Station 46

Materials Testing & Consulting, Inc.

June 2, 2003

MR. DAN NELSON
DESIGNS N.W. ARCHITECTS
P.O. BOX 1270
10031 SR 532, SUITE B
STANWOOD, WA 98292

Re: Geotechnical Investigation
Arlington Fire Station, Task 2A

Project #04BG058A

Dear Mr. Nelson:

In accordance with your request, Materials Testing & Consulting, Inc. (MTC) has conducted a soils investigation and geotechnical engineering analysis for the referenced project. The results of this investigation, together with our recommendations, are contained in the following report. Included with this report are three additional copies for your use.

To investigate the site, we excavated a series of test pits and obtained soil samples for laboratory testing. The results of the field and laboratory investigations have been carefully analyzed to determine soil bearing capacities and footing embedment depths. The results of the field and laboratory work indicate that the soils are suitable for the planned renovations and additions to the fire house and administration building.

Questions related to soil conditions often arise during design and construction of a project. We would be pleased to continue our role as geotechnical consultants during the project planning and construction. We also have a keen interest in providing materials testing and special inspection during construction of this project. We will be pleased to meet with you at your convenience to discuss these services.

We appreciate this opportunity to be of service to you and look forward to working with you in the future.

If you have any questions concerning the above items, the procedures used, or if MTC can be of any further assistance please call us at (360) 755-1990.

Respectfully Submitted,
MATERIALS TESTING & CONSULTING, INC.

Bellingham Office
1208 Bay Street, Suite 100
Bellingham, WA 98225
360-647-6061 ph
360-647-8111 fx

Corporate Headquarters
777 Chrysler Drive
Burlington, WA 98233
360-755-1990 ph
360-755-1980 fx
www.mtc-inc.net

Centralia Office
1710 Midway Court
Centralia, WA 98531
360-330-7926 ph
360-330-7946 fx

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Subsurface Investigation

INTRODUCTION

This report presents the results of a soils investigation and geotechnical engineering analysis of the existing fire station located in the City of Arlington at 115 North McLeod Ave. as shown on the location map, attached. The work described in this report was conducted in accordance with the scope of work outlined in Task 2A Alternate 1, Geotechnical Analysis of Downtown Station, of City of Arlington Project Nº 03-31. That scope of work is:

- Provide site geotechnical analysis for remodel/rebuild of existing station

We previously conducted a geotechnical investigation at the site to assess the stability of the steep slope occupying the eastern portion of the site the results of which were presented in our report dated April 28, 2004.

We were not requested to provide an environmental site assessment for this property. Any comments concerning on-site conditions and/or observations, including soil appearances and odors, are provided as general information. Information in this report is not intended to describe, quantify or evaluate any environmental concern or situation.

Project Description

The project consists of refurbishing an existing concrete block single story fire station. The fire station is at the base of an approximately 50 foot high, 40 degree (1.2:1) slope as shown on the attached site plan and profile. The building includes fire truck bays accessed from Macleod Street to the west. In addition to the station building, the site includes a one-story brick veneer administration building 70 feet to the south.

Site Description

GENERAL DESCRIPTION

The project site is located on Mcleod Street in downtown Arlington, Washington. The area encompassing the existing improvements is level on the west and is occupied by a single story fire station building approximately 170 feet by 45 feet in plan dimension surrounded by an asphalt parking lot. The site lies about 120 feet above sea level. The toe of the slope is at the rear of the building and partially retained by a cantilever retaining wall as shown on the site plan. The wall is 6 inches thick and varies from 3.8 to 5.6 feet tall. The slope rises abruptly to the east at a 40 degree incline (1.2:1 slope) to approximate elevation 170 feet. A utility easement runs along the eastern property boundary at the top of the slope. A more detailed description of the slope is included in our previous report.

AREA GEOLOGY

According to the USDA Soil Conservation Service Survey of Snohomish County, the site soils consist of Alderwood-Everett gravelly sandy loam. This map unit is on till plains, terraces and outwash plains. The Everett soil is very deep and somewhat excessively drained. It formed in glacial outwash. Permeability of the Everett soil is rapid and available water capacity is low. Runoff is rapid and the hazard of water erosion is moderate.

According to the Surficial Geologic Map of the Port Townsend Quadrangle (1989), the site is underlain by recessional continental glacial outwash deposits deposited by melt-water from the receding Pleistocene- age Vashon Stade ice sheet of the Late Wisconsin Frazer glaciation (Qvrc). These deposits in the study area and in the Arlington Heights immediately to the east are medium to well sorted pebble to cobble gravel and coarse to medium sand with local lenses of fine sand and silt. These glacial outwash units deposited by melt-water from the receding Vashon-age ice sheet are underlain by slightly older poorly sorted mixtures of fragments (glacial till) deposited directly by the Vashon-age ice sheet. Finer components of this glacial till include sand, silt and clay in variable proportions constituting a compact matrix in which the coarser components (pebbles, cobbles and boulders), are firmly embedded.

The soil conditions encountered during this investigation agree well with these descriptions.

Field Exploration

GENERAL NOTES

The field investigation included excavation of 4 test pits and recovering disturbed grab samples. Test pits were dug to depths of 8.5 to 10.0 feet below the existing ground surface. A site plan supplied by the City of Arlington was used to position the test pits. The test pits were located by the field technician by means of normal pacing procedures and are presumed to be accurate to within a few feet.

EXCAVATION & SAMPLING PROCEDURES

Prior to test pit excavation, the existing asphalt pavement was saw cut to provide access for the backhoe. A Case model 245 backhoe supplied and operated by MTC was used to excavate the test pits. Grab samples were obtained from the test pits from representative soil strata. The samples were classified in the field by our engineering geologist, identified according to test pit number and depth, placed in plastic bags to protect against moisture loss and transported to the laboratory for testing. Test Pit 4 was excavated next to the existing footing at the northwest corner of the fire house to enable us to measure its depth and width and to check the density of the bearing layer at its base and the condition of the confining soils. Upon the completion of our field work, the test pits were backfilled and the site leveled. Subsequent to our work, the fire department contracted with a private contractor to compact the backfill and patch the pavement. The logs of test pits are presented following the site plan.

LABORATORY TESTING

Upon demobilizing from the field, laboratory testing was conducted on selected samples to determine pertinent engineering characteristics of the soils encountered. The laboratory testing included supplementary visual classification and moisture content – ASTM D 2216, Atterberg Limits Tests - ASTM designation D-4318 and Grain Size Analysis - ASTM designation C-117, C-136. The results of these tests are presented in Laboratory Analysis after the Test Pit Logs.

Subsurface Conditions

The soil profiles were relatively consistent across the site. Three distinct soil units were observed in the test pits. The identified units are as follows with increasing depth below the surface:

Table 1: Soil Profiles

Pavement Section (AC) and (BR)	In Test Pits 2 - 4, consisting of 3" of asphalt concrete pavement and 3" of 5/8"- crushed surfacing top course.
Fill (UF)	Encountered in Test Pits 2 - 4 to depths of 1.5 – 6.2 feet, consisting of orange-brown, brown, dark brown and black sand and silt with varying amounts of gravel, metal, wood and brick fragments, medium dense to dense and moist.
Outwash (SP), (SW), (SW-SM) and (SM)	Encountered to the depths explored, 8.5 to 10.0 feet consisting of orange, tan and grey sand and silty sand, medium dense to dense, moist, with gravel and cobbles in varying amounts.

The outwash soils are considered to be normally consolidated, meaning that the soil has not experienced previous loading cycle(s) greater than the present loading condition.

Groundwater seepage was not encountered in any of the test pits. Some minor to moderate caving was observed in Test Pits 1 and 2.

The existing footing was comprised of two courses of concrete block and mortar underlain by a 12 inch deep by 12 inch thick cast-in-place concrete footing for a total depth of about 29 inches below the asphalt surface.

Discussion

EARTHWORK

Excessively organic and loose soils generally undergo high volume changes when subjected to loads. This is detrimental to the behavior of pavements, floor slabs, structural fills and foundations placed upon them. Excessively organic and loose soils should be stripped from these areas and wasted or stockpiled for later use.

The uncontrolled fill contains materials that are detrimental to the behavior of structural fills. This fill underlies portions of the existing fire house. Although there apparently haven't been any major detrimental effects to the building as a result, fire department personnel report that there has been some differential movement and minor cracking on building walls during earthquakes. Therefore, this material should not be left in place where it would be subject to new structure or vehicle loads, and should be over-excavated and wasted off site as necessary.

We estimate that stripping will be required to depths of 0.5 feet in the area of Test Pit 1, to remove the root layer and achieve a suitable bearing surface. New construction in the area of Test Pits 2 through 4, basically the remainder of the site, will necessitate the removal of the debris contaminated fill and replacement with imported structural fill to provide adequate bearing for footings. Exact depths of stripping should be adjusted in the field to ensure that the entire root or debris contaminated zone is removed. The final exposed subgrade should be inspected by MTC to verify that all deleterious material has been removed. Any soft spots or deflecting areas should be removed to firm unyielding soils and replaced with structural fill. The fills in Test Pits 2 through 4 containing debris contaminants should not be re-used for this purpose.

Once the existing soils are excavated to the design grade, proper control of the subgrade conditions (i.e., moisture content) and the placement and compaction of new fill (if required) should be overseen by a representative of MTC. The recommendations for structural fill presented below should be followed to minimize differential settlements that are detrimental to the behavior of footings, and floor slabs.

STRUCTURAL FILL

The use of onsite outwash soil and crushed surfacing top course is suitable as structural fill. Additionally, the existing asphalt pavement and concrete is suitable for this use provided it is crushed so that it meets the gradation specification for structural fill. Outwash soils containing more than about 7% fines are moisture sensitive and cannot be easily compacted to a dense and stable condition with conventional methods if they are exposed to rainy conditions. During fair weather, the native silty soils may be used as structural fill provided they are properly moisture conditioned, placed and compacted as discussed in the recommendations section of this report. Alternatively, imported structural fill that is less moisture sensitive should be used. Alluvial soils classified as (SP), (SW) and (GP) and existing clean fills, as discussed above, may be readily re-used for structural fill if they can be kept free of contaminating silts and clays.

Imported structural fill should consist of a mixture of clean sand and gravel that is relatively free of fines as outlined in the recommendations section below. If structural fill is used for the support of foundations, fill quality, placement and compaction should be monitored continuously by MTC so that the work is performed in accordance with the recommendations section outlined in this report.

Bearing Capacity

Two requirements must be fulfilled in the design of foundations. First, the load must be less than the ultimate bearing capacity of the foundation soils to maintain stability; and secondly, the differential settlement must not exceed an amount that will produce adverse behavior of the structure. The allowable settlement is usually exceeded before the bearing capacity is mobilized; therefore, the allowable bearing pressure is normally controlled by settlement considerations.

Bearing capacity analysis is based on the visual soil classification, density in the test pits, and results laboratory test results. These data indicate that the soils on this site are mostly sandy in nature and medium dense to dense. These native soils exhibit bearing capacities suitable for the planned improvements.

Excavations

Shallow foundation excavations that do not exceed four feet in depth may be constructed with side slopes approaching vertical. For deep excavations, the soils cannot be relied on to remain standing. These soils can fail, and collapse into any excavation. This is especially true when working at depths near the water table. Proper care must be taken to protect personnel and equipment working in or near excavations.

The information provided in the following table is for planning purposes. Maintaining safe working conditions is the responsibility of the contractor. Jobsite conditions such as soil moisture content, weather condition, earth movements and equipment type and operation can all affect slope stability. All excavations should be sloped or braced as required by applicable local, state and federal requirements. The contractor should not exceed the following maximum cut slope inclinations:

Table 2: Recommended Temporary Cut Slopes

Soil Type	Temporary Maximum Inclination	Permanent Maximum Inclination	OSHA Classification
Loose sand, medium dense to dense outwash and alluvium	1.5H:1V	2H:1V	C

Groundwater Control

Groundwater is not expected to cause any difficulties during construction on this site. Surface runoff should be directed away from all open excavations. The on-site silty soils can be expected to become soft and pump if subjected to excessive traffic after becoming wet during periods of rain. This can be avoided by constructing temporary or permanent driveway sections. All prepared subgrade surfaces should be protected from the adverse effects of freeze/thaw, rain and construction traffic

Geoseismic Setting

The site is in a seismically active zone according to the 2003 International Building Code (IBC). According to Table 1615.1.1, Site Class Definitions, the site is classified as a Class C site, defined as having an average SPT resistance of 50 or greater within the upper 100 feet of the formation.

Recent study of Puget Sound Lowland fault traces (Johnson, et al, 2002) indicates the subject property is located between two primary fault traces as shown in the fault trace map attached after the test laboratory testing. The South Whidbey Fault (SWF) is located about 25 km to the south and the Devils Mountain Fault (DMF) is located about 40 km to the north. Each of these traces is far enough from the subject property to not pose a significant risk of adverse surface rupture or displacements.

Liquefaction Potential

The materials on site are predominantly of a granular nature, consisting of medium dense to very dense sand, gravel and very stiff to hard silt. Because of the soil density, the potential for liquefaction of the soils in this area is negligible and not expected to present any problems for the project.

Conclusions and Recommendations

General Notes

Based on the subsurface conditions encountered, we conclude that the site is suitable for the planned development and that conventional shallow spread and continuous wall footing foundations are suitable for support of the anticipated loads. Loads of 2500 pounds per square foot for footings were assumed for settlement analysis. Settlements should not exceed tolerable limits if the design and construction recommendations presented below are followed. Our recommendations for site preparation fill placement and foundation and retaining wall design are outlined below.

Excavations

1. Prior to any site work, all organic and debris contaminated soils should be stripped from the site and stockpiled for later re-use in landscaped areas or disposed of off site.

2. Prior to placing concrete for footings, all water, debris and organic, loose or obviously compressive materials must be removed.
3. Prior to placing fills, the exposed subgrade should be proofrolled under the inspection of an MTC representative and if any other soft, pumping or otherwise unsuitable soils are encountered, they should be overexcavated and backfilled with compacted structural fill as outlined below.
4. Permanent cut slopes should be graded no steeper that 1-1/2 horizontal to 1 vertical (1.5:1).
5. Permanent cut slopes should be track walked to help retain topsoil and seed, covered with a layer of topsoil and protected from erosion by planting with grass or ground cover.
6. Excavated soils may be reused for structural fill as outlined below.

FILL QUALITY, PLACEMENT AND COMPACTION

1. Native fill used as structural fill should be near optimum moisture according to the modified Proctor test method (ASTM D 1557) and as determined by MTC. Soils not meeting optimum moisture content should be moisture conditioned by wetting or drying prior to placement. Soil with a moisture content exceeding 3% of optimum should be spread in thin lifts or wind rows, aerated, and turned over until it reaches near-optimum moisture conditions.
2. Native fill should be placed in loose lifts not exceeding 8" in thickness and compacted to 95% of maximum dry density according to the modified Proctor (ASTM D 1557).
3. Native fill should be free of organic debris or other deleterious material and should not contain cobbles or boulders that exceed 5" diameter.
4. Existing fills that are free of organics or other deleterious material may be re-used as structural fill provided they are placed in lifts not exceeding 12 inches in loose thickness at moisture contents within three percent of optimum moisture and compacted to a minimum of 95% relative compaction as determined by ASTM designation D-1557.
5. Imported structural fill should consist of 3 inch minus select, clean, granular soil with no more than 5% fines (-#200).
6. Imported structural fill should be placed in layers of not more than 12 inches in thickness, at moisture contents within three percent of optimum, and compacted to a minimum density of 95 percent of the maximum dry density as determined by ASTM designation D-1557.
7. For structural fill below footings, the compacted backfill should extend outside the perimeter of the footing for a distance equal to the thickness of the fill beneath the bottom of the footing.
8. Any excessively loose or soft spots or areas that do not meet the compaction requirements that are encountered in the footing subgrade will require over-excavation and backfilling with structural fill.
9. To prevent surface runoff from ponding against building foundations, the ground surface adjacent to the building and extending for a distance of at least five feet should be graded to slope away from the building at a 5% slope.
10. Permanent fill slopes should be graded no steeper than 2:1.

11. Permanent fill slopes should be track walked to help retain topsoil and seed, covered with a layer of topsoil and protected from erosion by planting with grass or ground cover.

FLOOR SLAB-ON-GRADE

1. Before placing concrete floors or pavements, or before any floor supporting fill is placed, the organic, loose or obviously compressive materials must be removed.
2. The subgrade should be proof rolled to confirm that the subgrade contains no soft or deflecting areas. Areas of excessive yielding should be excavated and backfilled with structural fill. Any additional fill used to increase the elevation of the floor slab should meet the requirements for structural fill.
3. To provide a capillary moisture break, a four inch thick, properly compacted granular mat should be provided below floor slabs. The mat should consist of an open graded gravel with non-plastic fines. The material should all pass a 3/4 inch sieve and should contain less than five percent passing the # 200 sieve.
4. Where moisture migration through floor slabs would be detrimental to floor coverings or the intended use of the slab, a vapor barrier such as 10 mil polyethylene film should be placed between the floor slab and capillary moisture barrier. Care should be taken during construction not to puncture or damage the vapor barrier.

BEARING CAPACITY AND FOUNDATION DESIGN

1. For fills installed as recommended above, and for undisturbed native soils, allowable bearing pressures of 2500 pounds per square foot (psf) may be used for foundation design. These values may be increased by 1/3 for dead plus live loads, including wind and seismic. In no case should new footings be constructed on the existing uncontrolled fill.
2. Resistance to lateral loads may be calculated by multiplying the buried portion of foundation elements by an equivalent fluid pressure of 500 pounds per cubic foot (pcf). Unless the adjacent ground surface is protected by slabs or pavement, neglect the upper one foot. Additional resistance to lateral loads may be calculated by multiplying the vertical dead load on the base of the footing by a factor of 0.35.
3. Footings should be proportioned to meet the stated bearing capacity and/or the International Building Code 2003 minimum requirements. Interior or isolated column footing should be a minimum of 24" wide. Continuous strip footings should be a minimum of 16" wide.
4. Isolated exterior and perimeter footings should be buried a minimum of 18 inches to protect against winter frost heave; interior footings should be buried a minimum of 12 inches.
5. In order to minimize the effects of any slight differential movement that may occur due to variations in the characters of the supporting soils and any variations in seasonal moisture contents, we recommend that all footings be suitably reinforced to make them as rigid as possible.
6. Total settlement of footings installed as recommended above should be limited to 1 inch with differential settlement between foundation elements limited to 1/2 inch.

7. Footing drains should be used to displace seasonal water from the bearing soil level. The drains should consist of 4" diameter perforated pipe, surrounded by drain rock, wrapped in a filter geotextile and having a sufficient gradient to displace water away from the structure and directed to an appropriate outfall. Roof or other storm drains should not outfall into the footing drains. See the attached recommended footing drain details.

EXISTING FOOTINGS

1. The bearing capacity of the soils under the existing footings may be assumed to be 2500 psf as outlined above for new footings. However, where existing footings rest on uncontrolled debris contaminated fill, the bearing capacity should be limited to 1500 psf. Additionally, the existing footings do not meet the recommended minimum width. Therefore, if new loads are imposed on existing footings, they should be widened to a minimum width of 16 inches with new concrete doweled into the existing footings.

NEW PAVEMENTS

1. Subgrades to receive pavements or slabs should be prepared in accordance with the recommendations presented above under Floor Slab-on-Grade.
2. In truck turn-around and parking areas, provide a minimum of 4 inches of Class B asphalt concrete pavement (ACP) over 3-1/2 inches of crushed surfacing base course (CSBC).
3. For Portland Cement Concrete Pavement (PCCP) in truck turn-around and parking areas, provide 8 inches of PCCP over a minimum of 3-1/2 inches of asphalt treated base (ATB). Provide slab reinforcing mesh. in lieu of ATB, provide 3-1/2 inches of CSBC. Thoroughly wet the base rock just prior to pouring concrete to facilitate full strength curing of the concrete slab.
4. In car parking areas, provide a minimum of 3 inches of Class B ACP over 3-1/2 inches of CSBC.
5. The above pavement recommendations assume a subgrade R-value of 30, traffic index of 5.5 and equivalent wheel loads of 190,000 lbs.

Additional Services

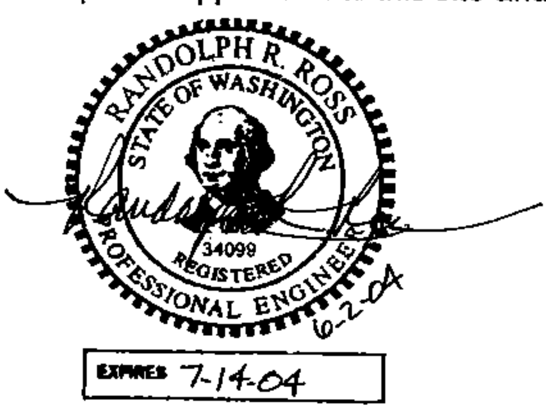
We recommend that MTC be engaged to test and evaluate the soils in the footing excavations before placing concrete to determine that the soils meet the required bearing capacities and that unexpected conditions are not present. Further, we recommend that MTC check the installation of wall drains and backfill. Monitoring and testing should be performed to verify that suitable materials are used for structural fills and that they are properly placed and compacted.

Limitations

The work described in this report is considered sufficient in detail and scope to form a reasonable basis for the foundation design. MTC should be notified of any revision in the plans for the proposed structure from those presented in this report so that we may determine if changes in the foundation recommendations are required. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to our attention.

MTC warrants that the findings, recommendations, specifications, or professional advice contained in this report, have been developed after being prepared in accordance with generally accepted professional practice in the fields of soil mechanics and engineering geology. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of Designs Northwest Architects and their retained design consultants. Findings and recommendations within this report are for specific application to this site and proposed project.



Randolph R. Ross, P.E.
Senior Geotechnical Engineer

Geotechnical General Notes

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split-spoon.
Q_u: Unconfined compressive strength, tons/ft^2
Q_p: Penetrometer value, unconfined compressive strength, lbs/ft^2
V: Vane value, ultimate shearing strength, lbs/ft^2
M: Water content, %
LL: Liquid limit, %
PI: Plasticity index, %
D: Natural dry density, lbs/ft^3
WT: Apparent groundwater level at time noted after completion.

DRILLING AND SAMPLING SYMBOLS

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
AU: Auger Sample.
GB: Grab Sample.
DB: Diamond Bit.
CB: Carbide Bit.
WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Terms (Non-Cohesive Soils)	Standard Penetration Resistance
Very Loose	0 - 2
Loose	2 - 4
Slightly Compact	4 - 8
Medium Dense	8 - 16
Dense	16 - 26
Very Dense	Over 26

Terms (Cohesive Soils)	Q_u - (tons/ft^2)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm (Medium)	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

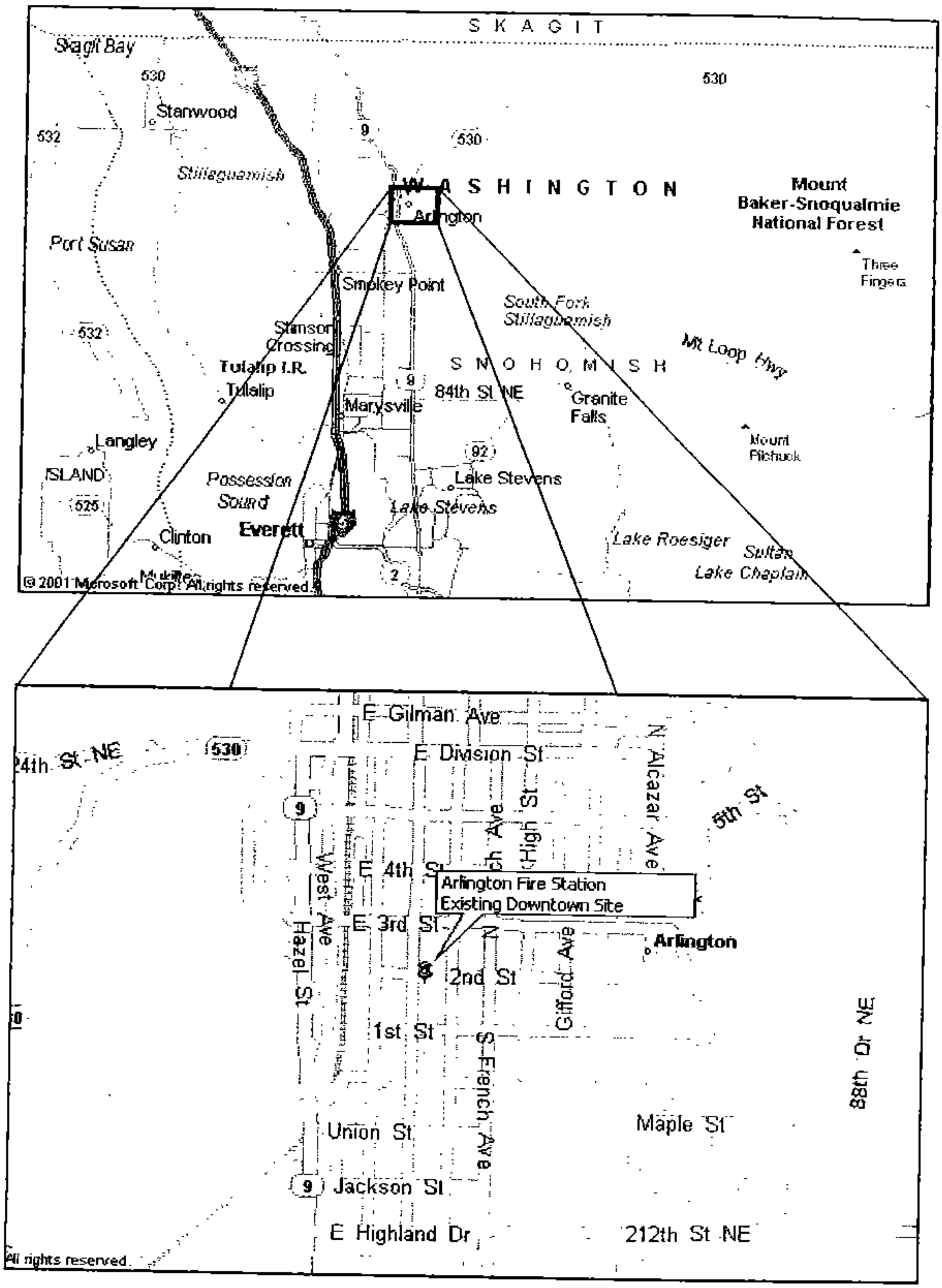
PARTICLE SIZE

Boulders	8 in. +	**Coarse Sand**	5 mm - 0.6 mm	**Silts**	0.074 mm - 0.005 mm
Cobbles	8 in. - 3 in.	**Medium Sand**	0.6 mm - 0.2 mm	**Clays**	0.005 mm & Smaller
Gravel	3 in. - 5 mm	**Fine Sand**	0.2 mm - 0.074 mm		

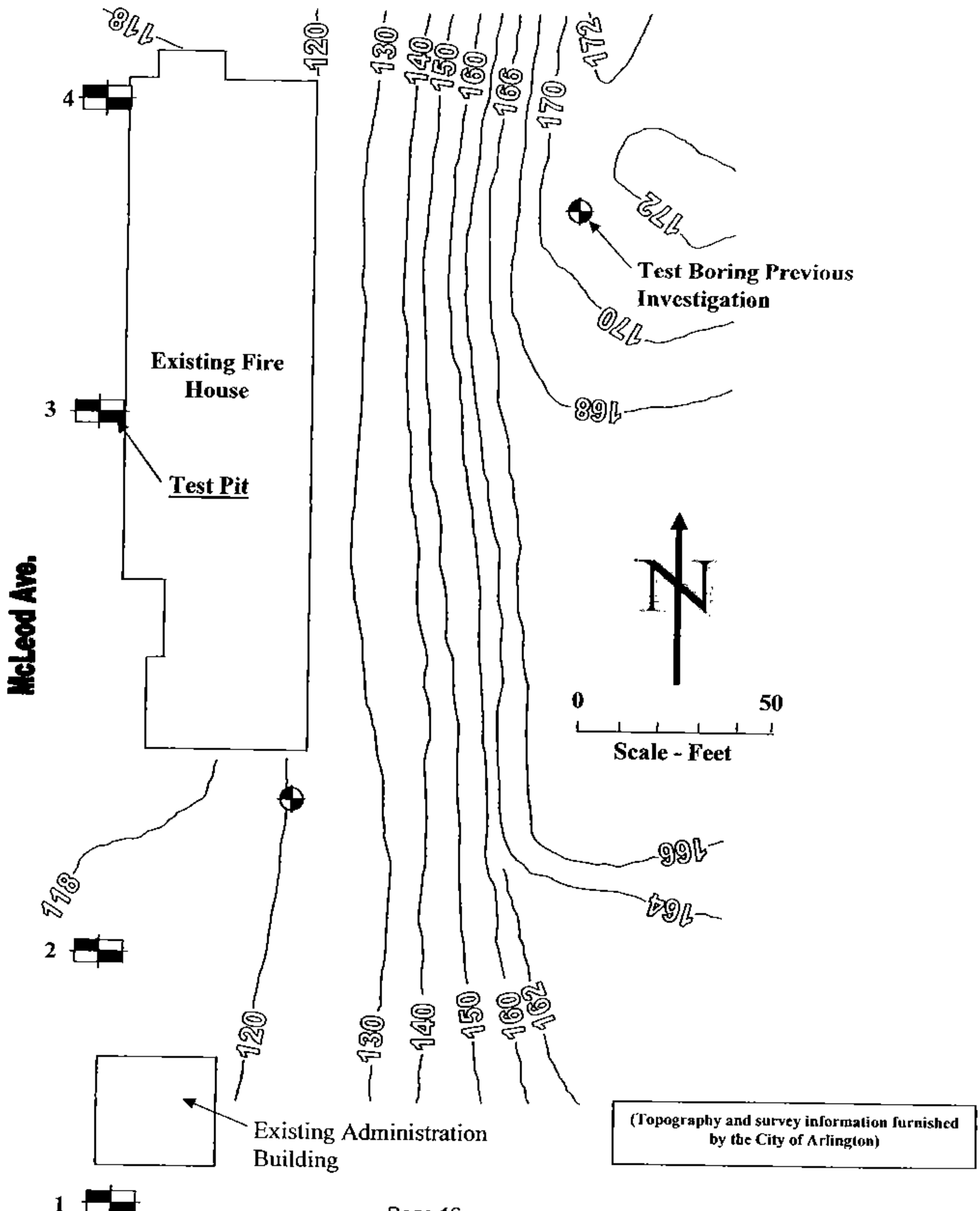
Unified Soil Classification System

Major Divisions			Group Descriptions	
Coarse Grained Soils More than 50% retained on No. 200 sieve size	Gravel and Gravelly Soils More than 50% of coarse fraction retained on No. 4 sieve	Clean gravel (little or no fines)	**GW**	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
		Gravel with appreciable fines	**GM**	Silty GRAVEL
			GC	Clayey GRAVEL
		Clean sand (little or no fines)	**SW**	Well-graded SAND
			SP	Poorly-graded SAND
		Sand with appreciable fines	**SM**	Silty SAND
			SC	Clayey SAND
Fine grained soils 50% or more passing No. 200 sieve size	Silt and Clay Liquid limit less than 50%		**ML**	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
	Silt and Clay Liquid limit 50% or more		**MH**	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			**PT**	PEAT

Location Map



Site Plan with Test Pit Locations



Test Pit Logs

Depth (ft)	USCS	Soil Description
Test Pit 1	**4' South of SW corner Administration Building**	
0.0-0.5	SW	Dark brown **SAND**, loose, dry, with gravel to 1" diameter and trace of silt, small roots throughout.
0.5-6.0	GP	Orange tan sandy **GRAVEL,** medium dense, dry, sand fine to very coarse grained, gravel to 4" diameter, orange oxidation to 3.1' Becomes tan at 2.3'
6.0-7.3	SP	Grey **SAND,** medium dense, moist, with some silt, sand fine to medium grained, trace roots.
7.3-8.5	SW	grey **SAND,** medium dense, moist, sand fine to very coarse grained, with some gravel to 1" diameter, trace silt.
		Samples taken at 1,5, 4.0, 6.2 and 8.0 feet. No seepage observed. Minor caving observed. Base of test pit at 8.5 feet.
		***Origin of Coordinates: SE property corner.**
Test Pit 2	**15' West, 38' North of NW corner Administration Building**	
0.0-0.25	AC	**ASPHALT.**
0.25-0.5	BR	**GRAVEL,** 5/8"- crushed surfacing top course.
0.5-6.2	UF	Alternating layers orange brown to black **SAND** and dark brown organic **SILT** with metal, glass, brick and wood fragments (fill).
6.2-7.8	SW-SM	Grey brown to light brown **SAND** with silt, medium dense, moist, sand fine to coarse grained, with gravel to 3" diameter.
7.8-9.2	SW	Grey **SAND,** dense, moist, sand fine to very coarse grained, with some gravel to 2" diameter.
		Samples taken at 2.7, 6.2 7.8 feet. No seepage observed. Minor to moderate caving observed. Base of test pit at 9.2 feet.

Depth (ft)	USCS	Soil Description
Test Pit 3	**15' West, 85' North of SW corner Fire House**	
0.0-0.25	AC	**ASPHALT.**
0.25-0.5	BR	**GRAVEL,** 5/8"- crushed surfacing top course.
0.5-1.5	UF	Dark brown gravelly **SAND,** medium dense, moist, sand fine to coarse grained, gravel to 2" diameter (fill).
1.5-5.0	SW	Grey brown **SAND,** medium dense to dense, moist, sand fine to coarse grained, gravel rounded to 3" diameter.
5.0-7.7	GP	Tan sandy **GRAVEL,** dense, moist, sand fine to very coarse grained, gravel rounded to 3" diameter, with rounded cobbles to 5" diameter.
7.7-9.1	SW	Grey brown **SAND,** medium dense, moist, sand fine to very coarse grained, with some gravel to 2" diameter.
		Samples taken at 2.3, 5.0 and 8.5 feet. No seepage observed. No caving observed. Base of test pit at 9.1 feet.
Test Pit 4	**2' West, 4' South of NW corner Fire House**	
0.0-0.25	AC	**ASPHALT.**
0.25-0.5	BR	**GRAVEL,** 5/8"- crushed surfacing top course.
0.5-4.1	UF	Brown **SAND,** dense, moist, with trace silt, with carbonized and unburned wood and glass debris in layers (fill).
4.1-7.0	SM	Orange silty **SAND,** medium dense, moist, sand fine to medium grained, with some gravel to 1" diameter and roots to ½" diameter, heavy mottling to 5'.
7.0-10.0	SM	Tan silty **SAND,** medium dense, moist, sand very fine to medium grained, with gravel to 1" diameter, with very fine roots throughout, with thin lenses of weakly cemented sand in bottom 2'.
		Samples taken at 3.0, 6.0 and 9.5 feet. No seepage observed. No caving observed. Base of test pit at 10.0 feet.

Laboratory Test Summary

Test Pit Number	Depth (ft)	USCS	Moisture Content (%)	Percent Passing #200 Sieve
1	1.5	GP	3.6	0.3
1	4.0	GP	3.3	0.7
1	6.2	SP	3.4	
1	8.0	SW	12.0	
2	4.3	UF	5.7	
2	7.8	SW-SM	17.1	9.6
3	2.3	SW	5.9	
3	5.0	GP	3.0	1.0
3	8.8	SW	4.1	1.0
4	3.0	UF	5.4	
4	6.0	SM	13.0	
4	9.5	SM	29.3	49.2

Sieve Report

Project: Arlington F.S., Task 2A
Project #: 04BG058A
Client: Architects N.W.
Source: TP I @ -4.0'
Sample#: 041324

Date Received: 14-May-04
Sampled By: A. Isle
Date Tested: 21-May-04
Tested By: C. Shear

ASTM D-2487 Unified Soils Classification System
GP, Poorly graded Gravel with Sand

Specifications
No Specs
Sample Meets Specs ? Yes

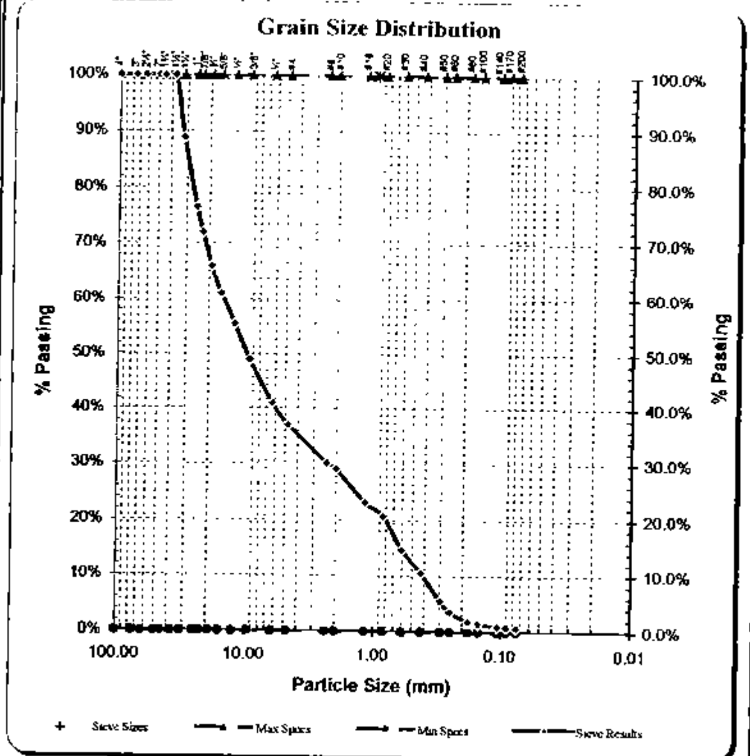
$D_{(10)}$ = 0.415 mm
$D_{(30)}$ = 2.320 mm
$D_{(60)}$ = 15.362 mm
Liquid Limit = n/a
Fracture % = n/a

% Gravel = 62.9%
% Sand = 36.3%
% Silt & Clay = 0.7%
Plastic Limit = n/a
Moisture %, as sampled = 3.3%

Coeff. of Curvature, C_C = 0.84
Coeff. of Uniformity, C_U = 37.02
Fineness Modulus = 5.73
Plasticity Index = n/a

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50	100%	100%	100.0%	0.0%
1.25"	31.50	89%	89%	100.0%	0.0%
1.00"	25.00	76%	76%	100.0%	0.0%
7/8"	22.40		72%	100.0%	0.0%
3/4"	19.00	66%	66%	100.0%	0.0%
5/8"	16.00		61%	100.0%	0.0%
1/2"	12.50	55%	55%	100.0%	0.0%
3/8"	9.50	49%	49%	100.0%	0.0%
1/4"	6.30		41%	100.0%	0.0%
#4	4.75	37%	37%	100.0%	0.0%
#8	2.360		30%	100.0%	0.0%
#10	2.000	29%	29%	100.0%	0.0%
#16	1.180		23%	100.0%	0.0%
#20	0.850	21%	21%	100.0%	0.0%
#30	0.600		15%	100.0%	0.0%
#40	0.425	10%	10%	100.0%	0.0%
#50	0.300		6%	100.0%	0.0%
#60	0.250	4%	4%	100.0%	0.0%
#80	0.180	2%	2%	100.0%	0.0%
#100	0.150	1%	1%	100.0%	0.0%
#140	0.106		1%	100.0%	0.0%
#170	0.090		1%	100.0%	0.0%
#200	0.075	0.7%	0.7%	100.0%	0.0%



Comments:

Reviewed by:

Sieve Report

Project: Arlington F.S., Task 2A
Project #: 04BG058A
Client: Architects N.W.
Source: TP 2 @ -7.8'
Sample#: 041328

Date Received: 14-May-04
Sampled By: A Isle
Date Tested: 21-May-04
Tested By: C Shear

ASTM D-2487 Unified Soils Classification System
SW-SM, Well-graded Sand with Silt

Specifications
No Specs
Sample Meets Specs ? Yes

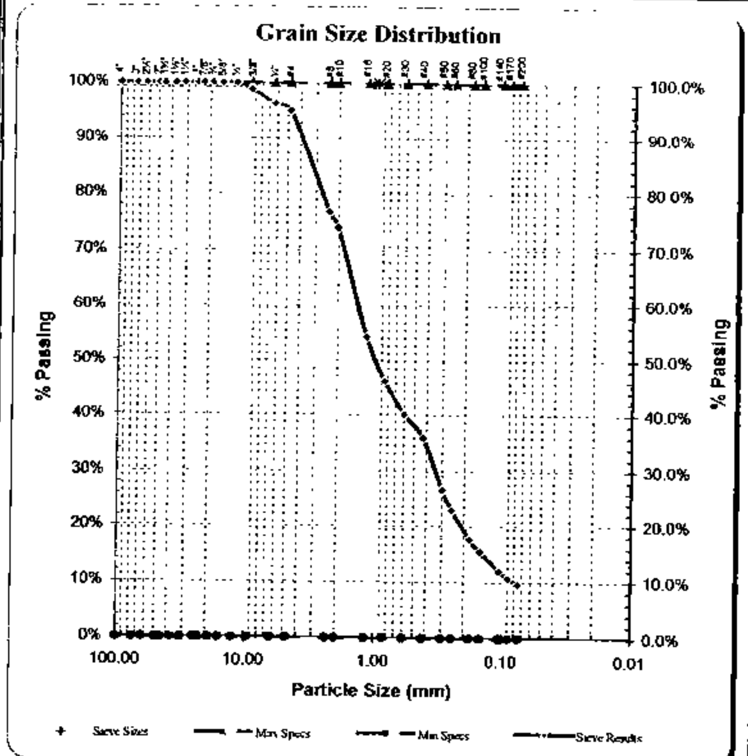
$D_{(10)}$ = 0.081 mm
$D_{(30)}$ = 0.345 mm
$D_{(60)}$ = 1.421 mm
Liquid Limit = n/a
Fracture % = n/a

% Gravel = 5.0%
% Sand = 85.5%
% Silt & Clay = 9.6%
Plastic Limit = n/a
Moisture %, as sampled = 17.1%

Coeff. of Curvature, C_C = 1.04
Coeff. of Uniformity, C_U = 17.61
Fineness Modulus = 2.93
Plasticity Index = n/a

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
7/8"	22.40		100%	100.0%	0.0%
3/4"	19.00		100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		96%	100.0%	0.0%
#4	4.75	95%	95%	100.0%	0.0%
#8	2.360		77%	100.0%	0.0%
#10	2.000	74%	74%	100.0%	0.0%
#16	1.180		54%	100.0%	0.0%
#20	0.850		46%	100.0%	0.0%
#30	0.600		40%	100.0%	0.0%
#40	0.425	36%	36%	100.0%	0.0%
#50	0.300		27%	100.0%	0.0%
#60	0.250		23%	100.0%	0.0%
#80	0.180	18%	18%	100.0%	0.0%
#100	0.150	15%	15%	100.0%	0.0%
#140	0.106		12%	100.0%	0.0%
#170	0.090		11%	100.0%	0.0%
#200	0.075	9.6%	9.6%	100.0%	0.0%



Comments:

Reviewed by:

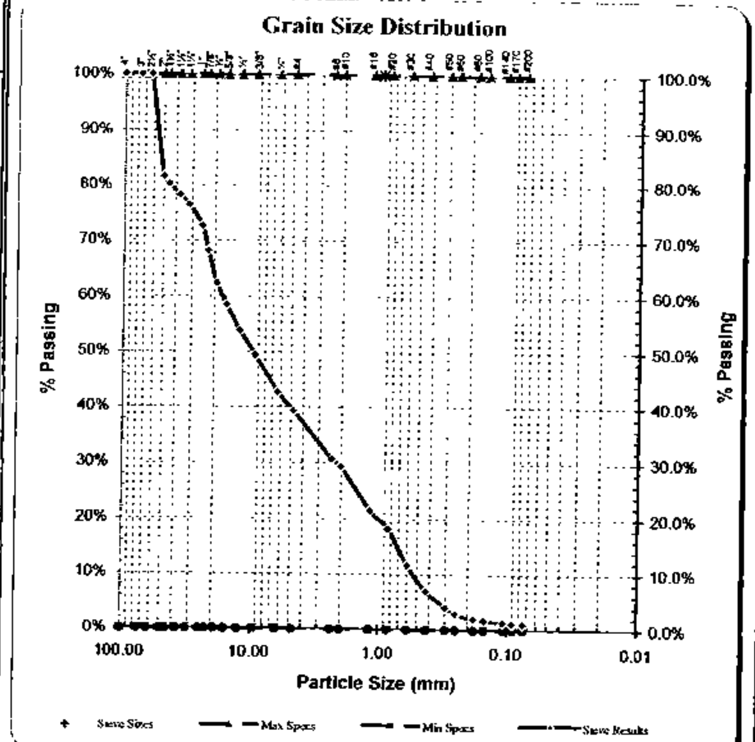
Sieve Report

Project: Arlington F S , Task 2A	**Date Received:** 14-May-04		
Project #: 04BG058A	**Sampled By:** A Isle	ASTM D-2487 Unified Soils Classification System	
Client: Architects N W	**Date Tested:** 21-May-04	GP, Poorly graded Gravel with Sand	
Source: TP 3 @ -5 0'	**Tested By:** C. Shear		
Sample#: 041330			

Specifications	$D_{(10)}$ = 0 539 mm	% Gravel = 60 6%	Coeff of Curvature, C_C = 0.50
No Specs	$D_{(30)}$ = 2 155 mm	% Sand = 38 3%	Coeff of Uniformity, C_U = 31 83
Sample Meets Specs ? Yes	$D_{(60)}$ = 17 171 mm	% Silt & Clay = 1.0%	Fineness Modulus = 6 01
	Liquid Limit = n/a	Plastic Limit = n/a	Plasticity Index = n/a
	Fracture % = n/a	Moisture %, as sampled = 3 0%	

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6 00"	150.00		100%	100.0%	0 0%
4 00"	100 00		100%	100 0%	0 0%
3 00"	75 00		100%	100 0%	0 0%
2 50"	63 00		100%	100 0%	0.0%
2 00"	50 00	82%	82%	100.0%	0 0%
1.75"	45 00		80%	100.0%	0.0%
1 50"	37 50		78%	100 0%	0.0%
1 25"	31 50	76%	76%	100 0%	0 0%
1 00"	25 00	73%	73%	100.0%	0.0%
7/8"	22 40		68%	100 0%	0.0%
3/4"	19 00	62%	62%	100 0%	0.0%
5/8"	16 00		58%	100.0%	0 0%
1/2"	12.50	54%	54%	100.0%	0 0%
3/8"	9 50	49%	49%	100 0%	0 0%
1/4"	6.30		43%	100.0%	0 0%
#4	4 75	39%	39%	100.0%	0.0%
#8	2.360		31%	100.0%	0.0%
#10	2 000	29%	29%	100 0%	0.0%
#16	1 180		21%	100.0%	0.0%
#20	0.850	18%	18%	100.0%	0.0%
#30	0.600		12%	100.0%	0.0%
#40	0.425	7%	7%	100.0%	0 0%
#50	0.300		4%	100.0%	0.0%
#60	0.250	3%	3%	100 0%	0 0%
#80	0.180	2%	2%	100.0%	0 0%
#100	0.150	2%	2%	100.0%	0.0%
#140	0.106		1%	100.0%	0 0%
#170	0.090		1%	100 0%	0 0%
#200	0 075	1 0%	1 0%	100 0%	0.0%



Comments:

Reviewed by:

Sieve Report

Project: Arlington F.S., Task 2A
Project #: 04BG058A
Client: Architects N.W
Source: TP 4 @ -6.0'
Sample#: 041333

Date Received: 14-May-04
Sampled By: A. Isle
Date Tested: 21-May-04
Tested By: C. Shear

ASTM D-2487 Unified Soils Classification System
SM, Silty Sand

Specifications
No Specs
Sample Meets Specs ? Yes

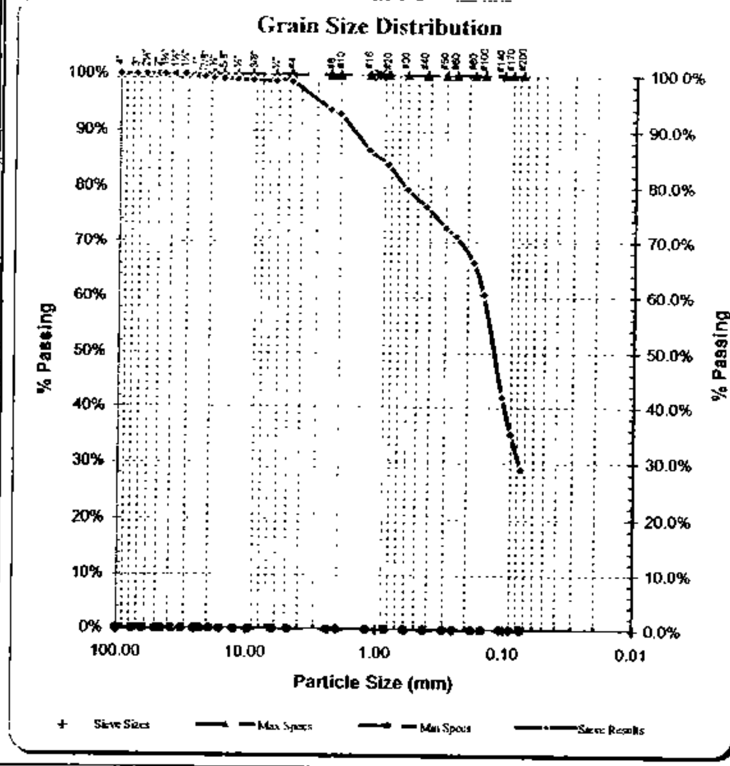
$D_{(10)}$ = 0.026 mm
$D_{(30)}$ = 0.078 mm
$D_{(60)}$ = 0.149 mm
Liquid Limit = n/a
Fracture % = n/a

% Gravel = 1.3%
% Sand = 69.8%
% Silt & Clay = 28.9%
Plastic Limit = n/a
Moisture %, as sampled = 13.0%

Coeff. of Curvature, C_C = 1.56
Coeff. of Uniformity, C_U = 5.73
Fineness Modulus = 1.10
Plasticity Index = n/a

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	100%	100%	100.0%	0.0%
7/8"	22.40		100%	100.0%	0.0%
3/4"	19.00		99%	100.0%	0.0%
5/8"	16.00		99%	100.0%	0.0%
1/2"	12.50		99%	100.0%	0.0%
3/8"	9.50		99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.360		94%	100.0%	0.0%
#10	2.000	93%	93%	100.0%	0.0%
#16	1.180		87%	100.0%	0.0%
#20	0.850	84%	84%	100.0%	0.0%
#30	0.600		80%	100.0%	0.0%
#40	0.425	77%	77%	100.0%	0.0%
#50	0.300		73%	100.0%	0.0%
#60	0.250	71%	71%	100.0%	0.0%
#80	0.180	66%	66%	100.0%	0.0%
#100	0.150	61%	61%	100.0%	0.0%
#140	0.106		42%	100.0%	0.0%
#170	0.090		35%	100.0%	0.0%
#200	0.075	28.9%	28.9%	100.0%	0.0%



Comments:

Reviewed by:

Sieve Report

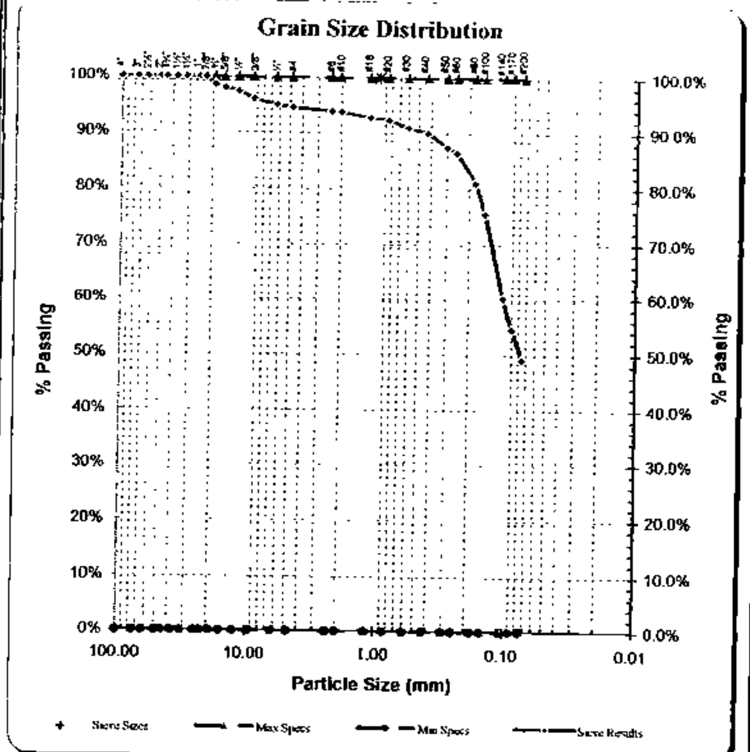
Project: Arlington F S , Task 2A **Project #:** 04BG058A **Client:** Architects N.W **Source:** TP 4 @ -9 5' **Sample#:** 041334	**Date Received:** 14-May-04 **Sampled By:** A. Isle **Date Tested:** 21-May-04 **Tested By:** C. Shear	**ASTM D-2487 Unified Soils Classification System** SM, Silty Sand

Specifications
No Specs
Sample Meets Specs ? Yes

$D_{(10)}$ = 0 015 mm	% Gravel = 5 4%	Coeff of Curvature, C_C = 1 30
$D_{(30)}$ = 0.046 mm	% Sand = 45 4%	Coeff of Uniformity, C_U = 6 93
$D_{(60)}$ = 0 106 mm	% Silt & Clay = 49 2%	Fineness Modulus = 0 70
Liquid Limit = n/a	Plastic Limit = n/a	Plasticity Index = n/a
Fracture % = n/a	Moisture %, as sampled = 29 3%	

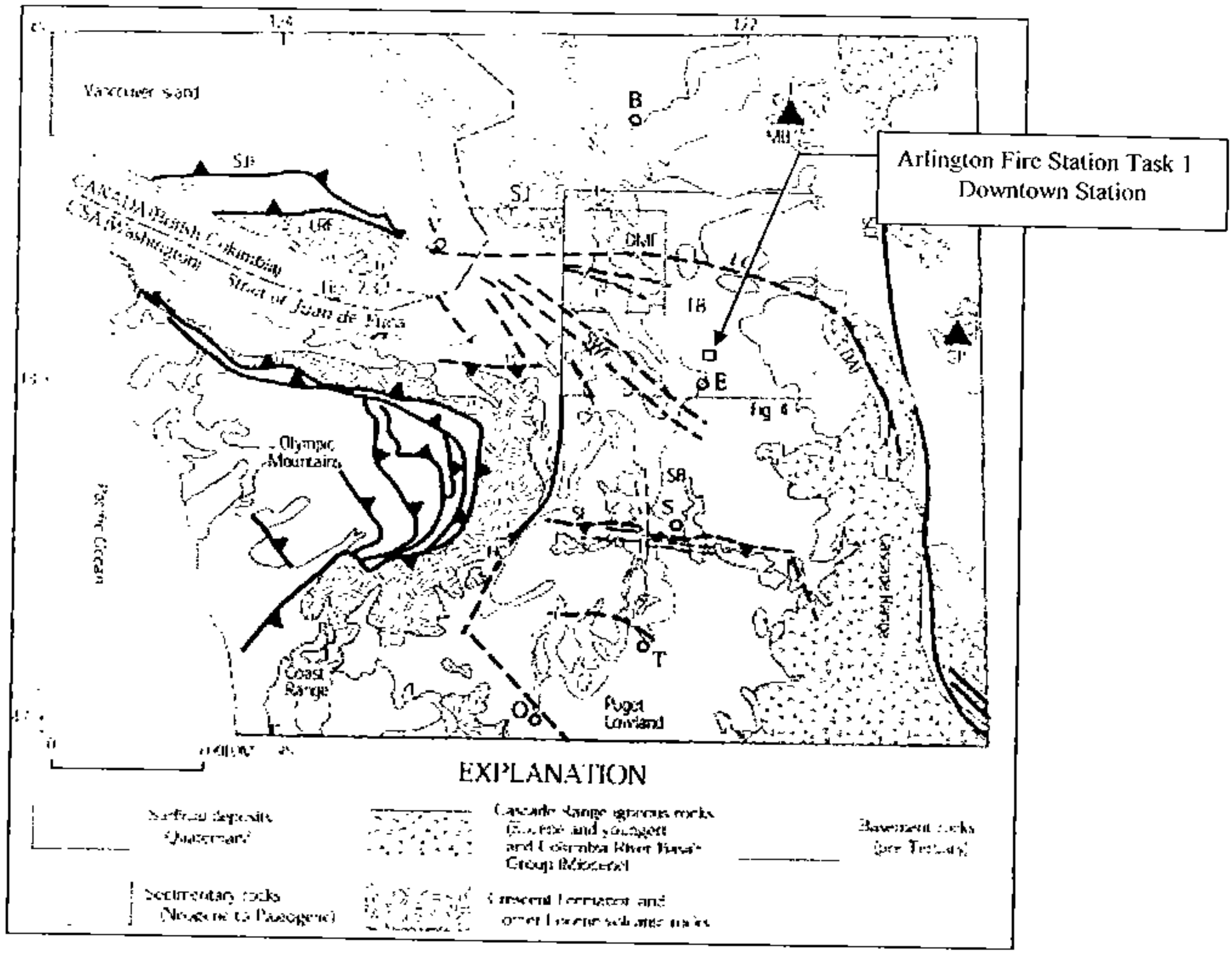
ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150 00		100%	100 0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100 0%	0.0%
2.50"	63 00		100%	100 0%	0.0%
2 00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0 0%
1 50"	37 50		100%	100.0%	0.0%
1.25"	31 50		100%	100.0%	0 0%
1 00"	25.00		100%	100.0%	0.0%
7/8"	22 40		100%	100 0%	0 0%
3/4"	19.00	98%	98%	100.0%	0 0%
5/8"	16.00		98%	100.0%	0.0%
1/2"	12.50	97%	97%	100.0%	0.0%
3/8"	9 50	96%	96%	100 0%	0.0%
1/4"	6.30		95%	100.0%	0 0%
#4	4.75	95%	95%	100.0%	0.0%
#8	2.360		94%	100.0%	0.0%
#10	2.000	94%	94%	100.0%	0 0%
#16	1.180		93%	100.0%	0 0%
#20	0.850	92%	92%	100.0%	0.0%
#30	0.600		91%	100.0%	0 0%
#40	0.425	90%	90%	100.0%	0 0%
#50	0.300		88%	100.0%	0.0%
#60	0.250	86%	86%	100.0%	0 0%
#80	0.180	81%	81%	100 0%	0.0%
#100	0.150	76%	76%	100 0%	0.0%
#140	0.106		60%	100.0%	0.0%
#170	0.090		54%	100.0%	0.0%
#200	0.075	49 2%	49 2%	100.0%	0.0%



Comments:

Reviewed by:



Fault Trace Map of the Puget Sound Lowland

After: Johnson, S., Dadisman, S., Mosher, D., Blakely, R., and Childs, J., 2002 "Active Tectonics of the Devils Mountain Fault and Related Structures, Northern Puget Lowland and Eastern Strait of Juan De Fuca Region, Pacific Northwest", U.S. Geological Survey Professional Paper 1643, URL http://geohazards.cr.usgs.gov/pacnw/actflts/dmf/index.html.

Recommended Footing Drain Details