2	-31	7374	7374	0.0	0	2758	2734	-0.9	-24	733	732	-0.1	-1
134u	62698	22000	21935	-0.3	-65	19284	19301	0.1	17	16080	16101	0.1	21	7265	7391	1.7	126	2702	2763	2.2	61	713	724	1.5	11
134c	66558	22933	22830	-0.5	-103	20118	20095	-0.1	-23	16770	16768	0.0	-2	7373	7544	2.2	171	2736	2859	4.5	123	718	746	3.8	28
137	67798	23080	22988	-0.4	-92	20237	20227	-0.1	-10	16869	16875	0.0	6	7433	7563	1.7	130	2796	2852	2.0	56	732	775	5.9	43
138	69102	23249	23151	-0.4	-98	20380	20354	-0.1	-26	16983	16977	-0.1	-6	7412	7565	2.0	153	2791	2873	2.9	82	737	774	4.9	37
139	69530	23299	23185	-0.5	-114	20423	20391	-0.2	-32	17013	16992	-0.1	-21	7415	7566	2.0	151	2807	2846	1.4	39	748	774	3.6	26

*Target values for the 100-, 50-, and 25-year peak discharges are from Table 2-12 of the ROMP while target 10-, 5-, and 2-yr peak discharges are the 2013 Ranch Plan ultimate values from Tables 14-9 to 14-11.

Table 2-15: Phased Condition PA-1, -2, -3 and -4 Developed Regional Hydrology San Juan Creek

Node	Area (ac)	100-year Expected Value Storm Event				50-year Expected Value Storm Event				25-year Expected Value Storm Event				10-year Expected Value Storm Event				5-year Expected Value Storm Event				2-year Expected Value Storm Event			
		Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model
119	49496	20321	20321	-	-	17850	17850	-	-	14918	14918	-	-	7196	7196	-	-	2407	2407	-	-	525	525	-	-
126	50439	20337	20030	-	20043	17836	17633	-	17648	14917	14786	-	14799	7134	7114	-	7134	2381	2353	-	2400	525	522	-	520
127	53506	20405	20189	-	20266	17848	17757	-	17828	14962	14847	-	14942	7092	7005		7102	2481	2352	2441	2468	598	539	598	614
133t	6638	3876	3888	-	2921	3412	3401	-	2690	2868	2848	-	2300	1905	1869	-	1639	865	857	-	842	403	451	-	403
133u	54354	20597	20284	-	20337	18105	17833	-	17898	15152	14942	-	14945	7146	6948		7055	2473	2348	2449	2479	611	543	602	619
133c	60992	21778	21900	-	21758	19165	19242	-	19144	16039	16053	-	15990	7510	7384	-	7407	2715	2577	2667	2670	769	682	750	732
134t	3860	2323	-	-	-	2048	-	-	-	1726	-	-	-	1021	-	-	-	348	-	-	-	131	-	-	-
134u	62698	22092	22127	-	21992	19363	19438	-	19340	16205	16211	-	16148	7433	7400	-	7435	2778	2596	2746	2778	774	717	764	737
134c	66558	22876	23040	-	22884	20087	20259	-	20136	16787	16896	-	16813	7538	7562	-	7588	2857	2700	2845	2873	808	756	796	714
137	67798	22970	23190	-	23044	20115	20379	-	20267	16750	17001	-	16921	7565	7587	-	7608	2868	2728	2848	2863	835	789	820	765
138	69102	23113	23351	-	23205	20214	20508	-	20389	16837	17095	-	17020	7531	7588	-	7608	2866	2749	2864	2887	842	810	838	775
139	69530	22994	23378	-	23238	20147	20538	-	20427	16830	17116	-	17036	7531	7590	-	7608	2887	2757	2829	2850	858	823	848	775

Table 2-16: Phased Condition PA-1, -2, -3 and -4 Developed Regional Hydrology San Juan Creek Mitigated Flow Comparison Table

Node	Area (ac)	100-year Expected Value Storm Event				50-year Expected Value Storm Event				25-year Expected Value Storm Event				10-year Expected Value Storm Event				5-year Expected Value Storm Event				2-year Expected Value Storm Event			
		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance	
				%	CFS			%	CFS			%	CFS			%	CFS			%	CFS			%	CFS
119	49496	20326	-	-	-	17844	-	-	-	14939	-	-	-	7239	-	-	-	2403		-	-	524	-	-	-
126	50439	20352	20043	-1.5	-309	17828	17648	-1.0	-180	14924	14799	-0.8	-126	7178	7134	-0.6	-44	2429	2400	-1.2	-29	533	520	-2.6	-14
127	53506	20460	20266	-1.0	-194	17925	17828	-0.5	-97	14964	14942	-0.1	-22	7159	7102	-0.8	-57	2414	2468	2.2	54	560	614	9.8	55
133u	54354	20361	20337	-0.1	-24	17911	17898	-0.1	-13	14948	14945	-0.0	-3	7221	7055	-2.4	-166	2575	2479	-3.8	-96	638	619	-3.0	-19
133c	60992	21828	21758	-0.3	-70	19143	19144	0.0	1	15972	15990	0.1	18	7374	7407	0.6	33	2758	2670	-3.3	-88	733	732	-0.1	-1
134u	62698	22000	21992	0.0	-8	19284	19340	0.3	56	16080	16148	0.4	68	7265	7435	2.3	170	2702	2778	2.8	78	713	737	3.2	24
134c	66558	22933	22884	-0.2	-49	20118	20136	0.1	18	16770	16813	0.3	43	7373	7588	2.9	215	2736	2873	5.0	137	718	714	-0.7	-4
137	67798	23080	23044	-0.2	-36	20237	20267	0.1	30	16869	16921	0.3	52	7433	7608	2.3	175	2796	2863	2.4	67	732	765	4.5	33
138	69102	23249	23205	-0.2	-44	20380	20389	0.0	9	16983	17020	0.2	37	7412	7608	2.6	196	2791	2887	3.4	96	737	775	5.0	38
139	69530	23299	23238	-0.3	-61	20423	20427	0.0	4	17013	17036	0.1	22	7415	7608	2.6	193	2807	2850	1.95	43	748	776	3.7	28

*Target values for the 100-, 50-, and 25-year peak discharges are from Table 2-12 of the ROMP while target 10-, 5-, and 2-yr peak discharges are the 2013 Ranch Plan ultimate values from Tables 14-9 to 14-11.

2.4.8 Ultimate Condition Regional Hydrology

To meet mitigation requirements, the 25-, 50-, and 100-yr complex models need to be less than or equal to the existing values and the target 10-, 5-, and 2-yr peak discharges are the 2013 Ranch Plan values. Based on the analysis, Table 2-17 and Table 2-18 describe the results of the single area, free draining, and complex phased condition models.

The PA-3&4 ROMP updates to the ultimate condition regional models assumes that PAs 1 through 5 and the six regional basins are constructed , including the final as-built condition of Gobernadora Basin. The ultimate phase is included in this ROMP Revision to provide a full update of the PA-3&4 ROMP, however, the values presented will be reevaluated in future revisions of the ROMP. Appendix G includes the following models: regional rational method free draining model, regional rational method complex model, single area unit hydrographs, free draining unit hydrographs, calibrated free draining unit hydrographs, and complex unit hydrographs. Appendix H contains the loss rate calculations. An ultimate condition hydrology map is included as Exhibit 9.

2.4.8.1 Model Development

In order to develop the ultimate condition model, the PA-3&4 .DNA files and hydrographs from the Ranch Plan ROMP were replaced with the updated hydrology for PA-3&4 presented in Section 2. The study used the Ranch Plan ROMP land use data and combined it with the current PA-3&4 land use. See Figure 2-22 for the revised ultimate land use.

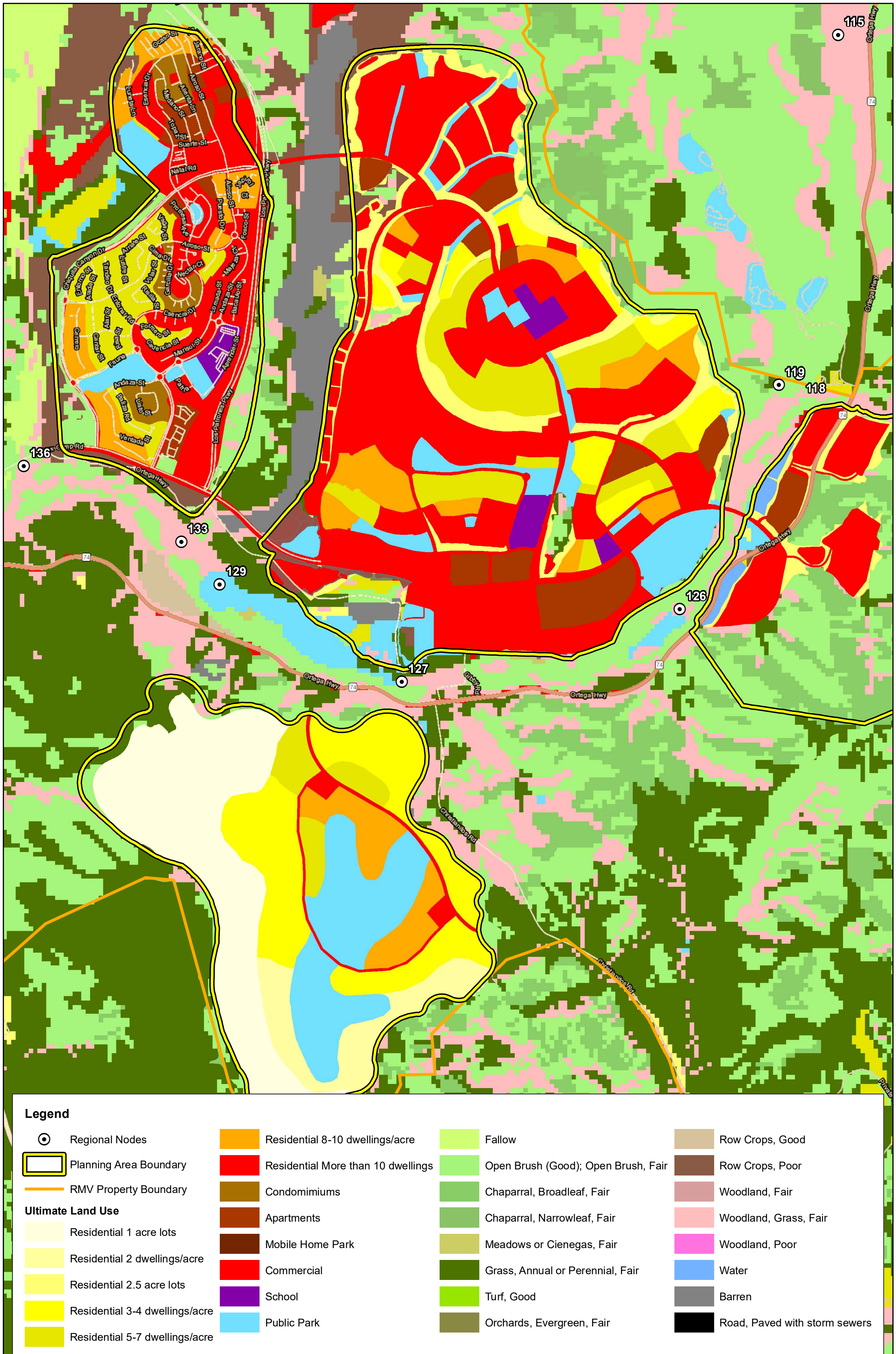
For the rational method, the proposed condition models from the Ranch Plan ROMP were used for all areas. The proposed condition models S19, S26, S27, S29, and S33 were modified to reflect the changes in land use and drainage patterns for PA-3/4. The loss rates were calculated by using the Ranch Plan ROMP land use data and replacing PA-2, PA-3 and PA-4 with the updated land use data.

Calibration was required for the 2-, 5- and 10-year events. The calibration was performed by increasing the rainfall in the free draining unit hydrograph models. Free draining models which underestimate the single area flow by less than 2% where not calibrated.

The following regional node points were analyzed: 119, 126, 127, 132c, 133t, 134t, 133c, 134c, 137, 138, and 139. The analyses were run for the following storms: 2, 5, 10, 25, 50, and 100-year expected value storm events.

2.4.8.2 Ultimate Condition Results

To meet mitigation requirements, the 25-, 50-, and 100-yr complex models need to be less than or equal to the existing values and the target 10-, 5-, and 2-yr peak discharges are the 2013 Ranch Plan value. Table 2-17 describes the results of the single area, free draining, and complex ultimate condition models. See appendix O.1 for memorandum regarding low frequency events.



2/8/2023 JN H:\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2023-02\MXD\Fig02-22_UltimateCondition_11x17_Update.mxd Michael Baker International

Michael Baker INTERNATIONAL

0 2,250 4,500 Feet

Source: ArcGIS Online

RANCHO MISSION VIEJO - PA3&4 ROMP REVISION 1

Ultimate Conditions Land Use

Figure 2-22

Table 2-17: Ultimate Condition Regional Hydrology San Juan Creek

Node	Area (ac)	100-year Expected Value Storm Event				50-year Expected Value Storm Event				25-year Expected Value Storm Event				10-year Expected Value Storm Event				5-year Expected Value Storm Event				2-year Expected Value Storm Event			
		Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model	Single Area Model	Free Draining Model	Calib Free Draining Model	w/Basin Model
119	49496	20321	20321	-	-	17850	17850	-	-	14918	14918	-	-	7196	7196	-	-	2407	2407	-	-	525	525	-	-
126	50439	20337	20192	-	20205	17836	17733	-	17748	14917	14831	-	14845	7134	7124	-	7144	2381	2353	-	2360	525	522	-	528
127	52666	20486	20289	-	20371	17920	17808	-	17889	15000	14864	-	14949	7262	7017	7144	7112	2475	2358	2425	2452	599	539	587	603
133t	6638	3876	3888	-	2921	3412	3401	-	2690	2868	2848	-	2300	1905	1869	-	1639	865	857	-	842	403	451	-	403
133u	54418	20747	20435	-	20348	18145	17921	-	17869	15168	14906	-	14932	7240	6960	7178	7068	2540	2363	2498	2559	650	551	638	657
133c	61056	21797	22062	-	21742	19212	19342	-	19095	16052	16108	-	15912	7577	7441	-	7413	2789	2611	2760	2767	798	720	782	722
134t	3860	2323	-	-	-	2052	-	-	-	1726	-	-	-	1021	-	-	-	348	-	-	-	131	-	-	-
134u	62747	22103	22268	-	21935	19372	19511	-	19265	16209	16250	-	16050	7498	7455	-	7427	2836	2628	2766	2767	808	760	797	703
134c	66607	22889	23180	-	22835	20091	20329	-	20054	16787	16934	-	16717	7586	7621	-	7577	2917	2738	2836	2829	843	797	821	736
137	67799	22973	23324	-	22977	20135	20446	-	20174	16752	17035	-	16815	7638	7642	-	7593	2929	2766	2865	2851	843	829	-	726
138	69103	23117	23487	-	23142	20253	20572	-	20294	16841	17128	-	16913	7618	7645	-	7591	2924	2787	2852	2832	877	828	860	774
139	69531	22992	23532	-	23190	20169	20606	-	20337	16832	17161	-	16945	7606	7647	-	7592	2933	2796	2855	2835	884	863	869	752

Table 2-18: Ultimate Condition Regional Hydrology San Juan Creek Comparison Table

Node	Area (ac)	100-year Expected Value Storm Event				50-year Expected Value Storm Event				25-year Expected Value Storm Event				10-year Expected Value Storm Event				5-year Expected Value Storm Event				2-year Expected Value Storm Event			
		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance		Target Value (CFS)	Post Development (CFS)	Variance	
				%	CFS			%	CFS			%	CFS			%	CFS			%	CFS			%	CFS
119	49496	20326	-	-	-	17844	-	-	-	14939	-	-	-	7239	-	-	-	2403		-	-	524	-	-	-
126	50439	20352	20205	-0.7	-147	17828	17748	-0.5	-80	14924	14845	-0.5	-79	7178	7144	-0.5	-34	2429	2360	-2.8	-69	533	528	-1.1	-6
127	52666	20460	20371	-0.4	-89	17925	17889	-0.2	-36	14964	14949	-0.1	-15	7159	7112	-0.7	-47	2414	2452	1.5	38	560	603	7.9	44
133u	54418	20361	20348	-0.1	-13	17911	17869	-0.2	-42	14948	14932	-0.1	-16	7221	7068	-2.2	-153	2575	2559	-0.7	-16	638	657	3.0	19
133c	61056	21828	21742	-0.4	-86	19143	19095	-0.3	-48	15972	15912	-0.4	-60	7374	7413	0.5	39	2758	2767	0.3	9	733	722	-1.5	-11
134u	62747	22000	21935	-0.3	-65	19284	19265	-0.1	-19	16080	16050	-0.2	-30	7265	7427	2.2	162	2702	2767	2.3	65	713	703	-1.4	-10
134c	66607	22933	22835	-0.4	-98	20118	20054	-0.3	-64	16770	16717	-0.3	-53	7373	7577	2.7	204	2736	2829	3.3	93	718	736	2.4	18
137	67799	23080	22977	-0.5	-103	20237	20174	-0.3	-63	16869	16815	-0.3	-54	7433	7593	2.1	160	2796	2851	2.0	55	732	726	-0.8	-6
138	69103	23249	23142	-0.5	-107	20380	20294	-0.4	-86	16983	16913	-0.4	-70	7412	7591	2.3	179	2791	2832	1.5	41	737	774	4.9	37
139	69531	23299	23190	-0.5	-109	20423	20337	-0.4	-86	17013	16945	-0.4	-68	7415	7592	2.4	177	2807	2835	1.0	28	748	752	0.4	4

*Target values for the 100-, 50-, and 25-year peak discharges are from Table 2-12 of the ROMP while target 10-, 5-, and 2-yr peak discharges are the 2013 Ranch Plan ultimate values from Tables 14-9 to 14-11.

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) or FlowMaster 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 211 to node 231 (with total length of 7658 ft
5. Line B1 – from hydrology node 206 to Line B node 230 with total length of 4319ft
6. Line C – from hydrology node 322 to node 331 with total length of 12437 ft.
7. Line C2 – from hydrology node 312 to node 317 with total length of 4220 ft
8. Line C3 – from hydrology node 302 to node 330 with total length of 9107 ft
9. Line D – from hydrology node 411 to node 430 with total length of 4931 ft
10. Line D1 – from hydrology node 402 to node 431 at the confluence of Line D1 with total length of 10479

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. Final design of the pipes will likely result in different sizes for the backbone system because the hydraulics included in the ROMP are for preliminary planning purposes and do not provide a detailed analysis of hydraulics, pipe alignment or profile.

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 130 inches. There are natural areas tributary to storm drains in Subwatershed C, E and F (approximately 85.7 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 13.1. 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 design plan drainage sheets for Phase 2B of Cow Camp Road (Plans for Construction of Cow Camp Road Phase 2B). The constructed 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.

Outlet 13 has been constructed to the 2019 ultimate flows and has been acting as an interim outlet for the phases of PA-3 that have been constructed. Ultimately, it will convey emergency overflow from the ultimate water quality basins.

Outlet 13.1 will be the primary outlet for Subwatershed C. The proposed outlet will extend to the San Juan Creek 100-year floodplain, with rock riprap protection extending to the 10-year floodplain. It is preliminarily sized as a 12’ x 8’ RCB and will include energy dissipation prior to the riprap channel.

Due to the preliminary nature of the site planning for the areas tributary to outlets 9, 13, 13.1, 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 2nd Edition .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.

3.1.3 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.

3.1.3.1 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.

3.1.3.2 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:

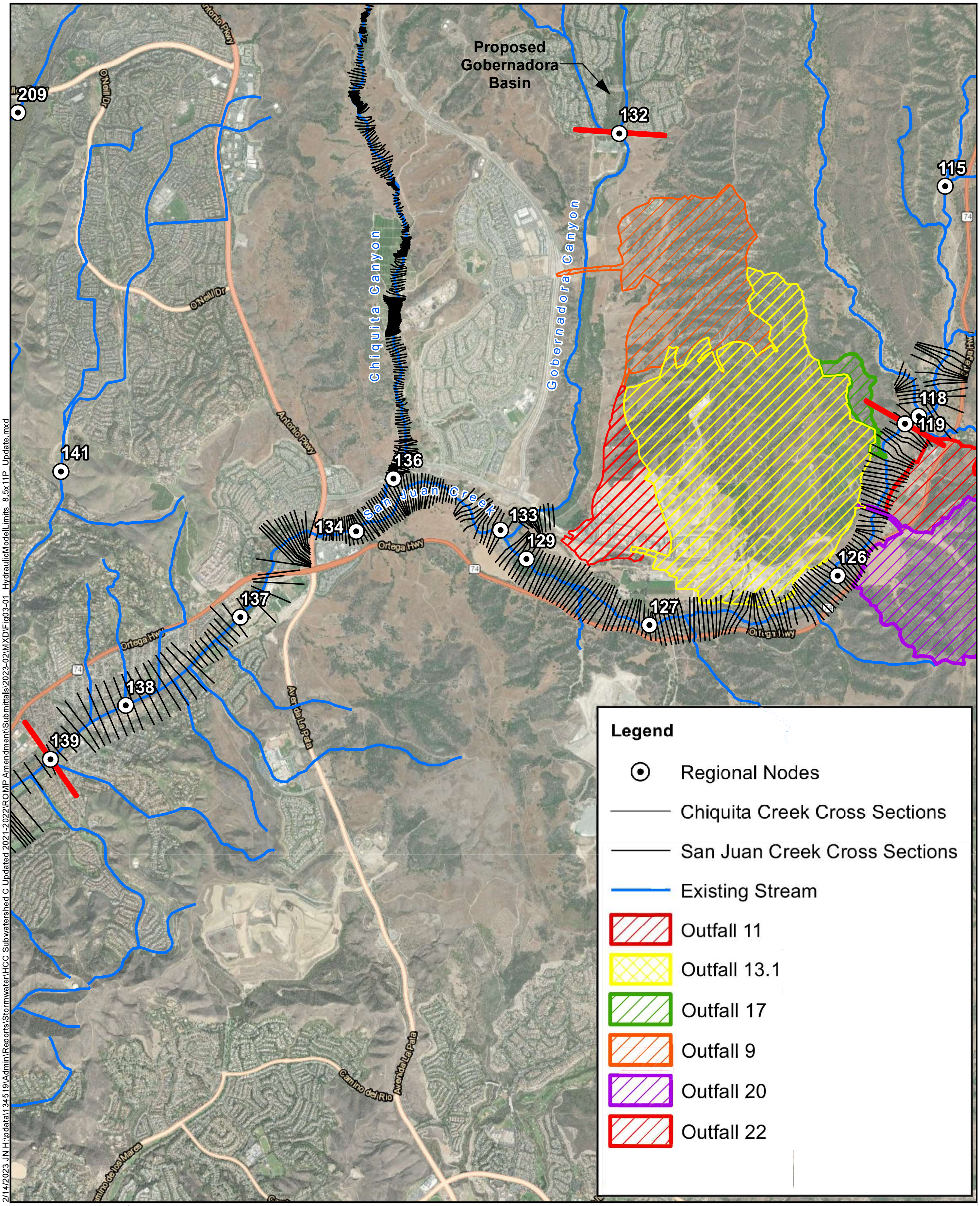
- Geometry: The existing and proposed condition geometry files were obtained from the Ranch Plan ROMP (April 2013) hydraulic analysis. A portion of the geometry was updated as part of Revision 1 from Bell Canyon to Chiquita Canyon to capture the stream cross sections in greater detail and accurately model Gibby Road.
- 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



Source: PACE, Huitt-Zollars, Geosyntec, ESR World and Street Imagery

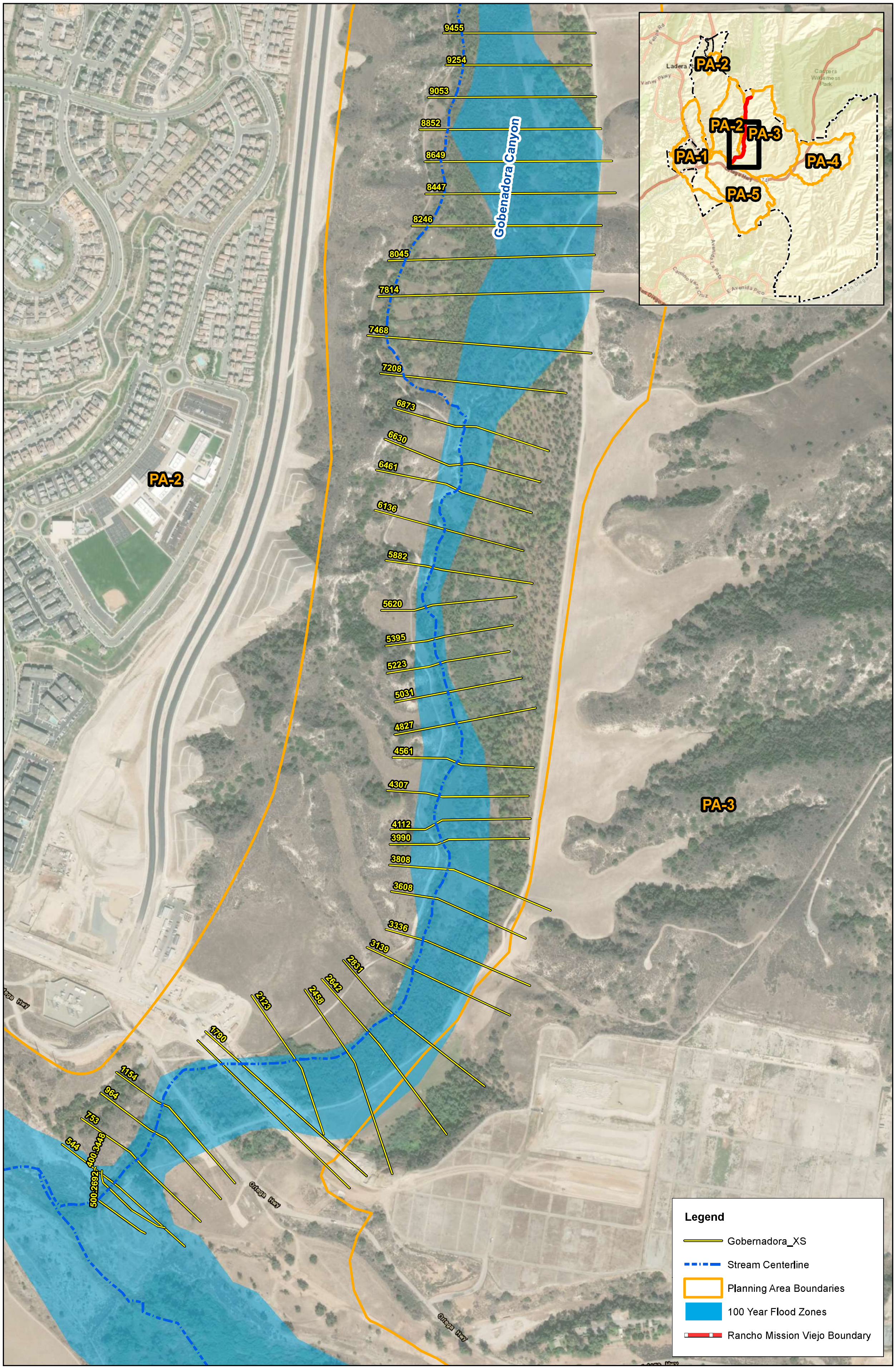
Michael Baker INTERNATIONAL

RANCHO MISSION VIEJO PA-3&4 ROMP Revision 1

Hydraulic Model Limits

Figure 3-1

2/14/2023 JN H:\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2023-02\MXD\Fig03-01_HydraulicModelLimits_8.5x11P_Update.mxd



7/25/2019 JN M:\Mdata\134519\GIS\MXD\PA-3_PA-4 ROMP\Report Figures\Fig03-02a_GobernadoraCrossSection.mxd JM DR

Michael Baker INTERNATIONAL

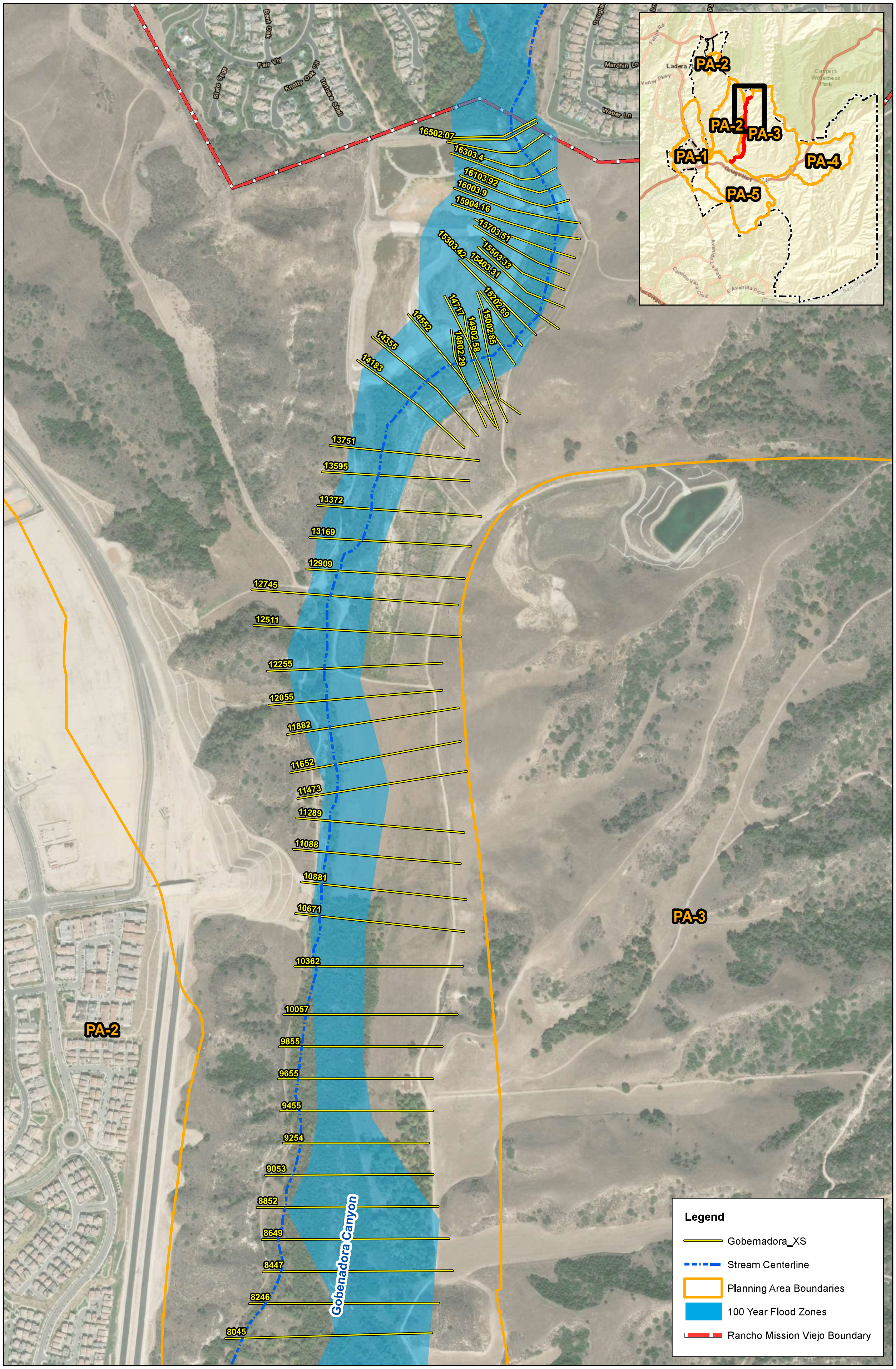
0 150 300 Feet

Source: PACE, Huitt-Zollars, Geosyntec, FEMA, ESRI Online

RANCHO MISSION VIEJO - PA3&4 ROMP

Gobernadora Cross Section

Figure3-2a



7/25/2019 JN M:\Mdata\134519\GIS\MXD\PA-3_PA-4 ROMP\Report Figures\Fig03-02b_GobernadoraCrossSection.mxd JM DR

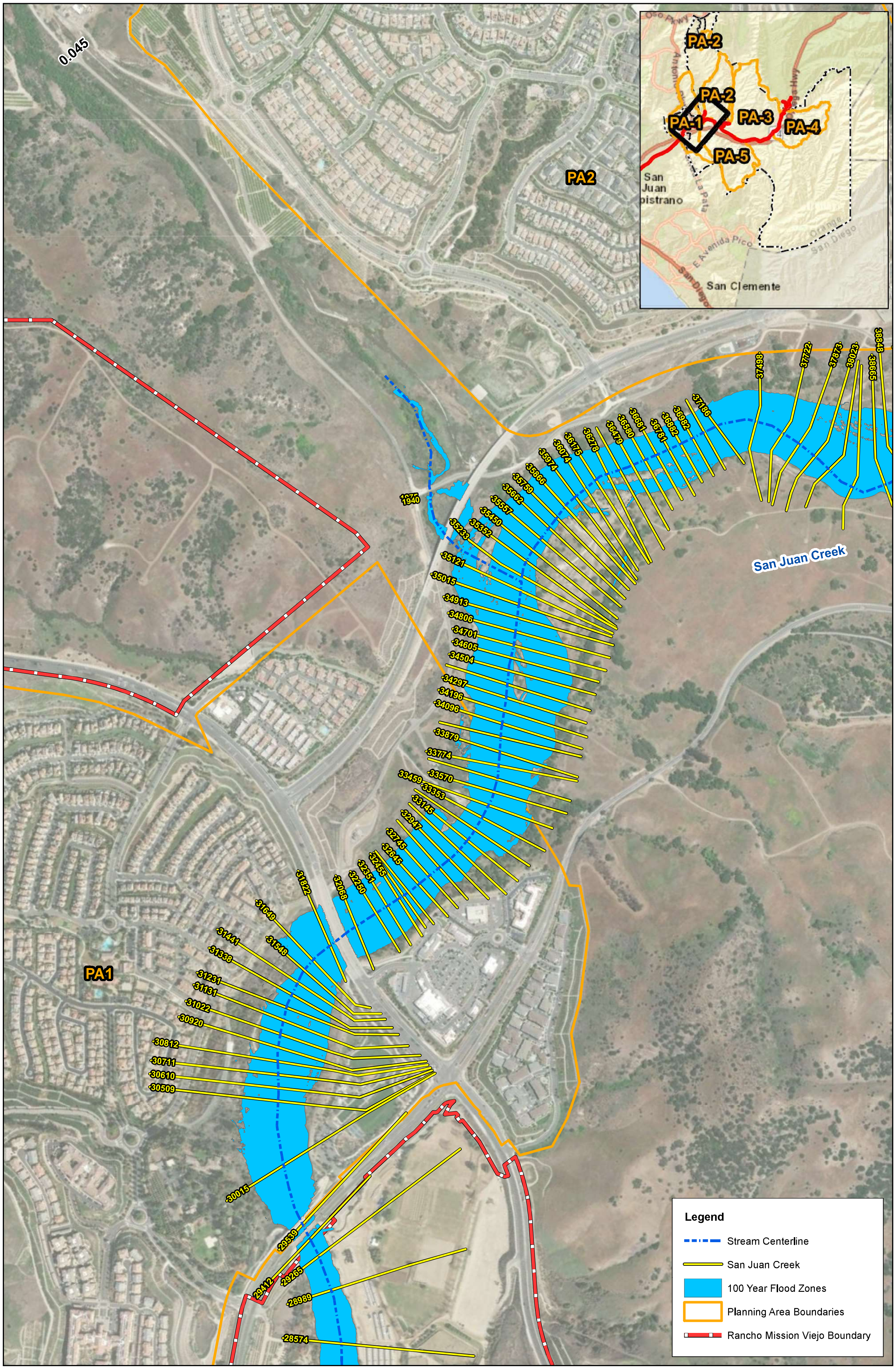
Michael Baker INTERNATIONAL

Source: PACE, Huitt-Zollars, Geosyntec, FEMA, ESRI Online

RANCHO MISSION VIEJO - PA3&4 ROMP

Gobernadora Cross Section

Figure3-2b



5/18/2023 JN H:\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2023-05\MXD\Fig03-03a_SanJuanCreekCrossSection.mxd JM DR

Michael Baker INTERNATIONAL

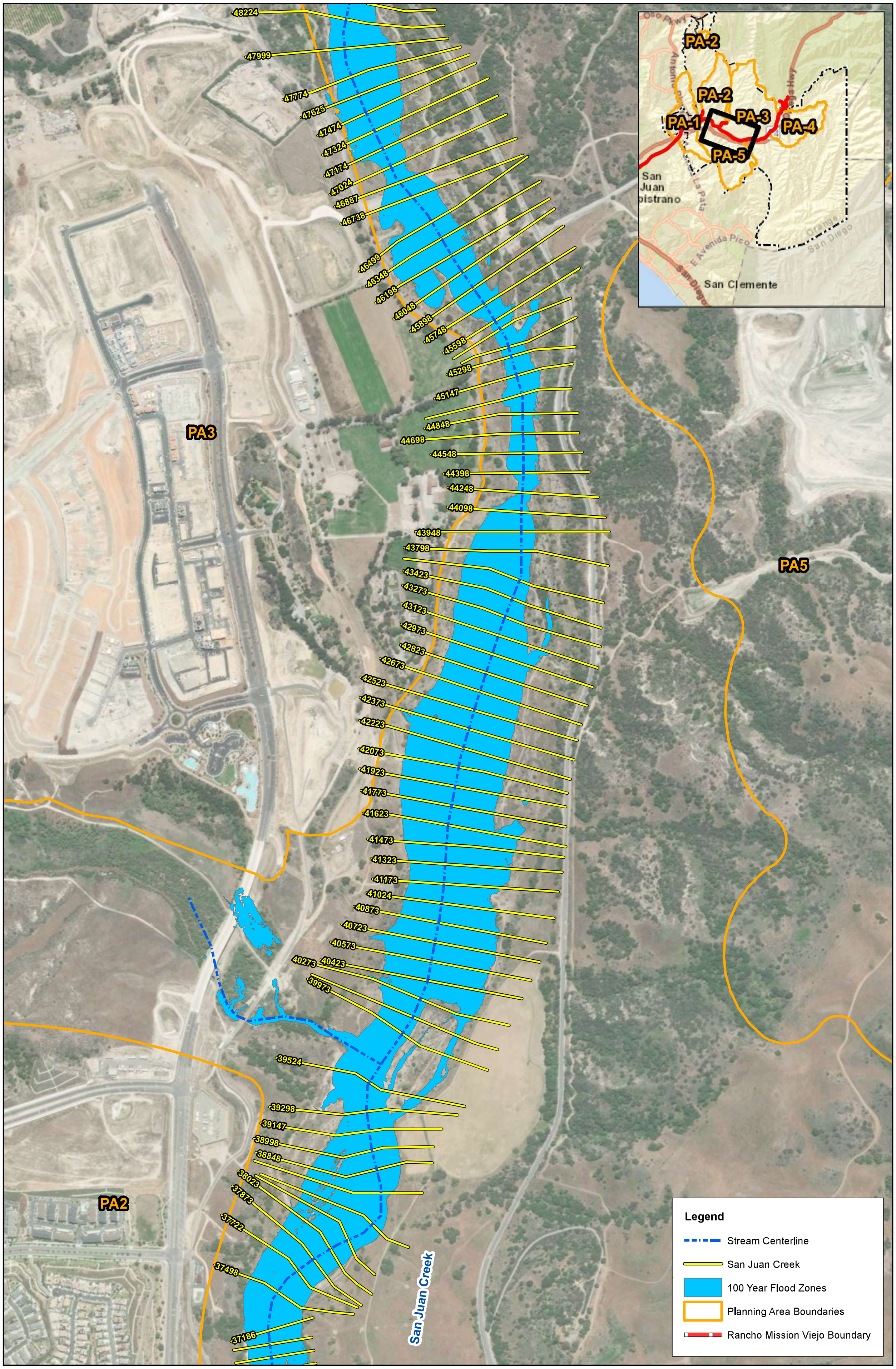
0 150 300 Feet

Source: PACE, Huitt-Zollars, Geosyntec, FEMA, ESRI Online

RANCHO MISSION VIEJO - PA3&4 ROMP Revision 1

San Juan Creek Cross Section

Figure3-3a



5/18/2023 JN H:\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2023-05\MXD\Fig03-03b_SanJuanCreekCrossSection.mxd JM DR

Michael Baker INTERNATIONAL

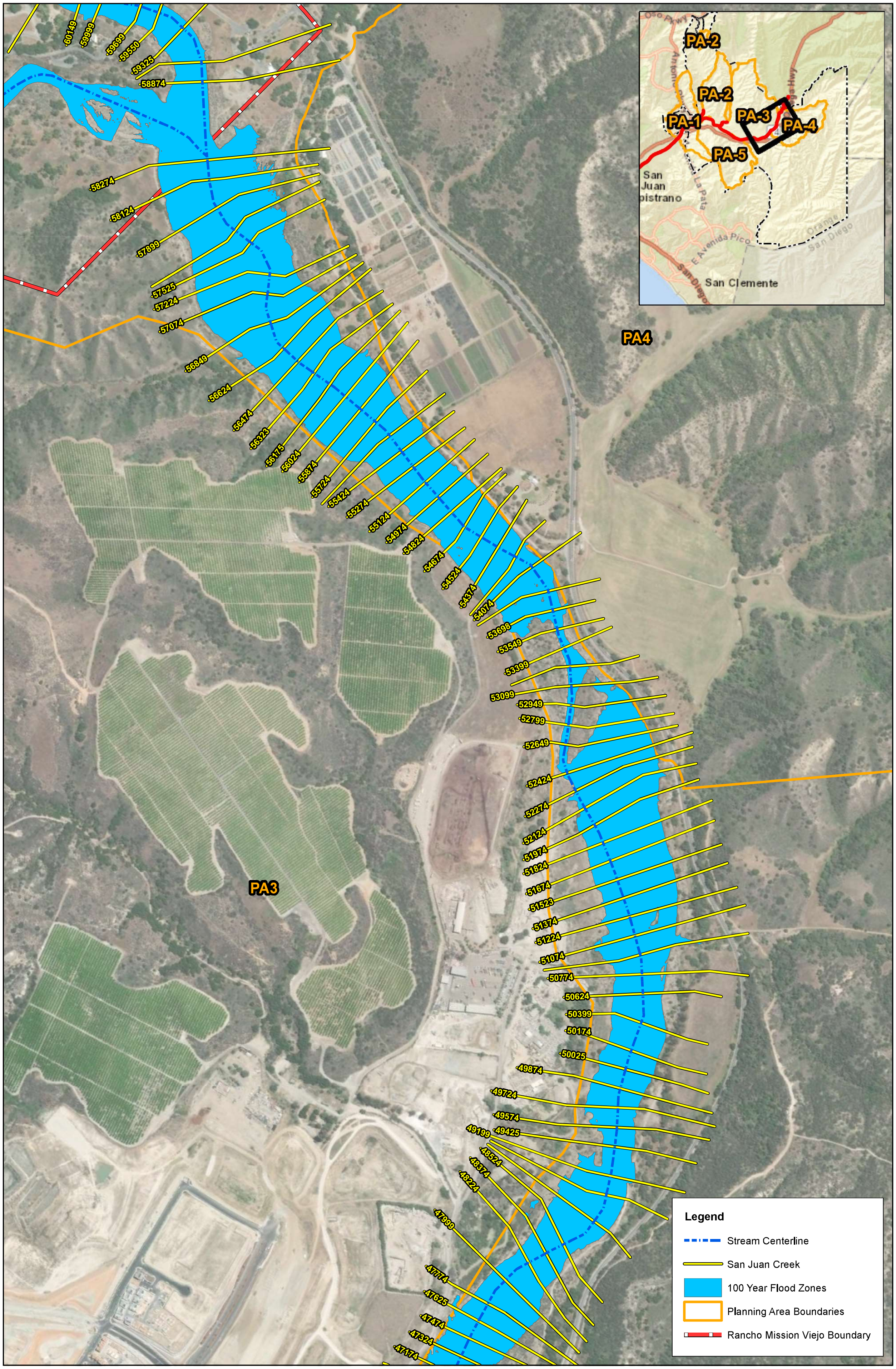
0 150 300 Feet

Source: PACE, Huitt-Zollars, Geosyntec, FEMA, ESRI Online

RANCHO MISSION VIEJO - PA3&4 ROMP Revision 1

San Juan Creek Cross Section

Figure3-3b



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Source: PACE, Huitt-Zollars, Geosyntec, FEMA, ESRI Online

RANCHO MISSION VIEJO - PA3&4 ROMP Revision 1

San Juan Creek Cross Section

Figure3-3c

Table 3-2: San Juan 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	126	52124	525	2380	7145	14924	17828	20352
	127	45373	514	2314	6990	14964	17925	20460
	133T	2096	354	786	1875	2942	3500	3986
	133U	39524	515	2308	6914	14948	17911	20361
	133C	39298	583	2458	7172	15972	19143	21828
	134U	35120	582	2415	7148	16080	19284	22000
	134C	33352	610	2525	7275	16770	20118	22933
	137	27635	617	2501	7267	16869	20237	23080
	138	22946	625	2510	7270	16983	20380	23249
	139	19802	640	2531	7270	17013	20423	23299
Phased PA-1, -2, -3, -4	126	52124	520	2400	7134	14799	17648	20043
	127	45373	614	2468	7102	14942	17828	20266
	133T	2096	403	842	1639	2300	2690	2921
	133U	39524	619	2479	7055	14945	17989	20337
	133C	39298	732	2670	7407	15990	19144	21758
	134U	35120	737	2778	7435	16148	19340	21992
	134C	33352	714	2873	7588	16813	20136	22884
	137	27635	765	2863	7608	16921	20267	23044
	138	22946	775	2887	7608	17020	20390	23205
	139	19802	775	2850	7608	17036	20427	23238
Phased PA-1, -2, -3	126	52124	518	2345	7101	14798	17683	20080
	127	45373	611	2457	7083	14929	17838	20271
	133T	2096	403	842	1639	2300	2690	2921
	133U	39524	614	2469	7033	14904	17859	20280
	133C	39298	732	2734	7374	15941	19102	21704
	134U	35120	724	2763	7391	16101	19301	21935
	134C	33352	746	2859	7544	16768	20098	22830
	137	27635	775	2852	7563	16875	20227	22988
	138	22946	774	2873	7565	16977	20354	23151
	139	19802	774	2846	7566	16992	20391	23185
Ultimate w/Basins	126	52124	528	2360	7144	14845	17748	20205
	127	45373	603	2452	7112	14949	17889	20371
	133T	2096	403	842	1639	2300	2690	2921
	133U	39524	657	2559	7068	14932	17869	20348
	133C	39298	722	2767	7413	15912	19095	21742
	134U	35120	703	2767	7427	16050	19265	21935
	134C	33352	736	2829	7577	16717	20054	22835
	137	27635	726	2851	7593	16815	20174	22977
	138	22946	774	2832	7591	16913	20294	23142
	139	19802	752	2835	7592	16945	20337	23190

Table 3-3 and Table 3-4 show the minimum, maximum, and average hydraulic parameters for the two different flow regimes and two different flowrates (existing and proposed) for Gobernadora. The tables show that there are no significant changes between the existing and proposed condition hydraulics. The results of the ultimate condition 100-year expected value floodplain hydraulic characteristics are very similar to the results of the 2013 Ranch Plan ROMP. The following conclusions can be drawn:

- Channel Depth: The fluctuation of computed depths suggests highly irregular bank heights, bed profile, and channel capacity, all of which indicate channel stability.
- Channel Area: In general, the variation of channel area varies marginally between adjacent cross sections, indicating that gradually varied geometry is present in the creek. The large spike in area near the downstream end of the reach is a result of backwater effects upstream of the culvert crossing at a Ranch access road.
- Top Width: The large fluctuations in top width further substantiate the variation in channel geometry and demonstrate the oscillation between incised channels, and shallow channels with access to a wider floodplain.
- Velocity: Average velocity varies significantly, which is reflective of the variability of channel cross-section shape and area. Velocities are moderate and occasionally high.
- Froude Number: The Froude number indicates that flow is mostly subcritical with a few areas of supercritical flow regime.

Table 3-5 and Table 3-6 show the minimum, maximum and average hydraulic parameters for the two different flow regimes and two different flowrates (existing and proposed) for San Juan Creek. The tables show that there are no significant changes between the existing and proposed condition analysis. The results of the ultimate condition 100-year expected value floodplain hydraulic characteristics are very similar to the results of the 2013 Ranch Plan ROMP. The following conclusions can be drawn:

- Channel Depth: The fluctuation of the computed maximum and hydraulic depths indicates that gradually varied conditions probably exist between adjacent cross sections.
- Channel Area: The variation of channel area varies marginally between adjacent cross sections, indicating that gradually varied geometry is present in the creek and that future channel adjustments to a more stable form may not necessarily occur.
- Top Width: The large fluctuations in top width further substantiate the variation in channel geometry between adjacent cross sections, and potential for large areas of flooding in some reaches.
- Velocity: Average velocity for the non-channelized reach of SJC is relatively low, although there are some areas where higher velocities occur, typically at bridges or in highly encroached reaches.
- Froude Number: The hydraulic water surface profile indicates that flow in the study reach is strongly subcritical through the comparison to critical depth, except at isolated cross sections. The spike in Froude number indicates a natural sandstone narrow area which accelerates the flow before expanding to wide floodplain area.

Detailed results including a comparison of results by cross section are included in Appendix I.3 and I.4 for all the storm events and hydraulics regime.

Table 3-3: Gobernadora HEC-RAS 100-year EV – Mixed Flow Regime Comparison

Parameter	Existing 100-year					Ultimate 100-year				
	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #
Minimum	0.9	0.98	293.4	47.8	0.1	0.1	0.8	172.7	41.9	0.1
Maximum	18.0	14.2	4631.9	973.4	1.1	17.1	16.5	3768.1	956.2	1.9
Average	5.9	5.3	966.3	453.9	0.5	5.2	5.1	762.1	419.3	0.6

Table 3-4: Gobernadora HEC-RAS 100-year EV – Subcritical Flow Regime Comparison

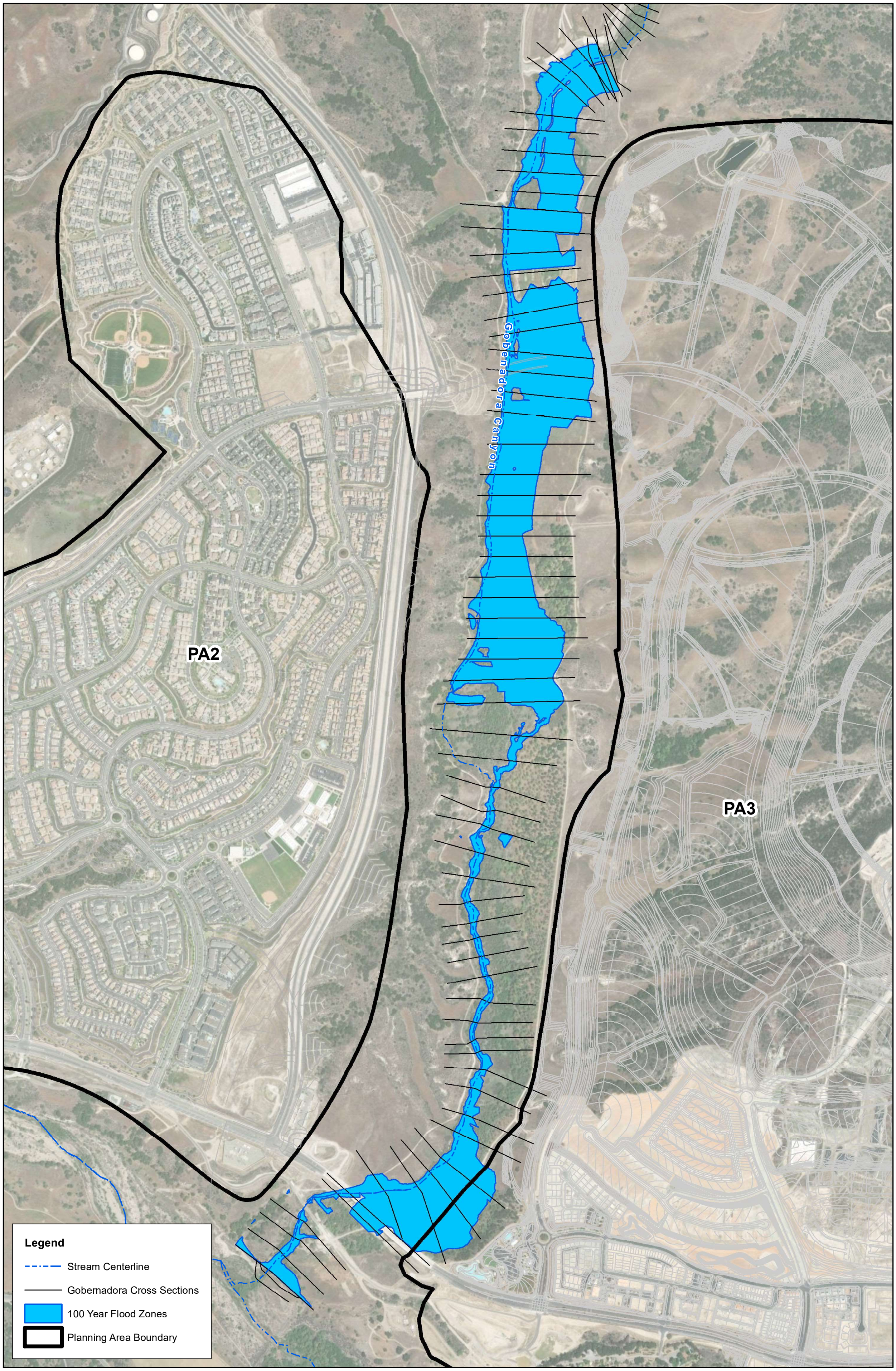
Parameter	Existing 100-year					Ultimate 100-year				
	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #
Minimum	0.9	1.0	293.4	47.8	0.1	0.1	0.8	223.9	41.9	0.1
Maximum	18.0	13.0	4631.9	973.4	1.0	17.1	12.7	3768.1	956.2	1.1
Average	5.9	5.2	970.9	455.3	0.5	5.2	4.9	767.0	420.1	0.5

Table 3-5: San Juan Creek HEC-RAS 100-year EV – Mixed Flow Regime Comparison

Parameter	Existing 100-year					Phase No PA-4&5 100-year					Phase No PA5 100-year					Ultimate 100-year				
	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #
Minimum	4.9	2.1	958.5	68.8	0.1	4.8	2.1	959.2	68.9	0.1	4.8	2.1	959.2	68.9	0.1	4.8	2.1	959.2	68.9	0.1
Maximum	30.8	25.7	9938.2	1538.9	2.1	30.8	25.7	9878.3	1538.9	1.0	30.8	25.7	9877.7	1538.9	2.1	30.8	25.7	9893.3	1538.9	2.1
Average	14.3	7.6	3923.2	540.8	0.5	14.1	7.7	3856.2	526.6	0.4	13.5	7.7	3858.4	526.8	0.5	14.1	7.7	3860.5	526.9	0.5

Table 3-6: San Juan Creek HEC-RAS 100-year EV – Subcritical Flow Regime Comparison

Parameter	Existing 100-year					Phase No PA-4&5 100-year					Phase No PA5 100-year					Ultimate 100-year				
	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #	Flow Depth (ft)	Velocity (ft/s)	Flow area (Sq. ft)	Top Width (ft)	Froude #
Minimum	6.7	2.1	958.5	68.8	0.1	6.3	2.1	959.2	68.9	0.1	6.4	2.1	959.2	68.9	0.1	6.3	2.1	959.2	68.9	0.1
Maximum	30.8	21.2	9938.2	1538.9	1.0	30.8	21.2	9879.3	1538.9	1.0	30.8	21.2	9877.7	1538.9	1.0	30.8	21.2	9893.3	1538.9	1.0
Average	14.3	7.5	3940.4	541.25	0.4	14.1	7.5	3873.0	527.1	0.4	13.5	7.5	3875.2	527.3	0.4	14.1	7.5	3896.1	532.1	0.4



12/14/2022 JN \\RVICA1FS1.bkr.mbakercorp.com\HROOT\pdata\134519\Admin\Reports\Stormwater\HCC Subwatershed C Updated 2021-2022\ROMP Amendment\Submittals\2022-12\MXD\Fig03-04_Gobernadora_Floodplain.mxd JM DR

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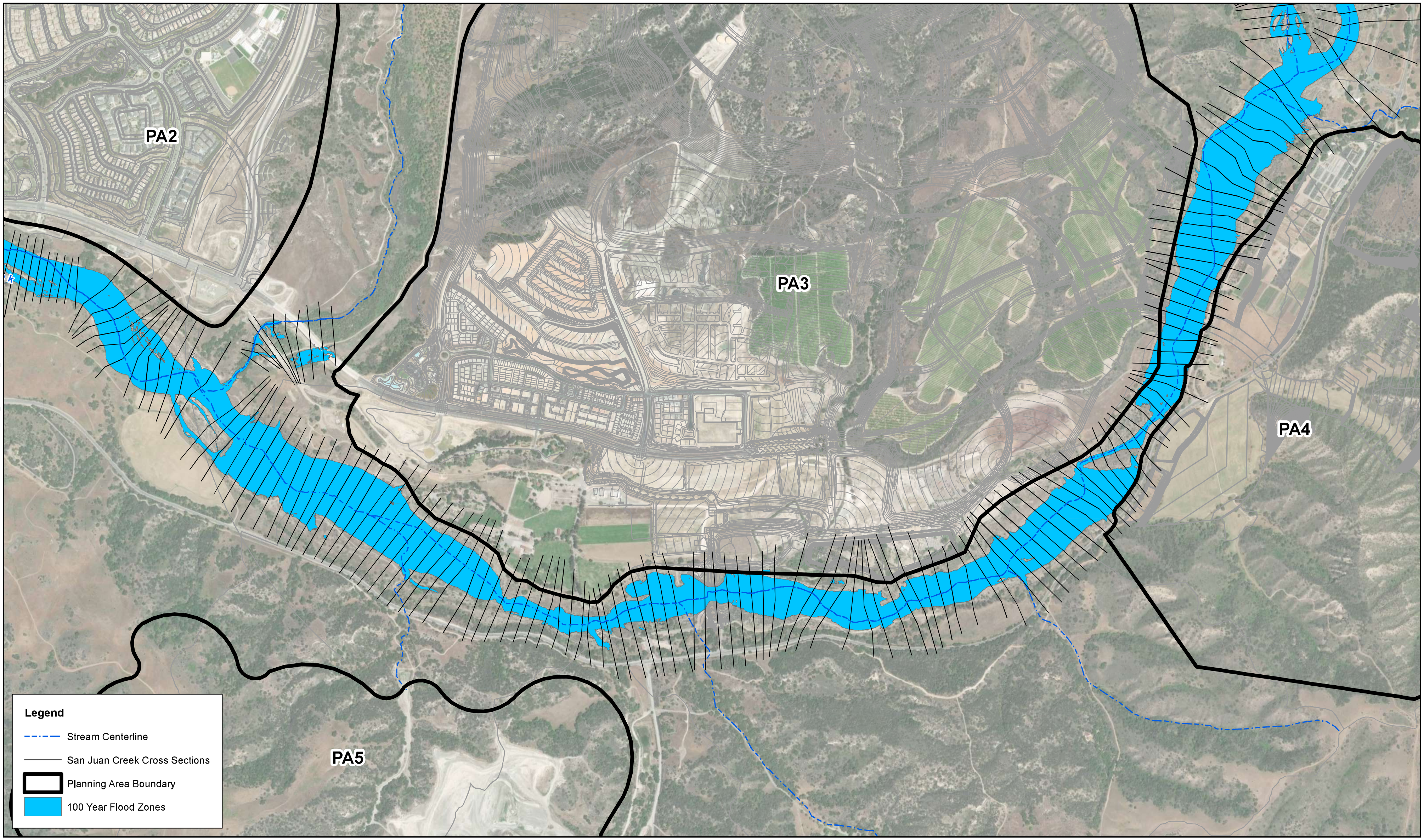
Source: PACE, Huitt-Zollars, Geosyntec, ESRI Online

RANCHO MISSION VIEJO - PA3&4 ROMP

Gobernadora Floodplain

Figure 3-4



Michael Baker INTERNATIONAL

0 1,000 2,000 Feet

Source: PACE, Huitt-Zollars, Geosyntec, ESRI Online

RANCHO MISSION VIEJO PA-3&4 ROMP Revision 1

Proposed San Juan Creek Floodplain

Figure 3-5

4 Stream Stability Analysis

As part of the Ranch Plan ROMP, a stream stability analysis was performed to evaluate the hydrologic (peak discharge, runoff volume, flow duration) and geomorphic (coarse sediment production and delivery) impacts of planned development and the effectiveness of proposed mitigation as it relates to the event-based and long-term streambed vertical response of San Juan Creek and its tributaries. The purpose of the analysis in this report is to update the hydrology and sediment yield/production based on the proposed PA-3&4 drainage patterns and land uses.

The stream stability analysis includes discussions on sediment yield, stream stability, and lateral bank migration. The results of the study will be used to document the impacts of the change in hydrology and sediment yield on stream stability along both Gobernadora Canyon and San Juan Creek.

4.1 Existing Geomorphic Characteristics

The approved Ranch Plan ROMP characterized the existing geomorphology of San Juan Creek, Chiquita Canyon, and Gobernadora Canyon. A brief summary of these characterizations is provided below except for Chiquita, which was not evaluated for stream stability as part of the PA-3&4 ROMP.

4.1.1 San Juan Creek

Channel pattern. Channel pattern relationships were evaluated using empirical relationships formulated by Lane (1952), Leopold and Wolman (1957), and Henderson (1961). San Juan Creek main stem channel form was categorized as a "braided channel" system.

Longitudinal profile. Indications of historical behavior were derived from the plotted longitudinal profile. The main stem profile was considered to be slightly concave up, which suggests San Juan Creek has been a reasonably graded, braided watercourse for a long period of time. A braided system can be considered near equilibrium.

Historical movement and trends. A qualitative overview of historical movement and trends was conducted using a sequence of historical aerial photographs (1930, 1938, 1986, and 2005), focusing on the planimetric form and relative width as well as the encroachment of development and agricultural operations. Long-term lateral movement was evaluated based on changes in channel width and thalweg position throughout the historical period of record. The results of this historical assessment identified the channel shape as remaining consistent; however, the channel width has decreased roughly 40 percent.

Geometric relationships. The stability of the channel was evaluated using empirical channel geometry relationships developed by Bray (1979), Hey (et al, 1982), Ackers and Charlton (1971), Lacey (1929), Chang (1988), Kellerhals (1967), AMAFCA (1994), and Moody and Odem (1999). Hydraulic geometry regression relationships (Leopold and Maddock, 1952) were attained using HEC-RAS data and results.

Allowable velocity. Empirical methods used to evaluate allowable or permissible velocities include Fortier and Scobey (1926), modified Mavis and Laushey (BUREC; Jurnikis, 1971), Neill (1975), and USACE (1970; 1990; 1995). The computed reach-averaged results show that San Juan Creek is marginally erosive in the lower reaches. The most erosive conditions will occur at bridge locations within channelized reaches. Erosion on the upper terraces of the floodplain are expected during the 100-year flood. While lateral stability is difficult to predict, the allowable velocity results suggest the channel banks will erode, even in small floods, if the banks are not cohesive, and the presence of cohesive soils will provide some measure of resistance.

Equilibrium slope. Empirical relationships used to evaluate the equilibrium slope include AMAFCA (1994), BUREC (MacBroom, 1981), Bray (1979), Henderson (1961), Schoklitsch (Shulits, 1935), Meyer-Peter Muller (1948), Shields (1936), and Lane (1952). The computed reach-averaged equilibrium slopes do not show a distinct trend. The results vary more than two orders of magnitudes and there is poor correlation between the various method parameters and the measured data for San Juan Creek, which contributes to widespread results.

Armoring potential. Empirical methods related to the initiation of sediment movement that are recommended by the Bureau of Reclamation (BUREC; Pemberton and Lara, 1984) include Meyer-Peter Muller (1948), Mavis and Lushey (1948), Shields (1936), and Yang (1973). The average computed results indicate that a generalized depth to armor roughly varies from 0.1 feet (2-year event) to 1 foot (100-year event) throughout the PA-3&4 study reach. Field evidence suggests armoring may not fully develop. The formation of an armor layer can lead to an increased potential for lateral erosion.

4.1.2 Gobernadora Canyon

Physical setting. Gobernadora Canyon is a relatively steep stream oscillating between incised channel sections disconnected from the flood plain to shallow channels sections connected to a wide floodplain. The flow regime alternates between subcritical and supercritical flow. The bed and banks are generally comprised of sandy soils with intermittent sections of moderately cohesive soils.

Longitudinal profile. The profile is relatively steep with an average slope of approximately 1.2 percent. There are significant head-cut formations that are active and can be expected to continue with or without development activities.

Allowable velocity. Gobernadora Canyon is considered moderately erosive for events as frequent as the 2-year flood.

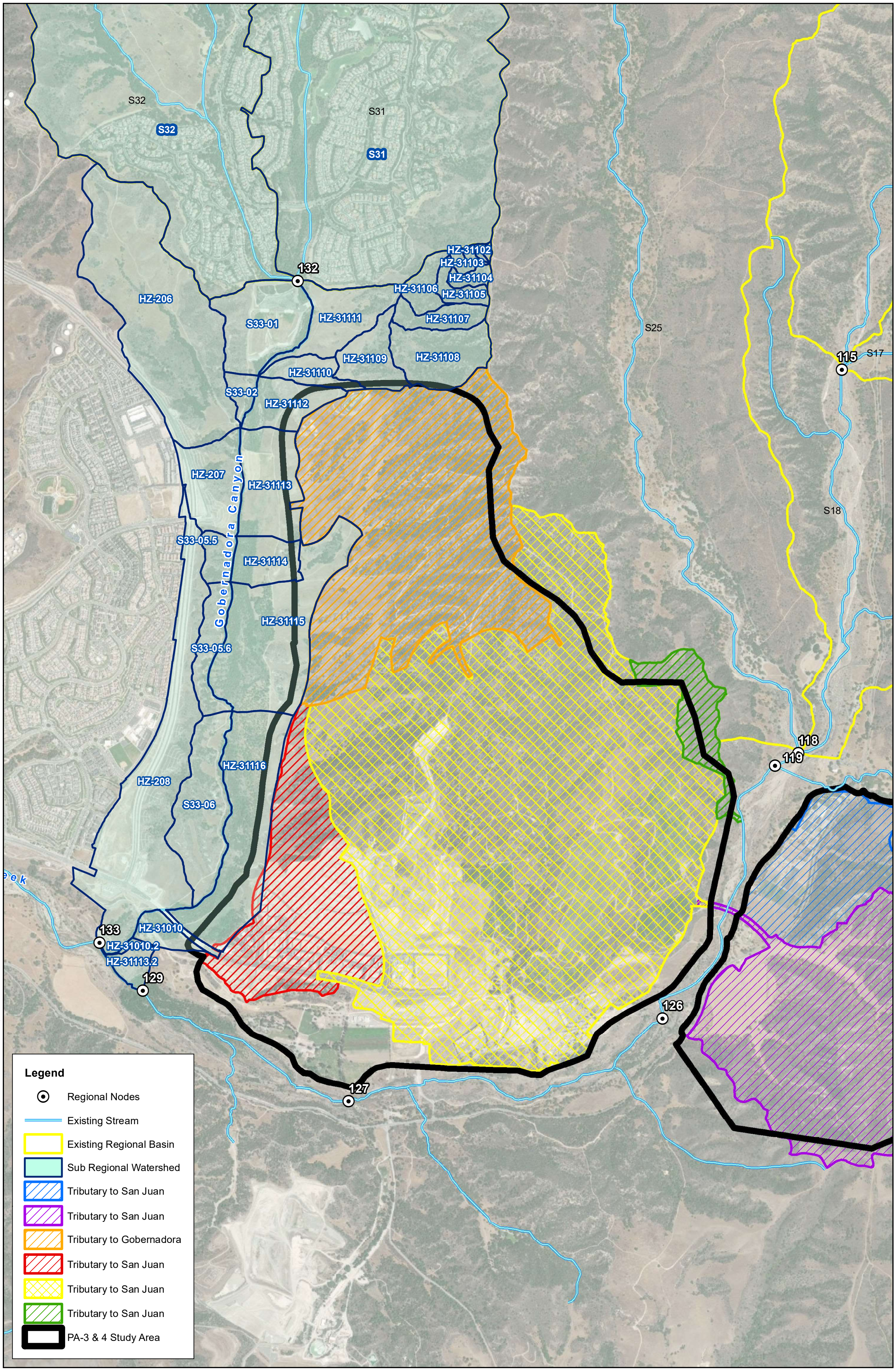
Equilibrium slope. The AMAFCA (1994) methodology produced the only results that were within an order of magnitude of the existing conditions. The equilibrium slope is generally flatter than the existing slope, which suggests that there will be a tendency for the watercourse to degrade over time.

Armoring potential. No significant evidence of armoring was observed during field reconnaissance.

4.2 Sediment Yield

One of the factors effecting stream stability is sediment. Sediment production contributes to the relationship of stream erosion/stability due to the balance between sediment yield and the transport capacity of the stream.

Watershed transport capacity corresponds to the amount of sediment capable of being delivered by the channel system. Sediment yield is the amount of erosional debris produced by a watershed. The Modified Universal Soil Loss Equation (MUSLE) was used to predict the sediment yield within the San Juan Creek, Chiquita Canyon, Gobernadora Canyon watersheds using an approach similar to what was used in the approved Ranch Plan ROMP. In this update, the MUSLE regional coefficient (β) was revised to adapt the MUSLE to the ordinate (“instantaneous”) discharges, which form a flood hydrograph and its application in the sediment transport model using rating curves to define the sediment inflow boundary conditions and tributary contributions. Figure 4-1 shows the sediment work map.



Michael Baker INTERNATIONAL

0 750 1,500 Feet

Source: PACE, Huitt-Zollars, Geosyntec, ESRI Online

RANCHO MISSION VIEJO - PA3&4

Sediment Work Map

Figure 4-1

The MUSLE predicts sediment yield for individual storm events using the following equation:

$$Y_s = \alpha \times (Q_p \times V)^{\beta} \times K \times LS \times C \times P \text{ (Equation 1)}$$

Where:

Y_s = Sediment yield (tons)
V = event runoff volume (acre-feet or ac-ft)
Q_p = event peak runoff rate (cubic feet per second or cfs)
K = soil erodibility factor
LS = hillslope length-slope factor
C = cover management factor
P = erosion management practice factor
α = Regional coefficient = 95
β = Regional coefficient = 0.56 (For entire watershed)

Assumptions:

1. LS, K, C values are as presented in the Ranch Plan ROMP and used in this study.
2. Proposed Land Use (LU) was updated to reflect changes within the PA-3&4 area.

Procedure:

The steps used herein to determine the sediment yield are consistent with the approved Ranch Plan ROMP except for these modifications.

1. The updated sub-watersheds for the existing, and ultimate conditions were used to determine portions of the watershed at each concentration point (inflow points).
2. Table 4-1 shows the subareas at each inflow point.

Table 4-1: Gobernadora Canyon inflow points and corresponding subareas

HEC-RAS XS	Hydrology Node	Subareas
14183	13222	S31, S32
2096	13305	HZ-31100, HZ-31101, HZ-31102, HZ-31103, HZ-31104, HZ-31105, HZ-31106, HZ-31107, HZ-31108, HZ-31109, HZ-31110, HZ-31111, S33-01, HZ-206, S33-02, HZ-31112, HZ-207, HZ-31113, S33-05.5, HZ-31114, S33-05.6, HZ-31115
544	13308	HZ-31116, S33-06, HZ-208, HZ-31010, HZ-31010.2, HZ-31113.2

3. In order to find the instantaneous sediment yield contributing from each sub-watershed, the product of the total volume and peak discharge at each concentration point was equated to the summation of volume and discharge at each time increment (See Equation 2). The equation was applied for the 2- thru 100-year storm events unit hydrographs at each of the concentration points to calculate the minimum and maximum regional coefficient (β) for the Gobernadora sub-watershed.

$$(QpV)^{0.56} = (\sum_{i=1}^{n}(QiVi))^{\mathrm{b}} \text{ (Equation 2)}$$

4. The minimum regional coefficient was selected for the sediment yield analysis to represent all storm events because it produces the least sediment for the watershed. Table 4-2 summarizes the results of the regional coefficient for each storm event.

Table 4-2: Gobernadora Canyon Sub-watershed Regional Coefficient (b)

Event	Node 132C	Node 133T	β
100	0.459	0.455	0.455
50	0.459	0.455	0.455
25	0.458	0.454	0.454
10	0.460	0.453	0.453
5	0.448	0.442	0.442
2	0.435	0.429	0.429
-		**Max**	0.455
-	-	**Min**	0.429

5. The sediment yield at each inflow point was calculated for a range of discharges using the MUSLE equation (Equation 1) with the minimum regional coefficient (β) as shown in Tables 4-2 and 4-3.

$$Y_s = 95 \times (Q_p \times V)^{\beta} \times K \times LS \times C \times P$$

6. The cumulative sediment yield from each watershed condition (Existing, Phased, and Ultimate) was used in the development of the San Juan Creek sediment transport model.
7. The PA-3&4 developed condition assumes zero sediment production from the planning area.
8. The coefficients for Chiquita Canyon were determined from the sediment yield calculations previously developed in the PA-2 ROMP. Table 4-3 summarizes the results of the regional coefficient for each storm event.
9. Sediment yield for San Juan Creek was determined using the sediment rating curve set up in the 2013 Ranch Plan ROMP at node 119.

Table 4-3: Chiquita Canyon Watershed Regional Coefficient (b)

Event	Ultimate Chiquita Node 134t (β)
100	0.456
50	0.454
25	0.452
10	0.450
5	0.428
2	0.404
Max	**0.456**
Min	**0.404**

4.2.1 Sediment Inflow

The Gobernadora Canyon sediment inflow was obtained using the relationship between the flood hydrograph and MUSLE sediment yield calculations as outlined above. The Gobernadora Canyon existing conditions subarea sediment yields are summarized in Table 4-4 for a range of discharges.

Table 4-4: Gobernadora Canyon Existing Conditions Sediment Yield

Q (cfs)	132C	133T
	tons	
1.00	2	5
5.00	20	31
10.00	34	96
50.00	107	317
100.00	326	524
250.00	596	1841
500.00	900	2877
1000.00	1260	4446
3000.00	2157	8022

The Gobernadora Canyon ultimate conditions subarea sediment yields are summarized in Table 4-5 for a range of discharges.

Table 4-5: Gobernadora Canyon Ultimate Conditions Sediment Yield

Q (cfs)	132C	133T
	tons	
1.00	2	2
5.00	20	15
10.00	34	44
50.00	107	143
100.00	328	278
250.00	602	857
500.00	909	1306
1000.00	1274	1960
3000.00	2184	3522

Table 4-6 summarizes the Chiquita Canyon existing and ultimate conditions subarea sediment yields computed for a range of discharges.

Table 4-6: Chiquita Canyon Sediment Yield

Q (cfs)	Existing	Ultimate
	Node 134T	
	Tons	
1.00	4	4
5.00	20	19
10.00	57	52
50.00	174	170
100.00	314	318
250.00	912	904
500.00	1440	1379
1000.00	2152	2033
3000.00	3835	3552

Table 4-7 summarizes the San Juan Creek existing and ultimate conditions subarea inflow sediment yields computed for a range of discharges at regional node 119. Development is not proposed upstream of 119 so existing and ultimate yields are the same.

Table 4-7: San Juan Creek Sediment Yield

Q (cfs)	Existing	Ultimate
	Node 119T	
	Tons	
1.00	21	21
5.00	135	135
10.00	283	283
50.00	1326	1326
100.00	2314	2314
500.00	10975	10975
1000.00	23326	23326
25000.00	400771	400771
50000.00	608124	608124

4.3 Sediment Transport Model Development

As part of the Ranch Plan ROMP, a stream stability analysis was performed to evaluate the hydrologic (peak discharge, runoff volume, flow duration) and geomorphic (coarse sediment production and delivery) impacts of planned development and the effectiveness of proposed mitigation as it relates to the event-based and long-term streambed behavior of San Juan Creek and its tributaries.

The methods, procedures, and applications used to previously evaluate the streambed stability of San Juan Creek and its tributaries (Chiquita and Gobernadora) are generally intended for reconnaissance-level planning studies. The calculations performed were static in nature, as no dynamic or quasi-dynamic model simulation was developed and implemented. Instead, sediment transport rates were computed based on single cross sections, each representative of a designated subreach, at a single point in time. The sediment transport yield for an event was determined for each cross section based on the product summation of ordinate sediment transport rates and the ordinate time interval. A budget analysis was conducted to determine the relative streambed vertical response trends (developed versus existing conditions) for the sequence of subreaches associated with the watercourse of interest.

As part of this previous assessment, San Juan Creek was segmented into 10 subreaches, ranging in streambed length from roughly 2,400 feet to 6,900 feet with an average length of nearly one mile. For each subreach, the net streambed vertical adjustment was determined for each set of conditions; however, variability with regard to deposition and/or scour that may occur within a subreach is unknown. For example, a subreach of constant streambed width may experience 5 feet of deposition along half its length and 5 feet of scour along the remaining half. From a subreach perspective, no vertical change would be observed, because the occurrence of deposition and scour offset each other; As a result, this type of analysis may falsely suggest that a subreach or a sequence of subreaches are unaffected.

To reduce the potential of a false assessment as it relates to streambed stability, a more detailed approach was pursued herein using HEC-6T v5.13.22.5 (MBH, 2005), a one-dimensional mobile boundary hydraulic and sediment transport computer model. HEC-6T is a proprietary version of HEC-6 v4.1.0 (USACE, 1993), which was developed based on the HEC-2 platform. However, HEC-6T does not use all of the capabilities implemented in HEC-2 (e.g., special bridge routines and split flow analysis).

HEC-6T theoretical assumptions and limitations. HEC-6T is a one-dimensional, quasi-dynamic, continuous simulation model that applies a sequence of steady flows to represent a flood hydrograph. The cross section is subdivided into two parts: one that has a moveable bed and one that does not. The moveable bed is constrained within the limits of the wetted perimeter. The entire wetted part of the cross section is normally moved uniformly up or down. Alternatively, HEC-6T can be directed to adjust the bed elevation in horizontal layers when deposition occurs. Secondary currents, transverse movement, transverse variation, lateral diffusion, and transmission losses are ignored; therefore, the model cannot simulate phenomena such as river meandering, point bar formation, pool-riffle formation, and many other planform changes. Bed forms are not simulated but can be emulated indirectly by assigning n-values as functions of discharge. Local erosion and deposition caused by water diversion, bridges, and other in-stream structures may not be simulated. Only one closed loop and one distributary can be defined.

HEC-6T event-based analysis. HEC-6T is designed to analyze long-term scour and deposition. Single flood event analyses should be performed with caution. The HEC-6T bed-material transport algorithms assume that equilibrium conditions are reached within each time step; however, the model is often influenced by unsteady non-equilibrium conditions during flood events. Equilibrium may not occur under these conditions because of the continuously changing hydraulic and sediment dynamics. If such situations predominate, single event analyses should be performed only on a qualitative basis. For gradually changing sediment and hydraulic conditions, such as for large rivers with slow rising and falling hydrographs, single event analyses may be performed with confidence.

4.3.1 HEC-6T Model Definitions

San Juan Creek. The previously developed San Juan Creek baseline HEC-6T model (PACE, 2010) was modified to support the streambed stability analysis for PA-3&4, performed herein, truncating the model to only consider the reach from 1,000 feet below La Novia Bridge up to regional node 119.

Gobernadora Canyon. The previously developed Gobernadora HEC-6T model (Michael Baker International, 2017) was modified to support the streambed stability analysis for PA-3&4.

Chiquita Canyon. There are no planned outfalls or diversions associated with PA-3&4 that would affect Chiquita Canyon, therefore, no evaluation was performed for this tributary, which borders the west side of PA-2.

4.3.1.1 Selection of Sediment Transport Relationships

There are 21 sediment transport relationships that are available for use in HEC-6T. The selection process of one or more appropriate transport functions for testing is imperfect at best. The predefined relationships have been tested to a specific set of conditions, which does not necessarily translate well to other watercourse environments, despite having similar characteristics. A simplistic selection process involves a comparison of basic information, which includes a range of velocities, hydraulic depths, effective widths, energy gradient or streambed slope, and sediment gradation. The influence of cohesive soils and armoring is also considered. Without some form of correlation or calibration the uncertainty in the results determined from the application of any transport function is unknown.

The sediment transport relationships available in HEC-6T include the following:

- Toffaleti (1968)
- Madden's (1963) modification of Laursen's (1958) relationship
- Yang's stream power (1973)
- Duboy's (Brown, 1950)
- Einstein
- Ackers-White (1973)
- Colby (1964)
- Toffaleti and Schoklitsch combination
- Meyer-Peter and Muller (MPM) gravel transport (1948)
- Schoklitsch gravel transport
- Toffaleti (1968) – MPM (1948) combination
- Madden's (1985) modification of Laursen's (1958) relationship
- Laursen-Copeland
- Engelund-Hansen
- Parker gravel transport (1990)
- Profitt (Sutherland)
- Brownlie with transport normalized at D50
- Brownlie with transport based on each grain size
- Yang high concentration formula (1996)

Comparing the tested parameter ranges of those sediment transport functions defined in HEC-6T (Table 4-8) to the average hydraulics and sediment gradation for San Juan Creek and Gobernadora Canyon suggests that several of the available sediment transport relationships generally satisfy this simplified screening/selection process; among those, the combination of Toffaleti (1969) and MPM (1948) was chosen to analyze the streambed stability of San Juan Creek and Gobernadora Canyon; in addition, several other functions were evaluated as a means of gauging relative performance: (1) Toffaleti (1969), (2) Yang (1973), (3) Ackers-White (1973), (4) Toffaleti (1969) combined with Schoklitsch (1930), (5) Laursen (1958) modified by Madden (1985), and (6) Laursen (1958) modified by Copeland and Thomas (1989).

Table 4-8: HEC6T available sediment transport functions and their original developed parameter range (USACE, 2003)

Available HEC6T sediment transport relationships	Data Source	Median Sediment Size (mm)	Sediment Size Range (mm)	Velocity (fps)	Depth (ft)	Effective Width (ft)	Energy Gradient (ft/ft)
Toffaleti (1968)	River	0.095 - 0.76	0.062 - 4	0.7 - 7.8	0.7 - 56.7	63 - 3,640	0.000002 - 0.0011
	Flume	0.91 - 0.45	0.062 - 4	0.7 - 6.3	0.07 - 1.1	0.8 - 8	0.00014 - 0.019
Meyer-Peter and Muller (1948)	Flume	-	0.4 - 29	1.2 - 9.4	0.03 - 3.9	0.5 - 6.6	0.0004 - 0.02
Schoklitsch (1930)	Flume	-	0.3 - 29	0.8 - 4.5	0.037 - 0.74	0.23 - 2	0.00012 - 0.055
Toffaleti (1968) and MPM (1948), combined		see individual listings for Toffaleti (1968) and MPM (1948)					
Toffaleti (1968) and Schoklitsch (1938), combined		see individual listings for Toffaleti (1968) and Scholltsch (1938)					
Yang (1973, 1984)	River	-	0.15 - 1.7	0.8 - 6.4	0.04 - 50	0.44 - 1,750	0.000043 - 0.028
	Flume	-	2.5 - 7	1.4 - 5.1	0.08 - 0.72	0.7 - 1.3	0.0012 - 0.029
Duboy (Brown, 1950)	Flume	0.1 - 4	-	-	-	-	-
Einstein (1950)	Flume	-	0.78 - 29	0.9 - 9.4	0.03 - 3.6	0.66 - 6.6	0.00037 - 0.018
Ackers-White (1973)	Flume	-	0.04 - 7	0.07 - 7.1	0.01 - 1.4	0.23 - 4	0.00006 - 0.037
Colby (1964)	River	-	0.18 - 0.7	0.7 - 8.0	0.2 - 57	0.88 - 3,000	0.000031 - 0.01
Laursen (1958), modified (Copeland and Thomas, 1989)	River	0.08 - 0.7	-	0.068 - 7.8	0.67 - 54	63 - 3,640	0.0000021 - 0.0018
	Flume	0.011 - 29	-	0.7 - 9.4	0.03 - 3.6	0.25 - 6.6	0.00025 - 0.025
Laursen (1958), modified (Madden, 1963)		data not available					
Laursen (1958), modified (Madden, 1985; 1993)	River	-	0.04 - 4.8	0.85 - 7.7	0.25 - 54	3 - 3,640	0.0001 - 0.1
Engelund and Hansen		data not available					
Parker (1990)	River	18 - 28	2 - 102	2.6 - 3.7	1 - 1.5	16 - 20	0.0097 - 0.011
Ackers-White (1973), modified (Proffitt-Sutherland, 1983)	River	-	2.9 - 12	2 - 3.4	0.35 - 0.84	2 - 2	0.003 - 0.003
Brownlie (1981)	River	-	0.086 - 1.4	1.2 - 7.9	0.35 - 57	6.6 - 3,640	0.00001 - 0.0018
	Flume	-	0.086 - 1.4	0.7 - 6.6	0.11 - 1.8	0.83 - 8	0.00027 - 0.017