COUNTY OF SACRAMENTO

Level 3 Drainage Study
Hydrology & Hydraulic Memorandum

FOR

Convenience Store & Fuel Station

Auburn Blvd & Myrtle Ave
Sacramento, CA 95841
Watershed: Date Creek

APN: 240-0061-001 & 240-0061-002
Datum: NAVD88

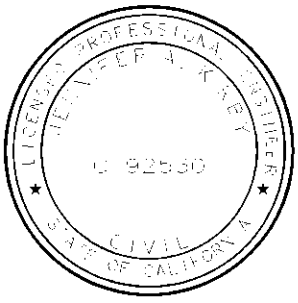
DATE OF REPORT:
December 2022

PREPARED FOR:

Auburn Blvd Partners, LLC
Omair Nasim
10033 Tagus Way
Elk Grove, CA 95757
(916) 807-4076
onasim@gmail.com

PREPARED BY:

Kimley-Horn
Jennifer Kirby, P.E.
4637 Chabot Drive, Suite 350
Pleasanton, CA 94588
(669) 800-4168
jennifer.kirby@kimley-horn.com



Purpose of Report

Kimley-Horn and Associates, Inc. (KH) has prepared this Memorandum for Omair Nasim of Auburn Blvd Partners, LLC. The report is intended to comply with the requirements of the County of Sacramento Stormwater Quality Design Manual. The report also is intended to assist in the development of construction documents for a Convenience store, a Fuel Island, and a Quick Serve Restaurant with a drive through.



Site Description and Drainage Patterns

The project is a redevelopment of two commercial properties, totaling 1.12 ac, located on the southwest side of the intersection of Auburn Blvd and Myrtle Ave. The proposed development will consist of a new 2,949 square foot convenience store, a new 1,495 square foot quick serve restaurant with a drive through, and a new fuel station area covered with a canopy.

Existing Conditions

Currently, the site drains to one of two ways. Approximately half of the site drains to the SW property line where there is a drainage swale that travels NW and discharges into the channel west of the site. The other half of the site drains towards Myrtle Ave where there is an existing drainage swale at the northern property line. This swale travels east to west and ultimately discharges to the existing drainage channel west of the site.

Project Conditions

In the project condition, the drainage pattern from the existing condition will be generally maintained. There is approximately a 4' elevation difference between the proposed elevation at the driveway in Auburn Blvd and the driveway in Myrtle Ave. Due to this, the entire site drains SE to NW. The site has a handful of SD inlets and area drains that will converge in the stormdrain pipe system and connect to a proposed SD main extension. This SD main extension is required due to the removal of the existing drainage swale at the northern property line. Once connected to the SD main extension, the stormwater will ultimately discharge to the existing channel to the west of the site. The proposed project has a total impervious area less than 1.0 acre, therefore, stormwater treatment BMPs are not proposed as part of this project. During a large storm event, water will pond a maximum of 6" before ultimately discharging into Myrtle Ave. The Preliminary Grading Plan shows the overland release point and can be found at the end of this report (Appendix A).

Methodology Used

SacCalc was used to determine the peak flow of the 100-year – 24 hour storm event for both the existing and proposed site condition. See Appendix B and C for SacCalc Calculations for each condition. We utilized FlowMaster, a Bentley Systems software program, to determine the existing swale maximum discharge. It was also used to determine the maximum discharge for the 36" SD line that is proposed to replace the existing swale (Appendix D). FlowMaster calculations are based on the Manning's equation.

Calculations

Project 100-Year Flow

Project 100-Year flow was calculated using Sacramento Method (See Appendix B & C).

Existing Condition 100-Year Flow = 3.34 ft^3/s

Proposed Condition 100-Year Flow = 3.96 ft^3/s

Pipe Sizing

Project existing and proposed drainage features were calculated using Flowmaster (See Appendix D).

Capacity of a full flowing 36-inch pipe @ 0.55% slope = 49.46 CFS

Capacity of existing Drainage Swale along Myrtle Ave = 15.50 CFS

Summary

Table 1 summarizes the 100-year peak flows for the existing and proposed conditions

Table 1 - Existing vs. Project Comparison – Total Peak Flow

Scenario	Total 100-year Peak Flow (cfs)
Existing Condition (The Sacramento Method)	3.38
Proposed Condition (The Sacramento Method)	3.96
Delta (Δ)	0.58

Table 2 summarizes the peak flows for the existing drainage swale and the proposed RCP Storm Drain main that is proposed to take its place.

Table 2 - Existing vs. Project Comparison – Peak Flow of Drainage Features

Scenario	Drainage Feature Capacity (cfs)
Drainage Swale (Existing Condition)	15.50
36" RCP Storm Drain Main (Proposed Condition)	49.46
Delta (Δ)	33.96

Conclusion

As shown above, the total 100-year peak flow is increased for the project site. This is due to an increase in impervious area in the proposed condition. The project proposes a 0.58 cfs increase to the 100-year peak flow. However, from Table 3-2 in the Stormwater Quality Design Manual for the Sacramento Region, we are below the 1 ac impervious area threshold and the project is exempt from hydromodification and stormwater treatment. Due to this, an exercise was performed to ensure our site was not creating a negative impact on our neighbors.

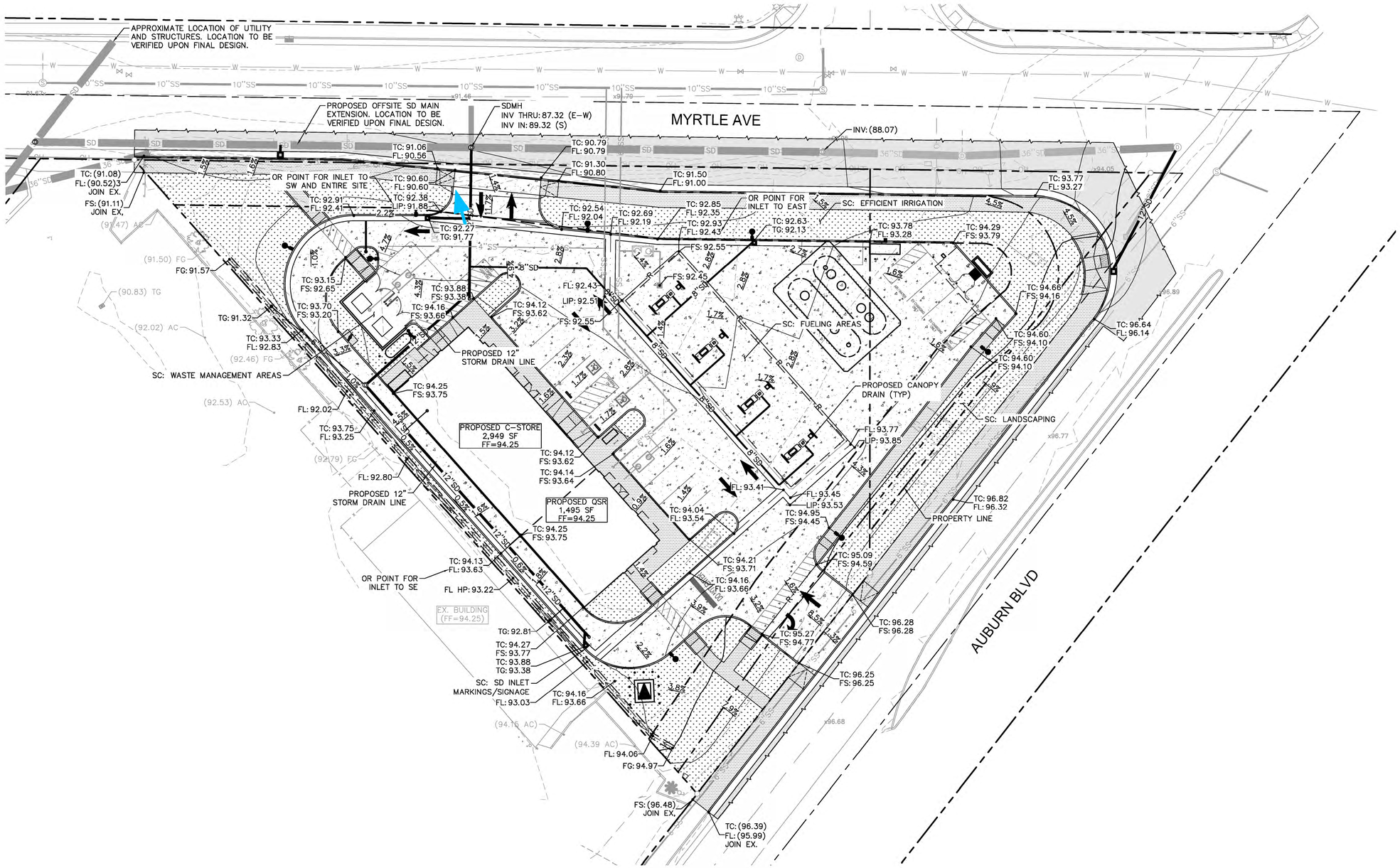
The existing drainage swale that conveys the existing project discharge is being replaced with a 36" RCP stormdrain main. The discharge capacity of theses drainage features were calculated, and the proposed condition is to have a capacity increase of 33.96 cfs. Due to this large increase in capacity, the increased peak flow amount of 0.58 cfs will be easily handled and won't pose a negative impact on the adjacent property.

Along with looking into discharge rates, overland release conditions were considered as well. The grading plan (Appendix A) shows the overland release grade where if an inlet failed, where water would start discharging into Myrtle Ave. This grade is well below the site finished floor elevation (FFE) along with the neighboring building FFE. In fact, the FFE of the proposed building is equal to that of the existing building on the adjacent property, ensuring no negative impact to the neighboring site.

While the project is exempt from stormwater treatment and hydromodification, the site still requires source control measures. The project will follow the source control best management practices (BMPs) laid out in the California Stormwater Quality Association (CASQA) Handbook. The applicable source control measure includes efficient irrigation, storm drain system signs, Fueling Areas, and Trash Enclosures. See Appendix E for details of each source control.

Appendix A

Preliminary Grading & Drainage Sheet, Preliminary Utility Plan & Pervious/Impervious Exhibit



LEGEND

- PROPERTY LINE
- CENTER LINE
- EASEMENT OR SETBACK LINE
- APPROXIMATE CIVIL LIMIT OF WORK LINE
- GB — GRADE BREAK LINE
- R — RIDGE LINE
- XXX — PROPOSED CONTOUR LINE
- XXX — EXISTING CONTOUR LINE
- SD — PROPOSED STORM DRAIN LINE
- SAWCUT LINE
- PROPOSED STORM DRAIN INLET
- PROPOSED STORM DRAIN CLEANOUT
- PROPOSED OVERLAND RELEASE
- PROPOSED ASPHALT CONCRETE PAVEMENT
- PROPOSED CONCRETE SIDEWALK
- PROPOSED HEAVY DUTY CONCRETE
- PROPOSED PERVIOUS CONCRETE
- PROPOSED LANDSCAPE AREA

ABBREVIATIONS

AC	– ASPHALT CONCRETE
FF	– FINISHED FLOOR
FG	– FINISHED GRADE
FL	– FLOW LINE
FS	– FINISHED SURFACE
OR	– OVERLAND RELEASE
SC	– SOURCE CONTROL
TC	– TOP OF CURB
TG	– TOP OF GRATE
XXX.XX	– PROPOSED ELEVATION
(XXX.XX)	– EXISTING ELEVATION

GENERAL NOTES

1. ALL NEW PAVEMENT WILL REQUIRE AN ALBEDO OF NOT LESS THAN 0.25.
2. THERE ARE TWO KNOW CLOSED CONTAMINATED GROUNDWATER AND SOIL CONTAMINATED SITES FOR GASOLINE (T0606701063, T0606767739) WITHIN 1,000 FEET OF THIS SITE. PRIOR TO ANY GRADING, DEMOLITION, OR CONSTRUCTION ACTIVITIES PLEASE CONTACT DAVID VON ASPERN AT VONASPERND@SACCOUNTY.NET.
3. IF AN ABANDONED WELL IS FOUND ON THE PROPERTY, IT MUST BE ISSUED AN INACTIVATION PERMIT (SUBJECT TO REVIEW AND APPROVAL FROM EMD), REPAIRED AND BROUGHT BACK INTO SERVICE, OR IT MUST BE DESTROYED AT THE PARCEL OWNER'S COST. ALL WELL RELATED ACTIVITIES MUST BE PERFORMED IN COMPLIANCE WITH EMD'S WELL PERMITTING AND INSPECTION PROGRAM REQUIREMENTS. CONTACT DEREK JACKS AT JACKSD@SACCOUNTY.NET WITH ANY QUESTIONS.
4. IF AN ABANDONED SEPTIC SYSTEM TANK IS DISCOVERED ON THE PROPERTY, IT MUST BE DESTROYED IN COMPLIANCE WITH EMD'S LIQUID WASTE PERMITTING AND INSPECTION PROGRAM REQUIREMENTS. CONTACT LEANA NGUYEN AT NGUYENL@SACCOUNT.NET WITH ANY QUESTIONS.
5. ANY FACILITY IN SACRAMENTO COUNTY THAT HANDLES AND/OR STORES A HAZARDOUS MATERIAL EQUAL TO OR GREATER THAN THE MINIMUM REPORTABLE QUANTITIES (55 GALLONS FOR LIQUIDS, 500 POUNDS FOR SOLIDS AND 200 CUBIC FEET (AT STANDARD TEMPERATURE AND PRESSURE) FOR COMPRESSED GASES) MUST OBTAIN A PERMIT AND SUBMIT A HAZARDOUS MATERIALS BUSINESS PLAN TO EMD. THE PURPOSE OF THE HMBP PROGRAM IS TO PROTECT PUBLIC HEALTH AND THE ENVIRONMENT AND GROUNDWATER FROM RISKS OR ADVERSE EFFECTS ASSOCIATED WITH THE STORAGE OF HAZARDOUS MATERIALS. CONTACT THOMAS VOHOSKA AT VOHOSKAT@SACCOUNTY.NET FOR ADDITIONAL INFORMATION.
6. ANY FACILITY IN SACRAMENTO COUNTY THAT GENERATES HAZARDOUS WASTE MUST OBTAIN A PERMIT FROM EMD. THE PURPOSE OF THE PROGRAM IS TO ENSURE COMPLIANCE WITH THE HAZARDOUS WASTE CONTROL ACT, VERIFY HAZARDOUS WASTE ACCUMULATION, LABELING, CONTAINER AND TANK MANAGEMENT STANDARDS, AND WASTE GENERATOR STATUS, RESPOND TO COMPLAINTS OF ILLEGAL DISPOSAL OF HAZARDOUS WASTE, AND ISSUE PERMITS AND INSPECTS BUSINESSES THAT TREAT HAZARDOUS WASTE PURSUANT TO PERMIT BY RULE, CONDITIONAL AUTHORIZATION, OR CONDITIONAL EXEMPTION LAWS AND REGULATIONS. CONTACT THOMAS VOHOSKA AT VOHOSKAT@SACCOUNTY.NET FOR ADDITIONAL INFORMATION.

NORTH

GRAPHIC SCALE IN FEET
0 10 20 40

No.	REVISIONS	DATE	BY

Kimley»Horn
4637 CHABOT DRIVE, SUITE 350, PLEASANTON, CA 94588
PHONE: 925-398-4840 FAX: 925-398-4849
WWW.KIMLEY-HORN.COM

NOT FOR CONSTRUCTION

KHA PROJECT	097672107
DATE	12/07/2022
SCALE	AS SHOWN
DESIGNED BY	SAL
DRAWN BY	CKC
CHECKED BY	JAK

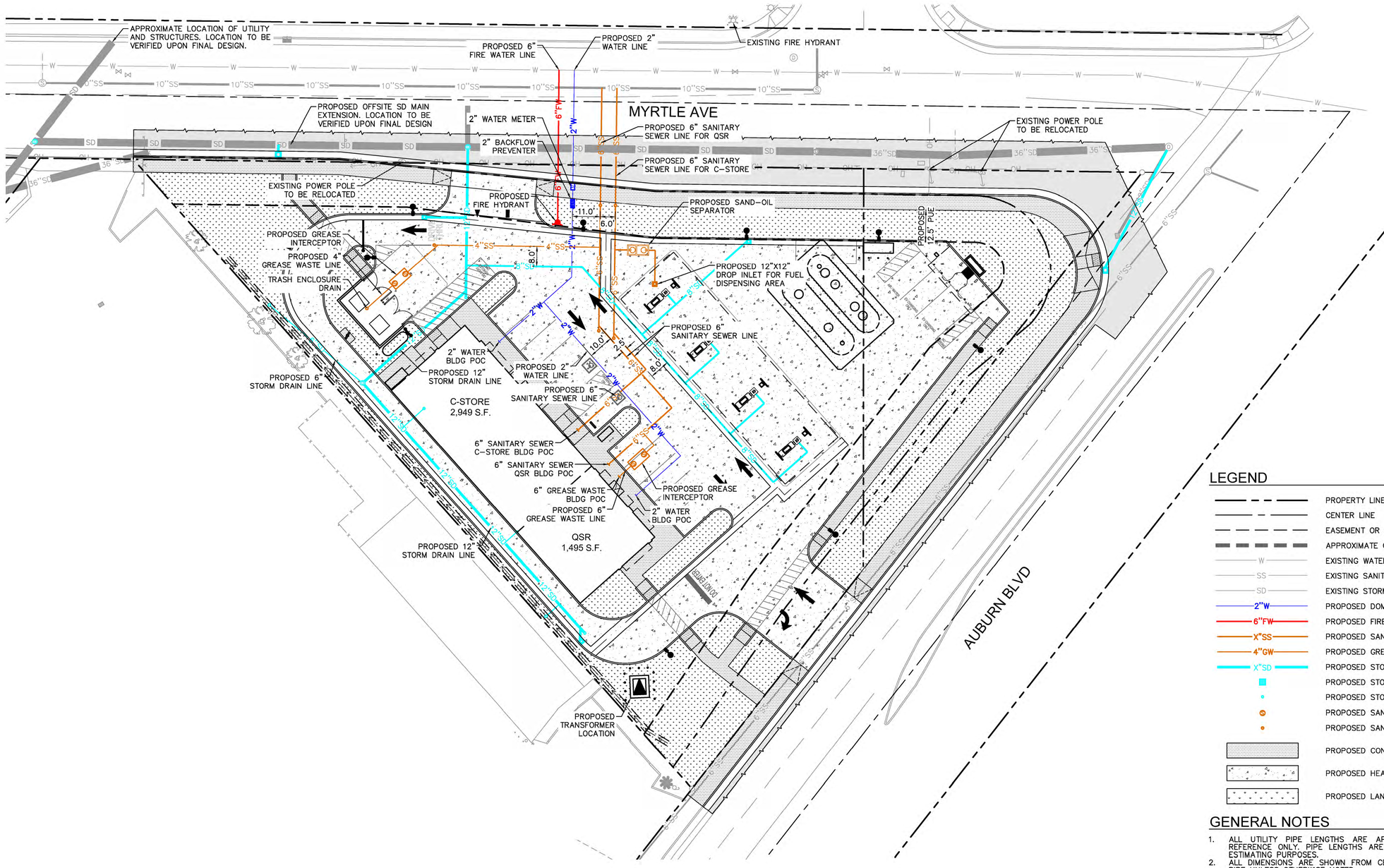
AUBURN BLVD PARTNERS, LLC
10033 TAGUS WAY
ELK GROVE, CA 95757

SACRAMENTO COUNTY FUEL STATION
4701 & 4705 AUBURN BLVD
SACRAMENTO, CA 95841

PRELIMINARY GRADING AND DRAINAGE PLAN

SHEET NUMBER
C1.0

C:\KHA\097672107\Civil\Drawings\Preliminary Grading & Drainage Plan.dwg
This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc. shall be without liability to Kimley-Horn and Associates, Inc.



LEGEND

- PROPERTY LINE
- CENTER LINE
- EASEMENT OR SETBACK LINE
- APPROXIMATE CIVIL LIMIT OF WORK LINE
- W — EXISTING WATER LINE
- SS — EXISTING SANITARY SEWER LINE
- SD — EXISTING STORM DRAIN LINE
- 2"W — PROPOSED DOMESTIC WATER LINE
- 6"FW — PROPOSED FIRE WATER LINE
- X"SS — PROPOSED SANITARY SEWER LINE
- 4"GW — PROPOSED GREASE WASTE LINE
- X"SD — PROPOSED STORM DRAIN LINE
- PROPOSED STORM DRAIN INLET
- PROPOSED STORM DRAIN CLEANOUT
- PROPOSED SANITARY SEWER MANHOLE
- PROPOSED SANITARY SEWER CLEANOUT
- PROPOSED CONCRETE SIDEWALK
- PROPOSED HEAVY DUTY CONCRETE
- PROPOSED LANDSCAPE AREA

GENERAL NOTES

1. ALL UTILITY PIPE LENGTHS ARE APPROXIMATE AND SHOWN FOR REFERENCE ONLY. PIPE LENGTHS ARE NOT SHOWN FOR BIDDING OR ESTIMATING PURPOSES.
2. ALL DIMENSIONS ARE SHOWN FROM CENTER OF PIPE TO CENTER OF PIPE UNLESS OTHERWISE NOTED.
3. BEFORE ANY DIGGING OR EXCAVATION OCCURS, PLEASE CONTACT UNDERGROUND SERVICE ALERT (USA) BY DIALING 811 A MINIMUM OF 2 WORKING DAYS PRIOR TO COMMENCING ANY WORK.
4. SMUD RESERVES THE RIGHT TO USE ANY PORTION OF ITS EASEMENTS ON OR ADJACENT TO THE SUBJECT PROPERTY THAT IT REASONABLY NEEDS AND SHALL NOT BE RESPONSIBLE FOR ANY DAMAGES TO THE DEVELOPED PROPERTY WITHIN SAID EASEMENT THAT UNREASONABLY INTERFERES WITH THOSE NEEDS.
5. PROPOSED INFRASTRUCTURE TO COMPLY WITH SMUD SITING REQUIREMENTS (E.G., PANEL SIZE/LOCATION, CLEARANCES FROM SMUD EQUIPMENT, TRANSFORMER LOCATION, SERVICE CONDUCTORS).

EXISTING UTILITY NOTE

EXISTING UTILITIES ARE SHOWN ON THESE PLANS AS THEY ARE BELIEVED TO EXIST BASED ON AVAILABLE RECORDS BY OTHERS. THE OWNER AND ENGINEER DO NOT ACCEPT RESPONSIBILITY FOR THEIR ACCURACY OR COMPLETENESS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXISTENCE, LOCATION, DEPTH, AND DIMENSION OF ALL UTILITIES PRIOR TO CONSTRUCTION. THIS SHALL INCLUDE CALLING UNDERGROUND SERVICE ALERT, POTHOLING, AND SURVEYING THE HORIZONTAL AND VERTICAL LOCATIONS OF UTILITIES AT ALL PROPOSED UTILITY CROSSINGS, AREAS OF EXCAVATION, AND WHERE CONSTRUCTION MAY BE AFFECTED BY THE LOCATION OR DEPTH OF THE UTILITY. DISCREPANCIES OR POTENTIAL CONFLICTS WITH PROPOSED IMPROVEMENTS MUST BE REPORTED TO AND RESOLVED BY THE ENGINEER PRIOR TO PROCEEDING WITH CONSTRUCTION.

NORTH

GRAPHIC SCALE IN FEET
0 10 20 40

No.	REVISIONS	DATE	BY

Kimley»Horn
4637 CHABOT DRIVE, SUITE 350, PLEASANTON, CA 94588
PHONE: 925-398-4840 FAX: 925-398-4849
WWW.KIMLEY-HORN.COM

NOT FOR CONSTRUCTION

KHA PROJECT	097672107
DATE	12/07/2022
SCALE	AS SHOWN
DESIGNED BY	SAL
DRAWN BY	CKC
CHECKED BY	JAK

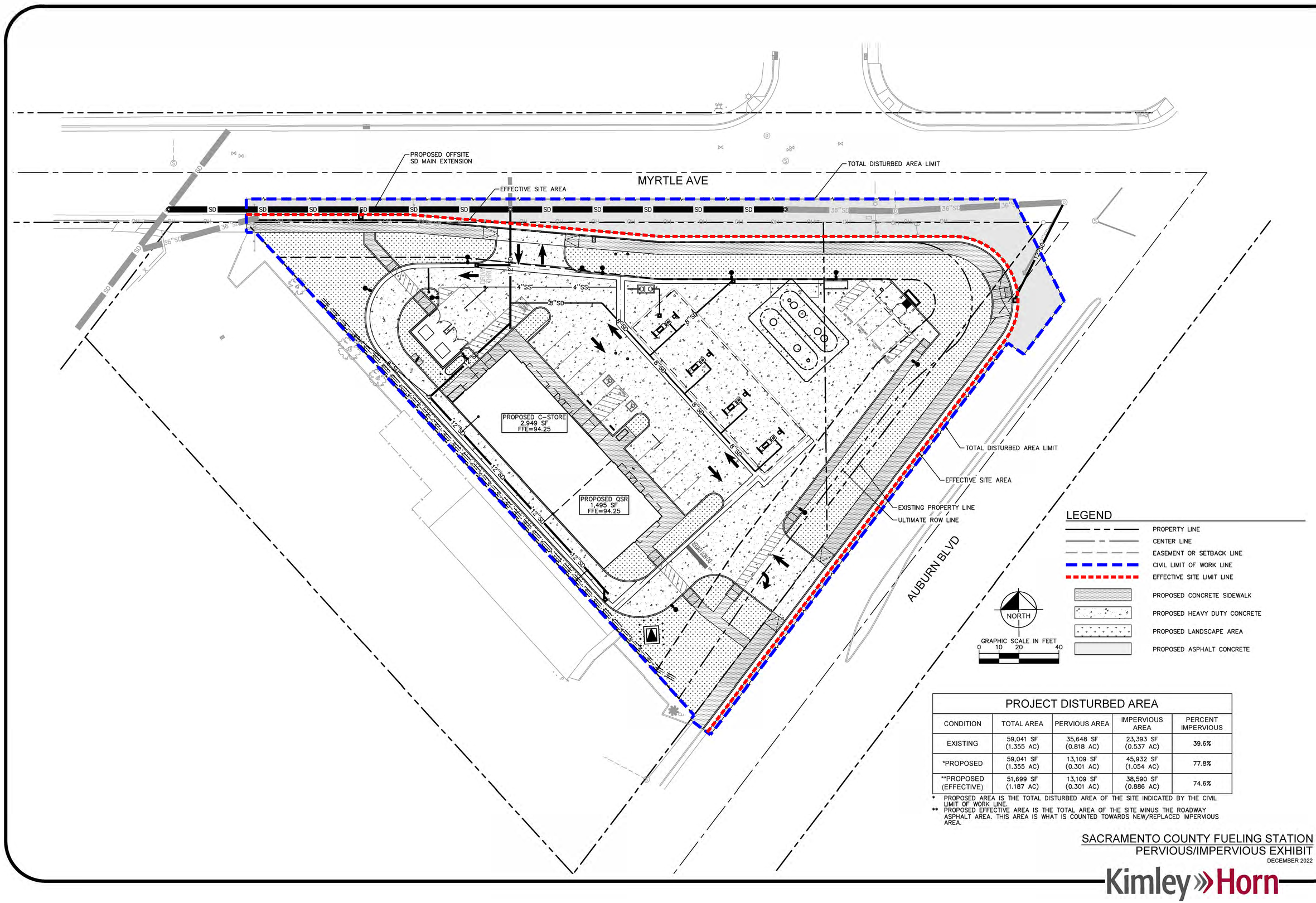
AUBURN BLVD PARTNERS, LLC
10033 TAGUS WAY
ELK GROVE, CA 95757

SACRAMENTO COUNTY FUEL STATION
4701 & 4705 AUBURN BLVD
SACRAMENTO, CA 95841

PRELIMINARY UTILITY PLAN

SHEET NUMBER
C2.0

C:\PW_USA\Drawings\097672018 - Sac County Fuel Station\CAD\Exhibits\Entitlements\PRELIMINARY UTILITY PLAN.dwg
This document, together with the concepts and designs presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Reuse of and improper reliance on this document without written authorization and adaptation by Kimley-Horn and Associates, Inc., shall be without liability to Kimley-Horn and Associates, Inc.



PROJECT DISTURBED AREA

CONDITION	TOTAL AREA	PERVIOUS AREA	IMPERVIOUS AREA	PERCENT IMPERVIOUS
EXISTING	59,041 SF (1.355 AC)	35,648 SF (0.818 AC)	23,393 SF (0.537 AC)	39.6%
*PROPOSED	59,041 SF (1.355 AC)	13,109 SF (0.301 AC)	45,932 SF (1.054 AC)	77.8%
**PROPOSED (EFFECTIVE)	51,699 SF (1.187 AC)	13,109 SF (0.301 AC)	38,590 SF (0.886 AC)	74.6%

* PROPOSED AREA IS THE TOTAL DISTURBED AREA OF THE SITE INDICATED BY THE CIVIL LIMIT OF WORK LINE.
** PROPOSED EFFECTIVE AREA IS THE TOTAL AREA OF THE SITE MINUS THE ROADWAY ASPHALT AREA. THIS AREA IS WHAT IS COUNTED TOWARDS NEW/REPLACED IMPERVIOUS AREA.

SACRAMENTO COUNTY FUELING STATION
PERVIOUS/IMPERVIOUS EXHIBIT

DECEMBER 2022

Kimley»Horn

Appendix B

SacCalc Existing Watershed Calculations

- Figure 1: Existing Watershed Input Information
- Figure 2: Existing Watershed Peak Flows
- Figure 3: SacCalc Existing Watershed Output file

Figure 1:

Sacramento Hydrologic Calculator Report

December 5, 2022 14:39

Project Title: Sac County Fuel Station Existing Condition
Comments:
Prepared by: Jennifer Kirby

Method: Sacramento County HEC-1 method
Date: 12/7/2022

Watershed Hydrologic Summary Data

Watershed	Area (acres)	Mean Elevation (ft)	Lag Times		Basin "n"		Loss Rates		Percent Impervious	
			Method	Lag Time (min)	Method	Basin "n"	Method	Loss Rate (in/hr)	Method	Impervious Area (%)
EXWS01	0.47	94	Basin "n"	-	Specified	0.07	Computed	-	Specified	100
EXWS02	0.717	94	Basin "n"	-	Specified	0.07	Computed	-	Specified	2

Basin "n" Method Data for Lag Time Computation

Watershed	Channel Length (ft)	Centroid Length (ft)	Slope (ft/ft)	Channelization	Land Use Impervious Area Percent (% or acres)																
					95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
EXWS01	264	132	.006	Undeveloped	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Developed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EXWS02	264	132	.006	Undeveloped	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
				Developed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Refer to the Drainage manual for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Infiltration Loss Rate Data

Watershed	Soil Cover Group	Land Use Impervious Area Percent (% or acres)																	
		95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
EXWS01	B																		
	C		100																
	D																		
EXWS02	B																		
	C																100		
	D																		

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Hydrograph Routing – Muskingum-Cunge 8-Point Cross Section

Routing ID	Route From	Route To	Channel Length (ft)	Slope (ft/ft)	Cross Section Geometry								
						Left OB 1	Left OB 2	Left Bank	Channel Point 1	Channel Point 2	Right Bank	Right OB 1	Right OB 2
CHA001	EXWS01	JNC001	264	.006	Station	0	1.75	1.75	3.5	4.5	6.25	6.25	8
					Elevation	5	3.95	3.95	2.9	2.9	3.95	3.95	5
					Mannings "n"	.08			.08		.08		
CHA002	EXWS02	JNC001	264	.006	Station	0	1.75	1.75	3.5	4.5	6.25	6.25	8
					Elevation	5	3.95	3.95	2.9	2.9	3.95	3.95	5
					Mannings "n"	.08			.08		.08		

Figure 2:

Watershed	Peak
EXWS01	1.48
EXWS02	2.19
CHA001	1.36
CHA002	2.01
JNC001	3.38

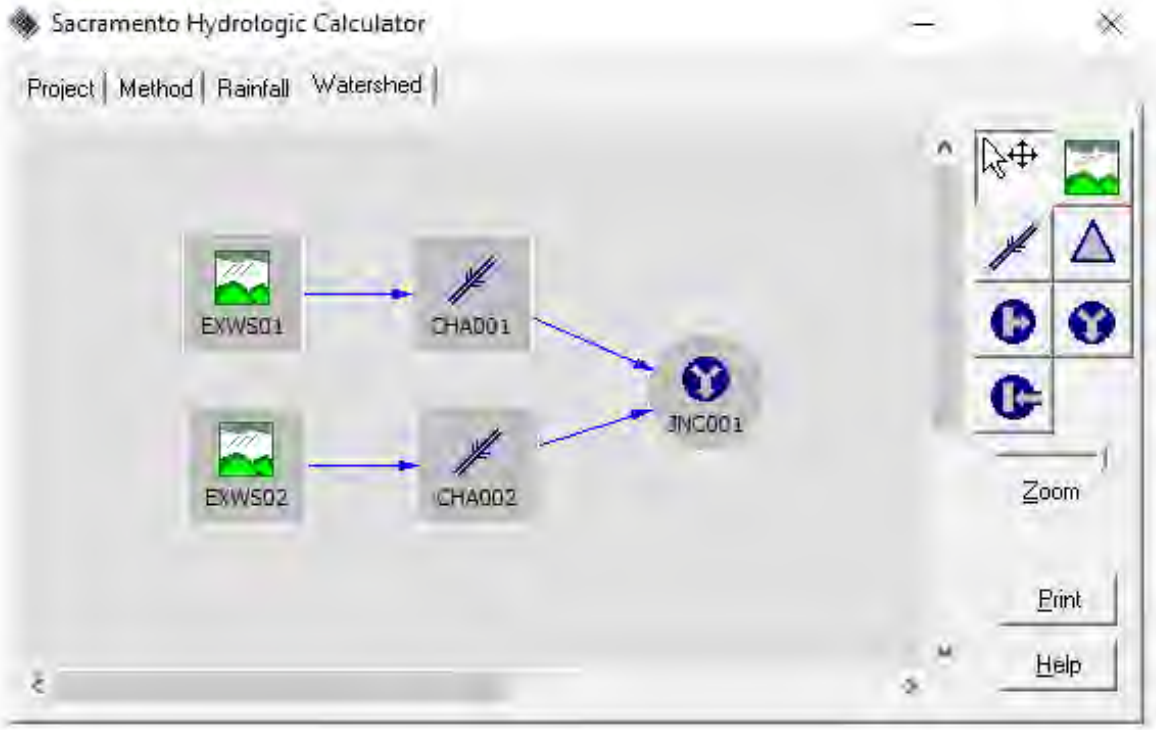


Figure 3:

```
* SacCalc, developed by David Ford Consulting Engineers
* File generated 12/05/2022 13:58:46
*
ID
* Lag computation for station EXWS01
*   Equation (7-1) with L=  0.0500, Lc=  0.0250, S=   31.680, n=0.0700
*   Resulting lag:    6.8 minutes
* Lag computation for station EXWS02
*   Equation (7-1) with L=  0.0500, Lc=  0.0250, S=   31.680, n=0.0700
*   Resulting lag:    6.8 minutes
* End of lag computations
*
*   NMIN  JXDATE  JXTIME      NQ            CENT
IT     1 31DEC99    2400    1487                    1900
*   IPRT    IPLT
IO     3       0
*
KKEXWS01
*  JXMIN    Time interval for input data
IN     5
KM
*
* Design storm construction details
*
* Regional multiplier (zone 2) applied:  1.000
* Areal adjustment using area:  0.002
*   multiplier from table 4-4: 1.0000
*
* Adjusted depths for each duration from table 4-1: frequency: 100
* Duration----Regional------Elev-----Areal (adjustments)
* 5 min         0.4400    0.4400    0.4400
* 10 min        0.6200    0.6200    0.6200
* 15 min        0.7300    0.7300    0.7300
* 30 min        0.9400    0.9400    0.9400
* 1 hour        1.2100    1.2100    1.2100
* 2 hours       1.5900    1.5900    1.5900
* 3 hours       1.8500    1.8500    1.8500
* 6 hours       2.5000    2.5000    2.5000
* 12 hours      3.3000    3.3000    3.3000
* 24 hours      4.2500    4.2500    4.2500
* 36 hours      5.0900    5.0900    5.0899
* 2 days        5.7000    5.7000    5.7000
* 3 days        6.8000    6.8000    6.8000
* 5 days        8.4200    8.4200    8.4198
* 10 days      11.0100   11.0100   11.0098
* Storm duration:  24, length:  288 ordinates
PB     0
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
```

```
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0450  0.0450
PI0.0450  0.0700  0.1100  0.4400  0.1800  0.0700  0.0700  0.0450  0.0450  0.0450
PI0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
*
* Precipitation losses computation (Chapter 5)
*   Computing CNSTL (infiltration rate) from soil type and table 5-2
*  TAREA   subbasin area (sq mi)
BA0.0007
*  STRTL   CNSTL   RTIMP
LU  0.10   0.080 100.000
*
* Runoff hydrograph computation (Chapter 6)
*   Using basin lag:   6.8 minutes
*   Using unit duration (Step 2): 1. min
*   Lag Time + Unit Duration / 2 (Step 3):  7.30101
*   Volume of runoff (Step 4) V=    0.019747
UI 0.368   0.819   1.413   2.129   3.031   3.227   2.830   2.142   1.725   1.410
UI 1.162   0.971   0.819   0.700   0.603   0.529   0.459   0.408   0.373   0.334
UI 0.302   0.274   0.248   0.227   0.204   0.185   0.167   0.153   0.139   0.126
UI 0.112   0.102   0.093   0.084   0.078   0.071   0.064   0.058   0.052   0.048
UI 0.043   0.039   0.036
ZW C=FLOW F=100YR-24HR A=SAC COUN
*
KKCHA001
KM
*      L       S       N           SHAPE      WD       Z
RD
ZW C=FLOW
*    ANL     ANCH     ANR   RLNTH     SEL   ELMAX
RC 0.080   0.080   0.080   264.0 0.00600
RX   0.0     1.8     1.8     3.5     4.5     6.3     6.3     8.0
RY   5.0     4.0     4.0     2.9     2.9     4.0     4.0     5.0
*
KKEXWS02
*  JXMIN    Time interval for input data
IN     5
KM
```

```
*
* Design storm construction details
*
* Regional multiplier (zone 2) applied:  1.000
* Areal adjustment using area:  0.002
*   multiplier from table 4-4: 1.0000
*
* Adjusted depths for each duration from table 4-1: frequency: 100
* Duration----Regional------Elev-----Areal (adjustments)
* 5 min         0.4400    0.4400    0.4400
* 10 min        0.6200    0.6200    0.6200
* 15 min        0.7300    0.7300    0.7300
* 30 min        0.9400    0.9400    0.9400
* 1 hour        1.2100    1.2100    1.2100
* 2 hours       1.5900    1.5900    1.5900
* 3 hours       1.8500    1.8500    1.8500
* 6 hours       2.5000    2.5000    2.5000
* 12 hours      3.3000    3.3000    3.3000
* 24 hours      4.2500    4.2500    4.2500
* 36 hours      5.0900    5.0900    5.0899
* 2 days        5.7000    5.7000    5.7000
* 3 days        6.8000    6.8000    6.8000
* 5 days        8.4200    8.4200    8.4198
* 10 days      11.0100   11.0100   11.0098
* Storm duration:  24, length:  288 ordinates
PB     0
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0450  0.0450
PI0.0450  0.0700  0.1100  0.4400  0.1800  0.0700  0.0700  0.0450  0.0450  0.0450
PI0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
```

```
*
* Precipitation losses computation (Chapter 5)
*   Computing CNSTL (infiltration rate) from soil type and table 5-2
*  TAREA   subbasin area (sq mi)
BA0.0011
*  STRTL   CNSTL   RTIMP
LU  0.10   0.100   2.000
*
* Runoff hydrograph computation (Chapter 6)
*   Using basin lag:   6.8 minutes
*   Using unit duration (Step 2): 1. min
*   Lag Time + Unit Duration / 2 (Step 3):  7.30101
*   Volume of runoff (Step 4) V=    0.030124
UI 0.562   1.250   2.155   3.248   4.624   4.923   4.317   3.268   2.631   2.151
UI 1.772   1.481   1.249   1.069   0.919   0.808   0.700   0.622   0.568   0.509
UI 0.461   0.419   0.379   0.346   0.311   0.282   0.255   0.233   0.212   0.192
UI 0.172   0.155   0.142   0.128   0.119   0.108   0.098   0.089   0.080   0.073
UI 0.066   0.059   0.055
ZW C=FLOW F=100YR-24HR A=SAC COUN
*
KKCHA002
KM
*      L       S       N           SHAPE      WD       Z
RD
ZW C=FLOW
*    ANL     ANCH     ANR   RLNTH     SEL    ELMAX
RC 0.080   0.080   0.080   264.0 0.00600
RX   0.0     1.8     1.8     3.5     4.5     6.3     6.3     8.0
RY   5.0     4.0     4.0     2.9     2.9     4.0     4.0     5.0
*
KKJNC001
KM
HC     2
ZW C=FLOW
ZZ
```

Appendix C

SacCalc Proposed Watershed Calculations

- Figure 1: Proposed Watershed Input Information
- Figure 2: Proposed Watershed Peak Flows
- Figure 3: SacCalc Proposed Watershed Output file

Figure 1:

Sacramento Hydrologic Calculator Report

December 5, 2022 14:44

Project Title: Sacramento County Fuel Station
Comments:
Prepared by: Jennifer Kirby

Method: Sacramento County HEC-1 method
Date: 5/31/2022

Watershed Hydrologic Summary Data

Watershed	Area (acres)	Mean Elevation (ft)	Lag Times		Basin "n"		Loss Rates		Percent Impervious	
			Method	Lag Time (min)	Method	Basin "n"	Method	Loss Rate (in/hr)	Method	Impervious Area (%)
PROWS1	0.886	94	Travel Time	-	-	-	Computed	-	Specified	100
PROWS2	0.301	94	Travel Time	-	-	-	Computed	-	Specified	2

Travel Time Component Method Data for Lag Time Computation

Watershed	Overflow		Gutter Flow			Channel and Pipe Flow					
	Land Use	Slope (ft/ft)	Length (ft)	Slope (ft/ft)	Side Slope (ft/ft)	Type	Length (ft)	Slope (ft/ft)	Width or Diameter (ft)	Design or Flow (cfs)	Mannings "n"
PROWS1	Commercial	-	69	0.005	0.067:1	Pipe	27	.005	1	0.41	0.1
PROWS2	Commercial	-	69	0.005	0.067:1	Pipe	27	.005	1	0.41	0.1

Infiltration Loss Rate Data

Watershed	Soil Cover Group	Land Use Impervious Area Percent (% or acres)																
		95	90	85	80	75	70	60	50	40	30	25	20	15	10	5	2	1	1*
PROWS1	B																		
	C		100																
	D																		
PROWS2	B																		
	C																100		
	D																		

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Hydrograph Routing – Muskingum–Cunge (Standard)

Routing ID	Route From	Route To	Channel Type	Length (ft)	Slope (ft/ft)	Width or Diameter (ft)	Side Slope (H:V)	Mannings "n"
CHA001	PROWS1	JNC001	Pipe	27	.005	1		.1
CHA002	PROWS2	JNC001	Pipe	27	.005	1		.1

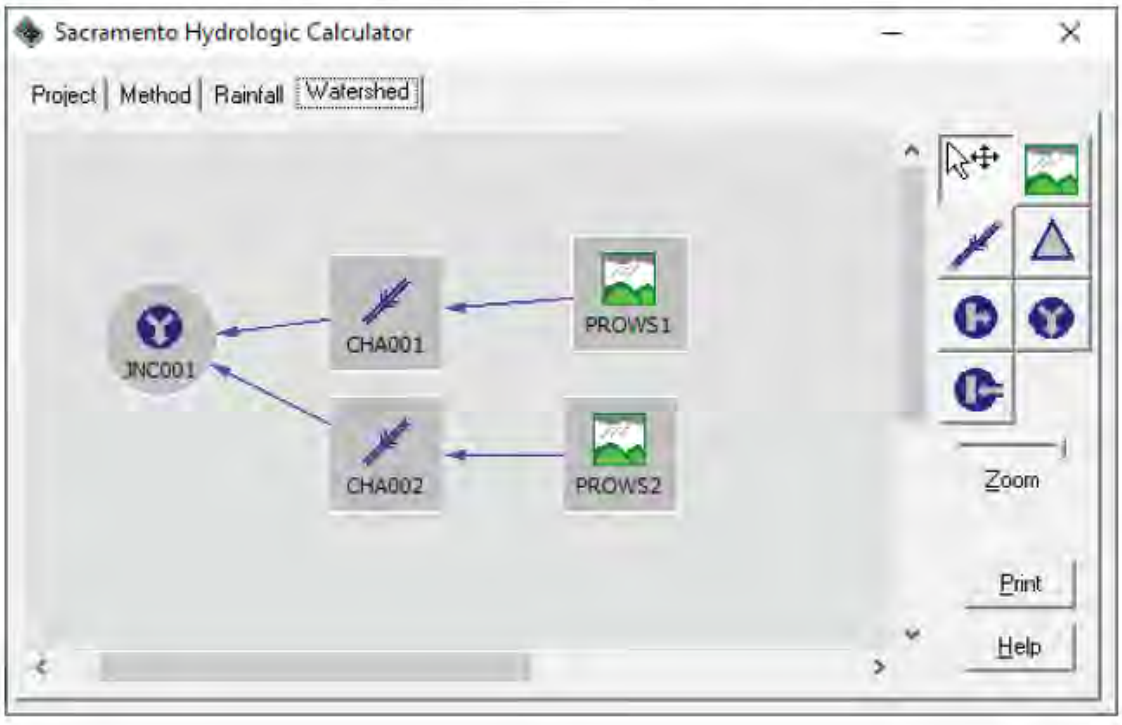


Figure 2:

Watershed	Peak
PROWS1	3.16
JNC001	3.96
CHA001	2.99
PROWS2	1.04
CHA002	0.98

Figure 3:

```
* SacCalc, developed by David Ford Consulting Engineers
* File generated 12/05/2022 13:07:43
*
ID
* Lag computation for station PROWS1
*   Travel times: To:   3.00, Tg:   0.00, Tp+Tc:   0.00
*   Resulting lag:    3.0 minutes
*   Travel times: To:   0.00, Tg:   0.46, Tp+Tc:   0.00
*   Resulting lag:    0.5 minutes
*   Lag frequency factor of 1.3 (Table 7-6) for frequency 100 years will be
applied to Tp
*   Manning's "n" used:0.100
*   Computed velocity:  24.97 ft/min
*   Travel times: To:   0.00, Tg:   0.00, Tp+Tc:   1.41
*   Resulting lag:    1.4 minutes
* Lag computation for station PROWS2
*   Travel times: To:   3.00, Tg:   0.00, Tp+Tc:   0.00
*   Resulting lag:    3.0 minutes
*   Travel times: To:   0.00, Tg:   0.46, Tp+Tc:   0.00
*   Resulting lag:    0.5 minutes
*   Lag frequency factor of 1.3 (Table 7-6) for frequency 100 years will be
applied to Tp
*   Manning's "n" used:0.100
*   Computed velocity:  24.97 ft/min
*   Travel times: To:   0.00, Tg:   0.00, Tp+Tc:   1.41
*   Resulting lag:    1.4 minutes
* End of lag computations
*
*   NMIN  JXDATE  JXTIME      NQ            CENT
IT     1 31DEC99    2400    1474                    1900
*   IPRT    IPLT
IO     3       0
*
KKPROWS1
*  JXMIN    Time interval for input data
IN     5
KM
*
* Design storm construction details
*
* Regional multiplier (zone 2) applied:  1.000
* Areal adjustment using area:  0.002
*   multiplier from table 4-4: 1.0000
*
* Adjusted depths for each duration from table 4-1: frequency: 100
* Duration----Regional------Elev-----Areal (adjustments)
* 5 min         0.4400    0.4400    0.4400
* 10 min        0.6200    0.6200    0.6200
* 15 min        0.7300    0.7300    0.7300
* 30 min        0.9400    0.9400    0.9400
* 1 hour        1.2100    1.2100    1.2100
* 2 hours       1.5900    1.5900    1.5900
* 3 hours       1.8500    1.8500    1.8500
* 6 hours       2.5000    2.5000    2.5000
* 12 hours      3.3000    3.3000    3.3000
```

```
* 24 hours      4.2500    4.2500    4.2500
* 36 hours      5.0900    5.0900    5.0899
* 2 days        5.7000    5.7000    5.7000
* 3 days        6.8000    6.8000    6.8000
* 5 days        8.4200    8.4200    8.4198
* 10 days      11.0100   11.0100   11.0098
* Storm duration:  24, length:  288 ordinates
PB     0
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0450  0.0450
PI0.0450  0.0700  0.1100  0.4400  0.1800  0.0700  0.0700  0.0450  0.0450  0.0450
PI0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
*
* Precipitation losses computation (Chapter 5)
*   Computing CNSTL (infiltration rate) from soil type and table 5-2
*  TAREA   subbasin area (sq mi)
BA0.0014
*  STRTL   CNSTL   RTIMP
LU  0.10   0.080 100.000
*
* Runoff hydrograph computation (Chapter 6)
*   (Note: lag increased to lower limit; see Table 9-1)
*   Using basin lag:   5.0 minutes
*   Using unit duration (Step 2): 1. min
*   Lag Time + Unit Duration / 2 (Step 3):  5.50000
*   Volume of runoff (Step 4) V=    0.037224
UI 1.295   2.981   5.295   7.929   7.711   5.416   4.052   3.128   2.449   1.955
UI 1.596   1.335   1.108   0.966   0.843   0.739   0.653   0.571   0.499   0.439
UI 0.388   0.341   0.299   0.258   0.228   0.201   0.181   0.159   0.136   0.121
UI 0.107   0.096   0.085
```

```
ZW C=FLOW F=100YR-24HR A=SACRAMEN
*
KKCHA001
KM
*      L        S        N            SHAPE       WD        Z
RD  27.00.005000   0.100             CIRC      1.0   0.000
ZW C=FLOW
*
KKPROWS2
*  JXMIN    Time interval for input data
IN     5
KM
*
* Design storm construction details
*
* Regional multiplier (zone 2) applied:  1.000
* Areal adjustment using area:  0.002
*   multiplier from table 4-4: 1.0000
*
* Adjusted depths for each duration from table 4-1: frequency: 100
* Duration----Regional------Elev-----Areal (adjustments)
* 5 min         0.4400    0.4400    0.4400
* 10 min        0.6200    0.6200    0.6200
* 15 min        0.7300    0.7300    0.7300
* 30 min        0.9400    0.9400    0.9400
* 1 hour        1.2100    1.2100    1.2100
* 2 hours       1.5900    1.5900    1.5900
* 3 hours       1.8500    1.8500    1.8500
* 6 hours       2.5000    2.5000    2.5000
* 12 hours      3.3000    3.3000    3.3000
* 24 hours      4.2500    4.2500    4.2500
* 36 hours      5.0900    5.0900    5.0899
* 2 days        5.7000    5.7000    5.7000
* 3 days        6.8000    6.8000    6.8000
* 5 days        8.4200    8.4200    8.4198
* 10 days      11.0100   11.0100   11.0098
* Storm duration:  24, length:  288 ordinates
PB     0
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0450  0.0450
PI0.0450  0.0700  0.1100  0.4400  0.1800  0.0700  0.0700  0.0450  0.0450  0.0450
PI0.0317  0.0317  0.0317  0.0317  0.0317  0.0317  0.0217  0.0217  0.0217  0.0217
PI0.0217  0.0217  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
```

```
PI0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181  0.0181
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0111
PI0.0111  0.0111  0.0111  0.0111  0.0111  0.0111  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
PI0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066  0.0066
*
* Precipitation losses computation (Chapter 5)
*   Computing CNSTL (infiltration rate) from soil type and table 5-2
*  TAREA   subbasin area (sq mi)
BA0.0005
*  STRTL   CNSTL   RTIMP
LU  0.10   0.100   2.000
*
* Runoff hydrograph computation (Chapter 6)
*   (Note: lag increased to lower limit; see Table 9-1)
*   Using basin lag:   5.0 minutes
*   Using unit duration (Step 2): 1. min
*   Lag Time + Unit Duration / 2 (Step 3):  5.50000
*   Volume of runoff (Step 4) V=    0.012646
UI 0.440   1.013   1.799   2.694   2.620   1.840   1.377   1.063   0.832   0.664
UI 0.542   0.454   0.376   0.328   0.286   0.251   0.222   0.194   0.169   0.149
UI 0.132   0.116   0.102   0.088   0.078   0.068   0.062   0.054   0.046   0.041
UI 0.036   0.033   0.029
ZW C=FLOW F=100YR-24HR A=SACRAMEN
*
KKCHA002
KM
*      L       S       N           SHAPE      WD       Z
RD  27.00.005000   0.100            CIRC     1.0   0.000
ZW C=FLOW
*
KKJNC001
KM
HC     2
ZW C=FLOW
ZZ
```

Appendix D

Flowmaster Calculations

- Discharge of Existing Drainage Swale
- Discharge of Proposed 36” Pipe

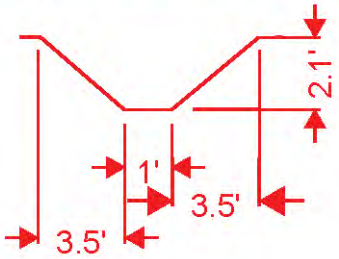
Worksheet for Trapezoidal Channel

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.0060 ft/ft
Normal Depth	25.0 in
Left Side Slope	0.600 H:V
Right Side Slope	0.600 H:V
Bottom Width	1.00 ft

Results	
Discharge	15.50 cfs
Flow Area	4.7 ft²
Wetted Perimeter	5.9 ft
Hydraulic Radius	9.6 in
Top Width	3.50 ft
Critical Depth	17.5 in
Critical Slope	0.0246 ft/ft
Velocity	3.31 ft/s
Velocity Head	0.17 ft
Specific Energy	2.25 ft
Froude Number	0.504
Flow Type	Subcritical

Existing Drainage Swale Section



GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	(N/A) ft/s
Upstream Velocity	(N/A) ft/s
Normal Depth	25.0 in
Critical Depth	17.5 in
Channel Slope	0.0060 ft/ft
Critical Slope	0.0246 ft/ft

Worksheet for 36" RCP @ 0.55% Slope

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.0055 ft/ft
Normal Depth	36.0 in
Diameter	36.0 in
Discharge	49.46 cfs

Results	
Discharge	49.46 cfs
Normal Depth	36.0 in
Flow Area	7.1 ft²
Wetted Perimeter	9.4 ft
Hydraulic Radius	9.0 in
Top Width	0.00 ft
Critical Depth	27.5 in
Percent Full	100.0 %
Critical Slope	0.0064 ft/ft
Velocity	7.00 ft/s
Velocity Head	0.76 ft
Specific Energy	3.76 ft
Froude Number	(N/A)
Maximum Discharge	53.21 cfs
Discharge Full	49.46 cfs
Slope Full	0.0055 ft/ft
Flow Type	Undefined

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	100.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	36.0 in
Critical Depth	27.5 in
Channel Slope	0.0055 ft/ft
Critical Slope	0.0064 ft/ft

Appendix E

CASQA Handbook Source Control Details

Section 4
Source Control BMPs

4.1 Introduction

This section describes specific source control Best Management Practices (BMPs) to be considered for incorporation into newly developed public and private infrastructure, as well as retrofit into existing facilities to meet stormwater management objectives.

4.2 BMP Fact Sheets

Source control fact sheets for design are listed in Table 4-1. The fact sheets detail planning methods and concepts that should be taken into consideration by developers during project design. The fact sheets are arranged in three categories: those that have to do with landscape, irrigation, and signage considerations; those that have to do with use of particular materials; and those that have to do with design of particular areas.

Table 4-1 Source Control BMPs for Design

Design	
SD-10	Site Design and Landscape Planning
SD-11	Roof Runoff Controls
SD-12	Efficient Irrigation
SD-13	Storm Drain System Signs
Materials	
SD-20	Pervious Pavements
SD-21	Alternative Building Materials
Areas	
SD-30	Fueling Areas
SD-31	Maintenance Bays and Docks
SD-32	Trash Enclosures
SD-33	Vehicle Washing Areas
SD-34	Outdoor Material Storage Areas
SD-35	Outdoor Work Areas
SD-36	Outdoor Processing Areas

4.3 Fact Sheet Format

A BMP fact sheet is a short document that provides information about a particular BMP. Typically, each fact sheet contains the information outlined in Figure 4-1. Supplemental information is provided if it is available. The fact sheets also contain side bar presentations with information on BMP design objectives. Completed fact sheets for each of the above activities are provided in Section 4.4.

SDxx Example Fact Sheet

Description of the BMP
Approach
Suitable Applications
Design Considerations
- Designing New Installations
- Redeveloping Existing Installations

Supplemental Information
- Examples
- Other Resources

Figure 4-1
Example Fact Sheet

4.4 BMP Fact Sheets

Source Control BMP Fact Sheets for design follow. The BMP fact sheets are individually page numbered and are suitable for photocopying and inclusion in stormwater quality management plans. Fresh copies of the fact sheets can be individually downloaded from the California Stormwater BMP Handbook website at www.cabmphandbooks.com.

Efficient Irrigation SD-12



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13



Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Fueling Areas SD-30



Photo Credit: Geoff Brosseau

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- ☑ Collect and Convey

Description

Fueling areas have the potential to contribute oil and grease, solvents, car battery acid, coolant and gasoline to the stormwater conveyance system. Spills at vehicle and equipment fueling areas can be a significant source of pollution because fuels contain toxic materials and heavy metals that are not easily removed by stormwater treatment devices.

Approach

Project plans must be developed for cleaning near fuel dispensers, emergency spill cleanup, containment, and leak prevention.

Suitable Applications

Appropriate applications include commercial, industrial, and any other areas planned to have fuel dispensing equipment, including retail gasoline outlets, automotive repair shops, and major non-retail dispensing areas.

Design Considerations

Design requirements for fueling areas are governed by Building and Fire Codes and by current local agency ordinances and zoning requirements. Design requirements described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements.

Designing New Installations Covering

Fuel dispensing areas should provide an overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area should drain to the project's treatment control BMP(s) prior to discharging to the stormwater conveyance system. Note - If fueling large equipment or vehicles that would prohibit the use of covers or roofs, the fueling island should be designed to sufficiently accommodate the larger vehicles and equipment and to prevent stormwater run-on and runoff. Grade to direct stormwater to a dead-end sump.

Surfacing

Fuel dispensing areas should be paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete should be prohibited. Use asphalt sealant to protect asphalt paved areas surrounding the fueling area. This provision may be made to sites that have pre-existing asphalt surfaces.

The concrete fuel dispensing area should be extended a minimum of 6.5 ft from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 ft, whichever is less.

Grading/Contouring

Dispensing areas should have an appropriate slope to prevent ponding, and be separated from the rest of the site by a grade break that prevents run-on of urban runoff. (Slope is required to be 2 to 4% in some jurisdictions' stormwater management and mitigation plans.)

Fueling areas should be graded to drain toward a dead-end sump. Runoff from downspouts/roofs should be directed away from fueling areas. Do not locate storm drains in the immediate vicinity of the fueling area.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

- In the case of an emergency, provide storm drain seals, such as isolation valves, drain plugs, or drain covers, to prevent spills or contaminated stormwater from entering the stormwater conveyance system.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.