STORMWATER SITE PLAN REPORT

CASCADE DOOR & HARDWARE BUILDING
199TH AVENUE N.E.
ARLINGTON, WASHINGTON

LOT 4, AIRPORT-37 INDUSTRIAL PARK
CITY OF ARLINGTON FILE #_____

Developer:

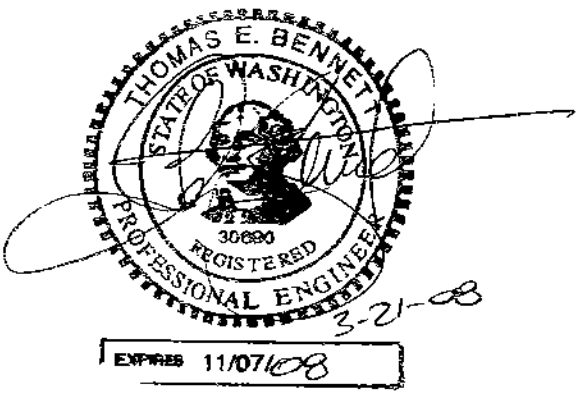
Cascade Door and Hardware
20350 – 71st Avenue N.E., Unit E
Arlington, WA 98223

Prepared By:

BENNETT ENGINEERING, LLC
2000 Franklin Street, Suite
Bellingham, WA 98229

BENNETT ENGR. PROJECT #07039

ORIGINAL ISSUE DATE: 03/21/08



Thomas E. Bennett, P.E.
Civil/Environmental Engineer

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1. DRAINAGE INFORMATION SUMMARY FORM

Project Name: Cascade Door & Hardware Building	Total Site Area: 1.24 Acres
Project Engineer: Bennett Engineering, LLC	New Impervious Areas: 0.89 Acres
Project Applicant: Glenn Bayha	Number of Lots: 1

The project site is located in SW ¼ of the NE ¼ of Section 15, Twp. 31N, Rng. 05E, of the Willamette Meridian in the City of Arlington, approximately 2 miles east of Interstate 5 and one-quarter mile northeast of the Arlington Airport (see Sheet C-1). The topography in the vicinity of the subject property is relatively flat, with a regional slope to the north and west. Portage Creek is situated approximately 1,000 feet north of the site.

The subject property is 1.24 acres (54,168 square feet) in areal extent. The existing site was previously cleared and graded under the Airport-37 Industrial Park Plat, which also included construction of street and public utility improvements in the 199th Street N.E. right-of-way. The proposed project includes construction of a 14,440 square foot commercial building, with 26 parking spaces, paved access lanes, truck loading ramps, landscaping, and stormwater management facilities. The frontage improvements anticipated for the project are limited to a new catch basin and paved access aprons on the east and west sides of the site (Sheet C-3).

The proposed stormwater management approach is to treat and infiltrate runoff from the project site, in accordance with the *1992 DOE Manual*. Reference is also made to selected sections of the *2005 DOE Manual*. Runoff from pollution generating impervious surfaces (PGIS) will be routed to a rain garden facility located north of the new building. The rain garden is designed to provide filtration treatment for the PGIS, and on-site disposal for site runoff in the underlying infiltration trench. Runoff from roof and ramp areas will be routed through catch basins for grit removal and then piped to the infiltration trench. The approach takes advantage of the well-drained native soils encountered at the site to fully infiltrate the 100-year storm event runoff from the developed areas. An emergency overflow pipe will be installed to the existing storm drain system in 199th Street N.E.

Summary Table

Drainage Basin	Basin Data		
Total Basin Area (acres)	1.24		
New Impervious Areas (acres)	0.89		
SCS Soil Type	Everett Gravelly Sandy Loam (0-8% Slopes, Soil Type #17)		
Pre-developed Runoff Rate (Assume Full Infiltration)			
Peak Q (cfs) 6-month	0.00		
10-year	0.00		
100-year	0.00		
Post-developed Runoff Rate Before / After Controlling (With Full Infiltration)			
Peak Q (cfs) 6-month	0.241/0.00		
2-year	0.405/0.00		
10-year	0.603/0.00		
100-year	1.037/0.00		

The proposed site development is presented in the attached civil engineering drawing set (Sheets C-1 through C-5, Section 10) prepared by Bennett Engineering, LLC. The types of water quality BMPs proposed for the project include:

1. Standard erosion control BMPs at the construction stage such as silt fencing, catch basin inserts, and mulching to control construction runoff. A stabilized construction entrance will be installed at the existing curb cut at 199th Street NE.
2. Treatment for runoff from new PGIS associated with the project, including the paved parking areas and access lanes, will be provided by a rain garden facility constructed in the northern portion of the site.
3. An infiltration trench, installed below the base of the rain garden, will be used to retain and dispose of all runoff from the project site.

2. EXISTING SITE CONDITIONS

The site is a 1.24-acre parcel located north of 199th Street N.E. in Arlington, Washington (Lot 4 of the Airport-37 Industrial Park Plat). The existing site was previously cleared and graded as part of the industrial plat. The south-central portion of the site was surfaced with gravel and a soil stockpile was created to the north of the gravel surfacing. Street and public utility improvements were completed in the 199th Street N.E. right-of-way, and City of Arlington water and sewer services were stubbed into the project site. Private utilities were installed within a utility easement located in the southern 10 feet of the property. A landscaped area has been established in the northerly 50 feet of the property to create a visual buffer between the industrial plat and the residential zoning to the north. An overlying utility easement has been established in the favor of the Snohomish County PUD in the northerly 25 feet of the property. Overhead power has been installed with the 25-foot utility easement.

Topography

A topographic survey was completed at the subject property by ADF Surveyors of Everett, Washington (February 2008). Sheet C-2 shows existing property dimensions, contours, and surface features. The subject property is relatively flat, with a surface elevations ranging from 98 to 101 feet. An existing swale is present within the 50-foot visual buffer, with a bottom elevation of approximately 98 feet.

Soils

The *Soil Survey of Snohomish County Area, Washington* (SCS, July 1983) identifies the soils as Everett gravelly sandy loam, 0 to 8% slopes (Soil Type 17), which is categorized as hydrologic group "A". This soil type typically has rapid permeability and slow runoff, and the hazard of water erosion is slight. The SCS soil description is attached in Section 7.

Seven test pits, labeled TP-1 through TP-7, were excavated at the subject property by Geotech Consultants, Inc. (Geotech) in January 2008, using a small, track mounted excavator. The purpose of the test pits was to confirm the SCS soil mapping and characterize the subsurface soil and ground water conditions with respect to design stormwater infiltration rates and construction recommendations for the proposed building. The location of the test pits are shown in Sheet C-2 and the Geotech test pit logs are attached in Section 7.

The Geotech report indicates that relatively uniform native soils, consisting of orange-brown weathered silty sand-sandy silt with variable amounts of gravel and cobbles, were encountered at the ground surface at Test Pits TP-1, 2, 5, 6, and 7. At TP-3 and 4, the weathered soils were overlain by 3.5 feet and 2.0 feet of man-placed fill materials, respectively. The weathered soils are underlain by relatively "clean" sand and gravel soils to the limited depths of the test pits, which extended from 8 to 10 feet below the ground surface (bgs). Ground water seepage or wet soils were not observed in any of the test pits, which were excavated during the wet season. The report states that the anticipated seasonal high ground water table is approximately 12 to 15 feet bgs, based on previous experience in the Arlington area.

Laboratory grain-size analyses were conducted on soil samples from TP-1 and TP-3 to confirm classification of the native soils and determine the applicable stormwater infiltration rate for the site. The laboratory data is presented in Section 7. The TP-1 sample was taken at 2.5 feet bgs and consisted of a clean, well graded sand with some gravel. The TP-1 sample had a D_{10} size of 0.25 mm, which, based on review of the soil logs, appears to be representative of the native sand and gravel soils encountered at the site. The TP-3 sample was taken from a sandy gravel layer encountered between 5.0 and 7.0 feet bgs, with a D_{10} size of 0.36 mm. The sandy gravel layer was not observed in any of the other test pits. Based on a typical D_{10} size of 0.25 mm, an infiltration rate of 3.5 inches/hour was selected for the project design (see attached Table 3.8 from Volume III of the *2005 DOE Manual*, Section 7).

Vegetation

The site has been previously cleared and graded. The central portion of the site has been surfaced with gravel. Grass is present along the eastern and western boundaries. A soil stockpile is located in the northern portion of the site, which is vegetated with Scots Broom and blackberry. A 50-foot visual buffer runs along the northern boundary of the site. The buffer is vegetated with coniferous trees, with an understory of Scots Broom and blackberry.

Critical Areas

No critical areas have been identified at the site.

Drainage

The existing site appears well-drained; no areas of ponding were observed during our site visit on January 8, 2008, including the low swale that runs through the northern portion of the site. An existing 8-inch storm drain system serves the 199th Street NE street improvements fronting the property. Existing storm drain catch basins are located approximately 10 feet west and 96 feet east of the site (Sheet C-2).

3. DEVELOPED SITE CONDITIONS

Clearing and Grading

Approximately 1.15 acres of clearing will be required for construction of the project. Clearing, grading, and excavation operations should be performed during the dry season which generally occurs from April through September. If earthwork operations are performed during the wet season (October through March), additional erosion control measures may be required. Following clearing and grubbing, topsoils will be stripped to expose the underlying native sand and gravel soils. The topsoils and other unsuitable soils encountered during excavation activities will be removed from the site.

Structural fill shall be placed and compacted in accordance with the Geotech report to achieve design subgrade elevations. The native, clean sand and gravel soils encountered at the site may be suitable as ballast and utility trench backfill material, as approved by the geotechnical engineer. For the paved access aprons, drive lanes, and parking areas, we recommend a pavement section consisting of 3 inches of Class B asphalt, underlain by a minimum 4 inches of crushed rock base (WSDOT 9-03.9(3)) over a minimum of 8 inches of compacted pit run gravel (WSDOT 9-03.9(1)). Proof rolling should be performed prior to placement of structural fill materials to identify localized soft areas. Pavement base course materials should be compacted to 95% minimum of maximum dry density, as determined by the ASTM D-1557 test procedure.

Drainage

The total impervious area for the post-development condition is approximately 0.89 acres (38,950 square feet). The proposed stormwater management approach is to treat and infiltrate all runoff from all impervious surfaces created by the project, in accordance with the *1992 DOE Manual*. Runoff from new PGIS will be routed via 8-inch PVC storm drain piping to a rain garden located in the northern portion of the project site. The rain garden will include an amended sand section to provide filtration treatment and an underlying gravel trench to allow for retention and infiltration of treated stormwater (Sheet C-5). Runoff from the building roof and ramp areas will be combined and routed via 6-inch PVC roof drains to catch basins at the east and west ends of the rain garden for grit removal and then distributed to the infiltration trench via a 6-inch perforated pipe. The approach takes advantage of the permeability of the native soils encountered at the site to fully infiltrate the 100-year storm event runoff from the developed areas. An overflow pipe will be installed to the existing storm drain system at 199th Street NE. An operation and maintenance manual for the stormwater facility is presented in Section 9.

4. UPSTREAM – DOWNSTREAM ANALYSIS

Upstream Conditions

Based on the local topography and our site observations, precipitation falling on in the vicinity of the subject property rapidly infiltrates; as such, there appear to be no off-site areas contributing runoff to the site.

Downstream Conditions

The proposed rain garden facility will fully infiltrate runoff from developed site during a 100-year design storm event. Therefore, there are no anticipated downstream impacts of the project.

5. DRAINAGE ANALYSIS

Design Data

Design data for the project are included in Section 7. This section contains a summary of the properties of the Everett gravelly sandy loam soils that are mapped at the site by the SCS. These soils are designated as hydrologic group "A" soils in the *Soil Survey of Snohomish County Area, Washington*, with a typical surface infiltration rate of 2.0 to 6.0 in/hr, increasing to 6.0 to 20.0 in/hr at 6 inches of depth (SCS, Table 14). Storm event and runoff curve number data were obtained from the *Stormwater Management Manual for Western Washington* (Ecology, February 2005). The design 6-month and 2-, 10-, and 100-year, 24-hour storm events for the subject property are 1.2, 1.8, 2.5, and 4.0 inches, respectively (Section 8).

Soil logs and representative grain-size analyses associated with the test pit investigation completed by Geotech Consultants, Inc. are also presented in Section 7. The soil logs indicate clean sand and gravel soils beginning at 0.5 to 5.0 feet bgs and extending to minimum depths of 8 to 10 feet bgs. No ground water was encountered in the test pits. Laboratory grain-size analysis of the native sands and gravels indicates a typical D_{10} size of 0.25 mm, with a design infiltration rate of 3.5 in/hr.

Stormwater Modeling

Drainage analysis was performed using the Santa Barbara Urban Hydrograph (SBUH) method, and the results are presented in Section 8. The contributing drainage basin was modeled as the entire project site (1.24 acres), including 0.89 acres of impervious roof and pavement surfaces, and 0.35 acres of existing and proposed landscaping. Runoff quantities and peak flow rates for the 6-month, 2-year, 10-year, and 100-year, 24-hour storm events were determined for the developed site conditions using *StormShed2G* software developed by Engenious, Inc. A separate model was run to determine the peak 6-month storm flow and volume from the PGIS associated with the project, with regards to design of stormwater treatment BMPs.

Stormwater Conveyance

Stormwater conveyance to the rain garden facility will be achieved using two separate piping systems. Runoff from the asphalt access lanes and parking areas will be routed via sheet flow to catch basins installed along the east and west edges of the site and conveyed to the rain garden in 8-inch PVC piping. At a design slope of 0.4%, the capacity of the 8-inch piping is 0.96 cfs (Section 8); whereas the 100-year peak flow rate for each half of the site is approximately 0.37 cfs. The 8-inch piping will discharge to a rock-lined outfall installed at the surface of the rain garden (Sheet C-4).

Runoff from the building roof and concrete ramp areas will be conveyed in 6-inch PVC roof drain piping to SDCB-3 and SDCB-4, which are located on the east and west sides of the rain garden, respectively. At a design slope of 1.0%, the capacity of the 6-inch pipe is 0.71 cfs; whereas the 100-year peak flow rate for each half of the building is approximately 0.15 cfs.

Stormwater Treatment – Rain Garden Facility

The PGIS identified for the site include the asphalt access lanes and parking areas. The concrete truck ramps located at the southeast and southwest corners of the building are considered non-PGIS for the following reasons: (1) they are topographically isolated from the asphalt parking areas; (2) the ramps are used very infrequently for deliveries (estimated 3-4 times per week); and (3) only the trailer portion of the larger truck and trailer delivery vehicles will be physically situated over the ramps. Runoff from the ramps will be collected in shallow inlet catch basins that will have a 4-inch tee baffle outlet connected to the 6-inch roof drains (Sheet C-3). The roof drains will be routed north to SDCB-3 and SDCB-4, installed at the west and east ends of the rain garden facility, respectively, and infiltrated to the ground. The catch basins and tee outlets installed at the base of the truck ramps will allow for capture and periodic removal of sediment and any other floating contaminants.

The rain garden facility will be located north of the paved access lane on the north side of the building, and will extend across the entire width of the project site (Sheet C-3). The facility will have a 10-foot base width, with a 3:1 side slope to the south and a 2:1 side slope to the north (Sheet C-5). The facility will include 18 inches of amended sand over a 24 inch section of drain rock. A non-woven fabric will be installed between the amended sand and drain rock. The top of the amended sand will be set at elevation 97.2 feet, with the base of the drain rock at elevation 93.7 feet, which is approximately 4.5 feet below the existing ground surface. The Geotech report estimated a seasonal high ground water lable at 12 to 15 feet bgs; therefore, the depth of unsaturated native soils beneath the rain garden is expected to be on the order of 7.5 to 10.5 feet. Catch basins SDCB-3 and SDCB-4 will be installed in the rain garden with rim elevations of 97.7 feet. The catch basins are designed to overflow during larger storm events. A 6-inch perforated pipe will be installed between the catch basins to distribute stormwater throughout the gravel infiltration trench. The catch basins allow for periodic inspection of water levels within the rain garden and removal of any accumulated sediment, as needed.

The proposed treatment BMP for the PGIS is filtration through 18 inches of compost amended sand installed at the top of the rain garden facility (Sheet C-5). The surface area of the rain garden (1620 square feet) is designed to accommodate the 6-month storm event from the PGIS. Using a design infiltration rate of 1.0 in/hour for the amended sand, the storm model indicates that the water level in the rain garden will temporarily rise to elevation 97.5 feet during the 6-month design storm (Section 8).

Stormwater Infiltration

Based on an infiltration rate of 3.5 in/hr and a void ratio of 0.35 for amended sand and drain rock sections, the required trench dimensions are 10' wide x 180' long x 2.0' deep to fully infiltrate the 100-year storm event for the developed site. The storm model indicates that the water level in the rain garden will temporarily rise to elevation 98.4 feet during the 100-year design storm (Section 8). The berm height around the facility will be set at elevation 99.4 feet minimum to provide at least one foot of freeboard above the 100-year surface.

The emergency overflow system for the rain garden will be routed to the existing storm drain system installed in 199th Street, via an 8-inch pipe installed between SDCB-6 and SDCB-7 on the east side of the site (Sheet C-3). The pipe will have an 8-inch elbow installed with an overflow elevation of 98.7 feet (Sheet C-4).

6. TEMPORARY EROSION AND SEDIMENTATION CONTROL

Twelve general erosion and sediment control elements are required for all site development projects. The various elements are listed below with a summary of how the element has been incorporated into the project design. A site specific TESC Plan is presented on Sheet C-2.

Element #1: Mark Clearing Limits

The clearing limits coincide with the property boundaries, with the exception of the utility easement located northerly 25 feet of the site. The existing trees located within the utility easement will be preserved, as shown on the TESC Plan.

Element #2: Establish Construction Access

Access to the site for construction equipment and materials will be provided via a rock construction entrance installed at the existing curb cut at 199th Street N.E.

Element #3: Control Flow Rates

The project site is relatively flat and underlain by well-drained sands and gravels. As such, there is very little risk of off-site erosion associated with the project.

Element #4: Install Sediment Controls

Erosion and sediment controls shall be installed prior to all clearing and grading work. Silt fencing shall be installed downgradient of all temporary soil stockpiles and disturbed soil areas. Additional BMPs shall be applied as necessary to stabilize the site and maintain the quality of stormwater runoff from the project site.

Element #5: Stabilize Soils

From October 1 to March 31, no substantially unworked soil areas shall remain exposed for more than two days. From April 1 to September 30, no substantially unworked soil areas shall remain exposed for more than seven days. All exposed and unworked soils shall be stabilized by suitable application of BMPs, including gravel surfacing, topsoil with mulching and/or hydroseeding, and plastic covering.

Element #6: Protect Cut and Fill Slopes

Permanent cut and fill slopes will be limited to 2:1 (or flatter) within the developed area. All cut and fill slopes associated with the project will be stabilized by equipment tracking, mulching, hydroseeding, or other erosion control measures as necessary to minimize erosion. For areas over 2:1 slope that are not at finish grade, the ground will be covered with plastic sheeting that is maintained tightly in place by using sand bags or tires on ropes, as necessary.

Element #7: Protect Drain Inlets

Catch basin inserts shall be installed at all existing catch basins in the 199th Street right-of-way within 100 feet of the project site, and at all new catch basins installed on-site.

Element #8: Stabilize Channels and Outlets

Quarry spall outfalls shall be installed at the 8-inch storm drain outlets to the rain garden.

Element #9: Control Pollutants

The primary pollutants, other than sediment, that have been identified for the project include solid wastes and dust created from construction activities, and petroleum products associated with fueling and lubricating equipment and vehicles. The contractor will be responsible to keep the project site in a neat and orderly condition. Water will be applied to exposed soils as necessary to control dust. All refuse and construction debris will be removed from the site on a regular basis, as soon as practical. The contractor will be responsible for restoring all off-site areas to their original condition. All fuel and oil spills will be cleaned up immediately.

Element #10: Control Dewatering

Based on the subsurface soil and ground water conditions observed during the geotechnical test pit investigation, the normal seasonal ground water level should be around 12 to 15 feet below the ground surface (Geotech Consultants, January 2008). As such, dewatering is not anticipated for the relatively shallow footing and utility excavations planned for the site.

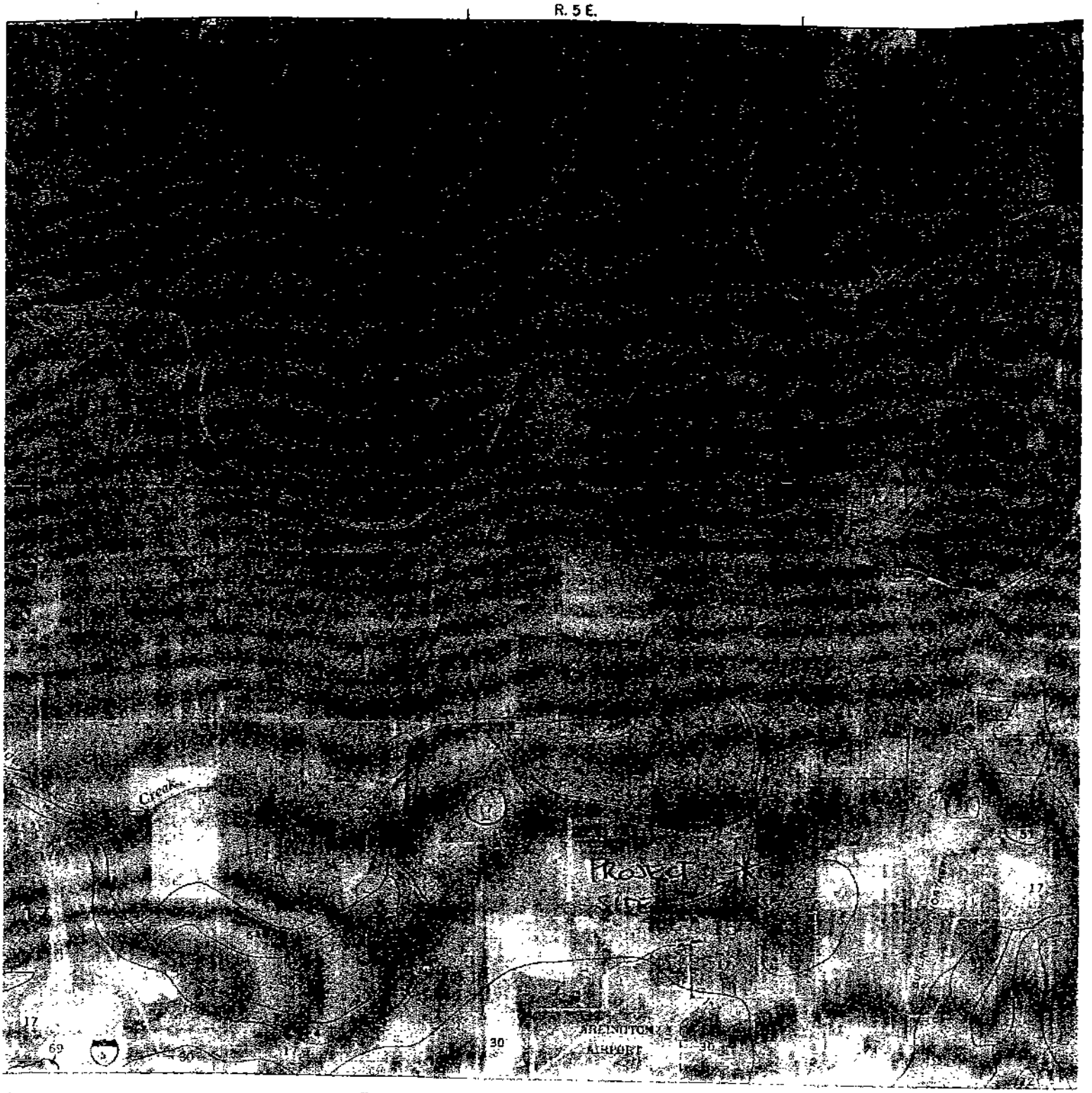
Element #11: Maintain BMPs

The erosion and sediment controls will be inspected, at a minimum, on a daily basis during the period of construction, and immediately following significant storm events (> 0.1 inch precipitation in a 24-hour period). Repairs, if needed, will be made to silt fencing immediately. Accumulated sediment will be removed from the silt fencing, as needed, to maintain adequate stormwater conveyance. The contractor will be responsible for maintenance of all erosion and sediment controls until construction and landscaping activities are completed and the potential for erosion has passed. The contractor shall then remove all controls after the site has been stabilized.

Element #12: Manage the Project

Site work is scheduled to be completed in the summer of 2008. If earthwork is performed during for the wet season (October through March), exposed soil areas will be managed in accordance with Element #5.

7. DESIGN DATA



SOIL TYPE 17 - EVERETT GRAVELLY SANDY LOAM (0 - 6% SLOPES)

this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover. Establishing plant cover on steep cut and fill slopes reduces erosion.

Seedling establishment and windthrow hazard are the main concerns in the production of timber. If seed trees are present, natural reforestation of cutover areas by western hemlock and Pacific silver fir occurs periodically. Reforestation can be accomplished by planting Douglas-fir seedlings. When openings are made in the canopy, invading brushy plants, if not controlled, can delay reforestation. Rock outcrop limits the even distribution of reforestation.

Because the rooting depth is restricted by the hardpan or bedrock, trees are occasionally subject to windthrow. Western hemlock, a shallow-rooted species, is more commonly subject to windthrow than are more deeply rooted trees.

The main limitations for homesites and septic tank absorption fields are steepness of slope and depth to bedrock or the hardpan. A seasonal high water table is perched above the hardpan or bedrock; therefore, drainage is needed if buildings with basements and crawl spaces are constructed. Deep cuts in the Olomount soil can expose bedrock.

This map unit is in capability subclass VIIs.

17—Everett gravelly sandy loam, 0 to 8 percent slopes. This very deep, somewhat excessively drained soil is on terraces and outwash plains. It formed in glacial outwash. Areas are long and narrow and are oriented in a northwest to southeast direction. They are 10 to 40 acres in size. The native vegetation is mainly conifers. Elevation is near sea level to 500 feet. The average annual precipitation is about 40 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 170 to 190 days.

Typically, the surface layer, where mixed to a depth of about 6 inches, is dark brown gravelly sandy loam. The subsoil is dark brown very gravelly sandy loam about 12 inches thick. The upper part of the substratum is brown very gravelly loamy sand about 5 inches thick. The lower part to a depth of 60 inches or more is dark brown extremely gravelly sand. In some areas the substratum is weakly cemented.

Included in this unit are small areas of Alderwood soils on till plains, Indianola soils on terraces and outwash plains, and Ragnar soils on outwash plains. Included areas make up about 15 percent of the total acreage.

Permeability of this Everett soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly as woodland and for urban development. It is also used for pasture.

Douglas-fir is the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 141. On the basis of a 50-year site curve, the mean site index is 111. The mean annual increment at culmination (CMAI) for Douglas-fir at age 65 is 146 cubic feet per acre. Among the trees of limited extent are western hemlock, western redcedar, and red alder. The common forest understory plants are salal, brackenfern, red huckleberry, common rose, and Oregon-grape.

This unit is well suited to year-round logging. Logging roads require suitable surfacing for year-round use. Rock for road construction is readily available on this unit.

Seedling mortality is the main limitation for the production of timber. Reforestation can be accomplished by planting Douglas-fir seedlings. High soil temperature and low soil moisture content during the growing season cause a high mortality of seedlings. When openings are made in the canopy, invading brushy plants, if not controlled, can delay the establishment of seedlings.

If this unit is used for pasture, the main limitations are low available water capacity and low soil fertility. Proper grazing practices, weed control, and fertilizer are needed for maximum quality of forage. Supplemental irrigation is also needed. Periodic mowing and spreading of droppings help to maintain uniform growth and discourage selective grazing.

This unit is suited to urban development; however, if the density of housing is moderate to high, community sewage systems are needed in places to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass VIs.

18—Everett gravelly sandy loam, 8 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces and outwash plains. It formed in glacial outwash. Areas are long and narrow and are oriented in a northwest to southeast direction. They are 10 to 40 acres in size. The native vegetation is mainly conifers. Elevation is near sea level to 500 feet. The average annual precipitation is about 40 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 170 to 190 days.

Typically, the surface layer, where mixed to a depth of about 6 inches, is dark brown gravelly sandy loam. The subsoil is dark brown very gravelly sandy loam about 12 inches thick. The upper part of the substratum is brown very gravelly loamy sand about 5 inches thick. The lower part to a depth of 60 inches or more is dark brown extremely gravelly sand. In some areas the substratum is weakly cemented.

Included in this unit are small areas of Alderwood soils on till plains, Indianola soils on terraces and outwash plains, and Ragnar soils on outwash plains. Included areas make up about 15 percent of the total acreage.

Permeability of this Everett soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly as woodland. It is also used for urban development and for hay and pasture.

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
14---------- Elwell	0-2	Silt loam--------	ML, OL	A-4, A-5	0-5	85-100	75-90	60-80	50-65	30-50	NP-10
	2-23	Silt loam, loam	ML	A-4, A-5	0-5	85-100	75-90	60-80	50-65	30-50	NP-10
	23-27	Gravelly loamy sand, gravelly fine sandy loam, gravelly loam.	SM	A-4, A-2	0-5	75-85	60-75	50-65	20-50	20-35	NP-10
	27	Cemented---------	---	---	---	---	---	---	---	---	---
15*: Elwell----------	0-2	Silt loam--------	ML, OL	A-4, A-5	0-5	85-100	75-90	60-80	50-65	30-50	NP-10
	2-23	Silt loam, loam	ML	A-4, A-5	0-5	85-100	75-90	60-80	50-65	30-50	NP-10
	23-27	Gravelly loamy sand, gravelly fine sandy loam, gravelly loam.	SM	A-4, A-2	0-5	75-85	60-75	50-65	20-50	20-35	NP-10
	27	Cemented---------	---	---	---	---	---	---	---	---	---
Olomount--------	0-2	Gravelly loam----	GM, SM	A-2, A-4	0-15	60-80	55-75	40-60	30-50	30-40	NP-5
	2-18	Gravelly silt loam, gravelly loam, cobbly loam.	GM, SM	A-2, A-4	0-25	60-80	60-75	40-60	30-50	30-40	NP-5
	18-32	Very gravelly silt loam, very gravelly loam, extremely gravelly loam.	GM, GP-GM	A-1, A-2	0-25	20-50	10-40	10-35	10-30	30-40	NP-5
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
16*: Elwell----------	0-2	Silt loam--------	ML, OL	A-4, A-5	0-5	85-100	75-90	60-80	50-65	30-50	NP-10
	2-23	Silt loam, loam	ML	A-4, A-5	0-5	85-100	75-90	60-80	50-65	30-50	NP-10
	23-27	Gravelly loamy sand, gravelly fine sandy loam, gravelly loam.	SM	A-4, A-2	0-5	75-85	60-75	50-65	20-50	20-35	NP-10
	27	Cemented---------	---	---	---	---	---	---	---	---	---
Olomount--------	0-2	Gravelly loam----	GM, SM	A-2, A-4	0-15	60-80	55-75	40-60	30-50	30-40	NP-5
	2-18	Gravelly silt loam, gravelly loam, cobbly loam.	GM, SM	A-2, A-4	0-25	60-80	60-75	40-60	30-50	30-40	NP-5
	18-32	Very gravelly silt loam, very gravelly loam, extremely gravelly loam.	GM, GP-GM	A-1, A-2	0-25	20-50	10-40	10-35	10-30	30-40	NP-5
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
* Rock outcrop.											
17, 18, 19------- Everett	0-6	Gravelly sandy loam.	SM	A-1, A-2	0-10	65-85	50-75	30-50	15-30	15-25	NP-5
	6-18	Very gravelly sandy loam.	GP-GM, GM	A-1	5-10	30-60	20-50	10-30	5-25	15-25	NP-5
	18-60	Very gravelly coarse sand, very gravelly loamy sand, extremely gravelly sand.	GP	A-1	5-20	25-50	15-45	5-20	0-5	---	NP

See footnote at end of table.

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Organic matter
							K	T	
	In	Pct	In/hr	In/in	pH				Pct
16*:									
Olomount	0-2	---	0.6-2.0	0.13-0.16	5.1-5.5	Low	0.24	2	2-5
	2-18	---	0.6-2.0	0.11-0.14	5.6-6.0	Low	0.28		
	18-32	---	0.6-2.0	0.08-0.10	5.6-6.5	Low	0.28		
	32	---	---	---	---	---	---		
Rock outcrop.									
17, 18, 19-- Everett	0-6	5-10	2.0-6.0	0.08-0.12	5.6-6.5	Low	0.17	1	10-15
	6-18	5-10	6.0-20	0.05-0.08	5.6-6.5	Low	0.10		
	18-60	0-5	6.0-20	0.02-0.05	5.6-6.5	Low	0.10		
20*. Fluvaquents									
21-- Getchell	0-2	---	0.6-2.0	0.19-0.21	3.6-5.0	Low	0.37	2	10-15
	2-36	---	0.6-2.0	0.19-0.21	4.5-5.5	Low	0.43		
	36	---	---	---	---	---	---		
22*:									
Getchell	0-2	---	0.6-2.0	0.19-0.21	3.6-5.0	Low	0.37	2	10-15
	2-36	---	0.6-2.0	0.19-0.21	4.5-5.5	Low	0.43		
	36	---	---	---	---	---	---		
Oso	0-5	---	0.6-2.0	0.12-0.16	3.6-5.0	Low	0.32	2	5-10
	5-29	---	0.6-2.0	0.13-0.17	4.5-5.5	Low	0.37		
	29	---	---	---	---	---	---		
23*:									
Getchell	0-2	---	0.6-2.0	0.19-0.21	3.6-5.0	Low	0.37	2	10-15
	2-36	---	0.6-2.0	0.19-0.21	4.5-5.5	Low	0.43		
	36	---	---	---	---	---	---		
Oso	0-5	---	0.6-2.0	0.12-0.16	3.6-5.0	Low	0.32	2	5-10
	5-29	---	0.6-2.0	0.13-0.17	4.5-5.5	Low	0.37		
	29	---	---	---	---	---	---		
Rock outcrop.									
24-- Greenwater	0-9	0-5	6.0-20	0.06-0.08	5.6-6.5	Low	0.17	5	.5-1
	9-21	0-5	6.0-20	0.06-0.08	5.6-6.5	Low	0.17		
	21-60	0-5	6.0-20	0.05-0.07	5.6-6.5	Low	0.10		
25*:									
Hartnit	0-4	---	0.6-2.0	0.18-0.21	3.6-6.0	Low	0.24	2	10-15
	4-27	---	0.6-2.0	0.17-0.20	4.5-6.0	Low	0.37		
	27	---	---	---	---	---	---		
Potchub	0-7	---	0.6-2.0	0.21-0.23	3.6-5.0	Low	0.24	2	15-25
	7-10	---	0.6-2.0	0.19-0.21	4.5-5.0	Low	0.37		
	10-34	---	0.6-2.0	0.18-0.20	4.5-6.0	Low	0.37		
	34	---	---	---	---	---	---		
Rock outcrop.									
26-- Indianola	0-4	0-5	2.0-6.0	0.08-0.11	5.1-7.3	Low	0.24	5	1-5
	4-24	0-5	6.0-20	0.07-0.10	5.1-7.3	Low	0.24		
	24-60	0-5	6.0-20	0.04-0.07	5.1-7.3	Low	0.20		
27, 28, 29-- Kitsap	0-6	5-15	0.6-2.0	0.19-0.21	5.6-7.3	Low	0.32	5	3-10
	6-33	20-35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.37		
	33-60	20-35	0.06-0.2	0.17-0.20	5.6-7.3	Moderate	0.37		

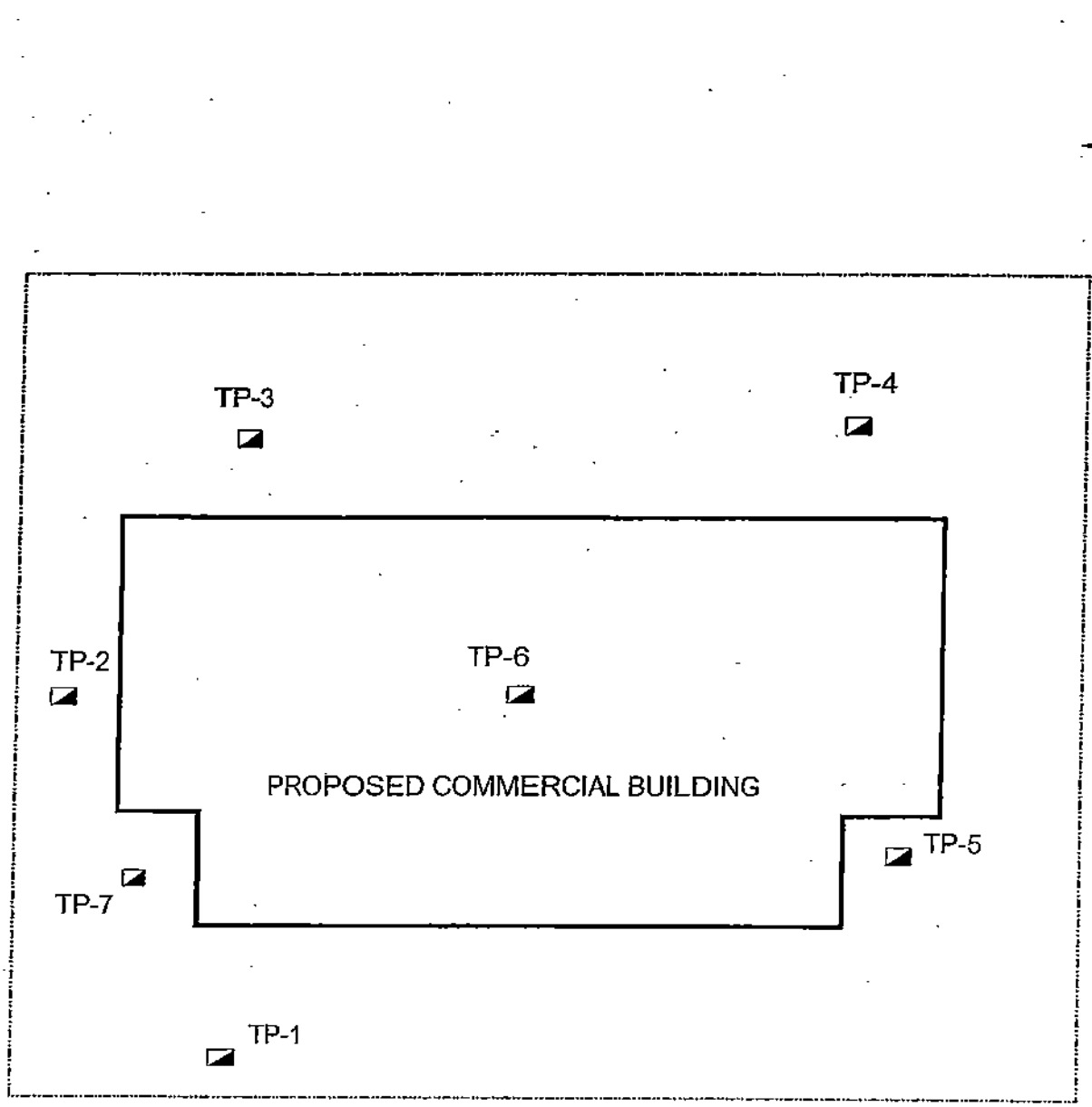
See footnote at end of table.

TABLE 15.--WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
1, 2, 3---------- Alderwood	C	None----------	---	---	1.5-3.0	Perched	Jan-Mar
4*: Alderwood----------	C	None----------	---	---	1.5-3.0	Perched	Jan-Mar
Everett----------	A	None----------	---	---	>6.0	---	---
5*, 6*: Alderwood----------	C	None----------	---	---	1.5-3.0	Perched	Jan-Mar
Urban land.							
7---------- Bellingham	C	None----------	---	Oct-Jun	+1-1.0	Apparent	Oct-Jun
8---------- Bellingham Variant	D	Frequent--------	Very long-----	Oct-Jun	+1-1.0	Apparent	Oct-Jun
9, 10, 11---------- Cathcart	C	None----------	---	---	>6.0	---	---
12*. Cryohemists							
13---------- Custer	C	None----------	---	---	0-1.0	Apparent	Nov-Mar
14---------- Elwell	C	None----------	---	---	1.5-3.0	Perched	Nov-Jun
15*: Elwell----------	C	None----------	---	---	1.5-3.0	Perched	Nov-Jun
Olomount----------	C	None----------	---	---	1.5-3.5	Perched	Nov-May
16*: Elwell----------	C	None----------	---	---	1.5-3.0	Perched	Nov-Jun
Olomount----------	C	None----------	---	---	1.5-3.5	Perched	Nov-May
Rock outcrop.							
17, 18, 19---------- Everett	A	None----------	---	---	>6.0	---	---
20*. Fluvaquents							
21---------- Getchell	C	None----------	---	---	1.5-3.0	Perched	Dec-May
22*: Getchell----------	C	None----------	---	---	1.5-3.0	Perched	Dec-May
Oso----------	C	None----------	---	---	1.5-3.0	Perched	Nov-May
23*: Getchell----------	C	None----------	---	---	1.5-3.0	Perched	Dec-May

See footnote at end of table.



Legend

= Approximate Test Pit Location

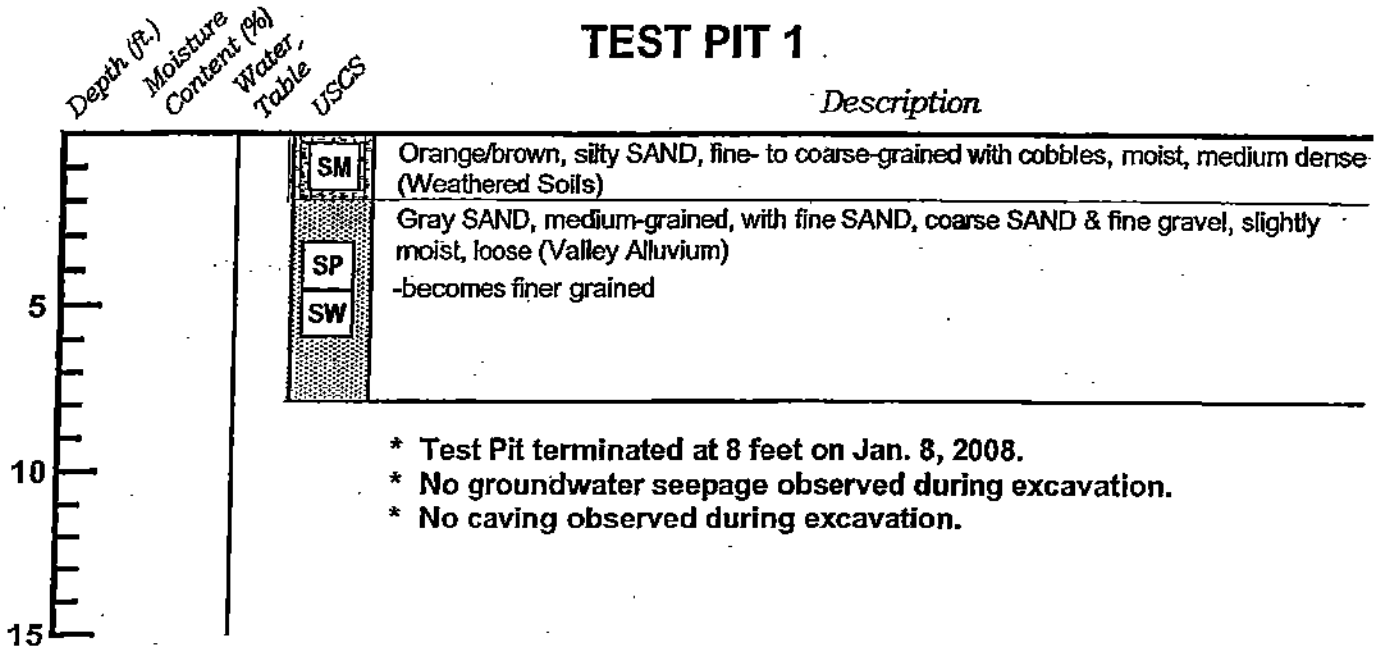
GEOTECH
CONSULTANTS, INC.

SITE EXPLORATION PLAN

6101 - 199th Street NE
Arlington, Washington

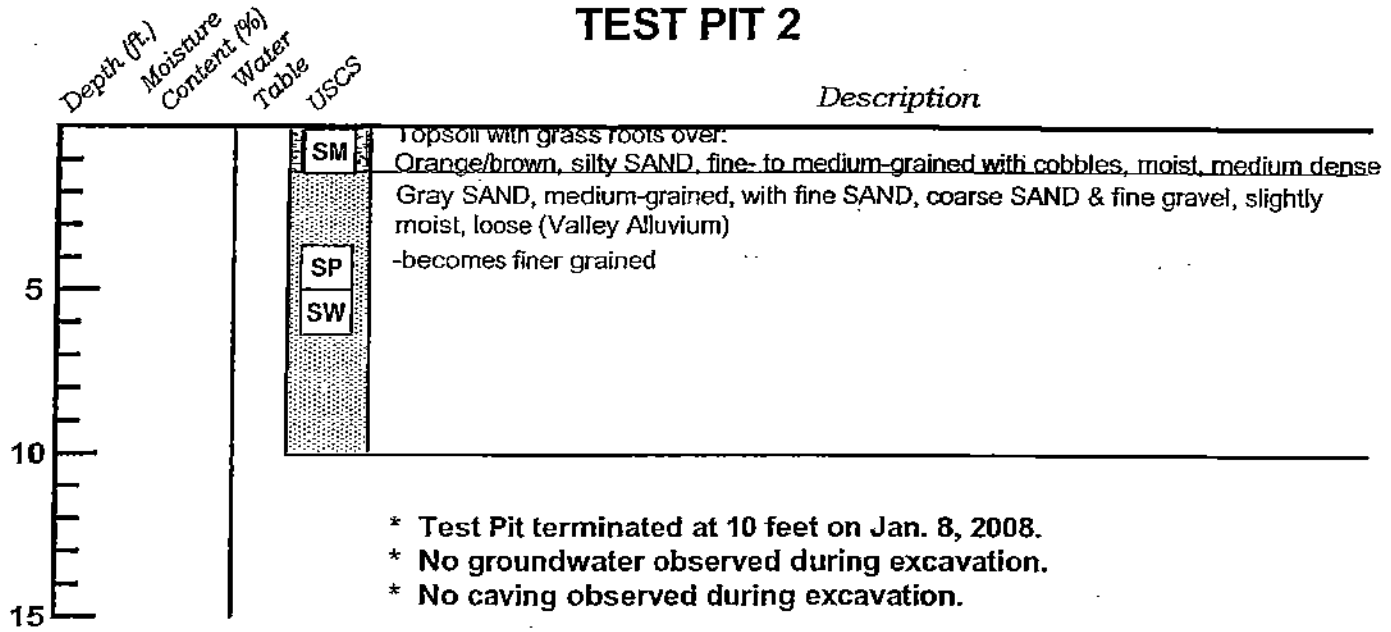
Job	Date:	Scale:	Plate:
07439	Dec. 2007	Not to Scale	2

TEST PIT 1



* **Test Pit terminated at 8 feet on Jan. 8, 2008.**
* **No groundwater seepage observed during excavation.**
* **No caving observed during excavation.**

TEST PIT 2



* **Test Pit terminated at 10 feet on Jan. 8, 2008.**
* **No groundwater observed during excavation.**
* **No caving observed during excavation.**

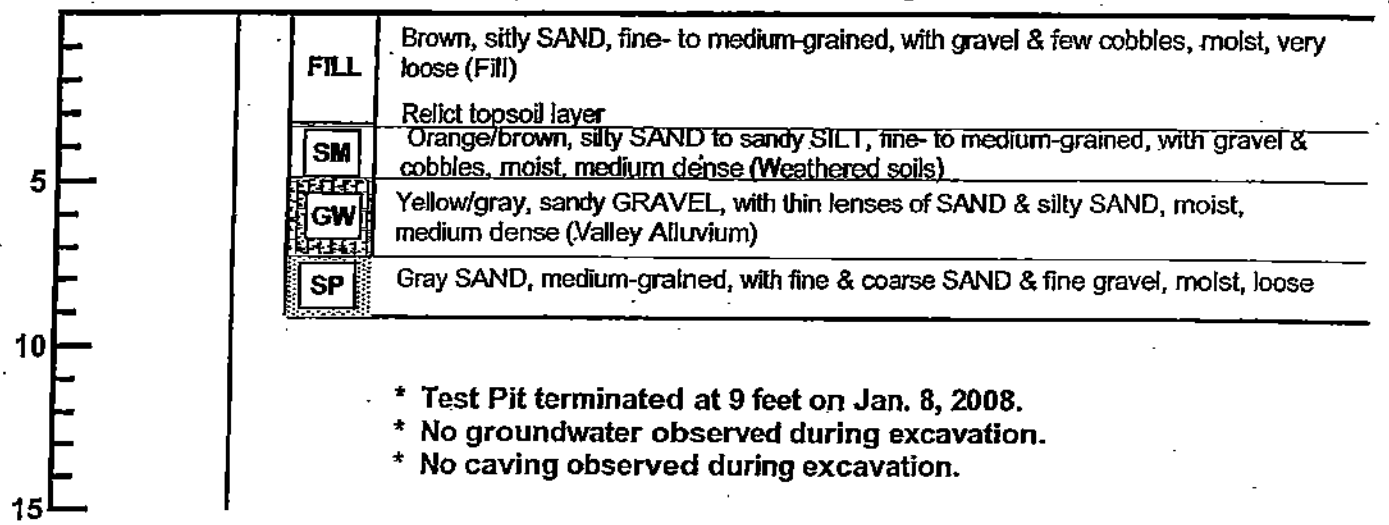
GEOTECH
CONSULTANTS, INC.

TEST PIT LOG

6101 - 199th Street NE
Arlington, Washington

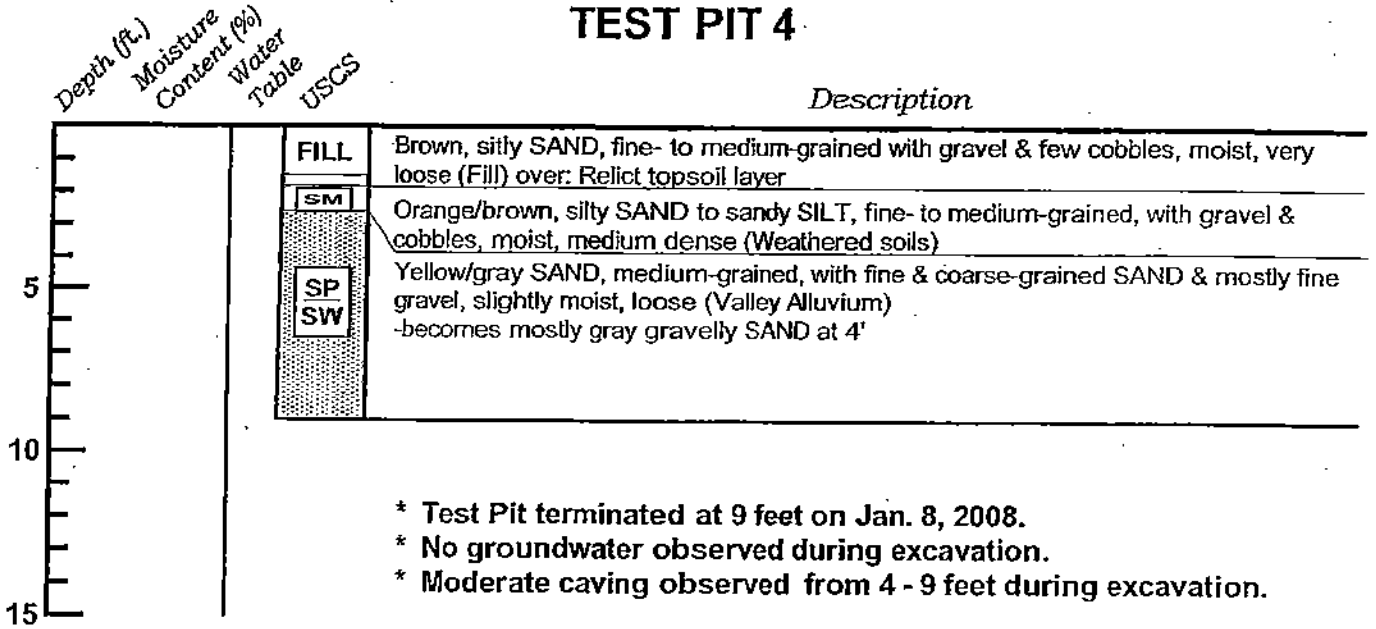
Job	Date:	Logged by:	Plate:
07439	Dec. 2007	GDB	3

TEST PIT 3



* **Test Pit terminated at 9 feet on Jan. 8, 2008.**
* **No groundwater observed during excavation.**
* **No caving observed during excavation.**

TEST PIT 4



* **Test Pit terminated at 9 feet on Jan. 8, 2008.**
* **No groundwater observed during excavation.**
* **Moderate caving observed from 4 - 9 feet during excavation.**

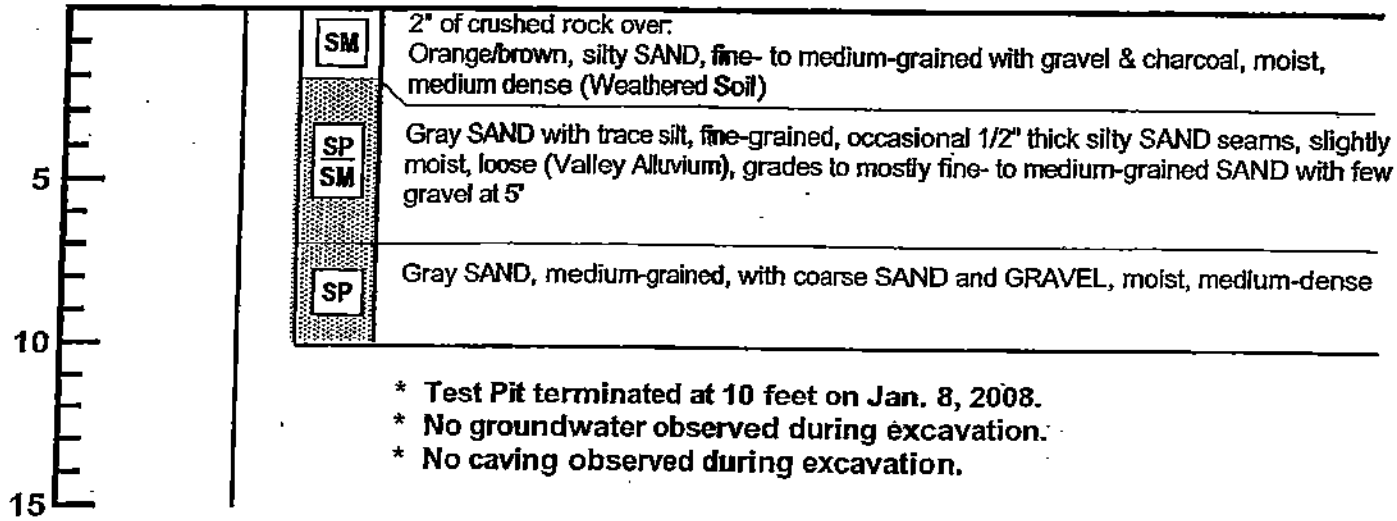
GEOTECH
CONSULTANTS, INC.

TEST PIT LOG

6101 - 199th. Street NE
Arlington, Washington

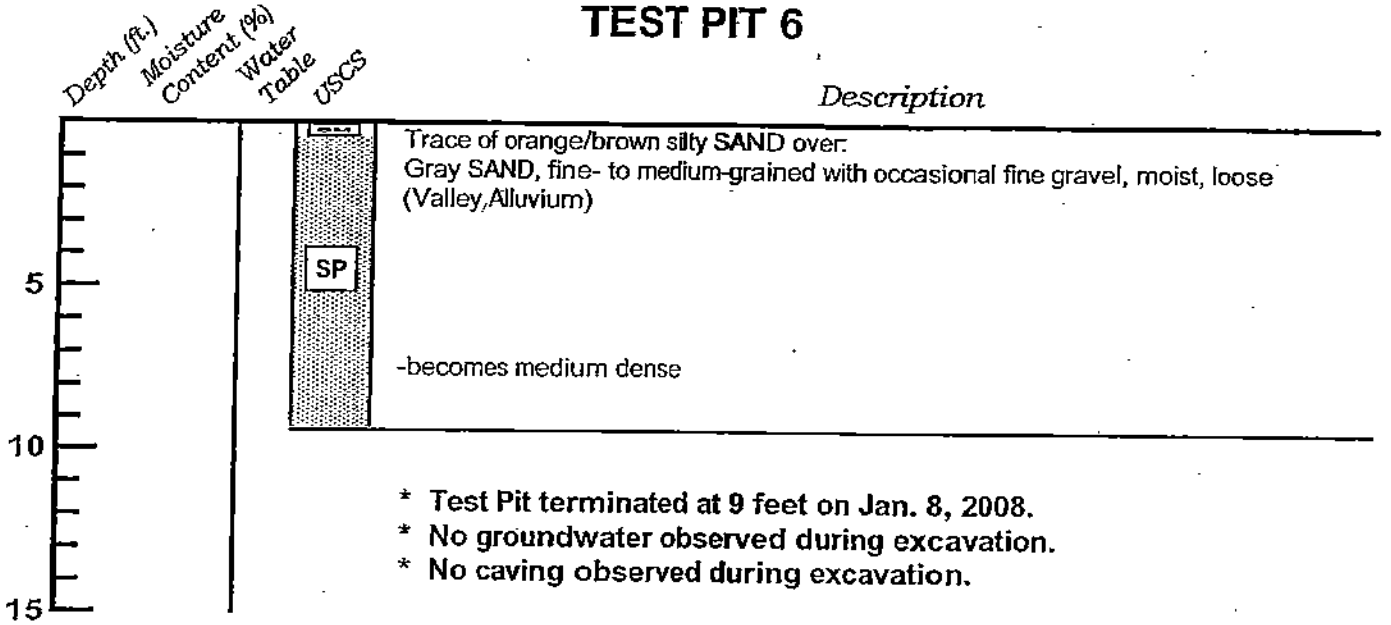
Job	Date:	Logged by:	Plate:
07439	Dec. 2007	GB	4

TEST PIT 5



* **Test Pit terminated at 10 feet on Jan. 8, 2008.**
* **No groundwater observed during excavation.**
* **No caving observed during excavation.**

TEST PIT 6



* **Test Pit terminated at 9 feet on Jan. 8, 2008.**
* **No groundwater observed during excavation.**
* **No caving observed during excavation.**

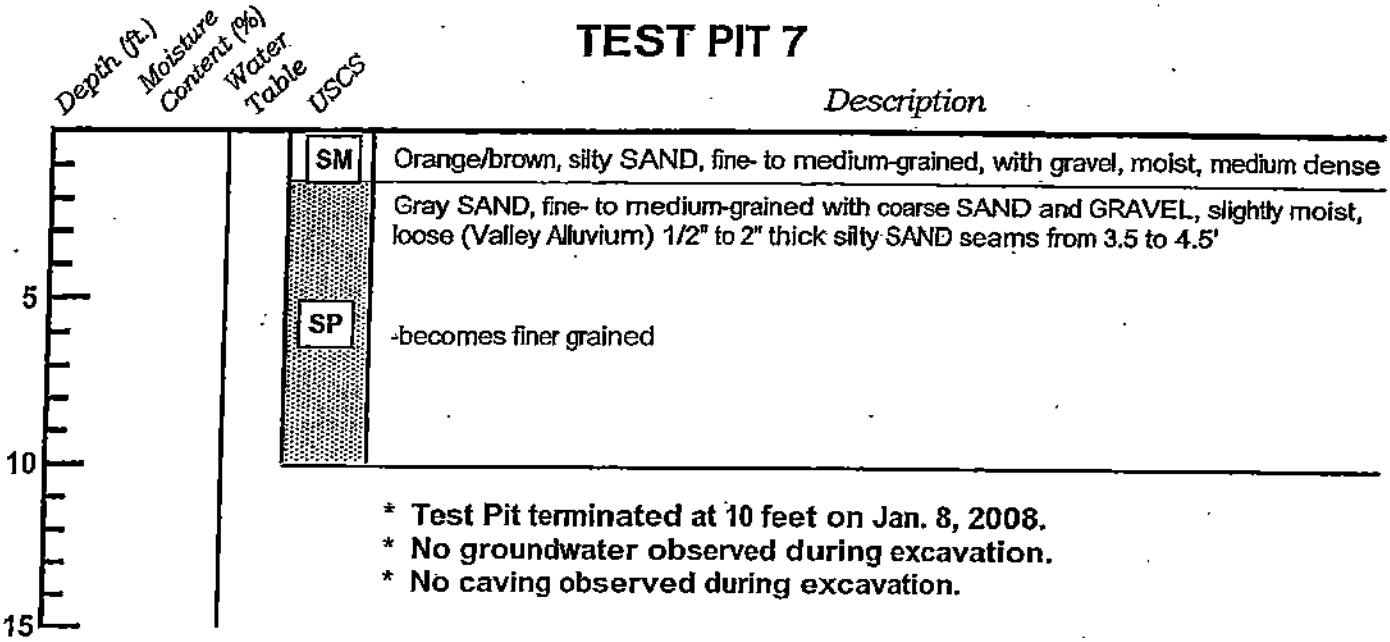
GEOTECH CONSULTANTS, INC.

TEST PIT LOG

6101 - 199th Street NE
Arlington, Washington

Job	Date:	Logged by:	Plate:
07439	Dec. 2007	GB	5

TEST PIT 7



* **Test Pit terminated at 10 feet on Jan. 8, 2008.**
* **No groundwater observed during excavation.**
* **No caving observed during excavation.**

GEOTECH
CONSULTANTS, INC.

TEST PIT LOG

6101 - 199th Street NE
Arlington, Washington

Job	Date:	Logged by:	Plate:
07439	Dec. 2007	GB	6

Job Data:

Client: 0

Job Number: 07439

Job Name: Cascade Door

Date: 2/19/2008

Sample Data:

Test Pit/Boring: 1

Sample:

Depth: 2.5

Data Label: TP 1, 2.5 feet, 4.2% moisture

Tare: 404

Wet Weight: 1001.8

Dry Weight: 977.9

% Moisture: 4.2

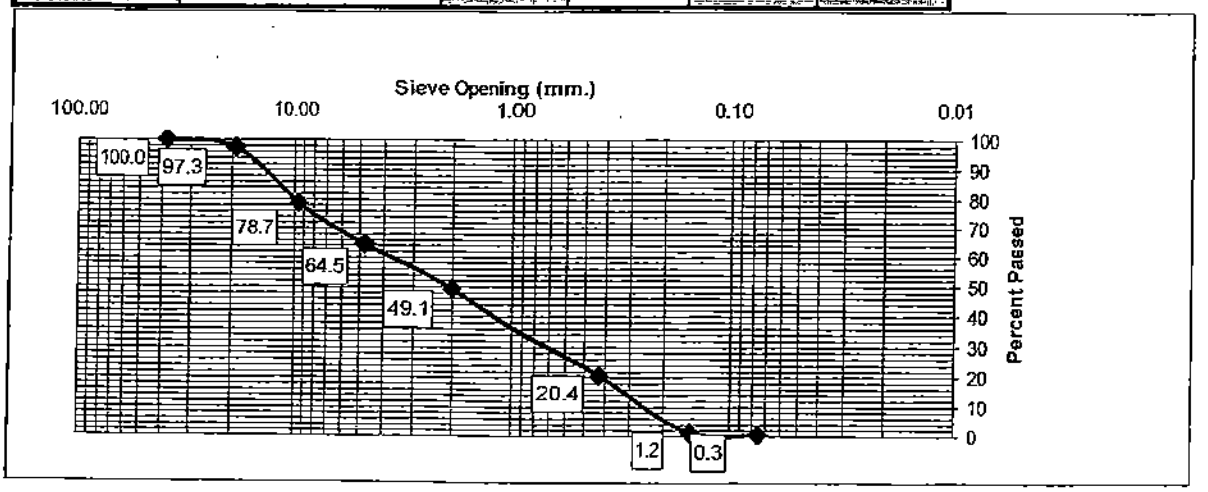
Wash Data:

Dry Weight (before wash): 573.9 grams

Dry Weight (after wash): 565.2 grams

Washed Soil Weight: 8.7 grams

Sieve US Std Inches or No.	Sieve Size from	Weight Retained (grams) Each	Weight Retained (grams) Total	Percent Retained Each	Percent Retained Total	Percent Passed Total
1 1/2	38.10	0.0	0.0	0.0	0.0	100.0
3/4	19.05	15.7	15.7	2.7	2.7	97.3
3/8	9.53	106.7	122.4	18.6	21.3	78.7
4	4.75	81.6	204.0	14.2	35.5	64.5
10	2.00	88.0	292.0	15.3	50.9	49.1
40	0.43	164.7	456.7	28.7	79.6	20.4
100	0.15	110.5	567.2	19.3	98.8	1.2
200	0.08	4.9	572.1	0.9	99.7	0.3
<200	0.00	0.5	572.6	0.1	99.8	0.2
Total			581.3		101.3	1.3



Job Data:

Client: _____ Job Number: 07439

Job Name: Cascade Door Date: 2/19/2008

Sample Data:

Test Pit/Boring: 3 Tare: 361.9

Sample: _____ Wet Weight: 1004.5

Depth: 7 Dry Weight: 986.8

Data Label: TP 3, 7 feet, 2.8% moisture % Moisture: 2.8

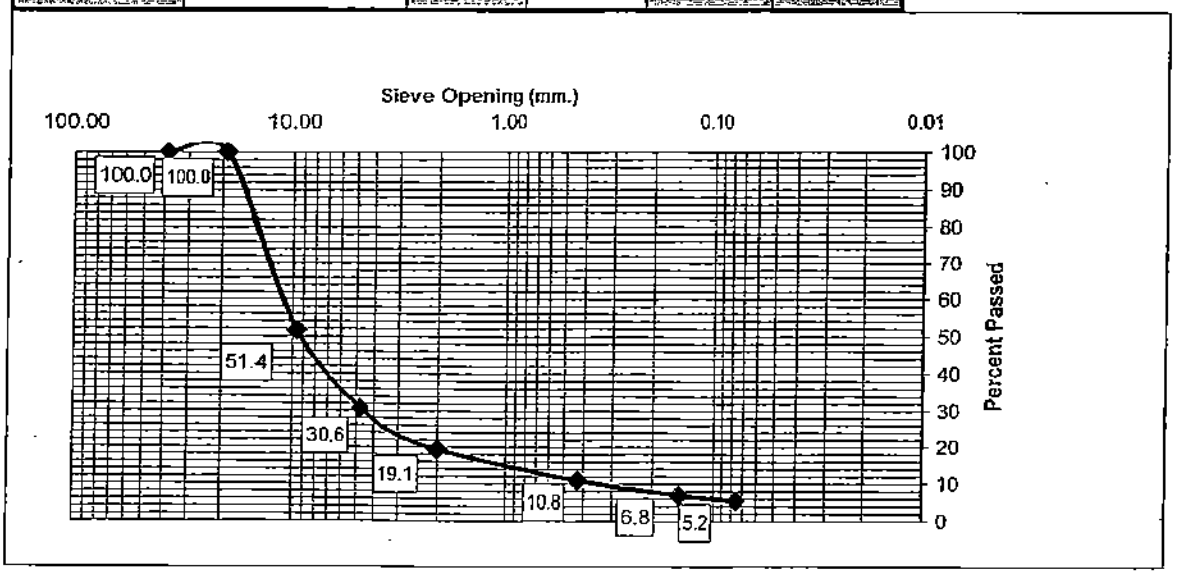
Wash Data:

Dry Weight (before wash): 624.9 grams

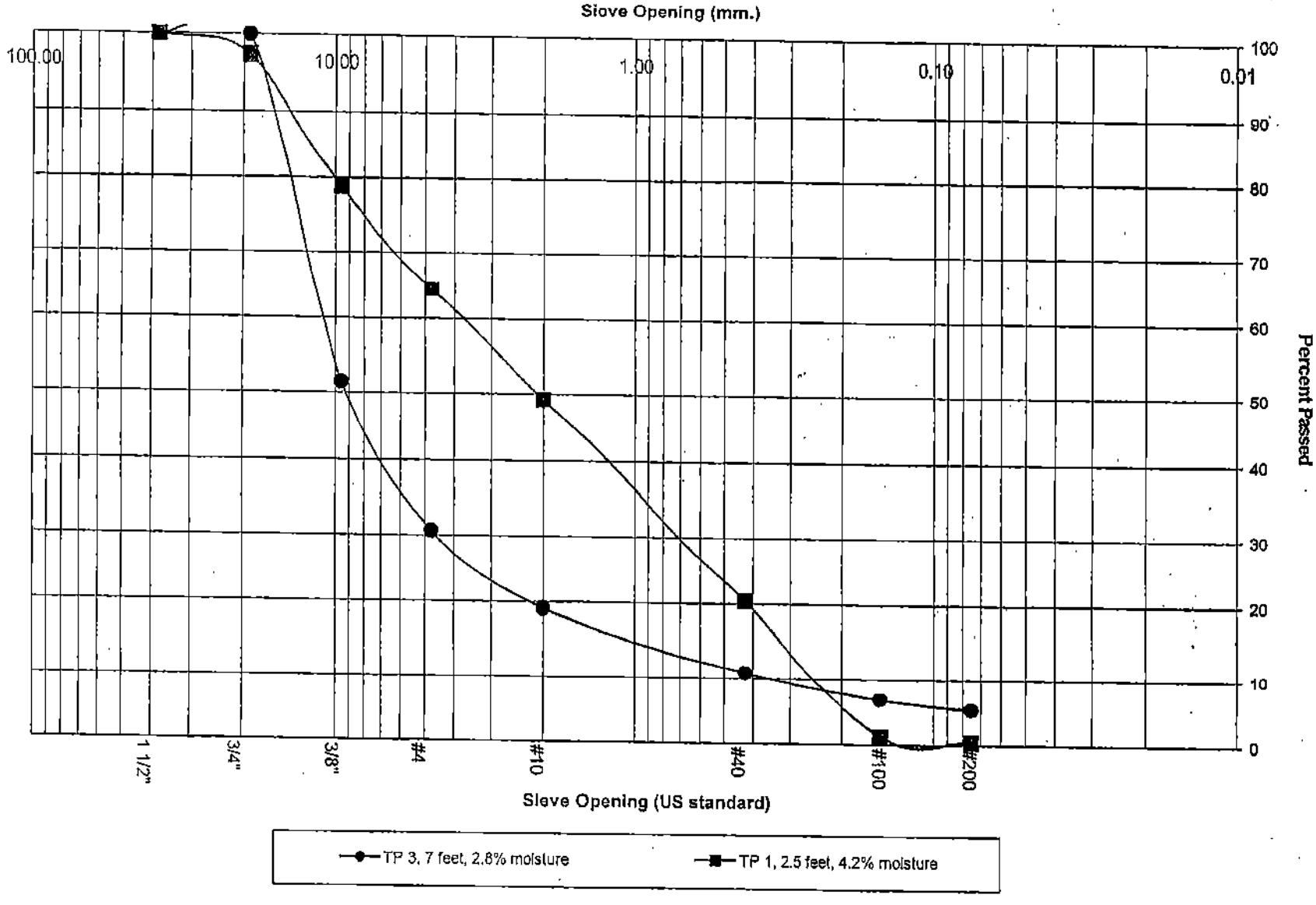
Dry Weight (after wash): 587.2 grams

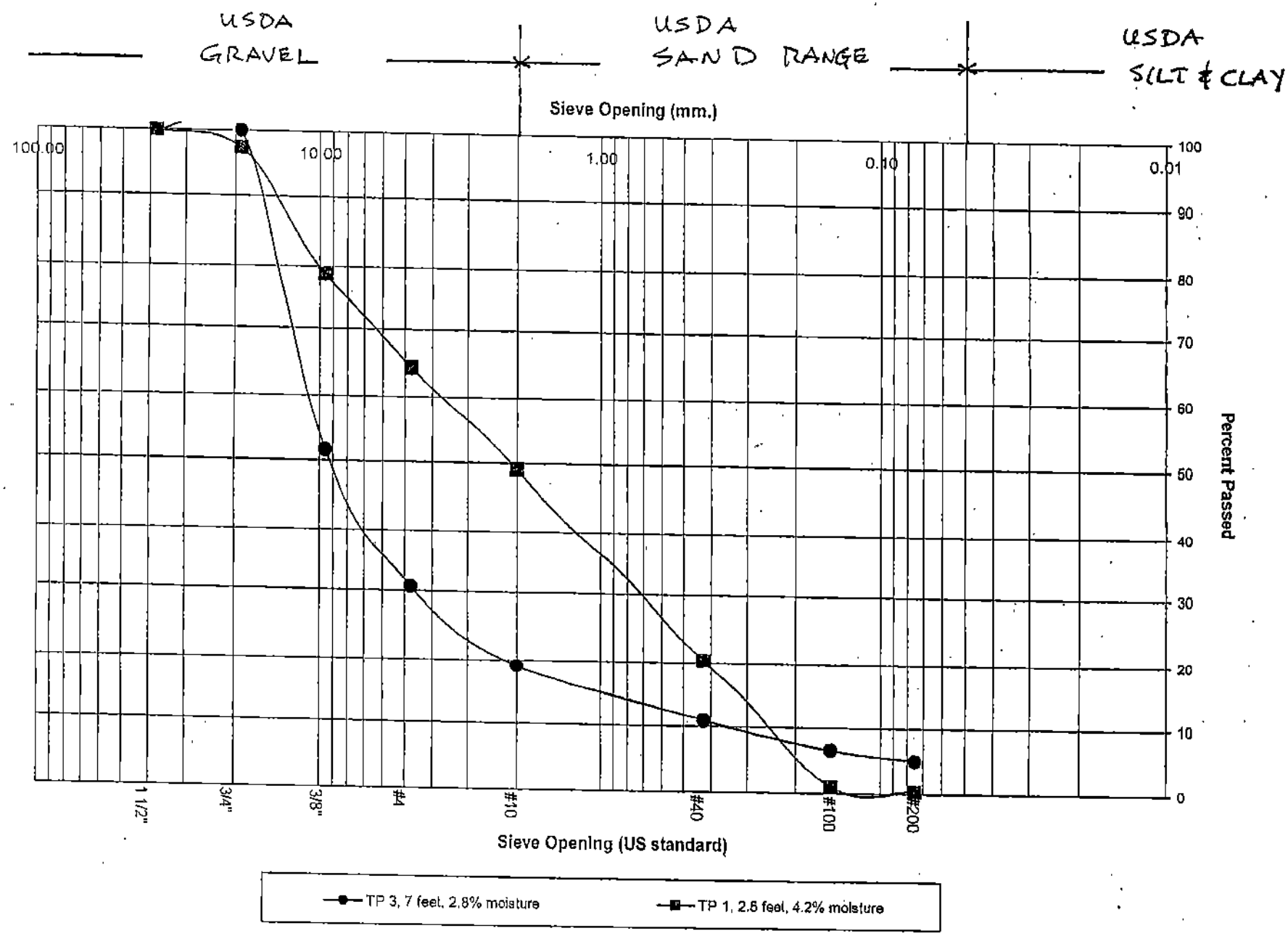
Washed Soil Weight: 37.7 grams

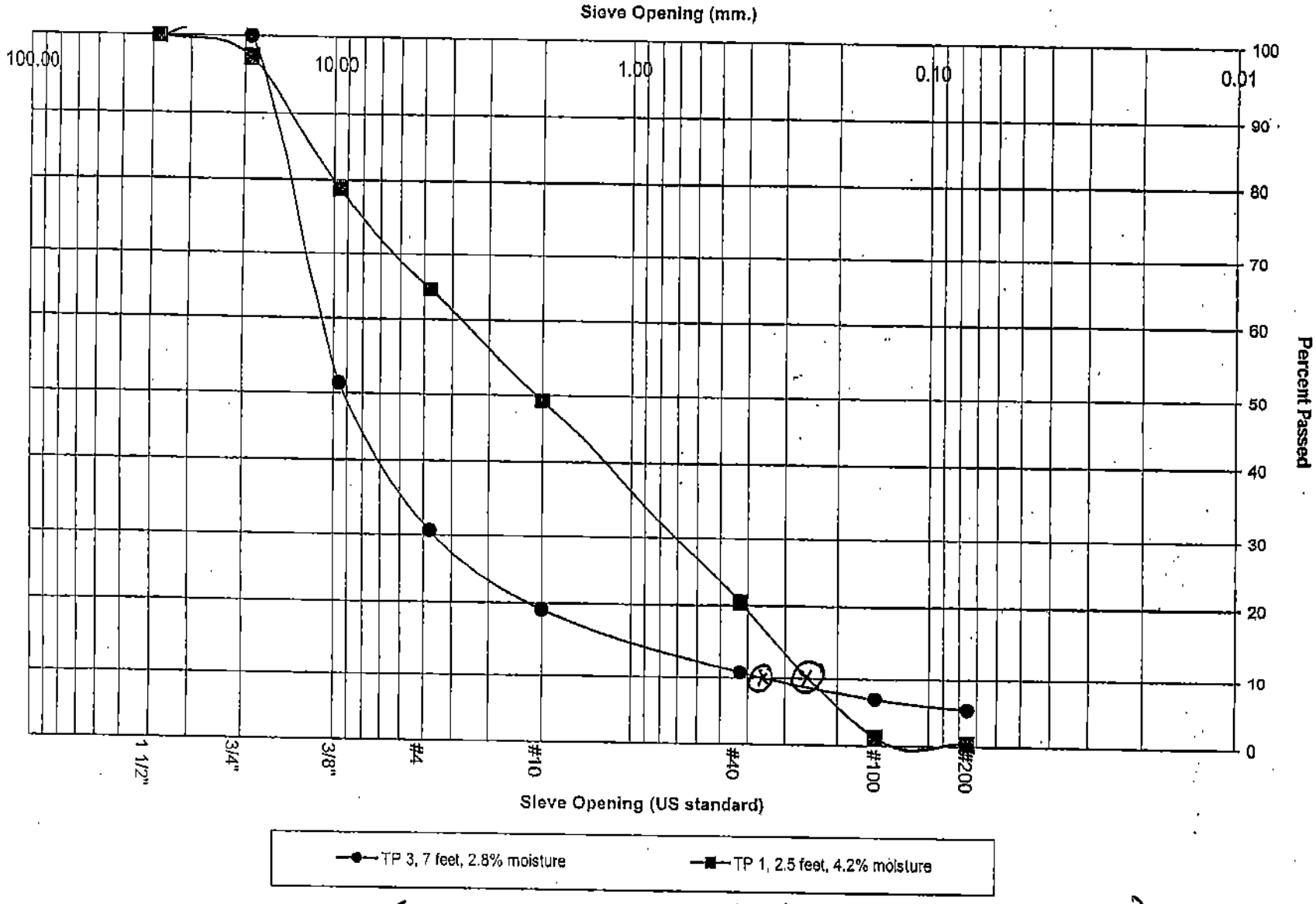
Sieve US Inches or No.	Sieve SI mm	Weight Retained (grams) Each	Total	Percent Retained Each	Total	Percent Passed Total
1 1/2	38.10	0.0	0.0	0.0	0.0	100.0
3/4	19.05	0.0	0.0	0.0	0.0	100.0
3/8	9.53	303.6	303.6	48.6	48.6	51.4
4	4.75	130.2	433.8	20.8	69.4	30.6
10	2.00	71.5	505.3	11.4	80.9	19.1
40	0.43	52.4	557.7	8.4	89.2	10.8
100	0.15	24.9	582.6	4.0	93.2	6.8
200	0.08	9.5	592.1	1.5	94.8	5.2
<200	0.00	2.0	594.1	0.3	95.1	4.9
Total			631.8		101.1	-1.1



Prepared by: Adam Hsu, 5/14/07


Sieve Opening (mm.)
100.00
10.00
1.00
0.10
0.01
100
90
80
70
60
50
40
30
20
10
0
Percent Passed
1 1/2"
3/4"
3/8"
#4
#10
#40
#100
#200
Sieve Opening (US standard)
TP 3, 7 feet, 2.8% moisture
TP 1, 2.5 feet, 4.2% moisture


USDA GRAVEL
USDA SAND RANGE
USDA SILT & CLAY
Sieve Opening (mm.)
100.00
10.00
1.00
0.10
0.01
100
90
80
70
60
50
40
30
20
10
0
Percent Passed
1 1/2"
3/4"
3/8"
#4
#10
#40
#100
#200
Sieve Opening (US standard)
TP 3, 7 feet, 2.8% moisture
TP 1, 2.5 feet, 4.2% moisture



$D_{10} \approx 0.36$ mm

$D_{10} \approx 0.25$ mm (TYPICAL)

Correction factors higher than those provided in Table 3.7 should be considered for situations where long-term maintenance will be difficult to implement, where little or no pretreatment is anticipated, or where site conditions are highly variable or uncertain. These situations require the use of best professional judgment by the site engineer and the approval of the local jurisdiction. An Operation and Maintenance plan and a financial bonding plan may be required by the local jurisdiction.

2. ASTM Gradation Testing at Full Scale Infiltration Facilities

As an alternative to Table 3.7, recent studies by Massmann and Butchart (2000) were used to develop the correlation provided in Table 3.8. These studies compare infiltration measurements from full-scale infiltration facilities to soil gradation data developed using the ASTM procedure (ASTM D422). The primary source of the data used by Massmann and Butchart was from Wiltsie (1998), who included limited infiltration studies only on Thurston County sites. However, Massmann and Butchart also included limited data from King and Clark County sites in their analysis. This table provides recommended long-term infiltration rates that have been correlated to soil gradation parameters using the ASTM soil gradation procedure.

Table 3.8 can be used to estimate long-term design infiltration rates directly from soil gradation data, subject to the approval of the local jurisdiction. As is true of Table 3.7, the long-term rates provided in Table 3.8 represent average conditions regarding site variability, the degree of long-term maintenance and pretreatment for TSS control. The long-term infiltration rates in Table 3.8 may need to be decreased if the site is highly variable, or if maintenance and influent characteristics are not well controlled. The data that forms the basis for Table 3.8 was from soils that would be classified as sands or sandy gravels. No data was available for finer soils at the time the table was developed. Therefore, Table 3.8 should not be used for soils with a d_{10} size (10% passing the size listed) less than 0.05 mm (U.S. Standard Sieve).

TP-1, D_{10} = 0.25mm
TP-3, D_{10} = 0.36mm

Table 3.8 – Alternative Recommended Infiltration Rates based on ASTM Gradation Testing.

D_{10} Size from ASTM D422 Soil Gradation Test (mm)	Estimated Long-Term (Design) Infiltration Rate (in./hr)
≥ 0.4	9*
RANGE OF D_{10} 0.3	6.5*
0.2	USE → 3.5*
0.1	2.0**
0.05	0.8

INFILT. RATES.

* Not recommended for treatment
* Refer to SSC-4 and SSC-6 for treatment acceptability criteria

8. DRAINAGE CALCULATIONS

BENNETT ENGINEERING, LLC

BY NCS DATE 3/21/08
CKD TB DATE 3/24/08 PROJECT CASCADE DOOR BUILDING
SHEET NO. _____ OF _____
JOB NO. 07039

DRAINAGE AREAS - TOTAL BASIN = 1.24 ACRES

PROPERTY AREA = 54,168 SF (1.24 ACRES)

BUILDING FLOOR AREA = 14440 SF
SIDEWALK = 1747 SF
CONCRETE RAMPS = 1200 SF
ASPHALT = 21,563 SF
} 38950 SF (0.89 Ac IMPERVIOUS)

LANDSCAPING = 15219 SF (0.35 Ac).

2000 FRANKLIN STREET, SUITE #101
BELLINGHAM, WA 98225

PHONE: (360) 671-2600
FAX: (360) 671-0122

DRAINAGE CALCULATIONS
Cascade Door Site Improvements
Job No. 07039

Proposed Event Summary (ENTIRE PROJECT AREA)

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
6 month 64%	0.2407	7.83	0.0823	1.2430	SBUH	TYPE1A
2 year	0.4053	7.83	0.1378	1.2430	SBUH	TYPE1A
10 year	0.6033	7.83	0.2054	1.2430	SBUH	TYPE1A
100 year	1.0374	7.83	0.3546	1.2430	SBUH	TYPE1A

Record Id: Proposed Project Including Roof Area

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area	0.35 ac	**DCIA**	0.89 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	11.32 min	**DC TC**	2.66 min

Pervious CN Calc

Description	SubArea	Sub cn
Golf crse/cemeteries/landscaping (>75% grass)	0.35 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Shallow	Paved	36.00 ft	1.00%	0.0100		0.19 min
Sheet	Dense grasses : 0.24	25.00 ft	2.00%	0.2400	1.80 in	6.28 min
Channel (interm)	Grassed (n=0.030)	700.00 ft	2.00%	0.0300		4.86 min
Pervious TC						11.43 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, roofs, etc)	0.89 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Smooth Surfaces.: 0.011	95.00 ft	1.00%	0.0110	1.80 in	2.05 min
Channel (cont)	Other streams, man-made channels and pipe	190.00 ft	0.50%	0.0110		0.61 min
Directly Connected TC						2.66min

Precipitation Data

Event	Precip (in)
6 month 64%	1.2000
2 year	1.8000
10 year	2.5000
100 year	4.0000

Record Id: S-1 Live Storage Above Rain Garden

Descrip:	Pond	Increment	0.10 ft	
Start El.	97.2000 ft	Max El.	99.2000 ft	
Length	162.3000 ft	Width	10.0000 ft	
Length ss1	2.00v:1h (w)	Length ss2	2.0000v:1h	(E)
Width ss1	3.00v:1h (s)	Width ss2	2.0000v:1h	(N)
Only consider bottom area for infiltration				

Stage Storage Rating Curve			
97.2000 ft	0.0050 cf	98.2000 ft	2055.4243 cf
97.3000 ft	166.5694 cf	98.3000 ft	2309.3388 cf
97.4000 ft	341.6888 cf	98.4000 ft	2572.2082 cf
97.5000 ft	525.4032 cf	98.5000 ft	2844.0727 cf
97.6000 ft	717.7527 cf	98.6000 ft	3124.9721 cf
97.7000 ft	918.7771 cf	98.7000 ft	3414.9466 cf
97.8000 ft	1128.5166 cf	98.8000 ft	3714.0360 cf
97.9000 ft	1347.0110 cf	98.9000 ft	4022.2805 cf
98.0000 ft	1574.3004 cf	99.0000 ft	4339.7199 cf
98.1000 ft	1810.4249 cf	99.1000 ft	4666.3944 cf
		99.2000 ft	5002.3334 cf

← OPEN WATER STORAGE REQ'D DURING 100-YEAR STORM EVENT = 2517.4 cf (PROVIDED WITH WATER LEVEL @ ELEV 98.4')

Record Id: S-2 Storage in Gravel & Amended Sand Layers

Descrip:	Gravel Storage	Increment	0.10 ft
Start El.	93.7000 ft	Max El.	97.2000 ft
Length	180.0000 ft	Width	10.0000 ft
Voids	35.0000 %	Consider Bottom Only	

Stage Storage Rating Curve			
93.0000 ft	0.0019 cf	96.5000 ft	1134.0019 cf
93.1000 ft	63.0019 cf	96.6000 ft	1197.0019 cf
93.2000 ft	126.0019 cf	96.7000 ft	1260.0019 cf
93.3000 ft	189.0019 cf	96.8000 ft	1323.0019 cf
93.4000 ft	252.0019 cf	96.9000 ft	1386.0019 cf
93.5000 ft	315.0019 cf	97.0000 ft	1449.0019 cf
93.6000 ft	378.0019 cf	97.1000 ft	1512.0019 cf
93.7000 ft	441.0019 cf	97.2000 ft	1575.0019 cf
93.8000 ft	504.0019 cf	97.3000 ft	1638.0019 cf
93.9000 ft	567.0019 cf	97.4000 ft	1701.0019 cf
94.0000 ft	630.0019 cf	97.5000 ft	1764.0019 cf
94.1000 ft	693.0019 cf	97.6000 ft	1827.0019 cf
94.2000 ft	756.0019 cf	97.7000 ft	1890.0019 cf
94.3000 ft	819.0019 cf	97.8000 ft	1953.0019 cf
94.4000 ft	882.0019 cf	97.9000 ft	2016.0019 cf
94.5000 ft	945.0019 cf	98.0000 ft	2079.0019 cf
94.6000 ft	1008.0019 cf	98.1000 ft	2142.0019 cf
94.7000 ft	1071.0019 cf	98.2000 ft	2205.0019 cf

← 2205 CF OF WATER STORAGE AT TOP OF AMENDED SAND LAYER (ELEV 97.2')

Record Id: I-2 Gravel Bed Infiltration Discharge

Descrip:	Gravel Infiltration Area	Increment	0.10 ft
Start El.	93.7000 ft	Max El.	99.2000 ft
Infiltration rate	3.5000 in/hr	WP Multiplier	1.00

LPOOLCOMPUTE [P-2] SUMMARY using Puls

Start of live storage: 93.7000 ft

Event	Match Q (cfs)	Peak Q (cfs)	Peak Stg (ft)	Vol (cf)	Vol (acft)	Time to Empty
2 year	0.0000	0.1458	94.6479	597.18	0.0137	25.00
10 year	0.0000	0.1458	95.9766	1434.26	0.0329	25.00
100 year	0.0000	0.1458	98.4024	4783.60	0.1098	32.50

↑ PEAK LEVEL DURING 100-YEAR STORM

PROJECT: CASCADE DOOR & HARDWARE
PROJECT #: 07039

TRENCH CHARACTERISTICS
LENGTH (FT): **180.0** WIDTH (FT): **10.0**
DEPTH (FT): **3.5** (INCLUDES AMENDED SAND AND DRAIN ROCK SECTIONS)
TRENCH STORAGE VOLUME AT 35% VOIDS (CF): **2205**
DESIGN INFILTRATION RATE FOR SAND (IN/HOUR): **3.5**
INFILTRATION RATE FOR TRENCH BOTTOM DIMENSIONS (CFS): **0.1458**

HYDROGRAPH TIME INTERVAL (MIN)	TIME INTERVAL (SEC)	100-YEAR INCREMENTAL RUNOFF RATE (CFS)	INFILTRATION RATE (CFS)	NET DIFF (CFS)	NET STORAGE REQUIRED (CF)	CUM STORAGE REQUIRED (CF)
290	600	0.1544	0.1458	0.0086	5.1	5.1
300	600	0.1549	0.1458	0.0091	5.4	10.6
310	600	0.1670	0.1458	0.0212	12.7	23.3
320	600	0.1757	0.1458	0.0299	17.9	41.2
330	600	0.1763	0.1458	0.0305	18.3	59.5
340	600	0.1885	0.1458	0.0427	25.6	85.1
350	600	0.1974	0.1458	0.0516	30.9	116.0
360	600	0.1980	0.1458	0.0522	31.3	147.3
370	600	0.2201	0.1458	0.0743	44.6	191.9
380	600	0.2366	0.1458	0.0908	54.5	246.3
390	600	0.2358	0.1458	0.0900	54.0	300.3
400	600	0.2693	0.1458	0.1235	74.1	374.4
410	600	0.2938	0.1458	0.1480	88.8	463.2
420	600	0.2920	0.1458	0.1462	87.7	550.9
430	600	0.3322	0.1458	0.1864	111.8	662.7
440	600	0.3614	0.1458	0.2156	129.3	792.0
450	600	0.3594	0.1458	0.2136	128.1	920.2
460	600	0.7416	0.1458	0.5958	357.5	1277.6
470	600	1.0374	0.1458	0.8916	534.9	1812.6
480	600	0.9995	0.1458	0.8537	512.2	2324.8
490	600	0.7243	0.1458	0.5785	347.1	2671.9
500	600	0.4830	0.1458	0.3372	202.3	2874.2
510	600	0.5298	0.1458	0.3840	230.4	3104.5
520	600	0.4269	0.1458	0.2811	168.6	3273.2
530	600	0.3698	0.1458	0.2240	134.4	3407.6
540	600	0.3779	0.1458	0.2321	139.2	3546.8
550	600	0.3192	0.1458	0.1734	104.0	3650.8
560	600	0.2786	0.1458	0.1328	79.7	3730.5
570	600	0.2849	0.1458	0.1391	83.4	3813.9
580	600	0.2649	0.1458	0.1191	71.4	3885.4
590	600	0.2531	0.1458	0.1073	64.4	3949.7
600	600	0.2548	0.1458	0.1090	65.4	4015.1
610	600	0.2378	0.1458	0.0920	55.2	4070.3
620	600	0.2255	0.1458	0.0797	47.8	4118.1
630	600	0.2275	0.1458	0.0817	49.0	4167.1
640	600	0.2157	0.1458	0.0699	41.9	4209.0
650	600	0.2076	0.1458	0.0618	37.1	4246.1
660	600	0.2089	0.1458	0.0631	37.8	4283.9
670	600	0.2028	0.1458	0.0570	34.2	4318.1
680	600	0.1988	0.1458	0.0530	31.8	4349.9
690	600	0.1995	0.1458	0.0537	32.2	4382.1
700	600	0.1939	0.1458	0.0481	28.8	4410.9
710	600	0.1898	0.1458	0.0440	26.4	4437.3
720	600	0.1905	0.1458	0.0447	26.8	4464.1
730	600	0.1848	0.1458	0.0390	23.4	4487.5
740	600	0.1807	0.1458	0.0349	20.9	4508.4
750	600	0.1814	0.1458	0.0356	21.3	4529.7
760	600	0.1757	0.1458	0.0299	17.9	4547.6
770	600	0.1716	0.1458	0.0258	15.5	4563.1
780	600	0.1722	0.1458	0.0264	15.8	4578.9
790	600	0.1719	0.1458	0.0261	15.6	4594.6
800	600	0.1720	0.1458	0.0262	15.7	4610.3
810	600	0.1721	0.1458	0.0263	15.8	4626.0
820	600	0.1667	0.1458	0.0209	12.5	4638.5
830	600	0.1626	0.1458	0.0168	10.1	4648.6
840	600	0.1632	0.1458	0.0174	10.4	4659.0
850	600	0.1629	0.1458	0.0171	10.2	4669.3
860	600	0.1630	0.1458	0.0172	10.3	4679.6
870	600	0.1630	0.1458	0.0172	10.3	4689.9
880	600	0.1577	0.1458	0.0119	7.1	4697.0
890	600	0.1535	0.1458	0.0077	4.6	4701.6
900	600	0.1541	0.1458	0.0083	5.0	4706.5
910	600	0.1537	0.1458	0.0079	4.7	4711.3
920	600	0.1538	0.1458	0.0080	4.8	4716.0
930	600	0.1538	0.1458	0.0080	4.8	4720.8
940	600	0.1485	0.1458	0.0027	1.6	4722.4

REQUIRED STORAGE VOLUME - 100-YEAR STORM (CF): **4722.4**
STORAGE VOLUME IN AMENDED SAND/DRAIN ROCK (CF): **2205.0**
OPEN WATER STORAGE VOLUME REQUIRED - 100-YEAR STORM (CF): **2517.4**
ESTIMATED WATER ELEVATION IN RAIN GARDEN (FT): **98.4**

Less Roof Event Summary (PGIS ONLY) (+ LANDSCAPING)

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
6 month 64%	0.1557	7.83	0.0551	0.9120	SBUH	TYPE1A
2 year	0.2735	7.83	0.0943	0.9120	SBUH	TYPE1A
10 year	0.4193	7.83	0.1427	0.9120	SBUH	TYPE1A
100 year	0.7457	7.83	0.2507	0.9120	SBUH	TYPE1A

Record Id: Proposed Project Less Bypassed Roof Area

Design Method	SBUH	Rainfall type	TYPE1A
Hyd Intv	10.00 min	Peaking Factor	484.00
		Abstraction Coeff	0.20
Pervious Area	0.35 ac	DCIA	0.56 ac
Pervious CN	86.00	DC CN	98.00
Pervious TC	5.04 min	DC TC	0.61 min

Pervious CN Calc

Description	SubArea	Sub cn
Golf crse/cemeteries/landscaping (>75% grass)	0.35 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Shallow	Paved	36.00 ft	1.00%	0.0100		0.19 min
Sheet	Dense grasses : 0.24	25.00 ft	2.00%	0.2400	0.00 in	0.00 min
Channel (interm)	Grassed (n=0.030)	700.00 ft	2.00%	0.0300		4.86 min
	Pervious TC					11.43 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Impervious surfaces (pavements, ~~roofs~~, etc)	0.56 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Smooth Surfaces.: 0.011	95.00 ft	1.00%	0.0110	0.00 in	0.00 min
Channel (cont)	Other streams, man-made channels and pipe	190.00 ft	0.50%	0.0110		0.61 min
	Directly Connected TC					2.66min

Record Id: S-1 Live Storage Above Rain Garden

Descrip:	Pond	Increment	0.10 ft
Start El.	97.2000 ft	Max El.	99.2000 ft
Length	162.3000 ft	Width	10.0000 ft
Length ss1	2.00v:1h	Length ss2	2.0000v:1h
Width ss1	3.00v:1h	Width ss2	2.0000v:1h
Only consider bottom area for infiltration			

Stage Storage Rating Curve			
97.2000 ft	0.0050 cf	98.2000 ft	2055.4243 cf
97.3000 ft	166.5694 cf	98.3000 ft	2309.3388 cf
97.4000 ft	341.6888 cf	98.4000 ft	2572.2082 cf
97.5000 ft	525.4032 cf	98.5000 ft	2844.0727 cf
97.6000 ft	717.7527 cf	98.6000 ft	3124.9721 cf
97.7000 ft	918.7771 cf	98.7000 ft	3414.9466 cf
97.8000 ft	1128.5166 cf	98.8000 ft	3714.0360 cf
97.9000 ft	1347.0110 cf	98.9000 ft	4022.2805 cf
98.0000 ft	1574.3004 cf	99.0000 ft	4339.7199 cf
98.1000 ft	1810.4249 cf	99.1000 ft	4666.3944 cf
		99.2000 ft	5002.3334 cf

Record Id: I-1 Rain Garden Soil Infiltration

Descrip:	Infiltration Area	Increment	0.10 ft
Start El.	97.2000 ft	Max El.	99.2000 ft
Infiltration rate	1.0000 in/hr	WP Multiplier	1.00

LPOOLCOMPUTE [P-1] SUMMARY using Puls

Start of live storage: 97.2000 ft

Event	Match Q (cfs)	Peak Q (cfs)	Peak Stg (ft)	Vol (cf)	Vol (acft)	Time to Empty
6 month 64%	0.0000	0.0376	97.4833	494.70	0.0114	30.83

PEAK LEVEL DURING 6-MONTH STORM

CASCADE PVC ROOF DRAINS
Rating Table for Circular Channel

Project Description	
Project File	c:\haestad\fmw\07039.fm2
Worksheet	CASCADE PVC ROOF DRAINS
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data		
Mannings Coefficient	0.011	
Channel Slope	0.010000	ft/ft
Diameter	6.00	in

→ SLOPE = 1%

Input Data			
	Minimum	Maximum	Increment
Depth	0.00	0.49	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.00	0.00	0.00
0.05	0.01	1.35
0.10	0.06	2.08
0.15	0.13	2.62
0.20	0.22	3.05
0.25	0.33	3.38
0.30	0.45	3.62
0.35	0.56	3.78
0.40	0.65	3.85
0.45	0.71	3.80
0.50	0.66	3.38

100-YEAR PEAK FLOW = 0.15 cfs
(6-INCH ROOF DRAINS)

← CAPACITY = 0.71 cfs (✓ok)

CASCADE PVC STORM DRAINS
Rating Table for Circular Channel

Project Description	
Project File	c:\haestad\fmw\07039.fm2
Worksheet	CASCADE PVC STORM DRAINS
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.011
Channel Slope	0.004000 ft/ft
Diameter	8.00 in

→ SLOPE = 0.4%

Input Data			
	Minimum	Maximum	Increment
Depth	0.00	0.65	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.00	0.00	0.00
0.05	0.01	0.86
0.10	0.04	1.34
0.15	0.10	1.71
0.20	0.18	2.01
0.25	0.27	2.26
0.30	0.38	2.47
0.35	0.49	2.64
0.40	0.61	2.77
0.45	0.72	2.87
0.50	0.82	2.93
0.55	0.91	2.95
0.60	0.96	2.91
0.65	0.96	2.77

100-YEAR PEAK FLOW = 0.37 cfs
(8-INCH STORM DRAIN)

← CAPACITY = 0.96 cfs (√ok)

9. STORMWATER FACILITY OPERATION AND MAINTENANCE PLAN

Cascade Door & Hardware
Stormwater Facility Operation and Maintenance Plan

March 2008

Purpose and Scope

The purpose of this Stormwater Facility Operation and Maintenance Plan is to define the responsible entity for maintenance of the facility and summarize the required maintenance activities and schedule for on-site stormwater structures.

Responsible Entity

Following acceptance of the completed project, the responsible entity for operation and maintenance of the stormwater facilities will be Glen Bayha, owner of Cascade Door and Hardware.

Stormwater Structures Maintenance

Table 1 lists the stormwater structures on-site and summarizes the recommended maintenance activities and maintenance/inspection schedule. Recommended facility-specific maintenance standards from the *2005 DOE Manual* are attached.

Table 1
Structure Maintenance/Inspection Schedule

STRUCTURE	INSPECTION	MAINTENANCE
Rain Garden	Quarterly	Remove accumulated sediment/debris from bottom. Maintain plantings, as needed.
Infiltration Trench	Semi-Annually	Check water levels in catch basins during large storm events (>1 inch/24 hours).
Catch Basins	Annually	Remove sediment from bottom of catch basins if depth >6 inches.
Storm Drain Piping	Annually	Check for blockage at structures.
Rock-lined Outfalls	Annually/After large storms (>1 inch/24 hours)	Remove accumulated debris. Replace displaced rocks.

Plan Revisions

This plan is to be revised after completion of the project to reflect as-built conditions. The plan should be reviewed and revised, if necessary, every two years after project completion.

4.6 Maintenance Standards for Drainage Facilities

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Table 4.5 – Maintenance Standards

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	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.~~
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation. If settlement is apparent, measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height.	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Emergency Overflow/ Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

No. 2 – Infiltration

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Poisonous/Noxious Vegetation	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Contaminants and Pollution	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Rodent Holes	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1)
Storage Area	Sediment	Water ponding in infiltration pond after rainfall ceases and appropriate time allowed for infiltration. (A percolation test pit or test of facility indicates facility is only working at 90% of its designed capabilities. If two inches or more sediment is present, remove).	Sediment is removed and/or facility is cleaned so that infiltration system works according to design.
Filter Bags (if applicable)	Filled with Sediment and Debris	Sediment and debris fill bag more than 1/2 full.	Filter bag is replaced or system is redesigned.
Rock Filters	Sediment and Debris	By visual inspection, little or no water flows through filter during heavy rain storms.	Gravel in rock filter is replaced.
Side Slopes of Pond	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway and Berms over 4 feet in height.	Tree Growth	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Piping	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Emergency Overflow Spillway	Rock Missing	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
	Erosion	See "Detention Ponds" (No. 1).	See "Detention Ponds" (No. 1).
Pre-settling Ponds and Vaults	Facility or sump filled with Sediment and/or debris	6" or designed sediment trap depth of sediment.	Sediment is removed.

No. 5 – Catch Basins

Maintenance Component	Defect	Condition When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & 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 regrouted 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.

No. 5 – Catch Basins

Maintenance Component	Defect	Condition When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
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 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.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

No. 7 – Energy Dissipaters

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 13 – Sand Filters (above ground/open)

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Above Ground (open sand filter)	Sediment Accumulation on top layer	Sediment depth exceeds 1/2-inch.	No sediment deposit on grass layer of sand filter that would impede permeability of the filter section.
	Trash and Debris Accumulations	Trash and debris accumulated on sand filter bed.	Trash and debris removed from sand filter bed.
	Sediment/ Debris in Clean-Outs	When the clean-outs become full or partially plugged with sediment and/or debris.	Sediment removed from clean-outs.
	Sand Filter Media	Drawdown of water through the sand filter media takes longer than 24-hours, and/or flow through the overflow pipes occurs frequently.	Top several inches of sand are scraped. May require replacement of entire sand filter depth depending on extent of plugging (a sieve analysis is helpful to determine if the lower sand has too high a proportion of fine material).
	Prolonged Flows	Sand is saturated for prolonged periods of time (several weeks) and does not dry out between storms due to continuous base flow or prolonged flows from detention facilities.	Low, continuous flows are limited to a small portion of the facility by using a low wooden divider or slightly depressed sand surface.
	Short Circuiting	When flows become concentrated over one section of the sand filter rather than dispersed.	Flow and percolation of water through sand filter is uniform and dispersed across the entire filter area.
	Erosion Damage to Slopes	Erosion over 2-inches deep where cause of damage is prevalent or potential for continued erosion is evident.	Slopes stabilized using proper erosion control measures.
	Rock Pad Missing or Out of Place	Soil beneath the rock is visible.	Rock pad replaced or rebuilt to design specifications.
	Flow Spreader	Flow spreader uneven or clogged so that flows are not uniformly distributed across sand filter.	Spreader leveled and cleaned so that flows are spread evenly over sand filter.
	Damaged Pipes	Any part of the piping that is crushed or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced.

10. CIVIL ENGINEERING PLAN SET (SHEETS C-1 THROUGH C-5)