CLARK 53RD SHORT PLAT

Concept

DRAINAGE REPORT

October 2025

The staff of Storhaug Engineering under the direction of the undersigned professional engineer whose seal and signature appear hereon has prepared this report.

Storhaug Engineering
Project No. 25-121

STORHAUG ENGINEERING
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Chapter 1

DRAINAGE SUMMARY

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Clark 53rd Short Plat
Concept Drainage Summary

PROJECT LOCATION AND DESCRIPTION

This project includes the development of 21 new duplex homes, proposed parking areas, an alley, new road improvements including pavement, separated sidewalks and drainage infrastructure, as well as utility infrastructure. The project consists of two (2) phases. Phase 1 is the road improvements to 53rd Avenue and Ray Street. The road improvements will consist of a paved alleyway, driveway/parking areas and duplexes. Phase 1 had infrastructure approved as part of a separate entitlement package which remains relatively unchanged. Phase 2 is the northern half of the property which includes an extension of Ray Street, the addition of 52nd Avenue, Nola Street and additional driveway/parking areas and duplexes. This report will provide calculations and conclusions for both phase 1 and 2 combined.

The existing property address is 3227 E 53rd Avenue, Spokane, WA 99223. Refer to the grading and drainage plans for further information on project location and layout. The project is located in a portion of the Northwest ¼ of Section 03, Township 24 North, Range 43 East, W.M. City of Spokane, Spokane County, Washington

SITE CHARACTERISTICS

The total property area is approximately 4.88 acres of undeveloped land. The existing site drainage generally flows to the northwest, north, and east sides within the property boundary. Four (4) pre-development basins encompass the property. Basins 1 and 2 flow to the northwest and north. Basin 3 and 4 have runoff which flows southwest and southeast to 53rd Avenue. The post development section in this report will have additional information regarding these basins.

Post Development Basins will encompass all the proposed development runoff.

The Geotechnical Report identified shallow bedrock throughout the site. Refer to Chapter 5 of this report for additional information.

SUBSURFACE CHARACTERISTICS

The USDA Natural Resources Conservation Service (NRCS) has mapped the soil on the property as Urban Land-Seaboldt, disturbed complex. The following table summarizes the site soil information and impervious/pervious areas for both the pre-development conditions and the post-development conditions. The values listed in the table show the existing conditions as well as the proposed construction. Class D soils were utilized due to the bedrock found onsite with zero infiltration capacity. Refer to Chapter 3 of this report for further information on calculations.

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FULL PROJECT AREA (Phase 1 and Phase 2)
PRE-DEVELOPMENT VS. POST-DEVELOPMENT

	Pre-Development	Post-Development
Surface Cover Type	**Unimproved**	**Landscaping/Lawn**
Pollutant Generating	No	
NRCS Soil Type	Type D	
C Value*	0.22	0.22
Surface Cover Area (acres)	4.48	1.82
Surface Cover Type	**Proposed Asphalt, Concrete and Curb**	
Pollutant Generating	Yes	
NRCS Soil Type	Type D	
C Value*	0.90	0.90
Surface Cover Area (acres)	0.00	1.96
Surface Cover Type	**Proposed Gravel**	
Pollutant Generating	Yes	
NRCS Soil Type	Type D	
C Value*	0.55	
Surface Cover Area (acres)	0.28	
Surface Cover Type	**Proposed Detached Sidewalk (Concrete)**	
Pollutant Generating	No	
NRCS Soil Type	Type D	
C Value*	0.90	0.90
Surface Cover Area (acres)	0.00	0.22
Surface Cover Type	**Building Roof**	
Pollutant Generating	No	
NRCS Soil Type	Type D	
C Value*	0.90	0.90
Surface Cover Area (acres)	0.05	0.81
Pollutant Generating Impervious Surface (acres)	**0.28**	**3.78**
Total Basin Area (acres)**	**4.81**	**4.81**
Composite C	**0.25**	**0.64**

*The C values listed are taken from the 10-year storm values from Section 5.5.1 of the Spokane Regional Stormwater Manual (SRSM). Per Section 5.5.1.
**This area does not include the backyard basins (L, M, O), or the fire access basin (N). See individual basin calculations for that.

METHODOLOGY

The basin areas associated with the project were analyzed for runoff flows utilizing the Rational & SCS Method. Peak runoff rates and volumes were established for the 10 and 50-year storm events. The detention ponds were sized to meet treatment requirements using the "1815" method as outlined in the SRSM. See the section titled "Water Quality Treatment" in this report for more information regarding water quality treatment of stormwater runoff.

Rainfall intensities used for the Rational Method were calculated using "m" and "n" coefficients and an associated equation from Section 2-5.4A of the WSDOT Hydraulics Manual. As no infiltration was recommended by the geotechnical engineer except for infiltration within the bio-retention media layer, the stormwater facilities are designed to store the runoff from each drainage basin up to the 50-year storm event. The storage volume will be met using both the pond volumes and volume within the voids of the rock underdrains below the ponds. While the individual roadside swales do provide storage volume, their main purpose is the treatment of the runoff. Calculations will show that within the individual basins, the swales provided are sized large enough to handle the treatment volume required.

Basins A, B, C, F, H, I, J and K are hydraulically connected via rock underdrains and perforated pipes which convey all stormwater to the larger swales located in Basin C and Basin F. These swales are located inside Tract A and B respectively. Swale C is a deep, walled swale with a drain rock gallery below. Swale F has a drain rock gallery below as well. Swale C has been sized to fully contain the 50-year event of upstream sub-basins and also has a metered release matching Swale F's release to ensure that Swale F is not flooded. The discharge from Swale F was developed using the City of Spokane's allowable discharge rate of 1.5 gallons/minute/acre for total acreage of the site. This rate equates to 0.0196 cfs which does include the public right-of-way area. For the discharge point to the public stormwater system, this discharge rate will be used. A 0.463-inch orifice will be used to limit the outflow from the ponds to the city system with the maximum allowable discharge rate.

Basins D and E are small offsite basins and are hydraulically connected via rock underdrains, perforated pipes and a culvert across 53rd Avenue which convey all stormwater to Swale E3, located in Basin E. This swale will have a catch basin structure which discharges stormwater into a medium-sized drain rock gallery below. The calculations will show that the retained stormwater (above ground) will drain within 72 hours for the 10-year storm event. The discharge from this infiltration gallery was set at 0.005 cfs . The outflow is based on an assumption that the underground water will slowly infiltrate laterally through the soil and rock layers.

Basin G is a stand-alone, small basin in the northwest portion of the property. Runoff in Basin G flows to Swale G via overland flow, catch basins and piping. Swale G will have a catch basin structure which discharges stormwater into a medium-sized drain rock gallery below. The calculations will show that the retained stormwater (above ground) will drain within 72 hours for the 10-year storm event. The discharge from this infiltration gallery was set at 0.03 cfs, which is less than the 2-year pre-development release rate. The outflow is based on an assumption that the underground water will slowly infiltrate laterally through the soil and rock layers.

Basins L, M and O are small backyard basins. Calculations are provided for these basins but the general design is that runoff within these basins will just be contained within the backyard grass areas.

Basin N is a stand-alone basin on the east side of the property containing the fire access road. Runoff in this basin will flow to the east down the fire access road to a new swale on the north side of the road (Swale N). The calculations will show that the retained stormwater (above ground) will drain within 72 hours for the 10-year storm event. The discharge from this swale was set at 0.005 cfs. The outflow is based on an assumption that the underground water will slowly infiltrate laterally through the soil and rock layers.

POST-DEVELOPMENT BASIN INFORMATION
Refer to Chapter 2 of this report for the Basin Map.

All runoff from the road, sidewalks, roof, landscaping, and asphalt parking areas will be captured and treated in their basins proposed onsite detention swale(s). Roof area was established as approx. 1,960 ft^2 per unit and will be a non-asphaltic material. All stormwater runoff within the basins will be captured and routed to the detention swales via overland flow. All stormwater from both pollutant generating and non-pollutant generating surfaces, will be collected and treated together in the same treatment pond(s) inside each basin. The detention ponds have been designed with adequate "208" volume to provide pre-treatment of the stormwater runoff from all contributing pollutant generating impervious areas. The table above summarizes the existing and proposed impervious/pervious areas within the entire project limits for Phase 1 and 2.

Additional storage is provided in each of the detention ponds via rock underdrains with perforated pipes. This will serve as temporary storage for the runoff as it moves laterally through the soil and conveyed through the perforated pipes. Below Swales C, E, F, G, H and J are drain rock galleries which also contribute to the storage of stormwater. As mentioned previously, an allowable 0.0196 cubic feet per second discharge rate was calculated for discharge to the public system for the large combined drainage basin. A 0.463-inch orifice will be drilled into the bottom of a flow control downturned pipe within a flow control structure. Swale F has 1.00' of above ground storage capacity and the gravel gallery is 5.00' deep with 12-inches of soil above. Swale C has 2.83' of total above ground storage, with 6.00' of below ground storage including a gravel gallery that is 5' deep. The remaining basins have smaller swales with up to 1.00' of above ground storage and roughly 1'-3' of below ground storage with rock underdrains.

POST-DEVELOPMENT – OFFSITE

No offsite basins are anticipated to impact the stormwater systems, as this property is located at a high point in relationship to the surrounding area.

PERPETUAL MAINTENANCE OF FACILITIES

The owner of the property will establish an HOA to be the entity responsible for the perpetual maintenance of all facilities associated with the storm water system. The proposed improvements should result in no significant increase in maintenance for the owner of the property.

OFF-SITE EASEMENTS

Swale H and N will require an offsite stormwater easement. These properties are currently under the same ownership as this development. Swale C and F will be within Drainage Tracts (Tract A and B).

REGIONAL FACILITIES

The proposed drainage design provides the treatment and proper distribution for all the proposed improvements. Additionally, the impervious surfaces of the future proposed improvements were taken into consideration for the design. The proposed and future improvements span multiple parcels. The owner of the properties shall establish an HOA to be the entity responsible for the joint management of the on-site stormwater system.

STORAGE ANALYSIS

There are four (4) main basins, **Basin 1** (A, B, C, F, H, I, J and K), **Basin 2** (D & E), **Basin 3** (G) and **Basin 4** (Fire Access Road sub-basin N). These basins are designed to fully contain stormwater runoff for up to the 50-year storm event. The following table represents the storm volume vs. the proposed storage capacity of the downstream swale, the combined storage volume of all swales and underdrains and drain rock gallery within the combined basins. The table also shows the expected time for disposal of the associated 50-year events completely and the time for disposal of stormwater from Swale F, Swale E3, Swale G and Swale N. Basins L, M and O are small backyard basins in which stormwater will be contained within the grassed backyards.

STORM VOLUME VS. STORAGE CAPACITY & TIME TO DRAIN

Combined Basin (Sub-Basins)	Storm Event	Post-Developed Storm Volume (CF)	Provided Pond & Rock Gallery Volume (CF)	Time to Drain 100% Proposed Storm Volume (Hours)
BASIN 1 (A, B, C, F, H, I, J, K)	50-yr	20,865	22,865	295.61
BASIN 2 (D, E)	50-yr	1,046	1,562	58.12
BASIN 3 (G)	50-yr	620	983	5.74
BASIN 4 (N)	50-yr	881	996	48.94

OVERFLOW STRUCTURE – EMERGENCY OUTFLOW PIPE CALCULATIONS

The overflow structure in Swale F is designed to allow stormwater from large storm events to enter the City system quickly. This 8" pipe will allow the 0.0196 cfs orifice flow to be conveyed to the city system during normal operating procedures and the overflow pipe located at the surface can allow free flow of stormwater during large historical storm events (i.e. 100-yr). The following table justifies the use and design of the 8" emergency outflow pipe.

EMERGENCY OUTFLOW PIPE CALCULATIONS

Outfall Basin	50-Year Peak Runoff Rate, Q_{50} (cfs)*	Pipe Diameter (ft)	Slope (ft/ft)	Depth in pipe at Peak Flow (ft)	Velocity in pipe at Peak Flow (ft/sec)
F	10.13	0.667	0.075	0.67**	2.46

*50-year storm event calculation can be found in Chapter 3 of this report

**Combined Basins A, B, C, F, H, I, J and K 50-year storm has a peak flow of 10.13 cfs. The 8" pipe will allow 0.87 cfs at max capacity. The remaining flow will be backed up within the drainage systems of the combined basins.

EMERGENCY OVERFLOW / 100-YR FLOOD PATH

The overall storm systems designed are sized to fully contain the 50-year storm event and/or release the runoff into the City stormwater system via 0.463-inch orifice, as explained above. In the event of a 100-year storm event, an emergency outlet pipe has been designed within the overflow structure in Swale F to be utilized by allowing the excess water to overflow into the system and drain to the city system.

In the event of a failure of all the drainage systems, stormwater will collect within the detention basins until it reaches the maximum storage height. Stormwater will overflow the top of the ponds and drain into the street and continue down the road to the west. Historically, this is the same flow path for storm events for this project area.

RESULTS AND CONCLUSIONS

The following tables show the treatment volume requirements to accommodate the proposed site improvements and the respective volumes provided by the proposed drainage improvements. Since the detention ponds are sized to fully contain the runoff from up to the 50-year storm event, no offsite drainage is expected to occur.

TREATMENT VOLUME (REQUIRED VS. PROVIDED)

Basin	Treatment Volume Required (CF)	Treatment Volume Provided (CF)
A	461	730
B	233	584
C	936	1,528
D	93	292
E	113	130
F	610	1,243
G	245	273
H	140	175
I	265	395
J	60	224
K	113	667
L	0*	0
M	0*	0
N	160	448
O	0*	0

*Basins L, M and O are small, back yard basins in which have no treatment requirements due to not having any PGIS areas.

Chapter 2

BASIN MAP

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Q = 50-YEAR STORM EVENT RUNOFF RATE

Q_1 = 2.63 CFS
2-yr = 0.97 cfs
25-yr = 2.27 cfs

Q_2 = 2.02 CFS
2-yr = 0.74 cfs
25-yr = 1.74 cfs

BASIN 1
2.4 AC

BASIN 2
2.4 AC

BASIN 3 & 4*
0.0 AC

Q_3 = 0.00 CFS

*BASINS 3 & 4 ARE THE THEORETICAL PRE-DEVELOPMENT BASINS FOR THE PROPOSED PHASE 1 AND 2 DEVELOPMENT.

PLAT BOUNDARY

30' SEWER EASEMENT

30' ROW

53RD AVE

2378 2379 2380 2381 2382 2383 2384 2385 2386

GRAPHIC SCALE
60 0 30 60 120
(IN FEET)
1 inch = 60 ft.

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23-078-BASIN MAP.dwg PRE-DEV - BASIN MAP

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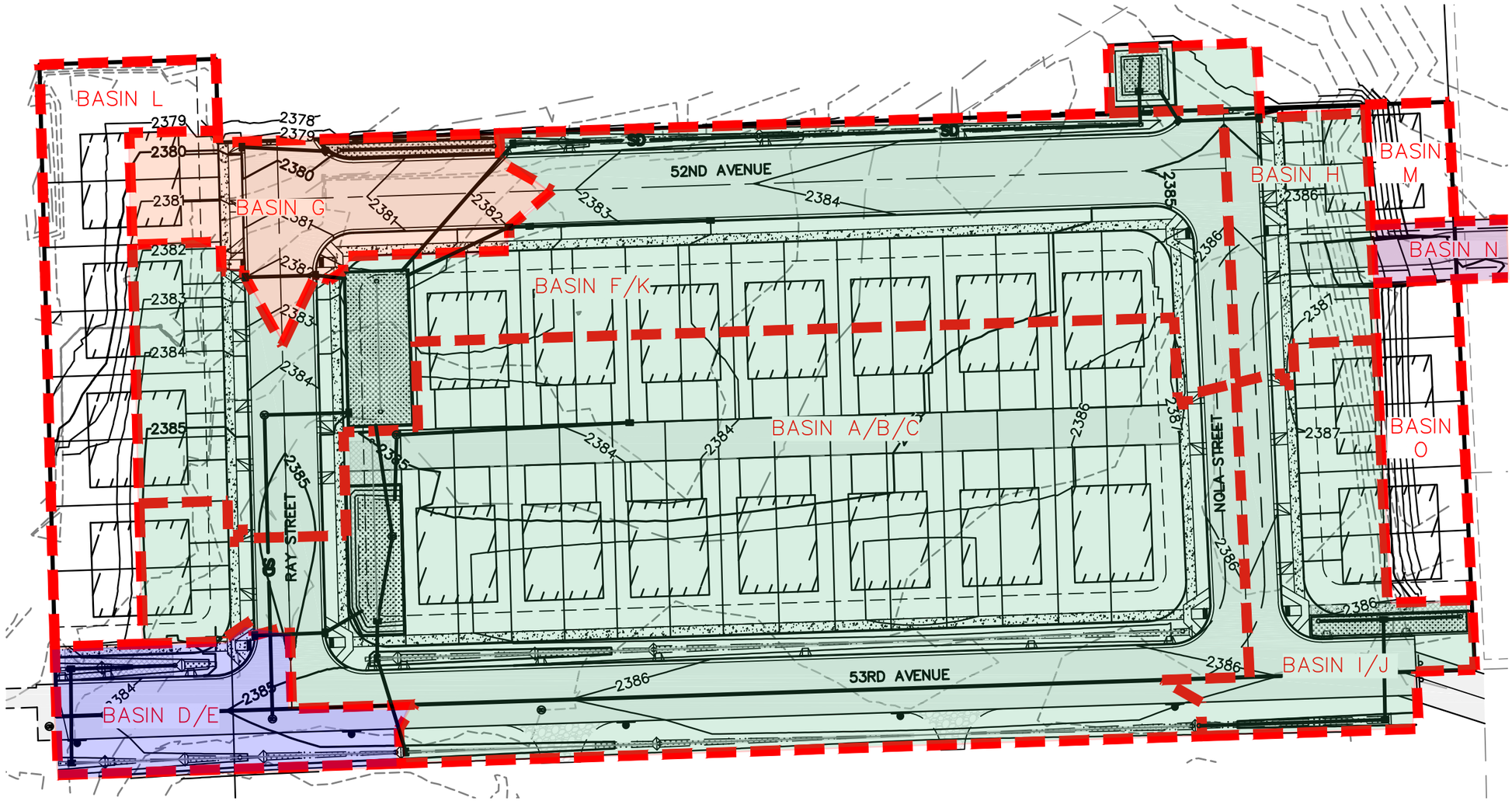
PRE-DEVELOPMENT DRAINAGE BASIN MAP
CLARK 53RD RESIDENCES
SPOKANE, WA.

DRAWN	RMS	DATE 10/25/23
CHECKED	AJS	SCALE 1" = 60'
1 OF 1		
PROJECT NUMBER		23-078



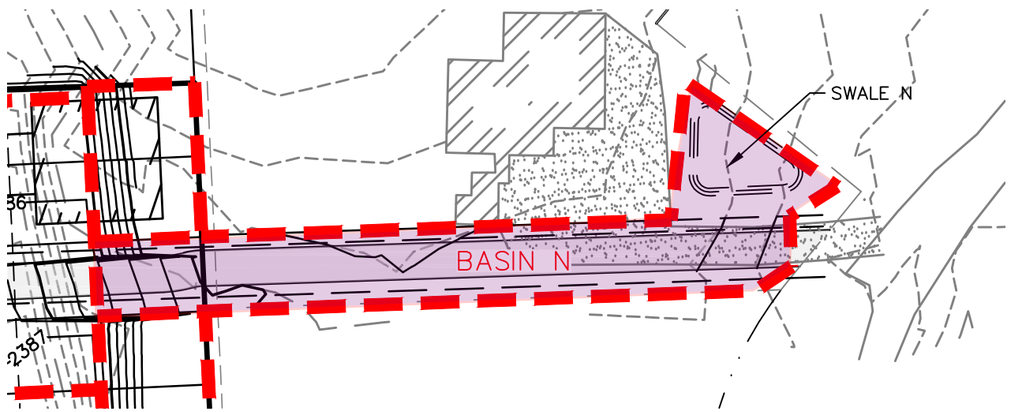
COMBINED MAIN BASIN DESIGNATIONS

BASIN 1 = BASINS A+B+C+F++H+I+J+K

BASIN 2 = D+E

BASIN 3 = G

BASIN 4 = N



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25-121 BASINS.dwg BASINS

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BASIN MAP

SPOKANE, WA.

DRAWN	SCE	DATE	9/23/25
CHECKED	LMC	SCALE	1"=60'
3	OF	2	
PROJECT NUMBER		25-121	

SWALES WITH DRAIN ROCK/PERFORATED PIPE UNDERDRAIN SYSTEM (TYP)

SD

SD

52ND AVENUE

K5 K4 K3 K2 K1

G1

F4 F5

H1 M1

N1

SEE BASIN N EXTENSION DETAIL, THIS SHEET

SWALE F (SUB-BASINS A,B,C,F,H,I,J,K) ALL EXIT THROUGH HERE

L1

F2

F1

FLOW CONTROL STRUCTURE

C1

O1

SWALE C - COLLECTS SOUTHERN HALF OF SITE (SUBBASINS A,B,C,I,J), THEN SLOWLY DRAINS INTO SWALE F WITH A FLOW CONTROL STRUCTURE.

NOLA STREET

RAY STREET

C2

C3

A3 A2 A1.2 A1.1

I1

53RD AVENUE

SWALES WITH DRAIN ROCK/PERFORATED PIPE UNDERDRAIN SYSTEM (TYP)

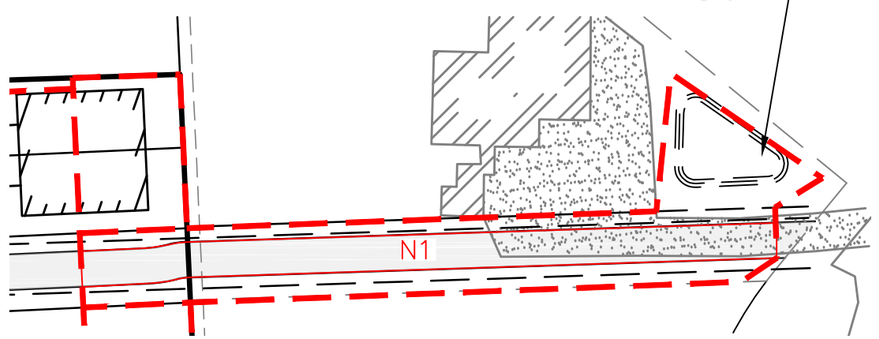
E3 E2 E1 A4

B1 J1

D4 D3 D2 D1 B4 B3 B2

SWALES WITH DRAIN ROCK/PERFORATED PIPE UNDERDRAIN SYSTEM (TYP)

SWALE N CONTAINS ALL STORMWATER FROM BASIN N



BASIN N EXTENSION

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SUB-BASIN MAP

SPOKANE, WA.

DRAWN	SCE
CHECKED	LMC
5 OF 6	
DATE	9/23/25
SCALE	1"=60'
PROJECT NUMBER	25-121

Chapter 3

RATIONAL & SCS METHOD STORMWATER CALCULATIONS

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PRE-DEVELOPMENT

CALCULATIONS

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RATIONAL & SCS METHOD (TWO YEAR STORM DESIGN)
DETENTION BASIN DESIGN

PROJECT: 23-078 Clark/53rd
BASIN: PRE-DEV BASIN 1
REVIEWER: AJS
DESIGNER: RMS
DATE: 6/20/2024

RUNOFF STORAGE

~~Single (Type A)~~	0	~~Double (Type B)~~	0
~~Exfiltration (cfs)~~	~~0.3~~		1.0

Time of Conc. (min)			5.00	
Area (Acres)			2.43	
Composite "C"			0.28	
208 Treated Area (acres)			0.28	
Volume Provided		208:	0	Storm: 0
Outflow (cfs)			0.0000	
Area * C" Factor			0.68	
Coef. of Intensity	m: 3.47			
	n: 0.556			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	1.42	0.97	390	0.00	390
~~5~~	~~300~~	~~1.42~~	~~0.97~~	~~390~~	~~0.00~~	~~390~~
~~10~~	~~600~~	~~0.96~~	~~0.66~~	~~463~~	~~0.00~~	~~463~~
~~15~~	~~900~~	~~0.77~~	~~0.53~~	~~528~~	~~0.00~~	~~528~~
~~20~~	~~1200~~	~~0.66~~	~~0.45~~	~~584~~	~~0.00~~	~~584~~
~~25~~	~~1500~~	~~0.58~~	~~0.40~~	~~635~~	~~0.00~~	~~635~~
~~30~~	~~1800~~	~~0.52~~	~~0.36~~	~~681~~	~~0.00~~	~~681~~
~~35~~	~~2100~~	~~0.48~~	~~0.33~~	~~724~~	~~0.00~~	~~724~~
~~40~~	~~2400~~	~~0.45~~	~~0.31~~	~~764~~	~~0.00~~	~~764~~
~~45~~	~~2700~~	~~0.42~~	~~0.29~~	~~801~~	~~0.00~~	~~801~~
~~50~~	~~3000~~	~~0.39~~	~~0.27~~	~~836~~	~~0.00~~	~~836~~
~~55~~	~~3300~~	~~0.37~~	~~0.26~~	~~870~~	~~0.00~~	~~870~~
~~60~~	~~3600~~	~~0.36~~	~~0.24~~	~~902~~	~~0.00~~	~~902~~
~~65~~	~~3900~~	~~0.34~~	~~0.23~~	~~932~~	~~0.00~~	~~932~~
~~70~~	~~4200~~	~~0.33~~	~~0.22~~	~~962~~	~~0.00~~	~~962~~
~~75~~	~~4500~~	~~0.31~~	~~0.22~~	~~990~~	~~0.00~~	~~990~~
~~80~~	~~4800~~	~~0.30~~	~~0.21~~	~~1018~~	~~0.00~~	~~1018~~
~~85~~	~~5100~~	~~0.29~~	~~0.20~~	~~1044~~	~~0.00~~	~~1044~~
~~90~~	~~5400~~	~~0.28~~	~~0.19~~	~~1070~~	~~0.00~~	~~1070~~
~~95~~	~~5700~~	~~0.28~~	~~0.19~~	~~1095~~	~~0.00~~	~~1095~~
~~100~~	~~6000~~	~~0.27~~	~~0.18~~	~~1119~~	~~0.00~~	~~1119~~
~~105~~	~~6300~~	~~0.26~~	~~0.18~~	~~1142~~	~~0.00~~	~~1142~~
~~110~~	~~6600~~	~~0.25~~	~~0.17~~	~~1165~~	~~0.00~~	~~1165~~
~~115~~	~~6900~~	~~0.25~~	~~0.17~~	~~1188~~	~~0.00~~	~~1188~~
4320	259200	0.03	0.02	5858	0.00	5858

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	1.42

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~		320 ~~cu. ft.~~	Inadequate
~~Volume Required [cf] = 1815*A~~		512 ~~cu. ft.~~	Inadequate
~~*Must meet SRSM soil requirements~~	~~Provided:~~	0 ~~cu. ft.~~	

~~STORAGE REQUIREMENTS - 2-YEAR DESIGN STORM~~

~~Maximum storage required by SCS Method =~~		4166 ~~cu. ft.~~
	~~Provided:~~	0 ~~cu. ft.~~
~~SCS Total Storm Volume - Total Detention Storage~~		~~4166~~

CONTRIBUTING AREAS

Site 2.43 Acres 105924 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Asphalt/Concrete	0.02	0.900	0.0162	783	Y
Attached Sidewalks	0.00	0.900	0.0000	0	Y
Detached Sidewalks	0.00	0.900	0.0000	0	N
Building/Roof	0.07	0.900	0.0655	3169	N
Grass / Landscaping	0.00	0.220	0.0000	0	N
Unimproved	2.08	0.220	0.4569	90460	N
Gravel	0.26	0.550	0.1454	11512	Y

	Total A	Comp "C"	Qpeak
Total Site	2.43	0.28	0.97
Connected Impervious	0.28	0.06	0.02

~~POND VOLUMES~~

~~Swale Number~~	~~Bottom Elevation (cf)~~	~~Depth to 208 Elevation (ft)~~	~~208 Elevation Area (sf)~~	~~Depth to Top Elevation (ft)~~	~~Top Elevation Area (cf)~~	~~208 Volume (cf)~~	~~Storage Volume (cf)~~
~~208 SWALE~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
~~XXX~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
						0	0

PEAK RUNOFF VOLUME (2-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Asphalt	0.02	98	1.762
Attached Sidewalks	0.00	98	0.000
Detached Sidewalks	0.00	98	0.000
Building/Roof	0.07	98	7.130
Grass / Landscaping	0.00	80	0.000
Unimproved	2.08	89	184.824
Gravel	0.26	98	25.899
	Total A	Comp "C"	
	2.43	90.31	

P_2= 1.2 in
S = 1.07
Total Runoff Depth(Q_2)= 0.47 in
Total Storm Volume (V) = 4166 cf
*Class D soils w/ >75% grass cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

RATIONAL & SCS METHOD (TWENTY-FIVE YEAR STORM DESIGN)
DETENTION BASIN DESIGN

PROJECT: 23-078 Clark/53rd
BASIN: PRE-DEV BASIN 1
REVIEWER: AJS
DESIGNER: RMS
DATE: 6/20/2024

RUNOFF STORAGE

~~Single (Type A)~~	0	~~Double (Type B)~~	0
~~Exfiltration (cfs)~~	~~0.3~~		~~1.0~~

Time of Conc. (min)			5.00	
Area (Acres)			2.43	
Composite "C"			0.28	
208 Treated Area (acres)			0.02	
Volume Provided		208:	0	Storm: 0
Outflow (cfs)			0.0000	
Area * C" Factor			0.68	
Coef. of Intensity	m: 9.09			
	n: 0.626			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
~~5.00~~	~~300.00~~	~~3.32~~	~~2.27~~	~~912~~	~~0.00~~	~~912~~
5	300	~~3.32~~	~~2.27~~	~~912~~	~~0.00~~	~~912~~
~~10~~	~~600~~	~~2.15~~	~~1.47~~	~~1032~~	~~0.00~~	~~1032~~
~~15~~	~~900~~	~~1.67~~	~~1.14~~	~~1143~~	~~0.00~~	~~1143~~
~~20~~	~~1200~~	~~1.39~~	~~0.95~~	~~1241~~	~~0.00~~	~~1241~~
~~25~~	~~1500~~	~~1.21~~	~~0.83~~	~~1328~~	~~0.00~~	~~1328~~
~~30~~	~~1800~~	~~1.08~~	~~0.74~~	~~1406~~	~~0.00~~	~~1406~~
~~35~~	~~2100~~	~~0.98~~	~~0.67~~	~~1478~~	~~0.00~~	~~1478~~
~~40~~	~~2400~~	~~0.90~~	~~0.62~~	~~1545~~	~~0.00~~	~~1545~~
~~45~~	~~2700~~	~~0.84~~	~~0.57~~	~~1607~~	~~0.00~~	~~1607~~
~~50~~	~~3000~~	~~0.79~~	~~0.54~~	~~1666~~	~~0.00~~	~~1666~~
~~55~~	~~3300~~	~~0.74~~	~~0.51~~	~~1721~~	~~0.00~~	~~1721~~
~~60~~	~~3600~~	~~0.70~~	~~0.48~~	~~1774~~	~~0.00~~	~~1774~~
~~65~~	~~3900~~	~~0.67~~	~~0.46~~	~~1824~~	~~0.00~~	~~1824~~
~~70~~	~~4200~~	~~0.64~~	~~0.44~~	~~1871~~	~~0.00~~	~~1871~~
~~75~~	~~4500~~	~~0.61~~	~~0.42~~	~~1917~~	~~0.00~~	~~1917~~
~~80~~	~~4800~~	~~0.59~~	~~0.40~~	~~1961~~	~~0.00~~	~~1961~~
~~85~~	~~5100~~	~~0.56~~	~~0.39~~	~~2004~~	~~0.00~~	~~2004~~
~~90~~	~~5400~~	~~0.54~~	~~0.37~~	~~2045~~	~~0.00~~	~~2045~~
~~95~~	~~5700~~	~~0.53~~	~~0.36~~	~~2085~~	~~0.00~~	~~2085~~
~~100~~	~~6000~~	~~0.51~~	~~0.35~~	~~2123~~	~~0.00~~	~~2123~~
~~110~~	~~6600~~	~~0.48~~	~~0.33~~	~~2197~~	~~0.00~~	~~2197~~
~~120~~	~~7200~~	~~0.45~~	~~0.31~~	~~2267~~	~~0.00~~	~~2267~~
~~125~~	~~7500~~	~~0.44~~	~~0.30~~	~~2300~~	~~0.00~~	~~2300~~
4320	259200	0.05	0.03	~~8541~~	0.00	~~8541~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~		~~20 cu. ft.~~	~~Inadequate~~
~~Volume Required [cf] = 1815*A~~		~~33 cu. ft.~~	~~Inadequate~~
~~*Must meet SRSM soil requirements~~	~~Provided:~~	~~0 cu. ft.~~	

~~*STORAGE REQUIREMENTS - 25-YEAR DESIGN STORM*~~

~~Maximum storage required by SCS Method =~~	~~9846 cu. ft.~~	
~~Provided:~~	~~0 cu. ft.~~	
~~SCS Total Storm Volume - Total Detention Storage~~	~~9846~~	

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.32

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 2.43 Acres 105924 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Asphalt	0.02	0.900	0.0162	783	Y
Driveways	0.00	0.900	0.0000	0	Y
Detached Sidewalks	0.00	0.900	0.0000	0	N
Building/Roof	0.07	0.900	0.0655	3169	N
Grass / Landscaping	0.00	0.220	0.0000	0	N
Unimproved	2.08	0.220	0.4569	90460	N
Gravel	0.26	0.550	0.1454	11512	N

	Total A	Comp "C"	Qpeak
Total Site	2.43	0.28	2.27
Connected Impervious	0.02	0.90	0.05

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
~~208 SWALE~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
~~XXX~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
						0	0

PEAK RUNOFF VOLUME (25-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Asphalt	0.02	98	1.762
Attached Sidewalks	0.00	98	0.000
Detached Sidewalks	0.00	98	0.000
Building/Roof	0.07	98	7.130
Grass / Landscaping	0.00	80	0.000
Unimproved	2.08	89	184.824
Gravel	0.26	98	25.899
	Total A	Comp "C"	
	2.43	90.31	

P_{25}= 2 in
S = 1.07
Total Runoff Depth(Q_2)= 1.12 in
Total Storm Volume (V) = 9846 cf
*Class D soils w/ >75% grass cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

RATIONAL & SCS METHOD (TWO YEAR STORM DESIGN)
DETENTION BASIN DESIGN

PROJECT: 23-078 Clark/53rd
BASIN: PRE-DEV BASIN 2
REVIEWER: AJS
DESIGNER: RMS
DATE: 6/20/2024

RUNOFF STORAGE

~~Single (Type A)~~	0	~~Double (Type B)~~	0
~~Exfiltration (cfs)~~	~~0.3~~		1.0

Time of Conc. (min)			5.00	
Area (Acres)			2.39	
Composite "C"			0.22	
208 Treated Area (acres)			0.00	
Volume Provided		208:	0	Storm: 0
Outflow (cfs)			0.0000	
Area * "C" Factor			0.52	
Coef. of Intensity	m: 3.47			
	n: 0.556			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	1.42	0.74	299	0.00	299
~~5~~	~~300~~	~~1.42~~	~~0.74~~	~~299~~	~~0.00~~	~~299~~
~~10~~	~~600~~	~~0.96~~	~~0.51~~	~~355~~	~~0.00~~	~~355~~
~~15~~	~~900~~	~~0.77~~	~~0.40~~	~~405~~	~~0.00~~	~~405~~
~~20~~	~~1200~~	~~0.66~~	~~0.34~~	~~448~~	~~0.00~~	~~448~~
~~25~~	~~1500~~	~~0.58~~	~~0.30~~	~~487~~	~~0.00~~	~~487~~
~~30~~	~~1800~~	~~0.52~~	~~0.27~~	~~523~~	~~0.00~~	~~523~~
~~35~~	~~2100~~	~~0.48~~	~~0.25~~	~~556~~	~~0.00~~	~~556~~
~~40~~	~~2400~~	~~0.45~~	~~0.23~~	~~586~~	~~0.00~~	~~586~~
~~45~~	~~2700~~	~~0.42~~	~~0.22~~	~~615~~	~~0.00~~	~~615~~
~~50~~	~~3000~~	~~0.39~~	~~0.21~~	~~642~~	~~0.00~~	~~642~~
~~55~~	~~3300~~	~~0.37~~	~~0.20~~	~~668~~	~~0.00~~	~~668~~
~~60~~	~~3600~~	~~0.36~~	~~0.19~~	~~692~~	~~0.00~~	~~692~~
~~65~~	~~3900~~	~~0.34~~	~~0.18~~	~~716~~	~~0.00~~	~~716~~
~~70~~	~~4200~~	~~0.33~~	~~0.17~~	~~738~~	~~0.00~~	~~738~~
~~75~~	~~4500~~	~~0.31~~	~~0.17~~	~~760~~	~~0.00~~	~~760~~
~~80~~	~~4800~~	~~0.30~~	~~0.16~~	~~781~~	~~0.00~~	~~781~~
~~85~~	~~5100~~	~~0.29~~	~~0.15~~	~~801~~	~~0.00~~	~~801~~
~~90~~	~~5400~~	~~0.28~~	~~0.15~~	~~821~~	~~0.00~~	~~821~~
~~95~~	~~5700~~	~~0.28~~	~~0.14~~	~~840~~	~~0.00~~	~~840~~
~~100~~	~~6000~~	~~0.27~~	~~0.14~~	~~859~~	~~0.00~~	~~859~~
~~105~~	~~6300~~	~~0.26~~	~~0.14~~	~~877~~	~~0.00~~	~~877~~
~~110~~	~~6600~~	~~0.25~~	~~0.13~~	~~894~~	~~0.00~~	~~894~~
~~115~~	~~6900~~	~~0.25~~	~~0.13~~	~~912~~	~~0.00~~	~~912~~
4320	259200	0.03	0.02	4496	0.00	4496

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	1.42

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 2.39 Acres 103924 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Asphalt/Concrete	0.00	0.900	0.0000	0	Y
Attached Sidewalks	0.00	0.900	0.0000	0	Y
Detached Sidewalks	0.00	0.900	0.0000	0	N
Building/Roof	0.00	0.900	0.0000	0	N
Grass / Landscaping	0.00	0.220	0.0000	0	N
Unimproved	2.39	0.220	0.5249	103924	N
Gravel	0.00	0.550	0.0000	0	Y

	Total A	Comp "C"	Qpeak
Total Site	2.39	0.22	0.74
Connected Impervious	0.00	#DIV/0!	#DIV/0!

POND VOLUMES

~~Swale Number~~	~~Bottom Elevation Area (sf)~~	~~Depth to 208 Elevation (ft)~~	~~208 Elevation Area (sf)~~	~~Depth to Top Elevation (ft)~~	~~Top Elevation Area (sf)~~	~~208 Volume (cf)~~	~~Storage Volume (cf)~~
~~208 SWALE~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
~~XXX~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
						~~0~~	~~0~~

PEAK RUNOFF VOLUME (2-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Asphalt	0.00	98	0.000
Attached Sidewalks	0.00	98	0.000
Detached Sidewalks	0.00	98	0.000
Building/Roof	0.00	98	0.000
Grass / Landscaping	0.00	80	0.000
Unimproved	2.39	89	212.333
Gravel	0.00	98	0.000
	Total A	Comp "C"	
	2.39	89.00	

P_2= 1.2 in
S = 1.24
Total Runoff Depth(Q_2)= 0.41 in
Total Storm Volume (V) = 3592 cf
*Class D soils w/ >75% grass cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~ 0 ~~cu. ft.~~ **Inadequate**
~~Volume Required [cf] = 1815*A~~ 0 ~~cu. ft.~~ **Inadequate**
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ 0 ~~cu. ft.~~

~~STORAGE REQUIREMENTS - 2-YEAR DESIGN STORM~~

~~Maximum storage required by SCS Method =~~ 3592 ~~cu. ft.~~
~~Provided:~~ 0 ~~cu. ft.~~
~~SCS Total Storm Volume - Total Detention Storage~~ **3592**

RATIONAL & SCS METHOD (TWENTY-FIVE YEAR STORM DESIGN)
DETENTION BASIN DESIGN

PROJECT: 23-078 Clark/53rd
BASIN: PRE-DEV BASIN 2
REVIEWER: AJS
DESIGNER: RMS
DATE: 6/20/2024

RUNOFF STORAGE

~~Single (Type A)~~	0	~~Double (Type B)~~	0
~~Exfiltration (cfs)~~	~~0.3~~		~~1.0~~

Time of Conc. (min)			5.00	
Area (Acres)			2.39	
Composite "C"			0.22	
208 Treated Area (acres)			0.00	
Volume Provided		208:	0	Storm: 0
Outflow (cfs)			0.0000	
Area * "C" Factor			0.52	
Coef. of Intensity	m: 9.09			
	n: 0.626			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
~~5.00~~	~~300.00~~	~~3.32~~	~~1.74~~	~~700~~	~~0.00~~	~~700~~
~~5~~	~~300~~	~~3.32~~	~~1.74~~	~~700~~	~~0.00~~	~~700~~
~~10~~	~~600~~	~~2.15~~	~~1.13~~	~~792~~	~~0.00~~	~~792~~
~~15~~	~~900~~	~~1.67~~	~~0.88~~	~~878~~	~~0.00~~	~~878~~
~~20~~	~~1200~~	~~1.39~~	~~0.73~~	~~952~~	~~0.00~~	~~952~~
~~25~~	~~1500~~	~~1.21~~	~~0.64~~	~~1019~~	~~0.00~~	~~1019~~
~~30~~	~~1800~~	~~1.08~~	~~0.57~~	~~1079~~	~~0.00~~	~~1079~~
~~35~~	~~2100~~	~~0.98~~	~~0.52~~	~~1135~~	~~0.00~~	~~1135~~
~~40~~	~~2400~~	~~0.90~~	~~0.47~~	~~1186~~	~~0.00~~	~~1186~~
~~45~~	~~2700~~	~~0.84~~	~~0.44~~	~~1234~~	~~0.00~~	~~1234~~
~~50~~	~~3000~~	~~0.79~~	~~0.41~~	~~1279~~	~~0.00~~	~~1279~~
~~55~~	~~3300~~	~~0.74~~	~~0.39~~	~~1321~~	~~0.00~~	~~1321~~
~~60~~	~~3600~~	~~0.70~~	~~0.37~~	~~1361~~	~~0.00~~	~~1361~~
~~65~~	~~3900~~	~~0.67~~	~~0.35~~	~~1400~~	~~0.00~~	~~1400~~
~~70~~	~~4200~~	~~0.64~~	~~0.33~~	~~1436~~	~~0.00~~	~~1436~~
~~75~~	~~4500~~	~~0.61~~	~~0.32~~	~~1472~~	~~0.00~~	~~1472~~
~~80~~	~~4800~~	~~0.59~~	~~0.31~~	~~1505~~	~~0.00~~	~~1505~~
~~85~~	~~5100~~	~~0.56~~	~~0.30~~	~~1538~~	~~0.00~~	~~1538~~
~~90~~	~~5400~~	~~0.54~~	~~0.29~~	~~1570~~	~~0.00~~	~~1570~~
~~95~~	~~5700~~	~~0.53~~	~~0.28~~	~~1600~~	~~0.00~~	~~1600~~
~~100~~	~~6000~~	~~0.51~~	~~0.27~~	~~1630~~	~~0.00~~	~~1630~~
~~110~~	~~6600~~	~~0.48~~	~~0.25~~	~~1686~~	~~0.00~~	~~1686~~
~~120~~	~~7200~~	~~0.45~~	~~0.24~~	~~1740~~	~~0.00~~	~~1740~~
~~125~~	~~7500~~	~~0.44~~	~~0.23~~	~~1766~~	~~0.00~~	~~1766~~
4320	259200	0.05	0.03	6556	0.00	6556

~~208-SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~		0 ~~cu. ft.~~	**Inadequate**
~~Volume Required [cf] = 1815*A~~		0 ~~cu. ft.~~	**Inadequate**
~~*Must meet SRSM soil requirements~~	~~Provided:~~	0 ~~cu. ft.~~	

~~STORAGE REQUIREMENTS--25-YEAR DESIGN STORM~~

~~Maximum storage required by SCS Method =~~	8903	~~cu. ft.~~
~~Provided:~~	0	~~cu. ft.~~
~~SCS Total Storm Volume--Total Detention Storage~~	~~8903~~	

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.32

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 2.39 Acres 103924 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Asphalt	0.00	0.900	0.0000	0	Y
Driveways	0.00	0.900	0.0000	0	Y
Detached Sidewalks	0.00	0.900	0.0000	0	N
Building/Roof	0.00	0.900	0.0000	0	N
Grass / Landscaping	0.00	0.220	0.0000	0	N
Unimproved	2.39	0.220	0.5249	103924	N
Gravel	0.00	0.550	0.0000	0	N

	Total A	Comp "C"	Qpeak
Total Site	2.39	0.22	1.74
Connected Impervious	0.00	#DIV/0!	#DIV/0!

~~POND VOLUMES~~

~~Swale Number~~	~~Bottom Elevation (sf)~~	~~Depth to 208 Elevation (ft)~~	~~208 Elevation Area (sf)~~	~~Depth to Top Elevation (ft)~~	~~Top Elevation Area (sf)~~	~~208 Volume (cf)~~	~~Storage Volume (cf)~~
~~208-SWALE~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
~~XXX~~	~~0~~	~~0.50~~	~~0~~	~~1.0~~	~~0~~	~~0~~	~~0~~
						~~0~~	~~0~~

PEAK RUNOFF VOLUME (25-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Asphalt	0.00	98	0.000
Attached Sidewalks	0.00	98	0.000
Detached Sidewalks	0.00	98	0.000
Building/Roof	0.00	98	0.000
Grass / Landscaping	0.00	80	0.000
Unimproved	2.39	89	212.333
Gravel	0.00	98	0.000
	Total A	Comp "C"	
	2.39	89.00	

P_{25}= 2 in
S = 1.24
Total Runoff Depth(Q_2)= 1.03 in
Total Storm Volume (V) = 8903 cf
*Class D soils w/ >75% grass cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

POST DEVELOPMENT

CALCULATIONS

(COMBINED BASINS)

STORHAUG ENGINEERING
510 East Third, Spokane, Washington
Phone 509-242-1000 Fax 509-242-1001

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: BASIN 1 (A+B+C+F+H+I+J+K)
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~	Orifice Outflow	1
~~Exfiltration (cfs)~~	~~0.3~~		0.0196

Time of Conc. (min)			5.00		
Area (Acres)			4.28		
Composite "C"			0.64		
208 Treated Area (acres)			1.65		
Volume Provided		208:	5549.5	Storm:	22865
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***		
Area * C" Factor			2.73		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	10.48	4212	5.88	4206
~~5~~	~~300~~	~~3.84~~	~~10.48~~	~~4212~~	~~5.88~~	~~4206~~
~~10~~	~~600~~	~~2.47~~	~~6.75~~	~~4736~~	~~11.76~~	~~4724~~
~~15~~	~~900~~	~~1.91~~	~~5.22~~	~~5226~~	~~17.65~~	~~5208~~
~~20~~	~~1200~~	~~1.59~~	~~4.34~~	~~5657~~	~~23.53~~	~~5633~~
~~25~~	~~1500~~	~~1.38~~	~~3.77~~	~~6040~~	~~29.41~~	~~6011~~
~~30~~	~~1800~~	~~1.23~~	~~3.36~~	~~6387~~	~~35.29~~	~~6352~~
~~35~~	~~2100~~	~~1.12~~	~~3.05~~	~~6705~~	~~41.17~~	~~6664~~
~~40~~	~~2400~~	~~1.03~~	~~2.80~~	~~7000~~	~~47.05~~	~~6953~~
~~45~~	~~2700~~	~~0.95~~	~~2.60~~	~~7274~~	~~52.94~~	~~7221~~
~~50~~	~~3000~~	~~0.89~~	~~2.43~~	~~7532~~	~~58.82~~	~~7473~~
~~55~~	~~3300~~	~~0.84~~	~~2.29~~	~~7775~~	~~64.70~~	~~7710~~
~~60~~	~~3600~~	~~0.79~~	~~2.16~~	~~8006~~	~~70.58~~	~~7935~~
~~65~~	~~3900~~	~~0.75~~	~~2.06~~	~~8226~~	~~76.46~~	~~8149~~
~~70~~	~~4200~~	~~0.72~~	~~1.96~~	~~8436~~	~~82.35~~	~~8353~~
~~75~~	~~4500~~	~~0.69~~	~~1.88~~	~~8637~~	~~88.23~~	~~8549~~
~~80~~	~~4800~~	~~0.66~~	~~1.80~~	~~8831~~	~~94.11~~	~~8737~~
~~85~~	~~5100~~	~~0.64~~	~~1.73~~	~~9017~~	~~99.99~~	~~8917~~
~~90~~	~~5400~~	~~0.61~~	~~1.67~~	~~9197~~	~~105.87~~	~~9092~~
~~95~~	~~5700~~	~~0.59~~	~~1.62~~	~~9372~~	~~111.75~~	~~9260~~
~~100~~	~~6000~~	~~0.57~~	~~1.56~~	~~9540~~	~~117.64~~	~~9423~~
~~600~~	~~36000~~	~~0.18~~	~~0.50~~	~~18092~~	~~705.82~~	~~17387~~
~~690~~	~~41400~~	~~0.17~~	~~0.46~~	~~19032~~	~~811.69~~	~~18221~~
~~695~~	~~41700~~	~~0.17~~	~~0.46~~	~~19082~~	~~817.57~~	~~18265~~
~~4320~~	~~259200~~	~~0.05~~	~~0.14~~	~~37099~~	~~5081.87~~	~~32017~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~1872~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~2998~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~5549.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 20865 cu. ft.
Provided: 22865 cu. ft. Excess Storage 2000.23

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **295.61 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 4.28 Acres 186599 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	1.26	0.900	1.1368	55020	Y
Driveway	0.39	0.900	0.3499	16933	Y
Sidewalk	0.18	0.900	0.1655	8012	N
Building	0.79	0.900	0.7084	34287	N
Landscape	1.66	0.220	0.3654	72347	N

	Total A	Comp "C"	Qpeak
Total Site	4.28	0.64	10.48
Connected Impervious	1.65	0.90	5.71

POND VOLUMES

Swale Number	208 Volume (cf)	Storage Volume (cf)
Basin A	730.25	1438
Basin B	584.5	1267
Basin C	1528.5	8512
Basin F	1243	7494
Basin H	175.5	853
Basin I	395.5	1812
Basin J	224.5	392
Baskin K	667.75	1097
Total	5549.50	22865.00

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	1.26	98	123.782
Driveway	0.39	98	38.095
Sidewalk	0.18	98	18.025
Building	0.79	98	77.138
Landscape	1.66	80	132.869

Total A	Comp "C"
4.28	91.02

P(50) = 2.2 in
S = 0.99
Total Runoff Depth(Q50) = 1.34 in
Total Storm Volume (V) = 20865 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: BASIN 2 (D+E)
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/29/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0000

Time of Conc. (min)			5.00
Area (Acres)			0.22
Composite "C"			0.61
208 Treated Area (acres)			0.11
Volume Provided		208:	422.25 Storm: 1562
Outflow (cfs)		***Seepage Ouflow Rate:***	***0.0050***
Area * C" Factor		**(assumed)**	0.14
Coef. of Intensity	m: 10.68		
	n: 0.635		

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.52	211	1.50	209
~~5~~	~~300~~	~~3.84~~	~~0.52~~	~~211~~	~~1.50~~	~~209~~
~~10~~	~~600~~	~~2.47~~	~~0.34~~	~~237~~	~~3.00~~	~~234~~
~~15~~	~~900~~	~~1.91~~	~~0.26~~	~~261~~	~~4.50~~	~~257~~
~~20~~	~~1200~~	~~1.59~~	~~0.22~~	~~283~~	~~6.00~~	~~277~~
~~25~~	~~1500~~	~~1.38~~	~~0.19~~	~~302~~	~~7.50~~	~~294~~
~~30~~	~~1800~~	~~1.23~~	~~0.17~~	~~319~~	~~9.00~~	~~310~~
~~35~~	~~2100~~	~~1.12~~	~~0.15~~	~~335~~	~~10.50~~	~~325~~
~~40~~	~~2400~~	~~1.03~~	~~0.14~~	~~350~~	~~12.00~~	~~338~~
~~45~~	~~2700~~	~~0.95~~	~~0.13~~	~~364~~	~~13.50~~	~~350~~
~~50~~	~~3000~~	~~0.89~~	~~0.12~~	~~377~~	~~15.00~~	~~362~~
~~55~~	~~3300~~	~~0.84~~	~~0.11~~	~~389~~	~~16.50~~	~~372~~
~~60~~	~~3600~~	~~0.79~~	~~0.11~~	~~400~~	~~18.00~~	~~382~~
~~65~~	~~3900~~	~~0.75~~	~~0.10~~	~~411~~	~~19.50~~	~~392~~
~~70~~	~~4200~~	~~0.72~~	~~0.10~~	~~422~~	~~21.00~~	~~401~~
~~75~~	~~4500~~	~~0.69~~	~~0.09~~	~~432~~	~~22.50~~	~~409~~
~~80~~	~~4800~~	~~0.66~~	~~0.09~~	~~441~~	~~24.00~~	~~417~~
~~85~~	~~5100~~	~~0.64~~	~~0.09~~	~~451~~	~~25.50~~	~~425~~
~~90~~	~~5400~~	~~0.61~~	~~0.08~~	~~460~~	~~27.00~~	~~433~~
~~95~~	~~5700~~	~~0.59~~	~~0.08~~	~~468~~	~~28.50~~	~~440~~
~~100~~	~~6000~~	~~0.57~~	~~0.08~~	~~477~~	~~30.00~~	~~447~~
~~600~~	~~36000~~	~~0.18~~	~~0.03~~	~~904~~	~~180.00~~	~~724~~
~~690~~	~~41400~~	~~0.17~~	~~0.02~~	~~951~~	~~207.00~~	~~744~~
~~695~~	~~41700~~	~~0.17~~	~~0.02~~	~~954~~	~~208.50~~	~~745~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~1855~~	~~1296.00~~	~~559~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~128~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~205~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~422.25~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 1046 cu. ft.
Provided: 1562 cu. ft. Excess Storage 515.31

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **58.12 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.22 Acres 9759 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.11	0.900	0.1017	4924	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.01	0.900	0.0134	648	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.10	0.220	0.0211	4187	N

	Total A	Comp "C"	Qpeak
Total Site	0.22	0.61	0.52
Connected Impervious	0.11	0.90	0.39

POND VOLUMES

Swale Number	208 Volume (cf)	Storage Volume (cf)
Basin D	292.25	518
Basin E	130	1044
Total	422.25	1561.53

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.11	98	11.078
Driveway	0.00	98	0.000
Sidewalk	0.01	98	1.458
Building	0.00	98	0.000
Landscape	0.10	80	7.690
	Total A	Comp "C"	
	0.22	90.28	

P(50) = 2.2 in
S = 1.08
Total Runoff Depth(Q50) = 1.29 in
Total Storm Volume (V) = 1046 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: Basin 3 (G)
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/29/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ ~~Orifice Outflow~~ ~~0~~
~~Exfiltration (cfs)~~ ~~0.3~~ ~~0.0000~~

Time of Conc. (min)			5.00		
Area (Acres)			0.27		
Composite "C"			0.54		
208 Treated Area (acres)			0.13		
Volume Provided		208:	273.5	Storm:	983
Outflow (cfs)		***Post-Dev Ouflow Rate:***	***0.0300***	0.03<0.97 therefore smaller post dev release	
Area * C" Factor		***(2-yr Pre-Dev =0.97)***	0.15		
Coef. of Intensity	m: 10.68				
	n: 0.635				

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.57	227	9.00	218
~~5~~	~~300~~	~~3.84~~	~~0.57~~	~~227~~	~~9.00~~	~~218~~
~~10~~	~~600~~	~~2.47~~	~~0.36~~	~~255~~	~~18.00~~	~~237~~
~~15~~	~~900~~	~~1.91~~	~~0.28~~	~~282~~	~~27.00~~	~~255~~
~~20~~	~~1200~~	~~1.59~~	~~0.23~~	~~305~~	~~36.00~~	~~269~~
~~25~~	~~1500~~	~~1.38~~	~~0.20~~	~~326~~	~~45.00~~	~~281~~
~~30~~	~~1800~~	~~1.23~~	~~0.18~~	~~345~~	~~54.00~~	~~291~~
~~35~~	~~2100~~	~~1.12~~	~~0.16~~	~~362~~	~~63.00~~	~~299~~
~~40~~	~~2400~~	~~1.03~~	~~0.15~~	~~378~~	~~72.00~~	~~306~~
~~45~~	~~2700~~	~~0.95~~	~~0.14~~	~~392~~	~~81.00~~	~~311~~
~~50~~	~~3000~~	~~0.89~~	~~0.13~~	~~406~~	~~90.00~~	~~316~~
~~55~~	~~3300~~	~~0.84~~	~~0.12~~	~~419~~	~~99.00~~	~~320~~
~~60~~	~~3600~~	~~0.79~~	~~0.12~~	~~432~~	~~108.00~~	~~324~~
~~65~~	~~3900~~	~~0.75~~	~~0.11~~	~~444~~	~~117.00~~	~~327~~
~~70~~	~~4200~~	~~0.72~~	~~0.11~~	~~455~~	~~126.00~~	~~329~~
~~75~~	~~4500~~	~~0.69~~	~~0.10~~	~~466~~	~~135.00~~	~~331~~
~~80~~	~~4800~~	~~0.66~~	~~0.10~~	~~476~~	~~144.00~~	~~332~~
~~85~~	~~5100~~	~~0.64~~	~~0.09~~	~~486~~	~~153.00~~	~~333~~
~~90~~	~~5400~~	~~0.61~~	~~0.09~~	~~496~~	~~162.00~~	~~334~~
~~95~~	~~5700~~	~~0.59~~	~~0.09~~	~~505~~	~~171.00~~	~~334~~
~~100~~	~~6000~~	~~0.57~~	~~0.08~~	~~515~~	~~180.00~~	~~335~~
~~600~~	~~36000~~	~~0.18~~	~~0.03~~	~~976~~	~~1080.00~~	~~-104~~
~~690~~	~~41400~~	~~0.17~~	~~0.02~~	~~1027~~	~~1242.00~~	~~-215~~
~~695~~	~~41700~~	~~0.17~~	~~0.02~~	~~1029~~	~~1251.00~~	~~-222~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~2001~~	~~7776.00~~	~~-5775~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~146~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~233~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~273.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 335 cu. ft.
Provided: 983 cu. ft. Excess Storage 648.49

Pre-Dev Volume = 4166 for 2 yr, 9846 for 25- year; We are releasing less than 2 and 25 yr for peak rate and volume

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **3.10 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **6.57 HRS**

CONTRIBUTING AREAS

Site 0.27 Acres 11818 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.11	0.900	0.0963	4662	Y
Driveway	0.02	0.900	0.0193	933	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.14	0.220	0.0314	6223	N

	Total A	Comp "C"	Qpeak
Total Site	0.27	0.54	0.57
Connected Impervious	0.13	0.90	0.44

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
G1	547	0.50	547	1.0	547	273.5	547
Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
G	82	6.5	2	6	40%	0	436.1
						273.5	983

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.11	98	10.488
Driveway	0.02	98	2.099
Sidewalk	0.00	98	0.000
Building	0.00	98	0.000
Landscape	0.14	80	11.429
	Total A	Comp "C"	
	0.27	88.52	

P(50) = 2.2 in
S = 1.30
Total Runoff Depth(Q50) = 1.16 in
Total Storm Volume (V) = 1146 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: Basin 4 (N)
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/29/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~	Orifice Outflow	1
~~Exfiltration (cfs)~~	~~0.3~~		0.0000

Time of Conc. (min)				5.00	
Area (Acres)				0.23	
Composite "C"				0.48	
208 Treated Area (acres)				0.09	
Volume Provided			208:	448.75	Storm: 996
Outflow (cfs)		***Seepage Ouflow Rate:***		***0.0050***	
Area * "C" Factor			**(assumed)**	0.11	
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.42	171	1.50	169
~~5~~	~~300~~	~~3.84~~	~~0.42~~	~~171~~	~~1.50~~	~~169~~
~~10~~	~~600~~	~~2.47~~	~~0.27~~	~~192~~	~~3.00~~	~~189~~
~~15~~	~~900~~	~~1.91~~	~~0.21~~	~~212~~	~~4.50~~	~~207~~
~~20~~	~~1200~~	~~1.59~~	~~0.18~~	~~229~~	~~6.00~~	~~223~~
~~25~~	~~1500~~	~~1.38~~	~~0.15~~	~~245~~	~~7.50~~	~~237~~
~~30~~	~~1800~~	~~1.23~~	~~0.14~~	~~259~~	~~9.00~~	~~250~~
~~35~~	~~2100~~	~~1.12~~	~~0.12~~	~~271~~	~~10.50~~	~~261~~
~~40~~	~~2400~~	~~1.03~~	~~0.11~~	~~283~~	~~12.00~~	~~271~~
~~45~~	~~2700~~	~~0.95~~	~~0.11~~	~~294~~	~~13.50~~	~~281~~
~~50~~	~~3000~~	~~0.89~~	~~0.10~~	~~305~~	~~15.00~~	~~290~~
~~55~~	~~3300~~	~~0.84~~	~~0.09~~	~~315~~	~~16.50~~	~~298~~
~~60~~	~~3600~~	~~0.79~~	~~0.09~~	~~324~~	~~18.00~~	~~306~~
~~65~~	~~3900~~	~~0.75~~	~~0.08~~	~~333~~	~~19.50~~	~~314~~
~~70~~	~~4200~~	~~0.72~~	~~0.08~~	~~342~~	~~21.00~~	~~321~~
~~75~~	~~4500~~	~~0.69~~	~~0.08~~	~~350~~	~~22.50~~	~~327~~
~~80~~	~~4800~~	~~0.66~~	~~0.07~~	~~358~~	~~24.00~~	~~334~~
~~85~~	~~5100~~	~~0.64~~	~~0.07~~	~~365~~	~~25.50~~	~~340~~
~~90~~	~~5400~~	~~0.61~~	~~0.07~~	~~372~~	~~27.00~~	~~345~~
~~95~~	~~5700~~	~~0.59~~	~~0.07~~	~~379~~	~~28.50~~	~~351~~
~~100~~	~~6000~~	~~0.57~~	~~0.06~~	~~386~~	~~30.00~~	~~356~~
~~600~~	~~36000~~	~~0.18~~	~~0.02~~	~~732~~	~~180.00~~	~~552~~
~~690~~	~~41400~~	~~0.17~~	~~0.02~~	~~771~~	~~207.00~~	~~564~~
~~695~~	~~41700~~	~~0.17~~	~~0.02~~	~~773~~	~~208.50~~	~~564~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~1502~~	~~1296.00~~	~~206~~

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~ ~~100~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~160~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~448.75~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 881 cu. ft.
Provided: 996 cu. ft. Excess Storage 114.64

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **48.94 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **48.94 HRS**

CONTRIBUTING AREAS

Site 0.23 Acres 9951 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.09	0.900	0.0795	3850	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.14	0.220	0.0308	6101	N

	Total A	Comp "C"	Qpeak
Total Site	0.23	0.48	0.42
Connected Impervious	0.09	0.90	0.31

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
Swale N	807	0.50	988	1.0	1184	448.75	995.5

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
						448.75	996

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.09	98	8.662
Driveway	0.00	98	0.000
Sidewalk	0.00	98	0.000
Building	0.00	98	0.000
Landscape	0.14	80	11.205
	Total A	Comp "C"	
	0.23	86.96	

P(50) = 2.2 in
S = 1.50
Total Runoff Depth(Q50) = 1.06 in
Total Storm Volume (V) = 881 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

POST DEVELOPMENT

CALCULATIONS

(INDIVIDUAL SUB-BASINS)

STORHAUG ENGINEERING
510 East Third, Spokane, Washington
Phone 509-242-1000 Fax 509-242-1001

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: A
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~ Orifice Outflow	1	
~~Exfiltration (cfs)~~	~~0.3~~	0.0196	

Time of Conc. (min)			5.00	
Area (Acres)			0.81	
Composite "C"			0.62	
208 Treated Area (acres)			0.25	
Volume Provided		208:	730.25	Storm: 1438
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***	
Area * "C" Factor			0.50	
Coef. of Intensity	m: 10.68			
	n: 0.635			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	1.93	774	5.88	768
~~5~~	~~300~~	~~3.84~~	~~1.93~~	~~774~~	~~5.88~~	~~768~~
~~10~~	~~600~~	~~2.47~~	~~1.24~~	~~870~~	~~11.76~~	~~858~~
~~15~~	~~900~~	~~1.91~~	~~0.96~~	~~960~~	~~17.65~~	~~943~~
~~20~~	~~1200~~	~~1.59~~	~~0.80~~	~~1039~~	~~23.53~~	~~1016~~
~~25~~	~~1500~~	~~1.38~~	~~0.69~~	~~1110~~	~~29.41~~	~~1080~~
~~30~~	~~1800~~	~~1.23~~	~~0.62~~	~~1174~~	~~35.29~~	~~1138~~
~~35~~	~~2100~~	~~1.12~~	~~0.56~~	~~1232~~	~~41.17~~	~~1191~~
~~40~~	~~2400~~	~~1.03~~	~~0.51~~	~~1286~~	~~47.05~~	~~1239~~
~~45~~	~~2700~~	~~0.95~~	~~0.48~~	~~1337~~	~~52.94~~	~~1284~~
~~50~~	~~3000~~	~~0.89~~	~~0.45~~	~~1384~~	~~58.82~~	~~1325~~
~~55~~	~~3300~~	~~0.84~~	~~0.42~~	~~1429~~	~~64.70~~	~~1364~~
~~60~~	~~3600~~	~~0.79~~	~~0.40~~	~~1471~~	~~70.58~~	~~1400~~
~~65~~	~~3900~~	~~0.75~~	~~0.38~~	~~1511~~	~~76.46~~	~~1435~~
~~70~~	~~4200~~	~~0.72~~	~~0.36~~	~~1550~~	~~82.35~~	~~1468~~
~~75~~	~~4500~~	~~0.69~~	~~0.34~~	~~1587~~	~~88.23~~	~~1499~~
~~80~~	~~4800~~	~~0.66~~	~~0.33~~	~~1623~~	~~94.11~~	~~1529~~
~~85~~	~~5100~~	~~0.64~~	~~0.32~~	~~1657~~	~~99.99~~	~~1557~~
~~90~~	~~5400~~	~~0.61~~	~~0.31~~	~~1690~~	~~105.87~~	~~1584~~
~~95~~	~~5700~~	~~0.59~~	~~0.30~~	~~1722~~	~~111.75~~	~~1610~~
~~100~~	~~6000~~	~~0.57~~	~~0.29~~	~~1753~~	~~117.64~~	~~1635~~
~~600~~	~~36000~~	~~0.18~~	~~0.09~~	~~3324~~	~~705.82~~	~~2619~~
~~690~~	~~41400~~	~~0.17~~	~~0.08~~	~~3497~~	~~811.69~~	~~2685~~
~~695~~	~~41700~~	~~0.17~~	~~0.08~~	~~3506~~	~~817.57~~	~~2689~~
4320	~~259200~~	~~0.05~~	~~0.03~~	~~6817~~	~~5081.87~~	~~1735~~

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.81 Acres 35326 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.25	0.900	0.2224	10765	Y
Driveway	0.01	0.900	0.0064	308	Y
Sidewalk	0.06	0.900	0.0563	2724	N
Building	0.16	0.900	0.1417	6860	N
Landscape	0.34	0.220	0.0741	14669	N

	Total A	Comp "C"	Qpeak
Total Site	0.81	0.62	1.93
Connected Impervious	0.25	0.90	0.88

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
A1	475	0.50	1310	0.5	1310	446.25	446.25
A2	150	0.50	336	0.5	336	121.5	121.5
A3	165	0.50	379	0.5	379	136	136
A4	25	0.50	81	0.5	81	26.5	26.5

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
A	410	1.57	2	12	40%	0	708.2
						730.25	1438

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.25	98	24.219
Driveway	0.01	98	0.693
Sidewalk	0.06	98	6.128
Building	0.16	98	15.433
Landscape	0.34	80	26.940

	Total A	Comp "C"
	0.81	90.53

P(50) = 2.2 in
S = 1.05
Total Runoff Depth(Q50) = 1.30 in
Total Storm Volume (V) = 3841 cf

*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~ ~~288~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~461~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~730.25~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 3841 cu. ft.
Provided: 1438 cu. ft. Excess Storage -2402.46 CF

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **54.42 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **44.38 HRS**

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: B
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~	Orifice Outflow	1
~~Exfiltration (cfs)~~	~~0.3~~		0.0196

Time of Conc. (min)			5.00		
Area (Acres)			0.27		
Composite "C"			0.54		
208 Treated Area (acres)			0.13		
Volume Provided		208:	584.5	Storm:	1267
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***		
Area * C" Factor			0.15		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.57	227	5.88	221
~~5~~	~~300~~	~~3.84~~	~~0.57~~	~~227~~	~~5.88~~	~~221~~
~~10~~	~~600~~	~~2.47~~	~~0.36~~	~~255~~	~~11.76~~	~~244~~
~~15~~	~~900~~	~~1.91~~	~~0.28~~	~~282~~	~~17.65~~	~~264~~
~~20~~	~~1200~~	~~1.59~~	~~0.23~~	~~305~~	~~23.53~~	~~282~~
~~25~~	~~1500~~	~~1.38~~	~~0.20~~	~~326~~	~~29.41~~	~~296~~
~~30~~	~~1800~~	~~1.23~~	~~0.18~~	~~345~~	~~35.29~~	~~309~~
~~35~~	~~2100~~	~~1.12~~	~~0.16~~	~~362~~	~~41.17~~	~~320~~
~~40~~	~~2400~~	~~1.03~~	~~0.15~~	~~378~~	~~47.05~~	~~330~~
~~45~~	~~2700~~	~~0.95~~	~~0.14~~	~~392~~	~~52.94~~	~~339~~
~~50~~	~~3000~~	~~0.89~~	~~0.13~~	~~406~~	~~58.82~~	~~347~~
~~55~~	~~3300~~	~~0.84~~	~~0.12~~	~~419~~	~~64.70~~	~~355~~
~~60~~	~~3600~~	~~0.79~~	~~0.12~~	~~432~~	~~70.58~~	~~361~~
~~65~~	~~3900~~	~~0.75~~	~~0.11~~	~~444~~	~~76.46~~	~~367~~
~~70~~	~~4200~~	~~0.72~~	~~0.11~~	~~455~~	~~82.35~~	~~373~~
~~75~~	~~4500~~	~~0.69~~	~~0.10~~	~~466~~	~~88.23~~	~~378~~
~~80~~	~~4800~~	~~0.66~~	~~0.10~~	~~476~~	~~94.11~~	~~382~~
~~85~~	~~5100~~	~~0.64~~	~~0.09~~	~~486~~	~~99.99~~	~~386~~
~~90~~	~~5400~~	~~0.61~~	~~0.09~~	~~496~~	~~105.87~~	~~390~~
~~95~~	~~5700~~	~~0.59~~	~~0.09~~	~~505~~	~~111.75~~	~~394~~
~~100~~	~~6000~~	~~0.57~~	~~0.08~~	~~515~~	~~117.64~~	~~397~~
~~600~~	~~36000~~	~~0.18~~	~~0.03~~	~~976~~	~~705.82~~	~~270~~
~~690~~	~~41400~~	~~0.17~~	~~0.02~~	~~1027~~	~~811.69~~	~~215~~
~~695~~	~~41700~~	~~0.17~~	~~0.02~~	~~1029~~	~~817.57~~	~~212~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~2001~~	~~5081.87~~	~~-3081~~

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~		~~146~~	~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~		~~233~~	~~cu. ft.~~
~~*Must meet SRSM soil requirements~~	~~Provided:~~	~~584.5~~	~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) =		1146	cu. ft.
	Provided:	1267	cu. ft.
	Excess Storage	121.04	

Time for disposal of Full Storm Event @ 0.0196 CFS	
Total Volume / Rate = Time >>>	**16.23 HRS**
Time for disposal of Surface Water (Volume above Pond)	
Volume of Pond / Rate = Time >>>	**6.57 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.27 Acres 11818 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.11	0.900	0.0963	4662	Y
Driveway	0.02	0.900	0.0193	933	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.14	0.220	0.0314	6223	N

	Total A	Comp "C"	Qpeak
Total Site	0.27	0.54	0.57
Connected Impervious	0.13	0.90	0.44

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
B1	230	0.50	583	0.5	583	203.25	203.25
B2	236	0.50	634	0.5	634	217.5	217.5
B3	89	0.50	195	0.5	195	71	71
B4	31	0.50	340	0.5	340	92.75	92.75

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
B	395	1.57	2	12	40%	0	682.3
						584.5	1267

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.11	98	10.488
Driveway	0.02	98	2.099
Sidewalk	0.00	98	0.000
Building	0.00	98	0.000
Landscape	0.14	80	11.429
	Total A	Comp "C"	
	0.27	88.52	

P(50) = 2.2 in
S = 1.30
Total Runoff Depth(Q50) = 1.16 in
Total Storm Volume (V) = 1146 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: C
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~	Orifice Outflow	1
~~Exfiltration (cfs)~~	~~0.3~~		0.0196

Time of Conc. (min)			5.00		
Area (Acres)			1.22		
Composite "C"			0.70		
208 Treated Area (acres)			0.52		
Volume Provided		208:	1528.5	Storm:	8512
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***		
Area * C" Factor			0.86		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	3.31	1330	5.88	1324
~~5~~	~~300~~	~~3.84~~	~~3.31~~	~~1330~~	~~5.88~~	~~1324~~
~~10~~	~~600~~	~~2.47~~	~~2.13~~	~~1495~~	~~11.76~~	~~1484~~
~~15~~	~~900~~	~~1.91~~	~~1.65~~	~~1650~~	~~17.65~~	~~1632~~
~~20~~	~~1200~~	~~1.59~~	~~1.37~~	~~1786~~	~~23.53~~	~~1763~~
~~25~~	~~1500~~	~~1.38~~	~~1.19~~	~~1907~~	~~29.41~~	~~1878~~
~~30~~	~~1800~~	~~1.23~~	~~1.06~~	~~2017~~	~~35.29~~	~~1982~~
~~35~~	~~2100~~	~~1.12~~	~~0.96~~	~~2117~~	~~41.17~~	~~2076~~
~~40~~	~~2400~~	~~1.03~~	~~0.88~~	~~2210~~	~~47.05~~	~~2163~~
~~45~~	~~2700~~	~~0.95~~	~~0.82~~	~~2297~~	~~52.94~~	~~2244~~
~~50~~	~~3000~~	~~0.89~~	~~0.77~~	~~2378~~	~~58.82~~	~~2319~~
~~55~~	~~3300~~	~~0.84~~	~~0.72~~	~~2455~~	~~64.70~~	~~2390~~
~~60~~	~~3600~~	~~0.79~~	~~0.68~~	~~2528~~	~~70.58~~	~~2457~~
~~65~~	~~3900~~	~~0.75~~	~~0.65~~	~~2597~~	~~76.46~~	~~2521~~
~~70~~	~~4200~~	~~0.72~~	~~0.62~~	~~2664~~	~~82.35~~	~~2581~~
~~75~~	~~4500~~	~~0.69~~	~~0.59~~	~~2727~~	~~88.23~~	~~2639~~
~~80~~	~~4800~~	~~0.66~~	~~0.57~~	~~2788~~	~~94.11~~	~~2694~~
~~85~~	~~5100~~	~~0.64~~	~~0.55~~	~~2847~~	~~99.99~~	~~2747~~
~~90~~	~~5400~~	~~0.61~~	~~0.53~~	~~2904~~	~~105.87~~	~~2798~~
~~95~~	~~5700~~	~~0.59~~	~~0.51~~	~~2959~~	~~111.75~~	~~2847~~
~~100~~	~~6000~~	~~0.57~~	~~0.49~~	~~3012~~	~~117.64~~	~~2895~~
~~600~~	~~36000~~	~~0.18~~	~~0.16~~	~~5713~~	~~705.82~~	~~5007~~
~~690~~	~~41400~~	~~0.17~~	~~0.14~~	~~6010~~	~~811.69~~	~~5198~~
~~695~~	~~41700~~	~~0.17~~	~~0.14~~	~~6025~~	~~817.57~~	~~5208~~
~~4320~~	~~259200~~	~~0.05~~	~~0.05~~	~~11714~~	~~5081.87~~	~~6633~~

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 1.22 Acres 53344 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.26	0.900	0.2377	11505	Y
Driveway	0.25	0.900	0.2263	10953	Y
Sidewalk	0.01	0.900	0.0113	548	N
Building	0.34	0.900	0.3073	14874	N
Landscape	0.36	0.220	0.0781	15464	N

	Total A	Comp "C"	Qpeak
Total Site	1.22	0.70	3.31
Connected Impervious	0.52	0.90	1.78

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
C1	1357	1.00	1700	2.8	1768	1528.5	4375
Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
C	98	21	5.00	8	40%	0	4136.5
						1528.5	8512

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

PEAK RUNOFF VOLUM	Areas (Ac.)	CN	A*C
Paved	0.26	98	25.884
Driveway	0.25	98	24.642
Sidewalk	0.01	98	1.233
Building	0.34	98	33.463
Landscape	0.36	80	28.400
	Total A	Comp "C"	
	1.22	92.78	

P(50) = 2.2 in
S = 0.78
Total Runoff Depth(Q50) = 1.48 in
Total Storm Volume (V) = 6583 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~584~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~936~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~1528.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 6583 cu. ft.
Provided: 8512 cu. ft. Excess Storage 1928.49

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **93.27 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **34.66 HRS**

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: D
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0196

Time of Conc. (min)			5.00		
Area (Acres)			0.12		
Composite "C"			0.50		
208 Treated Area (acres)			0.05		
Volume Provided		208:	292.25	Storm:	518
Outflow (cfs)		***Seepage Ouflow Rate:***	***0.0050***		
Area * "C" Factor		**(assumed)**	0.06		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.24	95	1.50	94
~~5~~	~~300~~	~~3.84~~	~~0.24~~	~~95~~	~~1.50~~	~~94~~
~~10~~	~~600~~	~~2.47~~	~~0.15~~	~~107~~	~~3.00~~	~~104~~
~~15~~	~~900~~	~~1.91~~	~~0.12~~	~~118~~	~~4.50~~	~~114~~
~~20~~	~~1200~~	~~1.59~~	~~0.10~~	~~128~~	~~6.00~~	~~122~~
~~25~~	~~1500~~	~~1.38~~	~~0.09~~	~~137~~	~~7.50~~	~~129~~
~~30~~	~~1800~~	~~1.23~~	~~0.08~~	~~144~~	~~9.00~~	~~135~~
~~35~~	~~2100~~	~~1.12~~	~~0.07~~	~~152~~	~~10.50~~	~~141~~
~~40~~	~~2400~~	~~1.03~~	~~0.06~~	~~158~~	~~12.00~~	~~146~~
~~45~~	~~2700~~	~~0.95~~	~~0.06~~	~~164~~	~~13.50~~	~~151~~
~~50~~	~~3000~~	~~0.89~~	~~0.05~~	~~170~~	~~15.00~~	~~155~~
~~55~~	~~3300~~	~~0.84~~	~~0.05~~	~~176~~	~~16.50~~	~~159~~
~~60~~	~~3600~~	~~0.79~~	~~0.05~~	~~181~~	~~18.00~~	~~163~~
~~65~~	~~3900~~	~~0.75~~	~~0.05~~	~~186~~	~~19.50~~	~~166~~
~~70~~	~~4200~~	~~0.72~~	~~0.04~~	~~191~~	~~21.00~~	~~170~~
~~75~~	~~4500~~	~~0.69~~	~~0.04~~	~~195~~	~~22.50~~	~~173~~
~~80~~	~~4800~~	~~0.66~~	~~0.04~~	~~200~~	~~24.00~~	~~176~~
~~85~~	~~5100~~	~~0.64~~	~~0.04~~	~~204~~	~~25.50~~	~~178~~
~~90~~	~~5400~~	~~0.61~~	~~0.04~~	~~208~~	~~27.00~~	~~181~~
~~95~~	~~5700~~	~~0.59~~	~~0.04~~	~~212~~	~~28.50~~	~~183~~
~~100~~	~~6000~~	~~0.57~~	~~0.04~~	~~216~~	~~30.00~~	~~186~~
~~600~~	~~36000~~	~~0.18~~	~~0.01~~	~~409~~	~~180.00~~	~~229~~
~~690~~	~~41400~~	~~0.17~~	~~0.01~~	~~430~~	~~207.00~~	~~223~~
~~695~~	~~41700~~	~~0.17~~	~~0.01~~	~~431~~	~~208.50~~	~~223~~
~~4320~~	~~259200~~	~~0.05~~	~~0.00~~	~~839~~	~~1296.00~~	~~-457~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~58~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~93~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~292.25~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 487 cu. ft.
Provided: 518 cu. ft. Excess Storage 30.55

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **27.06 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **14.54 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.12 Acres 5326 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.05	0.900	0.0460	2224	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.07	0.220	0.0157	3102	N

	Total A	Comp "C"	Qpeak
Total Site	0.12	0.50	0.24
Connected Impervious	0.05	0.90	0.18

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
D1	158	0.50	373	0.5	373	132.75	132.75
D2	78	0.50	200	0.5	200	69.5	69.5
D3	63	0.50	184	0.5	184	61.75	61.75
D4	20	0.50	93	0.5	93	28.25	28.25

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
D	164	1.57	2	6	40%	0	225.3
						292.25	518

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.05	98	5.003
Driveway	0.00	98	0.000
Sidewalk	0.00	98	0.000
Building	0.00	98	0.000
Landscape	0.07	80	5.697
	Total A	Comp "C"	
	0.12	87.52	

P(50) = 2.2 in
S = 1.43
Total Runoff Depth(Q50) = 1.10 in
Total Storm Volume (V) = 487 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: E
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0196

Time of Conc. (min)			5.00		
Area (Acres)			0.10		
Composite "C"			0.73		
208 Treated Area (acres)			0.06		
Volume Provided		208:	130	Storm:	1044
Outflow (cfs)		***Seepage Ouflow Rate:***	***0.0050***		
Area * "C" Factor		**(assumed)**	0.07		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.29	115	1.50	114
~~5~~	~~300~~	~~3.84~~	~~0.29~~	~~115~~	~~1.50~~	~~114~~
~~10~~	~~600~~	~~2.47~~	~~0.18~~	~~130~~	~~3.00~~	~~127~~
~~15~~	~~900~~	~~1.91~~	~~0.14~~	~~143~~	~~4.50~~	~~139~~
~~20~~	~~1200~~	~~1.59~~	~~0.12~~	~~155~~	~~6.00~~	~~149~~
~~25~~	~~1500~~	~~1.38~~	~~0.10~~	~~165~~	~~7.50~~	~~158~~
~~30~~	~~1800~~	~~1.23~~	~~0.09~~	~~175~~	~~9.00~~	~~166~~
~~35~~	~~2100~~	~~1.12~~	~~0.08~~	~~184~~	~~10.50~~	~~173~~
~~40~~	~~2400~~	~~1.03~~	~~0.08~~	~~192~~	~~12.00~~	~~180~~
~~45~~	~~2700~~	~~0.95~~	~~0.07~~	~~199~~	~~13.50~~	~~186~~
~~50~~	~~3000~~	~~0.89~~	~~0.07~~	~~206~~	~~15.00~~	~~191~~
~~55~~	~~3300~~	~~0.84~~	~~0.06~~	~~213~~	~~16.50~~	~~196~~
~~60~~	~~3600~~	~~0.79~~	~~0.06~~	~~219~~	~~18.00~~	~~201~~
~~65~~	~~3900~~	~~0.75~~	~~0.06~~	~~225~~	~~19.50~~	~~206~~
~~70~~	~~4200~~	~~0.72~~	~~0.05~~	~~231~~	~~21.00~~	~~210~~
~~75~~	~~4500~~	~~0.69~~	~~0.05~~	~~237~~	~~22.50~~	~~214~~
~~80~~	~~4800~~	~~0.66~~	~~0.05~~	~~242~~	~~24.00~~	~~218~~
~~85~~	~~5100~~	~~0.64~~	~~0.05~~	~~247~~	~~25.50~~	~~221~~
~~90~~	~~5400~~	~~0.61~~	~~0.05~~	~~252~~	~~27.00~~	~~225~~
~~95~~	~~5700~~	~~0.59~~	~~0.04~~	~~257~~	~~28.50~~	~~228~~
~~100~~	~~6000~~	~~0.57~~	~~0.04~~	~~261~~	~~30.00~~	~~231~~
~~600~~	~~36000~~	~~0.18~~	~~0.01~~	~~495~~	~~180.00~~	~~315~~
~~690~~	~~41400~~	~~0.17~~	~~0.01~~	~~521~~	~~207.00~~	~~314~~
~~695~~	~~41700~~	~~0.17~~	~~0.01~~	~~523~~	~~208.50~~	~~314~~
~~4320~~	~~259200~~	~~0.05~~	~~0.00~~	~~1016~~	~~1296.00~~	~~-280~~

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~ ~~70~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~113~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~130~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 572 cu. ft.
Provided: 1044 cu. ft. Excess Storage 471.68

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **31.79 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **-18.98 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.10 Acres 4433 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.06	0.900	0.0558	2700	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.01	0.900	0.0134	648	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.02	0.220	0.0055	1085	N

	Total A	Comp "C"	Qpeak
Total Site	0.10	0.73	0.29
Connected Impervious	0.06	0.90	0.21

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
E1	47	0.50	113	0.5	113	40	40
E2	63	0.50	184	0.5	184	61.75	61.75
E3	20	0.50	93	0.5	93	28.25	28.25

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
E	55	15	2.75	6	40%	0	914.0
						130	1044

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.06	98	6.074
Driveway	0.00	98	0.000
Sidewalk	0.01	98	1.458
Building	0.00	98	0.000
Landscape	0.02	80	1.993

	Total A	Comp "C"
	0.10	93.59

P(50) = 2.2 in
S = 0.68
Total Runoff Depth(Q50) = 1.55 in
Total Storm Volume (V) = 572 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: F
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0196

Time of Conc. (min)			5.00	
Area (Acres)			1.09	
Composite "C"			0.61	
208 Treated Area (acres)			0.34	
Volume Provided		208:	1243	Storm: 7494
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***	
Area * C" Factor			0.66	
Coef. of Intensity	m: 10.68			
	n: 0.635			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	2.55	1026	5.88	1020
~~5~~	~~300~~	~~3.84~~	~~2.55~~	~~1026~~	~~5.88~~	~~1020~~
~~10~~	~~600~~	~~2.47~~	~~1.64~~	~~1154~~	~~11.76~~	~~1142~~
~~15~~	~~900~~	~~1.91~~	~~1.27~~	~~1273~~	~~17.65~~	~~1255~~
~~20~~	~~1200~~	~~1.59~~	~~1.06~~	~~1378~~	~~23.53~~	~~1354~~
~~25~~	~~1500~~	~~1.38~~	~~0.92~~	~~1472~~	~~29.41~~	~~1442~~
~~30~~	~~1800~~	~~1.23~~	~~0.82~~	~~1556~~	~~35.29~~	~~1521~~
~~35~~	~~2100~~	~~1.12~~	~~0.74~~	~~1634~~	~~41.17~~	~~1592~~
~~40~~	~~2400~~	~~1.03~~	~~0.68~~	~~1705~~	~~47.05~~	~~1658~~
~~45~~	~~2700~~	~~0.95~~	~~0.63~~	~~1772~~	~~52.94~~	~~1719~~
~~50~~	~~3000~~	~~0.89~~	~~0.59~~	~~1835~~	~~58.82~~	~~1776~~
~~55~~	~~3300~~	~~0.84~~	~~0.56~~	~~1894~~	~~64.70~~	~~1829~~
~~60~~	~~3600~~	~~0.79~~	~~0.53~~	~~1950~~	~~70.58~~	~~1880~~
~~65~~	~~3900~~	~~0.75~~	~~0.50~~	~~2004~~	~~76.46~~	~~1927~~
~~70~~	~~4200~~	~~0.72~~	~~0.48~~	~~2055~~	~~82.35~~	~~1973~~
~~75~~	~~4500~~	~~0.69~~	~~0.46~~	~~2104~~	~~88.23~~	~~2016~~
~~80~~	~~4800~~	~~0.66~~	~~0.44~~	~~2151~~	~~94.11~~	~~2057~~
~~85~~	~~5100~~	~~0.64~~	~~0.42~~	~~2197~~	~~99.99~~	~~2097~~
~~90~~	~~5400~~	~~0.61~~	~~0.41~~	~~2241~~	~~105.87~~	~~2135~~
~~95~~	~~5700~~	~~0.59~~	~~0.39~~	~~2283~~	~~111.75~~	~~2171~~
~~100~~	~~6000~~	~~0.57~~	~~0.38~~	~~2324~~	~~117.64~~	~~2207~~
~~600~~	~~36000~~	~~0.18~~	~~0.12~~	~~4408~~	~~705.82~~	~~3702~~
~~690~~	~~41400~~	~~0.17~~	~~0.11~~	~~4637~~	~~811.69~~	~~3825~~
~~695~~	~~41700~~	~~0.17~~	~~0.11~~	~~4649~~	~~817.57~~	~~3831~~
~~4320~~	~~259200~~	~~0.05~~	~~0.03~~	~~9038~~	~~5081.87~~	~~3956~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~381~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~610~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~1243~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 5097 cu. ft.
Provided: 7494 cu. ft. Excess Storage 2397.52

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **72.21 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **1.25 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 1.09 Acres 47364 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.29	0.900	0.2618	12669	Y
Driveway	0.05	0.900	0.0408	1975	Y
Sidewalk	0.07	0.900	0.0674	3262	N
Building	0.21	0.900	0.1924	9311	N
Landscape	0.46	0.220	0.1018	20147	N

	Total A	Comp "C"	Qpeak
Total Site	1.09	0.61	2.55
Connected Impervious	0.34	0.90	1.16

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
F1	2486	0.50	2486	1.0	2486	1243	2486
Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
F	78	32	5.00	8	40%	0	5008.3
						1243	7494

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

PEAK RUNOFF VOLUM	Areas (Ac.)	CN	A*C
Paved	0.29	98	28.502
Driveway	0.05	98	4.443
Sidewalk	0.07	98	7.339
Building	0.21	98	20.948
Landscape	0.46	80	37.001
	Total A	Comp "C"	
	1.09	90.34	

P(50) = 2.2 in
S = 1.07
Total Runoff Depth(Q50) = 1.29 in
Total Storm Volume (V) = 5097 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: G
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ ~~Orifice Outflow~~ ~~0~~
~~Exfiltration (cfs)~~ ~~0.3~~ ~~0.0196~~

Time of Conc. (min)			5.00		
Area (Acres)			0.30		
Composite "C"			0.77		
208 Treated Area (acres)			0.19		
Volume Provided		208:	273.5	Storm:	983
Outflow (cfs)		***Post-Dev Ouflow Rate:***	***0.0300***	0.03<0.97 therefore smaller post dev release	
Area * C" Factor		***(2-yr Pre-Dev =0.97)***	0.23		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.88	353	9.00	344
~~5~~	~~300~~	~~3.84~~	~~0.88~~	~~353~~	~~9.00~~	~~344~~
~~10~~	~~600~~	~~2.47~~	~~0.57~~	~~397~~	~~18.00~~	~~379~~
~~15~~	~~900~~	~~1.91~~	~~0.44~~	~~438~~	~~27.00~~	~~411~~
~~20~~	~~1200~~	~~1.59~~	~~0.36~~	~~474~~	~~36.00~~	~~438~~
~~25~~	~~1500~~	~~1.38~~	~~0.32~~	~~507~~	~~45.00~~	~~462~~
~~30~~	~~1800~~	~~1.23~~	~~0.28~~	~~536~~	~~54.00~~	~~482~~
~~35~~	~~2100~~	~~1.12~~	~~0.26~~	~~562~~	~~63.00~~	~~499~~
~~40~~	~~2400~~	~~1.03~~	~~0.23~~	~~587~~	~~72.00~~	~~515~~
~~45~~	~~2700~~	~~0.95~~	~~0.22~~	~~610~~	~~81.00~~	~~529~~
~~50~~	~~3000~~	~~0.89~~	~~0.20~~	~~632~~	~~90.00~~	~~542~~
~~55~~	~~3300~~	~~0.84~~	~~0.19~~	~~652~~	~~99.00~~	~~553~~
~~60~~	~~3600~~	~~0.79~~	~~0.18~~	~~671~~	~~108.00~~	~~563~~
~~65~~	~~3900~~	~~0.75~~	~~0.17~~	~~690~~	~~117.00~~	~~573~~
~~70~~	~~4200~~	~~0.72~~	~~0.16~~	~~708~~	~~126.00~~	~~582~~
~~75~~	~~4500~~	~~0.69~~	~~0.16~~	~~724~~	~~135.00~~	~~589~~
~~80~~	~~4800~~	~~0.66~~	~~0.15~~	~~741~~	~~144.00~~	~~597~~
~~85~~	~~5100~~	~~0.64~~	~~0.15~~	~~756~~	~~153.00~~	~~603~~
~~90~~	~~5400~~	~~0.61~~	~~0.14~~	~~771~~	~~162.00~~	~~609~~
~~95~~	~~5700~~	~~0.59~~	~~0.14~~	~~786~~	~~171.00~~	~~615~~
~~100~~	~~6000~~	~~0.57~~	~~0.13~~	~~800~~	~~180.00~~	~~620~~
~~600~~	~~36000~~	~~0.18~~	~~0.04~~	~~1517~~	~~1080.00~~	~~437~~
~~690~~	~~41400~~	~~0.17~~	~~0.04~~	~~1596~~	~~1242.00~~	~~354~~
~~695~~	~~41700~~	~~0.17~~	~~0.04~~	~~1600~~	~~1251.00~~	~~349~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~3112~~	~~7776.00~~	~~-4664~~

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

208 SWALE POND CALCULATIONS

~~*Volume Required [cf] = 1133*A~~ ~~215~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~345~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~273.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 620 cu. ft.
Provided: 983 cu. ft. Excess Storage 362.92

Pre-Dev Volume = 4166 for 2 yr, 9846 for 25- year; We are releasing less than 2 and 25 yr for peak rate and volume

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **5.74 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **12.26 HRS**

CONTRIBUTING AREAS

Site 0.30 Acres 13005 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.17	0.900	0.1539	7451	Y
Driveway	0.02	0.900	0.0172	832	Y
Sidewalk	0.02	0.900	0.0196	950	N
Building	0.03	0.900	0.0249	1205	N
Landscape	0.06	0.220	0.0130	2567	N

	Total A	Comp "C"	Qpeak
Total Site	0.30	0.77	0.88
Connected Impervious	0.19	0.90	0.66

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
G1	547	0.50	547	1.0	547	273.5	547
Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
G	82	6.5	2	6	40%	0	436.1
						273.5	983

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.17	98	16.763
Driveway	0.02	98	1.872
Sidewalk	0.02	98	2.137
Building	0.03	98	2.711
Landscape	0.06	80	4.714
	Total A	Comp "C"	
	0.30	94.45	

P(50) = 2.2 in
S = 0.59
Total Runoff Depth(Q50) = 1.62 in
Total Storm Volume (V) = 1760 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: H
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0196

Time of Conc. (min)			5.00	
Area (Acres)			0.26	
Composite "C"			0.52	
208 Treated Area (acres)			0.08	
Volume Provided		208:	175.5	Storm: 853
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***	
Area * C" Factor			0.14	
Coef. of Intensity	m: 10.68			
	n: 0.635			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.52	210	5.88	204
~~5~~	~~300~~	~~3.84~~	~~0.52~~	~~210~~	~~5.88~~	~~204~~
~~10~~	~~600~~	~~2.47~~	~~0.34~~	~~236~~	~~11.76~~	~~224~~
~~15~~	~~900~~	~~1.91~~	~~0.26~~	~~260~~	~~17.65~~	~~242~~
~~20~~	~~1200~~	~~1.59~~	~~0.22~~	~~282~~	~~23.53~~	~~258~~
~~25~~	~~1500~~	~~1.38~~	~~0.19~~	~~301~~	~~29.41~~	~~271~~
~~30~~	~~1800~~	~~1.23~~	~~0.17~~	~~318~~	~~35.29~~	~~283~~
~~35~~	~~2100~~	~~1.12~~	~~0.15~~	~~334~~	~~41.17~~	~~293~~
~~40~~	~~2400~~	~~1.03~~	~~0.14~~	~~348~~	~~47.05~~	~~301~~
~~45~~	~~2700~~	~~0.95~~	~~0.13~~	~~362~~	~~52.94~~	~~309~~
~~50~~	~~3000~~	~~0.89~~	~~0.12~~	~~375~~	~~58.82~~	~~316~~
~~55~~	~~3300~~	~~0.84~~	~~0.11~~	~~387~~	~~64.70~~	~~322~~
~~60~~	~~3600~~	~~0.79~~	~~0.11~~	~~399~~	~~70.58~~	~~328~~
~~65~~	~~3900~~	~~0.75~~	~~0.10~~	~~409~~	~~76.46~~	~~333~~
~~70~~	~~4200~~	~~0.72~~	~~0.10~~	~~420~~	~~82.35~~	~~338~~
~~75~~	~~4500~~	~~0.69~~	~~0.09~~	~~430~~	~~88.23~~	~~342~~
~~80~~	~~4800~~	~~0.66~~	~~0.09~~	~~440~~	~~94.11~~	~~346~~
~~85~~	~~5100~~	~~0.64~~	~~0.09~~	~~449~~	~~99.99~~	~~349~~
~~90~~	~~5400~~	~~0.61~~	~~0.08~~	~~458~~	~~105.87~~	~~352~~
~~95~~	~~5700~~	~~0.59~~	~~0.08~~	~~467~~	~~111.75~~	~~355~~
~~100~~	~~6000~~	~~0.57~~	~~0.08~~	~~475~~	~~117.64~~	~~357~~
~~600~~	~~36000~~	~~0.18~~	~~0.02~~	~~901~~	~~705.82~~	~~195~~
~~690~~	~~41400~~	~~0.17~~	~~0.02~~	~~947~~	~~811.69~~	~~136~~
~~695~~	~~41700~~	~~0.17~~	~~0.02~~	~~950~~	~~817.57~~	~~132~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~1847~~	~~5081.87~~	~~-3235~~

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.26 Acres 11387 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.05	0.900	0.0471	2280	Y
Driveway	0.02	0.900	0.0225	1088	Y
Sidewalk	0.01	0.900	0.0115	559	N
Building	0.02	0.900	0.0224	1082	N
Landscape	0.15	0.220	0.0322	6378	N

	Total A	Comp "C"	Qpeak
Total Site	0.26	0.52	0.52
Connected Impervious	0.08	0.90	0.27

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
H1	295	0.50	407	1.0	538	175.5	416.5
Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
H	22.5	24.0	2	8	40%	0	436.7
						175.5	853

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

PEAK RUNOFF VOLUM	Areas (Ac.)	CN	A*C
Paved	0.05	98	5.129
Driveway	0.02	98	2.448
Sidewalk	0.01	98	1.258
Building	0.02	98	2.434
Landscape	0.15	80	11.713
	Total A	Comp "C"	
	0.26	87.92	

P(50) = 2.2 in
S = 1.37
Total Runoff Depth(Q50) = 1.12 in
Total Storm Volume (V) = 1066 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

208 SWALE POND CALCULATIONS

~~*Volume Required [cf] = 1133*A~~ ~~88~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~140~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~175.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 1066 cu. ft.
Provided: 853 cu. ft. Excess Storage -212.71

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **15.10 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **8.91 HRS**

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: I
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0196

Time of Conc. (min)			5.00	
Area (Acres)			0.30	
Composite "C"			0.70	
208 Treated Area (acres)			0.15	
Volume Provided		208:	395.5	Storm: 1812
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***	
Area * C" Factor			0.21	
Coef. of Intensity	m: 10.68			
	n: 0.635			

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.82	331	5.88	325
~~5~~	~~300~~	~~3.84~~	~~0.82~~	~~331~~	~~5.88~~	~~325~~
~~10~~	~~600~~	~~2.47~~	~~0.53~~	~~372~~	~~11.76~~	~~360~~
~~15~~	~~900~~	~~1.91~~	~~0.41~~	~~410~~	~~17.65~~	~~393~~
~~20~~	~~1200~~	~~1.59~~	~~0.34~~	~~444~~	~~23.53~~	~~421~~
~~25~~	~~1500~~	~~1.38~~	~~0.30~~	~~474~~	~~29.41~~	~~445~~
~~30~~	~~1800~~	~~1.23~~	~~0.26~~	~~502~~	~~35.29~~	~~466~~
~~35~~	~~2100~~	~~1.12~~	~~0.24~~	~~527~~	~~41.17~~	~~486~~
~~40~~	~~2400~~	~~1.03~~	~~0.22~~	~~550~~	~~47.05~~	~~503~~
~~45~~	~~2700~~	~~0.95~~	~~0.20~~	~~571~~	~~52.94~~	~~518~~
~~50~~	~~3000~~	~~0.89~~	~~0.19~~	~~592~~	~~58.82~~	~~533~~
~~55~~	~~3300~~	~~0.84~~	~~0.18~~	~~611~~	~~64.70~~	~~546~~
~~60~~	~~3600~~	~~0.79~~	~~0.17~~	~~629~~	~~70.58~~	~~558~~
~~65~~	~~3900~~	~~0.75~~	~~0.16~~	~~646~~	~~76.46~~	~~570~~
~~70~~	~~4200~~	~~0.72~~	~~0.15~~	~~663~~	~~82.35~~	~~580~~
~~75~~	~~4500~~	~~0.69~~	~~0.15~~	~~678~~	~~88.23~~	~~590~~
~~80~~	~~4800~~	~~0.66~~	~~0.14~~	~~694~~	~~94.11~~	~~600~~
~~85~~	~~5100~~	~~0.64~~	~~0.14~~	~~708~~	~~99.99~~	~~608~~
~~90~~	~~5400~~	~~0.61~~	~~0.13~~	~~722~~	~~105.87~~	~~617~~
~~95~~	~~5700~~	~~0.59~~	~~0.13~~	~~736~~	~~111.75~~	~~624~~
~~100~~	~~6000~~	~~0.57~~	~~0.12~~	~~749~~	~~117.64~~	~~632~~
~~600~~	~~36000~~	~~0.18~~	~~0.04~~	~~1421~~	~~705.82~~	~~715~~
~~690~~	~~41400~~	~~0.17~~	~~0.04~~	~~1495~~	~~811.69~~	~~683~~
~~695~~	~~41700~~	~~0.17~~	~~0.04~~	~~1499~~	~~817.57~~	~~681~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~2914~~	~~5081.87~~	~~-2168~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~165~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~265~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~395.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 1638 cu. ft.
Provided: 1812 cu. ft. Excess Storage 173.74

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **23.20 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **8.75 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.30 Acres 13247 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.11	0.900	0.0966	4676	Y
Driveway	0.04	0.900	0.0346	1676	Y
Sidewalk	0.02	0.900	0.0190	919	N
Building	0.05	0.900	0.0446	2160	N
Landscape	0.09	0.220	0.0193	3816	N

	Total A	Comp "C"	Qpeak
Total Site	0.30	0.70	0.82
Connected Impervious	0.15	0.90	0.50

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
I1	791	0.50	791	1.0	791	395.5	791
	Length	Width	Depth	Pipe Dia	Voids		
Gallery	(ft)	(ft)	(ft)	(in)	%		
I	79	16.0	2	6	40%	0	1020.5
						395.5	1812

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

PEAK RUNOFF VOLUM	Areas (Ac.)	CN	A*C
Paved	0.11	98	10.520
Driveway	0.04	98	3.771
Sidewalk	0.02	98	2.068
Building	0.05	98	4.860
Landscape	0.09	80	7.008
	Total A	Comp "C"	
	0.30	92.81	

P(50) = 2.2 in
S = 0.77
Total Runoff Depth(Q50) = 1.48 in
Total Storm Volume (V) = 1638 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: J
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~	Orifice Outflow	1
~~Exfiltration (cfs)~~	~~0.3~~		0.0196

Time of Conc. (min)			5.00		
Area (Acres)			0.08		
Composite "C"			0.51		
208 Treated Area (acres)			0.03		
Volume Provided		208:	224.5	Storm:	392
Outflow (cfs)	***Orifice Allowable Ouflow Rate:***		***0.0196***		
Area * C" Factor			0.04		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.15	61	5.88	55
~~5~~	~~300~~	~~3.84~~	~~0.15~~	~~61~~	~~5.88~~	~~55~~
~~10~~	~~600~~	~~2.47~~	~~0.10~~	~~68~~	~~11.76~~	~~57~~
~~15~~	~~900~~	~~1.91~~	~~0.08~~	~~75~~	~~17.65~~	~~58~~
~~20~~	~~1200~~	~~1.59~~	~~0.06~~	~~82~~	~~23.53~~	~~58~~
~~25~~	~~1500~~	~~1.38~~	~~0.05~~	~~87~~	~~29.41~~	~~58~~
~~30~~	~~1800~~	~~1.23~~	~~0.05~~	~~92~~	~~35.29~~	~~57~~
~~35~~	~~2100~~	~~1.12~~	~~0.04~~	~~97~~	~~41.17~~	~~56~~
~~40~~	~~2400~~	~~1.03~~	~~0.04~~	~~101~~	~~47.05~~	~~54~~
~~45~~	~~2700~~	~~0.95~~	~~0.04~~	~~105~~	~~52.94~~	~~52~~
~~50~~	~~3000~~	~~0.89~~	~~0.04~~	~~109~~	~~58.82~~	~~50~~
~~55~~	~~3300~~	~~0.84~~	~~0.03~~	~~112~~	~~64.70~~	~~47~~
~~60~~	~~3600~~	~~0.79~~	~~0.03~~	~~115~~	~~70.58~~	~~45~~
~~65~~	~~3900~~	~~0.75~~	~~0.03~~	~~119~~	~~76.46~~	~~42~~
~~70~~	~~4200~~	~~0.72~~	~~0.03~~	~~122~~	~~82.35~~	~~39~~
~~75~~	~~4500~~	~~0.69~~	~~0.03~~	~~125~~	~~88.23~~	~~36~~
~~80~~	~~4800~~	~~0.66~~	~~0.03~~	~~127~~	~~94.11~~	~~33~~
~~85~~	~~5100~~	~~0.64~~	~~0.03~~	~~130~~	~~99.99~~	~~30~~
~~90~~	~~5400~~	~~0.61~~	~~0.02~~	~~133~~	~~105.87~~	~~27~~
~~95~~	~~5700~~	~~0.59~~	~~0.02~~	~~135~~	~~111.75~~	~~23~~
~~100~~	~~6000~~	~~0.57~~	~~0.02~~	~~138~~	~~117.64~~	~~20~~
~~600~~	~~36000~~	~~0.18~~	~~0.01~~	~~261~~	~~705.82~~	~~-445~~
~~690~~	~~41400~~	~~0.17~~	~~0.01~~	~~275~~	~~811.69~~	~~-537~~
~~695~~	~~41700~~	~~0.17~~	~~0.01~~	~~275~~	~~817.57~~	~~-542~~
~~4320~~	~~259200~~	~~0.05~~	~~0.00~~	~~535~~	~~5081.87~~	~~-4547~~

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.08 Acres 3341 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.03	0.900	0.0297	1438	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.04	0.220	0.0096	1903	N

	Total A	Comp "C"	Qpeak
Total Site	0.08	0.51	0.15
Connected Impervious	0.03	0.90	0.11

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
J1	295	0.50	603	0.5	603	224.5	224.5
	Length	Width	Depth	Pipe Dia	Voids		
Gallery	(ft)	(ft)	(ft)	(in)	%		
J	97	1.57	2	12	40%	0	167.5
						224.5	392

PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

PEAK RUNOFF VOLUM	Areas (Ac.)	CN	A*C
Paved	0.03	98	3.235
Driveway	0.00	98	0.000
Sidewalk	0.00	98	0.000
Building	0.00	98	0.000
Landscape	0.04	80	3.495
	Total A	Comp "C"	
	0.08	87.75	

P(50) = 2.2 in
S = 1.40
Total Runoff Depth(Q50) = 1.11 in
Total Storm Volume (V) = 310 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

~~208 SWALE POND CALCULATIONS~~

~~*Volume Required [cf] = 1133*A~~ ~~37~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~60~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~224.5~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 310 cu. ft.
Provided: 392 cu. ft. Excess Storage 82.39

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **4.39 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **2.01 HRS**

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: E
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/23/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 0
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0196

Time of Conc. (min)			5.00
Area (Acres)			0.10
Composite "C"			0.73
208 Treated Area (acres)			0.06
Volume Provided		208:	667.75 Storm: 668
Outflow (cfs)	***Seepage Outflow Rate:***		***0.0050***
Area * C" Factor		**(assumed)**	0.07
Coef. of Intensity	m: 10.68		
	n: 0.635		

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.29	115	1.50	114
~~5~~	~~300~~	~~3.84~~	~~0.29~~	~~115~~	~~1.50~~	~~114~~
~~10~~	~~600~~	~~2.47~~	~~0.18~~	~~130~~	~~3.00~~	~~127~~
~~15~~	~~900~~	~~1.91~~	~~0.14~~	~~143~~	~~4.50~~	~~139~~
~~20~~	~~1200~~	~~1.59~~	~~0.12~~	~~155~~	~~6.00~~	~~149~~
~~25~~	~~1500~~	~~1.38~~	~~0.10~~	~~165~~	~~7.50~~	~~158~~
~~30~~	~~1800~~	~~1.23~~	~~0.09~~	~~175~~	~~9.00~~	~~166~~
~~35~~	~~2100~~	~~1.12~~	~~0.08~~	~~184~~	~~10.50~~	~~173~~
~~40~~	~~2400~~	~~1.03~~	~~0.08~~	~~192~~	~~12.00~~	~~180~~
~~45~~	~~2700~~	~~0.95~~	~~0.07~~	~~199~~	~~13.50~~	~~186~~
~~50~~	~~3000~~	~~0.89~~	~~0.07~~	~~206~~	~~15.00~~	~~191~~
~~55~~	~~3300~~	~~0.84~~	~~0.06~~	~~213~~	~~16.50~~	~~196~~
~~60~~	~~3600~~	~~0.79~~	~~0.06~~	~~219~~	~~18.00~~	~~201~~
~~65~~	~~3900~~	~~0.75~~	~~0.06~~	~~225~~	~~19.50~~	~~206~~
~~70~~	~~4200~~	~~0.72~~	~~0.05~~	~~231~~	~~21.00~~	~~210~~
~~75~~	~~4500~~	~~0.69~~	~~0.05~~	~~237~~	~~22.50~~	~~214~~
~~80~~	~~4800~~	~~0.66~~	~~0.05~~	~~242~~	~~24.00~~	~~218~~
~~85~~	~~5100~~	~~0.64~~	~~0.05~~	~~247~~	~~25.50~~	~~221~~
~~90~~	~~5400~~	~~0.61~~	~~0.05~~	~~252~~	~~27.00~~	~~225~~
~~95~~	~~5700~~	~~0.59~~	~~0.04~~	~~257~~	~~28.50~~	~~228~~
~~100~~	~~6000~~	~~0.57~~	~~0.04~~	~~261~~	~~30.00~~	~~231~~
~~600~~	~~36000~~	~~0.18~~	~~0.01~~	~~495~~	~~180.00~~	~~315~~
~~690~~	~~41400~~	~~0.17~~	~~0.01~~	~~521~~	~~207.00~~	~~314~~
~~695~~	~~41700~~	~~0.17~~	~~0.01~~	~~523~~	~~208.50~~	~~314~~
~~4320~~	~~259200~~	~~0.05~~	~~0.00~~	~~1016~~	~~1296.00~~	~~-280~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~70~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~113~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~667.75~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 572 cu. ft.
Provided: 668 cu. ft. Excess Storage 95.45

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **31.79 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **31.79 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.10 Acres 4433 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.06	0.900	0.0558	2700	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.01	0.900	0.0134	648	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.02	0.220	0.0055	1085	N

	Total A	Comp "C"	Qpeak
Total Site	0.10	0.73	0.29
Connected Impervious	0.06	0.90	0.21

Year	M	N	P
2	3.47	0.556	1.2
10	6.98	0.609	1.8
25	9.09	0.626	2
50	10.7	0.635	2.2
100	12.3	0.643	2.4

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
K1	248	0.50	548	0.5	548	199	199
K2	254	0.50	559	0.5	559	203.25	203.25
K3	253	0.50	558	0.5	558	202.75	202.75
K4	74	0.50	177	0.5	177	62.75	62.75
	Length	Width	Depth	Pipe Dia	Voids		
Gallery	(ft)	(ft)	(ft)	(in)	%		
K	0	0	2.75	6	40%	0	0.0
						667.75	668

PEAK RUNOFF VOLUME (2-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.06	98	6.074
Driveway	0.00	98	0.000
Sidewalk	0.01	98	1.458
Building	0.00	98	0.000
Landscape	0.02	80	1.993
	Total A	Comp "C"	
	0.10	93.59	

P(50) = 2.2 in
S = 0.68
Total Runoff Depth(Q50) = 1.55 in
Total Storm Volume (V) = 572 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

ORIFICE DISPOSAL RATE

C (Orifice Coefficient)	0.61	
Orifice Diameter	0.65	in
Water Depth Above Orifice	3.00	ft
Orifice Disposal Rate	0.0196	cfs

See orifice calculations for more information

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: L
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0000

Time of Conc. (min)			5.00		
Area (Acres)			0.34		
Composite "C"			0.44		
208 Treated Area (acres)			0.00		
Volume Provided		208:	0	Storm:	0
Outflow (cfs)		***Seepage Ouflow Rate:***	***0.0050***		
Area * C" Factor		**(assumed)**	0.15		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.58	232	1.50	230
~~5~~	~~300~~	~~3.84~~	~~0.58~~	~~232~~	~~1.50~~	~~230~~
~~10~~	~~600~~	~~2.47~~	~~0.37~~	~~261~~	~~3.00~~	~~258~~
~~15~~	~~900~~	~~1.91~~	~~0.29~~	~~288~~	~~4.50~~	~~283~~
~~20~~	~~1200~~	~~1.59~~	~~0.24~~	~~312~~	~~6.00~~	~~306~~
~~25~~	~~1500~~	~~1.38~~	~~0.21~~	~~333~~	~~7.50~~	~~325~~
~~30~~	~~1800~~	~~1.23~~	~~0.18~~	~~352~~	~~9.00~~	~~343~~
~~35~~	~~2100~~	~~1.12~~	~~0.17~~	~~369~~	~~10.50~~	~~359~~
~~40~~	~~2400~~	~~1.03~~	~~0.15~~	~~386~~	~~12.00~~	~~374~~
~~45~~	~~2700~~	~~0.95~~	~~0.14~~	~~401~~	~~13.50~~	~~387~~
~~50~~	~~3000~~	~~0.89~~	~~0.13~~	~~415~~	~~15.00~~	~~400~~
~~55~~	~~3300~~	~~0.84~~	~~0.13~~	~~428~~	~~16.50~~	~~412~~
~~60~~	~~3600~~	~~0.79~~	~~0.12~~	~~441~~	~~18.00~~	~~423~~
~~65~~	~~3900~~	~~0.75~~	~~0.11~~	~~453~~	~~19.50~~	~~434~~
~~70~~	~~4200~~	~~0.72~~	~~0.11~~	~~465~~	~~21.00~~	~~444~~
~~75~~	~~4500~~	~~0.69~~	~~0.10~~	~~476~~	~~22.50~~	~~453~~
~~80~~	~~4800~~	~~0.66~~	~~0.10~~	~~486~~	~~24.00~~	~~462~~
~~85~~	~~5100~~	~~0.64~~	~~0.10~~	~~497~~	~~25.50~~	~~471~~
~~90~~	~~5400~~	~~0.61~~	~~0.09~~	~~507~~	~~27.00~~	~~480~~
~~95~~	~~5700~~	~~0.59~~	~~0.09~~	~~516~~	~~28.50~~	~~488~~
~~100~~	~~6000~~	~~0.57~~	~~0.09~~	~~525~~	~~30.00~~	~~495~~
~~600~~	~~36000~~	~~0.18~~	~~0.03~~	~~996~~	~~180.00~~	~~816~~
~~690~~	~~41400~~	~~0.17~~	~~0.03~~	~~1048~~	~~207.00~~	~~841~~
~~695~~	~~41700~~	~~0.17~~	~~0.03~~	~~1051~~	~~208.50~~	~~843~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~2043~~	~~1296.00~~	~~747~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~0~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~0~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~0~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 1232 cu. ft.
Provided: 0 cu. ft. Excess Storage -1232.41

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **68.47 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **68.47 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.34 Acres 14978 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.00	0.900	0.0000	0	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.11	0.900	0.0986	4772	N
Landscape	0.23	0.220	0.0515	10206	N

	Total A	Comp "C"	Qpeak
Total Site	0.34	0.44	0.58
Connected Impervious	0.00	#DIV/0!	#DIV/0!

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
No Swale						0	0

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
						0	0

PEAK RUNOFF VOLUME (2-YR STORM, SCS METHOD)
PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.00	98	0.000
Driveway	0.00	98	0.000
Sidewalk	0.00	98	0.000
Building	0.11	98	10.736
Landscape	0.23	80	18.744
	Total A	Comp "C"	
	0.34	85.73	

P(50) = 2.2 in
S = 1.66
Total Runoff Depth(Q50) = 0.99 in
Total Storm Volume (V) = 1232 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: M
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~	~~0~~	Orifice Outflow	1
~~Exfiltration (cfs)~~	~~0.3~~		0.0000

Time of Conc. (min)				5.00	
Area (Acres)				0.06	
Composite "C"				0.50	
208 Treated Area (acres)				0.00	
Volume Provided			208:	0	Storm: 0
Outflow (cfs)		***Seepage Ouflow Rate:***		***0.0050***	
Area * C" Factor			**(assumed)**	0.03	
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.12	46	1.50	45
~~5~~	~~300~~	~~3.84~~	~~0.12~~	~~46~~	~~1.50~~	~~45~~
~~10~~	~~600~~	~~2.47~~	~~0.07~~	~~52~~	~~3.00~~	~~49~~
~~15~~	~~900~~	~~1.91~~	~~0.06~~	~~58~~	~~4.50~~	~~53~~
~~20~~	~~1200~~	~~1.59~~	~~0.05~~	~~62~~	~~6.00~~	~~56~~
~~25~~	~~1500~~	~~1.38~~	~~0.04~~	~~67~~	~~7.50~~	~~59~~
~~30~~	~~1800~~	~~1.23~~	~~0.04~~	~~70~~	~~9.00~~	~~61~~
~~35~~	~~2100~~	~~1.12~~	~~0.03~~	~~74~~	~~10.50~~	~~63~~
~~40~~	~~2400~~	~~1.03~~	~~0.03~~	~~77~~	~~12.00~~	~~65~~
~~45~~	~~2700~~	~~0.95~~	~~0.03~~	~~80~~	~~13.50~~	~~67~~
~~50~~	~~3000~~	~~0.89~~	~~0.03~~	~~83~~	~~15.00~~	~~68~~
~~55~~	~~3300~~	~~0.84~~	~~0.03~~	~~86~~	~~16.50~~	~~69~~
~~60~~	~~3600~~	~~0.79~~	~~0.02~~	~~88~~	~~18.00~~	~~70~~
~~65~~	~~3900~~	~~0.75~~	~~0.02~~	~~91~~	~~19.50~~	~~71~~
~~70~~	~~4200~~	~~0.72~~	~~0.02~~	~~93~~	~~21.00~~	~~72~~
~~75~~	~~4500~~	~~0.69~~	~~0.02~~	~~95~~	~~22.50~~	~~73~~
~~80~~	~~4800~~	~~0.66~~	~~0.02~~	~~97~~	~~24.00~~	~~73~~
~~85~~	~~5100~~	~~0.64~~	~~0.02~~	~~99~~	~~25.50~~	~~74~~
~~90~~	~~5400~~	~~0.61~~	~~0.02~~	~~101~~	~~27.00~~	~~74~~
~~95~~	~~5700~~	~~0.59~~	~~0.02~~	~~103~~	~~28.50~~	~~75~~
~~100~~	~~6000~~	~~0.57~~	~~0.02~~	~~105~~	~~30.00~~	~~75~~
~~600~~	~~36000~~	~~0.18~~	~~0.01~~	~~199~~	~~180.00~~	~~19~~
~~690~~	~~41400~~	~~0.17~~	~~0.01~~	~~210~~	~~207.00~~	~~3~~
~~695~~	~~41700~~	~~0.17~~	~~0.01~~	~~210~~	~~208.50~~	~~2~~
~~4320~~	~~259200~~	~~0.05~~	~~0.00~~	~~409~~	~~1296.00~~	~~-887~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~0~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~0~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~0~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 237 cu. ft.
Provided: 0 cu. ft. Excess Storage -237.49

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **13.19 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **13.19 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.06 Acres 2602 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.00	0.900	0.0000	0	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.02	0.900	0.0224	1082	N
Landscape	0.03	0.220	0.0077	1520	N

	Total A	Comp "C"	Qpeak
Total Site	0.06	0.50	0.12
Connected Impervious	0.00	#DIV/0!	#DIV/0!

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
No Swale						0	0

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
						0	0

PEAK RUNOFF VOLUME (2-YR STORM, SCS METHOD)
PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.00	98	0.000
Driveway	0.00	98	0.000
Sidewalk	0.00	98	0.000
Building	0.02	98	2.434
Landscape	0.03	80	2.792
	Total A	Comp "C"	
	0.06	87.49	

P(50) = 2.2 in
S = 1.43
Total Runoff Depth(Q50) = 1.10 in
Total Storm Volume (V) = 237 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

RATIONAL & SCS METHOD
DETENTION BASIN DESIGN

Design Year: 50

PROJECT: 25-121 Clark 53rd
BASIN: N
REVIEWER: AJS
DESIGNER: SCE
DATE: 10/28/2025

RUNOFF STORAGE

~~Single (Type A)~~ ~~0~~ Orifice Outflow 1
~~Exfiltration (cfs)~~ ~~0.3~~ 0.0000

Time of Conc. (min)			5.00		
Area (Acres)			0.23		
Composite "C"			0.48		
208 Treated Area (acres)			0.09		
Volume Provided		208:	448.75	Storm:	996
Outflow (cfs)		***Seepage Ouflow Rate:***	***0.0050***		
Area * "C" Factor		**(assumed)**	0.11		
Coef. of Intensity	m: 10.68				
	n: 0.635				

#1 Time Inc. (min.)	#2 Time Inc. (sec.) (#1*60)	#3 Intensity (in./hr.)	#4 Q dev. (cfs) (A*C*#3)	#5 V in (cu. ft.)	#6 V out (cu. ft.) (Outf.*#2)	#7 Storage (cu. ft.) (#5-#6)
5.00	300.00	3.84	0.42	171	1.50	169
~~5~~	~~300~~	~~3.84~~	~~0.42~~	~~171~~	~~1.50~~	~~169~~
~~10~~	~~600~~	~~2.47~~	~~0.27~~	~~192~~	~~3.00~~	~~189~~
~~15~~	~~900~~	~~1.91~~	~~0.21~~	~~212~~	~~4.50~~	~~207~~
~~20~~	~~1200~~	~~1.59~~	~~0.18~~	~~229~~	~~6.00~~	~~223~~
~~25~~	~~1500~~	~~1.38~~	~~0.15~~	~~245~~	~~7.50~~	~~237~~
~~30~~	~~1800~~	~~1.23~~	~~0.14~~	~~259~~	~~9.00~~	~~250~~
~~35~~	~~2100~~	~~1.12~~	~~0.12~~	~~271~~	~~10.50~~	~~261~~
~~40~~	~~2400~~	~~1.03~~	~~0.11~~	~~283~~	~~12.00~~	~~271~~
~~45~~	~~2700~~	~~0.95~~	~~0.11~~	~~294~~	~~13.50~~	~~281~~
~~50~~	~~3000~~	~~0.89~~	~~0.10~~	~~305~~	~~15.00~~	~~290~~
~~55~~	~~3300~~	~~0.84~~	~~0.09~~	~~315~~	~~16.50~~	~~298~~
~~60~~	~~3600~~	~~0.79~~	~~0.09~~	~~324~~	~~18.00~~	~~306~~
~~65~~	~~3900~~	~~0.75~~	~~0.08~~	~~333~~	~~19.50~~	~~314~~
~~70~~	~~4200~~	~~0.72~~	~~0.08~~	~~342~~	~~21.00~~	~~321~~
~~75~~	~~4500~~	~~0.69~~	~~0.08~~	~~350~~	~~22.50~~	~~327~~
~~80~~	~~4800~~	~~0.66~~	~~0.07~~	~~358~~	~~24.00~~	~~334~~
~~85~~	~~5100~~	~~0.64~~	~~0.07~~	~~365~~	~~25.50~~	~~340~~
~~90~~	~~5400~~	~~0.61~~	~~0.07~~	~~372~~	~~27.00~~	~~345~~
~~95~~	~~5700~~	~~0.59~~	~~0.07~~	~~379~~	~~28.50~~	~~351~~
~~100~~	~~6000~~	~~0.57~~	~~0.06~~	~~386~~	~~30.00~~	~~356~~
~~600~~	~~36000~~	~~0.18~~	~~0.02~~	~~732~~	~~180.00~~	~~552~~
~~690~~	~~41400~~	~~0.17~~	~~0.02~~	~~771~~	~~207.00~~	~~564~~
~~695~~	~~41700~~	~~0.17~~	~~0.02~~	~~773~~	~~208.50~~	~~564~~
~~4320~~	~~259200~~	~~0.05~~	~~0.01~~	~~1502~~	~~1296.00~~	~~206~~

~~*208 SWALE POND CALCULATIONS*~~

~~*Volume Required [cf] = 1133*A~~ ~~100~~ ~~cu. ft.~~
~~Volume Required [cf] = 1815*A~~ ~~160~~ ~~cu. ft.~~
~~*Must meet SRSM soil requirements~~ ~~Provided:~~ ~~448.75~~ ~~cu. ft.~~

STORAGE REQUIREMENTS - 50-YEAR DESIGN STORM

Maximum storage required by SCS Method (store entire storm) = 881 cu. ft.
Provided: 996 cu. ft. Excess Storage 114.64

Time for disposal of Full Storm Event @ 0.0196 CFS
Total Volume / Rate = Time >>> **48.94 HRS**
Time for disposal of Surface Water (Volume above Pond)
Volume of Pond / Rate = Time >>> **48.94 HRS**

TIME OF CONCENTRATION (minutes)

Tc (overland)		Tc (gutter)	
L(A) =	10	L(C) =	0
K(A)	420	K(C) =	0
S(A) =	0.0194	S(C) =	0
Tc (A) =	0.17	Tc (C) =	0.00
L(B) =	0		
K(B) =	0	Tc (C) =	0.00
S(B) =	0	Tc(A+B) =	0.17
Tc (B) =	0.00	Tc(tot.) =	5.00
		Intensity =	3.84

Tc (total) = Tc (overland) + Tc (gutter)
Tc = L / [K√(S)]
L = length of segment *(ft)*
S = slope of segment *(feet/foot)*
K = ground cover coefficient *(ft/min)*
-See Table 5-6 of SRSM for "K" values

CONTRIBUTING AREAS

Site 0.23 Acres 9951 s.f.

	Areas (Ac.)	"C"	A*C	Areas (s.f.)	Treat?
Paved	0.09	0.900	0.0795	3850	Y
Driveway	0.00	0.900	0.0000	0	Y
Sidewalk	0.00	0.900	0.0000	0	N
Building	0.00	0.900	0.0000	0	N
Landscape	0.14	0.220	0.0308	6101	N

	Total A	Comp "C"	Qpeak
Total Site	0.23	0.48	0.42
Connected Impervious	0.09	0.90	0.31

POND VOLUMES

Swale Number	Bottom Elevation Area (sf)	Depth to 208 Elevation (ft)	208 Elevation Area (sf)	Depth to Top Elevation (ft)	Top Elevation Area (sf)	208 Volume (cf)	Storage Volume (cf)
Swale N	807	0.50	988	1.0	1184	448.75	995.5

Gallery	Length (ft)	Width (ft)	Depth (ft)	Pipe Dia (in)	Voids %		
						448.75	996

PEAK RUNOFF VOLUME (2-YR STORM, SCS METHOD)
PEAK RUNOFF VOLUME (50-YR STORM, SCS METHOD)

	Areas (Ac.)	CN	A*C
Paved	0.09	98	8.662
Driveway	0.00	98	0.000
Sidewalk	0.00	98	0.000
Building	0.00	98	0.000
Landscape	0.14	80	11.205
	Total A	Comp "C"	
	0.23	86.96	

P(50) = 2.2 in
S = 1.50
Total Runoff Depth(Q50) = 1.06 in
Total Storm Volume (V) = 881 cf
*Class D Soils w/ >75% Grass Cover
*Class D Soils w/ 30%-70% ground cover (Herbaceous)

Chapter 4

NRCS SOILS MAP

STORHAUG ENGINEERING
510 East Third, Spokane, Washington
Phone 509-242-1000 Fax 509-242-1001

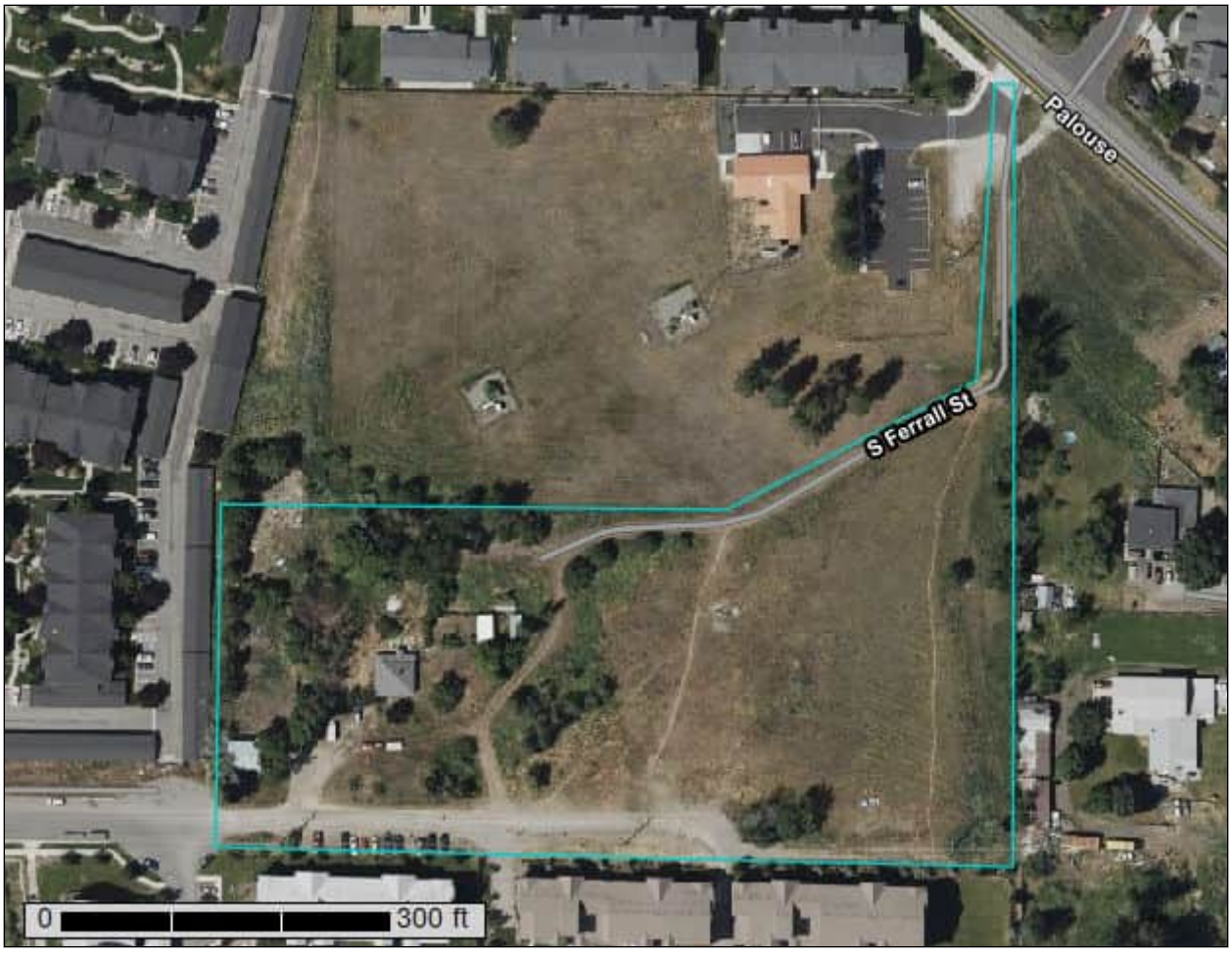
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Spokane County, Washington



October 24, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,830 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Spokane County, Washington
Survey Area Data: Version 15, Aug 28, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 9, 2022—Aug 15, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7120	Urban land-Marble, disturbed complex, 0 to 3 percent slopes	0.5	8.4%
7150	Urban land-Seaboldt, disturbed complex, 0 to 3 percent slopes	5.3	91.6%
Totals for Area of Interest		**5.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Spokane County, Washington

7120—Urban land-Marble, disturbed complex, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2mdn0
Elevation: 1,750 to 2,360 feet
Mean annual precipitation: 18 to 20 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 60 percent
Marble, disturbed, and similar soils: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Marble, Disturbed

Setting

Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

A - 0 to 4 inches: loamy sand
E - 4 to 8 inches: loamy sand
E and Bt1 - 8 to 27 inches: sand
E and Bt2 - 27 to 53 inches: sand
C - 53 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: B

Ecological site: F043AY509WA - Warm, Xeric, Sandy, Outwash Terraces and Plains (Ponderosa Pine/Dry Grass) Pinus ponderosa / Pseudoroegneria spicata , Pinus ponderosa / Festuca idahoensis
Other vegetative classification: ponderosa pine/Idaho fescue (CN140)
Hydric soil rating: No

Minor Components

Marblespring, disturbed
Percent of map unit: 3 percent
Landform: Outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/bluebunch wheatgrass (CN130)
Hydric soil rating: No

Hardesty, disturbed
Percent of map unit: 2 percent
Landform: Drainageways, depressions
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Other vegetative classification: ponderosa pine/ninebark (CN190)
Hydric soil rating: No

7150—Urban land-Seaboldt, disturbed complex, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: 2mdnp
Elevation: 2,300 to 2,380 feet
Mean annual precipitation: 18 to 20 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 45 percent
Seaboldt, disturbed, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Seaboldt, Disturbed

Setting

Landform: Outwash plains on plateaus
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt

Typical profile

Ap1 - 0 to 7 inches: ashy loam
Ap2 - 7 to 10 inches: ashy loam
Bw1 - 10 to 16 inches: loam
2Bw2 - 16 to 23 inches: sandy loam
2C - 23 to 28 inches: extremely gravelly sandy loam
3R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: F009XY001WA - Mesic Xeric Loamy Hills and Canyons Ponderosa Pine Moderately Warm Dry Shrub
Other vegetative classification: ponderosa pine/common snowberry (CN170)
Hydric soil rating: No

Minor Components

Uhlig, disturbed

Percent of map unit: 5 percent
Landform: Outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/bluebunch wheatgrass (CN130)
Hydric soil rating: No

Brincken, moist, disturbed

Percent of map unit: 5 percent
Landform: Outwash terraces on loess hills
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/Idaho fescue (CN140)

Hydric soil rating: No

Phoebe, disturbed

Percent of map unit: 3 percent
Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/common snowberry (CN170)
Hydric soil rating: No

Marble, disturbed

Percent of map unit: 2 percent
Landform: Outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: ponderosa pine/Idaho fescue (CN140)
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Chapter 5

GEOTECHNICAL REPORT

STORHAUG ENGINEERING
510 East Third, Spokane, Washington
Phone 509-242-1000 Fax 509-242-1001

Revised Geotechnical Engineering Report
5114 South Palouse Highway &
3227 East 53rd Avenue
Parcel No: 34032.0704, 34032.9093
Spokane, Washington 99223

Prepared For:
Will Clark
Palouse Landing LLC
2910 E 57th Avenue 5-122
Spokane, Washington 99223

Prepared By:

LIBERTY GEOTECH

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

Report Date: July 28, 2023
Job Number: 23010

Table of Contents

Appendices

1.0 EXECUTIVE SUMMARY

The following revised geotechnical engineering report has been prepared for the proposed multi-family residences located at 5114 South Palouse Highway and 3227 East 53rd Avenue in Spokane, Washington. From a geotechnical perspective, the following concepts were identified as favorable for the proposed construction:

- The site is suitable for the proposed multi-family residences provided the report recommendations are implemented.
- The residual bedrock or basalt bedrock at the site will provide adequate bearing capacity for the foundation of the proposed construction.

The following items have been identified at the project site and proposed construction that should be carefully considered during design and construction:

- Undocumented fill was observed in TP-4 and TP-5 to depths of 0.5 and 1.5 feet below the ground surface, respectively. The undocumented fill should be removed and replaced with compacted *Structural Fill* below any settlement-prone structures.
- All test pits met refusal due to bedrock to depths ranging from 1.5 to 5 feet below the ground surface. A hydraulic breaker is likely to be required to excavate underground utilities within intact bedrock.
- Foundations should bear on intact bedrock, residual bedrock or compacted *Structural Fill* placed over bedrock to avoid differential settlement. Intact bedrock should be over-excavated by six inches if a portion of the building's foundation is not bearing on residual bedrock or *Structural Fill.*
- Groundwater seepage was encountered in TP-2 at a depth of 5 feet. Stormwater design and grading should incorporate the observed groundwater elevations, account for seasonal fluctuations, and depth to bedrock.
- A separate *Geotechnical Report Addendum* was provided for stormwater infiltration recommendations, dated July 24, 2023. Stormwater drywells are not suitable due to the shallow bedrock encountered at the site.

If Liberty Geotech (or an approved third-party testing firm) is not afforded the opportunity to observe and test as recommended in this report, Liberty Geotech is not the engineer of record. Furthermore, Liberty Geotech does not have any liability for the recommendations provided if no observations or testing is performed. 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 several multi-family residences along with associated stormwater management facilities and pavement areas. The construction is assumed to consist of 3-story, wood-framed, 4-plexes and duplexes. Building foundations are assumed to be

shallow concrete footings with concrete slab-on-grade flooring support. No basement or subgrade floor area is anticipated.

3.0 GEOTECHNICAL EXPLORATION

Subsurface exploration was performed by excavating three test pits with a SANY SY26U mini-excavator. Subsurface exploration was performed at the project site on February 6, 2023. Additional exploration with six test pits was performed on July 12, 2023. The test pits were excavated through the topsoil, undocumented fill, glacial flood deposits, loess, residual bedrock, extremely weathered 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 Logs*. 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 the Google Earth™ mapping service with the GWS84 EGM96 geoid.

3.1 Geology, Topography, and Current Site Use

The *Preliminary Geologic Map of the Spokane SE 7.5-minute Quadrangle, Spokane County, Washington* (Derkey, 1999) was reviewed to determine the geologic deposit at the site. The geologic map indicated that the geologic unit was the Wanapum Basalt, Priest Rapids Member. In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2023) was reviewed. The soil survey indicates that the soil units are the following:

- Urban land-Seaboldt, a 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.
- Urban land-Marble, a disturbed complex consisting of loamy sand from the ground surface to a depth of 8 inches, and sand from 8 inches to 60 inches. The soil survey describes the soil as sandy glaciofluvial deposits.

The site is currently a vacant lot and is sparsely vegetated with trees and grasses. The topography obtained from Google Earth™ shows that the site is relatively level with approximately 20 feet of relief. The historical aerial imagery shows no significant historical disturbance at 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. Undocumented fill was observed in TP-4 and TP-5. Generally, the test pits encountered topsoil or loess overlying residual and weathered bedrock and met refusal due to bedrock. The residual bedrock and loess soils were classified as silty sand, silty gravel, and sandy silt. In addition, the extremely weathered basalt bedrock was friable to well-graded sand with gravel and well-graded gravel with silt and sand. Basalt cobbles were observed across the site.

3.3 Estimated Groundwater and Bedrock Elevations

Groundwater was observed in TP-2 at a depth of five feet. It is anticipated that groundwater will be present in perched locations at the interface between the topsoil or residual basalt and basalt bedrock. According to the well logs in the vicinity of the site (Ecology), the approximate depth of the static water level is 30 feet below the land surface. Seasonal and annual fluctuations in groundwater levels should be anticipated.

All test pits met refusal at depths ranging from 1.5 and 5 feet below the ground surface.

3.4 Test Pit Remediation

The test pits were backfilled using the excavator's bucket in two-foot lifts. The soil was not moisture conditioned. The soil density is much lower than required for *Structural Fill.*

The earthwork contractor and owner should locate the test pits and remediate them at least three feet below the bottom of all foundations and two feet below all slabs or other settlement-prone structures. Remediation is removing the fill, replacing it with *Structural Fill*, and compacting the *Structural Fill*. The location of the test pits was staked in the field and is shown on Plate 1 in Appendix A. If necessary, contact Liberty Geotech prior to construction to have the test pit locations re-staked in the field for remediation.

4.0 LABORATORY TESTING RESULTS

Soil samples were obtained in the exploration locations at varying depths to characterize the extremely weathered bedrock and residual bedrock. The results of laboratory testing results are presented in Appendix C: *Laboratory Testing Results*. The laboratory testing was performed referencing the following American Society for Testing and Material Standard Methods (ASTM):

- ASTM D1140 *Amount of Material in Soils Finer than the No. 200 Sieve*,
- ASTM D2216 *Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass,* and
- ASTM D6913 *Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis*.

4.1 Summary of Laboratory Testing Results

The following table summarizes the laboratory tests that were performed on the soil samples obtained from the site. Additional details are provided in Appendix B and C.

Table 4.1.A - Summary of Laboratory Testing

Soil Unit	Lab Tests Performed	Summary of Results
Residual Bedrock	● Percent Passing No. 200 Sieve ● Gradation Sieve ● Natural Moisture Content	Soil is classified as silty sand. ● C_u: 15.3 - 18.8 ● C_C: 0.9 - 1.6 ● % Passing No. 200: 18% - 24% ● Moisture Content: 12.1% - 13.8%
Loess	● Percent Passing No. 200 Sieve ● Gradation Sieve ● Natural Moisture Content	Soil is classified as sandy silt. ● C_u: 6.0 ● C_C: 1.5 ● % Passing No. 200: 47% - 60% ● Moisture Content: 8.3% - 10.9%
Glacial Flood Deposits	● Percent Passing No. 200 Sieve ● Gradation Sieve ● Natural Moisture Content	Soil is classified as poorly-graded sand with sand. ● C_u: 4.1 ● C_C: 1.6 ● % Passing No. 200: 7% ● Moisture Content: 3.4%

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 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.

5.1.1 Subgrade Preparation

Clear and grub all vegetation, strip all topsoil, and remove undocumented fill to prepare the subgrades under all shallow foundations, floor areas (either slab-on-grade or wood-framed flooring areas), deck column pads, or pavement areas. Topsoil and undocumented fill removal are estimated to be 0.5 to 1.5 feet across the project site. All footings should bear on residual

basalt bedrock, basalt bedrock, or *Structural Fill* placed on residual basalt bedrock or extremely weathered basalt bedrock.

All stormwater facilities should be a minimum of ten feet from foundations and hardscapes to minimize the effects of improvements.

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

5.1.2 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 5.1.2.A - Soil product selection.

Soil Product	Project Use	Soil Description
Structural Fill	● Fill areas under the foundation. ● Fill to achieve subgrade under the slab or driveway. ● Backfill of shallow foundations.	Soil classified as: ● GP-GM or GW-GM ● GM ● SP-SM or SW-SM ● SM Soil should be free of organics, deleterious material, and all material larger than 6-inches in diameter.
Concrete Slab Cushion	● Fill immediately below slab-on-grades, sidewalks, and exterior hardscapes.	Soil should meet the percent passing the following sieve size: ● 1”: 80-100% ● No. 4: 25-65% ● No. 200: 6% maximum Soil should be free of organics, clay fines, deleterious material, and all material larger than 2-inches in diameter.
Crushed Surfacing	● Fill immediately below slab-on-grades, asphaltic pavement, concrete pavement, sidewalks, and exterior hardscapes.	Crushed rock should meet the percent passing the following sieve size: ● 1-¼”: 99-100% ● 1”: 80-100% ● ⅝”: 50-80% ● No. 4: 25-45% ● No. 40: 3-18% ● No. 200: 7.5% maximum ● Sand equivalent: 40 minimum Also, the material should be free of

		wood, roots, bark, and deleterious material. For roadway base the following requirements should also be met: ● Fracture face: 75%, minimum ● Los Angeles Wear, 500 rev: 35%, maximum. ● Degradation factor: 15 minimum.
Landscaping Fill	● Non-structural fill areas. ● Vegetated areas.	Soil meeting the following requirements: ● Silt or Clay: 35% to 70% ● Sand: 20% to 60% ● Organic material: 2% to 20% ● Deleterious materials (gravel, rock, slag, cinder, roots, sod): 5% max ● pH between 5 and 7

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 5.1.2.B - Compaction recommendation.

Project Use	**Recommended Compaction**
● Fill areas under the foundation. ● Fill to achieve subgrade under the slab or driveway. ● Fill immediately below slab-on-grades. ● Fill immediately below the asphaltic-concrete pavement, concrete pavement, sidewalks, and exterior hardscapes.	95 percent of the maximum dry density of Modified Proctor.
● Exterior wall backfill. ● Utility trench backfills.	92 percent of the maximum dry density of Modified Proctor.
● Non-structural fill areas. ● Vegetated areas.	80 to 85 percent of the maximum 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 or as approved by the engineer of record.

Table 5.1.2.C - Testing Frequency.

Project Use	Testing Frequency
● Below interior building concrete slabs for fill less than a vertical foot.	2,500 square feet and a minimum of 2 tests.
● Along the building footings for every vertical foot of fill.	50 lineal feet and a minimum of 2 tests.
● Structural fill placements larger than one foot in height	100 cubic yards
● Fill under asphalt parking areas and exterior concrete flatwork	5,000 square feet and a minimum of 2 tests.
● Utility trenches for every two vertical feet of trench backfill.	300 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 sloped back in accordance with state and federal requirements in order to be compaction tested.

5.1.3 Excavation Construction Considerations

Topsoil, undocumented fill, glacial flood deposits, loess, residual bedrock, and extremely weathered basalt are removable with a toothed bucket on an excavator. A hydraulic breaker may be required to excavate underground utilities within intact bedrock.

No excavation support or sloped excavation has been reviewed in preparation for this report. The contractor should perform excavations in accordance with state and federal regulations. If requested, Liberty Geotech is available to provide further analysis of excavation support or shoring design. Liberty Geotech is not responsible for the safety of trenches, excavations, or shoring support.

5.1.4 Weather-Related Earthwork Considerations

Wet weather, freezing conditions, or snow can impede or prevent earthwork operations. The following recommendations should be considered by the contractors and owners during construction:

1. It is not recommended that soil products be placed during freezing conditions. No concrete or soil products should be placed on frozen soil.
2. The on-site soils and other imported materials may become saturated during earthwork operations and will reduce operation production.
3. Stockpiles of soil products should be protected during wet weather. Soil products that have been compacted should be protected and not traveled on during wet weather to prevent disturbing the subgrade.

This report does not provide recommendations for erosion, runoff, track out from trucks removing site stripping, or environmental considerations associated with earthwork operations.

5.2 Shallow Foundation Design

The following design parameters are provided based on the project understanding described in Section 2.0. Liberty Geotech should be notified to revise or confirm the following recommendations if the building location, locations of the site improvements, or structural loads change.

- Allowable bearing capacity for foundations on residual bedrock: 2,500 psf.
- Allowable bearing capacity for foundations on compacted *Structural Fill*: 2,500 psf.
- Allowable bearing capacity for foundations on weathered or intact bedrock: 3,000 psf.
- Footing embedment for exterior foundations on residual bedrock or *Structural Fill*: 2 feet
- Estimated total settlement for foundations on *Structural Fill*: Less than 1 inch. Minimal settlement for foundations on intact bedrock.
- A sliding coefficient of friction between the shallow foundations and residual bedrock or *Structural Fill* of 0.40 may be used.

Differential settlement can occur when two different foundations exert different bearing pressures on the soil. The magnitude of the differential settlement depends on the foundation pressure difference. Or, differential settlement can occur due to differences in the soil resistance to the foundation pressure. Foundations are not recommended to bear on both *Structural Fill* and intact bedrock to prevent differential settlement. Intact bedrock should be over-excavated by six inches if a portion of the building foundations are not bearing on residual bedrock or *Structural Fill*. The potential for differential settlement for this site is low due to the shallow bedrock. Differential settlement is anticipated to be less than ½ inch.

All foundations constructed on bedrock do not need to be embedded for frost heave. Foundations that are constructed on residual bedrock or *Structural Fill* should be embedded two feet below the adjacent exterior ground surface to mitigate frost heave.

5.3 Concrete Slab Design and Construction Considerations

The following recommendations should be considered to be the minimum design requirements. The structural engineer's design supersedes these recommendations. A structural engineer should design concrete slabs supporting more than 200 pounds per square foot.

- The concrete slab should be a minimum of four inches thick.
- The slab reinforcement is recommended to not be less than No. 3 rebar, 18 inches on center in both directions, and constructed in the middle of the slab. There is a high probability that the concrete slab will crack if rebar is not constructed in the slab.
- The modulus of subgrade support is recommended to be 250 pounds per square inch per inch (pci).
- The slab should be supported with four inches of compacted *Concrete Slab Cushion* soil in accordance with Section 5.1.

Vapor transmission through the concrete slabs may damage moisture-sensitive floor coverings. Also, substantial moisture can penetrate slabs if they are cast on soils that are saturated. The moisture may be measured and should not be above 3 pounds per 1,000 square feet per 24-hour period as measured in ASTM F2170 *Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride*. In addition, the in-situ relative humidity measurements may be determined at 40 percent of the slab depth. The client should consult with the flooring manufacturer for an acceptable slab relative humidity measurement prior to installing floor coverings. The relative humidity measurements should be made in accordance with ASTM F2170 *Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes*.

The design and ownership team should carefully consider the design publication *Guide to Concrete Floor and Slab Construction* (ACI, 2015) before omitting a vapor retarder under the slab. If a moisture retarder is used, it should meet the requirements of ASTM E1643: *Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs*.

Concrete slabs can crack because of numerous reasons. The following considerations should be mitigated during construction to reduce the risk of the concrete slab cracking.

- The concrete mix design can be altered based on the ambient temperature, aggregate moisture content, anticipated time in the mix truck, and finishing methods. A poorly designed mix that does not incorporate these factors can cause concrete slabs to crack.

- The contractor's means and methods can cause concrete slabs to crack including improper placement of rebar support, improper crack control joints, improper curing methods or poor finishing techniques, and placing concrete during cold or hot weather.

5.4 Seismicity and Liquefaction

The proposed site is designated a **Site Class D**. The following table presents seismicity coefficients referencing the 2018 International Building Code (IBC) code. The acceleration parameters listed are based on interpolated values calculated from the ASCE 7-16 code (OSHPD). The interpolations were visually confirmed with the maps in Table 1613.2.1(1) through 1613.2.1(8) in the 2018 IBC.

Table 5.4.A Seismic Design Parameters

0.2 Second MCE Spectral Response Acceleration	S_s	0.307
0.2 Second MCE Spectral Response Acceleration	S_1	0.111
1.0 Second MCE Spectral Response Acceleration	S_{DS}	0.318
1.0 Second MCE Spectral Response Acceleration	S_{D1}	0.176
Design Peak Ground Acceleration	PGA_M	0.21

Latitude: 47.607294,

Longitude: -117.36003

There is a very low potential for liquefaction based on the *Liquefaction Susceptibility Map of Spokane County, Washington*.

5.5 Lateral Earth Pressure Design

The following table provides equivalent fluid pressures recommended to be used by the structural engineer. Walls with a back slope or slope in front of the wall (toe slope) should have the global stability analyzed.

Table 5.5.A Lateral Earth Pressure Design Parameters

Equivalent Fluid Pressure Designation	Unit Weight (PCF)
Active Equivalent Fluid Pressure	40
At-rest Equivalent Fluid Pressure	60

Passive Equivalent Fluid Pressure	400

Concrete walls that are fully restrained should be designed for at-rest equivalent fluid pressure. Flexible walls or concrete walls that are allowed to crack may be designed for the active equivalent fluid pressure. Soil that is preventing a retaining wall or foundation wall from sliding may be analyzed with the passive equivalent fluid pressure.

5.6 Pavement Section Design Recommendations

The following pavement design recommendations are provided for 3.0 inches of asphaltic-concrete pavement over 6.0 inches of *Crushed Surfacing*. The Structural Number for this pavement section is 1.76 and the number of passes with an equivalent single-axle load (ESAL) is 30,000. The following design parameters were used in the analysis:

- Subgrade support modulus, M_r: 7,160 psi.
- Reliability percent: 80%.
- Standard deviation: 0.45.
- Asphaltic-concrete layer coefficient, a1: 0.42.
- Aggregate base layer coefficient, a2: 0.12.
- Drainage coefficient of aggregate base, m: 0.70.

Paving operations can be observed and tested by Liberty Geotech at the request of the owner. Asphalt should be compacted to 92 percent of the Rice density. Liberty Geotech can provide additional traffic analysis or life-cycle cost analysis upon request.

6.0 DESIGN REVIEW AND CONSTRUCTION OBSERVATIONS

6.1 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 January 17, 2023.

6.2 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.

Applied Technology Council (ATC). “Hazards by Location.” Accessed February 27, 2023. https://hazards.atcouncil.org/

Derkey, Robert E., Hamilton, Michael M., Stradling, Dale F., 1999. Preliminary Geologic Map of the Spokane SE 7.5-minute Quadrangle, Spokane County, Washington. Washington Division of Geology and Earth Resources.

Palmer, Stephen P., Magsino, Sammantha L., Bilderback, Eric L., *et. al.,* 2004. “Liquefaction Susceptibility Map of Spokane County, Washington.” Washington State Department of Natural Resources.

United States Department of Agriculture, Natural Resources Conservation Service. “Web Soil Survey.” Accessed July 26, 2023. http://websoilsurvey.nrcs.usda.gov/

Washington State Department of Ecology. “Washington State Well Report Viewer.” Accessed February 27, 2023. fortress.wa.gov/ecy/wellconstruction/map/WCLSWebMap/

APPENDIX A

Exploration Site Plan

VICINITY MAP
(GOOGLE MAPPING SERVICE™)

APPROXIMATE SCALE - FEET

0 50 100

LEGEND

TP-1 TEST PIT LOCATION

EXPLORATION SITE PLAN

5114 SOUTH PALOUSE HIGHWAY

PARCEL NO. 34032.0704

SPOKANE, WASHINGTON 99223

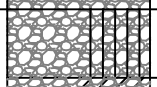
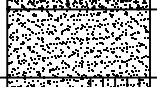
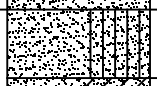
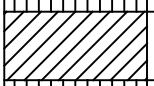
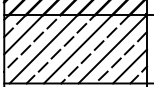
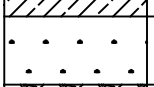
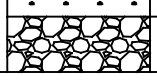
LIBERTY GEOTECH

JOB NO. 23010	JULY 28, 2023	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
	SILT AND CLAY LIQUID LIMIT LESS THAN 50%			ML	INELASTIC SILT
				CL	LEAN CLAY
				OL	ORGANIC SILT
FINE GRAINED SOIL	SILT AND CLAY LIQUID LIMIT GREATER THAN 50%			MH	ELASTIC SILT
				CH	FAT CLAY
				OH	ORGANIC CLAY
				PT	PEAT
					BASALT

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 - Sandy Silt (ML) Soft, Light Brown, Moist										
RESIDUAL BEDROCK - Silty Sand (SM) Dense, Brown, Moist	2375									
BASALT - Extremely Weathered, Medium Strength, Black,		5								

Test pit terminated at 5-feet bgs due to bedrock.

Client: Palouse Landing LLC	Test Pit Number: 1		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 2/6/2023		
Depth to Groundwater: NE	Logged By: AGR		Sheet: 1 of 9

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 - Sandy Silt (ML) Soft, Brown, Moist										
RESIDUAL BEDROCK - Silty Sand (SM) Medium Dense to Dense, Brown, Moist	2375	5		1-Gallon Bag 1-Gallon Bag		24 18		12.1 13.8		

Test pit terminated at 5-feet bgs due to bedrock.

Client: Palouse Landing LLC	Test Pit Number: 2		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 2/6/2023		
Depth to Groundwater: 5	Logged By: AGR		Sheet: 2 of 9

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 - Sandy Silt (ML) Soft, Brown, Moist										
RESIDUAL BEDROCK - Silty Sand (SM) Loose, Brown, Moist										
BASALT - Extremely Weathered, Medium Strength, Black,	2375									

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

Client: Palouse Landing LLC	Test Pit Number: 3		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 2/6/2023		
Depth to Groundwater: NE	Logged By: AGR		Sheet: 3 of 9

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
UNDOCUMENTED FILL - Poorly-Graded Gravel with Silt (GP-GM) Soft, Gray, Dry										
GLACIAL FLOOD DEPOSITS - Poorly-Graded Sand with Silt (SP-SM) Medium Dense, Brown, Dry to Moist	2380			1-Gallon Bag		7		3.4		

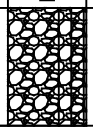
Test pit terminated at 3-feet bgs due to bedrock.

Client: Palouse Landing LLC	Test Pit Number: 4		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 7/12/2023		
Depth to Groundwater: NE	Logged By: BB		Sheet: 4 of 9

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
UNDOCUMENTED FILL - Silty Gravel (GM) Medium Dense, Brown, Dry										
LOESS - Silty Sand (SM) Medium Dense, Brown, Dry	2385			1-Gallon Bag		47		10.9		

Test pit terminated at 4-feet bgs due to bucket refusal on basalt bedrock.

Client: Palouse Landing LLC	Test Pit Number: 5		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 7/12/2023		
Depth to Groundwater: NE	Logged By: BB		Sheet: 5 of 9

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
LOESS - Silty Gravel (GM) Medium Dense, Brown, Dry	2383									

Test pit terminated at 2-feet bgs due to bucket refusal on basalt bedrock.

Client: Palouse Landing LLC	Test Pit Number: 6		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 7/12/2023		
Depth to Groundwater: NE	Logged By: BB		Sheet: 6 of 9

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
LOESS - Sandy Silt (ML) Medium Dense, Dark Brown to Brown, Dry	2385									

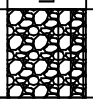
Test pit terminated at 2.3-feet bgs due to bucket refusal on basalt bedrock.

Client: Palouse Landing LLC	Test Pit Number: 7		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 7/12/2023		
Depth to Groundwater: NE	Logged By: BB		Sheet: 7 of 9

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
LOESS - Sandy Silt (ML) Medium Stiff, Dark Brown to Brown, Dry	2388			1-Gallon Bag		60		8.3		

Test pit terminated at 2-feet bgs due to bucket refusal on basalt bedrock.

Client: Palouse Landing LLC	Test Pit Number: 8		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 7/12/2023		
Depth to Groundwater: NE	Logged By: BB		Sheet: 8 of 9

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
LOESS - Silty Gravel with Sand (GM) Medium Dense, Brown, Dry	2385									

Test pit terminated at 1.5-feet bgs due to bucket refusal on basalt bedrock.

Client: Palouse Landing LLC	Test Pit Number: 9		
Project: 5114 South Palouse Highway	Project Number: 23010		
Equipment: SANY SY26U	Date Excavated: 7/12/2023		
Depth to Groundwater: NE	Logged By: BB		Sheet: 9 of 9

APPENDIX C

Laboratory Testing Results

ASTM D6913 Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Project: 5114 South Palouse Highway **Test No.:** 2 **Testing Date:** 2/8/2023

Job No: 23010 **Sample Location:** TP-2 @ 1.5'-2' **Lab Technician:** Alejandro Recabarren

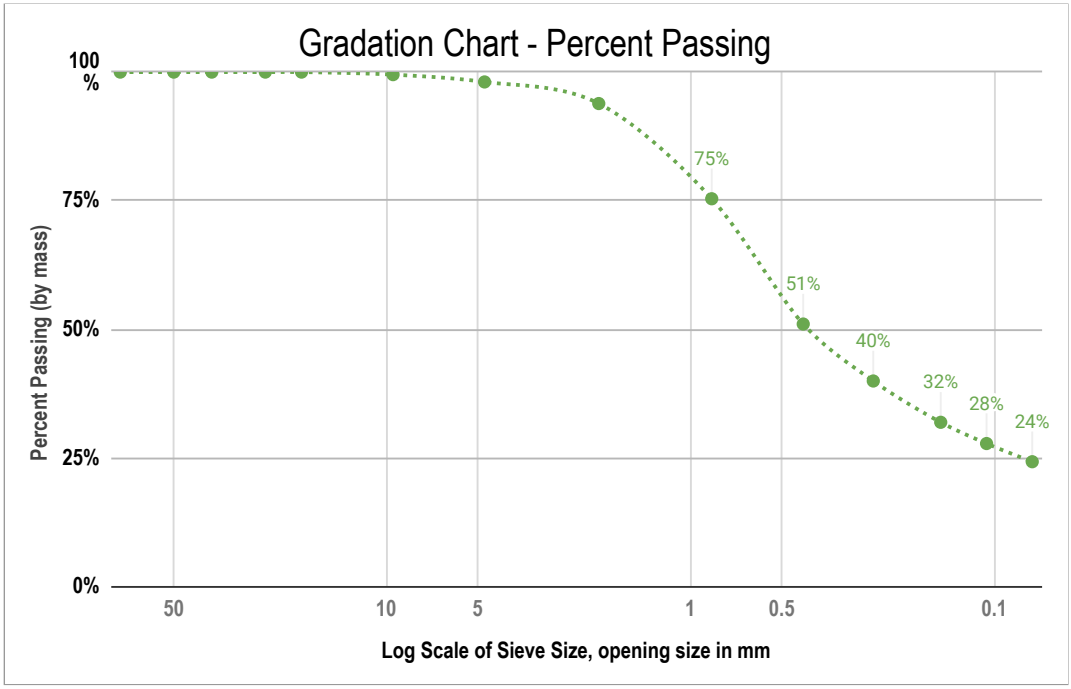
Method Used: Method A
Total Sample Mass: 710 grams
Drying Method: Oven Dry

Max Particle Size: #20
Minimum Sample Size: #N/A

LIBERTY GEOTECH

Summary:

3"	100%
2"	100%
1.5"	100%
1"	100%
3/4"	100%
3/8"	100%
#4	98%
#10	94%
#20	75%
#40	51%
#60	40%
#100	32%
#140	28%
#200	24%
Pan	0%



Notes:

#N/A

Excluded Material: None.

Additional Results

Soil Classification: Silty sand

Percent Moisture: 12.1%

%Gravel: 2% **%Sand:** 74% **%Fines:** 24%

Coefficient of Uniformity, Cu: 18.8

Coefficient of Curvature, Cc: 0.9

ASTM D6913 Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Project: 5114 South Palouse Highway **Test No.:** 3 **Testing Date:** 2/10/2023

Job No: 23010 **Sample Location:** TP-2 @ 4'-4.5' **Lab Technician:** Alejandro Recabarren

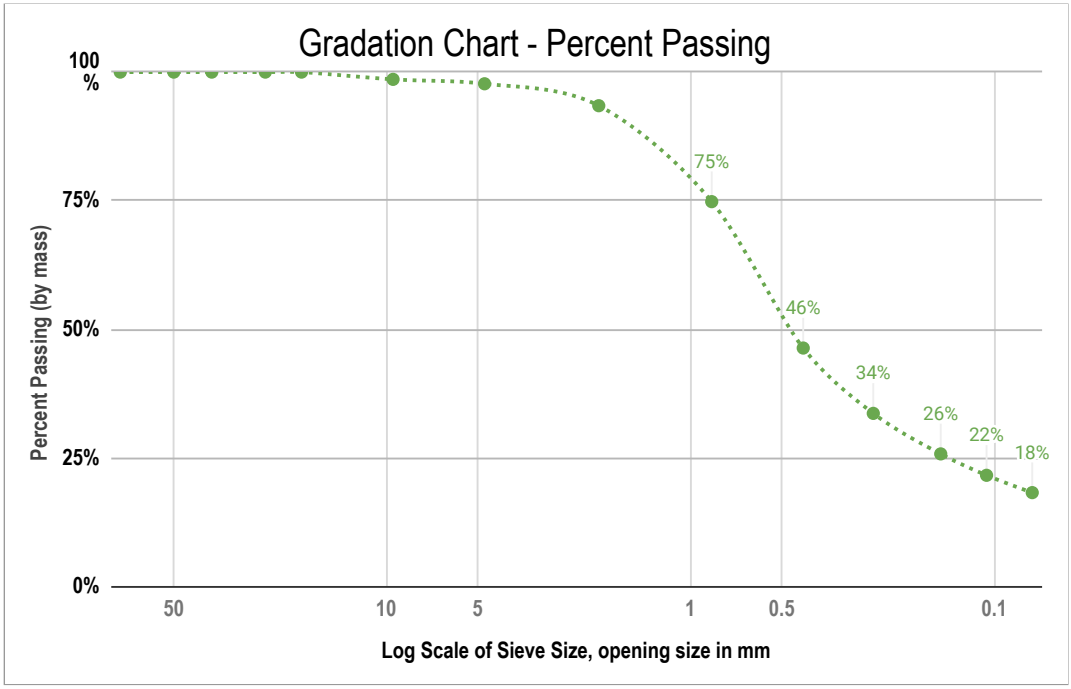
Method Used: Method A
Total Sample Mass: 1,339 grams
Drying Method: Oven Dry

Max Particle Size: #20
Minimum Sample Size: #N/A

LIBERTY GEOTECH

Summary:

3"	100%
2"	100%
1.5"	100%
1"	100%
3/4"	100%
3/8"	99%
#4	98%
#10	93%
#20	75%
#40	46%
#60	34%
#100	26%
#140	22%
#200	18%
Pan	0%



Notes:

#N/A

Excluded Material: None.

Additional Results

Soil Classification: Silty sand

Percent Moisture: 13.8%

%Gravel: 2% **%Sand:** 79% **%Fines:** 18%

Coefficient of Uniformity, Cu: 15.3

Coefficient of Curvature, Cc: 1.6

ASTM D6913 Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Project: 5114 South Palouse Highway **Test No.:** 4 **Testing Date:** 7/20/2023

Job No: 23010 **Sample Location:** TP-4 at 2.0' to 2.5' bgs **Lab Technician:**

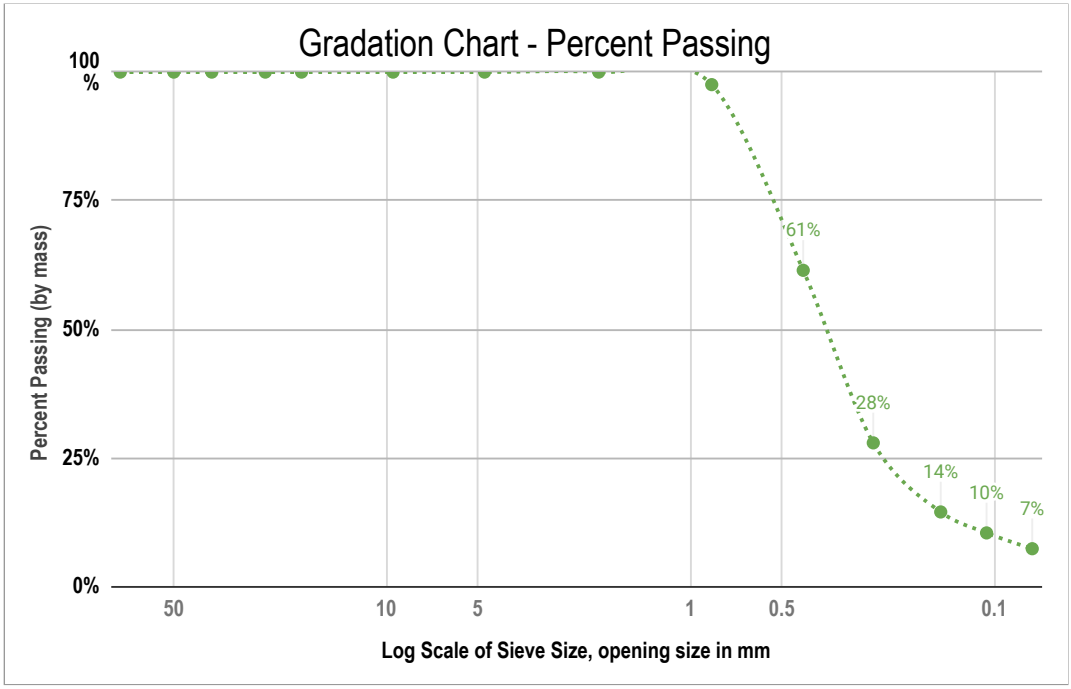
Method Used: Method A
Total Sample Mass: 349 grams
Drying Method: Oven Dry

Max Particle Size: #40
Minimum Sample Size: 50 grams

LIBERTY GEOTECH

Summary:

3"	100%
2"	100%
1.5"	100%
1"	100%
3/4"	100%
3/8"	100%
#4	100%
#10	100%
#20	98%
#40	61%
#60	28%
#100	14%
#140	10%
#200	7%
Pan	0%



Notes:

Excluded Material: None.

Additional Results

Soil Classification: Poorly-graded sand with silt
Percent Moisture: 3.4%
%Gravel: 0% **%Sand:** 93% **%Fines:** 7%
Coefficient of Uniformity, Cu: 4.1
Coefficient of Curvature, Cc: 1.6

ASTM D6913 Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Project: 5114 South Palouse Highway **Test No.:** 3 **Testing Date:** 7/20/2023

Job No: 23010 **Sample Location:** TP-8 at 1.5' to 2.0' bgs **Lab Technician:**

Method Used: Method A Max Particle Size: #20

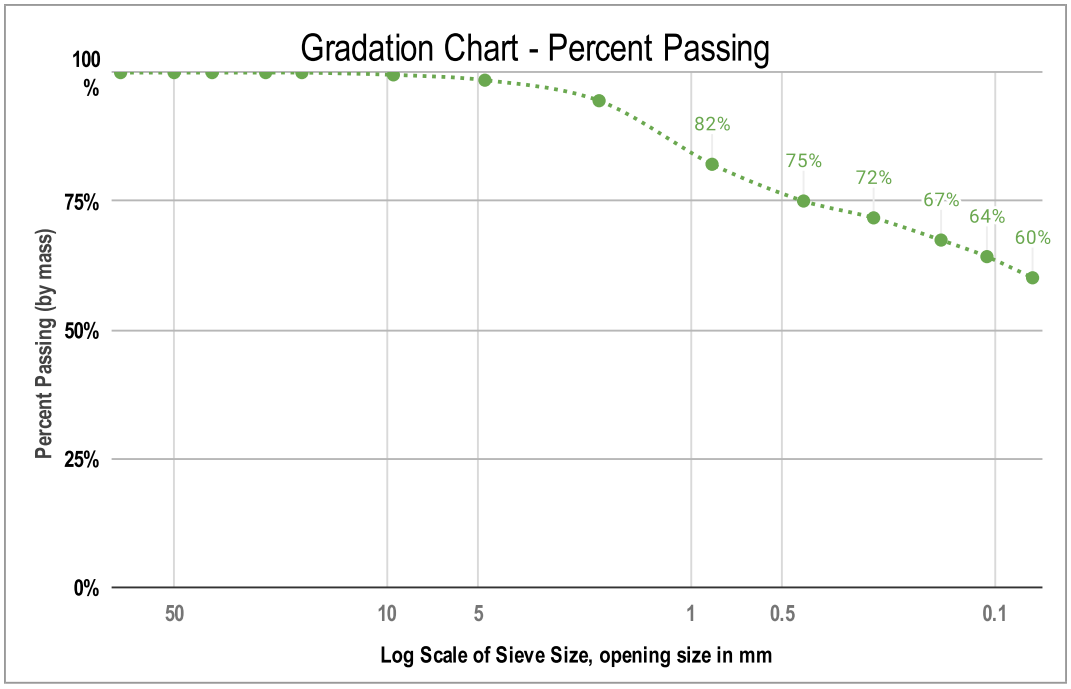
Total Sample Mass: 889 grams Minimum Sample Size: #N/A

Drying Method: Oven Dry

LIBERTY GEOTECH

Summary:

3"	100%
2"	100%
1.5"	100%
1"	100%
3/4"	100%
3/8"	100%
#4	99%
#10	95%
#20	82%
#40	75%
#60	72%
#100	67%
#140	64%
#200	60%
Pan	0%



Notes:

#N/A

Excluded Material: None.

Additional Results

Soil Classification: Sandy silt

Percent Moisture: 8.3%

%Gravel: 1% **%Sand:** 38% **%Fines:** 60%

Coefficient of Uniformity, Cu: 6.0

Coefficient of Curvature, Cc: 1.5

APPENDIX D

Photo Log

Appendix D: Photo Log

PHOTO 1: BASALT AT THE BOTTOM OF TP-1

PHOTO 2: TP-1

PHOTO 3: TP-2

PHOTO 4: TP-2

Appendix D: Photo Log

PHOTO 5: TP-2 GROUNDWATER AT 5-FEET DEEP.

PHOTO 6: TP-2 EXCAVATED SOILS.

PHOTO 7: TP-3 EXCAVATED SOILS.

PHOTO 8: MATERIAL FROM THE BOTTOM OF TP-3.

Appendix D: Photo Log

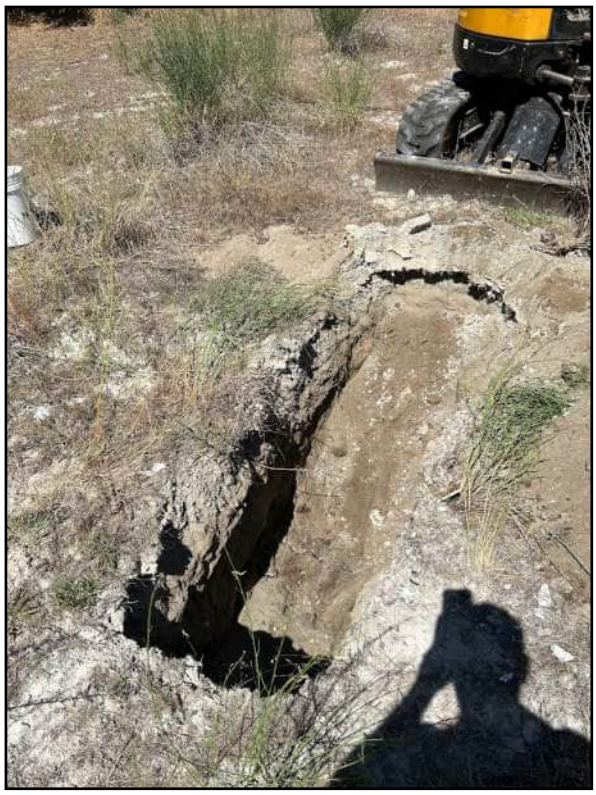


PHOTO 9: TP-4

PHOTO 10: TP-5

PHOTO 11: TP-6

PHOTO 12: TP-7

Appendix D: Photo Log

PHOTO 13: TP-8

PHOTO 14: VIEW OF SITE LOOKING EAST FROM TP-8.

PHOTO 15: TP-9

PHOTO 16: VIEW OF SITE LOOOKING SOUTHEAST.

LIBERTY GEOTECH

3012 N Sullivan Rd, Suite D
Spokane Valley, Washington 99216
(509) 213-0400

July 24, 2023
Project Number: 23010

Will Clark
Palouse Landing LLC
2910 E 57th Avenue 5-122
Spokane, Washington 99223

Subject: Geotechnical Report Addendum (Stormwater Recommendations)
5114 South Palouse Highway
3227 East 53rd Avenue
Parcel No: 34032.0704, 34032.9093
Spokane, Washington 99223

Dear Mr. Clark:

This addendum summarizes the recommendation for the stormwater design located at 5114 South Palouse Highway in Spokane, Washington. Liberty Geotech provided the *Geotechnical Engineering Report,* dated April 27, 2023. The geotechnical report provides additional project understanding, geologic, and geotechnical design recommendations that are not included herein.

Lid swale with gravel underground as shown in Civil Plans (C6.6) may be utilized to treat and retain stormwater Single and double-depth drywells are not suitable for the site based on the depth to bedrock. The following recommendations should be used by the civil engineer to the design swale:

- The infiltration swales should be sized for no infiltration of stormwater into the underlying basalt bedrock.
- The swales should be designed with a minimum 4½ feet of separation between the bottom of the swale and the underlying bedrock, as per the *Spokane Regional Stormwater Manual*.
- The proposed residential buildings should be constructed with a vapor barrier beneath the floor slab with a minimum thickness of 0.015 inches. The vapor barrier should be installed beneath the buildings, plumbing and utilities in order to prevent interstitial condensation.

Please contact Liberty Geotech if there are any questions about the recommendations in this addendum.

Respectfully,

Brian Binsfield, P.E.
Liberty Geotechnical Engineering, Inc.