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Utilities Div.

## Western Geotechnical Consultants, Inc.

4183 Saltspings Dr., Ferndale, WA 98248  
Phone/FAX (360)380-2507

February 2, 2004

Metron & Associates, Inc.  
307 N. Olympic, Suite 205  
Arlington, WA 98223  
Attn. Thomas Barry

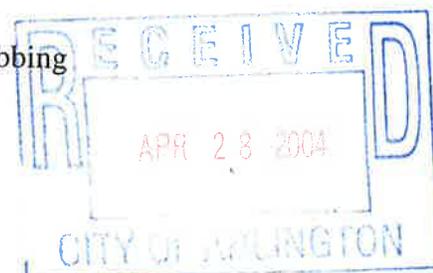
**Re: Report – Geotechnical Investigation  
Tibeau Short Plat  
7817 192<sup>nd</sup> Place NE  
Arlington, WA**

Western Geotechnical Consultants, Inc. is pleased to present the results of our geotechnical engineering investigation conducted at the above referenced property. The site is located on the north side of 192<sup>nd</sup> Place NE, Arlington, Washington. We were provided with a Preliminary Plat Plan by Metron & Associates, Inc. to aid in a preparing this report. The site development plan is to divide the site into a 2-lot short plat. The site contains a steep slope (40% to 50%) adjacent to the proposed development.

The purpose of our investigation was to evaluate the site with respect to building foundation design, minimum setback criteria, soil infiltration capacity and the impacts of the proposed drain fields on slope stability. The specific scope of our investigation for the site will included the following services:

- Excavating three test pits at the site and on the slope to obtain subsurface information for use in foundation design, general site development, drainage issues, and for performing slope stability analyses to help determine a safe setback from the slope crest. Piezometers were installed in all of the test pits for possible future monitoring of ground water levels.
- Developing logs for each test pit as to the thickness and depth of each soil unit and describing the soils encountered in accordance with the Unified Soil Classification System (USCS).
- Performing field and laboratory testing, as required, for use in our engineering evaluation of the site.
- Preparing an engineering report including a summary of work performed, and our recommendations for:
  - Foundation soil allowable bearing capacity.
  - Perform stability analyses so as to assess a safe setback distance from the slope crest.
  - General site development criteria including stripping and grubbing recommendations.

**Z-04-026-SP**



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- Cutting and structural fill criteria including the suitability of on site materials for use as structural fill.
- Drainage considerations including a discussion of groundwater impacts associated with site development.

## Site Conditions

### Surface Conditions

The front portion of the property is presently developed with an existing structure. The present plan is to subdivide the property and develop the back (northerly) portion as a single-family residence. This northerly part of the property is presently undeveloped. The ground surface in the project area is generally covered with grasses and several trees are present. The ground surface gradient is to the north, and a ravine extends along the easterly side of the property.

### Subsurface Conditions

Subsurface soil and groundwater conditions at the site were explored on January 19, 2004 using a track-mounted backhoe with a two-foot-wide bucket. A total of 3 test pits were excavated to a maximum depth of 8.5 feet. The locations of the test pits are shown on Site Plan, Figure 1. A Geotechnical Engineer from our office continuously logged and classified the soils encountered in the test pits using the Unified Soils Classification System (USCS), and obtained representative samples of the soils for further analyses and testing. Edited tabulated test pit logs are included with this report along with a USCS Chart explaining soil descriptions. The test pits were loosely backfilled upon completion of the explorations.

The focus of the investigation was to determine the subsurface conditions along the ravine/slope in order to determine an appropriate setback for the proposed house. This was accomplished by excavating test pits at the top and bottom of the slope. The subsurface profile as encountered in Test Pits 1 and 2 consisted of about a foot or less of organic and silty SAND (SM/OL by USCS) (topsoil layer), which is underlain by fine to medium SAND with trace silt (SP/SM by USCS). These soils were generally in a relatively compact condition, except in Test Pit 2, excavated near the bottom of the creek bed, where non-compact SAND was encountered. Test Pit 3, which was excavated near the west side of the property, had a different subsurface profile. At that location, we encountered an approximate 6-inch thick topsoil layer (OL/ML by the USCS) that was underlain by silty SAND (SM by the USCS) that was in a relatively compact condition. At a depth of 4-feet we encountered silty SAND that was in a very compact, till-like condition.

### Groundwater

Groundwater was not observed in any of the three test pits during our investigation on January 19, 2004. Piezometers were installed in the test pits for future monitoring of groundwater levels, if necessary.

### Slope Stability Analyses

Slope stability analyses were performed on a representative cross-section of the existing slope configuration, using the topographic survey information shown on the site plan provided by Metron and Associates (dated Nov. 2003). The survey information was used along with the results of our Geotechnical Investigation of the site and representative soil unit weight and strength values for the soil conditions encountered.

We used the engineering computer program Gslope to facilitate the analyses. Gslope utilizes limiting equilibrium techniques to analyze the margin of safety of global stability under static and seismic loading conditions. Safety factors of 1.5 and 1.1 are normally accepted values for static and dynamic (seismic) stability, respectively. Dynamic global stability analyses assumed a pseudostatic earthquake force equivalent to 30% of gravity, for Seismic Zone 3 per the Unified Building Code (UBC).

The slope stability analyses indicate margins of safety greater than the accepted standards of 1.5 and 1.1 for static and seismic global stability, respectively when the house setback of 10-feet or more is maintained. The results of the slope stability analyses are attached to this report.

## **Conclusions and Recommendations**

### General Development Recommendations

Based on our site investigation, we conclude the site will be suitable for the type of development planned from a geotechnical standpoint, provided our recommendations are followed and good construction practices are used. A 10-foot setback from the slope crest is an adequate setback provided the present stability of the slope is maintained. In that regard, vegetation on the slope must be maintained to protect to slope from erosion. We provide the following general recommendations.

Site Preparation: All topsoil, organics, soft material, and any other deleterious materials must be striped away from the areas to be occupied by structural improvements. Site improvements are defined as those areas that will support buildings, parking lots, etc. Based on the results of our subsurface investigation we estimate that the stripping depth will be about 1 foot. It should be verified that all organic or other unsuitable materials are removed during striping of the site.

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The soils below the stripping depth should exhibit no significant shrinkage or swelling with seasonal changes in moisture content. However, the silty soils near the surface are moisture sensitive and could soften when wet and disturbed by construction equipment. Therefore, earthwork operations will be easier and less costly if performed during the dry season.

**Building Foundation Support:** Based on the results of our subsurface exploration, the site will be suitable for foundation support using conventional shallow spread footings. The building foundations should be supported on isolated spread and continuous footings founded on compact, undisturbed native, non-organic soils or compacted granular structural fill. Bearing soil that is disturbed during foundation excavation should be re-compacted or removed and replaced with structural fill. All footings may be proportioned using Standard Uniform Building Code (UBC) recommendations. All footings should be founded a minimum of 18-inches below final grade for frost protection.

**Drainage and Grading Considerations:** We recommend that footing drains be placed around the perimeter of the house. The drains should be placed below the base of all foundations. The drains typically consist of a 4-inch diameter perforated pipe surrounded by washed rock.

### **Erosion Control**

Erosion control during construction of the proposed development 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 area. Typical details for siltation control using either hay bales or silt fences are attached to this report.

Siltation devices should be placed downgradient of all construction areas and cleared areas to provide siltation control during construction. All siltation control devices should be maintained 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.

### **Closure**

This report is intended for use by the owner or his representative in the development of the Tibeu Short Plat located at 7817 192<sup>nd</sup> Place NE in Arlington, Washington. This report should not be used for any other purposes or other project sites without the specific consent of Western Geotechnical Consultants, Inc.

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Our test pit logs show subsurface conditions at the dates and locations indicated. The analysis, conclusions, and recommendations contained in our report assume that the exploratory test pits are representative of the subsurface conditions throughout the site. If during construction, different subsurface conditions from those encountered during our explorations are observed or appear to be present in excavations, we must be advised promptly so that we can review these conditions and reconsider and/or modify our recommendations and conclusions where necessary.

We appreciate the opportunity to be of assistance to you on this project. 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.**

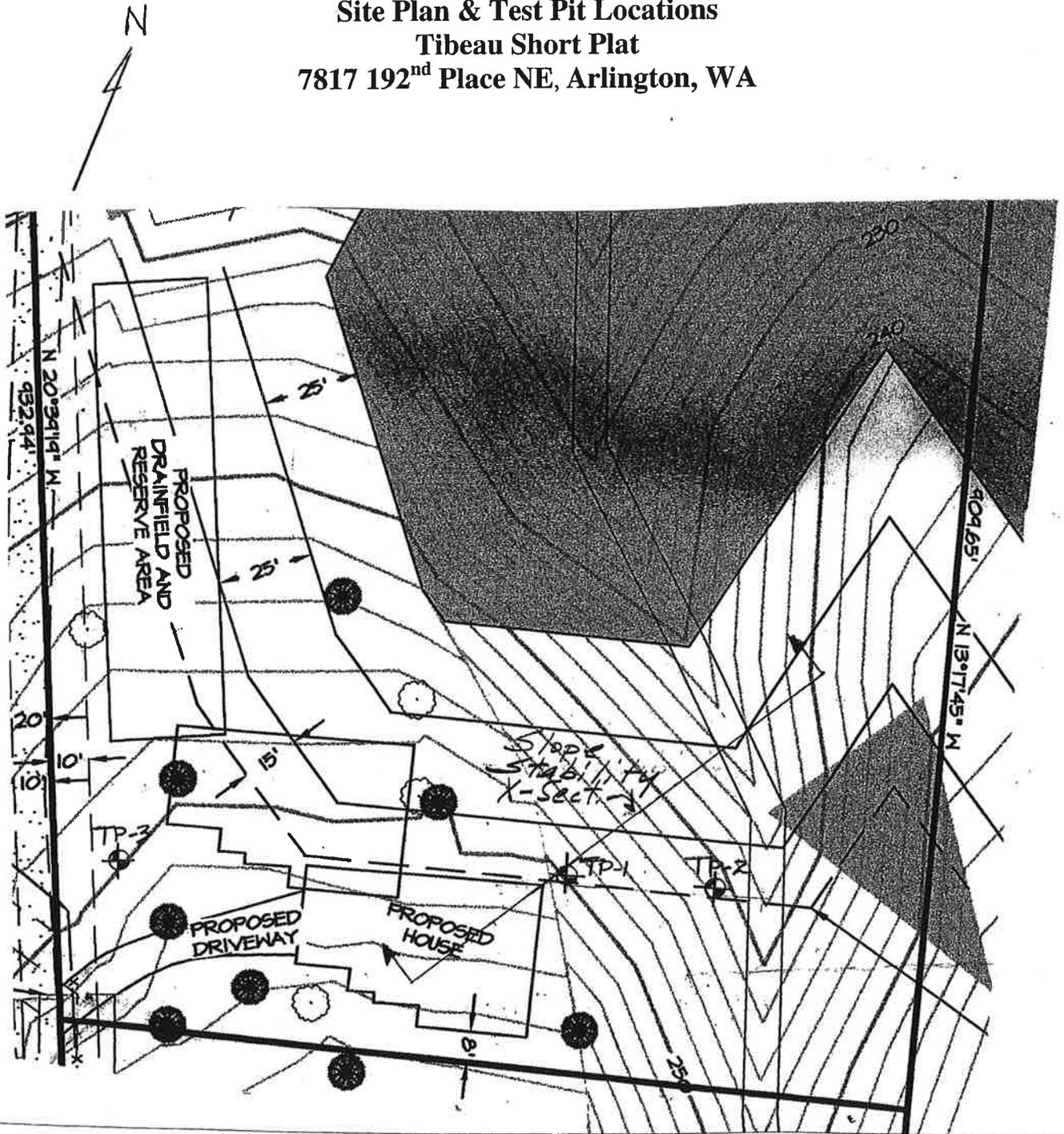
  
Theodore A. Hammer, P.E.  
Geotechnical Engineer

Attachments: Figure 1, Site Plan and Test Pit Locations  
Unified Soil Classification Chart  
Tabulated Test Pit Logs  
Stability Analyses Results  
Typical Erosion Control Facilities

File:03 205 1

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**Figure 1**  
**Site Plan & Test Pit Locations**  
**Tibeau Short Plat**  
**7817 192<sup>nd</sup> Place NE, Arlington, WA**



Ref: Site Plan of the Proposed Tibeau Short Plat, dated Nov. 2003, provided by Metron and Associates.

Approximate Test Pit Locations  TP-1

Scale: 1" = 40'

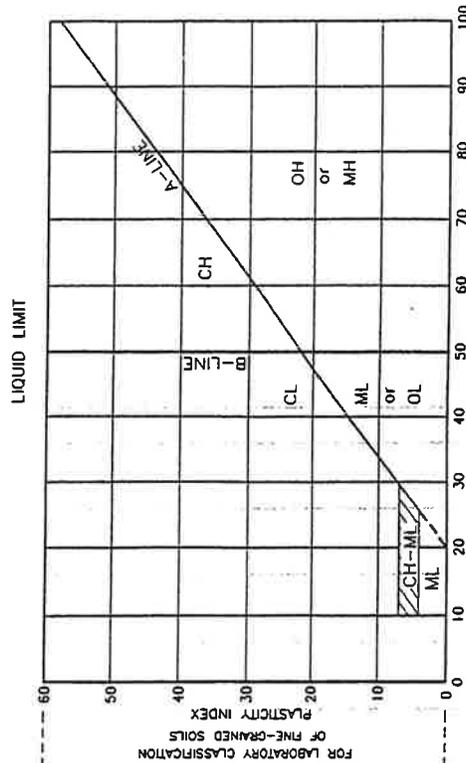
# USCS Classification Chart & Key to Test Pit Logs

## GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE		UPPER LIMIT MILLIMETERS	UPPER LIMIT SIEVE SIZE
	LOWER LIMIT MILLIMETERS	SIEVE SIZE		
SAND	.075	#200	0.42	#40
	0.425	#40	2.00	#10
	2.00	#10	4.75	#4
GRAVEL	4.75	#4	191	3/4"
	191	3/4"	762	3"
COBBLES	76.2	3"	304.8	12"
	304.8	12"	914.4	

• U.S. STANDARD • CLEAR SQUARE OPENINGS  
 5-12% FINES (SILT & CLAY) DUAL CLASS

## PLASTICITY CHART



## UNIFIED SOIL CLASSIFICATION CHART (USCS)

MAJOR DIVISIONS	GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	CLEAN GRAVELS (LITTLE OR NO FINES) <5% GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES) <12%	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	SAND AND SANDY SOILS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
		GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
FINE GRAINED SOILS	CLEAN SANDS (LITTLE OR NO FINES) <5% SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) <12%	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	SILTS AND CLAYS	SM	SILTY SANDS, SAND-SILT MIXTURES
		SC	CLAYEY SANDS, SAND-CLAY MIXTURES
HIGHLY ORGANIC SOILS	SILTS AND CLAYS	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, NO CLAYEY SILTS WITH SLIGHT PLASTICITY
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	SILTS AND CLAYS	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND, OR SILTY SOILS
	SILTS AND CLAYS	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
		PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

**Western Geotechnical Consultants, Inc.**

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Key to Test Pit Logs Using the Unified Soil Classification System

DATE: 5/11/95 SCALE: 1/4" = 1' V. HVA

		Log of Test Pit			File: 03-205-1	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
TP-1	0.0-1.0	SM/OL	Brown, organic SILT to silty SAND and numerous roots (topsoil) (relatively compact, moist)	1-1/0.8'	18.2%	
	1.0-8.5	SP	Brown to gray-brown, slightly silty fine SAND with occasional gravel (relatively compact, moist) -grades medium SAND at 5 feet -grades compact at 7.5'	1-2/2.0'  1-3/7.5'	15.8%  17.9%	

Notes:

- Test Pit terminated on 1/19/04 at 8.5 feet
- Test Pit loosely backfilled upon completion
- No groundwater seepage encountered
- Piezometer installed

		Log of Test Pit			File: 03-205-1	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
TP-2	0.0-0.7	SM/OL	Brown, silty SAND with little organic material and numerous roots (topsoil) (relatively compact, damp to moist)			
	0.7-8.0	SP/SM	Brown, slightly silty fine to medium SAND with trace fine gravel (relatively compact, moist) -grades medium SAND with occasional gravel, cobbles and small boulder at 4 feet (relatively non-compact, moist)	2-1/2.0'  2-2/7.5'	14.4%  9.2%	

Notes:

- Test Pit terminated on 1/19/04 at 8.0 feet
- Test Pit loosely backfilled upon completion
- No groundwater seepage encountered
- Caving from about 3 feet
- Piezometer installed

		Log of Test Pit			File: 03-205-1	
Test Pit No.	Depth Interval (feet)	USCS Class.	Soil Description	Sample No./ Depth (feet)	Water Content (%)	Pocket Pen. (Kg/sq. cm)
TP-3	0.0-0.5	ML/OL	Dark brown, organic and fine sandy SILT (topsoil and root zone)			
	6.0-5.5	SM	Reddish brown, silty fine SAND with little gravel (relatively compact, damp to moist) -grades gray brown with little orange mottling with an occasional cobble at 2 feet -grades very compact, till-like material at 4 feet	3-1/1.0'  3-2/2.5'  3-2/5.0'	19.9%  18.6%  13.4%	

Notes:

- Test Pit terminated on 1/19/04 at 5.5 feet
- Test Pit loosely backfilled upon completion
- No groundwater seepage encountered
- Piezometer installed

Western Geotechnical - Ferndale WA  
 Job Number 03-205-1  
 Tibeau Hort Plat, Arlington

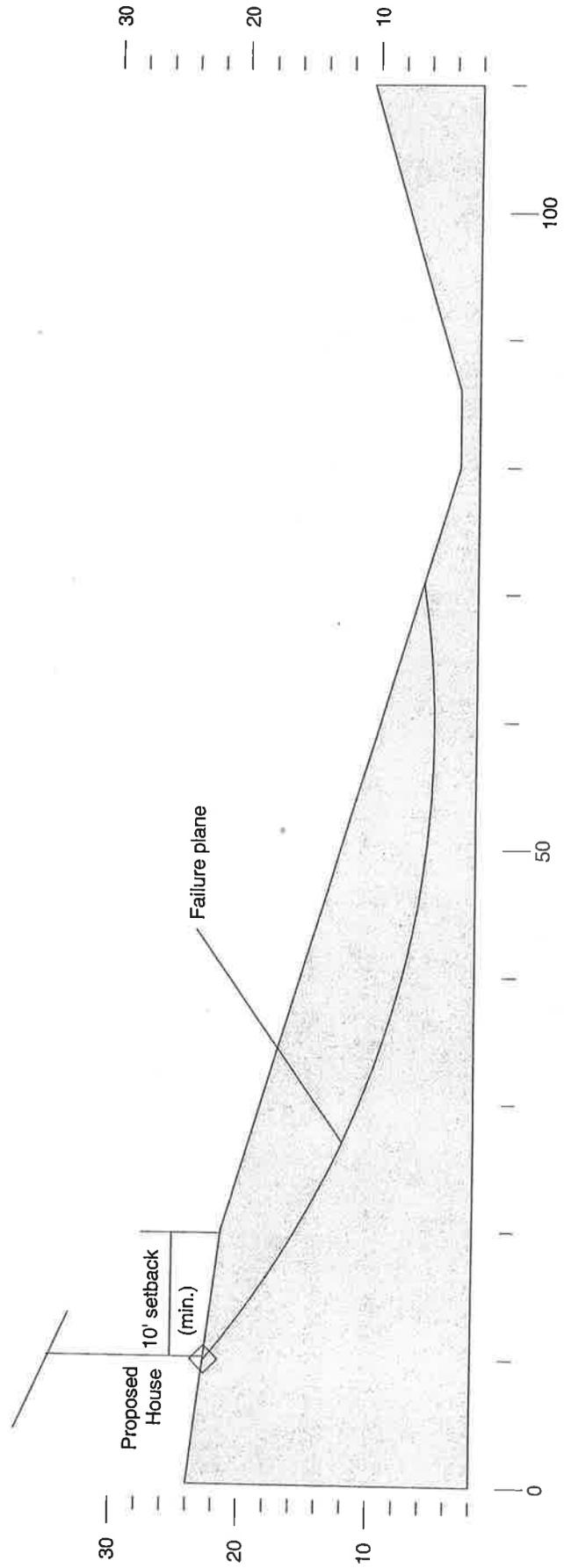
Seismic Stability of Slope for  
 Proposed House Setback

Ref.: Prelim. Site Plan by Metron  
 and Assoc., dated Nov. 2003

✱ F = 1.236

Gamma C	Phi	Plezo	Ru
pcf	deg	Surf.	
115	32	0	0

SP/SM  
 Seismic coefficient = 0.30



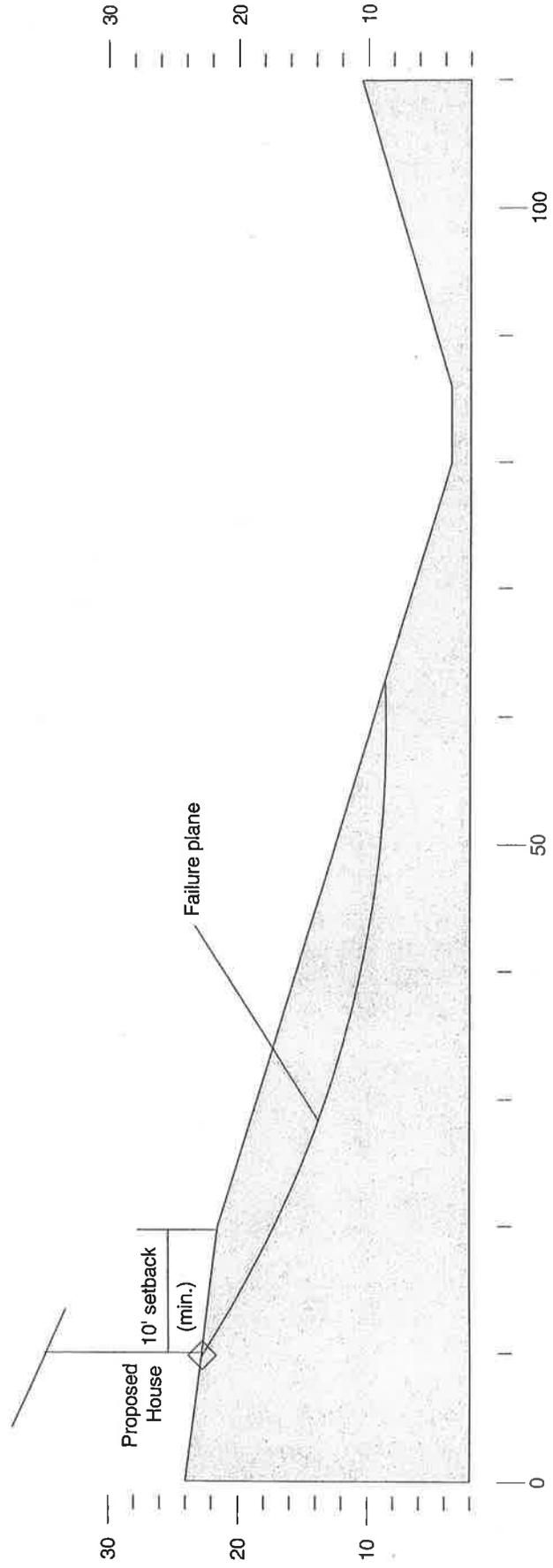
Western Geotechnical - Ferndale WA  
 Job Number 03-205-1  
 Tibeau Hort Plat, Arlington

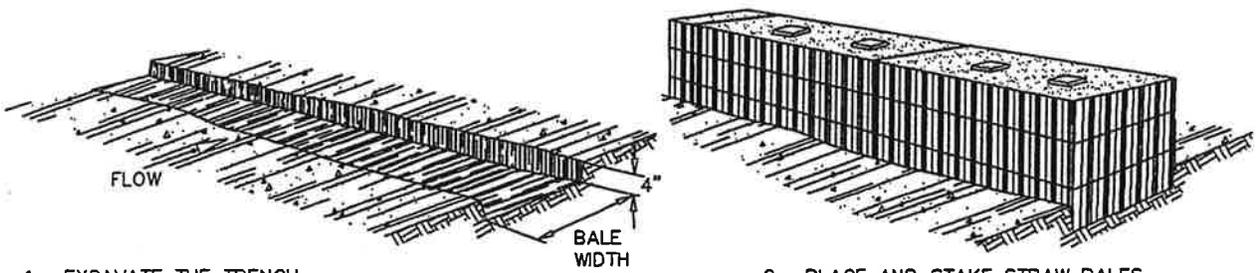
Static Stability of Slope for  
 Proposed House Setback

Gamma C	Phi	Piezo	Ru
pcf	deg	Surf.	
115 0	32	0 0	0

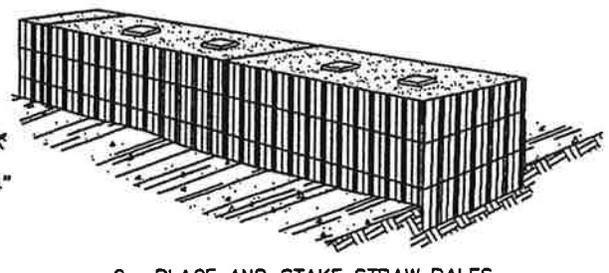
SP/SM

Ref.: Prelim. Site Plan by Metron  
 and Assoc., dated Nov. 2003)

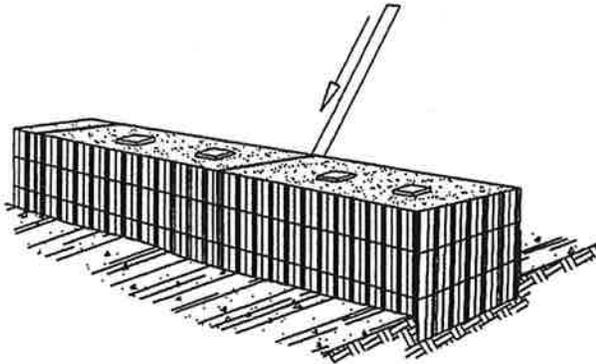




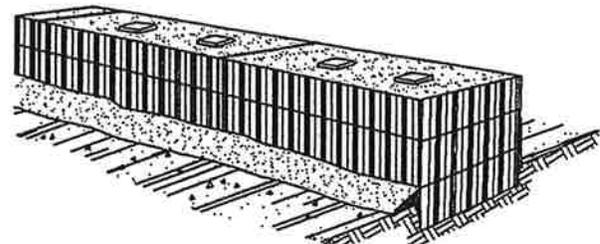
1. EXCAVATE THE TRENCH.



2. PLACE AND STAKE STRAW BALES.



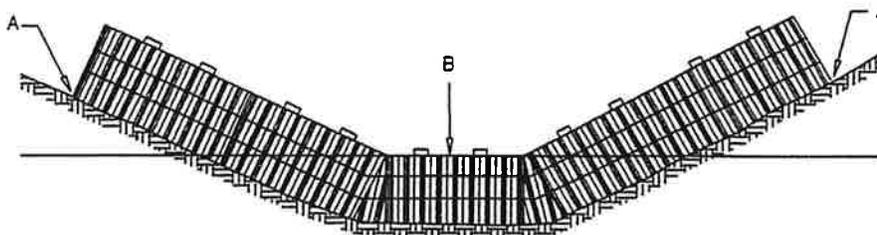
3. WEDGE LOOSE STRAW BETWEEN BALES.



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.**

DESIGNED BY:

DRAWN BY:

CHECKED BY:

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

**SEDIMENT CONTROL  
STRAW BALE BARRIER**

DATE:

SCALE:

h: N/A

v: N/A

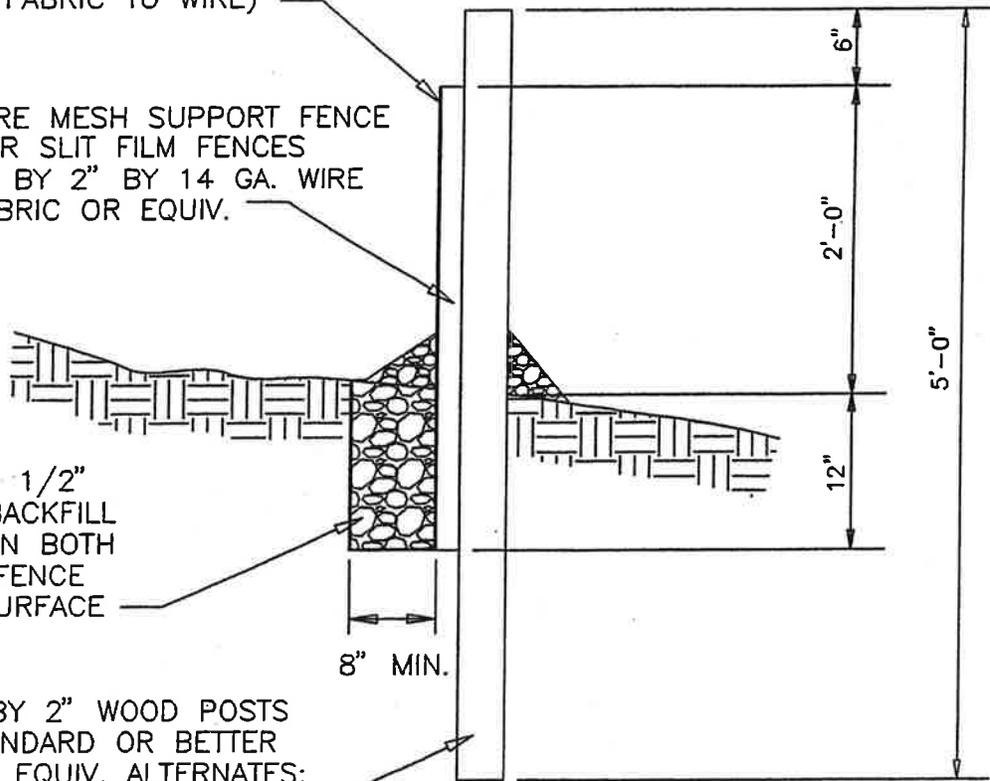
FILTER FABRIC MATERIAL 60" WIDE ROLLS  
(USE STAPLES OR WIRE RINGS TO  
ATTACH FABRIC TO WIRE)

NOTE: SPACING BETWEEN POSTS  
NOT TO EXCEED 6'

WIRE MESH SUPPORT FENCE  
FOR SLIT FILM FENCES  
2" BY 2" BY 14 GA. WIRE  
FABRIC OR EQUIV.

PROVIDE 3/4" - 1 1/2"  
WASHED GRAVEL BACKFILL  
IN TRENCH AND ON BOTH  
SIDES OF FILTER FENCE  
FABRIC ON THE SURFACE

2" BY 2" WOOD POSTS  
(STANDARD OR BETTER  
OR EQUIV. ALTERNATES:  
STEEL FENCE POSTS)



### FILTER FABRIC FENCE

NOT DRAWN TO SCALE

JOB NO.:

**Western Geotechnical Consultants, Inc.**

DESIGNED BY:

DRAWN BY:

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Phone (360) 380-2507 • Fax (360) 380-2507

CHECKED BY:

DATE:

SEDIMENT CONTROL  
FILTER FABRIC FENCE

SCALE:

H: N/A

V: N/A