

# **DRAINAGE PUMP DESIGN**

**FOR**

**SINGLE FAMILY RESIDENCE**

**2419 72<sup>ND</sup> AVE SE**

**MERCER ISLAND, WA 98040**

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## I. PROJECT OVERVIEW

This report provides the driveway drainage pump system design calculation for the redevelopment of a single-family residence building. The driveway drainage runoff cannot be drained by gravity to the roadway drainage system and hence a pump is needed. The pump system will include the footing drain runoff using 2 gpm flow rate.

### A. Pump Design Requirements:

Per city requirements:

- a. The pump system shall have dual, alternating pumps with emergency on-site, back-up power supply and an external alarm system for system failure and highwater level indicator.
- b. Provide a detail section for the pump system and the structure with all dimensions and invert elevations shown.
- c. Pumped flows shall not exceed the allowable discharge rates set forth herein. Each pump shall be capable of discharging the design flow rate for the 100-year, 24-hour design storm. Provide detail calculations for the pump system including pump curve.
- d. If a stormwater detention system is not required the pump system shall have a storage facility (pond, tank, or vault) sized to hold 25 percent of the total volume of runoff for the developed tributary drainage area for the 2-year, 24-hour design storm.
- e. The pump system shall discharge to an elevation higher than the downstream design water surface elevation to prevent backwater/backflow conditions. Provide such design.



**II. PUMP DESIGN DESIGN**

The calculated peak runoffs using the SBUH methodology are as follow:

Drainage area= 396 S.F. (0.0091 acs)

The proposed driveway design storm flow frequencies are calculated as follow:

- 2-yr/24hr – 0.0041 cfs
- 25-yr/24hr – 0.0075 cfs
- 100-yr/24hr – 0.0086 cfs

The flow rate for the footing drain is estimated to be 2 gpm and added to the peak runoff for pump calculation.

25% Storage facility required for non-detention system:

2-yr/24hr peak volume = 0.0013 ac-ft = 423.6 gallon

25% of storage volume = 105.9 gallon

The 3-ft diameter pump well with 3’ sump provide 158.6 gallon of volume > 105.9 gallon. O.k.

**A. SUMMARY OF INPUT DATA:**

Drainage area = 1005 SF

TIME OF CONCENTRATION CALCULATIONS

24 hr. ISOPLUVIALS:

P2=	2.00	in/day
P10=	3.00	in/day
P100=	4.00	in/day

sheet flow:	$Tt = \{(.42)(Ns*L)^{0.8}\}/\{(P2)^{0.5}*(So)^{0.4}\}$
conc. flow:	$Tt = L/(60*Ks*(So)^{0.5})$

TIME OF CONCENTRATION CALCULATIONS

Existing	Status	Length	Ns	Ks	So%(ave)	Tt(min)	Tc Used (min.)
Segment							
<b>Proposed</b>							
Impervious	Sheet Flow	41	0.011		13.3	0.37	5
Pervious	Sheet Flow						

**B. DEVELOPED PEAK FLOW CALCULATION:**

**Project Precips**

[2 yr]	2.00 in
[5 yr]	2.80 in
[10 yr]	3.00 in
[25 yr]	3.50 in
[100 yr]	4.00 in
[6-mo]	1.28 in

**Dev1 Event Summary:**

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
-----							
Dev1	0.0041	7.83	0.0013	0.01	SBUH/SCS	TYPE1A	2 yr
Dev1	0.0064	7.83	0.0021	0.01	SBUH/SCS	TYPE1A	10 yr
Dev1	0.0075	7.83	0.0025	0.01	SBUH/SCS	TYPE1A	25 yr
Dev1	0.0086	7.83	0.0029	0.01	SBUH/SCS	TYPE1A	100 yr

**Drainage Area: Dev1**

Hyd Method:	SBUH Hyd	Loss Method:	SCS CN Number
Peak Factor:	484.00	SCS Abs:	0.20
Storm Dur:	24.00 hrs	Intv:	10.00 min
	Area	CN	TC
Pervious	0.0000 ac	86.00	0.00 hrs
Impervious	0.0091 ac	98.00	0.01 hrs
Total	0.0091 ac		

**Supporting Data:**

**Impervious CN Data:**

Driveway	98.00	0.0091 ac
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**Impervious TC Data:**

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	Overland	43.00 ft	13.30%	0.0110	0.37 min

**C. STORM DUPLEX PUMP DESIGN:**

**2419 72nd Ave SE, Mercer Is, WA - STORM PUMP CAPACITY ANALYSIS**

11/13/2024

STORM WATER LIFT STATION DESIGN

A. DETERMINE THE REQUIRED RATE OF PUMPING;

100-YR PEAK FLOW, Q<sub>max</sub> = 0.0086 cfs = 5.9 GPM (From SBUH)  
(Including ftg.flow 2gpm)

B. COMPUTE THE STORAGE REQUIREMENT FOR THE WETWELL:

USING 2 PUMPS AND 1 CYCLE PER HOUR  
TIME FOR ONE PUMP CYCLE:

$$T=(V/Q-S)+(V/S)$$

Where:

T = THE TIME FOR ONE PUMP CYCLE IN MINUTES = 120  
 V = THE EFFECTIVE VOLUME OF THE WETWELL IN GALLON = V  
 Q = THE PUMPING RATE IN GALLONS PER MINUTE = 6  
 S = THE FLOW INTO THE WETWELL IN GALLONS PER MINUTE = 3.8 0.0041 cfs  
 (Using 2-yr Peak)  
 (Plus ftg. drain )

$$V = TS(Q-S)/Q = 159$$

USE 3 FEET DIAMETER WET WELL  
 VOLUME PER FOOT = 52.87 GAL/FT  
 WORKING DEPTH = 3.00 FEET

C. DETERMINE THE FORCEMAIN DIAMETER:

Q<sub>max</sub> = 5.9 GPM = 0.01 CFS

MAXIMUM CROSS SECTION REQUIRED = 0.00 SF  
 (FOR VEL. = 3 FPS) = 0.63 SI

USE 2 INCH DIAMETER HDPE PIPE, V= Q/A  
 ( 0.02 (SF) = 0.60 FPS ~ 3 FPS Used)  
 FOR 3 INCH DIAMETER HDPE PIPE, V= Q/A  
 0.05 (SF) = 0.27 FPS << 3FPS NG

D. DETERMINE HEAD LOSS OF HDPE FORCE MAIN:

$$H = (Q / (0.006757)(C)(D^{2.63}))^{1.85}$$

WHERE: H = THE HEAD LOSS IN FEET PER 1000 FEET OF PIPE = H  
 Q = THE FLOW IN GALLON PER MINUTE = 6  
 C = THE HAZEN-WILLIAM COEFFICIENT OF ROUGHNESS = 140  
 D = THE PIPE DIAMETER IN INCHES = 2 USED

H = 1.00 FEET (for 3-in Diameter Pipe)

LENGTH OF PIPE = 65 FEET HEAD LOSS IN PIPE = 0 FT.

E. COMPUTE THE TOTAL DYNAMIC HEAD (TDH)

a) STATIC DISCHARGE HEAD = 7.16 FEET  
 DISCHARGE ELEVATION = 221.16  
 PUMP OFF ELEVATION = 214

b) MINOR LOSSES = 5.9  
 2 - 90 DEG. ELL = 1.4  
 1 - GATE VALVE = 0.2  
 1 - CHECK VALVE = 2.5  
 1 - TEE = 1.8

c) TOTAL DISCHARGE HEAD LOSS = 13.13 FEET

G. COMPUTE THE REQUIRED BRAKE HORSEPOWER:

Hp<sub>brake</sub> = (GPM x TDH) / (3960 X EFF.) = 0.03 (Required Pump) USING SUBMERSIVE PUMP WITH EFF. OF 60 % (Use 1/3 HP pump)

WHERE: GPM = FLOW RATE IN GALLON PER MINUTE  
 TDH = TOTAL DYNAMIC HEAD OF THE SYSTEM IN FEET WHEN DELIVERING THE REQUIRED FLOW RATE  
 3930 = A CONSTANT  
 EFF = PUMP EFFICIENCY EXPRESSED IN DECIMAL FORM

**D. PUMP CURVE:**

Use Goulds Pump WS\_BHF Series, Model WE0318L (1/3 HP) or Equal.  
See Plan for pump details.

