Western Geotechnical Consultants, Inc.

4181 Saltsprings Drive • Ferndale, WA 98248
Phone (360) 380-2507 • Fax (360) 380-2507

March 4, 2000

Mr. Kim Gudgel
c/o RAMO Realty
16494 35th Ave. NE, Suite 301
Smokey Point, WA 98223

Re: Report – Geotechnical Feasibility Study
SW Quadrant from Intersection of 43rd Ave. NE and 172nd St. NE
Section 28, T31N, R05, WM
Snohomish County, WA

Western Geotechnical Consultants, Inc. is pleased to present the results of our geotechnical site investigation conducted at the above referenced property. On February 25, 2000 a geotechnical engineer from our firm traveled to the site to oversee the excavation of 5 test pits across the property.

Higa Engineering, Inc. provided us with a preliminary site plan for use in performing the investigation. The site plan shows that the property has approximately 280 feet of frontage along 172nd St. NE and is about 1330 feet deep. We understand the development of the approximate 8.6-acre parcel will consist of commercial buildings with storm water detention facilities located on the south side of the property. Figure 1 is a Site Plan showing the general property layout together with the approximate locations of our test pits.

The purpose of our investigation was to obtain subsurface soil and ground water information for use in evaluating the feasibility of constructing detention facilities on the site and to obtain geotechnical information for general site development. Specifically the scope of our services included:

- Excavating 5 test pits across the site to obtain subsurface information for use in general site development. We excavated 2 test pits at the storm water detention location and 3 additional test pits across the remainder of the site to obtain general geotechnical information. Piezometers were installed in all the test pits for future water level reading so as to define the seasonal high ground water table.
- Developing continuous logs of subsurface soil and groundwater conditions encountered. Soils encountered were classified in accordance with the Unified Soils Classification System (USCS).
- Performing engineering analyses and laboratory testing as deemed necessary in developing our conclusions and recommendations.

- Preparing this engineering report, which includes a summary of work performed, a description of the subsurface conditions encountered, and our conclusions and recommendations regarding detention pond design parameters and general geotechnical issues associated with development of the site.

SITE CONDITIONS

Surface Conditions

The property is approximately 8.6 acres in size and it is very nearly level, with a slight surface gradient to the south end of the site. Several buildings, including a house, are located in the front (northerly) third of the property. There is a driveway along the westerly property line providing access from 172nd St. A drainage channel extends back from the driveway along the westerly property line part way toward the back of the property.

The ground surface is covered primarily with grasses, with blackberry bushes and occasional small trees toward the back of the property. There is also a wet area at the back of the property (low point) where the storm water facilities are planned.

Subsurface Conditions

Subsurface conditions at the site were evaluated by excavating a total of 5 test pits on February 25, 2000, with a rubber tire backhoe using a 3-foot-wide bucket. The approximate locations of the test pits are shown on the attached Site Plan, Figure 1. The test pits were roughly located in the field from the property boundaries. Piezometers were installed in all of the test pits and the test pits were loosely backfilled upon completion of the explorations.

The soils encountered in the test pits were classified using the Unified Soils Classification System (USCS) and a log was maintained for each test pit. Edited, tabulated test pit logs are attached to in this report along with a USCS Chart explaining soil descriptions.

The general subsurface profile outside the wetland area (i.e., Test Pits 1, 2 and 5), consists of an organic rich topsoil layer (OL/ML by USCS classification) above silty SANDS (SM by USCS) that grades to fine to coarse sands (SP by USCS) with depth, extending to the bottom of the test pits. The two test pits excavated in the southern wet area (Test Pits 3 and 4) revealed an approximate 1.5-foot peat (Pt by USCS) layer underlain by sandy SILTS (ML) grading to some coarse SANDS (SP by USCS) at the bottom of the test pits. Note that the two test pits in the southern wet area were excavated to relatively shallow depths because the shallow ground water caused caving of the test pits.

Ground Water Conditions

The depth to ground water appears to reflect the surface gradient that slopes from the front (north) to back (south) of the property. At the time of our subsurface explorations, ground water was encountered at a maximum depth of about 6 feet in the front (north) of the property to near the surface in the wetland area at the back of the property. At the proposed storm water detention facility, the water table was measured at about 2 feet below the surface in our test pits, but standing water was present in other areas of the wetland. Piezometers were installed in each of the test pits for future monitoring of ground water levels. Water levels should be measured again this winter to establish the seasonal high ground water level.

Conclusions and Recommendations

General

Based on our geotechnical engineering investigation, we conclude that the site will likely be suitable for development of the type proposed provided good construction practices are used and provided our recommendations are followed. The area contains a high groundwater table, which can be problematic for storm water detention facilities. Storm water detention is planned for the south side of the property, and we understand the commercial development will utilize the remainder of the site. The following sections provide recommended soil and groundwater parameters for storm water detention and general site development.

Storm water Detention

The property is relatively level with a surface gradient toward the rear (south) of the property. The proposed storm water detention facility will occupy the southerly end of the site. We excavated 2 test pits within the proposed storm water detention area along with 3 additional test pits across the remainder of the site. Piezometers were installed in all of the test pits for future monitoring of ground water. The ground water table within the proposed stormwater detention area (see Figure 1) was measured at 2 feet below the surface in the two test pits excavated there as part of our exploration, but standing water was also present at the ground surface nearby.

The USDA Soil Conserfvation Service (SCS), "Soil Survey of Snohomish County Area, WA" has classified the near surface soils as Soil Unit 30, Lynnwood Loamy Sand, which the SCS also classifies as a member of Hydrologic Group A. According to the Stormwater Management Manual for the Puget Sound Basin the soils present at the site, which are classified as a Loamy Sand, also fall within Hydrologic Soil Group A.

We recommend the piezometers be read again this winter to verify the seasonal high water level. Once the seasonal high water level has been established the detention facilities can be final designed by Higa Engineering, Inc.

General Site Development

We make the following recommendations for general site development, in addition to the storm water detention design information provided above. Note that these recommendations are based on the limited scope of subsurface exploration performed as a part of our geotechnical services for this project. Additional subsurface explorations may be necessary once specific site development plans are determined, or if the nominal foundation dimensions indicated below are exceeded.

Site Preparation

All topsoil and other organic or soft material must be striped away from areas to be occupied by building foundations, paved areas, or other structural improvements. Based on our test pit explorations, we estimate that the stripping depth will be about ½ to 1 foot. Note that there could be isolated areas with deeper pockets of organic material (root balls, etc.), old building foundations, abandoned utilities, or unsuitable materials beneath existing structures that will have to be removed. All structural improvements should be founded on firm, non-organic, native soils or on structural fill placed on a properly prepared subgrade.

Fill and Compaction

We have assumed that some structural fill may be required beneath structures and/or paved areas. Structural fill may also be required to obtain proper elevation for the design of storm water detention facilities or to promote positive surface drainage away from structures. Structural fill used to obtain final grade elevations for footings and other structural improvements (pavements, floor slabs, etc.), must be properly placed and compacted.

Structural fill can be any non-organic, predominantly granular soil that is placed in maximum 8- to 10- inch loose, horizontal lifts and compacted to 95% of maximum dry density as determined by the ASTM D-1557 test procedure. The on-site native, non-organic, sandy soils could be used as structural fill provided the moisture content can be properly controlled and adequate compaction can be achieved.

Foundations

The on site soils will support moderately light structures using conventional shallow spread footings. Typical, 1 to 2 story, wood-frame structures without heavy column loads would be considered moderately light structures. Due to the limited depth and coverage of our test pits, an evaluation of foundations for heavier loaded structures was beyond the scope of this study.

For moderately light structures, conventional shallow spread foundations proportioned in accordance with the Uniform building code (UBC) will perform satisfactorily on a properly prepared subgrade in firm, non-organic, native soils or structural fill. Wall footings and column footings should have minimum dimensions of 18 inches and 24 , respectively. Continuous footings should not exceed 2 feet in width and isolated spread footings should not exceed 4 feet by 4 feet. These maximum dimensions are appropriate for the depth of subsurface exploration performed in our investigation of the property. These footings may be proportioned using a maximum bearing capacity of 2000 pounds per square foot (psf). All footings should be founded a minimum of 18 inches below the lowest adjacent grade for frost protection. Please note that test pit coverage was not extensive since the site layout is still in the preliminary planning stages. Once site development plans are known, it may be necessary to excavate additional test pits at known building locations or drill borings if heavy foundation loads will be part of the design.

Drainage

We recommend that an exterior footing drain system be constructed around the perimeter of all building foundations. The footing drain system is typically constructed with a perforated or slotted pipe placed in clean, free-draining gravel with less than 3% by weight passing the U.S. No. 200 sieve size, based on a wet sieve analysis of that portion passing the U.S. No. 4 Sieve. The perforated or slotted pipe should be placed at or below the level of the base of the footings and 1/2 foot outside the footings. Based on the sandy native soils present on the site, we recommend surrounding the footing drain system with a separation geotextile (Mirafi 4NP or equivalent). If fine-grained soils such as silts or clays are encountered at foundation level, we recommend against the use of a separation geotextile, since fine grained soils can clog geotextiles and make them inoperable.

The footing drains should discharge to the storm drainage system for the property. Roof drainage must not be introduced into the perimeter footing drain, but should be discharged separately to the storm drainage system by tightline. The final ground surface should be graded away from the building to promote surface runoff away from the footing drain system.

Erosion Control

Erosion control during construction of the proposed facilities can be accomplished through placement of proper sedimentation control facilities. We recommend siltation control facilities, consisting of either hay bales or silt fences, be fabricated around the construction areas. Typical details for siltation control facilities using either hay bales or silt fences are attached to this report.

Siltation devices should be placed down gradient of all construction areas and cleared areas to provide siltation control during construction. All siltation control devices should be maintained in operable condition during construction, and left in operable condition until the site has been revegetated and siltation is no longer a threat. At that time the siltation facilities should be removed.

We appreciate the opportunity to be of assistance to you on this project. We will be glad to discuss a scope of work for monitoring and reporting on the water levels in the piezometers installed at the site, at your request. If final plans require additional geotechnical studies we would be pleased to provide a proposal to perform the work. If you have any questions regarding the contents of this report, or if we can be of further assistance, please contact our office.

Sincerely,

Western Geotechnical Consultants, Inc.

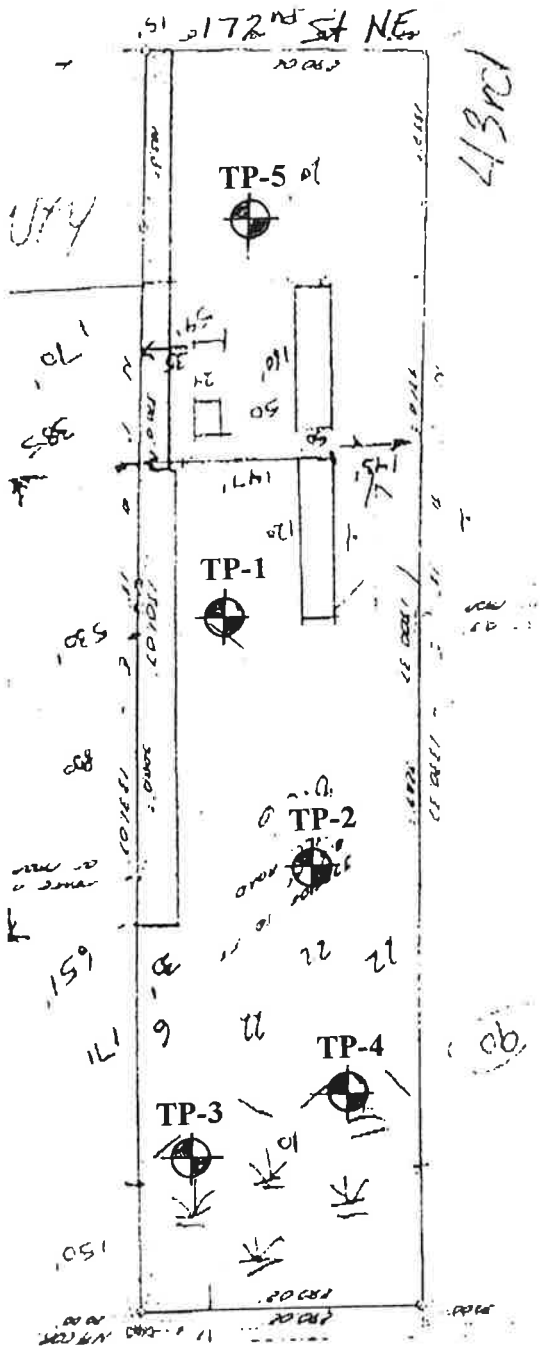
Theodore A. Hammer, P.E.
Geotechnical Engineer

Attachment: Figure 1, Site Plan Sketch
USCS Classification Chart
Tabulated Test Pit Logs
Typical Erosion Control Facilities

cc: Higa Engineering, Inc.

File:20181

Figure 1
Site Plan & Test Pit Locations
SW Quadrant From the Intersection of 43rd Ave. NE and 172nd St. NE
Section 28, T31N, R05E, WM
Snohomish County, WA



(Approximate Scale 1"=200')

North

Figure Source: Higa Engineering, Inc.
Everett, WA

Log of Test Pits

			Table A-1 Log of Test Pits		File: Turner	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
1	0.0-0.5	OL/ML	Dark brown, organic-rich sandy SILT (moist, soft) (topsoil and root zone)	1-1/0.5	21.9	
	0.5-2.2	ML/SM	Brown, sandy SILT to silty SAND (compact, moist)	1-2/1.5	18.9	
	2.2-7.0	SP	Light brown, fine to medium SAND with trace gravel (compact, moist) (grades brownish-gray with coarse sand and occasional gravel, and wet at 5')	1-3/3.5 1-4/5.0	9.8 19.3	

Notes:
- Test Pit terminated on 2/25/00 at 7.0 feet
- Test Pit loosely backfilled upon completion
- Ground water seepage encountered at 5.0 feet
- Piezometer installed to 7 feet

			Table A-1 Log of Test Pits		File: Turner	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
2	0.0-0.5	OL/ML	Dark brown, organic-rich sandy SILT (moist, soft) (topsoil and root zone)			
	0.5-2.5	ML/SM	Brown, sandy SILT to silty SAND (compact, moist)	2-1/1.5	29.0	
	2.2-5.5	SP	Brownish-gray, fine to medium SAND with trace gravel (compact, moist) (grades coarse sand and occasional gravel, wet at 5')	2-2/3.0 2-3/5.0	15.6 19.7	

Notes:
- Test Pit terminated on 2/25/00 at 5.5 feet
- Test Pit loosely backfilled upon completion
- Ground water seepage encountered at 4.8 feet
- Piezometer installed to 5.5 feet

			Table A-1 **Log of Test Pits**		File: Turner	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
3	0.0-1.5	Pt	Black, PEAT (soft, wet)	3-1/0.5	181	
	1.5-2.5	ML/SM	Brown, sandy SILT to silty SAND (compact, wet)	3-2/2.0	23.7	
	2.5-3.5	SP	Brownish-gray, fine to coarse SAND with trace gravel (compact, wet) (caving at 2 feet)	3-3/3.0	18.5	

Notes:

- Test Pit terminated on 2/25/00 at 3.5 feet
- Test Pit loosely backfilled upon completion
- Heavy ground water seepage encountered at 2 feet
- Piezometer installed to 3.5 feet

			Table A-1 **Log of Test Pits**		File: Turner	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
4	0.0-1.5	Pt	Black, PEAT (soft, wet)			
	1.5-2.5	ML/SM	Brown, sandy SILT to silty SAND (compact, wet)	4-1/1.5	22.2	
	2.5-3.0	SP	Brownish-gray, fine to coarse SAND with trace gravel (compact, wet) (caving at 2 feet)	4-2/2.5	22.3	

Notes:

- Test Pit terminated on 2/25/00 at 3.0 feet
- Test Pit loosely backfilled upon completion
- High ground water seepage encountered at 2 feet
- Piezometer installed to 3.0 feet

			Table A-1 **Log of Test Pits**		File: Turner	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
5	0.0-0.7	OL/ML	Dark brown, organic-rich sandy SILT (moist, soft) (topsoil and root zone)			
	0.5-2.0	ML/SM	Brown, sandy SILT to silty SAND (compact, moist)	5-1/1.5	14.8	
	2.0-8.0	SP/SW	Light brown, fine to medium SAND with trace gravel (compact, moist) (grades brownish-gray with coarse sand and occasional gravel, and wet at 5')	5-2/3.5 5-3/5.0	10.9 14.7	

Notes:

- Test Pit terminated on 2/25/00 at 8.0 feet
- Test Pit loosely backfilled upon completion
- Ground water seepage encountered at 6.0 feet
- Piezometer installed to 8 feet

UNIFIED SOIL CLASSIFICATION CHART (USCS)

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES) <5%		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES) <12%		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES) <5%		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) <12%		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS RO CLAYEY SILTS WITH SLIGHY PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

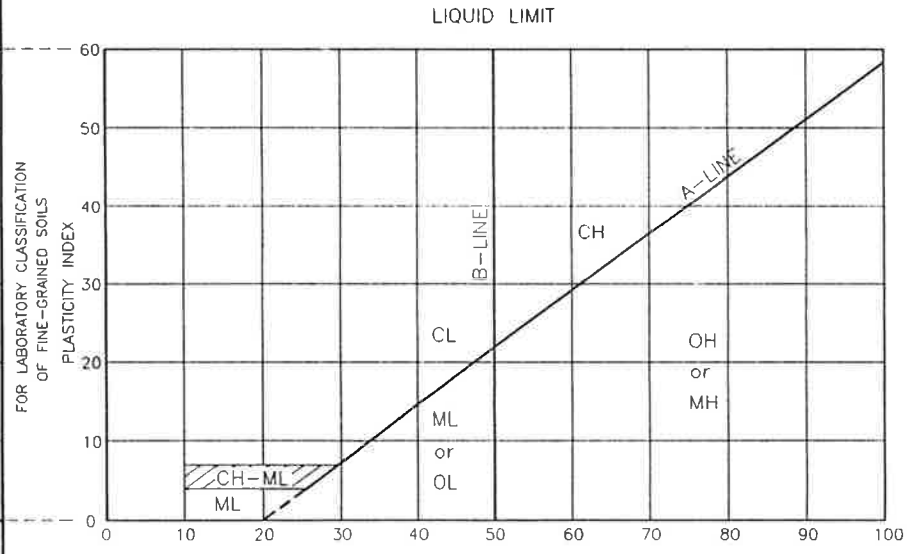
GRADATION CHART

MATERIAL SIZE		PARTICLE SIZE			
		LOWER LIMIT		UPPER LIMIT	
		MILLIMETERS	SIEVE SIZE	MILLIMETERS	SIEVE SIZE
SAND					
	FINE	.074	#200 •	0.42	#40 •
	MEDIUM	0.42	#40 •	2.00	#10 •
	COARSE	2.00	#10 •	4.76	#4 •
GRAVEL					
	FINE	4.76	#4 •	191	3/4" •
	COARSE	191	3/4" •	762	3" •
COBBLES		76.2	3" •	304.8	12" •
BOULDERS		304.8	12" •	914.4	

• U.S. STANDARD • CLEAR SQUARE OPENINGS

5-12% FINES (SILT & CLAY) DUAL CLASS

PLASTICITY CHART



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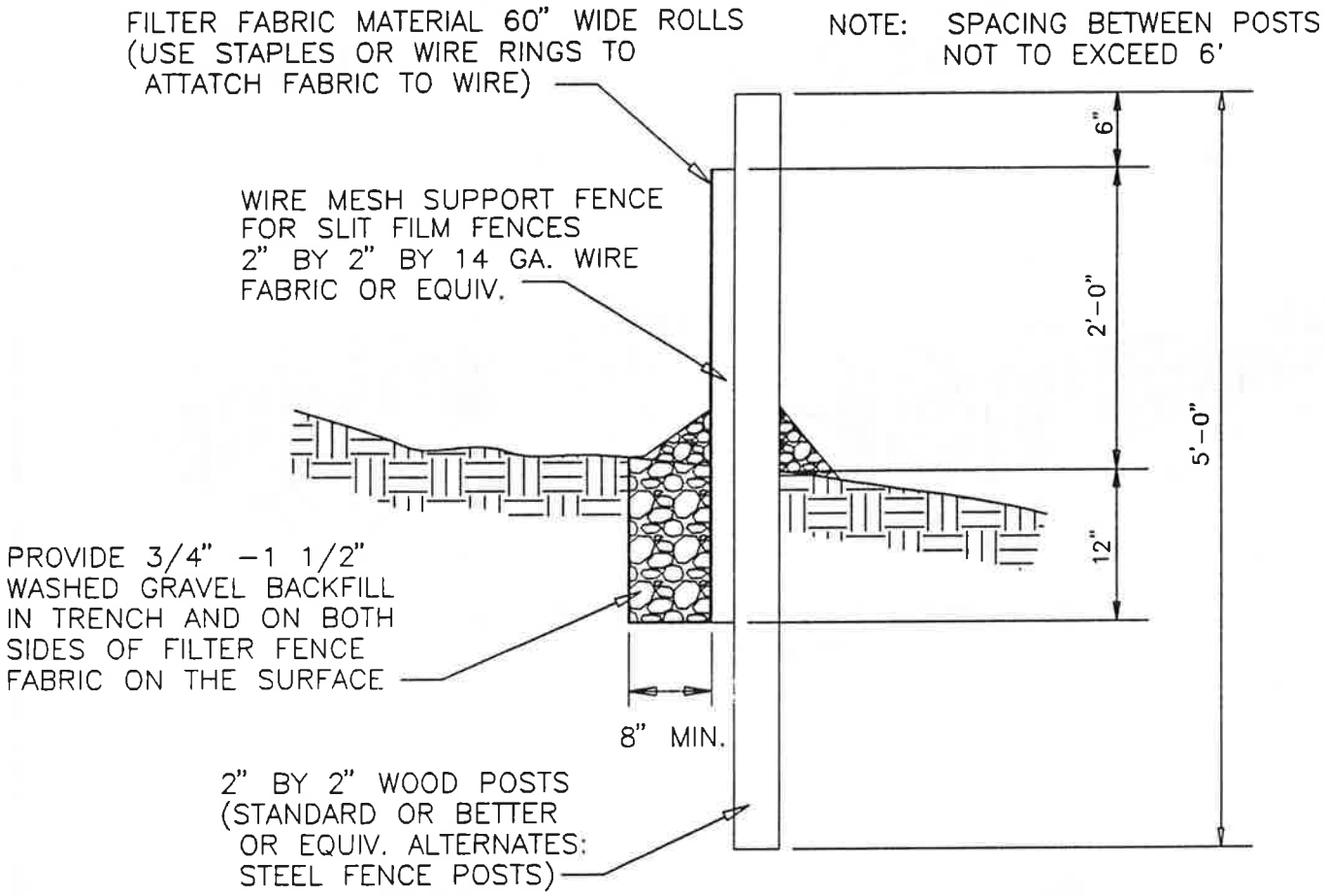
Key to Test Pit Logs Using the Unified Soil Classification System

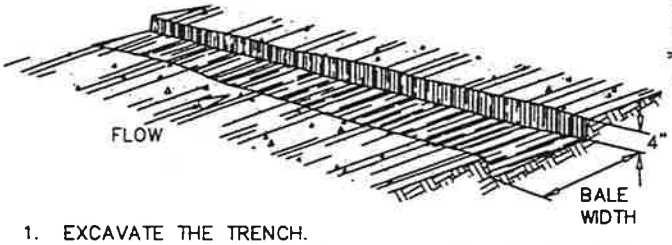
DATE: 5/11/95 SCALE: H: N/A V: N/A



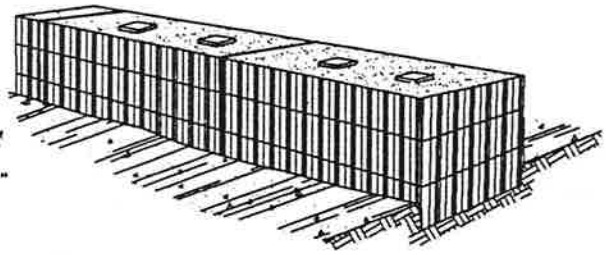
FILTER FABRIC FENCE

NOT DRAWN TO SCALE

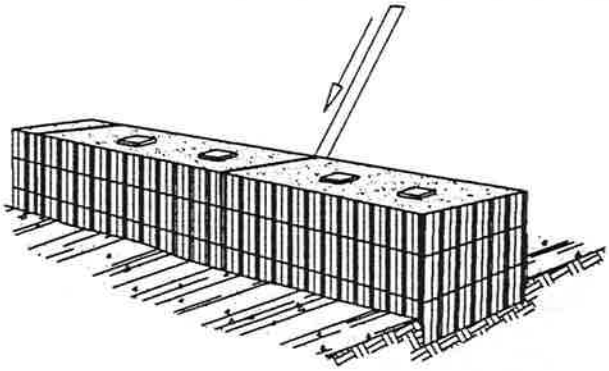
JOB NO.:	**Western Geotechnical Consultants, Inc.**	SEDIMENT CONTROL FILTER FABRIC FENCE
DESIGNED BY:		
DRAWN BY:	*4181 Saltsprings Drive • Ferndale, WA 98248*	
CHECKED BY:	*Phone (360) 380-2507 • Fax (360) 380-2507*	DATE: SCALE: H: N/A V: N/A



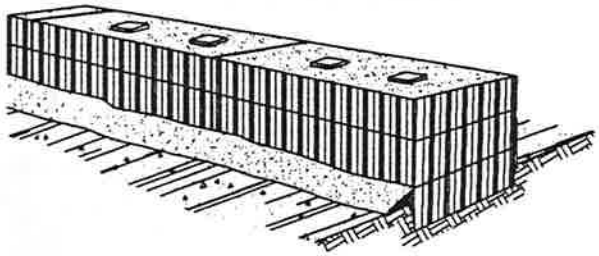
1. EXCAVATE THE TRENCH.



2. PLACE AND STAKE STRAW BALES.



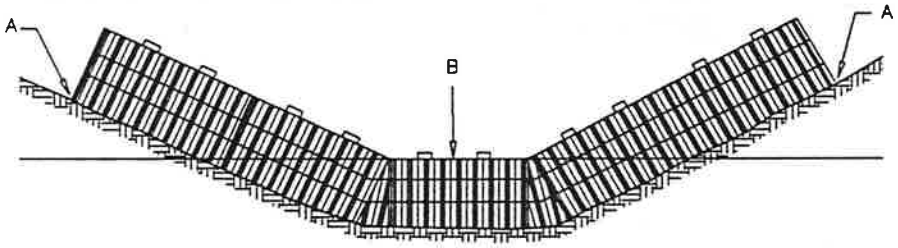
3. WEDGE LOOSE STRAW BETWEEN BALES.



4. BACKFILL AND COMPACT THE EXCAVATED SOIL.

CONSTRUCTION OF A STRAW BALE BARRIER

NOT DRAWN TO SCALE



POINTS A SHOULD BE HIGHER THAN POINT B

PROPER PLACEMENT OF STRAW BALE BARRIER IN DRAINAGE WAY

NOT DRAWN TO SCALE

JOB NO.:	**Western Geotechnical Consultants, Inc.**	SEDIMENT CONTROL STRAW BALE BARRIER
DESIGNED BY:		
DRAWN BY:	*4181 Saltsprings Drive • Ferndale, WA 98248*	
CHECKED BY:	*Phone (360) 380-2507 • Fax (360) 380-2507*	DATE: SCALE: H: N/A V: N/A