RICK
ENGINEERING COMPANY

November 10, 2023

Town of Parker
20120 E. Mainstreet
Parker, Colorado 80138

SUBJECT: SUPPLEMENTAL DRAINAGE MEMO FOR DUNKIN' DONUTS - CHAMBERS AND HESS FILING NO. 1 LOT 4 (RICK ENGINEERING COMPANY JOB NUMBER D-02243)

To Whom It May Concern:

This memorandum has been prepared to supplement the already approved Final Drainage Report for Chambers and Hess Filing No. 1, herein referred to as the "Final Drainage Report (FDR)". This memo has been prepared in support of the on-site drainage analyses/configurations for Lot 4 of Filing No.1 in particular.

Project Description:

The Chambers and Hess Filing No. 1 Lot 4 (herein referred to as the "project"), is within the Town of Parker, Douglas County, Colorado. The project is located towards the southwest corner of Chambers and Hess Filing No. 1. The project is bounded by Lot 3 to the North, Lot 5 to the South, Sliceroo Drive to the East, and South Chambers Road to the West. The project involves the development of a Dunkin' Donuts in Lot 4 of Filing No.1. Drainage analysis of the overall Filing No.1 was presented to the Town of Parker and was already approved under the report titled "Final Drainage Report for Chambers and Hess Filing No.1," last revised January 25, 2021, prepared by Rick Engineering Company (Rick JN D-1173). It addressed the overall drainage characteristics of the development including hydrology and hydraulics. However, the FDR referenced/referred to the drainage report titled, "Final Drainage Report for The Douglas 234 Subdivision", last revised April 29, 2003, prepared by CVL Consultants (herein referred to as the "Original Drainage Study") for detention. The following narrative addresses drainage characteristics specifically for Lot 4 while referring to the Original Drainage Study for detention.

Drainage Characteristics:

The site layout of Dunkin' Donuts – Lot 4 maintains similar drainage characteristics to the FDR. However, the current design proposes grading changes to accommodate the proposed lot configuration for Dunkin' Donuts. In the post-project condition, the project area is encompassed by three (3) sub-basins, A4-1, A4-2, and A4-3. Together these three (3) sub-basins make Basin A4 of the FDR. The hydrology and hydraulics calculations pertaining to Basin A4 were performed assuming the ultimate build out condition in the FDR. Please refer to Map Pocket 1 for the approved Post-Project Drainage Study Map from the FDR provided for reference purposes only.

The overall drainage area and land use per the current proposed design remain consistent with the previously approved values (percent imperviousness, acreage, etc.) in the FDR. The assumed imperviousness for Basin A4 in the FDR was 75%, and the calculated imperviousness for Basin A4 with this study is 67%. Delineation to all the proposed design points have been performed and the relevant hydrology calculations are included in Appendix A. Rational method calculations were performed using the latest Mile High Flood District's (MHFD) rational method spreadsheet (UD-Rational v2.0). Please refer to Map Pocket 2 at the end of this letter for the Post-Project Drainage Study Map.

Street capacity and inlet sizing calculations for the proposed streets and inlets have also been performed and included in Appendix B using MHFD's inlet sizing spreadsheet (UD-Inlet v5.01). The proposed storm drains for Lot 4 will tie into the existing Filing No.1 storm drain system, as previously approved. The proposed storm drains have been designed using the Hydraflow Storm Sewers Extension for AutoCAD Civil3D (v10.3). Hydraulic Grade Line (HGL) elevations at the point of connection to the existing storm drain system from the FDR were used as the starting Water Surface Elevation (WSEL) for the proposed storm drains.

The Original Drainage Study addresses detention and water quality for the entire Filing No.1 including Lot 4 assuming ultimate build out condition. Detention calculation excerpts for the existing Extended Detention Pond A from the approved Original Drainage Study have been included in Appendix C for reference purposes.

Conclusion:

This memo has been prepared in support of the proposed drainage configuration of the project and has been provided to show that project is consistent with what was assumed in the FDR. All design and calculations were performed consistent with the approved drainage design criteria and design standards discusses in the FDR. Storm water runoff from the project will be released at rates no greater than the previously assumed flow rates from the FDR and adverse impacts to the downstream drainage facilities are not anticipated.

Please refer to Appendix A for Hydrologic calculations. Hydraulic calculations are included in Appendix B. Detention calculation excerpts for the existing Extended Detention Pond A from the approved Original Drainage Study have been included in Appendix C for reference purposes. Post-project drainage map from the FDR has been provided in Map Pocket 1 for reference purposes. Post-project drainage map for Lot 4 of Filing No. 1 has been provided in Map Pocket 2.

Please feel free to contact me if you have any questions and/or concerns at (303) 537-8020.

Sincerely,

RICK ENGINEERING COMPANY

Troy Bales, P.E.
Associate

Enclosures

TB:ASH:vs/D0200/Report/D-2243.001

Certification

This report for the final design of Chambers and Hess Filing No. 1 Lot 4 was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for the drainage facilities designed by others.

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Troy Bales
Registered Professional Engineer
Date:

State of Colorado No.: 50961

APPENDIX A

Hydrologic Computations

Calculation of Peak Runoff using Rational Method

Designer: ASH
Company: Rick Engineering
Date: 11/1/2023
Project: Dunkin Donuts - Chambers & Hess Lot 4
Location: Town of Parker

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

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

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

$$\text{Computed } t_c = t_i + t_t$$

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

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

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

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) =		1.39				2.60	

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	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: 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A4-1	0.30	C	75.0	0.60	0.65	0.68	0.74	0.76	0.79	0.82
A4-2	0.43	C	86.0	0.70	0.74	0.76	0.80	0.82	0.84	0.86
A4-3	0.04	C	5.0	0.03	0.08	0.17	0.35	0.42	0.50	0.60

Subcatchment Name	Overland (Initial) Flow Time: 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 (Travel) Flow Time: 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)
A4-1	40.00	6080.00	6077.00	0.075	2.66	265.00	6077.00	6074.00	0.011	20	2.13	2.08
A4-2	40.00	6080.00	6077.00	0.075	2.14	280.00	6077.00	6071.00	0.021	20	2.93	1.59
A4-3	23.00	6078.20	6077.00	0.052	5.14	10.00	6077.00	6075.20	0.180	15	6.36	0.03

Subcatchment Name	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Rainfall Intensity, I (in/hr): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Peak Flow, Q (cfs): 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
A4-1	4.7	15.4	5.0		4.7				8.8			0.9				2.1	
A4-2	3.7	12.9	5.0		4.7				8.8			1.5				3.2	
A4-3	5.2	25.2	10.0		3.8				7.0			0.0				0.1	

APPENDIX B

Hydraulic Computations

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A4-1	A4-2	A4-3
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	AREA
Hydraulic Condition	On Grade	On Grade	Swale
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type C

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.9	1.4	0.0
Major Q_{Known} (cfs)	2.1	3.1	0.1

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	A4-1	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.2	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

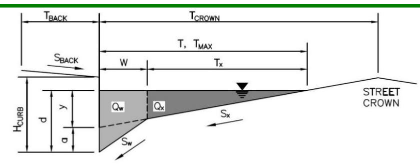
Minor Total Design Peak Flow, Q (cfs)	**0.9**	**1.4**	**0.0**
Major Total Design Peak Flow, Q (cfs)	**2.1**	**3.3**	**0.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.2	0.0	0.0

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Dunkin Donuts - Chambers & Hess Lot 4

Inlet ID: A4-1



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.050		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.5	14.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	8.70	8.70	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.79	0.79	inches
Water Depth at Gutter Flowline	d =	9.49	9.49	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	12.5	12.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.345	0.345	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	28.3	28.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	14.9	14.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**43.2**	**43.2**	**cfs**
Flow Velocity within the Gutter Section	V =	10.5	10.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	8.3	8.3	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	8.7	8.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	6.7	6.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.538	0.538	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	5.3	5.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	5.3	5.3	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	6.2	6.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.5	11.5	cfs
Average Flow Velocity Within the Gutter Section	V =	7.4	7.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.7	3.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6$") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.5**	**11.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	6.01	6.01	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

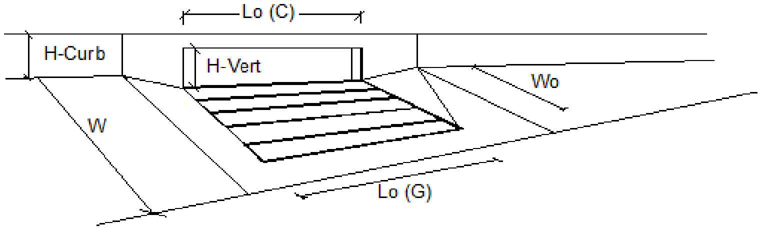
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.5**	**11.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



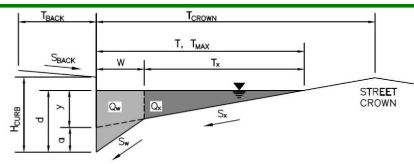
			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)		Q_o =	0.9	2.1	cfs
Water Spread Width		T =	2.8	4.3	ft
Water Depth at Flowline (outside of local depression)		d =	2.5	3.4	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.980	0.863	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	0.0	0.3	cfs
Discharge within the Gutter Section W		Q_w =	0.9	1.8	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.25	0.39	sq ft
Velocity within the Gutter Section W		V_W =	3.6	4.6	fps
Water Depth for Design Condition		d_{LOCAL} =	5.5	6.4	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.205	0.186	ft/ft
Required Length L_T to Have 100% Interception		L_T =	3.99	6.43	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	3.99	5.00	ft
Interception Capacity		Q_i =	0.9	2.0	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.10	0.10	
Effective (Unclogged) Length		L_e =	4.50	4.50	ft
Actual Interception Capacity		**Q_a =**	**0.9**	**1.9**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**0.2**	**cfs**
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**0.9**	**1.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**89**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Dunkin Donuts - Chambers & Hess Lot 4

Inlet ID: A4-2



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =			ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.5		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.030		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.050		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.5	26.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	9.54	9.54	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.27	1.27	inches
Water Depth at Gutter Flowline	d =	10.81	10.81	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	24.5	24.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.207	0.207	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	141.3	141.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	36.8	36.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**178.1**	**178.1**	**cfs**
Flow Velocity within the Gutter Section	V =	22.5	22.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	20.3	20.3	

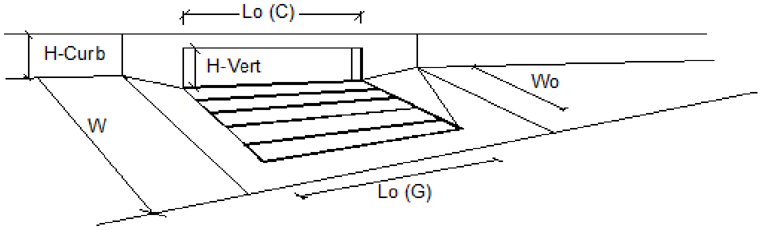
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	13.1	13.1	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	11.1	11.1	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.411	0.411	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	17.2	17.2	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	17.2	17.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	12.0	12.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	29.3	29.3	cfs
Average Flow Velocity Within the Gutter Section	V =	14.4	14.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	7.2	7.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.49	0.49	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.5**	**14.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.81	4.81	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.5**	**14.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

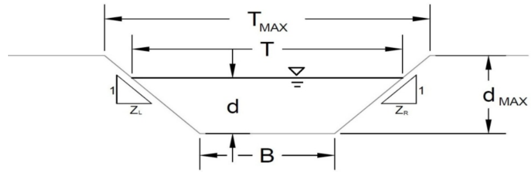


Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.4	3.3	cfs
Water Spread Width	T =	2.3	5.0	ft
Water Depth at Flowline (outside of local depression)	d =	2.1	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.002	0.852	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.5	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.18	0.34	sq ft
Velocity within the Gutter Section W	V_W =	7.6	8.3	fps
Water Depth for Design Condition	d_{LOCAL} =	5.1	6.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.208	0.181	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.76	9.56	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.76	9.56	ft
Interception Capacity	Q_i =	1.4	3.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**1.4**	**3.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**3.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

AREA INLET IN A SWALE

Dunkin Donuts - Chambers & Hess Lot 4

A4-3



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =	C	
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	see details below	
Channel Invert Slope	S_O =	0.0240	ft/ft
Bottom Width	B =	0.00	ft
Left Side Slope	Z1 =	5.40	ft/ft
Right Side Sloe	Z2 =	10.80	ft/ft

Check one of the following soil types:

Soil Type:	Max. Velocity (V_{MAX})	Max Froude No. (F_{MAX})
Non-Cohesive	5.0 fps	0.60
Cohesive	7.0 fps	0.80
Paved	N/A	N/A

Choose One:
- Non-Cohesive
- Cohesive (selected)
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	5.00	10.00	ft
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.25	0.70	ft

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	0.1	0.8	cfs
MAJOR STORM Allowable Capacity is based on Top Width Criterion	d_{allow} =	0.25	0.62	ft

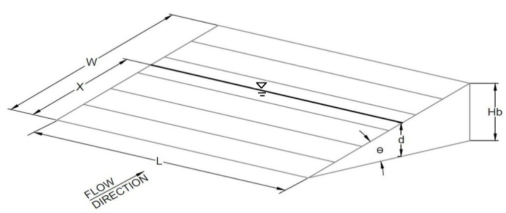
Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	0.0	0.1	cfs
Water Depth	d =	0.02	0.29	ft

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

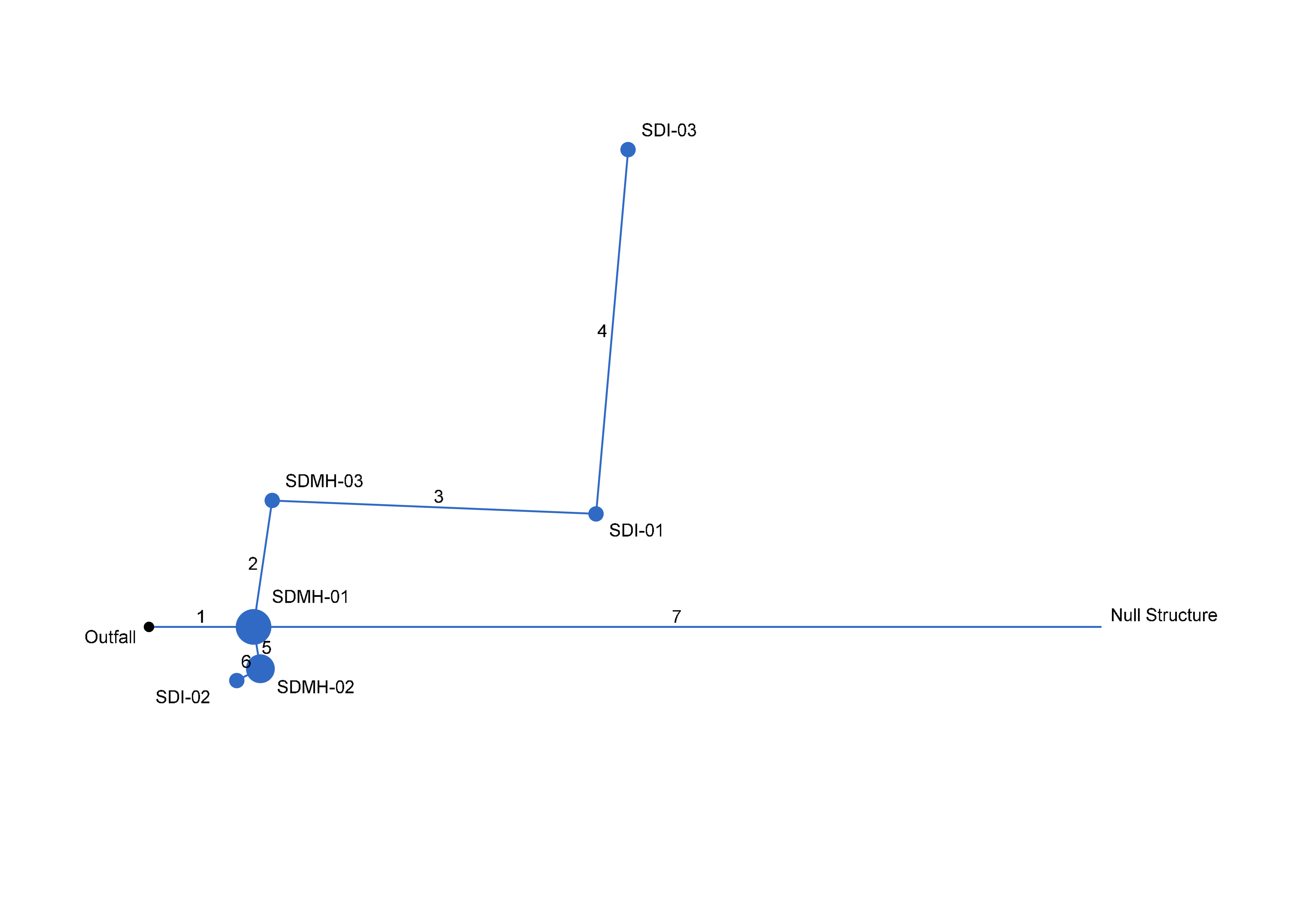
Inlet Design Information (Input)

Type of Inlet	CDOT Type C	Inlet Type =	CDOT Type C	
Angle of Inclined Grate (must be <= 30 degrees)		θ =	0.00	degrees
Width of Grate		W =	3.00	ft
Length of Grate		L =	3.00	ft
Open Area Ratio		A_{RATIO} =	0.70	
Height of Inclined Grate		H_B =	0.00	ft
Clogging Factor		C_f =	0.50	
Grate Discharge Coefficient		C_d =	0.96	
Orifice Coefficient		C_o =	0.64	
Weir Coefficient		C_w =	2.05	



		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	0.02	0.29	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	0.0	2.9	cfs
Bypassed Flow	Q_b =	0.0	0.0	cfs
Capture Percentage = Qa/Qo	C% =	100	100	%

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: New.stm	Number of lines: 7	Date: 11/3/2023

MyReport

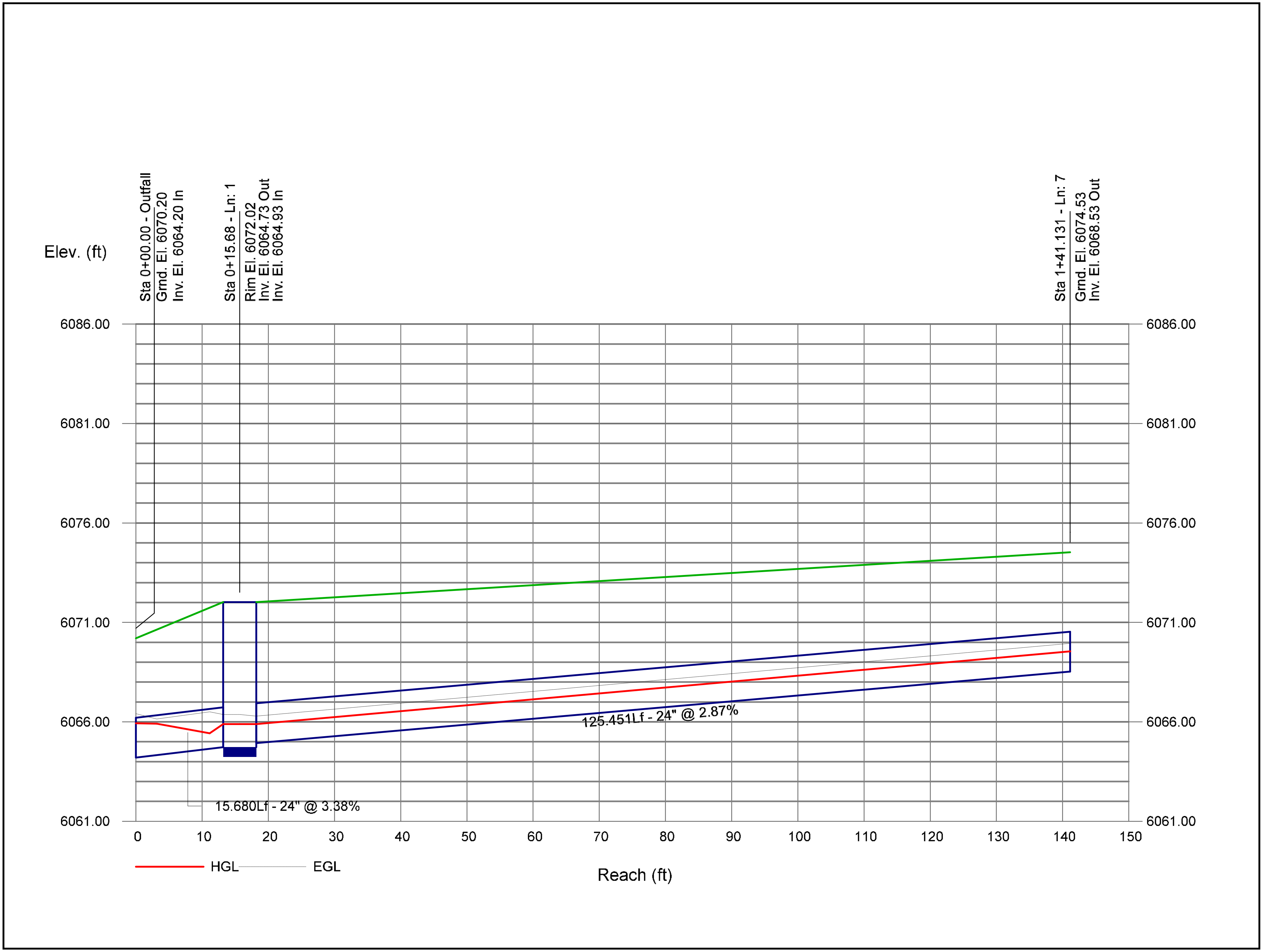
Line No.	Line ID	Known Q (cfs)	Line Size (in)	Line Length (ft)	Line Slope (%)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Gnd/Rim El Dn (ft)	Flow Rate (cfs)	Capac Full (cfs)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	Vel Ave (ft/s)	Vel Up (ft/s)	Vel Dn (ft/s)	J-Loss Coeff	
1	EX P8	0.00	24	15.680	3.38	6064.73	6064.20	6072.02	0.00	10.51	41.57	6065.89 j	6065.93	6066.37	6066.41	4.60	5.56	3.64	0.99 z	
2	P3	0.00	18	18.758	5.00	6066.37	6065.43	6073.21	6072.02	0.91	23.48	6066.73 j	6065.89	6066.85	6066.02	2.41	2.84	1.99	1.00 z	
3	P2	0.90	18	48.177	4.01	6068.50	6066.57	6074.44	6073.21	0.91	21.02	6068.86	6066.78	6068.98	6066.91	4.39	2.84	5.93	1.50 z	
4	P1	0.01	18	54.572	3.99	6070.88	6068.70	6075.00	6074.44	0.01	20.99	6070.92 j	6068.86	6070.93	6068.87	0.49	0.88	0.10	1.00 z	
5	P4	0.00	18	6.377	10.01	6065.87	6065.23	6071.45	6072.02	1.50	33.22	6066.33 j	6065.89	6066.49	6066.06	2.64	3.27	2.00	0.96 z	
6	P5	1.50	18	3.991	10.03	6066.47	6066.07	6071.70	6071.45	1.50	33.26	6066.93	6066.33	6067.10	6066.49	5.35	3.27	7.43	1.00 z	
7	EX P7	8.10	24	125.451	2.87	6068.53	6064.93	0.00	6072.02	8.10	38.31	6069.54	6065.89	6069.94	6066.29	5.25	5.07	5.43	1.00 z	

Project File: 2243_5year.stm	Number of lines: 7	Date: 11/3/2023

NOTES: ** Critical depth

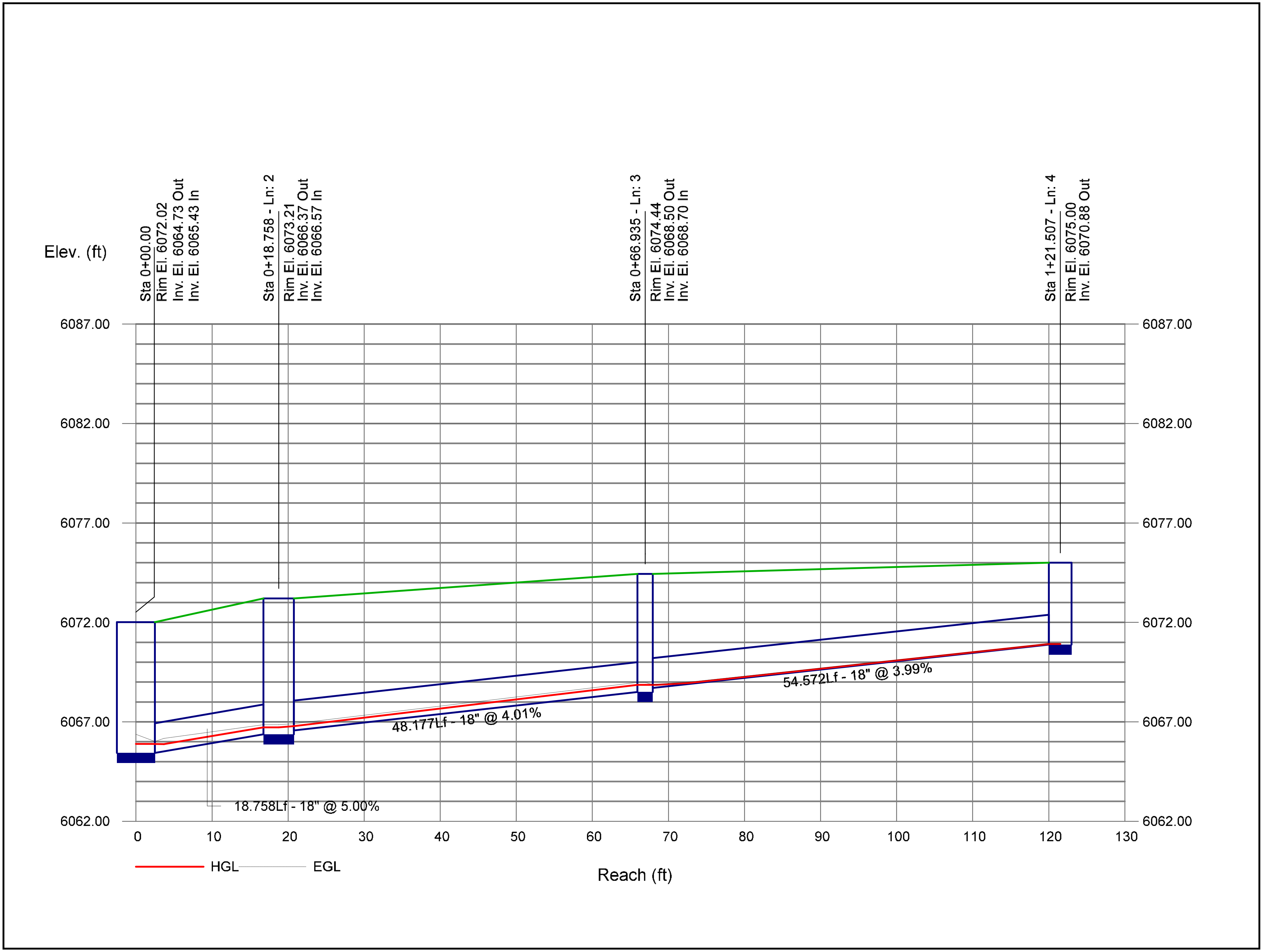
Storm Sewer Profile

Proj. file: 2243_5year.stm



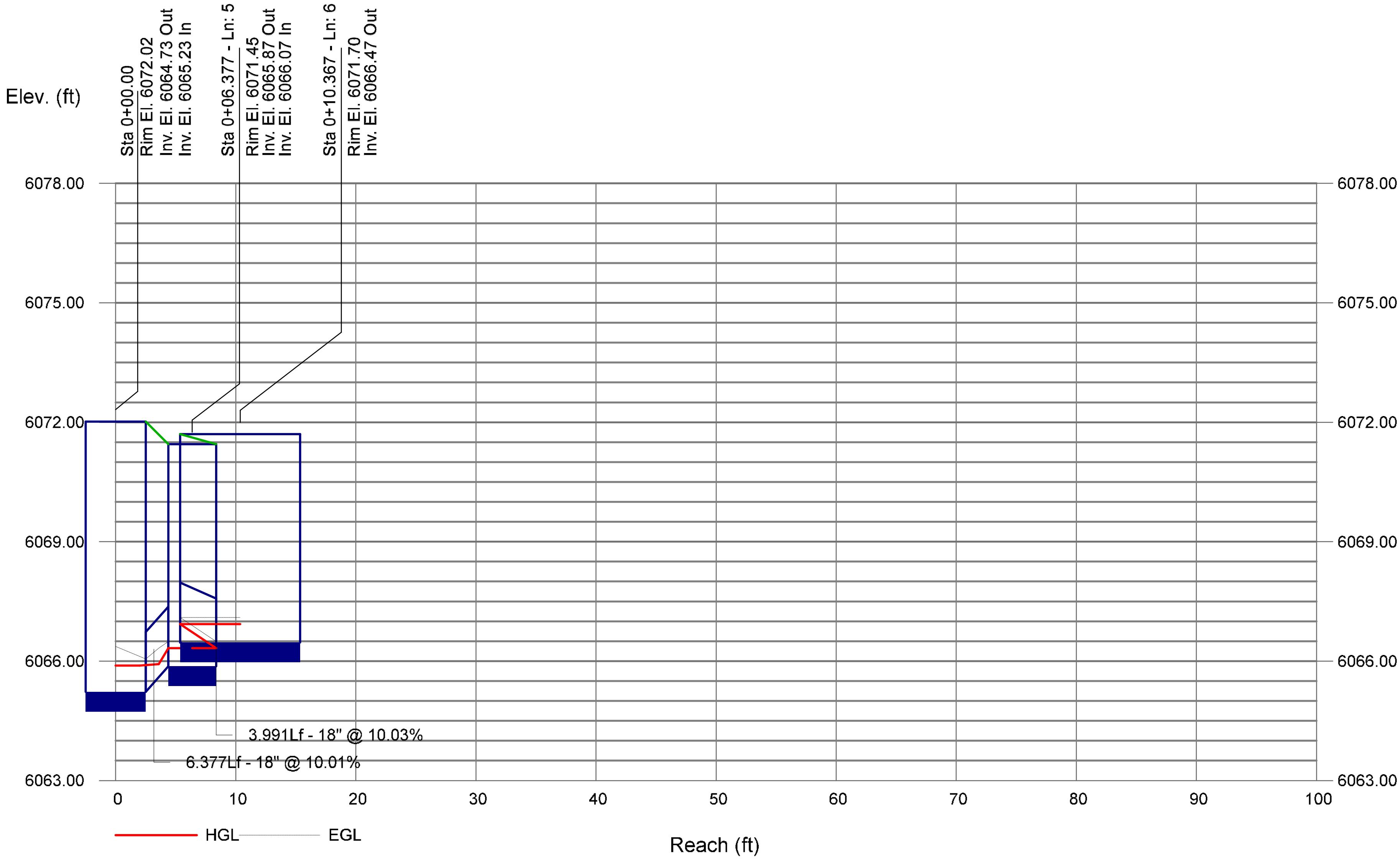
Storm Sewer Profile

Proj. file: 2243_5year.stm



Storm Sewer Profile

Proj. file: 2243_5year.stm



MyReport

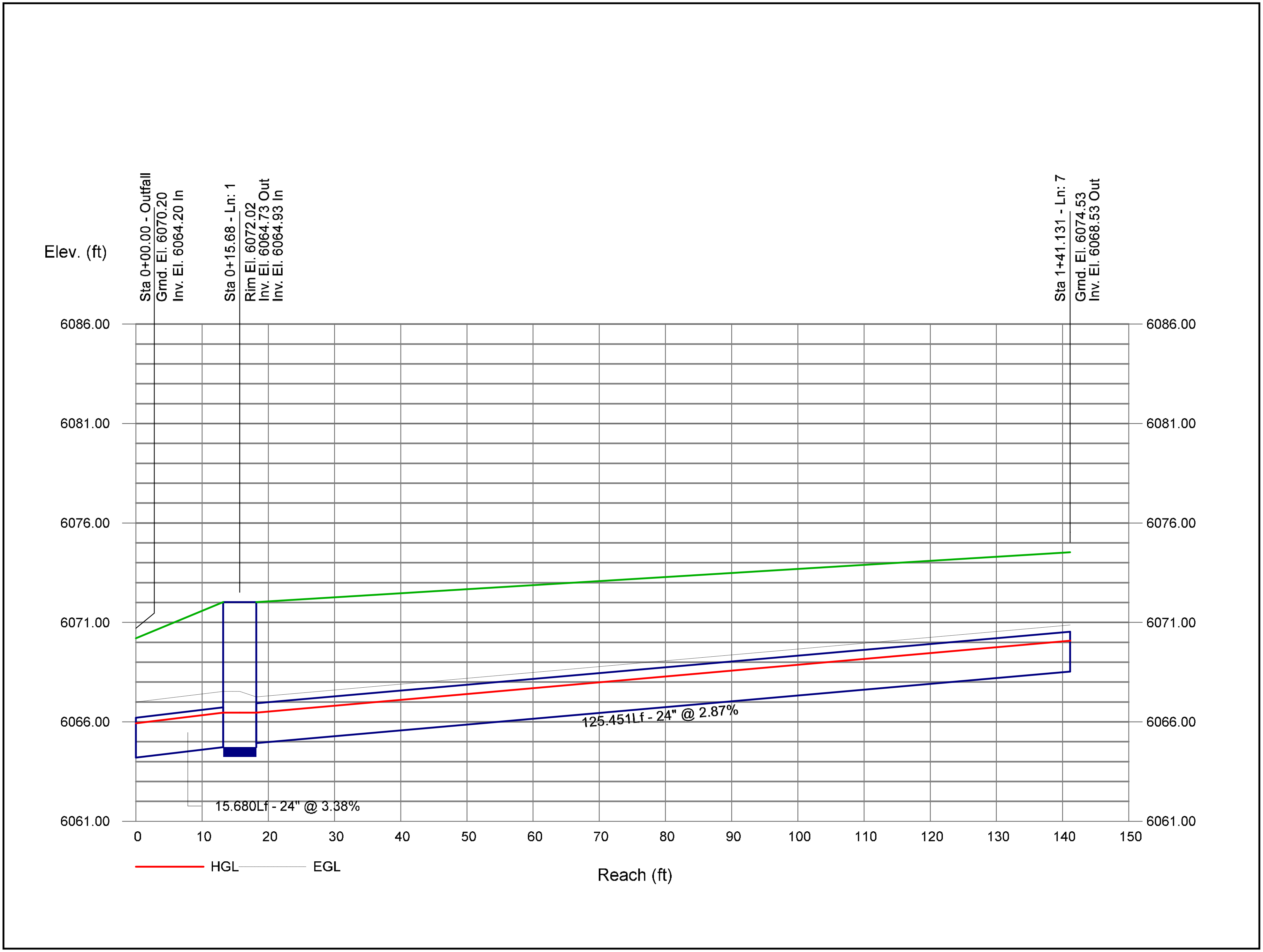
Line No.	Line ID	Known Q (cfs)	Line Size (in)	Line Length (ft)	Line Slope (%)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Gnd/Rim El Dn (ft)	Flow Rate (cfs)	Capac Full (cfs)	HGL Up (ft)	HGL Dn (ft)	EGL Up (ft)	EGL Dn (ft)	Vel Ave (ft/s)	Vel Up (ft/s)	Vel Dn (ft/s)	J-Loss Coeff
1	EX P8	0.00	24	15.680	3.38	6064.73	6064.20	6072.02	0.00	24.00	41.57	6066.46	6065.93	6067.53	6067.00	8.29	8.29	8.29	0.99 z
2	P3	0.00	18	18.758	5.00	6066.37	6065.43	6073.21	6072.02	2.20	23.48	6066.93 j	6066.46	6067.14	6066.67	2.68	3.66	1.70	1.00 z
3	P2	2.10	18	48.177	4.01	6068.50	6066.57	6074.44	6073.21	2.20	21.02	6069.06	6066.93	6069.27	6067.14	5.20	3.66	6.75	1.50 z
4	P1	0.10	18	54.572	3.99	6070.88	6068.70	6075.00	6074.44	0.10	20.99	6071.00 j	6069.06	6071.04	6069.10	0.95	1.59	0.31	1.00 z
5	P4	0.00	18	6.377	10.00	6065.87	6065.23	6071.45	6072.02	3.20	33.21	6066.55	6066.46	6066.81	6066.73	3.08	4.10	2.06	0.96 z
6	P5	3.20	18	3.991	10.03	6066.47	6066.07	6071.70	6071.45	3.20	33.26	6067.15	6066.55	6067.41	6066.81	5.35	4.10	6.59	1.00 z
7	EX P7	18.60	24	125.451	2.87	6068.53	6064.93	0.00	6072.02	18.60	38.31	6070.08	6066.46	6070.87	6067.25	7.15	7.11	7.20	1.00 z

Project File: New.stm | Number of lines: 7 | Date: 11/3/2023

NOTES: ** Critical depth

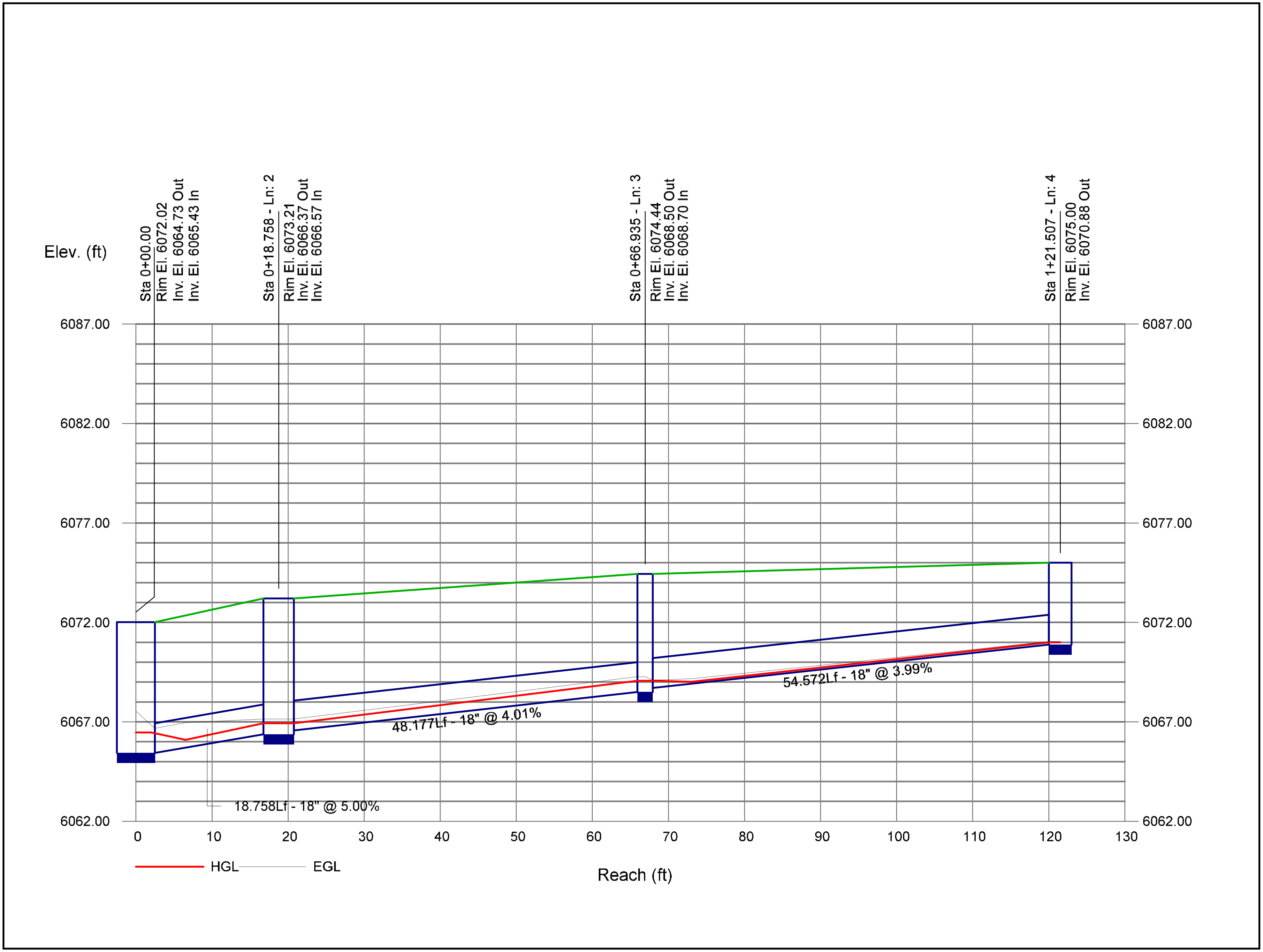
Storm Sewer Profile

Proj. file: 2243_100year.stm



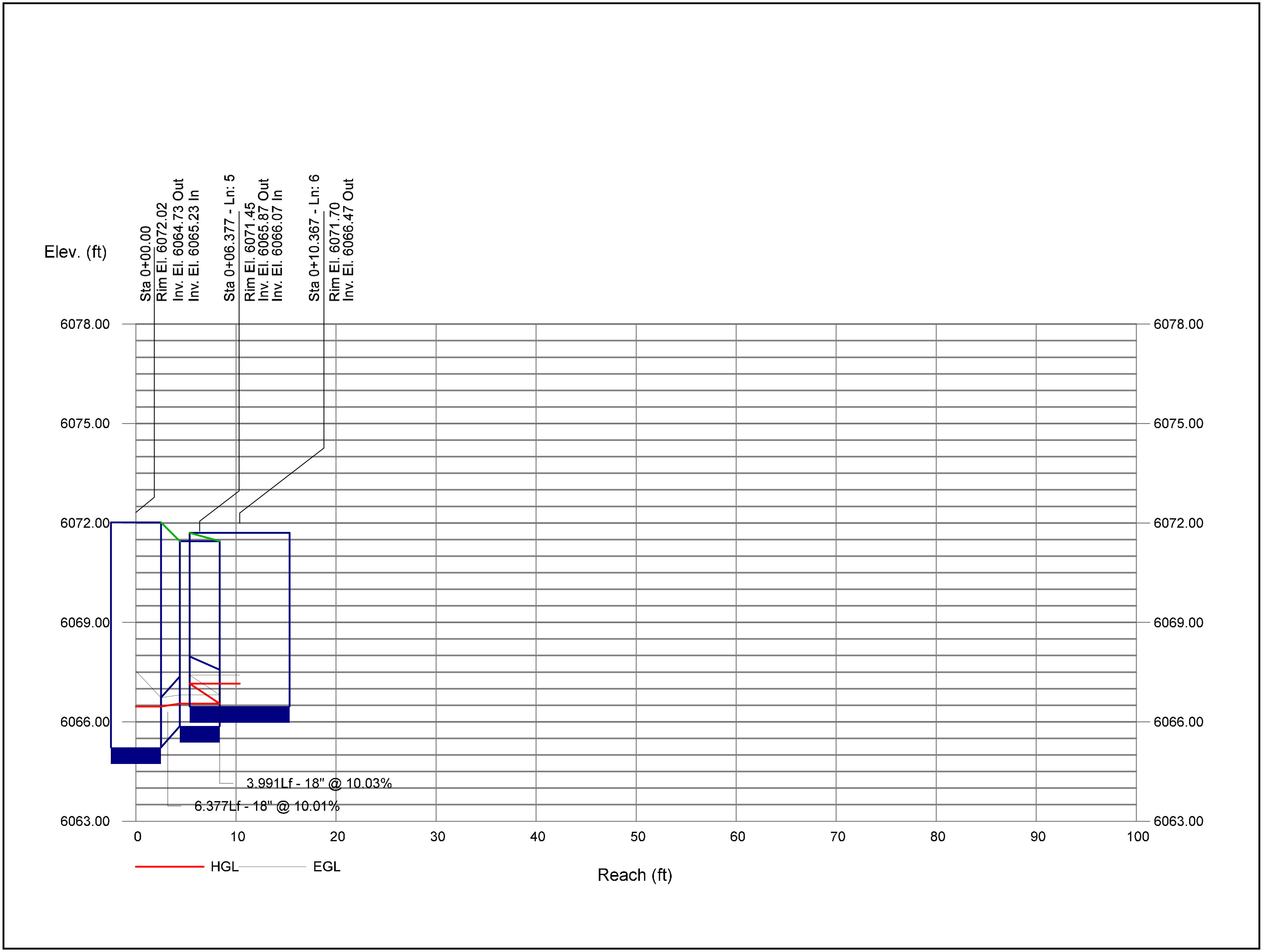
Storm Sewer Profile

Proj. file: 2243_100year.stm



Storm Sewer Profile

Proj. file: 2243_100year.stm



APPENDIX C

FOR REFERENCE ONLY

Detention calculation excerpts for the existing Extended Detention Pond A from the approved Original Drainage Study storm event flow. Emergency overflow spillways are designed for each of the ponds. They are sized to pass the developed 100-year flow, with one foot (1') of freeboard.

The developed site can be divided into four (4) major basins, being Basins A, B, C and D. Each of these major basins contains a proposed water quality/ detention pond area.

Basin A

Basin A is comprised of most of the eastern portion of the project, including the proposed commercial site, and contributes runoff to Pond A. The proposed detention pond for Basin A serves both the residential and commercial portions of the filing. This facility is located in the northeasterly corner of the site, adjacent to and immediately west of the southerly extension of Jordan Rd. Pond A will discharge easterly, under Jordan Road, to the existing drainageway to Cherry Creek. Basin A is subdivided into thirteen sub-basins, and generally corresponds to historic basins C-3, C-4, C-5 and a portion of historic basin C-2. Runoff within Basin A flows overland to the internal storm drainage system, and ultimately in Pond A.

Pond A is located in Tract F. Storm water will be directed to this pond via overland flow and Storm Drain Lines B and W. The pond is sized to hold the required volume for 100-year detention and water quality per the Town of Parker and UDFCD requirements. This needed 100 year volume is 4.38 Ac. Ft. The water quality volume required is 1.07 Ac.ft. The total volume, including 100-year detention and WQCV, is accumulated by elevation 5992.1. The weir structure will have a top elevation at 5995.0 and a bottom equal to the 100-year water surface elevation, 5991.2. A 1.61' diameter orifice plate will be installed on the outlet pipe to control to pond's allowable release rate, 37.76 cfs. The 10-year allowable release 10.22 cfs, will be controlled by a rectangular notch weir, cut into the face of the outlet box structure. Storm events that exceed the volume provided in Pond A will be routed through the pond by the emergency overflow spillway. Both pond exits, the spillway and the storm drain, will be protected by riprap.

During initial and interim construction phases, Pond A will have a temporary riser pipe, rather than the permanent outlet structure to allow it to function as a sediment control pond. Also, the spillway will not be cut out of the earth berm that surrounds the pond, so that the pond can have additional volume, which may be needed during the construction operations that typically produce additional sediment. During the final stages of construction, the pond will be modified to include the earth-weir. The perforated outlet pipe will be replaced by the concrete outlet structure.

Basin B

Basin B includes the north-central portion of the project, and directs runoff to detention Pond B. This facility is located adjacent to and immediately southwesterly of the proposed alignment of Chambers Road. Discharge of the computed release rate from Pond B will travel under Chambers Road via a 30' RCP (Storm Drain Line U), into the existing natural drainage-way at that location. The Antelope Heights project, immediately downstream from this discharge point, is coordinating engineering design to accommodate this historic runoff rate. Eventually, this pipe will be connected to the

CVL CONSULTANTS, INC.
CIVIL ENGINEERING
LAND SURVEYING
LAND PLANNING

Project Name/Number Parker 234 / 01804102
Date: 2-3-03
Sheet 2 of 5

Telephone Log ☐
Meeting Record ☐
Calculations ☒
Other ☐

POND A

Area = 44.42 Ac.

# of homes = 126 avg. sq. footage = 1660 ft², 2 story

Area (park) = 1.88 Ac.

Area (lots) = 18.01 Ac.

Area (roads) = 8.96 Ac.

Area (open space) = 3.12 Ac.

Area (commercial) = 12.45 Ac.

126/1.88 = 7.00 dwellings/Ac. → 36% impervious per RO-5

$$\frac{1.88(5\%) + 18.01(36\%) + 8.96(100\%) + 3.12(0\%) + 12.45(95\%)}{44.42 Ac.}$$

= 61.6%

7901 E. BELLEVIEW AVE., STE 150 • ENGLEWOOD, CO 80111 • TEL. (720) 482-9526 FAX (720) 482-9546

DETENTION REQUIREMENTS - ONSITE BASINS

Subdivision: Douglas 234
Location: Parker

Project Name: Douglas 234
Project No. 1804102
By: MEF
Checked By: KAL
Date: 03/31/03

SOIL GROUPS B/C

Q10R= 0.23
Q100R= 0.85

Note: Allowable release rates for type C soil groups is greater than type B soils, however, rates for type B soil was used for conservatism.

BASIN/LAND USE	DRAINAGE AREA (AC.)	% IMPERV.	V_{10} (AC. FT.)	V_{100} (AC. FT.)	Q_{10R} (CFS)	Q_{100R} (CFS)
Basin A	44.42	62	2.515	4.375	10.22	37.76
Basin B	59.88	54	2.958	5.193	13.77	50.90
Basin C	8.82	24	0.184	0.335	2.03	7.50
Basin D	34.41	26	0.785	1.423	7.91	29.25
SUM			6.442	11.327	33.9	125.4

DETENTION PONDING FORMULAS:

$V_{100} = K_{100} \times A$ $K_{100} = (1.78I-0.002I^2-3.56)/1000$

$V_{10} = K_{10} \times A$ $K_{10} = (0.95I-1.90)/1000$

$Q_{100R} = Q100R \times A$

$Q_{10R} = Q10R \times A$

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer:	MEF
Company:	CVL Consultants
Date:	March 31, 2003
Project:	Parker 234
Location:	Pond A

1. Basin Storage Volume	
A) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	I_a = 61.60 % i = 0.62
B) Contributing Watershed Area (Area)	Area = 44.42 acres
C) Water Quality Capture Volume (WQCV) ($WQCV = 1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$)	WQCV = 0.24 watershed inches
D) Design Volume: Vol = (WQCV / 12) * Area * 1.2	Vol = 1.073 acre-feet
2. Outlet Works	
A) Outlet Type (Check One)	X Orifice Plate __ Perforated Riser Pipe __ Other:
B) Depth at Outlet Above Lowest Perforation (H)	H = 5.57 feet
C) Required Maximum Outlet Area per Row, (A_o)	A_o = 0.59 square inches
D) Perforation Dimensions **(enter one only)**: i) Circular Perforation Diameter **OR** ii) 2" Height Rectangular Perforation Width	D = 0.500 inches, **OR** W = __ inches
E) Number of Columns (nc, See Table 6a-1 For Maximum)	nc = 3 number
F) Actual Design Outlet Area per Row (A_o)	A_o = 0.59 square inches
G) Number of Rows (nr)	nr = 17 number
H) Total Outlet Area (A_{ot})	A_{ot} = 9.84 square inches
3. Trash Rack	
A) Needed Open Area: $A_t = 0.5 * (\text{Figure 7 Value}) * A_{ot}$	A_t = 356 square inches
B) Type of Outlet Opening (Check One)	X ≤ 2" Diameter **Round** __ 2" High **Rectangular** __ Other:
C) For 2", or Smaller, **Round Opening** (Ref.: Figure 6a):	
i) Width of Trash Rack and Concrete Opening (W_{conc}) from Table 6a-1	W_{conc} = 9 inches
ii) Height of Trash Rack Screen (H_{TR})	H_{TR} = 97 inches

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer:	MEF
Company:	CVL Consultants
Date:	March 31, 2003
Project:	Parker 234
Location:	Pond A

iii) Type of Screen (Based on Depth H), Describe if "Other"	x S.S. #93 VEE Wire (US Filter) Other:
iv) Screen Opening Slot Dimension, Describe if "Other"	X 0.139" (US Filter) Other:
v) Spacing of Support Rod (O.C.) Type and Size of Support Rod (Ref.: Table 6a-2)	0.75 inches #156 VEE
vi) Type and Size of Holding Frame (Ref.: Table 6a-2)	3/8 in. x 1.0 in. flat bar
D) For 2" High **Rectangular Opening** (Refer to Figure 6b):	
i) Width of Rectangular Opening (W)	W = inches
ii) Width of Perforated Plate Opening (W_{conc} = W + 12")	W_{conc} = inches
iii) Width of Trashrack Opening ($W_{opening}$) from Table 6b-1	$W_{opening}$ = inches
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = inches
v) Type of Screen (based on depth H) (Describe if "Other")	Klemp™ KPP Series Aluminum Other:
vi) Cross-bar Spacing (Based on Table 6b-1, Klemp™ KPP Grating). Describe if "Other"	inches Other:
vii) Minimum Bearing Bar Size (Klemp™ Series, Table 6b-2) (Based on depth of WQCV surcharge)	
4. Detention Basin length to width ratio	2.00 (L/W)
5 Pre-sedimentation Forebay Basin - Enter design values	
A) Volume (no less than 5% of Design Volume from 1D)	0.067 acre-feet
B) Surface Area	0.053 acres
C) Connector Pipe Diameter (Size to drain this volume in 5-minutes under inlet control)	6 inches
D) Paved/Hard Bottom and Sides	y yes/no

Design Procedure Form: Extended Detention Basin (EDB) - Sedimentation Facility

Designer:	MEF
Company:	CVL Consultants
Date:	March 31, 2003
Project:	Parker 234
Location:	Pond A

6. Two-Stage Design - See Figure EDB-1	
A) Top Stage (Depth D_{WQ} = 2' Minimum)	D_{WQ} = 5.00 feet Storage= 1.570 acre-feet
B) Bottom Stage Depth (D_{BS} = 1.0' Minimum, 2.0' Maximum) Bottom Stage Storage (no less than 3% of Design Volume (0.0322003087988736 acre-fe	D_{BS} = 1.50 feet Storage= 0.082 acre-feet Surf. Area= 0.055 acres
C) Micro Pool (Minimum Depth = the Larger of 0.5 * Top Stage Depth (2.5 ') or 2.5 '	Depth= 2.50 feet Storage= 0.048 acre-feet Surf. Area= 0.019 acres
D) Total Volume: Vol_{tot} = Storage from 5A + 6A + 6B (Must be > Design Volume in 1D, or 1.07334362662912 acre-feet.)	Vol_{tot} = 1.719 acre-feet
7. Basin Side Slopes (Z, horizontal distance per unit vertical) Minimum Z = 4, Flatter Preferred	Z = 4.00 (horizontal/vertical)
8. Dam Embankment Side Slopes (Z, horizontal distance) per unit vertical) Minimum Z = 3, Flatter Preferred	Z = 4.00 (horizontal/vertical)
9. Vegetation (Check the method or describe "Other")	____ Native Grass x Irrigated Turf Grass ____ Other:

Notes:

Pond Volume
(FAA Method)

Subdivision Douglas 234
Location Parker

Project Name: Douglas 234
Project No. 1804102
By: MEF
Checked By: KAL
Date: 3/31/03

Volume=1/3 x Depth x (A+B+(A*B)^0.5)
A - Upper Surface
B - Lower Surface

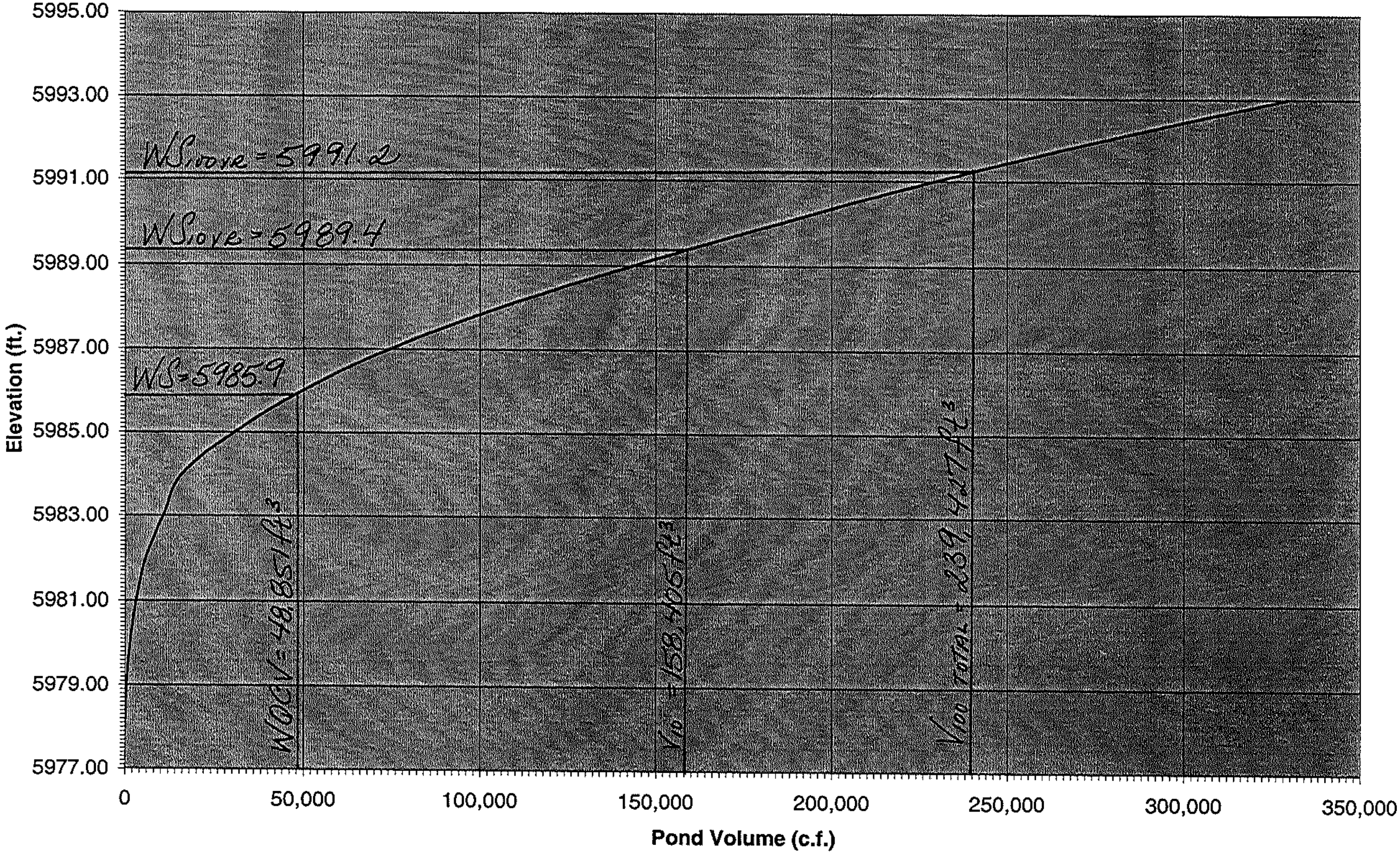
Pond A

Project drains to Pond A

Elevation	Surface Area (square feet)	A+B+(A*B)^0.5	1/3	Depth (feet)	Volume (cubic feet)	CumulativeVolume (cubic feet)
5978.00	579	579.0	193.0	0.00	0	0
5979.00	1,034	1034.0	344.7	1.00	345	345
5980.00	1,591	3129.8	1043.3	1.00	1,043	1,388
5980.50	1,907	4345.2	1448.4	0.50	724	2,112
5981.00	2,248	5730.2	1910.1	0.50	955	3,067
5982.00	3,005	7852.1	2617.4	1.00	2,617	5,685
5983.00	8,224	14771.7	4923.9	1.00	4,924	10,608
5984.00	12,604	15884.4	5294.8	1.00	5,295	15,903
5985.00	16,852	44030.0	14676.7	1.00	14,677	30,580
5986.00	21,585	57509.2	19169.7	1.00	19,170	49,750
5987.00	27,603	73597.2	24532.4	1.00	24,532	74,282
5988.00	35,789	94822.6	31607.5	1.00	31,608	105,890
5989.00	39,377	112706.2	37568.7	1.00	37,569	143,458
5990.00	42,820	123259.4	41086.5	1.00	41,086	184,545
5991.00	46,421	133825.2	44608.4	1.00	44,608	229,153
5992.00	50,185	144872.3	48290.8	1.00	48,291	277,444
5993.00	54,064	156337.4	52112.5	1.00	52,112	329,556

Project drains to Pond A

Pond A
Stage-Storage



Douglas 234-Pond A
Project No. 01804102
3/31/03
Drainage.xls

Emergency Spillway Weir Calculations

Project Name:	Douglas 23
Project No.	1804102
Calculated By:	MEF
Checked By:	KAL
Date:	4/21/2003

Weir Equation:

$Q = C*L*(H)^{3/2}$

$C_d =$ 3.37 (trapezoidal weirs)

Note: Weirs are designed to pass the developed 100yr. tributary flow.
(Refer to SF-3 form)

Pond A Emergency Spillway

Flow Rate $Q_{100yr.}$ =	**163.0 cfs**	
Top of Berm Elevation =	**5995.00 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**5994.00 feet**	
100 yr. Water Surface Elevation =	**5991.20 feet**	
Height (H)=	**2.80** feet	
Length (D) =	10.33 feet	

Project drains to Pond A

Pond B Emergency Spillway

Flow Rate $Q_{100yr.}$ =	**176.6 cfs**	
Top of Berm Elevation =	**6089.00 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**6088.00 feet**	
Bottom of Berm Elevation* =	**6086.00 feet**	**100 yr. W.S. Elevation = 6083.8 feet*
Height (H)=	**2.00** feet	
Length (D) =	18.54 feet	

Pond C Emergency Spillway

Flow Rate $Q_{100yr.}$ =	**30.1 cfs**	
Top of Berm Elevation =	**6120.00 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**6119.00 feet**	
100 yr. Water Surface Elevation =	**6118.50 feet**	
Height (H)=	**0.50** feet	
Length (D) =	25.29 feet	

Pond D Emergency Spillway

Flow Rate $Q_{100yr.}$ =	**80.0 cfs**	
Top of Berm Elevation =	**6050.50 feet**	**Freeboard = 1.00**
Emergency Spillway Elevation =	**6049.50 feet**	
100 yr. Water Surface Elevation =	**6048.50 feet**	
Height (H)=	**1.00** feet	
Length (D) =	23.77 feet	

10 year Orifice Design

Subdivision: Douglas 234
Location: Parker, CO

Project Name: Douglas 234
Project No. 1804102

Rectangular Sharp-crested Weir Equation

$$Q = CL^{1.02}H^{1.47}$$ C=3.10

	10 yr. W.S.	WQCV W. S.	Allowable $Q_{10yr.}$ (cfs)	H (ft)	L (ft)
Pond A	5989.4	5985.9	10.22	3.5	0.6
Pond B	6081.2	6076.6	13.77	4.6	0.5
Pond C	6118.0	6117.0	2.03	1.0	0.7
Pond D	6047.4	6045.8	7.91	1.6	1.3

Circular Orifice Sizing

Pond A

DATA:

Flow Rate ($Q_{100yr.}$) =	**37.76 cfs**
Water Surface Elevation =	**5991.20 feet**
Invert of Orifice =	**5977.84 feet**
Height of water surface = to invert of orifice (Y)	13.36 feet
Diameter of Orifice (D) =	1.61 feet
Height of water surface = to centroid of orifice (h)	13.36 feet
C_d =	0.65 for circular orifices
g =	32.20 ft/s^2

Project Name: Douglas 234
Project No. 1804102
Calculated By: MEF
Checked By: KAL
Date: 04/01/03

Orifice Equation:

$$Q = C_d*A*(2gh)^{1/2}$$

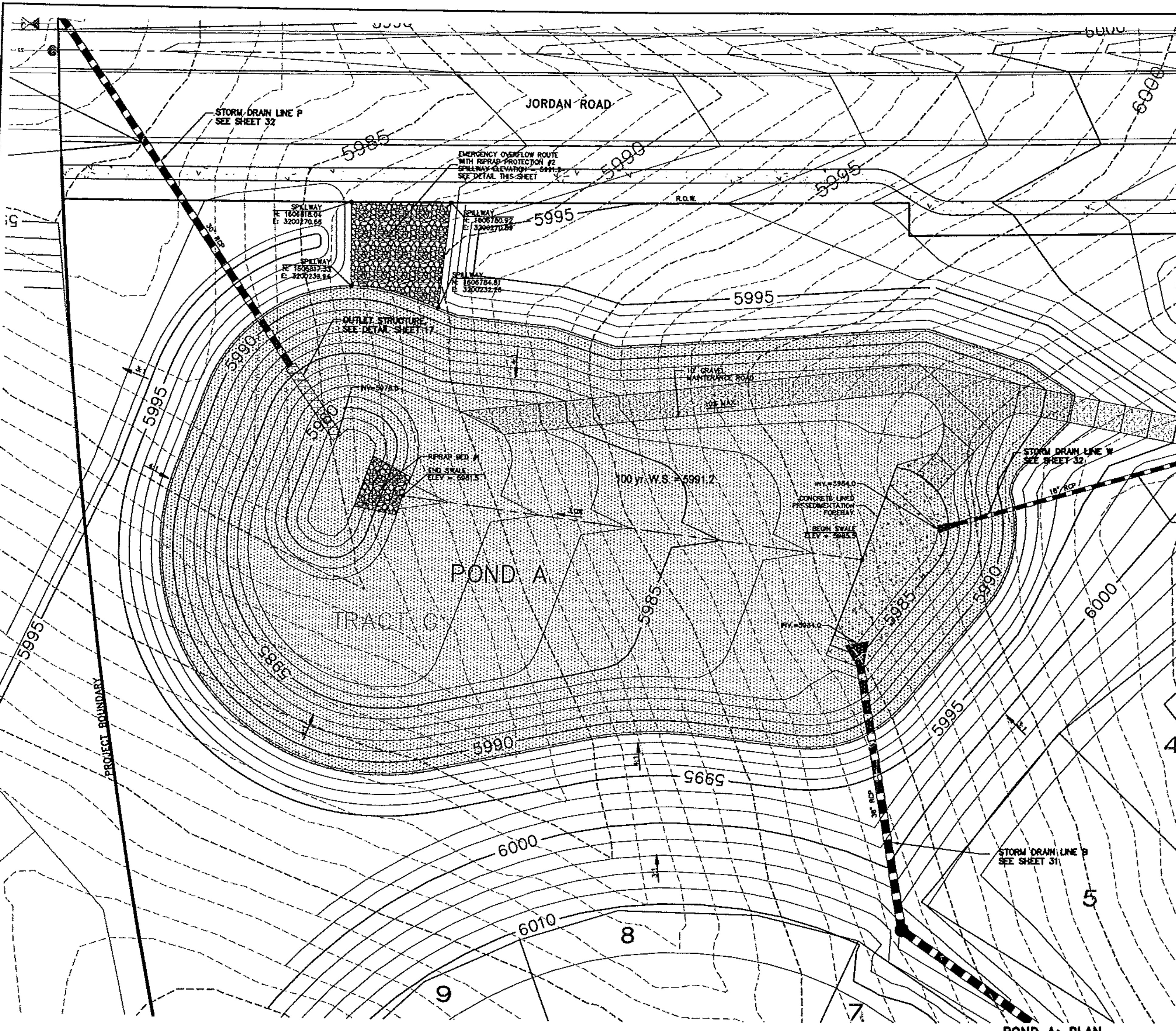
$$Q = C_d*3.1415*D^2/4*(2gh)^{1/2}$$

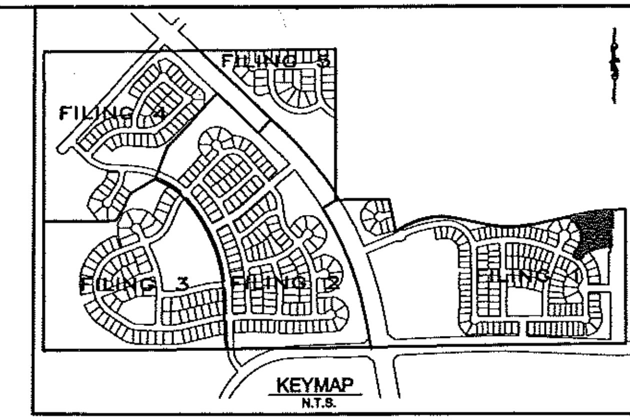
$$Q = 0.65*3.1415*D^2/4*(2*32.2*h)^{1/2}$$

$$D = (Q/(.5105*(64.4*h)^{1/2}))^{1/2}$$

Calculation Table for Orifice Size

%	h = %*Y	Diam. (D)	Actual h	h/Y
98%	13.09	1.60	12.56	94%
97%	12.96	1.60	12.56	94%
96%	12.83	1.60	12.56	94%
95%	12.69	1.61	12.56	94%
94%	12.56	1.61	12.55	94%
93%	12.42	1.62	12.55	94%
92%	12.29	1.62	12.55	94%
91%	12.16	1.63	12.55	94%
90%	12.02	1.63	12.54	94%
89%	11.89	1.63	12.54	94%
88%	11.76	1.64	12.54	94%
87%	11.62	1.64	12.54	94%
86%	11.49	1.65	12.54	94%
85%	11.36	1.65	12.53	94%
84%	11.22	1.66	12.53	94%
83%	11.09	1.66	12.53	94%
82%	10.96	1.67	12.53	94%
81%	10.82	1.67	12.52	94%
80%	10.69	1.68	12.52	94%
79%	10.55	1.68	12.52	94%
78%	10.42	1.69	12.52	94%





20 10 0 20 40

SCALE: 1" = 20'

100 YR. WATER SURFACE

RIRAP SUMMARY TABLE

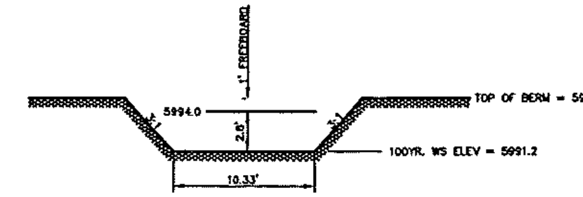
	RR#1	RR#2
LENGTH	16	33.1'
WIDTH	15, 20	40'
DEPTH	2.5'	1.5'
SIZE,d50	9"	12"
TYPE	L	M

* SEE DETAIL

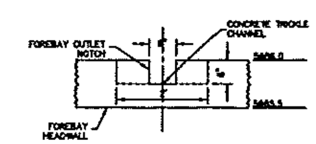
BURY TYPE L RIPRAP WITH 4" NATIVE TOPSOIL AND RESEED OR RESOD.

POND SUMMARY TABLE

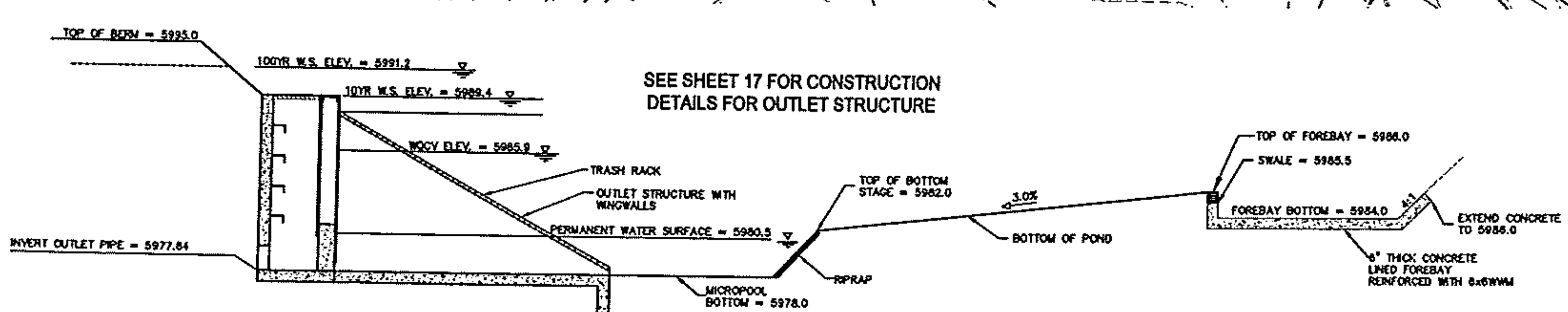
	Q 10yr.	Q 100yr.
PEAK INFLOW (cfs)	127.4	163.0
PEAK OUTFLOW (cfs)	10.2	37.8
WQCV (Ac.Ft.)	1.07	
10 yr. REQUIRED VOL. (Ac.Ft.)	2.52	
100 yr. REQUIRED VOL. (Ac.Ft.)	4.38	
DETENTION CAPACITY (Ac.Ft.)	5.50	
AVAILABLE FREEBOARD (ft.)	1.0	



EMERGENCY SPILLWAY DETAIL



FOREBAY OUTLET NOTCH



SEE SHEET 17 FOR CONSTRUCTION DETAILS FOR OUTLET STRUCTURE

POND A: CROSS SECTION

NOT TO SCALE

CALL UNCC
TWO WORKING DAYS
BEFORE YOU DIG
1-800-922-1987
534-6700 METRO DENVER AREA
UTILITY NOTIFICATION CENTER OF COLORADO

SHEET NUMBER	DRAWN BY: JAM	CHECKED BY: KAL	DATE: APRIL 29, 2003	SCALE: AS SHOWN	FILE NO: 01804102
16					

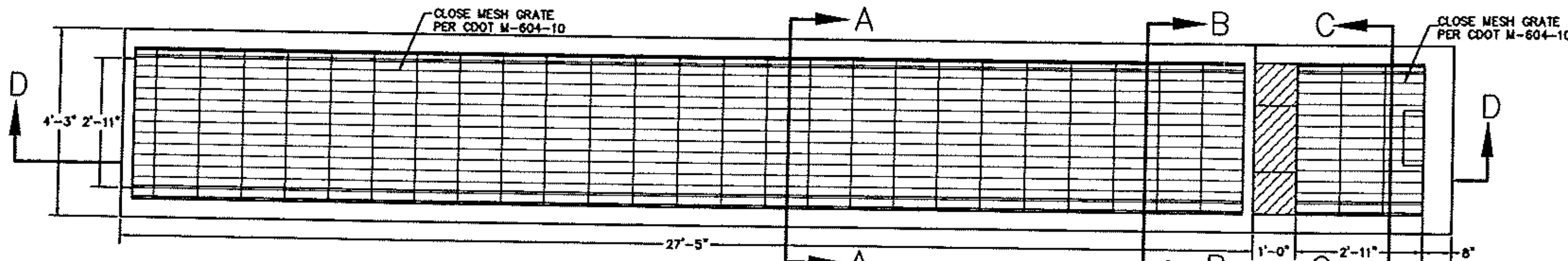
DOUGLAS 234
FILING 1
STREET AND DRAINAGE IMPROVEMENTS
POND A

Continental Homes
7600 East Orchard Road, Ste. 165-S
Greenwood Village, CO 80111

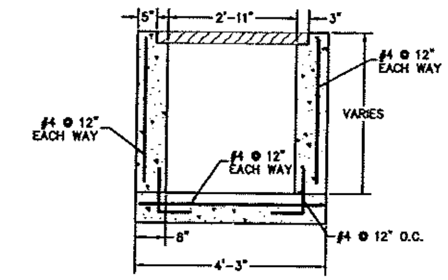
CVL
CONSULTANTS OF COLORADO, INC.
CIVIL ENGINEERING · LAND SURVEYING · LAND PLANNING
7901 E. Belleview Avenue
Suite 150
Englewood, CO 80111
Tel: (720) 482-9526
Fax: (720) 482-9546

No.	Revisions	Date	Init.	Appr.	Date
-					
-					
-					
-					

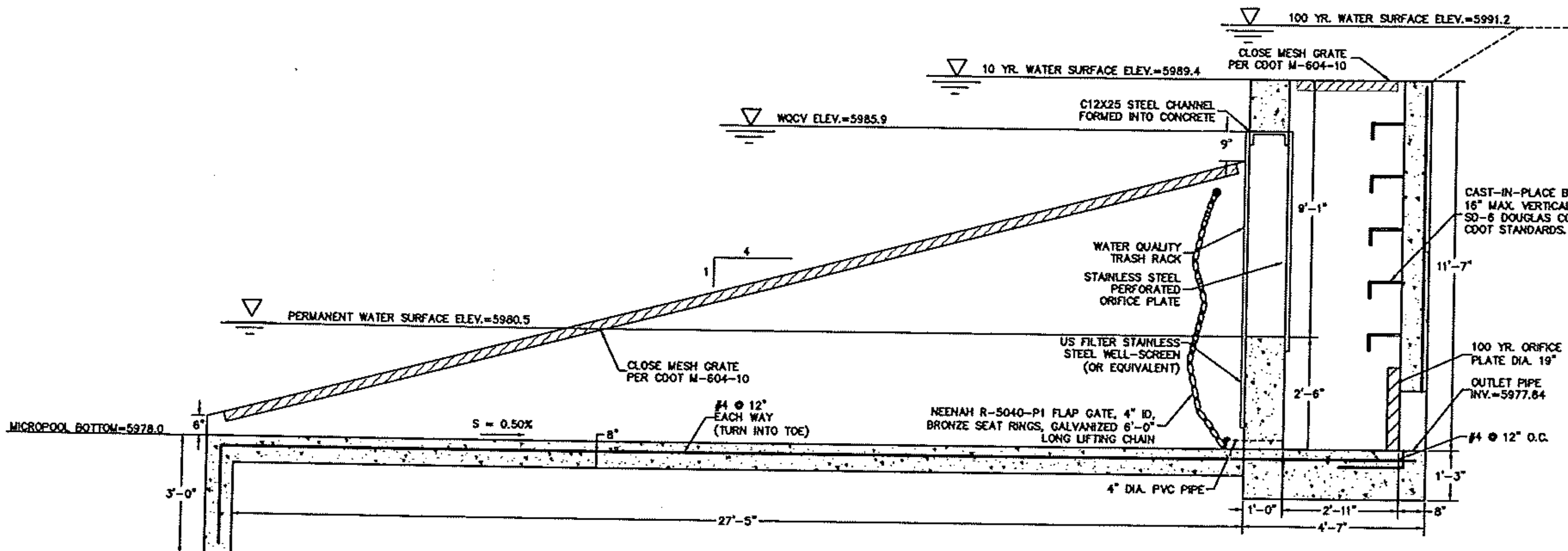
POND A DETAILS



PLAN VIEW
NTS



SECTION A–A
NTS



SECTION D–D
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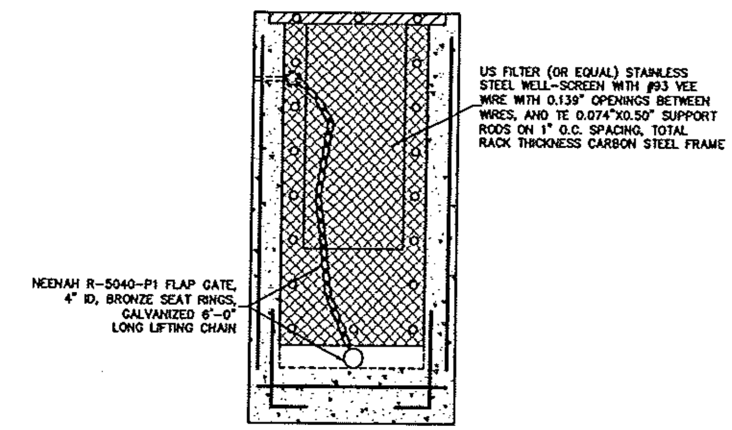
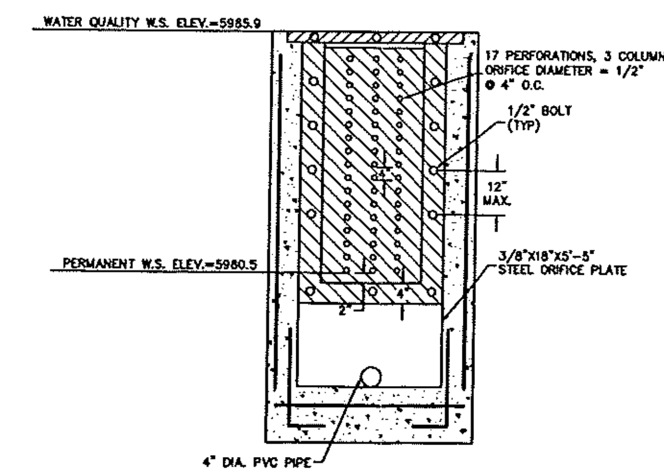
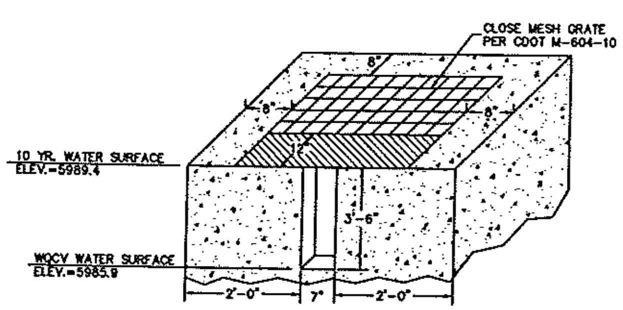


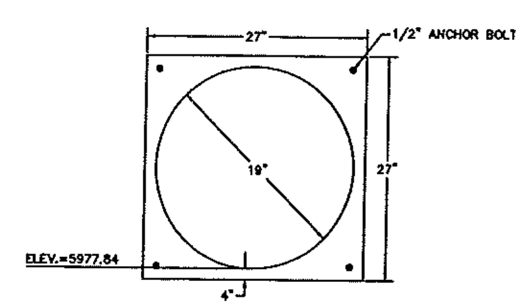
SECTION B–B
NTS



SECTION C–C
NTS



10 YR. RECTANGULAR WEIR
NTS



100 YR. ORIFICE
NTS

No.	Revisions	Date	Init.	Appr.	Date

CVL CONSULTANTS OF COLORADO, INC.
7901 E. Belleview Avenue Suite 150 Englewood, CO 80111 Tel: (720) 482-9526 Fax: (720) 482-9546

Continental Homes
7600 East Orchard Road, Ste. 165-S
Greenwood Village, CO 80111

DOUGLAS 234
FILING 1
STREET AND DRAINAGE IMPROVEMENTS
POND A OUTLET DETAILS

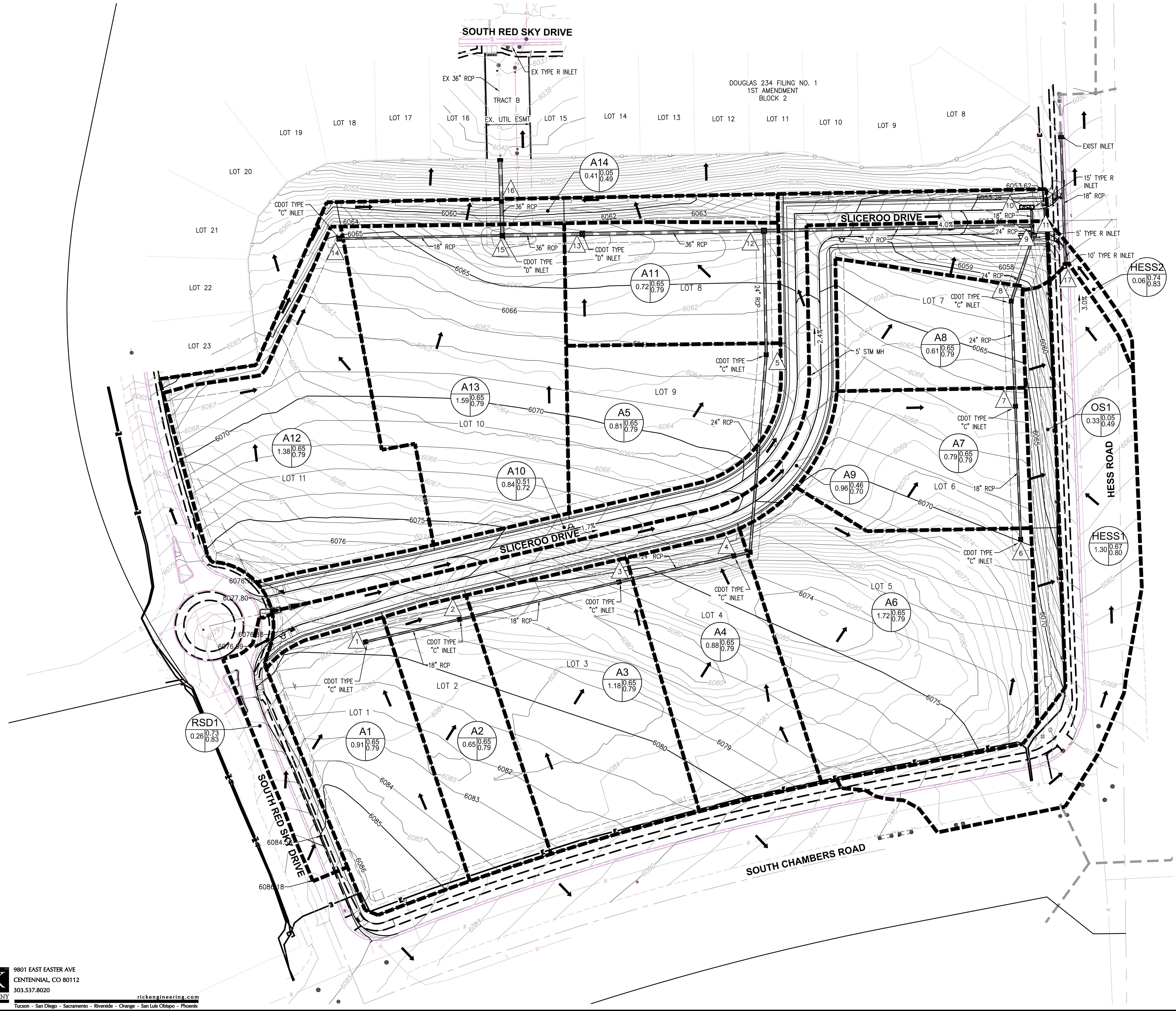
SCALE: AS SHOWN
FILE NO: 01804102
DRAWN BY: MEF
CHECKED BY: KAL
DATE: APRIL 29, 2003
SHEET NUMBER 17

MAP POCKET 1

FOR REFERENCE ONLY

Post-Project Drainage Study Map for Chambers and Hess Filing No. 1

from the approved Final Drainage Report



LEGEND

- BASIN ID
- 5 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPERTY BOUNDARY
- PROPOSED LOT LINE
- PROPOSED STORM SEWER

DESIGN POINT SUMMARY

DESIGN POINT	PEAK RUNOFF 5YR (CFS)	PEAK RUNOFF 100YR (CFS)
1	2.8	6.4
2	4.7	10.8
3	8.1	18.6
4	10.6	24.3
5	12.7	29.3
6	5.3	12.0
7	7.6	17.3
8	9.4	21.4
9	2.4	8.2
10	1.6	4.3
11	11.2	28.9
12	20.9	51.4
13	22.1	54.4
14	4.2	9.6
15	28.6	69.5
16	28.7	70.8
17	3.6	9.1

BASIN SUMMARY

BASIN	Q5 CFS	Q100 CFS
A1	2.8	6.4
A2	2.0	4.6
A3	3.6	8.2
A4	2.7	6.2
A5	2.5	5.7
A6	5.3	12.0
A7	2.4	5.5
A8	1.9	4.2
A9	1.7	4.7
A10	1.6	4.3
A11	2.2	5.0
A12	4.2	9.6
A13	4.9	11.1
A14	0.1	1.8
HESS1	3.5	7.8
HESS2	0.2	0.5
RSD1	0.9	1.9
OS1	0.1	1.4

RICK ENGINEERING COMPANY
Denver
9801 EAST EASTER AVE
CENTENNIAL, CO 80112
303.537.8020
rickengineering.com
Tucson - San Diego - Sacramento - Riverside - Orange - San Luis Obispo - Phoenix

POST-DEVELOPMENT DRAINAGE MAP FOR CHAMBERS & HESS FILING NO. 1

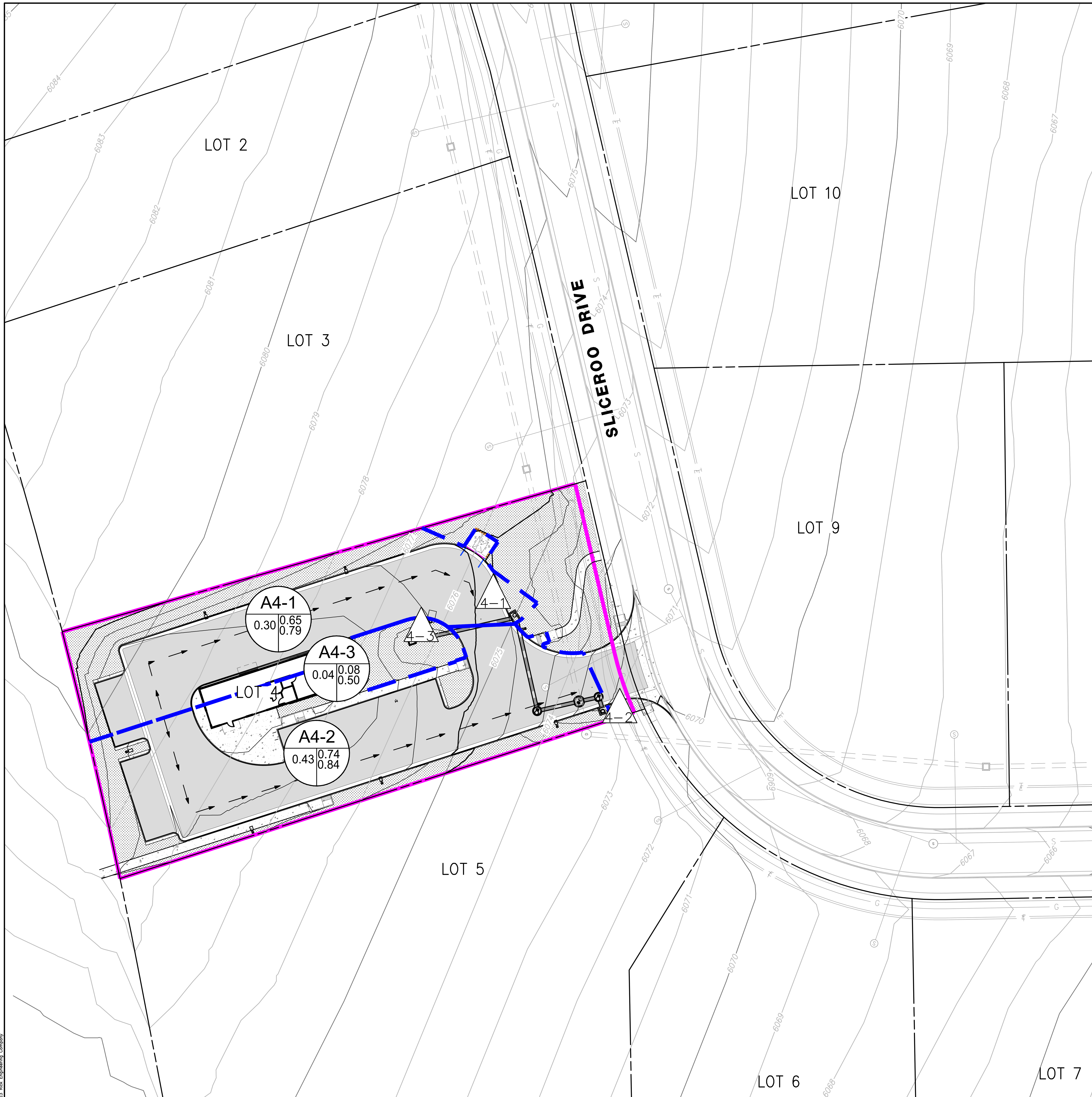
D-1173
DATE: JANUARY 25, 2021

SHEET 2 OF 2

NOT FOR CONSTRUCTION – EXHIBIT FOR DRAINAGE STUDY REPORT ONLY

MAP POCKET 2

Post-Project Drainage Study Map for Dunkin Donuts - Chambers & Hess Filing No. 1 Lot 4



RUNOFF SUMMARY TABLE

Design Point /	Area (acres)	Q5 (cfs)	Q100 (cfs)
A4-1	0.31	0.9	2.1
A4-2	0.43	1.4	3.1
A4-3	0.04	0.0	0.1

30 15 0 30 60 90

GRAPHIC SCALE: 1"=30'

LEGEND

- BASIN ID
- 5 YR. RUNOFF COEFFICIENT
- 100 YR. RUNOFF COEFFICIENT
- AREA IN ACRES
- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- MINOR DRAINAGE BASIN BOUNDARY
- FLOW ARROW
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED STORM SEWER
- LOT LINE

DRAINAGE STUDY MAP
FOR
DUNKIN DONUTS - CHAMBERS & HESS FILING NO.1 LOT 4
(POST-PROJECT)

DATE: NOVEMBER 10, 2023
SCALE: 1" = 30'

JOB NO. D02243
SHEET: 1 OF 1

RICK ENGINEERING COMPANY
8678 CONCORD CENTER DR
UNIT 200
ENGLEWOOD, CO 80112
303.537.8020
rickengineering.com