Lot 12, Block 1, Arapahoe Crossings Subdivision Filing No. 1

SW Corner of Stephen D. Hogan Parkway And Picadilly Road

A PARCEL OF LAND LOCATED IN THE SOUTHWEST ¼ OF SECTION 20, TOWNSHIP 5 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL MERIDIAN, CITY OF AURORA, COUNTY OF ARAPAHOE, STATE OF COLORADO

Preliminary Drainage Letter

Prepared by: Nicholas Andersen
Reviewed by: Mike Beach, P.E.

Date:
February 9, 2024

Approved For One Year From This Date _____
_____ **Aurora Water – Drainage Division** _____ **Date**

Note: PDL Approval is required prior to Civil Plan Approval.

RIDGETOP
ENGINEERING & CONSULTING
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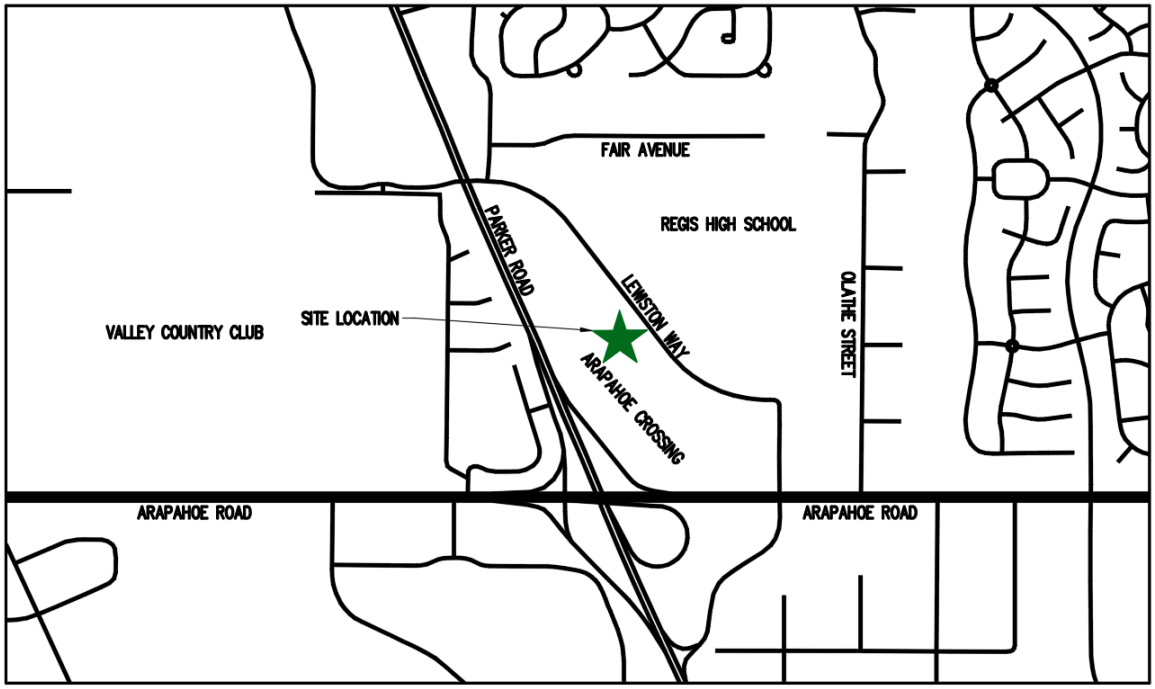
Table of Contents

A. Introduction

The site is located within the Arapahoe Crossings Shopping Mall at the NW corner of S. Parker Road and E. Arapahoe Road. The project is surrounded by commercial developments. Regis Jesuit High School is located to the NW of the site.



VICINITY MAP

The site currently flows to one of two detention ponds for treatment. The main portion of the site flows to an existing detention pond that has been recently redesigned and constructed. The remaining portion along the south side of the building flows to an existing detention pond located at the NW corner of S. Parker Road and E. Arapahoe Road.

The subject site is currently a developed +\-18.3-acre parcel. The NRCS has a hydrologic classification of class “B” soils for the site. The site was analyzed as 5 basins. The site is developed and slopes from the northeast to southwest at varying slopes. The overall basin consists mostly of asphalt and concrete paving. The project proposes no changes to use and only includes interior remodel, changes to exterior grading, and a new exterior garden center.

This project proposes a basin swap for a portion of the exterior modifications. Additional impervious will be treated and released at the required flows.

No variances are requested for this project.

B. Historic Drainage

a. The basin currently drains to one of two existing detention ponds.
b. According to FEMA FIRM 08005C0481L, the site is within zone X. Cherry Creek is located approximately ½ mile west of the site.
c. No existing irrigation facilities within 100' of the proposed development.
d. No offsite basins affect the proposed site.
e. Both ponds outfall west into public storm drainage. The runoff will eventually outfall into Cherry Creek.

C. Design Criteria

a. The site was designed for the 2-yr and 100-yr storms.
b. Rainfall depths were collected from NOAA Atlas 14 (See Appendix).
c. The Rational Method was used for calculation of rainfall volumes.
d. Detention was calculated using MHFD Detention v4.06 with input values based off of King Soopers Gas Station FDL.
e. All drainage structures are designed to convey the 100-yr flow.
f. All existing infrastructure is privately owned and to be maintained by the owners.

D. Drainage Plan

The site is split into 5 subbasins that include the proposed construction.

Basin 1 (Located in Basin DP5-B)
This basin is located at the front of the existing building. The majority of the work on this project is located within this basin. However, this work will not result in a change in basins or imperviousness as only grading of existing infrastructure will occur. This basin will flow into an existing Type R Inlet to the southwest.

Basin 2 (Located in Basin DP6-D)
This basin is located at the side of the existing building. This basin is proposed as an outdoor garden center. This basin located in a separate drainage basin (Basin DP6-D) per the site MDR. This project proposes to flow the basin to a different basin (DP5-B) and detention area. Detention will be provided for the additional imperviousness per the King Soopers Final Drainage Conformance Letter. This basin will flow into an existing Type R Inlet to the southwest.

Basin 3 (Located in Basin DP6-D)
This basin is existing parking located on the south site of the building. This basin will be replaced with landscaping to maintain equivalent flows to the existing detention pond. This replacement of ~493 sf of impervious area will replace the imperviousness added from basins 4 and 5. This basin will flow into an existing Type R Inlet directly adjacent to the building.

Basin 4 (Located in Basin DP6-D)

This basin is proposed as an ADA route into the site of the building. Runoff will flow down the ramp and into a proposed storm drain in the wall which will be tied into the existing storm infrastructure in the drive.

Basin 5 (Located in Basin DP6-D)
This basin is proposed as an ADA route into the site of the building. Runoff will flow down the ramp and flow into an existing Type R Inlet directly adjacent to the building.

Basin 1 will continue to flow runoff as it has before and as it was designed. Basin 2 will flow into a new basin with an increased flow rate. The increased flows are acceptable by the downstream detention pond. Basin 3 will continue to flow to its original design point with reduced flowrates. Basin 4 will be directly tied into the existing storm infrastructure upstream of the original design point. Basin 5 will continue to flow to its original design point with reduced flowrates. Together, basins 3-5 will generate 0.11 cfs in the 100-yr event, compared to the existing 0.12 cfs generated today.

Basin	Area (ac)	Existing Imperviousness (%)	Proposed Imperviousness (%)	Ex. 2-yr Runoff (cfs)	Ex. 100-yr Runoff (cfs)	Pr. 2-yr Runoff (cfs)	Pr. 100-yr Runoff (cfs)
1	0.12	95	95	0.27	0.81	0.27	0.81
2	0.04	20	95	0.01	0.14	0.10	0.30
3	0.01	95	20	0.03	0.08	0.00	0.04
4	0.01	20	95	0.00	0.03	0.02	0.06
5	0.00	20	95	0.00	0.01	0.00	0.01
Total	0.18	72.6	90.4	0.31	1.07	0.39	1.22

Two existing detention ponds are located along the southwest side of the site. Pond D-5 accepts runoff from basin DP5-B and will receive runoff from 0.16 ac of our project. This is an underground storage facility that has been updated per the King Soopers FDL. The available and required storage have been verified using MHFD detention (modified with the additional imperviousness from this project) and design documentation.

Pond D-6 accepts runoff from basin DP6-D and will receive runoff from 0.02 ac of our project. This is an aboveground storage facility. Size has not been verified due to the reduced imperviousness and runoff to the pond. See appendix for locations of ponds and relevant documents.

E. Conclusions

The storm drainage design for this project is in compliance with the original overall Stormwater Management System. This project will not contribute to flooding of downstream properties.

This project proposes to collect most of the runoff generated with the increased imperviousness and treat it within the existing detention ponds. The 100-yr will be detained and released at the required release rates.

Upstream and downstream developments will not be negatively affected by this development. The proposed site will add additional water quality treatment, which will reduce the flows from the site and reduce the amount of contaminants in the flows.

F. List of References

- Storm Drainage and Technical Criteria Manual, City of Aurora, Revised November 2023
- Urban Drainage & Flood Control District Drainage Criteria Manual, Vol 1,2,3
- FEMA Flood Insurance Rate Map
- USDA Natural Resources Conservation Service Web Soil Survey (WSS) aka NRCS Soils Map

G. Appendices

1. Hydrologic Computations
2. Hydraulic Computations
3. Copies of graphs, tables, and nomographs used
4. Variance

Calculation of Peak Runoff using Rational Method

Designer: NGA
Company: Ridgetop Engineering
Date: 3/4/2024
Project: Ace Hardware - Arapahoe Crossings
Location: Aurora, CO

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$

$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$= 5 (urban)
$t_{minimum}$= 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.86	1.12	1.36	1.72	2.02	2.35	3.19
Rainfall Intensity Equation Coefficients =	a: 28.50	b: 10.00	c: 0.786				

$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$

$Q(cfs) = CIA$

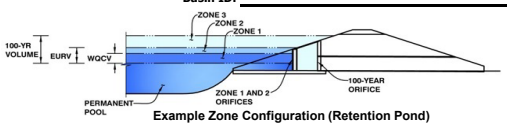
Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1	0.12	B	95.0	0.79	0.81	0.82	0.85	0.86	0.87	0.88	50.00			0.020	2.94	120.00			0.010	20	2.00	1.00	3.94	10.75	5.00	2.91	3.80	4.61	5.83	6.85	7.97	10.82	0.27	0.36	0.45	0.58	0.69	0.81	1.12
2	0.04	B	95.0	0.79	0.81	0.82	0.85	0.86	0.87	0.88	15.00			0.020	1.61	85.00			0.020	20	2.83	0.50	2.11	10.30	5.00	2.91	3.80	4.61	5.83	6.85	7.97	10.82	0.10	0.13	0.17	0.22	0.26	0.30	0.42
3	0.01	B	20.0	0.13	0.15	0.22	0.37	0.44	0.52	0.61	10.00			0.020	4.32	20.00			0.020	10	1.41	0.24	4.56	22.80	10.00	2.32	3.03	3.68	4.65	5.46	6.36	8.63	0.00	0.01	0.01	0.02	0.03	0.04	0.06
4	0.01	B	95.0	0.79	0.81	0.82	0.85	0.86	0.87	0.88	15.00			0.020	1.61	50.00			0.080	20	5.66	0.15	1.76	9.98	5.00	2.91	3.80	4.61	5.83	6.85	7.97	10.82	0.02	0.03	0.03	0.05	0.05	0.06	0.09
5	0.00	B	95.0	0.79	0.81	0.82	0.85	0.86	0.87	0.88	5.00			0.020	0.93	10.00			0.080	20	5.66	0.03	0.96	9.88	5.00	2.91	3.80	4.61	5.83	6.85	7.97	10.82	0.00	0.01	0.01	0.01	0.01	0.01	0.02
Ex-1	0.12	B	95.0	0.79	0.81	0.82	0.85	0.86	0.87	0.88	50.00			0.020	2.94	120.00			0.010	20	2.00	1.00	3.94	10.75	5.00	2.91	3.80	4.61	5.83	6.85	7.97	10.82	0.27	0.36	0.45	0.58	0.69	0.81	1.12
Ex-2	0.04	B	20.0	0.13	0.15	0.22	0.37	0.44	0.52	0.61	20.00			0.020	6.11	85.00			0.020	10	1.41	1.00	7.11	23.45	10.00	2.32	3.03	3.68	4.65	5.46	6.36	8.63	0.01	0.02	0.04	0.08	0.10	0.14	0.23
Ex-3	0.01	B	95.0	0.79	0.81	0.82	0.85	0.86	0.87	0.88	10.00			0.020	1.32	20.00			0.020	20	2.83	0.12	1.43	9.96	5.00	2.91	3.80	4.61	5.83	6.85	7.97	10.82	0.03	0.03	0.04	0.06	0.07	0.08	0.11
Ex-4	0.01	B	20.0	0.13	0.15	0.22	0.37	0.44	0.52	0.61	15.00			0.020	5.29	50.00			0.020	10	1.41	0.59	5.88	23.10	10.00	2.32	3.03	3.68	4.65	5.46	6.36	8.63	0.00	0.00	0.01	0.02	0.02	0.03	0.05
Ex-5	0.00	B	20.0	0.13	0.15	0.22	0.37	0.44	0.52	0.61	5.00			0.050	2.26	10.00			0.050	10	2.24	0.07	2.33	22.66	10.00	2.32	3.03	3.68	4.65	5.46	6.36	8.63	0.00	0.00	0.00	0.00	0.00	0.01	0.01

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **King Soopers Fuel #84**

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	6.84	acres
Watershed Length =	924	ft
Watershed Length to Centroid =	458	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	89.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.226	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.686	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	0.450	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.12 in.) =	0.542	acre-feet	1.12	inches
10-yr Runoff Volume (P1 = 1.36 in.) =	0.678	acre-feet	1.36	inches
25-yr Runoff Volume (P1 = 1.72 in.) =	0.891	acre-feet	1.72	inches
50-yr Runoff Volume (P1 = 2.02 in.) =	1.066	acre-feet	2.02	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	1.410	acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.19 in.) =	1.757	acre-feet	3.19	inches
Approximate 2-yr Detention Volume =	0.439	acre-feet		
Approximate 5-yr Detention Volume =	0.536	acre-feet		
Approximate 10-yr Detention Volume =	0.683	acre-feet		
Approximate 25-yr Detention Volume =	0.810	acre-feet		
Approximate 50-yr Detention Volume =	0.878	acre-feet		
Approximate 100-yr Detention Volume =	1.048	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.226	acre-feet
Zone 2 Volume (10-year - Zone 1) =	0.457	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.365	acre-feet
Total Detention Basin Volume =	1.048	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

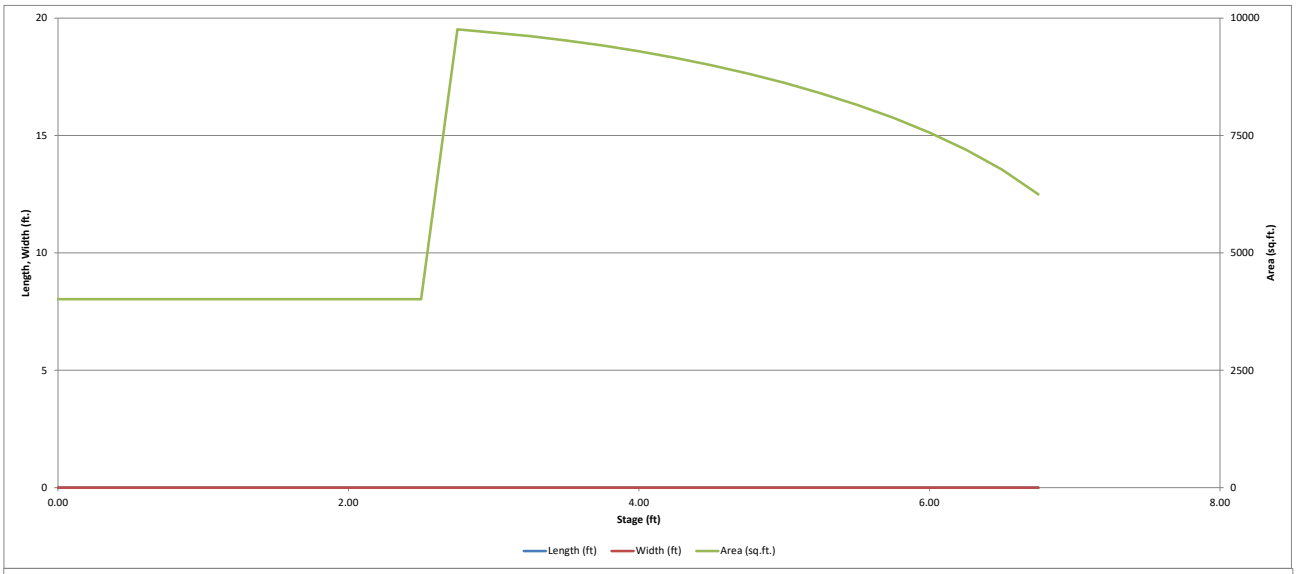
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

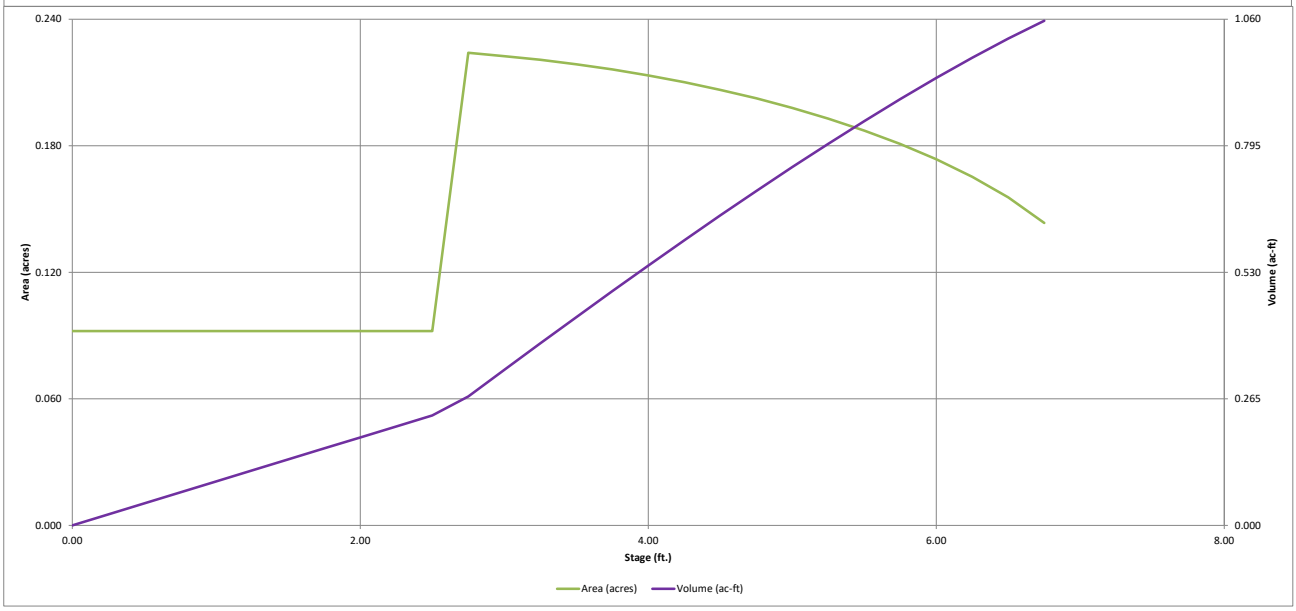
Depth Increment = 0.25 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	4,014	0.092		
5666.46	--	0.25	--	--	--	4,014	0.092	1,003	0.023
5666.71	--	0.50	--	--	--	4,014	0.092	2,007	0.046
5666.96	--	0.75	--	--	--	4,014	0.092	3,010	0.069
5667.21	--	1.00	--	--	--	4,014	0.092	4,014	0.092
5667.46	--	1.25	--	--	--	4,014	0.092	5,017	0.115
5667.71	--	1.50	--	--	--	4,014	0.092	6,021	0.138
5667.96	--	1.75	--	--	--	4,014	0.092	7,024	0.161
5668.21	--	2.00	--	--	--	4,014	0.092	8,027	0.184
5668.46	--	2.25	--	--	--	4,014	0.092	9,031	0.207
5668.71	--	2.50	--	--	--	4,014	0.092	10,034	0.230
5668.96	--	2.75	--	--	--	9,762	0.224	11,756	0.270
5669.21	--	3.00	--	--	--	9,692	0.222	14,188	0.326
5669.46	--	3.25	--	--	--	9,617	0.221	16,601	0.381
5669.71	--	3.50	--	--	--	9,524	0.219	18,994	0.436
5669.96	--	3.75	--	--	--	9,418	0.216	21,362	0.490
5670.21	--	4.00	--	--	--	9,294	0.213	23,701	0.544
5670.46	--	4.25	--	--	--	9,155	0.210	26,007	0.597
5670.71	--	4.50	--	--	--	8,996	0.207	28,276	0.649
5670.96	--	4.75	--	--	--	8,820	0.202	30,503	0.700
5671.21	--	5.00	--	--	--	8,623	0.198	32,683	0.750
5671.46	--	5.25	--	--	--	8,401	0.193	34,811	0.799
5671.71	--	5.50	--	--	--	8,154	0.187	36,880	0.847
5671.96	--	5.75	--	--	--	7,878	0.181	38,885	0.893
5672.21	--	6.00	--	--	--	7,563	0.174	40,815	0.937
5672.46	--	6.25	--	--	--	7,200	0.165	42,660	0.979
5672.71	--	6.50	--	--	--	6,775	0.156	44,407	1.019
5672.96	--	6.75	--	--	--	6,248	0.143	46,035	1.057

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





Pipe Calculations

Inlet Calculations

Copies of Graphs, Tables, and Nomographs Used

COA Coefficients

Table 5-6. Imperviousness Values for Urban Surfaces for Site and Small Watershed Analysis

Surface Type		Imperviousness
Paved Streets		100%
Concrete Drive and Walks		90%
Roofs		90%
Gravel	No Traffic Areas (pedestrian use)	40%
	Low Traffic Areas (maintenance paths and substations)	60%
	High Traffic Areas (roadways and parking)	80%
Landscaping (including water-wise vegetation, active turf, uncompacted gravel, planting beds, residential artificial turf, etc.)		20%
Artificial Turf (non-residential)	Landscape applications (with subgrade drainage layer)	25 - 45%
	Sport fields withs underdrain pipe system	65%
Open Water Areas, including footprint of WQCV		100%
Solar Panels Gravel Cover, Rows Parallel to Contours[#]		50%
Solar Panels, Gravel Cover, Rows Diagonal to Contours[#]		60%
Solar Panels, Gravel Cover, Rows Perpendicular to Contours[#]		75%
Solar Panels, Grass Cover, Rows Parallel to Contours[#]		5%
Solar Panels, Grass Cover, Rows Diagonal to Contours[#]		20%
Solar Panels, Grass Cover, Rows Perpendicular to Contours[#]		45%
Historic Flow Analysis, Greenbelts, Agricultural		5%
Newly Graded Areas		65%

[#]Assumes 1:1 ratio of panels to aisles. See MHFD's Technical Memorandum regarding Determination of Solar Panel Field Runoff Coefficients and Imperviousness Values for additional information on procedures to reflect other impervious areas such as roads and pads that may be part of a solar field and layouts with wider inter-panel spacing.

Isopleth Figures

NOAA Atlas 14, Volume 8, Version 2
Location name: Aurora, Colorado, USA*
Latitude: 39.5985°, Longitude: -104.8013°
Elevation: m/ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.228 (0.179-0.291)	0.281 (0.220-0.359)	0.373 (0.292-0.478)	0.455 (0.354-0.586)	0.575 (0.436-0.779)	0.674 (0.498-0.924)	0.778 (0.556-1.10)	0.890 (0.610-1.29)	1.04 (0.690-1.56)	1.17 (0.750-1.77)
10-min	0.334 (0.262-0.426)	0.411 (0.323-0.526)	0.546 (0.427-0.700)	0.666 (0.518-0.858)	0.842 (0.638-1.14)	0.987 (0.729-1.35)	1.14 (0.814-1.61)	1.30 (0.893-1.89)	1.53 (1.01-2.29)	1.71 (1.10-2.59)
15-min	0.407 (0.320-0.520)	0.502 (0.393-0.641)	0.666 (0.521-0.854)	0.812 (0.631-1.05)	1.03 (0.778-1.39)	1.20 (0.889-1.65)	1.39 (0.993-1.96)	1.59 (1.09-2.31)	1.87 (1.23-2.79)	2.09 (1.34-3.16)
30-min	0.553 (0.434-0.707)	0.681 (0.534-0.871)	0.904 (0.707-1.16)	1.10 (0.856-1.42)	1.39 (1.05-1.88)	1.63 (1.20-2.24)	1.88 (1.34-2.65)	2.15 (1.48-3.12)	2.53 (1.67-3.78)	2.83 (1.81-4.28)
60-min	0.708 (0.556-0.905)	0.857 (0.672-1.10)	1.12 (0.876-1.44)	1.36 (1.06-1.75)	1.72 (1.31-2.34)	2.02 (1.50-2.78)	2.35 (1.68-3.32)	2.70 (1.85-3.92)	3.19 (2.11-4.78)	3.59 (2.30-5.43)
2-hr	0.863 (0.683-1.09)	1.03 (0.816-1.31)	1.34 (1.05-1.70)	1.62 (1.27-2.07)	2.05 (1.58-2.77)	2.42 (1.80-3.30)	2.81 (2.03-3.93)	3.24 (2.25-4.67)	3.85 (2.57-5.71)	4.35 (2.82-6.50)
3-hr	0.970 (0.771-1.22)	1.15 (0.910-1.44)	1.47 (1.16-1.86)	1.78 (1.40-2.25)	2.24 (1.73-3.02)	2.65 (1.99-3.59)	3.08 (2.24-4.29)	3.56 (2.49-5.10)	4.25 (2.86-6.26)	4.81 (3.13-7.14)
6-hr	1.18 (0.942-1.47)	1.38 (1.11-1.73)	1.77 (1.41-2.21)	2.12 (1.68-2.67)	2.66 (2.07-3.54)	3.12 (2.37-4.19)	3.62 (2.66-4.99)	4.17 (2.93-5.90)	4.95 (3.35-7.20)	5.59 (3.67-8.18)
12-hr	1.42 (1.15-1.76)	1.69 (1.37-2.10)	2.17 (1.74-2.69)	2.59 (2.07-3.23)	3.21 (2.50-4.19)	3.72 (2.84-4.92)	4.27 (3.14-5.77)	4.85 (3.43-6.74)	5.66 (3.86-8.09)	6.31 (4.18-9.12)
24-hr	1.74 (1.41-2.13)	2.04 (1.66-2.50)	2.56 (2.08-3.16)	3.02 (2.44-3.74)	3.70 (2.90-4.76)	4.24 (3.25-5.53)	4.81 (3.57-6.43)	5.42 (3.87-7.44)	6.26 (4.31-8.83)	6.93 (4.64-9.88)
2-day	2.09 (1.71-2.54)	2.39 (1.96-2.90)	2.91 (2.38-3.55)	3.38 (2.74-4.13)	4.07 (3.23-5.19)	4.64 (3.59-5.98)	5.24 (3.93-6.92)	5.89 (4.25-7.99)	6.80 (4.72-9.46)	7.52 (5.08-10.6)
3-day	2.23 (1.84-2.70)	2.58 (2.13-3.12)	3.18 (2.61-3.85)	3.70 (3.02-4.50)	4.45 (3.54-5.62)	5.06 (3.93-6.47)	5.70 (4.29-7.46)	6.37 (4.61-8.56)	7.30 (5.10-10.1)	8.03 (5.46-11.2)
4-day	2.34 (1.94-2.82)	2.74 (2.26-3.29)	3.40 (2.80-4.10)	3.97 (3.25-4.81)	4.78 (3.81-6.00)	5.43 (4.23-6.90)	6.10 (4.60-7.92)	6.79 (4.93-9.06)	7.74 (5.42-10.6)	8.47 (5.78-11.8)
7-day	2.67 (2.22-3.18)	3.13 (2.60-3.74)	3.89 (3.23-4.66)	4.54 (3.74-5.46)	5.44 (4.36-6.76)	6.16 (4.82-7.74)	6.88 (5.23-8.85)	7.63 (5.58-10.1)	8.64 (6.09-11.7)	9.42 (6.48-12.9)
10-day	3.00 (2.51-3.56)	3.47 (2.90-4.12)	4.25 (3.54-5.07)	4.92 (4.08-5.89)	5.86 (4.71-7.23)	6.60 (5.19-8.24)	7.35 (5.61-9.39)	8.13 (5.97-10.6)	9.18 (6.50-12.3)	9.99 (6.91-13.6)
20-day	3.96 (3.34-4.66)	4.42 (3.72-5.20)	5.19 (4.36-6.13)	5.86 (4.89-6.94)	6.81 (5.54-8.32)	7.57 (6.02-9.36)	8.35 (6.44-10.6)	9.17 (6.81-11.9)	10.3 (7.38-13.7)	11.2 (7.80-15.0)
30-day	4.70 (3.99-5.51)	5.22 (4.42-6.11)	6.08 (5.13-7.14)	6.81 (5.72-8.02)	7.84 (6.40-9.49)	8.65 (6.91-10.6)	9.48 (7.34-11.9)	10.3 (7.71-13.3)	11.5 (8.28-15.1)	12.4 (8.70-16.5)
45-day	5.58 (4.75-6.49)	6.27 (5.33-7.30)	7.38 (6.26-8.62)	8.30 (7.00-9.72)	9.54 (7.79-11.4)	10.5 (8.39-12.7)	11.4 (8.86-14.1)	12.3 (9.22-15.6)	13.5 (9.77-17.6)	14.4 (10.2-19.0)
60-day	6.26 (5.35-7.26)	7.18 (6.13-8.33)	8.63 (7.34-10.0)	9.78 (8.28-11.4)	11.3 (9.22-13.4)	12.4 (9.92-14.9)	13.4 (10.4-16.5)	14.4 (10.8-18.1)	15.7 (11.3-20.2)	16.5 (11.7-21.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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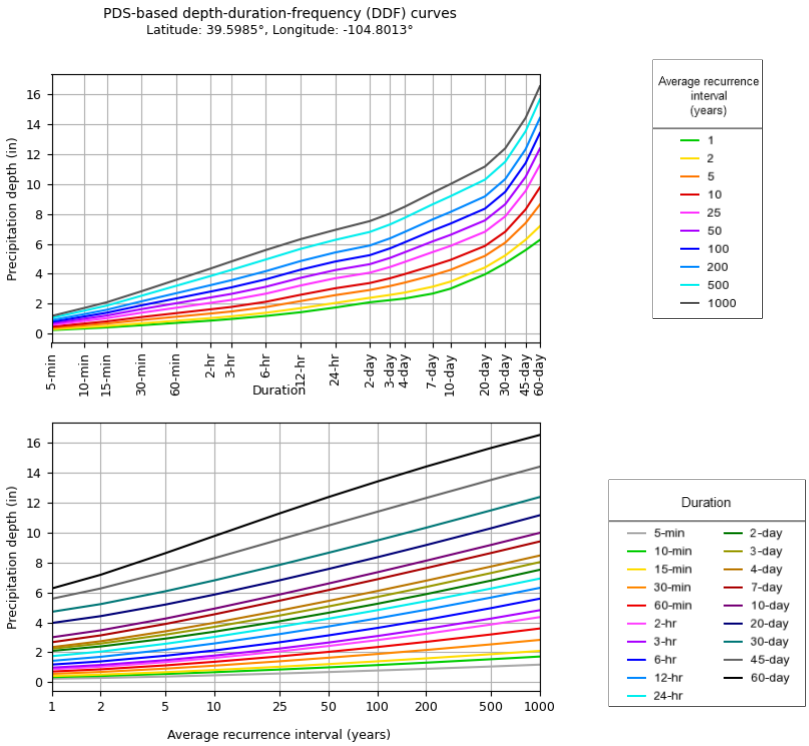
PF graphical



Created (GMT): Mon Feb 12 19:14:03 2024

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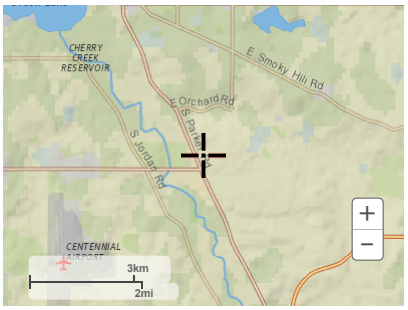
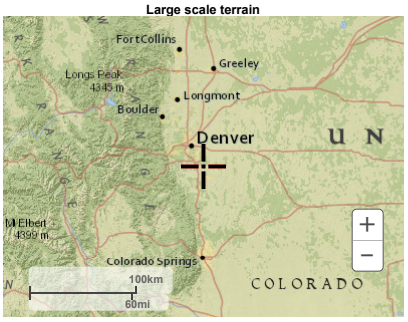
Maps & aerials

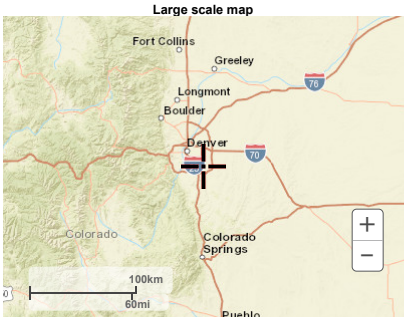
Small scale terrain



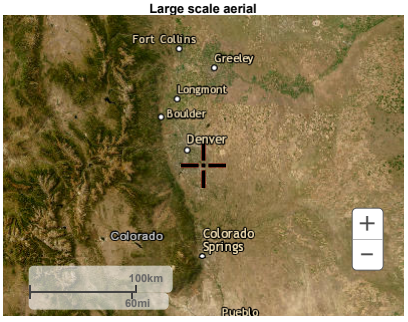
Large scale terrain



Large scale map



Large scale aerial



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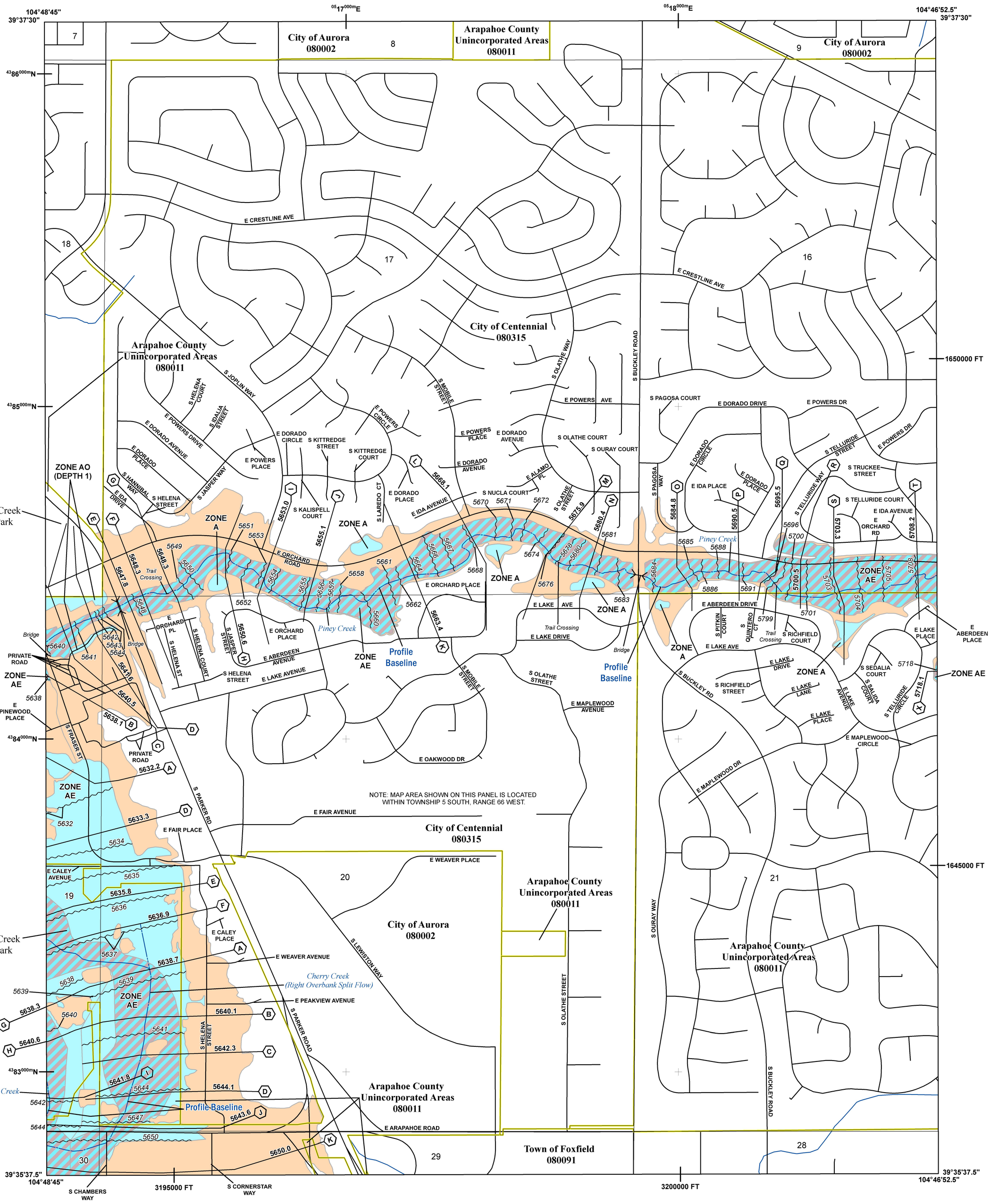
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

FIRM Map



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A,V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

OTHER AREAS
- NO SCREEN — Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall

OTHER FEATURES
- E 18.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 — Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided by the Arapahoe County and Cities of Aurora and Littleton GIS depts. The coordinate system used for production of the digital FIRM is Universal Transverse Mercator, Zone 13N, referenced to the North American Datum of 1983 and the GRS 1980 spheroid, Western Hemisphere.

NOTES TO USERS

SCALE

N

Map Projection:

NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR

ARAPAHOE COUNTY		0193	0194	0213
0476	0477	**0481**	0482	0501
0478	0479	0483	0484	0503

* PANEL NOT PRINTED

FEMA National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

ARAPAHOE COUNTY, COLORADO
And Incorporated Areas

PANEL 481 OF 725

FEMA

Panel Contains:

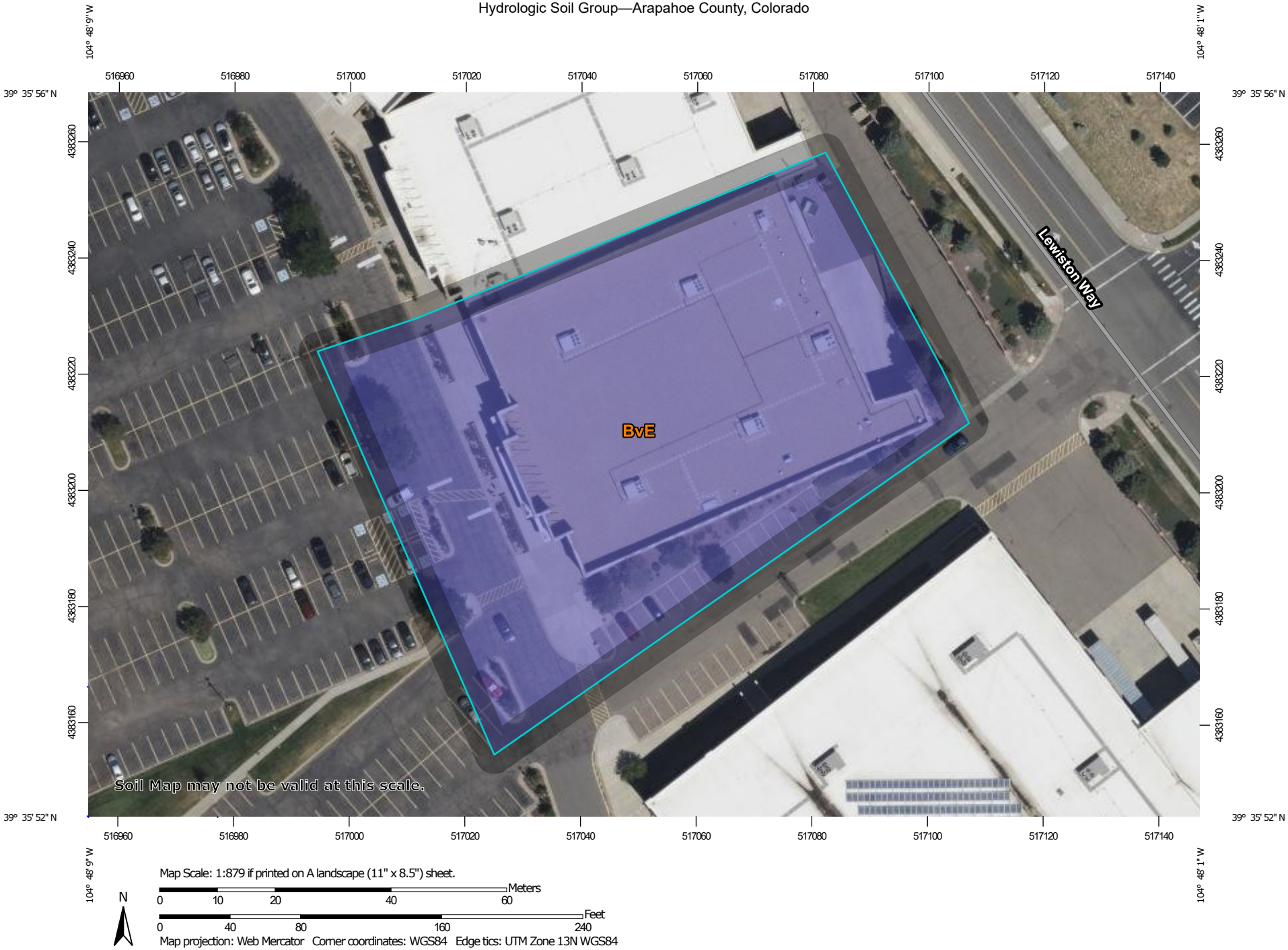
COMMUNITY	NUMBER	PANEL	SUFFIX
ARAPAHOE COUNTY	080011	0481	L
AURORA, CITY OF	080002	0481	L
CENTENNIAL, CITY OF	080315	0481	L
FOXFIELD, TOWN OF	080091	0481	L

VERSION NUMBER
2.3.3.2

MAP NUMBER
08005C0481L

MAP REVISED
FEBRUARY 17, 2017

Soil Report



Map Scale: 1:879 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 19, Aug 24, 2023

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BvE	Bresser-Truckton sandy loams, 5 to 20 percent slopes	B	1.5	100.0%
Totals for Area of Interest			**1.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Original Report

Galloway
5500 Greenwood Plaza Blvd, Suite 200
Greenwood Village, CO 80111
303.770.8884 • GallowayUS.com

September 13, 2023

Janet Bender, PE, CFM
Public Works Department – Engineering Division
City of Aurora
15151 E. Alameda Parkway
Aurora, CO 80012

RE: **Final Drainage Conformance Letter | Kings Soopers Fuel #84 | Lot 7, Block 1, Arapahoe Crossings Subdivision Filing No. 1**

Dear Mrs. Bender,

This drainage conformance letter has been prepared for King Soopers Fuel #84, Lot 7, Block 1, Arapahoe Crossings Subdivision Filing No. 1 located within the southwest quarter of Section 20, Township 5 South, Range 66 West of the 6th Principal Meridian, City of Aurora, County of Arapahoe, State of Colorado. The purpose of this letter is to show that the proposed drainage for this site conforms to the current City of Aurora *Storm Drainage Design and Technical Criteria*. A composite runoff coefficient calculation was performed for the subject site and included on the Composite % Impervious Calculations sheet attached to this letter. The impervious area percentages were taken from the *Aurora Storm Drainage Criteria,* Table 1. The flow rates were calculated using the rational method. The intensity was calculated using the intensity formula 5.5 in the City of Aurora *Storm Drainage Design and Technical Criteria*. The one-hour rainfall depth was found using Figures RA-1 and RA-6 from the *Urban Storm Drainage Criteria Manual, Volume 1*.

The proposed project area is 1.12-acre site. On site water quality and detention is required. The project will include construction of an underground detention pond. This pond will treat 1.04 acres of the existing site.

The existing site is a restaurant and associated parking, drives, and walks. The site generally slopes from southeast to northwest. The site is bounded by an internal road to the east, an existing multi-tenant site owned by Arapahoe Crossing LP to the south, South Parker Road to the west, and an existing greenway to the north. The site is located outside of the nearest FAA detention pond drain time zone (Centennial 10,000 Foot Critical Zone). A map has been included in Appendix C.

The proposed site will consist of a gas station with 9 multi-product dispensers, fuel canopy, and a sales kiosk. Site infrastructure will include asphalt paving, concrete curb and gutter, concrete paving, underground fuel storage tanks, and areas of landscaping including mulch, sod, shrubs, and trees consistent with commercial development. Construction will include overlot grading, building construction, storm drainage and utility infrastructure, and final stabilization (paving and landscaping). The proposed grading for the development is consistent with the existing grading and drainage patterns and the *Final Drainage Report for Arapahoe Crossings #1 Phase 1A* (970182FD) and the *Final Drainage Study at Applebee's at Arapahoe Crossings* (980013FD). This drainage letter shall supplant the *Final Drainage Study at Applebee's at Arapahoe Crossings* (980013FD). Proposed roof drains shall capture the kiosk and canopy roof runoff and outlet water through a series of proposed 12" underground storm pipes, which will be connected to the proposed storm sewer system on the site. The majority of the site runoff

will sheet flow to a series of proposed type 13 combination inlets and 12” ADS N12 storm pipe. This will then flow to the underground detention pond.

A review of the Flood Insurance Rate Map (FIRM) by the Federal Emergency Management Agency (FEMA) panel 08005C0481L dated February 17, 2017, shows the entire proposed development within an area of minimal flood hazard. A FIRMETTE map is included in Appendix D.

The NRCS Web Soil Survey of Arapahoe County, Colorado indicates site soils to be Bresser-Truckton sandy loams, 3 to 5 percent slopes and 5 to 20 percent slopes, hydrologic soil group B. Refer to Appendix D for soil survey information.

Runoff from the site piped southwest of the site through an existing 24” outfall pipe. The pipe connects directly to existing City of Aurora storm infrastructure that outfalls directly into pond D-6, per the *Final Drainage Report for Arapahoe Crossings #1* (960161FD2), which ultimately outfalls to Cherry Creek.

The existing drainage as shown in the *Final Drainage Study Applebee’s at Arapahoe Crossings* (980013FD) was designed with runoff of 5.25 cfs and 15.46 cfs in the 2- and 100-year storm events, respectively. The drainage map and original calculations are included with the letter in Appendix D for reference.

Proposed Basin 102 (0.16 acres) is located in the middle of the site. It consists of the kiosk and fueling canopy. It has a composite imperviousness of 90.0%. The runoff coefficients are 0.80 and 0.90 and the runoff is calculated to be 0.4 and 1.3 cfs in the 2- and 100-year storm events, respectively. Runoff from Basin 102 will be collected by a roof drain system (Design Point 1). From there, runoff flows to a junction with pipe P2 and combines with flows from Basin 104 (Design Point 3). It is then piped underground to the proposed underground detention system through the onsite storm system.

Proposed Basin 104 (0.28 acres) is located on the northwest side of the site. It consists of landscape area and drive aisles. It has a composite imperviousness of 83.1%. The runoff coefficients are 0.74 and 0.80 and the runoff is calculated to be 0.7 and 1.9 cfs in the 2- and 100-year storm events, respectively. Runoff from Basin 104 will sheet flow to the proposed on grade type 13 combination inlet (Design Point 2). From there, runoff flows to a junction with pipe P1 and combines with flows from Basin 102 (Design Point 3). It is then piped underground to the proposed underground detention system through the onsite storm system. The emergency overflow path of the inlet is east along the curb towards the private drive. From there water will flow down the proposed curb ramp towards the proposed sidewalk chase which releases into Parker Road.

Proposed Basin 106 (0.18 acres) is located on the northwest side of the site. It consists of landscape area, parking, and drive aisles. It has a composite imperviousness of 78.8%. The runoff coefficients are 0.70 and 0.77 and the runoff is calculated to be 0.4 and 1.2 cfs in the 2- and 100-year storm events, respectively. Runoff from Basin 106 will sheet flow the proposed type 13 combination inlet in sump (Design Point 4). From there it will be conveyed to the proposed underground detention system through the onsite storm system. The emergency overflow path of the inlet is east along the curb towards the private drive. From there water will flow down the proposed curb ramp towards the proposed sidewalk chase which releases into Parker Road.

Proposed Basin 108 (0.34 acres) is located on the south side of the site. It consists of landscape area and drive aisles. It has a composite imperviousness of 84.4%. The runoff coefficients are 0.75 and 0.81 and the runoff is calculated to be 0.8 and 2.5 cfs in the 2- and 100-year storm events, respectively. Runoff from Basin 108 will sheet flow to the proposed type R inlet in sump (Design Point 5). From there runoff will be conveyed to the proposed underground detention system through the onsite storm system. The emergency overflow path of the inlet is overtopping the curb and flowing west towards Parker Road.

Basin OS-1 was originally designed to surface flow onsite under the approved *Final Drainage Study Applebee's at Arapahoe Crossings* (980013FD). It will be routed to sheet flow (Design Point 6) to the proposed type 13 combination inlet (Design Point 5). From there it will be conveyed to the proposed underground detention system through the onsite storm system. No improvements have been made to the site since the above-mentioned drainage study was approved so the basin characteristics are identical to the characteristics from the original report.

Basin D5 was originally designed under the *approved Final Drainage Report for Arapahoe Crossings #1, Phase* 1A (970182FD). Flow is routed via the existing storm system into the proposed underground detention system. The existing storm sewer carrying the flow connects to the proposed storm sewer (Design Point 7). The storm system will be rerouted to the proposed underground detention system (Design Point 9) and is accounted for under the proposed design. No improvements have been made to the offsite basin since the above-mentioned drainage study was approved so the basin characteristics are identical to the characteristics from the original report.

Proposed Basin 110 (0.04 acres) is located on the east side of the site. It consists of paved area. It has a composite imperviousness of 100.0%. The runoff coefficients are 0.87 and 0.93 and the runoff is calculated to be 0.1 and 0.4 cfs in the 2- and 100-year storm events, respectively. Runoff from Basin 110 will sheet flow to the existing type R inlet in the private drive (Design Point 10). From there runoff will be conveyed to the proposed underground detention system through the onsite storm system.

Proposed Basin 202 (0.19 acres) is located on the west side of the site. It consists of landscape area and drive aisles. This basin has decreased from 0.34 acres to 0.19 acres and it still mostly landscape area with the same drive aisles as before. Therefore, the flow draining into Parker Road has been decreased with the proposed site. It has a composite imperviousness of 14.3%. The runoff coefficients are 0.24 and 0.29 and the runoff is calculated to be 0.1 and 0.4 cfs in the 2- and 100-year storm events, respectively. Runoff from Basin 202 will sheet flow east and free release offsite to Parker Road (Design Point 10).

Based on *Final Drainage Study for Arapahoe Crossings #1, Phase* 1A (970182FD), Basin D-5 is routed to the detention pond via existing underground storm system. The existing storm sewer will connect to proposed storm sewer (Design Point 7). The storm system will be rerouted to the proposed underground detention system (Design Point 8) and is accounted for under the proposed design.

The existing underground detention pond is 0.55 acre-ft according to the approved *Final Drainage Study for Arapahoe Crossings #1, Phase* 1A (970182FD). The proposed detention pond volume is designed using the current City of Aurora *Storm Drainage Design and Technical Criteria*. The calculations are included in Appendix C of this Drainage Letter. The V=kA method was used to find 100-year volume required. The total volume required is 1.05 acre-feet. The proposed storage volume is 1.06 acre-ft as noted in Appendix C of this letter.

The proposed on-site underground detention pond was sized using the MHFD-Detention v4.06 spreadsheet and the previously approved detention pond volume. The proposed location of the underground detention pond is shown on the Drainage Map included in this Construction Documents. The tributary area to the proposed underground detention pond is ± 6.77 acres with a composite imperviousness of 89.4%. The proposed runoff is below the existing values of 15.3 and 47.1 cfs in the 2- and 100-year storm events, respectively, based on the *Final Drainage Study Applebee's at Arapahoe Crossings* (980013FD). The runoff to the detention pond is calculated to be 12.8 and 38.5 cfs in the 2- and 100-year storm events, respectively. The release rates of the proposed underground detention pond are 0.2 and 5.4 cfs in the 10- and 100-year storm events, respectively, restricted to be less than the current release rate from the existing underground detention pond of 2.5 and 13.3 cfs in the 10- and 100-year storm events, respectively. These existing numbers are from the approved *Final Drainage Study for Arapahoe Crossings #1, Phase* 1A (970182FD). The maximum allowable release rates for the detention pond are 1.60 and 5.90 cfs in the 10- and 100-year storm events, respectively, per the current City of Aurora *Storm Drainage Design and Technical Criteria.*

The proposed underground detention pond will provide detention and water quality for the proposed development. If the system clogs, the emergency overflow path will be through Inlet 3, the lowest point on the site. The flow will surface flow to the north and then the east around the canopy. The flow will then enter the private road on the east side of the site and flow north then west along the existing sidewalk and swale into Parker Road. If Inlet 3 clogs and the overflow is not able to release through it, the emergency overflow path will be through Inlet 1. The flow will surface flow west, flow up the proposed ADA ramp, into the existing swale, and release into Parker Road. If both Inlet 1 and 3 are clogged and the system is clogged, the water will release through Inlet 2 and follow the same path as the overflow from Inlet 3 would have, into Parker Road. There are calculations showing that the private drive has capacity in Appendix B titled Section A-A. There are also calculations showing that the swale north of the property has capacity in Appendix B titled Section B-B. There are calculations showing that the water would flow down the ramp in Appendix B titled Broad Crested Weir – Ramp. The outfall control structure from the underground detention pond will be equipped with a restrictor plate to provide the appropriate release rates. The underground detention system uses isolator rows and underground percolation to provide appropriate water quality measures. The proposed underground detention pond will outfall into an existing private sewer network that conveys flows to the existing public storm sewer network and ultimately outfall to the Cherry Creek tributary. The proposed underground detention pond will be private and to be maintained by the property owner. Underground detention pond details are included in Appendix C for reference. Since the underground detention system is designed to store and treat multiple upstream tributary lots, the upstream lots will not require individual detention or water quality systems, even in the case of redevelopment, so long as the imperviousness does not increase from existing.

Stormwater quality for the site will be provided by an isolator row which is a part of the underground detention pond. The isolator row is a structure that acts as an extended detention basin, allowing water to infiltrate through its surrounding filter fabric while sediment is trapped within. Isolator row structure details are included in Appendix C for reference. The required water quality capture volume (WQCV) is 0.224 acre-feet. The provided WQCV is 0.225 acre-feet.

Variance

1. There is currently an underground detention pond on site. When the Applebee's was first designed in 1997, an underground detention pond was proposed to collect all water tributary to it. The areas tributary to the underground detention pond are shown on the drainage map in Appendix C. While on-site surface detention is required by the City of Aurora, a variance is being requested. There is not enough space on the site to provide the necessary storage volume per City of Aurora standards. On-site underground detention is being proposed to accommodate this requirement.
2. Historically, the City of Aurora has required total storage volume to be the 100-year detention volume and 1/2 of the EURV on top of that. They are in the process of changing their standards to allow for nested detention with the 1/2 EURV included within the 100-year detention volume. The project would like to request this variance in anticipation of updates to modified criteria.

I affirm that the proposed drainage design for King Soopers Fuel #84 at Lot 7, Block 1, Arapahoe Crossings Subdivision Filing No. 1 is in substantial conformance with existing site grading and drainage conditions, the approved *Final Drainage Study Applebee's at Arapahoe Crossings* (980013FD)*, the approved Final Drainage Report for Arapahoe Crossings #1, Phase* 1A (970182FD), the current City of Aurora Storm *Drainage Design and Technical Criteria Manual*, and the current *Mile High Flood District Urban Storm Drainage Criteria Manual*.

Please let us know if you have any questions related to this drainage compliance analysis letter.

FACSIMILE

THIS ELECTRONIC PLAN IS A FACSIMILE OF THE SIGNED AND SEALED PDF SET.

Sincerely,
GALLOWAY

1/8/2024

TROY KELTS, P.E. DATE

Troy Kelts
Registered Professional Engineer
TroyKelts@gallowayUS.com

References

1. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, January 2016 (with current revisions).

2. Flood Insurance Rate Map – City of Aurora, Colorado and Incorporated Areas Community Panel No. 08005C0481L, Effective February 17, 2017.

3. Soil Map – Arapahoe County Area, Colorado as available through the Natural Resources Conservation Service National Cooperative Soil Survey web site via Web Soil Survey 2.0.

4. Storm Drainage Design and Technical Criteria Manual, City of Aurora, September 2010

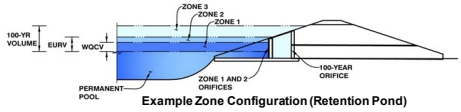
5. Final Drainage Report for Arapahoe Crossings #1, Phase 1A (970182FD), Arrow Civil Engineers, October 1997

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: King Soopers Fuel #84

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	6.77	acres
Watershed Length =	924	ft
Watershed Length to Centroid =	458	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	89.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

		Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.224 acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.678 acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	0.445 acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.12 in.) =	0.536 acre-feet	1.12	inches
10-yr Runoff Volume (P1 = 1.36 in.) =	0.670 acre-feet	1.36	inches
25-yr Runoff Volume (P1 = 1.72 in.) =	0.882 acre-feet	1.72	inches
50-yr Runoff Volume (P1 = 2.02 in.) =	1.055 acre-feet	2.02	inches
100-yr Runoff Volume (P1 = 2.6 in.) =	1.395 acre-feet	2.60	inches
500-yr Runoff Volume (P1 = 3.19 in.) =	1.739 acre-feet	3.19	inches
Approximate 2-yr Detention Volume =	0.434 acre-feet		
Approximate 5-yr Detention Volume =	0.530 acre-feet		
Approximate 10-yr Detention Volume =	0.676 acre-feet		
Approximate 25-yr Detention Volume =	0.801 acre-feet		
Approximate 50-yr Detention Volume =	0.868 acre-feet		
Approximate 100-yr Detention Volume =	1.037 acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.224	acre-feet
Zone 2 Volume (10-year - Zone 1) =	0.452	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.361	acre-feet
Total Detention Basin Volume =	1.037	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 0.25 ft

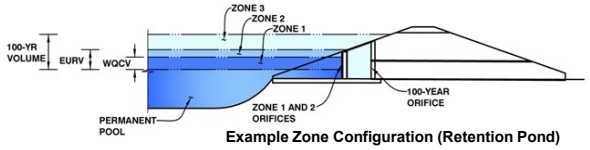
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	4,014	0.092		
5667.38	--	0.25	--	--	--	4,014	0.092	1,003	0.023
5667.63	--	0.50	--	--	--	4,014	0.092	2,007	0.046
5667.88	--	0.75	--	--	--	4,014	0.092	3,010	0.069
5668.13	--	1.00	--	--	--	9,762	0.224	4,732	0.109
5668.38	--	1.25	--	--	--	9,692	0.222	7,164	0.164
5668.63	--	1.50	--	--	--	9,617	0.221	9,577	0.220
5668.88	--	1.75	--	--	--	9,524	0.219	11,970	0.275
5669.13	--	2.00	--	--	--	9,418	0.216	14,338	0.329
5669.38	--	2.25	--	--	--	9,294	0.213	16,677	0.383
5669.63	--	2.50	--	--	--	9,155	0.210	18,983	0.436
5669.88	--	2.75	--	--	--	8,996	0.207	21,252	0.488
5670.13	--	3.00	--	--	--	8,820	0.202	23,479	0.539
5670.38	--	3.25	--	--	--	8,623	0.198	25,659	0.589
5670.63	--	3.50	--	--	--	8,401	0.193	27,787	0.638
5670.88	--	3.75	--	--	--	8,154	0.187	29,857	0.685
5671.13	--	4.00	--	--	--	7,878	0.181	31,861	0.731
5671.38	--	4.25	--	--	--	7,563	0.174	33,791	0.776
5671.63	--	4.50	--	--	--	7,200	0.165	35,636	0.818
5671.88	--	4.75	--	--	--	6,775	0.156	37,383	0.858
5672.13	--	5.00	--	--	--	6,248	0.143	39,011	0.896
5672.38	--	5.25	--	--	--	5,490	0.126	40,478	0.929
5672.63	--	5.50	--	--	--	4,502	0.103	41,727	0.958
5672.88	--	5.75	--	--	--	4,095	0.094	42,802	0.983
5673.13	--	6.00	--	--	--	4,014	0.092	43,815	1.006
5673.38	--	6.25	--	--	--	4,014	0.092	44,819	1.029
5673.63	--	6.50	--	--	--	4,014	0.092	45,822	1.052
5673.88	--	6.75	--	--	--	4,014	0.092	46,826	1.075

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: King Soopers Fuel #84

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.52	0.224	Orifice Plate
Zone 2 (10-year)	3.70	0.452	Circular Orifice
Zone 3 (100-year)	6.34	0.361	Weir&Pipe (Restrict)
Total (all zones)		1.037	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)

Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft^2

Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 3.21 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = inches

Orifice Plate: Orifice Area per Row = sq. inches

Calculated Parameters for Plate

WQ Orifice Area per Row = N/A ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.21	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.88	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.02	N/A	ft^2
Vertical Orifice Centroid =	0.08	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.21	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	0.00	N/A	feet
Overflow Grate Type =	No Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.21	N/A	feet
Overflow Weir Slope Length =	0.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	0.00	N/A	
Overflow Grate Open Area w/o Debris =	0.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	0.00	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	5.27		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.51	N/A	ft^2
Outlet Orifice Centroid =	0.26	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.98	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= ft (relative to basin bottom at Stage = 0 ft)

Spillway Crest Length = feet

Spillway End Slopes = H:V

Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= feet

Stage at Top of Freeboard = feet

Basin Area at Top of Freeboard = acres

Basin Volume at Top of Freeboard = acre-ft

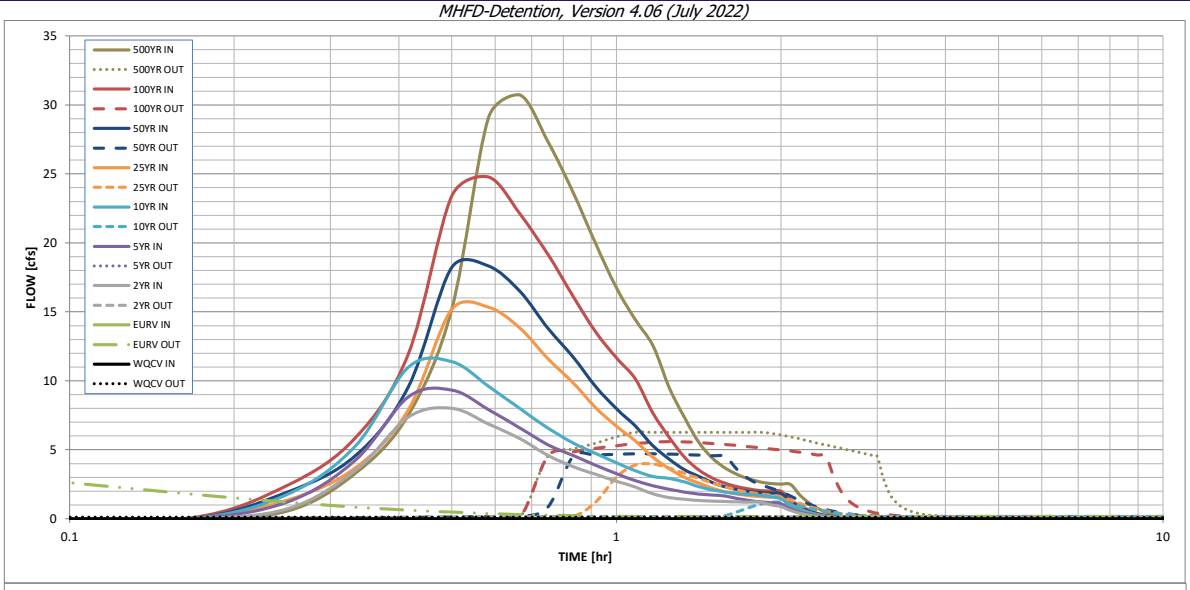
Routed Hydrograph Results

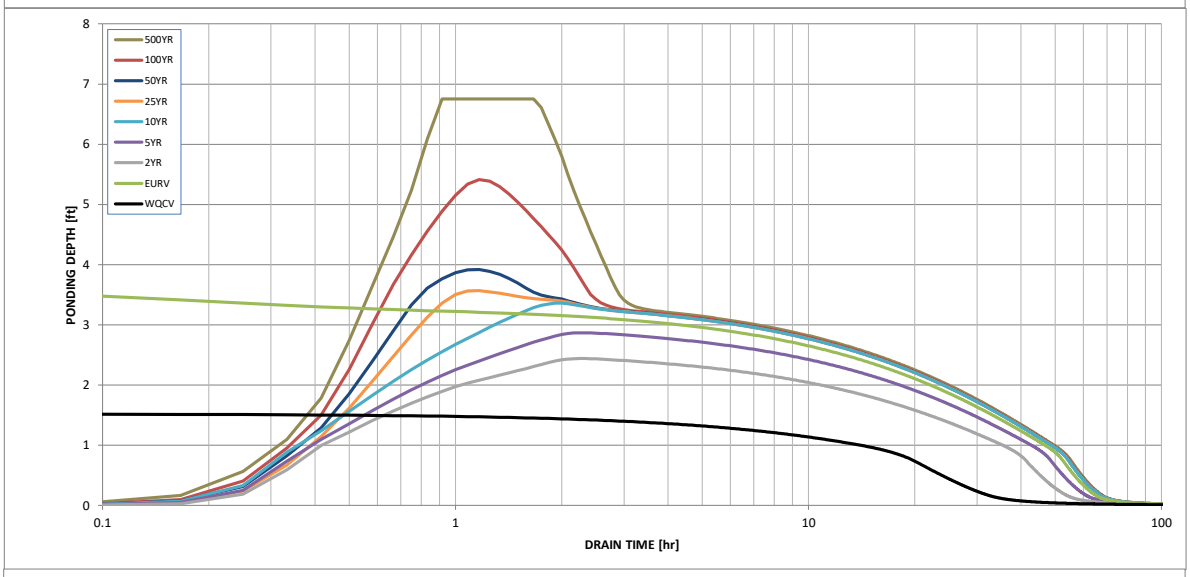
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

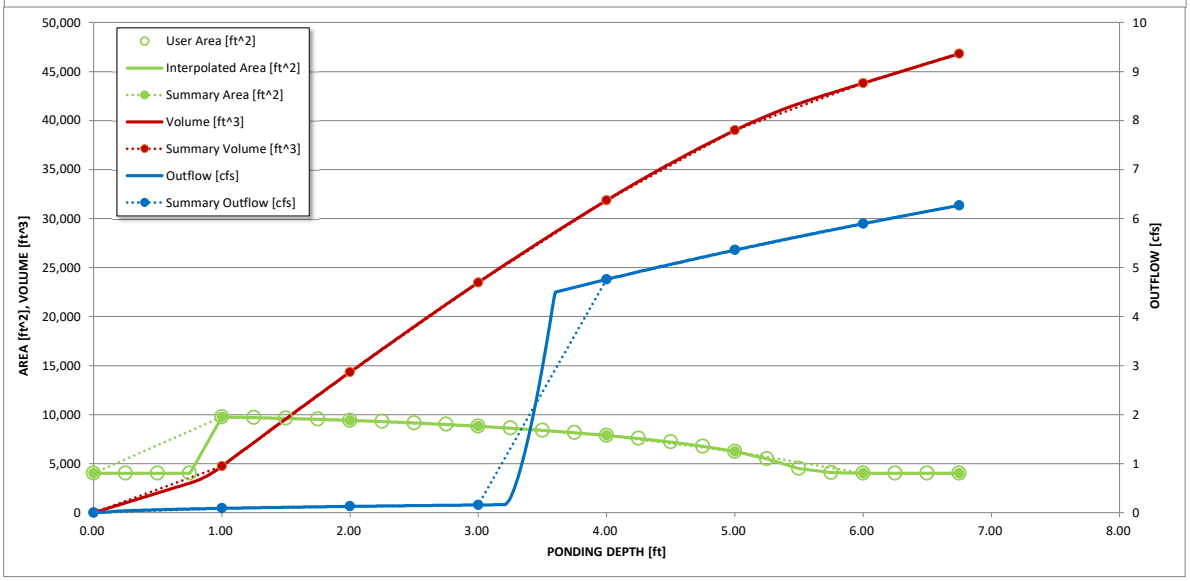
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.95	1.12	1.36	1.72	2.02	2.60	3.19
CUHP Runoff Volume (acre-ft) =	0.224	0.678	0.445	0.536	0.670	0.882	1.055	1.395	1.739
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.445	0.536	0.670	0.882	1.055	1.395	1.739
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	1.1	3.8	5.4	8.9	12.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.17	0.56	0.79	1.31	1.79
Peak Inflow Q (cfs) =	N/A	N/A	8.0	9.3	11.4	15.3	18.3	24.8	30.7
Peak Outflow Q (cfs) =	0.1	4.5	0.1	0.2	1.2	4.0	4.7	5.6	6.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.1	1.1	0.9	0.6	0.5
Structure Controlling Flow =	Vertical Orifice 1	Outlet Plate 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	63	55	61	65	63	62	60	58
Time to Drain 99% of Inflow Volume (hours) =	**62**	73	68	72	75	72	70	68	67
Maximum Ponding Depth (ft) =	1.52	3.72	2.44	2.87	3.36	3.56	3.92	5.41	6.75
Area at Maximum Ponding Depth (acres) =	0.22	0.19	0.21	0.20	0.20	0.19	0.18	0.11	0.09
Maximum Volume Stored (acre-ft) =	0.224	0.680	0.421	0.510	0.609	0.649	0.715	0.947	1.075

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.55
	0:15:00	0.00	0.00	0.72	1.21	1.76	1.35	1.93	2.42	3.29
	0:20:00	0.00	0.00	3.51	4.24	5.27	3.68	4.57	5.86	7.54
	0:25:00	0.00	0.00	7.37	8.84	10.98	7.91	9.59	11.98	15.18
	0:30:00	0.00	0.00	8.01	9.33	11.39	15.17	18.22	23.38	29.06
	0:35:00	0.00	0.00	6.88	7.91	9.61	15.34	18.32	24.78	30.71
	0:40:00	0.00	0.00	5.80	6.57	7.97	13.81	16.46	22.08	27.33
	0:45:00	0.00	0.00	4.59	5.37	6.57	11.59	13.80	19.15	23.69
	0:50:00	0.00	0.00	3.78	4.58	5.50	9.87	11.74	16.14	19.96
	0:55:00	0.00	0.00	3.22	3.88	4.73	8.06	9.58	13.54	16.74
	1:00:00	0.00	0.00	2.72	3.28	4.06	6.71	7.98	11.67	14.43
	1:05:00	0.00	0.00	2.30	2.76	3.47	5.65	6.72	10.14	12.54
	1:10:00	0.00	0.00	1.80	2.40	3.07	4.45	5.29	7.65	9.48
	1:15:00	0.00	0.00	1.54	2.13	2.92	3.62	4.30	5.89	7.32
	1:20:00	0.00	0.00	1.40	1.93	2.67	2.98	3.54	4.45	5.53
	1:25:00	0.00	0.00	1.32	1.80	2.33	2.59	3.07	3.52	4.38
	1:30:00	0.00	0.00	1.28	1.71	2.10	2.21	2.62	2.95	3.68
	1:35:00	0.00	0.00	1.25	1.65	1.94	1.95	2.31	2.57	3.20
	1:40:00	0.00	0.00	1.22	1.46	1.83	1.79	2.12	2.32	2.89
	1:45:00	0.00	0.00	1.21	1.32	1.75	1.68	1.98	2.15	2.67
	1:50:00	0.00	0.00	1.20	1.23	1.70	1.60	1.90	2.05	2.55
	1:55:00	0.00	0.00	1.01	1.16	1.61	1.56	1.85	2.01	2.51
	2:00:00	0.00	0.00	0.88	1.08	1.44	1.54	1.82	2.00	2.49
	2:05:00	0.00	0.00	0.60	0.74	0.98	1.05	1.24	1.37	1.71
	2:10:00	0.00	0.00	0.40	0.49	0.66	0.71	0.84	0.93	1.15
	2:15:00	0.00	0.00	0.26	0.32	0.44	0.47	0.56	0.62	0.77
	2:20:00	0.00	0.00	0.16	0.20	0.28	0.30	0.36	0.40	0.49
	2:25:00	0.00	0.00	0.10	0.13	0.17	0.19	0.23	0.25	0.31
	2:30:00	0.00	0.00	0.05	0.07	0.10	0.11	0.13	0.15	0.18
	2:35:00	0.00	0.00	0.02	0.03	0.04	0.05	0.06	0.07	0.09
	2:40:00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03
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	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

City of Aurora Max Storage Volume and Allowable Release Rate Calculation

Ultimate Condition (with Future Parking)

V = KA

100-yr $K = (1.78I - .002I^2 - 3.56) / 900$

Used to calculate the 100-year detention volume instead of using the MHFD 100-year detention volume per COA Section 6.33

A = 6.77 ac
I = 89.4%
100% Type B soil

K = (1.78 x 89.4 - .002 x (89.4)^2 - 3.56) / 900 = 0.155

V = 0.155 x 6.77 = 1.05

10-year allowable Release Rate = 0.23 cfs/acre = 1.56 cfs
100-year allowable Release Rate = 0.85 cfs/acre = 5.75 cfs

Water Quality Capture Volume Calculation

Per ADS details sheet 6		
Chamber Storage (A) (ft^3)	175.9	
Minimum Installed Storage (for 1.75' of stone) (B) (ft^3)	267.3	
(B - A) / Design Feet of Stone * Actual Feet of Stone + A		
End Cap Storage (C) (ft^3)	39.5	
Minimum Installed Storage (for 1.75' of stone) (D) (ft^3)	115.3	
(D - C) / Design Feet of Stone * Actual Feet of Stone + C		
30 chambers and 8 end caps	WQCV Volume (ft^3)	WQCV Volume (acre-feet)
40*267.3+8*115.3=	11614	0.27

PROJECT INFORMATION	
ENGINEERED PRODUCT MANAGER:	JEROME MAGSINO 303-349-7555 JEROME.MAGSINO@ADSPIPE.COM
ADS SALES REP:	AARON ZEE 303-548-3479 AARON.ZEE@ADSPIPE.COM
PROJECT NO:	S258823

Advanced Drainage Systems, Inc.

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FOR STORMTECH
INSTALLATION INSTRUCTIONS
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KING SOOPERS FUEL #84

AURORA, CO

MC-7200 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-7200.
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-7200 CHAMBER SYSTEM

1. STORMTECH MC-7200 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-7200 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-7200 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-7200 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-7200 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-7200 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-7200 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-7200 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.

PROPOSED LAYOUT

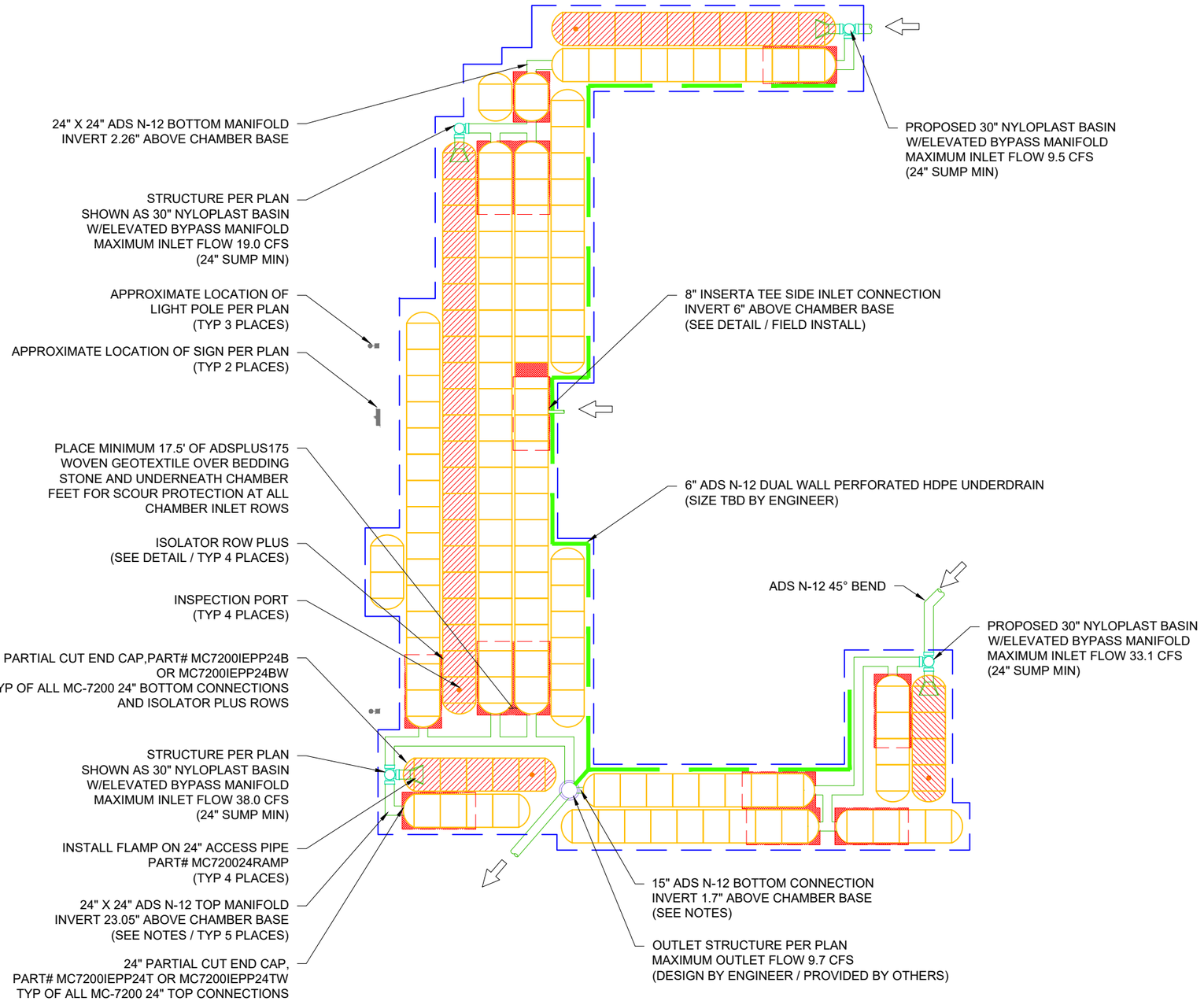
156	STORMTECH MC-7200 CHAMBERS
36	STORMTECH MC-7200 END CAPS
12	STONE ABOVE (in)
9	STONE BELOW (in)
30	% STONE VOID
47,297	**INSTALLED SYSTEM VOLUME (CF) (PERIMETER STONE INCLUDED)**
13379	SYSTEM AREA (ft²)
952	SYSTEM PERIMETER (ft)

PROPOSED ELEVATIONS

5680.92	MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED)
5675.38	MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC)
5674.88	MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC)
5674.88	MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT)
5674.88	MINIMUM ALLOWABLE GRADE (TOP OF RIGID PAVEMENT)
5673.88	TOP OF STONE
5672.88	TOP OF MC-7200 CHAMBER
5669.80	24" TOP MANIFOLD INVERT
5668.55	INSERTA TEE SIDE INLET CONNECTION INVERT
5668.07	24" ISOLATOR ROW PLUS CONNECTION INVERT
5668.07	24" BOTTOM MANIFOLD INVERT
5668.02	15" BOTTOM CONNECTION INVERT
5667.88	BOTTOM OF MC-7200 CHAMBER
5667.13	UNDERDRAIN INVERT
5667.13	BOTTOM OF STONE

NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECHNICAL 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.
- THE SITE DESIGN ENGINEER MUST REVIEW THE PROXIMITY OF THE CHAMBERS TO THE RETAINING WALL AND CONSIDER EFFECTS OF POSSIBLE SATURATED SOILS ON THE RETAINING WALL'S INTEGRITY.
- THIS DRAWING IS NOT INTENDED FOR USE IN BIDDING OR CONSTRUCTION WITHOUT THE PRIOR APPROVAL OF THE PROJECT'S ENGINEER OF RECORD ("EOR"). AS WITH ALL PROPOSED ADS LAYOUTS, THE EOR SHOULD REVIEW AND APPROVE THIS DRAWING PRIOR TO USE IN BIDDING AND/OR CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE EOR TO ENSURE THAT THE PRODUCT(S) DEPICTED AND THE ASSOCIATED DETAILS MEET ALL APPLICABLE LAWS, REGULATIONS, AND PROJECT REQUIREMENTS.



DATE	DRWN	CHKD	DESCRIPTION
9/13/23	CTS		CHANGE STONE VOID TO 30%
09/26/22	SVO	SVO	BOS AT 5667.13
09/ 22/22	SVO	SVO	ENG REVIEW: 9" BASE STONE
07/19/22	MPV	RWD	REVISE INLET TO PROVIDE REQ'D FLOW RATE
07/14/22	MPV	NPB	REVISE PER MARKUP
07/06/22	NAL	RWD	REVISE TO MC-7200
02/11/22	CTS	CTS	UPDATED BACKGROUND. RELOCATE 4 CHAMBERS
11/08/21	TSG	RWD	REVISED PER UPDATED VOLUME REQUIREMENT

KING SOOPERS FUEL #84

AURORA, CO

DATE: 09/18/21 DRAWN: TSG

PROJECT #: S258823 CHECKED: CTS

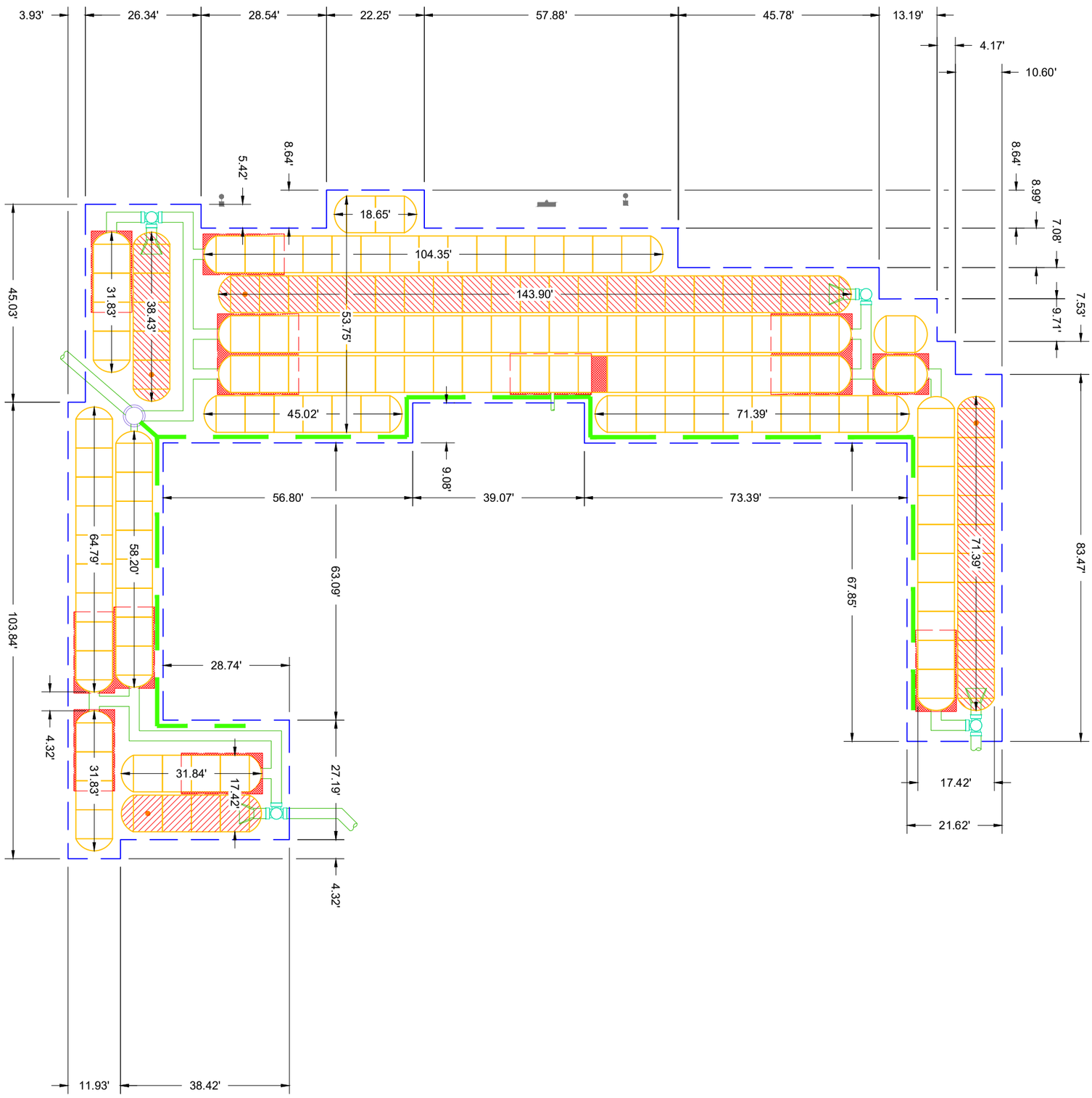
THIS DRAWING IS NOT INTENDED FOR USE IN BIDDING OR CONSTRUCTION WITHOUT THE PRIOR APPROVAL OF THE PROJECT'S ENGINEER OF RECORD ("EOR"). AS WITH ALL PROPOSED ADS LAYOUTS, THE EOR SHOULD REVIEW AND APPROVE THIS DRAWING PRIOR TO USE IN BIDDING AND/OR CONSTRUCTION. IT IS THE ULTIMATE RESPONSIBILITY OF THE EOR 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

0' 30' 60'



09/26/22	SVO	SVO	BOS AT 5667.13
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07/14/22	MPV	NPB	REVISE PER MARKUP
07/06/22	NAL	RWD	REVISE TO MC-7200
02/11/22	CTS	CTS	UPDATED BACKGROUND: RELOCATE 4 CHAMBERS
11/08/21	TSG	RWD	REVISED PER UPDATED VOLUME REQUIREMENT
DATE	DRWN	CHKD	DESCRIPTION

SHEET 3 OF 7

ADS

4640 TRUEMAN BLVD
HILLIARD, OH 43026

0 25' 50'

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KING SOOPERS FUEL #84

AURORA, CO

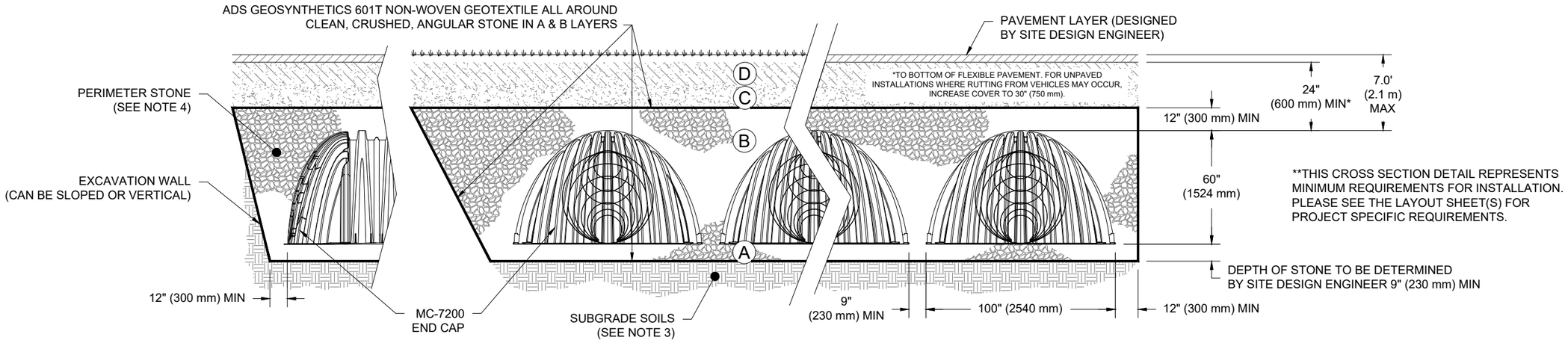
DATE: 09/18/21 DRAWN: TSG

PROJECT #: S258823 CHECKED: CTS

ACCEPTABLE FILL MATERIALS: STORMTECH MC-7200 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-7200 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 AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/FT/%. 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.

KING SOOPERS FUEL #84
AURORA, CO
DATE: 09/18/21 DRAWN: TSG
PROJECT #: S258823 CHECKED: CTS

DATE	DRWN	CHKD	DESCRIPTION
09/26/22	SVO	SVO	BOS AT 5667.13
09/ 22/22	SVO	SVO	ENG REVIEW: 9" BASE STONE
07/19/22	MPV	RWD	REVISE INLET TO PROVIDE REQ'D FLOW RATE
07/14/22	MPV	NPB	REVISE PER MARKUP
07/06/22	NAL	RWD	REVISE TO MC-7200
02/11/22	CTS	CTS	UPDATED BACKGROUND. RELOCATE 4 CHAMBERS
11/08/21	TSG	RWD	REVISED PER UPDATED VOLUME REQUIREMENT

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HILLIARD, OH 43026

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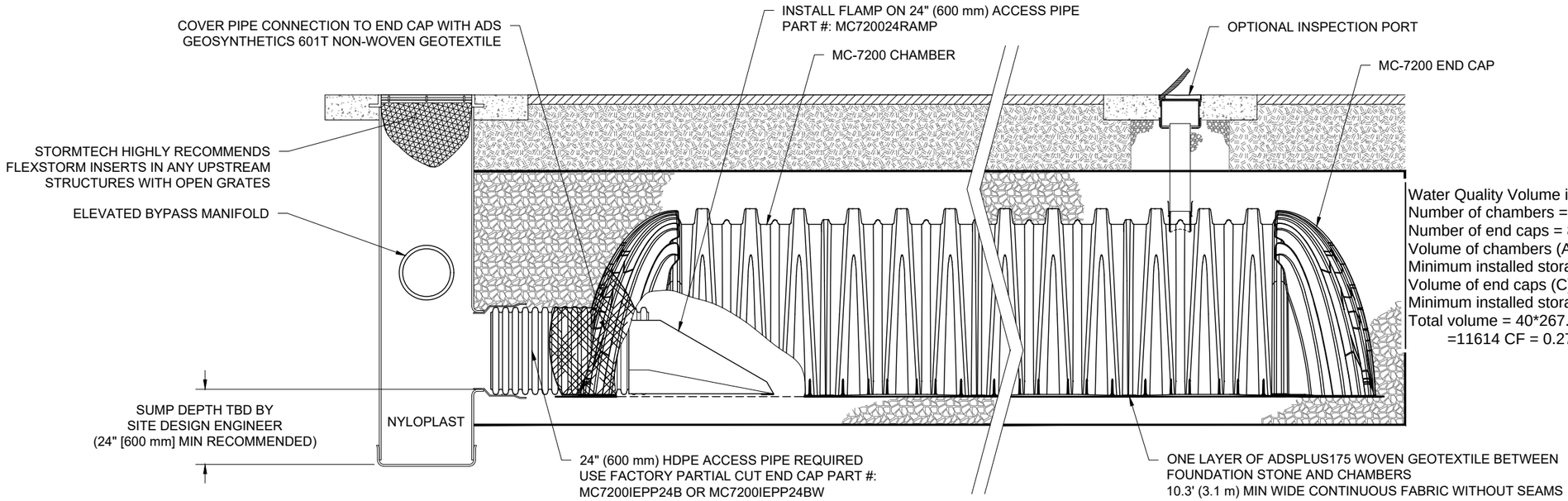


MC-7200 ISOLATOR ROW PLUS DETAIL
NTS

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

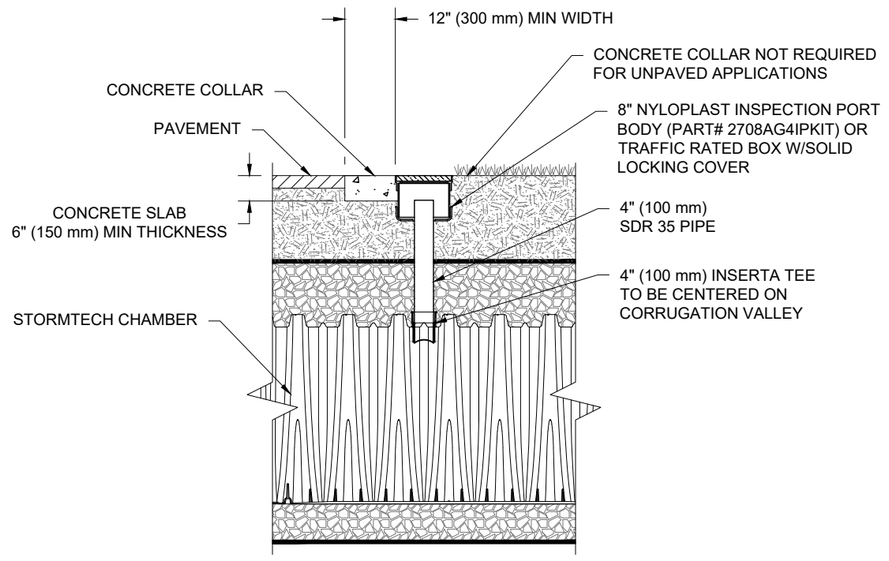
STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

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.



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION VALLEY.

4" PVC INSPECTION PORT DETAIL (MC SERIES CHAMBER)
NTS

KING SOOPERS FUEL #84
AURORA, CO
DATE: 09-18-21 DRAWN: TSG
PROJECT #: S258823 CHECKED: CTS

DATE	DRWN	CHKD	DESCRIPTION
07/19/22	MPV	RWD	REVISE SE INLET TO PROVIDE REQ'D FLOW RATE
07/14/22	MPV	NPB	REVISE PER MARKUP
07/06/2022	NAL	RWD	REVISE TO MC-7200
02-11-22	CTS	CTS	UPDATE BACKGROUND. RELOCATE 4 CHAMBERS
11-08-21	TSG	RWD	REVISED PER UPDATED VOLUME REQUIREMENT

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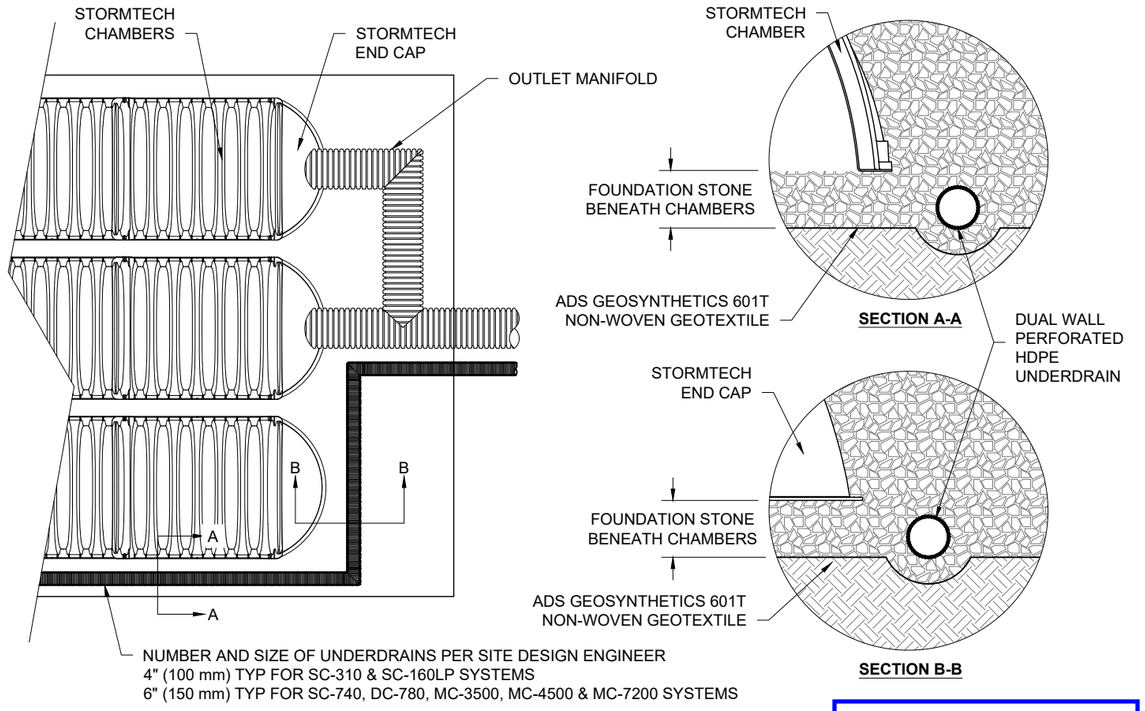
4640 TRUEMAN BLVD
HILLIARD, OH 43026

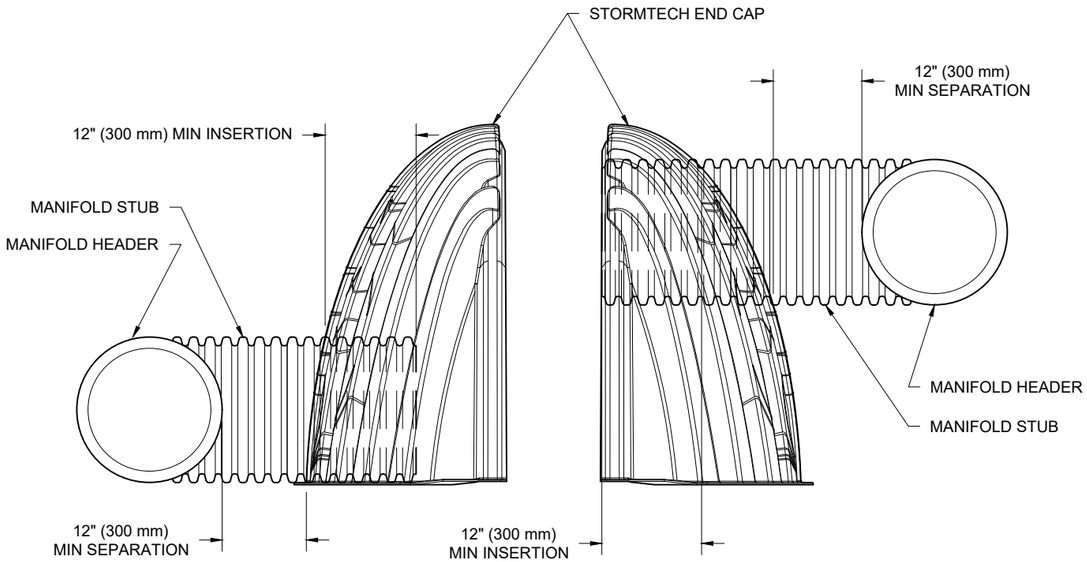
UNDERDRAIN DETAIL

NTS



MC-SERIES END CAP INSERTION DETAIL

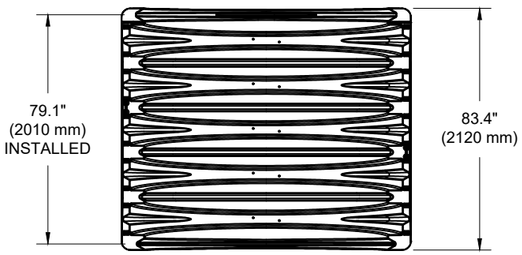
NTS

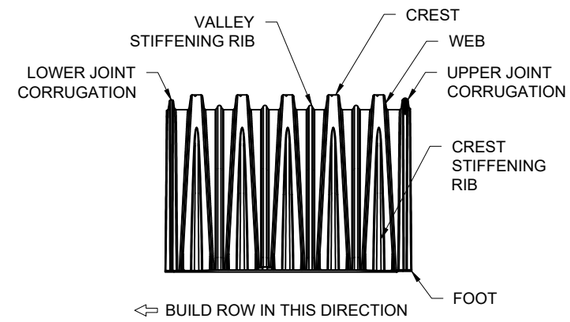


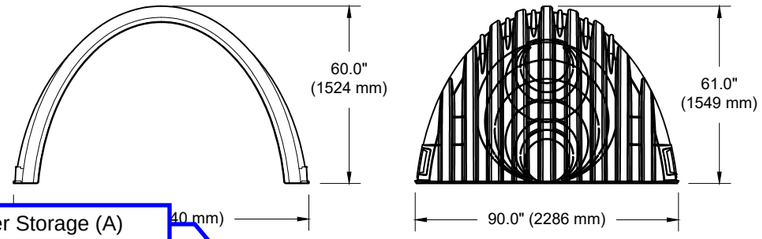
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

MC-7200 TECHNICAL SPECIFICATION

NTS







Chamber Storage (A)

Minimum Installed Storage (B)

End Cap Storage (C)

Minimum Installed Storage (D)

NOMINAL CHAMBER SPECIFICATIONS		
SIZE (W X H X INSTALLED LENGTH)	100.0" X 60.0" X 79.1"	(2540 mm X 1524 mm X 2010 mm)
CHAMBER STORAGE	175.9 CUBIC FEET	(4.98 m³)
MINIMUM INSTALLED STORAGE*	267.3 CUBIC FEET	(7.56 m³)
WEIGHT (NOMINAL)	205 lbs.	(92.9 kg)

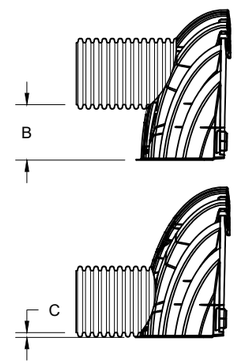
NOMINAL END CAP SPECIFICATIONS		
SIZE (W X H X INSTALLED LENGTH)	90.0" X 61.0" X 32.8"	(2286 mm X 1549 mm X 833 mm)
END CAP STORAGE	39.5 CUBIC FEET	(1.12 m³)
MINIMUM INSTALLED STORAGE*	115.3 CUBIC FEET	(3.26 m³)
WEIGHT (NOMINAL)	90 lbs.	(40.8 kg)

*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
MC7200IEPP06T	6" (150 mm)	42.54" (1081 mm)	---
MC7200IEPP06B		---	0.86" (22 mm)
MC7200IEPP08T	8" (200 mm)	40.50" (1029 mm)	---
MC7200IEPP08B		---	1.01" (26 mm)
MC7200IEPP10T	10" (250 mm)	38.37" (975 mm)	---
MC7200IEPP10B		---	1.33" (34 mm)
MC7200IEPP12T	12" (300 mm)	35.69" (907 mm)	---
MC7200IEPP12B		---	1.55" (39 mm)
MC7200IEPP15T	15" (375 mm)	32.72" (831 mm)	---
MC7200IEPP15B		---	1.70" (43 mm)
MC7200IEPP18T	18" (450 mm)	29.36" (746 mm)	---
MC7200IEPP18TW			
MC7200IEPP18B		---	1.97" (50 mm)
MC7200IEPP18BW			
MC7200IEPP24T	24" (600 mm)	23.05" (585 mm)	---
MC7200IEPP24TW			
MC7200IEPP24B		---	2.26" (57 mm)
MC7200IEPP24BW			
MC7200IEPP30BW	30" (750 mm)	---	2.95" (75 mm)
MC7200IEPP36BW	36" (900 mm)	---	3.25" (83 mm)
MC7200IEPP42BW	42" (1050 mm)	---	3.55" (90 mm)

NOTE: ALL DIMENSIONS ARE NOMINAL



CUSTOM PREFABRICATED 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-7200 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.

KING SOOPERS FUEL #84
AURORA, CO

DATE: 09-18-21 | DRAWN: TSG
PROJECT #: S258823 | CHECKED: CTS

DATE	DESCRIPTION	DRWN	CHKD
11-08-21	REVISED PER UPDATED VOLUME REQUIREMENT	TSG	RWD
02-11-22	UPDATE BACKGROUND. RELOCATE 4 CHAMBERS	CTS	RWD
07/06/2022	REVISE TO MC-7200	NAL	RWD
07/14/22	REVISE PER MARKUP	MPV	NPB
07/19/22	REVISE SE INLET TO PROVIDE REQ'D FLOW RATE	MPV	RWD

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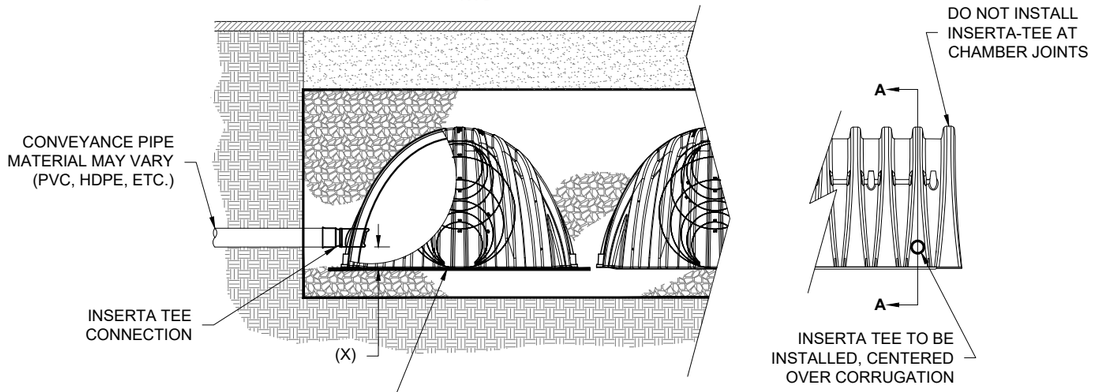
ADS

SHEET 6 OF 7

INSERTA TEE DETAIL

NTS



SECTION A-A **SIDE VIEW**

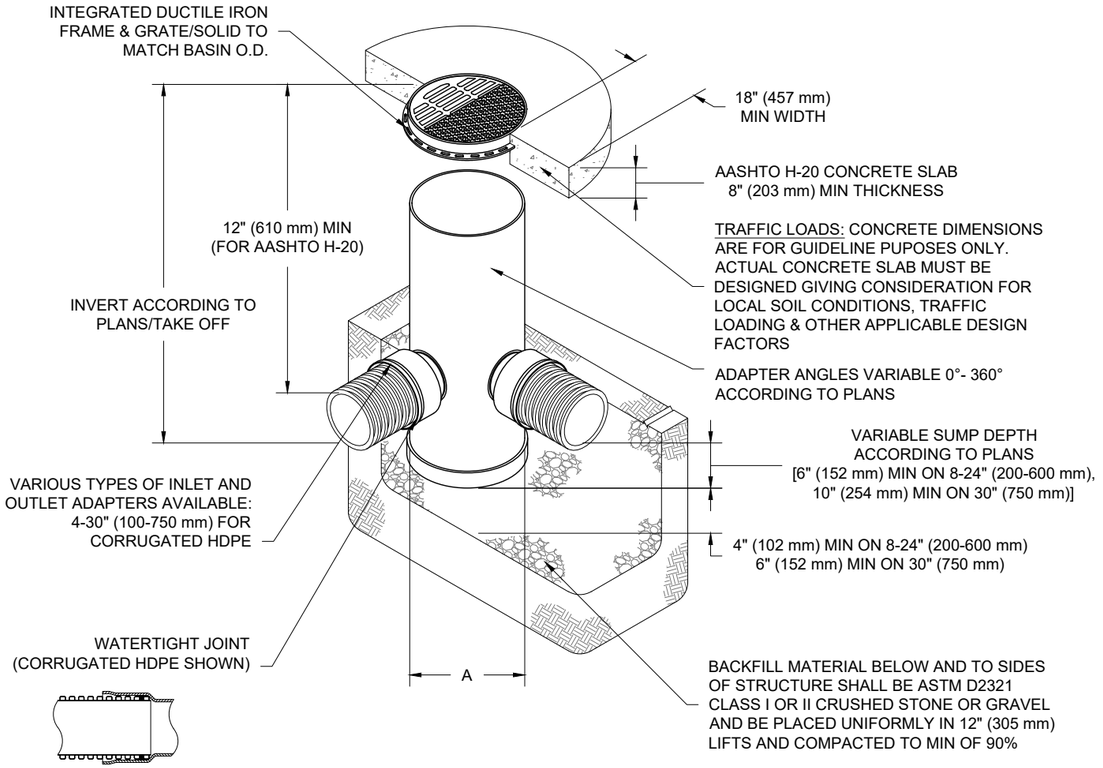
CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
MC-3500	12" (300 mm)	6" (150 mm)
MC-4500	12" (300 mm)	8" (200 mm)
MC-7200	12" (300 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTES:

- PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.
- CONTACT ADS ENGINEERING SERVICES IF INSERTA TEE INLET MUST BE RAISED AS NOT ALL INVERTS ARE POSSIBLE.

NYLOPLAST DRAIN BASIN

NTS



NOTES

1. 8-30" (200-750 mm) GRATES/SOLID COVERS SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
2. 12-30" (300-750 mm) FRAMES SHALL BE DUCTILE IRON PER ASTM A536 GRADE 70-50-05
3. DRAIN BASIN TO BE CUSTOM MANUFACTURED ACCORDING TO PLAN DETAILS
4. DRAINAGE CONNECTION STUB JOINT TIGHTNESS SHALL CONFORM TO ASTM D3212 FOR CORRUGATED HDPE (ADS & HANCOR DUAL WALL) & SDR 35 PVC
5. FOR COMPLETE DESIGN AND PRODUCT INFORMATION: **WWW.NYLOPLAST-US.COM**
6. TO ORDER CALL: **800-821-6710**

A	PART #	GRATE/SOLID COVER OPTIONS		
8" (200 mm)	2808AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
10" (250 mm)	2810AG	PEDESTRIAN LIGHT DUTY	STANDARD LIGHT DUTY	SOLID LIGHT DUTY
12" (300 mm)	2812AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
15" (375 mm)	2815AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
18" (450 mm)	2818AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
24" (600 mm)	2824AG	PEDESTRIAN AASHTO H-10	STANDARD AASHTO H-20	SOLID AASHTO H-20
30" (750 mm)	2830AG	PEDESTRIAN AASHTO H-20	STANDARD AASHTO H-20	SOLID AASHTO H-20

KING SOOPERS FUEL #84

AURORA, CO

DATE: 09-18-21 DRAWN: TSG

PROJECT #: S258823 CHECKED: CTS

DATE	DRWN	CHKD	DESCRIPTION
07/19/22	MPV	RWD	REVISE SE INLET TO PROVIDE REQ'D FLOW RATE
07/14/22	MPV	NPB	REVISE PER MARKUP
07/06/2022	NAL	RWD	REVISE TO MC-7200
02-11-22	CTS	CTS	UPDATE BACKGROUND. RELOCATE 4 CHAMBERS
11-08-21	TSG	RWD	REVISED PER UPDATED VOLUME REQUIREMENT

Nyloplast®

770-932-2443 | WWW.NYLOPLAST-US.COM

4640 TRUEMAN BLVD
HILLIARD, OH 43026

ADS

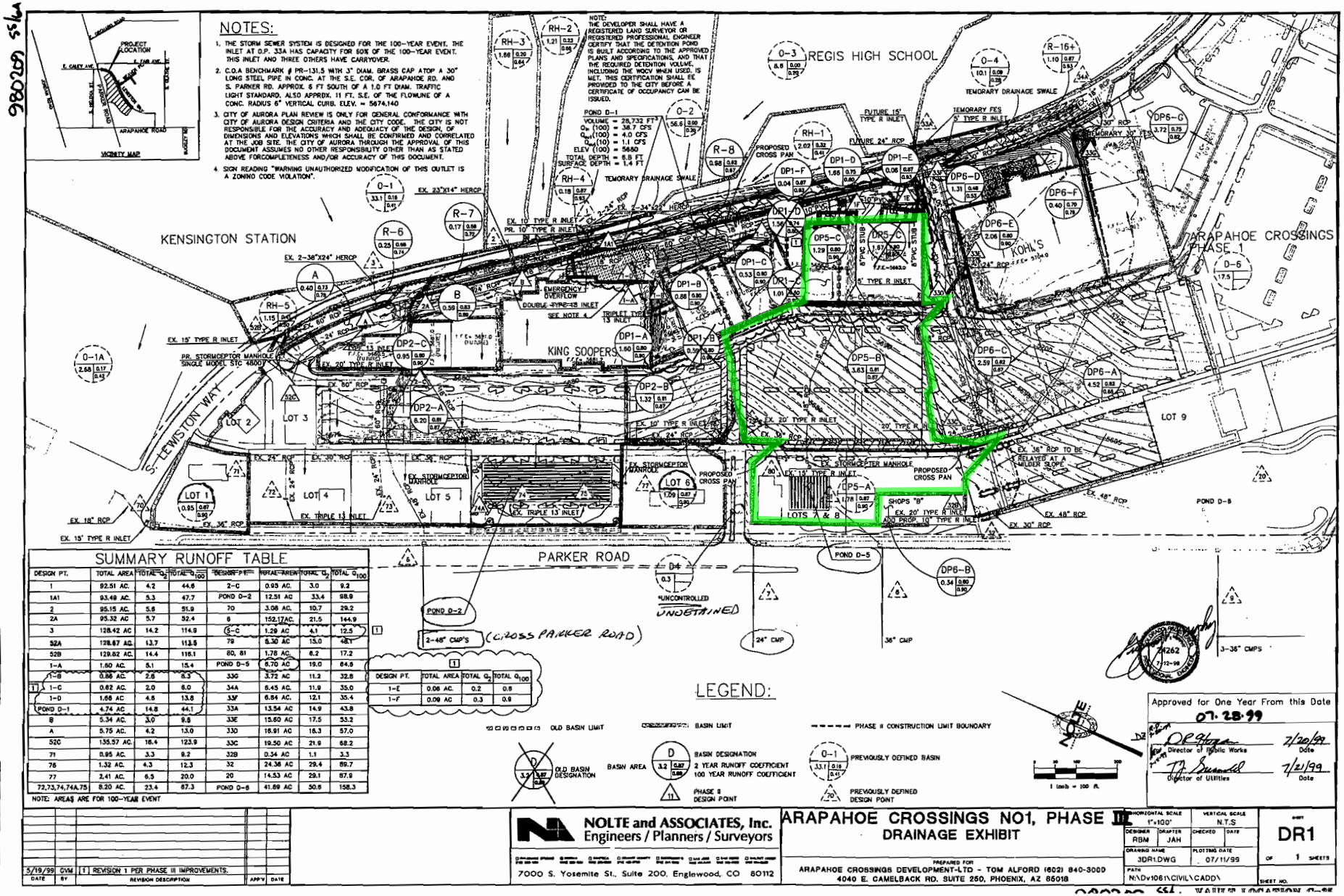
Project: King Scoopers Fuel #84

Chamber Model -	MC-7200	
Units -	Imperial	
Number of Chambers -	156	
Number of End Caps -	36	
Voids in the stone (porosity) -	30	%
Base of Stone Elevation -	5667.13	ft
Amount of Stone Above Chambers -	12	in
Amount of Stone Below Chambers -	9	in

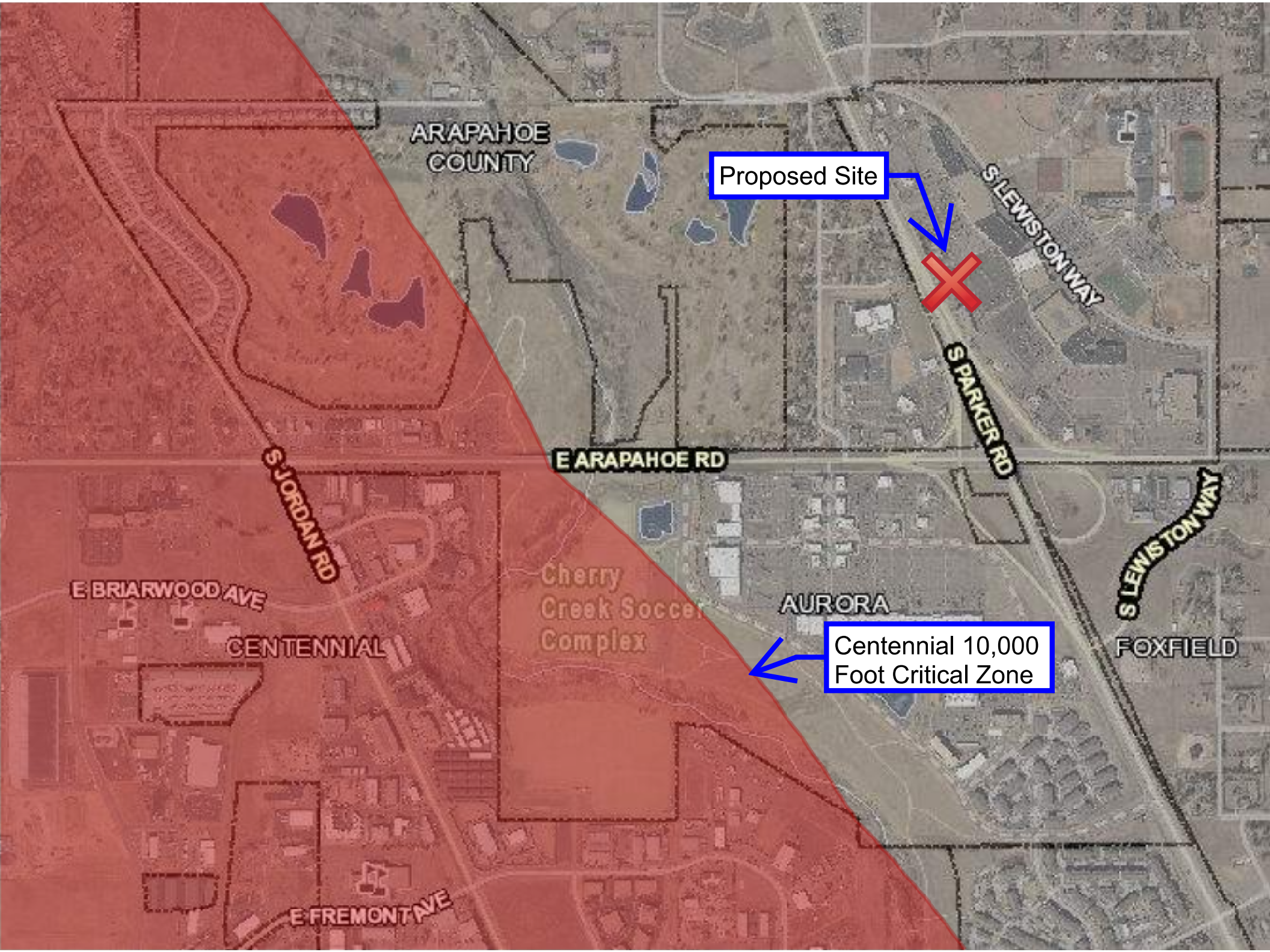
Area of system - 13379 sf Min. Area - 10561 sf min. area

StormTech MC-7200 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 (feet)	Cumulative System (cubic feet)	Elevation (feet)
81	0.00	0.00	0.00	0.00	334.48	334.48	47297.48	5673.88
80	0.00	0.00	0.00	0.00	334.48	334.48	46963.01	5673.80
79	0.00	0.00	0.00	0.00	334.48	334.48	46628.53	5673.71
78	0.00	0.00	0.00	0.00	334.48	334.48	46294.06	5673.63
77	0.00	0.00	0.00	0.00	334.48	334.48	45959.58	5673.55
76	0.00	0.00	0.00	0.00	334.48	334.48	45625.11	5673.46
75	0.00	0.00	0.00	0.00	334.48	334.48	45290.63	5673.38
74	0.00	0.00	0.00	0.00	334.48	334.48	44956.16	5673.30
73	0.00	0.00	0.00	0.00	334.48	334.48	44621.68	5673.21
72	0.00	0.00	0.00	0.00	334.48	334.48	44287.21	5673.13
71	0.00	0.00	0.00	0.00	334.48	334.48	43952.73	5673.05
70	0.00	0.00	0.00	0.00	334.48	334.48	43618.26	5672.96
69	0.06	0.01	9.26	0.47	331.56	341.29	43283.78	5672.88
68	0.19	0.03	29.67	1.22	325.21	356.10	42942.50	5672.80
67	0.28	0.05	42.93	1.86	321.04	365.83	42586.40	5672.71
66	0.36	0.07	55.73	2.38	317.04	375.15	42220.57	5672.63
65	0.46	0.08	71.51	2.99	312.12	386.63	41845.42	5672.55
64	0.74	0.11	115.70	3.79	298.63	418.12	41458.80	5672.46
63	1.10	0.13	171.03	4.77	281.73	457.54	41040.68	5672.38
62	1.32	0.16	205.68	5.80	271.03	482.51	40583.14	5672.30
61	1.50	0.19	233.72	6.79	262.32	502.84	40100.63	5672.21
60	1.65	0.22	258.10	7.87	254.68	520.65	39597.80	5672.13
59	1.79	0.25	279.86	8.89	247.85	536.60	39077.14	5672.05
58	1.92	0.28	299.47	9.91	241.66	551.04	38540.55	5671.96
57	2.04	0.30	317.84	10.87	235.86	564.57	37989.51	5671.88
56	2.15	0.33	334.67	11.79	230.54	577.00	37424.94	5671.80
55	2.25	0.35	350.64	12.76	225.45	588.86	36847.94	5671.71
54	2.34	0.38	365.53	13.81	220.67	600.02	36259.08	5671.63
53	2.43	0.41	379.62	14.73	216.17	610.52	35659.07	5671.55
52	2.52	0.44	392.97	15.87	211.82	620.67	35048.55	5671.46
51	2.60	0.47	405.69	16.88	207.71	630.27	34427.88	5671.38
50	2.68	0.50	417.83	17.83	203.78	639.44	33797.61	5671.30
49	2.75	0.52	429.40	18.74	200.03	648.18	33158.17	5671.21
48	2.82	0.54	440.46	19.60	196.46	656.51	32510.00	5671.13
47	2.89	0.57	451.06	20.40	193.04	664.50	31853.48	5671.05
46	2.96	0.59	461.19	21.19	189.76	672.14	31188.98	5670.96
45	3.02	0.61	470.93	21.96	186.61	679.50	30516.84	5670.88
44	3.08	0.63	480.27	22.76	183.57	686.59	29837.34	5670.80
43	3.14	0.64	489.26	23.15	180.75	693.16	29150.75	5670.71
42	3.19	0.68	497.92	24.38	177.79	700.08	28457.59	5670.63
41	3.25	0.70	506.22	25.19	175.05	706.47	27757.51	5670.55
40	3.30	0.72	514.23	26.01	172.41	712.64	27051.04	5670.46
39	3.35	0.74	521.92	26.77	169.87	718.56	26338.40	5670.38
38	3.39	0.76	529.33	27.52	167.42	724.27	25619.84	5670.30
37	3.44	0.79	536.46	28.28	165.05	729.79	24895.58	5670.21
36	3.48	0.80	543.33	28.90	162.81	735.03	24165.78	5670.13
35	3.53	0.82	549.96	29.52	160.63	740.11	23430.75	5670.05
34	3.57	0.84	556.32	30.19	158.52	745.03	22690.64	5669.96
33	3.61	0.85	562.47	30.65	156.54	749.66	21945.61	5669.88
32	3.64	0.86	568.38	30.94	154.68	754.00	21195.96	5669.80
31	3.68	0.89	574.07	32.02	152.65	758.74	20441.95	5669.71
30	3.71	0.90	579.54	32.55	150.85	762.94	19683.21	5669.63
29	3.75	0.92	584.80	33.02	149.13	766.95	18920.27	5669.55
28	3.78	0.92	589.84	33.11	147.59	770.54	18153.33	5669.46
27	3.81	0.94	594.68	33.96	145.88	774.52	17382.79	5669.38
26	3.84	0.96	599.30	34.43	144.36	778.09	16608.26	5669.30
25	3.87	0.97	603.75	34.87	142.89	781.51	15830.18	5669.21
24	3.90	0.98	607.99	35.33	141.48	784.80	15048.67	5669.13
23	3.92	0.97	612.06	34.96	140.37	787.39	14263.87	5669.05
22	3.95	1.00	615.93	36.12	138.86	790.91	13476.48	5668.96
21	3.97	1.01	619.62	36.40	137.67	793.69	12685.57	5668.88
20	3.99	1.02	623.15	36.73	136.51	796.39	11891.88	5668.80
19	4.02	1.03	626.49	37.09	135.40	798.98	11095.49	5668.71
18	4.04	1.04	629.65	37.39	134.36	801.40	10296.51	5668.63
17	4.06	1.05	632.65	37.67	133.38	803.70	9495.11	5668.55
16	4.07	1.05	635.47	37.94	132.45	805.87	8691.41	5668.46
15	4.09	1.05	638.12	37.82	131.69	807.63	7885.54	5668.38
14	4.11	1.06	640.64	38.04	130.87	809.55	7077.91	5668.30
13	4.12	1.08	643.05	38.72	129.95	811.71	6268.36	5668.21
12	4.14	1.08	645.30	38.98	129.19	813.47	5456.65	5668.13
11	4.15	1.09	647.40	39.17	128.50	815.07	4643.18	5668.05
10	4.17	1.11	650.68	39.83	127.32	817.83	3828.11	5667.96
9	0.00	0.00	0.00	0.00	334.48	334.48	3010.28	5667.88
8	0.00	0.00	0.00	0.00	334.48	334.48	2675.80	5667.80
7	0.00	0.00	0.00	0.00	334.48	334.48	2341.33	5667.71
6	0.00	0.00	0.00	0.00	334.48	334.48	2006.85	5667.63
5	0.00	0.00	0.00	0.00	334.48	334.48	1672.38	5667.55
4	0.00	0.00	0.00	0.00	334.48	334.48	1337.90	5667.46
3	0.00	0.00	0.00	0.00	334.48	334.48	1003.43	5667.38
2	0.00	0.00	0.00	0.00	334.48	334.48	668.95	5667.30
1	0.00	0.00	0.00	0.00	334.48	334.48	334.48	5667.21



The area shown in green is the area tributary to the detention system.


ARAPAHOE COUNTY
Proposed Site
S LEWISTON WAY
S PARKER RD
E ARAPAHOE RD
S JORDAN RD
E BRIARWOOD AVE
CENTENNIAL
Cherry Creek Soccer Complex
AURORA
S LEWISTON WAY
FOXFIELD
E FREMONT AVE
Centennial 10,000 Foot Critical Zone