Preliminary Hydrology Study

FOR

Rider Street Logistics Center

APN 317-120-021

Perris, CA

For: **Inland Gateway Partners, LLC**
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PREPARED BY: ENGINEER NAME, RCE 00000

DATE: October 2026

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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**	**48.00** cfs confluence, RCFC Plate D-1	**7.519** ac-ft

PROJECT

Project	**Rider Street Logistics Center**	Developer	**Inland Gateway Partners, LLC**
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**	24-hour depth	**5.10 in**
IDF	**NOAA Atlas 14 - 100-Year (33.816, -117.228)**	Method	**RCFC Hydrology Manual (1978, updated 2024)**

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 48.0 cfs against an existing 37.7 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.

No off-site tributary flows enter the site. The adjacent streets are graded to convey their runoff within the public right of way, and the site is protected from run-on by the proposed grading.

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, 3.8 ac of undeveloped land to the east sheet flows onto the site and is carried through it in Line D. 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 NOAA Atlas 14 for the site location, 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 21.52 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 17.53 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 9.50 cfs at the top of the curb at the 14 ft width selected; 19.8 ft takes all of it; CB D-2, in a sump, takes 4.31 cfs of 6.68 cfs at the top of the curb at the 7 ft width selected; 12.8 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 coefficients fitted to the site's NOAA Atlas 14 depths. 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	3.050	0.00	0.460	1.45	1.06	0.88	0.77	0.64	0.53	0.46
10 year	5.320	0.00	0.460	2.54	1.84	1.53	1.34	1.11	0.92	0.81
25 year	6.870	0.00	0.460	3.28	2.38	1.98	1.73	1.44	1.19	1.04
100 year	9.550	0.00	0.460	4.55	3.31	2.75	2.41	2.00	1.66	1.45

NOAA Atlas 14 point precipitation frequency estimates at the site (33.8160, -117.2280), Southwest region. Depths in inches.

DURATION	2-YR	10-YR	25-YR	100-YR
5-min	0.12	**0.21**	0.28	**0.38**
10-min	0.17	**0.30**	0.39	**0.55**
15-min	0.21	**0.37**	0.48	**0.66**
30-min	0.34	**0.60**	0.77	**1.07**
60-min	0.45	**0.79**	1.02	**1.41**
2-hr	0.66	**1.08**	1.35	**1.80**
3-hr	0.80	**1.28**	1.59	**2.08**
6-hr	1.12	**1.76**	2.16	**2.78**
12-hr	1.52	**2.38**	2.90	**3.71**
24-hr	2.03	**3.23**	3.96	**5.10**

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**	2.821
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**	1.932
DA-2	T-4	Commercial	0.00	1.20	0.80	0.00	2.00	**0.88**	1.765
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	**0.67**	0.808
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	**0.79**	3.005

DRAINAGE AREA	ΣA (AC)	Σ(C X A)	COMPOSITE C
DA-1	7.80	6.914	**0.89**
DA-2	6.10	5.455	**0.89**
DA-3	4.90	4.138	**0.84**
DA-4	3.80	3.005	**0.79**

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	6.5	13.0	11.7	21.5	Yes (Detention basin)
DA-2	6.10	5.3	10.4	9.6	17.5	Yes (Detention basin)
DA-3	4.90	4.5	8.8	5.1	9.5	Yes (Detention basin)
DA-4	3.80	3.4	6.7	3.4	6.7	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	1.41	1.28	11.1	**62.6**	0.92	2.416	critical peak
3-hour	2.08	1.73	11.1	37.6	2.67	3.253	
6-hour	2.78	2.22	11.1	32.3	5.50	4.188	
24-hour	5.10	3.85	11.1	13.3	13.50	**7.249**	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	3.0	12.50	9.3	18.75	1.1
0.25	0.6	6.50	3.0	12.75	10.3	19.00	0.7
0.50	0.9	6.75	3.3	13.00	10.8	19.25	1.0
0.75	1.0	7.00	3.4	13.25	12.9	19.50	1.3
1.00	1.3	7.25	3.4	13.50	13.3	19.75	1.1
1.25	1.1	7.50	3.6	13.75	9.0	20.00	0.7
1.50	1.0	7.75	4.0	14.00	8.4	20.25	1.0
1.75	1.0	8.00	4.3	14.25	9.9	20.50	1.0
2.00	1.3	8.25	4.9	14.50	9.8	20.75	1.0
2.25	1.3	8.50	5.0	14.75	9.8	21.00	0.7
2.50	1.3	8.75	5.3	15.00	9.4	21.25	1.0
2.75	1.6	9.00	5.7	15.25	9.0	21.50	0.7

TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)	TIME (HR)	Q (CFS)
3.00	1.7	9.25	6.3	15.50	8.6	21.75	1.0
3.25	1.7	9.50	6.7	15.75	7.0	22.00	0.7
3.50	1.7	9.75	7.0	16.00	6.7	22.25	1.0
3.75	1.7	10.00	7.3	16.25	2.2	22.50	0.7
4.00	2.0	10.25	5.4	16.50	1.5	22.75	0.7
4.25	2.0	10.50	5.1	16.75	1.1	23.00	0.7
4.50	2.3	10.75	6.5	17.00	1.0	23.25	0.7
4.75	2.3	11.00	6.7	17.25	1.6	23.50	0.7
5.00	2.6	11.25	6.4	17.50	1.7	23.75	0.7
5.25	2.1	11.50	6.4	17.75	1.7	24.00	0.7
5.50	2.3	11.75	5.8	18.00	1.4	24.25	0.1
5.75	2.6	12.00	6.0	18.25	1.4	24.50	0.0
6.00	2.7	12.25	8.5	18.50	1.3		

Rain and loss by 5-minute period, 24-hour storm: point rain 5.10 in times 100.00% (Plate E-5.8) = 5.10 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	0.041	0.011	0.030	8.08	0.306	0.084	0.222	16.08	0.082	0.023	0.059
0.17	0.041	0.011	0.030	8.17	0.306	0.084	0.222	16.17	0.082	0.023	0.059
0.25	0.041	0.011	0.030	8.25	0.306	0.084	0.222	16.25	0.082	0.023	0.059
0.33	0.061	0.017	0.044	8.33	0.306	0.084	0.222	16.33	0.082	0.023	0.059
0.42	0.061	0.017	0.044	8.42	0.306	0.084	0.222	16.42	0.082	0.023	0.059
0.50	0.061	0.017	0.044	8.50	0.306	0.084	0.222	16.50	0.082	0.023	0.059
0.58	0.061	0.017	0.044	8.58	0.326	0.090	0.236	16.58	0.061	0.017	0.044
0.67	0.061	0.017	0.044	8.67	0.326	0.090	0.236	16.67	0.061	0.017	0.044
0.75	0.061	0.017	0.044	8.75	0.326	0.090	0.236	16.75	0.061	0.017	0.044
0.83	0.082	0.023	0.059	8.83	0.347	0.096	0.251	16.83	0.061	0.017	0.044
0.92	0.082	0.023	0.059	8.92	0.347	0.096	0.251	16.92	0.061	0.017	0.044
1.00	0.082	0.023	0.059	9.00	0.347	0.096	0.251	17.00	0.061	0.017	0.044
1.08	0.061	0.017	0.044	9.08	0.388	0.107	0.281	17.08	0.102	0.028	0.074
1.17	0.061	0.017	0.044	9.17	0.388	0.107	0.281	17.17	0.102	0.028	0.074
1.25	0.061	0.017	0.044	9.25	0.388	0.107	0.281	17.25	0.102	0.028	0.074
1.33	0.061	0.017	0.044	9.33	0.408	0.113	0.295	17.33	0.102	0.028	0.074
1.42	0.061	0.017	0.044	9.42	0.408	0.113	0.295	17.42	0.102	0.028	0.074
1.50	0.061	0.017	0.044	9.50	0.408	0.113	0.295	17.50	0.102	0.028	0.074
1.58	0.061	0.017	0.044	9.58	0.428	0.118	0.310	17.58	0.102	0.028	0.074
1.67	0.061	0.017	0.044	9.67	0.428	0.118	0.310	17.67	0.102	0.028	0.074
1.75	0.061	0.017	0.044	9.75	0.428	0.118	0.310	17.75	0.102	0.028	0.074
1.83	0.082	0.023	0.059	9.83	0.449	0.124	0.325	17.83	0.082	0.023	0.059
1.92	0.082	0.023	0.059	9.92	0.449	0.124	0.325	17.92	0.082	0.023	0.059
2.00	0.082	0.023	0.059	10.00	0.449	0.124	0.325	18.00	0.082	0.023	0.059

HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.
2.08	0.082	0.023	0.059	10.08	0.306	0.084	0.222	18.08	0.082	0.023	0.059
2.17	0.082	0.023	0.059	10.17	0.306	0.084	0.222	18.17	0.082	0.023	0.059
2.25	0.082	0.023	0.059	10.25	0.306	0.084	0.222	18.25	0.082	0.023	0.059
2.33	0.082	0.023	0.059	10.33	0.306	0.084	0.222	18.33	0.082	0.023	0.059
2.42	0.082	0.023	0.059	10.42	0.306	0.084	0.222	18.42	0.082	0.023	0.059
2.50	0.082	0.023	0.059	10.50	0.306	0.084	0.222	18.50	0.082	0.023	0.059
2.58	0.102	0.028	0.074	10.58	0.408	0.113	0.295	18.58	0.061	0.017	0.044
2.67	0.102	0.028	0.074	10.67	0.408	0.113	0.295	18.67	0.061	0.017	0.044
2.75	0.102	0.028	0.074	10.75	0.408	0.113	0.295	18.75	0.061	0.017	0.044
2.83	0.102	0.028	0.074	10.83	0.408	0.113	0.295	18.83	0.041	0.011	0.030
2.92	0.102	0.028	0.074	10.92	0.408	0.113	0.295	18.92	0.041	0.011	0.030
3.00	0.102	0.028	0.074	11.00	0.408	0.113	0.295	19.00	0.041	0.011	0.030
3.08	0.102	0.028	0.074	11.08	0.388	0.107	0.281	19.08	0.061	0.017	0.044
3.17	0.102	0.028	0.074	11.17	0.388	0.107	0.281	19.17	0.061	0.017	0.044
3.25	0.102	0.028	0.074	11.25	0.388	0.107	0.281	19.25	0.061	0.017	0.044
3.33	0.102	0.028	0.074	11.33	0.388	0.107	0.281	19.33	0.082	0.023	0.059
3.42	0.102	0.028	0.074	11.42	0.388	0.107	0.281	19.42	0.082	0.023	0.059
3.50	0.102	0.028	0.074	11.50	0.388	0.107	0.281	19.50	0.082	0.023	0.059
3.58	0.102	0.028	0.074	11.58	0.347	0.096	0.251	19.58	0.061	0.017	0.044
3.67	0.102	0.028	0.074	11.67	0.347	0.096	0.251	19.67	0.061	0.017	0.044
3.75	0.102	0.028	0.074	11.75	0.347	0.096	0.251	19.75	0.061	0.017	0.044
3.83	0.122	0.034	0.089	11.83	0.367	0.101	0.266	19.83	0.041	0.011	0.030
3.92	0.122	0.034	0.089	11.92	0.367	0.101	0.266	19.92	0.041	0.011	0.030
4.00	0.122	0.034	0.089	12.00	0.367	0.101	0.266	20.00	0.041	0.011	0.030
4.08	0.122	0.034	0.089	12.08	0.510	0.118	0.392	20.08	0.061	0.017	0.044
4.17	0.122	0.034	0.089	12.17	0.510	0.117	0.393	20.17	0.061	0.017	0.044
4.25	0.122	0.034	0.089	12.25	0.510	0.117	0.393	20.25	0.061	0.017	0.044
4.33	0.143	0.039	0.103	12.33	0.530	0.116	0.414	20.33	0.061	0.017	0.044
4.42	0.143	0.039	0.103	12.42	0.530	0.116	0.415	20.42	0.061	0.017	0.044
4.50	0.143	0.039	0.103	12.50	0.530	0.115	0.415	20.50	0.061	0.017	0.044
4.58	0.143	0.039	0.103	12.58	0.571	0.114	0.457	20.58	0.061	0.017	0.044
4.67	0.143	0.039	0.103	12.67	0.571	0.114	0.457	20.67	0.061	0.017	0.044
4.75	0.143	0.039	0.103	12.75	0.571	0.113	0.458	20.75	0.061	0.017	0.044
4.83	0.163	0.045	0.118	12.83	0.592	0.113	0.479	20.83	0.041	0.011	0.030
4.92	0.163	0.045	0.118	12.92	0.592	0.112	0.479	20.92	0.041	0.011	0.030
5.00	0.163	0.045	0.118	13.00	0.592	0.112	0.480	21.00	0.041	0.011	0.030
5.08	0.122	0.034	0.089	13.08	0.694	0.111	0.583	21.08	0.061	0.017	0.044
5.17	0.122	0.034	0.089	13.17	0.694	0.110	0.583	21.17	0.061	0.017	0.044
5.25	0.122	0.034	0.089	13.25	0.694	0.110	0.584	21.25	0.061	0.017	0.044
5.33	0.143	0.039	0.103	13.33	0.694	0.109	0.584	21.33	0.041	0.011	0.030

HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.	HR	RAIN	LOSS	EFF.
5.42	0.143	0.039	0.103	13.42	0.694	0.109	0.585	21.42	0.041	0.011	0.030
5.50	0.143	0.039	0.103	13.50	0.694	0.108	0.585	21.50	0.041	0.011	0.030
5.58	0.163	0.045	0.118	13.58	0.469	0.108	0.361	21.58	0.061	0.017	0.044
5.67	0.163	0.045	0.118	13.67	0.469	0.107	0.362	21.67	0.061	0.017	0.044
5.75	0.163	0.045	0.118	13.75	0.469	0.107	0.363	21.75	0.061	0.017	0.044
5.83	0.163	0.045	0.118	13.83	0.469	0.106	0.363	21.83	0.041	0.011	0.030
5.92	0.163	0.045	0.118	13.92	0.469	0.106	0.364	21.92	0.041	0.011	0.030
6.00	0.163	0.045	0.118	14.00	0.469	0.105	0.364	22.00	0.041	0.011	0.030
6.08	0.184	0.051	0.133	14.08	0.551	0.104	0.446	22.08	0.061	0.017	0.044
6.17	0.184	0.051	0.133	14.17	0.551	0.104	0.447	22.17	0.061	0.017	0.044
6.25	0.184	0.051	0.133	14.25	0.551	0.103	0.447	22.25	0.061	0.017	0.044
6.33	0.184	0.051	0.133	14.33	0.530	0.103	0.428	22.33	0.041	0.011	0.030
6.42	0.184	0.051	0.133	14.42	0.530	0.102	0.428	22.42	0.041	0.011	0.030
6.50	0.184	0.051	0.133	14.50	0.530	0.102	0.429	22.50	0.041	0.011	0.030
6.58	0.204	0.056	0.148	14.58	0.530	0.101	0.429	22.58	0.041	0.011	0.030
6.67	0.204	0.056	0.148	14.67	0.530	0.101	0.430	22.67	0.041	0.011	0.030
6.75	0.204	0.056	0.148	14.75	0.530	0.100	0.430	22.75	0.041	0.011	0.030
6.83	0.204	0.056	0.148	14.83	0.510	0.100	0.410	22.83	0.041	0.011	0.030
6.92	0.204	0.056	0.148	14.92	0.510	0.099	0.411	22.92	0.041	0.011	0.030
7.00	0.204	0.056	0.148	15.00	0.510	0.099	0.411	23.00	0.041	0.011	0.030
7.08	0.204	0.056	0.148	15.08	0.490	0.098	0.391	23.08	0.041	0.011	0.030
7.17	0.204	0.056	0.148	15.17	0.490	0.098	0.392	23.17	0.041	0.011	0.030
7.25	0.204	0.056	0.148	15.25	0.490	0.097	0.392	23.25	0.041	0.011	0.030
7.33	0.224	0.062	0.162	15.33	0.469	0.097	0.372	23.33	0.041	0.011	0.030
7.42	0.224	0.062	0.162	15.42	0.469	0.096	0.373	23.42	0.041	0.011	0.030
7.50	0.224	0.062	0.162	15.50	0.469	0.096	0.373	23.50	0.041	0.011	0.030
7.58	0.245	0.068	0.177	15.58	0.388	0.095	0.292	23.58	0.041	0.011	0.030
7.67	0.245	0.068	0.177	15.67	0.388	0.095	0.293	23.67	0.041	0.011	0.030
7.75	0.245	0.068	0.177	15.75	0.388	0.094	0.293	23.75	0.041	0.011	0.030
7.83	0.265	0.073	0.192	15.83	0.388	0.094	0.294	23.83	0.041	0.011	0.030
7.92	0.265	0.073	0.192	15.92	0.388	0.093	0.294	23.92	0.041	0.011	0.030
8.00	0.265	0.073	0.192	16.00	0.388	0.093	0.295	24.00	0.041	0.011	0.030

Effective rain 3.85 in, loss 1.25 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 7.249 ac-ft. On-site detention basin with a controlled outlet. The Section 5 flood hydrograph of the 100-year 6-hour storm, 4.188 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	32.27 cfs	Peak outflow	8.94 cfs
Maximum water surface	1,443.41 ft	Storage at the maximum	2.422 ac-ft (105,516 ft³)
Peak reduction	72.3%	Freeboard to rim	3.59 ft

CHECK	REQUIRED	PROVIDED	RESULT
Peak outflow, 100-year, against the existing-condition peak	37.74 cfs	8.94 cfs	**Release does not exceed the existing peak**
Freeboard at the routed water surface, 1,443.41 ft	1.00 ft	3.59 ft	**One foot or more to the rim**
Storage at the maximum water surface	2.422 ac-ft	5.511 ac-ft	**Within the basin**

Volume and Project Hydrology

STORM VOLUME SUMMARY

NRCS TR-55 Curve Number Method · P24 = 5.10 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 — 2.891 ac-ft

T-1 initial — **1.136**
A = 3.20 ac · C = 0.88 → CN = 92.7 (HSG-weighted Table 2-2)
S = 0.79″ · I_e = 0.16″ · P_{24} = 5.10″

T-2 — **0.973**
A = 2.40 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 5.10″

T-3 — **0.782**
A = 2.20 ac · C = 0.88 → CN = 92.7 (HSG-weighted Table 2-2)
S = 0.78″ · I_e = 0.16″ · P_{24} = 5.10″

125,943 ft³

DA-2 — 2.374 ac-ft

T-4 initial — **0.712**
A = 2.00 ac · C = 0.88 → CN = 92.8 (HSG-weighted Table 2-2)
S = 0.78″ · I_e = 0.16″ · P_{24} = 5.10″

T-5 — **0.608**
A = 1.50 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 5.10″

T-6 initial — **0.648**
A = 1.60 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 5.10″

T-7 confluence — —

T-8 — **0.405**
A = 1.00 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 5.10″

103,407 ft³

DA-3 — 1.674 ac-ft

T-9 initial — **0.175**
A = 1.20 ac · C = 0.67 → CN = 65.3 (HSG-weighted Table 2-2)
S = 5.31″ · I_e = 1.06″ · P_{24} = 5.10″

T-10 — **1.499**
A = 3.70 ac · C = 0.90 → CN = 98.0 (HSG-weighted Table 2-2)
S = 0.20″ · I_e = 0.04″ · P_{24} = 5.10″

72,919 ft³

DA-4 — 0.580 ac-ft

T-11 initial — **0.580**
A = 3.80 ac · C = 0.79 → CN = 66.5 (HSG-weighted Table 2-2)
S = 5.04″ · I_e = 1.01″ · P_{24} = 5.10″

25,276 ft³

Total Across All DAs: **7.519 ac-ft · 327,544 ft³**

Same P, A and C under each method: NRCS CN = **7.519 ac-ft** · RCFC Volumetric = **8.293 ac-ft** · Tc-Duration = **2.515 ac-ft**

CRITICAL STORM EVENT ANALYSIS (MULTI-DURATION)

DA / Subarea	1-hour P = 1.41″	3-hour P = 2.08″	6-hour P = 2.78″	24-hour P = 5.10″	Governing
T-1 DA-1	0.205	0.363	0.538	**1.136**	**24-hour** 1.136 ac-ft
· T-2 DA-1	0.238	0.371	0.510	**0.973**	**24-hour** 0.973 ac-ft
· T-3 DA-1	0.141	0.250	0.370	**0.782**	**24-hour** 0.782 ac-ft
DA-1 total	**0.584**	**0.985**	**1.418**	**2.891**	**24-hour** 2.891 ac-ft
T-4 DA-2	0.129	0.229	0.338	**0.712**	**24-hour** 0.712 ac-ft
· T-5 DA-2	0.149	0.232	0.319	**0.608**	**24-hour** 0.608 ac-ft
T-6 DA-2	0.159	0.247	0.340	**0.648**	**24-hour** 0.648 ac-ft
⇄ T-7 DA-2	—	—	—	—	—
· T-8 DA-2	0.099	0.154	0.212	**0.405**	**24-hour** 0.405 ac-ft
DA-2 total	**0.536**	**0.862**	**1.209**	**2.374**	**24-hour** 2.374 ac-ft
T-9 DA-3	0.002	0.016	0.042	**0.175**	**24-hour** 0.175 ac-ft
· T-10 DA-3	0.367	0.572	0.786	**1.499**	**24-hour** 1.499 ac-ft
DA-3 total	**0.370**	**0.588**	**0.828**	**1.674**	**24-hour** 1.674 ac-ft
T-11 DA-4	0.009	0.059	0.146	**0.580**	**24-hour** 0.580 ac-ft
DA-4 total	**0.009**	**0.059**	**0.146**	**0.580**	**24-hour** 0.580 ac-ft
All drainage areas	**1.500**	**2.494**	**3.600**	**7.519**	**24-hour** 7.519 ac-ft

Governing event 24-hour · V = 7.519 ac-ft 327,544 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 = 5.10 in

Row	Type	Area (ac)	Tc (min)	Peak Q (cfs)	Volume (ac-ft)
DA-1					
T-1	initial	3.20	9.1	**9.76**	**1.136**
T-2	downstream	2.40	12.5	**16.21**	**0.973**
T-3	downstream	2.20	15.0	**21.52**	**0.782**
DA-1 OUTLET		-	**15.0**	21.52	2.891
DA-2					
T-4	initial	2.00	8.6	**6.27**	**0.712**
T-5	downstream	1.50	11.8	**10.41**	**0.608**
T-6	initial	1.60	7.7	**5.37**	**0.648**
T-7	confluence	0.00	11.8	**14.82**	—
T-8	downstream	1.00	12.2	**17.53**	**0.405**
DA-2 OUTLET		-	**12.2**	17.53	2.374
DA-3					
T-9	initial	1.20	20.5	**1.92**	**0.175**
T-10	downstream	3.70	22.6	**9.50**	**1.499**
DA-3 OUTLET		-	**22.6**	9.50	1.674
DA-4					
T-11	initial	3.80	23.8	**6.68**	**0.580**
DA-4 OUTLET		-	**23.8**	6.68	0.580
PROJECT TOTAL (sum of DA outlets)		**22.60**	-	55.23	7.519
PROJECT TOTAL Q (RCFC Plate D-1 confluence)		**22.60**	**15.0**	**48.00**	**7.519**

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	46.26	2.22	DA-4 6.68 cfs + DA-3 9.50 cfs × (2.22 in/hr / 2.28 in/hr) + DA-1 21.52 cfs × (2.22 in/hr / 2.75 in/hr) + DA-2 17.53 cfs × (2.22 in/hr / 3.02 in/hr)
2	Peak at the Tc of DA-3	22.6	46.89	2.28	DA-4 6.68 cfs × (22.6 min / 23.8 min) + DA-3 9.50 cfs + DA-1 21.52 cfs × (2.28 in/hr / 2.75 in/hr) + DA-2 17.53 cfs × (2.28 in/hr / 3.02 in/hr)
3	**Peak at the Tc of DA-1 (governs, PROJECT Q)**	**15.0**	**48.00**	**2.75**	**DA-4 6.68 cfs × (15.0 min / 23.8 min) + DA-3 9.50 cfs × (15.0 min / 22.6 min) + DA-1 21.52 cfs + DA-2 17.53 cfs × (2.75 in/hr / 3.02 in/hr)**
4	Peak at the Tc of DA-2	12.2	43.64	3.02	DA-4 6.68 cfs × (12.2 min / 23.8 min) + DA-3 9.50 cfs × (12.2 min / 22.6 min) + DA-1 21.52 cfs × (12.2 min / 15.0 min) + DA-2 17.53 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 = **48.00 cfs** at Tc = 15.0 min (RCFC Plate D-1 confluence) **Total V** = **7.519 ac-ft** (327,544 ft³ · 2,450,198 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

$$I = A / (Tc + B)^{n} \quad A = \mathbf{5.32}\ B = \mathbf{0}\ n = \mathbf{0.46}$$

DA-1	DA-2	DA-3	DA-4
Q = 6.54 cfs	**Q = 5.28 cfs**	**Q = 4.45 cfs**	**Q = 3.40 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**	1.18	0.71	**6.5**	**6.5**	0.0110	--	2.4	880	6.2	Existing, vacant
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **6.54 cfs**		Tc **26.30 min**		I **1.182 in/hr**									
DA-2	**E-2**	--	B/C/Natural	6.10	**24.9**	1.21	0.71	**5.3**	**5.3**	0.0110	--	2.2	760	5.7	Existing, vacant
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **5.28 cfs**		Tc **24.93 min**		I **1.212 in/hr**									
DA-3	**E-3**	--	B/C/Natural	4.90	**23.0**	1.26	0.72	**4.5**	**4.5**	0.0110	--	2.2	640	5.0	Existing, vacant
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **4.45 cfs**		Tc **23.03 min**		I **1.257 in/hr**									
DA-4	**E-4**	--	B/C/Natural	3.80	**23.8**	1.24	0.72	**3.4**	**3.4**	0.0200	--	2.7	940	5.7	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **3.40 cfs**		Tc **23.82 min**		I **1.237 in/hr**									

Rational Method Tabulation

Existing condition, 100-year storm

Rider Street Logistics Center
Q = C × I × A

$$I = A / (Tc + B)^{n} \quad A = \mathbf{9.55}\ B = \mathbf{0}\ n = \mathbf{0.46}$$

DA-1	DA-2	DA-3	DA-4
Q = 12.95 cfs	**Q = 10.43 cfs**	**Q = 8.75 cfs**	**Q = 6.68 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**	2.12	0.78	**13.0**	**13.0**	0.0110	--	2.8	880	5.2	Existing, vacant
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **12.95 cfs**		Tc **26.30 min**		I **2.122 in/hr**									
DA-2	**E-2**	--	B/C/Natural	6.10	**24.9**	2.18	0.79	**10.4**	**10.4**	0.0110	--	2.6	760	4.8	Existing, vacant
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **10.43 cfs**		Tc **24.93 min**		I **2.175 in/hr**									
DA-3	**E-3**	--	B/C/Natural	4.90	**23.0**	2.26	0.79	**8.8**	**8.8**	0.0110	--	2.5	640	4.2	Existing, vacant
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **8.75 cfs**		Tc **23.03 min**		I **2.256 in/hr**									
DA-4	**E-4**	--	B/C/Natural	3.80	**23.8**	2.22	0.79	**6.7**	**6.7**	0.0200	--	3.2	940	4.9	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **6.68 cfs**		Tc **23.82 min**		I **2.221 in/hr**									

Rational Method Tabulation

Proposed condition, 10-year storm

Rider Street Logistics Center
Q = C × I × A

$$I = A / (Tc + B)^{n} \quad A = \mathbf{5.32}\ B = \mathbf{0}\ n = \mathbf{0.46}$$

DA-1	DA-2	DA-3	DA-4
Q = 11.74 cfs	**Q = 9.61 cfs**	**Q = 5.09 cfs**	**Q = 3.40 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**	1.93	0.87	**5.4**	**5.4**	0.0090	--	2.0	480	3.9	Roof and truck court
DA-1	**T-2**	--	B/C/Paved	2.40	**13.0**	1.63	0.90	**3.5**	**8.9**	0.0070	Private Drive	3.0	520	2.9	Gutter flow, private drive
DA-1	**T-3**	--	B/C/Comm	2.20	**15.9**	1.49	0.87	**2.8**	**11.7**	0.0060	24" RCP	6.0	260	0.7	Pipe travel to CB A-6
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **11.74 cfs**		Tc **15.93 min**		I **1.489 in/hr**									
DA-2	**T-4**	--	B/C/Comm	2.00	**8.6**	1.98	0.87	**3.5**	**3.5**	0.0080	--	1.7	390	3.8	Building, east half
DA-2	**T-5**	--	B/C/Paved	1.50	**12.3**	1.68	0.90	**2.3**	**5.7**	0.0060	40' Local	2.6	410	2.7	Street gutter, Drive B
DA-2	**T-6**	--	B/C/Paved	1.60	**7.7**	2.08	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**	1.68	0.92	**0.0**	**8.1**	0.0060	30" RCP	5.4	150	0.5	Confluence, Plate D-1
DA-2	**T-8**	--	B/C/Paved	1.00	**12.8**	1.65	0.90	**1.5**	**9.6**	0.0050	30" RCP	5.3	190	0.6	Pipe travel to CB B-2
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **9.61 cfs**		Tc **12.79 min**		I **1.647 in/hr**									
DA-3	**T-9**	--	B/C/Park	1.20	**20.5**	1.33	0.56	**0.9**	**0.9**	0.0140	--	1.7	260	2.5	Landscape buffer
DA-3	**T-10**	--	B/C/Paved	3.70	**22.9**	1.26	0.90	**4.2**	**5.1**	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 **5.09 cfs**		Tc **22.95 min**		I **1.259 in/hr**									
DA-4	**T-11**	--	B/C/Natural	3.80	**23.8**	1.24	0.72	**3.4**	**3.4**	0.0200	--	2.7	940	5.7	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **3.40 cfs**		Tc **23.82 min**		I **1.237 in/hr**									

Rational Method Tabulation

Proposed condition, 100-year storm

Rider Street Logistics Center
Q = C × I × A

$$I = A / (Tc + B)^{n} \quad A = \mathbf{9.55}\ B = \mathbf{0}\ n = \mathbf{0.46}$$

DA-1	DA-2	DA-3	DA-4
Q = 21.52 cfs	**Q = 17.53 cfs**	**Q = 9.50 cfs**	**Q = 6.68 cfs**
Tc: 15.0 min	Tc: 12.2 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**	3.46	0.88	**9.8**	**9.8**	0.0090	--	2.4	480	3.4	Roof and truck court
DA-1	**T-2**	--	B/C/Paved	2.40	**12.5**	2.99	0.90	**6.5**	**16.2**	0.0070	Private Drive	3.4	520	2.5	Gutter flow, private drive
DA-1	**T-3**	--	B/C/Comm	2.20	**15.0**	2.75	0.88	**5.3**	**21.5**	0.0060	24" RCP	6.8	260	0.6	Pipe travel to CB A-6
DA-1 SUMMARY															Terminus: DA-1 OUTLET
Total Area **7.80 ac**		Total Q **21.52 cfs**		Tc **15.02 min**		I **2.746 in/hr**									
DA-2	**T-4**	--	B/C/Comm	2.00	**8.6**	3.55	0.88	**6.3**	**6.3**	0.0080	--	2.0	390	3.3	Building, east half
DA-2	**T-5**	--	B/C/Paved	1.50	**11.8**	3.06	0.90	**4.1**	**10.4**	0.0060	40' Local	2.9	410	2.3	Street gutter, Drive B
DA-2	**T-6**	--	B/C/Paved	1.60	**7.7**	3.73	0.90	**5.4**	**5.4**	0.0080	--	1.9	300	2.6	Auto parking, south lot
DA-2	**T-7**	--	B/Paved	0.00	**11.8**	3.06	0.92	**0.0**	**14.8**	0.0060	30" RCP	6.4	150	0.4	Confluence, Plate D-1
DA-2	**T-8**	--	B/C/Paved	1.00	**12.2**	3.02	0.90	**2.7**	**17.5**	0.0050	30" RCP	6.2	190	0.5	Pipe travel to CB B-2
DA-2 SUMMARY															Terminus: DA-2 OUTLET
Total Area **6.10 ac**		Total Q **17.53 cfs**		Tc **12.24 min**		I **3.018 in/hr**									
DA-3	**T-9**	--	B/C/Park	1.20	**20.5**	2.38	0.67	**1.9**	**1.9**	0.0140	--	2.0	260	2.1	Landscape buffer
DA-3	**T-10**	--	B/C/Paved	3.70	**22.6**	2.28	0.90	**7.6**	**9.5**	0.0080	Industrial	3.2	470	2.5	Industrial drive aisle
DA-3 SUMMARY															Terminus: DA-3 OUTLET
Total Area **4.90 ac**		Total Q **9.50 cfs**		Tc **22.60 min**		I **2.276 in/hr**									
DA-4	**T-11**	--	B/C/Natural	3.80	**23.8**	2.22	0.79	**6.7**	**6.7**	0.0200	--	3.2	940	4.9	Offsite run-on, natural
DA-4 SUMMARY															Terminus: DA-4 OUTLET
Total Area **3.80 ac**		Total Q **6.68 cfs**		Tc **23.82 min**		I **2.221 in/hr**									

CATCH BASIN INLET CAPACITY

CB A-6, Rider Street Logistics Center

Curb opening inlet, sump, 21.52 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 21.52 cfs at the top of the curb; no standard width takes all of it (49.3 ft would). Add a second inlet.

GUTTER	VALUE	INLET	VALUE
Design flow	21.52 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	4.27 in	Velocity	6.80 fps
Depth downstream, after capture	3.04 in	Over capacity at 28 ft	8.67 cfs
Capacity at the top of the curb	12.85 cfs	Ponding depth	**8.46 in, over curb**
Width to take all of the flow	**49.3 ft (over the 21 ft standard)**	**Width selected**	**28 ft, 60% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY
4 ft	14%	3.09 cfs	18.43 cfs
7 ft	20%	4.31 cfs	17.21 cfs
14 ft	33%	7.16 cfs	14.36 cfs
21 ft	46%	10.00 cfs	11.52 cfs

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CATCH BASIN INLET CAPACITY

CB B-2, Rider Street Logistics Center

Curb opening inlet, sump, 17.53 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 17.53 cfs at the top of the curb; no standard width takes all of it (39.5 ft would). Add a second inlet.

GUTTER	VALUE	INLET	VALUE
Design flow	17.53 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	3.95 in	Velocity	6.46 fps
Depth downstream, after capture	2.88 in	Over capacity at 21 ft	7.53 cfs
Capacity at the top of the curb	10.00 cfs	Ponding depth	**8.72 in, over curb**
Width to take all of the flow	**39.5 ft (over the 21 ft standard)**	**Width selected**	**21 ft, 57% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY	
4 ft	18%	3.09 cfs	14.44 cfs	
7 ft	25%	4.31 cfs	13.22 cfs	
14 ft	41%	7.16 cfs	10.37 cfs	
21 ft	**57%**	**10.00 cfs**	**7.53 cfs**	selected

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CATCH BASIN INLET CAPACITY

CB C-1, Rider Street Logistics Center

Curb opening inlet, sump, 9.50 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 9.50 cfs at the top of the curb; 19.8 ft takes all of it, the 21 ft standard width.

GUTTER	VALUE	INLET	VALUE
Design flow	9.50 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	3.14 in	Velocity	5.55 fps
Depth downstream, after capture	1.86 in	Over capacity at 14 ft	2.34 cfs
Capacity at the top of the curb	7.16 cfs	Ponding depth	**7.25 in, over curb**
Width to take all of the flow	**19.8 ft**	**Width selected**	**14 ft, 75% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY	
4 ft	33%	3.09 cfs	6.41 cfs	
7 ft	45%	4.31 cfs	5.19 cfs	
14 ft	**75%**	**7.16 cfs**	**2.34 cfs**	selected
21 ft	100%	9.50 cfs	0.00 cfs	recommended

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

CATCH BASIN INLET CAPACITY

CB D-2, Rider Street Logistics Center

Curb opening inlet, sump, 6.68 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 6.68 cfs at the top of the curb; 12.8 ft takes all of it, the 14 ft standard width.

GUTTER	VALUE	INLET	VALUE
Design flow	6.68 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	2.75 in	Velocity	5.08 fps
Depth downstream, after capture	1.87 in	Over capacity at 7 ft	2.37 cfs
Capacity at the top of the curb	4.31 cfs	Ponding depth	**8.04 in, over curb**
Width to take all of the flow	**12.8 ft**	**Width selected**	**7 ft, 65% capture**

Capture at the standard widths.

WIDTH	CAPTURE	INTERCEPTED	OVER CAPACITY	
4 ft	46%	3.09 cfs	3.59 cfs	
7 ft	**65%**	**4.31 cfs**	**2.37 cfs**	selected
14 ft	100%	6.68 cfs	0.00 cfs	recommended
21 ft	100%	6.68 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 43.65 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 8.04 fps; computed stone d50 9.9 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	43.65 cfs
Outlet velocity	**8.04 fps**
Stone specific gravity	2.65
Stability factor C	0.86

RIPRAP	VALUE
Stone d50	**9.9 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 ft^3
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 6.68 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 4.76 fps; computed stone d50 3.5 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	6.68 cfs
Outlet velocity	**4.76 fps**
Stone specific gravity	2.65
Stability factor C	0.86

RIPRAP	VALUE
Stone d50	**3.5 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

STREET FLOW CAPACITY

Drive B, Rider Street Logistics Center

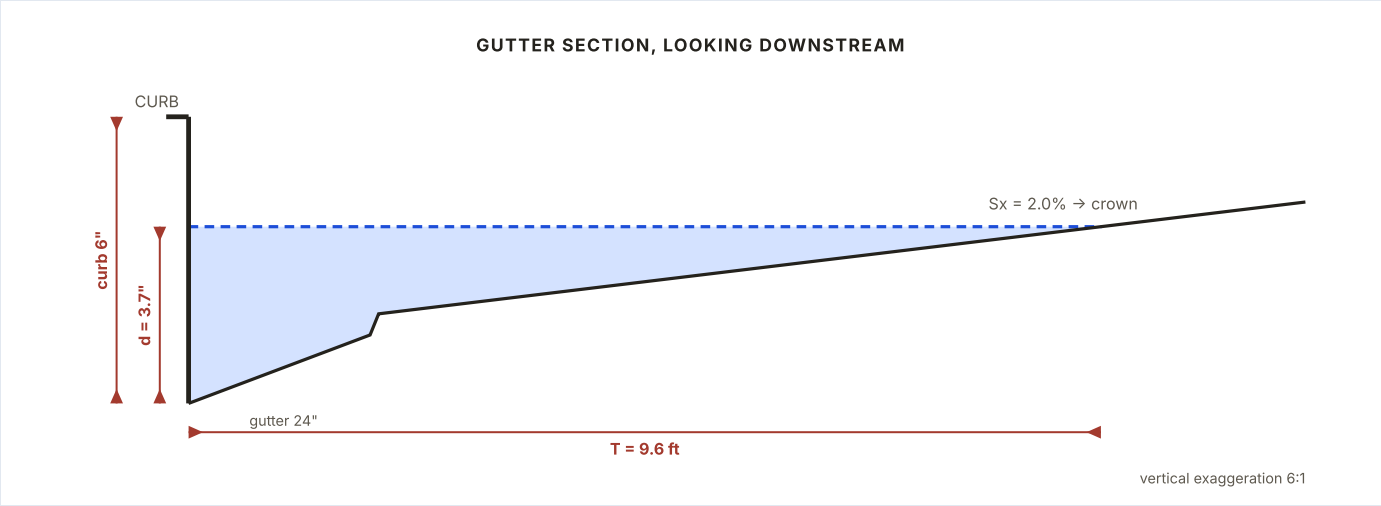
Gutter flow of 2.80 cfs in a 6" Curb & Gutter (Std 200) section by Manning's equation for the composite gutter and pavement section (HEC-22), solved for the spread at which the section carries the flow; the depth at the curb includes the gutter depression of 1.4 in (the 1-1/2 in fall of the 24 in gutter less the pavement cross fall over it, plus the 3/8 in lip at the edge of pavement, Std 200). Design targets applied here: spread within half the distance to crown (one lane clear) and depth within 80 percent of the curb height, both stricter than the County criteria of the 10-year flow within the top of curb and the 100-year within the right-of-way.

Meets. Spread 9.6 ft against 10.0 ft allowed (half the distance to crown); depth at the curb 3.7 in against 4.8 in (80 percent of the 6 in curb). Both within.

SECTION	VALUE
Curb	6" Curb & Gutter (Std 200)
Longitudinal slope	0.0100 ft/ft
Pavement cross slope	0.020 ft/ft
Distance to crown	20.0 ft
Manning's n	0.016

FLOW	VALUE
Design flow	2.80 cfs
Spread	**9.6 ft**
Allowed spread	10.0 ft
Depth at the curb	**3.7 in**
Allowed depth	4.8 in
Velocity	2.70 fps
Flow area	1.04 ft²

Section at the design flow.



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

DROP INLET GRATE CAPACITY

Truck court grate, Rider Street Logistics Center

Grate inlet in a sump, 1.00 cfs. Capacity per FHWA HEC-22 for a grate in a sag: the head is the larger of the weir depth, $Q = C_w P d^{1.5}$ with $C_w = 3.0$ over the grate perimeter, and the orifice depth, $Q = C A \sqrt{(2gd)}$ with $C = 0.6$ through the openings; the perimeter and the net opening are both halved for clogging (Riverside County practice). Weir control governs at shallow ponding, orifice once the grate is drowned. The head is the depth of ponding at the grate, and the ponding extends up each grade to where the ground meets that depth.

Meets. Head at the grate 0.22 ft, weir control with 50% of the grate clogged, within the 0.25 ft allowed; ponding covers about 1,052 ft².

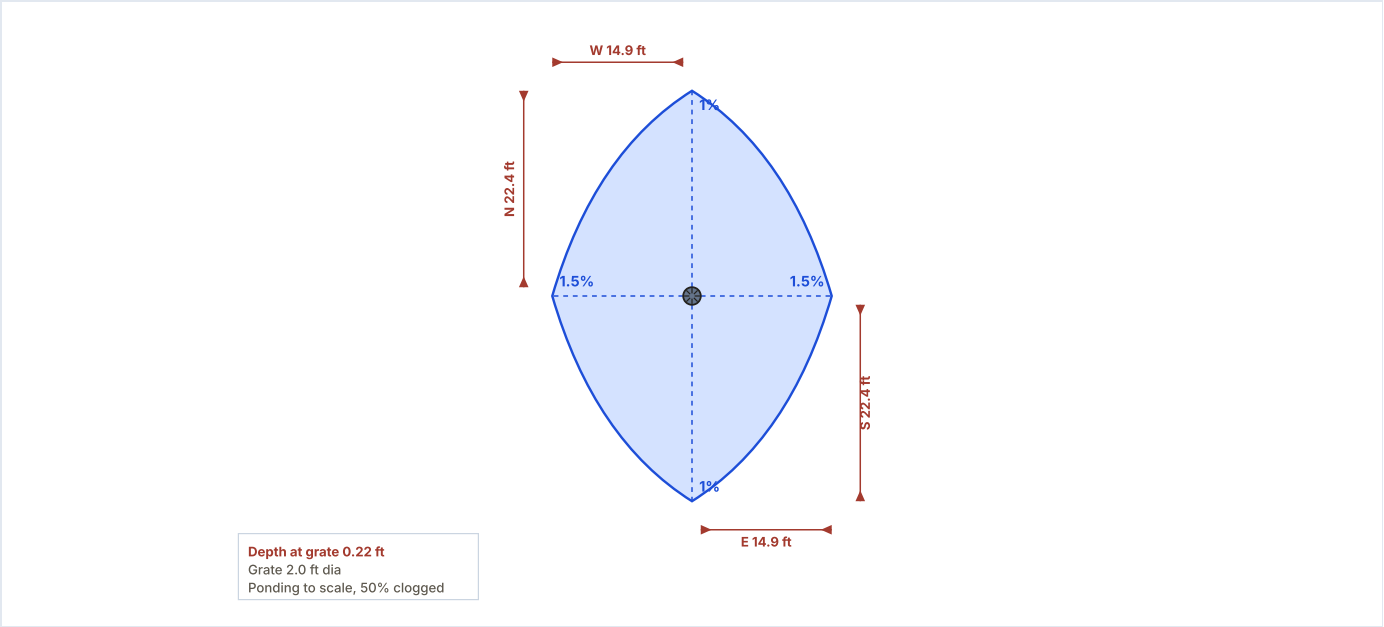
GRATE	VALUE
Model	Drop In - 24 IN
Size	24 in
Net opening	164.94 in² (1.145 ft²)
Opening at 50% clogged	0.573 ft²

GRADE SLOPE	PERCENT
North	1.0 %
South	1.0 %
East	1.5 %
West	1.5 %

HEAD	VALUE
Design flow	1.00 cfs
Weir depth, P = 3.14 ft clogged	0.22 ft
Orifice depth, A = 0.573 ft² clogged	0.13 ft
Head at the grate, weir governs	**0.22 ft**
Allowed head	0.25 ft
Ponding area	**1,052 ft²**

PONDING EXTENT	FEET
North	22.4 ft
South	22.4 ft
East	14.9 ft
West	14.9 ft

Plan of the ponding at the grate, to scale.



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

STORMWATER SIZING

Water Quality Volume, Rider Street Logistics Center

Design capture volume for water quality treatment, $V = C \cdot P_{85} \cdot A$, from the tributary area, its runoff coefficient and the 85th percentile 24-hour storm depth (Riverside County WQMP Technical Guidance Document).

Water quality volume 31,938 ft³, 0.7332 ac-ft, 238,914 gal.

INPUT	VALUE		
Tributary area	18.80 ac	85th percentile storm, P_{85}	0.6 in
Runoff coefficient, C	0.78	**Water quality volume**	**31,938 ft³**

Riverside County WQMP Technical Guidance Document. Rider Street Logistics Center · October 4, 2026

BASIN ROUTING

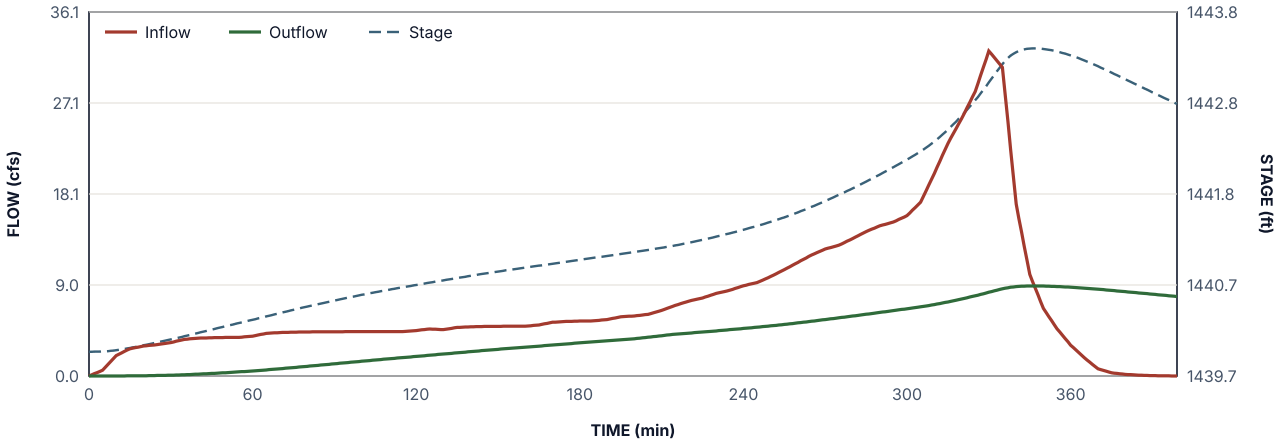
Modified Puls, Rider Street Logistics Center

Tributary to the basin: the whole site, DA-1, DA-2, DA-3, DA-4, 22.60 ac, 24-hour runoff volume 7.249 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 1,442.84 ft, 3-hour 1,443.22 ft, 6-hour 1,443.41 ft, 24-hour 1,442.79 ft). Inflow is the Section 5 flood hydrograph of the 6-hour storm, 4.188 ac-ft, peak 32.3 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	32.27 cfs at 330 min	Inflow volume	182,436 ft³
Peak outflow	8.94 cfs	Peak reduction	72.3%
Maximum water surface	**1,443.41 ft at 347 min**	**Maximum storage**	**105,516 ft³ (2.422 ac-ft)**
Freeboard to rim	3.59 ft	Storage used	44.0% of capacity

ROUTING HYDROGRAPH



REQUIREMENT	CALCULATED	REQUIRED	STATUS
Freeboard to rim	3.59 ft	≥ 1.0 ft	OK
Peak outflow	8.94 cfs	≤ 37.74 cfs	OK
Maximum water surface	1,443.41 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	3.06	0.04	2,570	1,440.09
46	3.81	0.27	7,238	1,440.26
69	4.30	0.69	12,086	1,440.43
92	4.40	1.26	16,768	1,440.59
115	4.40	1.83	20,706	1,440.72
138	4.86	2.37	24,200	1,440.84
161	4.97	2.88	27,356	1,440.95
184	5.47	3.37	30,357	1,441.05
207	6.28	3.91	33,412	1,441.15
230	8.19	4.48	37,612	1,441.29
253	10.29	5.06	43,591	1,441.49
276	13.12	5.81	52,442	1,441.78
299	15.79	6.64	63,910	1,442.14
322	26.63	7.77	82,489	1,442.72
345	10.09	8.94	105,459	1,443.41
368	1.15	8.66	99,647	1,443.23
391	0.03	8.10	88,472	1,442.90

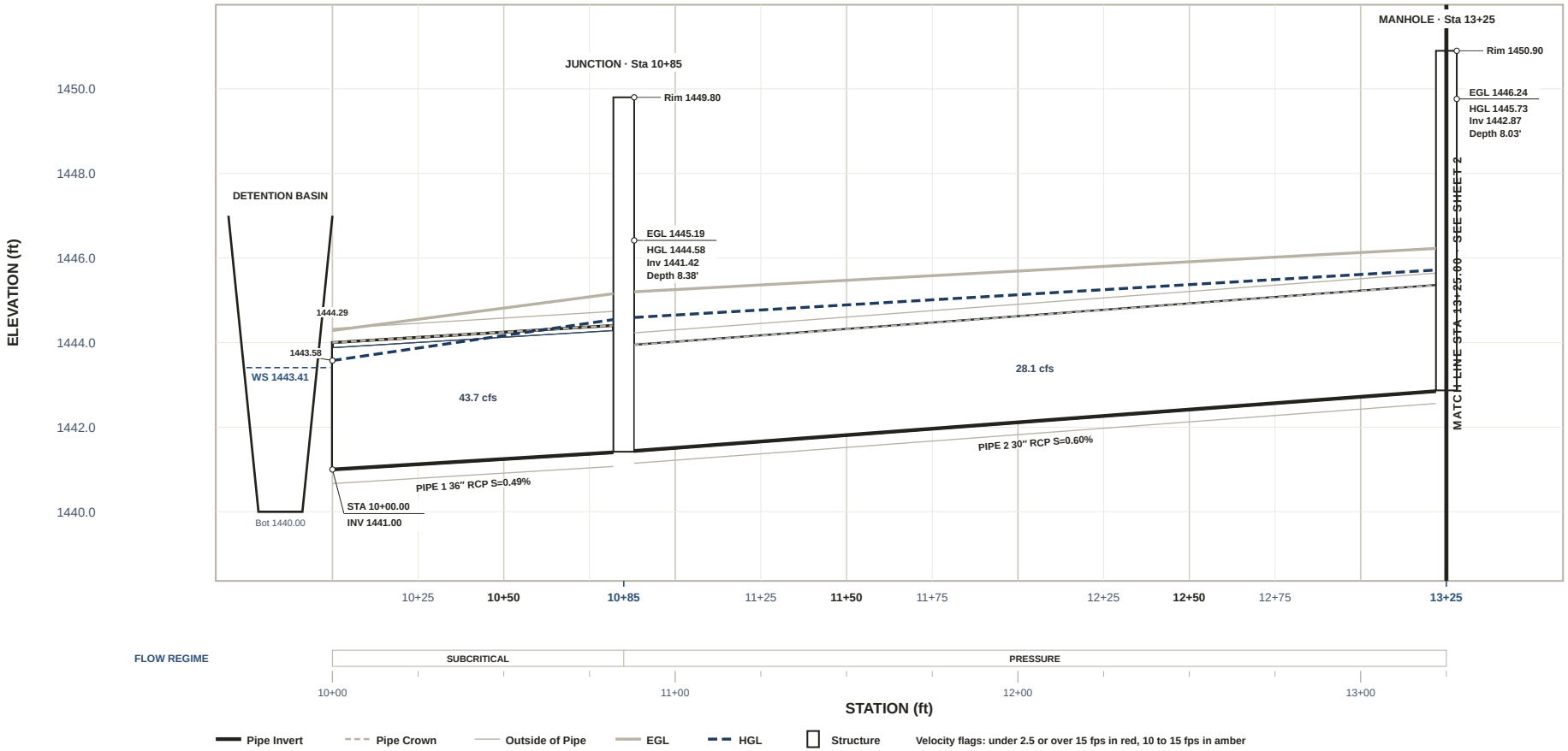
STORM DRAIN PROFILE

Line A (sheet 1 of 5)

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

2 pipes
Max V 6.3 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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



REDUCED FOR REPORT, NOT TO SCALE

STORM DRAIN PROFILE

Line A (sheet 2 of 5)

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

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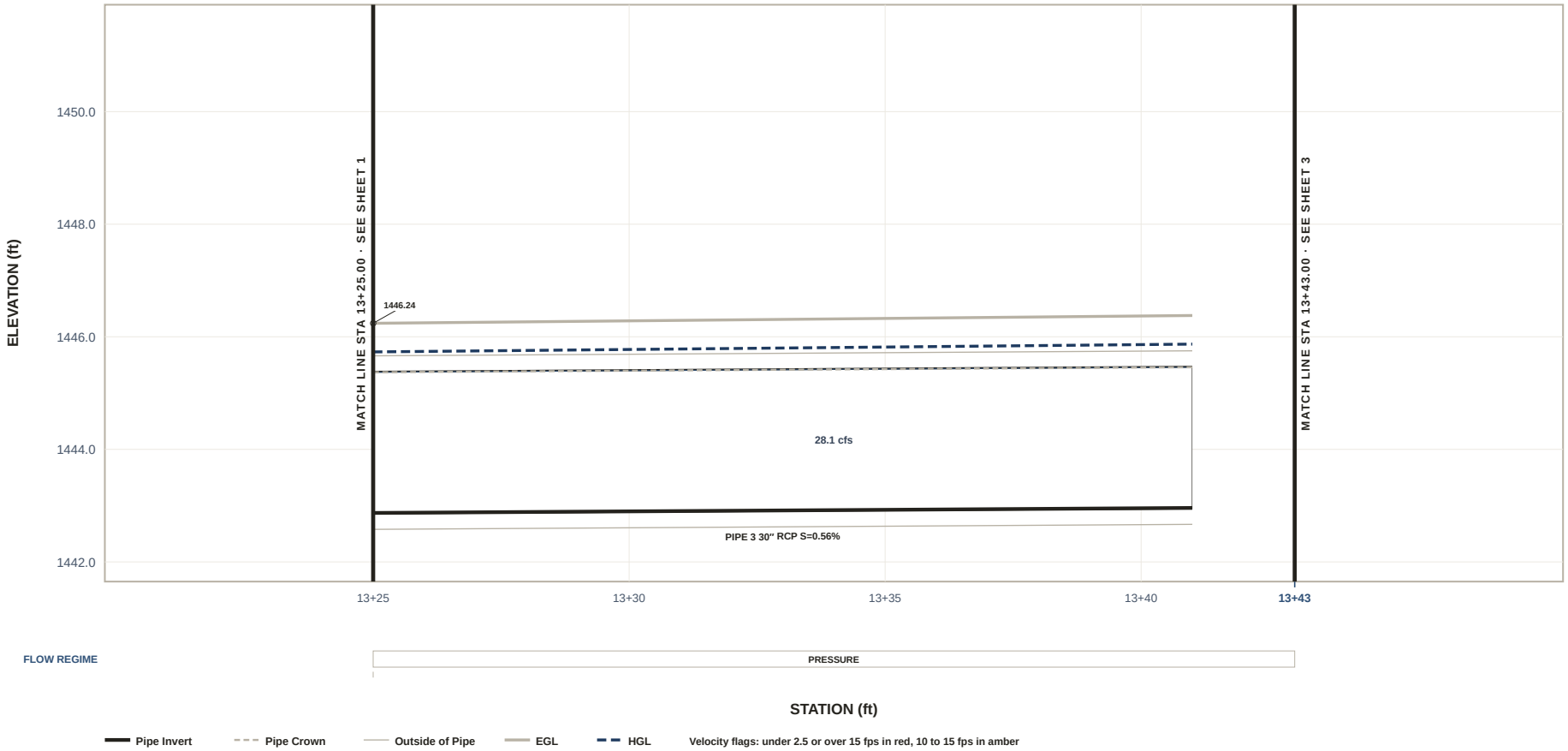
Max V 5.7 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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



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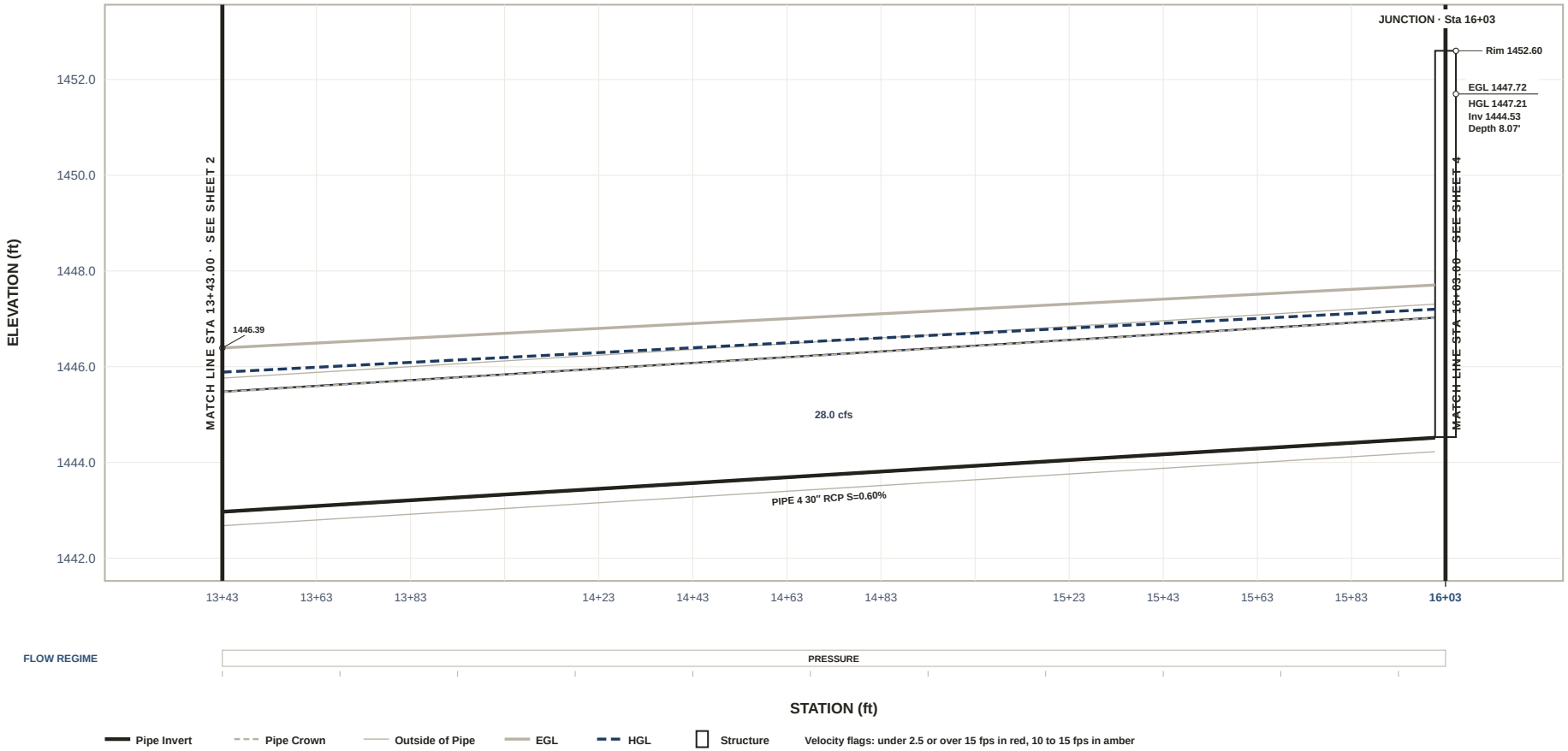
STORM DRAIN PROFILE

Line A (sheet 3 of 5)

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

1 pipe
Max V 5.7 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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



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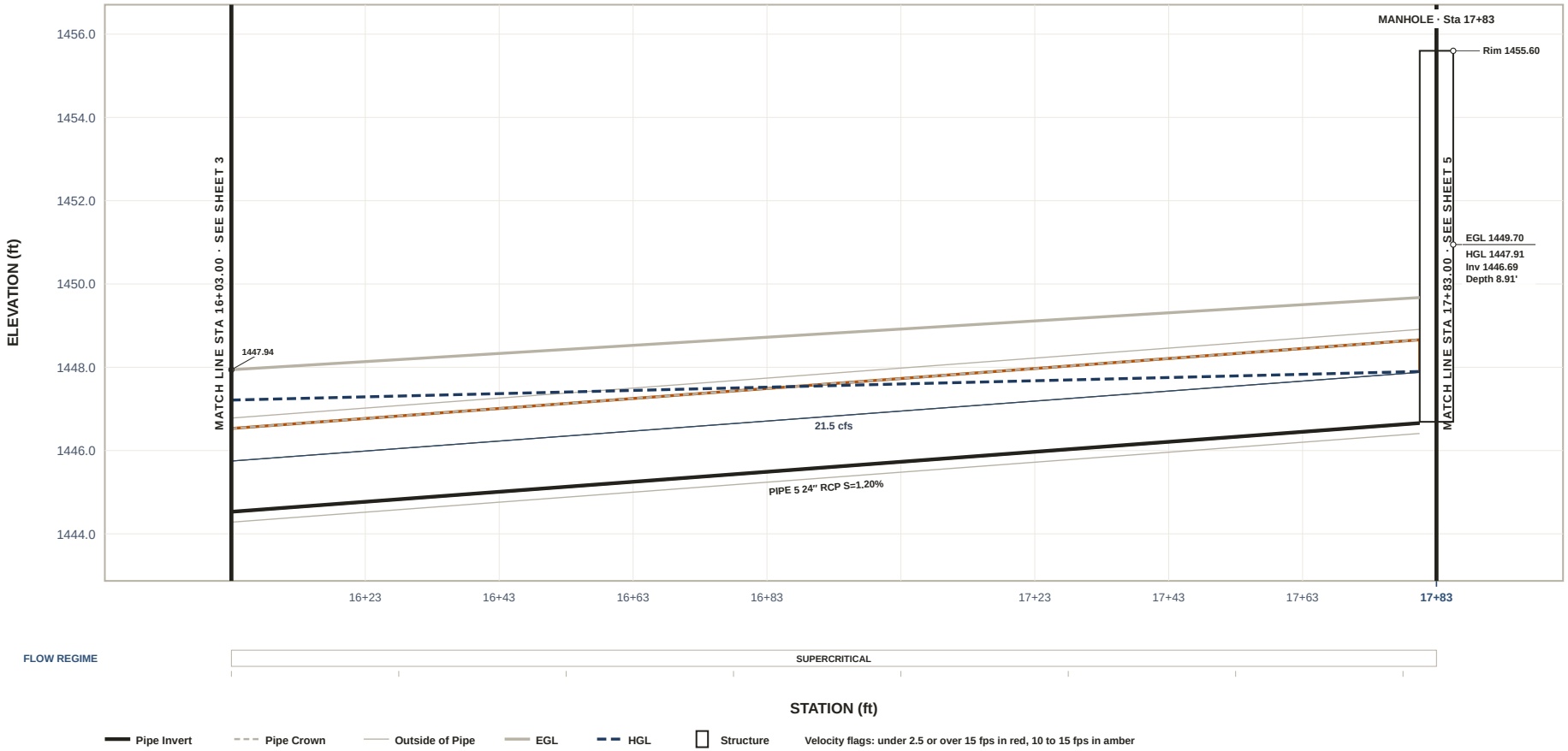
STORM DRAIN PROFILE

Line A (sheet 4 of 5)

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

1 pipe
Max V 10.7 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 5 of 5)

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

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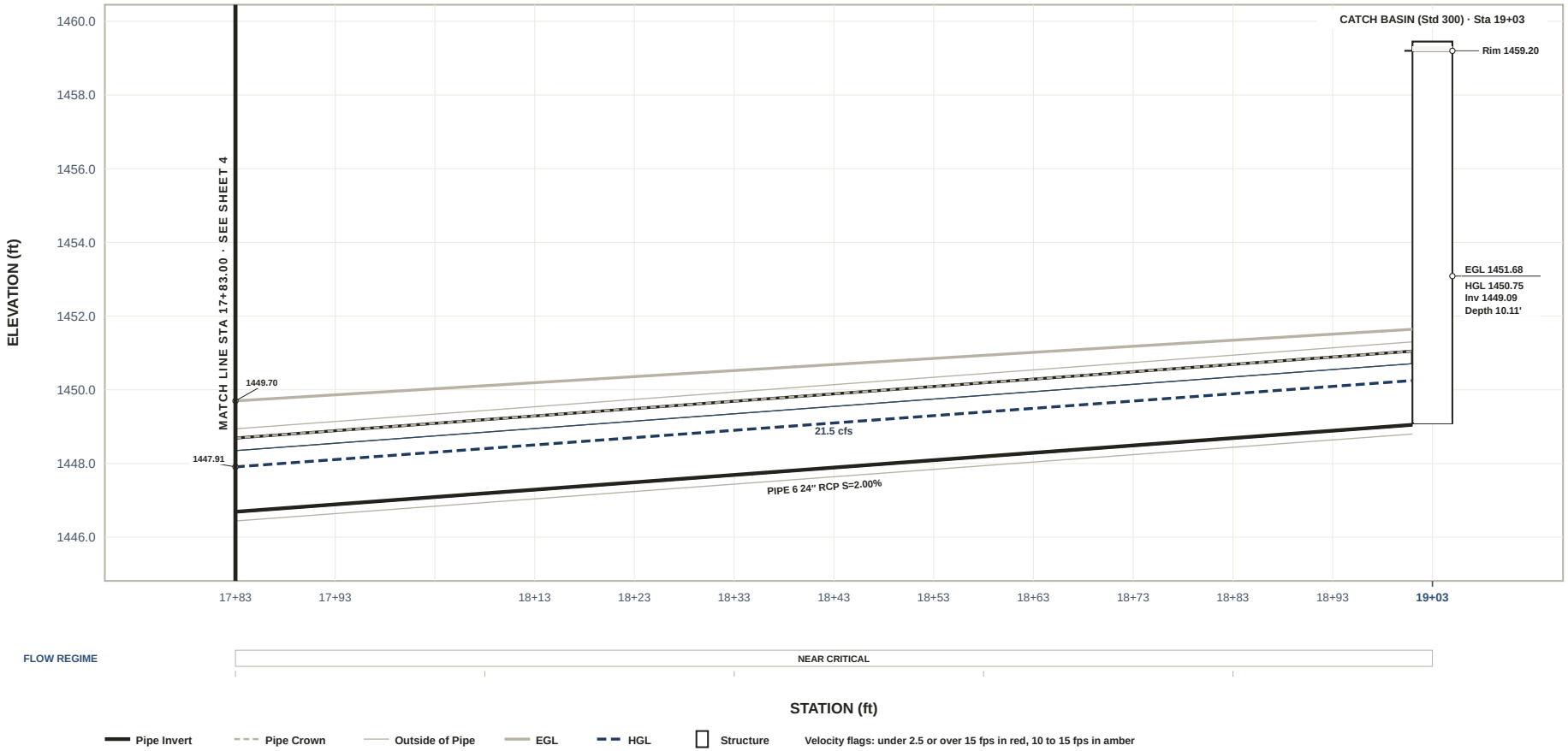
Max V 7.7 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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



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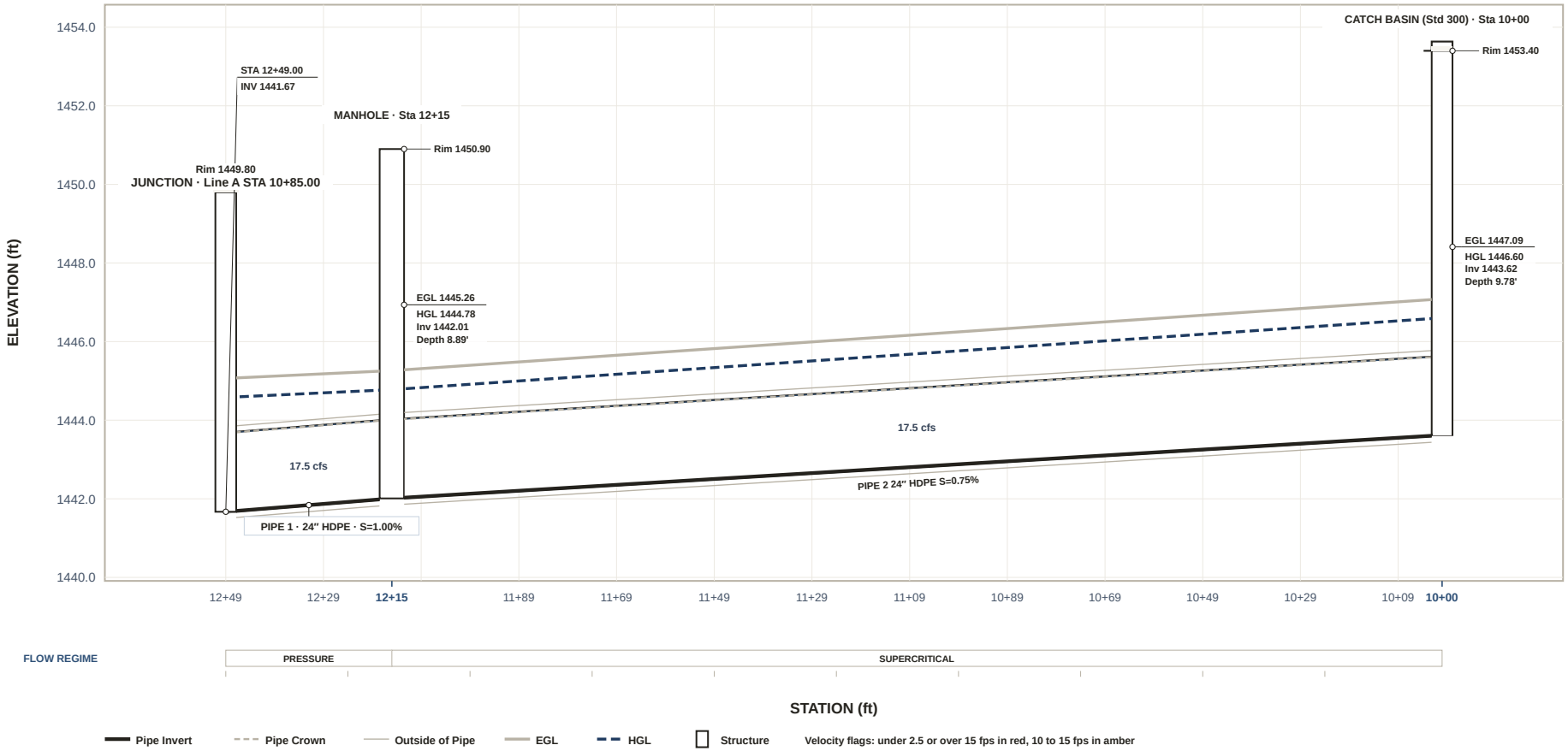
STORM DRAIN PROFILE

Line 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

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



REDUCED FOR REPORT, NOT TO SCALE

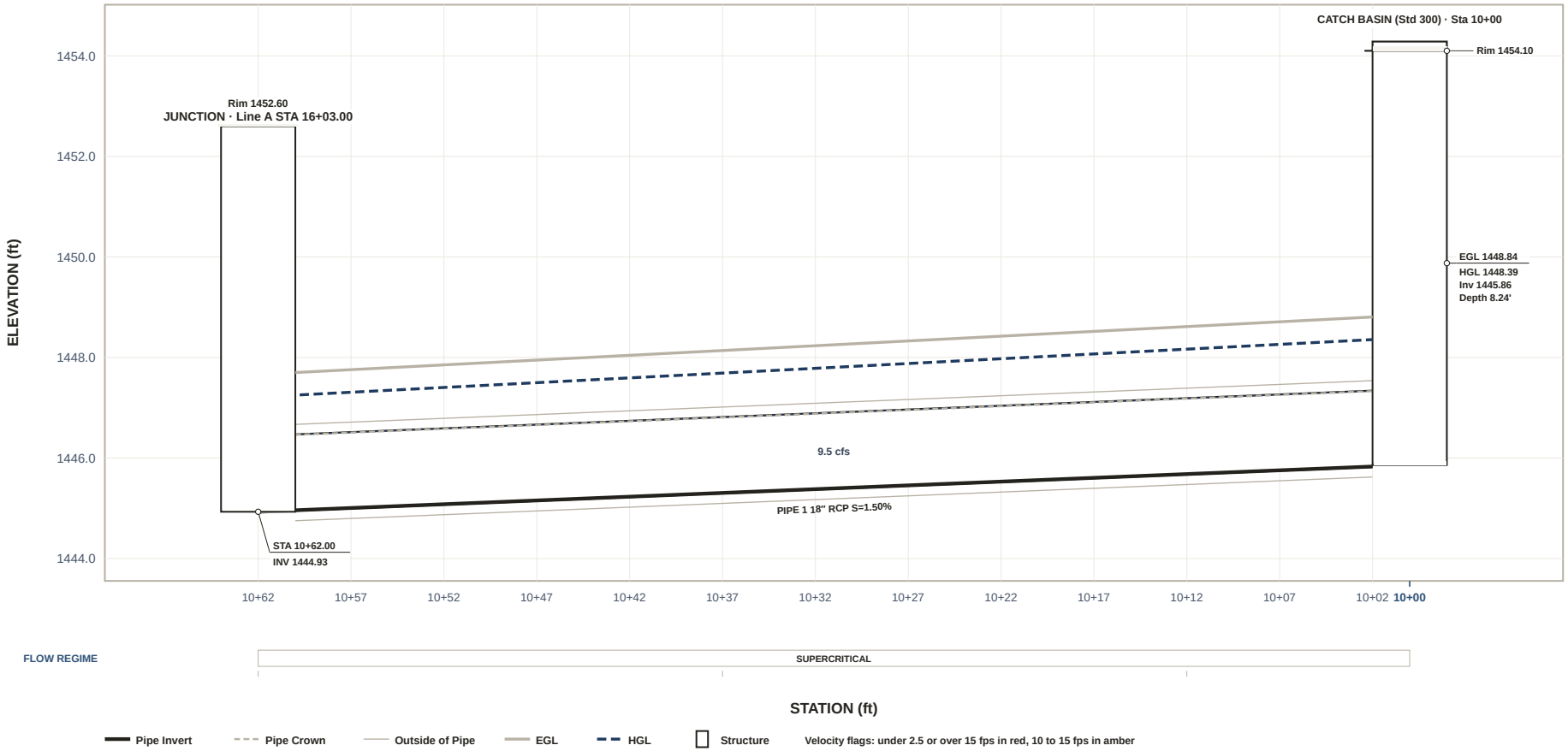
STORM DRAIN PROFILE

Line C

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

1 pipe
Max V 5.4 fps
Surcharge 0
Cover issues 0
ALL CRITERIA MET

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



REDUCED FOR REPORT, NOT TO SCALE

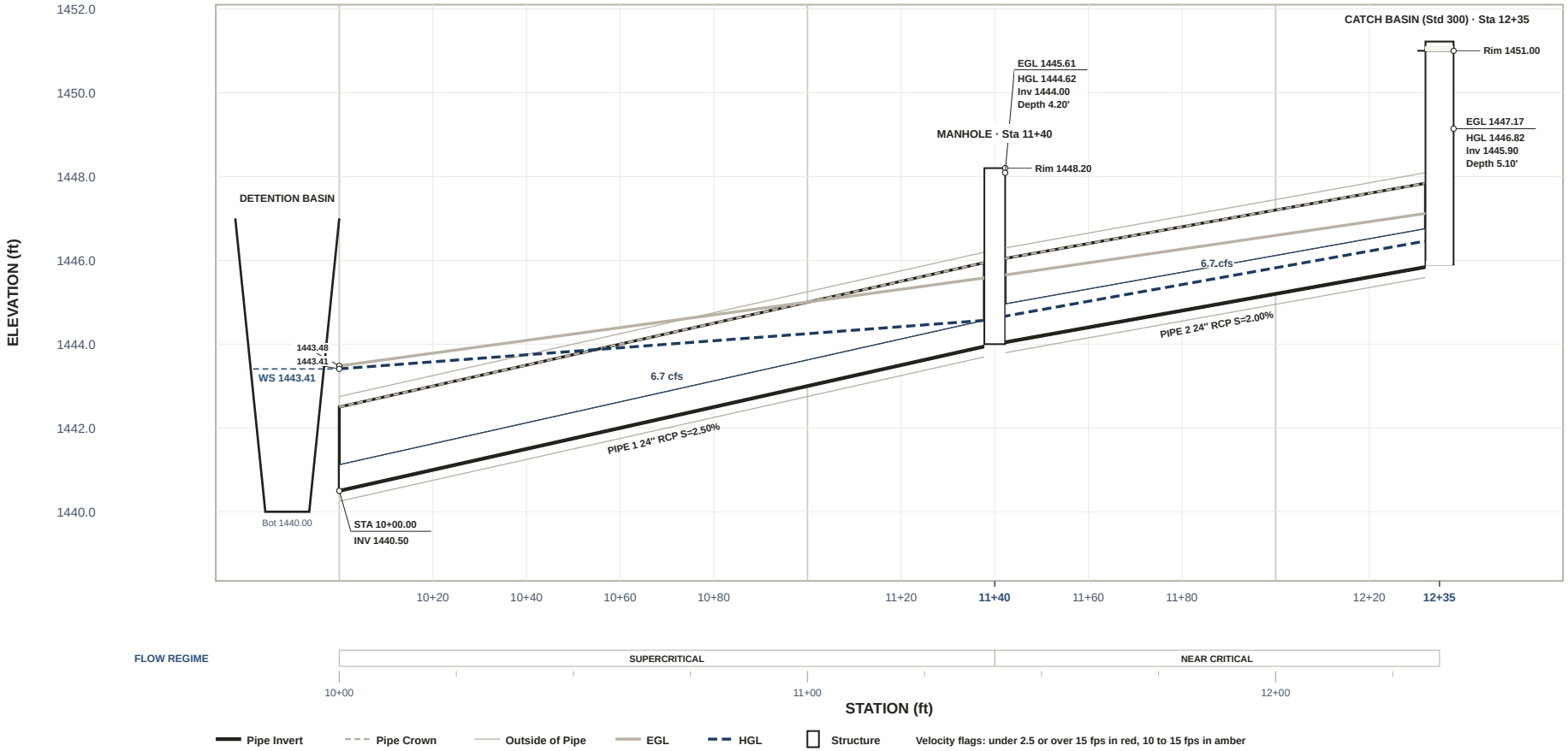
STORM DRAIN PROFILE

Line D

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

2 pipes
Max V 8.0 fps
Surcharge 0
Cover issues 0
REVIEW REQUIRED

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



REDUCED FOR REPORT, NOT TO SCALE

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: **3.58 ft** | Max V: **10.7 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: 1443.58 ft (tailwater 1443.41 ft) | Min FB: **5.11 ft** | Max V: 10.7 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	43.65 D-1 at 16.7 min	46.88	6.26	0.45 SUBCRIT	1441.00	**1443.58**	0.354	0.724	1441.42	**1444.58**	1449.80	**5.22**	OK
A-2 **MANHOLE** Δ	1085 25'	240	30	0.0060	28.09 D-1 at 16.2 min	31.88	5.72	0.00 PRESS	1441.42	**1444.58**	1.126	0.025	1442.87	**1445.73**	1450.90	**5.17**	OK
A-3 **45° BEND**	1325 25'	18	30	0.0056	28.09 D-1 at 16.1 min	30.57	5.72	0.00 PRESS	1442.87	**1445.73**	0.084	0.071	1442.97	**1445.89**	1451.00	**5.11**	OK
A-4 **JUNCTION** Δ	1343	260	30	0.0060	28.01 D-1 at 15.5 min	31.77	5.71	0.00 PRESS	1442.97	**1445.89**	1.213	0.113	1444.53	**1447.21**	1452.60	**5.39**	OK
A-5 **MANHOLE** Δ	1603 25'	180	24	0.0120	21.52	24.78	10.74	1.87 **JUMP**	1444.53	**1447.21**	1.630	0.036	1446.69	**1447.91**	1455.60	**7.69**	**JUMP**
A-6 **CATCH BASIN** Δ	1783 25'	120	24	0.0200	21.52	31.99	7.72	1.00 SUPERCRIT > CRIT	1446.69	**1447.91**	1.977	1.389	1449.09	**1450.75**	1459.20	**8.45**	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 = 43.65 cfs y_n = 2.29′ y_c = 2.15′ V = 6.26 fps Fr = 0.45, **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	2.58	6.76	0.68	SUBCRITICAL	1443.58	1444.29	3.97e-3	6.22
10+25	1441.12	2.53	6.86	0.71	SUBCRITICAL	1443.66	1444.39	4.08e-3	6.14
10+50	1441.25	2.49	6.96	0.74	SUBCRITICAL	1443.74	1444.49	4.19e-3	6.06
10+75	1441.37	2.45	7.06	0.76	SUBCRITICAL	1443.82	1444.60	4.31e-3	5.98
10+85	1441.42	3.00	6.18	0.00	PRESSURE	1444.58	1445.17	4.28e-3	5.22

Pipe A-2 D = 30″ (2.50′) L = 240′ S = 0.604% Q = 28.09 cfs y_n = 2.50′ y_c = 1.81′ V = 5.72 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	1441.42	2.50	5.72	0.00	PRESSURE	1444.58	1445.09	4.69e-3	6.32
11+00	1441.51	2.50	5.72	0.00	PRESSURE	1444.65	1445.16	4.69e-3	6.25
11+25	1441.66	2.50	5.72	0.00	PRESSURE	1444.77	1445.28	4.69e-3	6.13
11+50	1441.81	2.50	5.72	0.00	PRESSURE	1444.88	1445.39	4.69e-3	6.02
11+75	1441.96	2.50	5.72	0.00	PRESSURE	1445.00	1445.51	4.69e-3	5.90
12+00	1442.11	2.50	5.72	0.00	PRESSURE	1445.12	1445.63	4.69e-3	5.78
12+25	1442.27	2.50	5.72	0.00	PRESSURE	1445.24	1445.75	4.69e-3	5.66
12+50	1442.42	2.50	5.72	0.00	PRESSURE	1445.35	1445.86	4.69e-3	5.55
12+75	1442.57	2.50	5.72	0.00	PRESSURE	1445.47	1445.98	4.69e-3	5.43
13+00	1442.72	2.50	5.72	0.00	PRESSURE	1445.59	1446.10	4.69e-3	5.31
13+25	1442.87	2.50	5.72	0.00	PRESSURE	1445.73	1446.24	4.69e-3	5.17

Pipe A-3 D = 30″ (2.50′) L = 18′ S = 0.556% Q = 28.09 cfs y_n = 2.50′ y_c = 1.81′ V = 5.72 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)
13+25	1442.87	2.50	5.72	0.00	PRESSURE	1445.73	1446.24	4.69e-3	5.27
13+43	1442.97	2.50	5.72	0.00	PRESSURE	1445.89	1446.40	4.69e-3	5.11

Pipe A-4 D = 30″ (2.50′) L = 260′ S = 0.600% Q = 28.01 cfs y_n = 2.50′ y_c = 1.80′ V = 5.71 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)
13+43	1442.97	2.50	5.71	0.00	PRESSURE	1445.89	1446.39	4.66e-3	6.71
13+50	1443.01	2.50	5.71	0.00	PRESSURE	1445.92	1446.43	4.66e-3	6.68
13+75	1443.16	2.50	5.71	0.00	PRESSURE	1446.04	1446.54	4.66e-3	6.56
14+00	1443.31	2.50	5.71	0.00	PRESSURE	1446.15	1446.66	4.66e-3	6.45

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
14+25	1443.46	2.50	5.71	0.00	PRESSURE	1446.27	1446.77	4.66e-3	6.33
14+50	1443.61	2.50	5.71	0.00	PRESSURE	1446.39	1446.89	4.66e-3	6.21
14+75	1443.76	2.50	5.71	0.00	PRESSURE	1446.50	1447.01	4.66e-3	6.10
15+00	1443.91	2.50	5.71	0.00	PRESSURE	1446.62	1447.12	4.66e-3	5.98
15+25	1444.06	2.50	5.71	0.00	PRESSURE	1446.74	1447.24	4.66e-3	5.86
15+50	1444.21	2.50	5.71	0.00	PRESSURE	1446.85	1447.36	4.66e-3	5.75
15+75	1444.36	2.50	5.71	0.00	PRESSURE	1446.97	1447.47	4.66e-3	5.63
16+00	1444.51	2.50	5.71	0.00	PRESSURE	1447.09	1447.59	4.66e-3	5.51
16+03	1444.53	2.50	5.71	0.00	PRESSURE	1447.21	1447.72	4.66e-3	5.39

Pipe A-5 D = 24″ (2.00′) L = 180′ S = 1.200% Q = 21.52 cfs y_n = 1.44′ y_c = 1.66′ V = 10.74 fps Fr = 1.87, SUPERCRITICAL

Steep reach with a drowned outlet: the downstream water surface at 1447.21 ft stands above the sequent depth of the normal depth (y_2 = 1.90′, RCFC Eq. 4.46), so a hydraulic jump, weak, Fr_1 = 1.87, L_{jump} ≈ 12.2′ 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 1448.35 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	2.00	6.85	0.00	PRESSURE	1447.21	1447.94	9.05e-3	8.39
16+25	1444.79	2.00	6.85	0.00	PRESSURE	1447.41	1448.14	9.05e-3	8.19
16+50	1445.09	2.00	6.85	0.00	PRESSURE	1447.64	1448.37	9.05e-3	7.96
16+75	1445.39	2.00	6.85	0.00	PRESSURE	1447.86	1448.59	9.05e-3	7.74
17+00	1445.69	2.00	6.85	0.00	PRESSURE	1448.09	1448.82	9.05e-3	7.51
17+25	1445.99	2.00	6.85	0.00	PRESSURE	1448.32	1449.04	9.05e-3	7.28
17+50	1446.29	2.00	6.85	0.00	PRESSURE	1448.54	1449.27	9.05e-3	7.06
17+75	1446.59	2.00	6.85	0.00	PRESSURE	1448.77	1449.50	9.05e-3	6.83
17+83	1446.69	1.22	10.74	1.87	**SUPERCRITICAL**	1447.91	1449.70	1.91e-2	7.69

Pipe A-6 D = 24″ (2.00′) L = 120′ S = 2.000% Q = 21.52 cfs y_n = 1.20′ y_c = 1.66′ V = 7.72 fps Fr = 1.00, NEAR CRITICAL

Steep reach: the downstream water surface at 1447.91 ft is below the sequent depth of the normal depth (y_2 = 2.19′, 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 1450.75 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	1.22	10.74	1.87	**SUPERCRITICAL**	1447.91	1449.70	1.91e-2	11.29
18+00	1447.03	1.23	10.67	1.85	**SUPERCRITICAL**	1448.26	1450.02	1.88e-2	10.94
18+25	1447.53	1.24	10.50	1.80	**SUPERCRITICAL**	1448.77	1450.48	1.81e-2	10.43
18+50	1448.03	1.27	10.21	1.72	**SUPERCRITICAL**	1449.30	1450.92	1.69e-2	9.90

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
18+75	1448.53	1.33	9.70	1.58	**SUPERCRITICAL**	1449.86	1451.32	1.48e-2	9.34
19+00	1449.03	1.52	8.40	1.21	**SUPERCRITICAL**	1450.55	1451.65	1.05e-2	8.65
19+03	1449.09	1.66	7.72	1.00	NEAR CRITICAL	1450.75	1451.68	8.86e-3	8.45

Line "B"

2 Segments | HGL Start: 1444.58 ft | Min FB: **6.12 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	17.53	24.51	5.58	0.00 PRESS	1441.67	**1444.58**	0.174	0.024	1442.01	**1444.78**	1450.90	**6.12**	OK
B-2 CATCH BASIN Δ	1119 25'	215	24	0.0075	17.53	21.21	5.58	1.18 PRESS	1442.01	**1444.78**	1.101	0.726	1443.62	**1446.60**	1453.40	**6.80**	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 = 17.53 cfs y_n = 2.00′ y_c = 1.51′ V = 5.58 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	5.58	0.00	PRESSURE	1444.58	1445.06	5.12e-3	6.32
11+00	1441.82	2.00	5.58	0.00	PRESSURE	1444.66	1445.14	5.12e-3	6.24
11+19	1442.01	2.00	5.58	0.00	PRESSURE	1444.78	1445.26	5.12e-3	6.12

Pipe B-2 D = 24″ (2.00′) L = 215′ S = 0.749% Q = 17.53 cfs y_n = 1.39′ y_c = 1.51′ V = 5.58 fps Fr = 1.18, SUPERCRITICAL

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	5.58	0.00	PRESSURE	1444.78	1445.26	5.12e-3	8.62
11+25	1442.05	2.00	5.58	0.00	PRESSURE	1444.81	1445.29	5.12e-3	8.59
11+50	1442.24	2.00	5.58	0.00	PRESSURE	1444.94	1445.42	5.12e-3	8.46
11+75	1442.43	2.00	5.58	0.00	PRESSURE	1445.06	1445.55	5.12e-3	8.34
12+00	1442.62	2.00	5.58	0.00	PRESSURE	1445.19	1445.68	5.12e-3	8.21
12+25	1442.80	2.00	5.58	0.00	PRESSURE	1445.32	1445.80	5.12e-3	8.08

Station	Invert (ft)	y (ft)	V (fps)	Fr	Regime	HGL (ft)	EGL (ft)	S_f (ft/ft)	Cover to FL (ft)
12+50	1442.99	2.00	5.58	0.00	PRESSURE	1445.45	1445.93	5.12e-3	7.95
12+75	1443.18	2.00	5.58	0.00	PRESSURE	1445.58	1446.06	5.12e-3	7.82
13+00	1443.37	2.00	5.58	0.00	PRESSURE	1445.70	1446.19	5.12e-3	7.70
13+25	1443.55	2.00	5.58	0.00	PRESSURE	1445.83	1446.32	5.12e-3	7.57
13+34	1443.62	2.00	5.58	0.00	PRESSURE	1446.60	1447.09	5.12e-3	6.80

Line "C"

1 Segments | HGL Start: 1447.21 ft | Min FB: **5.71 ft** | Max V: 5.4 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	9.50	12.87	5.38	1.54 PRESS	1444.93	**1447.21**	0.507	0.674	1445.86	**1448.39**	1454.10	**5.71**	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 = 9.50 cfs y_n = 0.96′ y_c = 1.19′ V = 5.38 fps Fr = 1.54, SUPERCRITICAL

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	1.50	5.38	0.00	PRESSURE	1447.21	1447.66	8.18e-3	6.89
16+25	1445.26	1.50	5.38	0.00	PRESSURE	1447.39	1447.84	8.18e-3	6.71
16+50	1445.63	1.50	5.38	0.00	PRESSURE	1447.60	1448.05	8.18e-3	6.50
16+65	1445.86	1.50	5.38	0.00	PRESSURE	1448.39	1448.84	8.18e-3	5.71

Line "D"

2 Segments | HGL Start: 1443.41 ft | Min FB: **3.58 ft** | Max V: 8.0 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	6.68	35.77	7.99	2.10 **JUMP**	1440.50	**1443.41**	1.877	0.018	1444.00	**1444.62**	1448.20	**3.58**	**JUMP**

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-2 CATCH BASIN △	1140 25'	95	24	0.0200	6.68	31.99	4.76	1.00 SUPERCRIT > CRIT	1444.00	**1444.62**	1.555	0.528	1445.90	**1446.82**	1451.00	**4.18**	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 = 6.68 cfs y_n = 0.59′ y_c = 0.92′ V = 7.99 fps Fr = 2.10, SUPERCRITICAL

Steep reach with a drowned outlet: the downstream water surface at 1443.41 ft stands above the sequent depth of the normal depth (y_2 = 1.37′, RCFC Eq. 4.46), so a hydraulic jump, weak, Fr_1 = 2.35, L_{jump} ≈ 8.4′ 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 1444.92 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	2.12	0.00	PRESSURE	1443.41	1443.48	8.71e-4	4.79
10+25	1441.13	2.00	2.12	0.00	PRESSURE	1443.43	1443.50	8.71e-4	4.77
10+50	1441.75	1.69	2.36	0.30	SUBCRITICAL	1443.44	1443.52	8.31e-4	4.76
10+75	1442.38	0.59	8.65	2.34	**SUPERCRITICAL**	1442.96	1444.13	2.45e-2	5.24
11+00	1443.00	0.59	8.55	2.31	**SUPERCRITICAL**	1443.59	1444.73	2.37e-2	4.61
11+25	1443.63	0.61	8.30	2.21	**SUPERCRITICAL**	1444.23	1445.30	2.18e-2	3.97
11+40	1444.00	0.62	7.99	2.10	**SUPERCRITICAL**	1444.62	1445.61	1.96e-2	3.58

Pipe D-2 D = 24″ (2.00′) L = 95′ S = 2.000% Q = 6.68 cfs y_n = 0.62′ y_c = 0.92′ V = 4.76 fps Fr = 1.00, NEAR CRITICAL

Steep reach: the downstream water surface at 1444.62 ft is below the sequent depth of the normal depth (y_2 = 1.31′, 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 1446.82 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	0.62	7.99	2.10	**SUPERCRITICAL**	1444.62	1445.61	1.96e-2	6.38
11+50	1444.20	0.62	7.96	2.09	**SUPERCRITICAL**	1444.82	1445.81	1.94e-2	6.18
11+75	1444.70	0.63	7.83	2.04	**SUPERCRITICAL**	1445.33	1446.28	1.85e-2	5.67
12+00	1445.20	0.65	7.50	1.92	**SUPERCRITICAL**	1445.85	1446.73	1.64e-2	5.15
12+25	1445.70	0.72	6.50	1.57	**SUPERCRITICAL**	1446.42	1447.08	1.10e-2	4.58
12+35	1445.90	0.92	4.76	1.00	NEAR CRITICAL	1446.82	1447.17	4.72e-3	4.18

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 9.50 cfs, 23.9 min + DA-1 at A-6 21.52 cfs, 16.7 min + Line B 17.53 cfs, 12.8 min, Plate D-1 = 43.65 cfs at 16.7 min; travel to the next node 0.2 min	48.55	**43.65**
A A-2	Line C at A-4 9.50 cfs, 23.4 min + DA-1 at A-6 21.52 cfs, 16.2 min, Plate D-1 = 28.09 cfs at 16.2 min; travel to the next node 0.5 min	31.02	**28.09**
A A-3	Line C at A-4 9.50 cfs, 23.3 min + DA-1 at A-6 21.52 cfs, 16.1 min, Plate D-1 = 28.09 cfs at 16.1 min; travel to the next node 0.0 min	31.02	**28.09**
A A-4	Line C 9.50 cfs, 22.7 min + DA-1 at A-6 21.52 cfs, 15.5 min, Plate D-1 = 28.01 cfs at 15.5 min; travel to the next node 0.6 min	31.02	**28.01**

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.