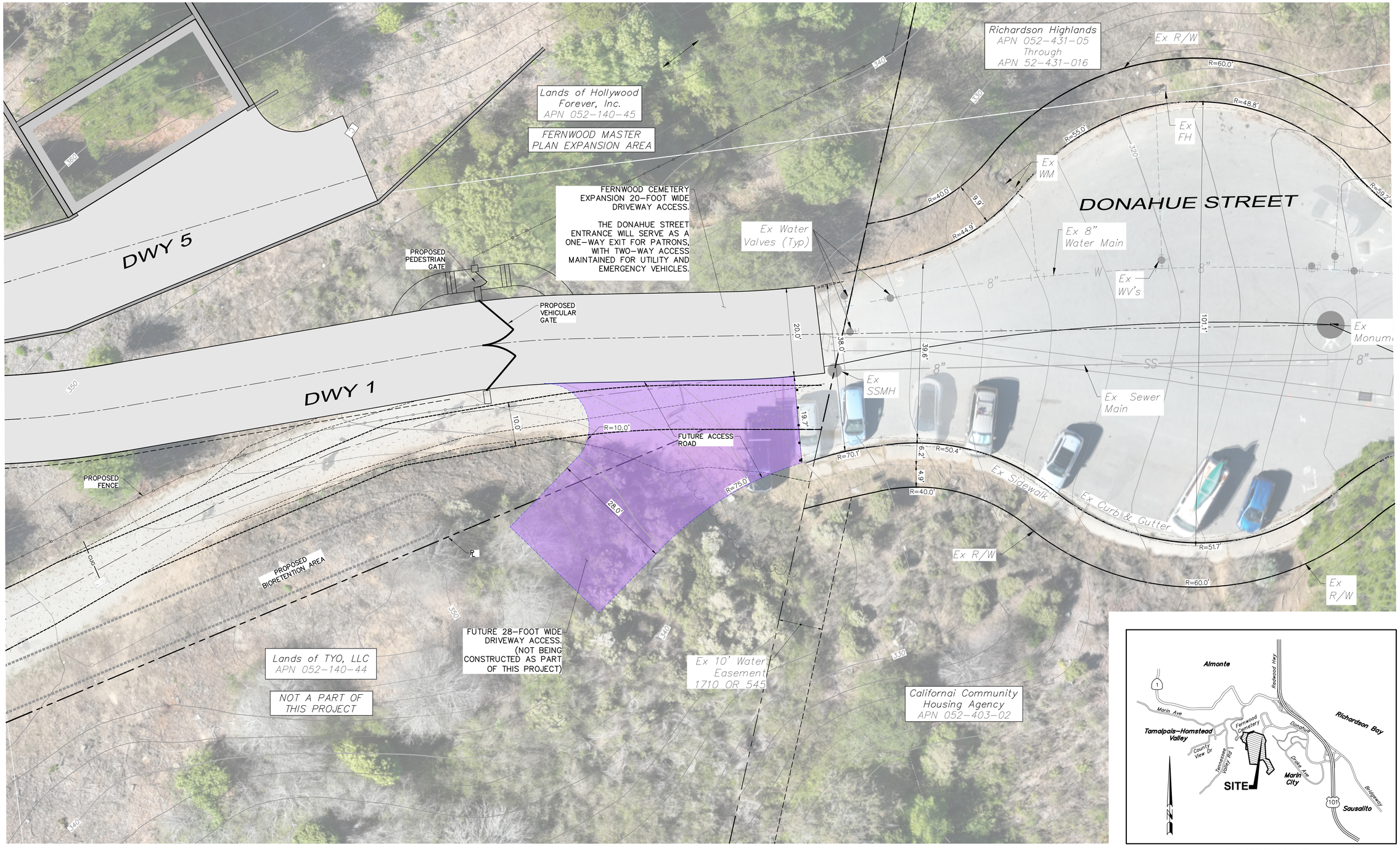

LOCATION MAP

NOT TO SCALE

10' 5' 0 5' 10' 20' 30'

Graphic Scale: 1" = 10'

April 17, 2026

DONAHUE ENTRANCE

FERNWOOD CEMETERY EXPANSION MASTER PLAN

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County of Marin
Preliminary Drainage Study
For the

Fernwood Cemetery Expansion
Master Plan

301 Tennessee Valley Road
Mill Valley, CA
APN 052-140-45

JN 23275
August, 2026

Prepared For:
Fernwood Cemetery
301 Tennessee Valley Road
Mill Valeey, CA
tyler@hollywoodforever.com
(323) 469-1181

PRELIMINARY

David R. Brown, RCE 41833
My license expires 3/31/2028

Prepared by:

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Prepared By:__ZR
Checked By:__KM

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1. Drainage Narrative

Preliminary Drainage Narrative

Introduction

The Fernwood Cemetery is located at 301 Tennessee Valley Road, in Mill Valley south-west of Highway 101 and Highway 1 interchange. The project proposes driveway improvements for a cemetery expansion, bioretention, two restrooms, and a maintenance facility.

The project site is currently zoned RMP-0.5-HOD Residential Multiple Planned. Through the Master Plan process, the proposed zoning will be for Cemetery Use. The change in zoning will significantly decrease the future impacts for the increase in stormwater in the existing infrastructure that this site drains too. This project is proposing that the post-construction runoff will be equal or less then the pre-construction runoff through the use of storage in the bioretention facilities.

Criteria

This is a Preliminary Drainage Study that addresses the hydrology and hydraulic calculations for all proposed drainage infrastructure. Pre and Post Hydrology and 100-Year Overland Release Maps have been provided as part of this preliminary study.

The Final Drainage Study will address all issues pertaining to this project in Marin County Code 24.04.

Bioretention facilities are proposed as part of the BASMAA requirements. To meet the pre-project and post-project peak runoff rates for the 10-year storm event, the bioretention facilities have been designed to be deeper than the required 1.5-ft of bioretention soil and 1-ft of drain rock. Two bioretention facilities (IMP 1 & 3) outfall onto natural slopes above natural water ways with Caltrans Class III rip-rap with a 12.75-ft length and 2.55-ft of depth to force the runoff back into a sheet condition. Bioretention (IMP-2) outfalls onto Donahue Street where the runoff is currently draining too.

Receiving Waters

Most of the site historically drains to the west toward Tennessee Valley Road and existing residences. With a large percentage of runoff flowing to those respective parcels, this will be mitigated through the inclusion of a new bioretention site dissipating such flows. There is an unmarked blue line stream on the south westerly end of the property which converges with Coyote Creek and ultimately outfalls into Richardson Bay.

The easterly part of the project drains down into Braun Court and Burgess Court through the Marin City drainage infrastructure and outfalls into Richardson Bay.

Site Characterization

Catchments

The Pre-Construction Hydrology Map has broken the areas up into three main subbasin for analyzing the pre-construction conditions and peak flows. There is no exiting drainage infrastructure on the site.

The Post Construction Hydrology Map has broken the proposed drainage areas into 18 separate drainage areas in order to size the storm drains.

For both the pre and post construction hydrology maps a drainage table has been added with the following information.

- Subbasin (pre and post construction)
- Drainage Area (post construction)
- Total Area in acres
- Vegetated Area in acres
- Gravel Area in acres
- Paved Area in acres
- Rational Method Runoff Coefficient "C"
- Time of concentration

Land Cover

The site is currently covered with tree, brush, and grasses. There is a few hiking trails and access roads. See **Pre-Construction Hydrology Map.**

Slope

The site is on a hillside above the City of Mill Valley with gentle to steep slopes ranging throughout the site. In areas where there are no proposed improvements existing slopes exceed 50%. See **Pre-Construction Hydrology Map.**

Soils/Geology

A geological study has been prepared by Miller Pacific dated October 29, 2025. The USDA Web Soil Survey has also been provided, see **Soil Analysis**

FEMA FIRM

This project does not have any floodways or floodplain on the site. However, it does drain into Coyote Creek and Marin City drainage infrastructure that does have base flood elevations due to the site being so close to Richardson Bay and the surrounding areas having low elevations.

Hydrology

Methodology

The incremental Rational Method has been used to calculate the 10 and 100 year peak runoff in accordance with the Sonoma County Water Agency (SCWA) Flood Management Design Manual (FMDM, 2020) as shown in the **10-yr & 100-yr Rational Method**

Drainage Study. Time of concentration has been calculated using the County of Marin Department of Public Works equation based on site specifics. The **Intensity Duration Frequency Curve (IDF Curve)** spreadsheet used **NOAA Atlas 14 Point Precipitation Frequency Estimates** for the design storm do calculate the intensity based on the time of concentration.

Site tributary areas and points of concentration are depicted on attached **Pre-Construction Hydrology Map & Post-Construction Hydrology Map**.

To analyze the post-construction peak runoff compared to the pre-construction runoff. We have used Subbasins in the **Pre-Construction Hydrology Map** to get the pre-construction peak runoff. We used these values and **Detention Volume Calculations** to determine the required storage volume increase to mitigate the post-construction condition to be equal or less then the pre-construction condition. The **Detention Analysis** was used to determine the storage capacity of the bioretention facilities respectively. The normal depth of a BASMAA Regulated Bioretention facility is 2.5-ft. The additional depth below the 2.5-ft is the required detention volume to achieve the peak runoff mitigation.

Results

The hydrology calculations for the pre vs post construction flow rates is presented in the table below. All the post-construction flow rates are equal or lower then the pre-construction flow rates, therefor we do not anticipate any adverse effects down stream of our proposed infrastructure. Additional depth has been added to their respective Bioretentions (IMP's) to account for the volume required to mitigate the post-construction 10-year storm event peak runoff rates.

Pre and Post 10-yr Hydrology Table

Subbasin	Pre Q (cfs)	Post Q (cfs)	Drains to IMP	IMP Area (sq. ft.)	Additional Depth[1]	Additional Detention Volume[2] (gallons)	Total Detention Volume[3] (gallons)
1	7.28	7.28	1	4,000	1.50	2,400	6,400
2	1.90	1.87	2	1,000	0.50	200	1,200
3	0.34	0.34	3	600	1.75	420	1,020

1 – The additional depth is added to the standard BASMAA Bioretention Facility Depth of 2.5 in the drain rock section for storage.

2 – The additional detention volume is added to the standard BASMAA Bioretention Facility volume of 1-cubic foot of storage for 1-square foot of bioretention area. The porosity of the drain rock and bioretention soil is 0.4.

3 – The total detention volume accounts for the bioretention soil and drain rock for each IMP.

Hydraulics

Methodology

The Federal Highway Administration's *Hydraulic Toolbox* has been used to calculate normal depth in the proposed drain pipes as presented in **10 and 100-Year Stormdrain Analysis** for each proposed storm drain. Proposed system was analyzed using a 10 and 100-year storm events. Manning's n value used was 0.012 for the pipe material.

Results

For both the 10 and 100-Year storm drain analysis, all calculated runoff will remain within the proposed storm drain with no anticipated inundation.

Conclusion

Project runoff will continue to discharge to the existing 24-inch County storm drain in the same location as existing conditions on Tennessee Valley Rd, the existing 18-inch County storm drain in the same location as existing conditions in Burgess Ct, and the existing 12-inch County storm drain in the same location as existing conditions on Donahue St. Post-development 10-year peak discharge is less than pre-development peak discharge. Because the discharge point and drainage path remain unchanged and the project does not increase peak runoff, adverse downstream hydraulic impacts are not anticipated.

In accordance with the Marin County Drainage Codes. The project has been designed to allow for overland release in case of inundation of the stormdrains. Since the existing conditions of the site is undeveloped trees, grasses, and brush, pollutants observed due to the new impervious surfacing will be treated via bioretention facilities prior to discharging from the site, thereby alleviating the possible impacts of this development.

Based on the design of the treatment and the routing of surface runoff, we do not anticipate any significant impacts to the neighboring properties and to the natural drainage features. The quantity and quality of stormwater discharge will be similar to pre existing conditions at point of release off the project site.

2. Aerial Photo & FEMA Map

National Flood Hazard Layer FIRMette

FEMA

122°31'30"W 37°52'48"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

122°30'53"W 37°52'19"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/11/2026 at 12:21 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

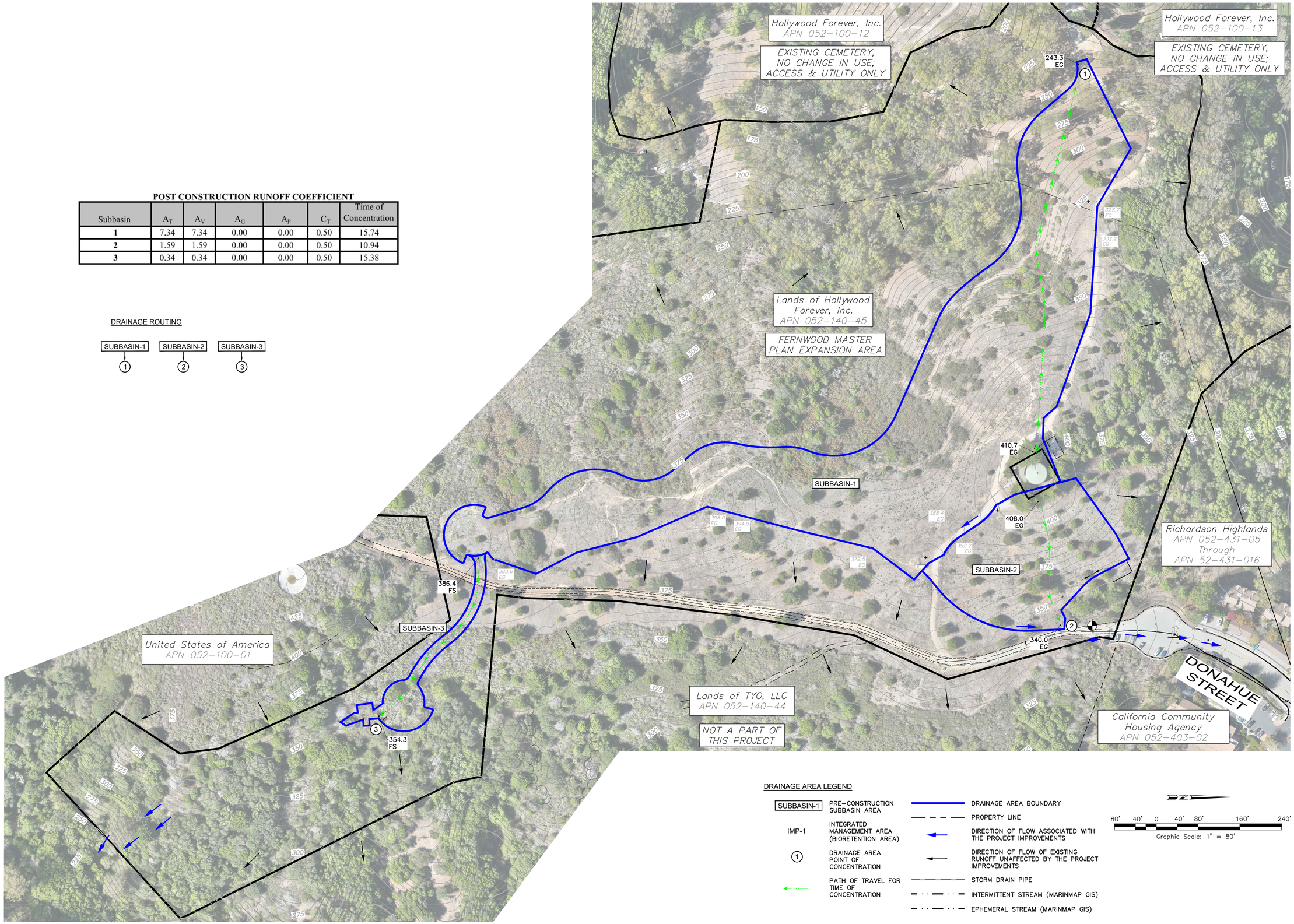
3. Pre-Construction Hydrology Map

POST CONSTRUCTION RUNOFF COEFFICIENT

Subbasin	A_T	A_V	A_G	A_P	C_T	Time of Concentration
1	7.34	7.34	0.00	0.00	0.50	15.74
2	1.59	1.59	0.00	0.00	0.50	10.94
3	0.34	0.34	0.00	0.00	0.50	15.38

DRAINAGE ROUTING

SUBBASIN-1 → ①
SUBBASIN-2 → ②
SUBBASIN-3 → ③



DRAINAGE AREA LEGEND

SUBBASIN-1	PRE-CONSTRUCTION SUBBASIN AREA		DRAINAGE AREA BOUNDARY
			PROPERTY LINE
IMP-1	INTEGRATED MANAGEMENT AREA (BIORETENTION AREA)		DIRECTION OF FLOW ASSOCIATED WITH THE PROJECT IMPROVEMENTS
①	DRAINAGE AREA POINT OF CONCENTRATION		DIRECTION OF FLOW OF EXISTING RUNOFF UNAFFECTED BY THE PROJECT IMPROVEMENTS
	PATH OF TRAVEL FOR TIME OF CONCENTRATION		STORM DRAIN PIPE
			INTERMITTENT STREAM (MARINMAP GIS)
			EPHEMERAL STREAM (MARINMAP GIS)

80' 40' 0 40' 80' 160' 240'
Graphic Scale: 1" = 80'

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PRE-CONSTRUCTION HYDROLOGY MAP

FERNWOOD CEMETERY EXPANSION MASTER PLAN

301 Tennessee Valley Road
Mill Valley, California
APN 052-140-45

Date: March 2026
Design by: ZR
Drawn by: ZR
Checked by:

Job 23275

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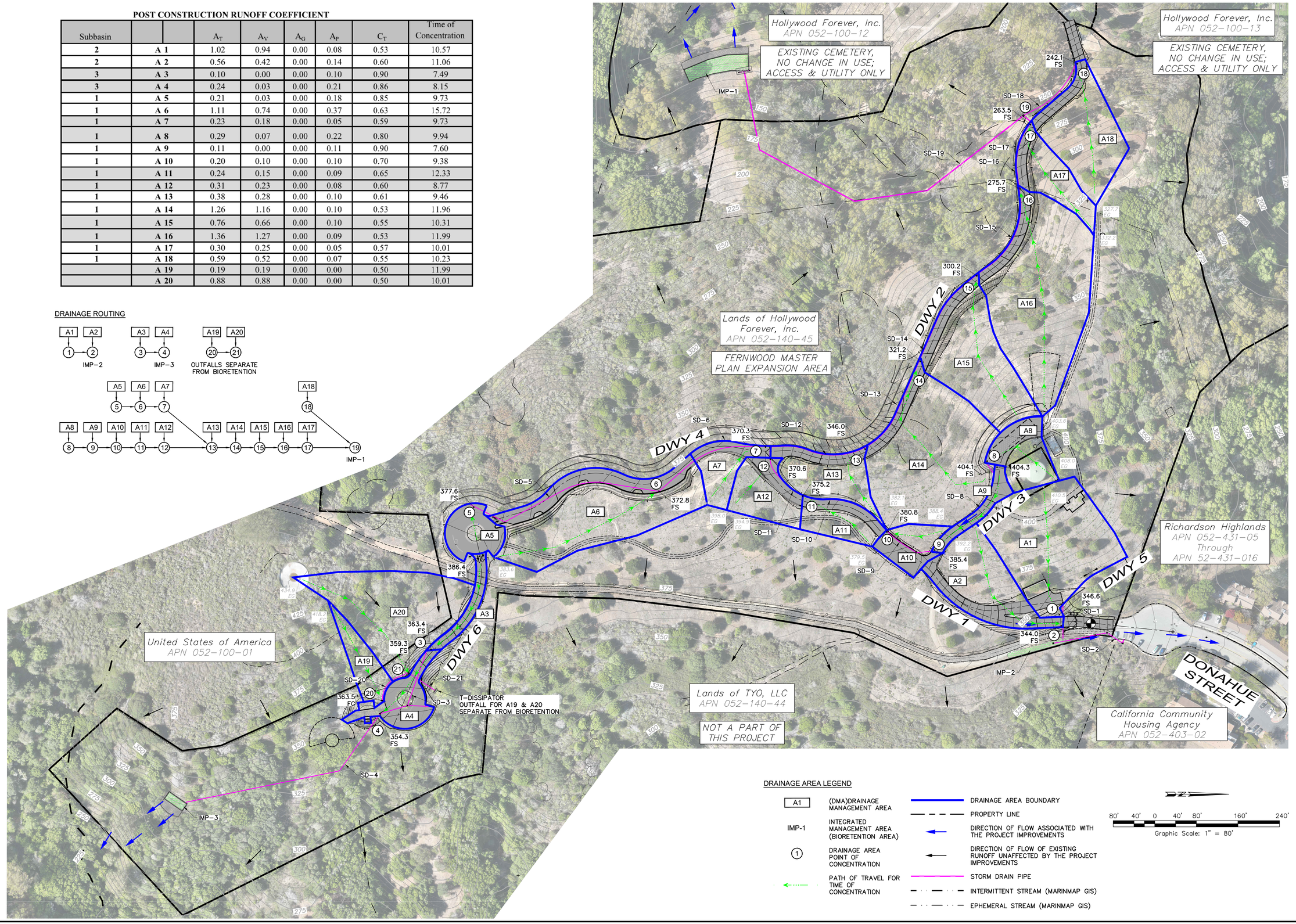
4. Post-Construction Hydrology Map

POST CONSTRUCTION RUNOFF COEFFICIENT

Subbasin		A_T	A_V	A_G	A_P	C_T	Time of Concentration
2	A 1	1.02	0.94	0.00	0.08	0.53	10.57
2	A 2	0.56	0.42	0.00	0.14	0.60	11.06
3	A 3	0.10	0.00	0.00	0.10	0.90	7.49
3	A 4	0.24	0.03	0.00	0.21	0.86	8.15
1	A 5	0.21	0.03	0.00	0.18	0.85	9.73
1	A 6	1.11	0.74	0.00	0.37	0.63	15.72
1	A 7	0.23	0.18	0.00	0.05	0.59	9.73
1	A 8	0.29	0.07	0.00	0.22	0.80	9.94
1	A 9	0.11	0.00	0.00	0.11	0.90	7.60
1	A 10	0.20	0.10	0.00	0.10	0.70	9.38
1	A 11	0.24	0.15	0.00	0.09	0.65	12.33
1	A 12	0.31	0.23	0.00	0.08	0.60	8.77
1	A 13	0.38	0.28	0.00	0.10	0.61	9.46
1	A 14	1.26	1.16	0.00	0.10	0.53	11.96
1	A 15	0.76	0.66	0.00	0.10	0.55	10.31
1	A 16	1.36	1.27	0.00	0.09	0.53	11.99
1	A 17	0.30	0.25	0.00	0.05	0.57	10.01
1	A 18	0.59	0.52	0.00	0.07	0.55	10.23
	A 19	0.19	0.19	0.00	0.00	0.50	11.99
	A 20	0.88	0.88	0.00	0.00	0.50	10.01

DRAINAGE ROUTING



DRAINAGE AREA LEGEND

A1	(DMA)DRAINAGE MANAGEMENT AREA
IMP-1	INTEGRATED MANAGEMENT AREA (BIORETENTION AREA)
1	DRAINAGE AREA POINT OF CONCENTRATION
	PATH OF TRAVEL FOR TIME OF CONCENTRATION
	DRAINAGE AREA BOUNDARY
	PROPERTY LINE
	DIRECTION OF FLOW ASSOCIATED WITH THE PROJECT IMPROVEMENTS
	DIRECTION OF FLOW OF EXISTING RUNOFF UNAFFECTED BY THE PROJECT IMPROVEMENTS
	STORM DRAIN PIPE
	INTERMITTENT STREAM (MARINMAP GIS)
	EPHEMERAL STREAM (MARINMAP GIS)

80' 40' 0 40' 80' 160' 240'
Graphic Scale: 1" = 80'

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POST-CONSTRUCTION HYDROLOGY MAP

FERNWOOD CEMETERY EXPANSION MASTER PLAN

301 Tennessee Valley Road
Mill Valley, California
APN 052–140–45

Date: August 2026
Design by: ZR
Drawn by: ZR
Checked by:

Job 23275

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5. Hydrology Calculations

- **10 Year Rational Method Analysis**
- **100-Year Rational Method Analysis**
- **IDF Curve**
- **NOAA Atlas 14**
- **Detention Volume Calculations**
- **Detention Analysis**

Rational Method Anaylsis

10 - Year Storm Event Post Construction

Project: 23275 - Fernwood Cemetery Expansion **Date:** 7/9/2026

Point of Concentration	Area	Δ Elev.	Distance	Slope	V(ft/s)	Travel Time (min)	Total Time (min)	I	C	A	A_{total}	AC	Sum AC	Q (cfs)	Remarks
10 year															
1	A 1	63.9	254	0.25		10.57	10.57	2.43	0.53	1.020	1.020	0.542	0.542	1.32	Total Flow to SD-1
2	A 2	48.2	293	0.16		11.06	11.06	2.38	0.60	0.560	0.560	0.336	0.336	0.80	Overland Flow to SD-2
2								Combined flow From POC 1 & 2						2.12	Total Flow to SD-2
3	A 3	22.8	224	0.10		7.49	7.49	2.90	0.90	0.100	0.100	0.090	0.090	0.26	Total Flow to SD-3
4	A 4	9.1	163	0.06		8.15	8.15	2.77	0.86	0.240	0.240	0.206	0.206	0.57	Overland Flow to SD-4
4								Combined flow From POC 3 & 4						0.83	Total Flow to SD-4
5	A 5	8.8	92	0.10		7.03	7.03	2.99	0.85	0.210	0.210	0.179	0.179	0.53	Total Flow to SD-5
6	A 6	10.8	347	0.03		15.72	15.72	1.99	0.63	1.110	1.110	0.703	0.703	1.40	Overland Flow to SD-6
6								Combined flow From POC 5 & 6						1.93	Total Flow to SD-6
7	A 7	27.7	169	0.16		9.73	9.73	2.54	0.59	0.230	0.230	0.135	0.135	0.34	Overland Flow to SD-12
7								Combined flow From POC 6 & 7						2.27	Overland Flow to SD-12
8	A 8	3.9	157	0.02		9.94	9.94	2.51	0.80	0.290	0.290	0.233	0.233	0.58	Overland Flow to SD-8
8								Combined flow From POC 8						0.58	Total Flow to SD-8
9	A 9	18.9	219	0.09		7.60	7.60	2.88	0.90	0.110	0.110	0.099	0.099	0.28	Overland Flow to SD-9
9								Combined flow From POC 8 & 9						0.87	Total Flow to SD-9
10	A 10	7.6	124	0.06		9.38	9.38	2.58	0.70	0.200	0.200	0.140	0.140	0.36	Overland Flow to SD-10
10								Combined flow From POC 9 & 10						1.23	Total Flow to SD-10
11	A 11	4.3	159	0.03		12.33	12.33	2.25	0.65	0.240	0.240	0.156	0.156	0.35	Overland Flow to SD-11
11								Combined flow From POC 10 & 11						1.58	Total Flow to SD-11
12	A 12	24.30	127	0.19		8.77	8.77	2.67	0.60	0.310	0.310	0.187	0.187	0.50	Overland Flow to SD-12
12								Combined flow From POC 11 & 12						2.08	Total Flow to SD-12

Point of Concentration	Area	Δ Elev.	Distance	Slope	V(ft/s)	Travel Time (min)	Total Time (min)	I	C	A	A_{total}	AC	Sum AC	Q (cfs)	Remarks
13	A 13	36.1	183	0.20		9.46	9.46	2.57	0.61	0.380	0.380	0.230	0.230	0.59	Overland Flow to SD-13
13								Combined flow From POC 7, 12 & 13						4.95	Total Flow to SD-13
14	A 14	83.1	369	0.23		11.96	11.96	2.28	0.53	1.260	1.260	0.670	0.670	1.53	Overland Flow to SD-14
14								Combined flow From POC 13 & 14						6.47	Total Flow to SD-14
15	A 15	100.4	301	0.33		10.31	10.31	2.46	0.55	0.760	0.760	0.420	0.420	1.03	Overland Flow to SD-15
15								Combined flow From POC 14 & 15						7.51	Total Flow to SD-15
16	A 16	127.9	436	0.29		11.99	11.99	2.28	0.53	1.360	1.360	0.716	0.716	1.63	Overland Flow to SD-16
16								Combined flow From POC 15 & 16						9.14	Total Flow to SD-16
17	A 17	68.7	249	0.28		10.01	10.01	2.50	0.57	0.300	0.300	0.170	0.170	0.42	Overland Flow to SD-17
17								Combined flow From POC 16 & 17						9.56	Total Flow to SD-17
18	A 18	85.6	274	0.31		10.23	10.23	2.47	0.55	0.590	0.590	0.323	0.323	0.80	Total Flow to SD-18
19								Combined flow From POC 17 & 18						10.36	Total Flow to SD-19
20	A 19	54.7	200	0.27		10.07	10.07	2.49	0.50	0.190	0.190	0.095	0.095	0.24	Total Flow to SD-20
21	A 20	75.6	280	0.27		11.02	11.02	2.38	0.50	0.880	0.880	0.440	0.440	1.05	Overland Flow to SD-21
21								Combined flow From POC 20 & 21						1.28	Total Flow to SD-21

POST CONSTRUCTION RUNOFF COEFFICIENT

Subbasin		A_T	A_V	A_G	A_P	C_T	Time of Concentration
2	**A 1**	1.02	0.94	0.00	0.08	0.53	10.57
2	**A 2**	0.56	0.42	0.00	0.14	0.60	11.06
3	**A 3**	0.10	0.00	0.00	0.10	0.90	7.49
3	**A 4**	0.24	0.03	0.00	0.21	0.86	8.15
1	**A 5**	0.21	0.03	0.00	0.18	0.85	9.73
1	**A 6**	1.11	0.74	0.00	0.37	0.63	15.72
1	**A 7**	0.23	0.18	0.00	0.05	0.59	9.73
1	**A 8**	0.29	0.07	0.00	0.22	0.80	9.94
1	**A 9**	0.11	0.00	0.00	0.11	0.90	7.60
1	**A 10**	0.20	0.10	0.00	0.10	0.70	9.38
1	**A 11**	0.24	0.15	0.00	0.09	0.65	12.33
1	**A 12**	0.31	0.23	0.00	0.08	0.60	8.77
1	**A 13**	0.38	0.28	0.00	0.10	0.61	9.46
1	**A 14**	1.26	1.16	0.00	0.10	0.53	11.96
1	**A 15**	0.76	0.66	0.00	0.10	0.55	10.31
1	**A 16**	1.36	1.27	0.00	0.09	0.53	11.99
1	**A 17**	0.30	0.25	0.00	0.05	0.57	10.01
1	**A 18**	0.59	0.52	0.00	0.07	0.55	10.23
	A 19	0.19	0.19	0.00	0.00	0.50	11.99
	A 20	0.88	0.88	0.00	0.00	0.50	10.01

NOTE:

Vegetated area : C_V = 0.50

Gravel area: C_G= 0.70

Residential area : C_P = 0.90

Mixed area : $C = (A_V / SA)*C_V + (A_P / SA)*C_P + (A_G/SA)*C_G$

Time of Concentration Equation

$$t_c = \frac{1.8(1.1-C)\sqrt{L}}{\sqrt[3]{S(100)}} + 5Min$$

C = Runoff Coefficient *

L = Longest run in feet

S = Average Slope in ft/ft $= \frac{\Delta H}{L}$

Rainfall Intensity vs Duration

$$I = 8.09 / t^{0.51}$$

I = intensity (in/hour)

t = time of concentration (minutes)

Rational Method Anaylsis

10 - Year Storm Event Post Construction

Project: 23275 - Fernwood Cemetery Expansion **Date:** 7/9/2026

Point of Concentration	Area	Δ Elev.	Distance	Slope	V(ft/s)	Travel Time (min)	Total Time (min)	I	C	A	A_{total}	AC	Sum AC	Q (cfs)	Remarks
10 year															
1	A 1	63.9	254	0.25		10.57	10.57	2.43	0.53	1.020	1.020	0.542	0.542	1.32	Total Flow to SD-1
2	A 2	48.2	293	0.16		11.06	11.06	2.38	0.60	0.560	0.560	0.336	0.336	0.80	Overland Flow to SD-2
2								Combined flow From POC 1 & 2						2.12	Total Flow to SD-2
3	A 3	22.8	224	0.10		7.49	7.49	2.90	0.90	0.100	0.100	0.090	0.090	0.26	Total Flow to SD-3
4	A 4	9.1	163	0.06		8.15	8.15	2.77	0.86	0.240	0.240	0.206	0.206	0.57	Overland Flow to SD-4
4								Combined flow From POC 3 & 4						0.83	Total Flow to SD-4
5	A 5	8.8	92	0.10		7.03	7.03	2.99	0.85	0.210	0.210	0.179	0.179	0.53	Total Flow to SD-5
6	A 6	10.8	347	0.03		15.72	15.72	1.99	0.63	1.110	1.110	0.703	0.703	1.40	Overland Flow to SD-6
6								Combined flow From POC 5 & 6						1.93	Total Flow to SD-6
7	A 7	27.7	169	0.16		9.73	9.73	2.54	0.59	0.230	0.230	0.135	0.135	0.34	Overland Flow to SD-12
7								Combined flow From POC 6 & 7						2.27	Overland Flow to SD-12
8	A 8	3.9	157	0.02		9.94	9.94	2.51	0.80	0.290	0.290	0.233	0.233	0.58	Overland Flow to SD-8
8								Combined flow From POC 8						0.58	Total Flow to SD-8
9	A 9	18.9	219	0.09		7.60	7.60	2.88	0.90	0.110	0.110	0.099	0.099	0.28	Overland Flow to SD-9
9								Combined flow From POC 8 & 9						0.87	Total Flow to SD-9
10	A 10	7.6	124	0.06		9.38	9.38	2.58	0.70	0.200	0.200	0.140	0.140	0.36	Overland Flow to SD-10
10								Combined flow From POC 9 & 10						1.23	Total Flow to SD-10
11	A 11	4.3	159	0.03		12.33	12.33	2.25	0.65	0.240	0.240	0.156	0.156	0.35	Overland Flow to SD-11
11								Combined flow From POC 10 & 11						1.58	Total Flow to SD-11
12	A 12	24.30	127	0.19		8.77	8.77	2.67	0.60	0.310	0.310	0.187	0.187	0.50	Overland Flow to SD-12
12								Combined flow From POC 11 & 12						2.08	Total Flow to SD-12

Point of Concentration	Area	Δ Elev.	Distance	Slope	V(ft/s)	Travel Time (min)	Total Time (min)	I	C	A	A_{total}	AC	Sum AC	Q (cfs)	Remarks
13	A 13	36.1	183	0.20		9.46	9.46	2.57	0.61	0.380	0.380	0.230	0.230	0.59	Overland Flow to SD-13
13								Combined flow From POC 7, 12 & 13						4.95	Total Flow to SD-13
14	A 14	83.1	369	0.23		11.96	11.96	2.28	0.53	1.260	1.260	0.670	0.670	1.53	Overland Flow to SD-14
14								Combined flow From POC 13 & 14						6.47	Total Flow to SD-14
15	A 15	100.4	301	0.33		10.31	10.31	2.46	0.55	0.760	0.760	0.420	0.420	1.03	Overland Flow to SD-15
15								Combined flow From POC 14 & 15						7.51	Total Flow to SD-15
16	A 16	127.9	436	0.29		11.99	11.99	2.28	0.53	1.360	1.360	0.716	0.716	1.63	Overland Flow to SD-16
16								Combined flow From POC 15 & 16						9.14	Total Flow to SD-16
17	A 17	68.7	249	0.28		10.01	10.01	2.50	0.57	0.300	0.300	0.170	0.170	0.42	Overland Flow to SD-17
17								Combined flow From POC 16 & 17						9.56	Total Flow to SD-17
18	A 18	85.6	274	0.31		10.23	10.23	2.47	0.55	0.590	0.590	0.323	0.323	0.80	Total Flow to SD-18
19								Combined flow From POC 17 & 18						10.36	Total Flow to SD-19
20	A 19	54.7	200	0.27		10.07	10.07	2.49	0.50	0.190	0.190	0.095	0.095	0.24	Total Flow to SD-20
21	A 20	75.6	280	0.27		11.02	11.02	2.38	0.50	0.880	0.880	0.440	0.440	1.05	Overland Flow to SD-21
21								Combined flow From POC 20 & 21						1.28	Total Flow to SD-21

POST CONSTRUCTION RUNOFF COEFFICIENT

Subbasin		A_T	A_V	A_G	A_P	C_T	Time of Concentration
2	**A 1**	1.02	0.94	0.00	0.08	0.53	10.57
2	**A 2**	0.56	0.42	0.00	0.14	0.60	11.06
3	**A 3**	0.10	0.00	0.00	0.10	0.90	7.49
3	**A 4**	0.24	0.03	0.00	0.21	0.86	8.15
1	**A 5**	0.21	0.03	0.00	0.18	0.85	9.73
1	**A 6**	1.11	0.74	0.00	0.37	0.63	15.72
1	**A 7**	0.23	0.18	0.00	0.05	0.59	9.73
1	**A 8**	0.29	0.07	0.00	0.22	0.80	9.94
1	**A 9**	0.11	0.00	0.00	0.11	0.90	7.60
1	**A 10**	0.20	0.10	0.00	0.10	0.70	9.38
1	**A 11**	0.24	0.15	0.00	0.09	0.65	12.33
1	**A 12**	0.31	0.23	0.00	0.08	0.60	8.77
1	**A 13**	0.38	0.28	0.00	0.10	0.61	9.46
1	**A 14**	1.26	1.16	0.00	0.10	0.53	11.96
1	**A 15**	0.76	0.66	0.00	0.10	0.55	10.31
1	**A 16**	1.36	1.27	0.00	0.09	0.53	11.99
1	**A 17**	0.30	0.25	0.00	0.05	0.57	10.01
1	**A 18**	0.59	0.52	0.00	0.07	0.55	10.23
	A 19	0.19	0.19	0.00	0.00	0.50	11.99
	A 20	0.88	0.88	0.00	0.00	0.50	10.01

NOTE:

Vegetated area : C_V = 0.50

Gravel area: C_G= 0.70

Residential area : C_P = 0.90

Mixed area : $C = (A_V / SA)*C_V + (A_P / SA)*C_P + (A_G/SA)*C_G$

Time of Concentration Equation

$$t_c = \frac{1.8(1.1-C)\sqrt{L}}{\sqrt[3]{S(100)}} + 5Min$$

C = Runoff Coefficient *

L = Longest run in feet

S = Average Slope in ft/ft $= \frac{\Delta H}{L}$

Rainfall Intensity vs Duration

$$I = 8.09 / t^{0.51}$$

I = intensity (in/hour)

t = time of concentration (minutes)

Intensity Duration Frequency Curve (IDF Curve)

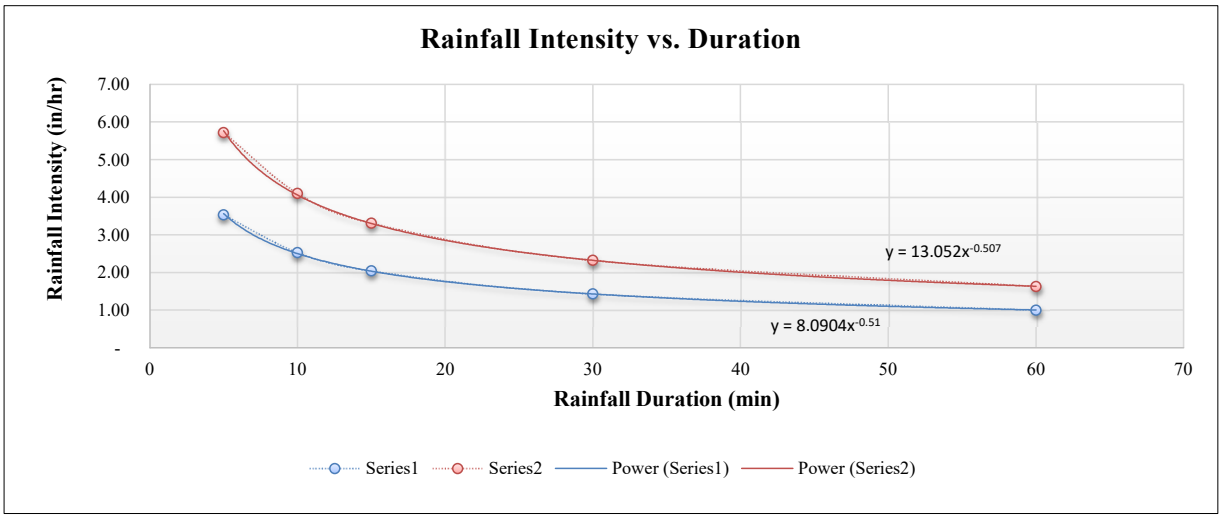
NOAA Atlas 14 Point Precipitation Frequency Estimates

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

Project: Fernwood Cemetery Expansion
JN: 23275

Date: 3/4/2026
Designer: ZR

Location: Santa Rosa, CA



NOAA Atlas 14 Data Rainfall Intensity (in/hr)		
Duration (min)	**10-yr**	**100-yr**
5	3.53	5.72
10	2.53	4.10
15	2.04	3.31
30	1.43	2.32
60	1.00	1.63

Rainfall Intensity vs Duration

$$I = a * t^{b}$$

I = intensity (in/hour)
t = time of concentration/ rainfall duration (minutes)

10-Year Trendline Values	
a =	8.090
b =	-0.51

100-Year Trendline Values	
a =	13.05
b =	-0.51

NOAA Atlas 14, Volume 6, Version 2
Location name: Sausalito, California, USA*
Latitude: 37.8741°, Longitude: -122.5194°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.86** (1.67-2.11)	**2.33** (2.06-2.64)	**2.96** (2.63-3.38)	**3.53** (3.10-4.06)	**4.34** (3.66-5.20)	**5.00** (4.12-6.16)	**5.72** (4.57-7.25)	**6.52** (5.03-8.52)	**7.64** (5.62-10.5)	**8.58** (6.05-12.3)
10-min	**1.34** (1.19-1.52)	**1.67** (1.48-1.89)	**2.13** (1.89-2.42)	**2.53** (2.22-2.91)	**3.11** (2.62-3.73)	**3.59** (2.95-4.41)	**4.10** (3.28-5.20)	**4.67** (3.60-6.11)	**5.48** (4.02-7.54)	**6.15** (4.33-8.81)
15-min	**1.08** (0.960-1.22)	**1.34** (1.20-1.52)	**1.72** (1.52-1.95)	**2.04** (1.79-2.34)	**2.51** (2.12-3.00)	**2.90** (2.38-3.56)	**3.31** (2.64-4.19)	**3.76** (2.90-4.92)	**4.42** (3.24-6.08)	**4.96** (3.50-7.10)
30-min	**0.756** (0.674-0.856)	**0.940** (0.838-1.07)	**1.20** (1.07-1.37)	**1.43** (1.25-1.64)	**1.76** (1.48-2.11)	**2.03** (1.67-2.49)	**2.32** (1.85-2.93)	**2.64** (2.03-3.45)	**3.09** (2.27-4.26)	**3.47** (2.45-4.98)
60-min	**0.531** (0.473-0.601)	**0.661** (0.589-0.750)	**0.845** (0.749-0.962)	**1.00** (0.881-1.15)	**1.24** (1.04-1.48)	**1.42** (1.17-1.75)	**1.63** (1.30-2.06)	**1.85** (1.43-2.42)	**2.17** (1.60-2.99)	**2.44** (1.72-3.50)
2-hr	**0.390** (0.348-0.442)	**0.485** (0.431-0.550)	**0.618** (0.548-0.704)	**0.735** (0.645-0.845)	**0.905** (0.763-1.08)	**1.05** (0.860-1.28)	**1.20** (0.956-1.52)	**1.36** (1.05-1.79)	**1.60** (1.18-2.21)	**1.81** (1.27-2.59)
3-hr	**0.330** (0.294-0.374)	**0.409** (0.364-0.465)	**0.522** (0.463-0.595)	**0.620** (0.544-0.713)	**0.763** (0.644-0.914)	**0.882** (0.725-1.08)	**1.01** (0.806-1.28)	**1.15** (0.887-1.50)	**1.35** (0.994-1.86)	**1.52** (1.07-2.18)
6-hr	**0.239** (0.213-0.271)	**0.297** (0.265-0.338)	**0.379** (0.336-0.432)	**0.450** (0.395-0.518)	**0.553** (0.466-0.662)	**0.637** (0.523-0.783)	**0.727** (0.580-0.921)	**0.825** (0.637-1.08)	**0.967** (0.710-1.33)	**1.08** (0.764-1.56)
12-hr	**0.161** (0.143-0.182)	**0.204** (0.181-0.231)	**0.263** (0.233-0.299)	**0.313** (0.274-0.360)	**0.384** (0.323-0.460)	**0.441** (0.362-0.542)	**0.501** (0.399-0.634)	**0.565** (0.436-0.740)	**0.656** (0.481-0.902)	**0.729** (0.514-1.04)
24-hr	**0.107** (0.096-0.121)	**0.137** (0.124-0.156)	**0.179** (0.160-0.203)	**0.213** (0.190-0.244)	**0.262** (0.226-0.309)	**0.300** (0.254-0.361)	**0.340** (0.282-0.419)	**0.382** (0.309-0.483)	**0.442** (0.343-0.579)	**0.489** (0.368-0.662)
2-day	**0.071** (0.064-0.080)	**0.090** (0.081-0.102)	**0.116** (0.104-0.132)	**0.139** (0.123-0.159)	**0.170** (0.147-0.200)	**0.194** (0.165-0.234)	**0.220** (0.183-0.271)	**0.248** (0.200-0.313)	**0.286** (0.222-0.376)	**0.317** (0.239-0.430)
3-day	**0.054** (0.049-0.062)	**0.069** (0.062-0.078)	**0.089** (0.080-0.101)	**0.106** (0.094-0.121)	**0.129** (0.112-0.153)	**0.148** (0.125-0.178)	**0.168** (0.139-0.206)	**0.188** (0.152-0.238)	**0.218** (0.169-0.286)	**0.241** (0.182-0.327)
4-day	**0.045** (0.041-0.051)	**0.057** (0.052-0.065)	**0.074** (0.066-0.084)	**0.088** (0.078-0.100)	**0.107** (0.092-0.126)	**0.122** (0.104-0.148)	**0.139** (0.115-0.171)	**0.156** (0.126-0.197)	**0.180** (0.140-0.236)	**0.199** (0.150-0.270)
7-day	**0.031** (0.028-0.036)	**0.040** (0.036-0.045)	**0.051** (0.046-0.058)	**0.061** (0.054-0.070)	**0.074** (0.064-0.088)	**0.085** (0.072-0.102)	**0.096** (0.079-0.118)	**0.107** (0.087-0.136)	**0.124** (0.096-0.162)	**0.137** (0.103-0.185)
10-day	**0.026** (0.023-0.029)	**0.033** (0.029-0.037)	**0.042** (0.038-0.048)	**0.050** (0.044-0.057)	**0.061** (0.052-0.072)	**0.069** (0.058-0.083)	**0.078** (0.064-0.096)	**0.087** (0.070-0.110)	**0.099** (0.077-0.130)	**0.109** (0.082-0.148)
20-day	**0.017** (0.015-0.019)	**0.021** (0.019-0.024)	**0.027** (0.025-0.031)	**0.032** (0.029-0.037)	**0.039** (0.034-0.046)	**0.044** (0.037-0.053)	**0.049** (0.041-0.061)	**0.054** (0.044-0.069)	**0.061** (0.048-0.081)	**0.067** (0.050-0.091)
30-day	**0.013** (0.012-0.015)	**0.017** (0.015-0.020)	**0.022** (0.020-0.025)	**0.026** (0.023-0.030)	**0.031** (0.027-0.037)	**0.035** (0.030-0.042)	**0.039** (0.032-0.048)	**0.043** (0.034-0.054)	**0.048** (0.037-0.063)	**0.051** (0.039-0.070)
45-day	**0.011** (0.010-0.012)	**0.014** (0.013-0.016)	**0.018** (0.016-0.021)	**0.021** (0.019-0.025)	**0.025** (0.022-0.030)	**0.028** (0.024-0.034)	**0.031** (0.026-0.038)	**0.034** (0.027-0.043)	**0.037** (0.029-0.049)	**0.040** (0.030-0.054)
60-day	**0.010** (0.009-0.011)	**0.013** (0.011-0.015)	**0.016** (0.015-0.019)	**0.019** (0.017-0.022)	**0.022** (0.019-0.027)	**0.025** (0.021-0.030)	**0.027** (0.022-0.034)	**0.029** (0.024-0.037)	**0.032** (0.025-0.042)	**0.034** (0.026-0.046)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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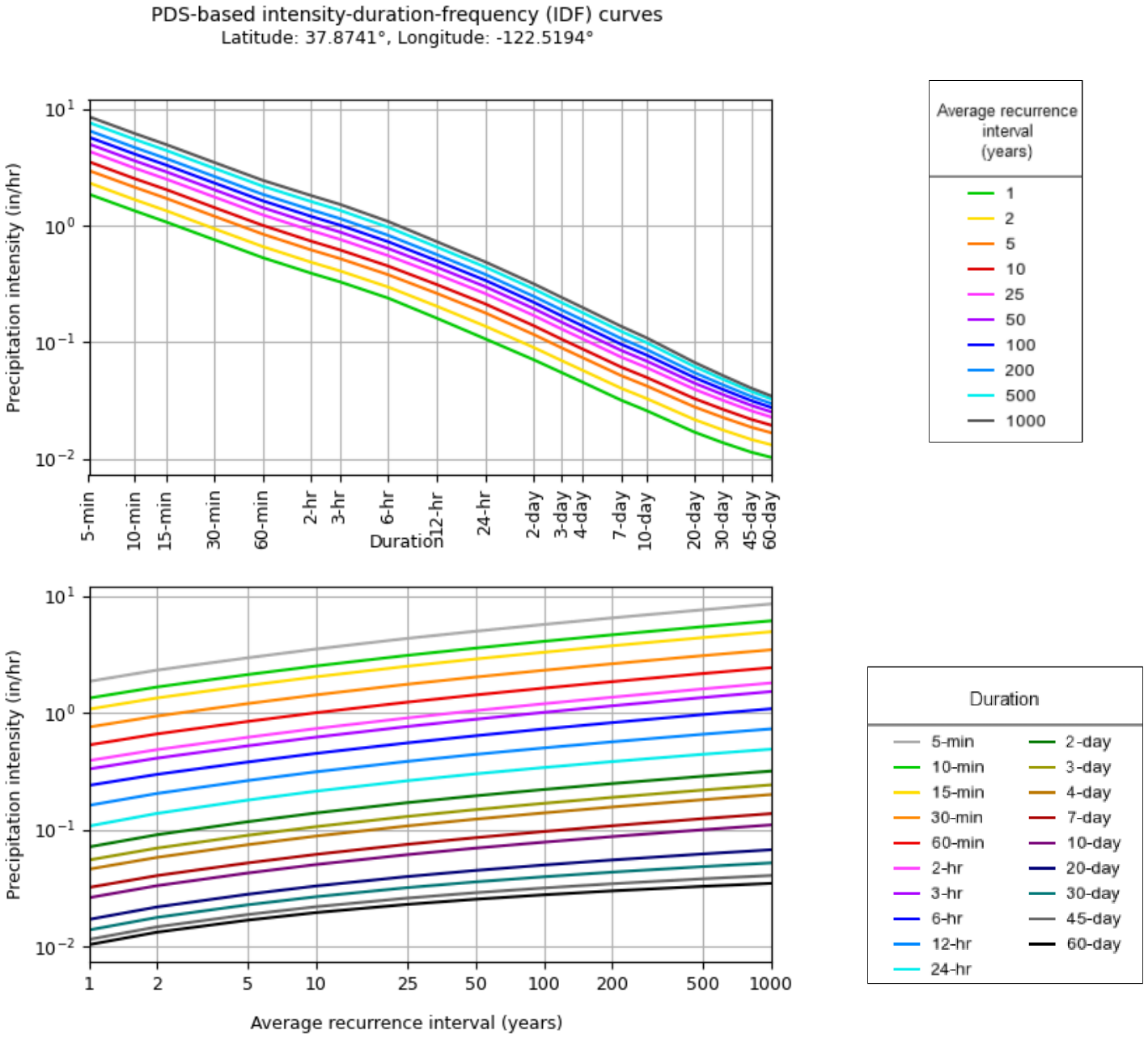
PF graphical



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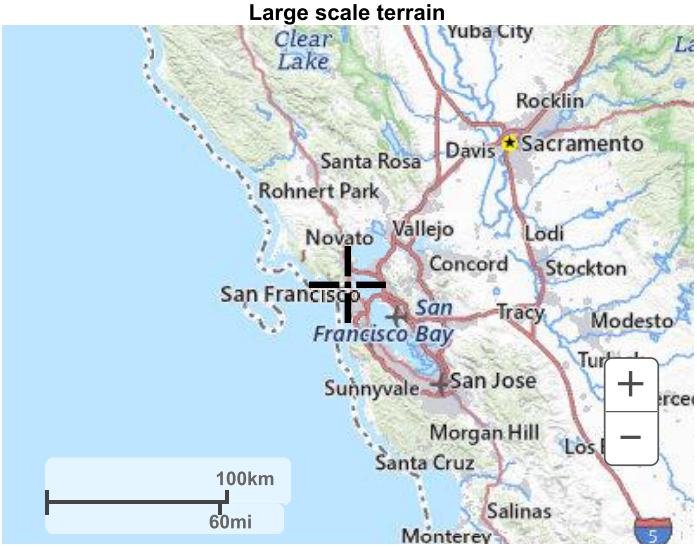
Maps & aerials

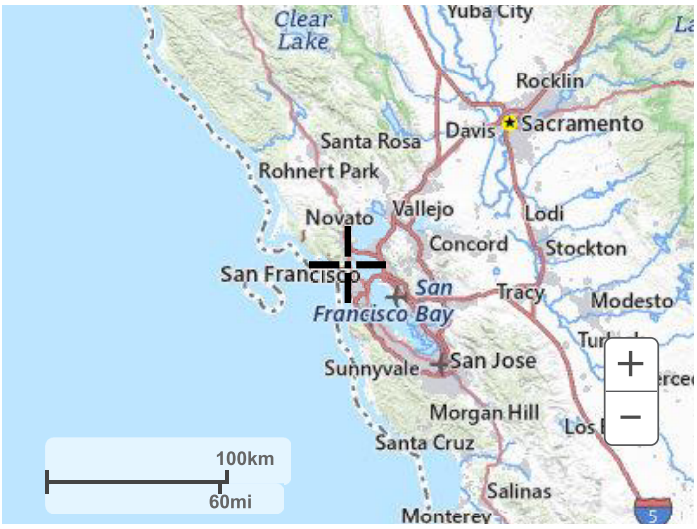
Small scale terrain

Large scale terrain



Large scale map

Large scale aerial



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National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Detention Volume Calculations

(Rational Method, 10-yr)

Project: Fernwood Cemetery Expansion **Date:** 3/10/2026

JN: 23275

Subbasin ID: 1

Pre-construction, 10-yr:

A_{PRE} = **7.34** acres

$T_{C,POST}$ = **15.74** min[1]

$Q_{a,Allowable\ Flow}$ = **7.28** cfs[1]

Post-construction 10-yr:

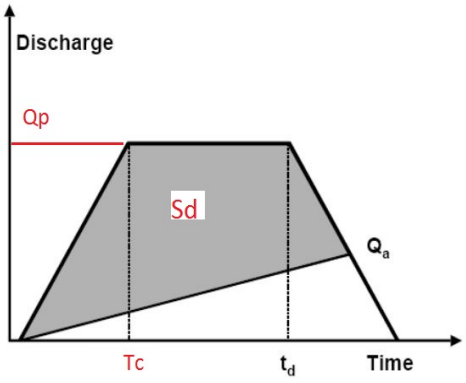
A_{POST} = **7.34** acres

C_{POST} = **0.59**

$T_{C,POST}$ = **12.33** min[2]

[1] Refer to the Rational Method Drainage Study

[2] Estimated from Post-Construction conditions



Required Storage Volume:

$$S_d = (Q_p * t_d - Q_a * (t_d + Tc)/2) * 60$$

PRE & POST CONSTRUCTION RUNOFF COEFFICIENT

	A_T	A_V	A_G	A_P	C_T
$Area_{Pre}$	7.35	7.35	0.00	0.00	0.50
$Area_{Post}$	7.35	5.64	0.00	1.71	0.59

NOTE:

(Ref. Plate No. B-1)

Vegetated area : C_V = 0.50 (=Pre-construction)

C_G = 0.70

Residential area : C_P = 0.90

Mixed area : $C = (A_V / SA) * C_V + (A_P / SA) * C_P + (A_G / SA) * C_G$

Storm Duration*		Rainfall Intensity	Peak Flow	Required Storage	Note
t_d/Tc	t_d (min)	I_{td} (in/hr)	Q_P (cfs)	S_d (ft^3)	
1.00	12.33	2.247	9.78	1,850	
1.25	15.41	2.005	8.73	2,013	
1.50	18.50	1.827	7.95	2,094	
1.75	21.58	1.69	7.28	2,020	MAX
2.00	24.66	1.578	6.87	2,083	
2.25	27.74	1.486	6.47	2,014	
2.50	30.83	1.408	6.13	1,911	
2.75	33.91	1.341	5.84	1,780	
3.00	36.99	1.283	5.58	1,624	
3.25	40.07	1.232	5.36	1,446	
3.50	43.16	1.186	5.16	1,250	
3.75	46.24	1.145	4.98	1,036	
4.00	49.32	1.108	4.82	807	
4.25	52.40	1.074	4.68	564	
4.50	55.49	1.043	4.54	309	
4.75	58.57	1.015	4.42	42	
5.00	61.65	0.989	4.30	(237)	
5.25	64.73	0.964	4.20	(525)	

Detention Analysis

IMP-1

Project Data

Project Title:	232475 - Fernwood Cemetery Expansion
Designer:	ZR
Project Date:	3/10/2026
Notes:	Subbasin 1

Storage Capacity: Known Area & Volume

Elevation (ft)	Depth (ft)	Area (ft^2)	Volume (ft^3)	Composite Porosity [1]	Effective Volume (ft^3) [2]	Total Volume (ft^3) [3]
0.00	0.00	4,000	0	0.40	0	0
1.50	1.50	4,000	6,000	0.40	2,400	2,400
2.50	1.00	4,000	4,000	0.40	1,600	4,000
4.00	1.50	4,000	6,000	0.40	2,400	6,400

Notes:

[1] Composit Porosity is the porosity of the storage medium.

[2] Effective volume is the area multiplied by the composit porosity.

[3] Total volume is the sum of the effective volumes for each storage medium.

T:\2023 PROJECTS\23275\Reports\Drainage\[23275-Bio Sizing for Detention Analysis_20260310.xlsx]IMP 3-Detention

Detention Volume Calculations

(Rational Method, 10-yr)

Project: Fernwood Cemetery Expansion **Date:** 3/10/2026

JN: 23275

Subbasin ID: 2

Pre-construction, 10-yr:

A_{PRE} = **1.59** acres

$T_{C,POST}$ = **10.94** min[1]

$Q_{a,Allowable\ Flow}$ = **1.90** cfs[1]

Post-construction 10-yr:

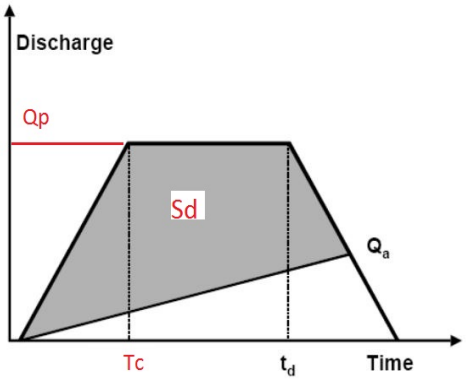
A_{POST} = **1.59** acres

C_{POST} = **0.56**

$T_{C,POST}$ = **11.06** min[2]

[1] Refer to the Rational Method Drainage Study

[2] Estimated from Post-Construction conditions



Required Storage Volume:

$$S_d = (Q_p * t_d - Q_a * (t_d + Tc)/2) * 60$$

PRE & POST CONSTRUCTION RUNOFF COEFFICIENT

	A_T	A_V	A_G	A_P	C_T
$Area_{Pre}$	1.59	1.59	0.00	0.00	0.50
$Area_{Post}$	1.59	1.37	0.00	0.22	0.56

NOTE:

(Ref. Plate No. B-1)

Vegetated area : C_V = 0.50 (=Pre-construction)

C_G= 0.70

Residential area : C_P = 0.90

Mixed area : $C = (A_V / SA) * C_V + (A_P / SA) * C_P + (A_G / SA) * C_G$

Storm Duration*		Rainfall Intensity	Peak Flow	Required Storage	Note
t_d/Tc	t_d (min)	I_{td} (in/hr)	Q_P (cfs)	S_d (ft^3)	
0.75	8.30	2.750	2.43	105	
1.00	11.06	2.375	2.10	131	
1.25	13.83	2.119	1.87	134	MAX
1.50	16.59	1.931	1.71	121	
1.75	19.36	1.785	1.58	97	
2.00	22.12	1.668	1.47	63	
2.25	24.89	1.570	1.39	22	
2.50	27.65	1.488	1.31	(26)	
2.75	30.42	1.418	1.25	(80)	
3.00	33.18	1.356	1.20	(138)	
3.25	35.95	1.302	1.15	(200)	
3.50	38.71	1.254	1.11	(266)	
3.75	41.48	1.210	1.07	(335)	
4.00	44.24	1.171	1.03	(407)	
4.25	47.01	1.135	1.00	(482)	
4.50	49.77	1.103	0.97	(559)	
4.75	52.54	1.073	0.95	(639)	
5.00	55.30	1.045	0.92	(721)	

Detention Analysis

IMP-2

Project Data

Project Title:	232475 - Fernwood Cemetery Expansion
Designer:	ZR
Project Date:	3/10/2026
Notes:	Subbasin 2

Storage Capacity: Known Area & Volume

Elevation (ft)	Depth (ft)	Area (ft^2)	Volume (ft^3)	Composite Porosity [1]	Effective Volume (ft^3) [2]	Total Volume (ft^3) [3]
0.00	0.00	1,000	0	0.40	0	0
1.50	1.50	1,000	1,500	0.40	600	600
2.50	1.00	1,000	1,000	0.40	400	1,000
3.00	0.50	1,000	500	0.40	200	1,200

Notes:

[1] Composit Porosity is the porosity of the storage medium.

[2] Effective volume is the area multiplied by the composit porosity.

[3] Total volume is the sum of the effective volumes for each storage medium.

T:\2023 PROJECTS\23275\Reports\Drainage\[23275-Bio Sizing for Detention Analysis_20260310.xlsx]IMP 3-Detention

Detention Volume Calculations

(Rational Method, 10-yr)

Project: Fernwood Cemetery Expansion **Date:** 3/10/2026

JN: 23275

Subbasin ID: 3

Pre-construction, 10-yr:

A_{PRE} = **0.34** acres

$T_{C,POST}$ = **15.38** min[1]

$Q_{a,Allowable\ Flow}$ = **0.34** cfs[1]

Post-construction 10-yr:

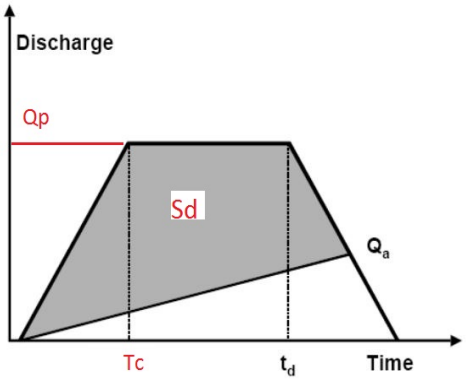
A_{POST} = **0.34** acres

C_{POST} = **0.86**

$T_{C,POST}$ = **8.15** min[2]

[1] Refer to the Rational Method Drainage Study

[2] Estimated from Post-Construction conditions



Required Storage Volume:

$$S_d = (Q_p * t_d - Q_a * (t_d + Tc)/2) * 60$$

PRE & POST CONSTRUCTION RUNOFF COEFFICIENT

	A_T	A_V	A_G	A_P	C_T
$Area_{Pre}$	0.34	0.34	0.00	0.00	0.50
$Area_{Post}$	0.34	0.03	0.00	0.31	0.86

NOTE:

(Ref. Plate No. B-1)

Vegetated area : C_V = 0.50 (=Pre-construction)

C_G= 0.70

Residential area : C_P = 0.90

Mixed area : $C = (A_V / SA) * C_V + (A_P / SA) * C_P + (A_G / SA) * C_G$

Storm Duration*		Rainfall Intensity	Peak Flow	Required Storage	Note
t_d/Tc	t_d (min)	I_{td} (in/hr)	Q_P (cfs)	S_d (ft^3)	
4.00	32.60	1.368	0.40	371	
4.25	34.64	1.327	0.39	374	
4.50	36.68	1.289	0.38	376	
4.75	38.71	1.254	0.37	378	
5.00	40.75	1.221	0.36	379	
5.25	42.79	1.191	0.34	353	MAX
5.50	44.83	1.163	0.34	379	
5.75	46.86	1.137	0.33	379	
6.00	48.90	1.113	0.33	378	
6.25	50.94	1.090	0.32	377	
6.50	52.98	1.068	0.31	375	
6.75	55.01	1.048	0.31	373	
7.00	57.05	1.029	0.30	370	
7.25	59.09	1.010	0.30	367	
7.50	61.13	0.993	0.29	364	
7.75	63.16	0.977	0.29	361	
8.00	65.20	0.961	0.28	357	
8.25	67.24	0.946	0.28	353	

Detention Analysis

IMP-3

Project Data

Project Title:	232475 - Fernwood Cemetery Expansion
Designer:	ZR
Project Date:	3/10/2026
Notes:	Subbasin 3

Storage Capacity: Known Area & Volume

Elevation (ft)	Depth (ft)	Area (ft^2)	Volume (ft^3)	Composite Porosity [1]	Effective Volume (ft^3) [2]	Total Volume (ft^3) [3]
0.00	0.00	600	0	0.40	0	0
1.50	1.50	600	900	0.40	360	360
2.50	1.00	600	600	0.40	240	600
4.25	1.75	600	1,050	0.40	420	1,020

Notes:

[1] Composit Porosity is the porosity of the storage medium.

[2] Effective volume is the area multiplied by the composit porosity.

[3] Total volume is the sum of the effective volumes for each storage medium.

T:\2023 PROJECTS\23275\Reports\Drainage\[23275-Bio Sizing for Detention Analysis_20260310.xlsx]IMP 3-Detention

6. 10 and 100-Year Stormdrain Analysis

Hydraulic Analysis Report

Project Data

Project Title: 23275-Hydraulic Analysis

Designer:

Project Date: Tuesday, March 10, 2026

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 1.3200 cfs

Result Parameters

Depth: 0.4145 ft

Area of Flow: 0.2290 ft^2

Wetted Perimeter: 1.2129 ft

Hydraulic Radius: 0.1888 ft

Average Velocity: 5.7639 ft/s

Top Width: 0.6509 ft

Froude Number: 1.7124

Critical Depth: 0.5418 ft

Critical Velocity: 4.3218 ft/s

Critical Slope: 0.0102 ft/ft

Critical Top Width: 0.53 ft

Calculated Max Shear Stress: 0.5172 lb/ft^2

Calculated Avg Shear Stress: 0.2356 lb/ft^2

Channel Analysis: SD-2

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.1100 ft/ft

Manning's n: 0.0120

Flow: 2.1200 cfs

Result Parameters

Depth: 0.3278 ft

Area of Flow: 0.1715 ft^2

Wetted Perimeter: 1.0380 ft

Hydraulic Radius: 0.1652 ft

Average Velocity: 12.3646 ft/s

Top Width: 0.6698 ft

Froude Number: 4.3068

Critical Depth: 0.6356 ft

Critical Velocity: 6.1320 ft/s

Critical Slope: 0.0221 ft/ft

Critical Top Width: 0.30 ft

Calculated Max Shear Stress: 2.2500 lb/ft^2

Calculated Avg Shear Stress: 1.1338 lb/ft^2

Channel Analysis: SD-2.1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.1100 ft/ft

Manning's n: 0.0120

Flow: 2.1200 cfs

Result Parameters

Depth: 0.3278 ft

Area of Flow: 0.1715 ft^2

Wetted Perimeter: 1.0380 ft

Hydraulic Radius: 0.1652 ft

Average Velocity: 12.3646 ft/s

Top Width: 0.6698 ft

Froude Number: 4.3068

Critical Depth: 0.6356 ft

Critical Velocity: 6.1320 ft/s

Critical Slope: 0.0221 ft/ft

Critical Top Width: 0.30 ft

Calculated Max Shear Stress: 2.2500 lb/ft^2

Calculated Avg Shear Stress: 1.1338 lb/ft^2

Channel Analysis: SD-3

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0650 ft/ft

Manning's n: 0.0120

Flow: 0.2600 cfs

Result Parameters

Depth: 0.1257 ft

Area of Flow: 0.0458 ft^2

Wetted Perimeter: 0.6002 ft

Hydraulic Radius: 0.0763 ft

Average Velocity: 5.6783 ft/s

Top Width: 0.5231 ft

Froude Number: 3.3822

Critical Depth: 0.2351 ft

Critical Velocity: 2.3566 ft/s

Critical Slope: 0.0055 ft/ft

Critical Top Width: 0.64 ft

Calculated Max Shear Stress: 0.5097 lb/ft^2

Calculated Avg Shear Stress: 0.3094 lb/ft^2

Channel Analysis: SD-4

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0500 ft/ft

Manning's n: 0.0120

Flow: 0.8300 cfs

Result Parameters

Depth: 0.2424 ft

Area of Flow: 0.1150 ft^2

Wetted Perimeter: 0.8648 ft

Hydraulic Radius: 0.1330 ft

Average Velocity: 7.2156 ft/s

Top Width: 0.6439 ft

Froude Number: 3.0085

Critical Depth: 0.4305 ft

Critical Velocity: 3.4669 ft/s

Critical Slope: 0.0071 ft/ft

Critical Top Width: 0.64 ft

Calculated Max Shear Stress: 0.7562 lb/ft^2

Calculated Avg Shear Stress: 0.4150 lb/ft^2

Channel Analysis: SD-5

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0400 ft/ft

Manning's n: 0.0120

Flow: 0.5300 cfs

Result Parameters

Depth: 0.2031 ft

Area of Flow: 0.0902 ft^2

Wetted Perimeter: 0.7812 ft

Hydraulic Radius: 0.1155 ft

Average Velocity: 5.8734 ft/s

Top Width: 0.6159 ft

Froude Number: 2.7040

Critical Depth: 0.3409 ft

Critical Velocity: 2.9407 ft/s

Critical Slope: 0.0060 ft/ft

Critical Top Width: 0.67 ft

Calculated Max Shear Stress: 0.5069 lb/ft^2

Calculated Avg Shear Stress: 0.2883 lb/ft^2

Channel Analysis: SD-6

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0120

Flow: 1.9300 cfs

Result Parameters

Depth: 0.5000 ft

Area of Flow: 0.3927 ft^2

Wetted Perimeter: 1.5709 ft

Hydraulic Radius: 0.2500 ft

Average Velocity: 4.9143 ft/s

Top Width: 1.0000 ft

Froude Number: 1.3819

Critical Depth: 0.5923 ft

Critical Velocity: 3.9838 ft/s

Critical Slope: 0.0058 ft/ft

Critical Top Width: 0.98 ft

Calculated Max Shear Stress: 0.3120 lb/ft^2

Calculated Avg Shear Stress: 0.1560 lb/ft^2

Channel Analysis: SD-8

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0800 ft/ft

Manning's n: 0.0120

Flow: 0.5800 cfs

Result Parameters

Depth: 0.1781 ft

Area of Flow: 0.0751 ft^2

Wetted Perimeter: 0.7258 ft

Hydraulic Radius: 0.1035 ft

Average Velocity: 7.7205 ft/s

Top Width: 0.5919 ft

Froude Number: 3.8191

Critical Depth: 0.3572 ft

Critical Velocity: 3.0338 ft/s

Critical Slope: 0.0062 ft/ft

Critical Top Width: 0.67 ft

Calculated Max Shear Stress: 0.8889 lb/ft^2

Calculated Avg Shear Stress: 0.5167 lb/ft^2

Channel Analysis: SD-9

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0400 ft/ft

Manning's n: 0.0120

Flow: 0.8700 cfs

Result Parameters

Depth: 0.2640 ft

Area of Flow: 0.1291 ft^2

Wetted Perimeter: 0.9094 ft

Hydraulic Radius: 0.1420 ft

Average Velocity: 6.7393 ft/s

Top Width: 0.6548 ft

Froude Number: 2.6748

Critical Depth: 0.4413 ft

Critical Velocity: 3.5322 ft/s

Critical Slope: 0.0072 ft/ft

Critical Top Width: 0.64 ft

Calculated Max Shear Stress: 0.6590 lb/ft^2

Calculated Avg Shear Stress: 0.3543 lb/ft^2

Channel Analysis: SD-10

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0300 ft/ft

Manning's n: 0.0120

Flow: 1.2300 cfs

Result Parameters

Depth: 0.3489 ft

Area of Flow: 0.1856 ft^2

Wetted Perimeter: 1.0802 ft

Hydraulic Radius: 0.1718 ft

Average Velocity: 6.6283 ft/s

Top Width: 0.6694 ft

Froude Number: 2.2186

Critical Depth: 0.5244 ft

Critical Velocity: 4.1545 ft/s

Critical Slope: 0.0094 ft/ft

Critical Top Width: 0.55 ft

Calculated Max Shear Stress: 0.6531 lb/ft^2

Calculated Avg Shear Stress: 0.3216 lb/ft^2

Channel Analysis: SD-11

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0400 ft/ft

Manning's n: 0.0120

Flow: 1.5800 cfs

Result Parameters

Depth: 0.3723 ft

Area of Flow: 0.2012 ft^2

Wetted Perimeter: 1.1272 ft

Hydraulic Radius: 0.1785 ft

Average Velocity: 7.8523 ft/s

Top Width: 0.6658 ft

Froude Number: 2.5172

Critical Depth: 0.5843 ft

Critical Velocity: 4.8428 ft/s

Critical Slope: 0.0129 ft/ft

Critical Top Width: 0.45 ft

Calculated Max Shear Stress: 0.9292 lb/ft^2

Calculated Avg Shear Stress: 0.4456 lb/ft^2

Channel Analysis: SD-12

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.1300 ft/ft

Manning's n: 0.0120

Flow: 2.0800 cfs

Result Parameters

Depth: 0.3090 ft

Area of Flow: 0.1589 ft^2

Wetted Perimeter: 1.0003 ft

Hydraulic Radius: 0.1588 ft

Average Velocity: 13.0938 ft/s

Top Width: 0.6680 ft

Froude Number: 4.7317

Critical Depth: 0.6330 ft

Critical Velocity: 6.0301 ft/s

Critical Slope: 0.0213 ft/ft

Critical Top Width: 0.31 ft

Calculated Max Shear Stress: 2.5063 lb/ft^2

Calculated Avg Shear Stress: 1.2882 lb/ft^2

Channel Analysis: SD-13

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.1300 ft/ft

Manning's n: 0.0120

Flow: 4.9500 cfs

Result Parameters

Depth: 0.4120 ft

Area of Flow: 0.3052 ft^2

Wetted Perimeter: 1.3939 ft

Hydraulic Radius: 0.2189 ft

Average Velocity: 16.2199 ft/s

Top Width: 0.9844 ft

Froude Number: 5.1337

Critical Depth: 0.9141 ft

Critical Velocity: 6.5764 ft/s

Critical Slope: 0.0143 ft/ft

Critical Top Width: 0.56 ft

Calculated Max Shear Stress: 3.3423 lb/ft^2

Calculated Avg Shear Stress: 1.7760 lb/ft^2

Channel Analysis: SD-14

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.1000 ft/ft

Manning's n: 0.0120

Flow: 6.4700 cfs

Result Parameters

Depth: 0.5177 ft

Area of Flow: 0.4103 ft^2

Wetted Perimeter: 1.6061 ft

Hydraulic Radius: 0.2555 ft

Average Velocity: 15.7671 ft/s

Top Width: 0.9994 ft

Froude Number: 4.3362

Critical Depth: 0.9663 ft

Critical Velocity: 8.3244 ft/s

Critical Slope: 0.0246 ft/ft

Critical Top Width: 0.36 ft

Calculated Max Shear Stress: 3.2302 lb/ft^2

Calculated Avg Shear Stress: 1.5943 lb/ft^2

Channel Analysis: SD-15

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.1200 ft/ft

Manning's n: 0.0120

Flow: 7.5100 cfs

Result Parameters

Depth: 0.5360 ft

Area of Flow: 0.4287 ft^2

Wetted Perimeter: 1.6430 ft

Hydraulic Radius: 0.2609 ft

Average Velocity: 17.5175 ft/s

Top Width: 0.9974 ft

Froude Number: 4.7086

Critical Depth: 0.9810 ft

Critical Velocity: 9.6046 ft/s

Critical Slope: 0.0340 ft/ft

Critical Top Width: 0.27 ft

Calculated Max Shear Stress: 4.0139 lb/ft^2

Calculated Avg Shear Stress: 1.9539 lb/ft^2

Channel Analysis: SD-16

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0900 ft/ft

Manning's n: 0.0120

Flow: 9.1400 cfs

Result Parameters

Depth: 0.5301 ft

Area of Flow: 0.5585 ft^2

Wetted Perimeter: 1.9098 ft

Hydraulic Radius: 0.2924 ft

Average Velocity: 16.3665 ft/s

Top Width: 1.4341 ft

Froude Number: 4.6218

Critical Depth: 1.1689 ft

Critical Velocity: 6.1858 ft/s

Critical Slope: 0.0071 ft/ft

Critical Top Width: 1.24 ft

Calculated Max Shear Stress: 2.9768 lb/ft^2

Calculated Avg Shear Stress: 1.6422 lb/ft^2

Channel Analysis: SD-17

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.1000 ft/ft

Manning's n: 0.0120

Flow: 9.5600 cfs

Result Parameters

Depth: 0.5279 ft

Area of Flow: 0.5553 ft^2

Wetted Perimeter: 1.9052 ft

Hydraulic Radius: 0.2915 ft

Average Velocity: 17.2156 ft/s

Top Width: 1.4327 ft

Froude Number: 4.8731

Critical Depth: 1.1938 ft

Critical Velocity: 6.3390 ft/s

Critical Slope: 0.0075 ft/ft

Critical Top Width: 1.21 ft

Calculated Max Shear Stress: 3.2939 lb/ft^2

Calculated Avg Shear Stress: 1.8188 lb/ft^2

Channel Analysis: SD-18

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0120

Flow: 0.8000 cfs

Result Parameters

Depth: 0.3752 ft

Area of Flow: 0.2032 ft^2

Wetted Perimeter: 1.1331 ft

Hydraulic Radius: 0.1793 ft

Average Velocity: 3.9377 ft/s

Top Width: 0.6652 ft

Froude Number: 1.2556

Critical Depth: 0.4227 ft

Critical Velocity: 3.4137 ft/s

Critical Slope: 0.0069 ft/ft

Critical Top Width: 0.65 ft

Calculated Max Shear Stress: 0.2341 lb/ft^2

Calculated Avg Shear Stress: 0.1119 lb/ft^2

Channel Analysis: SD-19

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.1600 ft/ft

Manning's n: 0.0120

Flow: 10.3600 cfs

Result Parameters

Depth: 0.4866 ft

Area of Flow: 0.4967 ft^2

Wetted Perimeter: 1.8179 ft

Hydraulic Radius: 0.2732 ft

Average Velocity: 20.8564 ft/s

Top Width: 1.4044 ft

Froude Number: 6.1802

Critical Depth: 1.2378 ft

Critical Velocity: 6.6420 ft/s

Critical Slope: 0.0082 ft/ft

Critical Top Width: 1.14 ft

Calculated Max Shear Stress: 4.8581 lb/ft^2

Calculated Avg Shear Stress: 2.7281 lb/ft^2

Hydraulic Analysis Report

Project Data

Project Title: 23275-Hydraulic Analysis-100 Year

Designer:

Project Date: Tuesday, March 10, 2026

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 2.1400 cfs

Result Parameters

Depth: 0.4145 ft

Area of Flow: 0.2290 ft^2

Wetted Perimeter: 1.2129 ft

Hydraulic Radius: 0.1888 ft

Average Velocity: 5.7639 ft/s

Top Width: 0.6509 ft

Froude Number: 1.7124

Critical Depth: 0.5418 ft

Critical Velocity: 4.3218 ft/s

Critical Slope: 0.0102 ft/ft

Critical Top Width: 0.53 ft

Calculated Max Shear Stress: 0.5172 lb/ft^2

Calculated Avg Shear Stress: 0.2356 lb/ft^2

Channel Analysis: SD-2

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.1100 ft/ft

Manning's n: 0.0120

Flow: 3.4400 cfs

Result Parameters

Depth: 0.4458 ft

Area of Flow: 0.2492 ft^2

Wetted Perimeter: 1.2783 ft

Hydraulic Radius: 0.1949 ft

Average Velocity: 13.8065 ft/s

Top Width: 0.6323 ft

Froude Number: 3.8759

Critical Depth: 0.6647 ft

Critical Velocity: 9.7688 ft/s

Critical Slope: 0.0624 ft/ft

Critical Top Width: 0.12 ft

Calculated Max Shear Stress: 3.0601 lb/ft^2

Calculated Avg Shear Stress: 1.3378 lb/ft^2

Channel Analysis: SD-2.1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.1100 ft/ft

Manning's n: 0.0120

Flow: 3.4400 cfs

Result Parameters

Depth: 0.4458 ft

Area of Flow: 0.2492 ft^2

Wetted Perimeter: 1.2783 ft

Hydraulic Radius: 0.1949 ft

Average Velocity: 13.8065 ft/s

Top Width: 0.6323 ft

Froude Number: 3.8759

Critical Depth: 0.6647 ft

Critical Velocity: 9.7688 ft/s

Critical Slope: 0.0624 ft/ft

Critical Top Width: 0.12 ft

Calculated Max Shear Stress: 3.0601 lb/ft^2

Calculated Avg Shear Stress: 1.3378 lb/ft^2

Channel Analysis: SD-3

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0650 ft/ft

Manning's n: 0.0120

Flow: 0.4200 cfs

Result Parameters

Depth: 0.1594 ft

Area of Flow: 0.0643 ft^2

Wetted Perimeter: 0.6828 ft

Hydraulic Radius: 0.0941 ft

Average Velocity: 6.5336 ft/s

Top Width: 0.5706 ft

Froude Number: 3.4304

Critical Depth: 0.3016 ft

Critical Velocity: 2.7279 ft/s

Critical Slope: 0.0058 ft/ft

Critical Top Width: 0.67 ft

Calculated Max Shear Stress: 0.6466 lb/ft^2

Calculated Avg Shear Stress: 0.3818 lb/ft^2

Channel Analysis: SD-4

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0500 ft/ft

Manning's n: 0.0120

Flow: 1.3500 cfs

Result Parameters

Depth: 0.3171 ft

Area of Flow: 0.1643 ft^2

Wetted Perimeter: 1.0166 ft

Hydraulic Radius: 0.1616 ft

Average Velocity: 8.2164 ft/s

Top Width: 0.6690 ft

Froude Number: 2.9218

Critical Depth: 0.5473 ft

Critical Velocity: 4.3783 ft/s

Critical Slope: 0.0104 ft/ft

Critical Top Width: 0.52 ft

Calculated Max Shear Stress: 0.9894 lb/ft^2

Calculated Avg Shear Stress: 0.5042 lb/ft^2

Channel Analysis: SD-5

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0400 ft/ft

Manning's n: 0.0120

Flow: 0.8700 cfs

Result Parameters

Depth: 0.2640 ft

Area of Flow: 0.1291 ft^2

Wetted Perimeter: 0.9094 ft

Hydraulic Radius: 0.1420 ft

Average Velocity: 6.7393 ft/s

Top Width: 0.6548 ft

Froude Number: 2.6748

Critical Depth: 0.4413 ft

Critical Velocity: 3.5322 ft/s

Critical Slope: 0.0072 ft/ft

Critical Top Width: 0.64 ft

Calculated Max Shear Stress: 0.6590 lb/ft^2

Calculated Avg Shear Stress: 0.3543 lb/ft^2

Channel Analysis: SD-6

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0120

Flow: 3.1400 cfs

Result Parameters

Depth: 0.6850 ft

Area of Flow: 0.5734 ft^2

Wetted Perimeter: 1.9498 ft

Hydraulic Radius: 0.2941 ft

Average Velocity: 5.4761 ft/s

Top Width: 0.9290 ft

Froude Number: 1.2284

Critical Depth: 0.7593 ft

Critical Velocity: 4.9075 ft/s

Critical Slope: 0.0077 ft/ft

Critical Top Width: 0.86 ft

Calculated Max Shear Stress: 0.4274 lb/ft^2

Calculated Avg Shear Stress: 0.1835 lb/ft^2

Channel Analysis: SD-8

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0800 ft/ft

Manning's n: 0.0120

Flow: 0.9500 cfs

Result Parameters

Depth: 0.2299 ft

Area of Flow: 0.1070 ft^2

Wetted Perimeter: 0.8385 ft

Hydraulic Radius: 0.1276 ft

Average Velocity: 8.8777 ft/s

Top Width: 0.6361 ft

Froude Number: 3.8145

Critical Depth: 0.4616 ft

Critical Velocity: 3.6673 ft/s

Critical Slope: 0.0076 ft/ft

Critical Top Width: 0.62 ft

Calculated Max Shear Stress: 1.1474 lb/ft^2

Calculated Avg Shear Stress: 0.6371 lb/ft^2

Channel Analysis: SD-9

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0400 ft/ft

Manning's n: 0.0120

Flow: 1.4100 cfs

Result Parameters

Depth: 0.3473 ft

Area of Flow: 0.1846 ft^2

Wetted Perimeter: 1.0771 ft

Hydraulic Radius: 0.1713 ft

Average Velocity: 7.6402 ft/s

Top Width: 0.6695 ft

Froude Number: 2.5645

Critical Depth: 0.5581 ft

Critical Velocity: 4.4928 ft/s

Critical Slope: 0.0110 ft/ft

Critical Top Width: 0.50 ft

Calculated Max Shear Stress: 0.8670 lb/ft^2

Calculated Avg Shear Stress: 0.4277 lb/ft^2

Channel Analysis: SD-10

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0300 ft/ft

Manning's n: 0.0120

Flow: 2.0000 cfs

Result Parameters

Depth: 0.4835 ft

Area of Flow: 0.2724 ft^2

Wetted Perimeter: 1.3601 ft

Hydraulic Radius: 0.2003 ft

Average Velocity: 7.3421 ft/s

Top Width: 0.6006 ft

Froude Number: 1.9212

Critical Depth: 0.6278 ft

Critical Velocity: 5.8261 ft/s

Critical Slope: 0.0196 ft/ft

Critical Top Width: 0.33 ft

Calculated Max Shear Stress: 0.9051 lb/ft^2

Calculated Avg Shear Stress: 0.3749 lb/ft^2

Channel Analysis: SD-11

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0400 ft/ft

Manning's n: 0.0120

Flow: 2.5700 cfs

Result Parameters

Depth: 0.5311 ft

Area of Flow: 0.2997 ft^2

Wetted Perimeter: 1.4715 ft

Hydraulic Radius: 0.2037 ft

Average Velocity: 8.5742 ft/s

Top Width: 0.5432 ft

Froude Number: 2.0341

Critical Depth: 0.6532 ft

Critical Velocity: 7.3384 ft/s

Critical Slope: 0.0333 ft/ft

Critical Top Width: 0.21 ft

Calculated Max Shear Stress: 1.3257 lb/ft^2

Calculated Avg Shear Stress: 0.5084 lb/ft^2

Channel Analysis: SD-12

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.1300 ft/ft

Manning's n: 0.0120

Flow: 3.3800 cfs

Result Parameters

Depth: 0.4157 ft

Area of Flow: 0.2298 ft^2

Wetted Perimeter: 1.2154 ft

Hydraulic Radius: 0.1891 ft

Average Velocity: 14.7084 ft/s

Top Width: 0.6503 ft

Froude Number: 4.3603

Critical Depth: 0.6643 ft

Critical Velocity: 9.5996 ft/s

Critical Slope: 0.0601 ft/ft

Critical Top Width: 0.12 ft

Calculated Max Shear Stress: 3.3719 lb/ft^2

Calculated Avg Shear Stress: 1.5338 lb/ft^2

Channel Analysis: SD-13

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.1300 ft/ft

Manning's n: 0.0120

Flow: 8.0300 cfs

Result Parameters

Depth: 0.5450 ft

Area of Flow: 0.4376 ft^2

Wetted Perimeter: 1.6608 ft

Hydraulic Radius: 0.2635 ft

Average Velocity: 18.3503 ft/s

Top Width: 0.9959 ft

Froude Number: 4.8786

Critical Depth: 0.9854 ft

Critical Velocity: 10.2547 ft/s

Critical Slope: 0.0393 ft/ft

Critical Top Width: 0.24 ft

Calculated Max Shear Stress: 4.4207 lb/ft^2

Calculated Avg Shear Stress: 2.1373 lb/ft^2

Channel Analysis: SD-14

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.1000 ft/ft

Manning's n: 0.0120

Flow: 10.5200 cfs

Result Parameters

Depth: 0.7160 ft

Area of Flow: 0.6018 ft^2

Wetted Perimeter: 2.0175 ft

Hydraulic Radius: 0.2983 ft

Average Velocity: 17.4814 ft/s

Top Width: 0.9019 ft

Froude Number: 3.7714

Critical Depth: 0.9950 ft

Critical Velocity: 13.4025 ft/s

Critical Slope: 0.0700 ft/ft

Critical Top Width: 0.14 ft

Calculated Max Shear Stress: 4.4679 lb/ft^2

Calculated Avg Shear Stress: 1.8613 lb/ft^2

Channel Analysis: SD-15

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.1200 ft/ft

Manning's n: 0.0120

Flow: 12.2000 cfs

Result Parameters

Depth: 0.7504 ft

Area of Flow: 0.6322 ft^2

Wetted Perimeter: 2.0954 ft

Hydraulic Radius: 0.3017 ft

Average Velocity: 19.2972 ft/s

Top Width: 0.8655 ft

Froude Number: 3.9790

Critical Depth: 0.9973 ft

Critical Velocity: 15.5373 ft/s

Critical Slope: 0.0956 ft/ft

Critical Top Width: 0.10 ft

Calculated Max Shear Stress: 5.6191 lb/ft^2

Calculated Avg Shear Stress: 2.2593 lb/ft^2

Channel Analysis: SD-16

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0900 ft/ft

Manning's n: 0.0120

Flow: 14.8500 cfs

Result Parameters

Depth: 0.6919 ft

Area of Flow: 0.7964 ft^2

Wetted Perimeter: 2.2398 ft

Hydraulic Radius: 0.3556 ft

Average Velocity: 18.6452 ft/s

Top Width: 1.4955 ft

Froude Number: 4.5025

Critical Depth: 1.4022 ft

Critical Velocity: 8.6427 ft/s

Critical Slope: 0.0147 ft/ft

Critical Top Width: 0.74 ft

Calculated Max Shear Stress: 3.8855 lb/ft^2

Calculated Avg Shear Stress: 1.9970 lb/ft^2

Channel Analysis: SD-17

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.1000 ft/ft

Manning's n: 0.0120

Flow: 15.5400 cfs

Result Parameters

Depth: 0.6890 ft

Area of Flow: 0.7921 ft^2

Wetted Perimeter: 2.2340 ft

Hydraulic Radius: 0.3546 ft

Average Velocity: 19.6181 ft/s

Top Width: 1.4950 ft

Froude Number: 4.7496

Critical Depth: 1.4165 ft

Critical Velocity: 8.9909 ft/s

Critical Slope: 0.0161 ft/ft

Critical Top Width: 0.69 ft

Calculated Max Shear Stress: 4.2992 lb/ft^2

Calculated Avg Shear Stress: 2.2126 lb/ft^2

Channel Analysis: SD-18

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0120

Flow: 1.3000 cfs

Result Parameters

Depth: 0.5374 ft

Area of Flow: 0.3031 ft^2

Wetted Perimeter: 1.4870 ft

Hydraulic Radius: 0.2038 ft

Average Velocity: 4.2889 ft/s

Top Width: 0.5339 ft

Froude Number: 1.0031

Critical Depth: 0.5382 ft

Critical Velocity: 4.2831 ft/s

Critical Slope: 0.0100 ft/ft

Critical Top Width: 0.53 ft

Calculated Max Shear Stress: 0.3353 lb/ft^2

Calculated Avg Shear Stress: 0.1272 lb/ft^2

Channel Analysis: SD-19

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.1600 ft/ft

Manning's n: 0.0120

Flow: 16.8400 cfs

Result Parameters

Depth: 0.6317 ft

Area of Flow: 0.7068 ft^2

Wetted Perimeter: 2.1185 ft

Hydraulic Radius: 0.3336 ft

Average Velocity: 23.8259 ft/s

Top Width: 1.4812 ft

Froude Number: 6.0783

Critical Depth: 1.4374 ft

Critical Velocity: 9.6677 ft/s

Critical Slope: 0.0191 ft/ft

Critical Top Width: 0.60 ft

Calculated Max Shear Stress: 6.3064 lb/ft^2

Calculated Avg Shear Stress: 3.3309 lb/ft^2

Channel Analysis: SD-20

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0120

Flow: 0.2400 cfs

Result Parameters

Depth: 0.1930 ft

Area of Flow: 0.0840 ft^2

Wetted Perimeter: 0.7590 ft

Hydraulic Radius: 0.1107 ft

Average Velocity: 2.8556 ft/s

Top Width: 0.6068 ft

Froude Number: 1.3522

Critical Depth: 0.2254 ft

Critical Velocity: 2.3036 ft/s

Critical Slope: 0.0055 ft/ft

Critical Top Width: 0.63 ft

Calculated Max Shear Stress: 0.1204 lb/ft^2

Calculated Avg Shear Stress: 0.0691 lb/ft^2

Channel Analysis: SD-21

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0500 ft/ft

Manning's n: 0.0120

Flow: 1.2800 cfs

Result Parameters

Depth: 0.3076 ft

Area of Flow: 0.1579 ft^2

Wetted Perimeter: 0.9976 ft

Hydraulic Radius: 0.1583 ft

Average Velocity: 8.1042 ft/s

Top Width: 0.6678 ft

Froude Number: 2.9366

Critical Depth: 0.5346 ft

Critical Velocity: 4.2441 ft/s

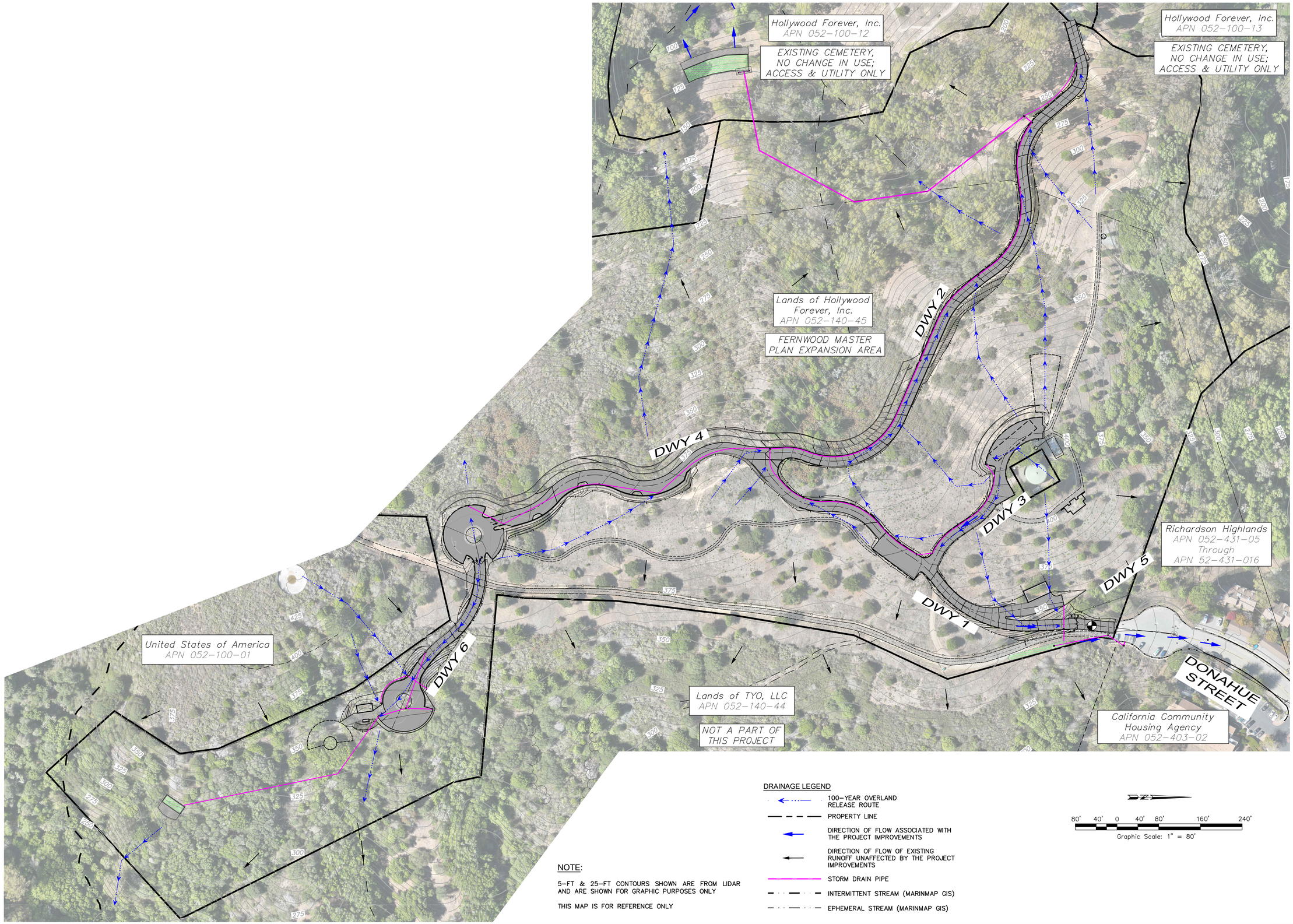
Critical Slope: 0.0098 ft/ft

Critical Top Width: 0.54 ft

Calculated Max Shear Stress: 0.9597 lb/ft^2

Calculated Avg Shear Stress: 0.4940 lb/ft^2

7. 100 Year Overland Release Map



DRAINAGE LEGEND

- 100-YEAR OVERLAND RELEASE ROUTE
- PROPERTY LINE
- DIRECTION OF FLOW ASSOCIATED WITH THE PROJECT IMPROVEMENTS
- DIRECTION OF FLOW OF EXISTING RUNOFF UNAFFECTED BY THE PROJECT IMPROVEMENTS
- STORM DRAIN PIPE
- INTERMITTENT STREAM (MARINMAP GIS)
- EPHEMERAL STREAM (MARINMAP GIS)

80' 40' 0 40' 80' 160' 240'

Graphic Scale: 1" = 80'

NOTE:

5-FT & 25-FT CONTOURS SHOWN ARE FROM LIDAR AND ARE SHOWN FOR GRAPHIC PURPOSES ONLY

THIS MAP IS FOR REFERENCE ONLY

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100-YEAR OVERLAND RELEASE MAP

FERNWOOD CEMETERY EXPANSION MASTER PLAN

301 Tennessee Valley Road
Mill Valley, California
APN 052-140-45

Date: March 2026
Design by: ZR
Drawn by: ZR
Checked by:

Job 23275

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8. Soil Analysis

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Marin County, California

March 10, 2026

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:6,240 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 7, 2021—Mar 31, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
117	Cronkhite-Barnabe complex, 30 to 50 percent slopes	4.4	4.0%
161	Saurin-Bonnydoon complex, 2 to 15 percent slopes	12.7	11.5%
165	Saurin-Urban land-Bonnydoon complex, 15 to 30 percent slopes	1.0	0.9%
175	Tamalpais-Barnabe variant very gravelly loams, 15 to 30 percent slopes	0.8	0.7%
176	Tamalpais-Barnabe variant very gravelly loams, 30 to 50 percent slopes	4.3	3.9%
179	Tocaloma-McMullin complex, 30 to 50 percent slopes	38.5	34.7%
184	Tocaloma-Saurin association, very steep	49.2	44.4%
Totals for Area of Interest		**110.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas

are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Marin County, California

117—Cronkhite-Barnabe complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf1n
Landscape: Uplands
Elevation: 50 to 800 feet
Mean annual precipitation: 24 to 35 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 275 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Cronkhite and similar soils: 40 percent
Barnabe and similar soils: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cronkhite

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 15 inches: loam
H2 - 15 to 26 inches: clay loam
H3 - 26 to 45 inches: clay loam
H4 - 45 to 55 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R015XC028CA - COASTAL LOAMY CLAYPAN
Hydric soil rating: No

Description of Barnabe

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and/or chert

Typical profile

H1 - 0 to 8 inches: very gravelly loam
H2 - 8 to 16 inches: very gravelly loam
H3 - 16 to 20 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XY009CA - Hills 20-40"ppt

Minor Components

Centissima

Percent of map unit: 4 percent
Hydric soil rating: No

Dipsea

Percent of map unit: 4 percent
Hydric soil rating: No

Slopes less than 30 percent

Percent of map unit: 4 percent
Hydric soil rating: No

Slumps

Percent of map unit: 4 percent
Hydric soil rating: No

Maymen

Percent of map unit: 4 percent
Hydric soil rating: No

Maymen variant

Percent of map unit: 3 percent

Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed, mod. deep

Percent of map unit: 3 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent
Hydric soil rating: No

161—Saurin-Bonnydoon complex, 2 to 15 percent slopes

Map Unit Setting

National map unit symbol: hf32
Landscape: Uplands
Elevation: 50 to 1,500 feet
Mean annual precipitation: 25 to 40 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Saurin and similar soils: 50 percent
Bonnydoon and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saurin

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 10 inches: clay loam
H2 - 10 to 33 inches: clay loam
H3 - 33 to 37 inches: bedrock

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained

Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R015XC034CA - LOAMY
Hydric soil rating: No

Description of Bonnydoon

Setting
Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Typical profile
H1 - 0 to 15 inches: gravelly loam
H2 - 15 to 19 inches: bedrock

Properties and qualities
Slope: 2 to 15 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.9 inches)

Interpretive groups
Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XC037CA - SHALLOW GRAVELLY LOAM
Hydric soil rating: No

Minor Components

Tocaloma
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, shallow
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, deep
Percent of map unit: 5 percent
Hydric soil rating: No

Los osos
Percent of map unit: 5 percent
Hydric soil rating: No

165—Saurin-Urban land-Bonnydoon complex, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: hf36
Landscape: Uplands
Elevation: 50 to 1,500 feet
Mean annual precipitation: 25 to 40 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition
Saurin and similar soils: 30 percent
Urban land: 25 percent
Bonnydoon and similar soils: 20 percent
Minor components: 21 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saurin

Setting
Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile
H1 - 0 to 10 inches: clay loam
H2 - 10 to 33 inches: clay loam
H3 - 33 to 37 inches: bedrock

Properties and qualities
Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Description of Urban Land

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

Interpretive groups

Land capability classification (irrigated): 8
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Description of Bonnydoon

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 11 inches: gravelly loam
H2 - 11 to 15 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): 6e

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Minor Components

Tocaloma
Percent of map unit: 5 percent
Hydric soil rating: No

Xerorthents
Percent of map unit: 5 percent
Hydric soil rating: No

Slopes less than 15 percent
Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, shallow
Percent of map unit: 2 percent
Hydric soil rating: No

Slumps
Percent of map unit: 2 percent
Hydric soil rating: No

Los osos
Percent of map unit: 2 percent
Hydric soil rating: No

175—Tamalpais-Barnabe variant very gravelly loams, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: hf3j
Landscape: Uplands
Elevation: 40 to 800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition
Tamalpais and similar soils: 60 percent
Barnabe variant and similar soils: 30 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tamalpais

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone, or chert

Typical profile

H1 - 0 to 19 inches: very gravelly loam
H2 - 19 to 39 inches: very gravelly clay loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: R015XC027CA - COASTAL GRAVELLY LOAM
Hydric soil rating: No

Description of Barnabe Variant

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and/or chert

Typical profile

H1 - 0 to 13 inches: very gravelly loam
H2 - 13 to 17 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: R015XC029CA - COASTAL SHALLOW GRAVELLY LOAM
Hydric soil rating: No

Minor Components

Barnabe

Percent of map unit: 2 percent
Hydric soil rating: No

Cronkhite

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 1 percent
Hydric soil rating: No

Unnamed, soils

Percent of map unit: 1 percent
Hydric soil rating: No

176—Tamalpais-Barnabe variant very gravelly loams, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf3k
Landscape: Uplands
Elevation: 40 to 800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Tamalpais and similar soils: 50 percent
Barnabe variant and similar soils: 30 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tamalpais

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone, or chert

Typical profile

H1 - 0 to 19 inches: very gravelly loam
H2 - 19 to 39 inches: very gravelly clay loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R015XC027CA - COASTAL GRAVELLY LOAM
Hydric soil rating: No

Description of Barnabe Variant

Setting

Landscape: Mountains
Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and/or chert

Typical profile

H1 - 0 to 13 inches: very gravelly loam
H2 - 13 to 17 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XC029CA - COASTAL SHALLOW GRAVELLY LOAM
Hydric soil rating: No

Minor Components

Barnabe

Percent of map unit: 4 percent
Hydric soil rating: No

Cronkhite

Percent of map unit: 4 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, soils

Percent of map unit: 1 percent
Hydric soil rating: No

179—Tocaloma-McMullin complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf3n
Landscape: Uplands
Elevation: 50 to 1,500 feet
Mean annual precipitation: 30 to 40 inches
Mean annual air temperature: 55 to 61 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Tocaloma and similar soils: 40 percent
Mcmullin and similar soils: 35 percent
Minor components: 19 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tocaloma

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 19 inches: loam
H2 - 19 to 39 inches: very gravelly loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Description of Mcmullin

Setting

Landscape: Uplands
Landform: Hills, Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from conglomerate

Typical profile

H1 - 0 to 4 inches: gravelly loam
H2 - 4 to 18 inches: gravelly loam
H3 - 18 to 22 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Minor Components

Saurin

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, dark surface

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 5 percent
Hydric soil rating: No

Los osos

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Hydric soil rating: No

184—Tocaloma-Saurin association, very steep

Map Unit Setting

National map unit symbol: hf3t
Landscape: Uplands
Elevation: 50 to 1,500 feet
Mean annual precipitation: 30 to 40 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Tocaloma and similar soils: 40 percent
Saurin and similar soils: 30 percent
Minor components: 26 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tocaloma

Setting

Landscape: Uplands
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 19 inches: loam
H2 - 19 to 39 inches: very gravelly loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Description of Saurin

Setting

Landscape: Uplands
Landform: Hills, Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave, convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 10 inches: clay loam
H2 - 10 to 33 inches: clay loam
H3 - 33 to 37 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R015XC034CA - LOAMY
Hydric soil rating: No

Minor Components

Mcmullin

Percent of map unit: 5 percent
Hydric soil rating: No

Bonnydoon

Percent of map unit: 5 percent
Hydric soil rating: No

Los osos

Percent of map unit: 5 percent
Hydric soil rating: No

Montara

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Unnamed, gravelly soils

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, light colored soils

Percent of map unit: 2 percent
Hydric soil rating: No

Preliminary
Stormwater Control Plan for Regulated Projects

For

Fernwood Cemetery Expansion

Master Plan

301 Tennessee Valley Road
Mill Valley, CA
APN 052-140-45

JN 23275
August, 2026

Prepared For:
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Stormwater Control Plan for Regulated Project For
Fernwood Cemetery
301 Tennessee Valley Rd, Mill Valley, California

I. Project Data Form

Project Name	Fernwood Cemetery Expansion Master Plan
Application Submittal Date	April, 2025
Project Location	301 Tennessee Valley Rd, CA
Project Phase No.	N/A
Project Type and Description	Preliminary Regulated Project
Total Project Site Area	32.89-acres
Total New and Replaced Impervious Area	95,175 SF (2.18 acres)
Total Pre-Project Impervious Surface Area	4,900 SF (0.11 acres)
Total Post-Project Impervious Surface Area	100,075 SF (2.30 acres)

II. Project Setting

A. Nature and Purpose of the Project

The Fernwood Cemetery is located at 301 Tennessee Valley Road, in Mill Valley south-west of Highway 101 and Highway 1 interchange. The project proposes driveway improvements for a cemetery expansion.

B. Existing Site Features and Conditions

The existing site consists of rural landscape with a fair amount of trees. There are currently gravel and dirt access driveways

The site is on a hillside above the City of Mill Valley with gentle to steep slopes ranging throughout the site. In areas where there are no proposed improvements existing slopes exceed 50%. Most of the site historically drains to the west toward Tennessee Valley Road and existing residences. With a large percentage of runoff flowing to those respective parcels, this will be mitigated through the inclusion of a new bioretention site dissipating such flows. There is an unmarked blue line stream on the south westerly end of the property which converges with Coyote Creek and ultimately outfalls into Richardson Bay.

The soil types in the project area are Tocaloma-Saurin association, Hydrologic Soil Type C, see **Appendix C**.

C. Opportunities and Constraints for Stormwater Control

Bioretention facilities have the ability to be incorporated into the early stages of design and will more easily be integrated into the existing aesthetics. Areas shown and discussed in this report are for potential future development, final design and location of the bioretention facilities will be determined as these parcels are being developed.

III. Low Impact Development Design Strategies

A. Optimization of Site Layout

Proposed improvements will be placed as close to existing grade as possible to minimize total site grading and preserve existing vegetation to the maximum extent practicable. The depth for each bioretention facility is shown on the Stormwater Control Plan Exhibit, as well as the Preliminary Grading Plan.

Restroom 1 and the Maintenance buildings will utilize a green roof that will drain into their respective storm drain systems and directed to the bioretention or infiltration. The proposed access driveways have been designed to minimize the amount of proposed asphalt. This was done through an iterative process from the beginning of the design to maximize access and minimize impacts of the excess pavement.

Due the geological hazards and the geotechnical engineers recommendations of not concentrating runoff at the top of the slopes. We placed bioretentions IMP 2 & 3 so that they would not affect downstream areas. Class III Caltrans rip-rap has been added to the downstream outfall of the bioretention to promote overflow getting back into a Sheetflow condition after it discharges from the basin. See updated detail on the Stormwater Control Plan.

IV. Documentation of Drainage Design

A. Description of Drainage Management Areas

DMA-1 totaling 312,630 SF drains to IMP-1 via drain inlets and storm drain system. IMP-1 has a total area of 4,000 SF.

DMA-2 totaling 74,150 SF drains to IMP-2 via drain inlets and storm drain system. IMP-2 has a total area of 1,000 SF. DMA-2 receives runoff from the from the existing impervious area of 4,900 SF from the MMWD Water Tank Parcel to offset the proposed impervious surface from DMA-4.

DMA-3 totaling 14,925 SF drains to IMP-3 via overland flow. IMP-3 has a total area of 600 SF.

DMA-4 totaling 2,448 SF does not drain to an IMP. This proposed impervious surface is offset within DMA-2 which treats the existing impervious surface from the MMWD Water Tank Parcel in IMP-2.

*See **Table 1. Approximate Bioretention Area Sizing** for individual lot potential requirements.

B. Areas Draining to Bioretention Facilities

Bioretention Sizing: IMP-1

DMA Name	Area (SF)[1]	Post-Project Surface Type	Runoff Factor	Area x Runoff Factor	Facility Name: Bioretention Facility		
					Sizing Factor	Minimum Facility Size (SF)[1]	Proposed Facility Size (SF)[1]
DMA-1	68,765	Roof/ Paving	1.0	68,765			
	243,865	Landscape Areas	0.1	24,387			
	-	Permeable Pavers	0.2	-			
Total >				93,151.50	0.04	3726	4,000
					Sized Correctly =		**TRUE**
					Area Oversized (SF) =		**274**

Bioretention Sizing: IMP-2

DMA Name	Area (SF)[1]	Post-Project Surface Type	Runoff Factor	Area x Runoff Factor	Facility Name: Bioretention Facility		
					Sizing Factor	Minimum Facility Size (SF)[1]	Proposed Facility Size (SF)[1]
DMA-2	16,260	Roof/ Paving	1.0	16,260			
	57,890	Landscape Areas	0.1	5,789			
	-	Permeable Pavers	0.2	-			
Total >				22049	0.04	882	1,000
					Sized Correctly =		**TRUE**
					Area Oversized (SF) =		**118**

Bioretention Sizing: IMP-3

DMA Name	Area (SF)[1]	Post-Project Surface Type	Runoff Factor	Area x Runoff Factor	Facility Name: Bioretention Facility		
					Sizing Factor	Minimum Facility Size (SF)[1]	Proposed Facility Size (SF)[1]
DMA-3	12,925	Roof/ Paving	1.00	12,925			
	2,000	Landscape Areas	0.10	200			
	-	Permeable Pavers	0.20	-			
Total >				13125	0.04	525	600
					Sized Correctly =		**TRUE**
					Area Oversized (SF) =		**75**

V. Stormwater Facility Maintenance

The applicant (owner) will be required to follow the recorded Operation and Maintenance Plan and to accept responsibility for interim operation and maintenance of stormwater treatment and flow-control facilities. An Operation and Maintenance Plan will be provided with the Final Stormwater Control Plan accompanying the Subdivision Construction Documents.

Some maintenance requirements for the landscape areas and Bioretention facilities will include general cleanup to remove any trash and debris that has collected, prune plants to

maintain the design surface elevation, control weeds using manual methods or natural herbicides, add mulch as needed.

During the preparation of construction documents. We will design a dirt access road for the maintenance team to access Bioretention Facilities IMP 2 & 3.

VI. Construction Checklist

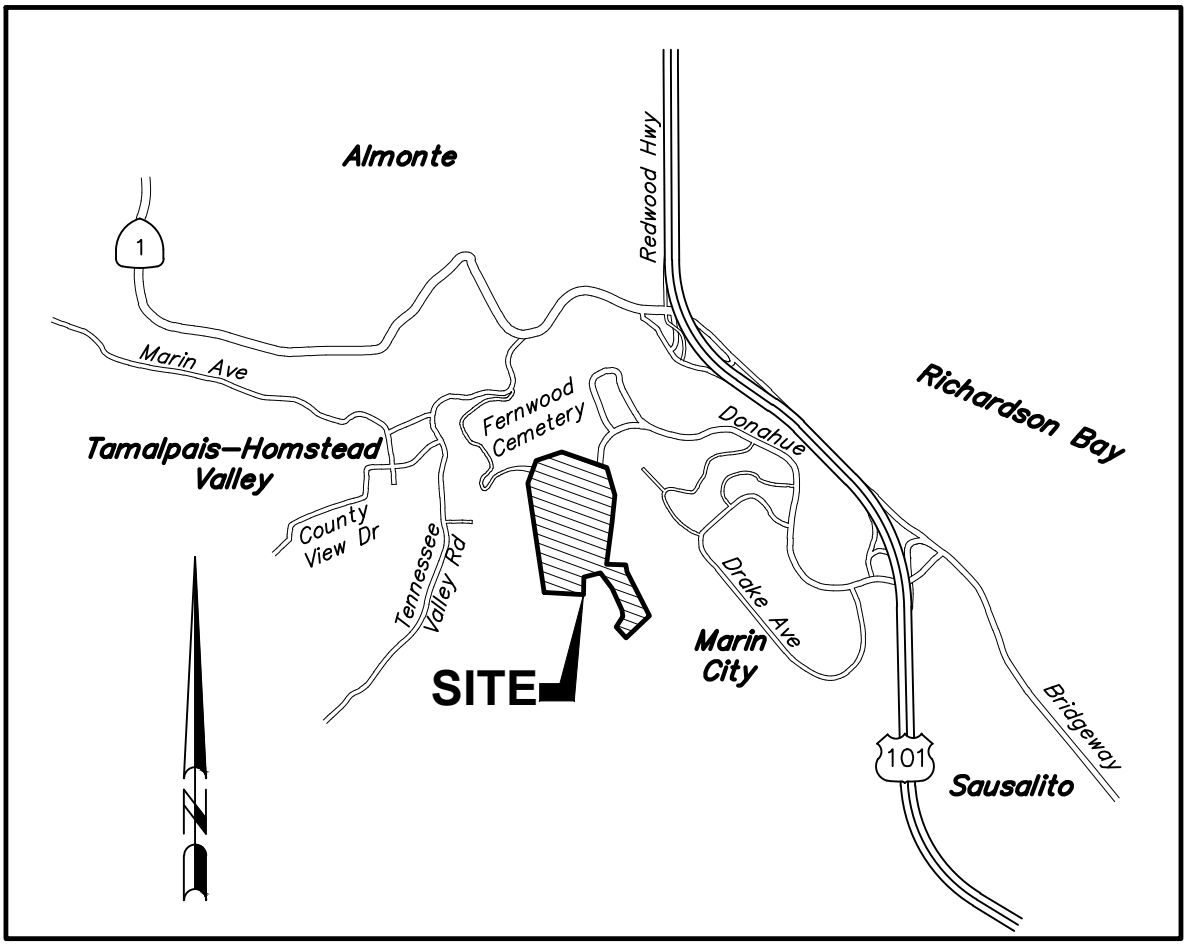
Construction and BMP details have been provided on the Preliminary Improvement Plans and the Stormwater Control Plan, see **Appendix B.**

VII. Certifications

The preliminary design of stormwater treatment facilities and other stormwater pollution control measures in this plan are in accordance with the current edition of the BASMAA Post-Construction Manual dated January 2019.

APPENDIX A

Vicinity Map & Groundwater Documents



VICINITY MAP

NOT TO SCALE

VICINITY MAP

FERNWOOD CEMETERY
301 Tennessee Valley Rd, Mill Valley, CA
APN 052-140-45

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APPENDIX B

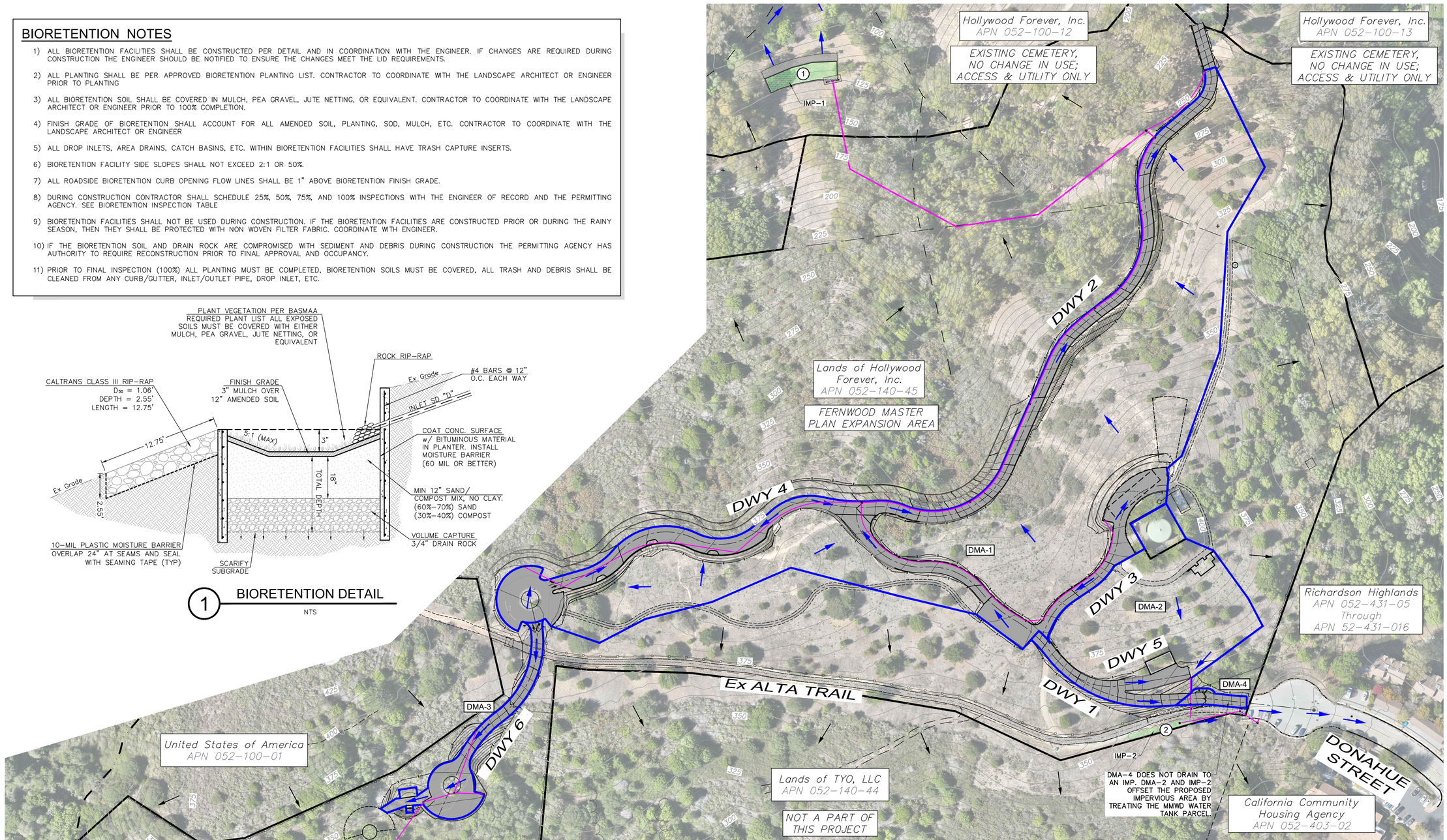
Stormwater Control Plan & BMP Typical Detail

BIORETENTION NOTES

1) ALL BIORETENTION FACILITIES SHALL BE CONSTRUCTED PER DETAIL AND IN COORDINATION WITH THE ENGINEER. IF CHANGES ARE REQUIRED DURING CONSTRUCTION THE ENGINEER SHOULD BE NOTIFIED TO ENSURE THE CHANGES MEET THE LID REQUIREMENTS.
2) ALL PLANTING SHALL BE PER APPROVED BIORETENTION PLANTING LIST. CONTRACTOR TO COORDINATE WITH THE LANDSCAPE ARCHITECT OR ENGINEER PRIOR TO PLANTING
3) ALL BIORETENTION SOIL SHALL BE COVERED IN MULCH, PEA GRAVEL, JUTE NETTING, OR EQUIVALENT. CONTRACTOR TO COORDINATE WITH THE LANDSCAPE ARCHITECT OR ENGINEER PRIOR TO 100% COMPLETION.
4) FINISH GRADE OF BIORETENTION SHALL ACCOUNT FOR ALL AMENDED SOIL, PLANTING, SOD, MULCH, ETC. CONTRACTOR TO COORDINATE WITH THE LANDSCAPE ARCHITECT OR ENGINEER
5) ALL DROP INLETS, AREA DRAINS, CATCH BASINS, ETC. WITHIN BIORETENTION FACILITIES SHALL HAVE TRASH CAPTURE INSERTS.
6) BIORETENTION FACILITY SIDE SLOPES SHALL NOT EXCEED 2:1 OR 50%.
7) ALL ROADSIDE BIORETENTION CURB OPENING FLOW LINES SHALL BE 1" ABOVE BIORETENTION FINISH GRADE.
8) DURING CONSTRUCTION CONTRACTOR SHALL SCHEDULE 25%, 50%, 75%, AND 100% INSPECTIONS WITH THE ENGINEER OF RECORD AND THE PERMITTING AGENCY. SEE BIORETENTION INSPECTION TABLE
9) BIORETENTION FACILITIES SHALL NOT BE USED DURING CONSTRUCTION. IF THE BIORETENTION FACILITIES ARE CONSTRUCTED PRIOR OR DURING THE RAINY SEASON, THEN THEY SHALL BE PROTECTED WITH NON WOVEN FILTER FABRIC. COORDINATE WITH ENGINEER.
10) IF THE BIORETENTION SOIL AND DRAIN ROCK ARE COMPROMISED WITH SEDIMENT AND DEBRIS DURING CONSTRUCTION THE PERMITTING AGENCY HAS AUTHORITY TO REQUIRE RECONSTRUCTION PRIOR TO FINAL APPROVAL AND OCCUPANCY.
11) PRIOR TO FINAL INSPECTION (100%) ALL PLANTING MUST BE COMPLETED, BIORETENTION SOILS MUST BE COVERED, ALL TRASH AND DEBRIS SHALL BE CLEANED FROM ANY CURB/GUTTER, INLET/OUTLET PIPE, DROP INLET, ETC.

1 BIORETENTION DETAIL

NTS



DRAINAGE ROUTING

DMA-1 → 1 IMP-1
DMA-2 → 2 IMP-2
DMA-3 → 3 IMP-3

DMA NO.	TOTAL AREA (SQ FT)	FACILITY NAME	TYPE(*)	TOTAL BIO AREA (SF)	TOTAL DEPTH (D FT)
DMA-1	312,630	IMP-1	1	4,000	4.00
DMA-2	74,150	IMP-2	1	1,000	3.00
DMA-3	14,925	IMP-3	1	600	4.25
DMA-4	2,448	-	-	-	-

DRAINAGE AREA LEGEND

- DMA-1 — (DMA)DRAINAGE MANAGEMENT AREA
- IMP-1 — INTEGRATED MANAGEMENT AREA (BIORETENTION AREA)
- (1) — IMP POINT OF CONCENTRATION
- DRAINAGE AREA BOUNDARY
- PROPERTY LINE
- DIRECTION OF FLOW ASSOCIATED WITH THE PROJECT IMPROVEMENTS
- DIRECTION OF FLOW OF EXISTING RUNOFF UNAFFECTED BY THE PROJECT IMPROVEMENTS
- STORM DRAIN PIPE
- INTERMITTENT STREAM (MARINMAP GIS)
- EPHEMERAL STREAM (MARINMAP GIS)

80' 40' 0 40' 80' 160' 240'
Graphic Scale: 1" = 80'

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STORMWATER CONTROL PLAN

FERNWOOD CEMETERY EXPANSION MASTER PLAN

301 Tennessee Valley Road
Mill Valley, California
APN 052-140-45

Date: August, 2026
Design by: ZR
Drawn by: ZR
Checked by: ZR

Sheet
SCP-1
1 of 1 Sheets
Job 23275

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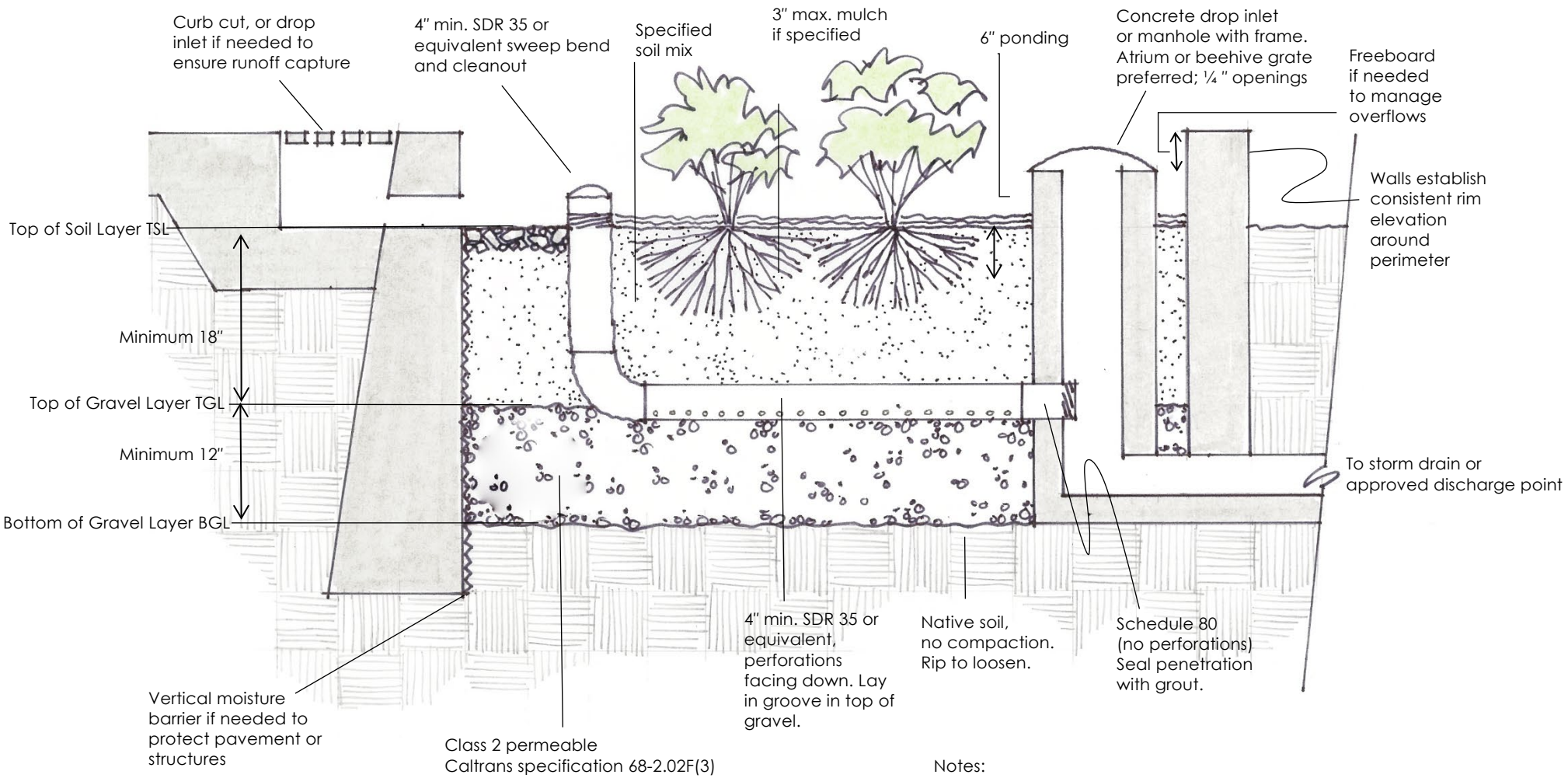
Figure 4-5. Bioretention Facility

Cross-section
Not to Scale



Notes:
No liner, no filter fabric, no landscape cloth.
Maintain BGL. TGL, TSL throughout facility area at elevations to be specified on drawing.
Elevation of perforated pipe underdrain is atop gravel layer.
See text for soil mix specification, planting and irrigation guidance.

		Plant Categories	Light Preference			Size (feet)		Watering				Tolerances					High Performers			
Scientific name	Common name		Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Wind	Zone 1	Zone 2	Best for irrigated sites	Best for non-irrigated sites	CA Native	Notes
Agrostis exerata	Spike bentgrass	*Grasses and Grass-like Plants*	✓	✓		1	1.25		✓	✓	✓		✓		✓	✓				Moist sand dunes ;adapts to shady woodlands from San Diego to Sonoma County
Bouteloua gracilis	blue grama	*Grasses and Grass-like Plants*	✓			1.5	1	✓				✓		✓		✓				Tolerates no summer water, good for non-irrigated remote sites. AKA= Mosquito Grass
Bromus carinatus	California brome	*Grasses and Grass-like Plants*	✓			2	1	✓			ok	✓		✓		✓			✓	Good for erosion control ; not a good meadow grass
Carex barbarea	Santa Barbara sedge	*Grasses and Grass-like Plants*	✓	✓		3	2	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	Stays green w/ summer H20, moist to drought tolerant, spreading large statured sedge
Carex divulsa	grassland sedge	*Grasses and Grass-like Plants*	✓	✓	✓	1	1		✓		ok		✓	✓	✓	✓	✓			Widely sold in CA as Carex tumulicola (Berkeley sedge). Native to Eurasia. Full sun along coast. Tolerates drought once established. Needs regular water in sun.
Carex nudata	California black sedge	*Grasses and Grass-like Plants*	✓	✓		2	2	✓	✓		✓	✓	✓		✓	✓			✓	Turns orange in frost, showy black flower spikes
Carex obnupta	slough sedge	*Grasses and Grass-like Plants*	✓	✓		2	1		✓	✓	✓		✓	✓	✓				✓	Some salt tolerance, drought tolerant once established. Thick, graceful, bright green stands in wetlands.
Carex pansa	dune sedge	*Grasses and Grass-like Plants*	✓	✓		2	2		✓		✓	✓	✓	✓	✓	✓	✓		✓	Native to Asilomar; Plug not seed planting; mow end of summer if desired.
Carex praegracilis	clustered field sedge	*Grasses and Grass-like Plants*	✓	✓		1.5	1.5		✓	✓	✓	✓	✓	✓	✓	✓			✓	Lawn alternative, tolerates some foot traffic; summer dormant in warmer areas
Chondropetalum tectorum	small cape rush	*Grasses and Grass-like Plants*	✓	✓		4	3			✓	✓	✓	✓		✓	✓				Native to S. Africa, drought tolerant
Danthonia californica	California oat grass	*Grasses and Grass-like Plants*	✓	✓		1.5	1.5		✓		✓		✓		✓	✓			✓	Bunch grass, recommend plugs not seed to start, tolerates some foot traffic
Distichlis spicata	salt grass	*Grasses and Grass-like Plants*	✓			0.3	3		✓	✓	✓	✓	✓	✓	✓	✓			✓	Looks like bermuda grass, withstands foot traffic, for soils with high salt
Festuca californica	California fescue	*Grasses and Grass-like Plants*	✓	✓	✓	2	2	✓			ok	✓	✓	✓					✓	Use only in driest areas of basin
Festuca idahoensis	Idaho fescue	*Grasses and Grass-like Plants*	✓	✓		1	1	✓	✓		ok	✓	✓	✓		✓			✓	Can mow. Needs light summer water at hot sites
Festuca rubra	red fescue	*Grasses and Grass-like Plants*	✓	✓		1	1.5		✓	✓	ok	✓	✓	✓		✓			✓	Can mow. Lawn alternative; Water conservation LDS; Bio Strips; Infiltration basins
Festuca rubra 'molate'	molate fescue	*Grasses and Grass-like Plants*	✓	✓		1	1.5	✓	✓		ok	✓	✓	✓		✓			✓	Can mow. Lawn alternative
Juncus effusus	common rush	*Grasses and Grass-like Plants*	✓	✓		2.5	2.5		✓		ok		✓	✓	✓	✓	✓		✓	Forms dense clumps
Juncus pallidus	giant rush	*Grasses and Grass-like Plants*	✓			4	2	✓			ok	✓	✓	✓	✓	✓	✓			Evergreen, heat and drought tolerant.
Juncus patens	blue rush	*Grasses and Grass-like Plants*	✓			2	1		✓	✓	✓	✓			✓	✓	✓		✓	Plant from plugs; Irrigate occasionally summer
Leymus triticoides	creeping wildrye	*Grasses and Grass-like Plants*	✓	✓		3	1	✓	✓		ok	✓	✓	✓	✓	✓			✓	Can mow 4 x yr.. Sub-surface H20 best. Can be aggressive in moist areas.
Muhlenbergia rigens	deergrass	*Grasses and Grass-like Plants*	✓			3	3	✓	✓		ok	✓				✓			✓	Evergreen, forms mounds.
Sisyrinchium bellum	blue eyed grass	*Grasses and Grass-like Plants*	✓	✓		1	1		✓		ok		✓	✓		✓	✓		✓	Needs occasional summer water, tolerates some foot traffic
Achillea millefolium	common yarrow	*Herbaceous Perennials and Groundcovers*	✓			1.5	1	✓			ok	✓				✓	✓	✓	✓	Good for hot sites. Tolerates mowing, and can be used in a lawn replacement mix.
Artemisia douglasiana	mugwort	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	3	3	✓	✓		ok	✓	✓	✓	✓	✓	✓	✓	✓	Rhizomatous
Artemisia ludoviciana	white sagebrush	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	1.5	2	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	Aromatic. Tolerates foot traffic and wide range of conditions
Asclepias fascicularis	narrowleaf milkweed	*Herbaceous Perennials and Groundcovers*	✓			3	2	✓	✓		ok	✓	✓			✓	✓	✓	✓	Monarch butterfly host plant, deciduous
Darmera peltata	Indian rhubarb	*Herbaceous Perennials and Groundcovers*		✓	✓	3	5			✓	✓					✓			✓	Prefers cool summers. Native to N CA, S OR; found on stream banks and in woodlands.
Epilobium canum	California fuchsia	*Herbaceous Perennials and Groundcovers*	✓	✓		1	4	✓			ok	✓				✓			✓	dormant in winter, best with winter mowing
Epipactis gigantea	stream orchid	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	3	1.5		✓	✓			✓		✓	✓			✓	Goes dormant with drought, salt tolerant
Fragaria chiloensis	beach strawberry	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	0.3	2	✓	✓		ok		✓	✓					✓	Evergreen groundcover, performs well as filler at the upper edges of facility.
Heuchera micrantha	alum root	*Herbaceous Perennials and Groundcovers*		✓	✓	2	1.5	✓	✓		✓			✓		✓			✓	Dainty white flowers
Heuchera pilosissima	hairy alum root	*Herbaceous Perennials and Groundcovers*		✓	✓	1.5	1.5	✓	✓		✓		✓			✓			✓	Tolerates sand, best at basin edges
Iris douglasiana	Douglas iris	*Herbaceous Perennials and Groundcovers*	✓	✓		1.5	2	✓	✓		ok	✓	✓	✓		✓	✓		✓	Also, Iris hybrids
Lilium pardalinum	leopard lily	*Herbaceous Perennials and Groundcovers*	✓	✓		6	4	✓	✓				✓		✓	✓			✓	Native to dry summer areas, deciduous
Lobelia cardinalis	cardinal flower	*Herbaceous Perennials and Groundcovers*		✓	✓	2	2		✓				✓			✓				Not drought tolerant, requires regular water
Lotus scoparius	deerweed	*Herbaceous Perennials and Groundcovers*	✓			4	3	✓				✓				✓			✓	Short-lived, nitrogen fixer
Mimulus aurantiacus	common monkeyflower	*Herbaceous Perennials and Groundcovers*	✓	✓		3	3	✓			ok	✓				✓			✓	Drought tolerant, stress deciduous
Mimulus cardinalis	scarlet monkeyflower	*Herbaceous Perennials and Groundcovers*	✓	✓	✓	3	3		✓	✓	✓	✓				✓			✓	Aggressive seeder, needs summer water
Mimulus guttatus	seep monkeyflower	*Herbaceous Perennials and Groundcovers*	✓	✓		3	3		✓	✓	✓	✓	✓		✓	✓			✓	Attracts Bees, stress deciduous, needs summer water
Mirabilis multiflora	Giant four o'clock	*Herbaceous Perennials and Groundcovers*		✓	✓	2	4	✓			✓	✓				✓			✓	Best for hot sites, native to Southern California
Oenethera hookeri	Hooker's evening primrose	*Herbaceous Perennials and Groundcovers*	✓	✓		3	2	✓			ok	✓			✓	✓	✓	✓	✓	Easy to establish biennial, self seeds
Polypodium californicum	California Polypody fern	*Herbaceous Perennials and Groundcovers*		✓	✓	2	2	✓			✓		✓							Summer dormant except at coast, spreads slowly by rhizomes, frost tender
Prunella vulgaris	self heal	*Herbaceous Perennials and Groundcovers*	✓	✓		0.5	2'	✓	✓		ok		✓	✓		✓			✓	Somewhat drought tolerant, long flowering
Rudebeckia californica	California coneflower	*Herbaceous Perennials and Groundcovers*	✓			3	2	✓	✓		ok	✓			✓	✓			✓	Native to dry summer areas, deciduous
Scaevola 'mauve clusters'	fan flower	*Herbaceous Perennials and Groundcovers*	✓	✓		1	4	✓				✓		✓		✓				Native to Australia, sensitive to frost
Scutellaria austinae	skullcap	*Herbaceous Perennials and Groundcovers*	✓			1	2	✓	✓		✓	✓		✓		✓			✓	Dies back in drought
Sisyrinchium californicum	yellow eyed grass	*Herbaceous Perennials and Groundcovers*	✓	✓		1	1		✓		✓		✓	✓	✓	✓			✓	Can be drought tolerant
Verbena lasiostachys	Western vervain	*Herbaceous Perennials and Groundcovers*	✓	✓		2	2	✓			ok	✓			✓	✓	✓	✓	✓	Attracts butterflies, can be weedy pioneer species
Verbena lilacina	Cedros Island verbena	*Herbaceous Perennials and Groundcovers*	✓	✓		2	4	✓			ok	✓	✓			✓				Drought tolerant, best with minimal irrigation, native to Baja CA
Alyogyne huegelil	blue hibiscus	*Shrubs*	✓			8	7	✓				✓				✓				Very low water after second year, Sunset zones 15-17 & 20-24, prune to encourage flowering
Baccharis pilularis consanguinea	bush baccharis	*Shrubs*	✓			6	6	✓	✓		ok	✓	✓	✓	✓	✓	✓	✓	✓	Fast-growing, somewhat short-lived; deer proof
Calycanthus occidentalis	western spicebush	*Shrubs*	✓	✓		8	8	✓			✓		✓		✓	✓			✓	Deer resistant, deciduous. Bright green leaves, good for hedgerow/screen. Riparian areas.
Carpenteria californica	bush anemone	*Shrubs*	✓	✓		6	4	✓	✓		ü	✓			✓	✓			ü	Interior climate with occasional water otherwise low water needs
Cornus sericera	redtwig dogwood	*Shrubs*	✓	✓		5	4	✓			✓	✓	✓		✓	✓			✓	Deciduous, red stems for winter color, best with afternoon shade. Can cut to ground to maintain small size and red stems.
Erigeron glaucus	seaside daisy	*Shrubs*	✓			1	1.5				ok		✓	✓		✓			✓	Not good for dusty sites
Lonicera hispidula	California honeysuckle	*Shrubs*	✓	✓	✓	4	2		✓	✓	✓		✓			✓			✓	Climbing vine-like. Best in part shade. Attracts birds
Lonicera involucrata	twinberry honeysuckle	*Shrubs*	✓	✓	✓	6	3		✓	✓	✓		✓			✓			✓	Needs good drainage, Best in part shade. Attracts birds
Mahonia pinnata	California holly grape	*Shrubs*	✓	✓	✓	4	4	✓	✓			✓		✓	✓	✓			✓	Slow but easy to grow
Physocarpus capitatus	pacific ninebark	*Shrubs*	✓	✓		8	8	✓	✓	✓	✓	✓	✓		✓	✓			✓	Part shade and summer water required in hot locations

		Plant Categories	Light Preference			Size (feet)		Watering				Tolerances					High Performers			
Scientific name	Common name		Sun	Part	Shade	Ht.	Width	L	M	H	Summer	Heat	Coast	Wind	Zone 1	Zone 2	Best for irrigated sites	Best for non-irrigated sites	CA Native	Notes
Rhamnus californica	California coffeeberry	*Shrubs*	✓	✓		12	8	✓			✓	✓		✓		✓	✓	✓	✓	'Eve Case' is compact with broad foliage. Syn. *Frangula californica*
Rhamnus crocea	redberry	*Shrubs*	✓	✓	✓	5	5	✓				✓	✓	✓		✓			✓	Pea sized fruits attract birds, stain concrete
Rhododendron occidentale	western azalea	*Shrubs*	✓	✓	✓	8	8		✓	✓	✓		✓		✓	✓			✓	Summer deciduous
Ribes aureum gracillimum	golden current	*Shrubs*	✓	✓		4	3	✓	✓	✓	ok	✓		✓		✓			✓	Easy, fall color, deciduous
Ribes divericatum	coast black gooseberry	*Shrubs*		✓	✓	5	5	✓	✓		ok		✓	✓		✓			✓	Thorny, good for discouraging entry, deciduous
Ribes sanguineum	red flowering currant	*Shrubs*		✓	✓	5	5	✓	✓		✓	✓	✓		✓	✓	✓		✓	Needs good air movement to avoid white fly, more drought tolerant at coast
Ribes speciosum	fuchsia-flowered gooseberry	*Shrubs*	✓	✓	✓	4	4	✓	✓			✓	✓			✓			✓	Prefers only light summer water after 2nd year, stress deciduous
Rosa californica	California wild rose	*Shrubs*	✓	✓		3	6		✓	✓	ok	✓	✓	✓	✓	✓	✓		✓	Hooked thorns, good for discouraging entry. Shade in interior, sun at coast
Rosa gymnocarpa	wood rose	*Shrubs*	✓	✓	✓	2	3		✓		ok	✓	✓			✓	✓		✓	Easy to grow, thorny
Rubus parviflorus	thimbleberry	*Shrubs*	✓	✓		8	5			✓	✓		✓		✓	✓			✓	Spreads readily in wet areas, prefers regular water
Rubus spectabilis	salmonberry	*Shrubs*		✓	✓	8	5		✓	✓	✓		✓	✓	✓	✓			✓	deciduous, soft spiny stems
Rubus ursinus	California blackberry	*Shrubs*		✓	✓	3	5		✓	✓	ok	✓	✓	✓	✓	✓			✓	Thorny, good for discouraging entry. Harbors beneficial insects
Symphoricarpos albus	common snowberry	*Shrubs*	✓	✓	✓	4	4	✓	✓	✓	ok	✓				✓	✓		✓	Adaptable to many conditions, try *Symphoicarpos mollis* at coast
Whipplea modesta	whipplevine	*Shrubs*		✓	✓	0.5	3		✓	✓	✓		✓			✓			✓	Best for moist shady spots near coast
Acer circinatum	vine maple	*Small Trees*		✓	✓	20	10		✓	✓	✓					✓			✓	In wide riparian areas; top of slope. Avoid hot inland climates and coastal conditions/salt spray.
Baccharis viminea	seep-willow	*Small Trees*	✓			8	5	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	Important plant for butterflies and beneficial insects.
Chilopsis linearis	desert-willow	*Small Trees*	✓			15	15		✓		✓	✓			✓	✓	✓		✓	Does best inland
Corylus cornuta v. california	California hazel	*Small Trees*		✓	✓	10	10		✓				✓		✓	✓			✓	Deciduous, edible nut
Fraxinus dipetala	California ash	*Small Trees*	✓	✓		20	20				ok	✓			✓	✓	✓		✓	drought tolerant, slow to establish, then fast
Garrya elliptica	coast silktassel	*Small Trees*	✓	✓		12	12	✓	✓		ok	✓	✓	✓		✓			✓	Winter blooms. 'Evie' is compact variety. Best at coast. Afternoon shade inland, deer resistant
Heteromeles arbutifolia	toyon	*Small Trees*	✓	✓	✓	8	5	✓	✓		✓	✓	✓			✓			✓	Doesn't respond well to pruning low branches, no summer water at coast
Laurus nobilis 'Saratoga'	Grecian bay	*Small Trees*	✓	✓		20	20	✓				✓		✓		✓				Specify 'standard' and prune for tree form, easy
Myrica californica	Pacific wax myrtle	*Small Trees*	✓	✓	✓	25	12	✓	✓				✓	✓		✓			✓	Best at coast
Sambucus mexicana	elderberry	*Small Trees*	✓	✓		20	15	✓	✓						✓	✓	✓		✓	Deciduous, edible fruit, attracts bees and birds, unripe fruits are poisonous but useful and common landscape plant
Acer negundo	box elder	*Trees*	✓	✓	✓	35	35	✓	✓		ok	✓	✓	✓	✓	✓	✓		✓	Tough shade tree, deciduous
Fraxinus latifolia	Oregon ash	*Trees*	✓	✓	✓	70	40			✓	✓		✓		✓	✓			✓	Plant in moist areas with rich soil.
Fraxinus velutina	velvet ash	*Trees*	✓			30	45	✓	✓		ok	✓		✓		✓	✓			Withstands poor drainage and drought
Pittosporum eugenioides	tarata	*Trees*	✓	✓		40	15	✓	✓		✓	✓		✓		✓				Shear to control height
Platanus acerifolia	London plane tree	*Trees*	✓	✓		80	30		✓			✓				✓				Large tree, aggressive roots will lift pavement
Platanus racemosa	California sycamore	*Trees*	✓	✓		80	30		✓	✓	ok	✓				✓			✓	Asymmetrical shape and wide trunk when mature. Give lots of room.
Populus fremontii	cottonwood	*Trees*	✓	✓		80	30		✓			✓				✓			✓	Riparian species with limited drought tolerance. Aggressive roots will lift pavement. Give lots of room.
Quercus agrifolia	coast live oak	*Trees*	✓	✓		60	60	✓				✓	✓	✓		✓			✓	Large evergreen tree, tolerant and widespread, important for wildlife, no summer water
Vitis californica	California grape	*Vine*	✓	✓		10	1-3	✓	✓		✓	✓	✓	✓	✓	✓			✓	Climbing vine. Best in full sun. Can be aggressive in moist area.

Plant Categories	
Grasses and Grass-like Plants	Grass refer to those species that are monocotyledonous plants with slender-leaved herbage.
Herbaceous Perennials and Groundcovers	Herbaceous refers to those species with soft upper growth rather than woody growth. Some species will die back to the roots at the end of the growing season and grow again at the start of the next season. This list only includes those that are perennial, i.e. live for several years.
Shrubs	Shrub is a horticultural distinction that refers to those species of woody plants which are distinguished from trees by their multiple stems and lower height. A large number of plants can be either shrubs or trees, depending on the growing conditions they experience.
Small Tree	Small trees refers to those species of woody plants with one main trunk and a distinct and elevated head with a maximum size of 25' tall and wide.
Tree	Tree refers to those species of woody plants with one main trunk and a rather distinct and elevated head with a size greater than 25' tall or wide.
Water Preference	
Water Preference-Low/Moderate/High	We have provided recommendations for irrigation. All plants should be watered with more frequency during the first two years after planting. After this establishment period, Low water use plants will only need supplemental irrigation at the hottest and driest sites. Plants with Moderate irrigation needs will be best with occasional supplemental water (once per week to once per month) and plants with High irrigation needs will be best with more frequent watering especially during periods of drought in the cooler seasons.
Water Preference-Summer Irrigation	Plants with a check in this column will not withstand a long period of summer drought without irrigation. Plants with an 'ok' in this column are tolerant of, but do not require, frequent summer irrigation. Plants with nothing in this column may not tolerate summer irrigation after establishment.
Stress Tolerance	
Tolerates Heat	A check in the heat column indicates that the plant will tolerate hot sites. It should not be confused with a plants preference for sun. Absence of the check indicates it should only be used in areas close to the Bay or other cool sites.
Tolerates Coast	The coast column indicates plants that perform well within 1,000 feet of the ocean or bay. Most of these plants tolerate some amount of salt air, fog, and wind.
Tolerates Wind	A check in the wind column means that the plant will tolerate winds of ten miles per hour or more.
Zone 1	Plants that tolerate Zone 1 are common riparian, wetland and bog plants capable of surviving in saturated soils for long durations throughout the year. Most of these plants are not drought tolerant and require some water throughout the growing season.
Zone 2	Plants that tolerate Zone 2 are common in riparian/upland transition areas, moist woodlands, and seasonal wetlands. They are capable of surviving in saturated soils for shorter durations especially in the winter or spring. Many of these plants tolerate summer drought but could benefit from some year-round moisture.
High Performers	
Best for irrigated sites	These plants have been used successfully in irrigated bioretention areas in the Bay Area.
Best for non-irrigated sites	These plants have been used successfully in non-irrigated bioretention areas in the Bay Area. Temporary irrigation for establishment is highly recommended.
Origin	
CA Native	Indicates native or cultivar of California native. Cultivars offer habitat benefits to native wildlife and are adapted to the local climate but have reduced genetic diversity.

APPENDIX C

Soil Analysis

Map Scale: 1:4,330 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 7, 2021—Mar 31, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
117	Cronkhite-Barnabe complex, 30 to 50 percent slopes	8.1	8.6%
161	Saurin-Bonnydoon complex, 2 to 15 percent slopes	9.7	10.2%
175	Tamalpais-Barnabe variant very gravelly loams, 15 to 30 percent slopes	3.6	3.8%
176	Tamalpais-Barnabe variant very gravelly loams, 30 to 50 percent slopes	4.2	4.4%
179	Tocaloma-McMullin complex, 30 to 50 percent slopes	9.6	10.1%
184	Tocaloma-Saurin association, very steep	59.6	62.9%
Totals for Area of Interest		**94.8**	**100.0%**

Marin County, California

184—Tocaloma-Saurin association, very steep

Map Unit Setting

National map unit symbol: hf3t
Elevation: 50 to 1,500 feet
Mean annual precipitation: 30 to 40 inches
Mean annual air temperature: 55 to 63 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Tocaloma and similar soils: 40 percent
Saurin and similar soils: 30 percent
Minor components: 26 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tocaloma

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 19 inches: loam
H2 - 19 to 39 inches: very gravelly loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Description of Saurin

Setting

Landform: Hills, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave, convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 10 inches: clay loam
H2 - 10 to 33 inches: clay loam
H3 - 33 to 37 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R015XC034CA - LOAMY
Hydric soil rating: No

Minor Components

Mcmullin

Percent of map unit: 5 percent
Hydric soil rating: No

Bonnydoon

Percent of map unit: 5 percent
Hydric soil rating: No

Los osos

Percent of map unit: 5 percent
Hydric soil rating: No

Montara

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Landform: Depressions

Hydric soil rating: Yes

Unnamed, gravelly soils
Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, light colored soils
Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Marin County, California

179—Tocaloma-McMullin complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf3n
Elevation: 50 to 1,500 feet
Mean annual precipitation: 30 to 40 inches
Mean annual air temperature: 55 to 61 degrees F
Frost-free period: 290 to 330 days
Farmland classification: Not prime farmland

Map Unit Composition

Tocaloma and similar soils: 40 percent
Mcmullin and similar soils: 35 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tocaloma

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 19 inches: loam
H2 - 19 to 39 inches: very gravelly loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Description of Mcmullin

Setting

Landform: Hills, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from conglomerate

Typical profile

H1 - 0 to 4 inches: gravelly loam
H2 - 4 to 18 inches: gravelly loam
H3 - 18 to 22 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XY009CA - Hills 20-40"ppt
Hydric soil rating: No

Minor Components

Saurin

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, dark surface

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 5 percent
Hydric soil rating: No

Los osos

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Marin County, California

176—Tamalpais-Barnabe variant very gravelly loams, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf3k
Elevation: 40 to 800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Tamalpais and similar soils: 50 percent
Barnabe variant and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tamalpais

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone, or chert

Typical profile

H1 - 0 to 19 inches: very gravelly loam
H2 - 19 to 39 inches: very gravelly clay loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: R015XC027CA - COASTAL GRAVELLY LOAM

Hydric soil rating: No

Description of Barnabe Variant

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and/or chert

Typical profile

H1 - 0 to 13 inches: very gravelly loam
H2 - 13 to 17 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XC029CA - COASTAL SHALLOW GRAVELLY LOAM
Hydric soil rating: No

Minor Components

Barnabe

Percent of map unit: 4 percent
Hydric soil rating: No

Cronkhite

Percent of map unit: 4 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 2 percent
Hydric soil rating: No

Unnamed, soils

Percent of map unit: 1 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Marin County, California

175—Tamalpais-Barnabe variant very gravelly loams, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hf3j
Elevation: 40 to 800 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Tamalpais and similar soils: 60 percent
Barnabe variant and similar soils: 30 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tamalpais

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone, or chert

Typical profile

H1 - 0 to 19 inches: very gravelly loam
H2 - 19 to 39 inches: very gravelly clay loam
H3 - 39 to 43 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: C
Ecological site: R015XC027CA - COASTAL GRAVELLY LOAM

Hydric soil rating: No

Description of Barnabe Variant

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and/or chert

Typical profile

H1 - 0 to 13 inches: very gravelly loam
H2 - 13 to 17 inches: bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: R015XC029CA - COASTAL SHALLOW GRAVELLY LOAM
Hydric soil rating: No

Minor Components

Barnabe

Percent of map unit: 2 percent
Hydric soil rating: No

Cronkhite

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 1 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 1 percent
Hydric soil rating: No

Unnamed, soils

Percent of map unit: 1 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Marin County, California

161—Saurin-Bonnydoon complex, 2 to 15 percent slopes

Map Unit Setting

National map unit symbol: hf32
Elevation: 50 to 1,500 feet
Mean annual precipitation: 25 to 40 inches
Mean annual air temperature: 57 to 63 degrees F
Frost-free period: 270 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Saurin and similar soils: 50 percent
Bonnydoon and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saurin

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 10 inches: clay loam
H2 - 10 to 33 inches: clay loam
H3 - 33 to 37 inches: bedrock

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R015XC034CA - LOAMY
Hydric soil rating: No

Description of Bonnydoon

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 15 inches: gravelly loam
H2 - 15 to 19 inches: bedrock

Properties and qualities

Slope: 2 to 15 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XC037CA - SHALLOW GRAVELLY LOAM
Hydric soil rating: No

Minor Components

Tocaloma

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, shallow

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed, deep

Percent of map unit: 5 percent
Hydric soil rating: No

Los osos

Percent of map unit: 5 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025

Marin County, California

117—Cronkhite-Barnabe complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hf1n
Elevation: 50 to 800 feet
Mean annual precipitation: 24 to 35 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 275 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Cronkhite and similar soils: 40 percent
Barnabe and similar soils: 30 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cronkhite

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 15 inches: loam
H2 - 15 to 26 inches: clay loam
H3 - 26 to 45 inches: clay loam
H4 - 45 to 55 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C

Ecological site: R015XC028CA - COASTAL LOAMY CLAYPAN
Hydric soil rating: No

Description of Barnabe

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and/or chert

Typical profile

H1 - 0 to 8 inches: very gravelly loam
H2 - 8 to 16 inches: very gravelly loam
H3 - 16 to 20 inches: bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 1.5 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R015XY009CA - Hills 20-40"ppt

Minor Components

Centissima

Percent of map unit: 4 percent
Hydric soil rating: No

Dipsea

Percent of map unit: 4 percent
Hydric soil rating: No

Slopes less than 30 percent

Percent of map unit: 4 percent
Hydric soil rating: No

Slumps

Percent of map unit: 4 percent
Hydric soil rating: No

Maymen

Percent of map unit: 4 percent

Hydric soil rating: No

Maymen variant
Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed, shallow
Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed, mod. deep
Percent of map unit: 3 percent
Hydric soil rating: No

Rock outcrop
Percent of map unit: 1 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Marin County, California
Survey Area Data: Version 19, Aug 29, 2025