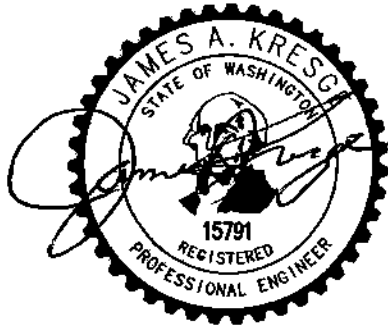


PEAK



ENGINEERING, INC.

**CONSTRUCTION
DRAINAGE REPORT
FOR
BEN WELLS
OFFICE BUILDING
City of Arlington
CFN: PLN 20090012**



DATE: 04/20/2009

**Prepared By: Brian R Lindsay
Peak Engineering, Inc.**

**March 31, 2009
Peak Job #1093**

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COA Engineering Dept.

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SOIL MAP
DEVELOPED CONDITIONS BASIN MAP
DOWNSTREAM ANALYSIS BASIN MAP EXHIBIT
TREATMENT FACILITY SELECTION FLOW CHART (FIGURE 4.1)
SWPPP RISK CATEGORY DECISION MATRIX

DRAINAGE INFORMATION SUMMARY FORM

Project Total Area: 0.17 acres

Project Development Area: 0.17 acres

Number of Lots (if applies): n/a

Summary Table

Drainage Basin Information	Individual Basin Information			
	SITE			
On-Site Sub-basin Area (ac)	0.17			
Type of Storage Proposed	Direct Discharge to Receiving Body of water			
Approx. Storage Volume (ft ³)	N/A			
Soil Type(s)	Alderwood-Everett Gravelly sandy loam			
Pre-developed Runoff Rates	N/A			
Q (cfs) 2 yr.				
10 yr.				
100 yr.				
Redevelopment Area	N/A			
Post-development Runoff Rates	N/A			
Q (cfs) 2yr.				
10 yr.				
100 yr.				
Offsite Upstream Area (ac)				
Number of acres				
Offsite Downstream Flow				
Q (cfs)				

SECTION I

INTRODUCTION AND EXISTING CONDITIONS

This project will construct a commercial office building and associated parking on approximately 0.17 acre site. The site is located at the northwest corner of Burke Ave and Newberry St with a site address of 229 Burke Avenue in the City of Arlington. The development area is relatively flat. The Soil Survey of Snohomish County identified the onsite soils as Alderwood-Everett gravelly sandy loam. (Hydrologic Soils Group A) The permeability of Alderwood-Everett soils is rapid and is suitable for infiltration, runoff is medium and hazard of water erosion is moderate.

The City of Arlington identified a potential erosion issue on the adjoining residential lots along the river making infiltration of onsite storm runoff unsuitable.

There are no buildings on the site currently. As such, no demolition will be required on site prior to development. The site is vegetated with light underbrush.

DEVELOPED CONDITIONS

The site's parking will be accessed from the Alley off of Newberry St. This site discharges to a Flow Control-Exempt Receiving Waters and is exempt of Flow Control per Volume I Section 2.5.7 of the 2005 DOE Stormwater Management Manual for Western Washington. No detention is proposed for this site. A backwater analysis of the existing downstream conveyance system to public storm drainage conveyance system within Haller Ave indicates adequate capacity for up to and including the 100yr storm event and is included in Section II of this drainage report.

Frontage improvements will consist of extending the existing sidewalk and asphalt roadway along Newberry Street. The Alley will also be widened along the site's north boundary.

Water Quality for the new onsite pollution generating asphalt surfaces will be provided by directing runoff to a Rain Garden placed onsite along the northern portion of Newberry St site boundary. The rain garden will be provided with a UV protected impervious membrane to prevent infiltration of runoff to the natural ground to prevent erosion on the adjacent properties. A Beehive grate has been provided as an emergency overflow of the rain garden facility to contain runoff and direct runoff to public downstream conveyance system. Non pollution generating roof surfaces will be conveyed to a new CB to bypass the rain garden facility.

Runoff rates and volume calculations for the backwater analysis were performed, using SBUH and SCS Curve Number methodologies in "StormSHED" by Engenious Systems (See Section II). The water quality storm event was determined by the water quality menu within the WWHM3 stormwater model.

WATER QUALITY

To meet water quality criteria, storm drainage from pollution generating surfaces will be directed to a Rain Garden (Bioretention area) adjacent to Newberry St. The treatment facilities were selected per Figure 4.1 (attached to the Appendix of this report) Treatment Facility Selection Flow Chart in Volume I of the DOE Manual. The Rain Garden has been designed and will be planted in accordance with criteria found in the Low Impact Development Technical Guidance Manual for Puget Sound. A dead storage volume of 418 cf (440 cf provided within 35 % void

space) for the 6-month water quality storm event, as determined by the WWHM3 hydraulic model, will be directed to and accumulate within the Rain Garden. The bottom and sides of the rain Garden will be lined with an impervious membrane to avoid infiltration to the sensitive soils existing on site. Runoff within the Rain Garden will be collected by a 6" dia infiltration under drain discharge pipe and conveyed to the downstream catch basin within the alley north of the site. See sizing calculations in Section II of this report.

OPERATION AND MAINTENANCE

The roof downspout, storm drainage piping system and Rain Garden shall be inspected annually to ensure that sediment is not filling up the catchments and shall be cleaned as necessary. Additionally, undesirable vegetation that has the potential to interfere with performance of or damage to the Rain Garden system shall be removed. The drainage system shall be inspected after large storm events to ensure debris has not caused a blockage and is not hindering the system's performance. Maintain a record of inspections and maintenance activities on site and made available upon request to the city. For additional information see Section III for the Operation and Maintenance Manual.

EROSION CONTROL RISK ASSESSMENT AND SWPPP

The project was evaluated to determine the erosion risk category and generate a Storm Water Pollution Prevention Plan (SWPPP). The soil on the proposed project site is classified as Alderwood-Everett gravelly sandy loam, which has a medium erosion risk categorization. The site is flat and the project is not located within ¼ mile of a critical area.

A Storm Water Pollution Prevention Plan (SWPPP) has been prepared for this project, which will comply with City and State of Washington D.O.E. standards for erosion control. The site is less than one acre in size, so an NPDES construction permit is not required.

Erosion control BMP's will include leaving existing vegetation as much as practical around the site. Temporary cover and/or surface roughening of exposed areas (mulching, plastic, etc.) will be provided. Measures to limit the level of sediment leaving the site will include silt fences and inlet protection of catch basins.

CONVEYANCE SYSTEM

The design Q_{100yr} post-developed peak flow rate is less than 0.35 cfs. Runoff from the Rain Garden, outfalls to the existing CB located within the Alley. The slope leading to the CB is 1.17%. Conservatively, the 8" dia. conveyance pipe was evaluated using Manning's Equation and determined to have a normal flow depth of 0.23 ft (2.75") (calculations attached in the Section II of this report). A backwater analysis of the downstream pipe conveyance system has been provided to analyze the capacity of the downstream conveyance system. No overtopping of the existing structures is predicted by the calculations. No concerns regarding the proposed conveyance system's ability to convey the developed flow rates have been observed.

UPSTREAM/DOWNSTREAM CONDITIONS

No off site upstream areas contribute runoff to the Ben Wells site. Stormwater runoff for the site and Newberry St currently collects at the three existing CB's within the Alley along the north boundary of the site. At approximately 30 ft east of the northwest corner of the site a type 1 CB with a potential headwater depth of 2.5 ft, runoff is directed to the north in an 8" diameter PVC

pipe. For additional information see the Downstream Analysis Basin Map Exhibit attached to the Appendix of this report. Runoff from the CB centered within the Alley way flows north 112 ft to a type 1 CB within the unopened right-of-way of the extension of Haller Ave, where runoff is directed approximately 150 ft to the west to the asphalt roadway and the start of Haller Ave. The 8" PVC pipe is connected to a type 1 CB that directs runoff to the north side of Haller Ave. At the north side of Haller Ave a 12" HDPE public storm drainage conveyance system conveys runoff to the west. The Broadway ST conveyance system discharges to the South Fork of the Stillaguamish River system a receiving body of water. A backwater analysis has been provided to the existing 12" public conveyance system within Haller Ave. No impacts to the down stream conveyance system are anticipated with the addition of the Ben Well's site.

SECTION II

BEN WELLS

RAIN GARDEN WATER QUALITY DESIGN:

Western Washington Hydrology Model
PROJECT REPORT

Project Name: 1093-BEN WELLS WQ
Site Address:
City : ARLINGTON
Report Date : 12/31/2008
Gage : Everett
Data Start : 1948/10/01
Data End : 1997/09/30
Precip Scale: 1.20
WWHM3 Version:

PREDEVELOPED LAND USE

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>Acres</u>
A B, Forest, Flat	.1

<u>Impervious Land Use</u>	<u>Acres</u>
----------------------------	--------------

Element Flows To:

Surface	Interflow	Groundwater
---------	-----------	-------------

Name : Basin 1
Bypass: No

GroundWater: No

<u>Pervious Land Use</u>	<u>Acres</u>
A B, Lawn, Flat	.02

<u>Impervious Land Use</u>	<u>Acres</u>
DRIVEWAYS FLAT	0.036
SIDEWALKS FLAT	0.007
PARKING FLAT	0.037

Element Flows To:
Surface

Interflow

Groundwater

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.000028
5 year	0.000065
10 year	0.000106
25 year	0.000189
50 year	0.000282
100 year	0.000412

Flow Frequency Return Periods for Mitigated. POC #1

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.028941
5 year	0.038617
10 year	0.045475
25 year	0.05467
50 year	0.061915
100 year	0.069508

Yearly Peaks for Predeveloped and Mitigated. POC #1

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1950	0.000	0.024
1951	0.000	0.042
1952	0.000	0.032
1953	0.000	0.024
1954	0.000	0.033
1955	0.000	0.041
1956	0.000	0.036
1957	0.000	0.017
1958	0.000	0.028
1959	0.000	0.051
1960	0.000	0.028
1961	0.000	0.022
1962	0.000	0.065
1963	0.000	0.029
1964	0.000	0.045
1965	0.000	0.022
1966	0.000	0.021
1967	0.000	0.022
1968	0.000	0.069
1969	0.000	0.037
1970	0.000	0.048
1971	0.000	0.023

1972	0.000	0.031
1973	0.000	0.052
1974	0.000	0.032
1975	0.000	0.036
1976	0.000	0.029
1977	0.000	0.026
1978	0.000	0.021
1979	0.000	0.018
1980	0.000	0.041
1981	0.000	0.021
1982	0.000	0.023
1983	0.000	0.026
1984	0.000	0.027
1985	0.000	0.028
1986	0.000	0.038
1987	0.000	0.037
1988	0.000	0.034
1989	0.000	0.029
1990	0.000	0.030
1991	0.000	0.020
1992	0.000	0.021
1993	0.000	0.024
1994	0.000	0.024
1995	0.000	0.019
1996	0.000	0.024
1997	0.000	0.027
1998	0.001	0.037

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0007	0.0691
2	0.0004	0.0654
3	0.0004	0.0523
4	0.0002	0.0506
5	0.0001	0.0476
6	0.0001	0.0454
7	0.0001	0.0415
8	0.0001	0.0411
9	0.0001	0.0407
10	0.0001	0.0381
11	0.0000	0.0369
12	0.0000	0.0369
13	0.0000	0.0369
14	0.0000	0.0364
15	0.0000	0.0359
16	0.0000	0.0344
17	0.0000	0.0326
18	0.0000	0.0322
19	0.0000	0.0318
20	0.0000	0.0310
21	0.0000	0.0298
22	0.0000	0.0293
23	0.0000	0.0289
24	0.0000	0.0287
25	0.0000	0.0283
26	0.0000	0.0283

27	0.0000	0.0281
28	0.0000	0.0268
29	0.0000	0.0267
30	0.0000	0.0258
31	0.0000	0.0257
32	0.0000	0.0243
33	0.0000	0.0242
34	0.0000	0.0239
35	0.0000	0.0239
36	0.0000	0.0235
37	0.0000	0.0234
38	0.0000	0.0227
39	0.0000	0.0218
40	0.0000	0.0216
41	0.0000	0.0215
42	0.0000	0.0214
43	0.0000	0.0212
44	0.0000	0.0212
45	0.0000	0.0212
46	0.0000	0.0196
47	0.0000	0.0188
48	0.0000	0.0182
49	0.0000	0.0167

Water Quality BMP Flow and Volume for POC 1.
On-line facility volume: 0.0096 acre-feet
On-line facility target flow: 0.01 cfs.
Adjusted for 15 min: 0.0309 cfs.
Off-line facility target flow: 0.0079 cfs.
Adjusted for 15 min: 0.0177 cfs.

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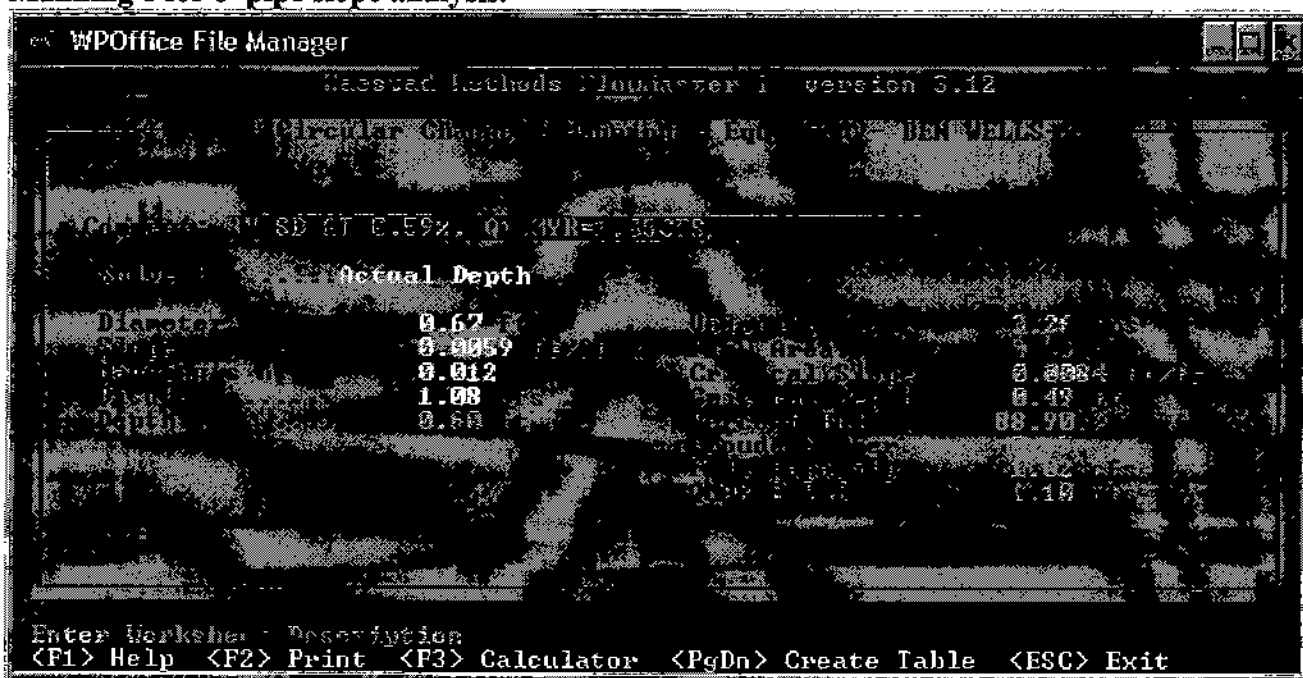
DOWNSTREAM DRAINAGE ANALYSIS

Event Summary:

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
BASIN CB1	0.08	8.00	0.0281	0.27	SBUH/SCS	TYPE1A	2 yr
BASIN CB1	0.12	8.00	0.0443	0.27	SBUH/SCS	TYPE1A	10 yr
BASIN CB1	0.18	8.00	0.0655	0.27	SBUH/SCS	TYPE1A	100 yr
BASIN CB2	0.04	8.00	0.0123	0.11	SBUH/SCS	TYPE1A	2 yr
BASIN CB2	0.05	8.00	0.0192	0.11	SBUH/SCS	TYPE1A	10 yr
BASIN CB2	0.08	8.00	0.0281	0.11	SBUH/SCS	TYPE1A	100 yr
BASIN CB3 POST	0.15	8.00	0.0543	0.51	SBUH/SCS	TYPE1A	2 yr
BASIN CB3 POST	0.23	8.00	0.0855	0.51	SBUH/SCS	TYPE1A	10 yr
BASIN CB3 POST	0.35	8.00	0.1259	0.51	SBUH/SCS	TYPE1A	100 yr
BASIN CB4	0.12	8.00	0.0422	0.41	SBUH/SCS	TYPE1A	2 yr
BASIN CB4	0.18	8.00	0.0668	0.41	SBUH/SCS	TYPE1A	10 yr
BASIN CB4	0.27	8.00	0.0988	0.41	SBUH/SCS	TYPE1A	100 yr
BASIN CB5	0.09	8.00	0.0313	0.31	SBUH/SCS	TYPE1A	2 yr
BASIN CB5	0.13	8.00	0.0498	0.31	SBUH/SCS	TYPE1A	10 yr
BASIN CB5	0.20	8.00	0.0738	0.31	SBUH/SCS	TYPE1A	100 yr

100yr total = 1.08cfs

Worst case 8" pipe at easement from alley to CB at the top of bank. Utilized surveyed information Manning's for 8" pipe slope analysis.



Drainage Area: BASIN CB1

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	0.0900 ac	68.00	0.20 hrs
Impervious	0.1800 ac	98.00	0.10 hrs
Total	0.2700 ac		

Supporting Data:

Pervious CN Data:
LAWN / LANDSCAPING

68.00 0.0900 ac

Impervious CN Data:
IMP

98.00 0.1800 ac

Pervious TC Data:

Flow type: Description:
Fixed TC

Length: Slope: Coeff: Travel Time
0.00 ft 0.00% 12.0000 12.00 min

Impervious TC Data:

Flow type: Description:
Fixed TC

Length: Slope: Coeff: Travel Time
0.00 ft 0.00% 6.0000 6.00 min

Drainage Area: BASIN CB2

Hyd Method: SBUH Hyd
Peak Factor: 484.00
Storm Dur: 24.00 hrs

Loss Method: SCS CN Number
SCS Abs: 0.20
Intv: 10.00 min

Area CN
Pervious 0.0300 ac 68.00
Impervious 0.0800 ac 98.00
Total 0.1100 ac

TC
0.20 hrs
0.10 hrs

Supporting Data:

Pervious CN Data:

LAWN / LANDSCAPING

68.00 0.0300 ac

Impervious CN Data:

IMP

98.00 0.0800 ac

Pervious TC Data:

Flow type: Description:
Fixed TC

Length: Slope: Coeff: Travel Time
0.00 ft 0.00% 12.0000 12.00 min

Impervious TC Data:

Flow type: Description:
Fixed TC

Length: Slope: Coeff: Travel Time
0.00 ft 0.00% 6.0000 6.00 min

Drainage Area: BASIN CB3 POST

Hyd Method: SBUH Hyd
Peak Factor: 484.00
Storm Dur: 24.00 hrs

Loss Method: SCS CN Number
SCS Abs: 0.20
Intv: 10.00 min

Area CN
Pervious 0.1600 ac 68.00
Impervious 0.3500 ac 98.00
Total 0.5100 ac

TC
0.20 hrs
0.10 hrs

Supporting Data:

Pervious CN Data:

LAWN / LANDSCAPING

68.00 0.1600 ac

Impervious CN Data:

EXISTING IMP

98.00 0.2200 ac

NEW IMP

98.00 0.1300 ac

Pervious TC Data:

Flow type: Description:
Fixed TC

Length: Slope: Coeff: Travel Time
0.00 ft 0.00% 12.0000 12.00 min

Impervious TC Data:

Flow type: Description:
Fixed TC

Length: Slope: Coeff: Travel Time
0.00 ft 0.00% 6.0000 6.00 min

Drainage Area: BASIN CB4

Hyd Method: SBUH Hyd
 Peak Factor: 484.00
 Storm Dur: 24.00 hrs

	Area	CN
Pervious	0.1400 ac	68.00
Impervious	0.2700 ac	98.00
Total	0.4100 ac	

Loss Method: SCS CN Number
 SCS Abs: 0.20
 Intv: 10.00 min
 TC
 0.20 hrs
 0.10 hrs

Supporting Data:**Pervious CN Data:**

LAWN / LANDSCAPING 68.00 0.1400 ac

Impervious CN Data:

IMP 98.00 0.2700 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	TC	0.00 ft	0.00%	12.0000	12.00 min

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	TC	0.00 ft	0.00%	6.0000	6.00 min

Drainage Area: BASIN CB5

Hyd Method: SBUH Hyd
 Peak Factor: 484.00
 Storm Dur: 24.00 hrs

	Area	CN
Pervious	0.1100 ac	68.00
Impervious	0.2000 ac	98.00
Total	0.3100 ac	

Loss Method: SCS CN Number
 SCS Abs: 0.20
 Intv: 10.00 min
 TC
 0.20 hrs
 0.10 hrs

Supporting Data:**Pervious CN Data:**

LAWN / LANDSCAPING 68.00 0.1100 ac

Impervious CN Data:

IMP 98.00 0.2000 ac

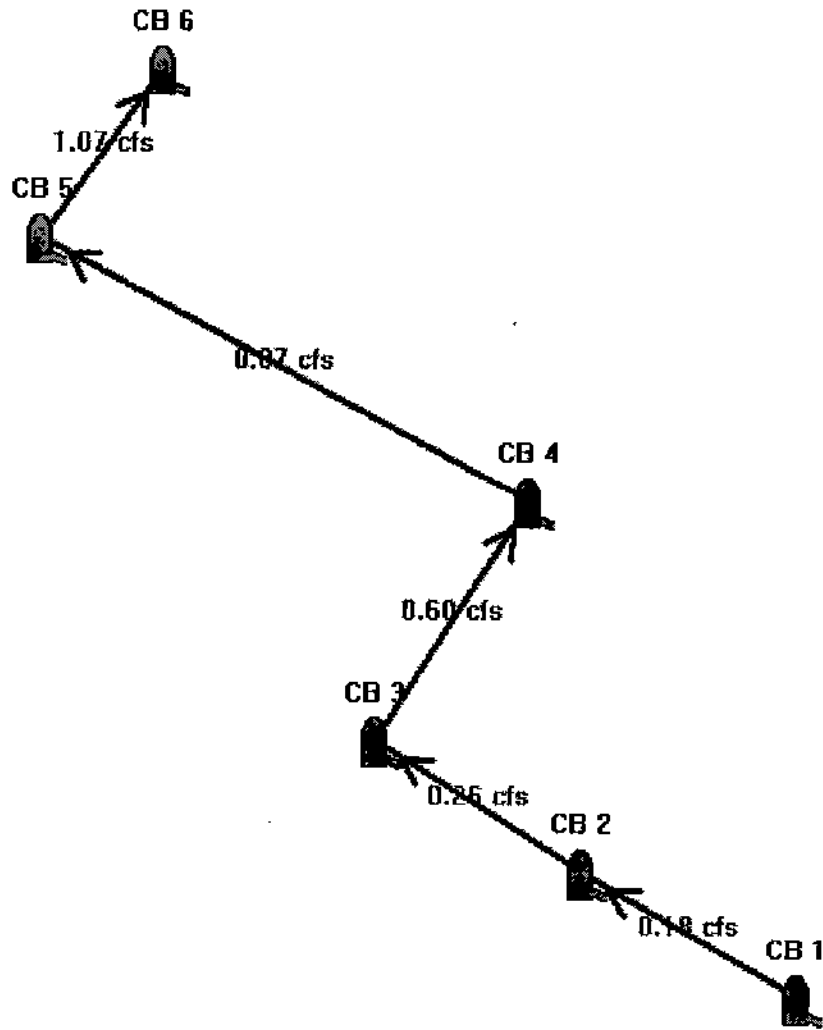
Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	TC	0.00 ft	0.00%	12.0000	12.00 min

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	TC	0.00 ft	0.00%	6.0000	6.00 min

BACKWATER HYDRAULIC ANALYSIS



DOWNSTREAM DRAINAGE COURSE SCHEMATIC
NTS

BACKWATER ANALYSIS:

ROUTEHYD [] THRU [Layout 1] USING TYPE1A AND [100 yr] NOTZERO RELATIVE

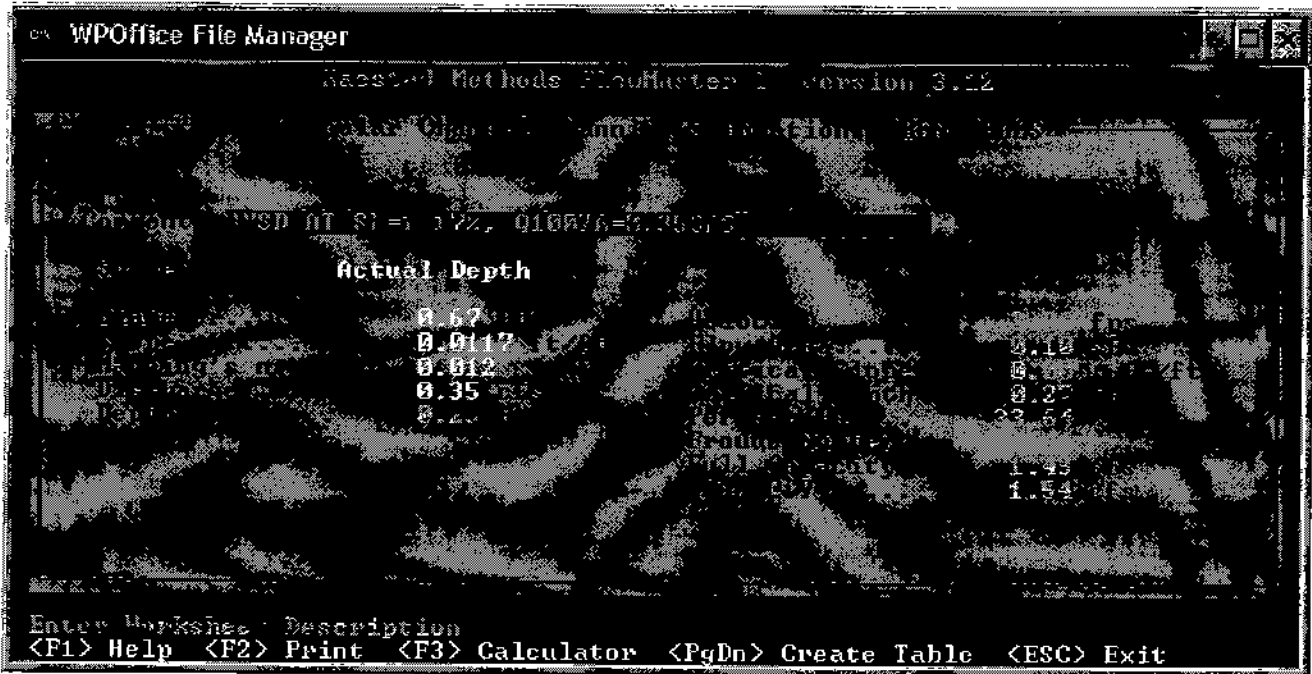
Reach	Area ac	Flow cfs	Full Q cfs	% Full ratio	nDepth ft	Size	nVel ft/s	fVel ft/s	CBasin / Hyd
CB 1 TO CB 2	0.2700	0.1789	1.1518	0.16	0.1776	8" Diam	2.3978	3.2998	BASIN CB1
CB 2 TO CB 3	0.3800	0.2568	0.4151	0.62	0.3794	8" Diam	1.2517	1.1892	BASIN CB2
CB 3 TO CB 4	0.8900	0.6021	1.0083	0.60	0.3711	8" Diam	3.0159	2.8884	BASIN CB3 POST
CB 4 TO CB 5	1.3000	0.8713	1.3126	0.66	0.3969	8" Diam	4.0217	3.7604	BASIN CB4
CB 5 TO CB 6	1.6100	1.0717	2.3845	0.45	0.3133	8" Diam	6.6485	6.8312	BASIN CB5

From Node	To Node	Rch Loss ft	App Head ft	Bend Loss ft	Junct Loss ft	HW Elev ft	Max El/ Rim El ft
CB 5	CB 6	105.6590	0.0967	0.1431	---	104.3500	106.7000
CB 4	CB 5	107.0450	0.0462	0.0620	---	107.0608	110.2500
CB 3	CB 4	107.3657	0.0243	0.0322	---	107.3736	109.4100
CB 2	CB 3	107.4858	0.0893	0.0007	---	107.3972	109.0700
CB 1	CB 2	107.6637	---	---	---	107.6637	108.7000

PIPE FLOW ANALYSIS:

- CB 1 TO CB 2: 8" Diam 0.18 cfs @ 0.7700%
- CB 2 TO CB 3: 8" Diam 0.26 cfs @ 0.1000%
- CB 3 TO CB 4: 8" Diam 0.60 cfs @ 0.5900%
- CB 4 TO CB 5: 8" Diam 0.87 cfs @ 1.0000%
- CB 5 TO CB 6: 8" Diam 1.07 cfs @ 3.3000%

ONSITE CONVEYANCE ANALYSIS:



SECTION III
OPERATIONS & MAINTENANCE MANUAL

OPERATION & MAINTENANCE MANUAL

SECTION III

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OPERATION & MAINTENANCE MANUAL

CATCH BASINS/MANHOLES

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Trash & debris (includes sediment)	Trash or debris of more than ½ ft ³ which is located immediately in front of the catch basin opening or is blocking capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin opening.
		Trash or debris (in the basin) that exceeds 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (i.e. methane).	No dead animals or vegetation present within the catch basin.
		Deposits of garbage exceeding 1 ft ³ in volume.	No condition present which would attract or support the breeding of insects or rodents.
		Trash, debris, or sediment in the basin that exceeds 60% of the sump depth, or trash, debris, or sediment that is within 6" of the invert of the lowest pipe	No trash, debris or sediment within the catch basin
	Structure Damage to Frame and/or top slab	Corner of frame extends more than ¾" past curb face into the street (if applicable).	Frame is even with curb.
		Top slab has holes larger than 2 in ² or cracks wider than ¼" (intent is to make sure all material is running into basin).	Top slab is free of holes & cracks.
		Frame not sitting flush on top slab; i.e. separation of more than ¾" of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in Basin Walls/Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Cracks wider than ½" and longer than 1 ft at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than ¼" wide at the joint of inlet/outlet pipe.
Settlement/Misalignment	Basin has settled more than 1" or has rotated more than 2" out of alignment.	Basin replaced or repaired to design standards.	
Fire Hazard	Presence of chemicals such as natural gas, oil, and/or gasoline.	No flammable chemicals present.	
Vegetation	Vegetation growing across & blocking more than 10% of the basin opening.	No Vegetation blocking opening to basin.	
	Vegetation growing in inlet/outlet pipe joints that is more than 6" tall and less than 6" apart.	No vegetation or root growth present.	
Pollution	Non-flammable chemicals of more than ½ ft ³ per 3 ft of basin length.	No pollution present other than surface film.	

OPERATION & MAINTENANCE MANUAL

CATCH BASINS/MANHOLES

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by 1 maintenance person with proper tools. Bolts into frame have less than 1/2" of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	1 Maint. person cannot remove lid after applying 80 lbs of lift; intent is to keep cover from sealing off access to maintenance personnel.	Mechanism opens with proper tools.
Ladder	Ladder rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards & allows maint. personnel safe access.
Metal Grates (if applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8"	Grate meets design standards.
	Trash & Debris	Trash & debris that is blocking more than 20% of grate surface.	Grate is free of trash & debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place & meets design standards.

OPERATION & MAINTENANCE MANUAL

CONVEYANCE SYSTEMS (PIPES, DITCHES & SWALES)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
Pipes	Sediment & Debris	Accumulated sediment that exceeds 20% of the pipe.	Pipe cleaned of all sediment & debris.
	Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipe.
	Damaged	Protective coating is damaged; rust is causing more than 50% deterioration to any part of the pipe.	Pipe repaired or replaced.
		Any dent that decreases the cross sectional area of the pipe by more than 20%.	Pipe repaired or replaced.
Open Ditches	Trash & Debris	Trash & debris exceeds 1 ft ³ per 1,000 ft of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flow freely through ditches.
	Erosion Damage to Slopes	Erosion of the ditch's side slopes and/or scouring of the ditch bottom that exceeds 6", or where continued erosion is prevalent.	Slopes should be stabilized by using proper erosion control measures, and repair methods.
	Rock Lining out of Place or Missing (if Applicable)	Maintenance person can see native soil beneath the rock lining.	Replace rocks to design standards.
Swales	Trash & Debris	See above for ditches	See above for ditches.
	Sediment buildup	See above for ditches	Vegetation may need to be replanted after cleaning.
Catch Basins		See "Catch Basins" standard.	See "Catch Basins" standard.
Debris Barriers (e.g. Trash Rack)	Sediment & Debris	Accumulated sediment/debris that exceeds 20% the inlet opening.	Debris barrier is free of sediment & debris.
	Vegetation	Vegetation obstructs more than 20% of the inlet opening.	Debris barrier is free of obstructing vegetation.

OPERATION & MAINTENANCE MANUAL

BIORETENTION AREA (RAIN GARDEN)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
Rain Garden	Sediment Accumulation	Sediment depth exceeds 2".	No sediment deposits on grass layer of the rain garden, which would impede filtration of runoff.
	Vegetation	When the plants becomes excessively tall; when nuisances, weeds, and other vegetation start to take over	Vegetation is mowed or nuisance vegetation is eradicated, such that flow is not impeded.
	Inlet/Outlet Pipe	Inlet/outlet pipe clogged with sediment/debris.	No clogging or blockage in the inlet or outlet piping.
	Erosion/Scouring	Where the Rain Garden has eroded or scoured the bottom due to flow channelization or higher flows.	Rain Garden should be re-graded and re-seeded to specification, to eliminate channeled flow. Overseeded when bare spots are evident.
	Heavy metal deposition	When significant heavy metal deposition is suspected (swales downstream of roads and parking)	Mulch is replaced annually. Maintain 2 to 3 inch mulch depth.
	Watering	While plants are being established (2 to 3 years)	Plants have been established and no longer need to be watered.
Storage Area	Sediment build-up in system	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. A sediment trapping area is installed to reduce sediment transport into infiltration area.
	Storage area drains slowly (more than 48 hours) or overflows	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Additional volume is added through excavation to provide needed storage. Soil is aerated and rototilled to improve drainage.
Rock Filters	Sediment & debris	By visual inspection little or no water flows through filter during heavy rain storms.	Replace gravel in rock filter.
Storage Area	Sediment build-up in system	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. A sediment trapping area is installed to reduce sediment transport into infiltration area.
	Sediment trapping area	Any sediment and debris filling area to 10% of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.

OPERATIONS & MAINTENANCE

ACCESS ROADS/EASEMENTS

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Blocked Roadway	Debris which could damage vehicle tires (glass or metal).	Roadway free of debris which could damage tires.
		Any obstructions which reduce clearance above road surface to less than 14 ft.	Roadway overhead clear to 14 ft high.
		Any obstructions restricting the access to less than 15 ft width.	Obstruction removed to allow at least 15 ft wide access.
Road Surface	Settlement, potholes, mush spots, ruts	When any surface irregularity exceeds 6" in depth and 6 ft ² . In general, any surface defect which hinders or prevents maintenance access	Road surface uniformly smooth with no evidence of settlement, potholes, mush spots, or ruts. Occasionally application of additional gravel or pitrun rock will be needed.
		Vegetation in road surface	Woody growth that could block vehicular access. Excessive weed cover.
Shoulders & Ditches	Erosion damage	Erosion within 1ft of the roadway more than 8" wide and 6" deep.	Shoulder free of erosion and matching the surrounding road.

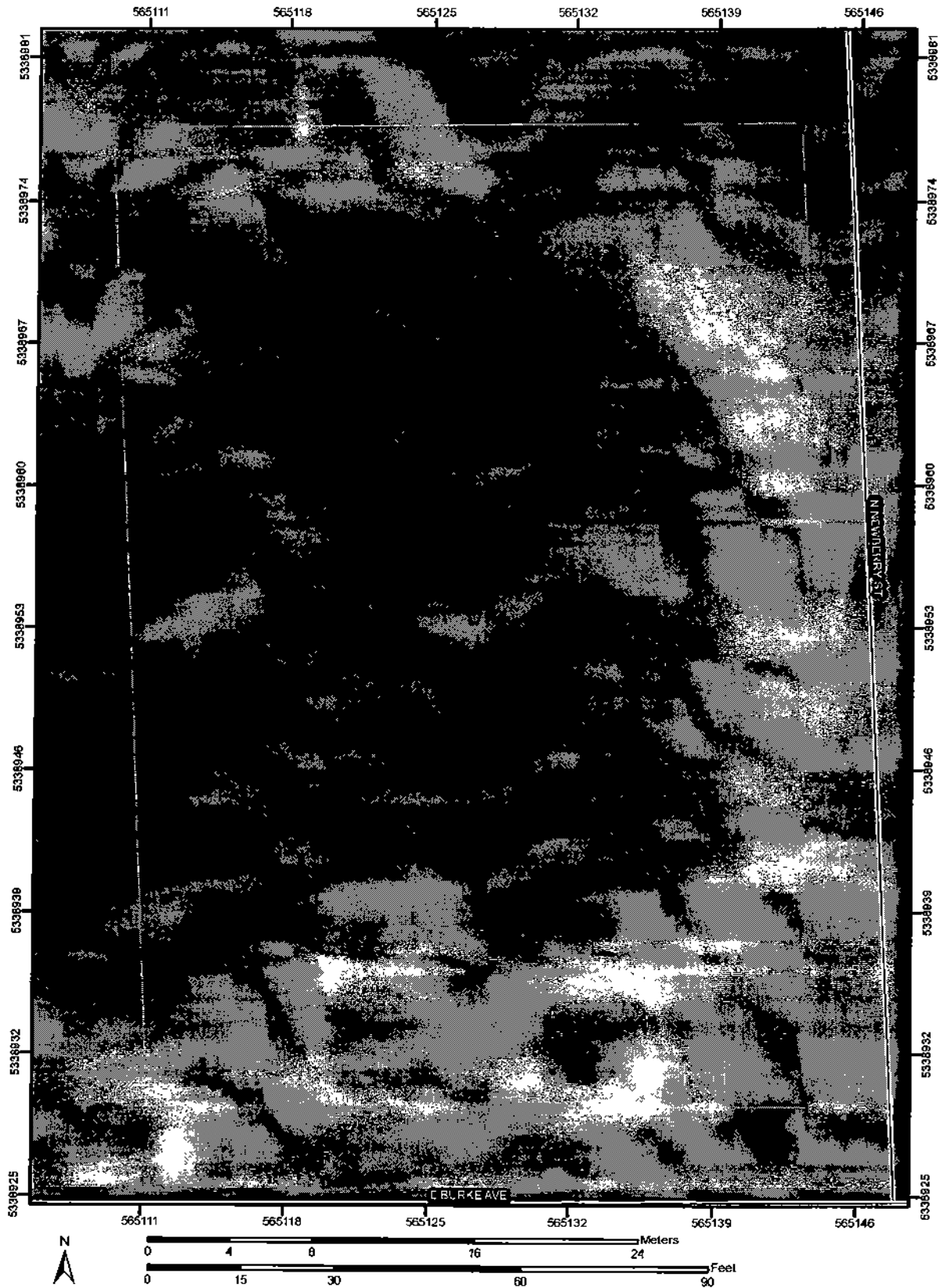
OPERATIONS & MAINTENANCE

FENCING, SHRUBBERY, AND OTHER LANDSCAPING

Maintenance Component	Defect	Conditions When Maintenance is Needed	Desired Conditions
General	Missing or broken/dead shrubbery	Any defect in the fence or screen that permits easy entry to a facility.	Fence is mended or shrubs replaced to form a solid barrier to entry.
	Erosion	Erosion has resulted in an opening under a fence that allows entry by people or pets.	Replace soil under fence so that no opening exceeds 4" in height.
	Unruly vegetation	Shrubbery is growing out of control or is infested with weeds.	Shrubbery is trimmed and weeded to provide appealing aesthetics. Do not use chemicals to control weeds.
Wire Fences	Damaged parts	Posts out of plumb more than 6".	Posts plumb to within 1-1/2" of plumb.
		Top rails bent more than 6".	Top rail free of bends greater than 1".
		Any part of fence (including posts, top rails, and fabric) more than 1 ft out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
		Missing or lose barbed wire that is sagging more than 2-1/2" between posts.	Barbed wire in place with less than 3/4" sag between posts.
		Extension arm missing, broken, or bent out of shape more than 1-1/2".	Extension arm in place with no bends larger than 3/4".
	Deteriorated paint or protective coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
Openings in fabric	Openings in fabric are such that an 8" diameter ball could fit through.	No openings in fabric.	









































APPENDIX

Soil Map—Snohomish County Area, Washington



Soil Map—Snohomish County Area, Washington

MAP LEGEND

 Area of Interest (AOI)	 Very Stony Spot
 Soils	 Wet Spot
 Soil Map Units	 Other
Special Point Features	Special Line Features
 Blowout	 Gully
 Borrow Pit	 Short Sleep Slope
 Clay Spot	 Other
 Closed Depression	Political Features
 Gravel Pit	Municipalities
 Gravelly Spot	 Cities
 Landfill	 Urban Areas
 Lava Flow	Water Features
 Marsh	 Oceans
 Mine or Quarry	 Streams and Canals
 Miscellaneous Water	Transportation
 Perennial Water	 Rails
 Rock Outcrop	Roads
 Saline Spot	 Interstate Highways
 Sandy Spot	 US Routes
 Severely Eroded Spot	 State Highways
 Sinkhole	 Local Roads
 Slide or Slip	 Other Roads
 Sodic Spot	
 Spoil Area	
 Stony Spot	

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 10N

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

Soil Survey Area: Snohomish County Area, Washington
 Survey Area Data: Version 4, Dec 12, 2006

Date(s) aerial images were photographed: 7/18/1990; 8/4/1990

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

Snohomish County Area, Washington (WA661)			
Map Unit Symbol	Map Unit Name	Area in AOI	Percent of AOI
4	Alderwood-Everett gravelly sandy loams, 25 to 70 percent slopes	0.0	0.0%
17	Everett gravelly sandy loam, 0 to 8 percent slopes	0.4	100.0%
Totals for Area of Interest (AOI)		0.4	100.0%

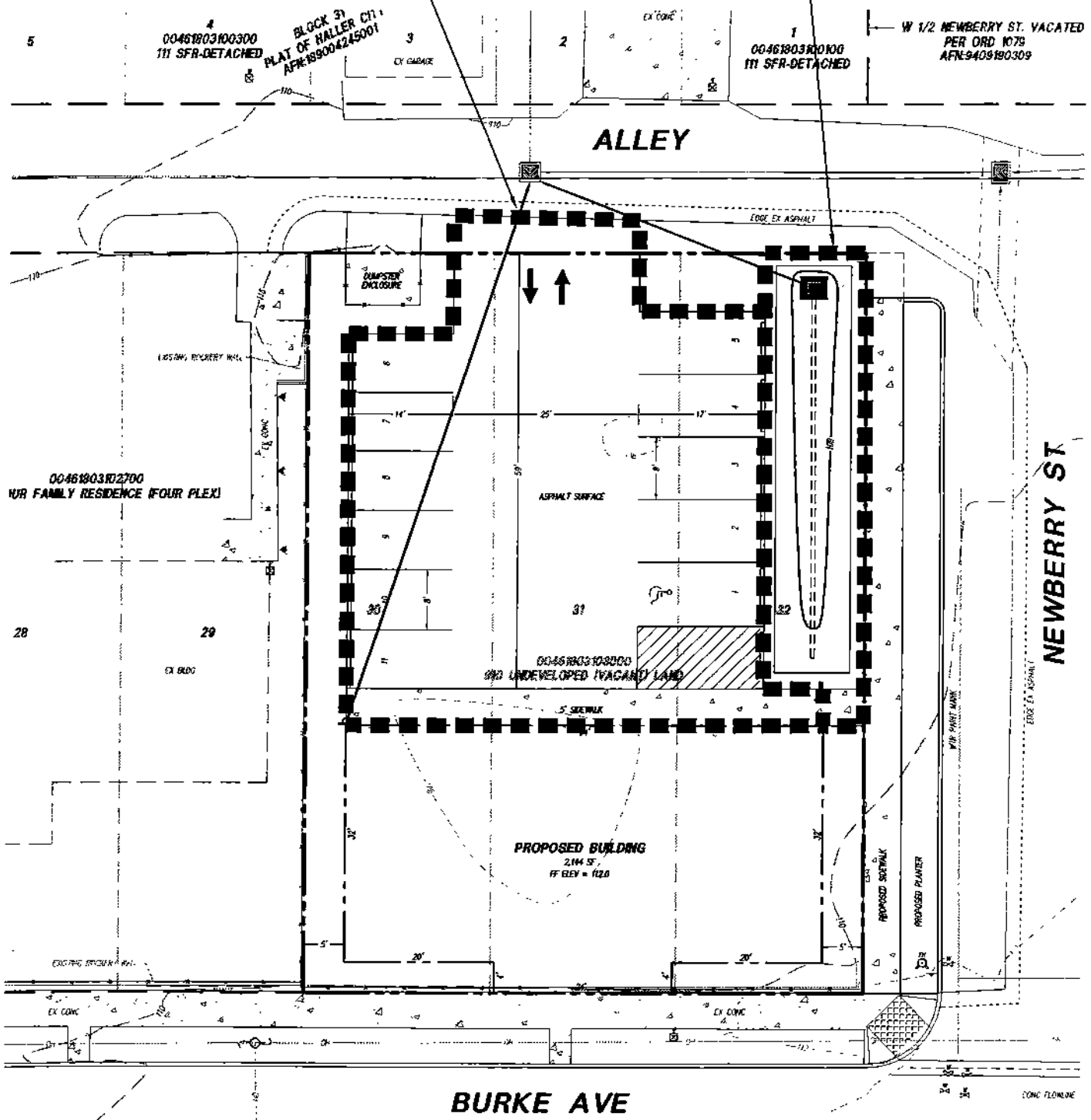


IMPERVIOUS LAND USE

DRIVEWAY FLAT=0.036 AC
SIDEWALK FLAT=0.007 AC
PARKING FLAT=0.037 AC
TOTAL=0.08 AC

PERVIOUS LAND USE

LAWN FLAT 0.02 AC



ARLINGTON BUSINESS PARK DEVELOPED CONDITIONS BASIN MAP EXHIBIT

PEAK JOB NO. 1093



BROADWAY ST

HALLER AVE

ALLEY

BURKE AVE

NEWBERRY ST

BASIN CB-4
0.41AC

BASIN CB-5
0.31AC

BASIN CB-3
0.51AC

BASIN CB-2
0.11AC

BASIN CB-1
0.27AC

SITE



BASIN CB-1 = 0.27AC

IMP = 0.18AC
PERVIOUS = 0.09AC

BASIN CB-2 = 0.11AC

IMP = 0.08AC
PERVIOUS = 0.03AC

BASIN CB-3 = 0.51AC

IMP = 0.22AC (PRE)
PERVIOUS = 0.29AC (PRE)

SITE = 0.17AC
NEW = 0.13AC
IMP = 0.35AC
PERVIOUS = 0.16AC (POST)

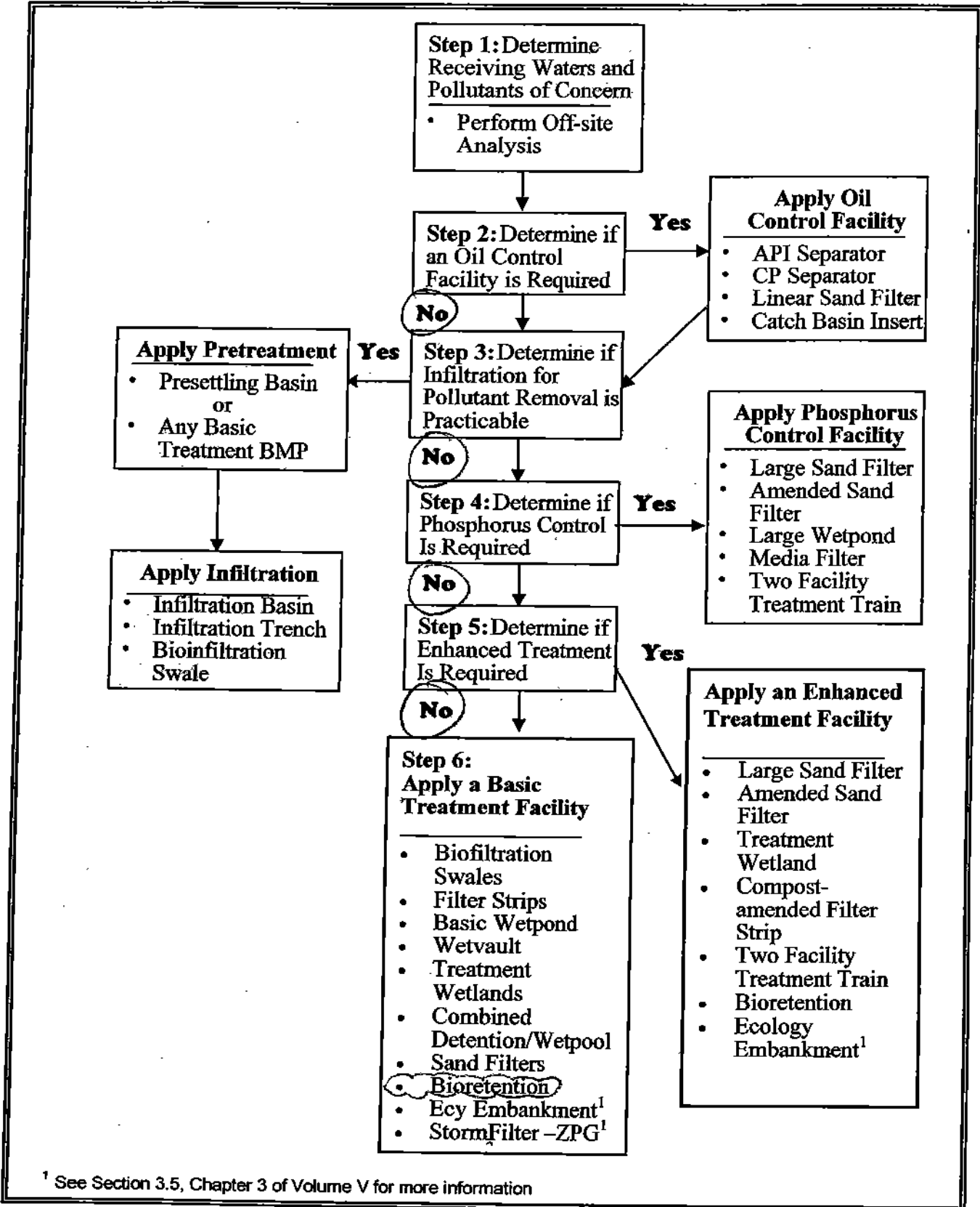
BASIN CB-4 = 0.41AC

IMP = 0.27AC
PERVIOUS = 0.14AC

BASIN CB-5 = 0.31AC

IMP = 0.20AC
PERVIOUS = 0.11AC

**BEN WELLS OFFICE BUILDING
DOWNSTREAM ANALYSIS
BASIN MAP EXHIBIT**



¹ See Section 3.5, Chapter 3 of Volume V for more information

Figure 4.1 Treatment Facility Selection Flow Chart

BEN WELLS OFFICE BUILDING

(PFN:xxxxxx)

SWPPP RISK CATEGORY DECISION MATRIX

	LOW	MED.	HIGH	VERY HIGH
Area Disturbed:	<u>Less than 1 acre</u>	1 to 5 acres	5 to 20 acres	More than 20 acres
Slope:	<u>Average less than 8% in development area</u>	Average more than 8% but all areas are less than 15%.	Average more than 8% but less than 15% no slope greater than 33%	Average more than 15%
Soil erosion hazard per Appendix A Rule-3044:	LOW SCS Soil type A (Permeable soil)	<u>LOW A or Type B</u>	MEDIUM type C	HIGH Type D
Critical Areas down slope of or downstream of discharge point:	<u>Greater than ¼ mile</u>	Greater than ¼ mile	Less than ¼ mile	Less than ¼ mile flows directly to ESA stream

SWPPP LEVEL DECISION MATRIX

		Risk Category			
		LOW	<u>MEDIUM</u>	HIGH	VERY HIGH
Winter Grading Requested	<u>IF NO</u>	LEVEL 1	<u>LEVEL 1</u>	LEVEL 2	LEVEL 3
	IF YES	LEVEL 2	<u>LEVEL 2 To 3</u>	LEVEL 3	NOT PERMITTED

Note: **Bold** and **underlined** indicates category this project falls in.

RUFECO®

2010B, 3010B & 4010B

PRODUCT DESCRIPTION

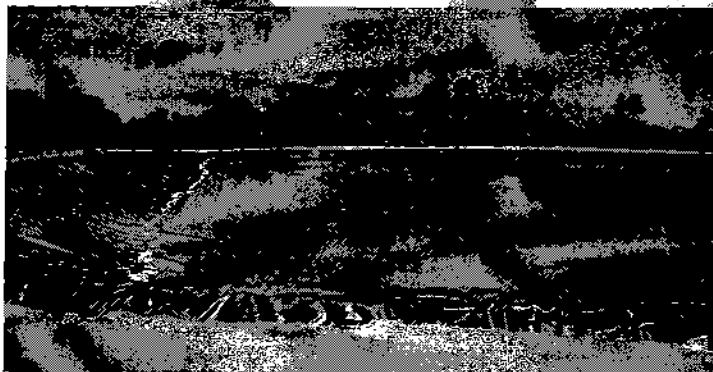
RUFECO 2010B, 3010B and 4010B are membranes consisting of a blended linear polyethylene. Carbon black provides protection from UV rays. RUFECO 2010B, 3010B and 4010B do not contain plasticizers that in time can migrate to the surface, causing premature aging. Manufactured from virgin and select reprocessed resins, they are designed to provide an economical solution to many applications.

PRODUCT USE

RUFECO 2010B, 3010B and 4010B are used in applications requiring a lower-cost material with high puncture and tear resistance. The carbon black additive assures long outdoor life. RUFECO 2010B, 3010B and 4010B are flexible and will conform to a variety of surfaces.

SIZE & PACKAGING

RUFECO 2010B, 3010B and 4010B are available in large fabricated panels up to 50,000 sq. ft. in 2010B, 33,000 sq. ft. in 3010B and 25,000 sq. ft. in 4010B. All panels are accordion folded every 5 feet and rolled tightly on a heavy-duty core for ease of handling.



Pond Liner

RAVEN
INDUSTRIES
Engineered Films Division

PRODUCT	PART NUMBER
RUFECO 2010B	2010B
RUFECO 3010B	3010B
RUFECO 4010B	4010B

COMMON APPLICATIONS

- Interim Landfill Covers
- Canal Linings
- Decorative Ponds
- Outdoor Coverings
- Brine Ponds
- Fire Ponds
- Remediation Liners
- Farm Ponds
- Oil Field Pit Liners



RUF[®]CO

2010B, 3010B & 4010B

PROPERTIES	TEST METHOD	RUF [®] CO 2010B		RUF [®] CO 3010B		RUF [®] CO 4010B	
		English	Metric	English	Metric	English	Metric
APPEARANCE		Black		Black		Black	
THICKNESS, NOMINAL		20 mil	0.51 mm	30 mil	0.75 mm	40 mil	1.00 mm
WEIGHT		93 lbs/MSF	453 g/m ²	142 lbs/MSF	692 g/m ²	189 lbs/MSF	921 g/m ²
TENSILE STRENGTH @ BREAK 1" (2.54 cm)	ASTM D6693	75 lbs	334 N	114 lbs	507 N	154 lbs	685 N
ELONGATION AT BREAK	ASTM D6693	800%	800%	800%	800%	800%	800%
TEAR RESISTANCE	ASTM D1004	11 lbf	49 N	16 lbf	71 N	22 lbf	98 N
HYDROSTATIC RESISTANCE	ASTM D751	100 psi	689 kPa	170 psi	1170 kPa	220 psi	1517 kPa
PUNCTURE RESISTANCE	ASTM D4833	30 lbf	133 N	45 lbf	200 N	60 lbf	267 N
VOLATILE LOSS	ASTM D1203	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
DIMENSIONAL STABILITY	ASTM D1204	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%
MAXIMUM USE TEMPERATURE		180°F	82°C	180°F	82°C	180°F	82°C
MINIMUM USE TEMPERATURE		-70°F	-57°C	-70°F	-57°C	-70°F	-57°C
PERMEABILITY							
PERM RATING	ASTM E96 Method A	0.041 U.S. Perms	0.027 Metric Perms	0.031 U.S. Perms	0.020 Metric Perms	0.024 U.S. Perms	0.015 Metric Perms
FACTORY SEAM REQUIREMENTS							
BONDED SEAM STRENGTH	ASTM D4545*	33 lbf/in.	58 N/cm	55 lbf/in.	96N/cm	70 lbf/in.	122N/cm
SEAM PEEL ADHESION	ASTM D1204*	28 lbf/in.	49N/cm	40 lbf/in.	70N/cm	55 lbf/in.	96N/cm

*Raven Industries performs seam testing at 12" per minute.



RUF[®]CO 2010B, 3010B and 4010B contain a very high-strength polyethylene resin blended with our in-house trim and start-up material. RUF[®]CO 2010B, 3010B and 4010B are offered as an alternative to our virgin resin films for non-critical applications. They may contain minor cosmetic gels, small surface particles and a lower minimum thickness tolerance.

Note: To the best of our knowledge, unless otherwise stated, these are typical property values and are intended as guides only, not as specification limits. NO WARRANTIES ARE MADE AS TO THE FITNESS FOR A SPECIFIC USE OR THE STABILITY OF PRODUCTS REFERRED TO, no guarantee of satisfactory results from reliance upon contained information or recommendations, and disclaims all liability for resulting loss or damage.

RAVEN
INDUSTRIES

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