INITIAL EROSION & SEDIMENT CONTROL CALCULATIONS
AUGUST 2023

LUCK SALUDA
LUCK STONE CORPORATION
SALUDA COUNTY, SOUTH CAROLINA

LUCK STONE

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1.0 EROSION & SEDIMENT CONTROL CALCULATIONS

1.1 General

The purpose of the sediment basin is to detain stormwater run-off and trap sediment from erodible areas to protect properties and drainage ways downstream from damage by excessive flow rates, erosion, and sedimentation. The sediment basin utilizes multiple systems such as a forebay riprap berm, surface dewatering skimmer, principal spillway concrete riser structure, and emergency spillway to accomplish the trapping of sediment and attenuation of stormwater. The site-specific design standards for the sediment basins are provided in **Table 1** below. A design detail of the sediment basins primary mechanisms is provided in **Figure 1** below.

Table 1. Sediment Basin Design Standards

Design Parameter	Standards
Total Suspended Solid (TSS) Removal Efficiency	≥ 80%
10-Yr, 24-Hour Storm Event Discharge Capacity	Discharge at most 1 ft above crest of principal spillway and at least 1 ft below crest of emergency spillway
Drainage Area	5 – 30 AC
Sediment Storage	3,600 c.f./AC
Minimum Dewatering Time @ 10-Yr, 24-Hour Storm Event	2 days (48 hours)
Maximum Dewatering Time @ 10-Yr, 24-Hour Storm Event	5 days (120 hours)
Basin Shape	L = 2W (Minimum)
Cleanout Height	1/2 Sediment Storage
Forebay Volume	Minimum 20% Sediment Storage
Embankments	Maximum Slope 2H:1V
Emergency Spillway Crest Length	Minimum of 10 ft
Emergency Spillway Crest Elevation	Minimum 1ft above riser crest or 10-Yr, 24-Hour storm event elevation / Minimum 1 ft below top of berm
100-Yr, 24-Hour Storm Event Discharge Capacity	Provide a minimum 0.5 ft. of freeboard from top of berm

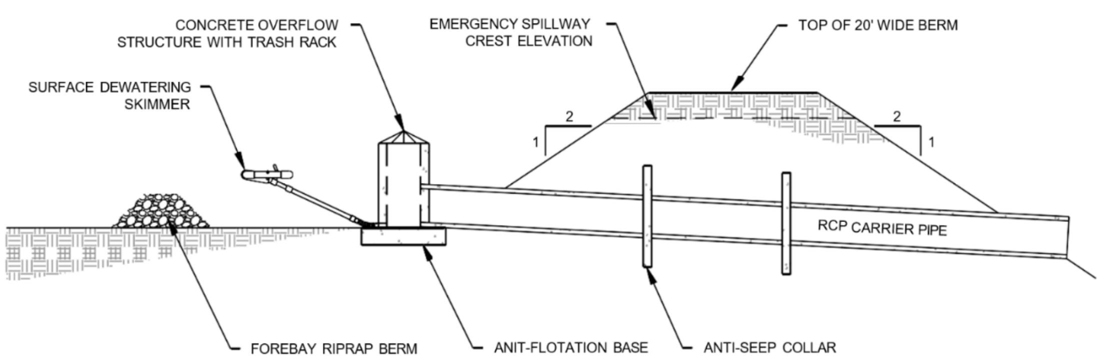


Figure 1. Sediment Basin Design Detail

1.2 Calculating Watershed Run-off

To determine the stormwater run-off routed through the sediment basin, a watershed is delineated that identifies the total area draining into the sediment basin (watershed map provided in **Appendix 2.1**). Once the drainage area is defined, the hydrologic characteristics of each soil type in the watershed is gathered using the NRCS Web Soil Survey database and employed to calculate the composite curve number (CN) for each watershed at the time of construction, modeled as either bare soil or gravel. This curve number is an empirical coefficient developed by the USDA to predict surface run-off based on hydrologic soil characteristics and cover conditions (**Reference 3.2**). A summary table for the composite CN calculations for each sediment basin watershed is provided in **Table 2** below. Full CN calculations for each sediment basin watershed are provided in **Appendix 2.2**.

Table 2. Sediment Basin Watershed Curve Number Summary

Sediment Basin	Soil Hydrologic Groups (%)				Area (AC)	Composite CN
	A	B	C	D		
1	1	75	24	0	29.50	87
2	0	99	1	0	29.84	87
3	0	84	13	3	26.81	87
4	0	87	1	12	27.69	86
5	0	98	0	2	28.43	87
6	0	59	17	24	29.40	89
7	0	81	9	10	10.67	88
8	1	99	0	0	11.47	86

The Technical Release-55 (TR-55) Urban Hydrology for Small Watershed's method is utilized to calculate the time of concentration in the watershed (**Reference 3.3**). This is the time required for water to travel from the most hydrologically distant point to the sediment basin. The TR-55 method is designed to predict the time of concentration during sheet flow, shallow concentrated flow and open channel flow conditions. For the watersheds analyzed in this report, no open channel flow was identified. The equation for calculating the time of concentration during the sheet flow stage can be seen below, where drainage length is less than or equal to 300 feet. Data for the precipitation at the 10, 25 and 100-Yr, 24-Hour storm events is collected from the NOAA Atlas 14 and is provided in **Reference 3.4**.

$$T_1 = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}s^{0.4}}$$ **(Reference 3.4: Eq. 3-3)**

The sheet flow time of concentration calculations for each sediment basin watershed are provided in **Table 3** below.

Table 3. Drainage Area Sheet Flow Summary					
Sediment Basin	**Manning's Roughness Coefficient (*n*)**	**Length (*L*) (ft)**	**Slope (*s*) (ft/ft)**	**2-Yr, 24-Hr Rainfall (P_2) (in)**	**Time of Concentration (T_1) (min)**
1	0.050	300	0.0467	3.62	6.6
2	0.050	300	0.0300	3.62	7.8
3	0.050	300	0.1000	3.62	4.8
4	0.011	300	0.0317	3.62	2.3
5	0.050	300	0.0600	3.62	5.9
6	0.050	300	0.0533	3.62	6.2
7	0.050	300	0.0467	3.62	6.6
8	0.050	300	0.0300	3.62	7.8

The shallow concentrated flow is then calculated using the flow time and average velocity equations below.

$$T_2 = \frac{L}{3{,}600V}$$ **(Reference 3.4: Eq. 3-1)**

$$V_{Unpaved} = 16.1345 * s^{0.5}$$

(Reference 3.4: Appendix F)

$$V_{Paved} = 20.3282 * s^{0.5}$$

The shallow concentrated flow time of concentration calculations for each sediment basin watershed are provided in **Table 4** below.

Table 4. Drainage Area Shallow Concentrated Flow Summary					
Sediment Basin	**Surface Area Description**	**Length (*L*) (ft)**	**Slope (*s*) (ft/ft)**	**Average Velocity (*V*) (ft/sec)**	**Time of Concentration (T_2) (min)**
1	Unpaved	1808	0.0254	2.6	11.7
2	Unpaved	1567	0.0211	2.3	11.1
3	Unpaved	1639	0.0207	2.3	11.8
4	Unpaved	594	0.0465	3.5	2.8
5	Unpaved	1887	0.0254	2.6	12.2
6	Unpaved	1062	0.0330	2.9	6.0
7	Unpaved	471	0.0297	2.8	2.8
8	Unpaved	645	0.0233	2.5	4.4

Following the time of concentration for sheet flow and shallow concentrated flow calculations, the overall time of concentration, drainage area, rainfall precipitation and CN data is input into Civil 3D 2022's Hydraflow Extension and the Soil Conservation Service (SCS) Curve Number method is used to estimate runoff at the 10, 25, and 100-Yr, 24-Hour storm events. The results are provided in **Table 5** below. The AutoCAD Civil 3D 2022's Hydraflow Extension Hydrograph Reports are provided in **Appendix 2.3**.

Table 5. Sediment Basin Run-off Summary

Sediment Basin	Drainage Area (AC)	Curve Number (CN)	Overall Time of Concentration (T_t) (min)	10-Year Storm Runoff (Q_{10}) (cfs)	25-Year Storm Runoff (Q_{25}) (cfs)	100-Year Storm Runoff (Q_{100}) (cfs)
1	29.50	87	18.3	127.89	161.17	219.15
2	29.84	87	18.9	129.37	163.03	221.67
3	26.81	87	16.6	125.73	158.26	214.93
4	27.69	86	5.1	166.70	210.23	286.06
5	28.43	87	18.1	123.26	155.32	211.20
6	29.40	89	12.2	164.04	204.50	274.83
7	10.67	88	9.4	63.62	79.59	107.36
8	11.47	86	12.2	60.05	75.93	103.63

1.3 Principal Spillway Design

The principal spillway is the primary structure designed to discharge stormwater from the sediment basin. The principal spillway consists of a concrete riser structure, an outlet pipe, and a surface dewatering skimmer. The principal spillway is designed to discharge the 10-Yr, 24-Hour storm event at a maximum of 1 foot above the top of the riser crest. Routing is performed using AutoCAD Civil 3D 2022's Hydraflow Extension. The design and Hydraflow results are provided in **Table 6** below. The AutoCAD Civil 3D 2022's Hydraflow Extension Pond Reports for all sediment basins are provided in **Appendix 2.4**.

Table 6. Principal Spillway Design Specifications

Sediment Basin	Riser Height (ft.)	Riser Dimensions (ft. x ft.)	Skimmer Dewatering Orifice (in.)	Outlet Pipe Diameter (in.)	Top of Riser Elevation (ft.)	10-Yr, 24-Hour Storm Elevation (ft.)	Head Above Riser Crest (ft.)
1	4.00	3 x 3	6”	24	432.00	432.50	0.50
2	4.00	3 x 3	6”	24	456.00	456.48	0.48
3	4.00	3 x 3	6”	24	488.00	488.54	0.54
4	4.00	3 x 3	6”	24	486.00	486.47	0.47
5	4.00	3 x 3	6”	24	428.00	428.39	0.39
6	4.00	3 x 3	6”	24	430.00	430.50	0.50
7	3.75	3 x 3	5”	24	421.75	421.97	0.22
8	3.75	3 x 3	5”	24	418.75	418.99	0.24

1.4 Emergency Spillway Design

The emergency spillway is a weir designed to discharge stormwater from the sediment basin in the event of a 100-Yr, 24-hour storm. The emergency spillway is designed to discharge the 100-Yr, 24-hour storm at a minimum of 0.5 ft below the top of the sediment basin berm. Grouted riprap or concrete is proposed on all 2:1 slopes to protect the spillway channel along the exterior berm of the sediment basin from erosion. If a 3:1 spillway channel slope is utilized, Landlok 450 TRM may be used for stabilization. Routing is performed using AutoCAD Civil 3D 2022's Hydraflow Extension. The design and Hydraflow results are provided in **Table 7** below.

Table 7. Emergency Spillway Design Specifications

Sediment Basin	Emergency Spillway Crest El. (CE) (ft.)	Emergency Spillway Crest Width (ft.)	Top of Berm El. (ft.)	10-Yr Storm El. (ft.)	25-Yr Storm El. (ft.)	100-Yr Storm El. (ft.)	Check: 10-Yr + 1 < CE 25-Yr < CE 100-Yr – 0.5 ft Freeboard
1	433.50	15	435.00	432.50	433.14	434.32	GOOD
2	457.50	15	459.00	456.48	457.10	458.29	GOOD
3	489.60	15	491.00	488.54	489.22	490.42	GOOD
4	487.50	15	489.00	486.47	487.10	488.38	GOOD
5	429.50	15	431.00	428.39	428.91	430.11	GOOD
6	431.50	15	433.00	430.50	431.12	432.34	GOOD
7	423.00	15	424.00	421.97	422.33	423.21	GOOD
8	420.00	15	421.00	418.99	419.38	420.28	GOOD

1.5 Anti-Flotation Base and Carrier Pipe Encasement Design

The anti-flotation base is a concrete structure designed to prevent the riser structure from floating due to the buoyancy force exerted by the displaced water. To calculate the size of the base required, the weight of the concrete riser structure and base are summed together and compared to the buoyancy force from the displaced water. SC DHEC recommends the weight of the riser structure and base be a minimum of 1.1 times greater than the buoyancy force created by the displaced water (**Reference 3.1**). The buoyancy force exerted on the carrier pipe is offset by the weight of the carrier pipe, the carrier pipe concrete encasement, anti-seep collars and the soil above the carrier pipe. A summary table of the anti-flotation base and carrier pipe buoyancy force calculations are provided in **Table 8A** and **Table 8B** below, respectively. The full set of buoyancy force calculations are provided in **Appendix 2.5**.

Table 8A. Anti-Flotation Buoyancy Force Calculations Summary

Sediment Basin	Riser Volume (ft^3)	Buoyancy Force from Riser (lbs)	Anti-Flotation Base Dimensions (L x W x H) (ft.)	Weight of Anti-Flotation Base in Water (lbs)	Weight of Riser Walls (lbs)	Weight of Concrete (lbs)	Factor of Safety Check: > 1.1
1	64	3,994	5’ x 5’ x 1’	2,190	3,964	6,154	1.54
2	64	3,994	5’ x 5’ x 1’	2,190	3,964	6,154	1.54
3	64	3,994	5’ x 5’ x 1’	2,190	3,964	6,154	1.54
4	64	3,994	5’ x 5’ x 1’	2,190	3,964	6,154	1.54
5	64	3,994	5’ x 5’ x 1’	2,190	3,964	6,154	1.54
6	64	3,994	5’ x 5’ x 1’	2,190	3,964	6,154	1.54
7	60	3,744	5’ x 5’ x 1’	2,190	3,702	5,892	1.57
8	60	3,744	5’ x 5’ x 1’	2,190	3,702	5,892	1.57

Table 8B. Carrier Pipe Buoyancy Force Calculations Summary

Sediment Basin	Buoyancy Force from Carrier Pipe (lbs)	Weight of Carrier Pipe Encasement in Water (lbs)	Weight of Anti-Seep Collars in Water (lbs)	Weight of Soil Above Carrier Pipe (lbs)	Weight of Carrier Pipe (lbs)	Total Weight of Concrete (lbs)	Factor of Safety Check: > 1.1
1	17,860	1,929	6,542	5,273	15,456	29,201	1.63
2	14,703	1,929	5,447	4,020	12,723	24,120	1.64
3	12,393	1,929	4,440	3,105	10,724	20,198	1.63
4	17,860	1,929	6,542	5,273	15,456	29,201	1.63
5	10,290	1,929	4,440	2,275	8,905	17,549	1.71
6	36,757	1,929	15,529	12,788	31,809	62,055	1.69
7	9,874	1,929	4,440	1,874	8,545	16,788	1.70
8	9,068	1,929	4,440	1,598	7,848	15,815	1.72

* Carrier Pipe Encasement dimensions are 3’ x 3.5’ x 3.5’ (L x W x H) (Typ.)

1.6 Anti-Seep Collar Design

The anti-seep collar is a concrete structure designed to prevent seepage along the principal spillway carrier pipe from washing out the carrier pipe. A summary table of the anti-seep collar dimensions is provided in **Table 9** below. The full set of anti-seep collar calculations are provided in **Appendix 2.5**.

Table 9. Anti-Seep Collar Design Summary

Sediment Basin	12” Thick Anti-Seep Collar Dimensions (L x W) (ft.)	No. of Anti-Seep Collars	Collar Projection (ft.)
1	6.5’ x 6.5’	2	2.20
2	6.0’ x 6.0’	2	1.50
3	5.5’ x 5.5’	2	1.50
4	6.5’ x 6.5’	2	1.80
5	5.5’ x 5.5’	2	1.50
6	8.0’ x 8.0’	3	2.80
7	5.5’ x 5.5’	2	1.50
8	5.5’ x 5.5’	2	1.50

1.7 Sediment Storage Calculations

The sediment storage for each of the sediment basins is designed to contain the SC DHEC minimum of 3,600 c.f. / AC of sediment from the watershed area (**Reference 3.1**). The total sediment storage is designed to be contained below the crest elevation of the riser structure. A minimum of 20% of the total sediment storage required is designed to be contained within the sediment forebay. The sediment storage cleanout height is designed to be half of the forebay berm height in accordance with SC DHEC recommendations (**Reference 3.1**). The calculations for the sediment storage are provided in **Table 10** below.

Table 10. Sediment Storage Calculations

Sediment Basin	Drainage Area (AC)	Sediment Storage Estimate (c.f. / AC)	Total Sediment Storage Required (c.f.)	Sediment Storage @ Riser Crest Elevation (c.f.)	20% of Total Sediment Storage Required (c.f.)	Sediment Storage @ Top of Forebay Berm (c.f.)
1	29.50	3,600	106,200	258,402	21,240	28,131
2	29.84	3,600	107,424	266,057	21,485	29,240
3	26.81	3,600	96,516	214,934	19,303	23,546
4	27.69	3,600	99,684	212,283	19,937	26,325
5	28.43	3,600	102,348	269,313	20,470	33,688
6	29.40	3,600	105,840	288,977	21,168	26,633
7	10.67	3,600	38,412	106,272	7,682	13,050
8	11.47	3,600	41,292	108,091	8,258	17,149

1.8 Trapping Efficiency Calculations

The trapping efficiency of the sediment basin is a ratio measuring the basin's ability to settle sediment particles in a given period of time. According to SC DHEC, the sediment basins must have at least an 80% trapping efficiency of Total Suspended Solids (TSS) (**Reference 3.1**). The sediment basins are designed with a 2-foot tall forebay riprap berm to be installed in conjunction with the surface dewatering skimmer to provide maximum trapping efficiency.

To calculate the trapping efficiency, the sediment particle settling velocity (V_{15}) over the basin surface area at the riser crest elevation (A) is compared to the outflow from the basin at the 10-Yr, 24-Hour storm event (Q_{10}). To determine the particle settling velocity, the watershed area soil types are identified, and the smallest eroded particle diameter (D_{15}) is selected utilizing Appendix E of the SC DHEC Stormwater BMP Handbook (**Reference 3.5**). The settling velocity of the eroded particle is then determined utilizing the equation below (**Reference 3.1**).

$$V_{15} = 2.81(D_{15})^2$$

Once the settling velocity is determined, the basin ratio is calculated using the equation below (**Reference 3.1**).

$$Basin\ Ratio = \frac{Q_{10}}{V_{15}A}$$

Figure SB-1 in Appendix K of the SC DHEC Stormwater BMP Handbook is then used to correlate Basin Ratio to trapping efficiency (**Reference 3.6**).

The trapping efficiency calculations for each sediment basin are provided in **Table 11** below. The following pages contain an example calculation for Sediment Basin 1.

Table 11. Sediment Basin Trapping Efficiency Calculations

Sediment Basin	Peak Outflow Rate (Q_{10}) (cf./sec)	Surface Area at Riser Crest (A) (AC)	Soil Class	Soil Characteristic Diameter (D_{15}) (mm)	Characteristic Settling Velocity (V_{15}) (ft./sec)	Basin Ratio:	Trapping Efficiency Check: ≥ 80%
1	14.94	1.60	Cecil	0.0043	5.19E-05	1.8E+05	81%
2	14.06	1.64	Cecil	0.0043	5.19E-05	1.7E+05	81%
3	16.70	1.36	Helena	0.0049	6.75E-05	1.8E+05	81%
4	13.78	1.37	Cecil	0.0043	5.19E-05	1.9E+05	80%
5	10.42	1.66	Cecil	0.0043	5.19E-05	1.2E+05	83%
6	14.77	1.77	Cecil	0.0043	5.19E-05	1.6E+05	82%
7	4.74	0.72	Cecil	0.0043	5.19E-05	1.3E+05	83%
8	5.13	0.75	Cecil	0.0043	5.19E-05	1.3E+05	83%

1.8 Trapping Efficiency Calculations (Example – Sediment Basin 1)

Sediment Basin 1 Watershed Soil Types:

Soil Type	Appendix E: Minimum D_{15} (mm)
Appling	0.0053
Cecil	0.0043
Durham	0.0080
Toccoa	0.0074
Wilkes	0.0058

Appendix E for Cecil **(Reference 3.5):**

Depth	D15(mm)
SOIL: CECIL (B)	
0 - 7	0.0066
7 - 11	0.0066
11 - 50	0.0043

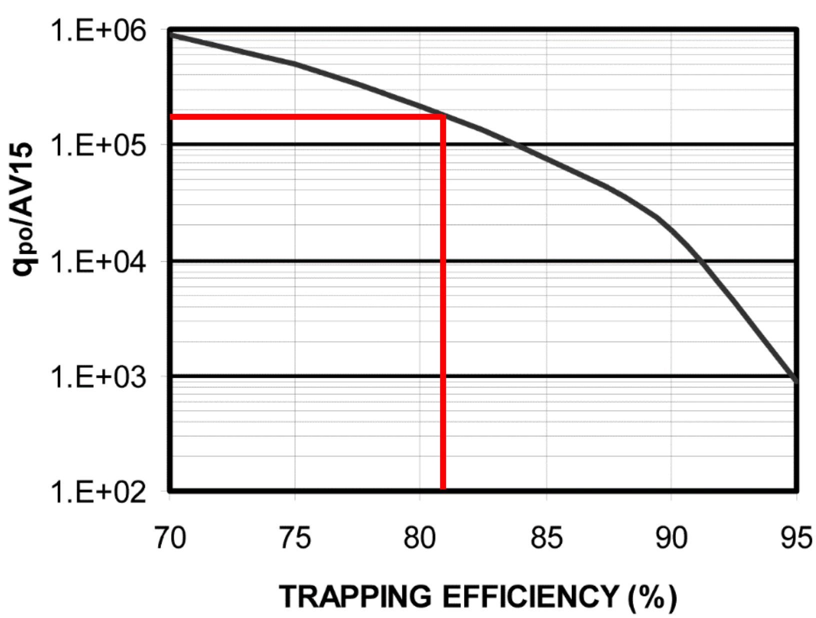
Characteristic Velocity (**Reference 3.1**):

$$V_{15} = 2.81(D_{15})^2 = 2.81(0.0043\ mm)^2 = 5.19E - 05\ ft/sec$$

Basin Ratio (**Reference 3.1**):

$$Basin\ Ratio = \frac{Q_{10}}{V_{15}A} = \frac{14.94\ cfs}{(5.19E - 05\ ft/sec)(1.60\ AC)} = 1.79E + 05$$

Figure SB-1 in Appendix K (**Reference 3.6**):



1.9 10-Yr, 24-Hour Storm Event Dewatering

According to SC DHEC, it is required that the 10-Year, 24-hour storm pass through the principal spillway within 48 to 120 hours to provide sufficient settling time for sediment particles (**Reference 3.1**). Civil 3D 2022's Hydraflow Extension is utilized to route each sediment basin, with the bottom of the basin set at the sediment cleanout elevation. The total 10-Yr, 24-Hour storm dewatering time is calculated as the difference between the time at peak elevation and time at fully dewatered elevation. The total dewatering times are provided in **Table 12** below. The AutoCAD Civil 3D 2022's Hydraflow Extension 10-Yr, 24-Hour Storm Event Hydrograph Reports are provided in **Appendix 2.6**.

Table 12. 10-Yr, 24-Hour Storm Dewatering Time

Sediment Basin	10-Year, 24-Hour Storm Dewatering Time (hrs)	Check: $48 < T_{10} < 120$ (hrs)
1	95.22	GOOD
2	95.19	GOOD
3	90.16	GOOD
4	90.16	GOOD
5	94.96	GOOD
6	97.93	GOOD
7	68.97	GOOD
8	70.76	GOOD

1.10 Basin Shape

According to SC DHEC, it is required that the sediment basin's length to width ratio be a minimum of 2:1 to maximize the flow length between the sediment basin's inlets and outlets (**Reference 3.1**). The flow lengths are measured from the basin's inlet to the principal spillway. Width lengths are measured across the top of the basin between embankments. **Table 13** below summarizes the sediment basin's flow length to width ratios.

Table 13. Sediment Basin Length to Width Ratio

Sediment Basin	Flow Length	Width	Length to Width Ratio (L:W)	Check: L ≥ 2W
1	541	160	3:1	GOOD
2	506	153	3:1	GOOD
3	465	161	2:1	GOOD
4	722	87	8:1	GOOD
5	296	146	2:1	GOOD
6	386	181	2:1	GOOD
7	270	118	2:1	GOOD
8	296	133	2:1	GOOD

1.11 Carrier Pipe Outlet Protection

To prevent stormwater from the sediment basin's carrier pipe from causing scour and erosion, riprap outlet protection is designed for each carrier pipe outlet location. The 25-Yr, 24-Hour storm event peak flow is utilized to design the size of riprap stone and apron dimensions. A summary table of the riprap outlet protection for each carrier pipe is provided in **Table 14** below. The full set of riprap outlet protection calculations are provided in **Appendix 2.7**.

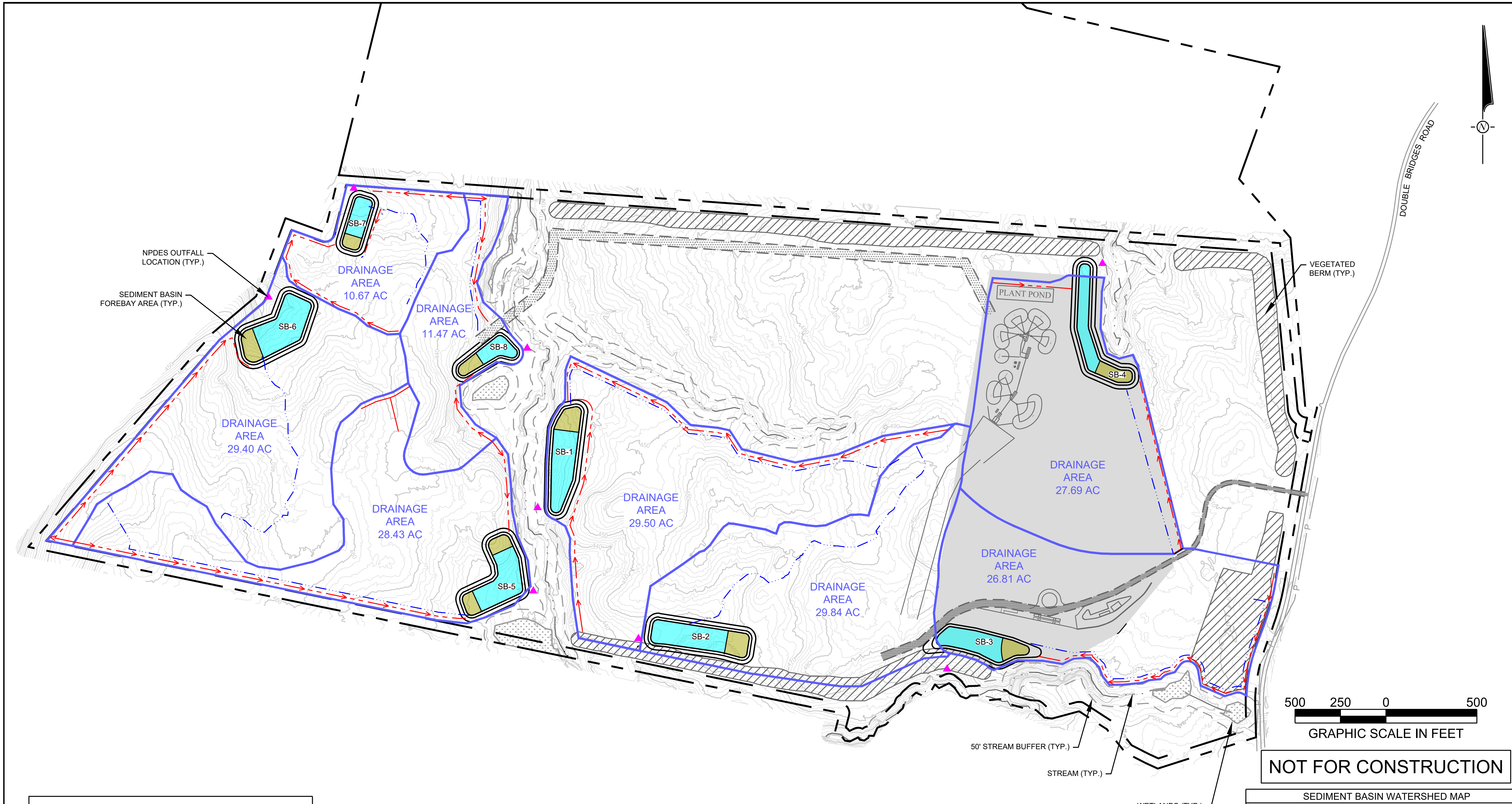
Table 14. Carrier Pipe Riprap Outlet Protection

Sediment Basin	Riprap d_{50} Size (in.)	Apron Length (ft.)	Apron Width @ Pipe Outlet (ft.)	Apron Width @ Full Length of Apron (ft.)	Riprap Volume (S.Y.)
1	9	19	6	21	28
2	9	19	6	21	28
3	9	19	6	21	28
4	9	19	6	21	28
5	9	18	6	20	26
6	9	19	6	21	28
7	6	13	6	15	16
8	6	13	6	15	16

2.0 APPENDICES

2.1 Appendix 1

Sediment Basin Watershed Map



NOT FOR CONSTRUCTION

LEGEND

PROPERTY LINE

50' PROPERTY LINE BUFFER

DRAINAGE AREA BOUNDARY

MAX. HYDRAULIC LENGTH

PROPOSED DIVERSION BERM

SEDIMENT BASIN WATERSHED MAP

LUCK SALUDA

FOR

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PROJ. NO.	4780-021-01	DWG. LUCK-SLDA-SB	EDIT 08/11/2023
SCALE	1" = 500'	DRAWING 1 OF 1	
DATE	AUGUST 2023		

2.0 APPENDICES

2.2 Appendix 2

Watershed Curve Number Calculations

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CURVE NUMBER CALCULATIONS

Site: Luck Stone Saluda
Date: 8/8/2023

Sediment Basin 1

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApC2	B	Fallow - Bare Soil	86	5.81	499.66
CdB	B	Fallow - Bare Soil	86	2.53	217.58
CdC2	B	Fallow - Bare Soil	86	11.80	1014.80
DuB	B	Fallow - Bare Soil	86	1.84	158.24
Mv	A	Fallow - Bare Soil	77	0.41	31.57
WkB	C	Fallow - Bare Soil	91	5.83	530.53
Pond Area	-	Paved Area	98	1.28	125.44
			Total =	29.50	2577.82
			Weighted CN =	87.38	
			Use CN =	87	

Sediment Basin 2

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApC2	B	Fallow - Bare Soil	86	11.84	1018.24
ApD2	C	Fallow - Bare Soil	91	0.38	34.58
ApB	B	Fallow - Bare Soil	86	5.75	494.50
CdC2	B	Fallow - Bare Soil	86	4.47	384.42
DuB	B	Fallow - Bare Soil	86	6.13	527.18
Pond Area	-	Paved Area	98	1.27	124.46
			Total =	29.84	2583.38
			Weighted CN =	86.57	
			Use CN =	87	

Sediment Basin 3

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApC2	B	Gravel	85	4.12	350.20
ApD2	C	Gravel	89	3.58	318.62
ApB	B	Gravel	85	5.21	442.85
ApC	B	Gravel	85	1.79	152.15
DuB	B	Fallow - Bare Soil	86	10.24	880.64
HeB	D	Fallow - Bare Soil	94	0.85	79.90
Pond Area	-	Paved Area	98	1.02	99.96
			Total =	26.81	2324.32
			Weighted CN =	86.70	
			Use CN =	87	

Sediment Basin 4

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApC2	B	Gravel	85	7.08	601.80
ApB	B	Gravel	85	8.11	689.35
CdB	B	Gravel	85	6.42	545.70
DuB	B	Gravel	85	1.00	85.00
HeB	D	Gravel	91	3.22	293.02
WoB	C	Fallow - Bare Soil	91	0.34	30.94
Pond Area	-	Paved Area	98	1.52	148.96
			Total =	27.69	2394.77
			Weighted CN =	86.49	
			Use CN =	86	

Sediment Basin 5

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApB	B	Fallow - Bare Soil	86	6.73	578.78
ApC2	B	Fallow - Bare Soil	86	1.15	98.90
CcC3	B	Fallow - Bare Soil	86	3.34	287.24
CdB	B	Fallow - Bare Soil	86	7.10	610.60
CdC2	B	Fallow - Bare Soil	86	8.30	713.80
WkE	D	Fallow - Bare Soil	94	0.65	61.10
Pond Area	-	Paved Area	98	1.16	113.68
			Total =	28.43	2464.10
			Weighted CN =	86.67	
			Use CN =	87	

Sediment Basin 6

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApB	B	Fallow - Bare Soil	86	3.70	318.20
ApC2	B	Fallow - Bare Soil	86	8.90	765.40
CcC3	B	Fallow - Bare Soil	86	3.43	294.98
CbD	C	Fallow - Bare Soil	91	4.99	454.09
WkE	D	Fallow - Bare Soil	94	7.11	668.34
Pond Area	-	Paved Area	98	1.27	124.46
			Total =	29.40	2625.47
			Weighted CN =	89.30	
			Use CN =	89	

Sediment Basin 7

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApC2	B	Fallow - Bare Soil	86	3.43	294.98
CcB3	B	Fallow - Bare Soil	86	2.00	172.00
CdB	B	Fallow - Bare Soil	86	1.05	90.30
CdC2	B	Fallow - Bare Soil	86	1.61	138.46
WkE	D	Fallow - Bare Soil	94	1.11	104.34
WkB	C	Fallow - Bare Soil	91	0.94	85.54
Pond Area	-	Paved Area	98	0.53	51.94
			Total =	10.67	937.56
			Weighted CN =	87.87	
			Use CN =	88	

Sediment Basin 8

Soil Type	Soil Hydrologic Group	Cover Description	CN (Table 2-2)	Area (ac)	Product of CN x Area
ApB	B	Fallow - Bare Soil	86	0.73	62.78
ApC2	B	Fallow - Bare Soil	86	0.14	12.04
CdB	B	Fallow - Bare Soil	86	3.95	339.70
CcB3	B	Fallow - Bare Soil	86	0.69	59.34
CdC2	B	Fallow - Bare Soil	86	5.07	436.02
Mv	A	Fallow - Bare Soil	77	0.40	30.80
Pond Area	-	Paved Area	98	0.49	48.02
			Total =	11.47	988.70
			Weighted CN =	86.20	
			Use CN =	86	

2.0 APPENDICES

2.3 Appendix 3

AutoCAD Civil 3D 2022’s Hydraflow Extension Hydrograph Reports

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	127.89	2	724	407,278	------	------	------	Sediment Basin 1 Runoff
2	SCS Runoff	129.37	2	724	411,972	------	------	------	Sediment Basin 2 Runoff
3	SCS Runoff	125.73	2	722	360,886	------	------	------	Sediment Basin 3 Runoff
4	SCS Runoff	166.70	2	716	348,751	------	------	------	Sediment Basin 4 Runoff
5	SCS Runoff	123.26	2	724	392,505	------	------	------	Sediment Basin 5 Runoff
6	SCS Runoff	164.04	2	720	441,517	------	------	------	Sediment Basin 6 Runoff
7	SCS Runoff	63.62	2	718	151,322	------	------	------	Sediment Basin 7 Runoff
8	SCS Runoff	60.05	2	720	158,909	------	------	------	Sediment Basin 8 Runoff
10	Reservoir	14.94	2	760	362,570	1	432.50	294,552	Sed. Basin 1 Routing
11	Reservoir	14.06	2	762	361,706	2	456.48	301,592	Sed. Basin 2 Routing
12	Reservoir	16.70	2	748	349,155	3	488.54	248,563	Sed. Basin 3 Routing
13	Reservoir	13.78	2	748	338,562	4	486.47	241,981	Sed. Basin 4 Routing
14	Reservoir	10.42	2	776	339,626	5	428.39	298,638	Sed. Basin 5 Routing
15	Reservoir	14.77	2	756	374,274	6	430.50	328,289	Sed. Basin 6 Routing
16	Reservoir	4.740	2	756	151,322	7	421.97	113,259	Sed. Basin 7 Routing
17	Reservoir	5.131	2	760	158,909	8	418.99	116,865	Sed. Basin 8 Routing

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	161.17	2	724	518,635	------	------	------	Sediment Basin 1 Runoff
2	SCS Runoff	163.02	2	724	524,612	------	------	------	Sediment Basin 2 Runoff
3	SCS Runoff	158.26	2	722	459,558	------	------	------	Sediment Basin 3 Runoff
4	SCS Runoff	210.23	2	716	446,029	------	------	------	Sediment Basin 4 Runoff
5	SCS Runoff	155.32	2	724	499,823	------	------	------	Sediment Basin 5 Runoff
6	SCS Runoff	204.50	2	720	557,471	------	------	------	Sediment Basin 6 Runoff
7	SCS Runoff	79.59	2	718	191,874	------	------	------	Sediment Basin 7 Runoff
8	SCS Runoff	75.93	2	720	203,234	------	------	------	Sediment Basin 8 Runoff
10	Reservoir	30.49	2	746	473,431	1	433.14	340,881	Sed. Basin 1 Routing
11	Reservoir	30.23	2	746	473,836	2	457.10	347,527	Sed. Basin 2 Routing
12	Reservoir	30.97	2	740	447,403	3	489.22	290,919	Sed. Basin 3 Routing
13	Reservoir	30.24	2	728	435,404	4	487.10	281,441	Sed. Basin 4 Routing
14	Reservoir	28.76	2	746	446,430	5	428.91	337,631	Sed. Basin 5 Routing
15	Reservoir	30.35	2	740	489,695	6	431.12	377,629	Sed. Basin 6 Routing
16	Reservoir	18.40	2	730	191,873	7	422.33	125,140	Sed. Basin 7 Routing
17	Reservoir	20.28	2	734	203,233	8	419.38	129,502	Sed. Basin 8 Routing

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	219.15	2	724	716,751	------	------	------	Sediment Basin 1 Runoff
2	SCS Runoff	221.67	2	724	725,011	------	------	------	Sediment Basin 2 Runoff
3	SCS Runoff	214.93	2	722	635,108	------	------	------	Sediment Basin 3 Runoff
4	SCS Runoff	286.06	2	716	619,479	------	------	------	Sediment Basin 4 Runoff
5	SCS Runoff	211.20	2	724	690,753	------	------	------	Sediment Basin 5 Runoff
6	SCS Runoff	274.83	2	720	762,937	------	------	------	Sediment Basin 6 Runoff
7	SCS Runoff	107.36	2	718	263,871	------	------	------	Sediment Basin 7 Runoff
8	SCS Runoff	103.63	2	720	282,267	------	------	------	Sediment Basin 8 Runoff
10	Reservoir	72.75	2	740	670,874	1	434.32	427,704	Sed. Basin 1 Routing
11	Reservoir	70.42	2	740	673,544	2	458.29	437,161	Sed. Basin 2 Routing
12	Reservoir	73.06	2	736	622,374	3	490.42	367,282	Sed. Basin 3 Routing
13	Reservoir	76.87	2	724	608,262	4	488.38	363,827	Sed. Basin 4 Routing
14	Reservoir	58.52	2	742	636,662	5	430.11	428,099	Sed. Basin 5 Routing
15	Reservoir	73.66	2	734	694,433	6	432.34	475,426	Sed. Basin 6 Routing
16	Reservoir	35.96	2	728	263,870	7	423.21	154,137	Sed. Basin 7 Routing
17	Reservoir	38.60	2	732	282,265	8	420.28	159,578	Sed. Basin 8 Routing

Saluda - Sediment Basin Hydrographs.gpw	Return Period: 100 Year	Friday, 08 / 11 / 2023

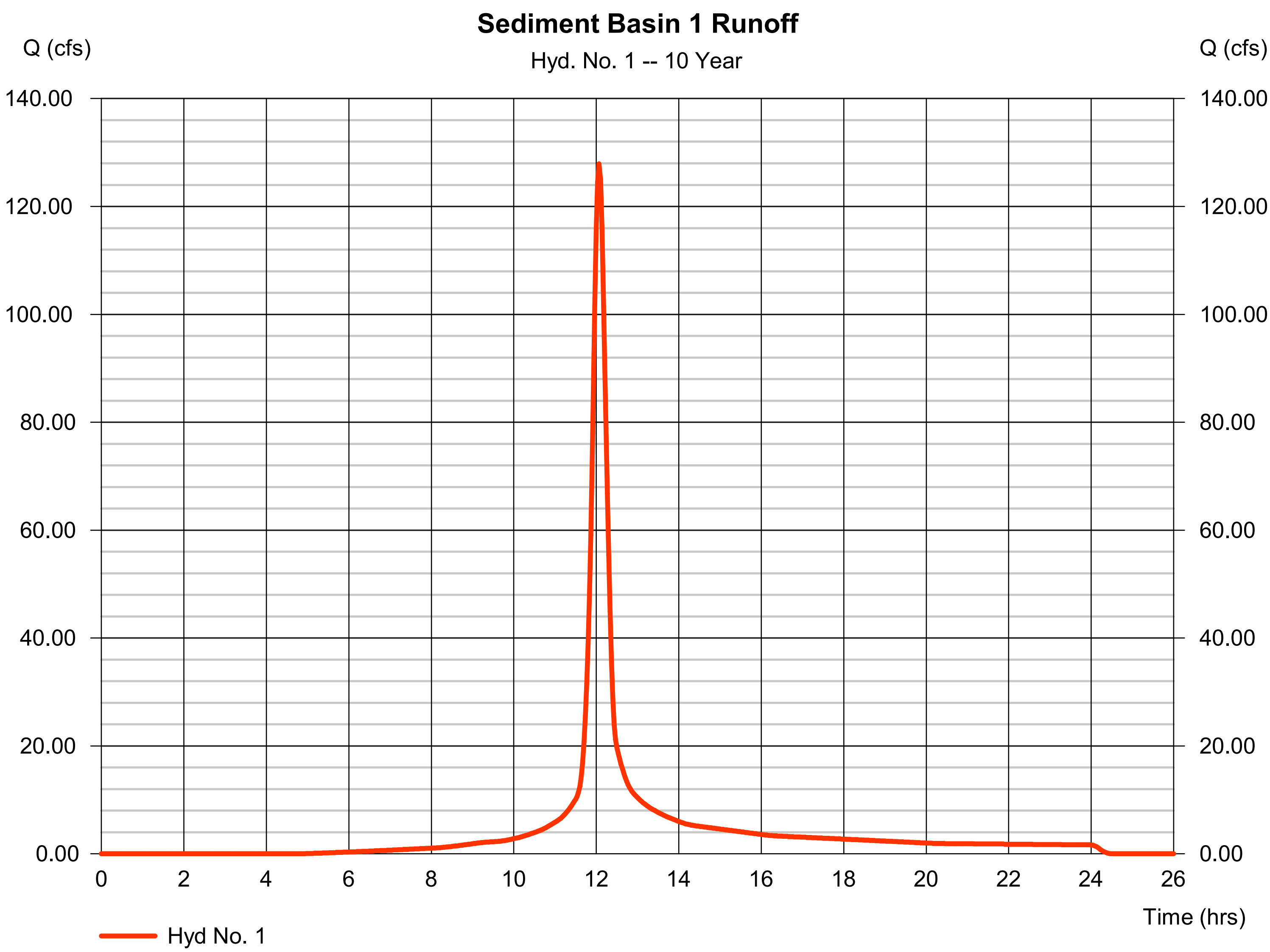
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 1

Sediment Basin 1 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 127.89 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 407,278 cuft
Drainage area	= 29.500 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.30 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



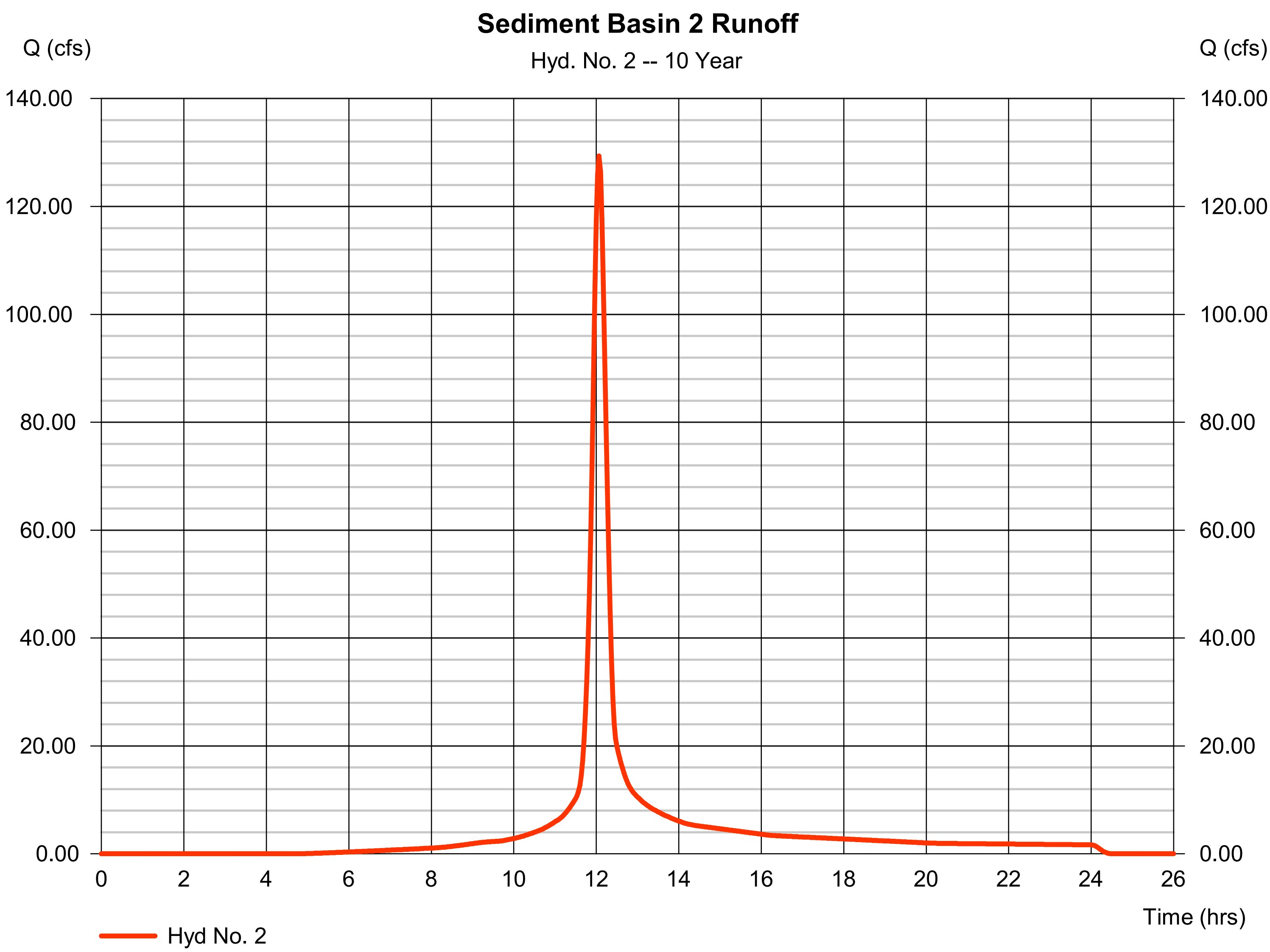
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 2

Sediment Basin 2 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 129.37 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 411,972 cuft
Drainage area	= 29.840 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.90 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



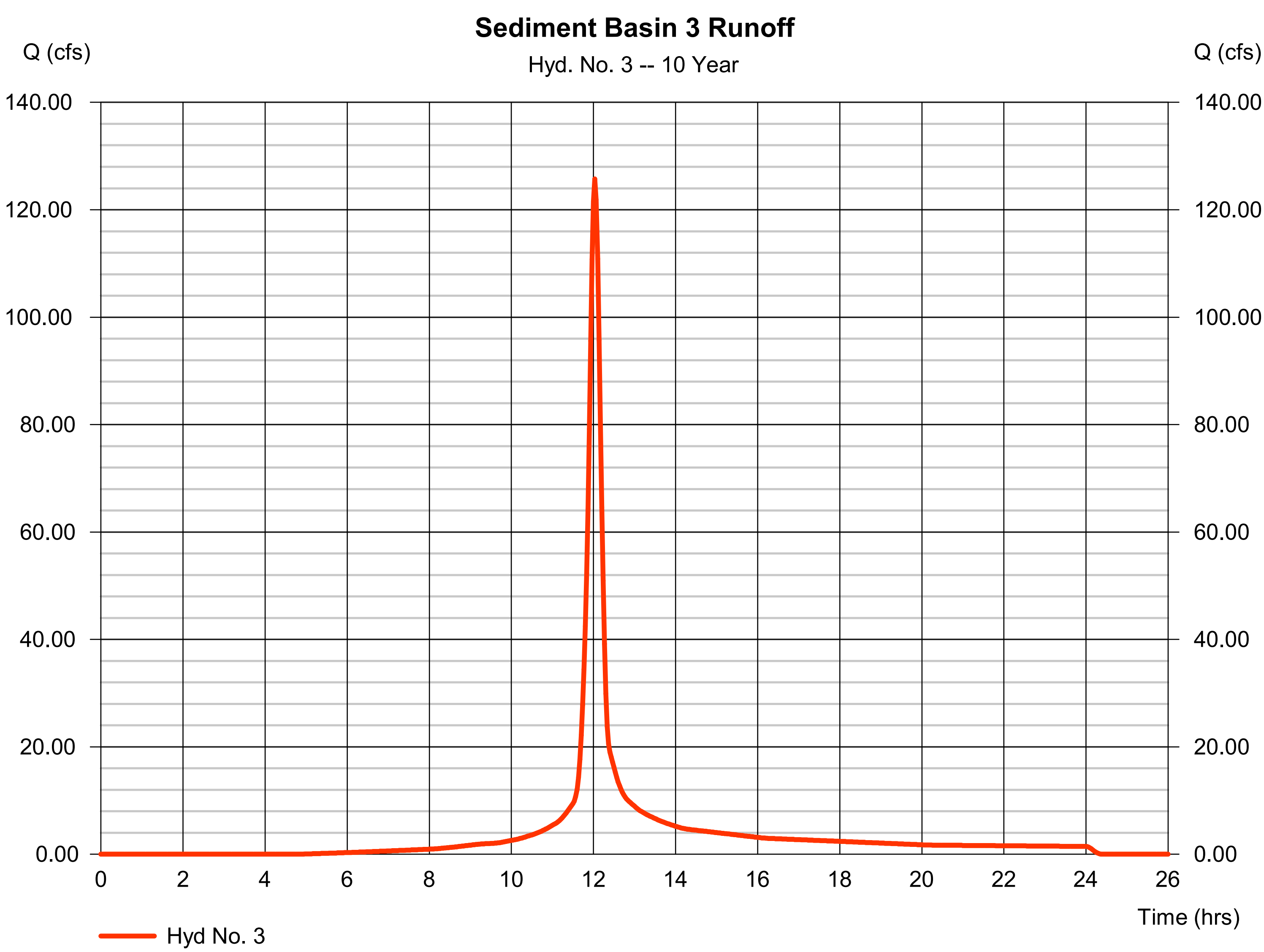
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 3

Sediment Basin 3 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 125.73 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 360,886 cuft
Drainage area	= 26.810 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.60 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



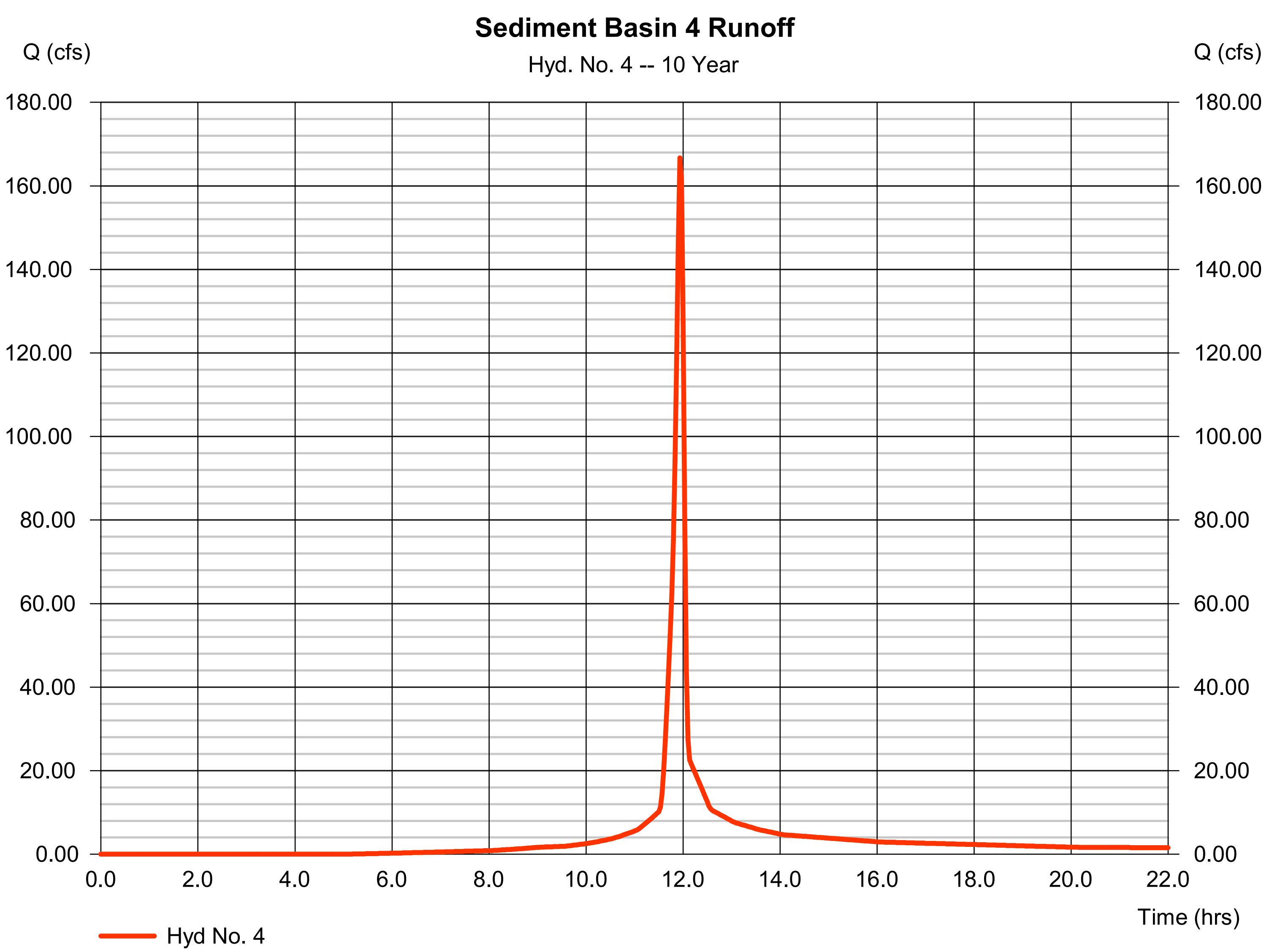
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 4

Sediment Basin 4 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 166.70 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 348,751 cuft
Drainage area	= 27.690 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.10 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



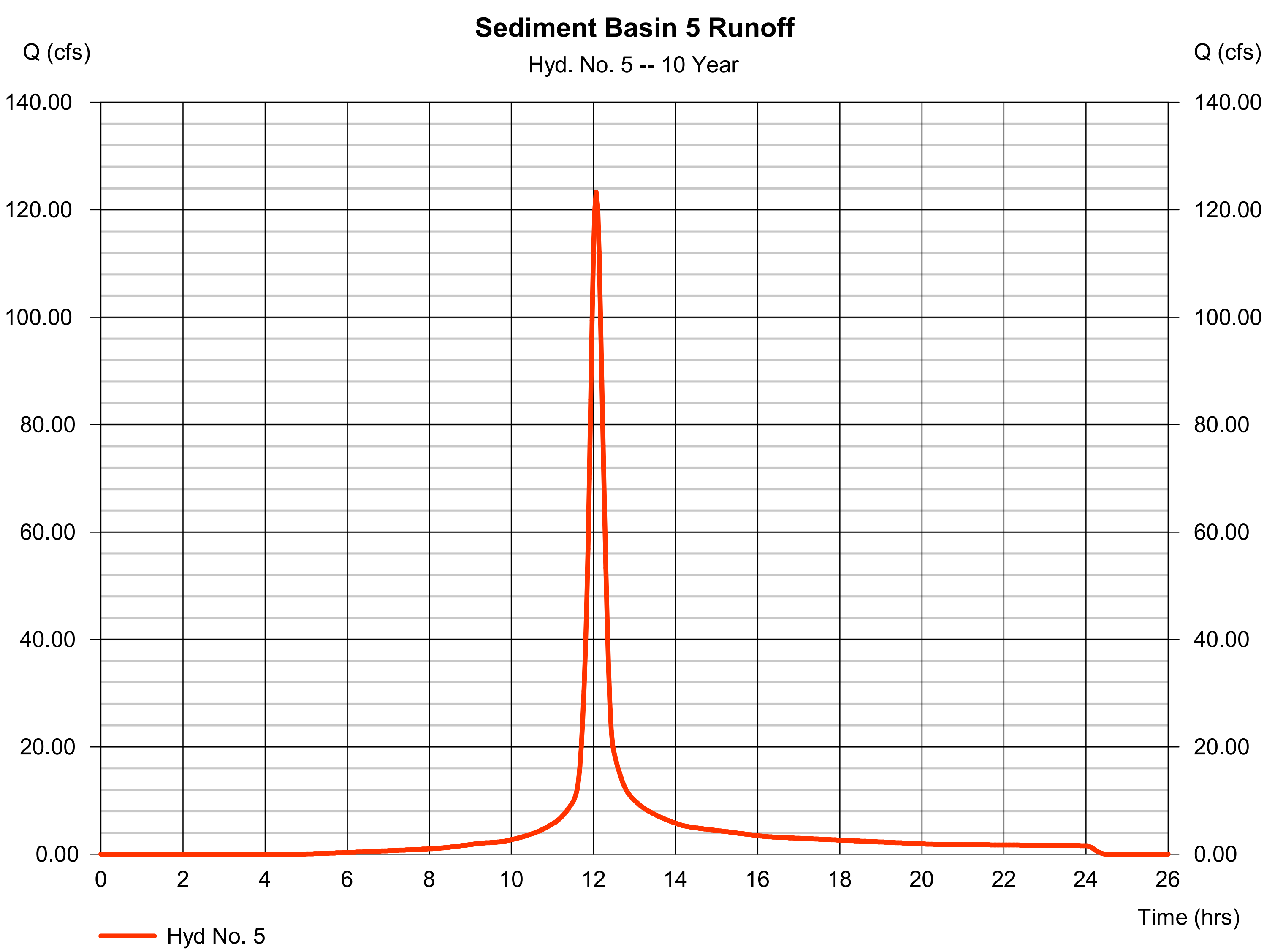
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 | Monday, 08 / 7 / 2023

Hyd. No. 5

Sediment Basin 5 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 123.26 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 392,505 cuft
Drainage area	= 28.430 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.10 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



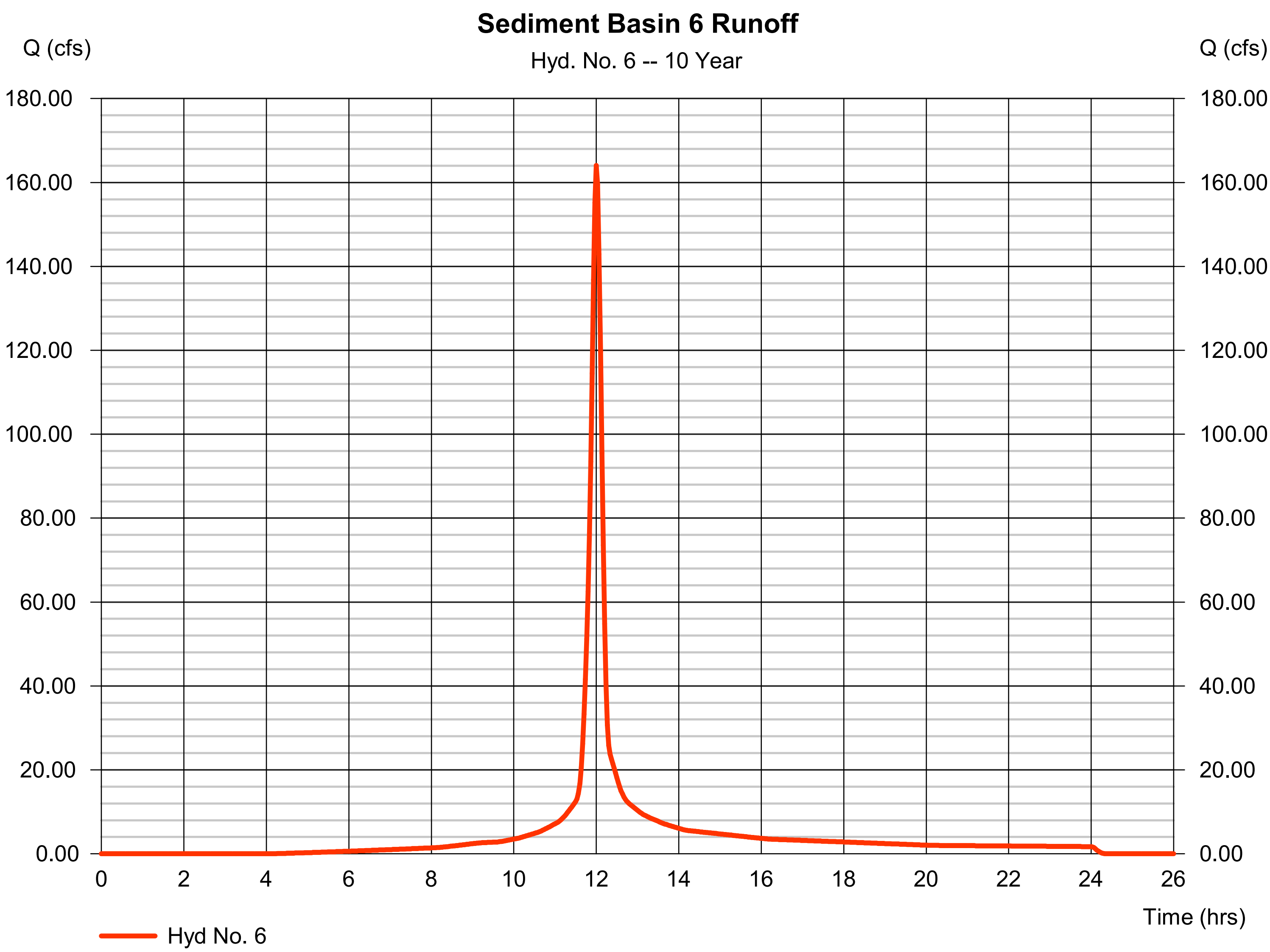
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 6

Sediment Basin 6 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 164.04 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 441,517 cuft
Drainage area	= 29.400 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.20 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



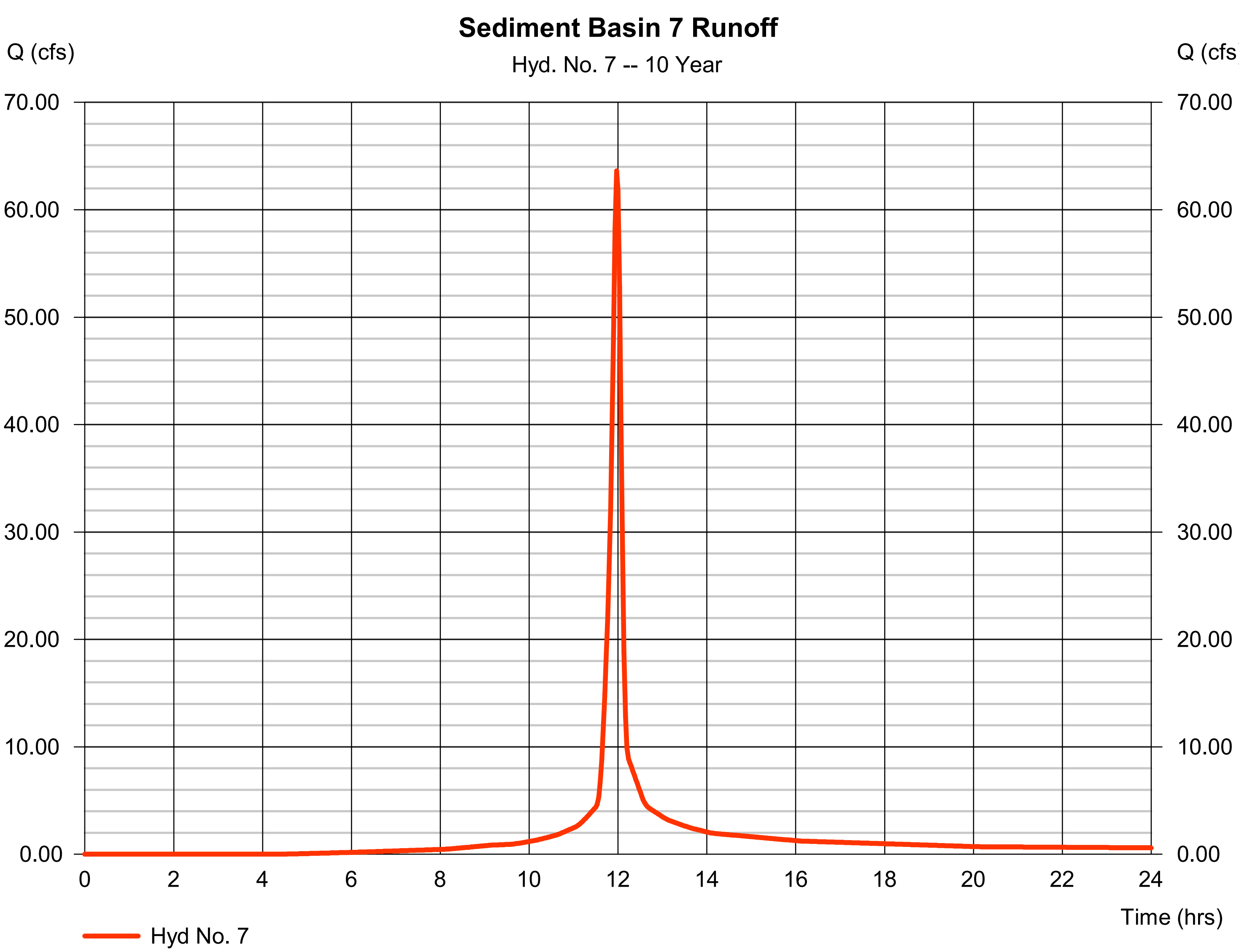
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 7

Sediment Basin 7 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 63.62 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 151,322 cuft
Drainage area	= 10.670 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.40 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



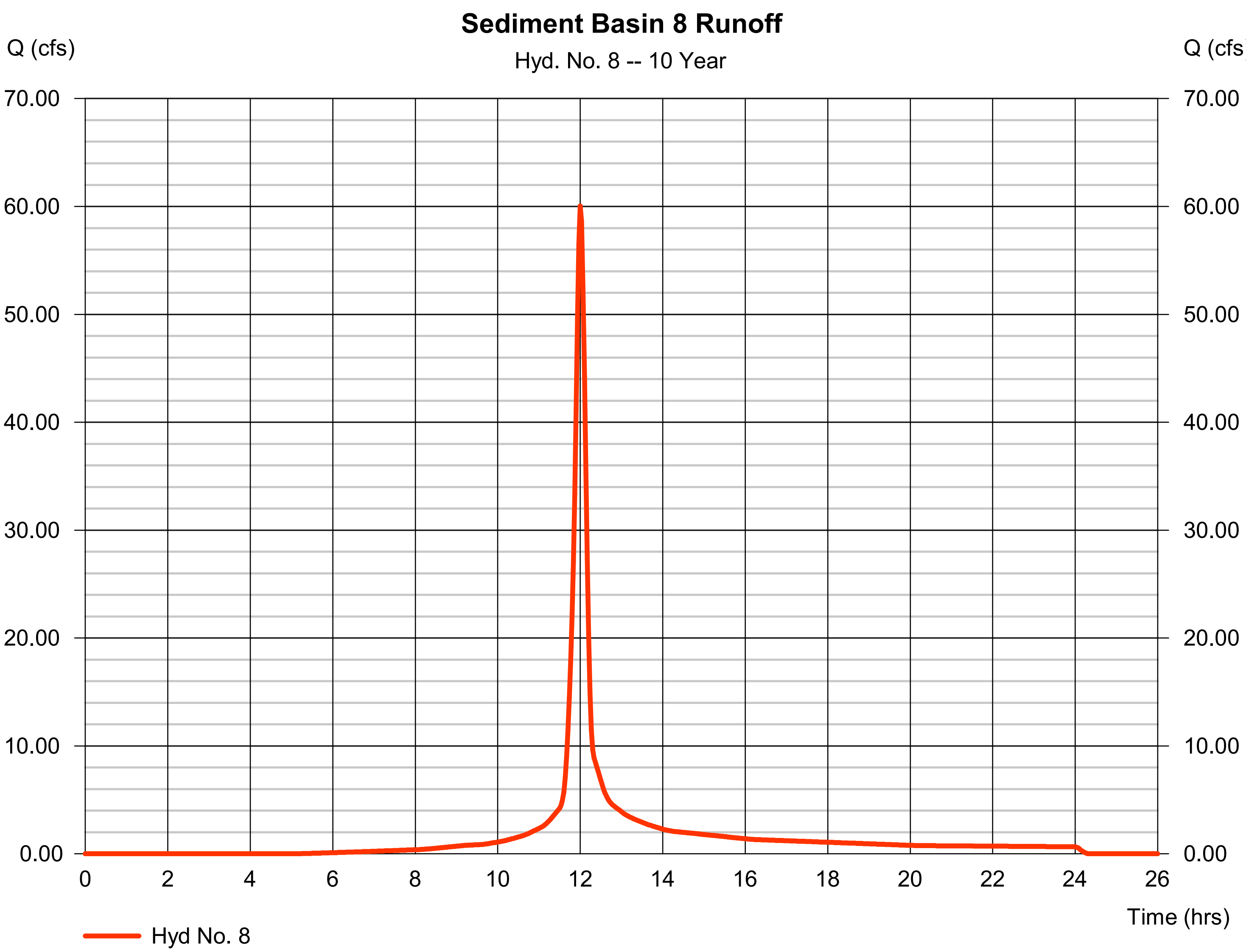
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 | Monday, 08 / 7 / 2023

Hyd. No. 8

Sediment Basin 8 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 60.05 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 158,909 cuft
Drainage area	= 11.470 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.20 min
Total precip.	= 5.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



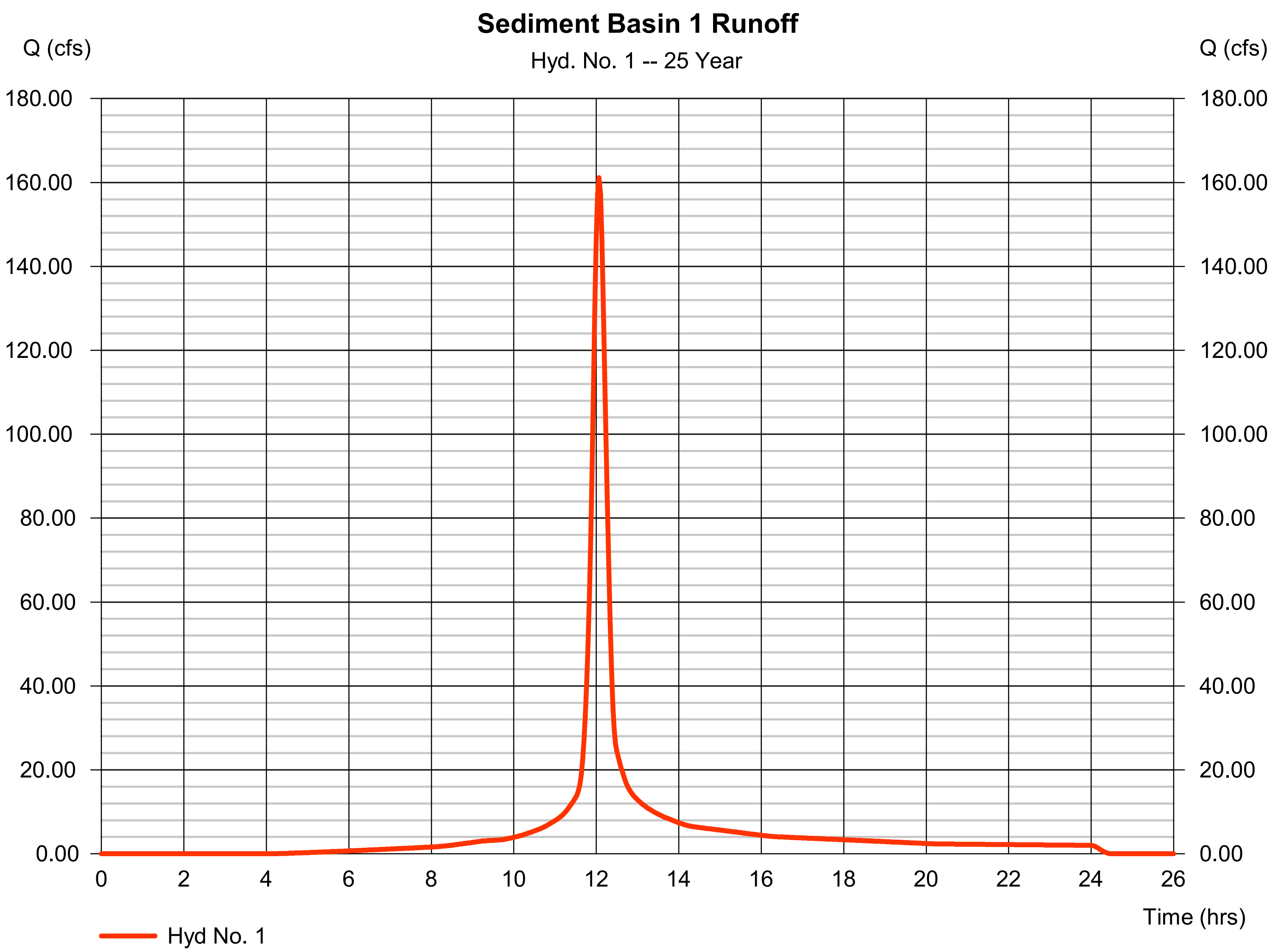
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 1

Sediment Basin 1 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 161.17 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 518,634 cuft
Drainage area	= 29.500 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.30 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



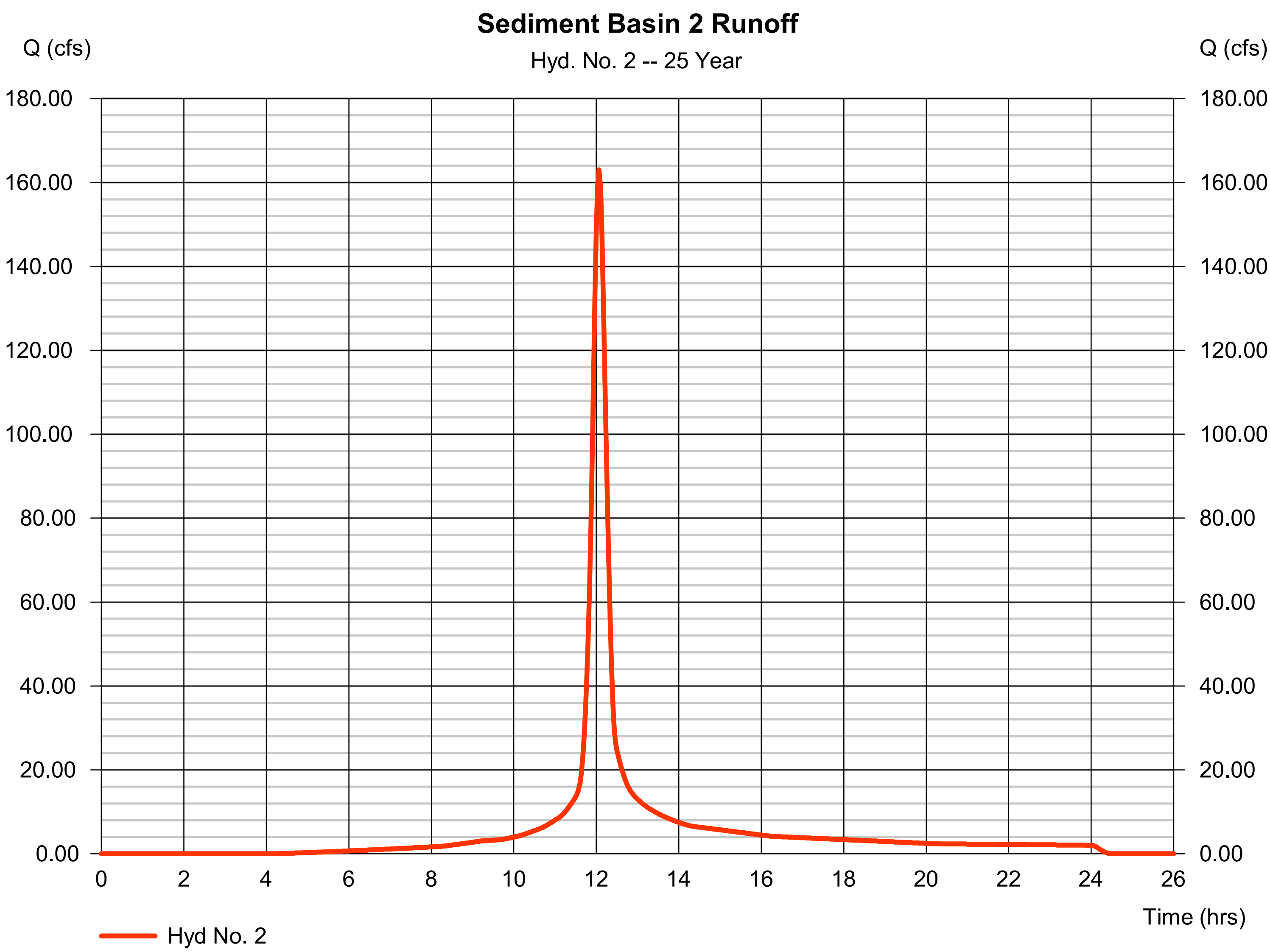
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 2

Sediment Basin 2 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 163.03 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 524,612 cuft
Drainage area	= 29.840 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.90 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



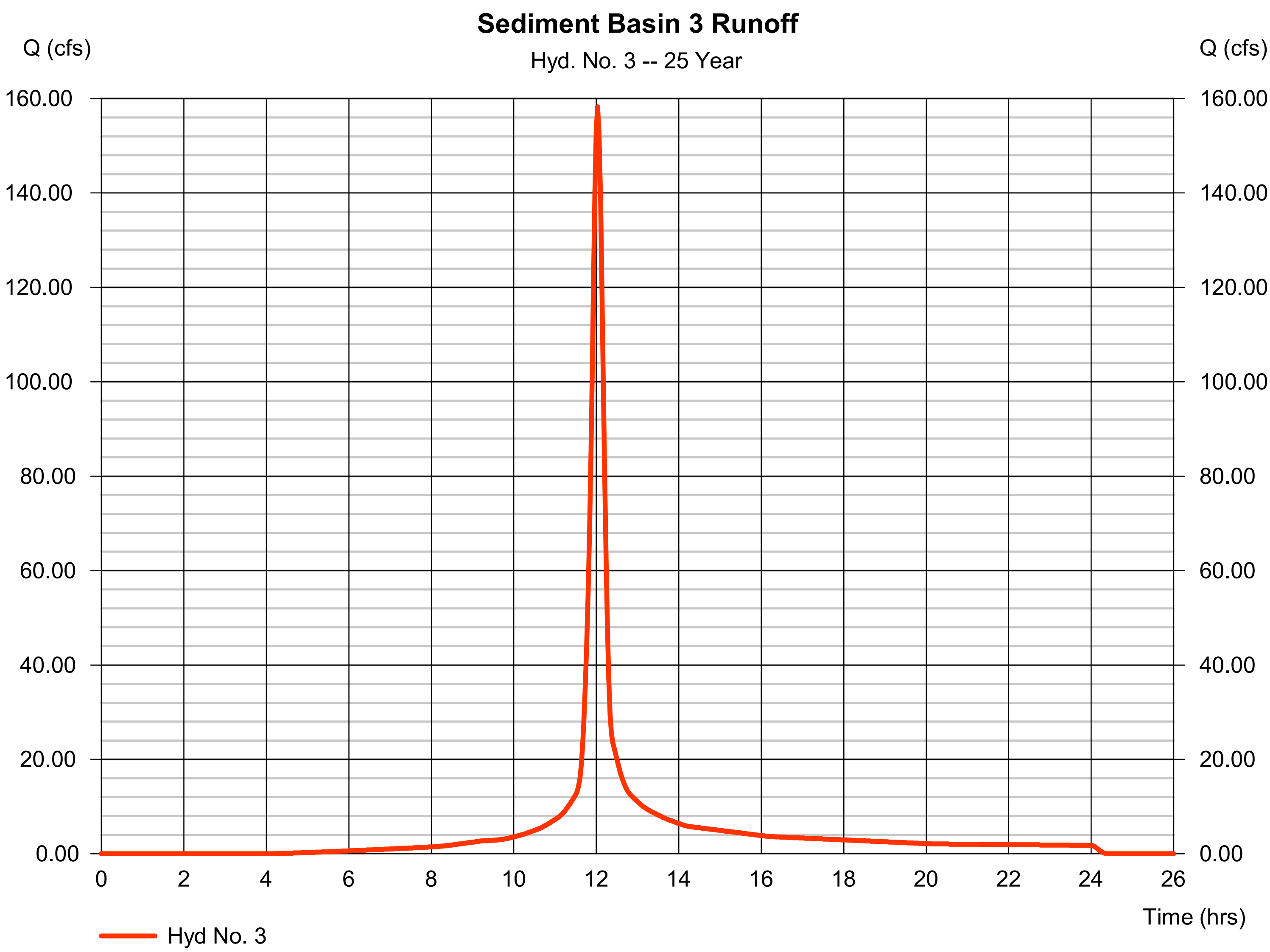
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 3

Sediment Basin 3 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 158.26 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 459,558 cuft
Drainage area	= 26.810 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.60 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



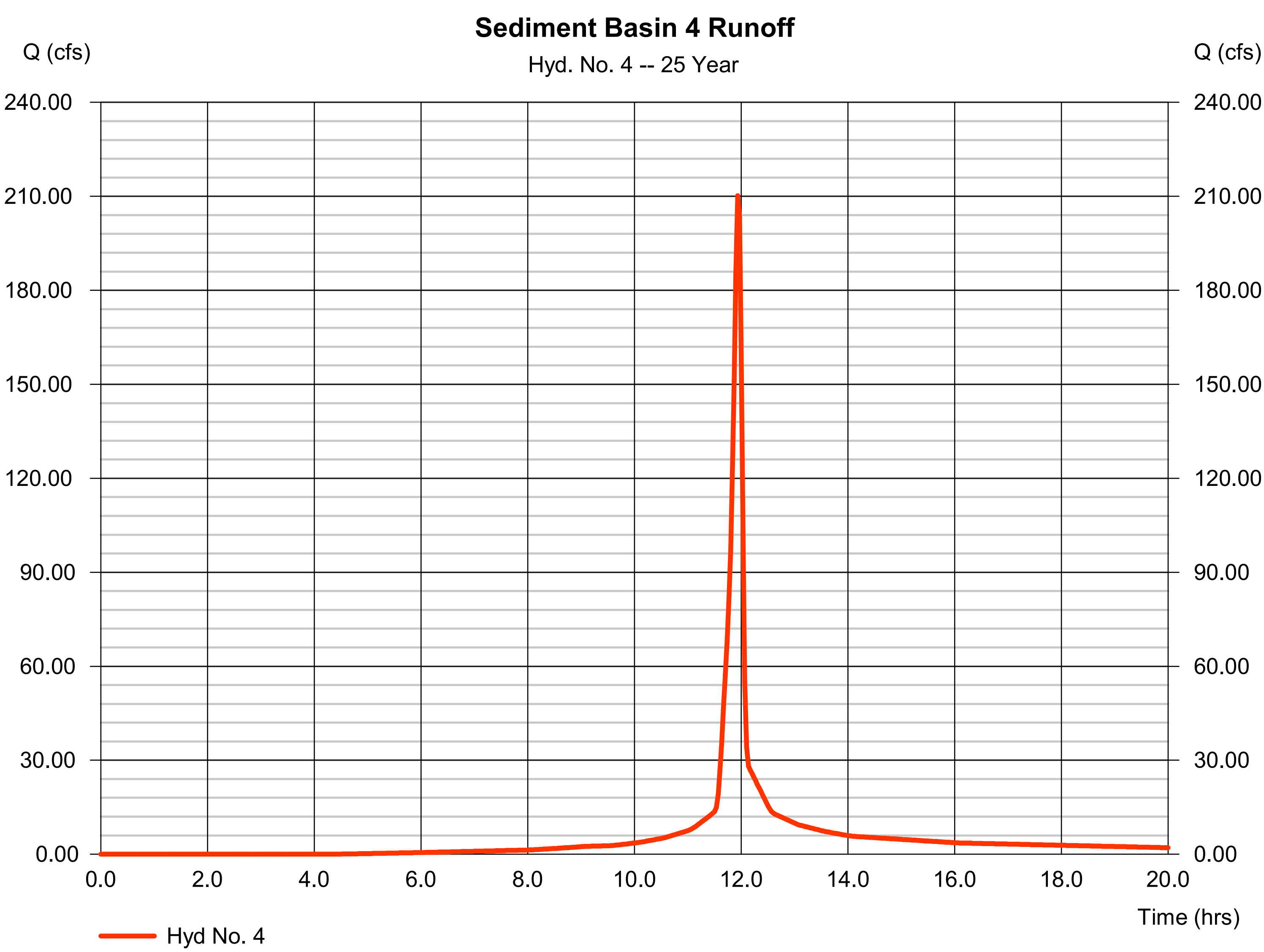
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 4

Sediment Basin 4 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 210.23 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 446,029 cuft
Drainage area	= 27.690 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.10 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



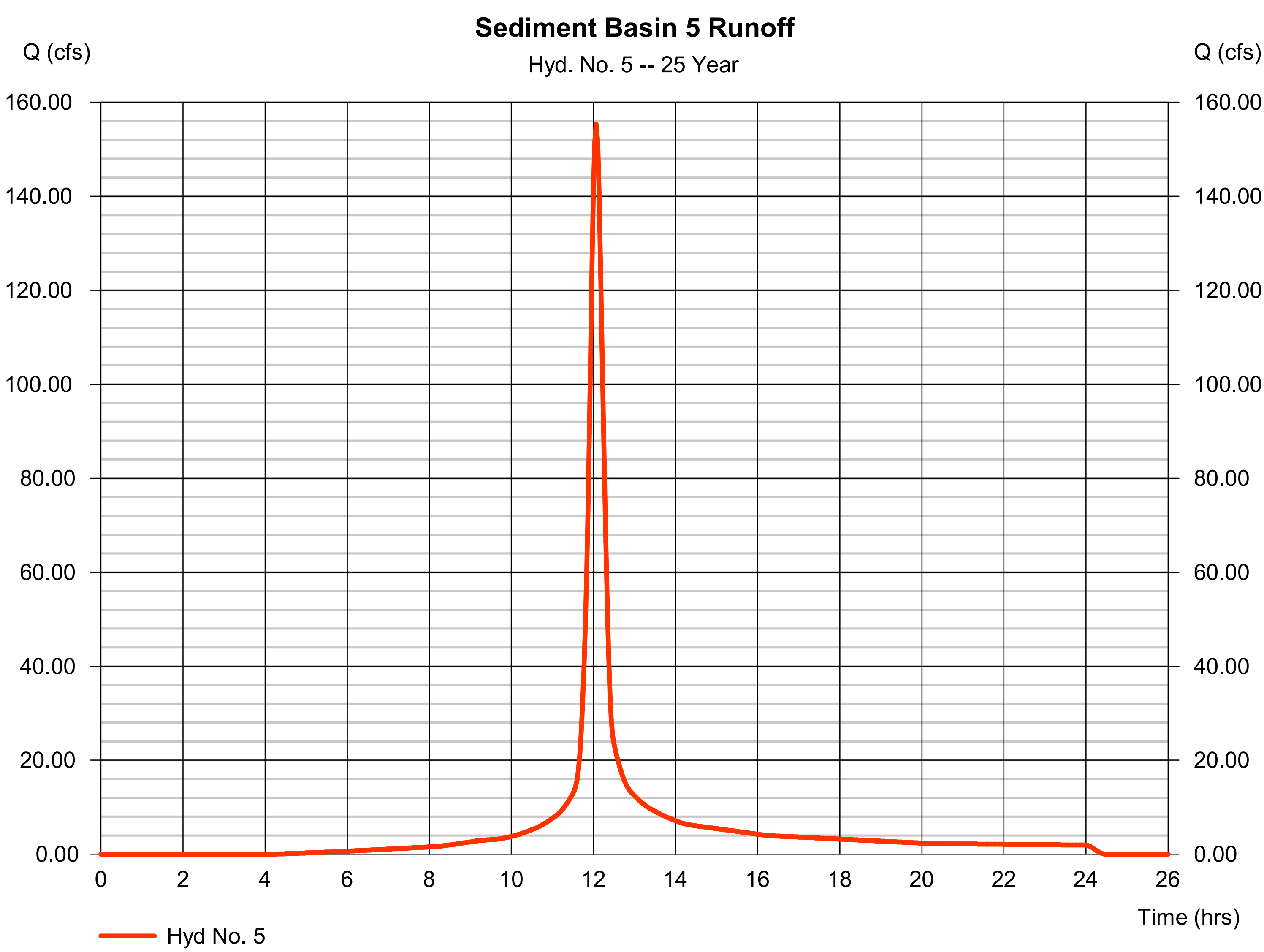
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 5

Sediment Basin 5 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 155.32 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 499,823 cuft
Drainage area	= 28.430 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.10 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



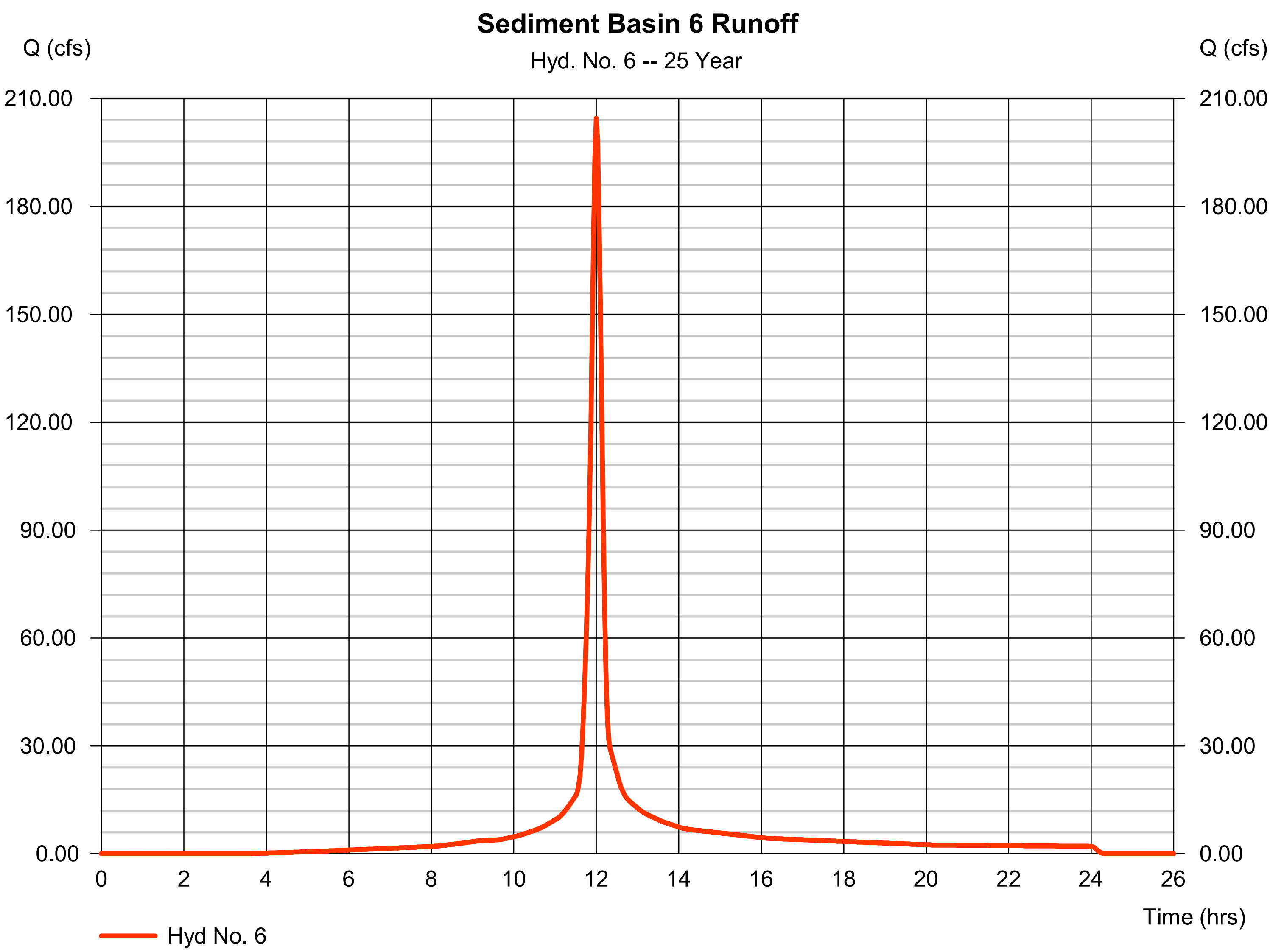
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 6

Sediment Basin 6 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 204.50 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 557,471 cuft
Drainage area	= 29.400 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.20 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



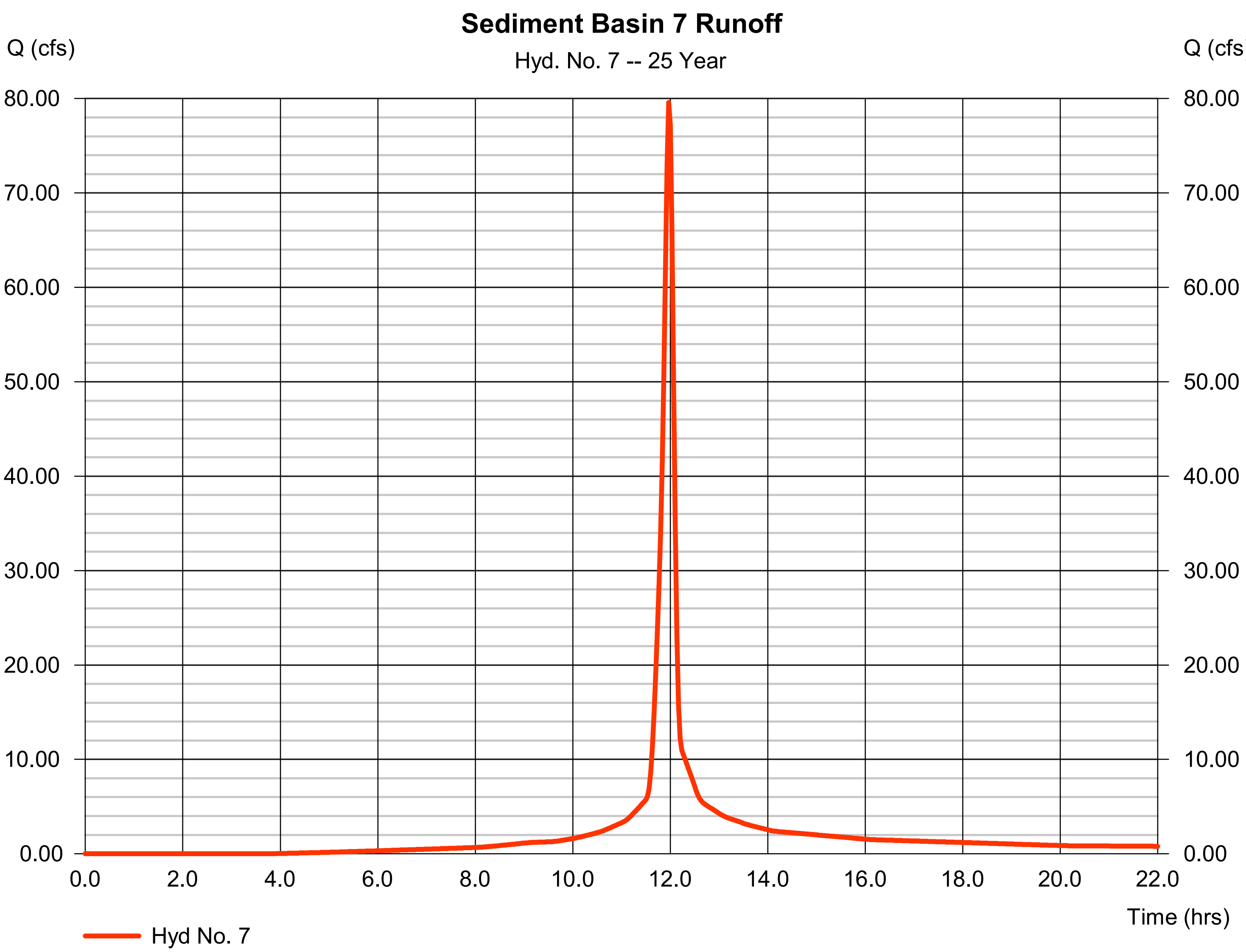
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 7

Sediment Basin 7 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 79.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 191,874 cuft
Drainage area	= 10.670 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.40 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



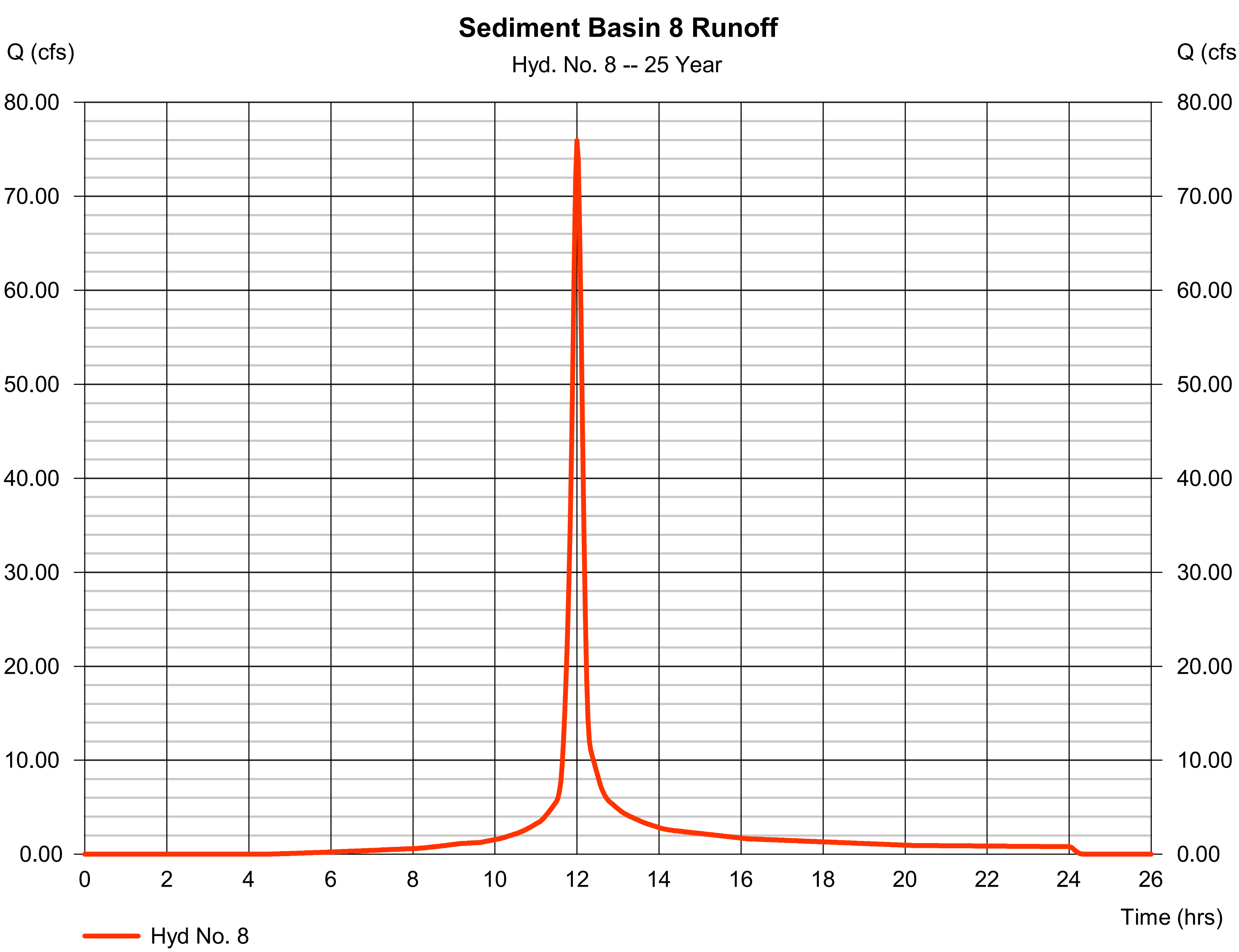
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 8

Sediment Basin 8 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 75.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 203,234 cuft
Drainage area	= 11.470 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.20 min
Total precip.	= 6.34 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



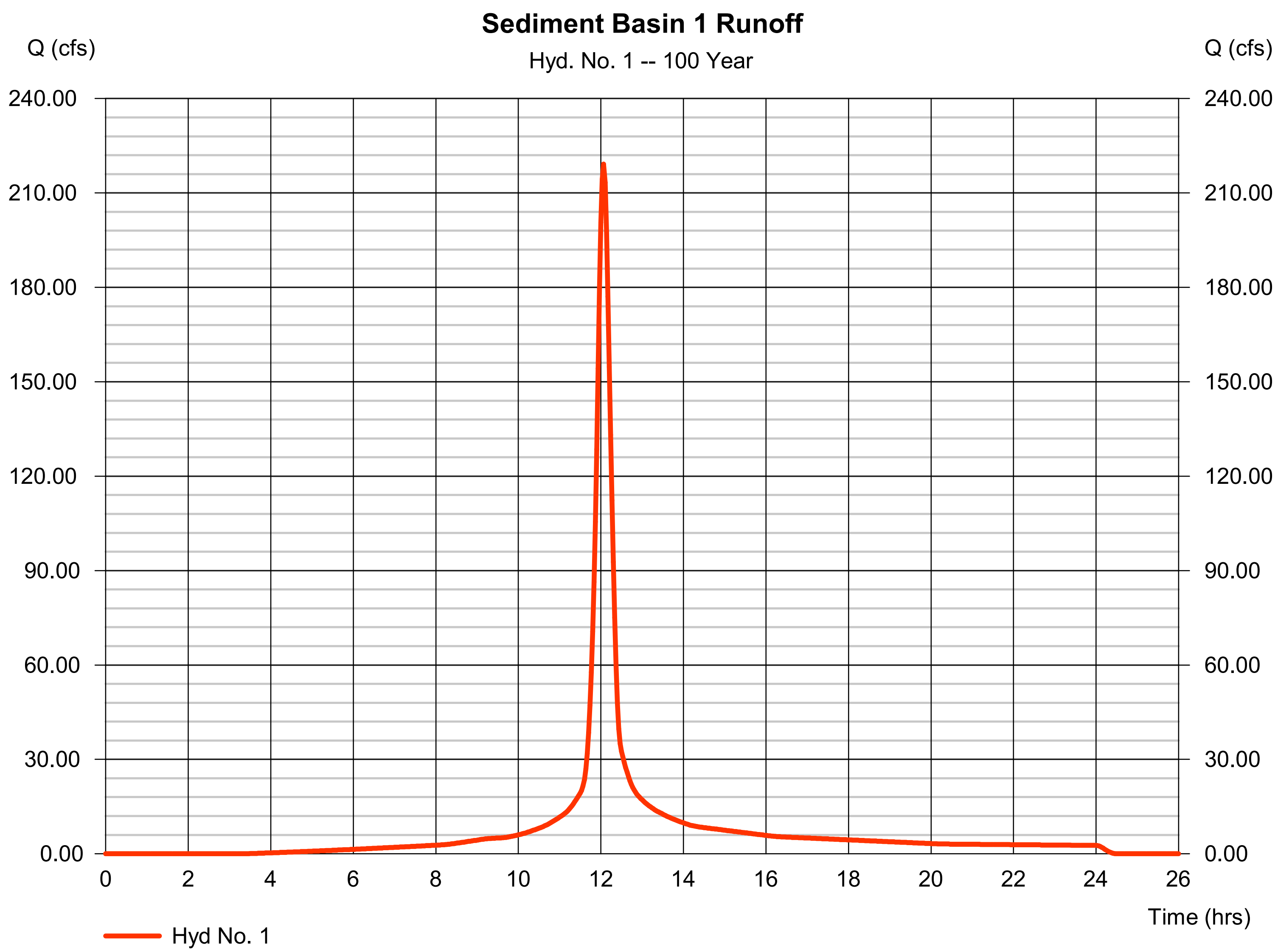
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 1

Sediment Basin 1 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 219.15 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 716,751 cuft
Drainage area	= 29.500 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.30 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



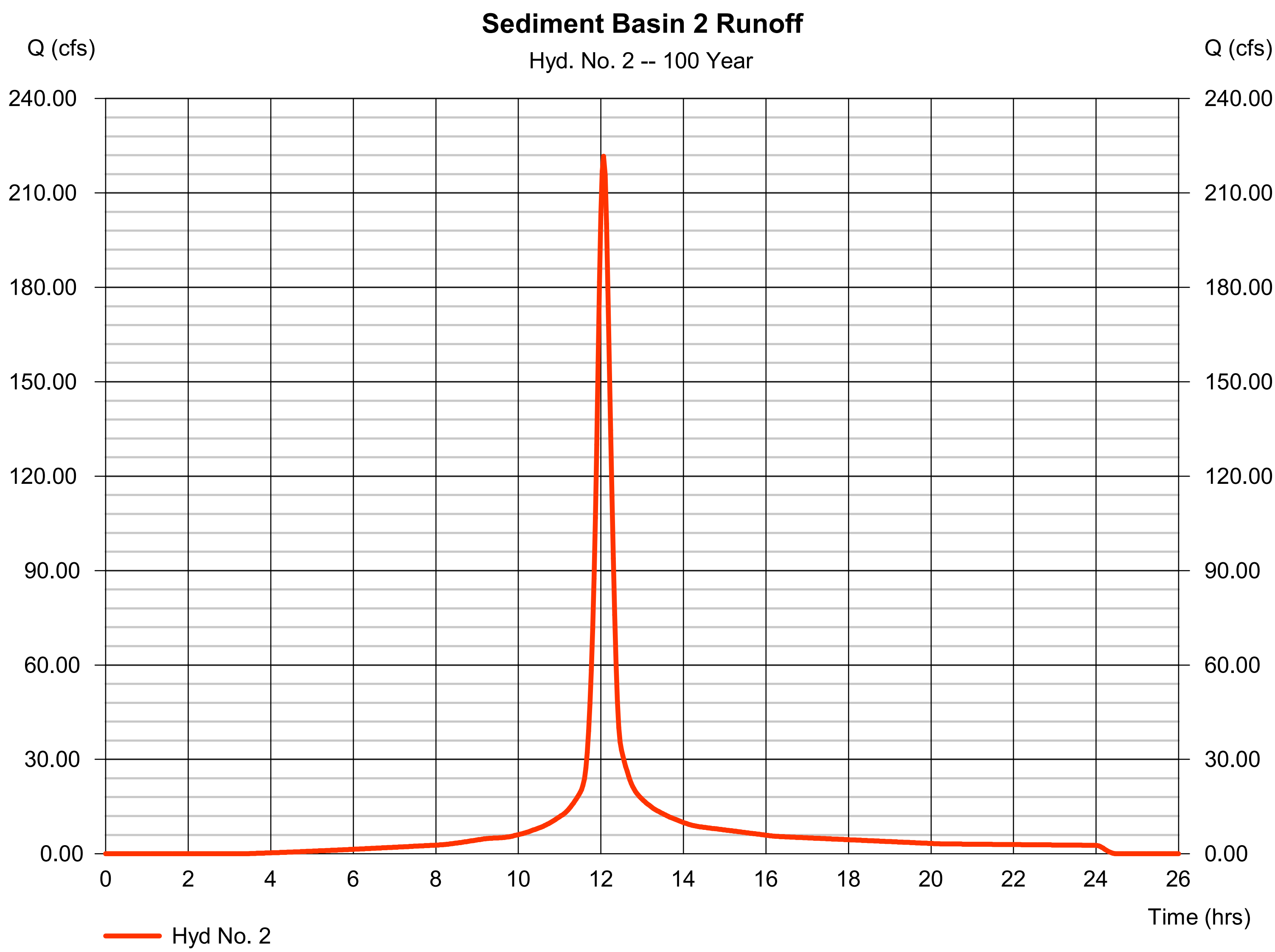
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 2

Sediment Basin 2 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 221.67 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 725,011 cuft
Drainage area	= 29.840 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.90 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



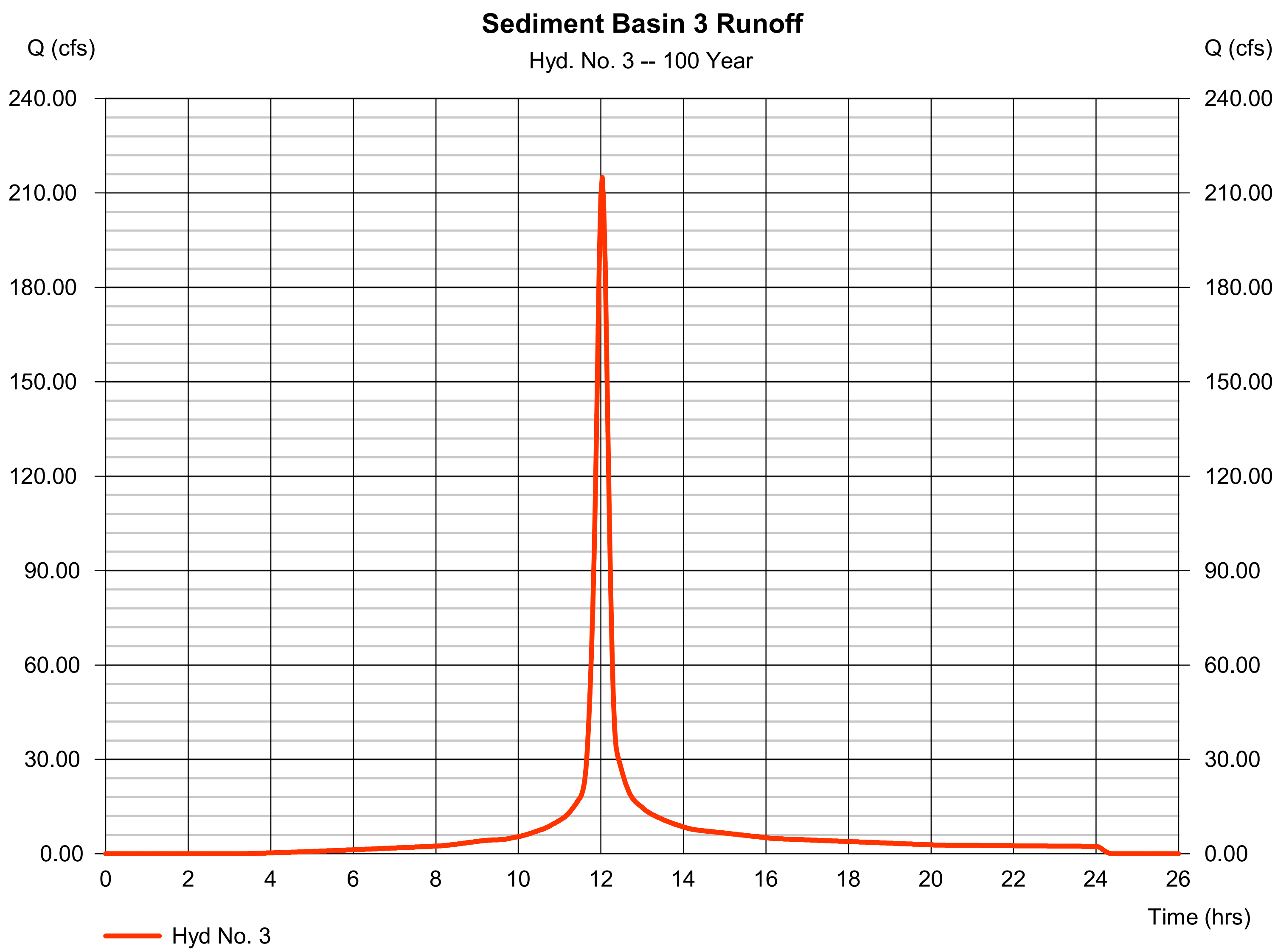
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 3

Sediment Basin 3 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 214.93 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 635,108 cuft
Drainage area	= 26.810 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.60 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



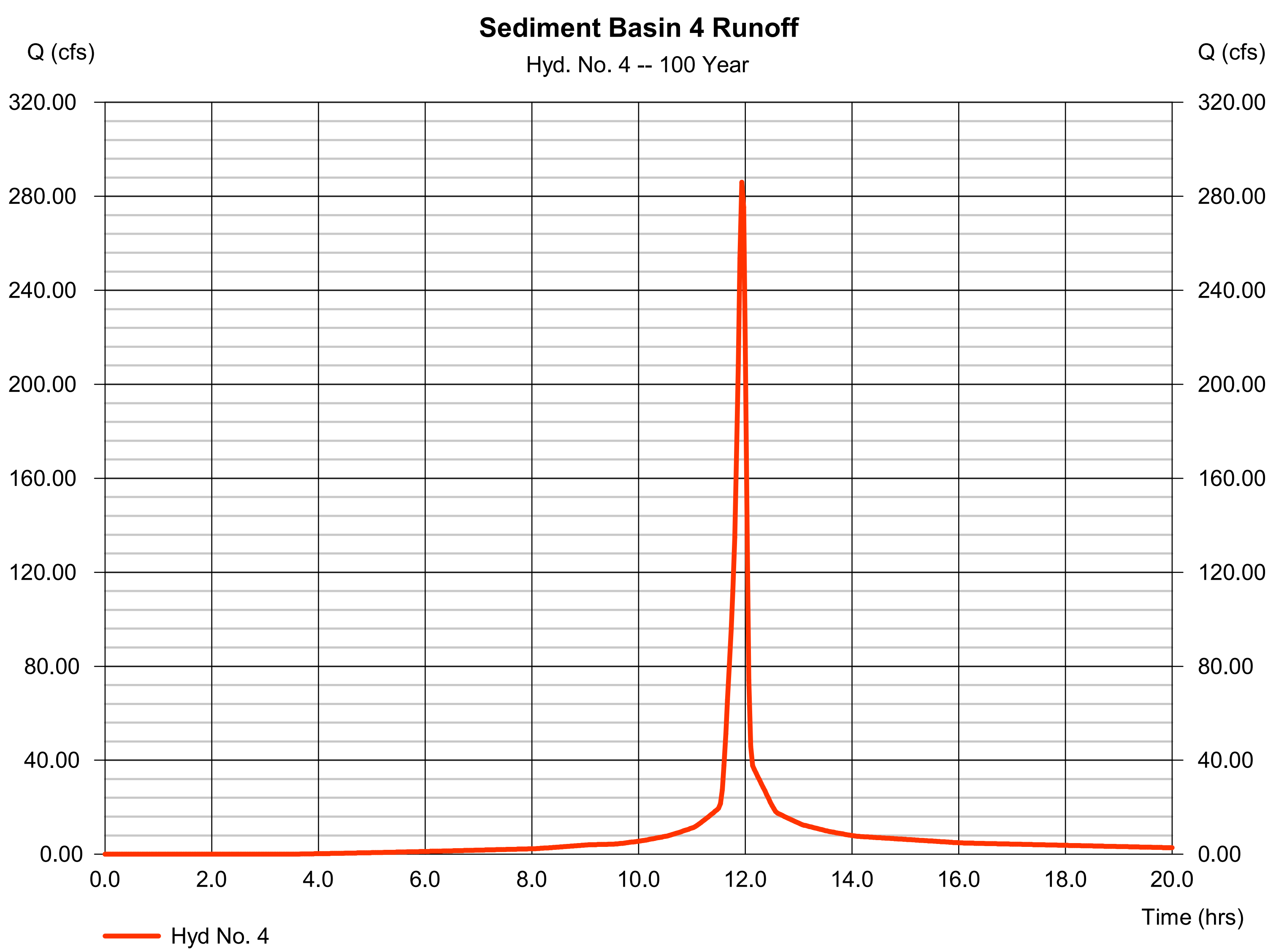
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 | Monday, 08 / 7 / 2023

Hyd. No. 4

Sediment Basin 4 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 286.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 619,479 cuft
Drainage area	= 27.690 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.10 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



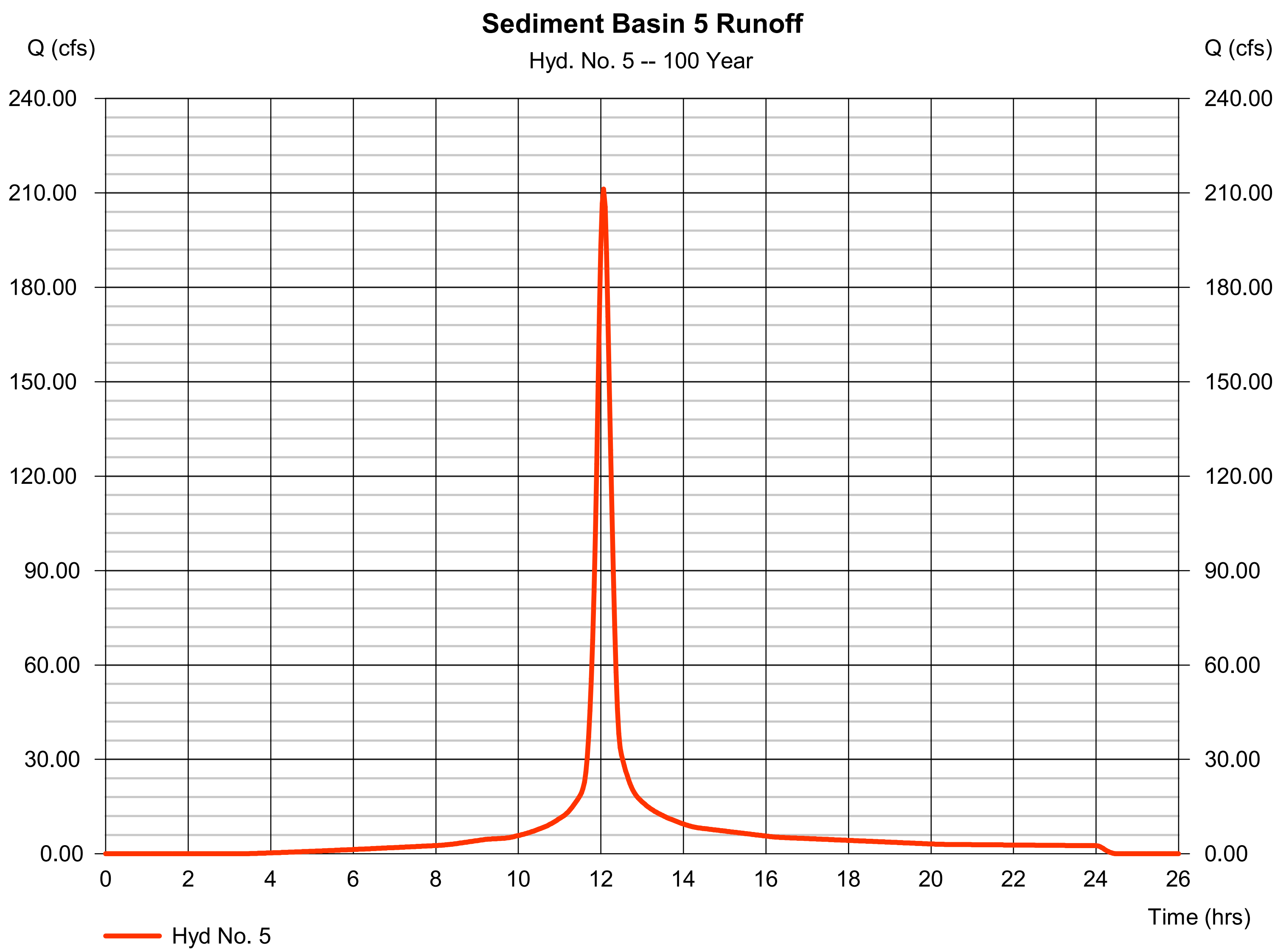
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 5

Sediment Basin 5 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 211.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 690,753 cuft
Drainage area	= 28.430 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.10 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



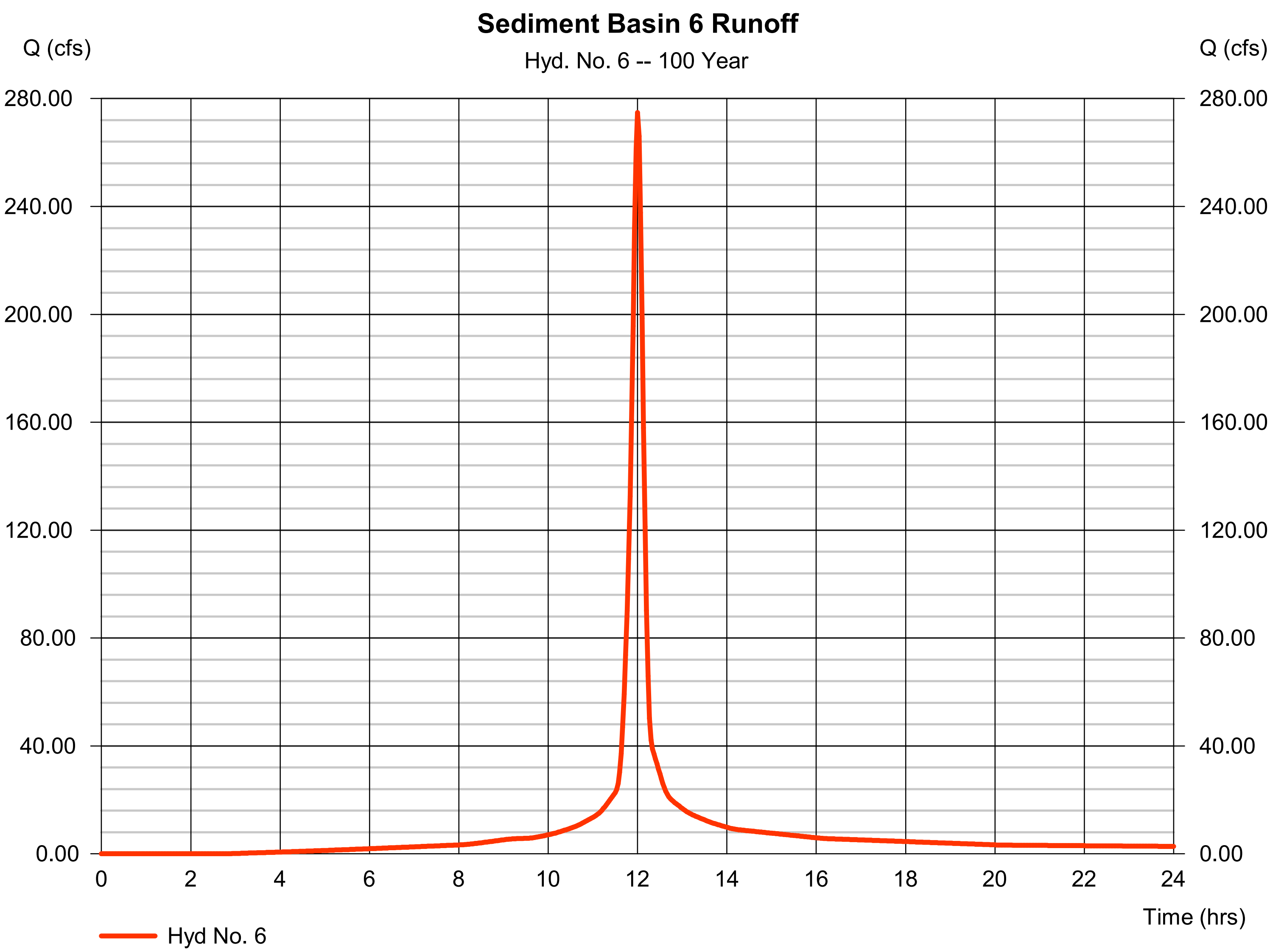
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 | Monday, 08 / 7 / 2023

Hyd. No. 6

Sediment Basin 6 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 274.83 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 762,937 cuft
Drainage area	= 29.400 ac	Curve number	= 89
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.20 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



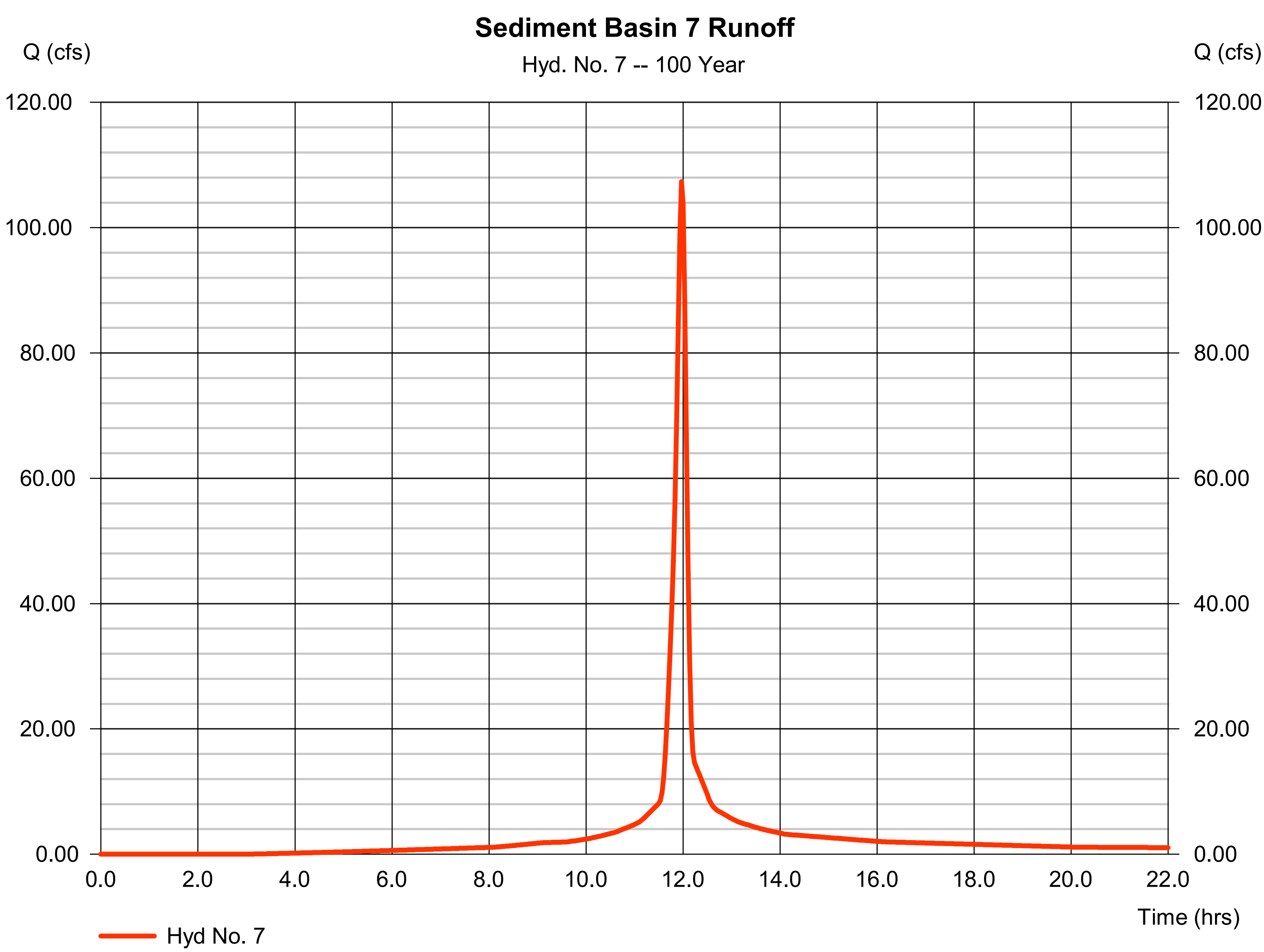
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 | Monday, 08 / 7 / 2023

Hyd. No. 7

Sediment Basin 7 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 107.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 263,871 cuft
Drainage area	= 10.670 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.40 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



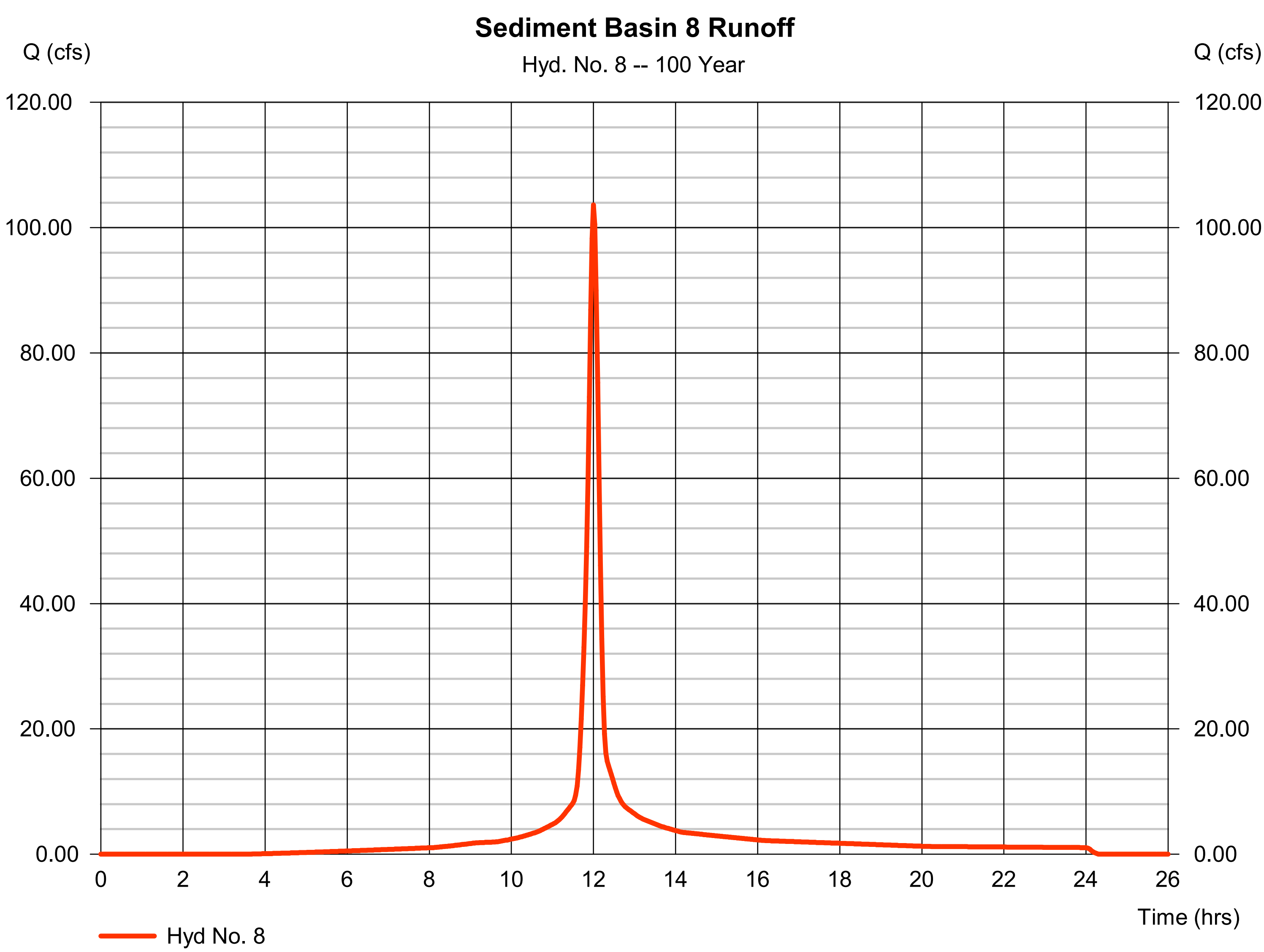
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 8

Sediment Basin 8 Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 103.63 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 282,267 cuft
Drainage area	= 11.470 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.20 min
Total precip.	= 8.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



2.0 APPENDICES

2.4 Appendix 4

AutoCAD Civil 3D 2022's Hydraflow Extension Pond Reports

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Friday, 08 / 4 / 2023

Pond No. 1 - Sediment Basin 1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 428.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	428.00	59,586	0	0
1.00	429.00	62,080	60,823	60,823
1.01	429.01	62,081	621	61,444
2.00	430.00	64,598	62,695	124,139
4.00	432.00	69,711	134,263	258,402
6.00	434.00	74,924	144,589	402,991
7.00	435.00	77,568	76,235	479,226

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 428.00	0.00	0.00	0.00
Length (ft)	= 68.00	0.00	0.00	0.00
Slope (%)	= 14.71	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 432.00	433.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	428.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	60,823	429.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	61,444	429.01	0.00	---	---	---	0.00	0.00	---	---	---	0.600	0.600
2.00	124,139	430.00	0.00	---	---	---	0.00	0.00	---	---	---	0.601	0.601
4.00	258,402	432.00	0.00	---	---	---	0.00	0.00	---	---	---	0.602	0.602
6.00	402,991	434.00	33.62 ic	---	---	---	33.62 s	17.66	---	---	---	0.603	51.89
7.00	479,226	435.00	36.98 ic	---	---	---	36.95 s	91.76	---	---	---	0.604	129.31

Pond Report

Pond No. 2 - Sediment Basin 2

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 452.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	452.00	61,526	0	0
1.00	453.00	64,006	62,756	62,756
1.01	453.01	64,007	641	63,396
2.00	454.00	66,512	64,596	127,992
4.00	456.00	71,598	138,065	266,057
6.00	458.00	76,785	148,338	414,395
7.00	459.00	79,417	78,090	492,485

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 452.00	0.00	0.00	0.00
Length (ft)	= 64.00	0.00	0.00	0.00
Slope (%)	= 12.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 456.00	457.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	452.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	62,756	453.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	63,396	453.01	0.00	---	---	---	0.00	0.00	---	---	---	0.601	0.601
2.00	127,992	454.00	0.00	---	---	---	0.00	0.00	---	---	---	0.602	0.602
4.00	266,057	456.00	0.00	---	---	---	0.00	0.00	---	---	---	0.603	0.603
6.00	414,395	458.00	33.62 ic	---	---	---	33.62 s	17.66	---	---	---	0.604	51.89
7.00	492,485	459.00	36.98 ic	---	---	---	36.95 s	91.76	---	---	---	0.605	129.31

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Friday, 08 / 4 / 2023

Pond No. 3 - Sediment Basin 3

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 484.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	484.00	48,549	0	0
1.00	485.00	50,750	49,640	49,640
1.01	485.01	50,751	508	50,148
2.00	486.00	53,810	51,745	101,893
4.00	488.00	59,286	113,041	214,934
6.00	490.00	64,976	124,206	339,140
7.00	491.00	67,902	66,427	405,567

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 484.00	0.00	0.00	0.00
Length (ft)	= 118.00	0.00	0.00	0.00
Slope (%)	= 10.17	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 488.00	489.60	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	484.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	49,640	485.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	50,148	485.01	0.00	---	---	---	0.00	0.00	---	---	---	0.600	0.600
2.00	101,893	486.00	0.00	---	---	---	0.00	0.00	---	---	---	0.601	0.601
4.00	214,934	488.00	0.00	---	---	---	0.00	0.00	---	---	---	0.602	0.602
6.00	339,140	490.00	33.62 ic	---	---	---	33.62 s	12.64	---	---	---	0.603	46.86
7.00	405,567	491.00	36.98 ic	---	---	---	36.95 s	82.74	---	---	---	0.604	120.29

Pond Report

Pond No. 4 - Sediment Basin 4

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 482.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	482.00	46,672	0	0
1.00	483.00	49,860	48,252	48,252
1.01	483.01	49,861	499	48,751
2.00	484.00	53,079	50,941	99,693
4.00	486.00	59,585	112,590	212,283
6.00	488.00	66,190	125,705	337,988
7.00	489.00	69,527	67,845	405,832

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 482.00	0.00	0.00	0.00
Length (ft)	= 68.00	0.00	0.00	0.00
Slope (%)	= 14.71	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 486.00	487.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	482.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	48,252	483.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	48,751	483.01	0.00	---	---	---	0.00	0.00	---	---	---	0.600	0.600
2.00	99,693	484.00	0.00	---	---	---	0.00	0.00	---	---	---	0.601	0.601
4.00	212,283	486.00	0.00	---	---	---	0.00	0.00	---	---	---	0.602	0.602
6.00	337,988	488.00	33.62 ic	---	---	---	33.62 s	17.66	---	---	---	0.603	51.89
7.00	405,832	489.00	36.98 ic	---	---	---	36.95 s	91.76	---	---	---	0.604	129.31

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Friday, 08 / 4 / 2023

Pond No. 5 - Sediment Basin 5

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 424.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	424.00	62,335	0	0
1.00	425.00	64,815	63,565	63,565
1.01	425.01	64,816	649	64,213
2.00	426.00	67,327	65,400	129,613
4.00	428.00	72,418	139,700	269,313
6.00	430.00	77,609	149,982	419,295
7.00	431.00	80,239	78,912	498,208

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 424.00	0.00	0.00	0.00
Length (ft)	= 56.00	0.00	0.00	0.00
Slope (%)	= 7.14	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 428.00	429.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	424.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	63,565	425.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	64,213	425.01	0.00	---	---	---	0.00	0.00	---	---	---	0.600	0.600
2.00	129,613	426.00	0.00	---	---	---	0.00	0.00	---	---	---	0.601	0.601
4.00	269,313	428.00	0.00	---	---	---	0.00	0.00	---	---	---	0.602	0.602
6.00	419,295	430.00	33.62 ic	---	---	---	33.62 s	17.66	---	---	---	0.603	51.89
7.00	498,208	431.00	36.98 ic	---	---	---	36.95 s	91.76	---	---	---	0.604	129.31

Pond Report

Pond No. 6 - Sediment Basin 6

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 426.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	426.00	67,670	0	0
1.00	427.00	69,936	68,793	68,793
1.01	427.01	69,937	700	69,493
2.00	428.00	72,243	70,368	139,861
4.00	430.00	76,912	149,116	288,977
6.00	432.00	81,675	158,547	447,524
7.00	433.00	84,093	82,873	530,397

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 426.00	0.00	0.00	0.00
Length (ft)	= 80.00	0.00	0.00	0.00
Slope (%)	= 20.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 430.00	431.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	426.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	68,793	427.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	69,493	427.01	0.00	---	---	---	0.00	0.00	---	---	---	0.601	0.601
2.00	139,861	428.00	0.00	---	---	---	0.00	0.00	---	---	---	0.602	0.602
4.00	288,977	430.00	0.00	---	---	---	0.00	0.00	---	---	---	0.603	0.603
6.00	447,524	432.00	33.62 ic	---	---	---	33.62 s	17.66	---	---	---	0.604	51.89
7.00	530,397	433.00	36.98 ic	---	---	---	36.95 s	91.76	---	---	---	0.605	129.31

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Friday, 08 / 4 / 2023

Pond No. 7 - Sediment Basin 7

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 418.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	418.00	25,603	0	0
1.00	419.00	27,015	26,303	26,303
1.01	419.01	27,016	270	26,574
2.00	420.00	28,548	27,498	54,071
4.00	422.00	31,511	60,029	114,100
6.00	424.00	34,575	66,056	180,156

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 418.00	0.00	0.00	0.00
Length (ft)	= 53.00	0.00	0.00	0.00
Slope (%)	= 7.55	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 421.75	423.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	418.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	26,303	419.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	26,574	419.01	0.00	---	---	---	0.00	0.00	---	---	---	0.380	0.380
2.00	54,071	420.00	0.00	---	---	---	0.00	0.00	---	---	---	0.381	0.381
4.00	114,100	422.00	5.01 ic	---	---	---	4.99	0.00	---	---	---	0.382	5.377
6.00	180,156	424.00	33.68 ic	---	---	---	33.65 s	49.95	---	---	---	0.383	83.98

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Friday, 08 / 4 / 2023

Pond No. 8 - Sediment Basin 8

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 415.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	415.00	25,760	0	0
1.00	416.00	27,387	26,567	26,567
1.01	416.01	27,388	274	26,841
3.00	418.00	30,698	57,758	84,599
5.00	420.00	34,591	65,244	149,843
6.00	421.00	35,846	35,213	185,056

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 415.00	0.00	0.00	0.00
Length (ft)	= 50.00	0.00	0.00	0.00
Slope (%)	= 6.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	15.00	Inactive	Inactive
Crest El. (ft)	= 418.75	420.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	415.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.00	26,567	416.00	0.00	---	---	---	0.00	0.00	---	---	---	---	0.000
1.01	26,841	416.01	0.00	---	---	---	0.00	0.00	---	---	---	0.380	0.380
3.00	84,599	418.00	0.00	---	---	---	0.00	0.00	---	---	---	0.381	0.381
5.00	149,843	420.00	29.62 ic	---	---	---	29.61 s	0.00	---	---	---	0.382	29.99
6.00	185,056	421.00	33.68 ic	---	---	---	33.68 s	49.95	---	---	---	0.383	84.01

2.0 APPENDICES

2.5 Appendix 5
Buoyancy Force Calculations

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC. Consulting Engineers

OVERFLOW STRUCTURE BUOYANCY FORCE

SALUDA: SEDIMENT BASIN 1

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure		
$F_R = (L_R)(W_R)(H_R)(\rho_w)$		
where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	4
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,994**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls)		
$W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$		
where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	4.00
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,964**

Step 3. Weight of Concrete from Riser Structure Base in Water		
$W_{SB,min} = F_R - W_{RS}$		
$W_{SB,W} = (L_B \times W_B \times H_B) \times \rho_{c,w}$		
where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3994
W_{RS} = Weight of Riser Structure (lb)	=	3964
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**29**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3994
Actual Total		
Riser Structure (lb)	=	3964
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**6,154**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $F_P=(\pi)(R_P)^2(L_s)(\rho)$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	58.31
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**17,860**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $W_{AS,W} = [(L_A x W_A)-(\pi)(R_P^2)]$ x 1' thick x # of collars x $\rho_{c,w}$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	6.50
W_A = Width of Anti-Seep Collar (ft)	=	6.50
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**6,542**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	58.31
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**15,456**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$		
$F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety)		
$W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$		
where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	56.1
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**140**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**5,273**

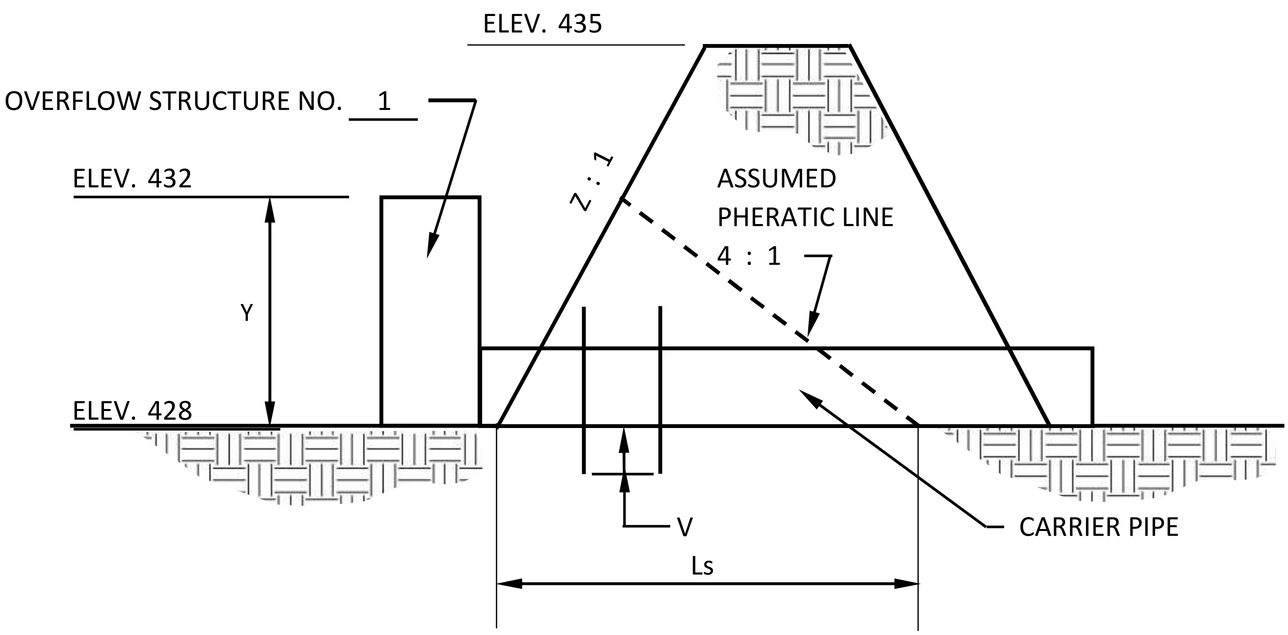
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	17860
Actual Total		
Anti-Seep Collars in Water (lb)	=	6542
Carrier Pipe (lb)	=	15456
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	5273

TOTAL (lb)	=	**29,201**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 1



Ls = LENGTH IN SATURATION ZONE

Y = OVERFLOW STRUCTURE HEIGHT = 4

Z = INSIDE SLOPE OF LEVEE = 2

PIPE SLOPE = 14.71 % = 0.1471 FEET/FEET

$$Ls = Y\ (Z + 4)\ \left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

Ls = 58.31 FEET

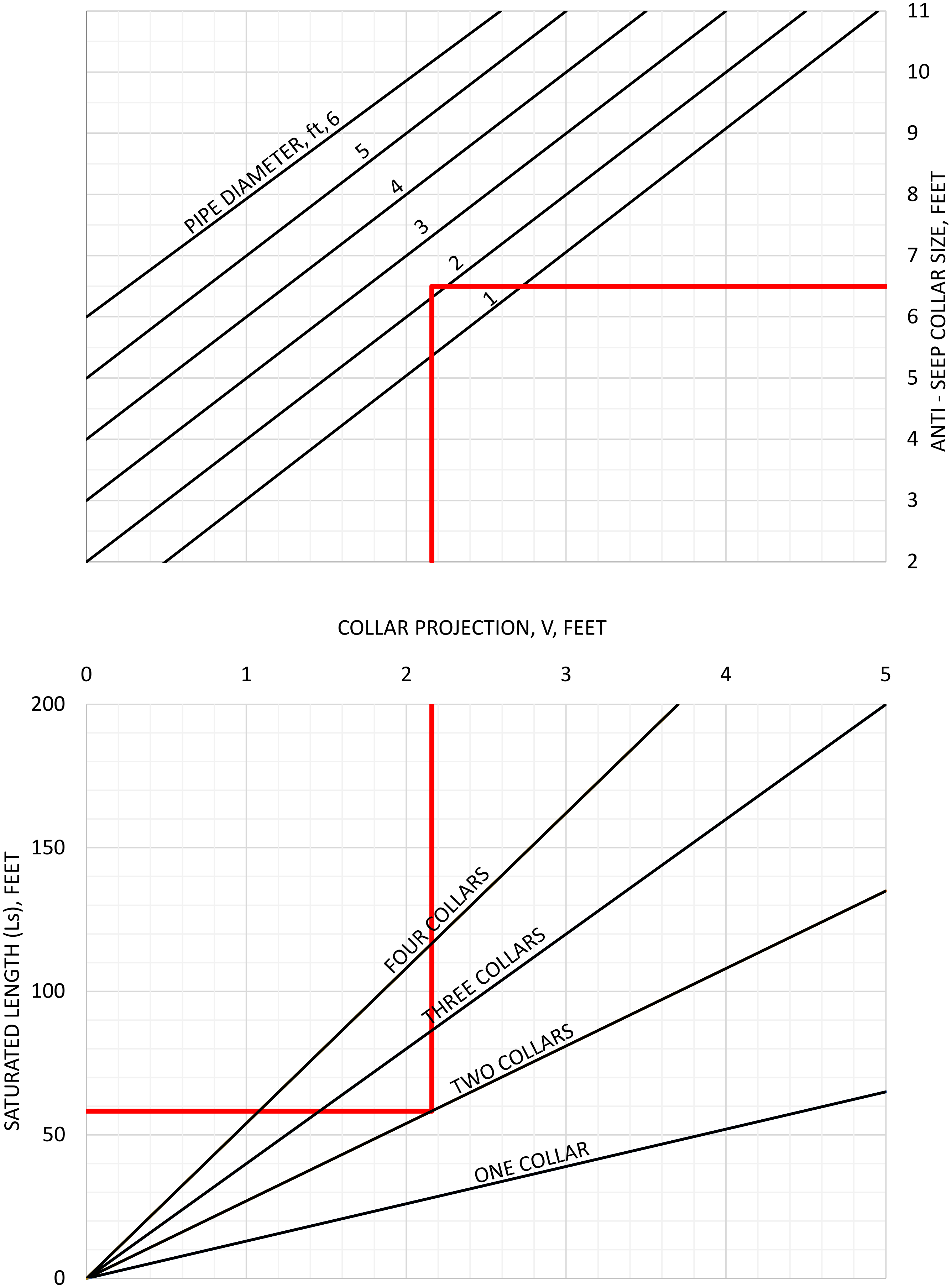
FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:

V = COLLAR PROJECTION = 2.20 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 6.5' x 6.5'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

OVERFLOW STRUCTURE BUOYANCY FORCE

HHNT
HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
Consulting Engineers

SALUDA: SEDIMENT BASIN 2

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure $F_R = (L_R)(W_R)(H_R)(\rho_w)$ where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	4
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,994**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls) $W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$ where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	4.00
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,964**

Step 3. Weight of Concrete from Riser Structure Base in Water $W_{SB,min} = F_R - W_{RS}$ $W_{SB,W} = (L_B \times W_B \times H_B) \times \rho_{c,w}$ where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3994
W_{RS} = Weight of Riser Structure (lb)	=	3964
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**29**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3994
Actual Total		
Riser Structure (lb)	=	3964
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**6,154**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $F_P=(\pi)(R_P)^2(L_s)(\rho)$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	48.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**14,703**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $W_{AS,W} = [(L_A x W_A)-(\pi)(R_P^2)]$ x 1' thick x # of collars x $\rho_{c,w}$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	6.00
W_A = Width of Anti-Seep Collar (ft)	=	6.00
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**5,447**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	48.00
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**12,723**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$		
$F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety)		
$W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$		
where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	42.8
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**107**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**4,020**

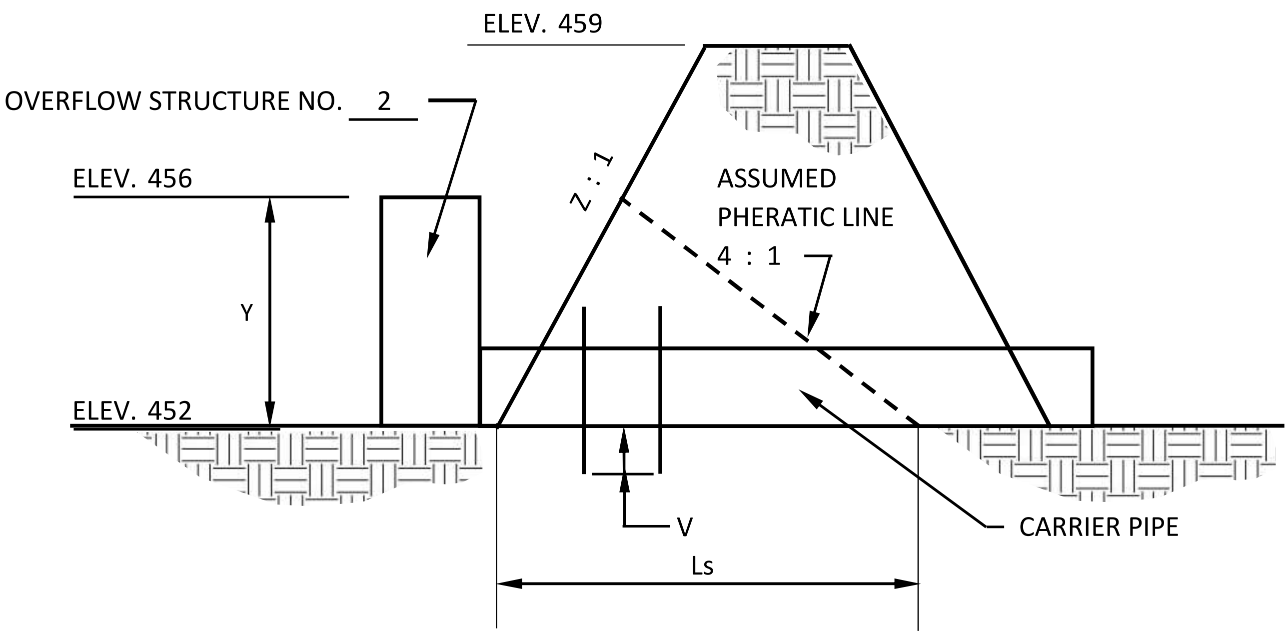
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	14703
Actual Total		
Anti-Seep Collars in Water (lb)	=	5447
Carrier Pipe (lb)	=	12723
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	4020

TOTAL (lb)	=	**24,120**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 2



Ls = LENGTH IN SATURATION ZONE
Y = OVERFLOW STRUCTURE HEIGHT = 4
Z = INSIDE SLOPE OF LEVEE = 2
PIPE SLOPE = 12.5 % = 0.125 FEET/FEET

$$Ls = Y\ (Z + 4)\ (1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}})$$

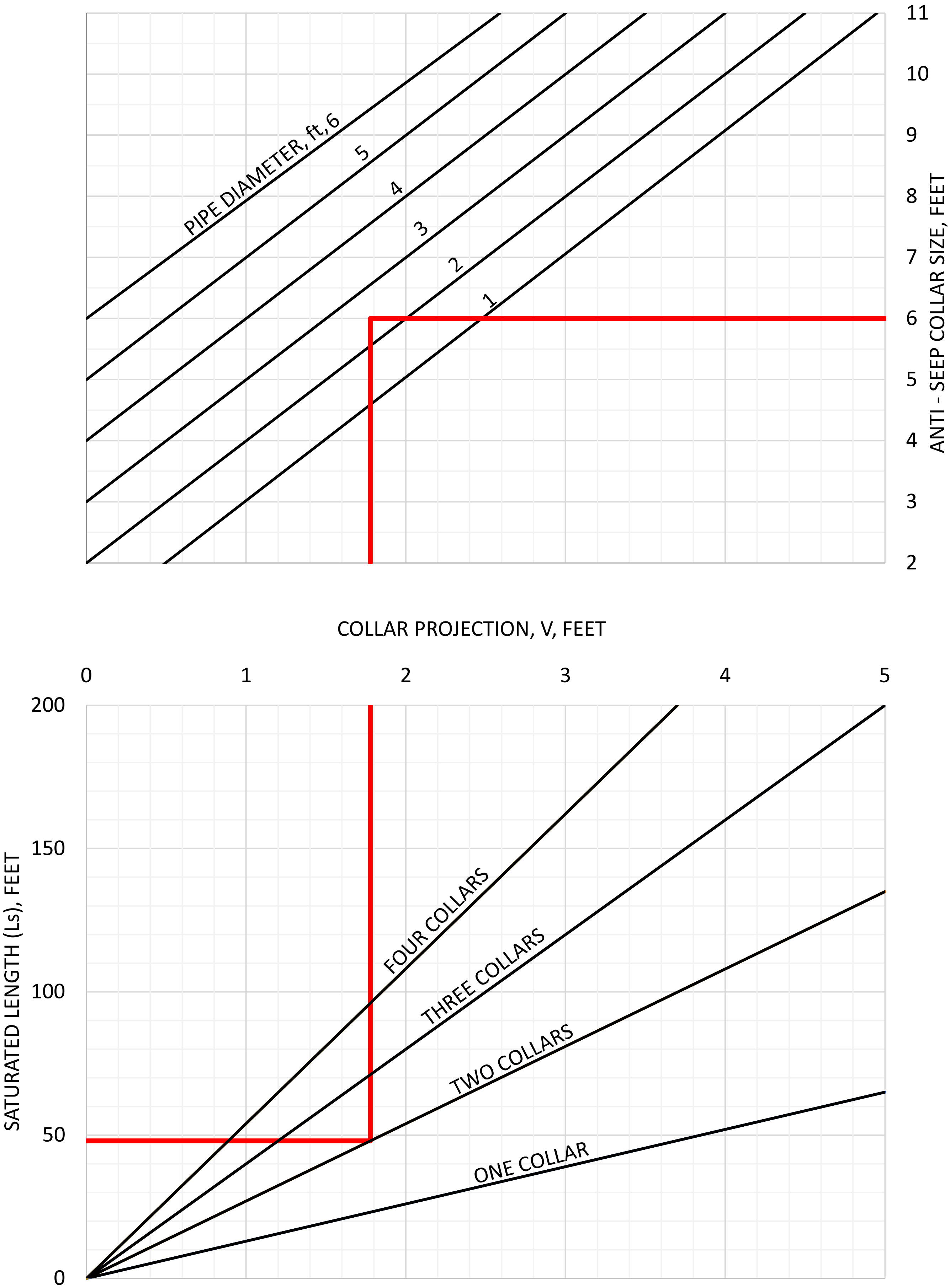
Ls = 48.00 FEET

FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:
V = COLLAR PROJECTION = 1.78 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 6' x 6'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

OVERFLOW STRUCTURE BUOYANCY FORCE

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.
Consulting Engineers

SALUDA: SEDIMENT BASIN 3

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure

$$F_R = (L_R)(W_R)(H_R)(\rho_w)$$

where:

L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	4
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,994**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls)

$$W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \text{ x } (\rho_c)$$

where:

L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	4.00
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,964**

Step 3. Weight of Concrete from Riser Structure Base in Water

$$W_{SB,min} = F_R - W_{RS}$$

$$W_{SB,W} = (L_B \text{ x } W_B \text{ x } H_B) \text{ x } \rho_{c,w}$$

where:

F_R = Buoyancy Force from Riser Structure (lb)	=	3994
W_{RS} = Weight of Riser Structure (lb)	=	3964
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**29**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3994
Actual Total		
Riser Structure (lb)	=	3964
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**6,154**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $F_P=(\pi)(R_P)^2(L_s)(\rho)$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	40.46
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**12,393**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $W_{AS,W} = [(L_A x W_A)-(\pi)(R_P^2)]$ x 1' thick x # of collars x $\rho_{c,w}$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	5.50
W_A = Width of Anti-Seep Collar (ft)	=	5.50
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**4,440**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	40.46
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**10,724**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$		
$F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety)		
$W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$		
where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	33.0
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**83**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**3,105**

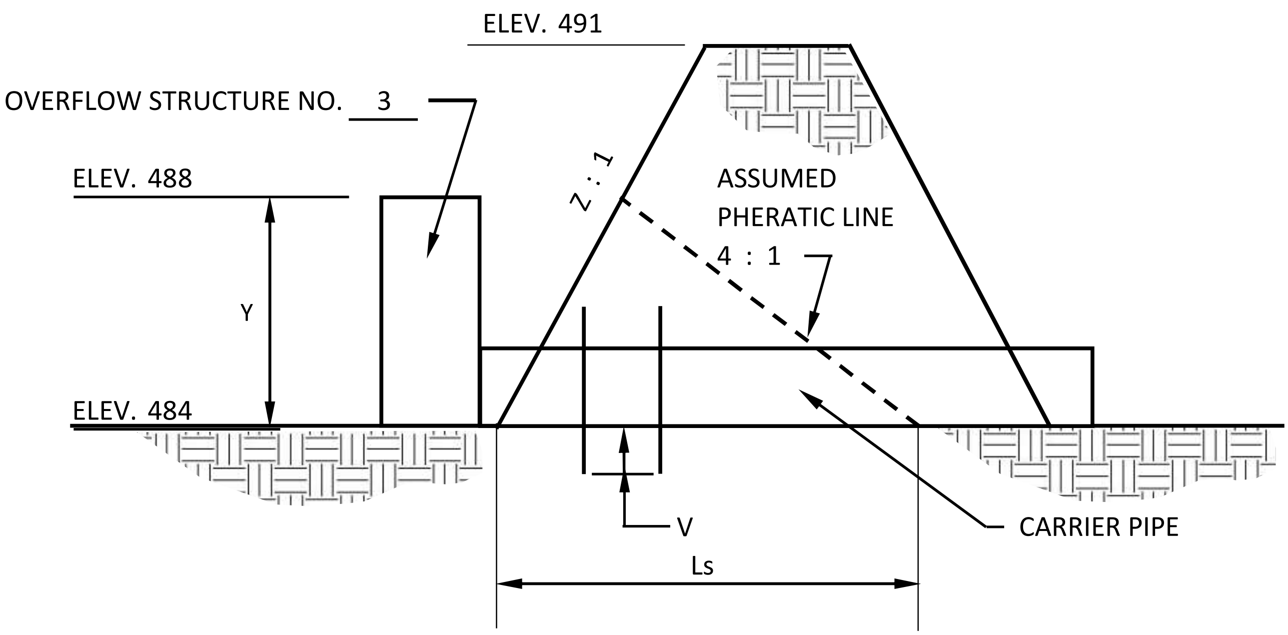
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	12393
Actual Total		
Anti-Seep Collars in Water (lb)	=	4440
Carrier Pipe (lb)	=	10724
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	3105

TOTAL (lb)	=	**20,198**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sedimen‌t Basin 3



Ls = LENGTH IN SATURATION ZONE
Y = OVERFLOW STRUCTURE HEIGHT = 4
Z = INSIDE SLOPE OF LEVEE = 2
PIPE SLOPE = 10.17 % = 0.1017 FEET/FEET

$$Ls = Y\ (Z + 4)\ \left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

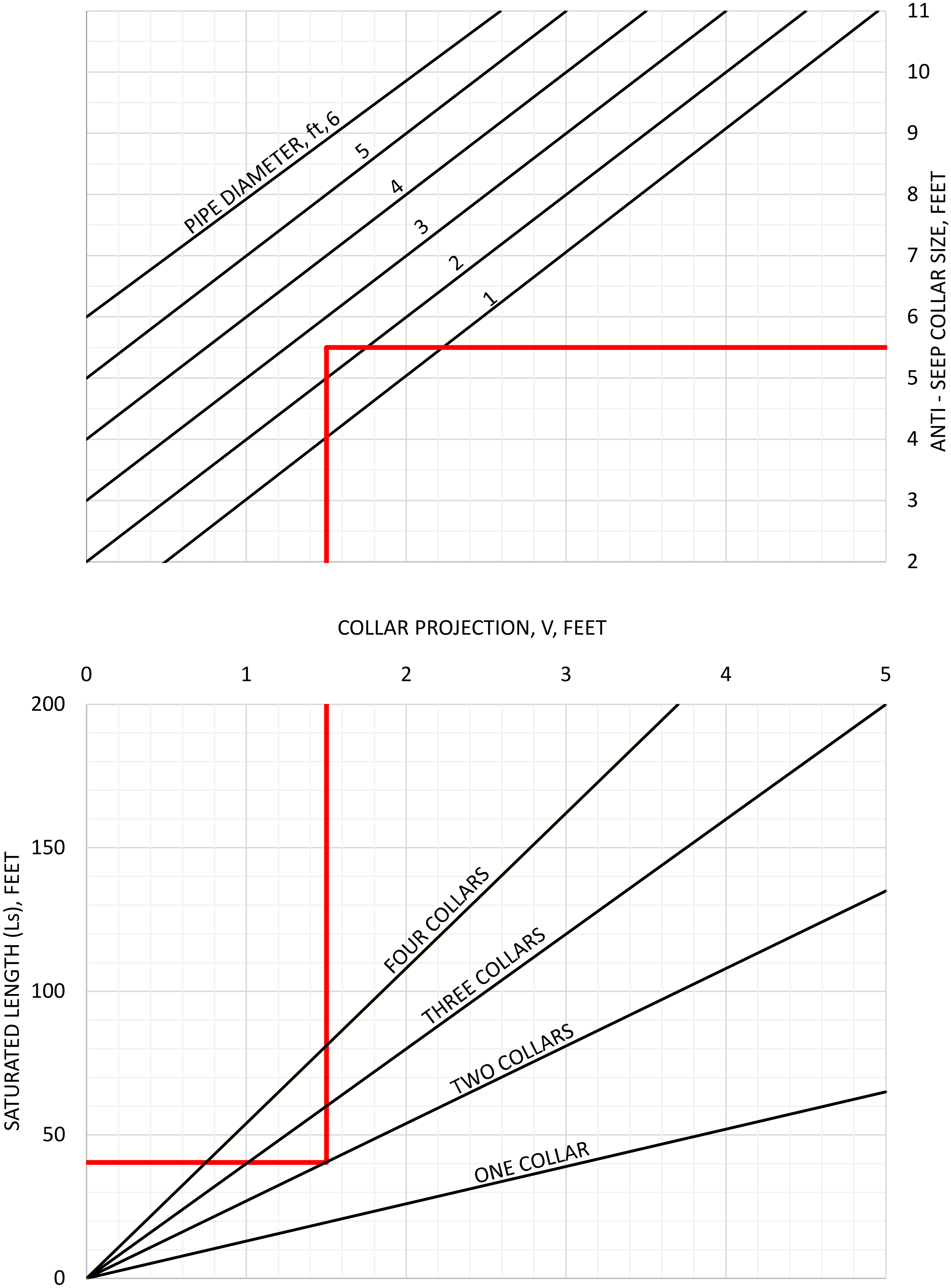
Ls = 40.46 FEET

FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:
V = COLLAR PROJECTION = 1.50 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 5.5' x 5.5'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

OVERFLOW STRUCTURE BUOYANCY FORCE

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Consulting Engineers

SALUDA: SEDIMENT BASIN 4

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure $F_R = (L_R)(W_R)(H_R)(\rho_w)$ where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	4
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,994**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls) $W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$ where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	4.00
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,964**

Step 3. Weight of Concrete from Riser Structure Base in Water $W_{SB,min} = F_R - W_{RS}$ $W_{SB,w} = (L_B \times W_B \times H_B) \times \rho_{c,w}$ where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3994
W_{RS} = Weight of Riser Structure (lb)	=	3964
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**29**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3994
Actual Total		
Riser Structure (lb)	=	3964
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**6,154**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe		
$F_P=(\pi)(R_P)^2(L_s)(\rho)$		
where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	58.31
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**17,860**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water		
$W_{AS,W} = [(L_A x W_A)-(\pi)(R_P^2)]$ x 1' thick x # of collars x $\rho_{c,w}$		
where:		
L_A = Length of Anti-Seep Collar (ft)	=	6.50
W_A = Width of Anti-Seep Collar (ft)	=	6.50
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**6,542**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	58.31
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**15,456**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$		
$F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety)		
$W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$		
where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	56.1
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**140**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**5,273**

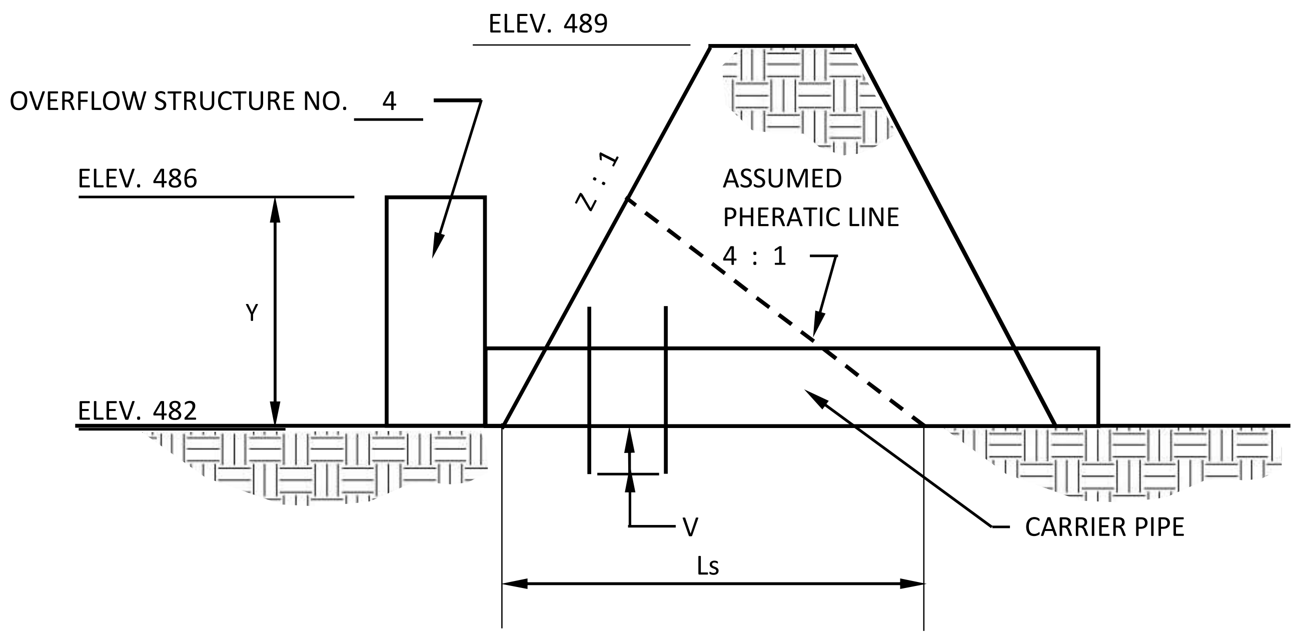
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	17860
Actual Total		
Anti-Seep Collars in Water (lb)	=	6542
Carrier Pipe (lb)	=	15456
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	5273

TOTAL (lb)	=	**29,201**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 4



Ls = LENGTH IN SATURATION ZONE
Y = OVERFLOW STRUCTURE HEIGHT = 4
Z = INSIDE SLOPE OF LEVEE = 2
PIPE SLOPE = 14.71 % = 0.1471 FEET/FEET

$$Ls = Y\,(Z + 4)\,\left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

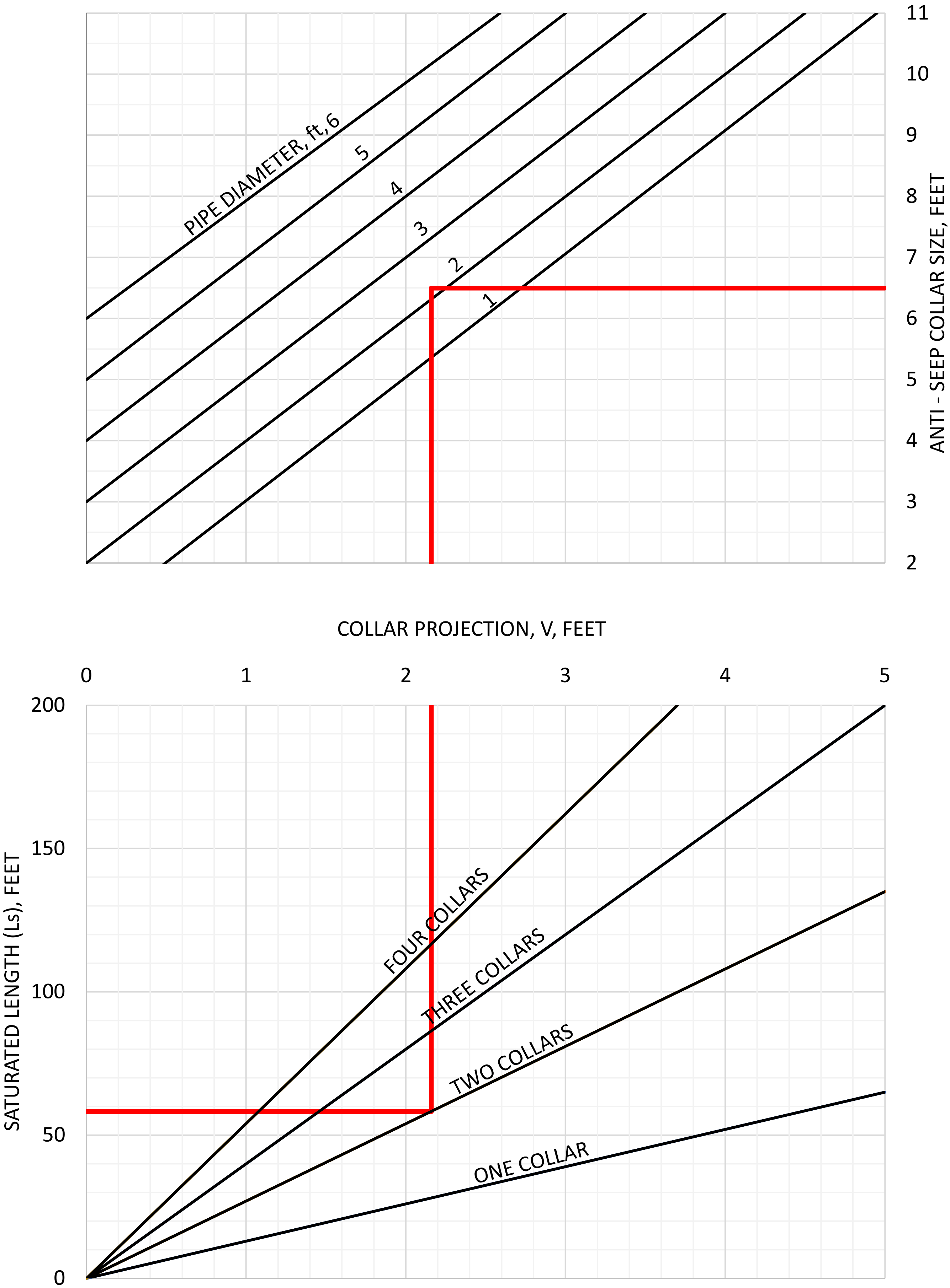
Ls = 58.31 FEET

FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:
V = COLLAR PROJECTION = 2.20 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 6.5' x 6.5'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

OVERFLOW STRUCTURE BUOYANCY FORCE

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Consulting Engineers

SALUDA: SEDIMENT BASIN 5

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure $F_R = (L_R)(W_R)(H_R)(\rho_w)$ where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	4
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,994**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls) $W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$ where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	4.00
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,964**

Step 3. Weight of Concrete from Riser Structure Base in Water $W_{SB,min} = F_R - W_{RS}$ $W_{SB,W} = (L_B \times W_B \times H_B) \times \rho_{c,w}$ where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3994
W_{RS} = Weight of Riser Structure (lb)	=	3964
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**29**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3994
Actual Total		
Riser Structure (lb)	=	3964
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**6,154**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $$F_P=(\pi)(R_P)^2(L_s)(\rho)$$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	33.59
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**10,290**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $$W_{AS,W} = [(L_A x W_A)-(\pi)(R_P^2)] \text{ x 1' thick x \# of collars x } \rho_{c,w}$$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	5.50
W_A = Width of Anti-Seep Collar (ft)	=	5.50
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**4,440**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	33.59
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**8,905**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$		
$F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety)		
$W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$		
where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	24.2
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**60**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**2,275**

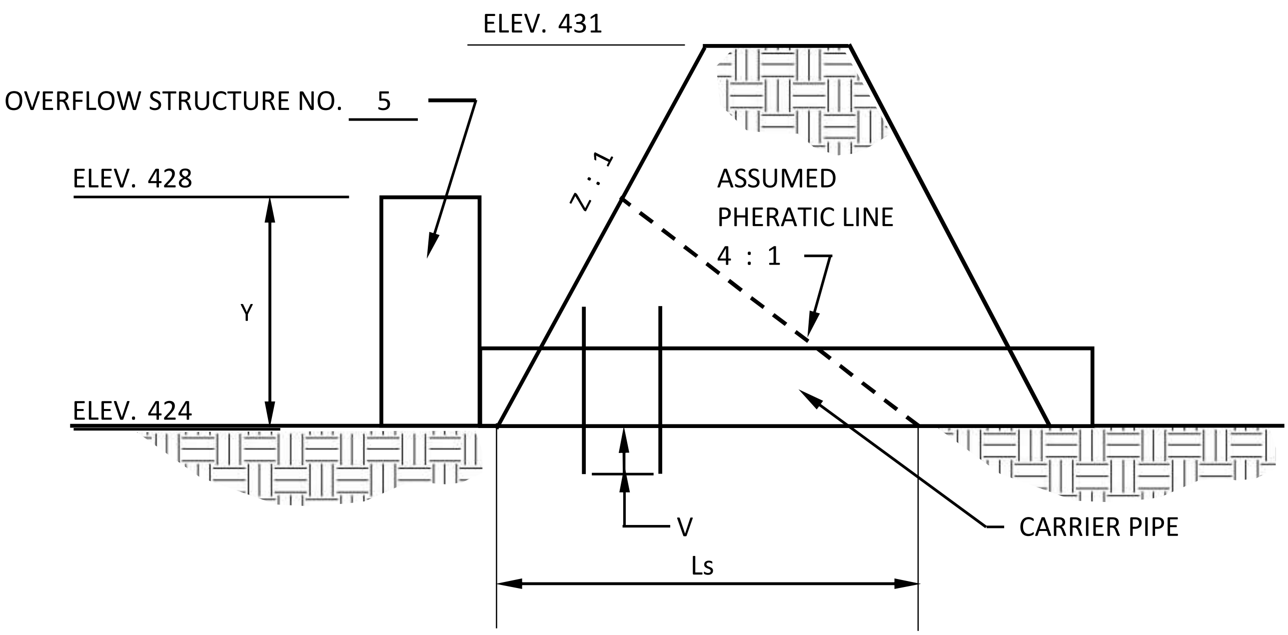
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	10290
Actual Total		
Anti-Seep Collars in Water (lb)	=	4440
Carrier Pipe (lb)	=	8905
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	2275

TOTAL (lb)	=	**17,549**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 5



Ls = LENGTH IN SATURATION ZONE
Y = OVERFLOW STRUCTURE HEIGHT = 4
Z = INSIDE SLOPE OF LEVEE = 2
PIPE SLOPE = 7.14 % = 0.0714 FEET/FEET

$$Ls = Y\,(Z + 4)\,\left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

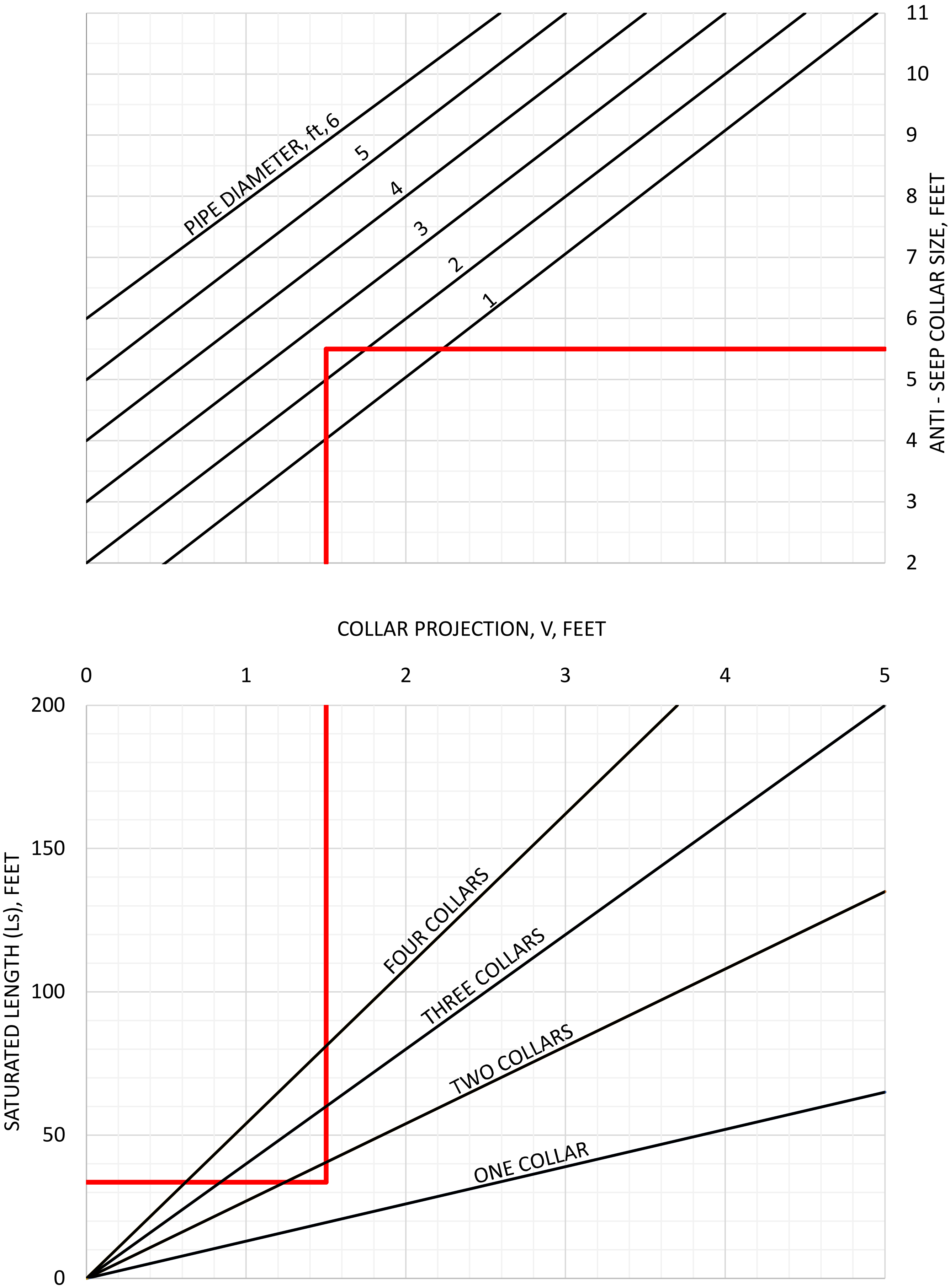
Ls = 33.59 FEET

FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:
V = COLLAR PROJECTION = 1.50 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 5.5' x 5.5'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

OVERFLOW STRUCTURE BUOYANCY FORCE

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SALUDA: SEDIMENT BASIN 6

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure		
$F_R = (L_R)(W_R)(H_R)(\rho_w)$		
where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	4
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,994**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls)		
$W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$		
where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	4.00
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,964**

Step 3. Weight of Concrete from Riser Structure Base in Water		
$W_{SB,min} = F_R - W_{RS}$		
$W_{SB,W} = (L_B \times W_B \times H_B) \times \rho_{c,w}$		
where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3994
W_{RS} = Weight of Riser Structure (lb)	=	3964
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**29**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3994
Actual Total		
Riser Structure (lb)	=	3964
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**6,154**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $F_P=(\pi)(R_P)^2(L_s)(\rho)$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	120.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**36,757**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $W_{AS,W} = [(L_A x W_A)-(\pi)(R_P{}^2)]$ **x 1' thick x # of collars x** $\rho_{c,w}$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	8.00
W_A = Width of Anti-Seep Collar (ft)	=	8.00
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	3
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**15,529**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	120.00
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**31,809**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$ $F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety) $W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$ where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	136.0
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**340**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**12,788**

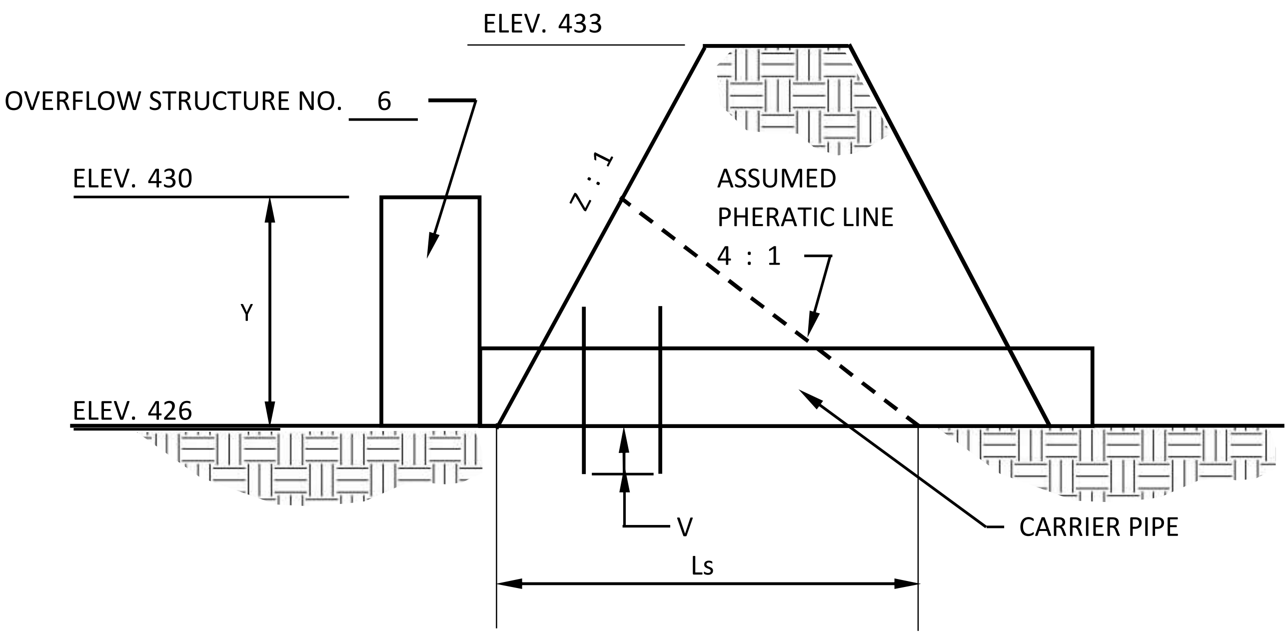
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	36757
Actual Total		
Anti-Seep Collars in Water (lb)	=	15529
Carrier Pipe (lb)	=	31809
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	12788

TOTAL (lb)	=	**62,055**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 6



Ls = LENGTH IN SATURATION ZONE
Y = OVERFLOW STRUCTURE HEIGHT = 4
Z = INSIDE SLOPE OF LEVEE = 2
PIPE SLOPE = 20 % = 0.2 FEET/FEET

$$Ls = Y\ (Z + 4)\ \left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

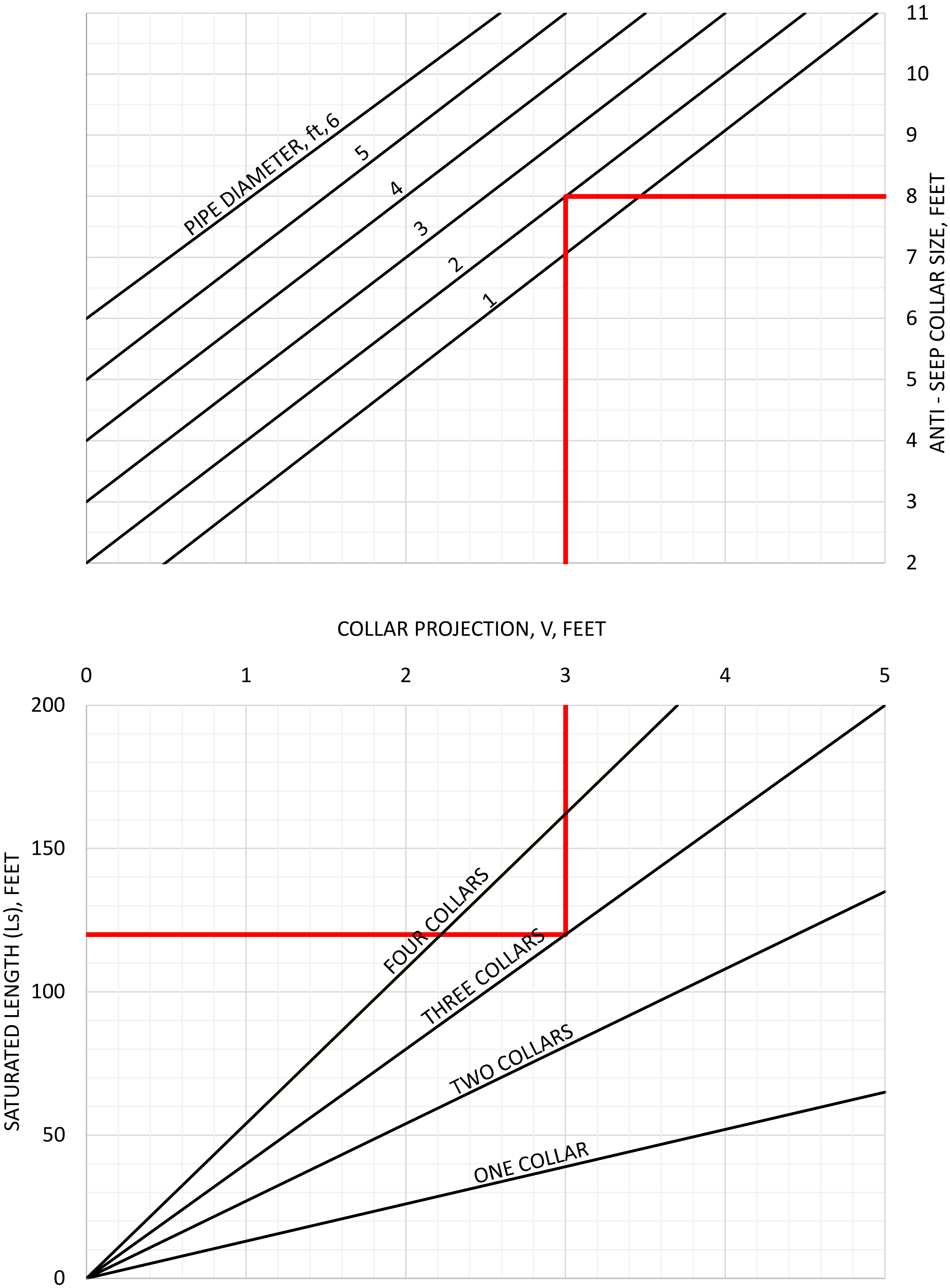
Ls = 120.00 FEET

FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:
V = COLLAR PROJECTION = 3.00 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 8' x 8'

NUMBER OF REQUIRED COLLARS = 3



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

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OVERFLOW STRUCTURE BUOYANCY FORCE

SALUDA: SEDIMENT BASIN 7

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure		
$F_R = (L_R)(W_R)(H_R)(\rho_w)$		
where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	3.75
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,744**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls)		
$W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$		
where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	3.75
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,702**

Step 3. Weight of Concrete from Riser Structure Base in Water		
$W_{SB,min} = F_R - W_{RS}$		
$W_{SB,W} = (L_B \times W_B \times H_B) \times \rho_{c,w}$		
where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3744
W_{RS} = Weight of Riser Structure (lb)	=	3702
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**42**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3744
Actual Total		
Riser Structure (lb)	=	3702
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**5,892**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $F_P=(\pi)(R_P)^2(L_s)(\rho)$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	32.23
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**9,874**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $W_{AS,W} = [(L_A x W_A)-(\pi)(R_P{}^2)]$ x 1' thick x # of collars x $\rho_{c,w}$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	5.50
W_A = Width of Anti-Seep Collar (ft)	=	5.50
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**4,440**

B. Weight of Concrete from Carrier Pipe		
$W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	32.23
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**8,545**

C. Weight of Concrete from Carrier Pipe Encasement in Water		
$W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$		
$F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety)		
$W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$		
where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$		
where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	19.9
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**50**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**1,874**

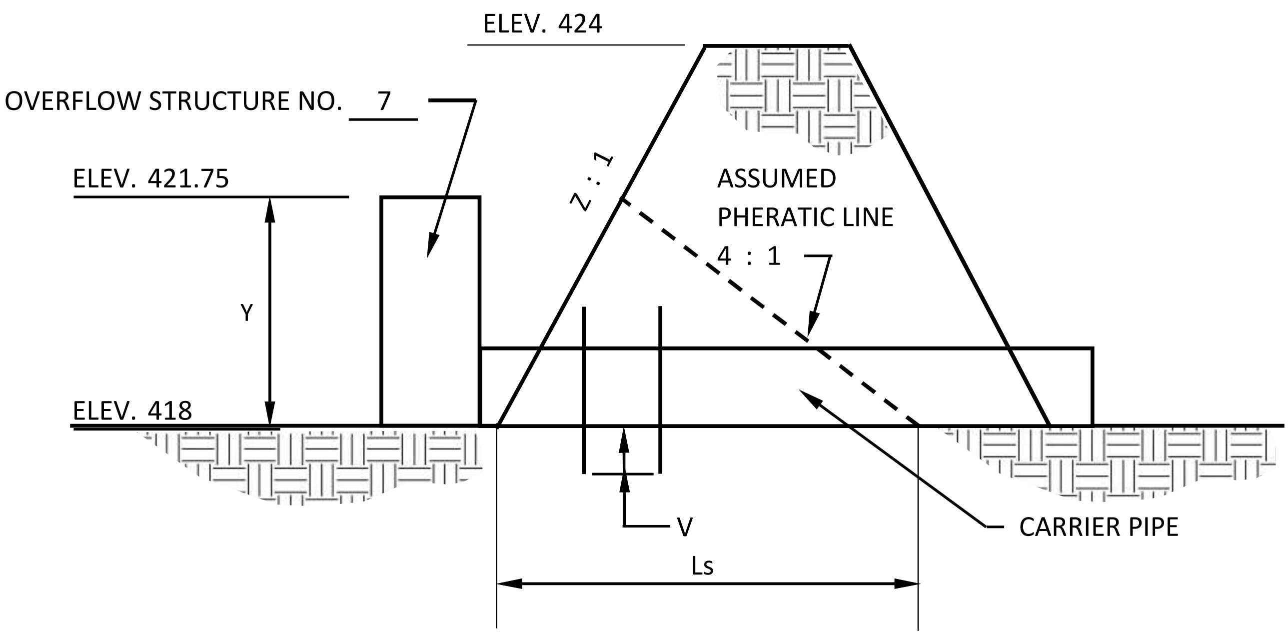
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	9874
Actual Total		
Anti-Seep Collars in Water (lb)	=	4440
Carrier Pipe (lb)	=	8545
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	1874

TOTAL (lb)	=	**16,788**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 7



Ls = LENGTH IN SATURATION ZONE

Y = OVERFLOW STRUCTURE HEIGHT = 3.75

Z = INSIDE SLOPE OF LEVEE = 2

PIPE SLOPE = 7.55 % = 0.0755 FEET/FEET

$$Ls = Y\ (Z + 4)\ \left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

Ls = 32.23 FEET

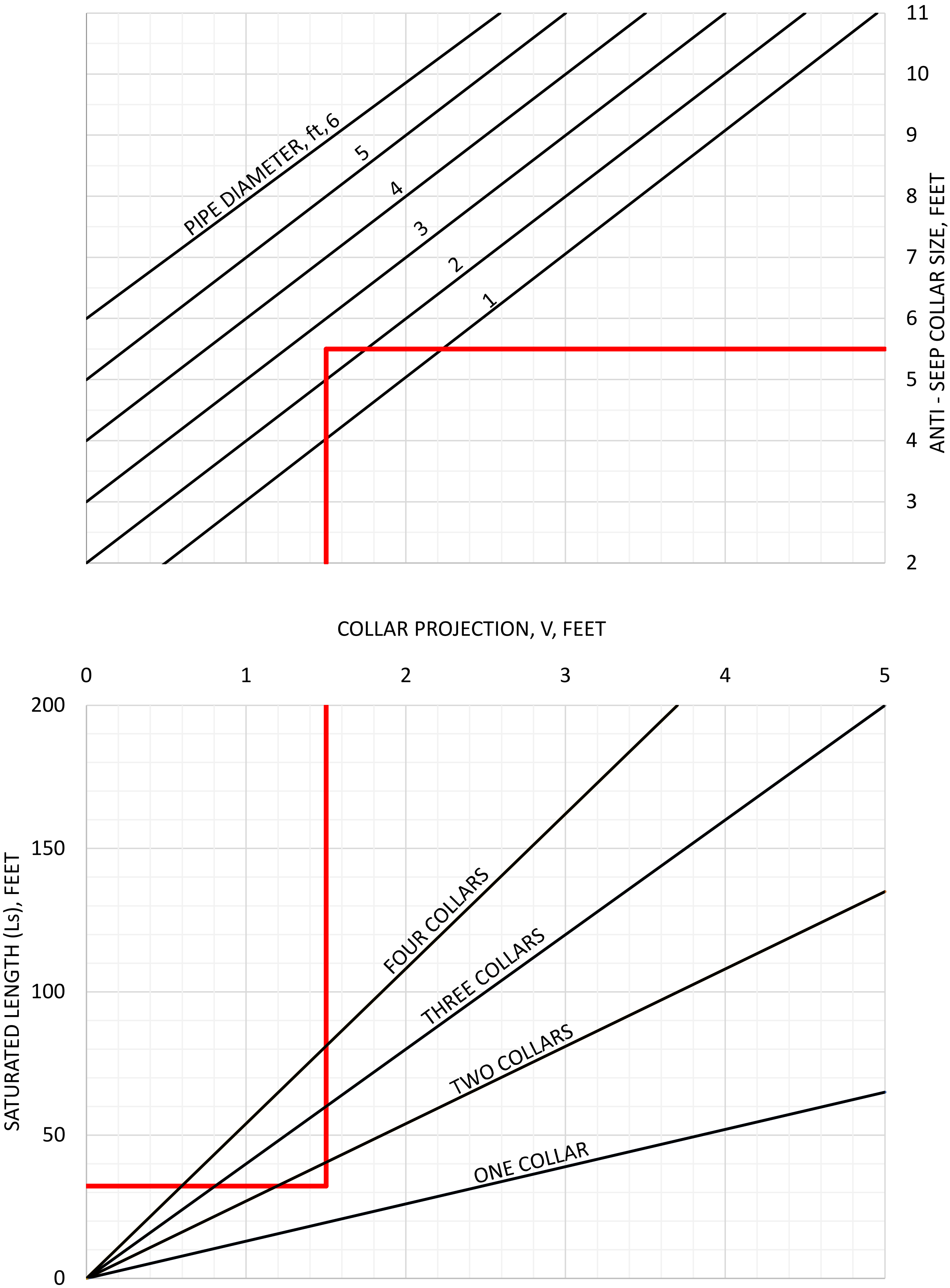
FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:

V = COLLAR PROJECTION = 1.50 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 5.5' x 5.5'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

OVERFLOW STRUCTURE BUOYANCY FORCE

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SALUDA: SEDIMENT BASIN 8

I. Buoyancy Force from Riser Structure

Step 1. Calculate the Buoyancy Force from Riser Structure		
$F_R = (L_R)(W_R)(H_R)(\rho_w)$		
where:		
L_R= Length of Riser Structure (ft)	=	4
W_R= Width of Riser Structure (ft)	=	4
H_R = Height of Riser Structure (ft)	=	3.75
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_R = Buoyancy Force from Riser Structure (lb)	=	**3,744**

II. Weight of Concrete Available to Overcome the Buoyancy Force from Riser Structure

Step 2. Weight of Concrete from Riser Structure (6" Thick walls)		
$W_{RS} = \{[(L_R)(W_R) - (L_i)(W_i)]*H_R - \pi(0.5)(r_p)^2\} \times (\rho_c)$		
where:		
L_R= Overall Length of Overflow Structure (ft)	=	4.00
W_R= Overall Width of Overflow Structure (ft)	=	4.00
H_R = Height of Overflow Structure (ft)	=	3.75
L_i = Inside Length of Overflow Structure (ft)	=	3.00
W_i = Inside Width of Overflow Structure (ft)	=	3.00
r_p = Inside Radius of Carrier Pipe (ft)	=	1
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_{RS} = Weight of Riser Structure (lb)	=	**3,702**

Step 3. Weight of Concrete from Riser Structure Base in Water		
$W_{SB,min} = F_R - W_{RS}$		
$W_{SB,W} = (L_B \times W_B \times H_B) \times \rho_{c,w}$		
where:		
F_R = Buoyancy Force from Riser Structure (lb)	=	3744
W_{RS} = Weight of Riser Structure (lb)	=	3702
$W_{SB,min}$ = Minimum Weight of Riser Structure Base Required (lb)	=	**42**
L_B = Length of Base (ft)	=	5
W_B = Width of Base (ft)	=	5
H_B = Height of Base (ft)	=	1
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{SB,W}$ = Weight of Riser Structure Base in Water (lb)	=	**2,190**

III. Total Weight of Riser and Base is Greater than Buoyancy Force from Riser Structure

Step 4: Check that the Total Weight of Concrete from the Riser Structure and Base is Greater than the Buoyancy Force from Riser Structure		
TOTAL REQUIRED WEIGHT (lb)	=	3744
Actual Total		
Riser Structure (lb)	=	3702
Riser Structure Base in Water (lb)	=	2190

TOTAL (lb)	=	**5,892**

(Actual) c.f. > (Required) c.f.	=	**OK**

IV. Buoyancy Force from Carrier Pipe

Step 5. Calculate the Buoyancy Force from Carrier Pipe $F_P=(\pi)(R_P)^2(L_s)(\rho)$ where:		
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
L_s = Length of Pipe in Saturation Zone (ft)	=	29.61
ρ_w = Density of Water (lb/ft^3)	=	62.4
F_P= Buoyancy Force from Carrier Pipe (lb)	=	**9,068**

V. Weight of Concrete/Soil Available to Overcome the Buoyancy Force from Carrier Pipe

Step 6: Calculate the Total Weight of Concrete/Soil Available

This Weight of Concrete Required will be made up from Four Areas:

A) Weight of Concrete from the Anti-Seep Collars in Water

B) Weight of Concrete from Carrier Pipe

C) Weight of Concrete from Carrier Pipe Encasement in Water

D) Weight of Saturated Soil above the Carrier Pipe

A. Weight of Concrete from Anti-Seep Collars in Water $W_{AS,W} = [(L_A x W_A)-(\pi)(R_P{}^2)] \text{ x 1' thick x \# of collars x } \rho_{c,w}$ where:		
L_A = Length of Anti-Seep Collar (ft)	=	5.50
W_A = Width of Anti-Seep Collar (ft)	=	5.50
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
# of Collars	=	2
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)	=	87.6
$W_{AS,W}$ = Weight of Concrete from Anti-Seep Collars in Water (lb)	=	**4,440**

B. Weight of Concrete from Carrier Pipe $W_P = \pi(R_P^2 - r_P^2)L_s \times \rho_c$		
R_p = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1
L_s = Length in Saturation Zone (ft)	=	29.61
ρ_c = Density of Concrete (lb/ft^3)	=	150
W_P = Weight of Concrete From Carrier Pipe (lb)	=	**7,848**

C. Weight of Concrete from Carrier Pipe Encasement in Water $W_{EC,W} = [(L_E \times W_E \times H_E) - (\pi)(R_p)^2(L_E)] \times \rho_{c,w}$ $F_{E,FT} = W_E \times H_E \times 1' \times \rho_w \times 1.5$ (Factor of Safety) $W_{EC,FT} = [(W_E \times H_E) - (\pi)(r_p)^2] \times 1' \times \rho_c$ where:		
L_E = Length of Encasement (ft)	=	3
W_E = Width of Encasement (ft)	=	3.5
H_E = Height of Encasement (ft)	=	3.5
R_P = Outside Radius of Carrier Pipe (ft)	=	1.25
r_P = Inside Radius of Carrier Pipe (ft)	=	1.00
ρ_w = Density of Water (lb/ft^3)	=	62.4
$\rho_{c,w}$ = Density of Concrete in Water (lb/ft^3)		87.6
ρ_c = Density of Concrete (lb/ft^3)		150
$W_{EC,W}$ = Weight of Carrier Pipe Encasement in Water (lb)	=	**1,929**
$F_{E,FT}$ = Buoyancy Force from Encasement per Foot (lb/ft)	=	**1,147**
$W_{EC,FT}$ = Carrier Pipe Encasement Weight per Foot (lb/ft)	=	**1,366**

D. Weight of Saturated Soil above the Carrier Pipe		
ρ_s = Density of Soil (lbs/ft^3)	=	100
W_{sat} = Weight of Saturated Soil		
ρ_{sat} = Density of Soil - Specific Weight of Water = W_s - 62.4 (lbs/ft3)	=	37.6
$V_s = (A_c)(W_p)$ where:		
A_c = Cross-sectional Profile Area of soil above pipe within the Saturation Zone (ft^2)	=	17.0
W_p = Width/Diameter of Pipe (ft)	=	2.5
V_s = Volume of soil in the Length of saturation over the carrier pipe	=	**43**
Weight of soil above pipe = $(V_s)*(W_{sat})$ (lbs)	=	**1,598**

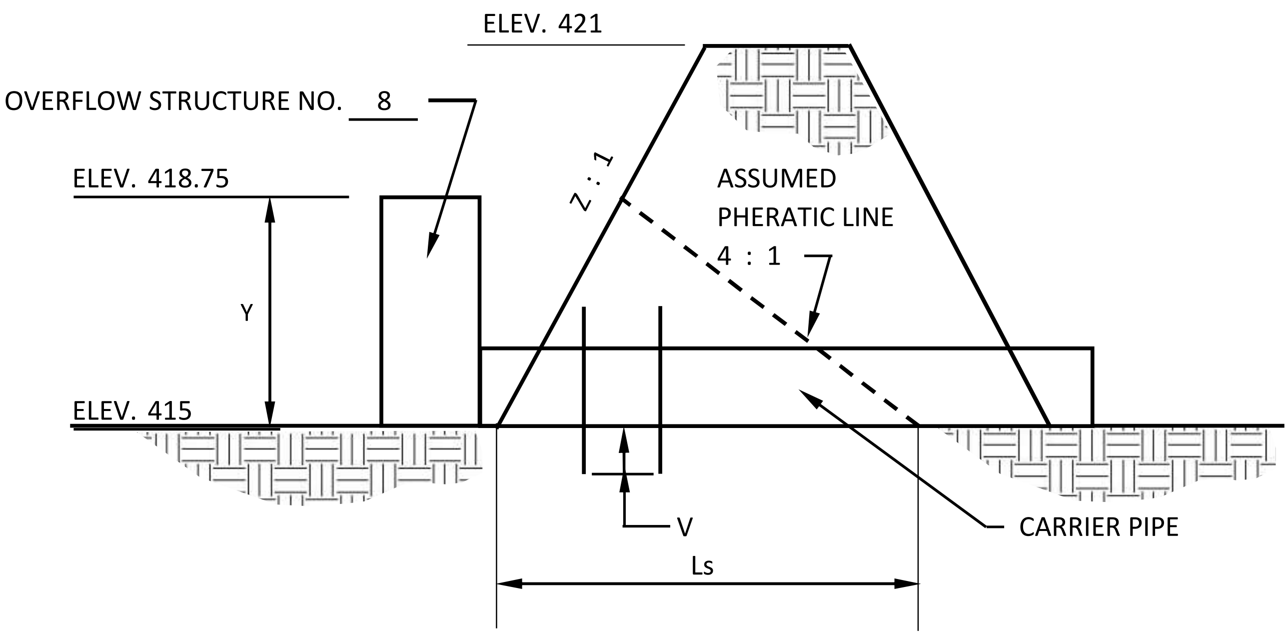
VI. Total Weight of Concrete/Soil from Four Areas is Greater than Required Weight

Step 7: Check that the Total Weight of Concrete/Soil from the Four Areas is Greater than the Buoyancy Force from Carrier Pipe		
TOTAL REQUIRED WEIGHT (lb)	=	9068
Actual Total		
Anti-Seep Collars in Water (lb)	=	4440
Carrier Pipe (lb)	=	7848
Carrier Pipe Encasement in Water (lb)	=	1929
Weight of Saturated Soil (lb)	=	1598

TOTAL (lb)	=	**15,815**

(Actual) c.f. > (Required) c.f.	=	**OK**

ANTI - SEEP COLLAR DESIGN - Sediment Basin 8



Ls = LENGTH IN SATURATION ZONE
Y = OVERFLOW STRUCTURE HEIGHT = 3.75
Z = INSIDE SLOPE OF LEVEE = 2
PIPE SLOPE = 6 % = 0.06 FEET/FEET

$$Ls = Y\ (Z + 4)\ \left(1 + \frac{\text{PIPE SLOPE}}{0.25 - \text{PIPE SLOPE}}\right)$$

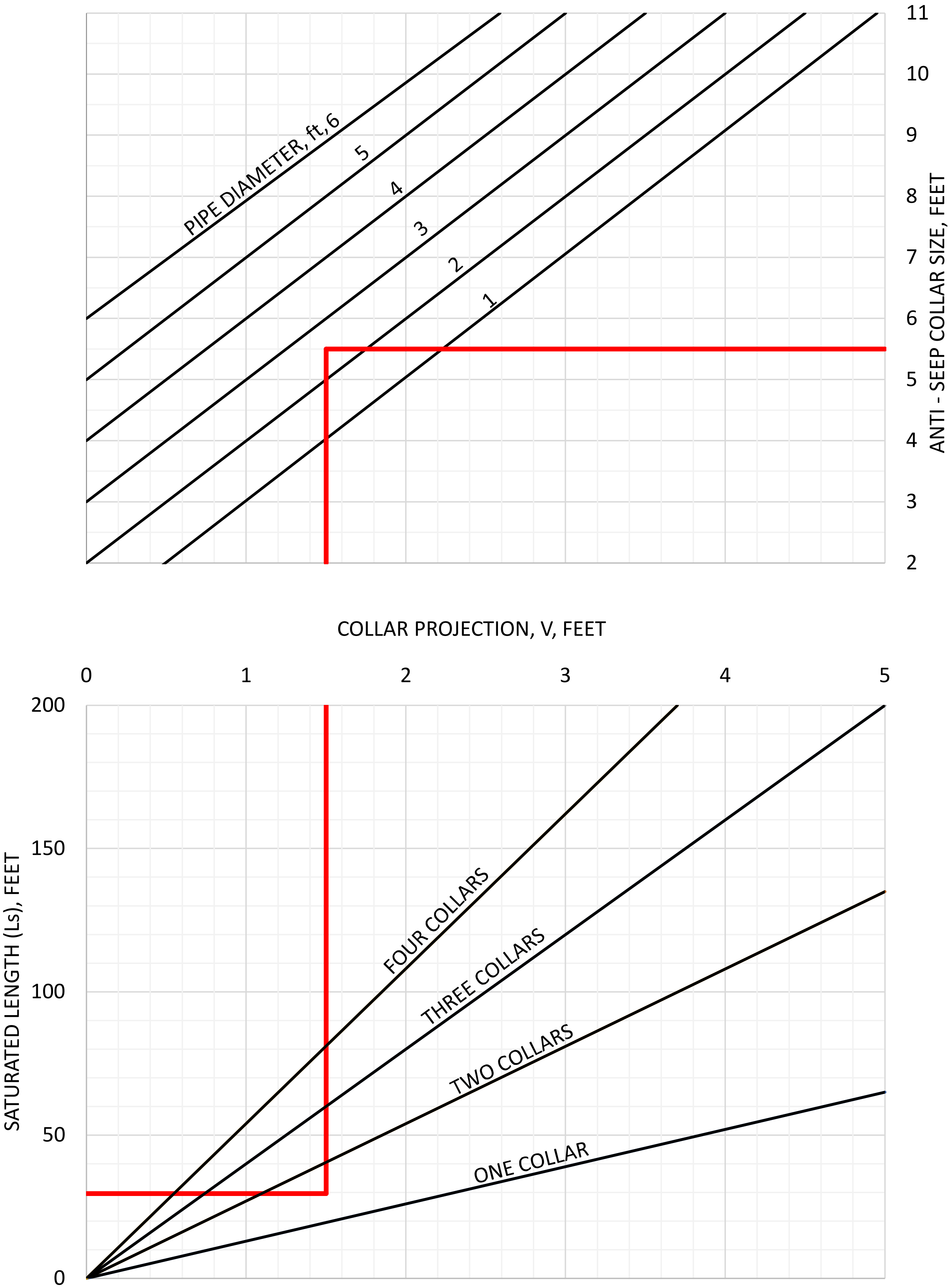
Ls = 29.61 FEET

FROM ANTI - SEEP COLLAR DESIGN CHART ON THE NEXT PAGE:
V = COLLAR PROJECTION = 1.50 FEET

PIPE DIAMETER = 2 FEET

DIMENSIONS OF 12" THICK COLLAR = 5.5' x 5.5'

NUMBER OF REQUIRED COLLARS = 2



*Anti-Seep Collar Size Rounded to the Nearest Nominal 0.5 ft

2.0 APPENDICES

2.6 Appendix 6

AutoCAD Civil 3D 2022's Hydraflow Extension 10-Yr, 24-Hour Storm Event Hydrograph Reports

Hydrograph Report

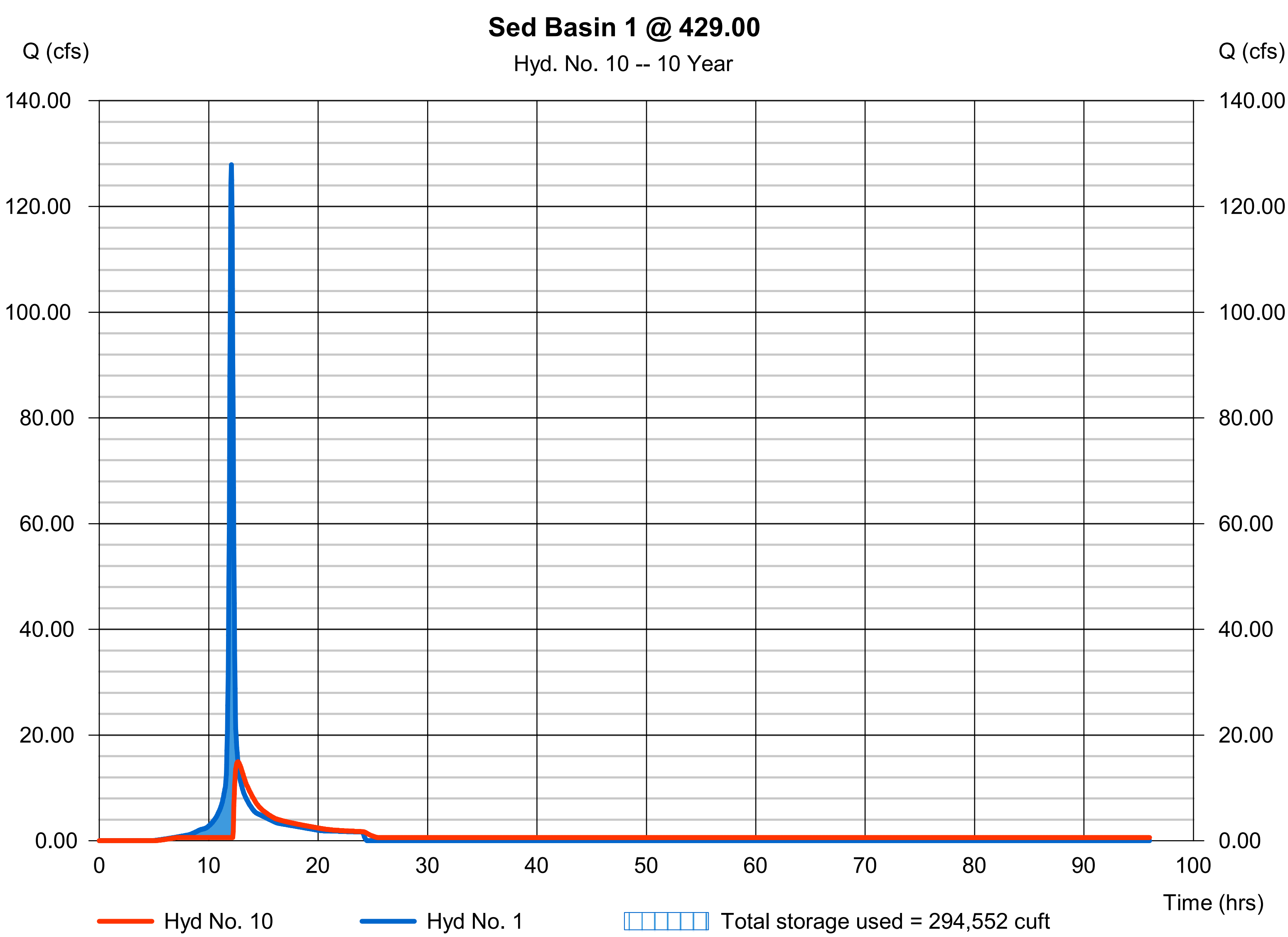
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 10

Sed Basin 1 @ 429.00

Hydrograph type	= Reservoir	Peak discharge	= 14.94 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.67 hrs
Time interval	= 2 min	Hyd. volume	= 362,570 cuft
Inflow hyd. No.	= 1 - Sediment Basin 1 Runoff	Max. Elevation	= 432.50 ft
Reservoir name	= Sediment Basin 1	Max. Storage	= 294,552 cuft

Storage Indication method used. Wet pond routing start elevation = 429.00 ft.



Hydrograph Report

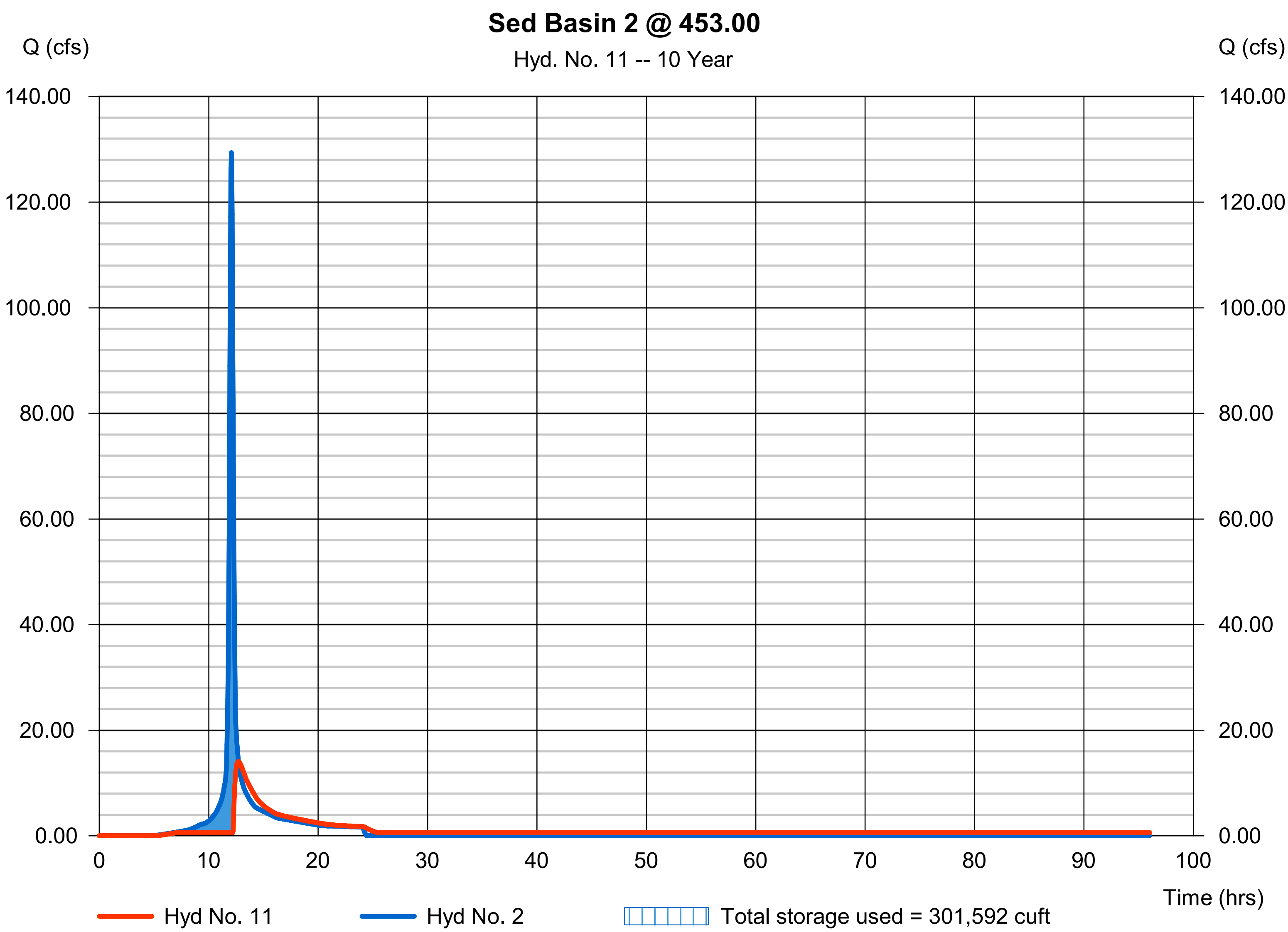
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 11

Sed Basin 2 @ 453.00

Hydrograph type	= Reservoir	Peak discharge	= 14.06 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.70 hrs
Time interval	= 2 min	Hyd. volume	= 361,706 cuft
Inflow hyd. No.	= 2 - Sediment Basin 2 Runoff	Max. Elevation	= 456.48 ft
Reservoir name	= Sediment Basin 2	Max. Storage	= 301,592 cuft

Storage Indication method used. Wet pond routing start elevation = 453.00 ft.



Hydrograph Report

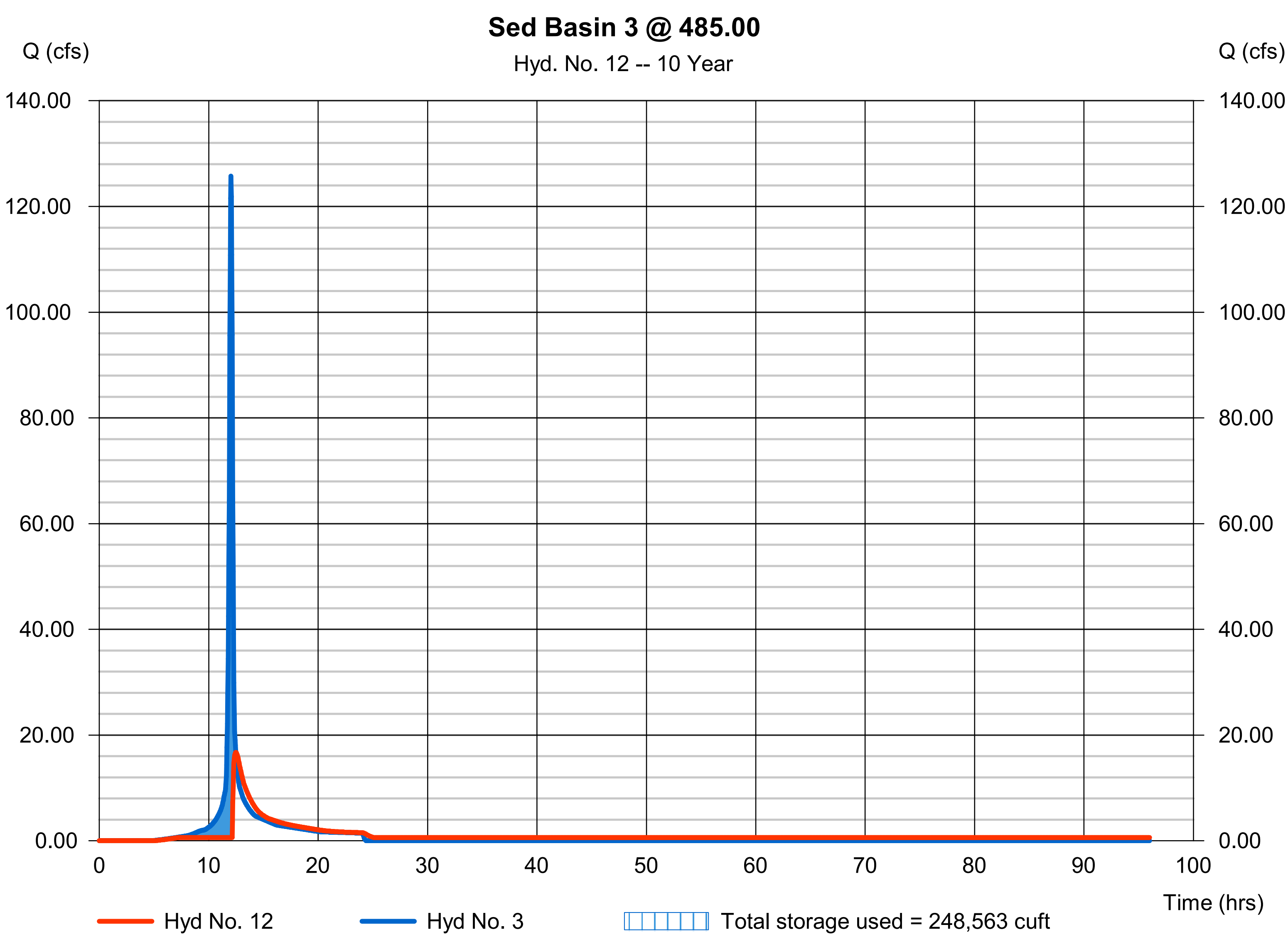
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 12

Sed Basin 3 @ 485.00

Hydrograph type	= Reservoir	Peak discharge	= 16.70 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 349,155 cuft
Inflow hyd. No.	= 3 - Sediment Basin 3 Runoff	Max. Elevation	= 488.54 ft
Reservoir name	= Sediment Basin 3	Max. Storage	= 248,563 cuft

Storage Indication method used. Wet pond routing start elevation = 485.00 ft.



Hydrograph Report

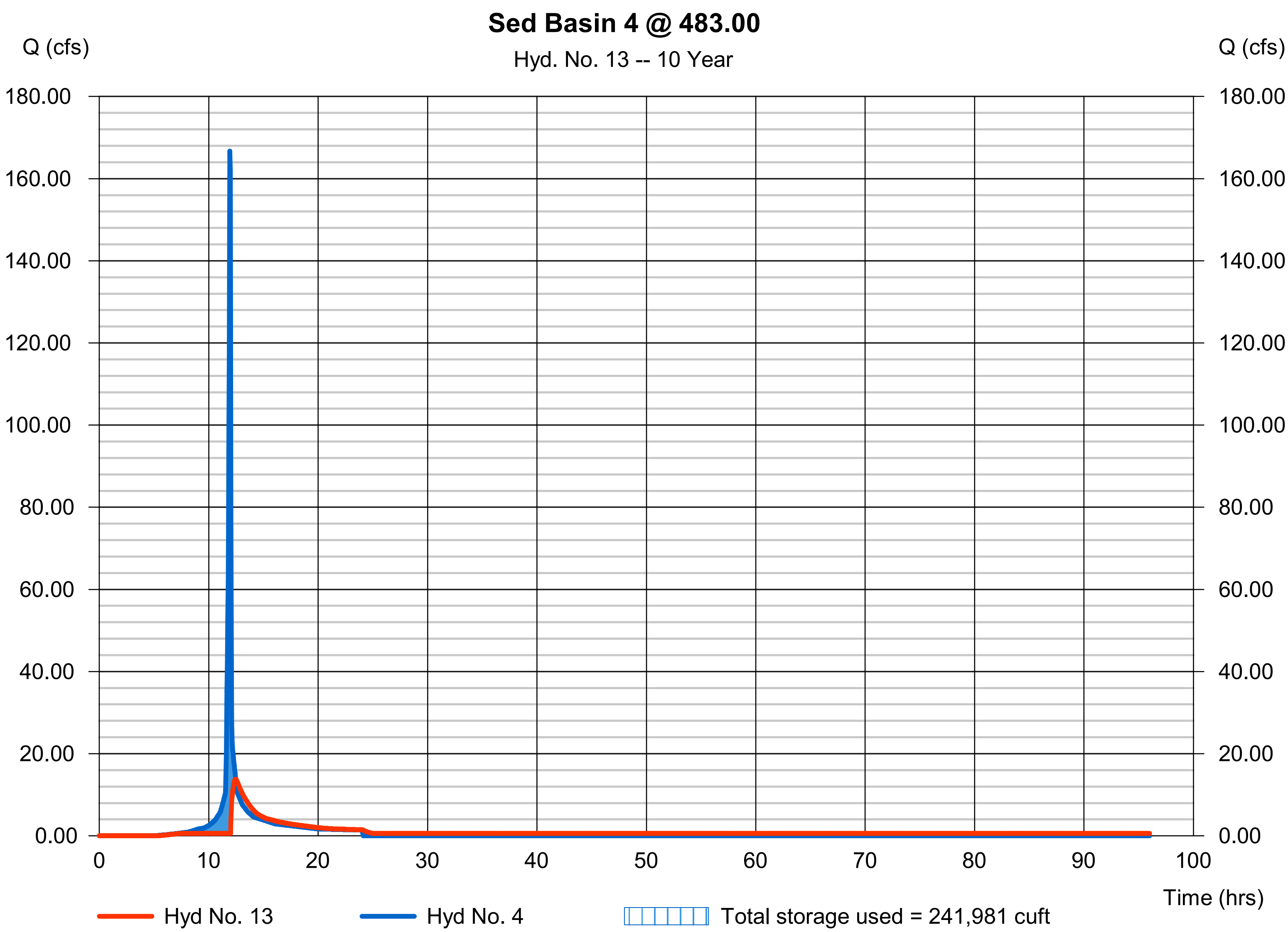
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 — Monday, 08 / 7 / 2023

Hyd. No. 13

Sed Basin 4 @ 483.00

Hydrograph type	= Reservoir	Peak discharge	= 13.78 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 338,562 cuft
Inflow hyd. No.	= 4 - Sediment Basin 4 Runoff	Max. Elevation	= 486.47 ft
Reservoir name	= Sediment Basin 4	Max. Storage	= 241,981 cuft

Storage Indication method used. Wet pond routing start elevation = 483.00 ft.



Hydrograph Report

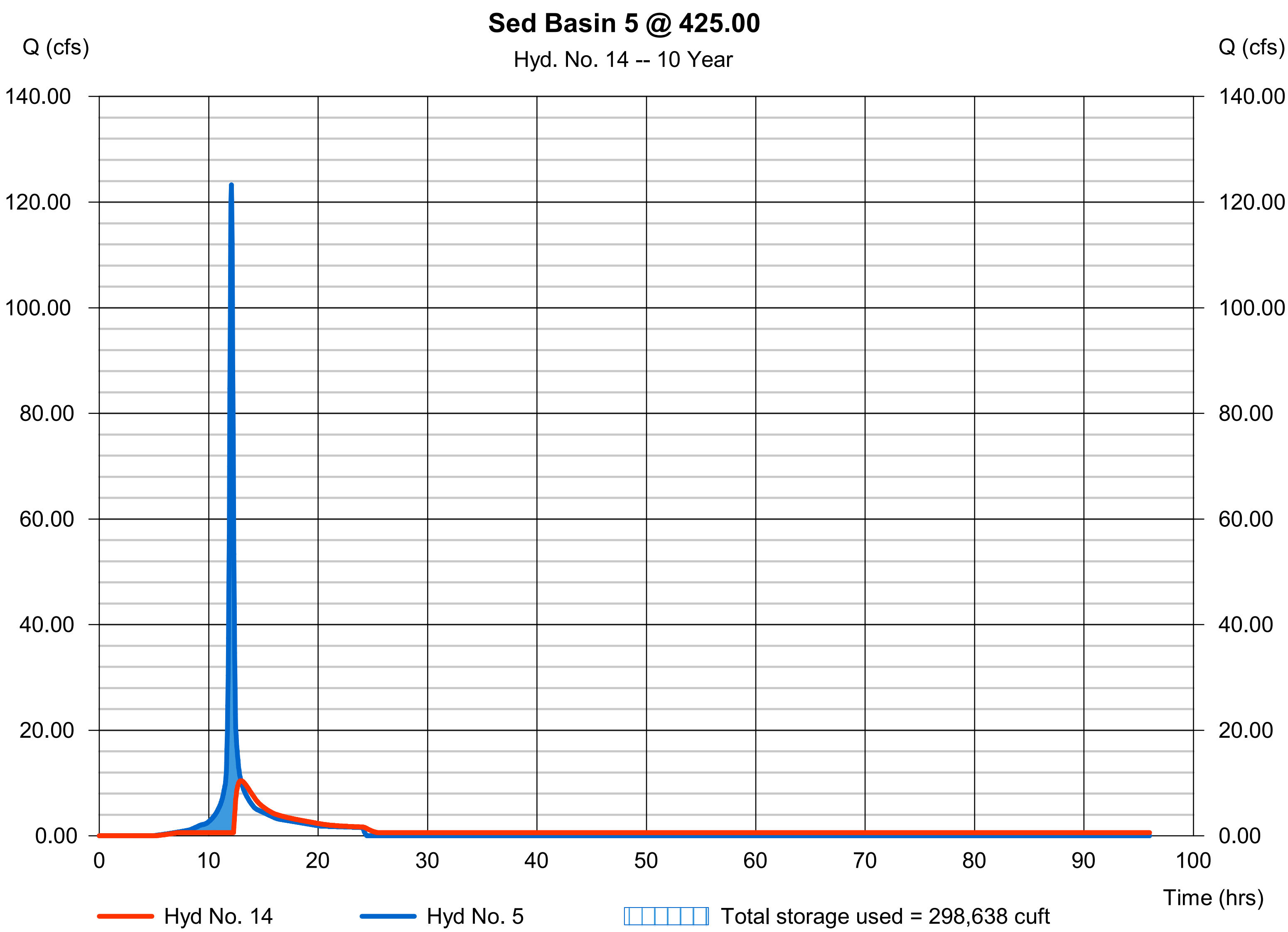
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 14

Sed Basin 5 @ 425.00

Hydrograph type	= Reservoir	Peak discharge	= 10.42 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.93 hrs
Time interval	= 2 min	Hyd. volume	= 339,626 cuft
Inflow hyd. No.	= 5 - Sediment Basin 5 Runoff	Max. Elevation	= 428.39 ft
Reservoir name	= Sediment Basin 5	Max. Storage	= 298,638 cuft

Storage Indication method used. Wet pond routing start elevation = 425.00 ft.



Hydrograph Report

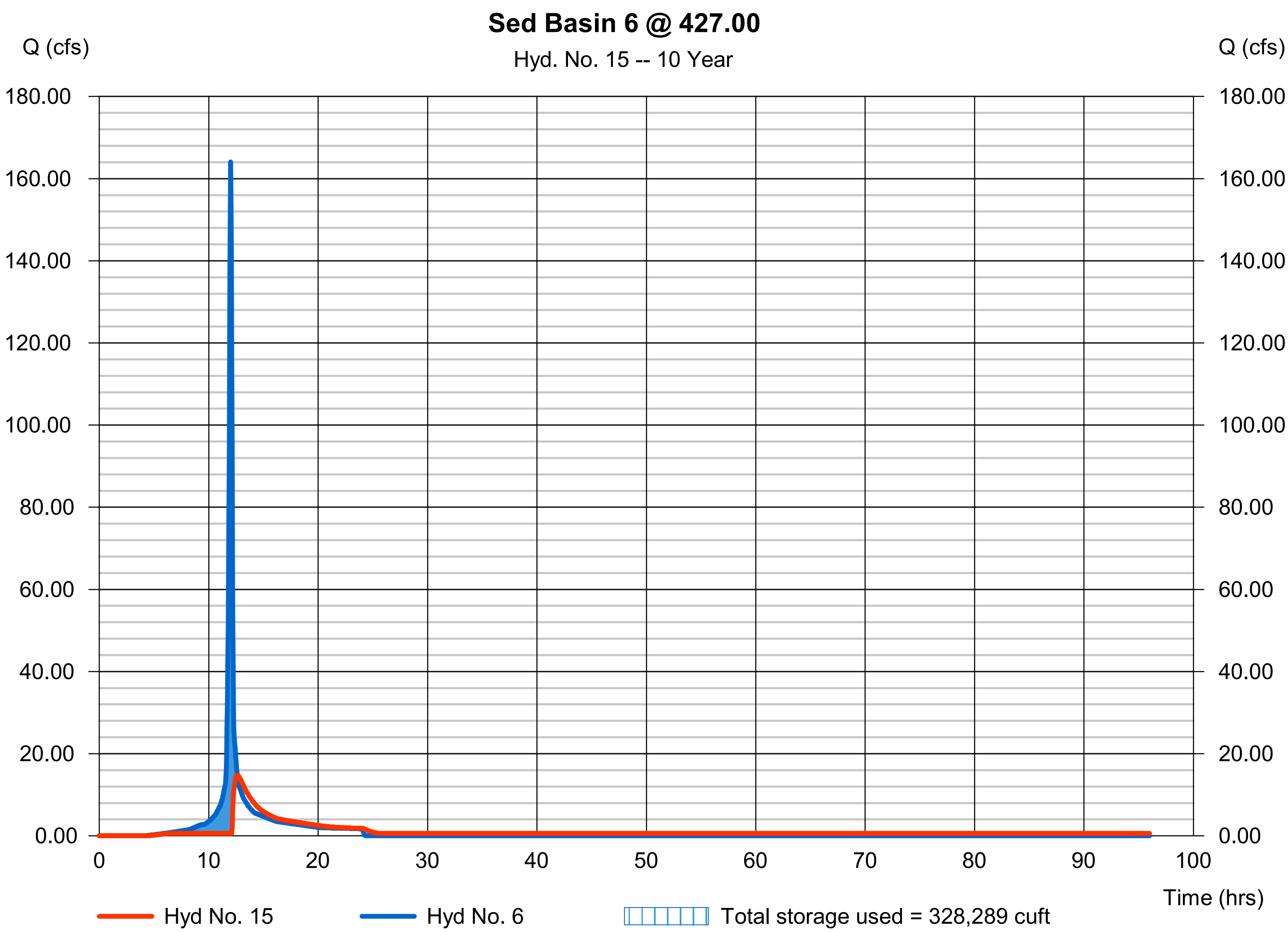
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 15

Sed Basin 6 @ 427.00

Hydrograph type	= Reservoir	Peak discharge	= 14.77 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.60 hrs
Time interval	= 2 min	Hyd. volume	= 374,274 cuft
Inflow hyd. No.	= 6 - Sediment Basin 6 Runoff	Max. Elevation	= 430.50 ft
Reservoir name	= Sediment Basin 6	Max. Storage	= 328,289 cuft

Storage Indication method used. Wet pond routing start elevation = 427.00 ft.



Hydrograph Report

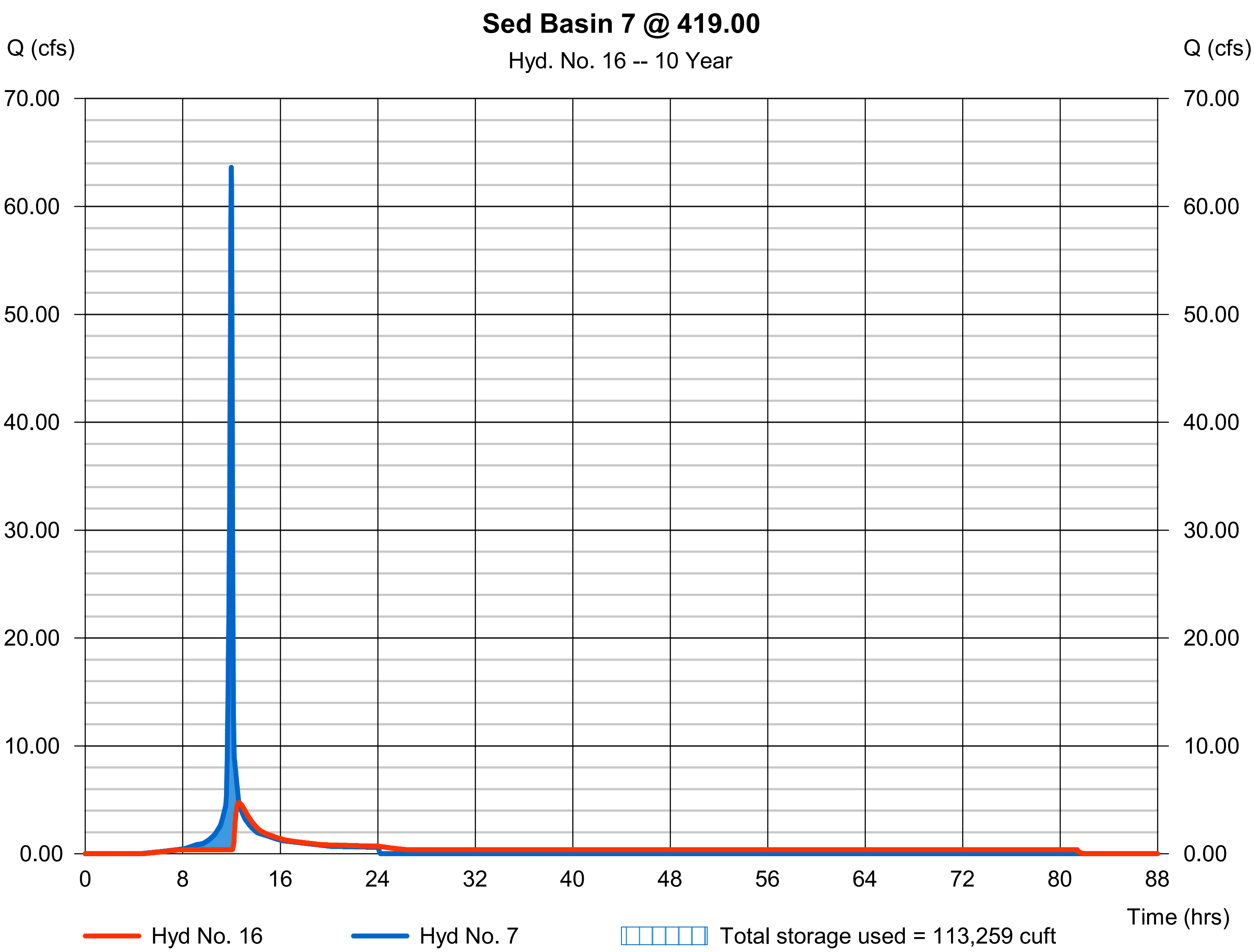
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 16

Sed Basin 7 @ 419.00

Hydrograph type	= Reservoir	Peak discharge	= 4.740 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.60 hrs
Time interval	= 2 min	Hyd. volume	= 151,322 cuft
Inflow hyd. No.	= 7 - Sediment Basin 7 Runoff	Max. Elevation	= 421.97 ft
Reservoir name	= Sediment Basin 7	Max. Storage	= 113,259 cuft

Storage Indication method used. Wet pond routing start elevation = 419.00 ft.



Hydrograph Report

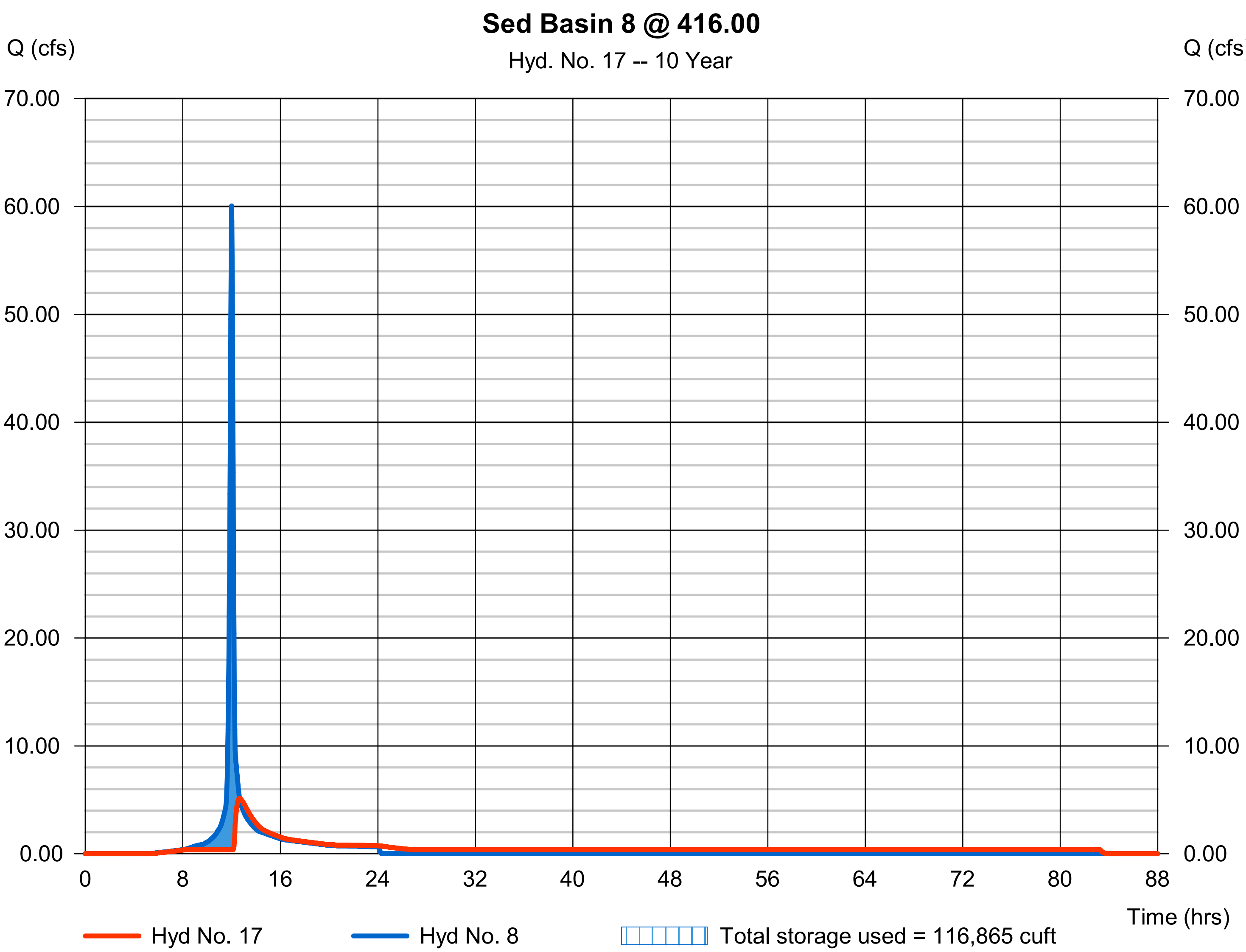
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022 Monday, 08 / 7 / 2023

Hyd. No. 17

Sed Basin 8 @ 416.00

Hydrograph type	= Reservoir	Peak discharge	= 5.131 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.67 hrs
Time interval	= 2 min	Hyd. volume	= 158,908 cuft
Inflow hyd. No.	= 8 - Sediment Basin 8 Runoff	Max. Elevation	= 418.99 ft
Reservoir name	= Sediment Basin 8	Max. Storage	= 116,865 cuft

Storage Indication method used. Wet pond routing start elevation = 416.00 ft.



2.0 APPENDICES

2.7 Appendix 7

Carrier Pipe Outlet Protection Calculations

OUTLET PROTECTION CALCULATIONS

Site: Luck Saluda
Date: 8/7/2023

SEDIMENT BASIN CARRIER PIPES

Sediment Basin	Q_{25} (ft^3/sec)	D_o (in)	La (ft)	d_{50} (ft)	W_1 (ft)	W_2 (ft)	Riprap (S.Y.)	$d_{50,design}$ (in)
1	30.49	24	19	0.6	6	21	28	9
2	30.23	24	19	0.6	6	21	28	9
3	30.97	24	19	0.6	6	21	28	9
4	30.24	24	19	0.6	6	21	28	9
5	28.76	24	18	0.6	6	20	26	9
6	30.35	24	19	0.6	6	21	28	9
7	18.40	24	13	0.4	6	15	16	6
8	20.28	24	13	0.4	6	15	16	6

Where:

Q_{25} = 25-year storm flow rate existing downdrain

D_o = Pipe diameter

La = Length of apron from chart

d_{50} = Size of Riprap from chart

W_1 = Length of Riprap at the pipe outlet

W_2 = Length of Riprap at the full length of apron

Riprap = Area of Riprap required

$d_{50,design}$ = Riprap sizing in inches and rounded to nominal Riprap size

Formulas:

$W_1 = 3 \times Do$

$W_2 = Do + La$

Riprap = $((W_1+W_2) \times La) / 18$

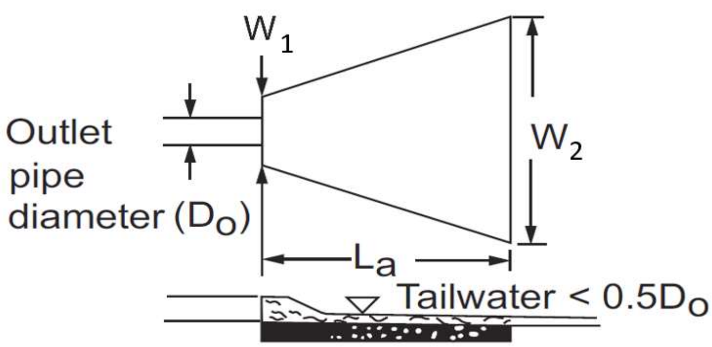
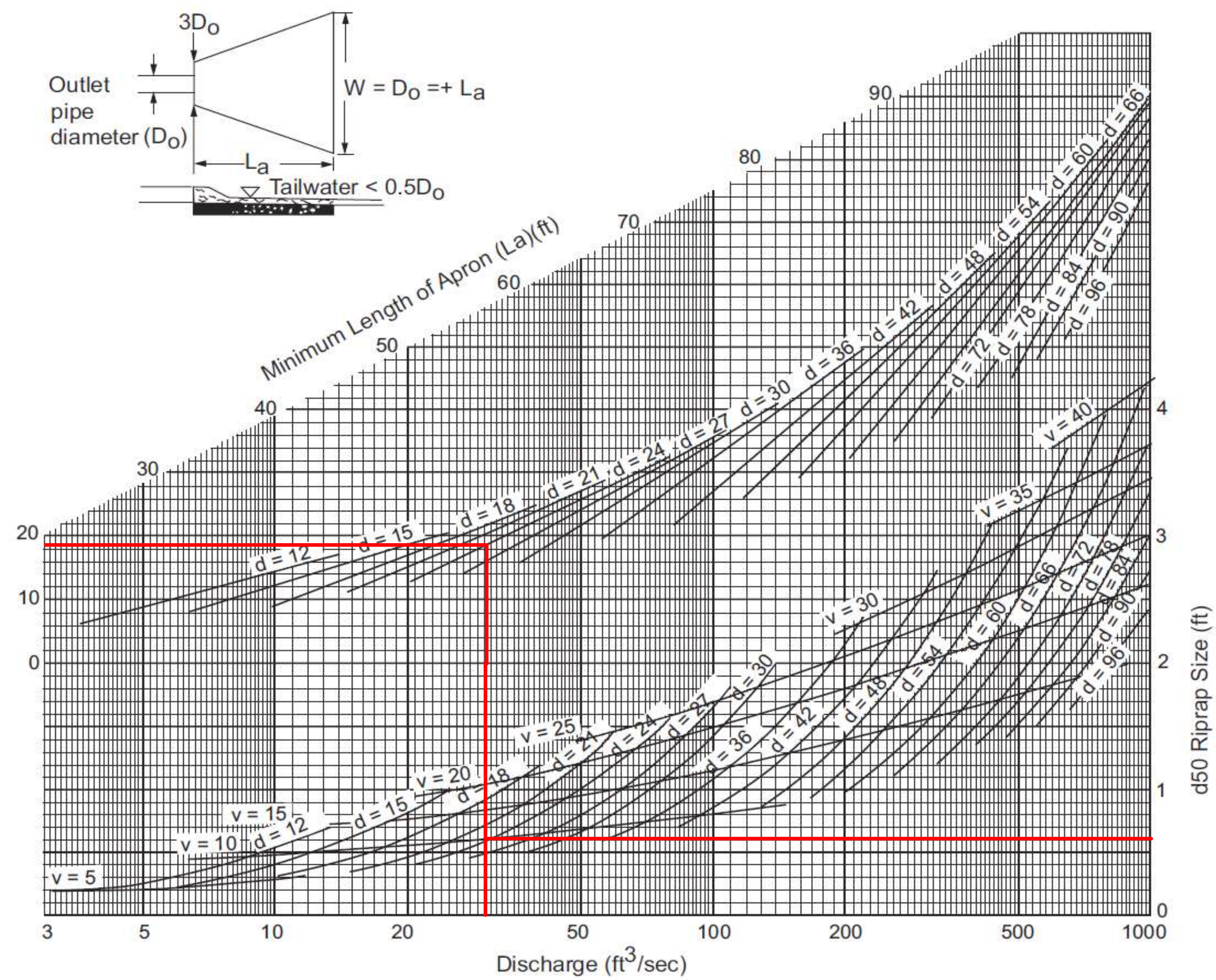
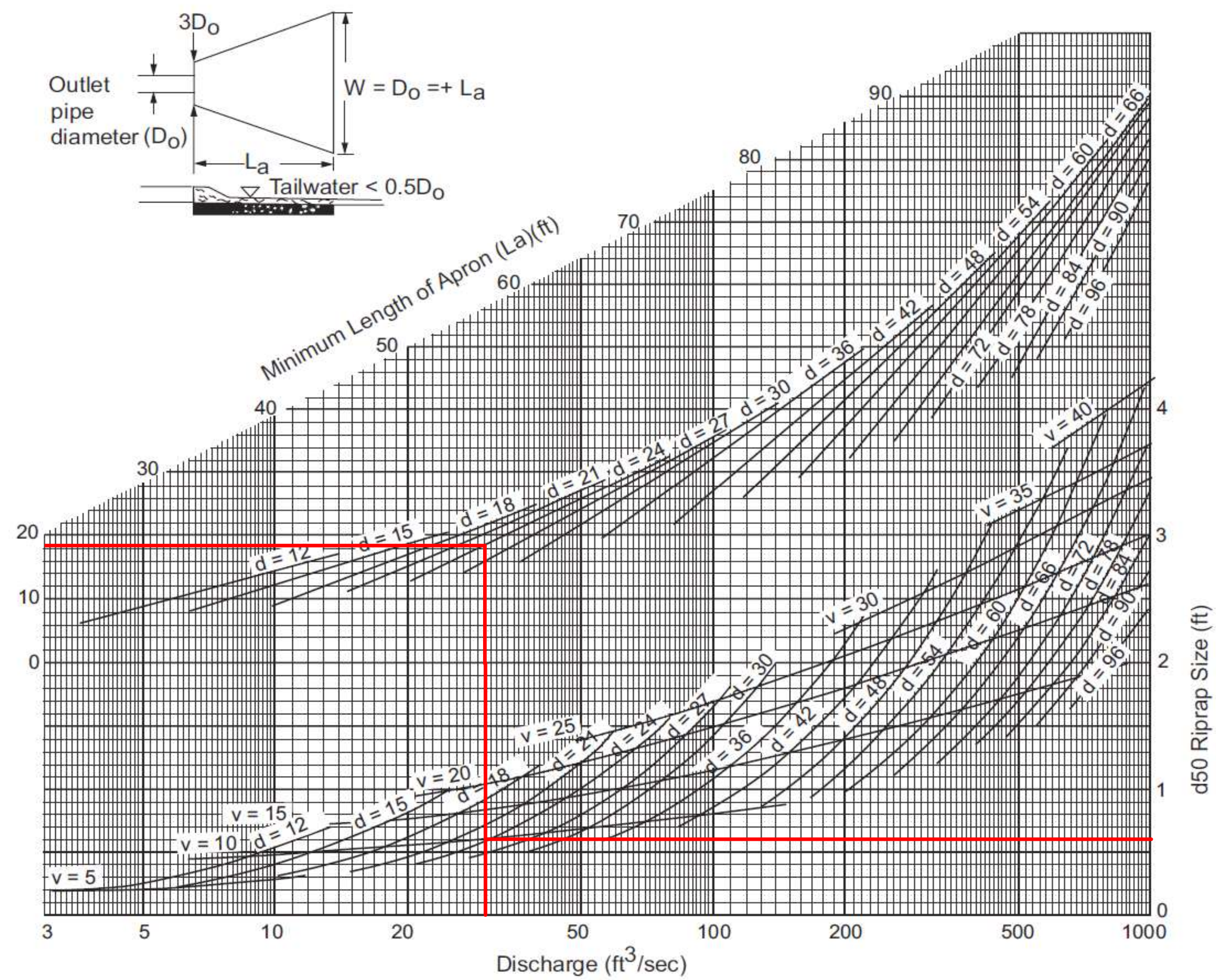


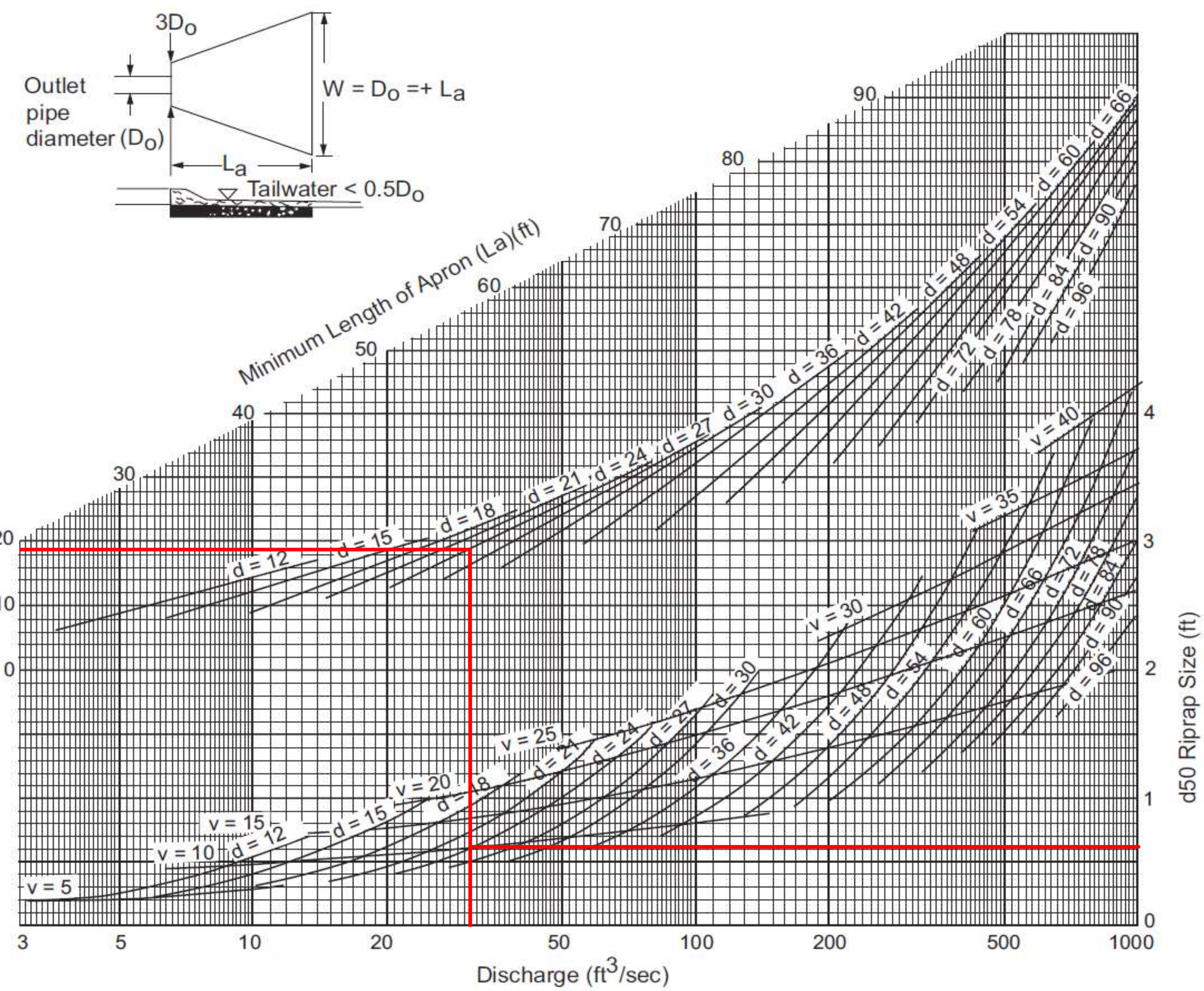
Figure 1. Riprap Area Diagram

Sediment Basin 1



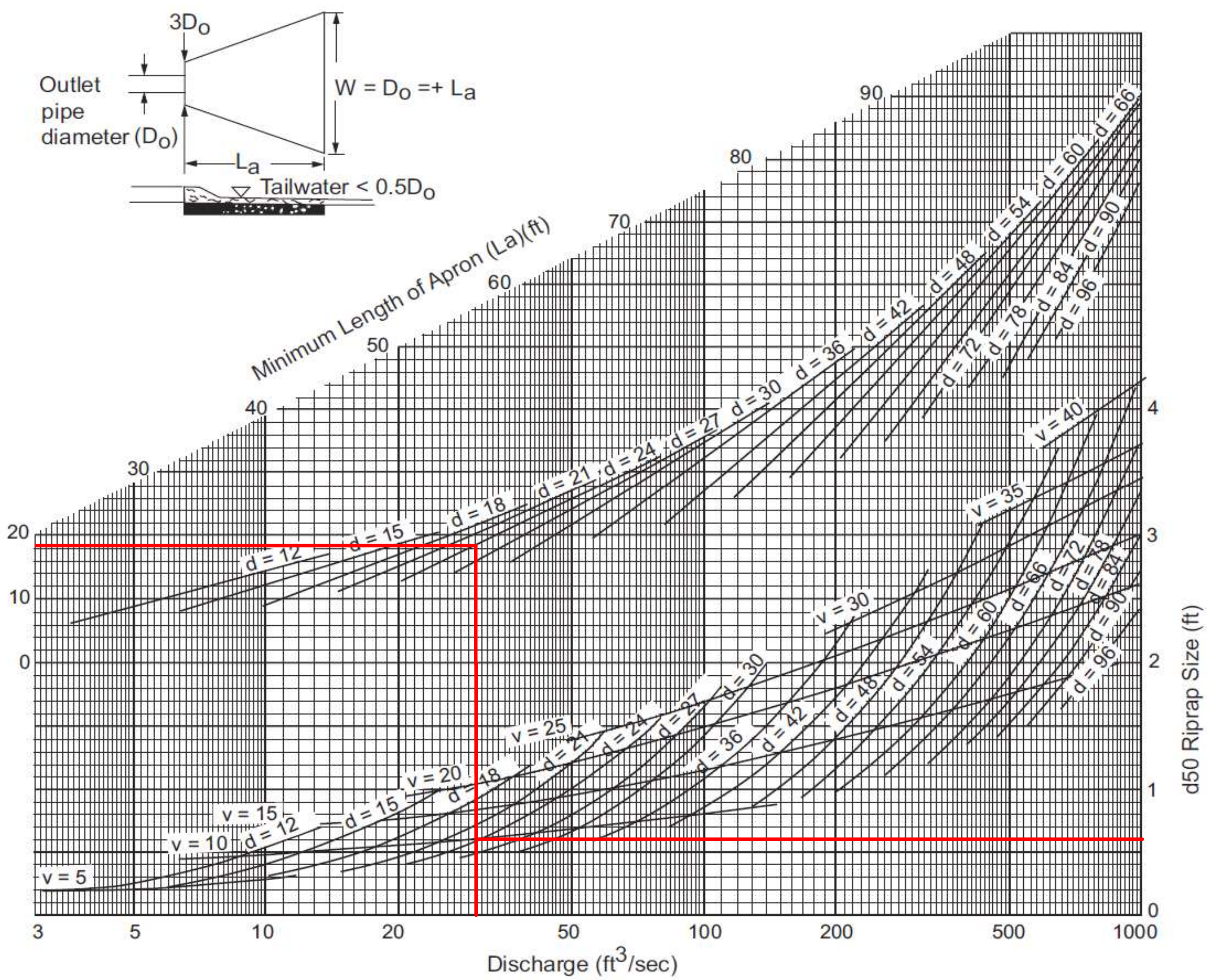
Sediment Basin 2



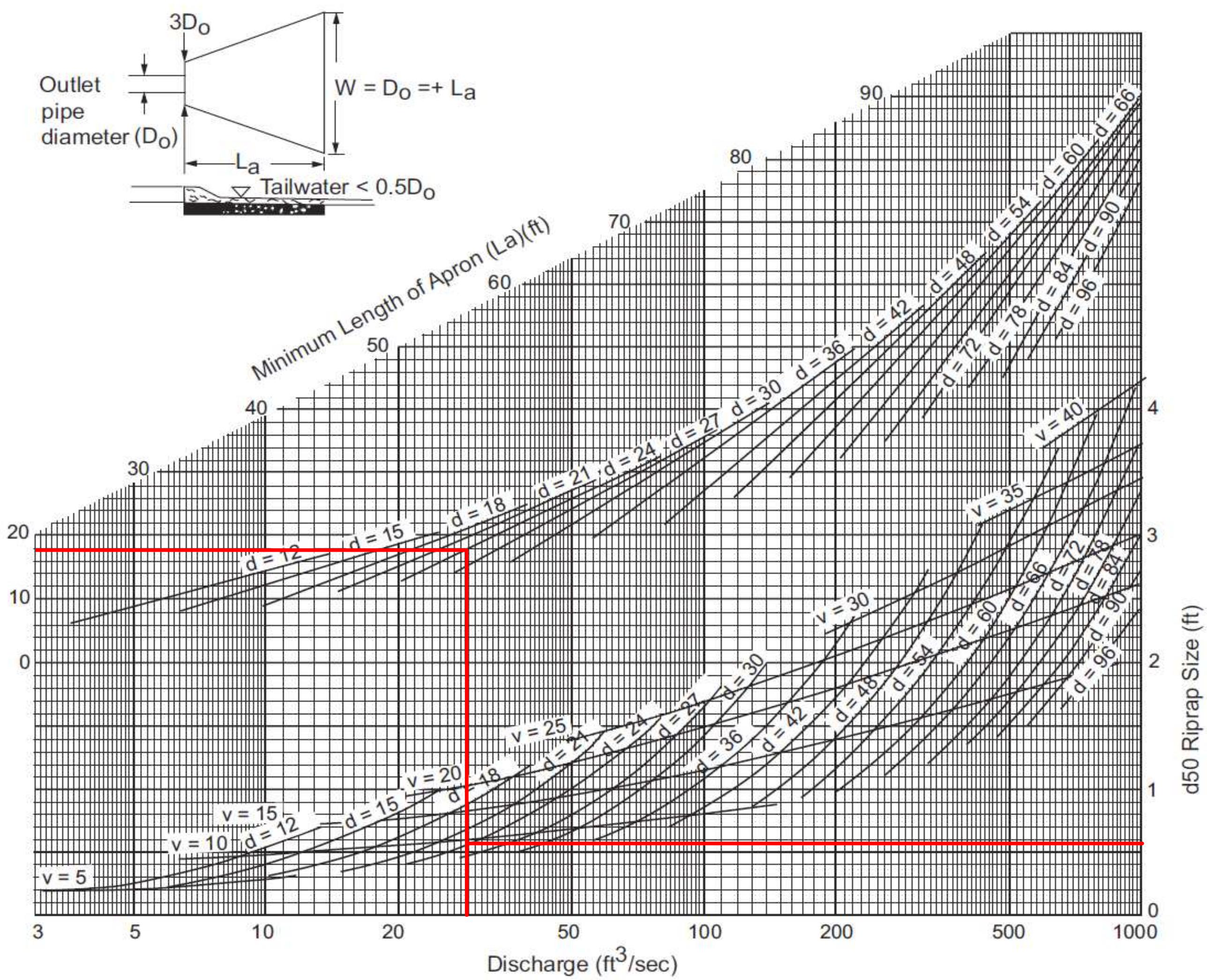


3Do
Outlet pipe diameter (Do)
W = Do =+ La
La
Tailwater < 0.5Do
Minimum Length of Apron (La)(ft)
Discharge (ft3/sec)
d50 Riprap Size (ft)

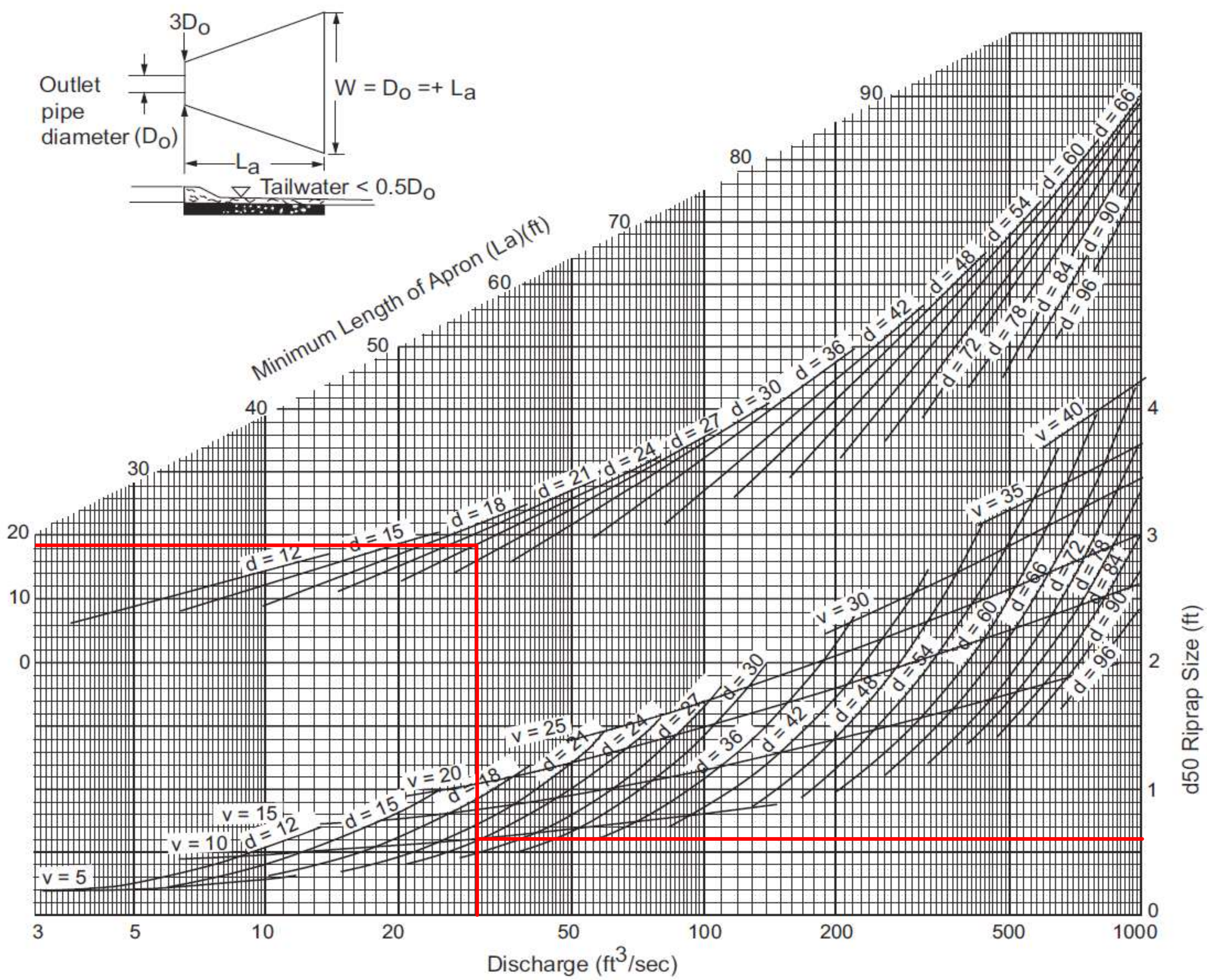
Sediment Basin 4

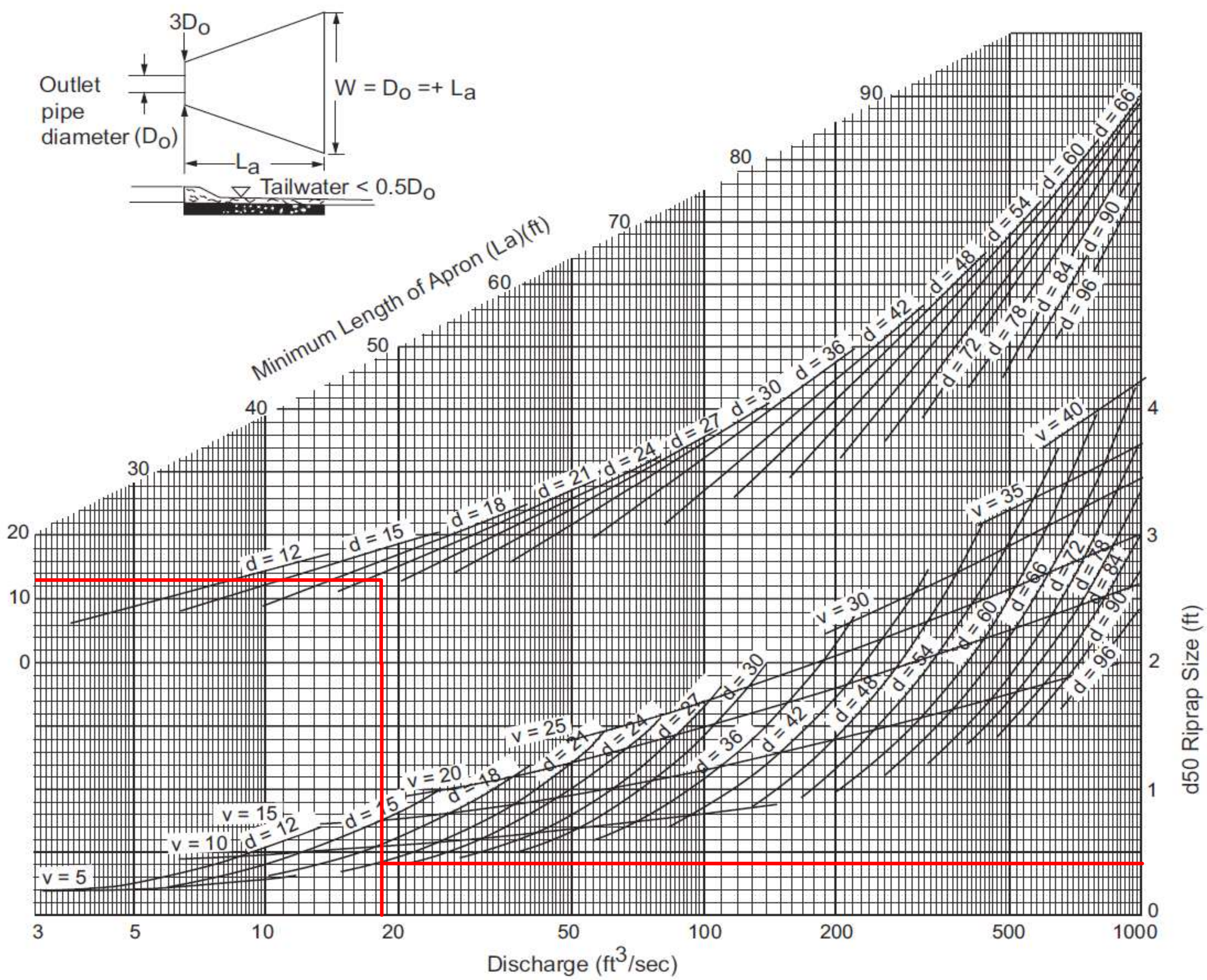


Sediment Basin 5

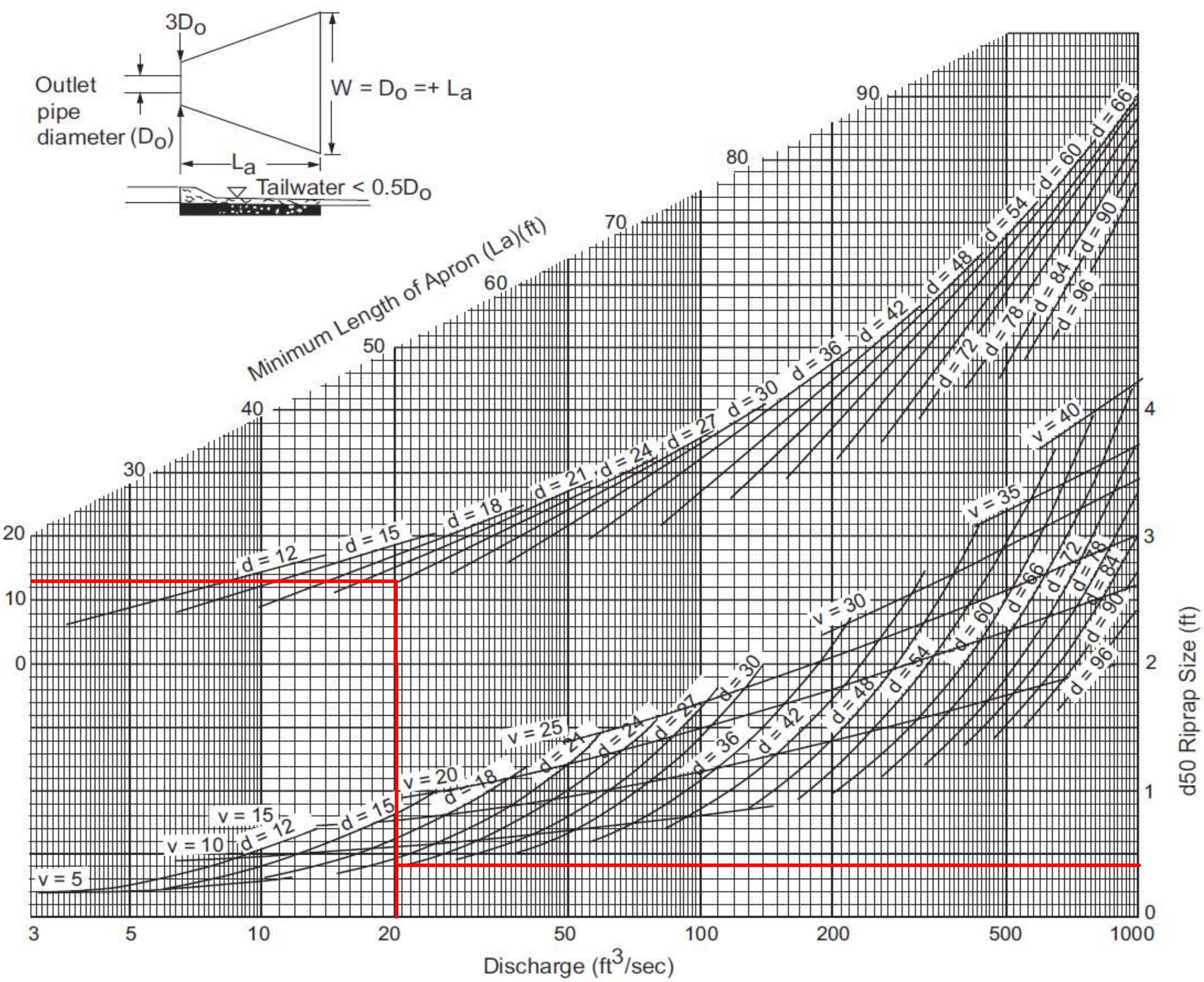


Sediment Basin 6





3D_O
Outlet pipe diameter (D_O)
W = D_O =+ L_a
L_a
Tailwater < 0.5D_O
Minimum Length of Apron (La)(ft)
d50 Riprap Size (ft)
Discharge (ft³/sec)



3Do
Outlet pipe diameter (Do)
W = Do =+ La
La
Tailwater < 0.5Do
Minimum Length of Apron (La)(ft)
d50 Riprap Size (ft)
Discharge (ft3/sec)

3.0 REFERENCES

3.1 Reference 1

SC DHEC Stormwater BMP Handbook, Sediment Control BMPs – Sediment Basins

Sediment Basins

FEATURES

- Sediment Control
- Volume Control
- Velocity Control

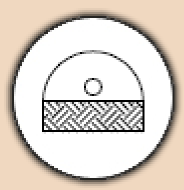
SECTIONS

- General Design
- Forebays
- Porous Baffles
- Basin Dewatering
- Skimmers
- Spillways
- Permanent Pools
- Maintenance
- Design Aids

ALSO ADDRESSED

- Inlet Protection
- Basin Safety
- Sediment Storage
- Slope Stabilization
- Rock Berms
- Outlet Protection
- Basin Removal

PLAN SYMBOL



Introduction

Sediment Basins are a Best Management Practice (BMP) used to collect and impound stormwater runoff from disturbed areas (typically 5 acres or more) at construction sites to restrict sediments and other pollutants from being discharged off-site. These basins may also be used to control the volume and velocity of the runoff through a timed release by utilizing multiple spillways. It is through this attenuation of runoff that sediment basins may be capable of meeting South Carolina's Design Requirements, specifically the Total Suspended Solids (TSS) removal efficiency of 80%.

These basins work most effectively in conjunction with additional sediment and erosion control BMPs installed and maintained up gradient of the basins.

Guidance Disclaimer

This is a guidance document and may not be feasible in all situations. Alternative means and methods for sediment basin design and construction also may be employed.

All means and methods must comply with the DHEC South Carolina NPDES General Permit for Stormwater Discharges from Construction Activities (Permit). Approved means and methods include those published and approved by an MS4 in compliance with the Permit.

In addition, a licensed Professional Engineer may design a sediment basin that, when constructed, accommodates the anticipated sediment loading from the land-disturbing activity and meets a removal efficiency of 80% suspended solids or 0.5 ML/L peak settable solids concentration, whichever is less, while remaining in compliance with the Permit.

`

General Information

Located near the site's perimeters, sediment basins can be created by the building of an embankment or through excavation, when the topography is relatively flat. Careful planning is necessary, during both design and construction phases, to ensure that sediment basins are not placed within Waters of the State (WoS) and are installed prior to the implementation of mass clearing, grubbing, and grading activities.

As runoff discharges into a sediment basin, specific mechanisms are used to reduce the velocity and turbulence of the runoff to allow for settling of suspended particles, a process known as sedimentation. Examples of these mechanisms include sediment forebays, porous baffles, and spillways with outlet structures that only discharge water from near the surface of the water column impounded within the basin.

After construction of the basin, routine inspection and maintenance of sediment basins along with the implementation of additional sediment and erosion control BMPs up gradient of the basin is essential to maintain the required trapping efficiency.

Image Source: Alabama NRCS

Design Requirements

- TSS Removal Efficiency* – > 80%
- Peak Settleable Solids Conc.* – < 0.5 mL/L
- Discharge Capacity – 10-yr, 24-hr Storm Event
- Inspections and Maintenance** – Weekly
- Internal Components***
  - Sediment Forebay – Basin Inlets
  - Porous Baffles – Between Inlets & Outlets
  - Water Surface Dewatering – Basin Outlets

** Whichever is less. ** Maintenance as necessary per inspection. ***Unless Infeasible.*

The above requirements shall serve as a baseline for all sediment basin design within the state of South Carolina. For further reference see SC State Regulations 72.300 Standards for Stormwater Management and Sediment Reduction (Section 72-307.C.5) and the SC NPDES General Permit for Stormwater Discharges from Construction Activities SCR100000 (Section 3.2.6.II).

The following sections of this guidance can be used to aid in the design of a sediment basin capable of meeting, if not exceeding, the above requirements. The selection and implementation of these practices should be based on the best professional judgment and the conditions expected at the construction site during the lifespan of each sediment basin.

Additional Design Considerations

- Drainage Area – 5-30 Acres*
- Sediment Storage – 3600 ft^3/Acre Draining
- Min Dewatering Time – 2 days (48 hours)
- Max Dewatering Time – 5 days (120 hours)
- Basin Shape - L = 2W (Minimum)
- Cleanout Height - 1/2 Sediment Storage
- Forebay Volume – 20% Sediment Storage
- Porous Baffles –3 Rows (Minimum)
- Basin Inlets – Stabilized to Prevent Scour
- Basin's Bottom Slope – 0.5% or Steeper
- Embankments – 2H:1V or Flatter

***30 Acre Limitation –** *Based off Design Aids Section. Larger drainage areas may be acceptable when using an alternative methodology to calculated trapping efficiencies.*

Location

The location of sediment basins at a construction site will vary due to site-specific conditions, but the following items should be used as guidance to determine the most appropriate location:

- **Not within Waters of the State:** It is prohibited to construct in or use Waters of the State as a sediment basin.
- **Down Gradient from Major Grading Activities:** Locations down gradient of large scale grading operations will promote sediment control during construction activities.
- **Near Identified Outfalls:** Locations near the determined site outfall will allow sediment basins to collect the majority of the runoff from the disturbed area.
- **Multipurpose Use:** Many construction sites will utilize a sediment basin as a detention pond after construction activities are completed. Selection of an area that allows for the installation of a sediment basin that can be converted to a detention pond post-construction is recommended.
- **Exclude Runoff from Off-Site and Undisturbed Areas:** The placement of sediment basins are recommended at a location that restricts the amount of stormwater runoff impounded from off-site and other undisturbed areas. Placement of temporary diversions berms, swales, or other conveyance measures may be required to divert the "clean" stormwater runoff away from the basin. This practice will minimize the drainage area being served by the sediment basin and may decrease the surface area required by the sediment basin.

Safety

Incorporate all possible safety precautions, such as signs and fencing, for sediment basins that are readily accessible to populated areas. For Example, a lateral shelf that is located above the sediment cleanout elevation may prevent entry onto the accumulated sediment and may also help with maintenance of the basin. In some circumstances, vector control may be necessary for sediment basins that routinely have a standing pool of water. This is especially important around residential areas to inhibit a rise in mosquito populations and the spread of disease. Maintaining a water depth of at least 3 feet within basins with permanent pools may also help prevent a rise in mosquito populations.

All other applicable safety criteria as outlined by the USDA Soil Conservation Service (previously the Natural Resources Conservation Service), the U.S. Army Corps of Engineers, and state Dam Safety Regulations should also be followed during design and construction of sediment basins.

Basin Design Criteria

Properly sizing a sediment basin is crucial to improving sediment control during construction conditions. When designing a basin the following criteria should be addressed:

- **Storage Volume:** The minimum sediment storage volume recommended within a sediment basin is equal to 3,600 cubic feet per acre draining to the basin. Twenty percent (20%) of this volume should be provided within the sediment forebay. (*Basin Volumes of 50 ac-ft or more may be subject to Dam Safety Regulations and Permits.*)
- **Shape:** Sediment basins should be designed to maximize the flow length between the basins' inlets and outlets. To accomplish this, the minimum length-to-width ratio of each basin should be no less than 2:1. This results with an effective flow length that is at least twice the width of the basin. Additional (non-porous) baffling may be required if site constraints prevents the basin from meeting this minimum ratio. In each circumstance, measures must be taken to prevent short-circuiting of the sediment basin. Length and width measurements may be measured from top of embankment.
- **Surface Area:** The surface area within a sediment basin can have a substantial impact on the basin's trapping efficiency. Maximizing the surface area may lead to higher trapping efficiencies and may prove to be very beneficial when employed with multiple rows of porous baffles.
- **Depth:** The provided depth in a sediment basin will be directly linked to the required storage volumes and the appropriate surface area. It is recommended that a depth of 5 - 10 ft be provided in order to maximize surface area within the basin. (*Basin Depths resulting in an embankment height of 25 ft or more may be subject to Dam Safety Regulations and Permits.*)
- **Slope:** The sediment basin's bottom must be graded to have a slope of not less than 0.5%.

Basin Dewatering

Sediment basins must be designed to have the capability to discharge the 10-yr, NRCS 24-hr storm event through the principle spillway while under **during construction** conditions. This spillway must employ a mechanism to withdraw the impounded stormwater runoff from near the surface of the water column impounded within a basin.

This volume of water should discharge through the principle spillway within a time frame of 2-5 days, with 3 days being the recommended target. Meeting this recommended dewatering time allows for finer particulates to fall from suspension, improving the trapping efficiency of the sediment basin.

Embankments

Proper construction and stabilization of basin embankments are important factors of sediment basin design. When designing a basin the following criteria on embankments should be addressed:

- **Construction:** The foundation of the embankment should be stripped and grubbed of all vegetation, stumps, topsoil and other organic matter prior to construction of the dam. Machine compact the soil material used to construct the dam.
- **Minimum Width:** The top width of the embankment should be no less than 5 feet.
- **Side Slopes**: All side slopes, including those located within basin areas that are not part of the embankment, shall be 2:1 (H:V) or flatter. The recommended slope is 3:1 to allow for ease of maintenance.

- **Penetrations**: Any penetrations, including conduits, through the embankment shall be equipped with anti-seep mechanisms, such as anti-seep collars or a core/key trench.
- **Top of Embankment:** Keep the top of the embankment at a minimum of 2 feet above the crest of the principle spillway's riser. (This minimum elevation provides an emergency spillway that is at least 1 foot in height and has a 1-foot separation between its crest and the principle spillway's crest.)
- **Stabilization:** Promptly stabilize all areas disturbed by the construction of the embankment including embankment side slopes and access areas. Temporary or permanent stabilization measures should be conducted as necessary.

Excavations

All sediment basins created or expanded through excavation shall retain side slopes of 2:1 or flatter, and all side slopes should be promptly stabilized to prevent the formation of rills and gullies. The recommended slope is 3:1 (H:V) to allow for ease of maintenance.

Inlet Protection

Inlets into a sediment basin shall be equipped with energy dissipation measures to prevent scour by reducing runoff velocities and/or shall be equipped with stabilization measures designed to handle peak flow conditions. This can be accomplished through the selection and use of BMPs such as riprap aprons, turf reinforcement matting, and plunge pools.

These BMPs should be provided at all inlets into the basin, including inlets that are submerged, and it is recommended that the invert of each inlet is cited to be at the bottom of the sediment basin to prevent erosion along side slopes. When an invert of a basin inlet is not cited at the bottom of the basin, proper conveyance measures should be proposed to allow runoff to enter the basin without eroding the basin's side slopes.

Sediment Forebay

Each sediment basin should be designed to incorporate the use of a sediment forebay, a settling area or impoundment constructed at the incoming points of stormwater runoff that promotes the settling of coarse particulates away from the basin's outlets. Inclusion of a sediment forebay may also help ease maintenance by allowing for the deposition of the larger suspended particles into an easily accessible area away from the principle spillway.

Proper design, construction, and stabilization of each sediment forebay will promote the required functions of sediment basins. When designing a basin the following criteria on forebays should be addressed:

- **Construction:** A riprap berm, gabion, or an earthen berm with a rock filled outlet should be constructed across the bottom of the sediment basin to create a cell within the basin for use as the sediment forebay. The location and height of this berm should be designed to meet the appropriate sediment forebay volume and depth criteria. Alternatively, plunge pools or rock berms may be constructed around each inlet to create a combined volume behind the berms equal to the minimum sediment forebay volume recommendation.
- **Volume:** The minimum volume provided within the forebay(s) should be twenty percent (20%) of the provided sediment storage volume of the basin.

- **Depth:** The depth of the forebay will be dependant upon the required volume. It is recommended to keep the depth between 2 and 4 feet.
- **Accessibility:** Direct access to the forebay will be necessary to allow for routine cleanout of the accumulated sediment. Side slopes adjacent to the forebay may be graded to create a safe path for equipment to access the forebay, or a maintenance ramp or shelf can be incorporated into the basin's design to allow for direct and easy access to all areas of the sediment basin.
- **Clean Out:** A fixed cleanout stake, solely for use within the sediment forebay is recommended near the forebay berm. This cleanout stake is beneficial since the forebay may become inundated with sediment faster than the rest of the basin. The recommended cleanout height for sediment forebays is 1/2 the height of the forebay's berm.

Photo: Sediment Forebay

Porous Baffles

Located between the sediment forebay and the basin's spillways (outlets), porous baffles must be installed to aid in the dispersion of runoff across the entire width of the basin and to promote sedimentation by reducing turbulence. Baffles function in basins with or without permanent pools.

Proper design, construction, and stabilization of porous baffles will promote the required functions of sediment basins. When designing a basin the following criteria on porous baffles should be addressed:

- **Height:** The recommended height of each baffle is 3 feet. When possible, the height of each baffle should be equal to or above the 10-yr, 24-hour NRCS Storm's design water surface elevation within the sediment basin.
- **Width:** The width of each baffle shall be equal to the entire width of the sediment basin, including the side slopes up to where the height of the baffle intersects the slope.
- **Spacing:** The minimum spacing between baffles should be 10 feet. Baffles should ultimately be placed to maximize the space between each of the rows of baffles and the basin’s sediment forebay/spillways and the adjacent baffle row.
- **Materials:** All porous baffles not composed of turf reinforcement matting (TRM) material should consist of materials derived from coir (coconut fibers) products. An example is coir woven

matting. TRMs should consist of materials that do not have loose Straw fibers. The selected material should have a light penetration (open space) between 10-30%. **Silt Fence may not be used.**

- **Posts:** The posts used to install porous baffles should be steel posts with a minimum weight of 1.25 lb. per liner foot. Install steel posts at a maximum of 4-feet on center.
- **Rows:** A minimum of three (3) porous baffle rows should be installed across the width of the entire basin (including side slopes) where the basin length is greater than 50 feet. For basins with a length of 50 ft or less, only two rows of (2) porous baffles are necessary to be installed.
- **Installation:** All baffles are to be trenched or anchored into the basin's bottom and tied into side slopes to prevent bypass. A rope or wire can be used along the top of the baffle to prevent excessive sagging between the posts.

Photo: Porous Baffles

Rock Berm

A rock berm, typically provided in a horseshoe orientation around the principle spillway, may be provided to restrict the deposition of sediment within the area directly adjacent to the principle spillway. Restriction of sedimentation within this area will promote proper skimmer function. This rock berm is not recommended when a permanent pool of water is designed to remain within the basin during construction.

Proper design and construction of a rock berm around the principle spillway will promote the desired functions of sediment basins. When designing a basin the following criteria on rock berms should be addressed:

- **Installation:** The rock berm is to be installed outside the scopes of the skimmer and associated mechanisms required for proper skimmer performance, such as skimmer pits and/or skimmer rock pads. The berm should completely surround the principle spillway and should be installed upon the sediment basin's embankment slopes up to the elevation where the height of the berm intersects the slope.

- **Width:** The width along the crest of the rock berm should be at a minimum of 2 feet. Wider rock berms may be necessary in larger basins.
- **Height:** The height of a rock berm should range between 2-4 feet, dependent upon the height of the basin.

Photo: Horseshoe Rock Berm Around Principle Spillway with Skimmer

Skimmers

The most common devices used to meet a sediment basin's surface water dewatering requirements are floating skimmers. These skimmers allow for the dewatering of a basin from the top of the water column up to a specified design elevation, which in South Carolina is the 10-yr, NRCS 24-hr Storm's design Water Surface Elevation (WSE).

The discharge through skimmers will approach a somewhat constant flow rate as the water surface elevation rises within the basin. As the elevation of water rises, the skimmer will remain at the top of the water's surface due to a floatation mechanisms incorporated into skimmer designs by the manufacturer. This floatation is typically designed to keep the depth of water above the skimmer's orifice constant as the water surface elevation rises.

Proper design and installation of skimmers will promote the desired functions of sediment basins. When designing a basin the following criteria on skimmers should be addressed:

- **Installation:** All skimmers should be installed based on manufacturer's recommendation. The skimmer should also be installed prior to clearing and grading of a basin’s drainage area.
- **Discharge Capacity:** Each skimmer must be designed/selected to allow the sediment basin to have the capacity to pass the 10-yr, NRCS 24-hr storm event within the recommended time of 2-5 days.
- **Skimmer Size:** The size of the skimmer device, which typically reflects the skimmer’s orifice size, should be selected to meet the basin discharge capacity requirements. Most skimmer manufacturers provided skimmer sizes ranging from 1.5" up to 8". Orifice size and associated flow rates are product specific and should be based off product-specific testing.

- **Skimmer Orifice Sizing:** In addition to skimmer size, some skimmer manufacturers provide the option to modify the intake orifice of a skimmer through the use of a plug or flap. These modifications are place within or over the skimmer's orifice to provide a smaller orifice size.
- **Additional Options:** Dependent on the skimmer manufacturer's recommendations, additional measures may need to be implemented around, near, or under the skimmer to prevent the skimmer from becoming clogged or stuck within deposited sediment. These additional measures included, and may not be limited to, skimmer pits, rock pads, and rope that is attached to the skimmer and then tied to a secure point along the basin's embankment.

A detail of the selected skimmer should be included on the construction site plans that should reference the skimmer's manufacturer, the Daily Discharge Capacity (ft^3/day), the Average Discharge Rate (cfs), and the Dewatering Time (days). Listing these parameters for each proposed skimmer allows the selection of an equivalent skimmer from an alternative manufacturer, when the need arises.

When selecting an equivalent skimmer, from what was specified on the approved plans, it is important to comply with the following guidance to ensure an "equivalent" skimmer is selected.

- **The Average Discharge Rate (cfs) from the selected skimmer should be equal to or greater than that discharge rate of the approved skimmer.** Any skimmer with a lower Average Discharge Rate would case the peak water surface elevation within the basin to rise during a given storm event.
- **The Daily Discharge Capacity (ft^3/day) from the selected skimmer should be equal to or greater than the discharge capacity of the approved skimmer.** Any skimmer with a Daily Discharge Capacity lower than the approved skimmer would case the peak water surface elevation within the basin to rise during a given storm event.
- **The Dewatering Time should remain within a time frame of 2-5 days.** It is recommended to keep the dewatering time as close to possible to that of the approved skimmer, but complying with this item keeps the basin from dewatering too quickly. The Dewatering Time is equal to the time it takes the skimmer(s) to completely dewater the basin.

Any rise in water surface elevation may allow for more water to flow over the riser crest, increasing the discharge rate of the basin. This potential for increased discharge may reduce the trapping efficiency below the required 80% efficiency.

Failing to follow this guidance would require review and approval of the "equivalent" skimmer prior to implementation (in most cases requiring a Major Modification of the approved plans). All skimmer data should be based off product-specific testing.

Photo: Skimmer with Attached Rope for Ease of Maintenance

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Principle Spillway

The Principle Spillway is the primary discharge mechanism for sediment basins. This spillway consists of a riser structure, a barrel (outlet pipe), and surface water dewatering mechanisms (typically a skimmer). The riser structure should also be equipped with a trash rack, an anti-vortex device, and an anti-floatation mechanism.

Proper design and installation of the principle spillway will promote the desired functions of sediment basins. When designing a basin the following criteria on principle spillways should be addressed:

- **Riser:** May be provided as a concrete box/pipe or corrugated pipe. Recommended heights range between 3 and 6 feet.
- **Barrel:** The barrel connects into the riser structure and extends through the basin's embankment to allow impounded stormwater runoff to discharge from the basin. Anti-seep mechanisms must be provided along the barrel to prevent embankment failure.
- **Orifices:** Limit orifices on the riser to those necessary to connect the skimmer device(s). Orifices along the riser in which a skimmer is not connected are not considered to meet the water surface dewatering requirements.
- **Weirs:** Limit the use of weirs along the riser to within 1-foot of the riser crest. Weirs below this elevation are not considered to meet the water surface dewatering requirements.
- **Trash Rack and Anti-Vortex Device:** Equip the riser structure with a trash rack and anti-vortex device to prevent clogging of the principle spillway and non-weir flow over the riser crest.
- **Anti-Floatation Mechanism:** Provide an anchor to prevent floatation of the riser structure. Recommended weight of the anti-floatation mechanism is 1.1 times greater than the weight of the volume of water displaced by the riser structure.
- **10-Yr Design WSE:** The 10-yr design WSE should target the crest of the riser. The maximum head above the riser crest should be limited to 1 foot to maintain water surface dewatering requirements. Basins with permanent pools subject to high ground water tables may be accepted with the 10-yr design WSE more than 1 foot above the riser crest.

Photo: Principle Spillway's Riser Structure with Skimmer

Emergency Spillway

The Emergency Spillway is the secondary discharge mechanism for the sediment basin designed to discharge larger storm events, such as the 100-yr, NRCS 24-hr storm event, from the basin. This spillway consists of a stabilized, open channel along the top of the basin's embankment.

Proper design and installation of the emergency spillway will promote the desired functions of sediment basins. When designing a basin the following criteria on emergency spillways should be addressed:

- **Location:** Where feasible, construct the emergency spillway in natural ground and not over fill material.
- **Elevation:** The crest of the emergency spillway should be at least 1 foot below the top of the basin's embankment. This spillway should also be located 1 foot above the crest of the principle spillway's riser or the 10-yr design WSE whichever is higher.
- **Height:** The height should be at least 1 foot and should be designed to successfully pass the 100-yr, NRCS 24-hr storm event with a freeboard of no less than 0.5 feet between the maximum water surface elevation from this storm event and the basin's embankment.
- **Width:** The width of the emergency spillway should be at a minimum of 10 feet.
- **Side Slopes:** The side slopes of the emergency spillway should be no steeper than a 2:1 slope.
- **Stabilization:** The entirety of the emergency spillway, including side slopes and the embankment's slopes, should be properly stabilized. When located on fill material, this stabilization should consist of rip-rap with underlying geotextile fabric or erosion prevention BMPs capable of conveying the expected velocities without failure.

Outlet Protection

Each of the sediment basin's outlets shall be designed to prevent scour and to reduce velocities during peak flow conditions. This can be accomplished through the selection and design of energy dissipation structures such as riprap aprons. Each outlet should also be directed towards pre-existing point source discharges or be equipped with a mechanism to release the discharge as close to sheet flow as possible, to prevent the creation of new point source discharges. Try to restrict the outlets from being placed within 20 linear feet of adjacent properties lines.

Photo: Principle Spillway's Barrel (Outlet Pipe) with Plunge Pool and Level Spreader

Permanent Pools

Sediment basins located in low-lying areas or areas with high ground water tables may be incapable of avoiding a standing pool of water within the basin. These conditions may result in a permanent pool of water within the basin during the course of construction activities. Under such conditions, the following design criteria will need to be re-evaluated:

- **Sediment Forebay:** The forebay should be located above the permanent pool elevation when possible. If site-specific constraints are limiting, a forebay may not be capable of being provided. Forebays may not be beneficial when the basin's inlets are submerged and there is little to no overland flow to basin during construction.
- **Rock Berm:** The rock berm may prove ineffective under these circumstances and is not recommended to be provided.
- **Cleanout Height:** Sediment should be removed when approximately ½ of the sediment storage volume is lost due to accumulated sediment. Removal of sediment will also need to be conducted when the skimmer mechanism fails to rise and fall with the water surface elevation due to sediment accumulation along riser structure.

Additionally many other aspects, including baffles and skimmers, of a sediment basin may prove challenging or infeasible to provide and may require other solutions to design a basin that remains in compliance with South Carolina requirements. This is especially true along the coastal regions of South Carolina where relatively flat topography and high water tables limit the depth of basins.

One option to address such circumstances is the use of a single weir as water surface dewatering mechanism. Allowance of this practice may be dependent upon the following:

- The basin's length-to-width ratio;
- The prevention of short-circuiting between the basin's inlets and outlets;
- Whether or not the basin's inlets are submerged;
- The dispersion of flow within the basin;
- The depth of the permanent pool; and
- The maximum head on the weir crest during the 10-yr, NRCS 24-hr storm event.

Another practice to consider when designing a sediment basin with a permanent pool is turbidity curtains. This practice provides an impermeable liner along the entirety of the water column and only allows flow to discharge near the top of the water surface. Upon proper selection and implementation, turbidity curtains may be capable of enhancing the sedimentation process, dispersion of flow, dewatering from the top of the water surface, and restricting the accumulation of sediment near or around the outlet structure.

The use of these suggested practices must be approved prior to being implemented at the construction site.

Inspections & Maintenance

The key to a functional sediment basin is continual inspections, routine maintenance and regular sediment removal. Each sediment basin should be inspected at a minimum of once every calendar week. It is also recommended to inspect sediment basins within 24 hours of a storm event producing 0.5" of precipitation or greater.

Any deficiencies noted during an inspection of the basin must be addressed within 7 calendar days, before the next scheduled inspection, or before the next storm event.

Over the course of the construction project, accumulated sediment will need to be removed from the basin. Ultimately, the accumulated sediment will need to be removed once it reaches ½ of the provided sediment storage volume within the sediment basin but it is recommended to cleanout certain sections of the sediment basin (such as the sediment forebay and the cells between the porous baffles) more frequently. For this reason the following sediment removal procedures may be necessary.

- **Sediment Forebay:** Accumulated sediment should be removed from the forebay when the elevation of the deposited sediment reaches 1/2 the height of the forebay's berm.
- **Porous Baffles' Cells:** Accumulated sediment should be removed from the cells created by each row of baffles when the elevation of the deposited sediment reaches 1/2 the height of the baffles or the cleanout mark located on the cleanout stake, whichever is lower.
- **Rock Berm:** Accumulated sediment should be removed from in front of the rock berm when the elevation of the deposited sediment reaches 1/2 the height of the berm or the cleanout mark located on the cleanout stake, whichever is lower.

When accumulated sediment is removed from a sediment basin, it should be placed in designated stockpile storage areas or spread thinly across the disturbed area and promptly stabilized.

Accumulate sediment is not the only issue that may prevent proper sediment basin functions. Additional maintenance issues that are commonly required to maintain sediment basins are listed in the table located on the following page.

Identified Sediment Basin Condition	Maintenance Measures To Be Taken
Outlet pipe (barrel) is clogged with debris.	Remove debris. Modify trash rack at top of riser structure to restrict larger debris particles from entering the outlet pipe.
Emergency Spillway has eroded due to high discharge velocities during recent storm event.	Stabilize spillway with Erosion Control Blankets (ECBs) or Turf Reinforcement Mats (TRMs) with higher sheer stress capabilities. Alternatively, stabilize spillway with Rip-Rap sized to address anticipated velocities. Extend stabilization down the embankment's interior and exterior slopes, if not already provided.
Basin's side slopes are eroding. The formation of rills and gullies are evident.	Re-grade slopes and provide proper tracking techniques. Seed slopes and stabilize with ECBs, TRMs, or equivalent erosion prevention BMPs, as necessary. Ensure that the slopes are graded correctly. **Do not fill rills/gullies with rip-rap.** Inspect upland areas for evidence of concentrated flows towards slopes. If evident provide a stabilized conveyance method to prevent further erosion along the slope.
Excessive accumulated sediment identified in basin.	Remove sediment to the elevations as denoted on the plans. Place removed sediment in stockpiles or across disturbed areas.
Principle Spillway and Embankment Failure.	Contact regulatory inspection agency. Install temporary BMP measures and stabilize disturbed areas to keep additional impacts to a minimum. Removal of any off-site sediment impacts should be done so at adjacent property owner’s consent.
Skimmer is stuck or is clogged with debris.	Use rope to free skimmer from mud. Clear debris from skimmer orifice and install anti-clog mechanism.
Inlets of basin cited for scouring which is increasing erosion within basin.	Stabilize each inlet with Rip-Rap Aprons. Be sure to extend rip-rap above inlet pipe or into inlet channel.

Basin Removal

Sediment Basin may be removed when all areas discharging to the basin have reached final stabilization or when the conditions listed within the approved On-Site SWPPP have been met. In most circumstances, the basin will not be removed but converted to a detention pond to serve the site post-construction.

When a basin is to be removed, it should be completed within 30 days after final site stabilization is achieved or when the approved conditions indicate removal requirements have been met. All areas disturbed as a result of the sediment basin removal will need to be permanently stabilized. Additional BMPs, such as silt fence may need to be utilized to accept runoff from this area until final stabilization is reached.

Design Aids

The following design methodology (Hayes et al. 1995) may be used to design sediment basins to meet the 80 percent trapping efficiency requirements for TSS, which has a drainage area limitation of 30 acres. Alternatively computer models that utilize eroded particle size distributions to calculate a corresponding trapping efficiency may also be used; these models may allow larger drainage areas.

The listed methodology utilizes an eroded particle diameter from on-site soils to determine the settling velocity associated with the soil's specified particle diameter, the surface area of the basin at the riser crest, and the 10-yr, NRCS 24-hr peak outflow from the basin. These three parameters will then be used to calculate a Basin Ratio that can then be used to determine the trapping efficiency from **Figure SB-1** or **SB-2** located in **Appendix K** of SC DHEC's Stormwater BMP Handbook.

Unfortunately, the majority of the available methodologies and computer models may not take into account the anticipated benefits of the various components of the sediment basin, such as water surface withdrawal, porous baffles, and the sediment forebay.

The suggested procedure to determine the trapping efficiency is outlined below.

Calculating the Trapping Efficiency of a Sediment Basin

1. **Determine on-site soils' characteristic eroded particle diameter.** Each soil has a unique eroded particle diameter and the D_{15} (the particle diameter in which only 15% of the soil particle diameters are less than). To determine the D_{15} use **Appendix E** of SC DHEC's Stormwater BMP Handbook to look up the smallest D_{15} listed for all soils identified on-site.
2. **Determine the characteristic settling velocity of on-site soils.** Use **Figure SV-1**, found in **Appendix K**, which plots eroded particle diameter (D_{15}) versus settling velocity (V_{15}), to determine the value of the settling velocity. This unit is provided in feet per second (fps).
3. **Calculate the Basin Ratio.** Use the provided formula to calculate the Basin Ratio (BR).

$$\text{Basin Ratio} = \frac{q_{po}}{A\,V_{15}}$$

Where:

q_{po} = Peak Outflow Rate from the Basin for the 10-yr, NRCS 24-hr Storm Event (cfs),

A = Surface Area of the Basin at the Riser Crest (acres),

V_{15} = Characteristic Settling Velocity (fps) of the Characteristic D_{15} Eroded Particle (mm).

4. **Determine Trapping Efficiency.** Use **Figure SB-1** or **Figure SB-2** to determine the trapping efficiency with the Basin Ratio calculated in step 3. These figures plot trapping efficiency versus the basin ratio, and each figure is for separate conditions identified as follows:
    - **Figure SB-1** is for basins not located in low lying areas and/or not having a high water table.
    - **Figure SB-2** is for basin located in low lying areas and/or having a high water table. This figure is appropriate for Hydrologic Soil Group (HSG) D soils classified as such due to the presence of a high water table. HSGs A/D, B/D, and C/D are also considered to have high water tables based upon the characteristics of dual hydrologic soil groups.

When using this methodology the following design constraints must be considered:

- Drainage Area to the Sediment Basin must be less than or equal to 30 Acres.
- Overland slope of this drainage area must be less than or equal to 20 percent.
- The sediment basin's Barrel (outlet pipe) must be less than or equal to 6 feet in diameter.
- Any Basin Ratios above the design curves on **Figures SB-1** and **SB-2** are not recommended for any application of the design aids.
- This methodology is not applicable to sediment basins in series.

Additional design guidance on this methodology is as follows:

- If the Basin Ratio intersects the design curve at a point having a trapping efficiency of less than the desired value, the design is inadequate and must be revised.
- A basin, **<u>not</u>** located in low lying area and not having a high water table, has a basin ratio equal to 2.20 E5 at 80 percent trapping efficiency as shown in **Figure SB-1**.
- A basin that **<u>is</u>** located in low lying area and does not have a high water table, has a basin ratio equal to 4.7 E3 at 80 percent trapping efficiency as shown in **Figure SB-2**.

Design Example

Design a sediment basin to accept stormwater runoff from a 14-acre (0.0219 mi2) construction site during construction conditions. Assume the entire area is disturbed and discharges into the sediment basin. (There are no additional discharges to the basin.) The proposed location of the sediment basin is not located in low-lying areas and does not have a high water table. The only constraint on the size of the basin is to limit the surface area at the basin's riser crest to 0.75 acres. Soil Maps indicate that both Cecil and Edisto soil types are found on-site. Calculate the trapping efficiency of the basin for a 10-year, NRCS 24-hour storm event with and without the use of a skimmer. (The peak discharge from the basin is 8.5 cfs when a skimmer is not employed. Assume that no weir flow occurs across riser crest when skimmer is employed.)

Skimmer Manufacturer Information

Skimmer Size	1.5"	2"	2.5"	3"	4"	5"	6"	8"
3 Day Discharge Capacity (Cubic Feet)	5500	10200	19500	31250	64500	102250	165580	298500

Design Example's Given and Find Information

Given:

- Drainage Area = 14 Acres (0.0219 mi2)
- A = 0.75 Acres (at Riser Crest)
- Cecil and Edisto Soil Types
- Not in Low-Lying Areas.
- There is not a High Water Table.
- Peak Discharge without Skimmer = 8.5 cfs

Find:

- Trapping Efficiency with Skimmer
- Trapping Efficiency without Skimmer

Solution 1 (No Skimmer):

1. **Determine D_{15}.** From Appendix E, determine the smallest D_{15} for both Cecil and Edisto Type Soils.
   - **a.** For Cecil Soils, D_{15} = 0.0043 mm
   - **b.** For Edisto Soils, D_{15} = 0.0093 mm

   Since Cecil has the smallest D_{15}, use **0.0043 mm**.
2. **Determine V_{15}.** From Appendix K, use Figure SV-1 to determine the V_{15}. From this figure and use a D_{15} = 0.0043 mm (from step 1), the V_{15} will be approximately **5.19 E-05 fps**.

   Alternatively, this may be calculated from the following equation $V_{15}=2.81(D_{15})^2$. (This equation may only be used if D_{15} is less than 0.01 mm.)
3. **Calculate Basin Ratio.** Calculate the Basin Ratio using the given information and the V_{15} determined is step 2.

$$\mathbf{BR} = \frac{\mathbf{(8.5\ cfs)}}{\mathbf{(0.75\ Acres)(5.19\ E\text{-}05\ fps)}}$$

BR = 218,368.65

4. **Determine Trapping Efficiency.** Determine the trapping efficiency using the calculated BR from step 3 and Figure SB-1 from Appendix K.

Trapping Efficiency = ~80%

Solution 2 (Skimmer):

1. **Discharge Volume.** The discharge volume could be estimated using the recommended sediment storage volume (3600 cubic feet per acre draining) as the discharge volume but, when known, the volume beneath the riser crest should be used as the discharge volume. For this example the sediment storage volume will be used.

   Calculate the required volume that the skimmer must have the capacity to discharge.

$$\textbf{Discharge Volume} = \frac{\mathbf{3600\ ft^3}}{\mathbf{Acre}} \times \mathbf{14\ Acres} = \mathbf{50{,}400\ ft^3}$$

2. **Calculate 3-Day Skimmer Dewatering Discharge.** Use the calculated discharge volume to select a skimmer based off the provided manufacturer's 3-Day Discharge Capacity. In order to

discharge 50,400 cubic feet within 3 days, select the 4" skimmer since it can discharge 64,500 cubic feet in 3 days.

Determine the average discharge rate through the skimmer in cubic feet per second (cfs) using the 4" skimmer's discharge capacity. (The manufacturer may directly cite the average discharge rate.)

$$\frac{\textbf{64,500 ft3}}{\textbf{3 days}} \times \frac{\textbf{1 day}}{\textbf{24 hrs}} \times \frac{\textbf{1 hour}}{\textbf{60 mins}} \times \frac{\textbf{1 min}}{\textbf{60 secs}} = \textbf{0.249 cfs}$$

Note: This average discharge rate of 0.249 cfs assumes that water does not overtop the riser crest during the 10-yr storm event. Basin routing should be conducted to confirm this. The peak discharge from the basin will be greater if the Water Surface Elevation (WSE) during this storm event overtops the riser crest. If the WSE is more than 1 foot above the riser crest, a larger or multiple skimmers may be necessary.

3. **Determine D15.** From Appendix E, determine the smallest D_{15} for both Cecil and Edisto Type Soils.
   - **a.** For Cecil Soils, D_{15} = 0.0043 mm
   - **b.** For Edisto Soils, D_{15} = 0.0093 mm

   Since Cecil has the smallest D_{15}, use **0.0043 mm**.

4. **Determine V15.** From Appendix K, use Figure SV-1 to determine the V_{15}. From this figure and use a D_{15} = 0.0043 mm (from step 1), the V_{15} will be approximately **5.19 E-05 fps**.

   Alternatively, this may be calculated from the following equation $V_{15}=2.81(D_{15})^2$. (This equation may only be used if D_{15} is less than 0.01 mm.)

5. **Calculate Basin Ratio.** Calculate the Basin Ratio using the given information and the V_{15} determined is step 2.

$$\textbf{BR} = \frac{\textbf{(0.249 cfs)}}{\textbf{(0.75 Acres)(5.19 E-05 fps)}}$$

BR = 6396.92

6. **Determine Trapping Efficiency.** Determine the trapping efficiency using the calculated BR from step 3 and Figure SB-1 from Appendix K.

Trapping Efficiency = ~92.5%

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3.0 REFERENCES

3.2 Reference 2

USDA Curve Number Values – Table 9-1

(2) Use of table 9–1

Chapters 7 and 8 of NEH 630 describe how soils and covers of watersheds or other land areas are classified in the field. After the classification is completed, CNs are read from table 9–1 and applied as described in chapter 10. Because the principal use of CNs is for estimating runoff from rainfall, the examples of applications are given in chapter 10.

Table 9–1 Runoff curve numbers for agricultural lands [1/]

Cover description: cover type	treatment [2/]	hydrologic condition [3/]	CN for hydrologic soil group: A	B	C	D
Fallow	Bare Soil	---	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C & T)	Poor	66	74	80	82
		Good	62	71	78	81
	C & T + CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C & T	Poor	61	72	79	82
		Good	59	70	78	81
	C & T + CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C & T	Poor	63	73	80	83
		Good	51	67	76	80

See footnotes at end of table.

Table 9–1 Runoff curve numbers for agricultural lands 1/ — Continued

Cover description: cover type	treatment 2/	hydrologic condition 3/	CN for hydrologic soil group: A	B	C	D
Pasture, grassland, or range-continuous forage for grazing 4/		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
Meadow-continuous grass, protected from grazing and generally mowed for hay		Good	30	58	71	78
Brush-brush-forbs-grass mixture with brush the major element 5/		Poor	48	67	77	83
		Fair	35	56	70	77
		Good	30 6/	48	65	73
Woods-grass combination (orchard or tree farm) 7/		Poor	57	73	82	86
		Fair	43	65	76	82
		Good	32	58	72	79
Woods 8/		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	30	55	70	77
Farmstead--buildings, lanes, driveways, and surrounding lots		---	59	74	82	86
Roads (including right-of-way):						
Dirt		---	72	82	87	89
Gravel		---	76	85	89	91

1/ Average runoff condition, and I_a=0.2s.

2/ Crop residue cover applies only if residue is on at least 5 percent of the surface throughout the year.

3/ Hydrologic condition is based on combinations of factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥20%), and (e) degree of surface toughness.
Poor: Factors impair infiltration and tend to increase runoff.
Good: Factors encourage average and better then average infiltration and tend to decrease runoff.
For conservation tillage poor hydrologic condition, 5 to 20 percent of the surface is covered with residue (less than 750 pounds per acre for row crops or 300 pounds per acre for small grain).
For conservation tillage good hydrologic condition, more than 20 percent of the surface is covered with residue (greater than 750 pounds per acre for row crops or 300 pounds per acre for small grain).

4/ Poor: < 50% ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

5/ Poor: < 50% ground cover.
Fair: 50 to 75% ground cover.
Good: > 75% ground cover.

6/ If actual curve number is less than 30, use CN = 30 for runoff computation.

7/ CNs shown were computed for areas with 50 percent woods and 50 percent grass (pasture) cover. Other combinations of conditions may be computed from the CNs for woods and pasture.

8/ Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed, but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

3.0 REFERENCES

3.3 Reference 3

TR-55 Urban Hydrology for Small Watersheds – Chapter 3 and Appendix F

Chapter 3 Time of Concentration and Travel Time

Travel time (T_t) is the time it takes water to travel from one location to another in a watershed. T_t is a component of time of concentration (T_c), which is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. T_c is computed by summing all the travel times for consecutive components of the drainage conveyance system.

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c, thereby increasing the peak discharge. But T_c can be increased as a result of (a) ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or (b) reduction of land slope through grading.

Factors affecting time of concentration and travel time

Surface roughness

One of the most significant effects of urban development on flow velocity is less retardance to flow. That is, undeveloped areas with very slow and shallow overland flow through vegetation become modified by urban development: the flow is then delivered to streets, gutters, and storm sewers that transport runoff downstream more rapidly. Travel time through the watershed is generally decreased.

Channel shape and flow patterns

In small non-urban watersheds, much of the travel time results from overland flow in upstream areas. Typically, urbanization reduces overland flow lengths by conveying storm runoff into a channel as soon as possible. Since channel designs have efficient hydraulic characteristics, runoff flow velocity increases and travel time decreases.

Slope

Slopes may be increased or decreased by urbanization, depending on the extent of site grading or the extent to which storm sewers and street ditches are used in the design of the water management system. Slope will tend to increase when channels are straightened and decrease when overland flow is directed through storm sewers, street gutters, and diversions.

Computation of travel time and time of concentration

Water moves through a watershed as sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type that occurs is a function of the conveyance system and is best determined by field inspection.

Travel time (T_t) is the ratio of flow length to flow velocity:

$$T_t = \frac{L}{3600V} \qquad \text{[eq. 3-1]}$$

where:

T_t = travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours.

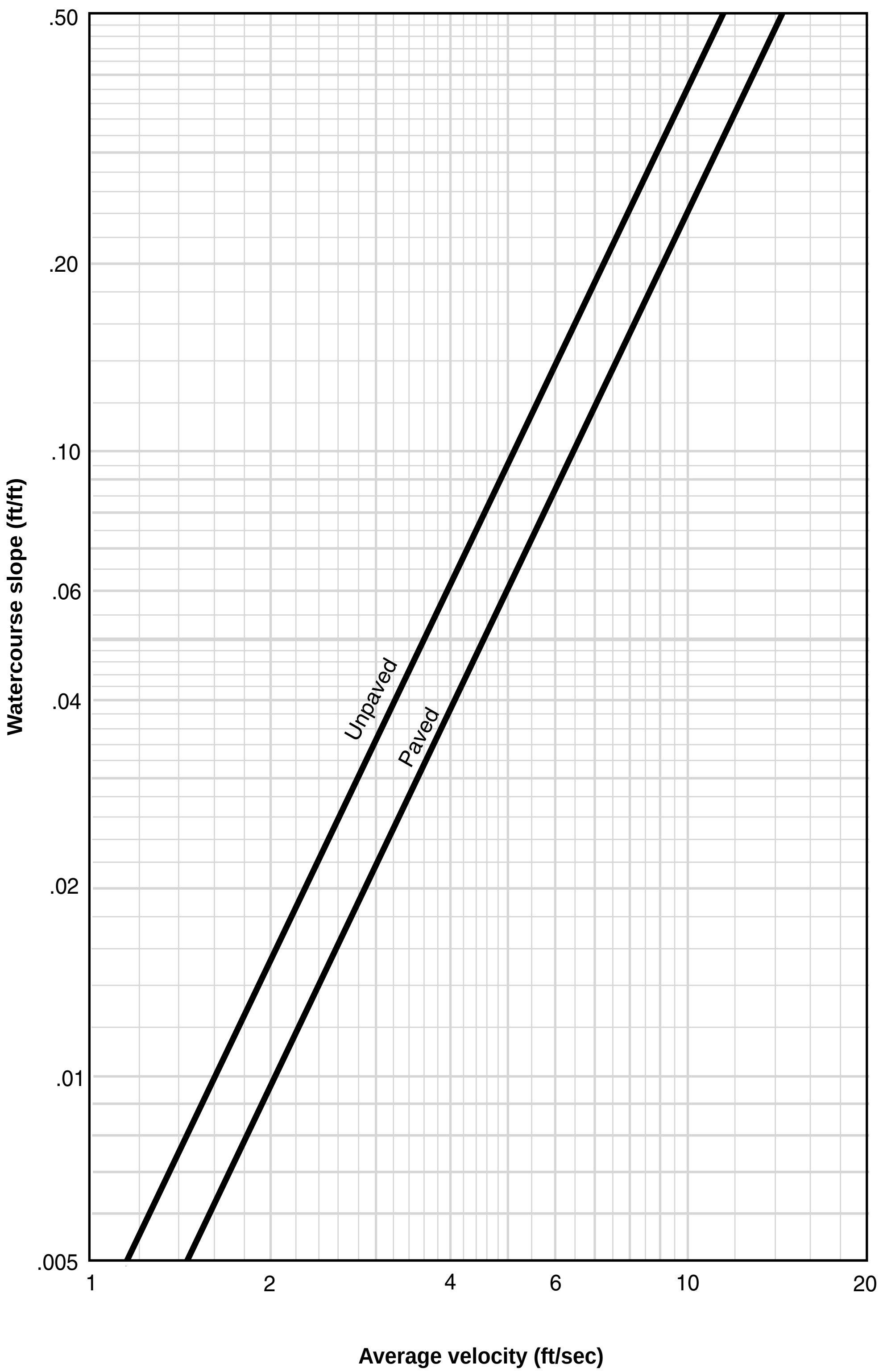
Time of concentration (T_c) is the sum of T_t values for the various consecutive flow segments:

$$T_c = T_{t_1} + T_{t_2} + \ldots T_{t_m} \qquad \text{[eq. 3-2]}$$

where:

T_c = time of concentration (hr)
m = number of flow segments

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow



Sheet flow

Sheet flow is flow over plane surfaces. It usually occurs in the headwater of streams. With sheet flow, the friction value (Manning's n) is an effective roughness coefficient that includes the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. These n values are for very shallow flow depths of about 0.1 foot or so. Table 3-1 gives Manning's n values for sheet flow for various surface conditions.

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

1 The n values are a composite of information compiled by Engman (1986).
2 Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
3 When selecting n , consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

For sheet flow of less than 300 feet, use Manning's kinematic solution (Overtop and Meadows 1976) to compute T_t:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}} \qquad \text{[eq. 3-3]}$$

where:

T_t = travel time (hr),
n = Manning's roughness coefficient (table 3-1)
L = flow length (ft)
P_2 = 2-year, 24-hour rainfall (in)
s = slope of hydraulic grade line (land slope, ft/ft)

This simplified form of the Manning's kinematic solution is based on the following: (1) shallow steady uniform flow, (2) constant intensity of rainfall excess (that part of a rain available for runoff), (3) rainfall duration of 24 hours, and (4) minor effect of infiltration on travel time. Rainfall depth can be obtained from appendix B.

Shallow concentrated flow

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from figure 3-1, in which average velocity is a function of watercourse slope and type of channel. For slopes less than 0.005 ft/ft, use equations given in appendix F for figure 3-1. Tillage can affect the direction of shallow concentrated flow. Flow may not always be directly down the watershed slope if tillage runs across the slope.

After determining average velocity in figure 3-1, use equation 3-1 to estimate travel time for the shallow concentrated flow segment.

Open channels

Open channels are assumed to begin where surveyed cross section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets. Manning's equation or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full elevation.

Manning's equation is:

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n} \qquad \text{[eq. 3-4]}$$

where:

V = average velocity (ft/s)
r = hydraulic radius (ft) and is equal to a/p_w
a = cross sectional flow area (ft^2)
p_w = wetted perimeter (ft)
s = slope of the hydraulic grade line (channel slope, ft/ft)
n = Manning's roughness coefficient for open channel flow.

Manning's n values for open channel flow can be obtained from standard textbooks such as Chow (1959) or Linsley et al. (1982). After average velocity is computed using equation 3-4, T_t for the channel segment can be estimated using equation 3-1.

Reservoirs or lakes

Sometimes it is necessary to estimate the velocity of flow through a reservoir or lake at the outlet of a watershed. This travel time is normally very small and can be assumed as zero.

Limitations

- Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 3-3 was developed for use with the four standard rainfall intensity-duration relationships.
- In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate T_c. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or nonpressure flow.
- The minimum T_c used in TR-55 is 0.1 hour.
- A culvert or bridge can act as a reservoir outlet if there is significant storage behind it. The procedures in TR-55 can be used to determine the peak flow upstream of the culvert. Detailed storage routing procedures should be used to determine the outflow through the culvert.

Example 3-1

The sketch below shows a watershed in Dyer County, northwestern Tennessee. The problem is to compute T_c at the outlet of the watershed (point D). The 2-year 24-hour rainfall depth is 3.6 inches. All three types of flow occur from the hydraulically most distant point (A) to the point of interest (D). To compute T_c, first determine T_t for each segment from the following information:

Segment AB: Sheet flow; dense grass; slope (s) = 0.01 ft/ft; and length (L) = 100 ft. Segment BC: Shallow concentrated flow; unpaved; s = 0.01 ft/ft; and L = 1,400 ft. Segment CD: Channel flow; Manning's n = .05; flow area (a) = 27 ft^2; wetted perimeter (p_w) = 28.2 ft; s = 0.005 ft/ft; and L = 7,300 ft.

See figure 3-2 for the computations made on worksheet 3.

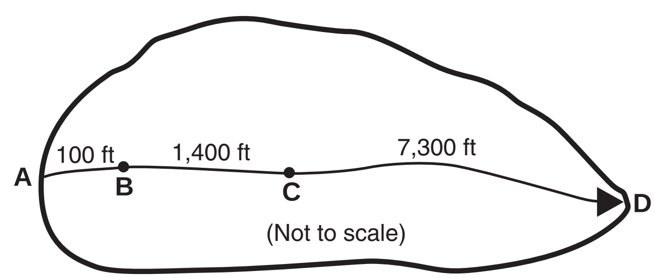


Figure 3-2 Worksheet 3 for example 3-1

Worksheet 3: Time of Concentration (T_c) or travel time (T_t)

Project *Heavenly Acres*	By *DW*	Date *10/6/85*
Location *Dyer County, Tennessee*	Checked *NM*	Date *10/8/85*

Check one: ☐ Present ☒ Developed

Check one: ☒ T_c ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)

	Segment ID	AB		
1.	Surface description (table 3-1)	*Dense Grass*		
2.	Manning's roughness coefficient, n (table 3-1)	*0.24*		
3.	Flow length, L (total L ≤ 300 ft) ... ft	*100*		
4.	Two-year 24-hour rainfall, P_2 ... in	*3.6*		
5.	Land slope, s ... ft/ft	*0.01*		
6.	$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{\ 0.5}\ s^{0.4}}$ Compute T_t ... hr	*0.30*	+	= *0.30*

Shallow concentrated flow

	Segment ID	BC		
7.	Surface description (paved or unpaved)	*Unpaved*		
8.	Flow length, L ... ft	*1400*		
9.	Watercourse slope, s ... ft/ft	*0.01*		
10.	Average velocity, V (figure 3-1) ... ft/s	*1.6*		
11.	$T_t = \frac{L}{3600\ V}$ Compute T_t ... hr	*0.24*	+	= *0.24*

Channel flow

	Segement ID	CD		
12.	Cross sectional flow area, a ... ft^2	*27*		
13.	Wetted perimeter, p_w ... ft	*28.2*		
14.	Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ... ft	*0.957*		
15	Channel slope, s ... ft/ft	*0.005*		
16.	Manning's roughness coefficient, n	*0.05*		
17.	$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ... ft/s	*2.05*		
18.	Flow length, L ... ft	*7300*		
19.	$T_t = \frac{L}{3600\ V}$ Compute T_t ... hr	*0.99*	+	= *0.99*
20.	Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ... Hr			*1.53*

Appendix F Equations for figures and exhibits

This appendix presents the equations used in procedure applications to generate figures and exhibits in TR-55.

Figure 2-1 (runoff equation):

$$Q = \frac{\left[P - .2\left(\frac{1000}{CN} - 10\right)\right]^2}{P + 0.8\left(\frac{1000}{CN} - 10\right)}$$

where
Q = runoff (in)
P = rainfall (in)
CN = runoff curve number

Figure 2-3 (composite CN with connected impervious area):

$$CN_c = CN_p + \left(\frac{P_{imp}}{100}\right)\left(98 - CN_p\right)$$

where
CN_c = composite runoff curve number
CN_p = pervious runoff curve number
P_{imp} = percent imperviousness.

Figure 2-4 (composite CN with unconnected impervious areas and total impervious area less than 30%):

$$CN_c = CN_p + \left(\frac{P_{imp}}{100}\right)\left(98 - CN_p\right)\left(1 - 0.5R\right)$$

where
R = ratio of unconnected impervious area to total impervious area.

Figure 3-1 (average velocities for estimating travel time for shallow concentrated flow):
Unpaved $V = 16.1345\ (s)^{0.5}$
Paved $V = 20.3282\ (s)^{0.5}$

where

V= average velocity (ft/s)
s = slope of hydraulic grade line (watercourse slope, ft/ft)

These two equations are based on the solution of Manning's equation (eq. 3-4) with different assumptions for n (Manning's roughness coefficient) and r (hydraulic radius, ft). For unpaved areas, n is 0.05 and r is 0.4; for paved areas, n is 0.025 and r is 0.2.

Exhibit 4 (unit peak discharges for SCS tvpe I, IA, II, and III distributions):

$$\log\left(q_u\right) = C_o + C_1 \log\left(T_c\right) + C_2\left[\log\left(T_c\right)\right]^2$$

where
q_u = unit peak discharge (csm/in)
T_c = time of concentration (hr) (minimum, 0.1; maximum, 10.0)
C_0, C_1, C_2 = coefficients from table F-1

Figure 6-1 (approximate detention basin routing through single- and multiple-stage structures for 24-hour rainfalls of the indicated type):

$$\frac{V_S}{V_r} = C_o + C_1\left(\frac{q_o}{q_1}\right) + C_2\left(\frac{q_o}{q_1}\right)^2 + C_3\left(\frac{q_o}{q_1}\right)^3$$

where
V_s/V_r = ratio of storage volume (V_s) to runoff volume (V_r)
q_o/q_i = ratio of peak outflow discharge (q_o) to peak inflow discharge (q_i)
C_0, C_1, C_2, C_3 = coefficients from table F-2

3.0 REFERENCES

3.4 Reference 4

NOAA Atlas 14, Volume 2, Version 3 – Batesburg, South Carolina

NOAA Atlas 14, Volume 2, Version 3
Location name: Batesburg, South Carolina, USA*
Latitude: 33.9664°, Longitude: -81.5851°
Elevation: 514 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.444 (0.408-0.486)	0.519 (0.477-0.566)	0.596 (0.547-0.651)	0.665 (0.610-0.725)	0.747 (0.682-0.813)	0.811 (0.738-0.884)	0.874 (0.790-0.951)	0.935 (0.839-1.02)	1.01 (0.898-1.10)	1.07 (0.948-1.17)
10-min	0.709 (0.652-0.776)	0.829 (0.763-0.906)	0.955 (0.877-1.04)	1.06 (0.976-1.16)	1.19 (1.09-1.30)	1.29 (1.18-1.41)	1.39 (1.26-1.51)	1.48 (1.33-1.61)	1.60 (1.42-1.74)	1.69 (1.49-1.85)
15-min	0.887 (0.815-0.971)	1.04 (0.959-1.14)	1.21 (1.11-1.32)	1.35 (1.23-1.47)	1.51 (1.38-1.64)	1.64 (1.49-1.78)	1.76 (1.59-1.91)	1.87 (1.68-2.04)	2.01 (1.79-2.19)	2.12 (1.87-2.32)
30-min	1.22 (1.12-1.33)	1.44 (1.32-1.57)	1.72 (1.58-1.87)	1.95 (1.79-2.13)	2.24 (2.04-2.43)	2.46 (2.24-2.68)	2.69 (2.43-2.92)	2.91 (2.61-3.17)	3.20 (2.85-3.49)	3.44 (3.04-3.76)
60-min	1.52 (1.39-1.66)	1.81 (1.66-1.97)	2.20 (2.02-2.40)	2.54 (2.33-2.77)	2.98 (2.72-3.24)	3.34 (3.04-3.64)	3.70 (3.35-4.03)	4.08 (3.66-4.44)	4.59 (4.08-5.00)	5.02 (4.43-5.48)
2-hr	1.75 (1.60-1.91)	2.09 (1.91-2.28)	2.55 (2.34-2.78)	2.97 (2.72-3.24)	3.54 (3.22-3.85)	4.03 (3.66-4.39)	4.55 (4.10-4.95)	5.12 (4.59-5.57)	5.93 (5.26-6.47)	6.66 (5.84-7.27)
3-hr	1.84 (1.69-2.02)	2.20 (2.02-2.41)	2.70 (2.47-2.95)	3.16 (2.89-3.46)	3.81 (3.46-4.16)	4.39 (3.97-4.78)	5.02 (4.50-5.45)	5.71 (5.08-6.20)	6.72 (5.91-7.31)	7.65 (6.64-8.33)
6-hr	2.20 (2.01-2.42)	2.62 (2.41-2.88)	3.22 (2.95-3.54)	3.78 (3.46-4.15)	4.58 (4.15-5.00)	5.29 (4.76-5.77)	6.06 (5.41-6.60)	6.92 (6.13-7.53)	8.19 (7.15-8.91)	9.35 (8.06-10.2)
12-hr	2.58 (2.36-2.86)	3.08 (2.82-3.42)	3.80 (3.48-4.21)	4.49 (4.08-4.96)	5.47 (4.94-6.02)	6.36 (5.70-6.99)	7.33 (6.51-8.05)	8.42 (7.40-9.24)	10.1 (8.69-11.0)	11.6 (9.84-12.7)
24-hr	3.01 (2.81-3.24)	3.62 (3.37-3.88)	4.51 (4.19-4.84)	5.25 (4.88-5.63)	6.34 (5.86-6.78)	7.26 (6.66-7.77)	8.25 (7.52-8.84)	9.33 (8.44-10.0)	10.9 (9.74-11.7)	12.2 (10.8-13.2)
2-day	3.55 (3.32-3.81)	4.26 (3.99-4.56)	5.27 (4.93-5.65)	6.11 (5.70-6.55)	7.31 (6.78-7.83)	8.31 (7.67-8.91)	9.37 (8.60-10.1)	10.5 (9.57-11.3)	12.1 (10.9-13.1)	13.4 (12.0-14.6)
3-day	3.78 (3.54-4.05)	4.53 (4.24-4.86)	5.59 (5.23-5.99)	6.46 (6.02-6.92)	7.69 (7.13-8.24)	8.71 (8.04-9.34)	9.78 (8.98-10.5)	10.9 (9.96-11.8)	12.5 (11.3-13.6)	13.8 (12.4-15.0)
4-day	4.01 (3.75-4.30)	4.81 (4.49-5.15)	5.91 (5.52-6.33)	6.81 (6.34-7.29)	8.07 (7.48-8.65)	9.11 (8.40-9.77)	10.2 (9.36-11.0)	11.3 (10.3-12.2)	13.0 (11.7-14.0)	14.2 (12.7-15.5)
7-day	4.68 (4.39-4.98)	5.57 (5.24-5.94)	6.79 (6.36-7.23)	7.77 (7.27-8.27)	9.17 (8.55-9.77)	10.3 (9.57-11.0)	11.5 (10.6-12.3)	12.8 (11.7-13.7)	14.6 (13.2-15.7)	16.0 (14.4-17.3)
10-day	5.29 (4.98-5.61)	6.29 (5.92-6.66)	7.58 (7.13-8.03)	8.63 (8.11-9.15)	10.1 (9.46-10.7)	11.3 (10.5-12.0)	12.6 (11.6-13.4)	13.9 (12.8-14.8)	15.7 (14.3-16.9)	17.2 (15.5-18.5)
20-day	7.06 (6.69-7.43)	8.34 (7.90-8.78)	9.84 (9.32-10.4)	11.0 (10.4-11.6)	12.7 (12.0-13.4)	14.0 (13.1-14.7)	15.3 (14.3-16.1)	16.6 (15.5-17.5)	18.4 (17.0-19.5)	19.7 (18.2-21.0)
30-day	8.69 (8.26-9.12)	10.2 (9.72-10.7)	11.9 (11.3-12.5)	13.3 (12.6-13.9)	15.0 (14.2-15.8)	16.4 (15.5-17.2)	17.7 (16.7-18.6)	19.0 (17.8-20.1)	20.8 (19.4-22.0)	22.1 (20.5-23.4)
45-day	10.9 (10.4-11.4)	12.8 (12.2-13.4)	14.7 (14.0-15.4)	16.2 (15.4-17.0)	18.2 (17.2-19.0)	19.6 (18.6-20.5)	21.0 (19.9-22.1)	22.4 (21.1-23.5)	24.2 (22.7-25.5)	25.5 (23.8-26.9)
60-day	13.1 (12.5-13.7)	15.3 (14.6-16.0)	17.5 (16.7-18.3)	19.1 (18.2-19.9)	21.1 (20.1-22.1)	22.6 (21.5-23.6)	24.0 (22.8-25.1)	25.3 (24.0-26.5)	26.9 (25.4-28.3)	28.0 (26.4-29.5)

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

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

Please refer to NOAA Atlas 14 document for more information.

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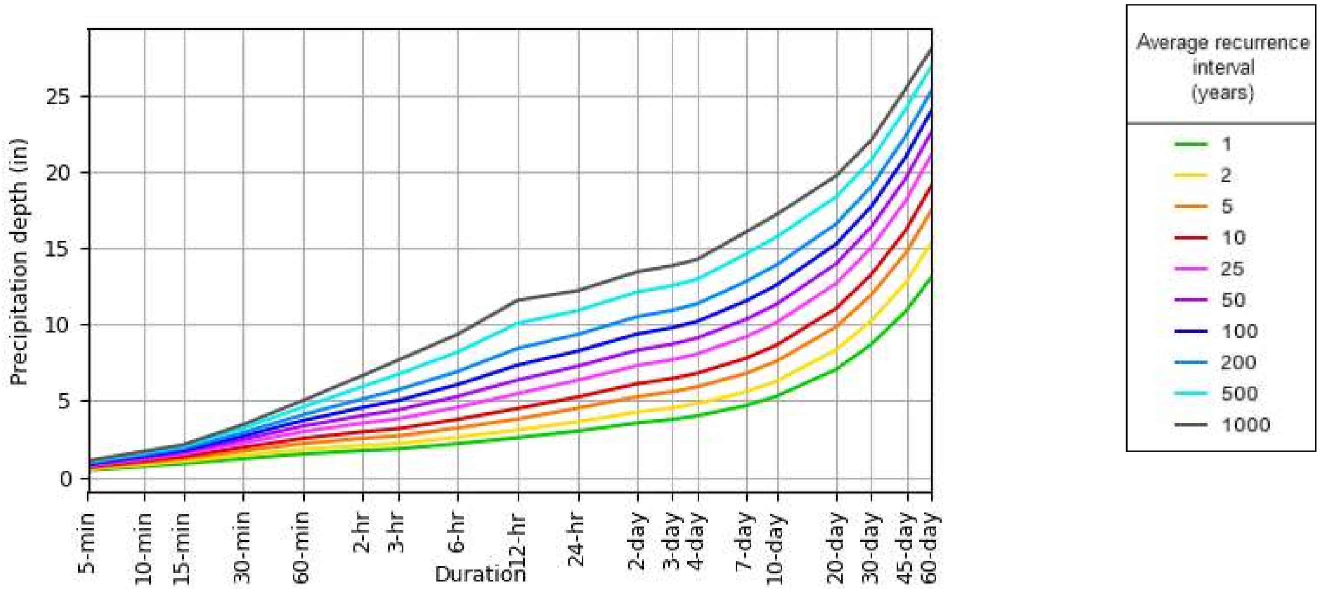
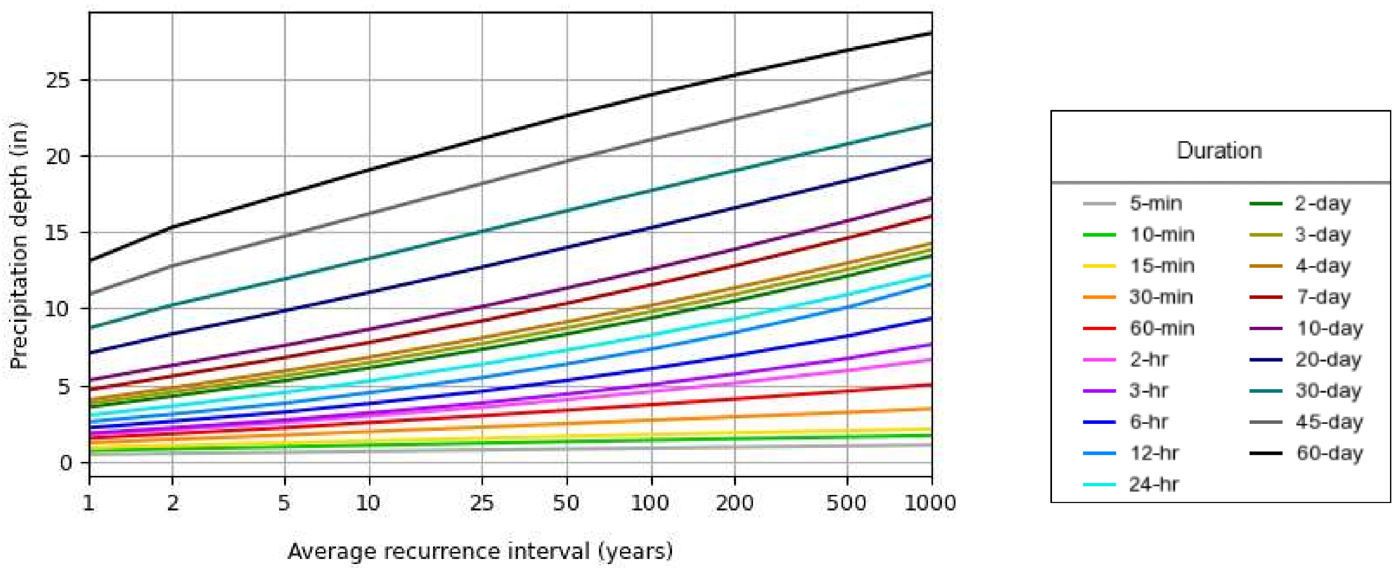
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 33.9664°, Longitude: -81.5851°





NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Tue Jul 11 16:52:52 2023

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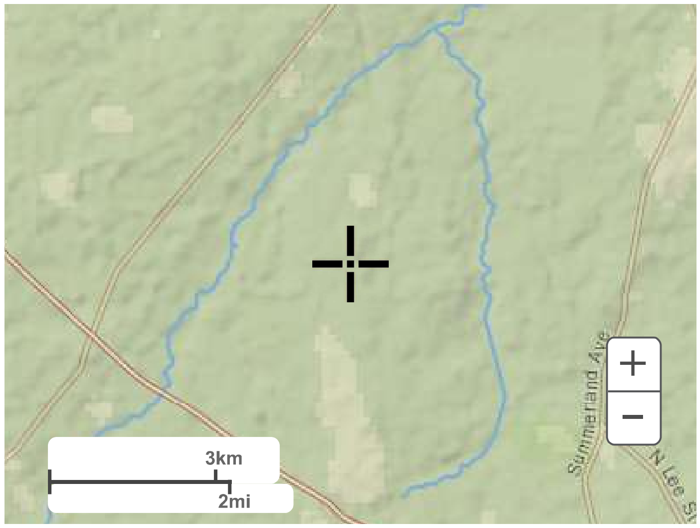
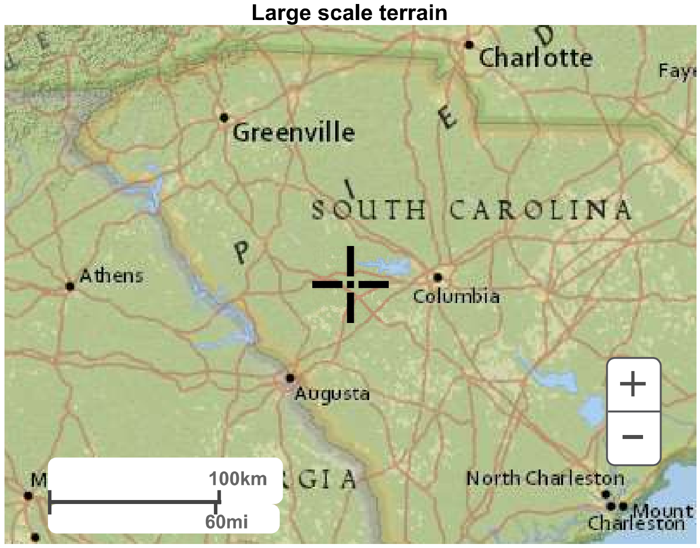
Maps & aerials

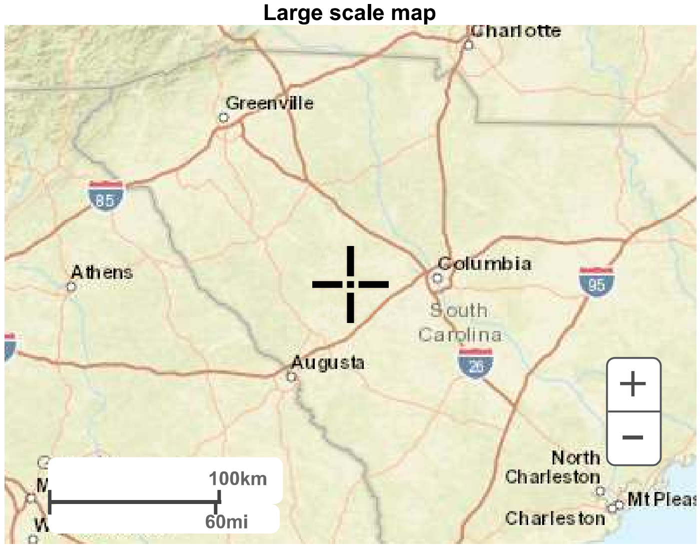
Small scale terrain



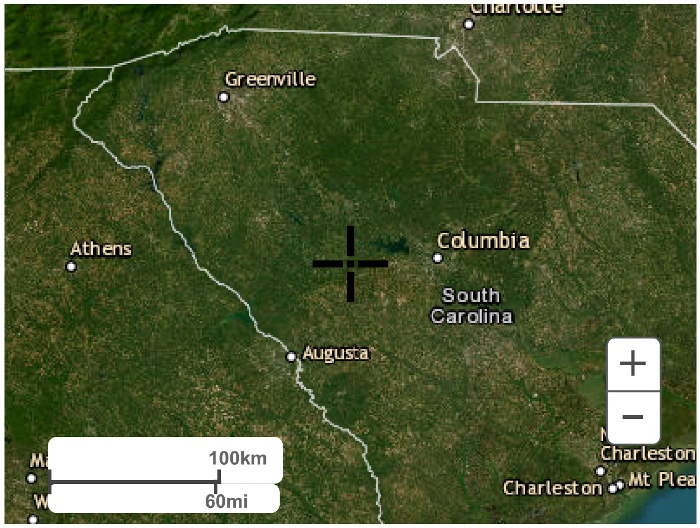
Large scale terrain



Large scale map



Large scale aerial



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

Disclaimer

3.0 REFERENCES

3.5 Reference 5

SC DHEC Stormwater BMP Handbook – Appendix E (Pages 11 and 23)

			Particle Sizes (mm)							
Depth	**D15(mm)**	**K**	**1.4**	**1.0**	**0.063**	**0.044**	**0.038**	**0.004**	**0.003**	**0.001**
SOIL: CECIL (B)										
0 - 7	0.0066	0.28	100.0	84.1	47.9	39.0	39.0	8.1	5.4	0.0
7 - 11	0.0066	0.28	100.0	84.1	47.9	39.0	39.0	8.1	5.4	0.0
11 - 50	0.0043	0.28	100.0	81.0	37.6	36.1	36.1	14.3	10.2	0.0
SOIL: CENTENARY (A)										
0 - 9	0.0465	0.10	100.0	93.3	77.9	3.7	3.7	1.2	0.9	0.0
9 - 58	0.0454	0.10	100.0	93.6	78.9	8.7	8.7	1.4	0.9	0.0
58 - 72	0.0460	0.10	100.0	91.6	72.4	7.1	7.1	1.7	1.2	0.0
SOIL: CHANDLER (B)										
0 - 4	0.0101	0.32	100.0	89.9	66.8	32.7	31.4	3.6	2.2	0.0
4 - 66	0.0101	0.32	100.0	89.9	66.8	32.7	31.4	3.6	2.2	0.0
SOIL: CHARLESTON (C)										
0 - 16	0.0125	0.15	100.0	88.8	63.0	26.4	26.1	3.6	2.2	0.0
16 - 44	0.0128	0.20	100.0	86.4	55.1	25.1	25.1	4.3	2.7	0.0
44 - 80	0.0458	0.15	100.0	89.0	63.7	8.7	8.7	2.4	1.7	0.0
SOIL: CHASTAIN (C)										
0 - 5	0.0049	0.28	100.0	87.8	59.8	54.7	53.6	11.1	7.5	0.0
5 – 52	0.0044	0.37	100.0	87.0	57.3	52.6	51.3	13.3	9.3	0.0
52 - 72	0.0453	0.10	100.0	91.8	73.2	10.1	10.1	1.8	1.2	0.0
SOIL: CHENNEBYPO (C)										
0 – 16	0.0052	0.32	100.0	90.6	69.1	61.8	60.0	9.3	6.0	0.0
16 - 55	0.0056	0.32	100.0	91.5	71.9	61.8	59.9	7.3	4.6	0.0
55 - 72	0.0092	0.24	100.0	84.8	49.9	30.9	30.9	5.7	3.7	0.0
SOIL: CHEWACLA (C)										
0 - 8	0.0056	0.28	100.0	91.1	70.7	59.7	58.8	7.2	4.4	0.0
8 - 24	0.0056	0.32	100.0	88.5	62.1	54.9	54.5	8.2	5.2	0.0
24 - 34	0.0074	0.28	100.0	83.4	45.5	34.6	34.6	7.7	5.2	0.0
34 - 58	0.0056	0.28	100.0	88.5	62.1	54.9	54.5	8.2	5.2	0.0
SOIL: CHIPLEY (C)										
0 - 6	0.0457	0.10	100.0	95.5	85.1	6.6	6.5	0.9	0.6	0.0
6 - 77	0.0459	0.10	100.0	94.1	80.5	6.0	6.0	1.2	0.8	0.0

Depth	D15(mm)	K	1.4	1.0	0.063	0.044	0.038	0.004	0.003	0.001
			|----------------	----------Particle Sizes (mm)	---------------------------					|
SOIL: HAYESVILLEST (C)										
0 - 5	0.0066	0.15	100.0	84.2	48.1	39.4	39.4	8.1	5.4	0.0
5 - 38	0.0044	0.28	100.0	82.4	42.0	40.5	40.5	13.8	9.8	0.0
38 – 48	0.0073	0.28	100.0	81.2	38.1	30.9	30.9	9.1	6.3	0.0
48 - 60	0.0089	0.24	100.0	90.0	67.1	36.6	35.0	3.9	2.4	0.0
SOIL: HAYWOOD (B)										
0 - 60	0.0085	0.24	100.0	86.1	54.3	34.3	34.2	5.4	3.4	0.0
SOIL: HELENAGR (C)										
0 - 12	0.0106	0.20	100.0	80.7	36.6	24.6	24.6	7.7	5.4	0.0
12 – 19	0.0066	0.28	100.0	84.1	47.9	39.0	39.0	8.1	5.4	0.0
19 - 43	0.0049	0.28	100.0	81.1	37.9	35.8	35.8	13.0	9.3	0.0
SOIL: HERNDON (B)										
0 - 9	0.0053	0.49	100.0	88.1	60.7	54.8	54.0	9.3	6.0	0.0
9 - 48	0.0045	0.28	100.0	84.8	50.2	47.3	46.8	13.3	9.3	0.0
48 - 68	0.0063	0.32	100.0	90.7	69.5	53.0	50.8	5.8	3.6	0.0
SOIL: HIWASSEE (B)										
0 - 7	0.0061	0.28	100.0	88.0	60.5	49.5	49.0	7.0	4.4	0.0
7 - 61	0.0048	0.28	100.0	81.7	39.8	37.8	37.8	13.1	9.3	0.0
61 - 70	0.0081	0.28	100.0	84.6	49.5	34.3	34.3	6.3	4.1	0.0
SOIL: HIWASSEEGR (B)										
0 - 7	0.0061	0.24	100.0	90.1	67.4	52.7	51.8	6.4	3.9	0.0
7 - 61	0.0048	0.28	100.0	81.7	39.8	37.8	37.8	13.1	9.3	0.0
61 –70	0.0081	0.28	100.0	84.6	49.5	34.3	34.3	6.3	4.1	0.0
SOIL: HOBCAW (D)										
0 - 18	0.0094	0.17	100.0	89.6	65.7	34.5	33.3	3.9	2.4	0.0
18 - 46	0.0074	0.24	100.0	83.4	45.5	34.6	34.6	7.7	5.2	0.0
SOIL: HOBCAWFL (D)										
0 – 18	0.0094	0.17	100.0	89.6	65.7	34.5	33.3	3.9	2.4	0.0
18 – 46	0.0074	0.24	100.0	83.4	45.5	34.6	34.6	7.7	5.2	0.0

3.0 REFERENCES

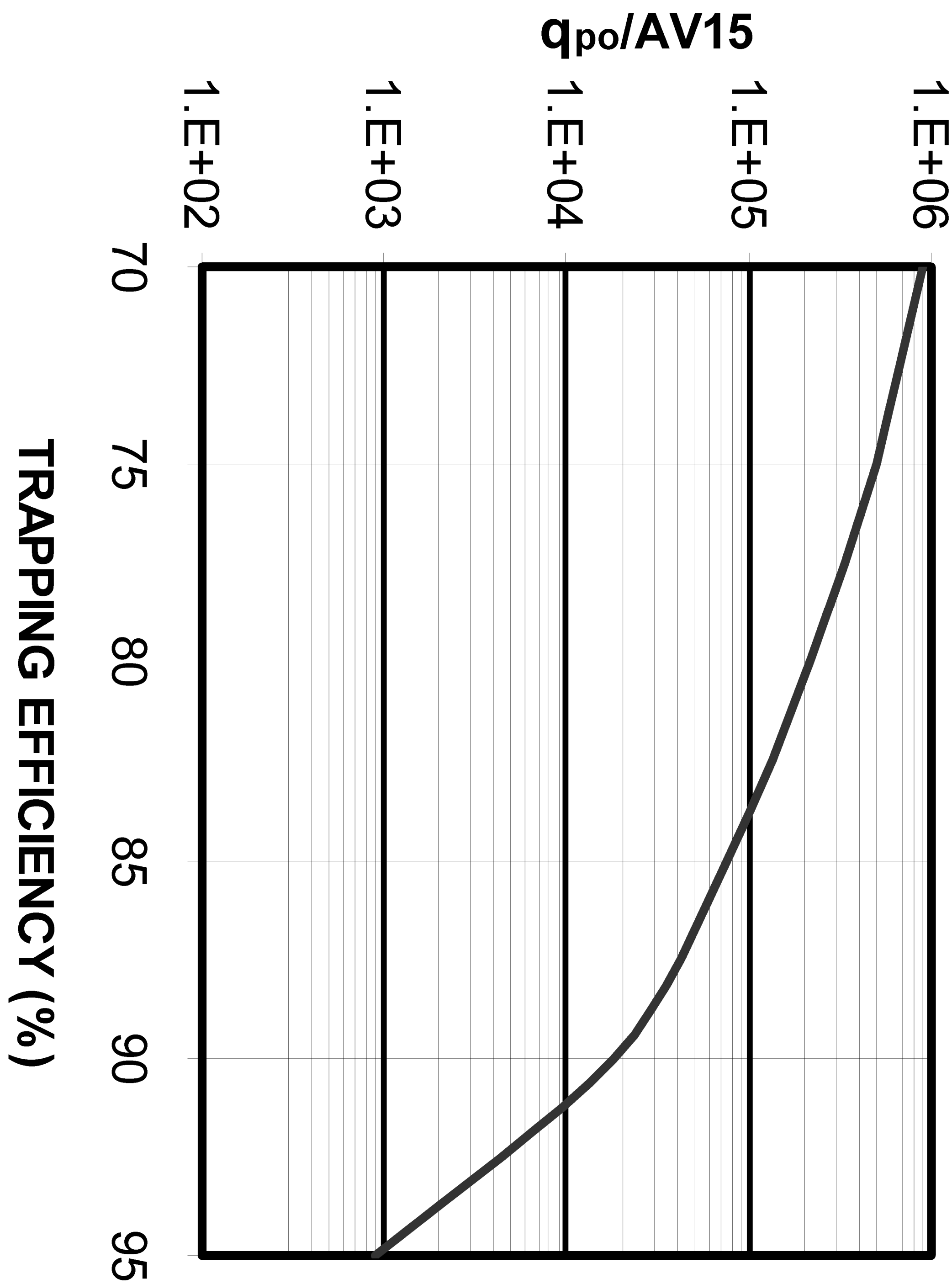
3.6 Reference 6

SC DHEC Stormwater BMP Handbook – Appendix K (Pages 14 and 28)

South Carolina
Department of Health
and Environmental Control

FIGURE SB-1
TRAPPING EFFIENCY FOR BASINS NOT IN LOW LYING AREAS

EFFECTIVE DATE: AUGUST, 2005



DESIGN AID FOR ESTIMATING TRAPPING EFFICIENCY FOR SEDIMENT BASINS NOT LOCATED IN LOW LYING AREAS AND/OR NOT HAVING A HIGH WATER TABLE

FIGURE SV-1
CHARACTERISTIC SETTLING VELOCITY AS A FUNCTION OF ERODED PARTICLE DIAMETER