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MEMORANDUM

Date:	August 5, 2016	BKF Job Number:	20120185-10
Deliver To:	Will Anderson		
Company:	City of San Bruno – Public Services Dept.		
From:	Brian Scott, BKF Engineers		
Subject:	Glenview Terrace – Storm Drainage Report		

This memo presents the proposed storm drainage calculations for the Glenview Terrace project. The memo includes a hydrology and hydraulics analysis, stormwater treatment calculations and Bay Area Hydrology Model (BAHM) analysis.

1. EXISTING CONDITIONS

The existing site is approximately 3.28 acres. The southern portion of the site was a gas station that was demolished several years ago. It is currently an open field. The northern portion is a church, residential house, and surface parking lot. The northeast area of the site is a steep slope that is heavily wooded.

Runoff from the southern portion surface flows towards San Bruno Avenue where it enters the gutter system and flows easterly and is eventually collected in a City catch basin.

On the northern portion of the site, runoff from the church and parking lot surface flows to the gutter system on Glenview Avenue. The gutter conveys flows north along Glenview Avenue to a City catch basin. Runoff from the residential house and the wooded area surface flows to the east into the canyon area.

2. PROPOSED CONDITIONS

The proposed project consists of a 29-unit subdivision with a network of streets and sidewalks. A new below-grade drainage system will be installed for the project. The private, onsite drainage systems will connect to the City drainage systems in San Bruno Avenue and Glenview Avenue. To maintain the existing drainage patterns, the site grading and drainage design conveys flows from the southern portion of the site (DA-02) to a new storm drain line in San Bruno Avenue. Runoff from the new improvements in the northern portion of the site (DA-01) is conveyed to a new storm drain line in Glenview Avenue. The drainage pattern from the existing slope to the east of DA-02 will not be modified.

3. HYDROLOGY AND HYDRAULIC CALCULATIONS

Per the San Bruno municipal code section 12.44.090, the storm drain system is designed to convey the 25-year storm event. Storm drain pipe flows and capacity are evaluated using the StormCAD computer model by Haestad Methods. The program uses the Rational Method to calculate runoff flows and Manning's Equation to analyze flow in pipes. The following describes the variables used by the program:

Runoff Coefficient (Per San Bruno Municipal Code)

- The runoff coefficient for landscaped areas is 0.35.
- The runoff coefficient for paved areas and roofs is 0.95.

Rainfall Intensity Duration Frequency Curve

Rainfall intensities were obtained from the Crestmoor (Glenview) Neighborhood Reconstruction project. The 25-year intensity, with a time of concentration of 10-minutes, equals 2.85 in/hr.

Drainage Area

The proposed drainage areas for the site are shown on Figure 1.

Time of Concentration

A minimum time of concentration of 10-minutes is used for this analysis.

Pipe Roughness

A Manning's roughness coefficient of 0.012 is used for PVC pipe.

Tailwater Elevation

For a conservative analysis, we assumed the existing City storm drain pipe at the point of connection is full and the starting tail-water elevation is the top of the pipe.

Hydraulic Grade Line

The 25-year hydraulic grade line (HGL) will be contained within the storm drainage system and at least 6-inches below the flow line elevation at catch basins.

Tables A1, A2 and A3 present the 25-year hydrology and hydraulic calculations. Figure 1 shows the StormCAD model pipe and node network.

4. STORMWATER TREATMENT

As required by the Municipal Regional Permit, runoff from newly created impervious surfaces will be treated prior to entering the City storm drain system. There will two large bioretention facilities to treat runoff. BMP#1 will treat runoff from DA-01 and BMP#2 will treat runoff from the DA-02. The size of the bioretention facilities has been calculated using the "Combination Flow and Volume Design Basis" as described in Chapter 5 of the San Mateo County C.3 Stormwater Technical Guidance.

In addition to providing stormwater treatment, the bioretention areas will also serve as detention basins to control the rate of runoff to meet the hydromodification requirements. As shown in

Tables A4 and A5, the ponding depths in the bioretention areas for the water quality storm event (0.2 in/hr) do not exceed 12-inches. For larger storm events, ponding depths in BMP #1 will exceed 12-inches to meet the hydromodification requirements.

5. BAY AREA HYDROLOGY MODEL (BAHM)

As required by the Municipal Regional Permit, the Project is required to attenuate runoff associated with the increase in runoff created by more impervious area. The BAHM program is used to analyze the Project's flows as prescribed in the Municipal Regional Permit (MRP). The goal of the HM program is to control the flow to match pre-project runoff flow rate and duration from 10 percent of the pre-project 2-year peak flow up to the pre-project 10-year peak flow. Stormwater attenuation will be achieved in the stormwater treatment BMPs by adding a riser structure with or without orifices, sizing larger pipes for storage, adding a weir structure with a small orifice, and adjusting the depth of the BMP as necessary.

The project is broken into two Points of Compliance (POC) for HM evaluation. The POCs are consistent with the pre-project runoff drainage pattern. POC 1 corresponds with the DA-01 improvements which drain to BMP #1 in the post-project condition and POC 2 corresponds with the DA-02 improvements which drain to BMP #2 in the post-project condition. The pre-project land uses that were modeled are shown on sheets C3.0-C3.1 of the Vesting Tentative Tract Map (VTTM). Sheet C3.0 shows the DA-01 site as undeveloped. It should be noted that a gas station existed on the DA-01 site for many years and was removed in the early 2000s. Since the DA-01 site was previously developed and generated more runoff to the City storm drain system than an undeveloped site, our analysis is very conservative. Post-project land uses modeled are shown on sheets C7.0-C7.1 of the VTTM.

Modeling results showing full compliance with the HM requirements for POC 2 and partial compliance for POC 1 are shown on the attached report, which is a direct output from the BAHM program.

Low Flow Issue

As shown in the attached report, HM for POC 1 has been met for the flow ranges 0.038 to 0.403 cfs, equivalent to 25 percent of the 2-year up to the 10-year peak flow. However, HM for POC 1 did not meet the flow ranges 0.014 cfs (6.3 gallons per minute - gpm) to 0.035 cfs (15.7 gpm), equivalent to 10 percent of the 2-yr and 25 percent of the 2-year peak flow, respectively.

These lower flow ranges cannot be detained for this project due to the practical limitations of detaining very small flow rates. For example, the most downstream manhole for POC 1 contains a 24-inch high weir with a 1-inch diameter orifice at the bottom of the weir to restrict the flow. Even with a 1-inch diameter orifice, the lower flow rates listed above cannot be detained. If the size of the orifice is reduced less than 1-inch diameter, the orifice size becomes so small it will create a long term maintenance issue due to clogging.

HM Facilities

The size and number of orifices and riser heights were determined by the iterative BAHM modeling process to control the outflow of site runoff to match pre-construction rates. Design parameters for the risers and orifices (i.e. heights, orifice diameter, and number of orifices) are entered into the BAHM modeling program and the output is reviewed to check if the post-construction rate of runoff complies with pre-construction rates. This iterative process continues until the results are satisfactory.

The BMPs include the following facilities for HM compliance:

BMP #1

- 6-inch diameter riser 1.7-feet above surface flowline with three 1.5-inch orifices 0.5-feet above surface flowline
- 24-inch high weir structure with 1-inch diameter orifice in downstream manhole (with 46 lf of 24-inch diameter pipe for storage)
- The 0.5-feet height of the orifices was designed to allow for 5.8-inches of ponding (Per Table A4) for treatment purposes.

BMP #2

- 6-inch diameter riser 0.88-feet above surface flowline with no orifices
- 24-inch high weir structure with 2-inch diameter orifice in downstream drop inlet (with 110 lf of 24-inch diameter pipe for storage)
- The 0.88-foot height of the riser was designed to allow for 10.4-inches of ponding (Per Table A5) for treatment purposes.

The rim elevations of the drop inlet overflow structures were designed to be slightly higher than the risers for redundancy should the risers and orifices get clogged.

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TABLE A1
GLENVIEW TERRACE
DRAINAGE AREAS

Pervious, C = 0.35
Impervious, C = 0.95

DA-01

Drainage Area	Total Area (SF)	Total Area (AC)	Impervious Area (SF)	Pervious Area (SF)	C_w
DA 1-1	2301	0.05	1284	1017	0.68
DA1-2a	1996	0.05	1365	631	0.76
DA1-2b	2205	0.05	1283	922	0.70
DA1-3a	6410	0.15	3874	2536	0.71
DA1-3b	8129	0.19	3914	4215	0.64
DA1-4	17183	0.39	13308	3875	0.81
DA1-5	5307	0.12	3404	1903	0.73
DA1-6	2976	0.07	198	2778	0.39
	46507	1.07	28630	17877	0.72

MODELING MODIFICATIONS for DA-01

Drainage Area	Total Area (SF)	Total Area (AC)	Impervious Area (SF)	Pervious Area (SF)	C_w
DA 1-2 & 4	21384	0.49	15956	5428	0.80

DA-02

Drainage Area	Total Area (SF)	Total Area (AC)	Impervious Area (SF)	Pervious Area (SF)	C_w
DA2-1	6920	0.16	5867	1053	0.86
DA2-2	7550	0.17	5660	1890	0.80
DA2-3a	6031	0.14	4293	1738	0.78
DA2-3b	2812	0.06	1291	1521	0.63
DA2-4	9402	0.22	5082	4320	0.67
DA2-5	9586	0.22	7534	2052	0.82
DA2-6	5125	0.12	3065	2060	0.71
DA2-8	1723	0.04	568	1155	0.55
DA2-9	9337	0.21	7710	1627	0.85
DA2-10a	6466	0.15	3656	2810	0.69
DA2-10b	8068	0.19	5455	2613	0.76
DA2-11	4442	0.10	378	4064	0.40
	77462	1.78	50559	26903	0.74

MODELING MODIFICATIONS for DA-02

Drainage Area	Total Area (SF)	Total Area (AC)	Impervious Area (SF)	Pervious Area (SF)	C_w
DA 2-1 & 2	14470	0.33	11527	2943	0.83
DA 2-4 & 5 & 9	28325	0.65	20326	7999	0.78

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TABLE A2
GLENVIEW SAN BRUNO
DRAINAGE CALCULATIONS
25 Year Storm Hydrology

Node [1] #	Ground Elevation (ft) [1]	Sump Elevation (ft)	Inlet Area (acres)	Lateral Area (acres)	Inlet C	Inlet C*A (acres)	Cumulative Area (acres)	Cumulative C*A (acres)	Inlet Tc (minutes)	System Tc (minutes)	Intensity (in/hr)	**Discharge [3] (cfs)**
Outfall 1												
I-2L-1	467.8	464.6	0.12		0.75	0.09	0.12	0.09	10.0	10.00	2.85	**0.3**
I-4	474.7	469.0	0.33		0.67	0.22	0.33	0.22	10.0	10.00	2.85	**0.6**
I-3	467.5	464.5	0.49		0.79	0.39	0.82	0.61	10.0	10.60	2.79	**1.7**
I-2	467.5	464.4	(N/A)	0.12	(N/A)	0.00	0.94	0.70	5.0	10.63	2.78	**2.0**
I-1	467.0	464.1	0.05		0.68	0.03	0.99	0.73	5.0	10.81	2.77	**2.0**
Outfall 2												
I-8	464.0	459.7	1.07		0.72	0.77	1.07	0.77	10.8	10.80	2.77	**2.2**
I-7	466.0	457.5	(N/A)		(N/A)	0.00	1.07	0.77	5.0	10.84	2.76	**2.2**
I-6	460.6	455.6	(N/A)		(N/A)	0.00	1.07	0.77	5.0	10.87	2.76	**2.1**
Outfall 3												
CB-2LL-1	446.0	443.3	0.04		0.55	0.02	0.04	0.02	10.0	10.00	2.85	**0.1**
CB-2L-1	448.8	443.5	0.20		0.72	0.14	0.20	0.14	10.0	10.00	2.85	**0.4**
CB-6	461.9	455.9	0.12		0.66	0.08	0.12	0.08	10.0	10.00	2.85	**0.2**
CB-5L-1	466.0	459.7	0.33		0.69	0.23	0.33	0.23	10.0	10.00	2.85	**0.7**
CB-5	457.1	451.1	(N/A)		(N/A)	0.00	0.33	0.23	5.0	10.28	2.82	**0.7**
CB-4	454.9	448.9	0.65		0.77	0.50	0.98	0.81	10.0	10.35	2.81	**2.3**
CB-3	446.1	443.1	(N/A)		(N/A)	0.00	0.98	0.81	5.0	10.47	2.80	**2.3**
CB-2	445.2	442.8	(N/A)	0.24	(N/A)	0.00	1.22	0.97	5.0	10.57	2.79	**2.7**
CB-1	444.9	442.6	0.33		0.83	0.27	1.55	1.25	10.0	10.63	2.79	**3.5**
Outfall 4												
CB-9	442.9	438.8	1.78		0.73	1.30	1.78	1.30	10.7	10.70	2.78	**3.6**
CB-8	443.0	438.6	(N/A)		(N/A)	0.00	1.78	1.30	5.0	10.74	2.77	**3.6**
CB-7	443.0	437.4	(N/A)		(N/A)	0.00	1.78	1.30	5.0	11.13	2.73	**3.6**

Notes
(1) See Exhibit for node locations
(2) ft = feet, in/hr = inches/hour rainfall, cfs = cubic feet per second
(3) Discharge is from the Rational Method, Q = CIA
(4) Based on a 10-minute time of concentration
(5) Intensity Duration Frequency curve (IDF) taken from other San Bruno Project

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TABLE A3
GLENVIEW SAN BRUNO
DRAINAGE CALCULATIONS
25 Year Storm Hydraulics

Pipe #	Upstream Node	Downstream Node	Total Discharge [3] (cfs) [1]	Capacity @ Constructed Slope (cfs)	Pipe [5] Size (inches)	Length (feet)	Constructed Slope (ft/ft)	Pipe Roughness (Mannings n) [A]	Invert Elevation		Ground/Rim Elevation		HGL Elevation [4]		**Freeboard [2] (feet)**	Upstream Cover (feet)	Velocity (ft/s)
									Upstream	Downstream	Upstream	Downstream	Upstream	Downstream			
Outfall 1																	
P-2L-1	I-2L-1	I-2	0.3	3.1	12	32	0.006	0.012	464.60	464.40	467.80	467.50	465.24	465.24	**2.6**	2.2	2.4
P-4	I-4	I-3	0.6	6.1	12	180	0.025	0.012	469.00	464.50	474.70	467.50	469.33	465.34	**5.4**	4.7	5.0
P-3	I-3	I-2	1.7	3.9	12	10	0.010	0.012	464.50	464.40	467.50	467.50	465.29	465.29	**2.2**	2.0	4.8
P-2	I-2	I-1	2.0	3.1	12	46	0.007	0.012	464.40	464.10	467.50	467.00	465.22	465.13	**2.3**	2.1	4.2
P-1	I-1	Outfall-1	2.0	2.1	12	33	0.003	0.012	464.10	464.00	467.00	465.00	465.09	465.00	**1.9**	1.9	3.1
Outfall 2																	
P-8	I-8	I-7	2.2	75.8	24	23	0.096	0.012	459.70	457.50	464.00	466.00	460.21	458.15	**3.8**	2.3	10.6
P-7	I-7	I-6	2.2	19.0	15	22	0.086	0.013	457.50	455.60	466.00	460.60	458.08	456.30	**7.9**	7.3	10.3
P-6	I-6	Outfall-2	2.1	14.6	15	352	0.051	0.013	455.60	437.70	460.60	442.20	456.18	438.95	**4.4**	3.8	8.5
Outfall 3																	
L-2LL-1	CB-2LL-1	CB-2	0.1	0.7	6	37	0.014	0.012	443.30	442.80	446.00	445.20	443.76	443.75	**2.2**	2.2	2.2
L-2L-1	CB-2L-1	CB-2	0.4	4.2	12	59	0.012	0.012	443.50	442.80	448.80	445.20	443.77	443.76	**5.0**	4.3	3.4
L-6	CB-6	CB-4	0.2	11.4	12	80	0.088	0.012	455.90	448.90	461.90	454.90	456.10	449.64	**5.8**	5.0	5.8
L-5L-1	CB-5L-1	CB-5	0.7	10.2	12	123	0.070	0.012	459.70	451.10	466.00	457.10	460.04	451.48	**6.0**	5.3	7.3
L-5	CB-5	CB-4	0.7	10.3	12	31	0.071	0.012	451.10	448.90	457.10	454.90	451.43	449.66	**5.7**	5.0	7.3
L-4	CB-4	CB-3	2.3	10.8	12	74	0.078	0.012	448.90	443.10	454.90	446.10	449.55	443.89	**5.3**	5.0	10.9
L-3	CB-3	CB-2	2.3	3.7	12	32	0.009	0.012	443.10	442.80	446.10	445.20	443.75	443.78	**2.4**	2.0	5.0
L-2	CB-2	CB-1	2.7	4.1	12	18	0.011	0.012	442.80	442.60	445.20	444.90	443.65	443.61	**1.6**	1.4	5.6
L-1	CB-1	Outfall-3	3.5	4.5	12	44	0.014	0.012	442.60	442.00	444.90	443.00	443.40	443.00	**1.5**	1.3	6.3
Outfall 4																	
L-9	CB-9	CB-8	3.6	8.1	15	15	0.013	0.012	438.80	438.60	442.90	443.00	439.57	439.23	**3.3**	2.9	6.4
L-8	CB-8	CB-7	3.6	23.7	24	128	0.009	0.012	438.60	437.40	443.00	443.00	439.27	438.20	**3.7**	2.4	5.5
L-7	CB-7	Outfall-4	3.6	16.5	15	40	0.065	0.013	437.40	434.80	443.00	443.00	438.16	436.05	**4.8**	4.4	10.7

Notes
(1) ft = feet, cfs = cubic feet per second, ft/s = feet per second
(2) Freeboard is HGL (Hydraulic Grade Line) below Rim of Inlet
(3) Discharge is from the Rational Method, Q = CIA
(4) Downstream tailwater set to Crown of Pipe

Worksheet for Calculating the Combination Flow and Volume Method

Instructions: After completing Section 1, make a copy of this Excel file for each Drainage Management Area within the project. Enter information specific to the project and DMA in the cells shaded in yellow. Cells shaded in light blue contain formulas and values that will be automatically calculated.

1.0 Project Information

1-1	Project Name:	Glenview Terrace
1-2	City application ID:	
1-3	Site Address or APN:	2880 San Bruno Ave
1-4	Tract or Parcel Map No:	TM13-001
1-5	Rainfall Region	6
1-6	Region Mean Annual Precipitation (MAP)	20.10
1-7	Site Mean Annual Precipitation (MAP)	34

The calculations presented here are based on the combination flow and volume sizing method provided in the Countywide Program's C.3 Technical Guidance, Version 4.0. The steps presented below are explained in Section 5.1 of the Guidance, applicable portions of which are included in this file, in the sheet named "Guidance from Chapter 5".

Click here for map

1-8 *MAP adjustment factor is automatically calculated as:* 1.69

(The "Site Mean Annual Precipitation (MAP)" is divided by the MAP for the applicable rain gauge, shown in Table 5-3, below.)
Refer to the map in Appendix C of the C.3 Technical Guidance to identify the Rainfall Region for the site.

2.0 Calculate Percentage of Impervious Surface for Drainage Management Area (DMA)

2-1 Name of DMA: DMA-1

For items 2-2 and 2-3, enter the areas in square feet for each type of surface within the DMA.

	Type of Surface	Area of surface type within DMA (Sq. Ft.)	Adjust Pervious Surface	Effective Impervious Area
2-2	Impervious surface	28,630	1.0	28,630
2-3	Pervious surface	17,877	0.1	1,788
	Total DMA Area (square feet) =	46,507		

2-4 *Total Effective Impervious Area (EIA)* 30,418 Square feet

3.0 Calculate Unit Basin Storage Volume in Inches

Table 5-3. Unit Basin Storage Volumes in Inches for 80 Percent Capture Using 48-Hour Drawdowns, based on runoff coefficient

Region	Station, and Mean Annual Precipitation (Inches)	Runoff Coefficient of 1.0
1	Boulder Creek, 55.9"	2.04"
2	La Honda, 24.4"	0.86"
3	Half Moon Bay, 25.92"	0.82"
4	Palo Alto, 14.6"	0.64"
5	San Francisco, 21.0"	0.73"
6	San Francisco airport, 20.1"	0.85"
7	San Francisco Oceanside, 19.3"	0.72"

3-1 *Unit basin storage volume from Table 5-3:* 0.85

(The coefficient for this method is always 1.0, due to the conversion of any landscaping to effective impervious area.)

3-2 *Adjusted unit basin storage volume:* 1.44 Inches

(The unit basin storage volume [Item 3-1] is adjusted by applying the MAP adjustment factor [Item 1-8].)

3-3 *Required Capture Volume (in cubic feet):* 3,645 Cubic feet

(The adjusted unit basin sizing volume [Item 3-2] is multiplied by the DMA EIA [Item 2-4] and converted to cubic feet)

4.0 Calculate the Duration of the Rain Event

4-1	Rainfall intensity	0.2	Inches per hour
4-2	Divide Item 3-2 by Item 4-1	7.19	Hours of Rain Event Duration

5.0 Preliminary Estimate of Surface Area of Treatment Measure

5-1	4% of DMA EIA (Item 2-4)	1,217	Square feet
5-2	Area 25% smaller than Item 5-1 (i.e., 3% of DMA EIA)	913	Square feet
5-3	Volume of treated runoff for area in Item 5-2	2,733	Cubic feet (Item 5-2 * 5 inches per hour * 1/12 * Item 4-2)

6.0 Initial Adjustment of Depth of Surface Ponding Area

6-1	Subtract Item 5-3 from Item 3-3	911	Cubic feet (Amount of runoff to be stored in ponding area)
6-2	Divide Item 6-1 by Item 5-2	1.00	Feet (Depth of stored runoff in surface ponding area)
6-3	Convert Item 6-2 from feet to inches	11.98	Inches (Depth of stored runoff in surface ponding area)

6-4 If ponding depth in Item 6-3 meets your target depth (recommend 6"), skip to Item 8-1. If not, continue to Step 7-1.
(Note: Overflow outlet elevation should be set based on the calculated ponding depth.)

7.0 Optimize Size of Treatment Measure

7-1	Enter an area larger than Item 5-2	1393	Sq.ft. (enter larger area if you need less ponding depth.)
7-2	Volume of treated runoff for area in Item 7-1	4,173	Cubic feet (Item 7-1 * 5 inches per hour * 1/12 * Item 4-2)
7-3	Subtract Item 7-2 from Item 3-3	(528)	Cubic feet (Amount of runoff to be stored in ponding area)
7-4	Divide Item 7-3 by Item 7-1	---	Feet (Depth of stored runoff in surface ponding area)
7-5	Convert Item 7-4 from ft. to inches	---	Inches (Depth of stored runoff in surface ponding area)

7-6 If the ponding depth in Item 7-5 meets target, stop here. If not, repeat Steps 7-1 through 7-5 until you obtain target depth.
(Note: Overflow outlet elevation should be set based on the calculated ponding depth.)

8.0 Surface Area of Treatment Measure for DMA

8-1	Final surface area of treatment	1,393	Square feet (Either Item 5-2 or final amount in Item 7-1)

Worksheet for Calculating the Combination Flow and Volume Method

Instructions: After completing Section 1, make a copy of this Excel file for each Drainage Management Area within the project. Enter information specific to the project and DMA in the cells shaded in yellow. Cells shaded in light blue contain formulas and values that will be automatically calculated.

1.0 Project Information

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1-3	Site Address or APN:	2880 San Bruno Ave
1-4	Tract or Parcel Map No:	TM13-001
1-5	Rainfall Region	6
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Click here for map

1-8 *MAP adjustment factor is automatically calculated as:* 1.69

(The "Site Mean Annual Precipitation (MAP)" is divided by the MAP for the applicable rain gauge, showin in Table 5-3, below.)
Refer to the map in Appendix C of the C.3 Technical Guidance to identify the Rainfall Region for the site.

2.0 Calculate Percentage of Impervious Surface for Drainage Management Area (DMA)

2-1 Name of DMA: DMA-2

For items 2-2 and 2-3, enter the areas in square feet for each type of surface within the DMA.

	Type of Surface	Area of surface type within DMA (Sq. Ft.)	Adjust Pervious Surface	Effective Impervious Area
2-2	Impervious surface	50,559	1.0	50,559
2-3	Pervious surface	26,903	0.1	2,690
	Total DMA Area (square feet) =	77,462		

2-4 *Total Effective Impervious Area (EIA)* 53,249 Square feet

3.0 Calculate Unit Basin Storage Volume in Inches

Table 5-3. Unit Basin Storage Volumes in Inches for 80 Percent Capture Using 48-Hour Drawdowns, based on runoff coefficient

Region	Station, and Mean Annual Precipitation (Inches)	Runoff Coefficient of 1.0
1	Boulder Creek, 55.9"	2.04"
2	La Honda, 24.4"	0.86"
3	Half Moon Bay, 25.92"	0.82"
4	Palo Alto, 14.6"	0.64"
5	San Francisco, 21.0"	0.73"
6	San Francisco airport, 20.1"	0.85"
7	San Francisco Oceanside, 19.3"	0.72"

3-1 *Unit basin storage volume from Table 5-3:* 0.85

(The coefficient for this method is always 1.0, due to the conversion of any landscaping to effective impervious area.)

3-2 *Adjusted unit basin storage volume:* 1.44 Inches

(The unit basin storage volume [Item 3-1] is adjusted by applying the MAP adjustment factor [Item 1-8].)

3-3 *Required Capture Volume (in cubic feet):* 6,380 Cubic feet

(The adjusted unit basin sizing volume [Item 3-2] is multiplied by the DMA EIA [Item 2-4] and converted to cubic feet)

4.0 Calculate the Duration of the Rain Event

4-1	Rainfall intensity	0.2	Inches per hour
4-2	Divide Item 3-2 by Item 4-1	7.19	Hours of Rain Event Duration

5.0 Preliminary Estimate of Surface Area of Treatment Measure

5-1	4% of DMA EIA (Item 2-4)	2,130	Square feet
5-2	Area 25% smaller than Item 5-1 (i.e., 3% of DMA EIA)	1,597	Square feet
5-3	Volume of treated runoff for area in Item 5-2	4,785	Cubic feet (Item 5-2 * 5 inches per hour * 1/12 * Item 4-2)

6.0 Initial Adjustment of Depth of Surface Ponding Area

6-1	Subtract Item 5-3 from Item 3-3	1,595	Cubic feet (Amount of runoff to be stored in ponding area)
6-2	Divide Item 6-1 by Item 5-2	1.00	Feet (Depth of stored runoff in surface ponding area)
6-3	Convert Item 6-2 from feet to inches	11.98	Inches (Depth of stored runoff in surface ponding area)

6-4 If ponding depth in Item 6-3 meets your target depth (recommend 6"), skip to Item 8-1. If not, continue to Step 7-1.
(Note: Overflow outlet elevation should be set based on the calculated ponding depth.)

7.0 Optimize Size of Treatment Measure

7-1	Enter an area larger than Item 5-2	2132	Sq.ft. (enter larger area if you need less ponding depth.)
7-2	Volume of treated runoff for area in Item 7-1	6,386	Cubic feet (Item 7-1 * 5 inches per hour * 1/12 * Item 4-2)
7-3	Subtract Item 7-2 from Item 3-3	(6)	Cubic feet (Amount of runoff to be stored in ponding area)
7-4	Divide Item 7-3 by Item 7-1	---	Feet (Depth of stored runoff in surface ponding area)
7-5	Convert Item 7-4 from ft. to inches	---	Inches (Depth of stored runoff in surface ponding area)

7-6 If the ponding depth in Item 7-5 meets target, stop here. If not, repeat Steps 7-1 through 7-5 until you obtain target depth.
(Note: Overflow outlet elevation should be set based on the calculated ponding depth.)

8.0 Surface Area of Treatment Measure for DMA

8-1	Final surface area of treatment	2,132	Square feet (Either Item 5-2 or final amount in Item 7-1)

ENGINEERS . SURVEYORS . PLANNERS

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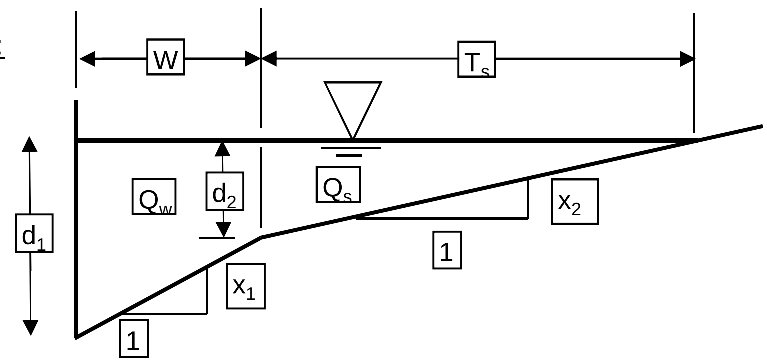
255 Shoreline Drive, Suite 200
Redwood City, CA, 94065
Tel 650.482.6300
Fax 650.482.6399

Approximate Gutter Capacity
5% Slope; Composite Cross Slope

Gutter Geometry:



d_1 [ft] =	0.50	Depth in feet (varies with flow)
d_2 [ft] =	0.42	Depth in feet (varies with flow)
w [ft] =	1.2	Width of gutter
T_s [ft] =	20.8	Width of street
x_1 [ft/ft]	0.07	Slope of gutter
x_2 [ft/ft]	0.02	Slope of street
S [ft/ft]	0.05	Slope of channel (H/L)
n =	0.01	Mannings Roughness Coefficient

Flow in Gutter (Q_w):

$Q_w = 0.56*(d_1^{8/3} - d_2^{8/3})*S^{1/2}/n*x_1$

Q [cfs] = 8.18 Flow at Specified Depth

Flow in Street (Q_s):

$Q_s = 0.56*(d_2^{8/3})*S^{1/2}/n*x_2$

Q [cfs] = 46.64 Flow at Specified Depth

Total Flow (Q):

$Q = Q_w + Q_s$

Q [cfs] = 54.82

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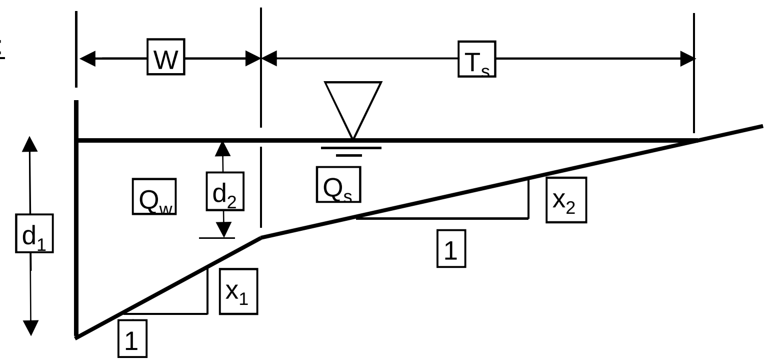
Approximate Gutter Capacity
6% Slope; Composite Cross Slope

Gutter Geometry:



d_1 [ft] =	0.50	Depth in feet (varies with flow)
d_2 [ft] =	0.42	Depth in feet (varies with flow)
w [ft] =	1.2	Width of gutter
T_s [ft] =	20.8	Width of street
x_1 [ft/ft]	0.07	Slope of gutter
x_2 [ft/ft]	0.02	Slope of street
S [ft/ft]	0.06	Slope of channel (H/L)
n =	0.01	Mannings Roughness Coefficient

Flow in Gutter (Q_w):

$Q_w = 0.56*(d_1^{8/3} - d_2^{8/3})*S^{1/2}/n*x_1$

Q [cfs] = 8.96 Flow at Specified Depth

Flow in Street (Q_s):

$Q_s = 0.56*(d_2^{8/3})*S^{1/2}/n*x_2$

Q [cfs] = 51.10 Flow at Specified Depth

Total Flow (Q):

$Q = Q_w + Q_s$

Q [cfs] = 60.05

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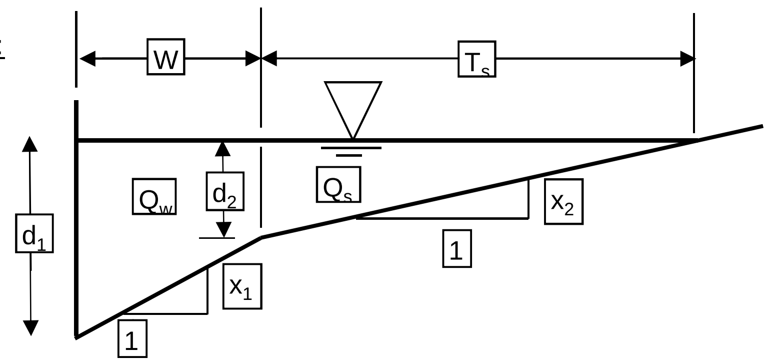
Approximate Gutter Capacity
9% Slope; Composite Cross Slope

Gutter Geometry:



d_1 [ft] =	0.50	Depth in feet (varies with flow)
d_2 [ft] =	0.42	Depth in feet (varies with flow)
w [ft] =	1.2	Width of gutter
T_s [ft] =	20.8	Width of street
x_1 [ft/ft]	0.07	Slope of gutter
x_2 [ft/ft]	0.02	Slope of street
S [ft/ft]	0.09	Slope of channel (H/L)
n =	0.01	Mannings Roughness Coefficient

Flow in Gutter (Q_w):

$Q_w = 0.56*(d_1^{8/3} - d_2^{8/3})*S^{1/2}/n*x_1$

Q [cfs] = 10.97 Flow at Specified Depth

Flow in Street (Q_s):

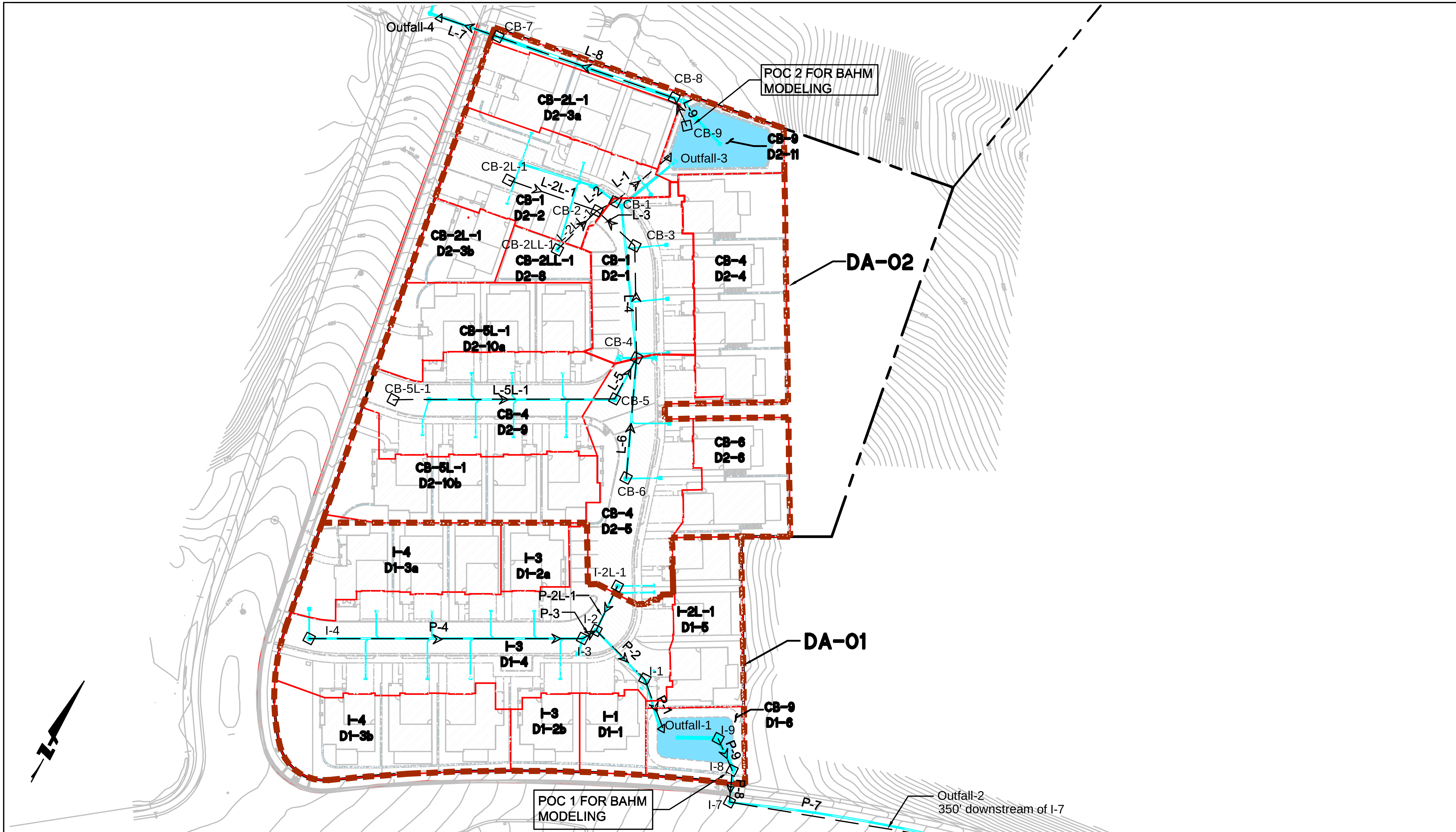
$Q_s = 0.56*(d_2^{8/3})*S^{1/2}/n*x_2$

Q [cfs] = 62.58 Flow at Specified Depth

Total Flow (Q):

$Q = Q_w + Q_s$

Q [cfs] = 73.55



DRAWING NAME: K:\Eng12\120185\DWG\HYDROLOGY\Quantities_StormCAD.dwg
PLOTTED BY: wort
PLOT DATE: 08-04-16

JOB No: 20120185
DATE: JULY 28, 2016
BY: R.A.M
REV:

GRAPHIC SCALE
60 0 60 120

LEGEND

I-2-X STORMCAD SYSTEM – ELEMENT NUMBER
DRAINAGE BOUNDADRY
I-6 / D1-4b INLET AT WHICH DRAINAGE ENTERS SD SYSTEM / DRAINAGE AREA NAME

FIGURE 1
GLENVIEW TERRACE
SAN BRUNO, CALIFORNIA
DRAINAGE CALCULATIONS
DRAINAGE AREAS & STORM CAD SCHEMATIC

BKF

Bay Area Hydrology Model
PROJECT REPORT

Project Name: GT
Site Address: San Bruno Ave & Glenview Dr
City : San Bruno
Report Date : 2/16/2016
Gage : San Francisco
Data Start : 1959/10/01
Data End : 1997/09/30
Precip Scale: 1.29
BAHM Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C D,Grass,Flat(0-5%)	1.05

Impervious Land Use	Acres

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	Acres
C D,Grass,Flat(0-5%)	1.62

Impervious Land Use	Acres		
Roads,Flat(0-5%)	0.44	Area	0.17

Element Flows To:

Surface	Interflow	Groundwater

Name : Basin 1
Bypass: No

GroundWater: No

Pervious Land Use	**Acres**
B,Urban,Flat(0-5%)	**.37**

Impervious Land Use	**Acres**		
Roads,Flat(0-5%)	**0.35**	**Area**	**0.35**

Element Flows To:

Surface	**Interflow**	**Groundwater**
Bioretenti Surface 1,	Bioretenti Surface 1,	

Name : Basin 2
Bypass: No

GroundWater: No

Pervious Land Use	**Acres**
B,Urban,Flat(0-5%)	**.61**

Impervious Land Use	**Acres**		
Roads,Flat(0-5%)	**0.69**	**Area**	**0.48**

Element Flows To:

Surface	**Interflow**	**Groundwater**
1,679Biore Surface 2,	1,679Biore Surface 2,	

Name : Basin 3
Bypass: No

GroundWater: No

Pervious Land Use	**Acres**
C D,Grass,Flat(0-5%)	**.42**

Impervious Land Use	**Acres**
Roof Area	**0.01**

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : Bioretention Swale 1

Element Flows To:
Outlet 1 **Outlet 2**
Tank 1,

Name : Bioretenti Surface 1

Element Flows To:
Outlet 1 **Outlet 2**
Tank 1, Bioretention Swale 1,

Name : 1,679Bioretention Swale 2

Element Flows To:
Outlet 1 **Outlet 2**
Tank 1,

Name : 1,679Biore Surface 2

Element Flows To:
Outlet 1 **Outlet 2**
Tank 1, 1,679Bioretention Swale 2,

Name : Tank 1
Tank Name: Tank 1

Dimensions
Depth: 24ft.
Tank Type : Circular
Diameter : 24 ft.
Length : 46 ft.
Discharge Structure
Riser Height: 2 ft.
Riser Diameter: 24 in.
Orifice 1 Diameter: 1 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Tank Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.000	0.000	0.000	0.000
0.267	0.005	0.001	0.014	0.000
0.533	0.007	0.003	0.019	0.000
0.800	0.009	0.005	0.023	0.000
1.067	0.010	0.007	0.027	0.000
1.333	0.012	0.010	0.030	0.000
1.600	0.013	0.014	0.033	0.000

1.867	0.014	0.017	0.036	0.000
2.133	0.014	0.021	0.987	0.000
2.400	0.015	0.025	4.968	0.000
2.667	0.016	0.029	10.65	0.000
2.933	0.017	0.033	17.61	0.000
3.200	0.017	0.038	25.65	0.000
3.467	0.018	0.043	34.65	0.000
3.733	0.018	0.047	44.50	0.000
4.000	0.019	0.052	55.14	0.000
4.267	0.019	0.057	66.52	0.000
4.533	0.020	0.063	78.59	0.000
4.800	0.020	0.068	91.32	0.000
5.067	0.021	0.073	104.7	0.000
5.333	0.021	0.079	118.6	0.000
5.600	0.021	0.085	133.1	0.000
5.867	0.022	0.090	148.2	0.000
6.133	0.022	0.096	163.7	0.000
6.400	0.022	0.102	179.8	0.000
6.667	0.023	0.108	196.4	0.000
6.933	0.023	0.114	213.5	0.000
7.200	0.023	0.121	231.0	0.000
7.467	0.023	0.127	249.0	0.000
7.733	0.024	0.133	267.5	0.000
8.000	0.024	0.139	286.3	0.000
8.267	0.024	0.146	305.6	0.000
8.533	0.024	0.152	325.3	0.000
8.800	0.024	0.159	345.5	0.000
9.067	0.025	0.165	366.0	0.000
9.333	0.025	0.172	386.9	0.000
9.600	0.025	0.178	408.2	0.000
9.867	0.025	0.185	429.8	0.000
10.13	0.025	0.192	451.9	0.000
10.40	0.025	0.198	474.3	0.000
10.67	0.025	0.205	497.0	0.000
10.93	0.025	0.212	520.2	0.000
11.20	0.025	0.219	543.6	0.000
11.47	0.025	0.225	567.4	0.000
11.73	0.025	0.232	591.6	0.000
12.00	0.025	0.239	616.0	0.000
12.27	0.025	0.246	640.8	0.000
12.53	0.025	0.252	666.0	0.000
12.80	0.025	0.259	691.4	0.000
13.07	0.025	0.266	717.2	0.000
13.33	0.025	0.273	743.3	0.000
13.60	0.025	0.279	769.6	0.000
13.87	0.025	0.286	796.3	0.000
14.13	0.025	0.293	823.3	0.000
14.40	0.025	0.299	850.6	0.000
14.67	0.025	0.306	878.2	0.000
14.93	0.025	0.312	906.1	0.000
15.20	0.024	0.319	934.2	0.000
15.47	0.024	0.325	962.7	0.000
15.73	0.024	0.332	991.4	0.000
16.00	0.024	0.338	1020.	0.000
16.27	0.024	0.345	1049.	0.000
16.53	0.023	0.351	1079.	0.000
16.80	0.023	0.357	1109.	0.000

17.07	0.023	0.363	1139.	0.000
17.33	0.023	0.369	1169.	0.000
17.60	0.022	0.375	1200.	0.000
17.87	0.022	0.381	1231.	0.000
18.13	0.022	0.387	1262.	0.000
18.40	0.021	0.393	1293.	0.000
18.67	0.021	0.399	1325.	0.000
18.93	0.021	0.404	1357.	0.000
19.20	0.020	0.410	1389.	0.000
19.47	0.020	0.415	1421.	0.000
19.73	0.019	0.420	1454.	0.000
20.00	0.019	0.425	1487.	0.000
20.27	0.018	0.430	1520.	0.000
20.53	0.018	0.435	1554.	0.000
20.80	0.017	0.440	1587.	0.000
21.07	0.017	0.444	1621.	0.000
21.33	0.016	0.449	1655.	0.000
21.60	0.015	0.453	1690.	0.000
21.87	0.014	0.457	1724.	0.000
22.13	0.014	0.461	1759.	0.000
22.40	0.013	0.464	1794.	0.000
22.67	0.012	0.467	1830.	0.000
22.93	0.010	0.470	1865.	0.000
23.20	0.009	0.473	1901.	0.000
23.47	0.007	0.475	1937.	0.000
23.73	0.005	0.477	1973.	0.000
24.00	0.000	0.478	2010.	0.000
24.27	0.000	0.000	2046.	0.000

Name : Tank 1
Tank Name: Tank 1

Dimensions
Depth: 24ft.
Tank Type : Circular
Diameter : 24 ft.
Length : 110 ft.
Discharge Structure
Riser Height: 2 ft.
Riser Diameter: 24 in.
Orifice 1 Diameter: 2 in. **Elevation:** 0 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Tank Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
0.000	0.000	0.000	0.000	0.000
0.267	0.013	0.002	0.054	0.000
0.533	0.018	0.006	0.077	0.000
0.800	0.022	0.012	0.094	0.000
1.067	0.025	0.018	0.109	0.000
1.333	0.028	0.025	0.121	0.000

1.600	0.030	0.033	0.133	0.000
1.867	0.032	0.041	0.144	0.000
2.133	0.034	0.050	1.102	0.000
2.400	0.036	0.059	5.090	0.000
2.667	0.038	0.069	10.77	0.000
2.933	0.040	0.080	17.74	0.000
3.200	0.041	0.091	25.79	0.000
3.467	0.043	0.102	34.79	0.000
3.733	0.044	0.113	44.65	0.000
4.000	0.045	0.125	55.30	0.000
4.267	0.046	0.137	66.69	0.000
4.533	0.047	0.150	78.76	0.000
4.800	0.048	0.163	91.49	0.000
5.067	0.049	0.176	104.8	0.000
5.333	0.050	0.189	118.8	0.000
5.600	0.051	0.203	133.3	0.000
5.867	0.052	0.216	148.4	0.000
6.133	0.053	0.230	163.9	0.000
6.400	0.054	0.245	180.0	0.000
6.667	0.054	0.259	196.6	0.000
6.933	0.055	0.274	213.7	0.000
7.200	0.056	0.288	231.2	0.000
7.467	0.056	0.303	249.2	0.000
7.733	0.057	0.318	267.7	0.000
8.000	0.057	0.333	286.6	0.000
8.267	0.058	0.349	305.9	0.000
8.533	0.058	0.364	325.6	0.000
8.800	0.058	0.380	345.7	0.000
9.067	0.059	0.395	366.2	0.000
9.333	0.059	0.411	387.1	0.000
9.600	0.059	0.427	408.4	0.000
9.867	0.060	0.443	430.1	0.000
10.13	0.060	0.459	452.1	0.000
10.40	0.060	0.475	474.5	0.000
10.67	0.060	0.491	497.3	0.000
10.93	0.060	0.507	520.4	0.000
11.20	0.060	0.523	543.9	0.000
11.47	0.061	0.539	567.7	0.000
11.73	0.061	0.555	591.8	0.000
12.00	0.061	0.571	616.3	0.000
12.27	0.061	0.587	641.1	0.000
12.53	0.061	0.604	666.2	0.000
12.80	0.060	0.620	691.7	0.000
13.07	0.060	0.636	717.5	0.000
13.33	0.060	0.652	743.5	0.000
13.60	0.060	0.668	769.9	0.000
13.87	0.060	0.684	796.6	0.000
14.13	0.060	0.700	823.6	0.000
14.40	0.059	0.716	850.9	0.000
14.67	0.059	0.731	878.5	0.000
14.93	0.059	0.747	906.4	0.000
15.20	0.058	0.763	934.5	0.000
15.47	0.058	0.778	963.0	0.000
15.73	0.058	0.794	991.7	0.000
16.00	0.057	0.809	1020.	0.000
16.27	0.057	0.824	1050.	0.000
16.53	0.056	0.839	1079.	0.000

16.80	0.056	0.854	1109.	0.000
17.07	0.055	0.869	1139.	0.000
17.33	0.054	0.883	1169.	0.000
17.60	0.054	0.898	1200.	0.000
17.87	0.053	0.912	1231.	0.000
18.13	0.052	0.926	1262.	0.000
18.40	0.051	0.940	1294.	0.000
18.67	0.050	0.953	1325.	0.000
18.93	0.049	0.967	1357.	0.000
19.20	0.048	0.980	1389.	0.000
19.47	0.047	0.993	1422.	0.000
19.73	0.046	1.005	1455.	0.000
20.00	0.045	1.017	1487.	0.000
20.27	0.044	1.029	1521.	0.000
20.53	0.043	1.041	1554.	0.000
20.80	0.041	1.052	1588.	0.000
21.07	0.040	1.063	1622.	0.000
21.33	0.038	1.073	1656.	0.000
21.60	0.036	1.083	1690.	0.000
21.87	0.034	1.092	1725.	0.000
22.13	0.032	1.101	1760.	0.000
22.40	0.030	1.110	1795.	0.000
22.67	0.028	1.117	1830.	0.000
22.93	0.025	1.124	1866.	0.000
23.20	0.022	1.131	1901.	0.000
23.47	0.018	1.136	1937.	0.000
23.73	0.013	1.140	1973.	0.000
24.00	0.000	1.142	2010.	0.000
24.27	0.000	0.000	2047.	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.135754
5 year	0.320869
10 year	0.403308
25 year	0.672722

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.105202
5 year	0.168113
10 year	0.224668
25 year	0.372554

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1961	0.101	0.031
1962	0.011	0.052
1963	0.279	0.115

1964	0.118	0.143
1965	0.054	0.102
1966	0.130	0.031
1967	0.117	0.035
1968	0.225	0.144
1969	0.088	0.095
1970	0.325	0.127
1971	0.364	0.276
1972	0.115	0.107
1973	0.012	0.027
1974	0.289	0.165
1975	0.178	0.137
1976	0.094	0.031
1977	0.000	0.026
1978	0.000	0.097
1979	0.142	0.088
1980	0.129	0.137
1981	0.183	0.045
1982	0.022	0.177
1983	0.399	0.223
1984	1.014	0.246
1985	0.246	0.167
1986	0.215	0.104
1987	0.539	0.163
1988	0.156	0.147
1989	0.250	0.123
1990	0.189	0.076
1991	0.087	0.041
1992	0.033	0.029
1993	0.456	0.174
1994	0.323	0.188
1995	0.058	0.032
1996	0.320	0.619
1997	0.029	0.029
1998	0.303	0.155

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	1.0136	0.6194
2	0.5388	0.2756
3	0.4562	0.2461
4	0.3989	0.2229
5	0.3643	0.1879
6	0.3251	0.1774
7	0.3234	0.1742
8	0.3203	0.1668
9	0.3028	0.1654
10	0.2890	0.1631
11	0.2793	0.1547
12	0.2498	0.1468
13	0.2456	0.1444
14	0.2248	0.1434
15	0.2146	0.1374
16	0.1889	0.1365
17	0.1832	0.1272
18	0.1781	0.1231

19	0.1558	0.1148
20	0.1419	0.1068
21	0.1299	0.1037
22	0.1293	0.1016
23	0.1182	0.0969
24	0.1174	0.0948
25	0.1151	0.0880
26	0.1008	0.0758
27	0.0937	0.0518
28	0.0876	0.0450
29	0.0874	0.0414
30	0.0581	0.0351
31	0.0544	0.0322
32	0.0334	0.0314
33	0.0294	0.0311
34	0.0220	0.0308
35	0.0125	0.0294
36	0.0107	0.0289
37	0.0002	0.0272
38	0.0001	0.0256

POC #1

Facility FAILED duration standard for 1+ flows.

Flow(CFS)	**Predev**	**Dev**	**Percentage**	**Pass/Fail**
0.0136	1455	6976	479	Fail
0.0175	1260	5926	470	Fail
0.0214	1111	4917	442	Fail
0.0254	985	3724	378	Fail
0.0293	896	2360	263	Fail
0.0333	817	1449	177	Fail
0.0372	742	476	64	Pass
0.0411	659	442	67	Pass
0.0451	605	410	67	Pass
0.0490	555	372	67	Pass
0.0529	516	354	68	Pass
0.0569	480	331	68	Pass
0.0608	440	309	70	Pass
0.0648	408	290	71	Pass
0.0687	369	265	71	Pass
0.0726	348	253	72	Pass
0.0766	317	234	73	Pass
0.0805	296	224	75	Pass
0.0844	277	208	75	Pass
0.0884	264	197	74	Pass
0.0923	243	182	74	Pass
0.0962	216	164	75	Pass
0.1002	205	150	73	Pass
0.1041	181	141	77	Pass
0.1081	166	132	79	Pass
0.1120	154	126	81	Pass
0.1159	143	114	79	Pass
0.1199	129	108	83	Pass
0.1238	124	97	78	Pass
0.1277	117	88	75	Pass

0.1317	110	87	79	Pass
0.1356	100	79	79	Pass
0.1395	93	69	74	Pass
0.1435	86	65	75	Pass
0.1474	83	59	71	Pass
0.1514	75	53	70	Pass
0.1553	69	46	66	Pass
0.1592	66	41	62	Pass
0.1632	64	40	62	Pass
0.1671	59	33	55	Pass
0.1710	56	33	58	Pass
0.1750	56	32	57	Pass
0.1789	54	29	53	Pass
0.1829	51	28	54	Pass
0.1868	49	25	51	Pass
0.1907	46	22	47	Pass
0.1947	43	22	51	Pass
0.1986	41	20	48	Pass
0.2025	40	20	50	Pass
0.2065	37	18	48	Pass
0.2104	36	18	50	Pass
0.2143	33	17	51	Pass
0.2183	31	15	48	Pass
0.2222	29	13	44	Pass
0.2262	27	10	37	Pass
0.2301	26	10	38	Pass
0.2340	25	10	40	Pass
0.2380	25	10	40	Pass
0.2419	25	10	40	Pass
0.2458	24	9	37	Pass
0.2498	23	8	34	Pass
0.2537	19	8	42	Pass
0.2577	18	8	44	Pass
0.2616	18	8	44	Pass
0.2655	18	8	44	Pass
0.2695	18	8	44	Pass
0.2734	18	8	44	Pass
0.2773	16	6	37	Pass
0.2813	15	6	40	Pass
0.2852	14	6	42	Pass
0.2891	13	6	46	Pass
0.2931	12	5	41	Pass
0.2970	12	5	41	Pass
0.3010	12	5	41	Pass
0.3049	11	5	45	Pass
0.3088	10	5	50	Pass
0.3128	10	5	50	Pass
0.3167	10	5	50	Pass
0.3206	10	5	50	Pass
0.3246	8	5	62	Pass
0.3285	7	5	71	Pass
0.3324	7	5	71	Pass
0.3364	7	5	71	Pass
0.3403	7	5	71	Pass
0.3443	7	5	71	Pass
0.3482	6	5	83	Pass
0.3521	6	5	83	Pass

0.3561	6	5	83	Pass
0.3600	6	4	66	Pass
0.3639	6	4	66	Pass
0.3679	5	4	80	Pass
0.3718	5	4	80	Pass
0.3758	5	4	80	Pass
0.3797	5	4	80	Pass
0.3836	5	4	80	Pass
0.3876	5	4	80	Pass
0.3915	5	4	80	Pass
0.3954	5	3	60	Pass
0.3994	4	3	75	Pass
0.4033	4	2	50	Pass

The development has an increase in flow durations for more than a 10% increase from the 2 year to the 10 year flow.

Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.421698
5 year	0.849425
10 year	0.969455
25 year	1.576476

Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.166336
5 year	0.530225
10 year	0.786194
25 year	1.186765

Yearly Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1961	0.318	0.082
1962	0.168	0.107
1963	0.683	0.192
1964	0.353	0.202
1965	0.224	0.150
1966	0.361	0.101
1967	0.317	0.119
1968	0.559	0.373
1969	0.407	0.139
1970	0.840	0.339
1971	0.956	1.107
1972	0.423	0.137
1973	0.156	0.069
1974	0.711	0.502
1975	0.421	0.217
1976	0.328	0.109
1977	0.124	0.066
1978	0.252	0.128
1979	0.342	0.156
1980	0.356	0.210
1981	0.453	0.152
1982	0.712	0.684
1983	0.907	0.759
1984	2.422	1.171
1985	0.565	0.441
1986	0.617	0.164
1987	1.244	0.658
1988	0.435	0.323

1989	0.816	0.281
1990	0.502	0.169
1991	0.319	0.125
1992	0.138	0.069
1993	1.131	0.430
1994	0.774	0.667
1995	0.304	0.092
1996	0.892	1.228
1997	0.138	0.069
1998	0.890	0.277

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #2

Rank	**Predeveloped**	**Mitigated**
1	2.4220	1.2278
2	1.2443	1.1707
3	1.1313	1.1068
4	0.9560	0.7595
5	0.9073	0.6840
6	0.8915	0.6671
7	0.8904	0.6583
8	0.8405	0.5022
9	0.8162	0.4413
10	0.7743	0.4303
11	0.7122	0.3730
12	0.7110	0.3389
13	0.6835	0.3230
14	0.6174	0.2811
15	0.5653	0.2769
16	0.5588	0.2167
17	0.5015	0.2097
18	0.4525	0.2023
19	0.4351	0.1918
20	0.4229	0.1690
21	0.4205	0.1638
22	0.4072	0.1559
23	0.3613	0.1520
24	0.3557	0.1503
25	0.3530	0.1390
26	0.3423	0.1371
27	0.3280	0.1281
28	0.3191	0.1247
29	0.3184	0.1188
30	0.3175	0.1093
31	0.3039	0.1072
32	0.2522	0.1012
33	0.2236	0.0922
34	0.1679	0.0817
35	0.1555	0.0690
36	0.1381	0.0687
37	0.1381	0.0686
38	0.1238	0.0660

POC #2

The Facility PASSED

The Facility PASSED.

Flow(CFS)	**Predev**	**Dev**	**Percentage**	**Pass/Fail**
0.0422	2946	2581	87	Pass
0.0515	2418	1888	78	Pass
0.0609	2014	1536	76	Pass
0.0703	1710	1169	68	Pass
0.0796	1483	973	65	Pass
0.0890	1270	792	62	Pass
0.0984	1119	658	58	Pass
0.1077	983	533	54	Pass

0.1171	867	409	47	Pass
0.1265	774	312	40	Pass
0.1358	685	241	35	Pass
0.1452	623	193	30	Pass
0.1546	562	160	28	Pass
0.1639	512	142	27	Pass
0.1733	458	127	27	Pass
0.1827	422	111	26	Pass
0.1920	388	106	27	Pass
0.2014	357	100	28	Pass
0.2108	331	95	28	Pass
0.2201	307	83	27	Pass
0.2295	282	79	28	Pass
0.2389	257	76	29	Pass
0.2482	232	75	32	Pass
0.2576	213	72	33	Pass
0.2670	200	66	33	Pass
0.2763	184	63	34	Pass
0.2857	170	59	34	Pass
0.2951	155	55	35	Pass
0.3044	144	53	36	Pass
0.3138	133	52	39	Pass
0.3232	118	49	41	Pass
0.3325	107	46	42	Pass
0.3419	101	43	42	Pass
0.3513	94	39	41	Pass
0.3606	85	38	44	Pass
0.3700	78	36	46	Pass
0.3794	73	34	46	Pass
0.3887	65	31	47	Pass
0.3981	64	30	46	Pass
0.4075	63	30	47	Pass
0.4168	60	30	50	Pass
0.4262	57	29	50	Pass
0.4356	56	27	48	Pass
0.4449	54	26	48	Pass
0.4543	49	25	51	Pass
0.4637	48	25	52	Pass
0.4730	42	24	57	Pass
0.4824	40	24	60	Pass
0.4918	38	24	63	Pass
0.5011	37	23	62	Pass
0.5105	36	21	58	Pass
0.5199	32	20	62	Pass
0.5292	31	20	64	Pass
0.5386	29	20	68	Pass
0.5480	28	19	67	Pass
0.5573	27	18	66	Pass
0.5667	25	18	72	Pass
0.5761	24	17	70	Pass
0.5854	24	17	70	Pass
0.5948	24	17	70	Pass
0.6042	23	17	73	Pass
0.6135	22	17	77	Pass
0.6229	19	17	89	Pass
0.6323	19	17	89	Pass
0.6416	19	17	89	Pass

0.6510	19	17	89	Pass
0.6604	18	14	77	Pass
0.6697	18	13	72	Pass
0.6791	18	13	72	Pass
0.6885	17	12	70	Pass
0.6978	15	12	80	Pass
0.7072	15	12	80	Pass
0.7166	13	12	92	Pass
0.7259	12	12	100	Pass
0.7353	12	11	91	Pass
0.7447	12	11	91	Pass
0.7540	12	10	83	Pass
0.7634	12	8	66	Pass
0.7728	12	7	58	Pass
0.7821	11	7	63	Pass
0.7915	10	7	70	Pass
0.8009	10	7	70	Pass
0.8102	10	7	70	Pass
0.8196	9	7	77	Pass
0.8290	9	7	77	Pass
0.8383	9	7	77	Pass
0.8477	8	7	87	Pass
0.8571	8	6	75	Pass
0.8664	8	6	75	Pass
0.8758	8	6	75	Pass
0.8852	8	5	62	Pass
0.8945	6	5	83	Pass
0.9039	6	5	83	Pass
0.9133	5	5	100	Pass
0.9226	5	5	100	Pass
0.9320	5	5	100	Pass
0.9414	5	5	100	Pass
0.9507	5	5	100	Pass
0.9601	4	4	100	Pass
0.9695	4	4	100	Pass

Perlnd and Implnd Changes

No changes have been made.