Appendix E

Placer Ranch Storm Drainage
Final Reports

PLACERRanch

Storm Drainage Final Reports

- Technical Memorandum, dated November 5, 2018
- Storm Drainage Master Plan, dated July 18, 2017

TECHNICAL MEMORANDUM

DATE: November 5, 2018

TO: County of Placer

FROM: Mark Sauer
MacKay & Somps Civil Engineers, Inc.

SUBJECT: Addendum #1 to the Storm Drainage Master Plan for the Placer Ranch Specific Plan

Introduction

This Technical Memorandum functions as an Addendum to the Storm Drainage Master Plan, dated July 18, 2017, prepared for the Placer Ranch Specific Plan. Its purpose is to evaluate the differences between the Original Project and the Revised Project (based on an updated Land Use Plan, dated October 17, 2018). Together, this Addendum and its associated Master Plan provide the appropriate technical data and analysis to guide buildout of Placer Ranch's backbone infrastructure as depicted on the Revised Project's Land Use Plan.

Background

The Master Plan evaluated the infrastructure requirements for the Original Project, however in October 2018, several refinements were made to the land use plan, which resulted in the Revised Project.

These refinements generally included the following revisions to the land use plan:

- In the area west of Fiddyment Road and north of Sunset Boulevard, several land use parcels were reconfigured to shift residential and school uses outside a 2,000' buffer from the Western Regional Sanitary Landfill's properties. This resulted in the enlargement of Park parcel PR-102, a southerly shift of school parcel PR-92, the conversion of GC and HDR (parcels PR-61 and PR-42) to a Campus Park use.
- Along Maple Park Drive, MDR and HDR uses (parcels PR-32 and PR-42) were converted to LDR and MDR.
- Along Campus Park Boulevard, the PF site for a water tank (parcel PR-100) was enlarged.
- Paseo's have been adjusted in response to land plan refinements in order to maintain the east/west connectivity.
- The alignments of C Street and Maple Park Drive were shifted slightly in response to the land use adjustments described above, while maintaining the prior street pattern and connections.
- Along Fiddyment Road, Campus Park parcel PR-70 was converted to MDR.
- Within the Town Center district south of Sunset Boulevard, HDR parcels PR-50 & 51 were converted to MDR, and MDR parcels PR-35-38 were converted to LDR.
- The allocation of "floating" reserve units in the Town Center district was increased from 150 units to 300 units. These units continue to be factored as HDR units.
- South of Sunset Boulevard, the alignment of Foothills Boulevard has been shifted in an eastward direction to align with the existing Duluth Avenue corridor south of the Plan Area. As a result of this shift, LDR parcel PR-24, CP parcel PR-88, and MDR parcel PR-38 have been slightly enlarged.
- In the area south of Sunset Boulevard and east of Foothills Boulevard, MDR parcel PR-38 was enlarged to provide vehicular access to Sunset Boulevard, per the Foothill Boulevard realignment noted above. This adjustment also resulted in a portion of OS parcel PR-134 being converted to MDR.
- In the area north of Sunset Boulevard and east of Foothills Boulevard, Campus Park parcels PR-86-89 were converted to a low-density, active-adult, residential use (LDR-A), and Campus Park parcels PR-84 and 85 were reduced in size.
- A private park site was added within the active adult community north of Sunset Boulevard and east of Foothills Boulevard.

- A 100'-wide paseo has been added along the east edge of the plan area as a buffer between the active adult residential parcels and offsite industrial uses located in the Sunset Area Plan.
- East of Foothills Boulevard, Campus Park Boulevard was slightly realigned in response to the land use adjustments described above, while maintaining the east/west connectivity to the Sunset Area Plan.
- Park sites were added and/or enlarged (as described above) to increase the plan-wide park acreage in a manner that meet the General Plan's active parkland requirement of 5 ac./1,000 population.

The table below summarizes the differences between the Original Project and the Revised Project.

Table 1: Comparison of Original and Revised Land Uses and Development Assumptions

		Acreage			Dwelling Units/ Square Footage		
Land Use Designation		**Revised Project**	**Original Project**	**Difference**	**Revised Project**	**Original Project**	**Difference**
Residential Uses							
LDR	Low Density Residential	446.0 ac	407.9 ac	38.2 ac	2,210 du	2,039 du	171 du
LDR-A	Low Density Res. - Age-Restricted	183.1 ac	131.0 ac	52.1 ac	1,050 du	720 du	330 du
MDR	Medium Density Residential	112.3 ac	132.3 ac	-20.0 ac	872 du	1,057 du	-185 du
HDR	High Density Residential*	60.0 ac	93.0 ac	-33.0 ac	1,504 du	2,011 du	-507 du
Subtotal		*801.4 ac*	*764.2 ac*	37.3 ac	*5,636 du*	*5,827 du*	*-191 du*
Commercial and Employment Uses							
GC	General Commercial	22.7 ac	25.6 ac	-2.9 ac	296,513 sf	334,933 sf	-38,420 sf
CMU	Commercial Mixed Use	48.8 ac	48.8 ac	0.0 ac	637,718 sf	637,718 sf	0 sf
CP	Campus Park	335.0 ac	395.5 ac	-60.6 ac	4,506,282 sf	5,384,152 sf	-877,870 sf
UZ	University	301.3 ac	301.3 ac	0.0 ac	3,000,000 sf	3,000,000 sf	0 sf
Subtotal		*707.7 ac*	*771.2 ac*	-63.5 ac	*8,440,513 sf*	*9,356,803 sf*	*-916,290 sf*
Open Space and Public Uses							
PF	Public Facilities (Schools)	32.7 ac	32.0 ac	0.7 ac			
PF	Public Facilities (County Facilities)	10.3 ac	5.5 ac	4.8 ac			
PR	Parks and Recreation	69.8 ac	50.7 ac	19.1 ac			
OS	Open Space (Preserves/Paseos)	264.8 ac	272.8 ac	-8.0 ac			
Subtotal		*377.5 ac*	*360.9 ac*	*16.6 ac*			
Other							
ROW	Placer Parkway	158.5 ac	158.5 ac	0.0 ac			
ROW	Major Roadways & Landscape	168.1 ac	158.5 ac	9.6 ac			
Subtotal		*326.6 ac*	*317.0 ac*	*9.6 ac*			
Total		**2,213.3 ac**	**2,213.3 ac**	**0.0 ac**	**5,636 du** **8,440,513 sf**	**5,827 du** **9,356,803 sf**	**-191 du** **-916,290 sf**

* includes 300 reserve units within the Town Center district

Analysis

An evaluation of the differences between the Original Project and the Revised Project, as described in the Background section above, was conducted to determine if changes in the overall project occurred. The table below shows the differences in contributary areas and percent impervious rates between the Original Project and the Revised Project by watershed and basin facility. Only minor differences can be observed at each basin and overall there is a decrease in percent impervious rates. Only slight changes to the facilities proposed in the Storm Drainage Master Plan are expected due to these minor changes. Additionally, due to the decrease in the percent impervious rates, it is expected that the required retention volume for the 100-year 8-day event will be less. If warranted, additional adjustments to the Master Plan will be made when the project's first Small Lot Tentative Subdivision Map is processed by Placer County.

In the approved SDMP, fifteen (15) basins are proposed to mitigate the 10-year 24-hour and 100-year 24-hour events' peak flows. In the University Creek corridor in-stream basins utilize culverts at planned road crossings to attenuate flows. In the Orchard Creek and North Branch Placer Tributary corridors, detention basins are proposed for attenuation. All the proposed basins mitigate both events so that at the project boundary, water surface elevations are at or below existing and peak flows are 90% or less than existing. At the three project boundary compliance points, the contributing land area remains the same however the percent impervious rates are reduced at two of the locations. The third location, Orchard Creek, the percent impervious rate remains the same. Due to the overall reduction of imperviousness of the site, it is expected that overall detention requirements will slightly decrease. (Table 2)

In addition to flood control, the proposed basins contribute to providing hydromodification compliance at the project boundary for the 2-year 24-hour event. Hydromodification compliance is met by the incorporation of on-site Low Impact Development (LID) measures described below and attenuation achieved through the proposed basins described above. Due to the same reasons that the detention facilities may see slight reductions, so should hydromodification requirements.

Low Impact Development measures are proposed on-site to clean and reduce storm water at discharge points for the 85th percentile 24-hour event. LID measures proposed are tree planting and preservation, disconnected impervious areas, and if warranted in the future, soil amendments. The quantity of each LID feature was allocated by land use and is specified as a LID measure per acre of land use type. Vegetated swales are proposed at outfalls to supplement the abovementioned measures. Since LID features were determined by land use type in the SDMP, proposed land use changes herein do not alter the rates of application found in the SDMP. Vegetated swales may see slight localized changes due to the contributing land use changes; however in general, higher percent impervious land use types have been replaced with lower percent impervious land use types as can be observed in Table 1 and on the attached exhibits.

To convey storm water runoff to the drainage corridor, conceptual trunk storm drain pipes are analyzed in the SDMP. These trunk storm drain pipes are sized to the 10-year 24-hour event with the consideration of overland flows in the streets from infrequent high intensity storm events such as the 100-year 24-hour event. As previously mentioned, generally, higher percent impervious land use types have decreased while lower percent impervious land use types have increased with the Revised Project. Localized increases and decreases in trunk storm drain pipes may occur, however, the overall inventory of pipes should not change at this level of analysis.

Placer Ranch Specific Plan is a part of the Natomas Cross Canal watershed. It has been found that upstream development in the watershed increases the potential flooding in the lower portion of Natomas Cross Canal watershed. Due to this, mitigation by way of retention for the 100-year 8-day event is required for the proposed project. To determine the required retention volume for Placer Ranch, the equations developed by Civil Engineering Solutions, Inc. in the Pleasant Grove/Curry Creek Watershed Mitigation Fee report updated in 2017 are used in the SDMP. These equations use soil types and percent impervious rates to determine the required volume for retention of a contributing area. The overall decrease in percent impervious rates directly relates to a reduction in overall volume needed to be retained for the 100-year 8-day event.

The contributory areas for each proposed basin for the Original Project and the Revised Project are shown in Exhibits 1 and 2 respectively.

Table 2: Comparison of Original and Revised by Detention Basin Contributory Areas

	Contributory Area			Percent Impervious Rates		
Watershed & Basin	**Revised Project**	**Original Project**	**Difference**	**Revised Project**	**Original Project**	**Difference**
University Creek						
Basin#1	629.8	639.9 ac	-10.1 ac	35.6%	36.9%	-1.3%
Basin#2	220.9	210.9 ac	10.1 ac	46.8%	45.7%	1.1%
Basin#3	43.2	43.2 ac		5.7%	5.7%	
Basin#4	487.5	487.5 ac		22.5%	22.5%	
Basin#5	125.4	125.4 ac		36.1%	36.1%	
Basin#6	106.0	106.0 ac		39.0%	40.4%	-1.4%
Basin#7	517.3	517.1 ac	0.2 ac	50.6%	50.8%	-0.2%
Basin#8	224.0	224.0 ac		19.5%	19.5%	
Basin#9	56.5	56.7 ac	-0.2 ac	71.6%	71.4%	0.1%
Basin#10	137.2	137.2 ac		51.2%	51.2%	
Subtotal	*2,547.7 ac*	*2,547.7 ac*	*0.0 ac*	*37.0%*	*37.3%*	*-0.3%*
North Branch Placer Tributary						
Basin#11	63.9 ac	64.0 ac	-0.2 ac	32.5%	36.4%	-3.8%
Basin#12	127.2 ac	127.1 ac	0.1 ac	43.9%	43.6%	0.2%
Basin#13	97.2 ac	85.8 ac	11.4 ac	45.2%	71.4%	-26.2%
Basin#14	85.4 ac	96.8 ac	-11.4 ac	76.4%	75.5%	0.9%
Subtotal	*373.7 ac*	*373.7 ac*	*0.0 ac*	*49.7%*	*57.0%*	*-7.3%*
Orchard Creek						
Basin#15	56.7 ac	56.7 ac		70.7%	70.7%	
Subtotal	*56.7 ac*	*56.7 ac*	*0.0 ac*	*70.7%*	*70.7%*	*0.0%*
Total	**2,978.0 ac**	**2,978.0 ac**	**0.0 ac**	**39.2%**	**40.4%**	**-1.2%**

* Percent Impervious Rates are weighted averages

Conclusion

Based on the analysis above, it is determined that the facilities proposed in the original Storm Drainage Master Plan would not be significantly impacted by the land use changes. Retention requirements to the project will be reduced due to the lower percent impervious. Detention and hydromodification facilities operate to comply at the project boundaries and will also undergo a reduction in size due to the reduced impervious cover. Only storm water quality and trunk drainage facilities may undergo minor increases and decreases based on contributing area. However, at the master plan level of analysis, these facilities remain adequately sized in the approved SDMP to provide a foundation for future studies' analysis when a greater level of detail is warranted for small lot tentative maps and improvement plans. In summary, the analysis demonstrates that the changes between the Original Project and the Revised Project are not significant.

PLACER RANCH

Storm Drainage Master Plan

Placer County, CA

July 18, 2017

FINAL REPORT

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XPStorm Model Files
Storm Water Quality Template Spreadsheets
Report Files

1. Executive Summary

Placer Ranch is a master-planned community that proposes to develop approximately 2,213 acres consisting of a mix of residential, commercial—employment and public use, recreational amenities including parks and significant open space, and a university campus. Placer Ranch (Plan Area) is located within the unincorporated area of Placer County within the Sunset Industrial Area. The Plan Area is adjacent to the City of Roseville's northern boundary, east of Industrial Avenue, and is bounded on the north by Sunset Boulevard West and on the west by Amoruso Ranch. Refer to Figure 1: Project Location Map to see the location of the proposed project.

The purpose of the Storm Drainage Master Plan (SDMP) is to analyze, identify, and document the Plan Area's existing hydrologic characteristics and determine the required on-site and off-site drainage facilities that are necessary such that the downstream drainage facilities remain unchanged. Flows generated by development of the site will be mitigated to 90% or less of the existing conditions. Downstream volumetric increases for the 100-year 8-day event will be tabulated herein and could be used for future retention facility design.

The Plan Area is within the Pleasant Grove watershed and the Orchard Creek watershed which are both a part of the larger Natomas Cross Canal watershed of northwestern Placer County and southeastern Sutter County (see Exhibit 7 in Appendix A). The Plan Area is dominated by a gentle grass covered undulating topography that rises from approximately 85-feet in the southwest to 145-feet in the northeast and is bisected diagonally by University Creek, a tributary of Pleasant Grove Creek. See Exhibit 1 in Appendix A to see the Plan Area in its pre-developed condition.

Based on the results of this SDMP, the Plan Area can develop as proposed by constructing storm drainage infrastructure consisting of pipelines, culvert crossings of University Creek and its tributaries, detention basins, and Low Impact Development features. This infrastructure will function to mitigate the increased storm runoff that will result from the development of the Plan Area.

The storm runoff impacts on local creeks due to pollutants and hydromodification will be mitigated by proposed Low Impact Development (LID) features including source controls, trees, disconnected impervious areas, swales, and if necessary, soil amendments. These LID measures not only treat runoff through natural physical and biological treatment processes but also reduce the amount of runoff through infiltration and evapotranspiration. This will keep developed flows from degrading the creek system due to erosion; while, at the same time, capture and remove urban pollutants from runoff flows from the developed areas prior to discharging the treated flows to the creek system. Water quality treatment will be treated for the 85th percentile, 24-hour design event and the hydromodification will be mitigated to the 2-year 24-hour design event.

Flows for the 2-year 24-hour, 10-year 24-hour, 100-year 24-hour events will be attenuated within the University Creek corridor in the over bank flow areas. These areas will coincide with planned culvert crossings of the creek and will utilize these crossings to detain flows as needed for flood control. Although the 200-year 24-hour event will not be attenuated, these crossings have also been sized to allow this event to be conveyed without overtopping the roadways or flood the adjacent developable areas within the Plan Area. Areas that drain to Orchard Creek and the North Branch Placer tributary are proposed to have detention basins to attenuate the flows larger than the 2-year event.

Drainage improvements on-site are designed to the 10-year 24-hour hydraulic grade line requirements and with the allowable street inundation in the 100-year 24-hour event standards in mind. For arterial streets, all travel lanes are to remain clear. For collectors, the center 12-feet of the road remains free of storm water. In both cases, the overland flows are to remain within the County's rights-of-ways. Positive overland flow routes have been created through grading and are shown on Exhibit 6 located in Appendix A.

Due to potential flooding in the lower portion of Natomas Cross Canal watershed, retention in excess of the existing runoff volume is required for the 100-year 8-day event for all upstream development. To determine the mitigation needed for the Plan Area's volumetric impacts, equations developed in the 2017 Pleasant Grove/Curry Creek Watershed Mitigation Fee report were used to calculate the volumetric impacts of the Plan Area. Retention will occur at an off-site location. The retention site is undetermined at this time; however, it will be within the Natomas Cross Canal watershed (see Exhibit 7 in Appendix A).

As the Plan Area lies in the most upstream area of both Pleasant Grove Creek and Orchard Creek watersheds, the Urban Level of Flood Protection (ULOP) does not apply. ULOP requires that several location criteria all be met in order to require the ULOP regulations. The Plan Area has less than the required watershed of 10 square miles (6400 acres) contributing to University Creek and tributaries of Orchard Creek and Pleasant Grove Creek. Since the Plan Area does not meet the criteria of ULOP, the 100-year inundation standards will continue to apply.

Portions of University Creek in the Plan Area are in a FEMA unnumbered Zone A area which means that no base flood elevations have been established. The North Branch Placer Tributary is in Zone AE and has established base flood elevations. The results of this study will be used as a basis for mapping the limits of inundation for University Creek within the Plan Area.

This SDMP demonstrates that the Plan Area can develop without exceeding the pre-development peak flow conditions, without adversely affecting the existing water quality of the receiving waters of the local creeks, and without impact to, or by mitigating for, loss of natural stormwater storage by means of planned stormwater retention areas. In this manner, University Creek and Orchard Creek and their tributaries as well as the downstream watercourses will be protected from the impacts of developing the lands within the Plan Area by constructing the drainage infrastructure discussed and identified in this study.

2. Introduction

2.1 Overview

The Plan Area is a proposed 2213± acre development project located in unincorporated Placer County. The proposed project consists of a mix of residential neighborhoods of diversified densities, commercial, schools, parks, open space areas along University Creek and its tributaries, a town center, and a centrally located campus for California State University Sacramento and Sierra College. The project site is in south Placer County, immediately north of the City of Roseville, south of the City of Lincoln, and west of the City of Rocklin. Refer to Figure 1: Project Location Map for the project's location. At full buildout, the Plan Area will support 5,827 dwelling units, 74 acres of commercial; 396 acres of Campus Park (mixed use); 301 acres of university campus; 38 acres of public facilities; and 324 acres of parks, recreation, and open space.

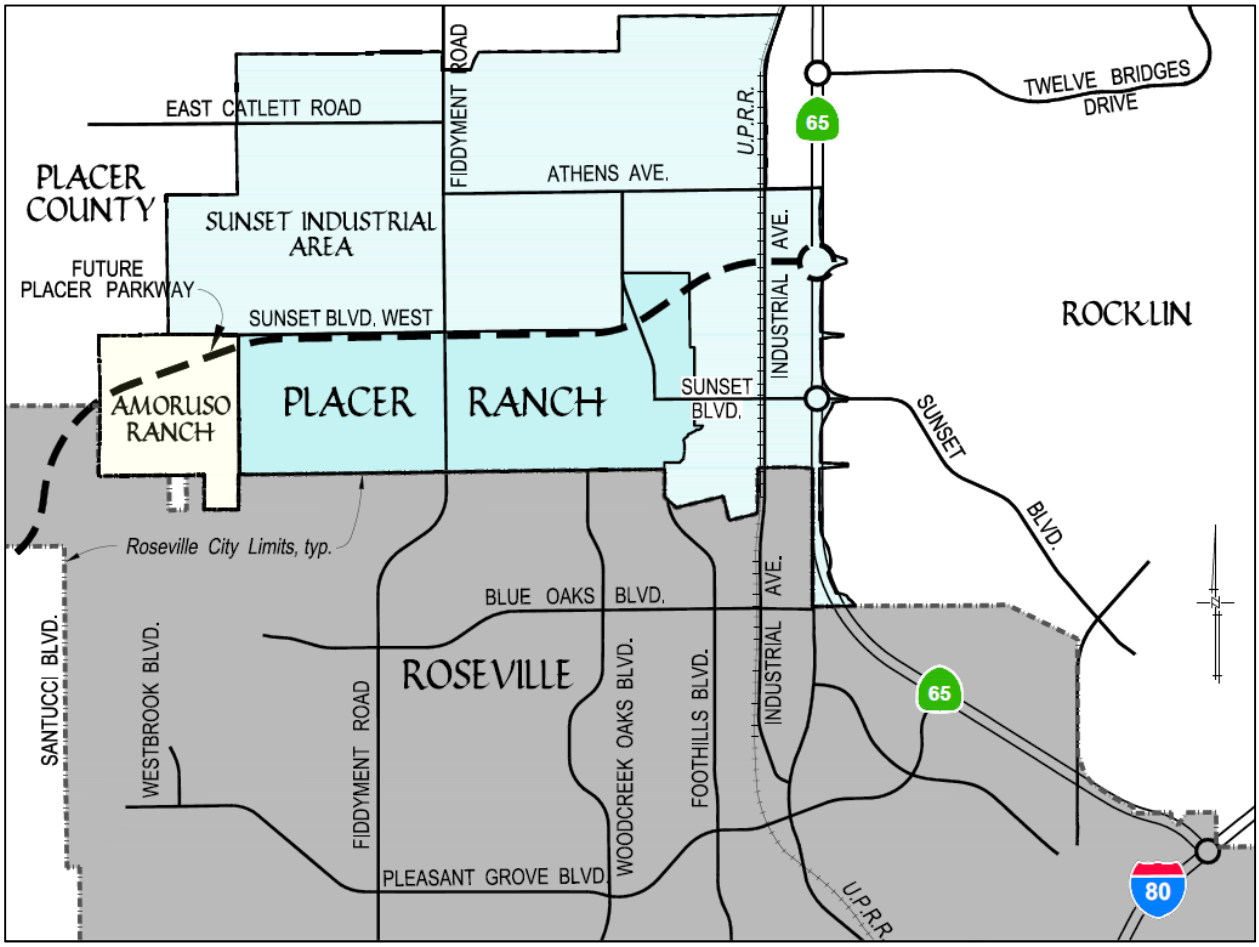

Figure 1: Project Location Map

The Plan Area is primarily undeveloped land with grassed covered flat to gently undulating terrain that rises from approximately 85-feet in the southwest to 145-feet above sea level in the northeast. Portions of the site were previously used for agriculture including cattle grazing as well as hay, wheat, and rice farming.

The Plan Area is predominately within the Pleasant Grove watershed with a smaller portion within the Orchard Creek watershed (Figure 2). Both of which are a part of the larger Natomas Cross Canal watershed of northwestern Placer County and southeastern Sutter County. University Creek, a tributary to Pleasant Grove Creek, bisects the Plan Area. The portion of the site that contributes to Orchard Creek is in the northeast corner. See Exhibit 1: Existing Conditions Aerial Photo in Appendix A.

University Creek is a tributary to Pleasant Grove Creek which drains to the Pleasant Grove Canal then on to the Natomas Cross Canal before entering the Sacramento River. Orchard Creek is a tributary to Auburn Ravine which drains to the East Side Canal then to Natomas Cross Canal before also entering the Sacramento River. Refer to Figure 2: Watershed Map and Exhibit 7 in Appendix A for an overall view of the watershed.

The study area for the Placer Ranch Drainage Master Plan (Plan Area SDMP) analyzes a watershed of approximately 3200 acres which drain in to, out of, or through the project. This study area includes not only on-site sheds but contributing off-site sheds as well.

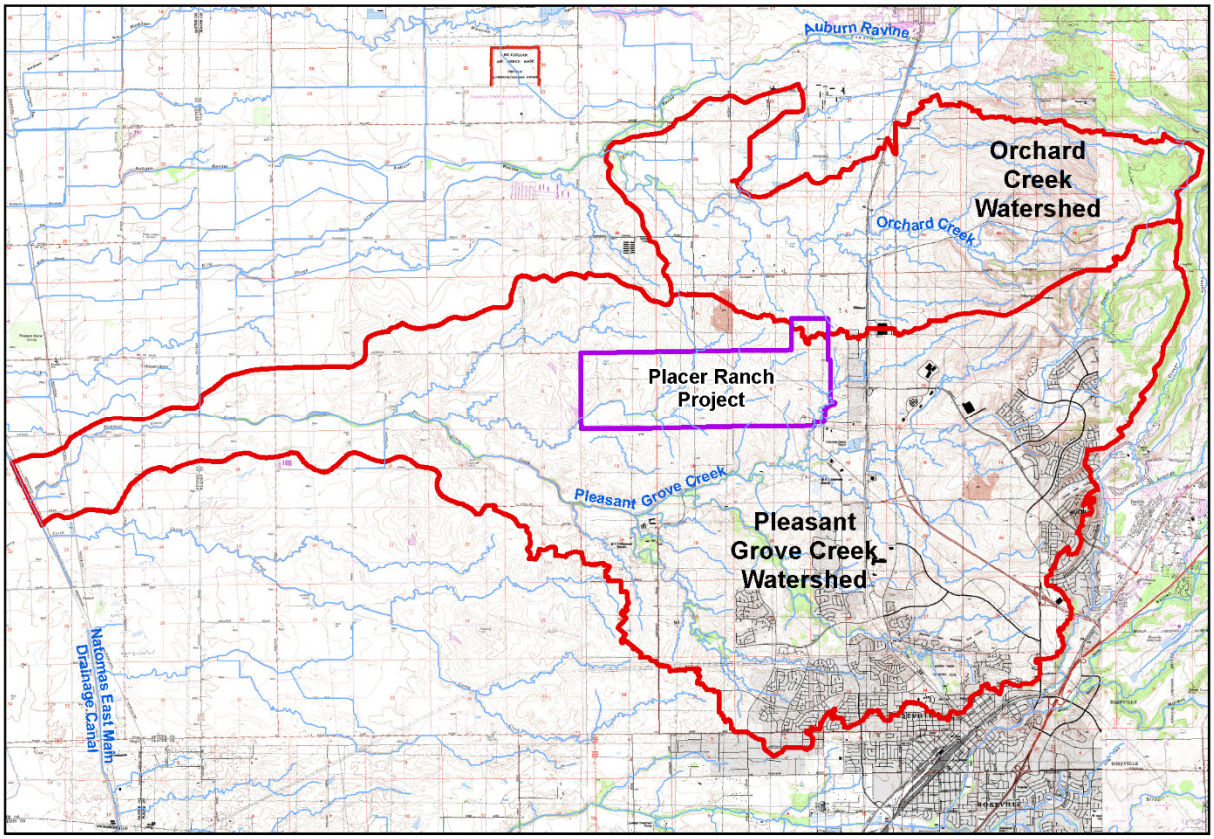

Figure 2: Watershed Map

2.2 Purpose

The purpose of the Plan Area SDMP is to analyze and document the existing pre-developed watershed characteristics and determine the drainage facilities that are necessary to maintain the receiving watercourses as close as practicable to the current pre-developed receiving watercourse characteristics. The Plan Area SDMP will confirm that the post-developed drainage characteristics will match the pre-developed drainage characteristics of the receiving watercourses in conformance with established design standards, and that the Plan Area develops in a safe and responsible manner. In addition, the Plan Area SDMP will determine the volumetric impacts of the 100-year 8-day event as the Natomas Cross Canal is subject to volumetric impact analysis.

The Plan Area SDMP investigates several detailed hydrologic and hydraulic modeling scenarios for the entire drainage study area. The electronic data files utilized with this analysis have been provided to Placer County so they will be able to update them as development occurs adjacent to or within the Plan Area. Therefore, as the Plan Area develops, the County will have a comprehensive understanding of the drainage facilities necessary to meet the goals of maintaining downstream impacts to 90% below existing conditions.

2.3 Previous Studies

There is one previous report that was used in the preparation of this analysis. This study is summarized as follows:

Amoruso Ranch Specific Plan Area Drainage Master Plan, Kimley-Horn, February 2016 Amoruso Ranch is the proposed development that is adjacent to the Plan Area on the western boundary. The site, which is anticipated to annex to the City of Roseville, lies entirely within the Pleasant Grove watershed, and is immediately downstream of the Plan Area. The Amoruso Ranch Specific Plan Area Drainage Master Plan describes and evaluates the drainage system that ultimately outfalls to University Creek. The HEC-RAS and HEC-HMS models presented in the Amoruso Ranch study are the basis for the analyses outlined in this report.

2.4 Topography

This study has utilized topography flown in December 2013 and is based on the National Geodetic Vertical Datum of 1929 (NVGD29) and references the City of Roseville's benchmark 115 located on the bridge at Fiddyment Road where it crosses Pleasant Grove Creek. All data presented in this study refers to the NGVD29.

2.5 Existing Conditions

The Plan Area is primarily within the Pleasant Grove watershed with a small portion in the Orchard Creek watershed which are both a part of the larger Natomas Cross Canal watershed of northwestern Placer County and southeastern Sutter County (see Exhibit 7 in Appendix A). The region is dominated by a gentle grass covered undulating topography that was formerly used for agricultural practices such as wheat, hay, and rice production as well as cattle grazing. Currently, site vegetation is dominated by non-native grasses; trees and brush are sparse.

The Plan Area can be characterized as rolling terrain with elevations above mean sea level ranging from 85-feet at the southwestern quadrant to 145-feet at the headwaters of University Creek. The majority of the Plan Area, via various tributaries and overland routes, contributes to University Creek which drains

from the east to the southwest. The portion of the Plan Area in the southeast corner drains to the North Branch Placer tributary of Pleasant Grove Creek which flows from the north alongside the eastern property line before discharging into the north main branch of Pleasant Grove Creek. The northeast quadrant of the Plan Area is located within the Orchard Creek watershed which drains to the north before joining the main branch of Orchard Creek before discharging to Auburn Ravine Creek.

As can be seen in Exhibit 1: Existing Conditions Aerial Photo in Appendix A, the majority of the Plan Area is currently undeveloped. Existing on-site development includes a City of Roseville power peaking facility in the southeast quadrant along the southern boundary that occasionally operates to provide power for peak hour demands. In addition, there are several existing roads that will be improved upon or relocated with the project as well as a couple of overhead power lines that traverse the project.

2.6 FEMA Information

The Federal Emergency Management Agency's (FEMA) Flood Insurance Study (FIS) Flood Insurance Rate Map (FIRM) encompassing the project area is FIRM Panel ID# 06061C0394F, effective June 8, 1998 and the preliminary map FIRM Panels ID# 06061C0929H and ID# 06061C0930H both dated December 28, 2015. The Pleasant Grove Creek North Branch, herein referred to as the North Branch Placer Tributary as identified in the HEC-RAS models, is identified as Zone AE on the preliminary map which means that it has established base flood elevations. Both the effective map and preliminary map identify parts of University Creek as being an Area of Special Flood Hazard for the 100-year event. The portion of University Creek identified is classified as unnumbered Zone A which means no base flood elevations have been determined but is a general idea of where flooding has the potential to occur. Thus, the results of this master plan will be used as the basis for mapping the existing floodplain within the project. A Letter of Map Revision for the existing conditions floodplain is not required at this time, however, it will be required at or before improvement plan level.

2.7 Soils Information

The soil type classification for each drainage subshed was determined by using the soils survey of California, Placer County. Image files from the US Department of Agriculture were downloaded from their web site and referenced in to the drainage exhibits for both pre- and post-development conditions. The soils classification is identified as either Type A, B, B/D, C, D, or water. The classifications B/D and water were modeled as D type soil. These classifications are used in the HEC-1 model for deriving the hydrology. The overall shed is predominately Type D soil, however, in some areas within the Plan Area the soils classifications vary, as seen in Exhibit 2: Existing Conditions Shed Area Soils and Exhibit 4: Proposed Shed Area Soils in Appendix A.

2.8 Storm Water Quality

The State Water Resources Control Board has found that with the urbanization of an area proportionately higher volume, velocity, peak flow rate, and duration from the pre-development area results. As such, the State Water Board developed the Small Municipal Separate Storm Sewer Systems (MS4) Order No. 2013-0001-DWQ effective July 1, 2013 as a means to manage storm water as a resource and as an asset. Per this order, the Plan Area is considered a Regulated Project. Regulated Projects are projects that create and/or replace 5,000 square feet or more of impervious surface. These projects shall implement, within the second year of the effective date of the permit, Low Impact Development (LID) measures. In reference to hydromodification management, Regulated Projects are projects that create and/or replace 1 acre or more of impervious surface and are required to implement hydromodification management within the

third year of the effective date of the permit. To execute this Order, Placer County developed the West Placer Storm Water Quality Design Manual (April 2016).

The Plan Area proposes to implement LID measures outlined in the West Placer Storm Water Quality Design Manual such as tree planting, impervious area disconnection, vegetated swales, and if necessary, soil amendments. These measures will mitigate to the 85th percentile 24-hour event as required by the Order and defined in the West Placer Storm Water Quality Design Manual. Hydromodification management will be mitigated to the 2-year 24-hour peak flow rate.

2.9 Urban Level of Flood Protection

In 2007, the State of California enacted six bills to improve flood management. One of which pertains to the Sacramento and San Joaquin river basins. Senate Bill 5 (SB5) is intended to bolster the relationship between local land use planning decisions and flood management practices. The requirement of SB5 is that an Urban Level of Flood Protection (ULOP) be given in specific areas of the Sacramento and San Joaquin river basins. ULOP is defined as the level of protection necessary to withstand a 1-in-200 chance of flooding in any given year. There are five location criteria that all must be met in order for the ULOP to apply. In order to determine whether or not the Plan Area is subject to SB5, the following table was developed.

Table 1: ULOP Applicability

ULOP Criteria	Response
It is located in the Sacramento San Joaquin Valley.	Yes. Essentially all areas west of the Sierra Nevada crest meet this criterion.
It is located within an urban area that is a developed area with 10,000 residents or more, or an urbanizing area that is a developed area or an area outside a developed area that is planned or anticipated to have 10,000 residents or more within the next ten years.	Yes. It is anticipated that the Plan Area will house approximately 13,677 residents at full build-out.
It is located within a flood hazard zone that is mapped as either a special hazard area or an area of moderate hazard on FEMA's official Flood Insurance Rate Map (FIRM) for the NFIP.	Yes. North Branch Placer Tributary and portions of University Creek are in a special flood hazard zone.
It is located within an area with a potential flood depth above 3-feet from sources of flooding other than localized conditions that may occur anywhere in a community, such as localized rainfall, water from storm water and drainage problems, and water from temporary water and wastewater distribution system failure.	Yes. With the floodplain analysis, it is shown that there are depths three feet or deeper in University Creek.
It is located within a watershed with a contributing area of more than 10 square miles.	No. The Plan Area is located at the upper most end of two watersheds.

Per the above matrix, the Plan Area is not subject to SB5 legislation due to not meeting the criterion of having watersheds with a contributing area of 10 or more square miles. The drainage area contributing to University Creek at the downstream project boundary (compliance point #1), including the upstream off-site areas, is approximately 4.0 square miles. The drainage area contributing to the North Branch Placer Tributary at the project boundary (compliance point #2), including upstream off-site areas, is

approximately 2.3 square miles. At the downstream project boundary in the Orchard Creek watershed, there is a total contributing area of 0.09 square miles.

2.10 100-Year Floodplain Impacts

Portions of the existing 100-year floodplain will be impacted with the proposed development. Fill is proposed alongside the main channels of the University Creek system and three small tributaries to University Creek are proposed to be routed within storm drainage infrastructure which is sized to carry the 100-year 24-hour event. Proposed in-line detention facilities will attenuate the increase in flow from development and replace lost detention due to the changes to the three abovementioned tributaries.

3. Creek Analysis - Hydrologic and Hydraulic Modeling

In general, the Placer County Flood Control and Water Conservation District Stormwater Management Manual (SWMM) was referenced for the development and use of these models. The following report subsections provide an overview of the model selections, data, and parameters used.

Several hydrologic and hydraulic models were utilized to evaluate the impacts of the proposed development. For the creek analysis, this drainage study utilizes a two-step modeling process:

1. **Hydrology**. The hydrology for each subshed was derived using the US Army Corps of Engineer's (USACE) Hydrologic Engineering Center HEC-1 Flood Hydrograph Package and the County's pre-processor PDP2 software for generating design event precipitation and computing storm centering factors.

2. **Hydraulics**. The hydrographs generated in HEC-1 were then incorporated into a US Army Corps of Engineers' (USACE) Hydraulic Engineering Center (HEC) River Analysis System (RAS) software package (HEC-RAS program version 4.1.0). An unsteady state analysis was used to determine the peak flow and hydraulic grade line using the geometry of the existing creek and tributaries. The results of this step were the output tables with peak flow rates and water surface profiles for the creeks and tributaries.

These two steps were utilized in a comprehensive, iterative approach for both flood control and hydromodification analyses. First, the existing conditions hydrology was prepared. See Appendix B for the hydrologic modeling parameters and data. Then existing conditions hydraulic analysis was prepared to evaluate the existing conditions floodplain information—the baseline for existing flooding conditions. In parallel, the existing conditions hydrology was utilized to determine the hydromodification baseline information.

Next, the proposed conditions hydrology was established. This information was then used to verify that hydromodification requirements of matching or being below existing peak flows for the 2-year 24-hour event was met. Once the hydromodification was proven, the proposed conditions 100-year floodplain mapping was prepared.

For the areas that drain to Orchard Creek, the flood control features were modeled in XPStorm.

For the on-site storm drainage infrastructure, the XPStorm Stormwater Management Model (XPStorm 2014 version 12.0) program was used to evaluate post-development hydrologic and hydraulic conditions for the subject site. The Placer County methodology was used and the cumulative precipitation depths for

the pipe analyses were created by the US Army Corps of Engineer's HEC-1 program utilizing the County's PDP2 software.

To evaluate the storm water quality provisions and hydromodification management for the development, the West Placer Storm Water Quality Design Manual, was referenced and used in this analysis. While the storm water quality calculations follow the calculation procedures outlined within that manual by utilizing the provided templates, hydromodification compliance was proven by comparing the pre-development to the post-development peak flows at the project boundary as determined in the HEC-RAS model for the 2-year 24-event.

Modeling Parameters

Parameters for the different hydrologic and hydraulic models prepared for this analysis were selected from information derived from the Placer County Flood Control and Water Conservation District Stormwater Management Manual, West Placer Storm Water Quality Design Manual, and the Placer Ranch Land Use Plan.

The percent imperviousness used for the hydrologic modeling is based on the 2010 Dry Creek Watershed Update and the Pleasant Grove watershed studies with the exception of High Density Residential and Commercial land uses which were increased from 60% and 70% respectively to 65% and 80%. The lower values for these two land uses used in the abovementioned studies did not reflect the same characteristics as the land uses in the Plan Area and thus were increased to better reflect the proposed land use herein.

Table 2 below shows the percent imperviousness for each land use type for both on-site and off-site sheds.

Table 2: Percent Imperviousness by Land Use Type

Land Use Designation	Percent Imperviousness
On-Site Land Use:	
Low Density Residential (LDR)	40%
Low Density Residential - Age Restricted (LDR-A)	40%
Medium Density Residential (MDR)	50%
High Density Residential (HDR)	65%
General Commercial (GC)	80%
Commercial Mixed Use (CMU)	80%
Campus Park (CP)	70%
University Campus (UZ)	50%
Public Facilities - Schools (PF)	50%
Public Facilities - County Facilities (PF)	50%
Parks and Recreation (PR)	5%
Open Space Preserves (OS)	5%
Placer Parkway (Parkway)	85%
Major Roads (Roadway)	85%
Existing Conditions and Off-Site Land Use:	
Existing Roadway	85%
Industrial	80%
Off-Site Parkway	85%
Park	5%
Residential	50%
Open Space (Pervious)	5%

For the creek analyses in both the existing and proposed conditions, Manning's roughness coefficients ('n' values) for the natural stream channels located within the Plan Area vary from 0.045 in vegetated bottom channels to 0.06 in the overbank areas with light brush. The values used are consistent with the values found in Table 3-1 of the HEC-RAS Hydraulic Reference Manual Version 4.1 (January 2010). Due to the relatively uniform vegetation over the site, there are limited variances in the 'n' values.

Typically for developed conditions models, an increased Manning's 'n' value is used due to increased runoff during summer months which was not previously experienced by the creek (summer nuisance flows). However, vegetative growth within the stream corridor from small increases in flows throughout the year due to development are not expected with the development of Placer Ranch. With the stormwater quality and hydromodification measures proposed and the current water savings guidelines, the smaller frequent flows are expected to infiltrate and evaporate prior to reaching the stream corridor. In addition, the proposed swales have required maintenance per the West Placer Storm Water Quality Design Manual as well as the stream corridor will be maintained as a part of the County's stream channel maintenance program. Because of these reasons, the Manning's roughness coefficients used in the existing conditions models will also be used in the proposed conditions models.

Pipe outfall invert elevations, HEC-RAS cross-sections, and swale locations were based on the topographic data mentioned previously in Section 2.4 Topography.

3.1 Existing Conditions Model

In order to determine the hydrologic impacts resulting from development of the Plan Area, an analysis was performed for the existing conditions of the creek systems within the study area. This existing conditions model provides a baseline for comparison with the proposed conditions models prepared as a subsequent part of this analysis. Existing conditions is defined by the current land uses within the Plan Area.

Soil type information and impervious coverage for the various existing conditions subsheds within the study area were then developed, see Exhibits 2 and 3, respectively in Appendix A. Additionally, water course lengths and centroids of each existing conditions subshed were determined and can be seen on Plate 1 which is in the rear pocket of this report. This data was then used to create an existing conditions HEC-1 model and resultant existing conditions hydrology was determined. For off-site drainage sheds, the impervious and pervious land cover areas were determined in accordance with the County's drainage standards assuming actual impervious land areas. These same values were used in the proposed conditions model.

Off-site upstream drainage sheds have been assumed to maintain their level of discharge onto the project area in perpetuity at or below existing levels. If these off-site lands develop in the future, the peak developed flows from those upstream areas will need to be mitigated with peak flow attenuation such that the resultant flows comply with the Sunset Industrial Area Plan Goal 3.E.7 of mitigating post-development peak flows to 90% of existing peak flows.

The existing conditions hydraulic model is based on the Amoruso Ranch Specific Plan Area Drainage Master Plan HEC-RAS model. To make the Plan Area's model more manageable, the portion of University Creek within the Plan Area was removed from the Amoruso Ranch model and made to be a standalone model. The resultant flow hydrographs from the Plan Area's University Creek model was then placed into the Amoruso Model at the upstream connecting cross-section. This separation of the models allows for increased focus on the Plan Area without compromising the Amoruso Ranch model of Pleasant Grove Creek.

Storm centering is not necessary for the 100-year 24-hour and the 200-year 24-hour events since the Plan Area is under 4-square miles. Per Table 5-1 in the Placer County Flood Control and Water Conservation District Stormwater Management Manual, areas 5-square miles and less for the 100-year event and larger do not require storm centering. Although storm centering would affect the 2-year 24-hour and 10-year 24-hour events, these events are for comparison purposes only and there is no risk in removing the storm centering aspect of the hydrology.

A small section of the North Branch Placer tributary of Pleasant Grove Creek runs through the southeast portion of the Plan Area. Since this branch is small, it was not removed from the Amoruso Ranch model and is analyzed within that model.

Refer to Plate 1: Existing Conditions Drainage Subsheds to review the map used as the basis for developing the existing conditions model. Plate 7 shows the key compliance points that were used to compare

existing and proposed conditions peak flow rates to be assured that post-development flows are equal or less than existing peak flow rates.

3.1.1 Existing Conditions Peak Flow Rates

Existing flows and hydraulic conditions were analyzed to establish a base line for the proposed conditions and to determine necessary drainage improvements. As explained above, a hydrologic model of the project area watershed was created using HEC-1 and the County's PDP2 software. Table 3 below provides the peak flows for the design events modeled in the existing conditions for each of the compliance points. Refer to Plate 7 for the compliance point locations.

The shed areas, detailed input parameters, and output results from the HEC-1 hydrologic models are included in Appendix C.

Table 3: Existing Conditions Peak Flows

Compliance Point No.	Creek Name	2-Year 24-Hour (cfs)	10-Year 24-Hour (cfs)	100-Year 24-Hour (cfs)	200-Year 24-Hour (cfs)
CP#1	University Creek	275.9	501.7	895.9	1003.0
CP#2	North Branch Placer	83.3	185.9	443.5	n/a
CP#3[1]	Orchard Creek	16.4	37.0	91.3	109.6
CP#4	Amoruso Ranch	305.2	563.6	1027.1	n/a
CP#5	North Branch Placer at Pleasant Grove	610.4	1121.6	2317.5	n/a
CP#6	University Creek at Pleasant Grove	1299.0	2698.7	5431.4	n/a

1. The compliance point for Orchard Creek is at the downstream end of existing shed PRE901 and proposed shed PROFF008. Hydrographs developed in XPStorm from the contributing sheds were added together in MS Excel to provide the above data.

3.1.2 Existing Conditions Limits of Inundation

Existing flows and hydraulic conditions were mapped to show the existing 100-year 24-hour limits of inundation for University Creek and Pleasant Grove Creek as shown in Plate 2: Existing 100-Year Floodplain. The existing conditions HEC-RAS analysis is presented in Appendix D and the model files are included on the disc in the back of this report.

A hybrid analysis of on-site existing and off-site unmitigated developed SIA was not performed after a comparison of the hydrographs of the existing, developed mitigated, and developed unmitigated subsheds for the contributing off-site subsheds demonstrated little difference in peak flows. This is due to a low infiltration rate for the soil type in those subsheds. With such small increases in peak flows, the differences from existing conditions floodplain are negligible when mapped.

3.2 Proposed Conditions Model

The proposed conditions model is based on a fully developed Placer Ranch Plan Area. This model utilized the existing conditions model as a starting point then replaced the existing conditions with the proposed conditions. Soil type information and impervious coverage for the various proposed conditions subsheds within the study area were developed, see Exhibits 4 and 5, respectively. Additionally, water course lengths and the centroids of each proposed conditions subshed were determined. This data was then used to create a proposed conditions HEC-1 model and resultant proposed conditions hydrology was determined. The 2-year 24-hour event scenario incorporates the LID features proposed by way of using the reduced percent imperviousness discussed in Section 5.0 of this report. The 10-year 24-hour, 100-year 24-hour, and the 200-year 24-hour events utilize the percent imperviousness rates in Table 2. There is no 200-year event run for the main Pleasant Grove Creek model and therefore 200-year results are not provided for compliance points 2, 4, 5, and 6. University Creek 200-year results have a downstream condition of the 100-year results of the Pleasant Grove Creek model.

It should be noted that the resultant flows from the HEC-1 differ from those created in XPStorm for the on-site pipe analysis. The resultant higher peak flows in the XPStorm pipe model are due to the effects of collecting and routing the subshed flows through the trunk storm drainage pipes. It is expected that these higher peak flows found in XPStorm will be reduced when the entire pipe and street system is added to the model during improvement plan level analysis. Additionally, to assist in closing the gap between the two models, the watercourse lengths used within the HEC-1 model are 90% of measured length to better represent the on-site peak flow timing.

Although in the developed conditions swales are proposed, the additional volume that they may contribute is not included in the hydraulic analysis for the creek systems. Not including the additional volume assures that the volume is not available for peak flow attenuation during major storm events. This is a conservative approach and the modeling shows that there is no adverse effect on the results contained in this study.

The HEC-RAS models for the proposed conditions are divided the same way as the existing HEC-RAS models. The portion of University Creek within the Plan Area is a standalone model. The resultant flow hydrographs from the Plan Area's University Creek model was then placed into the Amoruso Model at the upstream connecting cross-section. This separation of the models allows for increased focus on the Plan Area without compromising the Amoruso Ranch model of Pleasant Grove Creek. The North Branch Placer tributary remains a part of the Amoruso Ranch model. The storm centering and Manning's 'n' values are also consistent with the existing conditions HEC-RAS model for Placer Ranch University Creek.

The changes to the HEC-RAS models for University Creek and North Branch Placer tributary for the developed conditions include new cross section information, new roadway crossings on the University Creek tributary, and the inclusion of detention basins on the North Branch Placer tributary.

Refer to Plate 3: Proposed Conditions Drainage Subsheds to review the map used as the basis for developing the proposed conditions model. Plate 7 shows the locations of the compliance points that are used to compare the existing and proposed conditions peak flow rates. The hydrograph comparisons can be found in Appendix I.

3.2.1 In-Stream Detention and Proposed Detention Basins

In order to attenuate the proposed conditions peak flow rates to be less than existing conditions peak flow rates, detention for the 2-year 24-hour, 10-year 24-hour, and 100-year 24-hour events is needed. The peak flow attenuation needed for University Creek will occur in University Creek itself, which has significant naturally occurring in-stream and over-bank storage capacity. These storage areas will coincide with planned culvert crossings of the creek and will utilize these crossings to detain flows as needed for flood control. These crossings have also been sized to allow the 200-year 24-hour event to be conveyed without overtopping the roadways or flood the adjacent developable areas within the Plan Area

The subsheds that drain to Orchard Creek and the North Branch Placer tributary are proposed to have detention basins to attenuate the developed peak flows. The outfall pipes of both the in-stream detention and the detention basins will be sized to control the release of the flow for the 2-year 24-hour, 10-year 24-hour, and 100-year 24-hour design events.

The 100-year 24-hour event volumes to be detained, duration of detention, and basic design parameters are shown below (Table 4). Additionally, in Appendix G, are detailed design parameters including outlet structure schedules and hydrographs of each basins discharge.

At this level of analysis, it is assumed that the detention basins have a flat bottom and that the basin is considered empty when the modeled depth of the water is 3-inches or less. At the improvement plan level of analysis, a sloping basin bottom and a low flow channel will be designed which will efficiently handle the lower flows of smaller events as well as the residual flow of larger events. For the in-stream detention basins, the drawdown time is the length of time it takes for the water surface elevation to reach the soffit of the upstream end of the culvert. Per the Placer County Flood Control and Water Conservation District Stormwater Management Manual, basin drawdown times are to be less than 72-hours and for facilities that exceed 72-hours in drawdown time for the 100-year 24-hour event, an additional manually operated outlet is required to ensure full drawdown within that time.

Table 4: Basin Attributes and Performance

Basin	Location	Bottom Elevation (ft)	Roadway/ Top Elevation (ft)	100-Year Max Water Surface Elevation (ft)	100-year Storage Volume[1] (ac-ft)	Drawdown Time (hrs)
Basin#1	University Creek	84.4	93	90.8	90.0	23
Basin#2	University Creek	92.3	101	99.7	108.1	40[2]
Basin#3	University Creek	104.1	107	106.7	3.7	14
Basin#4	University Creek	99.9	108	107.1	33.2	15
Basin#5	University Creek	92.4	101	98.9	35.3	29[2]
Basin#6	University Creek	94.4	103	101.2	46.6	27[2]
Basin#7	University Creek	96.9	108	104.2	93.5	29[2]
Basin#8	University Creek	108.9	115	113.4	19.2	16
Basin#9	University Creek	111.9	119	115.9	9.5	15
Basin#10	University Creek	113.2	120	118.2	9.7	19
Basin#11	North Branch Placer Tributary	112.0	117	114.4	3.4	33[2]
Basin#12	North Branch Placer Tributary	107.0	113	110.6	5.2	33[2]
Basin#13	North Branch Placer Tributary	115.0	122	119.3	13.3	49[2]
Basin#14	North Branch Placer Tributary	123.0	131	128.2	16.9	81[2]
Basin#15	Orchard Creek	126.5	133	131.5	6.4	46

1. The storage volume listed here is the entire volume occupied by the 100-year event at the max water surface elevation.
2. These basins are analyzed in the HEC-RAS model which is a 24-hour model. These are extrapolated values based upon the slope of the stage hydrograph of the last 2 hours of the model run.

To ensure the safety of proposed residential, commercial, and public buildings; the proposed pads will be designed to be at least 2-feet higher than the maximum water surface elevation of the 100-year 24-hour design event within the creek system.

3.2.2 Proposed Conditions Mitigated Peak Flow Rates (Attenuated)

The proposed conditions attenuated peak flows are summarized below in Table 5. The results of the proposed conditions model confirm that a fully developed Plan Area will generate peak flow rates that are 90% of existing conditions peak flow rates as required by Goal 3.E.7 in the Sunset Industrial Area Plan and is achieved for the compliance points at the project boundary (CP#1, CP#2, and CP#3). Compliance points 4, 5, and 6 are further downstream from the project boundary and include additional contributing area that cannot nor will not be attenuated by the proposed project.

Table 5: Proposed Conditions Peak Flows - Mitigated

Compliance Point No.	Creek Name	2-Year 24-Hour (cfs)	10-Year 24-Hour (cfs)	100-Year 24-Hour (cfs)	200-Year 24-Hour (cfs)
CP#1	University Creek	248.3	435.2	612.9	657.9
CP#2	North Branch Placer	72.4	159.9	374.0	n/a
CP#3[1]	Orchard Creek	13.7	30.6	72.0	86.0
CP#4	Amoruso Ranch	281.4	554.9	968.7	n/a
CP#5	North Branch Placer at Pleasant Grove	599.8	1090.4	2226.4	n/a
CP#6	University Creek at Pleasant Grove	1276.8	2659.4	5251.4	n/a

1. The compliance point for Orchard Creek is at the downstream end of PROFF008 and includes PRD904, PRD903, PROFF009, and PROFF008. Hydrographs developed in XPStorm from the contributing sheds (Link326, OFF008, OFF009) were added together in MS Excel to provide the above data.

3.2.3 Proposed Conditions Limits of Inundation

Proposed conditions flows and hydraulic conditions were mapped to show the 100-year 24-hour design event for the Plan Area's creek systems. Post-development water surface elevations are at or below existing conditions at the project boundary. Refer to Plate 4: Proposed 100-Year Floodplain to see the mapped limits of inundation. The proposed conditions HEC-RAS analysis is presented in Appendix D and the model files are included on the disc in the back of this report.

3.2.4 Proposed Conditions Unmitigated Peak Flow Rates (Unattenuated)

In addition to the mitigated scenario, a fully developed unmitigated scenario for the 100-year 24-hour event was analyzed. The unmitigated model is based upon the mitigated model, however, with all detention facilities removed. The off-site contributing areas for the Sunset Industrial Area (SIA) were assumed fully developed and without detention. The fully developed hydrology for the SIA assumes a percent impervious of 80% based upon the draft land use plan dated October 20, 2016. Plate 5 in the back pocket of this report shows the unmitigated floodplain delineation.

Table 6: Proposed Conditions Peak Flows - Unmitigated

Compliance Point No.	Creek Name	100-Year 24-Hour (cfs)
CP#1	University Creek	998.7
CP#2	North Branch Placer	446.6
CP#3[1]	Orchard Creek	410.4
CP#4	Amoruso Ranch	1136.5
CP#5	North Branch Placer at Pleasant Grove	2317.6
CP#6	University Creek at Pleasant Grove	5581.3

1. The compliance point for Orchard Creek is at the downstream end of proposed shed PROFF008 and includes PRD904, PRD903, PROFF009, and PROFF008. Hydrographs developed in XPStorm from the contributing sheds (Link298, OFF008, OFF009) were added together in MS Excel to provide the above data.

4. Backbone Storm Water Infrastructure

The conceptual backbone storm water infrastructure system for the Plan Area was developed from preliminary drainage calculations based on the proposed conditions. The analysis was performed using XPStorm which routes hydrographs through the proposed pipes to develop hydraulic grade lines.

The precipitation data was developed using the Placer County methodology of utilizing HEC-1 and the PDP2 software and can be found in the models provided on the disc in the rear pocket and in Appendix C. Figure 3 and Figure 4 show the resulting rainfall intensity for both the 10-year and 100-year design events. The proposed conditions subshed data such as percent imperviousness, area, shed width, and slope were input into the XPStorm model at each subshed node. For infiltration, the initial loss was set to zero and a continuing loss for urban landscapes on D soils of 0.12 inches per hour was used.

The trunk drainage pipes were analyzed for both the 10-year 24-hour and 100-year 24-hour design events. The following criteria from the Placer County Flood Control and Water Conservation District Stormwater Management Manual were used in the pipe analysis:

- The design tailwater shall be the water level in the receiving major drainage way for computing the hydraulic grade line for the specific design event.
- The minimum flowing full or half full velocity shall be no less than two and one-half (2.5) feet per second using an ‘n’ value of 0.015.
- The 10-year 24-hour design event hydraulic grade line shall maintain, at a minimum, one-half foot (0.5’) of freeboard below the elevation of all manhole rims and inlet grates.
- The design hydraulic grade line should be at least six (6) inches below the gutter grade at the inlet to allow the inlet to function properly.
- Closed conduit sections shall be designed as flowing full whenever possible.

A fixed backwater was obtained from the respective creek analysis HEC-RAS models and was used at each of the pipe outfalls. Although manhole and drop inlets are not analyzed in this study, it is recognized that this preliminary analysis will be the foundation upon which the future detailed analysis will be based. Therefore, 1-foot to 1.5-feet of freeboard, road section dependent, below the elevation of the manhole rims is maintained in this study. The following are the freeboard parameters used for the different street sections: 1.5-feet for arterial streets, 1.2-feet for collector streets, and 1-foot for residential streets. For this level of analysis, the pipe slope requirement of being less than 70% of critical slope or more than 130% of critical slope at design flow was not included.

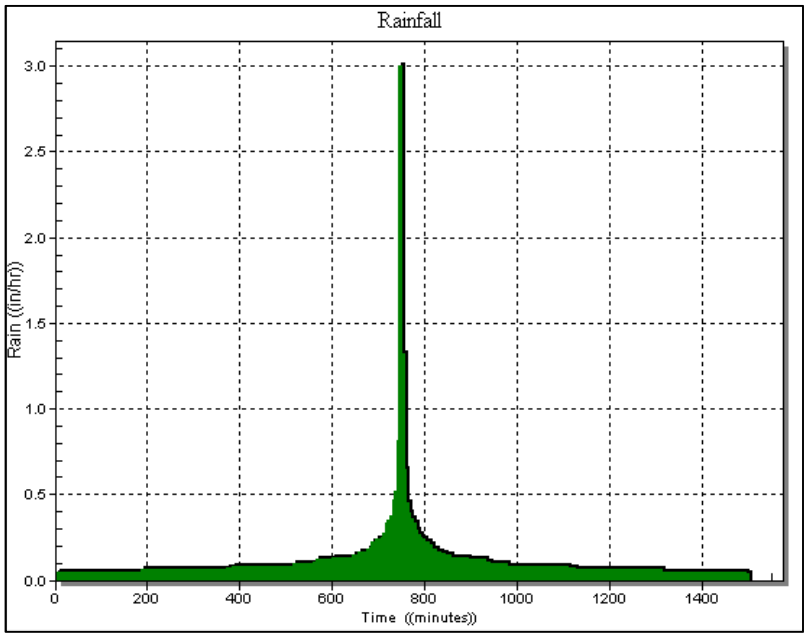

Figure 3: 10-Year Rainfall Hyetograph

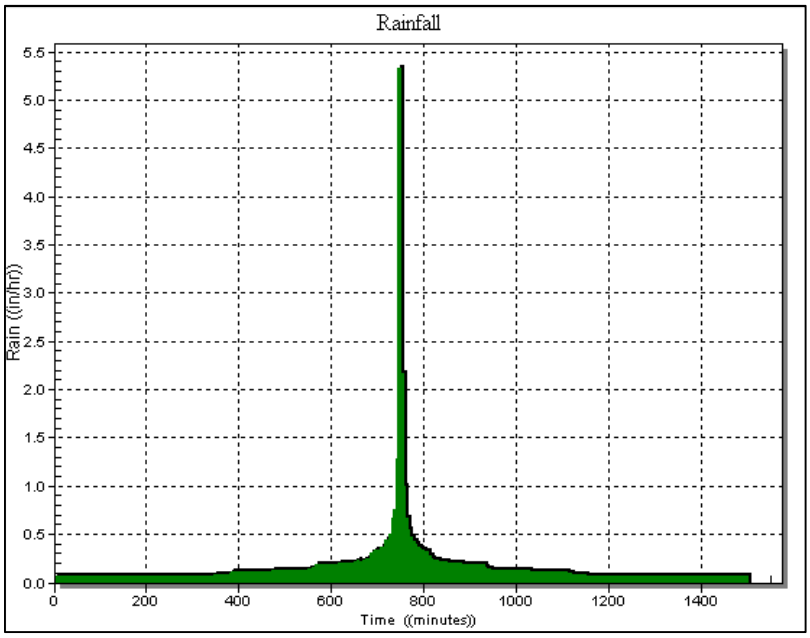

Figure 4: 100-Year Rainfall Hyetograph

Project specific drainage calculations for this conceptual system will be performed on a project-by-project basis as each of the various areas within the Plan Area are proposed for development. The conceptual backbone storm water infrastructure system for the Plan Area is shown on Plate 6: Conceptual Backbone Storm Water Infrastructure located in the back pocket of this report and the modeling data and results can be found in Appendix E.

4.1 Overland Release Considerations

Piped storm drain systems are not required to be designed to convey peak flows from infrequent high intensity storm events, such as the 100-year storm event. However, due to street inundation standards and a few existing channels being filled in, a portion of the pipes have been designed to convey the 100-year event. The 100-year event allowable street inundation standards, Placer County Flood Control and Water Conservation District Stormwater Management Manual Table 6-1 Allowable Street Encroachments (Addendum October 1997), are considered in the evaluation of overland release and for the previously discussed pipe system. Future design phases will include identified overland release points.

The overland release will discharge at the same locations as the underground facilities and if the pipes and inlets become clogged or overwhelmed, proposed grading will provide positive overland release. The overland flow routes are shown on Exhibit 6: Overland Release Routes in Appendix A.

5. Storm Water Quality

Storm water is a valuable resource and it is the intention of the Plan Area to maintain storm water quality using source control and Low Impact Development measures. These measures, through structures and operations, infiltration, evapotranspiration, and biotreatment can keep clean water clean and recharge groundwater supplies, protect and enhance natural habitat and biodiversity, and add value to new development.

A multi-layered approach was taken to ensure that the storm water quality including baseline hydromodification requirements were met per the West Placer Storm Water Quality Design Manual. Each land use type was analyzed as a whole using the West Placer Storm Water Quality Design Manual's SWQP Template to determine what LID measures are most effective for that particular land use. This analysis also provided the resultant modified percent imperviousness due to the addition of LID measures discussed in Section 5.2. Once the quantity of each measure was known for each land use, each drainage shed contributing to an outfall with its composite land use was evaluated. Two scenarios for each outfall were evaluated and a result for each was obtained. The results for both scenarios were directly from the SWQP Template's Form 3-4 and Form 3-5 (Appendix F). One was the storm water quality flow that discharges to the swale at the outfall and is shown on the SWQP Template Form 3-5 Item 6. This flow is based on calculating storm water quality credits using the on-site measures of tree planting and disconnected impervious areas. The resulting flow was used for the design of the swales. The other result obtained was the confirmation that storm water quality and baseline hydromodification criteria were met and is based on the use of on-site LID measures plus the swale. Compliance is demonstrated by having zero water quality volume and zero water quality flow on Form 3-5, Items 5 and 6 respectively. Plate 6: Conceptual Backbone Storm Water Infrastructure shows each outfall location and Appendix F contains the SWQP Template's Form 3-4 and Form 3-5 for each land use and for each outfall.

5.1 Source Control Measures

The first line of defense in maintaining storm water quality is to keep polluted water from commingling with clean water. This can be done using structural and operational measures at the pollutant source. At this level of analysis, source control measures are not proposed however, measures may be specified at the improvement plan level of design.

Potential structural measures may include covering of trash receptacles, using efficient irrigation to reduce overspray, and connecting industrial floor drains to the sanitary sewer system instead of the storm drainage system. Operational measures may include using good housekeeping measures to minimize the generation of pollutants, make stormwater pollution prevention BMPs a part of standard operating procedures, and employee training programs.

5.2 Low Impact Development Measures

Several Low Impact Development strategies are proposed to reduce the post-development flows. These strategies remove pollutants from runoff, attenuate peak flows, and reduce runoff volume. The proposed LID measures include impervious area disconnection, tree planting, vegetated swales, and if needed, soil amendments.

All proposed measures were designed to the specifications outlined in the West Placer Storm Water Quality Design Manual and implemented to mitigate the 85th percentile, 24-hour storm event. Although off-site contributing areas are factored into each drainage area, no LID measures are proposed for off-site contributing areas.

5.2.1 Tree Planting and Preservation

Planting trees throughout the site is proposed. Evergreen trees can be more beneficial to water quality because they retain their foliage year-round. However, both are beneficial and diversity provides additional benefits so therefore half of the trees are proposed to be evergreen and the other half deciduous.

Trees, at a minimum, have the following merits:

- decrease storm water runoff volume,
- reduce amount of pollutants to reach downstream,
- aesthetically pleasing,
- have a cooling effect through shade and evapotranspiration, and
- provide habitat for birds and insects.

Placement and care the proposed trees are an important part of the design considerations for this LID measure. All trees will require irrigation to become established and most may need irrigation to maintain. It is recommended to select trees appropriate to the site and soil characteristics for the best results.

Table 7 below shows the number of trees proposed by land use type.

Table 7: Proposed Tree Planting Rates

Land Use Designation	Number of Trees
Low Density Residential (LDR)	1 per lot
Low Density Residential - Age Restricted (LDR-A)	1 per lot
Medium Density Residential (MDR)	1 per lot
High Density Residential (HDR)	5 per pervious acre[1]
General Commercial (GC)	5 per pervious acre
Commercial Mixed Use (CMU)	5 per pervious acre
Campus Park (CP)	5 per pervious acre
University Campus (UZ)	5 per pervious acre
Public Facilities - Schools (PF)	5 per pervious acre
Public Facilities - County Facilities (PF)	5 per pervious acre
Parks and Recreation (PR)	10 per acre
Open Space Preserves (OS)	None
Placer Parkway (Parkway)	None
Major Roads (Roadway)	3-5 per 30 linear feet of road[2]

1. Pervious acreage is calculated with the following equation: (1-%Imperviousness)*Total Area
2. The number of trees per 30 linear feet of road is dependent upon the available landscape area for each type of road section.

5.2.2 Disconnected Impervious Areas

Disconnected impervious areas are rooftops or other hard surfaces such as streets or sidewalks that drain directly to pervious areas such as landscape. The rooftop disconnection is achieved through disconnected roof drains that route the rooftop flows into pervious area within the proposed lots. The design parameter of twice the area of rooftop to pervious area was used. Due to this design constraint, each size of lot was analyzed for probable pervious area. Once this pervious area was determined, the amount of rooftop draining to the pervious area was calculated per each lot. The impervious area disconnection is comprised of the separated sidewalks found throughout the proposed development and the impervious area of Placer Parkway as it sheet flows to roadside pervious area. Similar to the disconnected rooftops, a two-to-one ratio of impervious to pervious ratio was adhered to for the impervious area disconnection.

Disconnected impervious areas have the following benefits:

- decrease runoff volume,
- reduce peak flow rates, and
- encourage groundwater recharge.

The following table shows the disconnected impervious area used per acre of land use type.

Table 8: Disconnected Imperviousness Area Rates

Land Use Designation	Disconnected Impervious Area per Acre
Low Density Residential (LDR)	0.30 ac/ac
Low Density Residential - Age Restricted (LDR-A)	0.28 ac/ac
Medium Density Residential (MDR)	0.30 ac/ac
High Density Residential (HDR)	0.38 ac/ac
General Commercial (GC)	0.40 ac/ac
Commercial Mixed Use (CMU)	0.40 ac/ac
Campus Park (CP)	0.29 ac/ac
University Campus (UZ)	0.24 ac/ac
Public Facilities - Schools (PF)	0.25 ac/ac
Public Facilities - County Facilities (PF)	0.25 ac/ac
Parks and Recreation (PR)	0.05 ac/ac
Open Space Preserves (OS)	None
Placer Parkway (Parkway)	0.64 ac/ac
Major Roads (Roadway)	0.18 ac/ac

5.2.3 Vegetated Swales

As a final measure to improve storm water quality, vegetated swales are proposed at each drainage outfall. Swales are known to:

- reduce peak flows,
- decrease total runoff volume, and
- trap, filter, and infiltrate particulates and associated pollutants.

Swales for the Plan Area were designed with the following parameters:

- sufficient length to provide a 10-minute contact time with a minimum length of 100-feet,
- depth of 2/3 the grass height or 4-inches—whichever is less,
- maximum bottom width of 10-feet or have dividing berms,
- longitudinal slope between 0.5% and 2.5%,
- Manning's 'n' value of 0.25, and
- maximum velocity of 1 fps.

The flows used to design the swales were obtained from Item 6 on Form 3-6 of the SWQP Template as described previously. All areas on-site and off-site that drain to a swale are included in determining the flow with the exception of the area for the landfill. This off-site landfill area is reduced in contributing area for swale design due to the smaller design events not leaving the landfill site.

Swales with bottom widths 10-feet or less are proposed to be trapezoidal as shown in Figure 5. Those determined to have a bottom width greater than 10-feet are proposed to have dividing berms. A typical swale with dividing berms is shown in Figure 6. Calculations and results for the swales are in Appendix F. Proposed locations of the swales can be seen on Plate 6: Conceptual Backbone Storm Water Infrastructure.

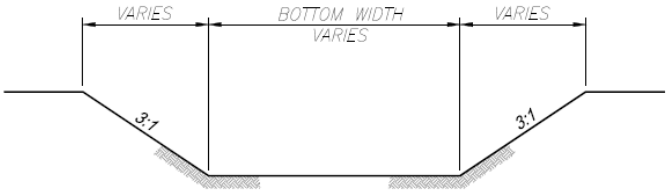

Figure 5: Typical Swale Layout

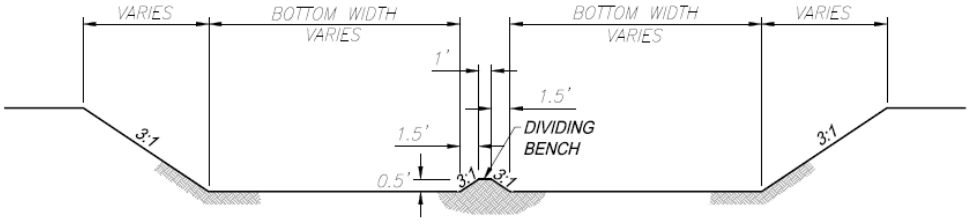

Figure 6: Typical Swale Layout with Dividing Berm

5.3 LID % Imperviousness Reductions

The table below shows the resultant percent imperviousness after implementing the above listed LID measures. Two scenarios are shown: one with only trees and disconnected impervious areas implemented and the other with trees, disconnected imperious areas, and swales. Soil amendments were not included in this analysis but will be available, if needed, during the design phase. The modified percent imperviousness without swales was calculated to aid in the design of the swales as previously described. The modified percent imperviousness with the swales is the ratio that is used to develop the hydrology for the mitigated 2-year 24-hour event HEC-RAS model. The resultant percent impervious values were calculated using the West Placer Storm Water Quality Design Manual's SWQP Template. Specifically, Form 3-5; Item 4—Composite DMA Runoff Coefficient shows the reduced percent imperviousness by land use, and can be found in Appendix F.

Table 9: Percent Imperviousness by Land Use Type

Land Use Designation	% Imperviousness	% Imperviousness[1] w/LID w/o Swale	% Imperviousness[2] w/LID and w/ Swale
On-Site Land Use:			
Low Density Residential (LDR)	40%	16%	0%
Low Density Residential - Age Restricted (LDR-A)	40%	17%	0%
Medium Density Residential (MDR)	50%	29%	0%
High Density Residential (HDR)	65%	47%	0%
General Commercial (GC)	80%	69%	0%
Commercial Mixed Use (CMU)	80%	69%	0%
Campus Park (CP)	70%	59%	0%
University Campus (UZ)	50%	35%	0%
Public Facilities - Schools (PF)	50%	35%	0%
Public Facilities - County Facilities (PF)	50%	35%	0%
Parks and Recreation (PR)	5%	0%	0%
Open Space Preserves (OS)	5%	5%	0%
Placer Parkway (Parkway)	85%	65%	0%
Major Roads (Roadway)	85%	77%	0%
Existing Conditions and Off-Site Land Use:			
Existing Roadway	85%	85%	85%
Industrial	80%	80%	80%
Off-Site Parkway	85%	85%	85%
Park	5%	5%	5%
Residential	50%	50%	50%
Open Space (Pervious)	5%	5%	5%

1. Modified percent imperviousness based on the addition of LID measures without a swale outfall.
2. Modified percent imperviousness based on all LID measures including the swale outfall.

5.4 Hydromodification

The goal of hydromodification per the West Placer Storm Water Quality Design Manual, is to mitigate the post-development peak flow rates to at or below that of the existing conditions peak flow rates. To determine the hydromodification compliance at Compliance Points 1, 2, 4, 5, and 6 a hydrologic HEC-1 model was developed using the modified percent imperviousness, shown in Table 9. Contributing sheds of these compliance points use the resulting modified percent imperviousness based on all three LID measures being applied: trees, disconnected impervious areas, and swales. Compliance Point 3 was modeled in XPStorm and used the resulting percent imperviousness from using only trees and disconnected impervious areas: no swales at the outfalls. Based on the results presented in Table 10 below, the proposed LID measures previously described are sufficient to mitigate the hydromodification impacts of the project. The resultant hydrographs for each of the compliance points can be found in Appendix I.

Table 10: Hydromodification Compliance

Compliance Point No.	Creek Name	Existing 2-Year 24-Hour (cfs)	Developed 2-Year 24-Hour (cfs)
CP#1	University Creek	275.9	248.3
CP#2	North Branch Placer	83.3	72.4
CP#3	Orchard Creek	16.4	13.7
CP#4	Amoruso Ranch	305.2	281.4
CP#5	North Branch Placer at Pleasant Grove	610.4	599.8
CP#6	University Creek at Pleasant Grove	1299.0	1276.8

6. Volumetric Impacts/Retention 100-Year 8-Day Event

The Plan Area is a part of the Pleasant Grove Creek and Orchard Grove Creek watersheds which are a part of the larger Natomas Cross Canal watershed (Exhibit 7). It has been previously identified by the Auburn Ravine, Coon, and Pleasant Grove Creeks Flood Mitigation study (CH2MHILL 1993), that upstream development increases the potential flooding in the lower portion of Natomas Cross Canal watershed. In order to mitigate the increase in runoff volume, the use of regional retention facilities are proposed.

To determine the share of funding and retention needed for Placer Ranch within the regional facilities, the equations in the Pleasant Grove/Curry Creek Watershed Mitigation Fee report updated by Civil Engineering Solutions, Inc. in 2017 for the City of Roseville were utilized. The infiltration rates used in the equations are from Table 5-3 in the Placer County Flood Control and Water Conservation District Stormwater Management Manual and are shown in Table 11. Tables 12 through 14 present the resultant volumetric impact rates, retention volume, and the retention volume by watershed, respectively. Appendix H contains the supporting documentation for the results presented in the tables below.

Table 11: Infiltration Rates

	USGS Soil Type		
	B/D	C	D
Pre-Project Infiltration Rate	0.07	0.09	0.07
Post-Project Infiltration Rate	0.12	0.16	0.12

Table 12: 100-Year 8-Day Volumetric Impact Rates by USGS Soil Type

Land Use Designation	% Impervious	Volumetric Impact Rates		
		Type B/D Soil (ac-ft/acre)	Type C Soil (ac-ft/acre)	Type D Soil (ac-ft/acre)
Low Density Residential (LDR & LDR-A)	40%	0.090323	0.117062	0.090323
Medium Density Residential (MDR)	50%	0.145981	0.178801	0.145981
High Density Residential (HDR)	65%	0.229469	0.271410	0.229469
General Commercial (GC)	80%	0.312956	0.364019	0.312956
Commercial Mixed Use (CMU)	80%	0.312956	0.364019	0.312956
Campus Park (CP)	70%	0.257298	0.302280	0.257298
University Campus (UZ)	50%	0.145981	0.178801	0.145981
Public Facilities - Schools (PF)	50%	0.145981	0.178801	0.145981
Public Facilities - County Facilities (PF)	50%	0.145981	0.178801	0.145981
Parks and Recreation (PR)	5%	-0.104481	-0.099025	-0.104481
Open Space Preserves (OS)	2%	0.000000	0.000000	0.000000
Placer Parkway (Parkway)	85%	0.340785	0.394888	0.340785
Major Roads (Roadway)	85%	0.340785	0.394888	0.340785

Table 13: 100-Year 8-Day Retention Volume by USGS Soil Type

Land Use Designation	Total Area (ac)	Volumetric Impact			
		Type B/D Soil (ac-ft)	Type C Soil (ac-ft)	Type D Soil (ac-ft)	Total Volume (ac-ft)
Low Density Residential (LDR & LDR-A)	538.84	1.15	5.29	43.44	49.88
Medium Density Residential (MDR)	130.74	0.07	7.22	13.12	20.41
High Density Residential (HDR)	93.13	0.00	15.65	8.14	23.79
General Commercial (GC)	26.24	0.00	0.86	7.47	8.33
Commercial Mixed Use (CMU)	48.77	0.00	6.11	10.01	16.12
Campus Park (CP)	395.52	0.00	37.59	69.77	107.36
University Campus (UZ)	301.21	0.67	0.00	43.30	43.97
Public Facilities – Schools, County Facilities (PF)	37.42	0.00	2.99	3.02	6.01
Parks and Recreation (PR)	99.96	-0.01	-2.72	-7.56	-10.29
Open Space Preserves (OS)	255.64	0.00	0.00	0.00	0.00
Placer Parkway (Parkway)	173.53	0.00	27.89	35.07	62.96
Major Roads (Roadway)	134.18	0.74	11.07	35.43	47.24
				Total Required Volume:	**375.78**

Table 14: 100-Year 8-Day Retention Volume by Watershed

Land Use Designation	Total Area (ac)	Watershed			Total Volume (ac-ft)
		University Creek (ac-ft)	Pleasant Grove Creek (ac-ft)	Orchard Creek (ac-ft)	
Low Density Residential (LDR & LDR-A)	538.84	48.97	0.91	0.00	49.88
Medium Density Residential (MDR)	130.74	9.23	11.19	0.00	20.41
High Density Residential (HDR)	93.13	15.57	8.22	0.00	23.79
General Commercial (GC)	26.24	8.33	0.00	0.00	8.33
Commercial Mixed Use (CMU)	48.77	13.52	2.60	0.00	16.12
Campus Park (CP)	395.52	54.81	36.27	16.27	107.36
University Campus (UZ)	301.21	43.97	0.00	0.00	43.97
Public Facilities – Schools, County Facilities (PF)	37.42	5.32	0.70	0.00	6.01
Parks and Recreation (PR)	99.96	-8.49	-1.80	0.00	-10.29
Open Space Preserves (OS)	255.64	0.00	0.00	0.00	0.00
Placer Parkway (Parkway)	173.53	50.74	12.21	0.01	62.96
Major Roads (Roadway)	134.18	34.81	11.35	1.08	47.24
Totals	**2235.18**	**276.77**	**81.64**	**17.36**	**375.78**

At this time, the specific location for retention has not been determined, however, regional retention facilities within the Natomas Cross Canal watershed are planned to be utilized. Should the Plan Area develop prior to regional facilities becoming available for use, interim retention facilities located on-site may be needed. The facilities proposed are located in areas to support a phased buildout of the project and are sized based upon the contributing sheds to that location. However, further study and detailed hydraulic analysis is necessary to verify the potential interim facilities. The location and size of these potential interim retention facilities are depicted on Exhibit 8 in Appendix A.

7. Conclusions

Based on the results of this SDMP, the Placer Ranch Plan Area can develop as proposed. This SDMP has analyzed the existing conditions and determined the required drainage facilities that are necessary to maintain downstream drainage, water quality, and hydromodification impacts equal to or below existing conditions.

Through the implementation of LID measures, the proposed Plan Area can fully mitigate for storm water quality and hydromodification. The LID measures proposed are tree planting, impervious area disconnection, and swales at each outfall. These measures reduce storm water runoff volumes and the amount of pollutants entering receiving waters for the 85th percentile, 24-hour event. By retaining storm water runoff on-site through the use of LID, it was found that hydromodification provisions in addition to the abovementioned measures at the storm drainage outfalls were not needed for the 2-year 24-hour event.

A total of 375.8 acre-feet of retention is estimated to be mitigated to account for potential downstream impacts of the 100-year 8-day design event. The required volume must be accounted for in the design of future retention facilities within the Natomas Cross Canal watershed.

In addition to storm water quality and retention, the traditional requirement for no adverse downstream impacts due to increasing peak storm drainage flows from a proposed development must be met. Peak flows are proposed to be attenuated by using in-stream storage in University Creek and detention basins for North Branch Placer tributary and Orchard Creek. The existing project analysis is compared to the proposed project analysis at six separate compliance points (shown on Plate 7). At these locations, the peak flow rate, peak timing, and water surface elevation under existing site conditions are compared to the peak flow rate, timing, and water surface elevation under proposed site conditions. The Sunset Industrial Area Plan Goal 3.E.7 of mitigating post-development peak flows to 90% of existing peak flows has been met through the abovementioned infrastructure and is achieved for the compliance points at the project boundary (CP#1, CP#2, and CP#3). Compliance points 4, 5, and 6 are further downstream from the project boundary and include additional contributing area that cannot nor will not be attenuated by the proposed project.

The drawdown times for the in-stream basins have limited influence on the peak flow time found downstream of the confluence of University Creek. The mitigated and unmitigated hydrographs share a similar peak timing at the project boundary. The peak flows from the project site do reach the project boundary quicker than in the existing conditions. This is, of course, due to the development of the watershed. Previously, the peak flow would reach the project boundary slightly less than 4 hours after the peak rainfall. After development, the peak flow is anticipated to reach the project boundary only 1 hour after the peak rainfall. This reduction in the delay between the existing and proposed hydrographs at the project boundary was compared against the timing present in the other reaches of the creek system. It is determined that the reduction of timing further offsets the hydrographs found in the main branch of Pleasant Grove Creek. The main branch of Pleasant Grove Creek reaches the confluence with University Creek 6 hours after peak rainfall. This matches the existing conditions peak found in University Creek of 6 hours. Under proposed conditions the peak flow in university Creek at the confluence is reduced to 4 hours after peak rainfall. The development of Placer Ranch speeds up the peak hydrograph timing which causes a further offset in hydrographs between the current conditions of Pleasant Grove Creek and the developed conditions of University Creek with the Placer Ranch Development.

Tables 15, 16, and 17 summarize the results for each of the compliance points. Comparisons of the hydrographs for each can be viewed in Appendix I. As can be observed in the tables below, the post-development peak flow rates and water surface elevations are less than existing conditions.

Table 15: Existing and Proposed Conditions – Peak Flows

Location	Existing Conditions Peak Flow (cfs)				Proposed Conditions Peak Flow (cfs)			
	2-Year 24-Hour	10-Year 24-Hour	100-Year 24-Hour	200-Year 24-Hour	2-Year 24-Hour	10-Year 24-Hour	100-Year 24-Hour	200-Year 24-Hour
CP#1	275.9	501.7	895.9	1003.0	248.3	435.2	612.9	657.9
CP#2	83.3	185.9	443.5	n/a	72.4	159.9	374.0	n/a
CP#3	16.4	37.0	91.3	109.6	13.7	30.6	72.0	86.0
CP#4	305.2	563.6	1027.1	n/a	281.4	554.9	968.7	n/a
CP#5	610.4	1121.6	2317.5	n/a	599.8	1090.4	2226.4	n/a
CP#6	1299.0	2698.7	5431.4	n/a	1276.8	2659.4	5251.4	n/a

Table 16: Existing and Proposed Conditions – Peak Timing

Location	Existing Conditions Peak Timing (hh:mm)				Proposed Conditions Peak Timing (hh:mm)			
	2-Year 24-Hour	10-Year 24-Hour	100-Year 24-Hour	200-Year 24-Hour	2-Year 24-Hour	10-Year 24-Hour	100-Year 24-Hour	200-Year 24-Hour
CP#1	04:10	03:30	03:45	03:45	01:25	01:15	01:10	01:10
CP#2	05:25	05:00	03:40	n/a	06:05	04:55	03:40	n/a
CP#3	12:00	12:00	12:00	12:00	12:00	12:00	12:00	12:04
CP#4	07:15	06:05	05:30	n/a	05:30	04:10	03:25	n/a
CP#5	04:10	04:30	03:50	n/a	04:05	04:25	03:50	n/a
CP#6	09:00	07:05	05:50	n/a	08:40	06:45	05:50	n/a

Table 17: Existing and Proposed Conditions – Water Surface Elevations

Location	Existing Conditions Water Surface Elevation (ft)				Proposed Conditions Water Surface Elevations (ft)			
	2-Year 24-Hour	10-Year 24-Hour	100-Year 24-Hour	200-Year 24-Hour	2-Year 24-Hour	10-Year 24-Hour	100-Year 24-Hour	200-Year 24-Hour
CP#1	86.81	87.41	88.15	88.16	86.70	87.31	87.69	87.70
CP#2	99.47	100.24	101.30	n/a	99.33	100.04	101.05	n/a
CP#3[1]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CP#4	75.31	75.82	76.55	n/a	75.26	75.79	76.45	n/a
CP#5	96.26	97.74	99.47	n/a	96.22	97.68	99.37	n/a
CP#6	65.26	66.59	68.55	n/a	65.23	66.56	68.45	n/a

1. No creek corridor was modeled at this location. Results are a combination of hydrographs to Orchard Creek.