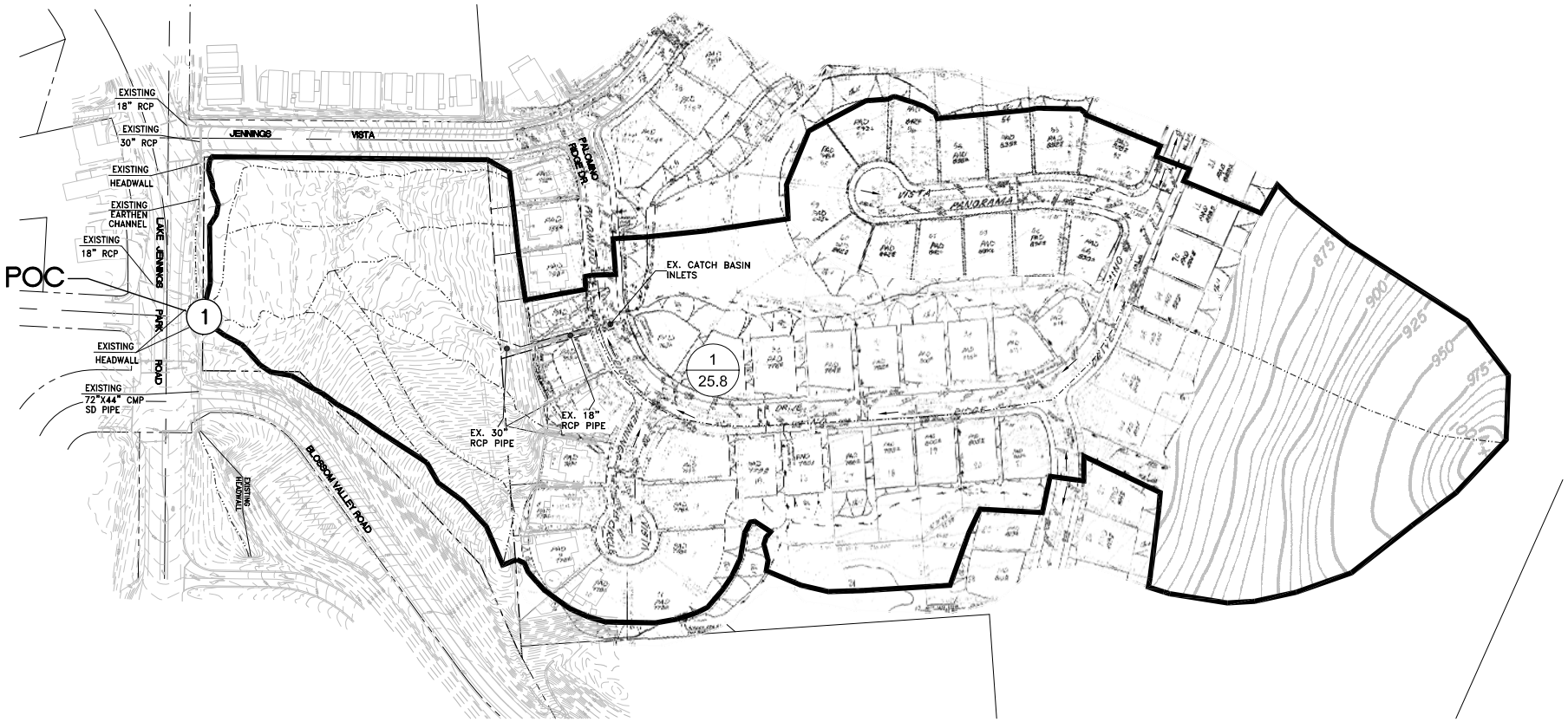


LEGEND

BASIN LIMITS

PROJECT BOUNDARY

BASIN ID

BASIN AREA

POC #

A-2 / 10.9

1

PRE-DEVELOPMENT HYDROLOGY

POINT OF COMPLIANCE

FIGURE 1

REVISIONS			
NO.	DESCRIPTION	DATE	APP'D

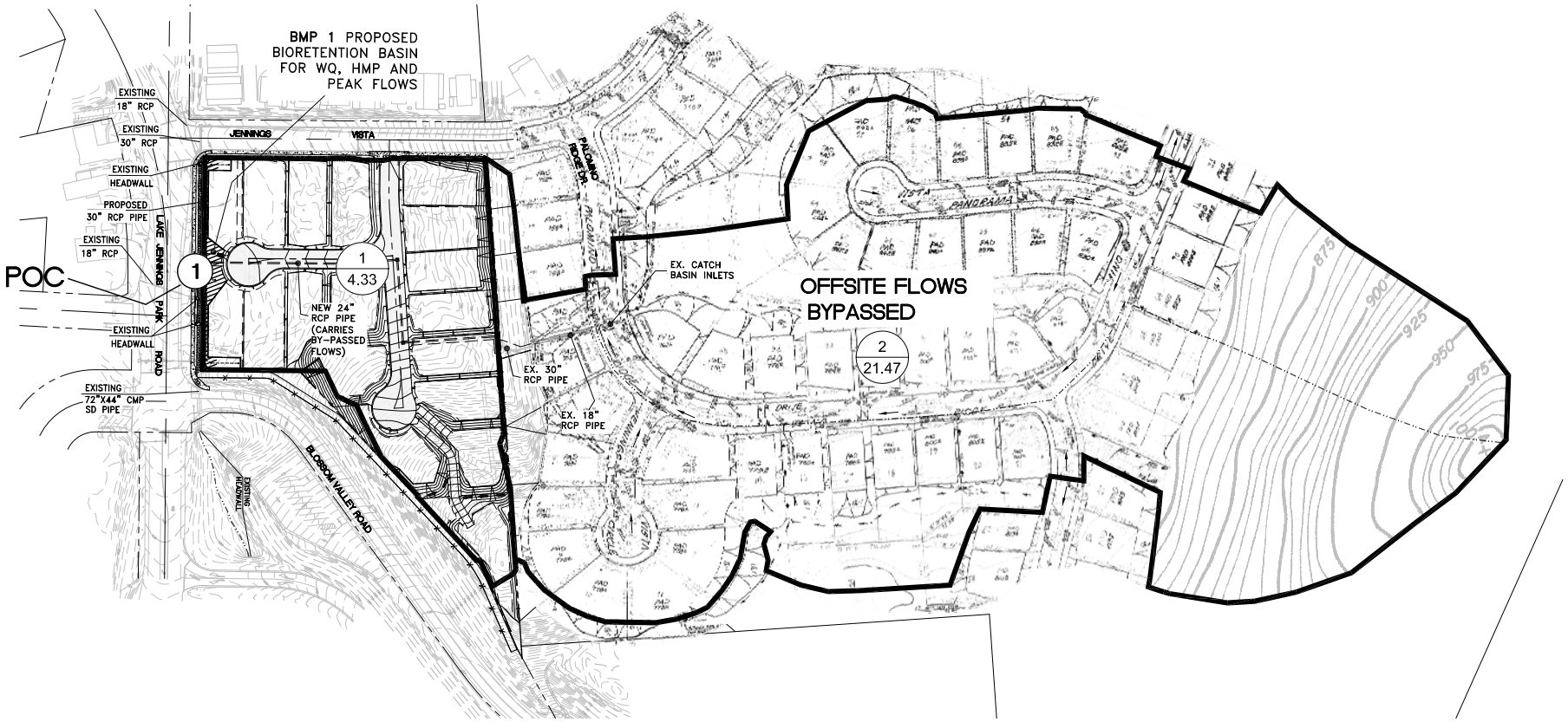
REC Consultants, Inc.
Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

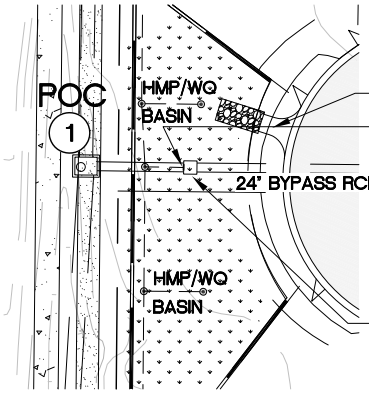
DATE: 08-08-13
SCALE: AS SHOWN
DRAWN: AP
CHECKED: AP

SHEET TITLE: PRE DEV POC
PROJECT: LAKE JENNINGS ROAD
LAKESIDE CA

SHEET 1 OF 2 SHEETS

SAVE DATE: 7/24/2015 ~ PLOT DATE: 2/25/2015 ~ FILE NAME: P:\Acad\681-LAKE JENNINGS\Civil\Reports\SWMP\SWMP\POC.dwg





LEGEND

BASIN LIMITS

PROJECT BOUNDARY

A-2 / 10.9 — BASIN AREA

1 — POC #

POST-DEVELOPMENT HYDROLOGY

POINT OF COMPLIANCE

FIGURE 2

REVISIONS			
NO.	DESCRIPTION	DATE	APP'D

REC Consultants, Inc.
Civil Engineering · Environmental
Land Surveying
2442 Second Avenue
San Diego, CA 92101
(619)232-9200 (619)232-9210 Fax

SHEET TITLE: POST DEV POC
PROJECT: LAKE JENNINGS ROAD, LAKESIDE CA
DATE: 06-12-14
SCALE: AS SHOWN
DRAWN: AP
CHECKED: AP
SHEET 1 OF 2 SHEETS

SAVE DATE: 7/24/2015 ~ PLOT DATE: 7/25/2015 ~ FILE NAME: P:\Acad\681-LAKE JENNINGS\Civil\Reports\SWMP\SWMP\POC PROPO.dwg

Regarding ponding elevations, the top of the BMP is placed at an elevation of 708.30 ft, while its surface bottom is 705.30 ft. The invert of the riser is 16 inches above the bottom surface of the pond at an elevation of 706.63 ft.

Beneath the basins' invert lies the proposed LID bioretention portion of the drainage facility. This portion of the basin is comprised of a 3-inch layer of mulch, a 18-inch layer of amended soil (a highly sandy, organic rich composite with an infiltration capacity of at least 5 inches/hr) and an 18-inch layer of gravel for additional detention and to accommodate the french drain system. This system is to be located beneath the bioretention layers to intercept treated storm water and convey these flows to a small diameter lower outlet orifice. Once flows have been routed by the outlet structure, flows are then discharged to the receiving POC discharge location.

The bioretention basins were modeled using the bioretention LID module within SWMM. The bioretention module can model the underground gravel storage layer, underdrain with an orifice plate, amended soil layer, and a surface storage pond up to the elevation of the invert of the lower orifices. It should be noted that detailed outlet structure location and elevations will be shown on the construction plans based on the recommendations of this study.

BMP MODELING FOR HMP PURPOSES

Modeling of dual purpose Water Quality/HMP BMPs

One (1) LID BMP bioretention basin is proposed for water quality treatment and hydromodification conformance for the project site. Table 2 illustrates the dimensions required for HMP compliance according to the SWMM model that was undertaken for the project.

TABLE 2 – SUMMARY OF DEVELOPED TRIPLE PURPOSE BMPS:

BMP	Impervious Tributary Area (Ac)	DIMENSIONS						
		Amended Soil (in)	Gravel(2) (in)	Lower Orif. Dia(3) (in)	Total Surface Depth (5) (in)	Riser Diameter (in)	Riser Height (4) (in)	Area(1), (ft2)
1	2.3	18	18	2.50	36	10	16	4550

Notes: (1): Area of amended soil equal to area of gravel
(2): Gravel depth needed to comply with hydromodification purposes.
(3): Diameter of orifice in gravel layer with invert at bottom of layer; tied with hydromod min threshold ($0.1 \cdot Q_2$).
(4): Depth of ponding beneath riser structure's surface spillway.
(5): Total surface depth of BMP from top crest elevation to surface invert.

FLOW DURATION CURVE COMPARISON

The Flow Duration Curve (FDC) for the site was compared at the POC by exporting the hourly runoff time series results from SWMM to a spreadsheet. The FDC was compared between 10% of the existing condition Q_2 up to the existing condition Q_{10}. The Q_2 and Q_{10} were determined with a partial duration statistical analysis of the runoff time series in an Excel spreadsheet using the Cunnane plotting position method (which is the preferred plotting methodology in the HMP Permit).

The range between 10% of Q_2 and Q_{10} was divided into 100 equal time intervals; the number of hours that each flow rate was exceeded was counted from the hourly series. Additionally, the intermediate peaks with a return period "i" were obtained (Q_i with i=3 to 9). For the purpose of the plot, the values were presented as percentage of time exceeded for each flow rate. FDC comparison at each POC is illustrated in Figure 4 in logarithmic scale. Attachment 5 provides a detailed drainage exhibit for the post-developed condition.

As can be seen in Attachment 2, the FDCs for the proposed condition with the HMP BMPs is within 110% of the curve for the existing condition in both peak flows and durations. The additional runoff volume generated from developing the site will be released to the existing points of discharge at a flow rate below the 10% Q_2 lower threshold of each POC. Additionally, the project will also not increase peak flow rates between the Q_2 and the Q_{10}, as shown in the graphic and also in the peak flow tables in Attachment 1.

SUMMARY

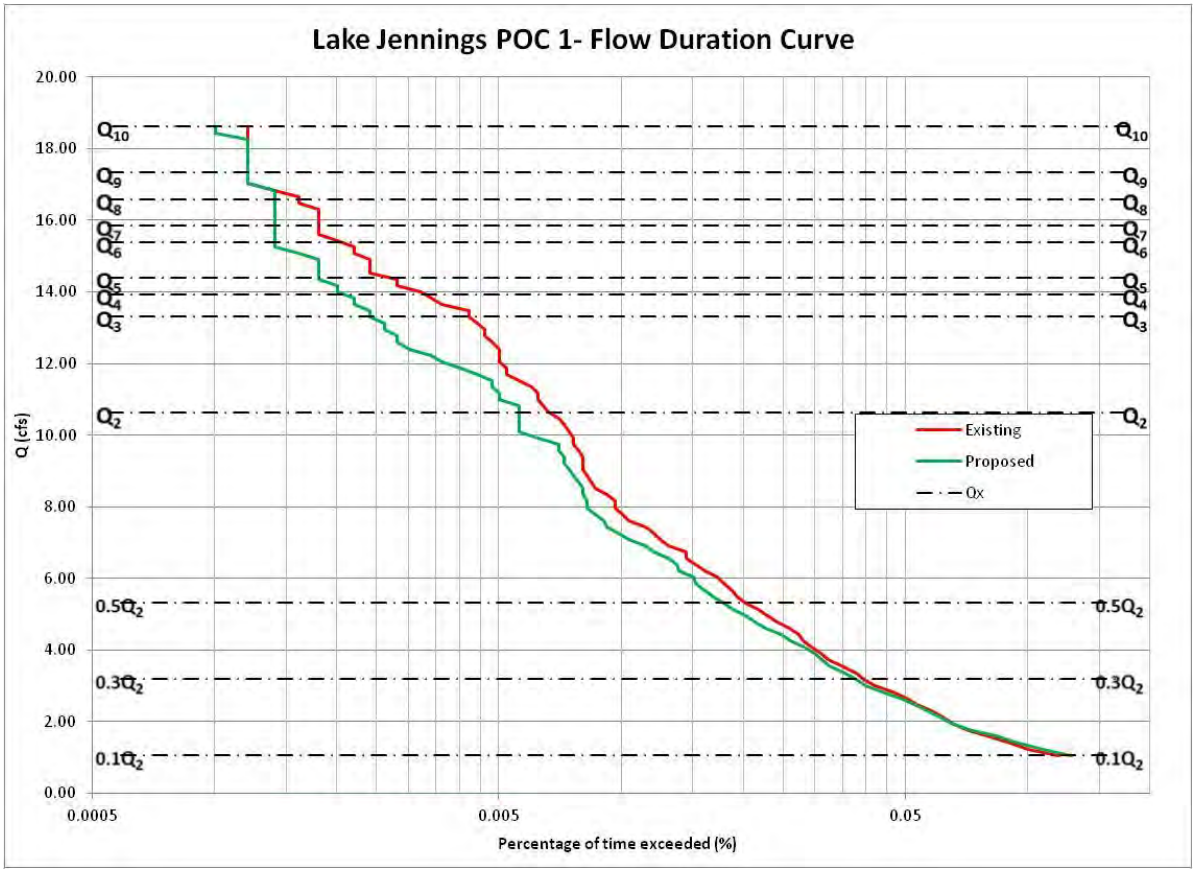
This study has demonstrated that the proposed HMP BMPs provided for the residential development site is sufficient to meet the current HMP criteria if the cross-section areas and volumes recommended within this technical memorandum, and the respective orifices and outlet structures are incorporated as specified within the proposed project site.

KEY ASSUMPTIONS

1. Type C Soil is representative of the existing condition site.

ATTACHMENTS

1. Q_2 to Q_{10} Comparison Tables
2. FDC Plots (log scale) and Flow Duration Tables.
3. List of the "n" largest Peaks for each POC: Pre-Development and Post-Development Conditions
4. Elevation vs. Area Curves and Elevations vs. Discharge Curves to be used in SWMM
5. Pre & Post Development Maps, Project plan and section sketches
6. SWMM Input Data in Input Format (Existing and Proposed Models)
7. SWMM Screens and Explanation of Significant Variables
8. Soil Information
9. Summary files from the SWMM Model
10. Response to Comments from third party reviewer



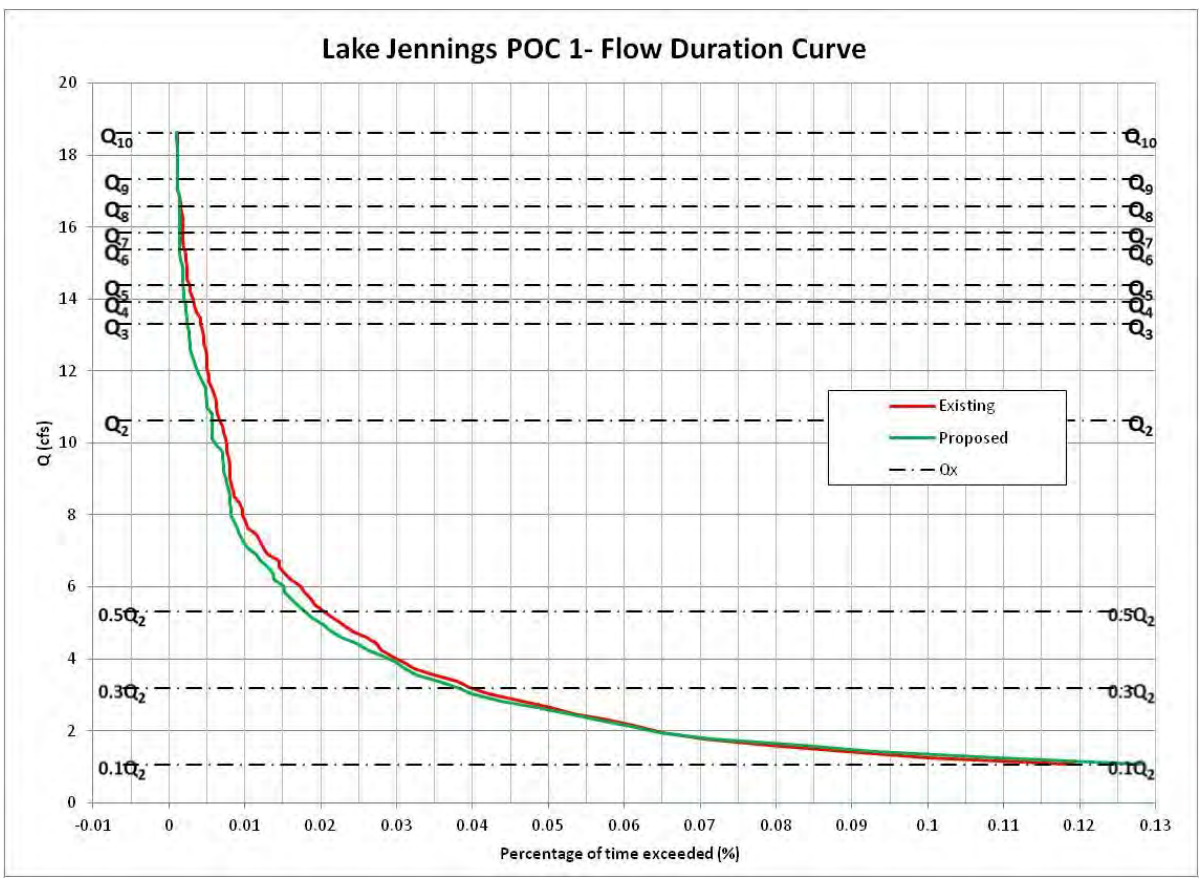


Figure 1a and 1b. Flow Duration Curve Comparison (logarithmic and normal "x" scale)

ATTACHMENT 1.

Q_2 to Q_{10} Comparison Table – POC 1

Return Period	Existing Condition (cfs)	Mitigated Condition (cfs)	Reduction, Exist - Mitigated (cfs)
2-year	10.620	9.840	0.780
3-year	13.313	11.735	1.577
4-year	13.914	12.366	1.549
5-year	14.391	12.960	1.432
6-year	15.371	13.623	1.748
7-year	15.855	14.116	1.739
8-year	16.571	14.561	2.010
9-year	17.336	15.641	1.696
10-year	18.616	17.864	0.752

ATTACHMENT 2

FLOW DURATION CURVE ANALYSIS

1) Flow duration curve shall not exceed the existing conditions by more than 10%, neither in peak flow nor duration.

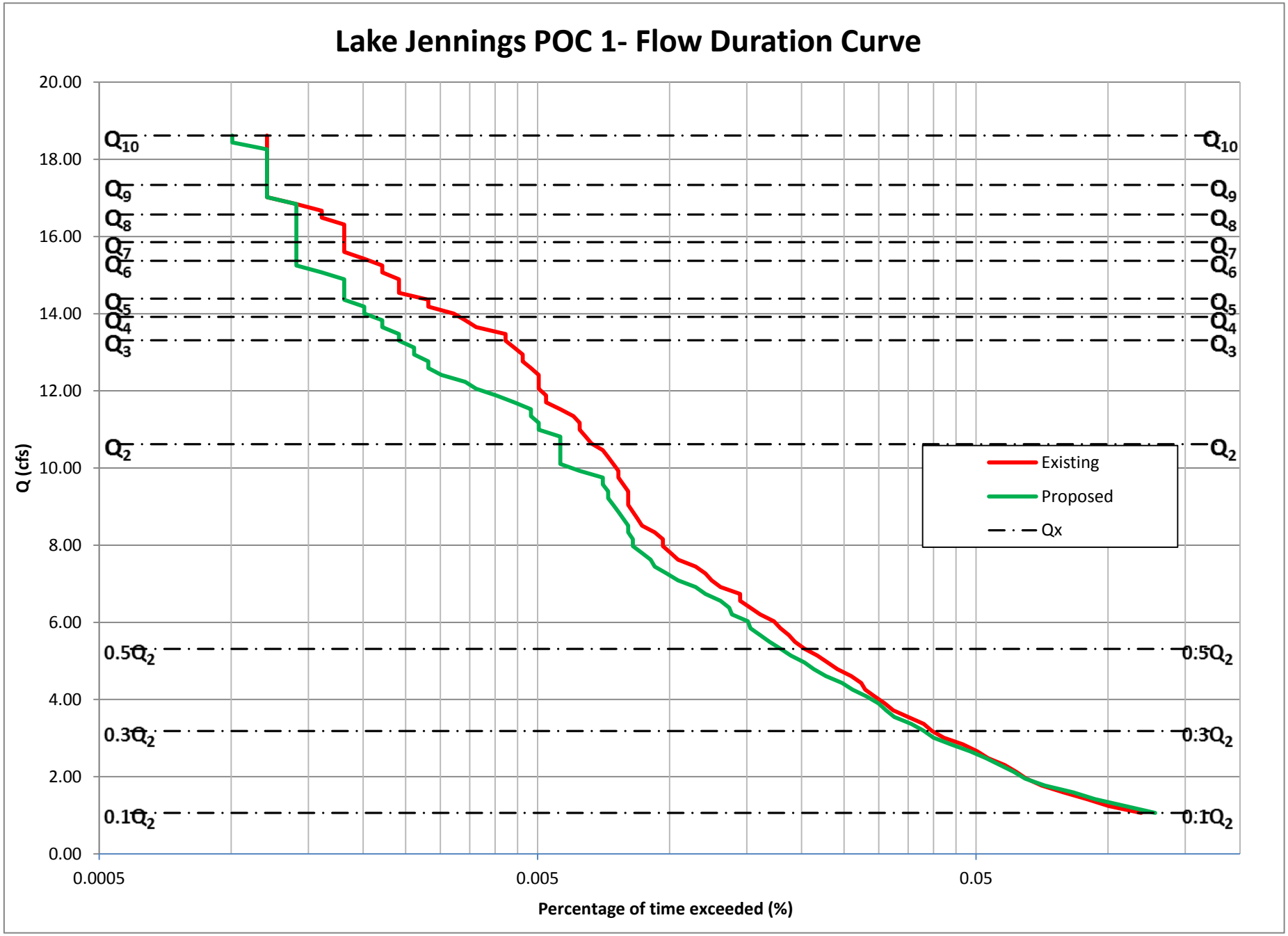
The figures on the following pages illustrate that the flow duration curve in post-development conditions after the proposed BMP is below the existing flow duration curve. The flow duration curve table following the curve shows that if the interval $0.10Q_2 - Q_{10}$ is divided in 100 sub-intervals, then a) the post development divided by pre-development durations are never larger than 110% (the permit allows up to 110%); and b) there are no more than 10 intervals in the range 101%-110% which would imply an excess over 10% of the length of the curve (the permit allows less than 10% of excesses measured as 101-110%).

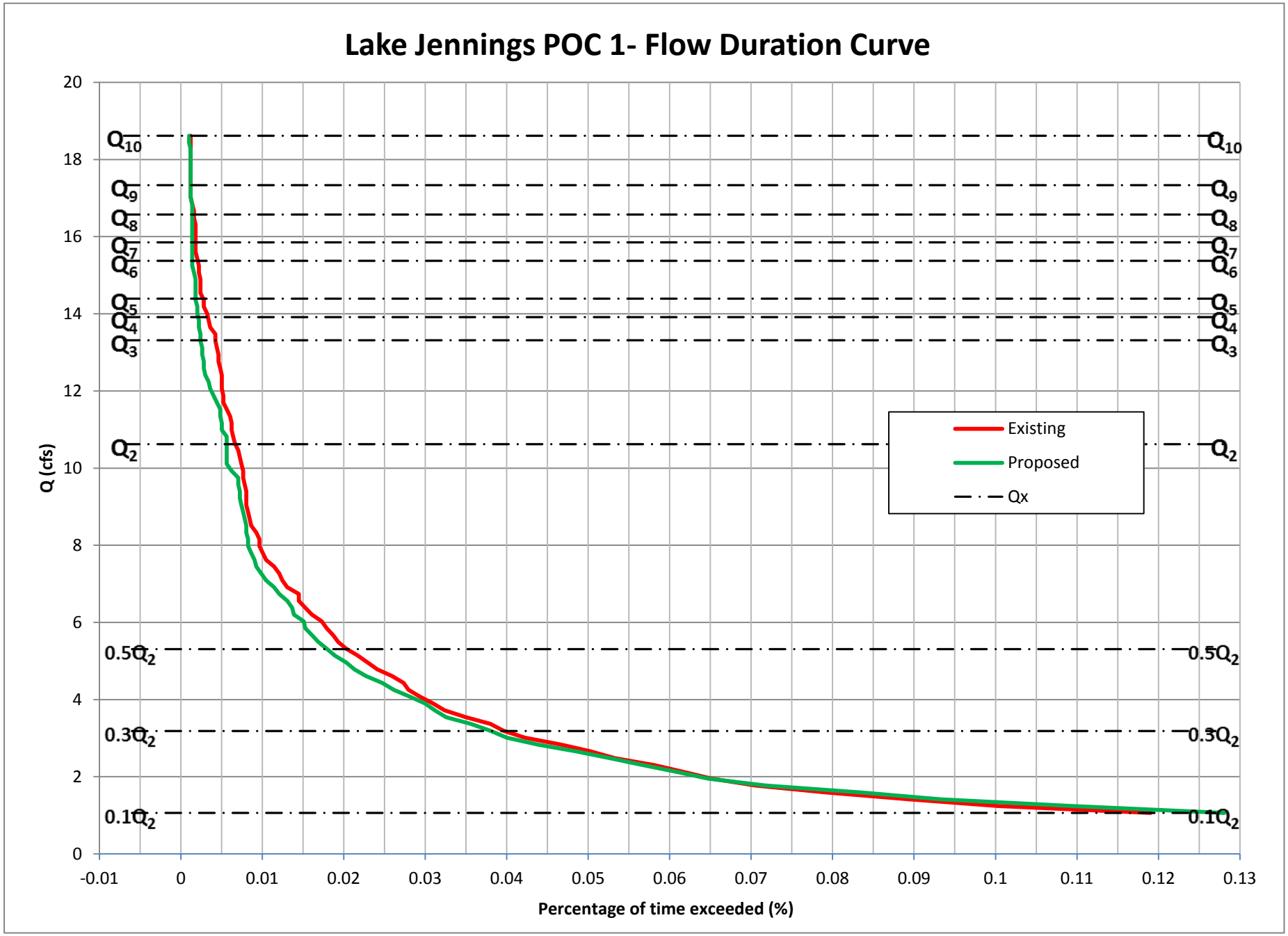
Consequently, the design passes the hydromodification test.

It is important to note that the flow duration curve can be expressed in the "x" axis as percentage of time, hours per year, total number of hours, or any other similar time variable. As those variables only differ by a multiplying constant, their plot in logarithmic scale is going to look exactly the same, and compliance can be observed regardless of the variable selected. However, in order to satisfy the County of San Diego HMP example, % of time exceeded is the variable of choice in the flow duration curve. The selection of a logarithmic scale in lieu of the normal scale is preferred, as differences between the pre-development and post-development curves can be seen more clearly in the entire range of analysis. Both graphics are presented just to prove the difference.

In terms of the "y" axis, the peak flow value is the variable of choice. As an additional analysis performed by REC, not only the range of analysis is clearly depicted (10% of Q_2 to Q_{10}) but also all intermediate flows are shown (Q_2, Q_3, Q_4, Q_5, Q_6, Q_7, Q_8 and Q_9) in order to demonstrate compliance at any range $Q_x - Q_{x+1}$. It must be pointed out that one of the limitations of both the SWMM and SDHM models is that the intermediate analysis is not performed (to obtain Q_i from i = 2 to 10). REC performed the analysis using the Cunnane Plotting position Method (the preferred method in the HMP permit) from the "n" largest independent peak flows obtained from the continuous time series.

The largest "n" peak flows are attached in this appendix, as well as the values of Q_i with a return period "i", from i=2 to 10. The Q_i values are also added into the flow-duration plot.


Lake Jennings POC 1- Flow Duration Curve
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Q (cfs)
0.0005
0.005
0.05
Percentage of time exceeded (%)
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
Existing
Proposed
Qx


Lake Jennings POC 1- Flow Duration Curve
Q (cfs)
Percentage of time exceeded (%)
Existing
Proposed
Qx
Q10
Q9
Q8
Q7
Q6
Q5
Q4
Q3
Q2
0.5Q2
0.3Q2
0.1Q2
20
18
16
14
12
10
8
6
4
2
0
-0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
0.11
0.12
0.13

Flow Duration Curve Data for Lake Jennings Residential Subdivision

Q2 =	10.62	cfs	Fraction	10	%
Q10 =	18.62	cfs			
Step =	0.1773	cfs			
Count =	497351	hours			
	56.74	years			

	Existing Condition			Detention Optimized			Pass or
Interval	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	Fail?
1	1.062	592	1.19E-01	637	1.28E-01	108%	Pass
2	1.239	499	1.00E-01	544	1.09E-01	109%	Pass
3	1.417	445	8.95E-02	464	9.33E-02	104%	Pass
4	1.594	394	7.92E-02	415	8.34E-02	105%	Pass
5	1.771	351	7.06E-02	357	7.18E-02	102%	Pass
6	1.949	324	6.51E-02	322	6.47E-02	99%	Pass
7	2.126	307	6.17E-02	303	6.09E-02	99%	Pass
8	2.303	289	5.81E-02	282	5.67E-02	98%	Pass
9	2.480	265	5.33E-02	262	5.27E-02	99%	Pass
10	2.658	250	5.03E-02	241	4.85E-02	96%	Pass
11	2.835	232	4.66E-02	218	4.38E-02	94%	Pass
12	3.012	210	4.22E-02	199	4.00E-02	95%	Pass
13	3.190	197	3.96E-02	189	3.80E-02	96%	Pass
14	3.367	189	3.80E-02	177	3.56E-02	94%	Pass
15	3.544	174	3.50E-02	162	3.26E-02	93%	Pass
16	3.722	161	3.24E-02	155	3.12E-02	96%	Pass
17	3.899	154	3.10E-02	149	3.00E-02	97%	Pass
18	4.076	146	2.94E-02	140	2.81E-02	96%	Pass
19	4.254	139	2.79E-02	130	2.61E-02	94%	Pass
20	4.431	136	2.73E-02	123	2.47E-02	90%	Pass
21	4.608	129	2.59E-02	113	2.27E-02	88%	Pass
22	4.786	120	2.41E-02	106	2.13E-02	88%	Pass
23	4.963	114	2.29E-02	101	2.03E-02	89%	Pass
24	5.140	108	2.17E-02	94	1.89E-02	87%	Pass
25	5.317	101	2.03E-02	89	1.79E-02	88%	Pass
26	5.495	96	1.93E-02	84	1.69E-02	88%	Pass
27	5.672	93	1.87E-02	80	1.61E-02	86%	Pass
28	5.849	89	1.79E-02	76	1.53E-02	85%	Pass
29	6.027	86	1.73E-02	75	1.51E-02	87%	Pass
30	6.204	80	1.61E-02	69	1.39E-02	86%	Pass
31	6.381	76	1.53E-02	68	1.37E-02	89%	Pass
32	6.559	72	1.45E-02	65	1.31E-02	90%	Pass
33	6.736	72	1.45E-02	60	1.21E-02	83%	Pass
34	6.913	65	1.31E-02	57	1.15E-02	88%	Pass
35	7.091	62	1.25E-02	52	1.05E-02	84%	Pass
36	7.268	60	1.21E-02	49	9.85E-03	82%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
37	7.445	57	1.15E-02	46	9.25E-03	81%	Pass
38	7.623	52	1.05E-02	45	9.05E-03	87%	Pass
39	7.800	50	1.01E-02	43	8.65E-03	86%	Pass
40	7.977	48	9.65E-03	41	8.24E-03	85%	Pass
41	8.154	48	9.65E-03	41	8.24E-03	85%	Pass
42	8.332	46	9.25E-03	40	8.04E-03	87%	Pass
43	8.509	43	8.65E-03	40	8.04E-03	93%	Pass
44	8.686	42	8.44E-03	39	7.84E-03	93%	Pass
45	8.864	41	8.24E-03	38	7.64E-03	93%	Pass
46	9.041	40	8.04E-03	37	7.44E-03	93%	Pass
47	9.218	40	8.04E-03	36	7.24E-03	90%	Pass
48	9.396	40	8.04E-03	36	7.24E-03	90%	Pass
49	9.573	39	7.84E-03	35	7.04E-03	90%	Pass
50	9.750	38	7.64E-03	35	7.04E-03	92%	Pass
51	9.928	38	7.64E-03	31	6.23E-03	82%	Pass
52	10.105	37	7.44E-03	28	5.63E-03	76%	Pass
53	10.282	36	7.24E-03	28	5.63E-03	78%	Pass
54	10.460	35	7.04E-03	28	5.63E-03	80%	Pass
55	10.637	33	6.64E-03	28	5.63E-03	85%	Pass
56	10.814	32	6.43E-03	28	5.63E-03	88%	Pass
57	10.991	31	6.23E-03	25	5.03E-03	81%	Pass
58	11.169	31	6.23E-03	25	5.03E-03	81%	Pass
59	11.346	30	6.03E-03	24	4.83E-03	80%	Pass
60	11.523	28	5.63E-03	24	4.83E-03	86%	Pass
61	11.701	26	5.23E-03	22	4.42E-03	85%	Pass
62	11.878	26	5.23E-03	20	4.02E-03	77%	Pass
63	12.055	25	5.03E-03	18	3.62E-03	72%	Pass
64	12.233	25	5.03E-03	17	3.42E-03	68%	Pass
65	12.410	25	5.03E-03	15	3.02E-03	60%	Pass
66	12.587	24	4.83E-03	14	2.81E-03	58%	Pass
67	12.765	23	4.62E-03	14	2.81E-03	61%	Pass
68	12.942	23	4.62E-03	13	2.61E-03	57%	Pass
69	13.119	22	4.42E-03	13	2.61E-03	59%	Pass
70	13.296	21	4.22E-03	12	2.41E-03	57%	Pass
71	13.474	21	4.22E-03	12	2.41E-03	57%	Pass
72	13.651	18	3.62E-03	11	2.21E-03	61%	Pass
73	13.828	17	3.42E-03	11	2.21E-03	65%	Pass
74	14.006	16	3.22E-03	10	2.01E-03	63%	Pass
75	14.183	14	2.81E-03	10	2.01E-03	71%	Pass
76	14.360	14	2.81E-03	9	1.81E-03	64%	Pass
77	14.538	12	2.41E-03	9	1.81E-03	75%	Pass
78	14.715	12	2.41E-03	9	1.81E-03	75%	Pass
79	14.892	12	2.41E-03	9	1.81E-03	75%	Pass
80	15.070	11	2.21E-03	8	1.61E-03	73%	Pass
81	15.247	11	2.21E-03	7	1.41E-03	64%	Pass

Interval	Existing Condition			Detention Optimized			Pass or Fail?
	Q (cfs)	Hours > Q	% time	Hours>Q	% time	Post/Pre	
82	15.424	10	2.01E-03	7	1.41E-03	70%	Pass
83	15.602	9	1.81E-03	7	1.41E-03	78%	Pass
84	15.779	9	1.81E-03	7	1.41E-03	78%	Pass
85	15.956	9	1.81E-03	7	1.41E-03	78%	Pass
86	16.133	9	1.81E-03	7	1.41E-03	78%	Pass
87	16.311	9	1.81E-03	7	1.41E-03	78%	Pass
88	16.488	8	1.61E-03	7	1.41E-03	88%	Pass
89	16.665	8	1.61E-03	7	1.41E-03	88%	Pass
90	16.843	7	1.41E-03	7	1.41E-03	100%	Pass
91	17.020	6	1.21E-03	6	1.21E-03	100%	Pass
92	17.197	6	1.21E-03	6	1.21E-03	100%	Pass
93	17.375	6	1.21E-03	6	1.21E-03	100%	Pass
94	17.552	6	1.21E-03	6	1.21E-03	100%	Pass
95	17.729	6	1.21E-03	6	1.21E-03	100%	Pass
96	17.907	6	1.21E-03	6	1.21E-03	100%	Pass
97	18.084	6	1.21E-03	6	1.21E-03	100%	Pass
98	18.261	6	1.21E-03	6	1.21E-03	100%	Pass
99	18.439	6	1.21E-03	5	1.01E-03	83%	Pass
100	18.616	6	1.21E-03	5	1.01E-03	83%	Pass

Peak Flows calculated with Cunnane Plotting Position

Return Period (years)	Pre-dev. Q (cfs)	Post-Dev. Q (cfs)	Reduction (cfs)
10	18.616	17.864	0.752
9	17.336	15.641	1.696
8	16.571	14.561	2.010
7	15.855	14.116	1.739
6	15.371	13.623	1.748
5	14.391	12.960	1.432
4	13.914	12.366	1.549
3	13.313	11.735	1.577
2	10.620	9.840	0.780

ATTACHMENT 3

List of the "n" Largest Peaks: Pre & Post-Developed Conditions

List of Peak events and Determination of Q2 and Q10 (Pre-Development)
Lake Jennings - POC 1

T (Year)	Cunnane (cfs)	Weibull (cfs)	Peaks (cfs)	Date	Posit	Period of Return (Years)	
						Weibull	Cunnane
10	18.62	19.40					
9	17.34	17.93	6.86	2/6/1969	57	1.02	1.01
8	16.57	16.75	6.9	1/15/1993	56	1.04	1.03
7	15.85	16.08	7.01	12/24/1971	55	1.05	1.05
6	15.37	15.42	7.03	1/15/1978	54	1.07	1.07
5	14.39	14.39	7.09	2/18/1980	53	1.09	1.09
4	13.91	13.95	7.15	1/9/2005	52	1.12	1.11
3	13.31	13.36	7.26	8/17/1977	51	1.14	1.13
2	10.62	10.62	7.4	3/1/1991	50	1.16	1.15
			7.44	2/23/2005	49	1.18	1.18
			7.53	11/11/1985	48	1.21	1.20
			7.55	2/22/1998	47	1.23	1.23
			7.55	2/12/2003	46	1.26	1.25
			7.57	11/8/2002	45	1.29	1.28
			7.61	1/11/2005	44	1.32	1.31
			7.76	9/18/1963	43	1.35	1.34
			7.91	2/15/1986	42	1.38	1.38
			7.95	2/4/1994	41	1.41	1.41
			8.17	12/2/1961	40	1.45	1.44
			8.34	3/11/1995	39	1.49	1.48
			8.48	2/22/2008	38	1.53	1.52
			8.54	1/18/1993	37	1.57	1.56
			8.74	2/14/1998	36	1.61	1.61
			8.87	3/2/1980	35	1.66	1.65
			9.49	1/29/1983	34	1.71	1.70
			9.72	1/29/1980	33	1.76	1.75
			9.97	1/6/2008	32	1.81	1.81
			10.22	1/16/1978	31	1.87	1.87
			10.39	2/16/1980	30	1.93	1.93
			10.62	2/17/1998	29	2.00	2.00
			10.98	2/27/1983	28	2.07	2.07
			11.37	12/30/1991	27	2.15	2.15
			11.45	10/20/2004	26	2.23	2.23
			11.53	1/27/2008	25	2.32	2.33
			11.58	2/23/1998	24	2.42	2.42
			12.58	11/22/1965	23	2.52	2.53
			12.75	2/3/1998	22	2.64	2.65
			13.02	2/10/1978	21	2.76	2.78
			13.12	3/17/1982	20	2.90	2.92
			13.49	10/27/2004	19	3.05	3.08
			13.64	11/15/1952	18	3.22	3.25
			13.64	4/1/1958	17	3.41	3.45
			13.81	3/1/1978	16	3.63	3.67
			13.86	1/16/1952	15	3.87	3.92
			14.05	10/29/2000	14	4.14	4.21
			14.08	12/19/1970	13	4.46	4.54
			14.39	2/18/2005	12	4.83	4.93
			14.4	1/14/1993	11	5.27	5.40
			15.36	2/20/1980	10	5.80	5.96
			15.54	9/23/1986	9	6.44	6.65
			16.33	2/4/1958	8	7.25	7.53
			16.91	2/25/1969	7	8.29	8.67
			18.89	2/25/2003	6	9.67	10.21
			21.84	1/15/1979	5	11.60	12.43
			22.98	1/4/1978	4	14.50	15.89
			23.13	1/4/1995	3	19.33	22.00
			23.2	10/1/1983	2	29.00	35.75
			28.85	4/14/2003	1	58.00	95.33

Note:
Cunnane is the preferred method by the HMP permit.

List of Peak events and Determination of Q2 and Q10 (Post-Development)
Lake Jennings - POC-1

T (Year)	Cunnane (cfs)	Weibull (cfs)
10	17.86	18.80
9	15.64	16.68
8	14.56	14.74
7	14.12	14.21
6	13.62	13.72
5	12.96	13.01
4	12.37	12.37
3	11.74	11.74
2	9.84	9.84

Note:
Cunnane is the preferred method by the HMP permit.

Peaks (cfs)	Date	Posit	Period of Return (Years)	
			Weibull	Cunnane
6.41	1/16/1993	57	1.02	1.01
6.51	12/5/1966	56	1.04	1.03
6.54	2/23/2005	55	1.05	1.05
6.63	3/1/1991	54	1.07	1.07
6.65	2/22/1998	53	1.09	1.09
6.65	2/12/2003	52	1.12	1.11
6.65	1/11/2005	51	1.14	1.13
6.66	11/8/2002	50	1.16	1.15
6.78	9/18/1963	49	1.18	1.18
6.82	11/11/1985	48	1.21	1.20
6.88	1/9/2005	47	1.23	1.23
6.95	3/8/1968	46	1.26	1.25
7.03	2/4/1994	45	1.29	1.28
7.05	8/17/1977	44	1.32	1.31
7.09	1/15/1978	43	1.35	1.34
7.22	12/2/1961	42	1.38	1.38
7.22	1/6/1979	41	1.41	1.41
7.36	3/11/1995	40	1.45	1.44
7.47	1/18/1993	39	1.49	1.48
7.63	2/14/1998	38	1.53	1.52
7.81	2/15/1986	37	1.57	1.56
7.93	3/2/1980	36	1.61	1.61
8.32	1/29/1983	35	1.66	1.65
8.63	1/6/2008	34	1.71	1.70
8.8	2/22/2008	33	1.76	1.75
9.02	2/16/1980	32	1.81	1.81
9.2	2/17/1998	31	1.87	1.87
9.51	2/27/1983	30	1.93	1.93
9.84	1/16/1978	29	2.00	2.00
9.87	10/20/2004	28	2.07	2.07
9.9	12/30/1991	27	2.15	2.15
9.94	1/27/2008	26	2.23	2.23
10	2/23/1998	25	2.32	2.33
10.1	1/29/1980	24	2.42	2.42
10.97	2/3/1998	23	2.52	2.53
11.55	2/10/1978	22	2.64	2.65
11.69	11/15/1952	21	2.76	2.78
11.73	4/1/1958	20	2.90	2.92
11.74	10/27/2004	19	3.05	3.08
11.97	1/16/1952	18	3.22	3.25
12.04	12/19/1970	17	3.41	3.45
12.12	10/29/2000	16	3.63	3.67
12.36	1/14/1993	15	3.87	3.92
12.38	2/18/2005	14	4.14	4.21
12.43	3/17/1982	13	4.46	4.54
12.93	11/22/1965	12	4.83	4.93
13.13	2/20/1980	11	5.27	5.40
13.6	9/23/1986	10	5.80	5.96
13.98	2/4/1958	9	6.44	6.65
14.32	3/1/1978	8	7.25	7.53
14.9	2/25/1969	7	8.29	8.67
18.34	2/25/2003	6	9.67	10.21
21	1/4/1978	5	11.60	12.43
22.08	1/15/1979	4	14.50	15.89
23.34	1/4/1995	3	19.33	22.00
23.58	10/1/1983	2	29.00	35.75
29.12	4/14/2003	1	58.00	95.33

ATTACHMENT 4

AREA VS ELEVATION

The LID module allows for the direct input of surface storage depth and BMP footprint area to determine surface ponded volume. As such no stage-storage calculations are required for this analysis.

DISCHARGE VS ELEVATION

The orifice has been selected to maximize their size while still restricting flows to conform with the required 10% of the Q2 event flow as mandated in the Final Hydromodification Management Plan by Brown & Caldwell, dated March 2011. While RECacknowledges that these orifices are small, to increase the size of these outlets would impact the basin's ability to restrict flows beneath the HMP thresholds, thus preventing the BMP from conformance with HMP requirements.

In order to further reduce the risk of blockage of the orifices, regular maintenance of the riser and orifices must be performed to ensure potential blockages are minimized. A detail of the orifice and riser structure is provided in Attachment 5 of this memorandum.

No stage-storage calculations were provided for the ultimate condition as there are no surface orifices; all HMP flows drain via the low orifice beneath the HMP facility.

ATTACHMENT 5

Pre & Post-Developed Maps, Project Plan and Detention Section Sketches