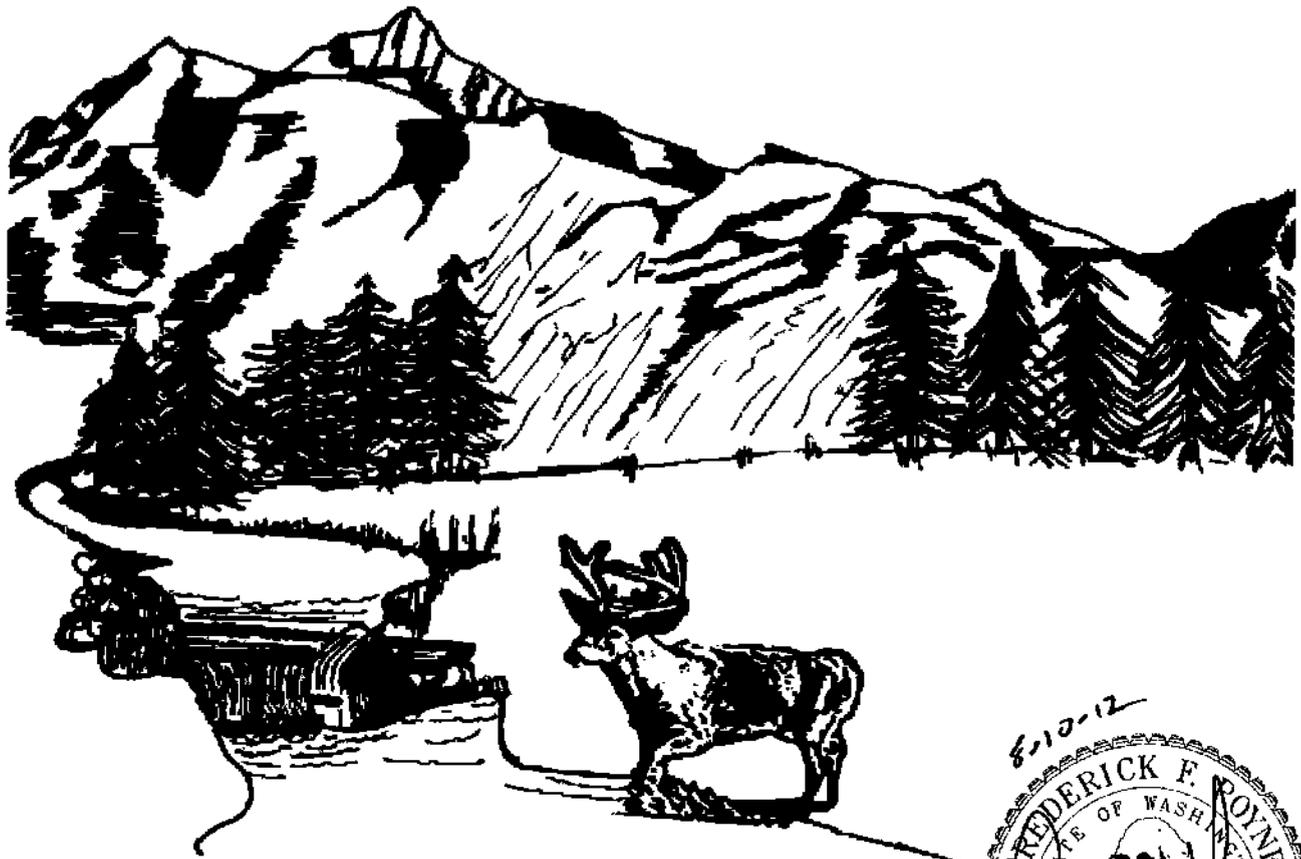

Drainage Report for:

Arlington Flight Services – Site Grading/Paving

August 10, 2012



RECEIVED

OCT 03 2012

COA Engineering Dept.



Prepared by:
Cascade Surveying & Engineering., Inc.

Project Summary

Upstream & Downstream Analysis

Flow Control & Runoff Treatment

Appendix

Soils

Infiltration Trench Design

Maintenance Manual



Drainage Information Summary Form

Project Total Area: **±0.91 acres**

Project Development Area: **±0.91 acres**

Number of Lots (if applies): **1**

Summary Table

Drainage Basin Information	Individual Basin Information	
	A	B
On-site Sub-basin Area (acres)	1.03 acres	
Type of Storage Proposed	N/A	
Appx. Dead Storage Vol (cf)	N/A	
Appx. Live Storage Vol (cf)	N/A	
Soil Type(s) (Natural Resource Conservation Service)	Lynnwood Loamy Sand	
Pre-developed Discharge Rates		
Q (cfs.)		
2 yr.	0.11	
10 yr.	0.18	
50 yr.	0.26	
Redevelopment Area (acres)	N/A	
Post-development Runoff Rates (without quantity controls)		
Q (cfs.)		
2 yr.	0.37	
10 yr.	0.58	
50 yr.	0.79	
Post-development Runoff Rates (with quantity controls)		
Q (cfs.)		
2 yr.	0	
10 yr.	0	
50 yr.	0	
Offsite Upstream Area		
Number of acres	0	
Offsite Downstream Flow		
Q(cfs) 50 yr.	0	

Project Summary

PROPERTY DESCRIPTION

The project site is located in a portion of Section 15, Township 31 North, Range 05 East W.M. More specifically the site lies in the Arlington Airport West of the intersection of 59th Dr. NE and 188th St. NE. The property is adjacent to the west side of Airport Lot # 44 as shown below in Figure 1, highlighted in red.



Figure 1: Vicinity Map. Not to scale.

EXISTING CONDITIONS

The project site is approximately 0.91 acre, and is a leased lot at the Arlington Airport. It lies West of the intersection of 59th Dr. NE and 188th St. NE. To the West it is bounded by the taxiway and to the East by airport lot #44. Lots to the North and South are developed sites for aeronautical use.

There is one building on the site and the rest is predominantly vegetated with grass, with a paved section providing access to the taxiway. On-site parking is a gravel area adjacent to the east side of the building, and there are a few evergreen trees throughout the site.

According to the USDA NRCS Soil Survey of Snohomish County, the soil type on site is Lynwood Loamy Sand. This very deep, and somewhat excessively drained soil, is on terraces and outwash plains. The surface layer is grayish brown loamy sand about 1 inch thick. The upper part of the subsoil is dark brown loamy sand about 14 inches thick. The substratum to a depth of 60 inches or more is grayish brown sand. In some areas the surface layer and subsoil are sandy loam. Attached are test pit records for three soil explorations that were conducted at the airport in the vicinity of the project site. The first soil exploration was done for Abbatare, located approximately 2400' south of the site. A second soil investigation, conducted for Universal Aerospace, was dug approximately 1600' south of the site. The last test pits were dug for the City Taxiway approximately 600' north of the site. All test pits were very similar, which leads us to believe that on-site soil conditions are the same as what has been presented in the soil logs.

Site topography is flat, with slopes between 0-3%. There are no offsite areas that drain onto the property. All storm water runoff drains to the vegetated areas on site.

DEVELOPED CONDITIONS

The proposal is to remove the existing asphalt, grade and re-pave it, and construct an infiltration trench so that all storm water runoff drains to catch basins and gets properly treated before infiltrating. Total area to be paved is approximately 33,034 sq ft.

The proposed development activity is considered new development and results in more than 5,000 sq ft of new/replaced impervious surface. Therefore according to the 2005 DOE Stormwater Manual, the new development project must comply with minimum requirements 1-9.

Below is an outline describing how the proposed development activity complies with all nine of the minimum requirements.

- 1. Preparation of a stormwater site plan** – A stormwater site plan has been prepared as part of and as a supplement to this report.
- 2. Stormwater Pollution Prevention Plan (SWPPP)** – A SWPP Plan and Narrative have been prepared in accordance with MR#2. Refer to the plan set for the SWPP Plan, and refer to the supplemental report titled SWPPP Narrative for complete detail. Land disturbance for the new development activity is estimated at 0.91-acre; therefore, the property owner or the operator of the site will not need to submit a Notice of Intent (NOI) application for a General Construction Stormwater Permit administered by the Washington State Department of Ecology (DOE). This project must be permitted by the City of Arlington before land disturbance can occur.
- 3. Water pollution source control for new development or redevelopment** – On-site pollution generating activities will be limited to an airplane fueling station on a concrete pad. In the rare event of a large spill, there will be a smart valve placed in the catch basin that will detect petroleum spills and prevent it from entering the treatment and infiltration trenches.
- 4. Preservation of natural drainage systems and outfalls** – The natural drainage patterns identified in the Drainage Report and on the Stormwater Site Plan will be maintained during construction and post development.
- 5. On-site stormwater management** – On-site stormwater management BMPs will be used to infiltrate stormwater runoff on-site. All runoff will be infiltrated using infiltration trenches.
- 6. Runoff Treatment** – On site treatment trenches will be used to provide runoff treatment.
- 7. Flow Control** – On site infiltration trenches will be used to provide flow control for stormwater runoff.
- 8. Detention or Treatment in Wetlands** – There are no on-site wetlands.
- 9. Operation & Maintenance** – An O & M manual is included with the drainage report.

Upstream & Downstream Analysis

UPSTREAM ANALYSIS

Since the site and surrounding areas are flat, 0-3% slope, there are no up stream areas which drain onto the property. This was based on site visits, in which no offsite drainage onto the property was observed. In the event that there is contributing drainage from upstream areas, the effects would be negligible, as any offsite storm water would be inconsequential in volume.

DOWNSTREAM ANALYSIS

Since the site and surrounding topography are flat, 0-3% slope, there is no downstream drainage. The site will be graded such that all stormwater will be captured and infiltrated onsite, thus there will be no downstream impacts.

Flow Control & Runoff Treatment

FLOW CONTROL & RUNOFF TREATMENT

On-site stormwater management will be implemented using a treatment/infiltration trench. The proposed development will be routed to a treatment trench, via catch basins, where it will be treated using a sand filter before it is infiltrated. The treatment trench is sized to treat runoff from the two year storm. Stormwater runoff volumes in excess of the two year storm will over flow into an infiltration trench where it will directly infiltrate into the native medium sand.

Appendix

CASCADE SURVEYING & ENGINEERING, INC.

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SURVEYORS
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PLANNERS

SOIL LOGS Abbatore #18566 4/27/2009

Soil Log 1

0'-2.5' Brown loamy sand
2.5'-5'+ Tan gravelly, medium sand
No H2O or Hard pan
Roots @ 2.5'

Soil Log 2

0'-2' Brown loamy sand
2'-3' Tan loamy gravelly medium sand
3'-9'+ Tan gravelly medium sand
No H2O or Hard pan
Roots @ 2.5'

Soil Log 3

0'-1' Brown loamy sand
1'-3' Tan loamy sand
3'-11' Tan gravelly medium sand

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SURVEYORS
ENGINEERS
PLANNERS

Universal Aerospace Co., Inc.

Project # 19425 June 6, 2012

SOIL LOG 1	0-24"	Red brown loamy sand
	24-60"	Gray gravelly medium sand
	60-120"+	Gray medium sand No H ² O
SOIL LOG 2	0-18"	Red brown loamy sand
	18-36"	Tan gray gravelly medium sand
	36-120"+	Gray gravelly medium sand No H ² O
SOIL LOG 3	0-12"	Topsoil (loamy sand)
	12-48"	Tan gravelly medium sand
	48-84"	Tan gray gravelly medium sand
	84-125"+	Gray medium sand No H ² O

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SURVEYORS
ENGINEERS
PLANNERS

City of Arlington Taxi-way

Project # 15538 July 7, 2004

SOIL LOG 1

0-2'

Brown Sandy Loam

2-4'

Tan Gravelly Medium Sand

4-12'

Gray Gravelly Medium Sand

Infiltration/Treatment Trench Design

Arlington Flight Services

Givens:

Impervious Area:	1.03ac	Runoff Coefficient:	0.90
Slope:	0.84%	Void Ratio:	30%
Length:	239.79'		

Time of Concentration:

Time of Concentration = T_c

Time of concentration was calculated using the FAA Equation as shown below.

$$T_c = \frac{1.8(1.1-C)L^{1/2}}{S^{1/3}}$$

$$T_c = \frac{1.8(1.1-0.9)239.79^{1/2}}{0.84^{1/3}}$$

$$T_c = 5.93\text{min} = 355.8\text{sec}$$

Flow Rate/Runoff Volume:

Flow Rate = Q Runoff Volume = V Return Interval = T_r

The flow rate for the developed conditions was calculated using the Western Washington Hydrology Model version 3.

$$V = Q * T_c$$

$$V \text{ (w/ Drain Rock)} = V / 0.3$$

T_r (yr)	Q (cfs)	V (ft ³)	V w/ Drain Rock
2	0.3707	131.89	439.63
5	0.4934	175.55	585.17
10	0.5802	206.44	688.13
25	0.6964	247.78	825.93
50	0.7879	280.33	934.43
100	0.8837	314.42	1048.07

Trench Size:

The Treatment Trench was sized to handle runoff from the 2yr storm event.

Treatment Trench: 3' x 3' x 49' Volume = 441 ft³

The infiltration Trench was sized to handle runoff volumes in excess of the 2yr storm, up to the 100yr storm.

Infiltration Trench: 3' x 3' x 68' Volume = 612 ft³ = 100yr (1048.07) – 2yr (441)

STORMWATER FACILITY MAINTENANCE MANUAL



**FOR PUBLIC & PRIVATELY OWNED
STORMWATER FACILITIES**

**PREPARED BY:
CASCADE SURVEYING & ENGINEERING, INC.**

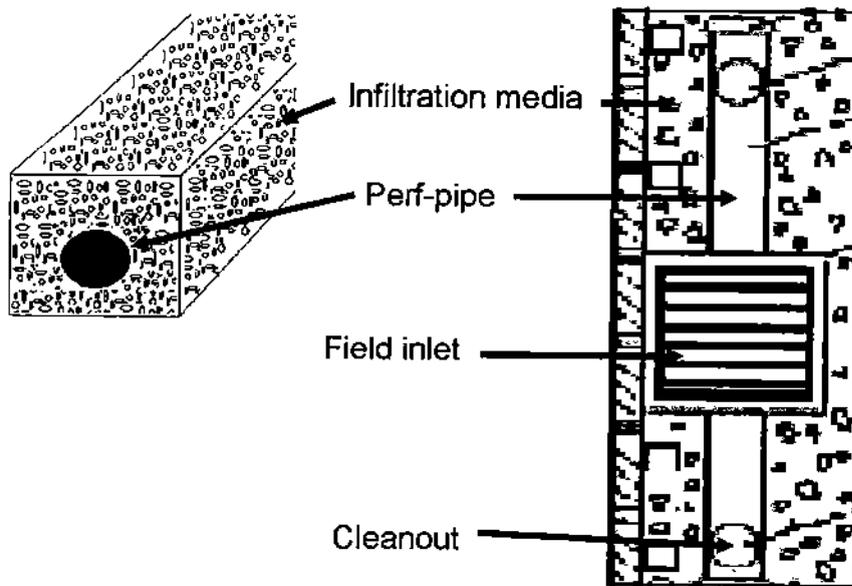
OCTOBER 2009

Infiltration Trench

A stormwater infiltration trench is a closed basin built by excavating below existing ground. Infiltration trenches temporarily store stormwater runoff during rain events. Infiltration trenches do not discharge to a downstream conveyance system or nearby surface water. Instead, infiltration trenches rely on the ability of the site's soils to infiltrate the stormwater into the ground.

Facility objects that are typically associated with an infiltration trench include:

- access road or easement
- fence, gate, and water quality sign
- bioswale
- sediment trap
- field inlet



Infiltration Trench			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants in or around facility. • Identify and remove source	No contaminants or pollutants present.
	Observation Well	Sediment depth greater than one foot above stone aggregate or the surface inlet.	No sediment in infiltration trench.
	Drainage Slow	Decreased capacity that indicates slow drainage.	Verify facility design rate. Clean perforated drain pipe. Do not allow removed sediment and water to discharge back into the storm sewer.

Catch Basin

A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

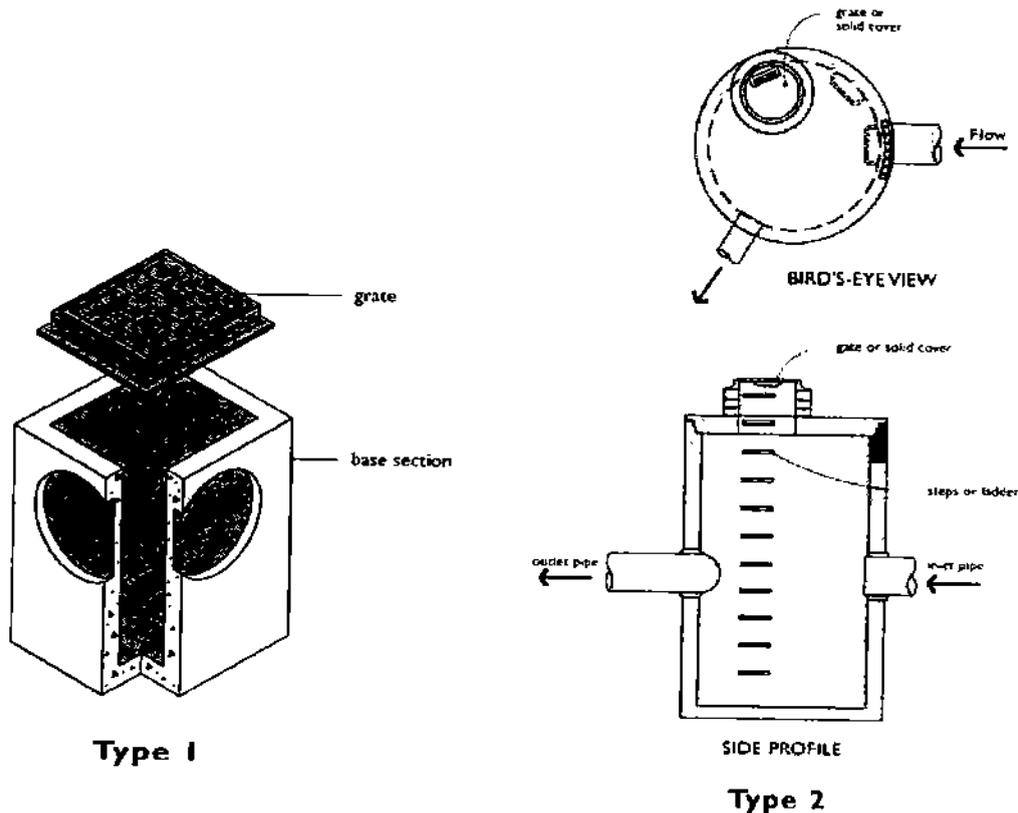
A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

Type 2 catch basins, also commonly referred to as storm manholes, are round concrete structures ranging in diameter from 4 feet to 8 feet. Type 2 catch basins are used when the connecting conveyance pipe is 18 inches or greater or the depth from grate to pipe bottom exceeds 5 feet. Type 2 catch basins typically have manhole steps mounted on the side of the structure to allow access.

Both types typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or oils.

The most common tool for cleaning catch basins is a truck with a tank and vacuum hose (vector truck) to remove sediment and debris from the sump. A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch basins are typically associated with all stormwater facilities.



Catch Basins			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 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 (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and 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 six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present

Catch Basins (Continued)			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed Or Not Needed
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 one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.