Drainage Study

for

Self Storage Facility

and

BP Fueling Station and Mini Storage

8695 Greenback Lane

Parcel 261-0210-020

Level 3 Study

NAVD 88 Datum

PLNP2022-00220

ARCADE CREEK WATERSHED

JUNE1, 2024



Prepared by:
Watermark Engineering, Inc.
Contact: Patrick Stiehr (916) 774-1111

The Olympus Group, Inc.
Contact: Richard Francis (916) 396-6228

3153 Jenna Court
Roseville, CA 95747

Phone: 916- 774- 1111, Fax: 916- 774- 1181
Mobile: 916- 715- 1167, email: pstiehr@wtrmark.com

Contents

Overview.....1
Hydrology.....2
Hydraulic analysis.....2
Low Impact Development.....6

3153 Jenna Court
Roseville, CA 95747

Phone: 916- 774- 1111, Fax: 916- 774- 1181
Mobile: 916- 715- 1167, email: pstiehr@wtrmark.com

OVERVIEW

The development site is located at the northwest corner of Greenback Lane and Hickory Avenue. The area is about 2 acres and will be divided into two parcels and two uses. The southern area fronting Greenback will be a BP fueling station and food mart. The second area, located farther north with Hickory frontage, will be a Mini Storage complex

The study area was significantly higher than the nearby streets. The site has been recently lowered with removal of the hill for better access, and then rough graded. Existing drainage was south easterly off of the site, then southerly along Hickory to the Greenback/Hickory intersection, then westerly along the north side of Greenback Lane.

The project site will be operated as separate businesses. The southern gas station and food mart site will be graded to generally drain southwest. The site will utilize a storm filter vault for water quality and discharge to an existing stub at Greenback at the southwest corner of the parcel. Bio retention around the store will provide LIDs. See Figure 1, Vicinity Map.



Figure 1. Vicinity Map

The northern self- storage facility will also drain to the southwest with a storm filter and on oversized pipe for high flow attenuation. The outfall will be connected to the gas station outfall just upstream of the tie-in to the existing 15-inch stub. This site will also have a storm filter for water quality and a bio retention area north of the structure.

The XP software was used to model the facilities and determine appropriate storage and flow control facilities to attenuate runoff to flows similar to existing conditions.

HYDROLOGY

Soils in the area are classified as Fiddyment-Orangevale complex and are within the Hydrologic Soil Group D. Estimated infiltration rate is 0.47 inches per hour per the NRCS soil website. See **Appendix A**. Default infiltration values were used for the hydrologic analysis.

The Sac Method embedded in the XP software was used to determine runoff hydrographs for the sheds identified in Figure 1, Site Layout and Figure 2, Model Map.

Table 1 provides a summary of the hydrologic parameters and the peak 2-, 10-, and 100-year flows. Note that the peaks are added for the developed conditions just to show the estimated peak flow that would occur if attenuation was not provided. The attenuated peaks are shown later in the Hy

Revise XP model land use impervious value to match report.

Table 1. Summary of Hydrologic Parameters and Peak Flows

Shed ID	Area (ac)	% Imprv	"Compute from Travel Time"	Slope (ft/ft)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Existing Conditions							
Site (A+B)	1.96	2	Open Space	0.033	1.4	3.0	5.8
Ex Frntge (C)	0.83	87	Open Space	0.02	0.9	1.8	3.0
All (A+B+C)	2.79	26	Open Space	0.036	2.0	4.4	8.4
Developed							
A1	0.40	90	Commercial	na	0.2	0.5	1.0
A2	0.06	90	Commercial	na	0.1	0.1	0.2
A3	0.56	90	Commercial	na	0.7	1.2	2.1
A4	0.10	2	Landscape	0.01	0.1	0.1	0.2
B-gas	0.84	90	Commercial	na	1.0	1.8	3.1
C1-	0.10	95	Street	na	0.2	0.4	0.7
C2 DI-Hikry	0.25	95	Street/sidewalk	na	0.7	1.7	2.4
C3-DI-Grenbk	0.48		Street/sidewalk	na	0.6	1.0	1.8
∑Devel- Out	2.79	93	Added*	na	3.6	6.8	11.5

- *: Peaks added for informational purposes only- no routing.

HYDRAULIC ANALYSIS

The BP Fueling and Mini-Storage Master Utility Exhibit was used as the basis of the preparation of the XP SWMM model.

An earlier analysis included a storage vault to attenuate flow coming from the fueling station. With the new reconfiguration and the fact that both businesses drain to the same outfall, the vault was eliminated and storage pipe within the self-storage unit was lengthened to attenuate the combined outflow to existing conditions. The previous design with the vault would have been difficult to construct with the nearby fuel tanks and other underground facilities.

The oversized pipe is designed as 120 lineal feet of 36-inch storm drain. The manhole downstream of the oversized pipe mini-storage facilities at will have a metal plate that will act as the "dam" to manage outflow. The plate will have the orifice at the bottom and the top will be at the estimated 100-year water surface elevation (WSE).

Flows in excess of the 100-year storm, or if the orifice becomes restricted, will overtop the weir and flow along the downstream pipe. An oversized trash rack in front of the relatively small orifice is recommended to reduce the potential of clogging. The rectangular orifice will be 0.6 feet wide and 0.5 feet tall at the flowline. The weir will be fitted in the 4 foot manhole with a weir height 3.1 feet above manhole invert. See **Appendix B**.

Note that Shed A4 is a landscaped corridor that will be graded as sump at a maximum depth of one foot, maximum side slopes at 4:1 with a 1-2 foot rounded bottom. Using 0.1 in/hr infiltration rate, the sump is expected to contain all design storms. Even if there is overflow, it would be minor and very infrequent.

Table 2 provides a summary of the computed flows leaving the site for both existing and developed conditions for the selected storms.

Table 2. Summary of Existing and Developed Flows Leaving Site

Location	2-yr Storm (cfs)	10-yr Storm (cfs)	100-yr Storm (cfs)
Ex Conditions (A+B)	1.4	3.0	5.8
Ex Conditions (A+B+C)	2.0	4.4	8.4
Dev Conditions (A+B)	1.5	2.7	4.5
Dev Conditions (A+B+C)	2.4	4.5	7.7

Please note that the selected peak runoffs for only the project site and fro the entire site are provided. For the 100-year storm, the attenuation facilities reduce the peak runoff whether the offsite frontage is included or not included.

There is a slight increase of the developed peak runoff during the 2-year storm. But note that for the 10- and 100-year storms, the developed conditions peak runoff is less for developed conditions. The focus of the trial and error procedure was on the 100-year storm. The logic was that during a small to moderate storms, the pipe capacity and possibly minor gutter flow would be similar to existing conditions and not create new issues. During significant to severe storms, the proposed facilities will not impact downstream surface flows compared to existing conditions.

Figure 1 provides a model map.
Figure 2 shows the 100-year water surface elevations and flow along the Shed A facilities.
Figure 3 shows the same information from the B node to Arcade Cr node.
Figure 4 shows the same information from Node A4 along the C system to node A+B+Cout.
Figure 5 shows the outflow hydrographs just downstream of the project site.

The XP files named Grnbk+Hikry-all-r5-2-20-24.xp are provided in a separate submittal.

In summary, the proposed facilities attenuate flows to less than existing conditions for the 100-year storm. Water quality vaults will provide treatment. The outfall along Greenback is approximately 10 feet lower than at the site. Backwater from Arcade Creek is not an issue.

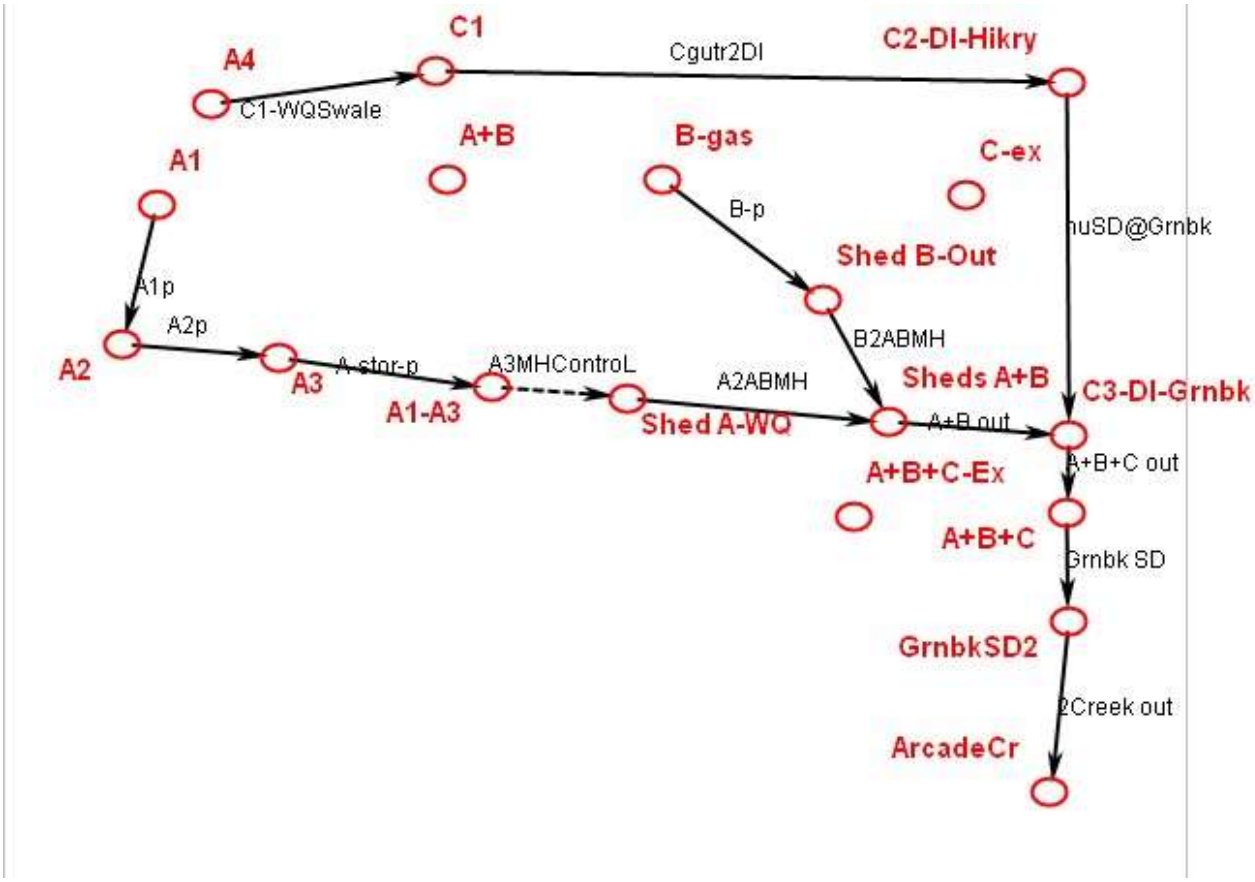
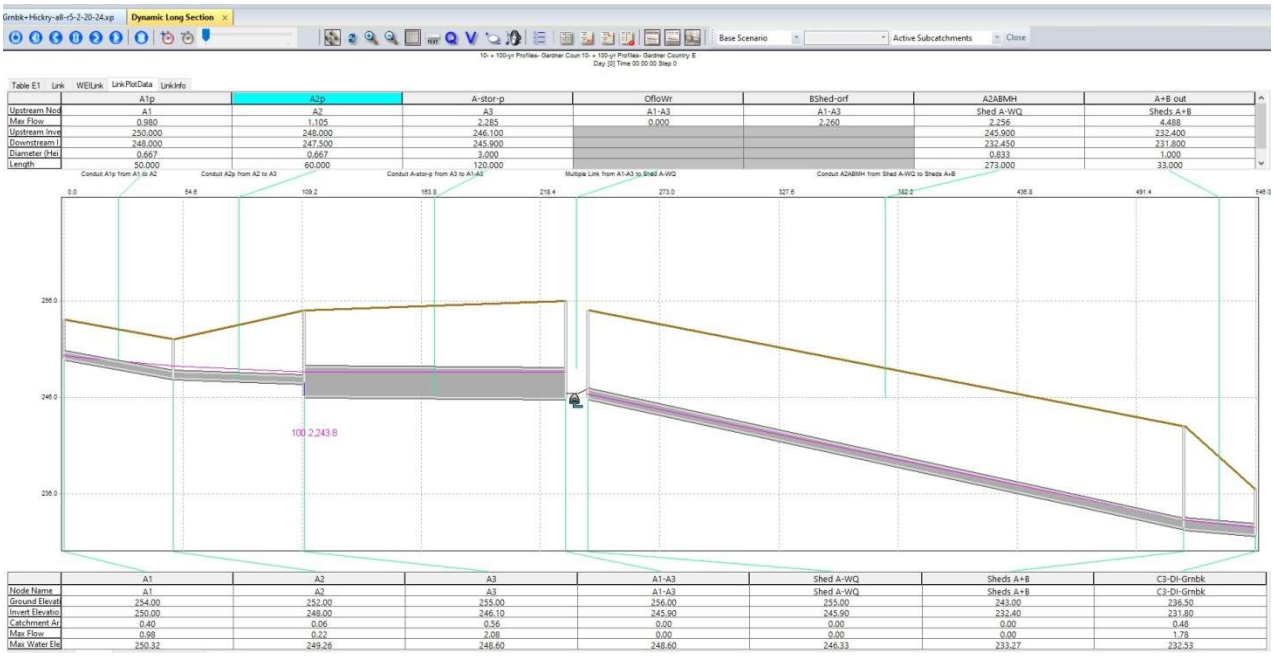


Figure 1. Model Map



	A1p	A2p	A-stor-p	OffloWr	BShed-orf	A2ABMH	A+B out
Upstream Nod	A1	A2	A3	A1-A3	A1-A3	Shed A-WQ	Sheds A+B
Max Flow	0.980	1.105	2.285	0.000	2.260	2.256	4.488
Upstream Inve	250.000	248.000	246.100			245.900	232.400
Downstream I	248.000	247.500	245.900			232.450	231.800
Diameter (Hei	0.667	0.667	3.000			0.833	1.000
Length	50.000	60.000	120.000			273.000	33.000

	A1	A2	A3	A1-A3	Shed A-WQ	Sheds A+B	C3-DI-Grnbk
Node Name	A1	A2	A3	A1-A3	Shed A-WQ	Sheds A+B	C3-DI-Grnbk
Ground Elevati	254.00	252.00	255.00	256.00	255.00	243.00	236.50
Invert Elevatio	250.00	248.00	246.10	245.90	245.90	232.40	231.80
Catchment Ar	0.40	0.06	0.56	0.00	0.00	0.00	0.48
Max Flow	0.98	0.22	2.08	0.00	0.00	0.00	1.78
Max Water Ele	250.32	249.26	248.60	248.60	246.33	233.27	232.53

Figure 2 Water Surface Profiles of Shed A- Mini Storage

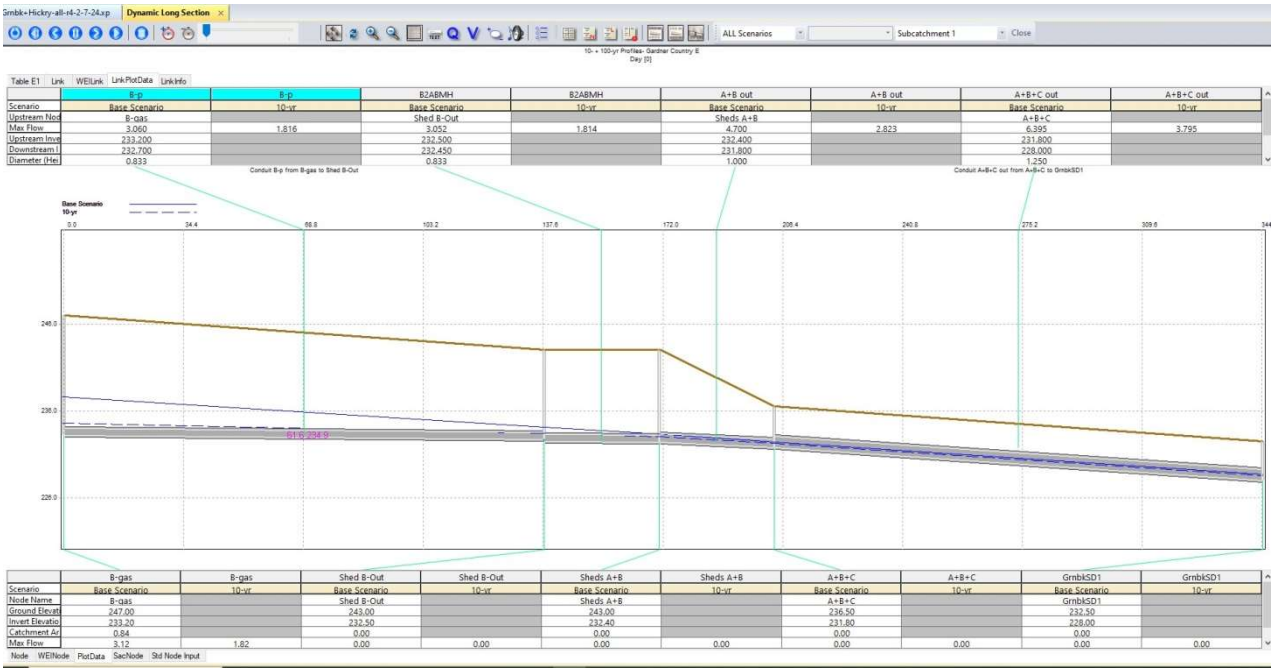


Figure 3 Water Surface Profiles of Shed B and the Combined Flow to Arcade Creek at Greenback

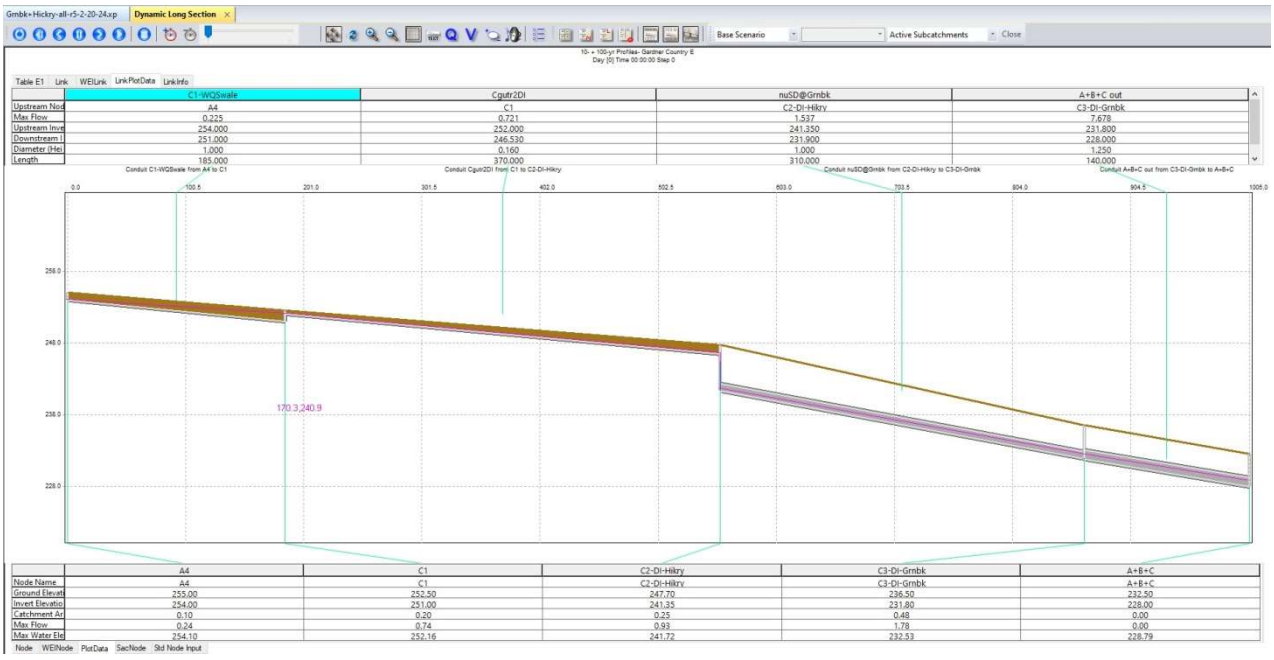


Figure 4 Water Surface Profile Along Hickory and Greenback Land

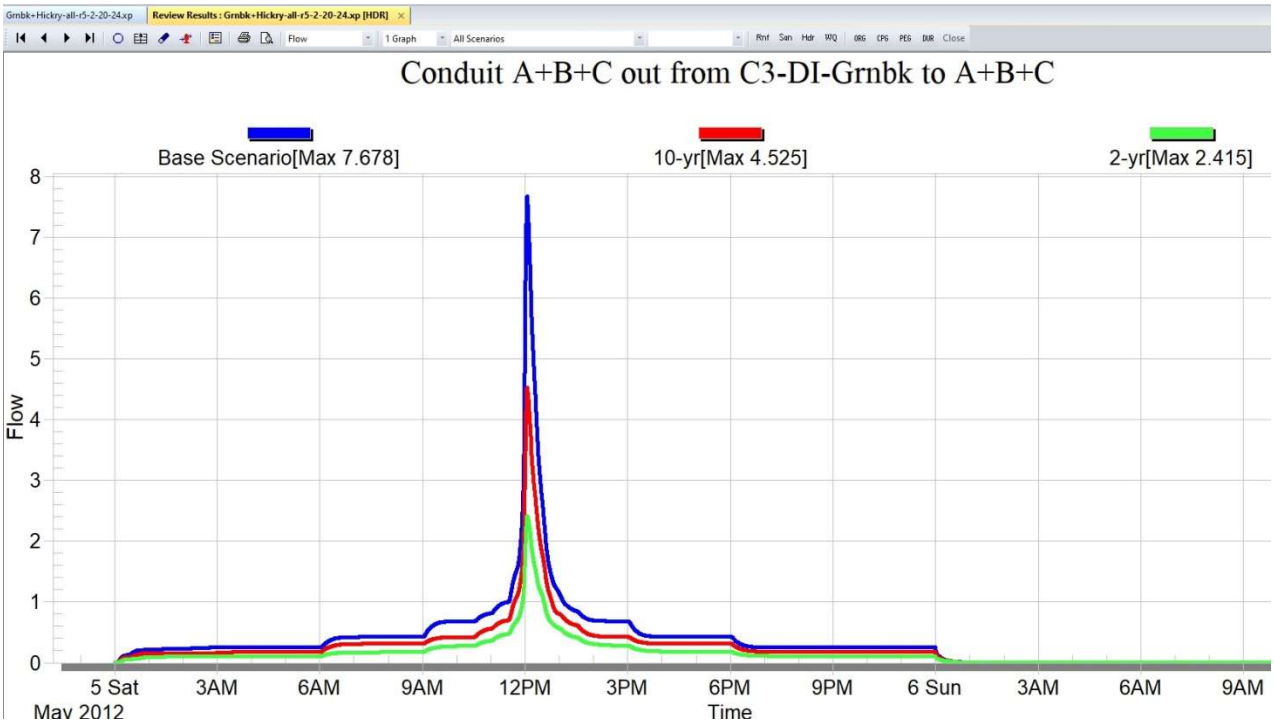


Figure 5 Sheds A, B and C. Total Flow (cfs) from Site

LOW IMPACT DEVELOPMENT

Note that the existing parcel will be divided into two parcels and the gas station parcel is less than one acre. Both projects have little space for LIDs and the grades are such that some of the hardscape areas cannot be graded to drain to bio retention areas.

The original LID worksheets showed the entire shed area and adequate facilities to treat the entire area. However, some of the shed area cannot drain to the bio retention. As a result of review comments, the revised LID worksheets show only the area tributary to the respective bio retention areas. In addition, an infiltration trench has been added to Shed A to increase the bio retention as much as reasonably feasible. There is no LID worksheet for this trench. It is supplemental only.

Appendices C and D provide the respective LID spreadsheets for the self-storage and the fueling station.

Hydrologic Soil Group—Sacramento County, California
(Hickory and Greenback)



Map Scale: 1:2,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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 Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

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: Sacramento County, California
Survey Area Data: Version 18, Sep 16, 2019

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

Date(s) aerial images were photographed: May 11, 2019—May 12, 2019

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
148	Fiddyment-Orangevale-Urban land complex, 2 to 8 percent slopes	D	8.1	42.5%
229	Urban land-Xerarents-Fiddyment complex, 0 to 8 percent slopes		11.0	57.5%
Totals for Area of Interest			**19.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Saturated Hydraulic Conductivity (Ksat)—Sacramento County, California
(Hickory and Greenback)



Map Scale: 1:2,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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 Rating Polygons

= 3.1999

Not rated or not available

Soil Rating Lines

= 3.1999

Not rated or not available

Soil Rating Points

= 3.1999

Not rated or not available

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.

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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.

Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
148	Fiddyment-Orangevale-Urban land complex, 2 to 8 percent slopes	3.1999	8.1	42.5%
229	Urban land-Xerarents-Fiddyment complex, 0 to 8 percent slopes		11.0	57.5%
Totals for Area of Interest			**19.1**	**100.0%**

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 4

Bottom Depth: 36

Units of Measure: Inches

Watermark Engineering, Inc.
3153 Jenna Court
Roseville, CA 95747
(916) 774-1111 Fax (916) 774-1181
pstiehr@wtrmark.com

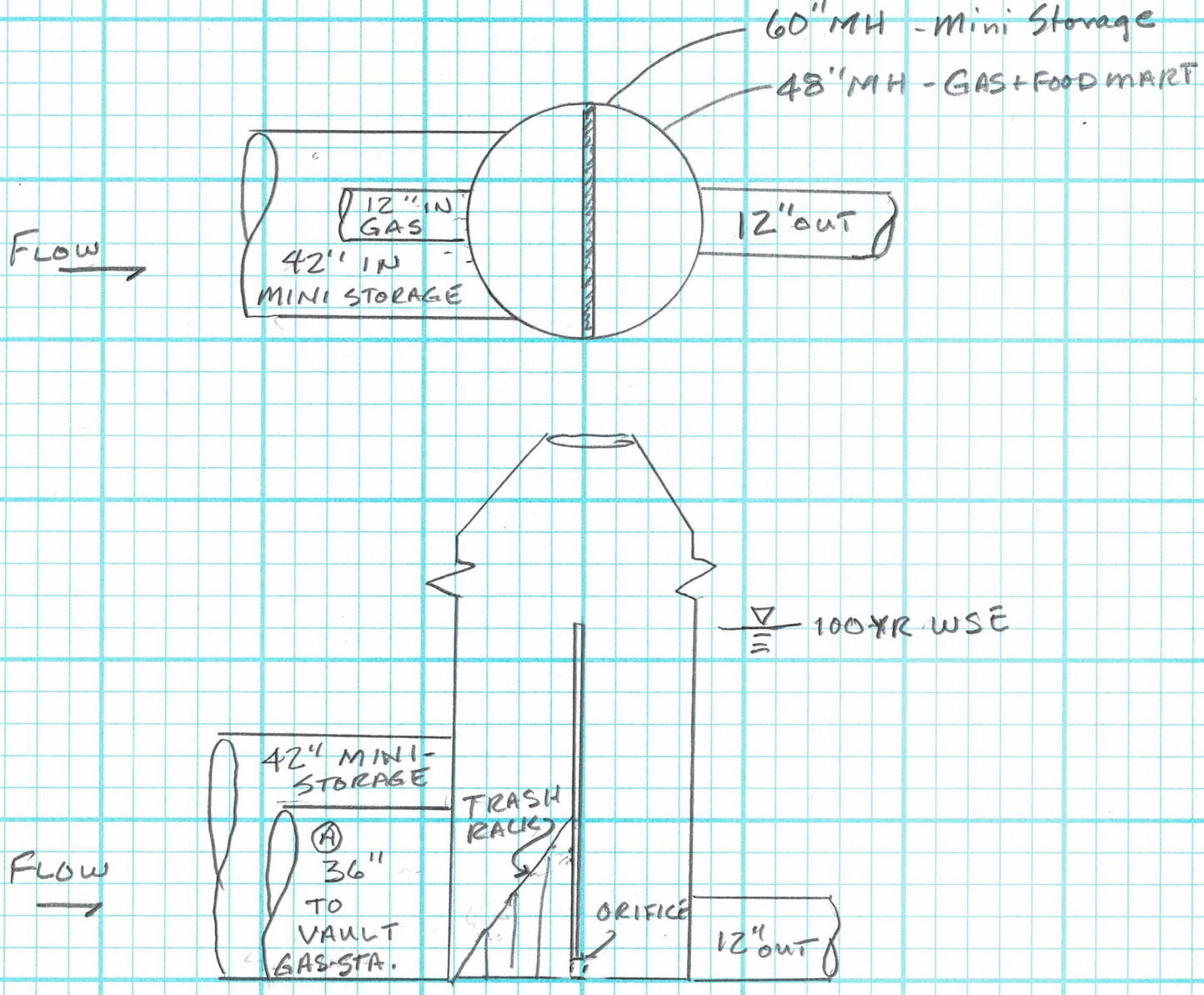
JOB GREENBACK & HICKORY

SHEET NO _____ OF _____

CALCULATED BY PLS DATE 7-17-20

CHECKED BY _____ DATE _____

ATTACHMENT A



Ⓐ Length of 36" SD to be sufficient to provide for compaction around vault and manhole (3' min recommended).

Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed:
Location of project:

Fill in Blue Highlighted boxes

Step 1 - Open Space and Pervious Area Credits

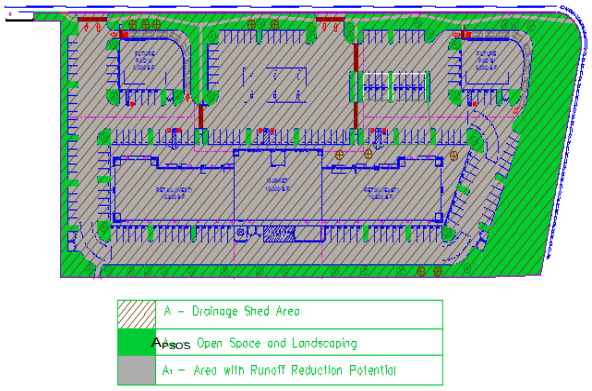
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

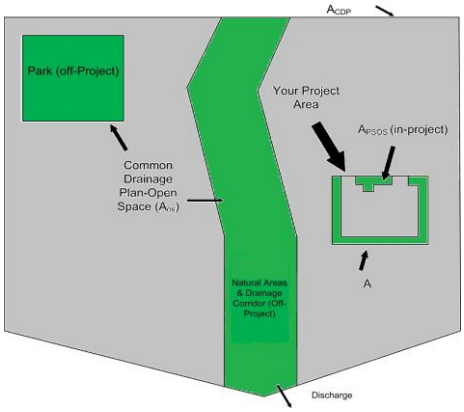
1 a. Common Drainage Plan Area	0	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	0.62	acres	A	
Project-Specific Open Space (In-project, communal)**	0.00	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		**see area example below**
d. Landscape area/park	0.00	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	0.62	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	1.00		I

Open Space & Pervious Area LID Credit (Step 1)
$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ = 0 pts





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)				$(A_C / A_T)*100$ =		0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - | enter gallons, for simple rain barrels | 0.00 | acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 | acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area ____ sq ft
Subdrain Elevation ____ inches
Ponding Depth, inches ____ inches | 0.00 | acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs ____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr ____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft 0.03 capture_vol_inf | 0.31 | acres

Sizing Option 2: Infiltration BMP surface area, sq ft ____ soil_surface_area | 0.00 | acres

Basin or trench? Trench | approximate BMP depth 3.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) | Mulched Infiltration Area, sq ft ____ mulch_area | 0.00 | acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 0.31 | A_{LIDc}

Runoff Management Credit (Step 3) | A_{LIDC}/A_T*200 = 100.5 | pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 100.5

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 0.31 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = 0.50 I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity): select a location o i

Obtain A_{AT} from Step 3: 0.31 A_{AT}

Use C = 0.95: 0.95 C

Flow = 0.95 * i * A_{AT}: #VALUE! cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1: 0.62 A ____ hrs Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.: 0.36 P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12): 0.02 Acre-Feet

v06232012

Appendix D-2: Commercial Sites: Low Impact Development (LID) Credits and Treatment BMP Sizing Calculations

Name of Drainage Shed: Gas Station- Greenback and Hickory
Location of project: Sacramento

Fill in Blue Highlighted boxes

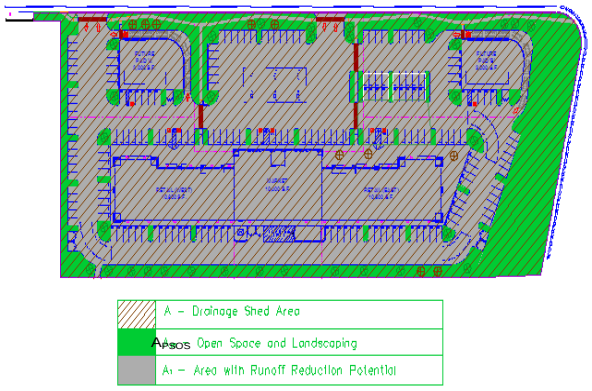
Step 1 - Open Space and Pervious Area Credits

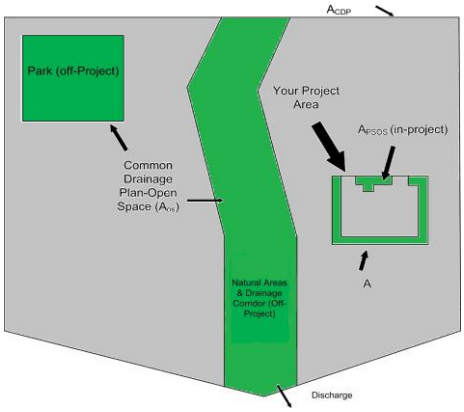
Is your project within the drainage area of a common drainage plan that includes open space? If not, skip to 1 b.

1 a. Common Drainage Plan Area	0	acres	A_{CDP}	
Common Drainage Plan Open Space (Off-project)	0	acres	A_{OS}	**see area example below**
a. Natural storage reservoirs and drainage corridors	0	acres		
b. Buffer zones for natural water bodies	0	acres		
c. Natural areas including existing trees, other vegetation, and soil	0	acres		
d. Common landscape area/park	0	acres		
e. Regional Flood Control/Drainage basins	0	acres		
1 b. Project Drainage Shed Area (Total)	0.10	acres	A	
Project-Specific Open Space (In-project, communal)**	0.00	acres	A_{PSOS}	
a. Natural storage reservoirs and drainage corridors	0.00	acres		
b. Buffer zones for natural water bodies	0.00	acres		**see area example below**
c. Natural areas including existing trees, other vegetation, and soil	0.00	acres		
d. Landscape area/park	0.00	acres		
e. Flood Control/Drainage basins	0.00	acres		

** Doesn't include impervious areas within individual lots and surrounding individual units. That is accounted for below using Form D-1a in Step 2.

Area with Runoff Reduction Potential	$A - A_{PSOS}$ =	0.10	acres	A_T
Assumed Initial Impervious Fraction	A_T / A =	1.00		I
Open Space & Pervious Area LID Credit (Step 1)	$(A_{OS}/A_{CDP}+A_{PSOS}/A)x100$ =	0	pts	





Step 2 - Runoff Reduction Credits

Runoff Reduction Treatments	Impervious Area Managed			Efficiency Factor		Effective Area Managed (A_C)	
Porous Pavement:							
Option 1: Porous Pavement (see Fact Sheet, excludes porous pavement used in Option 2)	0	acres	x		=	0.000	acres
Option 2: Disconnected Pavement (see Fact Sheet, excludes porous pavement used in Option 1)	use Form D-2a for credits →					0.00	acres
Landscaping used to Disconnect Pavement (see Fact Sheet)	0.0000	acres			=	0.00	acres
Disconnected Roof Drains (see Fact Sheet and/or Table D-2b for summary of requirements)	0	acres			=	0.00	acres
Ecoroof (see Fact Sheet)	0	acres			=	0.00	acres
Interceptor Trees (see Fact Sheet)	use Form D-2b for credits →					0.00	acres
Total Effective Area Managed by Runoff Reduction Measures				A_C		0.00	acres
Runoff Reduction Credit (Step 2)				$(A_C / A_T)*100$ =		0	pts

Table D-2a

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete/Asphalt	0.60
Modular Block Pavement &	0.75
Reinforced Grass Pavement	1.00

Table D-2b

Maximum roof size	Minimum travel distance
≤ 3,500 sq ft	21 ft
≤ 5,000 sq ft	24 ft
≤ 7,500 sq ft	28 ft
≤ 10,000 sq ft	32 ft

Form D-2a: Disconnected Pavement Worksheet

See Fact Sheet for more information regarding Disconnected Pavement credit guidelines

Effective Area Managed (A_C)

Pavement Draining to Porous Pavement

2. Enter area draining onto Porous Pavement	0.00	acres	Box K1
3. Enter area of Receiving Porous Pavement (excludes area entered in Step 2 under Porous Pavement)	0.00	acres	Box K2
4. Ratio of Areas (Box K1 / Box K2)	0.00		Box K3

5. Select multiplier using ratio from Box K3 and enter into Box K4

Ratio (Box D)	Multiplier
Ratio is ≤ 0.5	1.00
Ratio is > 0.5 and < 1.0	0.83
Ratio is > 1.0 and < 1.5	0.71
Ratio is > 1.5 and < 2.0	0.55

	1		Box K4
6. Enter Efficiency of Porous Pavement (see table below)			Box K5

Porous Pavement Type	Efficiency Multiplier
Cobblestone Block Pavement	0.40
Pervious Concrete Asphalt Pavement	0.60
Modular Block Pavement Porous Gravel Pavement	0.75
Reinforced Grass Pavement	1.00

7. Multiply Box K2 by Box K5 and enter into Box K6	0.00	acres	Box K6
8. Multiply Boxes K1,K4, and K5 and enter the result in Box K7	0.00	acres	Box K7
9. Add Box K6 to Box K7 and multiply by 60%, and enter the Result in Box K8			0.00 acres

This is the amount of area credit to enter into the "Disconnected Pavement" Box of Form D-2

Form D-2b: Interceptor Tree Worksheet

See Fact Sheet for more information regarding Interceptor Tree credit guidelines

New Evergreen Trees

1. Enter number of new evergreen trees that qualify as Interceptor Trees in Box L1.		trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	0	sq. ft.	Box L2

New Deciduous Trees

3. Enter number of new deciduous trees that qualify as Interceptor Trees in Box L3.		trees	Box L3
4. Multiply Box L3 by 100 and enter result in Box L4	0	sq. ft.	Box L4

Existing Tree Canopy

5. Enter square footage of existing tree canopy that qualifies as Existing Tree canopy in Box L5.	0	sq. ft.	Box L5
6. Multiply Box L5 by 0.5 and enter the result in Box L6	0	sq. ft.	Box L6

Total Interceptor Tree EAM Credits

Add Boxes L2, L4, and L6 and enter it into Box L7	0	sq. ft.	Box L7
Divide Box L7 by 43,560 and multiply by 20% to get effective area managed and enter result in Box L8	0.00	acres	Box L8

This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2

Step 3 - Runoff Management Credits

Capture and Use Credits

Impervious Area Managed by Rain barrels, Cisterns, and automatically-emptied systems

(see Fact Sheet) | - enter gallons, for simple rain barrels | 0.00 acres

Automated-Control Capture and Use System

(see Fact Sheet, then enter impervious area managed by the system) | 0.00 acres

Bioretention/Infiltration Credits

Impervious Area Managed by Bioretention BMPs

(see Fact Sheet)

Bioretention Area 300 sq ft
Subdrain Elevation 12 inches
Ponding Depth, inches 6 inches | 0.05 acres

Impervious Area Managed by Infiltration BMPs

(see Fact Sheet)

Drawdown Time, hrs _____ drawdown_hrs_inf
Soil Infiltration Rate, in/hr _____ soil_inf_rate

Sizing Option 1: Capture Volume, acre-ft _____ capture_vol_inf | 0.00 acres

Sizing Option 2: Infiltration BMP surface area, sq ft 0 soil_surface_area | 0.00 acres

Basin or trench? _____ approximate BMP depth 0.00 ft

Impervious Area Managed by Amended Soil or Mulch Beds

(see Fact Sheet) Mulched Infiltration Area, sq ft _____ mulch_area | 0.00 acres

Total Effective Area Managed by Capture-and-Use/Bioretention/Infiltration BMPs | 0.05 A_{LIDc}

Runoff Management Credit (Step 3) A_{LIDC}/A_T*200 = 102.7 pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 102.7

Does project require hydromodification management? If yes, proceed to using SacHM.

Adjusted Area for Flow-Based, Non-LID Treatment $A_T - A_C - A_{LIDC}$ = 0.05 A_{AT}

Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment A_{AT} / A = 0.49 I_A

Further treatment is required, see choose flow-based or volume-based sizing in Step 4

Step 4a Treatment - Flow-Based (Rational Method)

Calculate treatment flow (cfs): Flow = Runoff Coefficient x Rainfall Intensity x Area

Look up value for i in Table D-2c (Rainfall Intensity): 0.18 i

Obtain A_{AT} from Step 3: 0.05 A_{AT}

Use C = 0.95: 0.95 C

Flow = 0.95 * i * A_{AT}: 0.01 cfs

Table D-2c

Rainfall Intensity			
Roseville	i =	0.20	in/hr
Sacramento	i =	0.18	in/hr
Folsom	i =	0.20	in/hr

Step 4b Treatment - Volume-Based (ASCE-WEF)

Calculate water quality volume (Acre-Feet): WQV = Area x Maximized Detention Volume (P_0)

Obtain A from Step 1: 0.10 A _____ hrs Specified Draw Down time

Obtain P_0: Maximized Detention Volume from figures E-1 to E-4 in Appendix E of this manual using I_A from Step 2.: 0.35 P_0

Calculate treatment volume (acre-ft):

Treatment volume = A x (P_0 / 12): 0.00 Acre-Feet

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