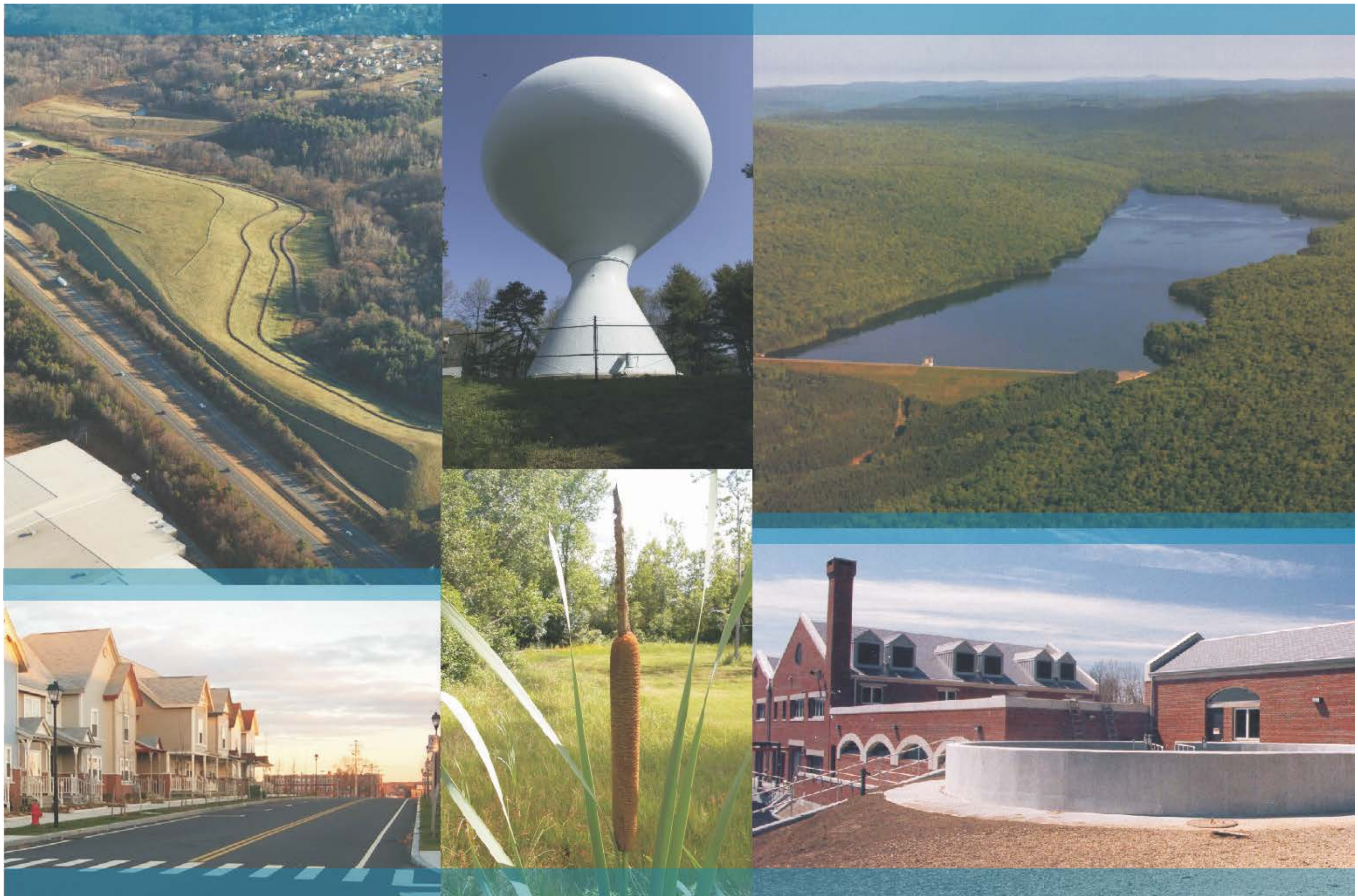
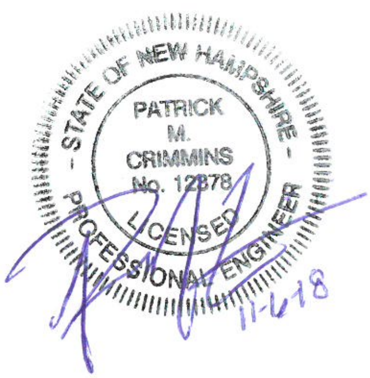




Tighe&Bond

Iron Parcel Redevelopment
70 & 80 Corporate Drive
Portsmouth, New Hampshire

Revised Drainage Analysis

Prepared For:

Lonza Biologics
101 International Drive
Portsmouth, New Hampshire

November 6, 2018

Appendices

Section 6
BMP Worksheets

GRAVEL WETLAND DESIGN CRITERIA
(Env-Wq 1508.05)

Type/Node Name: **Gravel Wetland 1 (POND 1.0)**

Enter the node name in the drainage analysis if applicable

10.57	ac	A = Area draining to the practice	
7.50	ac	A_I = Impervious area draining to the practice	
0.71	decimal	I = percent impervious area draining to the practice, in decimal form	
0.69	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
7.28	ac-in	WQV= 1" x Rv x A	
26,420	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
2,642	cf	10% x WQV (check calc for sediment forebay and micropool volume)	
11,889	cf	45% x WQV (check calc for gravel wetland treatment bay volume)	
3,205	cf	V_{SED} = sediment forebay volume	← **≥ 10%WQV**
14,269	cf	V_{TB1} = volume of treatment bay 1	← **≥ 45%WQV**
20,912	cf	V_{TB2} = volume of treatment bay 2	← **≥ 45%WQV**
44.19	ft	E_{WQV} = elevation of WQV (attach stage-storage table)	
0.53	cfs	Q_{WQV} = discharge at the E_{WQV} (attach stage-discharge table)	← **$<2Q_{avg}$**
27.69	hours	T_{ED} = drawdown time of extended detention = $2WQV/Q_{WQV}$	← **≥ 24-hrs**
3.00	:1	Pond side slopes	← **≥3:1**
39.50	ft	Elevation of SHWT	
41.35	ft	Epp = Elevation of the permanent pool (elevation of lowest orifice)[2]	← **≥ E_{SHWT} - 2 ft**
85.00	ft	Length of the flow path between the inlet and outlet in each cell	← **≥ 15 ft**
Trash rack		What mechanism is proposed to prevent the outlet structure from clogging (applicable for orifices/weirs with a dimension of ≤6")?	
47.47	ft	Peak elevation of the 50-year storm event (E_{50})	
48.00	ft	Berm elevation of the pond	
YES		E_{50} ≤ the berm elevation?	← **yes**

Qualified professional that developed the planting plan:
Name, Profession: Daniel Rukakoski, CWS

1. Volume stored above the wetland soil and below the high flow by-pass.
2. 4" to 8" below the wetland soil. If lowest orifice is less than 2 feet below SHWT, and saturated hydraulic conductivity (Ksat) is greater than 0.005 in/hr, the system must be lined.

Designer's Notes:

Stage-Discharge for Pond POND 1.0: GRAVEL WETLAND 1

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
39.05	0.00	0.00	0.00
39.15	0.00	0.00	0.00
39.25	0.00	0.00	0.00
39.35	0.00	0.00	0.00
39.45	0.00	0.00	0.00
39.55	0.00	0.00	0.00
39.65	0.00	0.00	0.00
39.75	0.00	0.00	0.00
39.85	0.00	0.00	0.00
39.95	0.00	0.00	0.00
40.05	0.00	0.00	0.00
40.15	0.00	0.00	0.00
40.25	0.00	0.00	0.00
40.35	0.00	0.00	0.00
40.45	0.00	0.00	0.00
40.55	0.00	0.00	0.00
40.65	0.00	0.00	0.00
40.75	0.00	0.00	0.00
40.85	0.00	0.00	0.00
40.95	0.00	0.00	0.00
41.05	0.00	0.00	0.00
41.15	0.00	0.00	0.00
41.25	0.00	0.00	0.00
41.35	0.00	0.00	0.00
41.45	0.02	0.02	0.00
41.55	0.07	0.07	0.00
41.65	0.13	0.13	0.00
41.75	0.16	0.16	0.00
41.85	0.19	0.19	0.00
41.95	0.22	0.22	0.00
42.05	0.24	0.24	0.00
42.15	0.26	0.26	0.00
42.25	0.28	0.28	0.00
42.35	0.30	0.30	0.00
42.45	0.31	0.31	0.00
42.55	0.33	0.33	0.00
42.65	0.35	0.35	0.00
42.75	0.36	0.36	0.00
42.85	0.37	0.37	0.00
42.95	0.39	0.39	0.00
43.05	0.40	0.40	0.00
43.15	0.41	0.41	0.00
43.25	0.43	0.43	0.00
43.35	0.44	0.44	0.00
43.45	0.45	0.45	0.00
43.55	0.46	0.46	0.00
43.65	0.47	0.47	0.00
43.75	0.48	0.48	0.00
43.85	0.49	0.49	0.00
43.95	0.50	0.50	0.00
44.05	0.51	0.51	0.00
44.15	0.52	0.52	0.00
44.25	0.53	0.53	0.00
44.35	0.54	0.54	0.00
44.45	0.55	0.55	0.00
44.55	0.56	0.56	0.00
44.65	0.57	0.57	0.00
44.75	0.58	0.58	0.00
44.85	0.59	0.59	0.00
44.95	0.60	0.60	0.00
45.05	0.61	0.61	0.00
45.15	0.66	0.66	0.00
45.25	0.71	0.71	0.00
45.35	0.74	0.74	0.00
45.45	0.77	0.77	0.00
45.55	0.80	0.80	0.00
45.65	0.83	0.83	0.00
45.75	0.85	0.85	0.00
45.85	0.87	0.87	0.00
45.95	0.89	0.89	0.00
46.05	1.02	1.02	0.00
46.15	1.50	1.50	0.00
46.25	2.17	2.17	0.00
46.35	2.98	2.98	0.00
46.45	3.90	3.90	0.00
46.55	5.28	4.83	0.45
46.65	7.86	5.53	2.34
46.75	11.16	6.13	5.03
46.85	15.04	6.66	8.37
46.95	19.39	7.16	12.23
47.05	29.31	12.79	16.52
47.15	40.23	19.12	21.11
47.25	45.18	19.31	25.87
47.35	50.50	19.50	31.00
47.45	56.24	19.68	36.56
47.55	62.35	19.86	42.49
47.65	68.84	20.05	48.79
47.75	75.57	20.23	55.34
47.85	82.52	20.40	62.11
47.95	**89.66**	**20.58**	**69.08**

Stage-Area-Storage for Pond POND 1.0: GRAVEL WETLAND 1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
39.05	9,855	0	44.35	15,143	38,789
39.15	9,855	296	44.45	15,412	40,317
39.25	9,855	591	44.55	15,681	41,872
39.35	9,855	887	44.65	15,950	43,453
39.45	9,855	1,183	44.75	16,219	45,062
39.55	9,855	1,478	44.85	16,488	46,697
39.65	9,855	1,774	44.95	16,757	48,359
39.75	9,855	2,070	45.05	17,034	50,049
39.85	9,855	2,365	45.15	17,320	51,766
39.95	9,855	2,661	45.25	17,606	53,513
40.05	9,855	2,957	45.35	17,892	55,288
40.15	9,855	3,252	45.45	18,178	57,091
40.25	9,855	3,548	45.55	18,465	58,923
40.35	9,855	3,843	45.65	18,751	60,784
40.45	9,855	4,139	45.75	19,037	62,673
40.55	9,855	4,435	45.85	19,323	64,591
40.65	9,855	4,730	45.95	19,609	66,538
40.75	9,855	5,026	46.05	19,848	68,512
40.85	9,855	5,322	46.15	20,039	70,506
40.95	9,855	5,617	46.25	20,231	72,520
41.05	9,855	5,913	46.35	20,423	74,553
41.15	9,855	6,209	46.45	20,614	76,604
41.25	9,855	6,504	46.55	20,806	78,675
41.35	9,855	6,800	46.65	20,997	80,766
41.45	9,855	7,243	46.75	21,189	82,875
41.55	9,855	7,687	46.85	21,381	85,003
41.65	9,855	8,130	46.95	21,572	87,151
41.75	9,855	8,574	47.05	21,762	89,318
41.85	9,855	9,017	47.15	21,951	91,503
41.95	9,855	9,461	47.25	22,140	93,708
42.05	9,959	10,178	47.35	22,329	95,932
42.15	10,168	11,184	47.45	22,518	98,174
42.25	10,377	12,212	47.55	22,707	100,435
42.35	10,586	13,260	47.65	22,896	102,715
42.45	10,795	14,329	47.75	23,085	105,014
42.55	11,003	15,419	47.85	23,274	107,332
42.65	11,212	16,529	47.95	**23,463**	**109,669**
42.75	11,421	17,661			
42.85	11,630	18,814			
42.95	11,839	19,987			
43.05	12,056	21,182			
43.15	12,282	22,398			
43.25	12,508	23,638			
43.35	12,734	24,900			
43.45	12,960	26,185			
43.55	13,185	27,492			
43.65	13,411	28,822			
43.75	13,637	30,174			
43.85	13,863	31,549			
43.95	14,089	32,947			
44.05	14,336	34,367			
44.15	14,605	35,815			
44.25	14,874	37,289			

GRAVEL WETLAND DESIGN CRITERIA
(Env-Wq 1508.05)

Type/Node Name: **Gravel Wetland 2 (POND 1.1)**

Enter the node name in the drainage analysis if applicable

5.89	ac	A = Area draining to the practice	
3.17	ac	A_I = Impervious area draining to the practice	
0.54	decimal	I = percent impervious area draining to the practice, in decimal form	
0.53	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
3.15	ac-in	WQV= 1" x Rv x A	
11,428	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1,143	cf	10% x WQV (check calc for sediment forebay and micropool volume)	
5,143	cf	45% x WQV (check calc for gravel wetland treatment bay volume)	
3,510	cf	V_{SED} = sediment forebay volume	← **≥ 10%WQV**
11,448	cf	V_{TB1} = volume of treatment bay 1	← **≥ 45%WQV**
17,112	cf	V_{TB2} = volume of treatment bay 2	← **≥ 45%WQV**
51.98	ft	E_{WQV} = elevation of WQV (attach stage-storage table)	
0.15	cfs	Q_{WQV} = discharge at the E_{WQV} (attach stage-discharge table)	← **<$2Q_{avg}$**
42.33	hours	T_{ED} = drawdown time of extended detention = $2WQV/Q_{WQV}$	← **≥ 24-hrs**
3.00	:1	Pond side slopes	← **≥3:1**
46.00	ft	Elevation of SHWT	
49.35	ft	Epp = Elevation of the permanent pool (elevation of lowest orifice)[2]	← **≥ E_{SHWT} - 2 ft**
105.00	ft	Length of the flow path between the inlet and outlet in each cell	← **≥ 15 ft**
Trash rack		What mechanism is proposed to prevent the outlet structure from clogging (applicable for orifices/weirs with a dimension of ≤6")?	
56.51	ft	Peak elevation of the 50-year storm event (E_{50})	
57.00	ft	Berm elevation of the pond	
YES		E_{50} ≤ the berm elevation?	← **yes**

Qualified professional that developed the planting plan:
Name, Profession: Daniel Rukakoski, CWS

1. Volume stored above the wetland soil and below the high flow by-pass.
2. 4" to 8" below the wetland soil. If lowest orifice is less than 2 feet below SHWT, and saturated hydraulic conductivity (Ksat) is greater than 0.005 in/hr, the system must be lined.

Designer's Notes:

Stage-Discharge for Pond POND 1.1: GRAVEL WETLAND 2

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
47.55	0.00	50.73	0.00	53.91	0.00	57.09	18.28
47.61	0.00	50.79	0.00	53.97	0.00	57.15	18.65
47.67	0.00	50.85	0.00	54.03	0.00	57.21	19.01
47.73	0.00	50.91	0.00	54.09	0.00	57.27	19.37
47.79	0.00	50.97	0.00	54.15	0.00	57.33	19.72
47.85	0.00	51.03	0.00	54.21	0.00	57.39	20.07
47.91	0.00	51.09	0.00	54.27	0.00	57.45	20.41
47.97	0.00	51.15	0.00	54.33	0.00	57.51	20.74
48.03	0.00	51.21	0.00	54.39	0.00	57.57	21.07
48.09	0.00	51.27	0.00	54.45	0.00	57.63	21.39
48.15	0.00	51.33	0.00	54.51	0.00	57.69	21.71
48.21	0.00	51.39	0.00	54.57	0.00	57.75	22.02
48.27	0.00	51.45	0.00	54.63	0.00	57.81	22.33
48.33	0.00	51.51	0.00	54.69	0.00	57.87	22.64
48.39	0.00	51.57	0.00	54.75	0.00	57.93	22.94
48.45	0.00	51.63	0.00	54.81	0.00	57.99	**23.24**
48.51	0.00	51.69	0.00	54.87	0.00		
48.57	0.00	51.75	0.00	54.93	0.00		
48.63	0.00	51.81	0.00	54.99	0.00		
48.69	0.00	51.87	0.00	55.05	0.00		
48.75	0.00	51.93	0.00	55.11	0.00		
48.81	0.00	51.99	0.00	55.17	0.00		
48.87	0.00	52.05	0.00	55.23	0.00		
48.93	0.00	52.11	0.00	55.29	0.00		
48.99	0.00	52.17	0.00	55.35	0.00		
49.05	0.00	52.23	0.00	55.41	0.00		
49.11	0.00	52.29	0.00	55.47	0.00		
49.17	0.00	52.35	0.00	55.53	0.00		
49.23	0.00	52.41	0.00	55.59	0.00		
49.29	0.00	52.47	0.00	55.65	2.14		
49.35	0.00	52.53	0.00	55.71	4.28		
49.41	0.00	52.59	0.00	55.77	5.66		
49.47	0.00	52.65	0.00	55.83	6.76		
49.53	0.00	52.71	0.00	55.89	7.71		
49.59	0.00	52.77	0.00	55.95	8.56		
49.65	0.00	52.83	0.00	56.01	9.32		
49.71	0.00	52.89	0.00	56.07	10.03		
49.77	0.00	52.95	0.00	56.13	10.70		
49.83	0.00	53.01	0.00	56.19	11.32		
49.89	0.00	53.07	0.00	56.25	11.91		
49.95	0.00	53.13	0.00	56.31	12.47		
50.01	0.00	53.19	0.00	56.37	13.01		
50.07	0.00	53.25	0.00	56.43	13.53		
50.13	0.00	53.31	0.00	56.49	14.03		
50.19	0.00	53.37	0.00	56.55	14.51		
50.25	0.00	53.43	0.00	56.61	14.97		
50.31	0.00	53.49	0.00	56.67	15.43		
50.37	0.00	53.55	0.00	56.73	15.87		
50.43	0.00	53.61	0.00	56.79	16.29		
50.49	0.00	53.67	0.00	56.85	16.71		
50.55	0.00	53.73	0.00	56.91	17.11		
50.61	0.00	53.79	0.00	56.97	17.51		
50.67	0.00	53.85	0.00	57.03	17.90		

Stage-Area-Storage for Pond POND 1.1: GRAVEL WETLAND 2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
47.55	6,269	0	55.50	18,225	64,512
47.70	6,269	282	55.65	18,699	67,281
47.85	6,269	564	55.80	19,173	70,121
48.00	6,269	846	55.95	19,647	73,033
48.15	6,269	1,128	56.10	19,989	76,009
48.30	6,269	1,411	56.25	20,264	79,028
48.45	6,269	1,693	56.40	20,540	82,088
48.60	6,269	1,975	56.55	20,816	85,190
48.75	6,269	2,257	56.70	21,091	88,333
48.90	6,269	2,539	56.85	21,367	91,517
49.05	6,269	2,821	57.00	21,643	94,743
49.20	6,269	3,103	57.15	21,918	98,010
49.35	6,269	3,385	57.30	22,194	101,318
49.50	6,269	3,667	57.45	22,469	104,668
49.65	6,269	3,949	57.60	22,745	108,059
49.80	6,269	4,232	57.75	23,021	111,492
49.95	6,269	4,608	57.90	**23,296**	**114,965**
50.10	6,269	5,031			
50.25	6,269	5,454			
50.40	6,269	5,877			
50.55	6,362	6,475			
50.70	6,641	7,450			
50.85	6,920	8,467			
51.00	7,199	9,526			
51.15	7,497	10,629			
51.30	7,795	11,775			
51.45	8,094	12,967			
51.60	8,392	14,204			
51.75	8,690	15,485			
51.90	8,988	16,811			
52.05	9,295	18,181			
52.20	9,619	19,600			
52.35	9,942	21,067			
52.50	10,266	22,583			
52.65	10,590	24,147			
52.80	10,913	25,759			
52.95	11,237	27,421			
53.10	11,592	29,132			
53.25	11,962	30,899			
53.40	12,333	32,721			
53.55	12,703	34,598			
53.70	13,073	36,532			
53.85	13,444	38,520			
54.00	13,814	40,565			
54.15	14,239	42,669			
54.30	14,663	44,836			
54.45	15,088	47,068			
54.60	15,513	49,363			
54.75	15,937	51,722			
54.90	16,362	54,144			
55.05	16,803	56,630			
55.20	17,277	59,186			
55.35	17,751	61,814			

FILTRATION PRACTICE DESIGN CRITERIA
(Env-Wq 1508.07)

Type/Node Name: **Rain Garden 1.0 (POND 1.4)**

Enter the type of filtration practice (e.g., bioretention system) and the node name in the drainage analysis, if applicable

Yes		Have you reviewed the restrictions on unlined systems outlined in Env-Wq 1508.07(a)?	
4.93	ac	A = Area draining to the practice	
4.19	ac	A_I = Impervious area draining to the practice	
0.85	decimal	I = percent impervious area draining to the practice, in decimal form	
0.82	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
4.02	ac-in	WQV= 1” x Rv x A	
14,597	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12”)	
3,649	cf	25% x WQV (check calc for sediment forebay volume)	
10,947	cf	75% x WQV (check calc for surface sand filter volume)	
Deep sumps		Method of Pretreatment? (not required for clean or roof runoff)	
	cf	V_{SED} = sediment forebay volume, if used for pretreatment	← **≥ 25%WQV**
10,418	sf	A_{SA} = surface area of the practice	
0.30	iph	I_{DESIGN} = design infiltration rate[1]	
Yes	Yes/No	If I_{DESIGN} is < 0.50 iph, has an underdrain been provided?	
56.0	hours	T_{DRAIN} = drain time = V / (A_{SA} * I_{DESIGN})	← **≤ 72-hrs**
43.50	feet	E_{FC} = elevation of the bottom of the filter course material[2]	
42.42	feet	E_{UD} = invert elevation of the underdrain (UD), if applicable	
39.00	feet	E_{SHWT} = elevation of SHWT (if none found, enter the lowest elevation of the test pit)	
36.50	feet	E_{ROCK} = elevation of bedrock (if none found, enter the lowest elevation of the test pit)	
1.08	feet	$D_{FC\ to\ UD}$ = depth to UD from the bottom of the filter course	← **≥ 1'**
7.00	feet	$D_{FC\ to\ ROCK}$ = depth to bedrock from the bottom of the filter course	← **≥ 1'**
4.50	feet	$D_{FC\ to\ SHWT}$ = depth to SHWT from the bottom of the filter course	← **≥ 1'**
49.56	ft	Peak elevation of the 50-year storm event (infiltration can be used in analysis)	
50.00	ft	Elevation of the top of the practice	
YES		50 peak elevation ≤ Elevation of the top of the practice	← **yes**

If a surface sand filter or underground sand filter is proposed:

YES	ac	Drainage Area check.	← **< 10 ac**
	cf	V = volume of storage[3] (attach a stage-storage table)	← **≥ 75%WQV**
	inches	D_{FC} = filter course thickness	← **18", or 24" if within GPA**
Sheet		Note what sheet in the plan set contains the filter course specification	
	Yes/No	Access grate provided?	← **yes**

If a bioretention area is proposed:

YES	ac	Drainage Area no larger than 5 ac?	← **yes**
27,158	cf	V = volume of storage[3] (attach a stage-storage table)	← **≥ WQV**
18.0	inches	D_{FC} = filter course thickness	← **18", or 24" if within GPA**
Sheet	C-509	Note what sheet in the plan set contains the filter course specification	
3.0	:1	Pond side slopes	← **≥3:1**
Sheet	C-509	Note what sheet in the plan set contains the planting plans and surface cover	

If porous pavement is proposed:

		Type of pavement proposed (concrete? Asphalt? Pavers? Etc)	
	acres	A_{SA} = surface area of the pervious pavement	
1.0	:1	ratio of the contributing area to the pervious surface area	← **5:1**
	inches	D_{FC} = filter course thickness	← **12", or 18" if within GPA**
Sheet		Note what sheet in the plan set contains the filter course spec.	← **304.1 sand**

1. Rate of the limiting layer (either the filter course or the underlying soil). See Env-Wq 1504.14 for guidance on determining the infiltration rate.

2. See lines 34, 40 and 48 for required depths of filter media.

3. Volume without depending on infiltration. The volume includes the storage above the filter (but below the invert of the outlet stucture, if any), the filter media voids, and the pretreatment area. The storage above the filter media shall not include the volume above the outlet structure, if any.

Designer's Notes:

Stage-Area-Storage for Pond POND 1.4: RAINGARDEN 1.0

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
42.17	10,418	0	47.47	13,890	37,029
42.27	10,418	417	47.57	14,036	38,425
42.37	10,418	833	47.67	14,182	39,836
42.47	10,418	1,250	47.77	14,328	41,261
42.57	10,418	1,667	47.87	14,474	42,702
42.67	10,418	2,084	47.97	14,620	44,156
42.77	10,418	2,500	48.07	14,773	45,626
42.87	10,418	2,917	48.17	14,930	47,111
42.97	10,418	3,334	48.27	15,086	48,612
43.07	10,418	3,750	48.37	15,242	50,128
43.17	10,418	4,167	48.47	15,399	51,660
43.27	10,418	4,584	48.57	15,555	53,208
43.37	10,418	5,001	48.67	15,711	54,771
43.47	10,418	5,417	48.77	15,868	56,350
43.57	10,418	5,615	48.87	16,024	57,945
43.67	10,418	5,719	48.97	16,180	59,555
43.77	10,418	5,824	49.07	16,336	61,181
43.87	10,418	5,928	49.17	16,493	62,822
43.97	10,418	6,032	49.27	16,649	64,479
44.07	10,418	6,136	49.37	16,805	66,152
44.17	10,418	6,240	49.47	16,962	67,840
44.27	10,418	6,345	49.57	17,118	69,544
44.37	10,418	6,449	49.67	17,274	71,264
44.47	10,418	6,553	49.77	17,431	72,999
44.57	10,418	6,657	49.87	17,587	74,750
44.67	10,418	6,761	49.97	**17,743**	**76,517**
44.77	10,418	6,865			
44.87	10,418	6,970			
44.97	10,418	7,074			
45.07	10,511	7,838			
45.17	10,644	8,895			
45.27	10,776	9,966			
45.37	10,909	11,051			
45.47	11,042	12,148			
45.57	11,174	13,259			
45.67	11,307	14,383			
45.77	11,440	15,520			
45.87	11,572	16,671			
45.97	11,705	17,835			
46.07	11,847	19,012			
46.17	11,993	20,204			
46.27	12,139	21,411			
46.37	12,285	22,632			
46.47	12,431	23,868			
46.57	12,577	25,118			
46.67	12,723	26,383			
46.77	12,869	27,663			
46.87	13,015	28,957			
46.97	13,161	30,266			
47.07	13,307	31,589			
47.17	13,453	32,927			
47.27	13,599	34,280			
47.37	13,745	35,647			

Section 7
Drainage Analysis

7.1 Calculation Methods

The design storms analyzed in this study are the 2-year, 10-year, 25-year and 50-year 24-hour duration storm events. The pre-development 1-year, 24-hour duration storm was also analyzed for channel protection requirements. The stormwater modeling system, HydroCAD 10.0 was utilized to predict the peak runoff rates from these storm events. The peak discharge rates were determined by analyzing Type III 24-hour storm events. The rainfall data for these storm events was obtained from the data published by the Northeast Regional Climate Center at Cornell University, with an additional 15% added factor of safety as required by Env-Wq 1503.08(l).

Tailwater conditions in the inlet structure PDMH203 and at the outlet of the existing triple arch culverts into the road side swale on Goose Bay Drive have been included in these calculations to account for any surcharging that may occur due to the tailwater condition. These tailwater elevations were determined by Streamworks, PLLC as part of their overall watershed analysis and are discussed in more detail in the attached memo.

The time of concentration was computed using the TR-55 Method, which provides a means of determining the time for an entire watershed to contribute runoff to a specific location via sheet flows, shallow concentrated flow and channel flow. Runoff curve numbers were calculated by estimating the coverage areas and then summing the curve number for the coverage area as a percent of the entire watershed.

References:

1. HydroCAD Stormwater Modeling System, by HydroCAD Software Solutions LLC, Chocorua, New Hampshire.

2. New Hampshire Stormwater Management Manual, Volume 2, Post-Construction Best Management Practices Selection and Design, December 2008.

7.2 Pre-Development Conditions

In order to analyze the pre-development condition, the site has been divided into three watershed areas modeled at two points of analysis. These points of analysis and watersheds are depicted on the plan entitled “Pre-Development Watershed Plan”, Sheet C-801.

Each of the points of analysis and their contributing watershed areas are described below:

Point of Analysis (PA1)

PRE 1.0 makes up almost the entire area to be developed. This area consists of the entire undeveloped parcel, as well as, a portion of Corporate Drive that drains onto the parcel via a closed drainage system. Currently the watershed is an undeveloped field area that with a portion of the site being used as a temporary construction parking area with associated stormwater management controls near the center of the parcel. This parcel was previously developed as military housing that was demolished in the mid to late 1990's. Runoff from this area travels southeast via overland flow to Point of Analysis 1 located at the existing Hodgson Brook outlet headwall.

PRE 1.1 includes roof drain runoff from the existing Lonza facility located at 101 International Drive that is connected into the existing Hodgson Brook Culvert. There is also a small portion of Goose Bay Drive that enters this culvert.

The existing tailwater elevations for the road side swale along Goose Bay Drive were determined by Streamworks, PLLC and can be found in the attached memo.

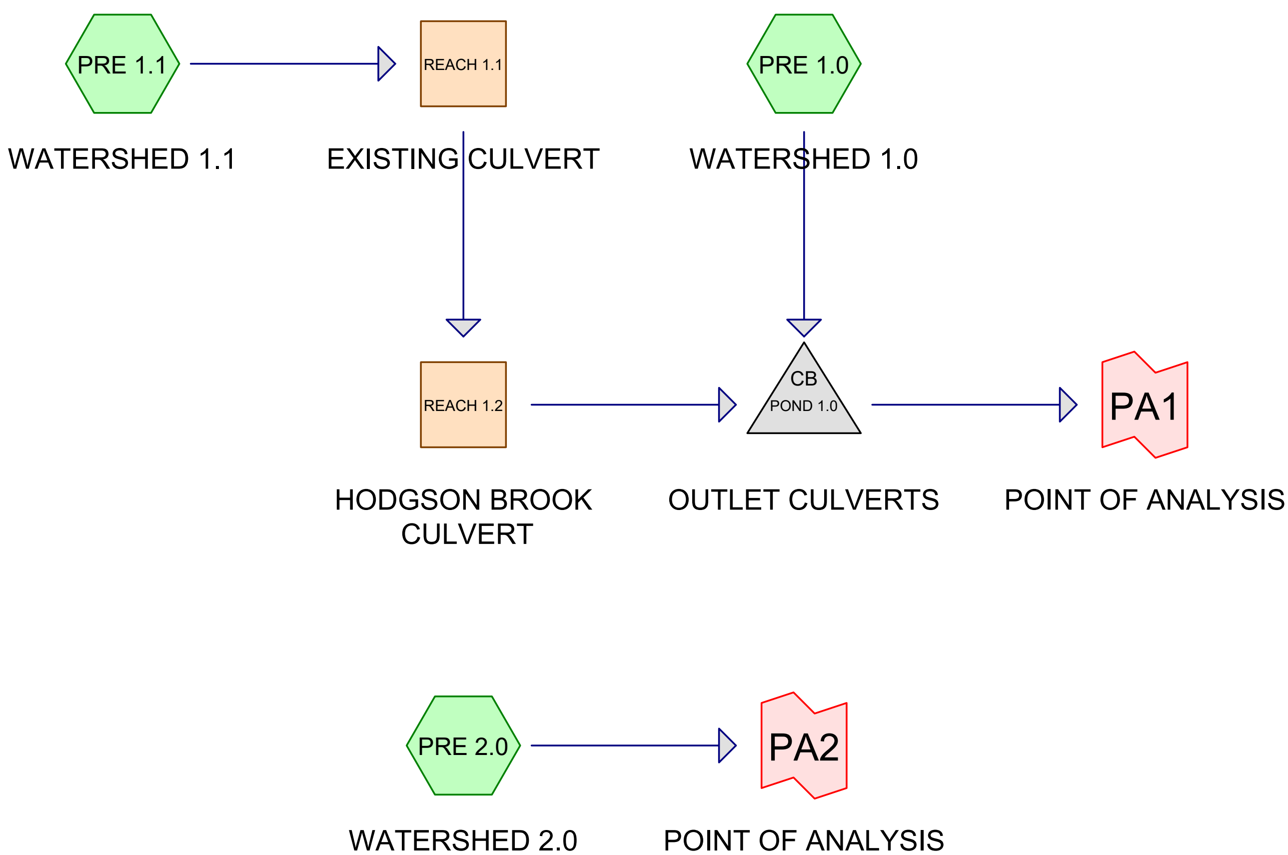
Point of Analysis (PA2)

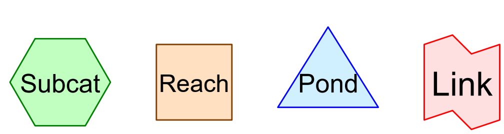
PRE 2.0 is comprised mostly of runoff from Goose Bay Drive that is located between the undeveloped parcel and the existing Lonza facility. Runoff from this area travels via overland flow to the existing stormwater basin located at the existing Lonza facility. Point of Analysis 2 (PA2) is located at the existing basin.

7.2.1 Pre-Development Calculations

7.2.2 Pre-Development Watershed Plans

7.2.3 Pre-Development Soil Plan





Routing Diagram for L-0700-13 PRE
Prepared by Tighe & Bond, Printed 11/2/2018
HydroCAD® 10.00-20 s/n 03436 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.736	74	>75% Grass cover, Good, HSG C (PRE 1.1, PRE 2.0)
2.274	91	Gravel roads, HSG D (PRE 1.0)
3.289	58	Meadow, non-grazed, HSG B (PRE 1.0)
19.420	71	Meadow, non-grazed, HSG C (PRE 1.0)
0.044	78	Meadow, non-grazed, HSG D (PRE 1.0)
3.668	98	Paved parking, HSG C (PRE 1.0, PRE 1.1, PRE 2.0)
0.758	98	Roofs, HSG C (PRE 1.1, PRE 2.0)
0.297	55	Woods, Good, HSG B (PRE 1.0)
1.123	70	Woods, Good, HSG C (PRE 1.0)
31.609	**75**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
3.586	HSG B	PRE 1.0
25.705	HSG C	PRE 1.0, PRE 1.1, PRE 2.0
2.318	HSG D	PRE 1.0
0.000	Other	
31.609		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PRE 1.0: WATERSHED 1.0 Runoff Area=1,275,727 sf 9.69% Impervious Runoff Depth>0.93"
Flow Length=1,805' Tc=34.4 min CN=74 Runoff=16.01 cfs 2.273 af

Subcatchment PRE 1.1: WATERSHED 1.1 Runoff Area=33,611 sf 90.29% Impervious Runoff Depth>2.60"
Flow Length=305' Tc=5.0 min CN=96 Runoff=2.21 cfs 0.167 af

Subcatchment PRE 2.0: WATERSHED 2.0 Runoff Area=67,564 sf 57.38% Impervious Runoff Depth>1.86"
Flow Length=872' Tc=5.0 min CN=88 Runoff=3.38 cfs 0.241 af

Reach REACH 1.1: EXISTING CULVERT Avg. Flow Depth=0.42' Max Vel=6.03 fps Inflow=2.21 cfs 0.167 af
15.0" Round Pipe n=0.012 L=515.0' S=0.0165 '/' Capacity=8.99 cfs Outflow=2.17 cfs 0.167 af

Reach REACH 1.2: HODGSON BROOK Avg. Flow Depth=0.31' Max Vel=4.41 fps Inflow=2.17 cfs 0.167 af
50.0" Round Pipe n=0.012 L=825.0' S=0.0112 '/' Capacity=183.23 cfs Outflow=1.99 cfs 0.167 af

Pond POND 1.0: OUTLET CULVERTS Peak Elev=37.85' Inflow=16.55 cfs 2.440 af
42.0" x 29.0", R=21.5"/66.1" Pipe Arch Culvert x 3.00 n=0.025 L=68.0' S=0.0044 '/' Outflow=16.59 cfs 2.440 af

Link PA1: POINT OF ANALYSIS Inflow=16.59 cfs 2.440 af
Primary=16.59 cfs 2.440 af

Link PA2: POINT OF ANALYSIS Inflow=3.38 cfs 0.241 af
Primary=3.38 cfs 0.241 af

Total Runoff Area = 31.609 ac Runoff Volume = 2.681 af Average Runoff Depth = 1.02"
86.00% Pervious = 27.184 ac 14.00% Impervious = 4.426 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PRE 1.0: WATERSHED 1.0 Runoff Area=1,275,727 sf 9.69% Impervious Runoff Depth>1.35"
Flow Length=1,805' Tc=34.4 min CN=74 Runoff=24.04 cfs 3.305 af

Subcatchment PRE 1.1: WATERSHED 1.1 Runoff Area=33,611 sf 90.29% Impervious Runoff Depth>3.22"
Flow Length=305' Tc=5.0 min CN=96 Runoff=2.71 cfs 0.207 af

Subcatchment PRE 2.0: WATERSHED 2.0 Runoff Area=67,564 sf 57.38% Impervious Runoff Depth>2.43"
Flow Length=872' Tc=5.0 min CN=88 Runoff=4.41 cfs 0.314 af

Reach REACH 1.1: EXISTING CULVERT Avg. Flow Depth=0.47' Max Vel=6.37 fps Inflow=2.71 cfs 0.207 af
15.0" Round Pipe n=0.012 L=515.0' S=0.0165 '/' Capacity=8.99 cfs Outflow=2.66 cfs 0.207 af

Reach REACH 1.2: HODGSON BROOK Avg. Flow Depth=0.34' Max Vel=4.68 fps Inflow=2.66 cfs 0.207 af
50.0" Round Pipe n=0.012 L=825.0' S=0.0112 '/' Capacity=183.23 cfs Outflow=2.46 cfs 0.207 af

Pond POND 1.0: OUTLET CULVERTS Peak Elev=38.24' Inflow=24.73 cfs 3.511 af
42.0" x 29.0", R=21.5"/66.1" Pipe Arch Culvert x 3.00 n=0.025 L=68.0' S=0.0044 '/' Outflow=24.86 cfs 3.511 af

Link PA1: POINT OF ANALYSIS Inflow=24.86 cfs 3.511 af
Primary=24.86 cfs 3.511 af

Link PA2: POINT OF ANALYSIS Inflow=4.41 cfs 0.314 af
Primary=4.41 cfs 0.314 af

Total Runoff Area = 31.609 ac Runoff Volume = 3.826 af Average Runoff Depth = 1.45"
86.00% Pervious = 27.184 ac 14.00% Impervious = 4.426 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PRE 1.0: WATERSHED 1.0 Runoff Area=1,275,727 sf 9.69% Impervious Runoff Depth>2.81"
Flow Length=1,805' Tc=34.4 min CN=74 Runoff=51.44 cfs 6.869 af

Subcatchment PRE 1.1: WATERSHED 1.1 Runoff Area=33,611 sf 90.29% Impervious Runoff Depth>5.11"
Flow Length=305' Tc=5.0 min CN=96 Runoff=4.19 cfs 0.328 af

Subcatchment PRE 2.0: WATERSHED 2.0 Runoff Area=67,564 sf 57.38% Impervious Runoff Depth>4.22"
Flow Length=872' Tc=5.0 min CN=88 Runoff=7.49 cfs 0.545 af

Reach REACH 1.1: EXISTING CULVERT Avg. Flow Depth=0.59' Max Vel=7.16 fps Inflow=4.19 cfs 0.328 af
15.0" Round Pipe n=0.012 L=515.0' S=0.0165 '/' Capacity=8.99 cfs Outflow=4.12 cfs 0.328 af

Reach REACH 1.2: HODGSON BROOK Avg. Flow Depth=0.42' Max Vel=5.38 fps Inflow=4.12 cfs 0.328 af
50.0" Round Pipe n=0.012 L=825.0' S=0.0112 '/' Capacity=183.23 cfs Outflow=3.88 cfs 0.328 af

Pond POND 1.0: OUTLET CULVERTS Peak Elev=39.02' Inflow=52.53 cfs 7.196 af
42.0" x 29.0", R=21.5"/66.1" Pipe Arch Culvert x 3.00 n=0.025 L=68.0' S=0.0044 '/' Outflow=52.70 cfs 7.195 af

Link PA1: POINT OF ANALYSIS Inflow=52.70 cfs 7.195 af
Primary=52.70 cfs 7.195 af

Link PA2: POINT OF ANALYSIS Inflow=7.49 cfs 0.545 af
Primary=7.49 cfs 0.545 af

Total Runoff Area = 31.609 ac Runoff Volume = 7.742 af Average Runoff Depth = 2.94"
86.00% Pervious = 27.184 ac 14.00% Impervious = 4.426 ac

Summary for Subcatchment PRE 1.0: WATERSHED 1.0

Runoff = 51.44 cfs @ 12.49 hrs, Volume= 6.869 af, Depth> 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
143,279	58	Meadow, non-grazed, HSG B
12,922	55	Woods, Good, HSG B
845,939	71	Meadow, non-grazed, HSG C
123,662	98	Paved parking, HSG C
48,932	70	Woods, Good, HSG C
1,932	78	Meadow, non-grazed, HSG D
99,061	91	Gravel roads, HSG D
1,275,727	74	Weighted Average
1,152,065		90.31% Pervious Area
123,662		9.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0400	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
0.1	11	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.0	70	0.0290	1.19		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
21.4	1,089	0.0147	0.85		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.6	120	0.0330	1.27		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.2	368	0.0160	1.90		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.2	47	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
34.4	1,805	Total			

Summary for Subcatchment PRE 1.1: WATERSHED 1.1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.19 cfs @ 12.07 hrs, Volume= 0.328 af, Depth> 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
22,865	98	Roofs, HSG C
3,263	74	>75% Grass cover, Good, HSG C
7,483	98	Paved parking, HSG C
33,611	96	Weighted Average
3,263		9.71% Pervious Area
30,348		90.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	100	0.0050	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.68"
1.2	205	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	305	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment PRE 2.0: WATERSHED 2.0

[49] Hint: Tc<2dt may require smaller dt

Runoff = 7.49 cfs @ 12.07 hrs, Volume= 0.545 af, Depth> 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
10,145	98	Roofs, HSG C
28,794	74	>75% Grass cover, Good, HSG C
28,625	98	Paved parking, HSG C
67,564	88	Weighted Average
28,794		42.62% Pervious Area
38,770		57.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	100	0.0650	2.36		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.68"
1.5	320	0.0560	3.55		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.2	42	0.0050	3.72	4.57	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Cast iron, coated
1.3	410	0.0050	5.09	16.00	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
3.7	872	Total, Increased to minimum Tc = 5.0 min			

Summary for Reach REACH 1.1: EXISTING CULVERT

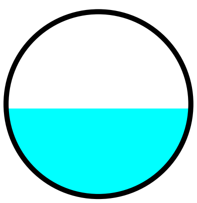
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 0.772 ac, 90.29% Impervious, Inflow Depth > 5.11" for 10 Year event
Inflow = 4.19 cfs @ 12.07 hrs, Volume= 0.328 af
Outflow = 4.12 cfs @ 12.09 hrs, Volume= 0.328 af, Atten= 2%, Lag= 1.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.16 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 2.41 fps, Avg. Travel Time= 3.6 min

Peak Storage= 296 cf @ 12.09 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 8.99 cfs

15.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 515.0' Slope= 0.0165 '/'
Inlet Invert= 53.60', Outlet Invert= 45.10'



Summary for Reach REACH 1.2: HODGSON BROOK CULVERT

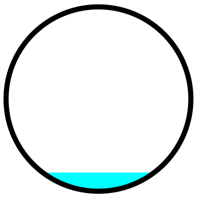
[52] Hint: Inlet/Outlet conditions not evaluated
[61] Hint: Exceeded Reach REACH 1.1 outlet invert by 0.42' @ 12.10 hrs

Inflow Area = 0.772 ac, 90.29% Impervious, Inflow Depth > 5.10" for 10 Year event
Inflow = 4.12 cfs @ 12.09 hrs, Volume= 0.328 af
Outflow = 3.88 cfs @ 12.12 hrs, Volume= 0.328 af, Atten= 6%, Lag= 1.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.38 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 1.85 fps, Avg. Travel Time= 7.4 min

Peak Storage= 591 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 4.17' Flow Area= 13.6 sf, Capacity= 183.23 cfs

50.0" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 825.0' Slope= 0.0112 '/'
Inlet Invert= 45.10', Outlet Invert= 35.90'



Summary for Pond POND 1.0: OUTLET CULVERTS

[90] Warning: Qout>Qin may require smaller dt or Finer Routing
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=123)
[62] Hint: Exceeded Reach REACH 1.2 OUTLET depth by 2.90' @ 12.55 hrs

Inflow Area = 30.058 ac, 11.76% Impervious, Inflow Depth > 2.87" for 10 Year event
Inflow = 52.53 cfs @ 12.48 hrs, Volume= 7.196 af
Outflow = 52.70 cfs @ 12.47 hrs, Volume= 7.195 af, Atten= 0%, Lag= 0.0 min
Primary = 52.70 cfs @ 12.47 hrs, Volume= 7.195 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 39.02' @ 12.47 hrs
Flood Elev= 41.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	35.60'	**42.0" W x 29.0" H, R=21.5"/66.1" Pipe Arch CMP_Arch_1/2 42x29 X 3.00** L= 68.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 35.60' / 35.30' S= 0.0044 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 6.72 sf

Primary OutFlow Max=52.41 cfs @ 12.47 hrs HW=39.01' TW=38.65' (Dynamic Tailwater)
↑**1=CMP_Arch_1/2 42x29** (Outlet Controls 52.41 cfs @ 2.60 fps)

Summary for Link PA1: POINT OF ANALYSIS

This link takes into account the tailwater condition in roadside swale along Goose Bay Drive which the existing culverts discharge into. These tailwater elevations were determined by Streamworks, PLLC as part of the overall watershed analysis they performed. These findings are discussed in the seperate memo prepared by Streamworks, PLLC.

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[80] Warning: Exceeded Pond POND 1.0 by 3.05' @ 0.00 hrs (92.51 cfs 19.754 af)

Inflow Area = 30.058 ac, 11.76% Impervious, Inflow Depth > 2.87" for 10 Year event
Inflow = 52.70 cfs @ 12.47 hrs, Volume= 7.195 af
Primary = 52.70 cfs @ 12.47 hrs, Volume= 7.195 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

10 Year 2 Point manual elevation table, To= 0.00 hrs, dt= 24.00 hrs, feet =
38.65 38.65

Summary for Link PA2: POINT OF ANALYSIS

Inflow Area = 1.551 ac, 57.38% Impervious, Inflow Depth > 4.22" for 10 Year event
Inflow = 7.49 cfs @ 12.07 hrs, Volume= 0.545 af
Primary = 7.49 cfs @ 12.07 hrs, Volume= 0.545 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PRE 1.0: WATERSHED 1.0 Runoff Area=1,275,727 sf 9.69% Impervious Runoff Depth>4.08"
Flow Length=1,805' Tc=34.4 min CN=74 Runoff=74.64 cfs 9.946 af

Subcatchment PRE 1.1: WATERSHED 1.1 Runoff Area=33,611 sf 90.29% Impervious Runoff Depth>6.59"
Flow Length=305' Tc=5.0 min CN=96 Runoff=5.34 cfs 0.424 af

Subcatchment PRE 2.0: WATERSHED 2.0 Runoff Area=67,564 sf 57.38% Impervious Runoff Depth>5.66"
Flow Length=872' Tc=5.0 min CN=88 Runoff=9.90 cfs 0.731 af

Reach REACH 1.1: EXISTING CULVERT Avg. Flow Depth=0.69' Max Vel=7.60 fps Inflow=5.34 cfs 0.424 af
15.0" Round Pipe n=0.012 L=515.0' S=0.0165 '/' Capacity=8.99 cfs Outflow=5.26 cfs 0.423 af

Reach REACH 1.2: HODGSON BROOK Avg. Flow Depth=0.47' Max Vel=5.82 fps Inflow=5.26 cfs 0.423 af
50.0" Round Pipe n=0.012 L=825.0' S=0.0112 '/' Capacity=183.23 cfs Outflow=4.99 cfs 0.423 af

Pond POND 1.0: OUTLET CULVERTS Peak Elev=39.52' Inflow=76.06 cfs 10.369 af
42.0" x 29.0", R=21.5"/66.1" Pipe Arch Culvert x 3.00 n=0.025 L=68.0' S=0.0044 '/' Outflow=76.06 cfs 10.369 af

Link PA1: POINT OF ANALYSIS Inflow=76.06 cfs 10.369 af
Primary=76.06 cfs 10.369 af

Link PA2: POINT OF ANALYSIS Inflow=9.90 cfs 0.731 af
Primary=9.90 cfs 0.731 af

Total Runoff Area = 31.609 ac Runoff Volume = 11.102 af Average Runoff Depth = 4.21"
86.00% Pervious = 27.184 ac 14.00% Impervious = 4.426 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment PRE 1.0: WATERSHED 1.0 Runoff Area=1,275,727 sf 9.69% Impervious Runoff Depth>5.30"
Flow Length=1,805' Tc=34.4 min CN=74 Runoff=96.90 cfs 12.947 af

Subcatchment PRE 1.1: WATERSHED 1.1 Runoff Area=33,611 sf 90.29% Impervious Runoff Depth>7.98"
Flow Length=305' Tc=5.0 min CN=96 Runoff=6.41 cfs 0.513 af

Subcatchment PRE 2.0: WATERSHED 2.0 Runoff Area=67,564 sf 57.38% Impervious Runoff Depth>7.01"
Flow Length=872' Tc=5.0 min CN=88 Runoff=12.13 cfs 0.907 af

Reach REACH 1.1: EXISTING CULVERT Avg. Flow Depth=0.77' Max Vel=7.92 fps Inflow=6.41 cfs 0.513 af
15.0" Round Pipe n=0.012 L=515.0' S=0.0165 '/' Capacity=8.99 cfs Outflow=6.32 cfs 0.513 af

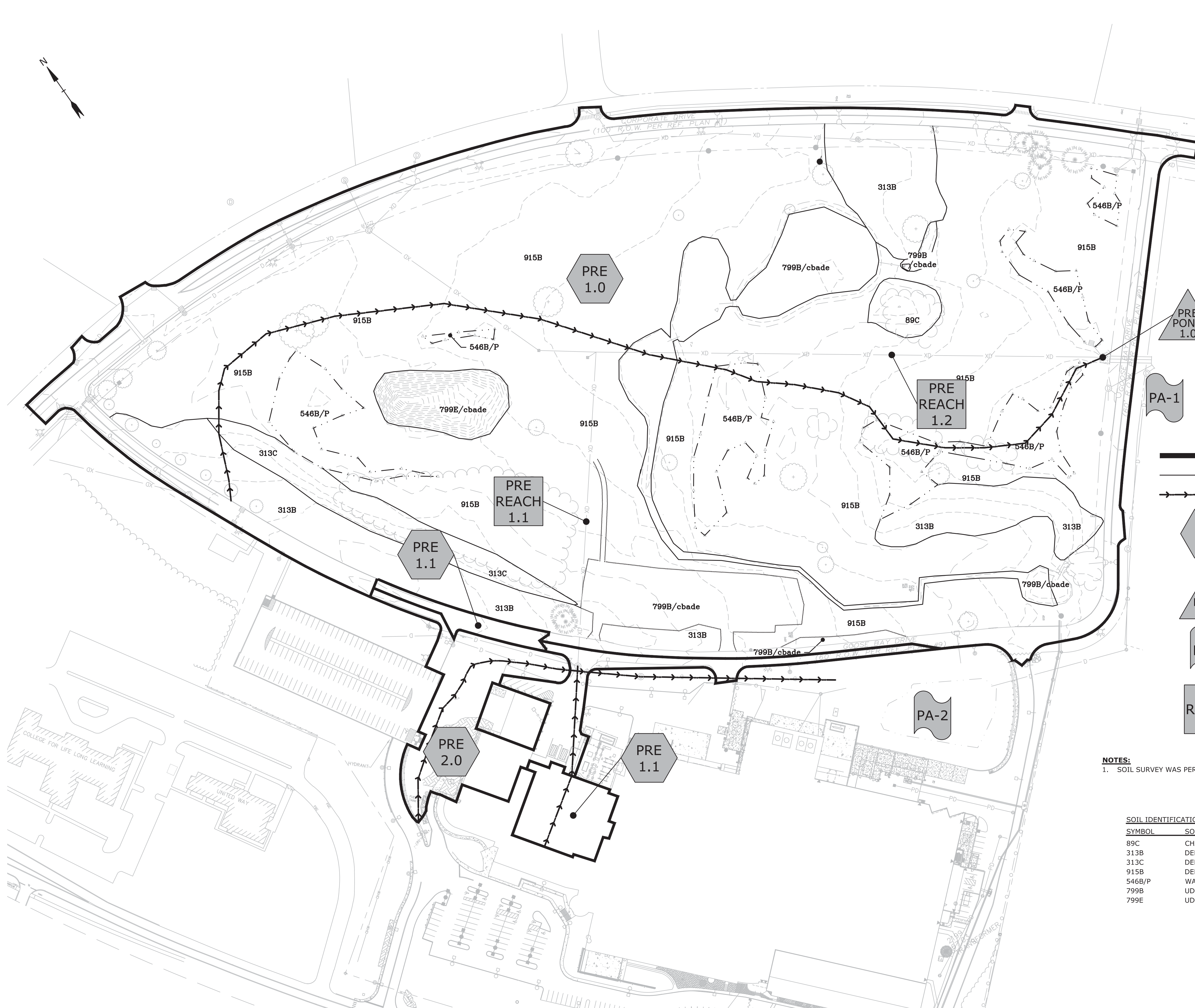
Reach REACH 1.2: HODGSON BROOK Avg. Flow Depth=0.52' Max Vel=6.16 fps Inflow=6.32 cfs 0.513 af
50.0" Round Pipe n=0.012 L=825.0' S=0.0112 '/' Capacity=183.23 cfs Outflow=6.02 cfs 0.512 af

Pond POND 1.0: OUTLET CULVERTS Peak Elev=40.14' Inflow=98.61 cfs 13.459 af
42.0" x 29.0", R=21.5"/66.1" Pipe Arch Culvert x 3.00 n=0.025 L=68.0' S=0.0044 '/' Outflow=98.56 cfs 13.459 af

Link PA1: POINT OF ANALYSIS Inflow=98.56 cfs 13.459 af
Primary=98.56 cfs 13.459 af

Link PA2: POINT OF ANALYSIS Inflow=12.13 cfs 0.907 af
Primary=12.13 cfs 0.907 af

Total Runoff Area = 31.609 ac Runoff Volume = 14.366 af Average Runoff Depth = 5.45"
86.00% Pervious = 27.184 ac 14.00% Impervious = 4.426 ac



LEGEND

	PRE-DEVELOPMENT WATERSHED BOUNDARY
	SOIL SURVEY BOUNDARIES
	LONGEST FLOW PATH
PRE 1.0	PRE DEVELOPMENT WATERSHED AREA DESIGNATION
PRE POND 1	PRE-DEVELOPMENT POND DESIGNATION
PA-1	POINT OF ANALYSIS
PRE REACH 1	PRE-DEVELOPMENT REACH DESIGNATION

NOTES:

1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

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Engineers | Environmental Specialists

SCALE IN FEET
0 80' 160'
GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

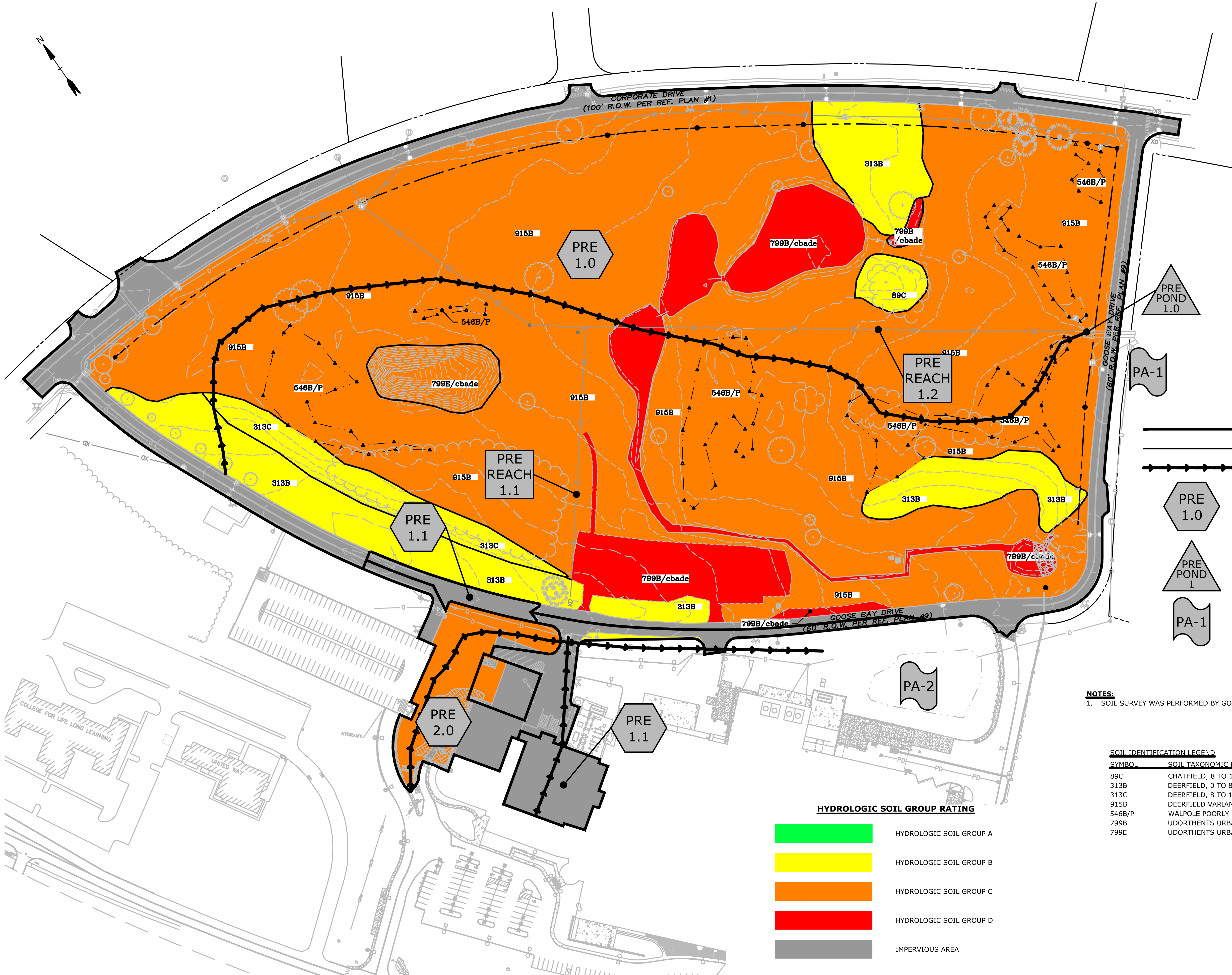
PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

PRE-DEVELOPMENT WATERSHED AREA PLAN

SCALE: AS SHOWN

C-801

Last Save Date: November 1, 2018 5:06 PM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-801



LEGEND

- PRE-DEVELOPMENT WATERSHED BOUNDARY
- SOIL SURVEY BOUNDARIES
- LONGEST FLOW PATH
- PRE 1.0 — PRE DEVELOPMENT WATERSHED AREA DESIGNATION
- PRE POND 1 — PRE-DEVELOPMENT POND DESIGNATION
- PA-1 — POINT OF ANALYSIS

HYDROLOGIC SOIL GROUP RATING

- HYDROLOGIC SOIL GROUP A
- HYDROLOGIC SOIL GROUP B
- HYDROLOGIC SOIL GROUP C
- HYDROLOGIC SOIL GROUP D
- IMPERVIOUS AREA

NOTES:

1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

Last Save Date: November 2, 2018 11:11 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-803

Tighe&Bond
Engineers | Environmental Specialists

SCALE IN FEET
0 80' 160'
GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

PRE-DEVELOPMENT SOIL PLAN

SCALE: AS SHOWN

C-803

7.3 Post-Development Conditions

The post-development condition was analyzed by dividing the watersheds into six sub-catchment areas. Stormwater runoff from these sub-catchment areas flow to two gravel wetlands and one rain garden for treatment prior to discharging to the existing Hodgson Brook outlet. Flows from these sub-catchment areas are modeled at the same two points of analysis that were modeled in the pre-development analysis, PA1 and PA2. These points of analysis and sub-catchment areas are depicted on the plan entitled “Post-Development Watershed Plan”, Sheet C-802.

Each of the points of analysis and their contributing watershed areas are described below:

Point of Analysis (PA1)

Point of Analysis 1 (PA1) is located at the existing Hodgson Brook outlet headwall. For the purposes of this analysis, the area contributing to Point of Analysis 1 (PA1) has been divided into five sub-catchment areas (see plan C-802). Sub-catchments POST 1.0, POST 1.1, POST 1.2, POST 1.3 and POST 1.4 contribute to this point of analysis and consist of grass, paved parking lots, concrete sidewalks, and roof areas. Runoff generated in these sub-catchment areas is collected via one (1) rain garden and two (2) gravel wetlands which treat and discharge stormwater runoff either to infiltration or to PA1. Runoff from sub-catchments POST 1.0, 1.1 and 1.4 flow via overland flow to the closed drainage then flows via underground piping to one of the gravel wetlands or rain garden. Flows from sub-catchment POST 1.2 flows via overland flow to the Hodgson Brook restoration area (REACH 1.0) then flows via the brook until reach PA1. Runoff from POND 1.1 also flows via REACH 1.0 to PA1. LINK 1.0 has been added to the calculations between gravel wetland 2 (POND 1.1) and PDMH203 (POND 1.2) to account for the tailwater elevation in PDMH203 caused by the Hodgson Brook inflow to PDMH203. Tailwater elevations at the road side swale on Goose Bay Drive (PA1) have also been included in these calculations to account for any surcharging that may occur due to the tailwater condition. These tailwater elevations were determined by Streamworks, PLLC as part of their overall watershed analysis and are discussed in more detail in the attached memo. Runoff from sub-catchment area POST 1.3 flows via overland flow to PA1. PA1 is shown on the Post-Development Watershed Plan (C-802).

Point of Analysis (PA2)

POST 2.0 is comprised mostly of runoff from Goose Bay Drive that is located between the undeveloped parcel and the existing Lonza facility. Runoff from this area travels via overland flow to the existing stormwater basin located at the existing Lonza facility. Point of Analysis 2 (PA2) is located at the existing basin.

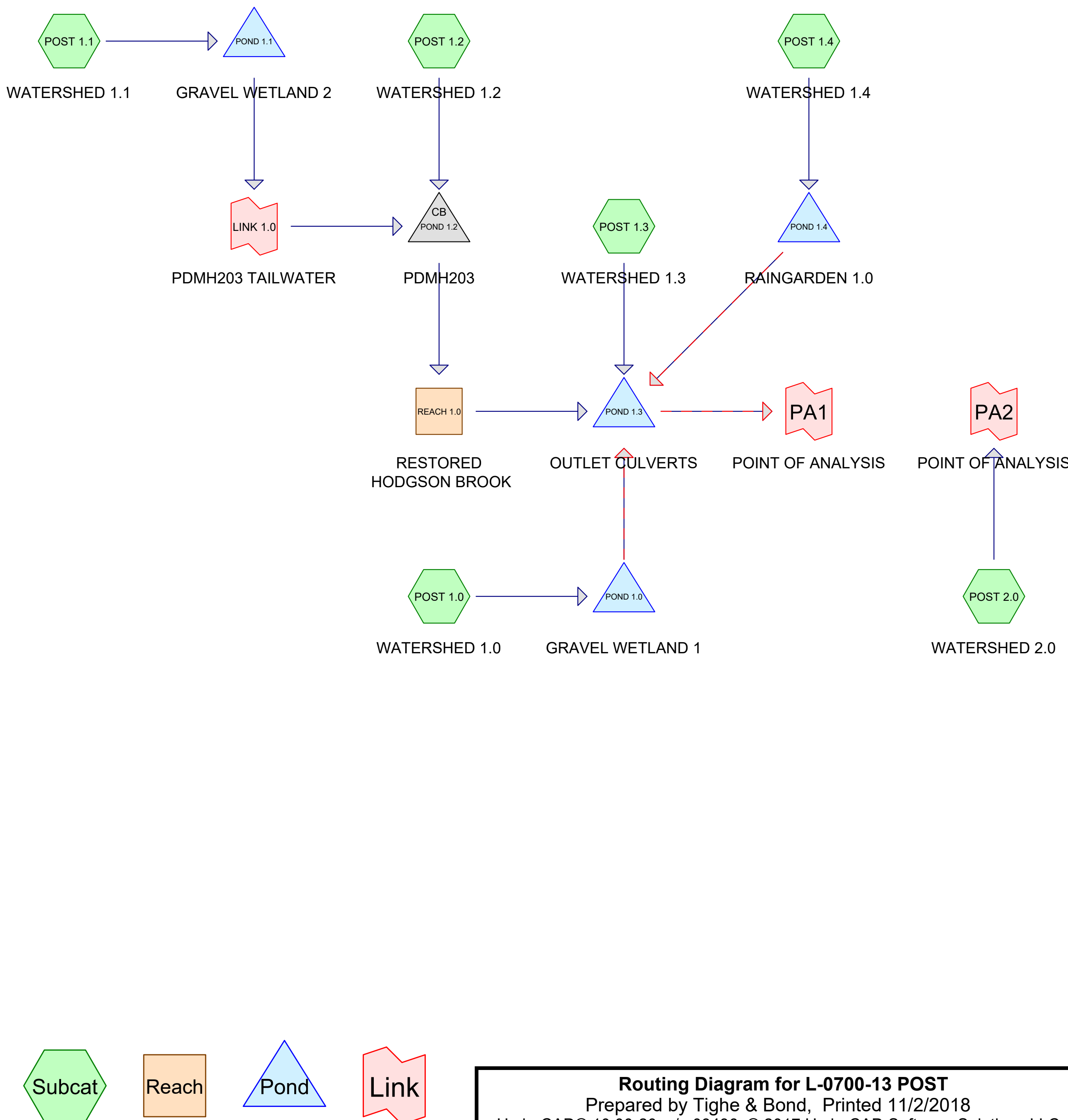
7.3.1 Post-Development Calculations

7.3.2 Post-Development Watershed Plans

7.3.3 Post-Development Soil Plan

7.3.4 Post-Development Subcatchment Calculations

7.3.5 Post-Development Subcatchment Plans



Routing Diagram for L-0700-13 POST
Prepared by Tighe & Bond, Printed 11/2/2018
HydroCAD® 10.00-20 s/n 03436 © 2017 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.198	61	>75% Grass cover, Good, HSG B (POST 1.0, POST 1.1, POST 1.2, POST 1.3, POST 1.4)
9.983	74	>75% Grass cover, Good, HSG C (POST 1.0, POST 1.1, POST 1.2, POST 1.3, POST 1.4, POST 2.0)
0.419	80	>75% Grass cover, Good, HSG D (POST 1.0, POST 1.3, POST 1.4)
0.504	71	Meadow, non-grazed, HSG C (POST 1.3)
0.738	98	Paved parking, HSG B (POST 1.0, POST 1.1, POST 1.2, POST 1.3, POST 1.4)
7.116	98	Paved parking, HSG C (POST 1.0, POST 1.1, POST 1.2, POST 1.3, POST 1.4, POST 2.0)
0.150	98	Paved parking, HSG D (POST 1.0, POST 1.3, POST 1.4)
0.649	98	Roofs, HSG B (POST 1.0, POST 1.1, POST 1.4)
8.101	98	Roofs, HSG C (POST 1.0, POST 1.1, POST 1.4, POST 2.0)
1.749	98	Roofs, HSG D (POST 1.0, POST 1.4)
31.609	**87**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
3.586	HSG B	POST 1.0, POST 1.1, POST 1.2, POST 1.3, POST 1.4
25.705	HSG C	POST 1.0, POST 1.1, POST 1.2, POST 1.3, POST 1.4, POST 2.0
2.318	HSG D	POST 1.0, POST 1.3, POST 1.4
0.000	Other	
31.609		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment POST 1.0: WATERSHED Runoff Area=460,200 sf 71.90% Impervious Runoff Depth>2.71"
Flow Length=933' Tc=11.4 min CN=91 Runoff=27.32 cfs 2.384 af

Subcatchment POST 1.1: WATERSHED Runoff Area=256,387 sf 53.86% Impervious Runoff Depth>2.17"
Flow Length=750' Tc=10.3 min CN=85 Runoff=12.85 cfs 1.064 af

Subcatchment POST 1.2: WATERSHED 1.2 Runoff Area=88,847 sf 67.84% Impervious Runoff Depth>2.61"
Flow Length=1,191' Tc=6.4 min CN=90 Runoff=5.96 cfs 0.444 af

Subcatchment POST 1.3: WATERSHED Runoff Area=306,556 sf 22.44% Impervious Runoff Depth>1.62"
Flow Length=1,525' Tc=45.9 min CN=78 Runoff=6.09 cfs 0.949 af

Subcatchment POST 1.4: WATERSHED Runoff Area=214,792 sf 85.07% Impervious Runoff Depth>3.01"
Flow Length=717' Tc=7.5 min CN=94 Runoff=15.51 cfs 1.236 af

Subcatchment POST 2.0: WATERSHED 2.0 Runoff Area=50,117 sf 50.42% Impervious Runoff Depth>2.26"
Tc=5.0 min CN=86 Runoff=3.04 cfs 0.216 af

Reach REACH 1.0: RESTORED Avg. Flow Depth=0.58' Max Vel=1.99 fps Inflow=5.96 cfs 0.609 af
n=0.040 L=1,309.0' S=0.0092 '/' Capacity=2,720.29 cfs Outflow=4.23 cfs 0.600 af

Pond POND 1.0: GRAVEL WETLAND 1 Peak Elev=46.16' Storage=70,610 cf Inflow=27.32 cfs 2.384 af
Primary=1.53 cfs 1.030 af Secondary=0.00 cfs 0.000 af Outflow=1.53 cfs 1.030 af

Pond POND 1.1: GRAVEL WETLAND 2 Peak Elev=53.90' Storage=39,239 cf Inflow=12.85 cfs 1.064 af
Outflow=0.44 cfs 0.165 af

Pond POND 1.2: PDMH203 Peak Elev=50.26' Inflow=5.96 cfs 0.609 af
54.0" Round Culvert n=0.013 L=269.0' S=0.0050 '/' Outflow=5.96 cfs 0.609 af

Pond POND 1.3: OUTLET CULVERTS Peak Elev=38.17' Storage=9,066 cf Inflow=9.40 cfs 3.277 af
Primary=10.56 cfs 3.071 af Secondary=0.00 cfs 0.000 af Outflow=10.56 cfs 3.071 af

Pond POND 1.4: RAINGARDEN 1.0 Peak Elev=47.27' Storage=34,236 cf Inflow=15.51 cfs 1.236 af
Primary=1.31 cfs 0.699 af Secondary=0.00 cfs 0.000 af Outflow=1.31 cfs 0.699 af

Link LINK 1.0: PDMH203 TAILWATER Inflow=0.44 cfs 0.165 af
Primary=0.44 cfs 0.165 af

Link PA1: POINT OF ANALYSIS Inflow=10.56 cfs 3.071 af
Primary=10.56 cfs 3.071 af

Link PA2: POINT OF ANALYSIS Inflow=3.04 cfs 0.216 af
Primary=3.04 cfs 0.216 af

Total Runoff Area = 31.609 ac Runoff Volume = 6.294 af Average Runoff Depth = 2.39"
41.46% Pervious = 13.105 ac 58.54% Impervious = 18.505 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment POST 1.0: WATERSHED Runoff Area=460,200 sf 71.90% Impervious Runoff Depth>4.54"
Flow Length=933' Tc=11.4 min CN=91 Runoff=44.65 cfs 3.997 af

Subcatchment POST 1.1: WATERSHED Runoff Area=256,387 sf 53.86% Impervious Runoff Depth>3.90"
Flow Length=750' Tc=10.3 min CN=85 Runoff=22.77 cfs 1.914 af

Subcatchment POST 1.2: WATERSHED 1.2 Runoff Area=88,847 sf 67.84% Impervious Runoff Depth>4.43"
Flow Length=1,191' Tc=6.4 min CN=90 Runoff=9.84 cfs 0.754 af

Subcatchment POST 1.3: WATERSHED Runoff Area=306,556 sf 22.44% Impervious Runoff Depth>3.18"
Flow Length=1,525' Tc=45.9 min CN=78 Runoff=12.12 cfs 1.865 af

Subcatchment POST 1.4: WATERSHED Runoff Area=214,792 sf 85.07% Impervious Runoff Depth>4.88"
Flow Length=717' Tc=7.5 min CN=94 Runoff=24.46 cfs 2.004 af

Subcatchment POST 2.0: WATERSHED 2.0 Runoff Area=50,117 sf 50.42% Impervious Runoff Depth>4.01"
Tc=5.0 min CN=86 Runoff=5.34 cfs 0.384 af

Reach REACH 1.0: RESTORED Avg. Flow Depth=0.79' Max Vel=2.24 fps Inflow=9.84 cfs 1.360 af
n=0.040 L=1,309.0' S=0.0092 '/' Capacity=2,720.29 cfs Outflow=6.51 cfs 1.347 af

Pond POND 1.0: GRAVEL WETLAND 1 Peak Elev=46.93' Storage=86,691 cf Inflow=44.65 cfs 3.997 af
Primary=7.06 cfs 2.098 af Secondary=11.37 cfs 0.424 af Outflow=18.42 cfs 2.521 af

Pond POND 1.1: GRAVEL WETLAND 2 Peak Elev=55.09' Storage=57,246 cf Inflow=22.77 cfs 1.914 af
Outflow=1.94 cfs 0.606 af

Pond POND 1.2: PDMH203 Peak Elev=50.54' Inflow=9.84 cfs 1.360 af
54.0" Round Culvert n=0.013 L=269.0' S=0.0050 '/' Outflow=9.84 cfs 1.360 af

Pond POND 1.3: OUTLET CULVERTS Peak Elev=38.86' Storage=14,426 cf Inflow=39.55 cfs 7.136 af
Primary=39.42 cfs 6.846 af Secondary=0.00 cfs 0.000 af Outflow=39.42 cfs 6.846 af

Pond POND 1.4: RAINGARDEN 1.0 Peak Elev=48.07' Storage=45,640 cf Inflow=24.46 cfs 2.004 af
Primary=6.60 cfs 1.402 af Secondary=0.00 cfs 0.000 af Outflow=6.60 cfs 1.402 af

Link LINK 1.0: PDMH203 TAILWATER Inflow=1.94 cfs 0.606 af
Primary=1.94 cfs 0.606 af

Link PA1: POINT OF ANALYSIS Inflow=39.42 cfs 6.846 af
Primary=39.42 cfs 6.846 af

Link PA2: POINT OF ANALYSIS Inflow=5.34 cfs 0.384 af
Primary=5.34 cfs 0.384 af

Total Runoff Area = 31.609 ac Runoff Volume = 10.918 af Average Runoff Depth = 4.14"
41.46% Pervious = 13.105 ac 58.54% Impervious = 18.505 ac

Summary for Subcatchment POST 1.0: WATERSHED 1.0

Runoff = 44.65 cfs @ 12.15 hrs, Volume= 3.997 af, Depth> 4.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
7,015	98	Roofs, HSG B
21,062	61	>75% Grass cover, Good, HSG B
18,252	98	Paved parking, HSG B
157,408	98	Roofs, HSG C
92,831	74	>75% Grass cover, Good, HSG C
110,781	98	Paved parking, HSG C
31,906	98	Roofs, HSG D
15,407	80	>75% Grass cover, Good, HSG D
5,538	98	Paved parking, HSG D
460,200	91	Weighted Average
129,300		28.10% Pervious Area
330,900		71.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	70	0.0150	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
0.2	32	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	19	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.8	162	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.4	84	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.5	113	0.0050	3.72	4.57	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
1.2	299	0.0050	4.20	7.43	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.4	94	0.0050	4.20	7.43	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.1	46	0.0240	11.16	35.05	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.0	5	0.0800	7.16	0.98	**Pipe Channel,** 5.0" Round Area= 0.1 sf Perim= 1.3' r= 0.10' n= 0.013
0.0	9	0.0110	9.90	69.95	**Pipe Channel,** 36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'

n= 0.013

11.4	933	Total

Summary for Subcatchment POST 1.1: WATERSHED 1.1

Runoff = 22.77 cfs @ 12.14 hrs, Volume= 1.914 af, Depth> 3.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
10,200	98	Roofs, HSG B
42,175	61	>75% Grass cover, Good, HSG B
3,434	98	Paved parking, HSG B
87,911	98	Roofs, HSG C
76,111	74	>75% Grass cover, Good, HSG C
36,556	98	Paved parking, HSG C
256,387	85	Weighted Average
118,286		46.14% Pervious Area
138,101		53.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.0380	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
1.2	163	0.0245	2.35		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.5	283	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.1	81	0.0240	9.21	16.27	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.4	123	0.0050	5.09	16.00	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
10.3	750	Total			

Summary for Subcatchment POST 1.2: WATERSHED 1.2

Runoff = 9.84 cfs @ 12.09 hrs, Volume= 0.754 af, Depth> 4.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,104	61	>75% Grass cover, Good, HSG B
2,340	98	Paved parking, HSG B
25,469	74	>75% Grass cover, Good, HSG C
57,934	98	Paved parking, HSG C
88,847	90	Weighted Average
28,573		32.16% Pervious Area
60,274		67.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0100	1.12		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.68"
1.0	153	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	343	0.0050	3.47	2.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	13	0.0050	3.72	4.57	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
1.8	453	0.0050	4.20	7.43	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.4	129	0.0050	5.91	29.00	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Corrugated PE, smooth interior
6.4	1,191	Total			

Summary for Subcatchment POST 1.3: WATERSHED 1.3

Runoff = 12.12 cfs @ 12.63 hrs, Volume= 1.865 af, Depth> 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
25,523	61	>75% Grass cover, Good, HSG B
903	98	Paved parking, HSG B
188,618	74	>75% Grass cover, Good, HSG C
67,403	98	Paved parking, HSG C
21,971	71	Meadow, non-grazed, HSG C
1,639	80	>75% Grass cover, Good, HSG D
499	98	Paved parking, HSG D
306,556	78	Weighted Average
237,751		77.56% Pervious Area
68,805		22.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	100	0.0130	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
1.1	52	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	27	0.2720	7.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
33.8	1,346	0.0090	0.66		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
45.9	1,525	Total			

Summary for Subcatchment POST 1.4: WATERSHED 1.4

Runoff = 24.46 cfs @ 12.10 hrs, Volume= 2.004 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
11,052	98	Roofs, HSG B
3,902	61	>75% Grass cover, Good, HSG B
7,239	98	Paved parking, HSG B
86,732	98	Roofs, HSG C
26,967	74	>75% Grass cover, Good, HSG C
32,896	98	Paved parking, HSG C
44,301	98	Roofs, HSG D
1,207	80	>75% Grass cover, Good, HSG D
496	98	Paved parking, HSG D
214,792	94	Weighted Average
32,076		14.93% Pervious Area
182,716		85.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	40	0.0150	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
0.3	53	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	65	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.4	115	0.0100	4.54	3.56	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.7	140	0.0050	3.21	2.52	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.9	275	0.0070	4.97	8.79	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
0.0	29	0.0550	13.94	24.63	**Pipe Channel,**

18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'
n= 0.013

7.5 717 Total

Summary for Subcatchment POST 2.0: WATERSHED 2.0

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.34 cfs @ 12.07 hrs, Volume= 0.384 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
20,850	98	Roofs, HSG C
24,850	74	>75% Grass cover, Good, HSG C
4,417	98	Paved parking, HSG C
50,117	86	Weighted Average
24,850		49.58% Pervious Area
25,267		50.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Reach REACH 1.0: RESTORED HODGSON BROOK

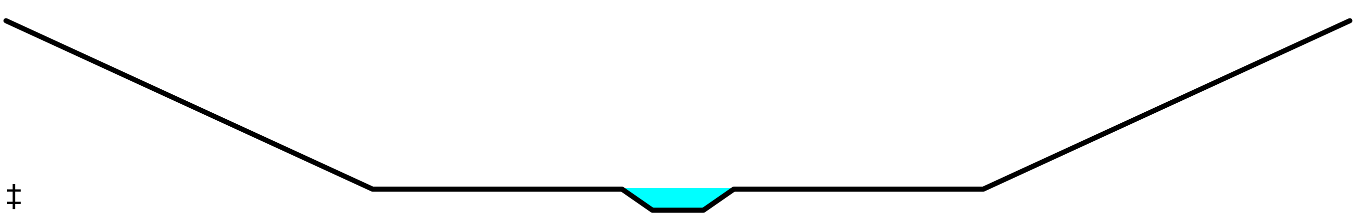
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 7.925 ac, 57.46% Impervious, Inflow Depth > 2.06" for 10 Year event
Inflow = 9.84 cfs @ 12.09 hrs, Volume= 1.360 af
Outflow = 6.51 cfs @ 12.09 hrs, Volume= 1.347 af, Atten= 34%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.24 fps, Min. Travel Time= 9.7 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 21.2 min

Peak Storage= 5,551 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 6.75' Flow Area= 291.0 sf, Capacity= 2,720.29 cfs

Custom cross-section, Length= 1,309.0' Slope= 0.0092 '/' (101 Elevation Intervals)
Constant n= 0.040 Winding stream, pools & shoals
Inlet Invert= 48.00', Outlet Invert= 36.00'



‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	12.00	0.00
18.00	6.00	6.00
30.25	6.00	6.00
31.75	5.25	6.75
34.25	5.25	6.75
35.75	6.00	6.00
48.00	6.00	6.00
66.00	12.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	2.5	0	0.00
0.75	3.0	30.4	3,927	2.28
6.75	291.0	68.3	380,919	2,720.29

Summary for Pond POND 1.0: GRAVEL WETLAND 1

[95] Warning: Outlet Device #4 rise exceeded

Inflow Area = 10.565 ac, 71.90% Impervious, Inflow Depth > 4.54" for 10 Year event
Inflow = 44.65 cfs @ 12.15 hrs, Volume= 3.997 af
Outflow = 18.42 cfs @ 12.46 hrs, Volume= 2.521 af, Atten= 59%, Lag= 18.2 min
Primary = 7.06 cfs @ 12.46 hrs, Volume= 2.098 af
Secondary = 11.37 cfs @ 12.46 hrs, Volume= 0.424 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.93' @ 12.46 hrs Surf.Area= 21,531 sf Storage= 86,691 cf
Flood Elev= 48.00' Surf.Area= 23,557 sf Storage= 110,845 cf

Plug-Flow detention time= 218.5 min calculated for 2.521 af (63% of inflow)
Center-of-Mass det. time= 119.6 min (906.9 - 787.3)

Volume	Invert	Avail.Storage	Storage Description
#1	39.05'	110,845 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
39.05	9,855	0.0	0	0
41.35	9,855	30.0	6,800	6,800
42.00	9,855	45.0	2,883	9,683
43.00	11,943	100.0	10,899	20,582
44.00	14,202	100.0	13,073	33,654
45.00	16,891	100.0	15,547	49,201
46.00	19,752	100.0	18,322	67,522
47.00	21,668	100.0	20,710	88,232
48.00	23,557	100.0	22,613	110,845

Device	Routing	Invert	Outlet Devices
#1	Primary	41.35'	**18.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 41.35' / 41.20' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	41.35'	**3.5" Vert. Orifice/Grate** C= 0.600
#3	Device 1	45.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#4	Device 1	46.00'	**3.0' long x 0.50' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 4.0' Crest Height
#5	Device 1	47.00'	**4.0" x 4.0" Horiz. Orifice/Grate X 106.00** C= 0.600 Limited to weir flow at low heads
#6	Secondary	46.50'	**15.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=7.05 cfs @ 12.46 hrs HW=46.93' TW=38.85' (Dynamic Tailwater)
1=Culvert (Passes 7.05 cfs of 18.69 cfs potential flow)
2=Orifice/Grate (Orifice Controls 0.75 cfs @ 11.22 fps)
3=Orifice/Grate (Orifice Controls 0.32 cfs @ 6.46 fps)
4=Sharp-Crested Rectangular Weir (Orifice Controls 5.98 cfs @ 4.13 fps)
5=Orifice/Grate (Controls 0.00 cfs)

Secondary OutFlow Max=11.30 cfs @ 12.46 hrs HW=46.93' TW=38.85' (Dynamic Tailwater)
6=Broad-Crested Rectangular Weir (Weir Controls 11.30 cfs @ 1.76 fps)

Summary for Pond POND 1.1: GRAVEL WETLAND 2

Inflow Area = 5.886 ac, 53.86% Impervious, Inflow Depth > 3.90" for 10 Year event
Inflow = 22.77 cfs @ 12.14 hrs, Volume= 1.914 af
Outflow = 1.94 cfs @ 13.51 hrs, Volume= 0.606 af, Atten= 91%, Lag= 81.9 min
Primary = 1.94 cfs @ 13.51 hrs, Volume= 0.606 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.09' @ 13.51 hrs Surf.Area= 16,918 sf Storage= 57,246 cf
Flood Elev= 57.00' Surf.Area= 21,643 sf Storage= 94,743 cf

Plug-Flow detention time= 337.6 min calculated for 0.605 af (32% of inflow)
Center-of-Mass det. time= 204.9 min (1,011.2 - 806.3)

Volume	Invert	Avail.Storage	Storage Description
#1	47.55'	117,304 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.55	6,269	0.0	0	0
49.85	6,269	30.0	4,326	4,326
50.50	6,269	45.0	1,834	6,159
51.00	7,199	100.0	3,367	9,526
52.00	9,187	100.0	8,193	17,719
53.00	11,345	100.0	10,266	27,985
54.00	13,814	100.0	12,580	40,565
55.00	16,645	100.0	15,230	55,794
56.00	19,805	100.0	18,225	74,019
58.00	23,480	100.0	43,285	117,304

Device	Routing	Invert	Outlet Devices
#1	Primary	49.85'	**24.0" Round Culvert** L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.85' / 49.45' S= 0.0333 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	49.85'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	53.50'	**4.0' long x 2.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 1	56.50'	**4.0" W x 4.0" H Vert. Orifice/Grate X 106.00** C= 0.600

Primary OutFlow Max=1.94 cfs @ 13.51 hrs HW=55.09' TW=55.07' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.94 cfs @ 0.62 fps)
  ├─**2=Orifice/Grate** (Passes < 0.01 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir** (Passes < 3.66 cfs potential flow)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond POND 1.2: PDMH203

Inflow Area = 7.925 ac, 57.46% Impervious, Inflow Depth > 2.06" for 10 Year event
Inflow = 9.84 cfs @ 12.09 hrs, Volume= 1.360 af
Outflow = 9.84 cfs @ 12.09 hrs, Volume= 1.360 af, Atten= 0%, Lag= 0.0 min
Primary = 9.84 cfs @ 12.09 hrs, Volume= 1.360 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 50.54' @ 12.09 hrs
Flood Elev= 57.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.35'	**54.0" Round Culvert** L= 269.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 49.35' / 48.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 15.90 sf

Primary OutFlow Max=9.68 cfs @ 12.09 hrs HW=50.53' TW=48.71' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 9.68 cfs @ 2.92 fps)

Summary for Pond POND 1.3: OUTLET CULVERTS

[62] Hint: Exceeded Reach REACH 1.0 OUTLET depth by 2.50' @ 23.95 hrs

```
Inflow Area =      30.459 ac,  58.85% Impervious,  Inflow Depth >   2.81"    for  10 Year event
Inflow      =      39.55 cfs @  12.48 hrs,  Volume=          7.136 af
Outflow     =      39.42 cfs @  12.51 hrs,  Volume=          6.846 af,  Atten= 0%,  Lag= 1.8 min
Primary     =      39.42 cfs @  12.51 hrs,  Volume=          6.846 af
Secondary =         0.00 cfs @   0.00 hrs,  Volume=          0.000 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 38.86' @ 12.51 hrs Surf.Area= 9,323 sf Storage= 14,426 cf
Flood Elev= 42.00' Surf.Area= 67,909 sf Storage= 110,415 cf

Plug-Flow detention time= 32.7 min calculated for 6.846 af (96% of inflow)
Center-of-Mass det. time= 11.9 min (904.9 - 893.0)

Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	110,415 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
35.00	960	0	0
36.00	1,428	1,194	1,194
38.00	5,472	6,900	8,094
40.00	14,470	19,942	28,036
42.00	67,909	82,379	110,415

Device	Routing	Invert	Outlet Devices
#1	Primary	35.60'	**42.0" W x 29.0" H, R=21.5"/66.1" Pipe Arch CMP_Arch_1/2 42x29 X 3.00** L= 68.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 35.60' / 35.30' S= 0.0044 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 6.72 sf
#2	Secondary	42.00'	**285.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=39.31 cfs @ 12.51 hrs HW=38.85' TW=38.65' (Dynamic Tailwater)
└─**1=CMP_Arch_1/2 42x29** (Outlet Controls 39.31 cfs @ 1.95 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=35.00' TW=38.65' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond POND 1.4: RAINGARDEN 1.0

```
Inflow Area =       4.931 ac,  85.07% Impervious,  Inflow Depth >   4.88"    for  10 Year event
Inflow      =      24.46 cfs @  12.10 hrs,  Volume=          2.004 af
Outflow     =       6.60 cfs @  12.48 hrs,  Volume=          1.402 af,  Atten= 73%,  Lag= 22.2 min
Primary     =       6.60 cfs @  12.48 hrs,  Volume=          1.402 af
Secondary =         0.00 cfs @   0.00 hrs,  Volume=          0.000 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.07' @ 12.48 hrs Surf.Area= 14,775 sf Storage= 45,640 cf
Flood Elev= 50.00' Surf.Area= 17,790 sf Storage= 77,050 cf

Plug-Flow detention time= 234.6 min calculated for 1.402 af (70% of inflow)
Center-of-Mass det. time= 143.1 min (914.3 - 771.2)

Volume	Invert	Avail.Storage	Storage Description
#1	42.17'	77,050 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
42.17	10,418	0.0	0	0
43.50	10,418	40.0	5,542	5,542
45.00	10,418	10.0	1,563	7,105
46.00	11,745	100.0	11,082	18,187
48.00	14,664	100.0	26,409	44,596
50.00	17,790	100.0	32,454	77,050

Device	Routing	Invert	Outlet Devices
#1	Primary	42.42'	**12.0" Round Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.42' / 42.20' S= 0.0046 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	42.42'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 2	45.00'	**10.000 in/hr Exfiltration over Surface area above 45.00'** Excluded Surface area = 10,418 sf
#4	Device 1	47.15'	**13.2" x 13.2" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	49.35'	**7.0' long x 8.9' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

Primary OutFlow Max=6.59 cfs @ 12.48 hrs HW=48.07' TW=38.85' (Dynamic Tailwater)
1=Culvert (Passes 6.59 cfs of 6.77 cfs potential flow)
2=Orifice/Grate (Passes 1.01 cfs of 2.20 cfs potential flow)
3=Exfiltration (Exfiltration Controls 1.01 cfs)
4=Orifice/Grate (Orifice Controls 5.59 cfs @ 4.62 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=42.17' TW=35.00' (Dynamic Tailwater)
5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Link LINK 1.0: PDMH203 TAILWATER

This link takes into account the tailwater condition in PDMH203 which the outlet of gravel wetland 2 connects. The purpose of this is to determine the effects of any surcharging caused by the tailwater of Hodgson Brook entering the structure. These tailwater elevations were determined by Streamworks, PLLC as part of the overall watershed analysis they performed. These findings are discussed in the seperate memo prepared by Streamworks, PLLC.

[80] Warning: Exceeded Pond POND 1.1 by 7.52' @ 0.00 hrs (23.95 cfs 24.969 af)

Inflow Area = 5.886 ac, 53.86% Impervious, Inflow Depth > 1.24" for 10 Year event
Inflow = 1.94 cfs @ 13.51 hrs, Volume= 0.606 af
Primary = 1.94 cfs @ 13.51 hrs, Volume= 0.606 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

10 Year 25 Point manual elevation table, To= 0.00 hrs, dt= 1.00 hrs, feet =

55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07
55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07
55.07	55.07	55.07	55.07	55.07	55.07	55.07		

Summary for Link PA1: POINT OF ANALYSIS

This link takes into account the tailwater condition in roadside swale along Goose Bay Drive which the existing culverts discharge into. These tailwater elevations were determined by Streamworks, PLLC as part of the overall watershed analysis they performed. These findings are discussed in the seperate memo prepared by Streamworks, PLLC.

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[80] Warning: Exceeded Pond POND 1.3 by 3.65' @ 0.00 hrs (92.51 cfs 85.505 af)

Inflow Area = 30.459 ac, 58.85% Impervious, Inflow Depth > 2.70" for 10 Year event
Inflow = 39.42 cfs @ 12.51 hrs, Volume= 6.846 af
Primary = 39.42 cfs @ 12.51 hrs, Volume= 6.846 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

10 Year 2 Point manual elevation table, To= 0.00 hrs, dt= 24.00 hrs, feet =
38.65 38.65

Summary for Link PA2: POINT OF ANALYSIS

Inflow Area = 1.151 ac, 50.42% Impervious, Inflow Depth > 4.01" for 10 Year event
Inflow = 5.34 cfs @ 12.07 hrs, Volume= 0.384 af
Primary = 5.34 cfs @ 12.07 hrs, Volume= 0.384 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment POST 1.0: WATERSHED Runoff Area=460,200 sf 71.90% Impervious Runoff Depth>6.00"
Flow Length=933' Tc=11.4 min CN=91 Runoff=58.10 cfs 5.281 af

Subcatchment POST 1.1: WATERSHED Runoff Area=256,387 sf 53.86% Impervious Runoff Depth>5.31"
Flow Length=750' Tc=10.3 min CN=85 Runoff=30.60 cfs 2.605 af

Subcatchment POST 1.2: WATERSHED 1.2 Runoff Area=88,847 sf 67.84% Impervious Runoff Depth>5.89"
Flow Length=1,191' Tc=6.4 min CN=90 Runoff=12.86 cfs 1.001 af

Subcatchment POST 1.3: WATERSHED Runoff Area=306,556 sf 22.44% Impervious Runoff Depth>4.50"
Flow Length=1,525' Tc=45.9 min CN=78 Runoff=17.11 cfs 2.638 af

Subcatchment POST 1.4: WATERSHED Runoff Area=214,792 sf 85.07% Impervious Runoff Depth>6.35"
Flow Length=717' Tc=7.5 min CN=94 Runoff=31.40 cfs 2.610 af

Subcatchment POST 2.0: WATERSHED 2.0 Runoff Area=50,117 sf 50.42% Impervious Runoff Depth>5.43"
Tc=5.0 min CN=86 Runoff=7.13 cfs 0.521 af

Reach REACH 1.0: RESTORED Avg. Flow Depth=0.83' Max Vel=2.26 fps Inflow=12.86 cfs 2.070 af
n=0.040 L=1,309.0' S=0.0092 '/' Capacity=2,720.29 cfs Outflow=6.71 cfs 2.055 af

Pond POND 1.0: GRAVEL WETLAND 1 Peak Elev=47.21' Storage=92,732 cf Inflow=58.10 cfs 5.281 af
Primary=19.22 cfs 2.775 af Secondary=23.73 cfs 0.974 af Outflow=42.95 cfs 3.749 af

Pond POND 1.1: GRAVEL WETLAND 2 Peak Elev=55.74' Storage=68,944 cf Inflow=30.60 cfs 2.605 af
Outflow=4.98 cfs 1.069 af

Pond POND 1.2: PDMH203 Peak Elev=50.72' Inflow=12.86 cfs 2.070 af
54.0" Round Culvert n=0.013 L=269.0' S=0.0050 '/' Outflow=12.86 cfs 2.070 af

Pond POND 1.3: OUTLET CULVERTS Peak Elev=39.31' Storage=19,115 cf Inflow=66.28 cfs 10.410 af
Primary=64.95 cfs 10.101 af Secondary=0.00 cfs 0.000 af Outflow=64.95 cfs 10.101 af

Pond POND 1.4: RAINGARDEN 1.0 Peak Elev=48.89' Storage=58,255 cf Inflow=31.40 cfs 2.610 af
Primary=7.29 cfs 1.967 af Secondary=0.00 cfs 0.000 af Outflow=7.29 cfs 1.967 af

Link LINK 1.0: PDMH203 TAILWATER Inflow=4.98 cfs 1.069 af
Primary=4.98 cfs 1.069 af

Link PA1: POINT OF ANALYSIS Inflow=64.95 cfs 10.101 af
Primary=64.95 cfs 10.101 af

Link PA2: POINT OF ANALYSIS Inflow=7.13 cfs 0.521 af
Primary=7.13 cfs 0.521 af

Total Runoff Area = 31.609 ac Runoff Volume = 14.656 af Average Runoff Depth = 5.56"
41.46% Pervious = 13.105 ac 58.54% Impervious = 18.505 ac

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment POST 1.0: WATERSHED Runoff Area=460,200 sf 71.90% Impervious Runoff Depth>7.37"
Flow Length=933' Tc=11.4 min CN=91 Runoff=70.54 cfs 6.487 af

Subcatchment POST 1.1: WATERSHED Runoff Area=256,387 sf 53.86% Impervious Runoff Depth>6.65"
Flow Length=750' Tc=10.3 min CN=85 Runoff=37.88 cfs 3.261 af

Subcatchment POST 1.2: WATERSHED 1.2 Runoff Area=88,847 sf 67.84% Impervious Runoff Depth>7.25"
Flow Length=1,191' Tc=6.4 min CN=90 Runoff=15.65 cfs 1.233 af

Subcatchment POST 1.3: WATERSHED Runoff Area=306,556 sf 22.44% Impervious Runoff Depth>5.77"
Flow Length=1,525' Tc=45.9 min CN=78 Runoff=21.83 cfs 3.384 af

Subcatchment POST 1.4: WATERSHED Runoff Area=214,792 sf 85.07% Impervious Runoff Depth>7.73"
Flow Length=717' Tc=7.5 min CN=94 Runoff=37.84 cfs 3.178 af

Subcatchment POST 2.0: WATERSHED 2.0 Runoff Area=50,117 sf 50.42% Impervious Runoff Depth>6.77"
Tc=5.0 min CN=86 Runoff=8.79 cfs 0.650 af

Reach REACH 1.0: RESTORED Avg. Flow Depth=0.88' Max Vel=2.23 fps Inflow=15.65 cfs 2.675 af
n=0.040 L=1,309.0' S=0.0092 '/' Capacity=2,720.29 cfs Outflow=9.18 cfs 2.658 af

Pond POND 1.0: GRAVEL WETLAND 1 Peak Elev=47.47' Storage=98,631 cf Inflow=70.54 cfs 6.487 af
Primary=19.72 cfs 3.332 af Secondary=37.73 cfs 1.596 af Outflow=57.44 cfs 4.928 af

Pond POND 1.1: GRAVEL WETLAND 2 Peak Elev=56.51' Storage=84,295 cf Inflow=37.88 cfs 3.261 af
Outflow=7.52 cfs 1.442 af

Pond POND 1.2: PDMH203 Peak Elev=50.87' Inflow=15.65 cfs 2.675 af
54.0" Round Culvert n=0.013 L=269.0' S=0.0050 '/' Outflow=15.65 cfs 2.675 af

Pond POND 1.3: OUTLET CULVERTS Peak Elev=39.74' Storage=24,444 cf Inflow=85.41 cfs 13.470 af
Primary=82.00 cfs 13.140 af Secondary=0.00 cfs 0.000 af Outflow=82.00 cfs 13.140 af

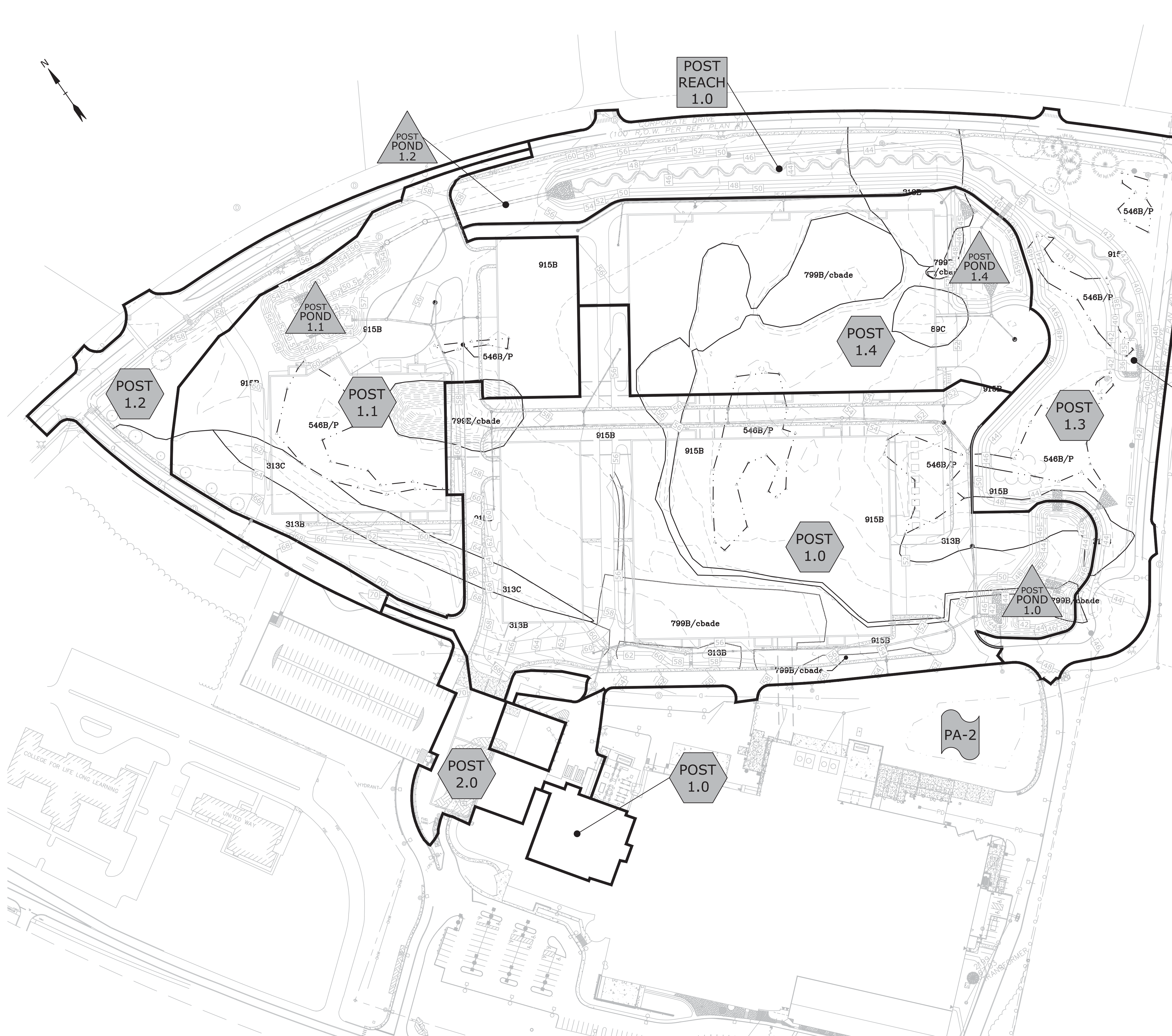
Pond POND 1.4: RAINGARDEN 1.0 Peak Elev=49.56' Storage=69,296 cf Inflow=37.84 cfs 3.178 af
Primary=7.69 cfs 2.462 af Secondary=1.61 cfs 0.039 af Outflow=9.30 cfs 2.501 af

Link LINK 1.0: PDMH203 TAILWATER Inflow=7.52 cfs 1.442 af
Primary=7.52 cfs 1.442 af

Link PA1: POINT OF ANALYSIS Inflow=82.00 cfs 13.140 af
Primary=82.00 cfs 13.140 af

Link PA2: POINT OF ANALYSIS Inflow=8.79 cfs 0.650 af
Primary=8.79 cfs 0.650 af

Total Runoff Area = 31.609 ac Runoff Volume = 18.191 af Average Runoff Depth = 6.91"
41.46% Pervious = 13.105 ac 58.54% Impervious = 18.505 ac



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Engineers | Environmental Specialists

SCALE IN FEET
0 80' 160'
GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

LEGEND

- POST-DEVELOPMENT WATERSHED BOUNDARY
- SOIL SURVEY BOUNDARIES
- LONGEST FLOW PATH
- POST 1.0 — PRE DEVELOPMENT WATERSHED AREA DESIGNATION
- POST POND 1 — POST-DEVELOPMENT POND DESIGNATION
- PA-1 — POINT OF ANALYSIS
- POST REACH 1 — POST-DEVELOPMENT REACH DESIGNATION

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

NOTES:
1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

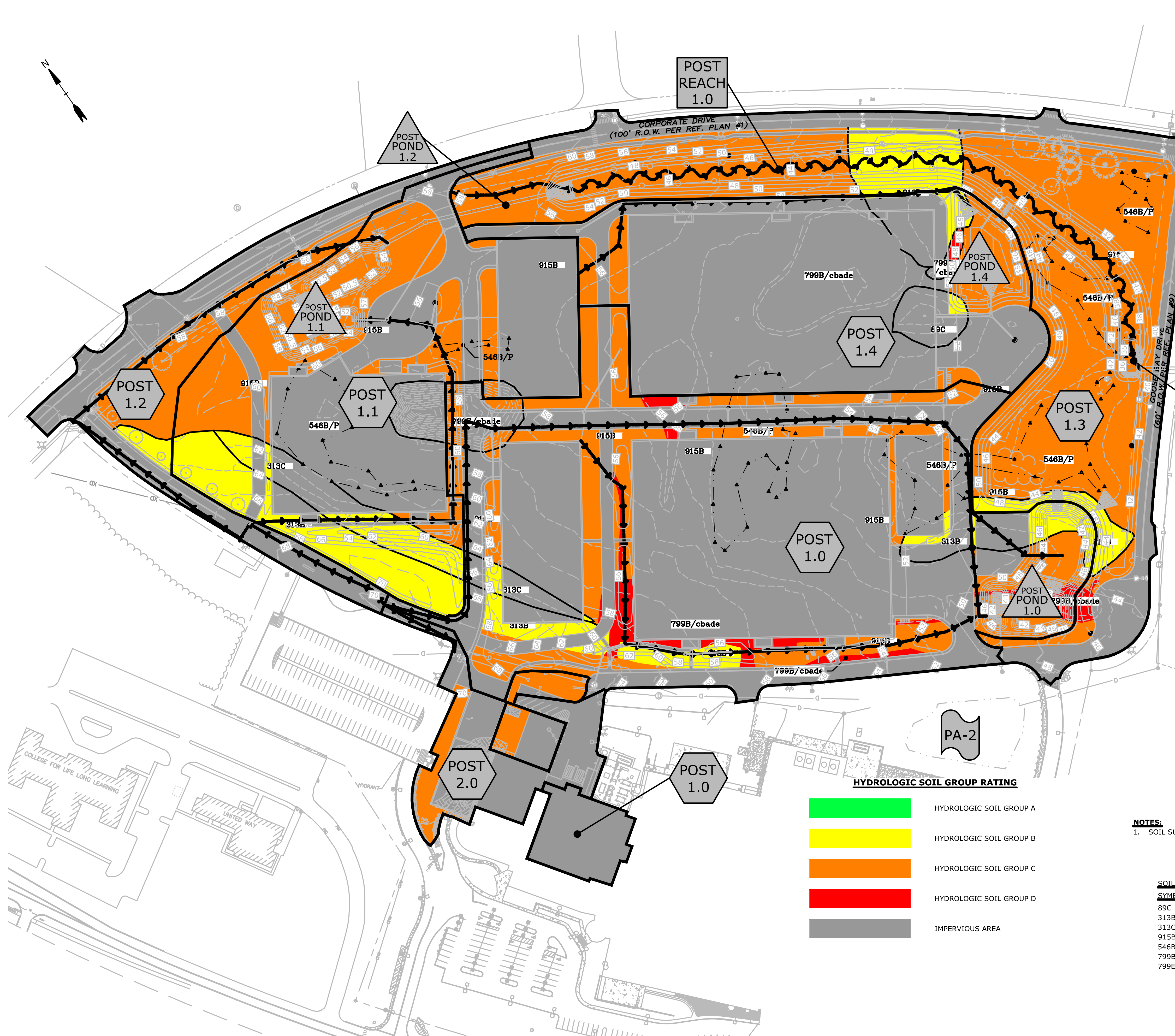
MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT WATERSHED AREA PLAN

SCALE: AS SHOWN

C-802



LEGEND

Heavy solid line	POST-DEVELOPMENT WATERSHED BOUNDARY
Thin solid line	SOIL SURVEY BOUNDARIES
Line with arrows	LONGEST FLOW PATH
POST 1.0	PRE DEVELOPMENT WATERSHED AREA DESIGNATION
POST POND 1	POST-DEVELOPMENT POND DESIGNATION
PA-1	POINT OF ANALYSIS
POST REACH 1	POST-DEVELOPMENT REACH DESIGNATION

SCALE IN FEET: 0, 80', 160'
GRAPHIC SCALE

HYDROLOGIC SOIL GROUP RATING

- HYDROLOGIC SOIL GROUP A
- HYDROLOGIC SOIL GROUP B
- HYDROLOGIC SOIL GROUP C
- HYDROLOGIC SOIL GROUP D
- IMPERVIOUS AREA

NOTES:

1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

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Proposed Industrial Development

Lonza Biologics

Portsmouth,
New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

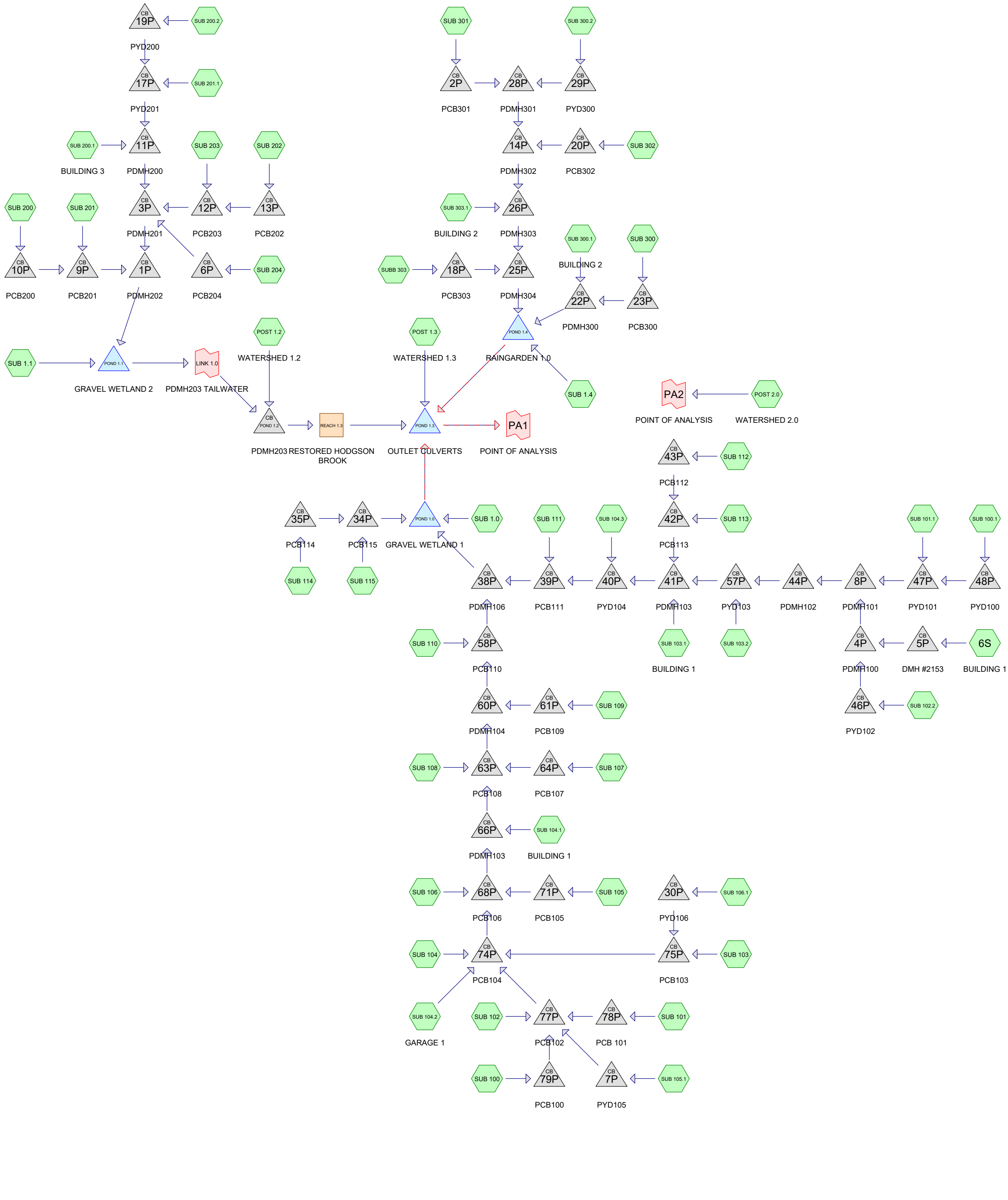
PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

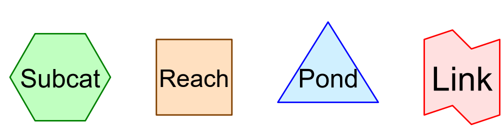
POST-DEVELOPMENT SOIL PLAN

SCALE: AS SHOWN

C-804

Last Save Date: November 2, 2018 11:11 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-804





Routing Diagram for L-0700-13 SUBCAT

Prepared by Tighe & Bond, Printed 11/2/2018

HydroCAD® 10.00-20 s/n 03436 © 2017 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
8.606	98	(SUB 103.1, SUB 104.1, SUB 104.2, SUB 200.1, SUB 300.1, SUB 303.1)
2.201	61	>75% Grass cover, Good, HSG B (POST 1.2, POST 1.3, SUB 1.0, SUB 1.1, SUB 1.4, SUB 101.1, SUB 102.2, SUB 103.2, SUB 105.1, SUB 110, SUB 200.2, SUB 201.1, SUBB 303)
9.466	74	>75% Grass cover, Good, HSG C (6S, POST 1.2, POST 1.3, POST 2.0, SUB 1.0, SUB 1.1, SUB 1.4, SUB 100, SUB 100.1, SUB 101, SUB 101.1, SUB 102, SUB 102.2, SUB 103, SUB 103.2, SUB 104, SUB 104.3, SUB 105, SUB 105.1, SUB 106, SUB 106.1, SUB 107, SUB 108, SUB 110, SUB 200, SUB 200.2, SUB 201.1, SUB 202, SUB 203, SUB 204, SUB 300, SUB 300.2, SUB 301, SUB 302, SUBB 303)
0.403	80	>75% Grass cover, Good, HSG D (POST 1.3, SUB 1.0, SUB 1.4, SUB 100.1, SUB 101.1, SUB 102.2, SUB 103.2, SUB 104.3, SUB 105, SUB 106)
0.504	71	Meadow, non-grazed, HSG C (POST 1.3)
0.747	98	Paved parking, HSG B (POST 1.2, POST 1.3, SUB 1.0, SUB 1.1, SUB 1.4, SUB 100, SUB 101.1, SUB 102, SUB 102.2, SUB 103.2, SUB 110, SUB 200.2, SUB 300, SUBB 303)
7.138	98	Paved parking, HSG C (POST 1.2, POST 1.3, POST 2.0, SUB 1.0, SUB 1.1, SUB 1.4, SUB 100, SUB 100.1, SUB 101, SUB 101.1, SUB 102, SUB 102.2, SUB 103, SUB 103.2, SUB 104, SUB 104.3, SUB 105, SUB 106, SUB 106.1, SUB 107, SUB 108, SUB 109, SUB 110, SUB 111, SUB 112, SUB 113, SUB 114, SUB 115, SUB 200, SUB 200.2, SUB 201, SUB 201.1, SUB 202, SUB 203, SUB 204, SUB 300, SUB 300.2, SUB 301, SUB 302, SUBB 303)
0.159	98	Paved parking, HSG D (POST 1.3, SUB 1.4, SUB 100.1, SUB 101.1, SUB 103.2, SUB 104.3, SUB 105, SUB 111)
0.525	98	Roofs, HSG C (6S)
29.749	**87**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
2.948	HSG B	POST 1.2, POST 1.3, SUB 1.0, SUB 1.1, SUB 1.4, SUB 100, SUB 101.1, SUB 102, SUB 102.2, SUB 103.2, SUB 105.1, SUB 110, SUB 200.2, SUB 201.1, SUB 300, SUBB 303
17.634	HSG C	6S, POST 1.2, POST 1.3, POST 2.0, SUB 1.0, SUB 1.1, SUB 1.4, SUB 100, SUB 100.1, SUB 101, SUB 101.1, SUB 102, SUB 102.2, SUB 103, SUB 103.2, SUB 104, SUB 104.3, SUB 105, SUB 105.1, SUB 106, SUB 106.1, SUB 107, SUB 108, SUB 109, SUB 110, SUB 111, SUB 112, SUB 113, SUB 114, SUB 115, SUB 200, SUB 200.2, SUB 201, SUB 201.1, SUB 202, SUB 203, SUB 204, SUB 300, SUB 300.2, SUB 301, SUB 302, SUBB 303
0.561	HSG D	POST 1.3, SUB 1.0, SUB 1.4, SUB 100.1, SUB 101.1, SUB 102.2, SUB 103.2, SUB 104.3, SUB 105, SUB 106, SUB 111
8.606	Other	SUB 103.1, SUB 104.1, SUB 104.2, SUB 200.1, SUB 300.1, SUB 303.1
29.749		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 6S: BUILDING 1 Runoff Area=26,128 sf 87.52% Impervious Runoff Depth>4.99"
Tc=5.0 min CN=95 Runoff=3.22 cfs 0.250 af

Subcatchment POST 1.2: WATERSHED 1.2 Runoff Area=88,847 sf 67.84% Impervious Runoff Depth>4.43"
Flow Length=1,191' Tc=6.4 min CN=90 Runoff=9.84 cfs 0.754 af

Subcatchment POST 1.3: WATERSHED Runoff Area=306,909 sf 22.42% Impervious Runoff Depth>3.18"
Flow Length=1,525' Tc=45.9 min CN=78 Runoff=12.14 cfs 1.868 af

Subcatchment POST 2.0: WATERSHED 2.0 Runoff Area=4,086 sf 97.28% Impervious Runoff Depth>5.22"
Tc=5.0 min CN=97 Runoff=0.51 cfs 0.041 af

Subcatchment SUB 1.0: Runoff Area=36,598 sf 21.71% Impervious Runoff Depth>3.21"
Tc=5.0 min CN=78 Runoff=3.16 cfs 0.225 af

Subcatchment SUB 1.1: Runoff Area=81,352 sf 9.58% Impervious Runoff Depth>2.83"
Flow Length=285' Tc=8.3 min CN=74 Runoff=5.65 cfs 0.441 af

Subcatchment SUB 1.4: Runoff Area=23,747 sf 11.82% Impervious Runoff Depth>2.93"
Tc=5.0 min CN=75 Runoff=1.87 cfs 0.133 af

Subcatchment SUB 100: Runoff Area=13,615 sf 69.93% Impervious Runoff Depth>4.54"
Tc=5.0 min CN=91 Runoff=1.59 cfs 0.118 af

Subcatchment SUB 100.1: Runoff Area=12,798 sf 25.93% Impervious Runoff Depth>3.50"
Tc=5.0 min CN=81 Runoff=1.20 cfs 0.086 af

Subcatchment SUB 101: Runoff Area=4,346 sf 64.01% Impervious Runoff Depth>4.33"
Tc=5.0 min CN=89 Runoff=0.49 cfs 0.036 af

Subcatchment SUB 101.1: Runoff Area=16,430 sf 27.66% Impervious Runoff Depth>3.40"
Tc=5.0 min CN=80 Runoff=1.50 cfs 0.107 af

Subcatchment SUB 102: Runoff Area=10,832 sf 79.94% Impervious Runoff Depth>4.77"
Tc=5.0 min CN=93 Runoff=1.31 cfs 0.099 af

Subcatchment SUB 102.2: Runoff Area=15,831 sf 38.13% Impervious Runoff Depth>3.40"
Tc=5.0 min CN=80 Runoff=1.45 cfs 0.103 af

Subcatchment SUB 103: Runoff Area=3,118 sf 53.75% Impervious Runoff Depth>4.11"
Tc=5.0 min CN=87 Runoff=0.34 cfs 0.025 af

Subcatchment SUB 103.1: BUILDING 1 Runoff Area=65,920 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=8.32 cfs 0.673 af

Subcatchment SUB 103.2: Runoff Area=12,163 sf 22.22% Impervious Runoff Depth>2.93"
Flow Length=158' Tc=5.0 min CN=75 Runoff=0.96 cfs 0.068 af

Subcatchment SUB 104: Runoff Area=3,315 sf 50.44% Impervious Runoff Depth>4.01"
Tc=5.0 min CN=86 Runoff=0.35 cfs 0.025 af

Subcatchment SUB 104.1: BUILDING 1 Runoff Area=65,920 sf 100.00% Impervious Runoff Depth>5.34"
Tc=0.0 min CN=98 Runoff=9.46 cfs 0.674 af

Subcatchment SUB 104.2: GARAGE 1 Runoff Area=37,700 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=4.76 cfs 0.385 af

Subcatchment SUB 104.3: Runoff Area=13,198 sf 25.05% Impervious Runoff Depth>3.50"
Flow Length=262' Slope=0.0200 '/' Tc=10.4 min CN=81 Runoff=1.06 cfs 0.088 af

Subcatchment SUB 105: Runoff Area=10,018 sf 59.44% Impervious Runoff Depth>4.33"
Tc=5.0 min CN=89 Runoff=1.13 cfs 0.083 af

Subcatchment SUB 105.1: Runoff Area=5,907 sf 0.00% Impervious Runoff Depth>2.30"
Tc=5.0 min CN=68 Runoff=0.36 cfs 0.026 af

Subcatchment SUB 106: Runoff Area=10,579 sf 60.00% Impervious Runoff Depth>4.33"
Tc=5.0 min CN=89 Runoff=1.20 cfs 0.088 af

Subcatchment SUB 106.1: Runoff Area=12,358 sf 27.31% Impervious Runoff Depth>3.50"
Tc=5.0 min CN=81 Runoff=1.16 cfs 0.083 af

Subcatchment SUB 107: Runoff Area=11,825 sf 53.08% Impervious Runoff Depth>4.11"
Tc=5.0 min CN=87 Runoff=1.29 cfs 0.093 af

Subcatchment SUB 108: Runoff Area=17,538 sf 69.10% Impervious Runoff Depth>4.54"
Tc=5.0 min CN=91 Runoff=2.05 cfs 0.152 af

Subcatchment SUB 109: Runoff Area=3,285 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.034 af

Subcatchment SUB 110: Runoff Area=21,026 sf 85.31% Impervious Runoff Depth>4.88"
Tc=5.0 min CN=94 Runoff=2.57 cfs 0.196 af

Subcatchment SUB 111: Runoff Area=10,712 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=1.35 cfs 0.109 af

Subcatchment SUB 112: Runoff Area=7,229 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=0.91 cfs 0.074 af

Subcatchment SUB 113: Runoff Area=5,080 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=0.64 cfs 0.052 af

Subcatchment SUB 114: Runoff Area=2,372 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=0.30 cfs 0.024 af

Subcatchment SUB 115: Runoff Area=2,131 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=0.27 cfs 0.022 af

Subcatchment SUB 200: Runoff Area=2,760 sf 78.88% Impervious Runoff Depth>4.77"
Tc=5.0 min CN=93 Runoff=0.33 cfs 0.025 af

Subcatchment SUB 200.1: BUILDING 3 Runoff Area=63,221 sf 100.00% Impervious Runoff Depth>5.34"
Tc=0.0 min CN=98 Runoff=9.08 cfs 0.646 af

Subcatchment SUB 200.2: Runoff Area=21,678 sf 8.80% Impervious Runoff Depth>2.05"
Flow Length=270' Slope=0.0370 '/' Tc=8.1 min CN=65 Runoff=1.06 cfs 0.085 af

Subcatchment SUB 201: Runoff Area=6,729 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=0.85 cfs 0.069 af

Subcatchment SUB 201.1: Runoff Area=11,396 sf 2.84% Impervious Runoff Depth>2.05"
Flow Length=140' Tc=9.1 min CN=65 Runoff=0.54 cfs 0.045 af

Subcatchment SUB 202: Runoff Area=9,155 sf 43.41% Impervious Runoff Depth>3.80"
Tc=5.0 min CN=84 Runoff=0.93 cfs 0.067 af

Subcatchment SUB 203: Runoff Area=5,888 sf 55.93% Impervious Runoff Depth>4.11"
Tc=5.0 min CN=87 Runoff=0.64 cfs 0.046 af

Subcatchment SUB 204: Runoff Area=21,058 sf 73.63% Impervious Runoff Depth>4.65"
Tc=5.0 min CN=92 Runoff=2.50 cfs 0.188 af

Subcatchment SUB 300: Runoff Area=20,165 sf 92.03% Impervious Runoff Depth>5.11"
Tc=5.0 min CN=96 Runoff=2.51 cfs 0.197 af

Subcatchment SUB 300.1: BUILDING 2 Runoff Area=71,050 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=8.97 cfs 0.726 af

Subcatchment SUB 300.2: Runoff Area=12,032 sf 38.02% Impervious Runoff Depth>3.70"
Tc=5.0 min CN=83 Runoff=1.20 cfs 0.085 af

Subcatchment SUB 301: Runoff Area=4,090 sf 87.11% Impervious Runoff Depth>4.99"
Tc=5.0 min CN=95 Runoff=0.50 cfs 0.039 af

Subcatchment SUB 302: Runoff Area=6,122 sf 86.65% Impervious Runoff Depth>4.99"
Tc=5.0 min CN=95 Runoff=0.76 cfs 0.058 af

Subcatchment SUB 303.1: BUILDING 2 Runoff Area=71,050 sf 100.00% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=98 Runoff=8.97 cfs 0.726 af

Subcatchment SUBB 303: Runoff Area=6,543 sf 89.30% Impervious Runoff Depth>4.99"
Tc=5.0 min CN=95 Runoff=0.81 cfs 0.062 af

Reach REACH 1.3: RESTORED Avg. Flow Depth=0.79' Max Vel=2.24 fps Inflow=9.84 cfs 1.056 af
n=0.040 L=1,309.0' S=0.0092 '/' Capacity=2,720.29 cfs Outflow=6.51 cfs 1.045 af

Pond 1P: PDMH202 Peak Elev=55.08' Inflow=13.76 cfs 1.170 af
24.0" Round Culvert n=0.013 L=51.0' S=0.0049 '/' Outflow=13.76 cfs 1.170 af

Pond 2P: PCB301 Peak Elev=52.44' Inflow=0.50 cfs 0.039 af
12.0" Round Culvert n=0.013 L=81.0' S=0.0123 '/' Outflow=0.50 cfs 0.039 af

Pond 3P: PDMH201 Peak Elev=55.08' Inflow=12.83 cfs 1.076 af
24.0" Round Culvert n=0.013 L=68.0' S=0.0051 '/' Outflow=12.83 cfs 1.076 af

Pond 4P: PDMH100 Peak Elev=53.01' Inflow=4.68 cfs 0.353 af
15.0" Round Culvert n=0.013 L=33.0' S=0.0788 '/' Outflow=4.68 cfs 0.353 af

Pond 5P: DMH #2153 Peak Elev=54.53' Inflow=3.22 cfs 0.250 af
15.0" Round Culvert n=0.013 L=53.0' S=0.0415 '/' Outflow=3.22 cfs 0.250 af

Pond 6P: PCB204 Peak Elev=55.08' Inflow=2.50 cfs 0.188 af
12.0" Round Culvert n=0.013 L=37.0' S=0.0054 '/' Outflow=2.50 cfs 0.188 af

Pond 7P: PYD105 Peak Elev=55.30' Inflow=0.36 cfs 0.026 af
12.0" Round Culvert n=0.013 L=127.0' S=0.0252 '/' Outflow=0.36 cfs 0.026 af

Pond 8P: PDMH101 Peak Elev=52.78' Inflow=7.40 cfs 0.545 af
15.0" Round Culvert n=0.013 L=95.0' S=0.0047 '/' Outflow=7.40 cfs 0.545 af

Pond 9P: PCB201 Peak Elev=55.08' Inflow=1.18 cfs 0.094 af
12.0" Round Culvert n=0.013 L=166.0' S=0.0051 '/' Outflow=1.18 cfs 0.094 af

Pond 10P: PCB200 Peak Elev=55.08' Inflow=0.33 cfs 0.025 af
12.0" Round Culvert n=0.013 L=18.0' S=0.0056 '/' Outflow=0.33 cfs 0.025 af

Pond 11P: PDMH200 Peak Elev=55.33' Inflow=9.82 cfs 0.776 af
18.0" Round Culvert n=0.013 L=81.0' S=0.0241 '/' Outflow=9.82 cfs 0.776 af

Pond 12P: PCB203 Peak Elev=55.08' Inflow=1.57 cfs 0.113 af
12.0" Round Culvert n=0.013 L=50.0' S=0.0050 '/' Outflow=1.57 cfs 0.113 af

Pond 13P: PCB202 Peak Elev=55.08' Inflow=0.93 cfs 0.067 af
12.0" Round Culvert n=0.013 L=18.0' S=0.0056 '/' Outflow=0.93 cfs 0.067 af

Pond 14P: PDMH302 Peak Elev=52.39' Inflow=2.46 cfs 0.183 af
18.0" Round Culvert n=0.013 L=137.0' S=0.0051 '/' Outflow=2.46 cfs 0.183 af

Pond 17P: PYD201 Peak Elev=55.72' Inflow=1.58 cfs 0.130 af
12.0" Round Culvert n=0.013 L=254.0' S=0.0051 '/' Outflow=1.58 cfs 0.130 af

Pond 18P: PCB303 Peak Elev=48.71' Inflow=0.81 cfs 0.062 af
12.0" Round Culvert n=0.013 L=23.0' S=0.0543 '/' Outflow=0.81 cfs 0.062 af

Pond 19P: PYD200 Peak Elev=55.85' Inflow=1.06 cfs 0.085 af
12.0" Round Culvert n=0.013 L=23.0' S=0.0109 '/' Outflow=1.06 cfs 0.085 af

Pond 20P: PCB302 Peak Elev=52.40' Inflow=0.76 cfs 0.058 af
12.0" Round Culvert n=0.013 L=4.0' S=0.0125 '/' Outflow=0.76 cfs 0.058 af

Pond 22P: PDMH300 Peak Elev=49.05' Inflow=11.48 cfs 0.923 af
18.0" Round Culvert n=0.013 L=29.0' S=0.0414 '/' Outflow=11.48 cfs 0.923 af

Pond 23P: PCB300 Peak Elev=49.41' Inflow=2.51 cfs 0.197 af
12.0" Round Culvert n=0.013 L=49.0' S=0.0061 '/' Outflow=2.51 cfs 0.197 af

Pond 25P: PDMH304 Peak Elev=48.26' Inflow=12.23 cfs 0.971 af
24.0" Round Culvert n=0.013 L=22.0' S=0.0727 '/' Outflow=12.23 cfs 0.971 af

Pond 26P: PDMH303 Peak Elev=52.32' Inflow=11.43 cfs 0.909 af
18.0" Round Culvert n=0.013 L=267.0' S=0.0069 '/' Outflow=11.43 cfs 0.909 af

Pond 28P: PDMH301 Peak Elev=52.48' Inflow=1.70 cfs 0.124 af
12.0" Round Culvert n=0.013 L=111.0' S=0.0099 '/' Outflow=1.70 cfs 0.124 af

Pond 29P: PYD300 Peak Elev=52.49' Inflow=1.20 cfs 0.085 af
12.0" Round Culvert n=0.013 L=65.0' S=0.0054 '/' Outflow=1.20 cfs 0.085 af

Pond 30P: PYD106 Peak Elev=52.74' Inflow=1.16 cfs 0.083 af
12.0" Round Culvert n=0.013 L=112.0' S=0.0054 '/' Outflow=1.16 cfs 0.083 af

Pond 34P: PCB115 Peak Elev=46.64' Inflow=0.57 cfs 0.046 af
12.0" Round Culvert n=0.013 L=29.0' S=0.0052 '/' Outflow=0.57 cfs 0.046 af

Pond 35P: PCB114 Peak Elev=46.64' Inflow=0.30 cfs 0.024 af
12.0" Round Culvert n=0.013 L=18.0' S=0.0056 '/' Outflow=0.30 cfs 0.024 af

Pond 38P: PDMH106 Peak Elev=47.45' Inflow=45.65 cfs 3.727 af
36.0" Round Culvert n=0.013 L=13.0' S=0.0077 '/' Outflow=45.65 cfs 3.727 af

Pond 39P: PCB111 Peak Elev=48.07' Inflow=20.42 cfs 1.610 af
30.0" Round Culvert n=0.013 L=5.0' S=0.0800 '/' Outflow=20.42 cfs 1.610 af

Pond 40P: PYD104 Peak Elev=48.85' Inflow=19.07 cfs 1.501 af
24.0" Round Culvert n=0.013 L=46.0' S=0.0239 '/' Outflow=19.07 cfs 1.501 af

Pond 41P: PDMH103 Peak Elev=49.42' Inflow=18.23 cfs 1.412 af
24.0" Round Culvert n=0.013 L=95.0' S=0.0053 '/' Outflow=18.23 cfs 1.412 af

Pond 42P: PCB113 Peak Elev=49.49' Inflow=1.55 cfs 0.126 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0075 '/' Outflow=1.55 cfs 0.126 af

Pond 43P: PCB112 Peak Elev=49.50' Inflow=0.91 cfs 0.074 af
12.0" Round Culvert n=0.013 L=18.0' S=0.0056 '/' Outflow=0.91 cfs 0.074 af

Pond 44P: PDMH102 Peak Elev=51.90' Inflow=7.40 cfs 0.545 af
15.0" Round Culvert n=0.013 L=73.0' S=0.0048 '/' Outflow=7.40 cfs 0.545 af

Pond 46P: PYD102 Peak Elev=53.03' Inflow=1.45 cfs 0.103 af
12.0" Round Culvert n=0.013 L=15.0' S=0.0400 '/' Outflow=1.45 cfs 0.103 af

Pond 47P: PYD101 Peak Elev=53.10' Inflow=2.70 cfs 0.193 af
12.0" Round Culvert n=0.013 L=84.0' S=0.0048 '/' Outflow=2.70 cfs 0.193 af

Pond 48P: PYD100 Peak Elev=53.16' Inflow=1.20 cfs 0.086 af
12.0" Round Culvert n=0.013 L=162.0' S=0.0046 '/' Outflow=1.20 cfs 0.086 af

Pond 57P: PYD103 Peak Elev=50.93' Inflow=8.36 cfs 0.613 af
18.0" Round Culvert n=0.013 L=242.0' S=0.0054 '/' Outflow=8.36 cfs 0.613 af

Pond 58P: PCB110 Peak Elev=48.24' Inflow=25.59 cfs 2.117 af
30.0" Round Culvert n=0.013 L=107.0' S=0.0061 '/' Outflow=25.59 cfs 2.117 af

Pond 60P: PDMH104 Peak Elev=48.64' Inflow=23.11 cfs 1.920 af
30.0" Round Culvert n=0.013 L=147.0' S=0.0048 '/' Outflow=23.11 cfs 1.920 af

Pond 61P: PCB109 Peak Elev=48.65' Inflow=0.41 cfs 0.034 af
12.0" Round Culvert n=0.013 L=38.0' S=0.0053 '/' Outflow=0.41 cfs 0.034 af

Pond 63P: PCB108 Peak Elev=49.47' Inflow=22.71 cfs 1.887 af
24.0" Round Culvert n=0.013 L=56.0' S=0.0259 '/' Outflow=22.71 cfs 1.887 af

Pond 64P: PCB107 Peak Elev=49.57' Inflow=1.29 cfs 0.093 af
12.0" Round Culvert n=0.013 L=23.0' S=0.0391 '/' Outflow=1.29 cfs 0.093 af

Pond 66P: PDMH103 Peak Elev=51.18' Inflow=19.54 cfs 1.641 af
24.0" Round Culvert n=0.013 L=159.0' S=0.0050 '/' Outflow=19.54 cfs 1.641 af

Pond 68P: PCB106 Peak Elev=51.97' Inflow=12.70 cfs 0.967 af
24.0" Round Culvert n=0.013 L=178.0' S=0.0101 '/' Outflow=12.70 cfs 0.967 af

Pond 71P: PCB105 Peak Elev=52.01' Inflow=1.13 cfs 0.083 af
12.0" Round Culvert n=0.013 L=18.0' S=0.0056 '/' Outflow=1.13 cfs 0.083 af

Pond 74P: PCB104 Peak Elev=52.63' Inflow=10.37 cfs 0.797 af
24.0" Round Culvert n=0.013 L=226.0' S=0.0077 '/' Outflow=10.37 cfs 0.797 af

Pond 75P: PCB103 Peak Elev=52.69' Inflow=1.51 cfs 0.107 af
12.0" Round Culvert n=0.013 L=18.0' S=0.0056 '/' Outflow=1.51 cfs 0.107 af

Pond 77P: PCB102 Peak Elev=54.32' Inflow=3.75 cfs 0.279 af
12.0" Round Culvert n=0.013 L=143.0' S=0.0052 '/' Outflow=3.75 cfs 0.279 af

Pond 78P: PCB 101 Peak Elev=54.33' Inflow=0.49 cfs 0.036 af
12.0" Round Culvert n=0.013 L=23.0' S=0.0065 '/' Outflow=0.49 cfs 0.036 af

Pond 79P: PCB100 Peak Elev=54.42' Inflow=1.59 cfs 0.118 af
12.0" Round Culvert n=0.013 L=40.0' S=0.0050 '/' Outflow=1.59 cfs 0.118 af

Pond POND 1.0: GRAVEL WETLAND 1 Peak Elev=46.64' Storage=80,593 cf Inflow=49.36 cfs 3.997 af
Primary=18.13 cfs 2.928 af Secondary=2.15 cfs 0.036 af Outflow=20.28 cfs 2.964 af

Pond POND 1.1: GRAVEL WETLAND 2 Peak Elev=55.07' Storage=57,027 cf Inflow=17.35 cfs 1.611 af
Outflow=0.90 cfs 0.303 af

Pond POND 1.2: PDMH203 Peak Elev=50.54' Inflow=9.84 cfs 1.056 af
54.0" Round Culvert n=0.013 L=269.0' S=0.0050 '/' Outflow=9.84 cfs 1.056 af

Pond POND 1.3: OUTLET CULVERTS Peak Elev=38.86' Storage=14,433 cf Inflow=39.54 cfs 7.304 af
Primary=39.48 cfs 7.015 af Secondary=0.00 cfs 0.000 af Outflow=39.48 cfs 7.015 af

Pond POND 1.4: RAINGARDEN 1.0 Peak Elev=48.17' Storage=46,096 cf Inflow=25.59 cfs 2.027 af
Primary=6.74 cfs 1.427 af Secondary=0.00 cfs 0.000 af Outflow=6.74 cfs 1.427 af

Link LINK 1.0: PDMH203 TAILWATER Inflow=0.90 cfs 0.303 af
Primary=0.90 cfs 0.303 af

Link PA1: POINT OF ANALYSIS Inflow=39.48 cfs 7.015 af
Primary=39.48 cfs 7.015 af

Link PA2: POINT OF ANALYSIS Inflow=0.51 cfs 0.041 af
Primary=0.51 cfs 0.041 af

Total Runoff Area = 29.749 ac Runoff Volume = 10.297 af Average Runoff Depth = 4.15"
42.27% Pervious = 12.574 ac 57.73% Impervious = 17.174 ac

Summary for Subcatchment 6S: BUILDING 1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.22 cfs @ 12.07 hrs, Volume= 0.250 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
22,866	98	Roofs, HSG C
3,262	74	>75% Grass cover, Good, HSG C
26,128	95	Weighted Average
3,262		12.48% Pervious Area
22,866		87.52% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment POST 1.2: WATERSHED 1.2

Runoff = 9.84 cfs @ 12.09 hrs, Volume= 0.754 af, Depth> 4.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,104	61	>75% Grass cover, Good, HSG B
2,340	98	Paved parking, HSG B
25,469	74	>75% Grass cover, Good, HSG C
57,934	98	Paved parking, HSG C
88,847	90	Weighted Average
28,573		32.16% Pervious Area
60,274		67.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	100	0.0100	1.12		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.68"
1.0	153	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.6	343	0.0050	3.47	2.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	13	0.0050	3.72	4.57	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
1.8	453	0.0050	4.20	7.43	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior

0.4	129	0.0050	5.91	29.00	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Corrugated PE, smooth interior
6.4	1,191	Total			

Summary for Subcatchment POST 1.3: WATERSHED 1.3

Runoff = 12.14 cfs @ 12.63 hrs, Volume= 1.868 af, Depth> 3.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
25,523	61	>75% Grass cover, Good, HSG B
903	98	Paved parking, HSG B
188,971	74	>75% Grass cover, Good, HSG C
67,403	98	Paved parking, HSG C
21,971	71	Meadow, non-grazed, HSG C
1,639	80	>75% Grass cover, Good, HSG D
499	98	Paved parking, HSG D
306,909	78	Weighted Average
238,104		77.58% Pervious Area
68,805		22.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	100	0.0130	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
1.1	52	0.0130	0.80		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.1	27	0.2720	7.82		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
33.8	1,346	0.0090	0.66		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
45.9	1,525	Total			

Summary for Subcatchment POST 2.0: WATERSHED 2.0

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.51 cfs @ 12.07 hrs, Volume= 0.041 af, Depth> 5.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
111	74	>75% Grass cover, Good, HSG C
3,975	98	Paved parking, HSG C
4,086	97	Weighted Average
111		2.72% Pervious Area
3,975		97.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 1.0:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.16 cfs @ 12.08 hrs, Volume= 0.225 af, Depth> 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
6,335	61	>75% Grass cover, Good, HSG B
5,010	98	Paved parking, HSG B
18,780	74	>75% Grass cover, Good, HSG C
2,936	98	Paved parking, HSG C
3,537	80	>75% Grass cover, Good, HSG D
36,598	78	Weighted Average
28,652		78.29% Pervious Area
7,946		21.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 1.1:

Runoff = 5.65 cfs @ 12.12 hrs, Volume= 0.441 af, Depth> 2.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
14,900	61	>75% Grass cover, Good, HSG B
2,623	98	Paved parking, HSG B
58,657	74	>75% Grass cover, Good, HSG C
5,172	98	Paved parking, HSG C
81,352	74	Weighted Average
73,557		90.42% Pervious Area
7,795		9.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	100	0.0450	0.25		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
1.7	170	0.0120	1.64		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.0	15	0.3330	8.66		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
8.3	285	Total			

Summary for Subcatchment SUB 1.4:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.87 cfs @ 12.08 hrs, Volume= 0.133 af, Depth> 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,560	61	>75% Grass cover, Good, HSG B
1,870	98	Paved parking, HSG B
16,172	74	>75% Grass cover, Good, HSG C
389	98	Paved parking, HSG C
1,207	80	>75% Grass cover, Good, HSG D
549	98	Paved parking, HSG D
23,747	75	Weighted Average
20,939		88.18% Pervious Area
2,808		11.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 100:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.59 cfs @ 12.07 hrs, Volume= 0.118 af, Depth> 4.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,170	98	Paved parking, HSG B
4,094	74	>75% Grass cover, Good, HSG C
7,351	98	Paved parking, HSG C
13,615	91	Weighted Average
4,094		30.07% Pervious Area
9,521		69.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 100.1:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.20 cfs @ 12.08 hrs, Volume= 0.086 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
8,607	74	>75% Grass cover, Good, HSG C
3,268	98	Paved parking, HSG C
872	80	>75% Grass cover, Good, HSG D
51	98	Paved parking, HSG D
12,798	81	Weighted Average
9,479		74.07% Pervious Area
3,319		25.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 101:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.49 cfs @ 12.07 hrs, Volume= 0.036 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
1,564	74	>75% Grass cover, Good, HSG C
2,782	98	Paved parking, HSG C
4,346	89	Weighted Average
1,564		35.99% Pervious Area
2,782		64.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 101.1:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.50 cfs @ 12.08 hrs, Volume= 0.107 af, Depth> 3.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,191	61	>75% Grass cover, Good, HSG B
1,198	98	Paved parking, HSG B
5,351	74	>75% Grass cover, Good, HSG C
1,539	98	Paved parking, HSG C
4,344	80	>75% Grass cover, Good, HSG D
1,807	98	Paved parking, HSG D
16,430	80	Weighted Average
11,886		72.34% Pervious Area
4,544		27.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 102:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.31 cfs @ 12.07 hrs, Volume= 0.099 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
1,936	98	Paved parking, HSG B
2,173	74	>75% Grass cover, Good, HSG C
6,723	98	Paved parking, HSG C
10,832	93	Weighted Average
2,173		20.06% Pervious Area
8,659		79.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 102.2:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.45 cfs @ 12.08 hrs, Volume= 0.103 af, Depth> 3.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,253	61	>75% Grass cover, Good, HSG B
1,155	98	Paved parking, HSG B
6,508	74	>75% Grass cover, Good, HSG C
4,881	98	Paved parking, HSG C
34	80	>75% Grass cover, Good, HSG D
15,831	80	Weighted Average
9,795		61.87% Pervious Area
6,036		38.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 103:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.34 cfs @ 12.07 hrs, Volume= 0.025 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
1,442	74	>75% Grass cover, Good, HSG C
1,676	98	Paved parking, HSG C
3,118	87	Weighted Average
1,442		46.25% Pervious Area
1,676		53.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 103.1: BUILDING 1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 8.32 cfs @ 12.07 hrs, Volume= 0.673 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

	Area (sf)	CN	Description
*	65,920	98	
	65,920		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 103.2:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.96 cfs @ 12.08 hrs, Volume= 0.068 af, Depth> 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,336	61	>75% Grass cover, Good, HSG B
703	98	Paved parking, HSG B
1,954	74	>75% Grass cover, Good, HSG C
804	98	Paved parking, HSG C
2,170	80	>75% Grass cover, Good, HSG D
1,196	98	Paved parking, HSG D
12,163	75	Weighted Average
9,460		77.78% Pervious Area
2,703		22.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	35	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
0.0	13	0.3080	8.32		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
0.7	110	0.0270	2.46		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
3.4	158	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment SUB 104:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.35 cfs @ 12.07 hrs, Volume= 0.025 af, Depth> 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
1,643	74	>75% Grass cover, Good, HSG C
1,672	98	Paved parking, HSG C
3,315	86	Weighted Average
1,643		49.56% Pervious Area
1,672		50.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 104.1: BUILDING 1

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 9.46 cfs @ 12.00 hrs, Volume= 0.674 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

	Area (sf)	CN	Description
*	65,920	98	
	65,920		100.00% Impervious Area

Summary for Subcatchment SUB 104.2: GARAGE 1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.76 cfs @ 12.07 hrs, Volume= 0.385 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

	Area (sf)	CN	Description
*	37,700	98	
	37,700		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 104.3:

Runoff = 1.06 cfs @ 12.15 hrs, Volume= 0.088 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,498	98	Paved parking, HSG C
7,602	74	>75% Grass cover, Good, HSG C
2,290	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG D
13,198	81	Weighted Average
9,892		74.95% Pervious Area
3,306		25.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0200	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
1.3	162	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
10.4	262	Total			

Summary for Subcatchment SUB 105:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.13 cfs @ 12.07 hrs, Volume= 0.083 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,004	74	>75% Grass cover, Good, HSG C
4,757	98	Paved parking, HSG C
1,059	80	>75% Grass cover, Good, HSG D
1,198	98	Paved parking, HSG D
10,018	89	Weighted Average
4,063		40.56% Pervious Area
5,955		59.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 105.1:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.36 cfs @ 12.08 hrs, Volume= 0.026 af, Depth> 2.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,679	61	>75% Grass cover, Good, HSG B
3,228	74	>75% Grass cover, Good, HSG C
5,907	68	Weighted Average
5,907		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 106:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.20 cfs @ 12.07 hrs, Volume= 0.088 af, Depth> 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,839	74	>75% Grass cover, Good, HSG C
5,700	98	Paved parking, HSG C
393	80	>75% Grass cover, Good, HSG D
647	98	Paved parking, HSG C
10,579	89	Weighted Average
4,232		40.00% Pervious Area
6,347		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 106.1:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.16 cfs @ 12.08 hrs, Volume= 0.083 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
8,983	74	>75% Grass cover, Good, HSG C
3,375	98	Paved parking, HSG C
12,358	81	Weighted Average
8,983		72.69% Pervious Area
3,375		27.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 107:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.29 cfs @ 12.07 hrs, Volume= 0.093 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,548	74	>75% Grass cover, Good, HSG C
6,277	98	Paved parking, HSG C
11,825	87	Weighted Average
5,548		46.92% Pervious Area
6,277		53.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 108:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.05 cfs @ 12.07 hrs, Volume= 0.152 af, Depth> 4.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,419	74	>75% Grass cover, Good, HSG C
12,119	98	Paved parking, HSG C
17,538	91	Weighted Average
5,419		30.90% Pervious Area
12,119		69.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 109:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.034 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,285	98	Paved parking, HSG C
3,285		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 110:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.57 cfs @ 12.07 hrs, Volume= 0.196 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
1,371	61	>75% Grass cover, Good, HSG B
6,038	98	Paved parking, HSG B
1,718	74	>75% Grass cover, Good, HSG C
11,899	98	Paved parking, HSG C
21,026	94	Weighted Average
3,089		14.69% Pervious Area
17,937		85.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 111:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.35 cfs @ 12.07 hrs, Volume= 0.109 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
9,915	98	Paved parking, HSG C
797	98	Paved parking, HSG D
10,712	98	Weighted Average
10,712		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 112:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.91 cfs @ 12.07 hrs, Volume= 0.074 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
7,229	98	Paved parking, HSG C
7,229		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 113:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.64 cfs @ 12.07 hrs, Volume= 0.052 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,080	98	Paved parking, HSG C
5,080		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 114:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.30 cfs @ 12.07 hrs, Volume= 0.024 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,372	98	Paved parking, HSG C
2,372		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 115:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.27 cfs @ 12.07 hrs, Volume= 0.022 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,131	98	Paved parking, HSG C
2,131		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 200:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.33 cfs @ 12.07 hrs, Volume= 0.025 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
583	74	>75% Grass cover, Good, HSG C
2,177	98	Paved parking, HSG C
2,760	93	Weighted Average
583		21.12% Pervious Area
2,177		78.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 200.1: BUILDING 3

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 9.08 cfs @ 12.00 hrs, Volume= 0.646 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

	Area (sf)	CN	Description
*	63,221	98	
	63,221		100.00% Impervious Area

Summary for Subcatchment SUB 200.2:

Runoff = 1.06 cfs @ 12.12 hrs, Volume= 0.085 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
18,788	61	>75% Grass cover, Good, HSG B
1,240	98	Paved parking, HSG B
982	74	>75% Grass cover, Good, HSG C
668	98	Paved parking, HSG C
21,678	65	Weighted Average
19,770		91.20% Pervious Area
1,908		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.0370	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
1.0	170	0.0370	2.89		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
8.1	270	Total			

Summary for Subcatchment SUB 201:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.85 cfs @ 12.07 hrs, Volume= 0.069 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
6,729	98	Paved parking, HSG C
6,729		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 201.1:

Runoff = 0.54 cfs @ 12.14 hrs, Volume= 0.045 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
8,482	61	>75% Grass cover, Good, HSG B
2,590	74	>75% Grass cover, Good, HSG C
324	98	Paved parking, HSG C
11,396	65	Weighted Average
11,072		97.16% Pervious Area
324		2.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0210	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.68"
0.1	40	0.2250	7.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.1	140	Total			

Summary for Subcatchment SUB 202:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.93 cfs @ 12.07 hrs, Volume= 0.067 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,181	74	>75% Grass cover, Good, HSG C
3,974	98	Paved parking, HSG C
9,155	84	Weighted Average
5,181		56.59% Pervious Area
3,974		43.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 203:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.64 cfs @ 12.07 hrs, Volume= 0.046 af, Depth> 4.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,595	74	>75% Grass cover, Good, HSG C
3,293	98	Paved parking, HSG C
5,888	87	Weighted Average
2,595		44.07% Pervious Area
3,293		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 204:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.50 cfs @ 12.07 hrs, Volume= 0.188 af, Depth> 4.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,554	74	>75% Grass cover, Good, HSG C
15,504	98	Paved parking, HSG C
21,058	92	Weighted Average
5,554		26.37% Pervious Area
15,504		73.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 300:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.51 cfs @ 12.07 hrs, Volume= 0.197 af, Depth> 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
2,018	98	Paved parking, HSG B
1,608	74	>75% Grass cover, Good, HSG C
16,539	98	Paved parking, HSG C
20,165	96	Weighted Average
1,608		7.97% Pervious Area
18,557		92.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 300.1: BUILDING 2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 8.97 cfs @ 12.07 hrs, Volume= 0.726 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

	Area (sf)	CN	Description
*	71,050	98	
	71,050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 300.2:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.20 cfs @ 12.07 hrs, Volume= 0.085 af, Depth> 3.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
7,458	74	>75% Grass cover, Good, HSG C
4,574	98	Paved parking, HSG C
12,032	83	Weighted Average
7,458		61.98% Pervious Area
4,574		38.02% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 301:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.50 cfs @ 12.07 hrs, Volume= 0.039 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
3,563	98	Paved parking, HSG C
527	74	>75% Grass cover, Good, HSG C
4,090	95	Weighted Average
527		12.89% Pervious Area
3,563		87.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 302:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.76 cfs @ 12.07 hrs, Volume= 0.058 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
5,305	98	Paved parking, HSG C
817	74	>75% Grass cover, Good, HSG C
6,122	95	Weighted Average
817		13.35% Pervious Area
5,305		86.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUB 303.1: BUILDING 2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 8.97 cfs @ 12.07 hrs, Volume= 0.726 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

	Area (sf)	CN	Description
*	71,050	98	
	71,050		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Subcatchment SUBB 303:

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.81 cfs @ 12.07 hrs, Volume= 0.062 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.58"

Area (sf)	CN	Description
343	61	>75% Grass cover, Good, HSG B
3,350	98	Paved parking, HSG B
357	74	>75% Grass cover, Good, HSG C
2,493	98	Paved parking, HSG C
6,543	95	Weighted Average
700		10.70% Pervious Area
5,843		89.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Summary for Reach REACH 1.3: RESTORED HODGSON BROOK

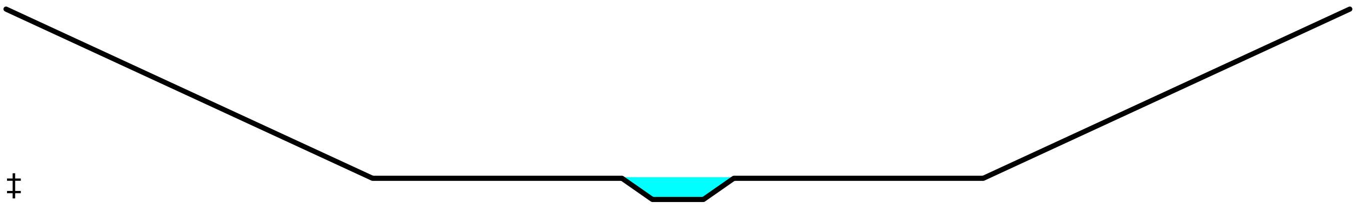
[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 7.164 ac, 52.93% Impervious, Inflow Depth > 1.77" for 10 Year event
Inflow = 9.84 cfs @ 12.09 hrs, Volume= 1.056 af
Outflow = 6.51 cfs @ 12.09 hrs, Volume= 1.045 af, Atten= 34%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.24 fps, Min. Travel Time= 9.7 min
Avg. Velocity = 0.95 fps, Avg. Travel Time= 22.9 min

Peak Storage= 5,551 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.79'
Bank-Full Depth= 6.75' Flow Area= 291.0 sf, Capacity= 2,720.29 cfs

Custom cross-section, Length= 1,309.0' Slope= 0.0092 '/' (101 Elevation Intervals)
Constant n= 0.040 Winding stream, pools & shoals
Inlet Invert= 48.00', Outlet Invert= 36.00'



Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	12.00	0.00
18.00	6.00	6.00
30.25	6.00	6.00
31.75	5.25	6.75
34.25	5.25	6.75
35.75	6.00	6.00
48.00	6.00	6.00
66.00	12.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	2.5	0	0.00
0.75	3.0	30.4	3,927	2.28
6.75	291.0	68.3	380,919	2,720.29

Summary for Pond 1P: PDMH202

[80] Warning: Exceeded Pond 3P by 0.04' @ 12.55 hrs (2.84 cfs 0.429 af)
[80] Warning: Exceeded Pond 9P by 0.33' @ 12.00 hrs (1.40 cfs 0.096 af)

Inflow Area = 3.257 ac, 68.46% Impervious, Inflow Depth > 4.31" for 10 Year event
Inflow = 13.76 cfs @ 12.02 hrs, Volume= 1.170 af
Outflow = 13.76 cfs @ 12.02 hrs, Volume= 1.170 af, Atten= 0%, Lag= 0.0 min
Primary = 13.76 cfs @ 12.02 hrs, Volume= 1.170 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.25 hrs
Flood Elev= 56.55'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.75'	**24.0" Round Culvert** L= 51.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.75' / 50.50' S= 0.0049 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=10.78 cfs @ 12.02 hrs HW=53.19' TW=52.68' (Dynamic Tailwater)
1=Culvert (Inlet Controls 10.78 cfs @ 3.43 fps)

Summary for Pond 2P: PCB301

Inflow Area = 0.094 ac, 87.11% Impervious, Inflow Depth > 4.99" for 10 Year event
Inflow = 0.50 cfs @ 12.07 hrs, Volume= 0.039 af
Outflow = 0.50 cfs @ 12.07 hrs, Volume= 0.039 af, Atten= 0%, Lag= 0.0 min
Primary = 0.50 cfs @ 12.07 hrs, Volume= 0.039 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.44' @ 12.21 hrs
Flood Elev= 55.65'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.65'	**12.0" Round Culvert** L= 81.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.65' / 50.65' S= 0.0123 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.45 cfs @ 12.07 hrs HW=52.01' TW=51.29' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.45 cfs @ 2.70 fps)

Summary for Pond 3P: PDMH201

[80] Warning: Exceeded Pond 6P by 0.21' @ 11.95 hrs (1.75 cfs 0.153 af)
[80] Warning: Exceeded Pond 11P by 0.01' @ 14.00 hrs (0.69 cfs 0.113 af)
[80] Warning: Exceeded Pond 12P by 0.32' @ 12.00 hrs (2.04 cfs 0.162 af)

Inflow Area = 3.039 ac, 66.64% Impervious, Inflow Depth > 4.25" for 10 Year event
Inflow = 12.83 cfs @ 12.02 hrs, Volume= 1.076 af
Outflow = 12.83 cfs @ 12.02 hrs, Volume= 1.076 af, Atten= 0%, Lag= 0.0 min
Primary = 12.83 cfs @ 12.02 hrs, Volume= 1.076 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.29 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.20'	**24.0" Round Culvert** L= 68.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.20' / 50.85' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=8.41 cfs @ 12.02 hrs HW=53.48' TW=53.17' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 8.41 cfs @ 2.68 fps)

Summary for Pond 4P: PDMH100

[80] Warning: Exceeded Pond 46P by 0.27' @ 12.15 hrs (1.83 cfs 0.008 af)

Inflow Area = 0.963 ac, 68.88% Impervious, Inflow Depth > 4.39" for 10 Year event
Inflow = 4.68 cfs @ 12.07 hrs, Volume= 0.353 af
Outflow = 4.68 cfs @ 12.07 hrs, Volume= 0.353 af, Atten= 0%, Lag= 0.0 min
Primary = 4.68 cfs @ 12.07 hrs, Volume= 0.353 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 53.01' @ 12.17 hrs
Flood Elev= 60.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.30'	**15.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.30' / 48.70' S= 0.0788 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.10 cfs @ 12.07 hrs HW=52.50' TW=52.14' (Dynamic Tailwater)
1=Culvert (Outlet Controls 3.10 cfs @ 3.29 fps)

Summary for Pond 5P: DMH #2153

Inflow Area = 0.600 ac, 87.52% Impervious, Inflow Depth > 4.99" for 10 Year event
Inflow = 3.22 cfs @ 12.07 hrs, Volume= 0.250 af
Outflow = 3.22 cfs @ 12.07 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min
Primary = 3.22 cfs @ 12.07 hrs, Volume= 0.250 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 54.53' @ 12.07 hrs
Flood Elev= 64.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.60'	**15.0" Round Culvert** L= 53.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.60' / 51.40' S= 0.0415 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.11 cfs @ 12.07 hrs HW=54.51' TW=52.50' (Dynamic Tailwater)
1=Culvert (Inlet Controls 3.11 cfs @ 3.25 fps)

Summary for Pond 6P: PCB204

Inflow Area = 0.483 ac, 73.63% Impervious, Inflow Depth > 4.65" for 10 Year event
Inflow = 2.50 cfs @ 12.07 hrs, Volume= 0.188 af
Outflow = 2.50 cfs @ 12.07 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min
Primary = 2.50 cfs @ 12.07 hrs, Volume= 0.188 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.34 hrs
Flood Elev= 55.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.40'	**12.0" Round Culvert**

L= 37.0' CPP, square edge headwall, Ke= 0.500
Inlet / Outlet Invert= 51.40' / 51.20' S= 0.0054 '/' Cc= 0.900
n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.70 cfs @ 12.07 hrs HW=53.92' TW=53.72' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 1.70 cfs @ 2.17 fps)

Summary for Pond 7P: PYD105

Inflow Area =	0.136 ac,	0.00% Impervious, Inflow Depth >	2.30"	for 10 Year event
Inflow =	0.36 cfs @	12.08 hrs, Volume=	0.026 af	
Outflow =	0.36 cfs @	12.08 hrs, Volume=	0.026 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.36 cfs @	12.08 hrs, Volume=	0.026 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.30' @ 12.09 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	55.00'	**12.0" Round Culvert** L= 127.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 55.00' / 51.80' S= 0.0252 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.32 cfs @ 12.08 hrs HW=55.29' TW=54.20' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.32 cfs @ 2.53 fps)

Summary for Pond 8P: PDMH101

[80] Warning: Exceeded Pond 4P by 0.16' @ 12.10 hrs (2.37 cfs 0.010 af)
[80] Warning: Exceeded Pond 47P by 0.67' @ 12.05 hrs (2.53 cfs 0.022 af)

Inflow Area =	1.634 ac,	51.65% Impervious, Inflow Depth >	4.00"	for 10 Year event
Inflow =	7.40 cfs @	12.07 hrs, Volume=	0.545 af	
Outflow =	7.40 cfs @	12.07 hrs, Volume=	0.545 af,	Atten= 0%, Lag= 0.0 min
Primary =	7.40 cfs @	12.07 hrs, Volume=	0.545 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.78' @ 12.14 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	48.60'	**15.0" Round Culvert** L= 95.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.60' / 48.15' S= 0.0047 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=5.04 cfs @ 12.07 hrs HW=52.17' TW=51.19' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 5.04 cfs @ 4.11 fps)

Summary for Pond 9P: PCB201

[80] Warning: Exceeded Pond 10P by 3.18' @ 15.30 hrs (6.19 cfs 2.217 af)

Inflow Area =	0.218 ac,	93.86% Impervious,	Inflow Depth > 5.17"	for 10 Year event
Inflow =	1.18 cfs @	12.07 hrs, Volume=	0.094 af	
Outflow =	1.18 cfs @	12.07 hrs, Volume=	0.094 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.18 cfs @	12.07 hrs, Volume=	0.094 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.25 hrs
Flood Elev= 56.65'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.70'	**12.0" Round Culvert** L= 166.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.70' / 50.85' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.69 cfs @ 12.07 hrs HW=53.41' TW=53.33' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.69 cfs @ 0.88 fps)

Summary for Pond 10P: PCB200

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=101)

Inflow Area =	0.063 ac,	78.88% Impervious,	Inflow Depth > 4.77"	for 10 Year event
Inflow =	0.33 cfs @	12.07 hrs, Volume=	0.025 af	
Outflow =	0.33 cfs @	12.07 hrs, Volume=	0.025 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.33 cfs @	12.07 hrs, Volume=	0.025 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.35 hrs
Flood Elev= 56.65'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.90'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.90' / 51.80' S= 0.0056 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=53.02' TW=53.41' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 11P: PDMH200

[80] Warning: Exceeded Pond 17P by 0.03' @ 12.00 hrs (0.18 cfs 0.001 af)

Inflow Area = 2.211 ac, 67.97% Impervious, Inflow Depth > 4.21" for 10 Year event
Inflow = 9.82 cfs @ 12.00 hrs, Volume= 0.776 af
Outflow = 9.82 cfs @ 12.00 hrs, Volume= 0.776 af, Atten= 0%, Lag= 0.0 min
Primary = 9.82 cfs @ 12.00 hrs, Volume= 0.776 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.33' @ 12.00 hrs
Flood Elev= 60.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.25'	**18.0" Round Culvert** L= 81.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 53.25' / 51.30' S= 0.0241 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=9.69 cfs @ 12.00 hrs HW=55.30' TW=53.39' (Dynamic Tailwater)
1=Culvert (Inlet Controls 9.69 cfs @ 5.48 fps)

Summary for Pond 12P: PCB203

[80] Warning: Exceeded Pond 13P by 0.44' @ 12.05 hrs (2.52 cfs 0.178 af)

Inflow Area = 0.345 ac, 48.31% Impervious, Inflow Depth > 3.92" for 10 Year event
Inflow = 1.57 cfs @ 12.07 hrs, Volume= 0.113 af
Outflow = 1.57 cfs @ 12.07 hrs, Volume= 0.113 af, Atten= 0%, Lag= 0.0 min
Primary = 1.57 cfs @ 12.07 hrs, Volume= 0.113 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.34 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.55'	**12.0" Round Culvert** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.55' / 51.30' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=53.71' TW=53.72' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 13P: PCB202

Inflow Area = 0.210 ac, 43.41% Impervious, Inflow Depth > 3.80" for 10 Year event
Inflow = 0.93 cfs @ 12.07 hrs, Volume= 0.067 af
Outflow = 0.93 cfs @ 12.07 hrs, Volume= 0.067 af, Atten= 0%, Lag= 0.0 min
Primary = 0.93 cfs @ 12.07 hrs, Volume= 0.067 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.08' @ 15.39 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.75'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.75' / 51.65' S= 0.0056 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=53.34' TW=53.71' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 14P: PDMH302

[80] Warning: Exceeded Pond 20P by 1.72' @ 12.10 hrs (4.96 cfs 0.033 af)
[80] Warning: Exceeded Pond 28P by 0.91' @ 12.10 hrs (2.70 cfs 0.011 af)

Inflow Area = 0.511 ac, 60.43% Impervious, Inflow Depth > 4.29" for 10 Year event
Inflow = 2.46 cfs @ 12.07 hrs, Volume= 0.183 af
Outflow = 2.46 cfs @ 12.07 hrs, Volume= 0.183 af, Atten= 0%, Lag= 0.0 min
Primary = 2.46 cfs @ 12.07 hrs, Volume= 0.183 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.39' @ 12.12 hrs
Flood Elev= 53.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.35'	**18.0" Round Culvert** L= 137.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.35' / 48.65' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=51.28' TW=52.05' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 17P: PYD201

[80] Warning: Exceeded Pond 19P by 0.14' @ 12.05 hrs (0.84 cfs 0.003 af)

Inflow Area = 0.759 ac, 6.75% Impervious, Inflow Depth > 2.05" for 10 Year event
Inflow = 1.58 cfs @ 12.13 hrs, Volume= 0.130 af
Outflow = 1.58 cfs @ 12.13 hrs, Volume= 0.130 af, Atten= 0%, Lag= 0.0 min
Primary = 1.58 cfs @ 12.13 hrs, Volume= 0.130 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.72' @ 12.07 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	54.65'	**12.0" Round Culvert** L= 254.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 54.65' / 53.35' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.70 cfs @ 12.13 hrs HW=55.58' TW=54.54' (Dynamic Tailwater)
└—**1=Culvert** (Outlet Controls 1.70 cfs @ 2.91 fps)

Summary for Pond 18P: PCB303

Inflow Area =	0.150 ac, 89.30% Impervious,	Inflow Depth > 4.99"	for 10 Year event	
Inflow =	0.81 cfs @	12.07 hrs, Volume=	0.062 af	
Outflow =	0.81 cfs @	12.07 hrs, Volume=	0.062 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.81 cfs @	12.07 hrs, Volume=	0.062 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.71' @ 12.07 hrs
Flood Elev= 52.25'

Device	Routing	Invert	Outlet Devices
#1	Primary	48.25'	**12.0" Round Culvert** L= 23.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.25' / 47.00' S= 0.0543 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.78 cfs @ 12.07 hrs HW=48.70' TW=48.24' (Dynamic Tailwater)
└—**1=Culvert** (Inlet Controls 0.78 cfs @ 2.28 fps)

Summary for Pond 19P: PYD200

Inflow Area =	0.498 ac, 8.80% Impervious,	Inflow Depth > 2.05"	for 10 Year event	
Inflow =	1.06 cfs @	12.12 hrs, Volume=	0.085 af	
Outflow =	1.06 cfs @	12.12 hrs, Volume=	0.085 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.06 cfs @	12.12 hrs, Volume=	0.085 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.85' @ 12.12 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	55.00'	**12.0" Round Culvert** L= 23.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 55.00' / 54.75' S= 0.0109 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.26 cfs @ 12.12 hrs HW=55.80' TW=55.59' (Dynamic Tailwater)
└—**1=Culvert** (Outlet Controls 1.26 cfs @ 2.55 fps)

Summary for Pond 20P: PCB302

Inflow Area =	0.141 ac, 86.65% Impervious,	Inflow Depth > 4.99"	for 10 Year event	
Inflow =	0.76 cfs @	12.07 hrs, Volume=	0.058 af	
Outflow =	0.76 cfs @	12.07 hrs, Volume=	0.058 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.76 cfs @	12.07 hrs, Volume=	0.058 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.40' @ 12.17 hrs
Flood Elev= 53.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.50'	**12.0" Round Culvert** L= 4.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.50' / 49.45' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=50.36' TW=51.21' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 22P: PDMH300

[80] Warning: Exceeded Pond 23P by 0.56' @ 12.05 hrs (2.71 cfs 0.017 af)

Inflow Area =	2.094 ac,	98.24% Impervious,	Inflow Depth > 5.29"	for 10 Year event
Inflow =	11.48 cfs @	12.07 hrs, Volume=	0.923 af	
Outflow =	11.48 cfs @	12.07 hrs, Volume=	0.923 af,	Atten= 0%, Lag= 0.0 min
Primary =	11.48 cfs @	12.07 hrs, Volume=	0.923 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.05' @ 12.09 hrs
Flood Elev= 51.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.20'	**18.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.20' / 45.00' S= 0.0414 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=10.13 cfs @ 12.07 hrs HW=48.93' TW=47.51' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 10.13 cfs @ 5.73 fps)

Summary for Pond 23P: PCB300

Inflow Area =	0.463 ac,	92.03% Impervious,	Inflow Depth > 5.11"	for 10 Year event
Inflow =	2.51 cfs @	12.07 hrs, Volume=	0.197 af	
Outflow =	2.51 cfs @	12.07 hrs, Volume=	0.197 af,	Atten= 0%, Lag= 0.0 min
Primary =	2.51 cfs @	12.07 hrs, Volume=	0.197 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.41' @ 12.12 hrs
Flood Elev= 50.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.60'	**12.0" Round Culvert** L= 49.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.60' / 46.30' S= 0.0061 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=48.71' TW=48.93' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 25P: PDMH304

Inflow Area =	2.292 ac,	90.48% Impervious,	Inflow Depth > 5.08"	for 10 Year event
Inflow =	12.23 cfs @	12.07 hrs, Volume=	0.971 af	
Outflow =	12.23 cfs @	12.07 hrs, Volume=	0.971 af,	Atten= 0%, Lag= 0.0 min
Primary =	12.23 cfs @	12.07 hrs, Volume=	0.971 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.26' @ 12.09 hrs
Flood Elev= 51.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.60'	**24.0" Round Culvert** L= 22.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.60' / 45.00' S= 0.0727 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=10.54 cfs @ 12.07 hrs HW=48.24' TW=47.51' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 10.54 cfs @ 5.20 fps)

Summary for Pond 26P: PDMH303

[80] Warning: Exceeded Pond 14P by 1.65' @ 12.05 hrs (9.09 cfs 0.038 af)

Inflow Area =	2.142 ac,	90.57% Impervious,	Inflow Depth > 5.09"	for 10 Year event
Inflow =	11.43 cfs @	12.07 hrs, Volume=	0.909 af	
Outflow =	11.43 cfs @	12.07 hrs, Volume=	0.909 af,	Atten= 0%, Lag= 0.0 min
Primary =	11.43 cfs @	12.07 hrs, Volume=	0.909 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.32' @ 12.07 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	48.55'	**18.0" Round Culvert** L= 267.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.55' / 46.70' S= 0.0069 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=10.97 cfs @ 12.07 hrs HW=52.06' TW=48.24' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 10.97 cfs @ 6.21 fps)

Summary for Pond 28P: PDMH301

[80] Warning: Exceeded Pond 2P by 0.45' @ 12.15 hrs (1.31 cfs 0.005 af)
[80] Warning: Exceeded Pond 29P by 0.79' @ 12.15 hrs (2.94 cfs 0.012 af)

Inflow Area = 0.370 ac, 50.47% Impervious, Inflow Depth > 4.03" for 10 Year event
Inflow = 1.70 cfs @ 12.07 hrs, Volume= 0.124 af
Outflow = 1.70 cfs @ 12.07 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.07 hrs, Volume= 0.124 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.48' @ 12.16 hrs
Flood Elev= 54.45'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.55'	**12.0" Round Culvert** L= 111.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.55' / 49.45' S= 0.0099 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=51.29' TW=51.31' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 29P: PYD300

Inflow Area = 0.276 ac, 38.02% Impervious, Inflow Depth > 3.70" for 10 Year event
Inflow = 1.20 cfs @ 12.07 hrs, Volume= 0.085 af
Outflow = 1.20 cfs @ 12.07 hrs, Volume= 0.085 af, Atten= 0%, Lag= 0.0 min
Primary = 1.20 cfs @ 12.07 hrs, Volume= 0.085 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.49' @ 12.21 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.00'	**12.0" Round Culvert** L= 65.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.00' / 50.65' S= 0.0054 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.03 cfs @ 12.07 hrs HW=51.67' TW=51.29' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.03 cfs @ 2.61 fps)

Summary for Pond 30P: PYD106

Inflow Area = 0.284 ac, 27.31% Impervious, Inflow Depth > 3.50" for 10 Year event
Inflow = 1.16 cfs @ 12.08 hrs, Volume= 0.083 af
Outflow = 1.16 cfs @ 12.08 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.16 cfs @ 12.08 hrs, Volume= 0.083 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 52.74' @ 12.23 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.75'	**12.0" Round Culvert** L= 112.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.75' / 51.15' S= 0.0054 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.67 cfs @ 12.08 hrs HW=52.51' TW=52.35' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.67 cfs @ 1.46 fps)

Summary for Pond 34P: PCB115

[80] Warning: Exceeded Pond 35P by 2.04' @ 14.55 hrs (4.68 cfs 1.747 af)

Inflow Area = 0.103 ac,100.00% Impervious, Inflow Depth > 5.34" for 10 Year event
Inflow = 0.57 cfs @ 12.07 hrs, Volume= 0.046 af
Outflow = 0.57 cfs @ 12.07 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.07 hrs, Volume= 0.046 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.64' @ 12.34 hrs
Flood Elev= 49.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.15'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 43.15' / 43.00' S= 0.0052 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=45.71' TW=46.05' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 35P: PCB114

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=105)

Inflow Area = 0.054 ac,100.00% Impervious, Inflow Depth > 5.34" for 10 Year event
Inflow = 0.30 cfs @ 12.07 hrs, Volume= 0.024 af
Outflow = 0.30 cfs @ 12.07 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min
Primary = 0.30 cfs @ 12.07 hrs, Volume= 0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.64' @ 12.39 hrs
Flood Elev= 49.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.35'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 43.35' / 43.25' S= 0.0056 '/' Cc= 0.900

n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=45.39' TW=45.71' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 38P: PDMH106

[80] Warning: Exceeded Pond 39P by 0.22' @ 12.05 hrs (11.02 cfs 0.075 af)

Inflow Area =	9.570 ac, 75.55% Impervious, Inflow Depth > 4.67" for 10 Year event			
Inflow =	45.65 cfs @	12.06 hrs, Volume=	3.727 af	
Outflow =	45.65 cfs @	12.06 hrs, Volume=	3.727 af,	Atten= 0%, Lag= 0.0 min
Primary =	45.65 cfs @	12.06 hrs, Volume=	3.727 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.45' @ 12.09 hrs
Flood Elev= 49.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.10'	**36.0" Round Culvert** L= 13.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 43.10' / 43.00' S= 0.0077 '/' Cc= 0.900 n= 0.013, Flow Area= 7.07 sf

Primary OutFlow Max=39.66 cfs @ 12.06 hrs HW=47.35' TW=45.99' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 39.66 cfs @ 5.61 fps)

Summary for Pond 39P: PCB111

Inflow Area =	4.258 ac, 71.01% Impervious, Inflow Depth > 4.54" for 10 Year event			
Inflow =	20.42 cfs @	12.07 hrs, Volume=	1.610 af	
Outflow =	20.42 cfs @	12.07 hrs, Volume=	1.610 af,	Atten= 0%, Lag= 0.0 min
Primary =	20.42 cfs @	12.07 hrs, Volume=	1.610 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.07' @ 12.12 hrs
Flood Elev= 49.40'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**30.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 44.00' S= 0.0800 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf

Primary OutFlow Max=9.48 cfs @ 12.07 hrs HW=47.54' TW=47.37' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 9.48 cfs @ 1.93 fps)

Summary for Pond 40P: PYD104

Inflow Area = 4.012 ac, 69.23% Impervious, Inflow Depth > 4.49" for 10 Year event
Inflow = 19.07 cfs @ 12.07 hrs, Volume= 1.501 af
Outflow = 19.07 cfs @ 12.07 hrs, Volume= 1.501 af, Atten= 0%, Lag= 0.0 min
Primary = 19.07 cfs @ 12.07 hrs, Volume= 1.501 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.85' @ 12.14 hrs
Flood Elev= 51.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.60'	**24.0" Round Culvert** L= 46.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.60' / 44.50' S= 0.0239 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=13.36 cfs @ 12.07 hrs HW=48.32' TW=47.54' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 13.36 cfs @ 4.25 fps)

Summary for Pond 41P: PDMH103

[80] Warning: Exceeded Pond 42P by 0.72' @ 12.05 hrs (3.20 cfs 0.056 af)

Inflow Area = 3.709 ac, 72.84% Impervious, Inflow Depth > 4.57" for 10 Year event
Inflow = 18.23 cfs @ 12.07 hrs, Volume= 1.412 af
Outflow = 18.23 cfs @ 12.07 hrs, Volume= 1.412 af, Atten= 0%, Lag= 0.0 min
Primary = 18.23 cfs @ 12.07 hrs, Volume= 1.412 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.42' @ 12.11 hrs
Flood Elev= 53.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.20'	**24.0" Round Culvert** L= 95.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.20' / 45.70' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=14.28 cfs @ 12.07 hrs HW=49.19' TW=48.30' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 14.28 cfs @ 4.55 fps)

Summary for Pond 42P: PCB113

[80] Warning: Exceeded Pond 43P by 0.82' @ 12.10 hrs (3.42 cfs 0.055 af)

Inflow Area = 0.283 ac,100.00% Impervious, Inflow Depth > 5.34" for 10 Year event
Inflow = 1.55 cfs @ 12.07 hrs, Volume= 0.126 af
Outflow = 1.55 cfs @ 12.07 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min
Primary = 1.55 cfs @ 12.07 hrs, Volume= 0.126 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.49' @ 12.16 hrs
Flood Elev= 53.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.45'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.45' / 46.30' S= 0.0075 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=48.66' TW=49.18' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 43P: PCB112

Inflow Area =	0.166 ac,100.00% Impervious,	Inflow Depth > 5.34"	for 10 Year event	
Inflow =	0.91 cfs @	12.07 hrs, Volume=	0.074 af	
Outflow =	0.91 cfs @	12.07 hrs, Volume=	0.074 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.91 cfs @	12.07 hrs, Volume=	0.074 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.50' @ 12.21 hrs
Flood Elev= 53.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.65'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.65' / 46.55' S= 0.0056 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=48.05' TW=48.66' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 44P: PDMH102

Inflow Area =	1.634 ac, 51.65% Impervious,	Inflow Depth > 4.00"	for 10 Year event	
Inflow =	7.40 cfs @	12.07 hrs, Volume=	0.545 af	
Outflow =	7.40 cfs @	12.07 hrs, Volume=	0.545 af,	Atten= 0%, Lag= 0.0 min
Primary =	7.40 cfs @	12.07 hrs, Volume=	0.545 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 51.90' @ 12.13 hrs
Flood Elev= 56.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	48.05'	**15.0" Round Culvert** L= 73.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.05' / 47.70' S= 0.0048 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=4.69 cfs @ 12.07 hrs HW=51.19' TW=50.47' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 4.69 cfs @ 3.82 fps)

Summary for Pond 46P: PYD102

Inflow Area = 0.363 ac, 38.13% Impervious, Inflow Depth > 3.40" for 10 Year event
Inflow = 1.45 cfs @ 12.08 hrs, Volume= 0.103 af
Outflow = 1.45 cfs @ 12.08 hrs, Volume= 0.103 af, Atten= 0%, Lag= 0.0 min
Primary = 1.45 cfs @ 12.08 hrs, Volume= 0.103 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 53.03' @ 12.22 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**12.0" Round Culvert** L= 15.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.40' S= 0.0400 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.14 cfs @ 12.08 hrs HW=52.71' TW=52.50' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.14 cfs @ 2.67 fps)

Summary for Pond 47P: PYD101

[80] Warning: Exceeded Pond 48P by 1.16' @ 12.10 hrs (2.64 cfs 0.024 af)

Inflow Area = 0.671 ac, 26.90% Impervious, Inflow Depth > 3.45" for 10 Year event
Inflow = 2.70 cfs @ 12.08 hrs, Volume= 0.193 af
Outflow = 2.70 cfs @ 12.08 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min
Primary = 2.70 cfs @ 12.08 hrs, Volume= 0.193 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 53.10' @ 12.17 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.10'	**12.0" Round Culvert** L= 84.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.10' / 48.70' S= 0.0048 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.08 hrs HW=51.78' TW=52.21' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 48P: PYD100

Inflow Area = 0.294 ac, 25.93% Impervious, Inflow Depth > 3.50" for 10 Year event
Inflow = 1.20 cfs @ 12.08 hrs, Volume= 0.086 af
Outflow = 1.20 cfs @ 12.08 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.0 min
Primary = 1.20 cfs @ 12.08 hrs, Volume= 0.086 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 53.16' @ 12.22 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.95'	**12.0" Round Culvert** L= 162.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.95' / 49.20' S= 0.0046 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.08 hrs HW=51.02' TW=51.78' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 57P: PYD103

Inflow Area = 1.913 ac, 47.35% Impervious, Inflow Depth > 3.85" for 10 Year event
Inflow = 8.36 cfs @ 12.07 hrs, Volume= 0.613 af
Outflow = 8.36 cfs @ 12.07 hrs, Volume= 0.613 af, Atten= 0%, Lag= 0.0 min
Primary = 8.36 cfs @ 12.07 hrs, Volume= 0.613 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 50.93' @ 12.11 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.60'	**18.0" Round Culvert** L= 242.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.60' / 46.30' S= 0.0054 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Primary OutFlow Max=6.56 cfs @ 12.07 hrs HW=50.47' TW=49.21' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 6.56 cfs @ 3.71 fps)

Summary for Pond 58P: PCB110

Inflow Area = 5.312 ac, 79.19% Impervious, Inflow Depth > 4.78" for 10 Year event
Inflow = 25.59 cfs @ 12.05 hrs, Volume= 2.117 af
Outflow = 25.59 cfs @ 12.05 hrs, Volume= 2.117 af, Atten= 0%, Lag= 0.0 min
Primary = 25.59 cfs @ 12.05 hrs, Volume= 2.117 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.24' @ 12.11 hrs
Flood Elev= 49.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.85'	**30.0" Round Culvert** L= 107.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 43.85' / 43.20' S= 0.0061 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf

Primary OutFlow Max=11.97 cfs @ 12.05 hrs HW=47.57' TW=47.31' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 11.97 cfs @ 2.44 fps)

Summary for Pond 60P: PDMH104

[80] Warning: Exceeded Pond 61P by 0.68' @ 12.10 hrs (3.11 cfs 0.088 af)

Inflow Area = 4.829 ac, 78.58% Impervious, Inflow Depth > 4.77" for 10 Year event
Inflow = 23.11 cfs @ 12.05 hrs, Volume= 1.920 af
Outflow = 23.11 cfs @ 12.05 hrs, Volume= 1.920 af, Atten= 0%, Lag= 0.0 min
Primary = 23.11 cfs @ 12.05 hrs, Volume= 1.920 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.64' @ 12.15 hrs
Flood Elev= 50.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.65'	**30.0" Round Culvert** L= 147.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.65' / 43.95' S= 0.0048 '/' Cc= 0.900 n= 0.013, Flow Area= 4.91 sf

Primary OutFlow Max=6.69 cfs @ 12.05 hrs HW=47.59' TW=47.51' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 6.69 cfs @ 1.46 fps)

Summary for Pond 61P: PCB109

Inflow Area = 0.075 ac,100.00% Impervious, Inflow Depth > 5.34" for 10 Year event
Inflow = 0.41 cfs @ 12.07 hrs, Volume= 0.034 af
Outflow = 0.41 cfs @ 12.07 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min
Primary = 0.41 cfs @ 12.07 hrs, Volume= 0.034 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.65' @ 12.20 hrs
Flood Elev= 50.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.95'	**12.0" Round Culvert** L= 38.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.95' / 44.75' S= 0.0053 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=47.37' TW=47.90' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 63P: PCB108

[80] Warning: Exceeded Pond 64P by 0.85' @ 12.00 hrs (3.50 cfs 0.031 af)

Inflow Area = 4.754 ac, 78.24% Impervious, Inflow Depth > 4.76" for 10 Year event
Inflow = 22.71 cfs @ 12.05 hrs, Volume= 1.887 af
Outflow = 22.71 cfs @ 12.05 hrs, Volume= 1.887 af, Atten= 0%, Lag= 0.0 min
Primary = 22.71 cfs @ 12.05 hrs, Volume= 1.887 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.47' @ 12.06 hrs
Flood Elev= 51.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.20'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.20' / 44.75' S= 0.0259 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=20.45 cfs @ 12.05 hrs HW=49.42' TW=47.59' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 20.45 cfs @ 6.51 fps)

Summary for Pond 64P: PCB107

Inflow Area = 0.271 ac, 53.08% Impervious, Inflow Depth > 4.11" for 10 Year event
Inflow = 1.29 cfs @ 12.07 hrs, Volume= 0.093 af
Outflow = 1.29 cfs @ 12.07 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.0 min
Primary = 1.29 cfs @ 12.07 hrs, Volume= 0.093 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 49.57' @ 12.11 hrs
Flood Elev= 51.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.20'	**12.0" Round Culvert** L= 23.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.20' / 46.30' S= 0.0391 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=49.33' TW=49.38' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 66P: PDMH103

Inflow Area = 4.080 ac, 80.81% Impervious, Inflow Depth > 4.83" for 10 Year event
Inflow = 19.54 cfs @ 12.04 hrs, Volume= 1.641 af
Outflow = 19.54 cfs @ 12.04 hrs, Volume= 1.641 af, Atten= 0%, Lag= 0.0 min
Primary = 19.54 cfs @ 12.04 hrs, Volume= 1.641 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 51.18' @ 12.07 hrs
Flood Elev= 54.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.10'	**24.0" Round Culvert** L= 159.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.10' / 46.30' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=16.76 cfs @ 12.04 hrs HW=50.90' TW=49.36' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 16.76 cfs @ 5.33 fps)

Summary for Pond 68P: PCB106

[80] Warning: Exceeded Pond 71P by 0.74' @ 12.10 hrs (3.24 cfs 0.049 af)

Inflow Area = 2.566 ac, 69.49% Impervious, Inflow Depth > 4.52" for 10 Year event
Inflow = 12.70 cfs @ 12.07 hrs, Volume= 0.967 af
Outflow = 12.70 cfs @ 12.07 hrs, Volume= 0.967 af, Atten= 0%, Lag= 0.0 min
Primary = 12.70 cfs @ 12.07 hrs, Volume= 0.967 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 51.97' @ 12.10 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.00'	**24.0" Round Culvert** L= 178.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.00' / 47.20' S= 0.0101 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=9.30 cfs @ 12.07 hrs HW=51.50' TW=51.03' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 9.30 cfs @ 3.04 fps)

Summary for Pond 71P: PCB105

Inflow Area = 0.230 ac, 59.44% Impervious, Inflow Depth > 4.33" for 10 Year event
Inflow = 1.13 cfs @ 12.07 hrs, Volume= 0.083 af
Outflow = 1.13 cfs @ 12.07 hrs, Volume= 0.083 af, Atten= 0%, Lag= 0.0 min
Primary = 1.13 cfs @ 12.07 hrs, Volume= 0.083 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.01' @ 12.15 hrs
Flood Elev= 54.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.20'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.20' / 49.10' S= 0.0056 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=50.85' TW=51.51' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 74P: PCB104

[80] Warning: Exceeded Pond 75P by 0.16' @ 12.05 hrs (1.51 cfs 0.018 af)

Inflow Area = 2.093 ac, 71.70% Impervious, Inflow Depth > 4.57" for 10 Year event
Inflow = 10.37 cfs @ 12.07 hrs, Volume= 0.797 af
Outflow = 10.37 cfs @ 12.07 hrs, Volume= 0.797 af, Atten= 0%, Lag= 0.0 min
Primary = 10.37 cfs @ 12.07 hrs, Volume= 0.797 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.63' @ 12.13 hrs
Flood Elev= 57.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	50.85'	**24.0" Round Culvert** L= 226.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 50.85' / 49.10' S= 0.0077 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf

Primary OutFlow Max=7.50 cfs @ 12.07 hrs HW=52.43' TW=51.50' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 7.50 cfs @ 3.87 fps)

Summary for Pond 75P: PCB103

Inflow Area = 0.355 ac, 32.64% Impervious, Inflow Depth > 3.62" for 10 Year event
Inflow = 1.51 cfs @ 12.07 hrs, Volume= 0.107 af
Outflow = 1.51 cfs @ 12.07 hrs, Volume= 0.107 af, Atten= 0%, Lag= 0.0 min
Primary = 1.51 cfs @ 12.07 hrs, Volume= 0.107 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 52.69' @ 12.18 hrs
Flood Elev= 57.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.05'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.05' / 50.95' S= 0.0056 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=52.35' TW=52.44' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 77P: PCB102

[80] Warning: Exceeded Pond 78P by 1.19' @ 12.05 hrs (4.13 cfs 0.036 af)
[80] Warning: Exceeded Pond 79P by 1.00' @ 12.05 hrs (3.78 cfs 0.023 af)

Inflow Area = 0.797 ac, 60.41% Impervious, Inflow Depth > 4.20" for 10 Year event
Inflow = 3.75 cfs @ 12.07 hrs, Volume= 0.279 af
Outflow = 3.75 cfs @ 12.07 hrs, Volume= 0.279 af, Atten= 0%, Lag= 0.0 min
Primary = 3.75 cfs @ 12.07 hrs, Volume= 0.279 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 54.32' @ 12.09 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.70'	**12.0" Round Culvert** L= 143.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.70' / 50.95' S= 0.0052 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.38 cfs @ 12.07 hrs HW=54.15' TW=52.43' (Dynamic Tailwater)
1=Culvert (Outlet Controls 3.38 cfs @ 4.31 fps)

Summary for Pond 78P: PCB 101

Inflow Area = 0.100 ac, 64.01% Impervious, Inflow Depth > 4.33" for 10 Year event
Inflow = 0.49 cfs @ 12.07 hrs, Volume= 0.036 af
Outflow = 0.49 cfs @ 12.07 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min
Primary = 0.49 cfs @ 12.07 hrs, Volume= 0.036 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 54.33' @ 12.14 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	51.95'	**12.0" Round Culvert** L= 23.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 51.95' / 51.80' S= 0.0065 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=53.39' TW=54.15' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 79P: PCB100

Inflow Area = 0.313 ac, 69.93% Impervious, Inflow Depth > 4.54" for 10 Year event
Inflow = 1.59 cfs @ 12.07 hrs, Volume= 0.118 af
Outflow = 1.59 cfs @ 12.07 hrs, Volume= 0.118 af, Atten= 0%, Lag= 0.0 min
Primary = 1.59 cfs @ 12.07 hrs, Volume= 0.118 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 54.42' @ 12.13 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	52.00'	**12.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 52.00' / 51.80' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.07 hrs HW=53.55' TW=54.15' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond POND 1.0: GRAVEL WETLAND 1

[95] Warning: Outlet Device #4 rise exceeded
[80] Warning: Exceeded Pond 34P by 1.89' @ 19.00 hrs (4.13 cfs 0.724 af)

Inflow Area = 10.514 ac, 71.49% Impervious, Inflow Depth > 4.56" for 10 Year event
Inflow = 49.36 cfs @ 12.06 hrs, Volume= 3.997 af
Outflow = 20.28 cfs @ 12.29 hrs, Volume= 2.964 af, Atten= 59%, Lag= 13.5 min
Primary = 18.13 cfs @ 12.29 hrs, Volume= 2.928 af
Secondary = 2.15 cfs @ 12.29 hrs, Volume= 0.036 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.64' @ 12.29 hrs Surf.Area= 20,982 sf Storage= 80,593 cf
Flood Elev= 48.00' Surf.Area= 23,557 sf Storage= 110,845 cf

Plug-Flow detention time= 199.6 min calculated for 2.964 af (74% of inflow)
Center-of-Mass det. time= 111.5 min (880.1 - 768.5)

Volume	Invert	Avail.Storage	Storage Description
#1	39.05'	110,845 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
39.05	9,855	0.0	0	0
41.35	9,855	30.0	6,800	6,800
42.00	9,855	45.0	2,883	9,683
43.00	11,943	100.0	10,899	20,582
44.00	14,202	100.0	13,073	33,654
45.00	16,891	100.0	15,547	49,201
46.00	19,752	100.0	18,322	67,522
47.00	21,668	100.0	20,710	88,232
48.00	23,557	100.0	22,613	110,845

Device	Routing	Invert	Outlet Devices
#1	Primary	41.35'	**18.0" Round Culvert** L= 30.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 41.35' / 41.20' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	41.35'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	43.80'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600

#4	Device 1	45.00'	**3.0' long x 0.50' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 1	46.25'	**4.0" x 4.0" Horiz. Orifice/Grate X 106.00** C= 0.600 Limited to weir flow at low heads
#6	Secondary	46.50'	**15.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=18.13 cfs @ 12.29 hrs HW=46.64' TW=38.83' (Dynamic Tailwater)
1=Culvert (Inlet Controls 18.13 cfs @ 10.26 fps)
2=Orifice/Grate (Passes < 0.54 cfs potential flow)
3=Orifice/Grate (Passes < 0.78 cfs potential flow)
4=Sharp-Crested Rectangular Weir (Passes < 8.37 cfs potential flow)
5=Orifice/Grate (Passes < 35.41 cfs potential flow)

Secondary OutFlow Max=2.10 cfs @ 12.29 hrs HW=46.64' TW=38.83' (Dynamic Tailwater)
6=Broad-Crested Rectangular Weir (Weir Controls 2.10 cfs @ 1.00 fps)

Summary for Pond POND 1.1: GRAVEL WETLAND 2

[80] Warning: Exceeded Pond 1P by 0.03' @ 12.50 hrs (2.71 cfs 0.403 af)

Inflow Area = 5.125 ac, 47.00% Impervious, Inflow Depth > 3.77" for 10 Year event
Inflow = 17.35 cfs @ 12.05 hrs, Volume= 1.611 af
Outflow = 0.90 cfs @ 15.20 hrs, Volume= 0.303 af, Atten= 95%, Lag= 189.3 min
Primary = 0.90 cfs @ 15.20 hrs, Volume= 0.303 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 55.07' @ 15.20 hrs Surf.Area= 16,877 sf Storage= 57,027 cf
Flood Elev= 57.00' Surf.Area= 21,643 sf Storage= 94,743 cf

Plug-Flow detention time= 551.1 min calculated for 0.302 af (19% of inflow)
Center-of-Mass det. time= 328.5 min (1,113.1 - 784.6)

Volume	Invert	Avail.Storage	Storage Description
#1	47.55'	117,304 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.55	6,269	0.0	0	0
49.85	6,269	30.0	4,326	4,326
50.50	6,269	45.0	1,834	6,159
51.00	7,199	100.0	3,367	9,526
52.00	9,187	100.0	8,193	17,719
53.00	11,345	100.0	10,266	27,985
54.00	13,814	100.0	12,580	40,565
55.00	16,645	100.0	15,230	55,794
56.00	19,805	100.0	18,225	74,019
58.00	23,480	100.0	43,285	117,304

Device	Routing	Invert	Outlet Devices
#1	Primary	49.85'	**24.0" Round Culvert** L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 49.85' / 49.45' S= 0.0333 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	49.85'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	53.50'	**4.0' long x 2.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Device 1	56.50'	**4.0" W x 4.0" H Vert. Orifice/Grate X 106.00** C= 0.600

Primary OutFlow Max=0.90 cfs @ 15.20 hrs HW=55.07' TW=55.07' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.90 cfs @ 0.29 fps)
  ├─**2=Orifice/Grate** (Passes < 0.01 cfs potential flow)
  ├─**3=Sharp-Crested Rectangular Weir** (Passes < 1.69 cfs potential flow)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond POND 1.2: PDMH203

Inflow Area = 7.164 ac, 52.93% Impervious, Inflow Depth > 1.77" for 10 Year event
Inflow = 9.84 cfs @ 12.09 hrs, Volume= 1.056 af
Outflow = 9.84 cfs @ 12.09 hrs, Volume= 1.056 af, Atten= 0%, Lag= 0.0 min
Primary = 9.84 cfs @ 12.09 hrs, Volume= 1.056 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 50.54' @ 12.09 hrs
Flood Elev= 57.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	49.35'	**54.0" Round Culvert** L= 269.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 49.35' / 48.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 15.90 sf

Primary OutFlow Max=9.68 cfs @ 12.09 hrs HW=50.53' TW=48.71' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 9.68 cfs @ 2.92 fps)

Summary for Pond POND 1.3: OUTLET CULVERTS

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=3)
[62] Hint: Exceeded Reach REACH 1.3 OUTLET depth by 2.51' @ 23.95 hrs

Inflow Area = 29.655 ac, 57.61% Impervious, Inflow Depth > 2.96" for 10 Year event
Inflow = 39.54 cfs @ 12.42 hrs, Volume= 7.304 af
Outflow = 39.48 cfs @ 12.46 hrs, Volume= 7.015 af, Atten= 0%, Lag= 2.6 min
Primary = 39.48 cfs @ 12.46 hrs, Volume= 7.015 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 38.86' @ 12.46 hrs Surf.Area= 9,326 sf Storage= 14,433 cf
Flood Elev= 42.00' Surf.Area= 67,909 sf Storage= 110,415 cf

Plug-Flow detention time= 32.5 min calculated for 7.015 af (96% of inflow)

Center-of-Mass det. time= 11.8 min (892.4 - 880.6)

Volume	Invert	Avail.Storage	Storage Description
#1	35.00'	110,415 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
35.00	960	0	0
36.00	1,428	1,194	1,194
38.00	5,472	6,900	8,094
40.00	14,470	19,942	28,036
42.00	67,909	82,379	110,415

Device	Routing	Invert	Outlet Devices
#1	Primary	35.60'	**42.0" W x 29.0" H, R=21.5"/66.1" Pipe Arch CMP_Arch_1/2 42x29 X 3.00** L= 68.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 35.60' / 35.30' S= 0.0044 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 6.72 sf
#2	Secondary	42.00'	**285.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83

Primary OutFlow Max=39.46 cfs @ 12.46 hrs HW=38.86' TW=38.65' (Dynamic Tailwater)
└─**1=CMP_Arch_1/2 42x29** (Outlet Controls 39.46 cfs @ 1.96 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=35.00' TW=38.65' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond POND 1.4: RAINGARDEN 1.0

Inflow Area = 4.931 ac, 85.08% Impervious, Inflow Depth > 4.93" for 10 Year event
Inflow = 25.59 cfs @ 12.07 hrs, Volume= 2.027 af
Outflow = 6.74 cfs @ 12.42 hrs, Volume= 1.427 af, Atten= 74%, Lag= 21.2 min
Primary = 6.74 cfs @ 12.42 hrs, Volume= 1.427 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.17' @ 12.42 hrs Surf.Area= 14,596 sf Storage= 46,096 cf
Flood Elev= 50.00' Surf.Area= 17,530 sf Storage= 75,568 cf

Plug-Flow detention time= 244.9 min calculated for 1.424 af (70% of inflow)
Center-of-Mass det. time= 151.5 min (907.4 - 755.9)

Volume	Invert	Avail.Storage	Storage Description
#1	42.17'	75,568 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
42.17	10,217	0.0	0	0
43.50	10,217	40.0	5,435	5,435
45.00	10,217	10.0	1,533	6,968
46.00	11,532	100.0	10,875	17,842
48.00	14,332	100.0	25,864	43,706
50.00	17,530	100.0	31,862	75,568

Device	Routing	Invert	Outlet Devices
#1	Primary	42.42'	**12.0" Round Culvert** L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.42' / 42.20' S= 0.0046 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	42.42'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Device 2	45.00'	**10.000 in/hr Exfiltration over Surface area above 45.00'** Excluded Surface area = 10,217 sf
#4	Device 1	47.20'	**13.2" x 13.2" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	49.35'	**3.0' long x 8.9' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

Primary OutFlow Max=6.73 cfs @ 12.42 hrs HW=48.16' TW=38.86' (Dynamic Tailwater)
└─**1=Culvert** (Passes 6.73 cfs of 6.84 cfs potential flow)
  ├─**2=Orifice/Grate** (Passes 1.01 cfs of 2.22 cfs potential flow)
  │ └─**3=Exfiltration** (Exfiltration Controls 1.01 cfs)
  └─**4=Orifice/Grate** (Orifice Controls 5.72 cfs @ 4.73 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=42.17' TW=35.00' (Dynamic Tailwater)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link LINK 1.0: PDMH203 TAILWATER

This link takes into account the tailwater condition in PDMH203 which the outlet of gravel wetland 2 connects. The purpose of this is to determine the effects of any surcharging caused by the tailwater of Hodgson Brook entering the structure. These tailwater elevations were determined by Streamworks, PLLC as part of the overall watershed analysis they performed. These findings are discussed in the seperate memo prepared by Streamworks, PLLC.

[80] Warning: Exceeded Pond POND 1.1 by 7.52' @ 0.00 hrs (23.95 cfs 26.327 af)

Inflow Area = 5.125 ac, 47.00% Impervious, Inflow Depth > 0.71" for 10 Year event
Inflow = 0.90 cfs @ 15.20 hrs, Volume= 0.303 af
Primary = 0.90 cfs @ 15.20 hrs, Volume= 0.303 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

10 Year 25 Point manual elevation table, To= 0.00 hrs, dt= 1.00 hrs, feet =

55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07
55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07	55.07
55.07	55.07	55.07	55.07	55.07	55.07	55.07		

Summary for Link PA1: POINT OF ANALYSIS

This link takes into account the tailwater condition in roadside swale along Goose Bay Drive which the existing culverts discharge into. These tailwater elevations were determined by Streamworks, PLLC as part of the overall watershed analysis they performed. These findings are discussed in the seperate memo prepared by Streamworks, PLLC.

---

[80] Warning: Exceeded Pond POND 1.3 by 3.65' @ 0.00 hrs (92.51 cfs 84.249 af)

Inflow Area = 29.655 ac, 57.61% Impervious, Inflow Depth > 2.84" for 10 Year event
Inflow = 39.48 cfs @ 12.46 hrs, Volume= 7.015 af
Primary = 39.48 cfs @ 12.46 hrs, Volume= 7.015 af, Atten= 0%, Lag= 0.0 min

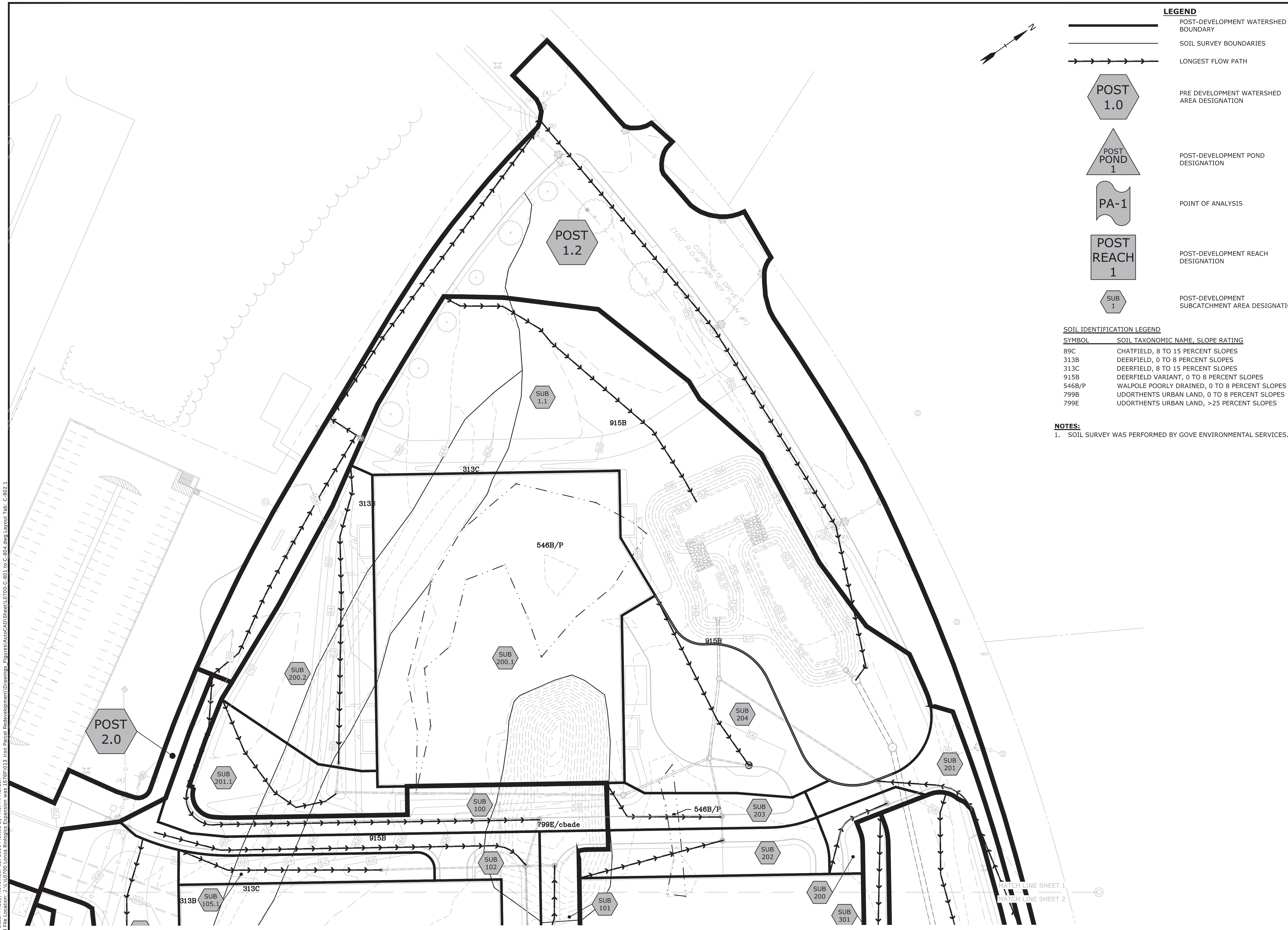
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

10 Year 2 Point manual elevation table, To= 0.00 hrs, dt= 24.00 hrs, feet =
38.65 38.65

Summary for Link PA2: POINT OF ANALYSIS

Inflow Area = 0.094 ac, 97.28% Impervious, Inflow Depth > 5.22" for 10 Year event
Inflow = 0.51 cfs @ 12.07 hrs, Volume= 0.041 af
Primary = 0.51 cfs @ 12.07 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



Last Save Date: November 2, 2018 10:33 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-802.1

Tighe&Bond
Engineers | Environmental Specialists

Proposed Industrial Development

Lonza Biologics

Portsmouth,
New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT SUBCATCHMENT AREA PLAN

SCALE: AS SHOWN

C-802.1

SCALE IN FEET
0 40' 80'
GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT SUBCATCHMENT AREA PLAN

SCALE: AS SHOWN

C-802.2

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Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT SUBCATCHMENT AREA PLAN

SCALE: AS SHOWN

C-802.3

Last Save Date: November 2, 2018 10:33 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576\F1013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-802.3

7.4 Peak Rate Comparisons

The following table summarizes and compares the pre- and post-development peak runoff rates for the 2-year, 10-year, 25-year and 50-year storm events at each point of analysis. The pre-development 1-year storm event is also included for channel protection requirements.

TABLE 7.4.1

Point of Analysis	Pre 1-Year Storm (cfs)	Pre/**Post** 2-Year Storm (cfs)	Pre/**Post** 10-Year Storm (cfs)	Pre/**Post** 25-Year Storm (cfs)	Pre/**Post** 50-Year Storm (cfs)
PA1	16.59	24.86/**10.56**	52.70/**39.42**	76.06/**64.95**	98.56/**82.00**
PA2	3.38	4.41/**3.04**	7.49/**5.34**	9.90/**7.13**	12.13/**8.79**

As depicted in Table 7.4.1, post-development peak runoff rates are less than the pre-development condition for PA1 and PA2.

7.5 Mitigation Description

7.5.1 Mitigation Calculations

The proposed project area has been evaluated to provide the required water quality volume (WQV) per the requirements of Env-Wq 1500. These calculations have been provided in Section 6. The water quality volumes (WQV) have been provided below outlets.

7.5.2 Pre-Treatment Methods for Protecting Water Quality

Pre-treatment for the two (2) proposed gravel wetlands is provided by a sediment forebay. Pre-treatment for the raingarden consists of deep sump catchbasins.

7.5.3 Treatment Methods for Protecting Water Quality

Treatment for the increased impervious area comes from one rain gardens/bio-retention basins and two gravel wetlands.

The BMP Worksheets for each treatment practice have been included in Section 6 of this report.

Section 8
Rip Rap Calculations

Tighe&Bond

Engineers | Environmental Specialists

Project:	Lonza Biologics
Location:	Portsmouth, NH
T&B #:	L-0700-13
Calculations By:	NAH
Checked By:	PMC
Date:	8/21/2018

APRON DESIGN

Terms: HW100

length of apron (ft.)	L_a	
discharge from pipe (cfs)	Q	(25 YR STORM EVENT)
pipe dia. or channel width (ft.)	Do	
tailwater depth (ft.)	T_w	
width of apron (at outlet)(ft)	W1	
width of apron (downstream)(ft)	W2	
median stone diameter (ft.)	d_{50}	

Equations Used:

Length of Apron (L_a)

when Tw < .5*Do $L_a = \frac{1.8(Q)}{Do^{(3/2)}} + 7Do$

when Tw >= .5*Do $L_a = \frac{3(Q)}{Do^{(3/2)}} + 7Do$

Width of Apron (W1)

W1= 3Do

Width of Apron (W2)

when Tw < .5*Do W2= 3Do + La

when Tw >= .5*Do W2= 3Do + 0.4La

Median Diameter $d_{50} = \frac{0.02 * Q^{(1.3)}}{(Tw * Do)}$

Input:

Q (cfs)	18.76	cfs
Do (ft.)	1.50	ft
T_w (ft.)	0.60	ft

Output:

Width of Apron (W1)	5	ft.
Width of Apron (W2)	33	ft.
Length of Apron (L_a)	29	ft.
Median Diameter	1.00	ft.
Riprap min. depth	2.26	ft.

Engineers | Environmental Specialists

Project:	Lonza Biologics
Location:	Portsmouth, NH
T&B #:	L-0700-013
Calculations By:	NAH
Checked By:	PMC
Date:	8/21/2018

PLUNGE POOL DESIGN

Terms: HW200

length of pool base (ft.)	L_a	
discharge from pipe (cfs)	Q	(25 YR STORM EVENT)
pipe dia. or channel width (ft.)	Do	
tailwater depth (ft.)	T_w	
width of pool base (at outlet)(ft)	W1	
median stone diameter (ft.)	d_{50}	

Equations Used:

Length of Apron (L_a)

when Tw < .5*Do $\quad L_a = \dfrac{1.8(Q)}{Do^{(3/2)}} + 7Do$

when Tw >= .5*Do $\quad L_a = \dfrac{3(Q)}{Do^{(3/2)}} + 7Do$

Width of Apron (W1)

W1= 3Do

Width of Apron (W2)

when Tw < .5*Do $\quad$ W2= 3Do + La

when Tw >= .5*Do $\quad$ W2= 3Do + 0.4La

Median Diameter $\quad d_{50} = \dfrac{0.02 * Q^{(1.3)}}{(Tw * Do)}$

Input:

Q (cfs)	43.71	cfs
Do (ft.)	4.50	ft
T_w (ft.)	1.80	ft

Output:

Width of Pool Base (W1)	9	ft.
Length of Pool Base (L_a)	14	ft.
Median Diameter	0.50	ft.
Riprap min. depth	1.13	ft.
Depth of Pool (S)	2.25	ft.

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Project:	Lonza Biologics
Location:	Portsmouth, NH
T&B #:	L-0700-13
Calculations By:	NAH
Checked By:	PMC
Date:	8/21/2018

APRON DESIGN

Terms: FES300

length of apron (ft.)	L_a	
discharge from pipe (cfs)	Q	(25 YR STORM EVENT)
pipe dia. or channel width (ft.)	Do	
tailwater depth (ft.)	T_w	
width of apron (at outlet)(ft)	W1	
width of apron (downstream)(ft)	W2	
median stone diameter (ft.)	d_{50}	

Equations Used:

Length of Apron (L_a)

when Tw < .5*Do $L_a = \frac{1.8(Q)}{Do^{(3/2)}} + 7Do$

when Tw >= .5*Do $L_a = \frac{3(Q)}{Do^{(3/2)}} + 7Do$

Width of Apron (W1)

W1= 3Do

Width of Apron (W2)

when Tw < .5*Do W2= 3Do + La

when Tw >= .5*Do W2= 3Do + 0.4La

Median Diameter $d_{50} = \frac{0.02 * Q^{(1.3)}}{(Tw * Do)}$

Input:

Q (cfs)	12.67	cfs
Do (ft.)	1.50	ft
T_w (ft.)	0.60	ft

Output:

Width of Apron (W1)	5	ft.
Width of Apron (W2)	27	ft.
Length of Apron (L_a)	23	ft.
Median Diameter	0.60	ft.
Riprap min. depth	1.36	ft.

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Project:	Lonza Biologics
Location:	Portsmouth, NH
T&B #:	L-0700-13
Calculations By:	NAH
Checked By:	PMC
Date:	11/2/2018

APRON DESIGN

Terms: FES301

length of apron (ft.)	L_a	
discharge from pipe (cfs)	Q	(25 YR STORM EVENT)
pipe dia. or channel width (ft.)	Do	
tailwater depth (ft.)	T_w	
width of apron (at outlet)(ft)	W1	
width of apron (downstream)(ft)	W2	
median stone diameter (ft.)	d_{50}	

Equations Used:

Length of Apron (L_a)

when Tw < .5*Do $L_a = \frac{1.8(Q)}{Do^{(3/2)}} + 7Do$

when Tw >= .5*Do $L_a = \frac{3(Q)}{Do^{(3/2)}} + 7Do$

Width of Apron (W1)

W1= 3Do

Width of Apron (W2)

when Tw < .5*Do W2= 3Do + La

when Tw >= .5*Do W2= 3Do + 0.4La

Median Diameter $d_{50} = \frac{0.02 * Q^{(1.3)}}{(Tw * Do)}$

Input:		
Q (cfs)	13.54	cfs
Do (ft.)	2.00	ft
T_w (ft.)	0.80	ft

Output:		
Width of Apron (W1)	6	ft.
Width of Apron (W2)	29	ft.
Length of Apron (L_a)	23	ft.
Median Diameter	0.50	ft.
Riprap min. depth	1.13	ft.

Tighe&Bond

Engineers | Environmental Specialists

Project:	Lonza Biologics
Location:	Portsmouth, NH
T&B #:	L-0700-13
Calculations By:	NAH
Checked By:	PMC
Date:	8/21/2018

APRON DESIGN

Terms: FES302

length of apron (ft.)	L_a	
discharge from pipe (cfs)	Q	(25 YR STORM EVENT)
pipe dia. or channel width (ft.)	Do	
tailwater depth (ft.)	T_w	
width of apron (at outlet)(ft)	W1	
width of apron (downstream)(ft)	W2	
median stone diameter (ft.)	d_{50}	

Equations Used:

Length of Apron (L_a)

when Tw < .5*Do L_a= $\frac{1.8(Q)}{Do^{(3/2)}}$ + 7Do

when Tw >= .5*Do L_a= $\frac{3(Q)}{Do^{(3/2)}}$ + 7Do

Width of Apron (W1)

W1= 3Do

Width of Apron (W2)

when Tw < .5*Do W2= 3Do + La

when Tw >= .5*Do W2= 3Do + 0.4La

Median Diameter d_{50}= $\frac{0.02 * Q^{(1.3)}}{(Tw * Do)}$

Input:		
Q (cfs)	7.03	cfs
Do (ft.)	1.00	ft
T_w (ft.)	0.40	ft

Output:		
Width of Apron (W1)	3	ft.
Width of Apron (W2)	23	ft.
Length of Apron (L_a)	20	ft.
Median Diameter	0.63	ft.
Riprap min. depth	1.42	ft.

Section 11
Long Term Operation & Maintenance Plan

It is the intent of this Operation and Maintenance Plan to identify the areas of this site that need special attention and consideration, as well as implementing a plan to assure routine maintenance. By identifying the areas of concern as well as implementing a frequent and routine maintenance schedule the site will maintain a high quality stormwater runoff.

11.1 Contact/Responsible Party

Lonza Biologics
101 International Drive
Portsmouth, NH 03801

(Note: The contact information for the Contact/Responsible Party shall be kept current. If ownership changes, the Operation and Maintenance Plan must be transferred to the new party.)

11.2 Maintenance Items

Maintenance of the following items shall be recorded:

- Litter/Debris Removal
- Landscaping
- Catchbasin Cleaning
- Pavement Sweeping
- Gravel Wetland Maintenance
- Rain Garden Maintenance
- Stream Maintenance

The following maintenance items and schedule represent the minimum action required. Periodic site inspections shall be conducted, and all measures must be maintained in effective operating condition. The following items shall be observed during site inspection and maintenance:

- Inspect vegetated areas, particularly slopes and embankments for areas of erosion. Replant and restore as necessary
- Inspect catch basins for sediment buildup
- Inspect site for trash and debris

11.3 Chloride Management Plan

Winter Operational Guidelines

The following Chloride Management Plan is for the Lonza Biologics – Iron Parcel Redevelopment in Portsmouth, New Hampshire. The Plan includes operational guidelines including: winter operator certification requirements, weather monitoring, equipment calibration requirements, mechanical removal, and salt usage evaluation and monitoring. Due to the evolving nature of chloride management efforts, the Chlorides Management Plan will be reviewed annually, in advance of the winter season, to reflect the current management standards.

11.3.1 Background Information

The Lonza Biologics – Iron Parcel Redevelopment located within the Upper Hodgson Brook Watershed in Newington and Portsmouth, New Hampshire. The Upper Hodgson Brook is identified as a chloride-impaired waterbody.

11.3.2 Operational Guidelines – Chloride Management

All Lonza Biologics private contractors engaged at the Lonza Biologics premises for the purposes of winter operational snow removal and surface maintenance, are responsible for assisting in meeting compliance for the following protocols. Lonza Biologics private contractors are expected to minimize the effects of the use of de-icing, anti-icing and pretreatment materials by adhering to the strict guidelines outlined below.

The Lonza Biologics winter operational de-icing, anti-icing and pretreatment materials will adhere to the following protocols:

11.3.2.1 Winter Operator Certification Requirements

All private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance must be current UNHT2 Green SnowPro Certified operators or equivalent and will use only pre-approved methods for spreading abrasives on private roadways and parking lots. All private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance shall provide to Lonza Biologics management two copies of the annual UNHT2 Green SnowPro certificate or equivalent for each operator utilized on the Lonza Biologics premises. The annual UNHT2 Green SnowPro certificate or equivalent for each operator will be available on file in the Lonza Biologics Facilities Management office and be present in the vehicle/carrier at all times.

11.3.2.2 Improved Weather Monitoring

Lonza Biologics will coordinate weather information for use by winter maintenance contractors. This information in conjunction with site specific air/ground surface temperature monitoring will ensure that private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance will make more informed decisions as to when and to what extent de-icing, anti-icing and pretreatment materials are applied to private roadways, sidewalks, and parking lots.

11.3.2.3 Equipment Calibration Requirements

All equipment utilized on the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance will conform to the following calibration requirements.

11.3.2.3.1 Annual Calibration Requirements

All private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance shall provide two copies of the annual calibration report for each piece of equipment utilized on the Lonza Biologics premises. Each calibration report shall include the vehicle/carrier VIN number and the serial numbers for each component including, but not limited to, spreader control units, salt aggregate spreader equipment, brining/pre-wetting equipment, ground speed orientation unit, and air/ground surface temperature monitor. Annual calibration reports will be available on file in the Lonza Biologics Facilities Management office and be present in the vehicle/carrier at all times.

Prior to each use, each vehicle/carrier operator will perform a systems check to verify that unit settings remain within the guidelines established by the Lonza Biologics Management Team in order to accurately dispense material. All private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance will be subject to spot inspections by members of the Lonza Biologics Management Team to ensure that each vehicle/carrier is operating in a manner consistent with the guidelines set herein or State and Municipal regulations. All units will be recalibrated, and the updated calibration reports will be provided each time repairs or maintenance procedures affect the hydraulic system of the vehicle/carrier.

11.3.2.4 Increased Mechanical Removal Capabilities

All private contractors engaged at the Lonza Biologics premises will endeavor to use mechanical removal means on a more frequent basis for roadways, parking lots and sidewalks. Dedicating more manpower and equipment to increase snow removal frequencies prevents the buildup of snow and the corresponding need for de-icing, anti-icing and pretreatment materials. Shortened maintenance routes, with shorter service intervals, will be used to stay ahead of snowfall. Minimized snow and ice packing will reduce the need for abrasives, salt aggregates, and/or brining solution to restore surfaces back to bare surface states after winter precipitation events.

After storm events the Lonza Biologics management team will be responsible for having the streets swept to recapture un-melted de-icing materials, when practical.

11.3.3 Salt Usage Evaluation and Monitoring

All private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance shall provide two copies of a storm report, which includes detailed information regarding treatment areas and the use of de-icing, anti- icing and pretreatment materials applied for the removal of snow and surface maintenance on the Lonza Biologics premises. Lonza Biologics will maintain copies of Summary Documents, including copies of the Storm Reports, operator certifications, equipment used for roadway and sidewalk winter maintenance, calibration reports and amount of de-icing materials used.

11.3.4 Summary

The above-described methodologies are incorporated into the Lonza Biologics Operational Manual and are to be used to qualify and retain all private contractors engaged at the Lonza Biologics premises for the purpose of winter operational snow removal and surface maintenance. This section of the Manual, is intended to be an adaptive management document that is modified as required based on experience gained from past practices and technological advancements that reflect chloride BMP standards. All Lonza Biologics employees directly involved with winter operational activities are required to review this document and the current standard Best Management Practices published by the UNH Technology Transfer (T2) program annually. All Lonza Biologics employees directly involved with winter operational activities, and all private contractors engaged at the Lonza Biologics premises for the purposes of winter operational snow removal and surface maintenance, must be current UNHT2 Green SnowPro Certified operators or equivalent and undergo the necessary requirements to maintain this certification annually.

11.4 Overall Site Operation & Maintenance Schedule

Overall Site Operation and Maintenance Schedule		
Maintenance Item	**Frequency of Maintenance**	**Operation**
Litter/Debris Removal - Trash and debris to be removed including long the full length of the stream.	Weekly	Management Company
Pavement Sweeping - Sweep impervious areas to remove sand and litter.	Annually	Parking Lot Sweeper
Sediment Forebay - Trash and debris to be removed including at check dam. - Embankment to be mowed. - Any required maintenance shall be addressed. - Inspect sediment accumulation and clean as needed.	Periodically (At least two (2) times annually)	Management Company
Gravel wetland - Trash and debris to be removed including at outlet structure. - Embankment to be mowed. - Any required maintenance shall be addressed.	Periodically (At least two (2) times annually)	Management Company
Rain Gardens/Infiltration Basin - Trash and debris to be removed. - Any required maintenance shall be addressed.	Two (2) times annually and after any rainfall event exceeding 2.5” in a 24-hr period	Management Company
Rip Rap Aprons - Trash and debris to be removed. - Any required maintenance shall be addressed.	Annually	Management Company
Catch Basin (CB) Cleaning - CB to be cleaned of solids and oils.	Annually	Vacuum Truck

Landscaping - Landscaped islands to be maintained and mulched.	Maintained as required and mulched each Spring	Management Company

Sediment Forebay Inspection/Maintenance Requirements		
Inspection/ Maintenance	**Frequency**	**Action**
Monitor Sediment Accumulation	Annually	- Install and maintain a staff gage or other measuring devise, to indicate depth of sediment accumulation and level at which clean-out is required
Visual inspection	Annually	- Remove trash and debris as needed - Remove any woody vegetation - Inspect and repair embankments - Inspect check dam
Mowing	Periodically (At least two (2) times annually)	- Embankments shall be mowed

Gravel Wetland Inspection/Maintenance Requirements		
Inspection/ Maintenance	**Frequency**	**Action**
Inspect inlets and outlets to ensure good condition and no evidence of deterioration. Check to see if high-flow bypass is functioning.	Annually, more frequently in the first year of operation	Repair or replace any damaged structural parts, inlets and outlets. Clear or remove debris or restrictions.
Check for internal erosion, evidence of short circuiting, and animal burrows.	Annually, more frequently in the first year of operation	Soil erosion from short-circuiting or animal boroughs should be repaired when they occur.
Monitor to ensure that Gravel Wetland functions effectively after storms	Four (4) times annually (quarterly) and after any rainfall event exceeding 2.5” in a 24-hr period	- Trash and debris to be removed - Any required maintenance shall be addressed

Inspect Vegetation	Annually	- Inspect the condition of all gravel wetland vegetation -Vegetation should cover >75% of the system and should be reseeded and cared for as needed. - Prune back overgrowth - Replace dead vegetation - Remove any invasive species -Coordinate with UNH Stormwater Center for further vegetation management guidelines
Cut and remove vegetation from the Gravel Wetland System and forebay in order to maintain nitrogen removal performance.	Once every 3 years	- The vegetation should be cut and removed from the system to prevent nitrogen from cycling back into the system.
Inspect Drawdown Time - The system shall drawdown between 24 and 48-hours following a rainfall event.	Annually, more frequently in the first year of operation	- Hire qualified professional to assess the condition of the facility to determine measures required to restore the filtration function, including but not limited to removal of accumulated sediments or reconstruction of the filter.

Additional Gravel Wetland Operation and Maintenance Requirements:

- ***1st Year Post-Construction:*** Inspection frequency shall be after every storm in the first year following construction.
- Inspect to be certain system drains within 24 - 48 hours (within the design period, but also not so quickly as to minimize stormwater treatment).
- Watering plants as necessary during the first growing season.
- Re-vegetating poorly established areas as necessary.
- Treating diseased vegetation as necessary.
- Inspect soil and repair eroded areas, especially on slopes, at a minimum quarterly.
- Check inlets, outlets, and overflow spillway for blockage, structural integrity and evidence of erosion.

Cleaning Criteria for Gravel Wetland Treatment Cells: Sediment shall be removed from the gravel wetland surface when it accumulates to a depth of several inches (>10 cm) across the wetland surface. Materials shall be removed with rakes rather than heavy construction equipment to avoid compaction of the gravel wetland surface. Heavy equipment may be used if the equipment is located outside the gravel wetland, while a backhoe shovel reaches inside the gravel wetland to remove sediment. Removed sediments shall be dewatered (if necessary) and disposed of in accordance with all local, state and federal requirements. Removal of vegetation within the gravel wetland shall occur every three (3) growing seasons, or the end of the summer of the third year. This is to prevent decay and release of nutrients from accumulated biomass.

Rain Garden Inspection/Maintenance Requirements		
Inspection/ Maintenance	**Frequency**	**Action**
Monitor to ensure that Rain Gardens function effectively after storms	Two (2) times annually and after any rainfall event exceeding 2.5” in a 24-hr period	- Trash and debris to be removed - Any required maintenance shall be addressed
Inspect Vegetation	Annually	- Inspect the condition of all Rain Garden vegetation - Prune back overgrowth - Replace dead vegetation - Remove any invasive species
Inspect Drawdown Time - The system shall drawdown within 48-hours following a rainfall event.	Annually	- Assess the condition of the facility to determine measures required to restore the filtration function, including but not limited to removal of accumulated sediments or reconstruction of the filter.

Rip Rap Inspection/Maintenance Requirements		
Inspection/ Maintenance	**Frequency**	**Action**
Visual Inspection	Annually	- Visually inspect for damage and deterioration - Repair damages immediately

11.4.1 Disposal Requirements

Disposal of debris, trash, sediment and other waste material should be done at suitable disposal/recycling sites and in compliance with all applicable local, state and federal waste regulations.

11.4.2 Snow & Ice Management for Standard Asphalt and Walkways

Snow storage areas shall be located such that no direct untreated discharges are possible to receiving waters from the storage site (snow storage areas have been shown on the Site Plan). Salt storage areas shall be covered or located such that no direct untreated discharges are possible to receiving waters from the storage site. Salt and sand shall be used to the minimum extent practical (refer to the attached for de-icing application rate guideline from the New Hampshire Stormwater Management Manual, Volume 2,).

Deicing Application Rate Guidelines

24' of pavement (typcial two-lane road)

These rates are not fixed values, but rather the middle of a range to be selected and adjusted by an agency according to its local conditions and experience.

			Pounds per two-lane mile			
Pavement Temp. (°F) and Trend (↑↓)	Weather Condition	Maintenance Actions	Salt Prewetted / Pretreated with Salt Brine	Salt Prewetted / Pretreated with Other Blends	Dry Salt*	Winter Sand (abrasives)
> 30° ↑	Snow	Plow, treat intersections only	80	70	100*	Not recommended
	Freezing Rain	Apply Chemical	80 - 160	70 - 140	100 - 200*	Not recommended
30° ↓	Snow	Plow and apply chemical	80 - 160	70 - 140	100 - 200*	Not recommended
	Freezing Rain	Apply Chemical	150 - 200	130 - 180	180 - 240*	Not recommended
25° - 30° ↑	Snow	Plow and apply chemical	120 - 160	100 - 140	150 - 200*	Not recommended
	Freezing Rain	Apply Chemical	150 - 200	130 - 180	180 - 240*	Not recommended
25° - 30° ↓	Snow	Plow and apply chemical	120 - 160	100 - 140	150 - 200*	Not recommended
	Freezing Rain	Apply Chemical	160 - 240	140 - 210	200 - 300*	400
20° - 25° ↑	Snow or Freezing Rain	Plow and apply chemical	160 - 240	140 - 210	200 - 300*	400
20° - 25° ↓	Snow	Plow and apply chemical	200 - 280	175 - 250	250 - 350*	Not recommended
	Freezing Rain	Apply Chemical	240 - 320	210 - 280	300 - 400*	400
15° - 20° ↑	Snow	Plow and apply chemical	200 - 280	175 - 250	250 - 350*	Not recommended
	Freezing Rain	Apply Chemical	240 - 320	210 - 280	300 - 400*	400
15° - 20° ↓	Snow or Freezing Rain	Plow and apply chemical	240 - 320	210 - 280	300 - 400*	500 for freezing rain
0° - 15° ↑↓	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	300 - 400	Not recommended	500 - 750 spot treatment as needed
< 0°	Snow	Plow, treat with blends, sand hazardous areas	Not recommended	400 - 600**	Not recommended	500 - 750 spot treatment as needed

* Dry salt is not recommended. It is likely to blow off the road before it melts ice.

** A blend of 6 - 8 gal/ton $MgCl_2$ or $CaCl_2$ added to NaCl can melt ice as low as -10°.

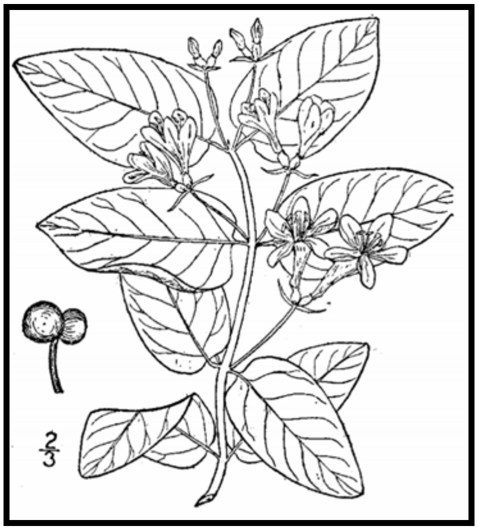
Anti-icing Route Data Form				
Truck Station:				
Date:				
Air Temperature	Pavement Temperature	Relative Humidity	Dew Point	Sky
Reason for applying:				
Route:				
Chemical:				
Application Time:				
Application Amount:				
Observation (first day):				
Observation (after event):				
Observation (before next application):				
Name:				

11.4.3 Invasive Species

With respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem is classified as an invasive species. Refer to the following fact sheet prepared by the University of New Hampshire Cooperative Extension entitled Methods for Disposing Non-Native Invasive Plants for recommended methods to dispose of invasive plant species.

Methods for Disposing Non-Native Invasive Plants

Prepared by the Invasives Species Outreach Group, volunteers interested in helping people control invasive plants. Assistance provided by the Piscataquog Land Conservancy and the NH Invasives Species Committee. Edited by Karen Bennett, Extension Forestry Professor and Specialist.



Tatarian honeysuckle
Lonicera tatarica
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* Vol. 3: 282.

Non-native invasive plants crowd out natives in natural and managed landscapes. They cost taxpayers billions of dollars each year from lost agricultural and forest crops, decreased biodiversity, impacts to natural resources and the environment, and the cost to control and eradicate them.

Invasive plants grow well even in less than desirable conditions such as sandy soils along roadsides, shaded wooded areas, and in wetlands. In ideal conditions, they grow and spread even faster. There are many ways to remove these non-native invasives, but once removed, care is needed to dispose the removed plant material so the plants don't grow where disposed.

Knowing how a particular plant reproduces indicates its method of spread and helps determine the appropriate disposal method. Most are spread by seed and are dispersed by wind, water, animals, or people. Some reproduce by vegetative means from pieces of stems or roots forming new plants. Others spread through both seed and vegetative means.

Because movement and disposal of viable plant parts is restricted (see NH Regulations), viable invasive parts can't be brought to most transfer stations in the state. Check with your transfer station to see if there is an approved, designated area for invasives disposal. This fact sheet gives recommendations for rendering plant parts non-viable.

Control of invasives is beyond the scope of this fact sheet. For information about control visit www.nhinvasives.org or contact your UNH Cooperative Extension office.

New Hampshire Regulations

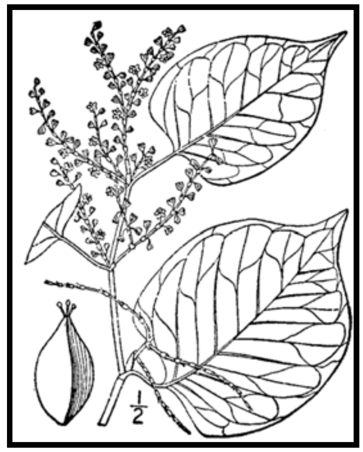
Prohibited invasive species shall only be disposed of in a manner that renders them nonliving and nonviable. (Agr. 3802.04)

No person shall collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species, which includes all of their cultivars and varieties, listed in Table 3800.1 of the New Hampshire prohibited invasive species list. (Agr 3802.01)

How and When to Dispose of Invasives?

To prevent seed from spreading remove invasive plants before seeds are set (produced). Some plants continue to grow, flower and set seed even after pulling or cutting. Seeds can remain viable in the ground for many years. If the plant has flowers or seeds, place the flowers and seeds in a heavy plastic bag “head first” at the weeding site and transport to the disposal site. The following are general descriptions of disposal methods. See the chart for recommendations by species.

Burning: Large woody branches and trunks can be used as firewood or burned in piles. For outside burning, a written fire permit from the local forest fire warden is required unless the ground is covered in snow. Brush larger than 5 inches in diameter can’t be burned. Invasive plants with easily airborne seeds like black swallow-wort with mature seed pods (indicated by their brown color) shouldn’t be burned as the seeds may disperse by the hot air created by the fire.



Japanese knotweed
Polygonum cuspidatum
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions.* Vol. 1: 676.

Bagging (solarization): Use this technique with softer-tissue plants. Use heavy black or clear plastic bags (contractor grade), making sure that no parts of the plants poke through. Allow the bags to sit in the sun for several weeks and on dark pavement for the best effect.

Tarping and Drying: Pile material on a sheet of plastic and cover with a tarp, fastening the tarp to the ground and monitoring it for escapes. Let the material dry for several weeks, or until it is clearly nonviable.

Chipping: Use this method for woody plants that don’t reproduce vegetatively.

Burying: This is risky, but can be done with watchful diligence. Lay thick plastic in a deep pit before placing the cut up plant material in the hole. Place the material away from the edge of the plastic before covering it with more heavy plastic. Eliminate as much air as possible and toss in soil to weight down the material in the pit. Note that the top of the buried material should be at least three feet underground. Japanese knotweed should be at least 5 feet underground!

Drowning: Fill a large barrel with water and place soft-tissue plants in the water. Check after a few weeks and look for rotted plant material (roots, stems, leaves, flowers). Well-rotted plant material may be composted. A word of caution- seeds may still be viable after using this method. Do this before seeds are set. This method isn’t used often. Be prepared for an awful stink!

Composting: Invasive plants can take root in compost. Don’t compost any invasives unless you know there is no viable (living) plant material left. Use one of the above techniques (bagging, tarping, drying, chipping, or drowning) to render the plants nonviable before composting. Closely examine the plant before composting and avoid composting seeds.

Be diligent looking for seedlings for *years* in areas where removal and disposal took place.

Suggested Disposal Methods for Non-Native Invasive Plants

This table provides information concerning the disposal of removed invasive plant material. If the infestation is treated with herbicide and left in place, these guidelines don't apply. Don't bring invasives to a local transfer station, unless there is a designated area for their disposal, or they have been rendered non-viable. This listing includes wetland and upland plants from the New Hampshire Prohibited Invasive Species List. The disposal of aquatic plants isn't addressed.

Woody Plants	Method of Reproducing	Methods of Disposal
Norway maple *(Acer platanoides)* European barberry *(Berberis vulgaris)* Japanese barberry *(Berberis thunbergii)* autumn olive *(Elaeagnus umbellata)* burning bush *(Euonymus alatus)* Morrow's honeysuckle *(Lonicera morrowii)* Tatarian honeysuckle *(Lonicera tatarica)* showy bush honeysuckle *(Lonicera x bella)* common buckthorn *(Rhamnus cathartica)* glossy buckthorn *(Frangula alnus)*	**Fruit and Seeds**	**Prior to fruit/seed ripening** Seedlings and small plants ▪ Pull or cut and leave on site with roots exposed. No special care needed. Larger plants ▪ Use as firewood. ▪ Make a brush pile. ▪ Chip. ▪ Burn.
		After fruit/seed is ripe Don't remove from site. ▪ Burn. ▪ Make a covered brush pile. ▪ Chip once all fruit has dropped from branches. ▪ Leave resulting chips on site and monitor.
oriental bittersweet *(Celastrus orbiculatus)* multiflora rose *(Rosa multiflora)*	**Fruits, Seeds, Plant Fragments**	**Prior to fruit/seed ripening** Seedlings and small plants ▪ Pull or cut and leave on site with roots exposed. No special care needed. Larger plants ▪ Make a brush pile. ▪ Burn.
		After fruit/seed is ripe Don't remove from site. ▪ Burn. ▪ Make a covered brush pile. ▪ Chip – only after material has fully dried (1 year) and all fruit has dropped from branches. Leave resulting chips on site and monitor.

<table>
<tr><th>Non-Woody Plants</th><th>Method of Reproducing</th><th>Methods of Disposal</th></tr>
<tr><td rowspan="2">garlic mustard
(Alliaria petiolata)
spotted knapweed
(Centaurea maculosa)
▪ Sap of related knapweed can cause skin irritation and tumors. Wear gloves when handling.
black swallow-wort
(Cynanchum nigrum)
▪ May cause skin rash. Wear gloves and long sleeves when handling.
pale swallow-wort
(Cynanchum rossicum)
giant hogweed
(Heracleum mantegazzianum)
▪ Can cause major skin rash. Wear gloves and long sleeves when handling.
dame’s rocket
(Hesperis matronalis)
perennial pepperweed
(Lepidium latifolium)
purple loosestrife
(Lythrum salicaria)
Japanese stilt grass
(Microstegium vimineum)
mile-a-minute weed
(Polygonum perfoliatum)</td><td rowspan="2">Fruits and Seeds</td><td>Prior to flowering
Depends on scale of infestation
Small infestation
▪ Pull or cut plant and leave on site with roots exposed.

Large infestation
▪ Pull or cut plant and pile. (You can pile onto or cover with plastic sheeting).
▪ Monitor. Remove any re-sprouting material.</td></tr>
<tr><td>During and following flowering
Do nothing until the following year or remove flowering heads and bag and let rot.

Small infestation
▪ Pull or cut plant and leave on site with roots exposed.

Large infestation
▪ Pull or cut plant and pile remaining material. (You can pile onto plastic or cover with plastic sheeting).
▪ Monitor. Remove any re-sprouting material.</td></tr>
<tr><td>common reed
(Phragmites australis)
Japanese knotweed
(Polygonum cuspidatum)
Bohemian knotweed
(Polygonum x bohemicum)</td><td>Fruits, Seeds, Plant Fragments
Primary means of spread in these species is by plant parts. Although all care should be given to preventing the dispersal of seed during control activities, the presence of seed doesn’t materially influence disposal activities.</td><td>Small infestation
▪ Bag all plant material and let rot.
▪ Never pile and use resulting material as compost.
▪ Burn.

Large infestation
▪ Remove material to unsuitable habitat (dry, hot and sunny or dry and shaded location) and scatter or pile.
▪ Monitor and remove any sprouting material.
▪ Pile, let dry, and burn.</td></tr>
</table>

January 2010

Managing Invasive Plants
Methods of Control

by Christopher Mattrick

They're out there. The problem of invasive plants is as close as your own backyard.

Maybe a favorite dogwood tree is struggling in the clutches of an Oriental bittersweet vine. Clawlike canes of multiflora rose are scratching at the side of your house. That handsome burning bush you planted few years ago has become a whole clump in practically no time … but what happened to the azalea that used to grow right next to it?

If you think controlling or managing invasive plants on your property is a daunting task, you're not alone. Though this topic is getting lots of attention from federal, state, and local government agencies, as well as the media, the basic question for most homeowners is simply, "How do I get rid of the invasive plants in my own landscape?" Fortunately, the best place to begin to tackle this complex issue is in our own backyards and on local conservation lands. We hope the information provided here will help you take back your yard. We won't kid you—there's some work involved, but the payoff in beauty, wildlife habitat, and peace of mind makes it all worthwhile.

PLAN OF ATTACK

Three broad categories cover most invasive plant control: mechanical, chemical, and biological. Mechanical control means physically removing plants from the environment through cutting or pulling. Chemical control uses herbicides to kill plants and inhibit regrowth. Techniques and chemicals used will vary depending on the species. Biological controls use plant diseases or insect predators, typically from the targeted species' home range. Several techniques may be effective in controlling a single species, but there is usually one preferred method—the one that is most resource efficient with minimal impact on non-target species and the environment.

Spraying chemicals to control invasive plants.

MECHANICAL CONTROL METHODS

Mechanical treatments are usually the first ones to look at when evaluating an invasive plant removal project. These procedures do not require special licensing or introduce chemicals into the environment. They do require permits in some situations, such as wetland zones. [See sidebar on page 23.] Mechanical removal is highly labor intensive and creates a significant amount of site disturbance, which can lead to rapid reinvasion if not handled properly.

Pulling and digging

Many herbaceous plants and some woody species (up to about one inch in diameter), if present in limited quantities, can be pulled out or dug up. It's important to remove as much of the root system as possible; even a small portion can restart the infestation. Pull plants by hand or use a digging fork, as shovels can shear off portions of the root system, allowing for regrowth. To remove larger woody stems (up to about three inches in diameter), use a Weed Wrench™, Root Jack, or Root Talon. These tools, available from several manufacturers, are designed to remove the aboveground portion of the plant as well as the entire root system. It's easiest to undertake this type of control in the spring or early summer when soils are moist and plants come out more easily.

Using tools to remove woody stems.

Volunteers hand pulling invasive plants.

Suffocation

Try suffocating small seedlings and herbaceous plants. Place double or triple layers of thick UV-stabilized plastic sheeting, either clear or black (personally I like clear), over the infestation and secure the plastic with stakes or weights. Make sure the plastic extends at least five feet past the edge of infestation on all sides. Leave the plastic in place for at least two years. This technique will kill everything beneath the plastic—invasive and non-invasive plants alike. Once the plastic is removed, sow a cover crop such as annual rye to prevent new invasions.

Cutting or mowing

This technique is best suited for locations you can visit and treat often. To be effective, you will need to mow or cut infested areas three or four times a year for up to five years. The goal is to interrupt the plant's ability to photosynthesize by removing as much leafy material as possible. Cut the plants at ground level and remove all resulting debris from the site. With this treatment, the infestation may actually appear to get worse at first, so you will need to be as persistent as the invasive plants themselves. Each time you cut the plants back, the root system gets slightly larger, but must also rely on its energy reserves to push up new growth. Eventually, you will exhaust these reserves and the plants will die. This may take many years, so you have to remain committed to this process once you start; otherwise the treatment can backfire, making the problem worse.

CHEMICAL CONTROL METHODS

Herbicides are among the most effective and resource-efficient tools to treat invasive species. Most of the commonly known invasive plants can be treated using only two herbicides—glyphosate (the active ingredient in Roundup™ and Rodeo™) and triclopyr (the active ingredient in Brush-B-Gone™ and Garlon™). Glyphosate is non-selective, meaning it kills everything it contacts. Triclopyr is selective and does not injure monocots (grasses, orchids, lilies, etc.). Please read labels and follow directions precisely for both environmental and personal safety. These are relatively benign herbicides, but improperly used they can still cause both short- and long-term health and environmental problems. Special aquatic formulations are required when working in wetland zones. You are required to have a state-issued pesticide applicator license when applying these chemicals on land you do not own. To learn more about the pesticide regulations in your state, visit or call your state's pesticide control division, usually part of the state's Department of Agriculture. In wetland areas, additional permits are usually required by the Wetlands Protection Act. [See sidebar on page 23.]

Foliar applications

When problems are on a small scale, this type of treatment is usually applied with a backpack sprayer or even a small handheld spray bottle. It is an excellent way to treat large monocultures of herbaceous plants, or to spot-treat individual plants that are difficult to remove mechanically, such as goutweed, swallowwort, or purple loosestrife. It is also an effective treatment for some woody species, such as Japanese barberry, multiflora rose, Japanese honeysuckle, and Oriental bittersweet that grow in dense masses or large numbers over many acres. The herbicide mixture should contain no more than five percent of the active ingredient, but it is important to follow the instructions on the product label. This treatment is most effective when the plants are actively growing, ideally when they are flowering or beginning to form fruit. It has been shown that plants are often more susceptible to this type of treatment if the existing stems are cut off and the regrowth is treated. This is especially true for Japanese knotweed. The target plants should be thoroughly wetted with the herbicide on a day when there is no rain in the forecast for the next 24 to 48 hours.

Cut stem treatments

There are several different types of cut stem treatments, but here we will review only the one most commonly used. All treatments of this type require a higher concentration of the active ingredient than is used in foliar applications. A 25 to 35 percent solution of the active ingredient should be used for cut stem treatments, but read and follow all label instructions. In most cases, the appropriate herbicide is glyphosate, except for Oriental bittersweet, on which triclopyr should be used. This treatment can be used on all woody stems, as well as phragmites and Japanese knotweed.

For woody stems, treatments are most effective when applied in the late summer and autumn—between late August and November. Stems should be cut close to the ground, but not so close that you will lose track of them. Apply herbicide directly to the cut surface as soon as possible after cutting. Delaying the application will reduce the effectiveness of the treatment. The herbicide can be applied with a sponge, paintbrush, or spray bottle.

Cut stem treatment tools.

For phragmites and Japanese knotweed, treatment is the same, but the timing and equipment are different. Plants should be treated anytime from mid-July through September, but the hottest, most humid days of the summer are best for this method. Cut the stems halfway between two leaf nodes at a comfortable height. Inject (or squirt) herbicide into the exposed hollow stem. All stems in an infestation should be treated. A wash bottle is the most effective application tool, but you can also use an eyedropper, spray bottle, or one of the recently developed high-tech injection systems.

It is helpful to mix a dye in with the herbicide solution. The dye will stain the treated surface and mark the areas that have been treated, preventing unnecessary reapplication. You can buy a specially formulated herbicide dye, or use food coloring or laundry dye.

There is not enough space in this article to describe all the possible ways to control invasive plants. You can find other treatments, along with more details on the above-described methods, and species-specific recommendations on The Nature Conservancy Web site (tncweeds.ucdavis.edu). An upcoming posting on the Invasive Plant Atlas of New England (www.ipane.org) and the New England Wild Flower Society (www.newfs.org) Web sites will also provide further details.


Hollow stem injection tools.

Biological controls—still on the horizon

Biological controls are moving into the forefront of control methodology, but currently the only widely available and applied biocontrol relates to purple loosestrife. More information on purple loosestrife and other biological control projects can be found at www.invasiveplants.net.

DISPOSAL OF INVASIVE PLANTS

Proper disposal of removed invasive plant material is critical to the control process. Leftover plant material can cause new infestations or reinfest the existing project area. There are many appropriate ways to dispose of invasive plant debris. I've listed them here in order of preference.

1. **Burn it**—Make a brush pile and burn the material following local safety regulations and restrictions, or haul it to your town's landfill and place it in their burn pile.

2. **Pile it**—Make a pile of the woody debris. This technique will provide shelter for wildlife as well.

3. **Compost it**—Place all your herbaceous invasive plant debris in a pile and process as compost. Watch the pile closely for resprouts and remove as necessary. Do not use the resulting compost in your garden. The pile is for invasive plants only.


Injecting herbicide into the hollow stem of phragmites.

4. **Dry it/cook it**—Place woody debris out on your driveway or any asphalt surface and let it dry out for a month. Place herbaceous material in a doubled-up black trash bag and let it cook in the sun for one month. At the end of the month, the material should be non-viable and you can dump it or dispose of it with the trash. The method assumes there is no viable seed mixed in with the removed material.

Care should be taken in the disposal of all invasive plants, but several species need extra attention. These are the ones that have the ability to sprout vigorously from plant fragments and should ideally be burned or dried prior to disposal: Oriental bittersweet, multiflora rose, Japanese honeysuckle, phragmites, and Japanese knotweed.

Christopher Mattrick is the former Senior Conservation Programs Manager for New England Wild Flower Society, where he managed conservation volunteer and invasive and rare plant management programs. Today, Chris and his family work and play in the White Mountains of New Hampshire, where he is the Forest Botanist and Invasive Species Coordinator for the White Mountain National Forest.

Controlling Invasive Plants in Wetlands

Special concerns; special precautions

Control of invasive plants in or around wetlands or bodies of water requires a unique set of considerations. Removal projects in wetland zones can be legal and effective if handled appropriately. In many cases, herbicides may be the least disruptive tools with which to remove invasive plants. You will need a state-issued pesticide license to apply herbicide on someone else's property, but all projects in wetland or aquatic systems fall under the jurisdiction of the Wetlands Protection Act and therefore require a permit. ***Yes, even hand-pulling that colony of glossy buckthorn plants from your own swampland requires a permit.*** Getting a permit for legal removal is fairly painless if you plan your project carefully.

1. Investigate and understand the required permits and learn how to obtain them. The entity charged with the enforcement of the Wetlands Protection Act varies from state to state. For more information in your state, contact:

   ME: Department of Environmental Protection
   www.state.me.us/dep/blwq/docstand/nrpapage.htm

   NH: Department of Environmental Services
   www.des.state.nh.us/wetlands/

   VT: Department of Environmental Conservation
   www.anr.state.vt.us/dec/waterq/permits/htm/pm_cud.htm

   MA: Consult your local town conservation commission

   RI: Department of Environmental Management
   www.dem.ri.gov/programs/benviron/water/permits/fresh/index.htm

   CT: Consult your local town Inland Wetland and Conservation Commission

2. Consult an individual or organization with experience in this area. Firsthand experience in conducting projects in wetland zones and navigating the permitting process is priceless. Most states have wetland scientist societies whose members are experienced in working in wetlands and navigating the regulations affecting them. A simple Web search will reveal the contact point for these societies. Additionally, most environmental consulting firms and some nonprofit organizations have skills in this area.

3. Develop a well-written and thorough project plan. You are more likely to be successful in obtaining a permit for your project if you submit a project plan along with your permit application. The plan should include the reasons for the project, your objectives in completing the project, how you plan to reach those objectives, and how you will monitor the outcome.

4. Ensure that the herbicides you plan to use are approved for aquatic use. Experts consider most herbicides harmful to water quality or aquatic organisms, but rate some formulations as safe for aquatic use. Do the research and select an approved herbicide, and then closely follow the instructions on the label.

5. If you are unsure—research, study, and most of all, ask for help. Follow the rules. The damage caused to aquatic systems by the use of an inappropriate herbicide or the misapplication of an appropriate herbicide not only damages the environment, but also may reduce public support for safe, well-planned projects.

11.4.4 Annual Updates and Log Requirements

The Owner and/or Contact/Responsible Party shall review this Operation and Maintenance Plan once per year for its effectiveness and adjust the plan and deed as necessary.

A log of all preventative and corrective measures for the stormwater system shall be kept on-site and be made available upon request by any public entity with administrative, health environmental or safety authority over the site including NHDES.

Stormwater Management Report						
Project Name		**Lonza – Iron Parcel**				
BMP Description	**Date of Inspection**	**Inspector**	**BMP Installed and Operating Properly?**	**Cleaning / Corrective Action Needed**	**Date of Cleaning / Repair**	**Performed By**
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			
			❑Yes ❑No			

J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Report_Evaluation\Applications\NHDES\AoT\L-0700-13_AoT Report.docx

Appendix A

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	New Hampshire
Location	
Longitude	70.802 degrees West
Latitude	43.085 degrees North
Elevation	0 feet
Date/Time	Tue, 06 Feb 2018 11:48:23 -0500

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.50	0.65	0.81	1.04	**1yr**	0.70	0.98	1.21	1.56	2.02	2.65	2.91	**1yr**	2.35	2.79	3.20	3.92	4.52	**1yr**
2yr	0.32	0.49	0.62	0.81	1.02	1.30	**2yr**	0.88	1.18	1.51	1.93	2.48	3.20	3.55	**2yr**	2.83	3.42	3.92	4.66	5.30	**2yr**
5yr	0.37	0.58	0.72	0.97	1.24	1.60	**5yr**	1.07	1.46	1.88	2.42	3.13	4.05	4.56	**5yr**	3.59	4.38	5.01	5.91	6.67	**5yr**
10yr	0.41	0.64	0.81	1.11	1.44	1.87	**10yr**	1.24	1.71	2.21	2.87	3.73	4.85	5.50	**10yr**	4.29	5.29	6.04	7.07	7.94	**10yr**
25yr	0.47	0.75	0.96	1.32	1.75	2.31	**25yr**	1.51	2.12	2.75	3.60	4.71	6.15	7.06	**25yr**	5.44	6.79	7.74	8.97	10.01	**25yr**
50yr	0.53	0.85	1.09	1.52	2.04	2.72	**50yr**	1.76	2.50	3.25	4.28	5.62	7.36	8.54	**50yr**	6.51	8.21	9.34	10.75	11.93	**50yr**
100yr	0.60	0.96	1.24	1.75	2.38	3.20	**100yr**	2.05	2.95	3.84	5.09	6.71	8.82	10.33	**100yr**	7.80	9.93	11.28	12.88	14.23	**100yr**
200yr	0.66	1.08	1.40	2.01	2.78	3.78	**200yr**	2.40	3.47	4.55	6.06	8.02	10.57	12.49	**200yr**	9.35	12.01	13.62	15.45	16.97	**200yr**
500yr	0.78	1.29	1.68	2.43	3.41	4.68	**500yr**	2.94	4.32	5.67	7.61	10.13	13.43	16.07	**500yr**	11.89	15.46	17.47	19.64	21.43	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.23	0.36	0.44	0.59	0.73	0.89	**1yr**	0.63	0.87	0.92	1.31	1.66	2.23	2.50	**1yr**	1.97	2.41	2.83	3.17	3.88	**1yr**
2yr	0.31	0.49	0.60	0.81	1.00	1.19	**2yr**	0.86	1.16	1.36	1.82	2.34	3.05	3.44	**2yr**	2.70	3.31	3.81	4.53	5.05	**2yr**
5yr	0.35	0.54	0.67	0.92	1.17	1.40	**5yr**	1.01	1.37	1.61	2.13	2.74	3.78	4.18	**5yr**	3.34	4.02	4.69	5.51	6.22	**5yr**
10yr	0.38	0.59	0.73	1.02	1.32	1.60	**10yr**	1.14	1.56	1.81	2.41	3.08	4.36	4.86	**10yr**	3.86	4.67	5.42	6.39	7.18	**10yr**
25yr	0.44	0.67	0.83	1.18	1.56	1.90	**25yr**	1.34	1.86	2.10	2.78	3.57	4.69	5.90	**25yr**	4.15	5.67	6.63	7.78	8.67	**25yr**
50yr	0.48	0.73	0.91	1.31	1.76	2.17	**50yr**	1.52	2.12	2.35	3.11	3.98	5.30	6.82	**50yr**	4.69	6.56	7.71	9.02	10.00	**50yr**
100yr	0.53	0.81	1.01	1.46	2.01	2.47	**100yr**	1.73	2.42	2.63	3.46	4.41	5.95	7.88	**100yr**	5.27	7.58	8.97	10.48	11.53	**100yr**
200yr	0.59	0.89	1.13	1.63	2.28	2.82	**200yr**	1.96	2.76	2.93	3.85	4.88	6.67	9.10	**200yr**	5.90	8.75	10.43	12.19	13.33	**200yr**
500yr	0.69	1.02	1.31	1.91	2.71	3.37	**500yr**	2.34	3.30	3.40	4.41	5.58	7.75	11.02	**500yr**	6.86	10.59	12.73	14.91	16.12	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.44	0.53	0.72	0.88	1.08	**1yr**	0.76	1.06	1.25	1.75	2.21	2.99	3.13	**1yr**	2.65	3.01	3.57	4.36	5.02	**1yr**
2yr	0.33	0.52	0.63	0.86	1.06	1.26	**2yr**	0.91	1.23	1.48	1.96	2.51	3.41	3.68	**2yr**	3.02	3.53	4.06	4.81	5.61	**2yr**
5yr	0.40	0.61	0.76	1.04	1.33	1.61	**5yr**	1.15	1.57	1.88	2.53	3.24	4.32	4.92	**5yr**	3.82	4.73	5.34	6.33	7.11	**5yr**
10yr	0.46	0.71	0.88	1.23	1.59	1.96	**10yr**	1.38	1.92	2.27	3.09	3.93	5.31	6.15	**10yr**	4.70	5.91	6.74	7.78	8.68	**10yr**
25yr	0.57	0.87	1.08	1.54	2.02	2.54	**25yr**	1.74	2.48	2.93	4.04	5.09	7.73	8.25	**25yr**	6.84	7.94	9.02	10.25	11.33	**25yr**
50yr	0.66	1.01	1.25	1.80	2.42	3.09	**50yr**	2.09	3.02	3.56	4.96	6.23	9.67	10.34	**50yr**	8.56	9.94	11.25	12.61	13.86	**50yr**
100yr	0.77	1.17	1.47	2.12	2.91	3.75	**100yr**	2.51	3.67	4.33	6.10	7.63	12.09	12.94	**100yr**	10.70	12.45	14.03	15.54	16.96	**100yr**
200yr	0.90	1.36	1.72	2.50	3.48	4.57	**200yr**	3.00	4.47	5.28	7.50	9.34	15.15	16.23	**200yr**	13.41	15.60	17.53	19.14	20.77	**200yr**
500yr	1.12	1.66	2.14	3.11	4.42	5.91	**500yr**	3.81	5.78	6.84	9.88	12.24	20.44	21.88	**500yr**	18.09	21.04	23.53	25.23	27.17	**500yr**

Powered by ACIS
Northeast Regional Climate Center

Coastal and Great Bay Region Precipitation Increase		
	24-hr Storm Event (in.)	24-hr Storm Event + 15% (in.)
1 Year	2.65	3.05
2 Year	3.20	3.68
10 Year	4.85	5.58
25 Year	6.15	7.07
50 Year	7.36	8.46
100 Year	8.82	10.14

Appendix B

Tighe&Bond
Engineers | Environmental Specialists

Project/Site Information

Proposed Industrial Development
101 International Drive
Portsmouth, NH

Test Pit No.	**TP-1**
Page No.	1 of 1
File No.	L-0700-013
Checked By:	D. Brogan

T&B Rep.	M. Trovato	Contractor	New England Boring Contractors			Date	03/21/18
		Operator	Ben Cross			Ground Elev.	± 48'
Weather	30 Degrees - Cloudy	Make	Kubota	Model	KX080	Time Started	7:50
		Capacity	0.3 yd^3	Reach	15.1 ft.	Time Completed	9:05

Depth	Soil Description	Sample No.	PID Reading (ppm)	Excav. Effort	Boulder Count/ Class	Note No.
0	Dark brown fine to coarse SAND and fine to coarse GRAVEL, little Silt (FILL) 0.5'		0.0	D	5-10%/A	1
1'	Brown, fine to coarse SAND and fine to coarse GRAVEL, some Silt, trace Brick, Wood, Clay Pipe (FILL) 3.5'	S-1		E	5-10%/A	
2'				E	5-10%/A	
3'				E	5-10%/A	
4'	Grayish-brown, fine to coarse SAND and SILT, with thin seems of Silty Clay (FILL) 6'	S-2	0.0	E	5%/A	
5'				E	5%/A	
6'	Grayish-brown, fine to medium SAND, some Silty Clay, some fine to coarse Gravel 8.5'	S-3		E	5%/A	
7'				M	5%/A	
8'			0.0	M	5%/A	2
9'	Bottom of exploration at 8.5 feet due to bedrock refusal					
10'						
11'						
12'						
13'						
14'						
15'						
16'						

Notes:

1) Frost layer observed to be approximately 6-inches thick.

2) Groundwater observed to infiltrate test pit at approximately 8.5 feet.

Test Pit Plan

13' × 3'

Volume = ________ cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" +

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
(X) Encountered
( ) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water
0.25	8.5'

J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Geo-Environmental\Explorations\[Test Pit Logs.xls]TP-1

Tighe&Bond
Engineers | Environmental Specialists

Project/Site Information

Proposed Industrial Development
101 International Drive
Portsmouth, NH

Test Pit No.	**TP-6**
Page No.	1 of 1
File No.	L-0700-013
Checked By:	D. Brogan

T&B Rep.	M. Trovato	Contractor	New England Boring Contractors			Date	03/21/18
		Operator	Ben Cross			Ground Elev.	± 44'
Weather	36 Degrees - Cloudy	Make	Kubota	Model	KX080	Time Started	13:55
		Capacity	0.3 yd^3	Reach	15.1 ft.	Time Completed	14:35

Depth	Soil Description	Sample No.	PID Reading (ppm)	Excav. Effort	Boulder Count/ Class	Note No.
0						
0-1'	Dark brown, fine to coarse SAND and SILT, little fine to coarse Gravel, trace Brick, Wood (FILL)			E	5%/A	
1'-2'	2'			E	5%/A-B	
2'-3'	Light gray, Silty CLAY, trace Wood (FILL)			E	5%/A	
3'-4'				E	5%/A	
4'-5'	5'			E	5%/A	
5'-6'	Light gray, Silty CLAY, trace fine to coarse Gravel			E	5%/A	1
6'-7'				E	0%	
7'-8'	7.5'			E	0%	
8'	Bottom of exploration at 7.5 feet due to bedrock refusal					
9'						
10'						
11'						
12'						
13'						
14'						
15'						
16'						

Notes:

1) Groundwater observed to infiltrate test pit sidewalls at approximately 5 feet below grade.

Test Pit Plan

13' × 3'

Volume = ______ cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" +

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
(X) Encountered
( ) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water
0.25	5'

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Project/Site Information

Proposed Industrial Development
101 International Drive
Portsmouth, NH

Test Pit No.	**TP-17**
Page No.	1 of 1
File No.	L-0700-013
Checked By:	D. Brogan

T&B Rep.	M. Trovato	Contractor	New England Boring Contractors			Date	03/23/18
		Operator	Ben Cross			Ground Elev.	± 57'
Weather	36 Degrees - Sunny	Make	Kubota	Model	KX080	Time Started	9:10
		Capacity	0.3 yd^3	Reach	15.1 ft.	Time Completed	10:00

Depth	Soil Description	Sample No.	PID Reading (ppm)	Excav. Effort	Boulder Count/ Class	Note No.
0	Brown, fine to coarse SAND, some fine to coarse Gravel, some Silt, trace Clay Pipe, Trash (FILL)		0.0	E	5%/A	
1'	2'			E	5%/A	
2'	Gray, fine to medium SAND and SILT 2.8'	S-1	0.0	E	5%/A	
3'	Gray, Silty CLAY	S-2		E	0%	1
4'				E	0%	
5'				E	0%	
6'	6.5'			E	5%/A	
7'	Grayish-brown, fine to medium SAND and SILT	S-3	0.0	E	0%	
8'				E	0%	
9'				E	0%	
10'	11'			E	0%	
11'	Bottom of exploration at 11 feet					
12'						
13'						
14'						
15'						
16'						

Notes:

1) 4-inch metal pipe encountered at approximately 3 feet below grade running perpendicular with test pit.

Test Pit Plan

12' × 3'

Volume = ________ cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" +

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
(   ) Encountered
(X) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water

Tighe&Bond
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Project/Site Information

Proposed Industrial Development
101 International Drive
Portsmouth, NH

Test Pit No.	**TP-18**
Page No.	1 of 1
File No.	L-0700-013
Checked By:	D. Brogan

T&B Rep.	M. Trovato	Contractor	New England Boring Contractors	Date	03/23/18
		Operator	Ben Cross	Ground Elev.	± 59'
Weather	38 Degrees - Sunny	Make	Kubota Model KX080	Time Started	10:10
		Capacity	$0.3\ yd^3$ Reach 15.1 ft.	Time Completed	11:15

Depth	Soil Description	Sample No.	PID Reading (ppm)	Excav. Effort	Boulder Count/ Class	Note No.
0	Brown, fine to coarse SAND and fine to coarse GRAVEL, some Silt, trace Trash, Clay Pipe, Brick (FILL) 1.5'			E	5-10%/A	
1'				E	5-10%/A	1
2'	Light brown, fine to coarse SAND, some Silt, little fine to coarse Gravel, trace Brick (FILL) 3.5'			E	10%/A	
3'				E	10%/A	
4'	Brown, fine to coarse SAND, some Silt, little fine to coarse Gravel (FILL) 7.4'	S-1		E	10-15%/A	
5'				E	10-15%/A	
6'				E	10%/A	
7'				E	10%/A	
8'	Light brown, fine to coarse SAND, some fine to coarse Gravel, little Silt 11'	S-2		E	10%/A	
9'				E	10%/A	
10'				E	10%/A	
11'	WEATHERED ROCK			M	10%/A	2
12'	Bottom of exploration at 11.4 feet					
13'						
14'						
15'						
16'						

Notes:

1) Metal pipe encountered at approximately 1 foot below grade.

2) Groundwater observed to infiltrate test pit at approximately 11 feet below grade.

Test Pit Plan

3' × 13'

Volume = ______ cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" +

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

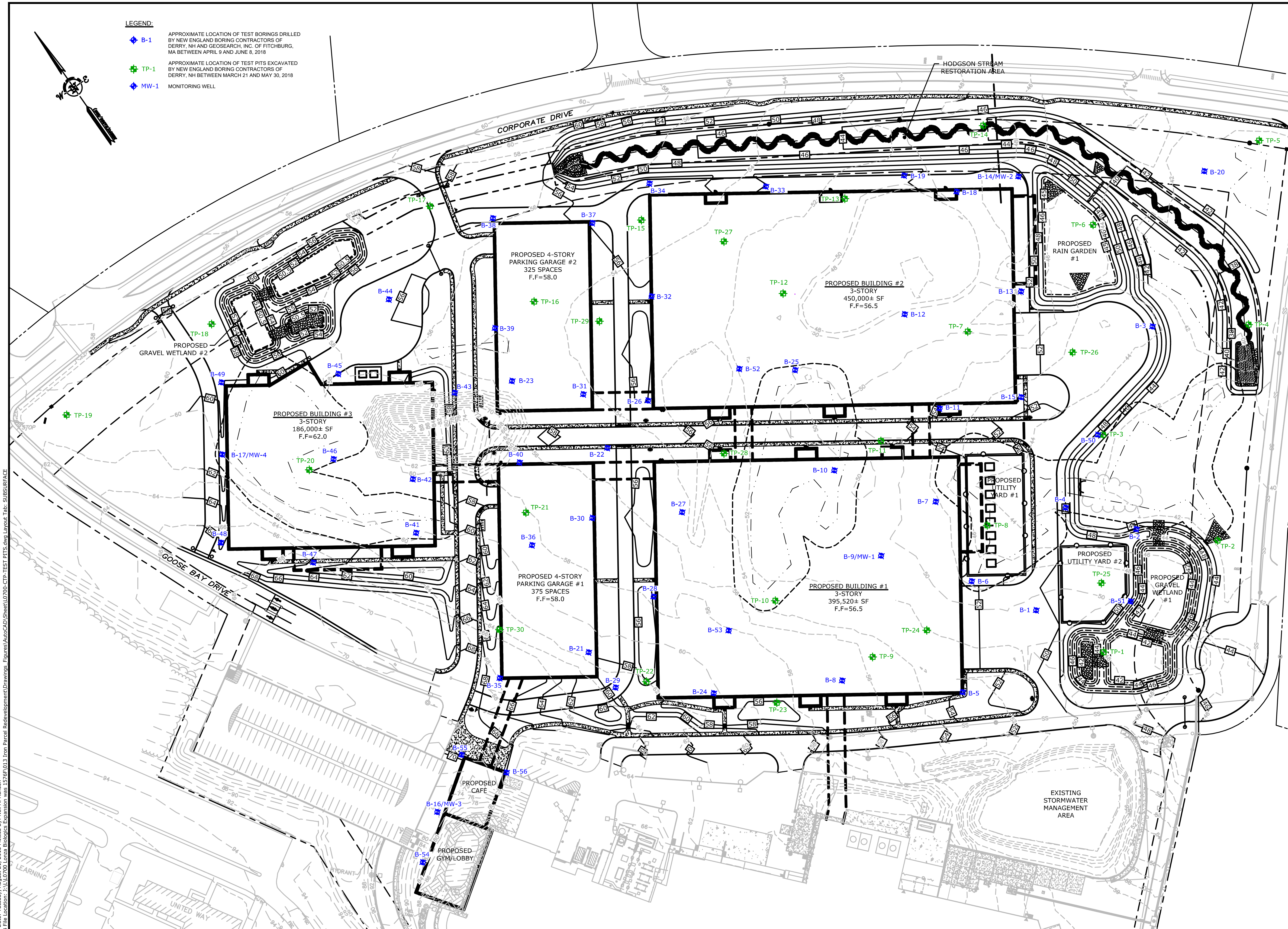
Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
(X) Encountered
(   ) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water
0.25	11'



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Plot Date: Tuesday, August 21, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-CTP-TEST PITS.dwg Layout Tab: SUBSURFACE

Tighe&Bond
Engineers | Environmental Specialists

Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

July 19, 2018

MARK	DATE	DESCRIPTION

PROJECT NO:	L-0700-13
DATE:	07/19/2018
FILE: L0700-CTP-TEST PITS.dwg	
DRAWN BY:	BJL
CHECKED:	DRB
APPROVED:	DRB

SUBSURFACE EXPLORATION PLAN

SCALE: AS SHOWN

FIGURE 2

LEGEND

	PRE-DEVELOPMENT WATERSHED BOUNDARY
	SOIL SURVEY BOUNDARIES
	LONGEST FLOW PATH
PRE 1.0	PRE DEVELOPMENT WATERSHED AREA DESIGNATION
PRE POND 1	PRE-DEVELOPMENT POND DESIGNATION
PA-1	POINT OF ANALYSIS
PRE REACH 1	PRE-DEVELOPMENT REACH DESIGNATION

NOTES:

1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

Tighe&Bond
Engineers | Environmental Specialists

SCALE IN FEET
0 80' 160'
GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth,
New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

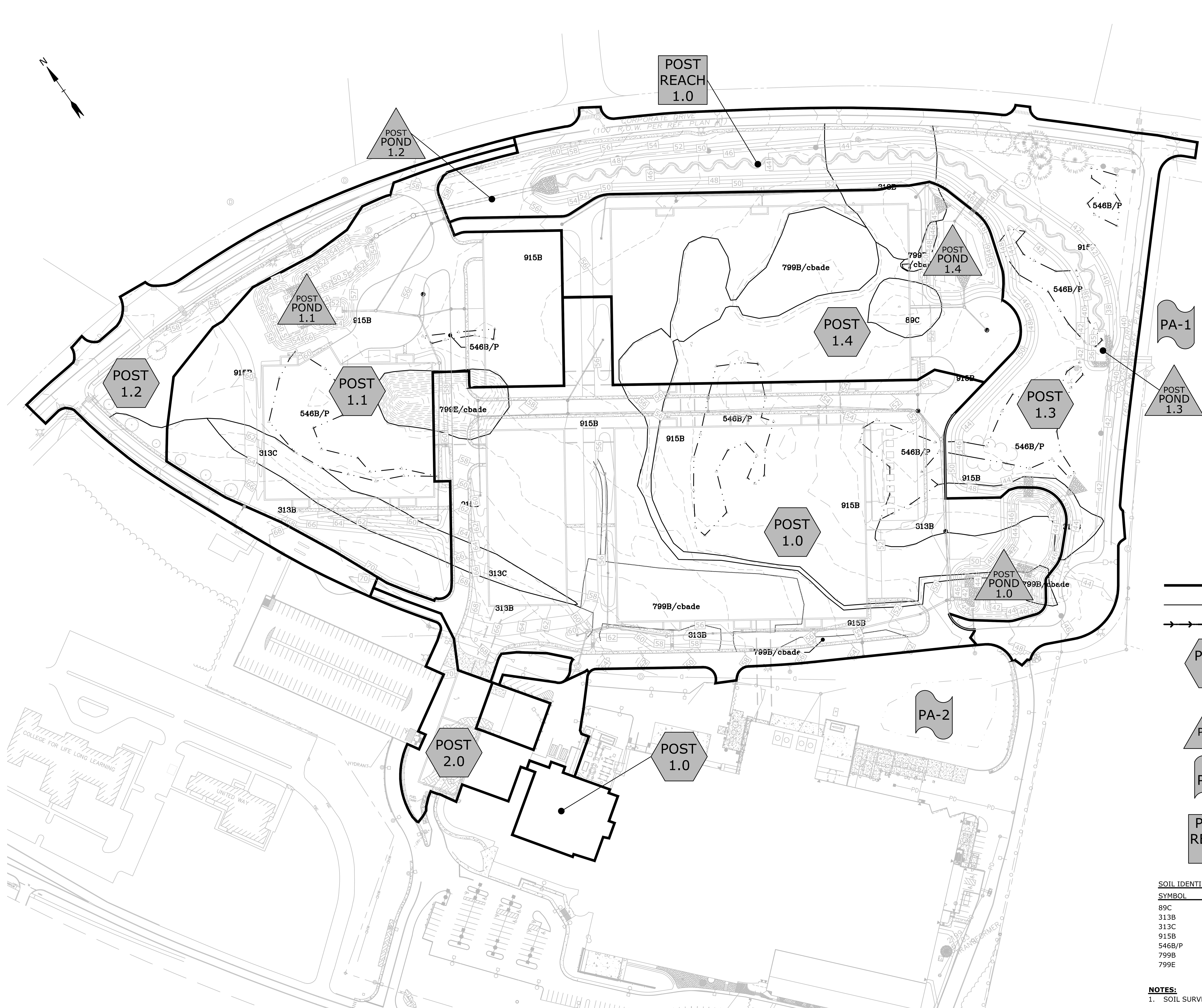
PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

PRE-DEVELOPMENT
WATERSHED AREA PLAN

SCALE: AS SHOWN

C-801

Last Save Date: November 1, 2018 5:06 PM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-801



LEGEND

POST-DEVELOPMENT WATERSHED BOUNDARY

SOIL SURVEY BOUNDARIES

LONGEST FLOW PATH

POST 1.0 — PRE DEVELOPMENT WATERSHED AREA DESIGNATION

POST POND 1 — POST-DEVELOPMENT POND DESIGNATION

PA-1 — POINT OF ANALYSIS

POST REACH 1 — POST-DEVELOPMENT REACH DESIGNATION

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

NOTES:

1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

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SCALE IN FEET
0 80' 160'
GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth,
New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

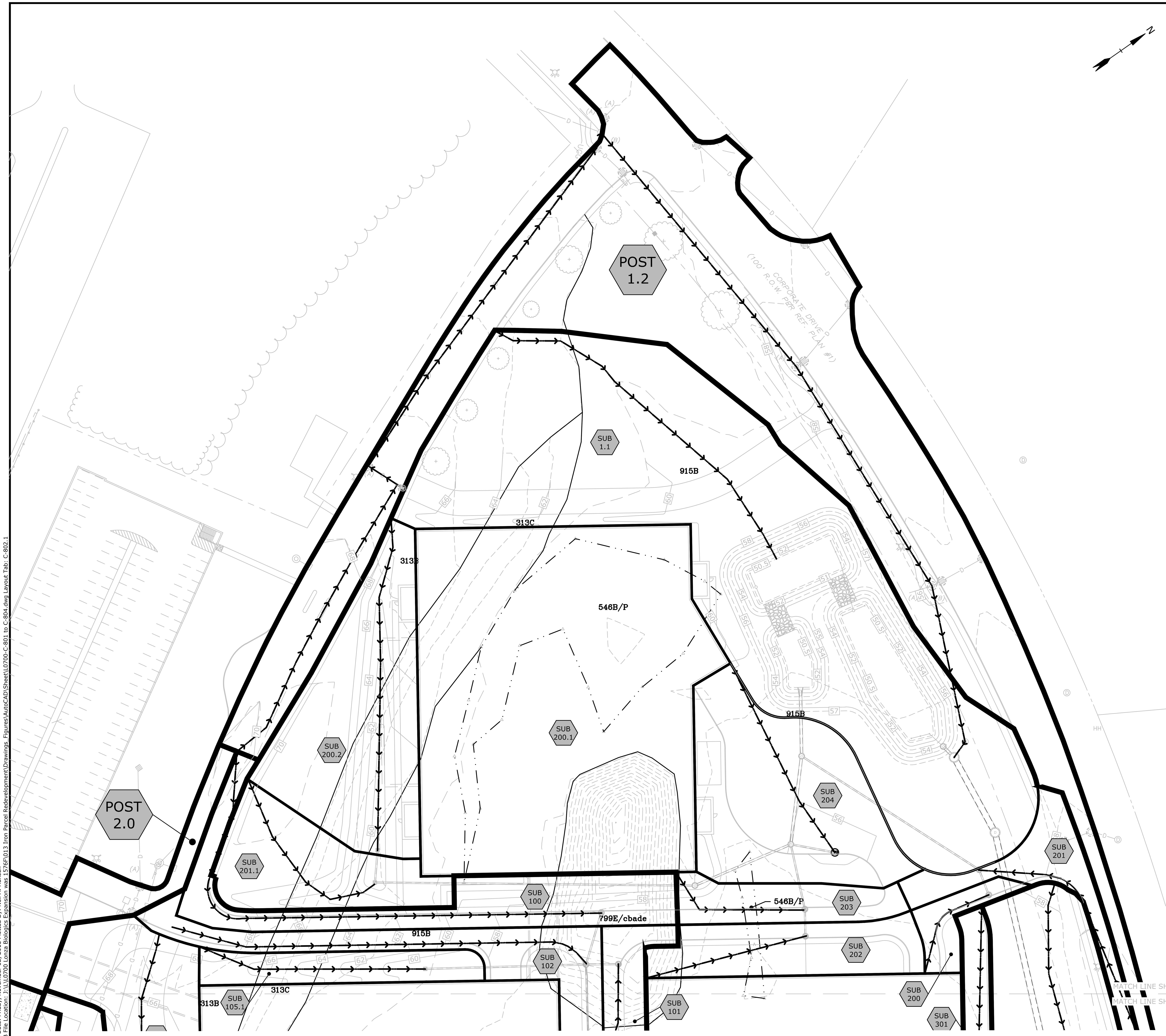
PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT WATERSHED AREA PLAN

SCALE: AS SHOWN

C-802

Last Save Date: November 1, 2018 5:06 PM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-802



LEGEND

POST-DEVELOPMENT WATERSHED BOUNDARY

SOIL SURVEY BOUNDARIES

LONGEST FLOW PATH

POST 1.0 — PRE DEVELOPMENT WATERSHED AREA DESIGNATION

POST POND 1 — POST-DEVELOPMENT POND DESIGNATION

PA-1 — POINT OF ANALYSIS

POST REACH 1 — POST-DEVELOPMENT REACH DESIGNATION

SUB 1 — POST-DEVELOPMENT SUBCATCHMENT AREA DESIGNATION

SOIL IDENTIFICATION LEGEND

SYMBOL	SOIL TAXONOMIC NAME, SLOPE RATING
89C	CHATFIELD, 8 TO 15 PERCENT SLOPES
313B	DEERFIELD, 0 TO 8 PERCENT SLOPES
313C	DEERFIELD, 8 TO 15 PERCENT SLOPES
915B	DEERFIELD VARIANT, 0 TO 8 PERCENT SLOPES
546B/P	WALPOLE POORLY DRAINED, 0 TO 8 PERCENT SLOPES
799B	UDORTHENTS URBAN LAND, 0 TO 8 PERCENT SLOPES
799E	UDORTHENTS URBAN LAND, >25 PERCENT SLOPES

NOTES:

1. SOIL SURVEY WAS PERFORMED BY GOVE ENVIRONMENTAL SERVICES.

SCALE IN FEET
0 40' 80'
GRAPHIC SCALE

Tighe&Bond
Engineers | Environmental Specialists

Proposed Industrial Development

Lonza Biologics

Portsmouth,
New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT SUBCATCHMENT AREA PLAN

SCALE: AS SHOWN

C-802.1

Last Save Date: November 2, 2018 10:33 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-802.1

Tighe&Bond
Engineers | Environmental Specialists

Proposed Industrial Development

Lonza Biologics

Portsmouth,
New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
CHECKED:	PMC
APPROVED:	BLM

POST-DEVELOPMENT SUBCATCHMENT AREA PLAN

SCALE: AS SHOWN

C-802.2

Last Save Date: November 2, 2018 10:33 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-802.2

SCALE IN FEET

0 40' 80'

GRAPHIC SCALE

Proposed Industrial Development

Lonza Biologics

Portsmouth, New Hampshire

MARK	DATE	DESCRIPTION
F	11/6/2018	P.B. Submission
E	8/30/2018	Revised AoT Submission
D	8/21/2018	Revised TAC Submission
C	6/18/2018	NHDES AoT Submission
B	5/21/2018	TAC Submission
A	4/3/2018	TAC W.S. Submission

PROJECT NO:	L-0700-013
DATE:	04/03/2018
FILE:	
DRAWN BY:	NAH
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APPROVED:	BLM

POST-DEVELOPMENT SUBCATCHMENT AREA PLAN

SCALE: AS SHOWN

C-802.3

Last Save Date: November 2, 2018 10:33 AM By: NAHANSEN
Plot Date: Friday, November 02, 2018 Plotted By: Neil A. Hansen
T&B File Location: J:\L\L0700 Lonza Biologics Expansion was 1576F\013 Iron Parcel Redevelopment\Drawings_Figures\AutoCAD\Sheet\L0700-C-801 to C-804.dwg Layout Tab: C-802.3

ALTUS ENGINEERING, INC.

Civil
Site Planning
Environmental
Engineering

133 Court Street
Portsmouth, NH
03801-4413

August 6, 2018

Juliet T. H. Walker, AICP, Planning Director
City of Portsmouth Municipal Complex
Planning Department
1 Junkins Avenue
Portsmouth, New Hampshire 03801

Re: Drainage Review for Lonza Biologics Proposed Industrial Development, 70 & 80 Corporate Drive, Tax Map 305, Lots 1 & 2
Altus Project 4940

Transmitted via email to: jthwalker@cityofportsmouth.com

Dear Juliet:

As requested by the City of Portsmouth Technical Advisory Committee, Altus Engineering, Inc. (Altus) has performed a review of the drainage calculations, plans and documents prepared for the above referenced development as prepared by Tighe & Bond Engineers.

The review is based on the following documents provided to Altus:

- Site plans for the Proposed Industrial Development, 70 & 80 Corporate Drive, Portsmouth, NH, Project No. L-0700-13 prepared by Tighe & Bond with revisions dated through June 18, 2018;
- Iron Parcel Redevelopment, 70 & 80 Corporate Drive, Portsmouth, New Hampshire, Alteration of Terrain Application, Prepared For: Lonza Biologics, 101 International Drive, Portsmouth, New Hampshire, dated June 18, 2018;
- The Restoration of Hodgson Brook at the Iron Rail Parcel at Pease Tradeport in Portsmouth, NH, prepared by Streamworks, PLLC, dated May 28, 2018.

Our review was limited to the following:

- Review of the drainage study and plans as they relate to temporary and permanent erosion control measures;
- Review of the drainage computations for irregularities;
- Review of the on-site restoration plans for Hodgson Brook; and
- Compare the results of the drainage study to City (PDA) requirements and customary engineering practices.

On August 3, 2018, Altus visited the site to familiarize ourselves with the existing site conditions.

Base on our review, we offer the following comments:

General Comments

1. In general, Altus supports the premise to eliminate the closed drainage system across this property to create an open and vegetated channel. With this modification to the watershed, Altus is concerned that there could be unintended consequences that could impact down gradient properties. The Hodgson Brook watershed is highly developed. The flow through the Lonza site is through a series of pipes which allows the runs to pass through the area rapidly. Opening the channel up slows the flow through the system which will delay and impact the overall watershed time of concentration and the peak rate of runoff during storm events. This could create conflicts with the peak rate of flow elsewhere. Streamworks should document as to how this change will impact the rest of the system.

2. The development project is very large and complex and according to the drainage computations over 13.2 acres of new impervious will be created. It is presumed that it will not be constructed in a single phase. As such, it would be prudent for the designer to provide detailed phasing and sequencing plans for both the building and site improvements aspects as well as the stormwater management.

3. The Streamworks report discusses the stream work sequencing. These requirements should also be incorporated into the site plans.

4. It is understood that the stream bed will be constructed in advance of the culvert removal. Special construction considerations need to be discussed on the plans as to how the lower concrete vault (oversized drain manhole) will be removed and the flow maintained.

5. The plans are deficient detailed construction sequencing details and notes that are referenced in the Streamworks report.

Site Plans

6. There is a discrepancy between the survey plans (Doucet sheet 4 of 4) and the grading and drainage plans (Tighe & Bond sheet C-110) for size and shape of the outlet pipes crossing Goose Bay Drive. Please verify which is correct and correct the plans.

7. The grading plans should include spot grades to confirm the subcatchment boundaries.

8. The plans should include locations for temporary sediment basins and other temporary erosion control measures typically seen on major site development projects.

9. The plans should provide documents as to how dewatering will occur on site and any special precautions necessary that are site specific.

10. The project will impact a significant amount of on-site wetlands. There may be an opportunity to reuse the excavated wetland soils for reuse in the gravel wetlands or in the stream channel. Altus has found that one challenge in creating wetlands is establishing the vegetation. The landscape architect and wetlands scientist may want to comment on this opportunity.

11. It appears that the culverts discharging into the gravel wetland forebays will be under tail water conditions. The designer should review this design approach to see if there are any alternative solutions.

Detail Sheets

12. In order to ensure that the gravel wetland water level remains at the desired level a clay or other impervious membrane liner should be provided.

13. The gravel wetland and rain garden planting plans should be stamped by a licensed landscape architect. In addition to the New England Erosion Control/Restoration mix, there are only 2 varieties of plantings in the gravel wetlands. A more diverse variety of plantings is recommended.

14. The Hodgson Brook Wetland Planting Plan should be stamped by a licensed landscape architect. In addition to the Riverbank stabilization mix, only three species of plantings are proposed along the entire corridor.

August 6, 2018

Alteration of Terrain (AOT) Package / Drainage Calculations.

15. The drainage study (AOT package) has not been stamped by the responsible Professional Engineer.

16. The Streamworks Report has not been stamped by the responsible Professional Engineer.

Section 6, BMP Worksheets

17. The name and stamp of the qualified professional who designed the planting plan for the gravel wetlands needs to be provided for all three gravel wetlands.

18. The flow lengths shown for the gravel wetlands do not seem to match the scaled flow lengths shown on the plans. Please review and correct as necessary.

Section 7.2, Pre-Development Conditions

19. The color-coded soil map shows the 500 series soil to be HSG D, however the soil type legend and the soils report indicate that it is HSG C. This should be corrected and the calculations revised to reflect the correct soil type.

20. For the calculation of sheet flow time of concentration, the 2-year rainfall depth should be 3.68 inches to match the depth assumed for the analysis.

21. The analysis is deficient computations for the off-site drainage that flows onto and through the site. It appears that there may be a significant flow coming onto the site from the existing facility. These computations should be included in the analysis in both the pre-and post-development scenarios.

22. The existing triple arch culverts are partially submerged with sediment and are under tail water conditions. It does not appear that the designer took the current field conditions into consideration with their computations.

Section 7.3, Post-Development Conditions

23. As with the pre-development model, the soil types should be corrected to reflect the 500 series soils as HSG C.

24. The Soil Listing for the post-development model should be revised to reflect that much of the site will be developed and the existing soil types will not necessarily remain as they are. Please review and revise as necessary.

25. For the calculation of sheet flow time of concentration, the 2-year rainfall depth should be 3.68 inches to match the depth assumed for the analysis.

26. In general, the time of concentration longest flow path does not match the pipe sizes and slopes depicted on the plans.

27. The site has been modeled as five large subcatchments feeding into either constructed gravel wetlands, a rain garden or the re-constructed Hodgson Brook. Modeling the site in this manner may result in some inaccuracies as the calculated times of concentration are much longer than what would be seen if each structure were modeled as a subcatchment and pond. Additionally, this method does not provide a way to determine if catch basin grate capacity or pipe sizing is adequate. It is recommended that the site be modeled in a more conventional way so as to provide a more detailed analysis of the stormwater management system.

28. Subcatchment Post 1.3 is shown as entering Reach 1.3 (Hodgson Brook) directly, however it will need to pass through the pipe network modeled as Reach 1.2 before it reaches the brook. Please revise.

29. Reach 1.2 is modeled as a 54-inch diameter pipe, however the engineer has not provided calculations to show that this is adequate to convey the existing upstream flows into the system.

30. Reaches 1.2 and 1.3 replace the existing underground culvert that carries Hodgson Brook. The model should reflect the existing brook flow and the anticipated flows from the modeled storms through these reaches.

31. The analysis should include calculations to show that the existing pipes crossing Goose Bay Drive have sufficient capacity to carry the anticipated flows from the site as well as the flows from the Hodgson Brook watershed. The culverts are flowing under tail water conditions.

Section 8, Rip Rap Apron Calculations

32. Please provide rip rap calculations for the outlet at HW 300 (Hodgson Brook). The design should include the flows from the upstream watershed.

Section 11, Long Term Operation & Maintenance Plan

33. The O & M plan should incorporate the recommended maintenance schedule for gravel wetlands contained in the publication "Design and Maintenance of Subsurface Gravel Wetlands" by the UNH Stormwater Center, dated February 4, 2015 or as amended. This document should recorded at the registry of deeds to

ensure that the owner and/or subsequence owners are aware of the maintenance requirements.

34. The O&M Plan should include the recommendations for the maintenance of the reconstructed Hodgson Brook.

Appendix B, Soil Report and Boring Logs

35. Provide boring logs for the test pits in the vicinity of the proposed gravel wetlands so as to verify the assumed seasonal high water shown in the BMP worksheets (TP-1, 2, 17 and 18).

We look forward to discussing the above with the project representatives and resolving all issues prior to final approval of the plan.

Please contact Altus to discuss any of the above comments or, if preferred, to set up a meeting to resolve any of the above issues.

Respectfully submitted,

Altus Engineering, Inc.

Dennis Moulton, PE
Project Engineer

Eric D. Weinrieb, PE
President

Wde/4940 review letter.docx

PROPOSED IRON PARCEL REDEVELOPMENT PROJECT - PEER REVIEW COMMENT RESPONSE **Date: November 6, 2018**

City of Portsmouth Third Party Review, Altus Engineering, September 3, 2018:			
	Altus Engineering Comment	**Applicant Response**	**Sheet**
General Comments:			
1	The applicant generally concurs with our comment above. However, they dispute that the modifications may have an adverse impact on the overall watershed. They have not provided any computations confirm their findings. Altus strongly believes that the applicant needs to substantiate their findings.	Streamwork's, LLC, the project's stream design consultant, has completed an overall watershed model for upper Hodgson Brook at the request of Altus. The findings are in the enclosed "Watershed Modeling for Hodgson Brook" memo. Detailed results of the watershed modeling substantiate Streamwork's response to the original peer review letter regarding the benefits of the stream. Regarding a storm hydrograph, the stream restoration will reduce peak flow times and increase time of concentration.	N/A
2	Altus supports the approach discussed in the DTC letter. It is our opinion that the phasing needs to be carefully vetted by the City to ensure that there are no adverse impacts to down gradient properties during the interim development phases.	The applicant agrees to develop a phasing agreement with the City that will require all phases subsequent to Phase 1B be submitted for Amended Site Plan Review with noticed TAC and Planning Board public hearings.	N/A
Site Plans:			
3	The multi-phased project will require detailed temporary erosion measures that are beyond the routine development project. The implementation of the basins and timing will be critical to stabilizing the site and should be included during permitting.	Erosion control measures including sedimentation basin locations are shown on the phasing drawings included in the revised plan set.	Sheets C-108 to C-110, C-128 to C-130, C-148 to C-150
4	The findings for all of the environmental studies should be provided to the City for their review as the City will be recipient of the receiving waters.	The applicant has retained Tighe & Bond to perform environmental services for the parcel. A detailed Environmental Assessment was conducted in various stages from April 2018 to October 2018. This assessment is being compiled and coordinated with NHDES and PDA in order to develop a Soil and Groundwater Management Plan for construction. A copy of the Soil and Groundwater Management Plan will be provided to the City upon completion.	N/A
5	Altus respectfully disagrees with the designer's response that there are no alternatives to the design that would avoid the culverts being designed with a tailwater condition.	Several alternatives were looked at in an effort to raise the elevation of the pipes discharging into the gravel wetlands. The site's topography limits pipe cover in the upstream drainage pipe network which prohibits the ability to raise the gravel wetland inlet elevations. The drainage pipes on-site have been appropriately sized to account for a tailwater condition in the gravel wetlands. NHDES has reviewed design and granted an Alteration of Terrain Permit.	Sheets C-108 to C-110
Detail Sheets:			
6	Altus respectfully disagrees with the designer. Complex planting beds and large gravel wetlands should be designed by professionals experienced in wetland plantings.	The gravel wetland planting plans and rain garden planting plan have been reviewed and stamped by a Certified Wetland Scientist.	Sheets C-507 to C-509
7	Altus respectfully disagrees with the designer. The revegetation of a complex wetland system and stream bank should be designed by professionals experienced in wetland restoration.	The Hodgson Brook restoration planting plan is included in the stamped Hodgson Brook Restoration Report prepared by Streamworks, PLLC. Streamworks are the designers of the planting plan and are experts in stream restoration design. Working with Streamworks, Tighe & Bond has incorporated this planting plan into the plan set.	C-702
Alteration of Terrain (AoT) Package/Drainage Calculations:			
8	The Streamworks Report has not been stamped by the responsible Professional Engineer.	The Streamworks Report has been stamped by the responsible Professional Engineer.	N/A
	Section 6, BMP Worksheets:		
9	See comments above regarding landscape architect.	The gravel wetland planting plans have been stamped by a Certified Wetland Scientist.	C-507 & C-508
	Section 7.2, Pre-Development Conditions:		
10	It has been reported to Altus by City Staff that there is runoff from the existing Lonza development that discharges across Goose Bay Drive onto the subject property . Either the situation needs to be corrected or the flow accounted for in the analysis.	The runoff from the existing Lonza facility that discharges into Goose Bay Drive has been reviewed by Lonza and is in the process of being corrected by Lonza as part the on-going work that is occurring at the existing facility.	N/A

ALTUS ENGINEERING, INC.

Civil
Site Planning
Environmental
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133 Court Street
Portsmouth, NH
03801-4413

September 3, 2018

Juliet T. H. Walker, AICP, Planning Director
City of Portsmouth Municipal Complex
Planning Department
1 Junkins Avenue
Portsmouth, New Hampshire 03801

Re: Follow up Drainage Review for Lonza Biologics Proposed Industrial Development, 70 & 80 Corporate Drive, Tax Map 305, Lots 1 & 2
Altus Project 4940

Transmitted via email to: jthwalker@cityofportsmouth.com

Dear Juliet:

As requested by the City of Portsmouth Technical Advisory Committee, Altus Engineering, Inc. (Altus) has performed a review of the drainage calculations, plans and documents prepared for the above referenced development as prepared by Tighe & Bond Engineers.

The review is based on the following documents provided to Altus on August 28, 2018:

- Site plans for the Proposed Industrial Development, 70 & 80 Corporate Drive, Portsmouth, NH, Project No. L-0700-13 prepared by Tighe & Bond with revisions dated through August 21, 2018;
- Iron Parcel Redevelopment, 70 & 80 Corporate Drive, Portsmouth, New Hampshire, Alteration of Terrain Application, Prepared For: Lonza Biologics, 101 International Drive, Portsmouth, New Hampshire, dated August 21, 2018;
- The Restoration of Hodgson Brook at the Iron Rail Parcel at Pease Tradeport in Portsmouth, NH, prepared by Streamworks, PLLC, dated May 28, 2018;
- Cover letter from DTC dated August 21, 2018
- Unsigned Peer Review Response dated August 21, 2018

Our follow up review was limited to the following:

- Review of the drainage study and plans as they relate to temporary and permanent erosion control measures;
- Review of the drainage computations for irregularities;
- Review of the on-site restoration plans for Hodgson Brook; and
- Compare the results of the drainage study to City (PDA) requirements and customary engineering practices.

On August 3, 2018, Altus visited the site to familiarize ourselves with the existing site conditions.

After review of the above documents, Altus submits the following comments and recommendations for the TAC Committee's consideration. Comments are organized by document and regulation to facilitate the review. Several of the earlier items have been satisfactorily addressed and have been dropped from the list. Below is the list of the remaining issues and their status in italics following.

General Comments

1. In general, Altus supports the premise to eliminate the closed drainage system across this property to create an open and vegetated channel. With this modification to the watershed, Altus is concerned that there could be unintended consequences that could impact down gradient properties. The Hodgson Brook watershed is highly developed. The flow through the Lonza site is through a series of pipes which allows the runs to pass through the area rapidly. Opening the channel up slows the flow through the system which will delay and impact the overall watershed time of concentration and the peak rate of runoff during storm events. This could create conflicts with the peak rate of flow elsewhere. Streamworks should document as to how this change will impact the rest of the system. **Open issue.**

   The applicant generally concurs with our comment above. However, they dispute that the modifications may have an adverse impact on the overall watershed. They have not provided any computations confirm their findings. Altus strongly believes that the applicant needs to substantiate their findings.

2. The development project is very large and complex and according to the drainage computations over 13.2 acres of new impervious will be created. It is presumed that it will not be constructed in a single phase. As such, it would be prudent for the designer to provide detailed phasing and sequencing plans for both the building

and site improvements aspects as well as the stormwater management. **Partially addressed.**

Altus supports the approach discussed in the DTC letter. It is our opinion that the phasing needs to be carefully vetted by the City to ensure that there are no adverse impacts to down gradient properties during the interim development phases.

Site Plans

3. The plans should include locations for temporary sediment basins and other temporary erosion control measures typically seen on major site development projects. **Open issue.**

   The multi-phased project will require detailed temporary erosion measures that are beyond the routine development project. The implementation of the basins and timing will be critical to stabilizing the site and should be included during permitting.

4. The plans should provide documents as to how dewatering will occur on site and any special precautions necessary that are site specific. **Open issue.**

   The findings for all of the environmental studies should be provided to the City for their review as the City will be recipient of the receiving waters.

5. It appears that the culverts discharging into the gravel wetland forebays will be under tail water conditions. The designer should review this design approach to see if there are any alternative solutions. **Open issue.**

   Altus respectfully disagrees with the designer's response that there are no alternatives to the design that would avoid the culverts being designed with a tailwater condition.

Detail Sheets

6. The gravel wetland and rain garden planting plans should be stamped by a licensed landscape architect. In addition to the New England Erosion Control/Restoration mix, there are only 2 varieties of plantings in the gravel wetlands. A more diverse variety of plantings is recommended. **Open issue.**

   Altus respectfully disagrees with the designer. Complex planting beds and large gravel wetlands should be designed by professionals experienced in wetland plantings.

7. The Hodgson Brook Wetland Planting Plan should be stamped by a licensed landscape architect. In addition to the Riverbank stabilization mix, only three species of plantings are proposed along the entire corridor. **Open issue.**

   Altus respectfully disagrees with the designer. The revegetation of a complex wetland system and stream bank should be designed by professionals experienced in wetland restoration.

Alteration of Terrain (AOT) Package / Drainage Calculations.

8. The Streamworks Report has not been stamped by the responsible Professional Engineer. **Open issue.**

Section 6, BMP Worksheets

9. The name and stamp of the qualified professional who designed the planting plan for the gravel wetlands needs to be provided for all three gravel wetlands. **Open issue.**

   See comments above regarding landscape architect.

Section 7.2, Pre-Development Conditions

10. The analysis is deficient computations for the off-site drainage that flows onto and through the site. It appears that there may be a significant flow coming onto the site from the existing facility. These computations should be included in the analysis in both the pre-and post-development scenarios. **Open issue.**

    It has been reported to Altus by City Staff that there is runoff from the existing Lonza development that discharges across Goose Bay Drive onto the subject property. Either the situation needs to be corrected or the flow accounted for in the analysis.

11. The existing triple arch culverts are partially submerged with sediment and are under tail water conditions. It does not appear that the designer took the current field conditions into consideration with their computations. **Open issue.**

    Regardless of whether the designer models the runoff at the outlet or the inlet of the triple culvert, the designer needs to account for the tailwater conditions as the flow will continue to back up possibly create flooding conditions.

Section 7.3, Post-Development Conditions

12. Reach 1.2 is modeled as a 54-inch diameter pipe, however the engineer has not provided calculations to show that this is adequate to convey the existing upstream flows into the system. **Open issue.**

    It appears that the Streamworks Hodgson Brook flow base data was arrived at using an analysis of other watersheds which in our opinion is appropriate for the restoration design. Altus remains of the opinion that the overall watershed needs to be analyzed using the NHDES design criteria runoff events.

13. Reaches 1.2 and 1.3 replace the existing underground culvert that carries Hodgson Brook. The model should reflect the existing brook flow and the anticipated flows from the modeled storms through these reaches. **Open issue.**

    The designer has provided a base flow for Hodgson Brook without documentation on the when the peak flow will occur. It is Altus' opinion that the flow data needs to be looked at closer by the designer. As presented, in the predevelopment conditions,10-year storm event, there will be peak flow 51 CFS generated from the site. The off-site contribution from the Hodgson Brook watershed will be only 15.5 CFS. Thus, the site runoff more than 3 times the remaining portion of the overall watershed. It is imperative to understand when the peak flows are occurring the storm events to ensure that the delay in the post development conditions does not create unintended flooding. The design makes no assumptions on when the brook watershed peak flow will occur.

14. The analysis should include calculations to show that the existing pipes crossing Goose Bay Drive have sufficient capacity to carry the anticipated flows from the site as well as the flows from the Hodgson Brook watershed. The culverts are flowing under tail water conditions. **Open issue.**

    As noted above, by not analyzing the flow in the culvert and not accounting for the tailwater conditions, the designer has not assured us that the flow will not overtop the roadway. Additionally, the designer needs to examine the head losses at the culvert entrance as the stream flow needs to make a 90 degree turn to enter the cross culverts.

Section 11, Long Term Operation & Maintenance Plan

15. The O & M plan should incorporate the recommended maintenance schedule for gravel wetlands contained in the publication "Design and Maintenance of Subsurface Gravel Wetlands" by the UNH Stormwater Center, dated February 4, 2015 or as amended. This document should recorded at the registry of deeds to

September 3, 2018

ensure that the owner and/or subsequence owners are aware of the maintenance requirements. **Open issue.**

Our copy of the O & M plan does not include the additional maintenance requirements for the gravel wetlands. It is Altus' opinion that the City have some mechanism in the approval to ensure that the Owner properly maintains the stormwater management system including the restored portion of Hodgson Brook.

We look forward to discussing the above with the project representatives and resolving all issues prior to final approval of the plan.

Please contact Altus to discuss any of the above comments or, if preferred, to set up a meeting to resolve any of the above issues.

Respectfully submitted,

Altus Engineering, Inc.

Eric D. Weinrieb, PE
President

Wde/4940 review letter-2

11	Regardless of whether the designer models the runoff at the outlet or the inlet of the triple culvert, the designer needs to account for the tailwater conditions as the flow will continue to back up possibly create flooding conditions.	A tailwater condition was incorporated into the site's HydroCAD model at the triple culvert discharging to the roadside swale along Goose Bay Drive. The tailwater elevations were determined by Streamworks, PLLC as part of the overall watershed analysis. These findings are discussed in the enclosed "Watershed Modeling for Hodgson Brook" memo prepared by Streamworks, PLLC.	N/A
	Section 7.3, Post-Development Conditions:		
12	It appears that the Streamworks Hodgson Brook flow base data was arrived at using an analysis of other watersheds which in our opinion is appropriate for the restoration design. Altus remains of the opinion that the overall watershed needs to be analyzed using the NHDES design criteria runoff events.	As noted above, Streamwork's, LLC has completed an overall watershed model for upper Hodgson Brook at the request of Altus. The findings are in the enclosed "Watershed Modeling for Hodgson Brook" memo. Subsequent consultations with Altus have further clarified that this comment is related to the proposed 54-inch pipe that will convey the upstream Hodgson Brook flow and the new flow coming out of proposed Gravel Wetland 2 into the proposed stream. The proposed condition was modeled as part of the SWMM model as detailed in the memo. The existing culvert that conveys the Hodgson Brook flow through the site is 48-inch. The proposed 54-inch culvert is sized appropriately to convey the upstream Hodgson Brook flow and the additional flow generated by Gravel Wetland 2 which is approximately 30 CFS during the 100-yr event. It should be noted that the upstream Hodgson Brook peak flows do not coincide with proposed Gravel Wetland 2 peak flows during the larger storm events (the amount of attenuation from the upstream infrastructure is quite large, though the volume of runoff is not reduced much).	N/A
13	The designer has provided a base flow for Hodgson Brook without documentation on the when the peak flow will occur. It is Altus ' opinion that the flow data needs to be looked at closer by the designer. As presented, in the predevelopment conditions, 10-year storm event, there will be peak flow 51 CFS generated from the site. The off-site contribution from the Hodgson Brook watershed will be only 15.5 CFS. Thus, the site runoff more than 3 times the remaining portion of the overall watershed. It is imperative to understand when the peak flows are occurring the storm events to ensure that the delay in the post development conditions does not create unintended flooding. The design makes no assumptions on when the brook watershed peak flow will occur.	In lieu of a constant base flow previously provided in the HydroCAD model, a constant tailwater condition has been added at PDMH203 (inlet to the site for Hodgson Brook) and the existing roadside swale along Goose Bay Drive (outlet from the site for Hodgson Brook). The constant tailwater condition included in the HydroCAD model is the elevation of the brook at those locations during the peak hour of a storm event as determined by Streamworks, PLLC in their overall watershed analysis. It should be noted that the peak of the brook does not coincide with peak of the on-site drainage. Thus, plugging in the peak brook elevation during a storm event as a constant is conservative approach to analyzing impacts from the brook's tailwater conditions. As demonstrated in the revised on-site HydroCAD model calculations, on-site flooding does not occur even with this conservative approach to modeling tailwater conditions.	N/A
14	As noted above, by not analyzing the flow in the culvert and not accounting for the tailwater conditions, the designer has not assured us that the flow will not overtop the roadway. Additionally, the designer needs to examine the head losses at the culvert entrance as the stream flow needs to make a 90 degree turn to enter the cross culverts.	These culverts are not to be altered; their condition as they are is to remain the same. Overall, upstream storage is set to increase, and the expected return period flows are to decrease. The overall watershed analysis performed by Streamworks, PLLC shows that the proposed conditions perform better with respect to flood stages than the existing conditions. These findings are discussed in detail in the attached "Watershed Modeling for Hodgson Brook" memo prepared by Streamworks, PLLC.	N/A
	Section 11, Long Term Operation and Maintenance Plan		
15	Our copy of the O & M plan does not include the additional maintenance requirements for the gravel wetlands. It's Altus' opinion that the City have some mechanism in the approval to ensure that the Owner properly maintains the stormwater management system including the restored portion of Hodgson Brook.	Section 11 in the drainage analysis includes all maintenance requirements for the gravel wetlands based on the recommendations by the UNH Stormwater center. Per Section 11.4.4, "A log of all preventative and corrective measures for the stormwater system shall be kept on-site and be made available upon request by any public entity with administrative, health environmental or safety authority over the site including NHDES". This would include the City of Portsmouth and the PDA.	N/A