

**SMART FIELDS PHASE 2
1700 SOUTH 4300 WEST
WEBER COUNTY, UTAH 84401
STORM WATER STUDY**

Project No. 21N700

1-24-2022

Updated 6-29-22

General Site Information:

Phase 2 of the proposed Smart Field Subdivision is located at 1700 South 4300 West along the west side of 4300 West in Weber County, Utah. Construction will consist of a new residential subdivision, single family homes, driveways, sidewalks, curb and gutter, underground utilities, and two ponds to serve stormwater when completed.

Storm water from the site will be collected in inlet boxes and catch basins and will continue via storm drain to two storm water ponds, one located in the southwest corner of the site, the other located towards the north. Storm water will be detained in the southwest corner pond. While water flowing into the northern pond will be retained. The site is allowed a unit-release of 0.1 cfs per acre for the 100-yr storm into an existing slough, water will then travel westwardly through the slough in a historical fashion. The attached figure shows the project site and location of the storm water outfall. Detention calculations have been provided for the site. (See attached figure and calculations).

The study area is broken up into 3 drainage areas (labeled A-1, A-2, and A-3). A runoff coefficient of 0.15 is used for natural ground and landscaped areas. A runoff coefficient of 0.90 is used for asphalt, concrete, buildings, and other hard surfaced areas. Average runoff coefficients of 0.37, 0.34 and 0.36, are calculated for areas A-1, A-2 and A-3, respectively. This yields a coefficient of 0.36 for the overall study area.

Times of concentration are calculated using the FAA method assuming flow resistance coefficients of $K=0.35$ for landscape and $K=0.91$ for hardscape for each of the areas. The times of concentration are about 18, 47, and 23 minutes respectively for areas A-1, A-2 and A-3. These times are based on the hydraulically longest drainage path inside each respective drainage area over grass or other vegetation, asphalt, concrete, and/or through a pipeline as applicable. Times calculated to be less than 5 minutes are rounded to 5 minutes (as applicable) when using this method. Rainfall Intensities were taken from NOAA Atlas 14 for pipe sizing and detention requirements. The values obtained were interpolated as necessary. A copy of these data is attached.

Data showing area information, runoff coefficient, time of concentration, peak flows, and detention storage requirements for the site are also provided and can be found in the attached calculations.

Pipe Sizes:

Storm water pipes in the project are to be reinforced concrete pipe (RCP). All pipes in the project are sloped to provide the design capacity while maintaining a minimum scour speed of at least 2.0 feet per second when the pipes are flowing at least half full. The pipes and inlet boxes have enough capacity to convey the 10-year storm without surcharging.

Required Retention:

Water falling on Area A-1 will be retained, while water falling on Areas A-2 and A-3 will be detained. The required retention for the 100-year storm with no release rate is 19,085 cubic feet for areas A-1. The available volume in the retention facility is 19,413 cubic feet. There is an excess capacity of 328 cubic feet. In the event the retention facility experiences a storm larger than the design storm water will overflow through a concrete spillway and flow westerly into an adjoining field in a historical fashion.

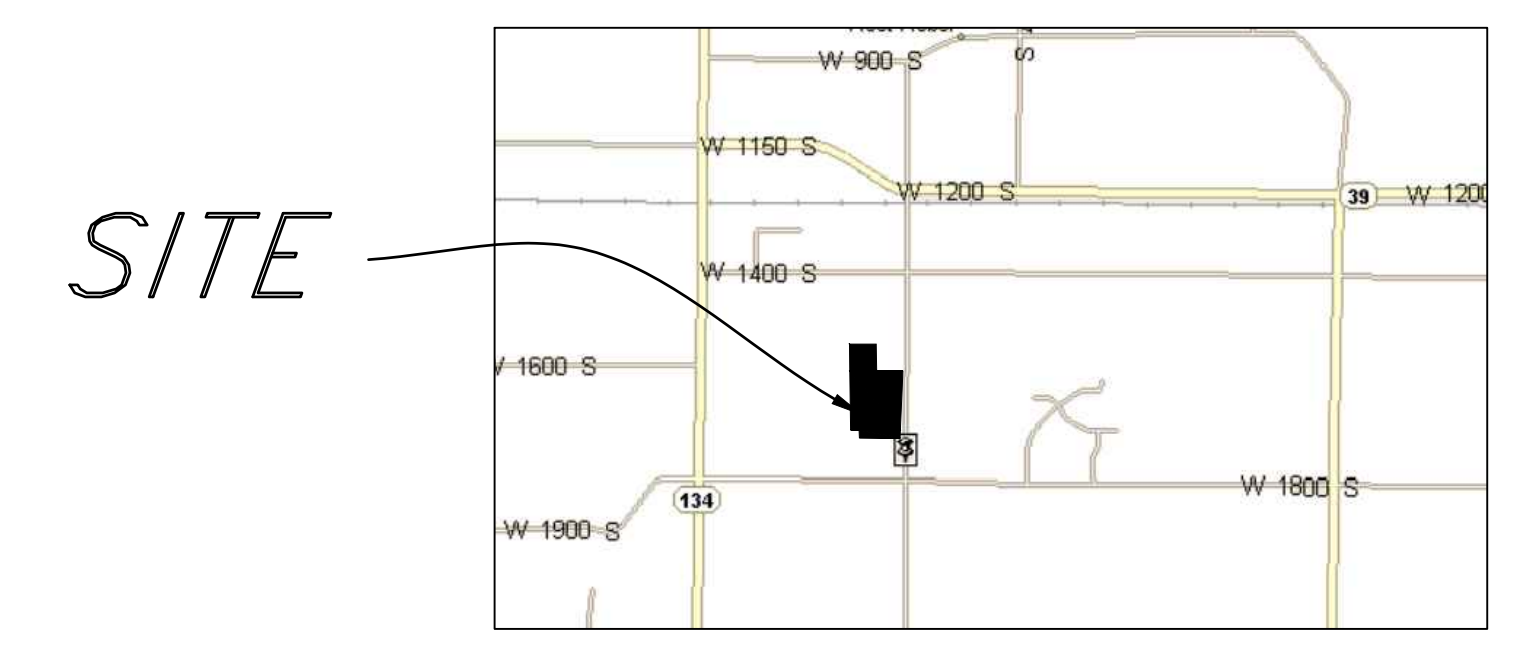
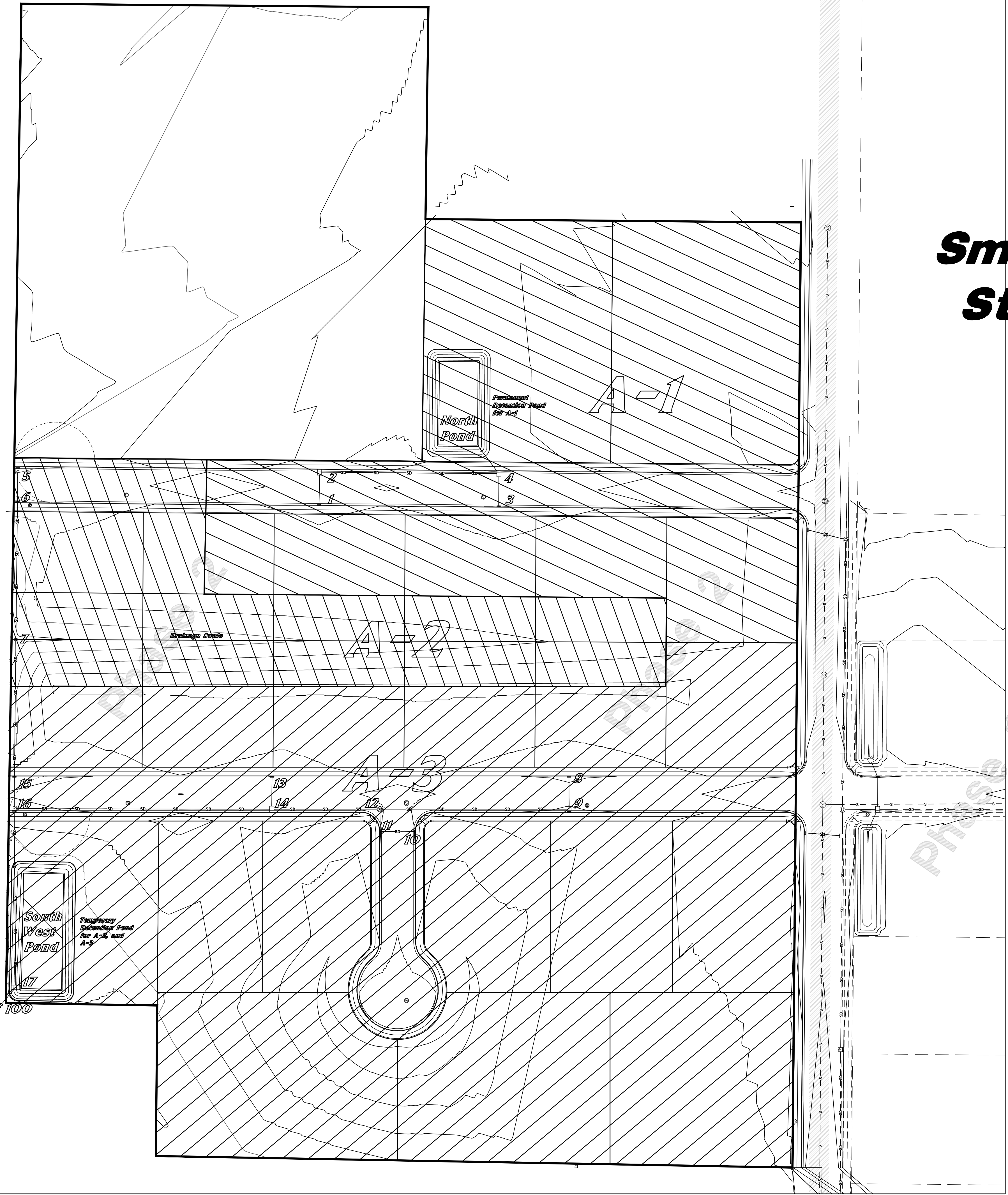
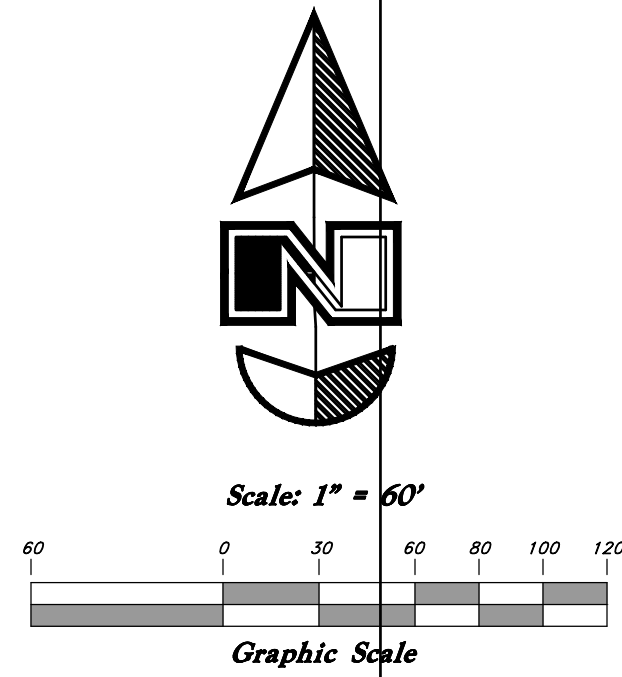
The required detention for the 100-year storm with a release rate of 0.1 cfs/acre is 21,199 cubic feet for area A-2 and A-3. The available volume in the detention facility is 21,254 cubic feet. There is an excess capacity of 55 cubic feet. In the event the detention facility experiences a storm larger than the design storm water will then spill over the emergency overflow within the inlet/outlet structure and flow into the slough unrestricted.

Orifice Plate:

An orifice plate will be used to control the rate that storm water flows from the project. It will be located at the inlet box at node 17 (See attached figure). The orifice opening is given a designation of Node 100 for convenience in modeling the reduced flow through the restriction. The orifice plate opening will be 5.9 inches in diameter for the detention facility to utilize its capacity during a 100-yr storm with a release rate of 0.1 cfs/ac. The orifice plate will allow small flows to pass through without detention. As the rate of storm water into the pipes and detention facilities increases, the orifice plates will restrict the flow. The maximum flow through the plates will occur when the detention basins reach their maximum design depths. A detail of an orifice plate can be found in the construction documents for this project.

Great Basin Engineering, Inc.

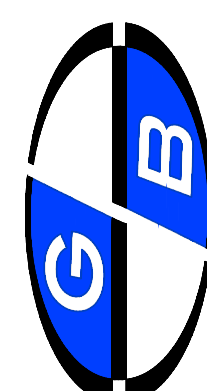
Prepared by James Ries EIT



Smart Fields Phase 2 Storm Water Study

REV	DATE	DESCRIPTION

GREAT BASIN ENGINEERING



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Storm Water Study

Smart Field Subdivision Phase 2

Approx. 1700 South 4300 West
 Weber County, Utah
 A part of Section 20, T6N, R2W, SLB&M, U.S. Survey

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Storm Water Calculations
 Smart Fields - Phase 2
 Approx. 1700 South 4300 West Street, Weber County, UT
 21N700 - SWS-Phase2.dwg

6/20/2022

3 Retained Areas

Hardscape C =	0.90
Landscape C =	0.15

	Zone 1 (ft ²)
Avg. lot size	20500
Avg. home size	2800
Avg. patio/driveway size	800
C =	0.282

Category Runoff Coefficients	
0.763	0.282

Drainage Areas	Total Area (acres)	60' Road Area (acres)	Zone 1 Area (acres)	C
Σ Det. Areas	17.632	2.821	14.811	0.359
Σ All Areas	17.632	2.821	14.811	0.359
A-1	5.036	0.910	4.126	0.369
A-2	2.441	0.295	2.146	0.340
A-3	10.154	1.616	8.538	0.358

Time of Concentration--use FAA Method

For FAA Method, use K's of..

K = 0.35 for landscape
 K = 0.91 for hardscape

$$t_c = \frac{1.8(1.1 - K)\sqrt{L}}{\sqrt[3]{S}}$$

Assume Pipe Flow is at 2 ft/s Scour Speed

**Note: S is in percent, 5 min is smallest allowed Tc

Area	Length on Landscape (ft)	Slope of Landscape (%)	Time on Landscape (min.)	Length on Hardscape (ft)	Slope of Hardscape (%)	Time on Hardscape (min.)	Length in Pipe (ft)	Time in Pipe (min.)	TC for entire Area (min.)
A-1	130.00	2.00	12.22	220.00	1.00	5.07	78.00	0.65	17.94
A-2	650.00	0.40	46.71	0.00	1.00	0.00	51.00	0.43	47.14
A-3	116.00	2.00	11.54	197.00	1.00	4.80	735.00	6.13	22.47

Rainfall Intensities
Data From NOAA

10-Year and 100-Year Intensities

The equations used for the 10-Year and 100-Year Intensities were found using the attached Rainfall data as well as Interpolated data where applicable.

Storm Intensities

AREA	Tc (minutes)	I (10-yr.) (in./hr.)	I (100-yr.) (in./hr.)
A-1	17.9	1.86	3.73
A-2	47.1	1.01	2.04
A-3	22.5	1.63	3.27

Peak Flow Information
 Use Rational Method
 10-Year and 100-Year Intensities

Q=CIA

AREA	C	I10 (in./hr.)	I100 (in./hr.)	A (acres)	Peak Flows	
					Q (10-yr.) (cfs)	Q (100-yr.) (cfs)
				Σ retained =	10.23	20.53
A-1	0.369	1.861	3.732	5.04	3.45	6.93
A-2	0.340	1.014	2.036	2.44	0.84	1.69
A-3	0.358	1.632	3.275	10.15	5.94	11.91

Node Inlet Requirements

Size pipes for		10	year storm
Area	Node #	% of Total	Q (cfs)
A-1	1	10.0%	0.35
A-1	2	2.0%	0.07
A-1	3	30.0%	1.04
A-1	4	58.0%	2.00
A-2	5	20.0%	0.17
A-2	6	30.0%	0.25
A-2	7	50.0%	0.42
A-3	8	15.0%	0.89
A-3	9	15.0%	0.89
A-3	10	15.0%	0.89
A-3	11	15.0%	0.89
A-3	12	5.0%	0.30
A-3	13	10.0%	0.59
A-3	14	5.0%	0.30
A-3	15	10.0%	0.59
A-3	16	10.0%	0.59
A-3	17	0.0%	0.00
A-3	100	0.0%	0.00

Summary of Node Inlet Requirements

Node	Is required to take (cfs)
1	0.35
2	0.07
3	1.04
4	2.00
5	0.17
6	0.25
7	0.42
8	0.89
9	0.89
10	0.89
11	0.89
12	0.30
13	0.59
14	0.30
15	0.59
16	0.59
17	0.00
100	0.00

PIPE FLOWS

Upstream Node	Downstream node	Pipe Flow (cfs)
1	2	0.35
2	4	0.41
3	4	1.04
4	North Pond	3.45
5	6	0.17
6	7	0.42
7	15	0.84
8	9	0.89
9	12	1.78
10	11	0.89
11	12	1.78
12	14	3.86
13	14	0.59
14	16	4.75
15	16	1.44
16	17	6.78
17	100	6.78
100	Outfall	6.78

Options for Pipe Sizes Between the Specified Nodes

Up Stream Node	Dn Stream Node	Q (cfs)	Pipe Size (in)	Design Min Slope (%)	Area (ft^2)	Rh (ft)	Manning's n	Scour Min. Slope (%)	First Trial Pipe Size
1	2	0.35	15	0.003%	1.227	0.313	0.013	0.145%	15
		0.35	18	0.001%	1.767	0.375	0.013	0.114%	
		0.35	24	0.000%	3.142	0.500	0.013	0.078%	
2	4	0.41	15	0.004%	1.227	0.313	0.013	0.145%	15
		0.41	18	0.002%	1.767	0.375	0.013	0.114%	
		0.41	24	0.000%	3.142	0.500	0.013	0.078%	
3	4	1.04	15	0.026%	1.227	0.313	0.013	0.145%	15
		1.04	18	0.010%	1.767	0.375	0.013	0.114%	
		1.04	24	0.002%	3.142	0.500	0.013	0.078%	
4	North Pond	3.45	15	0.286%	1.227	0.313	0.013	0.145%	15
		3.45	18	0.108%	1.767	0.375	0.013	0.114%	
		3.45	24	0.023%	3.142	0.500	0.013	0.078%	
5	6	0.17	18	0.000%	1.767	0.375	0.013	0.114%	18
		0.17	24	0.000%	3.142	0.500	0.013	0.078%	
		0.17	30	0.000%	4.909	0.625	0.013	0.058%	
6	7	0.42	18	0.002%	1.767	0.375	0.013	0.114%	18
		0.42	24	0.000%	3.142	0.500	0.013	0.078%	
		0.42	30	0.000%	4.909	0.625	0.013	0.058%	
7	15	0.84	15	0.017%	1.227	0.313	0.013	0.145%	15
		0.84	18	0.006%	1.767	0.375	0.013	0.114%	
		0.84	24	0.001%	3.142	0.500	0.013	0.078%	
8	9	0.89	15	0.019%	1.227	0.313	0.013	0.145%	15
		0.89	18	0.007%	1.767	0.375	0.013	0.114%	
		0.89	24	0.002%	3.142	0.500	0.013	0.078%	
9	12	1.78	15	0.076%	1.227	0.313	0.013	0.145%	15
		1.78	18	0.029%	1.767	0.375	0.013	0.114%	
		1.78	24	0.006%	3.142	0.500	0.013	0.078%	
10	11	0.89	15	0.019%	1.227	0.313	0.013	0.145%	15
		0.89	18	0.007%	1.767	0.375	0.013	0.114%	
		0.89	24	0.002%	3.142	0.500	0.013	0.078%	
11	12	1.78	15	0.076%	1.227	0.313	0.013	0.145%	15
		1.78	18	0.029%	1.767	0.375	0.013	0.114%	
		1.78	24	0.006%	3.142	0.500	0.013	0.078%	
12	14	3.86	18	0.135%	1.767	0.375	0.013	0.114%	18
		3.86	24	0.029%	3.142	0.500	0.013	0.078%	
		3.86	30	0.009%	4.909	0.625	0.013	0.058%	
13	14	0.59	15	0.008%	1.227	0.313	0.013	0.145%	15
		0.59	18	0.003%	1.767	0.375	0.013	0.114%	
		0.59	24	0.001%	3.142	0.500	0.013	0.078%	

14	16	4.75	18	0.204%	1.767	0.375	0.013	0.114%	18
		4.75	24	0.044%	3.142	0.500	0.013	0.078%	
		4.75	30	0.013%	4.909	0.625	0.013	0.058%	
15	16	1.44	18	0.019%	1.767	0.375	0.013	0.114%	18
		1.44	24	0.004%	3.142	0.500	0.013	0.078%	
		1.44	30	0.001%	4.909	0.625	0.013	0.058%	
16	17	6.78	18	0.416%	1.767	0.375	0.013	0.114%	18
		6.78	24	0.090%	3.142	0.500	0.013	0.078%	
		6.78	30	0.027%	4.909	0.625	0.013	0.058%	
17	100	6.78	15	1.101%	1.227	0.313	0.013	0.145%	18
		6.78	18	0.416%	1.767	0.375	0.013	0.114%	
		6.78	24	0.090%	3.142	0.500	0.013	0.078%	
100	Outfall	6.78	15	1.101%	1.227	0.313	0.013	0.145%	18
		6.78	18	0.416%	1.767	0.375	0.013	0.114%	
		6.78	24	0.090%	3.142	0.500	0.013	0.078%	

Northern Retention Facility

C = Remaining Unit Discharge = cfs/acre
 Area = acres Release through Restriction = cfs

Retention Pond Sized For The Year Storm

Time min	Rainfall Intensity in./hr.	Accumulated Volume (CF)	Allowable Release (CF)	Needed Detention (CF)
5	6.50	3620	0	3620
10	4.95	5513	0	5513
15	4.09	6833	0	6833
20	3.48	7753	0	7753
25	3.06	8529	0	8529
30	2.75	9188	0	9188
35	2.52	9824	0	9824
40	2.29	10216	0	10216
45	2.10	10549	0	10549
50	1.94	10821	0	10821
55	1.81	11076	0	11076
60	1.70	11360	0	11360
90	1.21	12087	0	12087
120	0.93	12403	0	12403
180	0.63	12690	0	12690
360	0.35	14153	0	14153
720	0.22	17241	0	17241
1440	0.12	19085	0	19085

Required Storage Volume = ft³

South Western Detention Facility

C = 0.35
 Area = 12.60 acres
 Remaining Unit Discharge = 0.100 cfs/acre
 Release through Restriction = 1.696 cfs

Retention Pond Sized For The 100 Year Storm

Time min	Rainfall Intensity in./hr.	Accumulated Volume (CF)	Allowable Release (CF)	Needed Detention (CF)
5	6.50	8700	509	8191
10	4.95	13251	1018	12233
15	4.09	16423	1526	14897
20	3.48	18635	2035	16599
25	3.06	20500	2544	17956
30	2.75	22085	3053	19032
35	2.52	23613	3562	20051
40	2.29	24554	4070	20484
45	2.10	25355	4579	20776
50	1.94	26008	5088	20920
55	1.81	26623	5597	21026
60	1.70	27305	6106	21199
90	1.21	29052	9158	19894
120	0.93	29811	12211	17599
180	0.63	30501	18317	12185
360	0.35	34019	36634	-2615
720	0.22	41439	73267	-31828
1440	0.12	45872	146534	-100662

Required Storage Volume = 21199 ft³

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 1, Version 5

PF tabular

PF graphical

Supplementary information

 [Print page](#)

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.50 (1.31-1.74)	1.88 (1.67-2.20)	2.58 (2.27-3.00)	3.24 (2.81-3.77)	4.31 (3.65-5.04)	5.30 (4.36-6.29)	6.50 (5.15-7.79)	7.92 (6.04-9.67)	10.2 (7.36-12.9)	12.3 (8.45-15.9)
10-min	1.15 (0.996-1.33)	1.44 (1.27-1.67)	1.97 (1.72-2.29)	2.46 (2.14-2.87)	3.28 (2.78-3.84)	4.04 (3.31-4.79)	4.94 (3.92-5.92)	6.02 (4.60-7.36)	7.78 (5.60-9.80)	9.40 (6.43-12.1)
15-min	0.944 (0.824-1.10)	1.19 (1.05-1.38)	1.62 (1.42-1.89)	2.04 (1.77-2.37)	2.71 (2.30-3.17)	3.34 (2.74-3.96)	4.09 (3.24-4.90)	4.98 (3.80-6.09)	6.42 (4.62-8.10)	7.76 (5.32-10.0)
30-min	0.636 (0.554-0.736)	0.800 (0.706-0.930)	1.09 (0.958-1.27)	1.37 (1.19-1.60)	1.82 (1.55-2.14)	2.25 (1.84-2.66)	2.75 (2.18-3.30)	3.35 (2.66-4.10)	4.33 (3.11-5.45)	5.23 (3.58-6.74)
60-min	0.394 (0.343-0.456)	0.495 (0.437-0.576)	0.677 (0.593-0.787)	0.848 (0.737-0.988)	1.13 (0.957-1.32)	1.39 (1.14-1.65)	1.70 (1.35-2.04)	2.08 (1.58-2.54)	2.68 (1.93-3.37)	3.24 (2.22-4.17)
2-hr	0.248 (0.220-0.283)	0.310 (0.274-0.354)	0.400 (0.353-0.458)	0.488 (0.424-0.560)	0.634 (0.540-0.734)	0.768 (0.638-0.901)	0.928 (0.744-1.11)	1.12 (0.883-1.36)	1.42 (1.04-1.79)	1.71 (1.18-2.19)
3-hr	0.193 (0.173-0.217)	0.237 (0.213-0.268)	0.298 (0.266-0.336)	0.353 (0.314-0.399)	0.443 (0.386-0.506)	0.528 (0.450-0.609)	0.633 (0.525-0.742)	0.758 (0.608-0.909)	0.962 (0.733-1.21)	1.15 (0.840-1.48)
6-hr	0.131 (0.120-0.144)	0.160 (0.146-0.176)	0.193 (0.176-0.214)	0.224 (0.201-0.248)	0.270 (0.240-0.302)	0.309 (0.271-0.348)	0.353 (0.305-0.403)	0.403 (0.340-0.468)	0.505 (0.411-0.610)	0.597 (0.472-0.748)
12-hr	0.083 (0.077-0.090)	0.101 (0.094-0.111)	0.122 (0.112-0.134)	0.141 (0.128-0.154)	0.168 (0.152-0.186)	0.191 (0.170-0.212)	0.215 (0.188-0.243)	0.242 (0.207-0.277)	0.282 (0.234-0.331)	0.315 (0.255-0.378)
24-hr	0.051 (0.047-0.055)	0.062 (0.057-0.067)	0.074 (0.068-0.080)	0.084 (0.078-0.091)	0.098 (0.090-0.106)	0.108 (0.099-0.117)	0.119 (0.109-0.129)	0.130 (0.118-0.141)	0.145 (0.131-0.168)	0.160 (0.140-0.192)
2-day	0.029 (0.027-0.032)	0.036 (0.033-0.039)	0.043 (0.039-0.046)	0.048 (0.045-0.052)	0.055 (0.051-0.060)	0.061 (0.056-0.066)	0.067 (0.061-0.072)	0.072 (0.066-0.078)	0.080 (0.073-0.086)	0.085 (0.077-0.097)
3-day	0.021 (0.020-0.023)	0.026 (0.024-0.028)	0.031 (0.029-0.033)	0.035 (0.032-0.038)	0.040 (0.037-0.043)	0.045 (0.041-0.048)	0.049 (0.045-0.053)	0.053 (0.049-0.057)	0.059 (0.053-0.064)	0.063 (0.057-0.070)
4-day	0.017 (0.016-0.019)	0.021 (0.019-0.023)	0.025 (0.023-0.027)	0.028 (0.026-0.030)	0.033 (0.030-0.035)	0.036 (0.034-0.039)	0.040 (0.037-0.043)	0.044 (0.040-0.047)	0.048 (0.044-0.053)	0.052 (0.047-0.057)
7-day	0.012 (0.011-0.012)	0.014 (0.013-0.015)	0.017 (0.016-0.018)	0.019 (0.018-0.020)	0.022 (0.020-0.024)	0.024 (0.022-0.026)	0.026 (0.024-0.028)	0.029 (0.026-0.031)	0.031 (0.029-0.034)	0.034 (0.030-0.037)
10-day	0.009 (0.008-0.010)	0.011 (0.010-0.012)	0.013 (0.012-0.014)	0.015 (0.014-0.016)	0.017 (0.016-0.018)	0.019 (0.017-0.020)	0.020 (0.019-0.022)	0.022 (0.020-0.023)	0.023 (0.022-0.025)	0.025 (0.023-0.027)
20-day	0.006 (0.005-0.006)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.009-0.010)	0.011 (0.010-0.011)	0.012 (0.011-0.012)	0.012 (0.012-0.013)	0.013 (0.012-0.014)	0.014 (0.013-0.015)	0.015 (0.014-0.016)
30-day	0.005 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.010)	0.010 (0.010-0.011)	0.011 (0.010-0.012)	0.011 (0.011-0.012)
45-day	0.004 (0.004-0.004)	0.005 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.006)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.008-0.009)	0.009 (0.008-0.009)	0.009 (0.009-0.010)
60-day	0.003 (0.003-0.004)	0.004 (0.004-0.004)	0.005 (0.005-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.007)	0.007 (0.007-0.008)	0.008 (0.007-0.008)	0.008 (0.007-0.009)

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

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

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in NOAA Atlas 14 document for precipitation frequency estimates. Submit