

HYDROLOGIC/HYDRAULIC DRAINAGE REPORT

For

**MONTECITO RANCH, RAMONA, SAN DIEGO COUNTY, CA
TENTATIVE MAP 5220 RPL 8**

Prepared for:

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PROJECT DESCRIPTION

The Montecito Ranch project is located south of HWY 78, and north of Cedar and Ash Streets, to the west of the City of Ramona, under the jurisdiction of the County of San Diego. The property site is over 500 acres (for hydromodification compliance 393 acres were studied under pre-developed conditions and 397 acres were analyzed under post-development conditions for 8 Points of Compliance, POCs). In existing conditions, there are multiple first order streams draining to the San Pasqual Valley. Only eight (8) discharge Points of Compliance (POCs) were selected, because the drainage to those points is modified as a consequence of the project. As the overall area draining to those eight (8) POCs increases by 4 acres, the overall area draining to other first order streams not receiving impervious areas reduces by the same amount within the property boundary, and therefore, no other discharges need to be analyzed, as no modification of imperviousness will occur outside those eight (8) POCs.

The purpose of this Drainage Report is to demonstrate that the twenty eight (28) proposed bio-retention facilities and two (2) off-site detention facilities will have enough volume to mitigate the difference of runoff volume between pre-development and post-development conditions for the 8 drainage points (POCs) selected, and therefore, have enough volume to reduce post-development peak flow below pre-development levels if a more detailed routing analyzes is carried out in future phases of this project. As each POC has its particularities (in some drainage area reduces, and in other, increases), a detailed volumetric analysis per POC will be performed.

The reader must be aware that there is no attempt in this report to generate the eight (8) Pre-development hydrographs and peak flows and the eight (8) resulting post-development hydrographs and peak flows, because the post-development conditions require a routing of the hydrographs at each of the facilities (30 routing procedures) plus combination with off-site area hydrographs not being routed (8 off-site hydrographs, one at each POC). If deemed necessary, a detailed hydrograph calculation and routing procedure will be prepared at later stages of this development.

DRAINAGE ASPECTS

Existing Drainage Runoff Volume

The volume of runoff in existing conditions is going to be calculated for each contributing area of each POC (see Appendix 1 for maps of the contributing areas at each POC in pre and post-development conditions).

As the contributing area to each POC is less than 1 sq-mile, an approximate Modified Rational Method procedure can be used to calculate the runoff volume.

Runoff volume may be determined as:

$$V = \frac{1}{12} \cdot C \cdot P_{6,100} \cdot A \tag{1}$$

Where:

V: volume of runoff (cu-ft)

A: Contributing area to the Point of Compliance (POC), sq-ft

$P_{6,100}$: Precipitation amount for the 6-hour duration, 100-year return period storm, determined according to the maps provided at the San Diego County Hydrology Manual (SDCHM), or by using the NOAA precipitation tables at the location of the project. The first alternative (SDCHM) was used here, and the precipitation $P_{6,100}$ was obtained equal to 3.3 inches (see Map in Appendix 2).

C: Runoff coefficient, calculated with the simplified approach of the San Diego County Hydrology Manual (SDCHM), mathematically described by equation 2, or by the more detailed Caltrans tables. In this report the SDCHM procedure will be used.

$$C = 0.2 \cdot f_A + 0.25 \cdot f_B + 0.3 \cdot f_C + 0.35 \cdot f_D + 0.9 \cdot f_i \quad (2)$$

In the previous equation:

f_A , f_B , f_C , and f_D : corresponds to the fraction of the contributing area that is not impervious belonging to the hydrologic soil types A, B, C or D (usually one or two soil types are considered, although the equation can also be used for contributing areas with all soil types). Soil types for each POC have been defined in the Hydromodification study.

f_i : corresponds to the fraction of the contributing area that is impervious (zero if not impervious areas exists in the contributing area).

It is clear that $f_A + f_B + f_C + f_D + f_i = 1$.

Proposed Drainage Runoff Volume

The volume to each POC in post-development conditions is calculated in the same manner, but the impervious fraction and the contributing areas may change as a consequence of the development.

It is expected that the runoff volume in post-development conditions is almost always larger than the runoff volume in pre-development conditions due to the increase in impervious areas. However, there is one exemption in this project: POC-7 has a smaller runoff volume because the contributing area will reduce more than the increase of C due to imperviousness. For detailed calculation of the runoff volume in pre and post-development conditions, see Appendix 3.

Difference between Post and Pre-Development Runoff Volume

If the volume of the detention/retention basins in a system is larger than the difference in runoff between the post-development less the pre-development, it is usually considered that the volumetric system can attenuate post-development peak flows below pre-development peak flows. In optimized systems, detention basins can even be 60 to 75% of such difference, but it all depends on the proper selection of the outlet structure, and how full a system is when the peak of the post-development hydrograph arrives at the detention facility. Nonetheless, systems where the detention volume is more

than 110% of the difference between post and pre-development runoff, it is almost guarantee that the system will perform adequately once properly design, and once detailed routing analysis is carried out.

In this report the difference between the pre and post-development hydrographs will be compared with the volume of voids in the bio-retention cells and off-site detention facilities at each POC.

The volume of the detention ponds for offsite runoff (V_p) is simply:

$$V_p = \sum_{i=1}^n 0.5 \cdot (A_i + A_{i+1})(h_{i+1} - h_i) \quad (3)$$

Where:

V_p : volume of pond (cu-ft)

h_i : Elevation at level "i" measured (ft); h_1 corresponds to the bottom and h_n to the top.

A_i : Area at level "i" (sq-ft)

The volume of the bio-retention facilities V_R is slightly more complex. It includes de volume of voids in the gravel layer (V_G), plus the volume of voids in the amended soil (V_{soil}), plus the surface volume V_s (including all volume below the invert of the riser because the 100-year peak flow more likely will reach the riser elevation) plus the volume between the invert of the riser and the maximum surface water elevation ($V_{max} - V_s$). This later volume can only be calculated with precision after executing a routing procedure; however, assuming that the peak flow released by the facility is approximately the peak flow in pre-development conditions, an approximate level was obtained above the riser (either 0.1 ft, 0.2 ft, 0.25 ft, 0.333 ft, 0.4 ft or 0.5 ft). The volume of voids between the riser and such upper level was also added for precision in the comparison.

The volume of the bio-retention cell is then:

$$V_R = V_G + V_{soil} + V_s + (V_{max} - V_s) \quad (4)$$

The gravel volume multiplied by its porosity (assumed 0.4) results in the volume of voids in the gravel; similarly, the amended soil volume multiplied by its effective porosity (assumed 0.3) results the volume of available voids in the amended soil.

Table 1 is a summary of the detailed calculations displayed in Appendix 3.

It can be established from observation of the previous table that the runoff volume of the facilities already designed for hydromodification compliance is more than 110% the difference of the volume between the runoff in post less the runoff in pre-development conditions, except in POC-2 where it is only 99%. However, the total volume is 143 % of the difference of runoff volume.

TABLE 1. SUMMARY OF THE RESULTS

Area contributing to:	Pre-Dev. area (acres)	C _{PRE}	Vol-Pre (acre-ft)	Post-Dev. area (acres)	C _{POST}	Vol-Post (acre-ft)	ΔVolume (acre-ft)	ΣV _S + ΣV _R (acre-ft)	$\frac{\Delta Vol}{\Sigma V_S + \Sigma V_R}$
POC-1	39.87	0.306	3.36	41.30	0.456	5.18	1.82	2.15	118%
POC-2	12.06	0.300	0.99	15.53	0.446	1.90	0.91	0.90	99%
POC-3	14.21	0.300	1.17	15.80	0.442	1.92	0.75	0.85	114%
POC-4	38.85	0.311	3.32	50.44	0.485	6.73	3.41	4.16	122%
POC-5	204.04	0.327	18.32	172.60	0.442	20.97	2.65	6.25	236%
POC-6	31.48	0.350	3.03	40.20	0.508	5.61	2.58	2.96	115%
POC-7	23.50	0.349	2.26	18.27	0.444	2.23	-0.02	0.22	N/A
POC-8	28.99	0.325	2.59	42.63	0.448	5.25	2.66	3.67	138%
TOTAL	392.99	0.324	35.05	396.77	0.456	49.80	14.75	21.16	143%

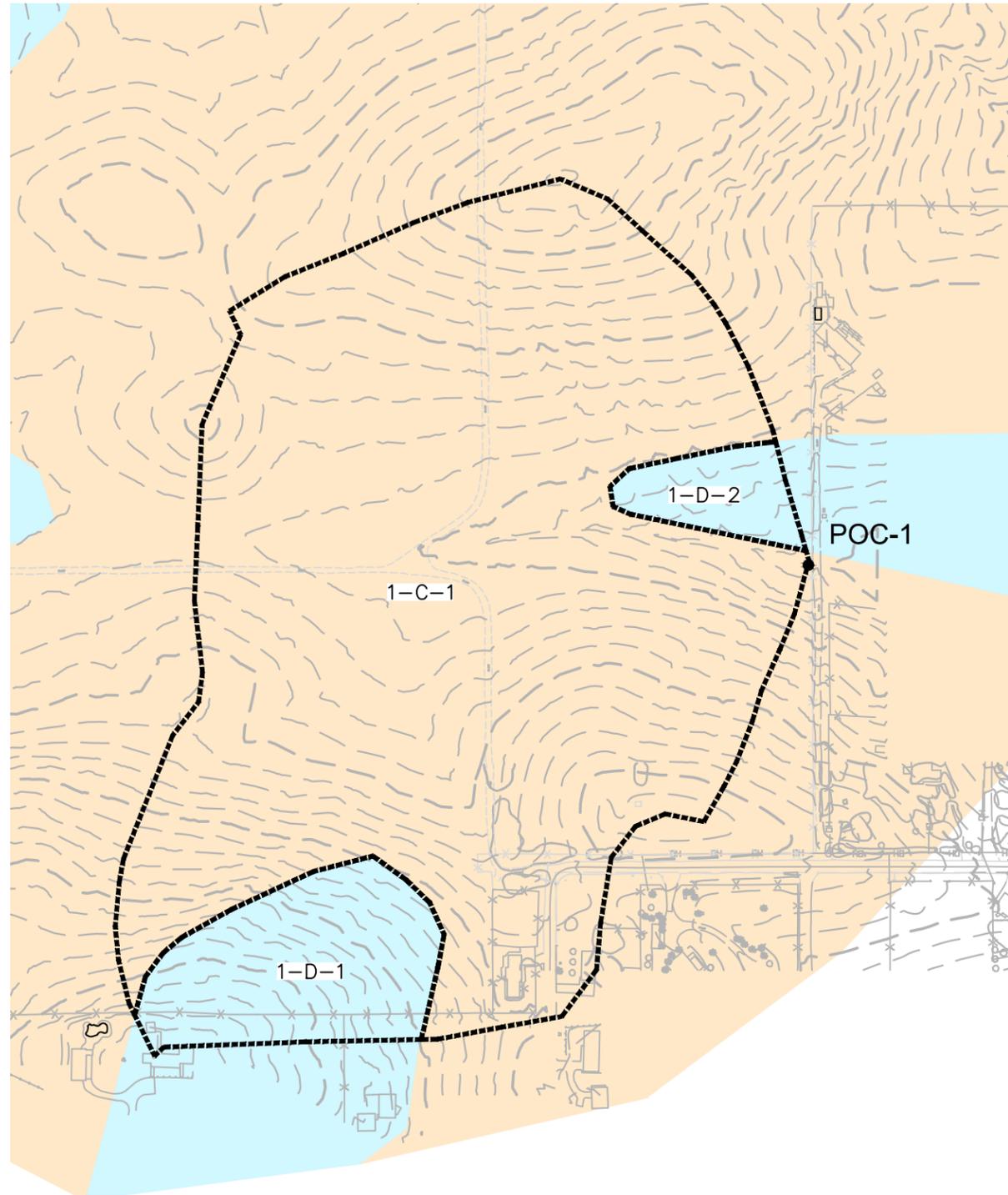
CONCLUSIONS

- It is almost certain that the post-development peak flow under the occurrence of the synthetic 6-hr, 100-year storm is smaller than the peak flow generated by the same storm under pre-development conditions, as all POCs (except POC-2) have detention volume in excess of 110% of the difference between the post-development and the pre-development runoff.
- Only a detailed routing analysis over the 30 facilities can establish the precise reduction of the peak flow at each POC from pre-development to post-development conditions. Such routing will be considered if deemed necessary at later stages of this development (Final or Detailed Engineering).

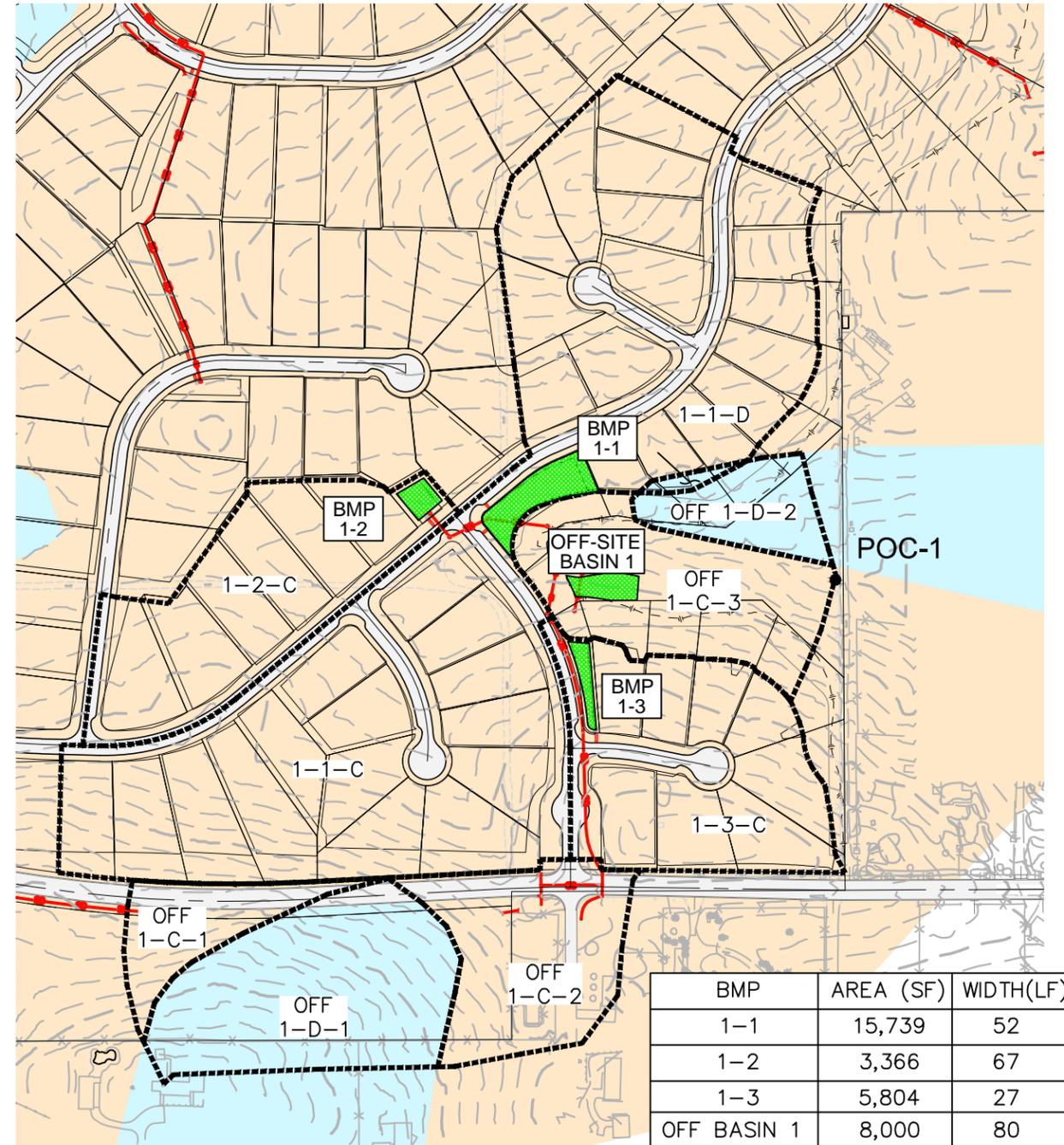
APPENDIX LIST

- Appendix 1: Pre and Post Development Maps
- Appendix 2: P_{6,100} Precipitation Map
- Appendix 3: Pre and Post-Development Runoff Volume
Bioretention and Offside Detention Volume

Appendix 1: Pre and Post-Development Maps

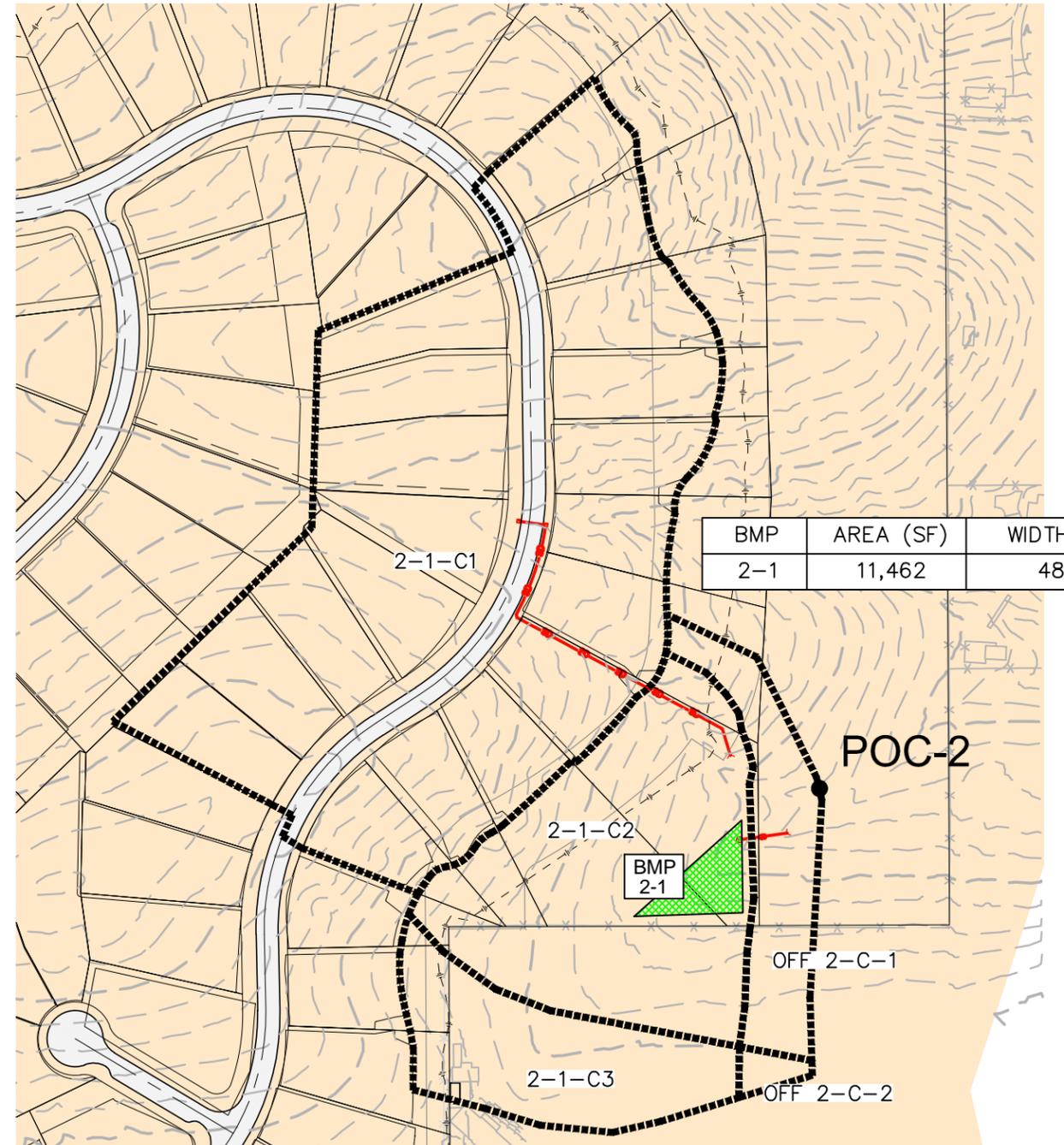
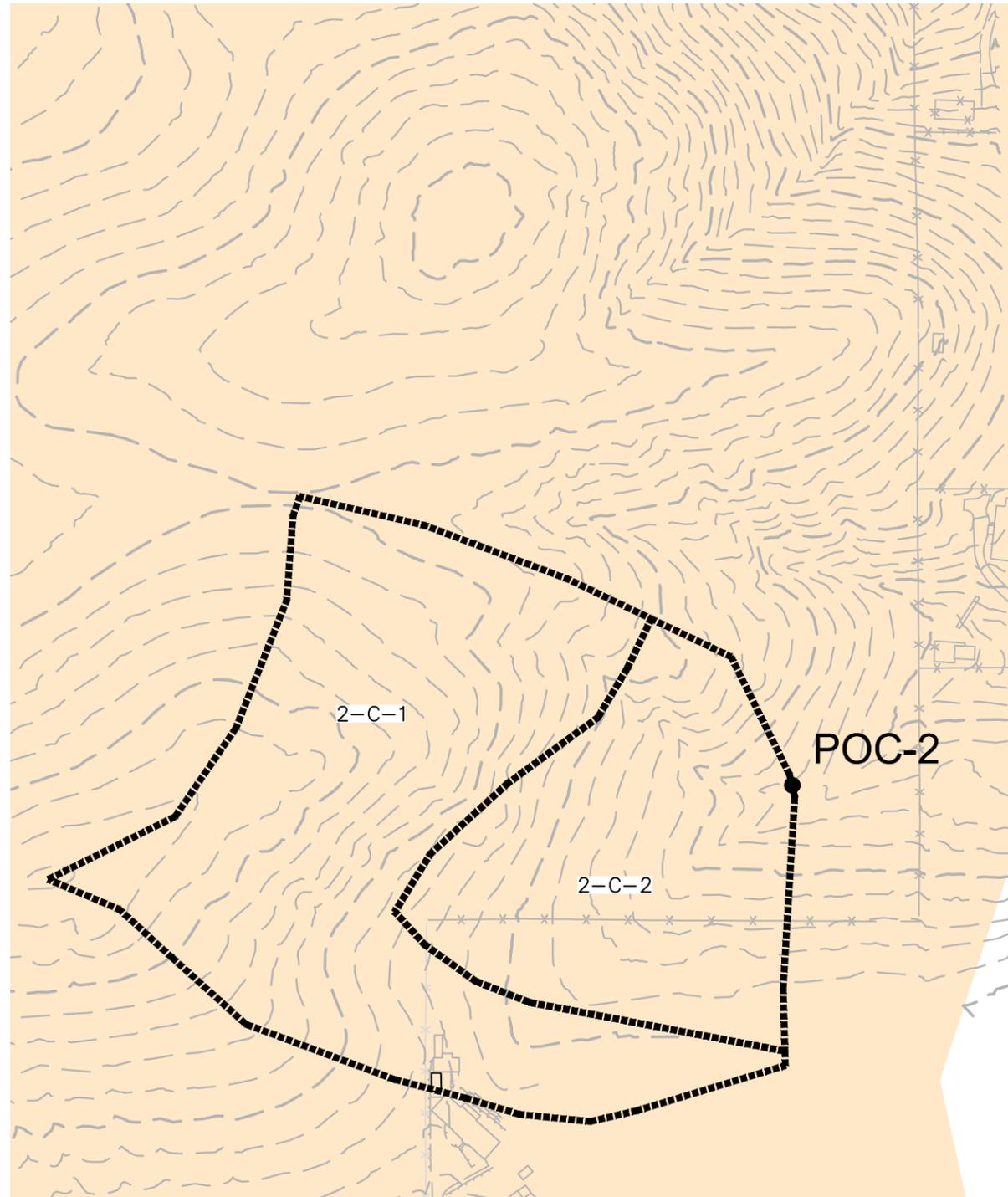


SOIL TYPE PER PRE-DEVELOPMENT AREA			
	1-C-1	1-D-1	1-D-2
AREA	1,511,711 S.F.	171,875 S.F.	53,028 S.F.
SLOPE	10.25%	15.48%	10.43%
FLOW LENGTH	1,219 L.F.	441 L.F.	353 L.F.

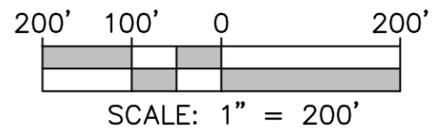


SOIL TYPE PER POST-DEVELOPMENT AREA				
DMA	1-1-C	1-1-D	1-2-C	1-3-C
AREA	861,596 S.F.	4,656 S.F.	188,192 S.F.	200,938 S.F.
SLOPE	2.5%	2.5%	2.5%	2.5%
FLOW LENGTH	1,271 L.F.	40 L.F.	1,110 L.F.	806 L.F.

OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA					
DMA	OFF 1-C-1	OFF 1-C-2	OFF 1-C-3	OFF 1-D-1	OFF 1-D-2
AREA	52,778 S.F.	124,772 S.F.	146,030 S.F.	171,875 S.F.	48,372 S.F.
SLOPE	18.61%	8.57%	14.12%	15.48%	10.42%
FLOW LENGTH	275 L.F.	430 L.F.	628 L.F.	441 L.F.	322 L.F.

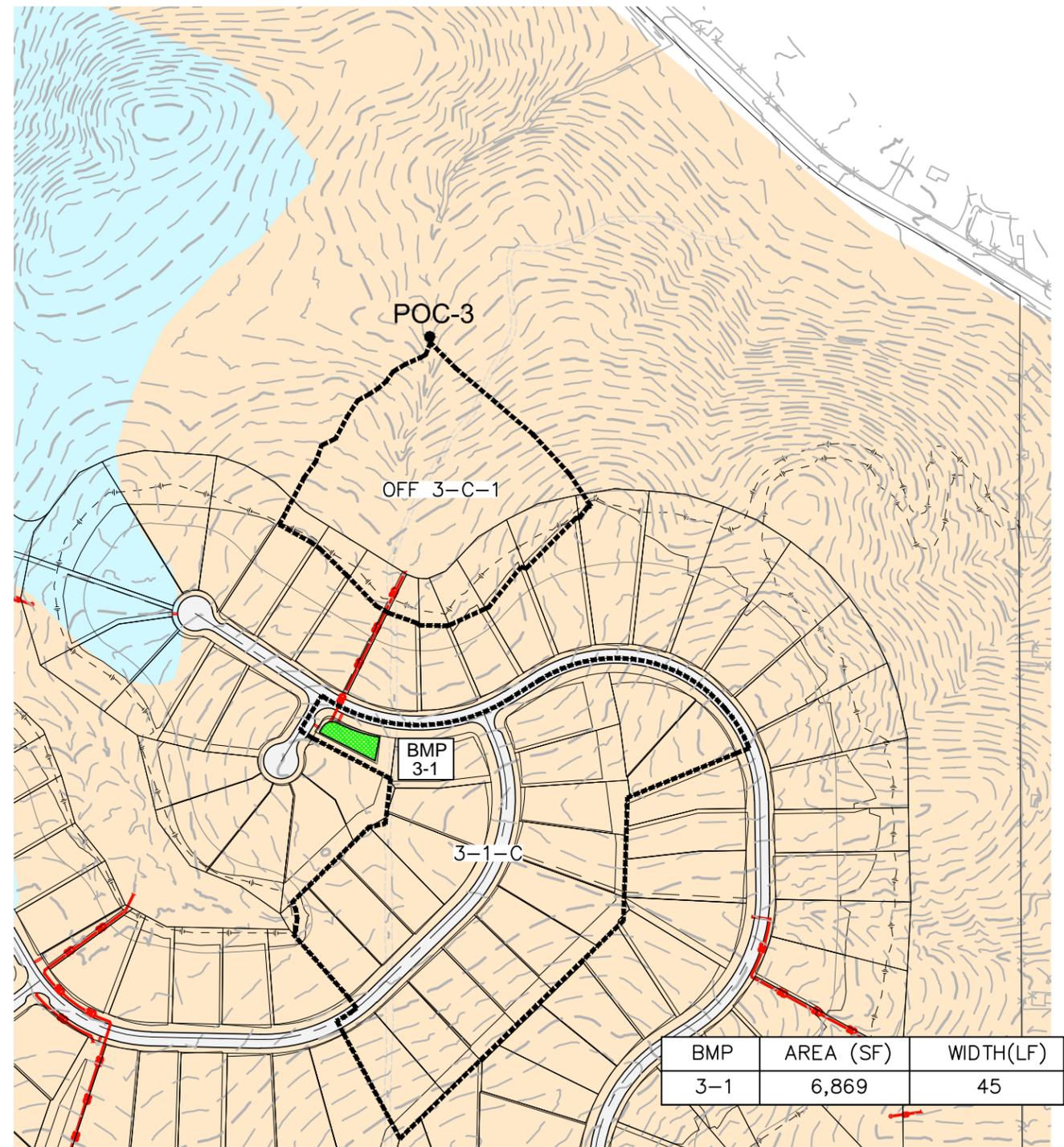
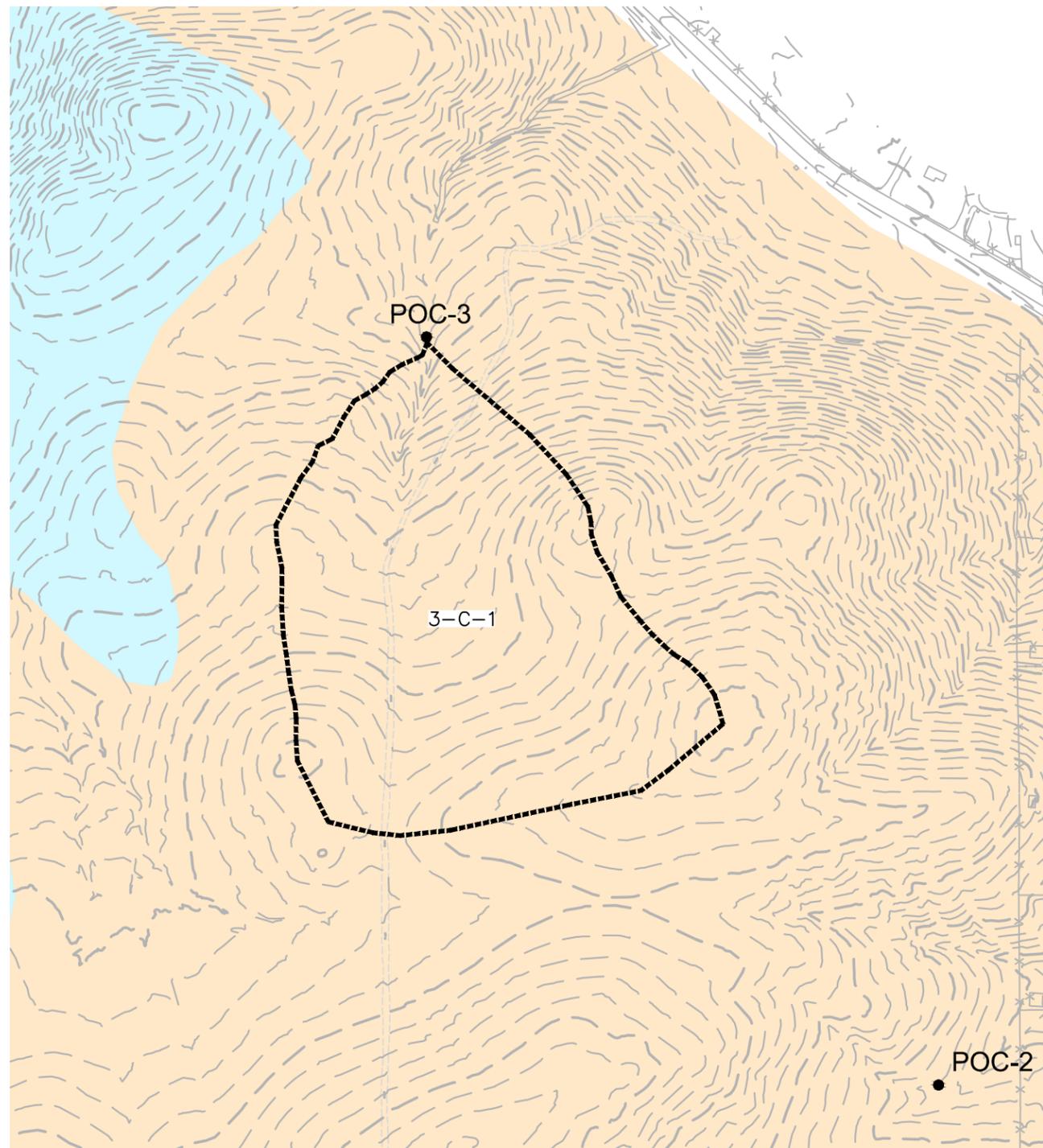


BMP	AREA (SF)	WIDTH(LF)
2-1	11,462	48

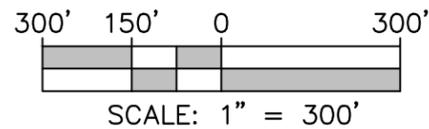


SOIL TYPE PER PRE-DEVELOPMENT AREA		
	2-C-1	2-C-2
AREA	336,659 S.F.	188,621 S.F.
SLOPE	12.31%	13.99%
FLOW LENGTH	866 L.F.	614 L.F.

SOIL TYPE PER POST-DEVELOPMENT AREA			
DMA	2-1-C1	2-1-C2	2-1-C3
AREA	424,119 S.F.	139,851 S.F.	62,687 S.F.
SLOPE	2.5%	20.73%	13.52%
FLOW LENGTH	980 L.F.	501 L.F.	236 L.F.
OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA			
DMA	OFF 2-C-1	OFF 2-D-1	
AREA	4,069 S.F.	45,695 S.F.	
SLOPE	6.82%	16.43%	
FLOW LENGTH	58 L.F.	366 L.F.	

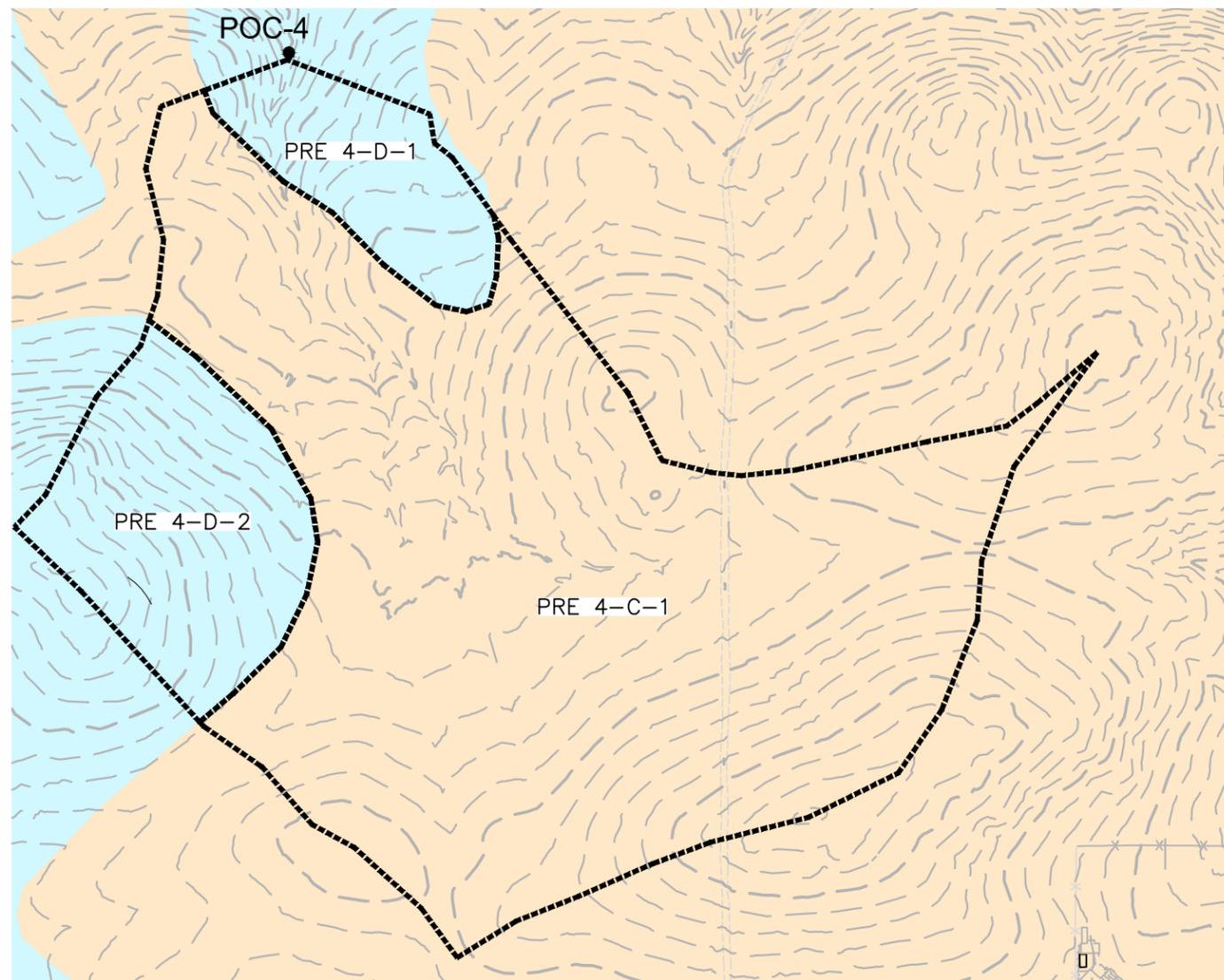


BMP	AREA (SF)	WIDTH(LF)
3-1	6,869	45



SOIL TYPE PER PRE-DEVELOPMENT AREA	
	3-C-1
AREA	618,821 S.F.
SLOPE	14.93%
FLOW LENGTH	970 L.F.

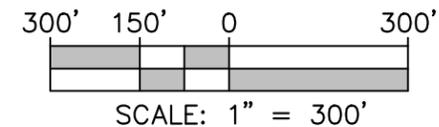
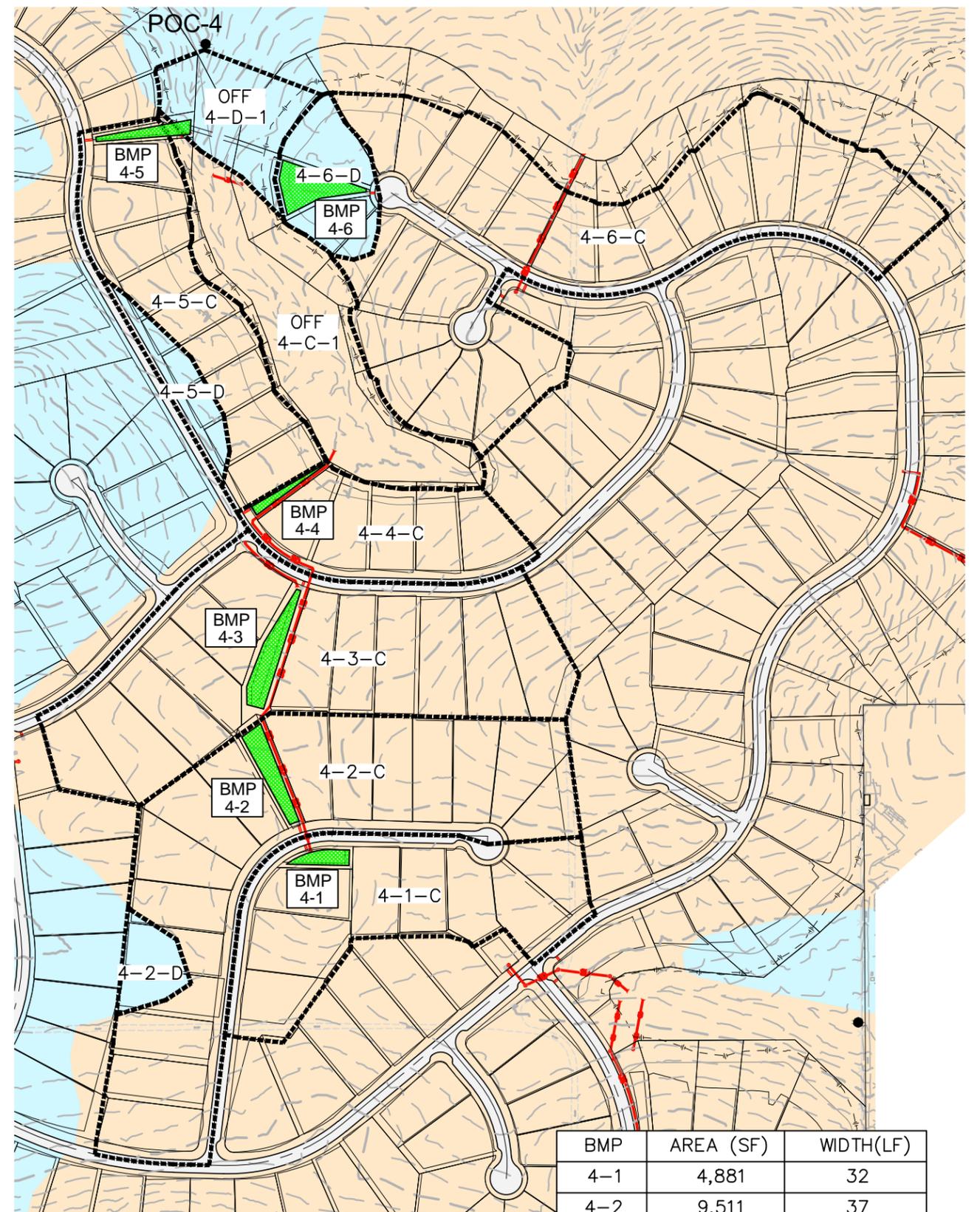
SOIL TYPE PER POST-DEVELOPMENT AREA	
DMA	3-1-C
AREA	476,627 S.F.
SLOPE	2.5%
FLOW LENGTH	1,449 L.F.
OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA	
DMA	OFF 3-C-1
AREA	211,498 S.F.
SLOPE	11.07%
FLOW LENGTH	874 L.F.



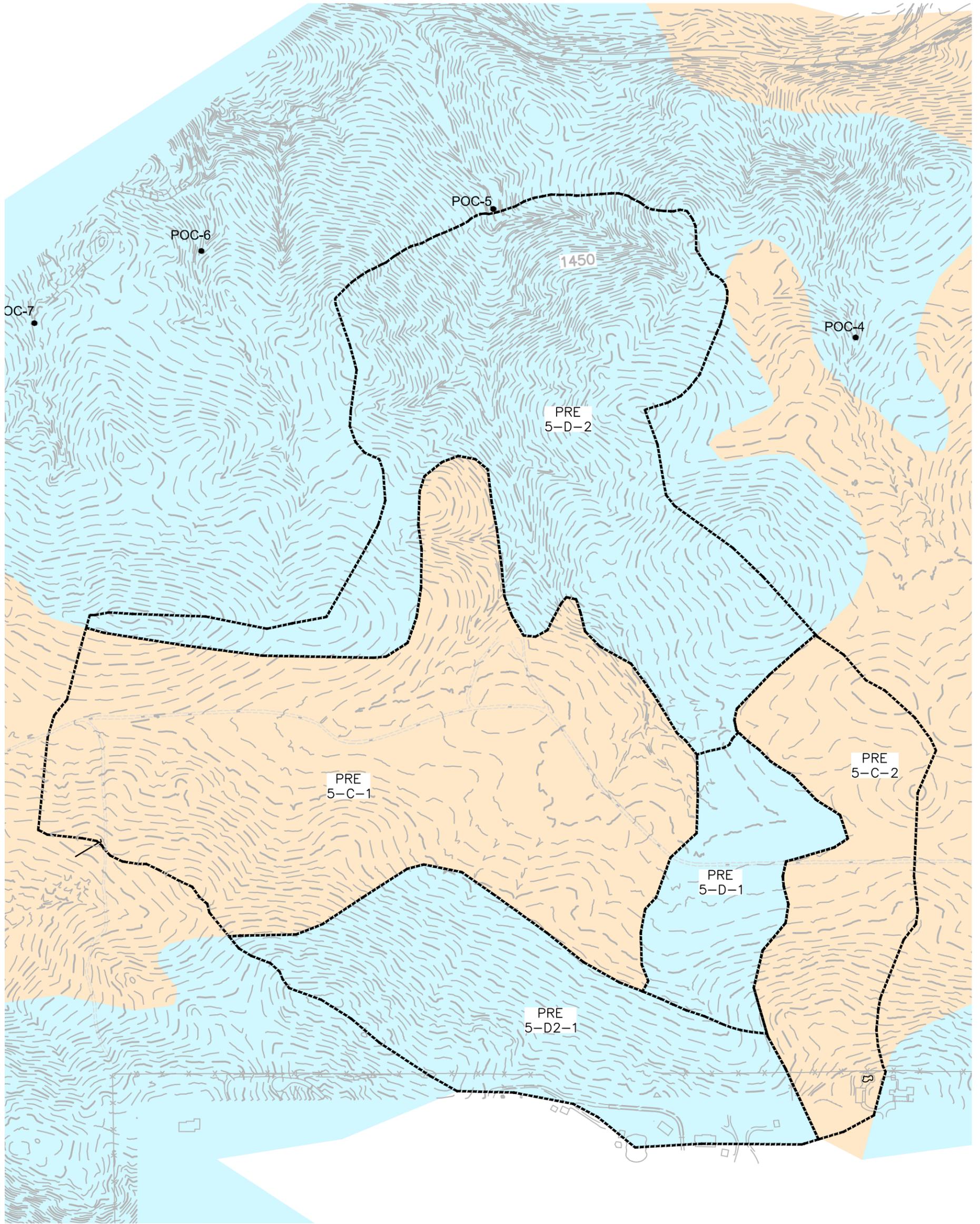
SOIL TYPE PER PRE-DEVELOPMENT AREA			
	4-C-1	4-D-1	4-D-2
AREA	1,320,597 S.F.	129,643 S.F.	242,084 S.F.
SLOPE	9.50%	12.70%	12.83%
FLOW LENGTH	1,978 L.F.	685 L.F.	493 L.F.



SOIL TYPE PER POST-DEVELOPMENT AREA							
DMA	4-1-C	4-2-C	4-2-D	4-3-C	4-4-C	4-5-C	4-5-D
AREA	222,861 S.F.	408,604 S.F.	24,996 S.F.	389,821 S.F.	125,184 S.F.	174,701 S.F.	32,301 S.F.
SLOPE	3.5%	3.5%	3.5%	2.5%	2.7%	2.2%	3.1%
FLOW LENGTH	745 L.F.	1,333 L.F.	162 L.F.	1,066 L.F.	1,145 L.F.	1,323 L.F.	499 L.F.
OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA							
DMA	4-6-C	4-6-D	OFF 4-C-1		OFF 4-D-1		
AREA	500,185 S.F.	61,986 S.F.	187,399 S.F.		69,189 S.F.		
SLOPE	3.1%	2.1%	9.0%		10.1%		
FLOW LENGTH	1,486 L.F.	481 L.F.	1,087 L.F.		416 L.F.		



BMP	AREA (SF)	WIDTH(LF)
4-1	4,881	32
4-2	9,511	37
4-3	7,401	47
4-4	3,342	12
4-5	5,650	24
4-6	13,553	28



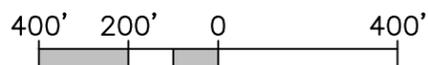
SOIL TYPE PER PRE-DEVELOPMENT AREA					
	5-C-1	5-C-2	5-D-1	5-D2-1	5-D-2
AREA	3,151,306 S.F.	1,013,521 S.F.	585,540 S.F.	1,372,102 S.F.	2,765,324 S.F.
SLOPE	10.59%	10.35%	6.93%	16.20%	16.20%
FLOW LENGTH	2,606 L.F.	1,198 L.F.	1,414 L.F.	861 L.F.	2,614 L.F.



SCALE: 1" = 400'

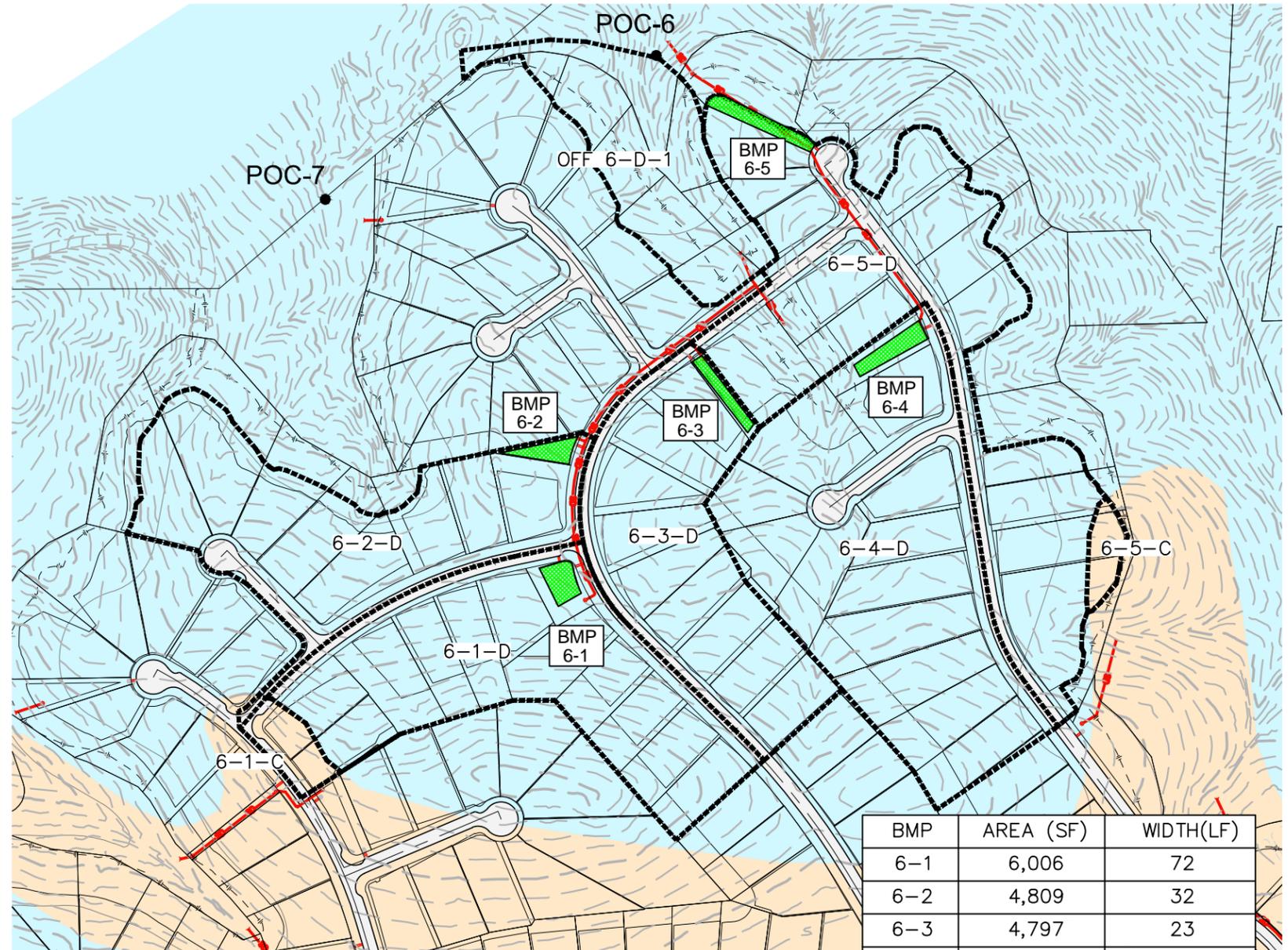
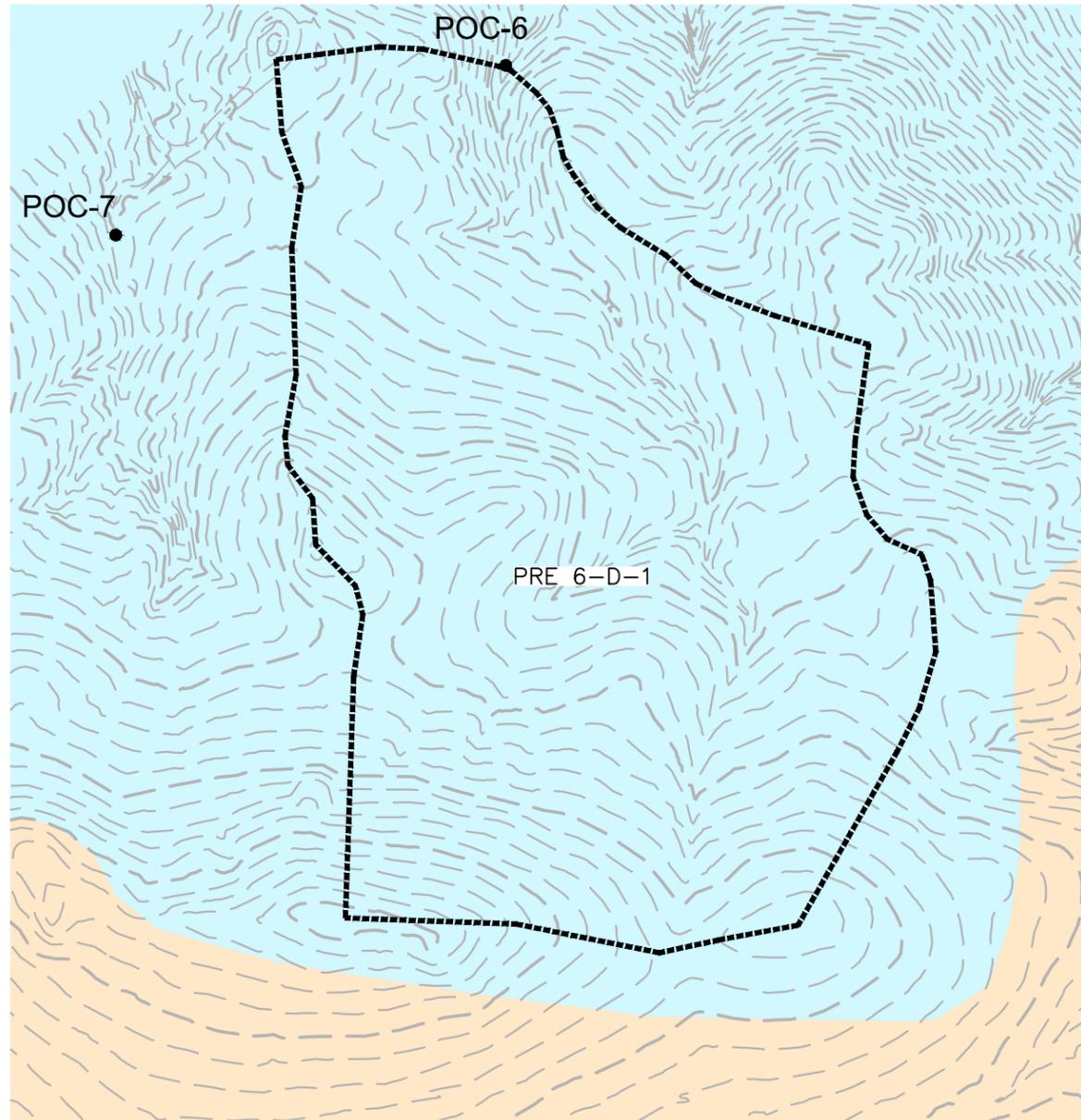


SOIL TYPE PER POST-DEVELOPMENT AREA							
DMA	5-1-C	5-1-D	5-2-D	5-2-C	5-3-D	5-4-C	5-4-D
AREA	599,579 S.F.	40,311 S.F.	103,363 S.F.	671,238 S.F.	270,971 S.F.	444,057 S.F.	146,313 S.F.
SLOPE	3.5%	3%	2.5%	3%	2.5%	3%	3%
FLOW LENGTH	1,411 L.F.	500 L.F.	480 L.F.	1,764 L.F.	1,102 L.F.	2,194 L.F.	493 L.F.
DMA	5-5-C1	5-5-C2	5-5-D	5-6-D	5-7-D	5-7-C	
AREA	102,886 S.F.	56,720 S.F.	207,213 S.F.	127,290 S.F.	983,955 S.F.	177,903 S.F.	
SLOPE	3.5%	2%	2.5%	3%	5%	3.5%	
FLOW LENGTH	518 L.F.	463 L.F.	1,132 L.F.	845 L.F.	1,564 L.F.	783 L.F.	



SCALE: 1" = 400'

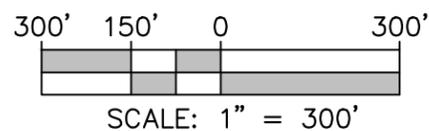
SOIL TYPE PER POST-DEVELOPMENT AREA					
DMA	OFF 5-C-1	OFF 5-C-2	OFF 5-C-3	OFF 5-D-1	OFF 5-D-2
AREA	494,802 S.F.	722,716 S.F.	252,364 S.F.	1,657,810 S.F.	1,496,757 S.F.
SLOPE	9.72%	15.12%	16.70%	13.94%	15.86%
FLOW LENGTH	827 L.F.	1,128 L.F.	537 L.F.	2613 L.F.	861 L.F.

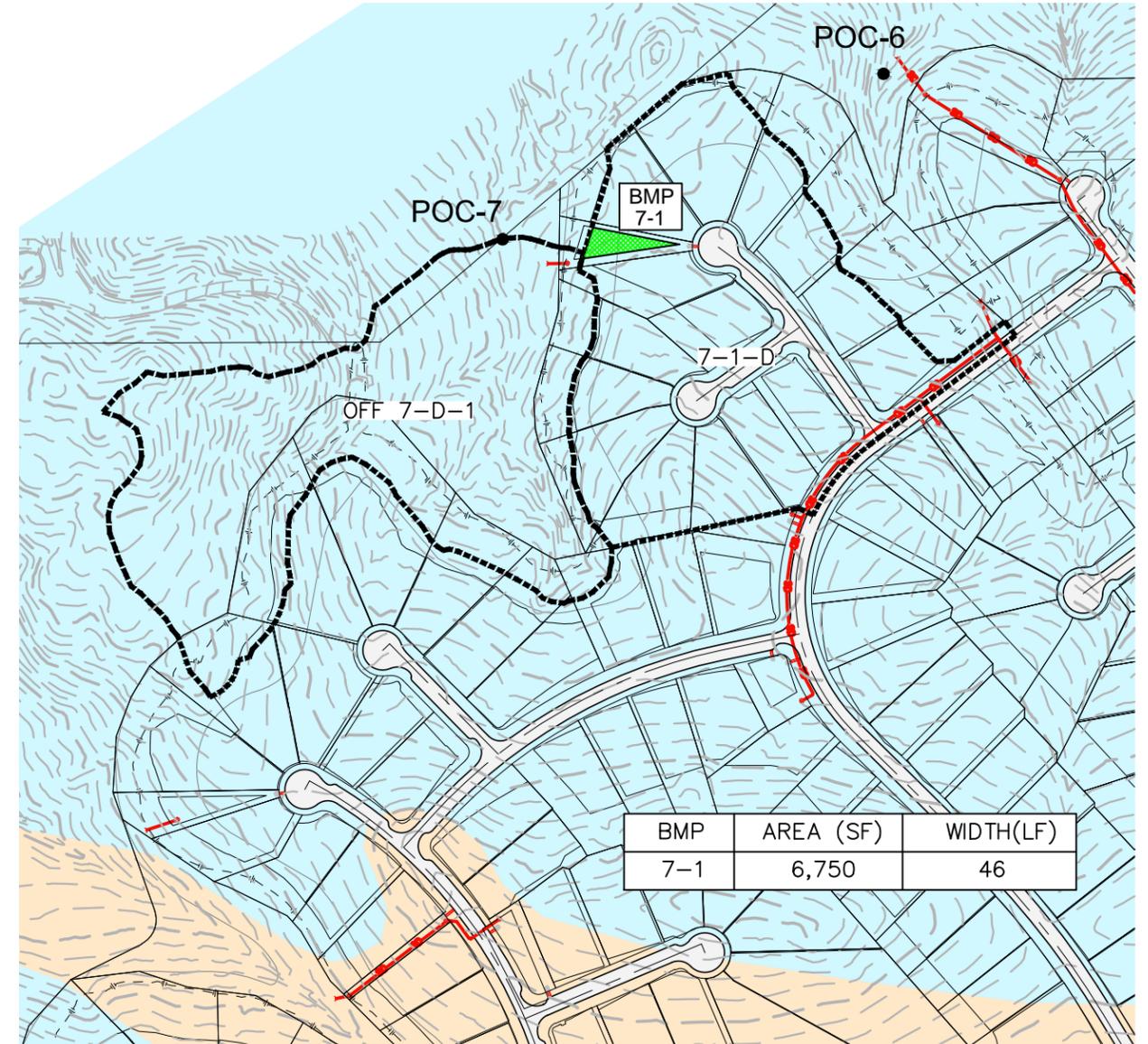
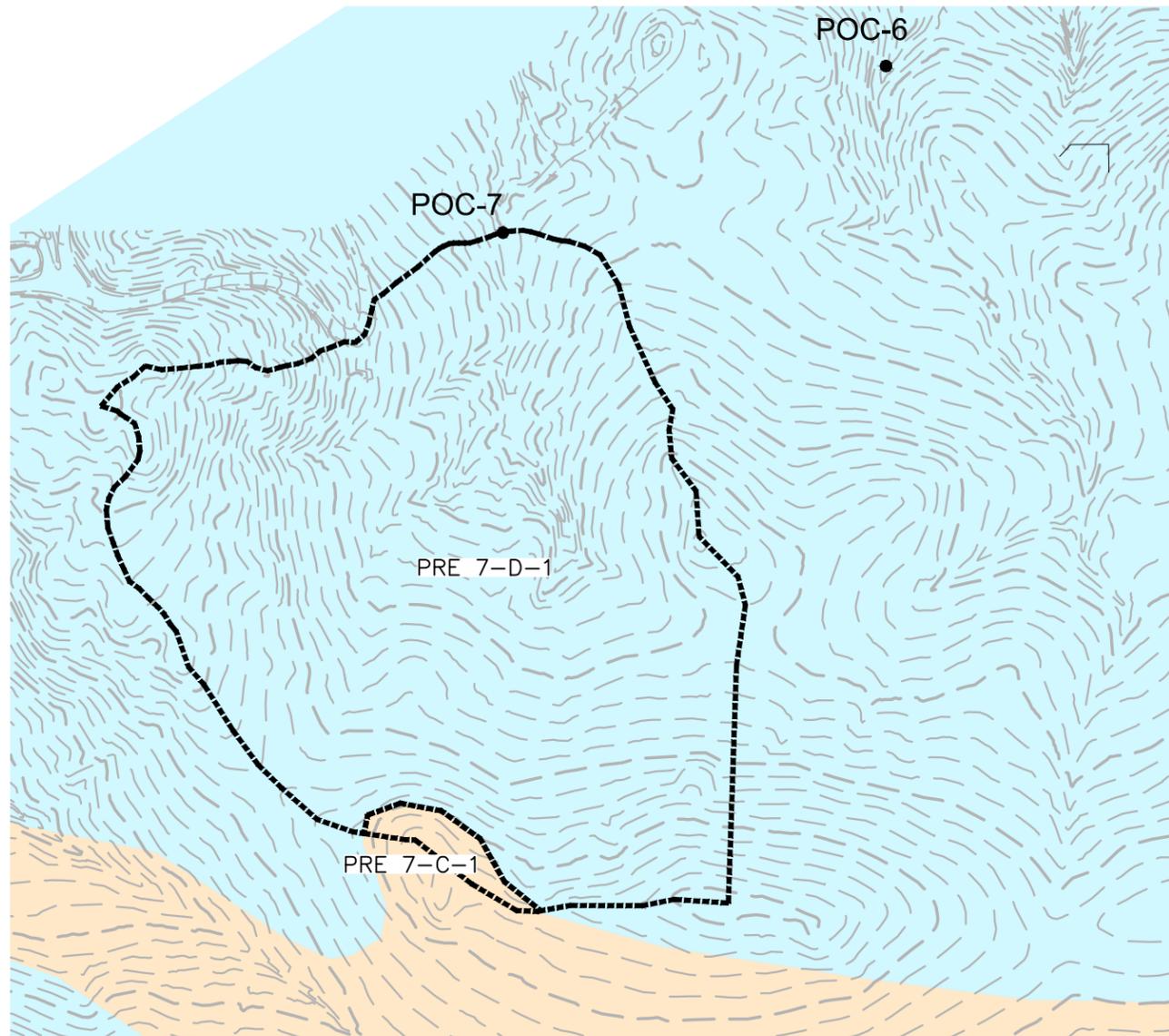


BMP	AREA (SF)	WIDTH(LF)
6-1	6,006	72
6-2	4,809	32
6-3	4,797	23
6-4	6,861	51
6-5	11,752	52

SOIL TYPE PER PRE-DEVELOPMENT AREA	
	6-D-1
AREA	1,371,224 S.F.
SLOPE	14.75%
FLOW LENGTH	2,081 L.F.

SOIL TYPE PER POST-DEVELOPMENT AREA							
DMA	6-1-C	6-1-D	6-2-D	6-3-D	6-4-D	6-5-C	6-5-D
AREA	20,743 S.F.	287,805 S.F.	260,510 S.F.	233,289 S.F.	399,995 S.F.	13,354 S.F.	391,230 S.F.
SLOPE	3%	5%	4%	4%	4%	2.5%	3%
FLOW LENGTH	347 L.F.	1,011 L.F.	1,477 L.F.	1,358 L.F.	1,298 L.F.	83 L.F.	1,563 L.F.
OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA							
DMA	OFF 6-D-1						
AREA	144,267 S.F.						
SLOPE	10.8%						
FLOW LENGTH	688 L.F.						

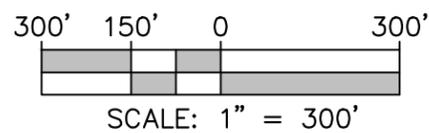


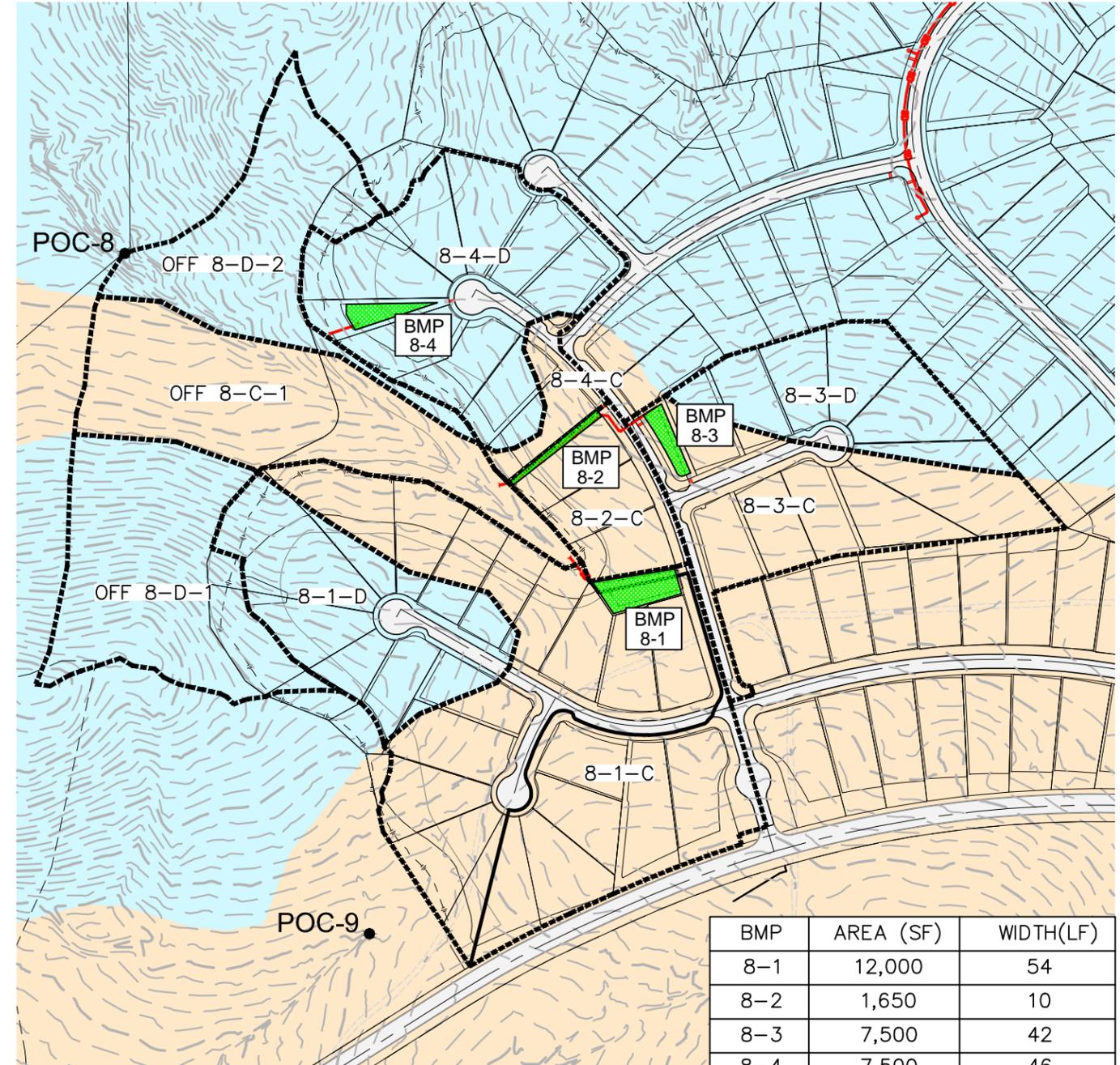
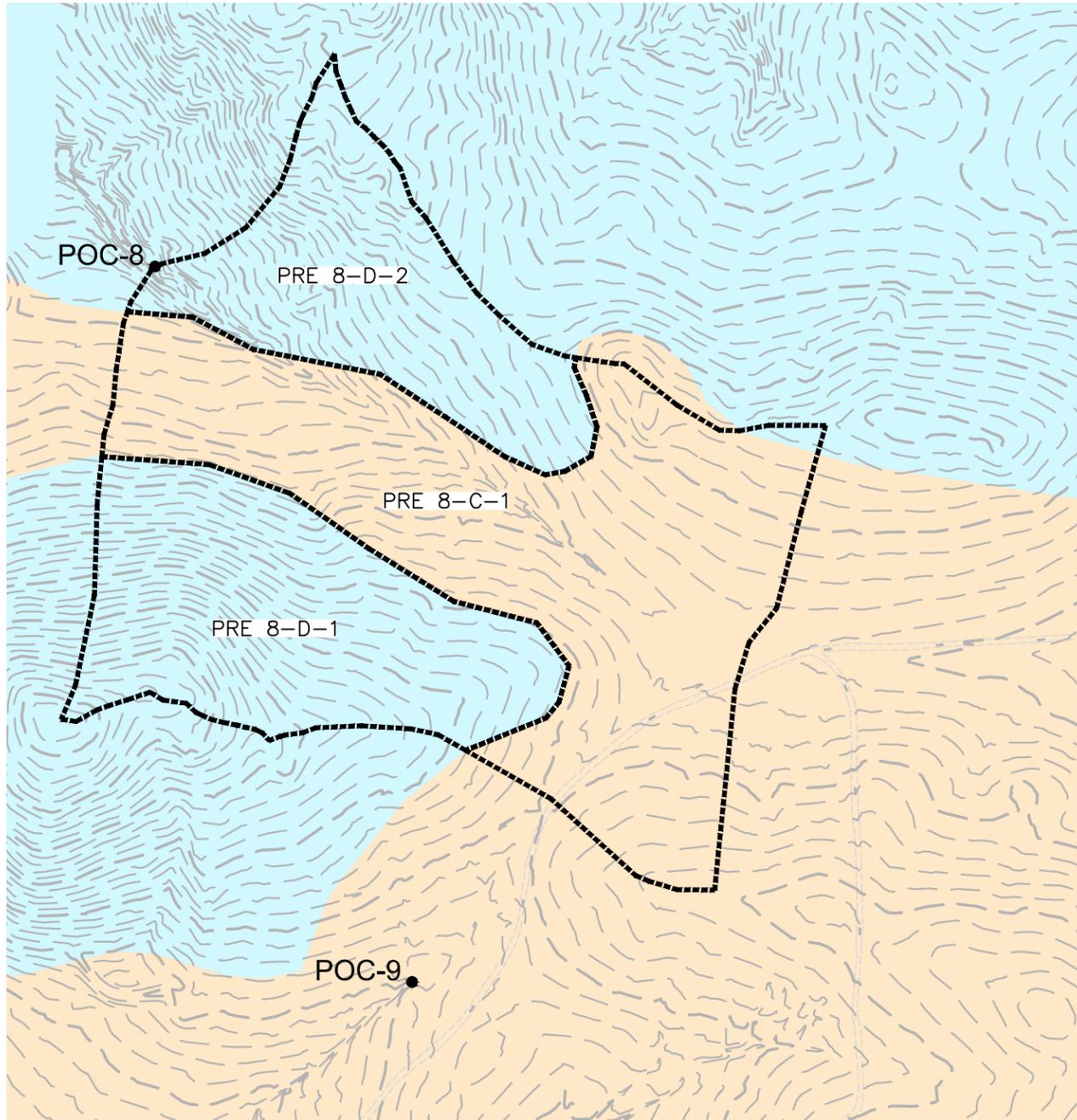


BMP	AREA (SF)	WIDTH(LF)
7-1	6,750	46

SOIL TYPE PER PRE-DEVELOPMENT AREA		
	7-C-1	7-D-1
AREA	19,926 S.F.	1,003,629 S.F.
SLOPE	18.36%	18.90%
FLOW LENGTH	163 L.F.	1,420 L.F.

SOIL TYPE PER POST-DEVELOPMENT AREA	
DMA	7-1-D
AREA	389,725 S.F.
SLOPE	8.63%
FLOW LENGTH	1,028 L.F.
OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA	
DMA	OFF 7-D-1
AREA	406,188 S.F.
SLOPE	28.83%
FLOW LENGTH	968 L.F.

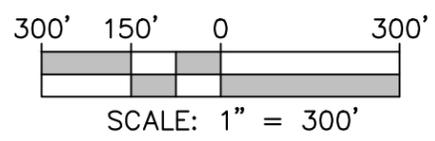




BMP	AREA (SF)	WIDTH(LF)
8-1	12,000	54
8-2	1,650	10
8-3	7,500	42
8-4	7,500	46



	8-C-1	8-D-1	8-D-2
AREA	641,409 S.F.	353,108 S.F.	268,468 S.F.
SLOPE	13.85%	22.79%	22.57%
FLOW LENGTH	1,531 L.F.	523 L.F.	737 L.F.



SOIL TYPE PER POST-DEVELOPMENT AREA					
DMA	8-1-C	8-1-D	8-2-C	8-3-C	8-3-D
AREA	492,991 S.F.	166,647 S.F.	76,050 S.F.	188,945 S.F.	121,593 S.F.
SLOPE	3.5%	3%	4%	2.5%	1.25%
FLOW LENGTH	1,959 L.F.	678 L.F.	806 L.F.	1,055 L.F.	432 L.F.
OFFSITE SOIL TYPE PER POST-DEVELOPMENT AREA					
DMA	8-4-C	8-4-D	OFF 8-C-1	OFF 8-D-1	OFF 8-D-2
AREA	30,319 S.F.	233,589 S.F.	204,734 S.F.	193,091 S.F.	148,994 S.F.
SLOPE	3%	4%	18.89%	21.10%	23.7%
FLOW LENGTH	470 L.F.	816 L.F.	864 L.F.	476 L.F.	593 L.F.

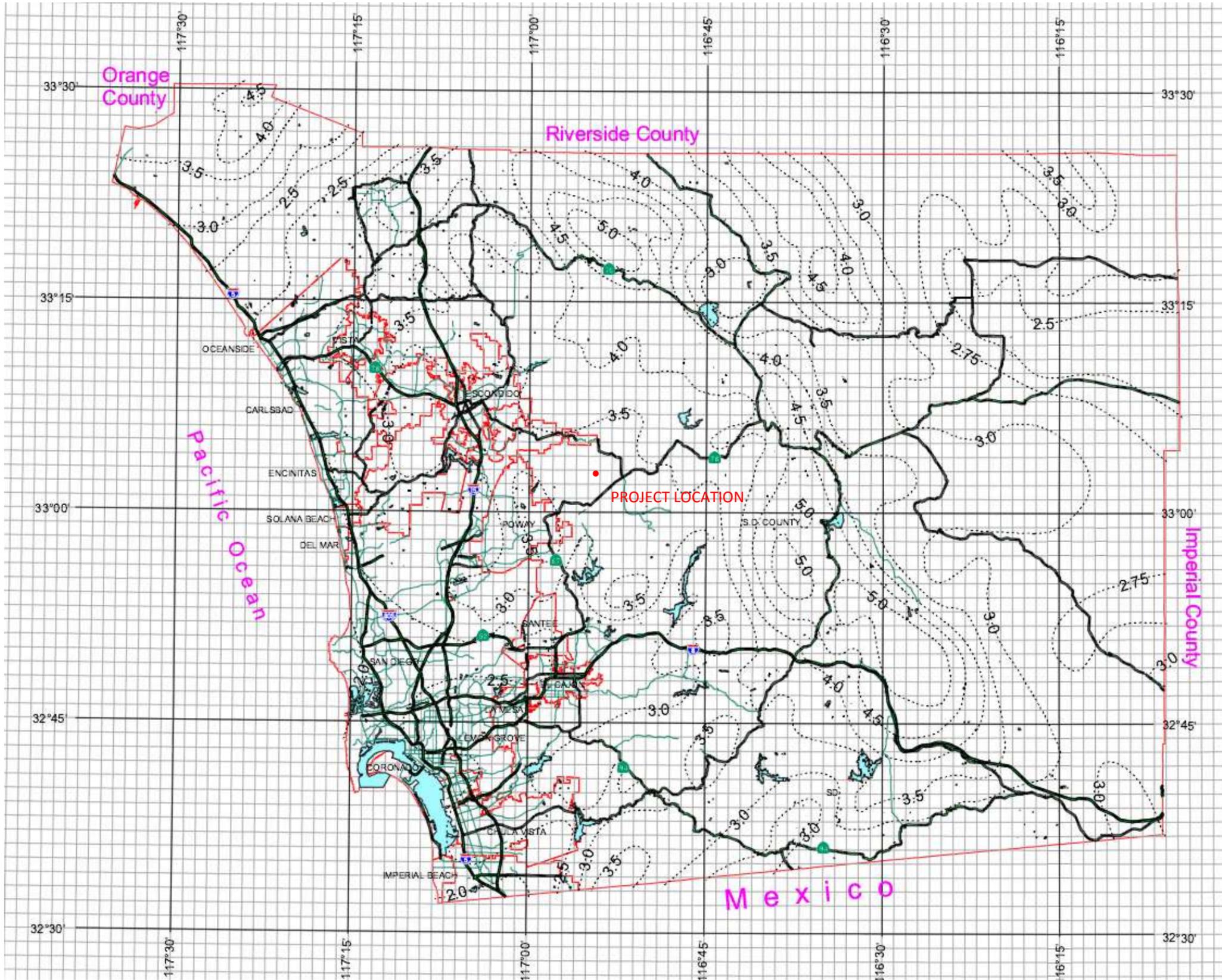
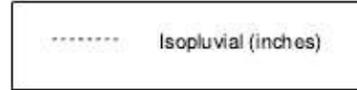
Appendix 2: P_{6,100} Precipitation Map

County of San Diego Hydrology Manual



Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours



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Appendix 3: Pre and Post-Development Runoff Volume
Bioretention and Offside Detention Volume

POC-1 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-1 Pre-Dev.

	1-D-1
Area, ft ²	53028
% imper	0
C:	0.35

	1-D-2
Area, ft ²	171875
% imper	0
C:	0.35

	1-C-1
Area, ft ²	1511711
% imper	0
C:	0.3

TOTAL PRE.

A	1736614	sq-ft
C	0.3065	
P	3.3	inches
Vol:	146363	cu-ft

POC-1 Post-Dev.

	1-1-C	1-1-D	BMP 1-1	TOTAL 1-1
Area, ft ²	845857	4656	15739	866252
% imper	33.07	32.5	0	32.47%
C	0.3	0.35	0.3	
Ctot	0.498	0.529	0.300	0.495

	1-2-C	BMP 1-2	TOTAL 1-2
Area, ft ²	184826	3366	188192
% imper	29.2	0	28.68%
C	0.3	0.3	
Ctot	0.475	0.300	0.472

	1-3-C	BMP 1-3	TOTAL 1-3
Area, ft ²	195134	5804	200938
% imper	36.9	0	35.83%
C	0.3	0.3	
Ctot	0.521	0.300	0.515

POC-1 OFFSITE

	OFF-1-C-3	OFF-1-D-2	OFF-1-C-2	OFF-1-C-1	OFF-1-D-1	TOTAL
Area, ft ²	146030	48372	124772	52788	171875	543837
% imperv	0	0	16.06	32.51	3.46	7.93
C	0.3	0.35	0.3	0.3	0.35	
Ctot	0.300	0.350	0.396	0.495	0.369	0.367

TOTAL POST.

A	1799219	sq-ft
C	0.4562	
P	3.3	inches
Vol:	225735	cu-ft

Difference: 79371 cu-ft

VOLUME PROVIDED

OFFSITE BASIN: 19500 cu-ft
 BMP 1-1 soils: 13378 cu-ft
 BMP 1-1 below riser: 28878 cu-ft
 BMP 1-1, 0.4 ft above riser: 6296 cu-ft

BMP 1-2 soils: 2861 cu-ft
 BMP 1-2 below riser: 5865 cu-ft
 BMP 1-2, 0.25 ft above riser: 842 cu-ft
 BMP 1-3 soils: 4933 cu-ft
 BMP 1-3 below riser: 9890 cu-ft
 BMP 1-3, 0.2 ft above riser: 1161 cu-ft

TOTAL 93604 cu-ft

Volume provided/ Difference: 118% OK

POC-2 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-2 Pre-Dev.

	2-C-1	2-C-2
Area, ft ²	336659	188621
% imper	0	0
C:	0.3	0.3

TOTAL PRE.

A	525280	sq-ft
C	0.3000	
P	3.3	inches
Vol:	43336	cu-ft

POC-2 Post-Dev.

	2-1-C1	2-1-C2	2-1-C3	BMP 2-1	TOTAL 2-1
Area, ft ²	424119	128389	62667	11462	626637
% imper	27.28	20.73	35.1	0	26.22%
C	0.3	0.3	0.3	0.3	
Ctot	0.464	0.424	0.511	0.300	0.457

POC-2 OFFSITE

	OFF-2-C-1	OFF-2-C-2	TOTAL
Area, ft ²	4069	45695	49764
% imperv	0	0	0.00
C	0.3	0.3	
Ctot	0.300	0.300	0.300

TOTAL POST.

A	676401	sq-ft
C	0.4458	
P	3.3	inches
Vol:	82914	cu-ft

Difference: 39579 cu-ft

VOLUME PROVIDED

BMP 2-1 soils: 9743 cu-ft
 BMP 2-1 below riser: 24899 cu-ft
 BMP 2-1, 0.33 ft above riser: 4595 cu-ft

TOTAL 39237 cu-ft

Volume provided/ Difference: 99% too close

Detail routing needed in final engineering

POC-3 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-3 Pre-Dev.

	3-C-1
Area, ft ²	618821
% imper	0
C:	0.3

POC-3 Post-Dev.

	3-1-C	BMP 3-1	TOTAL 3-1
Area, ft ²	469758	6869	476627
% imper	34.56	0	34.06%
C	0.3	0.3	
Ctot	0.507	0.300	0.504

POC-3 OFFSITE

	OFF-3-C-1
Area, ft ²	211498
% imperv	0
C	0.3
Ctot	0.300

VOLUME PROVIDED

BMP 3-1 soils: 8586 cu-ft
 BMP 3-1 below riser: 24431 cu-ft
 BMP 3-1, 0.4 ft above riser: 3914 cu-ft

TOTAL 36930 cu-ft

TOTAL PRE.

A	618821	sq-ft
C	0.3000	
P	3.3	inches
Vol:	51053	cu-ft

TOTAL POST.

A	688125	sq-ft
C	0.4416	
P	3.3	inches
Vol:	83558	cu-ft

Difference: 32505 cu-ft

Volume provided/ Difference: 114% ok

POC-4 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-4 Pre-Dev.

	4-C-1	4-D-1	4-D-2
Area, ft ²	1320597	129643	242084
% imper	0	0	0
C:	0.3	0.35	0.35

TOTAL PRE.

A	1692324	sq-ft
C	0.3110	
P	3.3	inches
Vol:	144728	cu-ft

POC-4 Post-Dev.

	4-1-C	BMP 4-1	TOTAL
Area, ft ²	217980	4881	222861
% imper	33.02	0	32.30%
C	0.3	0.3	
Ctot	0.498	0.300	0.494

	4-2-C	4-2-D	BMP 4-2	TOTAL
	399093	24996	9511	433600
	33.99	33.2	0	33.20
	0.3	0.35	0.3	
	0.504	0.533	0.300	0.501

	4-3-C	BMP 4-3	TOTAL
	382420	7401	389821
	28.24	0	27.70%
	0.3	0.3	
	0.469	0.300	0.466

	4-4-C	BMP 4-4	TOTAL
Area, ft ²	121842	3342	125184
% imper	36.88	0	35.90%
C	0.3	0.3	
Ctot	0.521	0.300	0.515

	4-5-C	4-5-D	BMP 4-5	TOTAL
	169051	32301	5650	207002
	40.44	39.13	0	39.13
	0.3	0.35	0.3	
	0.543	0.565	0.300	0.540

	4-6-C	4-6-D	BMP 4-6	TOTAL
Area, ft ²	500185	48433	13553	562171
% imperv	38.4	49.15	0	38.40
C	0.3	0.35	0.35	
Ctot	0.530	0.620	0.350	0.534

POC-4 OFFSITE

	OFF 4-C-1	OFF 4-D-1	TOTAL
	187399	69189	256588
	0	0	0%
	0.3	0.35	
	0.300	0.350	0.313

TOTAL POST.

A	2197227	sq-ft
C	0.4851	
P	3.3	inches
Vol:	293094	cu-ft

Difference: 148366 cu-ft

VOLUME PROVIDED

BMP 4-1 soils: 4149 cu-ft
 BMP 4-1 below riser: 12069 cu-ft
 BMP 4-1, 0.2 ft over riser: 1396 cu-ft
 BMP 4-2 soils: 8084 cu-ft
 BMP 4-2 below riser: 23028 cu-ft
 BMP 4-2, 0.25 ft over riser: 3184 cu-ft

BMP 4-3 soils: 6291 cu-ft
 BMP 4-3 below riser: 18435 cu-ft
 BMP 4-3, 0.25 ft above riser: 2713 cu-ft
 BMP 4-4 soils: 2841 cu-ft
 BMP 4-4 below riser: 8763 cu-ft
 BMP 4-4, 0.1 ft above riser: 574 cu-ft

BMP 4-5 soils: 4803 cu-ft
 BMP 4-5 below riser: 14233 cu-ft
 BMP 4-5, 0.2 ft above riser: 1715 cu-ft
 BMP 4-6 soils: 11520 cu-ft
 BMP 4-6 below riser: 53318 cu-ft
 BMP 4-6, 0.25 ft over riser: 3914 cu-ft

TOTAL 181029 cu-ft

Volume provided/ Difference: 122% OK

POC-5 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-5 Pre-Dev.

	5-C-1	5-C-2	5-D-1	5-D2-1	5-D-2
Area, ft ²	3151306	1013521	585540	1372102	2765324
% imper	0	0	0	0	0
C:	0.3	0.3	0.35	0.35	0.35

TOTAL PRE.

A	8887793	sq-ft
C	0.3266	
P	3.3	inches
Vol:	798184	cu-ft

POC-5 Post-Dev.

	5-1-C	5-1-D	BMP 5-1	TOTAL
Area, ft ²	589229	40311	10350	639890
% imperv	32.92	32.35	0	32.35
C	0.3	0.35	0.3	
Ctot	0.498	0.528	0.300	0.496

	5-2-C	5-2-D	BMP 5-2	TOTAL
Area, ft ²	657738	103363	13500	774601
% imperv	35.59	34.86	0	34.87
C	0.3	0.35	0.3	
Ctot	0.514	0.542	0.300	0.514

OFFSITE, BASIN

5-C-2	5-C-3
722716	252364
21.2	11.9
0.3	0.3
0.427	0.371
5-D-2	TOTAL
1496757	2471837
1.9	8.6%
0.35	
0.360	0.381

	5-3-D1	5-3-D	BMP 5-3	TOTAL
Area, ft ²	150805	115216	4950	270971
% imperv	37.74	36.54	0	36.54
C	0.35	0.35	0.35	
Ctot	0.558	0.551	0.350	0.551

	5-4-C	5-4-D	BMP 5-4	TOTAL
Area, ft ²	434607	146313	9450	590370
% imperv	32.71	32.01	0	32.01
C	0.3	0.35	0.3	
Ctot	0.496	0.526	0.300	0.501

	5-5-C1	5-5-C2	5-5-D	BMP 5-5	TOTAL
Area, ft ²	93436	51314	207213	5400	263927
% imper	32.42	32.54	29.44	0	29.44
C	0.3	0.3	0.35	0.3	
Ctot	0.495	0.495	0.512	0.300	0.504

	5-6-D	BMP 5-6	TOTAL
Area, ft ²	125490	1800	127290
% imper	28.69	0	28.28%
C	0.35		
Ctot	0.508	0.000	0.501

	5-7-C	5-7-D	BMP 5-7	TOTAL
Area, ft ²	177903	963255	20700	1161858
% imperv	35.64	36.41	0	35.64
C	0.3	0.35		
Ctot	0.514	0.550	0.000	0.535

POC-5 OFFSITE, NO BASIN

OFF5-C-1	OFF 5-D-1	TOTAL
494802	722716	1217518
0	0	0%
0.3	0.35	
0.300	0.350	0.330

TOTAL POST.

A	7518262	sq-ft
C	0.4418	
P	3.3	inches
Vol:	913492	cu-ft

VOLUME PROVIDED

OFFSITE BASIN: 15364 cu-ft
BMP 5-1 soils: 8798 cu-ft
BMP 5-1 below riser: 27573 cu-ft
BMP 5-1, 4" over riser: 4321 cu-ft
BMP 5-2 soils: 11475 cu-ft
BMP 5-2 below riser: 35678 cu-ft
BMP 5-2, 4" over riser: 5489 cu-ft

BMP 5-3 soils: 4208 cu-ft
BMP 5-3 below riser: 10845 cu-ft
BMP 5-3, 4" over riser: 2181 cu-ft
BMP 5-4 soils: 8033 cu-ft
BMP 5-4 below riser: 20187 cu-ft
BMP 5-4, 4" over riser: 3871 cu-ft

Difference: 115308 cu-ft

BMP 5-5 soils: 4590 cu-ft
BMP 5-5 below riser: 11785 cu-ft
BMP 5-5, 4" over riser: 2353 cu-ft
BMP 5-6 soils: 1530 cu-ft
BMP 5-6 below riser: 3533 cu-ft
BMP 5-6, 0.2 ft over riser: 519 cu-ft
BMP 5-7 soils: 19665 cu-ft
BMP 5-7 below riser: 60190 cu-ft
BMP 5-7, 0.4 ft over riser: 9962 cu-ft

TOTAL 272148 cu-ft

Volume provided/ Difference: 236% OK

POC-6 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-6 Pre-Dev.

	6-D-1
Area, ft ²	1371224
% imper	0
C:	0.35

TOTAL PRE.

A	1371224	sq-ft
C	0.3500	
P	3.3	inches
Vol:	131980	cu-ft

POC-6 Post-Dev.

	6-1-C	6-1-D	BMP 6-1	TOTAL 6-1
Area, ft ²	20743	281799	6006	308548
% imper	32.2	32.8	0	32.12%
C	0.3	0.35	0.35	
Ctot	0.493	0.530	0.350	0.524

6-2-D	BMP 6-2	TOTAL 6-2
255701	4809	260510
28.2	0	27.68%
0.35	0.35	
0.505	0.350	0.502

6-3-D	BMP 6-3	TOTAL 6-3
228492	4797	233289
31.6	0	30.95%
0.35	0.35	
0.524	0.350	0.520

	6-5-C	6-5-D	BMP 6-5	TOTAL 6-5
Area, ft ²	13354	379478	11752	404584
% imper	37.9	39	0	37.83%
C	0.3	0.35	0.35	
Ctot	0.527	0.565	0.350	0.557

6-4-D	BMP 6-4	TOTAL 6-4
393134	6861	399995
27.5	0	27.03%
0.35	0.35	
0.501	0.350	0.499

POC-6 OFFSITE :	OFF 6-D-1
	144267
	0.00%
	0.35
	0.350

VOLUME PROVIDED

BMP 6-1 soils:	5105 cu-ft	BMP 6-4 soils:	5832 cu-ft
BMP 6-1 below riser:	15480 cu-ft	BMP 6-4 below riser:	17881 cu-ft
BMP 6-1, 0.25 ft above riser:	4602 cu-ft	BMP 6-4, 0.2 ft above riser:	1190 cu-ft
BMP 6-2 soils:	4088 cu-ft	BMP 6-5 soils:	9989 cu-ft
BMP 6-2 below riser:	10239 cu-ft	BMP 6-5 below riser:	35077 cu-ft
BMP 6-2, 0.25 ft above riser:	1316 cu-ft	BMP 6-5, 0.25 ft above riser:	2792 cu-ft
BMP 6-3 soils:	4077 cu-ft		
BMP 6-3 below riser:	10104 cu-ft		
BMP 6-3, 0.25 ft above riser:	1334 cu-ft		

TOTAL POST.

A	1751193	sq-ft
C	0.5078	
P	3.3	inches
Vol:	244564	cu-ft

Difference: 112584 cu-ft

TOTAL 129106 cu-ft

Volume provided/ Difference: 115% OK

POC-7 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-7 Pre-Dev.

	7-C-1	7-D-1
Area, ft ²	19926	1003629
% imper	0	0
C:	0.3	0.35

POC-7 Post-Dev.

	7-1-D	BMP 7-1	TOTAL 7-1
Area, ft ²	382975	6750	389725
% imper	35.6	0	34.98%
C	0.35	0.35	
Ctot	0.546	0.350	0.542

POC-7 OFFSITE

	OFF-7-D-1
Area, ft ²	406188
% imperv	0
C	0.35
Ctot	0.350

VOLUME PROVIDED

BMP 7-1 soils: 5738 cu-ft
 BMP 7-1 below riser: 1715 cu-ft
 BMP 7-1, 0.33 ft above riser: 2323 cu-ft

TOTAL 9776 cu-ft

TOTAL PRE.

A	1023555	sq-ft
C	0.3490	
P	3.3	inches
Vol:	98243	cu-ft

TOTAL POST.

A	795913	sq-ft
C	0.4442	
P	3.3	inches
Vol:	97228	cu-ft

Difference: -1015 cu-ft

Note: More runoff in pre than post development, due to diversion

Volume provided/ Difference: -963% ok

POC-8 VOLUMETRIC COMPARISON PRE AND POST DEVELOPMENT RUNOFF, 6hr - 100yr PRECIPITATION

POC-8 Pre-Dev.

	8-D-1	8-D-2	8-C-1
Area, ft ²	353108	268468	641409
% imper	0	0	0
C:	0.35	0.35	0.3

TOTAL PRE.

A	1262985	sq-ft
C	0.3246	
P	3.3	inches
Vol:	112743	cu-ft

POC-8 Post-Dev.

	8-1-C	8-1-D	BMP 8-1	TOTAL 8-1
Area, ft ²	480991	166647	12000	659638
% imper	30.8	30.06	0	30.05%
C	0.3	0.35	0.3	
Ctot	0.485	0.515	0.300	0.489

	8-2-C	BMP 8-2	TOTAL 8-2
Area, ft ²	74400	1650	76050
% imper	36.4	0	35.61%
C	0.3	0.3	
Ctot	0.518	0.300	0.514

	8-3-C	8-3-D	BMP 8-3	TOTAL 8-3
Area, ft ²	181445	121593	7500	310538
% imper	31.3	30.05	0	30.05%
C	0.3	0.35	0.3	
Ctot	0.488	0.515	0.300	0.494

	8-4-C	8-4-D	BMP 8-4	TOTAL 8-4
Area, ft ²	30319	226089	7500	263908
% imper	30.03	31.03	0	30.03%
C	0.3	0.35	0.35	
Ctot	0.480	0.521	0.350	0.511

POC-8 OFFSITE

	OFF-8-C-1	OFF-8-D-1	OFF-8-D-2	TOTAL
Area, ft ²	204734	193091	148994	546819
% imperv	0	0	0	0.00
C	0.3	0.35	0.35	
Ctot	0.300	0.350	0.350	0.331

TOTAL POST.

A	1856953	sq-ft
C	0.4476	
P	3.3	inches
Vol:	228577	cu-ft

Difference: 115834 cu-ft

VOLUME PROVIDED

BMP 8-1 soils: 12600 cu-ft
 BMP 8-1 below riser: 47844 cu-ft
 BMP 8-1, 0.33 ft above riser: 5063 cu-ft
 BMP 8-2 soils: 1733 cu-ft
 BMP 8-2 below riser: 4889 cu-ft
 BMP 8-2, 0.1 ft above riser: 303 cu-ft

BMP 8-3 soils: 14625 cu-ft
 BMP 8-3 below riser: 29080 cu-ft
 BMP 8-3, 0.2 ft above riser: 2087 cu-ft
 BMP 8-4 soils: 12375 cu-ft
 BMP 8-4 below riser: 27057 cu-ft
 BMP 8-4, 0.2 ft above riser: 2099 cu-ft

TOTAL 159755 cu-ft

Volume provided/ Difference: 138% OK