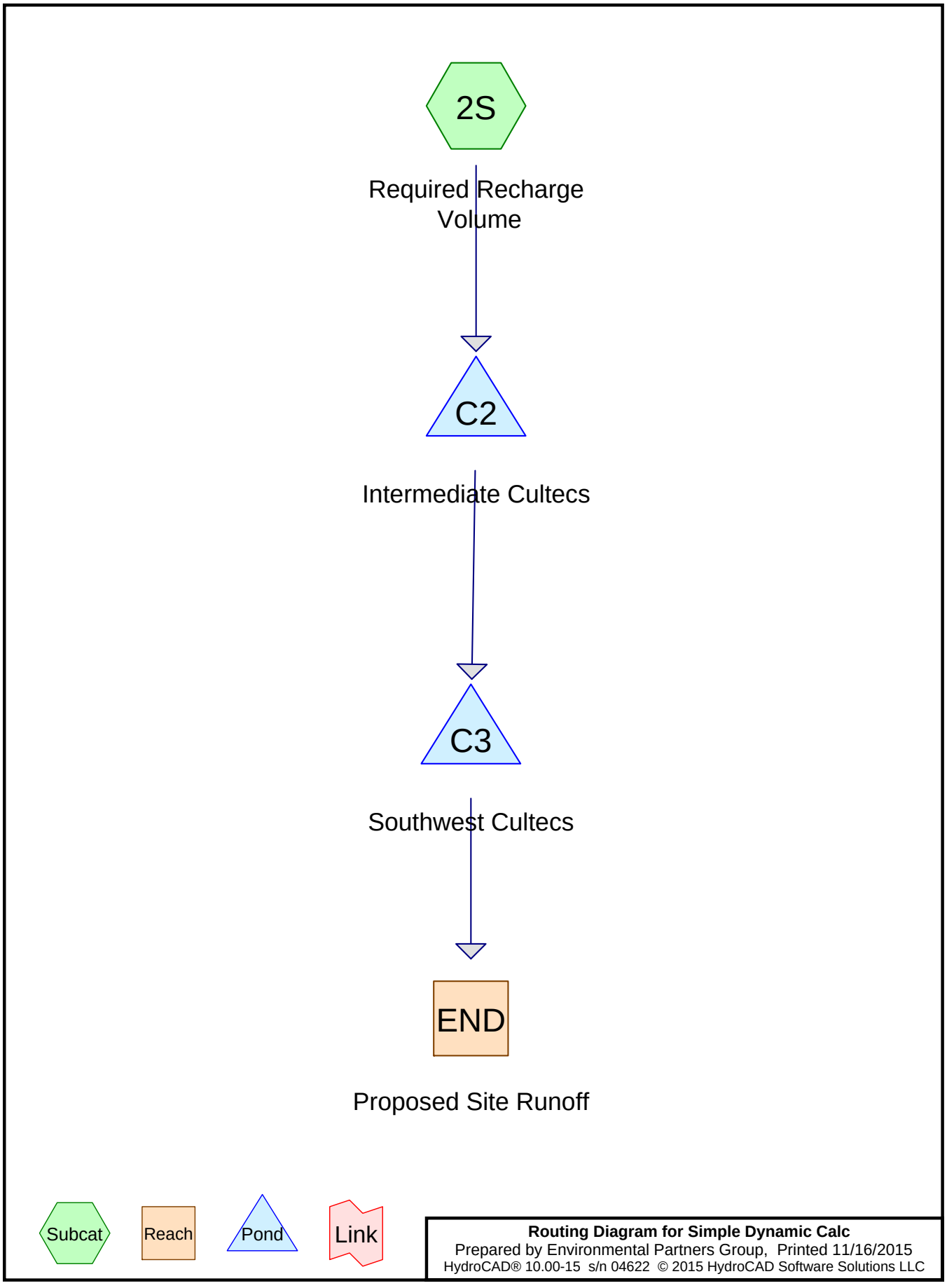

2S
Required Recharge Volume
C2
Intermediate Cultecs
C3
Southwest Cultecs
END
Proposed Site Runoff
Subcat
Reach
Pond
Link
Routing Diagram for Simple Dynamic Calc
Prepared by Environmental Partners Group, Printed 11/16/2015
HydroCAD® 10.00-15 s/n 04622 © 2015 HydroCAD Software Solutions LLC

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C2	230.00	230.00	10.0	0.0000	0.012	8.0	0.0	0.0
2	C3	230.61	230.41	20.0	0.0100	0.012	8.0	0.0	0.0

Time span=11.00-13.00 hrs, dt=0.02 hrs, 101 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 2S: Required Recharge Runoff Area=5,205 sf 100.00% Impervious Runoff Depth>4.06"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.95 cfs 1,761 cf

Reach END: Proposed Site Runoff Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond C2: Intermediate Cultecs Peak Elev=230.78' Storage=440 cf Inflow=0.95 cfs 1,761 cf
Discarded=0.07 cfs 420 cf Primary=0.76 cfs 1,011 cf Outflow=0.83 cfs 1,431 cf

Pond C3: Southwest Cultecs Peak Elev=230.55' Storage=0.015 af Inflow=0.76 cfs 1,011 cf
Discarded=0.12 cfs 463 cf Primary=0.00 cfs 0 cf Outflow=0.12 cfs 463 cf

Total Runoff Area = 5,205 sf Runoff Volume = 1,761 cf Average Runoff Depth = 4.06"
0.00% Pervious = 0 sf 100.00% Impervious = 5,205 sf

Summary for Subcatchment 2S: Required Recharge Volume

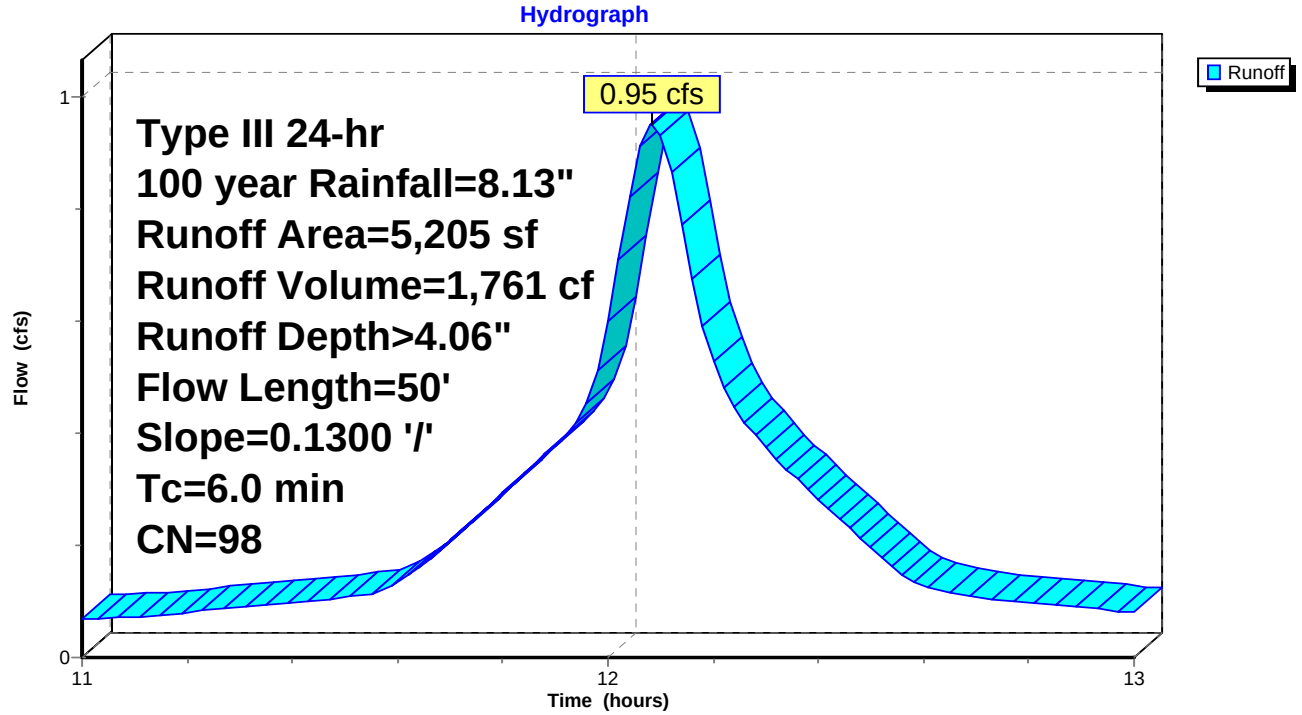
Runoff = 0.95 cfs @ 12.08 hrs, Volume= 1,761 cf, Depth> 4.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
5,205	98	Roofs, HSG A
5,205		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Required Recharge Volume



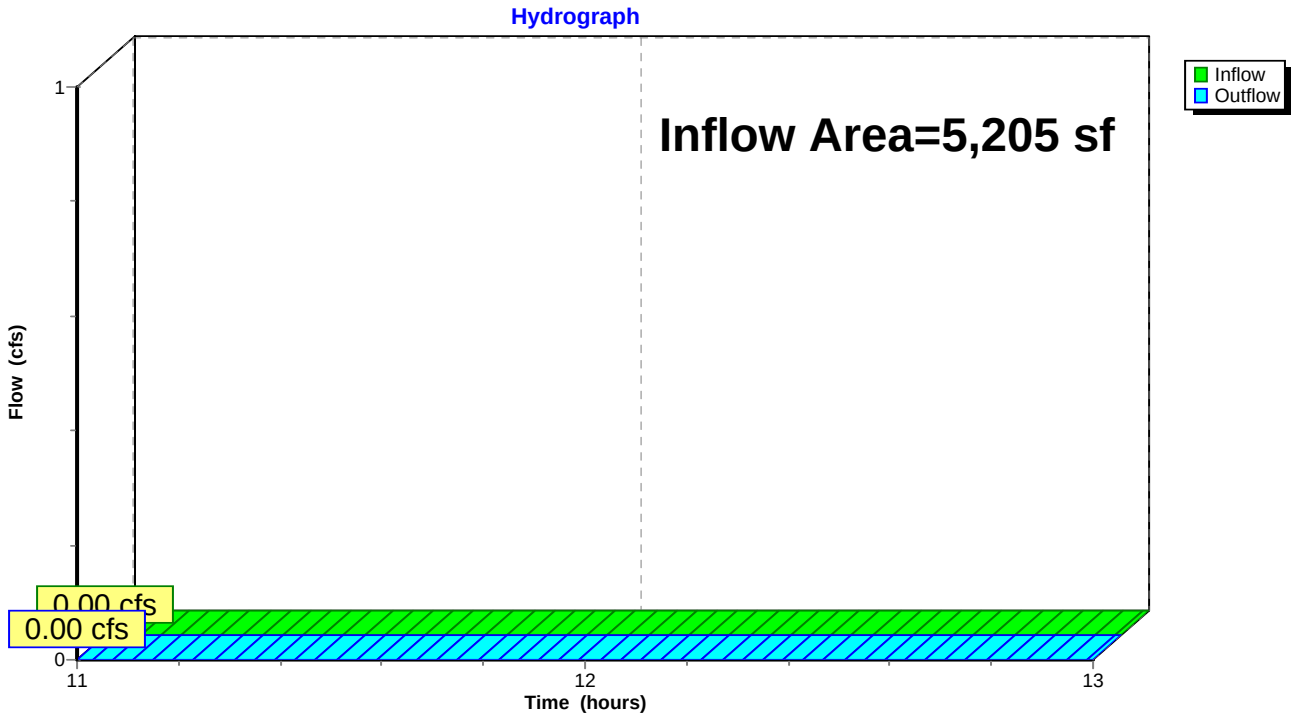
Summary for Reach END: Proposed Site Runoff

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5,205 sf,100.00% Impervious, Inflow Depth = 0.00" for 100 year event
Inflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs

Reach END: Proposed Site Runoff



Summary for Pond C2: Intermediate Cultecs

[82] Warning: Early inflow requires earlier time span

Inflow Area = 5,205 sf,100.00% Impervious, Inflow Depth > 4.06" for 100 year event
Inflow = 0.95 cfs @ 12.08 hrs, Volume= 1,761 cf
Outflow = 0.83 cfs @ 12.13 hrs, Volume= 1,431 cf, Atten= 13%, Lag= 2.8 min
Discarded = 0.07 cfs @ 12.13 hrs, Volume= 420 cf
Primary = 0.76 cfs @ 12.13 hrs, Volume= 1,011 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.78' @ 12.13 hrs Surf.Area= 392 sf Storage= 440 cf
Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 14.6 min calculated for 1,416 cf (80% of inflow)
Center-of-Mass det. time= 7.2 min (731.2 - 723.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	**16.00'W x 24.50'L x 4.54'H Field A** 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	**5.100 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	230.00'	**8.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 12.13 hrs HW=230.77' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.76 cfs @ 12.13 hrs HW=230.77' TW=229.92' (Dynamic Tailwater)
2=Culvert (Barrel Controls 0.76 cfs @ 2.35 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

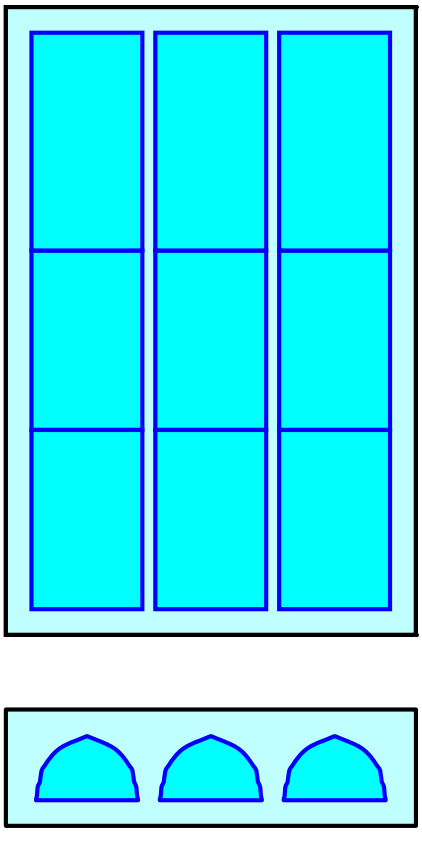
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

9 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 502.9 cf Chamber Storage

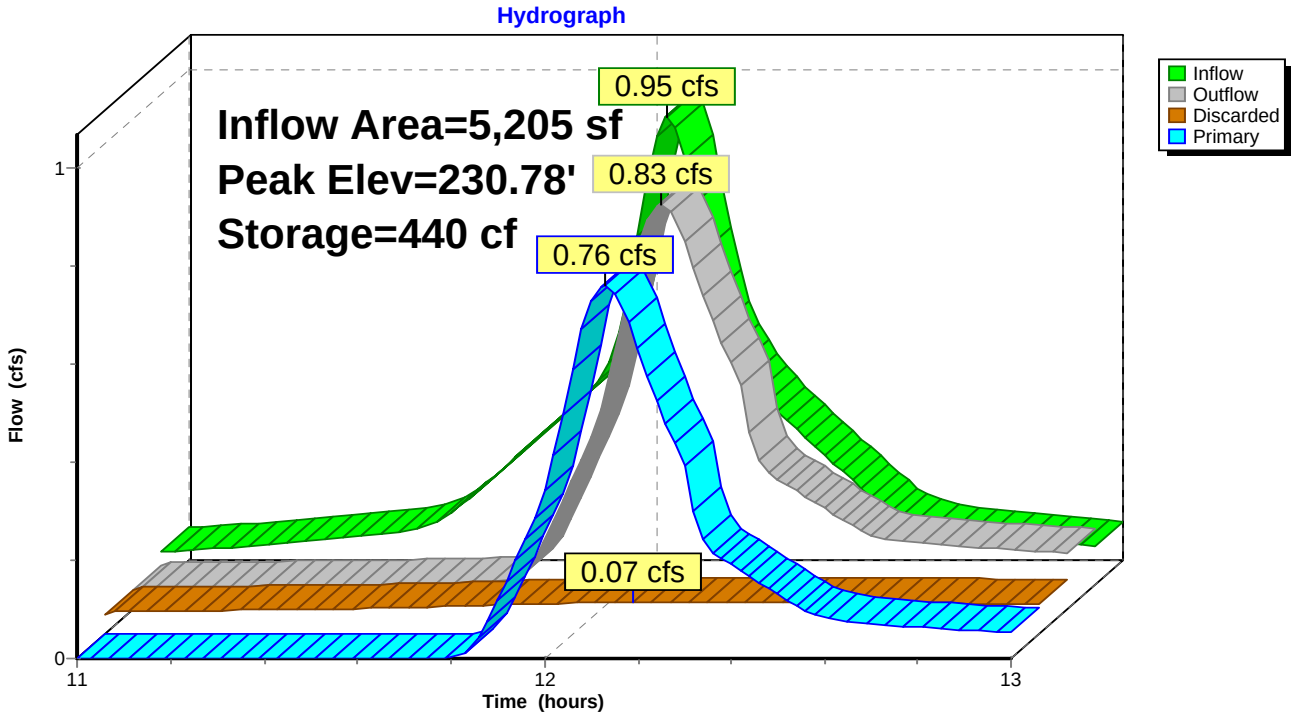
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

Inflow Area = 5,205 sf,100.00% Impervious, Inflow Depth > 2.33" for 100 year event
Inflow = 0.76 cfs @ 12.13 hrs, Volume= 1,011 cf
Outflow = 0.12 cfs @ 12.52 hrs, Volume= 463 cf, Atten= 84%, Lag= 23.2 min
Discarded = 0.12 cfs @ 12.52 hrs, Volume= 463 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.55' @ 12.52 hrs Surf.Area= 0.017 ac Storage= 0.015 af

Plug-Flow detention time= 23.8 min calculated for 459 cf (45% of inflow)
Center-of-Mass det. time= 13.4 min (747.8 - 734.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	**6.33'W x 24.50'L x 3.71'H Field A** 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	**Cultec R-330XLHD** x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	**11.17'W x 52.50'L x 3.71'H Field B** 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	**Cultec R-330XLHD** x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	**5.100 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	230.61'	**8.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.61' / 230.41' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.12 cfs @ 12.52 hrs HW=230.55' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=229.07' TW=0.00' (Dynamic Tailwater)
2=Culvert (Controls 0.00 cfs)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

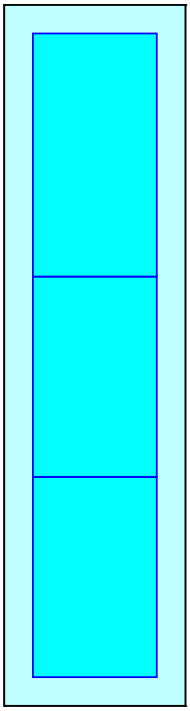
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

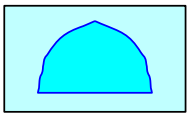
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

575.4 cf Field - 167.6 cf Chambers = 407.8 cf Stone x 35.0% Voids = 142.7 cf Stone Storage

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

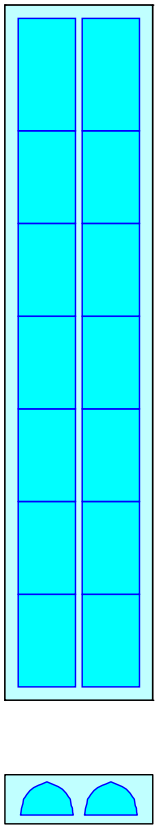
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

14 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 2 Rows = 752.6 cf Chamber Storage

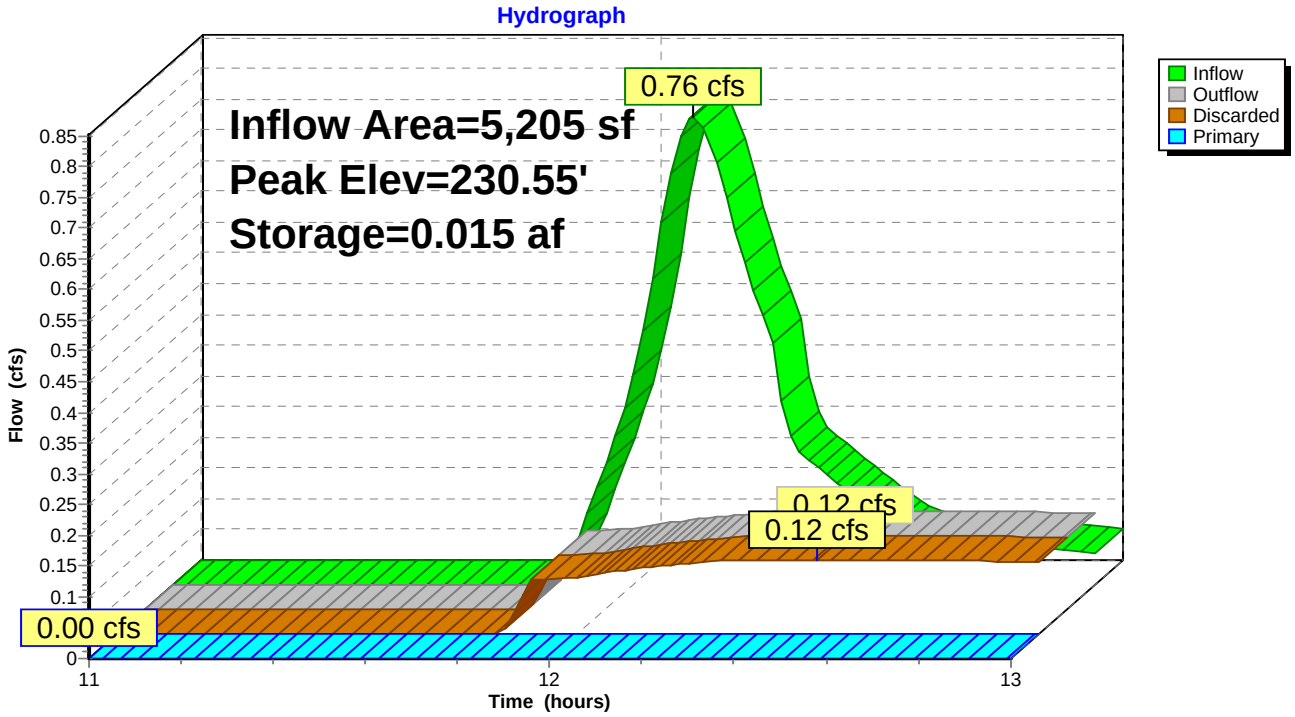
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



ATTACHMENT E
STANDARD 4 WATER QUALITY CALCULATIONS

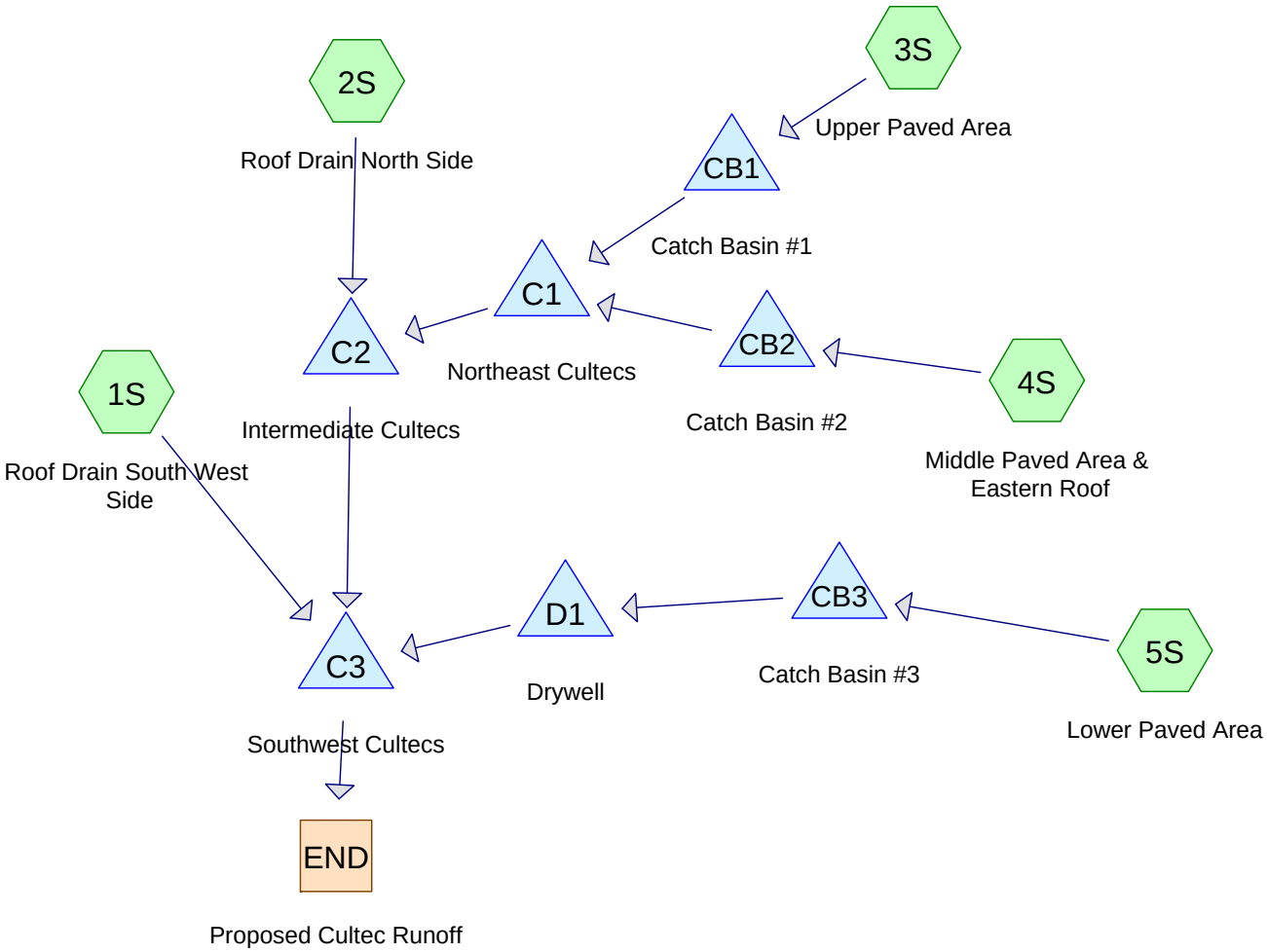
Standard 4 Stormwater Calculations:

Water Quality Treatment Volume

Vwq(cf)=(1/12)*impervious area

Imperv. Area (sf)= 29,656.87

V_{WQ}(cf)=	**2471.41**



Subcat Reach Pond Link

Routing Diagram for WQ Volume Calc

Prepared by Environmental Partners Group, Printed 11/16/2015

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C1	231.67	230.95	145.0	0.0050	0.012	4.0	0.0	0.0
2	C1	232.33	231.44	145.0	0.0061	0.012	8.0	0.0	0.0
3	C2	230.00	230.00	10.0	0.0000	0.012	8.0	0.0	0.0
4	C3	230.68	230.48	20.0	0.0100	0.012	8.0	0.0	0.0
5	CB1	232.95	231.75	20.0	0.0600	0.012	6.0	0.0	0.0
6	CB2	232.95	231.75	75.0	0.0160	0.012	6.0	0.0	0.0
7	CB3	232.95	232.38	115.0	0.0050	0.012	6.0	0.0	0.0
8	D1	231.25	231.00	5.0	0.0500	0.012	6.0	0.0	0.0

Time span=11.00-13.00 hrs, dt=0.02 hrs, 101 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 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth>1.50"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.19 cfs 345 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth>1.50"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.22 cfs 405 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth>0.93"
Tc=6.0 min CN=85 Runoff=0.45 cfs 797 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth>1.50"
Tc=6.0 min CN=98 Runoff=0.29 cfs 530 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth>1.50"
Tc=6.0 min CN=98 Runoff=0.27 cfs 496 cf

Reach END: Proposed Cultec Runoff Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond C1: Northeast Cultecs Peak Elev=232.05' Storage=0.021 af Inflow=0.74 cfs 1,286 cf
Discarded=0.00 cfs 0 cf Primary=0.15 cfs 433 cf Outflow=0.15 cfs 433 cf

Pond C2: Intermediate Cultecs Peak Elev=230.36' Storage=315 cf Inflow=0.25 cfs 838 cf
Discarded=0.05 cfs 275 cf Primary=0.13 cfs 246 cf Outflow=0.18 cfs 522 cf

Pond C3: Southwest Cultecs Peak Elev=230.35' Storage=0.012 af Inflow=0.45 cfs 994 cf
Discarded=0.09 cfs 472 cf Primary=0.00 cfs 0 cf Outflow=0.09 cfs 472 cf

Pond CB1: Catch Basin #1 Peak Elev=233.56' Storage=27 cf Inflow=0.45 cfs 797 cf
6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/' Outflow=0.45 cfs 776 cf

Pond CB2: Catch Basin #2 Peak Elev=233.35' Storage=24 cf Inflow=0.29 cfs 530 cf
6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/' Outflow=0.29 cfs 510 cf

Pond CB3: Catch Basin #3 Peak Elev=233.34' Storage=24 cf Inflow=0.27 cfs 496 cf
6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/' Outflow=0.27 cfs 476 cf

Pond D1: Drywell Peak Elev=231.63' Storage=35 cf Inflow=0.27 cfs 476 cf
Discarded=0.01 cfs 44 cf Primary=0.26 cfs 404 cf Outflow=0.27 cfs 448 cf

Total Runoff Area = 24,430 sf Runoff Volume = 2,573 cf Average Runoff Depth = 1.26"
12.67% Pervious = 3,095 sf 87.33% Impervious = 21,335 sf

Summary for Subcatchment 1S: Roof Drain South West Side

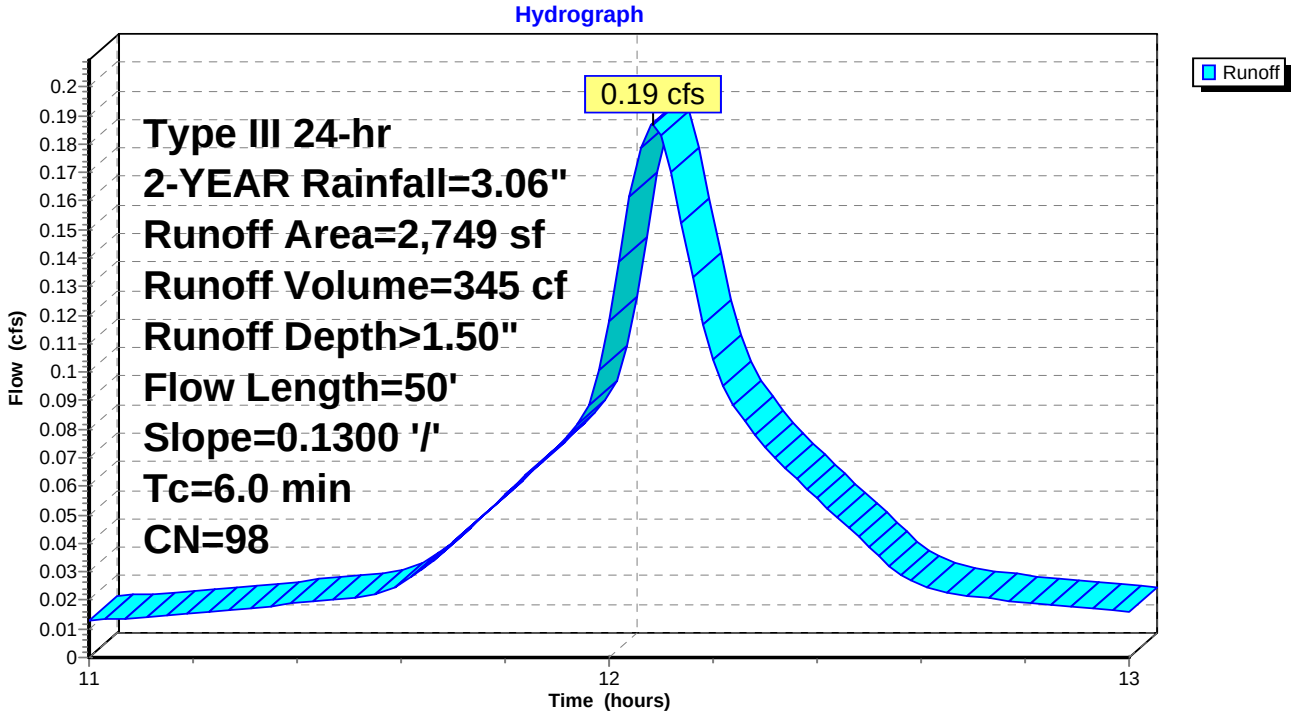
Runoff = 0.19 cfs @ 12.08 hrs, Volume= 345 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side



Summary for Subcatchment 2S: Roof Drain North Side

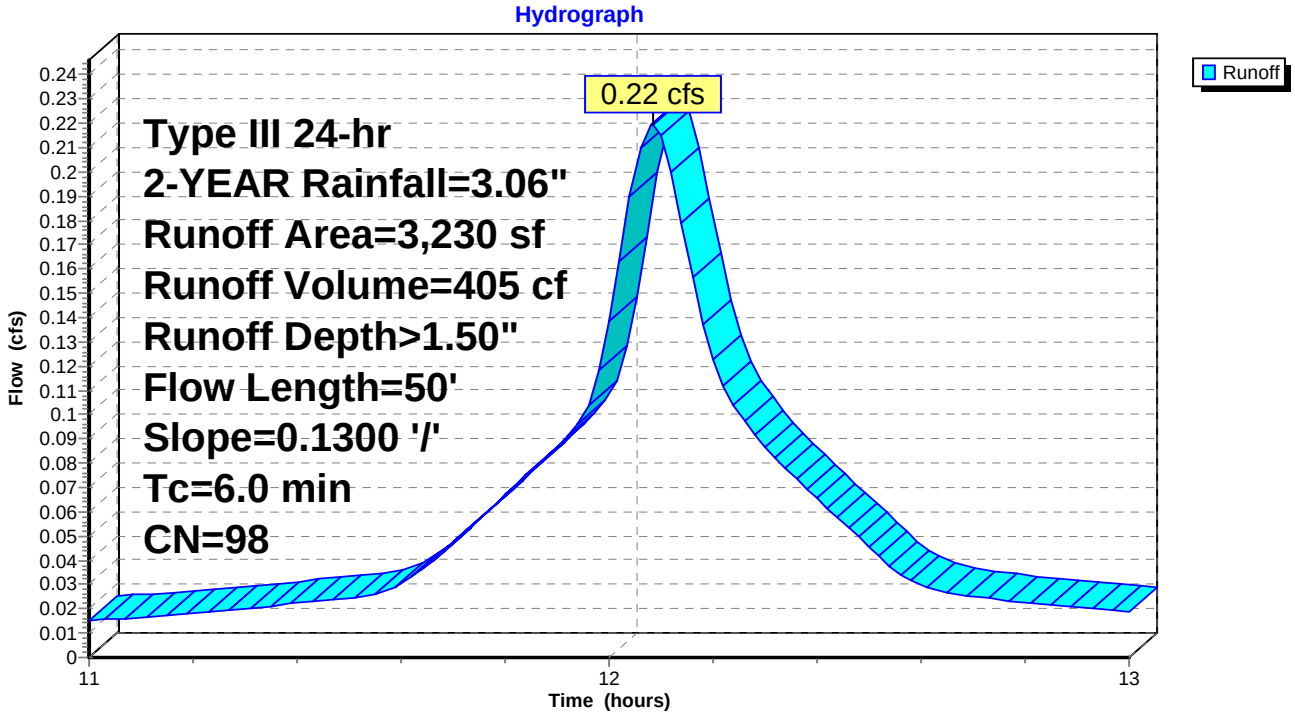
Runoff = 0.22 cfs @ 12.08 hrs, Volume= 405 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		**Sheet Flow, sheet flow** Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side



Summary for Subcatchment 3S: Upper Paved Area

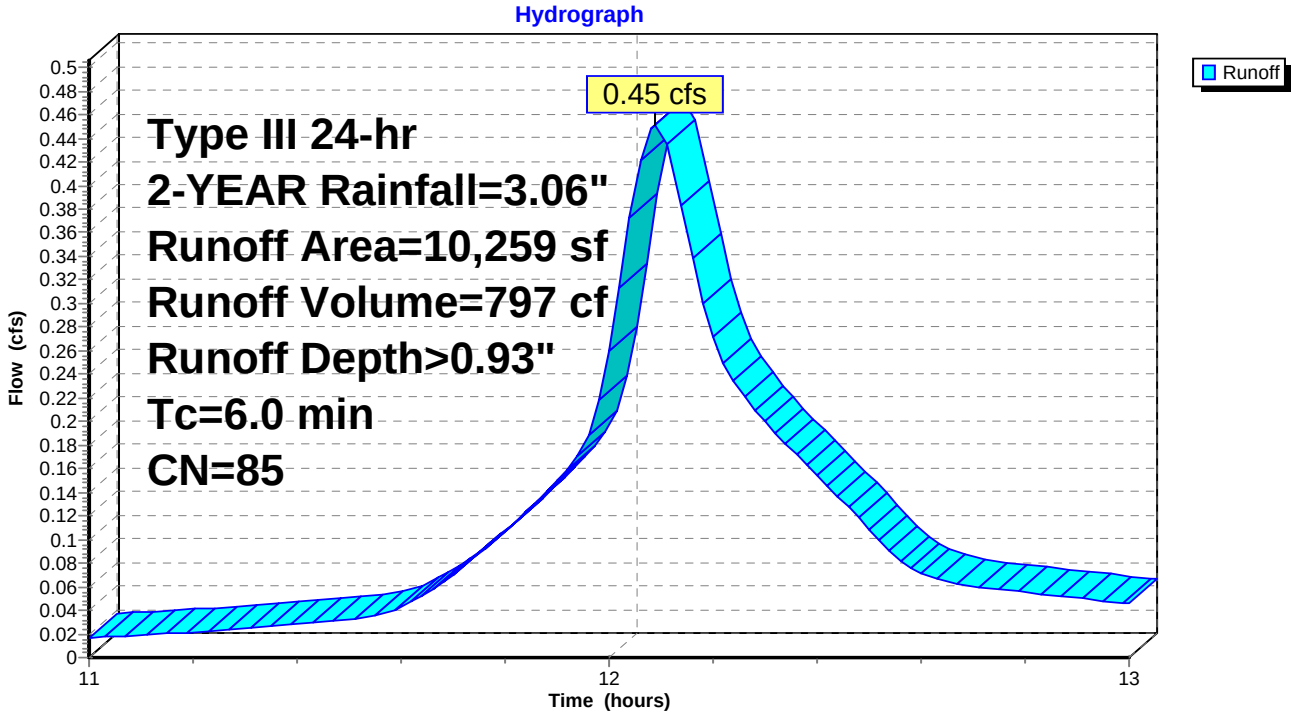
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 797 cf, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

	Area (sf)	CN	Description
	7,164	98	Paved parking, HSG A
	1,956	49	50-75% Grass cover, Fair, HSG A
	441	49	50-75% Grass cover, Fair, HSG A
*	698	76	Gravel roads, HSG A (rip rap)
	10,259	85	Weighted Average
	3,095		30.17% Pervious Area
	7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

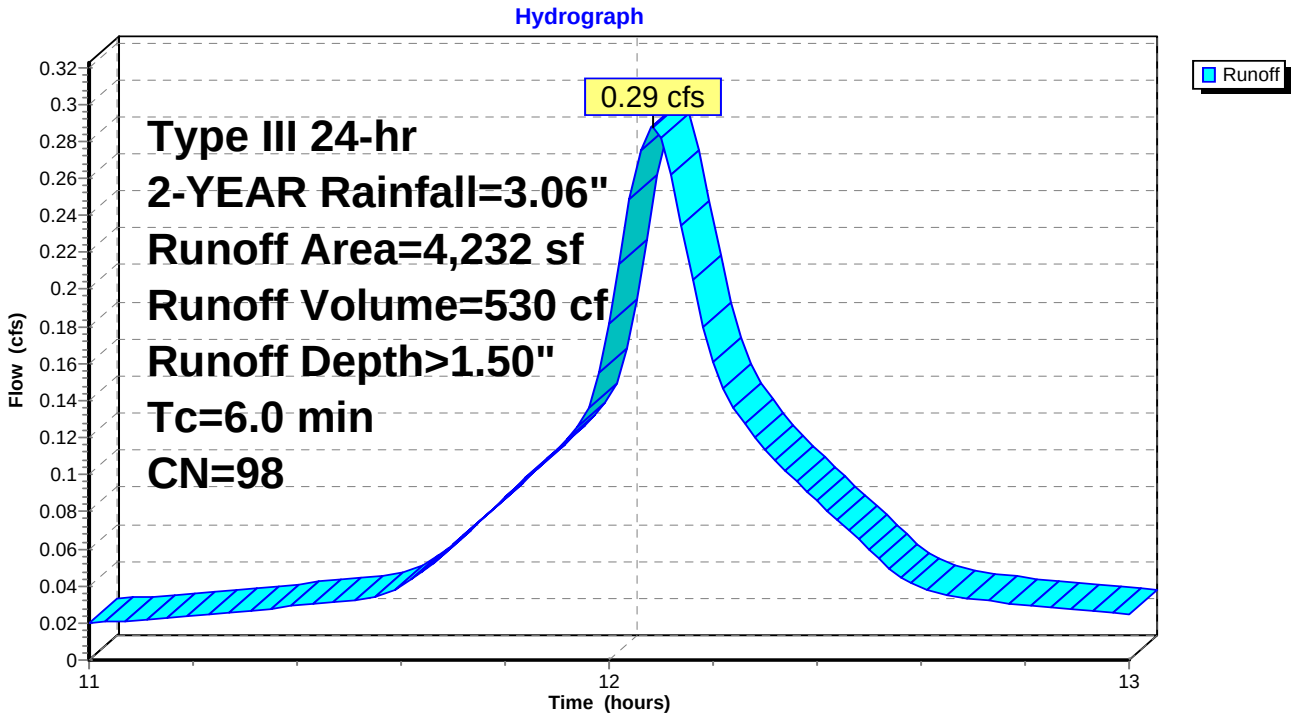
Runoff = 0.29 cfs @ 12.08 hrs, Volume= 530 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof



Summary for Subcatchment 5S: Lower Paved Area

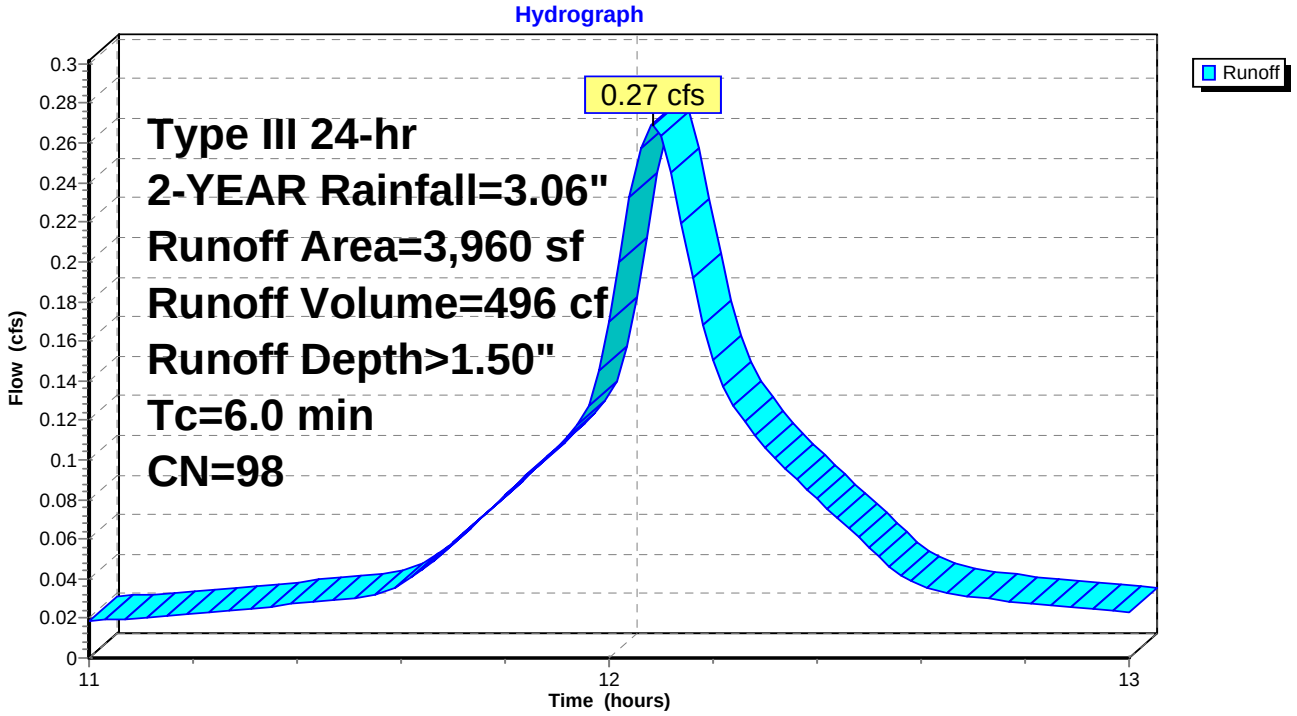
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 496 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area



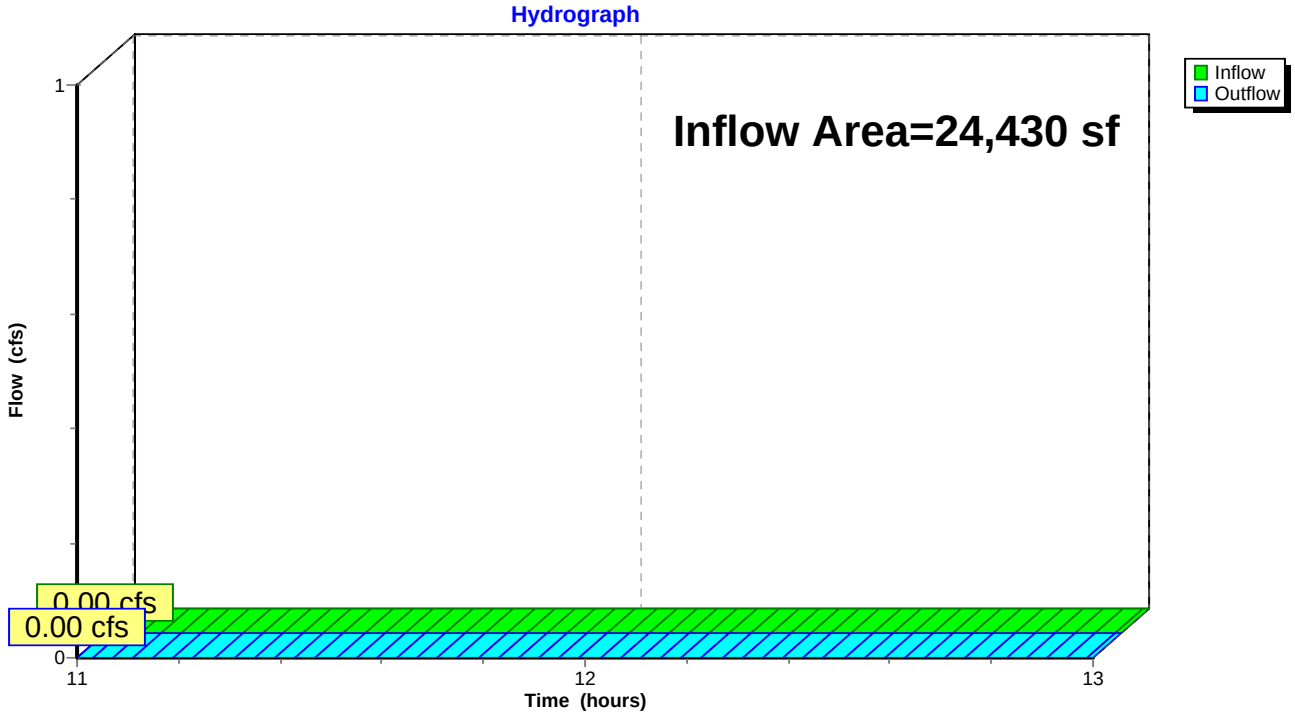
Summary for Reach END: Proposed Cultec Runoff

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth = 0.00" for 2-YEAR event
Inflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs

Reach END: Proposed Cultec Runoff



Summary for Pond C1: Northeast Cultecs

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth > 1.07" for 2-YEAR event
Inflow = 0.74 cfs @ 12.09 hrs, Volume= 1,286 cf
Outflow = 0.15 cfs @ 12.53 hrs, Volume= 433 cf, Atten= 80%, Lag= 26.3 min
Discarded = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Primary = 0.15 cfs @ 12.53 hrs, Volume= 433 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 232.05' @ 12.53 hrs Surf.Area= 0.046 ac Storage= 0.021 af

Plug-Flow detention time= 45.9 min calculated for 429 cf (33% of inflow)
Center-of-Mass det. time= 25.9 min (754.6 - 728.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	231.17'	0.018 af	**14.50'W x 84.75'L x 2.54'H Field A** 0.072 af Overall - 0.020 af Embedded = 0.052 af x 35.0% Voids
#2A	231.67'	0.020 af	**Cultec R-150XLHD** x 32 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
#3B	231.17'	0.012 af	**14.50'W x 54.00'L x 2.54'H Field B** 0.046 af Overall - 0.013 af Embedded = 0.033 af x 35.0% Voids
#4B	231.67'	0.013 af	**Cultec R-150XLHD** x 20 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	231.17'	**0.090 in/hr Exfiltration X 0.00 over Surface area** Phase-In= 0.01'
#2	Primary	231.67'	**4.0" Round Culvert** L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.67' / 230.95' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#3	Primary	232.33'	**8.0" Round Culvert** L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.33' / 231.44' S= 0.0061 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 11.00 hrs HW=231.17' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.15 cfs @ 12.53 hrs HW=232.05' TW=230.29' (Dynamic Tailwater)
├**2=Culvert** (Barrel Controls 0.15 cfs @ 1.88 fps)
└**3=Culvert** (Controls 0.00 cfs)

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

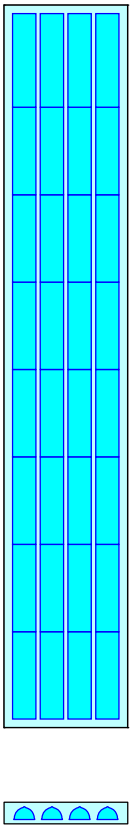
8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

32 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 876.8 cf Chamber Storage

3,123.4 cf Field - 876.8 cf Chambers = 2,246.6 cf Stone x 35.0% Voids = 786.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af
Overall Storage Efficiency = 53.2%

32 Chambers
115.7 cy Field
83.2 cy Stone



Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

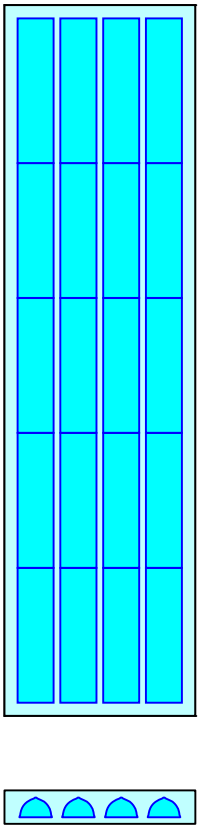
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

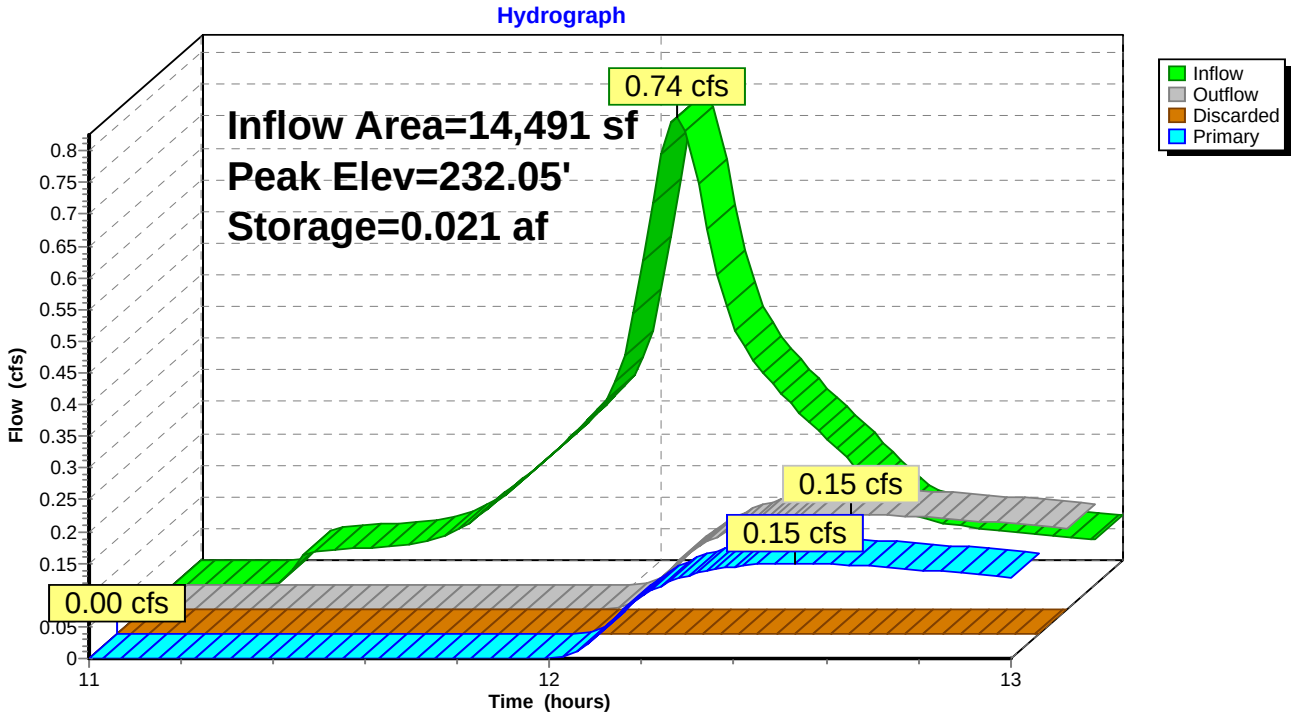
1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 35.0% Voids = 503.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af
Overall Storage Efficiency = 53.0%

20 Chambers
73.7 cy Field
53.3 cy Stone



Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

[82] Warning: Early inflow requires earlier time span

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 0.57" for 2-YEAR event
Inflow = 0.25 cfs @ 12.11 hrs, Volume= 838 cf
Outflow = 0.18 cfs @ 12.59 hrs, Volume= 522 cf, Atten= 28%, Lag= 28.7 min
Discarded = 0.05 cfs @ 11.84 hrs, Volume= 275 cf
Primary = 0.13 cfs @ 12.59 hrs, Volume= 246 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.36' @ 13.00 hrs Surf.Area= 392 sf Storage= 315 cf
Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 18.7 min calculated for 516 cf (62% of inflow)
Center-of-Mass det. time= 4.1 min (744.0 - 739.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	**16.00'W x 24.50'L x 4.54'H Field A** 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	**Cultec R-330XLHD** x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	**5.100 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	230.00'	**8.0" Round Culvert** L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.05 cfs @ 11.84 hrs HW=228.84' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.13 cfs @ 12.59 hrs HW=230.29' TW=230.20' (Dynamic Tailwater)
2=Culvert (Barrel Controls 0.13 cfs @ 1.34 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

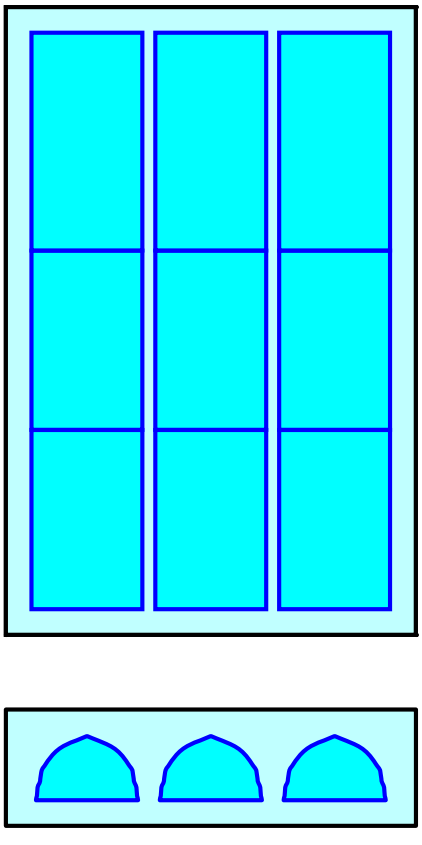
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

9 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 502.9 cf Chamber Storage

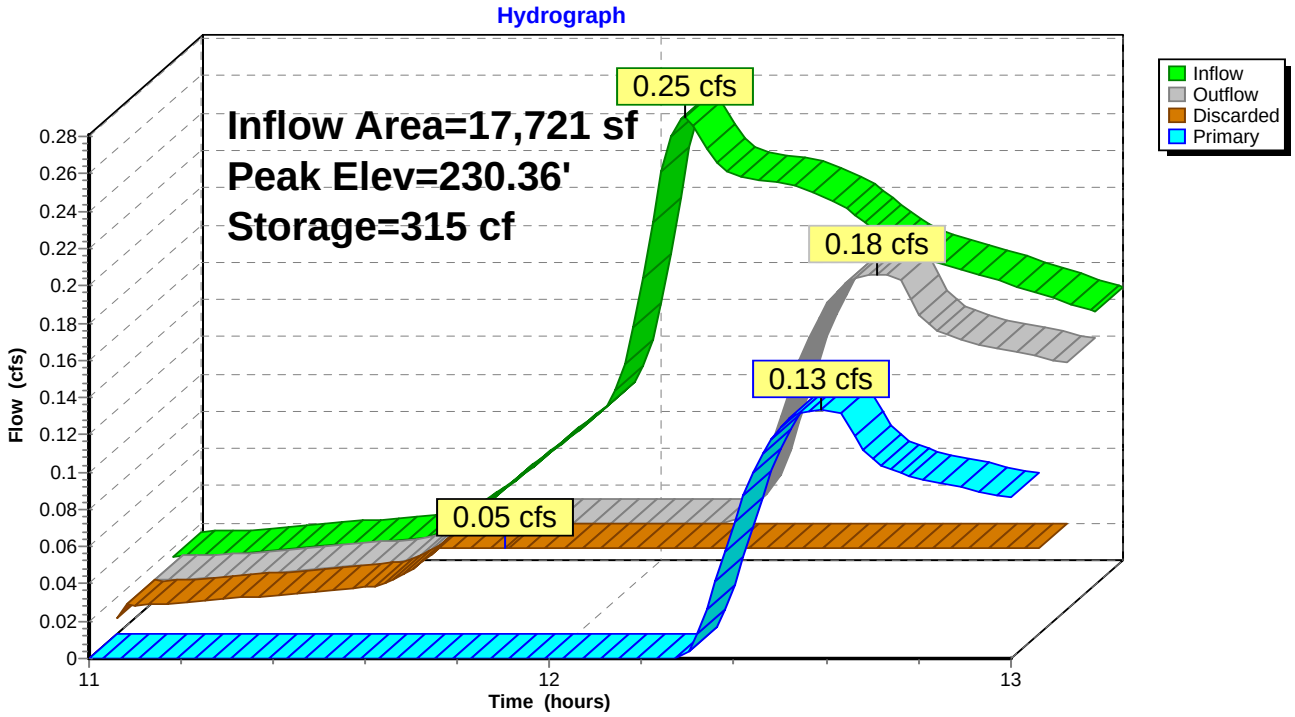
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

When the time span is extended beyond 13 hours, the peak elevation during the 2-year storm is 230.39' at 13.5 hours. The elevation begins to decline at 13.70 hours. The peak elevation is below the culvert invert, so all water will be exfiltrated.

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[82] Warning: Early inflow requires earlier time span

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth > 0.49" for 2-YEAR event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 994 cf
Outflow = 0.09 cfs @ 11.80 hrs, Volume= 472 cf, Atten= 80%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.80 hrs, Volume= 472 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.35' @ 13.00 hrs Surf.Area= 0.017 ac Storage= 0.012 af

Plug-Flow detention time= 18.4 min calculated for 467 cf (47% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	**6.33'W x 24.50'L x 3.71'H Field A** 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	**Cultec R-330XLHD** x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	**11.17'W x 52.50'L x 3.71'H Field B** 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	**Cultec R-330XLHD** x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	**5.100 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	230.68'	**8.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.68' / 230.48' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.09 cfs @ 11.80 hrs HW=229.11' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=229.07' TW=0.00' (Dynamic Tailwater)
2=Culvert (Controls 0.00 cfs)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

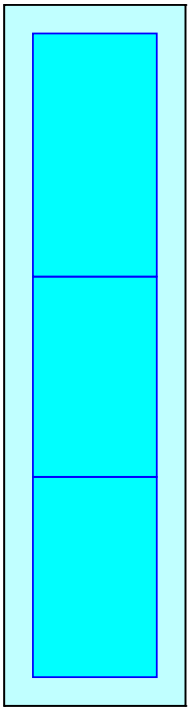
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

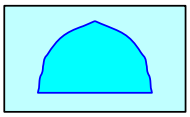
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

575.4 cf Field - 167.6 cf Chambers = 407.8 cf Stone x 35.0% Voids = 142.7 cf Stone Storage

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

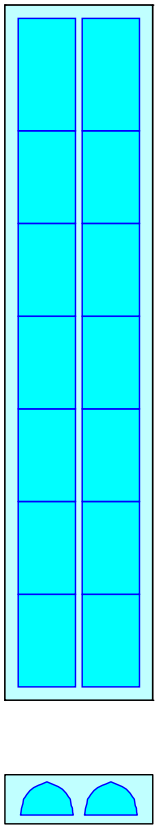
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

14 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 2 Rows = 752.6 cf Chamber Storage

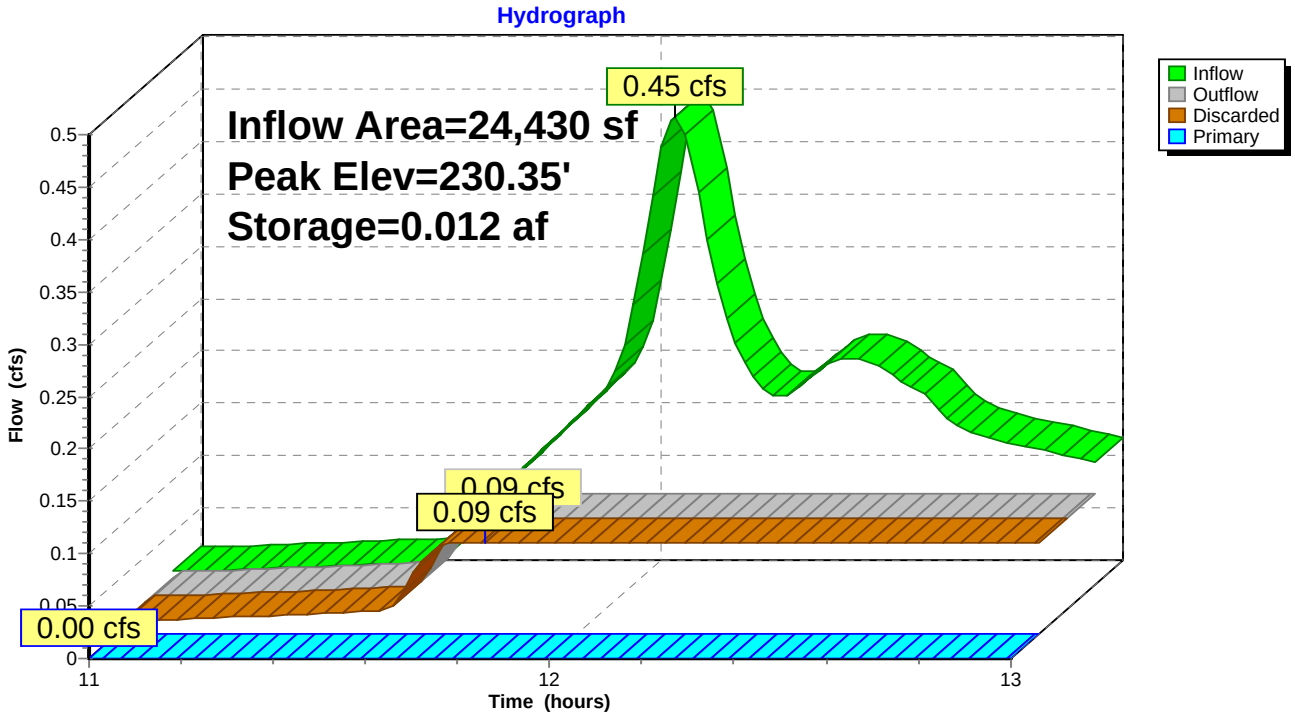
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

[82] Warning: Early inflow requires earlier time span

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth > 0.93" for 2-YEAR event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 797 cf
Outflow = 0.45 cfs @ 12.10 hrs, Volume= 776 cf, Atten= 0%, Lag= 0.4 min
Primary = 0.45 cfs @ 12.10 hrs, Volume= 776 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 233.56' @ 12.10 hrs Surf.Area= 13 sf Storage= 27 cf

Plug-Flow detention time= 3.1 min calculated for 768 cf (96% of inflow)
Center-of-Mass det. time= 1.8 min (730.1 - 728.3)

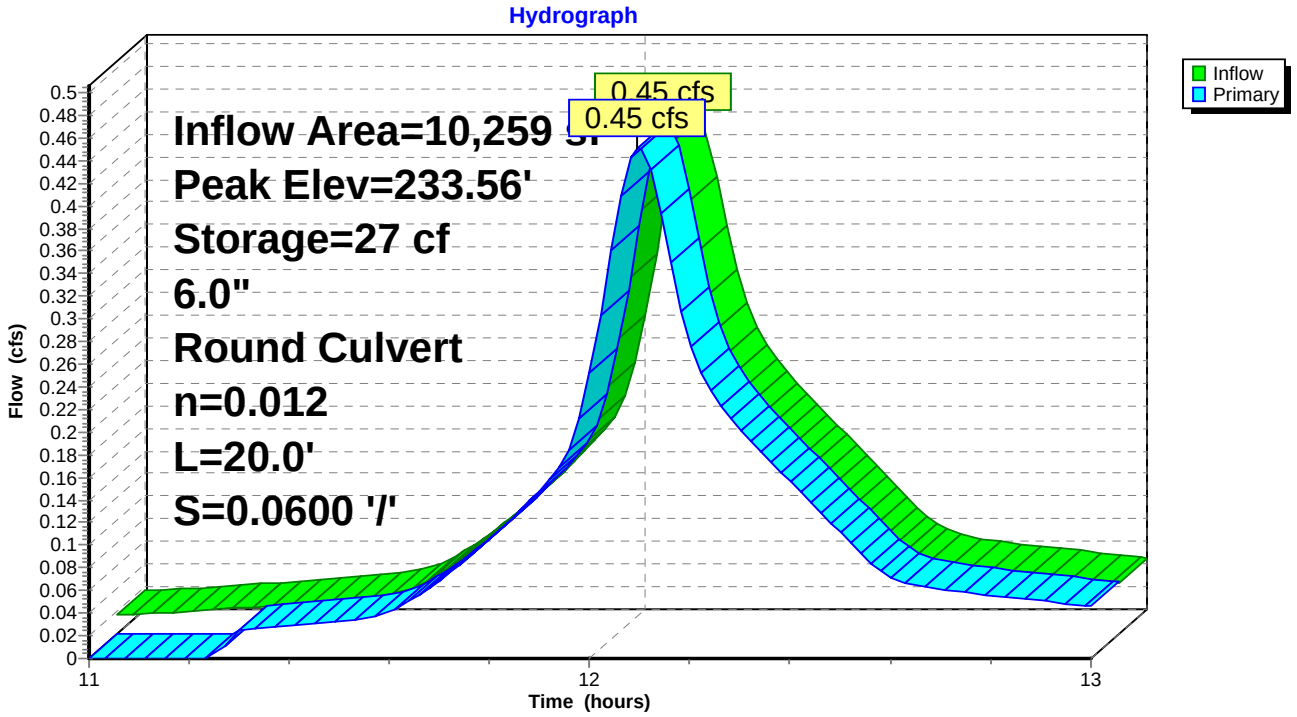
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	**6.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0600 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.45 cfs @ 12.10 hrs HW=233.56' TW=231.81' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.45 cfs @ 2.28 fps)

Pond CB1: Catch Basin #1



Summary for Pond CB2: Catch Basin #2

[82] Warning: Early inflow requires earlier time span

Inflow Area = 4,232 sf,100.00% Impervious, Inflow Depth > 1.50" for 2-YEAR event
Inflow = 0.29 cfs @ 12.08 hrs, Volume= 530 cf
Outflow = 0.29 cfs @ 12.09 hrs, Volume= 510 cf, Atten= 0%, Lag= 0.2 min
Primary = 0.29 cfs @ 12.09 hrs, Volume= 510 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 233.35' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 4.6 min calculated for 509 cf (96% of inflow)
Center-of-Mass det. time= 2.5 min (726.6 - 724.1)

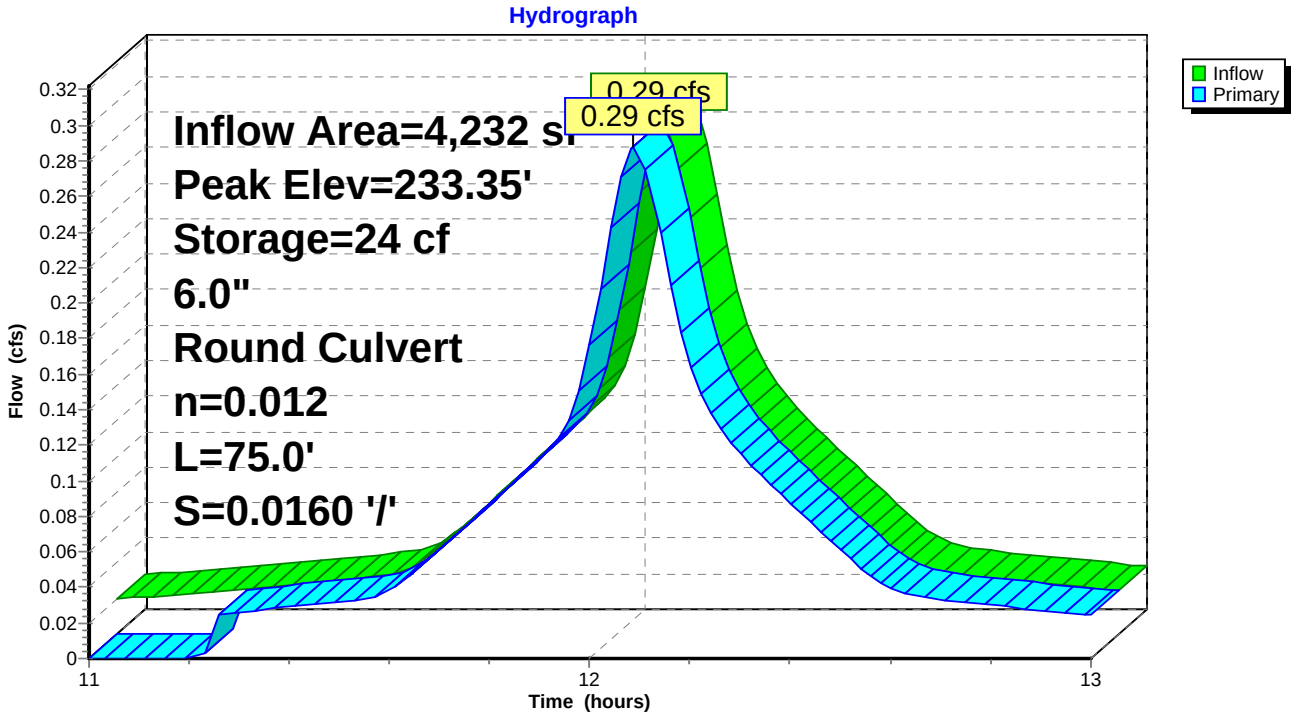
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	**6.0" Round Culvert** L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0160 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.29 cfs @ 12.09 hrs HW=233.35' TW=231.80' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.29 cfs @ 1.70 fps)

Pond CB2: Catch Basin #2



Summary for Pond CB3: Catch Basin #3

[82] Warning: Early inflow requires earlier time span

Inflow Area = 3,960 sf,100.00% Impervious, Inflow Depth > 1.50" for 2-YEAR event
Inflow = 0.27 cfs @ 12.08 hrs, Volume= 496 cf
Outflow = 0.27 cfs @ 12.09 hrs, Volume= 476 cf, Atten= 0%, Lag= 0.2 min
Primary = 0.27 cfs @ 12.09 hrs, Volume= 476 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 233.34' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 4.8 min calculated for 471 cf (95% of inflow)
Center-of-Mass det. time= 2.6 min (726.8 - 724.1)

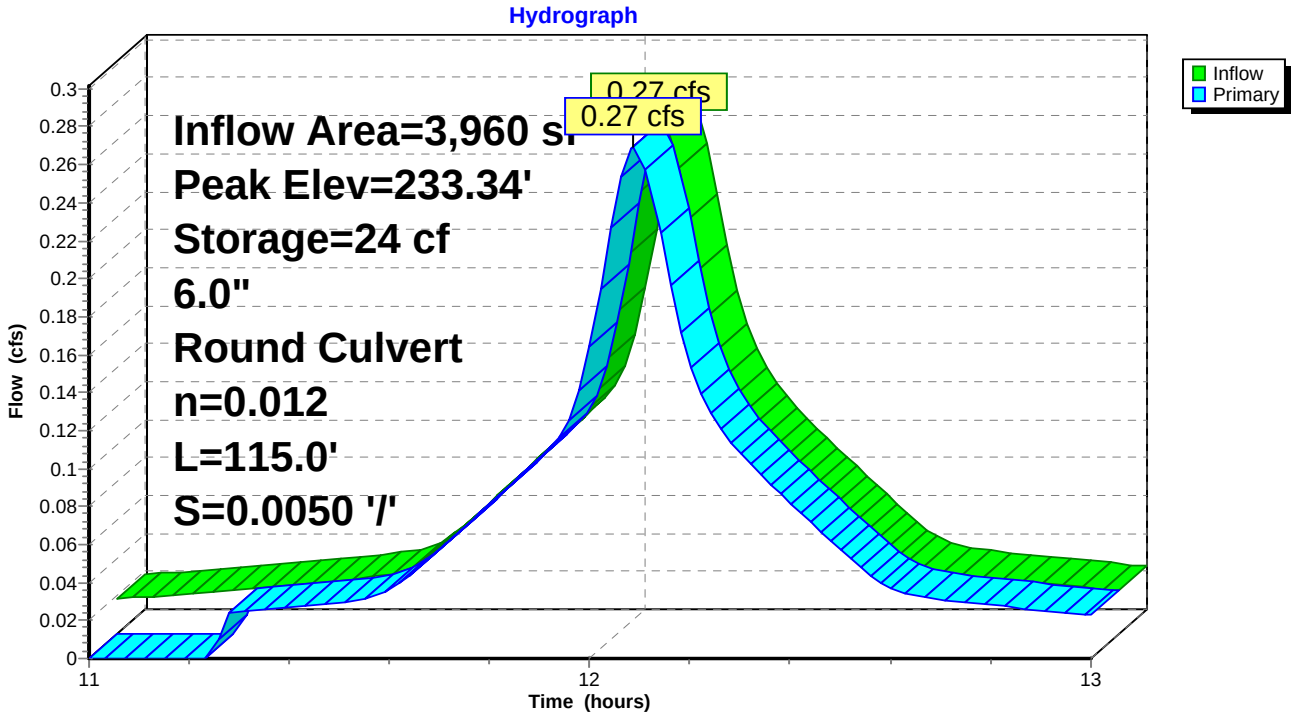
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	**6.0" Round Culvert** L= 115.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 232.38' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.27 cfs @ 12.09 hrs HW=233.34' TW=231.62' (Dynamic Tailwater)
1=Culvert (Barrel Controls 0.27 cfs @ 2.22 fps)

Pond CB3: Catch Basin #3



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf,100.00% Impervious, Inflow Depth > 1.44" for 2-YEAR event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 476 cf
Outflow = 0.27 cfs @ 12.09 hrs, Volume= 448 cf, Atten= 0%, Lag= 0.4 min
Discarded = 0.01 cfs @ 12.09 hrs, Volume= 44 cf
Primary = 0.26 cfs @ 12.09 hrs, Volume= 404 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 231.63' @ 12.09 hrs Surf.Area= 33 sf Storage= 35 cf

Plug-Flow detention time= 5.7 min calculated for 448 cf (94% of inflow)
Center-of-Mass det. time= 2.9 min (729.7 - 726.8)

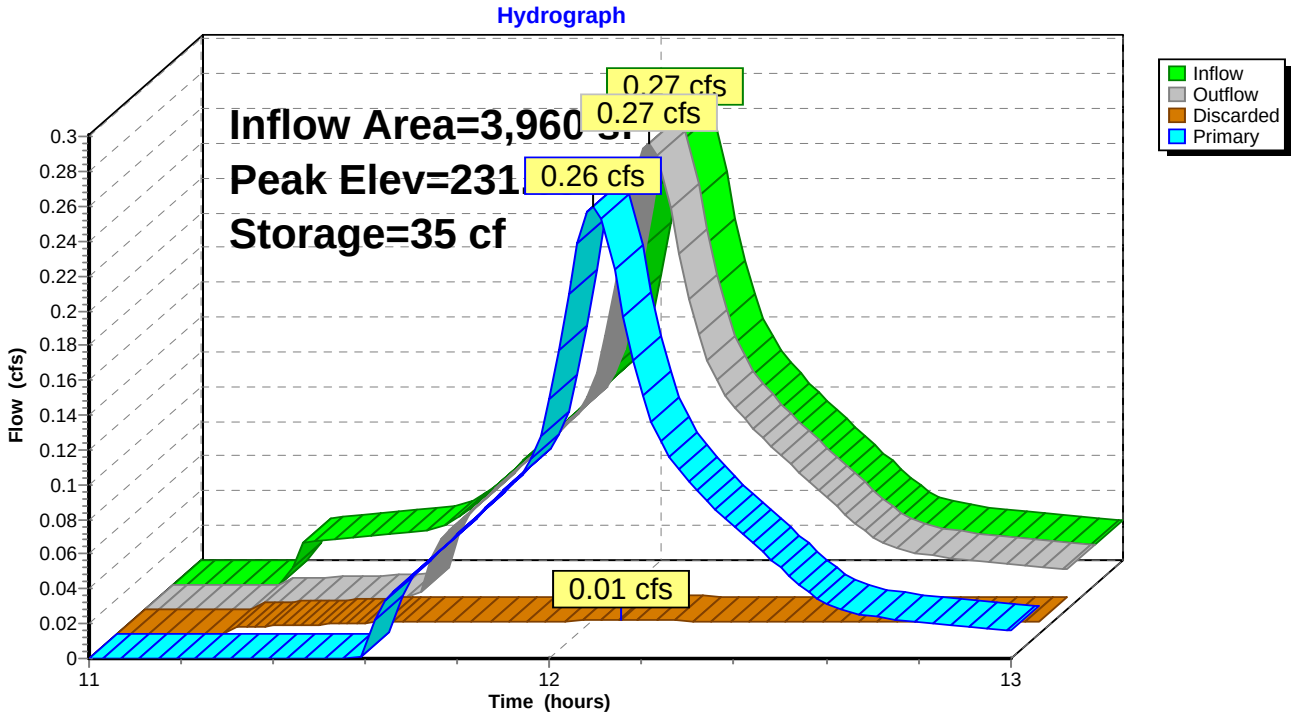
Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	**5.00'D x 5.00'H Vertical Cone/Cylinder** Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	**6.50'D x 5.00'H Vertical Cone/Cylinder** 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	231.25'	**6.0" Round Culvert** L= 5.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.25' / 231.00' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Discarded	230.00'	**5.100 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 12.09 hrs HW=231.62' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.26 cfs @ 12.09 hrs HW=231.62' TW=229.72' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.26 cfs @ 1.64 fps)

Pond D1: Drywell



ATTACHMENT F
LONG TERM POLLUTION PREVENTION PLAN AND OPERATIONS AND MAINTENANCE PLAN

1. Long Term Pollution Prevention Plan

This Long Term Pollution Prevention Plan (LTPPP) was prepared in accordance with Standard 4 of the Massachusetts Stormwater Management Handbook, the Massachusetts Department of Environmental Protection Stormwater Management Policy and the Massachusetts Wetlands Protection regulations (310 CMR 10.00). This LTPPP was prepared to address long term pollution prevention measures at the Nagog Pond Water Treatment Plant to be located at 180 Skyline Drive in Acton, Massachusetts (Site Locus, Attachment 1, Appendix B).

Good Housekeeping Practices

All chemicals will be stored inside. All treatment plant operators/employees will be instructed in the importance of not spilling fluids and chemicals onto the ground. All areas in the immediate vicinity of the treatment plant will be kept clean of excess debris.

Storing Materials and Waste Products

All chemicals and treatment process waste will be stored in adequately sized containers within the treatment plant. All treatment waste products will be disposed of in a legal manner at a state licensed recycling center or landfill. General trash generated by treatment plant personnel will be collected in standard trash barrels and disposed of at the public waste facility.

Vehicle Washing

Due to the nature of the site, very few vehicles will be accessing the site on a daily basis. Vehicle washing will not be allowed on the property to limit any potential contamination.

Routine Inspections and Maintenance of Stormwater BMPs

Refer to Stormwater Operation and Maintenance Plan within this Appendix.

Spill Prevention

The following measures will be taken at all loading/ unloading areas:

1. A significant amount of debris can accumulate outside uncovered loading/unloading areas. Sweep these surfaces frequently to remove material that could otherwise be washed off by stormwater. Sweep outside areas that are covered for a period of time by containers, logs, or other material after the areas are cleared.
2. Place drip pans, or other appropriate temporary containment device, at locations where leaks or spills may occur, such as hose connections, hose reels and filler

nozzles. Always use drip pans when making and breaking connections. Check loading and unloading equipment such as valves, pumps, flanges, and connections regularly for leaks and repair as needed.

Maintenance of Lawns, Gardens, and Other Landscaped Areas

A special wetland mix has been selected for the lawn area that will be under the PV array that will only require mowing on a biannual basis. The remaining landscaped area will be trimmed and maintained on an as needed basis. Any loose vegetation created from maintenance will be disposed of offsite.

Pet Waste Management

The proposed fencing is designed to limit pedestrian access to the site and surrounding areas, so pet waste is not expected to be a concern.

Proper Management of Deicing Chemicals

Any deicing chemicals, such as road salt, will be stored inside.

1. **Introduction**

This Stormwater Management Operations and Maintenance Plan (O&M Plan) was prepared in accordance with Standard 9 of the Massachusetts Stormwater Management Handbook, the Massachusetts Department of Environmental Protection Stormwater Management Policy and the Massachusetts Wetlands Protection regulations (310 CMR 10.00). This O&M Plan was prepared for the stormwater management system proposed for the Nagog Pond Water Treatment Plant to be located at 180 Skyline Drive in Acton, Massachusetts (Site Locus, Attachment 1, Appendix B). This O&M plan addresses both construction and post-development stormwater management. The proposed construction stormwater management system is shown on the Erosion Control Plans (Sheets C-4 and C-8 of Appendix C). The proposed post-development stormwater management system is shown on the WTP and Solar Array Grading and Drainage Plan (Sheet C-11 of Appendix C). The construction details for typical construction and the proposed post-development stormwater management system are provided within Appendix C (Sheets CD-1 through CD-7).

This O&M Plan serves to identify the following:

- The Owner of the stormwater management system at the Nagog Pond Water Treatment Plant;
- The party responsible for the operation and maintenance of the stormwater management systems;
- The typical/proposed components of both systems;
- The construction details of both systems;
- The routine and non-routine maintenance tasks to be undertaken;
- A schedule for inspection and maintenance of both systems; and
- An inspection and maintenance log template.

2. Ownership and Operation/Maintenance

The Nagog Pond Water Treatment Plant and its stormwater management system will be located on the southeast portion of a 56 acre parcel owned by the Town of Concord. The parcel is partially developed with the existing Nagog Pond Water Treatment Plant and its ancillary facilities, and partially forested. The existing treatment facility and proposed treatment facility will be operated by the Town of Concord's Water Department, which is a division of the Concord Department of Public Works. Therefore, the Town of Concord is identified as the Owner of the proposed post-development stormwater management system for the Nagog Pond Water Treatment Plant. A General Contractor selected through the public bidding process will be responsible for the operation and maintenance of the construction stormwater management system throughout the construction of the new treatment facility, PV Array, and raw water intake. The Water Department will be charged with the operation and maintenance responsibilities for the proposed post-development stormwater management system.

3. Description of the Proposed Construction Stormwater Management System

The goal of the proposed construction stormwater management system is to prevent off-site (i.e. Nagog Pond, wetlands) migration of stormwater pollution and/or soil erosion. Generally, the means of accomplishing this goal are achieved through proper planning, soil stabilization, runoff control and sediment control.

Prior to the start of construction, a system of straw wattles will be installed between the limits of work and the sensitive resource areas (i.e., Nagog Pond and wetlands). During construction, efforts should be made to maximize the preservation of natural vegetation within the limits of work and to minimize the amount of disturbed area. Dust control activities should be implemented to prevent the aerial transport of dust off-site. During clearing, grading, and excavation operations, temporary stormwater runoff diversions should be constructed to divert flow away from sensitive receptors. The stormwater diversions should incorporate sediment traps/barriers and inlet/outlet protection. Stockpiled aggregate materials should be stabilized (poly-sheeting, temporary seeding, etc.) and protected with sediment trap/barriers. The proposed construction stormwater management system is shown on the Erosion Control Plans (Sheets C-4 and C-8 of Appendix C). Typical construction details are shown on the Sheets CD-1 through CD-7 of Appendix C.

The construction Stormwater Pollution Prevention Plan will be defined in greater detail in the Contractor's erosion and sediment control plan, which will also account for conditions detailed in the Town of Acton's Conservation Commission Order of Conditions.

4. Description of the Proposed Post-Development Stormwater Management System

The proposed post-development stormwater management system is comprised of storm drains with deep sump catch basins, HDPE drainage pipe, R-150XLHD and R-330XLHD Cultec chambers, a dry well, and improved use of an existing rip rap swale. The proposed post-development Stormwater Management system is shown on the WTP and Solar Array Grading and Drainage Plan (Sheet C-11 of Appendix C) and typical construction details are provided on the construction detail sheets of Appendix C.

Storm Drains and Deep Sump Catch Basins

Storm drains with deep sump catch basins will be installed for pretreatment of stormwater runoff. Storm drains will be installed in the paved driveways and parking areas of the new facility. Two storm drains will be located on the eastern side of the facility and one will be located on the southern side of the facility. The storm drains will receive storm water runoff from the paved areas, which will be sloped to convey sheet flow towards the drains. The drains will be comprised of removable grated covers overlying deep sump catch basins. The deep sump catch basins are designed to remove trash, debris, sediment, and oil and grease. Stormwater flow will enter the catch basin through the grated cover and then flow through the inverted opening of a drain pipe, which either connects to a drywell or Cultec structure.

Cultec Chambers

Model R-150 XLHD and R-330 XLHD Cultec Chambers, as manufactured by CULTEC, Inc., will be installed for infiltration and detention of stormwater runoff. Three sets of clusters will be installed, with one set installed to the east of the proposed treatment plant and two installed to the west of the proposed treatment plant. The cluster to the east will consist of 52 Cultec R-150XLHD chambers, the cluster to the northwest will consist of 9 Cultec R-330 XLHD chambers, and the cluster to the immediate west will consist of 17 Cultec R-330 XLHD chambers. All clusters will be interconnected, with the cluster to the east connecting to the cluster in the northwest with an 8” and 4” HDPE drain pipe, followed by the cluster to the northwest connecting to the cluster in the west with a 6” HDPE drain pipe. The final cluster located in the west will be equipped with an overflow directed towards the wetlands.

Drywell

A drywell will be installed to the southwest of the proposed facility to provide additional infiltration detention time for runoff flowing to the southernmost catch basin. The drywell will connect the southernmost catch basin to the cultic chamber cluster in the west, while also serving as a means to increase detention time and provide some pre-infiltration before the runoff reaches the cultec cluster.

Existing Rip Rap Swale

The existing rip rap swale runs parallel to the existing access road a few feet to the east. The eastern limits of the proposed access road will extend to the top of the existing swale to increase the amount of runoff that is diverted to the rip rap swale. The swale has a high point in the same location as the proposed access road, so all runoff from the swale that is north of the highpoint will be directed to the proposed deep sump catch basins, while the runoff from the swale on the south side of the high point will be directed to an existing catch basin at the bottom of the access road. In addition to increasing the runoff directed to the swale, the proposed maintenance and inspection activities aim to improve the existing swale to ensure that it functions as efficiently as possible at all times by means of continuous upkeep.

5. Maintenance and Inspection Activities

Construction Stormwater Management System

During the course of the construction phase of the project, the Town's General Contractor shall be responsible for the maintenance and inspection of the stormwater management system and erosion and sediment controls.

The Town's General Contractor shall conduct weekly inspections of the stormwater management system and erosion/sediment controls for stability and operation. In addition to the weekly inspections, the General Contractor shall inspect the stormwater system and controls within 24-hours of any runoff producing precipitation event. Any needed repairs will be made immediately to maintain barriers and controls.

Maintenance will include:

- Removing built up sediment at sediment traps and sediment barriers;
- Repairing straw wattle that become damaged or displaced;
- Remove built up sediment at truck tracking pads and wheel wash stations;
- Clean or replace gravel/stone when the sediment traps and/or truck pads/washes no longer drain properly;
- Maintain stormwater diversions to control stormwater flow and limit erosion;
- Identify and address locations of stormwater scouring or erosion;
- Practice good site housekeeping (i.e., trash collection, material staging areas, management of aggregate stockpiles);
- All seeded areas will be fertilized and reseeded, as necessary, and mulched according to contract specifications; and
- Comply with the conditions of Acton Conservation Commission's Order of Conditions.

Post-Development Stormwater Management System

After receiving a Certificate of Compliance from the Acton Conservation Commission and achieving "Substantial Completion" of construction, the Town (Concord Water Department) will take over all maintenance responsibilities for the post-development stormwater management system.

Storm Drains, Deep Sump Catch Basins, Drywell, Cultec Chambers, and Rip Rap Swale

Regular maintenance of the storm drains, deep sump catch basins, drywell, and Cultec chambers is essential to their proper operation. Therefore, regular maintenance and inspection activities include:

- Good housekeeping practices within driveways and parking areas (i.e., routine collection of trash from trash receptacles, keeping storm drain grates clear of obstructions, etc.);
- Monthly inspection of storm drains and deep sump catch basins;
- Quarterly cleaning of deep sump catch basins to remove built up sediments, debris, and oil and grease;
- Annual street sweeping of driveways and parking areas; and
- Disposal of removed catch basin cleanings in accordance with applicable state, local, and federal guidelines and regulations.

6. Maintenance Schedule

Construction Stormwater Management System

During the construction phase, the Town's General Contractor should provide a maintenance and inspection schedule for the stormwater management system for the Town's approval. A typical maintenance and inspection schedule is as follows:

Daily:	Repair stormwater, erosion, and sedimentation controls as necessary;
Weekly:	Inspect stormwater management system for effective and proper operation; repair as necessary.
Run-off Events:	Inspect stormwater management system within 24-hours of event; repair as necessary;

Post-Development Stormwater Management System

Following substantial completion of construction, the Town (Water Department) shall finalize a maintenance and inspection schedule for the stormwater management system

and have it on file at the treatment facility and at the Department of Public Works main office. The proposed maintenance and inspection schedule is as follows:

Daily/Weekly:	Repair stormwater, erosion, and sedimentation controls as necessary; Promote good housekeeping practices in driveways, parking areas, and stormwater management areas;
Monthly:	Inspect storm drains and deep sump catch basins for proper operation;
Quarterly:	Clean out sediments from deep sump catch basins;
Semi-Annual:	Inspect water quality swales for proper operation and condition;
Annual:	Removal of sediment from water quality swales;

7. Maintenance Log Form

The following is a typical maintenance and inspection form for the stormwater management system.

Date: _____
Name of Inspector: _____
Organization: _____

Type of Inspection
(Circle One): Daily / Weekly / Monthly / Quarterly / Semi-Annual / Annual

Reason for Inspection
(Circle All that Apply): Routine Maintenance / Routine Inspection / Run-Off Event / Emergency

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Additional Notes:

_____
_____
_____
_____
_____
_____

Signature: _____ Date: _____

CULTEC STORMWATER CHAMBERS OPERATION AND MAINTENANCE GUIDELINES

Contactor® & Recharger®
Stormwater Chambers The Chamber With The Stripe®

Operation and Maintenance Guidelines

CULTEC™

Operation & Maintenance

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access

This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. StormFilter Access
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. Minor Maintenance
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris as required.

B. Major Maintenance
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

Major Maintenance *(continued)*

	Frequency	Action
Inlets and Outlets	Every 3 years	• Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	• Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commissioning every 9 years following	• Clean stormwater management chambers and feed connectors of any debris. • Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique.
	45 to 50 years after commissioning	• Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. • Attain the appropriate approvals as required. • Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1st year	• Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	• Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.

CULTEC™
Chamber of Choice™

CULTEC, Inc.
878 Federal Road • P.O. Box 280 • Brookfield, CT 06804
Phone: 203-775-4416 • Toll Free: 800-4-CULTEC • Fax: 203-775-1462
Web: www.cultec.com • E-mail: custservice@cultec.com

ATTACHMENT G
STORMWATER FIGURES

SW-1: Existing Soil Conditions and Boring Locations

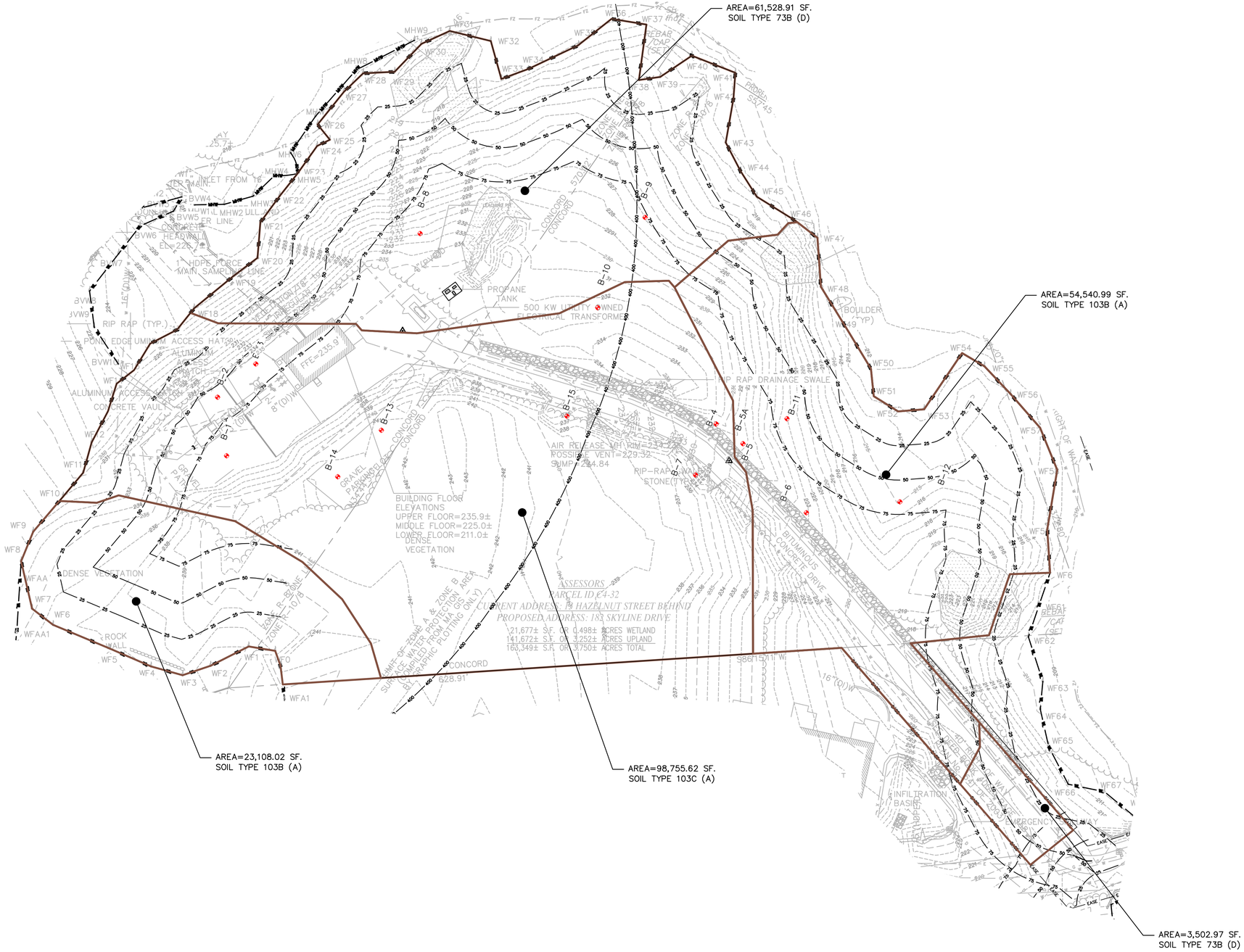
SW-2: Existing Cover Type Areas and Tc Path

SW-3: Proposed Cover Type Areas

SW-4: Proposed BMP Structures and Catchment Areas

LEGEND

EXISTING SOIL CONDITION LIMITS



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CONSULTING ENGINEERS

DiMarinisi & Wolfe
ARCHITECTS • URBAN DESIGNERS
BOSTON, MASSACHUSETTS

MARK	DATE	DESCRIPTION

Scale	1"=40'
Date	NOVEMBER 2015
Job No.	200-1501
Designed by	ASK
Drawn by	JFB
Checked by	DNRP
Approved by	SCO

THIS LINE IS ONE INCH LONG WHEN PLOTTED AT FULL SCALE ON A 22" X 34" DRAWING

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

EXISTING SOIL CONDITIONS AND BORING LOCATIONS

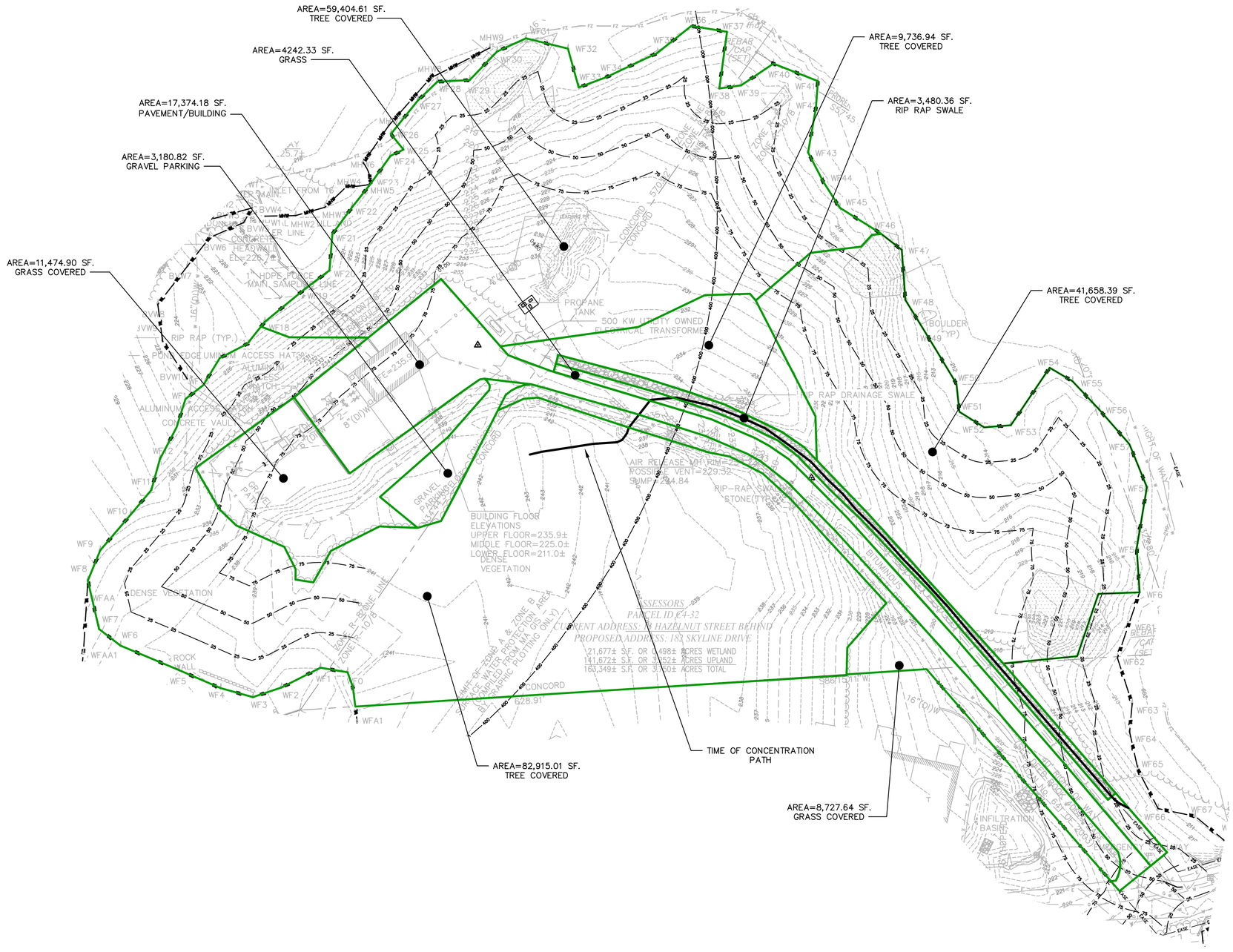
FOR PERMITTING

Sheet No.

SW-1

LEGEND

EXISTING COVER TYPE LIMITS



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NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

EXISTING COVER TYPE AREAS AND Tc PATH

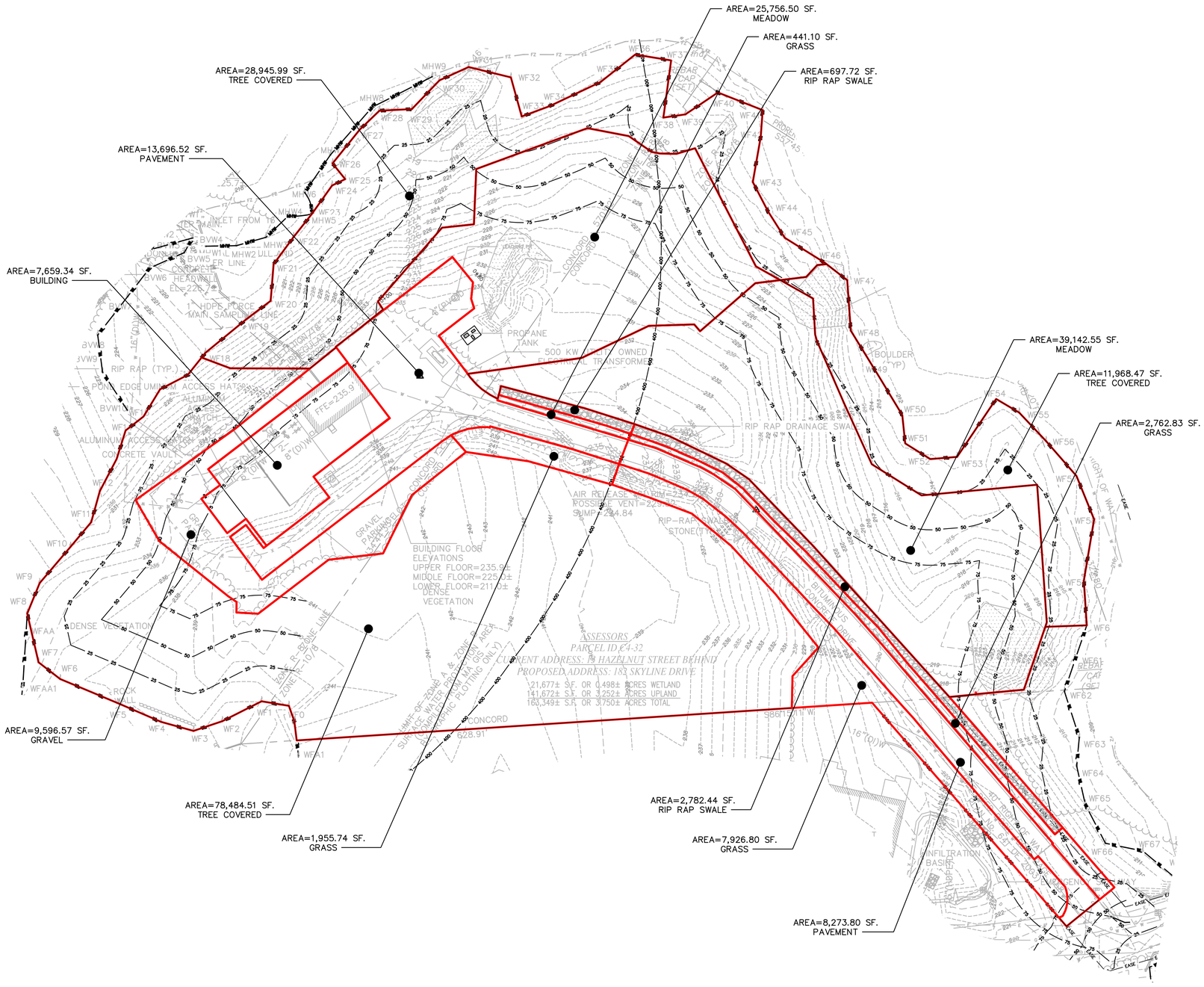
FOR PERMITTING

Sheet No.

SW-2

LEGEND

PROPOSED COVER TYPE LIMITS



			Scale	1"=40'
			Date	NOVEMBER 2015
			Job No.	200-1501
			Designed by	ASK/JFB
			Drawn by	JFB
			Checked by	DNRP
MARK	DATE	DESCRIPTION	Approved by	SCO

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BOSTON, MASSACHUSETTS

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

PROPOSED COVER TYPE AREAS

FOR PERMITTING

Sheet No.

SW-3

Drawing file: I:\Concord 200\200-1501 Nagog Pond WTP Conceptual Design\Permitting\NOI\Appendix D-Stormwater Report\watershed areas.dwg Plot Date: Nov 17,2015-5:08pm

LEGEND

- PROPOSED CATCHMENT AREAS
- PROPOSED DRAINAGE PIPE
- PROPOSED CATCH BASIN
- PROPOSED DRYWELL
- PROPOSED R-150 XLHD CHAMBER
- PROPOSED R-330 XLHD CHAMBER

SUBSURFACE CHAMBERS, C-1
52 CULTEC R-150XLHD CHAMBERS
INV. IN(CB-1) = 231.75'
INV. IN(CB-2) = 231.75'
INV. OUT(8") = 232.33'
SLOPE OUT(8") = 0.61%
INV. OUT(4") = 231.67'
SLOPE OUT(4") = 0.5%

CB-1
RIM = 235.0'
INV. OUT = 232.95'
SLOPE OUT = 6.0%

CB-2
RIM = 235.0'
INV. OUT = 232.95'
SLOPE OUT = 1.6%

8" HDPE DRAIN PIPE

4" HDPE DRAIN PIPE

SUBSURFACE CHAMBERS, C-2
9 CULTEC R-330XLHD CHAMBERS
INV. IN(8") = 231.44'
INV. IN(4") = 230.95'
INV. OUT = 230.00'
SLOPE OUT = 0.0%

SUBSURFACE CHAMBERS, C-3
17 CULTEC R-330XLHD CHAMBERS
INV. IN(C-2) = 230.00'
INV. IN(DRYWELL) = 231.00'
INV. OUT = 230.68'
SLOPE OUT = 1.0%

FLARED END-SECTION
WITH RIP RAP PROTECTION

8" HDPE DRAIN PIPE
INV. OUT = 230.48'
SLOPE OUT = 1.0%

DRYWELL, D-1
INV. IN = 232.38'
INV. OUT = 231.25'
SLOPE OUT = 5.0%

CLEAN OUT (TYP.)

CB-3
RIM = 235.0'
INV. OUT = 232.95'
SLOPE OUT = 0.5%

PROPANE TANK

500 KW UTILITY OWNED ELECTRICAL TRANSFORMER

RIP RAP DRAINAGE SWALE

AIR RELEASE MH RIM=234.43
POSSIBLE VENT=229.32
SUMP=224.84

RIP-RAP SWALE STONE(TYP.)

BUILDING FLOOR ELEVATIONS
UPPER FLOOR=235.9±
MIDDLE FLOOR=225.0±
LOWER FLOOR=211.0±

DENSE VEGETATION

ASSESSORS
PARCEL ID C4-32
CURRENT ADDRESS: 19 HAZELNUT STREET BEHIND
PROPOSED ADDRESS: 182 SKYLINE DRIVE
21,677± S.F. OR 0.498± ACRES WETLAND
141,672± S.F. OR 3.252± ACRES UPLAND
160,349± S.F. OR 3.750± ACRES TOTAL

INFILTRATION BASIN

EMERGENCY WAY

NOTES:

1. ALL DRAINAGE PIPES TO BE 6" HDPE (ADS N-12 OR EQUAL) UNLESS OTHERWISE NOTED.

Drawing file: I:\Concord 200\200-1501 Nagog Pond WTP Conceptual Design\Permitting\NOI\Appendix D-Stormwater Report\watershed areas.dwg Plot Date: Nov 17,2015 6:10pm

Environmental Partners GROUP
A partnership for engineering solutions.

LIN ASSOCIATES, INC.
CONSULTING ENGINEERS

DiMarinisi & Wolfe
ARCHITECTS • URBAN DESIGNERS
BOSTON, MASSACHUSETTS

MARK	DATE	DESCRIPTION

Scale	1"=40'
Date	NOVEMBER 2015
Job No.	200-1501
Designed by	ASK/JFB
Drawn by	JFB
Checked by	DNRP
Approved by	SCO

THIS LINE IS ONE INCH LONG WHEN PLOTTED AT FULL SCALE ON A 22" X 34" DRAWING

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

PROPOSED BMP STRUCTURES AND CATCHMENT AREAS

FOR PERMITTING

Sheet No.

SW-4

APPENDIX G
WETLANDS DELINEATION REPORT

PINEBROOK CONSULTING

April 29, 2015

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Alex Richards

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Alex:

On April 20, 2015, I investigated the above-referenced property (hereinafter referred to as the site) for the presence of wetland resource areas as defined under the Massachusetts Wetlands Protection Act (M.G.L. Chapter 131, Section 40) and the associated regulations, 310 CMR 10.00 (Regulations). The property, which is located west of the residential neighborhood (s) of Acorn Park Drive in Acton, supports the Nagog Pond Disinfection Facility (Facility) operated by the Town of Concord Department of Public Works (DPW). The purpose of the investigation was to identify any wetland resource areas near the Facility to be located and addressed for the improvement project proposed by the Concord DPW. The following provides a description of my findings.

Four different resource areas, as defined under Section 10.54, 10.56, 10.55 and 10.58, exist in the vicinity of the Facility; bank, land under a waterway/waterbody (LUWW), bordering vegetated wetland (BVW) and riverfront area, respectively. The most encompassing of the resource areas; BVW and riverfront; were identified/flagged in the field to establish the 100-foot buffer zone and the 100- and 200-foot riverfront areas.

Under Section 10.54 and 10.56 of the Regulations Nagog Pond (Pond) and Nagog Brook (Brook) are defined as bank and LUWW; the small intermittent stream, that flows from the wetland on/off the southwesterly side of the site, is defined as LUWW; and Nagog Brook has a 100 and 200-foot riverfront area associated with it. The Pond and Brook, located on the westerly portion of the site and the stream are all located within/encompassed by the flagged boundary of the BVW. The BVW, which would be most closely characterized as a wooded shrub swamp system was identified, primarily, by the presence of wetland and transitional vegetation such as: red maple (Acer rubrum), black birch (Betula lenta), tupelo (Nyssa sylvatica), shagbark hickory ((Carya ovata), hemlock (Tsuga canadensis) and white pine (Pinus strobus) in the overstory; highbush blueberry (Vaccinium corymbosum), sweet pepperbush (Clethra alnifolia), arrow-wood (Viburnum dentatum), and witch hazel (Hamamelis virginiana) in the shrub layer; and skunk cabbage (Symplocarpus foetidus), cinnamon fern (Osmunda cinnamomea), Massachusetts fern (Thelypteris simulata), sedges (Carex, spp.), princess pine (Lycopodium obscurum) and teaberry (Gaultheria procumbens) in the herbaceous layer.

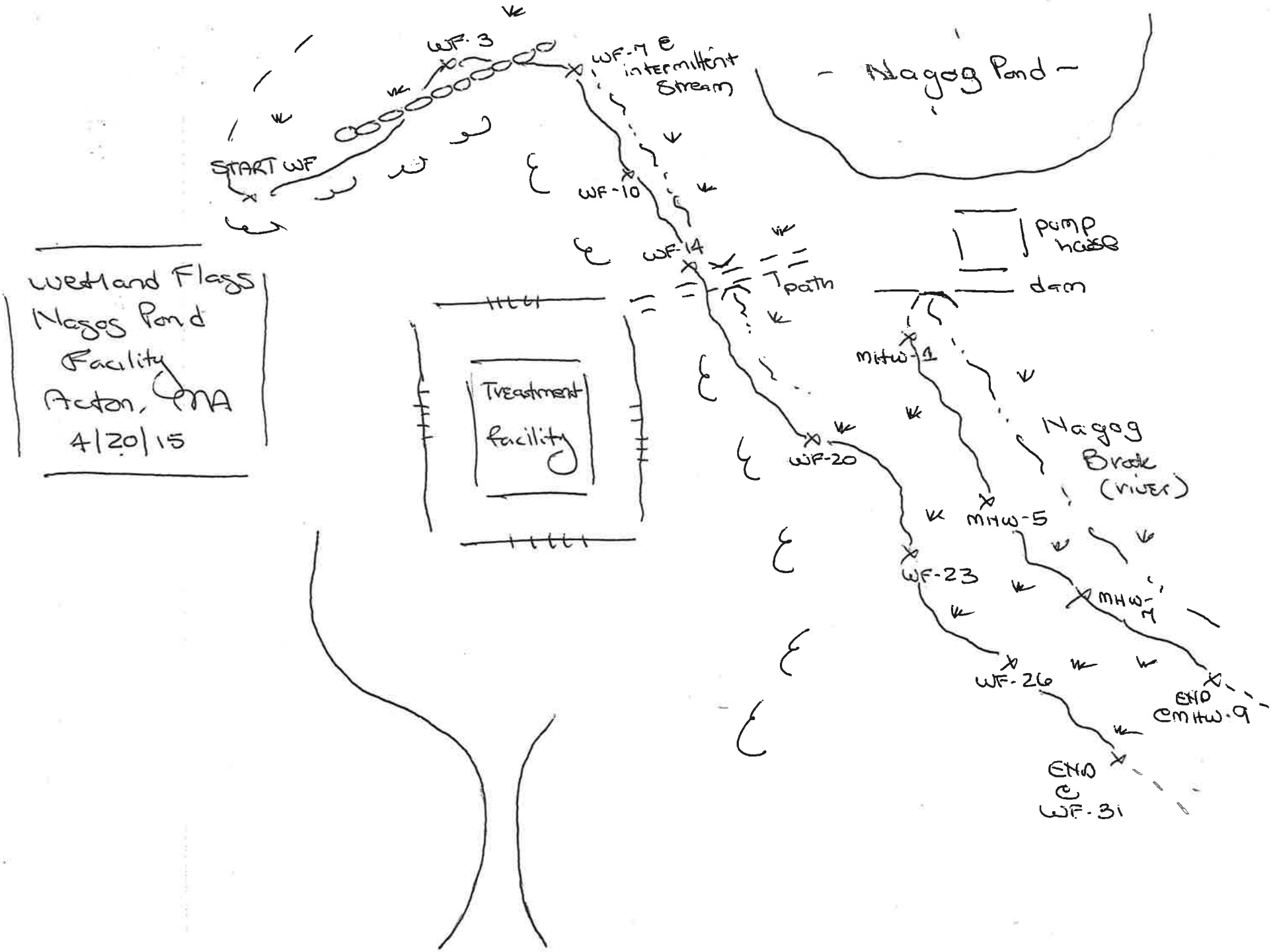
Other hydrological indicators, such as stained/matted leaves, saturated soils and buttressed root systems were also evident within the BVW and used to establish the BVW boundary. The BVW was flagged in the field with pink flags labeled WF-1 through WF-31 (with a start flag) (see attached sketch of the wetland flags). The BVW flags commence on the southerly side of the site, extend in a northerly then easterly direction around the Facility building, to where they terminate on the north-northeasterly side of the site. The mean high water (MHW) associated with Nagog Brook, from where it exits the Pond by the existing gatehouse, was identified/flagged in the field with blue flags labeled MHW-1 through MHW-9 (refer to sketch). The MHW flags, which generally coincide with the bank of the Brook, are the point from which the 100 and 200-foot riverfront areas are measured. It is my understanding that the flags identifying the BVW and MHW are to be surveyed and put on a plan to be submitted with a Notice of Intent (NOI) detailing the proposed project activities.

According to the most recent Massachusetts Natural Heritage Atlas (13th Edition) dated October 1, 2008, the site is not mapped as estimated and/or priority habitat for rare wildlife or rare species nor are there any certified/mapped vernal pools within the area.

If you have any questions regarding these findings and/or you need additional information, please feel free to call me at any time. I am glad I could assist you with this project and let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist


Wetland Flags
Nagog Pond
Facility
Acton, MA
4/20/15
START WF
WF-3
WF-7 & intermittent Stream
WF-10
WF-14
Nagog Pond
pump house
dam
path
Treatment facility
MHW-1
WF-20
Nagog Brook (river)
MHW-5
WF-23
MHW-7
WF-26
END @ MHW-9
END @ WF-31

PINEBROOK CONSULTING

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Alex Richards

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Alex:

On April 20, 2015, I delineated/flagged the wetland resource areas on the above-referenced property (hereinafter referred to as the site) in preparation for improvements proposed at Nagog Pond Disinfection Facility (Facility) (see Letter/Report from Pinebrook Consulting dated April 24, 2015). The wetland delineation consisted of the extent of the resource areas within 100 feet of the Facility building. On August 11, 2015, I re-visited the site to continue the delineation in an easterly direction, to the vicinity of Hazelnut Road, in preparation for the installation of a solar array proposed northeast of the Facility. Wetland flags labeled WF-32 through WF-68 were placed in the field to complete the delineation. The WF flags, which represent the boundary of the bordering vegetated wetland (BVW) associated with Nagog Brook, commence at previous flag WF-31 and extend to the culvert under the driveway into the Facility (WF-68), and in the vicinity of Hazelnut Road. The same method for determining the BVW boundary in April was used for the remaining delineation (refer to the Letter/Report mentioned above).

If you have any questions regarding this delineation and/or you need additional information, please feel to call me at any time. I am glad I could assist you this project and please let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist

PINEBROOK **CONSULTING**

October 15, 2015

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Alex Richards

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Alex:

On April 20, 2015 I delineated/flagged the wetland resource areas on the above-referenced property (hereinafter referred to as the site) in preparation for improvements proposed at Nagog Pond Disinfection Facility (Facility) (see Letter/Report from Pinebrook Consulting dated April 24, 2015). On August 11, 2015, I delineated an additional area on the site for the potential solar array. On October 3, 2105, at your request, I hung additional flags off the site to the south. This wetland delineation; which consists of the bordering vegetated wetland (BVW) boundary previously delineated for the adjacent residential development off Hazelnut Drive; is identified with flags BVWA-1 thru BVW-A-12 and BVWAA-1 thru BVWAA-11. The vernal pool located within the BVW was also identified with flags VP-1 thru VP-7. The same method for determining the BVW boundary in April and was used for the remaining delineation (refer to the Letter/Report mentioned above).

If you have any questions regarding this delineation and/or you need additional information, please feel to call me at any time. I am glad I could assist you this project and please let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist

PINEBROOK CONSULTING

November 5, 2015

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Steve Olsen

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Steve:

On April 20, 2015, I delineated/flagged the wetland resource areas on the above-referenced property (hereinafter referred to as the site) in preparation for improvements proposed at Nagog Pond Disinfection Facility (Facility) (see Letter/Report from Pinebrook Consulting dated April 24, 2015). On August 11, 2015, I delineated an additional area on the site for the potential solar array. On October 3, 2015, at your request, I hung additional flags to delineate the wetland off the site to the south (see Letter dated October 15, 2015). On November 4, 2015, in preparation for proposed work on the dam located on Nagog Pond, I also delineated the resource area directly adjacent to the dam. These wetland flags; labeled BVW-1 through BVW-11; delineate a small freshwater marsh that supports such herbaceous species as cattails (Typha, spp.), tussock sedge (Carex stricta), sensitive fern (Onoclea sensibilis), marsh fern (Thelypteris thelypteroides) and woolgrass (Scirpus cyperinus). The flags extend from the culverts associated with the dam and connect to the wetland system (WF flags) associated with Nagog Brook that was delineated in April of 2015.

If you have any questions regarding this delineation and/or you need additional information, please feel to call me at any time. I am glad I could assist you this project and please let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist

APPENDIX H
UNDERWATER ARCHAEOLOGICAL RESOURCES RESPONSE LETTER