

**Exhibit E**

**EXHIBIT G – PRELIMINARY**  
**STORMWATER REPORT**

# SITE HYDRAULICS REPORT

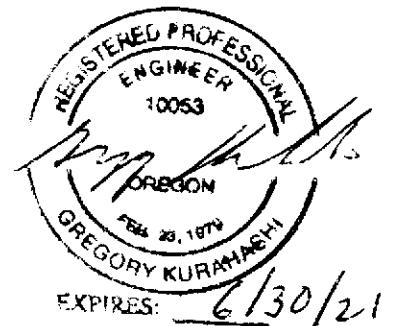
“THE PAD” DRAINAGE REPORT

FOR “THE PAD” DEVELOPMENT

SANDY, OREGON

JULY 6, 2020

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# TABLE OF CONTENTS

**1 Introduction**

**2 Existing Stormwater System**

**3 Proposed Stormwater System**

**4 Storm Water Analysis**

**5 Appendix**

# INTRODUCTION

## 1.1 Project Overview

This report contains the hydrologic and hydraulic design parameters for the “THE PAD” Sandy Development Project at tax lot 1500; Assessor Map 2S-24E-13DB-01500, with the total area is approximately 0.478 acres. The property is situated at 17650 Meinig Avenue in Sandy, Oregon. This report reviews and confirms the information necessary to design on-site conveyance systems as well as water quality treatment facilities for “THE PAD” Sandy Development Project and the retention system on the site which will be located in the south driveway of the development.

Please note that the methodology used to analyze the storm water conveyance system uses a computer program (Hydraflow 2002 by inteliSOLV) that uses SCS unit hydrograph as the method for calculating the Storm Flow. The land for the development required the use of a Contech storm filter system for treatment. The plan includes 1 Contech manhole storm filter that is shown on the C3 Utility Plan attached in the appendix.

## 1.2 Existing Conditions

The site originally had a home, shed and yard that encompassed the central portion of the property. The structures are no longer present.

## 1.3 Proposed Improvements

The proposed development will include a 10 unit 2 story townhouse apartments. 6 units will be on the south end while 4 will be on the north end of the development. 1 handicap parking space and 20 regular parking spaces will be provided. Six 9’x18’ parking spaces will be on the north end while seven 9’x19’ parking spaces will be on the east side and seven 9’x18’ parking spaces the south side along with the 9’x18’ handicap space and 9’x18’ handicap loading zone. The southwest corner of the development will have mail boxes, picnic tables and a grassy recreation area. The East side of the lot will have a trash/recycling enclosure at the southern end. The site will have a grassy recreation area with trees and a gazebo bordered by the south, east and north portions of the development as well as the west property line. The building and parking rain water collection system will be directed to the SE area of the parking lot in front of the trash/recycling enclosure. The storm water after detention and treatment will accommodate the 1yr, 2yr, 5yr, 10yr and 25yr storms using City of Sandy 24 hour rainfall. It will be metered out to retain the flow to reduce the storms to be stored and discharged at the same rate that the project discharged at existing conditions. The discharges will no longer be overland to City and Park District property but directed to the ditch along Meinig Ave. Storm drainage will be

detained in a system of two 40' pipes 5' in diameter pipes. The project is in a location that does not allow for significant infiltration and this could be dangerous to downstream areas.

## **Existing Stormwater System**

The existing system discharged storm drainage was discharge from the original house roof to daylight on to the ground and then be discharged overland to the city property and to the Park southeasterly from the property this water has no direct discharge to a channel. Continuing the discharge in pipes or overland would require approval of the Park district and require DSL and Corps approval to discharge with pipes to the street. By directing the flow to the existing storm drainage system of pipes we would not require approval because it enters a City pipes system after discharging to a ditch along Meinig Ave.

# Storm Water Analysis

## 4.1 Design Solution:

The proposed storm water design on property includes: One catch basin, 2 5' diameter 40' long detention pipes, one detention manhole, and a water quality manhole.

## 4.2 Design Assumptions and Parameters of Detention

City of Sandy Rainfall in Inches per 24 hour period: 3.5 (2 year), 4.5 (5 year), 4.8 (10 year), 5.5 (25 year),  
6.5 (100 year)

Impervious Area of Roof, Driveway Sidewalks and Patio

Prior to Development.: 0.0 Acres

CN# used for Impervious areas: 98

Length N/A

Time interval of analysis: N/A

Unit Hydrograph: N/A

Storm Distribution: Type 1A

Area of Site Prior to Development.: 0.65 Acres (Including Large Right of Way)

CN# used for Pervious areas: 77

Slope: 15%

Length: 125 Feet

Time interval of analysis: 1 minute

Unit Hydrograph: Lag

Storm Distribution: Type 1A

Impervious Area of Roof, Driveway, Sidewalks and Deck

after Development: 0.478 Acres

CN# used for Impervious areas: 98

Slope: 2%

Length: 100 Feet

Time interval of analysis: 1 minute

Unit Hydrograph: Lag

Storm Distribution: Type 1A

Area of Landscaping after Development: 0.21 Acres

CN# used for Pervious areas: 77

Slope: 15%

Length: 125 Feet

Time interval of analysis: 1 minute

Unit Hydrograph: Lag

Storm Distribution: Type 1A

### **4.3 Reservoir Analysis:**

Please note the proposed Detention utilizes no percolation.

The storage was developed using detention pipes to modify the discharge to pre-development levels.

The pipe system uses 80 lineal feet of 5 foot diameter N12 PVC conduits.

Most of the storm water collection system backwaters into the detention pipes.

Attached in the Appendix is the Reservoir Stage Storage Discharge Table (Reservoir Report)

The report analyzes a 2.4 inch orifice at the bottom of the pipe storage a 2.8 inch orifice at 2.5 feet and a 2 inch orifice at 4.15 feet which was never reached. The Final Analysis will refine the preliminary design and may change to Storm Tech Chambers.

This utilizes 1,288 cubic feet of storage of the 1571 cubic feet of pipe storage available.

### **4.4 Design Flow Analysis:**

The values of discharge for each storm are tabulated. On the tables provided for each return interval in the Appendix. Below are the comparisons of peak discharge or each return interval.

Return Interval	Existing (CFS)	Proposed (CFS)
2 Year	0.19	0.19
5 Year	0.32	0.32
10 Year	0.36	0.36
25 Year	0.43	0.43

#### 24 hour Statistical Storm Data:

Storm Inches Peak Flow (cfs)

Year in 24

	Hours	Impervious	Pervious	Combined	Existing	Detention
2	3.5"	0.37	0.06	0.43	0.19	0.19
5	4.5"	0.48	0.10	0.58	0.32	0.32
10	4.8"	0.52	0.12	0.63	0.36	0.36
25	5.5"	0.59	0.15	0.74	0.46	0.43
100	6.5"					

The allowable discharge that was the limit for Developed Discharge.



#### **4.5 CONCLUSION:**

Based on the analysis and findings above, the proposed stormwater drainage system complies with the requirements of the City of Sandy.

# Appendix

	PAGE
THE PAD Development UTILITY PLAN	1
THE PAD Development Original Site Conditions	2
Runoff Curve Numbers	3
RESERVOIR REPORT	4
FLOW SUMMARY REPORTS (.5 YEAR HYDO MOD. WQ), 2,5,10,25 YR. RET. PER.	5-8





**Table 2.2**  
**Runoff Curve Numbers for Selected Agricultural, Suburban, and Urban Areas**

(Sources: TR 55, 1986, and Stormwater Management Manual, 1992. See Section 2.1.1 for explanation)

Cover type and hydrologic condition.	CNs for hydrologic soil group			
	A	B	C	D
<b>Curve Numbers for Pre-Development Conditions</b>				
<b>Pasture, grassland, or range-continuous forage for grazing:</b>				
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
<b>Woods:</b>				
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
<b>Curve Numbers for Post-Development Conditions</b>				
<b>Open space (lawns, parks, golf courses, cemeteries, landscaping, etc.)<sup>1</sup></b>				
Fair condition (grass cover on 50% - 75% of the area).	77	85	90	92
Good condition (grass cover on >75% of the area)	68	80	86	90
<b>Impervious areas:</b>				
Open water bodies: lakes, wetlands, ponds etc.	100	100	100	100
Paved parking lots, roofs <sup>2</sup> , driveways, etc. (excluding right-of-way)	98	98	98	98
<b>Permeable Pavement (See Appendix C to decide which condition below to use)</b>				
Landscaped area	77	85	90	92
50% landscaped area/50% impervious	87	91	94	96
100% impervious area	98	98	98	98
Paved	98	98	98	98
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
<b>Pasture, grassland, or range-continuous forage for grazing:</b>				
Poor condition (ground cover <50% or heavily grazed with no mulch).	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed).	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
<b>Woods:</b>				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning).	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil).	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil).	30	55	70	77
<b>Single family residential<sup>3</sup>:</b>	Should only be used for subdivisions > 50 acres	Average Percent impervious area <sup>3,4</sup>		
Dwelling Unit/Gross Acre				
1.0 DU/GA		15	Separate curve number	
1.5 DU/GA		20	shall be selected for	
2.0 DU/GA		25	pervious & impervious	
2.5 DU/GA		30	portions of the site or	
3.0 DU/GA		34	basin	
3.5 DU/GA		38		
4.0 DU/GA		42		
4.5 DU/GA		46		
5.0 DU/GA		48		
5.5 DU/GA		50		
6.0 DU/GA		52		
6.5 DU/GA		54		
7.0 DU/GA		56		
7.5 DU/GA		58		
PUD's, condos, apartments, commercial businesses, industrial areas & subdivisions < 50 acres	%impervious must be computed	Separate curve numbers shall be selected for pervious and impervious portions of the site		

For a more detailed and complete description of land use curve numbers refer to chapter two (2) of the Soil Conservation Service's Technical Release No. 55, (210-VI-TR-55, Second Ed., June 1986).

<sup>1</sup> Composite CN's may be computed for other combinations of open space cover type.

<sup>2</sup> Where roof runoff and driveway runoff are infiltrated or dispersed according to the requirements in Chapter 3, the average percent impervious area may be adjusted in accordance with the procedure described under "Flow Credit for Roof Downspout Infiltration" (Section 3.1.1), and "Flow Credit for Roof Downspout Dispersion" (Section 3.1.2).

<sup>3</sup> Assumes roof and driveway runoff is directed into street/storm system.

<sup>4</sup> All the remaining pervious area (lawn) are considered to be in good condition for these curve numbers.

# Reservoir Report

## Reservoir No. 1 - Detention Pipe

### Pond Data

Pipe diameter = 5.00 ft    Pipe length = 160.0 ft    Pipe slope = 0.00 %    Invert elev. = 100.00 ft

### Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	00	0	0
0.25	100.25	00	29	29
0.50	100.50	00	52	82
0.75	100.75	00	66	148
1.00	101.00	00	76	224
1.25	101.25	00	84	307
1.50	101.50	00	89	397
1.75	101.75	00	94	490
2.00	102.00	00	96	587
2.25	102.25	00	99	686
2.50	102.50	00	100	786
2.75	102.75	00	100	885
3.00	103.00	00	99	985
3.25	103.25	00	97	1,081
3.50	103.50	00	93	1,175
3.75	103.75	00	89	1,264
4.00	104.00	00	84	1,348
4.25	104.25	00	76	1,423
4.50	104.50	00	66	1,489
4.75	104.75	00	52	1,542
5.00	105.00	00	29	1,571

### Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 2.4	2.8	2.0	0.0
Span in	= 2.4	2.8	2.0	0.0
No. Barrels	= 1	1	1	0
Invert El. ft	= 100.00	102.50	104.15	0.00
Length ft	= 10.0	10.0	10.0	0.0
Slope %	= 1.00	1.00	1.00	0.00
N-Value	= .013	.013	.013	.000
Orif. Coeff.	= 0.60	0.60	0.60	0.00
Multi-Stage	= n/a	No	No	No

### Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 0.00	0.00	0.00	0.00
Crest El. ft	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft    Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

### Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Civ A cfs	Civ B cfs	Civ C cfs	Civ D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	100.00	0.00	0.00	0.00	---	---	---	---	---	---	0.00
0.25	29	100.25	0.05	0.00	0.00	---	---	---	---	---	---	0.05
0.50	82	100.50	0.08	0.00	0.00	---	---	---	---	---	---	0.08
0.75	148	100.75	0.10	0.00	0.00	---	---	---	---	---	---	0.10
1.00	224	101.00	0.12	0.00	0.00	---	---	---	---	---	---	0.12
1.25	307	101.25	0.13	0.00	0.00	---	---	---	---	---	---	0.13
1.50	397	101.50	0.15	0.00	0.00	---	---	---	---	---	---	0.15
1.75	490	101.75	0.16	0.00	0.00	---	---	---	---	---	---	0.16
2.00	587	102.00	0.17	0.00	0.00	---	---	---	---	---	---	0.17
2.25	686	102.25	0.18	0.00	0.00	---	---	---	---	---	---	0.18
2.50	786	102.50	0.19	0.00	0.00	---	---	---	---	---	---	0.19
2.75	885	102.75	0.20	0.06	0.00	---	---	---	---	---	---	0.26
3.00	985	103.00	0.21	0.10	0.00	---	---	---	---	---	---	0.32
3.25	1,081	103.25	0.22	0.14	0.00	---	---	---	---	---	---	0.36
3.50	1,175	103.50	0.23	0.16	0.00	---	---	---	---	---	---	0.39
3.75	1,264	103.75	0.24	0.18	0.00	---	---	---	---	---	---	0.42
4.00	1,348	104.00	0.24	0.20	0.00	---	---	---	---	---	---	0.45
4.25	1,423	104.25	0.25	0.22	0.02	---	---	---	---	---	---	0.49
4.50	1,489	104.50	0.26	0.24	0.04	---	---	---	---	---	---	0.54
4.75	1,542	104.75	0.27	0.25	0.06	---	---	---	---	---	---	0.58
5.00	1,571	105.00	0.27	0.26	0.07	---	---	---	---	---	---	0.61

Hyd. No.	Hydrograph type	Peak flow	Time interval	Time to peak	Volume	Inflow hyd(s)	Maximum elevation	Maximum storage	Hydrograph description
	(origin)	(cfs)	(min)	(min)	(cuft)		(ft)	(cuft)	
1	SCS Runoff	0.37	1	469.00	5,309				Pad Impervious
2	SCS Runoff	0.06	1	477.00	1,021				The Pad Pervious
3	Combine	0.43	1	470.00	6,330	1, 2			Combined Site
4	SCS Runoff	0.19	1	477.00	3,160				Existing Conditions
5	Reservoir	0.19	1	500.00	6,309	3	102.33	718	Detention Pipe
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Hyd. No.	Hydrograph type	Peak flow	Time interval	Time to peak	Volume	Inflow hyd(s)	Maximum elevation	Maximum storage	Hydrograph description
	(origin)	(cfs)	(min)	(min)	(cuft)		(ft)	(cuft)	
1	SCS Runoff	0.48	1	469.00	6,931				Pad Impervious
2	SCS Runoff	0.10	1	475.00	1,578				The Pad Pervious
3	Combine	0.58	1	470.00	8,509	1, 2			Combined Site
4	SCS Runoff	0.32	1	475.00	4,884				Existing Conditions
5	Reservoir	0.32	1	489.00	8,475	3	103.03	998	Detention Pipe
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Hyd. No.	Hydrograph type	Peak flow	Time interval	Time to peak	Volume	Inflow hyd(s)	Maximum elevation	Maximum storage	Hydrograph description
	(origin)	(cfs)	(min)	(min)	(cuft)		(ft)	(cuft)	
1	SCS Runoff	0.52	1	469.00	7,418				Pad Impervious
2	SCS Runoff	0.12	1	475.00	1,754				The Pad Pervious
3	Combine	0.63	1	470.00	9,171	1, 2			Combined Site
4	SCS Runoff	0.36	1	475.00	5,428				Existing Conditions
5	Reservoir	0.36	1	488.00	9,131	3	103.25	1,081	Detention Pipe
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Hyd. No.	Hydrograph type	Peak flow	Time interval	Time to peak	Volume	Inflow hyd(s)	Maximum elevation	Maximum storage	Hydrograph description
	(origin)	(cfs)	(min)	(min)	(cuft)		(ft)	(cuft)	
1	SCS Runoff	0.59	1	469.00	8,554				Pad Impervious
2	SCS Runoff	0.15	1	474.00	2,175				The Pad Pervious
3	Combine	0.74	1	470.00	10,729	1, 2			Combined Site
4	SCS Runoff	0.46	1	474.00	6,731				Existing Conditions
5	Reservoir	0.43	1	487.00	10,673	3	103.82	1,288	Detention Pipe
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