Drainage Study
Level 3

For

Woodward Suites
4725 Chippendale Drive Sacramento CA 95841
APN: 228-0151-033
Application #: PAMP2022-00067
Watershed #57

Owner:

WS California Sacramento, LLC
7701 E. Kellog Drive, Suite 820
Wichita, KS 67207

Prepared by:

Hawkins & Associates Engineering, Inc.
436 Mitchell Road
Andrew S. Fox

REGISTERED PROFESSIONAL ENGINEER
ANDREW S. FOX
C 84375
CIVIL
STATE OF CALIFORNIA

Date:
July 24th, 2024

Contents

Introduction:

Existing Conditions

The proposed development is located at 4725 Chippendale Drive, Sacramento CA 95841. 38°39’47.0”N, 121°21’16.0”W , on a parcel that is on the northeastern corner of the intersection of Chippendale Drive and Date Ave. APN: 228-0151-033. This parcel is within the Sacramento #57 watershed and is currently undeveloped. The underlying soil of the project area is composed of stiff to hard low plastic fine grained soils. The historic groundwater elevation for this area is typically between 135 to 150 feet below grade.

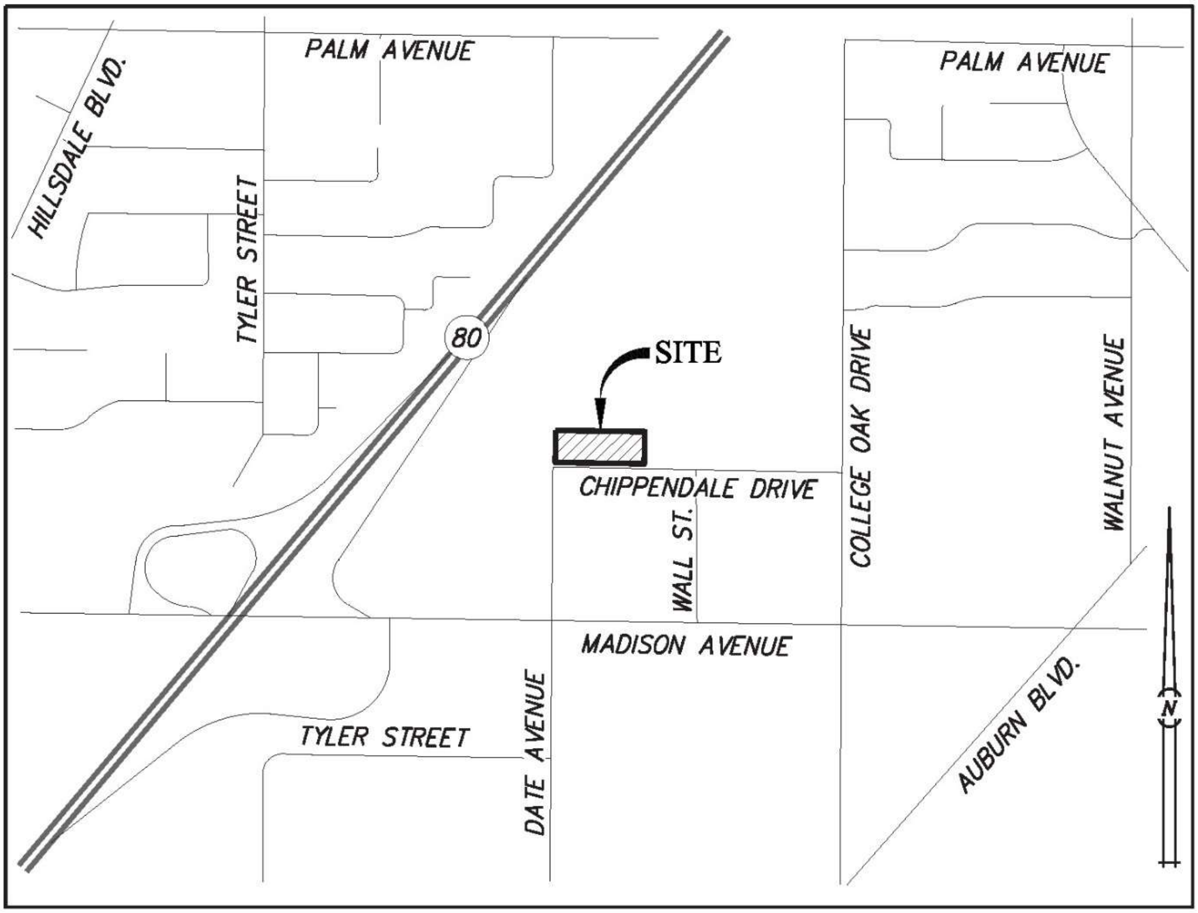
Project Description

The proposed redevelopment will consist of construction of a new hotel facility and associated parking facilities. This development will take place on 1.74 acres which is 100% of the parcel’s land area. The impervious coverage of the development will be approximately 1.30 acres and will cover approximately 75% of the total project area. In addition to the building and parking lot facilities, the development will also include landscape facilities, on-site storm water conveyance facilities and an underground french drain system. This french drain system will be designed to both treat and retain storm runoff generated by the site in order to meet the treatment requirements of the NPDES MS4 permit. Additionally, this on-site french drain system will serve mitigate the peak flow discharge from the site during the 100 year storm event so that the existing municipal infrastructure will not be adversely impacted.

Objectives of Analysis

This report was put together in order to analyze the impact that the proposed development will have on the existing municipal drainage infrastructure and surrounding area. It was prepared in accordance of the Sacramento County Department of Water Resources standards and requirements. This report will analyze runoff generated by both the pre and post development project site using the Sacramento Hydrologic Calculator (SacCalc) software provided by the county. It will also analyze impact on the existing off-site storm drain conveyance infrastructure using a Nolte pipe hydraulics analysis.

Vicinity Map



VICINITY MAP

NTS

HAWKINS & ASSOCIATES
ENGINEERING, INC.
436 MITCHELL ROAD
MODESTO, CA. 95354
PH: (209) 575 - 4295
FX: (209) 578 - 4295

VICINITY MAP

WOODSPRING SUITES
4725 CHIPPENDALE DRIVE
SACRAMENTO CA 95841

BY: A.S.F.
CHK: R.H.H.
DATE: 10-25-2023
SCALE: N/A
JOB #: 3657
FILE:

1 OF 1

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Baseline – Existing Conditions

The project site is currently undeveloped and is covered by sparse native vegetation. Storm drain infrastructure exists within the surrounding streets, Chippendale Drive and Date Avenue but it is not currently connected to the undeveloped project site. The surrounding area is fully developed with functional drainage facilities and no significant run-on from adjacent properties contributes to this analysis. Runoff from the site currently drains overland and discharges into Chippendale Drive and Date Avenue where it ultimately enters the municipal drainage system.

Data for the existing conditions was gathered from design standards and assumptions as well as historic records provided by the County of Sacramento and from a topographic survey prepared by Hawkins & Associates Engineering. Inc.

An analysis of the existing condition was performed using SacCalc software to generate a peak runoff flow for the existing condition. The following data was used for inputs and assumptions

Storm Event	100yr-24hr
Hydraulic Soil Group	Group C
Site Area	1.74 ac (100% of project site)
Existing percent impervious	2%

Using the above information the SacCalc software was able to compute a pre-development peak runoff for the 100 year – 24 Hour storm event of 3.9cfs for the existing project site

Pre-Development SacCalc Report

Sacramento Hydrologic Calculator Report

March 4, 2024 13:04

Project Title:	WSS Sacramento Pre-Construction	Method:	Sacramento County HEC-1 method
Comments:		Date:	10/26/2023
Prepared by:	ASF		

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 (%)
DMA1	1.74	110	Basin "n"	-	Computed	-	Computed	-	Specified	0

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*
DMA1	430	215	0.015	Undeveloped																100		
				Developed																0		

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*
DMA1	B																		
	C																100		
	D																		

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Pre-Development SacCalc Run

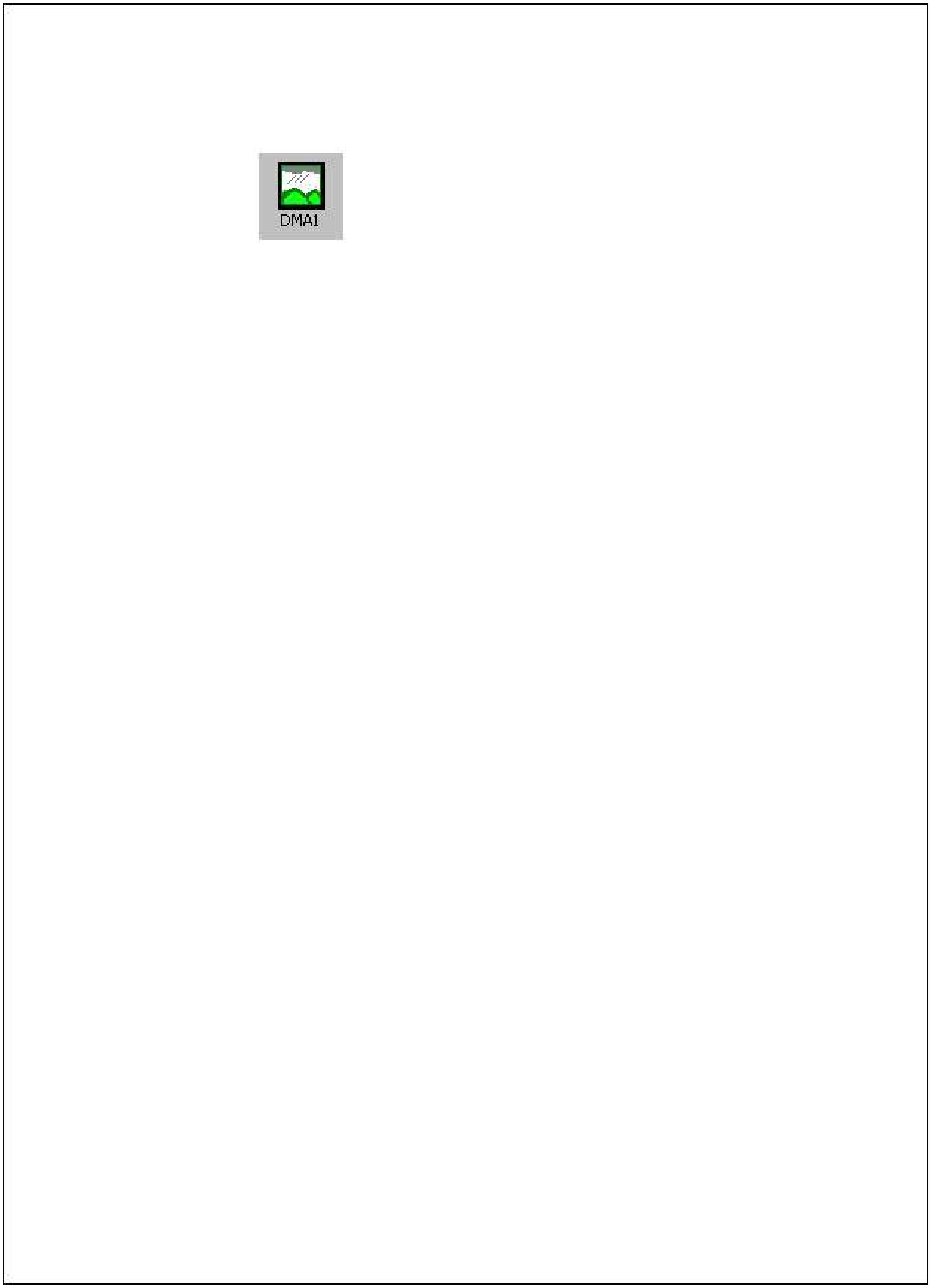
Sacramento method results

(Project: WSS Sacramento Pre-Construction)

(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
DMA1	3.9	12:09	.00			

Pre-Development SacCalc Watershed Map



Mitigated Project – Proposed Condition

The post-construction project site will include a new hotel facility and associated parking facilities. This development will take place on 1.74 acres which is 100% of the parcel's land area. This parcel shall be treated as single management area. Strom water will fall and collect within this drainage management area, the storm runoff will then drain overland to a local drain inlet which will collect and convey the runoff to an on-site underground retention facility french drain system that will fill to capacity before any storm runoff is directed off-site. In addition to the underground retention system, additional storm runoff will pool and collect on the surface of the parking lot during high intensity storm events. Storm runoff from the project site will be directed into existing offsite infrastructure. This connection shall utilized a properly sized orifice plate that will limit the peak runoff from the project site and allow for runoff to be temporarily stored on the surface of the parking lot during high intensity storms. The inclusion of a French Drain system, the orifice plate and the surface storage in the parking lot will result in a decreased the peak flow runoff that will leave the post-development project site during a 100 year storm. The total storage capacity of the on-site retention facilities will be sufficient to store the difference between the pre-development and post-development 100 year 24 hour runoff volume combined with the 85th percentile storm runoff volume for the project site

An analysis of the post-construction condition was performed using SacCalc software to generate a peak runoff flow for the proposed condition. The following data for the individual nodes was used for inputs and assumptions

All Nodes:

Storm Event	100yr-24hr
Hydraulic Soil Group	Group C

DMA1:

DMA1 comprises the entirety of the proposed development. It contains a hotel it's associated parking lot and landscaping.

Total Size	75,811 s.f.
Impervious area:	56,539 s.f.
Surface Storage available:	1,026 c.f.

FD1

FD is the french drain system, it has been modeled as a bypass that will fill to it's capacity of 12,844 c.f. (0.295 ac-ft) before allowing the flow to continue down the system.

PARK

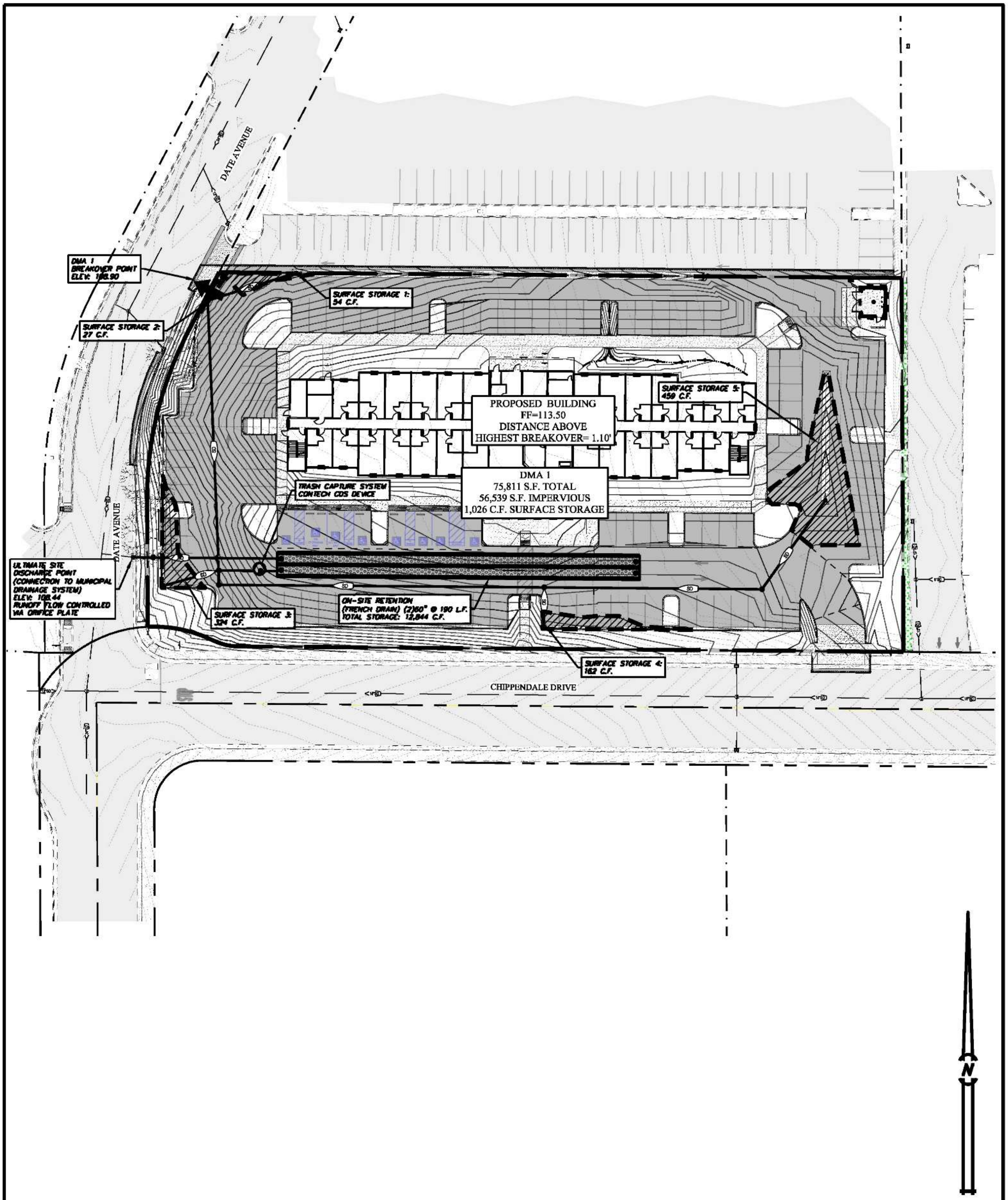
Park is the combined total for all the parking lot surface storage areas, It has been modeled as a bypass that must reach a peak flow of 0.5cfs before it starts to fill up. It will then reach it's maximum of capacity of 1,026 c.f. (0.024 ac-ft) before allowing the excess stormwater to discharge into the municipal drainage system.

OUT

OUT is modeled as a conduit and it represents the ultimate discharge point of the site.

The above information was entered into a model withing the SacCalc software and it was ultimately possible to compute a post-development peak runoff for the 100 year – 24 Hour storm event of 0.5 cfs for the post-construction project site. This peak runoff flow will be used to perform a nolte pipe analysis of the existing municipal storm conveyance system

Post-Development Drainage Management Area Map



HAWKINS & ASSOCIATES ENGINEERING, INC. 436 MITCHELL ROAD MODESTO, CA. 95354 PH: (209) 575 - 4295 FX: (209) 578 - 4295	**DRAINAGE MANAGEMENT AREAS MAP** **WOODSPRING SUITES** **4725 CHIPPENDALE DRIVE** **SACRAMENTO CA 95841**	BY: A.S.F. CHK: R.H.H. DATE: 07-01-2024 SCALE: N/A JOB #: 3657 FILE:	1 OF 1

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Post-Development SacCalc Report

Sacramento Hydrologic Calculator Report

July 1, 2024 16:01

Project Title:	WSS Sacramento Post-Construction	Method:	Sacramento County HEC-1 method
Comments:		Date:	10/26/2023
Prepared by:	ASF		

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 (%)
DMA1	1.74	110	Basin "n"	-	Computed	-	Computed	-	Specified	75

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*
DMA1	280	140	0.0015	Undeveloped		0																
				Developed		100																

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*
DMA1	B																		
	C		100																
	D																		

Refer to the help file for Land Use Impervious Area Percent

*Dense Oaks, Shrubs, Vines

Hydrograph Routing – Kinematic Wave

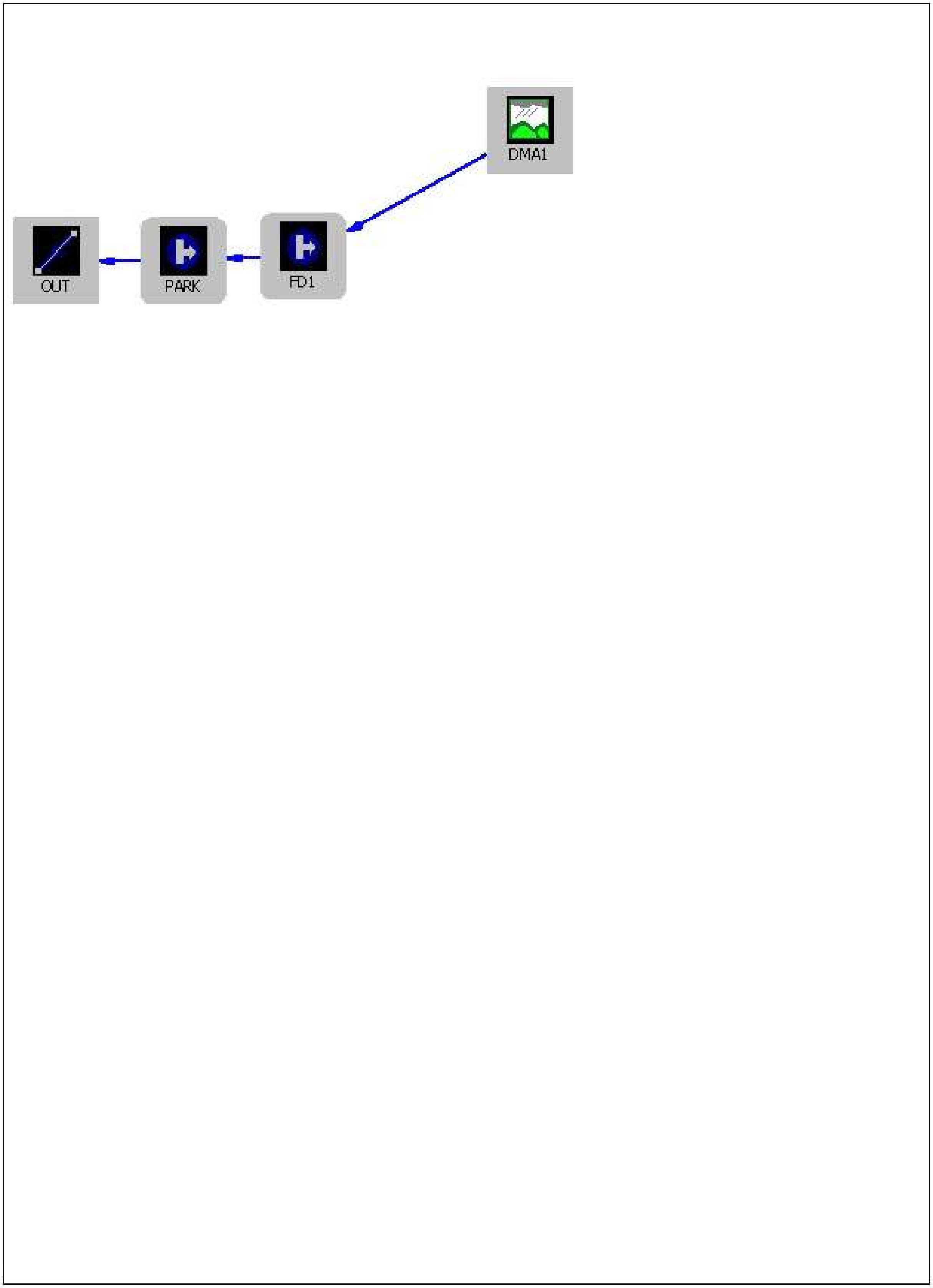
Routing ID	Route From	Route To	Channel Type	Length (ft)	Slope (ft/ft)	Width or Diameter (ft)	Side Slope (H:V)	Mannings "n"
OUT	PARK	-	Pipe	100	0.005	-		0.031

Post-Development SacCalc Run

Sacramento method results
(Project: WSS Sacramento Post-Construction)
(100-year, 1-day rainfall)

ID	Peak flow (cfs)	Time of peak (hours)	Basin area (sq. mi)	Peak stage (feet)	Peak storage (ac-ft)	Diversion volume (ac-ft)
DMA1	6.1	12:02	.00			
FD1	3.1	12:10	.00			.30
PARK	.5	12:14	.00			.05
OUT	.5	12:14	.00			

Post-Development SacCalc Watershed Map



Stormwater Quality Control

In order to comply with the requirements of the Sacramento Region Stormwater Quality Design Manual and ultimately the NPDES MS4 Permit it is necessary to implement mitigation measures to limit the impact that the proposed project could have on the water quality of the surround area.

The proposed redevelopment will consist of construction of a new hotel facility and associated parking facilities. This development will take place on 1.74 acres which is 100% of the parcel’s land area. The impervious coverage of the development will be approximately 1.30 acres and will cover approximately 75% of the total project area. In addition to the building and parking lot facilities, the development will also include landscape facilities, on-site storm water conveyance facilities and an underground french drain system.

As a hotel this project is a defined a priority commercial and light industrial development as per the Stormwater Quality Design Manual and will develop an area that is greater than 1 acre in size and will therefor be subject to the following stormwater quality control measures:

- Source Control
- Low Impact Development Control
- Treatment Control

Source Control:

The following source controls are applicable and shall be implemented in this project.

- Efficient Irrigation
  The use of drip irrigation and micro sprinklers along with seasonally appropriate scheduling shall be implemented for this development

- Landscaping
  This project shall utilize “river-friendly” landscaping. Landscaping shall take into account the local flora when selecting species to plant. The soil shall be amended with compost and mulched regularly. Use of pesticides shall be kept to a minimum.

- Storm Drain Marking and Signs
  Storm drain inlets will be marked with signage that indicates that dumping is not allowed and that the drain ultimately drains to the river.

- Waste Management area

  Adequate space shall be provided for trash collection that will minimize potential spillage. The waste storage area shall be paved with Portland Cement Concrete and graded in a way that prevents run-on. The Waste storage area shall be covered. Signs shall be provided that prohibit the disposal of liquids and hazardous maerials.

Low Impact Development Control:

The site will be landscaped with tress that will intercept the rainwater before it reaches the site, this will result in an overall reduction of storm water runoff that the site will produce. In addition, the project will also utilize an onsite underground retention and infiltration device referred to as a French Drain. The french drain will store and dispose of the water quality volume onsite.

Treatment Control:

The french drain system shall be utilized as a treatment control measure for this project. The full water quality volume run-off will be captured and infiltrated into the native soil which will filter the water through natural processes before it enters the water table.

Full Trash Capture:

The proposed development shall meet the full trash capture requirement by utilizing a CDS system manufactured by Contech. This system will separate trash and debris prior to entering the french drain system.;

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

Name of Drainage Shed: Woodspring Suites

Location of project: Sacramento

Fill in Blue Highlighted boxes

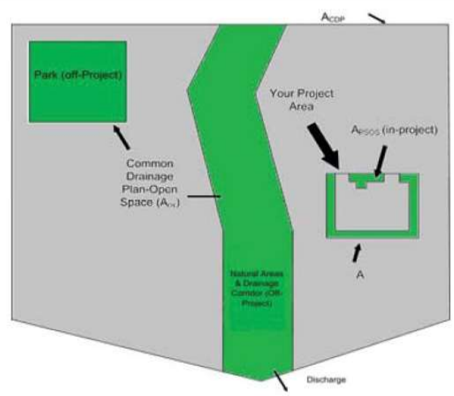
Step 1 - Open Space and Pervious Area Credits

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)	1.74	acres	A	
Project-Specific Open Space (In-project, communal**)	0.44	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	0.44	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	$A - A_{PSOS} =$	1.30	acres	A_T
Assumed Initial Impervious Fraction	$A_T / A =$	0.75		I
Open Space & Pervious Area LID Credit (Step 1)	$(A_{OS}/A_{CDP} + A_{PSOS}/A) \times 100 =$	25	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)				$(A_C / A_T) \times 100 =$		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

Box K4: 1

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.	1	trees	Box L1
2. Multiply Box L1 by 200 and enter result in Box L2	200	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	200	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. This is the amount of area credit to enter into the "Interceptor Trees" Box of Form D-2	0.00	acres	Box L8

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	24	drawdown_hrs_inf		
	Soil Infiltration Rate, in/hr	1.00	soil_inf_rate		
Sizing Option 1:	Capture Volume, acre-ft	0.04	capture_vol_inf	0.62	acres
Sizing Option 2:	Infiltration BMP surface area, sq ft	0	soil_surface_area	0.00	acres

Basin or trench? Basin — approximate BMP depth 2.00 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		0.62	A_{LIDc}
Runoff Management Credit (Step 3)	A_{LIDc}/A_T*200 =	95.1	pts

Total LID Credits (Step 1+2+3) LID compliant, check for treatment sizing in Step 4 120.5

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

Adjusted Area for Flow-Based, Non-LID Treatment	$A_T - A_C - A_{LIDc}$ =	0.68	A_{AT}
Adjusted Impervious Fraction of A for Volume-Based, Non-LID Treatment	A_{AT} / A =	0.39	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	0.68	A_{AT}
Use C = 0.95	0.95	C
Flow = 0.95 * i * A_{AT}	0.12	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	1.74	A
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.	0.24	P_0
Calculate treatment volume (acre-ft): **Treatment volume = A x (P_0 / 12)**	0.03	Acre-Feet

24 hrs **Specified Draw Down time**

v06232012

Efficient Irrigation

Purpose

This fact sheet provides details about efficient irrigation for the purpose of reducing water use and dry weather runoff from excess irrigation for residential and commercial projects. Improper irrigation generates runoff that transports bacteria, fertilizers and pesticides to local natural waterways. Some jurisdictions have specific water conservation ordinances that outline how customers can save water by adjusting their irrigation schedules to prevent overspray and runoff. Below are links to some of the jurisdiction's water conservation codes.

- City of Elk Grove: Chapter 14.10 Water Efficient Landscape Requirements
  http://www.codepublishing.com/CA/ElkGrove/html/ElkGrove14/ElkGrove1410.html#14.10
- City of Folsom: Municipal Code, Title 13 Water and Sewage – Chapter 13.26 Water Conservation
  http://www.folsom.ca.us/depts/city_clerk/charter.asp
- Citrus Heights: Municipal Code, Chapter 98 – Utilities, Article II. - Water, Division 3. – Use and Conservation
  http://library.municode.com/index.aspx?clientId=13326
- City of Sacramento: Water Efficient Landscape Requirements-Chapter 15.92: Landscaping Requirements for Water Conservation
  http://www.qcode.us/codes/sacramento/?view=desktop&topic=15-15_92-15_92_010
- City of Galt Water: Chapter 13.10: Water Conservation
  http://www.codepublishing.com/CA/galt/
- County of Sacramento and City of Rancho Cordova: Title 14 Agricultural Activities And Water Use And Conservation
  http://qcode.us/codes/sacramentocounty/view.php?topic=14-14_10&frames=on

Some ordinances have strong enforcement measures including fines for repeat offenders. By following a few simple steps for efficient irrigation, residents can make a positive impact on local water quality.

Applicability

Efficient irrigation should be implemented to the maximum extent practicable for all landscaped areas that require irrigation and in accordance with Model Water Efficient Landscape Ordinance AB 1881.

Design Requirements

General

Most irrigation systems can easily be designed or updated to offer maximum water use efficiency and prevent runoff. A well-designed irrigation system will deliver the appropriate amount of water needed, but will not generate excess runoff or overspray onto impervious surfaces. Automatic shutoff valves that turn off irrigation systems when there is a broken pipe or sprinkler head, or when it is raining, should be incorporated into the design. Timers should be installed to control the schedule of the irrigation. Landscapes should include drought tolerant vegetation where feasible, reducing the required frequency of watering.

Smart irrigation controllers can automatically adjust the rate and timing of irrigation based on soil and weather conditions. These systems often use historic weather data as well as site-specific data and include underground sensors that monitor soil moisture. Smart systems will not only automatically shut off when it is raining, but can also make automatic seasonal adjustments.

Manual Irrigation

There are a variety of products available to make hand watering easy – soaker hoses, automatic shutoff hose nozzles, and portable sprinklers. When watering manually, allow water to soak into the ground by using slow spray patterns as opposed to a constant and direct watering stream; many commercially available portable sprinklers incorporate a rotor action to meet this need.

Drip/Micro Spray Irrigation

Drip irrigation is the most effective way of getting water directly to plant roots. This is done by delivering small amounts of water to the ground over a longer period of time. This eliminates wasted water to misting, foliage blockage, and overspray, and also significantly reduces the potential for runoff. These systems work very well in areas with clay soils; which are more prone to irrigation runoff, or cobble/rocky soils, which can drain too quickly. There are several different types of drip irrigation systems that are available – bubblers, micro sprayers and drippers. Drip systems require a low pressure water system. This can be achieved by installing a pressure regulator to an existing in-ground system. These systems can clog over time from lime build up and suspended particles - installing filter systems can help alleviate this problem. Most systems come pre-packaged with user installation and operation instructions.

Scheduling

- To reduce water loss from evaporation, water landscapes before 10 a.m. or after 6 p.m.
- Spring and Summer- irrigate no more than three times per week.
- Fall and Winter- keep systems turned off as much as possible and irrigate no more than once per week when necessary.
- Reduce the frequency of irrigation during and immediately after rain events. Automatic shut off devices can be used to automatically stop irrigation during a rain event.
- New landscaping may require more frequent irrigation for root establishment.

Operation & Maintenance

- Check for broken sprinkler heads and leaks monthly. Leaks are easy identified by looking for wet spots, areas that are overgrown or weak water outputs.
- Cap, close (tighten small screw on top), or remove any unnecessary sprinklers.
- If a sprinkler head is blocked by foliage move the sprinkler head, install a riser, or eliminate the foliage.

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Landscaping

Purpose

Proper planning and design of landscaping is an easy way to positively impact local and regional water quality. Aside from the aesthetic value that is created, a well-designed landscape is an effective source control measure that can reduce runoff volume, peak flow rate, pollutant load, and water usage.

2500 River Plaza, City of Sacramento

Applicability

The source control options provided in this fact sheet must be considered within all new development and redevelopment projects, and incorporated to the maximum extent practicable.

Design Requirements

When designing landscape to reduce water quality impacts, the following design principles should be considered:

- Incorporate natural depressions, rain gardens and/or swales into the design to maximize natural water storage and infiltration opportunities. Refer to the Bioretention Planter and Vegetated Swale BMP Fact Sheets.
- Protect existing slopes and channels (additional guidance can be found in the City of Sacramento Manual for Grading and Erosion and Sediment Control[1], from CASQA and/or other local agency publications).
  - Protect disturbed slopes and channel crossings as quickly as possible.
  - Use methods to slow runoff flow where appropriate to prevent erosion.
- Organic fertilizers should be used instead of synthetic fertilizer because they are less soluble in water and less likely to be transported to natural water ways by stormwater runoff. In some cases, use of organic wood mulch can eliminate the need to use any fertilizers.

[1] http://www.sacstormwater.org/ConstructionandNewDevelopment/ConstructionandNewDevelopment.html

The Sacramento Stormwater Quality Partnership has adopted several principles of "river-friendly" landscaping. These include the following:

- Landscape locally – take into account the existing site characteristics.
- Landscape for less to the landfill – compost onsite plant debris and select plants that require minimal pruning.
- Nurture the soil – amend the soil with compost before planting and mulch regularly after planting.
- Conserve Water – minimize the use of lawns and select drought resistant Californian & native plant varieties.
- Conserve Energy – plant trees to shade homes and reduce unnecessary outdoor lighting.
- Protect water & air quality –Minimize the use of pesticides.
- Create and protect wildlife habitat – preserve existing vegetation and select native plants.

Operation and Maintenance

General

- Reduce the potential for dry weather runoff by installing efficient irrigation systems (see Efficient Irrigation BMP Fact Sheet).
- Over watering after fertilizer application can leach nitrogen into the surrounding water ways.
- Apply fertilizer only in the spring and fall (if needed).
- Sweep up all fertilizer, soil and plant clippings off of paved surfaces to prevent contact with stormwater runoff.
- Limit soil compaction when constructing landscaped areas. Compaction will reduce the amount of runoff that can be stored and infiltrated.

Fertilizer Application

If fertilizers are improperly applied, the nutrients they contain will bypass the plant and end up polluting stormwater runoff. These nutrients can cause detrimental algae blooms in the receiving creek. It is very important to follow the instructions included with the fertilizer for application. There are several different fertilized application methods:

- Surface Application – a fertilizer spreader should be used to apply evenly over an area.
- Soil Incorporation – the best method for applying low soluble nutrients like potassium and phosphorus is to place it into a hole or a trench dug around an individual plant.
- Foliage Spraying - spraying a fertilizer solution onto the leaves of plants is an efficient way to apply micro nutrients such as zinc and iron. It is not recommended for applying potassium or phosphorus.

Table L-1 Fertilizer Comparison

Fertilizer Type*:	Nutrient Origin	Advantages	Disadvantages
Organic	Remains or byproduct of ounce-living organisms, such as compost, bone meal, sewage sludge and fish emulsion	Improves soil health, less leachable, contains multiple nutrients	High cost per unit of nutrient
Inorganic (synthetic)	Synthesized from non-living materials. They are typically salts like ammonium sulfate, potassium chloride and potassium phosphate.	Low cost, consistent nutrient levels, readily available to plants, easy to handle	Potential loss by leaching, more easily over-applied

**Use of mulch can reduce or eliminate the need to apply fertilizer*

References Used to Develop This Fact Sheet

- California Stormwater Quality Association, *California Storm Water Best Management Practice Handbook for New Development and Redevelopment*, January 2003 (revised September 2004). www.cabmphandbooks.com
- River-Friendly Landscaping, *The Seven Principles of River-Friendly Landscaping (RFL)*, http://www.msa.saccounty.net/sactostormwater/RFL/principles.asp, accessed 6/12/13.
- University of Nevada, Reno, *Using Fertilizers Properly, A Tahoe Landscape BMP Fact Sheet for Lake Tahoe*, Fact Sheet 94-11.

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Storm Drain Inlet Markings and Signage

Purpose

This fact sheet provides details about permanent "No dumping-drains to creek/river" messages at storm drain inlets and "No dumping" signs at public access points to channels and creeks on the development project site, where applicable. Storm drain markings are intended to help stop illegal dumping by alerting people that the drain leads directly to a waterbody and dumping is prohibited. Signs at access points to creeks and channels serve as reminders that dumping is illegal at these locations.

Inlet marking directly in concrete
Photo source: County of Sacramento

Applicability

As indicated in Table 3-3, permanent storm drain inlet markings are required on all new drain inlets (also known as catch basins) installed in development/ redevelopment projects. Signs are also required at public access points to any creeks or drainage channels within or adjacent to the site.

Pre-fabricated inlet marker
Photo source: County of Sacramento

Design Requirements

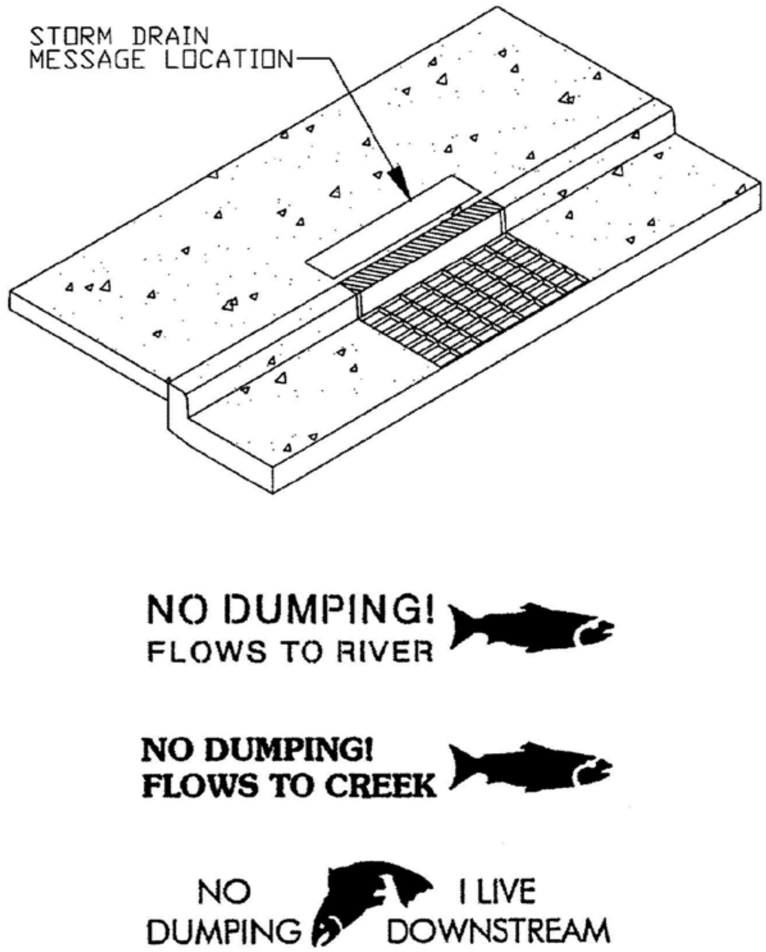
To protect water quality, follow the requirements shown in Table SD-1 to create consistent "no dumping" messages at storm drain inlets and public access points at creeks and channels.

Operation and Maintenance

The legibility of storm drain inlet messages and signs must be maintained to ensure effective pollution prevention over time.

Table SD-1. Design Requirements for Storm Drain Inlet Markings and Signage

Design Feature	Requirement
Location	▪ Identify all storm drain inlets on the improvement plans and indicate they must be marked with appropriate storm drain messages. ▪ Locate the message on each inlet as described in the next section.
Message Layout and Content	▪ Follow the message layout, content, and other specifications provided by the local permitting agency. Each agency may have its own design. See Figure SD-1 for an example detail. ▪ For signs posted at access points to waterways, consult the local permitting agency for their required/preferred message and style. ▪ Alternatively, obtain approval from the local jurisdiction for a different layout/message that clearly prohibits dumping using words or graphical icons. ▪ Consider the use of bilingual messages where appropriate based on local population.
Method of Application	▪ Permanently apply the message at storm drain inlets by stamping it in concrete, affixing as a tile or cast-iron plate, or using an alternative approach approved by the local jurisdiction. ▪ For area drain markers, make sure any inset tiles or plates are flush with the surface of the inlet to avoid a tripping hazard. ▪ Consider permanently affixing signs at access points to creeks and channels.



NOTES:

1. STORM DRAIN MESSAGE SHALL BE APPLIED IN SUCH A WAY AS TO PROVIDE A CLEAR, LEGIBLE IMAGE.
2. STORM DRAIN MESSAGE SHALL BE PERMANENTLY APPLIED DURING THE CONSTRUCTION OF THE CURB AND GUTTER USING A METHOD APPROVED BY THE LOCAL AGENCY.
3. FOR AREA DRAIN INLETS, STORM DRAIN MESSAGE SHALL BE PLACED ADJACENT AND PARALLEL TO THE LONG AXIS OF THE DRAIN.
4. LETTERS SHALL BE 1-1/2" IN HEIGHT. DIMENSIONS OF STORM DRAIN MESSAGE SHALL NOT EXCEED 12" X 33".
5. IF THE MESSAGE IS STAMPED IN CONCRETE, THE DEPTH SHOULD BE APPROXIMATELY 0.25".
6. IF AN ALTERNATIVE STORM DRAIN MESSAGE IS PROPOSED, IT SHALL BE APPROVED BY THE LOCAL AGENCY.

Figure SD-1. Storm Drain Inlet Message

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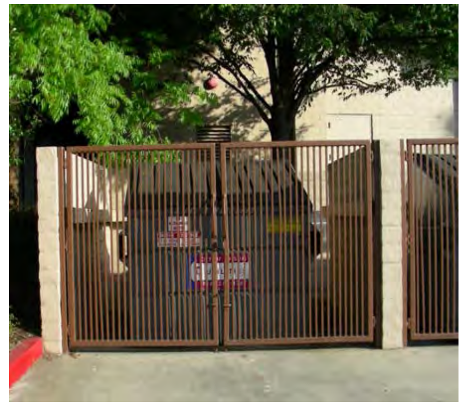
Waste Management Areas

Purpose

This fact sheet specifies how to design waste and recycling storage areas so that they aren't sources of pollutants to the storm drainage system and receiving waters. A properly designed waste/recycling storage area keeps rain, runoff, and other site water from leaching away pollutants; minimizes the chance of spills and leaks; and prevents any spilled or leaked wastes from entering the storm drainage system. Potential pollutants from waste include fats/oils/greases (from food), particulates, organic matter, toxic chemicals, and more.



Trash enclosure with covered dumpster.
Photo: City of Folsom

Applicability

Refer to Table 3-3 regarding the project land use types that need to comply with this fact sheet. The design requirements provided in this fact sheet are primarily intended for new development. If applied to significant redevelopment, the requirements would only apply in the case of complete redesign of the portion of the facility involving the waste management/trash enclosure area(s).

Design Requirements

To protect water quality, design waste and recycling storage areas as explained in Table WM-1. Design requirements in this fact sheet are intended to supplement (not supersede) those in other codes (such as the Building, Fire, and Zoning Codes and the hazardous waste requirements in Title 22, California Code of Regulations, as applicable). Discuss any potential conflicts with the local permitting agency early in the planning process before proceeding with design. In addition, check with the appropriate waste management agency regarding design or access requirements.

Covered Storage for Waste and Recycling Bins and Compactor, Pleasanton, California
Photo: CKB Environmental

Operation and Maintenance

The design features required by this fact sheet need to be maintained and properly operated. This includes regular maintenance of the grease interceptor and handling and disposal of materials which accumulate in the interceptor, and maintenance of covers and sanitary sewer connections, if applicable.

Table WM-1. Design Requirements for Waste Management Areas to Protect Water Quality

Design Feature	Requirement
Location and Enclosure – General	▪ Design an enclosed area for waste and recycling storage and collection on the site so that containers cannot be knocked over and where unauthorized use or vandalism is unlikely. This will help keep debris from being blown off site and pollutants from entering the storm drain system.
Location/Access – Enclosure Area	▪ Provide adequate room for waste collection trucks to pick up and empty dumpsters to minimize chance of accidents and spillage. Check with the local solid waste agency for access standards. ▪ In the absence of local standards, design the enclosure to have direct access for collection trucks, meaning the truck can drive directly at the bin and insert the forks into the sides of the bin. A minimum straight approach of 50-65 feet is recommended to line up directly with the bin.
Paving	▪ Pave the waste/recycling storage area with Portland Cement Concrete.
Space and Waste Segregation	▪ Provide ample space inside the waste management area for bins to contain the maximum amount of expected waste and recycling matter to be generated at the facility, considering the typical waste collection schedule. Check with the local solid waste agency for detail drawings if available. ▪ For areas designated to contain tallow bin(s), provide a separate enclosed area for storage of the tallow bin, segregated from the area used to store solid and recycling wastes, and covered if acceptable to permitting agency (some agencies may not want solid waste enclosures covered [see discussion below], but will allow tallow bin enclosures to be covered due to different loading practices).
Cover	▪ Provide a cover for the entire waste area if acceptable to permitting agency. Some local waste haulers may not allow a cover, due to vertical clearance/accessibility needs for front loading trucks. ▪ If a cover will be installed, check with local fire department about possible sprinkling requirements.
Grading/Drainage	▪ Direct runoff from roof downspouts away from the waste/recycling storage area. ▪ Locate the waste management area at least 35 feet from the nearest storm drain inlet. The intention is to deter employees/tenants/contractors from directing wash water to the storm drain system with a hose or pressure washer. ▪ Hydraulically isolate the area; this can be achieved by reverse grading at the perimeter, perimeter curbing or berming, or the use of perimeter or area drains to collect and divert runoff.
Sanitary Sewer Connection	▪ If acceptable to the permitting agency, connect the hydraulically isolated area to the sanitary sewer via a trench drain at the back of the enclosure or similar, to facilitate proper disposal of polluted wash water. Check with the local waste management agency for detail drawings if available. ▪ Provide pretreatment with an approved grease interceptor prior to discharge to the sanitary sewer. Check with the local sanitary sewer permitting agency for specifics and approval. Note that the Plumbing Code limits the number of connections to a single grease interceptor at a facility.

Design Feature	Requirement
	▪ See Appendix C for sanitary sewer connection and contact information.
Signage	▪ Post signs inside the enclosure and/or on the bins prohibiting the disposal of liquids and hazardous materials therein. ▪ Consider posting signs on the inside of the enclosure walls to educate employees and tenants about proper wash down procedures (procedures will vary depending on whether or not the area is connected to the sanitary sewer system).
These requirements are intended to supplement, not supersede, those found in other codes (e.g., building, plumbing, fire, hazardous waste). If conflicts are identified, consult with the local permitting agency and other agencies as needed (e.g., fire, sanitation district) for resolution.	

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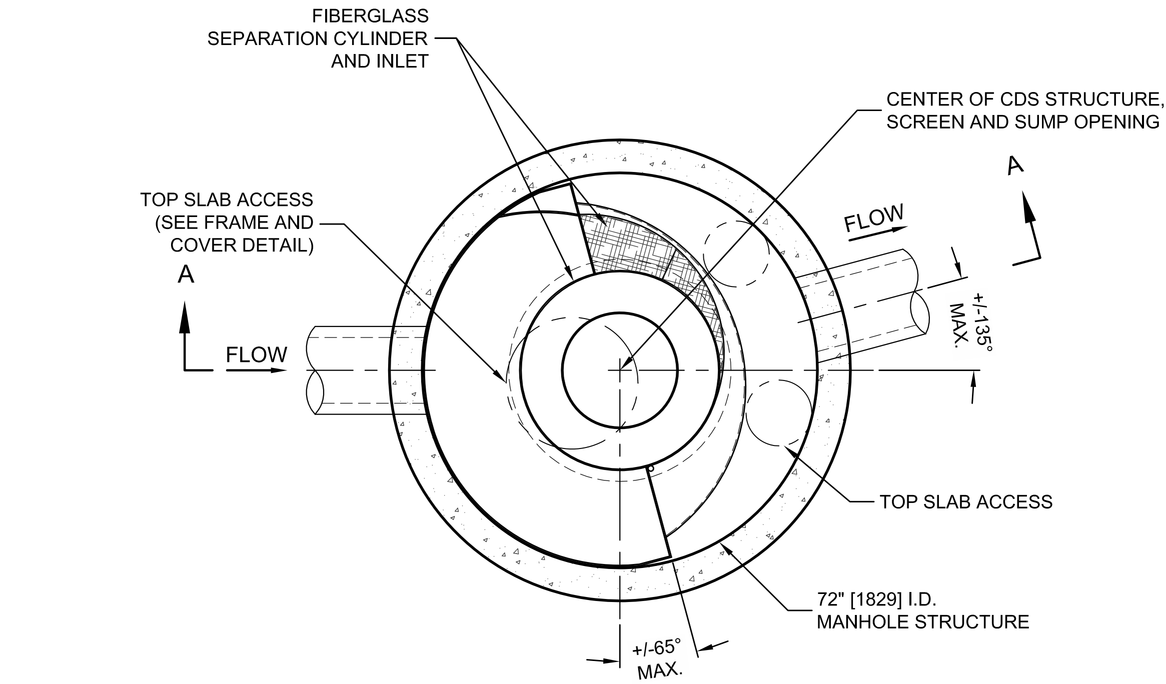
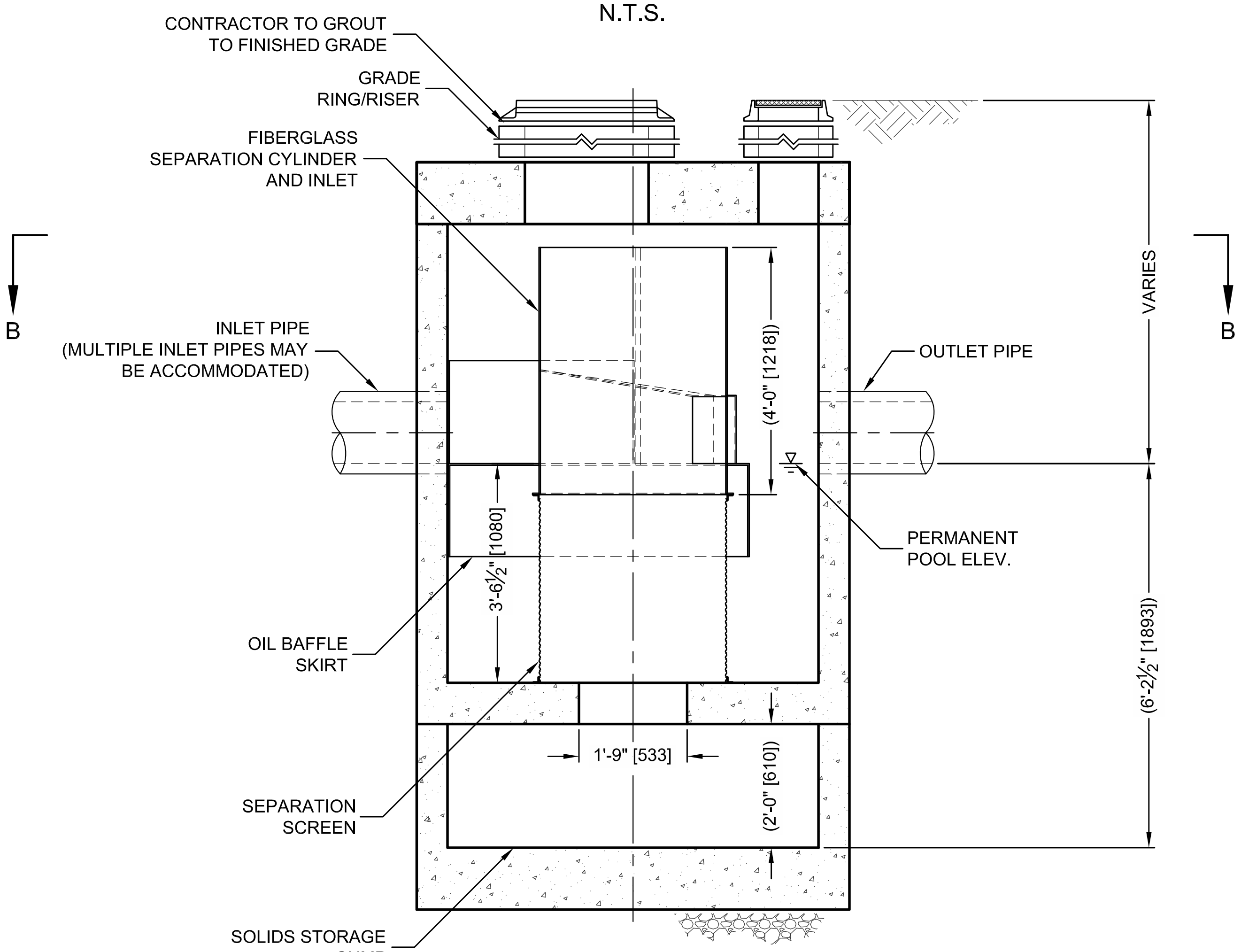


PLAN VIEW B-B
N.T.S.

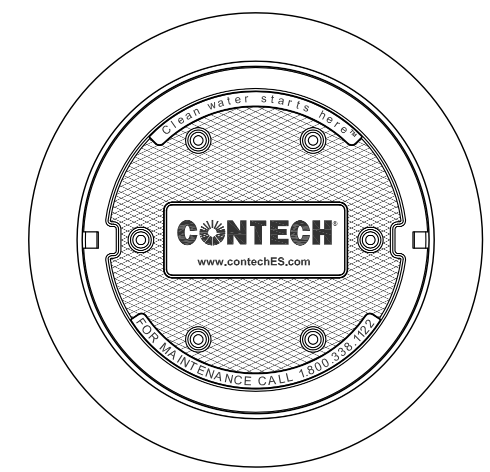


ELEVATION A-A
N.T.S.

CDS3030-6-C DESIGN NOTES

THE STANDARD CDS3030-6-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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