PRELIMINARY DRAINAGE STUDY




NEWLAND SIERRA
PDS 2014 MPA-14-018
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Prepared For: Newland Sierra

Prepared By: Kenneth T. Kozlik

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FUSCOE
ENGINEERING
full circle thinking

PRELIMINARY DRAINAGE STUDY FOR

NEWLAND SIERRA

FEBRUARY 2017

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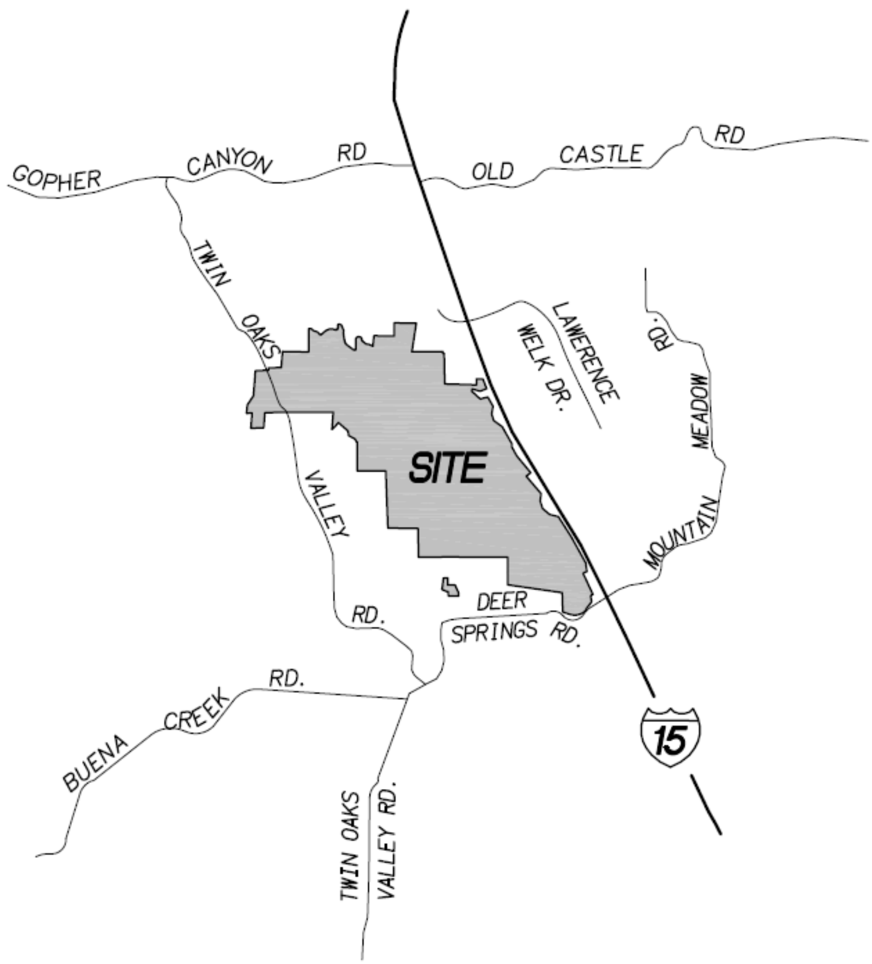
1. PROJECT DESCRIPTION

The proposed project is for The Newland Sierra in the county of San Diego, California. The project site is located near the intersection of Highway I-15 and Highway 78. It is bordered on the north near Gopher Canyon Road, to the west near Twin Oaks Valley Road, to the south near Deer Springs Road and to the east by Highway I-15. Refer to Figure 1: Vicinity Map for project location.

The proposed development will include multiple neighborhoods, access roads, circulation roads, parking areas, and utilities for a master planned community, and a significant amount of natural open space.

This study addresses the onsite project area only. Offsite improvements will be analyzed at a later date. For additional information regarding water quality and hydromodification refer to the project's Storm Water Quality Management Plan.

FIGURE 1. VICINITY MAP



1.1 SIGNIFICANCE THRESHOLDS

A significant impact to Hydrology/Water Quality would occur if the Newland Sierra project would result in:

1. Violations of any water quality standards or waste discharge requirements or conflict(s) with the goals and requirements of applicable federal, state and local regulations including the Clean Water Act, Porter-Cologne Water Quality Act, County of San Diego Revised Grading Ordinance, County of San Diego Watershed Protection, Stormwater Management and Discharge Control Ordinance;

2. Substantial alteration of the existing drainage pattern of the site or vicinity in a manner that would result in substantial erosion or siltation onsite or offsite or would substantially increase the rate or manner of surface runoff resulting in flooding onsite or offsite;

3. Generation of runoff water that would exceed the capacity of the existing or planned stormwater drainage systems or result in substantial additional sources of polluted runoff;

4. An impact to a floodway or mapped 100-year floodplain;

5. The degradation of the water quality of any water course or water body, as listed on the Clean Water Act Section 303(d) list and the project will contribute additional pollutants for which the receiving water body is already impaired;

6. An exceedance of applicable Federal or State Drinking Water Standards, for Maximum Contaminant Levels in waters designated in the Basin Plan with an "MUN" beneficial use.

None of the above thresholds will be met during or following development of the Newland Sierra project.

2. EXISTING DRAINAGE BASINS

The project site consists of natural hills and valleys totaling 1,985 acres. From a drainage perspective, the site straddles the divide between three major watersheds. These are the South Fork Moosa Canyon, San Marcos Creek and South Fork Gopher Canyon watersheds. These three major watersheds total 3152 acres of land, including areas outside the project boundary. This drainage study will address the area of the total watershed. Refer to Figure 2 for locations and areas of the existing major watersheds. Existing storm drain systems and design flows for Highway I-15, Deer Springs Road, and Twin Oaks Valley Road were obtained from as-built drawings, from maps at Caltrans and the County. Impacts on existing watercourses and existing structures are discussed in depth in Section 3.2 of this report.

2.1 SOUTH FORK MOOSA CANYON,

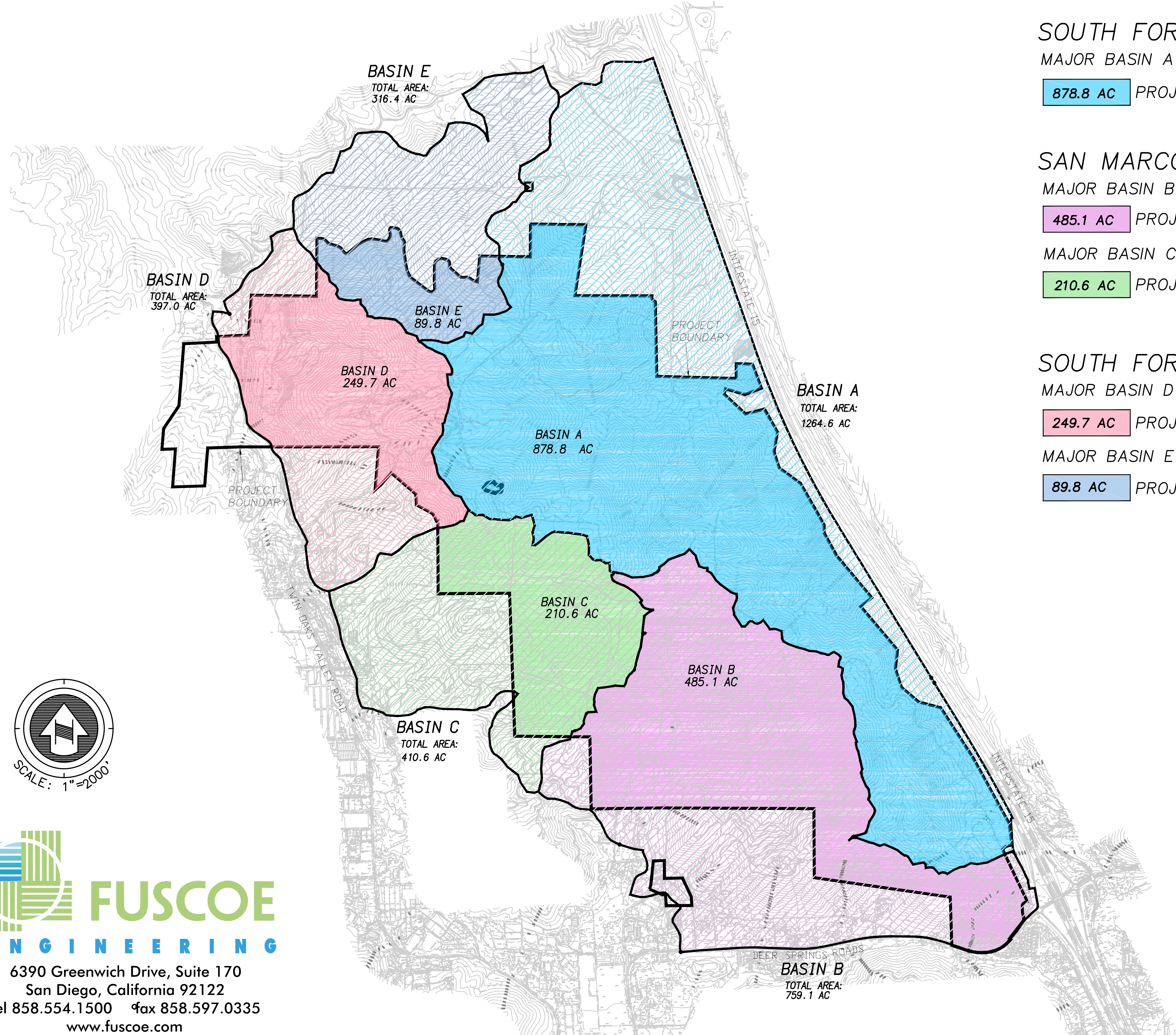
The South Fork Moosa Canyon watershed is designated Basin A, and drains to the East toward Highway I-15. This watershed consists of 879 acres within the project boundary and a total of 1,265 acres for the entire South Fork Moosa Canyon. Under existing conditions, flow is conveyed to the east through natural valleys and channels to Highway I-15. Project subbasins discharge under Highway I-15 through multiple culverts and storm drain systems. Under existing conditions, Basin A conveys a calculated maximum runoff rate (Q) of 1,781 cfs toward the east.

2.2 SAN MARCOS CREEK

The portion of the analysis area draining to San Marcos Creek is divided into two project basins, Basin B and Basin C. Runoff from Basins B and C flows south to Deer Springs Road, where it is conveyed under the roadway through multiple culverts and channels. This watershed consists of 696 acres within the project boundary and total of 1170 acres for the San Marcos Creek watershed. The maximum runoff rate (Q) for existing conditions is 1529 cfs draining to the southwest into San Marcos Creek.

2.3 SOUTH FORK GOPHER CANYON

The portion of the analysis area draining to South Fork Gopher Canyon is also divided into two basins, Basin D and Basin E. Runoff from Basins D and E flows northwest toward Twin Oaks Valley Road. This watershed consists of 340 acres within the project boundary and a total of 713 acres within the area of analysis. The maximum runoff rate (Q) for existing conditions for this area is 1191 cfs.



SOUTH FORK MOOSA CANYON

MAJOR BASIN A

878.8 AC	PROJECT AREA	1264.6 AC	HYDRAULIC ANALYSIS AREA

SAN MARCOS CREEK

MAJOR BASIN B

485.1 AC	PROJECT AREA	759.1 AC	HYDRAULIC ANALYSIS AREA

MAJOR BASIN C

210.6 AC	PROJECT AREA	410.6 AC	HYDRAULIC ANALYSIS AREA

SOUTH FORK GOPHER CANYON

MAJOR BASIN D

249.7 AC	PROJECT AREA	397.0 AC	HYDRAULIC ANALYSIS AREA

MAJOR BASIN E

89.8 AC	PROJECT AREA	316.4 AC	HYDRAULIC ANALYSIS AREA

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FIGURE 2
NEWLAND SIERRA
EXISTING MAJOR WATERSHEDS

M:\PROJECTS\2660 NEWLAND COMMUNITIES\002-02 NEWLAND SIERRA\ENG\STORMWATER\DRAINAGE STUDY\MAIN REPORT\FIG 2 – EXISTING MAJOR BASINS Plotted by: kkozlik

3. PROPOSED DRAINAGE BASINS

The drainage system for The Newland Sierra development has been designed for a storm drain system that will safely convey the 100-year storm event. It will include storm drain pipe, swales, curb and gutter, and detention basins to control runoff. Calculations for the design were made using methodology presented in the County of San Diego Hydrology Manual.

With the development along the divide of the existing watersheds, the drainage area for each designated basin remains within 0.2 acre in proposed conditions. Proposed grading and storm drain systems ensure the preservation of the runoff acreage to the original basins where development extends over the ridgeline and diversions of areas occur. Changes to basin drainage area were less than two tenths of an acre of diversion in each of the major basins.

For drainage study analysis, the major watersheds are divided into 47 subbasins to quantify flows at particular points of interest. Most of these subbasins remain unchanged within the proposed project site. Where development does occur, swales, storm drain pipe and detention are utilized to maintain or decrease peak runoff rates. Table 3.0 provides a summary of basin areas and peak flows for existing and proposed conditions, including the effects of detention storage as described below.

TABLE 3.0 – Basin Areas and Peak Flows for Existing and Proposed Conditions

MAJOR WATERSHEDS	BASIN	Pre-development		Post-development (After Mitigation)	
		Area (ac)	Q (cfs)	Area (ac)	Q (cfs)
South Fork Moosa Canyon	Basin A	1,264.5	1,781	1,264.7	1,707
San Marcos Creek	Basin B	759.2	1,106	764.6	1,040
	Basin C	410.6	423	410.7	355
South Fork Gopher Canyon	Basin D	397.0	620	396.9	617
	Basin E	316.4	568	316.4	568

Peak flow rates were obtained using Advance Engineering Systems (AES) -2014, Rational Method Hydrologic Analysis. Results for individual subbasins (areas and peak flow rates) are provided in Section 3.1.3 of this report. AES-generated reports for Rational Method Hydrologic Analysis are included in Appendix A.

As expected, developed conditions entail an increase in storm runoff and the requirement of peak flow mitigation. In order to reduce peak flows and protect areas downstream of the Newland Sierra development, a number of detention basins will be implemented. These will reduce peak outlet flows and provide water quality treatment. Details regarding storage routing analysis are presented in Section 3.1.2 of this report.

The overall site plan is displayed on Figure 3.0.1, and Figure 3.0.2 shows the extents of the proposed basins. The proposed development is constructed along or near the ridgeline of the existing drainage basins to conserve the natural flow, and runoff flow rates are as close as possible to existing conditions.

Details of drainage basins, subbasins, flow-lines and hydrologic model nodes are shown in the Hydrology Maps later in this report.

FIGURE 3.0.1 NEWLAND SIERRA SITE PLAN

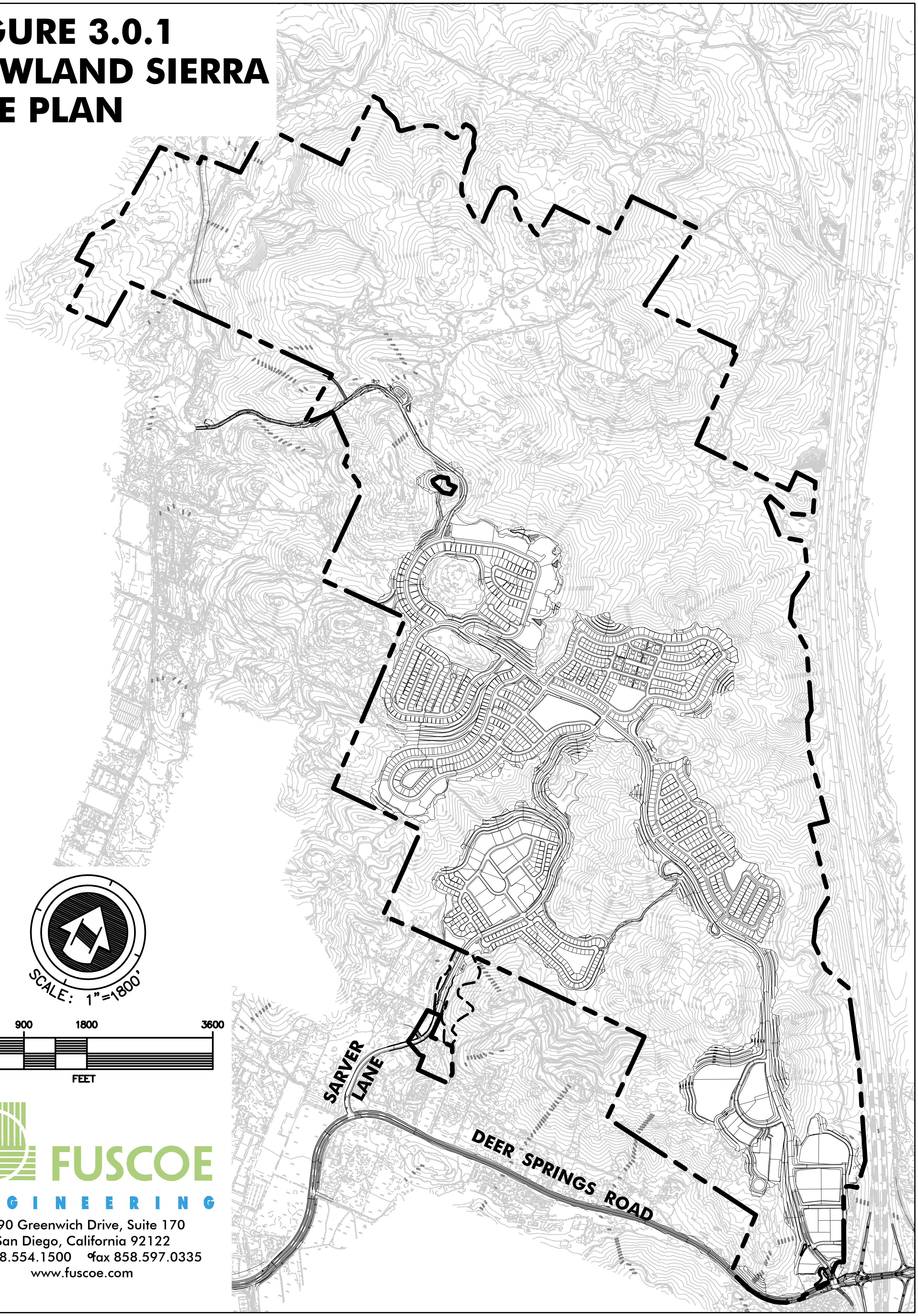

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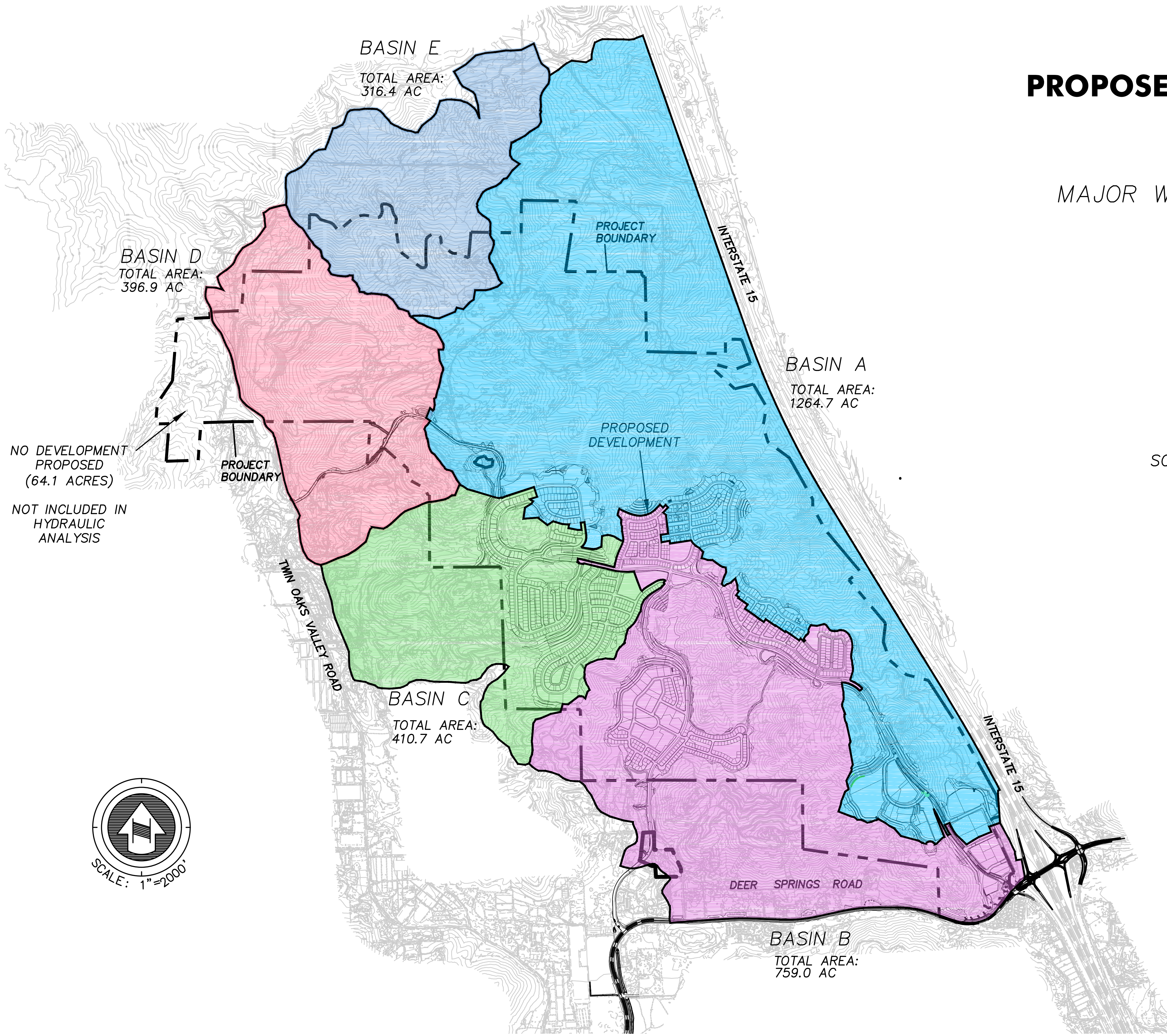
FIGURE 3.0.2
NEWLAND SIERRA
PROPOSED MAJOR WATERSHEDS



MAJOR WATERSHED TRIBUTARY AREA:

SOUTH FORK MOOSA CANYON TRIBUTARY:

1264.7 AC	MAJOR BASIN A

SAN MARCOS CREEK TRIBUTARY:

759.0 AC	MAJOR BASIN B
410.7 AC	MAJOR BASIN C

SOUTH FORK GOPHER CANYON TRIBUTARY:

396.9 AC	MAJOR BASIN D
316.4 AC	MAJOR BASIN E

3.1 RATIONAL METHOD ANALYSIS: PEAK RUNOFF RATES

The Advanced Engineering Systems (AES) 2014, Rational Method Hydrology software was used to model and estimate maximum runoff rates (Q) and time of concentration (Tc). This latest edition of AES 2014 uses the guidelines set forth in the San Diego County's June 2003 Hydrology Manual. The three watersheds (South Fork Moosa Canyon, San Marcos Creek and South Fork Gopher Canyon) were divided into 5 basins and a total of 47 subbasins for this hydrologic analysis. Subbasins were further divided into smaller subareas as required for modeling.

The following parameters were used for the Rational Method Hydrology, AES 2012 modeling:

- 100 Year Rainfall Event (Q_{100})
- 6-hour duration precipitation: 3.5 inches (see Figure 9: County of San Diego Rainfall Isopluvials Map).
- Flow length for each initial sub-areas is not more than 100' long

3.1.1 RUNOFF COEFFICIENT DETERMINATION

Runoff coefficients (C) for the rational method analysis were determined for each subarea based upon the Hydrologic Soil Group (HSG) of the underlying soil as well as the land use or density of the proposed neighborhoods pertaining to the conditions under consideration. Hydrologic Soil Groups for each subbasin were taken from the San Diego County Soils Interpretation Study: Hydrologic Soil Groups – Runoff Potential map (Appendix E2). The amount of land area within each subarea associated with each land use and HSG was determined, and runoff coefficients were computed based upon a weighted average, with the C values indicated in Table 3.1.1.

Table 3.1.1 – Runoff Coefficients by Land Use and HSG

Neighborhood/Land Use		Runoff Coefficient (C) According to HSG		
		B	C	D
Summit & Knolls	(4.3DU/A or less)	0.45	0.48	0.52
Mesa & Hillside	(7.3 DU/A or less)	0.51	0.54	0.57
Valley	(10.9 DU/A or less)	0.54	0.57	0.60
Terraces	(14.5 DU/A or less)	0.58	0.60	0.63
Town Center	(General Commercial)	0.80	0.81	0.82
Paved Roads		0.88	0.89	0.90
Natural Terrain		0.25	0.3	0.35

A discussion of AES modeling procedures is included in Section 5, Methodology and Model Development.

3.1.2 DETENTION STORAGE ROUTING ANALYSIS

At a number of locations throughout the project site, detention storage was utilized in order to mitigate increases in peak flow. In several subbasins along Interstate 15, there is existing detention storage in the form of depressions at the existing culvert entrances within Caltrans right-of-way. In order to avoid impacts to Caltrans right-of-way, these existing detention storage areas are ignored, and proposed detention facilities have been provided onsite to reduce peak flow before it enters Caltrans right-of-way.

Proposed Detention Storage

In Subbasins 13, 16, 19, 20, 21, 22, 23, 23.4, 24, 25, 26, 27, 28, and 29 it was necessary to design detention storage ponds in order to mitigate increases in peak flow due to development. The same procedure was followed for all proposed detention storage routing analyses. First, the subbasin under consideration was modeled (using the AES Rational Method Hydrology Program) assuming proposed conditions, without including any detention storage routing, and the peak flow (Q) entering the detention basin was determined. Using this flow value, as well as the time of concentration, the 6-hour rainfall, the contributing drainage area, and the average runoff coefficient for the drainage area, the Rational Method hydrograph computation program, RatHydro, from Rick Engineering Company, was used to generate an inflow hydrograph to the existing depression. The specific dimensions of the existing detention storage were determined based on the proposed grading of the detention basin. An initial design of an outlet structure, generally consisting of a vertical orifice in a concrete outlet structure, was chosen and refined in an iterative process. With the computed inflow hydrograph, stage-storage relationship, and the proposed outlet structure configuration, the proposed detention basin was modeled using the HEC-HMS 4.0 software program developed by the US Army Corps of Engineers. The computed peak outflow was then input into the Rational Method Hydrology simulation for further analysis or reporting.

In Subbasin 25, three separate detention ponds were designed (Canyon/BMP M1MR1K1, Valley West/BMP V11VR2 and Valley East/V14). In Subbasin 21, three separate detention ponds were also designed (at nodes 2107.5/BMP TCR2, 2118.6/BMP TCR3, and 2127/BMP TC4). At node 2127 which is a commercial area of the Town Center, the detention basin is assumed to be an underground vault, with a 10,000 sf footprint and a depth of 4 feet. In Subbasins 13, 16, 20, 26, 27, 28, and 29 one detention pond was designed per subbasin.

Details of the Proposed Detention Storage Analysis are included in Appendix B, along with figures showing the extents of the proposed detention storage areas.

Proposed Water Quality/Hydromodification Storage

There are many proposed water quality/hydromodification basins spread throughout the site. These basins have areas designed for water quality treatment and volumes designed for hydromod storage. For flood routing purposes, they were assumed to be full during the 100 year storm. In cases where the water quality/hydromodification basins also function as peak detention basins, the "dead" storage below the detention basin outlet orifice was assumed to be full in the detention basin analysis. This is a conservative assumption because it may result in a higher Q downstream. Refer to the Storm Water Quality management Plan for additional information on these basins.

Summary of Storage Routing Results

Key results from the Existing and Proposed Detention Storage Routing Analysis are included in Table 3.1.2. The Depth-Storage relationship and outlet dimensions for each storage area are shown in Table 3.1.3.

Table 3.1.2a – Detention Storage Routing Analysis Summary

Detention Pond ID	Contributing Drainage Area (acre)	Peak Inflow (cfs)	Peak Outflow (cfs)	Volume Stored (ac*ft)	Maximum Ponding Depth (ft)
Proposed Detention Ponds (Proposed Conditions Only)					
13	14.1	37	13.1	1.0	2.1
16	1.1	8.4	1.0	0.1	1.3
19 (BMP TR1T1T2)	73.9	199	50	6.2	8.0
20 (BMP TC2TCR1)	9.90	43	11	1.1	2.4
2107.5 (BMP TCR2)	1.9	16	2.0	0.2	1.9
2118.6 (BMP TCR3)	11.0	61	13	1.5	3.0
2127 (BMP TC4)	5.5	32	1.8	0.9	3.8
22 (BMP D1)	6.3	47	18	0.9	1.9
23 (BMP D3)	4.0	29	5	0.5	2.2
23.4 (BMP D2)	1.4	10	1	0.2	1.9
24 (BMP D4)	3.0	18	5	0.3	1.9
25 Canyon (BMP M1MR1K1)	81.7	151	20	5.9	2.2
25 Valley West (BMP V11VR2)	13.8	46	7.4	1.1	2.0
25 Valley East (BMP V14)	16.6	54	3.7	1.8	5.7
26 Lower Knolls (BMP K8)	38.5	149	7.4	6.1	5.3
27 Summit (BMP S2)	20.2	37	11	1.0	2.5
28 (BMP CM5)	1.7	14	1.2	0.2	2.0
29 (BMP CM2)	0.6	4.7	0.3	0.1	2.1

Table 3.1.3 – Detention Basin Depth-Storage-Outlet Tables

Subbasin 1307/BMP M4 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	21″ Orifice
4	1.873	

Subbasin 1604/BMP TR2 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	6″ Orifice
4	0.439	

Subbasin 19 Detention/BMP TR1T1T2 Adjacent to School (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	1′x3.75′ Orifice
4	2.801	
9	7.017	

Subbasin 20 Detention/BMP TC2TCR1 Town Center Northwest (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	18″ Orifice
4	1.884	

Subbasin 21 Detention/BMP TCR2 Node 2107.5

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	8″ Orifice
4	0.480	

Subbasin 21 Detention/BMP TCR3 Node 2118.6

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	18″ Orifice
4	2.046	

Subbasin 21 Detention/BMP TC4 Node 2127

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	6″ Orifice
4	0.918	
5	1.148	

Subbasin 22/BMP D1 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	2 – 18″ Orifice
3	0.858	
4	1.194	

Subbasin 23/BMP D3 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	12″ Orifice
4	0.859	

Subbasin 23.4/BMP D2 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	6″ Orifice
1	0.083	
4	0.387	

Subbasin 24/BMP D4 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	12″ Orifice
3.5	0.585	

Subbasin 25 Detention/BMP M1MR1K1 Canyon

Depth (ft)	Storage (ac-ft)	Outlet
0	0	6′x6″ Orifice
2	4.387	
5	12.025	
5.9	14.459	

Subbasin 25 Detention/BMP V11VR2 Valley West (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	3.5′x4″ Orifice
4	2.187	

Subbasin 25 Detention/BMP V14 Valley East (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	1.3′x3″ Orifice
3	0.777	
8	2.584	

Subbasin 26 Detention/BMP K8 Lower Knolls (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	12″ Orifice
4	4.391	
9	10.896	

Subbasin 27 Detention/BMP S2 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0	24″ Orifice
4	1.575	
9	4.489	

Subbasin 28 Detention/BMP CM5 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	6″ Orifice
2	0.237	
4	0.521	

Subbasin 29 Detention/BMP CM2 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	Outlet
0	0.00	3″ Orifice
4	0.029	
2	0.074	
3	0.137	
4	0.169	

Subbasin 2552/BMP M8 (Proposed Conditions)

Depth (ft)	Storage (ac-ft)	
0	0	12″ Orifice
4	1.541	

3.1.3 RATIONAL METHOD ANALYSIS SUMMARY

Table 3.1.4(a-e) provides a summary of the areas, the longest flow length, peak runoff rates and time of concentration for both existing and proposed conditions for individual basins. The flows indicated in the proposed conditions portion of the table reflect the effects of detention storage as described above. Refer to Table 3.1.2 for existing and proposed conditions peak flows prior to mitigation (i.e., detention basin peak inflows), and to Figure 3.2 for basin breakdown on existing and proposed conditions.

Table 3.1.4a Basin A: Rational Method Hydrologic Analysis

	Pre-Developed (Existing)				Post-Developed (Proposed) (Includes Detention Where Present)				Flow Change
Sub-basin	Area (acre)	Length (ft)	Q (cfs)	Tc (min)	Area (acre)	Length (ft)	Q_{out} (cfs)	Tc (min)	ΔQ (cfs)
1	71.9	3799	87	16.1	71.9	3799	87	16.1	0
2	13.2	1135	27	10.4	13.2	1135	27	10.4	0
3	199.7	5359	217	21.3	199.7	5359	217	21.3	0
4	11.6	1841	14	14.2	11.6	1841	14	14.2	0
5	68.9	4285	72	18.8	68.9	4285	72	18.8	0
6	2.5	659	5	7.9	2.5	659	5	7.9	0
7	2.1	806	4	9.2	2.1	806	4	9.2	0
8	11.7	1458	16	12.5	11.7	1458	16	12.5	0
9	25.8	2405	30	16.3	25.8	2405	30	16.3	0
10	486.9	8570	783	15.6	474.3	8805	762	14.1	-21
11	21.7	2050	43	9.0	21.6	2000	43	8.9	0
12	14.2	1967	23	11.6	14.2	1967	23	11.6	0
13	130.0	3854	199	15.9	142.6	4770	177	18.1	-22
14	3.9	1040	6	9.6	3.9	1040	6	9.6	0
14.1	4.4	1087	7	10.2	4.4	1087	7	10.2	0
15	43.3	2551	51	14.7	36.2	2836	47	10.6	-4
15.1	6.8	1380	8	13.5	6.8	1380	8	13.5	0
16	29.6	2650	41	12.4	23.8	2935	41	9.1	0
17	14.3	1600	21	11.5	14.3	1600	21	11.6	0
18	6.5	1498	8	13.9	6.5	1498	8	14.5	0
19	81.2	4511	93	19.2	95.0	5370	74	13.1	-19
20	14.3	1882	26	13.5	13.7	2472	18	12.7	-8

Table 3.1.4b Basin B: Rational Method Hydrologic Analysis

	Pre-Developed (Existing)				Post-Developed (Proposed) (Includes Detention Where Present))				Flow Change
Sub-basin	Area (acre)	Length (ft)	Q (cfs)	Tc (min)	Area (acre)	Length (ft)	Q_{out} (cfs)	Tc (min)	ΔQ (cfs)
21	35.8	2150	42	20.0	35.7	3158	41	12.7	-1
22.4	5.3	1032	9	12.5	4.2	1045	8	12.2	-1
22.3	4.9	768	13	10.3	4.6	770	13	9.5	0
22.2	13.4	1507	34	11.0	13.3	1475	25	16.8	-9
22.1	12.1	1678	26	13.6	11.3	1690	24	13.8	-2
22	38.4	1995	75	16.4	42.0	3157	80	16.4	+5
23.4	10.4	2515	16	21.6	10.9	1655	20	14.3	+4
23	24.6	1780	50	13.1	28.1	1785	53	12.9	+3
23.3	7.5	1369	18	11.2	6.9	1585	18	10.8	0
23.2	7.9	1580	18	12.3	7.2	1615	17	12.1	-1
23.1	4.5	1076	10	11.8	4.2	1105	10	11.4	0
24	33.5	1780	79	11.8	34.9	1770	79	11.7	0
24.2	9.0	1216	19	13.5	8.3	1265	18	13.4	-1
24.1	10.7	1252	20	15.4	-	-	-	-	-
25	541.2	7304	677	27.7	553.0	10,962	634	22.6	-43

Note: Total of areas for Basin B listed above is greater than the total area listed in Table 3.0 due to the extension of some sub-basins further downstream to include areas with offsite improvements.

Table 3.1.4c Basin C: Rational Method Hydrologic Analysis

	Pre-Developed (Existing)				Post-Developed (Proposed) (Includes Detention Where Present))				Flow Change
Sub-basin	Area (acre)	Length (ft)	Q (cfs)	Tc (min)	Area (acre)	Length (ft)	Qout (cfs)	Tc (min)	ΔQ (cfs)
26	174.3	5674	193	21.4	177.9	7085	170	18.8	-23
27	236.3	6155	230	22.7	232.8	7240	185	27.4	-45

Table 3.1.4d Basin D: Rational Method Hydrologic Analysis

	Pre-Developed (Existing)				Post-Developed (Proposed) (Includes Detention Where Present))				Flow Change
Sub-basin	Area (acre)	Length (ft)	Q (cfs)	Tc (min)	Area (acre)	Length (ft)	Q_{out} (cfs)	Tc (min)	ΔQ (cfs)
28	107.4	3481	131	17.5	107.7	3,685	127	17.9	-4
29	143.9	4158	226	20.5	143.5	4,158	227	20.5	+1
30	107.8	4289	181	16.9	107.8	4,289	181	16.9	0
31	37.9	2501	82	14.2	37.9	2,501	82	14.2	0

Table 3.1.4e Basin E: Rational Method Hydrologic Analysis

	Pre-Developed (Existing)				Post-Developed (Proposed) (Includes Detention Where Present))				Flow Change
Sub-basin	Area (acre)	Length (ft)	Q (cfs)	Tc (min)	Area (acre)	Length (ft)	Q_{out} (cfs)	Tc (min)	ΔQ (cfs)
32	136.2	4295	232	16.5	136.2	4295	232	16.5	0
33	35.6	1790	84	12.0	35.6	1790	84	12.0	0
34	97.6	3470	156	15.6	97.6	3470	156	15.6	0
35	47.0	2215	96	14.4	47.0	2215	96	14.4	0