LAND DEVELOPMENT DIVISION
STORM DRAIN & HYDROLOGY UNIT

TO: John Cataldo and Associates
ATTN: Nathan Battle

DATE 4/15/25

REVIEW OF HYDROLOGY STUDY

PD/MTD. NO.	**N/A**	**DATE OF REPORT**	**04/14/2025**
CUP NO.	**RPPL2021008074**	**PLAN CHECK NO.**	**5**
		PLAN CASE NO.	**ESTU2023000539**

We have reviewed your Hydrology Study and LID Plan.

[X] The Hydrology Study has been approved.

[X] The LID Plan has been approved.

REVIEWED BY _____
ALEX MIKHAILPOOR - (626) 458-4921

APPROVED BY: _____

HYDROLOGY STUDY & LOW IMPACT DEVELOPMENT REPORT

14500 S AVALON BLVD
GARDENA, CA 90248

RPPL2021008074

PREPARED FOR:
Cataldo & Associates
835 Mission Street, Pasadena, CA 91030

PREPARED BY:
DCA Civil Engineering Group, Suite 300
Torrance, CA 90504

PROJECT NO. 21-2756-4679.000-1710
09/29/2023
REVISED 03/27/2025

REGISTERED PROFESSIONAL ENGINEER
CHARLES STEPHEN CUMMINS
No. C 34526
Exp. 9/30/25
CIVIL
STATE OF CALIFORNIA

3/27/25

HYDROLOGY STUDY APPROVED

REVIEWED BY: _____ DATE 04/15/2025

APPROVED BY: _____ DATE 04/15/2025

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

Contents

1. PURPOSE AND SCOPE....2
2. PROJECT DESCRIPTION....2
3. EXISTING HYDROLOGIC ANALYSIS....3
4. PROPOSED HYDROLOGIC ANALYSIS....4
5. LID CALCULATIONS....6
6. MAINTENANCE RECOMMENDATIONS....10
7. SUMMARY....10
8. LIMITATIONS....11

APPENDICES

APPENDIX 1: HYDROCALC RESULTS

APPENDIX 2: STORMTECH UNDERGROUND INFILTRATION SYSTEM

APPENDIX 3: GEOTECHNICAL INVESTIGATION REPORT

APPENDIX 4: HEC-HMS MODEL RESULTS

APPENDIX 5: BMP INSPECTION & MAINTENANCE GUIDELINES

EXHIBITS

EXHIBIT 1: HYDROLOGY PLANS

EXHIBIT 2: DRAINAGE DESIGN EXHIBIT

EXHIBIT 3: L.I.D. PLAN

1. PURPOSE AND SCOPE

The purpose of this report is to demonstrate the design and technical investigation processes in order to quantify the hydrologic/hydraulic (Hydrology) characteristics of the site as well as prepare the Low Impact Development (LID) Plan for the planned redevelopment of the subject site. The project site is in an unincorporated area of Los Angeles County. The type of redevelopment is industrial and the entire site will be disturbed (2.00 acres). As this redevelopment will result in the creation/addition/replacement of 5,000 sq. ft. of impervious area, the County of Los Angeles Stormwater LID Ordinance requires the incorporation of Stormwater Best Management Practices (BMPs) and it is identified as a designated project. Hence, this Hydrology/LID report was prepared in compliance with this ordinance. The redevelopment will result in an alteration of **greater than** fifty percent of the total impervious surface area of the existing developed site. As per the County of Los Angeles LID Manual, the entire development must meet the requirements of the LID Standards Manual.

The preparation and approval of the Hydrology/LID report is part of the project approval process prior to issuance of a grading and site development permit with the City of Gardena, CA.

2. PROJECT DESCRIPTION

The project comprises approximately 2.00 acres and is located to the east of S Avalon Blvd. in the City of Gardena, Los Angeles County, CA 90248. The property is located behind adjacent property and the street access is facilitated by a 25'wide easement. The site is currently made up of small individual buildings and 94% of is made up of previous area and mostly dirt.

The proposed development will demolish all existing buildings. The site will be developed for use as a cargo storage facility. One office building will be constructed. The site will be paved with concrete. Landscaping areas will be provided next to the proposed building and along the property lines.

Ground disturbing activities will consist primarily of site grading, paving, installation of storm drain pipes, construction of stormwater BMP and catch basins. 100% of the project site will be disturbed. The new development will result in approximately 92.9% of impervious surface for the site.

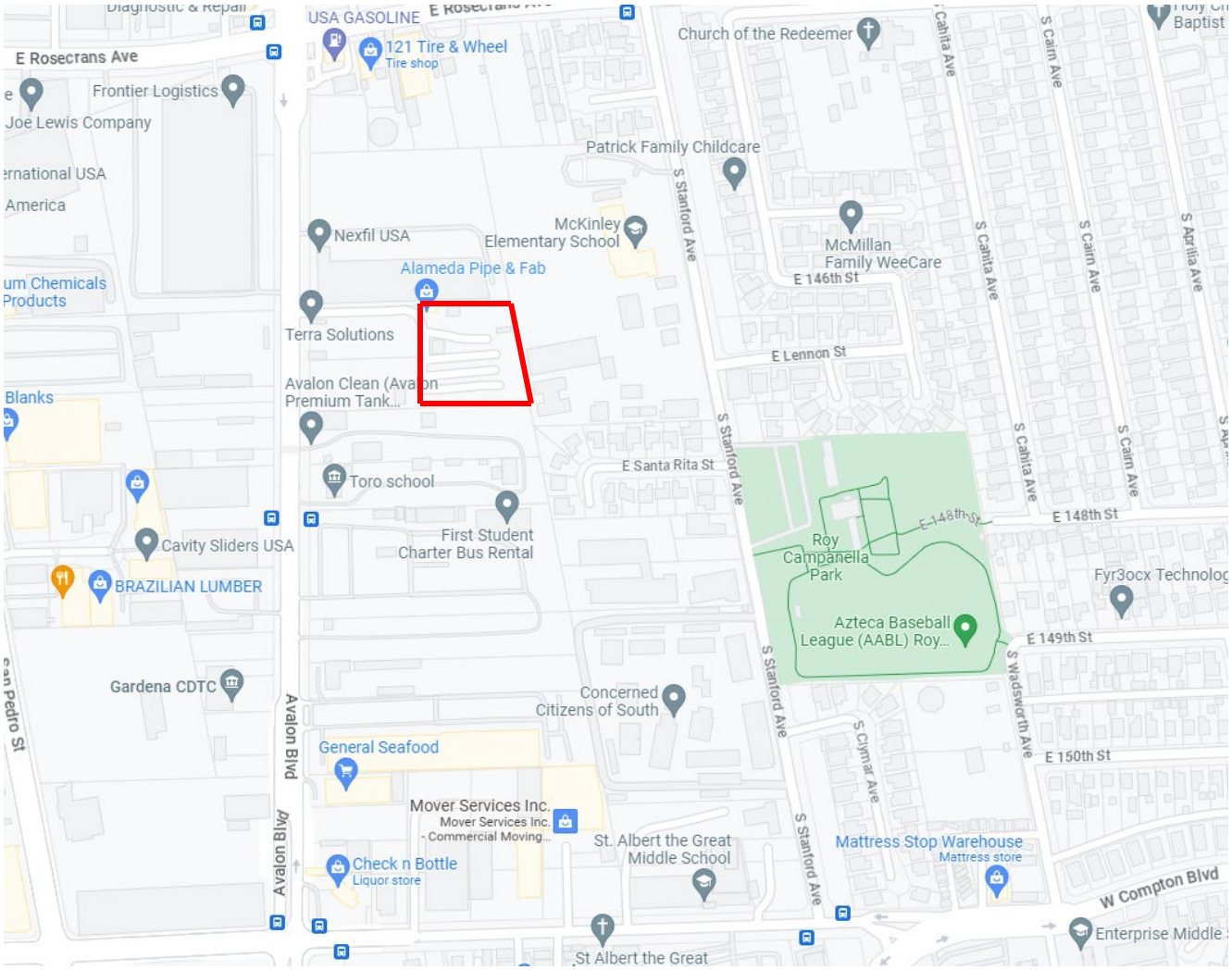


Figure 1: Site Location

3. EXISTING HYDROLOGIC ANALYSIS

The major part of the project site is covered by dirt. There are four small individual buildings. The existing topography of the site consists of two major slopes at elevations of approximately 119.2 to 114 feet above mean sea level. The major part of site slopes towards the access driveway towards Northwest. The site elevations are higher than the adjacent property at East and South and the areas along the east and south property lines slopes towards these property lines.

The project area for the pre-developed conditions is divided into two subareas (see Exhibit-1; HY-1) as per the drainage characteristics of the site. The access driveway which is outside the project site in included in the hydrology study as Subarea 3. The runoff from Subarea 1 joins the runoff from Subarea 3, and discharges to Avalon Blvd.

3.1 SITE HYDROLOGY

The methodology described in the Los Angeles County Department of Public Works (LACDPW) Hydrology Manual was used to compute storm water flow rates for the project site. The LACDPW HydroCalc program was used to generate the 25-year peak discharge and time of concentration (Refer to Appendix 1 for computer program Output Results).

Please refer to Table 3-1 for Watershed Area information & Table 3-2 regarding quantifiable data for the Pre-Developed Drainage Condition.

Hydrologic Data:

Soil Classification = 13
24-hr, 50-yr Rainfall Depth = 5.95 in

Table 3-1: Watershed Area

Site Condition	Area (AC)	Pervious (%)	Impervious (%)	Pervious (AC)	Impervious (AC)
Pre-Developed	2.200	87.0	13.0	1.915	0.285

Existing Hydrology Analysis Tabulation (Q25):

Table 3-2: Pre- Developed Onsite- Q25

Area Designation	Ai * (acres)	Ap* (acres)	25-yr Rainfall		
			T_c (min)	Q_{25} (cfs)	V_{25} (cf)
1	0.087	1.501	6	4.1	6,349
2	0	0.414	5	1.2	1,396
3	0.198	0	5	0.58	671
Total	0.285	1.915		5.3	8,416

* Ai = Impervious Area, Ap = Pervious Area, T_c = Time of Concentration
(Refer to Exhibit #1, Hydrology, Pre-Developed Condition, Sheet HY-1)

4. PROPOSED HYDROLOGIC ANALYSIS

The project area, for post-developed condition, is divided into 3 major subareas (see Exhibit-1; HY-2). The runoff for Subarea A will surface flow towards a proposed drop inlet. The roof runoffs of the proposed building (Subarea B) will be directed to a proposed storm drain pipe by 3 roof drains. The runoff for Subarea C which consists a big portion of the project site will surface flow to proposed curb & gutter or v-gutter and will be directed to a proposed curb opening catch

basin with grating. The storm water from Subarea A, B & C will be joined at the proposed 36" dia. manhole and then will be directed to the underground infiltration system. When the infiltration system becomes full, the overflow will happen at the manhole with a 12" SD pipe. Then, the storm water will enter to a 60" dia. retention pipe. The outlet of this retention pipe is controlled by a 10" SD pipe and it will lower the peak flow rates during heavy rains (Refer to Section 4.2). The 10" SD pipe is connected to the proposed channel with grates (trench drain) at the end of the access driveway. The surface flow from the access driveway (Subarea D) which is outside of the project site enters this channel and joins the flow from the project site. The channel is connected to the public curb and gutter by proposed parkway drain.

4.1 SITE HYDROLOGY

As mentioned before, the methodology described in the Los Angeles County Department of Public Works (LACDPW) Hydrology Manual was used to compute storm water flow rates for the project site. The LACDPW HydroCalc program was used to generate the 25-year peak discharge and time of concentration (Refer to Appendix 1 for computer program Output Results).

Hydrologic Data:

Soil Classification = 13
24-hr, 50-yr Rainfall Depth = 5.95 in

Table 4.1-1: Watershed Area

Site Condition	Area (AC)	Pervious (%)	Impervious (%)	Pervious (AC)	Impervious (AC)
Post-Developed	2.200	7.0	93.0	0.156	2.044

Proposed Hydrology Analysis Tabulation (Q25)

Table 4.1-2: Post - Developed Onsite-Q25

Area Designation	Ai * (acres)	Ap* (acres)	25-yr Rainfall		
			T_c (min)	Q_{25} (cfs)	V_{25} (cf)
A	0.121	0.034	5	0.43	2,155
B	0.065	0	5	0.18	1,100
C	1.674	0.107	7	4.3	28,489
D	0.198	0	5	0.58	671
	Total Area = 2.200 acres		Total Q_{25} (cfs)	5.5	32,415

* Ai = Impervious Area, Ap = Pervious Area, T_c = Time of Concentration
(Refer to Exhibit #1, Hydrology, Post-Developed Condition, Sheet HY-2)

4.2 RETENTION PIPE

The runoffs for the main part of the project site (except driveway access) are directed to the proposed 36" dia. manhole. The bottom outlet of the manhole is connected to the underground infiltration system. When this system becomes full, the overflow will take place at the manhole and the excess flow will enter to a 60" dia. & 80' long retention pipe. The outlet of this retention pipe is controlled by a 10" SD pipe and it will lower the peak flow rates during heavy rains. With reservoir routing, the retention pipe reduces the Q_{25} inflow value from 4.9 cfs to outflow value of 2.9 cfs. Inflow and outflow hydrographs for 25-yr design rain are plotted using Los Angeles County approved HEC-HMS software. Refer to Appendix 4 for hydrology analysis of the retention pipe. Refer to Exhibit #2 for the overall drainage of the site.
Summary of retention pipe is listed in the Table 4.2-1 below.

Table 4.2-1: Retention Pipe Information

Retention Size	60" Diameter, L= 80' (4 × 20' segments)
Pipe Slope	0.2%
Inlet Pipe size	12 in Diameter
Oulet Pipe size	10 in Diameter
Oulet Pipe Length	290.1'
Oulet Pipe Slope	0.9%

5. LID CALCULATIONS

5.1 DESIGN CONSIDERATIONS

1 Pollutants of Concern (POC)

The major pollutants of concern for mitigation are anticipated to be car oil, grease, hydrocarbons, heavy metals, trash, and suspended solids.

2 Protection of Slopes and Channels

There are slopes and channels associated with this site located towards the north and it will be the responsibility of the property owner to protect them to control the erosion.

3 Trash Storage Areas

There is one trash storage area located close to the southwest corners of the site. It will be the responsibility of the owner to keep these areas clean as not to allow trash and debris to be transported by wind into nearby storm drain inlet.

4 Stenciling and Signage

"NO DUMPING · DRAINS TO OCEAN" stencils will be painted at all catch basin locations within the project area.

5 BMP Design and Source Control

Site Design BMPs

Site design BMPs were designed to be implemented. The grades on-site are designed to drain stormwater runoff to treatment control BMPs. The initial runoff will drain into the drop inlet with grate and the curb opening catch basin with grating, then it will be directed to the Stormtech chamber systems to minimize the quantity of stormwater and maximize underground water conservation.

Source Control BMPs

BMP's applicable to this site and that have been implemented into the design are listed below in Table 5.1-1 – Source & Treatment Control BMPs.

TABLE 5.1-1: Source Control & Treatment Control BMPs

	SOURCE CONTROL	TREATMENT CONTROL
SC-30	**Outdoor Loading/Unloading**	**TC-11 Infiltration Basin**
SC-43	**Parking/ Storage Area Maintenance**	
SC-44	**Drainage System Maintenance**	**Catch Basin Filter Insert**
SC-60	**Housekeeping Practices**	
SD-10	**Site Design & Landscape Planning**	
SD-11	**Roof Runoff Controls**	
SD-12	**Efficient Irrigation**	
SD-13	**Storm Drain Signage**	
SD-32	**Trash Storage Area**	

5.2 BMP REQUIREMENTS

1 Peak Stormwater Runoff Discharge Rate

Rainfall runoff is based on the 85th percentile rainfall requirement for the County of Los Angeles. The Peak Stormwater Mitigation Discharge Rates (Q_{pm}) and Mitigation Volumes (V_m) were obtained by using LACDPW HydroCalc program. This site is designed to retain and filter 100% of the required storm water quality design for the 85^{th} percentile, 24-hour storm event. The depth of the 85^{th} percentile, 24-hr runoff event for the project site is 0.89 inch based on the Los Angeles County 85th percentile precipitation isohyetal map and it is greater than 0.75 inch, 24-hr runoff event. Therefore, the project design storm volume will be calculated based on 0.89 inch, 24-hr runoff event. The runoff rate and volume for the disturbed area is presented in Table 5.2-1 below.

TABLE 5.2-1: Runoff Based On 85th Percentile, 24-Hour Rain Event

AREA DESIGNATION	AREA (AC)	HYDROCALC Q_{pm} (CFS)*	HYDROCALC V_m (CF)*
Area A	0.155	0.05	359
Area B	0.065	0.03	187
Area C	1.782	0.38	4,825
TOTAL	2.002	0.45	5,371

Drainage Boundary: See Exhibit 3.
* Q_{pm} and V_m values are generated by HydroCalc software. See Appendix 1.

2 Treatment Control for Stormwater Pollutants

The stormwater pollutants expected will be sediment, small debris, suspended solids, and traces of hydrocarbons washed from private parking. One StormTech Underground Infiltration System will be installed within the project site. These vessels will intercept particles and pollutants from the stormwater before discharging into the concrete gutter. Before the runoff enters the infiltration basin, it will pass through filter inserts in the catch basin & drop inlet which remove pollutants and eliminate small debris and suspended solids. The size and model number of units used will depend on the total tributary area to the project site (see Exhibit 3: LID Plan).

3 Treatment Design and Capacity

StormTech Underground Infiltration System

The Stormtech System is a storage vessel that holds stormwater runoff underground while allowing it to infiltrate into the surrounding soil. It is a half dome-shaped pipe that can withhold H20 loading. This system is designed for infiltration and retention. Please see Appendix 2 for the details of the Stormtech system. The Stormtech system can help achieve runoff detainment and storage to help attenuate the peak flow to pre-construction levels and can help conform to current Low Impact Development requirements (see Exhibit 3: LID Plan).

Soil Percolation

A geotechnical investigation report provided by NorCal Engineering (Project Number 22746-21, dated August 23, 2021) & amended letter dated January 4, 2024 show the design percolation rate is 0.72in/hr at the depth of 10'.
Please see Appendix 3.

5.3 BMP SIZING

The LA County LID Standards Manual is used to size the proposed BMPs. The total mitigate volume from Table 5.2-1 is used to design the infiltration system.

Maximum depth of water (d_{max}) that can be infiltrated within maximum retention time is calculated by equation below:

$$d_{max} = (f_{design} /12) \times t$$

Where:
t = Maximum Retention Time (max 96 hours)
Therefore:

$$d_{max} = (0.72 /12) \times 96 = 5.76 \text{ FT}$$

Surface area (A_{system})for the infiltration system can be calculated by equation below:

$$A_{system} = SWQDv / (d_t \times n_t)$$

Where:
$d_t =< d_{max} / n_t$
d_t = Depth of Infiltration System [FT]
n_t = Infiltration System Void Ratio (Void Volume / Total Cut Volume)

Since n_t for the underground chambers varies by the design, the minimum required surface area (A_{min}) for the infiltration system is calculated by assuming n_t and checking actual n_t after the design. The n_t for the final proposed system is calculated by dividing the system capacity (installed system volume; please see Appendix 2) by the total cut volume for the system using overall BMP size; width, height & depth (please see LID plan for BMP size , and Appendix 2 for infiltration system details)

V_{system} = 5,905 CF
V_{total} = 19.42’ × 71.61’ × 7.00’ = 9,734.7 CF
$n_t = V_{system} / V_{total}$ = 5,905 / 9,734.7 = 0.61

Therefore:
(d_t =7 FT) < (d_{max} / n_t = 5.76/0.61 = 9.44 FT)
$A_{min} = SWQDv / d_t \times n_t$ = 5,371 / (7 × 0.61) = 1,258 ST

The proposed infiltration system is designed to meet the minimum requirements (A_{min} & SWQDv). The proposed capacities are shown in Appendix 2.
The drawdown time of the system can be calculated by dividing the system volume to the total infiltration rate of the bottom surface of the system or by using the following equation:

$t_{drawdown} = (d_t \times n_t) / (f_{design} /12) = (7 \times 0.61) / (0.72/12) = 71.2$ hours < 96 hours

Table 5.3-1: BMP Design

Area Designation	A_{min} (SF)	SWQDv (CF)	A_{system} (SF)	V_{system} (CF)
Infiltration System				
ALL AREAS	1,258	5,371	1,390	5,905

See Exhibit 3, LID Plan for details.

6. MAINTENANCE RECOMMENDATIONS

6.1 Routine Maintenance

The concrete parking area should be swept regularly to remove excess trash and debris. Trash receptacles should be emptied regularly.

6.2 BMP Maintenance

As noted in the previous section, regular sweeping and sufficient trash receptacles should be planned for the site to help mitigate trash and debris from the paved and unpaved areas. The proposed Stormtech systems should be maintained in accordance with the manufacturer's maintenance outline (See Appendix 2). The catch basin & trench drain filter inserts, also, should be maintained per the manufacturers' maintenance guidelines.

7. SUMMARY

The study shows that the post development storm water runoff peak flow rate leaving site for a 25-yr storm condition (2.9 cfs) is lower than the total pre-developed 25-yr storm runoff volume (5.3 cfs). This is achieved by infiltrating the flow into stormwater infiltration system and by retaining the peak flows at the retention pipe.
The post-developed condition will detain and infiltrate the 85th percentile storm event and 100% of the design volume will be retained on-site. The proposed infiltration system has the sufficient capacity to treat the initial stormwater runoff.
The retention pipe will enable the peak attenuation of the Q25 inflow hydrograph from 4.9 cfs to 2.9 cfs before it discharges to the public right of way.
The retention pipe will reduce the peak flow and thus, the peak outflow rate to Avalon Blvd right-of-way in post-developed condition including runoff from the access driveway (Q_{post} = 3.5 cfs) will not exceed the total outflow rate for the pre-developed condition (Q_{pre} = 4.7 cfs). Table 7.1 below summarizes reduction of flow rates due to retention pipe.

Table 7.1: Summary of Inflow & Outflow Hydrographs for Retention Pipe

Storm Detail	Inflow (cfs)	Outflow(cfs)	Reduction of Flow (cfs)
Q-25 year	4.9	2.9	2.0

8. LIMITATIONS

This report was based on the Los Angeles County Department of Public Works and their representative. Evaluation of the appropriateness of guidelines and the accuracy of County data was beyond the scope of this study.

Usage of this report is limited to address the purpose and scope previously defined by the project owner. The contents of this report are professional opinion and as such, are not to be considered a guarantee or warranty. The opinions presented in this report have been derived in accordance with current standards of civil engineering practice. This report may not contain sufficient information for other parties or other purposes.

Respectfully submitted,

DCA Civil Engineering Group

Charles S. Cummins
Principal Engineer
R.C.E. No. 34526

Appendix 1

HydroCalc Results

Pre- Developed Hydrology Results

Peak Flow Hydrologic Analysis

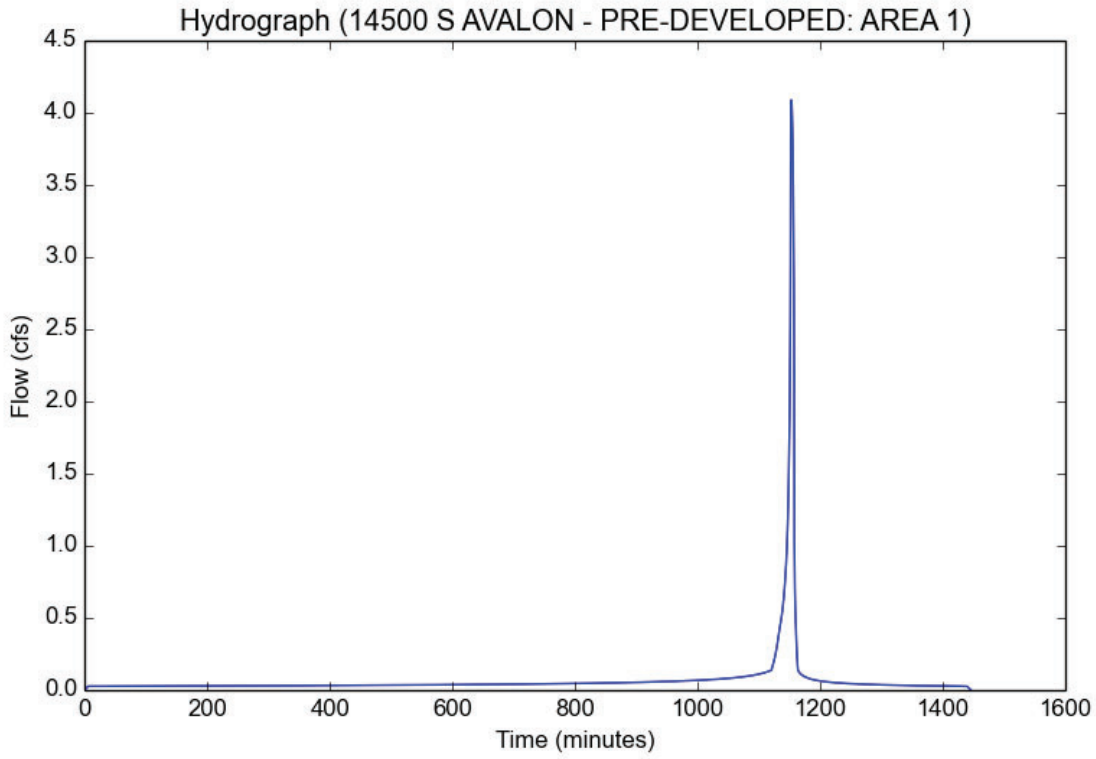
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON - PRE-DEVELOPED - AREA 1.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON - PRE-DEVELOPED
Subarea ID	AREA 1
Area (ac)	1.588
Flow Path Length (ft)	369.9
Flow Path Slope (vft/hft)	0.0143
50-yr Rainfall Depth (in)	5.95
Percent Impervious	0.055
Soil Type	13
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	5.2241
Peak Intensity (in/hr)	2.8609
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	6.0
Burned Peak Flow Rate (cfs)	4.0888
24-Hr Clear Runoff Volume (ac-ft)	0.1457
24-Hr Clear Runoff Volume (cu-ft)	6348.508



Peak Flow Hydrologic Analysis

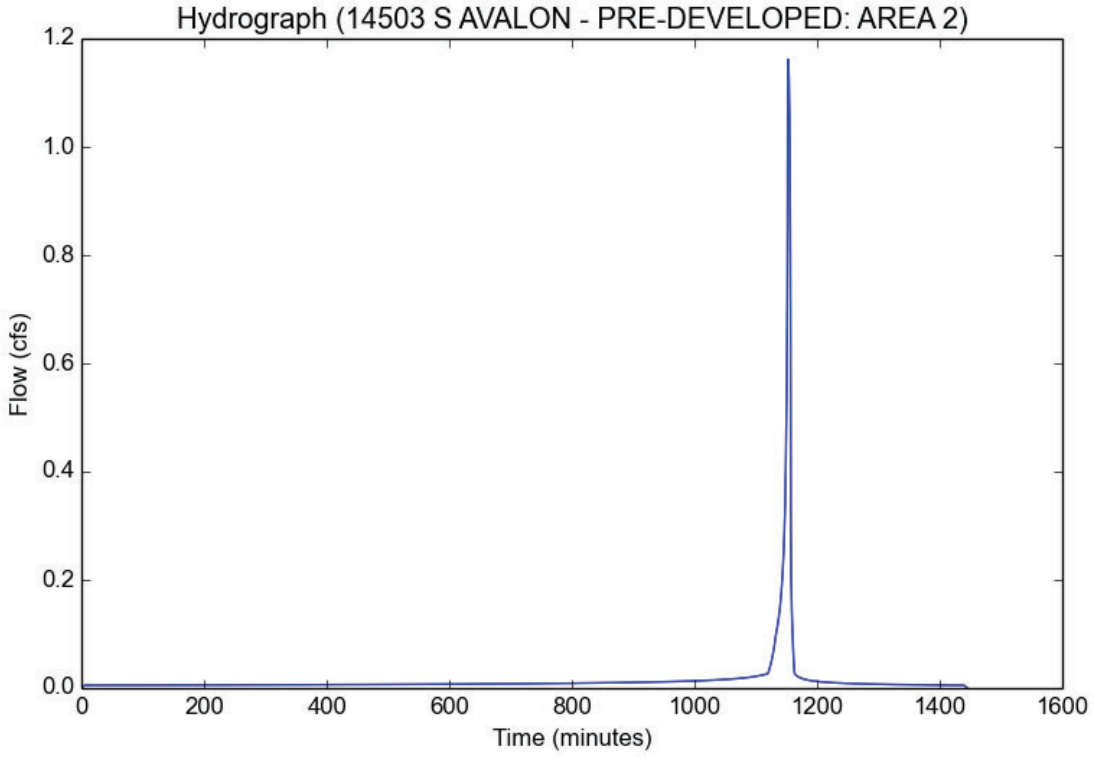
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON - PRE-DEVELOPED Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON - PRE-DEVELOPED
Subarea ID	AREA 2
Area (ac)	0.414
Flow Path Length (ft)	266.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.95
Percent Impervious	0.01
Soil Type	13
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	5.2241
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.1613
Burned Peak Flow Rate (cfs)	1.1613
24-Hr Clear Runoff Volume (ac-ft)	0.032
24-Hr Clear Runoff Volume (cu-ft)	1395.8877



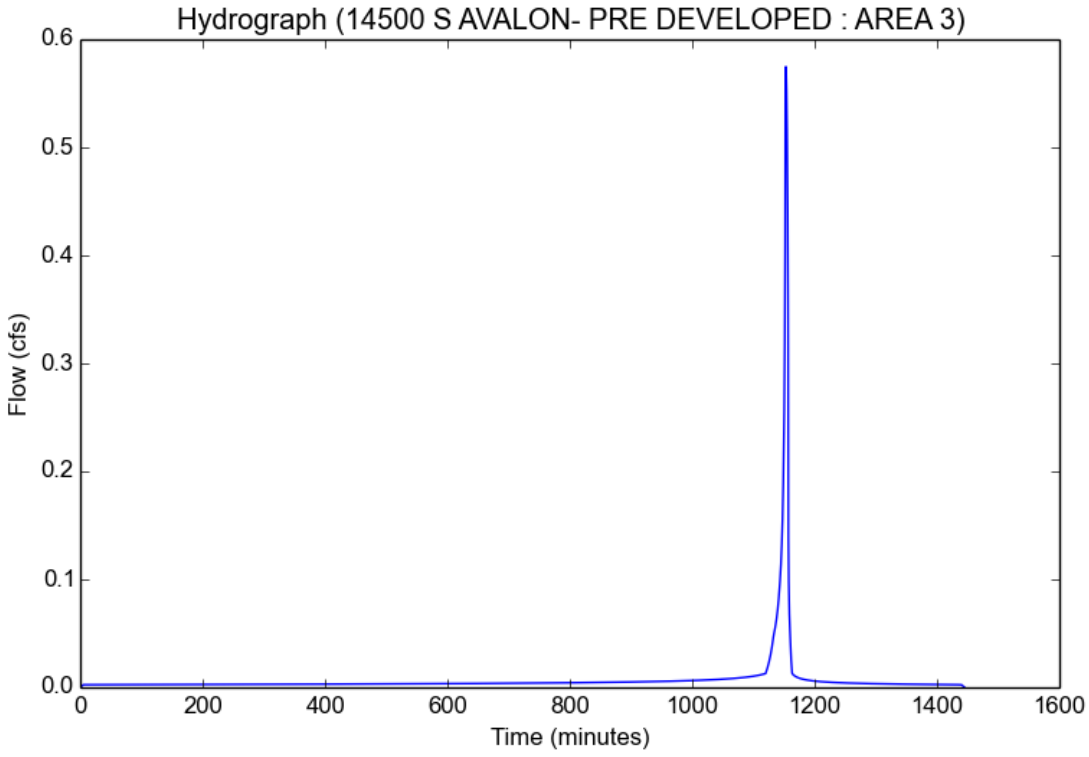
Peak Flow Hydrologic Analysis

File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON- PRE DEVELOPED - AREA 3.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

PED

Output Results



Post- Developed Hydrology Results

Peak Flow Hydrologic Analysis

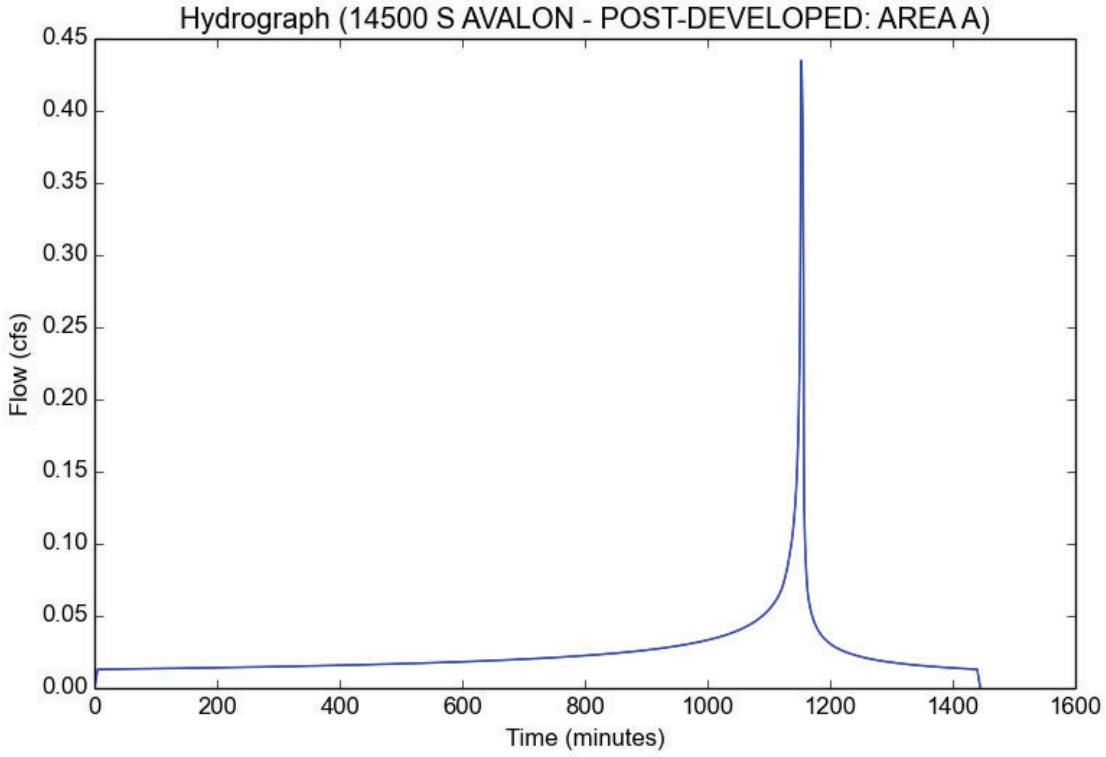
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON - POST-DEVELOPED Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON - POST-DEVELOPED
Subarea ID	AREA A
Area (ac)	0.155
Flow Path Length (ft)	92.4
Flow Path Slope (vft/hft)	0.017
50-yr Rainfall Depth (in)	5.95
Percent Impervious	0.779
Soil Type	13
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	5.2241
Peak Intensity (in/hr)	3.1168
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Burned Peak Flow Rate (cfs)	0.4348
24-Hr Clear Runoff Volume (ac-ft)	0.0495
24-Hr Clear Runoff Volume (cu-ft)	2154.5486



Peak Flow Hydrologic Analysis

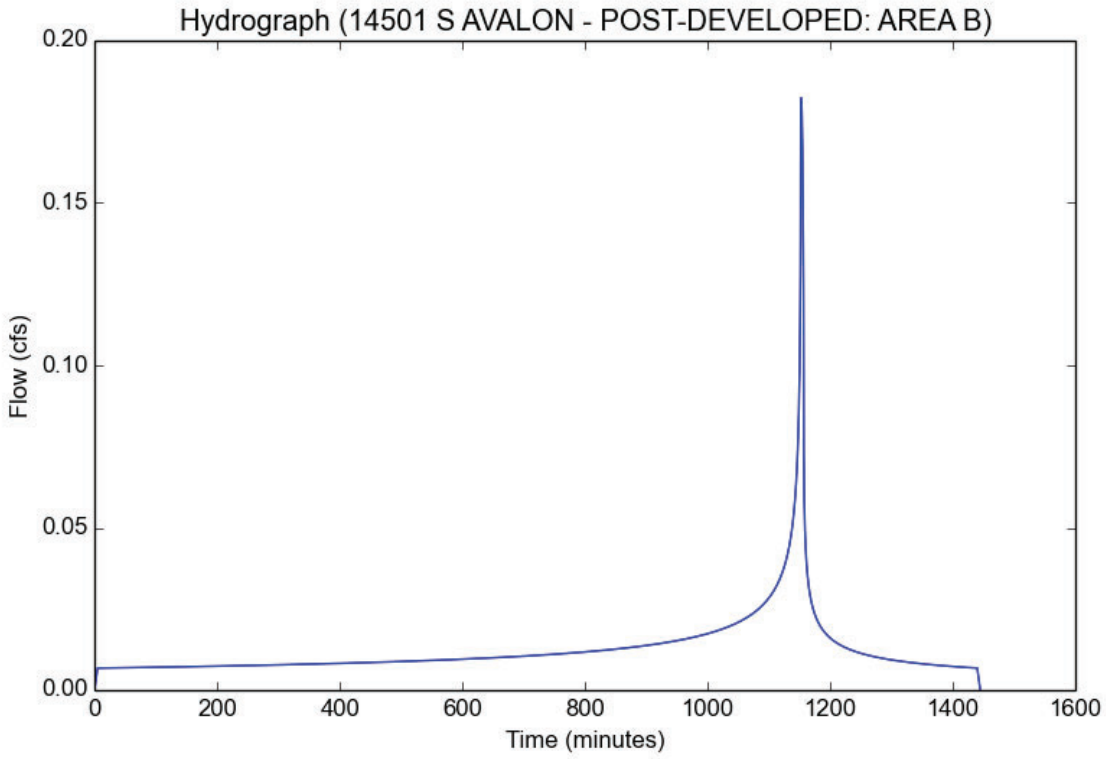
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON - POST-DEVELOPED Report.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14501 S AVALON - POST-DEVELOPED
Subarea ID	AREA B
Area (ac)	0.065
Flow Path Length (ft)	56.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.95
Percent Impervious	1.0
Soil Type	13
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	5.2241
Peak Intensity (in/hr)	3.1168
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Burned Peak Flow Rate (cfs)	0.1823
24-Hr Clear Runoff Volume (ac-ft)	0.0253
24-Hr Clear Runoff Volume (cu-ft)	1100.1958



Peak Flow Hydrologic Analysis

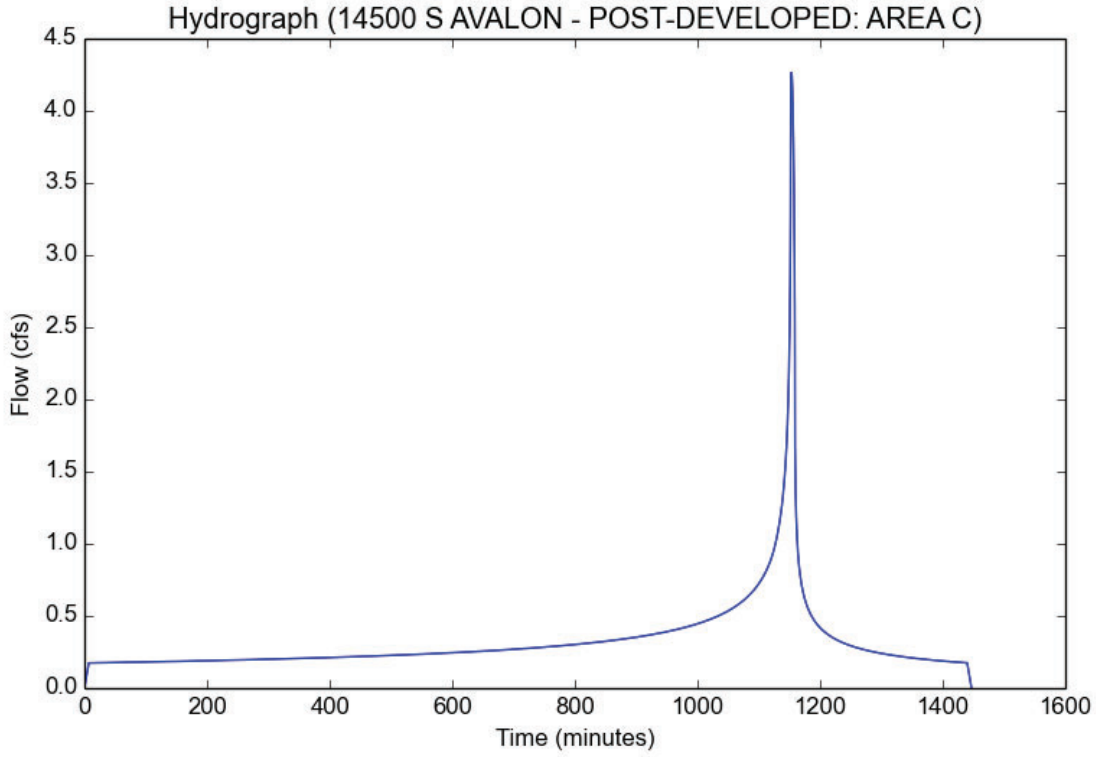
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON - POST-DEVELOPED - AREA C.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON - POST-DEVELOPED
Subarea ID	AREA C
Area (ac)	1.781
Flow Path Length (ft)	459.5
Flow Path Slope (vft/hft)	0.01
50-yr Rainfall Depth (in)	5.95
Percent Impervious	0.932
Soil Type	13
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	5.2241
Peak Intensity (in/hr)	2.6609
Undeveloped Runoff Coefficient (Cu)	0.9
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	7.0
Burned Peak Flow Rate (cfs)	4.2652
24-Hr Clear Runoff Volume (ac-ft)	0.654
24-Hr Clear Runoff Volume (cu-ft)	28489.406



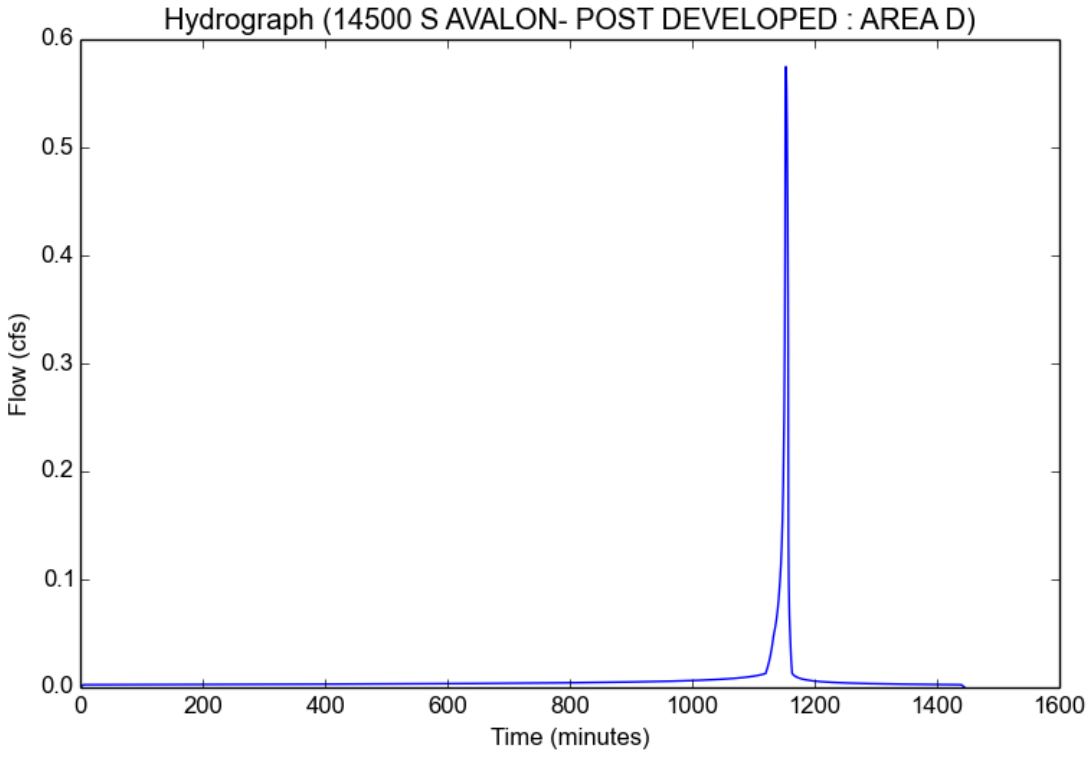
Peak Flow Hydrologic Analysis

File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/HYDR/14500 S AVALON- POST DEVELOPED - AREA D.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

OPED

Output Results



LID Results

Peak Flow Hydrologic Analysis

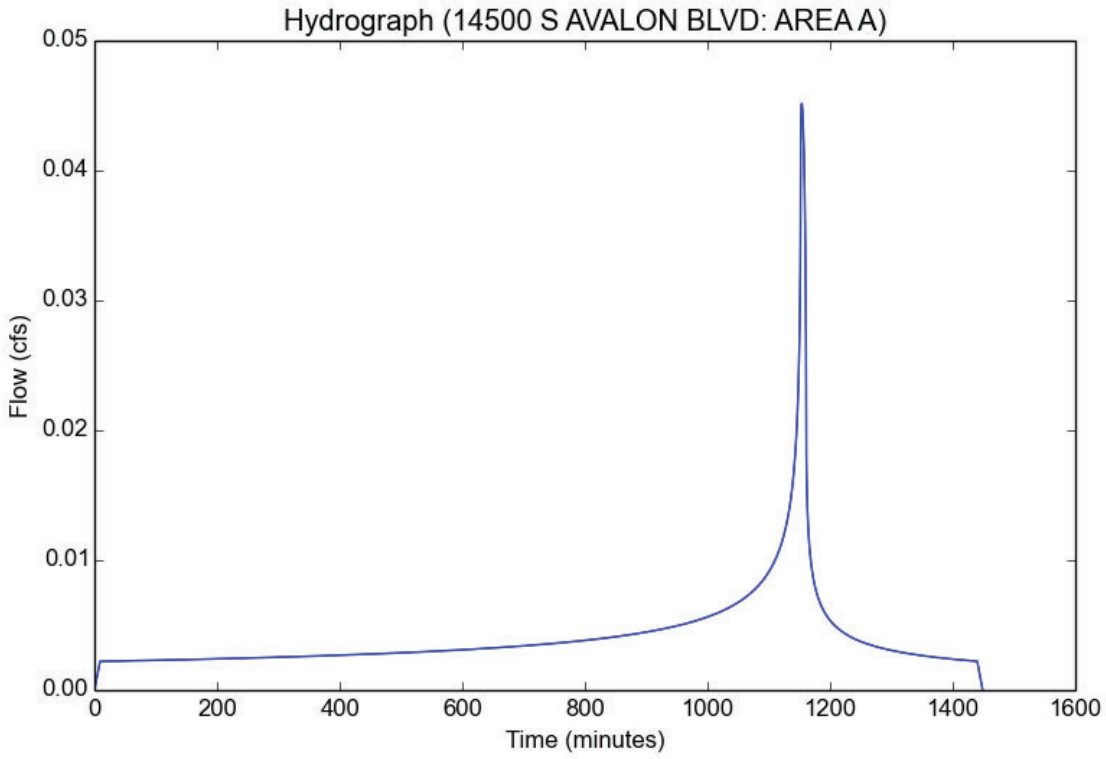
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/CALCS/LID/14500 S AVALON BLVD - AREA A - LID.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON BLVD
Subarea ID	AREA A
Area (ac)	0.155
Flow Path Length (ft)	92.4
Flow Path Slope (vft/hft)	0.017
85th Percentile Rainfall Depth (in)	0.89
Percent Impervious	0.779
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.89
Peak Intensity (in/hr)	0.4028
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7232
Time of Concentration (min)	9.0
Burned Peak Flow Rate (cfs)	0.0452
24-Hr Clear Runoff Volume (ac-ft)	0.0082
24-Hr Clear Runoff Volume (cu-ft)	359.1559



Peak Flow Hydrologic Analysis

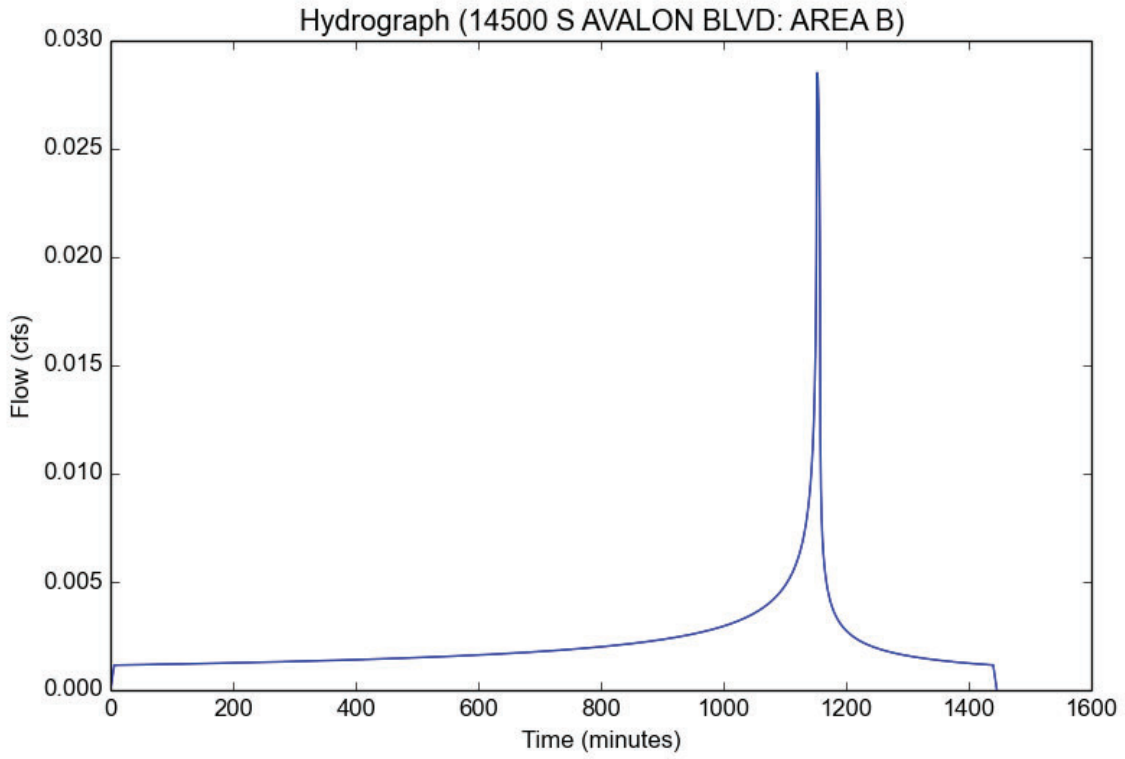
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/CALCS/LID/14500 S AVALON BLVD - AREA B - LID.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON BLVD
Subarea ID	AREA B
Area (ac)	0.065
Flow Path Length (ft)	56.0
Flow Path Slope (vft/hft)	0.02
85th Percentile Rainfall Depth (in)	0.89
Percent Impervious	1.0
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.89
Peak Intensity (in/hr)	0.4874
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	6.0
Burned Peak Flow Rate (cfs)	0.0285
24-Hr Clear Runoff Volume (ac-ft)	0.0043
24-Hr Clear Runoff Volume (cu-ft)	187.4341



Peak Flow Hydrologic Analysis

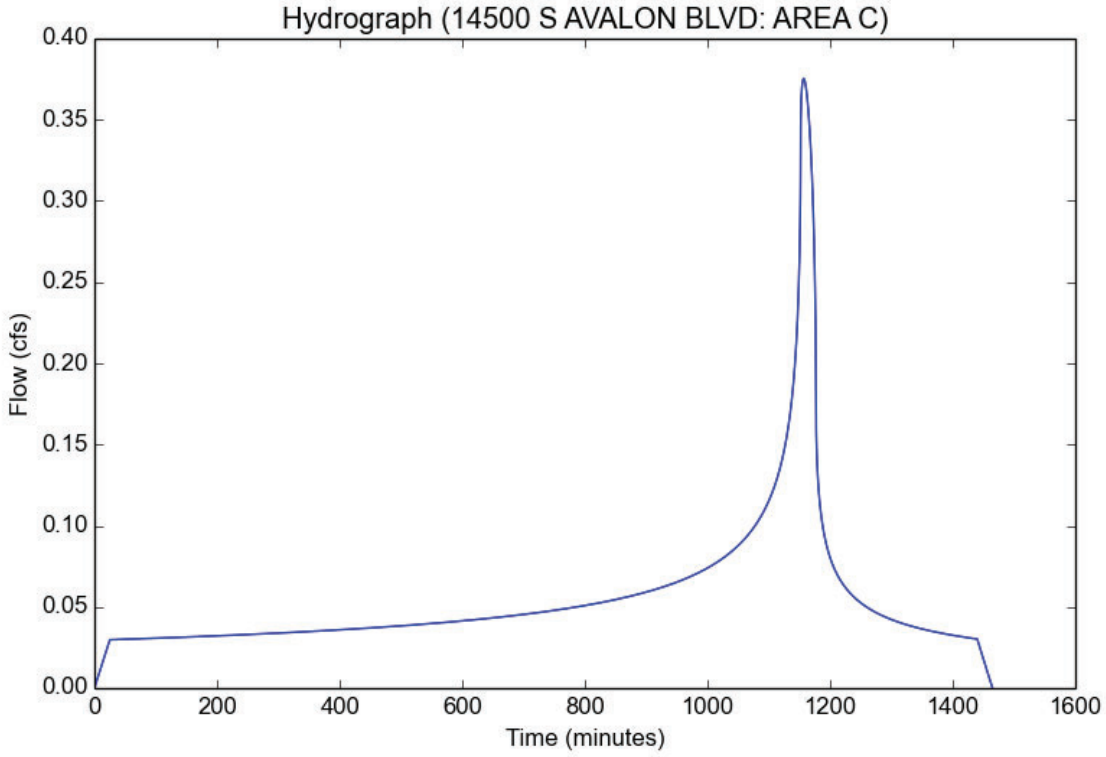
File location: S:/PROJECTS/4679.000 - 14500 S Avalon Blvd/1637/ENGR/DESIGN/SUSMP/DOCS/Tables/14500 S AVALON BLVD - AREA C - LID-02.p
Version: HydroCalc 1.0.3

Input Parameters

Project Name	14500 S AVALON BLVD
Subarea ID	AREA C
Area (ac)	1.781
Flow Path Length (ft)	459.5
Flow Path Slope (vft/hft)	0.01
85th Percentile Rainfall Depth (in)	0.89
Percent Impervious	0.932
Soil Type	13
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.89
Peak Intensity (in/hr)	0.2492
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.8456
Time of Concentration (min)	25.0
Burned Peak Flow Rate (cfs)	0.3753
24-Hr Clear Runoff Volume (ac-ft)	0.1108
24-Hr Clear Runoff Volume (cu-ft)	4825.3059



Appendix 2

STORMTECH UNDERGROUND INFILTRATION SYSTEM

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER	
ADS SALES REP	
PROJECT NO.	

Advanced Drainage Systems, Inc.

ADS SiteAssist™
FOR STORMTECH
INSTALLATION INSTRUCTIONS
VISIT OUR APP

AVALON

GARDENA, CA, USA

MC-4500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-4500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-4500 CHAMBER SYSTEM

1. STORMTECH MC-4500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR EXCAVATOR SITUATED OVER THE CHAMBERS. STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE SHALL BE BROUGHT UP EVENLY AROUND CHAMBERS SO AS NOT TO DISTORT THE CHAMBER SHAPE. STONE DEPTHS SHOULD NEVER DIFFER BY MORE THAN 12" (300 mm) BETWEEN ADJACENT CHAMBER ROWS.
10. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING.
11. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIAL BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
12. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-4500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-4500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

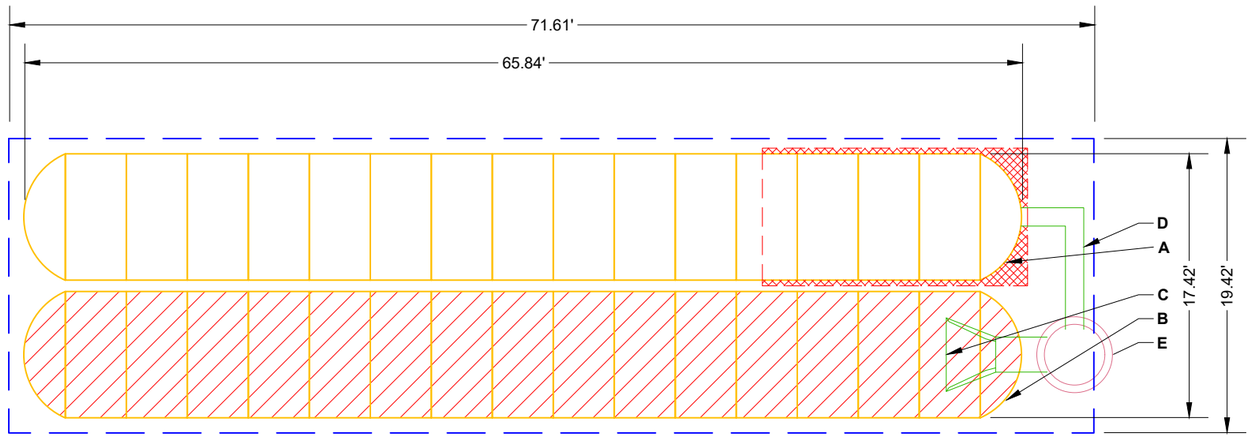
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

©2023 ADS, INC.

PROPOSED LAYOUT		PROPOSED ELEVATIONS:	
30	STORMTECH MC-4500 CHAMBERS	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED):	117.50
4	STORMTECH MC-4500 END CAPS	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC):	113.00
12	STONE ABOVE (in)	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC):	112.50
12	STONE BELOW (in)	MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT):	112.50
40	STONE VOID	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT):	112.50
5905	INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED) (COVER STONE INCLUDED) (BASE STONE INCLUDED)	TOP OF STONE:	111.50
		TOP OF MC-4500 CHAMBER:	110.50
		12" x 12" TOP MANIFOLD INVERT:	108.47
		24" ISOLATOR ROW PLUS INVERT:	105.69
1390	SYSTEM AREA (SF)	BOTTOM OF MC-4500 CHAMBER:	105.50
182.1	SYSTEM PERIMETER (ft)	BOTTOM OF STONE:	104.50

*INVERT ABOVE BASE OF CHAMBER

PART TYPE	ITEM ON LAYOUT	DESCRIPTION	INVERT*	MAX FLOW
PREFABRICATED END CAP	A	12" TOP PARTIAL CUT END CAP, PART#: MC4500IEPP12T / TYP OF ALL 12" TOP CONNECTIONS	35.69"	
PREFABRICATED END CAP	B	24" BOTTOM PARTIAL CUT END CAP, PART#: MC4500IEPP24B / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS	2.26"	
FLAMP	C	INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MCFLAMP		
MANIFOLD	D	12" x 12" TOP MANIFOLD, ADS N-12	35.69"	
CONCRETE STRUCTURE	E	(DESIGN BY ENGINEER / PROVIDED BY OTHERS)		2.5 CFS IN



ISOLATOR ROW PLUS
(SEE DETAIL)

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

AVALON
GARDENA, CA, USA

DATE:
DRAWN: VN
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

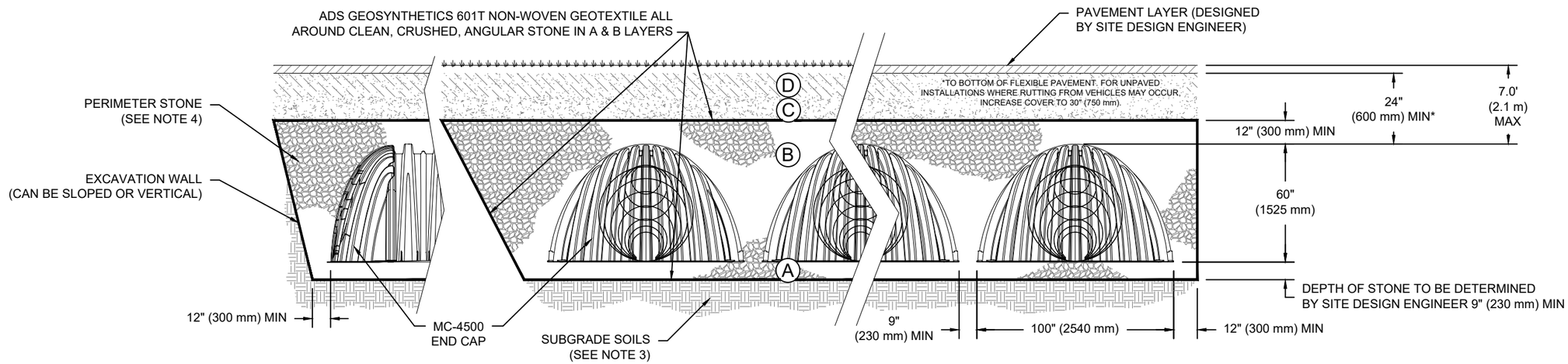
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

0 10 20

ACCEPTABLE FILL MATERIALS: STORMTECH MC-4500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 60x101
2. MC-4500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT SHALL BE GREATER THAN OR EQUAL TO 450 LBS/FT/%. THE ASC IS DEFINED IN SECTION 6.2.8 OF ASTM F2418. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

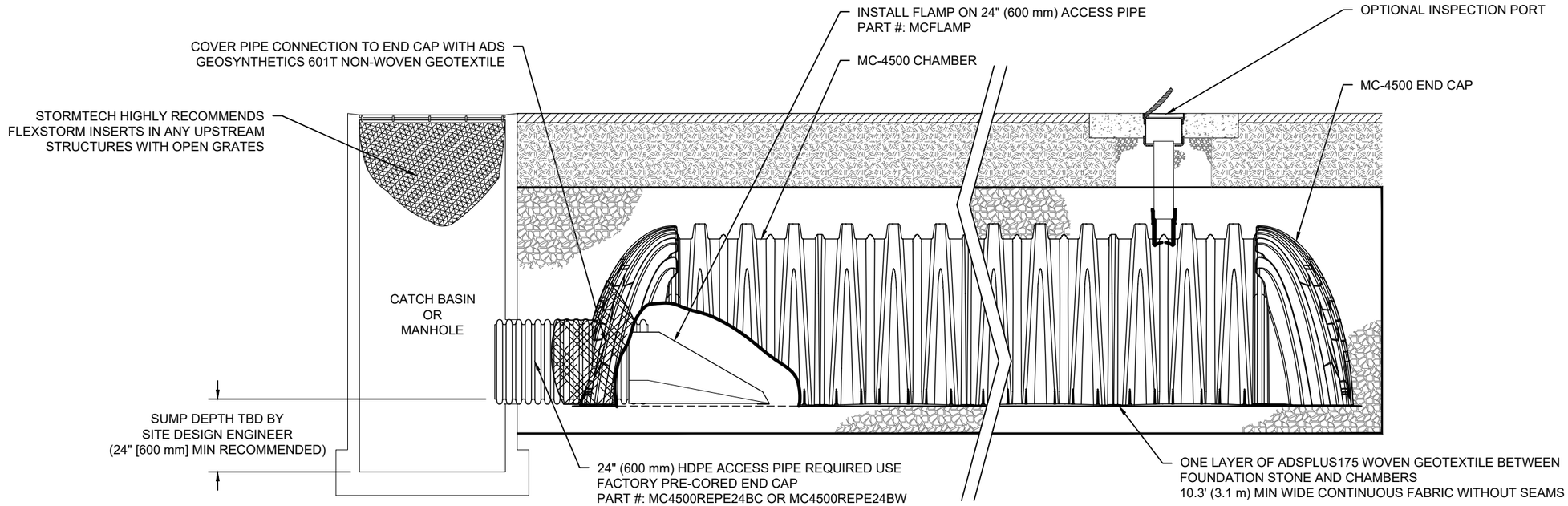
AVALON
GARDENA, CA, USA
DRAWN: VN
CHECKED: N/A
DATE:
PROJECT #:

DATE	DRW	CHK	DESCRIPTION

StormTech® Chamber System
888-892-2694 | WWW.STORMTECH.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.



MC-4500 ISOLATOR ROW PLUS DETAIL
NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.

2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.

AVALON
GARDENA, CA, USA
DATE:
DRAWN: VN
PROJECT #:
CHECKED: N/A

DESCRIPTION	CHK	DRW	DATE

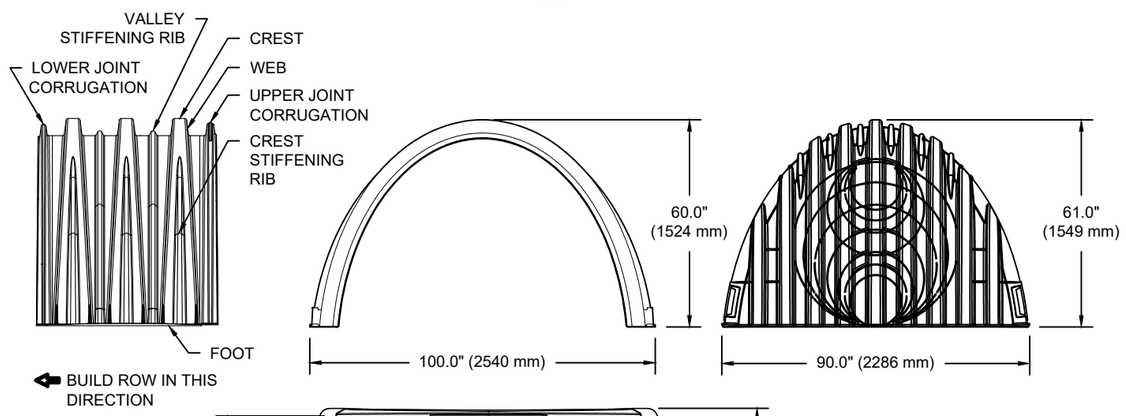
StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

MC-4500 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	100.0" X 60.0" X 48.3"	(2540 mm X 1524 mm X 1227 mm)
CHAMBER STORAGE	106.5 CUBIC FEET	(3.01 m³)
MINIMUM INSTALLED STORAGE*	162.6 CUBIC FEET	(4.60 m³)
WEIGHT (NOMINAL)	125.0 lbs.	(56.7 kg)

NOMINAL END CAP SPECIFICATIONS

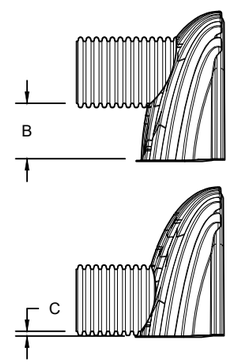
SIZE (W X H X INSTALLED LENGTH)	90.0" X 61.0" X 32.8"	(2286 mm X 1549 mm X 833 mm)
END CAP STORAGE	39.5 CUBIC FEET	(1.12 m³)
MINIMUM INSTALLED STORAGE*	115.3 CUBIC FEET	(3.26 m³)
WEIGHT (NOMINAL)	90 lbs.	(40.8 kg)

*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY.

PARTIAL CUT HOLES AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
PARTIAL CUT HOLES AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

PART #	STUB	B	C
MC4500IEPP06T	6" (150 mm)	42.54" (1081 mm)	---
MC4500IEPP06B		---	0.86" (22 mm)
MC4500IEPP08T	8" (200 mm)	40.50" (1029 mm)	---
MC4500IEPP08B		---	1.01" (26 mm)
MC4500IEPP10T	10" (250 mm)	38.37" (975 mm)	---
MC4500IEPP10B		---	1.33" (34 mm)
MC4500IEPP12T	12" (300 mm)	35.69" (907 mm)	---
MC4500IEPP12B		---	1.55" (39 mm)
MC4500IEPP15T	15" (375 mm)	32.72" (831 mm)	---
MC4500IEPP15B		---	1.70" (43 mm)
MC4500IEPP18T	18" (450 mm)	29.36" (746 mm)	---
MC4500IEPP18TW			
MC4500IEPP18B		---	1.97" (50 mm)
MC4500IEPP18BW			
MC4500IEPP24T	24" (600 mm)	23.05" (585 mm)	---
MC4500IEPP24TW			
MC4500IEPP24B		---	2.26" (57 mm)
MC4500IEPP24BW			
MC4500IEPP30BW	30" (750 mm)	---	2.95" (75 mm)
MC4500IEPP36BW	36" (900 mm)	---	3.25" (83 mm)
MC4500IEPP42BW	42" (1050 mm)	---	3.55" (90 mm)

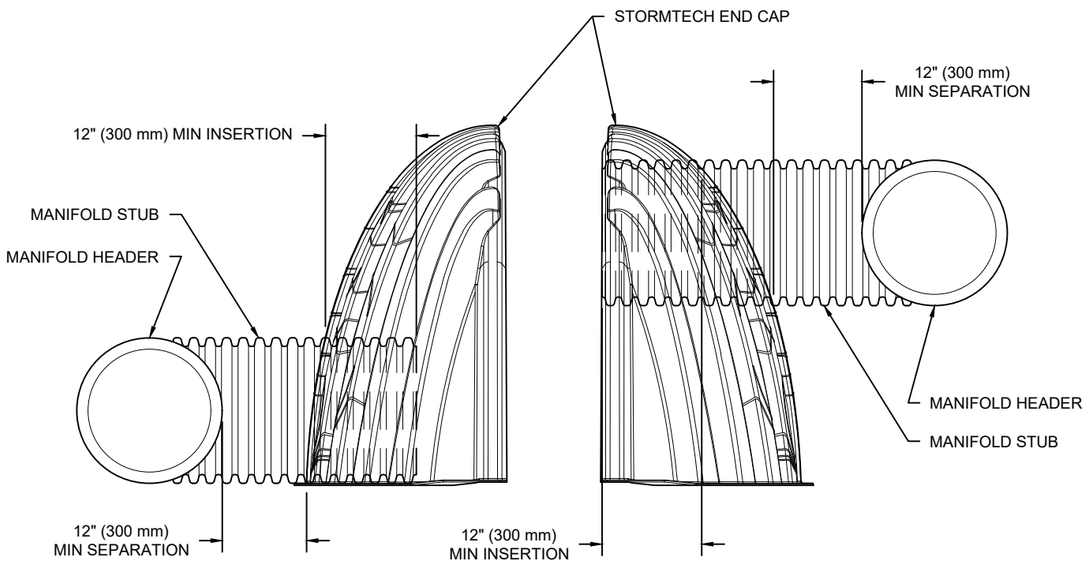
NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PARTIAL CUT INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS. CUSTOM INVERT LOCATIONS ON THE MC-4500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm). THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHEST POSSIBLE FOR THE PIPE SIZE.

MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

AVALON
GARDENA, CA, USA
DATE:
DRAWN: VN
PROJECT #:
CHECKED: N/A

DATE	DRW	CHK	DESCRIPTION

THIS DRAWING HAS BEEN PREPARED BASED ON INFORMATION PROVIDED TO ADS UNDER THE DIRECTION OF THE SITE DESIGN ENGINEER OR OTHER PROJECT REPRESENTATIVE. THE SITE DESIGN ENGINEER SHALL REVIEW THIS DRAWING PRIOR TO CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE SITE DESIGN ENGINEER TO ENSURE THAT THE PRODUCT(S) DEPICTED AND ALL ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

Project: **14500 S. Avalon Blvd**

Chamber Model -	MC-4500	
Units -	Imperial	
Number of Chambers -	30	
Number of End Caps -	4	
Voids in the stone (porosity) -	40	%
Base of Stone Elevation -	104.50	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	12	in

Area of system - 1390 sf Min. Area - 1232 sf min. area

StormTech MC-4500 Cumulative Storage Volumes

Height of System (inches)	Incremental Single Chamber (cubic feet)	Incremental Single End Cap (cubic feet)	Incremental Chambers (cubic feet)	Incremental End Cap (cubic feet)	Incremental Stone (cubic feet)	Incremental Ch, EC and Stone (cubic feet)	Cumulative System (cubic feet)	Elevation (feet)
84	0.00	0.00	0.00	0.00	46.35	46.35	5905.26	111.50
83	0.00	0.00	0.00	0.00	46.35	46.35	5858.91	111.42
82	0.00	0.00	0.00	0.00	46.35	46.35	5812.56	111.33
81	0.00	0.00	0.00	0.00	46.35	46.35	5766.21	111.25
80	0.00	0.00	0.00	0.00	46.35	46.35	5719.86	111.17
79	0.00	0.00	0.00	0.00	46.35	46.35	5673.52	111.08
78	0.00	0.00	0.00	0.00	46.35	46.35	5627.17	111.00
77	0.00	0.00	0.00	0.00	46.35	46.35	5580.82	110.92
76	0.00	0.00	0.00	0.00	46.35	46.35	5534.47	110.83
75	0.00	0.00	0.00	0.00	46.35	46.35	5488.12	110.75
74	0.00	0.00	0.00	0.00	46.35	46.35	5441.78	110.67
73	0.00	0.00	0.00	0.00	46.35	46.35	5395.43	110.58
72	0.04	0.01	1.23	0.05	45.84	47.12	5349.08	110.50
71	0.12	0.03	3.48	0.14	44.90	48.52	5301.96	110.42
70	0.16	0.05	4.94	0.21	44.29	49.44	5253.45	110.33
69	0.21	0.07	6.26	0.26	43.74	50.26	5204.01	110.25
68	0.27	0.08	8.05	0.33	42.99	51.38	5153.74	110.17
67	0.45	0.11	13.58	0.42	40.75	54.75	5102.37	110.08
66	0.67	0.13	19.96	0.53	38.15	58.64	5047.62	110.00
65	0.80	0.16	23.97	0.64	36.50	61.12	4988.98	109.92
64	0.91	0.19	27.24	0.75	35.15	63.15	4927.86	109.83
63	1.00	0.22	30.09	0.87	33.96	64.92	4864.71	109.75
62	1.09	0.25	32.62	0.99	32.90	66.51	4799.79	109.67
61	1.16	0.28	34.90	1.10	31.95	67.95	4733.27	109.58
60	1.23	0.30	37.02	1.21	31.06	69.28	4665.32	109.50
59	1.30	0.33	38.99	1.31	30.23	70.53	4596.04	109.42
58	1.36	0.35	40.83	1.42	29.45	71.70	4525.51	109.33
57	1.42	0.38	42.56	1.53	28.71	72.81	4453.81	109.25
56	1.47	0.41	44.20	1.64	28.01	73.85	4381.01	109.17
55	1.53	0.44	45.75	1.76	27.34	74.86	4307.16	109.08
54	1.57	0.47	47.23	1.88	26.70	75.81	4232.30	109.00
53	1.62	0.50	48.64	1.98	26.10	76.72	4156.48	108.92
52	1.67	0.52	49.99	2.08	25.52	77.59	4079.76	108.83
51	1.71	0.54	51.27	2.18	24.97	78.42	4002.17	108.75
50	1.75	0.57	52.50	2.27	24.44	79.21	3923.75	108.67
49	1.79	0.59	53.68	2.35	23.93	79.97	3844.54	108.58
48	1.83	0.61	54.82	2.44	23.45	80.70	3764.58	108.50
47	1.86	0.63	55.90	2.53	22.98	81.41	3683.87	108.42
46	1.90	0.64	56.95	2.57	22.54	82.06	3602.47	108.33
45	1.93	0.68	57.96	2.71	22.08	82.75	3520.41	108.25
44	1.96	0.70	58.92	2.80	21.66	83.38	3437.66	108.17
43	2.00	0.72	59.85	2.89	21.25	83.99	3354.28	108.08
42	2.03	0.74	60.75	2.97	20.86	84.58	3270.29	108.00
41	2.05	0.76	61.61	3.06	20.48	85.15	3185.70	107.92
40	2.08	0.79	62.44	3.14	20.11	85.70	3100.55	107.83
39	2.11	0.80	63.24	3.21	19.77	86.22	3014.85	107.75
38	2.13	0.82	64.02	3.28	19.43	86.73	2928.63	107.67
37	2.16	0.84	64.76	3.35	19.10	87.22	2841.91	107.58
36	2.18	0.85	65.48	3.41	18.80	87.68	2754.69	107.50
35	2.21	0.86	66.17	3.44	18.51	88.11	2667.01	107.42
34	2.23	0.89	66.83	3.56	18.19	88.58	2578.90	107.33
33	2.25	0.90	67.47	3.62	17.91	89.00	2490.32	107.25
32	2.27	0.92	68.08	3.67	17.65	89.40	2401.32	107.17
31	2.29	0.92	68.67	3.68	17.41	89.76	2311.93	107.08
30	2.31	0.94	69.24	3.77	17.14	90.15	2222.17	107.00
29	2.33	0.96	69.78	3.83	16.91	90.51	2132.02	106.92
28	2.34	0.97	70.30	3.87	16.68	90.85	2041.51	106.83
27	2.36	0.98	70.80	3.93	16.46	91.18	1950.65	106.75
26	2.38	0.97	71.27	3.88	16.28	91.44	1859.47	106.67
25	2.39	1.00	71.73	4.01	16.05	91.79	1768.03	106.58
24	2.41	1.01	72.16	4.04	15.86	92.07	1676.24	106.50
23	2.42	1.02	72.58	4.08	15.68	92.34	1584.16	106.42
22	2.43	1.03	72.97	4.12	15.51	92.60	1491.82	106.33
21	2.44	1.04	73.35	4.15	15.35	92.85	1399.21	106.25
20	2.46	1.05	73.70	4.19	15.19	93.08	1306.37	106.17
19	2.47	1.05	74.03	4.22	15.05	93.30	1213.29	106.08
18	2.48	1.05	74.35	4.20	14.93	93.48	1119.99	106.00
17	2.49	1.06	74.65	4.23	14.80	93.67	1026.51	105.92
16	2.50	1.08	74.93	4.30	14.66	93.89	932.84	105.83
15	2.51	1.08	75.20	4.33	14.54	94.06	838.95	105.75
14	2.51	1.09	75.44	4.35	14.43	94.22	744.89	105.67
13	2.53	1.11	75.81	4.43	14.25	94.49	650.66	105.58
12	0.00	0.00	0.00	0.00	46.35	46.35	556.18	105.50
11	0.00	0.00	0.00	0.00	46.35	46.35	509.83	105.42
10	0.00	0.00	0.00	0.00	46.35	46.35	463.48	105.33
9	0.00	0.00	0.00	0.00	46.35	46.35	417.13	105.25
8	0.00	0.00	0.00	0.00	46.35	46.35	370.78	105.17
7	0.00	0.00	0.00	0.00	46.35	46.35	324.44	105.08
6	0.00	0.00	0.00	0.00	46.35	46.35	278.09	105.00
5	0.00	0.00	0.00	0.00	46.35	46.35	231.74	104.92
4	0.00	0.00	0.00	0.00	46.35	46.35	185.39	104.83
3	0.00	0.00	0.00	0.00	46.35	46.35	139.04	104.75
2	0.00	0.00	0.00	0.00	46.35	46.35	92.70	104.67
1	0.00	0.00	0.00	0.00	46.35	46.35	46.35	104.58

Appendix 3

Geotechnical Investigation Report

NorCal Engineering
Soils and Geotechnical Consultants
Los Alamitos, California 90720
(562)799-9469

January 4, 2024 Project Number 22746-21

County of Los Angeles Department of Public Works
Geotechnical and Materials Engineering Division
900 S. Fremont Avenue
Alhambra, California 91803

Attn.: Mr. Davis Vo

RE: **Response to County Geologic and Geotechnical Engineering Review Sheet** - Proposed Truck Storage Development - Located at 14500 S. Avalon Boulevard, Gardena, California

Dear Mr. Vo:
Submitted herewith is response to the recent Los Angeles Geologic and Soils Engineering Review Sheet dated December 11, 2023 of our Geotechnical Engineering Investigation report for the above referenced project. The following items are provided in the same order of the review sheet for clarity.

Response to Item No. 1
The flow rate and percolation rate from our two (2) field tests were computed with our calculations given in Appendix A.

Response to Item No. 2
A total reduction factor of 3.0 should be used to calculate the design infiltration rates, as listed below.

Reduction Factors

a) $RF_t = Rf = 1.0$ for small diameter borings.

b) $RF_v = 1.0$ for site variability.

c) $RF_s = 1.0$ for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Based upon the results of our field testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following infiltration rates.

Boring/Test No.	Depth	Soil Classification	Field Infiltration Rate	Design Rate
B-1/TH-1	5'	Silty CLAY	0.11 in/hr	0.04 in/hr
B-2/TH-2	10'	Sandy SILT	2.16 in/hr	0.72 in/hr

Response to Item No. 3
This County of Los Angeles response report will be submitted through the web portal https://epicla.lacounty.gov/SelfService/#/home per your request.

Response to Item No. S8
A copy of the review sheet is attached.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING



Keith D. Tucker
Project Engineer
R.G.E. 841

Scott D. Spensiero
Project Manager

Dist. Office 7.0
PCA L000539LID
EPIC LA ESTU2023000640
Telephone: (626) 458-4925
Email: GMEDSubmittals@dpw.lacounty.gov

Los Angeles County Public Works
Geotechnical and Materials Engineering Division
GEOLOGIC AND GEOTECHNICAL ENGINEERING REVIEW SHEET
900 S. Fremont Avenue, Alhambra, CA 91803

Tract / Parcel Map		**Lot(s)**		**Parent Tract**	
Site Address	14500 Avalon Boulevard	**Location**	Gardena	**APN**	6137005032
Geologist		**Developer/Owner**	Cataldo & Associates		
Soils Engineer	NorCal Engineering	**Engineer/Arch.**	DCA Civil Engineering		

Review of:

C.U.P. No.: RPPL2021008074 For: New two 5,547sf. story building and truck trailer parking – for LID purposes
Submittal Received by GMED: **11/02/2023**

Geologic Report(s) Dated:
Soils Engineering Report(s) Dated: **08/23/2021**
Geotechnical Report(s) Dated:
References: 09/29/2023 (Hydrology Report – DCA)

REMARKS:

1. Provide a field infiltration rate based on change in volume divided by (wetted area and time interval).

2. Provide a design infiltration rate based on reduction factors (RF_t, RF_v, and RF_s) in accordance with County of Los Angeles Administrative Manual GS200.1.

3. Please submit documents in response to this review to the EPIC-LA plan case: ESTU2023000640 using the EPIC-LA system at the following URL: https://epicla.lacounty.gov/SelfService/#/home. Contact GMED at GMEDSubmittals@dpw.lacounty.gov or call (626) 458-4925 if documents cannot be uploaded to the plan case.

S8. Include a copy of this review sheet with your response.

Prepared by

REGISTERED PROFESSIONAL ENGINEER · DAVIS VO · C 94547 · CIVIL · STATE OF CALIFORNIA

Davis Vo
Geotechnical Section

-
--

Date 12/11/2023

Please complete a Customer Service Survey at http://dpw.lacounty.gov/go/gmedsurvey
NOTICE: Public safety, relative to geotechnical subsurface exploration, shall be provided in accordance with current codes for excavations, inclusive of the Los Angeles County Code, Chapter 11.48, and the State of California, Title 8, Construction Safety Orders.

Appendix A

Test Hole	Time Period (min)	(Δh) Water Drop (in)	Volume of Water (in^3)	Flow Rate (in^3/min)	(Z_{ave}) Head of Water (in)	Perimeter Area (in^2)	Perc. Rate (in/hr)
TH-1	30	0.5	14.1	0.47	11.75	249.7	0.11 ←
TH-2	10	3.5	99.1	9.91	10.75	230.8	2.58
		3.0	84.9	8.49	11.0	235.5	2.16 ←

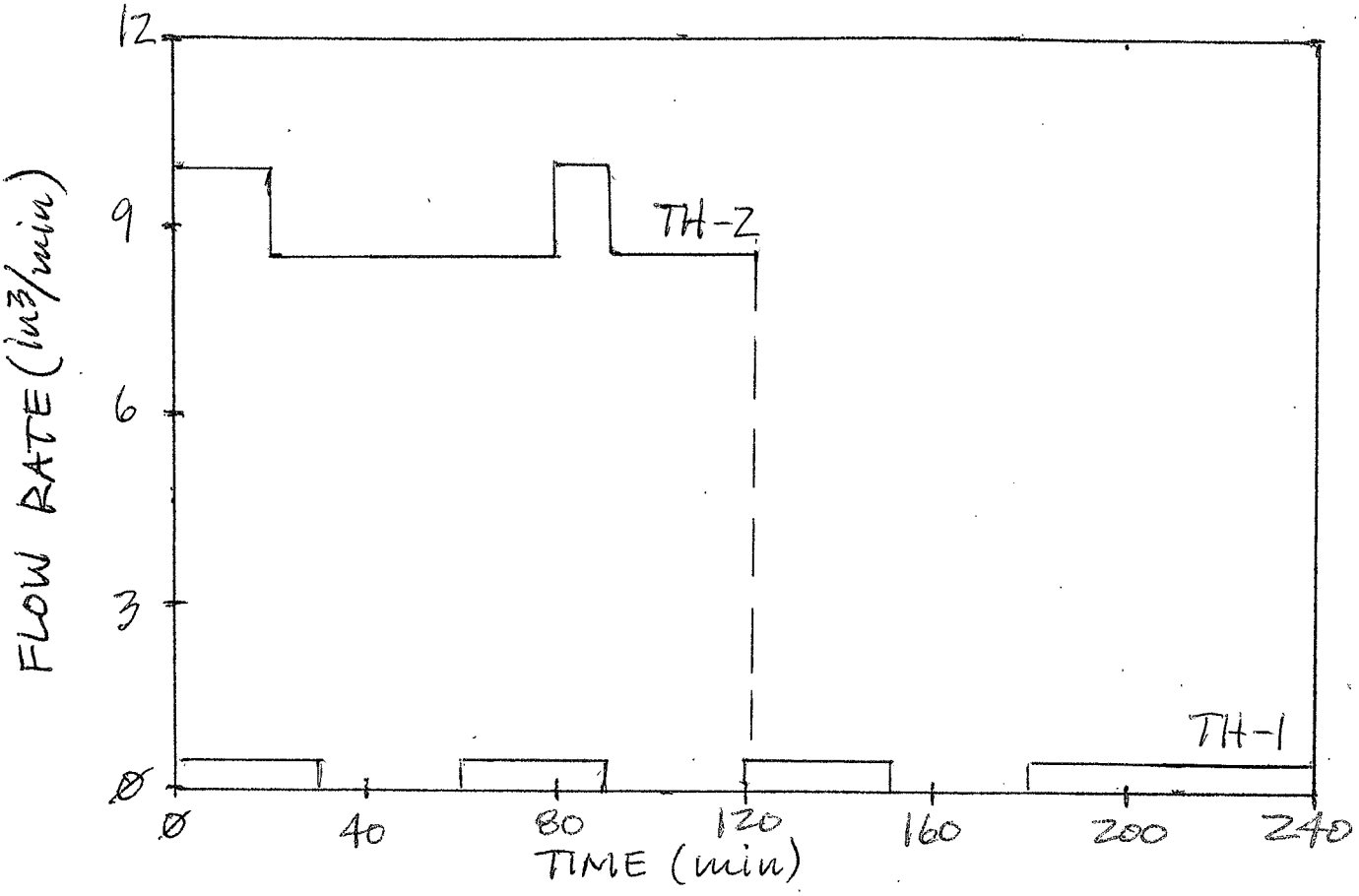
Volume of Water = $\pi/4\,(Dia)^2\,\Delta h$

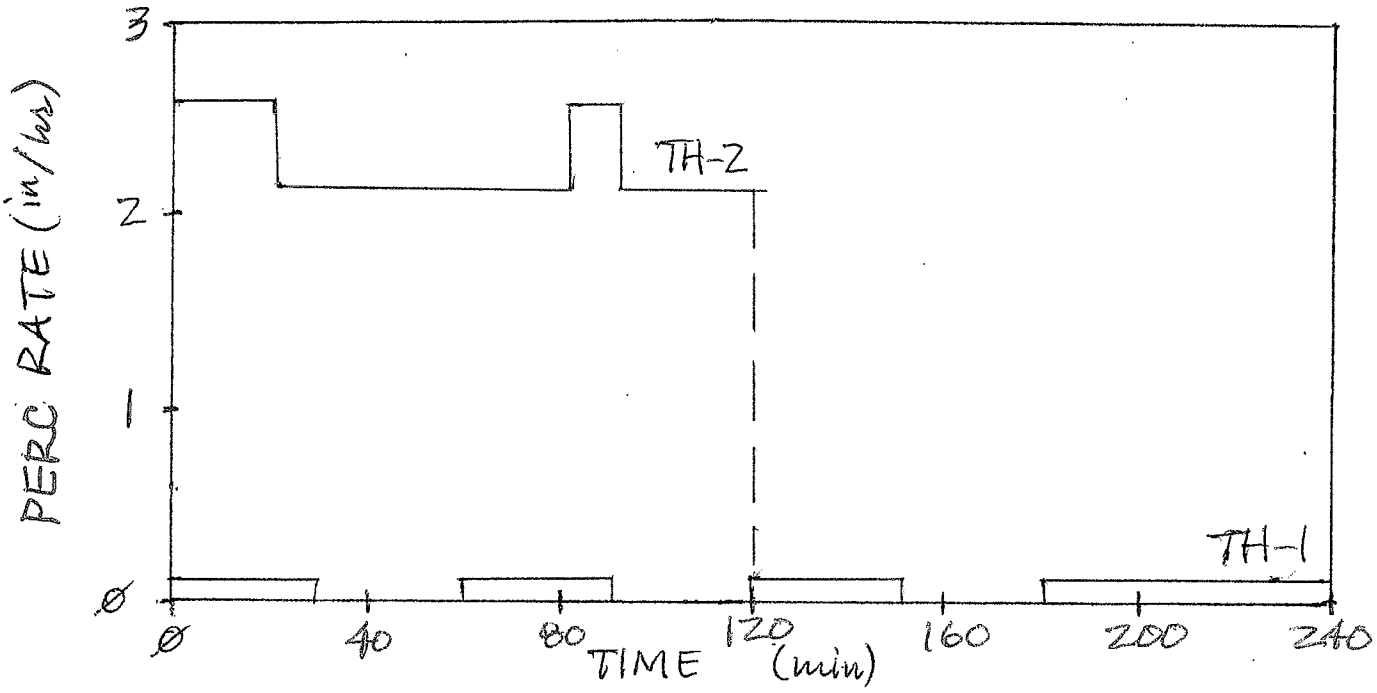
Perimeter Area = $\pi(Dia)(Z_{ave}) + \pi/4\,(Dia)^2$

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT:

DATE:





NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT:	DATE:

Geotechnical Engineering Investigation

Proposed Truck Storage Development
14500 S. Avalon Boulevard, Gardena
County of Los Angeles, California

Cataldo & Associates
835 Mission Street
South Pasadena, California 91030

Attn: Mr. Edwin Cruz

Project Number 22746-21
August 23, 2021

NorCal Engineering

NorCal Engineering

Soils and Geotechnical Consultants
10641 Humbolt Street Los Alamitos, CA 90720
(562) 799-9469 Fax (562) 799-9459

August 23, 2021

Project Number 22746-21

Cataldo & Associates
835 Mission Street
South Pasadena, California 91030

Attn: Mr. Edwin Cruz

RE: **Geotechnical Engineering Investigation** - Proposed Truck Storage Development - Located at 14500 S. Avalon Boulevard, Gardena, in the County of Los Angeles, California

Dear Mr. Cruz:

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of our proposal dated July 2, 2021. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed truck storage facility.

The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) soil infiltration testing; 5) engineering analysis of field and laboratory data; 6) preparation of a geotechnical engineering report. It is the opinion of this firm that the proposed development is feasible from a geotechnical standpoint provided that the recommendations presented in this report are followed in the design and construction of the project.

1.0 Project Description

It is proposed to construct truck storage development consisting of a 40' X 60' building as shown on the attached Site Plan. The proposed structure will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will include asphalt and concrete pavement areas, site walls, hardscape and landscaping. It is assumed that the proposed grading for the development will consist of minor cut and fill procedures on the order of a few feet to achieve finished grade elevations. Final building plans shall be reviewed by this firm prior to submittal for city/county approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

2.0 Site Description

The 2.0-acre subject property is located within the south 14500 block and east side of Avalon Street, Gardena area, in the County of Los Angeles. The generally flag-shaped parcel is elongated in an east to west direction and is relatively level in topography. The site is slightly elevated from its neighboring properties with descending slopes on the order of 5 to 10 feet in height along the east, west and south property perimeter. The site was a former utility storage yard and is currently under demolition operations consisting of the removal of buildings and pavement.

3.0 Site Exploration

The investigation consisted of the placement of seven (7) subsurface exploratory borings by a truckmounted hollow stem auger to depths ranging between 5 and 20 feet below current ground elevations. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached plan.

The exploratory borings revealed the existing earth materials to consist of fill and natural soil. Detailed descriptions of the subsurface conditions are listed on the boring logs in Appendix A. It should be noted that the transition from one soil type to another as shown on the trench logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying as a brown, silty CLAY was encountered to a depth of 1 to 2 feet below ground surface. These soils were noted to be soft and damp to moist. Exploratory Boring B-6 encountered fill soils to a depth of 6 feet which was classified as a silty CLAY and was observed to be firm to stiff and moist. A layer of pulverized asphalt was noted at the ground surface along a majority of our borings.

Natural: A natural undisturbed soil classifying as a brown to grey brown, silty CLAY to a sandy SILT was encountered beneath the fill soils. The native soils were observed to be stiff and moist. Deeper soils consisted of a clayey SILT to a silty SAND which were noted to be stiff to dense and moist.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was not encountered to the depths of our borings and no caving occurred.

4.0 Laboratory Tests

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These relatively undisturbed ring samples were obtained by driving a thin-walled steel sampler lined with one-inch long brass rings with an inside diameter of 2.42 inches into the undisturbed soils. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests. All test results are included in Appendix B, unless otherwise noted.

4.1 **Field Moisture Content** (ASTM: D 2216) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.

4.2 **Maximum Density tests** (ASTM: D 1557) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.

4.3 **Expansion Index tests** (ASTM: D 4829) were performed on remolded samples of the upper soils to determine expansive characteristics. Results of these tests are provided on Table II.

4.4 **Atterberg Limits** (ASTM: D 4318) consisting of liquid limit, plastic limit and plasticity index were performed on representative soil samples. Results are shown on Table III.

4.5 **Corrosion tests** consisting of sulfate, pH, resistivity and chloride analysis to determine potential corrosive effects of soils on concrete and underground utilities. Test results are provided on Table IV.

4.6 **R-Value test** per California Test Method 301 was performed on a representative sample, which may be anticipated to be near subgrade to determine pavement design. Results are provided within the pavement design section of the report.

4.7 **Direct Shear tests** (ASTM: D 3080) were performed on undisturbed and/or remolded samples of the subsurface soils. The test is performed under saturated conditions at loads of 1,000 lbs./sq.ft., 2,000 lbs./sq.ft., and 3,000 lbs./sq.ft. with results shown on Plate A.

4.8 **Consolidation tests** (ASTM: D 2435) were performed on undisturbed samples to determine the differential and total settlement which may be anticipated based upon the proposed loads. Water was added to the samples at a surcharge of one KSF and the settlement curves are plotted on Plates B and C.

5.0 Seismicity Evaluation

The proposed development lies within an Alquist Priolo Special Studies Zone as shown on the attached fault map in Appendix C. The Avalon-Compton fault segment of the Newport-Inglewood fault zone consists of two branches trending in a northwest to southeast direction and located approximately 50 feet to 130 feet from the subject site and capable of producing a Maximum Moment Magnitude 7.1 earthquake. Any proposed building will require to be setback a minimum horizontal distance of 50 feet from an active fault.

Ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults. The following seismic design acceleration parameters are provided on the following page and are based upon the 2019 California Building Code (CBC) for the referenced project. The data was obtained from the American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/.

Seismic Design Acceleration Parameters

Latitude	33.900
Longitude	-118.264
Site Class	D
Risk Category	II
Mapped Spectral Response Acceleration	S_S = 1.789 S_1 = 0.636
Adjusted Maximum Acceleration	S_{MS} = 1.789
Design Spectral Response Acceleration Parameters	S_{DS} = 1.193
Peak Ground Acceleration	PGA_M = 0.849

Use of these values is dependent on requirements of ASCE 7-16, 11-4.8, Exception 2 that requires the value of the seismic response coefficient C_s be determined by Equation 12.8.2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either 12.8-3 for $T_L \geq T \geq 1.5T_s$ or Equation 12.8-4 for $T > T_L$. Computations and verification of these conditions is referred to the structural engineer.

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of Southern California area. It is during severe ground shaking that loose, granular soils below the groundwater table can liquefy. Based upon information in the California Division of Mines and Geology "Seismic Hazard Zone Map – Inglewood Quadrangle", dated March 25, 1999, the subject site is not situated in an area of historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions to indicate a potential for permanent ground displacement.

7.0 Infiltration Characteristics

Infiltration tests within the site were performed to provide preliminary infiltration rates for the purpose of planning and design of an on-site water disposal system field testing per County of Los Angeles Department of Public Works (LADPW) – Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration dated June 20, 2017. A truck mounted Simco 2800 Drill Rig equipped with a hollow stem auger was used to excavate the exploratory borings (B-1 and B-2) to depths of 5 and 10 feet below existing ground surface within the proposed infiltration areas. The borings consisted of six-inch diameter test holes. A three-inch diameter perforated PVC casing with solid end cap was installed in the borings and then surrounded with gravel materials to prevent caving.

The infiltration holes were carefully filled with clean water and refilled after two initial readings. Based upon the initial rates of infiltration at each location, test measurements were measured at selected maximum intervals thereafter. Measurements were obtained by using an electronic tape measure with 1/16-inch divisions and timed with a stopwatch. The field infiltration rate was computed using a reduction factor – R_f based on the field measurements with our calculations given in Appendix D. Based upon the results of our testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following infiltration rates.

Boring/Test No.	Depth	Soil Classification	Field Infiltration Rate	Design Rate
B-1/TH-1	5'	Silty CLAY	0.2 in/hr	0.1 in/hr
B-2/TH-2	10'	Sandy SILT	4.0 in/hr	2.0 in/hr

The correction factors CF_t, CF_v and CF_s are given below based on soils at 5 and 10 feet from our field tests.

a) $CF_t = Rf = 4.5$ and 4.92 for our two infiltration test holes.

b) $CF_v = 1.0$ based on uniform soils encountered in two borings for infiltration tests.

c) $CF_s = 2.0$ for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Based on the results of our field testing, the subsurface soils encountered in the proposed on-site drainage disposal system shall utilize the design infiltration rates based on the safety factor required by the city/county standard. Based on the California Division of Mines and Geology Seismic Hazard Zone Report for the Inglewood 7.5 Minute Quadrangle, the site is mapped with a historic groundwater depth greater than 30 feet deep.

All systems must meet the latest city and/or county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements. It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

8.0 Conclusions and Recommendations

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

The following recommendations are based upon soil conditions encountered in our field investigation; these near-surface soil conditions could vary across the site. Variations in the soil conditions may not become evident until the commencement of grading operations for the proposed development and revised recommendations from the soils engineer may be necessary based upon the conditions encountered.

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

8.1 Site Grading Recommendations

Any vegetation and/or demolition debris shall be removed and hauled from proposed grading areas prior to the start of grading operations. Existing vegetation shall not be mixed or disced into the soils. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) is removed. Grading operations shall be performed in accordance with the attached *Specifications for Placement of Compacted Fill.*

8.1.1 Removal and Recompaction Recommendations

All disturbed soils and/or fill (about 1 to 2 feet below ground surface) shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D-1557) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

In areas within proposed pavement areas that are underlain by deep fills, it is recommended that an engineered fill blanket be placed beneath the proposed pavement. The upper three feet beneath proposed subgrade shall be removed to competent material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D 1557) prior to placement of any additional compacted fill soils. Theses areas will require to be assessed in the field and additional recommendations may be warranted as necessary.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be treated as discussed earlier. A diligent search shall also be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If encountered, these structures and lines shall be either removed or properly abandoned prior to the proposed construction.

Any imported fill material should be preferably soil similar to the upper soils encountered at the subject site. All soils shall be approved by this firm prior to importing at the site and will be subjected to additional laboratory testing to assure concurrence with the recommendations stated in this report.

If placement of slabs-on-grade and pavement is not completed immediately upon completion of grading operations, additional testing and grading of the areas may be necessary prior to continuation of construction operations. Likewise, if adverse weather conditions occur which may damage the subgrade soils, additional assessment by the soils engineer as to the suitability of the supporting soils may be needed.

Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

8.1.2 Fill Blanket Recommendations

Due to the potential for differential settlement of foundations placed on compacted fill and native materials, it is recommended that all foundations including floor slab areas be underlain by a uniform compacted fill blanket at least two feet in thickness. This fill blanket shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

8.2 Shrinkage and Subsidence

Results of our in-place density tests reveal that the soil shrinkage will be less than 5% due to excavation and recompaction, based upon the assumption that the fill is compacted to 92% of the maximum dry density per ASTM standards. Subsidence should be 0.2 feet die to earthwork operations. The volume change does not include any allowance for vegetation or organic stripping, removal of subsurface improvements, or topographic approximations.

Although these values are only approximate, they represent our best estimate of lost yardage, which will likely occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field testing the actual equipment and grading techniques should be conducted.

8.3 Temporary Excavations

Temporary unsurcharged excavations in the existing site materials may be made at vertical inclinations up to 4 feet in height unless cohesionless soils are encountered. In areas where soils with little or no binder are encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring or flatter excavations may be required. The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of the soils engineer, CAL-OSHA and other public agencies having jurisdiction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase.

8.4 Foundation Design

All foundations may be designed utilizing an allowable bearing capacity of 2,000 psf for an embedded depth of 24 inches into approved engineered fill. The bearing value may be increased by 500 psf for each additional foot of depth in excess of the 24-inch minimum depth, up to a maximum of 4,000 psf. A one-third increase may be used when considering short-term loading and seismic forces.

Any foundations located along property line or where lateral overexcavation is not possible may utilize an allowable bearing capacity of 1,500 psf embedded into competent native soils. Any foundations located near adjacent slopes shall meet all setback criteria per the latest California Building Code (CBC) standards. All foundations shall be reinforced a minimum of two No. 4 bars, top and bottom.

8.5 **Settlement Analysis**

Resultant pressure curves for the consolidation tests are shown on Plates B and C. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of ¾ inch and differential settlements of less than ¼ inch.

8.6 **Lateral Resistance**

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the California Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.35

Equivalent Passive Fluid Pressure = 200 lbs./cu.ft.

Maximum Passive Pressure = 2,000 lbs./cu.ft.

The passive pressure recommendations are valid only for approved compacted fill soils or competent native materials.

8.7 **Retaining Wall Design Parameters**

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **granular backfill material** placed behind the walls at various ground slopes above the walls.

Surface Slope of Retained Materials (Horizontal to Vertical	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. An equivalent fluid pressure of 45 pcf may be utilized for the restrained wall condition with a level grade behind the wall.

The seismic-induced lateral soil pressure for walls greater than 6 feet may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of (20 pcf) H where H is the height of the retained soils above the wall footing should be used in final design of retaining walls. Sliding resistance values and passive fluid pressure values may be increased by 1/3 during short-term wind and seismic loading conditions.

All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system. The subsurface drainage system shall consist of a four-inch diameter perforated PVC pipe encased with gravel and wrapped with filter fabric. The granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved select granular soil with a sand equivalency greater than 30. This backfill zone of free draining material shall consist of a wedge beginning a minimum of one horizontal foot from the base of the wall extending upward at an inclination of no less than ¾ to 1 (horizontal to vertical).

8.8 Slab Design

All concrete slabs shall be a minimum of five inches in thickness in the proposed office and hardscape areas both reinforced a minimum of No. 4 bars, sixteen inches in each direction and positioned in the center of slab and placed on approved subgrade soils. All subgrade soils shall be moisture conditioned to 3% over optimum moisture content to a depth eighteen inches.

A vapor retarder (10-mil minimum thickness) should be utilized in areas which would be sensitive to the infiltration of moisture. This retarder shall meet requirements of ASTM E 96, *Water Vapor Transmission of Materials* and ASTM E 1745, *Standard Specification for Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs.* The vapor retarder shall be installed in accordance with procedures stated in ASTM E 1643, *Standard practice for Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slabs.*

The moisture retarder may be placed directly upon compacted subgrade soils conditioned to near optimum moisture levels, although one to two inches of sand beneath the membrane is desirable. The subgrade upon which the retarder is placed shall be smooth and free of rocks, gravel or other protrusions which may damage the retarder. Use of sand above the retarder is under the purview of the structural engineer; if sand is used over the retarder, it should be placed in a dry condition.

8.9 Pavement Section Design

The table below provides a preliminary pavement design based upon an R-Value of 10 for the subgrade soils for the proposed pavement areas. Final pavement design may need to be based on R-Value testing of the subgrade soils near the conclusion of site grading to assure that these soils are consistent with those assumed in this preliminary design.

The recommendations are based upon estimated traffic loads. Client should submit any other anticipated traffic loadings to the geotechnical engineer, if necessary, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.5	5.0
Heavy Truck Access	7.0	4.0	16.0

Any concrete slab-on-grade in pavement areas shall be a minimum of seven inches in thickness and placed on approved subgrade soils. All pavement areas shall have positive drainage toward an approved outlet from the site. Drain lines behind curbs and/or adjacent to landscape areas should be considered by client and the appropriate design engineers to prevent water from infiltrating beneath pavement. If such infiltration occurs, damage to pavement, curbs and flow lines, especially on sites with expansive soils, may occur during the life of the project.

Any approved base material shall consist of a Class II aggregate or equivalent and should be compacted to a minimum of 95% relative compaction. All pavement materials shall conform to the requirements set forth by the County of Los Angeles. The base material; and asphaltic concrete should be tested prior to delivery to the site and during placement to determine conformance with the project specifications. A pavement engineer shall designate the specific asphalt mix design to meet the required project specifications.

8.10 Utility Trench and Excavation Backfill

Trenches from installation of utility lines and other excavations may be backfilled with on-site soils or approved imported soils compacted to a minimum of 90% relative compaction. All utility lines shall be properly bedded with clean sand having a sand equivalency rating of 30 or more. This bedding material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

8.11 Corrosion Design Criteria

Representative samples of the surficial soils, typical of the subgrade soils expected to be encountered within foundation excavations and underground utilities were tested for corrosion potential. The minimum resistivity value obtained for the samples tested is representative of an environment that may be severely corrosive to metals. The soil pH value was considered mildly acidic and may not have a significant effect on soil corrosivity. Consideration should be given to corrosion protection systems for buried metal such as protective coatings, wrappings or the use of PVC where permitted by local building codes.

According to Table 4.3.1 of ACI 318 Building Code and Commentary, these contents revealed negligible sulfate concentrations. Therefore, a Type II cement according to latest CBC specifications may be utilized for building foundations at this time. It is recommended that additional sulfate tests be performed at the completion of site grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Corrosion test results may be found on the attached Table IV.

8.12 **Expansive Soil**

Since expansive soils were encountered, special attention should be given to the project design and maintenance. The attached *Expansive Soil Guidelines* should be reviewed by the engineers, architects, owner, maintenance personnel and other interested parties and considered during the design of the project and future property maintenance.

9.0 Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and soil engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

Keith D. Tucker
Project Engineer
R.G.E. 841

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/2022
GEOTECHNICAL
STATE OF CALIFORNIA

Scott D. Spensiero
Project Manager

References

1. American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/

2. California Building Code, 2019.

3. Earthquake Zones of Required Investigation, Seismic Hazard Zones, Inglewood Quadrangle, published by the California Geological Survey.

4. California Division of Mines and Geology, 1998, Seismic Hazard Zone for the Inglewood 7.5-Minute Quadrangle, Los Angeles County, California - Seismic Hazard Zone Report 98-27.

5. California Division of Mines and Geology, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: Special Publication 117A.

6. State of California, 1986, Special Studies Zones, Inglewood Quadrangle, 7.5 Minute Series.

7. Ziony, J.L and Yerkes, R.F., 1985 Evaluating Earthquake and Surface-Faulting Potential, Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective: United States Geological Survey Professional Paper 1360.

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Excavation

Any existing low-density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Geotechnical Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557).

In any area where a transition between fill and native soil or between bedrock and soil are encountered, additional excavation beneath foundations and slabs will be necessary in order to provide uniform support and avoid differential settlement of the structure.

Material for Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Geotechnical Engineering firm a minimum of 72 hours prior to importation of site.

Placement of Compacted Fill Soils

The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 2% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Geotechnical Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Geotechnical Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Geotechnical Engineering firm as deemed necessary. A 24-hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Geotechnical Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.

EXPANSIVE SOIL GUIDELINES

The following expansive soil guidelines are provided for your project. The intent of these guidelines is to inform you, the client, of the importance of proper design and maintenance of projects supported on expansive soils. ***You, as the owner or other interested party, should be warned that you have a duty to provide the information contained in the soil report including these guidelines to your design engineers, architects, landscapers and other design parties in order to enable them to provide a design that takes into consideration expansive soils.***

In addition, you should provide the soil report with these guidelines to any property manager, lessee, property purchaser or other interested party that will have or assume the responsibility of maintaining the development in the future.

Expansive soils are fine-grained silts and clays which are subject to swelling and contracting. The amount of this swelling and contracting is subject to the amount of fine-grained clay materials present in the soils and the amount of moisture either introduced or extracted from the soils. Expansive soils are divided into five categories ranging from "very low" to "very high". Expansion indices are assigned to each classification and are included in the laboratory testing section of this report. *If the expansion index of the soils on your site, as stated in this report, is 21 or higher, you have expansive soils.* The classifications of expansive soils are as follows:

Classification of Expansive Soil*

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

*From Table 18A-I-B of California Building Code (1988)

When expansive soils are compacted during site grading operations, care is taken to place the materials at or slightly above optimum moisture levels and perform proper compaction operations. Any subsequent excessive wetting and/or drying of expansive soils will cause the soil materials to expand and/or contract. These actions are likely to cause distress of foundations, structures, slabs-on-grade, sidewalks and pavement over the life of the structure. ***It is therefore imperative that even after construction of improvements, the moisture contents are maintained at relatively constant levels, allowing neither excessive wetting or drying of soils.***

Evidence of excessive wetting of expansive soils may be seen in concrete slabs, both interior and exterior. Slabs may lift at construction joints producing a trip hazard or may crack from the pressure of soil expansion. Wet clays in foundation areas may result in lifting of the structure causing difficulty in the opening and closing of doors and windows, as well as cracking in exterior and interior wall surfaces. In extreme wetting of soils to depth, settlement of the structure may eventually result. Excessive wetting of soils in landscape areas adjacent to concrete or asphaltic pavement areas may also result in expansion of soils beneath pavement and resultant distress to the pavement surface.

Excessive drying of expansive soils is initially evidenced by cracking in the surface of the soils due to contraction. Settlement of structures and on-grade slabs may also eventually result along with problems in the operation of doors and windows.

Projects located in areas of expansive clay soils will be subject to more movement and "hairline" cracking of walls and slabs than similar projects situated on non-expansive sandy soils. There are, however, measures that developers and property owners may take to reduce the amount of movement over the life the development. The following guidelines are provided to assist you in both design and maintenance of projects on expansive soils:

- Drainage away from structures and pavement is essential to prevent excessive wetting of expansive soils. Grades should be designed to the latest building code and maintained to allow flow of irrigation and rain water to approved drainage devices or to the street. Any "ponding" of water adjacent to buildings, slabs and pavement after rains is evidence of poor drainage; the installation of drainage devices or regrading of the area may be required to assure proper drainage. Installation of rain gutters is also recommended to control the introduction of moisture next to buildings. Gutters should discharge into a drainage device or onto pavement which drains to roadways.

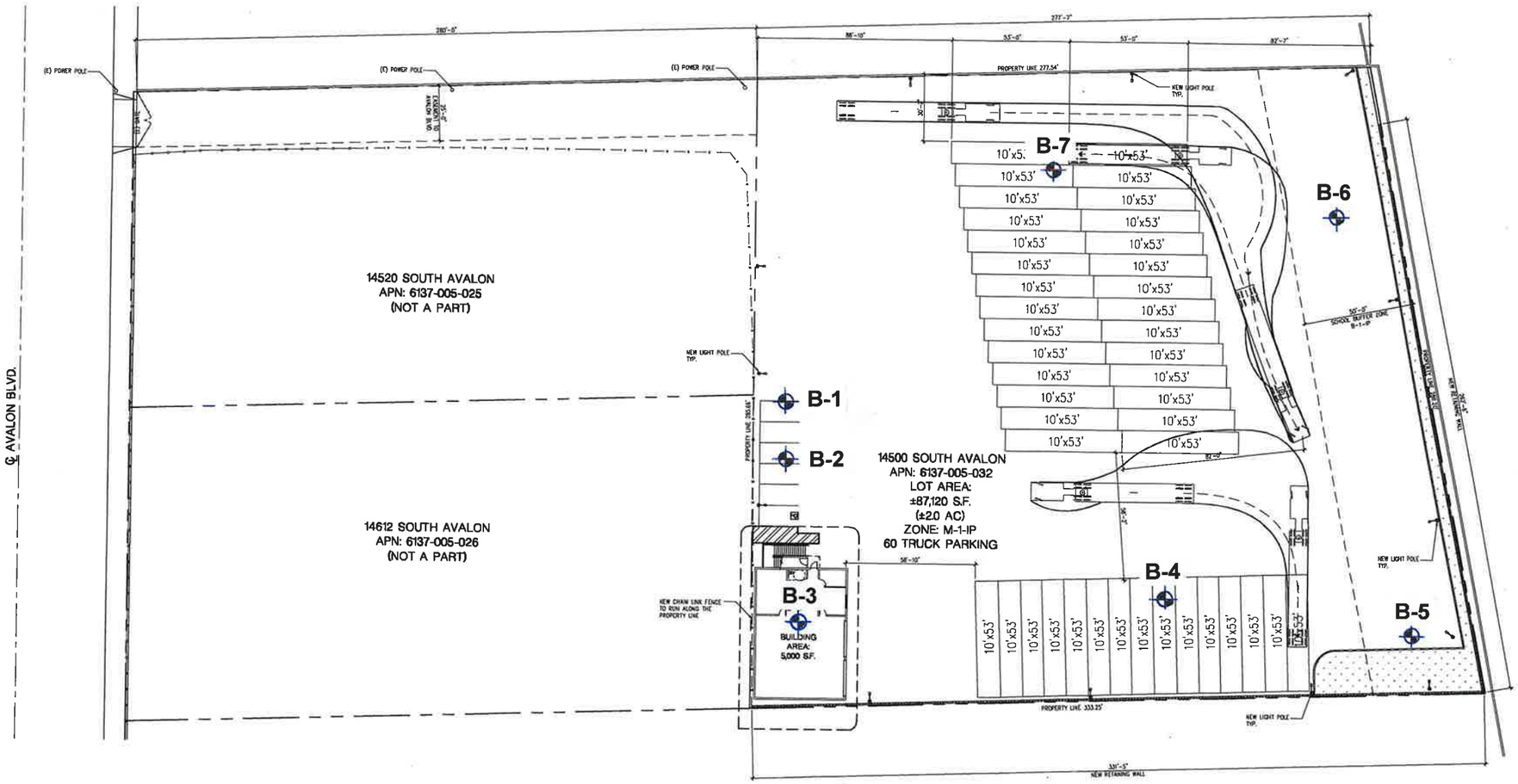
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.

- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the fine-grained soils.

- Thickened edges on exterior slabs will assist in keeping excessive moisture from entering directly beneath the concrete. A six-inch thick or greater deepened edge on slabs may be considered. Underlying interior and exterior slabs with 6 to 12 inches or more of non-expansive soils and providing presaturation of the underlying clayey soils as recommended in the soil report will improve the overall performance of on-grade slabs.

- Increase the amount of steel reinforcing in concrete slabs, foundations and other structures to resist the forces of expansive soils. The precise amount of reinforcing should be determined by the appropriate design engineers and/or architects.

- Recommendations of the soil report should always be followed in the development of the project. Any recommendations regarding presaturation of the upper subgrade soils in slab areas should be performed in the field and verified by the Soil Engineer.



NORTH

1 INCH = 60 FEET

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 22746-21	DATE AUGUST 2021

SITE PLAN

List of Appendices
(in order of appearance)

Appendix A – Log of Excavations

Log of Borings B-1 to B-7

Appendix B – Laboratory Tests

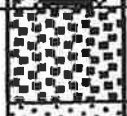
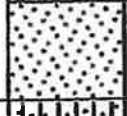
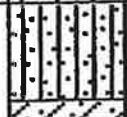
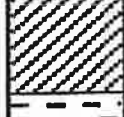
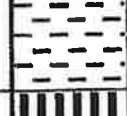
Table I – Maximum Dry Density
Table II – Expansion
Table III – Atterberg Limits
Table IV – Corrosion
Plate A – Direct Shear
Plates B and C - Consolidation

Appendix C – Fault Maps and Seismic Design Report

Appendix D – Soil Infiltration Data

Appendix A
Log of Excavations

NorCal Engineering

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL, SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

- ■ Indicates 2.5-inch Inside Diameter. Ring Sample.
- ⊠ Indicates 2-inch OD Split Spoon Sample (SPT).
- ⧅ Indicates Shelby Tube Sample.
- ◫ Indicates No Recovery.
- ◧ Indicates SPT with 140# Hammer 30 in. Drop.
- ⊠ Indicates Bulk Sample.
- ◩ Indicates Small Bag Sample.
- ◨ Indicates Non-Standard
- ⊠ Indicates Core Run.

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

Cataldo & Associates 22746-21	Log of Boring B-1
Boring Location: 14500 S Avalon Blvd., Gardena	
Date of Drilling: 8/10/2021	Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation: Not Measured	

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty CLAY Brown, soft, damp					
		GWT not encountered					
		NATURAL Silty CLAY Brown, stiff, moist					
5		Boring completed at depth of 5'					
10							
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

NorCal Engineering

Cataldo & Associates 22746-21	Log of Boring B-2
Boring Location: 14500 S Avalon Blvd., Gardena	
Date of Drilling: 8/10/2021	Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation: Not Measured	

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL Silty CLAY Brown, soft, damp					
		NATURAL Silty CLAY Brown, stiff, moist					
5		GWT not encountered					
10		Sandy SILT Grey-brown, stiff, moist Boring completed at depth of 10'					
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

Cataldo & Associates
22746-21

Log of Boring B-3

Boring Location: 14500 S Avalon Blvd., Gardena

Date of Drilling: 8/10/2021 | **Groundwater Depth:** None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop:** 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL Silty CLAY Brown, soft, damp					
		NATURAL Silty CLAY Brown, stiff, moist		17/27	9.5	116.4	
5				15/25	9.8	116.1	
10		Sandy SILT Grey-brown, stiff, moist		8/12	8.3	100.3	
15		Clayey SILT Brown, stiff, moist		22/43	15.6	101.4	
20		Silty SAND Brown, dense, moist		12/22	6.2	103.2	
		Boring completed at depth of 21'					
25							
30							
35							

GWT not encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

NorCal Engineering

Cataldo & Associates
22746-21

Log of Boring B-4

Boring Location: 14500 S Avalon Blvd., Gardena

Date of Drilling: 8/10/2021

Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured



Depth (feet)	Lithology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		Pulverized Asphalt					
		FILL Silty CLAY Brown, firm, damp					
5		NATURAL Silty CLAY Brown, stiff, moist	■	18/20	7.9	118.0	
10		Sandy SILT Grey-brown, stiff, moist	■	9/14	10.1	105.1	
		Boring completed at depth of 10'					
15							
20							
25							
30							
35							

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

NorCal Engineering

Cataldo & Associates
22746-21

Log of Boring B-5

Boring Location: 14500 S Avalon Blvd., Gardena

Date of Drilling: 8/10/2021 | Groundwater Depth: None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		Pulverized Asphalt					
		FILL					
		Silty CLAY					
		Brown, firm, damp	■	12/20	7.9	113.5	
		NATURAL					
5		Silty CLAY					
		Brown, stiff, moist					
		Boring completed at depth of 5'					
10							
15							
20							
25							
30							
35							

GWT not encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

NorCal Engineering

Cataldo & Associates 22746-21	Log of Boring B-6
Boring Location: 14500 S Avalon Blvd., Gardena	
Date of Drilling: 8/10/2021	Groundwater Depth: None Encountered
Drilling Method: Simco 2800HS	
Hammer Weight: 140 lbs	Drop: 30"
Surface Elevation: Not Measured	

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		Pulverized Asphalt					
		FILL Silty CLAY Brown, firm to stiff, moist; with occasional gravel and some asphalt					
5				8/10	7.9	112.8	
		NATURAL Silty CLAY Brown, stiff, moist		14/21	6.7	117.4	
10		Sandy SILT Grey-brown, stiff, moist		10/11	7.9	99.5	
		Boring completed at depth of 11'					
15							
20							
25							
30							
35							

GWT not encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

Cataldo & Associates
22746-21

Log of Boring B-7

Boring Location: 14500 S Avalon Blvd., Gardena

Date of Drilling: 8/10/2021 | **Groundwater Depth:** None Encountered

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop:** 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		Base Material					
		FILL					
		Silty CLAY					
		Brown, firm, damp					
		NATURAL					
5		Silty CLAY	■	12/15	11.3	116.6	
		Brown, stiff, moist					
		Boring completed at depth of 6'	■	9/11	8.7	114.6	
10							
15							
20							
25							
30							
35							

GWT not encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\22746-21.log Date: 8/23/2021

NorCal Engineering

Appendix B
Laboratory Tests

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture (%)	Maximum Dry Density (lbs/cu.ft)
B-3 @ 2'	Silty CLAY	13.5	124.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
B-3 @ 2'	Silty CLAY	71

TABLE III
ATTERBERG LIMITS

Sample	Liquid Limit	Plastic Limit	Plasticity Index
B-3 @ 5	40	23	17
B-3 @ 10'	25	19	6

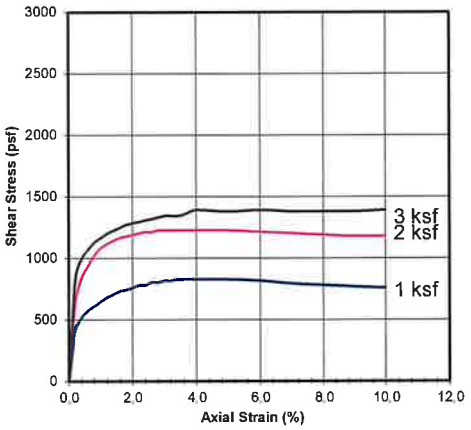
TABLE IV
CORROSION TESTS

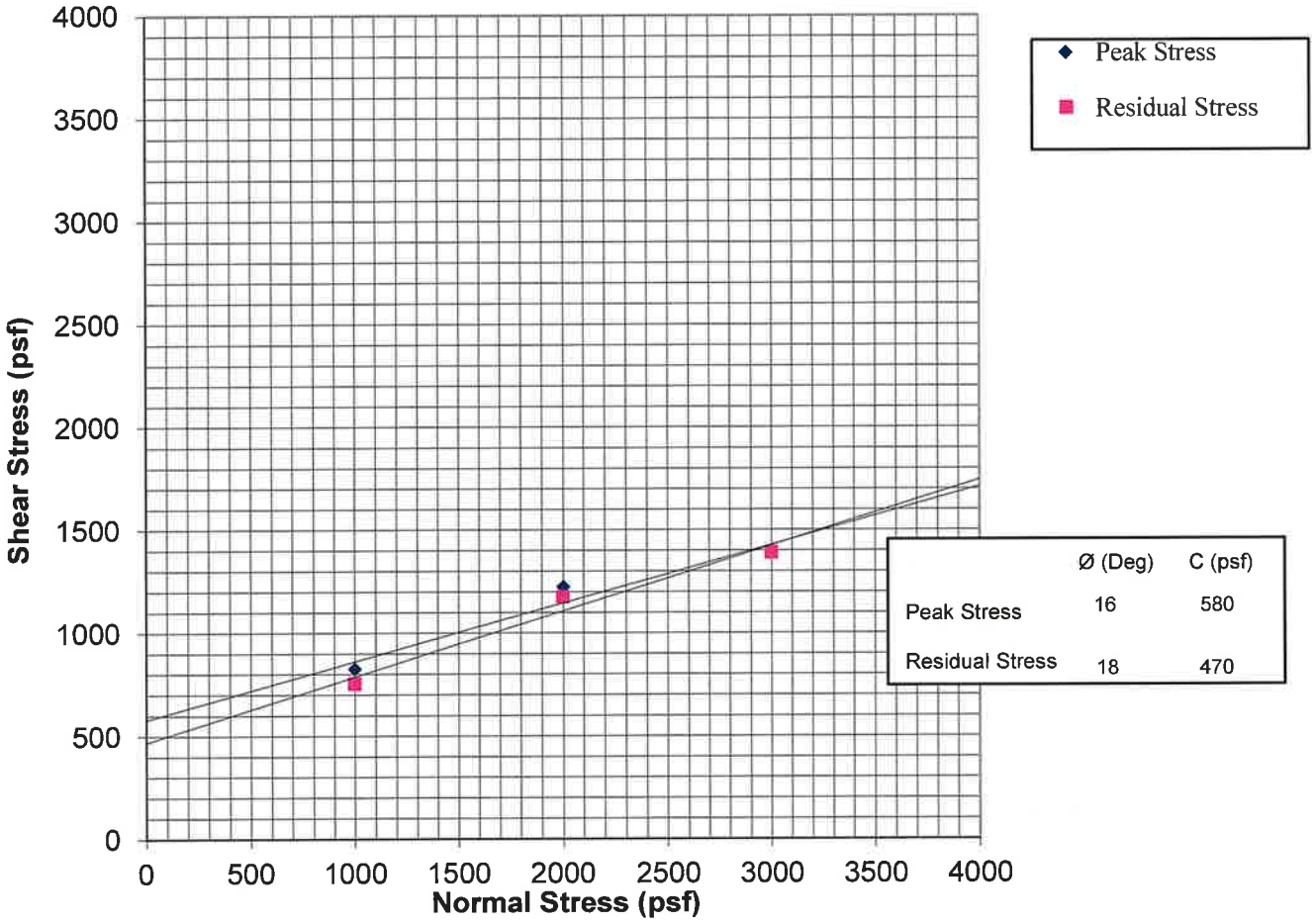
Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
B-3 @ 2'	7.3	1,350	0.032	222

% by weight
ppm – mg/kg

Sample No.	B3@2'	
Sample Type:	Undisturbed-Saturated	
Soil Description:	Silty Clay	

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	828	1224	1392
Displacement	(in.)	0.085	0.070	0.100
Residual Stress	(psf)	756	1176	1392
Displacement	(in.)	0.250	0.250	0.250
Initial Dry Density	(pcf)	116.4	116.4	116.4
Initial Water Content	(%)	9.5	9.5	9.5
Strain Rate	(in./min.)	0.020	0.020	0.020





NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Cataldo & Associates

PROJECT NUMBER: 22746-21 DATE: 8/23/2021

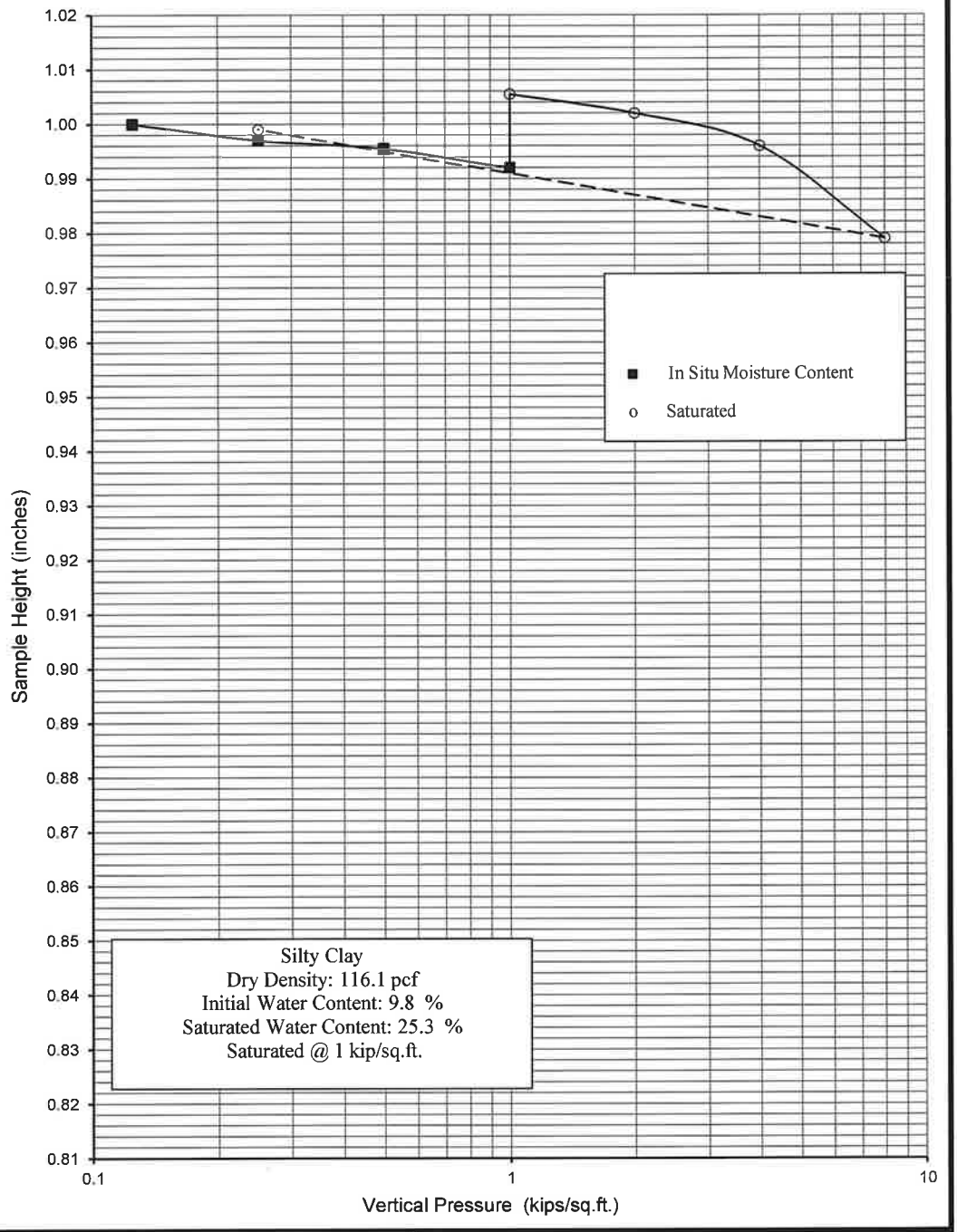
DIRECT SHEAR TEST

ASTM D3080

Plate A

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No. B3	Depth 5'	Date 8/23/2021
0.125	1.0000	0.0			
0.25	0.9970	0.3			
0.5	0.9955	0.4			
1	0.9920	0.8			
1	1.0055	-0.6	Saturated		
2	1.0020	-0.2			
4	0.9960	0.4			
8	0.9790	2.1			
0.25	0.9990	0.1			

Date Tested: 8/19/2021
Sample: B3
Depth: 5'



NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Cataldo & Associates

PROJECT NUMBER: 22746-21 DATE: 8/23/2021

CONSOLIDATION TEST

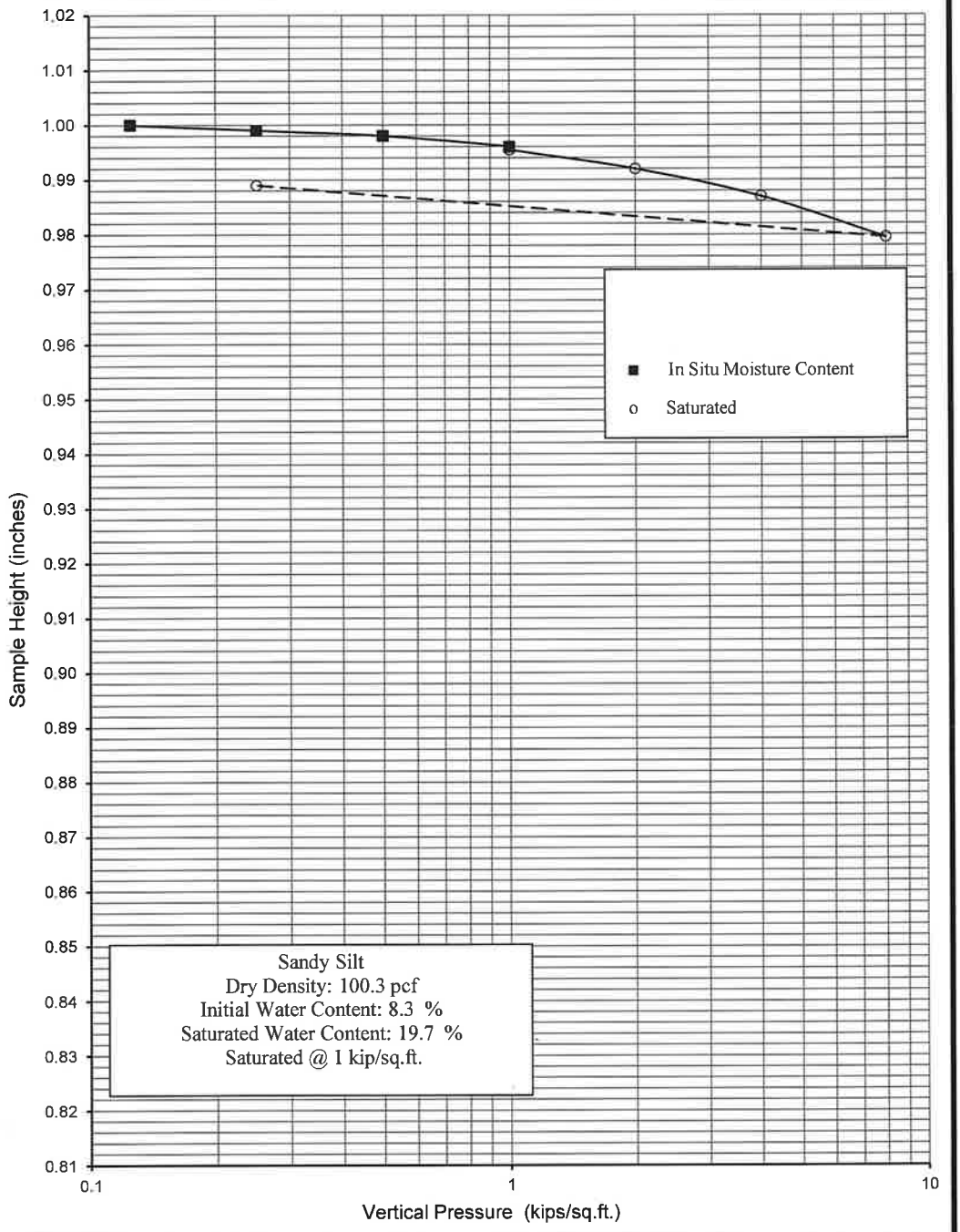
ASTM D2435

Plate B

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No. B3	Depth 10'	Date 8/23/2021
0.125	1.0000	0.0			
0.25	0.9990	0.1			
0.5	0.9980	0.2			
1	0.9960	0.4			
1	0.9955	0.4			
2	0.9920	0.8			
4	0.9870	1.3			
8	0.9795	2.1			
0.25	0.9890	1.1			

Saturated

Date Tested: 8/19/2021
Sample: B3
Depth: 10'



NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

Cataldo & Associates

PROJECT NUMBER: 22746-21 DATE: 8/23/2021

CONSOLIDATION TEST

ASTM D2435

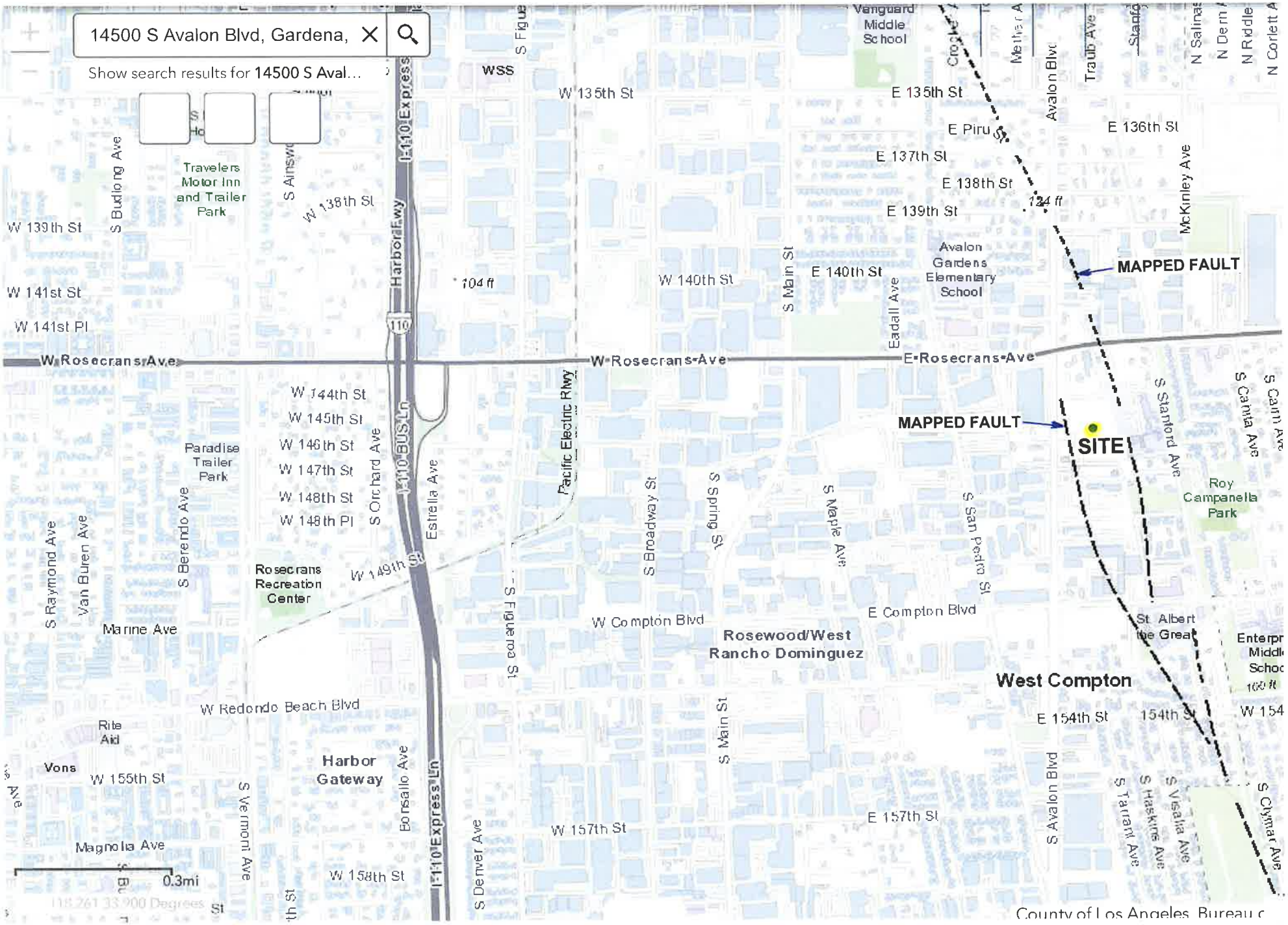
Plate C

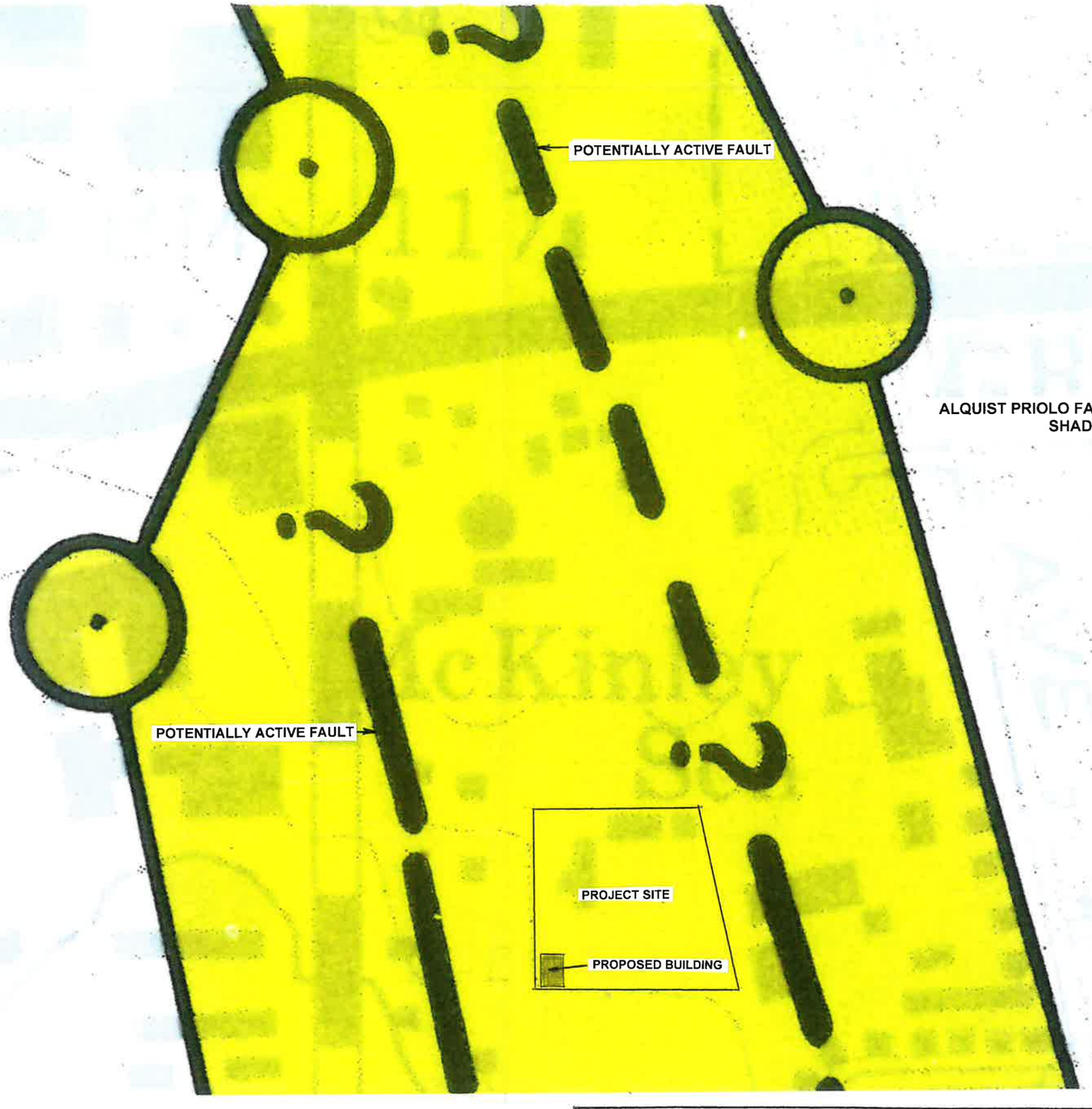
Appendix C
Fault Maps and
Seismic Design Report

NorCal Engineering

Earthquake Zones of Required Investigation

CGS Homepage





ALQUIST PRIOLO FAULT SPECIAL STUDIES ZONE
SHADED IN YELLOW

NORTH

1 INCH = 200 FEET

MODIFIED MAP FROM SPECIAL STUDIES ZONES MAP OF STATE OF CALIFORNIA
INGLEWOOD QUADRANGLE JULY 1, 1986

DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT 22746-21 | DATE AUGUST 2021

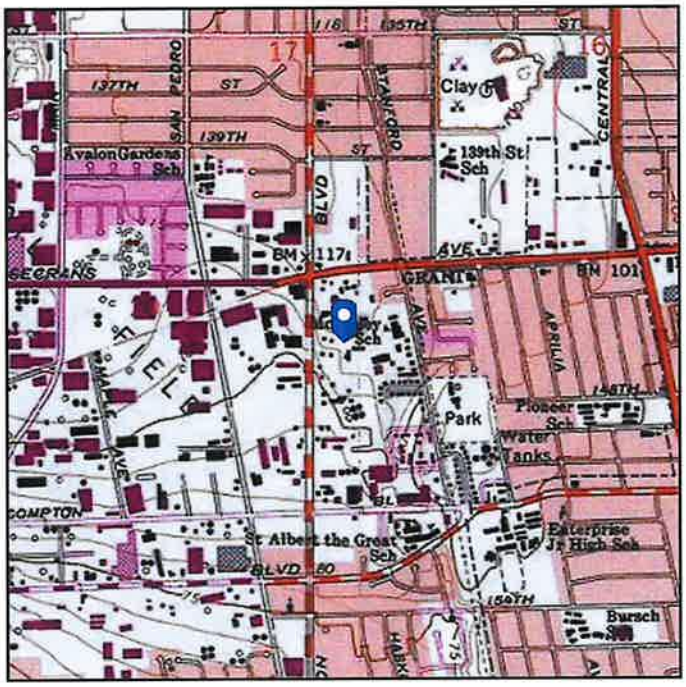
FAULT MAP

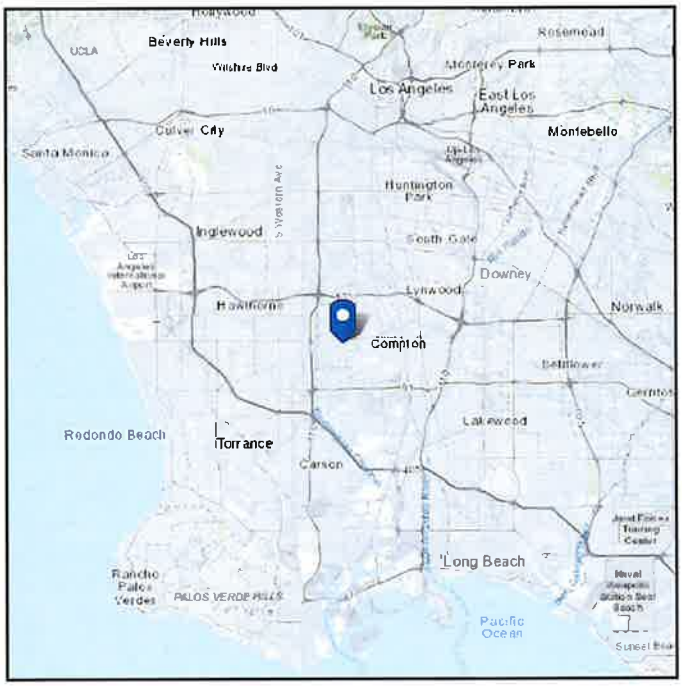
ASCE 7 Hazards Report

Address:
14500 S Avalon Blvd
Gardena, California
90248

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 114.47 ft (NAVD 88)
Latitude: 33.900027
Longitude: -118.263988





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.789	S_{D1} :	N/A
S_1 :	0.636	T_L :	8
F_a :	1	PGA :	0.772
F_v :	N/A	PGA_M :	0.849
S_{MS} :	1.789	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1.193	C_v :	1.458

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Tue Aug 17 2021

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

Appendix D
Soil Infiltration Data

NORCAL ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Cataldo & Associates	**Tested By:** D.R.
Project No.: 22746-21	**Date Tested:** 8/10/2021
Test Hole: 1	**Caving:**
Depth of Test Hole: 5'	**Notes:**
Diameter of Test Hole: 6"	
Date Excavated: 8/10/2021	

PRE-SOAK

TIME	PRE-SOAK NO.	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL
7:46	1	30	30	48.0	48.5	0.5
8:16						
8:16	2	30	60	48.0	48.0	0.0
8:46						

PERCOLATION TEST

TIME	TEST NO.	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL
12:46	1	30	30	48.0	48.5	0.5
1:16						
1:16	2	30	60	48.0	48.0	0.0
1:46						
1:46	3	30	90	48.0	48.5	0.5
2:16						
2:16	4	30	120	48.0	48.0	0.0
2:46						
2:46	5	30	150	48.0	48.5	0.5
3:16						
3:16	6	30	180	48.0	48.0	0.0
3:46						
3:46	7	30	210	48.0	48.5	0.5
4:16						
4:16	8	30	240	48.0	48.5	0.5
4:46						

Revised - Copyright 2013 M. Barone

NORCAL ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

PERCOLATION TEST DATA

Client: Cataldo & Associates	**Tested By:** D.R.
Project No.: 22746-21	**Date Tested:** 8/10/2021
Test Hole: 2	**Caving:**
Depth of Test Hole: 10'	**Notes:**
Diameter of Test Hole: 6"	
Date Excavated: 8/10/2021	

PRE-SOAK

TIME	PRE-SOAK NO.	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL
8:15	1	21	21	108.0	120.0	12.0
8:36						
8:36	2	29	50	107.0	120.0	13.0
9:05						

PERCOLATION TEST

TIME	TEST NO.	TIME INTERVAL	TOTAL ELAPSED TIME	INITIAL WATER LEVEL	FINAL WATER LEVEL	CHANGE IN WATER LEVEL
9:05	1	10	10	107.5	111.0	3.5
9:15						
9:15	2	10	20	107.5	111.0	3.5
9:25						
9:25	3	10	30	107.5	110.5	3.0
9:35						
9:35	4	10	40	108.0	111.0	3.0
9:45						
9:45	5	10	50	108.0	111.0	3.0
9:55						
9:55	6	10	60	108.0	111.0	3.0
10:05						
10:05	7	10	70	108.0	111.0	3.0
10:15						
10:15	8	10	80	108.0	111.0	3.0
10:25						
10:25	9	10	90	108.0	111.5	3.5
10:35						
10:35	10	10	100	108.0	111.0	3.0
10:45						
10:45	11	10	110	108.0	111.0	3.0
10:55						
10:55	12	10	120	108.0	111.0	3.0
11:05						

Revised - Copyright 2013 M. Barone

SOIL INFILTRATION RATE CALCS ⇒ Auger Boring

Location:	TH-1	TH-2
• Depth =	5.0'	10.0'
• Hole Dia. =	6"	6"
• Drop = Δd	0.5"	3"
• Time = Δt Interval	30 min	10 min
• Preadjusted Perc. Rate	1 in/hr	18 in/hr
• Initial Water Depth = d_1	12"	12"
• Reduction Factor = R_f	4.92	4.5
• INFILTRATION RATE	0.20 in/hr	4.0 in/hr

$$\text{Infiltration Rate} = \frac{\text{Preadjusted Perc. Rate}}{\text{Reduction Factor}}$$

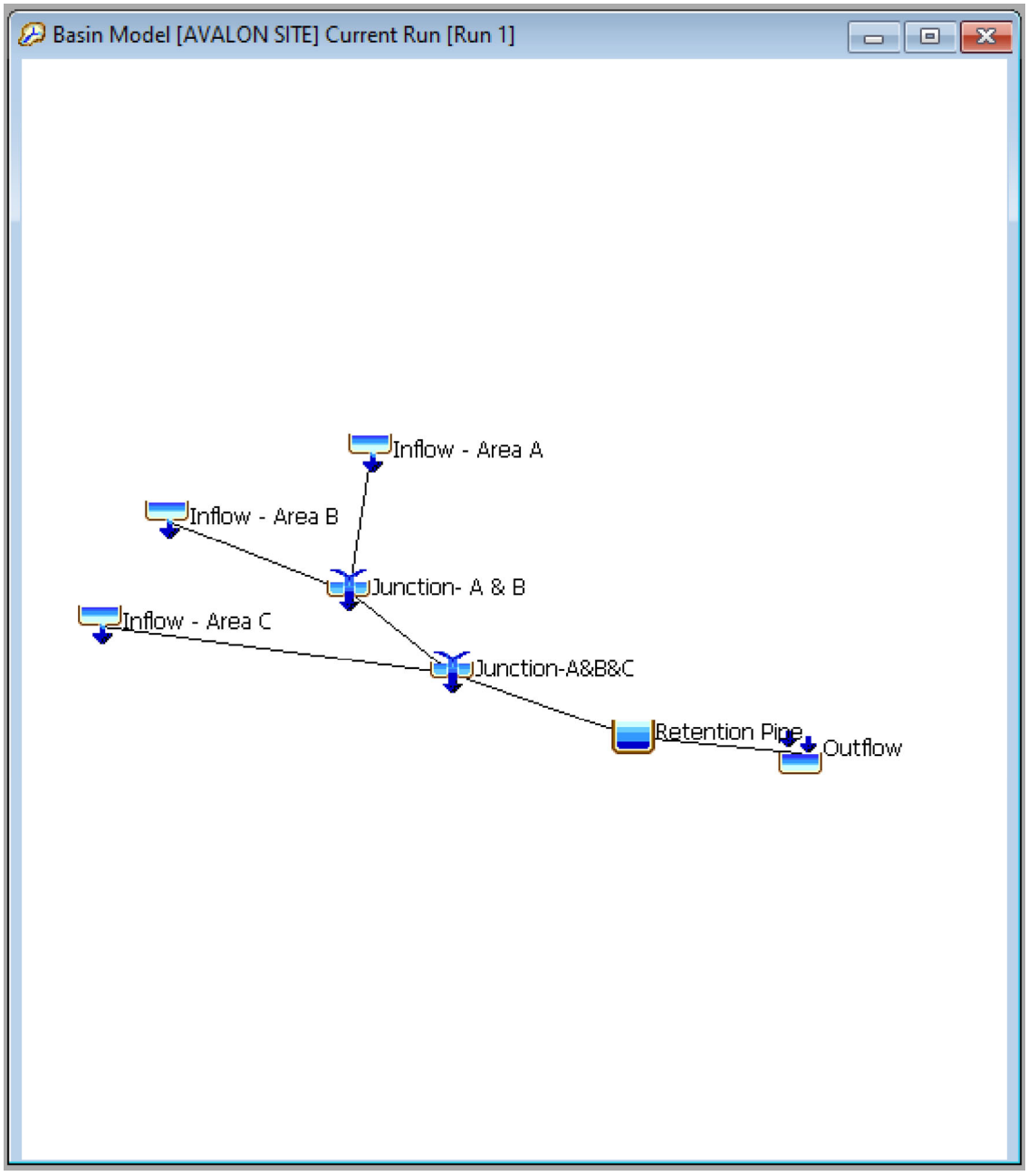
$$\text{Reduction Factor} = R_f = \left[\frac{2 \cdot d_1 - \Delta d}{\text{Dia.}}\right] + 1$$

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

JOB NO. 22746-21 | DATE AUG. 2021

Appendix 4

HEC-HMS Model Results


Basin Model [AVALON SITE] Current Run [Run 1]
Inflow - Area A
Inflow - Area B
Junction- A & B
Inflow - Area C
Junction-A&B&C
Retention Pipe
Outflow

Project: Avalon Retention Pipe
Simulation un: un 1
Simulation Start: 31 December 1999, 24:00
Simulation End: 2 January 2000, 00:07

HMS Version: 4.12
Executed: 05 June 2024, 17:23

Global Results Summary

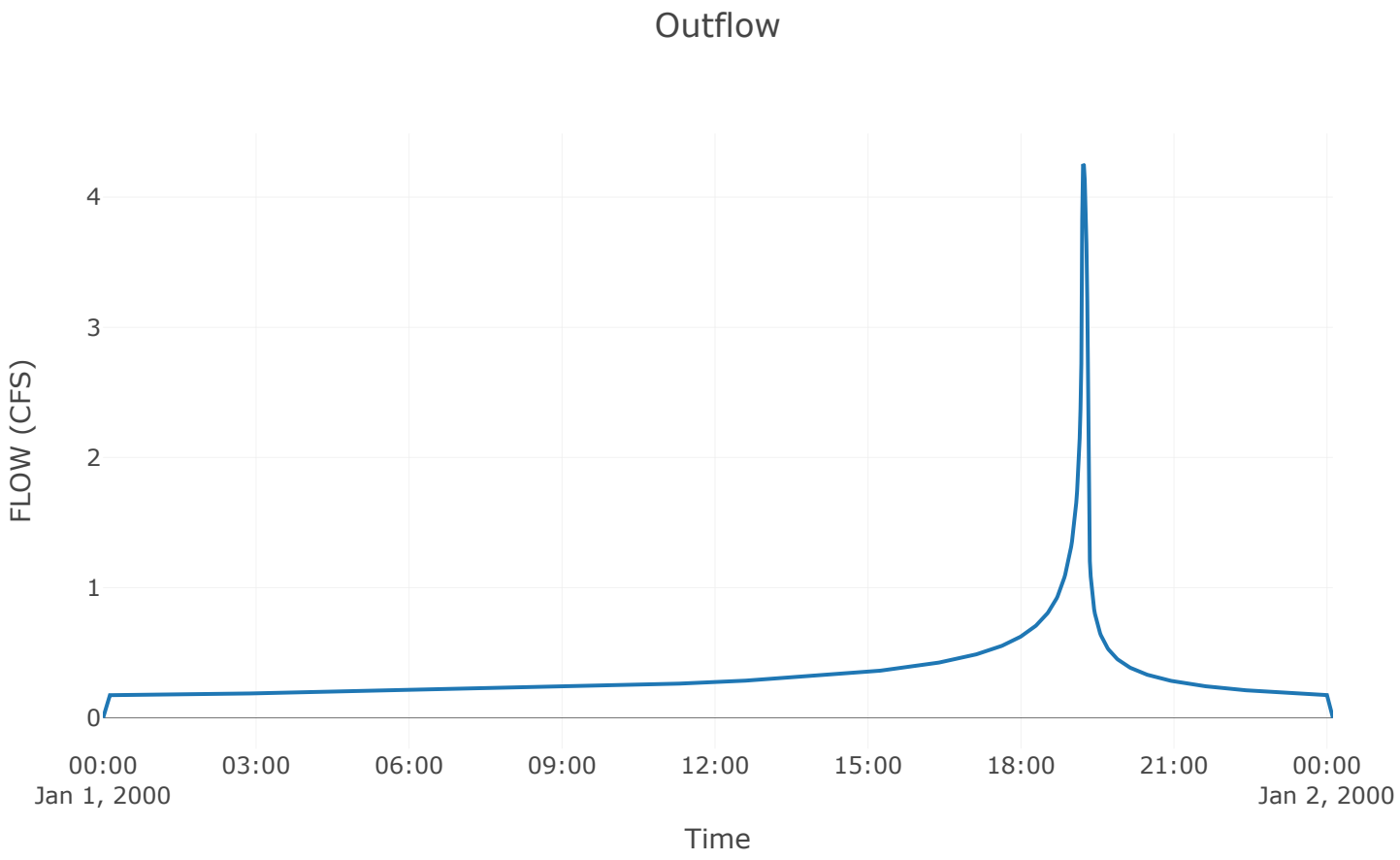
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume ()
In ow - Area C	Not speci ed	4.25	01Jan2000, 19:13	Not speci ed
In ow - Area A	Not speci ed	0.43	01Jan2000, 19:13	Not speci ed
In ow - Area B	Not speci ed	0.18	01Jan2000, 19:13	Not speci ed
Junction - A & B	Not speci ed	0.62	01Jan2000, 19:13	Not speci ed
Junction - A&B&C	Not speci ed	4.87	01Jan2000, 19:13	Not speci ed
Retention Pipe	Not speci ed	2.88	01Jan2000, 19:18	Not speci ed
Out ow	Not speci ed	2.88	01Jan2000, 19:18	Not speci ed

Source: Inflow - Area C

Downstream : Junction - A&B&C
Flow Method : Gage Flow
Flow Gage : In ow C - Hydrograph

Results: Inflow - Area C

Peak Discharge (CFS)	4.25
Time of Peak Discharge	01Jan2000, 19:13

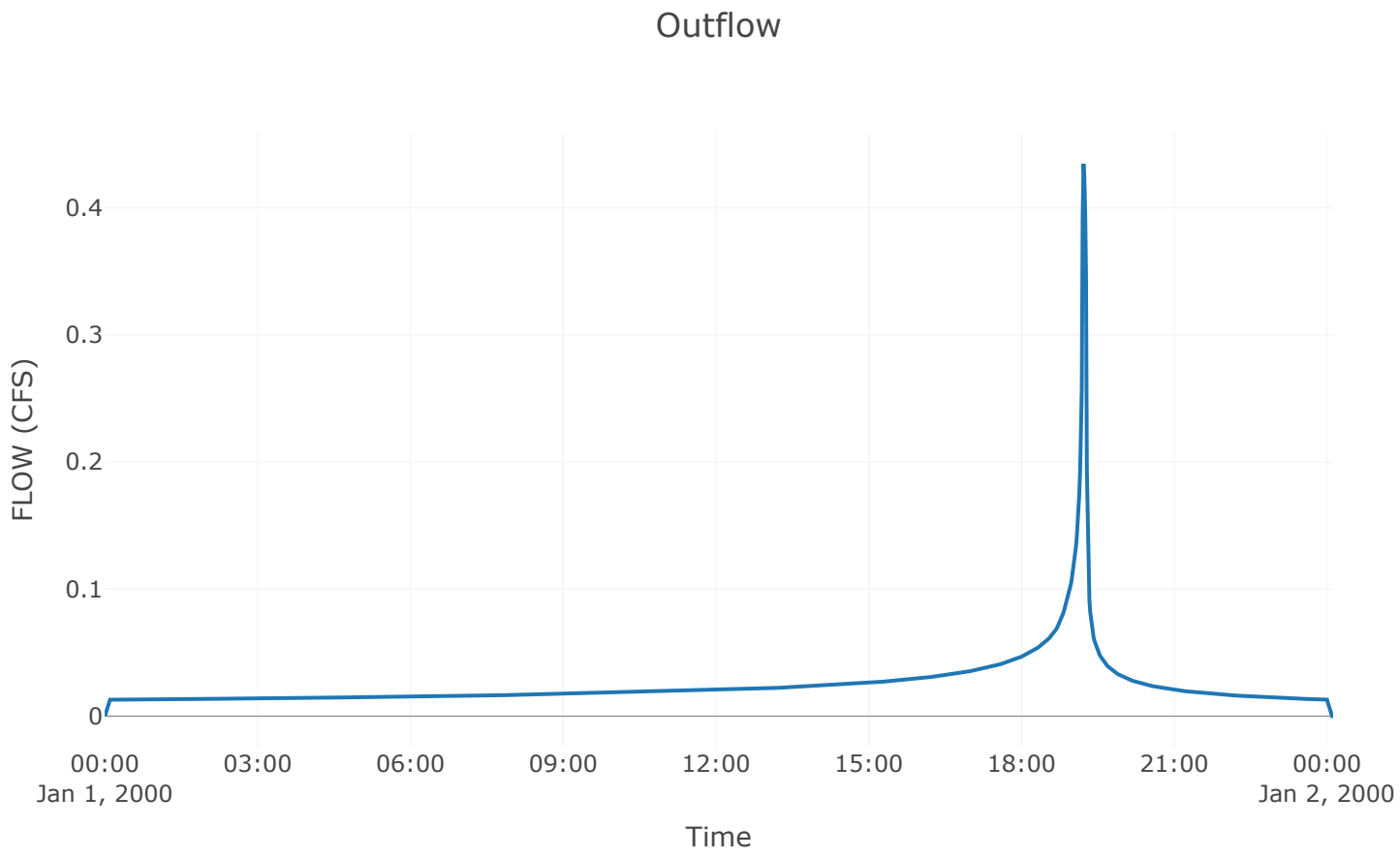


Source: Inflow - Area A

Downstream : Junction - A & B
Flow Method : Gage Flow
Flow Gage : In ow A - Hydrograph

Results: Inflow - Area A

Peak Discharge (CFS)	0.43
Time of Peak Discharge	01Jan2000, 19:13

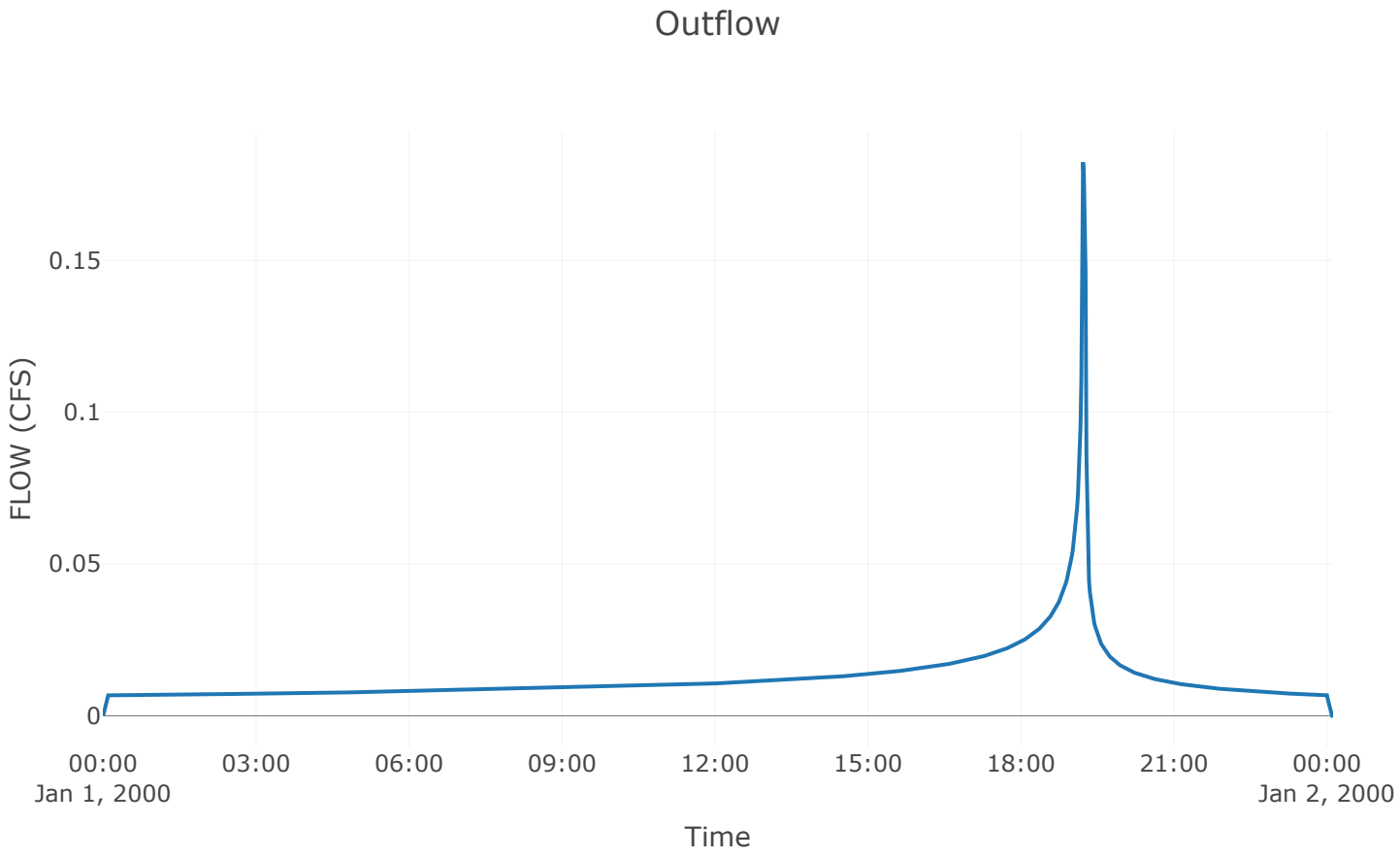


Source: Inflow - Area B

Downstream : Junction - A & B
Flow Method : Gage Flow
Flow Gage : In ow B - Hydrograph

Results: Inflow - Area B

Peak Discharge (CFS)	0.18
Time of Peak Discharge	01Jan2000, 19:13

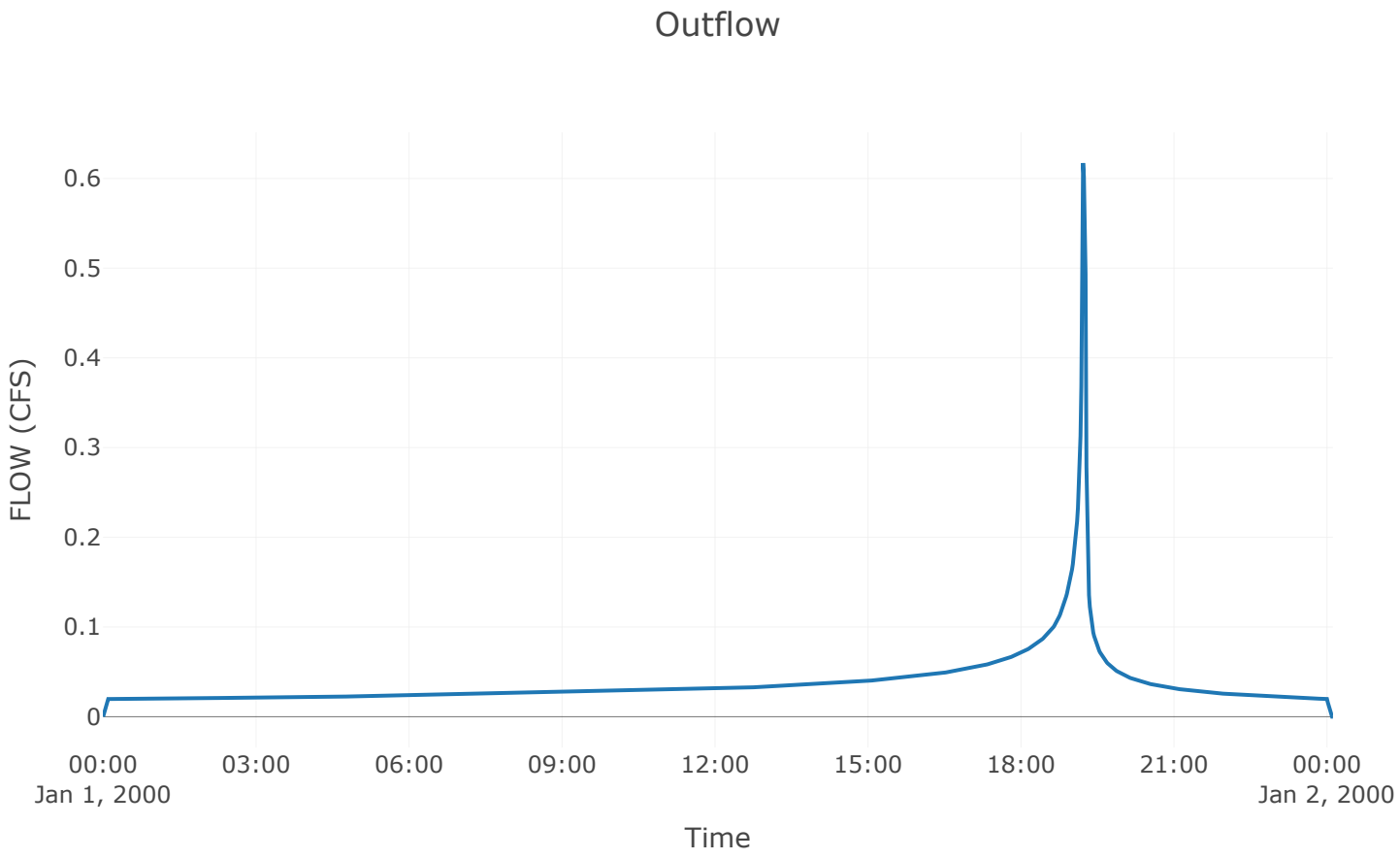


Junction: Junction- A & B

Downstream : Junction - A&B&C

Results: Junction- A & B

Peak Discharge (CFS)	0.62
Time of Peak Discharge	01Jan2000, 19:13

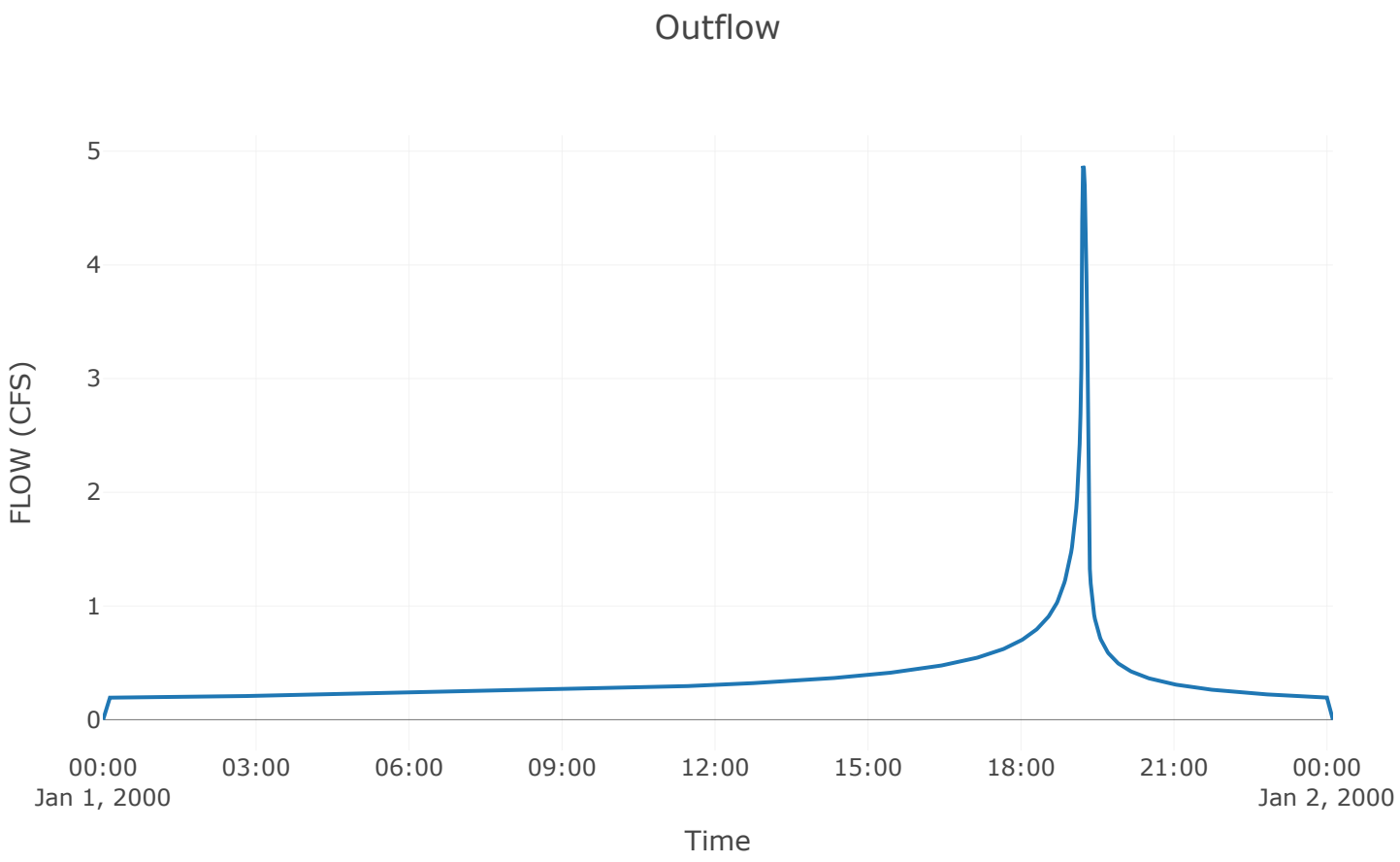


Junction: Junction-A&B&C

Downstream : Retention Pipe

Results: Junction-A&B&C

Peak Discharge (CFS)	4.87
Time of Peak Discharge	01Jan2000, 19:13

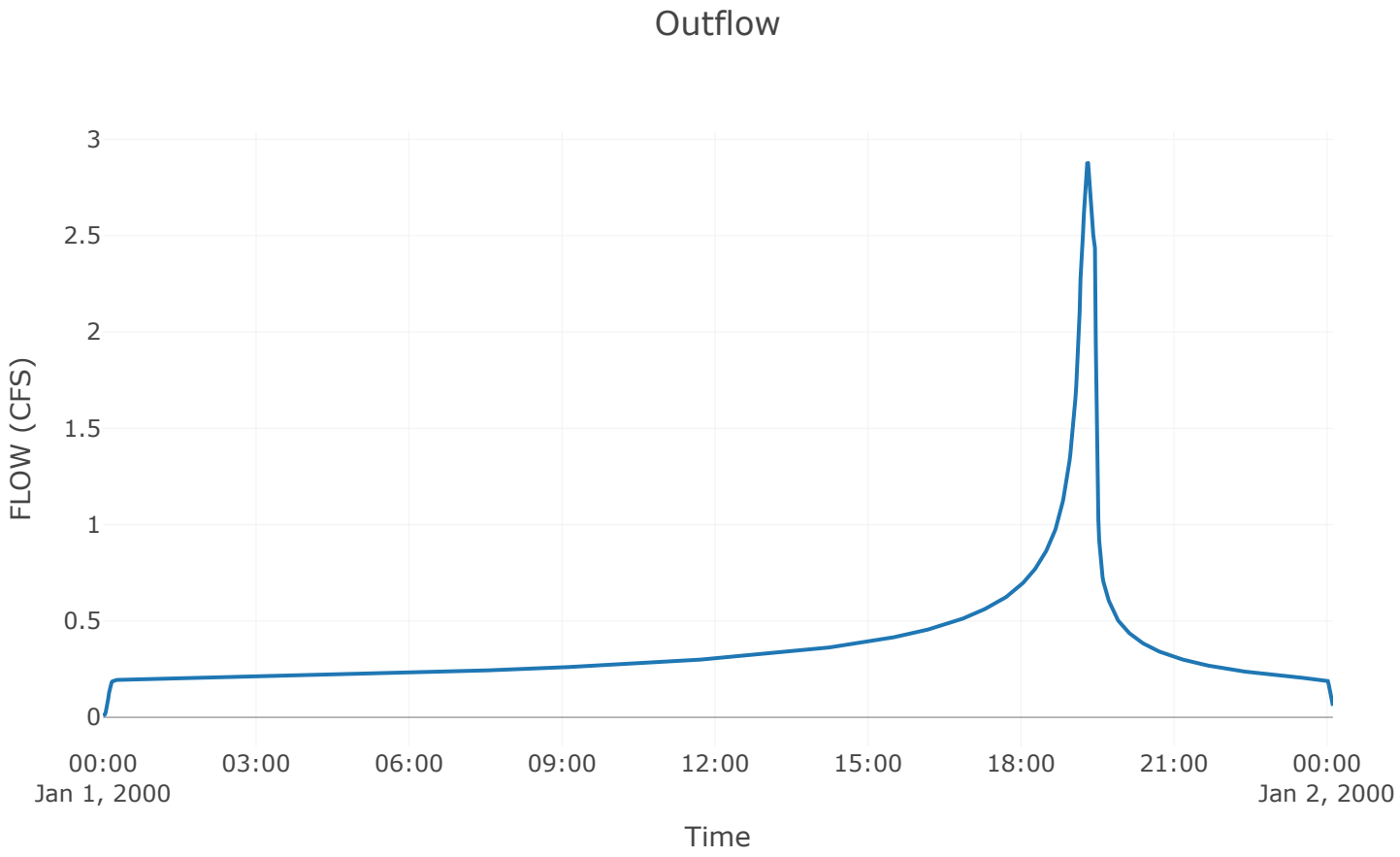


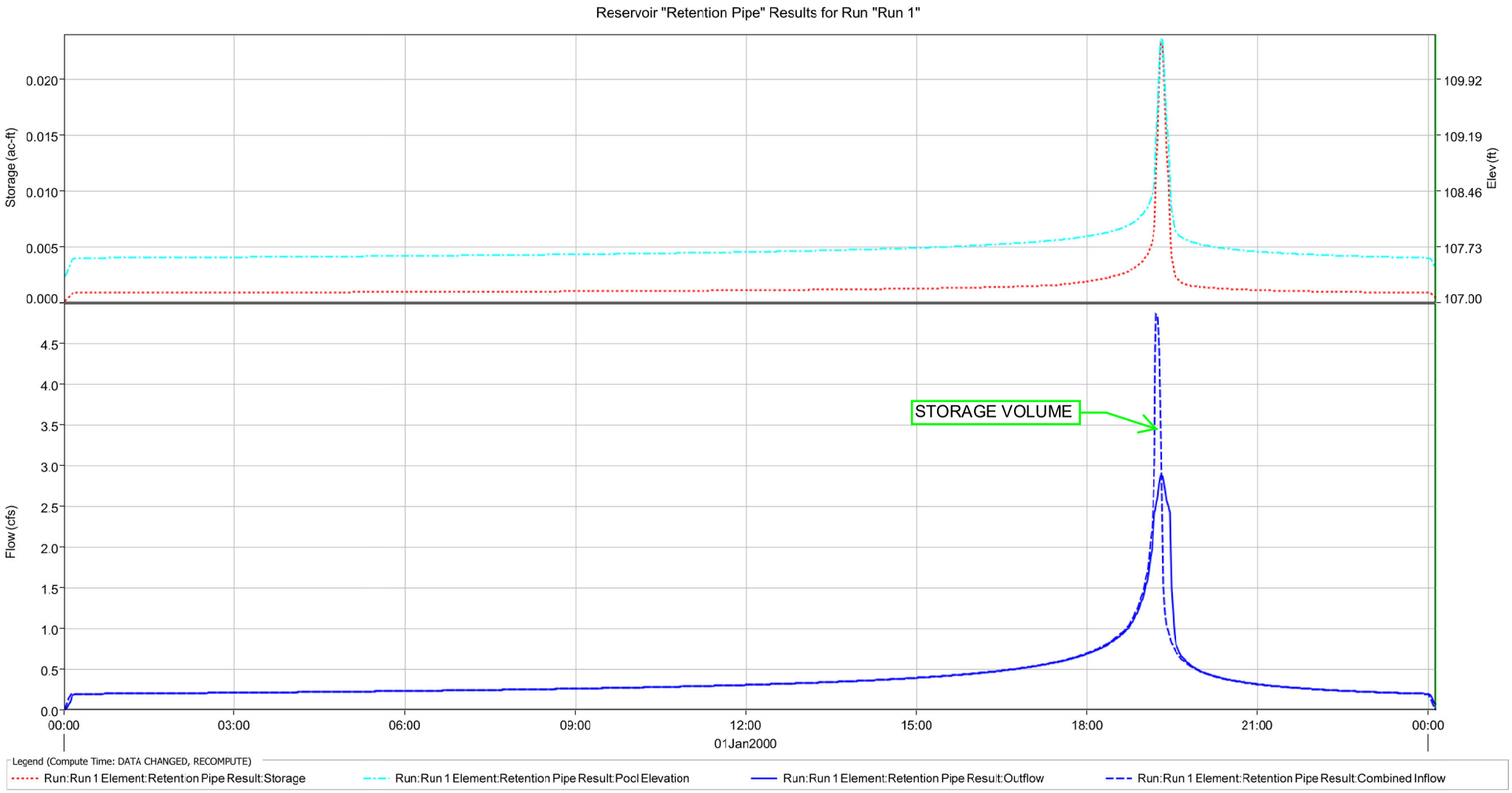
Reservoir: Retention Pipe

Downstream : Out ow

Results: Retention Pipe

Peak Discharge (CFS)	2.88
Time of Peak Discharge	01Jan2000, 19:18
Peak In ow (CFS)	4.87
Time of Peak In ow	01Jan2000, 19:13
In ow Volume (AC - FT)	0.73
Maximum Storage (AC - FT)	0.02
Peak Elevation (FT)	110.44
Discharge Volume (AC - FT)	0.73

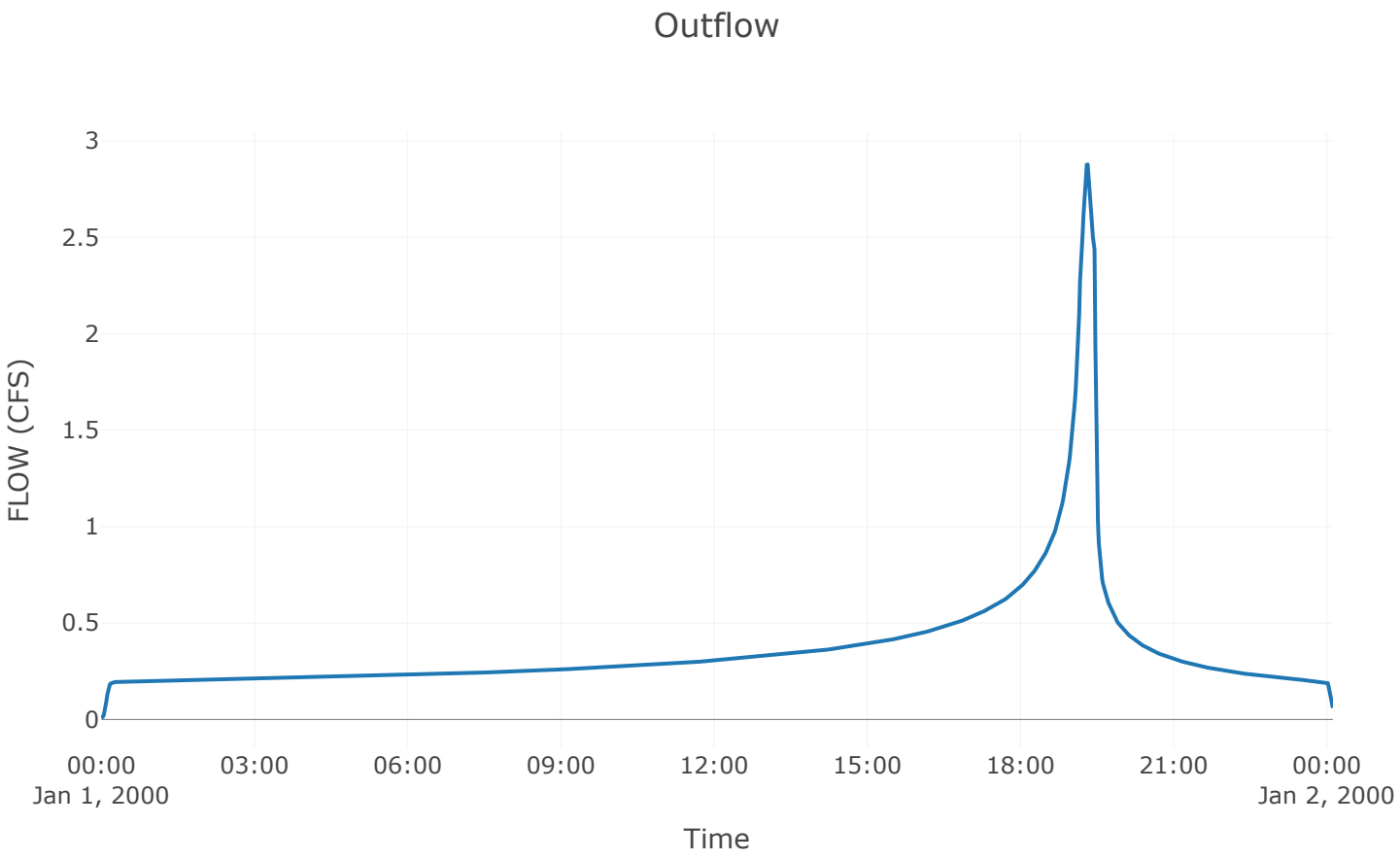



Reservoir "Retention Pipe" Results for Run "Run 1"
Storage (ac-ft)
0.020
0.015
0.010
0.005
0.000
Elev (ft)
109.92
109.19
108.46
107.73
107.00
Flow (cfs)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
STORAGE VOLUME
00:00
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
01Jan2000
Legend (Compute Time: DATA CHANGED, RECOMPUTE)
Run:Run 1 Element:Retention Pipe Result:Storage
Run:Run 1 Element:Retention Pipe Result:Pool Elevation
Run:Run 1 Element:Retention Pipe Result:Outflow
Run:Run 1 Element:Retention Pipe Result:Combined Inflow

Sink: Outflow

Results: Outflow

Peak Discharge (CFS)	2.88
Time of Peak Discharge	01Jan2000, 19:18



Appendix 5

BMP Inspection & Maintenance Guidelines

MC-4500 Design Manual

StormTech® Chamber Systems for Stormwater Management



ADS StormTech™

Table of Contents

1.0 Product Information 4

2.0 Foundation for Chambers. 6

3.0 Required Materials/Row Separation 8

4.0 Hydraulics. 10

5.0 Cumulative Storage Volume 12

6.0 System Sizing 15

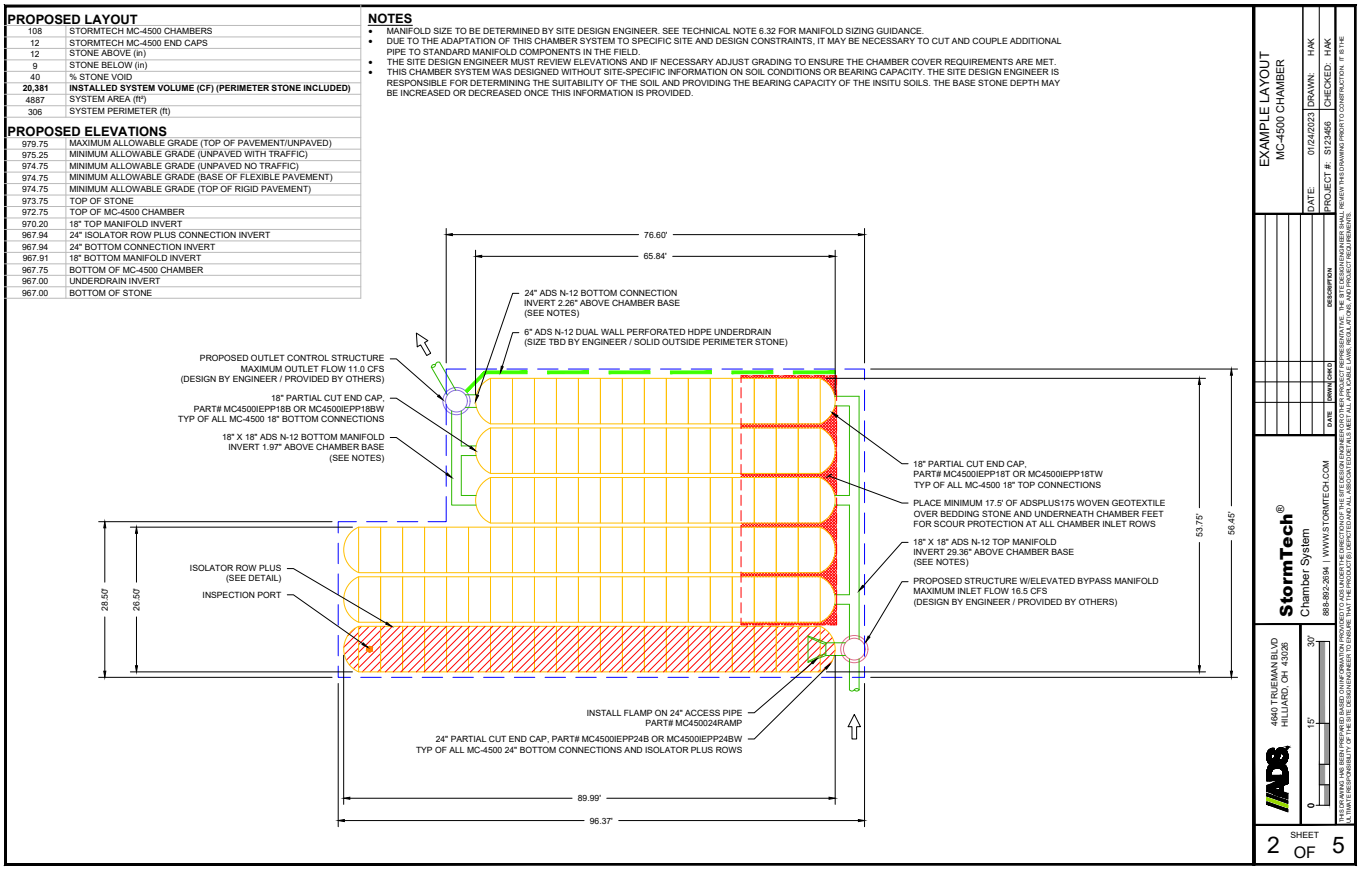
7.0 Structural Cross Sections and Specifications 16

8.0 General Notes 17

9.0 Inspection and Maintenance 18

*For SC-160LP, SC-310, SC-740 & DC-780 designs, please refer to the SC-160LP/SC-310/SC-740/DC-780 Design Manual.
For MC-3500 & MC-7200 designs, please refer to the MC-3500 & MC-7200 Design Manual.

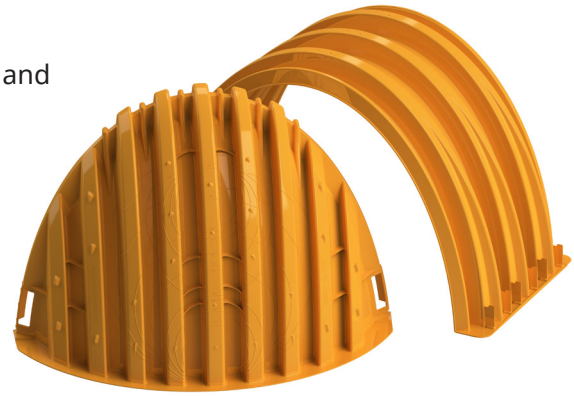
StormTech Engineering Services assists design professionals in specifying StormTech stormwater systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. They can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete vaults and other manufactured stormwater detention/ retention products. Please note that it is the responsibility of the site design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing a project.



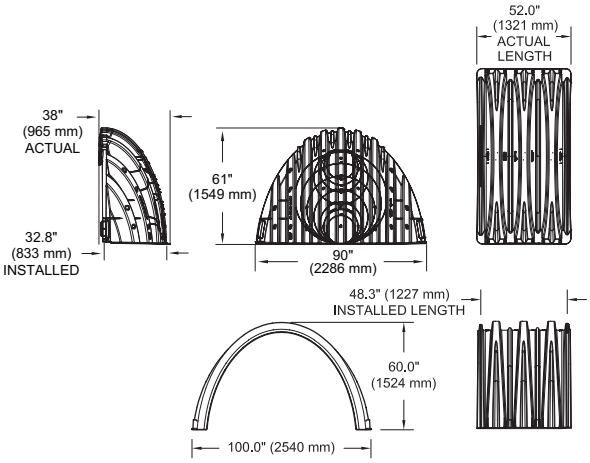
This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

StormTech MC-4500 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.



MC-4500 Chamber
(not to scale)



Nominal Chamber Specifications

Size (L x W x H)
52” x 100” x 60”
1321 x 2540 x 1524 mm

Chamber Storage
106.5 ft³ (3.01 m³)

Min. Installed Storage*
162.6 ft³ (4.60 m³)

Weight
Nominal 125 lbs (56.7 kg)

Shipping
7 chambers/pallet
5 end caps/pallet
11 pallets/truck

*Assumes a minimum of 12” (300 mm) of stone above, 9” (230 mm) of stone below chambers, 9” (230 mm) of stone between chambers/ end caps and 40% stone porosity.

MC-4500 End Cap
(not to scale)

Nominal End Cap Specifications

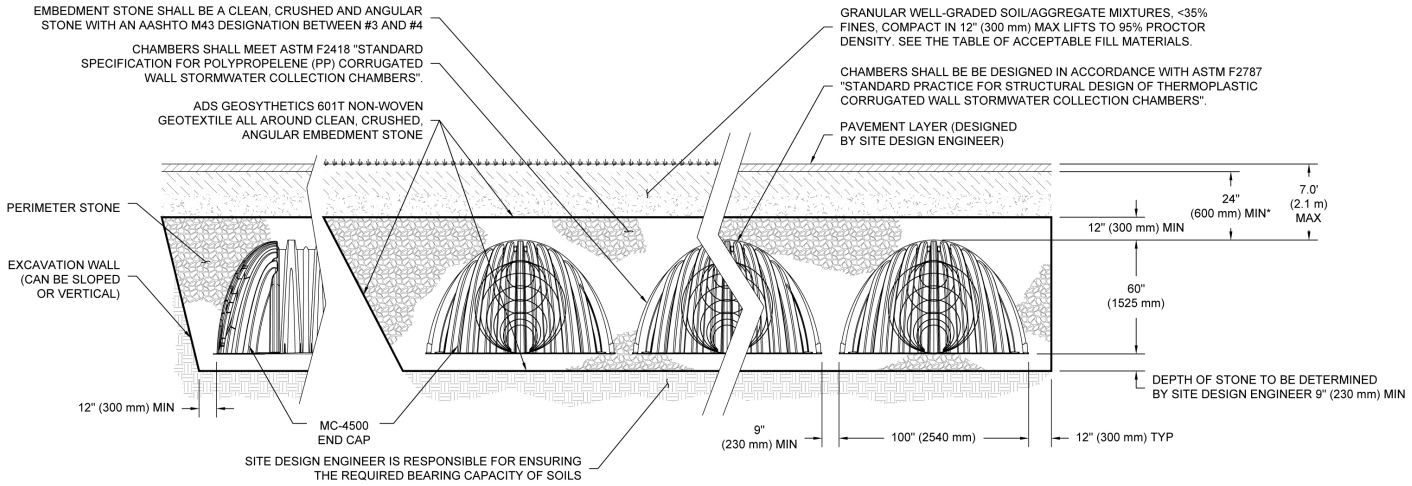
Size (L x W x H)
38” x 90” x 61”
965 x 2286 x 1549 mm

End Cap Storage
39.5 ft³ (1.12 m³)

Min. Installed Storage*
115.3 ft³ (3.26 m³)

Weight
Nominal 90.0 lbs (40.8 kg)

*Assumes a minimum of 12” (300 mm) of stone above, 9” (230 mm) of stone below, 12” (300 mm) of stone perimeter, 9” (230 mm) of stone between chambers/end caps and 40% stone porosity.



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

StormTech MC-4500 Chamber

Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage ft³ (m³)	Chamber/End Cap and Stone Volume Stone Foundation Depth in. (mm)			
		9 (230)	12 (300)	15 (375)	18 (450)
MC-4500 Chamber	106.5 (3.02)	162.6 (4.60)	166.3 (4.71)	169.9 (4.71)	173.6 (4.91)
MC-4500 End Cap	39.5 (1.12)	115.3 (3.26)	111.9 (3.17)	121.9 (3.45)	125.2 (3.54)

Note: Assumes 9" (230 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/ end cap volume. End cap volume assumes 12" (300 mm) stone perimeter in front of end cap.



Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth			
	9"	12"	15"	18"
Chamber	7.4 (5.2)	7.8 (5.5)	8.3 (5.9)	8.8 (6.2)
End Cap	9.8 (7.0)	10.2 (7.3)	10.6 (7.6)	11.1 (7.9)
METRIC kg (m³)	**230 mm**	**300 mm**	**375 mm**	**450 mm**
Chamber	6713 (4.0)	7076 (4.2)	7529 (4.5)	7983 (4.7)
End Cap	8890 (5.3)	9253 (5.5)	9616 (5.8)	10069 (6.0)

Note: Assumes 12" (300 mm) of stone above and 9" (230 mm) row spacing and 12" (300 mm) of perimeter stone in front of end caps.

Volume of Excavation Per Chamber/End Cap yd³ (m³)

	Stone Foundation Depth			
	9" (230 mm)	12" (300 mm)	15" (375 mm)	18" (450 mm)
Chamber	10.5 (8.0)	10.8 (8.3)	11.2 (8.5)	11.5 (8.8)
End Cap	9.7 (7.4)	10.0 (7.6)	10.3 (7.9)	10.6 (8.1)

Note: Assumes 9" (230 mm) of separation between chamber rows, 12" (300 mm) of perimeter in front of the end caps, and 24" (600 mm) of cover. The volume of excavation will vary as depth of cover increases.

Special applications will be considered on a project by project basis. Please contact our application department should you have a unique application for our team to evaluate.



1.0 Product Information

1.1 Product Design

StormTech's commitment to thorough product testing programs, materials evaluation and adherence to national standards has resulted in two more superior products. Like other StormTech chambers, the MC-4500 is designed to meet the full scope of design requirements of the American Society of Testing Materials (ASTM) International specification F2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers" and produced to the requirements of the ASTM F 2418 "Standard Specification for Polypropylene (PP) Corrugated Stormwater Collection Chambers".

The StormTech MC-4500 chamber provides the full AASHTO safety factors for live loads and permanent earth loads. The ASTM F 2787 standard provides specific guidance on how to design thermoplastic chambers in accordance with AASHTO Section 12.12. of the AASHTO LRFD Bridge Design Specifications. ASTM F 2787 requires that the safety factors included in the AASHTO guidance are achieved as a prerequisite to meeting ASTM F 2418. The three standards provide both the assurance of product quality and safe structural design.

The design of larger chambers in the same tradition of our other chambers required the collaboration of experts in soil-structure interaction, plastics and manufacturing. Years of extensive research, including laboratory testing and field verification, were required to produce chambers that are ready to meet both the rigors of installation and the longevity expected by engineers and owners.

This Design Manual provides the details and specifications necessary for consulting engineers to design stormwater management systems using the MC-4500 chamber. It provides specifications for storage capacities, layout dimensions as well as requirements for design to ensure a long service life. The basic design concepts for foundation and backfill materials, subgrade bearing capacities and row spacing remain equally as pertinent for the MC-4500 as the SC-740, SC-310, DC-780, MC-3500 and MC-7200 chamber systems. However, since many design values and dimensional requirements are different for these larger chambers than the SC-740, SC-310 and DC-780 chambers, design manuals and installation instructions are not interchangeable.

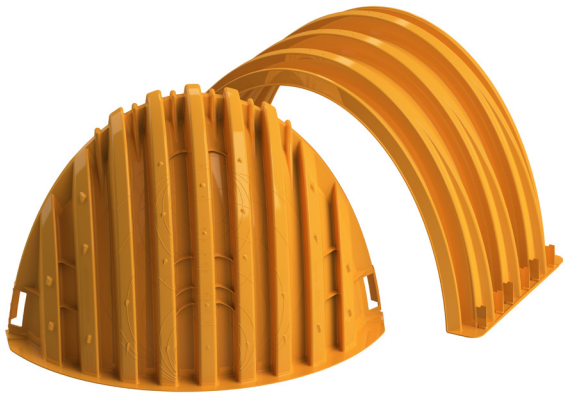
This manual includes only those details, dimensions, cover limits, etc for the MC-4500 and is intended to be a stand-alone design guide for the MC-4500 chambers. A installation guide specifically for this chamber model has also been published.

1.2 Technical Support

The StormTech Technical Services Department is available to assist the engineer with the layout of the MC-4500 chamber systemand answer questions regarding all the StormTech chamber models. Call the Technical Services Department, email us at info@stormtech.com or contact your local StormTech representative.

1.3 MC-4500 Chamber

All StormTech chambers are designed to the full scope of AASHTO requirements without repeating end walls or other structural reinforcing. StormTech's continuously curved, elliptical arch and the surrounding angular backfill are the key components of the structural system. With the addition of patent pending integral stiffening ribs **(Figure 5)**, the MC-4500 is assured to provide a long, safe service life. Like other StormTech chambers, the MC-4500 is produced from high quality, impact modified resins which are tested for short-term and long-term mechanical



properties.

With all StormTech chambers, one chamber type is used for the start, middle and end of rows. Rows are formed by overlapping the upper joint corrugation of the next chamber over the lower joint corrugation of the previous chamber **(Figure 6)**.

1.4 CHAMBER JOINTS

All StormTech chambers are designed with an optimized joining system. The height and width of the end corrugations have been designed to provide the required structural safety factors while providing an unobstructed flow path down each row.

1.0 Product Information

To assist the contractor, StormTech chambers are molded with simple assembly instructions and arrows that indicate the direction in which to build rows. The corrugation valley immediately adjacent to the lower joint corrugation is marked "Overlap Here - Lower Joint." The corrugation valley immediately adjacent to the upper joint corrugation is marked "Build This Direction - Upper Joint."

Two people can safely and efficiently carry and place chambers without cumbersome connectors, special tools or heavy equipment. Each row of chambers must begin and end with a joint corrugation. Since joint corrugations are of a different size than the corrugations along the body of the chamber, chambers cannot be field cut and installed. Only whole MC-4500 chambers can be used. For system layout assistance contact StormTech.

1.5 MC-4500 End Caps

The MC-4500 end caps are easy to install. These end caps are designed with a corrugation joint that fits over the top of either end of the chamber. The end cap joint is simply set over the top of either of the upper or lower chamber joint corrugations **(Figure 7)**.

The MC-4500 end cap has pipe cutting guides for 12"–42" (300 mm–1050 mm) bottom inverts and 12"–24" (300 mm–600 mm) top inverts **(Figure 8)**.

Standard and custom pre-cored end caps are available.

Figure 5 - Chamber and End Cap Components

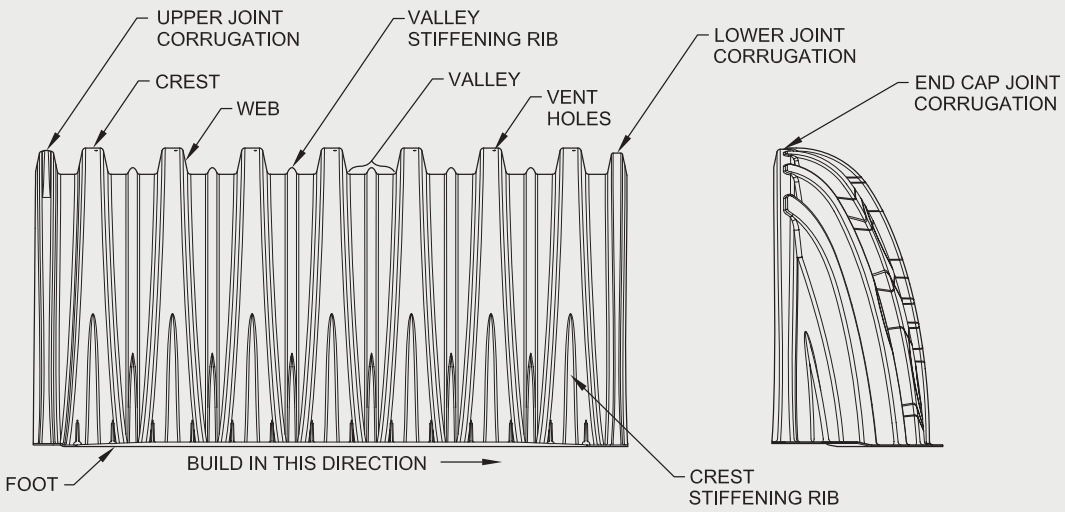


Figure 6 - Chamber Joint Overlap

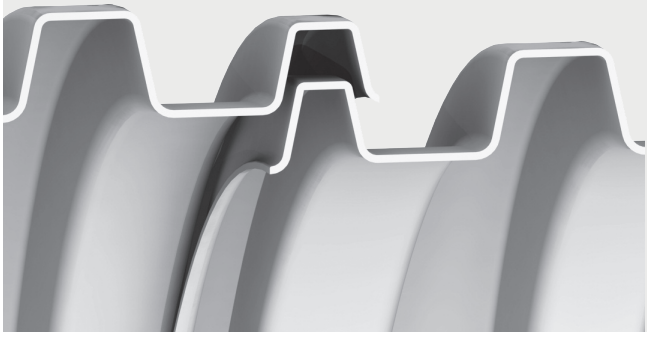
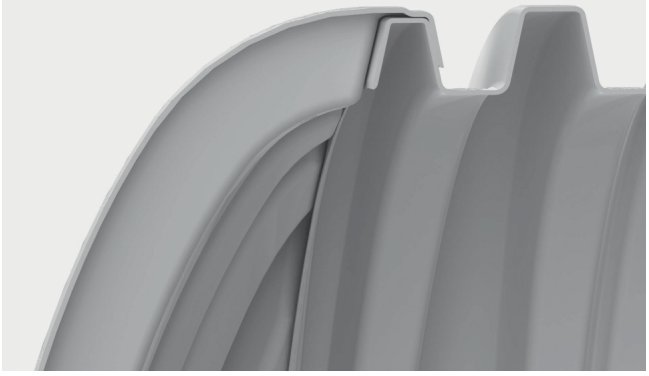
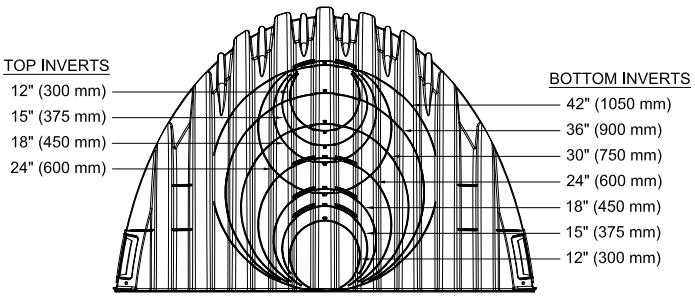


Figure 7 - End Cap Joint Overlap



1.0 Product Information

Figure 8—MC-4500 End Cap Inverts



2.0 Foundations for Chambers

2.1 FOUNDATION REQUIREMENTS

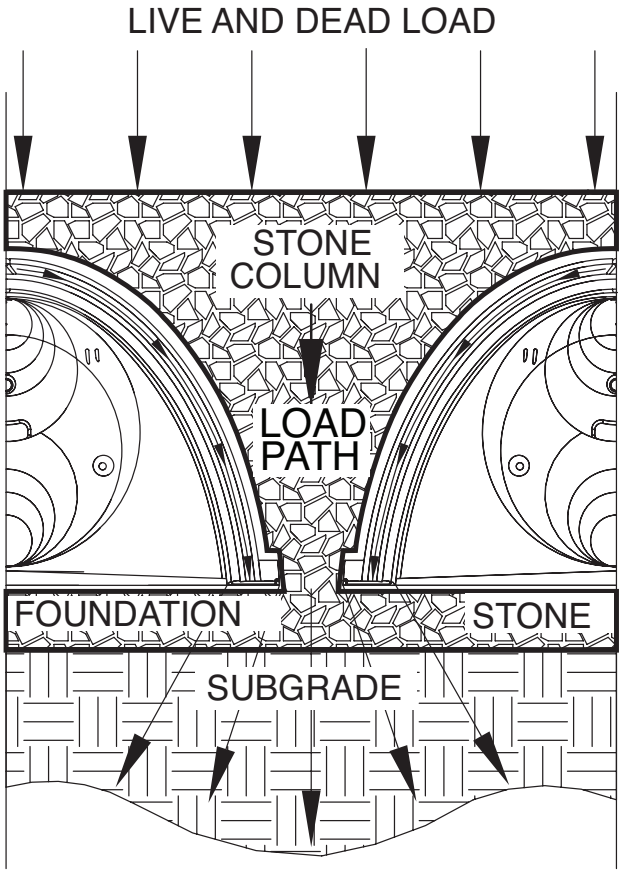
StormTech chamber systems can be installed in various soil types. The subgrade bearing capacity and the cover height over the chambers determine the required depth of clean, crushed, angular foundation stone below the chambers. Foundation stone, also called bedding, is the stone between the subgrade soils and the feet of the chamber. Flexible structures are designed to transfer a significant portion of both live and dead loads through the surrounding soils. Chamber systems accomplish this by creating load paths through the columns of embedment stone between and around the rows of chambers. This creates load concentrations at the base of the columns between the rows. The foundation stone spreads out the concentrated loads to distributed loads that can be supported by the subgrade soils.

Since increasing the cover height (top of chamber to finished grade) causes increasing soil load, a greater depth of foundation stone is necessary to distribute the load to the subgrade soils. **Table 1** specify the minimum required foundation depths for varying cover heights and allowable subgrade bearing capacities. These tables are based on StormTech service loads. The minimum required foundation depth is 9” (230 mm) for both chambers. For additional guidance on foundation stone design please see our Technical Note 6.22 - StormTech Subgrade Performance

2.2 WEAKER SOILS

StormTech has not provided guidance for subgrade bearing capacities less than 2000 pounds per square foot [(2.0 ksf) (96 kPa)]. These soils are often highly vari- able, may contain organic materials and could be more sensitive to moisture. A geotechnical engineer must be consulted if soils with bearing capacities less than 2000 psf (96 kPa) are present.

Figure 9 - Chamber Joint Overlap



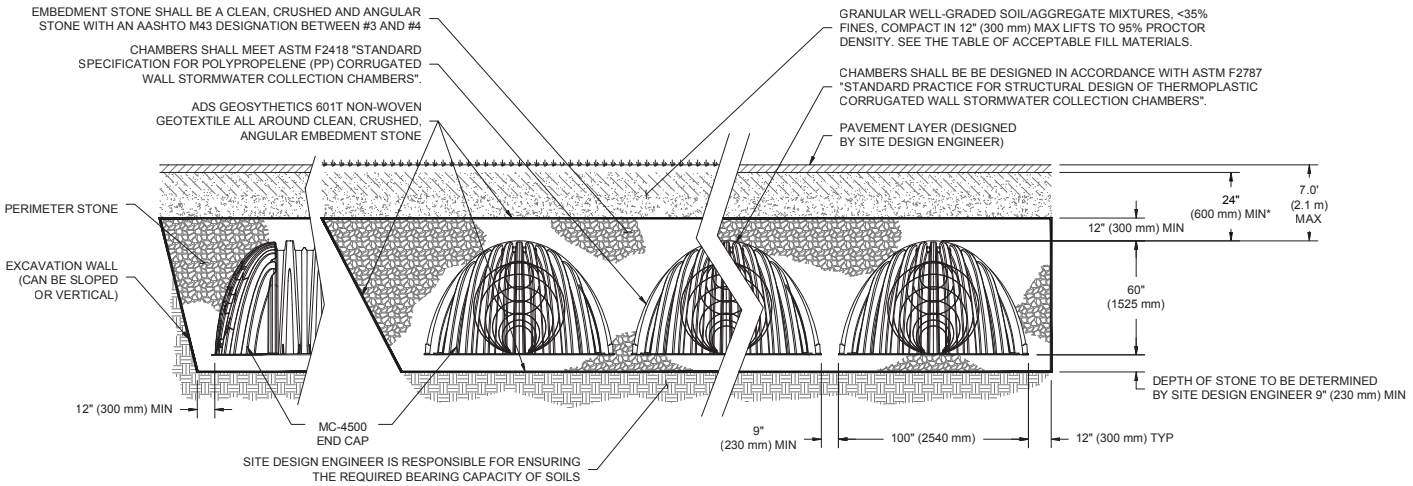
2.0 Foundations for Chambers

Table 1 - MC-4500 Minimum Required Foundation Depth in inches (millimeters)
Assumes 9” (230 mm) row spacing.

Cover Hgt. ft. (m)	Minimum Bearing Resistance for Service Loads ksf (kPa)																								
	4.4 (211)	4.3 (206)	4.2 (201)	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
2.0 (0.61)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	21 (525)	21 (525)
2.5 (0.76)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	24 (600)
3.0 (0.91)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	21 (525)	21 (525)	24 (600)	24 (600)	27 (675)
3.5 (1.07)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	24 (600)	24 (600)	27 (675)	30 (750)
4.0 (1.22)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	21 (525)	24 (600)	27 (675)	27 (675)	30 (750)	30 (750)
4.5 (1.37)	9 (230)	9 (230)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	24 (600)	24 (600)	27 (675)	27 (675)	30 (750)	33 (825)	33 (825)
5.0 (1.52)	9 (230)	9 (230)	9 (230)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	21 (525)	24 (600)	24 (600)	27 (675)	27 (675)	30 (750)	33 (825)	33 (825)	36 (900)
5.5 (1.68)	9 (230)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	24 (600)	24 (600)	24 (600)	27 (675)	27 (675)	30 (750)	33 (825)	33 (825)	36 (900)	36 (900)
6.0 (1.83)	12 (300)	12 (300)	12 (300)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	21 (525)	24 (600)	24 (600)	27 (675)	27 (675)	30 (750)	30 (750)	33 (825)	33 (825)	36 (900)	36 (900)	36 (900)
6.5 (1.98)	12 (300)	12 (300)	15 (375)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	24 (600)	24 (600)	24 (600)	27 (675)	27 (675)	30 (750)	30 (750)	33 (825)	33 (825)	36 (900)	36 (900)	36 (900)	36 (900)
7.0 (2.13)	15 (375)	15 (375)	15 (375)	15 (375)	18 (450)	18 (450)	18 (450)	18 (450)	21 (525)	21 (525)	21 (525)	24 (600)	24 (600)	24 (600)	27 (675)	27 (675)	30 (750)	30 (750)	33 (825)	36 (900)	36 (900)	36 (900)	36 (900)	36 (900)	36 (900)

Note: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

Figure 10 - MC-4500 Structural Cross Section Detail (Not to Scale)



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

Special applications will be considered on a project by project basis. Please contact our applications department should you have a unique application for our team to evaluate.

3.0 Required Materials/Row Separation

3.1 Foundation and Embedment Stone

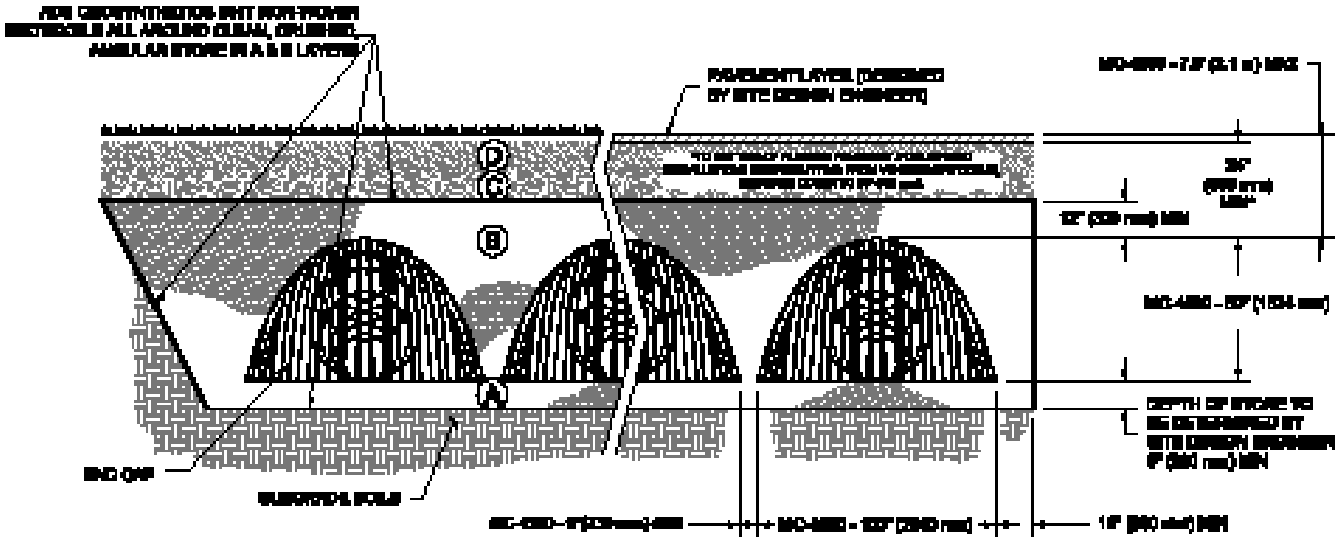
The stone surrounding the chambers consists of the foundation stone below the chambers and embedment stone surrounding the chambers. The foundation stone and embedment stone are important components of the structural system and also provide open void space for stormwater storage. **Table 2** provides the stone specifications that achieve both structural requirements and a porosity of 40% for stormwater storage. **Figure 11** specifies the extents of each backfill stone location.

Table 2 - Acceptable Fill Materials

Material Location		Description	AASHTO Designation	Compaction/Density Requirement
D	**Final Fill:** fill material for layer 'D' starts from the top of the 'C' layer to the bottom of flexible pavement or unpaved finished grade above. note that pavement subbase may be part of the 'D' layer	Any soil/rock materials, native soils, or per engineer's plans. check plans for pavement subgrade requirements.	N/A	Prepare per site design engineer's plans. paved installations may have stringent material and preparation requirements.
C	**Initial Fill:** fill material for layer 'C' starts from the top of the embedment stone ('B' layer) to 24" (600 mm) above the top of the chamber. note that pavement subbase may be a part of the 'C' layer.	Granular well-graded soil/aggregate mixtures, <35% fines or processed aggregate. Most pavement subbase materials can be used in lieu of this layer.	AASHTO M145[1] A-1,A-2-4,A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	Begin compactoins after 24" (600 mm) of material over the chambers is reached. compact addtional layers in 12" (300 mm) max lifts to a min. 95% proctor density for well-graded material and 95% relative density for processed aggregate materials.
B	**Embedment Stone:** fill surrounding the chambers form the foudation stone ('A' layer) to the 'C' layer above.	Clean, crushed, angular stone	AASHTO M43[1] 3, 4	No compaction required
A	**Foundation Stone:** fill below chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone	AASHTO M43[1] 3, 4	Plate compact or roll to achieve a flat surface. [2 3]

Note:
1. The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "clean, crushed, angular no. 4 (AASHTO M43) stone".
2. Stormtech compaction requirements are met for 'A' location materials when placed and compacted in 9" (230 mm) (max) lifts using two full coverages with a vibratory compactor.
3. Where infiltration surfaces may be compromised by compaction, for standard design load conditions, a flat surface may be achieved by raking or dragging without compaction equipment. For special load designs, contact stormtech for compaction requirements.

Figure 11 - Fill Material Locations



Once layer 'C' is placed, any soil/material can be placed in layer 'D' up to the finished grade. Most pavement subbase soils can be used to replace the materials of layer 'C' or 'D' at the design engineer's discretion.

3.0 Required Materials/Row Separation

3.2 Fill Above Chambers

Refer to **Table 2** and **Figure 11** for acceptable fill material above the clean, crushed, angular stone. StormTech requires a minimum of 24" (600 mm) from the top of the chamber to the bottom of flexible pavement. For non-paved installations where rutting from vehicles may occur StormTech requires a minimum of 30" (750 mm) from top of chamber to finished grade.

3.3 Geotextile Separation

A non-woven geotextile meeting AASHTO M288 Class 2 separation requirements must be installed to completely envelope the system and prevent soil intrusion into the crushed, angular stone. Overlap adjacent geotextile rolls per AASHTO M288 separation guidelines. Contact StormTech for a list of acceptable geotextiles.

3.4 Parallel Row Separation/ Perpendicular Bed Separation

Parallel Row Separation

The minimum installed spacing between parallel rows after backfilling is 9" (230 mm) for the MC-4500 chambers (measurement taken between the outside edges of the feet). Spacers may be used for layout convenience. Row spacing wider than the minimum spacing above may be specified.

Perpendicular Bed Separation

When beds are laid perpendicular to each other, a minimum installed spacing of 36" (900 mm) between beds is required.

3.5 Special Structural Designs

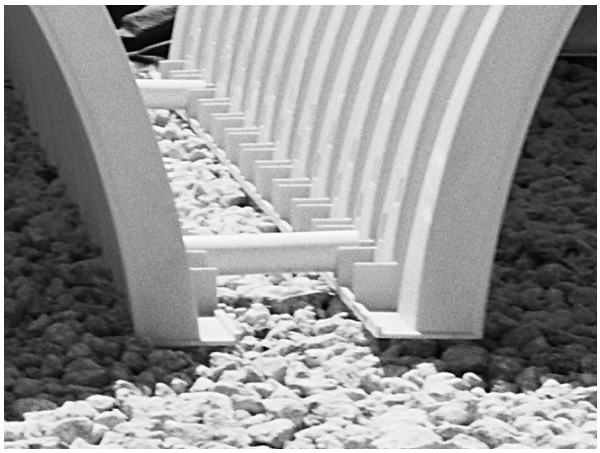
StormTech engineers may provide special structural designs to enable deeper cover depths or increase the capacity to carry higher live loads. Special designs may utilize the additional strength that can be achieved by compaction of embedment stone or by increasing the spacing between rows.

Increasing the spacing between chamber rows may also facilitate the application of StormTech chambers with either less foundation stone or with weaker subgrade soils. This may be a good option where vertical restrictions on site prevent the use of a deeper foundation.

Contact ADS Engineering Services for more information on special structural designs.



System Cross Section



Minimum Row Spacing

4.0 Hydraulics

4.1 General

StormTech subsurface chamber systems offer the flexibility for a variety of inlet and outlet configurations. Contact the StormTech Technical Services Department or your local StormTech representative for assistance configuring inlet and outlet connections.

The open graded stone around and under the chambers provides a significant conveyance capacity ranging from approximately 0.54 cfs (15 l/s) to 8.5 cfs (240 l/s) for the MC-4500 chamber. The actual conveyance capacity is dependent upon stone size, depth of foundation stone and head of water. Although the high conveyance capacity of the open graded stone is an important component of the flow network, StormTech recommends that a system of inlet and outlet manifolds be designed to distribute and convey the peak flow through the chamber system.

It is the responsibility of the design engineer to provide the design flow rates and storage volumes for the stormwater system and to ensure that the final design meets all conveyance and storage requirements. However, StormTech will work with the design engineer to assist with manifold and chamber layouts that meet the design objectives.

4.2 The Isolator® Row Plus

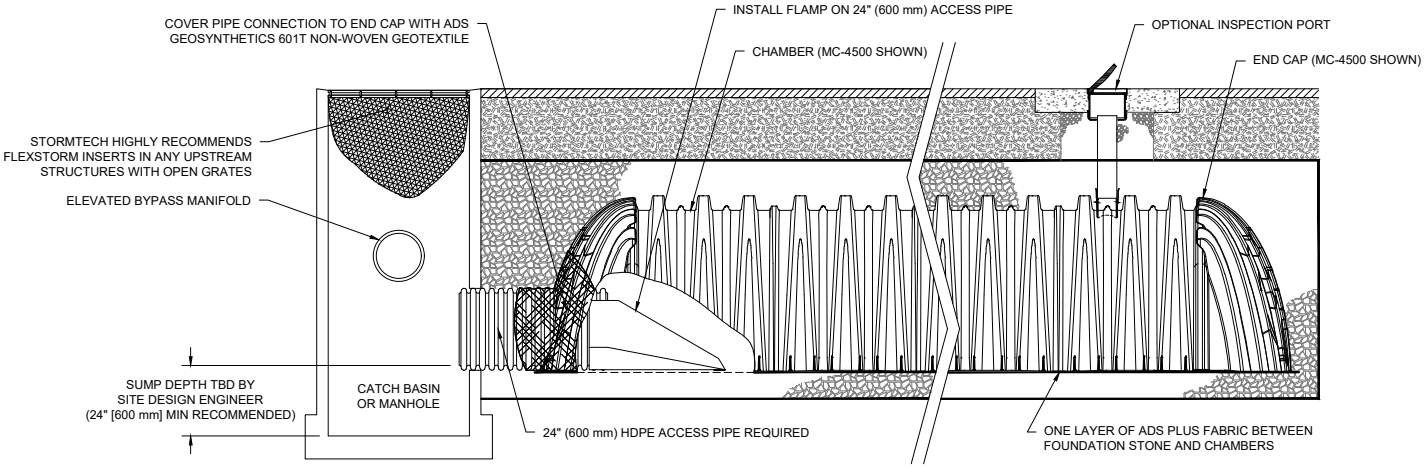
The Isolator Row PLUS is a patented system that inexpensively captures total suspended solids (TSS) and debris and provides easy access for inspection and maintenance. In a typical configuration, a single layer of ADS PLUS fabric is placed between the chambers and the stone foundations. This fabric traps and filters sediments as well as protects the stone base during cleaning and maintenance. Each installed MC-4500 chamber and MC-4500 end cap provides 30.1 ft^2 (2.80 m^2) and 12.8 ft^2 (1.19 m^2) of bottom filter area respectively.

The Isolator Row PLUS can be configured for maintenance objectives or, in some regulatory jurisdictions, for water quality objectives. For water quality applications, the Isolator Row PLUS can be sized based on water quality volume or flow rate.

All Isolator Plus Rows require: 1) a manhole for maintenance access, 2) a means of diversion of flows to the Isolator Row PLUS 3) a high flow bypass and 4)FLAMP (Flared End Ramp). When used on an Isolator Row PLUS, a 24” FLAMP (flared end ramp) is attached to the inside of the inlet pipe with a provided threaded rod and bolt. The FLAMP then lays on top of the ADS PLUS fabric.. Flow diversion can be accomplished by either a weir in the upstream access manhole or simply by feeding the Isolator Row PLUS at a lower elevation than the high flow bypass. Contact StormTech for assistance sizing Isolator Plus Rows.

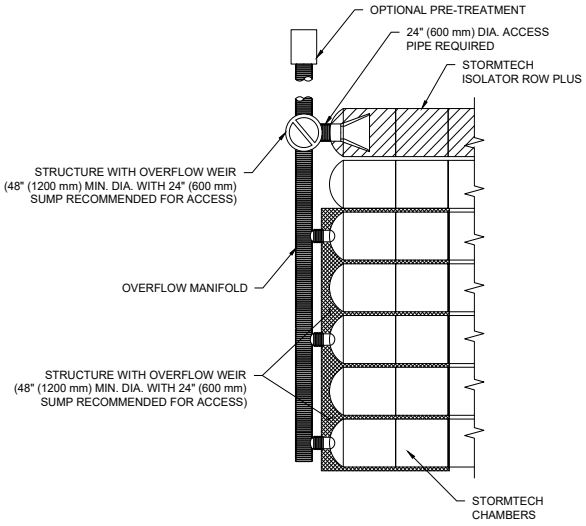
When additional stormwater treatment is required, StormTech systems can be configured using a treatment train approach where other stormwater BMPs are located in series.

Figure 12 - StormTech Isolator Row Plus Detail



4.0 Hydraulics

Figure 13 - Typical Inlet Configuration With Isolator Row Plus and Scour Protection



4.3 Inlet Manifolds

The primary function of the inlet manifold is to convey and distribute flows to a sufficient number of rows in the chamber bed such that there is ample conveyance capacity to pass the peak flows without creating an unacceptable backwater condition in upstream piping or scour the foundation stone under the chambers.

Manifolds are connected to the end caps either at the top or bottom of the end cap. Standard distances from the base of chamber to the invert of inlet and outlet manifolds connecting to StormTech end caps can be found in table 6. High inlet flow rates from either connection location produce a shear scour potential of the foundation stone. Inlet flows from top inlets also produce impingement scour potential. Scour potential is reduced when standing water is present over the foundation stone. However, for safe design across the wide range of applications, StormTech assumes minimal standing water at the time the design flow occurs.

To minimize scour potential, StormTech recommends the installation of woven scour protection fabric at each inlet row. This enables a protected transition zone from the concentrated flow coming out of the inlet pipe to a uniform flow across the entire width of the chamber for both top and bottom connections.

Allowable flow rates for design are dependent upon: the elevation of inlet pipe, foundation stone size and scour protection. With an appropriate scour protection geotextile installed from the end cap to at least 14.5 ft (4.42 m) in front of the inlet pipe for the MC-4500, for both top and bottom feeds, the flow rates listed in **Table 3** can be used for all StormTech specified foundation stone gradations.

***See StormTech's Tech Note 6.32 for manifold sizing guidance.**

Table 3 - Allowable Inlet Flows*

Inlet Pipe Diameter Inches (mm)	Allowable Maximum Flow Rate cfs (l/s)
12 (300)	2.48 (70)
15 (375)	3.5 (99)
18 (450)	5.5 (156)
24 (600)	9.5 (269)

*Assumes appropriate length of scour fabric per section 4.3

Table 4 - Maximum Outlet Flow Rate Capacities From StormTech Oulet Manifolds

Pipe Diameter	Flow (CFS)	Flow (L/S)
6" (150 mm)	0.4	11.3
8" (200 mm)	0.7	19.8
10" (250 mm)	1.0	28.3
12" (300 mm)	2.0	56.6
15" (375 mm)	2.7	76.5
18" (450 mm)	4.0	113.3
24" (600 mm)	7.0	198.2
30" (750 mm)	11.0	311.5
36" (900 mm)	16.0	453.1
42" (1050 mm)	22.0	623.0
48" (1200 mm)	28.0	792.9

Table 5 - Standard Distances From Base of Chamber to Invert of Inlet and Outlet Manifolds on StormTech MC-4500 End Caps

Pipe Diameter		Inv. (IN)	Inv. (MM)
TOP	12" (300 mm)	35.69	907
	15" (375 mm)	32.72	831
	18" (450 mm)	29.36	746
	24" (600 mm)	23.05	585
BOTTOM	12" (750 mm)	1.55	34
	15" (900 mm)	1.7	43
	18" (1050 mm)	1.97	50
	24" (1200 mm)	2.26	57

5.0 Cumulative Storage Volumes

4.4 Outlet Manifolds

The primary function of the outlet manifold is to convey peak flows from the chamber system to the outlet control structure. Outlet manifolds are often sized for attenuated flows. They may be smaller in diameter and have fewer row connections than inlet manifolds. In some applications however, the intent of the outlet piping is to convey an unattenuated bypass flow rate and manifolds may be sized similar to inlet manifolds.

Since chambers are generally flowing at or near full at the time of the peak outlet flow rate, scour is generally not governing and outlet manifold sizing is based on pipe flow equations. In most cases, StormTech recommends that outlet manifolds connect the same rows that are connected to an inlet manifold. This provides a continuous flow path through open conduits to pass the peak flow without dependence on passing peak flows through stone.

The primary function of the underdrains is to draw down water stored in the stone below the invert of the manifold. Underdrains are generally not sized for conveyance of the peak flow.

The maximum outlet flow rate capacities from StormTech outlet manifolds can be found in **Table 5.**

Figure 14 - Typical Inlet, Outlet and Underdrain Configuration

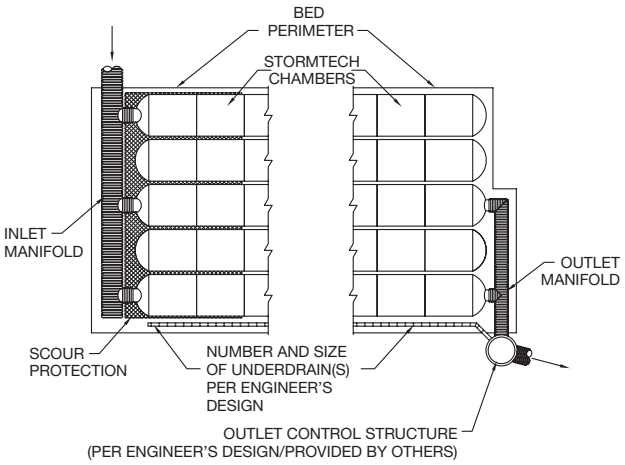
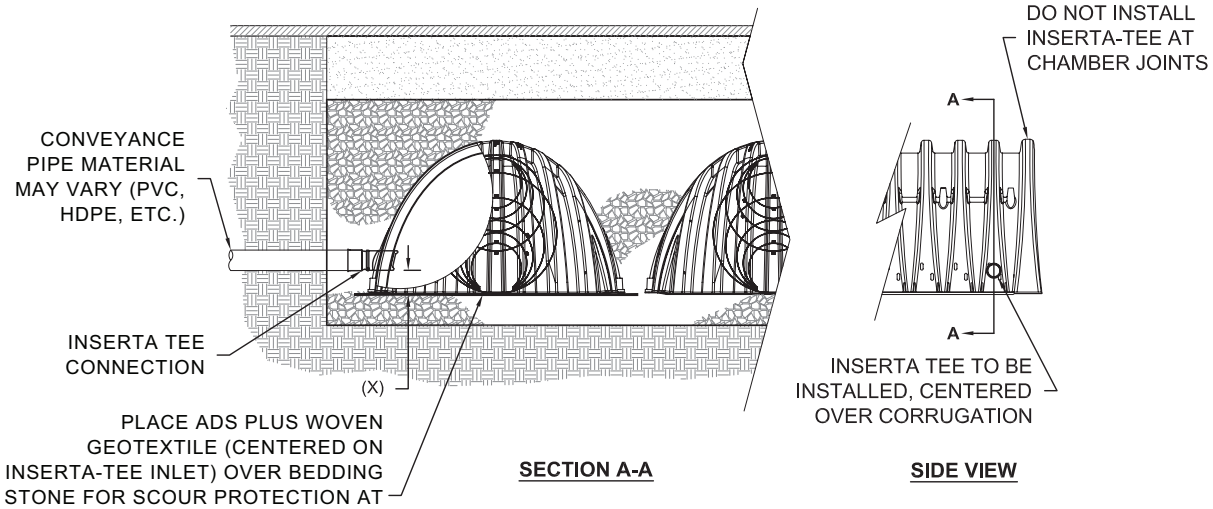


Figure 15 - Inserta Tee Detail



CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
MC-4500	12" (250 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

5.0 Cumulative Storage Volumes

Tables 6 and **7** provide cumulative storage volumes for the MC-4500 chamber and end cap. These tables can be used to calculate the stage-storage relationship for the retention or detention system. Digital spreadsheets in which the number of chambers and end caps can be input for quick cumulative storage calculations are available at www.stormtech.com. For assistance with site-specific calculations or input into routing software, contact the StormTech Technical Services Department.

Table 6 – MC-4500 Incremental Storage Volume Per Chamber

Assumes 40% stone porosity. Calculations are based upon a 9" (230 mm) stone base under the chambers, 12" (300 mm) of stone above chambers, and 9" (230 mm) of spacing between chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
81 (2057)	0.00	162.62 (4.065)
80 (2032)	0.00	161.40 (4.570)
79 (2007)	0.00	160.18 (4.536)
78 (1981)	Stone 0.00	158.98 (4.501)
77 (1956)	Cover 0.00	157.74 (4.467)
76 (1930)	0.00	156.62 (4.432)
75 (1905)	0.00	155.30 (4.398)
74 (1880)	0.00	154.09 (4.363)
73 (1854)	0.00	152.87 (4.329)
72 (1829)	0.00	151.65 (4.294)
71 (1803)	0.00	150.43 (4.294)
70 (1778)	0.00	149.21 (4.225)
69 (1753)	106.51 (3.016)	147.99 (4.191)
68 (1727)	106.47 (3.015)	146.75 (4.156)
67 (1702)	106.35 (3.012)	145.46 (4.119)
66 (1676)	106.18 (3.007)	144.14 (4.082)
65 (1651)	105.98 (3.001)	142.80 (4.044)
64 (1626)	105.71 (2.993)	141.42 (4.005)
63 (1600)	105.25 (2.981)	139.93 (3.962)
62 (1575)	104.59 (2.962)	138.31 (3.917)
61 (1549)	103.79 (2.939)	136.61 (3.869)
60 (1524)	102.88 (2.913)	134.85 (3.819)
59 (1499)	101.88 (2.885)	133.03 (3.767)
58 (1473)	100.79 (2.854)	131.16 (3.714)
57 (1448)	99.63 (2.821)	129.24 (3.660)
56 (1422)	98.39 (2.786)	127.28 (3.604)
55 (1397)	97.10 (2.749)	125.28 (3.548)
54 (1372)	95.73 (2.711)	123.25 (3.490)
53 (1346)	94.32 (2.671)	121.18 (3.490)
52 (1321)	92.84 (2.629)	119.08 (3.372)
51 (1295)	91.32 (2.586)	116.94 (3.311)
50 (1270)	89.74 (2.541)	114.78 (3.250)
49 (1245)	88.12 (2.495)	112.59 (3.188)
48 (1219)	86.45 (2.448)	110.37 (3.125)
47 (1194)	84.75 (2.400)	108.13 (3.062)
46 (1168)	83.00 (2.350)	105.86 (2.998)
45 (1143)	81.21 (2.300)	103.56 (2.933)
44 (1118)	79.38 (2.248)	101.25 (2.867)
43 (1092)	77.52 (2.195)	98.91 (2.801)
42 (1067)	75.62 (2.141)	96.55 (2.734)
41 (1041)	73.69 (2.087)	94.18 (2.667)
40 (1016)	71.72 (2.031)	91.78 (2.599)
39 (991)	69.73 (1.974)	89.36 (2.531)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
38 (965)	67.70 (1.917)	86.93 (2.462)
37 (948)	65.65 (1.859)	84.48 (2.392)
36 (914)	63.57 (1.800)	82.01 (2.322)
35 (889)	61.46 (1.740)	79.53 (2.252)
34 (864)	59.32 (1.680)	77.03 (2.181)
33 (838)	57.17 (1.619)	74.52 (2.110)
32 (813)	54.98 (1.557)	71.99 (2.038)
31 (787)	52.78 (1.495)	69.45 (1.966)
30 (762)	50.55 (1.431)	66.89 (1.894)
29 (737)	48.30 (1.368)	64.32 (1.821)
28 (711)	46.03 (1.303)	61.74 (1.748)
27 (686)	43.74 (1.239)	59.19 (1.675)
26 (680)	41.43 (1.173)	56.55 (1.601)
25 (610)	39.11 (1.107)	53.93 (1.527)
24 (609)	36.77 (1.041)	51.31 (1.453)
23 (584)	34.41 (0.974)	48.67 (1.378)
22 (559)	32.03 (0.907)	46.03 (1.303)
21 (533)	29.64 (0.839)	43.38 (1.228)
20 (508)	27.23 (0.771)	40.71 (1.153)
19 (483)	24.81 (0.703)	38.04 (1.077)
18 (457)	22.38 (0.634)	35.37 (1.001)
17 (432)	19.94 (0.565)	32.68 (0.925)
16 (406)	17.48 (0.495)	29.99 (0.849)
15 (381)	15.01 (0.425)	27.29 (0.773)
14 (356)	12.53 (0.355)	24.58 (0.696)
13 (330)	10.05 (0.284)	21.87 (0.619)
12 (305)	7.55 (0.214)	19.15 (0.542)
11 (279)	5.04 (0.143)	16.43 (0.465)
10 (254)	2.53 (0.072)	13.70 (0.388)
9 (229)	0.00	10.97 (0.311)
8 (203)	0.00	9.75 (0.276)
7 (178)	0.00	8.53 (0.242)
6 (152)	Stone 0.00	7.31 (0.207)
5 (127)	Cover 0.00	6.09 (0.173)
4 (102)	0.00	4.87 (0.138)
3 (76)	0.00	3.66 (0.104)
2 (51)	0.00	2.44 (0.069)
1 (25)	0.00	1.22 (0.035)

NOTE: Add 1.22 ft³ (0.035 m³) of storage for each additional inch (25 mm) of stone foundation. Contact StormTech for cumulative volume spreadsheets in digital format.

5.0 Cumulative Storage Volumes

Table 7– MC-4500 Incremental Storage Volume Per End Cap

Assumes 40% stone porosity. Calculations are based upon a 9" (230 mm) stone base under the chambers, 12" (300 mm) of stone above end caps, and 9" (230 mm) of spacing between end caps and 6" (150 mm) of stone perimeter.

Depth of Water in System Inches (mm)	Cumulative End Cap Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
81 (2057)	0.00	115.28 (3.264)
80 (2032)	0.00	114.15 (3.232)
79 (2007)	0.00	113.02 (3.200)
78 (1981)	0.00	111.89 (3.168)
77 (1956)	0.00	110.76 (3.136)
76 (1930)	0.00	109.63 (3.104)
75 (1905)	0.00	108.50 (3.072)
74 (1880)	0.00	107.37 (3.040)
73 (1854)	0.00	106.24 (3.008)
72 (1829)	0.00	105.11 (2.976)
71 (1803)	0.00	103.98 (2.944)
70 (1778)	0.00	102.85 (2.912)
69 (1753)	39.54 (1.120)	101.72 (2.880)
68 (1727)	39.53 (1.119)	100.58 (2.848)
67 (1702)	39.50 (1.118)	99.43 (2.816)
66 (1676)	39.45 (1.117)	98.27 (2.783)
65 (1651)	39.38 (1.115)	97.10 (2.750)
64 (1626)	39.30 (1.113)	95.92 (2.716)
63 (1600)	39.19 (1.110)	94.73 (2.682)
62 (1575)	39.06 (1.106)	93.52 (2.648)
61 (1549)	38.90 (1.101)	92.29 (2.613)
60 (1524)	38.71 (1.096)	91.04 (2.578)
59 (1499)	38.49 (1.090)	89.78 (2.542)
58 (1473)	38.24 (1.083)	88.50 (2.506)
57 (1448)	37.97 (1.075)	87.21 (2.469)
56 (1422)	37.67 (1.067)	85.90 (2.432)
55 (1397)	37.34 (1.057)	84.57 (2.395)
54 (1372)	36.98 (1.047)	83.23 (2.357)
53 (1346)	36.60 (1.036)	81.87 (2.318)
52 (1321)	36.19 (1.025)	80.49 (2.279)
51 (1295)	35.75 (1.012)	79.10 (2.240)
50 (1270)	35.28 (0.999)	77.69 (2.200)
49 (1245)	34.79 (0.985)	76.26 (2.159)
48 (1219)	34.27 (0.970)	74.82 (2.119)
47 (1194)	33.72 (0.955)	73.36 (2.077)
46 (1168)	33.15 (0.939)	71.89 (2.036)
45 (1143)	32.57 (0.922)	70.40 (1.994)
44 (1118)	31.96 (0.905)	68.91 (1.951)
43 (1092)	31.32 (0.887)	67.40 (1.909)
42 (1067)	30.68 (0.869)	65.88 (1.866)
41 (1041)	30.00 (0.850)	64.35 (1.822)
40 (1016)	29.30 (0.830)	62.80 (1.778)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
39 (991)	28.58 (0.809)	61.23 (1.734)
38 (965)	27.84 (0.788)	59.65 (1.689)
37 (948)	27.07 (0.767)	58.07 (1.644)
36 (914)	26.29 (0.744)	56.46 (1.599)
35 (889)	25.48 (0.722)	54.85 (1.553)
34 (864)	24.66 (0.698)	53.23 (1.507)
33 (838)	23.83 (0.675)	51.60 (1.461)
32 (813)	22.98 (0.651)	49.96 (1.415)
31 (787)	22.12 (0.626)	48.31 (1.368)
30 (762)	21.23 (0.601)	46.65 (1.321)
29 (737)	20.32 (0.575)	44.97 (1.273)
28 (711)	19.40 (0.549)	43.29 (1.226)
27 (686)	18.48 (0.523)	41.61 (1.178)
26 (680)	17.54 (0.497)	39.91 (1.130)
25 (610)	16.59 (0.470)	38.21 (1.082)
24 (609)	15.62 (0.442)	36.50 (1.033)
23 (584)	14.64 (0.414)	34.78 (0.985)
22 (559)	13.66 (0.387)	33.07 (0.936)
21 (533)	12.66 (0.359)	31.33 (0.887)
20 (508)	11.65 (0.330)	29.60 (0.838)
19 (483)	10.63 (0.301)	27.85 (0.3789)
18 (457)	9.60 (0.272)	26.11 (0.739)
17 (432)	8.56 (0.242)	24.35 (0.690)
16 (406)	7.51 (0.213)	22.59 (0.640)
15 (381)	6.46 (0.183)	20.83 (0.590)
14 (356)	5.41 (0.153)	19.07 (0.540)
13 (330)	4.35 (0.123)	17.31 (0.490)
12 (305)	3.28 (0.093)	15.53 (0.440)
11 (279)	2.19 (0.062)	13.75 (0.389)
10 (254)	1.11 (0.031)	11.97 (0.339)
9 (229)	0.00	10.17 (0.288)
8 (203)	0.00	9.04 (0.256)
7 (178)	0.00	7.91 (0.224)
6 (152)	0.00	6.78 (0.192)
5 (127)	0.00	5.65 (0.160)
4 (102)	0.00	4.52 (0.128)
3 (76)	0.00	3.39 (0.096)
2 (51)	0.00	2.26 (0.064)
1 (25)	0.00	1.13 (0.032)

Stone foundation

NOTE: Add 1.08 ft³ (0.031 m³) of storage for each additional inch (25 mm) of stone foundation. Contact StormTech for cumulative volume spreadsheets in digital format.

6.0 MC-4500 Chamber System Sizing

The following steps provide the calculations necessary for preliminary sizing of an MC-4500 chamber system. For custom bed configurations to fit specific sites, contact the StormTech Technical Services Department or your local StormTech representative.

1) Determine the amount of storage volume (VS) required. It is the design engineer's sole responsibility to determine the storage volume required.

Table 8—Storage Volume Per Chamber/End Cap ft³ (m³)

	Bare Unit Storage ft³ (m³)	Chamber/End Cap and Stone Volume Stone Foundation Depth in. (mm)			
		9 (230)	12 (300)	15 (375)	18 (450)
MC-4500 Chamber	106.5 (3.01)	162.6 (4.60)	166.3 (4.71)	169.9 (4.81)	173.6 (4.91)
MC-4500 End Cap	39.5 (1.12)	115.3 (3.26)	118.6 (3.36)	121.9 (3.45)	125.2 (3.54)

NOTE: Assumes 9" (230 mm) row spacing, 40% stone porosity, 12" (300 mm) stone above and includes the bare chamber/end cap volume. End cap volume assumes 12" (300 mm) stone perimeter.

2) Determine the number of chambers (C) required. To calculate the number of chambers required for adequate storage, divide the storage volume (Vs) by the storage volume of the chamber (from **Table 8**), as follows: **C = Vs / Storage Volume per Chamber**

3) Determine the number of end caps required. The number of end caps (EC) required depends on the number of rows required by the project. Once the number of chamber rows is determined, multiply the number of chamber rows by 2 to determine the number of end caps required. **EC = No. of Chamber Rows x 2**

Note: Additional end caps may be required for systems having inlet locations within the chamber bed.

4) Determine additional storage provided by end caps. End Caps will provide additional storage to the project. Multiply the number of end caps (EC) by the storage volume per end cap (ECS) to determine the additional storage (As) provided by the end caps. **As = EC x ECs**

5) Adjust number of chambers (C) to account for additional end cap storage (As). The original number of chambers (C) can now be reduced due to the additional storage in the end caps. Divide the additional storage (As) by the storage volume per chamber to determine the number of chambers that can be removed. **Number of chambers to remove = As/ volume per chamber**

NOTE: Additional storage exists in the stone perimeter as well as in the inlet and outlet manifold systems. Contact StormTech's Technical Services Department for assistance with determining the number of chambers and end caps required for your project.

6) Determine the required bed size (S). The size of the bed will depend on the number of chambers and end caps required:
MC-4500 area per chamber = 36.6 ft² (3.4 m²)
MC-4500 area per end cap = 23.9 ft² (2.2 m²)

S = (C x area per chamber) + (EC x area per end cap)

Note: It is necessary to add 12" (300 mm) of stone perimeter parallel to the chamber rows and 6" (150 mm) of stone perimeter from the base of all end caps. The additional area due to perimeter stone is not included in the area numbers above.

Table 9 - Amount of Stone Per Chamber

ENGLISH tons (yd³)	Stone Foundation Depth			
	9"	12"	15"	18"
MC-4500	7.4 (5.2)	7.8 (5.5)	8.3 (5.9)	8.8 (6.2)
End Cap	9.8 (7.0)	10.2 (7.3)	10.6 (7.6)	11.1 (7.9)
METRIC kg (m³)	**230 mm**	**300 mm**	**375 mm**	**450 mm**
MC-4500	6681 (4.0)	7117 (4.2)	7552 (4.5)	7987 (4.7)
End Cap	8890 (5.3)	9253 (5.5)	9616 (5.8)	10069 (6.0)

Note: Assumes 12" (300 mm) of stone above, and 9" (230 mm) row spacing, and 12" (300 mm) of perimeter stone in front of end caps.

7) Determine the amount of stone (Vst) required. To calculate the total amount of clean, crushed, angular stone required, multiply the number of chambers (C) and the number of end caps (EC) by the selected weight of stone from **Table 10.**

Note: Clean, crushed, angular stone is also required around the perimeter of the system.

Table 10 - Vol. of Excavation Per Chamber/End Cap yd³ (m³)

	Stone Foundation Depth			
	9" (230 mm)	12" (300 mm)	15" (375 mm)	18" (450 mm)
MC-4500	10.5 (8.0)	10.8 (8.3)	11.2 (8.5)	11.5 (8.8)
End Cap	9.7 (7.4)	10.0 (7.6)	10.3 (7.9)	10.6 (8.1)

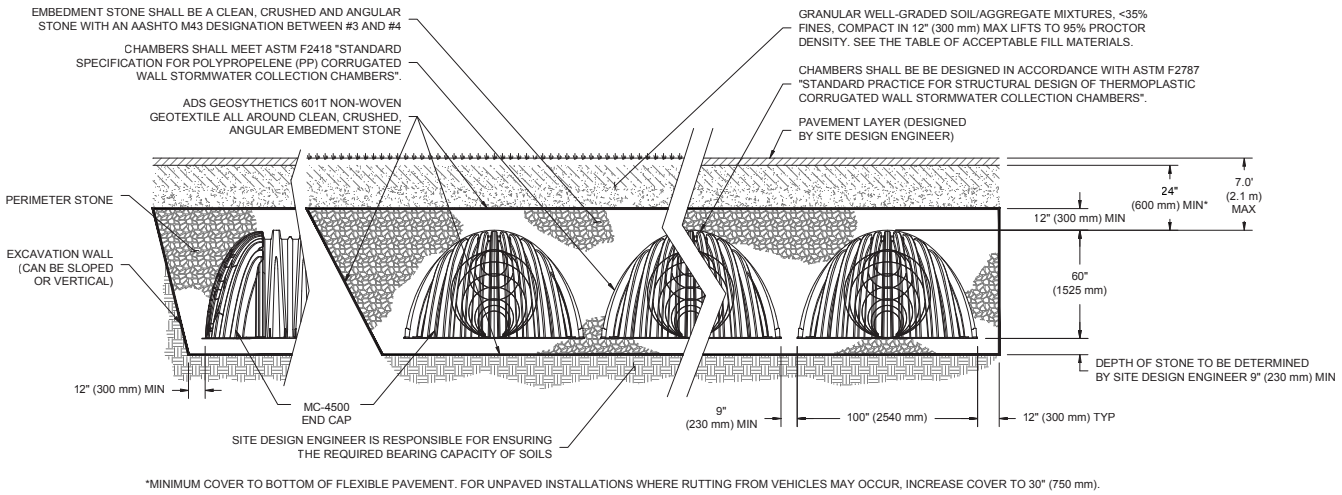
NOTE: Assumes 9" (230 mm) separation between chamber rows, 12" (300 mm) of perimeter in front of end caps, and 24" (600 mm) of cover. The volume of excavation will vary as the depth of cover increases.

8) Determine the volume of excavation (Ex) required. Each additional foot of cover will add a volume of excavation of 1.4 yd³ (1.0 m³) per MC-4500 chamber and 1.4 yd³ (0.8 m³) per MC-4500 end cap.

9) Determine the area of geotextile (F) required. The bottom, top and sides of the bed must be covered with a non-woven geotextile (filter fabric) that meets AASHTO M288 Class 2 requirements. The area of the sidewalls must be calculated and a 24" (600 mm) overlap must be included for all seams. Geotextiles typically come in 15 foot (4.57 m) wide rolls.

7.0 Structural Cross Sections and Specifications

Figure 16 - MC-4500 Structural Cross Section Detail (Not to Scale)



*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

Special applications will be considered on a project by project basis. Please contact our application department should you have a unique application for our team to evaluate.

MC-4500 Stormwater Chamber Specifications

1. Chambers shall be StormTech MC-4500 or approved equal.
2. Chambers shall be made from virgin, impact-modified polypropylene copolymers.
3. Chamber rows shall provide continuous, unobstructed internal space with no internal panels that would impede flow.
4. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for: 1) long-duration dead loads and 2) short-duration live loads, based on the AASHTO Design Truck with consideration for impact and multiple vehicle presences.
5. Chambers shall meet the requirements of ASTM F 2418, “Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers.”
6. Chambers shall conform to the requirements of ASTM F 2787, “Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers.”
7. Only chambers that are approved by the engineer will be allowed. The contractor shall submit (3 sets) of the following to the engineer for approval before delivering chambers to the project site:
   - A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met. The 50-year creep modulus data specified in ASTM F 2418 must be used as part of the AASHTO structural evaluation to verify long-term performance.
   - Structural cross section detail on which the structural cross section is based.
8. The installation of chambers shall be in accordance with the manufacturer’s latest Construction Guide.

Detail drawings available in Cad Rev. 2000 format at www.stormtech.com

8.0 General Notes

1. StormTech requires installing contractors to use and understand the latest **StormTech MC-4500 Construction Guide** prior to beginning system installation.

2. StormTech offers installation consultations to installing contractors. Contact our Technical Service Department or local StormTech representative at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can then answer questions or address comments on the StormTech chamber system and inform the installing contractor of the minimum installation requirements before beginning the system's construction. Call 860-529-8188 to speak to a Technical Service Representative or visit www.stormtech.com to receive a copy of our Construction Guide.

3. StormTech requirements for systems with pavement design (asphalt, concrete pavers, etc.): Minimum cover is 24"(600mm) for the MC-4500 not including pavement; MC-4500 maximum cover is 7.0' (2.43 m) both including pavement. For designs with cover depths deeper than these maximums, please contact Stormtech. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is increased to 30" (762 mm).

4. The contractor must report any discrepancies with the bearing capacity of the subgrade materials to the design engineer.

5. AASHTO M288 Class 2 non-woven geotextile (ADS601 or equal) (filter fabric) must be used as indicated in the project plans.

6. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of StormTech MC-4500 Construction Guide.

7. Backfilling over the chambers must follow require- ments as indicated in the most current version of StormTech MC-4500 Construction Guide.

8. The contractor must refer to StormTech MC-4500 Construction Guide for a Table of Acceptable Vehicle Loads at various depths of cover. This information is also available at the StormTech website: www.stormtech.com. The contractor is responsible for preventing vehicles that exceed StormTech requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.

9. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.

10. STORMTECH PRODUCT WARRANTY IS LIMITED. Contact StormTech for warranty information.

9.0 Inspection and Maintenance

9.1 Isolator Row Plus Inspection

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row PLUS. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a con- fined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3" (76 mm), cleanout is required.

A StormTech Isolator Row PLUS should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row PLUS should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

9.2 Isolator Row Plus Maintenance

JetVac maintenance is recommended if sediment has been collected to an average depth of 3" (76 mm) inside the Isolator Row PLUS. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row PLUS. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row PLUS while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combi- nation vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" (1143 mm) are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. The JetVac process shall only be performed on StormTech Rows that have ADS PLUS fabric over the foundation stone.

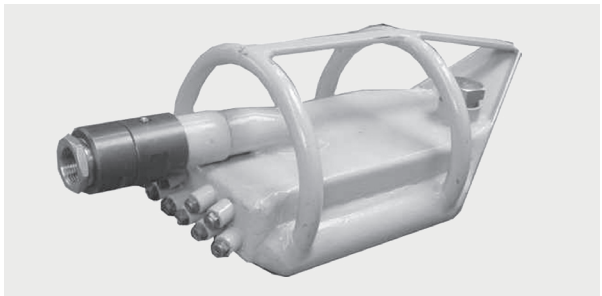
A FLAMP (flared end ramp) is attached to the inlet pipe on the inside of the chamber end cap to provide a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance over time by distributing sediment and debris that would otherwise collect at the inlet. It also serves to improve the fluid and solid flow back into the inlet pipe during maintenance and cleaning, and to guide cleaning and inspection equipment back into the inlet pipe when complete.



FLAMP (Flared End Ramp)



A typical JetVac truck
(This is not a StormTech product.)







Examples of culvert cleaning nozzles appropriate for Isolator Row PLUS maintenance. (These are not StormTech products).



MC-7200 MC-3500 DC-780 SC-740 SC-310 SC-160LP

A Family of Products and Services for the Stormwater Industry:

MC-3500 and MC-7200 Chambers and End Caps

SC-160LP, SC-310 and SC-740 Chambers & End Caps

DC-780 Chambers and End Caps

Fabricated End Caps

Fabricated Manifold Fittings

Patented Isolator Row PLUS for Maintenance and Water Quality

Chamber Separation Spacers

In-House System Layout Assistance

On-Site Educational Seminars

Worldwide Technical Sales Group

Centralized Product Applications Department

Research and Development Team

Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Website

StormTech provides state-of-the-art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that Saves Valuable Land and Protects Water Resources.

adspipe.com

800-821-6710

ADS Terms and Conditions of Sale are available on the ADS website, www.ads-pipe.com
Advanced Drainage Systems, the ADS logo and the Green Stripe are registered trademarks of Advanced Drainage Systems, Inc.
StormTech® and the Isolator® Row Plus are registered trademarks of StormTech, Inc.
© 2023 Advanced Drainage Systems, Inc. # S250211 2/23

ADS StormTech™

Oldcastle Infrastructure™
A CRH COMPANY

FLOGARD+PLUS®
CATCH BASIN INSERT FILTER

Inspection and Maintenance Guide



DRAINAGE PROTECTION SYSTEMS
DPS
A division of
Oldcastle Infrastructure

Water

SCOPE:

Federal, State and Local Clean Water Act regulations and those of insurance carriers require that stormwater filtration systems be maintained and serviced on a recurring basis. The intent of the regulations is to ensure that the systems, on a continuing basis, efficiently remove pollutants from stormwater runoff thereby preventing pollution of the nation's water resources. These specifications apply to the FloGard+Plus® Catch Basin Insert Filter.

RECOMMENDED FREQUENCY OF SERVICE:

Drainage Protection Systems (DPS) recommends that installed FloGard+Plus Catch Basin Insert Filters be serviced on a recurring basis. Ultimately, the frequency depends on the amount of runoff, pollutant loading and interference from debris (leaves, vegetation, cans, paper, etc.); however, it is recommended that each installation be serviced a minimum of three times per year, with a change of filter medium once per year. DPS technicians are available to do an on-site evaluation, upon request.

RECOMMENDED TIMING OF SERVICE:

DPS guidelines for the timing of service are as follows:

1. For areas with a definite rainy season: Prior to, during and following the rainy season.
2. For areas subject to year-round rainfall: On a recurring basis (at least three times per year).
3. For areas with winter snow and summer rain: Prior to and just after the snow season and during the summer rain season.
4. For installed devices not subject to the elements (wash racks, parking garages, etc.): On a recurring basis (no less than three times per year).

SERVICE PROCEDURES:

1. The catch basin grate shall be removed and set to one side. The catch basin shall be visually inspected for defects and possible illegal dumping. If illegal dumping has occurred, the proper authorities and property owner representative shall be notified as soon as practicable.
2. Using an industrial vacuum, the collected materials shall be removed from the liner. (Note: DPS uses a truck-mounted vacuum for servicing FloGard+Plus catch basin inserts).
3. When all of the collected materials have been removed, the filter medium pouches shall be removed by unsnapping the tether from the D-ring and set to one side. The filter liner, gaskets, stainless steel frame and mounting brackets, etc., shall be inspected for continued serviceability. Minor damage or defects found shall be corrected on-the-spot and a notation made on the Maintenance Record. More extensive deficiencies that affect the efficiency of the filter (torn liner, etc.), if approved by the customer representative, will be corrected and an invoice submitted to the representative along with the Maintenance Record.
4. The filter medium pouches shall be inspected for defects and continued serviceability and replaced as necessary, and the pouch tethers re-attached to the liner's D-ring.
5. The grate shall be replaced.

REPLACEMENT AND DISPOSAL OF EXPOSED FILTER MEDIUM AND COLLECTED DEBRIS

The frequency of filter medium exchange will be in accordance with the existing DPS-Customer Maintenance Contract. DPS recommends that the medium be changed at least once per year. During the appropriate service, or if so determined by the service technician during a non-scheduled service, the filter medium will be replaced with new material. Once the exposed pouches and debris have been removed, DPS has possession and must dispose of it in accordance with local, state and federal agency requirements.

DPS also has the capability of servicing all manner of storm drain filters, catch basin inserts and catch basins without inserts, underground oil/water separators, stormwater interceptors and other such devices. All DPS personnel are highly qualified technicians and are confined-space trained and certified. Call us at (888) 950-8826 for further information and assistance.

FLOGARD+PLUS®
CATCH BASIN INSERT FILTER

OUR MARKETS



BUILDING STRUCTURES



COMMUNICATIONS



WATER



ENERGY



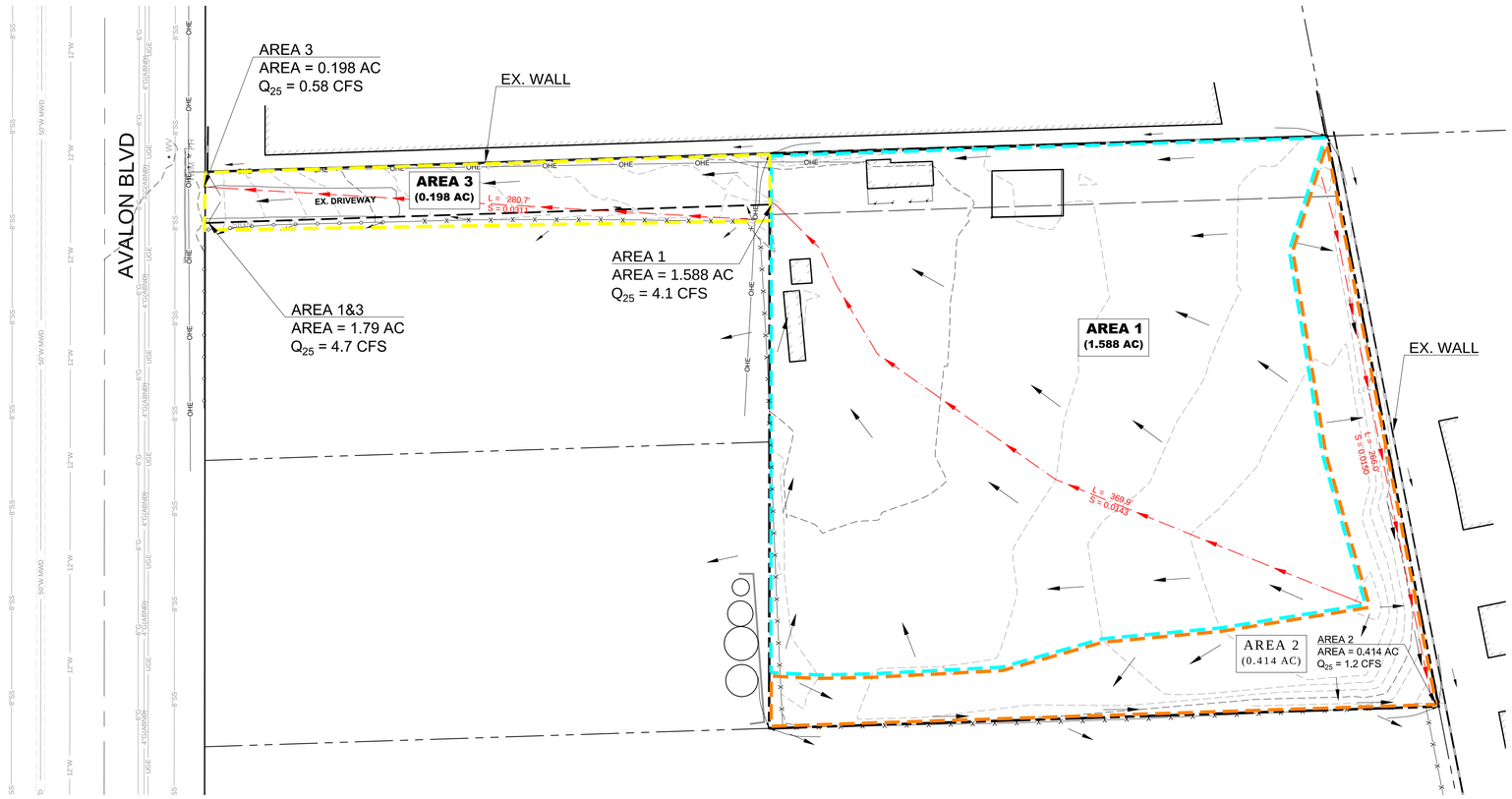
TRANSPORTATION

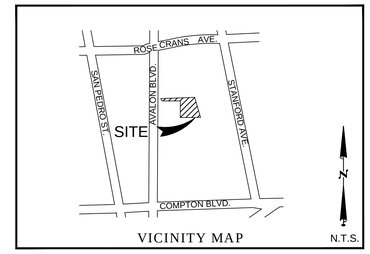
Exhibit 1

Hydrology Plans

PRE-DEVELOPED HYDROLOGY

COUNTY OF LOS ANGELES, STATE OF CALIFORNIA





LEGEND

- FLOW PATH
- L = LENGTH
- S = SLOPE
- DRAINAGE DIRECTION

HYDROLOGY INFORMATION

AREA	2.2 ACRES
TYPE OF DEVELOPMENT	COMMERCIAL/ INDUSTRIAL
ISOHYET (Q50)	5.95 INCHES
SOIL CLASSIFICATION #	13
% OF PROJECT IMPERVIOUS	13%
% OF PROJECT PERVIOUS	87%
Ai (IMPERVIOUS)	0.285 AC
Ap (PERVIOUS)	1.915 AC
TOTAL EXISTING Q25*	5.9 CFS
TIME OF CONCENTRATION	VARIES

* CALCULATED USING HYDROCALC, 1.03 BETA; VALUES BASED ON L.A. COUNTY DEPT. OF PUBLIC WORKS HYDROLOGY MANUAL 2006 EDITION

HYDROLOGY STUDY RESULTS (BY HYDROCALC)

AREA DESIGNATION	Ai (AC)	Ap (AC)	TOTAL AREA (ACRES)	Q_{25} (CFS)	V_{25} (CF)
1	0.087	1.501	1.588	4.1	6,349
2	0	0.414	0.414	1.2	1,396
3	0.198	0	0.198	0.58	671
TOTAL	0.285	1.915	2.2	5.9	8,416

HYDROLOGY STUDY APPROVED

REVIEWED BY: _____ DATE: 04/15/2025

APPROVED BY: _____ DATE: 04/15/2025

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

N

GRAPHIC SCALE

0' 30' 60'

SCALE: 1" = 30'

NOT FOR CONSTRUCTION

NO.	DATE	REVISION
1		

PLANS PREPARED BY:
DCA CIVIL ENGINEERING GROUP
• CIVIL ENGINEERING • LAND PLANNING • SURVEYING & MAPPING • A.L.T.A. SPECIALISTS
Corona Office
1760 Frontera Way, Ste. 300
Corona, CA 92879
Tel: (951) 277-0080 Fax: (951) 277-0070
www.dcaengineering.com

(C)2025 DCA ENGINEERING GROUP ALL RIGHTS RESERVED

PRE-DEVELOPED HYDROLOGY
SITE ADDRESS: 14500 S. AVALON BLVD., GARDENA, CA
PREPARED FOR: CATALDO AND ASSOCIATES

PROFESSIONAL STAMP:

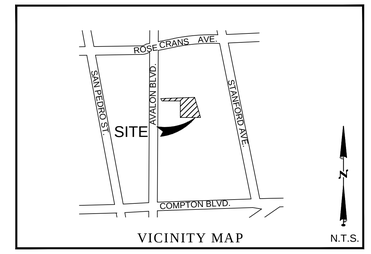
REGISTERED PROFESSIONAL ENGINEER
CHARLES STEPHEN CUMMINS
No. C 34526
Exp. 9/30/25
CIVIL
STATE OF CALIFORNIA

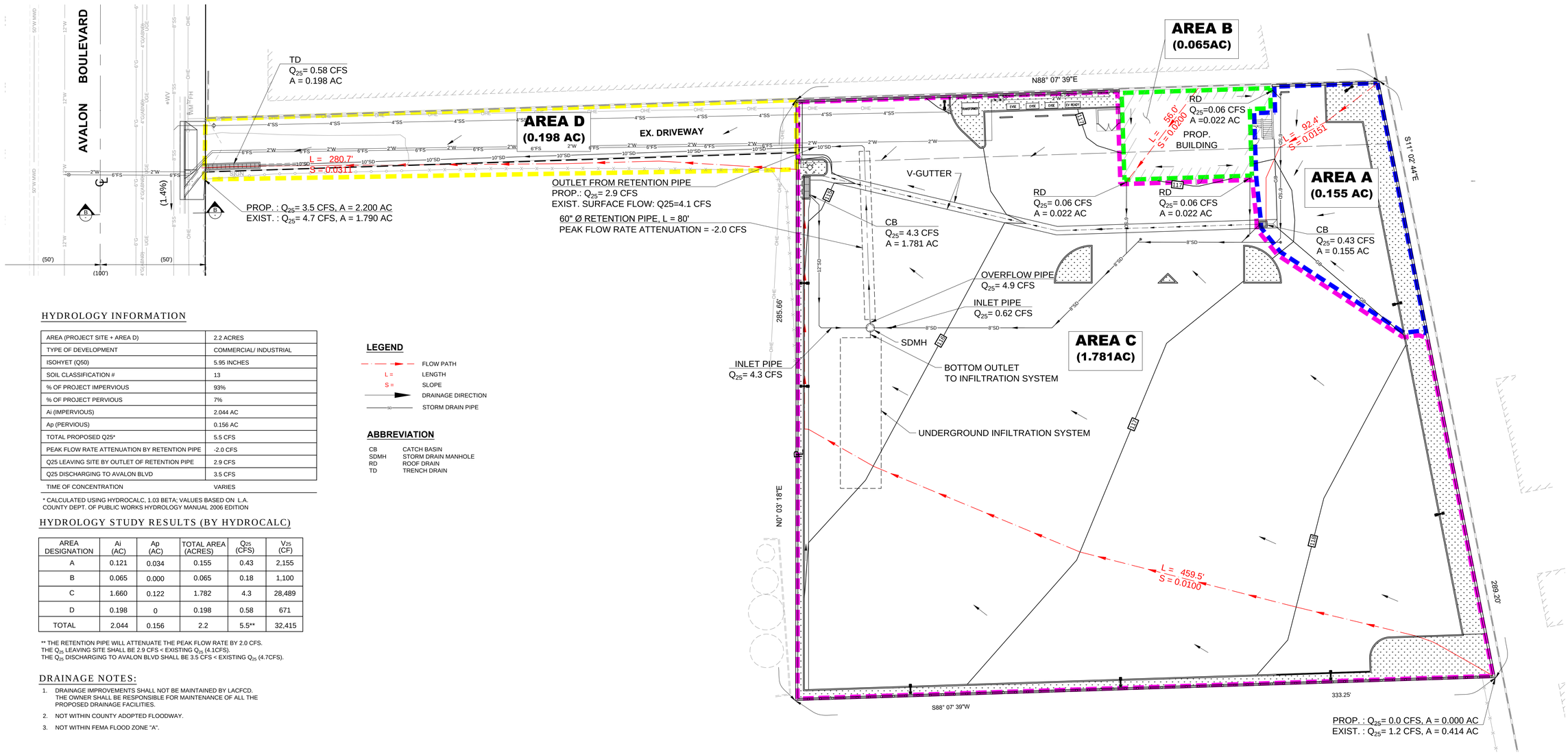
DATE: 03/26/2025
SCALE: AS SHOWN
DESIGNED: CSH DRAWN: VN
SHEET NO.: HY-1
SHEET 1 OF 2
PROJECT NO.: 21-2756-4679.000-1710

3/26/2025 2:38 PM
S:\PROJECTS\4679.000 - 14500 S Avalon Blvd\1637\EXPA\SHEETS\HY-1 - PRE-DEVELOPED HYDROLOGY.dwg

POST-DEVELOPED HYDROLOGY

COUNTY OF LOS ANGELES, STATE OF CALIFORNIA





HYDROLOGY INFORMATION

AREA (PROJECT SITE + AREA D)	2.2 ACRES
TYPE OF DEVELOPMENT	COMMERCIAL/ INDUSTRIAL
ISOHYET (Q50)	5.95 INCHES
SOIL CLASSIFICATION #	13
% OF PROJECT IMPERVIOUS	93%
% OF PROJECT PERVIOUS	7%
Ai (IMPERVIOUS)	2.044 AC
Ap (PERVIOUS)	0.156 AC
TOTAL PROPOSED Q25*	5.5 CFS
PEAK FLOW RATE ATTENUATION BY RETENTION PIPE	-2.0 CFS
Q25 LEAVING SITE BY OUTLET OF RETENTION PIPE	2.9 CFS
Q25 DISCHARGING TO AVALON BLVD	3.5 CFS
TIME OF CONCENTRATION	VARIES

* CALCULATED USING HYDROCALC, 1.03 BETA; VALUES BASED ON L.A. COUNTY DEPT. OF PUBLIC WORKS HYDROLOGY MANUAL 2006 EDITION

LEGEND

- FLOW PATH
- L = LENGTH
- S = SLOPE
- DRAINAGE DIRECTION
- STORM DRAIN PIPE

ABBREVIATION

CB	CATCH BASIN
SDMH	STORM DRAIN MANHOLE
RD	ROOF DRAIN
TD	TRENCH DRAIN

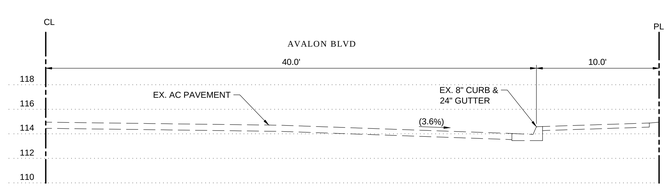
HYDROLOGY STUDY RESULTS (BY HYDROCALC)

AREA DESIGNATION	Ai (AC)	Ap (AC)	TOTAL AREA (ACRES)	Q_{25} (CFS)	V_{25} (CF)
A	0.121	0.034	0.155	0.43	2,155
B	0.065	0.000	0.065	0.18	1,100
C	1.660	0.122	1.782	4.3	28,489
D	0.198	0	0.198	0.58	671
TOTAL	2.044	0.156	2.2	5.5**	32,415

** THE RETENTION PIPE WILL ATTENUATE THE PEAK FLOW RATE BY 2.0 CFS.
THE Q_{25} LEAVING SITE SHALL BE 2.9 CFS < EXISTING Q_{25} (4.1CFS).
THE Q_{25} DISCHARGING TO AVALON BLVD SHALL BE 3.5 CFS < EXISTING Q_{25} (4.7CFS).

DRAINAGE NOTES:

1. DRAINAGE IMPROVEMENTS SHALL NOT BE MAINTAINED BY LACFCD. THE OWNER SHALL BE RESPONSIBLE FOR MAINTENANCE OF ALL THE PROPOSED DRAINAGE FACILITIES.
2. NOT WITHIN COUNTY ADOPTED FLOODWAY.
3. NOT WITHIN FEMA FLOOD ZONE "A".



SECTION A-A : STREET

SCALE: 1" = 5'

HYDROLOGY STUDY APPROVED

REVIEWED BY: _____ DATE 04/15/2025

APPROVED BY: _____ DATE 04/15/2025

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

GRAPHIC SCALE

0' 30' 60'

SCALE: 1" = 30'

NOT FOR CONSTRUCTION

NO.	DATE	REVISION

PLANS PREPARED BY:
DCA CIVIL ENGINEERING GROUP
• CIVIL ENGINEERING • LAND PLANNING • SURVEYING & MAPPING • A.L.T.A. SPECIALISTS

POST-DEVELOPED HYDROLOGY

SITE ADDRESS: 14500 S. AVALON BLVD., GARDENA, CA

PREPARED FOR: CATALDO AND ASSOCIATES

PROFESSIONAL STAMP

REGISTERED PROFESSIONAL ENGINEER
CHARLES STEPHEN CUMMINS
No. C 34526
Exp. 9/30/25
CIVIL
STATE OF CALIFORNIA

DATE:	03/26/2025
SCALE:	AS SHOWN
DESIGNED: CSH	DRAWN: VN
SHEET NO.	HY-2
	SHEET 2 OF 2
PROJECT NO.	21-2756-4679.000-1710

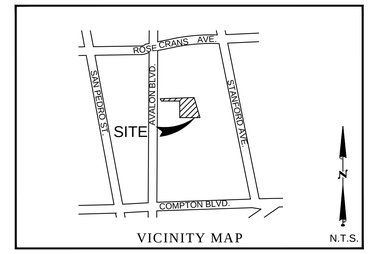
3/27/2025 10:39 AM
S:\PROJECTS\4679.000 – 14500 S Avalon Blvd \ 1637\ ENGR\ SHEETS \ HY-2 – POST-DEVELOPED HYDROLOGY.dwg

Exhibit 2

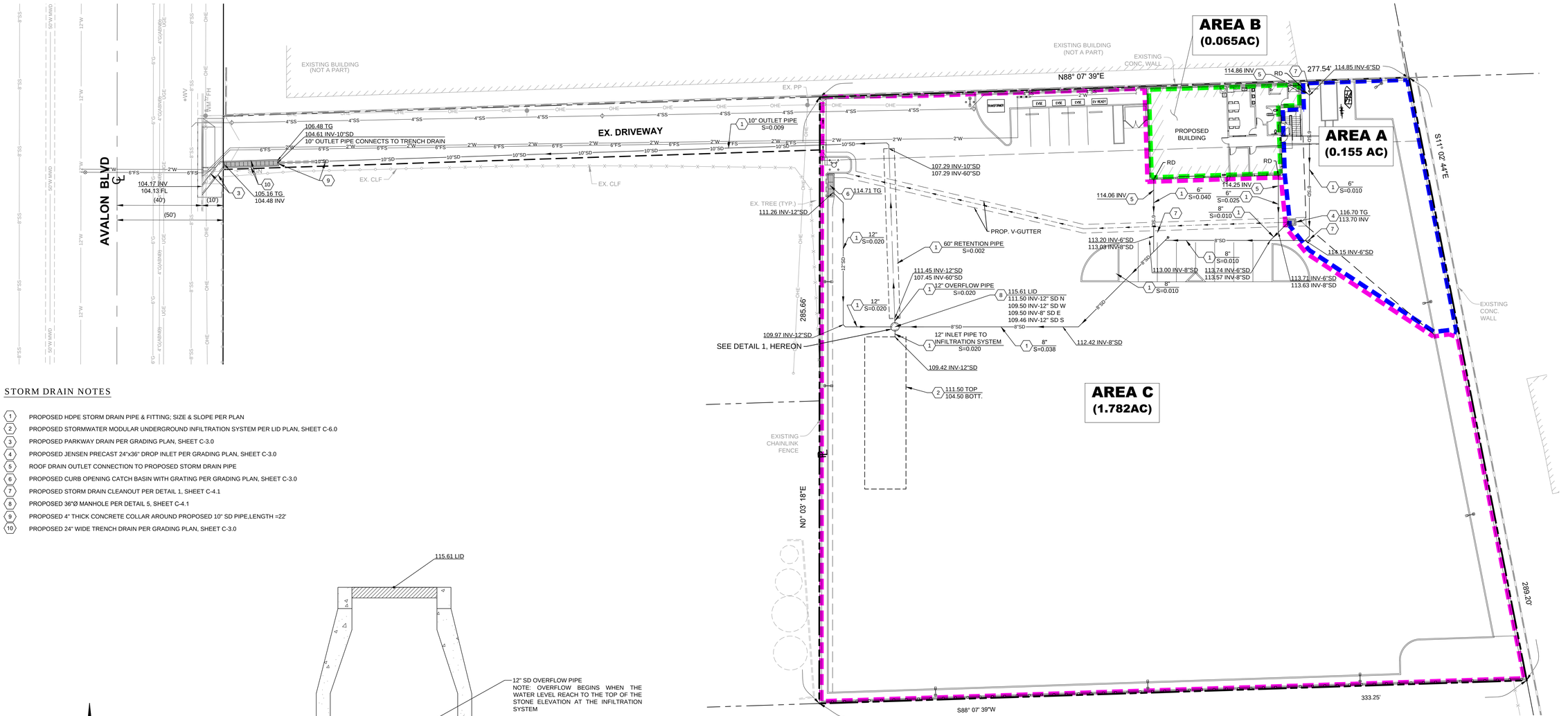
Drainage Design Exhibit

DRAINAGE DESIGN EXHIBIT

COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



VICINITY MAP

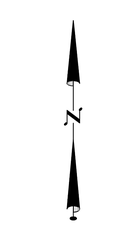


STORM DRAIN NOTES

1. PROPOSED HDPE STORM DRAIN PIPE & FITTING; SIZE & SLOPE PER PLAN
2. PROPOSED STORMWATER MODULAR UNDERGROUND INFILTRATION SYSTEM PER LID PLAN, SHEET C-6.0
3. PROPOSED PARKWAY DRAIN PER GRADING PLAN, SHEET C-3.0
4. PROPOSED JENSEN PRECAST 24"x36" DROP INLET PER GRADING PLAN, SHEET C-3.0
5. ROOF DRAIN OUTLET CONNECTION TO PROPOSED STORM DRAIN PIPE
6. PROPOSED CURB OPENING CATCH BASIN WITH GRATING PER GRADING PLAN, SHEET C-3.0
7. PROPOSED STORM DRAIN CLEANOUT PER DETAIL 1, SHEET C-4.1
8. PROPOSED 36"Ø MANHOLE PER DETAIL 5, SHEET C-4.1
9. PROPOSED 4" THICK CONCRETE COLLAR AROUND PROPOSED 10" SD PIPE,LENGTH =22'
10. PROPOSED 24" WIDE TRENCH DRAIN PER GRADING PLAN, SHEET C-3.0

DETAIL 1: SD MANHOLE

SCALE: 1" = 1'



GRAPHIC SCALE

0' 20' 40'

SCALE: 1" = 20'

HYDROLOGY STUDY APPROVED

REVIEWED BY: _____ DATE 04/15/2025

APPROVED BY: _____ DATE 04/15/2025

COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

NOT FOR CONSTRUCTION

REVISION | DATE | NO.

PLANS PREPARED BY:
DCA CIVIL ENGINEERING GROUP
• CIVIL ENGINEERING • LAND PLANNING • SURVEYING & MAPPING • A.L.T.A. SPECIALISTS
Corona Office
1762 Corona Pointe Court, Ste. 100
Corona, California 92879-6576
Tel: (951) 549-1490 Fax: (951) 549-1399
www.dcacivil.com

DRAINAGE DESIGN EXHIBIT
SITE ADDRESS: 14500 S. AVALON BLVD., GARDENA, CA
PREPARED FOR: CATALDO AND ASSOCIATES

PROFESSIONAL STAMP

REGISTERED PROFESSIONAL ENGINEER
CHARLES STEPHEN CUMMINS
No. C 34526
Exp. 9/30/25
CIVIL
STATE OF CALIFORNIA

DATE: 03/26/2025
SCALE: AS SHOWN
DESIGNED: CSH DRAWN: VN
SHEET NO.: EX-1
SHEET 1 OF 1
PROJECT NO.: 21-2756-4679.000-1710

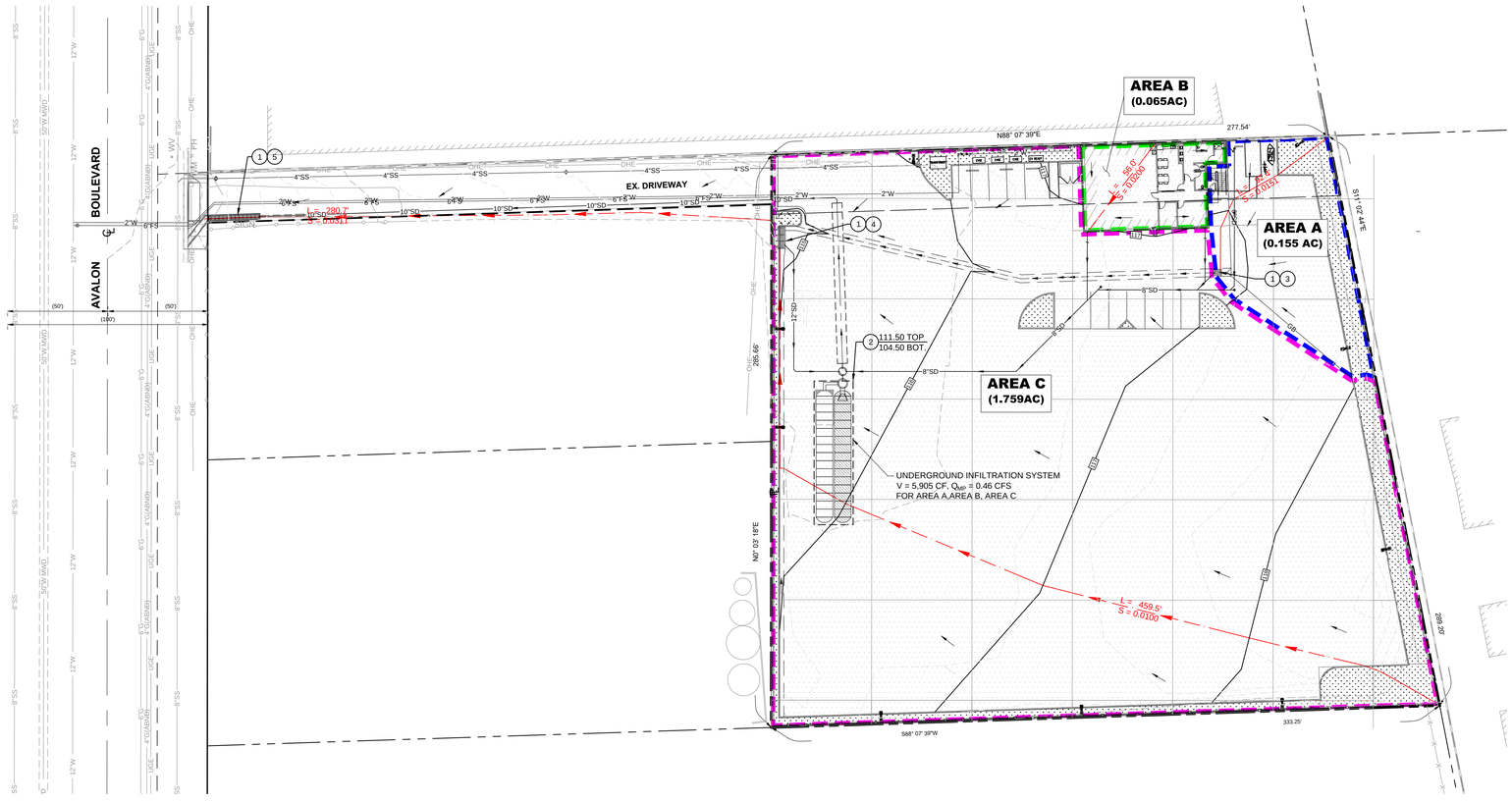
3/26/2025 1:51 PM
S:\PROJECTS\4679.000 – 14500 S. Avalon Blvd\1637\ENGR\EXHIBIT\SHEET\A1L–002–HYD.dwg

Exhibit 3

L.I.D. Plan

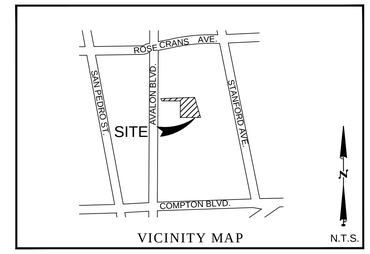
LOW IMPACT DEVELOPMENT PLAN

COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



DRAINAGE NOTES

1. THE DRAINAGE IMPROVEMENTS SHALL NOT BE MAINTAINED BY LACFCD. THE OWNER IS RESPONSIBLE FOR MAINTAINING THE PROPOSED DRAINAGE FACILITIES.



TYPICAL STENCILS AT DRAIN INLET





NOTES

1. STENCILS MAY BE PURCHASED AT THE LOCAL BUILDING AND SAFETY OFFICE OR CALL (626) 458-6390.

CONSTRUCTION NOTES

1. PAINT STENCIL AND ICON "NO DUMPING-DRAINS TO OCEAN " PER DETAIL HEREON
2. CONSTRUCT STORMTECH SYSTEM MODEL MC-4500 PER DETAIL 7; SHEET C-4.2/C-4.3 AND TABLES HEREON
3. INSTALL FLOGARD CATCH BASIN INSERT FILTER, GRATED INLET STYLE, MODEL FF-2436SD PER DETAIL 3; SHEET C-4.1
4. INSTALL FLOGARD CATCH BASIN INSERT FILTER, COMBINATION INLET STYLE, MODEL FGP, COSTUME SIZED PER DETAIL 4; SHEET C-4.1
5. INSTALL FLOGARD TRENCH DRAIN INSERT FILTER PER DETAIL 6; SHEET C-4.1

LEGEND

DIRECTION OF SURFACE DRAINAGE

FLOW PATH

IMPERVIOUS DISTURBED AREA

PERVIOUS DISTURBED AREA

STORM WATER MANAGEMENT NOTES

1. THE FOLLOWING INDUSTRIAL/COMMERCIAL DEVELOPMENT BMP'S AS OUTLINED IN, BUT NOT LIMITED TO, THE CALIFORNIA BEST MANAGEMENT PRACTICE HANDBOOK, LATEST EDITION, MAY APPLY TO SITE (ADDITIONAL MEASURES MAY BE REQUIRED IF DEEMED APPROPRIATE BY THE GOVERNING AGENCY.)

   SC30 - OUTDOOR LOADING/UNLOADING
   SC43 - PARKING/STORAGE AREA MAINTENANCE
   SC44 - DRAINAGE SYSTEM MAINTENANCE
   SC60 - HOUSEKEEPING PRACTICES
   SD10 - SITE DESIGN & LANDSCAPE PLANNING
   SD11 - ROOF RUNOFF CONTROLS
   SD12 - EFFICIENT IRRIGATION
   SD13 - STORM DRAIN SIGNAGE
   SD32 - TRASH STORAGE AREAS
   TC32 - BIORETENTION

PROJECT CHARACTERISTICS

TOTAL DISTURBED AREA	2.002 ACRES
TYPE OF DEVELOPMENT	INDUSTRIAL
PREDOMINATE SOIL TYPE #	013
85TH PERCENTILE STORM SIZE	0.89 IN
% OF PROJECT IMPERVIOUS	92.2%
% OF PROJECT PERVIOUS	7.8%
% OF PROJECT CONTRIBUTING UNDEVELOPED AREA	0%
Ai (IMPERVIOUS)	1.846 ACRES
Ap (PERVIOUS)	0.156 ACRES
Au (UNDEVELOPED)	0 ACRES
I_{DESIGN}	0.72 IN/HR
ANTICIPATED POTENTIAL POLLUTANTS	GREASE, OIL, AND TRASH
PERCENT OF DESIGN STORM RETAINED ON-SITE	100%

LID

SUB-AREA (DISTURBED)	A_{TOTAL} (ACRES)	$A_{IMPERVIOUS}$ (ACRES)	$A_{PERVIOUS}$ (ACRES)	Q_{PM}* (CFS)	SWQDv (CF)
STORM CAPTURE SYSTEM					
AREA A	0.155	0.121	0.034	0.05	359
AREA B	0.065	0.065	0.000	0.03	187
AREA C	1.781	1.660	0.122	0.38	4,825
TOTAL	2.002	1.846	0.156	0.46	5,371

* MITIGATED FLOW RATES ARE BASED ON 85TH PERCENTILE, 24-HOUR RAINFALL EVENT.

PROPOSED BMP SUMMARY TABLE

A MIN (SF)	DESIGNED A (SF)	SWQDv* (CF)	DESIGNED V (CF)	BMP SIZE	PROPOSED BMP IN SUB-AREAS
1,258	1,390	5,371	5,905**	19.42'W X 71.61'L X7'H	STORMTECH MC-4500

* PER MITIGATED VOLUME GENERATED BY THE 85TH PERCENTILE STORM EVENT
** 100% OF THE DESIGN VOLUME IS RETAINED ON-SITE.

HYDROLOGY STUDY APPROVED
REVIEWED BY: _____ DATE 04/15/2025
APPROVED BY: _____ DATE 04/15/2025
COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

N

GRAPHIC SCALE
0' 30' 60'
SCALE: 1" = 30'

NOT FOR CONSTRUCTION

Know what's below. Call before you dig.

NO.	DATE	REVISION

PLANS PREPARED BY:
DCA CIVIL ENGINEERING GROUP
• CIVIL ENGINEERING • LAND PLANNING • SURVEYING & MAPPING • A.L.T.A. SPECIALISTS
Corporate Office:
1762 E. Avenue J, Suite 201
Lancaster, CA 93535
Tel: (661) 607-0660 Fax: (661) 607-0670
www.dcaengineering.com

(C)2025 DCA ENGINEERING GROUP ALL RIGHTS RESERVED

LOW IMPACT DEVELOPMENT

SITE ADDRESS: 14500 S. AVALON BLVD., GARDENA, CA

PREPARED FOR: CATALDO AND ASSOCIATES

PROFESSIONAL STAMP:

REGISTERED PROFESSIONAL ENGINEER
CHARLES STEPHEN CUMMINS
No. C 34526
Exp. 9/30/25
CIVIL
STATE OF CALIFORNIA

DATE:	03/26/2025
SCALE:	AS SHOWN
DESIGNED: CH	DRAWN: VN
SHEET NO.	C-6.0
	SHEET 12 OF 12
PROJECT NO.	21-2756-4679.000-1710

3/27/2025 10:35 AM
S:\PROJECTS\4679.000 – 14500 S Avalon Blvd\1637\EXPA SHEETS\1OCL101.dwg