APPENDIX D
Hydrology and Water Quality Documentation

PRELIMINARY HYDROLOGY CALCULATIONS

FOR

PROPOSED BUILDINGS
2112 E. 223RD STREET
CARSON, CA 90810

PREPARED FOR

PANATTONI DEVELOPMENT COMPANY, INC.
20411 SW BIRCH STREET, SUITE 200
NEWPORT BEACH, CA 92660
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NOVEMBER 21, 2019

JOB NO. 3826

PREPARED BY

THIENES ENGINEERING
14349 FIRESTONE BLVD.
LA MIRADA, CALIFORNIA 90638
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PRELIMINARY HYDROLOGY CALCULATIONS

FOR

2112 EAST 223RD STREET

PREPARED UNDER
THE SUPERVISION OF:

REINHARD STENZEL DATE:
R.C.E. 56155
EXP. 12/31/20

INTRODUCTION

A: PROJECT LOCATION

The project site is located on the southerly side of 223rd Street in the City of Carson. See following page for vicinity map.

B: STUDY PURPOSE

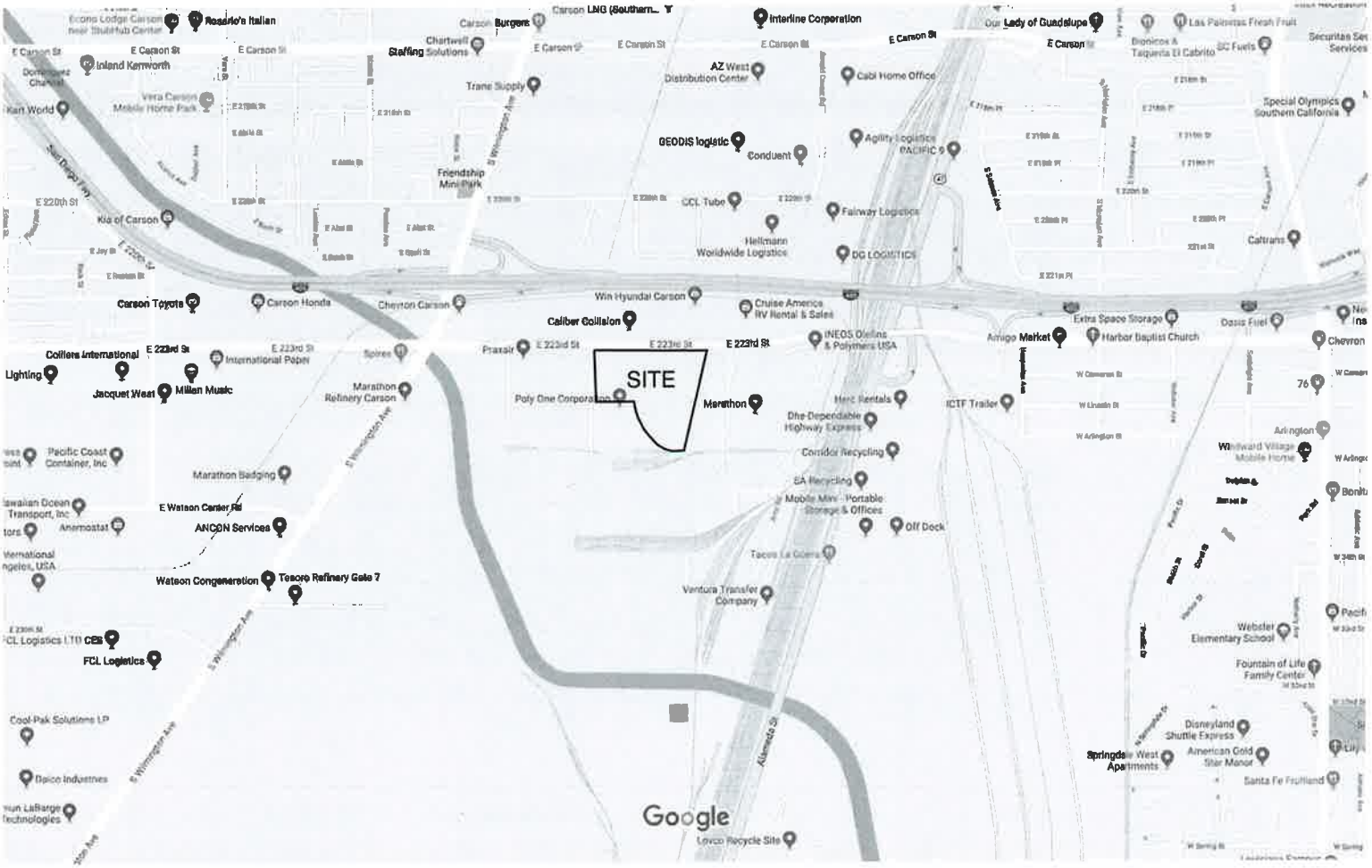
The purpose of this study is to determine the proposed condition 50-year peak flow rate from the site.

C: PROJECT STAFF:

Thienes Engineering staff involved in this study include:

Reinhard Stenzel
Brian Weil

Google Maps



VICINITY MAP

DISCUSSION

The project site encompasses approximately 14.35 acres. Improvements consist three warehouse type buildings with approximately 58,400 square feet, 92,000 square feet and 129,000 square feet. Each building has a truck yard area and vehicle parking around the perimeter. Proposed landscaping will be adjacent to the street and smaller areas throughout the site.

Existing Condition

The project site was formerly used as a chemical plant. The plant was deactivated in 1982 and the majority of the structures and storage areas have been removed. There is an existing Enhanced In-situ Anaerobic Bioremediation (EISB) system located at the southerly portion of the site. This system will remain active and undisturbed.

There are no existing drainage features within the project site. Overall, the site is very flat. Storm water runoff tends to drain to the southwesterly portion of the site, where it appears to pond. The existing condition 50-year peak flow rate for the site is approximately 11.0 cfs.

See Appendix "A" for existing condition hydrology calculations and Appendix "C" for existing condition hydrology map.

Proposed Condition

Runoff from the northerly portion of Buildings "A" and "B" and the northerly parking areas (Areas 1A-4A on proposed condition hydrology map) drain to grate inlets located in the northerly parking areas. A storm drain system conveys flows southerly between the two buildings. Additional parking areas between the buildings (Areas 5A-7A) are also tributary to this drain.

The storm drain system continues southerly then westerly around Building "A". Additional runoff from the southerly half of Buildings "A" and "B" and Building "C" (areas 7A-16A) are added via grate inlets in the respective truck yard areas. The onsite storm drain continues northerly around Building "A" where the westerly parking area (Area 17A) is added to the storm drain.

A portion of the existing EISB system at the southerly portion of the site (Area 1C) flows southerly offsite with some of the area draining westerly to the proposed improvements. Conservatively, the entire EISB area has been added to the proposed onsite storm drain system.

The total 50-year peak flow rate for the project site is approximately 42.8 cfs. This is the direct sum of the individual subareas.

The proposed storm drain system continues northerly towards 223rd Street. Existing utilities prevent the proposed storm drain system from connecting to the existing storm drain facility in 223rd Street. A proposed sump pump will be utilized to pump runoff to the street. The pump will only discharge a portion of the 50-year peak flow (3.0 cfs) with the remaining volume to be temporarily stored onsite within the underground storage chambers and on the surface of the truck yard.

The proposed landscaped areas adjacent to 223rd Street (Areas 1B-3B) will sheet flow into the street. The 50-year peak flow rate for these areas is approximately 0.7 cfs.

See Appendix "A" for the proposed condition hydrology calculations and Appendix "C" for the proposed condition hydrology map.

Detention

As previously mentioned, a pump will be utilized to discharge runoff to 223rd Street. The pump will be sized to discharge 3.0 cfs with the remaining volume to be stored in the underground storage system and the surface of the truck yard at Building "A".

Hydrograph volumes were determined from the Hydro-Calc Excel spreadsheet. Cumulative volumes are shown up to the allowable peak flow rate before and after the peak occur. The difference in the volume before and after the peak (along with the volume of the allowable peak flow rate) is the volume to be temporarily detained. With 3.0 cfs pumped out, the remaining volume is approximately 56,604 cubic feet. There is approximately 11,330 cubic feet of volume available in the truck yard area associated with Building "A".

The remaining volume (45,274 cubic feet) will be contained in the underground storage system. Here, the bottom half of the underground chamber system will be utilized for water quality purposes. The volume above will be available for peak flow storage. The total underground storage volume is approximately 95,076 cubic feet. The required water quality volume is approximately 49,459 cubic feet. The remaining underground volume for peak flow storage is approximately 45,617 cubic feet. The overall storage volume for peak flow purposes is about 56,947 cubic feet.

See Appendix "B" for detention calculations.

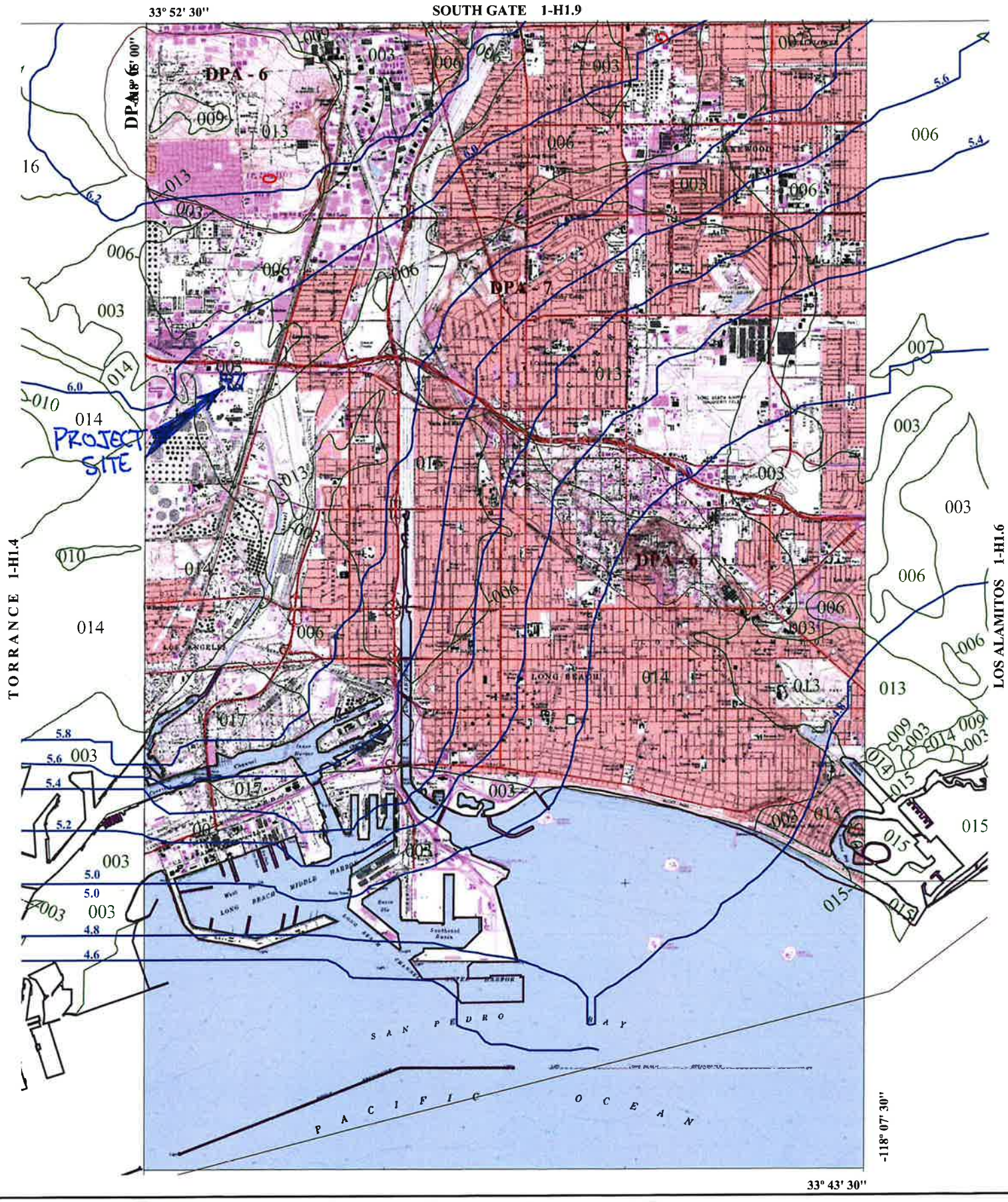
Methodology

Los Angeles County's Hydro-Calc spread sheet was used for the hydrology and detention calculations. The soil type is 003 and the rainfall depth is 6.0" per the Los Angeles County Hydrology Manual. See Appendix "A" for reference material from the Los Angeles County Hydrology Manual.

APPENDIX	DESCRIPTION
A	HYDROLOGY CALCULATIONS
B	DETENTION CALCULATIONS
C	HYDROLOGY MAP

APPENDIX A

HYDROLOGY CALCULATIONS



25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

LONG BEACH
50-YEAR 24-HOUR ISOHYET

1-H1.5

LOS ANGELES COUNTY PUBLIC WORKS
Public Service That Works

EXISTING CONDITION

Peak Flow Hydrologic Analysis

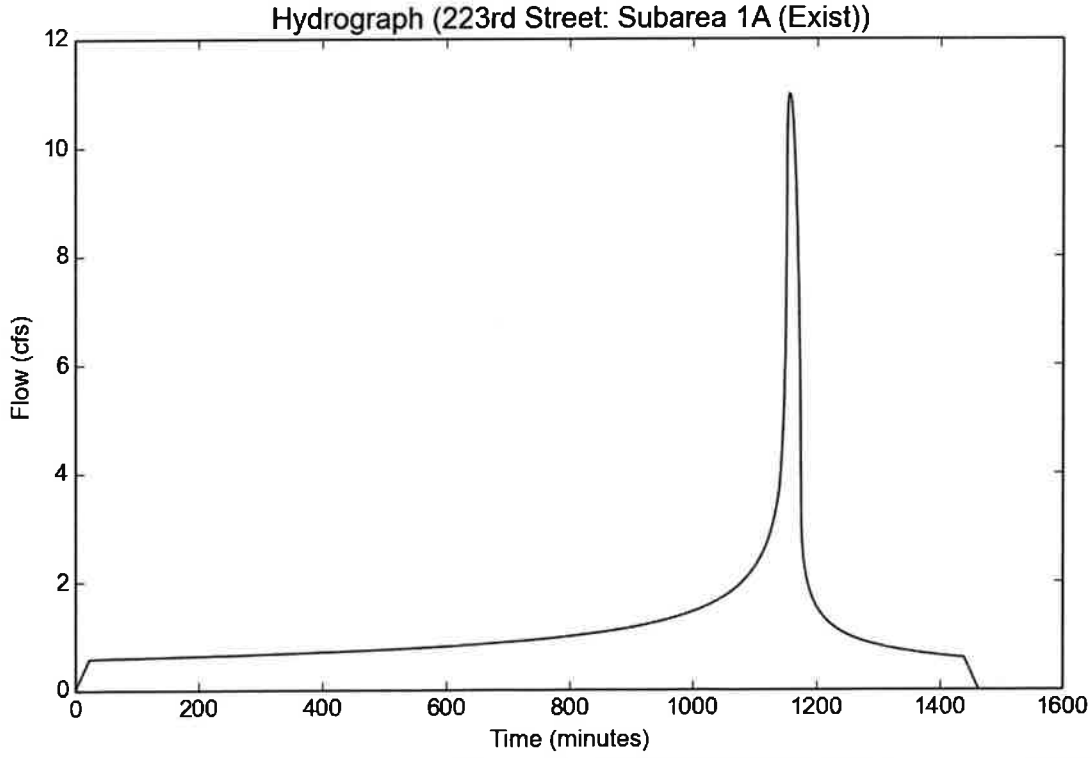
File location: O:/3800-3899/3826/hydrocalc/223rd Street - Subarea 1A (Exist).pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	223rd Street
Subarea ID	Subarea 1A (Exist)
Area (ac)	14.35
Flow Path Length (ft)	1028.0
Flow Path Slope (vft/hft)	0.0022
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.25
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	1.7473
Undeveloped Runoff Coefficient (Cu)	0.2835
Developed Runoff Coefficient (Cd)	0.4376
Time of Concentration (min)	23.0
Clear Peak Flow Rate (cfs)	10.9724
Burned Peak Flow Rate (cfs)	10.9724
24-Hr Clear Runoff Volume (ac-ft)	2.2258
24-Hr Clear Runoff Volume (cu-ft)	96953.7252



PROPOSED CONDITION

Peak Flow Hydrologic Analysis

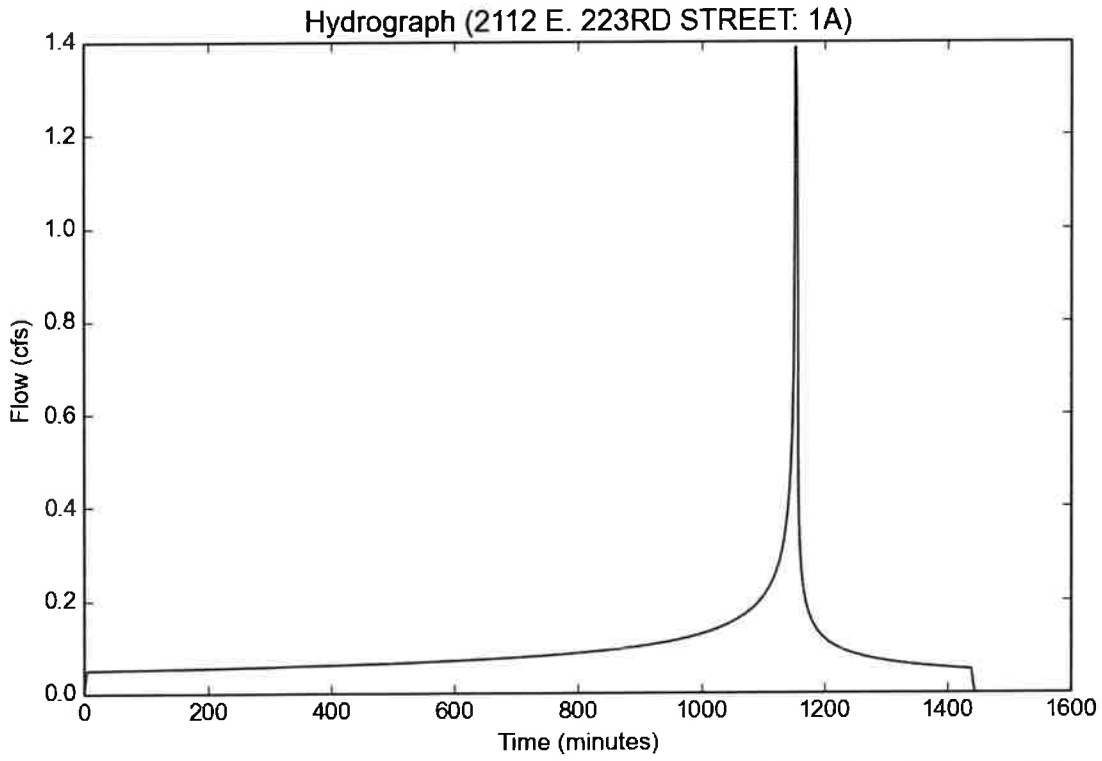
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	1A
Area (ac)	0.45
Flow Path Length (ft)	240.0
Flow Path Slope (vft/hft)	0.007
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.3867
Burned Peak Flow Rate (cfs)	1.3867
24-Hr Clear Runoff Volume (ac-ft)	0.1835
24-Hr Clear Runoff Volume (cu-ft)	7994.6062



Peak Flow Hydrologic Analysis

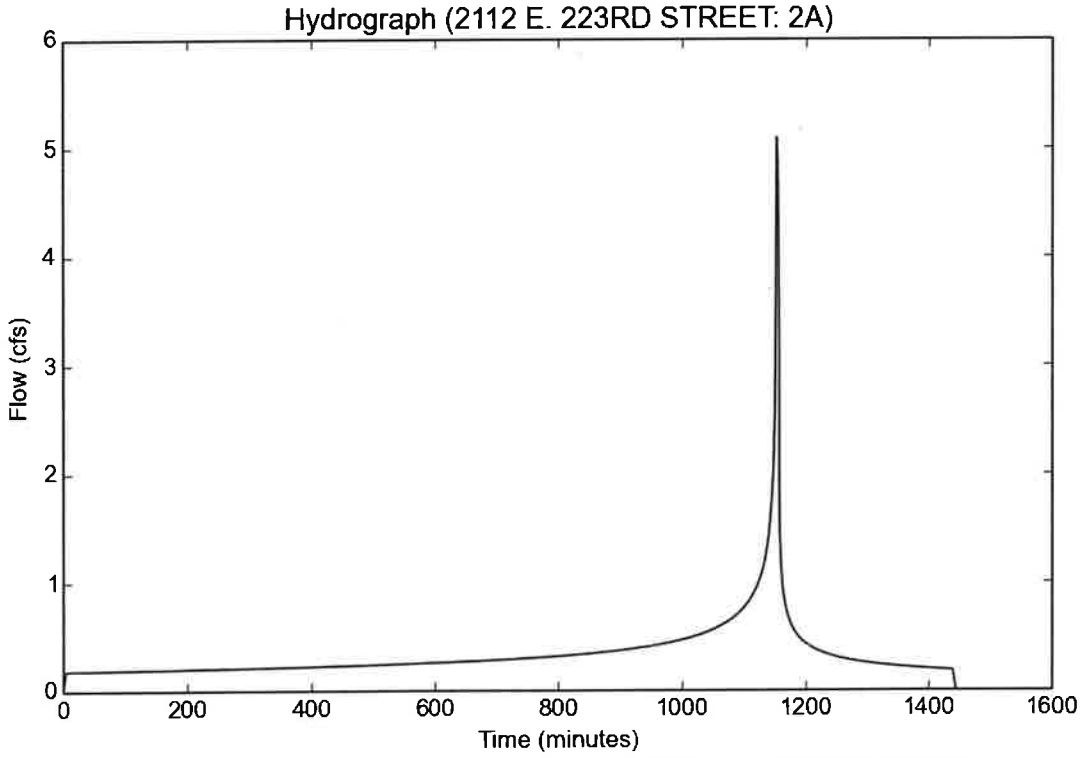
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	2A
Area (ac)	1.65
Flow Path Length (ft)	186.0
Flow Path Slope (vft/hft)	0.009
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	5.0847
Burned Peak Flow Rate (cfs)	5.0847
24-Hr Clear Runoff Volume (ac-ft)	0.6729
24-Hr Clear Runoff Volume (cu-ft)	29313.556



Peak Flow Hydrologic Analysis

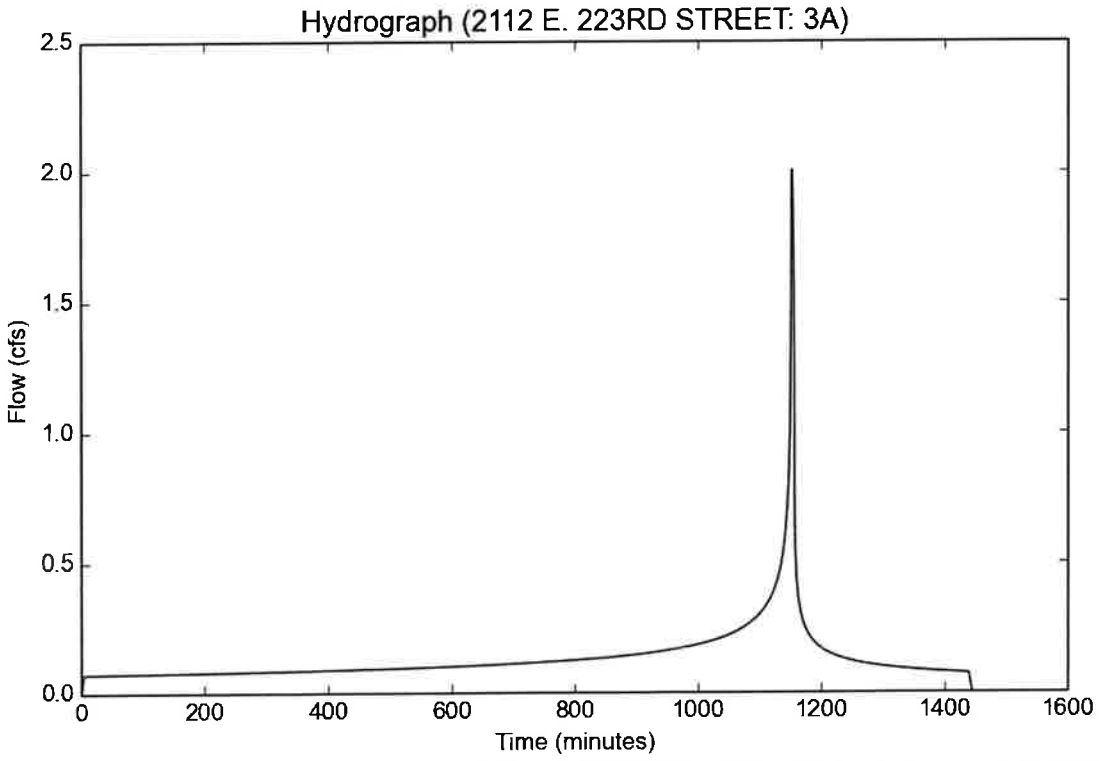
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	3A
Area (ac)	0.65
Flow Path Length (ft)	151.0
Flow Path Slope (vft/hft)	0.0081
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.0031
Burned Peak Flow Rate (cfs)	2.0031
24-Hr Clear Runoff Volume (ac-ft)	0.2651
24-Hr Clear Runoff Volume (cu-ft)	11547.7645



Peak Flow Hydrologic Analysis

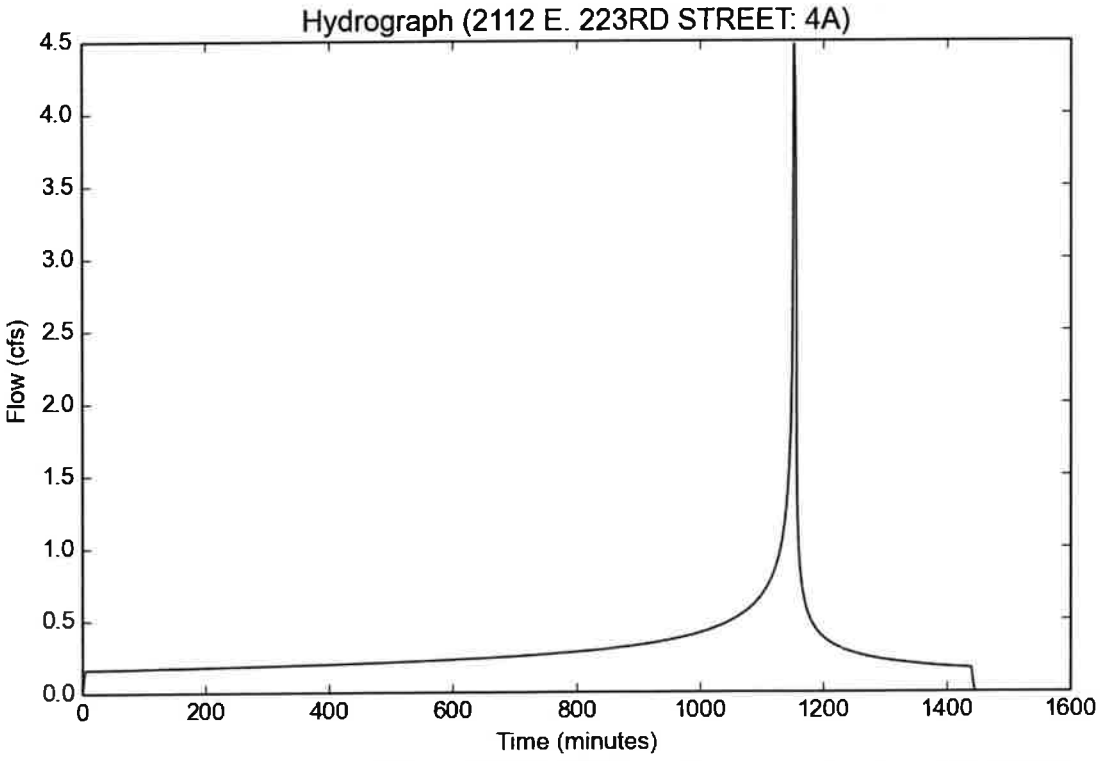
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	4A
Area (ac)	1.45
Flow Path Length (ft)	188.0
Flow Path Slope (vft/hft)	0.0082
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	4.4683
Burned Peak Flow Rate (cfs)	4.4683
24-Hr Clear Runoff Volume (ac-ft)	0.5914
24-Hr Clear Runoff Volume (cu-ft)	25760.3977



Peak Flow Hydrologic Analysis

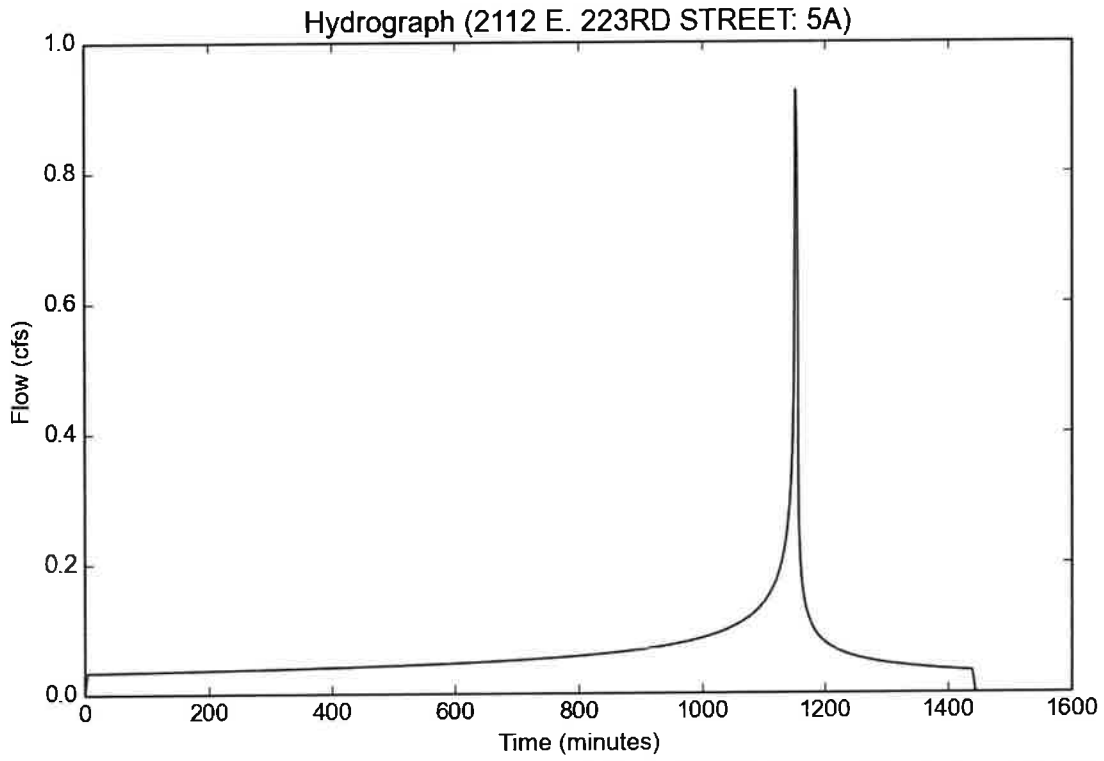
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	5A
Area (ac)	0.3
Flow Path Length (ft)	194.0
Flow Path Slope (vft/hft)	0.005
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9245
Burned Peak Flow Rate (cfs)	0.9245
24-Hr Clear Runoff Volume (ac-ft)	0.1224
24-Hr Clear Runoff Volume (cu-ft)	5329.7375



Peak Flow Hydrologic Analysis

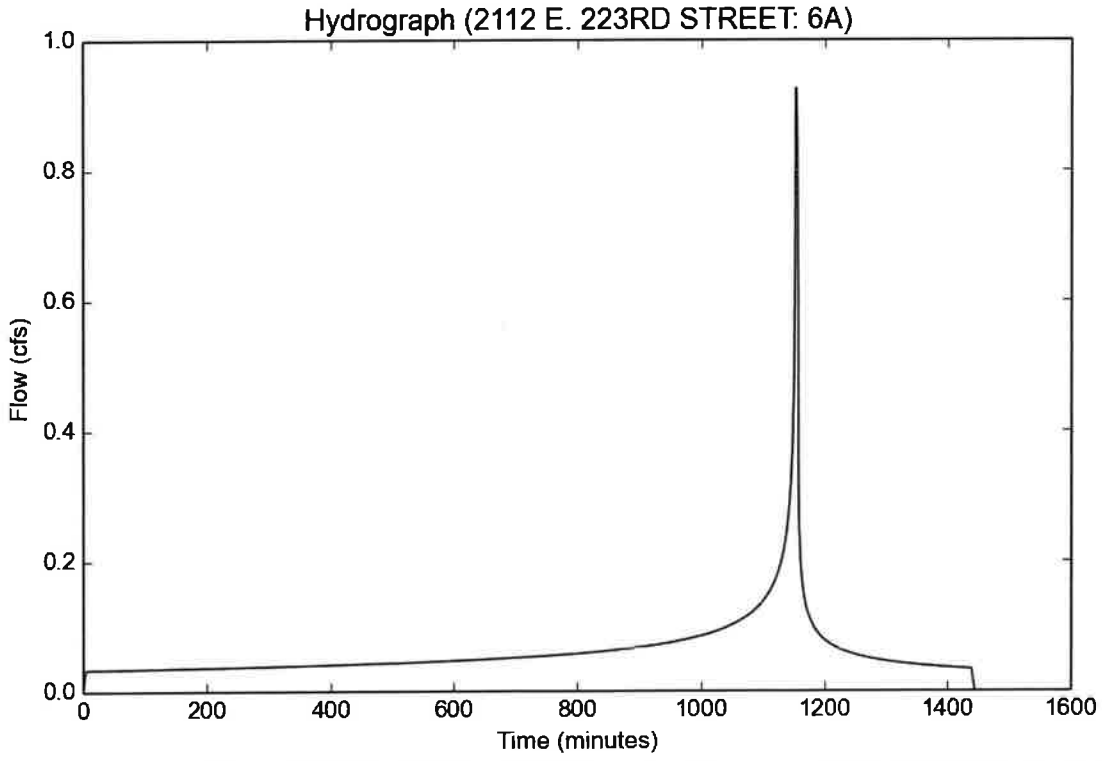
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	6A
Area (ac)	0.3
Flow Path Length (ft)	192.0
Flow Path Slope (vft/hft)	0.0051
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9245
Burned Peak Flow Rate (cfs)	0.9245
24-Hr Clear Runoff Volume (ac-ft)	0.1224
24-Hr Clear Runoff Volume (cu-ft)	5329.7375



Peak Flow Hydrologic Analysis

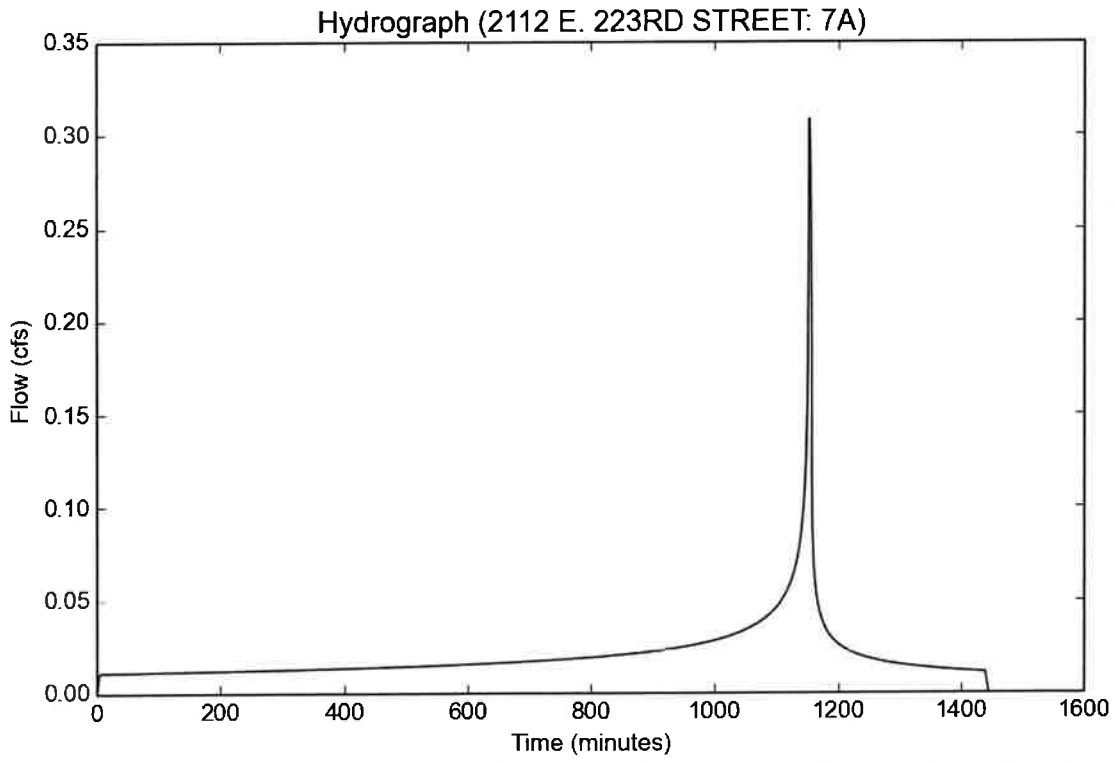
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	7A
Area (ac)	0.1
Flow Path Length (ft)	82.0
Flow Path Slope (vft/hft)	0.0128
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.3082
Burned Peak Flow Rate (cfs)	0.3082
24-Hr Clear Runoff Volume (ac-ft)	0.0408
24-Hr Clear Runoff Volume (cu-ft)	1776.5792



Peak Flow Hydrologic Analysis

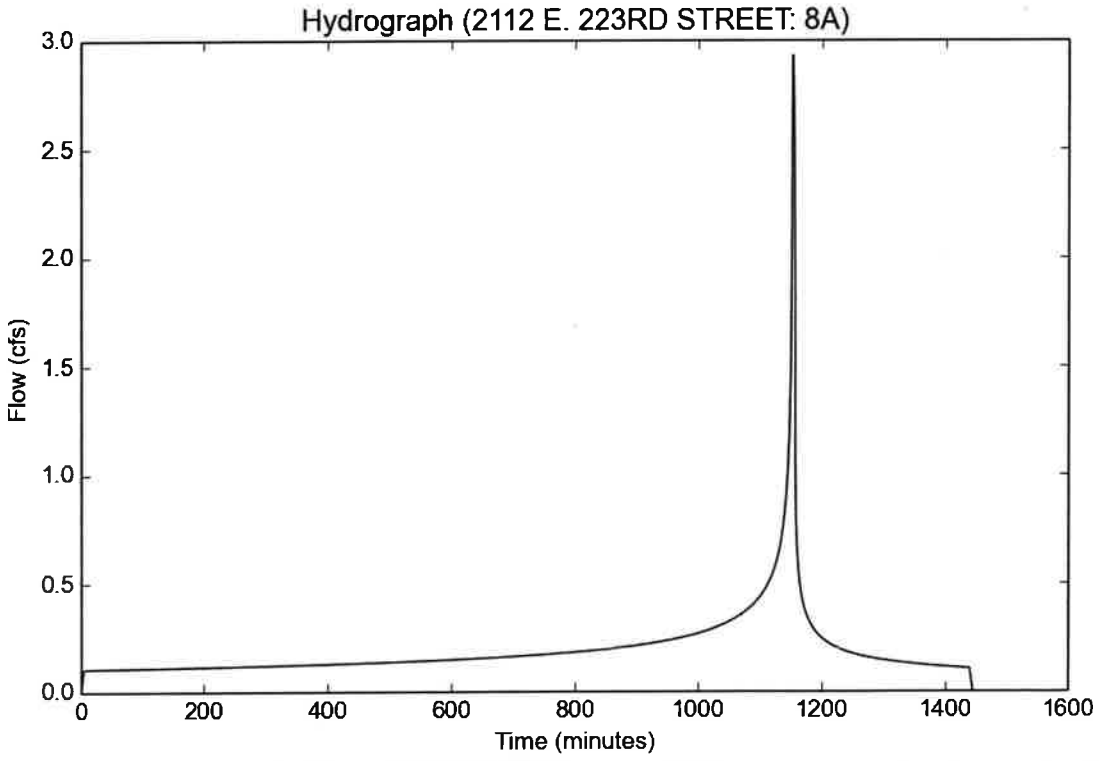
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	8A
Area (ac)	0.95
Flow Path Length (ft)	175.0
Flow Path Slope (vft/hft)	0.0114
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.9275
Burned Peak Flow Rate (cfs)	2.9275
24-Hr Clear Runoff Volume (ac-ft)	0.3875
24-Hr Clear Runoff Volume (cu-ft)	16877.502



Peak Flow Hydrologic Analysis

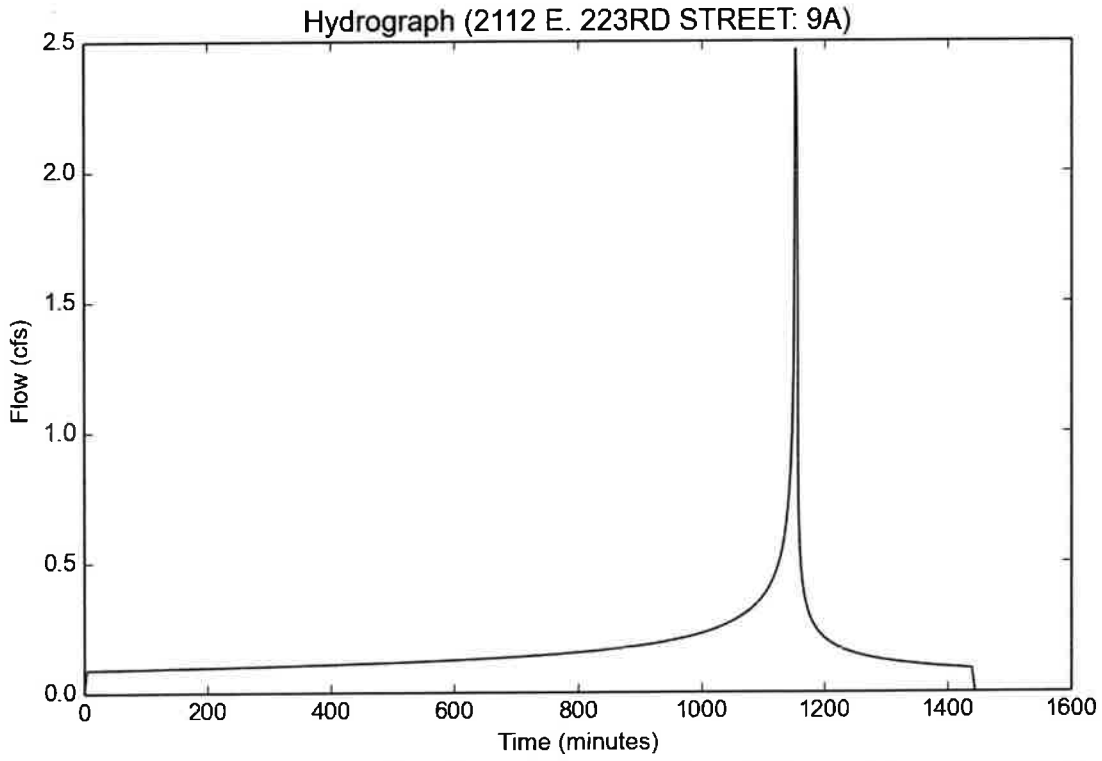
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	9A
Area (ac)	0.8
Flow Path Length (ft)	147.0
Flow Path Slope (vft/hft)	0.0314
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.4653
Burned Peak Flow Rate (cfs)	2.4653
24-Hr Clear Runoff Volume (ac-ft)	0.3263
24-Hr Clear Runoff Volume (cu-ft)	14212.6332



Peak Flow Hydrologic Analysis

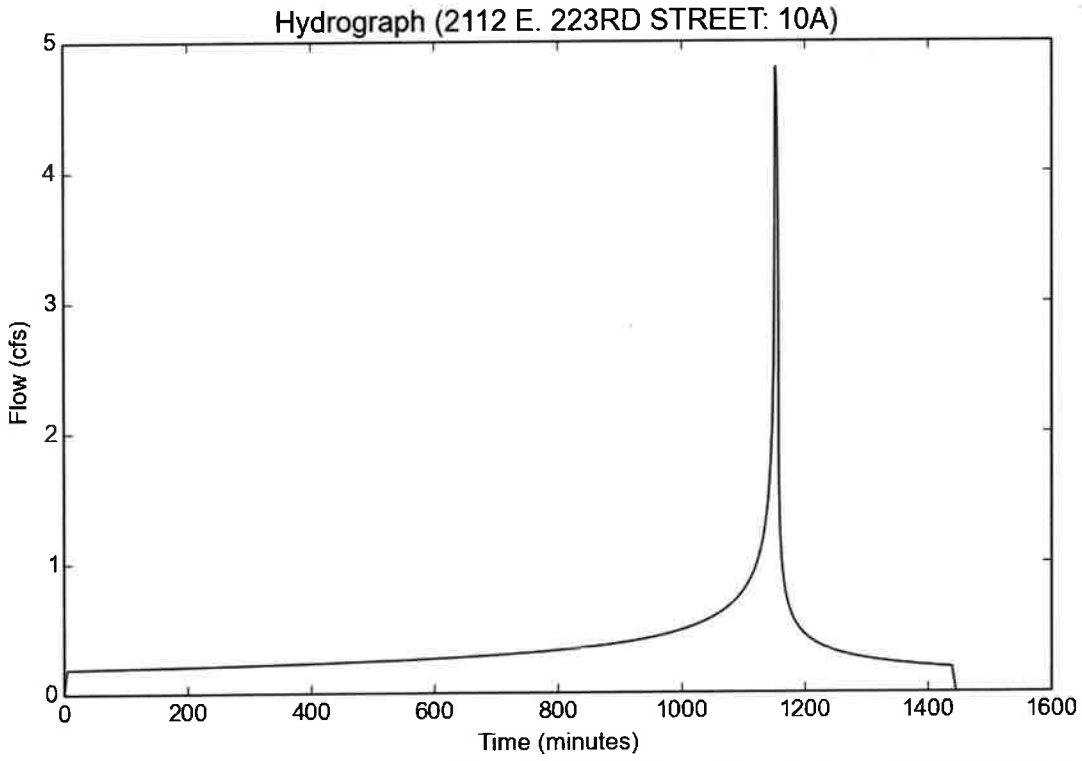
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	10A
Area (ac)	1.7
Flow Path Length (ft)	347.0
Flow Path Slope (vft/hft)	0.0105
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.2858
Undeveloped Runoff Coefficient (Cu)	0.4801
Developed Runoff Coefficient (Cd)	0.858
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	4.7927
Burned Peak Flow Rate (cfs)	4.7927
24-Hr Clear Runoff Volume (ac-ft)	0.6933
24-Hr Clear Runoff Volume (cu-ft)	30199.5576



Peak Flow Hydrologic Analysis

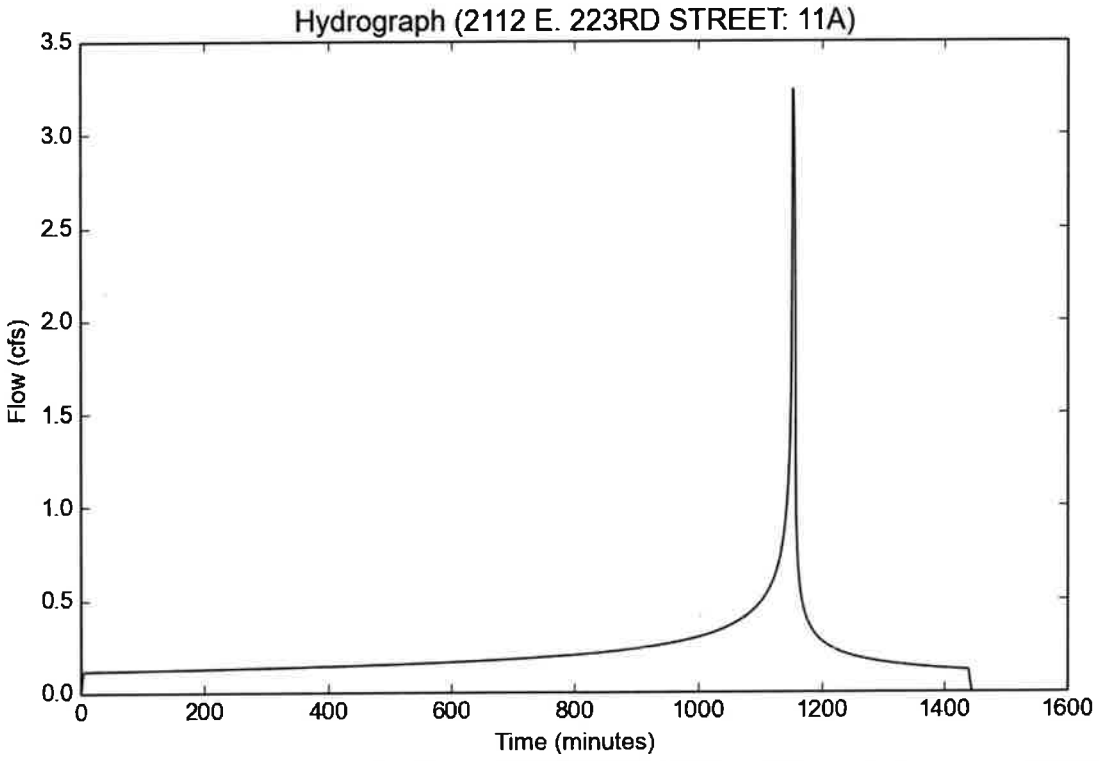
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	11A
Area (ac)	1.05
Flow Path Length (ft)	292.0
Flow Path Slope (vft/hft)	0.0093
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	3.2357
Burned Peak Flow Rate (cfs)	3.2357
24-Hr Clear Runoff Volume (ac-ft)	0.4282
24-Hr Clear Runoff Volume (cu-ft)	18654.0811



Peak Flow Hydrologic Analysis

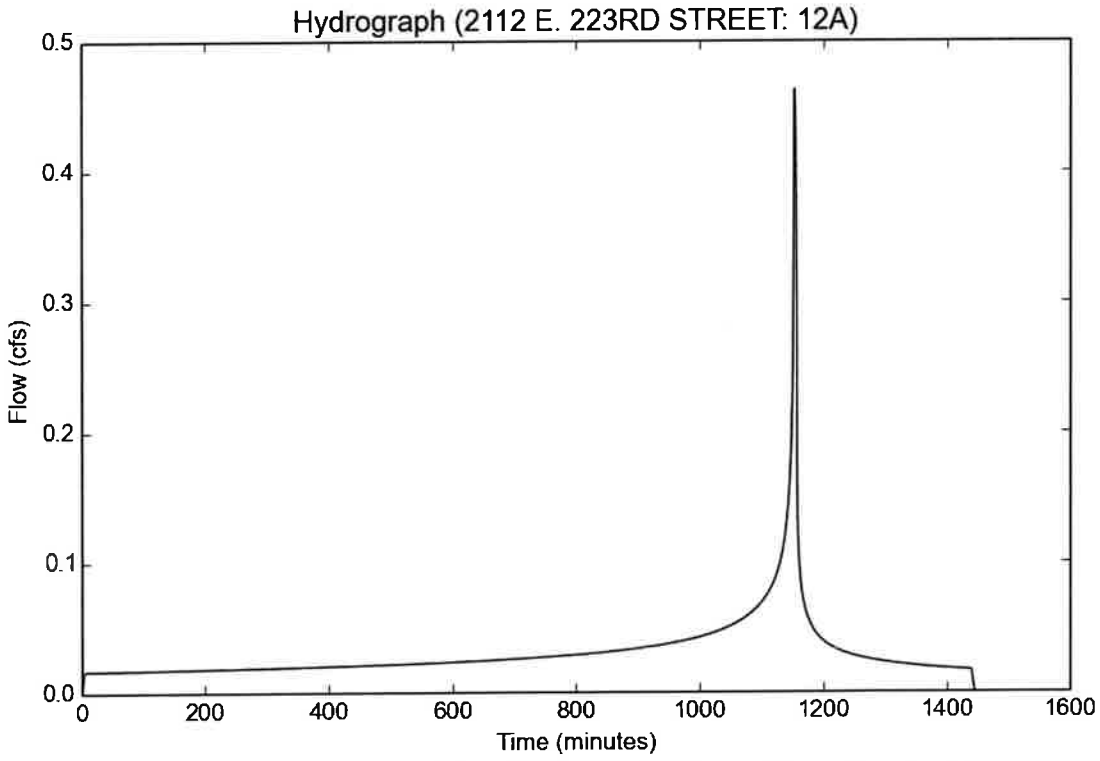
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	12A
Area (ac)	0.15
Flow Path Length (ft)	138.0
Flow Path Slope (vft/hft)	0.0122
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.4622
Burned Peak Flow Rate (cfs)	0.4622
24-Hr Clear Runoff Volume (ac-ft)	0.0612
24-Hr Clear Runoff Volume (cu-ft)	2664.8687



Peak Flow Hydrologic Analysis

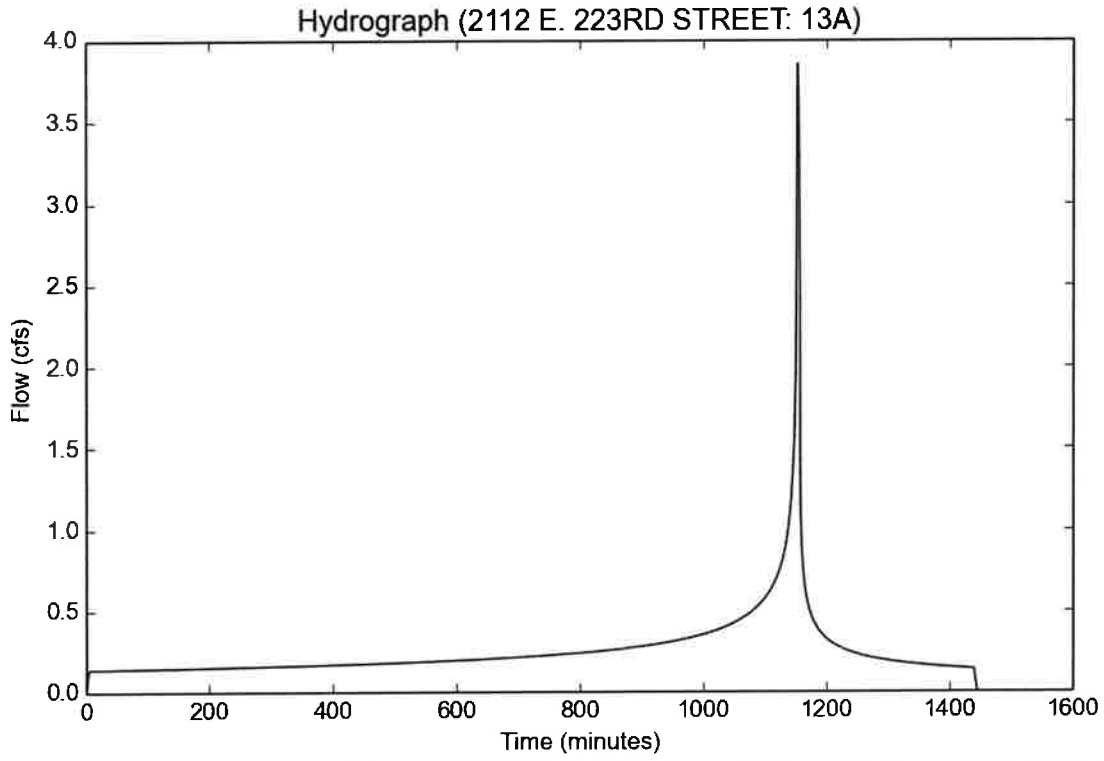
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	13A
Area (ac)	1.25
Flow Path Length (ft)	245.0
Flow Path Slope (vft/hft)	0.0094
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	3.852
Burned Peak Flow Rate (cfs)	3.852
24-Hr Clear Runoff Volume (ac-ft)	0.5098
24-Hr Clear Runoff Volume (cu-ft)	22207.2394



Peak Flow Hydrologic Analysis

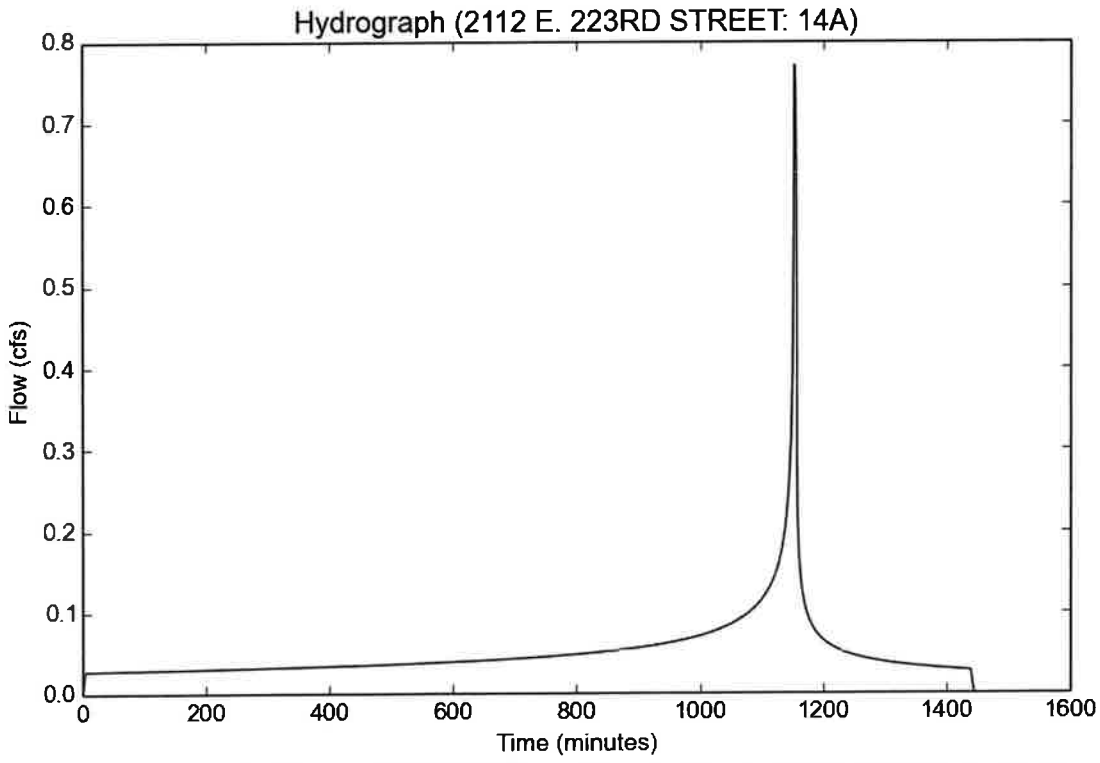
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	14A
Area (ac)	0.25
Flow Path Length (ft)	101.0
Flow Path Slope (vft/hft)	0.018
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.7704
Burned Peak Flow Rate (cfs)	0.7704
24-Hr Clear Runoff Volume (ac-ft)	0.102
24-Hr Clear Runoff Volume (cu-ft)	4441.4479



Peak Flow Hydrologic Analysis

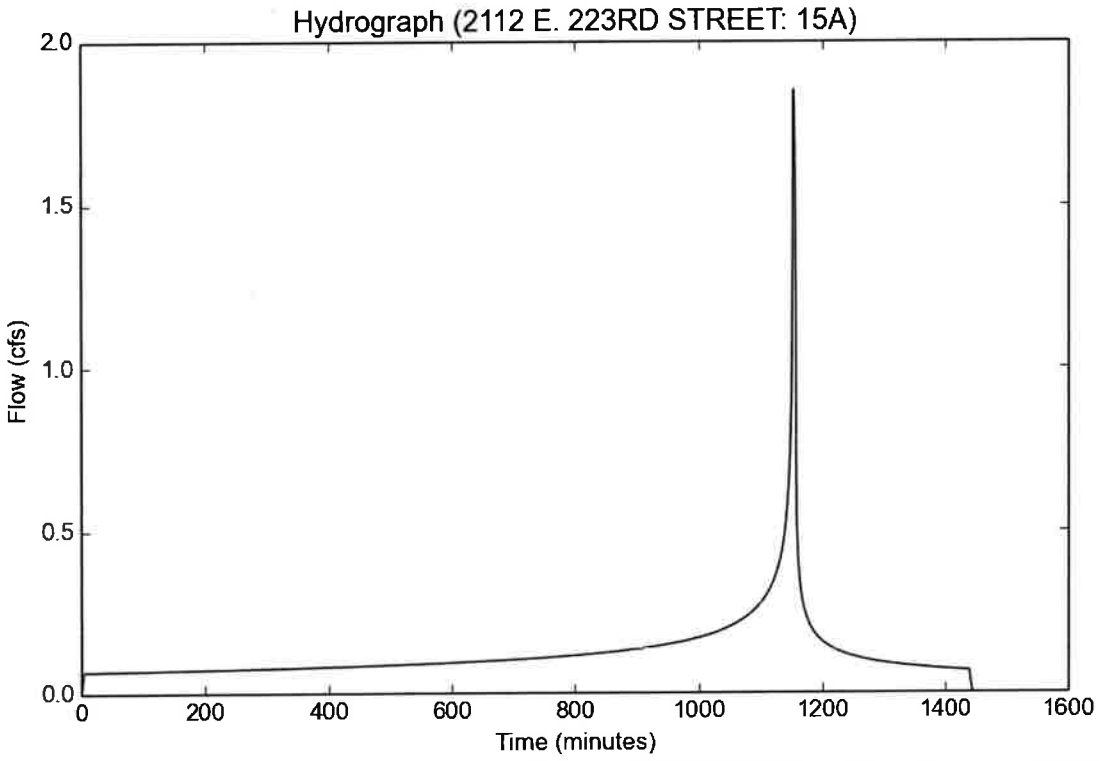
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	15A
Area (ac)	0.6
Flow Path Length (ft)	101.0
Flow Path Slope (vft/hft)	0.018
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.849
Burned Peak Flow Rate (cfs)	1.849
24-Hr Clear Runoff Volume (ac-ft)	0.2447
24-Hr Clear Runoff Volume (cu-ft)	10659.4749



Peak Flow Hydrologic Analysis

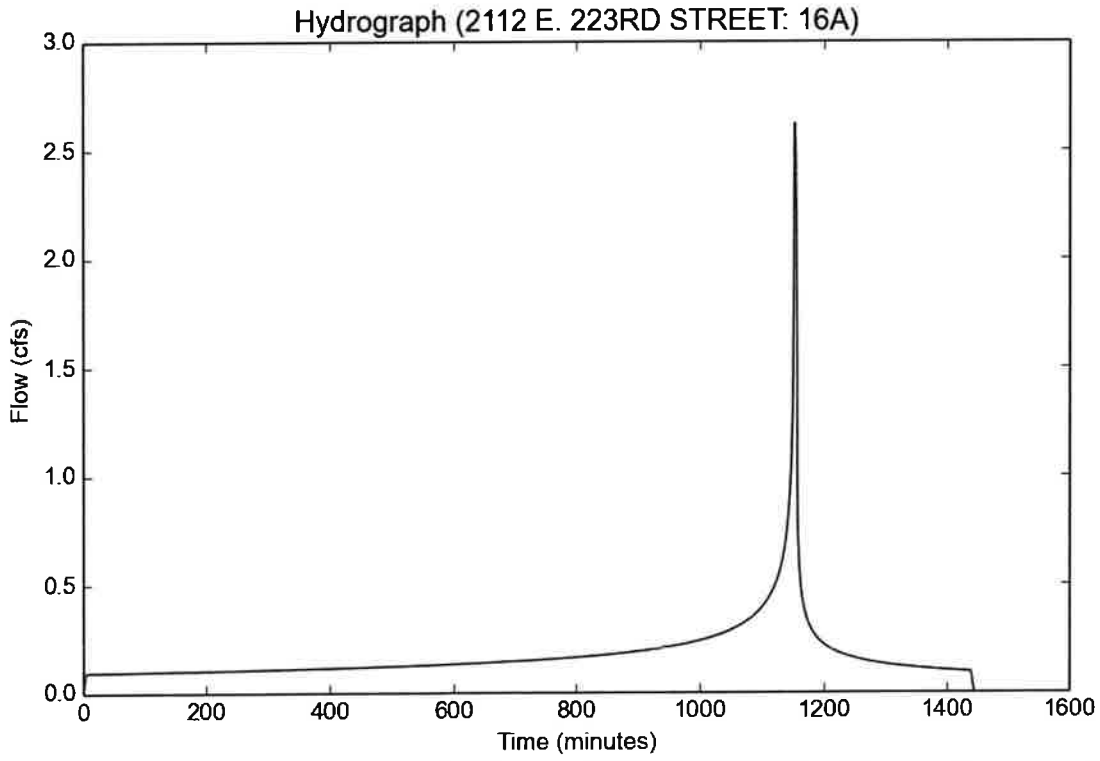
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	16A
Area (ac)	0.85
Flow Path Length (ft)	133.0
Flow Path Slope (vft/hft)	0.014
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.6194
Burned Peak Flow Rate (cfs)	2.6194
24-Hr Clear Runoff Volume (ac-ft)	0.3467
24-Hr Clear Runoff Volume (cu-ft)	15100.9228



Peak Flow Hydrologic Analysis

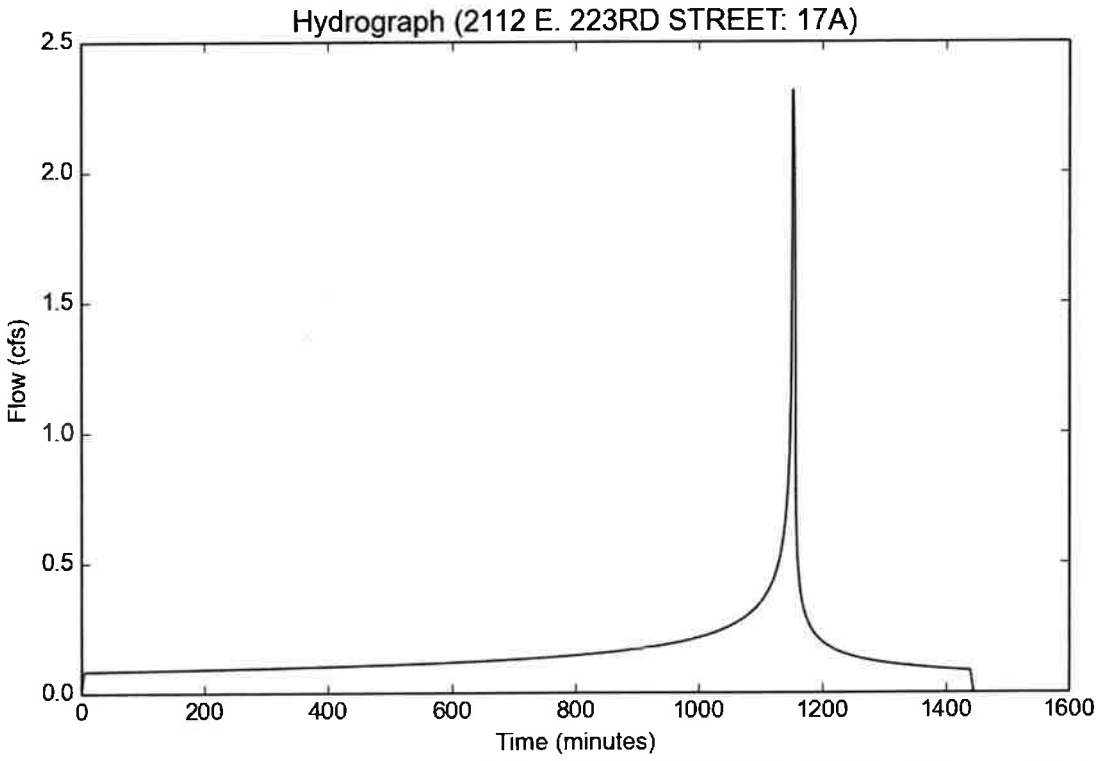
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	17A
Area (ac)	0.75
Flow Path Length (ft)	281.0
Flow Path Slope (vft/hft)	0.0078
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.3112
Burned Peak Flow Rate (cfs)	2.3112
24-Hr Clear Runoff Volume (ac-ft)	0.3059
24-Hr Clear Runoff Volume (cu-ft)	13324.3437



Peak Flow Hydrologic Analysis

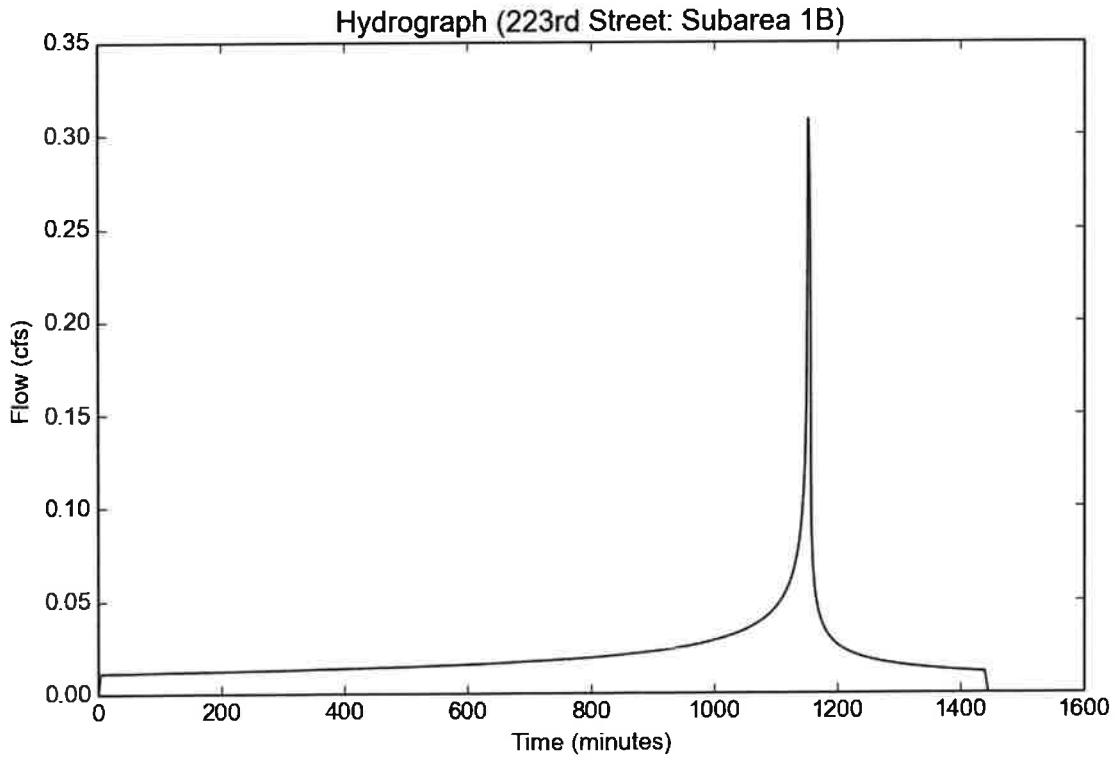
File location: O:/3800-3899/3826/hydrocalc/223rd Street - Subarea 1B.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	223rd Street
Subarea ID	Subarea 1B
Area (ac)	0.1
Flow Path Length (ft)	36.0
Flow Path Slope (vft/hft)	0.03
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.3082
Burned Peak Flow Rate (cfs)	0.3082
24-Hr Clear Runoff Volume (ac-ft)	0.0408
24-Hr Clear Runoff Volume (cu-ft)	1776.5792



Peak Flow Hydrologic Analysis

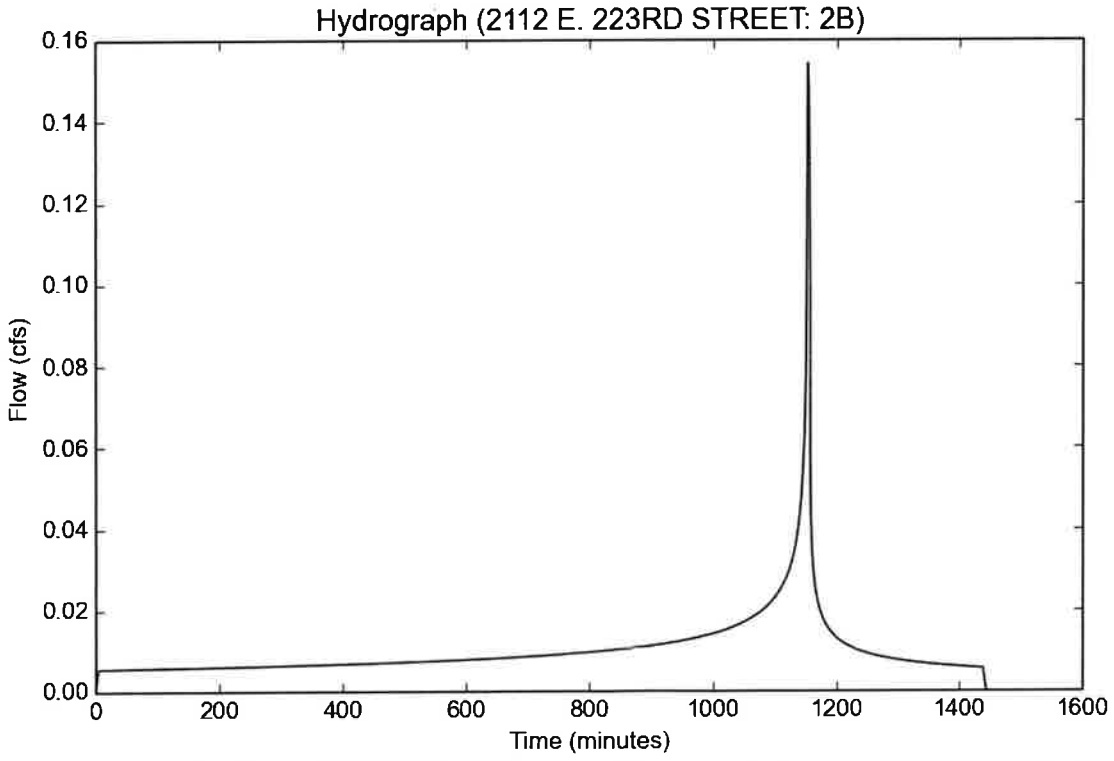
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	2B
Area (ac)	0.05
Flow Path Length (ft)	23.0
Flow Path Slope (vft/hft)	0.0118
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1541
Burned Peak Flow Rate (cfs)	0.1541
24-Hr Clear Runoff Volume (ac-ft)	0.0204
24-Hr Clear Runoff Volume (cu-ft)	888.2896



Peak Flow Hydrologic Analysis

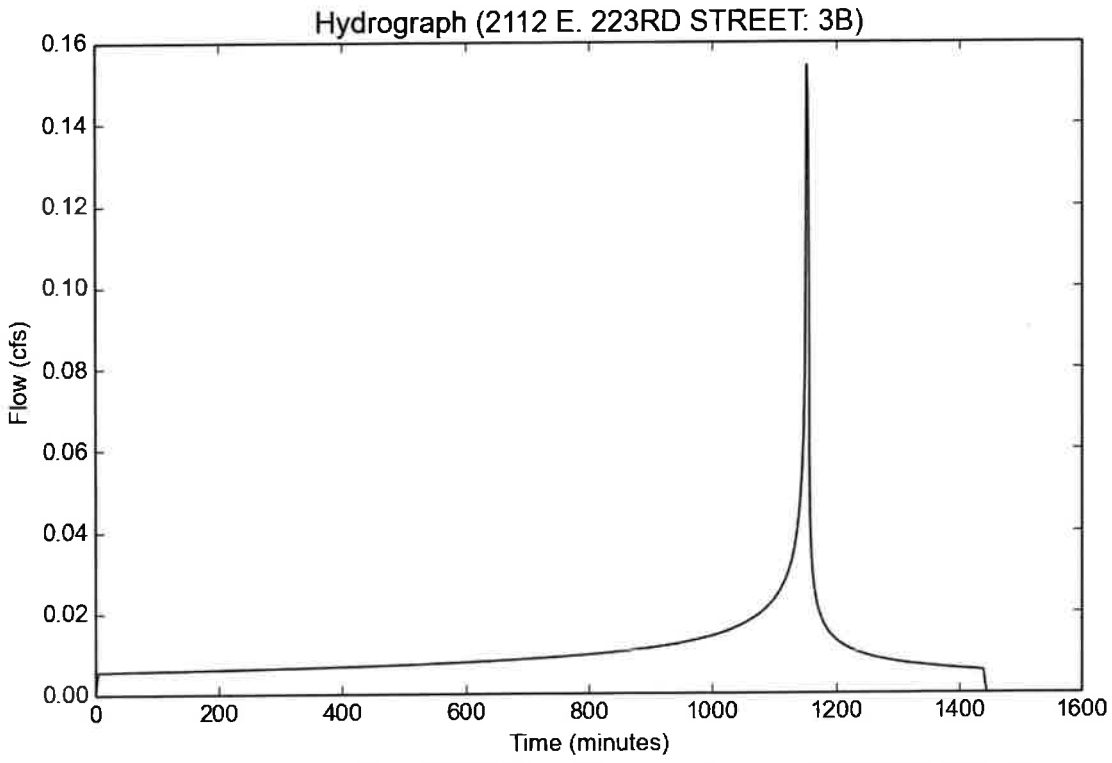
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	3B
Area (ac)	0.05
Flow Path Length (ft)	28.0
Flow Path Slope (vft/hft)	0.0292
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1541
Burned Peak Flow Rate (cfs)	0.1541
24-Hr Clear Runoff Volume (ac-ft)	0.0204
24-Hr Clear Runoff Volume (cu-ft)	888.2896



Peak Flow Hydrologic Analysis

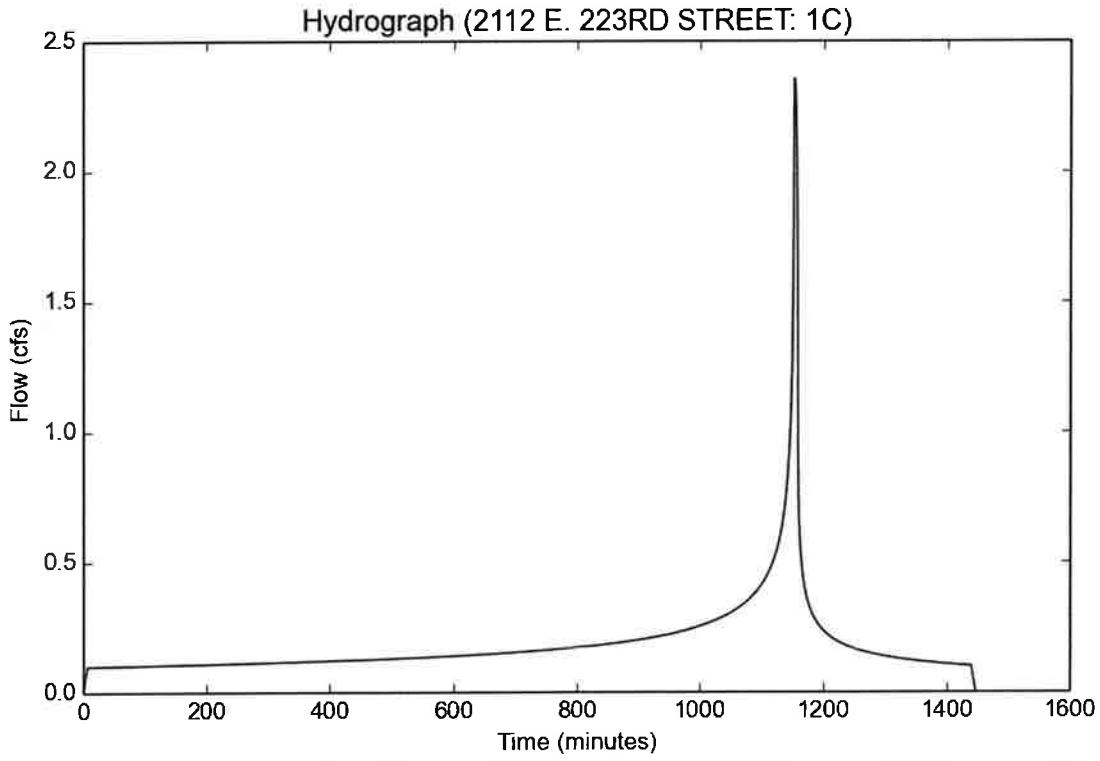
File location: O:/3800-3899/3826/hydrocalc/2112 E. 223RD STREET Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 E. 223RD STREET
Subarea ID	1C
Area (ac)	0.9
Flow Path Length (ft)	339.0
Flow Path Slope (vft/hft)	0.0018
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.0561
Undeveloped Runoff Coefficient (Cu)	0.456
Developed Runoff Coefficient (Cd)	0.8556
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	2.3534
Burned Peak Flow Rate (cfs)	2.3534
24-Hr Clear Runoff Volume (ac-ft)	0.367
24-Hr Clear Runoff Volume (cu-ft)	15986.9357



APPENDIX B

DETENTION CALCULATIONS

BUILDING "A" TRUCK YARD

Elevation	Depth (feet)	Area (sq. ft.)	Volume (c.f.)	Σ Volume (c.f.)	Σ Volume (ac-ft)
20.50	0.00	0			
			53	53	0.00
20.60	0.10	1051			
			1146	1198	0.03
20.80	0.30	10408			
			3420	4619	0.11
21.00	0.50	23795			
			5243	9861	0.23
21.20	0.70	28631			
			1468	11330	0.26
21.25	0.75	30100			

Peak Flow Hydrologic Analysis

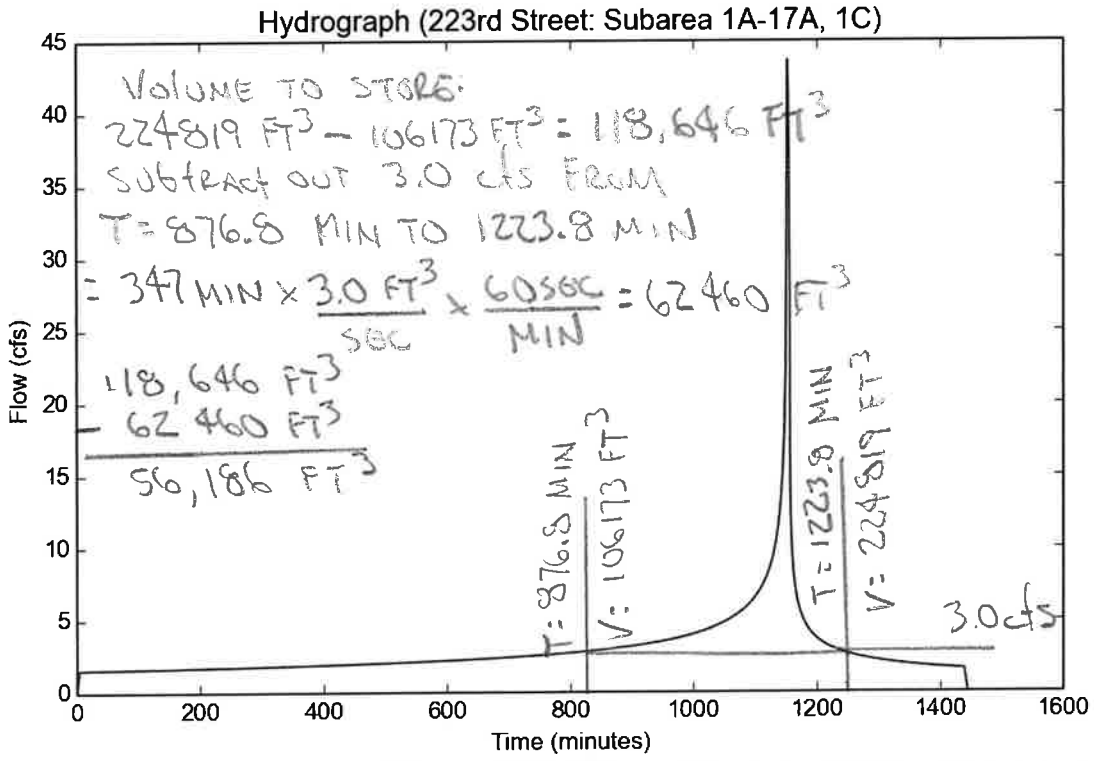
File location: O:/3800-3899/3826/hydrocalc/223rd Street - Subarea 1A-17A, 1C.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	223rd Street
Subarea ID	Subarea 1A-17A, 1C
Area (ac)	14.15
Flow Path Length (ft)	292.0
Flow Path Slope (vft/hft)	0.0093
50-yr Rainfall Depth (in)	6.0
Percent Impervious	0.9
Soil Type	3
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	6.0
Peak Intensity (in/hr)	3.5798
Undeveloped Runoff Coefficient (Cu)	0.5084
Developed Runoff Coefficient (Cd)	0.8608
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	43.6049
Burned Peak Flow Rate (cfs)	43.6049
24-Hr Clear Runoff Volume (ac-ft)	5.771
24-Hr Clear Runoff Volume (cu-ft)	251385.9503



TIME								ΣVOLUME
873.4	0.422984	2.537902	0.257121	0.1	0.82	2.983377	35.79455	105562.1
873.6	0.423127	2.538763	0.257207	0.1	0.82	2.984376	35.80652	105598
873.8	0.423271	2.539624	0.257293	0.1	0.82	2.985375	35.8185	105633.8
874	0.423414	2.540485	0.25738	0.1	0.82	2.986375	35.8305	105669.6
874.2	0.423558	2.541347	0.257466	0.1	0.82	2.987376	35.84251	105705.4
874.4	0.423701	2.542209	0.257552	0.1	0.82	2.988379	35.85453	105741.3
874.6	0.423845	2.543071	0.257639	0.1	0.82	2.989382	35.86657	105777.2
874.8	0.423989	2.543934	0.257725	0.1	0.82	2.990387	35.87861	105813
875	0.424133	2.544797	0.257812	0.1	0.82	2.991392	35.89068	105848.9
875.2	0.424277	2.54566	0.257899	0.1	0.82	2.992399	35.90275	105884.8
875.4	0.424421	2.546523	0.257986	0.1	0.82	2.993407	35.91483	105920.8
875.6	0.424565	2.547387	0.258073	0.1	0.82	2.994415	35.92693	105956.7
875.8	0.424709	2.548251	0.25816	0.1	0.82	2.995425	35.93904	105992.6
876	0.424853	2.549115	0.258247	0.1	0.82	2.996436	35.95117	106028.6
876.2	0.424997	2.54998	0.258334	0.1	0.82	2.997448	35.9633	106064.5
876.4	0.425141	2.550845	0.258421	0.1	0.82	2.998461	35.97545	106100.5
876.6	0.425285	2.55171	0.258509	0.1	0.82	2.999475	35.98762	106136.5
876.8	0.425429	2.552576	0.258596	0.1	0.82	3.00049	35.99979	106172.5
877	0.425574	2.553441	0.258684	0.1	0.82	3.001507	36.01198	106208.5
877.2	0.425718	2.554307	0.258771	0.1	0.82	3.002524	36.02418	106244.5
877.4	0.425862	2.555174	0.258859	0.1	0.82	3.003542	36.0364	106280.6
877.6	0.426007	2.556041	0.258947	0.1	0.82	3.004562	36.04862	106316.6
877.8	0.426151	2.556908	0.259035	0.1	0.82	3.005582	36.06086	106352.7
878	0.426296	2.557775	0.259123	0.1	0.82	3.006604	36.07312	106388.8
878.2	0.42644	2.558642	0.259211	0.1	0.82	3.007627	36.08538	106424.8
878.4	0.426585	2.55951	0.259299	0.1	0.82	3.00865	36.09766	106460.9
878.6	0.42673	2.560378	0.259388	0.1	0.82	3.009675	36.10995	106497
878.8	0.426874	2.561247	0.259476	0.1	0.82	3.010701	36.12226	106533.2
879	0.427019	2.562116	0.259565	0.1	0.82	3.011728	36.13458	106569.3
879.2	0.427164	2.562985	0.259653	0.1	0.82	3.012757	36.14691	106605.4
879.4	0.427309	2.563854	0.259742	0.1	0.82	3.013786	36.15925	106641.6
879.6	0.427454	2.564724	0.259831	0.1	0.82	3.014816	36.17161	106677.8
879.8	0.427599	2.565594	0.25992	0.1	0.82	3.015848	36.18398	106714
880	0.427744	2.566464	0.260009	0.1	0.82	3.01688	36.19637	106750.2
880.2	0.427889	2.567335	0.260098	0.1	0.82	3.017914	36.20877	106786.4
880.4	0.428034	2.568206	0.260187	0.1	0.82	3.018949	36.22118	106822.6
880.6	0.428179	2.569077	0.260276	0.1	0.82	3.019985	36.2336	106858.8
880.8	0.428325	2.569948	0.260366	0.1	0.82	3.021022	36.24604	106895.1
881	0.42847	2.57082	0.260455	0.1	0.82	3.02206	36.25849	106931.3
881.2	0.428615	2.571692	0.260545	0.1	0.82	3.023099	36.27095	106967.6
881.4	0.428761	2.572564	0.260634	0.1	0.82	3.02414	36.28343	107003.9
881.6	0.428906	2.573437	0.260724	0.1	0.82	3.025181	36.29592	107040.2
881.8	0.429052	2.57431	0.260814	0.1	0.82	3.026224	36.30843	107076.5
882	0.429197	2.575183	0.260904	0.1	0.82	3.027267	36.32095	107112.8
882.2	0.429343	2.576057	0.260994	0.1	0.82	3.028312	36.33348	107149.1
882.4	0.429488	2.576931	0.261084	0.1	0.82	3.029358	36.34602	107185.5
882.6	0.429634	2.577805	0.261174	0.1	0.82	3.030405	36.35858	107221.8

882.8	0.42978	2.57868	0.261265	0.1	0.82	3.031454	36.37115	107258.2
883	0.429926	2.579554	0.261355	0.1	0.82	3.032503	36.38374	107294.6
883.2	0.430072	2.58043	0.261446	0.1	0.82	3.033554	36.39634	107331
883.4	0.430217	2.581305	0.261536	0.1	0.82	3.034605	36.40895	107367.4
883.6	0.430363	2.582181	0.261627	0.1	0.82	3.035658	36.42158	107403.8
883.8	0.430509	2.583057	0.261718	0.1	0.82	3.036712	36.43422	107440.3
884	0.430656	2.583933	0.261809	0.1	0.82	3.037767	36.44688	107476.7
884.2	0.430802	2.58481	0.2619	0.1	0.82	3.038823	36.45954	107513.2
884.4	0.430948	2.585687	0.261991	0.1	0.82	3.039881	36.47223	107549.6
884.6	0.431094	2.586564	0.262082	0.1	0.82	3.040939	36.48492	107586.1
884.8	0.43124	2.587442	0.262174	0.1	0.82	3.041999	36.49763	107622.6
885	0.431387	2.588319	0.262265	0.1	0.82	3.04306	36.51035	107659.1
885.2	0.431533	2.589198	0.262356	0.1	0.82	3.044122	36.52309	107695.7
885.4	0.431679	2.590076	0.262448	0.1	0.82	3.045185	36.53584	107732.2
885.6	0.431826	2.590955	0.26254	0.1	0.82	3.04625	36.54861	107768.7
885.8	0.431972	2.591834	0.262632	0.1	0.82	3.047315	36.56139	107805.3
886	0.432119	2.592714	0.262724	0.1	0.82	3.048382	36.57418	107841.9
886.2	0.432266	2.593593	0.262816	0.1	0.82	3.04945	36.58699	107878.5
886.4	0.432412	2.594473	0.262908	0.1	0.82	3.050519	36.59981	107915.1
886.6	0.432559	2.595354	0.263	0.1	0.82	3.051589	36.61264	107951.7
886.8	0.432706	2.596234	0.263092	0.1	0.82	3.05266	36.62549	107988.3
887	0.432853	2.597115	0.263185	0.1	0.82	3.053733	36.63836	108024.9
887.2	0.432999	2.597997	0.263277	0.1	0.82	3.054806	36.65124	108061.6
887.4	0.433146	2.598878	0.26337	0.1	0.82	3.055881	36.66413	108098.3
887.6	0.433293	2.59976	0.263463	0.1	0.82	3.056957	36.67703	108134.9
887.8	0.43344	2.600643	0.263556	0.1	0.82	3.058035	36.68995	108171.6
888	0.433588	2.601525	0.263648	0.1	0.82	3.059113	36.70289	108208.3
888.2	0.433735	2.602408	0.263742	0.1	0.82	3.060193	36.71584	108245
888.4	0.433882	2.603291	0.263835	0.1	0.82	3.061274	36.7288	108281.8
888.6	0.434029	2.604175	0.263928	0.1	0.82	3.062356	36.74178	108318.5
888.8	0.434176	2.605059	0.264021	0.1	0.82	3.063439	36.75477	108355.3
889	0.434324	2.605943	0.264115	0.1	0.82	3.064523	36.76777	108392
889.2	0.434471	2.606827	0.264208	0.1	0.82	3.065609	36.78079	108428.8
889.4	0.434619	2.607712	0.264302	0.1	0.82	3.066696	36.79383	108465.6
889.6	0.434766	2.608597	0.264396	0.1	0.82	3.067784	36.80688	108502.4
889.8	0.434914	2.609482	0.26449	0.1	0.82	3.068873	36.81994	108539.2
890	0.435061	2.610368	0.264584	0.1	0.82	3.069964	36.83302	108576.1
890.2	0.435209	2.611254	0.264678	0.1	0.82	3.071055	36.84611	108612.9
890.4	0.435357	2.612141	0.264772	0.1	0.82	3.072148	36.85922	108649.8
890.6	0.435505	2.613027	0.264866	0.1	0.82	3.073242	36.87234	108686.6
890.8	0.435652	2.613914	0.264961	0.1	0.82	3.074338	36.88548	108723.5
891	0.4358	2.614802	0.265055	0.1	0.82	3.075434	36.89863	108760.4
891.2	0.435948	2.615689	0.26515	0.1	0.82	3.076532	36.9118	108797.3
891.4	0.436096	2.616577	0.265244	0.1	0.82	3.077631	36.92498	108834.3
891.6	0.436244	2.617465	0.265339	0.1	0.82	3.078731	36.93817	108871.2
891.8	0.436392	2.618354	0.265434	0.1	0.82	3.079833	36.95138	108908.2
892	0.43654	2.619243	0.265529	0.1	0.82	3.080935	36.96461	108945.1

892.2	0.436689	2.620132	0.265624	0.1	0.82	3.082039	36.97785	108982.1
892.4	0.436837	2.621022	0.26572	0.1	0.82	3.083145	36.9911	109019.1
892.6	0.436985	2.621912	0.265815	0.1	0.82	3.084251	37.00437	109056.1
892.8	0.437134	2.622802	0.26591	0.1	0.82	3.085359	37.01766	109093.1
893	0.437282	2.623692	0.266006	0.1	0.82	3.086468	37.03096	109130.1
893.2	0.437431	2.624583	0.266102	0.1	0.82	3.087578	37.04427	109167.2
893.4	0.437579	2.625474	0.266197	0.1	0.82	3.088689	37.0576	109204.2
893.6	0.437728	2.626366	0.266293	0.1	0.82	3.089802	37.07094	109241.3
893.8	0.437876	2.627258	0.266389	0.1	0.82	3.090916	37.0843	109278.4
894	0.438025	2.62815	0.266485	0.1	0.82	3.092031	37.09768	109315.5
894.2	0.438174	2.629042	0.266582	0.1	0.82	3.093147	37.11107	109352.6
894.4	0.438323	2.629935	0.266678	0.1	0.82	3.094265	37.12447	109389.7
894.6	0.438471	2.630828	0.266774	0.1	0.82	3.095384	37.13789	109426.9
894.8	0.43862	2.631722	0.266871	0.1	0.82	3.096504	37.15133	109464
895	0.438769	2.632615	0.266968	0.1	0.82	3.097626	37.16478	109501.2
895.2	0.438918	2.63351	0.267064	0.1	0.82	3.098748	37.17824	109538.4
895.4	0.439067	2.634404	0.267161	0.1	0.82	3.099872	37.19172	109575.6
895.6	0.439216	2.635299	0.267258	0.1	0.82	3.100998	37.20522	109612.8
895.8	0.439366	2.636194	0.267355	0.1	0.82	3.102124	37.21873	109650
896	0.439515	2.637089	0.267453	0.1	0.82	3.103252	37.23226	109687.2
896.2	0.439664	2.637985	0.26755	0.1	0.82	3.104381	37.2458	109724.5
896.4	0.439814	2.638881	0.267647	0.1	0.82	3.105512	37.25936	109761.7
896.6	0.439963	2.639777	0.267745	0.1	0.82	3.106643	37.27293	109799
896.8	0.440112	2.640674	0.267842	0.1	0.82	3.107776	37.28652	109836.3
897	0.440262	2.641571	0.26794	0.1	0.82	3.108911	37.30012	109873.6
897.2	0.440411	2.642469	0.268038	0.1	0.82	3.110046	37.31374	109910.9
897.4	0.440561	2.643366	0.268136	0.1	0.82	3.111183	37.32738	109948.2
897.6	0.440711	2.644264	0.268234	0.1	0.82	3.112321	37.34103	109985.6
897.8	0.44086	2.645163	0.268332	0.1	0.82	3.113461	37.35469	110022.9
898	0.44101	2.646062	0.268431	0.1	0.82	3.114602	37.36838	110060.3
898.2	0.44116	2.646961	0.268529	0.1	0.82	3.115744	37.38207	110097.7
898.4	0.44131	2.64786	0.268628	0.1	0.82	3.116887	37.39579	110135.1
898.6	0.44146	2.64876	0.268726	0.1	0.82	3.118032	37.40952	110172.5
898.8	0.44161	2.64966	0.268825	0.1	0.82	3.119178	37.42326	110209.9
899	0.44176	2.65056	0.268924	0.1	0.82	3.120325	37.43702	110247.3
899.2	0.44191	2.651461	0.269023	0.1	0.82	3.121474	37.4508	110284.8
899.4	0.44206	2.652362	0.269122	0.1	0.82	3.122624	37.46459	110322.2
899.6	0.442211	2.653263	0.269221	0.1	0.82	3.123776	37.4784	110359.7
899.8	0.442361	2.654165	0.269321	0.1	0.82	3.124928	37.49222	110397.2
900	0.442511	2.655067	0.26942	0.1	0.82	3.126082	37.50606	110434.7
900.2	0.442662	2.65597	0.26952	0.1	0.82	3.127238	37.51992	110472.2
900.4	0.442812	2.656872	0.269619	0.1	0.82	3.128394	37.53379	110509.8
900.6	0.442963	2.657775	0.269719	0.1	0.82	3.129552	37.54768	110547.3
900.8	0.443113	2.658679	0.269819	0.1	0.82	3.130712	37.56158	110584.9
901	0.443264	2.659582	0.269919	0.1	0.82	3.131872	37.5755	110622.5
901.2	0.443414	2.660487	0.270019	0.1	0.82	3.133034	37.58944	110660.1
901.4	0.443565	2.661391	0.27012	0.1	0.82	3.134198	37.60339	110697.7

901.6	0.443716	2.662296	0.27022	0.1	0.82	3.135363	37.61736	110735.3
901.8	0.443867	2.663201	0.27032	0.1	0.82	3.136529	37.63135	110772.9
902	0.444018	2.664106	0.270421	0.1	0.82	3.137696	37.64535	110810.5
902.2	0.444169	2.665012	0.270522	0.1	0.82	3.138865	37.65937	110848.2
902.4	0.44432	2.665918	0.270623	0.1	0.82	3.140035	37.6734	110885.9
902.6	0.444471	2.666825	0.270724	0.1	0.82	3.141207	37.68745	110923.6
902.8	0.444622	2.667732	0.270825	0.1	0.82	3.14238	37.70152	110961.3
903	0.444773	2.668639	0.270926	0.1	0.82	3.143554	37.7156	110999
903.2	0.444924	2.669546	0.271027	0.1	0.82	3.14473	37.7297	111036.7
903.4	0.445076	2.670454	0.271129	0.1	0.82	3.145907	37.74382	111074.5
903.6	0.445227	2.671362	0.27123	0.1	0.82	3.147085	37.75795	111112.2
903.8	0.445378	2.672271	0.271332	0.1	0.82	3.148265	37.7721	111150
904	0.44553	2.67318	0.271434	0.1	0.82	3.149446	37.78627	111187.8
904.2	0.445681	2.674089	0.271536	0.1	0.82	3.150629	37.80045	111225.6
904.4	0.445833	2.674998	0.271638	0.1	0.82	3.151813	37.81465	111263.4
904.6	0.445985	2.675908	0.27174	0.1	0.82	3.152998	37.82886	111301.2
904.8	0.446136	2.676819	0.271842	0.1	0.82	3.154185	37.8431	111339.1
905	0.446288	2.677729	0.271945	0.1	0.82	3.155373	37.85735	111376.9
905.2	0.44644	2.67864	0.272047	0.1	0.82	3.156563	37.87161	111414.8
905.4	0.446592	2.679551	0.27215	0.1	0.82	3.157753	37.8859	111452.7
905.6	0.446744	2.680463	0.272253	0.1	0.82	3.158946	37.9002	111490.6
905.8	0.446896	2.681375	0.272355	0.1	0.82	3.16014	37.91451	111528.5
906	0.447048	2.682287	0.272458	0.1	0.82	3.161335	37.92885	111566.4
906.2	0.4472	2.6832	0.272562	0.1	0.82	3.162531	37.9432	111604.4
906.4	0.447352	2.684113	0.272665	0.1	0.82	3.163729	37.95757	111642.3
906.6	0.447504	2.685026	0.272768	0.1	0.82	3.164929	37.97195	111680.3
906.8	0.447657	2.68594	0.272872	0.1	0.82	3.16613	37.98635	111718.3
907	0.447809	2.686854	0.272975	0.1	0.82	3.167332	38.00077	111756.3
907.2	0.447961	2.687769	0.273079	0.1	0.82	3.168536	38.01521	111794.3
907.4	0.448114	2.688683	0.273183	0.1	0.82	3.169741	38.02966	111832.3
907.6	0.448266	2.689599	0.273287	0.1	0.82	3.170947	38.04413	111870.4
907.8	0.448419	2.690514	0.273391	0.1	0.82	3.172156	38.05862	111908.4
908	0.448572	2.69143	0.273495	0.1	0.82	3.173365	38.07312	111946.5
908.2	0.448724	2.692346	0.2736	0.1	0.82	3.174576	38.08765	111984.6
908.4	0.448877	2.693263	0.273704	0.1	0.82	3.175788	38.10218	112022.7
908.6	0.44903	2.69418	0.273809	0.1	0.82	3.177002	38.11674	112060.8
908.8	0.449183	2.695097	0.273913	0.1	0.82	3.178217	38.13132	112098.9
909	0.449336	2.696014	0.274018	0.1	0.82	3.179434	38.14591	112137.1
909.2	0.449489	2.696932	0.274123	0.1	0.82	3.180652	38.16052	112175.2
909.4	0.449642	2.697851	0.274228	0.1	0.82	3.181872	38.17514	112213.4
909.6	0.449795	2.698769	0.274334	0.1	0.82	3.183093	38.18979	112251.6
909.8	0.449948	2.699688	0.274439	0.1	0.82	3.184315	38.20445	112289.8
910	0.450101	2.700608	0.274544	0.1	0.82	3.18554	38.21913	112328
910.2	0.450255	2.701528	0.27465	0.1	0.82	3.186765	38.23383	112366.3
910.4	0.450408	2.702448	0.274756	0.1	0.82	3.187992	38.24854	112404.5
910.6	0.450561	2.703368	0.274862	0.1	0.82	3.18922	38.26327	112442.8
910.8	0.450715	2.704289	0.274968	0.1	0.82	3.19045	38.27803	112481.1

911	0.450868	2.70521	0.275074	0.1	0.82	3.191682	38.29279	112519.4
911.2	0.451022	2.706132	0.27518	0.1	0.82	3.192915	38.30758	112557.7
911.4	0.451176	2.707054	0.275286	0.1	0.82	3.194149	38.32238	112596
911.6	0.451329	2.707976	0.275393	0.1	0.82	3.195385	38.33721	112634.3
911.8	0.451483	2.708898	0.2755	0.1	0.82	3.196622	38.35205	112672.7
912	0.451637	2.709821	0.275606	0.1	0.82	3.197861	38.3669	112711
912.2	0.451791	2.710745	0.275713	0.1	0.82	3.199102	38.38178	112749.4
912.4	0.451945	2.711669	0.27582	0.1	0.82	3.200344	38.39667	112787.8
912.6	0.452099	2.712593	0.275928	0.1	0.82	3.201587	38.41158	112826.2
912.8	0.452253	2.713517	0.276035	0.1	0.82	3.202832	38.42651	112864.7
913	0.452407	2.714442	0.276142	0.1	0.82	3.204078	38.44146	112903.1
913.2	0.452561	2.715367	0.27625	0.1	0.82	3.205326	38.45643	112941.6
913.4	0.452715	2.716292	0.276357	0.1	0.82	3.206576	38.47141	112980
913.6	0.45287	2.717218	0.276465	0.1	0.82	3.207827	38.48642	113018.5
913.8	0.453024	2.718145	0.276573	0.1	0.82	3.209079	38.50144	113057
914	0.453179	2.719071	0.276681	0.1	0.82	3.210334	38.51648	113095.5
914.2	0.453333	2.719998	0.27679	0.1	0.82	3.211589	38.53154	113134.1
914.4	0.453488	2.720926	0.276898	0.1	0.82	3.212846	38.54661	113172.6
914.6	0.453642	2.721853	0.277006	0.1	0.82	3.214105	38.56171	113211.2
914.8	0.453797	2.722781	0.277115	0.1	0.82	3.215365	38.57682	113249.7
915	0.453952	2.72371	0.277224	0.1	0.82	3.216627	38.59195	113288.3
915.2	0.454106	2.724639	0.277333	0.1	0.82	3.21789	38.6071	113326.9
915.4	0.454261	2.725568	0.277442	0.1	0.82	3.219155	38.62227	113365.6
915.6	0.454416	2.726497	0.277551	0.1	0.82	3.220422	38.63746	113404.2
915.8	0.454571	2.727427	0.27766	0.1	0.82	3.22169	38.65267	113442.9
916	0.454726	2.728358	0.277769	0.1	0.82	3.222959	38.66789	113481.5
916.2	0.454881	2.729288	0.277879	0.1	0.82	3.22423	38.68314	113520.2
916.4	0.455037	2.730219	0.277989	0.1	0.82	3.225503	38.6984	113558.9
916.6	0.455192	2.731151	0.278099	0.1	0.82	3.226777	38.71368	113597.6
916.8	0.455347	2.732083	0.278208	0.1	0.82	3.228053	38.72898	113636.3
917	0.455502	2.733015	0.278319	0.1	0.82	3.22933	38.7443	113675.1
917.2	0.455658	2.733947	0.278429	0.1	0.82	3.230609	38.75964	113713.9
917.4	0.455813	2.73488	0.278539	0.1	0.82	3.23189	38.775	113752.6
917.6	0.455969	2.735813	0.27865	0.1	0.82	3.233172	38.79037	113791.4
917.8	0.456125	2.736747	0.27876	0.1	0.82	3.234456	38.80577	113830.2
918	0.45628	2.737681	0.278871	0.1	0.82	3.235741	38.82118	113869
918.2	0.456436	2.738615	0.278982	0.1	0.82	3.237028	38.83662	113907.9
918.4	0.456592	2.73955	0.279093	0.1	0.82	3.238317	38.85207	113946.7
918.6	0.456748	2.740485	0.279204	0.1	0.82	3.239607	38.86754	113985.6
918.8	0.456903	2.741421	0.279316	0.1	0.82	3.240899	38.88303	114024.5
919	0.457059	2.742357	0.279427	0.1	0.82	3.242192	38.89854	114063.4
919.2	0.457216	2.743293	0.279539	0.1	0.82	3.243487	38.91408	114102.3
919.4	0.457372	2.74423	0.27965	0.1	0.82	3.244784	38.92962	114141.2
919.6	0.457528	2.745167	0.279762	0.1	0.82	3.246082	38.94519	114180.2
919.8	0.457684	2.746104	0.279874	0.1	0.82	3.247382	38.96078	114219.1
920	0.45784	2.747042	0.279986	0.1	0.82	3.248683	38.97639	114258.1
920.2	0.457997	2.74798	0.280099	0.1	0.82	3.249986	38.99202	114297.1

920.4	0.458153	2.748919	0.280211	0.1	0.82	3.251291	39.00767	114336.1
920.6	0.45831	2.749858	0.280324	0.1	0.82	3.252598	39.02333	114375.1
920.8	0.458466	2.750797	0.280437	0.1	0.82	3.253906	39.03902	114414.2
921	0.458623	2.751737	0.280549	0.1	0.82	3.255215	39.05473	114453.2
921.2	0.458779	2.752677	0.280662	0.1	0.82	3.256527	39.07045	114492.3
921.4	0.458936	2.753617	0.280776	0.1	0.82	3.25784	39.0862	114531.4
921.6	0.459093	2.754558	0.280889	0.1	0.82	3.259154	39.10197	114570.5
921.8	0.45925	2.755499	0.281002	0.1	0.82	3.260471	39.11775	114609.6
922	0.459407	2.756441	0.281116	0.1	0.82	3.261789	39.13356	114648.7
922.2	0.459564	2.757383	0.28123	0.1	0.82	3.263108	39.14938	114687.9
922.4	0.459721	2.758325	0.281344	0.1	0.82	3.26443	39.16523	114727
922.6	0.459878	2.759268	0.281458	0.1	0.82	3.265753	39.18109	114766.2
922.8	0.460035	2.760211	0.281572	0.1	0.82	3.267077	39.19698	114805.4
923	0.460192	2.761155	0.281686	0.1	0.82	3.268404	39.21289	114844.6
923.2	0.46035	2.762099	0.281801	0.1	0.82	3.269732	39.22881	114883.9
923.4	0.460507	2.763043	0.281915	0.1	0.82	3.271062	39.24476	114923.1
923.6	0.460665	2.763988	0.28203	0.1	0.82	3.272393	39.26073	114962.4
923.8	0.460822	2.764933	0.282145	0.1	0.82	3.273726	39.27671	115001.7
924	0.46098	2.765878	0.28226	0.1	0.82	3.275061	39.29272	115040.9
924.2	0.461137	2.766824	0.282375	0.1	0.82	3.276397	39.30875	115080.3
924.4	0.461295	2.767771	0.28249	0.1	0.82	3.277736	39.3248	115119.6
924.6	0.461453	2.768717	0.282606	0.1	0.82	3.279076	39.34087	115158.9
924.8	0.461611	2.769664	0.282721	0.1	0.82	3.280417	39.35696	115198.3
925	0.461769	2.770612	0.282837	0.1	0.82	3.281761	39.37307	115237.6
925.2	0.461927	2.77156	0.282953	0.1	0.82	3.283106	39.3892	115277
925.4	0.462085	2.772508	0.283069	0.1	0.82	3.284453	39.40535	115316.4
925.6	0.462243	2.773457	0.283185	0.1	0.82	3.285801	39.42152	115355.9
925.8	0.462401	2.774406	0.283302	0.1	0.82	3.287151	39.43772	115395.3
926	0.462559	2.775355	0.283418	0.1	0.82	3.288503	39.45393	115434.8
926.2	0.462717	2.776305	0.283535	0.1	0.82	3.289857	39.47016	115474.2
926.4	0.462876	2.777255	0.283652	0.1	0.82	3.291213	39.48642	115513.7
926.6	0.463034	2.778206	0.283769	0.1	0.82	3.29257	39.5027	115553.2
926.8	0.463193	2.779157	0.283886	0.1	0.82	3.293929	39.51899	115592.7
927	0.463351	2.780108	0.284003	0.1	0.82	3.29529	39.53531	115632.3
927.2	0.46351	2.78106	0.284121	0.1	0.82	3.296652	39.55165	115671.8
927.4	0.463669	2.782012	0.284238	0.1	0.82	3.298017	39.56801	115711.4
927.6	0.463827	2.782965	0.284356	0.1	0.82	3.299383	39.5844	115751
927.8	0.463986	2.783918	0.284474	0.1	0.82	3.300751	39.6008	115790.6
928	0.464145	2.784871	0.284592	0.1	0.82	3.30212	39.61722	115830.2
928.2	0.464304	2.785825	0.28471	0.1	0.82	3.303492	39.63367	115869.8
928.4	0.464463	2.786779	0.284828	0.1	0.82	3.304865	39.65014	115909.5
928.6	0.464622	2.787733	0.284947	0.1	0.82	3.30624	39.66663	115949.1
928.8	0.464781	2.788688	0.285066	0.1	0.82	3.307616	39.68314	115988.8
929	0.464941	2.789644	0.285184	0.1	0.82	3.308995	39.69967	116028.5
929.2	0.4651	2.7906	0.285303	0.1	0.82	3.310375	39.71622	116068.2
929.4	0.465259	2.791556	0.285423	0.1	0.82	3.311757	39.7328	116108
929.6	0.465419	2.792512	0.285542	0.1	0.82	3.313141	39.74939	116147.7

929.8	0.465578	2.793469	0.285661	0.1	0.82	3.314527	39.76601	116187.5
930	0.465738	2.794427	0.285781	0.1	0.82	3.315915	39.78265	116227.3
930.2	0.465897	2.795385	0.285901	0.1	0.82	3.317304	39.79931	116267.1
930.4	0.466057	2.796343	0.28602	0.1	0.82	3.318695	39.816	116306.9
930.6	0.466217	2.797302	0.286141	0.1	0.82	3.320088	39.8327	116346.7
930.8	0.466377	2.798261	0.286261	0.1	0.82	3.321483	39.84943	116386.6
931	0.466537	2.79922	0.286381	0.1	0.82	3.32288	39.86618	116426.4
931.2	0.466697	2.80018	0.286502	0.1	0.82	3.324279	39.88295	116466.3
931.4	0.466857	2.80114	0.286622	0.1	0.82	3.325679	39.89974	116506.2
931.6	0.467017	2.802101	0.286743	0.1	0.82	3.327081	39.91656	116546.1
931.8	0.467177	2.803062	0.286864	0.1	0.82	3.328485	39.9334	116586.1
932	0.467337	2.804023	0.286985	0.1	0.82	3.329891	39.95026	116626
932.2	0.467498	2.804985	0.287107	0.1	0.82	3.331299	39.96714	116666
932.4	0.467658	2.805948	0.287228	0.1	0.82	3.332709	39.98405	116706
932.6	0.467818	2.80691	0.28735	0.1	0.82	3.33412	40.00097	116746
932.8	0.467979	2.807873	0.287472	0.1	0.82	3.335534	40.01792	116786
933	0.46814	2.808837	0.287594	0.1	0.82	3.336949	40.03489	116826
933.2	0.4683	2.809801	0.287716	0.1	0.82	3.338366	40.05189	116866.1
933.4	0.468461	2.810765	0.287838	0.1	0.82	3.339785	40.06891	116906.1
933.6	0.468622	2.81173	0.287961	0.1	0.82	3.341206	40.08595	116946.2
933.8	0.468783	2.812695	0.288083	0.1	0.82	3.342629	40.10301	116986.3
934	0.468944	2.813661	0.288206	0.1	0.82	3.344054	40.12009	117026.5
934.2	0.469105	2.814627	0.288329	0.1	0.82	3.34548	40.1372	117066.6
934.4	0.469266	2.815594	0.288452	0.1	0.82	3.346909	40.15433	117106.7
934.6	0.469427	2.81656	0.288575	0.1	0.82	3.348339	40.17149	117146.9
934.8	0.469588	2.817528	0.288699	0.1	0.82	3.349772	40.18866	117187.1
935	0.469749	2.818495	0.288822	0.1	0.82	3.351206	40.20586	117227.3
935.2	0.469911	2.819464	0.288946	0.1	0.82	3.352642	40.22309	117267.5
935.4	0.470072	2.820432	0.28907	0.1	0.82	3.35408	40.24033	117307.8
935.6	0.470234	2.821401	0.289194	0.1	0.82	3.35552	40.2576	117348
935.8	0.470395	2.82237	0.289318	0.1	0.82	3.356962	40.27489	117388.3
936	0.470557	2.82334	0.289443	0.1	0.82	3.358406	40.29221	117428.6
936.2	0.470718	2.824311	0.289568	0.1	0.82	3.359852	40.30955	117468.9
936.4	0.47088	2.825281	0.289692	0.1	0.82	3.3613	40.32691	117509.2
936.6	0.471042	2.826252	0.289817	0.1	0.82	3.36275	40.3443	117549.6
936.8	0.471204	2.827224	0.289942	0.1	0.82	3.364201	40.3617	117589.9
937	0.471366	2.828196	0.290068	0.1	0.82	3.365655	40.37914	117630.3
937.2	0.471528	2.829168	0.290193	0.1	0.82	3.367111	40.39659	117670.7
937.4	0.47169	2.830141	0.290319	0.1	0.82	3.368568	40.41407	117711.1
937.6	0.471852	2.831114	0.290445	0.1	0.82	3.370028	40.43158	117751.6
937.8	0.472015	2.832088	0.29057	0.1	0.82	3.371489	40.4491	117792
938	0.472177	2.833062	0.290697	0.1	0.82	3.372953	40.46665	117832.5
938.2	0.472339	2.834036	0.290823	0.1	0.82	3.374419	40.48423	117873
938.4	0.472502	2.835011	0.290949	0.1	0.82	3.375886	40.50183	117913.5
938.6	0.472664	2.835987	0.291076	0.1	0.82	3.377356	40.51945	117954
938.8	0.472827	2.836962	0.291203	0.1	0.82	3.378827	40.5371	117994.5
939	0.47299	2.837939	0.29133	0.1	0.82	3.380301	40.55477	118035.1

939.2	0.473153	2.838915	0.291457	0.1	0.82	3.381776	40.57246	118075.6
939.4	0.473315	2.839892	0.291584	0.1	0.82	3.383254	40.59018	118116.2
939.6	0.473478	2.84087	0.291712	0.1	0.82	3.384734	40.60793	118156.8
939.8	0.473641	2.841848	0.29184	0.1	0.82	3.386215	40.62569	118197.5
940	0.473804	2.842826	0.291967	0.1	0.82	3.387699	40.64348	118238.1
940.2	0.473967	2.843805	0.292096	0.1	0.82	3.389185	40.6613	118278.8
940.4	0.474131	2.844784	0.292224	0.1	0.82	3.390672	40.67914	118319.5
940.6	0.474294	2.845764	0.292352	0.1	0.82	3.392162	40.69701	118360.2
940.8	0.474457	2.846744	0.292481	0.1	0.82	3.393654	40.7149	118400.9
941	0.474621	2.847724	0.292609	0.1	0.82	3.395148	40.73281	118441.6
941.2	0.474784	2.848705	0.292738	0.1	0.82	3.396644	40.75075	118482.4
941.4	0.474948	2.849687	0.292868	0.1	0.82	3.398142	40.76871	118523.1
941.6	0.475111	2.850669	0.292997	0.1	0.82	3.399642	40.7867	118563.9
941.8	0.475275	2.851651	0.293126	0.1	0.82	3.401144	40.80472	118604.7
942	0.475439	2.852634	0.293256	0.1	0.82	3.402648	40.82275	118645.5
942.2	0.475603	2.853617	0.293386	0.1	0.82	3.404155	40.84082	118686.4
942.4	0.475767	2.8546	0.293516	0.1	0.82	3.405663	40.85891	118727.2
942.6	0.475931	2.855585	0.293646	0.1	0.82	3.407173	40.87702	118768.1
942.8	0.476095	2.856569	0.293776	0.1	0.82	3.408686	40.89516	118809
943	0.476259	2.857554	0.293907	0.1	0.82	3.410201	40.91332	118849.9
943.2	0.476423	2.858539	0.294038	0.1	0.82	3.411718	40.93151	118890.9
943.4	0.476588	2.859525	0.294168	0.1	0.82	3.413236	40.94972	118931.8
943.6	0.476752	2.860511	0.2943	0.1	0.82	3.414758	40.96796	118972.8
943.8	0.476916	2.861498	0.294431	0.1	0.82	3.416281	40.98623	119013.8
944	0.477081	2.862485	0.294562	0.1	0.82	3.417806	41.00452	119054.8
944.2	0.477245	2.863473	0.294694	0.1	0.82	3.419333	41.02284	119095.8
944.4	0.47741	2.864461	0.294826	0.1	0.82	3.420863	41.04118	119136.8
944.6	0.477575	2.86545	0.294958	0.1	0.82	3.422395	41.05955	119177.9
944.8	0.47774	2.866438	0.29509	0.1	0.82	3.423928	41.07794	119219
945	0.477905	2.867428	0.295222	0.1	0.82	3.425464	41.09636	119260.1
945.2	0.47807	2.868418	0.295355	0.1	0.82	3.427003	41.1148	119301.2
945.4	0.478235	2.869408	0.295488	0.1	0.82	3.428543	41.13327	119342.3
945.6	0.4784	2.870399	0.295621	0.1	0.82	3.430085	41.15177	119383.5
945.8	0.478565	2.87139	0.295754	0.1	0.82	3.43163	41.17029	119424.6
946	0.47873	2.872382	0.295887	0.1	0.82	3.433177	41.18884	119465.8
946.2	0.478896	2.873374	0.296021	0.1	0.82	3.434726	41.20742	119507
946.4	0.479061	2.874366	0.296154	0.1	0.82	3.436277	41.22602	119548.2
946.6	0.479227	2.875359	0.296288	0.1	0.82	3.43783	41.24465	119589.5
946.8	0.479392	2.876353	0.296422	0.1	0.82	3.439386	41.2633	119630.8
947	0.479558	2.877347	0.296556	0.1	0.82	3.440944	41.28198	119672
947.2	0.479724	2.878341	0.296691	0.1	0.82	3.442504	41.30069	119713.3
947.4	0.479889	2.879336	0.296825	0.1	0.82	3.444066	41.31942	119754.7
947.6	0.480055	2.880331	0.29696	0.1	0.82	3.445631	41.33818	119796
947.8	0.480221	2.881327	0.297095	0.1	0.82	3.447197	41.35697	119837.4
948	0.480387	2.882323	0.297231	0.1	0.82	3.448766	41.37578	119878.7
948.2	0.480553	2.88332	0.297366	0.1	0.82	3.450337	41.39462	119920.1
948.4	0.48072	2.884317	0.297502	0.1	0.82	3.451911	41.41349	119961.5

948.6	0.480886	2.885315	0.297637	0.1	0.82	3.453486	41.43238	120003
948.8	0.481052	2.886313	0.297773	0.1	0.82	3.455064	41.4513	120044.4
949	0.481219	2.887311	0.29791	0.1	0.82	3.456644	41.47025	120085.9
949.2	0.481385	2.88831	0.298046	0.1	0.82	3.458227	41.48922	120127.4
949.4	0.481552	2.88931	0.298182	0.1	0.82	3.459811	41.50823	120168.9
949.6	0.481718	2.890309	0.298319	0.1	0.82	3.461398	41.52726	120210.4
949.8	0.481885	2.89131	0.298456	0.1	0.82	3.462987	41.54631	120252
950	0.482052	2.892311	0.298593	0.1	0.82	3.464579	41.5654	120293.5
950.2	0.482219	2.893312	0.298731	0.1	0.82	3.466173	41.58451	120335.1
950.4	0.482386	2.894314	0.298868	0.1	0.82	3.467769	41.60365	120376.7
950.6	0.482553	2.895316	0.299006	0.1	0.82	3.469367	41.62282	120418.3
950.8	0.48272	2.896319	0.299144	0.1	0.82	3.470968	41.64201	120460
951	0.482887	2.897322	0.299282	0.1	0.82	3.472571	41.66123	120501.6
951.2	0.483054	2.898325	0.299421	0.1	0.82	3.474176	41.68048	120543.3
951.4	0.483222	2.89933	0.299559	0.1	0.82	3.475784	41.69976	120585
951.6	0.483389	2.900334	0.299698	0.1	0.82	3.477394	41.71906	120626.7
951.8	0.483557	2.901339	0.299837	0.1	0.82	3.479006	41.7384	120668.5
952	0.483724	2.902345	0.299976	0.1	0.82	3.480621	41.75776	120710.2
952.2	0.483892	2.903351	0.300115	0.1	0.82	3.482238	41.77715	120752
952.4	0.48406	2.904357	0.300255	0.1	0.82	3.483857	41.79657	120793.8
952.6	0.484227	2.905364	0.300395	0.1	0.82	3.485479	41.81601	120835.6
952.8	0.484395	2.906372	0.300535	0.1	0.82	3.487103	41.83549	120877.5
953	0.484563	2.907379	0.300675	0.1	0.82	3.488729	41.85499	120919.3
953.2	0.484731	2.908388	0.300815	0.1	0.82	3.490358	41.87452	120961.2
953.4	0.484899	2.909397	0.300956	0.1	0.82	3.491989	41.89408	121003.1
953.6	0.485068	2.910406	0.301097	0.1	0.82	3.493623	41.91367	121045
953.8	0.485236	2.911416	0.301238	0.1	0.82	3.495259	41.93329	121086.9
954	0.485404	2.912426	0.301379	0.1	0.82	3.496897	41.95294	121128.9
954.2	0.485573	2.913437	0.30152	0.1	0.82	3.498538	41.97261	121170.9
954.4	0.485741	2.914448	0.301662	0.1	0.82	3.500181	41.99231	121212.9
954.6	0.48591	2.91546	0.301804	0.1	0.82	3.501827	42.01205	121254.9
954.8	0.486079	2.916472	0.301946	0.1	0.82	3.503475	42.03181	121296.9
955	0.486247	2.917485	0.302088	0.1	0.82	3.505125	42.0516	121338.9
955.2	0.486416	2.918498	0.30223	0.1	0.82	3.506778	42.07142	121381
955.4	0.486585	2.919511	0.302373	0.1	0.82	3.508433	42.09127	121423.1
955.6	0.486754	2.920526	0.302516	0.1	0.82	3.510091	42.11115	121465.2
955.8	0.486923	2.92154	0.302659	0.1	0.82	3.511751	42.13105	121507.4
956	0.487093	2.922555	0.302802	0.1	0.82	3.513414	42.15099	121549.5
956.2	0.487262	2.923571	0.302946	0.1	0.82	3.515079	42.17096	121591.7
956.4	0.487431	2.924587	0.303089	0.1	0.82	3.516747	42.19096	121633.9
956.6	0.487601	2.925604	0.303233	0.1	0.82	3.518417	42.21098	121676.1
956.8	0.48777	2.926621	0.303378	0.1	0.82	3.520089	42.23104	121718.3
957	0.48794	2.927638	0.303522	0.1	0.82	3.521765	42.25112	121760.6
957.2	0.488109	2.928656	0.303666	0.1	0.82	3.523442	42.27124	121802.8
957.4	0.488279	2.929675	0.303811	0.1	0.82	3.525122	42.29139	121845.1
957.6	0.488449	2.930694	0.303956	0.1	0.82	3.526805	42.31156	121887.4
957.8	0.488619	2.931713	0.304102	0.1	0.82	3.52849	42.33177	121929.8

958	0.488789	2.932733	0.304247	0.1	0.82	3.530177	42.352	121972.1
958.2	0.488959	2.933754	0.304393	0.1	0.82	3.531868	42.37227	122014.5
958.4	0.489129	2.934775	0.304538	0.1	0.82	3.53356	42.39257	122056.9
958.6	0.489299	2.935796	0.304685	0.1	0.82	3.535255	42.41289	122099.3
958.8	0.48947	2.936818	0.304831	0.1	0.82	3.536953	42.43325	122141.7
959	0.48964	2.937841	0.304977	0.1	0.82	3.538653	42.45364	122184.2
959.2	0.489811	2.938864	0.305124	0.1	0.82	3.540356	42.47406	122226.7
959.4	0.489981	2.939887	0.305271	0.1	0.82	3.542062	42.49451	122269.1
959.6	0.490152	2.940911	0.305418	0.1	0.82	3.54377	42.51499	122311.7
959.8	0.490323	2.941936	0.305566	0.1	0.82	3.54548	42.5355	122354.2
960	0.490493	2.942961	0.305713	0.1	0.82	3.547194	42.55604	122396.8
960.2	0.490664	2.943986	0.305861	0.1	0.82	3.548909	42.57662	122439.3
960.4	0.490835	2.945012	0.306009	0.1	0.82	3.550628	42.59722	122481.9
960.6	0.491006	2.946039	0.306158	0.1	0.82	3.552349	42.61786	122524.5
960.8	0.491178	2.947066	0.306306	0.1	0.82	3.554072	42.63852	122567.2
961	0.491349	2.948093	0.306455	0.1	0.82	3.555798	42.65922	122609.8
961.2	0.49152	2.949121	0.306604	0.1	0.82	3.557527	42.67995	122652.5
961.4	0.491692	2.95015	0.306753	0.1	0.82	3.559259	42.70072	122695.2
961.6	0.491863	2.951179	0.306903	0.1	0.82	3.560993	42.72151	122737.9
961.8	0.492035	2.952208	0.307052	0.1	0.82	3.562729	42.74233	122780.7
962	0.492206	2.953238	0.307202	0.1	0.82	3.564469	42.76319	122823.5
962.2	0.492378	2.954269	0.307352	0.1	0.82	3.566211	42.78408	122866.2
962.4	0.49255	2.9553	0.307503	0.1	0.82	3.567956	42.805	122909
962.6	0.492722	2.956332	0.307653	0.1	0.82	3.569703	42.82595	122951.9
962.8	0.492894	2.957364	0.307804	0.1	0.82	3.571453	42.84694	122994.7
963	0.493066	2.958396	0.307955	0.1	0.82	3.573206	42.86795	123037.6
963.2	0.493238	2.959429	0.308107	0.1	0.82	3.574961	42.889	123080.5
963.4	0.493411	2.960463	0.308258	0.1	0.82	3.576719	42.91008	123123.4
963.6	0.493583	2.961497	0.30841	0.1	0.82	3.57848	42.9312	123166.3
963.8	0.493755	2.962532	0.308562	0.1	0.82	3.580244	42.95234	123209.3
964	0.493928	2.963567	0.308714	0.1	0.82	3.58201	42.97352	123252.2
964.2	0.4941	2.964603	0.308867	0.1	0.82	3.583779	42.99474	123295.2
964.4	0.494273	2.965639	0.309019	0.1	0.82	3.585551	43.01598	123338.3
964.6	0.494446	2.966676	0.309172	0.1	0.82	3.587325	43.03726	123381.3
964.8	0.494619	2.967713	0.309325	0.1	0.82	3.589103	43.05857	123424.3
965	0.494792	2.968751	0.309479	0.1	0.82	3.590883	43.07991	123467.4
965.2	0.494965	2.969789	0.309632	0.1	0.82	3.592665	43.10129	123510.5
965.4	0.495138	2.970828	0.309786	0.1	0.82	3.594451	43.1227	123553.6
965.6	0.495311	2.971867	0.30994	0.1	0.82	3.596239	43.14414	123596.8
965.8	0.495485	2.972907	0.310095	0.1	0.82	3.59803	43.16562	123640
966	0.495658	2.973947	0.310249	0.1	0.82	3.599824	43.18713	123683.1
966.2	0.495831	2.974988	0.310404	0.1	0.82	3.601621	43.20867	123726.4
966.4	0.496005	2.97603	0.310559	0.1	0.82	3.60342	43.23025	123769.6
966.6	0.496179	2.977072	0.310715	0.1	0.82	3.605223	43.25186	123812.8
966.8	0.496352	2.978114	0.31087	0.1	0.82	3.607028	43.2735	123856.1
967	0.496526	2.979157	0.311026	0.1	0.82	3.608836	43.29518	123899.4
967.2	0.4967	2.980201	0.311182	0.1	0.82	3.610647	43.3169	123942.7

967.4	0.496874	2.981245	0.311338	0.1	0.82	3.61246	43.33864	123986.1
967.6	0.497048	2.98229	0.311495	0.1	0.82	3.614277	43.36042	124029.4
967.8	0.497222	2.983335	0.311652	0.1	0.82	3.616096	43.38224	124072.8
968	0.497397	2.98438	0.311809	0.1	0.82	3.617918	43.40409	124116.2
968.2	0.497571	2.985427	0.311966	0.1	0.82	3.619744	43.42597	124159.6
968.4	0.497746	2.986473	0.312124	0.1	0.82	3.621572	43.44789	124203.1
968.6	0.49792	2.987521	0.312282	0.1	0.82	3.623402	43.46984	124246.6
968.8	0.498095	2.988568	0.31244	0.1	0.82	3.625236	43.49183	124290
969	0.498269	2.989617	0.312598	0.1	0.82	3.627073	43.51385	124333.6
969.2	0.498444	2.990666	0.312756	0.1	0.82	3.628912	43.53591	124377.1
969.4	0.498619	2.991715	0.312915	0.1	0.82	3.630755	43.558	124420.7
969.6	0.498794	2.992765	0.313074	0.1	0.82	3.6326	43.58013	124464.2
969.8	0.498969	2.993816	0.313234	0.1	0.82	3.634449	43.6023	124507.8
970	0.499144	2.994867	0.313393	0.1	0.82	3.6363	43.62449	124551.5
970.2	0.49932	2.995918	0.313553	0.1	0.82	3.638154	43.64673	124595.1
970.4	0.499495	2.996971	0.313713	0.1	0.82	3.640012	43.669	124638.8
970.6	0.499671	2.998023	0.313873	0.1	0.82	3.641872	43.6913	124682.5
970.8	0.499846	2.999076	0.314034	0.1	0.82	3.643735	43.71364	124726.2
971	0.500022	3.00013	0.314195	0.1	0.82	3.645601	43.73602	124769.9
971.2	0.500197	3.001185	0.314356	0.1	0.82	3.64747	43.75843	124813.7
971.4	0.500373	3.00224	0.314517	0.1	0.82	3.649343	43.78088	124857.5
971.6	0.500549	3.003295	0.314679	0.1	0.82	3.651218	43.80336	124901.3
971.8	0.500725	3.004351	0.314841	0.1	0.82	3.653096	43.82588	124945.1
972	0.500901	3.005407	0.315003	0.1	0.82	3.654977	43.84844	124988.9
972.2	0.501077	3.006465	0.315165	0.1	0.82	3.656861	43.87103	125032.8
972.4	0.501254	3.007522	0.315328	0.1	0.82	3.658749	43.89366	125076.7
972.6	0.50143	3.00858	0.315491	0.1	0.82	3.660639	43.91633	125120.6
972.8	0.501607	3.009639	0.315654	0.1	0.82	3.662533	43.93903	125164.6
973	0.501783	3.010698	0.315817	0.1	0.82	3.664429	43.96177	125208.5
973.2	0.50196	3.011758	0.315981	0.1	0.82	3.666329	43.98454	125252.5
973.4	0.502136	3.012819	0.316145	0.1	0.82	3.668231	44.00736	125296.5
973.6	0.502313	3.01388	0.316309	0.1	0.82	3.670137	44.03021	125340.5
973.8	0.50249	3.014941	0.316474	0.1	0.82	3.672046	44.0531	125384.6
974	0.502667	3.016003	0.316639	0.1	0.82	3.673958	44.07602	125428.7
974.2	0.502844	3.017066	0.316804	0.1	0.82	3.675873	44.09898	125472.8
974.4	0.503022	3.018129	0.316969	0.1	0.82	3.677791	44.12198	125516.9
974.6	0.503199	3.019193	0.317135	0.1	0.82	3.679712	44.14502	125561
974.8	0.503376	3.020257	0.3173	0.1	0.82	3.681637	44.16809	125605.2
975	0.503554	3.021322	0.317467	0.1	0.82	3.683564	44.1912	125649.4
975.2	0.503731	3.022388	0.317633	0.1	0.82	3.685495	44.21436	125693.6
975.4	0.503909	3.023454	0.3178	0.1	0.82	3.687429	44.23754	125737.8
975.6	0.504087	3.02452	0.317967	0.1	0.82	3.689366	44.26077	125782.1
975.8	0.504265	3.025588	0.318134	0.1	0.82	3.691306	44.28403	125826.4
976	0.504443	3.026655	0.318301	0.1	0.82	3.69325	44.30734	125870.7
976.2	0.504621	3.027724	0.318469	0.1	0.82	3.695196	44.33068	125915
976.4	0.504799	3.028793	0.318637	0.1	0.82	3.697146	44.35406	125959.4
976.6	0.504977	3.029862	0.318805	0.1	0.82	3.6991	44.37748	126003.8

976.8	0.505155	3.030932	0.318974	0.1	0.82	3.701056	44.40093	126048.2
977	0.505334	3.032003	0.319143	0.1	0.82	3.703015	44.42443	126092.6
977.2	0.505512	3.033074	0.319312	0.1	0.82	3.704978	44.44796	126137
977.4	0.505691	3.034146	0.319482	0.1	0.82	3.706944	44.47154	126181.5
977.6	0.50587	3.035218	0.319651	0.1	0.82	3.708914	44.49515	126226
977.8	0.506048	3.036291	0.319821	0.1	0.82	3.710886	44.5188	126270.5
978	0.506227	3.037364	0.319992	0.1	0.82	3.712862	44.54249	126315.1
978.2	0.506406	3.038439	0.320162	0.1	0.82	3.714842	44.56622	126359.6
978.4	0.506586	3.039513	0.320333	0.1	0.82	3.716824	44.58999	126404.2
978.6	0.506765	3.040588	0.320504	0.1	0.82	3.71881	44.61381	126448.8
978.8	0.506944	3.041664	0.320676	0.1	0.82	3.720799	44.63766	126493.5
979	0.507123	3.042741	0.320847	0.1	0.82	3.722792	44.66155	126538.1
979.2	0.507303	3.043818	0.321019	0.1	0.82	3.724788	44.68548	126582.8
979.4	0.507483	3.044895	0.321192	0.1	0.82	3.726787	44.70945	126627.5
979.6	0.507662	3.045973	0.321364	0.1	0.82	3.728789	44.73346	126672.3
979.8	0.507842	3.047052	0.321537	0.1	0.82	3.730795	44.75751	126717
980	0.508022	3.048132	0.32171	0.1	0.82	3.732805	44.7816	126761.8
980.2	0.508202	3.049211	0.321884	0.1	0.82	3.734817	44.80573	126806.6
980.4	0.508382	3.050292	0.322058	0.1	0.82	3.736833	44.8299	126851.4
980.6	0.508562	3.051373	0.322232	0.1	0.82	3.738853	44.85412	126896.3
980.8	0.508742	3.052455	0.322406	0.1	0.82	3.740876	44.87837	126941.2
981	0.508923	3.053537	0.322581	0.1	0.82	3.742902	44.90267	126986.1
981.2	0.509103	3.05462	0.322755	0.1	0.82	3.744932	44.927	127031
981.4	0.509284	3.055704	0.322931	0.1	0.82	3.746965	44.95138	127075.9
981.6	0.509465	3.056788	0.323106	0.1	0.82	3.749002	44.9758	127120.9
981.8	0.509645	3.057872	0.323282	0.1	0.82	3.751042	45.00026	127165.9
982	0.509826	3.058958	0.323458	0.1	0.82	3.753086	45.02476	127210.9
982.2	0.510007	3.060043	0.323635	0.1	0.82	3.755133	45.04931	127256
982.4	0.510188	3.06113	0.323811	0.1	0.82	3.757183	45.0739	127301.1
982.6	0.51037	3.062217	0.323988	0.1	0.82	3.759237	45.09852	127346.2
982.8	0.510551	3.063305	0.324166	0.1	0.82	3.761295	45.12319	127391.3
983	0.510732	3.064393	0.324343	0.1	0.82	3.763356	45.14791	127436.4
983.2	0.510914	3.065482	0.324521	0.1	0.82	3.765421	45.17266	127481.6
983.4	0.511095	3.066571	0.3247	0.1	0.82	3.767489	45.19746	127526.8
983.6	0.511277	3.067662	0.324878	0.1	0.82	3.769561	45.2223	127572
983.8	0.511459	3.068752	0.325057	0.1	0.82	3.771636	45.24718	127617.3
984	0.511641	3.069844	0.325236	0.1	0.82	3.773715	45.27211	127662.5
984.2	0.511823	3.070936	0.325416	0.1	0.82	3.775798	45.29708	127707.8
984.4	0.512005	3.072028	0.325595	0.1	0.82	3.777884	45.32209	127753.2
984.6	0.512187	3.073121	0.325776	0.1	0.82	3.779974	45.34715	127798.5
984.8	0.512369	3.074215	0.325956	0.1	0.82	3.782067	45.37224	127843.9
985	0.512552	3.07531	0.326137	0.1	0.82	3.784164	45.39739	127889.3
985.2	0.512734	3.076405	0.326318	0.1	0.82	3.786265	45.42257	127934.7
985.4	0.512917	3.0775	0.326499	0.1	0.82	3.788369	45.4478	127980.2
985.6	0.513099	3.078596	0.326681	0.1	0.82	3.790477	45.47308	128025.6
985.8	0.513282	3.079693	0.326863	0.1	0.82	3.792589	45.49839	128071.1
986	0.513465	3.080791	0.327045	0.1	0.82	3.794704	45.52375	128116.7

986.2	0.513648	3.081889	0.327228	0.1	0.82	3.796823	45.54916	128162.2
986.4	0.513831	3.082988	0.327411	0.1	0.82	3.798946	45.57461	128207.8
986.6	0.514015	3.084087	0.327594	0.1	0.82	3.801072	45.60011	128253.4
986.8	0.514198	3.085187	0.327777	0.1	0.82	3.803202	45.62564	128299
987	0.514381	3.086288	0.327961	0.1	0.82	3.805336	45.65123	128344.7
987.2	0.514565	3.087389	0.328146	0.1	0.82	3.807474	45.67686	128390.3
987.4	0.514748	3.088491	0.32833	0.1	0.82	3.809615	45.70253	128436
987.6	0.514932	3.089593	0.328515	0.1	0.82	3.81176	45.72825	128481.8
987.8	0.515116	3.090696	0.3287	0.1	0.82	3.813909	45.75402	128527.5
988	0.5153	3.0918	0.328886	0.1	0.82	3.816062	45.77983	128573.3
988.2	0.515484	3.092905	0.329072	0.1	0.82	3.818219	45.80568	128619.1
988.4	0.515668	3.09401	0.329258	0.1	0.82	3.820379	45.83158	128664.9
988.6	0.515853	3.095115	0.329444	0.1	0.82	3.822543	45.85753	128710.8
988.8	0.516037	3.096222	0.329631	0.1	0.82	3.824711	45.88353	128756.7
989	0.516221	3.097329	0.329818	0.1	0.82	3.826883	45.90957	128802.6
989.2	0.516406	3.098436	0.330006	0.1	0.82	3.829059	45.93565	128848.5
989.4	0.516591	3.099544	0.330194	0.1	0.82	3.831238	45.96178	128894.5
989.6	0.516776	3.100653	0.330382	0.1	0.82	3.833422	45.98796	128940.5
989.8	0.51696	3.101763	0.33057	0.1	0.82	3.835609	46.01419	128986.5
990	0.517145	3.102873	0.330759	0.1	0.82	3.837801	46.04046	129032.5
990.2	0.517331	3.103984	0.330949	0.1	0.82	3.839996	46.06678	129078.6
990.4	0.517516	3.105095	0.331138	0.1	0.82	3.842195	46.09315	129124.7
990.6	0.517701	3.106207	0.331328	0.1	0.82	3.844398	46.11956	129170.8
990.8	0.517887	3.10732	0.331518	0.1	0.82	3.846605	46.14602	129216.9
991	0.518072	3.108433	0.331709	0.1	0.82	3.848816	46.17253	129263.1
991.2	0.518258	3.109547	0.3319	0.1	0.82	3.851031	46.19909	129309.3
991.4	0.518444	3.110662	0.332091	0.1	0.82	3.85325	46.22569	129355.5
991.6	0.51863	3.111777	0.332282	0.1	0.82	3.855473	46.25234	129401.8
991.8	0.518816	3.112893	0.332474	0.1	0.82	3.8577	46.27904	129448.1
992	0.519002	3.11401	0.332667	0.1	0.82	3.859931	46.30579	129494.4
992.2	0.519188	3.115127	0.332859	0.1	0.82	3.862167	46.33259	129540.7
992.4	0.519374	3.116245	0.333052	0.1	0.82	3.864406	46.35943	129587.1
992.6	0.519561	3.117364	0.333246	0.1	0.82	3.866649	46.38633	129633.5
992.8	0.519747	3.118483	0.333439	0.1	0.82	3.868896	46.41327	129679.9
993	0.519934	3.119603	0.333633	0.1	0.82	3.871148	46.44026	129726.3
993.2	0.520121	3.120724	0.333828	0.1	0.82	3.873403	46.4673	129772.8
993.4	0.520307	3.121845	0.334022	0.1	0.82	3.875663	46.4944	129819.3
993.6	0.520494	3.122967	0.334218	0.1	0.82	3.877926	46.52154	129865.8
993.8	0.520682	3.124089	0.334413	0.1	0.82	3.880194	46.54872	129912.3
994	0.520869	3.125213	0.334609	0.1	0.82	3.882466	46.57596	129958.9
994.2	0.521056	3.126337	0.334805	0.1	0.82	3.884743	46.60325	130005.5
994.4	0.521244	3.127461	0.335002	0.1	0.82	3.887023	46.63059	130052.2
994.6	0.521431	3.128586	0.335198	0.1	0.82	3.889308	46.65798	130098.8
994.8	0.521619	3.129712	0.335396	0.1	0.82	3.891596	46.68542	130145.5
995	0.521806	3.130839	0.335593	0.1	0.82	3.893889	46.71291	130192.2
995.2	0.521994	3.131966	0.335791	0.1	0.82	3.896187	46.74045	130239
995.4	0.522182	3.133094	0.33599	0.1	0.82	3.898488	46.76805	130285.7

995.6	0.52237	3.134223	0.336188	0.1	0.82	3.900794	46.79569	130332.5
995.8	0.522559	3.135352	0.336387	0.1	0.82	3.903104	46.82338	130379.3
996	0.522747	3.136482	0.336587	0.1	0.82	3.905418	46.85113	130426.2
996.2	0.522935	3.137613	0.336787	0.1	0.82	3.907737	46.87893	130473.1
996.4	0.523124	3.138744	0.336987	0.1	0.82	3.910059	46.90678	130520
996.6	0.523313	3.139876	0.337188	0.1	0.82	3.912387	46.93468	130566.9
996.8	0.523501	3.141009	0.337388	0.1	0.82	3.914718	46.96263	130613.9
997	0.52369	3.142142	0.33759	0.1	0.82	3.917054	46.99063	130660.9
997.2	0.523879	3.143277	0.337791	0.1	0.82	3.919394	47.01869	130707.9
997.4	0.524069	3.144411	0.337994	0.1	0.82	3.921739	47.0468	130754.9
997.6	0.524258	3.145547	0.338196	0.1	0.82	3.924088	47.07496	130802
997.8	0.524447	3.146683	0.338399	0.1	0.82	3.926442	47.10318	130849.1
998	0.524637	3.14782	0.338602	0.1	0.82	3.928799	47.13145	130896.2
998.2	0.524826	3.148957	0.338806	0.1	0.82	3.931162	47.15977	130943.4
998.4	0.525016	3.150096	0.33901	0.1	0.82	3.933528	47.18814	130990.6
998.6	0.525206	3.151235	0.339214	0.1	0.82	3.9359	47.21657	131037.8
998.8	0.525396	3.152374	0.339419	0.1	0.82	3.938275	47.24505	131085
999	0.525586	3.153515	0.339624	0.1	0.82	3.940656	47.27359	131132.3
999.2	0.525776	3.154656	0.339829	0.1	0.82	3.94304	47.30218	131179.6
999.4	0.525966	3.155797	0.340035	0.1	0.82	3.945429	47.33082	131227
999.6	0.526157	3.15694	0.340242	0.1	0.82	3.947823	47.35952	131274.3
999.8	0.526347	3.158083	0.340448	0.1	0.82	3.950222	47.38827	131321.7
1000	0.526538	3.159227	0.340655	0.1	0.82	3.952624	47.41708	131369.1
1000.2	0.526729	3.160371	0.340863	0.1	0.82	3.955032	47.44594	131416.6
1000.4	0.526919	3.161517	0.341071	0.1	0.82	3.957444	47.47485	131464
1000.6	0.52711	3.162663	0.341279	0.1	0.82	3.95986	47.50383	131511.5
1000.8	0.527302	3.163809	0.341488	0.1	0.82	3.962282	47.53285	131559.1
1001	0.527493	3.164957	0.341697	0.1	0.82	3.964708	47.56194	131606.6
1001.2	0.527684	3.166105	0.341906	0.1	0.82	3.967138	47.59107	131654.2
1001.4	0.527876	3.167254	0.342116	0.1	0.82	3.969573	47.62027	131701.9
1001.6	0.528067	3.168403	0.342326	0.1	0.82	3.972013	47.64952	131749.5
1001.8	0.528259	3.169554	0.342537	0.1	0.82	3.974458	47.67883	131797.2
1002	0.528451	3.170705	0.342748	0.1	0.82	3.976907	47.70819	131844.9
1002.2	0.528643	3.171856	0.34296	0.1	0.82	3.979361	47.73761	131892.6
1002.4	0.528835	3.173009	0.343172	0.1	0.82	3.98182	47.76709	131940.4
1002.6	0.529027	3.174162	0.343384	0.1	0.82	3.984283	47.79662	131988.2
1002.8	0.529219	3.175316	0.343597	0.1	0.82	3.986752	47.82621	132036
1003	0.529412	3.176471	0.34381	0.1	0.82	3.989225	47.85586	132083.9
1003.2	0.529604	3.177626	0.344023	0.1	0.82	3.991703	47.88557	132131.8
1003.4	0.529797	3.178782	0.344237	0.1	0.82	3.994185	47.91533	132179.7
1003.6	0.52999	3.179939	0.344452	0.1	0.82	3.996673	47.94515	132227.6
1003.8	0.530183	3.181096	0.344667	0.1	0.82	3.999165	47.97503	132275.6
1004	0.530376	3.182255	0.344882	0.1	0.82	4.001663	48.00497	132323.6
1004.2	0.530569	3.183414	0.345097	0.1	0.82	4.004165	48.03497	132371.6
1004.4	0.530762	3.184574	0.345313	0.1	0.82	4.006672	48.06502	132419.7
1004.6	0.530956	3.185734	0.34553	0.1	0.82	4.009184	48.09514	132467.8
1004.8	0.531149	3.186895	0.345747	0.1	0.82	4.011701	48.12531	132515.9

1005	0.531343	3.188057	0.345964	0.1	0.82	4.014223	48.15554	132564.1
1005.2	0.531537	3.18922	0.346182	0.1	0.82	4.01675	48.18583	132612.3
1005.4	0.531731	3.190383	0.3464	0.1	0.82	4.019281	48.21618	132660.5
1005.6	0.531925	3.191548	0.346619	0.1	0.82	4.021818	48.2466	132708.7
1005.8	0.532119	3.192713	0.346838	0.1	0.82	4.02436	48.27707	132757
1006	0.532313	3.193878	0.347057	0.1	0.82	4.026907	48.3076	132805.3
1006.2	0.532507	3.195045	0.347277	0.1	0.82	4.029459	48.33819	132853.6
1006.4	0.532702	3.196212	0.347498	0.1	0.82	4.032016	48.36885	132902
1006.6	0.532897	3.19738	0.347718	0.1	0.82	4.034578	48.39956	132950.4
1006.8	0.533091	3.198549	0.34794	0.1	0.82	4.037145	48.43034	132998.8
1007	0.533286	3.199718	0.348161	0.1	0.82	4.039717	48.46117	133047.3
1007.2	0.533481	3.200888	0.348384	0.1	0.82	4.042295	48.49207	133095.8
1007.4	0.533677	3.202059	0.348606	0.1	0.82	4.044877	48.52303	133144.3
1007.6	0.533872	3.203231	0.348829	0.1	0.82	4.047465	48.55405	133192.9
1007.8	0.534067	3.204404	0.349053	0.1	0.82	4.050058	48.58513	133241.5
1008	0.534263	3.205577	0.349277	0.1	0.82	4.052656	48.61628	133290.1
1008.2	0.534459	3.206751	0.349501	0.1	0.82	4.055259	48.64749	133338.7
1008.4	0.534654	3.207926	0.349726	0.1	0.82	4.057868	48.67876	133387.4
1008.6	0.53485	3.209101	0.349951	0.1	0.82	4.060481	48.71009	133436.1
1008.8	0.535046	3.210278	0.350177	0.1	0.82	4.063101	48.74149	133484.9
1009	0.535242	3.211455	0.350403	0.1	0.82	4.065725	48.77295	133533.6
1009.2	0.535439	3.212633	0.35063	0.1	0.82	4.068355	48.80448	133582.4
1009.4	0.535635	3.213812	0.350857	0.1	0.82	4.07099	48.83607	133631.3
1009.6	0.535832	3.214991	0.351084	0.1	0.82	4.07363	48.86772	133680.1
1009.8	0.536029	3.216171	0.351312	0.1	0.82	4.076276	48.89943	133729
1010	0.536225	3.217352	0.351541	0.1	0.82	4.078927	48.93122	133778
1010.2	0.536422	3.218534	0.35177	0.1	0.82	4.081583	48.96306	133826.9
1010.4	0.536619	3.219717	0.351999	0.1	0.82	4.084245	48.99497	133875.9
1010.6	0.536817	3.2209	0.352229	0.1	0.82	4.086913	49.02695	133924.9
1010.8	0.537014	3.222084	0.352459	0.1	0.82	4.089586	49.05899	133974
1011	0.537212	3.223269	0.35269	0.1	0.82	4.092264	49.0911	134023.1
1011.2	0.537409	3.224455	0.352921	0.1	0.82	4.094948	49.12327	134072.2
1011.4	0.537607	3.225641	0.353153	0.1	0.82	4.097637	49.15551	134121.4
1011.6	0.537805	3.226829	0.353385	0.1	0.82	4.100332	49.18781	134170.6
1011.8	0.538003	3.228017	0.353618	0.1	0.82	4.103032	49.22018	134219.8
1012	0.538201	3.229206	0.353851	0.1	0.82	4.105738	49.25262	134269
1012.2	0.538399	3.230396	0.354085	0.1	0.82	4.10845	49.28513	134318.3
1012.4	0.538598	3.231586	0.354319	0.1	0.82	4.111167	49.3177	134367.6
1012.6	0.538796	3.232777	0.354554	0.1	0.82	4.11389	49.35034	134417
1012.8	0.538995	3.233969	0.354789	0.1	0.82	4.116618	49.38305	134466.4
1013	0.539194	3.235162	0.355025	0.1	0.82	4.119352	49.41582	134515.8
1013.2	0.539393	3.236356	0.355261	0.1	0.82	4.122092	49.44866	134565.2
1013.4	0.539592	3.237551	0.355497	0.1	0.82	4.124837	49.48158	134614.7
1013.6	0.539791	3.238746	0.355735	0.1	0.82	4.127589	49.51456	134664.2
1013.8	0.53999	3.239942	0.355972	0.1	0.82	4.130346	49.54761	134713.8
1014	0.54019	3.241139	0.35621	0.1	0.82	4.133108	49.58072	134763.4
1014.2	0.540389	3.242337	0.356449	0.1	0.82	4.135877	49.61391	134813

1014.4	0.540589	3.243536	0.356688	0.1	0.82	4.138651	49.64717	134862.6
1014.6	0.540789	3.244735	0.356928	0.1	0.82	4.141431	49.6805	134912.3
1014.8	0.540989	3.245935	0.357168	0.1	0.82	4.144218	49.71389	134962
1015	0.541189	3.247136	0.357408	0.1	0.82	4.147009	49.74736	135011.8
1015.2	0.54139	3.248338	0.35765	0.1	0.82	4.149807	49.7809	135061.5
1015.4	0.54159	3.249541	0.357891	0.1	0.82	4.152611	49.81451	135111.4
1015.6	0.541791	3.250745	0.358133	0.1	0.82	4.155421	49.84819	135161.2
1015.8	0.541991	3.251949	0.358376	0.1	0.82	4.158236	49.88194	135211.1
1016	0.542192	3.253154	0.358619	0.1	0.82	4.161058	49.91576	135261
1016.2	0.542393	3.25436	0.358863	0.1	0.82	4.163885	49.94966	135311
1016.4	0.542595	3.255567	0.359107	0.1	0.82	4.166719	49.98362	135360.9
1016.6	0.542796	3.256775	0.359352	0.1	0.82	4.169558	50.01766	135411
1016.8	0.542997	3.257983	0.359597	0.1	0.82	4.172404	50.05178	135461
1017	0.543199	3.259193	0.359843	0.1	0.82	4.175256	50.08596	135511.1
1017.2	0.5434	3.260403	0.360089	0.1	0.82	4.178114	50.12022	135561.2
1017.4	0.543602	3.261614	0.360336	0.1	0.82	4.180978	50.15455	135611.4
1017.6	0.543804	3.262826	0.360583	0.1	0.82	4.183848	50.18895	135661.6
1017.8	0.544006	3.264039	0.360831	0.1	0.82	4.186724	50.22343	135711.8
1018	0.544209	3.265252	0.36108	0.1	0.82	4.189607	50.25799	135762
1018.2	0.544411	3.266467	0.361329	0.1	0.82	4.192496	50.29261	135812.3
1018.4	0.544614	3.267682	0.361578	0.1	0.82	4.195391	50.32732	135862.7
1018.6	0.544816	3.268898	0.361828	0.1	0.82	4.198292	50.36209	135913
1018.8	0.545019	3.270115	0.362079	0.1	0.82	4.201199	50.39695	135963.4
1019	0.545222	3.271333	0.36233	0.1	0.82	4.204113	50.43187	136013.9
1019.2	0.545425	3.272552	0.362582	0.1	0.82	4.207033	50.46688	136064.3
1019.4	0.545629	3.273772	0.362834	0.1	0.82	4.20996	50.50196	136114.8
1019.6	0.545832	3.274992	0.363087	0.1	0.82	4.212893	50.53711	136165.4
1019.8	0.546036	3.276214	0.36334	0.1	0.82	4.215832	50.57235	136215.9
1020	0.546239	3.277436	0.363594	0.1	0.82	4.218778	50.60766	136266.5
1020.2	0.546443	3.278659	0.363848	0.1	0.82	4.22173	50.64305	136317.2
1020.4	0.546647	3.279883	0.364103	0.1	0.82	4.224689	50.67851	136367.9
1020.6	0.546851	3.281108	0.364359	0.1	0.82	4.227654	50.71405	136418.6
1020.8	0.547056	3.282333	0.364615	0.1	0.82	4.230625	50.74967	136469.3
1021	0.54726	3.28356	0.364871	0.1	0.82	4.233603	50.78537	136520.1
1021.2	0.547465	3.284788	0.365129	0.1	0.82	4.236588	50.82115	136570.9
1021.4	0.547669	3.286016	0.365387	0.1	0.82	4.23958	50.85701	136621.8
1021.6	0.547874	3.287245	0.365645	0.1	0.82	4.242578	50.89294	136672.7
1021.8	0.548079	3.288475	0.365904	0.1	0.82	4.245582	50.92896	136723.6
1022	0.548284	3.289706	0.366163	0.1	0.82	4.248593	50.96505	136774.6
1022.2	0.54849	3.290938	0.366423	0.1	0.82	4.251611	51.00123	136825.6
1022.4	0.548695	3.292171	0.366684	0.1	0.82	4.254636	51.03749	136876.6
1022.6	0.548901	3.293405	0.366945	0.1	0.82	4.257668	51.07382	136927.7
1022.8	0.549107	3.294639	0.367207	0.1	0.82	4.260706	51.11024	136978.8
1023	0.549312	3.295875	0.36747	0.1	0.82	4.263751	51.14674	137029.9
1023.2	0.549519	3.297111	0.367733	0.1	0.82	4.266803	51.18332	137081.1
1023.4	0.549725	3.298349	0.367996	0.1	0.82	4.269861	51.21998	137132.3
1023.6	0.549931	3.299587	0.368261	0.1	0.82	4.272927	51.25673	137183.6

1023.8	0.550138	3.300826	0.368525	0.1	0.82	4.275999	51.29356	137234.9
1024	0.550344	3.302066	0.368791	0.1	0.82	4.279078	51.33047	137286.2
1024.2	0.550551	3.303307	0.369057	0.1	0.82	4.282165	51.36746	137337.6
1024.4	0.550758	3.304549	0.369323	0.1	0.82	4.285258	51.40454	137389
1024.6	0.550965	3.305791	0.36959	0.1	0.82	4.288358	51.4417	137440.4
1024.8	0.551173	3.307035	0.369858	0.1	0.82	4.291466	51.47894	137491.9
1025	0.55138	3.30828	0.370127	0.1	0.82	4.29458	51.51627	137543.4
1025.2	0.551588	3.309525	0.370396	0.1	0.82	4.297701	51.55369	137595
1025.4	0.551795	3.310772	0.370665	0.1	0.82	4.30083	51.59119	137646.6
1025.6	0.552003	3.312019	0.370936	0.1	0.82	4.303965	51.62877	137698.2
1025.8	0.552211	3.313267	0.371206	0.1	0.82	4.307108	51.66644	137749.9
1026	0.552419	3.314517	0.371478	0.1	0.82	4.310258	51.7042	137801.6
1026.2	0.552628	3.315767	0.37175	0.1	0.82	4.313416	51.74204	137853.3
1026.4	0.552836	3.317018	0.372023	0.1	0.82	4.31658	51.77997	137905.1
1026.6	0.553045	3.31827	0.372296	0.1	0.82	4.319752	51.81799	137956.9
1026.8	0.553254	3.319523	0.37257	0.1	0.82	4.322931	51.8561	138008.8
1027	0.553463	3.320777	0.372845	0.1	0.82	4.326117	51.89429	138060.7
1027.2	0.553672	3.322032	0.37312	0.1	0.82	4.329311	51.93257	138112.6
1027.4	0.553881	3.323287	0.373396	0.1	0.82	4.332512	51.97094	138164.6
1027.6	0.554091	3.324544	0.373672	0.1	0.82	4.335721	52.0094	138216.6
1027.8	0.5543	3.325802	0.37395	0.1	0.82	4.338937	52.04794	138268.6
1028	0.55451	3.32706	0.374227	0.1	0.82	4.34216	52.08658	138320.7
1028.2	0.55472	3.32832	0.374506	0.1	0.82	4.345391	52.12531	138372.8
1028.4	0.55493	3.329581	0.374785	0.1	0.82	4.348629	52.16412	138425
1028.6	0.55514	3.330842	0.375065	0.1	0.82	4.351876	52.20303	138477.2
1028.8	0.555351	3.332105	0.375345	0.1	0.82	4.355129	52.24203	138529.5
1029	0.555561	3.333368	0.375626	0.1	0.82	4.35839	52.28112	138581.7
1029.2	0.555772	3.334632	0.375908	0.1	0.82	4.361659	52.3203	138634.1
1029.4	0.555983	3.335898	0.37619	0.1	0.82	4.364936	52.35957	138686.4
1029.6	0.556194	3.337164	0.376473	0.1	0.82	4.36822	52.39894	138738.8
1029.8	0.556405	3.338432	0.376757	0.1	0.82	4.371512	52.4384	138791.3
1030	0.556617	3.3397	0.377041	0.1	0.82	4.374812	52.47795	138843.7
1030.2	0.556828	3.340969	0.377327	0.1	0.82	4.37812	52.51759	138896.2
1030.4	0.55704	3.342239	0.377612	0.1	0.82	4.381435	52.55733	138948.8
1030.6	0.557252	3.343511	0.377899	0.1	0.82	4.384759	52.59716	139001.4
1030.8	0.557464	3.344783	0.378186	0.1	0.82	4.38809	52.63709	139054
1031	0.557676	3.346056	0.378474	0.1	0.82	4.391429	52.67711	139106.7
1031.2	0.557888	3.34733	0.378762	0.1	0.82	4.394776	52.71723	139159.4
1031.4	0.558101	3.348605	0.379051	0.1	0.82	4.398131	52.75744	139212.2
1031.6	0.558314	3.349882	0.379341	0.1	0.82	4.401494	52.79775	139265
1031.8	0.558526	3.351159	0.379632	0.1	0.82	4.404866	52.83816	139317.8
1032	0.558739	3.352437	0.379923	0.1	0.82	4.408245	52.87866	139370.7
1032.2	0.558953	3.353716	0.380215	0.1	0.82	4.411632	52.91926	139423.6
1032.4	0.559166	3.354996	0.380507	0.1	0.82	4.415028	52.95996	139476.6
1032.6	0.55938	3.356278	0.380801	0.1	0.82	4.418432	53.00076	139529.6
1032.8	0.559593	3.35756	0.381095	0.1	0.82	4.421844	53.04165	139582.6
1033	0.559807	3.358843	0.38139	0.1	0.82	4.425264	53.08264	139635.7

1033.2	0.560021	3.360127	0.381685	0.1	0.82	4.428692	53.12374	139688.8
1033.4	0.560235	3.361412	0.381981	0.1	0.82	4.432129	53.16493	139742
1033.6	0.56045	3.362699	0.382278	0.1	0.82	4.435574	53.20622	139795.2
1033.8	0.560664	3.363986	0.382576	0.1	0.82	4.439028	53.24761	139848.5
1034	0.560879	3.365274	0.382874	0.1	0.82	4.44249	53.28911	139901.7
1034.2	0.561094	3.366564	0.383173	0.1	0.82	4.44596	53.3307	139955.1
1034.4	0.561309	3.367854	0.383473	0.1	0.82	4.449439	53.3724	140008.4
1034.6	0.561524	3.369145	0.383774	0.1	0.82	4.452927	53.4142	140061.9
1034.8	0.56174	3.370438	0.384075	0.1	0.82	4.456423	53.4561	140115.3
1035	0.561955	3.371731	0.384377	0.1	0.82	4.459928	53.4981	140168.8
1035.2	0.562171	3.373026	0.38468	0.1	0.82	4.463441	53.54021	140222.4
1035.4	0.562387	3.374321	0.384983	0.1	0.82	4.466963	53.58242	140275.9
1035.6	0.562603	3.375618	0.385288	0.1	0.82	4.470494	53.62474	140329.6
1035.8	0.562819	3.376916	0.385593	0.1	0.82	4.474033	53.66716	140383.2
1036	0.563036	3.378214	0.385899	0.1	0.82	4.477581	53.70969	140436.9
1036.2	0.563252	3.379514	0.386205	0.1	0.82	4.481138	53.75232	140490.7
1036.4	0.563469	3.380815	0.386512	0.1	0.82	4.484704	53.79505	140544.5
1036.6	0.563686	3.382117	0.386821	0.1	0.82	4.488279	53.8379	140598.3
1036.8	0.563903	3.38342	0.387129	0.1	0.82	4.491863	53.88085	140652.2
1037	0.564121	3.384724	0.387439	0.1	0.82	4.495455	53.92391	140706.1
1037.2	0.564338	3.386029	0.387749	0.1	0.82	4.499057	53.96707	140760.1
1037.4	0.564556	3.387335	0.388061	0.1	0.82	4.502668	54.01035	140814.1
1037.6	0.564774	3.388642	0.388373	0.1	0.82	4.506287	54.05373	140868.2
1037.8	0.564992	3.38995	0.388685	0.1	0.82	4.509916	54.09722	140922.3
1038	0.56521	3.39126	0.388999	0.1	0.82	4.513554	54.14082	140976.4
1038.2	0.565428	3.39257	0.389313	0.1	0.82	4.517202	54.18454	141030.6
1038.4	0.565647	3.393881	0.389628	0.1	0.82	4.520858	54.22836	141084.8
1038.6	0.565866	3.395194	0.389944	0.1	0.82	4.524524	54.27229	141139.1
1038.8	0.566085	3.396508	0.390261	0.1	0.82	4.528199	54.31634	141193.4
1039	0.566304	3.397822	0.390579	0.1	0.82	4.531883	54.3605	141247.8
1039.2	0.566523	3.399138	0.390897	0.1	0.82	4.535577	54.40476	141302.2
1039.4	0.566743	3.400455	0.391216	0.1	0.82	4.539281	54.44915	141356.6
1039.6	0.566962	3.401773	0.391536	0.1	0.82	4.542993	54.49364	141411.1
1039.8	0.567182	3.403093	0.391857	0.1	0.82	4.546716	54.53825	141465.6
1040	0.567402	3.404413	0.392179	0.1	0.82	4.550447	54.58298	141520.2
1040.2	0.567622	3.405734	0.392501	0.1	0.82	4.554189	54.62782	141574.9
1040.4	0.567843	3.407057	0.392824	0.1	0.82	4.55794	54.67277	141629.5
1040.6	0.568063	3.40838	0.393148	0.1	0.82	4.561701	54.71784	141684.2
1040.8	0.568284	3.409705	0.393473	0.1	0.82	4.565471	54.76303	141739
1041	0.568505	3.411031	0.393799	0.1	0.82	4.569251	54.80833	141793.8
1041.2	0.568726	3.412358	0.394126	0.1	0.82	4.573041	54.85376	141848.7
1041.4	0.568948	3.413686	0.394453	0.1	0.82	4.576841	54.8993	141903.6
1041.6	0.569169	3.415015	0.394782	0.1	0.82	4.580651	54.94495	141958.5
1041.8	0.569391	3.416345	0.395111	0.1	0.82	4.584471	54.99073	142013.5
1042	0.569613	3.417677	0.395441	0.1	0.82	4.5883	55.03663	142068.5
1042.2	0.569835	3.41901	0.395772	0.1	0.82	4.59214	55.08264	142123.6
1042.4	0.570057	3.420343	0.396104	0.1	0.82	4.59599	55.12878	142178.8

1042.6	0.57028	3.421678	0.396436	0.1	0.82	4.59985	55.17504	142233.9
1042.8	0.570502	3.423014	0.39677	0.1	0.82	4.60372	55.22142	142289.1
1043	0.570725	3.424352	0.397104	0.1	0.82	4.6076	55.26792	142344.4
1043.2	0.570948	3.42569	0.39744	0.1	0.82	4.611491	55.31455	142399.7
1043.4	0.571172	3.427029	0.397776	0.1	0.82	4.615392	55.36129	142455.1
1043.6	0.571395	3.42837	0.398113	0.1	0.82	4.619303	55.40817	142510.5
1043.8	0.571619	3.429712	0.398451	0.1	0.82	4.623224	55.45516	142566
1044	0.571842	3.431055	0.39879	0.1	0.82	4.627156	55.50228	142621.5
1044.2	0.572067	3.432399	0.399129	0.1	0.82	4.631099	55.54953	142677
1044.4	0.572291	3.433744	0.39947	0.1	0.82	4.635052	55.5969	142732.6
1044.6	0.572515	3.435091	0.399812	0.1	0.82	4.639015	55.6444	142788.2
1044.8	0.57274	3.436439	0.400154	0.1	0.82	4.642989	55.69203	142843.9
1045	0.572965	3.437788	0.400498	0.1	0.82	4.646974	55.73978	142899.7
1045.2	0.57319	3.439138	0.400842	0.1	0.82	4.65097	55.78767	142955.5
1045.4	0.573415	3.440489	0.401187	0.1	0.82	4.654976	55.83568	143011.3
1045.6	0.57364	3.441841	0.401534	0.1	0.82	4.658993	55.88382	143067.2
1045.8	0.573866	3.443195	0.401881	0.1	0.82	4.663021	55.93209	143123.1
1046	0.574092	3.44455	0.402229	0.1	0.82	4.66706	55.98049	143179.1
1046.2	0.574318	3.445906	0.402578	0.1	0.82	4.67111	56.02902	143235.1
1046.4	0.574544	3.447263	0.402928	0.1	0.82	4.675171	56.07769	143291.2
1046.6	0.57477	3.448622	0.403279	0.1	0.82	4.679243	56.12649	143347.3
1046.8	0.574997	3.449981	0.403631	0.1	0.82	4.683326	56.17542	143403.5
1047	0.575224	3.451342	0.403983	0.1	0.82	4.68742	56.22448	143459.7
1047.2	0.575451	3.452704	0.404337	0.1	0.82	4.691526	56.27368	143516
1047.4	0.575678	3.454068	0.404692	0.1	0.82	4.695643	56.32301	143572.3
1047.6	0.575905	3.455432	0.405048	0.1	0.82	4.699771	56.37248	143628.7
1047.8	0.576133	3.456798	0.405405	0.1	0.82	4.70391	56.42209	143685.1
1048	0.576361	3.458165	0.405762	0.1	0.82	4.708061	56.47183	143741.6
1048.2	0.576589	3.459533	0.406121	0.1	0.82	4.712223	56.52171	143798.1
1048.4	0.576817	3.460903	0.406481	0.1	0.82	4.716397	56.57172	143854.7
1048.6	0.577046	3.462274	0.406842	0.1	0.82	4.720583	56.62188	143911.3
1048.8	0.577274	3.463646	0.407203	0.1	0.82	4.72478	56.67217	143968
1049	0.577503	3.465019	0.407566	0.1	0.82	4.728989	56.72261	144024.7
1049.2	0.577732	3.466393	0.40793	0.1	0.82	4.733209	56.77319	144081.5
1049.4	0.577962	3.467769	0.408295	0.1	0.82	4.737442	56.8239	144138.3
1049.6	0.578191	3.469146	0.40866	0.1	0.82	4.741686	56.87476	144195.2
1049.8	0.578421	3.470524	0.409027	0.1	0.82	4.745942	56.92577	144252.1
1050	0.578651	3.471904	0.409395	0.1	0.82	4.75021	56.97691	144309.1
1050.2	0.578881	3.473285	0.409764	0.1	0.82	4.75449	57.0282	144366.1
1050.4	0.579111	3.474667	0.410134	0.1	0.82	4.758782	57.07963	144423.2
1050.6	0.579342	3.47605	0.410505	0.1	0.82	4.763087	57.13121	144480.3
1050.8	0.579572	3.477435	0.410877	0.1	0.82	4.767403	57.18294	144537.5
1051	0.579803	3.478821	0.41125	0.1	0.82	4.771732	57.23481	144594.7
1051.2	0.580035	3.480208	0.411624	0.1	0.82	4.776073	57.28683	144652
1051.4	0.580266	3.481596	0.411999	0.1	0.82	4.780427	57.339	144709.4
1051.6	0.580498	3.482986	0.412375	0.1	0.82	4.784793	57.39132	144766.8
1051.8	0.58073	3.484377	0.412753	0.1	0.82	4.789171	57.44378	144824.2

1052	0.580962	3.48577	0.413131	0.1	0.82	4.793562	57.4964	144881.7
1052.2	0.581194	3.487164	0.413511	0.1	0.82	4.797966	57.54917	144939.2
1052.4	0.581426	3.488559	0.413891	0.1	0.82	4.802382	57.60209	144996.8
1052.6	0.581659	3.489955	0.414273	0.1	0.82	4.806811	57.65516	145054.5
1052.8	0.581892	3.491353	0.414656	0.1	0.82	4.811253	57.70839	145112.2
1053	0.582125	3.492752	0.41504	0.1	0.82	4.815708	57.76177	145170
1053.2	0.582359	3.494152	0.415425	0.1	0.82	4.820176	57.8153	145227.8
1053.4	0.582592	3.495554	0.415811	0.1	0.82	4.824656	57.86899	145285.7
1053.6	0.582826	3.496957	0.416198	0.1	0.82	4.82915	57.92284	145343.6
1053.8	0.58306	3.498361	0.416587	0.1	0.82	4.833657	57.97684	145401.6
1054	0.583294	3.499767	0.416976	0.1	0.82	4.838177	58.031	145459.6
1054.2	0.583529	3.501174	0.417367	0.1	0.82	4.84271	58.08532	145517.7
1054.4	0.583764	3.502582	0.417759	0.1	0.82	4.847257	58.1398	145575.8
1054.6	0.583999	3.503992	0.418152	0.1	0.82	4.851817	58.19444	145634
1054.8	0.584234	3.505403	0.418546	0.1	0.82	4.85639	58.24924	145692.3
1055	0.584469	3.506816	0.418941	0.1	0.82	4.860977	58.3042	145750.6
1055.2	0.584705	3.508229	0.419338	0.1	0.82	4.865577	58.35933	145808.9
1055.4	0.584941	3.509645	0.419736	0.1	0.82	4.870192	58.41461	145867.3
1055.6	0.585177	3.511061	0.420134	0.1	0.82	4.87482	58.47007	145925.8
1055.8	0.585413	3.512479	0.420534	0.1	0.82	4.879461	58.52568	145984.3
1056	0.58565	3.513899	0.420936	0.1	0.82	4.884117	58.58147	146042.9
1056.2	0.585887	3.515319	0.421338	0.1	0.82	4.888786	58.63742	146101.5
1056.4	0.586124	3.516742	0.421742	0.1	0.82	4.89347	58.69353	146160.2
1056.6	0.586361	3.518165	0.422147	0.1	0.82	4.898167	58.74982	146219
1056.8	0.586598	3.51959	0.422553	0.1	0.82	4.902879	58.80627	146277.8
1057	0.586836	3.521017	0.42296	0.1	0.82	4.907604	58.8629	146336.7
1057.2	0.587074	3.522444	0.423368	0.1	0.82	4.912345	58.91969	146395.6
1057.4	0.587312	3.523874	0.423778	0.1	0.82	4.917099	58.97666	146454.6
1057.6	0.587551	3.525304	0.424189	0.1	0.82	4.921868	59.0338	146513.6
1057.8	0.587789	3.526736	0.424602	0.1	0.82	4.926651	59.09112	146572.7
1058	0.588028	3.52817	0.425015	0.1	0.82	4.931449	59.1486	146631.8
1058.2	0.588267	3.529605	0.42543	0.1	0.82	4.936262	59.20627	146691
1058.4	0.588507	3.531041	0.425846	0.1	0.82	4.941089	59.26411	146750.3
1058.6	0.588746	3.532479	0.426263	0.1	0.82	4.945931	59.32212	146809.6
1058.8	0.588986	3.533918	0.426682	0.1	0.82	4.950788	59.38032	146869
1059	0.589226	3.535359	0.427102	0.1	0.82	4.95566	59.43869	146928.4
1059.2	0.589467	3.536801	0.427523	0.1	0.82	4.960547	59.49725	146987.9
1059.4	0.589707	3.538244	0.427945	0.1	0.82	4.965449	59.55598	147047.5
1059.6	0.589948	3.539689	0.428369	0.1	0.82	4.970367	59.6149	147107.1
1059.8	0.590189	3.541136	0.428794	0.1	0.82	4.975299	59.674	147166.8
1060	0.590431	3.542584	0.429221	0.1	0.82	4.980247	59.73328	147226.5
1060.2	0.590672	3.544034	0.429648	0.1	0.82	4.98521	59.79275	147286.3
1060.4	0.590914	3.545485	0.430078	0.1	0.82	4.990189	59.8524	147346.2
1060.6	0.591156	3.546937	0.430508	0.1	0.82	4.995184	59.91224	147406.1
1060.8	0.591398	3.548391	0.43094	0.1	0.82	5.000194	59.97227	147466
1061	0.591641	3.549846	0.431373	0.1	0.82	5.00522	60.03248	147526.1
1061.2	0.591884	3.551303	0.431807	0.1	0.82	5.010261	60.09289	147586.2

1061.4	0.592127	3.552762	0.432243	0.1	0.82	5.015319	60.15348	147646.3
1061.6	0.59237	3.554222	0.432681	0.1	0.82	5.020393	60.21427	147706.5
1061.8	0.592614	3.555683	0.433119	0.1	0.82	5.025482	60.27525	147766.8
1062	0.592858	3.557146	0.433559	0.1	0.82	5.030588	60.33642	147827.2
1062.2	0.593102	3.558611	0.434001	0.1	0.82	5.03571	60.39779	147887.6
1062.4	0.593346	3.560077	0.434444	0.1	0.82	5.040849	60.45935	147948
1062.6	0.593591	3.561545	0.434888	0.1	0.82	5.046004	60.52111	148008.5
1062.8	0.593836	3.563014	0.435334	0.1	0.82	5.051175	60.58307	148069.1
1063	0.594081	3.564485	0.435781	0.1	0.82	5.056363	60.64523	148129.8
1063.2	0.594326	3.565957	0.436229	0.1	0.82	5.061568	60.70759	148190.5
1063.4	0.594572	3.567431	0.436679	0.1	0.82	5.06679	60.77015	148251.2
1063.6	0.594818	3.568906	0.437131	0.1	0.82	5.072028	60.83291	148312.1
1063.8	0.595064	3.570383	0.437584	0.1	0.82	5.077284	60.89587	148373
1064	0.59531	3.571862	0.438038	0.1	0.82	5.082556	60.95904	148433.9
1064.2	0.595557	3.573342	0.438494	0.1	0.82	5.087846	61.02241	148494.9
1064.4	0.595804	3.574824	0.438951	0.1	0.82	5.093153	61.08599	148556
1064.6	0.596051	3.576307	0.43941	0.1	0.82	5.098477	61.14978	148617.2
1064.8	0.596299	3.577792	0.439871	0.1	0.82	5.103819	61.21377	148678.4
1065	0.596546	3.579278	0.440333	0.1	0.82	5.109178	61.27798	148739.7
1065.2	0.596794	3.580767	0.440796	0.1	0.82	5.114555	61.3424	148801
1065.4	0.597043	3.582256	0.441261	0.1	0.82	5.11995	61.40703	148862.4
1065.6	0.597291	3.583748	0.441727	0.1	0.82	5.125362	61.47187	148923.9
1065.8	0.59754	3.585241	0.442195	0.1	0.82	5.130793	61.53693	148985.4
1066	0.597789	3.586735	0.442665	0.1	0.82	5.136241	61.6022	149047
1066.2	0.598039	3.588231	0.443136	0.1	0.82	5.141708	61.6677	149108.7
1066.4	0.598288	3.589729	0.443609	0.1	0.82	5.147193	61.7334	149170.4
1066.6	0.598538	3.591229	0.444083	0.1	0.82	5.152696	61.79933	149232.2
1066.8	0.598788	3.59273	0.444559	0.1	0.82	5.158218	61.86548	149294.1
1067	0.599039	3.594233	0.445036	0.1	0.82	5.163758	61.93186	149356
1067.2	0.59929	3.595737	0.445516	0.1	0.82	5.169317	61.99845	149418
1067.4	0.599541	3.597243	0.445996	0.1	0.82	5.174895	62.06527	149480.1
1067.6	0.599792	3.598751	0.446479	0.1	0.82	5.180491	62.13232	149542.2
1067.8	0.600043	3.600261	0.446963	0.1	0.82	5.186107	62.19959	149604.4
1068	0.600295	3.601772	0.447448	0.1	0.82	5.191741	62.26709	149666.7
1068.2	0.600547	3.603285	0.447935	0.1	0.82	5.197395	62.33482	149729
1068.4	0.6008	3.6048	0.448424	0.1	0.82	5.203068	62.40278	149791.4
1068.6	0.601053	3.606316	0.448915	0.1	0.82	5.208761	62.47098	149853.9
1068.8	0.601306	3.607834	0.449407	0.1	0.82	5.214473	62.5394	149916.4
1069	0.601559	3.609354	0.449901	0.1	0.82	5.220205	62.60807	149979.1
1069.2	0.601813	3.610875	0.450397	0.1	0.82	5.225956	62.67696	150041.7
1069.4	0.602066	3.612398	0.450894	0.1	0.82	5.231727	62.7461	150104.5
1069.6	0.602321	3.613923	0.451394	0.1	0.82	5.237519	62.81548	150167.3
1069.8	0.602575	3.61545	0.451894	0.1	0.82	5.24333	62.88509	150230.2
1070	0.60283	3.616978	0.452397	0.1	0.82	5.249162	62.95495	150293.1
1070.2	0.603085	3.618508	0.452901	0.1	0.82	5.255014	63.02506	150356.2
1070.4	0.60334	3.62004	0.453407	0.1	0.82	5.260886	63.0954	150419.3
1070.6	0.603596	3.621574	0.453915	0.1	0.82	5.266779	63.16599	150482.4

1070.8	0.603852	3.623109	0.454425	0.1	0.82	5.272693	63.23684	150545.7
1071	0.604108	3.624647	0.454936	0.1	0.82	5.278628	63.30793	150609
1071.2	0.604364	3.626186	0.45545	0.1	0.82	5.284583	63.37927	150672.3
1071.4	0.604621	3.627726	0.455965	0.1	0.82	5.29056	63.45086	150735.8
1071.6	0.604878	3.629269	0.456482	0.1	0.82	5.296558	63.5227	150799.3
1071.8	0.605136	3.630813	0.457	0.1	0.82	5.302577	63.59481	150862.9
1072	0.605393	3.63236	0.457521	0.1	0.82	5.308617	63.66716	150926.6
1072.2	0.605651	3.633908	0.458044	0.1	0.82	5.314679	63.73978	150990.3
1072.4	0.60591	3.635457	0.458568	0.1	0.82	5.320763	63.81266	151054.1
1072.6	0.606168	3.637009	0.459094	0.1	0.82	5.326869	63.88579	151118
1072.8	0.606427	3.638563	0.459622	0.1	0.82	5.332997	63.95919	151182
1073	0.606686	3.640118	0.460152	0.1	0.82	5.339146	64.03286	151246
1073.2	0.606946	3.641675	0.460684	0.1	0.82	5.345318	64.10679	151310.1
1073.4	0.607206	3.643234	0.461218	0.1	0.82	5.351513	64.18099	151374.3
1073.6	0.607466	3.644795	0.461754	0.1	0.82	5.35773	64.25546	151438.6
1073.8	0.607726	3.646358	0.462292	0.1	0.82	5.363969	64.33019	151502.9
1074	0.607987	3.647923	0.462831	0.1	0.82	5.370232	64.40521	151567.3
1074.2	0.608248	3.649489	0.463373	0.1	0.82	5.376517	64.48049	151631.8
1074.4	0.60851	3.651058	0.463917	0.1	0.82	5.382825	64.55605	151696.3
1074.6	0.608771	3.652628	0.464462	0.1	0.82	5.389157	64.63189	151761
1074.8	0.609033	3.654201	0.46501	0.1	0.82	5.395512	64.70801	151825.7
1075	0.609296	3.655775	0.46556	0.1	0.82	5.40189	64.78441	151890.4
1075.2	0.609558	3.657351	0.466112	0.1	0.82	5.408292	64.8611	151955.3
1075.4	0.609821	3.658929	0.466665	0.1	0.82	5.414718	64.93806	152020.2
1075.6	0.610085	3.660509	0.467221	0.1	0.82	5.421168	65.01532	152085.3
1075.8	0.610348	3.662091	0.467779	0.1	0.82	5.427642	65.09286	152150.4
1076	0.610612	3.663675	0.468339	0.1	0.82	5.43414	65.17069	152215.5
1076.2	0.610877	3.665261	0.468901	0.1	0.82	5.440663	65.24882	152280.8
1076.4	0.611141	3.666849	0.469466	0.1	0.82	5.44721	65.32724	152346.1
1076.6	0.611406	3.668438	0.470032	0.1	0.82	5.453782	65.40595	152411.5
1076.8	0.611672	3.67003	0.470601	0.1	0.82	5.460378	65.48496	152477
1077	0.611937	3.671624	0.471171	0.1	0.82	5.467	65.56427	152542.6
1077.2	0.612203	3.67322	0.471744	0.1	0.82	5.473647	65.64388	152608.2
1077.4	0.61247	3.674817	0.472319	0.1	0.82	5.48032	65.7238	152673.9
1077.6	0.612736	3.676417	0.472896	0.1	0.82	5.487017	65.80402	152739.7
1077.8	0.613003	3.678019	0.473476	0.1	0.82	5.493741	65.88455	152805.6
1078	0.61327	3.679623	0.474058	0.1	0.82	5.50049	65.96539	152871.6
1078.2	0.613538	3.681229	0.474642	0.1	0.82	5.507265	66.04653	152937.6
1078.4	0.613806	3.682837	0.475228	0.1	0.82	5.514067	66.12799	153003.8
1078.6	0.614074	3.684447	0.475816	0.1	0.82	5.520895	66.20977	153070
1078.8	0.614343	3.686059	0.476407	0.1	0.82	5.527749	66.29187	153136.3
1079	0.614612	3.687673	0.477	0.1	0.82	5.53463	66.37428	153202.6
1079.2	0.614882	3.689289	0.477595	0.1	0.82	5.541538	66.45701	153269.1
1079.4	0.615151	3.690907	0.478193	0.1	0.82	5.548473	66.54007	153335.6
1079.6	0.615421	3.692528	0.478793	0.1	0.82	5.555436	66.62345	153402.2
1079.8	0.615692	3.69415	0.479395	0.1	0.82	5.562425	66.70717	153469
1080	0.615962	3.695775	0.48	0.1	0.82	5.569443	66.79121	153535.7

1080.2	0.616234	3.697402	0.480607	0.1	0.82	5.576488	66.87558	153602.6
1080.4	0.616505	3.69903	0.481217	0.1	0.82	5.58356	66.96029	153669.6
1080.6	0.616777	3.700661	0.481829	0.1	0.82	5.590662	67.04533	153736.6
1080.8	0.617049	3.702295	0.482443	0.1	0.82	5.597791	67.13072	153803.8
1081	0.617322	3.70393	0.48306	0.1	0.82	5.604949	67.21644	153871
1081.2	0.617595	3.705567	0.48368	0.1	0.82	5.612136	67.30251	153938.3
1081.4	0.617868	3.707207	0.484302	0.1	0.82	5.619351	67.38892	154005.7
1081.6	0.618141	3.708849	0.484926	0.1	0.82	5.626596	67.47568	154073.1
1081.8	0.618415	3.710493	0.485553	0.1	0.82	5.63387	67.5628	154140.7
1082	0.61869	3.712139	0.486182	0.1	0.82	5.641174	67.65026	154208.4
1082.2	0.618965	3.713787	0.486814	0.1	0.82	5.648507	67.73808	154276.1
1082.4	0.61924	3.715438	0.487449	0.1	0.82	5.65587	67.82626	154343.9
1082.6	0.619515	3.717091	0.488086	0.1	0.82	5.663263	67.9148	154411.8
1082.8	0.619791	3.718746	0.488726	0.1	0.82	5.670687	68.0037	154479.8
1083	0.620067	3.720404	0.489368	0.1	0.82	5.678141	68.09297	154547.9
1083.2	0.620344	3.722063	0.490013	0.1	0.82	5.685626	68.1826	154616.1
1083.4	0.620621	3.723725	0.490661	0.1	0.82	5.693142	68.2726	154684.4
1083.6	0.620898	3.725389	0.491312	0.1	0.82	5.700689	68.36298	154752.7
1083.8	0.621176	3.727056	0.491965	0.1	0.82	5.708267	68.45373	154821.2
1084	0.621454	3.728725	0.492621	0.1	0.82	5.715877	68.54486	154889.7
1084.2	0.621733	3.730396	0.493279	0.1	0.82	5.723519	68.63637	154958.4
1084.4	0.622012	3.732069	0.493941	0.1	0.82	5.731193	68.72827	155027.1
1084.6	0.622291	3.733745	0.494605	0.1	0.82	5.738899	68.82055	155095.9
1084.8	0.62257	3.735423	0.495272	0.1	0.82	5.746637	68.91322	155164.8
1085	0.622851	3.737103	0.495941	0.1	0.82	5.754409	69.00628	155233.9
1085.2	0.623131	3.738786	0.496614	0.1	0.82	5.762213	69.09973	155303
1085.4	0.623412	3.740471	0.49729	0.1	0.82	5.770051	69.19359	155372.1
1085.6	0.623693	3.742159	0.497968	0.1	0.82	5.777922	69.28784	155441.4
1085.8	0.623975	3.743849	0.498649	0.1	0.82	5.785827	69.38249	155510.8
1086	0.624257	3.745541	0.499333	0.1	0.82	5.793765	69.47755	155580.3
1086.2	0.624539	3.747236	0.500021	0.1	0.82	5.801738	69.57302	155649.9
1086.4	0.624822	3.748933	0.500711	0.1	0.82	5.809746	69.6689	155719.5
1086.6	0.625105	3.750632	0.501404	0.1	0.82	5.817788	69.7652	155789.3
1086.8	0.625389	3.752334	0.5021	0.1	0.82	5.825865	69.86191	155859.2
1087	0.625673	3.754039	0.502799	0.1	0.82	5.833977	69.95905	155929.1
1087.2	0.625958	3.755746	0.503501	0.1	0.82	5.842124	70.05661	155999.2
1087.4	0.626243	3.757455	0.504206	0.1	0.82	5.850308	70.15459	156069.3
1087.6	0.626528	3.759167	0.504915	0.1	0.82	5.858527	70.25301	156139.6
1087.8	0.626814	3.760882	0.505626	0.1	0.82	5.866782	70.35186	156209.9
1088	0.6271	3.762599	0.506341	0.1	0.82	5.875074	70.45114	156280.4
1088.2	0.627386	3.764318	0.507059	0.1	0.82	5.883403	70.55087	156350.9
1088.4	0.627673	3.76604	0.50778	0.1	0.82	5.891769	70.65103	156421.6
1088.6	0.627961	3.767765	0.508504	0.1	0.82	5.900172	70.75165	156492.3
1088.8	0.628249	3.769492	0.509232	0.1	0.82	5.908613	70.85271	156563.2
1089	0.628537	3.771221	0.509962	0.1	0.82	5.917092	70.95423	156634.1
1089.2	0.628826	3.772954	0.510696	0.1	0.82	5.925609	71.0562	156705.2
1089.4	0.629115	3.774689	0.511434	0.1	0.82	5.934164	71.15864	156776.4

1089.6	0.629404	3.776426	0.512174	0.1	0.82	5.942758	71.26154	156847.6
1089.8	0.629694	3.778166	0.512918	0.1	0.82	5.951392	71.3649	156919
1090	0.629985	3.779909	0.513666	0.1	0.82	5.960064	71.46874	156990.5
1090.2	0.630276	3.781654	0.514417	0.1	0.82	5.968777	71.57304	157062
1090.4	0.630567	3.783402	0.515171	0.1	0.82	5.977529	71.67783	157133.7
1090.6	0.630859	3.785153	0.515929	0.1	0.82	5.986321	71.7831	157205.5
1090.8	0.631151	3.786906	0.51669	0.1	0.82	5.995154	71.88885	157277.4
1091	0.631444	3.788662	0.517455	0.1	0.82	6.004028	71.9951	157349.4
1091.2	0.631737	3.790421	0.518223	0.1	0.82	6.012944	72.10183	157421.5
1091.4	0.63203	3.792182	0.518995	0.1	0.82	6.021901	72.20907	157493.7
1091.6	0.632324	3.793947	0.519771	0.1	0.82	6.030899	72.3168	157566
1091.8	0.632619	3.795714	0.52055	0.1	0.82	6.03994	72.42504	157638.4
1092	0.632914	3.797483	0.521333	0.1	0.82	6.049024	72.53378	157711
1092.2	0.633209	3.799256	0.522119	0.1	0.82	6.05815	72.64304	157783.6
1092.4	0.633505	3.801031	0.52291	0.1	0.82	6.06732	72.75282	157856.4
1092.6	0.633802	3.802809	0.523704	0.1	0.82	6.076533	72.86312	157929.2
1092.8	0.634098	3.80459	0.524501	0.1	0.82	6.08579	72.97394	158002.2
1093	0.634396	3.806374	0.525303	0.1	0.82	6.095091	73.08529	158075.3
1093.2	0.634693	3.80816	0.526109	0.1	0.82	6.104437	73.19717	158148.5
1093.4	0.634992	3.80995	0.526918	0.1	0.82	6.113828	73.30959	158221.8
1093.6	0.63529	3.811742	0.527731	0.1	0.82	6.123265	73.42256	158295.2
1093.8	0.63559	3.813537	0.528548	0.1	0.82	6.132747	73.53607	158368.7
1094	0.635889	3.815336	0.52937	0.1	0.82	6.142275	73.65013	158442.4
1094.2	0.636189	3.817137	0.530195	0.1	0.82	6.15185	73.76475	158516.2
1094.4	0.63649	3.818941	0.531024	0.1	0.82	6.161471	73.87993	158590
1094.6	0.636791	3.820747	0.531857	0.1	0.82	6.17114	73.99567	158664
1094.8	0.637093	3.822557	0.532695	0.1	0.82	6.180856	74.11198	158738.2
1095	0.637395	3.82437	0.533536	0.1	0.82	6.190621	74.22886	158812.4
1095.2	0.637698	3.826186	0.534382	0.1	0.82	6.200434	74.34633	158886.7
1095.4	0.638001	3.828005	0.535232	0.1	0.82	6.210295	74.46438	158961.2
1095.6	0.638304	3.829827	0.536086	0.1	0.82	6.220206	74.58301	159035.8
1095.8	0.638609	3.831652	0.536945	0.1	0.82	6.230167	74.70224	159110.5
1096	0.638913	3.833479	0.537807	0.1	0.82	6.240178	74.82207	159185.3
1096.2	0.639218	3.835311	0.538674	0.1	0.82	6.250239	74.9425	159260.2
1096.4	0.639524	3.837145	0.539546	0.1	0.82	6.260351	75.06354	159335.3
1096.6	0.63983	3.838982	0.540422	0.1	0.82	6.270515	75.1852	159410.5
1096.8	0.640137	3.840822	0.541302	0.1	0.82	6.28073	75.30747	159485.8
1097	0.640444	3.842666	0.542187	0.1	0.82	6.290998	75.43037	159561.2
1097.2	0.640752	3.844512	0.543077	0.1	0.82	6.301318	75.5539	159636.8
1097.4	0.64106	3.846362	0.543971	0.1	0.82	6.311692	75.67806	159712.5
1097.6	0.641369	3.848215	0.544869	0.1	0.82	6.322119	75.80287	159788.3
1097.8	0.641679	3.850071	0.545773	0.1	0.82	6.3326	75.92832	159864.2
1098	0.641988	3.851931	0.546681	0.1	0.82	6.343136	76.05442	159940.2
1098.2	0.642299	3.853793	0.547593	0.1	0.82	6.353727	76.18118	160016.4
1098.4	0.64261	3.855659	0.548511	0.1	0.82	6.364374	76.30861	160092.7
1098.6	0.642921	3.857528	0.549433	0.1	0.82	6.375076	76.4367	160169.2
1098.8	0.643233	3.859401	0.550361	0.1	0.82	6.385835	76.56547	160245.7

1099	0.643546	3.861277	0.551293	0.1	0.82	6.396651	76.69492	160322.4
1099.2	0.643859	3.863156	0.55223	0.1	0.82	6.407525	76.82506	160399.3
1099.4	0.644173	3.865038	0.553172	0.1	0.82	6.418457	76.95589	160476.2
1099.6	0.644487	3.866924	0.554119	0.1	0.82	6.429447	77.08742	160553.3
1099.8	0.644802	3.868813	0.555072	0.1	0.82	6.440496	77.21966	160630.5
1100	0.645118	3.870706	0.556029	0.1	0.82	6.451605	77.35261	160707.9
1100.2	0.645434	3.872602	0.556992	0.1	0.82	6.462775	77.48628	160785.4
1100.4	0.64575	3.874501	0.55796	0.1	0.82	6.474004	77.62067	160863
1100.6	0.646067	3.876404	0.558933	0.1	0.82	6.485296	77.7558	160940.7
1100.8	0.646385	3.878311	0.559911	0.1	0.82	6.496649	77.89167	161018.6
1101	0.646703	3.880221	0.560895	0.1	0.82	6.508064	78.02828	161096.7
1101.2	0.647022	3.882134	0.561884	0.1	0.82	6.519543	78.16565	161174.8
1101.4	0.647342	3.884051	0.562879	0.1	0.82	6.531085	78.30377	161253.1
1101.6	0.647662	3.885972	0.563879	0.1	0.82	6.542692	78.44266	161331.6
1101.8	0.647983	3.887896	0.564885	0.1	0.82	6.554363	78.58233	161410.1
1102	0.648304	3.889824	0.565897	0.1	0.82	6.566099	78.72277	161488.9
1102.2	0.648626	3.891755	0.566914	0.1	0.82	6.577902	78.86401	161567.7
1102.4	0.648948	3.89369	0.567937	0.1	0.82	6.589771	79.00604	161646.7
1102.6	0.649271	3.895629	0.568966	0.1	0.82	6.601708	79.14888	161725.9
1102.8	0.649595	3.897571	0.57	0.1	0.82	6.613713	79.29252	161805.2
1103	0.64992	3.899517	0.571041	0.1	0.82	6.625786	79.43699	161884.6
1103.2	0.650245	3.901467	0.572087	0.1	0.82	6.637928	79.58228	161964.2
1103.4	0.65057	3.903421	0.57314	0.1	0.82	6.65014	79.72841	162043.9
1103.6	0.650896	3.905378	0.574198	0.1	0.82	6.662423	79.87538	162123.8
1103.8	0.651223	3.907339	0.575263	0.1	0.82	6.674778	80.02321	162203.8
1104	0.651551	3.909304	0.576334	0.1	0.82	6.687204	80.17189	162284
1104.2	0.651879	3.911273	0.577411	0.1	0.82	6.699703	80.32144	162364.3
1104.4	0.652208	3.913246	0.578495	0.1	0.82	6.712275	80.47187	162444.8
1104.6	0.652537	3.915223	0.579585	0.1	0.82	6.724922	80.62318	162525.4
1104.8	0.652867	3.917203	0.580681	0.1	0.82	6.737643	80.77539	162606.2
1105	0.653198	3.919188	0.581784	0.1	0.82	6.75044	80.9285	162687.1
1105.2	0.653529	3.921176	0.582893	0.1	0.82	6.763313	81.08252	162768.2
1105.4	0.653861	3.923169	0.58401	0.1	0.82	6.776264	81.23746	162849.4
1105.6	0.654194	3.925165	0.585132	0.1	0.82	6.789292	81.39334	162930.8
1105.8	0.654528	3.927166	0.586262	0.1	0.82	6.8024	81.55015	163012.4
1106	0.654862	3.929171	0.587399	0.1	0.82	6.815586	81.70792	163094.1
1106.2	0.655197	3.931179	0.588542	0.1	0.82	6.828853	81.86664	163176
1106.4	0.655532	3.933192	0.589692	0.1	0.82	6.842202	82.02633	163258
1106.6	0.655868	3.935209	0.59085	0.1	0.82	6.855632	82.187	163340.2
1106.8	0.656205	3.93723	0.592015	0.1	0.82	6.869145	82.34867	163422.5
1107	0.656543	3.939256	0.593186	0.1	0.82	6.882742	82.51133	163505
1107.2	0.656881	3.941286	0.594366	0.1	0.82	6.896424	82.675	163587.7
1107.4	0.65722	3.943319	0.595552	0.1	0.82	6.910191	82.83969	163670.5
1107.6	0.65756	3.945358	0.596746	0.1	0.82	6.924044	83.00541	163753.6
1107.8	0.6579	3.9474	0.597948	0.1	0.82	6.937985	83.17218	163836.7
1108	0.658241	3.949447	0.599157	0.1	0.82	6.952014	83.34	163920.1
1108.2	0.658583	3.951498	0.600373	0.1	0.82	6.966133	83.50888	164003.6

1108.4	0.658926	3.953554	0.601598	0.1	0.82	6.980341	83.67884	164087.3
1108.6	0.659269	3.955614	0.60283	0.1	0.82	6.99464	83.84989	164171.1
1108.8	0.659613	3.957679	0.604071	0.1	0.82	7.009032	84.02203	164255.1
1109	0.659958	3.959748	0.605319	0.1	0.82	7.023517	84.19529	164339.3
1109.2	0.660304	3.961821	0.606576	0.1	0.82	7.038096	84.36967	164423.7
1109.4	0.66065	3.963899	0.60784	0.1	0.82	7.05277	84.54519	164508.2
1109.6	0.660997	3.965982	0.609113	0.1	0.82	7.06754	84.72186	164593
1109.8	0.661345	3.96807	0.610395	0.1	0.82	7.082407	84.89968	164677.9
1110	0.661694	3.970162	0.611684	0.1	0.82	7.097373	85.07869	164762.9
1110.2	0.662043	3.972258	0.612983	0.1	0.82	7.112439	85.25887	164848.2
1110.4	0.662393	3.97436	0.61429	0.1	0.82	7.127605	85.44026	164933.6
1110.6	0.662744	3.976466	0.615606	0.1	0.82	7.142872	85.62286	165019.3
1110.8	0.663096	3.978577	0.61693	0.1	0.82	7.158243	85.80669	165105.1
1111	0.663449	3.980693	0.618264	0.1	0.82	7.173717	85.99176	165191.1
1111.2	0.663802	3.982813	0.619607	0.1	0.82	7.189297	86.17809	165277.2
1111.4	0.664156	3.984939	0.620959	0.1	0.82	7.204983	86.36568	165363.6
1111.6	0.664512	3.987069	0.62232	0.1	0.82	7.220777	86.55456	165450.2
1111.8	0.664867	3.989205	0.62369	0.1	0.82	7.23668	86.74474	165536.9
1112	0.665224	3.991345	0.625071	0.1	0.82	7.252693	86.93624	165623.8
1112.2	0.665582	3.993491	0.62646	0.1	0.82	7.268818	87.12906	165711
1112.4	0.66594	3.995641	0.62786	0.1	0.82	7.285055	87.32323	165798.3
1112.6	0.666299	3.997797	0.629269	0.1	0.82	7.301406	87.51877	165885.8
1112.8	0.66666	3.999958	0.630688	0.1	0.82	7.317873	87.71568	165973.5
1113	0.667021	4.002124	0.632117	0.1	0.82	7.334457	87.91398	166061.4
1113.2	0.667382	4.004295	0.633557	0.1	0.82	7.351159	88.11369	166149.5
1113.4	0.667745	4.006471	0.635007	0.1	0.82	7.36798	88.31484	166237.9
1113.6	0.668109	4.008653	0.636467	0.1	0.82	7.384923	88.51742	166326.4
1113.8	0.668473	4.01084	0.637937	0.1	0.82	7.401989	88.72147	166415.1
1114	0.668839	4.013033	0.639419	0.1	0.82	7.419178	88.927	166504
1114.2	0.669205	4.015231	0.640911	0.1	0.82	7.436493	89.13403	166593.2
1114.4	0.669572	4.017434	0.642415	0.1	0.82	7.453936	89.34257	166682.5
1114.6	0.66994	4.019643	0.643929	0.1	0.82	7.471507	89.55265	166772.1
1114.8	0.67031	4.021857	0.645454	0.1	0.82	7.489208	89.76429	166861.8
1115	0.67068	4.024078	0.646991	0.1	0.82	7.507042	89.9775	166951.8
1115.2	0.671051	4.026303	0.64854	0.1	0.82	7.525009	90.1923	167042
1115.4	0.671422	4.028535	0.6501	0.1	0.82	7.543111	90.40872	167132.4
1115.6	0.671795	4.030772	0.651672	0.1	0.82	7.561351	90.62677	167223
1115.8	0.672169	4.033015	0.653256	0.1	0.82	7.579729	90.84648	167313.9
1116	0.672544	4.035264	0.654852	0.1	0.82	7.598248	91.06787	167404.9
1116.2	0.67292	4.037518	0.65646	0.1	0.82	7.61691	91.29095	167496.2
1116.4	0.673296	4.039779	0.658081	0.1	0.82	7.635716	91.51576	167587.7
1116.6	0.673674	4.042045	0.659715	0.1	0.82	7.654668	91.7423	167679.5
1116.8	0.674053	4.044318	0.661361	0.1	0.82	7.673768	91.97062	167771.5
1117	0.674433	4.046597	0.66302	0.1	0.82	7.693018	92.20072	167863.7
1117.2	0.674814	4.048882	0.664692	0.1	0.82	7.712421	92.43263	167956.1
1117.4	0.675195	4.051173	0.666377	0.1	0.82	7.731977	92.66639	168048.8
1117.6	0.675578	4.05347	0.668076	0.1	0.82	7.75169	92.902	168141.7

1117.8	0.675962	4.055773	0.669789	0.1	0.82	7.771561	93.1395	168234.8
1118	0.676347	4.058083	0.671515	0.1	0.82	7.791592	93.37892	168328.2
1118.2	0.676733	4.060399	0.673256	0.1	0.82	7.811786	93.62027	168421.8
1118.4	0.67712	4.062722	0.67501	0.1	0.82	7.832145	93.86359	168515.7
1118.6	0.677509	4.065051	0.676779	0.1	0.82	7.852671	94.10889	168609.8
1118.8	0.677898	4.067387	0.678563	0.1	0.82	7.873366	94.35622	168704.1
1119	0.678288	4.069729	0.680361	0.1	0.82	7.894234	94.6056	168798.7
1119.2	0.67868	4.072078	0.682175	0.1	0.82	7.915275	94.85705	168893.6
1119.4	0.679072	4.074434	0.684004	0.1	0.82	7.936494	95.11061	168988.7
1119.6	0.679466	4.076797	0.685848	0.1	0.82	7.957891	95.36631	169084.1
1119.8	0.679861	4.079166	0.687708	0.1	0.82	7.97947	95.62417	169179.7
1120	0.680257	4.081543	0.689583	0.1	0.82	8.001234	95.88423	169275.6
1120.2	0.680654	4.083926	0.691475	0.1	0.82	8.023185	96.14651	169371.7
1120.4	0.681053	4.086317	0.693383	0.1	0.82	8.045325	96.41106	169468.1
1120.6	0.681452	4.088714	0.695308	0.1	0.82	8.067658	96.6779	169564.8
1120.8	0.681853	4.091119	0.69725	0.1	0.82	8.090187	96.94707	169661.8
1121	0.682255	4.093531	0.699208	0.1	0.82	8.112914	97.2186	169759
1121.2	0.682658	4.09595	0.701184	0.1	0.82	8.135842	97.49253	169856.5
1121.4	0.683063	4.098377	0.703178	0.1	0.82	8.158974	97.7689	169954.2
1121.6	0.683469	4.100811	0.70519	0.1	0.82	8.182314	98.04773	170052.3
1121.8	0.683876	4.103253	0.707219	0.1	0.82	8.205864	98.32907	170150.6
1122	0.684284	4.105702	0.709267	0.1	0.82	8.229628	98.61296	170249.2
1122.2	0.684693	4.108159	0.711334	0.1	0.82	8.253609	98.89943	170348.1
1122.4	0.685104	4.110624	0.71342	0.1	0.82	8.277811	99.18852	170447.3
1122.6	0.685516	4.113097	0.715525	0.1	0.82	8.302236	99.48028	170546.8
1122.8	0.68593	4.115577	0.71765	0.1	0.82	8.326888	99.77474	170646.6
1123	0.686344	4.118066	0.719794	0.1	0.82	8.351772	100.072	170746.6
1123.2	0.68676	4.120563	0.721959	0.1	0.82	8.37689	100.372	170847
1123.4	0.687178	4.123067	0.724144	0.1	0.82	8.402246	100.6748	170947.7
1123.6	0.687597	4.12558	0.72635	0.1	0.82	8.427844	100.9805	171048.7
1123.8	0.688017	4.128102	0.728578	0.1	0.82	8.453689	101.2892	171150
1124	0.688439	4.130632	0.730827	0.1	0.82	8.479783	101.6008	171251.6
1124.2	0.688862	4.13317	0.733098	0.1	0.82	8.506132	101.9155	171353.5
1124.4	0.689286	4.135717	0.735391	0.1	0.82	8.532739	102.2332	171455.7
1124.6	0.689712	4.138272	0.737706	0.1	0.82	8.559608	102.5541	171558.3
1124.8	0.690139	4.140837	0.740045	0.1	0.82	8.586745	102.8781	171661.1
1125	0.690568	4.14341	0.742407	0.1	0.82	8.614153	103.2054	171764.4
1125.2	0.690999	4.145992	0.744793	0.1	0.82	8.641838	103.5359	171867.9
1125.4	0.691431	4.148584	0.747204	0.1	0.82	8.669803	103.8698	171971.8
1125.6	0.691864	4.151184	0.749638	0.1	0.82	8.698054	104.2071	172076
1125.8	0.692299	4.153794	0.752098	0.1	0.82	8.726596	104.5479	172180.5
1126	0.692735	4.156413	0.754584	0.1	0.82	8.755434	104.8922	172285.4
1126.2	0.693174	4.159042	0.757095	0.1	0.82	8.784572	105.24	172390.6
1126.4	0.693613	4.16168	0.759633	0.1	0.82	8.814017	105.5915	172496.2
1126.6	0.694055	4.164328	0.762197	0.1	0.82	8.843773	105.9467	172602.2
1126.8	0.694498	4.166985	0.764789	0.1	0.82	8.873847	106.3057	172708.5
1127	0.694942	4.169653	0.767409	0.1	0.82	8.904244	106.6685	172815.2

1127.2	0.695388	4.172331	0.770057	0.1	0.82	8.93497	107.0353	172922.2
1127.4	0.695836	4.175019	0.772734	0.1	0.82	8.96603	107.406	173029.6
1127.6	0.696286	4.177717	0.77544	0.1	0.82	8.997432	107.7808	173137.4
1127.8	0.696738	4.180425	0.778177	0.1	0.82	9.029182	108.1597	173245.5
1128	0.697191	4.183145	0.780943	0.1	0.82	9.061286	108.5428	173354.1
1128.2	0.697646	4.185874	0.783741	0.1	0.82	9.09375	108.9302	173463
1128.4	0.698102	4.188615	0.786571	0.1	0.82	9.126583	109.322	173572.3
1128.6	0.698561	4.191367	0.789433	0.1	0.82	9.15979	109.7182	173682.1
1128.8	0.699022	4.194129	0.792328	0.1	0.82	9.193379	110.119	173792.2
1129	0.699484	4.196903	0.795256	0.1	0.82	9.227357	110.5244	173902.7
1129.2	0.699948	4.199688	0.798219	0.1	0.82	9.261733	110.9345	174013.6
1129.4	0.700414	4.202485	0.801216	0.1	0.82	9.296514	111.3495	174125
1129.6	0.700882	4.205293	0.80425	0.1	0.82	9.331708	111.7693	174236.7
1129.8	0.701352	4.208113	0.807319	0.1	0.82	9.367324	112.1942	174348.9
1130	0.701824	4.210946	0.810426	0.1	0.82	9.40337	112.6242	174461.6
1130.2	0.702298	4.21379	0.81357	0.1	0.82	9.439854	113.0593	174574.6
1130.4	0.702774	4.216646	0.816753	0.1	0.82	9.476787	113.4998	174688.1
1130.6	0.703253	4.219515	0.819976	0.1	0.82	9.514177	113.9458	174802.1
1130.8	0.703733	4.222397	0.823238	0.1	0.82	9.552034	114.3973	174916.5
1131	0.704215	4.225291	0.826542	0.1	0.82	9.590369	114.8544	175031.3
1131.2	0.7047	4.228199	0.829888	0.1	0.82	9.62919	115.3174	175146.6
1131.4	0.705187	4.231119	0.833277	0.1	0.82	9.668509	115.7862	175262.4
1131.6	0.705676	4.234053	0.836709	0.1	0.82	9.708337	116.2611	175378.7
1131.8	0.706167	4.237001	0.840187	0.1	0.82	9.748684	116.7421	175495.4
1132	0.70666	4.239962	0.84371	0.1	0.82	9.789563	117.2295	175612.7
1132.2	0.707156	4.242937	0.84728	0.1	0.82	9.830985	117.7233	175730.4
1132.4	0.707654	4.245927	0.850897	0.1	0.82	9.872962	118.2237	175848.6
1132.6	0.708155	4.248931	0.854564	0.1	0.82	9.915508	118.7308	175967.3
1132.8	0.708658	4.251949	0.858281	0.1	0.82	9.958635	119.2449	176086.6
1133	0.709164	4.254982	0.862049	0.100459	0.820046	10.00292	119.7693	176206.4
1133.2	0.709672	4.25803	0.86587	0.101315	0.820132	10.0483	120.3073	176326.7
1133.4	0.710182	4.261094	0.869744	0.102183	0.820218	10.09433	120.8558	176447.5
1133.6	0.710695	4.264173	0.873673	0.103064	0.820306	10.14102	121.4121	176568.9
1133.8	0.711211	4.267267	0.877659	0.103957	0.820396	10.18839	121.9765	176690.9
1134	0.71173	4.270378	0.881703	0.104863	0.820486	10.23646	122.5491	176813.5
1134.2	0.712251	4.273505	0.885805	0.105782	0.820578	10.28524	123.1302	176936.6
1134.4	0.712775	4.276649	0.889968	0.106715	0.820671	10.33476	123.72	177060.3
1134.6	0.713302	4.279809	0.894194	0.107661	0.820766	10.38502	124.3187	177184.6
1134.8	0.713831	4.282987	0.898483	0.108622	0.820862	10.43605	124.9265	177309.5
1135	0.714364	4.286182	0.902837	0.109598	0.82096	10.48788	125.5436	177435.1
1135.2	0.714899	4.289395	0.907258	0.110589	0.821059	10.54051	126.1703	177561.3
1135.4	0.715438	4.292625	0.911749	0.111595	0.821159	10.59398	126.8069	177688.1
1135.6	0.715979	4.295875	0.91631	0.112617	0.821262	10.6483	127.4537	177815.5
1135.8	0.716524	4.299142	0.920943	0.113655	0.821365	10.7035	128.1108	177943.6
1136	0.717072	4.302429	0.925651	0.11471	0.821471	10.7596	128.7786	178072.4
1136.2	0.717623	4.305735	0.930436	0.115782	0.821578	10.81662	129.4573	178201.9
1136.4	0.718177	4.309061	0.935299	0.116871	0.821687	10.8746	130.1474	178332

1136.6	0.718735	4.312407	0.940243	0.117979	0.821798	10.93356	130.849	178462.9
1136.8	0.719296	4.315774	0.945271	0.119106	0.821911	10.99353	131.5626	178594.4
1137	0.71986	4.319161	0.950384	0.120251	0.822025	11.05454	132.2884	178726.7
1137.2	0.720428	4.32257	0.955585	0.121417	0.822142	11.11661	133.0269	178859.7
1137.4	0.721	4.326	0.960877	0.122602	0.82226	11.17979	133.7784	178993.5
1137.6	0.721575	4.329452	0.966263	0.123809	0.822381	11.2441	134.5433	179128.1
1137.8	0.722155	4.332928	0.971744	0.125037	0.822504	11.30957	135.322	179263.4
1138	0.722738	4.336426	0.977325	0.126288	0.822629	11.37626	136.115	179399.5
1138.2	0.723325	4.339948	0.983008	0.127561	0.822756	11.44418	136.9226	179536.4
1138.4	0.723916	4.343493	0.988797	0.128858	0.822886	11.51339	137.7454	179674.2
1138.6	0.724511	4.347064	0.994695	0.130179	0.823018	11.58392	138.5838	179812.8
1138.8	0.72511	4.350659	1.000704	0.131526	0.823153	11.65581	139.4384	179952.2
1139	0.725713	4.354281	1.00683	0.132899	0.82329	11.72912	140.3096	180092.5
1139.2	0.726321	4.357928	1.013076	0.134298	0.82343	11.80389	141.1981	180233.7
1139.4	0.726934	4.361603	1.019446	0.135725	0.823573	11.88017	142.1044	180375.8
1139.6	0.727551	4.365305	1.025944	0.137181	0.823718	11.95801	143.0291	180518.8
1139.8	0.728172	4.369035	1.032575	0.138667	0.823867	12.03746	143.9728	180662.8
1140	0.728799	4.372794	1.039343	0.140183	0.824018	12.11859	144.9363	180807.7
1140.2	0.72943	4.376582	1.046253	0.141732	0.824173	12.20145	145.9203	180953.7
1140.4	0.730067	4.380401	1.05331	0.143313	0.824331	12.28611	146.9254	181100.6
1140.6	0.730709	4.384251	1.06052	0.144928	0.824493	12.37264	147.9525	181248.5
1140.8	0.731356	4.388133	1.067889	0.146579	0.824658	12.4611	149.0024	181397.5
1141	0.732008	4.392048	1.075422	0.148267	0.824827	12.55157	150.076	181547.6
1141.2	0.732666	4.395996	1.083126	0.149993	0.824999	12.64413	151.1742	181698.8
1141.4	0.73333	4.399978	1.091007	0.151759	0.825176	12.73886	152.2979	181851.1
1141.6	0.733999	4.403996	1.099072	0.153566	0.825357	12.83584	153.4482	182004.5
1141.8	0.734675	4.408051	1.10733	0.155416	0.825542	12.93518	154.6262	182159.2
1142	0.735357	4.412143	1.115788	0.157311	0.825731	13.03697	155.8329	182315
1142.2	0.736046	4.416274	1.124453	0.159253	0.825925	13.14131	157.0697	182472.1
1142.4	0.736741	4.420445	1.133336	0.161243	0.826124	13.24832	158.3378	182630.4
1142.6	0.737443	4.424656	1.142446	0.163284	0.826328	13.3581	159.6385	182790
1142.8	0.738152	4.42891	1.151792	0.165378	0.826538	13.4708	160.9734	182951
1143	0.738868	4.433208	1.161386	0.167528	0.826753	13.58653	162.344	183113.4
1143.2	0.739592	4.437551	1.171238	0.169735	0.826974	13.70545	163.7519	183277.1
1143.4	0.740323	4.44194	1.181361	0.172004	0.8272	13.8277	165.1988	183442.3
1143.6	0.741063	4.446378	1.191768	0.174335	0.827434	13.95344	166.6868	183609
1143.8	0.741811	4.450866	1.202473	0.176734	0.827673	14.08285	168.2177	183777.2
1144	0.742567	4.455405	1.21349	0.179202	0.82792	14.21612	169.7938	183947
1144.2	0.743333	4.459998	1.224835	0.181744	0.828174	14.35344	171.4174	184118.4
1144.4	0.744108	4.464647	1.236527	0.184364	0.828436	14.49503	173.0908	184291.5
1144.6	0.744892	4.469353	1.248582	0.187065	0.828707	14.64112	174.8169	184466.3
1144.8	0.745687	4.47412	1.261022	0.189852	0.828985	14.79197	176.5985	184642.9
1145	0.746492	4.478949	1.273867	0.19273	0.829273	14.94783	178.4388	184821.4
1145.2	0.747307	4.483844	1.287141	0.195705	0.82957	15.10901	180.341	185001.7
1145.4	0.748135	4.488807	1.30087	0.198755	0.829875	15.27577	182.3087	185184
1145.6	0.748974	4.493841	1.315079	0.201516	0.830152	15.44777	184.3413	185368.4
1145.8	0.749825	4.49895	1.329801	0.204377	0.830438	15.62608	186.4431	185554.8

1146	0.750689	4.504136	1.345066	0.207344	0.830734	15.8111	188.6231	185743.4
1146.2	0.751567	4.509405	1.360911	0.210423	0.831042	16.00329	190.8864	185934.3
1146.4	0.75246	4.51476	1.377375	0.213623	0.831362	16.20313	193.2385	186127.6
1146.6	0.753367	4.520205	1.394501	0.216952	0.831695	16.41117	195.6858	186323.2
1146.8	0.754291	4.525746	1.412338	0.220418	0.832042	16.62801	198.2351	186521.5
1147	0.755231	4.531388	1.430937	0.224033	0.832403	16.8543	200.8938	186722.4
1147.2	0.75619	4.537137	1.450357	0.227807	0.832781	17.09079	203.6705	186926
1147.4	0.757167	4.543	1.470665	0.231754	0.833175	17.33831	206.5746	187132.6
1147.6	0.758164	4.548984	1.491933	0.235887	0.833589	17.59777	209.6165	187342.2
1147.8	0.759183	4.555097	1.514245	0.240223	0.834022	17.87023	212.808	187555
1148	0.760225	4.561349	1.537693	0.244781	0.834478	18.15687	216.1626	187771.2
1148.2	0.761292	4.567749	1.562385	0.249579	0.834958	18.45904	219.6955	187990.9
1148.4	0.762385	4.57431	1.588442	0.254643	0.835464	18.77827	223.4238	188214.3
1148.6	0.763507	4.581045	1.616003	0.26	0.836	19.11635	227.3677	188441.7
1148.8	0.764661	4.587968	1.645233	0.265681	0.836568	19.47534	231.5502	188673.2
1149	0.76585	4.595098	1.67632	0.271722	0.837172	19.85767	235.9981	188909.2
1149.2	0.767076	4.602455	1.70949	0.277763	0.837776	20.2652	240.7372	189150
1149.4	0.768344	4.610064	1.745008	0.283146	0.838315	20.69955	245.7885	189395.8
1149.6	0.769659	4.617953	1.783198	0.288934	0.838893	21.16716	251.2003	189647
1149.8	0.771026	4.626158	1.824452	0.295187	0.839519	21.67301	257.041	189904
1150	0.772454	4.634721	1.86926	0.301978	0.840198	22.22326	263.3776	190167.4
1150.2	0.77395	4.643698	1.91824	0.309402	0.84094	22.82572	270.2938	190437.7
1150.4	0.775526	4.653156	1.972192	0.317579	0.841758	23.49053	277.8975	190715.6
1150.6	0.777198	4.66319	2.032181	0.326671	0.842667	24.23119	286.3303	191001.9
1150.8	0.778987	4.673923	2.099674	0.3369	0.84369	25.06635	295.7853	191297.7
1151	0.780923	4.685535	2.176788	0.348588	0.844859	26.02296	306.5359	191604.2
1151.2	0.78305	4.698303	2.266774	0.362227	0.846223	27.14247	318.9926	191923.2
1151.4	0.785447	4.712684	2.375099	0.378645	0.847864	28.49473	333.8232	192257
1151.6	0.788262	4.729569	2.512371	0.398875	0.849887	30.21354	352.2496	192609.3
1151.8	0.79187	4.751223	2.705723	0.419184	0.851918	32.61653	376.9804	192986.3
1152	0.8	4.8	3.223345	0.473552	0.857355	39.10426	430.3247	193416.6
1152.2	0.804237	4.825424	3.459446	0.498352	0.859835	42.08993	487.1651	193903.8
1152.4	0.806118	4.836711	3.52453	0.504404	0.86044	42.91197	510.0114	194413.8
1152.6	0.807585	4.845512	3.558332	0.506874	0.860687	43.33596	517.4876	194931.3
1152.8	0.808835	4.853008	3.574927	0.508087	0.860809	43.5442	521.281	195452.5
1153	0.809944	4.859663	3.579765	0.508441	0.860844	43.60491	522.8947	195975.4
1153.2	0.810953	4.865716	3.575595	0.508136	0.860814	43.55258	522.9449	196498.4
1153.4	0.811885	4.87131	3.563998	0.507288	0.860729	43.40704	521.7577	197020.1
1153.6	0.812757	4.87654	3.545939	0.505968	0.860597	43.18048	519.5251	197539.7
1153.8	0.813578	4.88147	3.522021	0.50422	0.860422	42.88051	516.3659	198056
1154	0.814358	4.886149	3.492606	0.501835	0.860183	42.51059	512.3466	198568.4
1154.2	0.815102	4.890612	3.457883	0.498187	0.859819	42.07011	507.4842	199075.9
1154.4	0.815815	4.894889	3.417898	0.493987	0.859399	41.56333	501.8006	199577.7
1154.6	0.8165	4.899001	3.372574	0.489227	0.858923	40.98944	495.3166	200073
1154.8	0.817161	4.902967	3.321708	0.483884	0.858388	40.34612	488.0134	200561
1155	0.8178	4.906802	3.264965	0.477924	0.857792	39.62937	479.8529	201040.8
1155.2	0.81842	4.910518	3.201845	0.471294	0.857129	38.83319	470.7754	201511.6

1155.4	0.819021	4.914127	3.131643	0.46392	0.856392	37.94908	460.6937	201972.3
1155.6	0.819606	4.917637	3.053368	0.455699	0.85557	36.96503	449.4847	202421.8
1155.8	0.820176	4.921057	2.965609	0.446481	0.854648	35.86391	436.9737	202858.8
1156	0.820732	4.924393	2.866289	0.436049	0.853605	34.62049	422.9064	203281.7
1156.2	0.821275	4.927651	2.752183	0.424064	0.852406	33.19559	406.8965	203688.6
1156.4	0.821806	4.930838	2.61784	0.409953	0.850995	31.52294	388.3112	204076.9
1156.6	0.822326	4.933957	2.452653	0.390399	0.84904	29.46596	365.9334	204442.8
1156.8	0.822835	4.937013	2.22948	0.356574	0.845657	26.67808	336.8643	204779.7
1157	0.823335	4.940009	1.680113	0.272459	0.837246	19.90435	279.4946	205059.2
1157.2	0.823825	4.94295	1.410312	0.220024	0.832002	16.60337	219.0463	205278.2
1157.4	0.824306	4.945838	1.30953	0.200438	0.830044	15.38059	191.9037	205470.1
1157.6	0.824779	4.948677	1.237979	0.184689	0.828469	14.51263	179.3593	205649.5
1157.8	0.825245	4.951468	1.181517	0.172039	0.827204	13.82958	170.0533	205819.5
1158	0.825702	4.954214	1.134613	0.161529	0.826153	13.2637	162.5597	205982.1
1158.2	0.826153	4.956917	1.094419	0.152523	0.825252	12.77988	156.2615	206138.4
1158.4	0.826597	4.95958	1.059239	0.144641	0.824464	12.35726	150.8229	206289.2
1158.6	0.827034	4.962204	1.027971	0.137635	0.823764	11.98229	146.0373	206435.2
1158.8	0.827465	4.964791	0.99985	0.131334	0.823133	11.64559	141.7673	206577
1159	0.82789	4.967342	0.97432	0.125614	0.822561	11.34035	137.9156	206714.9
1159.2	0.82831	4.969859	0.950964	0.120381	0.822038	11.06146	134.4109	206849.3
1159.4	0.828724	4.972344	0.929461	0.115563	0.821556	10.80501	131.1988	206980.5
1159.6	0.829133	4.974797	0.909556	0.111103	0.82111	10.56786	128.2372	207108.8
1159.8	0.829537	4.97722	0.891042	0.106955	0.820696	10.34753	125.4924	207234.2
1160	0.829936	4.979614	0.873753	0.103082	0.820308	10.14197	122.937	207357.2
1160.2	0.83033	4.98198	0.857549	0.1	0.82	9.950147	120.5527	207477.7
1160.4	0.83072	4.984319	0.842314	0.1	0.82	9.77337	118.3411	207596.1
1160.6	0.831105	4.986633	0.827948	0.1	0.82	9.60668	116.2803	207712.4
1160.8	0.831487	4.98892	0.814366	0.1	0.82	9.449093	114.3346	207826.7
1161	0.831864	4.991184	0.801496	0.1	0.82	9.299761	112.4931	207939.2
1161.2	0.832237	4.993424	0.789274	0.1	0.82	9.157949	110.7463	208049.9
1161.4	0.832607	4.995642	0.777645	0.1	0.82	9.023012	109.0858	208159
1161.6	0.832973	4.997837	0.766559	0.1	0.82	8.894385	107.5044	208266.5
1161.8	0.833335	5.000011	0.755974	0.1	0.82	8.771566	105.9957	208372.5
1162	0.833694	5.002164	0.745851	0.1	0.82	8.654113	104.5541	208477.1
1162.2	0.834049	5.004297	0.736157	0.1	0.82	8.541628	103.1745	208580.2
1162.4	0.834402	5.00641	0.72686	0.1	0.82	8.433757	101.8523	208682.1
1162.6	0.834751	5.008504	0.717933	0.1	0.82	8.330179	100.5836	208782.7
1162.8	0.835097	5.01058	0.709352	0.1	0.82	8.230606	99.36471	208882
1163	0.83544	5.012638	0.701093	0.1	0.82	8.134777	98.19229	208980.2
1163.2	0.83578	5.014679	0.693136	0.1	0.82	8.042454	97.06339	209077.3
1163.4	0.836117	5.016702	0.685463	0.1	0.82	7.953423	95.97526	209173.3
1163.6	0.836451	5.018709	0.678056	0.1	0.82	7.867484	94.92544	209268.2
1163.8	0.836783	5.020699	0.6709	0.1	0.82	7.784458	93.91165	209362.1
1164	0.837112	5.022674	0.663982	0.1	0.82	7.704178	92.93181	209455
1164.2	0.837439	5.024633	0.657286	0.1	0.82	7.626492	91.98402	209547
1164.4	0.837763	5.026577	0.650802	0.1	0.82	7.551258	91.0665	209638.1
1164.6	0.838085	5.028507	0.644518	0.1	0.82	7.478348	90.17764	209728.3

1164.8	0.838404	5.030422	0.638425	0.1	0.82	7.40764	89.31593	209817.6
1165	0.838721	5.032324	0.632511	0.1	0.82	7.339022	88.47997	209906.1
1165.2	0.839035	5.034211	0.626768	0.1	0.82	7.272392	87.66848	209993.7
1165.4	0.839348	5.036085	0.621189	0.1	0.82	7.207652	86.88026	210080.6
1165.6	0.839658	5.037946	0.615764	0.1	0.82	7.144712	86.11418	210166.7
1165.8	0.839966	5.039794	0.610488	0.1	0.82	7.083489	85.36921	210252.1
1166	0.840272	5.04163	0.605352	0.1	0.82	7.023904	84.64436	210336.7
1166.2	0.840576	5.043454	0.600352	0.1	0.82	6.965884	83.93873	210420.7
1166.4	0.840877	5.045265	0.59548	0.1	0.82	6.909359	83.25146	210503.9
1166.6	0.841177	5.047064	0.590732	0.1	0.82	6.854266	82.58175	210586.5
1166.8	0.841475	5.048852	0.586102	0.1	0.82	6.800543	81.92885	210668.4
1167	0.841772	5.050629	0.581585	0.1	0.82	6.748133	81.29206	210749.7
1167.2	0.842066	5.052395	0.577177	0.1	0.82	6.696983	80.6707	210830.4
1167.4	0.842358	5.054149	0.572873	0.1	0.82	6.647042	80.06415	210910.5
1167.6	0.842649	5.055894	0.568669	0.1	0.82	6.598262	79.47183	210989.9
1167.8	0.842938	5.057627	0.564561	0.1	0.82	6.550598	78.89316	211068.8
1168	0.843225	5.05935	0.560545	0.1	0.82	6.504007	78.32763	211147.2
1168.2	0.843511	5.061064	0.556619	0.1	0.82	6.458449	77.77473	211224.9
1168.4	0.843794	5.062767	0.552778	0.1	0.82	6.413885	77.234	211302.2
1168.6	0.844077	5.06446	0.54902	0.1	0.82	6.370279	76.70498	211378.9
1168.8	0.844357	5.066144	0.545341	0.1	0.82	6.327597	76.18725	211455.1
1169	0.844636	5.067819	0.54174	0.1	0.82	6.285806	75.68041	211530.7
1169.2	0.844914	5.069484	0.538212	0.1	0.82	6.244874	75.18408	211605.9
1169.4	0.84519	5.07114	0.534756	0.1	0.82	6.204773	74.69788	211680.6
1169.6	0.845465	5.072788	0.531369	0.1	0.82	6.165473	74.22148	211754.8
1169.8	0.845738	5.074426	0.528049	0.1	0.82	6.126949	73.75454	211828.6
1170	0.846009	5.076056	0.524793	0.1	0.82	6.089175	73.29674	211901.9
1170.2	0.84628	5.077678	0.5216	0.1	0.82	6.052126	72.8478	211974.7
1170.4	0.846548	5.079291	0.518467	0.1	0.82	6.015778	72.40742	212047.2
1170.6	0.846816	5.080896	0.515393	0.1	0.82	5.980111	71.97533	212119.1
1170.8	0.847082	5.082492	0.512376	0.1	0.82	5.945101	71.55127	212190.7
1171	0.847347	5.084081	0.509414	0.1	0.82	5.91073	71.13499	212261.8
1171.2	0.84761	5.085662	0.506505	0.1	0.82	5.876978	70.72625	212332.5
1171.4	0.847873	5.087236	0.503648	0.1	0.82	5.843825	70.32482	212402.9
1171.6	0.848134	5.088801	0.500841	0.1	0.82	5.811255	69.93048	212472.8
1171.8	0.848393	5.090359	0.498082	0.1	0.82	5.77925	69.54303	212542.3
1172	0.848652	5.09191	0.495371	0.1	0.82	5.747794	69.16226	212611.5
1172.2	0.848909	5.093454	0.492706	0.1	0.82	5.71687	68.78798	212680.3
1172.4	0.849165	5.09499	0.490086	0.1	0.82	5.686465	68.42001	212748.7
1172.6	0.84942	5.096519	0.487509	0.1	0.82	5.656562	68.05816	212816.8
1172.8	0.849674	5.098042	0.484974	0.1	0.82	5.62715	67.70227	212884.5
1173	0.849926	5.099557	0.48248	0.1	0.82	5.598213	67.35218	212951.8
1173.2	0.850178	5.101066	0.480026	0.1	0.82	5.569739	67.00771	213018.8
1173.4	0.850428	5.102568	0.477611	0.1	0.82	5.541717	66.66874	213085.5
1173.6	0.850677	5.104063	0.475233	0.1	0.82	5.514133	66.3351	213151.8
1173.8	0.850925	5.105552	0.472893	0.1	0.82	5.486976	66.00665	213217.8
1174	0.851172	5.107035	0.470588	0.1	0.82	5.460236	65.68327	213283.5

1174.2	0.851418	5.108511	0.468319	0.1	0.82	5.433901	65.36482	213348.9
1174.4	0.851663	5.109981	0.466083	0.1	0.82	5.407962	65.05118	213413.9
1174.6	0.851907	5.111445	0.463881	0.1	0.82	5.382408	64.74222	213478.7
1174.8	0.85215	5.112902	0.461711	0.1	0.82	5.35723	64.43783	213543.1
1175	0.852392	5.114354	0.459572	0.1	0.82	5.332418	64.13789	213607.3
1175.2	0.852633	5.1158	0.457465	0.1	0.82	5.307964	63.84229	213671.1
1175.4	0.852873	5.11724	0.455387	0.1	0.82	5.283859	63.55094	213734.7
1175.6	0.853112	5.118674	0.453339	0.1	0.82	5.260095	63.26373	213797.9
1175.8	0.85335	5.120102	0.45132	0.1	0.82	5.236664	62.98055	213860.9
1176	0.853588	5.121525	0.449328	0.1	0.82	5.213557	62.70133	213923.6
1176.2	0.853824	5.122943	0.447364	0.1	0.82	5.190768	62.42595	213986
1176.4	0.854059	5.124354	0.445427	0.1	0.82	5.168289	62.15434	214048.2
1176.6	0.854293	5.125761	0.443516	0.1	0.82	5.146113	61.88641	214110.1
1176.8	0.854527	5.127162	0.44163	0.1	0.82	5.124232	61.62207	214171.7
1177	0.85476	5.128558	0.439769	0.1	0.82	5.102642	61.36125	214233
1177.2	0.854991	5.129948	0.437933	0.1	0.82	5.081335	61.10386	214294.2
1177.4	0.855222	5.131333	0.43612	0.1	0.82	5.060304	60.84983	214355
1177.6	0.855452	5.132713	0.434331	0.1	0.82	5.039545	60.59909	214415.6
1177.8	0.855681	5.134089	0.432565	0.1	0.82	5.01905	60.35157	214476
1178	0.85591	5.135459	0.430821	0.1	0.82	4.998815	60.1072	214536.1
1178.2	0.856137	5.136824	0.429099	0.1	0.82	4.978834	59.8659	214595.9
1178.4	0.856364	5.138184	0.427398	0.1	0.82	4.959102	59.62762	214655.6
1178.6	0.85659	5.13954	0.425719	0.1	0.82	4.939613	59.39229	214714.9
1178.8	0.856815	5.14089	0.42406	0.1	0.82	4.920362	59.15985	214774.1
1179	0.857039	5.142236	0.422421	0.1	0.82	4.901345	58.93025	214833
1179.2	0.857263	5.143578	0.420801	0.1	0.82	4.882557	58.70342	214891.7
1179.4	0.857486	5.144914	0.419201	0.1	0.82	4.863993	58.4793	214950.2
1179.6	0.857708	5.146246	0.41762	0.1	0.82	4.845649	58.25785	215008.5
1179.8	0.857929	5.147574	0.416058	0.1	0.82	4.82752	58.03901	215066.5
1180	0.858149	5.148897	0.414514	0.1	0.82	4.809602	57.82273	215124.3
1180.2	0.858369	5.150215	0.412987	0.1	0.82	4.791891	57.60896	215181.9
1180.4	0.858588	5.15153	0.411478	0.1	0.82	4.774384	57.39765	215239.3
1180.6	0.858807	5.15284	0.409987	0.1	0.82	4.757075	57.18875	215296.5
1180.8	0.859024	5.154145	0.408512	0.1	0.82	4.739962	56.98222	215353.5
1181	0.859241	5.155446	0.407053	0.1	0.82	4.72304	56.77801	215410.3
1181.2	0.859457	5.156744	0.405611	0.1	0.82	4.706307	56.57608	215466.9
1181.4	0.859673	5.158037	0.404185	0.1	0.82	4.689758	56.37639	215523.2
1181.6	0.859888	5.159325	0.402774	0.1	0.82	4.67339	56.17888	215579.4
1181.8	0.860102	5.16061	0.401379	0.1	0.82	4.6572	55.98354	215635.4
1182	0.860315	5.161891	0.399999	0.1	0.82	4.641185	55.79031	215691.2
1182.2	0.860528	5.163167	0.398633	0.1	0.82	4.625341	55.59915	215746.8
1182.4	0.86074	5.16444	0.397282	0.1	0.82	4.609665	55.41004	215802.2
1182.6	0.860951	5.165709	0.395945	0.1	0.82	4.594155	55.22292	215857.4
1182.8	0.861162	5.166974	0.394623	0.1	0.82	4.578808	55.03778	215912.5
1183	0.861372	5.168235	0.393314	0.1	0.82	4.56362	54.85457	215967.3
1183.2	0.861582	5.169492	0.392018	0.1	0.82	4.548589	54.67325	216022
1183.4	0.861791	5.170746	0.390736	0.1	0.82	4.533712	54.4938	216076.5

1183.6	0.861999	5.171995	0.389467	0.1	0.82	4.518987	54.31619	216130.8
1183.8	0.862207	5.173241	0.388211	0.1	0.82	4.50441	54.14038	216184.9
1184	0.862414	5.174484	0.386967	0.1	0.82	4.48998	53.96634	216238.9
1184.2	0.86262	5.175722	0.385736	0.1	0.82	4.475694	53.79404	216292.7
1184.4	0.862826	5.176957	0.384517	0.1	0.82	4.461549	53.62346	216346.3
1184.6	0.863031	5.178189	0.38331	0.1	0.82	4.447544	53.45456	216399.8
1184.8	0.863236	5.179417	0.382115	0.1	0.82	4.433676	53.28732	216453.1
1185	0.86344	5.180641	0.380931	0.1	0.82	4.419942	53.1217	216506.2
1185.2	0.863644	5.181862	0.379759	0.1	0.82	4.40634	52.95769	216559.2
1185.4	0.863847	5.183079	0.378598	0.1	0.82	4.392869	52.79526	216611.9
1185.6	0.864049	5.184294	0.377448	0.1	0.82	4.379527	52.63438	216664.6
1185.8	0.864251	5.185504	0.376309	0.1	0.82	4.36631	52.47502	216717.1
1186	0.864452	5.186711	0.37518	0.1	0.82	4.353218	52.31717	216769.4
1186.2	0.864653	5.187915	0.374063	0.1	0.82	4.340248	52.1608	216821.5
1186.4	0.864853	5.189116	0.372955	0.1	0.82	4.327398	52.00588	216873.5
1186.6	0.865052	5.190313	0.371858	0.1	0.82	4.314667	51.85239	216925.4
1186.8	0.865251	5.191508	0.370771	0.1	0.82	4.302053	51.70032	216977.1
1187	0.86545	5.192699	0.369693	0.1	0.82	4.289553	51.54963	217028.6
1187.2	0.865648	5.193886	0.368626	0.1	0.82	4.277166	51.40031	217080
1187.4	0.865845	5.195071	0.367568	0.1	0.82	4.264891	51.25234	217131.3
1187.6	0.866042	5.196252	0.366519	0.1	0.82	4.252726	51.1057	217182.4
1187.8	0.866238	5.197431	0.36548	0.1	0.82	4.240668	50.96036	217233.4
1188	0.866434	5.198606	0.36445	0.1	0.82	4.228717	50.81631	217284.2
1188.2	0.86663	5.199778	0.363429	0.1	0.82	4.216871	50.67353	217334.9
1188.4	0.866824	5.200947	0.362417	0.1	0.82	4.205129	50.532	217385.4
1188.6	0.867019	5.202113	0.361414	0.1	0.82	4.193488	50.3917	217435.8
1188.8	0.867213	5.203276	0.36042	0.1	0.82	4.181948	50.25261	217486
1189	0.867406	5.204436	0.359433	0.1	0.82	4.170506	50.11472	217536.1
1189.2	0.867599	5.205593	0.358456	0.1	0.82	4.159162	49.97801	217586.1
1189.4	0.867791	5.206748	0.357486	0.1	0.82	4.147914	49.84246	217636
1189.6	0.867983	5.207899	0.356525	0.1	0.82	4.136761	49.70806	217685.7
1189.8	0.868175	5.209048	0.355572	0.1	0.82	4.125702	49.57478	217735.2
1190	0.868366	5.210193	0.354627	0.1	0.82	4.114734	49.44262	217784.7
1190.2	0.868556	5.211336	0.353689	0.1	0.82	4.103857	49.31155	217834
1190.4	0.868746	5.212476	0.35276	0.1	0.82	4.09307	49.18157	217883.2
1190.6	0.868936	5.213613	0.351838	0.1	0.82	4.082371	49.05265	217932.2
1190.8	0.869125	5.214748	0.350923	0.1	0.82	4.07176	48.92479	217981.2
1191	0.869313	5.215879	0.350016	0.1	0.82	4.061234	48.79796	218030
1191.2	0.869501	5.217008	0.349116	0.1	0.82	4.050793	48.67216	218078.6
1191.4	0.869689	5.218135	0.348223	0.1	0.82	4.040436	48.54737	218127.2
1191.6	0.869876	5.219258	0.347338	0.1	0.82	4.030161	48.42358	218175.6
1191.8	0.870063	5.220379	0.346459	0.1	0.82	4.019967	48.30077	218223.9
1192	0.87025	5.221498	0.345588	0.1	0.82	4.009854	48.17893	218272.1
1192.2	0.870436	5.222613	0.344723	0.1	0.82	3.99982	48.05805	218320.1
1192.4	0.870621	5.223726	0.343865	0.1	0.82	3.989865	47.93811	218368.1
1192.6	0.870806	5.224837	0.343014	0.1	0.82	3.979986	47.8191	218415.9
1192.8	0.870991	5.225945	0.342169	0.1	0.82	3.970184	47.70102	218463.6

1193	0.871175	5.22705	0.34133	0.1	0.82	3.960457	47.58385	218511.2
1193.2	0.871359	5.228153	0.340499	0.1	0.82	3.950804	47.46757	218558.6
1193.4	0.871542	5.229253	0.339673	0.1	0.82	3.941225	47.35217	218606
1193.6	0.871725	5.230351	0.338854	0.1	0.82	3.931718	47.23765	218653.2
1193.8	0.871908	5.231446	0.33804	0.1	0.82	3.922282	47.124	218700.4
1194	0.87209	5.232539	0.337233	0.1	0.82	3.912917	47.01119	218747.4
1194.2	0.872272	5.23363	0.336432	0.1	0.82	3.903622	46.89923	218794.3
1194.4	0.872453	5.234718	0.335637	0.1	0.82	3.894395	46.7881	218841.1
1194.6	0.872634	5.235803	0.334848	0.1	0.82	3.885236	46.67779	218887.7
1194.8	0.872814	5.236886	0.334064	0.1	0.82	3.876145	46.56829	218934.3
1195	0.872995	5.237967	0.333286	0.1	0.82	3.86712	46.45959	218980.8
1195.2	0.873174	5.239046	0.332514	0.1	0.82	3.85816	46.35168	219027.1
1195.4	0.873354	5.240122	0.331747	0.1	0.82	3.849265	46.24455	219073.4
1195.6	0.873533	5.241195	0.330986	0.1	0.82	3.840434	46.13819	219119.5
1195.8	0.873711	5.242267	0.330231	0.1	0.82	3.831666	46.0326	219165.5
1196	0.873889	5.243336	0.32948	0.1	0.82	3.82296	45.92775	219211.5
1196.2	0.874067	5.244403	0.328735	0.1	0.82	3.814316	45.82366	219257.3
1196.4	0.874245	5.245468	0.327996	0.1	0.82	3.805733	45.72029	219303
1196.6	0.874422	5.24653	0.327261	0.1	0.82	3.79721	45.61766	219348.6
1196.8	0.874598	5.24759	0.326532	0.1	0.82	3.788747	45.51574	219394.1
1197	0.874775	5.248648	0.325807	0.1	0.82	3.780342	45.41453	219439.6
1197.2	0.874951	5.249704	0.325088	0.1	0.82	3.771996	45.31403	219484.9
1197.4	0.875126	5.250757	0.324374	0.1	0.82	3.763707	45.21421	219530.1
1197.6	0.875301	5.251809	0.323664	0.1	0.82	3.755474	45.11508	219575.2
1197.8	0.875476	5.252858	0.322959	0.1	0.82	3.747298	45.01663	219620.2
1198	0.875651	5.253905	0.32226	0.1	0.82	3.739177	44.91885	219665.1
1198.2	0.875825	5.25495	0.321564	0.1	0.82	3.731112	44.82173	219710
1198.4	0.875999	5.255993	0.320874	0.1	0.82	3.7231	44.72527	219754.7
1198.6	0.876172	5.257033	0.320188	0.1	0.82	3.715142	44.62945	219799.3
1198.8	0.876345	5.258072	0.319507	0.1	0.82	3.707237	44.53427	219843.8
1199	0.876518	5.259108	0.31883	0.1	0.82	3.699384	44.43973	219888.3
1199.2	0.87669	5.260143	0.318158	0.1	0.82	3.691584	44.34581	219932.6
1199.4	0.876862	5.261175	0.31749	0.1	0.82	3.683834	44.25251	219976.9
1199.6	0.877034	5.262205	0.316826	0.1	0.82	3.676135	44.15982	220021
1199.8	0.877206	5.263234	0.316167	0.1	0.82	3.668487	44.06773	220065.1
1200	0.877377	5.26426	0.315512	0.1	0.82	3.660888	43.97625	220109.1
1200.2	0.877547	5.265284	0.314861	0.1	0.82	3.653338	43.88535	220153
1200.4	0.877718	5.266306	0.314215	0.1	0.82	3.645837	43.79505	220196.8
1200.6	0.877888	5.267327	0.313573	0.1	0.82	3.638383	43.70532	220240.5
1200.8	0.878057	5.268345	0.312934	0.1	0.82	3.630977	43.61616	220284.1
1201	0.878227	5.269361	0.3123	0.1	0.82	3.623618	43.52757	220327.6
1201.2	0.878396	5.270376	0.31167	0.1	0.82	3.616306	43.43955	220371.1
1201.4	0.878565	5.271388	0.311044	0.1	0.82	3.60904	43.35207	220414.4
1201.6	0.878733	5.272399	0.310421	0.1	0.82	3.601819	43.26515	220457.7
1201.8	0.878901	5.273407	0.309803	0.1	0.82	3.594643	43.17877	220500.8
1202	0.879069	5.274414	0.309188	0.1	0.82	3.587512	43.09293	220543.9
1202.2	0.879236	5.275419	0.308577	0.1	0.82	3.580424	43.00762	220586.9

1202.4	0.879404	5.276422	0.30797	0.1	0.82	3.573381	42.92283	220629.9
1202.6	0.87957	5.277423	0.307367	0.1	0.82	3.566381	42.83857	220672.7
1202.8	0.879737	5.278422	0.306767	0.1	0.82	3.559423	42.75482	220715.5
1203	0.879903	5.279419	0.306171	0.1	0.82	3.552508	42.67158	220758.1
1203.2	0.880069	5.280415	0.305579	0.1	0.82	3.545634	42.58885	220800.7
1203.4	0.880235	5.281408	0.30499	0.1	0.82	3.538802	42.50662	220843.2
1203.6	0.8804	5.2824	0.304405	0.1	0.82	3.532012	42.42488	220885.7
1203.8	0.880565	5.28339	0.303823	0.1	0.82	3.525261	42.34364	220928
1204	0.88073	5.284379	0.303245	0.1	0.82	3.518551	42.26287	220970.3
1204.2	0.880894	5.285365	0.30267	0.1	0.82	3.511881	42.18259	221012.4
1204.4	0.881058	5.28635	0.302099	0.1	0.82	3.50525	42.10279	221054.5
1204.6	0.881222	5.287333	0.301531	0.1	0.82	3.498658	42.02345	221096.6
1204.8	0.881386	5.288314	0.300966	0.1	0.82	3.492105	41.94458	221138.5
1205	0.881549	5.289293	0.300404	0.1	0.82	3.48559	41.86618	221180.4
1205.2	0.881712	5.290271	0.299846	0.1	0.82	3.479114	41.78822	221222.2
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1205.6	0.882037	5.292221	0.298739	0.1	0.82	3.466272	41.63368	221305.5
1205.8	0.882199	5.293194	0.298191	0.1	0.82	3.459906	41.55707	221347.1
1206	0.882361	5.294165	0.297645	0.1	0.82	3.453577	41.4809	221388.6
1206.2	0.882522	5.295134	0.297103	0.1	0.82	3.447284	41.40517	221430
1206.4	0.882684	5.296102	0.296564	0.1	0.82	3.441027	41.32987	221471.3
1206.6	0.882845	5.297067	0.296027	0.1	0.82	3.434806	41.255	221512.5
1206.8	0.883005	5.298032	0.295494	0.1	0.82	3.428619	41.18055	221553.7
1207	0.883166	5.298994	0.294964	0.1	0.82	3.422467	41.10651	221594.8
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1207.6	0.883645	5.301872	0.293391	0.1	0.82	3.404216	40.88689	221717.7
1207.8	0.883805	5.302828	0.292873	0.1	0.82	3.3982	40.8145	221758.5
1208	0.883964	5.303782	0.292357	0.1	0.82	3.392217	40.7425	221799.3
1208.2	0.884123	5.304735	0.291844	0.1	0.82	3.386267	40.67091	221839.9
1208.4	0.884281	5.305686	0.291334	0.1	0.82	3.380349	40.5997	221880.5
1208.6	0.884439	5.306636	0.290827	0.1	0.82	3.374464	40.52888	221921.1
1208.8	0.884597	5.307584	0.290322	0.1	0.82	3.368611	40.45845	221961.5
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1209.4	0.88507	5.310419	0.288825	0.1	0.82	3.351239	40.24943	222082.5
1209.6	0.885227	5.31136	0.288332	0.1	0.82	3.345511	40.1805	222122.7
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1210	0.88554	5.313239	0.287352	0.1	0.82	3.334145	40.04375	222202.8
1210.2	0.885696	5.314177	0.286866	0.1	0.82	3.328507	39.97591	222242.8
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1210.8	0.886163	5.316979	0.285424	0.1	0.82	3.311772	39.77455	222362.3
1211	0.886318	5.317911	0.284948	0.1	0.82	3.306251	39.70814	222402
1211.2	0.886473	5.31884	0.284475	0.1	0.82	3.30076	39.64206	222441.7
1211.4	0.886628	5.319769	0.284004	0.1	0.82	3.295296	39.57634	222481.2
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1213.2	0.88801	5.328058	0.279873	0.1	0.82	3.247368	38.99972	222834.5
1213.4	0.888162	5.328972	0.279426	0.1	0.82	3.242176	38.93726	222873.5
1213.6	0.888314	5.329884	0.27898	0.1	0.82	3.23701	38.87512	222912.3
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1214.4	0.88892	5.33352	0.277221	0.1	0.82	3.216601	38.6296	223067.2
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1220.4	0.893354	5.360122	0.265049	0.1	0.82	3.075364	36.93076	224199.2
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TIME						Q50		ΣVOLUME
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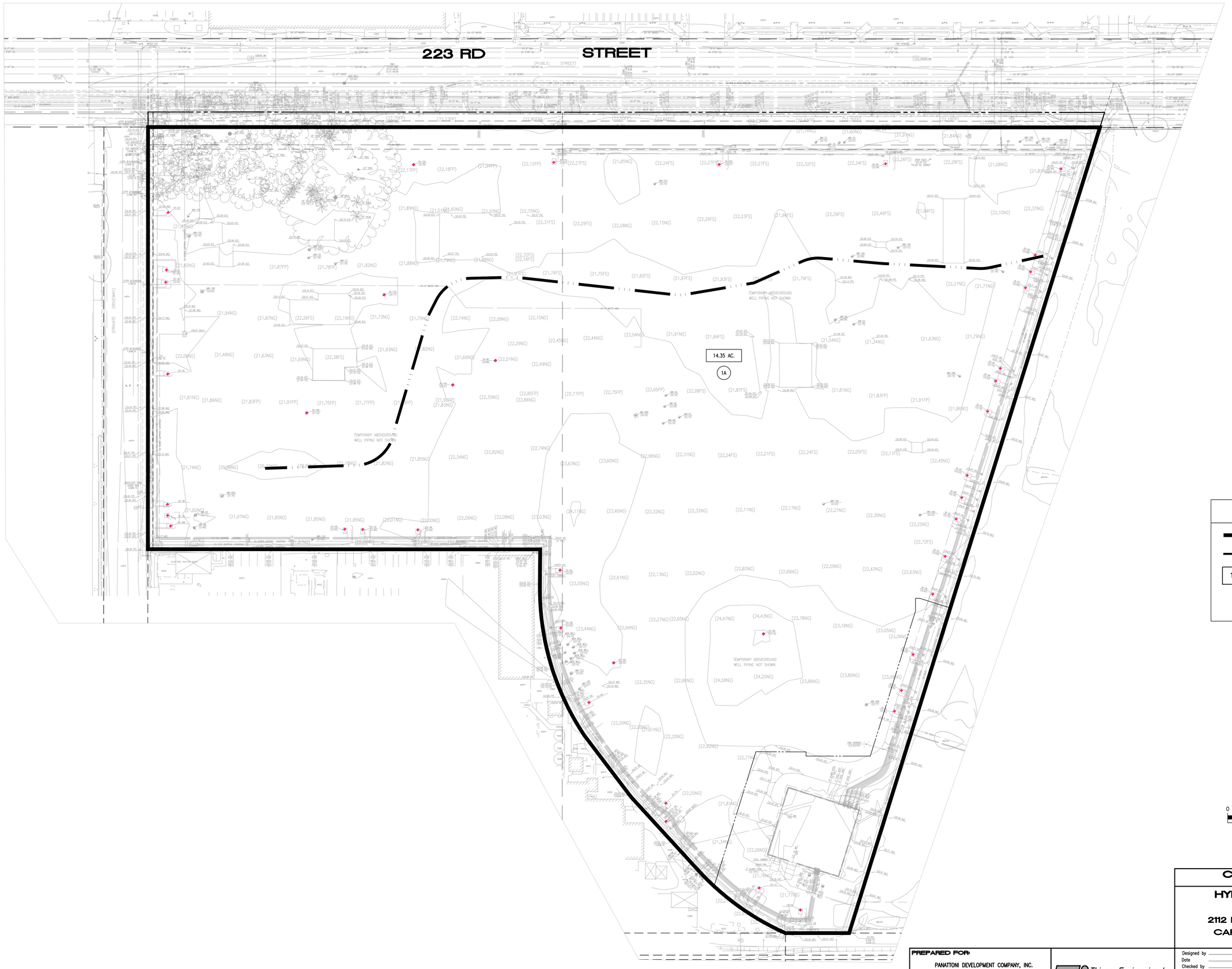
APPENDIX C

HYDROLOGY MAP



LEGEND

- PROJECT BOUNDARY
- FLOW LINE
- 1.0 ac — SUBAREA AREA
- (100) — NODE NUMBER

0 20 40 80 120

SCALE:1"=40'

Last Update:11/12/19
O:\3600-3899\3826\3826HYD.dwg

CITY OF CARSON
PUBLIC WORKS DEPARTMENT

HYDROLOGY MAP
FOR
2112 EAST 223RD STREET
CARSON, CALIFORNIA.

3826 / 1 OF 1 SHEET

PREPARED FOR:

PANATTONI DEVELOPMENT COMPANY, INC.
20411 SW BIRCH STREET, SUITE 200
NEWPORT BEACH, CA 92660
PHONE: (949) 296-2960
FAX: (888) 793-7363

Thienes Engineering, Inc.
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH:(714)521-4811 FAX(714)521-4173

Designed by _____ Date _____
Checked by _____ Date _____
Designed by _____ Date _____
Checked by _____ Date _____

Approved by _____ Date _____

Public Works Director R.C.E. XXXXX

Sheet 1 of 1 Sheets

223 RD STREET

(PUBLIC STREET)

(PRIVATE DRIVEWAY)

2B 0.05 AC.

0.05 AC. 3B

0.10 AC. 1B

0.45 AC. 1A

1.45 AC. 4A

1.65 AC. 2A

0.65 AC. 3A

0.30 AC. 5A

0.30 AC. 6A

17A 0.75 AC.

BLDG. A

BLDG. B

TEMPORARY ABOVEGROUND WELL PIPING NOT SHOWN

0.80 AC. 9A

0.95 AC. 8A

0.85 AC. 16A

0.60 AC. 15A

1.25 AC. 13A

7A

0.10 AC.

.25 AC. 14A

APPROXIMATE LIMITS OF 50-YEAR PONDING

1.70 AC. 10A

0.15 AC. 12A

TEMPORARY ABOVEGROUND WELL PIPING NOT SHOWN

BLDG. C

1.05 AC. 11A

0.90 AC. 1C

LEGEND

	PROJECT BOUNDARY
	SUBAREA BOUNDARY
	FLOW LINE
1.0 ac	SUBAREA AREA
(100)	NODE NUMBER
	APPROXIMATE LIMITS OF 100-YEAR PONDING
Tc	TIME OF CONCENTRATION
Q_{100}	DISCHARGE (CUBIC FEET PER SECOND) NUMBER DESIGNATE YEAR OF FREQUENCY

0 20 40 80 120

SCALE:1"=40'

Last Update:11/21/19
O:\3800-3899\3826\3826HYD.dwg

CITY OF CARSON
PUBLIC WORKS DEPARTMENT

HYDROLOGY MAP
FOR
2112 EAST 223RD STREET
CARSON, CALIFORNIA.

3826 / 1 OF 1 SHEET

PREPARED FOR:

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Designed by _____ Date _____
Checked by _____ Date _____
Designed by _____ Date _____
Checked by _____ Date _____

Approved by _____ Date _____

Public Works Director R.C.E. XXXXX

Sheet 1 of 1 Sheets

LOW IMPACT DEVELOPMENT (LID)

FOR:
2112 EAST 223RD STREET
CARSON, CALIFORNIA 90810
APNs: 7315-008-049

OWNER:
PANNATONI DEVELOPMENT COMPANY, INC.
2442 DUPONT DRIVE
IRVINE, CA 92612
PHONE: (949) 296-2960
CONTACT: RYAN JONES

JANUARY 6, 2020

JOB NO. 3826

PREPARED BY:
THIENES ENGINEERING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PHONE: (714) 521-4811
FAX: (714) 521-4173
CONTACT: LUIS PRADO (luisp@thieneseng.com)

LOW IMPACT DEVELOPMENT (LID)

FOR

"2112 EAST 223RD STREET"

PREPARED BY LUIS PRADO
UNDER THE SUPERVISION OF:

1/6/2020

REINHARD STENZEL DATE
R.C.E. 56155
EXP. 12/31/2020

TABLE OF CONTENTS

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Appendix A Stormwater Quality Design Calculations (SWQDv)

Appendix B LID Site Plan

Appendix C BMP Operation and Maintenance

Appendix D Maintenance and Covenant Agreement

Appendix E Educational Materials

Appendix F Infiltration Feasibility

1.0 Project Description

The project site is located at 2112 East 223rd Street within the city of Carson (Figure 1 - Vicinity Map), at APN: 7315-008-049 of Los Angeles County. The project site encompasses approximately 14.35 acres. Improvements consist of three warehouse type buildings of approximately 58,400 square feet, 92,000 square feet and 129,000 square feet. Each building has a truck yard area and vehicle parking around the perimeter. Proposed landscaping will be adjacent to the street and throughout the site.

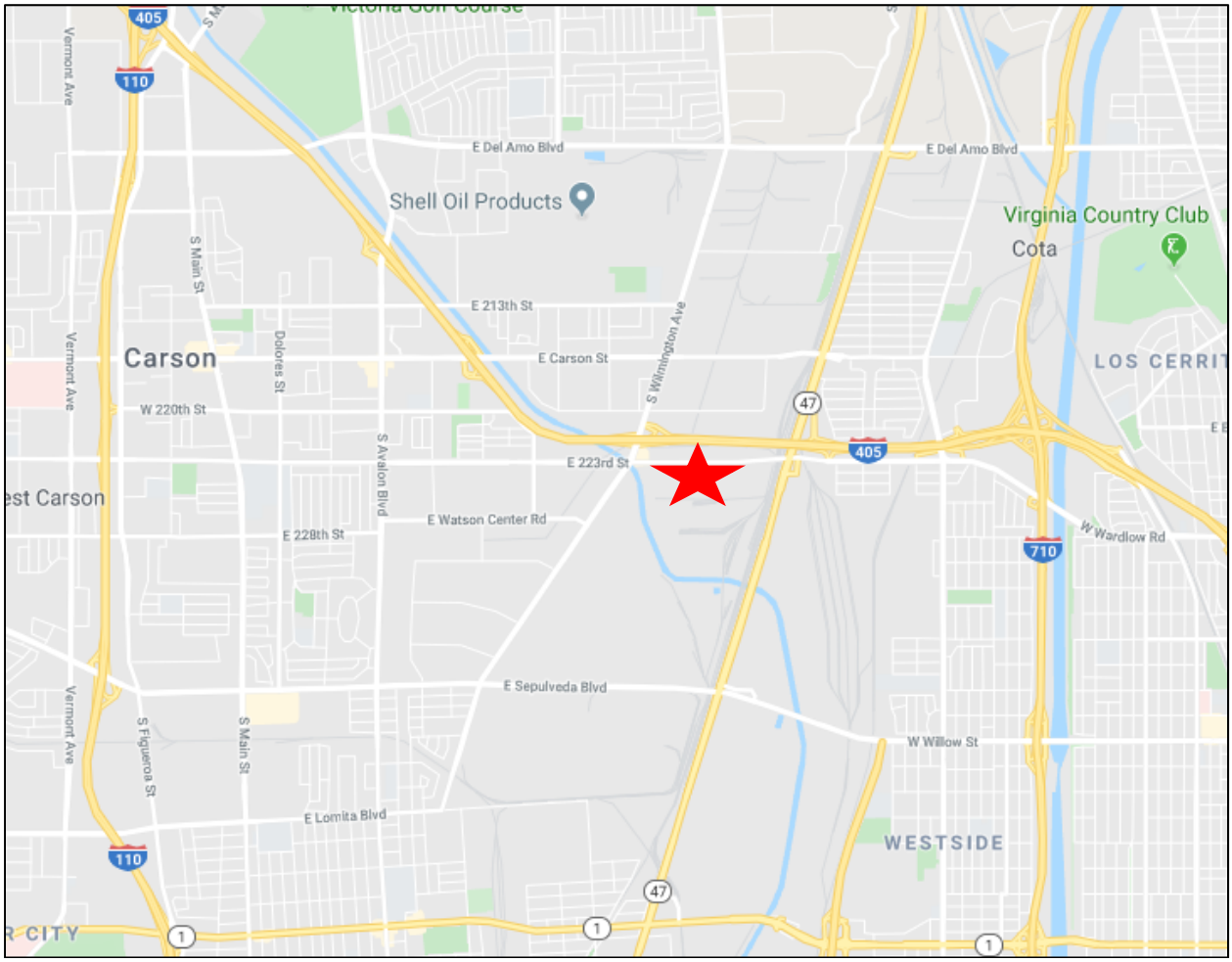


Figure 1 - Vicinity Map (North↑)

The project will treat stormwater runoff generated by the project through the use of WetlandMOD biofiltration systems (WetlandMODs) and an underground detention system sized to treat 1.5 times the Stormwater Quality Design volume (SWQDv). The 1.5x SWQDv is achieved by multiplying the 85th percentile rainfall depth by 1.5. Refer to Appendix A for references and calculations.

1.1 Existing Site Description

The project site was formerly used as a chemical plant. The plant was deactivated in 1982 and the majority of the structures and storage areas have been removed. There is an existing Enhanced In-situ Anaerobic Bioremediation (EISB) system located at the southerly portion of the site. This system will remain active and undisturbed.

There are no existing drainage features within the project site. Overall, the site is very flat. Storm water runoff tends to drain to the southwesterly portion of the site, where it appears to pond.

1.2 Proposed Site Description

Runoff from the northerly portion of Buildings "A" and "B" and the northerly parking areas (Areas 1A-4A) drain to grate inlets located in the northerly parking areas. A storm drain system conveys flows southerly between the two buildings. Additional parking areas between the buildings (Areas 5A-7A) are also tributary to this drain.

The storm drain system continues southerly then westerly around Building "A". Additional runoff from the southerly half of Buildings "A" and "B" and Building "C" (areas 8A-16A) are added via grate inlets in the respective truck yard areas. The onsite storm drain continues northerly around Building "A" where the westerly parking area (Area 17A) is added to the storm drain.

A portion of the existing EISB system at the southerly portion of the site (Area 1C) flows southerly offsite with some of the area draining westerly to the proposed improvements. Conservatively, the entire EISB area has been added to the proposed onsite storm drain system.

The proposed storm drain system continues northerly towards 223rd Street. Existing utilities prevent the proposed storm drain system from connecting to the existing storm drain facility in 223rd Street; therefore, a proposed sump pump will be utilized to pump runoff to the street. The pump will only discharge a portion of the 50-year peak flow (3.0 cfs) with the remaining volume to be temporarily stored onsite within the underground detention system and on the surface of the truck yard.

The proposed landscaped areas adjacent to 223rd Street (Areas 1B-3B) will sheet flow into the street. These landscaped areas are considered self-treating areas.

In regards to the BMP system, the 1.5x SWQDv will bleed off via low flow storm drain pipes to an underground detention system. The SWQDv will then be pumped into WetlandMODs that utilizes the MS4 Permit's Attachment H soils. A return pipe, connecting the WetlandMODs to the pumps, will convey flows back to the pumps once the WetlandMODs have reached the maximum treatment flowrate/HGL, and in return, the remaining SWQDv will back up and be detained within the underground detention system. The entire 1.5x SWQDv will be biofiltered through the WetlandMODs over 96 hours. Uniform rainfall intensity is assumed. See Appendix A for detailed calculations.

1.3 Geological Investigation/Infiltration Feasibility

Based on the Phase I Environmental Site Assessment (ESA) dated November 22, 2019 by Avocet Environmental, Inc, between 1959 and 1982, the site was a polyvinyl chloride (PVC) manufacturing facility (the facility) operated by American Chemical Company and Stauffer Chemical Company (Stauffer). As a result of PVC manufacturing operations, soil and groundwater beneath the site are contaminated with volatile organic compounds (VOCs) and the site is subject to a consent order with the California Department of Toxic Substances Control (DTSC). Soil remediation at the former Stauffer facility has been completed, although significant residual contamination remains at depth, and groundwater remediation is ongoing. Due to the conditions of the site, infiltration is not recommended and instead, the project proposes the use of WetlandMODs and an underground detention system. Refer to Appendix F for an excerpt of the ESA.

2.0 Project Specific Requirements

The proposed site is a redevelopment project and the entire site must meet the requirements of Los Angeles County's Low Impact Development Standards Manual (February 2014).

2.1 Peak Storm Water Runoff Discharge Rates

Excerpt from "Preliminary Hydrology Calculations" dated November 21, 2019, prepared by Thienes Engineering:

"As previously mentioned, a pump will be utilized to discharge runoff to 223rd Street. The pump will be sized to discharge 3.0 cfs with the remaining volume to be stored in the underground storage system and the surface of the truck yard at Building "A".

Hydrograph volumes were determined from the Hydro-Calc Excel spreadsheet. Cumulative volumes are shown up to the allowable peak flow rate before and after the peak occur. The difference in the volume before and after the peak (along with the volume of the allowable peak flow rate) is the volume to be temporarily detained. With 3.0 cfs pumped out, the remaining volume is approximately 56,604 cubic feet. There is approximately 11,330 cubic feet of volume available in the truck yard area associated with Building "A".

The remaining volume (45,274 cubic feet) will be contained in the underground storage system. Here, the bottom half of the underground chamber system will be utilized for water quality purposes. The volume above will be available for peak flow storage. The total underground storage volume is approximately 95,076 cubic feet. The required water quality volume is approximately 49,459 cubic feet. The remaining underground volume for peak flow storage is approximately 45,617 cubic feet. The overall storage volume for peak flow purposes is about 56,947 cubic feet."

2.2 Source Controls

Source control measures are designed to prevent pollutants from contacting stormwater runoff or prevent discharge of contaminated stormwater runoff to the storm drain system and/or receiving water. This section describes structural-type, source control measures that must be considered for implementation in conjunction with appropriate nonstructural source control measures, such as good housekeeping and employee training, to optimize pollution prevention.

Source control measures should be implemented to the maximum extent practicable to mitigate pollutant mobilization from the project site in stormwater and non-stormwater runoff. A summary of the source control measures that should be implemented for each type of project is summarized below.

2.2.A Storm Drain Message and Signage (S-1)

All proposed and any existing inlets to remain will be stenciled with prohibitive language and/or graphical icons to prevent dumping. Legibility of the stencils/markers will be maintained on a yearly basis, or as needed.

2.2.B Outdoor Material Storage Area (S-2)

There are no proposed outdoor material storage areas for this project. Any and all materials will be stored indoors.

2.2.C Outdoor Trash Storage/Waste Handling Areas (S-3)

Trash enclosures will be located away from roof drainage. The bin's lid will remain closed when not in use and will be walled off.

2.2.D Outdoor Loading/Unloading Dock Area (S-4)

The proposed project will construct several loading docks. The concrete surface is designed to minimize run-on to the loading docks and will be treated by biofiltration. Dock area flows are captured by an inlet that utilizes drain inserts to filter out pollutants prior to entering the underground detention system and WetlandMods. Additionally, the proposed buildings will be utilized as warehouses for finished goods and consequently, items being loaded and unloaded do not have the potential to contribute to stormwater pollution.

2.2.F Outdoor Vehicle/Equipment Repair/Maintenance Area (S-5)

Not applicable

2.2.G Outdoor Vehicle/Equipment Accessory Wash Area (S-6)

Not applicable

2.2.H Fuel & Maintenance Area (S-7)

Not applicable

2.2.I Landscape Irrigation Practices (S-8)

Install irrigation systems that utilize a weather-based smart irrigation controller to minimize water usage and reduce dry weather urban runoff.

2.2.J Building Materials (S-9)

Alternative building materials could not be used in-lieu of traditional materials due to the nature of the project (industrial warehouse).

2.2.K Animal Care and Handling Facilities (S-10)

Not applicable

2.2.L Outdoor Horticulture Areas (S-11)

Not applicable

2.3 Low Impact Development (LID)

2.3.A Infiltration

Refer to section 1.3 Geotechnical Investigation/Infiltration Feasibility.

2.3.B Harvest and Use

This concept was not utilized because it is an industrial facility where the amount of impervious area is much greater than landscape and toilet use. However, stormwater is detained for biofiltration prior to discharging into the storm drain system.

2.3.C Biofiltration

The 1.5x SWQDv will bleed off via low flow storm drain pipes to an underground detention system. The SWQDv will then be pumped into WetlandMODs that utilizes the MS4 Permit's Attachment H soils. A return pipe, connecting the WetlandMODs to the pumps, will convey flows back to the pumps once the WetlandMODs have reached the maximum treatment flowrate/HGL, and in return, the remaining SWQDv will back up and be detained within the underground detention system. The entire 1.5x SWQDv will be biofiltered through the WetlandMODs over 96 hours. Uniform rainfall intensity is assumed. See Appendix A for detailed calculations.

2.4 Hydromodification

The proposed site is tributary to an engineered channel (Dominguez Channel) that is regularly maintained and is not susceptible to hydromodification impacts. In addition, the onsite water quality BMPs will assist in increasing the time of concentration and discharging flows at a control rate.

2.5 Conserve Natural Areas

During the subdivision design and approval process, the site layout must be consistent with the applicable General Plan and Local Area Plan policies and implement the following:

- *Concentrate or cluster development on portions of the site while leaving the remaining land in a natural undisturbed condition;*
- *Limit clearing and grading of native vegetation at the site to the minimum amount needed to build lots, allow access, and provide fire protection;*
- *Maximize trees and other vegetation at the site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants;*
- *Promote natural vegetation by using parking lot islands and other landscaped areas;*
- *Preserve riparian areas and wetlands.*

The property was previously developed with no natural areas to conserve.

2.6 Minimize Storm Water Pollutants of Concern

Stormwater runoff from a site has the potential to contribute oil and grease, suspended solids, metals, gasoline, pesticides, and pathogens to the stormwater conveyance system. The development must be designed so as to minimize, to the maximum extent practicable, the introduction of pollutants of concern that may result in significant impacts, generated from site runoff of directly connected impervious areas (DCIA), to the stormwater conveyance system as approved by the building official. Pollutants of concern, consist of any pollutants that exhibit one or more of the following characteristics: current loadings or historic deposits of the pollutant are impacting the beneficial uses of a receiving water, elevated levels of the pollutant are found in sediments of a receiving water and/or have the potential to bioaccumulate in organisms therein, or the detectable inputs of the pollutant are at concentrations or loads considered potentially toxic to humans and/or flora and fauna.

In meeting this specific requirement, "minimization of the pollutants of concern" will require the incorporation of a BMP or combination of BMPs best suited to maximize the reduction of pollutant loadings in that runoff to the Maximum Extent Practicable.

Anticipated pollutants generated from the proposed development are:

- Suspended Solids
- Total Phosphorus
- Total Nitrogen
- Total Kjeldahl Nitrogen
- Cadmium, Total
- Chromium, Total
- Copper, Total
- Lead, Total
- Zinc, Total

The receiving waters and their impairments are:

- Dominguez Channel (lined portion above Vermont Ave): Copper, Diazinon, Indicator Bacteria, Lead, Toxicity, and Zinc.
- Dominguez Channel Estuary (unlined portion below Vermont Ave): Benthic Community Effects, Benzo(a)pyrene (3-4-Benzonpyrene-7-d), Benzon(a)anthracene, Chlordane (tissue), Chrysene (C1-C4), Copper, Indicator Bacteria, DDT (tissue & sediment), Dieldrin (tissue), Lead, PCBs (Polychlorinated biphenyls), Phenanthrene, Pyrene, Toxicity and Zinc (sediment).
- Los Angeles/Long Beach Inner Harbor: Beach Closures, Benthic Community Effects, Benzo(a)pyrene (3-4-Benzonpyrene-7-d), Chrysene (C1-C4), Copper, DDT (Dichlorodiphenyltrichloroethane), PCBs (Polychlorinated biphenyls), Toxicity, and Zinc.

The pollutants of concern of the project site are:

- Heavy Metals
- Nutrients
- Trash

The proposed project will disconnect runoff from impervious areas by means WetlandMODs and an underground detention system. Inlets are used to intercept "low flows" towards the biofiltration systems for treatment prior to discharging offsite.

2.7 Protect Slopes and Channels

Project plans must include BMPs consistent with local codes and ordinances and LID to decrease the potential of slopes and/or channels from eroding and impacting stormwater runoff:

- *Convey runoff safely from the tops of slopes and stabilize disturbed slopes.*
- *Utilize natural drainage systems to the maximum extent practicable.*
- *Control or reduce or eliminate flow to natural drainage systems to the maximum extent practicable.*
- *Stabilize permanent channel crossings.*
- *Vegetate slopes with native or drought tolerant vegetation.*
- *Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion, with the approval of all agencies with jurisdiction, e.g., the U.S. Army Corps of Engineers and the California Department of Fish and Game.*

The proposed project site is located on a flat terrain. There are no slopes, natural drainage systems, or channel crossings to protect.

2.8 Provide Proof of Ongoing BMP Maintenance

Improper maintenance is one of the most common reasons why water quality controls will not function as designed or which may cause the system to fail entirely. It is important to consider who will be responsible for maintenance of a permanent BMP, and what equipment is required to perform the maintenance properly. If Structural or Treatment Control BMPs are required or included in project plans, the applicant must provide verification of maintenance provisions through such means as may be appropriate, including, but not limited to legal agreements, covenants, CEQA mitigation requirements and/or Conditional Use Permits.

The verification will include the developer's signed statement, as part of the project application, accepting responsibility for all Structural and Treatment Control BMP maintenance until the time the property is transferred and, where applicable, a signed agreement from the public entity assuming responsibility for Structural or Treatment Control BMP maintenance. The transfer of property to a private or public owner must have conditions requiring the recipient to assume responsibility for maintenance of any Structural or Treatment Control BMP to be included in the

sales or lease agreement for that property, and will be the owner's responsibility. The condition of transfer shall include a provision that the property owners conduct maintenance inspection of all Structural or Treatment Control BMPs at least once a year and retain proof of inspection. For residential properties where the Structural or Treatment Control BMPs are located within a common area, which will be maintained by a homeowner's association, language regarding the responsibility for maintenance must be included in the project's conditions, covenants and restrictions (CC&Rs). Printed educational materials will be required to accompany the first deed transfer to highlight the existence of the requirement and to provide information on what stormwater management facilities are present, signs that maintenance is needed, how the necessary maintenance can be performed, and assistance that the Permittee can provide. The transfer of this information shall also be required with any subsequent sale of the property.

Structural or Treatment Control BMPs located within a public area proposed for transfer will be the responsibility of the developer until accepted for transfer by the appropriate public agency. Structural or Treatment Control BMPs proposed for transfer must meet design standards adopted by the public entity for the BMP installed and should be approved by the appropriate public agency prior to its installation.

The property owner/operator will maintain proof of ongoing maintenance at the site as recorded in the covenant and agreement (see Appendix D).

2.9 Design Standards for Structural or Treatment Controls BMPs

The proposed site is a redevelopment project and the entire site must meet the requirements of Los Angeles County's Low Impact Development Standards Manual (February 2014).

Biofiltration systems and underground detention: The 1.5x SWQDv will bleed off via low flow storm drain pipes to an underground detention system. The SWQDv will then be pumped into WetlandMODs that utilizes the MS4 Permit's Attachment H soils. A return pipe, connecting the WetlandMODs to the pumps, will convey flows back to the pumps once the WetlandMODs have reached the maximum treatment flowrate/HGL, and in return, the remaining SWQDv will back up and be detained within the underground detention system. The entire 1.5x SWQDv will be biofiltered through the WetlandMODs over 96 hours. Uniform rainfall intensity is assumed. See Appendix A for detailed calculations.

2.10 Provisions Applicable to Individual Priority Project Categories

2.10.A Parking Lots

2.10.A.1 Properly Design Parking Area

Parking lots contain pollutants such as heavy metals, oil and grease, and polycyclic aromatic hydrocarbons that are deposited on parking lot surfaces by motor-vehicles. These pollutants are directly transported to surface waters. To minimize the offsite transport of pollutants, the following design criteria are required:

- *Reduce impervious land coverage of parking areas.*
- *Infiltrate runoff before it reaches storm drain system.*
- *Treat runoff before it reaches storm drain system.*

The proposed project is designed so that pollutants from the impervious surfaces are disconnected prior to discharging offsite. Runoff from the parking lots is transported through WetlandMODs and underground detention for treatment.

2.10.A.2 Properly Design to Limit Oil Contamination and Perform Maintenance

Parking lots may accumulate oil, grease, and water insoluble hydrocarbons from vehicle drippings and engine system leaks.

- *Treat to remove oil and petroleum hydrocarbons at parking lots that are heavily used (e.g. fast food outlets, lots with 25 or more parking spaces, sports event parking lots, shopping malls, grocery stores, discount warehouse stores).*
- *Ensure adequate operation and maintenance of treatment systems particularly sludge and oil removal, and system fouling and plugging prevention control.*

The project owner will ensure that grease and oil are contained. The parking lot will be swept on a monthly basis, minimum, and before any rain events. Absorbent materials will be used to collect any spilled oil, and disposed of properly, to ensure they do not contaminate stormwater. Drain inserts will be used at all proposed onsite inlets and collect drainage from impervious areas prior to flowing through the BMP system for treatment. Hydrocarbon booms from the drain inserts are highly effective in the removal of hydrocarbons.

2.11 Waiver

A Permittee may, through adoption of an ordinance or code incorporating the treatment requirements of LID, provide for a waiver from the requirement if impracticability for a specific property can be established. A waiver of impracticability shall be granted only when all other Structural or Treatment Control BMPs have been considered and rejected as infeasible. Recognized situations of impracticability include, (i) extreme limitations of space for treatment on a redevelopment project, (ii) unfavorable or unstable soil conditions at a site to attempt infiltration, and (iii) risk of ground water contamination because a known unconfined aquifer lies beneath the land surface or an existing or potential underground source of drinking water is less than 10 feet from the soil surface. Any other justification for impracticability must be separately petitioned by the Permittee and submitted to the Regional Board for consideration. The Regional Board may consider approval of the waiver justification or may delegate the authority to approve a class of waiver justifications to the Regional Board Executive Officer. The supplementary waiver justification becomes recognized and effective only after approval by the Regional Board or the Regional Board Executive Officer. A waiver granted by a Permittee to any development or redevelopment project may be revoked by the Regional Board Executive Officer for cause and with proper notice upon petition.

The proposed project does not require a waiver of impracticability from any LID conditions.

2.12 Mitigation Funding

The Permittees may propose a management framework, for endorsement by the Regional Board Executive Officer, to support regional or sub-regional solutions to storm water pollution, where any of the following situations occur:

- *A waiver for impracticability is granted;*
- *Legislative funds become available;*
- *Off-site mitigation is required because of loss of environmental habitat; or*
- *An approved watershed management plan or a regional storm water mitigation plan exists that incorporates an equivalent or improved strategy for storm water mitigation.*

No management framework for mitigation funding is necessary for the proposed project.

Funding will be the responsibility of the owner:

PANNATONI DEVELOPMENT COMPANY, INC.
2442 DUPONT DRIVE
IRVINE, CA 92612
PHONE: (949) 296-2960
CONTACT: RYAN JONES

2.13 Limitation on Use of Infiltration BMPs

Three factors significantly influence the potential for storm water to contaminate ground water. They are (i) pollutant mobility, (ii) pollutant abundance in storm water, (iii) and soluble fraction of pollutant. The risk of contamination of groundwater may be reduced by pretreatment of storm water. A discussion of limitations and guidance for infiltration practices is contained in, Potential Groundwater Contamination from Intentional and Non-Intentional Stormwater Infiltration, Report No. EPA/600/R-94/051, USEPA (1994).

In addition, the distance of the groundwater table from the infiltration BMP may also be a factor determining the risk of contamination. A water table distance separation of ten feet depth in California presumptively poses negligible risk for storm water not associated with industrial activity or high vehicular traffic.

Infiltration BMPs are not recommended for areas of industrial activity or areas subject to high vehicular traffic (25,000 or greater average daily traffic (ADT) on main roadway or 15,000 or more ADT on any intersecting roadway) unless appropriate pretreatment is provided to ensure groundwater is protected and the infiltration BMP is not rendered ineffective by overload.

See Section 1.3 of this LID report for details.

2.14 Alternative Certification for Storm Water Treatment Mitigation

In lieu of conducting detailed BMP review to verify Structural or Treatment Control BMPs adequacy, a Permittee may elect to accept a signed certification from a Civil Engineer or a Licensed Architect registered in the State of California, that the plan meets the criteria established herein. The Permittee is encouraged to verify that certifying person(s) have been trained on BMP design for water quality, not more than two years prior to the signature date. Training conducted by an organization with storm water BMP design expertise (e.g., a University, American Society of Civil Engineers, American Society of Landscape Architects, American Public Works Association, or the California Water Environment Association) may be considered qualifying.

A California licensed civil engineer has provided a detailed BMP review of this report.

2.15 Resources and Reference

California Storm Water Best Management Practices Handbooks for Construction Activity (2009), Municipal (2003), and Industrial/Commercial (2003).

APPENDIX A

Stormwater Quality Design Calculations (SWQDv)

Department of Public Works
dpw.lacounty.gov

vhdufk#rxu#vwh111 St

Hydrology Map A GIS viewer application to view the data for the hydrology manual.

LAYERS

- [ ] 50yr Two Tenths (Rainfall)
- [ ] DPA Zones
- [ ] Soils 2004
- [ ] TG Page
- [x] Final 85th Percentile, 24-hr Rainfall
- [x] 1-year, 1-hour Rainfall Intensity

SEARCH

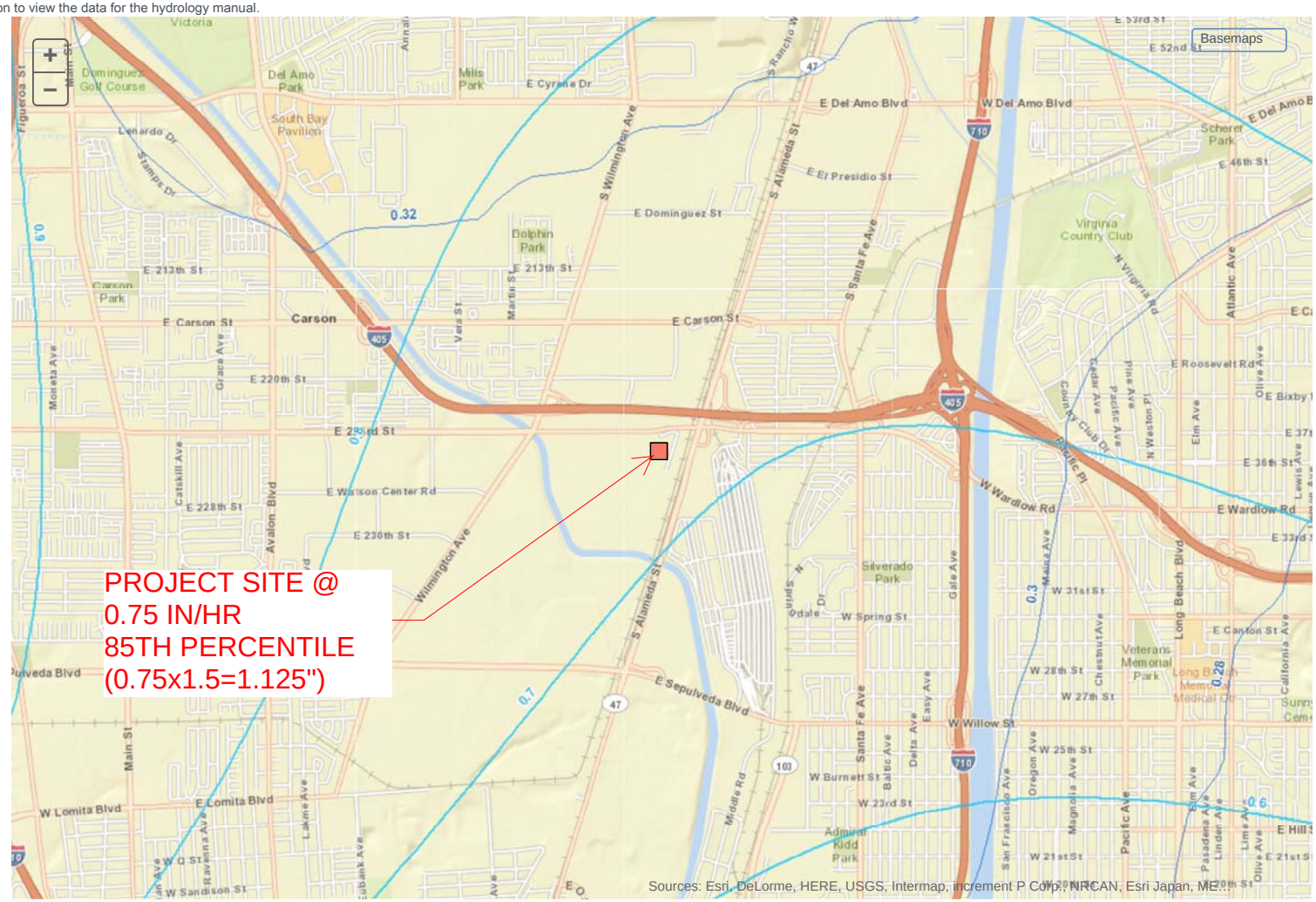
Zoom to TG Page:

Enter Address, Cross Street, or Parcel No.:
(ex: 900 S. Fremont Ave., Fremont@Valley, 5342005904)

2350 E 223rd St Vhdufk

Address Search Results:

2350 E 223rd St



Map Tips

odfrxqw|ljry###Sxedf#Z runv#IDT###|###Sulydf|# #Vhfxuw|#Srdf|###Dffhvvleklw|###Whup v#ri#Xvh###|###Ihhgedfn###|###Iromz#Xv#

Peak Flow Hydrologic Analysis

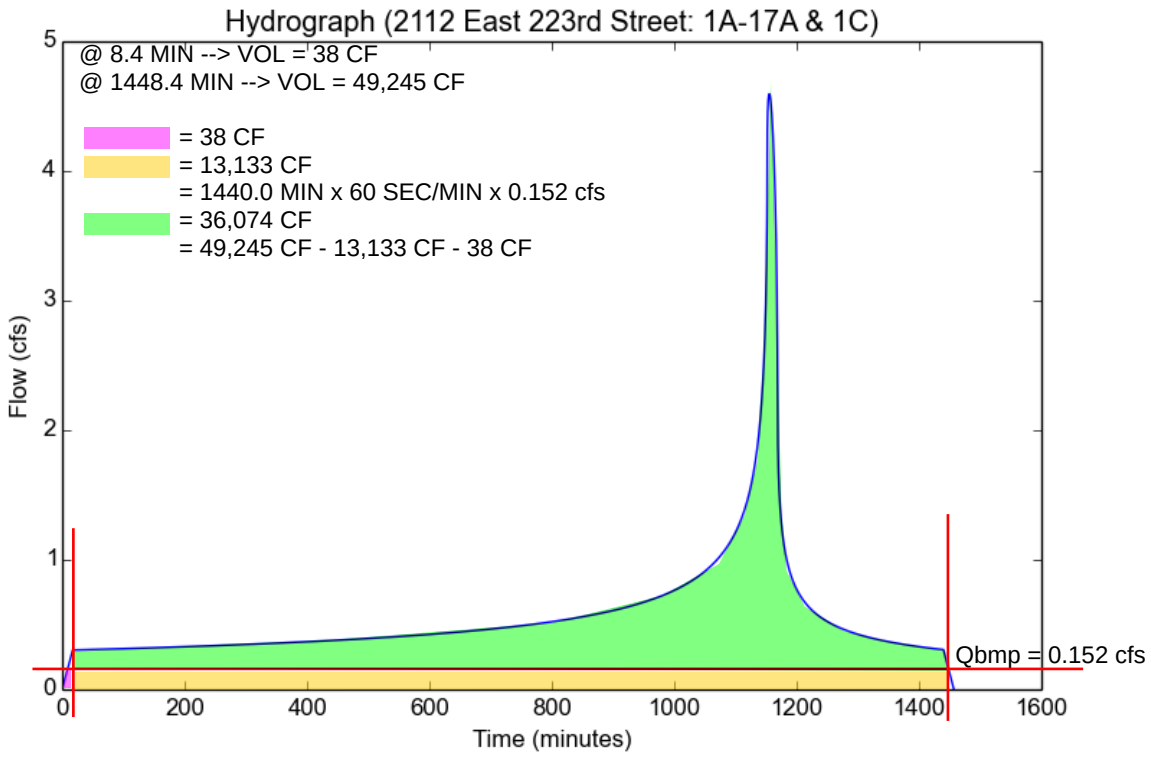
File location: O:/3800-3899/3826/SUSMP/2020-01-XX 2nd Submittal/Appendices/Appendix A - SWQDv Calculations (PRINT IN COLOR)/HydroCalc/211
Version: HydroCalc 1.0.3

Input Parameters

Project Name	2112 East 223rd Street
Subarea ID	1A-17A & 1C
Area (ac)	14.15
Flow Path Length (ft)	347.0
Flow Path Slope (vft/hft)	0.0105
85th Percentile Rainfall Depth (in)	1.125
Percent Impervious	0.95
Soil Type	3
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	1.125
Peak Intensity (in/hr)	0.3776
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.86
Time of Concentration (min)	17.0
Clear Peak Flow Rate (cfs)	4.5953
Burned Peak Flow Rate (cfs)	4.5953
24-Hr Clear Runoff Volume (ac-ft)	1.1314
24-Hr Clear Runoff Volume (cu-ft)	49284.6302



Inputs: 2112 East 223rd Street

Subarea ID	Area (ac)	Flow Path L	Flow Path S	85th Perce	Percent Im	Soil Type	Design Sto	Fire Factor
1A-17A & 1	14.15	347	0.0105	1.125	0.95	3	85th perce	0

Outputs: 2112 East 223rd Street

Area (ac)	Modeled (8	Time of Co	Clear Peak	24-Hr Clear	Burned Pea	Peak Inten	Undevelop	Developed
1A-17A & 1	1.125	17	4.595318	1.131419	4.595318	0.377625	0.1	0.86

Hydrograph: 2112 East 223rd Street - 1A-17A & 1C

Time (min)	Incrementa	Incrementa	Intensity (i	Undevelop	Developed	Clear Peak	Incrementa	Cumulative
0	0	0	0	0	0	0	0	0
0.2	7.36E-05	8.28E-05	0	0	0	0.003569	0.021415	0.021415
0.4	0.000147	0.000166	0	0	0	0.007138	0.064245	0.08566
0.6	0.000221	0.000248	0	0	0	0.010708	0.107075	0.192735
0.8	0.000294	0.000331	0	0	0	0.014277	0.149905	0.342641
1	0.000368	0.000414	0	0	0	0.017846	0.192735	0.535376
1.2	0.000442	0.000497	0	0	0	0.021415	0.235565	0.770941
1.4	0.000515	0.00058	0	0	0	0.024984	0.278395	1.049337
1.6	0.000589	0.000663	0	0	0	0.028553	0.321226	1.370562
1.8	0.000663	0.000746	0	0	0	0.032123	0.364056	1.734618
2	0.000736	0.000828	0	0	0	0.035692	0.406886	2.141504
2.2	0.00081	0.000911	0	0	0	0.039261	0.449716	2.591219
2.4	0.000884	0.000994	0	0	0	0.04283	0.492546	3.083765
2.6	0.000957	0.001077	0	0	0	0.046399	0.535376	3.619141
2.8	0.001031	0.00116	0	0	0	0.049968	0.578206	4.197347
3	0.001105	0.001243	0	0	0	0.053538	0.621036	4.818383
3.2	0.001179	0.001326	0	0	0	0.057107	0.663866	5.482249
3.4	0.001252	0.001409	0	0	0	0.060676	0.706696	6.188945
3.6	0.001326	0.001492	0	0	0	0.064245	0.749526	6.938471
3.8	0.0014	0.001575	0	0	0	0.067814	0.792356	7.730828
4	0.001473	0.001658	0	0	0	0.071383	0.835186	8.566014
4.2	0.001547	0.001741	0	0	0	0.074953	0.878016	9.444031
4.4	0.001621	0.001824	0	0	0	0.078522	0.920847	10.36488
4.6	0.001695	0.001906	0	0	0	0.082091	0.963677	11.32855
4.8	0.001768	0.001989	0	0	0	0.08566	1.006507	12.33506
5	0.001842	0.002072	0	0	0	0.089229	1.049337	13.3844
5.2	0.001916	0.002155	0	0	0	0.092798	1.092167	14.47656
5.4	0.00199	0.002238	0	0	0	0.096368	1.134997	15.61156
5.6	0.002063	0.002321	0	0	0	0.099937	1.177827	16.78939
5.8	0.002137	0.002404	0	0	0	0.103506	1.220657	18.01004
6	0.002211	0.002487	0	0	0	0.107075	1.263487	19.27353
6.2	0.002285	0.00257	0	0	0	0.110644	1.306317	20.57985
6.4	0.002359	0.002653	0	0	0	0.114214	1.349147	21.929
6.6	0.002432	0.002737	0	0	0	0.117783	1.391977	23.32097
6.8	0.002506	0.00282	0	0	0	0.121352	1.434807	24.75578

7	0.00258	0.002903	0	0	0	0.124921	1.477637	26.23342
7.2	0.002654	0.002986	0	0	0	0.12849	1.520468	27.75389
7.4	0.002728	0.003069	0	0	0	0.132059	1.563298	29.31718
7.6	0.002802	0.003152	0	0	0	0.135629	1.606128	30.92331
7.8	0.002875	0.003235	0	0	0	0.139198	1.648958	32.57227
8	0.002949	0.003318	0	0	0	0.142767	1.691788	34.26406
8.2	0.003023	0.003401	0	0	0	0.146336	1.734618	35.99867
8.4	0.003097	0.003484	0	0	0	0.149905	1.777448	37.77612
8.6	0.003171	0.003567	0	0	0	0.153474	1.820278	39.5964
8.8	0.003245	0.00365	0	0	0	0.157044	1.863108	41.45951
9	0.003319	0.003733	0	0	0	0.160613	1.905938	43.36545
9.2	0.003392	0.003817	0	0	0	0.164182	1.948768	45.31421
9.4	0.003466	0.0039	0	0	0	0.167751	1.991598	47.30581
9.6	0.00354	0.003983	0	0	0	0.17132	2.034428	49.34024
9.8	0.003614	0.004066	0	0	0	0.174889	2.077258	51.4175
10	0.003688	0.004149	0	0	0	0.178459	2.120088	53.53759
10.2	0.003762	0.004232	0	0	0	0.182028	2.162919	55.70051
10.4	0.003836	0.004315	0	0	0	0.185597	2.205749	57.90626
10.6	0.00391	0.004399	0	0	0	0.189166	2.248579	60.15483
10.8	0.003984	0.004482	0	0	0	0.192735	2.291409	62.44624
11	0.004058	0.004565	0	0	0	0.196304	2.334239	64.78048
11.2	0.004132	0.004648	0	0	0	0.199874	2.377069	67.15755
11.4	0.004206	0.004731	0	0	0	0.203443	2.419899	69.57745
11.6	0.00428	0.004815	0	0	0	0.207012	2.462729	72.04018
11.8	0.004354	0.004898	0	0	0	0.210581	2.505559	74.54574
12	0.004428	0.004981	0	0	0	0.21415	2.548389	77.09413
12.2	0.004502	0.005064	0	0	0	0.21772	2.591219	79.68535
12.4	0.004575	0.005147	0	0	0	0.221289	2.634049	82.3194
12.6	0.004649	0.005231	0	0	0	0.224858	2.676879	84.99628
12.8	0.004723	0.005314	0	0	0	0.228427	2.719709	87.71598
13	0.004797	0.005397	0	0	0	0.231996	2.76254	90.47852
13.2	0.004871	0.00548	0	0	0	0.235565	2.80537	93.28389
13.4	0.004946	0.005564	0	0	0	0.239135	2.8482	96.13209
13.6	0.00502	0.005647	0	0	0	0.242704	2.89103	99.02312
13.8	0.005094	0.00573	0	0	0	0.246273	2.93386	101.957
14	0.005168	0.005814	0	0	0	0.249842	2.97669	104.9337
14.2	0.005242	0.005897	0	0	0	0.253411	3.01952	107.9532
14.4	0.005316	0.00598	0	0	0	0.25698	3.06235	111.0155
14.6	0.00539	0.006063	0	0	0	0.26055	3.10518	114.1207
14.8	0.005464	0.006147	0	0	0	0.264119	3.14801	117.2687
15	0.005538	0.00623	0	0	0	0.267688	3.19084	120.4596
15.2	0.005612	0.006313	0	0	0	0.271257	3.23367	123.6932
15.4	0.005686	0.006397	0	0	0	0.274826	3.2765	126.9697
15.6	0.00576	0.00648	0	0	0	0.278395	3.31933	130.2891
15.8	0.005834	0.006563	0	0	0	0.281965	3.362161	133.6512
16	0.005908	0.006647	0	0	0	0.285534	3.404991	137.0562
16.2	0.005982	0.00673	0	0	0	0.289103	3.447821	140.504

1445.2	1	1.125	0.017414	0.1	0.86	0.21191	2.564691	49209.86
1445.4	1	1.125	0.017116	0.1	0.86	0.208284	2.521163	49212.38
1445.6	1	1.125	0.016818	0.1	0.86	0.204658	2.477649	49214.86
1445.8	1	1.125	0.01652	0.1	0.86	0.201034	2.43415	49217.29
1446	1	1.125	0.016222	0.1	0.86	0.197411	2.390666	49219.68
1446.2	1	1.125	0.015925	0.1	0.86	0.193789	2.347197	49222.03
1446.4	1	1.125	0.015627	0.1	0.86	0.190168	2.303742	49224.33
1446.6	1	1.125	0.01533	0.1	0.86	0.186549	2.260302	49226.59
1446.8	1	1.125	0.015033	0.1	0.86	0.182931	2.216877	49228.81
1447	1	1.125	0.014735	0.1	0.86	0.179314	2.173466	49230.98
1447.2	1	1.125	0.014438	0.1	0.86	0.175698	2.130071	49233.11
1447.4	1	1.125	0.014141	0.1	0.86	0.172084	2.08669	49235.2
1447.6	1	1.125	0.013844	0.1	0.86	0.16847	2.043323	49237.24
1447.8	1	1.125	0.013547	0.1	0.86	0.164858	1.999971	49239.24
1448	1	1.125	0.013251	0.1	0.86	0.161247	1.956634	49241.2
1448.2	1	1.125	0.012954	0.1	0.86	0.157638	1.913311	49243.11
1448.4	1	1.125	0.012658	0.1	0.86	0.154029	1.870003	49244.98
1448.6	1	1.125	0.012361	0.1	0.86	0.150422	1.82671	49246.81
1448.8	1	1.125	0.012065	0.1	0.86	0.146816	1.783431	49248.6
1449	1	1.125	0.011769	0.1	0.86	0.143211	1.740166	49250.34
1449.2	1	1.125	0.011472	0.1	0.86	0.139608	1.696917	49252.03
1449.4	1	1.125	0.011176	0.1	0.86	0.136006	1.653681	49253.69
1449.6	1	1.125	0.01088	0.1	0.86	0.132404	1.61046	49255.3
1449.8	1	1.125	0.010585	0.1	0.86	0.128805	1.567254	49256.86
1450	1	1.125	0.010289	0.1	0.86	0.125206	1.524062	49258.39
1450.2	1	1.125	0.009993	0.1	0.86	0.121608	1.480885	49259.87
1450.4	1	1.125	0.009698	0.1	0.86	0.118012	1.437722	49261.31
1450.6	1	1.125	0.009402	0.1	0.86	0.114417	1.394573	49262.7
1450.8	1	1.125	0.009107	0.1	0.86	0.110823	1.351439	49264.05
1451	1	1.125	0.008812	0.1	0.86	0.10723	1.308319	49265.36
1451.2	1	1.125	0.008517	0.1	0.86	0.103639	1.265214	49266.63
1451.4	1	1.125	0.008222	0.1	0.86	0.100048	1.222123	49267.85
1451.6	1	1.125	0.007927	0.1	0.86	0.096459	1.179046	49269.03
1451.8	1	1.125	0.007632	0.1	0.86	0.092871	1.135984	49270.16
1452	1	1.125	0.007337	0.1	0.86	0.089285	1.092936	49271.26
1452.2	1	1.125	0.007042	0.1	0.86	0.085699	1.049902	49272.31
1452.4	1	1.125	0.006748	0.1	0.86	0.082115	1.006882	49273.31
1452.6	1	1.125	0.006453	0.1	0.86	0.078532	0.963877	49274.28
1452.8	1	1.125	0.006159	0.1	0.86	0.07495	0.920886	49275.2
1453	1	1.125	0.005865	0.1	0.86	0.071369	0.87791	49276.08
1453.2	1	1.125	0.005571	0.1	0.86	0.067789	0.834947	49276.91
1453.4	1	1.125	0.005277	0.1	0.86	0.064211	0.791999	49277.7
1453.6	1	1.125	0.004983	0.1	0.86	0.060633	0.749065	49278.45
1453.8	1	1.125	0.004689	0.1	0.86	0.057057	0.706145	49279.16
1454	1	1.125	0.004395	0.1	0.86	0.053482	0.663239	49279.82
1454.2	1	1.125	0.004101	0.1	0.86	0.049909	0.620348	49280.44
1454.4	1	1.125	0.003808	0.1	0.86	0.046336	0.57747	49281.02

1454.6	1	1.125	0.003514	0.1	0.86	0.042765	0.534607	49281.55
1454.8	1	1.125	0.003221	0.1	0.86	0.039195	0.491758	49282.04
1455	1	1.125	0.002928	0.1	0.86	0.035626	0.448923	49282.49
1455.2	1	1.125	0.002634	0.1	0.86	0.032058	0.406102	49282.9
1455.4	1	1.125	0.002341	0.1	0.86	0.028491	0.363295	49283.26
1455.6	1	1.125	0.002048	0.1	0.86	0.024926	0.320502	49283.58
1455.8	1	1.125	0.001755	0.1	0.86	0.021361	0.277723	49283.86
1456	1	1.125	0.001463	0.1	0.86	0.017798	0.234958	49284.1
1456.2	1	1.125	0.00117	0.1	0.86	0.014236	0.192207	49284.29
1456.4	1	1.125	0.000877	0.1	0.86	0.010675	0.149471	49284.44
1456.6	1	1.125	0.000585	0.1	0.86	0.007116	0.106748	49284.54
1456.8	1	1.125	0.000292	0.1	0.86	0.003557	0.064039	49284.61
1457	1	1.125	0	0.1	0.86	0	0.021344	49284.63

1457 min x 60 (sec/min) x 0.152 cfs = 13,288 cf biofiltered

WetlandMOD - 24" Media Thickness, Volume Based

Project ID:	TEI 3826
Project Name:	2112 East 223rd Street (1A-17A & 1C)
City, State, ZIP:	Carson, CA
Date:	4-Jan

Blue = User Input
Gray = Formula
Green = Proceed
Red = Redo

WetlandMOD Size	**WM-22-22-V**

	User Input Data	
LA County 24"; Bay Area 18"	Media Thickness (in)	24
Provided by EOR/ DMA area(s)	Treatment Volume (CF)	49285
Drain Down Time in hours	Drain Down Time (hrs)	96
LA 5-12in/hr; Bay Area 10 in/hr	Infiltration Rate (in/hr)	12
Add Row(s) to gain treatment flow	Number of Row(s)	4
RIM/FS to Outlet pipe	Unit Depth (ft)	4.50

	Treatment Data	
treatment volume x 448.8 =	Treatment Flow (gpm)	64.00
in/hr / 100 =	Media Loading Rate (gpm/sf)	0.12
treatment flow / loading rate =	Requried Media Area (sf)	533.35

	Cage, HGL Height	
Provding 3" Multch on top	Cage Height (ft)	4.25
Reduced by 4" from FS	HGL Height (ft)	4.17
Length of cage in each row	Cage Length/ Row (ft)	17.0

	Final Checks	
Based on Gravel Layer surface area	Provided Media Surface Area (sf)	566.67
Unit discharge rate	Discharge Rate (cfs)	0.152

Provided >= Required surface area, unit dimensions in good standing.

	Unit Dimensions	
Length of Media row + Baffle wall	Length Media Row(s) (ft)	18.0
Pre-treatment + Filtration chm.	Length of Unit (ft)	22.0
Total width of unit	Width of Unit (ft)	22.0

Media, Gravel Volume	
WM Media Volume (cy)	42.81
Gravel Layer Volume (cy)	8.92

Feel free to fax or email proposed sizing calculations to BioClean, for assistance with sizing, compliance, and design.
Phone: 760.433.7640 |Fax: 760.433.3176
Email: Info@modularwetlands.com

BioClean
A Forterra Company

UrbanPond Configurations

UrbanPond is a modular precast concrete structure which can be assembled from one to several hundred modules in various shapes and configurations to meet site specific constraints and volume requirements.

Each UrbanPond module is 8 ft wide x 8 ft long (O.D.) - specifically designed to fit on a standard flatbed truck.

UrbanPond can be configured in a combination of modules from as low as 2 ft to as high as 14 ft inside height.

Single UrbanPond

The Bio Clean Single UrbanPond module is available in heights from 2 ft to 7 ft

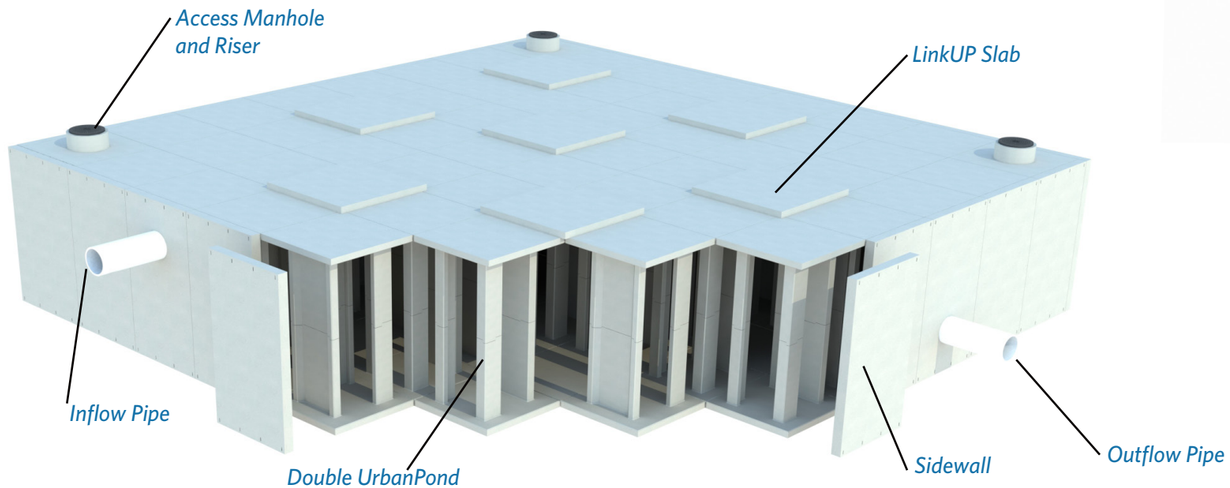
Double UrbanPond

The Bio Clean Double UrbanPond module is available in heights from 4 ft to 14 ft

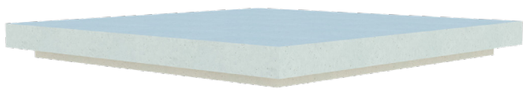
UrbanPond can be engineered with optional infiltration openings

UrbanPond Advantages

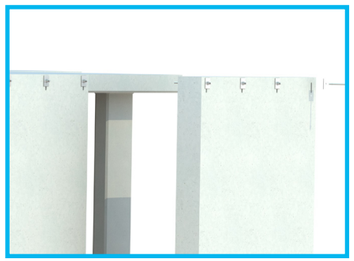
- The square tessellation provides superior strength and load capacity.
- Designed to exceed H20 loading requirements.
- Can be installed deeper without the need to increase wall thickness or add additional rebar.
- Higher void percentages and increased material efficiency for best in class cost per cubic foot storage.
- Lighter weight means it's easier to install.
- Every module drains down fully.
- In 9-module arrays, a linkUP slab allows us to eliminate a module, further decreasing cost and installation time.



LinkUP Slabs span the open cavities in a 9-module array.



Sidewalls easily attach using standard wedge anchors and bolts.



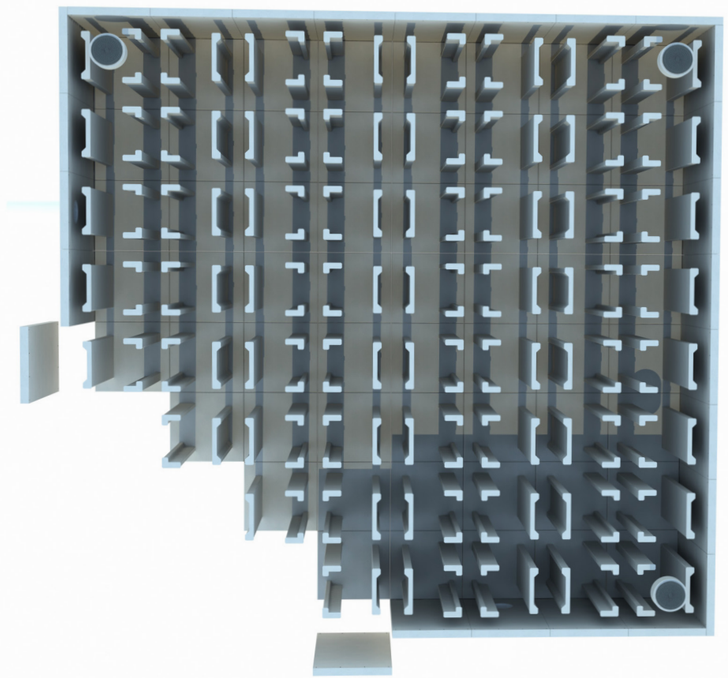
UrbanPond Assembly

The UrbanPond is based on a square tessellation. A tessellation is created when a shape is repeated over and over again covering a plane without any gaps or overlaps. Because of the self-supporting characteristic of tessellated shaped structures, Bio Clean has been able to further reduce material usage and costs up to 20% without sacrificing structural strength.

As shown in the image to the right the offset leg configuration of the modules creates a very open and channel-less internal space.

Each module offers access walkways of greater than 3 ft in each module and between modules for easy inspection and maintenance.

View looking down with top slabs removed



UrbanPond Sizing

UrbanPond is available from heights of 2 ft (I.D.) to up to 14 ft. Single UrbanPond modules are available up to 7 ft height and the Double UrbanPond modules up to 14 ft.

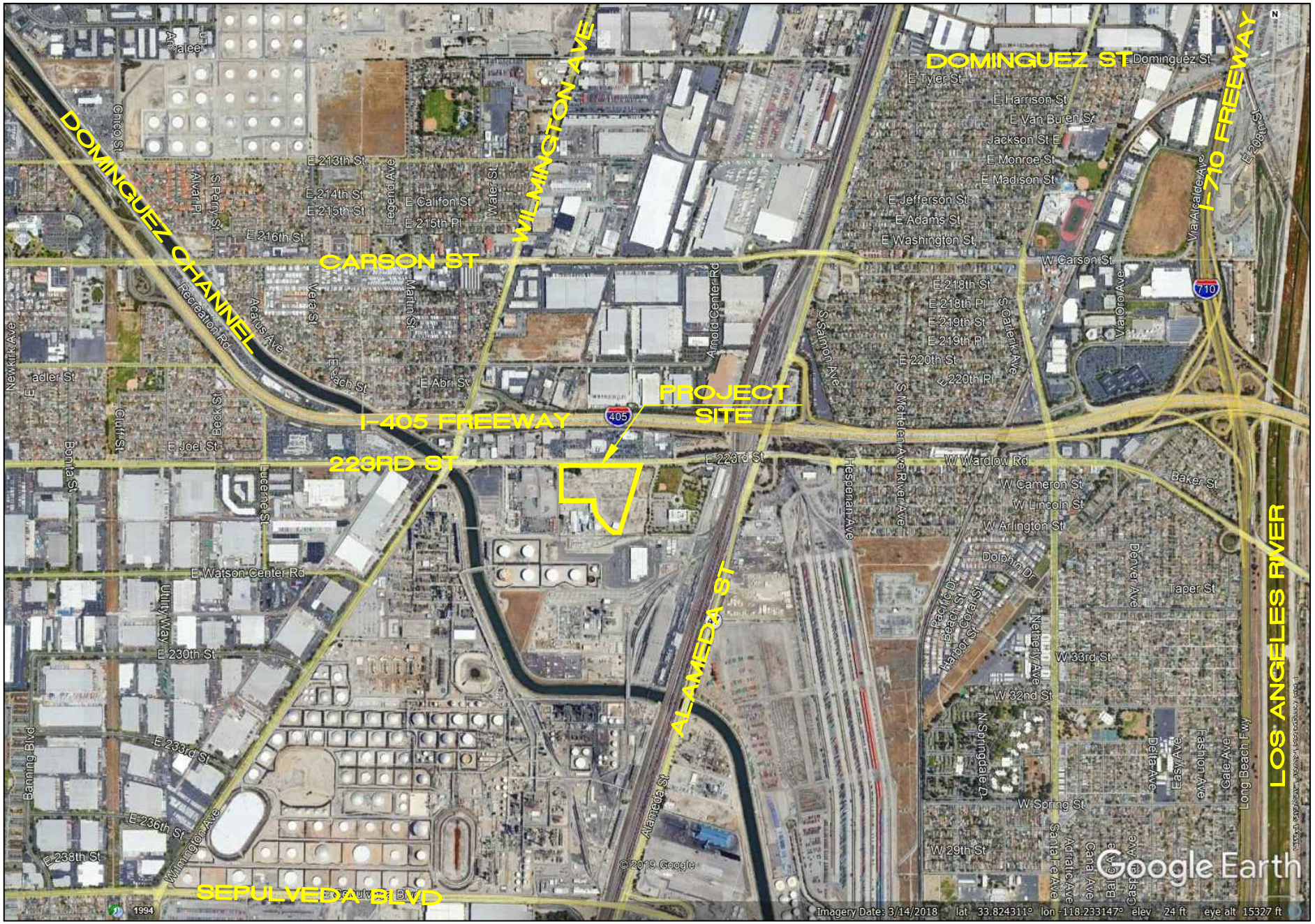
The system's internal offset leg configuration provides channel-less water distribution for stormwater entering and exiting the system.

	I.D. Module Height (ft)	Module Storage Capacity (cu ft)
Single UrbanPond	2	119
	3	179
	4	238
	5	298
	6	357
	7	417
Double UrbanPond	8	477
	9	536
	10	596
	11	655
	12	715
	13	775
	14	834

36,074 CF/834 = 44 UrbanPOND units required.

APPENDIX B

LID Site Plan



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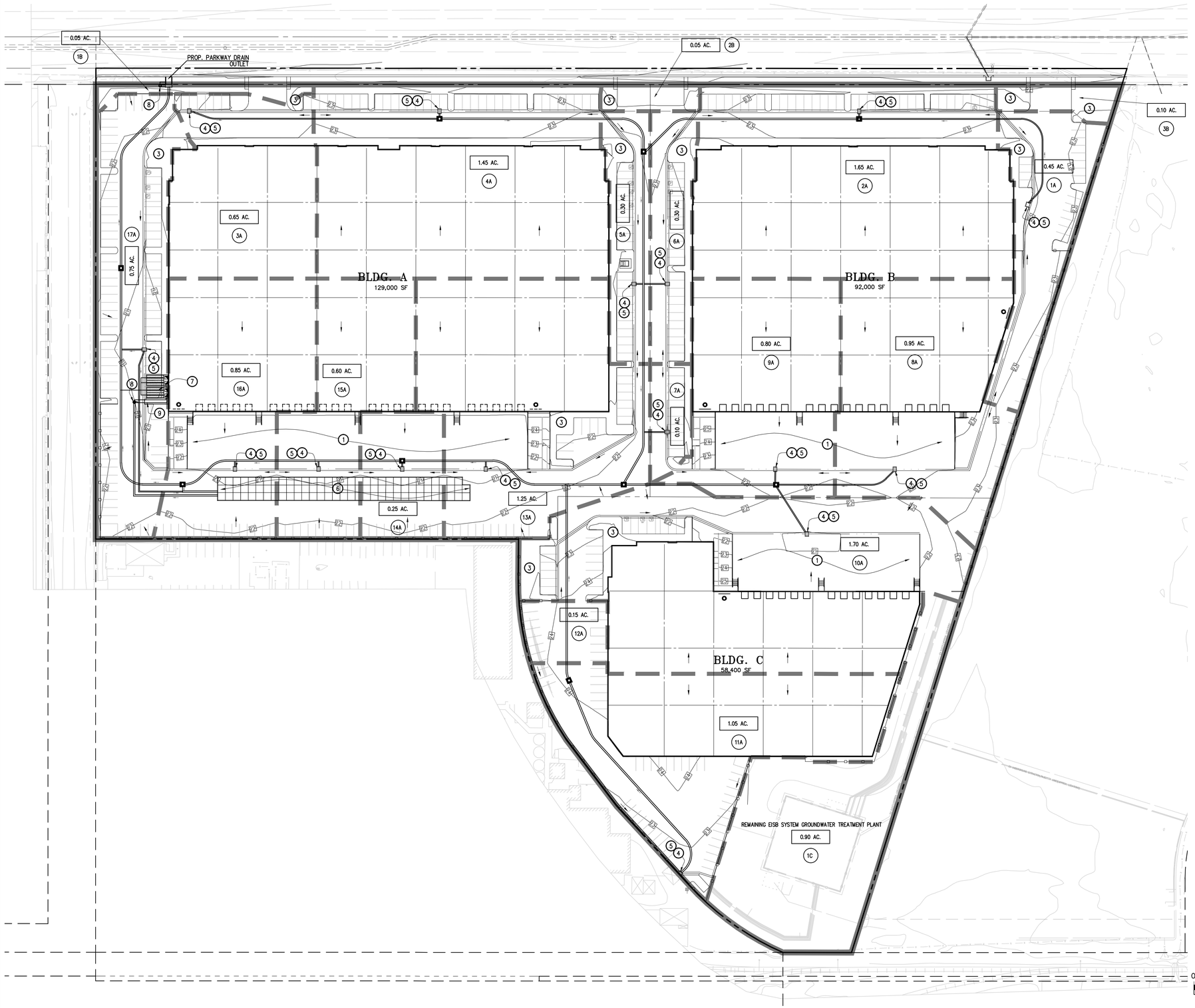
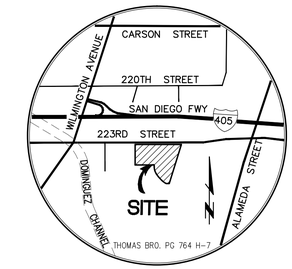
Thienes Engineering, Inc.
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

VICINITY MAP

FOR

2112 EAST 223RD STREET





VICINITY MAP

N.T.S.

LEGEND

1. ABOVEGROUND LOADING DOCK
2. TRASH ENCLOSURE
3. LANDSCAPE/EFFICIENT IRRIGATION
4. DRAIN INSERT(S)
5. STORM DRAIN SYSTEM SIGNS "NO DUMPING–DRAINS TO OCEAN"
6. BIO CLEAN – URBANPOND UNDERGROUND DETENTION SYSTEM (UBP)
7. PROPRIETARY BIOFILTRATION UNIT
8. SUMP PUMP
9. FORCE MAIN

NOTES:

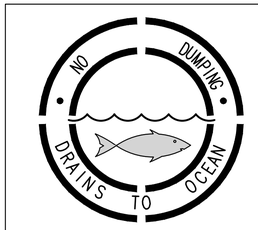
RD ROOF DRAIN

BOUNDARY

DRAINAGE AREAS

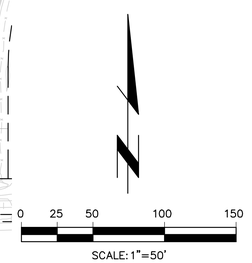
FLOW LINE

SD FLOW LINE



SAMPLE STENCIL TO BE USED NEAR GRATE AND CURB OPENING INLETS

SAMPLE CATCH BASIN STENCIL



Last Update: 1/6/20
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CITY OF CARSON
PUBLIC WORKS DEPARTMENT

LID SITE MAP

2112 EAST 223RD STREET

3826/1 OF 2 SHEET

PREPARED FOR:

PANATTONI DEVELOPMENT COMPANY, INC.
2442 DUPONT DRIVE
IRVINE, CA 92612
PHONE: (949) 296-2960

PREPARED BY:

Thienes Engineering, Inc.
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

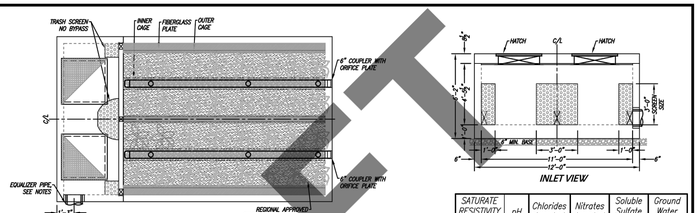
Designed by _____ Date _____
Checked by _____ Date _____
Designed by _____ Date _____
Checked by _____ Date _____

Approved by _____ Date _____

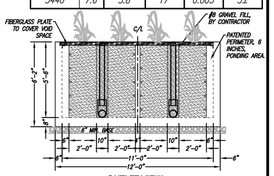
Public Works Director _____ R.C.E. _____

Sheet 1 of 2 Sheets

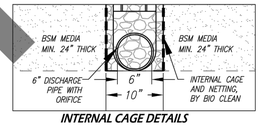
SITE SPECIFIC DATA			
PROJECT ID		9247.00	
PROJECT NAME		3900 ARDEN DRIVE	
PROJECT LOCATION		EL MONTE, CA	
STRUCTURE ID		A1-A5	
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
20874 OF 31574		---	
TREATMENT HGL AVAILABLE (FT)			---
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			OFFLINE
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE	N/A	N/A	N/A
EQUALIZER PIPE	276.83	PVC	12"
OUTLET PIPE	276.50	PVC-SDR35	6"
PRETREATMENT		BIOFILTRATION	N/A
RIM ELEVATION	282.00	282.00	N/A
SURFACE LOAD	PEDESTRIAN	OPEN PLANTER	N/A
FRAME & COVER	36" X 36"	N/A	N/A
LA COUNTY MEDIA MIX VOLUME (CY)			23.50
GRAVEL LAYER WITHIN MEDIA CHAMBER (CY)			5.90
ORIFICE DIAMETER (IN)			---
NOTES: PRELIMINARY, NOT FOR CONSTRUCTION.			



SATURATE RESISTIVITY (OHM-CM)	pH	Chlorides (mg/kg)	Nitrates (mg/kg)	Soluble Sulfate (%)	Ground Water (ft)
3440	7.6	3.8	17	0.003	5±



REQUIRED HORIZ. MEDIA THICKNESS (INCHES)	24
TREATMENT VOLUME (CF)	20874
TARGETED DRAINDOWN DURATION (HR)	96
WETLANDMEDIA INFILTRATION RATE (IN/HR)	12
OR	
WETLANDMEDIA LOADING RATE (GPM/SF)	0.12
DISCHARGE RATE (CFS)	0.060
REQUIRED TOTAL MEDIA SURFACE AREA (SF)	225.89
PROVIDED TOTAL MEDIA SURFACE AREA (SF)	116.67
NUMBER OF ROW(S)	2



INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURER'S SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURER'S STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.

GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT MANUFACTURER.

Bio Clean — A Forterra Company

WetlandMOD-11-19-5'-6"L-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

BIO CLEAN SCREENING FILTER WITH TROUGH SYSTEM

FOR USE IN CURB INLETS

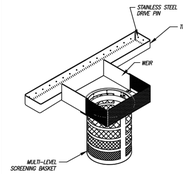


FIGURE 1:
DETAIL OF PARTS

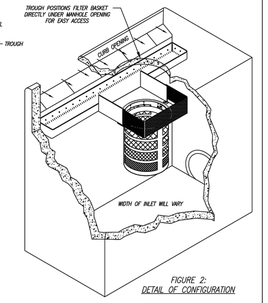


FIGURE 2:
DETAIL OF CONFIGURATION

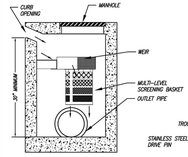


FIGURE 4:
DETAIL OF PROFILE

FIGURE 3:
DETAIL OF MOUNTING

MODEL NUMBER	TREATMENT FLOW (cfs)*	SOLIDS STORAGE CAPACITY (cu ft)
BC-CURB-30	2.85	2.21
BC-CURB-24	2.85	1.77
BC-CURB-18	2.85	1.33
BC-CURB-12	2.81	0.88
DRAWING: BIO CLEAN CURB INLET FILTER DETAILS		MULTI-LEVEL SCREENING
TREATMENT FLOW RATE: 2.85 cfs		MODEL #: BC-CURB-MLS
WARRANTY: 5 YEAR MANUFACTURERS		PROJECT:
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE: 760-433-7640 FAX: 760-433-3176		REVISIONS: DATE:
DATE: 10/13/2017	SCALE: NTS	REVISIONS: DATE:
DRAWTEK M.C.P.	UNITS = INCHES	REVISIONS: DATE:

*SEE PAGE 2 FOR EXPLANATION OF FLOW RATES

NOTES:
1. TROUGH SYSTEM PROVIDES FOR ENTIRE COVERAGE OF INLET OPENING SO TO DIVERT ALL FLOW TO FILTER.
2. TROUGH SYSTEM MANUFACTURED FROM MARINE GRADE FIBERGLASS, GEL COATED FOR UV PROTECTION.
3. SYSTEM ATTACHED TO THE CATCH BASIN WITH NON-CORROSIVE HARDWARE.
4. FILTER MANUFACTURED OF 100% STAINLESS STEEL.
5. FILTER MADE OF NON-CLOGGIN SCREEN WITH 4.7 MM OPENINGS AND MEETS FULL CAPTURE REQUIREMENTS.
6. FILTER CAN BE FITTED WITH HYDROCARBON ABSORBENT BOOM THAT CAN BE EASILY REMOVED UNDER THE MANHOLE FOR EASY REMOVAL AND MAINTENANCE.
8. LENGTH OF TROUGH CAN VARY FROM 2' TO 30'
9. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
10. CONSIDERS A SAFETY FACTOR OF 2.0
11. BYPASS IS FACILITATED VIA OVERFLOW OF THE TROUGH SYSTEM AND IS EQUAL TO THE CAPACITY OF THE CURB OPENING
12. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.
13. ADDITIONAL TREATMENT AND STORAGE CAPACITY CAN BE ACHIEVED BY UTILIZING MULTIPLE FILTER BASKETS.

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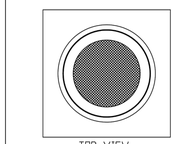
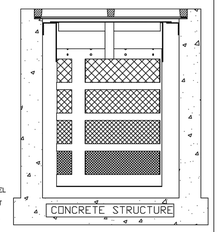
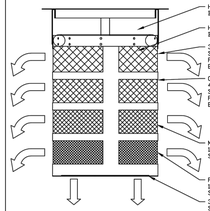
BIO CLEAN SCREENING FILTER

FOR USE IN GRATE INLETS





NOTES:
1. ALL HARDWARE, FLANGE, FRAME, SCREENS SHALL BE STAINLESS STEEL
2. HYDROCARBON BOOM SHALL BE 2" DIAMETER AND CONNECTED, MECHANICALLY TO THE FILTER FRAME, WITH RAILS ALLOWING IT TO FLOAT ON THE WATER SURFACE, REGARDLESS OF HEIGHT
3. SEE PERFORMANCE REPORTS IN MANUFACTURES SPECIFICATIONS
4. OTHER STANDARD AND CUSTOM MODEL SIZES AVAILABLE – CONTACT BIO CLEAN FOR MORE INFORMATION.
5. BASED ON 31% OPEN AREA.
6. CONSIDERS A SAFETY FACTOR OF 2.0.
7. CONSIDERS A LOCAL DEPRESSION PONDING DEPTH OF 6 INCHES.
8. STORAGE CAPACITY BASED ON THE BASKET HALF FULL.



FLOW SCHEMATIC

MODEL #	TREATMENT FLOW (CFS)	BYPASS FLOW (CFS)	SOLIDS STORAGE CAPACITY (CF)
BC-GRATE-MLS 12-12-12	1.19	1.55	0.27
BC-GRATE-MLS 18-18-18	4.32	3.68	1.05
BC-GRATE-MLS 24-24-24	7.67	4.83	2.41
BC-GRATE-MLS 30-30-24	12.97	6.21	3.98
BC-GRATE-MLS 25-38-24	13.53	6.59	4.16
BC-GRATE-MLS 36-36-24	19.64	7.60	5.94
BC-GRATE-MLS 48-48-18	24.84	10.13	7.92

*FLOW RATES CALCULATED USING THE FOLLOWING EQUATION

$Q = 5.9 C_d A \sqrt{2gh}$ C_d = COEFFICIENT OF DISCHARGE = .62

DRAWING: BIO CLEAN GRATE INLET FILTER DETAILS	MULTI-LEVEL SCREENING
TYPICAL MODEL DETAIL	
WARRANTY: 5 YEAR MANUFACTURERS	PROJECT:
BIO CLEAN ENVIRONMENTAL SERVICES, INC. 398 VIA EL CENTRO, OCEANSIDE CA 92058 PHONE: 760-433-7640 FAX: 760-433-3176	REVISIONS: DATE:
DATE: 10/20/17	SCALE: 3/4" = 1'0" REVISIONS: DATE:
DRAWTEK M.C.P.	UNITS = INCHES REVISIONS: DATE:

Bio Clean — A Forterra Company

UrbanPond Configurations

UrbanPond is a modular precast concrete structure which can be assembled from one to several hundred modules in various shapes and configurations to meet site specific constraints and volume requirements.

Each UrbanPond module is 8 ft wide x 8 ft long (O.D.) - specifically designed to fit on a standard flatbed truck.

UrbanPond can be configured in a combination of modules from as low as 2 ft to as high as 14 ft inside height.

Single UrbanPond

The Bio Clean Single UrbanPond module is available in heights from 2 ft to 7 ft

Double UrbanPond

The Bio Clean Double UrbanPond module is available in heights from 4 ft to 14 ft

UrbanPond can be engineered with optional infiltration openings

UrbanPond Advantages

- The square tessellation provides superior strength and load capacity.
- Designed to exceed H20 loading requirements.
- Can be installed deeper without the need to increase wall thickness or add additional rebar.
- Higher void percentages and increased material efficiency for best in class cost per cubic foot storage.
- Lighter weight means it's easier to install.
- Every module drains down fully.
- In 9-module arrays, a linkUP slab allows us to eliminate a module, further decreasing cost and installation time.

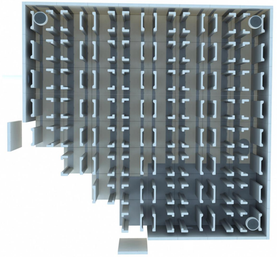
UrbanPond Assembly

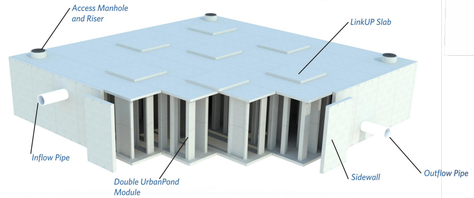
The UrbanPond is based on a square tessellation. A tessellation is created when a shape is repeated over and over again covering a plane without any gaps or overlaps. Because of the self-supporting characteristic of tessellated shaped structures, Bio Clean has been able to further reduce material usage and costs up to 20% without sacrificing structural strength.

As shown in the image to the right the offset leg configuration of the modules creates a very open and channel-less internal space.

Each module offers access walkways of greater than 3 ft in each module and between modules for easy inspection and maintenance.

View looking down with top slabs removed





LinkUP Slabs span the open cavities in a 9-module array.

Sidewalls easily attach using standard wedge anchors and bolts.

UrbanPond Sizing

UrbanPond is available from heights of 2 ft (I.D.) to up to 14 ft. Single UrbanPond modules are available up to 7 ft height and the Double UrbanPond modules up to 14 ft.

The system's internal offset leg configuration provides channel-less water distribution for stormwater entering and exiting the system.

	I.D. Module Height (ft)	Module Storage Capacity (cu ft)
Single UrbanPond	2	119
	3	179
	4	238
	5	298
	6	357
	7	417
Double UrbanPond	8	477
	9	536
	10	596
	11	655
	12	715
	13	775
	14	834

Last Update: 1/6/20
O:\3800-3899\3826\3826BMPSITEMAP.dwg

CITY OF CARSON
PUBLIC WORKS DEPARTMENT

LID SITE MAP

2112 EAST 223RD STREET

PREPARED FOR:
PANATTONI DEVELOPMENT COMPANY, INC.
2442 DUPONT DRIVE
IRVINE, CA 92612
PHONE: (949) 296-2960

PREPARED BY:
Thienes Engineering, Inc.
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

Designed by _____ Date _____
Checked by _____ Date _____
Designed by _____ Date _____
Checked by _____ Date _____

Approved by _____ Date _____

Public Works Director _____ R.C.E. _____

Sheet 2 of 2 Sheets

3826/2 OF 2 SHEET

APPENDIX C

BMP Operation and Maintenance

BMP Operation and Maintenance			
BMP	**Operation/Maintenance**	**Inspection Frequency**	**Responsibility**
Storm Drain Stencil and Signage	➢ Visually inspect for legibility and replace/repaint as necessary.	Annually	Owner
Parking Lot Sweeping	➢ At a minimum, sweep on a monthly basis.	Monthly (minimum)	Owner
WetlandMOD System	➢ All work to be done by the supplier or by a supplier approved contractor. ➢ Clean separation (sediment) chamber. The chamber is located directly under the manhole. ➢ Replace media in pre-filtration cartridges. Media life depends on the loading conditions and can easily be replaced and disposed of without any equipment. The BioMediaGREEN filter can be ordered from the manufacturer. ➢ Replace drain down filter media. Replacement of media takes approximately 5 minutes and is performed without any equipment. ➢ Replace wetland media. The life of the media can be up to 20 years. Remove spent media with shovel or vacuum truck and replace with new media. Media can be ordered from the manufacturer. ➢ See manufacturer's maintenance requirements for additional information.	Semi-annually (October 1st and February 1st) through maintenance service contract with the vendor or equally qualified contractor.	Owner

BMP Operation and Maintenance			
BMP	**Operation/Maintenance**	**Inspection Frequency**	**Responsibility**
Concrete Boxes Underground Detention	➢ Visually inspect the system at all manhole locations. Utilizing a sediment pole, measure and document the amount of silt at each manhole location. Inspect each pipe opening to ensure that the silt level or any foreign objects are not blocking the pipes. ➢ Inspect outlet pipe for large trash or blockages. Remove any blockages during inspection if it can be done safely from the top without entering the system. ➢ **Do not go into the system under any circumstances without proper ventilation equipment and training.** ➢ The sediment level of the system should also be measured and recorded during the inspection process. ➢ The system should be cleaned whenever sediment occupies more than 10% to 15% of the originally designed system's volume. ➢ System should be cleaned by authorized and trained personnel typically through a maintenance service contract with vendor or a qualified contractor. ➢ See manufacturer's maintenance manual for detailed information.	Semi-annually (October 1st and February 1st) through maintenance service contract with the vendor or equally qualified contractor.	Owner
Drain Inserts	➢ Visually inspect for defects and illegal dumping. Notify proper authorities if illegal dumping has occurred. ➢ Using an industrial vacuum, the collected materials shall be removed from the filter basket and disposed of properly. ➢ Inspect biosorb hydrocarbon boom and replace as necessary.	Semi-annually (October 1st and February 1st) through maintenance service contract with the vendor or equally qualified contractor.	Owner
Maintenance Log	➢ Keep a log of all inspection and maintenance performed on the above mentioned BMPs for at least 5 years. Keep this log on-site.	Ongoing	Owner

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

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– 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.

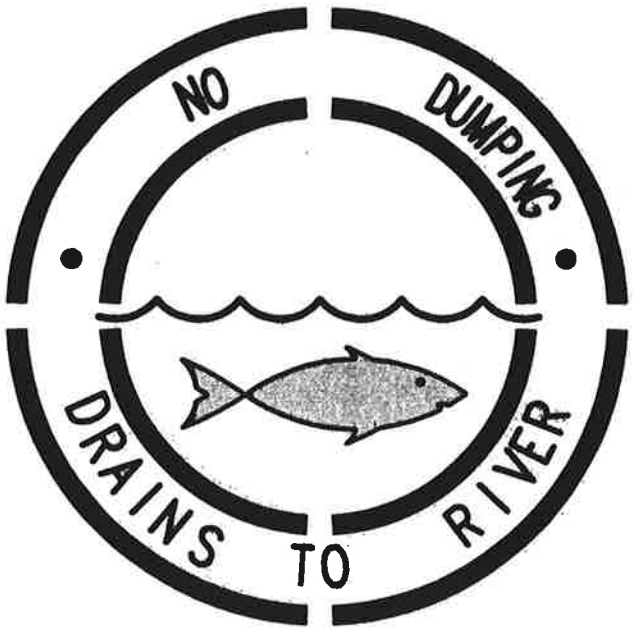
Other Resources

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.



SAMPLE STENCIL TO BE USED NEAR GRATE AND CURB OPENING INLETS

SYMBOL TO BE 24" IN DIAMETER

Thienes Engineering
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

SAMPLE CATCH BASIN STENCIL
PER BMP SD-13

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

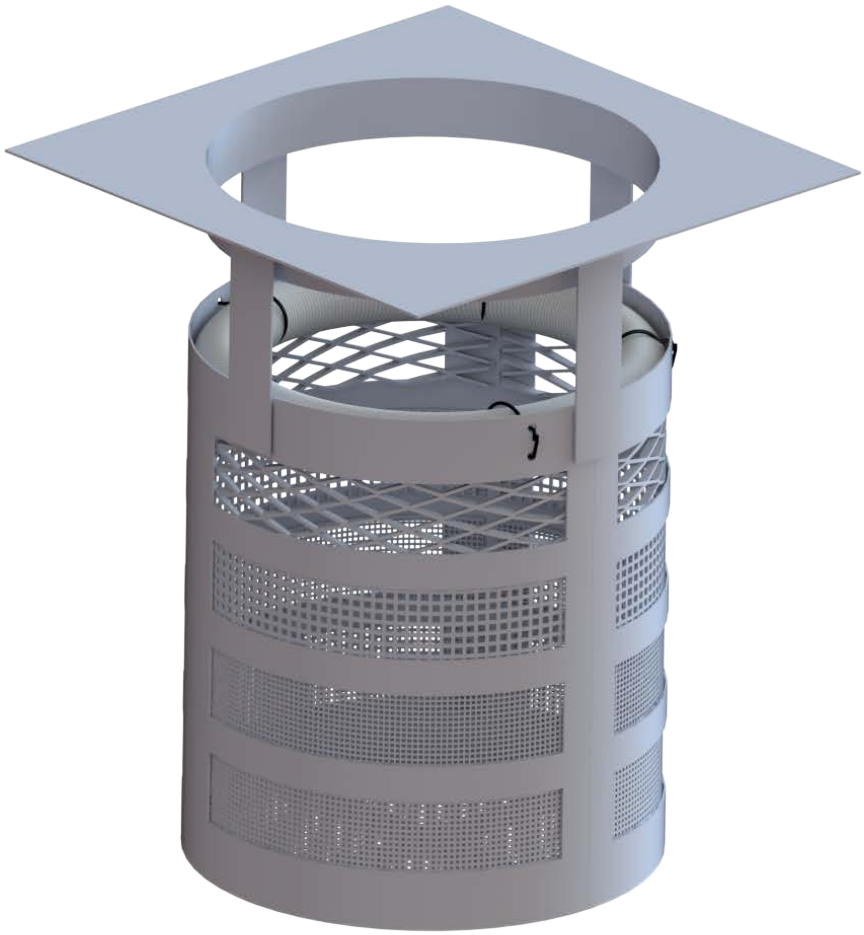
Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Grate Inlet Filter
MLS Type

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



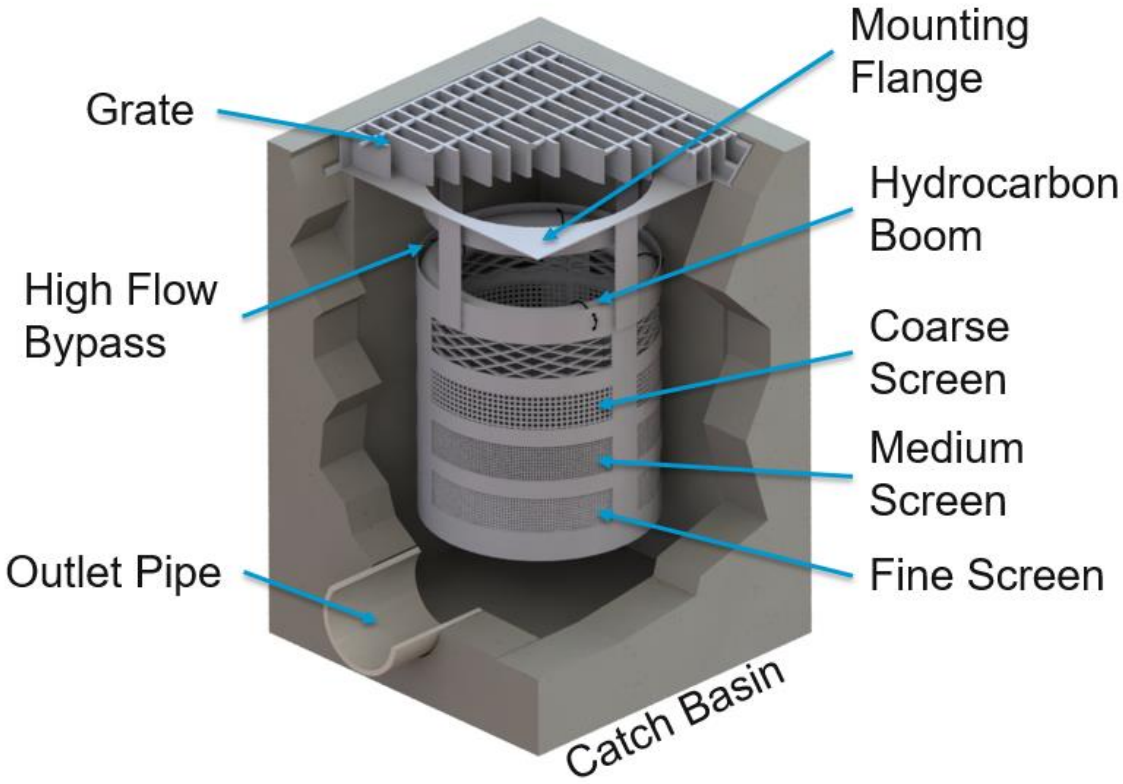
Bio Clean Environmental Services, Inc.
398 Via El Centro
Oceanside, CA 92058

www.BioCleanEnvironmental.com
p: 760.433.7640
f: 760.433.3176

OPERATION & MAINTENANCE

The Bio Clean Grate Inlet Filter is a stormwater device designed to remove high levels of trash, debris, sediments and hydrocarbons. The filter is available in several configurations including trash full capture, multi-level screening, Kraken membrane filter and media filter variations. This manual covers maintenance procedures of the multi-level screening configuration. A supplemental manual is available for the trash full capture configuration, as well as the Kraken and media filter variations. This filter is made of 100% stainless steel and is available in various sizes and depths allowing it to fit in any grated catch basin inlet. The filter's heavy duty construction allows for cleaning with any vacuum truck. The filter can also easily be cleaned by hand.

As with all stormwater BMPs, inspection and maintenance on the Grate Inlet Filter is necessary. Stormwater regulations require BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.



System Diagram:

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the Grate Inlet Filter:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.

Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Grate Inlet Filter are quick and easy. As mentioned above, the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The Grate Inlet Filter can be inspected though visual observation. All necessary pre-inspection steps must be carried out before inspection occurs, such as safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open grated inlet. Once the grate has been safely removed the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the filter with the grate removed.
- Look for any out of the ordinary obstructions on the grate or in the filter and its bypass. Write down any observations on the inspection form.
- Through observation and/or digital photographs, estimate the amount of trash, foliage and sediment accumulated inside the filter basket. Record this information on the inspection form.
- Observe the condition and color of the hydrocarbon boom. Record this information on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the filter basket and its bypass.
- Excessive accumulation of trash, foliage and sediment in the filter basket. Maintenance is required when the basket is greater than half-full.
- The following chart shows the 50% and 100% storage capacity of each filter height:

Model	Filter Basket Diameter (in)	Filter Basket Height (in)	50% Storage Capacity (cu ft)	100% Storage Capacity (cu ft)
BC-GRATE-12-12-18	10.00	18.00	0.41	0.82
BC-GRATE-18-18-18	16.00	18.00	1.05	2.09
BC-GRATE-24-24-24	21.00	24.00	2.40	4.81
BC-GRATE-30-30-24	27.00	24.00	3.97	7.95
BC-GRATE-25-38-24	21.00	24.00	4.15	8.31
BC-GRATE-36-36-24	33.00	24.00	5.94	11.87
BC-GRATE-48-48-18	44.00	18.00	7.92	15.83

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the Curb Inlet Filter, though it can be easily cleaned by hand:

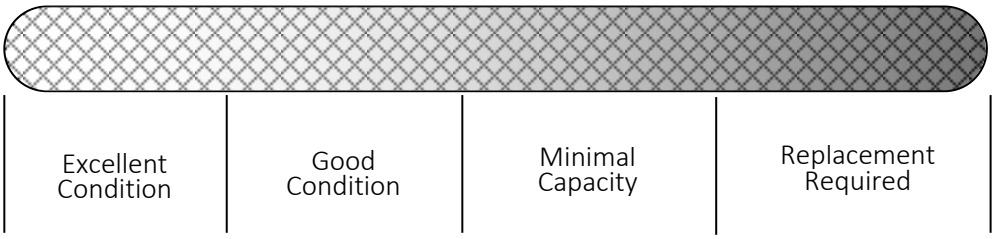
- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Manhole hook or appropriate tools to remove the grate.
- Appropriate safety signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system. Small or large vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

It is recommended that maintenance occurs at least two days after the most recent rain event to allow debris and sediments to dry out. Maintaining the system while flows are still entering it will

increase the time and complexity required for maintenance. Cleaning of the Grate Inlet Filter can be performed utilizing a vacuum truck. Once all safety measures have been set up, cleaning of the Grate Inlet Filter can proceed as followed:

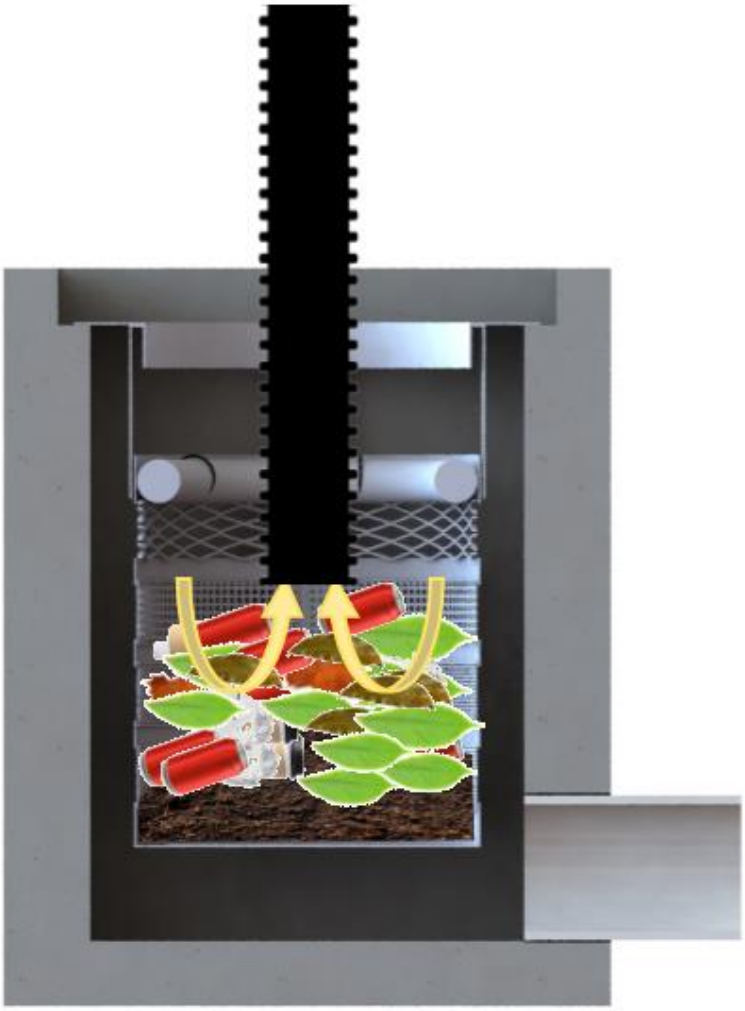
- Remove grate (traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck, position the hose over the opened catch basin. Insert the vacuum hose down into the filter basket and suck out trash, foliage and sediment. A pressure wash is recommended and will assist in spraying off any debris stuck on the side or bottom of the filter basket. Power wash the sides and bottom of the filter basket off.
- Next, remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is zip tied to the top perimeter of the filter. Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required, install and fasten on a new hydrocarbon boom. Booms can be ordered directly from the manufacturer.
- The following is a replacement indication color chart for the hydrocarbon booms:



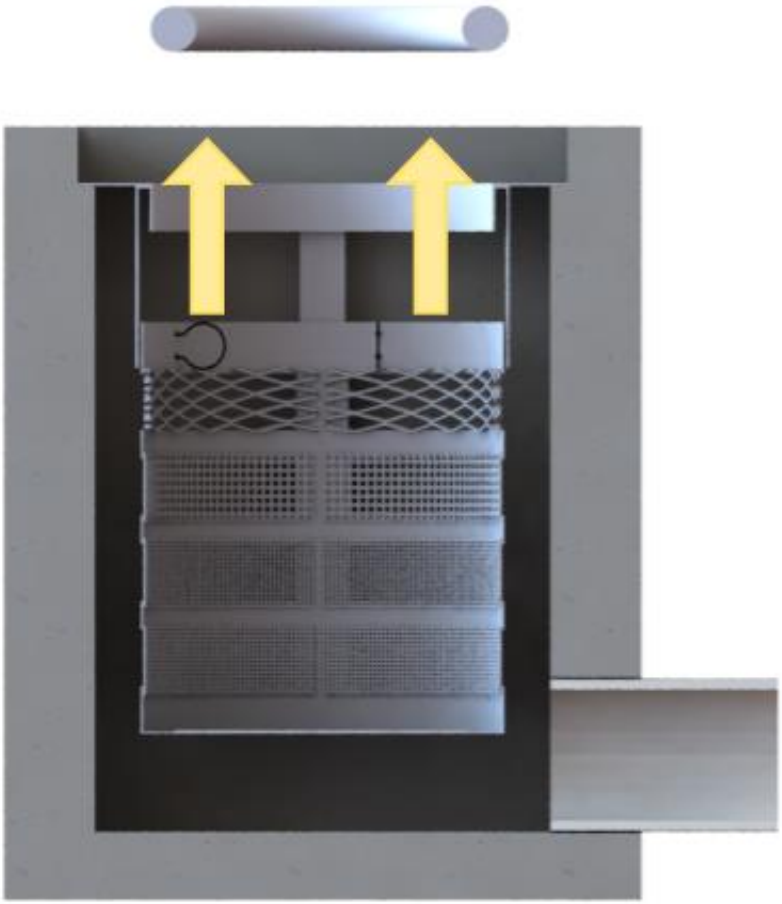
- The last step is to replace the grate and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered from the manufacturer. Hydrocarbon booms can also be ordered directly from the manufacturer as previously noted. NOTE: outlet to catch basin (if it does not have a sump) should be blocked during power washing to prevent any dirty water from discharging from the catch basin.

Maintenance Sequence

Remove grate and set up vacuum truck to clean the filter basket.



Insert the vacuum hose down into the filter basket and suck out debris. Use a pressure washer to assist in vacuum removal. Pressure wash off screens.



Remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is zip tied to the top perimeter of the filter. Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required, install and fasten on a new hydrocarbon boom.

Close up and replace the grate and remove all traffic control. All removed debris and pollutants shall be disposed of following local and state requirements.

For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email:
info@biocleanenvironmental.com

Bio Clean
A Forterra Company

Inspection and Maintenance Report
Catch Basin Only

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ollow Up ☐omplaint ☐torm Storm Event in Last 72-hours? ☐ ☐s

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Catch Basin Size	Evidence of Illicit Discharge?	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Signs of Structural Damage?	Functioning Properly or Maintenance Needed?
1	Lat: Long:							
2	Lat: Long:							
3	Lat: Long:							
4	Lat: Long:							
5	Lat: Long:							
6	Lat: Long:							
7	Lat: Long:							
8	Lat: Long:							
10	Lat: Long:							
11	Lat: Long:							
12	Lat: Long:							

Comments:

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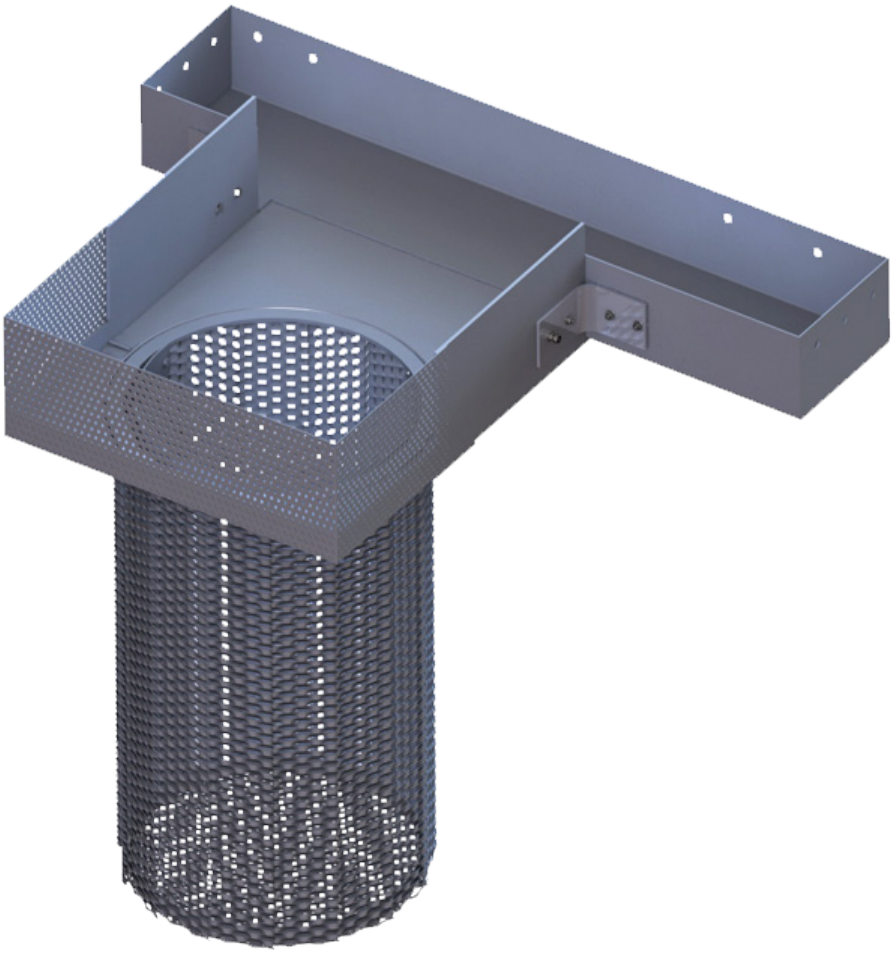
Curb Inlet Filter

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



Bio Clean Environmental Services, Inc.
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Oceanside, CA 92058

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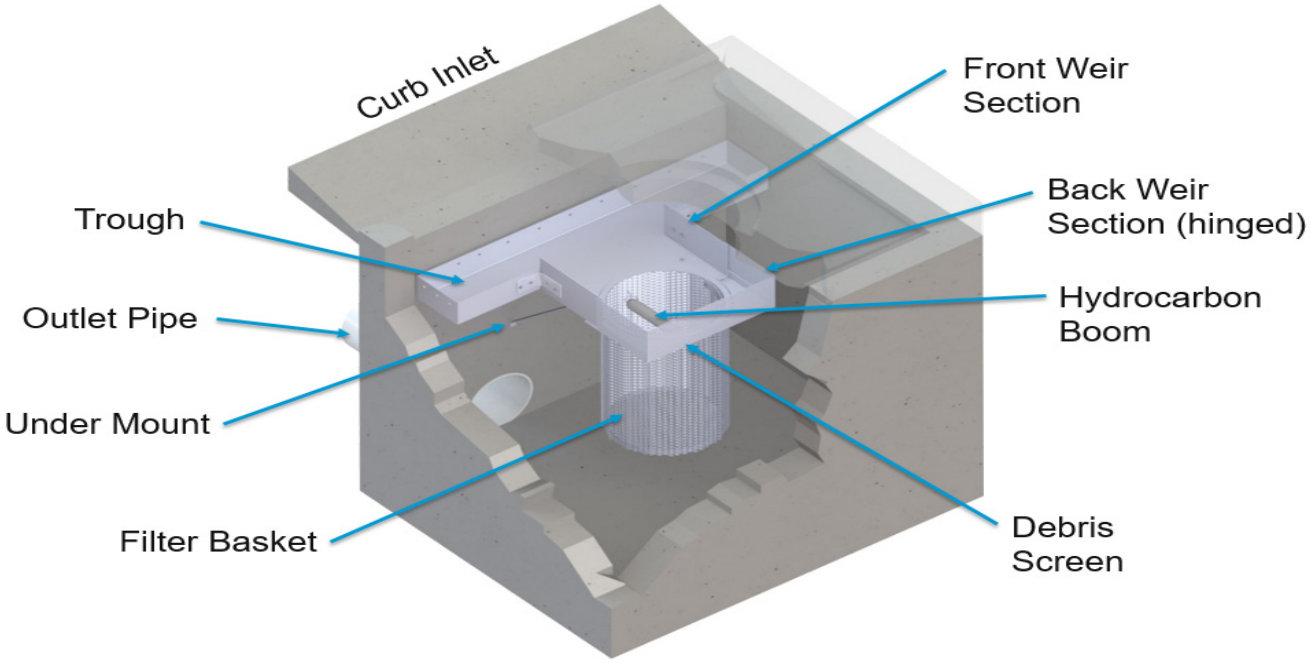
OPERATION & MAINTENANCE

The Bio Clean Curb Inlet Filter is a stormwater device designed to remove high levels of trash, debris, sediments and hydrocarbons. The filter is available in several configurations including trash full capture, multi-level screening, Kraken membrane filter and media filter variations. This manual covers maintenance procedures of the trash full capture and multi-level screening configurations. A supplemental manual is available for the Kraken and media filter variations. The innovative trough & weir system is mounted along the curb face and directs incoming stormwater toward the filter basket which is positioned "directly" under the manhole access opening regardless of its location in the catch basin. This innovative design allows the filter to be cleaned from finish surface without access into the catch basin, therefore drastically reducing maintenance time and eliminating confined space entry. The filter has a lifting handle allowing for the filter to be removed easily through the manhole. The weir also folds up to allow for unimpeded access into the basin for routine maintenance or pipe jetting.

As with all stormwater BMPs, inspection and maintenance on the Curb Inlet Filter is necessary. Stormwater regulations require BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.



System Diagram:

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the Curb Inlet Filter:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.

Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Curb Inlet Fitler are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The Curb Inlet Filter can be inspected though visual observation without entry into the catch basin. All necessary pre-inspection steps must be carried out before inspection occurs, such as safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open access hatch or manhole. Once the manhole has been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the inside of the catch basin through the manhole. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the catch basin.
- Look for any out of the ordinary obstructions in the catch basin, trough, weir, filter basket, basin floor our outlet pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of trash, foliage and sediment accumulated inside the filter basket. Record this information on the inspection form.
- Observe the condition and color of the hydrocarbon boom. Record this information on the inspection form.

- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the trough, weir, filter basket or catch basin.
- Excessive accumulation of trash, foliage and sediment in the filter basket and/or trough and weir sections. Maintenance is required when the basket is greater than half-full.
- The following chart shows the 50% and 100% storage capacity of each filter height:

Model	Filter Basket Diameter (in)	Filter Basket Height (in)	50% Storage Capacity (cu ft)	100% Storage Capacity (cu ft)
BC-CURB-30	18	30	2.21	4.42
BC-CURB-24	18	24	1.77	3.53
BC-CURB-18	18	18	1.33	2.65
BC-CURB-12	18	12	0.88	1.77

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the Curb Inlet Filter though it can easily cleaned by hand:

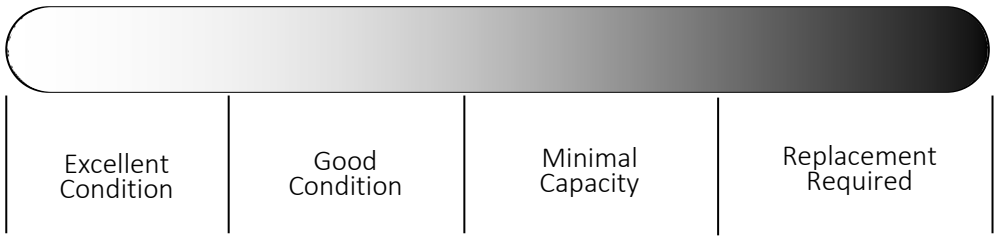
- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Manhole hook or appropriate tools to access hatches and covers.
- Appropriate safety signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system. Small or large vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

It is recommended that maintenance occurs at least two days after the most recent rain event to allow debris and sediments to dry out. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Cleaning of the Curb Inlet Filter can be performed from finish surface without entry into catch basin utilizing a vacuum truck. Some unique

and custom configurations may create conditions which would require entry for some or all of the maintenance procedures. Once all safety measures have been set up cleaning of the Curb Inlet Filter can proceed as followed:

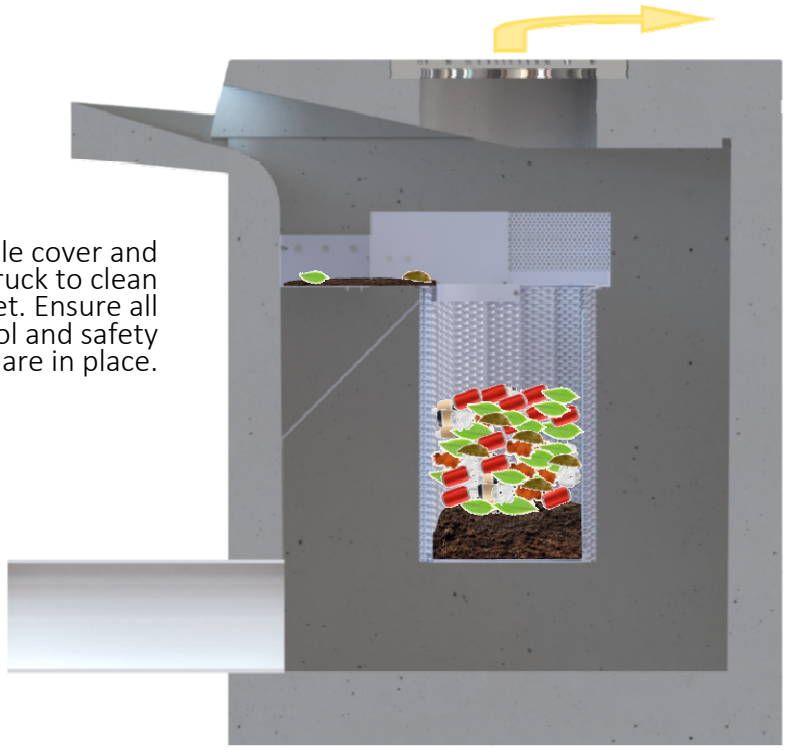
- Remove all manhole cover or access hatches (traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck position the hose over the opened manhole or hatch opening. Insert the vacuum hose down into the filter basket and suck out trash, foliage and sediment. A pressure wash is recommended and will assist in spraying of any debris stuck on the side or bottom of the filter basket. If the filter basket is full, trash, sediment, and debris will accumulate inside the trough and weir sections of the system. Once the filter basket is clean power wash the weir and trough pushing these debris into the filter basket (leave the hose in the filter basket during this process so entering debris will be sucked out). Power wash off the trough, weir, debris screen, and filter basket sides and bottom.
- Next remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is fastened to rails on two opposite sides of the basket (vertical rails). Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required install and fasten on a new hydrocarbon boom. Booms can be ordered directly from the manufacturer.
- Follow is a replacement indication color chart for the hydrocarbon booms:



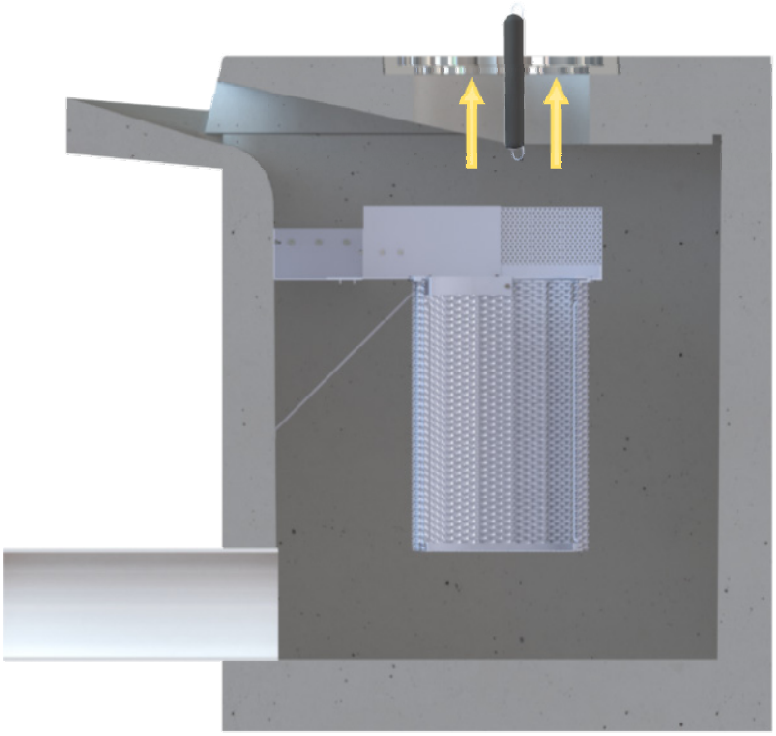
- The last step is to close up and replace the manhole or hatch and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered from the manufacturer. Hydrocarbon booms can also be ordered directly from the manufacturer as previously noted.

Maintenance Sequence

Remove manhole cover and set up vacuum truck to clean the filter basket. Ensure all traffic control and safety measures are in place.

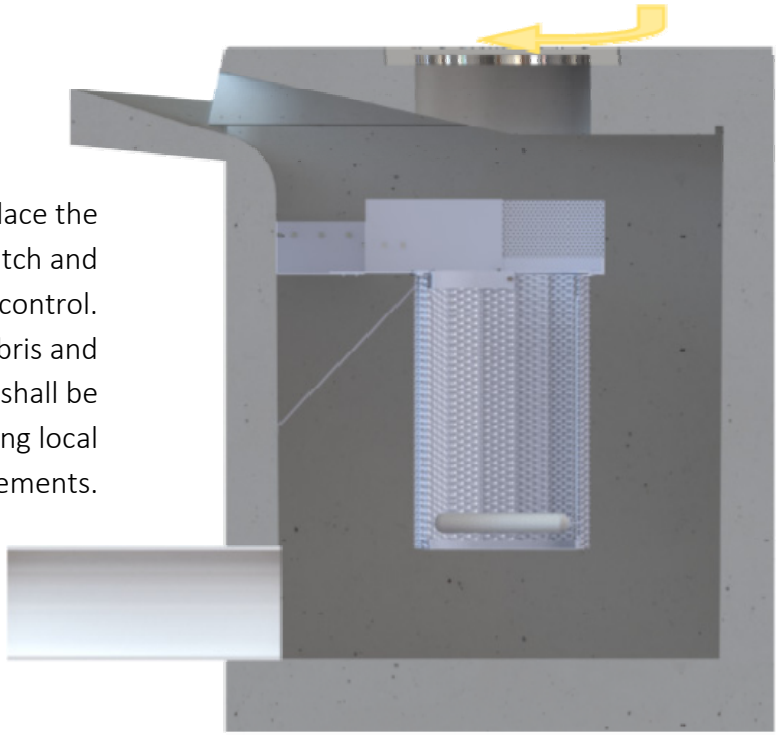


Insert the vacuum hose down into the filter basket and suck out debris. Use a pressure washer to assist in vacuum removal. Pressure wash off the weir and trough and vacuum out any remaining debris.



Remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is fastened to rails on two opposite sides of the basket (vertical rails). Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required install and fasten on a new hydrocarbon boom.

Close up and replace the manhole or hatch and remove all traffic control. All removed debris and pollutants shall be disposed of following local and state requirements.



For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email: info@biocleanenvironmental.com

Bio Clean
A Forterra Company

Inspection and Maintenance Report
Catch Basin Only

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ollow Up ☐omplaint ☐torm Storm Event in Last 72-hours? ☐ ☐s

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Catch Basin Size	Evidence of Illicit Discharge?	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Signs of Structural Damage?	Functioning Properly or Maintenance Needed?
1	Lat: Long:							
2	Lat: Long:							
3	Lat: Long:							
4	Lat: Long:							
5	Lat: Long:							
6	Lat: Long:							
7	Lat: Long:							
8	Lat: Long:							
10	Lat: Long:							
11	Lat: Long:							
12	Lat: Long:							

Comments:

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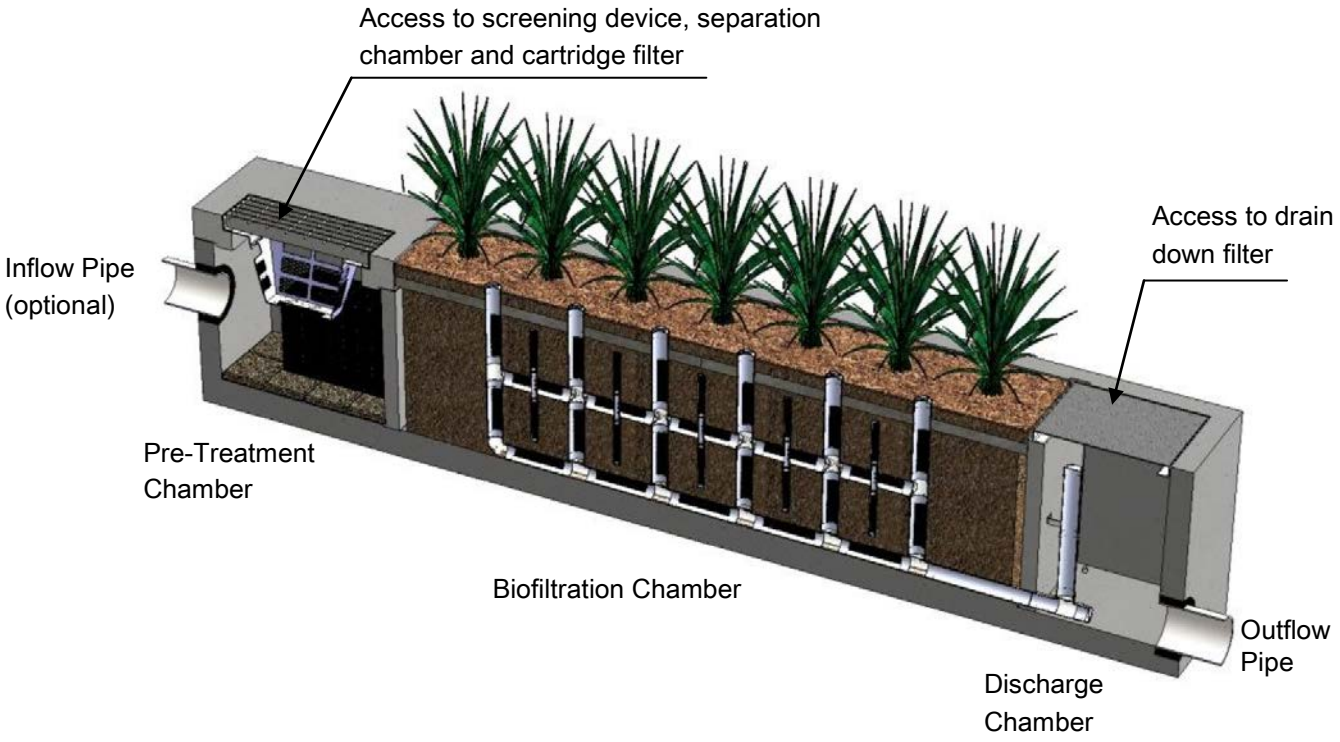
Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

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Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

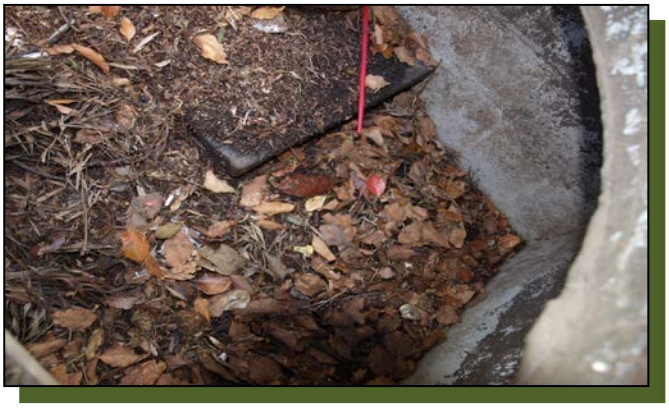
Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

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Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Bio Clean
P. 855-566-3938
F. 760-433-3176
E. Info@BioCleanEnvironmental.com

Bio Clean
A Forterra Company

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ___/___/___ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____

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Maintenance Report

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P. 855-566-3938
F. 760-433-3176
E. Info@BioCleanEnvironmental.com

Bio Clean
A Forterra Company

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

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Bio Clean

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UrbanPond™

A Stormwater Storage Solution

INSPECTION & MAINTENANCE MANUAL

5796 Armada Drive Suite 250 | Carlsbad, CA 92008 | 855.566.3938

stormwater@forterrabp.com | biocleanenvironmental.com

URBAN POND INSPECTION & MAINTENANCE

Inspection and maintenance of the Urban Pond underground detention, retention, or infiltration system is vital for the performance and life cycle of the stormwater management system. All local, state, and federal permits and regulations must be followed for system compliance. Manway access locations are provided on each system for ease of ingress and egress for routine inspection and maintenance activities. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed and providing protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess the site specific conditions. Inspection after the first significant rainfall event and at quarterly intervals is typical. This is recommended because pollutant loading and pollutant characteristics can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding on roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years to ensure appropriate maintenance is provided. Without appropriate maintenance a BMP can exceed its storage capacity, become blocked, or damaged, which can negatively affect its continued performance.

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the underground detention, retention, or infiltration system:

- Bio Clean Environmental Inspection and Maintenance Report Form
- Flashlight
- Manhole hook or appropriate tools to access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure
- Protective clothing and eye protection
- Note: Entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system.

Inspection Steps

The key to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Urban Pond underground detention, retention, or infiltration system are quick and easy. As mentioned above, the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order

to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long term inspection and maintenance interval requirements.

The Urban Pond underground detention, retention, or infiltration system can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other information (see inspection form).
- Observe the upstream drainage area and look for sources of pollution, sediment, trash and debris.
- Observe the inside of the system through the access manholes. If minimal light is available and vision into the unit is impaired, utilize a flashlight to see inside the system and all of its modules.
- Look for any out of the ordinary obstructions in the inflow and outflow pipes. Check pipes for movement or leakage. Write down any observations on the inspection form.
- Observe any movement of modules.
- Observe concrete for cracks and signs of deterioration.
- In detention and retention systems inspect for any signs of leakage.
- In infiltration systems inspect for any signs of blockage or reasons that the soils are not infiltrating.
- Through observation and/or digital photographs, estimate the amount of floatable debris accumulated in the system. Record this information on the inspection form. Next, utilizing a tape measure or measuring stick, estimate the amount of sediment accumulated in the system. Sediment depth may vary throughout the system, depending on the flow path. Record this depth on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Damaged inlet and outlet pipes.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatables.
- Excessive accumulation of sediment of more than 6” in depth.
- Damaged joint sealant.

Maintenance Equipment

While maintenance can be done fully by hand it is recommended that a vacuum truck be utilized to minimize time requirements required to maintain the Urban Pond underground detention, retention, or infiltration system:

- Bio Clean Environmental Inspection and Maintenance Report Form
- Flashlight
- Manhole hook or appropriate tools to access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure
- Protective clothing and eye protection
- Vacuum truck
- Trash can
- Pressure washer
- Note: Entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system. Entry into the system will be required if maintenance is required.

Maintenance Procedures

It is recommended that maintenance occurs at least three days after the most recent rain event to allow for drain down of the system and any upstream detention systems designed to drain down over an extended period of time. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Once all safety measures have been set up cleaning of the system can proceed as follows:

- Using an extension on a boom on the vacuum truck, position the hose over the opened manway and lower into the system. Remove all floating debris, standing water (as needed) and sediment from the system. A power washer can be used to assist if sediments have become hardened and stuck to the walls and columns. Repeat the same procedure at each manway until the system has been fully maintained. Be sure not to pressure wash the infiltration area as it may scour.

If maintenance requires entry into the vault:

- Following rules for confined space entry use a gas meter to detect the presence of any hazardous gases. If hazardous gases are present do not enter the vault. Follow appropriate confined space procedures, such as utilizing venting system, to address the hazard. Once it is determined to be safe, enter utilizing appropriate entry equipment such as a ladder and tripod with harness.

- The last step is to close up and replace all manhole covers and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.

For Maintenance Services please contact Bio Clean at 760-433-7640, or email info@biocleanenvironmental.com.

APPENDIX D

Maintenance and Covenant Agreement

RECORDING REQUESTED BY
AND MAIL TO:

COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
BUILDING AND SAFETY DIVISION
900 S. FREMONT AVENUE, 3RD FLOOR
ALHAMBRA, CA 91803-1331

Space above this line is for Recorder's use

COVENANT AND AGREEMENT
REGARDING THE MAINTENANCE OF LOW IMPACT DEVELOPMENT (LID) & NATIONAL POLLUTANTS DISCHARGE ELIMINATION SYSTEM (NPDES) BMPs

The undersigned, Pannatoni Development Company, Inc. ("Owner"), hereby certifies that it owns the real property described as follows ("Subject Property"), located in the County of Los Angeles, State of California:

LEGAL DESCRIPTION

ASSESSOR'S ID # 7315-008-049 TRACT NO. _____ LOT NO. _____

ADDRESS: 2112 East 223rd Street, Carson, California 90248

Owner is aware of the requirements of County of Los Angeles' Green Building Standards Code, Title 3m Section 4.106.4 (LID), and the National Pollutant Discharge Elimination System (NPDES) permit. The following post-construction BMP features have been installed on the Subject Property:

- □ Porous pavement
- □ Cistern/rain barrel
- □ Infiltration trench/pit
- ☒ Bioretention or biofiltration
- □ Rain garden/planter box
- □ Disconnect impervious surfaces
- □ Dry Well
- □ Storage containers
- □ Landscape and landscape irrigation
- □ Green roof
- ☒ Other UrbanPond chambers for storing 1.5x SWQDv

The location, including GPS x-y coordinates, and type of each post-construction BMP feature installed on the Subject Property is identified on the site diagram attached hereto as Exhibit 1.

Owner hereby covenants and agrees to maintain the above-described post-construction BMP features in a good and operable condition at all times, and in accordance with the LID/NPDES Maintenance Guidelines, attached hereto as Exhibit 2.

Owner further covenants and agrees that the above-described post-construction BMP features shall not be removed from the Subject Property unless and until they have been replaced with other post-construction BMP features in accordance with County of Los Angeles' Green Building Standards Code, Title 31.

Owner further covenants and agrees that if Owner hereafter sells the Subject Property, Owner shall provide printed educational materials to the buyer regarding the post-construction BMP features that are located on the Subject Property, including the type(s) and location(s) of all such features, and instructions for properly maintaining all such features.

Owner makes this Covenant and Agreement on behalf of itself and its successors and assigns. This Covenant and Agreement shall run with the Subject Property and shall be binding upon Owner, future owners, and their heirs, successors and assignees, and shall continue in effect until the release of this Covenant and Agreement by the County of Los Angeles, in its sole discretion.

Owner(s):

By: _____ Date: _____

By: _____ Date: _____

A notary public or other officer completing the attached certificate verifies only the identity of the individual who signed the document to which the certificate is attached, and not the truthfulness, accuracy, or validity of that document.

(PLEASE ATTACH NOTARY)

FOR DEPARTMENT USE ONLY:

MUST BE APPROVED BY COUNTY OF LOS ANGELES BUILDING AND SAFETY DIVISION PRIOR TO RECORDING.

APPROVED BY: _____ _____ Date _____
(Print Name) (Signature)

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

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– 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.

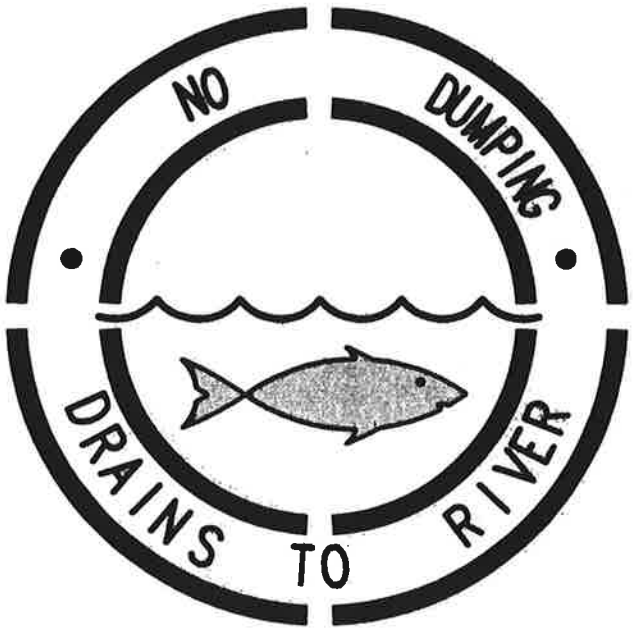
Other Resources

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.



SAMPLE STENCIL TO BE USED NEAR GRATE AND CURB OPENING INLETS

SYMBOL TO BE 24" IN DIAMETER

Thienes Engineering
CIVIL ENGINEERING • LAND SURVEYING
14349 FIRESTONE BOULEVARD
LA MIRADA, CALIFORNIA 90638
PH.(714)521-4811 FAX(714)521-4173

SAMPLE CATCH BASIN STENCIL
PER BMP SD-13

Drain Inserts MP-52

Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

California Experience

The number of installations is unknown but likely exceeds a thousand. Some users have reported that these systems require considerable maintenance to prevent plugging and bypass.

Advantages

- Does not require additional space as inserts as the drain inlets are already a component of the standard drainage systems.
- Easy access for inspection and maintenance.
- As there is no standing water, there is little concern for mosquito breeding.
- A relatively inexpensive retrofit option.

Limitations

Performance is likely significantly less than treatment systems that are located at the end of the drainage system such as ponds and vaults. Usually not suitable for large areas or areas with trash or leaves than can plug the insert.

Design and Sizing Guidelines

Refer to manufacturer's guidelines. Drain inserts come any many configurations but can be placed into three general groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are

Design Considerations

- Use with other BMPs
- Fit and Seal Capacity within Inlet

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- Bacteria
- ☑ Oil and Grease
- ☑ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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one box; that is, the setting area and filtration through media occurs in the same box. One manufacturer has a double-box. Stormwater enters the first box where setting occurs. The stormwater flows into the second box where the filter media is located. Some products consist of one or more trays or mesh grates. The trays can hold different types of media. Filtration media vary with the manufacturer: types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Construction/Inspection Considerations

Be certain that installation is done in a manner that makes certain that the stormwater enters the unit and does not leak around the perimeter. Leakage between the frame of the insert and the frame of the drain inlet can easily occur with vertical (drop) inlets.

Performance

Few products have performance data collected under field conditions.

Siting Criteria

It is recommended that inserts be used only for retrofit situations or as pretreatment where other treatment BMPs presented in this section area used.

Additional Design Guidelines

Follow guidelines provided by individual manufacturers.

Maintenance

Likely require frequent maintenance, on the order of several times per year.

Cost

- The initial cost of individual inserts ranges from less than $100 to about $2,000. The cost of using multiple units in curb inlet drains varies with the size of the inlet.
- The low cost of inserts may tend to favor the use of these systems over other, more effective treatment BMPs. However, the low cost of each unit may be offset by the number of units that are required, more frequent maintenance, and the shorter structural life (and therefore replacement).

References and Sources of Additional Information

Hrachovec, R., and G. Minton, 2001, Field testing of a sock-type catch basin insert, Planet CPR, Seattle, Washington

Interagency Catch Basin Insert Committee, Evaluation of Commercially-Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites, 1995

Larry Walker Associates, June 1998, NDMP Inlet/In-Line Control Measure Study Report

Manufacturers literature

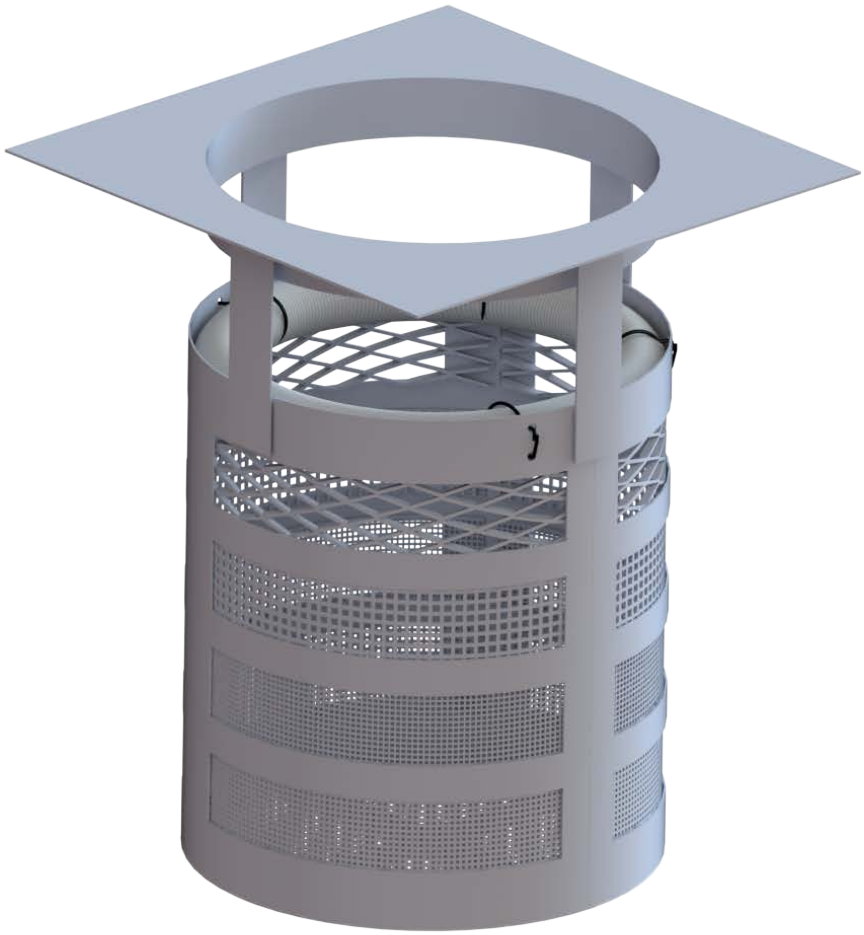
Santa Monica (City), Santa Monica Bay Municipal Stormwater/Urban Runoff Project - Evaluation of Potential Catch basin Retrofits, Woodward Clyde, September 24, 1998

Woodward Clyde, June 11, 1996, Parking Lot Monitoring Report, Santa Clara Valley Nonpoint Source Pollution Control Program.

Grate Inlet Filter
MLS Type

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



Bio Clean Environmental Services, Inc.
398 Via El Centro
Oceanside, CA 92058

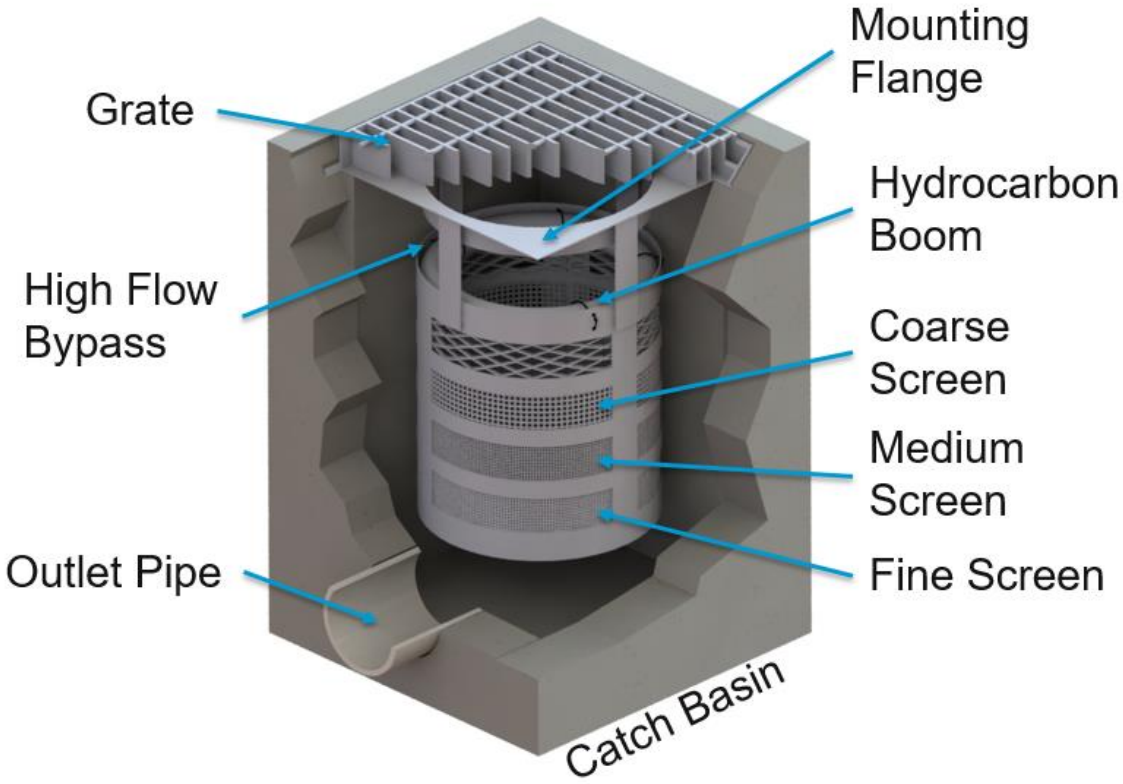
www.BioCleanEnvironmental.com
p: 760.433.7640
f: 760.433.3176

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE

The Bio Clean Grate Inlet Filter is a stormwater device designed to remove high levels of trash, debris, sediments and hydrocarbons. The filter is available in several configurations including trash full capture, multi-level screening, Kraken membrane filter and media filter variations. This manual covers maintenance procedures of the multi-level screening configuration. A supplemental manual is available for the trash full capture configuration, as well as the Kraken and media filter variations. This filter is made of 100% stainless steel and is available in various sizes and depths allowing it to fit in any grated catch basin inlet. The filter's heavy duty construction allows for cleaning with any vacuum truck. The filter can also easily be cleaned by hand.

As with all stormwater BMPs, inspection and maintenance on the Grate Inlet Filter is necessary. Stormwater regulations require BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.



System Diagram:

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the Grate Inlet Filter:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.

Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Grate Inlet Filter are quick and easy. As mentioned above, the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The Grate Inlet Filter can be inspected though visual observation. All necessary pre-inspection steps must be carried out before inspection occurs, such as safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open grated inlet. Once the grate has been safely removed the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the filter with the grate removed.
- Look for any out of the ordinary obstructions on the grate or in the filter and its bypass. Write down any observations on the inspection form.
- Through observation and/or digital photographs, estimate the amount of trash, foliage and sediment accumulated inside the filter basket. Record this information on the inspection form.
- Observe the condition and color of the hydrocarbon boom. Record this information on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the filter basket and its bypass.
- Excessive accumulation of trash, foliage and sediment in the filter basket. Maintenance is required when the basket is greater than half-full.
- The following chart shows the 50% and 100% storage capacity of each filter height:

Model	Filter Basket Diameter (in)	Filter Basket Height (in)	50% Storage Capacity (cu ft)	100% Storage Capacity (cu ft)
BC-GRATE-12-12-18	10.00	18.00	0.41	0.82
BC-GRATE-18-18-18	16.00	18.00	1.05	2.09
BC-GRATE-24-24-24	21.00	24.00	2.40	4.81
BC-GRATE-30-30-24	27.00	24.00	3.97	7.95
BC-GRATE-25-38-24	21.00	24.00	4.15	8.31
BC-GRATE-36-36-24	33.00	24.00	5.94	11.87
BC-GRATE-48-48-18	44.00	18.00	7.92	15.83

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the Curb Inlet Filter, though it can be easily cleaned by hand:

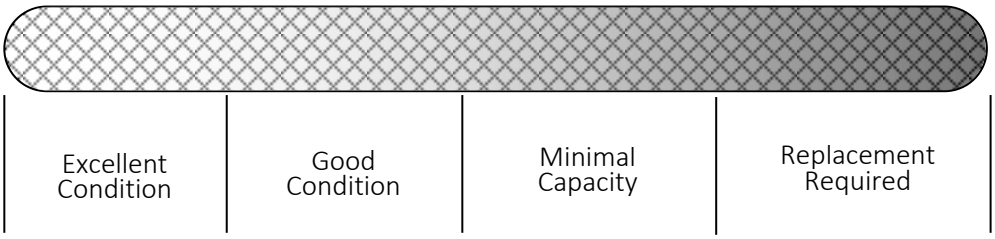
- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Manhole hook or appropriate tools to remove the grate.
- Appropriate safety signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system. Small or large vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

It is recommended that maintenance occurs at least two days after the most recent rain event to allow debris and sediments to dry out. Maintaining the system while flows are still entering it will

increase the time and complexity required for maintenance. Cleaning of the Grate Inlet Filter can be performed utilizing a vacuum truck. Once all safety measures have been set up, cleaning of the Grate Inlet Filter can proceed as followed:

- Remove grate (traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck, position the hose over the opened catch basin. Insert the vacuum hose down into the filter basket and suck out trash, foliage and sediment. A pressure wash is recommended and will assist in spraying off any debris stuck on the side or bottom of the filter basket. Power wash the sides and bottom of the filter basket off.
- Next, remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is zip tied to the top perimeter of the filter. Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required, install and fasten on a new hydrocarbon boom. Booms can be ordered directly from the manufacturer.
- The following is a replacement indication color chart for the hydrocarbon booms:



- The last step is to replace the grate and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered from the manufacturer. Hydrocarbon booms can also be ordered directly from the manufacturer as previously noted. NOTE: outlet to catch basin (if it does not have a sump) should be blocked during power washing to prevent any dirty water from discharging from the catch basin.

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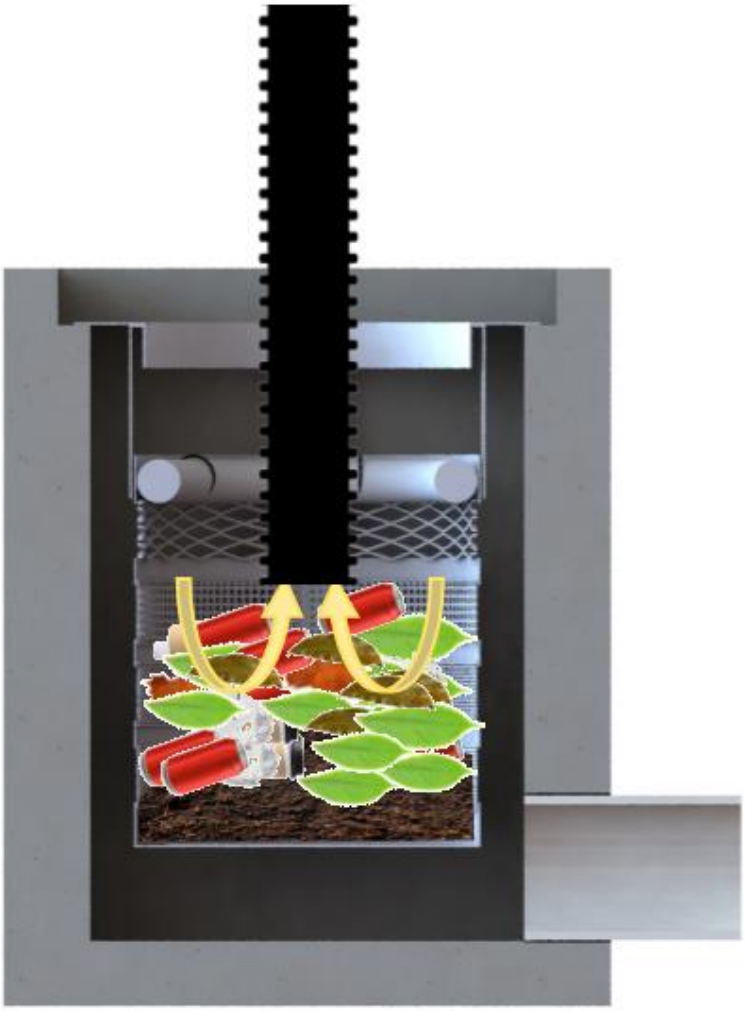
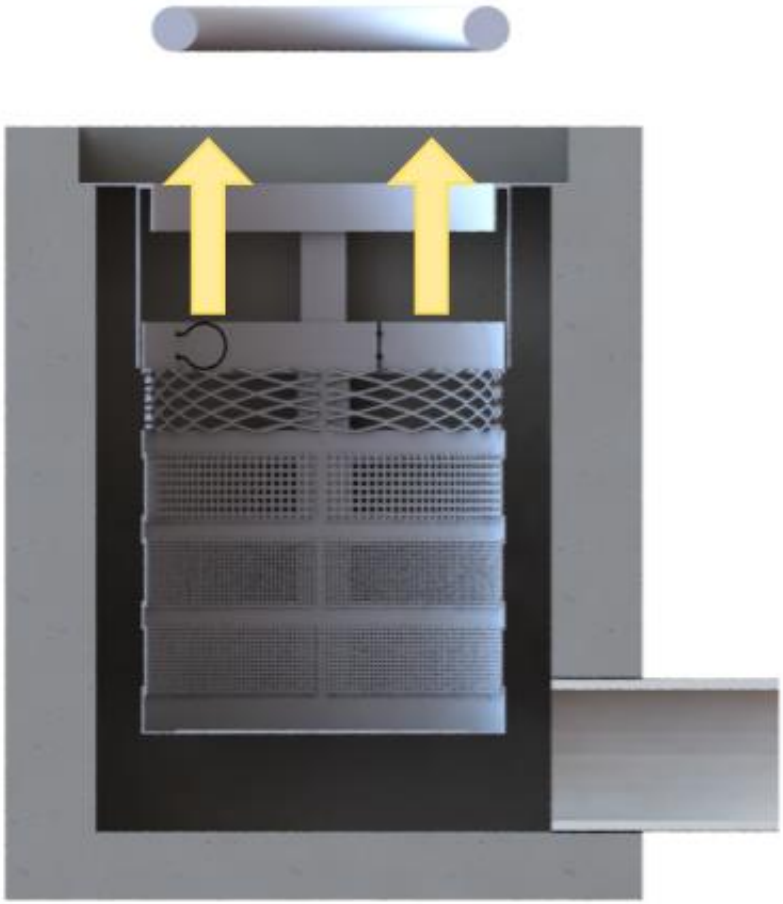
Maintenance Sequence

Remove grate and set up vacuum truck to clean the filter basket.



Insert the vacuum hose down into the filter basket and suck out debris. Use a pressure washer to assist in vacuum removal. Pressure wash off screens.



Remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is zip tied to the top perimeter of the filter. Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required, install and fasten on a new hydrocarbon boom.

Close up and replace the grate and remove all traffic control. All removed debris and pollutants shall be disposed of following local and state requirements.

For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email:
info@biocleanenvironmental.com

Bio Clean
A Forterra Company

Inspection and Maintenance Report
Catch Basin Only

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ ollow Up ☐ omplaint ☐ torm Storm Event in Last 72-hours? ☐) ☐ s

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

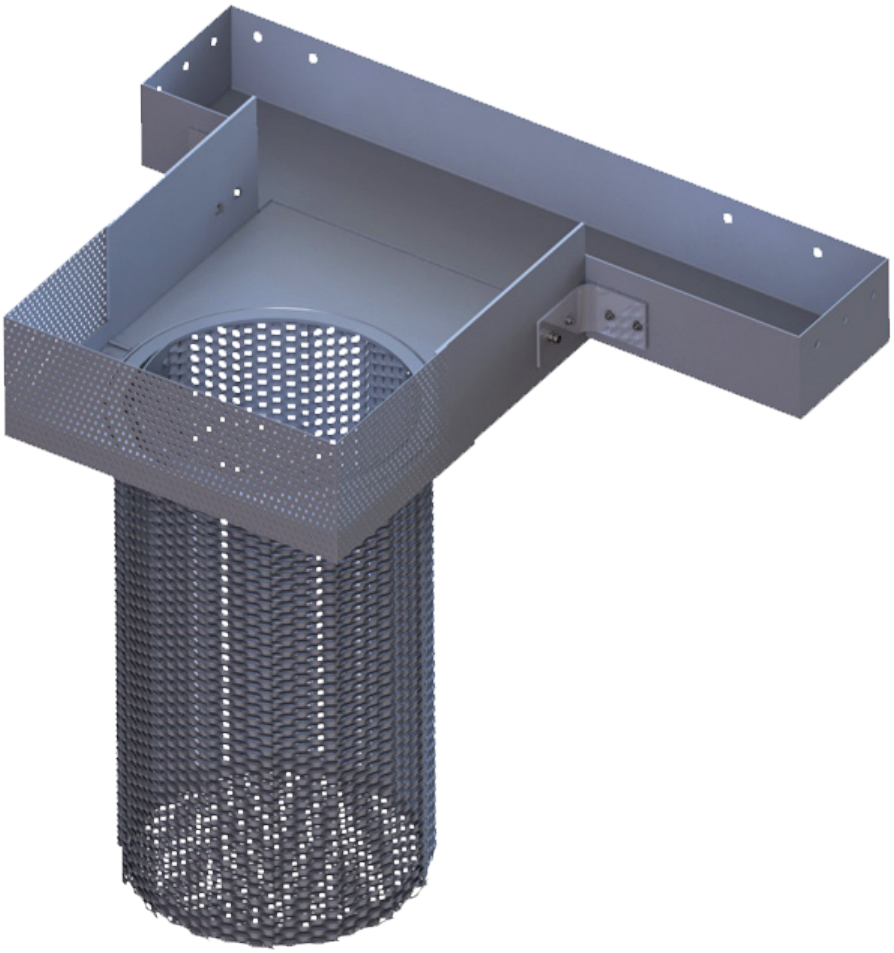
Site Map #	GPS Coordinates of Insert	Catch Basin Size	Evidence of Illicit Discharge?	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Signs of Structural Damage?	Functioning Properly or Maintenance Needed?
1	Lat: Long:							
2	Lat: Long:							
3	Lat: Long:							
4	Lat: Long:							
5	Lat: Long:							
6	Lat: Long:							
7	Lat: Long:							
8	Lat: Long:							
10	Lat: Long:							
11	Lat: Long:							
12	Lat: Long:							

Comments:

Curb Inlet Filter

Bio Clean
A Forterra Company

OPERATION & MAINTENANCE



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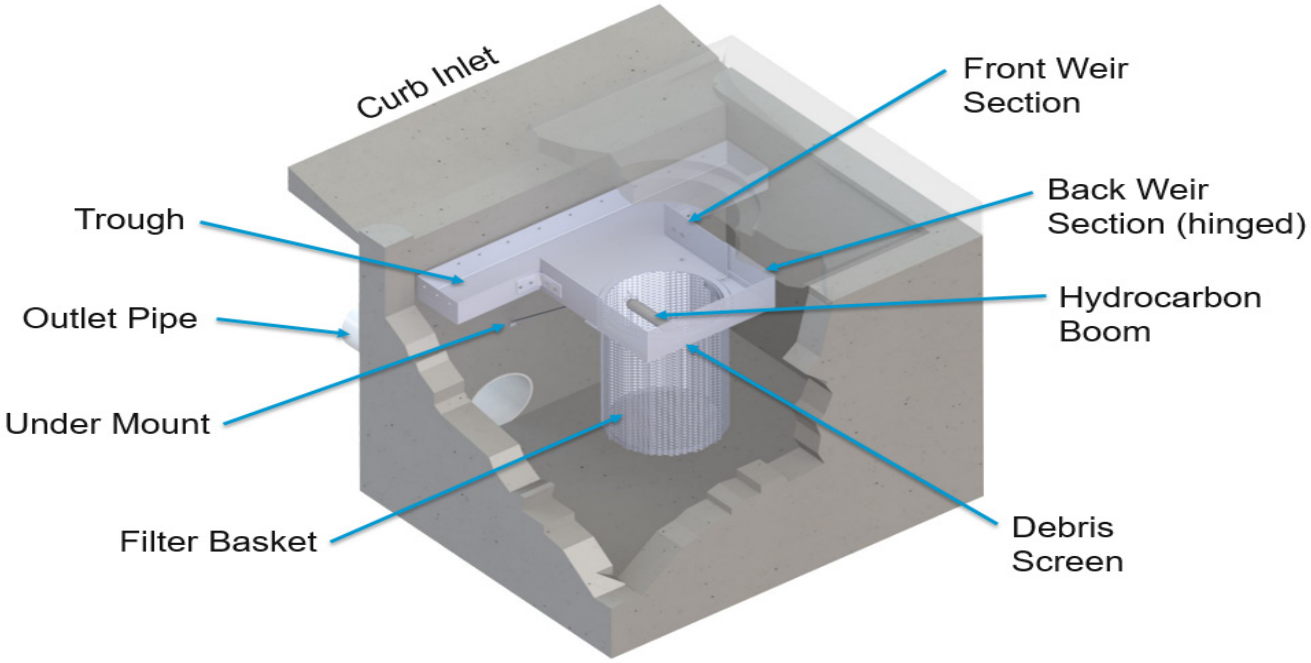
OPERATION & MAINTENANCE

The Bio Clean Curb Inlet Filter is a stormwater device designed to remove high levels of trash, debris, sediments and hydrocarbons. The filter is available in several configurations including trash full capture, multi-level screening, Kraken membrane filter and media filter variations. This manual covers maintenance procedures of the trash full capture and multi-level screening configurations. A supplemental manual is available for the Kraken and media filter variations. The innovative trough & weir system is mounted along the curb face and directs incoming stormwater toward the filter basket which is positioned "directly" under the manhole access opening regardless of its location in the catch basin. This innovative design allows the filter to be cleaned from finish surface without access into the catch basin, therefore drastically reducing maintenance time and eliminating confined space entry. The filter has a lifting handle allowing for the filter to be removed easily through the manhole. The weir also folds up to allow for unimpeded access into the basin for routine maintenance or pipe jetting.

As with all stormwater BMPs, inspection and maintenance on the Curb Inlet Filter is necessary. Stormwater regulations require BMPs be inspected and maintained to ensure they are operating as designed to allow for effective pollutant removal and provide protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess site-specific loading conditions. This is recommended because pollutant loading can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding of roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years. Without appropriate maintenance a BMP can exceed its storage capacity which can negatively affect its continued performance in removing and retaining captured pollutants.



System Diagram:

Bio Clean
A Forterra Company

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the Curb Inlet Filter:

- Bio Clean Environmental Inspection Form (contained within this manual).
- Manhole hook or appropriate tools to remove access hatches and covers.
- Appropriate traffic control signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections or maintenance of the system.

Inspection Steps

The core to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Curb Inlet Fitler are quick and easy. As mentioned above the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long-term inspection and maintenance interval requirements.

The Curb Inlet Filter can be inspected though visual observation without entry into the catch basin. All necessary pre-inspection steps must be carried out before inspection occurs, such as safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open access hatch or manhole. Once the manhole has been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other info (see inspection form).
- Observe the inside of the catch basin through the manhole. If minimal light is available and vision into the unit is impaired utilize a flashlight to see inside the catch basin.
- Look for any out of the ordinary obstructions in the catch basin, trough, weir, filter basket, basin floor our outlet pipe. Write down any observations on the inspection form.
- Through observation and/or digital photographs estimate the amount of trash, foliage and sediment accumulated inside the filter basket. Record this information on the inspection form.
- Observe the condition and color of the hydrocarbon boom. Record this information on the inspection form.

- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Missing or damaged internal components.
- Obstructions in the trough, weir, filter basket or catch basin.
- Excessive accumulation of trash, foliage and sediment in the filter basket and/or trough and weir sections. Maintenance is required when the basket is greater than half-full.
- The following chart shows the 50% and 100% storage capacity of each filter height:

Model	Filter Basket Diameter (in)	Filter Basket Height (in)	50% Storage Capacity (cu ft)	100% Storage Capacity (cu ft)
BC-CURB-30	18	30	2.21	4.42
BC-CURB-24	18	24	1.77	3.53
BC-CURB-18	18	18	1.33	2.65
BC-CURB-12	18	12	0.88	1.77

Maintenance Equipment

It is recommended that a vacuum truck be utilized to minimize the time required to maintain the Curb Inlet Filter though it can easily cleaned by hand:

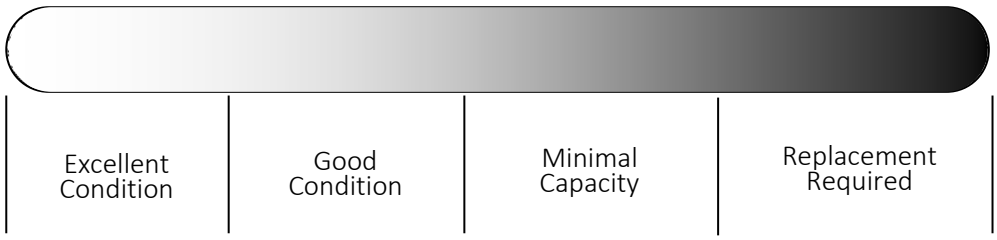
- Bio Clean Environmental Maintenance Form (contained in O&M Manual).
- Manhole hook or appropriate tools to access hatches and covers.
- Appropriate safety signage and procedures.
- Protective clothing and eye protection.
- Note: entering a confined space requires appropriate safety and certification. It is generally not required for routine maintenance of the system. Small or large vacuum truck (with pressure washer attachment preferred).

Maintenance Procedures

It is recommended that maintenance occurs at least two days after the most recent rain event to allow debris and sediments to dry out. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Cleaning of the Curb Inlet Filter can be performed from finish surface without entry into catch basin utilizing a vacuum truck. Some unique

and custom configurations may create conditions which would require entry for some or all of the maintenance procedures. Once all safety measures have been set up cleaning of the Curb Inlet Filter can proceed as followed:

- Remove all manhole cover or access hatches (traffic control and safety measures to be completed prior).
- Using an extension on a vacuum truck position the hose over the opened manhole or hatch opening. Insert the vacuum hose down into the filter basket and suck out trash, foliage and sediment. A pressure wash is recommended and will assist in spraying of any debris stuck on the side or bottom of the filter basket. If the filter basket is full, trash, sediment, and debris will accumulate inside the trough and weir sections of the system. Once the filter basket is clean power wash the weir and trough pushing these debris into the filter basket (leave the hose in the filter basket during this process so entering debris will be sucked out). Power wash off the trough, weir, debris screen, and filter basket sides and bottom.
- Next remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is fastened to rails on two opposite sides of the basket (vertical rails). Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required install and fasten on a new hydrocarbon boom. Booms can be ordered directly from the manufacturer.
- Follow is a replacement indication color chart for the hydrocarbon booms:



- The last step is to close up and replace the manhole or hatch and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.
- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.
- In the case of damaged components, replacement parts can be ordered from the manufacturer. Hydrocarbon booms can also be ordered directly from the manufacturer as previously noted.

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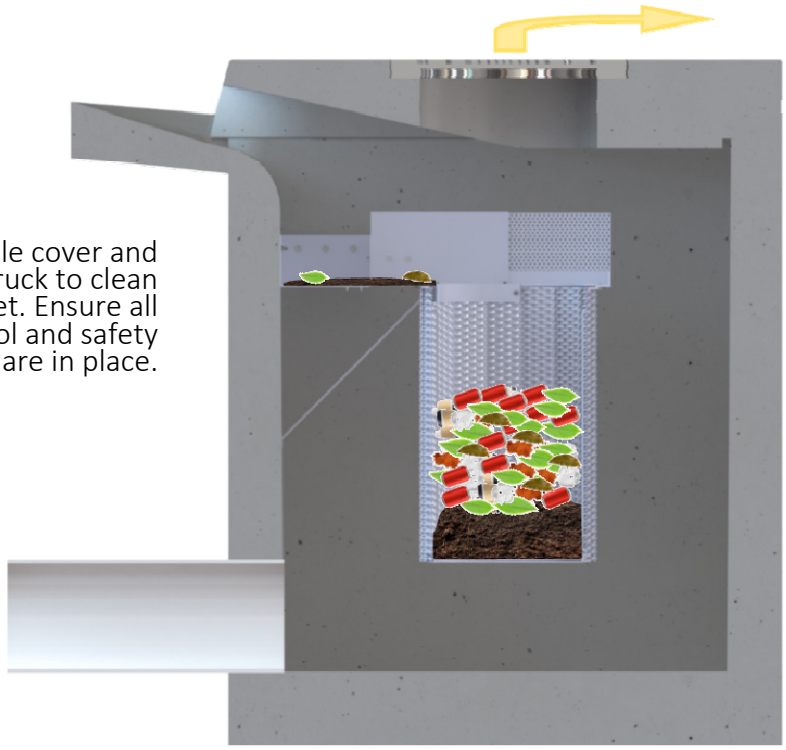
Maintenance Sequence

Remove manhole cover and set up vacuum truck to clean the filter basket. Ensure all traffic control and safety measures are in place.



Insert the vacuum hose down into the filter basket and suck out debris. Use a pressure washer to assist in vacuum removal. Pressure wash off the weir and trough and vacuum out any remaining debris.

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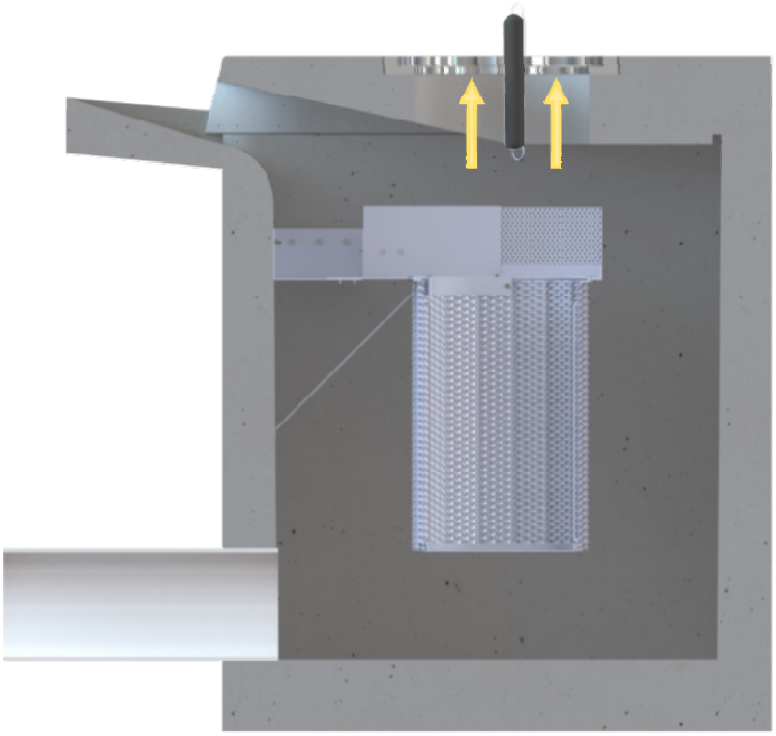
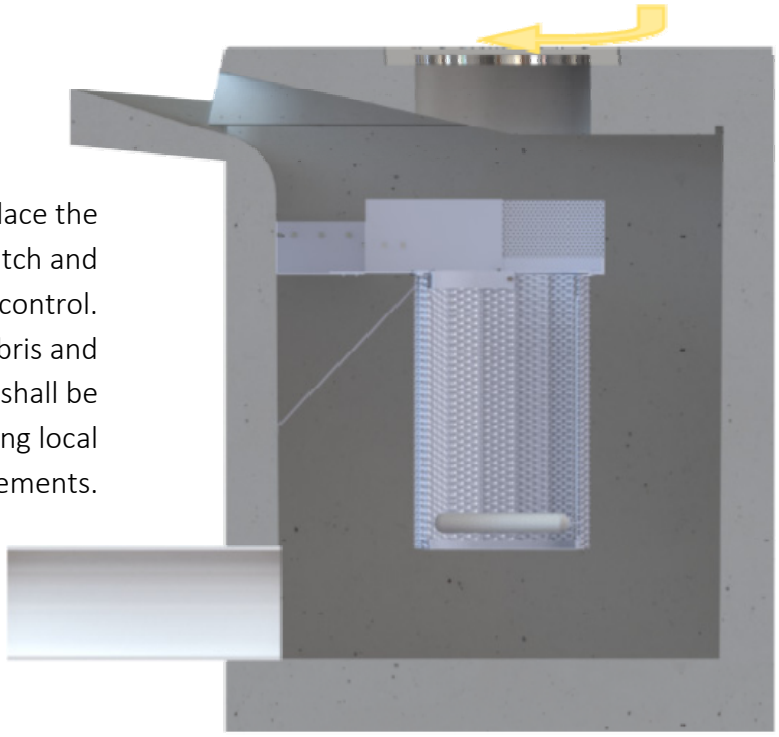


Remove the hydrocarbon boom that is attached to the inside of the filter basket. The hydrocarbon boom is fastened to rails on two opposite sides of the basket (vertical rails). Assess the color and condition of the boom using the following information in the next bullet point. If replacement is required install and fasten on a new hydrocarbon boom.

Close up and replace the manhole or hatch and remove all traffic control. All removed debris and pollutants shall be disposed of following local and state requirements.



For Maintenance Services or Information Please Contact Us At:
760-433-7640
Or Email: info@biocleanenvironmental.com

Bio Clean
A Forterra Company

Inspection and Maintenance Report
Catch Basin Only

Project Name _____

Project Address _____ (city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ollow Up ☐omplaint ☐torm Storm Event in Last 72-hours? ☐ ☐s

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Catch Basin Size	Evidence of Illicit Discharge?	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Signs of Structural Damage?	Functioning Properly or Maintenance Needed?
1	Lat: Long:							
2	Lat: Long:							
3	Lat: Long:							
4	Lat: Long:							
5	Lat: Long:							
6	Lat: Long:							
7	Lat: Long:							
8	Lat: Long:							
10	Lat: Long:							
11	Lat: Long:							
12	Lat: Long:							

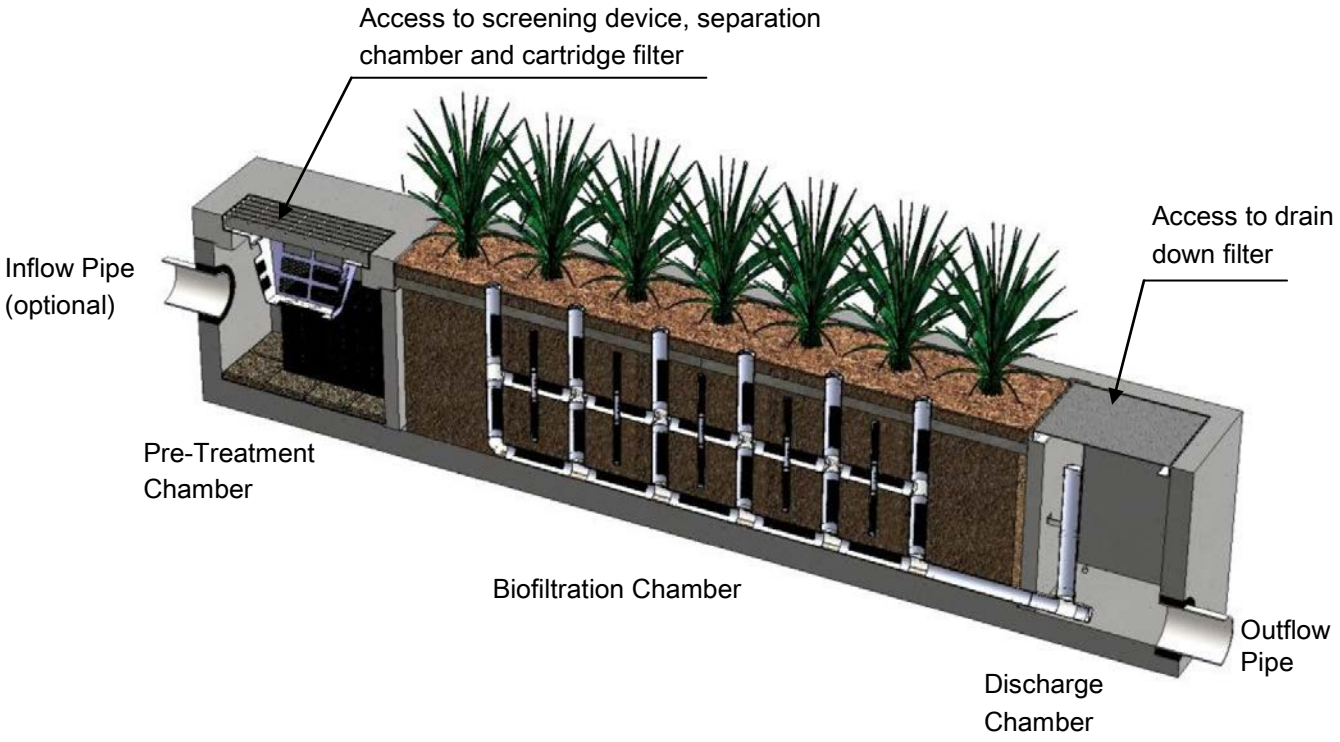
Comments:

Maintenance Guidelines for Modular Wetland System - Linear

Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - (*5 minute average service time*).
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - (*10 minute average service time*).
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - (*10-15 minute per cartridge average service time*).
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - (*5 minute average service time*).
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - (*Service time varies*).

System Diagram



Maintenance Procedures

Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.

Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.

2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.

3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.

4. Entry into chambers may require confined space training based on state and local regulations.

5. No fertilizer shall be used in the Biofiltration Chamber.

6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

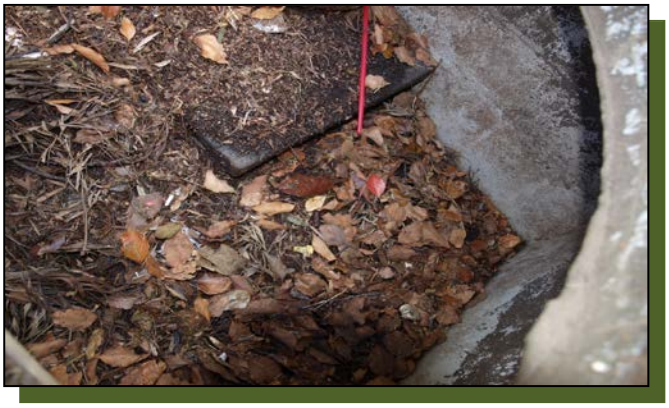
Maintenance Procedure Illustration

Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.

Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



Cartridge Filters

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.

Drain Down Filter

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.

Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.

Inspection Form

Bio Clean
P. 855-566-3938
F. 760-433-3176
E. Info@BioCleanEnvironmental.com

Bio Clean
A Forterra Company

Inspection Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ___/___/___ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): _____ Size (22', 14' or etc.): _____

Structural Integrity:	**Yes**	**No**	**Comments**
Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?			
Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?			
Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?			
Working Condition:			
Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?			
Is there standing water in inappropriate areas after a dry period?			
Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?			
Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber.			Depth:
Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?			Chamber:
Any signs of improper functioning in the discharge chamber? Note issues in comments section.			
Other Inspection Items:			
Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?			
Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.			
Is there a septic or foul odor coming from inside the system?			

Waste:	**Yes**	**No**
Sediment / Silt / Clay		
Trash / Bags / Bottles		
Green Waste / Leaves / Foliage		

Recommended Maintenance	
No Cleaning Needed	
Schedule Maintenance as Planned	
Needs Immediate Maintenance	

Plant Information	
Damage to Plants	
Plant Replacement	
Plant Trimming	

Additional Notes: _____

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Maintenance Report

Bio Clean
P. 855-566-3938
F. 760-433-3176
E. Info@BioCleanEnvironmental.com

Bio Clean
A Forterra Company

Cleaning and Maintenance Report
Modular Wetlands System

Project Name _____

Project Address _____
(city) (Zip Code)

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

For Office Use Only
(Reviewed By)
(Date)
Office personnel to complete section to the left.

Site Map #	GPS Coordinates of Insert	Manufacturer / Description / Sizing	Trash Accumulation	Foliage Accumulation	Sediment Accumulation	Total Debris Accumulation	Condition of Media 25/50/75/100 (will be changed @ 75%)	Operational Per Manufactures' Specifications (If not, why?)
	Lat: Long:	MWS Catch Basins						
		MWS Sedimentation Basin						
		Media Filter Condition						
		Plant Condition						
		Drain Down Media Condition						
		Discharge Chamber Condition						
		Drain Down Pipe Condition						
		Inlet and Outlet Pipe Condition						

Comments:

Bio Clean
A Forterra Company

UrbanPond™

A Stormwater Storage Solution

INSPECTION & MAINTENANCE MANUAL

5796 Armada Drive Suite 250 | Carlsbad, CA 92008 | 855.566.3938
stormwater@forterrabp.com | biocleanenvironmental.com

URBAN POND INSPECTION & MAINTENANCE

Inspection and maintenance of the Urban Pond underground detention, retention, or infiltration system is vital for the performance and life cycle of the stormwater management system. All local, state, and federal permits and regulations must be followed for system compliance. Manway access locations are provided on each system for ease of ingress and egress for routine inspection and maintenance activities. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed and providing protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess the site specific conditions. Inspection after the first significant rainfall event and at quarterly intervals is typical. This is recommended because pollutant loading and pollutant characteristics can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding on roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years to ensure appropriate maintenance is provided. Without appropriate maintenance a BMP can exceed its storage capacity, become blocked, or damaged, which can negatively affect its continued performance.

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the underground detention, retention, or infiltration system:

- Bio Clean Environmental Inspection and Maintenance Report Form
- Flashlight
- Manhole hook or appropriate tools to access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure
- Protective clothing and eye protection
- Note: Entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system.

Inspection Steps

The key to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the Urban Pond underground detention, retention, or infiltration system are quick and easy. As mentioned above, the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order

to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long term inspection and maintenance interval requirements.

The Urban Pond underground detention, retention, or infiltration system can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other information (see inspection form).
- Observe the upstream drainage area and look for sources of pollution, sediment, trash and debris.
- Observe the inside of the system through the access manholes. If minimal light is available and vision into the unit is impaired, utilize a flashlight to see inside the system and all of its modules.
- Look for any out of the ordinary obstructions in the inflow and outflow pipes. Check pipes for movement or leakage. Write down any observations on the inspection form.
- Observe any movement of modules.
- Observe concrete for cracks and signs of deterioration.
- In detention and retention systems inspect for any signs of leakage.
- In infiltration systems inspect for any signs of blockage or reasons that the soils are not infiltrating.
- Through observation and/or digital photographs, estimate the amount of floatable debris accumulated in the system. Record this information on the inspection form. Next, utilizing a tape measure or measuring stick, estimate the amount of sediment accumulated in the system. Sediment depth may vary throughout the system, depending on the flow path. Record this depth on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Damaged inlet and outlet pipes.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatables.
- Excessive accumulation of sediment of more than 6” in depth.
- Damaged joint sealant.

Maintenance Equipment

While maintenance can be done fully by hand it is recommended that a vacuum truck be utilized to minimize time requirements required to maintain the Urban Pond underground detention, retention, or infiltration system:

- Bio Clean Environmental Inspection and Maintenance Report Form
- Flashlight
- Manhole hook or appropriate tools to access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure
- Protective clothing and eye protection
- Vacuum truck
- Trash can
- Pressure washer
- Note: Entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system. Entry into the system will be required if maintenance is required.

Maintenance Procedures

It is recommended that maintenance occurs at least three days after the most recent rain event to allow for drain down of the system and any upstream detention systems designed to drain down over an extended period of time. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Once all safety measures have been set up cleaning of the system can proceed as follows:

- Using an extension on a boom on the vacuum truck, position the hose over the opened manway and lower into the system. Remove all floating debris, standing water (as needed) and sediment from the system. A power washer can be used to assist if sediments have become hardened and stuck to the walls and columns. Repeat the same procedure at each manway until the system has been fully maintained. Be sure not to pressure wash the infiltration area as it may scour.

If maintenance requires entry into the vault:

- Following rules for confined space entry use a gas meter to detect the presence of any hazardous gases. If hazardous gases are present do not enter the vault. Follow appropriate confined space procedures, such as utilizing venting system, to address the hazard. Once it is determined to be safe, enter utilizing appropriate entry equipment such as a ladder and tripod with harness.

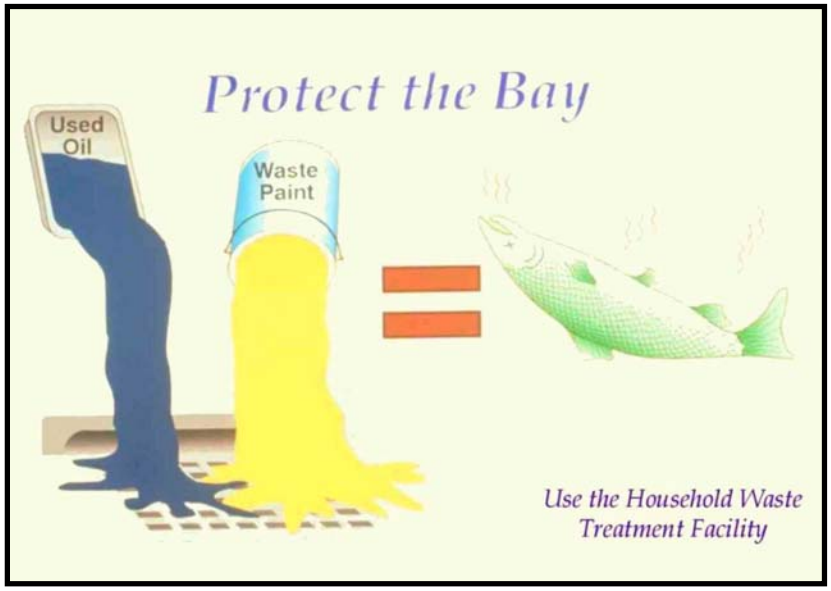
- The last step is to close up and replace all manhole covers and remove all traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.

For Maintenance Services please contact Bio Clean at 760-433-7640, or email info@biocleanenvironmental.com.

APPENDIX E

Educational Materials

Non-Stormwater Discharges SC-10



Art Credit: Margie Winter

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

CASQA California Stormwater Quality Association

Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms
  - Educational materials

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for a day or two following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

Review Infield Piping

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.
- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

Dye Testing

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Document and report annually the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots

- Types and quantities (in some cases) of wastes
- Patterns in time of occurrence (time of day/night, month, or year)
- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

- Facilities subject to stormwater permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The State's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

- Responsible parties

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan (Health & Safety Code Chapter 6.67).

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Outdoor Loading/Unloading SC-30

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

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Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:

  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.

  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Outdoor Equipment Operations SC-32

Description

Outside process equipment operations and maintenance can contaminate stormwater runoff. Activities, such as grinding, painting, coating, sanding, degreasing or parts cleaning, landfills and waste piles, solid waste treatment and disposal, are examples of process operations that can lead to contamination of stormwater runoff. Source controls for outdoor process equipment operations and maintenance include reducing the amount of waste created, enclosing or covering all or some of the equipment, installing secondary containment, and training employees.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Approach

Pollution Prevention

- Perform the activity during dry periods.
- Use non-toxic chemicals for maintenance and minimize or eliminate the use of solvents.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Suggested Protocols

- Consider enclosing the activity in a building and connecting the floor drains to the sanitary sewer.
- Cover the work area with a permanent roof if possible.
- Minimize contact of stormwater with outside process equipment operations through berming and drainage routing (run-on prevention). If possible, connect process equipment area to public sewer or facility wastewater treatment system. Some municipalities require that secondary containment areas be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.
- Dry clean the work area regularly.

Training

- Train employees to perform the activity during dry periods only or substituting benign materials for more toxic ones.
- Train employee and contractors in proper techniques for spill containment and cleanup. Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.

- Have employees trained in emergency spill cleanup procedures present when dangerous waste, liquid chemicals, or other wastes are delivered.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Prevent operator errors by using engineering safe guards and thus reducing accidental releases of pollutant.
- Inspect storage areas regularly for leaks or spills. Also check for structural failure, spills and overfills due to operator error, and/or failure of piping system.

Other Considerations

- Providing cover may be expensive.
- Space limitations may preclude enclosing some equipment.
- Storage sheds often must meet building and fire code requirements.

Requirements

Costs

Costs vary depending on the complexity of the operation and the amount of control necessary for stormwater pollution control.

Maintenance

- Conduct routine preventive maintenance, including checking process equipment for leaks.
- Clean the storm drain system regularly.

Supplemental Information

Further Detail of the BMP

Hydraulic/Treatment Modifications

If stormwater becomes polluted, it should be captured and treated. If you do not have your own process wastewater treatment system, consider discharging to the public sewer system. Use of the public sewer might be allowed under the following conditions:

- If the activity area is very small (less than a few hundred square feet), the local sewer authority may be willing to allow the area to remain uncovered with the drain connected to the public sewer.
- It may be possible under unusual circumstances to connect a much larger area to the public sewer, as long as the rate of stormwater discharges does not exceed the capacity of the wastewater treatment plant. The stormwater could be stored during the storm and then transferred to the public sewer when the normal flow is low, such as at night.

Industries that generate large volumes of process wastewater typically have their own treatment system and corresponding permit. These industries have the discretion to use their wastewater treatment system to treat stormwater within the constraints of their permit requirements for process treatment. It may also be possible for the industry to discharge the stormwater directly to an effluent outfall without treatment as long as the total loading of the discharged process

water and stormwater does not exceed the loading had a stormwater treatment device been used. This could be achieved by reducing the loading from the process wastewater treatment system. Check with your Regional Water Quality Control Board or local sewering agency, as this option would be subject to permit constraints and potentially regular monitoring.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net

Waste Handling & Disposal SC-34

Photo Credit: Geoff Brosseau

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Approach

Pollution Prevention

- Accomplish reduction in the amount of waste generated using the following source controls:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

CASQA California Stormwater Quality Association

Suggested Protocols

General

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

Waste Collection

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc., may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

Good Housekeeping

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g., sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.

Chemical/Hazardous Wastes

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers and protect them from vandalism.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- Stencil or demarcate storm drains on the facility's property with prohibitive message regarding waste disposal.

Run-on/Runoff Prevention

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropyleneor hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

Inspection

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.

- Repair leaking equipment including valves, lines, seals, or pumps promptly.

Training

- Train staff in pollution prevention measures and proper disposal methods.
- Train employees and contractors in proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
- Train employees and subcontractors in proper hazardous waste management.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Have an emergency plan, equipment and trained personnel ready at all times to deal immediately with major spills
- Collect all spilled liquids and properly dispose of them.
- Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- Ensure that vehicles transporting waste have spill prevention equipment that can prevent spills during transport. Spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

Other Considerations (Limitations and Regulations)

Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Requirements

Costs

Capital and O&M costs for these programs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

Maintenance

- None except for maintaining equipment for material tracking program.

Supplemental Information

Further Detail of the BMP

Land Treatment System

Minimize runoff of polluted stormwater from land application by:

- Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, and there is a closed drainage system

- Avoiding application of waste to the site when it is raining or when the ground is saturated with water
- Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site
- Maintaining adequate barriers between the land application site and the receiving waters (planted strips are particularly good)
- Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins
- Performing routine maintenance to ensure the erosion control or site stabilization measures are working

Examples

The port of Long Beach has a state-of-the-art database for identifying potential pollutant sources, documenting facility management practices, and tracking pollutants.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety. Harvard University. 2002.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Safer Alternative Products SC-35

Description

Promote the use of less harmful products and products that contain little or no TMDL pollutants. Alternatives exist for most product classes including chemical fertilizers, pesticides, cleaning solutions, janitorial chemicals, automotive and paint products, and consumables (batteries, fluorescent lamps).

Approach

Pattern a new program after the many established programs around the state and country. Integrate this best management practice as much as possible with existing programs at your facility.

Develop a comprehensive program based on:

- The "Precautionary Principle," which is an alternative to the "Risk Assessment" model that says it's acceptable to use a potentially harmful product until physical evidence of its harmful effects are established and deemed too costly from an environmental or public health perspective. For instance, a risk assessment approach might say it's acceptable to use a pesticide until there is direct proof of an environmental impact. The Precautionary Principle approach is used to evaluate whether a given product is safe, whether it is really necessary, and whether alternative products would perform just as well.
- Environmentally Preferable Purchasing Program to minimize the purchase of products containing hazardous ingredients used in the facility's custodial services, fleet maintenance, and facility maintenance in favor of using alternate products that pose less risk to employees and to the environment.
- Integrated Pest Management (IPM) or Less-Toxic Pesticide Program, which uses a pest management approach that minimizes the use of toxic chemicals and gets rid of pests by methods that pose a lower risk to employees, the public, and the environment.
- Energy Efficiency Program including no-cost and low-cost energy conservation and efficiency actions that can reduce both energy consumption and electricity bills, along with long-term energy efficiency investments.

Consider the following mechanisms for developing and implementing a comprehensive program:

- Policies

Objectives

- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

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- Procedures
  - Standard operating procedures (SOPs)
  - Purchasing guidelines and procedures
  - Bid packages (services and supplies)
- Materials
  - Preferred or approved product and supplier lists
  - Product and supplier evaluation criteria
  - Training sessions and manuals
  - Fact sheets for employees

Implement this BMP in conjunction with the Vehicle and Equipment Management fact sheets (SC20 – SC22) and SC41, Building and Grounds Maintenance.

Training

- Employees who handle potentially harmful materials in the use of safer alternatives.
- Purchasing departments should be encouraged to procure less hazardous materials and products that contain little or no harmful substances or TMDL pollutants.

Regulations

This BMP has no regulatory requirements. Existing regulations already encourage facilities to reduce the use of hazardous materials through incentives such as reduced:

- Specialized equipment storage and handling requirements,
- Storm water runoff sampling requirements,
- Training and licensing requirements, and
- Record keeping and reporting requirements.

Equipment

- There are no major equipment requirements to this BMP.

Limitations

- Alternative products may not be available, suitable, or effective in every case.

Requirements

Cost Considerations

- The primary cost is for staff time to: 1) develop new policies and procedures and 2) educate purchasing departments and employees who handle potentially harmful materials about the availability, procurement, and use of safer alternatives.

- Some alternative products may be slightly more expensive than conventional products.

Supplemental Information

Employees and contractors / service providers can both be educated about safer alternatives by using information developed by a number of organizations including the references and resources listed below.

The following discussion provides some general information on safer alternatives. More specific information on particular hazardous materials and the available alternatives may be found in the references and resources listed below.

- Automotive products – Less toxic alternatives are not available for many automotive products, especially engine fluids. But there are alternatives to grease lubricants, car polishes, degreasers, and windshield washer solution. Rerefined motor oil is also available.
- Vehicle/Trailer lubrication – Fifth wheel bearings on trucks require routine lubrication. Adhesive lubricants are available to replace typical chassis grease.
- Cleaners – Vegetables-based or citrus-based soaps are available to replace petroleum-based soaps/detergents.
- Paint products – Water-based paints, wood preservatives, stains, and finishes are available.
- Pesticides – Specific alternative products or methods exist to control most insects, fungi, and weeds.
- Chemical Fertilizers – Compost and soil amendments are natural alternatives.
- Consumables – Manufacturers have either reduced or are in the process of reducing the amount of heavy metals in consumables such as batteries and fluorescent lamps. All fluorescent lamps contain mercury, however low-mercury containing lamps are now available from most hardware and lighting stores. Fluorescent lamps are also more energy efficient than the average incandescent lamp.
- Janitorial chemicals – Even biodegradable soap can harm fish and wildlife before it biodegrades. Biodegradable does not mean non-toxic. Safer products and procedures are available for floor stripping and cleaning, as well as carpet, glass, metal, and restroom cleaning and disinfecting.

Examples

There are a number of business and trade associations, and communities with effective programs. Some of the more prominent are listed below in the references and resources section.

References and Resources

Note: Many of these references provide alternative products for materials that typically are used inside and disposed to the sanitary sewer as well as alternatives to products that usually end up in the storm drain.

General Sustainable Practices and Pollution Prevention Including Pollutant-Specific Information

California Department of Toxic Substances Control (www.dtsc.ca.gov)

California Integrated Waste Management Board (www.ciwmb.ca.gov)

City of Santa Monica (www.santa-monica.org/environment)

City of Palo Alto (www.city.palo-alto.ca.us/cleanbay)

City and County of San Francisco, Department of the Environment (www.ci.sf.ca.us/sfenvironment)

Earth 911 (www.earth911.org/master.asp)

Environmental Finance Center Region IX (www.greenstart.org/efc9)

Flex Your Power (www.flexyourpower.ca.gov)

GreenBiz.com (www.greenbiz.com)

Green Business Program (www.abag.org/bayarea/enviro/gbus/gb.html)

Pacific Industrial and Business Association (www.piba.org)

Sacramento Clean Water Business Partners (www.sacstormwater.org)

USEPA BMP fact sheet – Alternative products (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/poll_2.cfm)

USEPA Region IX Pollution Prevention Program (www.epa.gov/region09/p2)

Western Regional Pollution Prevention Network (www.westp2net.org)

Metals (mercury, copper)

National Electrical Manufacturers Association - Environment, Health and Safety (www.nema.org)

Sustainable Conservation (www.suscon.org)

- Auto Recycling Project
- Brake Pad Partnership

Pesticides and Chemical Fertilizers

Bio-Integral Resource Center (www.birc.org)

California Department of Pesticide Regulation (www.cdpr.ca.gov)

University of California Statewide IPM Program (www.ipm.ucdavis.edu/default.html)

Dioxins

Bay Area Dioxins Project (http://dioxin.abag.ca.gov/)

Building & Grounds Maintenance SC-41

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building Repair and Construction SC-42

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Recycle

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Modifications are common particularly at large industrial sites. The activity may vary from minor and normal building repair to major remodeling, or the construction of new facilities. These activities can generate pollutants including solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos installation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

Approach

Pollution Prevention

- Recycle residual paints, solvents, lumber, and other materials to the maximum extent practical.
- Buy recycled products to the maximum extent practical.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contract to ensure certain proper housekeeping and disposal practices are implemented.

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- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

Suggested Protocols

Repair & Remodeling

- Follow BMPs identified in Construction BMP Handbook.
- Maintain good housekeeping practices while work is underway.
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Cover materials of particular concern that must be left outside, particularly during the rainy season.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store materials properly that are normally used in repair and remodeling such as paints and solvents.
- Sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout if when repairing roofs, small particles have accumulated in the gutter. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck, and clean the catch basin sump where you placed the plug.
- Properly store and dispose waste materials generated from construction activities. See Construction BMP Handbook.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed.

Painting

- Enclose painting operations consistent with local air quality regulations and OSHA.
- Local air pollution regulations may, in many areas of the state, specify painting procedures which if properly carried out are usually sufficient to protect water quality.
- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.

- Do not transfer or load paint near storm drain inlets.
- Plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete when there is significant risk of a spill reaching storm drains.
- Cover nearby storm drain inlets prior to starting work if sand blasting is used to remove paint.
- Use a ground cloth to collect the chips if painting requires scraping or sand blasting of the existing surface. Dispose the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- Clean the application equipment in a sink that is connected to the sanitary sewer if using water based paints.
- Capture all cleanup-water and dispose of properly.
- Dispose of paints containing lead or tributyl tin and considered a hazardous waste properly.
- Store leftover paints if they are to be kept for the next job properly, or dispose properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

Training

Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employees can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

Limitations

- This BMP is for minor construction only. The State's General Construction Activity Stormwater Permit has more requirements for larger projects. The companion "Construction Best Management Practice Handbook" contains specific guidance and best management practices for larger-scale projects.
- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Be certain that actions to help stormwater quality are consistent with Cal- and Fed-OSHA and air quality regulations.

SC-42 Building Repair and Construction

Requirements

Costs

These BMPs are generally low to modest in cost.

Maintenance

N/A

Supplemental Information

Further Detail of the BMP

Soil/Erosion Control

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction Best Management Practice Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated or Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If because of the remodeling a new drainage system is to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective "in-line" treatment devices. See Treatment Control Fact Sheet TC-20 Wet Pond/Basin in Section 5 of the New Development and Redevelopment Handbook regarding design criteria. Include in the catch basin a "turn-down" elbow or similar device to trap floatables.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Drain Insert MP-52

General Description

Drain inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris. There are a multitude of inserts of various shapes and configurations, typically falling into one of three different groups: socks, boxes, and trays. The sock consists of a fabric, usually constructed of polypropylene. The fabric may be attached to a frame or the grate of the inlet holds the sock. Socks are meant for vertical (drop) inlets. Boxes are constructed of plastic or wire mesh. Typically a polypropylene "bag" is placed in the wire mesh box. The bag takes the form of the box. Most box products are one box; that is, the setting area and filtration through media occur in the same box. Some products consist of one or more trays or mesh grates. The trays may hold different types of media. Filtration media vary by manufacturer. Types include polypropylene, porous polymer, treated cellulose, and activated carbon.

Inspection/Maintenance Considerations

Washout problems increase with rain intensity. Susceptibility of accumulated sediments to be re-suspended at low flow rates, can be corrected with an energy dissipater between gate and treatment areas.

Inspection Activities	Suggested Frequency
■ Inspect for sediment buildup and proper functioning.	At the beginning of the wet season and after significant storms
■ Verify that stormwater enters the unit and does not leak around the perimeter.	After construction.
Maintenance Activities	**Suggested Frequency**
■ Remove sediment as needed.	At the beginning of the wet season and as necessary

Maintenance Concerns, Objectives, and Goals

■ Sediment Removal

Targeted Constituents

- ✓ Sediment
- ✓ Nutrients
- ✓ Trash
- ✓ Metals
- Bacteria
- ✓ Oil and Grease
- ✓ Organics

Removal Effectiveness

See New Development and Redevelopment Handbook-Section 5.

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.

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- 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

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– 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.

Maintenance Bays & Docks SD-31

Design Objectives

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

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for vehicle maintenance and repair 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 requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

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- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.

- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.

- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.

- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.

- Other features may be comparable and equally effective.

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

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

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.

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- 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.

APPENDIX F

Infiltration Feasibility

PHASE I ENVIRONMENTAL SITE ASSESSMENT

Former Stauffer Chemical Company Facility
2112 East 223rd Street
Carson, California 90745

November 22, 2019

PREPARED FOR

Panattoni Development Company, Inc.
7887 East Belleview Avenue, Suite 475
Denver, Colorado 80111

PREPARED BY

Avocet Environmental, Inc.
1 Technology Drive, Suite C515
Irvine, California 92618-5302

Project No. 1362.005

AVOCET ENVIRONMENTAL, INC.

EXECUTIVE SUMMARY

This report documents a Phase I environmental site assessment (ESA) for the approximately 14-acre[1] Stauffer Management Company LLC (SMC) property at 2212 East 223rd Street in Carson, California (the site). Between 1959 and 1982, the now vacant site was a polyvinyl chloride (PVC) manufacturing facility (the facility) operated by American Chemical Company and Stauffer Chemical Company (Stauffer). As a result of PVC manufacturing operations, soil and groundwater beneath the site are contaminated with volatile organic compounds (VOCs) and the site is subject to a consent order with the California Department of Toxic Substances Control (DTSC). Soil remediation at the former Stauffer facility has been completed, although significant residual contamination remains at depth, and groundwater remediation is ongoing. Because of the residual soil contamination, the site is "deed-restricted" through a land use covenant (LUC).

Avocet Environmental, Inc. (Avocet) conducted this Phase I ESA in general accordance with the scope and limitations of ASTM International (ASTM) Standard E1527-13 while recognizing that the site is contaminated, is subject to the DTSC consent order and a LUC, but is "mature" in having undergone approximately 37 years of subsurface investigation and remediation. Moreover, the Phase I ESA recognizes that Stauffer's successor in interest is responsible for soil and groundwater contamination related to its former operations and the potential future consequences thereof. This report updates and supersedes Avocet's February 16, 2014 draft Phase I ESA report for the subject site.

SUMMARY OF SITE HISTORY AND OPERATIONS

The approximately 14-acre SMC property was first developed in 1958 by American Chemical Company as a PVC manufacturing facility. Prior to 1958, the property and much of the surrounding area had been agricultural. American Chemical Company was a joint venture between Stauffer and ARCO, although Stauffer purchased ARCO's interest in 1974 and thereafter was the sole owner/operator until PVC manufacturing operations ceased in 1982. American Chemical Company and Stauffer produced PVC resin utilizing ethylene chloride, ethylene dichloride (EDC, aka 1,2-dichloroethane or 1,2-DCA) and vinyl chloride monomer (VCM) as manufacturing intermediates. The original manufacturing plant was located in the southwest corner of the SMC property, in what became known as Area 1, with the remainder (Area 2) occupied by office and support buildings or vacant. In 1961, 1964, and 1971, the plant was expanded eastward, eventually occupying all of the SMC property. In 1978, Stauffer expanded the plant again into the adjoining former Coon Trust property (Area 3) to the east. In addition to numerous aboveground storage tanks (ASTs) for raw materials, intermediary and finished products, and waste products, the SMC property featured three underground storage tanks (USTs) in which leaded gasoline and waste oil were stored. All three of these USTs were permanently closed by removal in 1993 and are covered by a "no further action" (NFA) letter

[1] The acreages and measurements provided in this report are approximate only and have not been independently verified by Avocet unless specifically indicated otherwise.

issued by the Los Angeles County Department of Public Works (LACoDPW). The facility also included wastewater treatment facilities in which wastewater, and later surface water runoff, was treated prior to discharge to the sanitary sewer system. Avocet has not been able to determine the type (e.g., tiered permit) and status (e.g., active or closed with no outstanding obligations) of the permit under which treated wastewater was discharged to the sanitary sewer. In 1982, Stauffer ceased manufacturing PVC resin and, over the next few years, demolished and removed its former infrastructure "to grade," leaving foundations and other subsurface features, including pipelines, in place. No use has been made of the SMC property since Stauffer terminated PVC manufacturing operations in 1982.

American Chemical Company and Stauffer manufacturing operations resulted in very significant impacts to vadose zone soil and groundwater. The principal contaminants include 1,2-DCA, vinyl chloride (VC), and trichloroethylene. Consistent with the concentration of manufacturing infrastructure, most of the soil impacts were beneath the SMC property; however, migration in the subsurface resulted in localized vadose zone impacts beneath the adjoining former Coon Trust property. The highest contaminant concentrations in groundwater were in the uppermost water-bearing zone, dubbed Unit A, but groundwater in three deeper water-bearing zones has also been impacted. Laterally, contaminants in groundwater have migrated from the SMC property beneath neighboring properties, many of which have their own groundwater contamination issues, and beneath the former Coon Trust property. After characterizing subsurface conditions, SMC remediated vadose zone soil using high-vacuum vapor liquid extraction (VLE) between 1998 and 2011. In its 13 years of operation, the VLE system is estimated to have removed 300,810 pounds of contaminant mass from the subsurface; however, significant residual contamination remains in fine-grained, saturated soils between 25 and 35 feet below ground surface (bgs), mostly beneath the central process area in Area 2. Soil VOC concentrations in the upper 15 feet of the vadose zone were below the target cleanup levels at the end of the VLE remediation effort. Residual 1,2-DCA and VC isoconcentrations in soil at different depth intervals, as interpreted by AECOM (Appendix B), are presented in Figures 5 and 6, respectively. Because of the residual contamination in soil between 25 and 35 feet bgs, the SMC property has been deed-restricted via a recorded LUC. The LUC for the SMC property prohibits residential and sensitive land uses and requires vapor barriers beneath new buildings unless DTSC accepts "analysis" that indicates they are unnecessary. After the LUC for the SMC property was recorded, DTSC certified the soil remediation effort.

Groundwater remediation using enhanced *in-situ* bioremediation (EISB) was initiated at the former Stauffer facility in 2011 and is ongoing. EISB involves extracting contaminated groundwater from wells along the hydraulically downgradient (western) boundary of the SMC property, amending it with electron donors and nutrients, and then reinjecting it via hydraulically upgradient injection wells located along the northern and eastern boundary of the subject site and the eastern boundary of the adjoining City of Carson property. It is noted that extracted groundwater is not treated to remove VOCs prior to being reinjected. It is further noted that the easement recorded to accommodate the EISB infrastructure will be required until remediation is completed. The duration of the EISB effort is not known but will probably be at least five years.

S:\GIS\1362 Former Stauffer Chemical\1362.005 Ph 1 ESA Update 2112 E 223rd\ArcMapDocuments\001 1362.005 Location Map.mxd\10/14/2019

DOMINGUEZ OIL FIELD

FACILITY

LONG BEACH OIL FIELD

WILMINGTON OIL FIELD

TORRANCE OIL FIELD

REFERENCE:
7.5 MINUTE U.S.G.S. TOPOGRAPHIC MAPS
OF LONG BEACH AND TORRANCE, CALIFORNIA
DATED: 1964
PHOTOREVISED: 1981

VICINITY MAP

N

KEY MAP

SMC PROPERTY (APN 7315-008-049)
2112 E. 223rd STREET; APPROXIMATELY 14 ACRES

FORMER COON TRUST PROPERTY (APN NOT AVAILABLE)
2254 E. 223rd STREET; APPROXIMATELY 11 ACRES

CARSON INDUSTRIAL LLC. PROPERTY (APN 7315-007-903)
2254 E. 223rd STREET; APPROXIMATELY 5 ACRES

MARATHON PARCEL (APN 7315-007-012)
2414 E. 223rd STREET; APPOXIMATELY 6 ACRES

0 2,000 4,000
FEET

FIGURE 1

LOCATION MAP

FORMER STAUFFER FACILITY
CARSON, CALIFORNIA

PREPARED FOR

PANATTONI DEVELOPMENT COMPANY, INC.
DENVER, COLORADO

AVOCET
ENVIRONMENTAL, INC.

V:\1362 Former Stauffer Chemical\1362.005 Ph 1 ESA Update 2112 E 223rd\002 1362.005 Former VLE Sys Layout.ai\10/14/2019

223rd Street

SMC PARCEL
(14 ACRES)

POLYONE
PROPERTY
(FORMER GEON)

SITE

SMC/CITY OF CARSON/NRRPELP LLC

MW-7A MW-7C MW-7B MW-16B MW-16D MW-16C IN-6A MW-3A
BMP-2 IN-9A IN-10A IN-11A IN-12A
MW-19A IN-5B IN-5A IN-5C MW-8A
MW-15D MW-15C MW-1A MW-1B MW-1D MW-1C EX-2C EX-2A EX-2B MW-15B EX-3C
MW-2B MW-2A MW-18A MW-9A MW-9D MW-9E MW-9DR MW-9B MW-9C
MW-6D MW-6A MW-6DR MW-6C MW-6B EX-3B EX-3A MW-11B EX-4C EX-4B EX-4A
MW-10A EX-5A EX-5B MW-12B MW-12C MW-12D EX-6A
EX-7A EX-1B MW-13B MW-5C EX-1C MW-5A EX-1A
IN-6C IN-6B IN-3C IN-3B IN-2A IN-2B IN-2C
MW-14A MW-14B MW-17B MW-17C MW-4A

VLEW-84 VLEW-85 VLEW-83 VLEW-86 VLEW-112 VLEW-17 VLEW-18 VLEW-19 VLEW-100 VLEW-101 VLEW-111 VLEW-102 VLEW-110 VLEW-125 VLEW-103 VLEW-106 VLEW-99 VLEW-24 VLEW-107* VLEW-108** VLEW-30 VLEW-31 VLEW-113 VLEW-20 VLEW-21 VLEW-22 VLEW-23 VLEW-26 VLEW-27 VLEW-28 VLEW-29 VLEW-33 VLEW-34 VLEW-35 VLEW-36 VLEW-37 VLEW-114 VLEW-115 VLEW-43 VLEW-41 VLEW-42 VLEW-38 VLEW-39 VLEW-40 VLEW-44 VLEW-48 VLEW-32 VLEW-45 VLEW-46 VLEW-47 VLEW-116 VLEW-49 VLEW-50 VLEW-51 VLEW-117 VLEW-52 VLEW-53 VLEW-54 VLEW-55 VLEW-56 VLEW-57 VLEW-58 VLEW-60 VLEW-59 VLEW-94 VLEW-61 VLEW-62 VLEW-63 VLEW-64 VLEW-66 VLEW-123 VLEW-124 VLEW-68 VLEW-69 VLEW-70 VLEW-95 VLEW-65 VLEW-67 VLEW-120 VLEW-121*** VLEW-121R VLEW-109 VLEW-72 VLEW-73 VLEW-118 VLEW-75 VLEW-74 VLEW-71 VLEW-122 VLEW-119 VLEW-76 VLEW-77 VLEW-78 VLEW-79 VLEW-80 VLEW-81 VLEW-82

MP-1 MP-2 MP-3 MP-4 MP-5 MP-6 MP-7 MP-8 MP-9 MP-10

1A 1B 2A 2B 3A 3B 4A 4B 5A 5B 6A 6B 7A 7B 8A 8B 9A 9B 10A 10B 11A 11B 12A 12B 13A 13B 14A 14B 15A 15B 16A 16B

KEY MAP

- SMC PROPOPERTY
- FORMER COON TRUST PROPERTY
- CARSON INDUSTRIAL LLC PROPERTY
- MARATHON PROPERTY

REFERENCE:
AECOM DRAWING: 60134535.FIGURE 1.0111.DWG

Notes:

1. SOURCE: BASE MAP FROM GEOREFERENCED SATELLITE IMAGERY FROM AIRPHOTO USA, IMAGE TAKEN 2003. LOS ANGELES COUNTY ASSESSORS ONLINE GIS DATABASE, 2004.
2. WELL LOCATIONS SURVEYED BY WM SURVEYS INC., MOST RECENT WELL SURVEY INFO FROM OCTOBER 2010.

Explanation

- SITE PROPERTY/BOUNDARY LINE
- MW-19A GROUNDWATER MONITORING WELL LOCATION
- MW-6D GROUNDWATER MONITORING WELL (ABANDONED)
- 2A SHALLOW VLE WELL LOCATION
- 2B DEEP VLE WELL LOCATION
- VLEW-106 VLE WELL LOCATION
- VLEW-100 STEP-OUT VLE WELL LOCATION
- VLEW-120 PREVIOUS FRACTURE POINT INSTALLED FEBRUARY 2008 CONVERTED TO VLE WELL IN AUGUST 2008
- VLEW-37 VLE WELL LOCATION ABANDONED JUNE 2010
- VLEW-121R VLE WELL LOCATION INSTALLED JANUARY 2010
- VLEW-125 VLE WELL LOCATION INSTALLED SEPTEMBER 2010
- EX-1A GROUNDWATER EXTRACTION WELL LOCATION
- IN-1A GROUNDWATER INJECTION WELL LOCATION
- * WELL RE-INSTALLED NOVEMBER 2005
- ** WELL INSTALLED AUGUST 2007
- *** VLE WELL ABANDONED JANUARY 2010
- VLEW-75 STEP-OUT VLE WELL LOCATION ABANDONED JUNE 2010
- ZONE 1 EXTRACTION PIPING
- ZONE 2 EXTRACTION PIPING
- ZONE 3 EXTRACTION PIPING

FIGURE 4

FORMER VLE SYSTEM LAYOUT

FORMER STAUFFER FACILITY
CARSON, CALIFORNIA

PREPARED FOR

PANATTONI DEVELOPMENT COMPANY, INC.
DENVER, COLORADO

AVOCET ENVIRONMENTAL, INC.

V:\1362_Former_Stauffer_Chemical\1362.005_Ph_1_ESA_Update_2112_E_223rd\003_1362.005_EISB_Sys_Layout.ai\10/14/2019

223rd Street

SMC PROPERTY (14 ACRES)

POLYONE PROPERTY (FORMER GEON)

CITY OF CARSON PROPERTY (11 ACRES) (FORMERLY SUBLEASED TO SMC)

TESORO NORTHEAST REFINERY PROPERTY (FORMER BP) (GATE 60)

SITE

SMC/CITY OF CARSON PROPERTY LINE

TRUCK PAD

EISB SYSTEM GROUNDWATER TREATMENT PLANT

TREATMENT PLANT CONTROL ROOM

(GATE 23)

MW-7A MW-7C MW-7B MW-16B MW-16D MW-16C IN-12A IN-11A MW-27A IN-10A BMP-2 IN-9A IN-6A EX-2C MW-15D MW-15C MW-1AR MW-1B MW-1C IN-13A MW-19A MW-18A IN-5B MW-8A IN-5A IN-5C EX-2A EX-2B MW-15B MW-2B MW-2A EX-3C IN-9B IN-14A IN-16A MW-9A MW-9E MW-9DR MW-9C MW-9B MW-28B IN-4A IN-4B IN-4C IN-7A MW-10A IN-6C IN-6B MW-29A IN-3A MW-14A MW-14B IN-7B EX-3B EX-3A MW-6DR MW-6C MW-6B MW-6AR/EX-3AR EX-4B EX-4C EX-4A MW-11B GMW-3 EX-5A IN-3C IN-3B EX-8A IN-8A GMW-2 EX-5B MW-12B IN-15A MW-12C MW-12D EX-6A IN-2A MW-30B IN-2B IN-2C IN-8B MW-17B MW-17C AW-97D MW-4 EX-7A EX-1B MW-13B MW-4A IN-1C IN-1B IN-1A EX-1C MW-5C MW-5A EX-1A GMW-1 GMW-5 AW-35S AW-35D AW-95D AW-100D GMW-7

Explanation

- SITE PROPERTY/BOUNDARY LINE
- EASEMENT/RIGHT-OF-WAY
- MW-28B — MONITORING WELL LOCATIONS
- EX-8A — EXTRACTION WELL LOCATIONS
- IN-16A — INJECTION WELL LOCATIONS
- APPROXIMATE WELL VAULT LOCATION
- APPROXIMATE PULL BOX LOCATION
- FENCE LINE
- EXTRACTION PIPING AND CONDUIT
- INJECTION PIPING AND CONDUIT
- PROPOSED 223RD STREET EXPANSION
- PLANNED LANDSCAPING AREA
- PAVED ACCESS ROAD
- BP — BRITISH PETROLEUM
- EISB — ENHANCED IN-SITU BIOREMEDIATION
- SMC — STAUFFER MANAGEMENT COMPANY LLC

N

0 120' 240'

KEY MAP

- SMC PROPOPERTY
- FORMER COON TRUST PROPERTY
- CARSON INDUSTRIAL LLC PROPERTY
- MARATHON PROPERTY

REFERENCE:
GROUP DELTA DRAWING EN065 FIG 1&3 EISB COM_1H19.0519.DWG
DATED: SEPTEMBER 30, 2019.

Notes:

1. BASEMAP LINEWORK DERIVED FROM: SATELLITE IMAGERY COLLECTED JUNE 17, 2015 DOWNLOADED FROM U.S.G.S. EARTH EXPLORER™. IMAGE IS A 1-FOOT RESOLUTION GROUND SAMPLE DISTANCE (GSD) ORTHORECTIFIED COLOR (RGB) WITH THE PROJECTION OF NAD83 STATE PLANE, ZONE 5, U.S. FOOT MEETING THE NATIONAL MAP ACCURACY STANDARDS (95% ACCURACY); AND LOS ANGELES COUNTY ASSESSOR'S OFFICE ONLINE GEOGRAPHIC INFORMATION SYSTEM DATABASE, COPYRIGHT 2017.
2. WELL LOCATIONS SURVEYED BY DULIN & BOYNTON, SURVEYS CONDUCTED BETWEEN 2002 AND 2015. ADDITIONAL SURVEYS CONDUCTED BY W.M. SURVEYS INC., FEBRUARY AND MARCH 2011, JANUARY AND JULY 2012. CALVADA SURVEYING, INC., FEBRUARY 2015, APRIL 2016 AND JULY 2017.

FIGURE 7

EISB SYSTEM LAYOUT

FORMER STAUFFER FACILITY
CARSON, CALIFORNIA

PREPARED FOR

PANATTONI DEVELOPMENT COMPANY, INC.
DENVER, COLORADO

AVOCET ENVIRONMENTAL, INC.