Preliminary Hydrology Study

FOR

Rider Street Logistics Center

APN 317-120-021

Perris, CA

For: **Developer Name**
Street Address
City, State ZIP
Telephone: 000-000-0000
Contact: Contact Name

PREPARED BY: ENGINEER NAME, RCE 00000

DATE: October 2026

Engineering Firm Name
Street Address
City, State ZIP
Ph: 000-000-0000 email: name@firm.com

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PROJECT SUMMARY

HYDROLOGY CALCULATIONS · DETENTION / RETENTION BASIN

Rider Street Logistics Center
Perris, CA

PREPARED BY: **Engineering Firm Name** | AGENCY: **Riverside County FCD & WCD** | DATE: **October 4, 2026**

RESULTS · PROPOSED CONDITION, 100-YEAR STORM

PROJECT AREA	TRIBUTARY AREAS	PEAK FLOW, PROJECT	STORM VOLUME
22.60 ac	**10**	**43.83** cfs confluence, RCFC Plate D-1	**6.808** ac-ft

PROJECT

Project	**Rider Street Logistics Center**	Developer	**Developer Name**
Project type	**Detention / Retention Basin**	Study	**Preliminary**
Location	**Perris, CA**	Agency	**Riverside County FCD & WCD**
APN	**317-120-021**	Date	**October 4, 2026**

RAINFALL

Source	**NOAA Atlas 14 PFDS**	Method	**RCFC Hydrology Manual (1978, updated 2024)**
24-hour depth	**4.69 in**		

ENGINEER OF RECORD CERTIFICATION

I, **Engineer Name**, License No. **00000**, certify that these hydrology calculations were prepared under my direct supervision using methodology consistent with the **Riverside County FCD** (RCFC Hydrology Manual (1978, updated 2024)) and applicable federal standards. Rainfall source: **NOAA Atlas 14 PFDS**.

ENGINEER'S STAMP

Signature, Engineer Name, P.E. No. 00000

Date

SECTION 1

Introduction

This preliminary hydrology study for Rider Street Logistics Center (APN 317-120-021) determines existing and developed condition runoff for the 10 year and 100 year storm events and sizes the on-site drainage facilities. Developed 100 year peak flow totals 43.8 cfs against an existing 35.1 cfs.

Rider Street Logistics Center (APN 317-120-021) is located at 2350 Rider Street in Perris, CA. The site is approximately 22.60 acres.

The existing site is vacant, consisting of natural undeveloped land. Existing runoff drains as sheet flow across the site in the direction of the historic gradient to the existing point of discharge at Rider Street right-of-way, southwest corner. There are no existing drainage improvements on the site.

Off-site tributary flows enter the site. Undeveloped land to the east, 3.8 ac, sheet flows onto the site and is carried through it in Line D. These flows are accounted for in the tabulations and conveyed through the site to the point of discharge.

The proposed development consists of paved areas, commercial development and natural undeveloped land with associated grading, paving and landscaping, and is approximately 78% impervious. On-site runoff is collected by the proposed on-site storm drain system and directed to the proposed detention basin and released through a controlled outlet. Emergency overflow is provided to the public street. The proposed storm drain system consists of 4 lines with catch basins at the points of concentration.

The purpose of this study is to determine the runoff generated by the proposed development and to size the on-site drainage facilities. Detention storage is sized for the governing duration of the design storm, the 100-year 24-hour event, with the release limited to the existing-condition peak.

Peak flows are computed by the Rational Method in accordance with the Riverside County Flood Control and Water Conservation District Hydrology Manual, appropriate for a watershed of this size. Rainfall intensities are from the intensity-duration coefficients entered for the site, times of concentration from the Plate D-3 nomograph for initial subareas with travel times computed along the flow path, and runoff coefficients from the Plate D-5.7 runoff coefficient curve data, C = 0.90 [Ai + (1 - Ai) I / (I + S / 7.5)] with S = 1000 / RI - 10, at each subarea's intensity, for the runoff index of the pervious cover (Plate D-5.5; AMC II, AMC I for the 2 and 5-year storms) and impervious fractions Ai from Plate D-5.6. Storage volumes for the 100-year 24-hour event are determined from the storm volume analysis in this report, by the NRCS curve number method. Where a synthetic unit hydrograph is presented, it follows Section E of the Manual: basin lag by the Manual's lag relation, the District S-graph, the Plate E-5.9 rainfall patterns and the adjusted loss rate. Storm drain hydraulics follow the District Hydraulic Manual with FHWA HEC-22 inlet methods.

The proposed detention basin provides 5.51 ac-ft of storage for the 100-year 24-hour event, with outflow limited to the allowable release rate. On-site storm drains have been sized for the design storm as shown in the calculations herein. CB A-6, in a sump, takes 12.85 cfs of 19.40 cfs at the top of the curb at the 28 ft width selected; no standard width takes all of it and a second inlet is required; CB B-2, in a sump, takes 10.00 cfs of 15.73 cfs at the top of the curb at the 21 ft width selected; no standard width takes all of it and a second inlet is required; CB C-1, in a sump, takes 7.16 cfs of 8.88 cfs at the top of the curb at the 14 ft width selected; 18.2 ft takes all of it; CB D-2, in a sump, takes 4.31 cfs of 6.21 cfs at the top of the curb at the 7 ft width selected; 11.7 ft takes all of it (inlet capacity sheets).

SECTION 2

Design Storm and Rainfall

Rainfall intensity per RCFC Hydrology Manual Plate D-4.1, $I = A / (T_C + B)^n$, with the coefficients entered for the site. Intensities in in/hr.

RETURN PERIOD	A	B	N	T_C 5 MIN	T_C 10 MIN	T_C 15 MIN	T_C 20 MIN	T_C 30 MIN	T_C 45 MIN	T_C 60 MIN
2 year	6.600	8.00	0.620	1.35	1.10	0.94	0.84	0.69	0.56	0.48
10 year	11.600	8.00	0.620	2.36	1.93	1.66	1.47	1.22	0.99	0.85
25 year	14.400	8.00	0.620	2.94	2.40	2.06	1.82	1.51	1.23	1.05
100 year	17.800	8.00	0.620	3.63	2.97	2.55	2.26	1.87	1.52	1.30

Design frequencies: 100 year for on-site conveyance sizing, 100 year for storage and overflow. Storage sized for the 100-year 24-hour event, the governing duration.

SECTION 3

Soils and Runoff Coefficients

Runoff coefficients by soil group and development type, $C = 0.90\,[A_i + (1 - A_i)(1 - F_p / I)]$ (RCFC Section D) at each subarea's rainfall intensity. Composite C per drainage area is area weighted: $C = \Sigma(C_i \times A_i) / \Sigma A_i$.

DA	AREA	DEVELOPMENT	SOIL A	SOIL B	SOIL C	SOIL D	TOTAL AC	C	C X A
DA-1	T-1	Commercial	0.00	2.10	1.10	0.00	3.20	**0.88**	2.816
DA-1	T-2	Pavement	0.00	1.60	0.80	0.00	2.40	**0.90**	2.160
DA-1	T-3	Commercial	0.00	1.40	0.80	0.00	2.20	**0.88**	1.929
DA-2	T-4	Commercial	0.00	1.20	0.80	0.00	2.00	**0.88**	1.761
DA-2	T-5	Pavement	0.00	1.00	0.50	0.00	1.50	**0.90**	1.350
DA-2	T-6	Pavement	0.00	1.10	0.50	0.00	1.60	**0.90**	1.440
DA-2	T-7	Pavement	0.00	0.00	0.00	0.00	0.00	**0.92**	—
DA-2	T-8	Pavement	0.00	0.60	0.40	0.00	1.00	**0.90**	0.900
DA-3	T-9	Parks / open	0.00	0.80	0.40	0.00	1.20	**0.66**	0.795
DA-3	T-10	Pavement	0.00	2.10	1.60	0.00	3.70	**0.90**	3.330
DA-4	T-11	Natural	0.00	2.20	1.60	0.00	3.80	**0.78**	2.981

DRAINAGE AREA	ΣA (AC)	Σ(C X A)	COMPOSITE C
DA-1	7.80	6.905	**0.89**
DA-2	6.10	5.451	**0.89**
DA-3	4.90	4.125	**0.84**
DA-4	3.80	2.981	**0.78**

SECTION 4

Peak Flow Summary

Rational Method peak flows at each point of concentration, existing and developed conditions, 10 and 100 year events. Values from the Rational Method tabulation in this report.

NODE	AREA (AC)	EXISTING Q10 (CFS)	EXISTING Q100 (CFS)	DEVELOPED Q10 (CFS)	DEVELOPED Q100 (CFS)	MITIGATION
DA-1	7.80	7.3	12.0	12.5	19.4	Yes (Detention basin)
DA-2	6.10	5.9	9.7	10.1	15.7	Yes (Detention basin)
DA-3	4.90	5.0	8.1	5.6	8.9	Yes (Detention basin)
DA-4	3.80	3.8	6.2	3.8	6.2	Yes (Detention basin)

SECTION 5

Synthetic Unit Hydrograph

Storage volumes by synthetic unit hydrograph for the 100 year event. Basin lag per the RCFC Hydrology Manual lag relation from watercourse length, length to centroid, slope and basin factor n; the unit hydrograph from the District valley S-graph (Plates E-4.1 to E-4.4) at a 5-minute unit time; the Plate E-5.9 rainfall patterns (for the 1-hour storm, the District HEC-HMS Preprocessor pattern at an intensity-duration slope of 0.46, Plate D-4.6); effective rain after the adjusted loss rate F = F_p (1 − 0.9 A_i), constant for the 1, 3 and 6-hour storms and varying with time for the 24-hour storm, the loss in a period is the smaller of F and the low loss rate times the rain, point rain adjusted for the drainage area by Plate E-5.8, AMC I for the 2 and 5-year storms (RCFC Hydrology Manual Section E).

BASIN PARAMETER	VALUE		
Drainage area, A	22.60 ac	S-graph	Valley
Watercourse length, L	1450 ft	Unit time	5 min
Length to centroid, Lca	640 ft	Adjusted loss rate, F (from the soils and 78% impervious)	0.126 in/hr
Minimum loss rate, 24-hour, Fm = F / 2	0.063 in/hr	Low loss rate (0.9 - 0.8 Ai, Ai 78%)	28%
		Depth-area factor (Plate E-5.8)	1 hr 99.98%, 3 hr 99.99%, 6 hr 99.99%, 24 hr 100.00%
Slope, S	0.0090 ft/ft	Basin factor, n	0.025
Lag time	**0.08 hr**	Ultimate discharge, K = 645 A	22.8 cfs per in/hr

STORM DURATION	DEPTH (IN)	RUNOFF (IN)	UNIT GRAPH PEAK (CFS PER IN/HR)	PEAK Q (CFS)	T_{PEAK} (HR)	VOLUME (AC-FT)	
1-hour	1.30	1.17	11.1	**57.5**	0.92	2.209	critical peak
3-hour	2.08	1.73	11.1	37.6	2.67	3.253	
6-hour	2.74	2.19	11.1	31.8	5.50	4.121	
24-hour	4.69	3.51	11.1	12.0	13.50	**6.603**	critical volume

Flood hydrograph, 24-hour storm (critical volume), tabulated at 15 minute intervals with the peak; ordinates below 0.01 cfs omitted.

TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)
0.00	0.0	6.25	2.7	12.50	8.3	18.75	1.0
0.25	0.5	6.50	2.8	12.75	9.2	19.00	0.7
0.50	0.9	6.75	3.0	13.00	9.7	19.25	0.9
0.75	0.9	7.00	3.1	13.25	11.7	19.50	1.2
1.00	1.2	7.25	3.1	13.50	12.0	19.75	1.0
1.25	1.0	7.50	3.4	13.75	8.1	20.00	0.7
1.50	0.9	7.75	3.7	14.00	7.5	20.25	0.9
1.75	0.9	8.00	4.0	14.25	8.9	20.50	0.9
2.00	1.2	8.25	4.5	14.50	8.8	20.75	0.9
2.25	1.2	8.50	4.6	14.75	8.8	21.00	0.7
2.50	1.2	8.75	4.9	15.00	8.5	21.25	0.9
2.75	1.5	9.00	5.2	15.25	8.1	21.50	0.7

TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)
3.00	1.5	9.25	5.8	15.50	7.7	21.75	0.9
3.25	1.5	9.50	6.1	15.75	6.2	22.00	0.7
3.50	1.5	9.75	6.4	16.00	6.0	22.25	0.9
3.75	1.5	10.00	6.7	16.25	2.0	22.50	0.7
4.00	1.8	10.25	5.0	16.50	1.4	22.75	0.6
4.25	1.8	10.50	4.7	16.75	1.0	23.00	0.6
4.50	2.1	10.75	5.9	17.00	0.9	23.25	0.6
4.75	2.2	11.00	6.1	17.25	1.5	23.50	0.6
5.00	2.4	11.25	5.9	17.50	1.5	23.75	0.6
5.25	1.9	11.50	5.9	17.75	1.5	24.00	0.6
5.50	2.1	11.75	5.4	18.00	1.3	24.25	0.1
5.75	2.4	12.00	5.5	18.25	1.2	24.50	0.0
6.00	2.5	12.25	7.6	18.50	1.2		

Rain and loss by 5-minute period, 24-hour storm: point rain 4.69 in times 100.00% (Plate E-5.8) = 4.69 in. In/hr. Loss is F when the rain is above it, otherwise the low loss rate times the rain.

HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.
0.08	0.038	0.010	0.027	8.08	0.281	0.078	0.204	16.08	0.075	0.021	0.054
0.17	0.038	0.010	0.027	8.17	0.281	0.078	0.204	16.17	0.075	0.021	0.054
0.25	0.038	0.010	0.027	8.25	0.281	0.078	0.204	16.25	0.075	0.021	0.054
0.33	0.056	0.016	0.041	8.33	0.281	0.078	0.204	16.33	0.075	0.021	0.054
0.42	0.056	0.016	0.041	8.42	0.281	0.078	0.204	16.42	0.075	0.021	0.054
0.50	0.056	0.016	0.041	8.50	0.281	0.078	0.204	16.50	0.075	0.021	0.054
0.58	0.056	0.016	0.041	8.58	0.300	0.083	0.217	16.58	0.056	0.016	0.041
0.67	0.056	0.016	0.041	8.67	0.300	0.083	0.217	16.67	0.056	0.016	0.041
0.75	0.056	0.016	0.041	8.75	0.300	0.083	0.217	16.75	0.056	0.016	0.041
0.83	0.075	0.021	0.054	8.83	0.319	0.088	0.231	16.83	0.056	0.016	0.041
0.92	0.075	0.021	0.054	8.92	0.319	0.088	0.231	16.92	0.056	0.016	0.041
1.00	0.075	0.021	0.054	9.00	0.319	0.088	0.231	17.00	0.056	0.016	0.041
1.08	0.056	0.016	0.041	9.08	0.356	0.098	0.258	17.08	0.094	0.026	0.068
1.17	0.056	0.016	0.041	9.17	0.356	0.098	0.258	17.17	0.094	0.026	0.068
1.25	0.056	0.016	0.041	9.25	0.356	0.098	0.258	17.25	0.094	0.026	0.068
1.33	0.056	0.016	0.041	9.33	0.375	0.104	0.272	17.33	0.094	0.026	0.068
1.42	0.056	0.016	0.041	9.42	0.375	0.104	0.272	17.42	0.094	0.026	0.068
1.50	0.056	0.016	0.041	9.50	0.375	0.104	0.272	17.50	0.094	0.026	0.068
1.58	0.056	0.016	0.041	9.58	0.394	0.109	0.285	17.58	0.094	0.026	0.068
1.67	0.056	0.016	0.041	9.67	0.394	0.109	0.285	17.67	0.094	0.026	0.068
1.75	0.056	0.016	0.041	9.75	0.394	0.109	0.285	17.75	0.094	0.026	0.068
1.83	0.075	0.021	0.054	9.83	0.413	0.114	0.299	17.83	0.075	0.021	0.054
1.92	0.075	0.021	0.054	9.92	0.413	0.114	0.299	17.92	0.075	0.021	0.054
2.00	0.075	0.021	0.054	10.00	0.413	0.114	0.299	18.00	0.075	0.021	0.054

HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.
2.08	0.075	0.021	0.054	10.08	0.281	0.078	0.204	18.08	0.075	0.021	0.054
2.17	0.075	0.021	0.054	10.17	0.281	0.078	0.204	18.17	0.075	0.021	0.054
2.25	0.075	0.021	0.054	10.25	0.281	0.078	0.204	18.25	0.075	0.021	0.054
2.33	0.075	0.021	0.054	10.33	0.281	0.078	0.204	18.33	0.075	0.021	0.054
2.42	0.075	0.021	0.054	10.42	0.281	0.078	0.204	18.42	0.075	0.021	0.054
2.50	0.075	0.021	0.054	10.50	0.281	0.078	0.204	18.50	0.075	0.021	0.054
2.58	0.094	0.026	0.068	10.58	0.375	0.104	0.272	18.58	0.056	0.016	0.041
2.67	0.094	0.026	0.068	10.67	0.375	0.104	0.272	18.67	0.056	0.016	0.041
2.75	0.094	0.026	0.068	10.75	0.375	0.104	0.272	18.75	0.056	0.016	0.041
2.83	0.094	0.026	0.068	10.83	0.375	0.104	0.272	18.83	0.038	0.010	0.027
2.92	0.094	0.026	0.068	10.92	0.375	0.104	0.272	18.92	0.038	0.010	0.027
3.00	0.094	0.026	0.068	11.00	0.375	0.104	0.272	19.00	0.038	0.010	0.027
3.08	0.094	0.026	0.068	11.08	0.356	0.098	0.258	19.08	0.056	0.016	0.041
3.17	0.094	0.026	0.068	11.17	0.356	0.098	0.258	19.17	0.056	0.016	0.041
3.25	0.094	0.026	0.068	11.25	0.356	0.098	0.258	19.25	0.056	0.016	0.041
3.33	0.094	0.026	0.068	11.33	0.356	0.098	0.258	19.33	0.075	0.021	0.054
3.42	0.094	0.026	0.068	11.42	0.356	0.098	0.258	19.42	0.075	0.021	0.054
3.50	0.094	0.026	0.068	11.50	0.356	0.098	0.258	19.50	0.075	0.021	0.054
3.58	0.094	0.026	0.068	11.58	0.319	0.088	0.231	19.58	0.056	0.016	0.041
3.67	0.094	0.026	0.068	11.67	0.319	0.088	0.231	19.67	0.056	0.016	0.041
3.75	0.094	0.026	0.068	11.75	0.319	0.088	0.231	19.75	0.056	0.016	0.041
3.83	0.113	0.031	0.081	11.83	0.338	0.093	0.244	19.83	0.038	0.010	0.027
3.92	0.113	0.031	0.081	11.92	0.338	0.093	0.244	19.92	0.038	0.010	0.027
4.00	0.113	0.031	0.081	12.00	0.338	0.093	0.244	20.00	0.038	0.010	0.027
4.08	0.113	0.031	0.081	12.08	0.469	0.118	0.351	20.08	0.056	0.016	0.041
4.17	0.113	0.031	0.081	12.17	0.469	0.117	0.352	20.17	0.056	0.016	0.041
4.25	0.113	0.031	0.081	12.25	0.469	0.117	0.352	20.25	0.056	0.016	0.041
4.33	0.131	0.036	0.095	12.33	0.488	0.116	0.372	20.33	0.056	0.016	0.041
4.42	0.131	0.036	0.095	12.42	0.488	0.116	0.372	20.42	0.056	0.016	0.041
4.50	0.131	0.036	0.095	12.50	0.488	0.115	0.373	20.50	0.056	0.016	0.041
4.58	0.131	0.036	0.095	12.58	0.525	0.114	0.411	20.58	0.056	0.016	0.041
4.67	0.131	0.036	0.095	12.67	0.525	0.114	0.411	20.67	0.056	0.016	0.041
4.75	0.131	0.036	0.095	12.75	0.525	0.113	0.412	20.75	0.056	0.016	0.041
4.83	0.150	0.041	0.109	12.83	0.544	0.113	0.431	20.83	0.038	0.010	0.027
4.92	0.150	0.041	0.109	12.92	0.544	0.112	0.432	20.92	0.038	0.010	0.027
5.00	0.150	0.041	0.109	13.00	0.544	0.112	0.432	21.00	0.038	0.010	0.027
5.08	0.113	0.031	0.081	13.08	0.638	0.111	0.527	21.08	0.056	0.016	0.041
5.17	0.113	0.031	0.081	13.17	0.638	0.110	0.527	21.17	0.056	0.016	0.041
5.25	0.113	0.031	0.081	13.25	0.638	0.110	0.528	21.25	0.056	0.016	0.041
5.33	0.131	0.036	0.095	13.33	0.638	0.109	0.528	21.33	0.038	0.010	0.027

HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.
5.42	0.131	0.036	0.095	13.42	0.638	0.109	0.529	21.42	0.038	0.010	0.027
5.50	0.131	0.036	0.095	13.50	0.638	0.108	0.530	21.50	0.038	0.010	0.027
5.58	0.150	0.041	0.109	13.58	0.431	0.108	0.324	21.58	0.056	0.016	0.041
5.67	0.150	0.041	0.109	13.67	0.431	0.107	0.324	21.67	0.056	0.016	0.041
5.75	0.150	0.041	0.109	13.75	0.431	0.107	0.325	21.75	0.056	0.016	0.041
5.83	0.150	0.041	0.109	13.83	0.431	0.106	0.325	21.83	0.038	0.010	0.027
5.92	0.150	0.041	0.109	13.92	0.431	0.106	0.326	21.92	0.038	0.010	0.027
6.00	0.150	0.041	0.109	14.00	0.431	0.105	0.326	22.00	0.038	0.010	0.027
6.08	0.169	0.047	0.122	14.08	0.506	0.104	0.402	22.08	0.056	0.016	0.041
6.17	0.169	0.047	0.122	14.17	0.506	0.104	0.403	22.17	0.056	0.016	0.041
6.25	0.169	0.047	0.122	14.25	0.506	0.103	0.403	22.25	0.056	0.016	0.041
6.33	0.169	0.047	0.122	14.33	0.488	0.103	0.385	22.33	0.038	0.010	0.027
6.42	0.169	0.047	0.122	14.42	0.488	0.102	0.385	22.42	0.038	0.010	0.027
6.50	0.169	0.047	0.122	14.50	0.488	0.102	0.386	22.50	0.038	0.010	0.027
6.58	0.188	0.052	0.136	14.58	0.488	0.101	0.386	22.58	0.038	0.010	0.027
6.67	0.188	0.052	0.136	14.67	0.488	0.101	0.387	22.67	0.038	0.010	0.027
6.75	0.188	0.052	0.136	14.75	0.488	0.100	0.388	22.75	0.038	0.010	0.027
6.83	0.188	0.052	0.136	14.83	0.469	0.100	0.369	22.83	0.038	0.010	0.027
6.92	0.188	0.052	0.136	14.92	0.469	0.099	0.370	22.92	0.038	0.010	0.027
7.00	0.188	0.052	0.136	15.00	0.469	0.099	0.370	23.00	0.038	0.010	0.027
7.08	0.188	0.052	0.136	15.08	0.450	0.098	0.352	23.08	0.038	0.010	0.027
7.17	0.188	0.052	0.136	15.17	0.450	0.098	0.353	23.17	0.038	0.010	0.027
7.25	0.188	0.052	0.136	15.25	0.450	0.097	0.353	23.25	0.038	0.010	0.027
7.33	0.206	0.057	0.149	15.33	0.431	0.097	0.335	23.33	0.038	0.010	0.027
7.42	0.206	0.057	0.149	15.42	0.431	0.096	0.335	23.42	0.038	0.010	0.027
7.50	0.206	0.057	0.149	15.50	0.431	0.096	0.336	23.50	0.038	0.010	0.027
7.58	0.225	0.062	0.163	15.58	0.356	0.095	0.261	23.58	0.038	0.010	0.027
7.67	0.225	0.062	0.163	15.67	0.356	0.095	0.262	23.67	0.038	0.010	0.027
7.75	0.225	0.062	0.163	15.75	0.356	0.094	0.262	23.75	0.038	0.010	0.027
7.83	0.244	0.067	0.177	15.83	0.356	0.094	0.263	23.83	0.038	0.010	0.027
7.92	0.244	0.067	0.177	15.92	0.356	0.093	0.263	23.92	0.038	0.010	0.027
8.00	0.244	0.067	0.177	16.00	0.356	0.093	0.264	24.00	0.038	0.010	0.027

Effective rain 3.51 in, loss 1.18 in.

SECTION 6

Detention Basin

Tributary to the basin: the whole site, DA-1, DA-2, DA-3, DA-4, 22.60 ac, 24-hour runoff volume 6.603 ac-ft. On-site detention basin with a controlled outlet. The Section 5 flood hydrograph of the 100-year 6-hour storm, 4.121 ac-ft, the storm that gives the highest water surface, is routed through the basin by the Modified Puls method (Basin Routing sheet); the peak outflow is compared with the existing-condition peak at the same return period, and freeboard is read at the routed water surface.

BASIN GEOMETRY	VALUE	OUTLET WORKS	VALUE
Bottom elevation	1,440.00 ft	Primary outlet	Orifice, 14 in at 1,440.00 ft
Top elevation	1,447.00 ft	Emergency spillway	Weir, 20.0 ft at 1,446.00 ft
Bottom area	28,000 ft²	Top area	41,000 ft²
Depth	**7.00 ft**	**Provided volume**	**5.511 ac-ft (240,058 ft³)**

ROUTING RESULT	VALUE		
Peak inflow	31.76 cfs	Peak outflow	8.85 cfs
Maximum water surface	1,443.35 ft	Storage at the maximum	2.379 ac-ft (103,630 ft³)
Peak reduction	72.1%	Freeboard to rim	3.65 ft

CHECK	REQUIRED	PROVIDED	RESULT
Peak outflow, 100-year, against the existing-condition peak	35.07 cfs	8.85 cfs	**Release does not exceed the existing peak**
Freeboard at the routed water surface, 1,443.35 ft	1.00 ft	3.65 ft	**One foot or more to the rim**
Storage at the maximum water surface	2.379 ac-ft	5.511 ac-ft	**Within the basin**

Volume and Project Hydrology

STORM VOLUME SUMMARY

NRCS TR-55 Curve Number Method · P24 = 4.69 in · CN per tributary area: HSG-weighted NRCS Table 2-2 from the row's soils, else CN ≈ 55 + 50·C (Plate D-5.7 fit)

DA-1 — 2.629 ac-ft

T-1 initial — **1.029**
A = 3.20 ac · C = 0.88 → CN = 92.7 (HSG-weighted Table 2-2)
S = 0.79″ · I_e = 0.16″ · P_{24} = 4.69″

T-2 — **0.891**
A = 2.40 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 4.69″

T-3 — **0.708**
A = 2.20 ac · C = 0.88 → CN = 92.7 (HSG-weighted Table 2-2)
S = 0.78″ · I_e = 0.16″ · P_{24} = 4.69″

114,503 ft³

DA-2 — 2.167 ac-ft

T-4 initial — **0.645**
A = 2.00 ac · C = 0.88 → CN = 92.8 (HSG-weighted Table 2-2)
S = 0.78″ · I_e = 0.16″ · P_{24} = 4.69″

T-5 — **0.557**
A = 1.50 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 4.69″

T-6 initial — **0.594**
A = 1.60 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 4.69″

T-7 confluence — —

T-8 — **0.371**
A = 1.00 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 4.69″

94,397 ft³

DA-3 — 1.521 ac-ft

T-9 initial — **0.147**
A = 1.20 ac · C = 0.66 → CN = 65.3 (HSG-weighted Table 2-2)
S = 5.31″ · I_e = 1.06″ · P_{24} = 4.69″

T-10 — **1.373**
A = 3.70 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 4.69″

66,237 ft³

DA-4 — 0.492 ac-ft

T-11 initial — **0.492**
A = 3.80 ac · C = 0.78 → CN = 66.5 (HSG-weighted Table 2-2)
S = 5.04″ · I_e = 1.01″ · P_{24} = 4.69″

21,426 ft³

Total Across All DAs: **6.808 ac-ft · 296,563 ft³**

Same P, A and C under each method: NRCS CN = **6.808 ac-ft** · RCFC Volumetric = **7.607 ac-ft** · Tc-Duration = **2.289 ac-ft**

CRITICAL STORM EVENT ANALYSIS (MULTI-DURATION)

DA / Subarea	1-hour P = 1.30″	3-hour P = 2.08″	6-hour P = 2.74″	24-hour P = 4.69″	Governing
T-1 DA-1	0.180	0.363	0.527	**1.029**	**24-hour** 1.029 ac-ft
· T-2 DA-1	0.217	0.371	0.502	**0.891**	**24-hour** 0.891 ac-ft
· T-3 DA-1	0.124	0.250	0.363	**0.708**	**24-hour** 0.708 ac-ft
DA-1 total	**0.521**	**0.985**	**1.393**	**2.629**	**24-hour** 2.629 ac-ft
T-4 DA-2	0.114	0.229	0.331	**0.645**	**24-hour** 0.645 ac-ft
· T-5 DA-2	0.135	0.232	0.314	**0.557**	**24-hour** 0.557 ac-ft
T-6 DA-2	0.144	0.247	0.335	**0.594**	**24-hour** 0.594 ac-ft
⇄ T-7 DA-2	—	—	—	—	—
· T-8 DA-2	0.090	0.154	0.209	**0.371**	**24-hour** 0.371 ac-ft
DA-2 total	**0.484**	**0.862**	**1.189**	**2.167**	**24-hour** 2.167 ac-ft
T-9 DA-3	0.001	0.016	0.040	**0.147**	**24-hour** 0.147 ac-ft
· T-10 DA-3	0.334	0.572	0.774	**1.373**	**24-hour** 1.373 ac-ft
DA-3 total	**0.335**	**0.588**	**0.814**	**1.521**	**24-hour** 1.521 ac-ft
T-11 DA-4	0.005	0.059	0.140	**0.492**	**24-hour** 0.492 ac-ft
DA-4 total	**0.005**	**0.059**	**0.140**	**0.492**	**24-hour** 0.492 ac-ft
All drainage areas	**1.345**	**2.494**	**3.536**	**6.808**	**24-hour** 6.808 ac-ft

Governing event 24-hour · V = 6.808 ac-ft 296,563 ft³ · size the retention or detention basin for this event

PROJECT HYDROLOGY SUMMARY final Q and V per tributary, with confluence trace — Method: NRCS TR-55 CN · P_24hr critical = 4.69 in

Row	Type	Area (ac)	Tc (min)	Peak Q (cfs)	Volume (ac-ft)
DA-1					
T-1	initial	3.20	9.1	**8.62**	**1.029**
T-2	downstream	2.40	12.6	**14.51**	**0.891**
T-3	downstream	2.20	15.2	**19.40**	**0.708**
DA-1 OUTLET		-	**15.2**	19.40	2.629
DA-2					
T-4	initial	2.00	8.6	**5.50**	**0.645**
T-5	downstream	1.50	11.9	**9.25**	**0.557**
T-6	initial	1.60	7.7	**4.65**	**0.594**
T-7	confluence	0.00	11.9	**13.26**	—
T-8	downstream	1.00	12.4	**15.73**	**0.371**
DA-2 OUTLET		-	**12.4**	15.73	2.167
DA-3					
T-9	initial	1.20	20.5	**1.77**	**0.147**
T-10	downstream	3.70	22.6	**8.88**	**1.373**
DA-3 OUTLET		-	**22.6**	8.88	1.521
DA-4					
T-11	initial	3.80	23.8	**6.21**	**0.492**
DA-4 OUTLET		-	**23.8**	6.21	0.492
PROJECT TOTAL (sum of DA outlets)		**22.60**	-	50.22	6.808
PROJECT TOTAL Q (RCFC Plate D-1 confluence)		**22.60**	**15.2**	**43.83**	**6.808**

FINAL CONFLUENCE, EACH TC TRIED (RCFC PLATE D-1, ITEM 10)

Trial	Time of the peak	Tc (min)	Q (cfs)	I (in/hr)	Each outlet's share
1	Peak at the Tc of DA-4	23.8	42.76	2.08	DA-4 6.21 cfs + DA-3 8.88 cfs × (2.08 in/hr / 2.13 in/hr) + DA-1 19.40 cfs × (2.08 in/hr / 2.53 in/hr) + DA-2 15.73 cfs × (2.08 in/hr / 2.75 in/hr)
2	Peak at the Tc of DA-3	22.6	43.31	2.13	DA-4 6.21 cfs × (22.6 min / 23.8 min) + DA-3 8.88 cfs + DA-1 19.40 cfs × (2.13 in/hr / 2.53 in/hr) + DA-2 15.73 cfs × (2.13 in/hr / 2.75 in/hr)
3	**Peak at the Tc of DA-1 (governs, PROJECT Q)**	**15.2**	**43.83**	**2.53**	**DA-4 6.21 cfs × (15.2 min / 23.8 min) + DA-3 8.88 cfs × (15.2 min / 22.6 min) + DA-1 19.40 cfs + DA-2 15.73 cfs × (2.53 in/hr / 2.75 in/hr)**
4	Peak at the Tc of DA-2	12.4	39.57	2.75	DA-4 6.21 cfs × (12.4 min / 23.8 min) + DA-3 8.88 cfs × (12.4 min / 22.6 min) + DA-1 19.40 cfs × (12.4 min / 15.2 min) + DA-2 15.73 cfs

Each DA outlet's Tc is tried as the time of the peak. An outlet with a longer Tc counts Q × (T / T of that outlet); one with a shorter Tc counts Q × (I / I of that outlet); one with the same Tc counts in full. The largest total governs and is the PROJECT TOTAL Q at the final outfall.

PROJECT TOTAL Q & V (use these for design submittal)

Total Q = **43.83 cfs** at Tc = 15.2 min (RCFC Plate D-1 confluence) **Total V** = **6.808 ac-ft** (296,563 ft³ · 2,218,442 gal)

Peak Q sum = arithmetic sum of each DA's outlet Q (assumes all DAs flow to a common downstream point without timing correction). **RCFC Plate D-1 confluence** applies the time-of-concentration correction (cases a / b(1) / b(2)) for the true peak when DAs combine at a junction with different Tcs. The storm drain applies the same combination at each node, with pipe travel time between nodes; the flow at the outfall is on the hydraulic calculation sheet. **Volume** is always the linear sum across DAs (volumes don't time-shift).

Rational Method Tabulation

Existing condition, 10-year storm

Rider Street Logistics Center
Q = C × I × A

$$I = A / (Tc + B)^{n} \quad A = \mathbf{11.6}\ B = \mathbf{8}\ n = \mathbf{0.62}$$

DA-1	DA-2	DA-3	DA-4
Q = 7.31 cfs	**Q = 5.90 cfs**	**Q = 4.97 cfs**	**Q = 3.79 cfs**
Tc: 26.3 min	Tc: 24.9 min	Tc: 23.0 min	Tc: 23.8 min

DA	AREA	TERM	Soil/Dev	A (Ac)	T (MIN)	I (in/hr)	C	dQ (CFS)	Q (CFS)	SLOPE	SECTION	V (FPS)	L (FT)	T (MIN)	REMARKS
DA-1	**E-1**	--	B/C/Natural	7.80	**26.3**	1.30	0.72	**7.3**	**7.3**	0.0110	--	2.4	880	6.1	Existing, vacant
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **7.31 cfs**		Tc **26.30 min**		I **1.296 in/hr**									
DA-2	**E-2**	--	B/C/Natural	6.10	**24.9**	1.33	0.73	**5.9**	**5.9**	0.0110	--	2.3	760	5.5	Existing, vacant
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **5.90 cfs**		Tc **24.93 min**		I **1.329 in/hr**									
DA-3	**E-3**	--	B/C/Natural	4.90	**23.0**	1.38	0.74	**5.0**	**5.0**	0.0110	--	2.2	640	4.8	Existing, vacant
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **4.97 cfs**		Tc **23.03 min**		I **1.379 in/hr**									
DA-4	**E-4**	--	B/C/Natural	3.80	**23.8**	1.36	0.73	**3.8**	**3.8**	0.0200	--	2.8	940	5.6	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **3.79 cfs**		Tc **23.82 min**		I **1.358 in/hr**									

Rational Method Tabulation

Existing condition, 100-year storm

$$I = A / (Tc + B)^{n} \quad A = 17.8 \; B = 8 \; n = 0.62$$

DA-1	DA-2	DA-3	DA-4
Q = 12.03 cfs	**Q = 9.69 cfs**	**Q = 8.14 cfs**	**Q = 6.21 cfs**
Tc: 26.3 min	Tc: 24.9 min	Tc: 23.0 min	Tc: 23.8 min

DA	AREA	TERM	Soil/Dev	A (Ac)	T (MIN)	I (in/hr)	C	dQ (CFS)	Q (CFS)	SLOPE	SECTION	V (FPS)	L (FT)	T (MIN)	REMARKS
DA-1	**E-1**	--	B/C/Natural	7.80	**26.3**	1.99	0.78	**12.0**	**12.0**	0.0110	--	2.7	880	5.3	Existing, vacant
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **12.03 cfs**		Tc **26.30 min**		I **1.989 in/hr**									
DA-2	**E-2**	--	B/C/Natural	6.10	**24.9**	2.04	0.78	**9.7**	**9.7**	0.0110	--	2.6	760	4.9	Existing, vacant
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **9.69 cfs**		Tc **24.93 min**		I **2.040 in/hr**									
DA-3	**E-3**	--	B/C/Natural	4.90	**23.0**	2.12	0.79	**8.1**	**8.1**	0.0110	--	2.5	640	4.3	Existing, vacant
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **8.14 cfs**		Tc **23.03 min**		I **2.116 in/hr**									
DA-4	**E-4**	--	B/C/Natural	3.80	**23.8**	2.08	0.78	**6.2**	**6.2**	0.0200	--	3.1	940	5.0	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **6.21 cfs**		Tc **23.82 min**		I **2.083 in/hr**									

Rational Method Tabulation

Proposed condition, 10-year storm

Rider Street Logistics Center
Q = C × I × A

$$I = A / (Tc + B)^{n} \quad A = 11.6 \; B = 8 \; n = 0.62$$

DA-1	DA-2	DA-3	DA-4
Q = 12.47 cfs	**Q = 10.15 cfs**	**Q = 5.62 cfs**	**Q = 3.79 cfs**
Tc: 15.9 min	Tc: 12.8 min	Tc: 22.9 min	Tc: 23.8 min

DA	AREA	TERM	Soil/Dev	A (Ac)	T (MIN)	I (in/hr)	C	dQ (CFS)	Q (CFS)	SLOPE	SECTION	V (FPS)	L (FT)	T (MIN)	REMARKS
DA-1	T-1	--	B/C/Comm	3.20	**9.1**	2.00	0.87	**5.6**	**5.6**	0.0090	--	2.1	480	3.9	Roof and truck court
DA-1	T-2	--	B/C/Paved	2.40	**13.0**	1.76	0.90	**3.8**	**9.4**	0.0070	Private Drive	3.0	520	2.9	Gutter flow, private drive
DA-1	T-3	--	B/C/Comm	2.20	**15.9**	1.62	0.87	**3.1**	**12.5**	0.0060	24" RCP	6.1	260	0.7	Pipe travel to CB A-6
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **12.47 cfs**		Tc **15.86 min**		I **1.623 in/hr**									
DA-2	T-4	--	B/C/Comm	2.00	**8.6**	2.03	0.87	**3.6**	**3.6**	0.0080	--	1.7	390	3.7	Building, east half
DA-2	T-5	--	B/C/Paved	1.50	**12.3**	1.79	0.90	**2.4**	**6.0**	0.0060	40' Local	2.6	410	2.7	Street gutter, Drive B
DA-2	T-6	--	B/C/Paved	1.60	**7.7**	2.10	0.90	**3.0**	**3.0**	0.0080	--	1.7	300	3.0	Auto parking, south lot
DA-2	T-7	--	B/Paved	0.00	**12.3**	1.79	0.92	**0.0**	**8.6**	0.0060	30" RCP	5.5	150	0.5	Confluence, Plate D-1
DA-2	T-8	--	B/C/Paved	1.00	**12.8**	1.77	0.90	**1.6**	**10.1**	0.0050	30" RCP	5.4	190	0.6	Pipe travel to CB B-2
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **10.15 cfs**		Tc **12.76 min**		I **1.769 in/hr**									
DA-3	T-9	--	B/C/Park	1.20	**20.5**	1.45	0.58	**1.0**	**1.0**	0.0140	--	1.8	260	2.4	Landscape buffer
DA-3	T-10	--	B/C/Paved	3.70	**22.9**	1.38	0.90	**4.6**	**5.6**	0.0080	Industrial	2.8	470	2.8	Industrial drive aisle
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **5.62 cfs**		Tc **22.89 min**		I **1.383 in/hr**									
DA-4	T-11	--	B/C/Natural	3.80	**23.8**	1.36	0.73	**3.8**	**3.8**	0.0200	--	2.8	940	5.6	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **3.79 cfs**		Tc **23.82 min**		I **1.358 in/hr**									

Rational Method Tabulation

Proposed condition, 100-year storm

Rider Street Logistics Center
Q = C × I × A

$$I = A / (Tc + B)^{n} \quad A = 17.8 \; B = 8 \; n = 0.62$$

DA-1	DA-2	DA-3	DA-4
Q = 19.40 cfs	**Q = 15.73 cfs**	**Q = 8.88 cfs**	**Q = 6.21 cfs**
Tc: 15.2 min	Tc: 12.4 min	Tc: 22.6 min	Tc: 23.8 min

DA	AREA	TERM	Soil/Dev	A (Ac)	T (MIN)	I (in/hr)	C	dQ (CFS)	Q (CFS)	SLOPE	SECTION	V (FPS)	L (FT)	T (MIN)	REMARKS
DA-1	T-1	--	B/C/Comm	3.20	**9.1**	3.06	0.88	**8.6**	**8.6**	0.0090	--	2.3	480	3.5	Roof and truck court
DA-1	T-2	--	B/C/Paved	2.40	**12.6**	2.73	0.90	**5.9**	**14.5**	0.0070	Private Drive	3.3	520	2.6	Gutter flow, private drive
DA-1	T-3	--	B/C/Comm	2.20	**15.2**	2.53	0.88	**4.9**	**19.4**	0.0060	24" RCP	6.2	260	0.7	Pipe travel to CB A-6
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **19.40 cfs**		Tc **15.19 min**		I **2.535 in/hr**									
DA-2	T-4	--	B/C/Comm	2.00	**8.6**	3.12	0.88	**5.5**	**5.5**	0.0080	--	1.9	390	3.4	Building, east half
DA-2	T-5	--	B/C/Paved	1.50	**11.9**	2.78	0.90	**3.8**	**9.3**	0.0060	40' Local	2.8	410	2.4	Street gutter, Drive B
DA-2	T-6	--	B/C/Paved	1.60	**7.7**	3.23	0.90	**4.6**	**4.6**	0.0080	--	1.9	300	2.7	Auto parking, south lot
DA-2	T-7	--	B/Paved	0.00	**11.9**	2.78	0.92	**0.0**	**13.3**	0.0060	30" RCP	6.2	150	0.4	Confluence, Plate D-1
DA-2	T-8	--	B/C/Paved	1.00	**12.4**	2.75	0.90	**2.5**	**15.7**	0.0050	30" RCP	6.0	190	0.5	Pipe travel to CB B-2
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **15.73 cfs**		Tc **12.35 min**		I **2.748 in/hr**									
DA-3	T-9	--	B/C/Park	1.20	**20.5**	2.23	0.66	**1.8**	**1.8**	0.0140	--	2.0	260	2.2	Landscape buffer
DA-3	T-10	--	B/C/Paved	3.70	**22.6**	2.13	0.90	**7.1**	**8.9**	0.0080	Industrial	3.1	470	2.5	Industrial drive aisle
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **8.88 cfs**		Tc **22.64 min**		I **2.133 in/hr**									
DA-4	T-11	--	B/C/Natural	3.80	**23.8**	2.08	0.78	**6.2**	**6.2**	0.0200	--	3.1	940	5.0	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **6.21 cfs**		Tc **23.82 min**		I **2.083 in/hr**									

CATCH BASIN INLET CAPACITY

CB A-6, Rider Street Logistics Center

Curb opening inlet, sump, 19.40 cfs. Gutter flow depth and velocity by Manning's equation for a triangular section (HEC-22); capture at each standard width by the HEC-22 sag curb opening with water at the top of the curb: weir Q = 2.3 (L + 1.8 W) $d^{1.5}$ (3.0 L $d^{1.5}$ with no depression), orifice above 1.4 h, with a 50 percent clogging factor. The required width takes all of the flow.

Does not meet. 28 ft takes 12.85 cfs of 19.40 cfs at the top of the curb; no standard width takes all of it (44.1 ft would). Add a second inlet.

GUTTER	VALUE	INLET	VALUE
Design flow	19.40 cfs	Inlet type	Sump
Street length	8 ft	Depression width	2 ft
Upstream elevation	1459.50 ft	Depression depth	4 in
Downstream elevation	1459.20 ft	Inlet height	6 in
Longitudinal slope	0.0375 ft/ft	Manning's n	0.016
Cross slope	0.02 ft/ft	Curb height	6 in

GUTTER FLOW	VALUE		
Depth upstream of the inlet	4.11 in	Velocity	6.63 fps
Depth downstream, after capture	2.73 in	Over capacity at 28 ft	6.55 cfs
Capacity at the top of the curb	12.85 cfs	Ponding depth	**7.90 in, over curb**
Width to take all of the flow	**44.1 ft (over the 21 ft standard)**	**Width selected**	**28 ft, 66% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY
4 ft	16%	3.09 cfs	16.31 cfs
7 ft	22%	4.31 cfs	15.09 cfs
14 ft	37%	7.16 cfs	12.24 cfs
21 ft	52%	10.00 cfs	9.40 cfs

FHWA HEC-22 Urban Drainage Design Manual (3rd ed.). Rider Street Logistics Center · October 4, 2026

CATCH BASIN INLET CAPACITY

CB B-2, Rider Street Logistics Center

Curb opening inlet, sump, 15.73 cfs. Gutter flow depth and velocity by Manning's equation for a triangular section (HEC-22); capture at each standard width by the HEC-22 sag curb opening with water at the top of the curb: weir Q = 2.3 (L + 1.8 W) $d^{1.5}$ (3.0 L $d^{1.5}$ with no depression), orifice above 1.4 h, with a 50 percent clogging factor. The required width takes all of the flow.

Does not meet. 21 ft takes 10.00 cfs of 15.73 cfs at the top of the curb; no standard width takes all of it (35.1 ft would). Add a second inlet.

GUTTER	VALUE	INLET	VALUE
Design flow	15.73 cfs	Inlet type	Sump
Street length	8 ft	Depression width	2 ft
Upstream elevation	1453.70 ft	Depression depth	4 in
Downstream elevation	1453.40 ft	Inlet height	6 in
Longitudinal slope	0.0375 ft/ft	Manning's n	0.016
Cross slope	0.02 ft/ft	Curb height	6 in

GUTTER FLOW	VALUE		
Depth upstream of the inlet	3.79 in	Velocity	6.29 fps
Depth downstream, after capture	2.60 in	Over capacity at 21 ft	5.73 cfs
Capacity at the top of the curb	10.00 cfs	Ponding depth	**8.11 in, over curb**
Width to take all of the flow	**35.1 ft (over the 21 ft standard)**	**Width selected**	**21 ft, 64% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY	
4 ft	20%	3.09 cfs	12.64 cfs	
7 ft	27%	4.31 cfs	11.42 cfs	
14 ft	45%	7.16 cfs	8.57 cfs	
21 ft	**64%**	**10.00 cfs**	**5.73 cfs**	selected

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CATCH BASIN INLET CAPACITY

CB C-1, Rider Street Logistics Center

Curb opening inlet, sump, 8.88 cfs. Gutter flow depth and velocity by Manning's equation for a triangular section (HEC-22); capture at each standard width by the HEC-22 sag curb opening with water at the top of the curb: weir Q = 2.3 (L + 1.8 W) $d^{1.5}$ (3.0 L $d^{1.5}$ with no depression), orifice above 1.4 h, with a 50 percent clogging factor. The required width takes all of the flow.

Does not meet. 14 ft takes 7.16 cfs of 8.88 cfs at the top of the curb; 18.2 ft takes all of it, the 21 ft standard width.

GUTTER	VALUE	INLET	VALUE
Design flow	8.88 cfs	Inlet type	Sump
Street length	8 ft	Depression width	2 ft
Upstream elevation	1454.40 ft	Depression depth	4 in
Downstream elevation	1454.10 ft	Inlet height	6 in
Longitudinal slope	0.0375 ft/ft	Manning's n	0.016
Cross slope	0.02 ft/ft	Curb height	6 in

GUTTER FLOW	VALUE		
Depth upstream of the inlet	3.06 in	Velocity	5.45 fps
Depth downstream, after capture	1.66 in	Over capacity at 14 ft	1.72 cfs
Capacity at the top of the curb	7.16 cfs	Ponding depth	**6.93 in, over curb**
Width to take all of the flow	**18.2 ft**	**Width selected**	**14 ft, 81% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY	
4 ft	35%	3.09 cfs	5.79 cfs	
7 ft	49%	4.31 cfs	4.57 cfs	
14 ft	**81%**	**7.16 cfs**	**1.72 cfs**	selected
21 ft	100%	8.88 cfs	0.00 cfs	recommended

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CATCH BASIN INLET CAPACITY

CB D-2, Rider Street Logistics Center

Curb opening inlet, sump, 6.21 cfs. Gutter flow depth and velocity by Manning's equation for a triangular section (HEC-22); capture at each standard width by the HEC-22 sag curb opening with water at the top of the curb: weir Q = 2.3 (L + 1.8 W) $d^{1.5}$ (3.0 L $d^{1.5}$ with no depression), orifice above 1.4 h, with a 50 percent clogging factor. The required width takes all of the flow.

Does not meet. 7 ft takes 4.31 cfs of 6.21 cfs at the top of the curb; 11.7 ft takes all of it, the 14 ft standard width.

GUTTER	VALUE	INLET	VALUE
Design flow	6.21 cfs	Inlet type	Sump
Street length	8 ft	Depression width	2 ft
Upstream elevation	1451.30 ft	Depression depth	4 in
Downstream elevation	1451.00 ft	Inlet height	6 in
Longitudinal slope	0.0375 ft/ft	Manning's n	0.016
Cross slope	0.02 ft/ft	Curb height	6 in

GUTTER FLOW	VALUE		
Depth upstream of the inlet	2.68 in	Velocity	4.99 fps
Depth downstream, after capture	1.72 in	Over capacity at 7 ft	1.90 cfs
Capacity at the top of the curb	4.31 cfs	Ponding depth	**7.65 in, over curb**
Width to take all of the flow	**11.7 ft**	**Width selected**	**7 ft, 69% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY	
4 ft	50%	3.09 cfs	3.12 cfs	
7 ft	**69%**	**4.31 cfs**	**1.90 cfs**	selected
14 ft	100%	6.21 cfs	0.00 cfs	recommended
21 ft	100%	6.21 cfs	0.00 cfs	

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RIPRAP OUTLET PROTECTION

Line A outlet to the detention basin, Rider Street Logistics Center

Riprap at a circular pipe outlet discharging 39.78 cfs. Stone size from the outlet velocity (at the outlet flow depth) by the Isbash relation, d50 = V^2 / (2g C^2 (Ss − 1)), C the stability factor (0.86 high turbulence, 1.20 low); apron length, flare and thickness from FHWA HEC-14 Table 10.1 by stone size. The rock class is the smallest standard class whose nominal size covers the stone, RSP classes per RCFC Hydraulic Design Manual Table 8.9.

Sized. Outlet velocity 7.72 fps; computed stone d50 9.1 in, below the Class III minimum; Class III (12 in, 150 lb) governs; apron 15.0 ft long by 19.0 ft wide, 2.00 ft thick, about 34.7 tons.

OUTLET	VALUE
Discharge type	circular pipe
Diameter	3.00 ft
Design flow	39.78 cfs
Outlet velocity	**7.72 fps**
Stone specific gravity	2.65
Stability factor C	0.86

RIPRAP	VALUE
Stone d50	**9.1 in computed; 12 in (class minimum) governs**
Class	Class III (12 in, 150 lb)
Apron length	15.0 ft
Apron width	19.0 ft
Thickness	2.00 ft
Volume	420 ft³
Weight	34.7 tons

FHWA HEC-14, Hydraulic Design of Energy Dissipators (3rd ed.), riprap aprons; Riverside County Flood Control and Water Conservation District Hydraulic Design Manual (March 2024), 8.7.5 rock size and Table 8.9 RSP classes, 9.3.4 riprap aprons. Rider Street Logistics Center · October 4, 2026

RIPRAP OUTLET PROTECTION

Line D outlet to the detention basin, Rider Street Logistics Center

Riprap at a circular pipe outlet discharging 6.21 cfs. Stone size from the outlet velocity (at the outlet flow depth) by the Isbash relation, d50 = V^2 / (2g C^2 (Ss − 1)), C the stability factor (0.86 high turbulence, 1.20 low); apron length, flare and thickness from FHWA HEC-14 Table 10.1 by stone size. The rock class is the smallest standard class whose nominal size covers the stone, RSP classes per RCFC Hydraulic Design Manual Table 8.9.

Sized. Outlet velocity 4.65 fps; computed stone d50 3.3 in, below the Class I minimum; Class I (6 in, 20 lb) governs; apron 8.0 ft long by 11.3 ft wide, 1.46 ft thick, about 8.3 tons.

OUTLET	VALUE
Discharge type	circular pipe
Diameter	2.00 ft
Design flow	6.21 cfs
Outlet velocity	**4.65 fps**
Stone specific gravity	2.65
Stability factor C	0.86

RIPRAP	VALUE
Stone d50	**3.3 in computed; 6 in (class minimum) governs**
Class	Class I (6 in, 20 lb)
Apron length	8.0 ft
Apron width	11.3 ft
Thickness	1.46 ft
Volume	101 ft^3
Weight	8.3 tons

FHWA HEC-14, Hydraulic Design of Energy Dissipators (3rd ed.), riprap aprons; Riverside County Flood Control and Water Conservation District Hydraulic Design Manual (March 2024), 8.7.5 rock size and Table 8.9 RSP classes, 9.3.4 riprap aprons. Rider Street Logistics Center · October 4, 2026

BASIN ROUTING

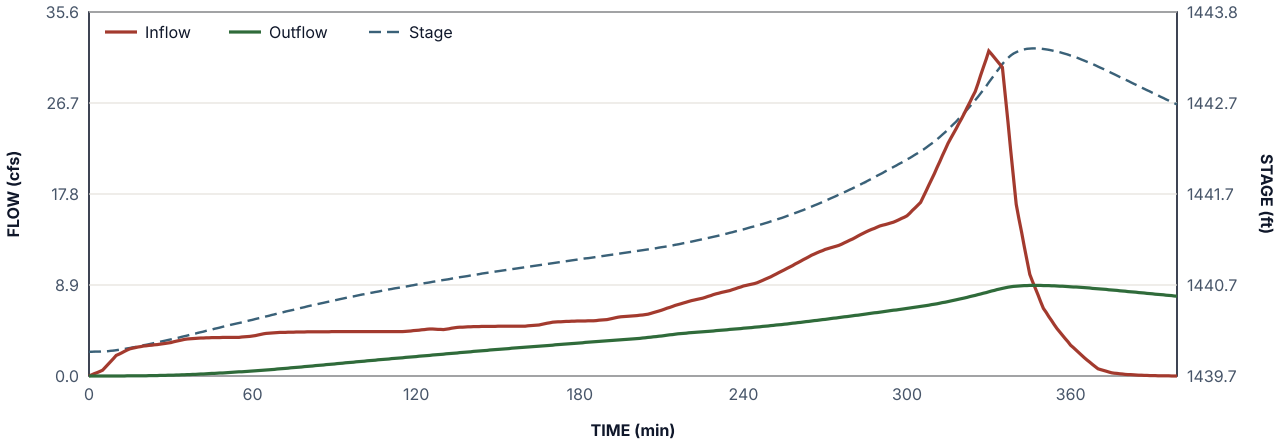
Modified Puls, Rider Street Logistics Center

Tributary to the basin: the whole site, DA-1, DA-2, DA-3, DA-4, 22.60 ac, 24-hour runoff volume 6.603 ac-ft. The design inflow hydrograph routed through the basin by the Modified Puls (storage indication) method with prismoidal stage-storage. The 1-hour, 3-hour, 6-hour and 24-hour storms were each routed; the 6-hour storm gives the highest water surface (1-hour 1,442.61 ft, 3-hour 1,443.22 ft, 6-hour 1,443.35 ft, 24-hour 1,442.47 ft). Inflow is the Section 5 flood hydrograph of the 6-hour storm, 4.121 ac-ft, peak 31.8 cfs. Outlet: orifice, 14 in at 1,440.00 ft; overflow weir, 20.0 ft wide, crest 1,446.00 ft.

BASIN	VALUE		
Bottom elevation	1,440.00 ft	Bottom area	28,000 ft²
Top elevation	1,447.00 ft	Top area	41,000 ft²
Depth	7.00 ft	Capacity to rim	240,058 ft³ (5.511 ac-ft)

RESULT	VALUE		
Peak inflow	31.76 cfs at 330 min	Inflow volume	179,501 ft³
Peak outflow	8.85 cfs	Peak reduction	72.1%
Maximum water surface	**1,443.35 ft at 347 min**	**Maximum storage**	**103,630 ft³ (2.379 ac-ft)**
Freeboard to rim	3.65 ft	Storage used	43.2% of capacity

ROUTING HYDROGRAPH



REQUIREMENT	CALCULATED	REQUIRED	STATUS
Freeboard to rim	3.65 ft	≥ 1.0 ft	OK
Peak outflow	8.85 cfs	≤ 35.07 cfs	OK
Maximum water surface	1,443.35 ft	< 1,447.00 ft (rim)	OK

Routing table at 23 minute intervals.

TIME (MIN)	INFLOW (CFS)	OUTFLOW (CFS)	STORAGE (FT³)	STAGE (FT)
0	0.00	0.00	0	1,440.00
23	3.01	0.04	2,534	1,440.09
46	3.75	0.26	7,136	1,440.25
69	4.24	0.67	11,921	1,440.42
92	4.33	1.23	16,550	1,440.58
115	4.34	1.79	20,447	1,440.71
138	4.79	2.32	23,908	1,440.83
161	4.90	2.83	27,036	1,440.94
184	5.39	3.32	30,006	1,441.04
207	6.19	3.83	33,032	1,441.14
230	8.04	4.43	37,142	1,441.28
253	10.10	5.00	42,960	1,441.47
276	12.89	5.74	51,605	1,441.75
299	15.52	6.57	62,823	1,442.11
322	26.21	7.69	81,042	1,442.67
345	9.94	8.85	103,580	1,443.35
368	1.14	8.57	97,793	1,443.18
391	0.03	8.00	86,739	1,442.85

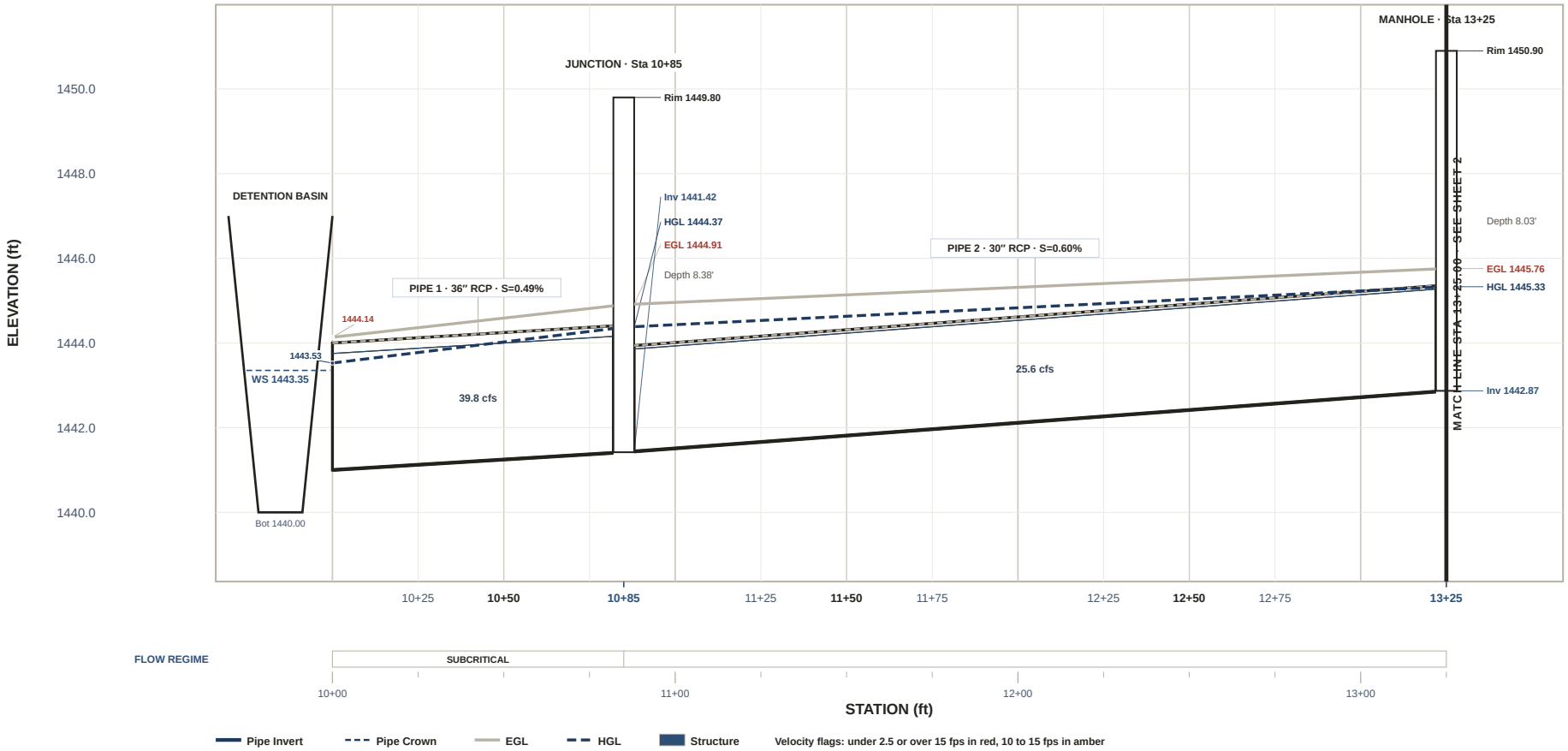
STORM DRAIN PROFILE

Line A (sheet 1 of 5)

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

2 pipes
Max V 5.9 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

Auto-Fit Scale (NTS) · October 4, 2026 · SDX



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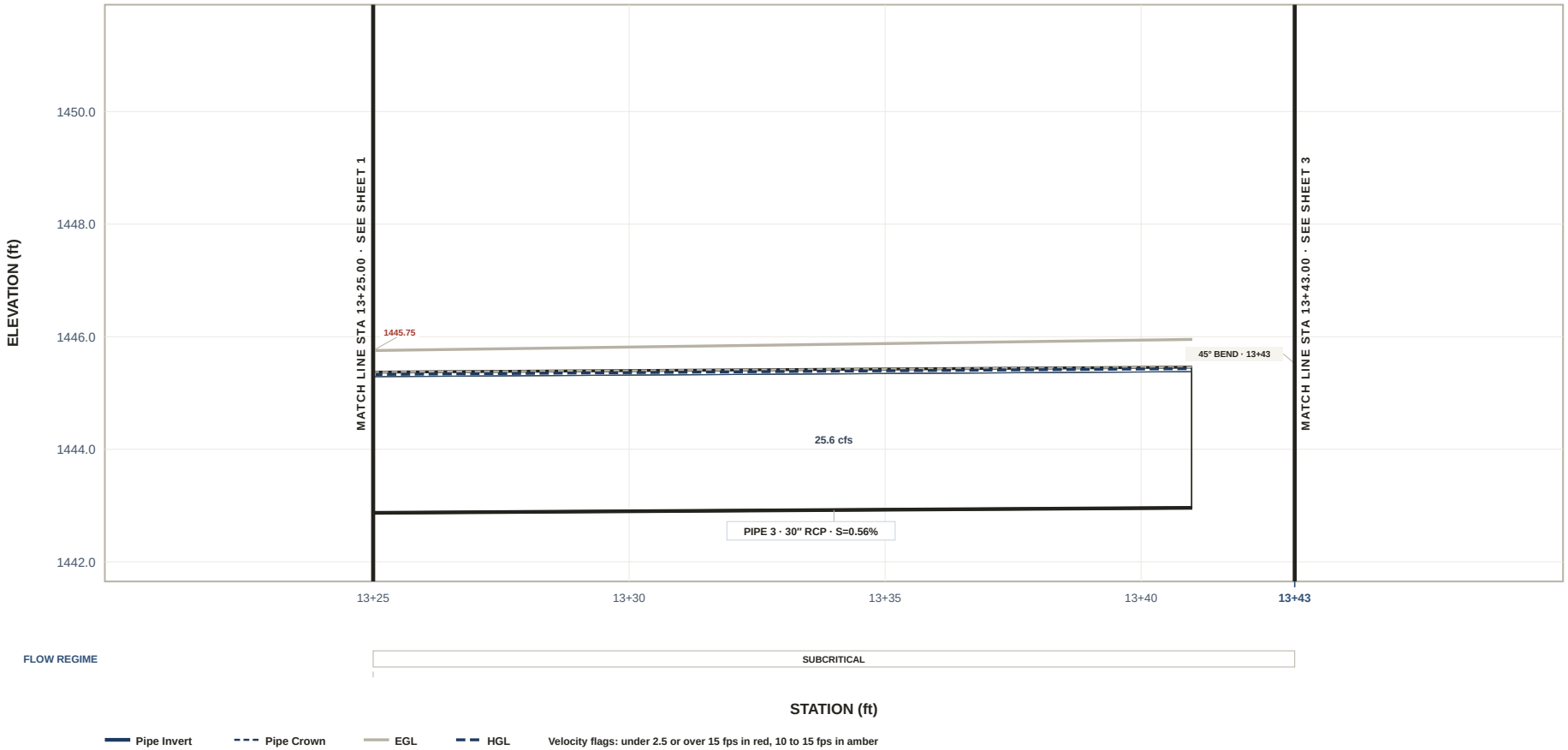
STORM DRAIN PROFILE

Line A (sheet 2 of 5)

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

1 pipe
Max V 5.3 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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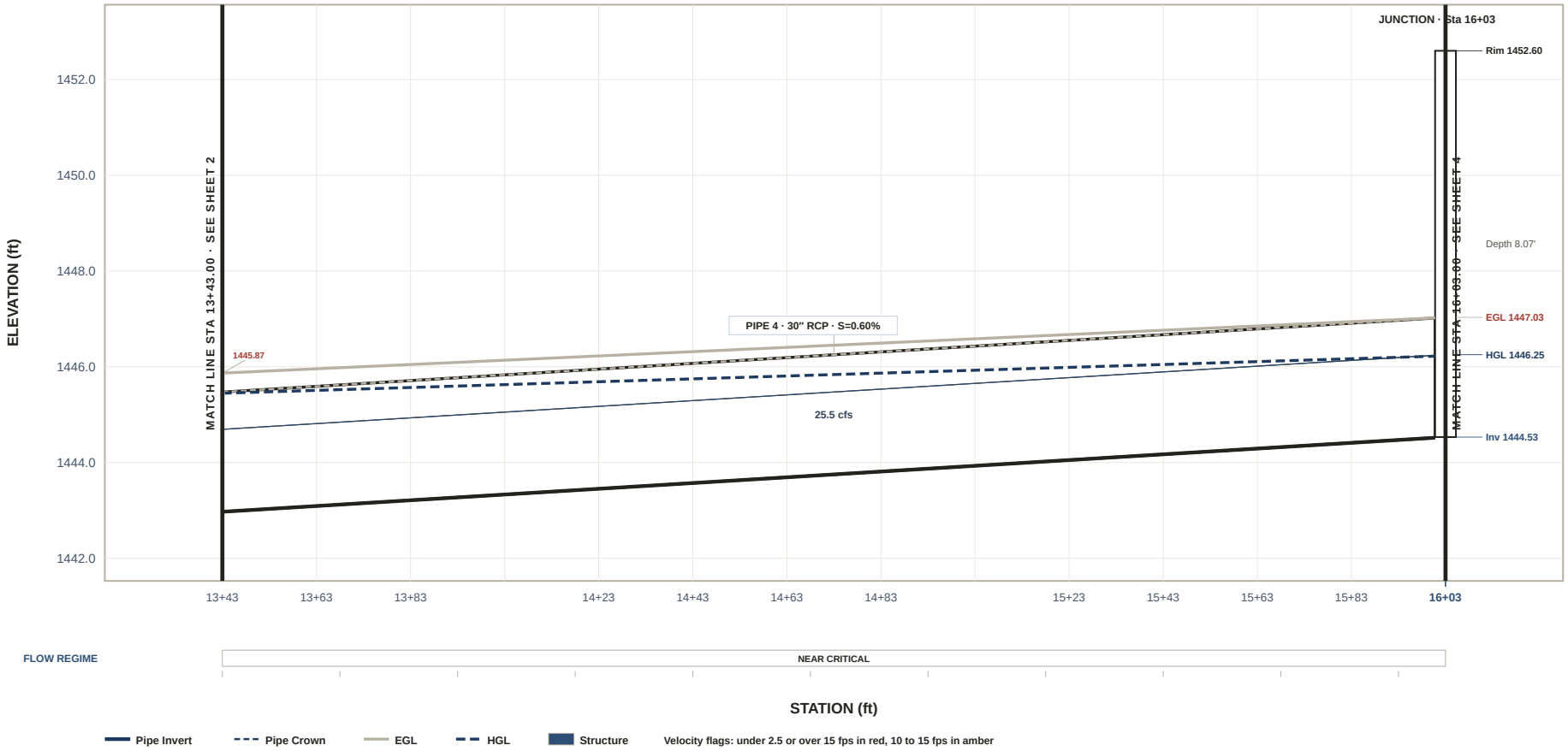
STORM DRAIN PROFILE

Line A (sheet 3 of 5)

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

1 pipe
Max V 7.1 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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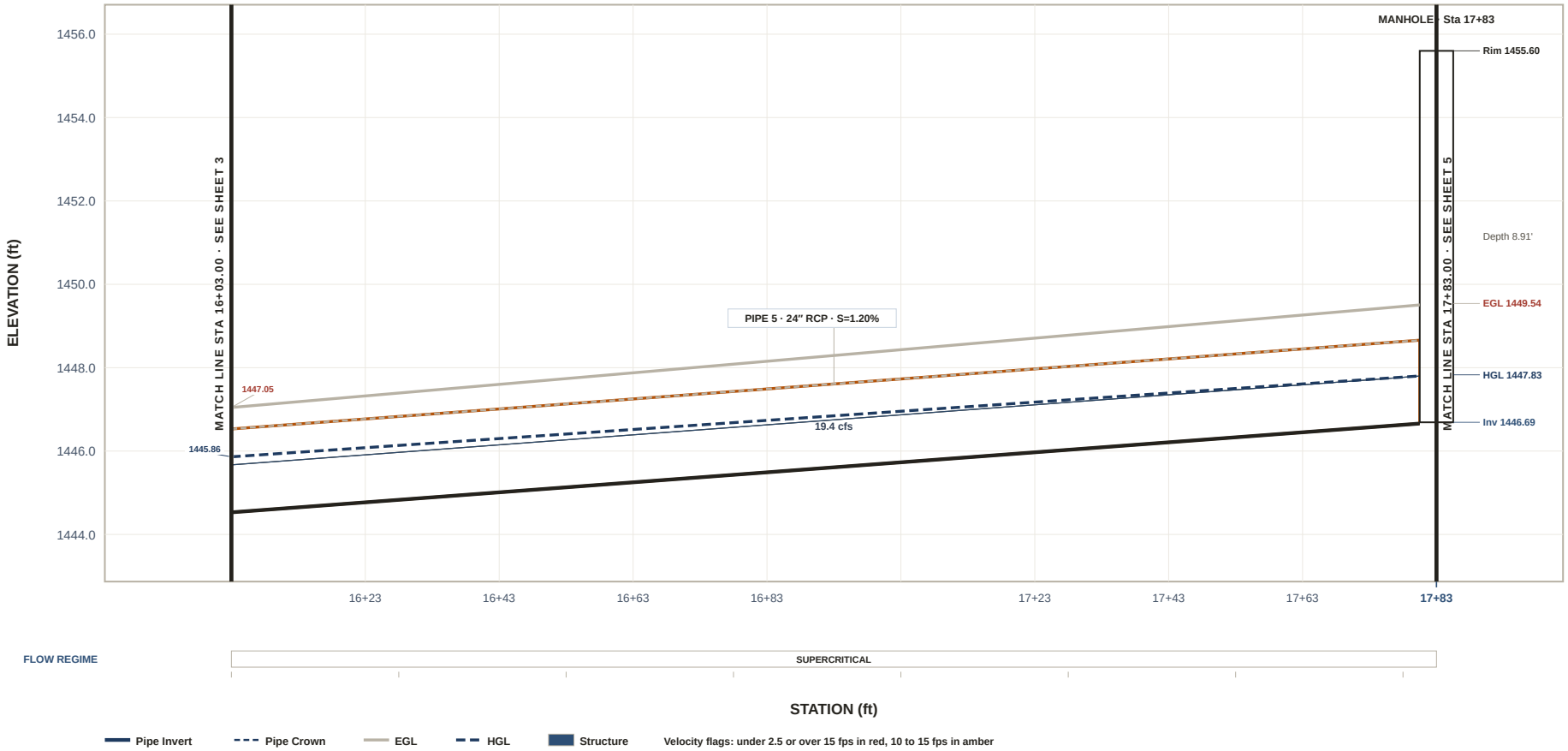
STORM DRAIN PROFILE

Line A (sheet 4 of 5)

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

1 pipe
Max V 10.5 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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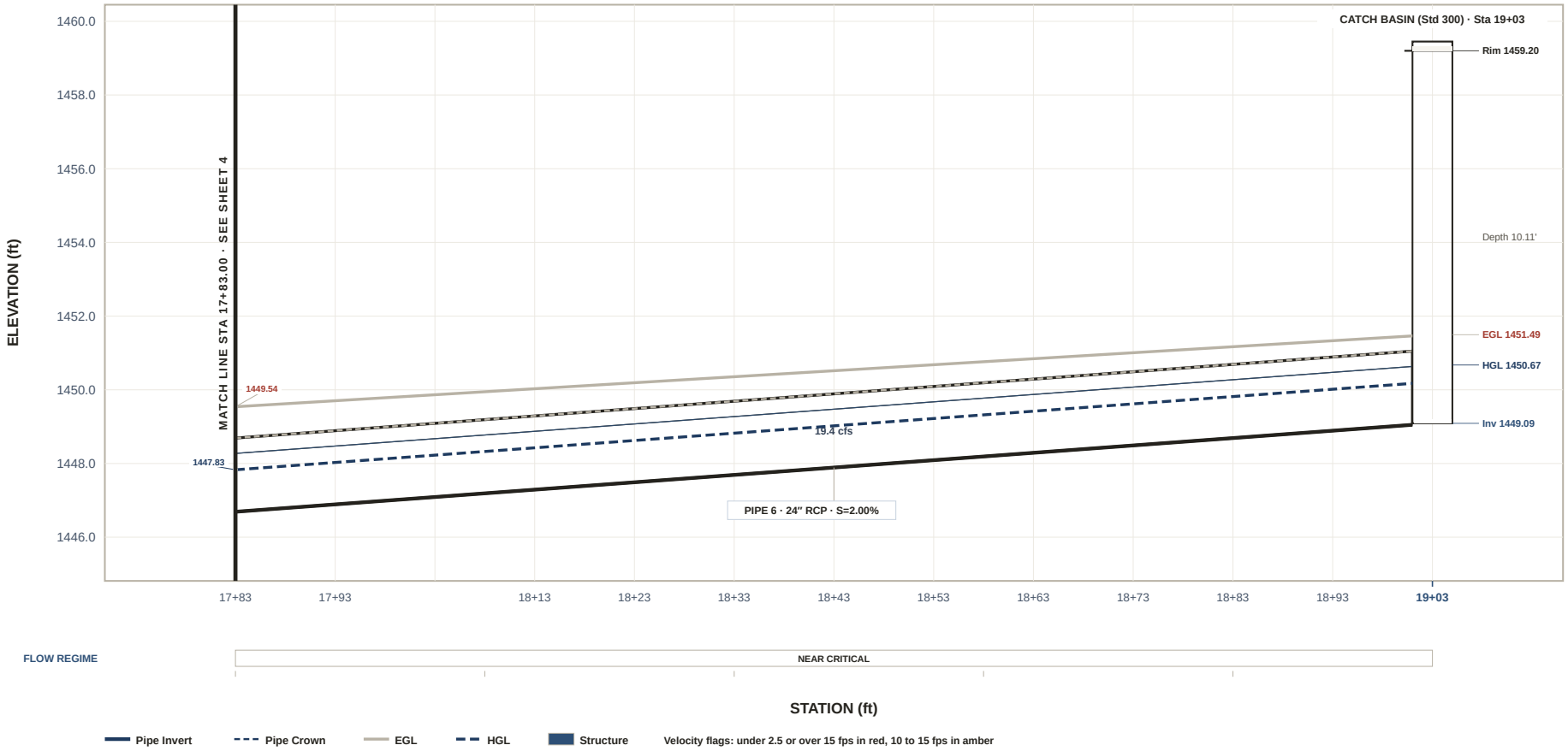
STORM DRAIN PROFILE

Line A (sheet 5 of 5)

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

1 pipe
Max V 7.3 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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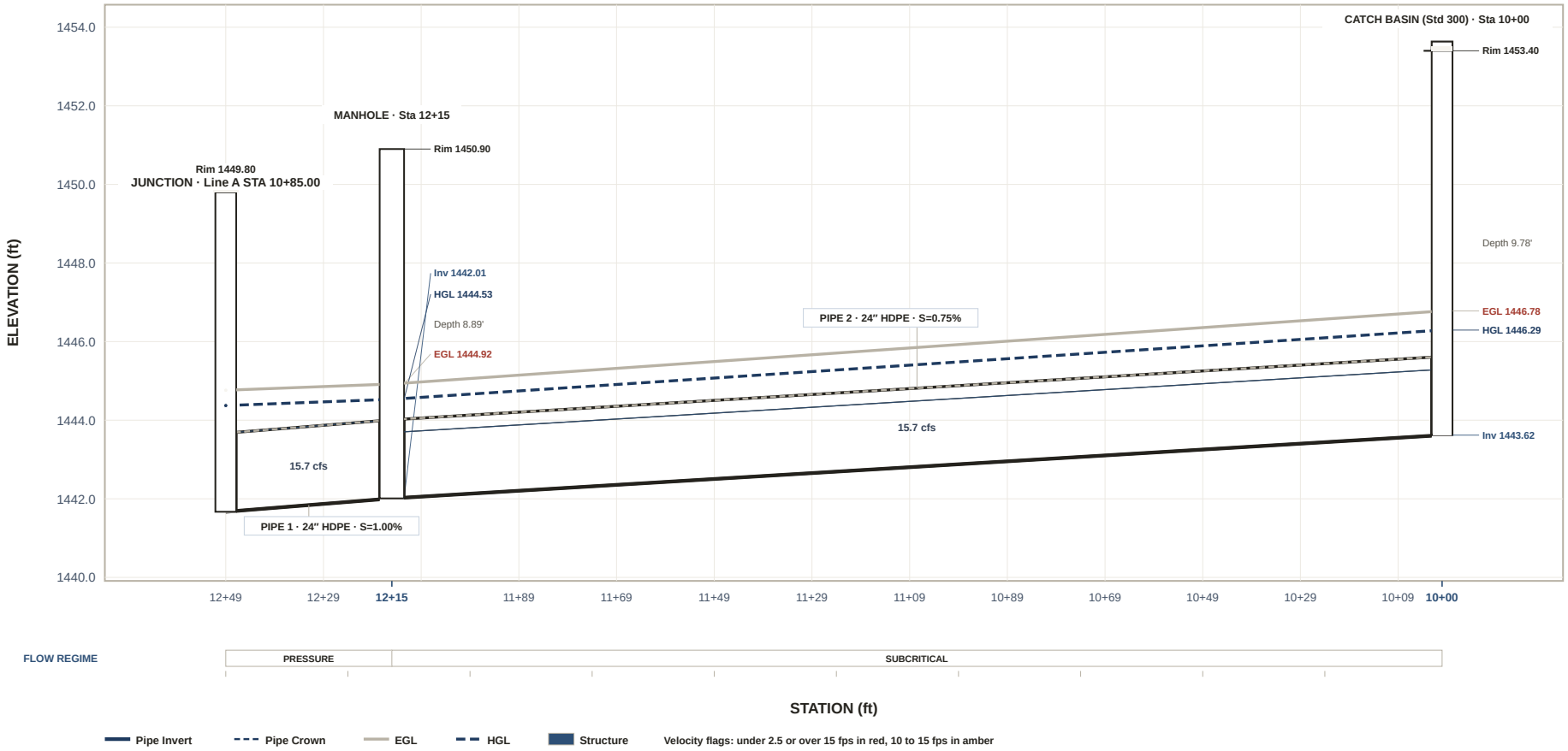
STORM DRAIN PROFILE

Line B

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

2 pipes
Max V 5.6 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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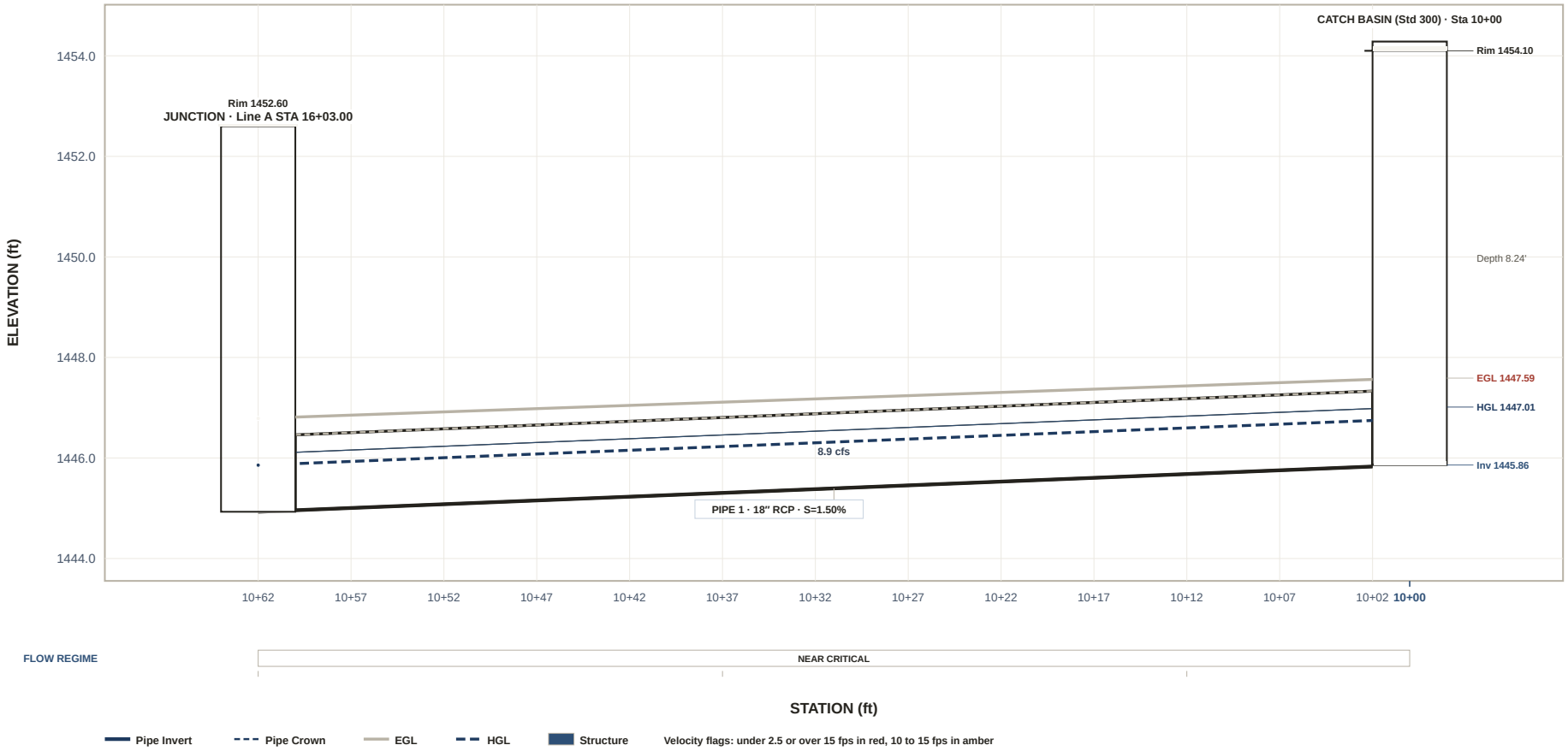
STORM DRAIN PROFILE

Line C

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

1 pipe
Max V 6.1 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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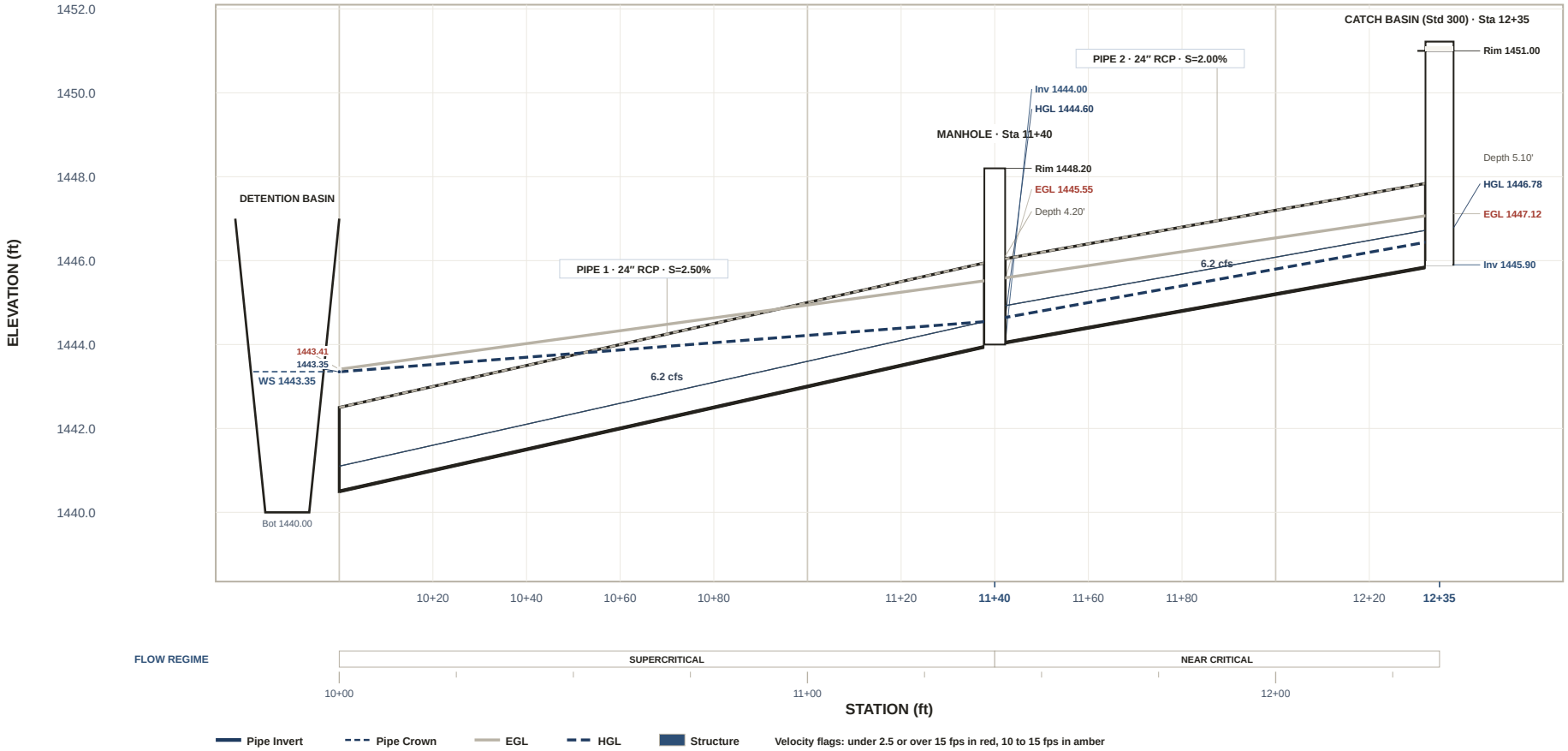
STORM DRAIN PROFILE

Line D

Rider Street Logistics Center · Engineer Name, PE 00000 · Engineering Firm Name

2 pipes
Max V 7.8 fps
Surcharge 0
Cover issues 0
REVIEW REQUIRED

Auto-Fit Scale (NTS) · October 4, 2026 · SDX



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STORM DRAIN HYDRAULIC CALCULATIONS

HYDRAULIC GRADE LINE ANALYSIS · Riverside County FCD & WCD

Rider Street Logistics Center
2350 Rider Street, Perris, CA

PREPARED BY: **Engineer Name** | SYSTEM: **PRIVATE ON-SITE STORM DRAIN · PRIVATELY MAINTAINED** | METHOD: Manning's Equation · Standard-Step HGL · Junction & Transition Losses | DATE: **October 4, 2026**

ALL SEGMENTS MEET REQUIREMENTS

Freeboard ≥ 0.5 ft required (RCFC Hyd. Manual §4.4) | Min FB: **3.60 ft** | Max V: **10.5 fps**

Pass	Caution	Fail
11	**0**	**0**

Key: **HGL** in bold. Freeboard against the 0.5 ft minimum (RCFC Hyd. Manual §4.4) and capacity are stated in the Status column; a segment that fails is set in bold. A rule above a row marks a 25 ft interval; a heavier rule marks a system change.

Line "A"

6 Segments | HGL Start: 1443.53 ft (tailwater 1443.35 ft) | Min FB: **5.43 ft** | Max V: 10.5 fps | PASS

HYDRAULIC GRADE LINE ANALYSIS - Water Surface Profile (25' Intervals & System Changes)

Seg	Station (ft)	Length (ft)	Dia (in)	Slope (ft/ft)	Q (cfs)	Cap (cfs)	V (fps)	Fr	DS INV (ft)	DS HGL (ft)	h_f (ft)	h_m (ft)	US INV (ft)	US HGL (ft)	FL EL (ft)	FREE-BOARD	Status
A-1 JUNCTION	1000 25'	85	36	0.0049	39.78 D-1 at 16.9 min	46.88	5.86	0.51 SUBCRIT	1441.00	**1443.53**	0.314	0.645	1441.42	**1444.37**	1449.80	**5.43**	OK
A-2 MANHOLE Δ	1085 25'	240	30	0.0060	25.61 D-1 at 16.4 min	31.88	5.27	0.39 PRESS > SUBCRIT	1441.42	**1444.37**	0.926	0.039	1442.87	**1445.33**	1450.90	**5.57**	OK
A-3 45° BEND	1325 25'	18	30	0.0056	25.60 D-1 at 16.3 min	30.57	5.27	0.40 SUBCRIT	1442.87	**1445.33**	0.062	0.060	1442.97	**1445.45**	1451.00	**5.55**	OK
A-4 JUNCTION Δ	1343	260	30	0.0060	25.53 D-1 at 15.7 min	31.77	7.08	1.00 JUMP	1442.97	**1445.45**	1.164	0.087	1444.53	**1446.25**	1452.60	**6.35**	JUMP
A-5 MANHOLE Δ	1603 25'	180	24	0.0120	19.40	24.78	10.50	1.91 SUPERCRIT	1444.53	**1445.86**	2.161	0.041	1446.69	**1447.83**	1455.60	**7.77**	OK
A-6 CATCH BASIN Δ	1783 25'	120	24	0.0200	19.40	31.99	7.27	1.00 SUPERCRIT > CRIT	1446.69	**1447.83**	1.956	1.232	1449.09	**1450.67**	1459.20	**8.53**	OK

25-FOOT STATION WATER SURFACE PROFILE - RCFC Hyd. Manual §4.4

Per RCFC Hydraulic Design Manual (March 2024) §4.1.2 (Froude / Flow Regimes), §4.3.5 (Hydraulic Jumps, Eq. 4.46), Table 4.7 (Jump Types), §4.4 (Water Surface Profiles). Depth at each station is the water surface less the invert; velocity, Froude number and regime follow it. Stations are the line's, downstream end of each segment rising to its upstream end. Critical depth solved from Eq. (4.4) iteratively for circular section.

Pipe A-1 D = 36″ (3.00′) L = 85′ S = 0.494% Q = 39.78 cfs y_n = 2.12′ y_c = 2.05′ V = 5.86 fps Fr = 0.51, **SUBCRITICAL**

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
10+00	1441.00	2.53	6.26	0.65	SUBCRITICAL	1443.53	1444.14	3.40e-3	6.27
10+25	1441.12	2.46	6.41	0.69	SUBCRITICAL	1443.58	1444.22	3.55e-3	6.22
10+50	1441.25	2.39	6.57	0.73	SUBCRITICAL	1443.64	1444.31	3.74e-3	6.16
10+75	1441.37	2.33	6.75	0.77	SUBCRITICAL	1443.70	1444.41	3.95e-3	6.10
10+85	1441.42	2.95	5.65	0.32	SUBCRITICAL	1444.37	1444.87	3.22e-3	5.43

Pipe A-2 D = 30″ (2.50′) L = 240′ S = 0.604% Q = 25.61 cfs y_n = 1.70′ y_c = 1.72′ V = 5.27 fps Fr = 0.39, **SUBCRITICAL**

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
10+85	1441.42	2.50	5.22	0.00	PRESSURE	1444.37	1444.80	3.90e-3	6.53
11+00	1441.51	2.50	5.22	0.00	PRESSURE	1444.43	1444.85	3.90e-3	6.47
11+25	1441.66	2.50	5.22	0.00	PRESSURE	1444.53	1444.95	3.90e-3	6.37
11+50	1441.81	2.50	5.22	0.00	PRESSURE	1444.63	1445.05	3.90e-3	6.27
11+75	1441.96	2.50	5.22	0.00	PRESSURE	1444.72	1445.15	3.90e-3	6.18
12+00	1442.11	2.50	5.22	0.00	PRESSURE	1444.82	1445.24	3.90e-3	6.08
12+25	1442.27	2.50	5.22	0.00	PRESSURE	1444.92	1445.34	3.90e-3	5.98
12+50	1442.42	2.50	5.22	0.00	PRESSURE	1445.02	1445.44	3.90e-3	5.88
12+75	1442.57	2.50	5.22	0.00	PRESSURE	1445.11	1445.54	3.90e-3	5.79
13+00	1442.72	2.49	5.22	0.23	SUBCRITICAL	1445.21	1445.63	3.70e-3	5.69
13+25	1442.87	2.46	5.24	0.33	SUBCRITICAL	1445.33	1445.75	3.52e-3	5.57

Pipe A-3 D = 30″ (2.50′) L = 18′ S = 0.556% Q = 25.60 cfs y_n = 1.75′ y_c = 1.72′ V = 5.27 fps Fr = 0.40, **SUBCRITICAL**

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
13+25	1442.87	2.46	5.23	0.33	SUBCRITICAL	1445.33	1445.75	3.52e-3	5.67
13+43	1442.97	2.48	5.22	0.29	SUBCRITICAL	1445.45	1445.87	3.59e-3	5.55

Pipe A-4 D = 30″ (2.50′) L = 260′ S = 0.600% Q = 25.53 cfs y_n = 1.70′ y_c = 1.72′ V = 7.08 fps Fr = 1.00, **NEAR CRITICAL**

Steep reach with a drowned outlet: the downstream water surface at 1445.45 ft stands above the sequent depth of the normal depth (y_2 = 1.75′, RCFC Eq. 4.46), so a hydraulic jump, undular, Fr_1 = 1.03, L_{jump} ≈ 10.7′ forms at the outlet and the reach above it runs at normal depth. The control is at the upstream structure, where the flow passes through critical depth; its water surface of 1446.25 ft is critical depth plus the entrance losses at the critical velocity.

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
13+43	1442.97	2.48	5.21	0.29	SUBCRITICAL	1445.45	1445.87	3.57e-3	7.15
13+50	1443.01	2.46	5.22	0.34	SUBCRITICAL	1445.47	1445.89	3.49e-3	7.13
13+75	1443.16	2.38	5.29	0.44	SUBCRITICAL	1445.54	1445.98	3.36e-3	7.06
14+00	1443.31	2.29	5.41	0.51	SUBCRITICAL	1445.61	1446.06	3.37e-3	6.99
14+25	1443.46	2.20	5.58	0.59	SUBCRITICAL	1445.66	1446.15	3.48e-3	6.94
14+50	1443.61	2.10	5.79	0.66	SUBCRITICAL	1445.72	1446.24	3.71e-3	6.88
14+75	1443.76	2.00	6.07	0.74	SUBCRITICAL	1445.76	1446.33	4.06e-3	6.84
15+00	1443.91	1.89	6.41	0.83	SUBCRITICAL	1445.80	1446.44	4.58e-3	6.80
15+25	1444.06	1.76	6.90	0.96	NEAR CRITICAL	1445.82	1446.56	5.43e-3	6.78
15+50	1444.21	1.70	7.20	1.03	NEAR CRITICAL	1445.91	1446.71	6.00e-3	6.69
15+75	1444.36	1.70	7.20	1.03	NEAR CRITICAL	1446.06	1446.86	6.00e-3	6.54
16+00	1444.51	1.70	7.20	1.03	NEAR CRITICAL	1446.21	1447.01	6.00e-3	6.39
16+03	1444.53	1.72	7.08	1.00	NEAR CRITICAL	1446.25	1447.03	5.77e-3	6.35

Pipe A-5 D = 24″ (2.00′) L = 180′ S = 1.200% Q = 19.40 cfs y_n = 1.33′ y_c = 1.58′ V = 10.50 fps Fr = 1.91, SUPERCRITICAL

Steep reach: the downstream water surface at 1446.25 ft is below the sequent depth of the normal depth (y_2 = 1.87′, RCFC Eq. 4.46), so it does not reach into the barrel and the reach runs at normal depth to its outlet. The control is at the upstream structure, where the flow passes through critical depth; its water surface of 1448.27 ft is critical depth plus the entrance losses at the critical velocity.

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
16+03	1444.53	1.33	8.73	1.42	**SUPERCRITICAL**	1445.86	1447.05	1.20e-2	9.74
16+25	1444.79	1.33	8.73	1.42	**SUPERCRITICAL**	1446.13	1447.31	1.20e-2	9.47
16+50	1445.09	1.33	8.73	1.42	**SUPERCRITICAL**	1446.43	1447.61	1.20e-2	9.17
16+75	1445.39	1.33	8.73	1.42	**SUPERCRITICAL**	1446.73	1447.91	1.20e-2	8.87
17+00	1445.69	1.33	8.73	1.42	**SUPERCRITICAL**	1447.03	1448.21	1.20e-2	8.57
17+25	1445.99	1.33	8.73	1.42	**SUPERCRITICAL**	1447.33	1448.51	1.20e-2	8.27
17+50	1446.29	1.33	8.73	1.42	**SUPERCRITICAL**	1447.63	1448.81	1.20e-2	7.97
17+75	1446.59	1.33	8.73	1.42	**SUPERCRITICAL**	1447.93	1449.11	1.20e-2	7.67
17+83	1446.69	1.14	10.50	1.91	**SUPERCRITICAL**	1447.83	1449.54	1.92e-2	7.77

Pipe A-6 D = 24″ (2.00′) L = 120′ S = 2.000% Q = 19.40 cfs y_n = 1.12′ y_c = 1.58′ V = 7.27 fps Fr = 1.00, NEAR CRITICAL

Steep reach: the downstream water surface at 1447.83 ft is below the sequent depth of the normal depth (y_2 = 2.14′, RCFC Eq. 4.46), so it does not reach into the barrel and the reach runs at normal depth to its outlet. The control is at the upstream structure, where the flow passes through critical depth; its water surface of 1450.67 ft is critical depth plus the entrance losses at the critical velocity.

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
17+83	1446.69	1.14	10.50	1.91	**SUPERCRITICAL**	1447.83	1449.54	1.92e-2	11.37
18+00	1447.03	1.15	10.42	1.89	**SUPERCRITICAL**	1448.18	1449.86	1.88e-2	11.02
18+25	1447.53	1.16	10.26	1.85	**SUPERCRITICAL**	1448.69	1450.32	1.80e-2	10.51
18+50	1448.03	1.19	9.96	1.76	**SUPERCRITICAL**	1449.22	1450.76	1.68e-2	9.98
18+75	1448.53	1.25	9.42	1.61	**SUPERCRITICAL**	1449.78	1451.15	1.45e-2	9.42
19+00	1449.03	1.44	8.02	1.22	**SUPERCRITICAL**	1450.47	1451.47	9.77e-3	8.73
19+03	1449.09	1.58	7.27	1.00	NEAR CRITICAL	1450.67	1451.49	7.86e-3	8.53

Line "B"

2 Segments | HGL Start: 1444.37 ft | Min FB: **6.37 ft** | Max V: 5.6 fps | PASS

HYDRAULIC GRADE LINE ANALYSIS - Water Surface Profile (25' Intervals & System Changes)

Seg	Station (ft)	Length (ft)	Dia (in)	Slope (ft/ft)	Q (cfs)	Cap (cfs)	V (fps)	Fr	DS INV (ft)	**DS HGL (ft)**	h_f (ft)	h_m (ft)	US INV (ft)	**US HGL (ft)**	FL EL (ft)	**FREE-BOARD**	Status
B-1 MANHOLE	1085 25'	34	24	0.0100	15.73	24.51	5.01	0.00 PRESS	1441.67	**1444.37**	0.140	0.019	1442.01	**1444.53**	1450.90	**6.37**	OK
B-2 CATCH BASIN Δ	1119 25'	215	24	0.0075	15.73	21.21	5.60	0.72 PRESS > SUBCRIT	1442.01	**1444.53**	0.860	0.998	1443.62	**1446.29**	1453.40	**7.11**	OK

25-FOOT STATION WATER SURFACE PROFILE - RCFC Hyd. Manual §4.4

Per RCFC Hydraulic Design Manual (March 2024) §4.1.2 (Froude / Flow Regimes), §4.3.5 (Hydraulic Jumps, Eq. 4.46), Table 4.7 (Jump Types), §4.4 (Water Surface Profiles). Depth at each station is the water surface less the invert; velocity, Froude number and regime follow it. Stations are the line's, downstream end of each segment rising to its upstream end. Critical depth solved from Eq. (4.4) iteratively for circular section.

Pipe B-1 D = 24″ (2.00′) L = 34′ S = 1.000% Q = 15.73 cfs y_n = 2.00′ y_c = 1.43′ V = 5.01 fps Fr = 0.00, PRESSURE

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
10+85	1441.67	2.00	5.01	0.00	PRESSURE	1444.37	1444.76	4.12e-3	6.53
11+00	1441.82	2.00	5.01	0.00	PRESSURE	1444.43	1444.82	4.12e-3	6.47
11+19	1442.01	2.00	5.01	0.00	PRESSURE	1444.53	1444.92	4.12e-3	6.37

Pipe B-2 D = 24″ (2.00′) L = 215′ S = 0.749% Q = 15.73 cfs y_n = 1.28′ y_c = 1.43′ V = 5.60 fps Fr = 0.72, **SUBCRITICAL**

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
11+19	1442.01	2.00	5.01	0.00	PRESSURE	1444.53	1444.92	4.12e-3	8.87
11+25	1442.05	2.00	5.01	0.00	PRESSURE	1444.56	1444.95	4.12e-3	8.84
11+50	1442.24	2.00	5.01	0.00	PRESSURE	1444.66	1445.05	4.12e-3	8.74
11+75	1442.43	2.00	5.01	0.00	PRESSURE	1444.76	1445.15	4.12e-3	8.64
12+00	1442.62	2.00	5.01	0.00	PRESSURE	1444.87	1445.26	4.12e-3	8.53
12+25	1442.80	2.00	5.01	0.00	PRESSURE	1444.97	1445.36	4.12e-3	8.43
12+50	1442.99	2.00	5.01	0.00	PRESSURE	1445.07	1445.46	4.12e-3	8.33
12+75	1443.18	2.00	5.01	0.20	SUBCRITICAL	1445.17	1445.56	3.98e-3	8.23
13+00	1443.37	1.88	5.13	0.50	SUBCRITICAL	1445.25	1445.66	3.56e-3	8.15
13+25	1443.55	1.74	5.43	0.65	SUBCRITICAL	1445.29	1445.75	3.77e-3	8.11
13+34	1443.62	2.00	5.01	0.00	PRESSURE	1446.29	1446.68	4.12e-3	7.11

Line "C"

1 Segments | HGL Start: 1445.86 ft | Min FB: **7.09 ft** | Max V: 6.1 fps | PASS

HYDRAULIC GRADE LINE ANALYSIS - Water Surface Profile (25' Intervals & System Changes)

Seg	Station (ft)	Length (ft)	Dia (in)	Slope (ft/ft)	Q (cfs)	Cap (cfs)	V (fps)	Fr	DS INV (ft)	DS HGL (ft)	h_f (ft)	h_m (ft)	US INV (ft)	US HGL (ft)	FL EL (ft)	FREE-BOARD	Status
C-1 CATCH BASIN	1603 25'	62	18	0.0150	8.88	12.87	6.09	1.00 SUPERCRIT > CRIT	1444.93	**1445.86**	0.802	0.864	1445.86	**1447.01**	1454.10	**7.09**	OK

25-FOOT STATION WATER SURFACE PROFILE - RCFC Hyd. Manual §4.4

Per RCFC Hydraulic Design Manual (March 2024) §4.1.2 (Froude / Flow Regimes), §4.3.5 (Hydraulic Jumps, Eq. 4.46), Table 4.7 (Jump Types), §4.4 (Water Surface Profiles). Depth at each station is the water surface less the invert; velocity, Froude number and regime follow it. Stations are the line's, downstream end of each segment rising to its upstream end. Critical depth solved from Eq. (4.4) iteratively for circular section.

Pipe C-1 D = 18″ (1.50′) L = 62′ S = 1.500% Q = 8.88 cfs y_n = 0.92′ y_c = 1.15′ V = 6.09 fps Fr = 1.00, **NEAR CRITICAL**

Steep reach: the downstream water surface at 1446.25 ft is below the sequent depth of the normal depth (y_2 = 1.43′, RCFC Eq. 4.46), so it does not reach into the barrel and the reach runs at normal depth to its outlet. The control is at the upstream structure, where the flow passes through critical depth; its water surface of 1447.01 ft is critical depth plus the entrance losses at the critical velocity.

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
16+03	1444.93	0.93	7.74	1.54	**SUPERCRITICAL**	1445.86	1446.79	1.45e-2	8.24
16+25	1445.26	0.94	7.61	1.49	**SUPERCRITICAL**	1446.20	1447.10	1.38e-2	7.90
16+50	1445.63	0.99	7.20	1.36	**SUPERCRITICAL**	1446.62	1447.43	1.21e-2	7.48
16+65	1445.86	1.15	6.09	1.00	NEAR CRITICAL	1447.01	1447.59	8.12e-3	7.09

Line "D"

2 Segments | HGL Start: 1443.35 ft | Min FB: **3.60 ft** | Max V: 7.8 fps | PASS

HYDRAULIC GRADE LINE ANALYSIS - Water Surface Profile (25' Intervals & System Changes)

Seg	Station (ft)	Length (ft)	Dia (in)	Slope (ft/ft)	Q (cfs)	Cap (cfs)	V (fps)	Fr	DS INV (ft)	DS HGL (ft)	h_f (ft)	h_m (ft)	US INV (ft)	US HGL (ft)	FL EL (ft)	FREE-BOARD	Status
D-1 MANHOLE	1000 25'	140	24	0.0250	6.21	35.77	7.83	2.10 JUMP	1440.50	**1443.35**	1.895	0.017	1444.00	**1444.60**	1448.20	**3.60**	JUMP
D-2 CATCH BASIN △	1140 25'	95	24	0.0200	6.21	31.99	4.65	1.00 SUPERCRIT > CRIT	1444.00	**1444.60**	1.566	0.504	1445.90	**1446.78**	1451.00	**4.22**	OK

25-FOOT STATION WATER SURFACE PROFILE - RCFC Hyd. Manual §4.4

Per RCFC Hydraulic Design Manual (March 2024) §4.1.2 (Froude / Flow Regimes), §4.3.5 (Hydraulic Jumps, Eq. 4.46), Table 4.7 (Jump Types), §4.4 (Water Surface Profiles). Depth at each station is the water surface less the invert; velocity, Froude number and regime follow it. Stations are the line's, downstream end of each segment rising to its upstream end. Critical depth solved from Eq. (4.4) iteratively for circular section.

Pipe D-1 D = 24'' (2.00') L = 140' S = 2.500% Q = 6.21 cfs y_n = 0.56' y_c = 0.88' V = 7.83 fps Fr = 2.10, SUPERCRITICAL

Steep reach with a drowned outlet: the downstream water surface at 1443.35 ft stands above the sequent depth of the normal depth (y_2 = 1.32', RCFC Eq. 4.46), so a hydraulic jump, weak, Fr_1 = 2.35, L_{jump} ≈ 8.1' forms at the outlet and the reach above it runs at normal depth. The control is at the upstream structure, where the flow passes through critical depth; its water surface of 1444.88 ft is critical depth plus the entrance losses at the critical velocity.

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
10+00	1440.50	2.00	1.98	0.00	PRESSURE	1443.35	1443.41	7.54e-4	4.85
10+25	1441.13	2.00	1.98	0.00	PRESSURE	1443.37	1443.43	7.54e-4	4.83
10+50	1441.75	1.62	2.28	0.31	SUBCRITICAL	1443.37	1443.45	7.74e-4	4.83
10+75	1442.38	0.57	8.48	2.34	**SUPERCRITICAL**	1442.94	1444.06	2.45e-2	5.26
11+00	1443.00	0.57	8.39	2.31	**SUPERCRITICAL**	1443.57	1444.66	2.38e-2	4.63
11+25	1443.63	0.58	8.15	2.22	**SUPERCRITICAL**	1444.21	1445.24	2.19e-2	3.99
11+40	1444.00	0.60	7.83	2.10	**SUPERCRITICAL**	1444.60	1445.55	1.96e-2	3.60

Pipe D-2 D = 24'' (2.00') L = 95' S = 2.000% Q = 6.21 cfs y_n = 0.60' y_c = 0.88' V = 4.65 fps Fr = 1.00, NEAR CRITICAL

Steep reach: the downstream water surface at 1444.60 ft is below the sequent depth of the normal depth (y_2 = 1.26', RCFC Eq. 4.46), so it does not reach into the barrel and the reach runs at normal depth to its outlet. The control is at the upstream structure, where the flow passes through critical depth; its water surface of 1446.78 ft is critical depth plus the entrance losses at the critical velocity.

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
11+40	1444.00	0.60	7.83	2.10	**SUPERCRITICAL**	1444.60	1445.55	1.96e-2	6.40
11+50	1444.20	0.60	7.81	2.09	**SUPERCRITICAL**	1444.80	1445.75	1.95e-2	6.20
11+75	1444.70	0.61	7.69	2.05	**SUPERCRITICAL**	1445.31	1446.23	1.87e-2	5.69

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
12+00	1445.20	0.63	7.38	1.93	**SUPERCRITICAL**	1445.83	1446.67	1.66e-2	5.17
12+25	1445.70	0.70	6.39	1.58	**SUPERCRITICAL**	1446.40	1447.03	1.12e-2	4.60
12+35	1445.90	0.88	4.65	1.00	NEAR CRITICAL	1446.78	1447.12	4.67e-3	4.22

FLOW AT NODES, RCFC PLATE D-1

Where two flows with different times of concentration meet, the peak below the node is the Plate D-1 combination (RCFC Hydrology Manual, Item 10), carried down each pipe by its travel time at normal depth. Flows with no time of concentration behind them are added arithmetically.

Line, pipe	Combination	Sum (cfs)	Q (cfs)
A A-1	Line C at A-4 8.88 cfs, 24.0 min + DA-1 at A-6 19.40 cfs, 16.9 min + Line B 15.73 cfs, 12.9 min, Plate D-1 = 39.78 cfs at 16.9 min; travel to the next node 0.2 min	44.01	**39.78**
A A-2	Line C at A-4 8.88 cfs, 23.4 min + DA-1 at A-6 19.40 cfs, 16.4 min, Plate D-1 = 25.61 cfs at 16.4 min; travel to the next node 0.6 min	28.28	**25.61**
A A-3	Line C at A-4 8.88 cfs, 23.4 min + DA-1 at A-6 19.40 cfs, 16.3 min, Plate D-1 = 25.60 cfs at 16.3 min; travel to the next node 0.0 min	28.28	**25.60**
A A-4	Line C 8.88 cfs, 22.8 min + DA-1 at A-6 19.40 cfs, 15.7 min, Plate D-1 = 25.53 cfs at 15.7 min; travel to the next node 0.6 min	28.28	**25.53**

DESIGN PARAMETERS & METHODOLOGY

Hydraulic Analysis:

- **Flow:** Manning's Equation $Q = (1.486/n)AR^{2/3}S^{1/2}$
- **Friction Loss:** $h_f = S_f \times L$
- **Minor Losses:** $h_m = K \times V^2/2g$
- **HGL Profile:** Standard Step Method

Design Criteria:

- **Minimum Freeboard:** 0.5 ft (required), RCFC Hyd. Manual (March 2024) §4.4
- **Manning's n basis:** HDPE per pipe manufacturer / agency acceptance; RCP per RCFC Table 4-1. Values as entered per segment.
- **Basis of design flows:** Rational Method per RCFC & WCD Hydrology Manual; inlet Q at nodes per the Hydrology exhibit of this report.
- **Recommended Freeboard:** 1.0 ft
- **Minimum Velocity:** 2.5 fps (self-cleansing target)
- **Applicability:** Agency minimums (18" dia., 2.5 fps) govern PUBLIC storm drains; shown for reference. This on-site private system is designed to RCFC methodology with criteria applied as engineering targets.
- **Maximum Velocity:** 15 fps

Loss Coefficients (K) - RCFC Hyd Manual (March 2024): Exit (outlet) K=1.0 (Eq. 4.45) · Manhole (straight-through) K=0.05 (Eq. 4.40) · Bend K=0.20·√(θ/90) (Eq. 4.41): 90°=0.20, 45°=0.14, 22.5°=0.10 · Angle Point K=0.0033·θ (Eq. 4.43, θ≤6°) · Junction = Thompson momentum (Eq. 4.35/4.36) · Transitions (Table 4.6 pg 4-28): Expansion Ko=0.20-0.70 by angle, Contraction Ki=0.10 · Inlet K=ken from Table 7.1 (Eq. 4.44)

REFERENCES

1. Riverside County Flood Control & Water Conservation District - *Hydraulic Design Manual* (March 2024): HGL/EGL standard-step method; junction (Thompson, Eq. 4.35/4.36), bend (Eq. 4.41), transition (Table 4.6), manhole, angle-point, and exit losses.
2. Riverside County Flood Control & WCD - *Hydrology Manual*: Rational Method, runoff coefficients, time of concentration.
3. FHWA *HEC-22, Urban Drainage Design Manual* (3rd Ed., 2009): gutter flow and inlet interception (grate, curb-opening, combination, sag).
4. FHWA *HEC-14, Hydraulic Design of Energy Dissipators* (3rd Ed.): riprap aprons / outlet protection.
5. NOAA *Atlas 14* Precipitation-Frequency Data Server: design rainfall depths/intensities.
6. USDA-NRCS *TR-55*: runoff / time-of-concentration (where applied).
7. Manning's equation, continuity, and momentum (junction) - standard open-channel and pressurized-conduit hydraulics.