GREAT BASIN ENGINEERING INC

SMART FIELDS PHASE 1
1700 SOUTH 4300 WEST
WEBER COUNTY, UTAH 84401
STORM WATER STUDY
Project No. 21N700
10-1-2021

General Site Information:

The proposed Smart Field Subdivision is located at 1700 South 4300 West along the east 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 detention ponds when completed.

Storm water from the site will be treated one of two ways. Water that falls on or near the right of way will be collected in inlet boxes and catch basins and will continue via storm drain to the west side of phase 1. Storm water will be detained in a detention pond located next to the 4300 West Right-of-Way. The site is allowed a unit-release of 0.1 cfs per acre for the 100-yr storm into an existing storm drainage system in 4300 West and will continue south along 4300 West 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. Water that falls further that 30' from the right of way will be collected on a per lot basis in small retention ponds. These small ponds will be located near the rear property line and sized to handle the 24hr-100-year storm for the individual lot. (See attached figure and calculations).

The study area is broken up into 13 drainage areas (labeled A-1, A-2, L-1 through L-13 excluding L-4and L-5). Drainage areas A-1 and A-2 consist of the right of way area, a 30' strip outside the drainage area, and all of Lots 4 and 5. Drainage area A-1 and A-2 drain into afore mentioned detention facility. Drainage areas designated with an "L" are composed of the individual lot minus a 30' strip which will drain into the ROW. 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. An average runoff coefficient of 0.45 was calculated for A-1 and 0.53 for A-2. This yields a coefficient of 0.46 for the right of way study area. Run off coefficients for the individual Lots are located in a table on the following pages.

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 14 and 16 minutes respectively for areas A-1 and A-2. 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.

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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.

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 11 (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 5.5 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 facility increases, the orifice plate will restrict the flow. The maximum flow through the plate will occur when the detention basin reaches the maximum design depth. A detail of the orifice plate can be found in the construction documents for this project.

Required Detention:

The required detention for the 100-year storm with a release rate of 0.1 cfs/acre is 7,351 cubic feet for areas A-1 and A-2. The available volume in the detention facility is 8,100 cubic feet. There is an excess capacity of 749 cubic feet. In the event the detention facility experiences a storm larger than the design storm water will then spill out onto 4300 West and continue southeasterly in a historical fashion.

Required Retention:

Each lot, with the exception of Lots 4 and Lot 5, will be responsible for their own storm water. Water retention volumes have be calculated assuming 5,000 sqft of hardscape on each lot. Required retention volumes can be found on the following pages.

Great Basin Engineering, Inc.

Prepared by James Ries EIT

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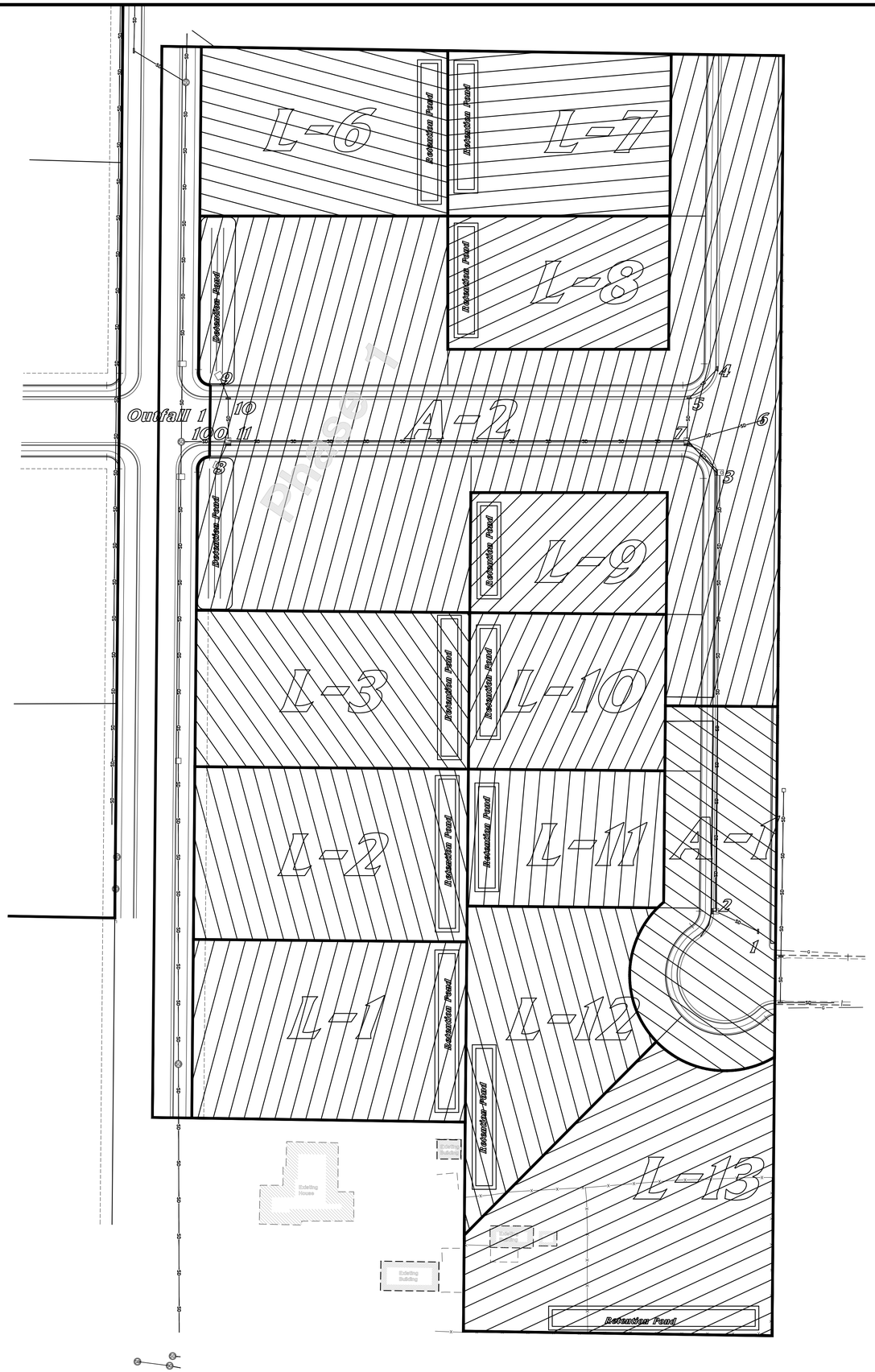

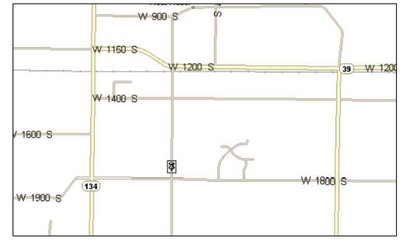

Smart Fields Storm Water Study

Scale: 1" = 50'

50 0 25 50 60 70 80 90 100

Graphic Scale

REV	DATE	DESCRIPTION

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Storm Water Study

Smart Fields

Approx. 1800 South 4300 West Street
Ogden City, Weber County, Utah
A part of Section 20, T6N. R2W, SLB&M, U.S. Survey

OCT, 2021

SHEET NO.

C1

21N700

Smart Fields - Ph 1 Lots

Per Lot Retention Facility

Remaining Unit Discharge = 0.000 cfs/acre

Release through Restriction = 0.000 cfs

Retention Ponds Sized For The 100 Year Storm

Lot	Area acres	C unitless	Time min	Rainfall Intensity in./hr.	Accumulated Volume (CF)	Allowable Release (CF)	Needed Retention (CF)
Lot 1	0.675	0.26	1440	0.12	1798	0	1798
Lot 2	0.646	0.26	1440	0.12	1748	0	1748
Lot 3	0.574	0.28	1440	0.12	1623	0	1623
Lot 4	0.408	0.31	1440	0.12	Accounted for in A2		
Lot 5	0.418	0.31	1440	0.12	Accounted for in A2		
Lot 6	0.550	0.28	1440	0.12	1581	0	1581
Lot 7	0.472	0.30	1440	0.12	1440	0	1440
Lot 8	0.360	0.33	1440	0.12	1226	0	1226
Lot 9	0.268	0.38	1440	0.12	1032	0	1032
Lot 10	0.380	0.32	1440	0.12	1266	0	1266
Lot 11	0.318	0.35	1440	0.12	1141	0	1141
Lot 12	0.554	0.28	1440	0.12	1588	0	1588
Lot 13	0.997	0.23	1440	0.12	2331	0	2331

Storm Water Calculations
Smart Fields - Phase 1
Approx. 1800 South 4300 West Street, Ogden, UT
21N700 - SWS.dwg

10/1/2021

2 Detained Areas

Hardscape C =	0.90
Landscape C =	0.15

Drainage Areas	Total Area (ft^2)	Total Area (acres)	Hardscape Area (ft^2)	Hardscape Area (ft^2)	Landscape (ft^2)	Landscape Area (acres)	C
∑ Det. Areas	174415	4.004	72326	1.660	102089	2.344	0.461
∑ All Areas	174415	4.004	72326	1.660	102089	2.344	0.461
A-1	143848	3.302	56998	1.308	86850	1.994	0.447
A-2	30567	0.702	15328	0.352	15239	0.350	0.526

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	40.00	2.00	6.78	258.00	0.50	6.92	52.00	0.43	14.13
A-2	40.00	2.00	6.78	187.00	0.50	5.89	444.00	3.70	16.37

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	14.1	2.11	4.24
A-2	16.4	1.96	3.92

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

Q=CIA

					Peak Flows	
				Σ detained =	3.85	7.71
AREA	C	I10 (in./hr.)	I100 (in./hr.)	A (acres)	Q (10-yr.) (cfs)	Q (100-yr.) (cfs)
A-1	0.447	2.115	4.239	3.30	3.12	6.26
A-2	0.526	1.957	3.923	0.70	0.72	1.45

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	0.94	15	0.02%	1.227	0.313	0.013	0.15%	15
		0.94	18	0.01%	1.767	0.375	0.013	0.11%	
		0.94	24	0.00%	3.142	0.500	0.013	0.08%	
2	3	3.12	15	0.23%	1.227	0.313	0.013	0.15%	15
		3.12	18	0.09%	1.767	0.375	0.013	0.11%	
		3.12	24	0.02%	3.142	0.500	0.013	0.08%	
3	7	3.23	15	0.25%	1.227	0.313	0.013	0.15%	15
		3.23	18	0.09%	1.767	0.375	0.013	0.11%	
		3.23	24	0.02%	3.142	0.500	0.013	0.08%	
4	5	0.11	15	0.00%	1.227	0.313	0.013	0.15%	15
		0.11	18	0.00%	1.767	0.375	0.013	0.11%	
		0.11	24	0.00%	3.142	0.500	0.013	0.08%	
5	7	0.18	15	0.00%	1.227	0.313	0.013	0.15%	15
		0.18	18	0.00%	1.767	0.375	0.013	0.11%	
		0.18	24	0.00%	3.142	0.500	0.013	0.08%	
6	7	0.14	15	0.00%	1.227	0.313	0.013	0.15%	15
		0.14	18	0.00%	1.767	0.375	0.013	0.11%	
		0.14	24	0.00%	3.142	0.500	0.013	0.08%	
7	11	3.63	15	0.32%	1.227	0.313	0.013	0.15%	15
		3.63	18	0.12%	1.767	0.375	0.013	0.11%	
		3.63	24	0.03%	3.142	0.500	0.013	0.08%	
8	11	0.04	15	0.00%	1.227	0.313	0.013	0.15%	15
		0.04	18	0.00%	1.767	0.375	0.013	0.11%	
		0.04	24	0.00%	3.142	0.500	0.013	0.08%	
9	10	0.04	15	0.00%	1.227	0.313	0.013	0.15%	15
		0.04	18	0.00%	1.767	0.375	0.013	0.11%	
		0.04	24	0.00%	3.142	0.500	0.013	0.08%	
10	11	0.11	15	0.00%	1.227	0.313	0.013	0.15%	15
		0.11	18	0.00%	1.767	0.375	0.013	0.11%	
		0.11	24	0.00%	3.142	0.500	0.013	0.08%	
11	100	3.85	15	0.35%	1.227	0.313	0.013	0.15%	15
		3.85	18	0.13%	1.767	0.375	0.013	0.11%	
		3.85	24	0.03%	3.142	0.500	0.013	0.08%	
100	Outfall 1	1.17	15	0.03%	1.227	0.313	0.013	0.15%	15
		1.17	18	0.01%	1.767	0.375	0.013	0.11%	
		1.17	24	0.00%	3.142	0.500	0.013	0.08%	

Node Inlet Requirements

Size pipes for 10 year storm

Area	Node #	% of Total	Q (cfs)
A-1	1	70.0%	2.19
A-1	2	30.0%	0.94
A-2	3	20.0%	0.14
A-2	4	15.0%	0.11
A-2	5	10.0%	0.07
A-2	6	15.0%	0.11
A-2	7	10.0%	0.07
A-2	8	5.0%	0.04
A-2	9	5.0%	0.04
A-2	10	10.0%	0.07
A-2	11	10.0%	0.07
A-2	100	0.0%	0.00

Summary of Node Inlet Requirements

Node	Is required to take (cfs)
1	2.19
2	0.94
3	0.14
4	0.11
5	0.07
6	0.11
7	0.07
8	0.04
9	0.04
10	0.07
11	0.07
100	0.00

PIPE FLOWS

Upstream Node	Downstream node	Pipe Flow (cfs)
1	2	2.19
2	3	3.12
3	7	3.27
4	5	0.11
5	7	0.18
6	7	0.11
7	11	3.63
8	11	0.04
9	10	0.04
10	11	0.11
11	100	3.85
100	Outfall 1	1.17

Smart Fields - Phase 1

Combined Detention Facility

C = 0.46

Area = 4.00 acres

Remaining Unit Discharge = 0.100 cfs/acre

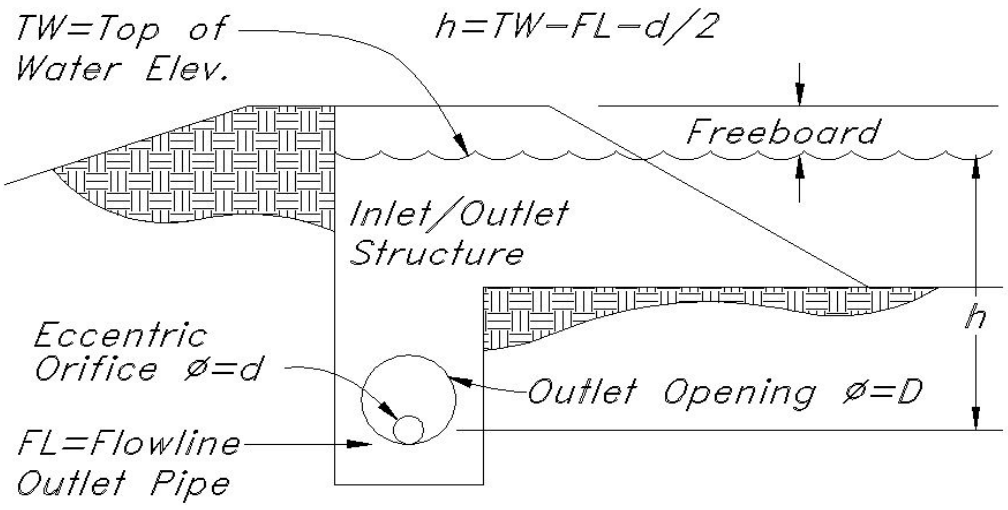
Release through Restriction = 1.170 cfs

Detention Pond Sized For The 100 Year Storm

Time	Rainfall Intensity	Accumulated Volume	Allowable Release	Needed Detention	
min	in./hr.	(CF)	(CF)	(CF)	
5	6.50	3599	351	3248	
10	4.95	5482	702	4780	
15	4.09	6795	1053	5742	
20	3.48	7710	1404	6306	
25	3.06	8481	1755	6726	
30	2.75	9137	2106	7031	
35	2.52	9769	2457	7312	
40	2.29	10159	2808	7351	<- Req. Det.
45	2.10	10490	3159	7331	
50	1.94	10760	3510	7250	
55	1.81	11015	3861	7154	
60	1.70	11297	4212	7085	
90	1.21	12020	6318	5702	
120	0.93	12333	8424	3909	
180	0.63	12619	12636	-17	
360	0.35	14075	25272	-11197	
720	0.22	17145	50544	-33399	
1440	0.12	18979	101088	-82109	

Required Storage Volume = **7351** ft^3

ORIFICE PLATE CALCULATIONS



$$Q_{orif} = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

$$h = TW - FL - {}^{d}/_{2}$$

$$Q_{req} = Q_{orif}$$

Let $\Delta = Q_{req} - Q_{orif}$, and Goal Seek Δ to zero by changing "trial d".

TW =	37.00	
FL =	34.75	
Q_{req} =	1.170	cfs
trial d=	0.4588	ft
Δ =	0.001	ft
d =	5.51	inches