DEQ Certification Class Presentations

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July 2024

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Module 8

Sediment Trap and Basin Problems

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Module 8 Contents

8a. Sediment Trap Problems

8b. Sediment Basin Problems

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Module 8a.

Sediment Trap Problems

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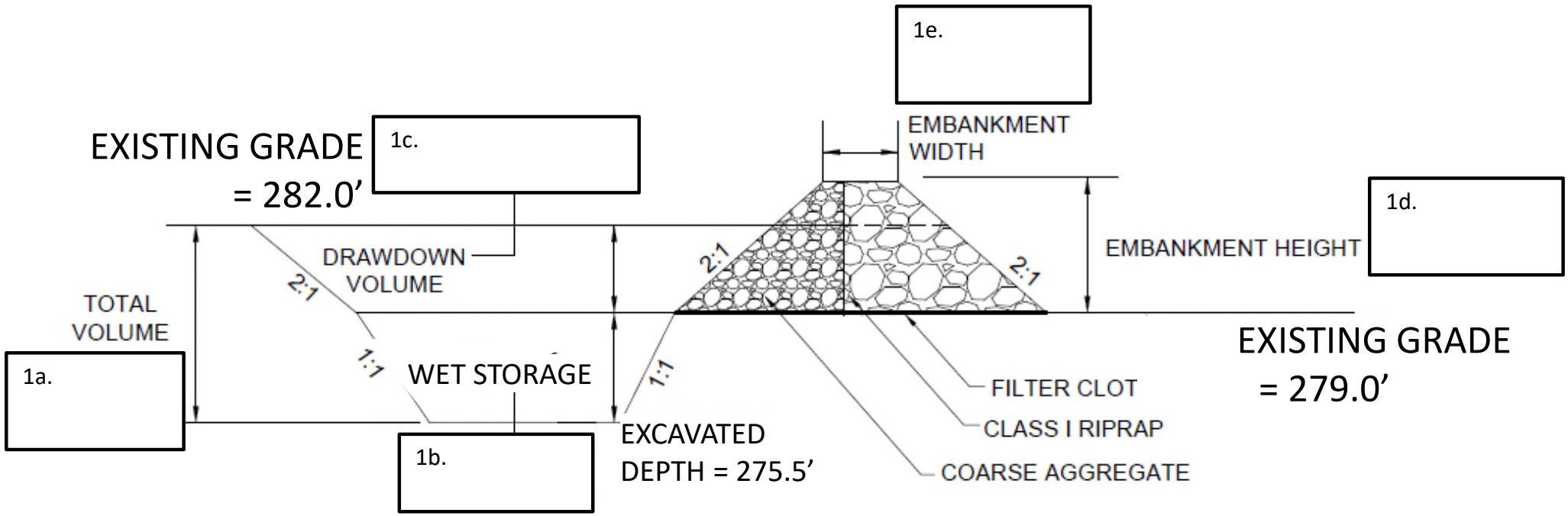
Figure 8-1. Sediment Trap Cross-Section



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1a. Total Storage

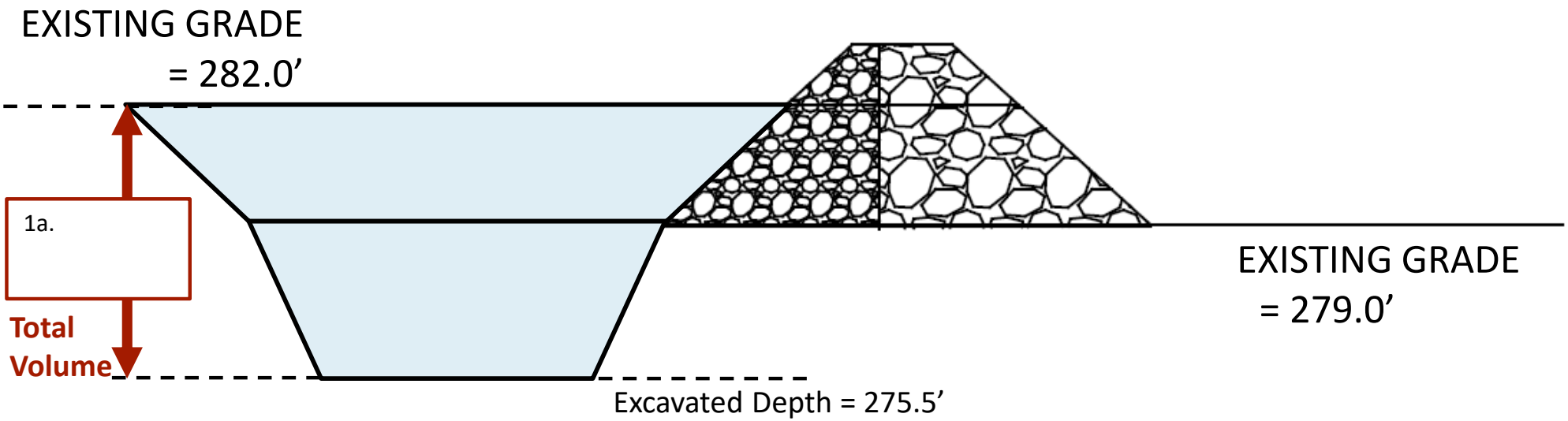

Figure 8-1. Sediment Trap Cross-Section

1a. Total Storage

Total Drainage Area

= **2.46** acres disturbed + **0.40** acres off site

= **2.86** total acres draining to trap

Total Storage Volume

= **2.86** acres × **134** cubic yards (cy) per acre

= 383.24 cy

round to 383.2 cy

1a. Total Storage

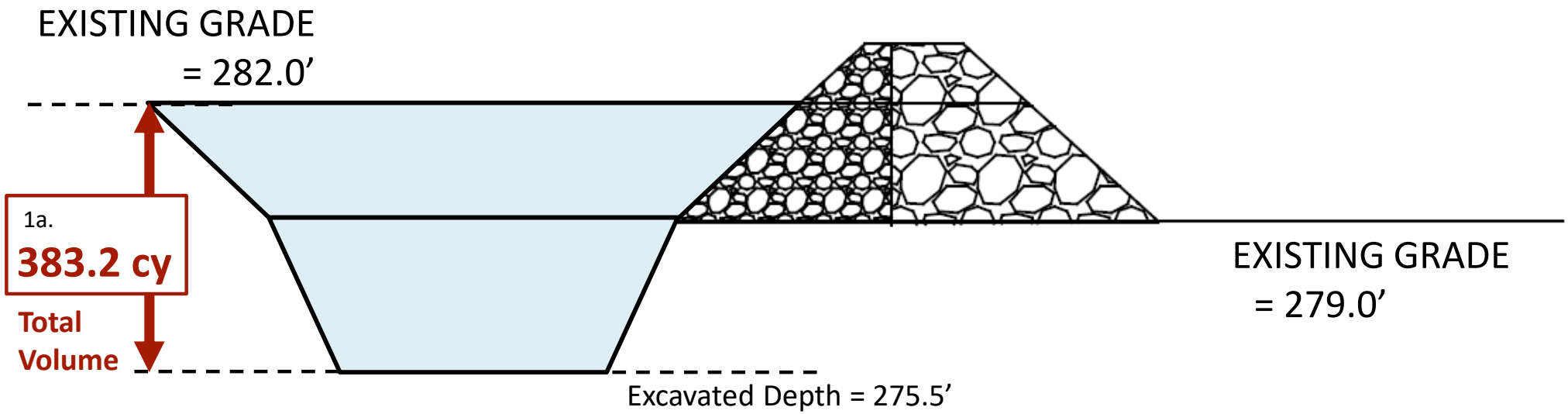

Figure 8-1. Sediment Trap Cross-Section

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1b. Permanent Pool (Wet Storage)

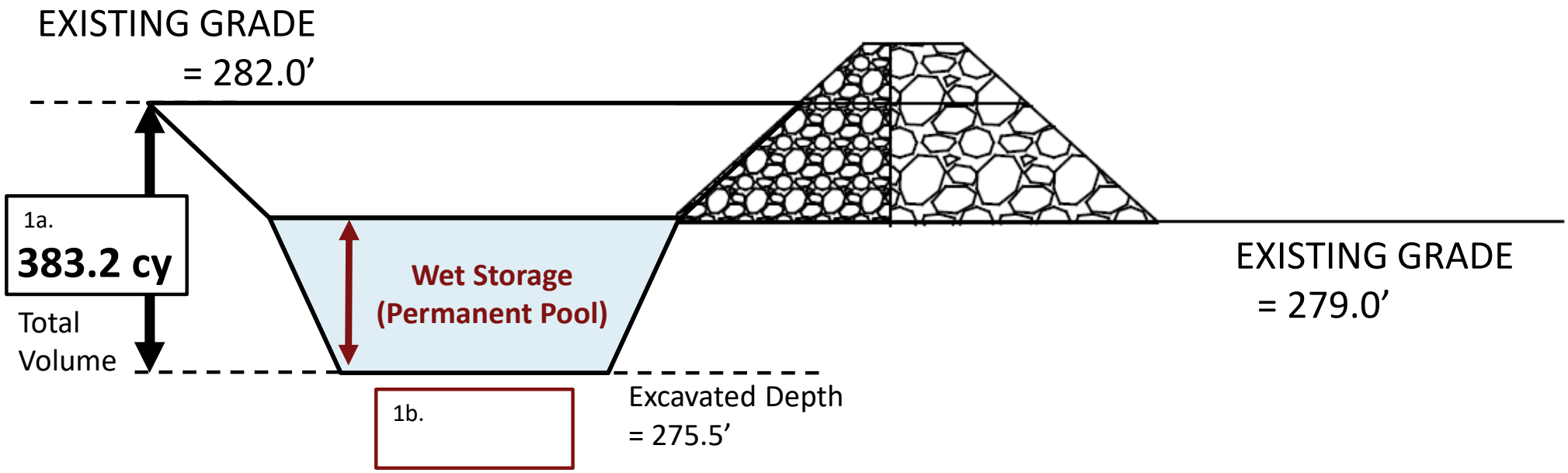

Figure 8-1. Sediment Trap Cross-Section

8a. | SEDIMENT TRAP PROBLEMS | Pg. 3-4

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1b. Permanent Pool (Wet Storage)

2.86 acres × **67** cubic yards (cy) per acre

= 191.62 cy

round to 191.6 cy

1b. Permanent Pool (Wet Storage)

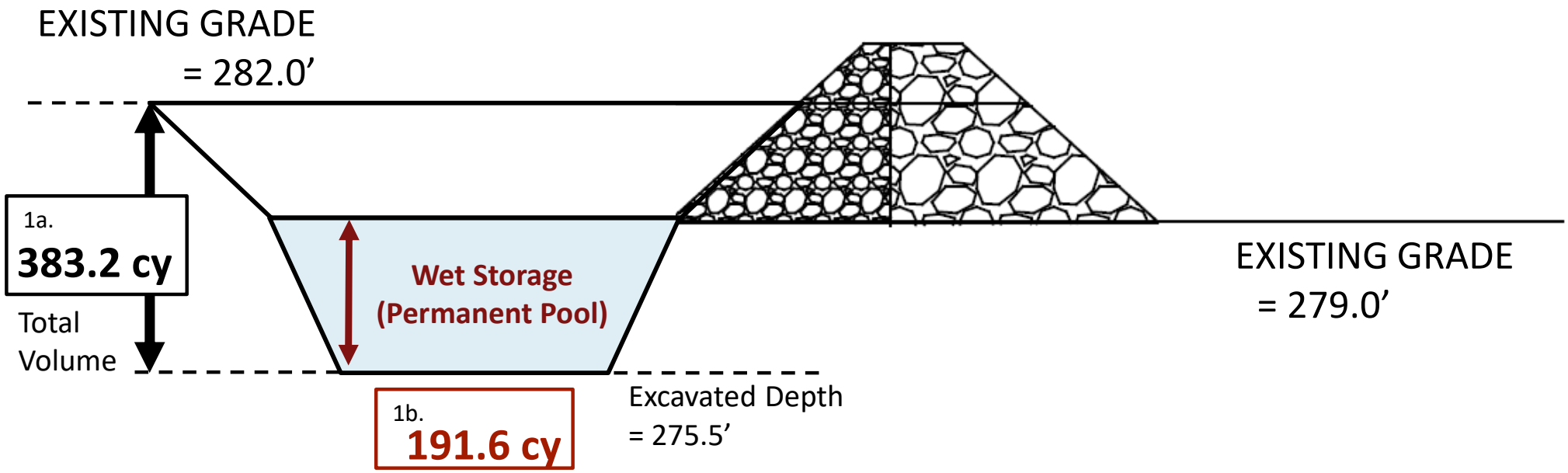

Figure 8-1. Sediment Trap Cross-Section

8a. | SEDIMENT TRAP PROBLEMS | Pg. 3-4

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1c. Temporary Pool (Dry Storage)

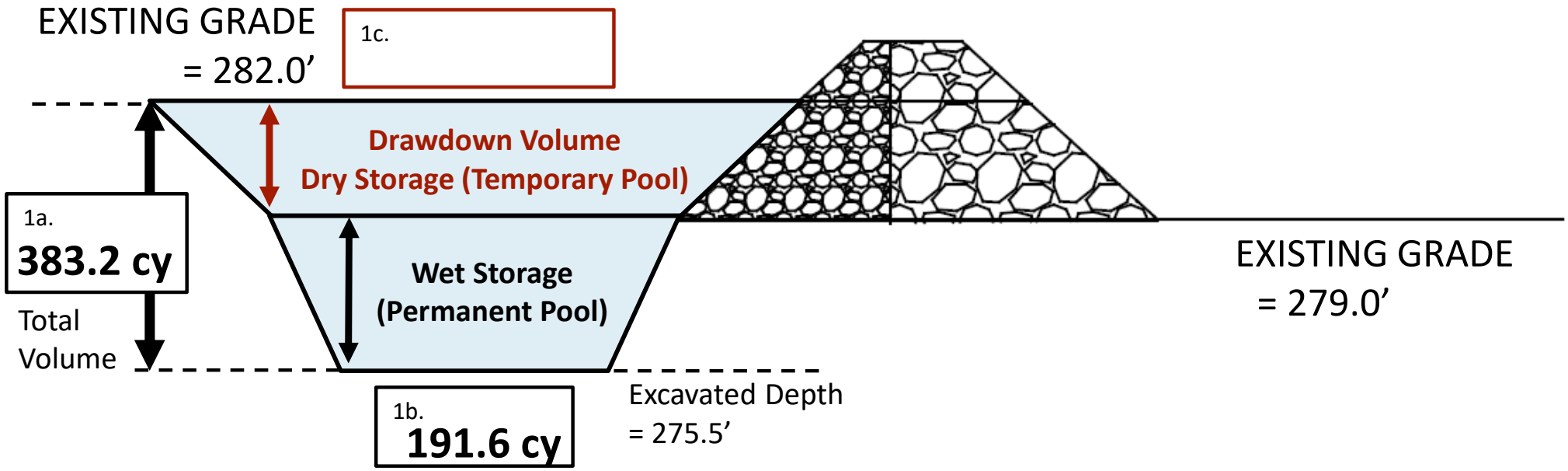

Figure 8-1. Sediment Trap Cross-Section

1c. Temporary Pool (Dry Storage)

2.86 acres × **67** cubic yards (cy) per acre

= 191.62 cy

round to 191.6 cy

1c. Temporary Pool (Dry Storage)

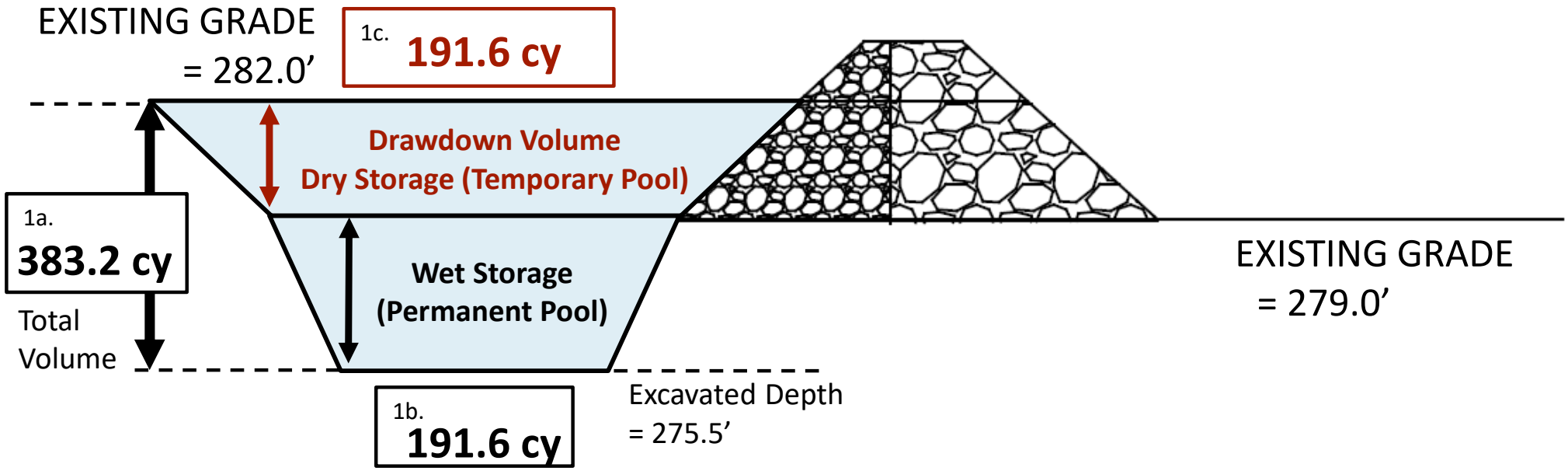

Figure 8-1. Sediment Trap Cross-Section

1d. Embankment Height

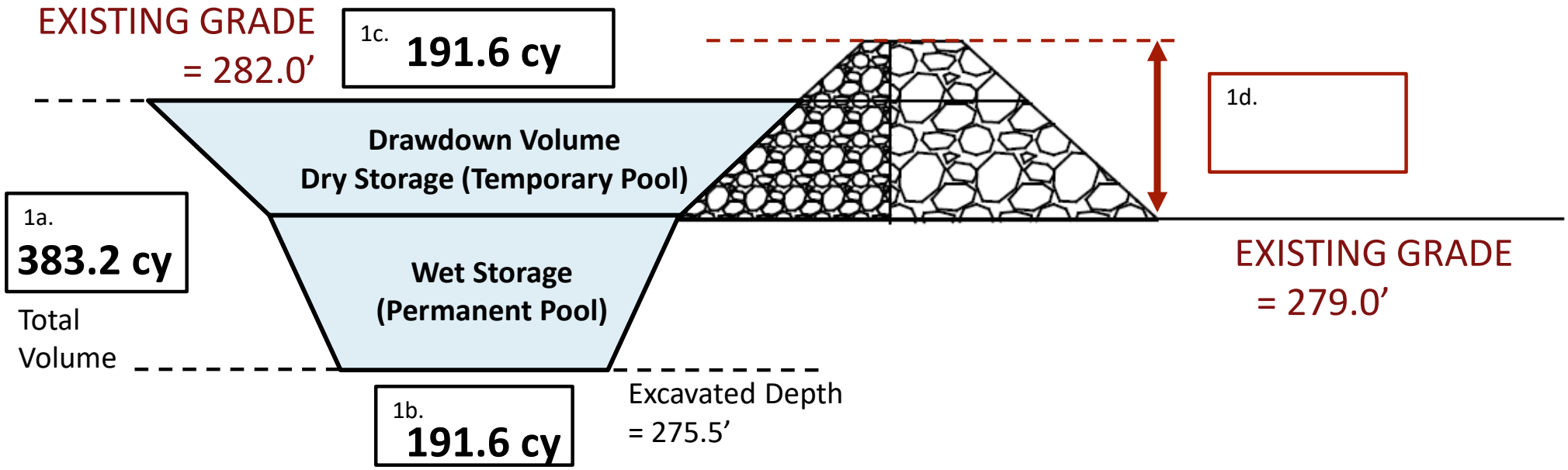

Figure 8-1. Sediment Trap Cross-Section

1d. Embankment Height

Existing grade at top of wet storage = 279.0 feet (ft)

Existing grade at top of dry storage = 282.0 ft

Dry storage depth (temporary pool) = **3 ft**

Required height between crest of spillway and top of embankment = **1 ft**

3 ft + 1ft = 4 ft

1d. Embankment Height

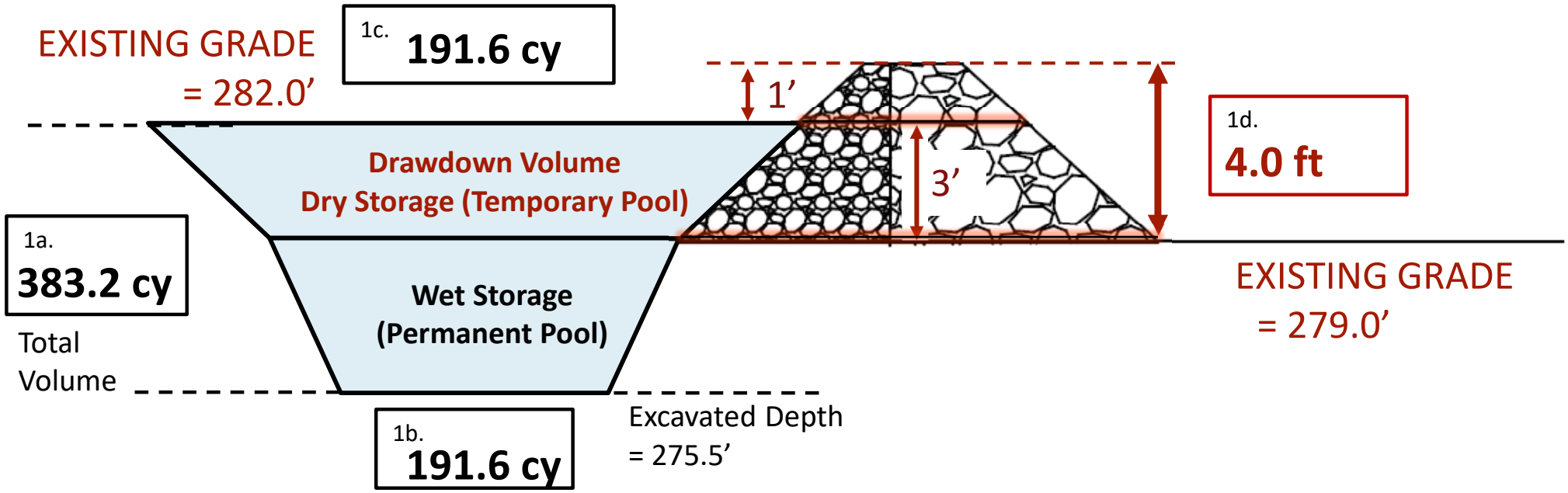

Figure 8-1. Sediment Trap Cross-Section

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1e. Embankment Width

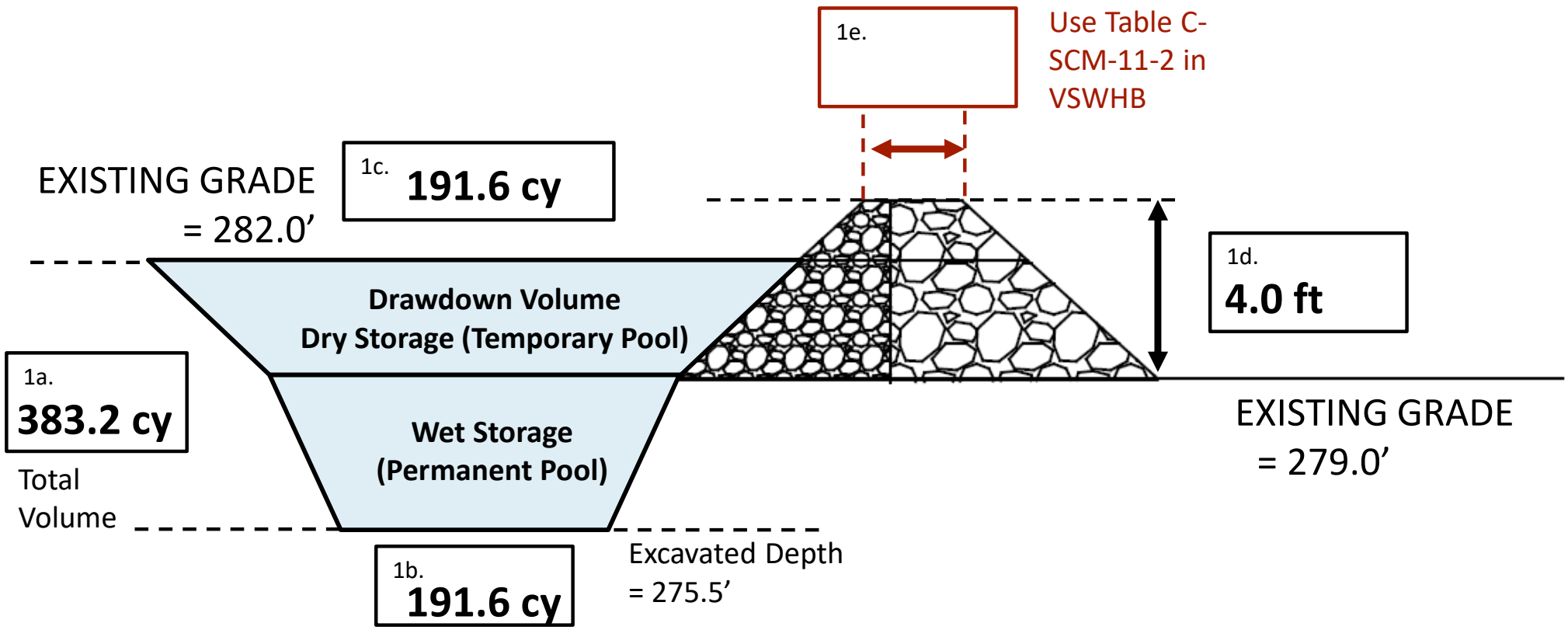

Figure 8-1. Sediment Trap Cross-Section

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1e. Embankment Width

Table C-SCM-11-2 Minimum Top Width Required for Sediment Trap Embankments According to Height of Embankment		
Embankment Height (ft)	Outlet Crest Height (ft)	Minimum Embankment Top Width (ft)
1.5	0.5	2.0
2.0	1.0	2.0
2.5	1.5	2.5
3.0	2.0	2.5
3.5	2.5	3.0
4.0	3.0	3.0
4.5	3.5	4.0
5.0	4.0	4.5

1e. Embankment Width

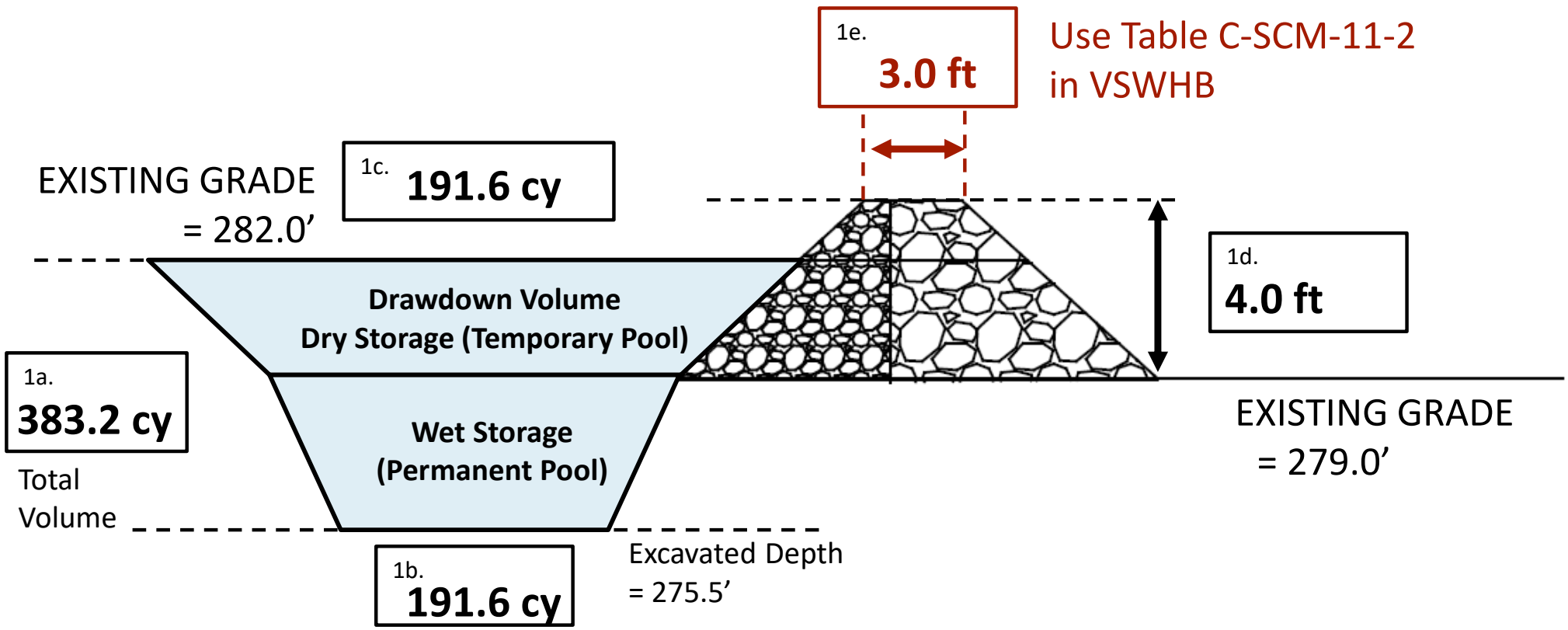

Figure 8-1. Sediment Trap Cross-Section

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Answers 1a–1e

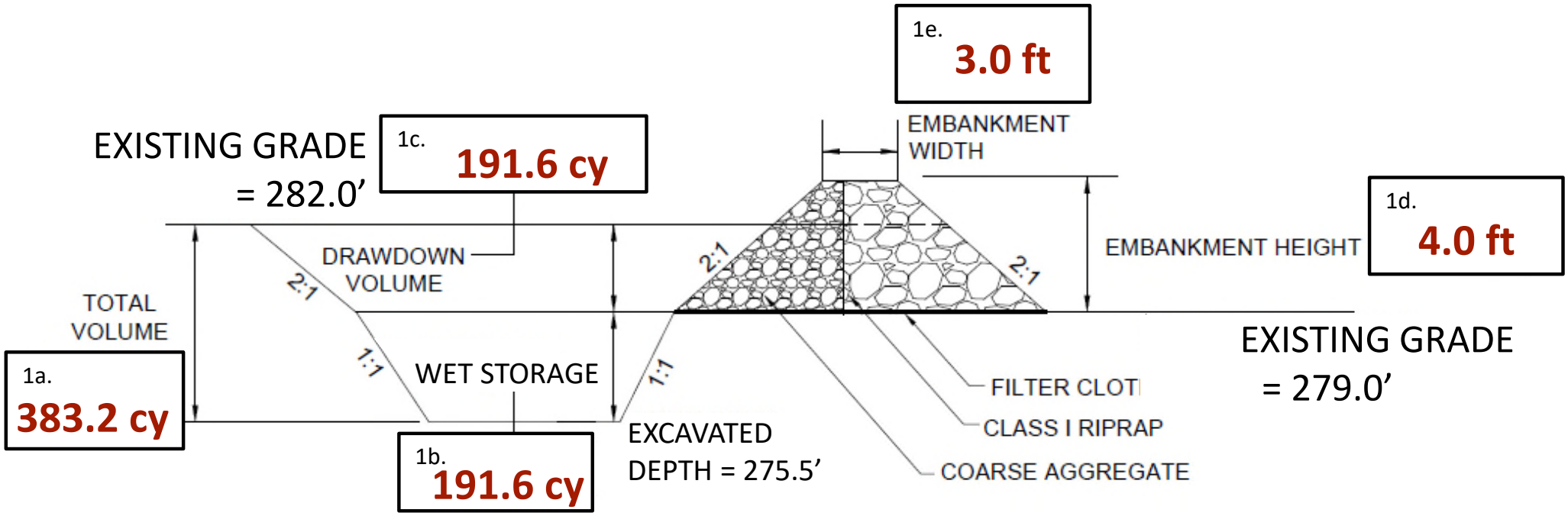

Figure 8-1. Sediment Trap Cross-Section

1f. Stone Outlet Length

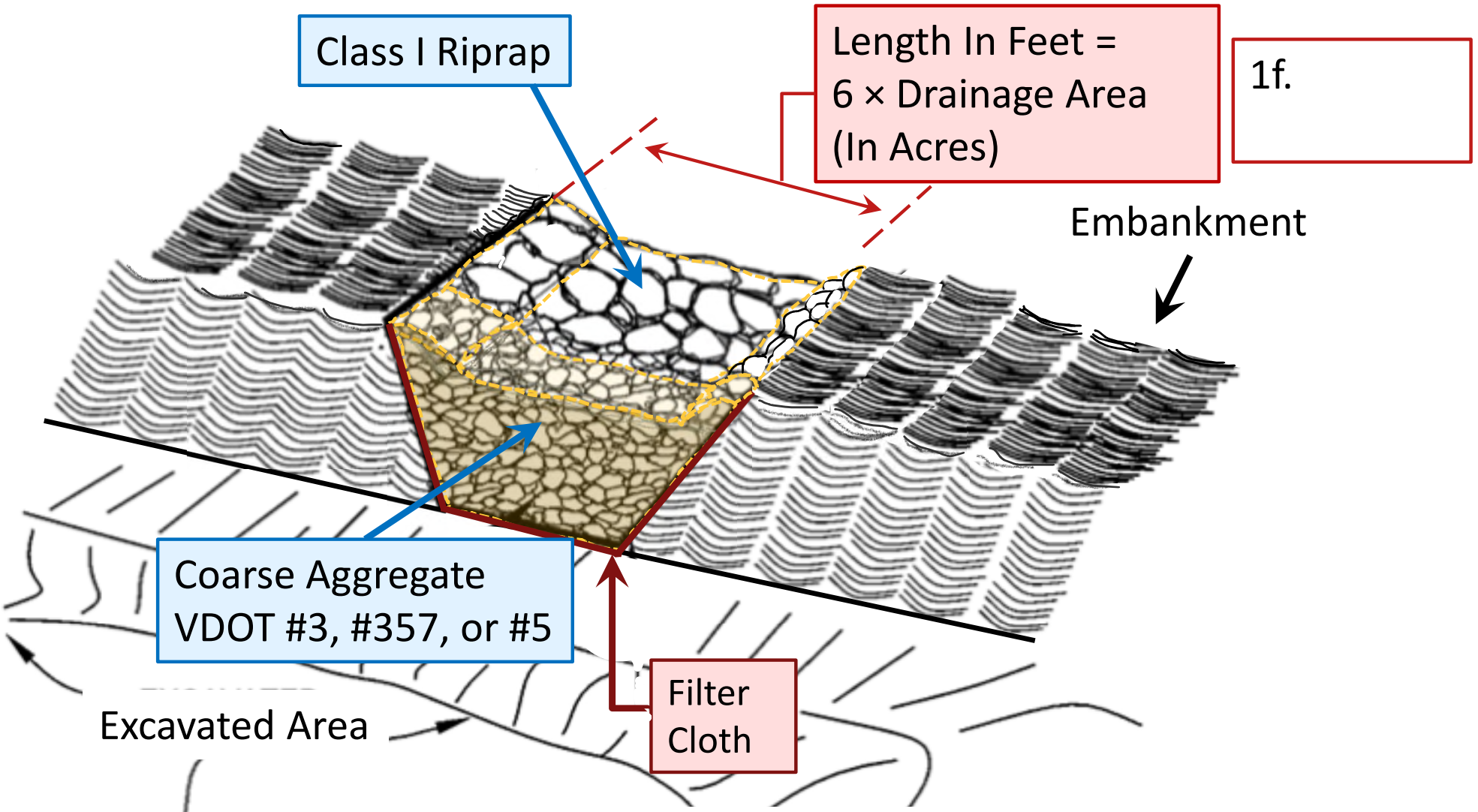

Fig. 8-2. Sediment Trap Outlet (Perspective View)

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1f. Outlet Stone Length

Outlet Length in feet = **6** × Drainage Area in acres

= **6** × 2.86-acre Drainage Area

= 17.16 ft

= 18 ft

1f. Stone Outlet Length

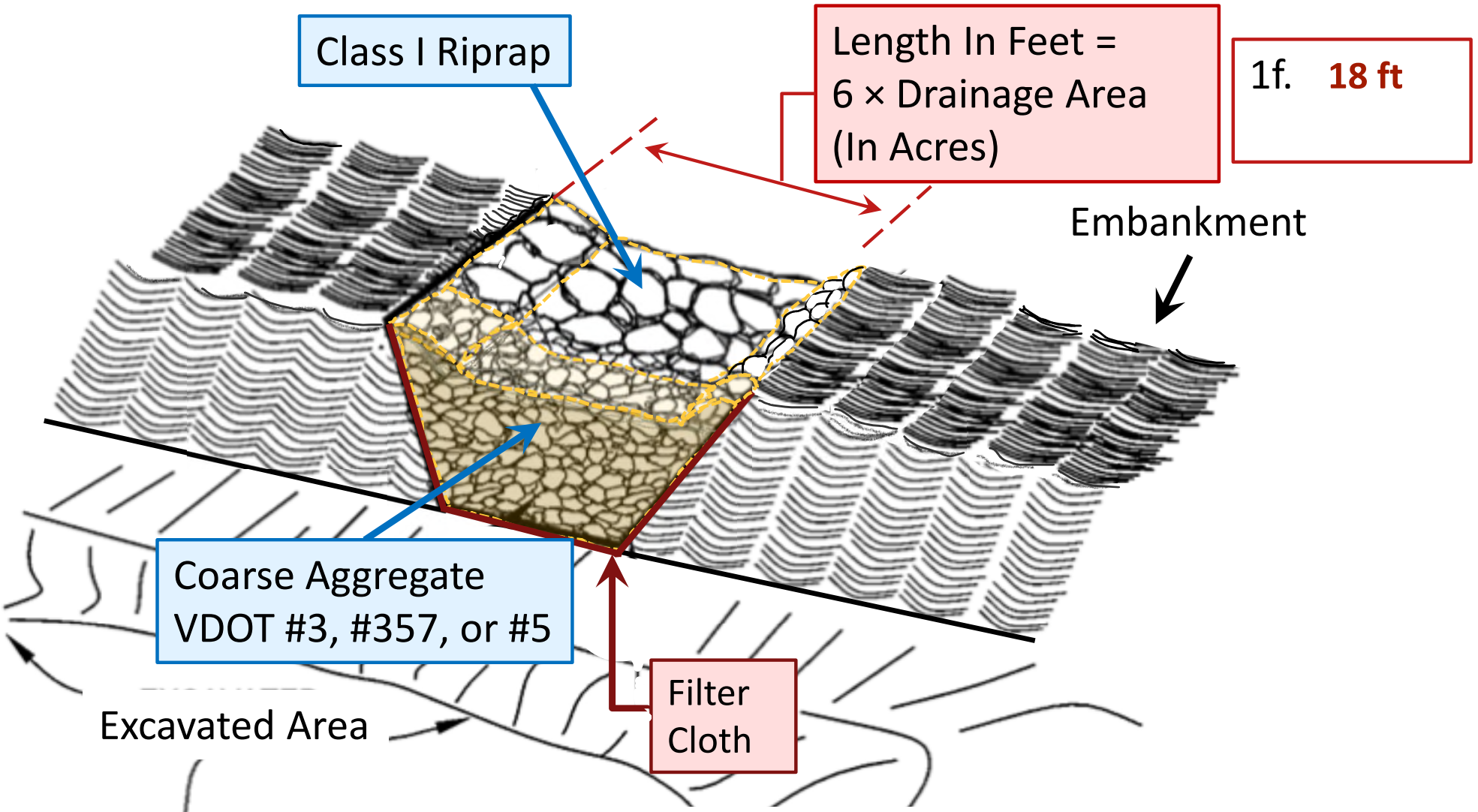

Fig. 8-2. Sediment Trap Outlet (Perspective View)

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Module 8b.

Sediment Basin Problems

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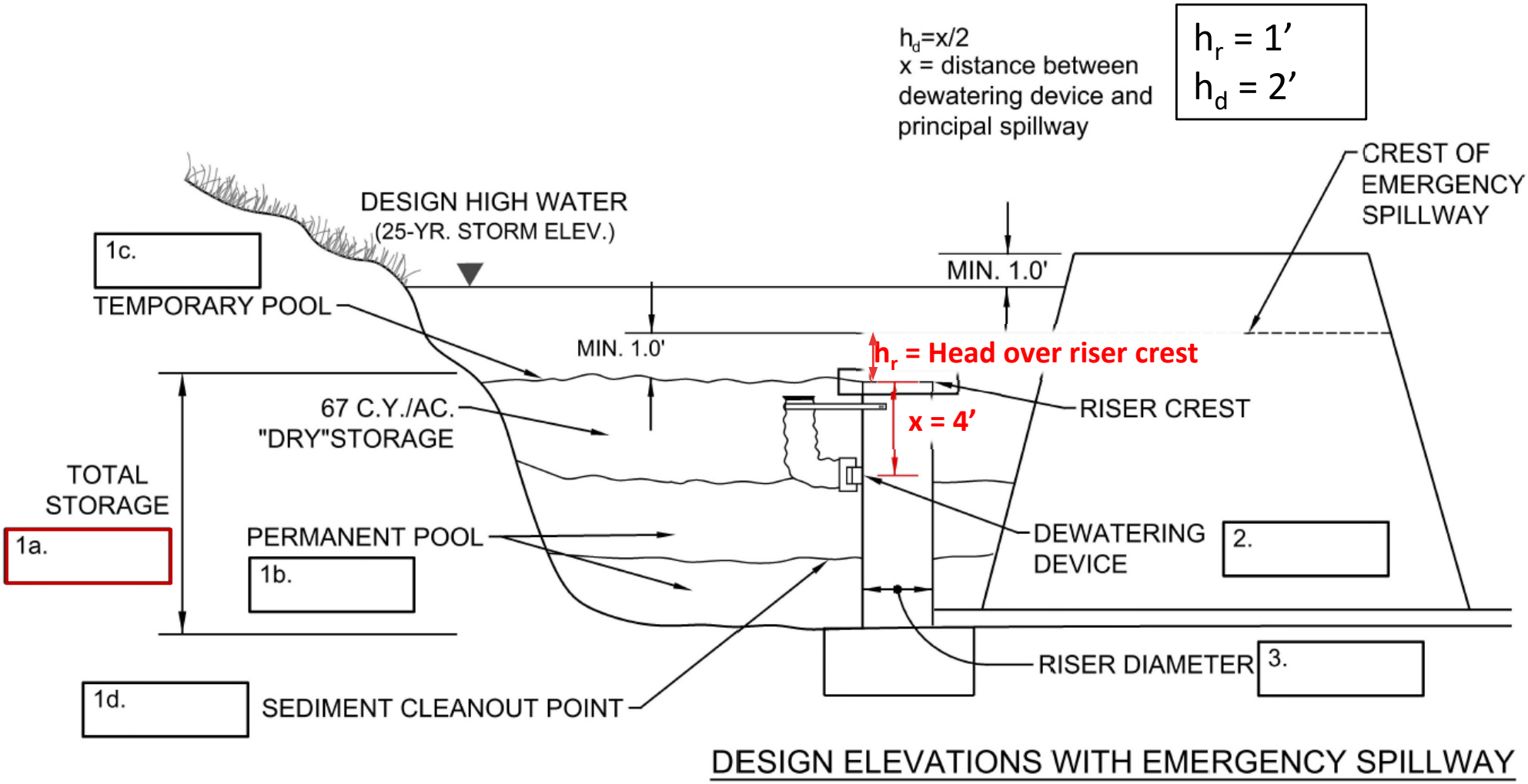
Figure 8-3 Sediment Basin



1a. Total Volume

Total Volume in cubic yards (cy) =

Total Drainage Area in acres × **134** cubic yards per acre

$$V = A \times \mathbf{134}$$

A = **12** acres disturbed + **3** acres undisturbed

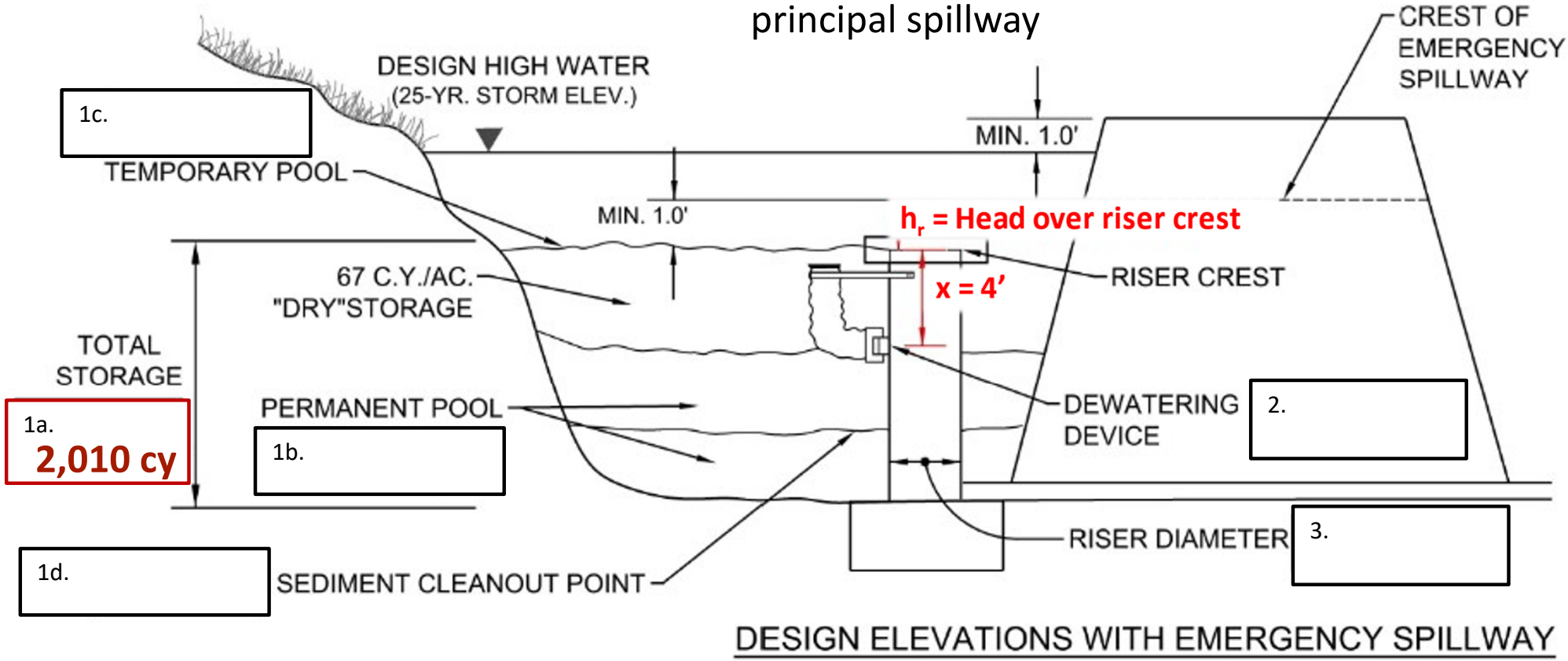
= **15** total acres to sediment basin

15 acres × **134** cubic yards per acre = 2,010 cy

Figure 8-3 Sediment Basin

$h_d = x/2$
x = Distance between dewatering orifice and principal spillway

$h_r = 1'$
$h_d = 2'$



1b. Permanent Pool

Permanent Pool in cubic yards (cy) =

Total Drainage Area in acres × **67** cubic yards per acre

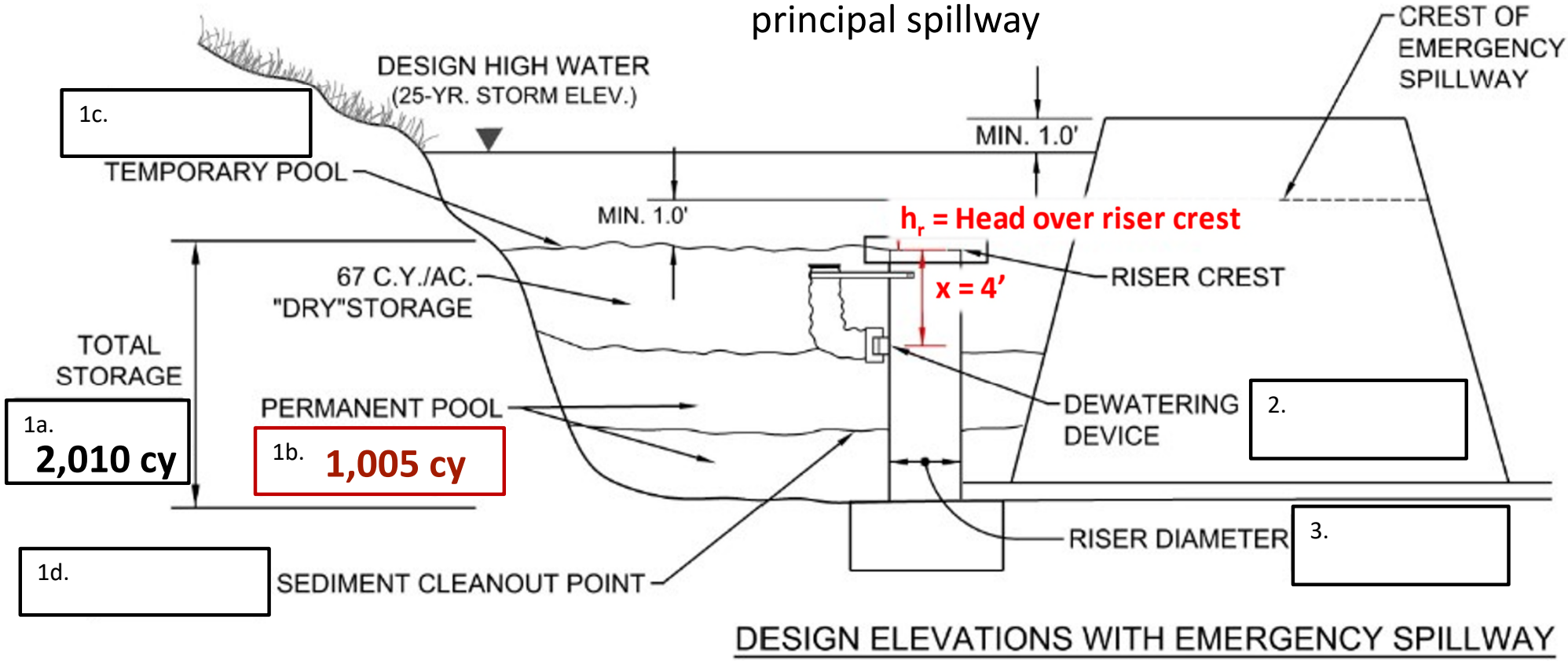
$$V = A \times \mathbf{67}$$

15 acres × **67** cubic yards per acre = 1,005 cy

Figure 8-3 Sediment Basin

$h_d = x/2$
x = Distance between dewatering orifice and principal spillway

$h_r = 1'$
$h_d = 2'$



1c. Temporary Pool

Temporary Pool in cubic yards (cy) =

Total Drainage Area in acres × **67** cubic yards per acre

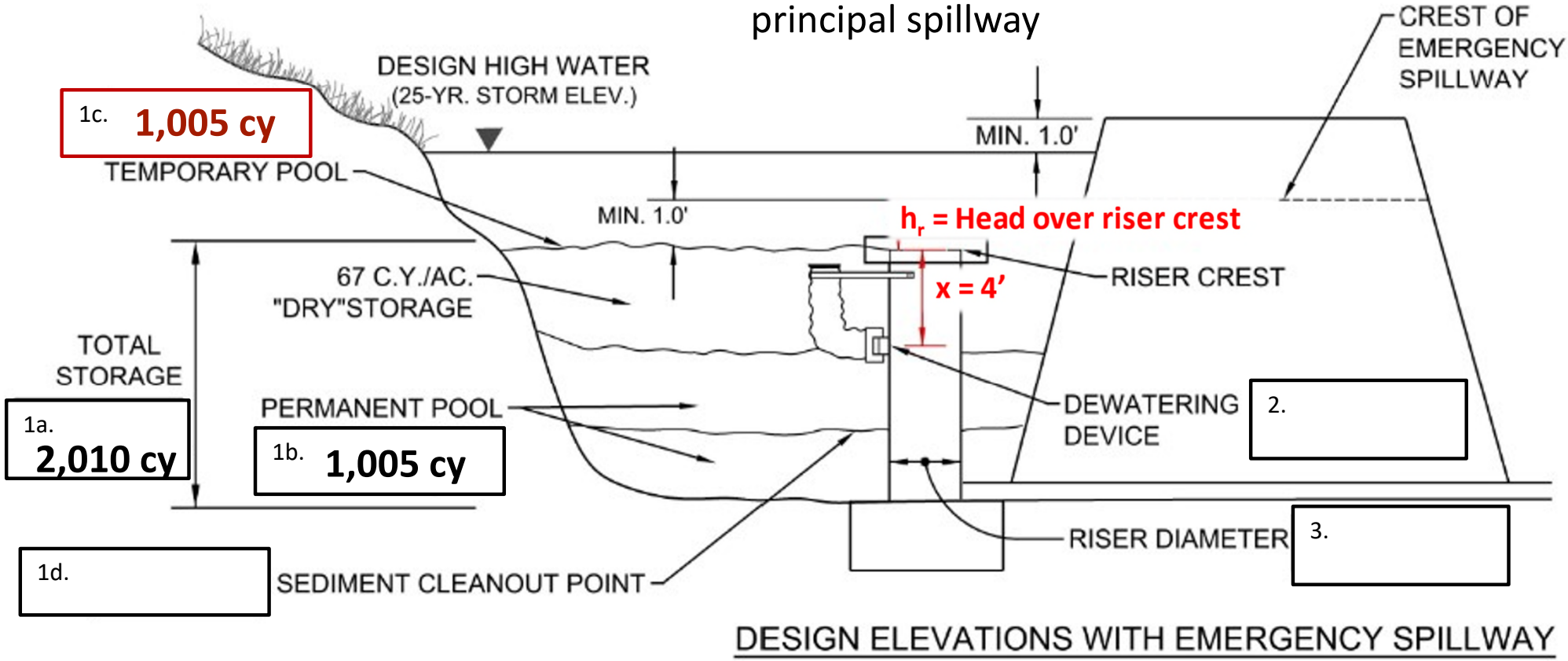
$$V = A \times \mathbf{67}$$

15 acres × **67** cubic yards per acre = 1,005 cy

Figure 8-3 Sediment Basin

$h_d = x/2$
x = Distance between dewatering orifice and principal spillway

$h_r = 1'$
$h_d = 2'$



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1d. Cleanout Volume

Remove sediment from basin when:

Sediment level is no higher than 1 foot below the bottom of the dewatering orifice

OR

When cleanout volume is:

Half the permanent volume

$$\frac{1{,}005 \text{ cy}}{2} = \boxed{502.5 \text{ cy}}$$

Same as

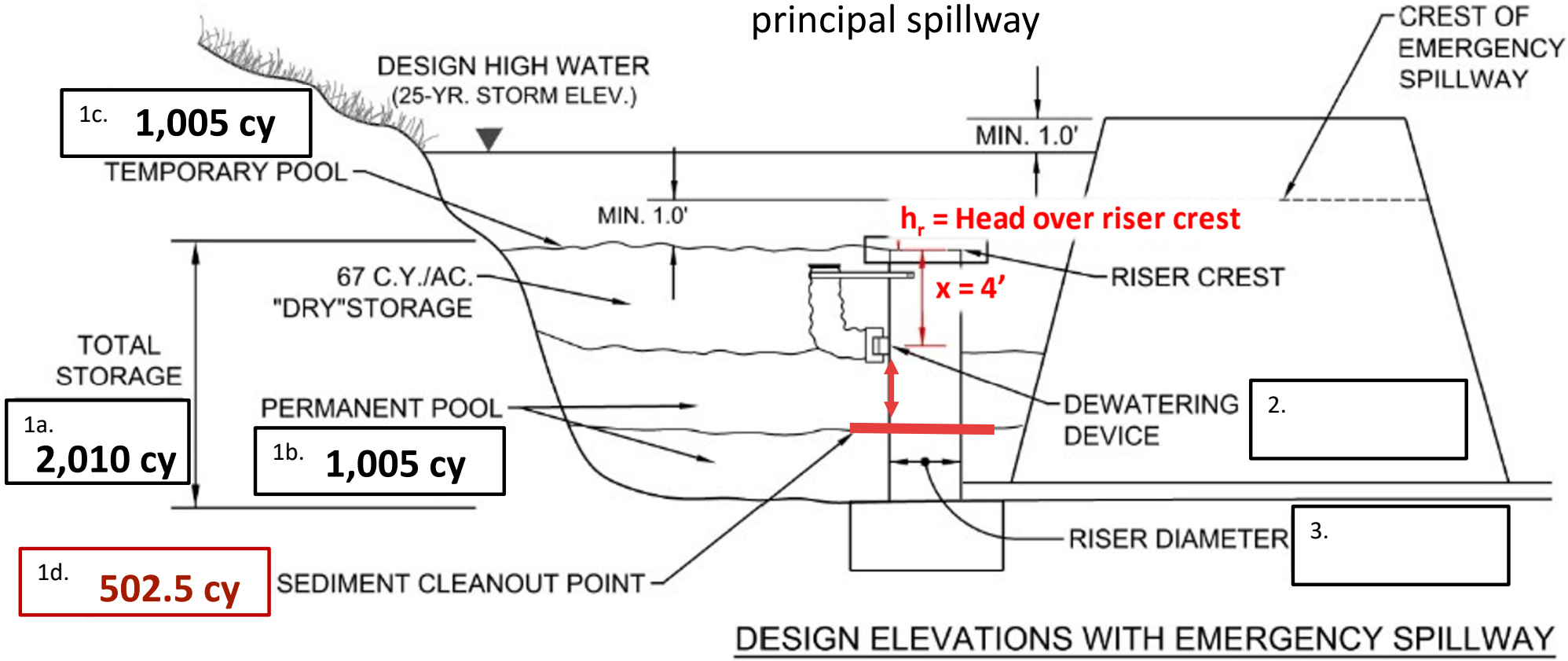
1/4 × total storage

$$= \frac{2{,}010 \text{ cy}}{4}$$

Figure 8-3 Sediment Basin

$h_d = x/2$
x = Distance between dewatering orifice and principal spillway

$h_r = 1'$
$h_d = 2'$



DESIGN ELEVATIONS WITH EMERGENCY SPILLWAY

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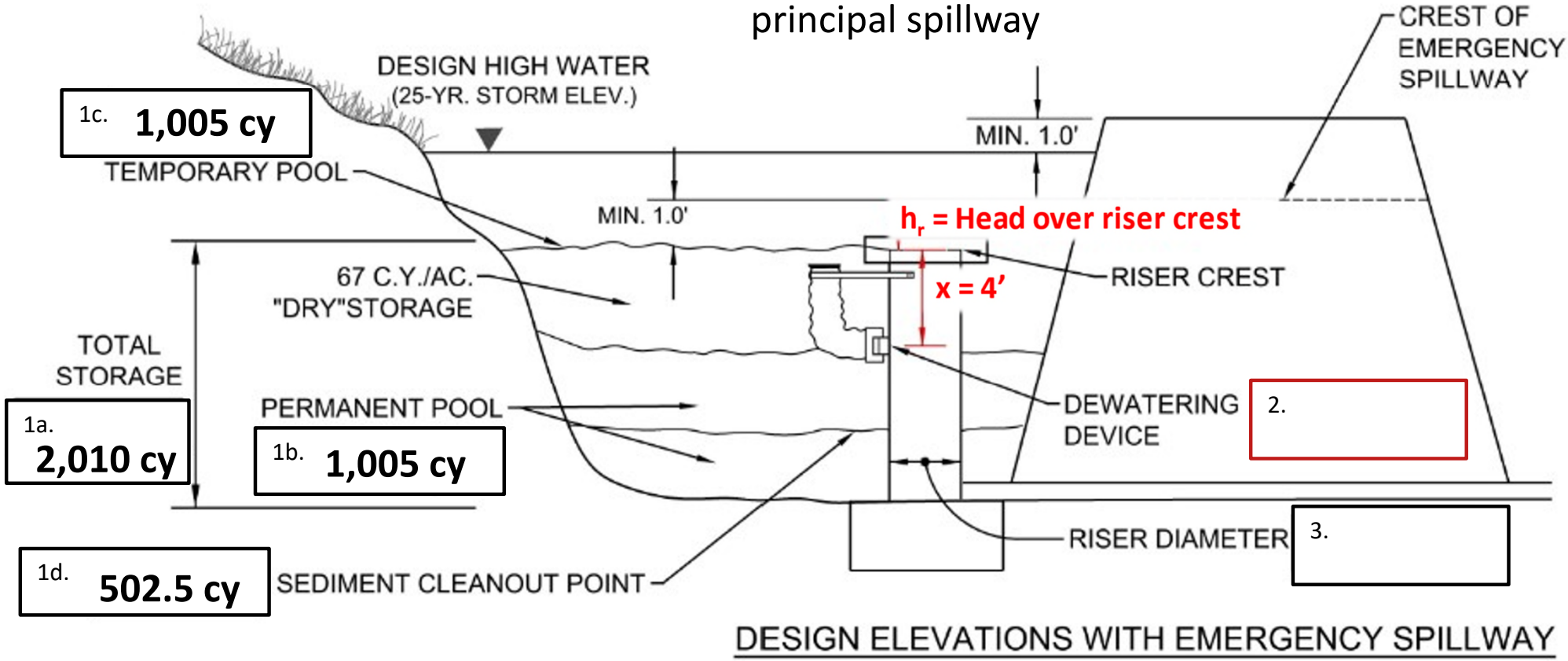
Figure 8-3 Sediment Basin

$h_d = x/2$
x = Distance between dewatering orifice and principal spillway

$h_r = 1'$
$h_d = 2'$



2. Dewatering Orifice

Step 1: Calculate the total dry storage (S).

Temporary Pool in cubic yards (cy) =
Total Drainage Area in acres × **67** cubic yards per acre

$$V = A \times \mathbf{67}$$

15 acres × **67** cubic yards per acre = 1,005 cy

2. Dewatering Orifice

Step 2: Convert cubic yards to cubic feet.

1 cubic yard = 27 cubic feet

1,005 cy × 27 cf = 27,135 cf

2. Dewatering Orifice

Step 3: Required drawdown time in seconds

(given as 24 hrs).

$$= 24\ hrs \times \frac{60\ minutes}{hour} \times \frac{60\ seconds}{minute}$$

$$= \boxed{86{,}400\ seconds}$$

2. Dewatering Orifice

Step 4: Calculate the flow rate required to get a 24-hour drawdown.

$$Q = \left(\frac{S}{86{,}400 \text{ seconds}}\right)$$

$$= \left(\frac{27{,}135 \text{ cubic feet}}{86{,}400 \text{ seconds}}\right)$$

$$= \boxed{0.31 \; cubic \; feet \; per \; second \; (cfs)}$$

2. Dewatering Orifice

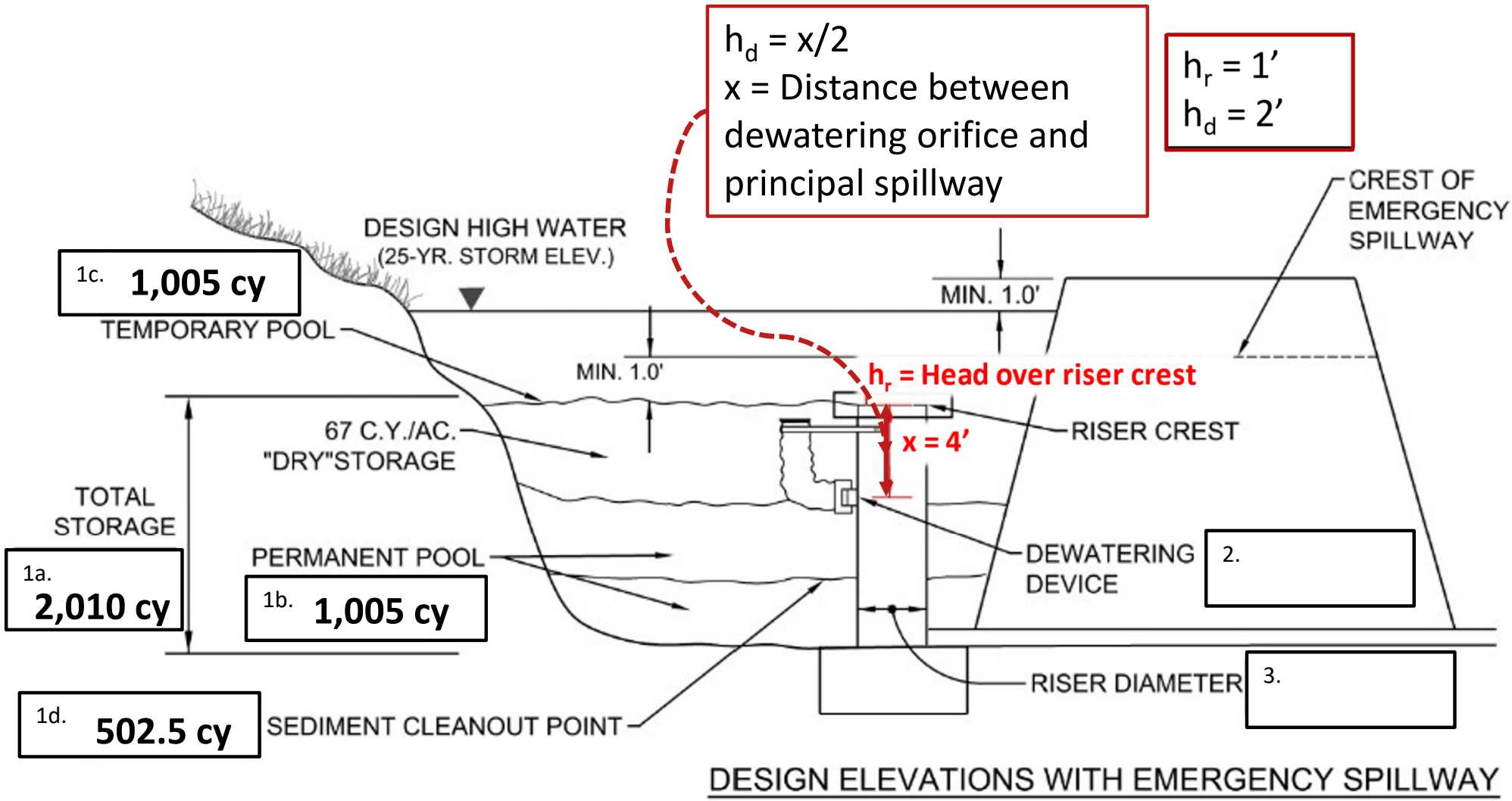
Step 5: Find the flow area of the orifice (A).

To the half power ($^{1/2}$) is the same as square root ($\sqrt{}$)

$$A = \frac{Q}{(64.32 \times h_d)^{1/2} (0.6)}$$

Where does h_d come from?

Figure 8-3 Sediment Basin



8b. | SEDIMENT BASIN PROBLEMS | Pg. 6, 8

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2. Dewatering Orifice

Step 5: Find the flow area of the orifice (A).

$$A = \frac{Q}{(64.32 \text{ x } h_d)^{1/2} (0.6)}$$

$$= \frac{0.31 \text{ cfs}}{(64.32 \text{ x } 2)^{1/2} (0.6)}$$

$$= \boxed{0.046\ ft^2}$$

2. Dewatering Orifice

Step 6: Using the area of the orifice (A), find the pipe diameter (d).

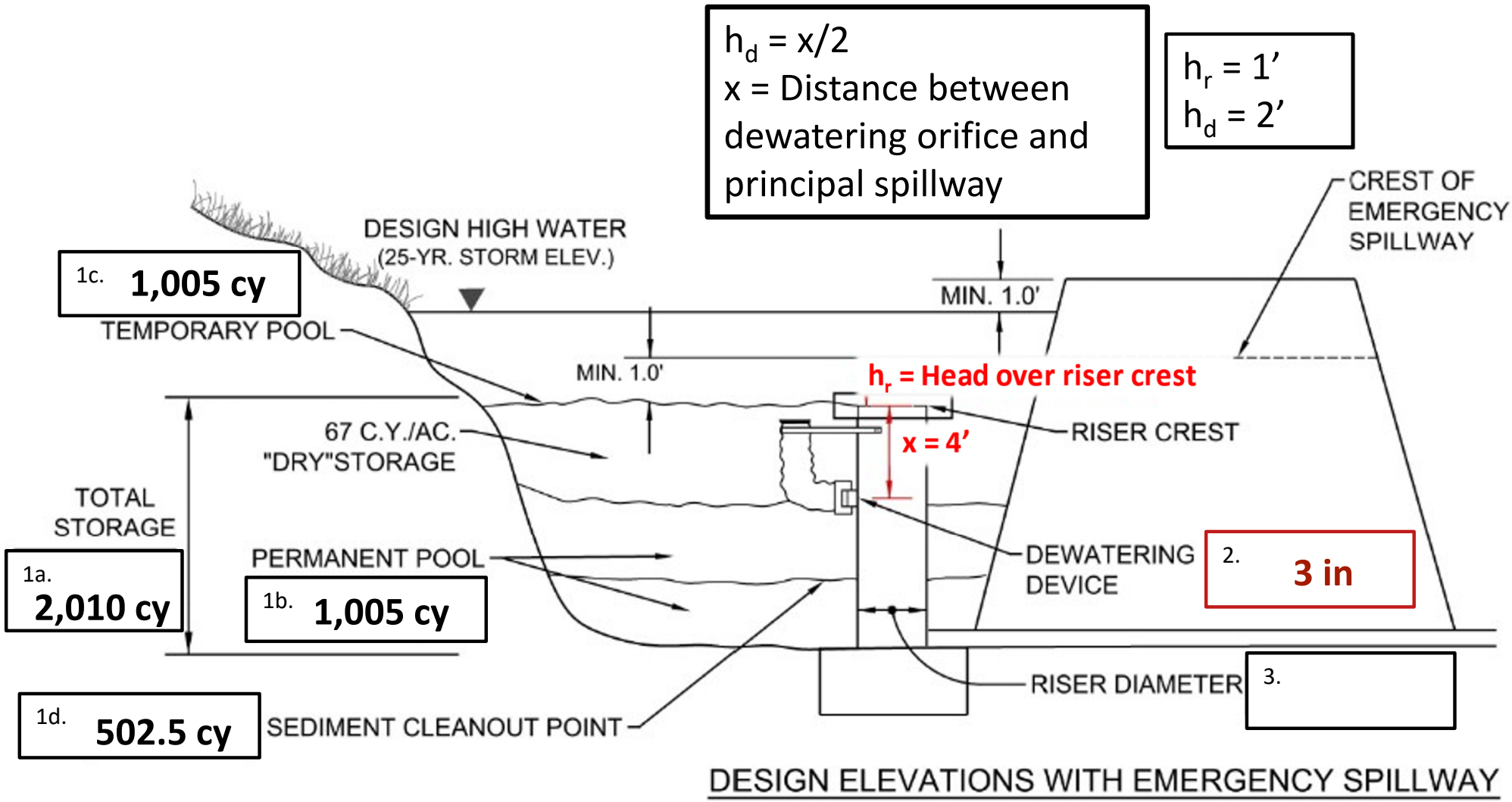
$$d = 2 \times \left(\frac{\mathrm{A}}{3.14}\right)^{1/2}$$

$$= 2 \times \left(\frac{0.046}{3.14}\right)^{1/2}$$

$$= 0.24 \times \frac{12\ in}{1\ ft}$$

$$= 2.9\ in, round\ to\ \boxed{3\ in}$$

Figure 8-3 Sediment Basin



3a. Riser Diameter

Complete on your own

Step 1: Determine peak flow rate (Q_p) using Figure 8-3.

Q_p = 2-storm (basin with emergency spillway)

Q_p = 25-storm (basin without emergency spillway)

2-year storm = 31 cubic feet per second (cfs)

25-year storm = 82 cfs

3a. Riser Diameter

Step 1: Determine what Q_p should be from the given information:

2-year storm = 31 cubic feet per second (cfs)

25-year storm = 82 cfs

3.a Riser Diameter to Pass Flow Safely

Q_p = 31 cfs

h_r = 1.0’

Riser Diameter = 42”

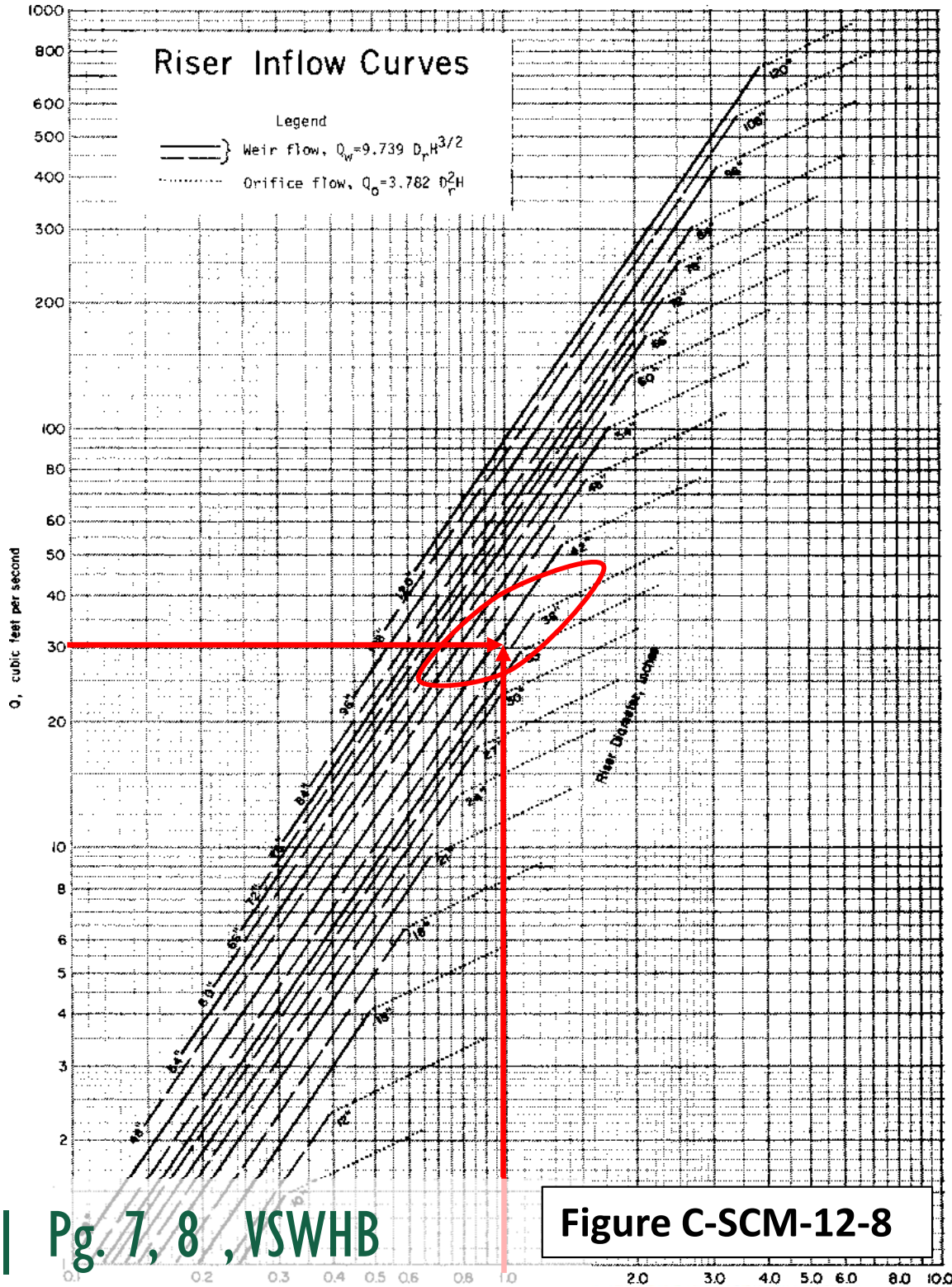
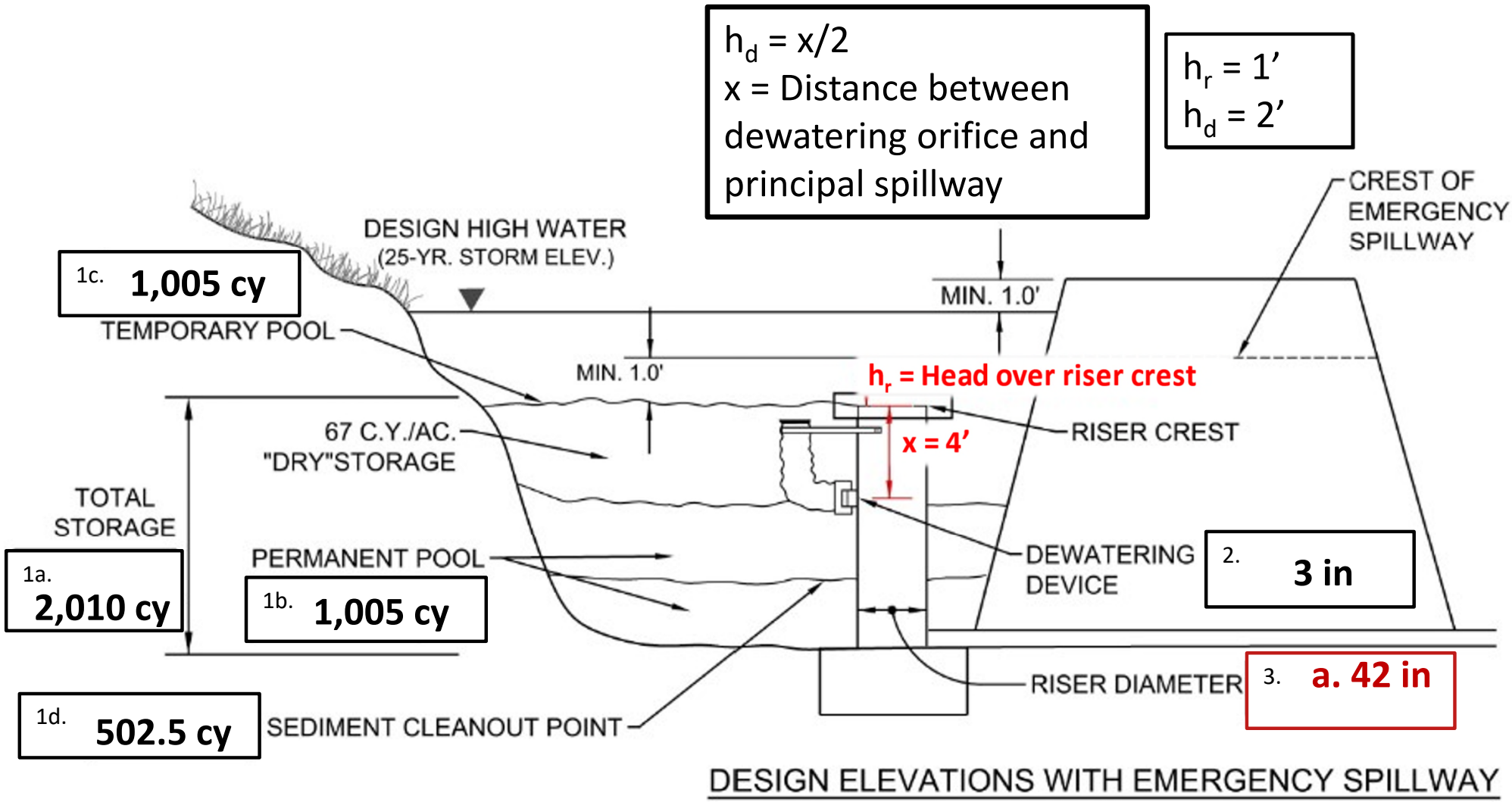


Figure C-SCM-12-8

Figure 8-3 Sediment Basin



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3b. Riser Diameter if Conveyance System is Not Adequate

- Existing conveyance system not adequate for proposed discharge
- Comply with water quantity requirements without needing to improve system
- Use site predevelopment runoff peak flows (cfs):

1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
1.99	5.47	13.37	21.38	34.9	47.54	62.36

- GM 22-2012, Chapter 2.303 and 9VAC25-875-560

3b. Riser Diameter if Conveyance System is Not Adequate

- Existing conveyance system **not adequate** for proposed discharge
- Sediment basin cannot discharge 31 cfs flow rate
- If no improvements, peak discharge flow (2-yr storm) during construction must be less or equal to predevelopment flow

1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
1.99	5.47	13.37	21.38	34.9	47.54	62.36

- Per GM 22-2012, Chapter 2.303 and 9VAC25-875-560

3b. Riser Diameter if Conveyance System is Not Adequate

- Use peak flow rate of 5.47 cfs per table
- Use h_r of 1 foot, per Figure 8-3
- Use Fig. C-SCM-12-8 to find riser diameter

1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
1.99	5.47	13.37	21.38	34.9	47.54	62.36

3b. Riser Diameter if Conveyance System is Not Adequate

Q_p = 5.47cfs

h_r = 1.0’

Riser Diameter = 12”

Why?

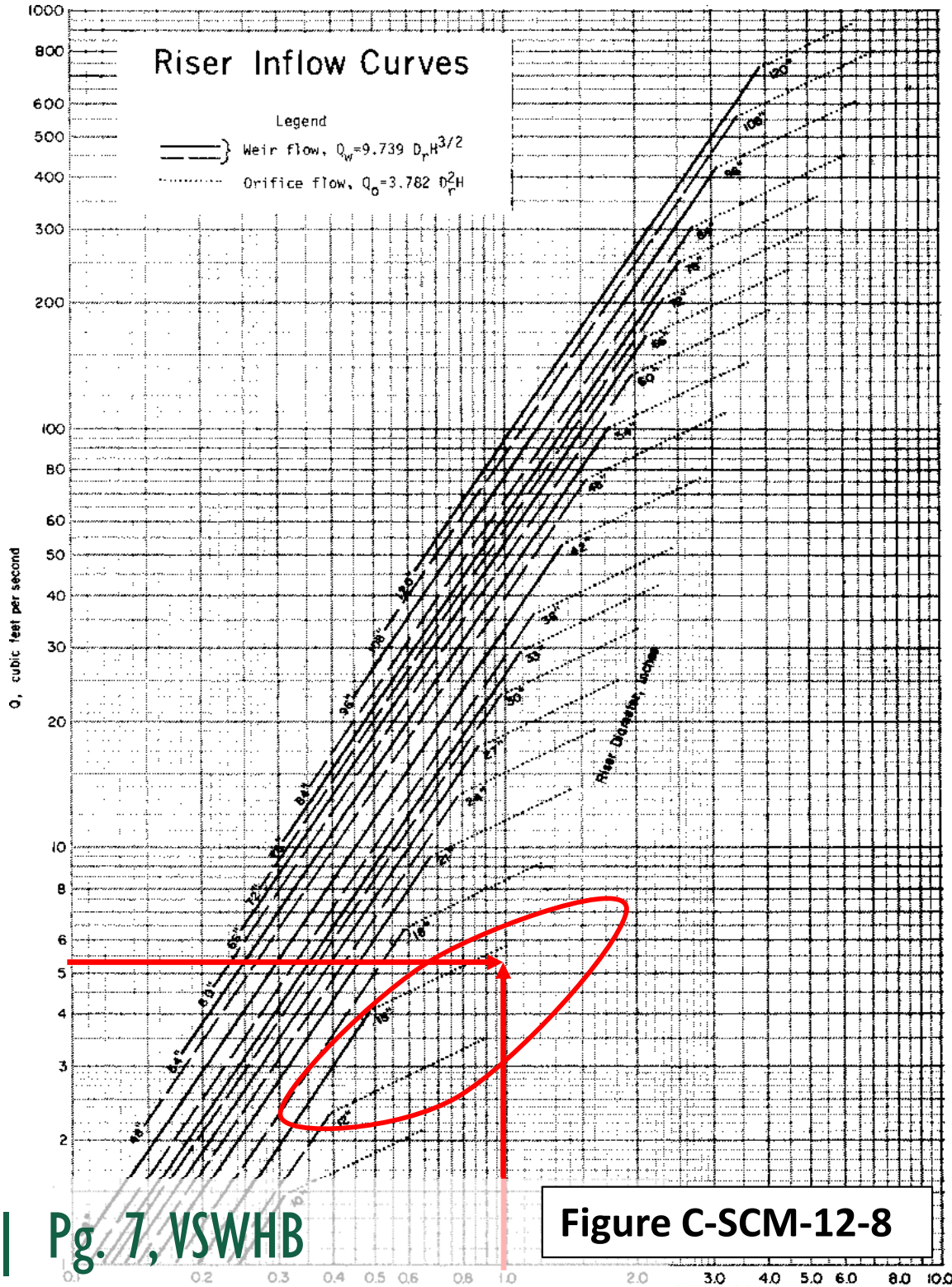


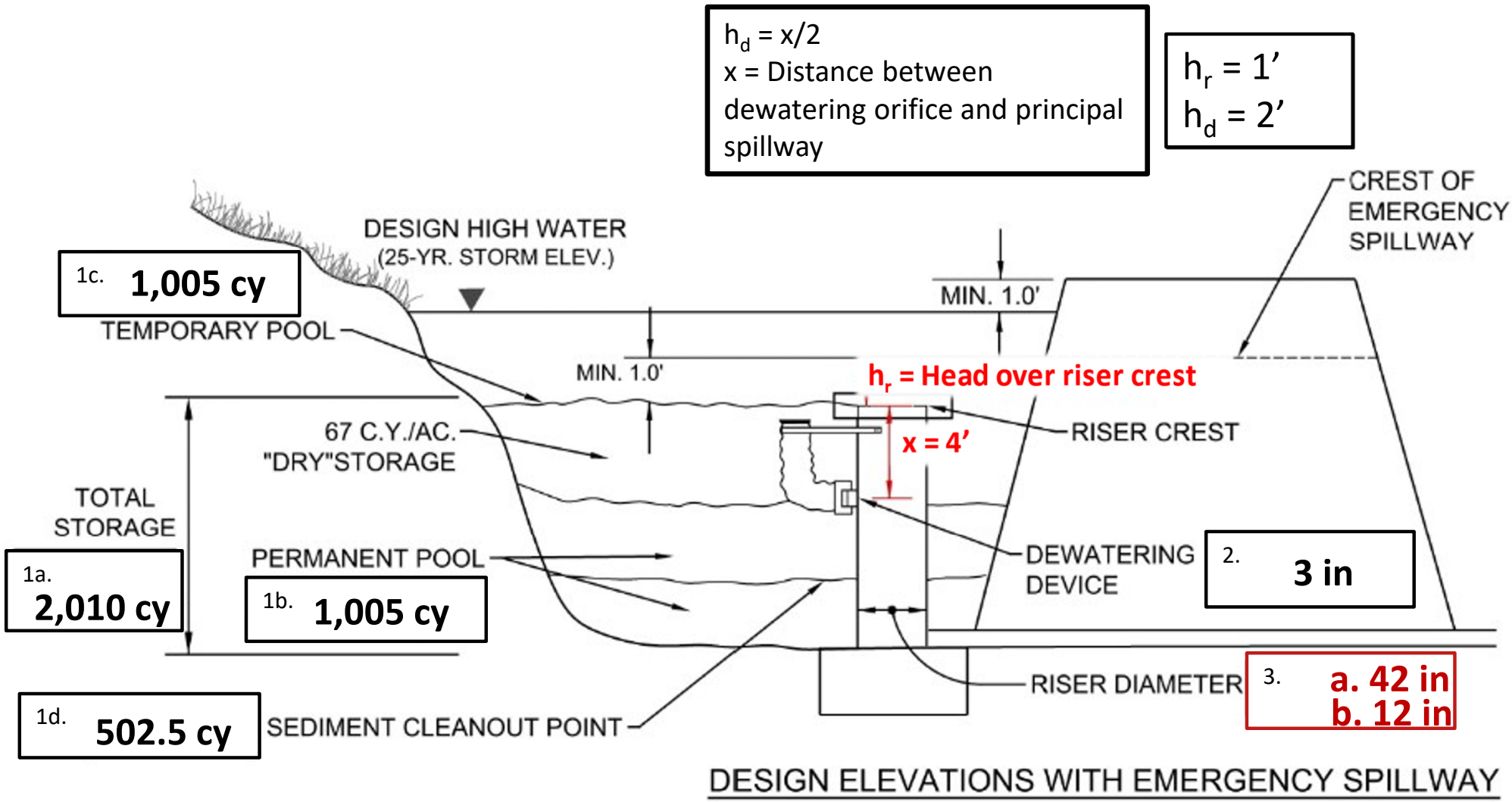
Figure C-SCM-12-8

3b. Riser Diameter if Conveyance System is Not Adequate

- Use peak flow rate of 5.47 cfs per table
- Use h_r of 1 foot, per Figure 8-3
- Use Fig. C-SCM-12-8; riser diameter should be 12”
  - Diameter between 12” and 15” on chart, but since flow cannot be greater than 5.47 cfs, select 12”

1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
1.99	5.47	13.37	21.38	34.9	47.54	62.36

Figure 8-3 Sediment Basin



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4. Trash Rack Dimensions

Complete on your own

Step 1: Find the riser diameter in Table C-SCM-12-7, Anti-Vortex Device Design.

Step 2: In the same table, find “Cylinder Diameter.”

Step 3: In the same table, find “Height.”

4. Trash Rack Dimensions

Table C-SCM-12-7 Anti Vortex Device Design

Riser Dia. (in.)	Cylinder		Height (inches)
	Diameter (inches)	Thickness (gage)	
12	18	16	6
15	21	16	7
18	27	16	8
21	30	16	11
24	36	16	13
27	42	16	15
36	54	14	17
42	60	16	19
48	72	16	21
54	78	16	25
60	90	14	29
66	96	14	33
72	102	14	36
78	114	14	39
84	120	12	42

<u>Step 1:</u> Riser diameter

= 12 inches

<u>Step 2:</u> Cylinder diameter

= 18 inches

<u>Step 3:</u> Trash rack height

= 6 inches

4. Trash Rack Dimensions

Table C-SCM-12-7 Anti Vortex Device Design

Riser Dia. (in.)	Cylinder Diameter (inches)	Cylinder Thickness (gage)	Height (inches)
12	18	16	6
15	21	16	7
18	27	16	8
21	30	16	11
24	36	16	13
27	42	16	15
36	54	14	17
42	60	16	19
48	72	16	21
54	78	16	25
60	90	14	29
66	96	14	33
72	102	14	36
78	114	14	39
84	120	12	42

<u>Step 1:</u> Riser diameter

= 42 inches

<u>Step 2:</u> Cylinder diameter

= 60 inches

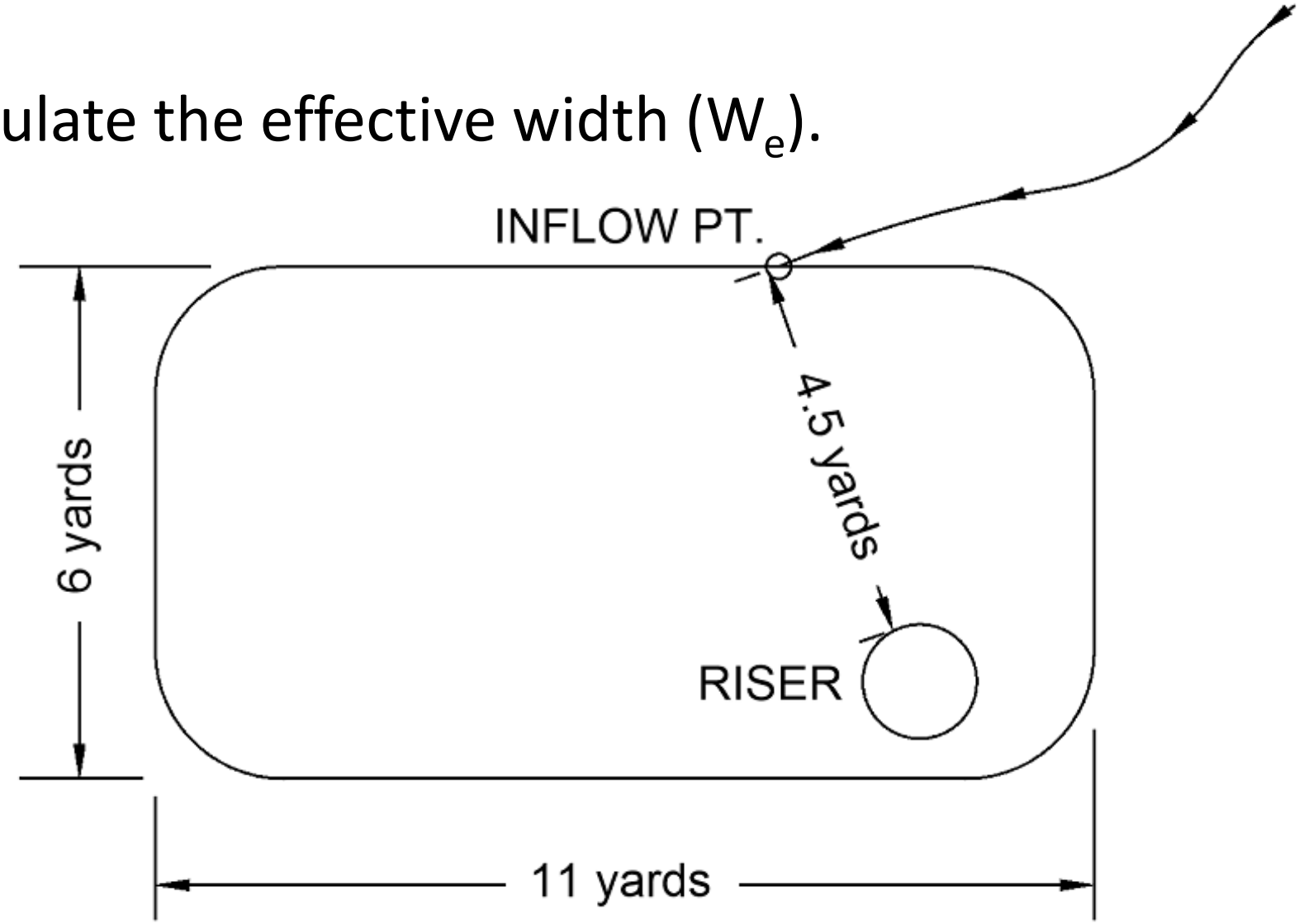
<u>Step 3:</u> Trash rack height

= 19 inches

5a. Baffles Needed?

<u>Step 1:</u> Calculate the effective width (W_e).

$$W_e = \frac{\mathbf{A}}{\mathbf{L}}$$



5a. Baffles Needed?

Step 1: Calculate the effective width (W_e).

$$W_e = \frac{\mathbf{A}}{\mathbf{L}}$$

Area = Length × Width
= 11 yards × 6 yards
= 66 square yards (sy)

$$W_e = \frac{66 \text{ square yards}}{4.5 \text{ yards}}$$

$$W_e = \boxed{14.67}$$

5a. Baffles Needed?

Step 2: Calculate the length-to-width ratio.

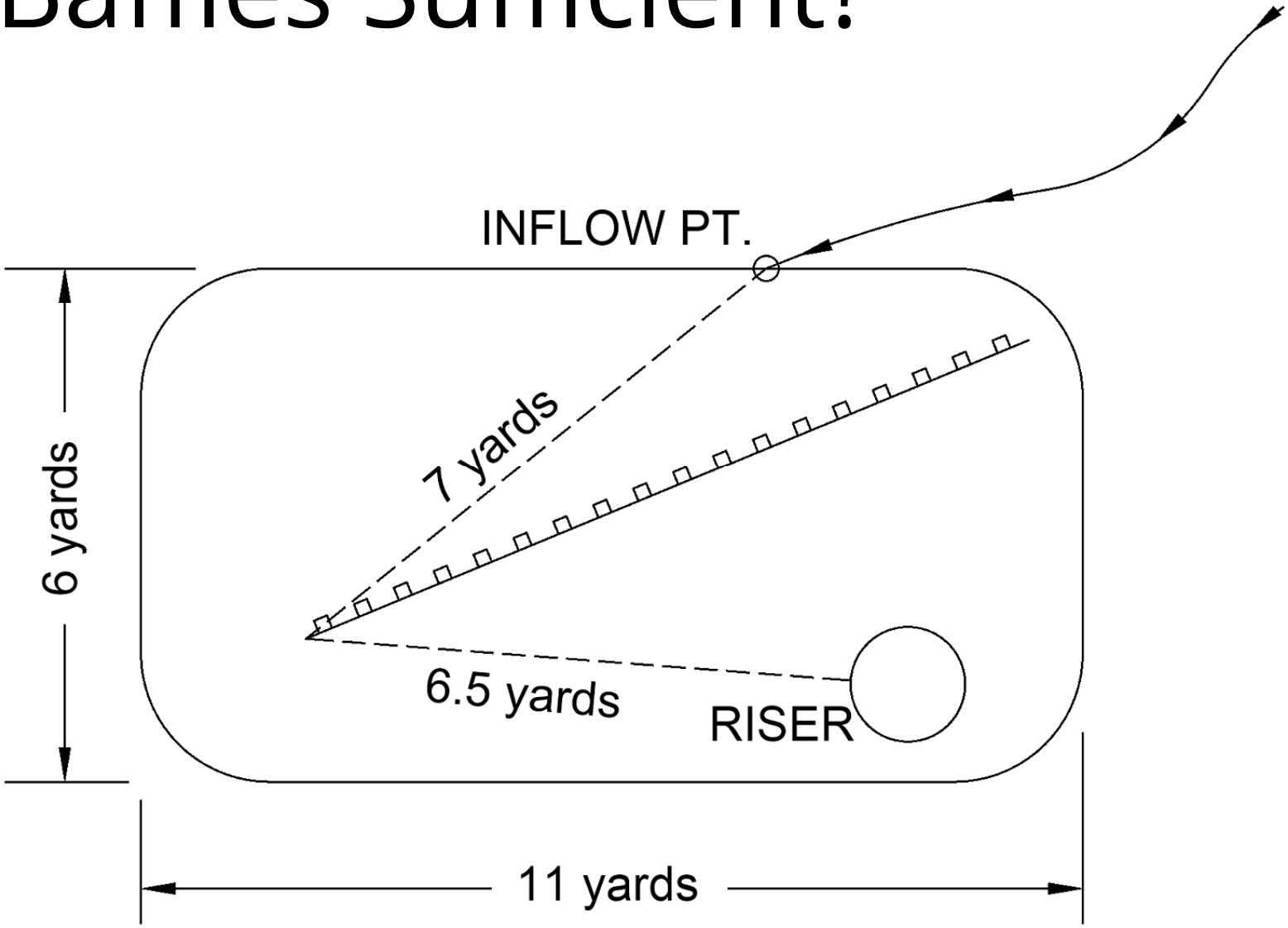
$$\text{Length-to-width ratio} = \frac{\text{L}}{\text{W}_\text{e}}$$

$$\frac{L}{W_e} = \frac{4.5 \text{ yards}}{14.67} = 0.307$$

The ratio is less than 2,

so the sediment basin ***will require baffles****.*

5b. Baffles Sufficient?



5b. Baffles Sufficient?

Step 1: Calculate the effective width (W_e).

$$W_e = \frac{\mathbf{A}}{\mathbf{L}}$$

$$W_e = \frac{\mathbf{66\ square\ yards}}{\mathbf{13.5\ yards}}$$

→ Our new flow path (L)
= 7 + 6.5
= 13.5 yards

$$W_e = 4.89$$

5b. Baffles Sufficient?

Step 2: Calculate the length-to-width ratio.

$$\text{Length-to-width ratio} = \frac{\text{L}}{\text{W}_\text{e}}$$

$$\frac{L}{W_e} = \frac{13.5 \text{ yards}}{4.89} = \boxed{2.76}$$

Since this ratio is greater than 2,

baffles are sufficient.

6. Embankment Width

What is the minimum embankment width if the embankment height is 12 feet, given the embankment cross-section discussion in Table C-SCM-12-1 from VSWHB Chapter 7.4?

Table C-SCM-12-1 Design Criteria Parameters

Parameter	Details
	The designer may opt to use a hydraulic routing model in place of the traditional long-hand calculations to determine sediment basin capacity.
Length of Use	Do not use for longer than 18 months unless the device is designated as a permanent impoundment.
Basin Shape	For embankments of less than 10 feet: • Minimum top width of 6 feet • Maximum side slopes of 2H:1V or flatter For embankments 10 to 14 feet in height: • Minimum top width of 8 feet • Maximum side slopes of 2.5H:1V or flatter For 15-foot embankments (maximum allowed under these specifications): • Minimum top width of 10 feet • Maximum of 2.5H:1V side slopes

Embankment Cross-section

6. Embankment Width

What is the minimum embankment width if the embankment height is 12 feet, given the embankment cross-section discussion in Table C-SCM-12-1 from VSWHB Chapter 7.4?

Table C-SCM-12-1 Design Criteria Parameters

Parameter	Details
	The designer may opt to use a hydraulic routing model in place of the traditional long-hand calculations to determine sediment basin capacity.
Length of Use	Do not use for longer than 18 months unless the device is designated as a
Basin Shape	

Embankment Cross-section

For embankments of less than 10 feet:

- Minimum top width of 6 feet
- Maximum side slopes of 2H:1V or flatter

For embankments 10 to 14 feet in height:

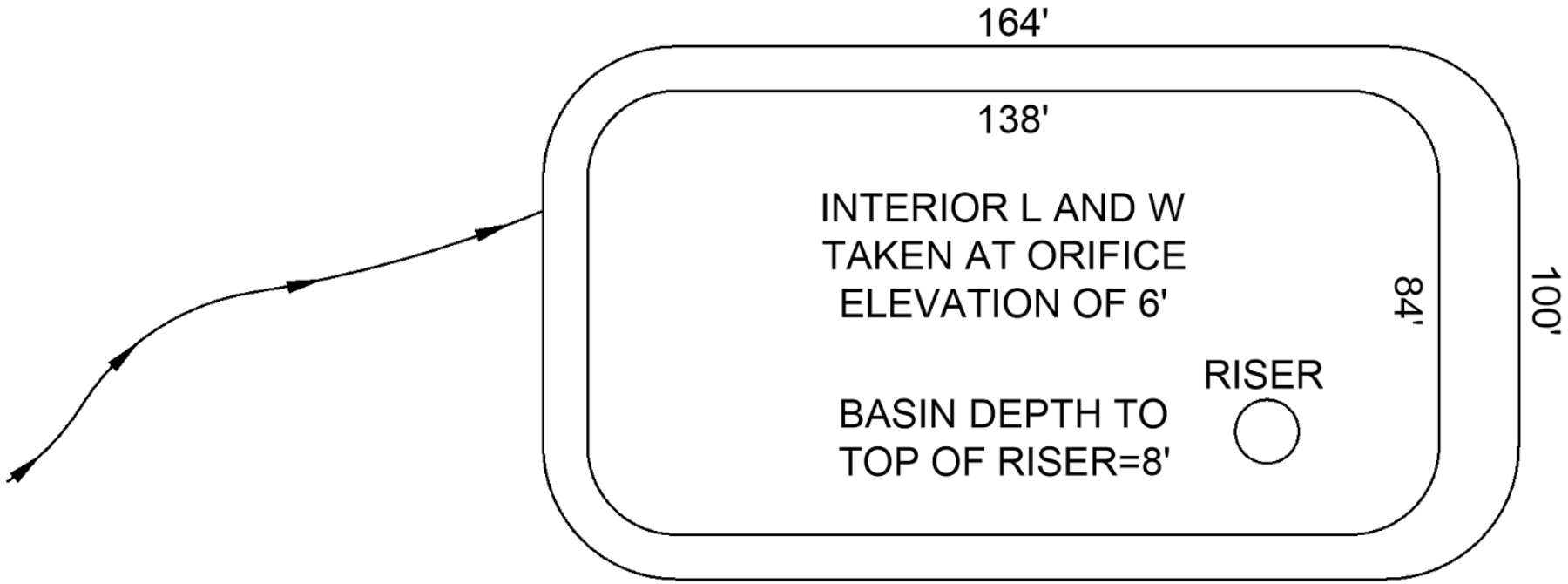
- Minimum top width of 8 feet
- Maximum side slopes of 2.5H:1V or flatter

For 15 foot high embankments (maximum allowed under these specifications):

- Minimum top width of 10 feet
- Maximum of 2.5H:1V side slopes

SN(0

7. Basin Sizing



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VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

7. Basin Sizing

Step 1: Calculate total storage needed.

Total Volume in cubic yards (cy) =

Total Drainage Area in acres × **134** cy per acre

$$V = A \times \mathbf{134}$$

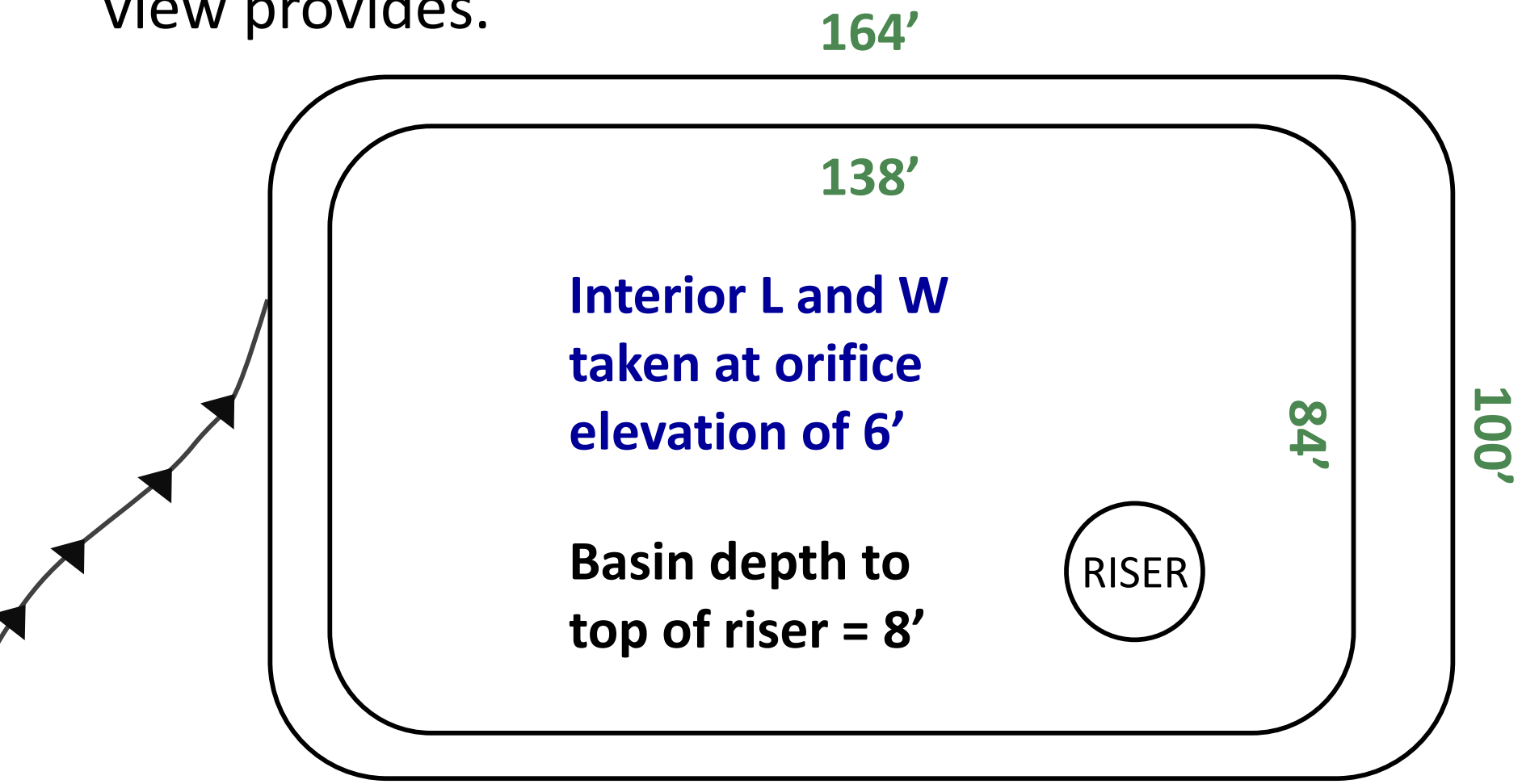
= **15** acres × **134** cy per acre

= **2,010 cy required**

2,010 cy × 27 cf/cy = 54,270 cf

7. Basin Sizing

Step 2: Determine the wet storage volume the plan view provides.



Plan View of Sediment Basin

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7. Basin Sizing

Step 2: Determine wet storage volume provided.

Surface Area = Length × Width

$\mathbf{A_1}$ = 138 ft × 84 ft = 11,592 square ft (sf)

Volume = 0.4 × A_1 × D_1

= 0.4 × 11,592 sf × 6 ft deep

$\mathbf{V_1}$ = 27,820.8 cubic feet (cf)

7. Basin Sizing

Complete on your own

Step 3: Determine dry storage volume (V_2) provided.

Surface Area (A_2) = surface area of flooded area at crest of principal spillway

Depth (D_2) = orifice elevation to crest of principal spillway

Volume (V_2) = $\frac{A_1 + A_2}{2} \times D_2$

7. Basin Sizing

Step 3: Determine dry storage volume (V_2) provided.

Surface Area = Length × Width

$$\mathbf{A_2} = 164 \text{ ft} \times 100 \text{ ft} = 16{,}400 \text{ square ft (sf)}$$

Depth = orifice elevation to crest of principal spillway

$$\mathbf{D_2} = 8 \text{ ft} - 6 \text{ ft} = 2 \text{ ft}$$

$$\textbf{Volume } (\mathbf{V_2}) = \frac{A_1 + A_2}{2} \times D_2 = \frac{11{,}592 + 16{,}400}{2} \times 2 \text{ ft deep}$$

$$\mathbf{V_2} = \boxed{27{,}992 \text{ cubic feet (cf)}}$$

7. Basin Sizing

Step 4: Add the wet and dry storage volumes (in cubic feet).

Storage Volume provided = $V_1 + V_2$

= 27,820.8 cubic feet (cf) + 27,992 cf

= 55,812.8 cf

7. Basin Sizing

Step 5: Convert volume from cubic feet to cubic yards and compare.

$$Volume = 55{,}812.8\ cf \times \frac{1\ cy}{27\ sf}$$

$$= \boxed{2{,}067.14\ \text{cy}}$$

2,010 cy required

✓ **Basin volume appears to be in compliance!**

8. Barrel Diameter Steps 1–4

Table C-SCM-12-4 Pipe Flow Chart

H, in feet	6"	8"	10"	12"	15"	18"	21"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"
8	0.94	1.99	3.53	5.61	9.84	15.5	22.6	31.2	53.2	81.5	116	158	205	260	320	388	461	541	628	721	820
9	1.00	2.11	3.74	5.95	10.4	16.4	24	33.1	56.4	86.5	123	167	218	275	340	411	489	574	666	764	870
10	1.05	2.22	3.94	6.27	11	17.3	25.3	34.9	59.5	91.2	130	176	230	290	358	433	516	605	702	806	917
11	1.10	2.33	4.13	6.58	11.5	18.2	26.5	36.6	62.4	95.6	136	185	241	304	376	454	541	635	736	845	962
12	1.15	2.43	4.32	6.87	12.1	19	27.7	38.2	65.2	99.9	142	193	252	318	392	475	565	663	769	883	1004
13	1.20	2.53	4.49	7.15	12.6	19.7	28.8	39.8	67.8	104	148	201	262	331	408	494	588	690	800	919	1045
14	1.25	2.63	4.66	7.42	13	20.5	29.9	41.3	70.4	108	154	208	272	343	424	513	610	716	830	953	1085
15	1.29	2.72	4.83	7.68	13.5	21.2	30.9	42.8	72.8	112	159	216	281	355	439	531	631	741	860	987	1123
16	1.33	2.81	4.99	7.93	13.9	21.9	32	44.2	75.2	115	165	223	290	367	453	548	652	765	888	1019	1160
17	1.37	2.9	5.14	8.18	14.3	22.6	32.9	45.5	77.5	119	170	230	229	378	467	565	672	789	915	1051	1195
18	1.41	2.98	5.29	8.41	14.8	23.2	33.9	46.8	79.8	120	174	236	308	389	480	581	692	812	942	1081	1230
19	1.45	3.06	5.43	8.64	15.2	23.9	34.8	48.1	82	126	179	243	316	400	494	597	711	834	967	1111	1264
20	1.49	3.14	5.57	8.87	15.6	24.5	35.7	49.4	84.1	129	184	249	325	410	506	613	729	856	993	1139	1297
21	1.53	3.22	5.71	9.09	15.9	25.1	36.6	50.6	86.2	132	188	255	333	421	519	628	747	877	1017	1168	1329
22	1.56	3.29	5.85	9.3	16.3	25.7	37.5	51.8	88.2	135	193	261	341	430	531	643	765	898	1041	1195	1360
23	1.60	3.37	5.98	9.51	16.7	26.2	38.3	53	90.2	138	197	267	348	440	543	657	782	918	1064	1222	1390
24	1.63	3.44	6.11	9.72	17	26.8	39.1	54.1	92.1	141	201	273	356	450	555	671	799	937	1087	1248	1420
25	1.66	3.51	6.23	9.92	17.4	27.4	39.9	55.2	94	144	206	279	363	459	566	685	815	957	1110	1274	1450
26	1.7	3.58	6.36	10.1	17.7	27.9	40.7	56.3	95.9	147	210	284	370	468	577	699	831	976	1132	1299	1478
27	1.73	3.65	6.48	10.3	18.1	28.4	41.5	57.4	97.7	150	214	290	377	477	588	712	847	994	1153	1324	1507
28	1.76	3.72	6.6	10.5	18.4	29	42.3	58.4	99.5	153	218	295	384	486	599	725	863	1013	1174	1348	1534
29	1.79	3.78	6.71	10.7	18.7	29.5	43	59.5	101	155	221	300	391	494	610	738	878	1030	1195	1372	1561
30	1.82	3.85	6.83	10.9	19.1	30	43.7	60.5	103	158	225	305	398	503	620	750	893	1048	1216	1396	1588
L, in feet	**Correction Factors for Other Pipe Lengths**																				
20	1.69	1.63	1.58	1.53	1.47	1.42	1.37	1.34	1.28	1.24	1.2	1.18	1.16	1.14	1.13	1.11	1.1	1.1	1.09	1.08	1.08
30	1.44	1.41	1.39	1.36	1.32	1.29	1.27	1.24	1.21	1.18	1.15	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.07	1.06	1.06
40	1.28	1.27	1.25	1.23	1.21	1.2	1.18	1.17	1.14	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.05	1.04
50	1.16	1.16	1.15	1.14	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.03	1.03	1.03
60	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99

Notes:

For corrugated metal pipe inlet Km = Kc + Kb = 1.0 and 70 feet of corrugated metal pipe conduit (full flow assumed)

Correction factors for pipe lengths other than 70 feet diameter of pipe in inches

Source: USDA-SCS

8. Barrel Diameter Steps 5-6

Table C-SCM-12-4 Pipe Flow Chart

H, in feet	6"	8"	10"	12"	15"	18"	21"	24"	30"	36"	42"	48"	5								
8	0.94	1.99	3.53	5.61	9.84	15.5	22.6	31.2	53.2	81.5	116	158	205	260	320	388	461	541	628	721	820
9	1.00	2.11	3.74	5.95	10.4	16.4	24	33.1	56.4	86.5	123	167	218	275	340	411	489	574	666	764	870
10	1.05	2.22	3.94	6.27	11	17.3	25.3	34.9	59.5	91.2	130	176	230	290	358	433	516	605	702	806	917
11	1.10	2.33	4.13	6.58	11.5	18.2	26.5	36.6	62.4	95.6	136	185	241	304	376	454	541	635	736	845	962
12	1.15	2.43	4.32	6.87	12.1	19	27.7	38.2	65.2	99.9	142	193	252	318	392	475	565	663	769	883	1004
13	1.20	2.53	4.49	7.15	12.6	19.7	28.8	39.8	67.8	104	148	201	262	331	408	494	588	690	800	919	1045
14	1.25	2.63	4.66	7.42	13	20.5	29.9	41.3	70.4	108	154	208	272	343	424	513	610	716	830	953	1085
15	1.29	2.72	4.83	7.68	13.5	21.2	30.9	42.8	72.8	112	159	216	281	355	439	531	631	741	860	987	1123
16	1.33	2.81	4.99	7.93	13.9	21.9	32	44.2	75.2	115	165	223	290	367	453	548	652	765	888	1019	1160
17	1.37	2.9	5.14	8.18	14.3	22.6	32.9	45.5	77.5	119	170	230	229	378	467	565	672	789	915	1051	1195
18	1.41	2.98	5.29	8.41	14.8	23.2	33.9	46.8	79.8	120	174	236	308	389	480	581	692	812	942	1081	1230
19	1.45	3.06	5.43	8.64	15.2	23.9	34.8	48.1	82	126	179	243	316	400	494	597	711	834	967	1111	1264
20	1.49	3.14	5.57	8.87	15.6	24.5	35.7	49.4	84.1	129	184	249	325	410	506	613	729	856	993	1139	1297
21	1.53	3.22	5.71	9.09	15.9	25.1	36.6	50.6	86.2	132	188	255	333	421	519	628	747	877	1017	1168	1329
22	1.56	3.29	5.85	9.3	16.3	25.7	37.5	51.8	88.2	135	193	261	341	430	531	643	765	898	1041	1195	1360
23	1.60	3.37	5.98	9.51	16.7	26.2	38.3	53	90.2	138	197	267	348	440	543	657	782	918	1064	1222	1390
24	1.63	3.44	6.11	9.72	17	26.8	39.1	54.1	92.1	141	201	273	356	450	555	671	799	937	1087	1248	1420
25	1.66	3.51	6.23	9.92	17.4	27.4	39.9	55.2	94	144	206	279	363	459	566	685	815	957	1110	1274	1450
26	1.7	3.58	6.36	10.1	17.7	27.9	40.7	56.3	95.9	147	210	284	370	468	577	699	831	976	1132	1299	1478
27	1.73	3.65	6.48	10.3	18.1	28.4	41.5	57.4	97.7	150	214	290	377	477	588	712	847	994	1153	1324	1507
28	1.76	3.72	6.6	10.5	18.4	29	42.3	58.4	99.5	153	218	295	384	486	599	725	863	1013	1174	1348	1534
29	1.79	3.78	6.71	10.7	18.7	29.5	43	59.5	101	155	221	300	391	494	610	738	878	1030	1195	1372	1561
30	1.82	3.85	6.83	10.9	19.1	30	43.7	60.5	103	158	225	305	398	503	620	750	893	1048	1216	1396	1588
L, in feet	**Correction Factors for Other Pipe Lengths**																				
20	1.69	1.63	1.58	1.53	1.47	1.42	1.37	1.34	1.28	1.24	1.2	1.18	1.16	1.14	1.13	1.11	1.1	1.1	1.09	1.08	1.08
30	1.44	1.41	1.39	1.36	1.32	1.29	1.27	1.24	1.21	1.18	1.15	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.07	1.06	1.06
40	1.28	1.27	1.25	1.23	1.21	1.2	1.18	1.17	1.14	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.05	1.04
50	1.16	1.16	1.15	1.14	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.03	1.03	1.03
60	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99
90	0.89	0.89	0.9	0.9	0.91	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.97	0.94
100	0.85	0.85	0.86	0.86	0.87	0.88	0.89	0.89	0.9	0.91	0.92	0.93	0.93	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.94
120	0.78	0.79	0.79	0.9	0.81	0.82	0.83	0.83	0.85	0.86	0.87	0.89	0.89	0.9	0.91	0.89	0.92	0.93	0.93	0.94	0.92
140	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.81	0.82	0.84	0.85	0.86	0.87	0.88	0.86	0.89	0.9	0.91	0.91	0.9
160	0.68	0.69	0.69	0.7	0.71	0.73	0.74	0.75	0.77	0.79	0.8	0.82	0.83	0.84	0.85	0.92	0.87	0.88	0.89	0.89	

Notes:

8. Barrel Diameter

Step 7: Determine the pipe capacity.

$$Q_1 = CF \times Q_{70}$$

$$= 0.96 \times 25.3 \text{ cubic feet per second (cfs)}$$

$$Q_1 = 24.288 \text{ cfs}$$

(less than the required 25 cfs)

8. Barrel Diameter: Step 8

Table C-SCM-12-4 Pipe Flow Chart

Table C-SCM-12-4 Pipe Flow Chart,																					
H, in feet	6"	8"	10"	12"	15"	18"	21"	24"	30"	36"	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	102"
8	0.94	1.99	3.53	5.61	9.84	15.5	22.6	31.2	53.2	81.5	116	158	205	260	320	388	461	541	628	721	820
9	1.00	2.11	3.74	5.95	10.4	16.4	24	33.1	56.4	86.5	123	167	218	275	340	411	489	574	666	764	870
10	1.05	2.22	3.94	6.27	11	17.3	25.3	34.9	59.5	91.2	130	176	230	290	358	433	516	605	702	806	917
11	1.10	2.33	4.13	6.58	11.5	18.2	26.5	36.6	62.4	95.6	136	185	241	304	376	454	541	635	736	845	962
12	1.15	2.43	4.32	6.87	12.1	19	27.7	38.2	65.2	99.9	142	193	252	318	392	475	565	663	769	883	1004
13	1.20	2.53	4.49	7.15	12.6	19.7	28.8	39.8	67.8	104	148	201	262	331	408	494	588	690	800	919	1045
14	1.25	2.63	4.66	7.42	13	20.5	29.9	41.3	70.4	108	154	208	272	343	424	513	610	716	830	953	1085
15	1.29	2.72	4.83	7.68	13.5	21.2	30.9	42.8	72.8	112	159	216	281	355	439	531	631	741	860	987	1123
16	1.33	2.81	4.99	7.93	13.9	21.9	32	44.2	75.2	115	165	223	290	367	453	548	652	765	888	1019	1160
17	1.37	2.9	5.14	8.18	14.3	22.6	32.9	45.5	77.5	119	170	230	229	378	467	565	672	789	915	1051	1195
18	1.41	2.98	5.29	8.41	14.8	23.2	33.9	46.8	79.8	120	174	236	308	389	480	581	692	812	942	1081	1230
19	1.45	3.06	5.43	8.64	15.2	23.9	34.8	48.1	82	126	179	243	316	400	494	597	711	834	967	1111	1264
20	1.49	3.14	5.57	8.87	15.6	24.5	35.7	49.4	84.1	129	184	249	325	410	506	613	729	856	993	1139	1297
21	1.53	3.22	5.71	9.09	15.9	25.1	36.6	50.6	86.2	132	188	255	333	421	519	628	747	877	1017	1168	1329
22	1.56	3.29	5.85	9.3	16.3	25.7	37.5	51.8	88.2	135	193	261	341	430	531	643	765	898	1041	1195	1360
23	1.60	3.37	5.98	9.51	16.7	26.2	38.3	53	90.2	138	197	267	348	440	543	657	782	918	1064	1222	1390
24	1.63	3.44	6.11	9.72	17	26.8	39.1	54.1	92.1	141	201	273	356	450	555	671	799	937	1087	1248	1420
25	1.66	3.51	6.23	9.92	17.4	27.4	39.9	55.2	94	144	206	279	363	459	566	685	815	957	1110	1274	1450
26	1.7	3.58	6.36	10.1	17.7	27.9	40.7	56.3	95.9	147	210	284	370	468	577	699	831	976	1132	1299	1478
27	1.73	3.65	6.48	10.3	18.1	28.4	41.5	57.4	97.7	150	214	290	377	477	588	712	847	994	1153	1324	1507
28	1.76	3.72	6.6	10.5	18.4	29	42.3	58.4	99.5	153	218	295	384	486	599	725	863	1013	1174	1348	1534
29	1.79	3.78	6.71	10.7	18.7	29.5	43	59.5	101	155	221	300	391	494	610	738	878	1030	1195	1372	1561
30	1.82	3.85	6.83	10.9	19.1	30	43.7	60.5	103	158	225	305	398	503	620	750	893	1048	1216	1396	1588
L, in feet	**Correction Factors for Other Pipe Lengths**																				
20	1.69	1.63	1.58	1.53	1.47	1.42	1.37	1.34	1.28	1.24	1.2	1.18	1.16	1.14	1.13	1.11	1.1	1.1	1.09	1.08	1.08
30	1.44	1.41	1.39	1.36	1.32	1.29	1.27	1.24	1.21	1.18	1.15	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.07	1.06	1.06
40	1.28	1.27	1.25	1.23	1.21	1.2	1.18	1.17	1.14	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.05	1.04
50	1.16	1.16	1.15	1.14	1.13	1.12	1.11	1.1	1.09	1.08	1.07	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.03	1.03	1.03
60	1.07	1.07	1.07	1.06	1.06	1.05	1.05	1.05	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
80	0.94	0.94	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.99	0.99	0.99
90	0.89	0.89	0.9	0.9	0.91	0.91	0.92	0.92	0.93	0.94	0.94	0.95	0.95	0.96	0.96	0.96	0.97	0.97	0.97	0.97	0.94
100	0.85	0.85	0.86	0.86	0.87	0.88	0.89	0.89	0.9	0.91	0.92	0.93	0.93	0.94	0.94	0.95	0.95	0.95	0.96	0.96	0.94
120	0.78	0.79	0.79	0.9	0.81	0.82	0.83	0.83	0.85	0.86	0.87	0.89	0.89	0.9	0.91	0.89	0.92	0.93	0.93	0.94	0.92
140	0.72	0.73	0.74	0.75	0.76	0.77	0.78	0.79	0.81	0.82	0.84	0.85	0.86	0.87	0.88	0.86	0.89	0.9	0.91	0.91	0.9
160	0.68	0.69	0.69	0.7	0.71	0.73	0.74	0.75	0.77	0.79	0.8	0.82	0.83	0.84	0.85	0.92	0.87	0.88	0.89	0.89	

Notes:

8. Barrel Diameter

Step 8: Adjust the pipe capacity.

$$Q_1 = CF \times Q_{70}$$

$$= 0.96 \times 34.9 \text{ cubic feet per second (cfs)}$$

$$Q_1 = 33.504 \text{ cfs}$$

(greater than the required 25 cfs)

Barrel must be at least 24 inches

Questions?

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