WCE

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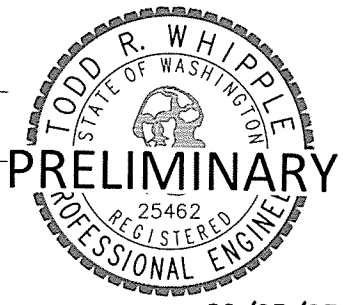


09/05/23

MEMORANDUM

TO:	Mike Nilsson, P.E.		
FROM:	Todd R. Whipple, P. E.		
DATE:	09-05-2023		
PROJECT NO:	22-3376	**NAME:**	Replat of Crest View Estates 1st Addition
REGARDING:	Strom Drainage Report		

This report has been prepared by Elliott Whipple under the direction of the undersigned professional engineer whose seal and signature appears hereon:

INTRODUCTION:

The purpose of this drainage report is to identify drainage impacts resulting from the proposed Crest View Estates Short Plat. This drainage report will describe the drainage infrastructure improvements that are necessary to control and treat the stormwater runoff from the project site. The results reported will demonstrate there is no negative impact to the adjacent properties with the proposed development. The proposed project lies within the City of Spokane and will be designed in accordance with the Spokane Regional Stormwater Manual (SRSM). and treatment methods will be based on equation 6-1d; V=1815A, as outlined in the SRSM, and updated soil, and swale amendments per the 2019 Eastern Washington Stormwater Management Manual (EWSMM).

The proposed project is a 2-lot short plat development on an approximately 0.56 +/- acre site located off Tieton Avenue & Ash Street. The site is currently mostly developed with an existing grassed swale. The site is located within the City of Spokane and lies in the SE 1/4 of Section 24, T 26 N., R 42 E., W.M.

Table 1 -Site Summary

Item No.	Description	Volume @ 0.5 ft of depth
A	Required treatment volume	3,113 cf **Generated by this Project**
B	Provided treatment volume	3,570 cf **Provided by this Project**
C	Extra area if Any (A – B)	457 sf/cf **Excess**

NARRATIVE:

Project Description:

- Parcel # 26241.0410 & 26241.0310
- Property address: 8903 N ASH ST & 8904 N ASH ST
- NE 1/4 of Section 24, T 26 N., R 42 E., W.M.
- Lot size: 24,393 sf or 0.56± ac
- Bio-retention swales proposed with 12" treatment depth, & 2.5-foot gravel gallery beneath pond
- See Geotech information below for surface soils
- Existing site is vegetated with, field grass, and weeds.

Geotechnical Information:

Per Liberty Geotech Report 04-05-2022

The geologic map indicated that the geologic unit was the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene). In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2021) was reviewed. The soil survey indicates that the soil unit is the Urban land-Seaboldt, warm, disturbed-Brincken, moist, disturbed complex consisting of ashy loam from the ground surface to a depth of 10 inches, loam from 10 inches to 16 inches, sandy loam from 16 inches to 23 inches, extremely gravelly sandy loam from 23 inches to 28 inches, and bedrock from 28 inches to 38 inches. The soil survey describes the soil as loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt.

Per Budinger & Associates Report 09-29-1995

Their recommendations are the following:

"We recommend that accumulated stormwater be discharged to / lowly percolating retention swales utilizing permeability rates of the sodland topsoil or 0.5 in/hr,' whichever is slower. Excess stormwater in the southern portion of the site may be discharged to the permeable sand and gravel through an infiltration gallery at a permeability of ks30 ft/day {15 in/hr) ."

Test Pit	Depth (feet)
TP-1	3.0
TP-2	4.0

The existing pond are not the same elevation. TP-1 is 1-foot +/- lower than TP-2. For this reason bedrock is expected to be the same elevation.

PRE-DEVELOPMENT BASIN INFORMATION:

As shown on the Pre-Developed Basin Map table 1 located in the Appendix, the site gradually slopes to the south at approximately 2% to 5%. Per the original civil engineering plans in 2003 the is conveyed to two (2) existing ponds with a gravel gallery and a discharge structure connected to the gravel galley. From the existing ground contours, it appears that the excess stormwater is absorb into the soil generated in the pre-developed condition.

Per the original storm report in 2003 they accounted for 41-acres of undeveloped grass field runoff to the existing crest view estates subdivision. Since then development has occurred in the 5-mile area and basin 1 has been developed into an existing subdivision, and basin 2 has also had portion of it developed. Leaving a 2.5-acres of undeveloped grass field that is being discharge to Crest view estates, and conveyed along the easter property line in a ditch to a ponds A and B per WCE proposed short plat located along Ash Street and Tieton. The below table reflect this reduction in runoff compared to the Taylor report.

Table 1A – Pre-Development Project Site Basin Summary

Pre-Basin	Ponds	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)	PGIS Area (sf)
A	N/A	312,811	79,800	233,011	79,800
Total	-	312,811	79,800	233,011	79,800

POST-DEVELOPMENT BASIN INFORMATION:

The Post-Development basins has been divided into 1 basin that contribute to the and existing Pond B, see Table 4,5 and 6 located in within storm drainage report for additional information.

Per the original report they accounted for 41-acres of undeveloped grass field runoff to the existing crest view estates subdivision. Since then development has occurred in the 5-mile area and basin 1 has been developed into an existing subdivision, and basin 2 has also had portion of it developed. Leaving a 2.5-acres of undeveloped grass field that is being discharge to Crest view estates.

Table 4 – Post-Development Project Site Basin Summary

Basins	Ponds	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)	PGIS Area (sf)
Basin A	**Pond A**	312,811	74,700	238,111	74,700
TOTAL	-	312,811	74,700	238,111	74,700

Table 5 – Post-Development Project Site Pond Summary

Basins	Ponds	(Method 1815A (ac)) Treatment Area/Volume (square feet/cubic feet)				
		Required		Provided		
		Pond area	Pond vol.	Pond area	Treatment volume	Pond vol.
Basin A	Pond B	6,225 sf	3,113 sf	6,890 sf	3,570 cf	14,016 cf
TOTAL	-	6,225 sf	3,113 sf	**6,890 sf**	**3,570 cf**	**14,016 cf**

Refer to basin calculations in Appendix for areas and peak flows for all basins.


W Johannsen Rd
Spokane Jump Company
N Cedar Rd
PROJECT
W Teton Ave


W Dawn Ave
W Chaucer Ave
W Sienna Ave
N Bradbury Dr
W Jay Ct
N Cedar Rd
N Ash St
W Maxine Ct
PROJECT
W Tieton Ave
W Tieton Ct
W Kedlin Ln
N Maple St
N Kensington Dr
W Strong Rd
Palm Pl
SCOUT
Spokane County

Critical Areas:
Based on the Critical Area Maps provided by Spokane County, (DNR Streams, Fish and Wildlife, Wetlands, Geo-hazard Area and Critical Aquifer Resource Area), there does not appear to be any critical areas on site. No inventoried wetlands or federal flood zones are present within the project site.

Down-Gradient Analysis:
Tieton Avenue & Ash Street Avenue Analysis:
The stormwater generated from Ash Street and Tieton avenue will continue to flow to the existing curb inlets. The existing curb inlets are not proposed to be removed or changed.

Methodology:
As required by the SRSM, and the EWLID the storm drainage facilities proposed for this site have been sized to attenuate the 10- and 50-year storm events using the Rational Method as outlined in Section 5.5 of the SRSM. Due to the small size of the onsite basins within this analysis, the Rational Method has been used to calculate peak flows and volumes. The peak flows and volumes for these storm events are shown in the calculations that are included within the Appendix of this report.

Water Quality Treatment:
The proposed storm drainage pond has been designed to provide treatment volume based on SWMMEW (Stormwater Management Manual for Eastern Washington) chapter 5.4.3, SSC-6 Soil Physical and Chemical Suitability for Treatment, and Equation 6-1d (V=1815A) of the SRSM, and as outlined in Section 6.7.1. see the below description for bio-infiltration swale.

Results:
As shown in Table 4 within this report we have provided the required treatment volume for the improvements proposed for the development. Table 6 below shows the onsite pond/swale storage summary for the 50-year storm events as well as the peak pond/swale depth.

Table 6 – Project Site Pond/Swale Storage Summary 100-Year Check

	50-YR Storm	
	Required	Provided
Basin	Vol. (cf)	Vol. (cf)
A	13,759 cf	14,016 cf *

NOTE: Pond Bottom Infiltration was not accounted for within the Bowstring Calculations

* An infiltration of 5 X 10 -7 cfs /sf was used on the updated bowstring

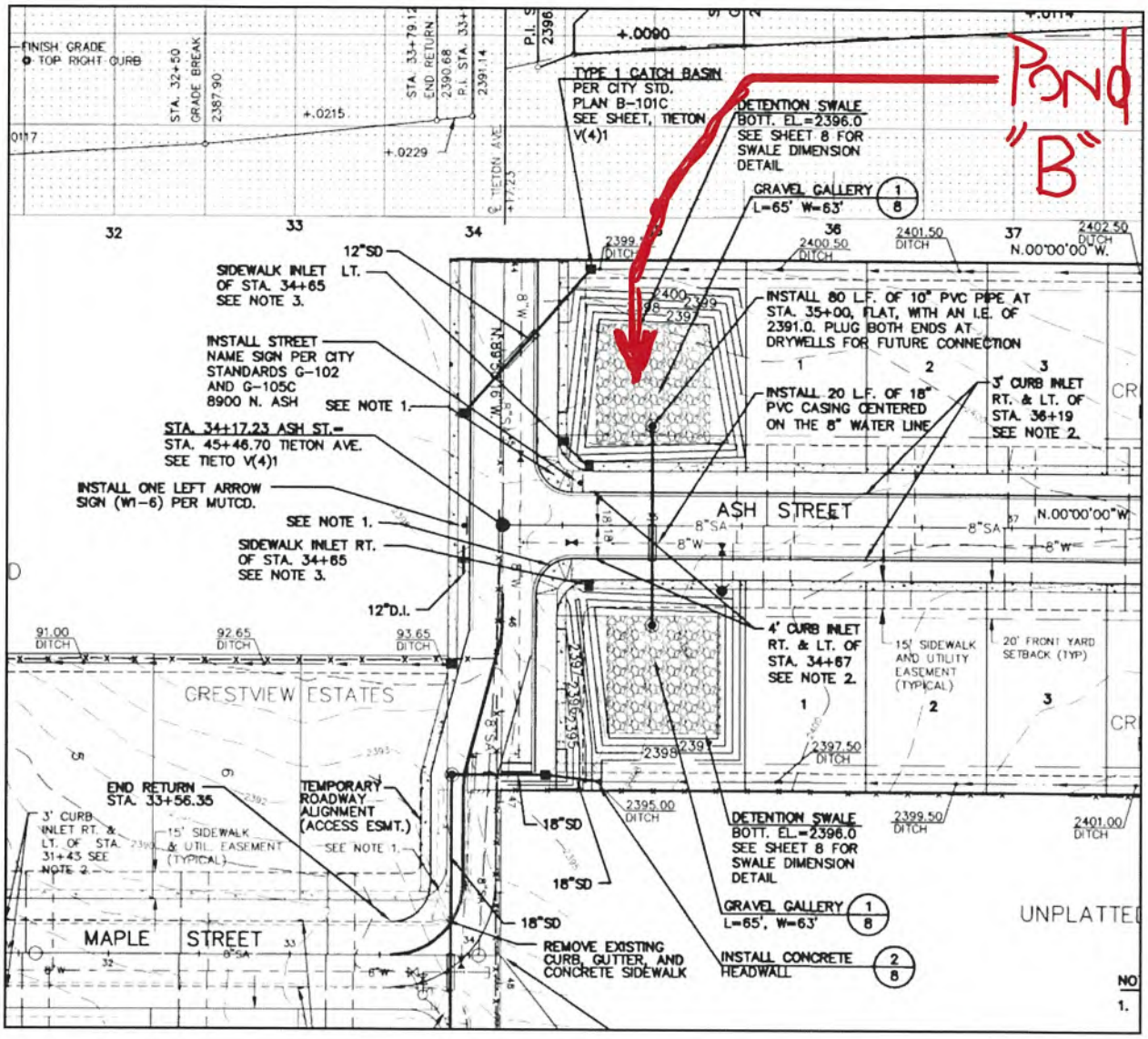
Operation Characteristics:

Bio-infiltration Swale

The stormwater generated by the existing asphalt and proposed driveways will be conveyed in the existing Ash street gutter, this storm water will be conveyed to the proposed existing pond "B" expansion via a curb inlet and types 2 under walk drain and a proposed catch basin that will have a proposed 8-inch ductile iron conveyance pipe that is interconnected to the updated existing pond "B" bottom. Once the storm water has been attenuated in the existing pond "B" the stormwater will infiltrate through the existing and proposed 12-inches of treatment soil until the depth of 6-inches. Once the stormwater exceeds the height of 6-inches, excess stormwater will spill into a single depth drywell and be discharged underground as required per the Spokane Regional Stormwater Manual, and the Eastern Washington Low Impact Development Guidance Manual.

Results:

Refer to Table 1 and Pre & Post basin tables in Appendix for Post-Development storm drainage information.


Pond "B"
FINISH GRADE
TOP RIGHT CURB
STA. 32+50
GRADE BREAK
2387.90
+.0215
+.0229
STA. 33+79.12
END RETURN
2390.68
P.I. STA. 33+
2391.14
P.I.
2396
+.0090
TYPE 1 CATCH BASIN
PER CITY STD.
PLAN B-101C
SEE SHEET, TIETON
V(4)1
DETENTION SWALE
BOTT. EL.=2396.0
SEE SHEET 8 FOR
SWALE DIMENSION
DETAIL
GRAVEL GALLERY
L=65' W=63'
1
8
32
33
34
36
37
2401.50
DITCH
2402.50
DITCH
N.00°00'00"W.
2400.50
DITCH
12"SD
SIDEWALK INLET LT.
OF STA. 34+65
SEE NOTE 3.
INSTALL STREET
NAME SIGN PER CITY
STANDARDS G-102
AND G-105C
8900 N. ASH
SEE NOTE 1.
STA. 34+17.23 ASH ST.=
STA. 45+46.70 TIETON AVE.
SEE TIETO V(4)1
INSTALL ONE LEFT ARROW
SIGN (W1-6) PER MUTCD.
SEE NOTE 1.
SIDEWALK INLET RT.
OF STA. 34+65
SEE NOTE 3.
12"D.I.
INSTALL 80 L.F. OF 10" PVC PIPE AT
STA. 35+00, FLAT, WITH AN I.E. OF
2391.0. PLUG BOTH ENDS AT
DRYWELLS FOR FUTURE CONNECTION
INSTALL 20 L.F. OF 18"
PVC CASING CENTERED
ON THE 8" WATER LINE
3' CURB INLET
RT. & LT. OF
STA. 36+19
SEE NOTE 2.
ASH STREET
8"SA
8"W
4' CURB INLET
RT. & LT. OF
STA. 34+67
SEE NOTE 2.
15' SIDEWALK
AND UTILITY
EASEMENT
(TYPICAL)
20' FRONT YARD
SETBACK (TYP)
91.00
DITCH
92.65
DITCH
93.65
DITCH
CRESTVIEW ESTATES
END RETURN
STA. 33+56.35
TEMPORARY
ROADWAY
ALIGNMENT
(ACCESS ESMT.)
SEE NOTE 1.
3' CURB
INLET RT. &
LT. OF STA.
31+43 SEE
NOTE 2.
15' SIDEWALK
& UTIL. EASEMENT
(TYPICAL)
18"SD
2395.00
DITCH
2397.50
DITCH
2399.50
DITCH
2401.00
DITCH
DETENTION SWALE
BOTT. EL.=2396.0
SEE SHEET 8 FOR
SWALE DIMENSION
DETAIL
GRAVEL GALLERY
L=65', W=63'
MAPLE STREET
REMOVE EXISTING
CURB, GUTTER, AND
CONCRETE SIDEWALK
INSTALL CONCRETE
HEADWALL
2
8
UNPLATTE
NO
1.

Perpetual Maintenance of Facilities:

There is an existing homeowner association and the swales within the proposed tracts "A" will be maintained by the existing HOA. The City of Spokane will not be liable for any maintenance or operation of the facilities. A maintenance plan will be provided to the owner if requested.

Offsite Easements:

There are no offsite easements required for this property.

Regional Facilities:

There are no known regional facilities that lie within or are affected by the project site.

CONCLUSION:

As required by the City of Spokane and the Spokane Regional Stormwater Manual, the onsite storm drainage facilities for this project will adequately collect, treat and discharge stormwater runoff generated by the site during the 50-year storm event. Also, the storm drainage facilities will contain and discharge the 50-year storm under non frozen conditions. Therefore, this project will have no adverse impact to adjacent and/or downstream properties.

Per the SRSM 2.2.4 Basic requirement No. 4 – Flow control. The proposed ponds as designed can attenuate the 50-year storm as designed. Should a higher order storm occur the proposed onsite pond will overflow to W. Tieton avenue. An overflow path of travel map is attached in the Appendix.

APPENDIX

VICINITY MAP

VICINITY MAP

N
W E
S
NOT TO SCALE

PROJ #: 22-TOM DATE: 09/07/22 DRAWN: TEW APPROVED: TRW	DRAINAGE REPORT CREST VIEW ESTATS SHORT PLAT 8904 N. ASH STREET SPOKANE, WASHINGTON	WCE WHIPPLE CONSULTING ENGINEERS 21 SOUTH PINES ROAD SPOKANE VALLEY, WASHINGTON 99206 PH: 509-893-2617 FAX: 509-926-0227
FIGURE 1	VICINITY MAP	

BASIN MAPS

SHEET 1 OF 5

PRE-DEVELOPMENT BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

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SHEET 2 OF 5

PRE OVER ALL -DEVELOPMENT BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

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POST-DEVELOPMENT BASIN MAP

CREST VIEW ESTATS SHORT PLAT

8904 N. ASH STREET

SPOKANE, WASHINGTON

SHEET 3 OF 5

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

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POST-DEVELOPMENT BASIN MAP

CREST VIEW ESTATS SHORT PLAT

8904 N. ASH STREET
SPOKANE, WASHINGTON

SHEET 4 OF 5

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

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SHEET 5 OF 5

100 YEAR FLOWS BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

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BASIN SUMMARY SHEET

Whipple Consulting Engineers

Basin Calculation Worksheet

			Imp	0.9	Intensities from SRSM eqn. 5-13, per Table 5-7, Assumes Tc = 5 min				
			Per	0.15	I (2 yr) =	1.418 inches	I (10 yr)=	2.619 inches	NOTE:
	WCE No.	Project Name			I (25 yr) =	3.319 inches	I (50 yr)=	3.843 inches	
9/5/2023	-	Crest View Short Plat			I (100 yr) =	4.381 inches			
TEW					driveway area	1,200 sf			
					1/2 House Area	1,200 sf			

SPOKANE COUNTY - SRSM - GRASSED PERCOLATION METHOD

Basin	Total	Access/Parking	Sidewalk	Lot #	DV	Buildings	Total	Total	Wtd	PGIS	1815 A Pond	Pond	Q=CIA (cfs)				
	sf	/Street (sf)	sf	#	sf	sf	Impervious	Pervious	"C"	sf	Area (sf)	Vol (cf)	2 yr	10 yr	25 yr	50 yr	100 yr
Pre Onsite Flow																	
Pre A	312,811	26,700	0	18	21,600	21,600	69,900	242,911	0	69,900	5,825	2,913	3.23	5.97	7.57	8.76	9.99
Total	**312,811**	**26,700**	**0**	**0**	**21,600**	**21,600**	**69,900**	**242,911**	**0**	**69,900**	**5,825**	**2,913**	**3.23**	**5.97**	**7.57**	**8.76**	**9.99**
Post Onsite Flow																	
POST A	312,811	26,700	0	20	24,000	24,000	74,700	238,111	0.33	74,700	6,225	3,113	3.35	6.19	7.84	9.08	10.35
Total	**312,811**	**26,700**	**0**	**20**	**24,000**	**24,000**	**74,700**	**238,111**	**0.33**	**74,700**	**6,225**	**3,113**	**3.35**	**6.19**	**7.84**	**9.08**	**10.35**

POND VOLUME WORKSHEET

WHIPPLE CONSULTING ENGINEERS **Date: 9/5/2023**

POND VOLUME CALC SHEET

Project: 22-3376 CREST VIEW ESTATS SHORT PLAT

Designer: TEW

								Treatment					*Storage*
Basins	Ponds/ Swales	Bottom Area sf	Treatment Area (w/ Side Slopes)	Squared Side lf	Pond Bottom Elevation at Drywell	Pond Drywell Elevation	Pond Inlet Elevation (avg)	Conic Volume to Rim cf	Side * Slope Volume cf	Total Volume to to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	Total Volume to Inlet cf
A	**A**	6,890	7,139	83.01	1000.00	1000.50	1001.80	3,445	125	**3,570**	12,402	1,614	14,016
Totals		**6,890**	**7,139**	-	-	-	-	-	-	**3,570**	-	-	**14,016**

* LID ponds do not calculate side slopes.

50 – YEAR STORM EVENT BOWSTRING CALCULATIONS

PEAK FLOW CALCULATION PROJECT:
50-Year Design Storm **CREST VIEW EST. S.PLAT**

BASIN: A

Tot. Area	312,811	SF	7.18	Acres
Imp. Area	74,700	SF	C=	0.9
Perv. Area	238,111	SF	C=	0.15
Wt. C =	0.33	PGIS Area =	74,700	

WCE Applicable Travel Time Ground Cover Coefficients

Per Table 5-6 SRSM	
Type of Cover	K (ft/min)
Short Pasture	420
Nearly Bare Ground	600
Small Roadside Ditch/ Grass	900
Paved Area (use for parking lots)	1200
Gutter - 4 inches deep	1500
Gutter - 6 inches deep	2400
Pipe - 12-inch PVC/DI	3000
Pipe - 15/18-inch PVC/DI	3900
Pipe - 24-inch PVC/DI	4700

Reaches		
Reach 1	Offsite	also applicable for Pre-Developed Tc
Length	800.00	
K	420.00	
Slope (ft/ft)	0.0400	be sure this is decimal equivalent slope 0.0000
Travel Time	9.52	Minutes
Reach 2	Finished Lot from House to Street	
Length	700.00	
K	2400.00	
Slope (ft/ft)	0.0300	be sure this is decimal equivalent slope 0.0000
Travel Time	1.68	Minutes
Reach 3	Gutter Flow to Inlet/Catch Basin	
Length	60.00	
K	3000.00	
Slope (ft/ft)	0.0200	be sure this is decimal equivalent slope 0.0000
Travel Time	0.14	Minutes
Reach 4	Pipe Flow	Pipe Reach One (only need one if no Dia change)
Length	0.00	
K	3000.00	12-inch Pipe minimum
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	0.00	Minutes
Reach 5	Pipe Flow	Add additional pipe reacheds for other Dia
Length	0.00	
K	3900.00	15/18-inch Pipe
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	0.00	Minutes
Sum of Tc	11.35	Minutes
Tc for Analysis	11.35	Minutes

BOWSTRING METHOD PROJECT: 0
DETENTION BASIN DESIGN BASIN: A
DESIGNER: TEW
DATE: 5-Sep-23

Time Increment (min)	10
Time of Conc. (min)	11.35
Outflow (cfs)	5.00E-07
Design Year Flow	50
Area (acres)	7.18
Impervious Area (sq ft)	74700
'C' Factor	0.33
Area * C	2.363
PGIS Area	74,700

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)
11.35	681	2.28	5.40	4925	0	4925
15	900	1.91	4.52	5116	0	5116
25	1500	1.38	3.27	5660	0	5660
35	2100	1.12	2.64	6155	0	6155
45	2700	0.95	2.25	6598	0	6598
55	3300	0.84	1.98	6997	0	6997
65	3900	0.75	1.78	7362	0	7362
75	4500	0.69	1.63	7699	0	7699
85	5100	0.64	1.50	8012	0	8012
95	5700	0.59	1.40	8306	0	8306
105	6300	0.56	1.31	8583	0	8583
115	6900	0.52	1.24	8846	0	8846
125	7500	0.50	1.18	9095	0	9095
135	8100	0.47	1.12	9334	0	9334
145	8700	0.45	1.07	9562	0	9562
155	9300	0.43	1.03	9781	0	9781
165	9900	0.42	0.99	9992	0	9992
175	10500	0.40	0.95	10196	0	10196
185	11100	0.39	0.92	10393	0	10393
195	11700	0.38	0.89	10583	0	10583
205	12300	0.36	0.86	10768	0	10768
215	12900	0.35	0.83	10947	0	10947
225	13500	0.34	0.81	11122	0	11122
235	14100	0.33	0.79	11292	0	11292
245	14700	0.32	0.77	11457	0	11457
255	15300	0.32	0.75	11619	0	11619
265	15900	0.31	0.73	11776	0	11776
275	16500	0.30	0.71	11930	0	11930
285	17100	0.29	0.70	12081	0	12081
295	17700	0.29	0.68	12229	0	12229
305	18300	0.28	0.67	12373	0	12373
315	18900	0.28	0.65	12515	0	12515
325	19500	0.27	0.64	12653	0	12653
335	20100	0.27	0.63	12790	0	12790
345	20700	0.26	0.62	12924	0	12924
355	21300	0.26	0.61	13036	0	13036
365	21900	0.25	0.59	13141	0	13141
375	22500	0.25	0.58	13225	0	13225
385	23100	0.25	0.58	13574	0	13574

Rainfall Intensity Coefficients for ***Spokane***
taken from Table 5-7 SRSM
M_{50} = 10.68
N_{50} = 0.635

Flow (weighted c)
Qwc= 9.08 cfs
Flow (time of concentration)
Qtc= 5.40 cfs

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)	
385							
395	23700	0.24	0.56	13358	0	13358	
405	24300	0.24	0.56	13693	0	13693	
415	24900	0.23	0.53	13433	0	13433	
425	25500	0.23	0.53	13754	0	13754	
435	26100	0.22	0.51	13453	0	13453	
445	26700	0.22	0.51	13759	0	13759	<==
455	27300	0.21	0.49	13415	0	13415	
465	27900	0.21	0.49	13707	0	13707	
475	28500	0.20	0.46	13321	0	13321	
485	29100	0.20	0.46	13599	0	13599	
495	29700	0.19	0.44	13170	0	13170	
505	30300	0.19	0.44	13434	0	13434	
515	30900	0.18	0.42	12962	0	12962	
525	31500	0.18	0.42	13212	0	13212	
535	32100	0.17	0.39	12697	0	12697	
545	32700	0.17	0.39	12933	0	12933	
555	33300	0.16	0.37	12376	0	12376	
565	33900	0.16	0.37	12598	0	12598	
575	34500	0.15	0.35	11998	0	11998	
585	35100	0.15	0.35	12206	0	12206	
595	35700	0.14	0.32	11564	0	11564	
605	36300	0.14	0.32	11757	0	11757	
615	36900	0.13	0.30	11072	0	11072	
625	37500	0.13	0.30	11251	0	11251	
635	38100	0.12	0.27	10524	0	10524	
645	38700	0.12	0.27	10689	0	10689	
655	39300	0.11	0.25	9920	0	9920	
665	39900	0.11	0.25	10070	0	10070	
675	40500	0.10	0.23	9258	0	9258	
685	41100	0.10	0.23	9394	0	9394	
695	41700	0.09	0.20	8540	0	8540	
705	42300	0.09	0.20	8662	0	8662	
715	42900	0.08	0.18	7765	0	7765	
725	43500	0.08	0.18	7873	0	7873	
735	44100	0.07	0.16	6933	0	6933	
745	44700	0.07	0.16	7027	0	7027	

"1815A" TREATMENT REQUIREMENTS		
Minimum "1815A" Volume Required	3,113	cu ft
Provided Treatment Volume - Min.	3,570	cu ft
STORAGE REQ. - 50 YEAR DESIGN STORM		
Maximum Storage Required by Bowstring	13,759	cu ft
Provided Pond Storage Volume to Inlet - Min.	14,016	cu ft
Provided Drywell/Gallery Storage Volume	0	cu ft
Total Provided Volume	**14,016**	**cu ft**

GEOTECHNICAL REPORT

Geotechnical Engineering Report
Crestview Estates 1st Addition
Ash Street and Tieton Avenue
Spokane County, Washington

Prepared For:
Austin J Fuller
Whipple Consulting Engineers, Inc.
21 South Pines Road
Spokane Valley, Washington 99206

WCE
Whipple Consulting Engineers

Prepared By:

LIBERTY GEOTECH

Liberty Geotechnical Engineering, Inc.
3012 N Sullivan Rd
Spokane Valley, Washington 99216
(509) 213-0400

BENJAMIN D VANCE
STATE OF WASHINGTON
54048
REGISTERED
PROFESSIONAL ENGINEER

Report Date: April 5, 2022
Job Number: 21425

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Appendices

1.0 EXECUTIVE SUMMARY

The following geotechnical engineering report has been prepared for Crestview Estates 1st Addition in Ash Street, Spokane County, Washington. The following items have been identified at the project site and proposed construction that should be carefully considered during design and construction:

- Standing water was observed within the existing drywells located at the site. This may be due to fluctuations of groundwater and perching between the topsoil or undocumented fill, and bedrock at the site.
- Swales consisting of single or double-depth drywells were not feasible across the site due to the limiting layer of shallow bedrock. Drainage retention swales are recommended to treat and retain the stormwater.
- The area appears to be a stormwater disposal facility. Drain rock, filter fabric and drywells were observed in the area.
- Undocumented fill was observed in both test pits to a depth of 1 ½- to 2-feet below the ground surface. Undocumented fill may be reused as *Embankment Fill* provided it meets the requirements of *Table 4.1.2.A* of this report.

Liberty Geotech should be involved in the design development and earthwork construction to help ensure that the report recommendations are incorporated into the design and construction. Liberty Geotech is available to discuss these items further in-person or via a conference call.

2.0 PROPOSED CONSTRUCTION

The proposed construction consists of a stormwater drainage facility. Stormwater disposal will consist of swales and typical single or double-depth drywells position within the swale areas. The recommendations included in this report are based on a plat map prepared by Taylor Engineering, Inc. dated October 10, 2003.

3.0 GEOTECHNICAL EXPLORATION

Subsurface exploration was performed by excavating two test pits with a SANY SY26U mini-excavator. Subsurface exploration was performed at the project site on December 2, 2021. The test pits were excavated through the topsoil, undocumented fill, and bedrock and terminated on the rock surface. The contractor or client is recommended to notify Liberty Geotech if the soil conditions are different from those described in the following sections.

Throughout this report, test pits are abbreviated TP and are hyphenated with a numbering system that corresponds to Appendix A: *Exploration Site Plan* and Appendix B: *Subsurface Exploration Results*. The test pits depicted in Appendix A were located using the accuracy of a cell phone location system. The locations were not surveyed and the accuracy is expected to be

within 10-feet of the depicted location. Also, the elevation of each test pit was estimated using Google Earth™ mapping service with the GWS84 EGM96 geoid.

3.1 Geology, Topography, and Current Site Use

The *Geologic map of the Spokane Northwest 7.5-minute quadrangle, Spokane County, Washington* (Derkey, 2004) was reviewed to determine the geologic deposit at the site. The geologic map indicated that the geologic unit was the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene). In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2021) was reviewed. The soil survey indicates that the soil unit is the Urban land-Seaboldt, warm, disturbed-Brincken, moist, disturbed complex consisting of ashy loam from the ground surface to a depth of 10 inches, loam from 10 inches to 16 inches, sandy loam from 16 inches to 23 inches, extremely gravelly sandy loam from 23 inches to 28 inches, and bedrock from 28 inches to 38 inches. The soil survey describes the soil as loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt.

The two lots have existing drainage swales and both with a single-depth drywell. According to the historical aerial images, the earthwork construction for the residential development within the site's vicinity was between 2003 to 2006. The existing swales and drywells appeared to be placed within the site during that time. In addition, based on the topography obtained from Google Earth™, the site is relatively level with approximately five to seven feet of relief across the site.

3.2 Summary of Soil and Rock Encountered During Exploration

The soil encountered during the exploration is generally consistent with the geologic research. However, both test pits observed undocumented fill to depths of 2 ½- to 3-feet below the ground surface. The test pits encountered one foot of topsoil overlying a separation fabric overlying drain rock with a separation fabric overlying bedrock.

3.3 Estimated Groundwater and Bedrock Elevations

Groundwater was not observed in both test pits. However, there was standing water at the drywells during the exploration. This may be due to fluctuations of groundwater and perching between the topsoil and bedrock at the site.

According to the well logs in the vicinity of the site (Ecology), the static water level is approximately 37-feet below the ground surface. Seasonal and annual fluctuations in groundwater levels should be anticipated.

Both test pits met refusal due to basalt bedrock to depths ranging from three to four feet below the ground surface. In TP-2, residual bedrock was observed 2 ½-feet below the ground surface.

4.0 GEOTECHNICAL RECOMMENDATIONS

4.1 Earthwork

The following recommendations should be considered by the general contractors and earthwork subcontractors prior to providing a cost estimate for the earthwork on the project.

4.1.1 Subgrade Preparation

Clear and grub all vegetation, strip all topsoil. Topsoil and undocumented fill removal are estimated to be one to three feet across the site.

Liberty Geotech should be contacted once the subgrade areas have been exposed to review the subgrade conditions.

4.1.2 Earthwork Soil Products, Compaction, and Testing Frequency

Different soil products should be used for different applications. The following table presents recommendations for anticipated earthwork construction:

Table 4.1.2.A - Soil product selection.

Soil Product	Project Use	Soil Description
Embankment Fill	• Utility trench backfill	Soil classified as: • GP-GM or GW-GM • GM • SP-SM or SW-SM • SM • ML Soil should have less than 6% organic deleterious material, and all material larger than 3-inches in diameter.

The following table provides compaction recommendations specific to ASTM D1557 *Laboratory Compaction Characteristics of Soil Using Modified Effort.* All fill products should be compacted in lifts of soil not exceeding 12 inches measured prior to compaction.

Table 4.1.2.B - Compaction recommendation.

Project Use	Recommended Compaction
• Exterior wall backfill. • Utility trench backfills.	92 percent of the maximum dry density of Modified Proctor.
• Non-structural fill areas.	80 to 85 percent of the maximum

• Vegetated areas.	dry density of Modified Proctor.

If more than 30 percent of native or imported *Structural Fill* material is retained on the ¾" sieve, ASTM D1557 *Laboratory Compaction Characteristics of Soil Using Modified Effort* is not recommended to be used. In this case, a soil-specific method specification can be developed. A nuclear density gauge can be used during earthwork operations to establish a moisture and compaction method that provides an acceptable maximum dry density. Method specification earthwork operations are recommended to have full-time soil testing to ensure adequate compaction.

The soil products are recommended to have passing compaction testing results at the following frequency to ensure the soil is uniformly meeting compaction requirements. Failing test results should be retested after additional compactive effort and, if necessary, water is added. At least 90% of the compaction testing results must achieve the required maximum dry density.

Table 4.1.2.C - Testing Frequency.

Project Use	Testing Frequency
• Utility trenches for every two vertical feet of trench backfill.	100 lineal feet and a minimum of 2 tests.

The jurisdictional requirements should be conformed to if there is a conflict with the requirements of Table 5.1.2.C. Excavations deeper than four feet must have adequate trenching protection or be sloped back in accordance with state and federal requirements in order to be compaction tested.

4.2 Drainage and Stormwater Infiltration Recommendations

Drainage retention swales may be utilized to treat and retain stormwater. The following recommendations should be used by the civil engineer to retention swales:

- The depth to a restrictive layer is at least three feet below the ground surface based on the shallow bedrock encountered at the site during the exploration.
- Swales should be located 10-feet from the edge of buildings and concrete hardscapes to minimize the effects of retention.

5.0 DESIGN REVIEW AND CONSTRUCTION OBSERVATIONS

5.1 Geotechnical Consultant versus Geotechnical Inspector

In order to retain Liberty Geotech as the geotechnical engineer of record, the client must contact Liberty Geotech or require their contractor to contact Liberty Geotech to perform the observations and notifications that are recommended within this report. Liberty Geotech is not the engineer of record and has no liability for the construction or design based on this report if

observations and material testing are not performed and meet the recommendations contained within this report. In addition, Liberty Geotech's liability is limited to the authorized proposal dated November 24, 2021.

5.2 Revisions and Transfer of Geotechnical Recommendations

Liberty Geotech should be notified to update recommendations if the proposed development changes or subsurface soil or groundwater conditions vary from those described in this report. This report cannot be relied upon by property owners adjacent to this property without confirmation of their specific site soil conditions. Also, the report recommendations cannot be transferred to other business entities or subsequent property owners without written authorization. No warranty or certification of construction is provided with this report. Liberty Geotech should review the final construction drawings to confirm the incorporation of the recommendations of this report.

7.0 REFERENCES

ACI Committee 302. "Guide for Concrete Floor and Slab Construction." ACI 302.1R-15. American Concrete Institute, P.O. Box 19150 Redford Station, Detroit, Michigan 48219.

Derkey, Robert E., Hamilton, Michael M., Stradling, Dale F., 2004. Geologic Map of the Spokane Northwest 7.5-Minute Quadrangle, Spokane County, Washington. Washington Division of Geology and Earth Resources.

Spokane County, City of Spokane, and City of Spokane Valley. "Spokane Regional Stormwater Manual." April 2008.

United States Department of Agriculture, Natural Resources Conservation Service. "Web Soil Survey." Accessed December 23, 2021. http://websoilsurvey.nrcs.usda.gov/

Washington State Department of Ecology. "Washington State Well Report Viewer." Accessed December 23, 2021. fortress.wa.gov/ecy/wellconstruction/map/WCLSWebMap/

APPENDIX A

Exploration Site Plan

EXPLORATION SITE PLAN

CRESTVIEW ESTATES 1ST ADDITION

ASH STREET AND TIETON AVENUE

SPOKANE COUNTY, WASHINGTON

LIBERTY GEOTECH

JOB NO. 21425	APRIL 5, 2022	PLATE 1

APPENDIX B

Subsurface Exploration Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS GROUP SYMBOL	SOIL DECRIPTION
COURSE GRAINED SOIL	GRAVEL	CLEAN GRAVEL		GW	WELL-GRADED GRAVEL
				GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES		GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
				GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	SAND	CLEAN SAND		SW	WELL-GRADED SAND
				SP	POORLY-GRADED SAND
		SAND WITH FINES		SM	SILTY SAND
				SC	CLAYEY SAND
FINE GRAINED SOIL	SILT AND CLAY LIQUID LIMIT LESS THAN 50%			ML	INELASTIC SILT
				CL	LEAN CLAY
				OL	ORGANIC SILT
	SILT AND CLAY LIQUID LIMIT GREATER THAN 50%			MH	ELASTIC SILT
				CH	FAT CLAY
				OH	ORGANIC CLAY
				PT	PEAT

ABBREVATIONS
BGS - BELOW EXISTING GROUND SURFACE
N.E. - NOT ENCOUNTERED

USCS DESCRIPTION	ELEVATION (FT)	DEPTH (FT)	LITHOLOGY	SAMPLE INTERVAL	POCKET PEN. (TSF)	% PASSING NO. 200 SIEVE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	VOID RATIO (%)	ADDITIONAL NOTES
TOPSOIL - Well-Graded Sand with Silt (SW-SM) Medium Dense, Brown, Moist	2385									1-foot treatment soil overlying geo fabric overlying drain rock overlying bedrock.
UNDOCUMENTED FILL - Well-Graded Gravel (GW) Medium Dense, Black, Moist		3								

Test pit terminated at 3-feet bgs due to bedrock.

Client: Whipple Consulting Engineers, Inc.	Test Pit Number: 1		
Project: Crestview Estates 1st Addition	Project Number: 21425		
Equipment: SANY SY26U	Date Excavated: 12/2/2021		
Depth to Groundwater: NE	Logged By: TMC		Sheet: 1 of 2

USCS DESCRIPTION	ELEVATION (FT)	DEPTH (FT)	LITHOLOGY	SAMPLE INTERVAL	POCKET PEN. (TSF)	% PASSING NO. 200 SIEVE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	VOID RATIO (%)	ADDITIONAL NOTES
TOPSOIL - Well-Graded Sand with Silt (SW-SM) Medium Dense, Brown, Moist	2385									1-foot treatment soil overlying geo fabric overlying drain rock overlying geo fabric overlying bedrock. Drain rock.
UNDOCUMENTED FILL - Poorly-Graded Gravel (GP) Medium Dense, Black, Moist										
BEDROCK - Well-Graded Gravel (GW) Very Dense, Black, Dry		4								

Test pit terminated at 4-feet bgs due to bedrock.

Client: Whipple Consulting Engineers, Inc.	Test Pit Number: 2		
Project: Crestview Estates 1st Addition	Project Number: 21425		
Equipment: SANY SY26U	Date Excavated: 12/2/2021		
Depth to Groundwater: NE	Logged By: TMC		Sheet: 2 of 2

APPENDIX C

Photo Log

Appendix C: Photo Log

PHOTO 1: TP-1 LOCATION

PHOTO 2: GEOFABRIC WITHIN TP-1

PHOTO 3: TP-1 EXCAVATED SOILS

PHOTO 4: BOULDERS WITHIN TP-1

Appendix C: Photo Log

PHOTO 5: TP-1 STANDING WATER WITHIN DRYWELL

PHOTO 6: TP-2 LOCATION

PHOTO 7: TP-2 EXCAVATED SOILS AND BOULDERS

PHOTO 8: GEOFABRIC WITHIN TP-2

TAYLOR 1996 STORM REPORT

STM020

DRAINAGE REPORT

FOR

CRESTVIEW ESTATES

Taylor Engineering, Inc.

Civil Design and Land Planning

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UIC

Underground Injection Control

Non-Municipal Stormwater

For UIC stormwater wells used along roads and in parking lots not owned by a county or city.

Registration Status

Site Number:38047
Authorization Status: Pending
Comments:

Facility/Site Information

Facility Name: CrEview Homeowners Association
Address:8400 N Ash Street
PO Box/Suite/Building:
City: Spokane
State:Zip:WA99208
Phone:509-458-5542
County: Spokane

Contact Information

Well Owner

Name: Terry Tombari
Organization: CrEview Homeowners Association
Address:8205 N Division St
PO Box/Suite/Building:
City:SPOKANE
State:Zip:WA99208
Email:terry@tombariproperties.com
Phone:509-458-5542

Property Owner

Name: Terry Tombari
Organization: CrEview Homeowners Association
Address:8205 N Division St
PO Box/Suite/Building:
City:SPOKANE
State:Zip:WA99208
Email:terry@tombariproperties.com
Phone:509-458-5542

Technical Contact

Name: Elliott Whipple
Organization: Whipple Consulting Engineers
Address:21 S Pines Rd
PO Box/Suite/Building:
City: Spokane Valley
State:Zip:WA99206
Email:ewhipple@whipplece.com
Phone:505-893-2617

Main Well Information

Well Name	Right-of-way Location	Construction Date	EPA Well Type	Status	UIC Construction Type	Depth of UIC Well (ft.)	Latitude	Longitude	Google Map Link
02		6/1/2003	Stormwater (residential, paved streets, roofs, parking lots)	Proposed	Manhole with perforated pipe	4	47.738940	-117.438900	https://google.com/maps/place/47.738940,-117.438900/@47.738940,-

Well Name	Right-of-way Location	Construction Date	EPA Well Type	Status	UIC Construction Type	Depth of UIC Well (ft.)	Latitude	Longitude	Google Map Link
01		6/1/2003	Stormwater (residential, paved streets, roofs, parking lots)	Proposed	Manhole with perforated pipe	4	47.739003	-117.435650	https://google.com/maps/place/47.739003,-117.435650/@47.739003,-

Main Well Information (cont.)

Well Name	IT constructed in accordance with approved stormwater manual?	Within 1000 feet of surface water?	Within 100 feet of a drinking water well or spring?	Is High Susceptible Aquifer?	Is Confining Layer Present?	Zoning	Within a Ground Water Protection Area?
02		N	N	N	Y	Residential	Critical Aquifer Recharge Area
01		N	N	N	N	Residential	Critical Aquifer Recharge Area

Documents

Document Type	Document	Uploaded By
Miscellaneous Support Documents	ENG - Street, 2003070, ASH, STRONG, STREET PLAN AND PROFILE.pdf	whipplece on 9/5/2023 11:52:10 AM
UIC Drainage Plans	Choose File No file chosen	

UIC Registration Signature Page

Site Number: 38047

I hereby certify that the information contained in the above referenced registration is true and correct to the best of my knowledge.

Name of legally authorized representative	Title
Elliott Whipple	TECH
Signature of legally authorized representative	Date
Elliott Whipple	09/05/2023