PRELIMINARY
STORM
DRAINAGE REPORT

FOR

WOODRIDGE VIEW ESTATES 3RD ADDITION

City of Spokane, Washington

March, 2019

2015-1409

Prepared by:

Whipple Consulting Engineers
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This report has been prepared by Justin Penner, EIT of Whipple Consulting Engineers under the direction of the undersigned professional engineer whose seal and signature appears hereon:

TODD R. WHIPPLE
STATE OF WASHINGTON
25462
REGISTERED
PROFESSIONAL ENGINEER

3/20/19

Todd R Whipple, P.E.

INTRODUCTION:

The purpose of this drainage report is to identify drainage impacts resulting from the proposed development for the Woodridge View Estates 3rd Addition. Note that this drainage report will utilize and update the Woodridge View Estates 1st & 2nd Addition storm drainage report calculations as prepared by CLC Associates and Sawyer's Engineering as necessary. This drainage report will determine the drainage infrastructure improvements that are necessary to control and treat the stormwater runoff from the project site. The report 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). As outlined in the SRSM, treatment methods will be based on equation 6-1c:, V=1133A.

NARRATIVE:

PROJECT DESCRIPTION:

The proposed project is an addition to an existing residential neighborhood located off of the Indian Trail Road corridor. The project proposes to extend Wieber Dr and Navaho Dr to the north and east. There are also six (6) new roads. The site is currently undeveloped hillside covered in trees, field grass and weeds. The proposed development of the site will result in 138 new lots, driveways, extension of public streets, and associated onsite/offsite storm drainage facilities. The proposed and existing stormwater facilities will adequately collect, treat and discharge the stormwater runoff from the proposed development including previous and future phases. The stormwater from the proposed development will be collected and join the stormwater from the previous original phases, 1st and 2nd addition, of the Woodridge View Estates development. The stormwater will be discharged into the existing four (4) ponds that were constructed during the Woodridge View Estates 1st Addition. Note that Ex. Pond C will be expanded to accommodate the increase in PGIS as required. Additionally, in order for conservatism four new drywells will be installed without credit for additional discharge.

The proposed project site is located within the City of Spokane and lies in the NE ¼ of Section 15, T 26 N., R 42 E., W.M. The parcel numbers for the project is 26155.0001. A vicinity map is attached in the Appendix.

GEOTECHNICAL INFORMATION:

The existing soils on site consist of Marble variant sandy loam. The Marble soil is described as a very deep, excessively drained soil that is formed in sandy glacial outwash. Based on our observations, test pit data, laboratory results, and review of geologic maps and data, the on-site soils appear to be consistent with soil mapping. With this information, we have used a design outflow rate of 0.3 cfs for Type 1 drywells and 1.0 cfs for Type 2 drywells. The geotechnical report provided by STI Northwest can be seen in the appendix.

PRE-DEVELOPMENT BASIN INFORMATION:

As shown on the Pre-Developed Basin Map located in the Appendix, the site slopes to the west towards the previous phases of the Woodridge View Estates development. There are four (4) existing storm drainage ponds that were constructed with the intent of treating and storing all the stormwater for the Woodridge View Estates Development. The pre-basins from the previous storm drainage reports were taken and outlined within the new basin maps, see appendix. The PGIS and impervious area of Woodridge View Estates 1st Addition were used, while the general outline of Woodridge View Estates 2nd addition was utilized, the road length and number of lots actually constructed and final platted were different than planned in the accepted storm drainage report. It is to be noted that twenty-five (25) lots were final platted in the Woodridge View Estates 2nd Addition and a five (5) lot short plat was completed. The updated PGIS and impervious areas within this report were updated using the same basic driveway and house footprints and using the actual length of road constructed. Please see appendix for references of previous calculations and drainage basins.

Table 1 – Pre-Development Project Site Basin Summary

	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)
Pre-Basin A	917,736	7,854	909,882
Pre-Basin B	1,483,909	0	1,483,909
***Pre-Ex.**	1,171,332	0	1,171,332
Pre-Basin 4	706,375	0	706,375

*PGIS/Impervious Area counted as if not developed as of yet. See Post Basin for updated PGIS/Impervious area calculations.

POST-DEVELOPMENT BASIN INFORMATION:

The Post-Development stormwater was separated into four (4) major basins.

The Post Ex. Offsite basin includes the area associated with the Woodridge View Estates 1st and 2nd Addition area. This basin also included the area associated with the Woodridge View Estates Short Plat. The basin is captured by catch basin and piped to the existing series of four (4) ponds.

Basin C in the project area directly above Woodridge View Estate 2nd Addition. The area mainly includes the backyards of lots and will drain to the existing catch basin/pipe system in Woodridge View Estates 2nd Addition. Also, part of a new road will be draining to the pipe system within the Woodridge View Estates 2nd Addition phase.

Basin D includes the majority of the project lots and will be collected via a catch basin/pipe system that will discharge into the existing ditch which in-turn discharges into the stepped pond series.

Basin F is divided into three (3) sub-basins based on access road locations. Basin F will be collected via roadside ditches and culverts that lead the existing ditch that discharges in to the stepped pond series.

The entire project site, including existing and future phases, will drain to the existing stepped pond series as planned for and allowed within previous storm drainage analysis. Ponds will be expanded or new ponds added as required per calculations and construction of the Woodridge View Estates development.

Basin 4 is associated with the Spokane County cluster development and will be treated and stored in a series of stepped ponds located just to the south of Wieber Dr. It has been included within this drainage report for completeness only as the County project allows for a secondary access to the project site and the storm drainage ponds will be linked together through the Woodridge South existing storm drainage ponds that discharge across Wieber Rd to the north.

While the SRSM requires analysis of the 10 and 25-year storm events, for this project due to its hillside nature, we have provided bowstring calculations and pond sizing for the 100-year event for conservatism.

Table 2 – Post-Development Project Site Basin Summary

	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)
1st & 2nd Add.	1,171,332	459,883	711,449
Post C	377,116	43,440	333,676
Post D	954,423	426,800	527,623
Post F	740,951	96,000	644,951
Overall Total	3,243,822	1,026,123	2,217,699
Basin 4	548,691	140,600	408,091

Table 3 – Post-Development Project Site Pond Summary

	PGIS Area (sf)	(Method 1133A (ac)) Treatment Area/Volume (square feet/cubic feet)	
		Required	**Provided**
1st & 2nd Add.	286,202	14,888/7,444	Combined
Post C	26,840	1,396/698	Combined*
Post D	222,400	11,569/5,785	Combined
Post F	96,000	4,994/2,497	Combined
Overall Total	631,442	32,848/16,424	34,992/16,898*
Basin 4	103,300	5,374/2,687	5,708/2,734

Refer to basin calculations in Appendix for areas and peak flows for all basins.
*Pond C bottom area was expanded by 5,380-sf.

Operational Characteristics:

The stormwater for the Woodridge View Estates development will be collected in existing catch basins and pipes or proposed catch basins and pipes that will discharge into the existing ditch which in-turn discharges into the stepped pond series.

Flooded Width & Inlet Analysis

A flooded width and inlet analysis was not performed at this time as this a preliminary drainage report, one will be performed during the design phase of the project.

Methodology:

As required by the SRSM, the storm drainage facilities proposed for this site have been sized to attenuate the 10- and 25-year storm events using the Rational Method as outlined in Section 5.5 of the SRSM. Due to the small size of the 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.

IT IS IMPORTANT TO NOTE THAT FOR CONSERVATISM, WE HAVE DESIGNED THIS PROJECT AND PROJECT PONDS FOR THE 100-YEAR RATIONAL EVENT DUE TO THE HILLSIDE NATURE OF THIS PROJECT. THIS IS REFLECTED IN THE ATTACHED BOWSTRING CALCULATONS AND SUBSEQUENT TABLES.

Water Quality Treatment:

The proposed storm drainage ponds have been designed to provide treatment volume based on Equation 6-1c (V=1133A) of the SRSM, as outlined in Section 6.7.1. Once the treated stormwater exceeds a height of 6 inches, it will spill into drywells, where it will be discharged underground.

Critical Areas:

Based on the Critical Area Maps provided by The City of Spokane, (Fema Flood Zone, Erodible Soil, Hazardous Geology, Spokane-Rathdrum Aquifer), there appears to be Hazardous Geology described as Landslide Deposit-Qmw. The items listed above will have no effect on the stormwater facilities for this project.

Down-Gradient Analysis/100 Year Storm Event/Snow Melt Analysis:

A down-gradient analysis is not needed for this site as we have reduced the amount of runoff to the southwest by collecting stormwater in ponds onsite and infiltrating the water into the soil. The ponds have been sized to hold the 100-year storm event. The 100-year bowstrings can be seen in the appendix. If for some reason, the ponds do not hold/store all the stormwater the stormwater will continue to run downhill in the Bonneville Power Association (BPA) easement toward Indian Trail Rd, the stormwater will continue to flow to the original destination. The storage summary can be seen in table 4.

Results:

As shown in Table 3 within this report we have provided the required treatment volume for the improvements proposed for the development. Table 4 below shows the onsite pond/swale storage summary for the 100-year storm event.

Table 4 – Project Site Pond/Swale Storage Summary

	100-YR Storm	
	Required	Provided
Basin	Vol. (cf)	Vol. (cf)
Overall	97,540	117,577

Perpetual Maintenance of Facilities:
There is an existing access road the existing ponds that will be maintained by the homeowner's association. 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. However, the City of Spokane will be responsible for the maintenance of the storm pipe and system.

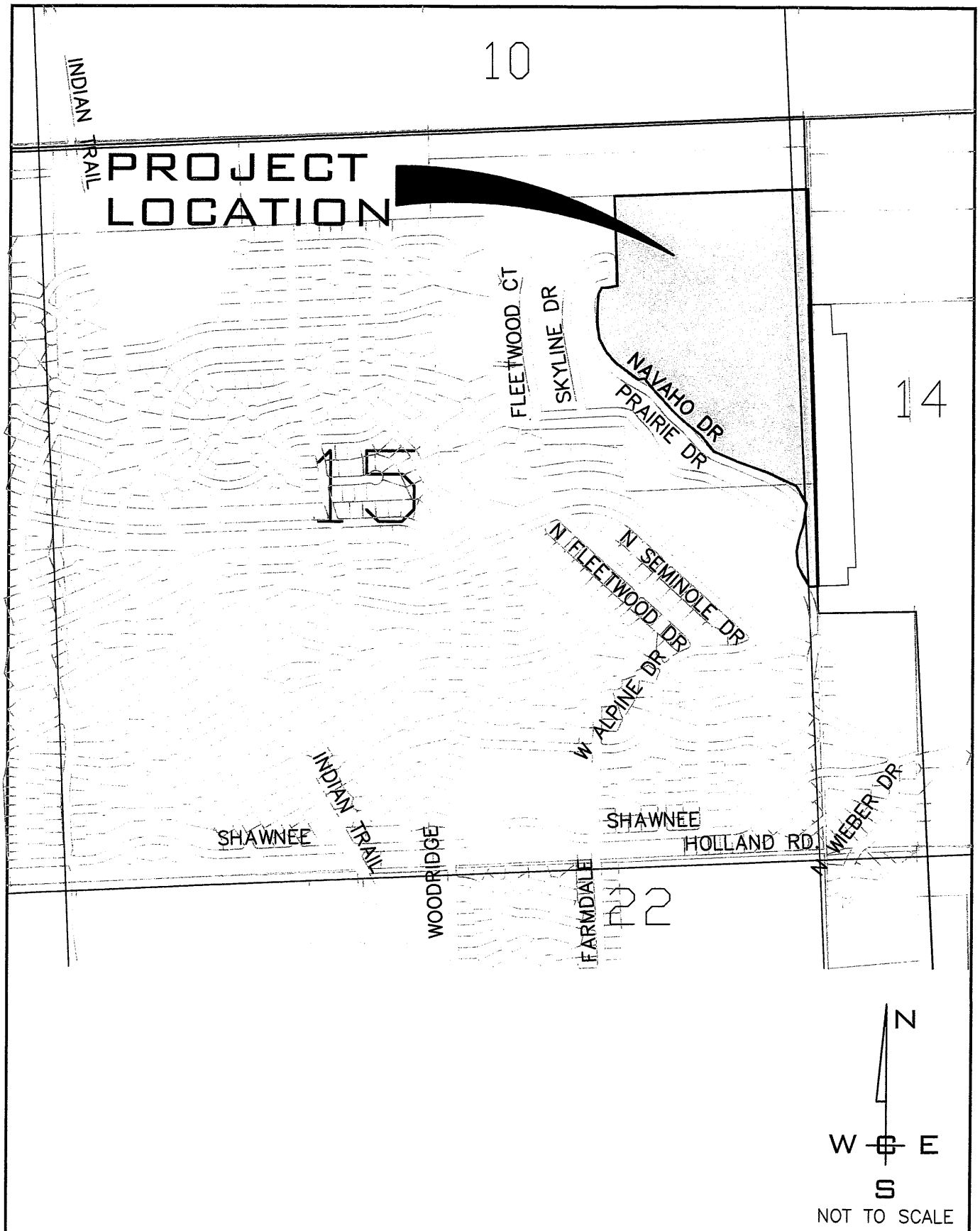
Offsite Easements:
There are no offsite easements required for this property.

Regional Facilities:
There are no known regional facilities that lie within 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 10-year storm event. Also, the storm drainage facilities will contain and discharge the 100-year storm under non-frozen conditions. Therefore, this project will have no adverse impact to adjacent and/or downstream properties.

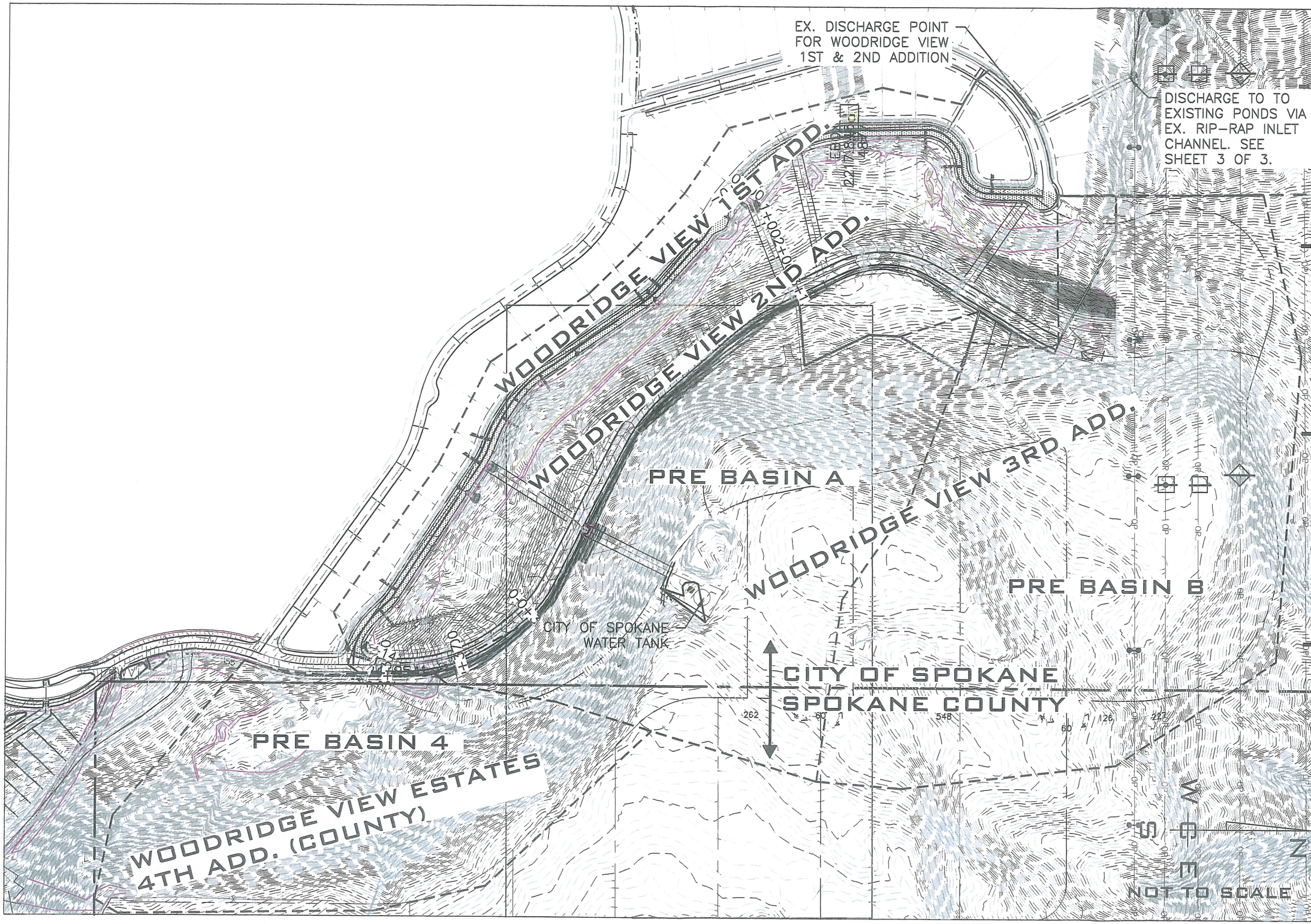
APPENDIX

VICINITY MAP



PROJ #: 15-1409 DATE: 2/15/19 DRAWN: JPP APPROVED: TRW	DRAINAGE REPORT **WOODRIDGE 3RD ADDITION** WIEBER DR & NAVAHO DR 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



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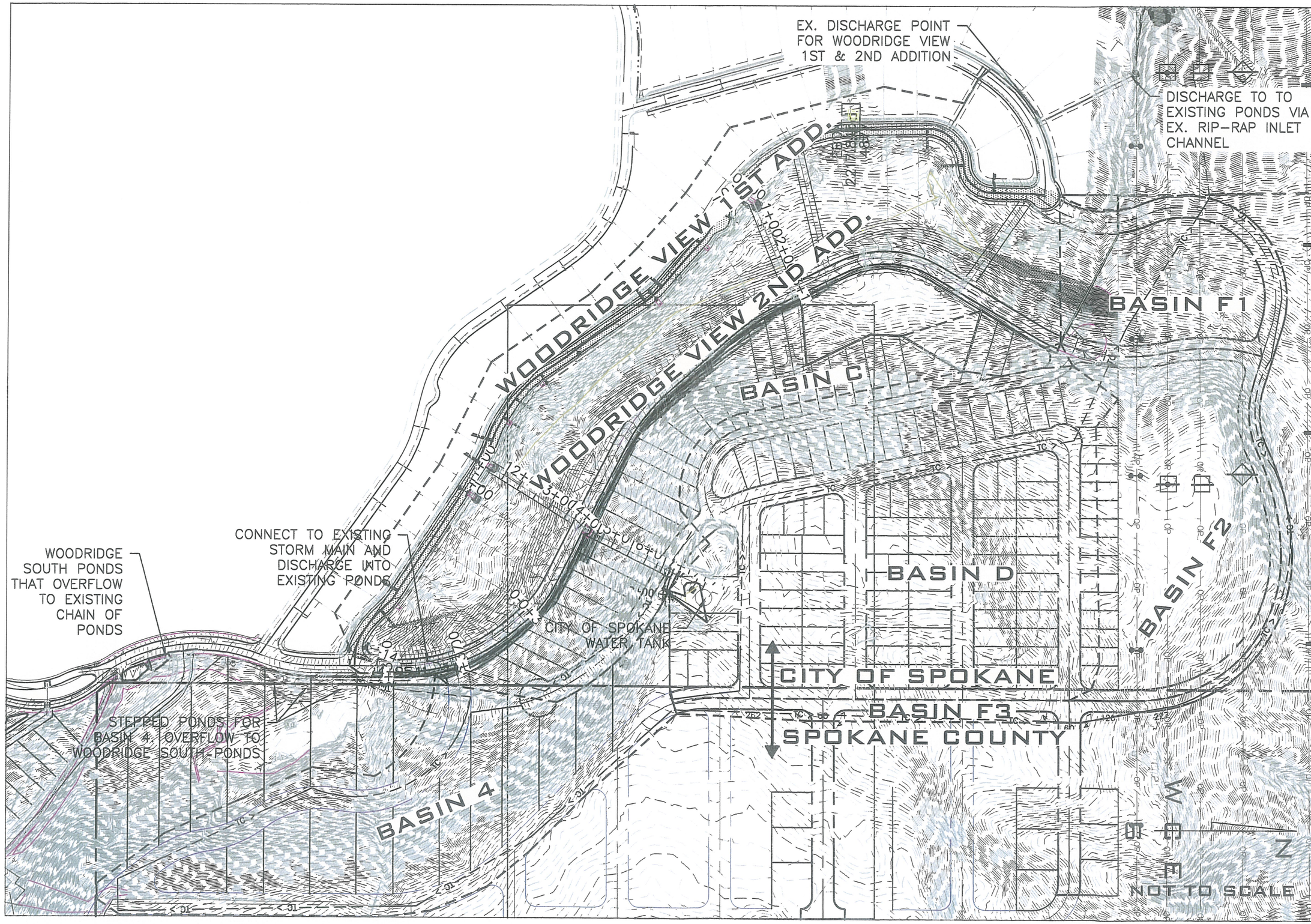
DATE: 2/15/19
DRAWN: JPP
APPROVED: TRW

PRE-DEVELOPMENT BASIN MAP
WOODRIDGE 3RD ADDITION
WIEBER DR & NAVAHO DR
SPOKANE, WASHINGTON

SHEET 1 OF 3



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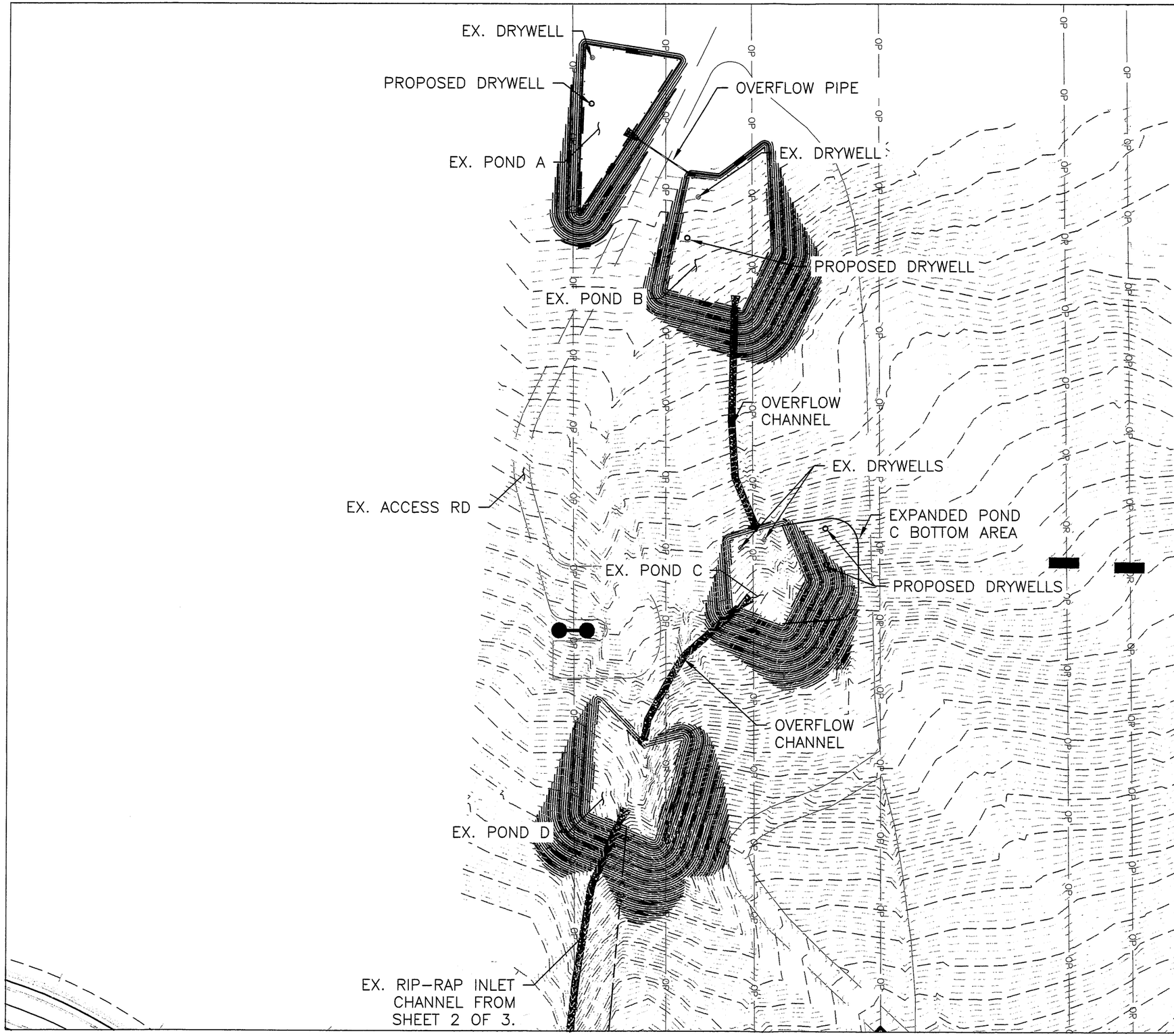
POST-DEVELOPMENT BASIN MAP
WOODRIDGE 3RD ADDITION
WIEBER DR & NAVAHO DR
SPOKANE, WASHINGTON

SHEET 2 OF 3



NOTE: FROM CITY OF SPOKANE GIS THERE ARE 4 DRYWELLS BETWEEN THE EX. PONDS AND EACH OVERFLOW THE OTHER VIA CATCH BASIN/PIPE OR DITCH. AT TIME OF DESIGN ASBUILT/TOPO INFORMATION WILL BE USED TO VERIFY DRYWELL LOCATION AND DITCH LOCATIONS.

ALSO TO BE NOTED IS THAT THERE WILL BE 4 ADDITIONAL DRYWELLS ADDED AT TIME OF DESIGN FOR CONSERVATISM.

W E S N

NOT TO SCALE

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PROJ #: 15-1409
DATE: 2/15/19
DRAWN: JPP
APPROVED: TRW

POST-DEVELOPMENT POND PLAN
WOODRIDGE 3RD ADDITION
WIEBER DR & NAVAHO DR
SPOKANE, WASHINGTON

SHEET 3 OF 3

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	
3/19/2019	15-1409	Woodridge 3rd			I (100 yr) =	4.381 inches			
JPP									

SPOKANE COUNTY - SRSM - GRASSED PERCOLATION METHOD

Basin	Total sf	Access/Parking /Street (sf)	Sidewalk sf	DV WY	Buildings sf	Total Impervious	Total Pervious	Weighted "C"	PGIS sf	1133 A Pond Area (sf)	Pond Vol (cf)	Q=CIA (cfs) 2 yr	10 yr	25 yr	50 yr	100 yr
Pre A	917,736	0	0	0	7,854	7,854	909,882	0.16	0	0	0	4.67	8.63	10.94	12.66	14.44
Pre B	1,483,909	0	0	0	0	0	1,483,909	0.15	0	0	0	7.25	13.38	16.96	19.64	22.39
PRE Ex.	1,171,332	0	0	0	0	0	1,171,332	0.15	0	0	0	5.72	10.56	13.39	15.50	17.67
Pre 4	706,375	0	0	0	0	0	706,375	0.15	0	0	0	3.45	6.37	8.07	9.35	10.66
Pre Total	**4,279,352**	**0**	**0**	**0**	**7,854**	**7,854**	**4,271,498**	**0.15**	**0.00**	**0.00**	**0.00**	**21.09**	**38.95**	**49.36**	**57.15**	**65.15**
Post Onsite Flow																
1st Add.	585,666	138,442	21,281	32,000	80,000	271,723	313,943	0.50	170,442	8,866	4,433	9.49	17.53	22.22	25.73	29.33
2nd Add.	585,666	91,760	12,400	24,000	60,000	188,160	397,506	0.39	115,760	6,022	3,011	7.45	13.77	17.45	20.20	23.03
Total	**1,171,332**	**230,202**	**33,681**	**56,000**	**140,000**	**459,883**	**711,449**	**0.44**	**286,202**	**14,888**	**7,444**	**16.95**	**31.30**	**39.67**	**45.93**	**52.36**
Post C	377,116	22,440	3,400	4,400	13,200	43,440	333,676	0.24	26,840	1,396	698	2.90	5.36	6.79	7.86	8.97
Post D	954,423	171,600	52,000	50,800	152,400	426,800	527,623	0.49	222,400	11,569	5,785	15.08	27.85	35.30	40.87	46.59
Post F1	158,950	0	0	0	0	0	158,950	0.15	0	0	0	0.78	1.43	1.82	2.10	2.40
Post F2	419,901	28,500	0	0	0	28,500	391,401	0.20	28,500	1,483	741	2.75	5.07	6.43	7.44	8.48
Post F3	162,100	67,500	0	0	0	67,500	94,600	0.46	67,500	3,511	1,756	2.44	4.51	5.71	6.61	7.54
Total F	**740,951**	**96,000**	**0**	**0**	**0**	**96,000**	**644,951**	**0.25**	**96,000**	**4,994**	**2,497**	**5.96**	**11.01**	**13.95**	**16.16**	**18.42**
Total	**3,243,822**	**520,242**	**89,081**	**111,200**	**305,600**	**1,026,123**	**2,217,699**	**0.39**	**631,442**	**32,848**	**16,424**	**40.89**	**75.53**	**95.71**	**110.82**	**126.34**
Basin 4	**548,691**	**95,700**	**14,500**	**7,600**	**22,800**	**140,600**	**408,091**	**0.34**	**103,300**	**5,374**	**2,687**	**6.11**	**11.29**	**14.31**	**16.56**	**18.88**

POND VOLUME WORKSHEET

WHIPPLE CONSULTING ENGINEERS

POND VOLUME CALC SHEET

Date: 3/12/2019

Project: 15-1409

Designer: JPP

Woodrdidge 3rd

Basins	Ponds/ Swales	Bottom Area sf	Treatment Area (w/ Side Slopes)	Squared Side lf	Pond Bottom Elevation at Drywell	Pond Drywell Elevation	Pond Outlet Elevation (avg)	Conic Volume to Rim cf	Side Slope Volume cf	*Treatment* Total Volume to to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	*Storage* Total Volume to Inlet cf
Ex.+C+D+F	**Ex. Pond A**	6,809	7,331	82.52	1000.00	1000.50	1003.00	3,405	124	**3,528**	20,427	4,456	**24,883**
Ex.+C+D+F	**Ex. Pond B**	9,688	10,311	98.43	1000.00	1000.50	1003.00	4,844	148	**4,992**	29,064	5,315	**34,379**
Ex.+C+D+F	**Ex. Pond C (expanded)**	10,054	10,688	100.27	1000.00	1000.50	1003.00	5,027	150	**5,177**	30,162	5,415	**35,577**
Ex.+C+D+F	**Ex. Pond D**	6,166	6,663	78.52	1000.00	1000.50	1003.00	3,083	118	**3,201**	18,498	4,240	**22,738**
Total	**Pond A-D**	**32,717**	**34,992**							**16,898**			**117,577**
Basin 4	**Pond 1-3**	5,250	**5,708**	72.46	1000.00	1000.50	1002.00	2,625	109	**2,734**	10,500	1,739	**12,239**

100-YEAR STORM EVENT BOWSTRING CALCULATIONS

PEAK FLOW CALCULATION — PROJECT: **1409**

100-Year Design Storm

BASIN: Overall

Tot. Area	3,243,822 SF	74.47 Acres	
Imp. Area	1,026,123 SF	C=	0.9
Perv. Area	2,217,699 SF	C=	0.15
Wt. C =	0.39	PGIS Area =	631,442

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	300.00	
K	420.00	
Slope (ft/ft)	0.0400	be sure this is decimal equivalent slope 0.0000
Travel Time	3.57	Minutes
Reach 2	Finished Lot from House to Street	
Length	100.00	
K	420.00	
Slope (ft/ft)	0.0300	be sure this is decimal equivalent slope 0.0000
Travel Time	1.37	Minutes
Reach 3	Gutter Flow to Inlet/Catch Basin	
Length	500.00	
K	2400.00	
Slope (ft/ft)	0.0200	be sure this is decimal equivalent slope 0.0000
Travel Time	1.47	Minutes
Reach 4	Pipe Flow 1	Pipe Reach One (only need one if no Dia change)
Length	1500.00	
K	3000.00	12-inch Pipe minimum
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	7.07	Minutes
Reach 5	Pipe Flow 2	Add additional pipe reacheds for other Dia
Length	1000.00	
K	3900.00	15/18-inch Pipe
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	3.63	Minutes
Sum of Tc	17.12	Minutes
Tc for Analysis	17.12	Minutes

BOWSTRING METHOD — PROJECT: 0

DETENTION BASIN DESIGN — BASIN: Overall

DESIGNER: BNG

DATE: 12-Mar-19

Time Increment (min)	10
Time of Conc. (min)	17.12
Outflow (cfs)	4.0
Design Year Flow	100
Area (acres)	74.47
Impervious Area (sq ft)	1026123
'C' Factor	0.39
Area * C	28.838
PGIS Area	631,442

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel. (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)	
17.12	1027	1.99	57.26	78797	4108	74689	
15	900	2.16	62.33	75170	3600	71570	
25	1500	1.56	44.88	82990	6000	76990	
35	2100	1.25	36.15	88533	8400	80133	
45	2700	1.07	30.75	93775	10800	82975	
55	3300	0.94	27.03	98642	13200	85442	
65	3900	0.84	24.28	103163	15600	87563	
75	4500	0.77	22.14	107381	18000	89381	
85	5100	0.71	20.43	111336	20400	90936	
95	5700	0.66	19.02	115065	22800	92265	
105	6300	0.62	17.84	118595	25200	93395	
115	6900	0.58	16.82	121950	27600	94350	
125	7500	0.55	15.94	125151	30000	95151	
135	8100	0.53	15.17	128213	32400	95813	
145	8700	0.50	14.49	131151	34800	96351	
155	9300	0.48	13.88	133977	37200	96777	
165	9900	0.46	13.34	136700	39600	97100	
175	10500	0.45	12.84	139330	42000	97330	
185	11100	0.43	12.39	141875	44400	97475	
195	11700	0.42	11.98	144340	46800	97540	<==
205	12300	0.40	11.60	146733	49200	97533	
215	12900	0.39	11.25	149057	51600	97457	
225	13500	0.38	10.93	151319	54000	97319	
235	14100	0.37	10.62	153521	56400	97121	
245	14700	0.36	10.34	155669	58800	96869	
255	15300	0.35	10.08	157764	61200	96564	
265	15900	0.34	9.84	159811	63600	96211	
275	16500	0.33	9.60	161812	66000	95812	
285	17100	0.33	9.39	163769	68400	95369	
295	17700	0.32	9.18	165685	70800	94885	
305	18300	0.31	8.98	167563	73200	94363	
315	18900	0.31	8.80	169403	75600	93803	
325	19500	0.30	8.63	171208	78000	93208	
335	20100	0.29	8.46	172979	80400	92579	
345	20700	0.29	8.30	174719	82800	91919	
355	21300	0.28	8.17	176887	85200	91687	
365	21900	0.28	8.01	178263	87600	90663	
375	22500	0.27	7.88	180103	90000	90103	
385	23100	0.27	7.88	184832	92400	92432	

Rainfall Intensity Coefficients for ***Spokane***

taken from Table 5-7 SRSM

M_{100} = 12.33

N_{100} = 0.643

Flow (weighted c)

Qwc= 126.32 cfs

Flow (time of concentration)

Qtc= 57.26 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	0.26	7.59	182626	94800	87826
405	24300	0.26	7.59	187182	97200	89982
415	24900	0.25	7.31	184457	99600	84857
425	25500	0.25	7.31	188841	102000	86841
435	26100	0.24	7.02	185597	104400	81197
445	26700	0.24	7.02	189807	106800	83007
455	27300	0.23	6.73	186044	109200	76844
465	27900	0.23	6.73	190081	111600	78481
475	28500	0.22	6.44	185799	114000	71799
485	29100	0.22	6.44	189663	116400	73263
495	29700	0.21	6.15	184862	118800	66062
505	30300	0.21	6.15	188553	121200	67353
515	30900	0.20	5.86	183233	123600	59633
525	31500	0.20	5.86	186751	126000	60751
535	32100	0.19	5.58	180911	128400	52511
545	32700	0.19	5.58	184257	130800	53457
555	33300	0.18	5.29	177898	133200	44698
565	33900	0.18	5.29	181070	135600	45470
575	34500	0.17	5.00	174193	138000	36193
585	35100	0.17	5.00	177192	140400	36792
595	35700	0.16	4.71	169795	142800	26995
605	36300	0.16	4.71	172621	145200	27421
615	36900	0.15	4.42	164706	147600	17106
625	37500	0.15	4.42	167359	150000	17359
635	38100	0.14	4.13	158924	152400	6524
645	38700	0.14	4.13	161404	154800	6604
655	39300	0.13	3.84	152450	157200	-4750
665	39900	0.13	3.84	154757	159600	-4843
675	40500	0.12	3.56	145284	162000	-16716
685	41100	0.12	3.56	147418	164400	-16982
695	41700	0.11	3.27	137426	166800	-29374
705	42300	0.11	3.27	139387	169200	-29813
715	42900	0.10	2.98	128876	171600	-42724
725	43500	0.10	2.98	130664	174000	-43336
735	44100	0.09	2.69	119633	176400	-56767
745	44700	0.09	2.69	121248	178800	-57552

"1133A" TREATMENT REQUIREMENTS		
Minimum "1133A" Volume Required	16,424	cu ft
Provided Treatment Volume - Min.	16,898	cu ft
STORAGE REQ. - 100 YEAR DESIGN STORM		
Maximum Storage Required by Bowstring	97,540	cu ft
Provided Pond Storage Volume to Inlet - Min.	117,577	cu ft
Provided Drywell/Gallery Storage Volume	-	cu ft
Total Provided Volume	**117,577**	**cu ft**

PEAK FLOW CALCULATION — PROJECT: **1409**

100-Year Design Storm

BASIN: Basin 4

Tot. Area	548,691 SF	12.60 Acres		
Imp. Area	140,600 SF	C=	0.9	
Perv. Area	408,091 SF	C=	0.15	
Wt. C =	0.34	PGIS Area =	103,300	

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	300.00					
K	420.00					
Slope (ft/ft)	0.0400	be sure this is decimal equivalent slope 0.0000				
Travel Time	3.57	Minutes				
Reach 2	Finished Lot from House to Street					
Length	100.00					
K	420.00					
Slope (ft/ft)	0.0300	be sure this is decimal equivalent slope 0.0000				
Travel Time	1.37	Minutes				
Reach 3	Gutter Flow to Inlet/Catch Basin					
Length	500.00					
K	2400.00					
Slope (ft/ft)	0.0200	be sure this is decimal equivalent slope 0.0000				
Travel Time	1.47	Minutes				
Reach 4	Pipe Flow 1	Pipe Reach One (only need one if no Dia change)				
Length	1500.00					
K	3000.00	12-inch Pipe minimum				
Slope (ft/ft)	0.0050	Average Slope for total pipe run				
Travel Time	7.07	Minutes				
Reach 5	Pipe Flow 2	Add additional pipe reacheds for other Dia				
Length	1000.00					
K	3900.00	15/18-inch Pipe				
Slope (ft/ft)	0.0050	Average Slope for total pipe run				
Travel Time	3.63	Minutes				
Sum of Tc	17.12	Minutes				
Tc for Analysis	17.12	Minutes				

BOWSTRING METHOD — PROJECT: 0

DETENTION BASIN DESIGN — BASIN: Basin 4

DESIGNER: BNG

DATE: 12-Mar-19

Time Increment (min)	10
Time of Conc. (min)	17.12
Outflow (cfs)	1.0
Design Year Flow	100
Area (acres)	12.60
Impervious Area (sq ft)	140600
'C' Factor	0.34
Area * C	4.310
PGIS Area	103,300

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel. (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)	
17.12	1027	1.99	8.56	11777	1027	10750	
15	900	2.16	9.32	11235	900	10335	
25	1500	1.56	6.71	12404	1500	10904	
35	2100	1.25	5.40	13233	2100	11133	
45	2700	1.07	4.60	14016	2700	11316	
55	3300	0.94	4.04	14744	3300	11444	
65	3900	0.84	3.63	15419	3900	11519	
75	4500	0.77	3.31	16050	4500	11550	<==
85	5100	0.71	3.05	16641	5100	11541	
95	5700	0.66	2.84	17198	5700	11498	
105	6300	0.62	2.67	17726	6300	11426	
115	6900	0.58	2.51	18227	6900	11327	
125	7500	0.55	2.38	18706	7500	11206	
135	8100	0.53	2.27	19163	8100	11063	
145	8700	0.50	2.17	19603	8700	10903	
155	9300	0.48	2.08	20025	9300	10725	
165	9900	0.46	1.99	20432	9900	10532	
175	10500	0.45	1.92	20825	10500	10325	
185	11100	0.43	1.85	21205	11100	10105	
195	11700	0.42	1.79	21574	11700	9874	
205	12300	0.40	1.73	21931	12300	9631	
215	12900	0.39	1.68	22279	12900	9379	
225	13500	0.38	1.63	22617	13500	9117	
235	14100	0.37	1.59	22946	14100	8846	
245	14700	0.36	1.55	23267	14700	8567	
255	15300	0.35	1.51	23580	15300	8280	
265	15900	0.34	1.47	23886	15900	7986	
275	16500	0.33	1.44	24185	16500	7685	
285	17100	0.33	1.40	24478	17100	7378	
295	17700	0.32	1.37	24764	17700	7064	
305	18300	0.31	1.34	25045	18300	6745	
315	18900	0.31	1.32	25320	18900	6420	
325	19500	0.30	1.29	25590	19500	6090	
335	20100	0.29	1.26	25854	20100	5754	
345	20700	0.29	1.24	26114	20700	5414	
355	21300	0.28	1.22	26439	21300	5139	
365	21900	0.28	1.20	26644	21900	4744	
375	22500	0.27	1.18	26919	22500	4419	
385	23100	0.27	1.18	27626	23100	4526	

Rainfall Intensity Coefficients for ***Spokane***

taken from Table 5-7 SRSM

M_{100} = 12.33

N_{100} = 0.643

Flow (weighted c)

Qwc= 18.88 cfs

Flow (time of concentration)

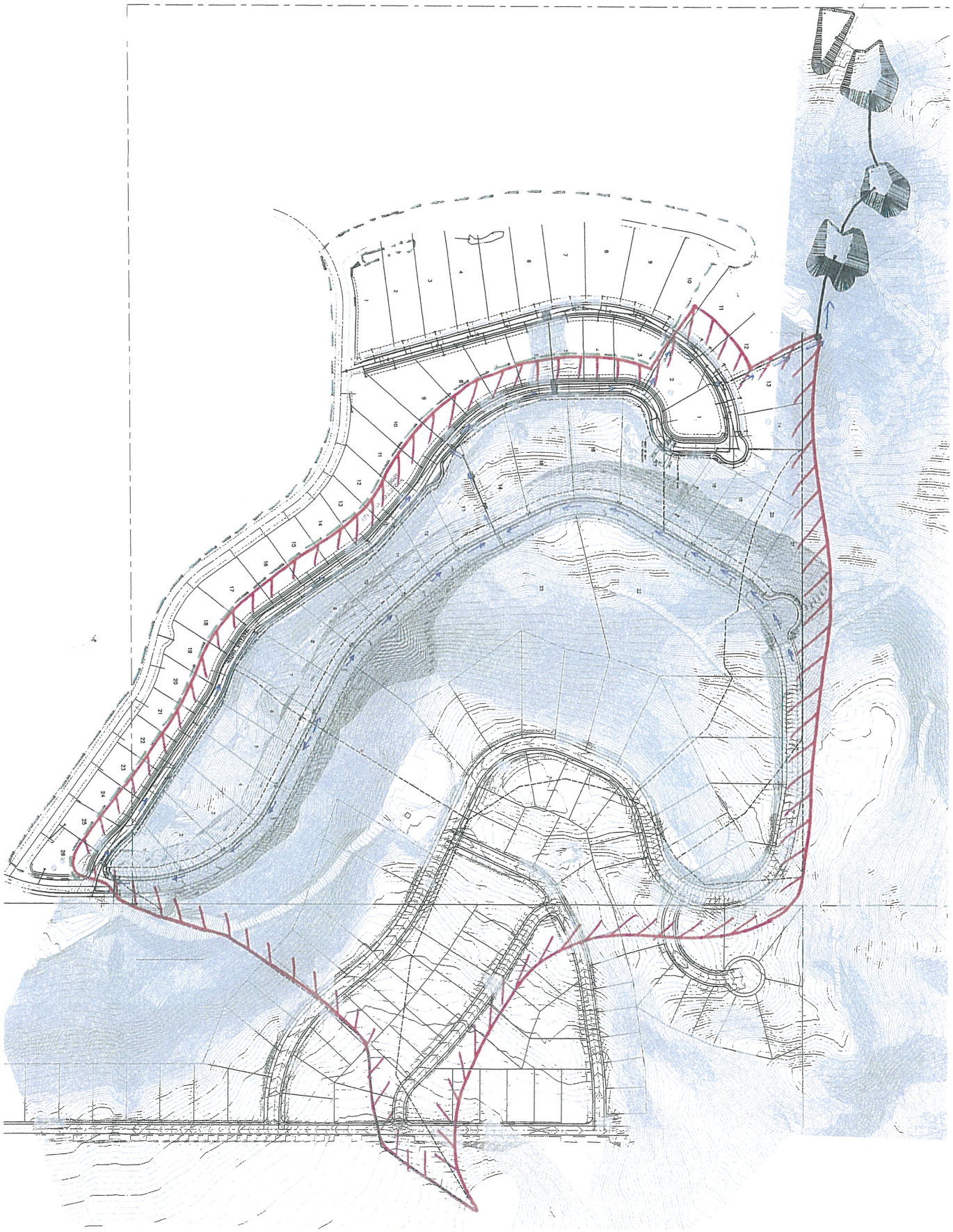
Qtc= 8.56 cfs

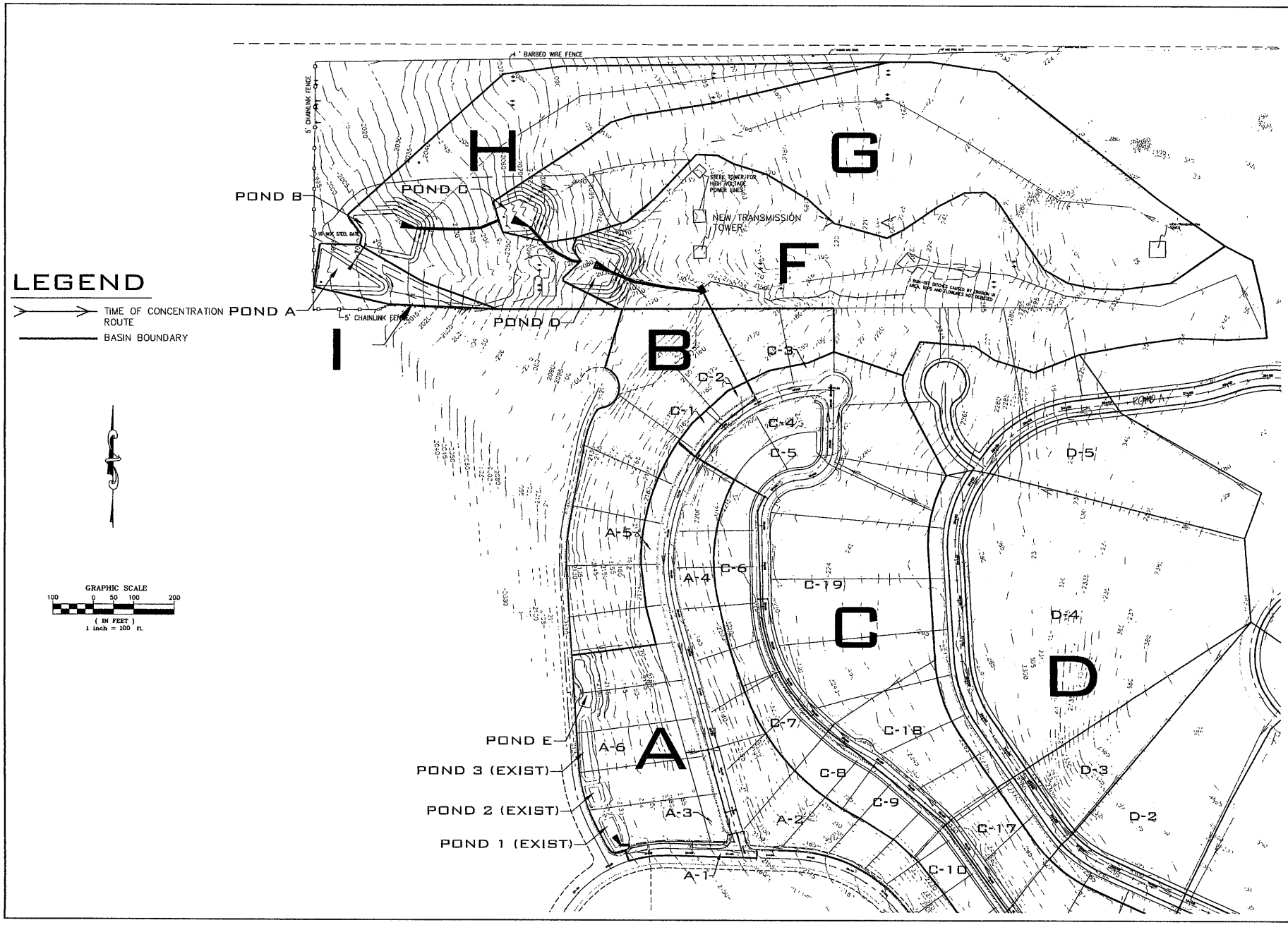
Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)
385						
395	23700	0.26	1.14	27296	23700	3596
405	24300	0.26	1.14	27977	24300	3677
415	24900	0.25	1.09	27570	24900	2670
425	25500	0.25	1.09	28225	25500	2725
435	26100	0.24	1.05	27740	26100	1640
445	26700	0.24	1.05	28370	26700	1670
455	27300	0.23	1.01	27807	27300	507
465	27900	0.23	1.01	28411	27900	511
475	28500	0.22	0.96	27771	28500	-729
485	29100	0.22	0.96	28348	29100	-752
495	29700	0.21	0.92	27631	29700	-2069
505	30300	0.21	0.92	28182	30300	-2118
515	30900	0.20	0.88	27387	30900	-3513
525	31500	0.20	0.88	27913	31500	-3587
535	32100	0.19	0.83	27040	32100	-5060
545	32700	0.19	0.83	27540	32700	-5160
555	33300	0.18	0.79	26590	33300	-6710
565	33900	0.18	0.79	27064	33900	-6836
575	34500	0.17	0.75	26036	34500	-8464
585	35100	0.17	0.75	26484	35100	-8616
595	35700	0.16	0.70	25379	35700	-10321
605	36300	0.16	0.70	25801	36300	-10499
615	36900	0.15	0.66	24618	36900	-12282
625	37500	0.15	0.66	25014	37500	-12486
635	38100	0.14	0.62	23754	38100	-14346
645	38700	0.14	0.62	24124	38700	-14576
655	39300	0.13	0.57	22786	39300	-16514
665	39900	0.13	0.57	23131	39900	-16769
675	40500	0.12	0.53	21715	40500	-18785
685	41100	0.12	0.53	22034	41100	-19066
695	41700	0.11	0.49	20540	41700	-21160
705	42300	0.11	0.49	20834	42300	-21466
715	42900	0.10	0.45	19263	42900	-23637
725	43500	0.10	0.45	19530	43500	-23970
735	44100	0.09	0.40	17881	44100	-26219
745	44700	0.09	0.40	18122	44700	-26578

"1133A" TREATMENT REQUIREMENTS		
Minimum "1133A" Volume Required	2,687	cu ft
Provided Treatment Volume - Min.	2,734	cu ft
STORAGE REQ. - 100 YEAR DESIGN STORM		
Maximum Storage Required by Bowstring	11,550	cu ft
Provided Pond Storage Volume to Inlet - Min.	12,239	cu ft
Provided Drywell/Gallery Storage Volume	-	cu ft
Total Provided Volume	**12,239**	**cu ft**

BASIN MAPS & PGIS/IMPERVOUAS AREA CALCULATIONS FROM PREVIOUS STORM DRAINAGE REPORT

P:\WCE_WORK\2012 WCE PROJECTS\2012-931 Kinney - Woodridge\DWG\BASIN MAP.dwg, 2/12/2013 9:12:08 AM, rayk, RICOH WCE WIDE FORMAT





Sawyer Engineering
3221 W 9th Ave, Suite 240
Spokane, WA 99204
(509) 744-0300
(509) 744-0302 Fax

NO	REVISION	DATE

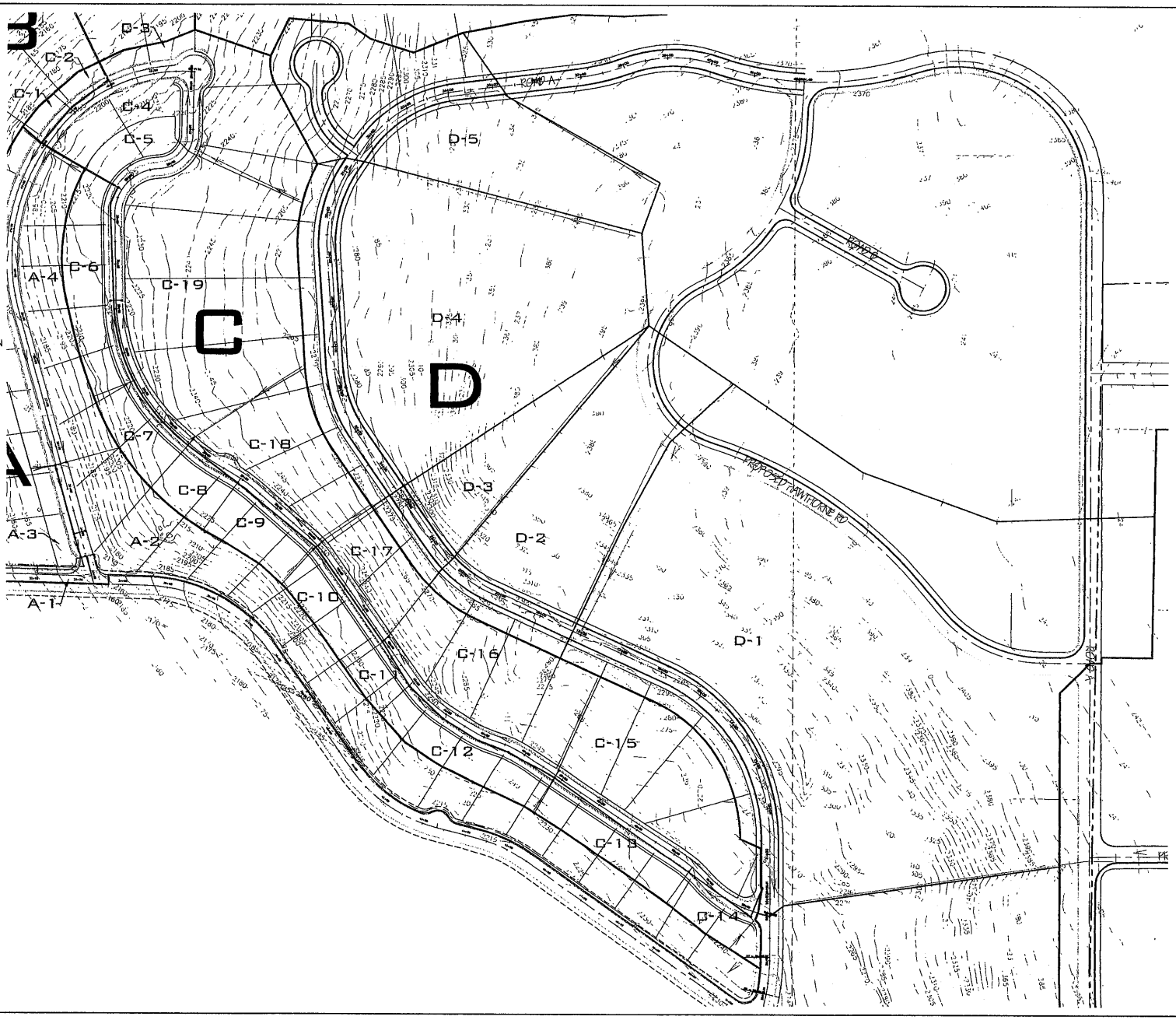
POST DEVELOPED BASIN MAP
WOODRIDGE VIEW ESTATES 1ST ADD
BASINS A, B, F, G, H, AND I
SPOKANE WASHINGTON

JOHN FRANK SAWYER
STATE OF WASHINGTON
36211
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 5/18/06

Job no. 05003

DRAWN BY:	DESIGNED BY:
GLA	GLA
CHECKED BY:	Date
JFS	4/20/06

1/3



LEGEND

TIME OF CONCENTRATION ROUTE

BASIN BOUNDARY

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.

Sayers Engineering
327 W 8th Ave, Suite 240
Spokane, WA 99204
(509) 744-0300
(509) 744-0302 Fax

NO	REVISION	DATE

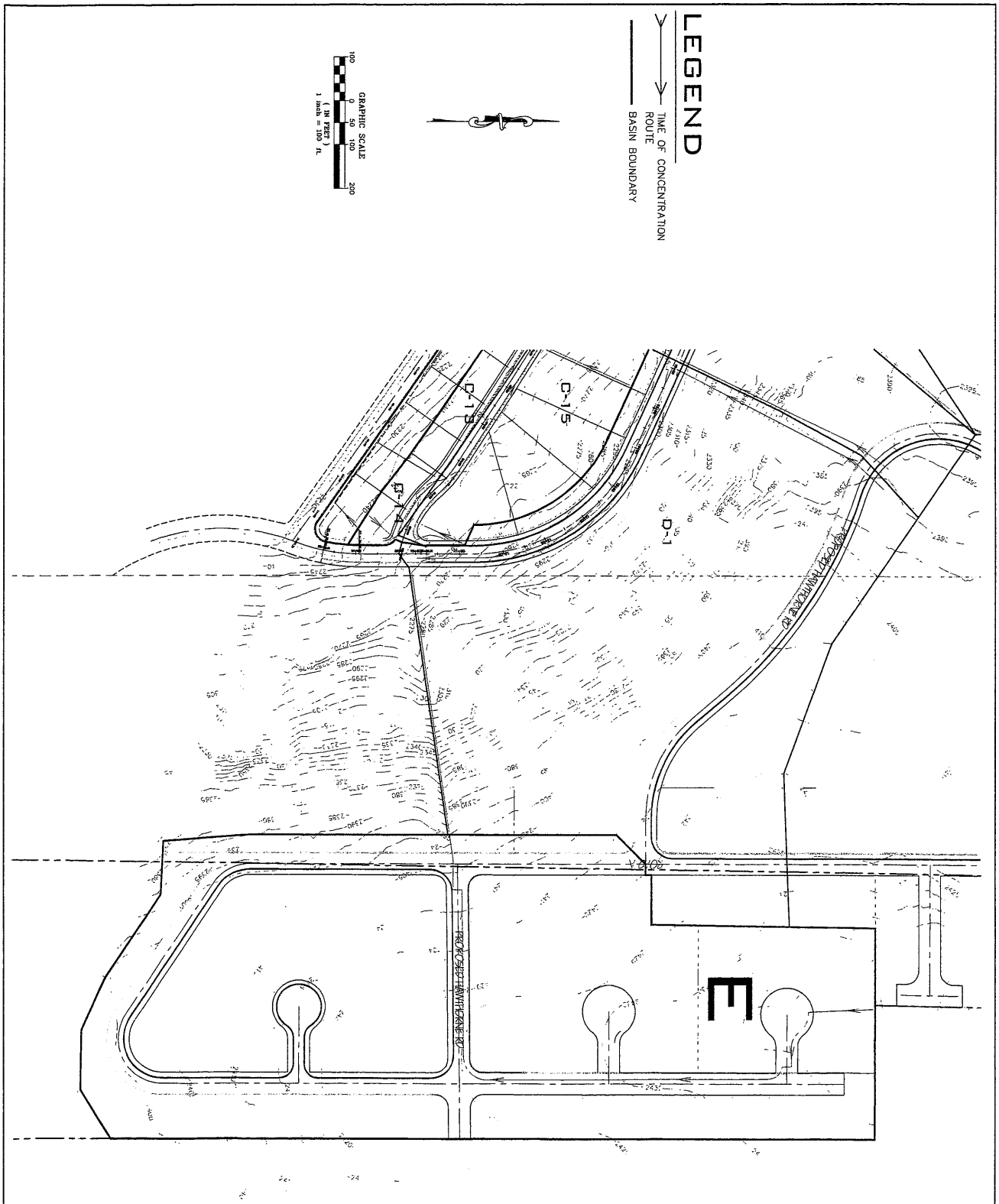
POST DEVELOPED BASIN MAP
WOODRIDGE VIEW ESTATES 1ST ADD
BASINS C AND D
SPOKANE WASHINGTON

JOHN FRANK SAYERS
STATE OF WASHINGTON
16319
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES 5/18/06

Job no. 05003	
DRAWN BY: GLA	DESIGNED BY: GLA
CHECKED BY: JFS	Date 4/20/06

sheet 2/3



Sheet 3/3	DRAWN BY: GLA	DESIGNED BY: GLA	Job No. 05003
	CHECKED BY: JFS	Date 4/20/06	EXPIRES 3/10/06

POST DEVELOPED BASIN MAP

WOODRIDGE VIEW ESTATES 1ST ADD

BASIN E

SPOKANE WASHINGTON

NO	REVISION	DATE

Saywers Engineering
327 W 8th Ave, Suite 240
Spokane, WA 99204
(509) 744-0300
(509) 744-0302 Fax

*

Woodridge View Estates 1st Addition

Basin	Total Area (ft^2)	# of Houses (2000 ft^2)	# of Driveways (800 ft^2)	Street Area (ft^2)	Sidewalk Area (ft^2)	Impervious Area (ft^2)	Pervious Area (ft^2)	
Onsite	1,091,471	40	40	138,442	21,281	271,723	819,748	899748
Offsite-2nd Add	~~1,223,446~~	~~15~~	~~15~~	~~35,245~~	~~9,615~~	~~86,860~~	~~1,136,586~~	1166586
Offsite-Falcon	~~1,049,227~~	~~67~~	~~67~~	~~124,729~~	~~17,740~~	~~330,069~~	~~719,158~~	196069
Total	~~3,364,144~~	~~122~~	~~122~~	~~298,416~~	~~48,636~~	~~688,652~~	~~2,675,492~~	

Δ *

Woodridge View Estates 2nd Addition

Basin	Total Area (ft^2)	# of Houses (2000 ft^2)	# of Driveways (800 ft^2)	Street Area (ft^2)	Sidewalk Area (ft^2)	Impervious Area (ft^2)	Pervious Area (ft^2)		
Onsite	2,628,142	~~77~~ 25	~~77~~ 25	201,651	33,280	450,531	2,177,611	296531	
Offsite (to 1st Add)	~~1,223,446~~	~~15~~	~~15~~	~~35,245~~	~~9,615~~	~~86,860~~	~~1,136,586~~		
Offsite-Falcon	~~190,163~~	~~13~~	~~13~~	~~25,336~~	~~0~~	~~61,736~~	~~128,427~~	154427	
Total	~~4,041,751~~	~~105~~	~~105~~	~~262,232~~	~~42,895~~	~~537,391~~	~~3,504,360~~		
Total for Treatment	~~2,818,305~~	~~90~~	~~90~~	~~226,987~~	~~33,280~~	~~512,267~~	~~2,306,038~~		
								3,851,588	88.420294

**

Falcon Ridge

Basin	Total Area (ft^2)	# of Houses (2000 ft^2)	# of Driveways (800 ft^2)	Street Area (ft^2)	Sidewalk Area (ft^2)	Impervious Area (ft^2)	Pervious Area (ft^2)
Offsite (to 1st Add)	1,049,227	67	67	124,729	17,740	330,069	719,158
Offsite (to 2nd Add)	190,163	13	13	25,336	0	61,736	128,427
Total	1,239,390	80	80	150,065	17,740	391,805	847,585

** Future basin at time of spreadsheet creation. This basin is included w/ new spreadsheet.

* Only onsite totals were used for new spreadsheet.

Δ Road length was reduced & # of lots was reduced to 25. Also, 5 lot short plat was added. New calculations were done on new spread sheet.

SOILS INFORMATION

GEOTECHNICAL ENGINEERING REPORT

FOR

WOODRIDGE VIEW ESTATES

Shawnee Avenue and Wieber Drive
Spokane, Washington

STI W.O. # C-70-S010001

PRESENTED TO:

North Division Complex
8225 North Division
Spokane, Washington 99208

PREPARED BY:

STI Northwest
3628 East Ferry
Spokane, Washington 99202

(509) 534-9711

March 26, 2001