INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT FOR FOOTHILLS FARM CAMPUS FILING NO. 2 AMENDMENT TO MASTER DEVELOMENT DRAINAGE PLAN FOR MARKETPLACE AT INTERQUEST AND FINAL DRAINAGE REPORT FOR MARKETPLACE AT INTERQUEST FILING NO. 1 AND FILING NO. 2 FINAL HGL REPORT ADDENDUM

Prepared for:

Prepared for:
ALLISON VALLEY DEVELOPMENT COMPANY, LLC
1755 TELSTAR DRIVE, SUITE 211
COLORADO SPRINGS, CO 80920
(719) 867-2279

Date prepared 09/30/19

Job no. 2206.86

CLASSIC CONSULTING
619 N. Cascade Ave, Suite 200 | Colorado Springs, CO 80903 | (719) 785-0790
ClassicConsulting.net

FINAL DRAINAGE REPORT FOR FOOTHILLS FARM CAMPUS FILING NO. 2

Engineer's Statement

This report and plan for the drainage design of **Foothills Farm Campus Filing No. 2** was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Design and Technical Criteria and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): _____ 10/01/19

Catherine M. Tessin, Colorado P.E. No. 45004 Date

Developer's Statement

Allison Valley Development Company, LLC hereby certifies that the drainage facilities for **Foothills Farm Campus Filing No. 2** shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of **Foothills Farm Campus Filing No. 2**, guarantee that final drainage design review will absolve **Allison Valley Development Company, LLC.** and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

La Plata Communities, Inc. Manager for

Allison Valley Development Co., LLC a Colorado Limited Liability Company

Name of Developer

Steve Rossoll 10/1/19

Authorized Signature Date

Steve Rossoll

Printed Name

La Plata Communities, Inc. A Colorado Corporation, Manager

Title

1755 Telstar Drive, Suite 211, Colorado Springs, CO 80920

Address:

City of Colorado Springs Statement:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

Anna Bergmark 10/09/2019

For City Engineer Date

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FINAL DRAINAGE REPORT ADDENDUM FOR FOOTHILLS FARM CAMPUS FILING NO. 2 – ENT HGLS

September 30, 2019

City of Colorado Springs
Engineering Development Review Division
30 S. Nevada Ave., Suite 401
Colorado Springs, CO 80903

ATTN: Ms. Anna Bergmark

RE: Foothills Farm Campus Filing No. 2 - Final Drainage Report Storm HGL Addendum

Dear Anna:

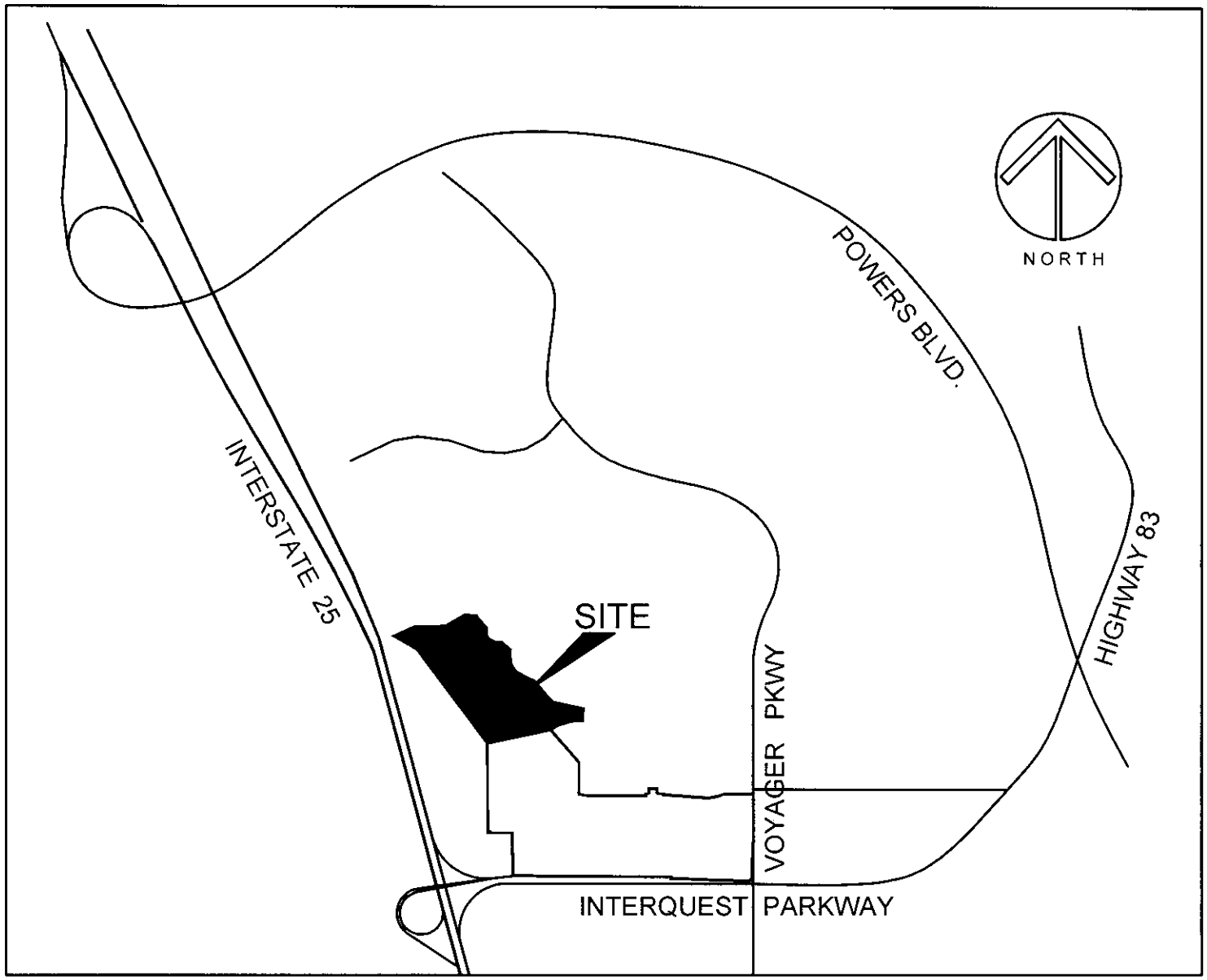
This Addendum is being provided to supply the HGL calculations for the Foothills Farm Campus Filing No. 2 Final Design - private storm system plans. Please see attached calculations for all storm mains.

The approved Final Drainage Report for Foothills Farm Campus Filing No. 2 has not changed from the approved calculations.

Respectfully submitted,

Catherine M. Tessin, P.E.
Project Manager

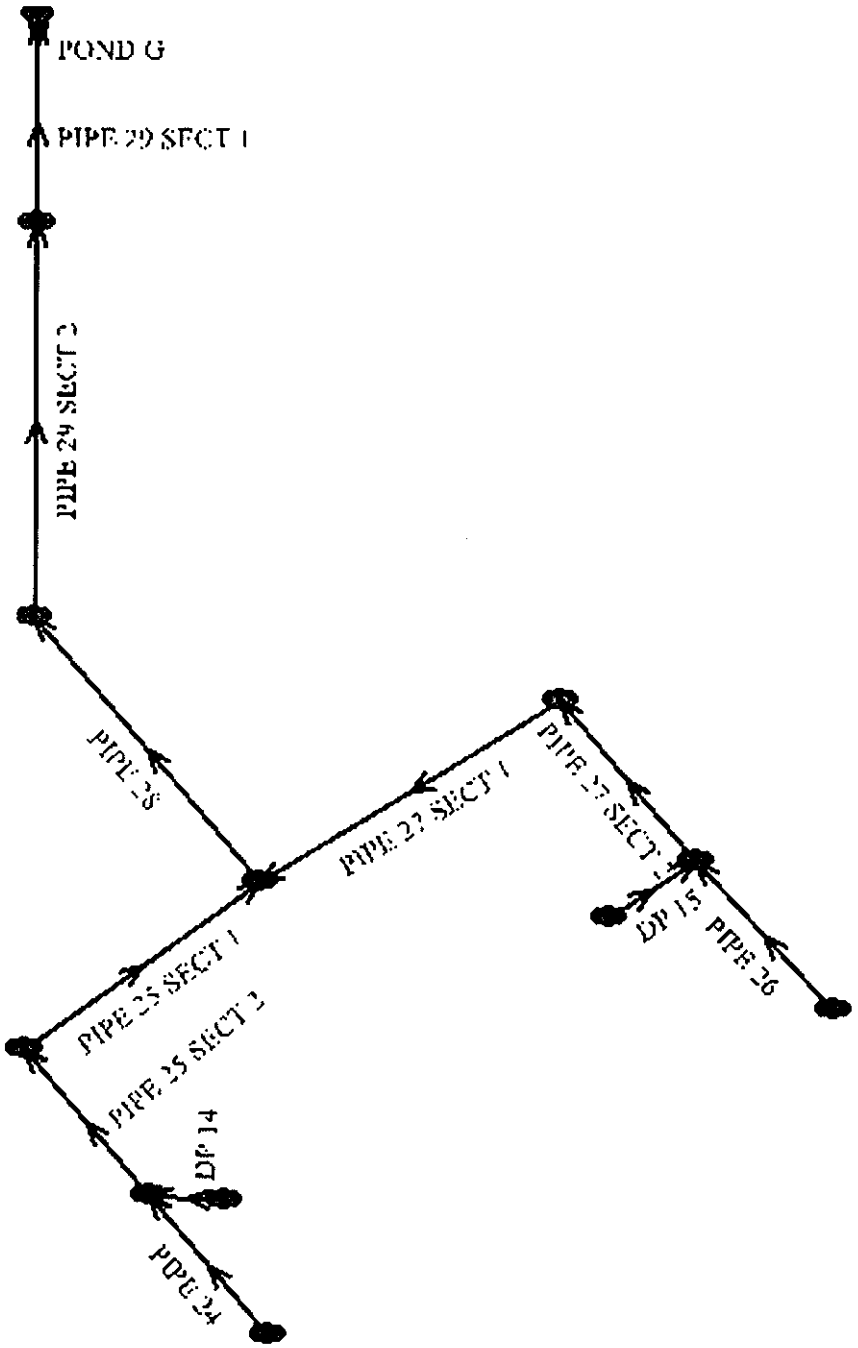
CLASSIC
CONSULTING
ENGINEERS & SURVEYORS



VICINITY / KEY MAP

HGL CALCULATIONS

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS


POND G
PIPE 29 SECT 1
PIPE 29 SECT 2
PIPE 28
PIPE 27 SECT 1
PIPE 27 SECT 2
DP 15
PIPE 26
PIPE 25 SECT 1
PIPE 25 SECT 2
DP 14
PIPE 24

System Input Summary – STM-01 – 5 YR HGL REPORT

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 0.42
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: No

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6603.30

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow		Sub Basin Information						
		Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
POND G	6609.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 29 SECT 1	6613.85	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 29 SECT 2	6614.45	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 28	6621.78	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 25 SECT 1	6617.64	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 25 SECT 2	6622.65	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DP 14	6623.74	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 24	6625.43	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 27 SECT 1	6627.13	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 27 SECT 2	6626.60	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DP 15	6626.46	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 26	6623.98	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

Element Name	Local Contribution					Total Design Flow				Comment
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	
POND G	0.00	0.00	0.00	0.00	0.00	19.63	1.94	0.16	38.00	
PIPE 29 SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	
PIPE 29 SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	
PIPE 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	
PIPE 25 SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	
PIPE 25 SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	
DP 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	
PIPE 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	
PIPE 27 SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	
PIPE 27 SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	
DP 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	
PIPE 26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	

Sewer Input Summary:

Element Name	Sewer Length (ft)	Elevation			Loss Coefficients			Given Dimensions		
		Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE 29 SECT 1	50.04	6603.30	0.5	6603.55	0.013	0.00	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 29 SECT 2	338.35	6603.65	1.5	6608.72	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 28	197.98	6609.03	0.5	6610.02	0.013	0.27	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 25 SECT 1	177.01	6610.32	1.0	6612.09	0.013	1.93	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 25 SECT 2	134.88	6612.39	0.5	6613.06	0.013	1.93	0.00	CIRCULAR	24.00 in	24.00 in
DP 14	8.44	6614.06	1.5	6614.19	0.013	0.38	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 24	165.68	6613.36	0.5	6614.19	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 27 SECT 1	232.47	6610.32	0.5	6611.48	0.013	0.83	0.00	CIRCULAR	30.00 in	30.00 in
PIPE 27 SECT 2	119.72	6611.78	0.5	6612.38	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
DP 15	30.96	6613.38	1.5	6613.84	0.013	1.19	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 26	42.45	6613.48	0.5	6613.70	0.013	0.05	0.25	CIRCULAR	24.00 in	24.00 in

Sewer Flow Summary:

Element Name	Full Flow Capacity		Critical Flow		Normal Flow						
	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE 29 SECT 1	47.27	6.69	24.07	7.57	24.44	7.44	0.97	Subcritical	38.00	0.00	
PIPE 29 SECT 2	81.87	11.58	24.07	7.57	17.24	11.37	1.90	Supercritical	38.00	0.00	
PIPE 28	47.30	6.69	15.82	5.69	14.92	6.14	1.12	Supercritical	17.00	0.00	
PIPE 25 SECT 1	22.68	7.22	10.39	4.60	8.43	6.10	1.50	Supercritical	6.00	0.00	
PIPE 25 SECT 2	15.99	5.09	10.39	4.60	10.19	4.73	1.04	Supercritical	6.00	0.00	
DP 14	28.14	8.96	5.89	3.34	4.33	5.18	1.82	Supercritical	2.00	0.00	
PIPE 24	16.06	5.11	8.42	4.07	8.16	4.24	1.06	Supercritical	4.00	0.00	
PIPE 27 SECT 1	29.05	5.92	13.32	5.22	12.80	5.51	1.08	Supercritical	11.00	0.00	
PIPE 27 SECT 2	29.12	5.93	13.32	5.22	12.78	5.52	1.08	Supercritical	11.00	0.00	
DP 15	12.84	7.26	7.90	4.02	5.92	5.93	1.74	Supercritical	3.00	0.00	
PIPE 26	16.34	5.20	12.85	5.26	12.71	5.33	1.02	Supercritical	9.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used			Comment
			Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	
PIPE 29 SECT 1	38.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
PIPE 29 SECT 2	38.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PIPE 28	17.00	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
PIPE 25 SECT 1	6.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
PIPE 25 SECT 2	6.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
DP 14	2.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
PIPE 24	4.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
PIPE 27 SECT 1	11.00	CIRCULAR	30.00 in	30.00 in	21.00 in	21.00 in	30.00 in	30.00 in	4.91	
PIPE 27 SECT 2	11.00	CIRCULAR	30.00 in	30.00 in	21.00 in	21.00 in	30.00 in	30.00 in	4.91	
DP 15	3.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 26	9.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6603.30

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE 29 SECT 1	6603.30	6603.55	0.00	0.00	6605.31	6605.61	6606.19	0.25	6606.45
PIPE 29 SECT 2	6603.65	6608.72	0.02	0.00	6605.63	6610.73	6607.09	4.52	6611.61
PIPE 28	6609.03	6610.02	0.02	0.00	6611.53	6611.53	6611.64	0.24	6611.88
PIPE 25 SECT 1	6610.32	6612.09	0.11	0.00	6611.91	6612.96	6611.99	1.29	6613.28
PIPE 25 SECT 2	6612.39	6613.06	0.11	0.00	6613.24	6613.93	6613.59	0.67	6614.25
DP 14	6614.06	6614.19	0.00	0.00	6614.42	6614.68	6614.84	0.02	6614.85
PIPE 24	6613.36	6614.19	0.00	0.00	6614.04	6614.89	6614.32	0.83	6615.15
PIPE 27 SECT 1	6610.32	6611.48	0.06	0.00	6611.70	6612.59	6611.95	1.07	6613.01
PIPE 27 SECT 2	6611.78	6612.38	0.10	0.00	6612.84	6613.49	6613.32	0.60	6613.91
DP 15	6613.38	6613.84	0.05	0.00	6613.87	6614.50	6614.42	0.33	6614.75
PIPE 26	6613.48	6613.70	0.01	0.05	6614.54	6614.77	6614.98	0.22	6615.20

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

System Input Summary – STM-01 – 100 YR HGL REPORT

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 0.42
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: No

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6603.30

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow		Sub Basin Information						
		Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
POND G	6609.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 29 SECT 1	6613.85	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 29 SECT 2	6614.45	78.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 28	6621.78	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 25 SECT 1	6617.64	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 25 SECT 2	6622.65	14.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DP 14	6623.74	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 24	6625.43	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 27 SECT 1	6627.13	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 27 SECT 2	6626.60	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DP 15	6626.46	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 26	6623.98	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

Element Name	Local Contribution				Total Design Flow					Comment
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	
POND G	0.00	0.00	0.00	0.00	0.00	40.05	1.95	0.08	78.00	
PIPE 29 SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.00	
PIPE 29 SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	78.00	
PIPE 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	
PIPE 25 SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00	
PIPE 25 SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.00	
DP 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PIPE 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PIPE 27 SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	
PIPE 27 SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	
DP 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	
PIPE 26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE 29 SECT 1	50.04	6603.30	0.5	6603.55	0.013	0.00	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 29 SECT 2	338.35	6603.65	1.5	6608.72	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 28	197.98	6609.03	0.5	6610.02	0.013	0.27	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 25 SECT 1	177.01	6610.32	1.0	6612.09	0.013	1.93	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 25 SECT 2	134.88	6612.39	0.5	6613.06	0.013	1.93	0.00	CIRCULAR	24.00 in	24.00 in
DP 14	8.44	6614.06	1.5	6614.19	0.013	0.38	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 24	165.68	6613.36	0.5	6614.19	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PIPE 27 SECT 1	232.47	6610.32	0.5	6611.48	0.013	0.83	0.00	CIRCULAR	30.00 in	30.00 in
PIPE 27 SECT 2	119.72	6611.78	0.5	6612.38	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
DP 15	30.96	6613.38	1.5	6613.84	0.013	1.19	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 26	42.45	6613.48	0.5	6613.70	0.013	0.05	0.25	CIRCULAR	24.00 in	24.00 in

Sewer Flow Summary:

Element Name	Full Flow Capacity		Critical Flow		Normal Flow						
	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE 29 SECT 1	47.27	6.69	36.00	11.03	36.00	11.03	0.00	Pressurized	78.00	50.04	
PIPE 29 SECT 2	81.87	11.58	33.01	11.49	28.09	13.18	1.51	Supercritical Jump	78.00	307.90	
PIPE 28	47.30	6.69	24.07	7.57	24.43	7.44	0.97	Pressurized	38.00	197.98	
PIPE 25 SECT 1	22.68	7.22	16.17	6.22	13.64	7.60	1.39	Pressurized	14.00	177.01	
PIPE 25 SECT 2	15.99	5.09	16.17	6.22	17.40	5.74	0.86	Pressurized	14.00	134.88	
DP 14	28.14	8.96	12.08	5.05	8.76	7.72	1.85	Pressurized	8.00	8.44	
PIPE 24	16.06	5.11	12.08	5.05	11.98	5.11	1.02	Pressurized	8.00	165.68	
PIPE 27 SECT 1	29.05	5.92	20.02	6.90	20.79	6.61	0.93	Pressurized	24.00	232.47	
PIPE 27 SECT 2	29.12	5.93	20.02	6.90	20.75	6.62	0.93	Pressurized	24.00	119.72	
DP 15	12.84	7.26	12.29	5.45	9.48	7.42	1.65	Pressurized	7.00	30.96	
PIPE 26	16.34	5.20	24.00	5.41	24.00	5.41	0.00	Pressurized	17.00	42.45	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used		Area (ft^2)	Comment
			Rise	Span	Rise	Span	Rise	Span		
PIPE 29 SECT 1	78.00	CIRCULAR	36.00 in	36.00 in	48.00 in	48.00 in	36.00 in	36.00 in	7.07	
PIPE 29 SECT 2	78.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
PIPE 28	38.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
PIPE 25 SECT 1	14.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
PIPE 25 SECT 2	14.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
DP 14	8.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
PIPE 24	8.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
PIPE 27 SECT 1	24.00	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
PIPE 27 SECT 2	24.00	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
DP 15	7.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 26	17.00	CIRCULAR	24.00 in	24.00 in	27.00 in	27.00 in	24.00 in	24.00 in	3.14	

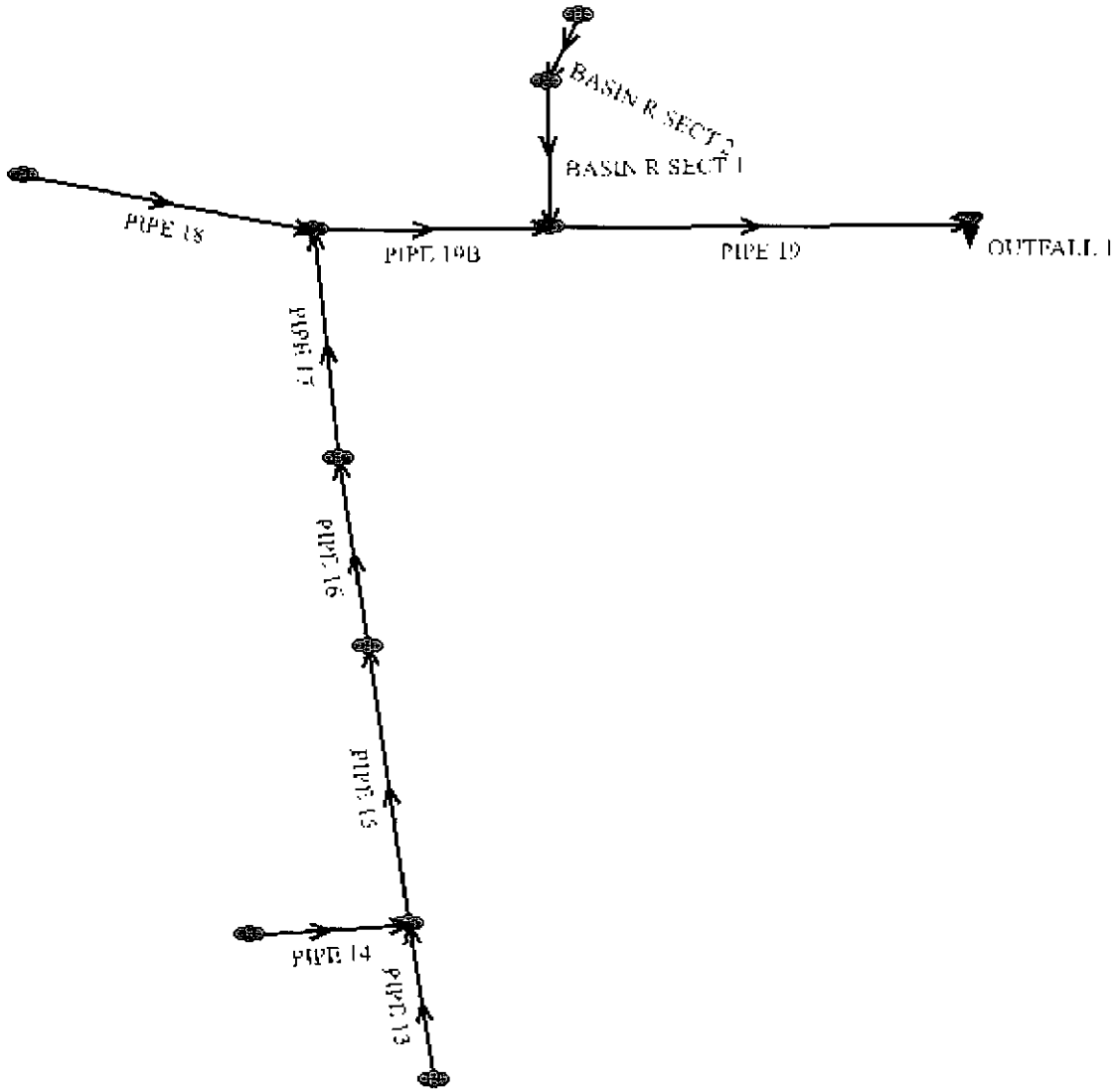
- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6603.30

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE 29 SECT 1	6603.30	6603.55	0.00	0.00	6606.30	6606.98	6608.19	0.68	6608.87
PIPE 29 SECT 2	6603.65	6608.72	0.09	0.00	6607.08	6611.47	6608.97	4.55	6613.52
PIPE 28	6609.03	6610.02	0.12	0.00	6613.19	6613.83	6613.64	0.64	6614.28
PIPE 25 SECT 1	6610.32	6612.09	0.60	0.00	6614.57	6615.24	6614.88	0.67	6615.55
PIPE 25 SECT 2	6612.39	6613.06	0.60	0.00	6615.84	6616.35	6616.15	0.51	6616.66
DP 14	6614.06	6614.19	0.04	0.00	6616.60	6616.61	6616.70	0.01	6616.71
PIPE 24	6613.36	6614.19	0.01	0.00	6616.56	6616.77	6616.66	0.21	6616.87
PIPE 27 SECT 1	6610.32	6611.48	0.31	0.00	6614.22	6615.01	6614.59	0.79	6615.38
PIPE 27 SECT 2	6611.78	6612.38	0.49	0.00	6615.50	6615.91	6615.87	0.41	6616.28
DP 15	6613.38	6613.84	0.29	0.00	6616.32	6616.46	6616.57	0.14	6616.71
PIPE 26	6613.48	6613.70	0.02	0.26	6616.19	6616.43	6616.64	0.24	6616.88

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.


BASIN R SECT 2
BASIN R SECT 1
PIPE 18
PIPE 19B
PIPE 19
OUTFALL 1
PIPE 17
PIPE 16
PIPE 15
PIPE 14
PIPE 13

System Input Summary – STM-02 – 5 YR HGL REPORT

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 0.42
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6624.44

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow		Sub Basin Information						
		Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6643.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 19	6639.77	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 19B	6639.15	31.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 18	6638.39	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 17	6638.14	28.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 16	6638.57	23.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15	6639.43	13.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 14	6638.66	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 13	6640.64	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BASIN R SECT 1	6641.23	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BASIN R SECT 2	6639.89	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

Element Name	Local Contribution					Total Design Flow				Comment
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	19.66	1.88	0.53	37.00	
PIPE 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PIPE 19B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.00	
PIPE 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	
PIPE 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.00	

PIPE 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.00
PIPE 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.00
PIPE 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
PIPE 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
BASIN R SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00
BASIN R SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
PIPE 19	165.63	6624.44	1.0	6626.10	0.013	0.03	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 19B	61.51	6626.30	0.7	6626.73	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 18	74.30	6628.23	1.0	6628.97	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 17	95.33	6627.04	0.6	6627.61	0.013	1.32	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 16	40.34	6627.90	0.5	6628.10	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 15	142.45	6628.40	0.5	6629.11	0.013	0.05	0.00	CIRCULAR	30.00 in	30.00 in
PIPE 14	52.52	6629.61	1.0	6630.14	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 13	60.60	6629.41	1.0	6630.02	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
BASIN R SECT 1	48.00	6627.60	3.0	6629.04	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
BASIN R SECT 2	17.80	6629.35	3.0	6629.88	0.013	0.57	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

Element Name	Full Flow Capacity		Critical Flow		Normal Flow						
	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE 19	66.88	9.46	23.74	7.48	19.12	9.70	1.51	Supercritical	37.00	0.00	
PIPE 19B	55.95	7.92	22.02	7.06	19.51	8.18	1.26	Supercritical	31.00	0.00	
PIPE 18	10.53	5.96	9.18	4.41	7.69	5.55	1.40	Supercritical	4.00	0.00	
PIPE 17	51.80	7.33	20.54	6.72	18.85	7.47	1.18	Supercritical	28.00	0.00	
PIPE 16	47.29	6.69	18.53	6.27	17.71	6.64	1.09	Supercritical	23.00	0.00	
PIPE 15	29.08	5.92	14.54	5.51	14.05	5.76	1.07	Supercritical	13.00	0.00	
PIPE 14	10.53	5.96	7.90	4.02	6.57	5.14	1.42	Supercritical	3.00	0.00	
PIPE 13	22.68	7.22	14.27	5.65	11.79	7.17	1.44	Supercritical	11.00	0.00	
BASIN R SECT 1	18.24	10.32	11.35	5.11	7.11	9.25	2.45	Supercritical	6.00	0.00	
BASIN R SECT 2	18.24	10.32	11.35	5.11	7.11	9.25	2.45	Supercritical	6.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used		Area (ft^2)	Comment
			Rise	Span	Rise	Span	Rise	Span		
PIPE 19	37.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PIPE 19B	31.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PIPE 18	4.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 17	28.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PIPE 16	23.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PIPE 15	13.00	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PIPE 14	3.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 13	11.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
BASIN R SECT 1	6.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
BASIN R SECT 2	6.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6624.44

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE 19	6624.44	6626.10	0.00	0.00	6626.04	6628.08	6627.50	1.45	6628.95
PIPE 19B	6626.30	6626.73	0.02	0.00	6628.09	6628.56	6628.96	0.38	6629.34
PIPE 18	6628.23	6628.97	0.00	0.00	6628.87	6629.74	6629.35	0.69	6630.04
PIPE 17	6627.04	6627.61	0.32	0.00	6629.28	6629.32	6629.66	0.36	6630.02
PIPE 16	6627.90	6628.10	0.01	0.00	6629.37	6629.64	6630.06	0.20	6630.26
PIPE 15	6628.40	6629.11	0.01	0.00	6630.03	6630.32	6630.26	0.53	6630.79
PIPE 14	6629.61	6630.14	0.06	0.00	6630.79	6630.80	6630.85	0.20	6631.05
PIPE 13	6629.41	6630.02	0.01	0.00	6630.40	6631.21	6631.19	0.51	6631.70
BASIN R SECT 1	6627.60	6629.04	0.24	0.00	6628.31	6629.99	6629.52	0.87	6630.39
BASIN R SECT 2	6629.35	6629.88	0.10	0.00	6630.09	6630.97	6631.27	0.00	6631.27

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

System Input Summary – STM-02 – 100 YR HGL REPORT

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 0.42
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6624.44

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow: Total Known Flow (cfs)	Given Flow: Local Contribution (cfs)	Sub Basin Information: Drainage Area (Ac.)	Sub Basin Information: Runoff Coefficient	Sub Basin Information: 5yr Coefficient	Sub Basin Information: Overland Length (ft)	Sub Basin Information: Overland Slope (%)	Sub Basin Information: Gutter Length (ft)	Sub Basin Information: Gutter Velocity (fps)
OUTFALL 1	6643.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 19	6639.77	68.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 19B	6639.15	57.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 18	6638.39	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 17	6638.14	52.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 16	6638.57	43.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 15	6639.43	25.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 14	6638.66	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 13	6640.64	20.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BASIN R SECT 1	6641.23	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BASIN R SECT 2	6639.89	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

Element Name	Local Contribution: Overland Time (min)	Local Contribution: Gutter Time (min)	Local Contribution: Basin Tc (min)	Local Contribution: Intensity (in/hr)	Local Contribution: Local Contrib (cfs)	Total Design Flow: Coeff. Area	Total Design Flow: Intensity (in/hr)	Total Design Flow: Manhole Tc (min)	Total Design Flow: Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	35.49	1.92	0.29	68.00	
PIPE 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.00	
PIPE 19B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.00	
PIPE 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PIPE 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.00	

PIPE 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.00
PIPE 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.00
PIPE 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
PIPE 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
BASIN R SECT 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00
BASIN R SECT 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
PIPE 19	165.63	6624.44	1.0	6626.10	0.013	0.03	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 19B	61.51	6626.30	0.7	6626.73	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 18	74.30	6628.23	1.0	6628.97	0.013	0.05	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 17	95.33	6627.04	0.6	6627.61	0.013	1.32	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 16	40.34	6627.90	0.5	6628.10	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PIPE 15	142.45	6628.40	0.5	6629.11	0.013	0.05	0.00	CIRCULAR	30.00 in	30.00 in
PIPE 14	52.52	6629.61	1.0	6630.14	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 13	60.60	6629.41	1.0	6630.02	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
BASIN R SECT 1	48.00	6627.60	3.0	6629.04	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
BASIN R SECT 2	17.80	6629.35	3.0	6629.88	0.013	0.57	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE 19	66.88	9.46	36.00	9.62	36.00	9.62	0.00	Pressurized	68.00	165.63	
PIPE 19B	55.95	7.92	36.00	8.06	36.00	8.06	0.00	Pressurized	57.00	61.51	
PIPE 18	10.53	5.96	13.15	5.78	11.73	6.56	1.25	Pressurized	8.00	74.30	
PIPE 17	51.80	7.33	36.00	7.36	36.00	7.36	0.00	Pressurized	52.00	95.33	
PIPE 16	47.29	6.69	25.63	7.99	26.93	7.58	0.91	Pressurized	43.00	40.34	
PIPE 15	29.08	5.92	20.44	7.02	21.44	6.66	0.91	Pressurized	25.00	142.45	
PIPE 14	10.53	5.96	10.32	4.77	8.73	5.88	1.38	Pressurized	5.00	52.52	
PIPE 13	22.68	7.22	19.27	7.40	17.50	8.15	1.22	Pressurized	20.00	60.60	
BASIN R SECT 1	18.24	10.32	15.24	6.89	10.08	10.80	2.30	Pressurized	11.00	48.00	
BASIN R SECT 2	18.24	10.32	15.24	6.89	10.08	10.80	2.30	Pressurized	11.00	17.80	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used			Comment
			Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	
PIPE 19	68.00	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	
PIPE 19B	57.00	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	
PIPE 18	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 17	52.00	CIRCULAR	36.00 in	36.00 in	42.00 in	42.00 in	36.00 in	36.00 in	7.07	
PIPE 16	43.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
PIPE 15	25.00	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
PIPE 14	5.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 13	20.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
BASIN R SECT 1	11.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
BASIN R SECT 2	11.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

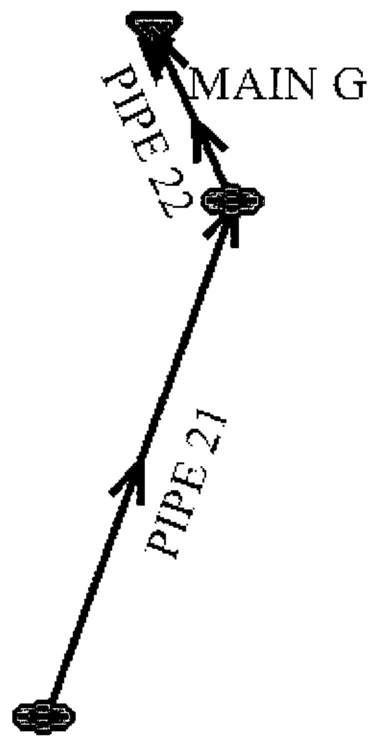
- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6624.44

Element Name	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE 19	6624.44	6626.10	0.00	0.00	6627.44	6629.16	6628.88	1.71	6630.59
PIPE 19B	6626.30	6626.73	0.05	0.00	6629.63	6630.08	6630.64	0.45	6631.09
PIPE 18	6628.23	6628.97	0.02	0.00	6630.79	6631.22	6631.11	0.43	6631.54
PIPE 17	6627.04	6627.61	1.11	0.00	6631.36	6631.94	6632.20	0.58	6632.78
PIPE 16	6627.90	6628.10	0.03	0.00	6632.23	6632.40	6632.80	0.17	6632.97
PIPE 15	6628.40	6629.11	0.02	0.00	6632.59	6633.12	6632.99	0.53	6633.52
PIPE 14	6629.61	6630.14	0.16	0.00	6633.56	6633.68	6633.68	0.12	6633.80
PIPE 13	6629.41	6630.02	0.03	0.00	6633.15	6633.62	6633.78	0.47	6634.25
BASIN R SECT 1	6627.60	6629.04	0.79	0.00	6630.79	6631.31	6631.39	0.52	6631.91
BASIN R SECT 2	6629.35	6629.88	0.34	0.00	6631.65	6631.85	6632.25	0.19	6632.45

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.



MAIN G
PIPE 22
PIPE 21

System Input Summary – STM-03 – 5 YR HGL REPORT

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 0.42
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: No

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6620.82

Manhole Input Summary:

Element Name	Given Flow		Sub Basin Information						
	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
MAIN G	6634.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 22	6633.78	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 21	6633.78	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

Element Name	Local Contribution				Total Design Flow					Comment
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	
MAIN G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	
PIPE 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	
PIPE 21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	

Sewer Input Summary:

Element Name	Sewer Length (ft)	Elevation			Loss Coefficients			Given Dimensions		
		Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE 22	7.63	6620.22	1.0	6620.30	0.013	1.16	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 21	31.34	6621.61	1.0	6621.93	0.013	0.14	0.54	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

Element Name	Full Flow Capacity		Critical Flow		Normal Flow				Flow (cfs)	Surcharged Length (ft)	Comment
	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition			
PIPE 22	10.76	6.09	9.18	4.41	7.60	5.64	1.44	Supercritical	4.00	0.00	
PIPE 21	10.65	6.03	7.90	4.02	6.54	5.18	1.44	Supercritical	3.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

Element Name	Peak Flow (cfs)	Cross Section	Existing		Calculated		Used		Area (ft^2)	Comment
			Rise	Span	Rise	Span	Rise	Span		
PIPE 22	4.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 21	3.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6620.82

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE 22	6620.22	6620.30	0.00	0.00	6620.85	6621.07	6621.35	0.02	6621.37
PIPE 21	6621.61	6621.93	0.01	0.06	6622.15	6622.59	6622.57	0.27	6622.84

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

System Input Summary – STM-03 – 100 YR HGL REPORT

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 0.42
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: No

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6621.89

Manhole Input Summary:

Element Name	Ground Elevation (ft)	Given Flow		Sub Basin Information						
		Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
MAIN G	6634.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 22	6633.78	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE 21	6633.78	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

Element Name	Local Contribution					Total Design Flow				
	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
MAIN G	0.00	0.00	0.00	0.00	0.00	4.09	1.95	0.03	8.00	
PIPE 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PIPE 21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	

Sewer Input Summary:

Element Name	Sewer Length (ft)	Elevation			Loss Coefficients			Given Dimensions		
		Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE 22	7.63	6620.22	1.0	6620.30	0.013	1.16	0.00	CIRCULAR	18.00 in	18.00 in
PIPE 21	31.34	6621.61	1.0	6621.93	0.013	0.14	0.54	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE 22	10.76	6.09	13.15	5.78	11.56	6.67	1.29	Pressurized	8.00	7.63	
PIPE 21	10.65	6.03	10.32	4.77	8.68	5.93	1.39	Supercritical	5.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PIPE 22	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE 21	5.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6621.89

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE 22	6620.22	6620.30	0.00	0.00	6621.89	6621.93	6622.21	0.04	6622.25
PIPE 21	6621.61	6621.93	0.02	0.25	6622.33	6622.79	6622.88	0.26	6623.14

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

September 30, 2019

City of Colorado Springs
Water Resources Engineering Division
30 S. Nevada Avenue, Suite 401
Colorado Springs, CO 80903

ATTN: Ms. Anna Bergmark

RE: Final Drainage Report for Ent HQ – Foothills Farm Campus Filing No. 2 onsite private storm - Variance Requests

Dear Ms. Bergmark:

Classic Consulting Engineers & Surveyors, LLC (CCES), on behalf of our client, Allison Valley Development Company, LLC respectfully requests the City's consideration of the following variances:

1a. Drop manhole exceeding 1 foot - Drainage Criteria Manual Volume 1 (Chapter 9, Section 6.4)
1b. Pipe Crown match - Drainage Criteria Manual Volume 1 (Chapter 9, Section 6.4)
2. Horizontal Alignment angle of confluence shall be 90° or less (Chapter 9, Section 5.1)

Background:
Ent HQ – Foothills Farm Campus Filing No. 2 is located in the City of Colorado Springs, County of El Paso, State of Colorado. This project has been included in the approved Final Drainage Report for Foothills Farm Campus Filing No. 2 Amendment to Master Development Drainage Plan for Marketplace at Interquest and Final Drainage Report for Marketplace at Interquest Filing No. 1 & 2, prepared by Classic Consulting Engineers and Surveyors.

This site is part of an overall planned commercial development with an approved regional public Full Spectrum Detention Facility (Pond G) that serves the subject property, located in Foothills Farm Campus Filing No. 2. All stormwater is detained to be released at or below required release rate levels in conformance with previously approved reports.

The following variance is respectfully requested:

1a. Drop manhole exceeding 1 foot - Drainage Criteria Manual Volume 1 (Chapter 9, Section 6.4)– The proposed private storm system extension of 18" main (Storm-03 Pipe 21 and 22) connects to the 66" RCP public storm outfall north of Ent Parkway, and is intentionally designed to accommodate the required utility clearance to a proposed 8" PVC water, 12" force main, and wastewater main crossing. The only way to achieve the pipe clearance as required by Colorado Springs Utilities standards is to place the Storm-03 pipe crossing between the proposed utilities, creating a drop condition of 1.3' at Pipe 21 and 22. The pipe size difference between the 18" connection and the 66" public RCP cannot be avoided without exceeding maximum velocity with a steeper pipe slope.

Justification:
Variance for criteria Chapter 9, Section 6.4: We feel a variance is justified as it meets the intent of language included in Section 6.4: There are cases when a drop larger than 1 foot may be necessary to avoid a utility conflict, reduce the slope of the downstream pipe, match the crowns of the upstream and downstream pipes

619 N. Cascade Ave, Suite 200 Colorado Springs, CO 80903
OFC: (719) 785-0790 FAX (719) 785-0799
www.classicconsulting.net

or to account for energy losses in the manhole. Drops that exceed 1 foot will be evaluated on a case-by-case basis. The drop in this manhole is required to allow for the required utility crossings and connection to the 66" RCP storm outfall.

1b: Pipe Crown match - Drainage Criteria Manual Volume 1 (Chapter 9, Section 6.4)– The proposed private storm system extension of 36"/30"/24" main (Storm 02) profile crosses the proposed water mainline, and the domestic water and fire services to the building, limiting the slope of the pipe and setting the depth of the proposed private storm sewer. The storm profile is designed as flat as possible to accommodate the water main crossings, however the flatter pipe slopes require the larger pipe diameter to convey the flows with minimal drops at the manholes. The change in pipe diameter from Pipe 16, 15, and 13 creates a condition where the pipe crowns do not match. Per the DCM Chapter 9 Section 6.4, the crowns should match to account for energy losses at the manhole, however the HGL calculations are very minimally affected by the vertical design as proposed as shown on the profile. The resultant HGL line for the 100 year event is within criteria.

Justification:
Variance for criteria Chapter 9, Section 6.4: We feel a variance is justified as it meets the intent of language included in Section 6.4. The design of the system is required to allow for a utility clearance crossing and is not impacting the overall pipe velocity, HGL, or maintenance of the private system.

1. Horizontal Alignment angle of confluence shall be 90° or less (Chapter 9, Section 5.1)
– The proposed private storm system extension Storm-01A main alignment exceeds 90° deflection at Manhole Station 2+84.51 and 7+23.53 along a 24" private storm. The alignment of the storm system was intentional to follow the utility corridor for the ultimate campus layout between proposed buildings, and to maintain required separation from parallel utilities. The deflection through the manholes at these locations does exceed criteria at 110°, however it eliminates the need for additional bend fittings on the mainline to achieve the 90° angle. The private 24" storm pipe is carrying only 14 cfs in the 100 year event, and the resultant HGL calculations show that there is no adverse impact to the alignment as designed.

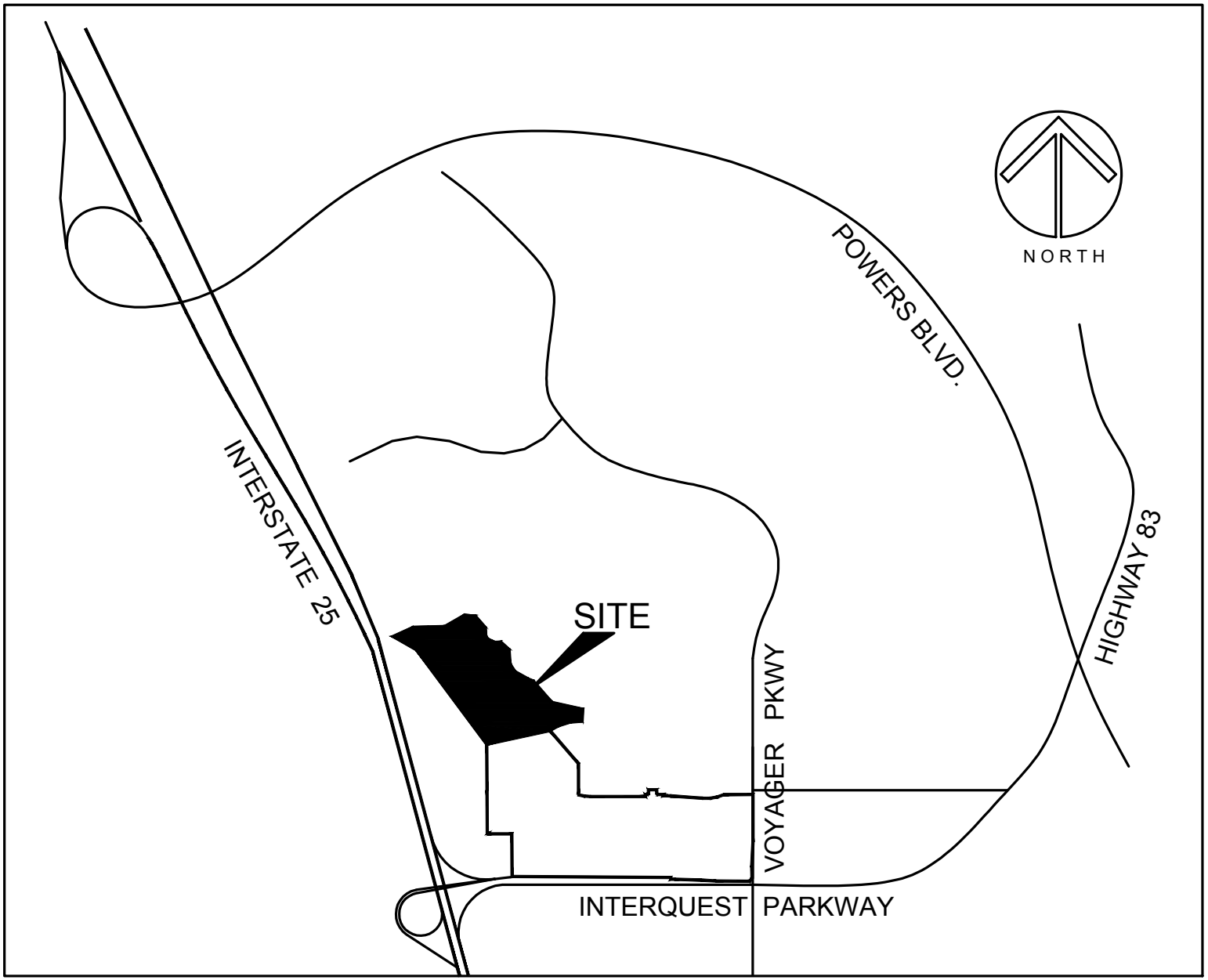
Justification:
Variance for criteria Chapter 9, Section 5.1: We feel a variance is justified as it is necessary to maintain adequate utility horizontal separation from parallel mains, and also fit within the overall campus utility corridor layout. The proposed alignment of the mainline as designed is not impacting the overall pipe velocity criteria, HGL criteria, or maintenance of the private system.

Based upon this request, the overall design approval will not affect peak flows or water quality in Fountain Creek, as all stormwater will continue to be treated and detained per the approved Final Drainage report(s).

We respectfully request your favorable consideration of this request.

Respectfully submitted,

Cathy M. Tessin, P.E.
Project Manager
Attachment: Vicinity Map



VICINITY / KEY MAP