SHOALWATER BAY INDIAN TRIBE
Contractor Section 3 Compliance Form

Required for projects under HUD ICDBG grants.

Company: _____

Contact: _____

Address: _____

Phone: _____ E-mail: _

Applicability

Is the contract you were hired under worth $100,000 or more? If no, stop here, this form does not apply to you. _____

Part I – Employment and Training

Business Category *(Circle One)*: Professionals - Technicians - Office & Clerical

Officials & Managers - Sales - Craft Workers (Skilled) Operatives

(Semi-Skilled) - Laborers (Unskilled) - Service Workers

Other *(List)*: _____

1. How many new hires did you bring on for this project, if any? _____
2. How many new hires qualified as a Section 3 resident? _____
3. How many new hires did you bring on solely to provide job training? _____
4. How many trainees qualified as a Section 3 resident? _____
5. What job training was provided to Section 3 residents?* _____
   _____

Part II – Contracts and Awards

1. Did you sign any <u>construction</u> sub-contracts to complete this project?
   ☐ Yes, I hired _____construction sub-contractors. ☐ No

2. If yes, how many <u>construction</u> sub-contractors did you hire who qualified as Section 3 Business Concern? _____ What was the total dollar amount of all construction sub-contracts awarded to Section 3 Business Concerns? _____

3. Did you hire any non-construction sub-contractors to complete this project?
   ☐ Yes, I hired _____non-construction sub-contractors. ☐ No

4. If yes, how many non-construction sub-contractors did you hire who qualified as a Section 3 business? _____ What was the total dollar amount of all non-construction sub-contracts awarded to Section 3 Business Concerns?* _____

**Please provide documentation that verifies the Section 3 status of the Section 3 residents identified above.*

Part II – Contracts and Awards

Indicate the efforts made to direct employment and other economic opportunities generated by HUD financial assistance for housing and community development programs, to the greatest extent feasible, to low- and very low-income persons, particularly those who are recipients of government assistance for housing.

(Check mark all that apply.)

_____ Recruited low-income residents through: local advertising media, signs prominently displayed at the project site, contacts with community organizations and public or private agencies operating within the metropolitan area (or Nonmetropolitan County) in which the Section 3 covered program or project is located, or similar methods.

_____ Participated in a HUD program or other program which promotes the training or employment of Section 3 residents.

_____ Participated in a HUD program or other program which promotes the award of contracts to business concerns which meet the definition of Section 3 business concerns.

_____ Coordinated with Youthbuild Programs and administered in the metropolitan area in which the Section 3 covered project is located.

_____ Other Efforts; Please describe.

_____

_____

_____

_____

Section 3 Guidance

What is a Section 3 Business Concern? Section 3 business concerns are businesses that can provide evidence that they meet one of the following criteria:

a) 51 percent or more owned by Section 3 residents; or

b) At least 30 percent of its full time employees include persons that are currently Section 3 residents, or were Section 3 residents within three years of the date of first hire; or

c) Provides evidence, as required, of a commitment to subcontract in excess of 25 percent of the dollar award of all subcontracts to business concerns that meet one of the first two qualifications above.

What is a Section 3 Resident? Section 3 residents are those individuals living on or near Shoalwater Bay Indian Reservation who are EITHER residents of Shoalwater Housing Authority housing OR whose median household income (varies by household size) is 80% or less of the area median income. On Shoalwater Bay Indian Reservation the maximum income for each household size is shown in this chart:

NAHASDA - 80% of National Median Income (US Non-Metropolitan)								
Family Size	1	2	3	4	5	6	7	8
80%	28,900	33,050	37,150	41,300	44,550	47,900	51,200	54,500

BLACKBERRY - 60% of Regional Median Income (Pacific County, WA)								
Family Size	1	2	3	4	5	6	7	8
60%	24,120	27,600	31,020	34,440	37,200	39,960	42,720	45,480

Section 3 requires that Section 3 Residents have the opportunity to apply to all available full time positions (be they seasonal, permanent, or temporary) created by the use of Section 3 covered funds. The types of jobs include construction, administrative, management, services, etc.; any and all jobs that arise in connection with construction or rehabilitation activities. As part of HPD's Section 3 procedures, firms are required to report the number of employees hired in connection with a Section 3 Project.

How can a business find Section 3 residents? Shoalwater Bay Tribe holds a list of non-Section 3 and Section 3 employable Tribal Members. Contact the Willapa Bay Enterprise office at 360.268.7076 for this list.

Otherwise, businesses may recruit utilizing a local employment referral source, such as contacting resident organizations, local community development and employment agencies to find potential workers. Or businesses can recruit utilizing the list of employment entities listed on HPD's HUD Section 3 page.

23.05 CULTURAL RESOURCES

23.05.010 Purpose This section establishes specific policies and procedures to protect archaeological and historic sites on the Shoalwater Reservation. Given the long occupation of the Reservation, and the relatively small areas conducive to dwelling construction, the Shoalwater Reservation has many areas, no longer discernible to the untrained eye, that were once sites of ceremonies, dwellings, fishing camps, cemeteries, and other cultural uses. Therefore, the following policies and procedures are hereby adopted.

23.05.020 Policies Regarding Archaeological and Historic Sites In addition to all federal statutes and regulations that govern the treatment of cultural and archaeological resources, the Shoalwater Bay Indian Tribe adopts the following policies governing archaeological and historic sites:

a) Any application for a permit under this Ordinance may be required to be reviewed by a professional archaeologist, or tribal cultural resource specialist, to determine whether the proposed activity poses any danger to known or suspected archaeological sites. A literature search shall be required in addition to a check of known or registered sites. The expense of such review shall be borne by the applicant.

b) If evidence of an archaeological site is unearthed during the construction of a project for which a permit has been issued, the project developer and/or

the persons involved in construction must cease work immediately and notify the SBEPD and Tribal Council.

c) The Shoalwater Bay Tribe reserves the right to conduct its own archaeological inspection of any construction, earthmoving, or excavation work on the Reservation.

d) The Tribe hereby reserves the right to halt construction of a project if it deems that an archaeological site of importance to the Tribe may have been unearthed. During the construction halt, the Tribe must begin professional examination of the site to determine the significance. Extensions of the construction halt will be allowed if needed to complete this professional examination. The Tribe may condition the permit for the project after the discovery of the site and require a professional archaeological excavation or require modification of the activity to preserve the site. The expense of such examination and any excavation or modification of the activity shall be borne by the applicant.

e) Applicants may be required to post a deposit with the Tribe of up to $5,000 to insure that notification of any archaeological evidence is made to the Tribe. The deposit is fully refundable if no archaeological site is unearthed, but will be forfeited if violation of these policies occurs.

23.05.030 Notification of Tribal Council

Any person who fails to notify the Tribal Council when a cultural resource has been located or unearthed has committed a Class C infraction.

23.05.040 Failure to Halt Construction

Any person who fails to halt construction on any site where a cultural resource has been located or unearthed has committed a Class B infraction.

23.05.050 Digging/Excavation/Removal

Any person who digs, excavates, fills or removes or allows any digging excavation, filling or removal of artifacts or any other materials, including soil, sand

23.05.050 Digging/Excavation/Removal

Any person who digs, excavates, fills or removes or allows any digging excavation, filling or removal of artifacts or any other materials, including soil, sand

and gravel from a cultural resource without the express written approval of the Tribal Council has committed a Class A infraction.

23.05.060 Destruction

Any person who injures, defaces, or destroys any cultural resource has committed a Class A infraction.

U.S. Department of Housing
And Urban Development
Community Planning and Development
Environmental Branch

Environmental Assessment

(24 CFR 58.36)

Project Identification: Eagle Hill Road Slope Stabilization, Road-Widening and Multipurpose Building Construction Project

Prepared by:
ADESA Environmental
PO Box 1009
Tenino, WA 98589
(360)701-8797

Responsible Entity: Shoalwater Bay Tribe

November 8, 2011

Environmental Assessment

Responsible Entity [24 CFR 58.2(a)(7)]**:** Shoalwater Bay Indian Tribe

Certifying Officer [24 CFR 58.2(a)(2)]**:** Pete Chadwick, Project Coordinator, Shoalwater Bay Indian Tribe

Project Name: Eagle Hill Road Slope Stabilization, Road-Widening and Multipurpose Building Construction Project

Project Location: The proposed project site is located on the Shoalwater Bay Indian Reservation, approximately 0.25 miles northwest of the Shoalwater Bay Tribal Casino, in Section 3, Township 14 N Range 11 W. The proposed project area includes the lowermost 2,000 feet of Eagle Hill Road, above its junction with State Route 105, and its general location is approximately 1-mile east and 1-mile west of the unincorporated communities of North Cove and Tokeland, respectively. The intersection of State Route 105 and Eagle Hill Road marks the southernmost extent of road-widening activities and bounds the southeastern corner of the immediate project area. Bands of emergent wetland extending between SR105 and Eagle Hill Road are located just south of the project area and drain seasonally through a partially functioning culvert.

Eagle Hill Road
Tokeland, WA 98590.
Section: Township: 14, Section 3, Range: 11W
Latitude: 46.7258 Longitude: -124.0242

Estimated total project cost: The proposed Shoalwater Bay Tsunami Evacuation Route Modifications, Hillside Stabilization and Multipurpose Building are design build projects with a combined estimated cost of $1,433,000.

Grant Recipient [24 CFR 58.2(a)(5)]**:**
Shoalwater Bay Indian Tribe

Federal Action Agencies

Primary: U.S. Department of Housing and Urban Development (HUD): $481,163.00 awarded for construction of multipurpose building

To facilitate the tiering of related or redundant assessments, this Environmental Assessment has incorporated the environmental review of all related project actions. Other potential funding sources include:

- Bureau of Indian Affairs: A maximum grant amount of $800,000 for road widening and resurfacing activities and hill slope stabilization – this grant has not yet been awarded to this project; appointment of the funding is contingent upon successful completion of the environmental permitting and review process.
- FEMA/Homeland Security: FEMA/DHS Environmental and Historic Preservation Screening Form OMB No.: 1660-0115– this grant has not yet been awarded to this project; appointment of the funding is contingent upon successful completion of the environmental permitting and review process. This grant would pay for infrastructure, equipment, training and administration associated with the operation of the Multipurpose Building and the Tsunami Evacuation Route. Total currently requested amount: $399,000.

Recipient Address:
PO Box 130
Tokeland, WA 98590

Project Representative: Pete Chadwick, Project Coordinator, Shoalwater Bay Indian Tribe
Telephone Number:
Office: (360)267-8164
Fax: (360)267-6778
Cell: (360)591-5105
Email: **pchadwick@shoalwaterbay-nsn.gov**

Conditions for Approval: (List all mitigation measures adopted by the responsible entity to eliminate or minimize adverse environmental impacts. These conditions must be included in project contracts or other relevant documents as requirements). [24 CFR 58.40(d), 40 CFR 1505.2(c)]

- Complete the necessary USACE Section 404 Clean Water Act permitting process to establish appropriate mitigation measures for impacts to the wetland areas adjacent to the intersection of SR 105 and Eagle Hill Road, and impacts to the wetland buffers in the area of the proposed hillside stabilization and multipurpose building.
- The storm water control technology employed on the multipurpose building site will be based on best management practices and applicable regulations, and designed to prevent continuing impacts to the wetlands. It will be selected during the design phase of this design-build project. Stormwater and runoff will be treated onsite and allowed to infiltrate into the groundwater.
- A mitigation plan is in place should anything of cultural significance be discovered during said construction. See Appendix A for the Eagle Hill Project Final Cultural Report.
    a. Should anything of potential cultural/historic significance be discovered all work is to stop immediately and the area be left undisturbed.
    b. The SBIT Heritage/Culture Dept. is to be notified as soon as possible and called upon to investigate the findings. Earl Davis, Heritage/Culture Director is the appropriate contact and can be reached at (360) 267-0731 or (360) 580-6274. A determination will then be made by the SBIT Heritage/Culture Dept. as to the nature/significance of human materials/artifacts discovered during the course of the proposed work and a decision of further action will be made.
    c. If, during the course of the proposed work, materials are discovered that are of a nature where it is both culturally and/or physically possible to relocate them they will be moved and preserved so that work may continue.
    d. If materials are discovered that are of a nature where it is both culturally and/or physically not possible to relocate them, the Heritage/Culture Dept. will make a motion to stop work entirely and discuss with the Shoalwater Bay Indian Tribe all other options.

FINDING: [58.40(g)]

☒ **Finding of No Significant Impact**
(The project will not result in a significant impact on the quality of the human environment)

☐ **Finding of Significant Impact**
(The project may significantly affect the quality of the human environment)

Preparer Signature: _____ **Date: 11/8/11**
Title/Agency: ADESA, LLC

RE Approving Official Signature: _____ **Date: 10/28/11**
Title/ Agency: Shoalwater Bay Indian Tribe, Tribal Chair

Statement of Purpose and Need for the Proposal: [40 CFR 1508.9(b)]

The Shoalwater Bay Indian Tribe's tsunami evacuation route, Eagle Hill Road, is currently inadequate for the Tribe's safety needs in the event of a tsunami. The evacuation route is an unpaved, single lane road that does not allow multi-directional traffic, there are few pull-off parking areas and 350 feet of the hillside north of Eagle Hill Road (overlying the Shoalwater Tribe's water main) is subject to frequent landslides from unstable slopes (Chadwick, 2011)(Shoalwater, 2008). Another issue being addressed by the currently proposed project is the need for a multipurpose building for the Tribal Community. The multipurpose building will provide the Shoalwater Bay Tribe a much needed multi-use community facility and parking area at an elevation above 50ft AMSL, the elevation recommended for tsunami evacuation assembly areas by the Pacific County Emergency Management, the Emergency Management Division of the Washington Military Department, and the Shoalwater Bay Tribe's emergency management services.

Description of the Proposal: Include all contemplated actions that logically are either geographically or functionally a composite part of the project, regardless of the source of funding. [24 CFR 58.32, 40 CFR 1508.25]

The Shoalwater Bay Indian Tribe is considering the widening of an existing tsunami evacuation route and the development of a multipurpose building on Eagle Hill Road within the current reservation boundaries. The project would involve the following components:

1) Stabilizing a 350ft slide area/unstable hill-slope north of Eagle Hill Road by removing an estimated 72,432 cubic yards of overburden material and re-grading the immediate area to the approximate elevation of the existing road (~55ft AMSL).

2) On the site of the regarded hill-slope, construct a Tribal Community two storey multipurpose building (approximately 3200ft^2), an associated parking area (also 3200ft^2), and septic system at an elevation of approximately 55ft AMSL, well above the predicted tsunami height for the area. The Multipurpose building will be constructed using HUD funds. Once construction is commenced, upgrades to the multipurpose building, proposed to be funded by a FEMA/DHS grant, include the purchase and installation of communications equipment.

3) Make necessary improvements to the lower 0.4 miles of Eagle Hill Road, including: widening the existing roadway to two lanes, completing minor realignments and resurfacing activities, and making needed improvements to drainage structures.

Existing Conditions and Trends: Describe the existing conditions of the project area and its surroundings, and trends likely to continue in the absence of the project. [24 CFR 58.40(a)]

The Shoalwater Bay Indian Tribe is small, but increasing in population. The Shoalwater Bay Tribe currently has over 120 individuals residing on the Reservation with 333 enrolled tribal members who reside as close as on the Reservation to as far away as Louisiana. The Tribe's BIA designated service area population is 1,204 with 384 of these individuals under the age of 16, 689 individuals ages 16-64 and 131 over the age of 64. (Shoalwater Bay Tribal Enrollment Clerk, 2011). Many tribal members work at the Tribal casino or in the Tribal Government. Tribal members are also commercial fishermen within Willapa Bay and make use of local native plant species for Tribal crafts and ceremonial use.

The Shoalwater Bay Indian Tribe's tsunami evacuation route, Eagle Hill Road, is currently inadequate for the Tribe's safety needs in the event of a tsunami. The evacuation route is an unpaved, single lane road that does not allow multi-directional traffic and there are few parking areas. Eagle Hill Road overlies the Shoalwater Tribe's water main, which emanates from a well/tower water system located within the project area. For approximately 350ft of Eagle Hill Road, in the area of the proposed stabilization and multipurpose building construction, frequent landslides from the unstable slopes north of the roadway threaten the tsunami evacuation route, the tribal water supply and wetland areas along SR 105 (Shoalwater, 2008).

There are few developable areas within the boundaries of the Shoalwater Bay Reservation that higher in elevation than the recommended evacuation height (>50ft AMSL). There is also a need for tribal community multi-use facilities. The multipurpose building will provide the Shoalwater Bay Tribe a much needed multi-use facility and parking area at a proposed elevation of 55' AMSL, above the elevation recommended for tsunami evacuation assembly areas by the Pacific County Emergency Management, the Emergency Management

Division of the Washington Military Department, and the Shoalwater Bay Tribe's emergency management services.

The implementation of this construction proposal will result in short term employment during the construction phases but is not anticipated to impact long term jobs. The Shoalwater Bay Indian Tribe's Eagle Hill Road Project will enhance the resilience of the Tribal emergency management capabilities in accordance with the goals expressed in the Shoalwater Bay Tribe's Hazard Mitigation Plan, greatly enhancing the Tribe's tsunami evacuation route while protecting Eagle Hill Road, the tribal water supply, and wetland areas along SR105 from actively sliding hillsides.

Attachment 1: FEMA Firmette Community Panel Number 530126 0016B
Attachment 2: Sole Source Aquifers Map
Attachment 3: 1995 USGS Topographic Map
Attachment 4: Aerial Photograph of Proposed Project Site
Attachment 5: Preliminary Site Plan

Appendix A: THPO Letter and Historic Determination
Appendix B: Floodplain and Wetland Determination
Appendix C: Biological Assessment (BA)
Appendix D: Phase I Environmental Site Assessment
Appendix E: Geotechnical Report

Statutory Checklist

[24CFR §58.5]

For each listed statute, executive order or regulation, record the determinations made. Note reviews and consultations completed as well as any applicable permits or approvals obtained. Attach evidence that all required actions have been taken. Record any conditions or mitigation measures required. Then, make a determination of compliance or consistency.

Factors	Determinations and Compliance Documentation
Historic Preservation [36 CFR 800]	"...The Shoalwater Bay Heritage department recommends that a good faith effort be made to transplant the three species of plants mentioned above (Red Elder Berry, Thimble berry and Salmon Berry). These three species are not as common as other on the reservation and their preservation is of cultural importance. It is also recommended that the trees to be felled during the project be utilized in a culturally sensitive manner, (i.e. firewood for tribal people, carving materials etc...) It is the determination of the Heritage Department that the shell layer (discovered on the unstable hillside to be regarded) is that of a natural occurrence as opposed to human in nature. No evidence of human contributions could found within the shell layer. The SBIT Heritage department recommends that work proceed as proposed. In the event of any inadvertent discoveries the SBIT Heritage Department should be notified immediately and all work shall cease..." (Davis, 2010). These findings indicate that there is a low likelihood of potential disturbance of culturally/historically sensitive materials. The Washington State DAHP office concurred with the findings of the Shoalwater Bay Indian Tribe Heritage/Cultural Department. See attached documentation in Appendix A
Floodplain Management [24 CFR 55, Executive Order 11988]	The proposed road widening activities near the intersection of Eagle Hill Road and SR 105 would involve work within the FEMA designated 100 year flood plain and the filling of a small area of wetlands on the east and west sides of Eagle Hill Road (totaling approx. 2450ft^2) to accommodate the expanded road surface/right of way. This finding is based on the FEMA Flood Insurance Rate Map Community Panel Number 5301260016B dated September 27, 1985. The BFE on the site is approximately 11 feet above mean sea level. Four alternative properties were evaluated, and it was determined that the currently proposed location represents the best location based on site access, current land ownership, proximity to the Shoalwater Bay Tribal Community, access to utilities and overall development potential. The project design will attempt to minimize potential impacts to flood plain values. A 15-day comment period was allowed and published in the Willapa Harbor Herald and the South Beach Bulletin. Once a determination of No Practicable Alternative was reached, an additional 7-day comment period began, and an announcement was published in the Willapa Harbor Herald and South Beach Bulletin. One comment was received during the public/agency notice periods from the Washington Department of Transportation. Refer to the Flood Plain Map Attachment 1, and the Floodplain and Wetland Determination in Appendix B.
Wetlands Protection [Executive Order 11990]	The proposed project would involve direct impacts to approximately 0.07 acres areas of wetlands. In accordance with the EO, a 15-day comment period was allowed and advertised in the Willapa Harbor Herald and the South Beach Bulletin. Once a determination of No Practicable Alternative was reached, an additional 7-day comment period began, and an announcement published in the Willapa Harbor Herald and South Beach Bulletin. One comment was received during the public/agency notice periods from the Washington Department of Transportation. Refer to the Floodplain and Wetland Determination in Appendix B.
Coastal Zone Management Act [Sections 307(c),(d)]	The Subject Property is located on tribal lands owned by the Shoalwater Bay Indian Tribe. Coastal Zone Management laws do not apply on tribal lands. Source: 15 CFR Part 930

Sole Source Aquifers [40 CFR 149]	The aquifer underlying this property is not in a critical aquifer protection area according to the National Summary of Sole Source Aquifer Designation as determined by the U.S. EPA. Source: http://cfpub.epa.gov/safewater/sourcewater/sourcewater.cfm?action=SSA. For map see Attachment 2
Endangered Species Act [50 CFR 402]	Under contract with the Shoalwater Bay Indian Tribe, Forest & Channel Metrics, of Olympia, WA, performed a Biological Assessment of the project area. USFWS and NMFS were consulted early on in the project. A biologist representative from USFWS, Ken Livezy, attended a project meeting and site walk-through in May 2011, and provided concurrence with the no effect determination. Primary impacts resulting from the proposed project are associated with the clearing and removal of vegetation and soils and elevated noise levels related to the operation of heavy equipment. Minor impacts to aquatic species as a result of short term alterations in water quality, while not anticipated, may occur within the project action area following the onset of fall precipitation, as residual construction related sediment is washed off site. Forest & Channel Metrics has concluded that the project is not likely to adversely affect threatened or endangered species including the Bull Trout, Marbled Murrelet, Northern Spotted Owl, and the North American Green Sturgeon. The project is also anticipated to have no effect on the protected Bald Eagle species (Forest & Channel Metrics, 2011). Based on their review of the work performed by Forest & Channel Metrics, the Shoalwater Bay Tribal Department of Natural Resources has made a no effect determination for listed species and/or designated critical habitat from the proposed action. More details are discussed in Appendix C. Source: (Forest & Channel Metrics, 2011)(Burns, 2011)
Wild and Scenic Rivers Act [Sections 7 (b), (c)]	The Subject Property is not located within one mile of any National Park Service designated Wild and Scenic Rivers. (Source: http://www.rivers.gov/wildriverslist.html#wa)
Air Quality [Clean Air Act, Sections 176 (c) and (d), and 40 CFR 6, 51, 93]	The State of Washington does not currently have any non-attainment areas (counties). Short term air quality impacts that may be expected to result from this project are related to construction activities. Typical dust control measures will be implemented during the construction phases of the project. Source: (EPA .http://www.epa.gov/air/data/geosel.html)
Farmland Protection Policy Act [7 CFR 658]	The Subject Property is located in a commercially zoned area of the Shoalwater Bay Indian Reservation. The Subject Property does not include prime or unique farmland defined by the U.S. Department of Agriculture.
Environmental Justice [Executive Order 12898]	Environmental impacts associated with the development of the proposed site are related to unlikely non-commercial species impacts, runoff, and wetland and floodplain issues discussed elsewhere in this assessment. Once construction is complete, and assuming the facility is operated in accordance with relevant best management practices and regulations, there will be little detrimental environmental impact. The Subject Property is currently undeveloped, with the exception of Eagle Hill Road, and no area residents will be displaced during or following the construction required for the project. The property is bound to the east, west and north by forested areas on the Shoalwater Reservation and to the south by State Route 105 with dune and tide land areas of Willapa Bay beyond. The project will benefit local residents and guests to the area by provided needed improvements to a local tsunami evacuation route/assembly area; therefore, the project does not pose an Environmental Justice concern.

HUD Environmental Standards	Determinations and Compliance Documentation
Noise Abatement and Control [24 CFR 51 B]	Current pre-project ambient noise levels are low, and consist primarily of limited light vehicle traffic on Eagle Hill Road as well as noise generated from light vehicle and log truck traffic from nearby SR105, which lies within 500 feet of the proposed project site; background noise levels generated by the highway are estimated at between 60 and 65dB. During the preliminary phases of the proposed project some short term, periodic noise associated with the use of chainsaws will occur during the removal of the trees. In addition, short term noise (within the range of 1-2 hours, total duration) associated with the operation of diesel engines is anticipated while the trees are yarded onto the existing roadway for loading and transport. On or after June 15, 2012, stabilization of the slide area, including the excavation and removal of soils and re-grading the project site will begin. An estimated 72,432 cubic yards of soil will be removed from the project site during the course of this project and recycled off-site. The total area directly impacted during the excavation, removal, and re-grading activities is estimated at approximately 1.09 acre (47,480 feet^2). Equipment used during this portion of the project includes excavators, bulldozers and dump trucks, in addition to periodic use of a street sweeper to maintain State Route 105 in the vicinity of its junction with Eagle Hill Road. It is expected that noise levels generated by heavy equipment and chainsaws used during this phase of the project will fall within the range of 80-90dB. (Forest & Channel Metrics, 2011)
Toxic or Hazardous Substances and Radioactive Materials [HUD Notice 79-33] , 24 CFR 58.5(i)(2)	The Subject Property was inspected using typical criteria used for Phase I Environmental Site Assessments (EPA AAI & ASTM 1527-05). No potential toxic, hazardous or radioactive substances or materials were identified in the immediate area that may potentially impact the project area. Based on the site inspection, historical information and the environmental records review associated with the Phase I ESA report, no recognized environmental conditions (RECs) were found in association with the Subject Property or properties within the required search radius. Source: (ADESA, 2011) The future construction phases of the project will involve portable fuel tanks and heavy equipment use, and the completed multipurpose building will operate an above ground diesel fuel tank to operate an emergency generator. The above ground storage tank (AST) system will be constructed and operated in accordance with all relevant best management practices and State/ Federal regulations, providing all of the leak and vapor protections afforded under those standards.
Siting of HUD-Assisted Projects near Hazardous, Explosive or Flammable Operations [24 CFR 51 C], 24 CFR 58.5(i)(2)	The Subject Property was inspected using typical criteria used for Phase I Environmental Site Assessments (ASTM 1527-05). No hazardous operations were identified within the search radius. The Shoalwater Bay Casino currently utilizes one 3,000-gallon aboveground storage tank (AST) that holds diesel fuel used to power a backup generator. The proposed project is located beyond the acceptable separation distance calculated for the tank of 437ft. Other UST/ASTs in the area are utilized exclusively for residential purposes and/or are tanks not regulated by the Washington State Department of Ecology or the US EPA, and are ancillary to the operation of buildings; therefore based on HUD's stated policy, the regulation does not apply. Source: (ADESA, 2011)
Airport Clear Zones and Accident Potential Zones [24 CFR 51 D]	The Subject Property does not lie within an FAA designated airport Runway Clear Zone (RCZ) or Accident Potential Zone (APZ). Source: (http://www.hud.gov/local/shared/working/r10/environment/airports.pdf)

Environmental Assessment Checklist

[Environmental Review Guide HUD CPD 782, 24 CFR 58.40; Ref. 40 CFR 1508.8 &1508.27]
Evaluate the significance of the effects of the proposal on the character, features and resources of the project area. Enter relevant base data and verifiable source documentation to support the finding. Then enter the appropriate impact code from the following list to make a finding of impact. **Impact Codes**: **(1)** - No impact anticipated; **(2)** - Potentially beneficial; **(3)** - Potentially adverse; **(4)** - Requires mitigation; **(5)** - Requires project modification. Note names, dates of contact, telephone numbers and page references. Attach additional materials as needed.

Land Development	Code	Source or Documentation
Conformance with Comprehensive Plans and Zoning	1	The project is located within a commercially zoned area of the Shoalwater Bay Indian Reservation. The proposed activities conform to Tribal land use guidelines for Reservation trust properties. Source: (Chadwick, 2011)
Compatibility and Urban Impact	2	The proposed activities include widening the Shoalwater Bay Tribe's existing tsunami evacuation route (Eagle Hill Road), the stabilization of a hillside threatening the Tribal water supply, and the development of a multipurpose building of the stabilized slope. The proposed site is located on the Shoalwater Bay Tribes existing tsunami evacuation route and the building site located above the anticipated height of potential tsunami events. The Shoalwater Bay Tribal Council has achieved consensus on the proposed work on the Eagle Hill Road site. Source: (Chadwick, 2011)
Slope	2	The project area contains areas of 30-65 percent slopes. Slopes in on the Shoalwater Reservation north of SR 105, have a history of instability including the area of Eagle Hill Road and the proposed Multipurpose Building site (Shoalwater, 2008). The most recent slides on Eagle Hill Road have occurred in January/February and September of 2011. One of the components of the proposed project involves stabilizing a 350ft slide area/unstable hill-slope north of Eagle Hill Road by removing an estimated 72,432 cubic yards of overburden material and re-grading the immediate area to the approximate elevation of the existing road (~55ft AMSL). Prior to initiating construction, a stormwater runoff control plan will be reviewed and approved by the Shoalwater Bay Tribe's Natural Resources Department or the approved contractor to prevent impacts to Willapa Bay. Source: (Chadwick, 2011) Also see Attachment 3 Topographic Map, and Appendix E Geotechnical Report.
Erosion	2	The geotechnical report for the project site, performed by E3RA of Tacoma, WA, recommends completing the earthwork portion of the project during the dry season and installing an erosion control system of berms and drainage ditches around all construction areas. (E3RA, 2010) Following the construction phases, assuming appropriate stormwater and runoff control measures are taken, the project are will not significantly contribute to the erosion of soils in the vicinity. The geotechnical report for the Subject Property is attached as Appendix E of this document.
Soil Suitability	2	According to the USDA Soil Survey of Pacific County According to the NRCS soil survey for Pacific County, the dominant soil types on the Subject Property are the Ocosta silty clay loam (104) and the Newskah loam, 30-65% slopes (96) (USDA, 1986). The geotechnical investigation performed on the project site suggests that while surface soils are unsuitable for construction or reuse in many areas of the property, test pits exhibited that underlying soil suitable for the project needs are present. The report further provides recommendations for the areas where specific project tasks are to occur (E3RA, 2010). See attached Appendix E Geotechnical Report for additional information.
Hazards and Nuisances including Site Safety	2	Slope stability and erosion hazards will be present during the slope stabilization and road modification, particularly in the early phases. These issues are discussed further above and in the geotechnical report (E3RA, 2010) and in the Tribal Hazard Mitigation Plan (Shoalwater, 2008). For construction hazard and safety impacts and mitigation, the selected

		Contractors' construction Site Safety Plan will be implemented. The above ground diesel storage tank system will be installed and operated using best management practices for dealing with hazards and safety issues. Source: (Chadwick, 2011)
Energy Consumption	1	The Shoalwater Bay Tribe designs and builds all HUD funded community and commercial structures per the requirements of HUD regulations (24 CFR 1000). Source: (Chadwick, 2011)
Noise - Contribution to Community Noise Levels	1	Construction activities will be conducted during general business hours. After construction phases are complete, there will be little noise contribution above the noise currently experienced in the project area, estimated 60 and 65dB, which includes light vehicle traffic on Eagle Hill Road as well as noise generated from light vehicle and log truck traffic from nearby SR105. The Multipurpose Building will not serve as housing and will generally operate only during normal business hours. Source: (Chadwick, 2011)
Air Quality Effects of Ambient Air Quality on Project and Contribution to Community Pollution Levels	1	Short term air quality impacts related to phased construction of the proposed project will be mitigated by controlling dust using standard methods. The Subject Property is not currently in a non-attainment area. Once the proposed project is complete it will have little effect on local air quality. Source: (Chadwick, 2011)
Environmental Design Visual Quality - Coherence, Diversity, Compatible Use and Scale	1	The Shoalwater Bay Tribe anticipates the design of the building and infrastructures will reflect the heritage and tradition of the Shoalwater Bay Indian Tribe. The building will be designed to enhance the visual aesthetic to the highest degree practical/possible. Source: (Chadwick, 2011)

Socioeconomic	**Code**	**Source or Documentation**
Demographic Character Changes	1	The demographic character of the community is not anticipated to be impacted by the currently proposed project. Source: (Chadwick, 2011)
Displacement	2	Access to the single residential property located off Eagle Road will be maintained during construction activities. The remainder of the Tribal property off Eagle Hill Road is undeveloped forest and timber land. No displacement of individuals or businesses is anticipated as a result of this project. Stabilizing the hill side on Eagle Road will actually prevent the possibility of displacement of the occupants of the residential property by reducing the risk of landslides and erosion from the unstable slopes. Source: (Chadwick, 2011)
Employment and Income Patterns	1	The implementation of this construction proposal will result in short term employment during the construction phases, but will have little or no impact on long term employment patterns in the area. Source: (Chadwick, 2011)

Community Facilities and Services	**Code**	**Source or Documentation**
Educational Facilities	1	Construction of this facility will not impact current educational facilities directly. Source: (Chadwick, 2011)
Commercial Facilities	1	Construction of this facility will not impact current commercial facilities directly. Source: (Chadwick, 2011)
Health Care	1	The proposed project will not have an impact of in-place health services provided by the Shoalwater Bay Indian Tribe through its Wellness Center. Source: (Chadwick, 2011)
Social Services	2	The proposed project will enhance the Shoalwater Bay Tribe's existing tsunami evacuation route making is more suitable for its prescribed task through resurfacing, stabilization and widening to allow multidirectional

		traffic. Additionally, the multipurpose building will be available for various tribal activities and will be equipped with an above ground diesel fuel tank and emergency generator. Source: (Chadwick, 2011)
Solid Waste	1	Solid Waste disposal for the Shoalwater Bay Tribe is contracted to LeMay Enterprises and will not be altered or stressed significantly by the proposed project. Source: (Chadwick, 2011)
Waste Water	4	The waste water system for the proposed multipurpose building will be an onsite septic system that will be designed in accordance with relevant regulations to protect local surface water and groundwater. Source: (Chadwick, 2011)
Storm Water	4	The project specifications will call for the contractor to follow standard erosion control practices during construction. A construction stormwater pollution prevention plan (SWPP) will be provided by a licensed civil engineer. During the construction phases, a Washington State CESCL will be used to assess stormwater controls and monitor runoff. None of the areas affected by this project are currently paved. If necessary, a NPDES NOI will be filed for the project. The project will adhere to the best management practices found in The Stormwater Management Manual for Western Washington. The completed project, including the finished multi-purpose building and associated parking area will result in the addition of approximately 6,400 feet^2 of impervious surface. Source: (Chadwick, 2011), Estimates of impervious surface based on the Red Plains Professionals preliminary site plan presented as Attachment 5.
Water Supply	2	The capacity of the existing Shoalwater Bay Tribal water service will be adequate to accommodate the additional use required by the operation of the multipurpose building. The proposed project will protect the existing water system by stabilizing the unstable hill side on Eagle Hill Road that is currently threatening the water supply infrastructure. Source: (Chadwick, 2011)
Public Safety Police	2	The Tribal Police Department handles most criminal or safety response calls. In the event that an emergency tsunami evacuation of the Shoalwater community is necessary, the improvements to Eagle Hill Road will greatly ease local emergency responders in coordinating evacuees at the assembly point on Eagle Hill Road. Source: (Chadwick, 2011)
Fire	2	Pacific County Fire District #5 is the first responder to emergency health and fire related incidents on the Shoalwater Bay Indian Reservation. In the event that an emergency tsunami evacuation of the Shoalwater community is necessary, the improvements to Eagle Hill Road will greatly ease local emergency responders in coordinating evacuees at the assembly point on Eagle Hill Road. Source: (Chadwick, 2011)
Emergency Medical	1	The Shoalwater Bay Wellness Center and the Pacific County Fire Protection District will provide emergency medical care to the proposed facility. In the event that an emergency tsunami evacuation of the Shoalwater community is necessary, the improvements to Eagle Hill Road will greatly ease local emergency responders in coordinating evacuees at the assembly point on Eagle Hill Road. Source: (Chadwick, 2011)
Open Space & Recreation Open Space	1	The proposed use of the site will not significantly reduce open space or recreation in the project area. Approximately 1.09 acres of uplands will be disturbed during the construction phases of this project. Following and concurrent to the construction disturbed areas not slated for development will be replanted. Source: (Chadwick, 2011)
Recreation	1	The tribal gymnasium, the Shoalwater Bay Casino, hiking, fishing, and historic sites will not be negatively impacted by the proposed construction. The proposed project will not impact existing recreational activities in the

		region. Source: (Chadwick, 2011)
Cultural Facilities	2	The proposed project will not negatively impact or negate the use of the cultural facilities or any other local attractions or activities. One of the functions of the proposed Multipurpose Building will be to provide a space various cultural activities. Source: (Chadwick, 2011)
Transportation	2	Pacific Harbor Transit and personal vehicles are the primary modes of transportation for residents and visitors. The proposed project will not negatively impact the operation of the bus line or private vehicles in the area. Source: (Chadwick, 2011)

Natural Features	Code	Source or Documentation
Water Resources	4	The stormwater control capture, storage and treatment technologies will be based on best management practices in the design phase of the project. The design will capture, treat, and release stormwater and waste water resulting from the operation of the site. When operated and maintained in compliance, the proposed project will pose little threat to nearby water resources. Source: (Chadwick, 2011) (Forest & Channel Metrics, 2011)
Surface Water	4	The stormwater control capture, storage and treatment technologies will be based on best management practices in the design phase of the project. The design will capture, treat, and release stormwater and waste water resulting from the operation of the site in compliance with current regulations. When operated and maintained in compliance, the proposed project will pose little threat to nearby surface water resources. Source: (Chadwick, 2011) (Forest & Channel Metrics, 2011)
Unique Natural Features and Agricultural Lands	1	Based on the site inspection, interviews with Shoalwater Tribal representatives (Chadwick, 2011) and the findings of the biological assessment (Forest & Channel Metrics, 2011), there are no unique natural features or agricultural lands within the project area or in the immediate surrounding area.
Vegetation and Wildlife	1	The Biological Assessment performed by Forest & Channel Metrics has found no or unlikely affects are anticipated to sensitive, threatened and/or endangered species and habitats as a result of the construction and operation of the Eagle Hill Tsunami Evacuation Route and Multipurpose Building. Source (Forest & Channel Metrics, 2011)

NOTE: The Responsible Entity must additionally document and ensure compliance with 24 CFR §58.6 in the ERR, particularly with the Flood Insurance requirements of the Flood Disaster Protection Act and the Buyer Disclosure requirements of the HUD Airport Runway Clear Zone/Clear Zone regulation at 24 CFR 51 Subpart D.

Summary of Findings and Conclusions

The Shoalwater Bay Tribe proposes to make improvements to their existing tsunami evacuation route and assembly area and construct a Mulitpurpose Building, both requiring the stabilization of hazardous slopes along Eagle Hill Road. The Subject Property is within the geographic boundaries of the Shoalwater Bay Indian Reservation. It is located northwest of Tokeland, Washington at the intersection of State Route 105 and Eagle Hill Road. The proposed Multipurpose Building site is forested undeveloped land and Eagle Hill Road is a single lane, unpaved tsunami evacuation route that also serves as access to the commercial forest north of the project site and a single residential dwelling to the northwest.

ALTERNATIVES TO THE PROPOSED ACTION

Alternatives and Project Modifications Considered [24 CFR 58.40(e), Ref. 40 CFR 1508.9] (Identify other reasonable courses of action that were considered and not selected, such as other sites, design modifications, or other uses of the subject site. Describe the benefits and adverse impacts to the human environment of each alternative and the reasons for rejecting it.)

The Shoalwater Bay Indian Tribe considered alternative actions and four alternative sites (including the currently proposed site) and actions site alternatives were evaluated. The currently proposed site was selected due to its fulfillment of the evaluation criteria. The criteria utilized by the Shoalwater Bay Indian Tribe for selecting the project site included:

- Access to the site
- Current land ownership
- Proximity to the Shoalwater Bay Tribal Community
- Access to utilities
- Development potential

Site 1: This site is located on Eagle Hill Road, the current designated tsunami evacuation route for the Tribe, within the current Shoalwater Indian Tribal Reservation. It was eliminated due to engineering and geotechnical concerns that the proposed building pad for the multipurpose building and the proposed two lane tsunami evacuation route widening could not be accommodated at a reasonable expense. Simply inadequate area exits on the ridge line. This site would also require the extension of the road and utility work required to support the tsunami route upgrades and the multipurpose building.
Site 2: This site is located on Eagle Hill Road, the current designated tsunami evacuation route for the Tribe, within the current Shoalwater Indian Tribal Reservation. It was eliminated due to the extensive excavation that would be required to accommodate the building pad for the multipurpose building and the lack of water lines in that portion of Eagle Hill Road, which would require additional investment in the utility infrastructure.
Site 3: This site is located on the eastern Shoalwater Tribal Reservation boundary off of an unpaved logging access road running through Teal Duck Slough. The site was eliminated due to the expense of establishing the necessary water and power utilities to the remote area, and the extensive impacts to the wetlands and the floodplain of Teal Duck Slough that the widening of the small access road would require.
Site 4: The proposed building site for Multipurpose Building that was selected during the evaluation possesses the required utility infrastructure and only requires site clearing and grading. See Appendix B for additional information about the alternatives examined.

Portions of the four alternative sites evaluated would require floodplain/wetland impacts resulting from the road widening necessary to upgrade and widen the unpaved roads leading to areas of higher elevation on the Shoalwater Bay Indian Reservation required for a tsunami evacuation route. The four sites are depicted and labeled on the aerial photograph presented in Appendix B. The site selected for the project minimizes impacts to the floodplain; however, given the surface water and wetland characteristics of the vicinity, all access routes on the Shoalwater Bay Tribal Reservation that lead to areas of sufficient tsunami evacuation elevation would require some impact to the floodplain.

The proposed multipurpose building, slope stabilization and tsunami route modification project is being undertaken as a *design build project*, and the plans are currently conceptual. Appendix E contains a report describing the site alternative selection process. See Attachment 5 for a preliminary site plan completed by engineering firm, Red Plains Professionals of Vancouver, WA.

No Action Alternative [24 CFR 58.40(e)]
(Discuss the benefits and adverse impacts to the human environment of not implementing the preferred alternative).

Not moving forward with the currently proposed tsunami evacuation route widening and development may place the Shoalwater Tribal Community in jeopardy during any future tsunami events. Eagle Hill Road is the current tsunami evacuation route; however the road is an unpaved, single lane road with no potential parking and no opportunity for two-way traffic, making it very difficult to provide for an effective evacuation (Shoalwater, 2008).
A water tower located further up Eagle Hill Road that provides water to the Tribal Community. Not moving forward with the road and slope enhancements on Eagle Hill Road would place the water supply in danger due to the unstable slopes located in the area of the proposed multipurpose building and slope stabilization portions of the project.

Mitigation Measures Recommended [24 CFR 58.40(d), 40 CFR 1508.20]
(Recommend feasible ways in which the proposal or external factors relating to the proposal should be modified in order to eliminate or minimize adverse environmental impacts.)

- Complete the necessary USACE Section 404 Clean Water Act permitting process to establish appropriate mitigation measures for impacts to the wetland areas adjacent to the intersection of SR 105 and Eagle Hill Road, and impacts to the wetland buffers in the area of the proposed hillside stabilization and multipurpose building.
- The storm water control technology employed on the multipurpose building site will be based on best management practices and applicable regulations, and designed to prevent continuing impacts to the wetlands. It will be selected during the design phase of this design-build project. Stormwater and runoff will be treated onsite and allowed to infiltrate into the groundwater.
- A mitigation plan is in place should anything of cultural significance be discovered during said construction. See Appendix A
    a. Should anything of potential cultural/historic significance be discovered all work is to stop immediately and the area be left undisturbed.
    b. The SBIT Heritage/Culture Dept. is to be notified as soon as possible and called upon to investigate the findings. Earl Davis, Heritage/Culture Director is the appropriate contact and can be reached at (360) 267-0731 or (360) 580-6274. A determination will then be made by the SBIT Heritage/Culture Dept. as to the nature/significance of human materials/artifacts discovered during the course of the proposed work and a decision of further action will be made.
    c. If, during the course of the proposed work, materials are discovered that are of a nature where it is both culturally and/or physically possible to relocate them they will be moved and preserved so that work may continue.
    d. If materials are discovered that are of a nature where it is both culturally and/or physically not possible to relocate them, the Heritage/Culture Dept. will make a motion to stop work entirely and discuss with the Shoalwater Bay Indian Tribe all other options.

Attachments and Appendices
Attachment 1: FEMA FRIM Community Panel Number 530126 0016B
Attachment 2: Sole Source Aquifers Map
Attachment 3: 1995 USGS Topographic Map
Attachment 4: Aerial Photograph of Proposed Project Site
Attachment 5: Preliminary Site Plan

Appendix A: THPO Letter and Historic Determination
Appendix B: Floodplain and Wetland Determination
Appendix C: Biological Assessment (BA)
Appendix D: Phase I Environmental Site Assessment
Appendix E: Geotechnical Report

References

ADESA. "Phase I Environmental Site Assessment: Eagle Hill Road: A Portion of Pacific County Tax Parcel #14110317000" October 20, 2011.

Burns, Gary. Director of the Shoalwater Department of Natural Resources. "No Effect Determination". 2011.

Chadwick, Pete. Project Coordinator, Shoalwater Bay Indian Tribe. Various email and telephone interviews March 2010-October 2011.

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E3RA. "Geotechnical Engineering Report Eagle Hill Road Improvements and Landslide Mitigation Tokeland, Washington" prepared for Red Plains Professionals under contract with the Shoalwater Bay Indian Tribe. August 5, 2010.

Forest & Channel Metrics. "Eagle Hill Road Slope Stabilization, Road-Widening and Multi-purpose Building Construction Project: Biological Assessment for listed and proposed species and designated critical habitat as protected under the Endangered Species Act, Section 7" prepared for the Shoalwater Bay Indian Tribe. October 2011.

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Shoalwater Bay Tribal Enrollment Clerk, "Shoalwater Bay BIA Report 2005". Updated 2011

US Army Corps of Engineers, Seattle District. DRAFT Report. "Final Environmental Assessment: Shoalwater Bay Shoreline Erosion Project Pacific County, WA. Shoalwater Bay Indian Reservation Flood and Coastal Storm Damage Reduction" April 2009.

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List of Sources, Agencies and Persons Consulted Not Otherwise Identified in the Checklist Above

[40 CFR 1508.9(b)]

See additional investigations included as Appendices to this report for additional references consulted.

E3RA

Geotechnical Engineering Report

Multi Purpose Building
Eagle Hill Road
Tokeland, Washington

Submitted to:

Shoalwater Bay Indian Tribe
Attention: Jon Erickson
PO Box 130
Tokeland, Washington 98590

Submitted by:

E3RA, Inc.
PO Box 44840
Tacoma, Washington 98448

October 24, 2013

Project No. T10065f

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PO Box 44840
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E3RA

October 24, 2013
T10065f

Shoalwater Bay Indian Tribe
P.O. Box 130
Tokeland, Washington 98590

Attention Jon Erickson, Project Coordinator

Subject: **Geotechnical Engineering Report**
Multi Purpose Building
Eagle Hill Road
Tokeland, Washington

Dear Mr. Erickson:

E3RA is pleased to submit this report describing the results of our geotechnical engineering evaluation for the new Multi Purpose Building that is planned for Eagle Hill Road on Shoalwater Bay Tribal Lands in Tokeland, Washington. E3RA prepared a Geotechnical Report, dated July 27, 2010, for improvement of Eagle Hill Road and stabilization of site slopes.

This report has been prepared for the exclusive use of the Shoalwater Bay Indian Tribe, and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice.

1.0 SITE AND PROJECT DESCRIPTION

The site was once an unstable hill. The upper part of the hill was recently removed and slopes modified to a stable configuration. As part of the stabilization process, the site was reduced in elevation by as much as 40 feet. The project site location is depicted on the attached Topographic and Location Map (Figure 1).

Plans call for the construction of a new, two-story multi purpose building, with a footprint measuring about 40 by 80 feet, on the site. The building will have a slab floor. We understand that the building will be built at least 20 feet from nearby slopes. Much of the remaining, relatively level part of the site will be paved for vehicle access and parking.

2.0 EXPLORATORY METHODS

We explored surface and subsurface conditions at the project site on October 16, 2013. Our exploration program comprised the following elements:

- A surface reconnaissance of the site;
- Four test pits (designated TP-1 through TP-4), advanced on site; and
- A review of published geologic and seismologic maps and literature.

Table 1 summarizes the approximate functional locations and termination depths of our subsurface explorations, and Figure 2 depicts their approximate relative locations. The following sections describe the procedures used for excavation of test pits.

TABLE 1
APPROXIMATE LOCATIONS AND DEPTHS OF EXPLORATIONS

Exploration	Functional Location	Termination Depth (feet)
TP-1	Near southeast corner planned building	3
TP-2	Near northeast corner planned building	4
TP-3	Near northwest corner planned building	5
TP-4	Near southwest corner planned building	4
Elevation datum: Unavailable		

The specific number and locations of our explorations were selected in relation to the existing site features, under the constraints of surface access, underground utility conflicts, and budget considerations. We estimated the relative location of each exploration. Consequently, the data listed in Table 1 and the locations depicted on Figure 2 should be considered accurate only to the degree permitted by our data sources and implied by our measuring methods.

It should be realized that the explorations performed and utilized for this evaluation reveal subsurface conditions only at discrete locations across the project site and that actual conditions in other areas could vary. Furthermore, the nature and extent of any such variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed at that time, we may need to modify our conclusions and recommendations contained in this report to reflect the actual site conditions.

2.1 Test Pit Procedures

Our exploratory test pits were excavated with a rubber-tired backhoe owned and operated by the client. An engineering geologist from our firm observed the test pit excavations and logged the subsurface conditions.

The enclosed Test Pit Logs indicate the vertical sequence of soils and materials encountered in each test pit, based on our field classifications. Where a soil contact was observed to be gradational or undulating, our logs indicate the average contact depth. We estimated the relative density and consistency of the in-situ soils by means of the excavation characteristics and the stability of the test pit sidewalls. Our logs also indicate the approximate depths of any sidewall caving or groundwater seepage observed in the test pits and the depths at which samples were collected.

3.0 SITE CONDITIONS

The following sections present our observations, measurements, findings, and interpretations regarding, surface, soil, groundwater, seismic, and liquefaction conditions.

3.1 Surface Conditions

The site is comprised of a relatively level to gently sloping building area that measures a quarter to a third of an acre. Sloped terrain surrounds the building area. Generally, slopes adjacent to the building area to the north and east have not been modified. Slopes adjacent to the north reach a maximum of about 70 to 75 percent over

an elevation change of 20 feet or so, while adjacent slopes to the east average 50 percent or less over an elevation change of 5 to 20 feet. Slopes to the south rise 10 feet or so and have been recently graded down to about 2H:1V. Slopes to the west descend west to Eagle Hill Road and have been recently graded down to an average of about 2H:1V over an elevation change of about 20 feet.

Recently graded slopes have been covered with coconut matting. Unmodified slopes, which have had vegetation removed, but not stripped of duff and topsoil, have not been covered with matting.

Quarry spalls line a drainage ditch that is located at the toe of the graded slope on the west part of the site, where the slope toe meets Eagle Hill Road.

No vegetation grows on the site, which has been recently modified by grading.

No springs or seeps were observed in the building area. Groundwater slowly seeps into the drainage ditch from the toe of the modified slope on the west part of the site, where it meets Eagle Hill Road.

3.2 Soil Conditions

Our onsite explorations revealed that soil on the area to be developed consists of dense silty sand over which a cap of fill, derived from the site during prior grading activities, has been placed. The fill, which also consists of silty sand, has been compacted to a loose to medium dense condition and measures 1½ to 3 feet thick on the east part of the footprint of the planned building and 3½ to 4 feet thick on the west part of the footprint of the planned building.

E3RA was on site during some of the previous grading activities. At that time, a layer of hard silt was observed at the toe of the slope to the west, and likely extends under the site. The elevation of the top of the silt layer was observed to be about 15 feet lower in elevation than the current elevation of the building site.

3.3 Groundwater Conditions

At the time of our site reconnaissance and subsurface explorations (October 16, 2013), we observed very slow seepage at the toe of the graded slope west of the building area, where it meets Eagle Hill Road. It is likely that the seepage is due to groundwater that is perched on the silt layer described above.

3.4 Seismic Conditions

Based on our analysis of subsurface exploration logs and our review of published geologic maps, we interpret the onsite soil conditions to generally correspond with site class D, as defined by Table 1613.5.2 of the 2012 *International Building Code (IBC)*.

Using 2012 IBC information on the USGS Design Summary Report website, Risk Category I/II/III seismic parameters for the site are as follows:

$S_s = 1.423$ g	$S_{\mu s} = 1.423$ g	$S_{DS} = 0.949$ g
$S_1 = 0.713$ g	$S_{\mu 1} = 1.070$ g	$S_{D1} = 0.713$ g

Using the 2012 IBC information, MCE_R Response Spectrum Graph on the USGS Design Summary Report website, Risk Category I/II/III, S_a at a period of 0.2 seconds is 1.42 g and S_a at a period of 1.0 seconds is 1.08g.

The Design Response Spectrum Graph from the same website, using the same IBC information and Risk Category, S_a at a period of 0.2 seconds is 0.95 g and S_a at a period of 1.0 seconds is 0.72 g.

3.5 Liquefaction Potential

Liquefaction is a sudden increase in pore water pressure and a sudden loss of soil shear strength caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose sand with fines (silt and clay) content less than about 20 percent are most susceptible to liquefaction. Our explorations did not encounter any easily liquefiable soils underlying the project site.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Plans call for the construction of a new, two-story multi purpose building with a slab floor and associated pavement on the site.

- Feasibility: Based on our field explorations, research, and analyses, the proposed development appears feasible from a geotechnical standpoint.

  Foundation Options: We recommend spread footings that are based on dense, undisturbed, in situ soil native soils, which are found 1½ to 4 feet below existing site grades, or on structural fill bearing pads that extend down to dense native soils. Specific recommendations for spread footings and bearing pads are provided in Section 4.

- Floor Options: Because surficial fill soils can be somewhat loose, we recommend a 1 foot thick floor subbase for concrete slab floors for the planned building, provided that, after the subbase subgrade has been exposed, it can be surface compacted to firm, non-yielding condition. If subbase subgrades cannot be compacted to a firm, non-yielding condition, we recommend that the floor subbase be 2 feet thick. Recommendations for slab on grade floors are presented in Section 4.

- Pavement Sections: We recommend a pavement section comprised of asphalt concrete over a crushed rock base course. All pavement subgrades should be proof-rolled prior to pavement construction, and soft, yielding areas removed to a minimum depth of 12 inches and replaced with properly compacted structural fill. Recommendations for structural fill are presented in Section 4.

The following sections present our specific geotechnical conclusions and recommendations concerning site preparation, spread footings, slab-on-grade floors, drainage, asphalt pavement and structural fill. The Washington State Department of Transportation (WSDOT) Standard Specifications and Standard Plans cited herein refer to WSDOT publications M41-10, *Standard Specifications for Road, Bridge, and Municipal Construction*, and M21-01, *Standard Plans for Road, Bridge, and Municipal Construction*, respectively.

4.1 Site Preparation

Preparation of the project site should involve erosion control, temporary drainage, cutting, filling, excavations, and subgrade compaction.

Erosion Control: Before new construction begins, an appropriate erosion control system should be installed. This system should collect and filter all surface water runoff through silt fencing. We anticipate a system of berms and drainage ditches around construction areas will provide an adequate collection system. Silt fencing fabric should meet the requirements of WSDOT Standard Specification 9-33.2 Table 3. In addition, silt

fencing should embed a minimum of 6 inches below existing grade. An erosion control system requires occasional observation and maintenance. Specifically, holes in the filter and areas where the filter has shifted above ground surface should be replaced or repaired as soon as they are identified.

Temporary Drainage: We recommend intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding drainage systems are best made in the field at the time of construction. Based on our current understanding of the construction plans, surface and subsurface conditions, we anticipate that curbs, berms, or ditches placed around the work areas will adequately intercept surface water runoff.

Site Excavations: Based on our explorations and previous site work, we expect that conventional earthwork machinery will adequately excavate site soils.

Dewatering: We do not anticipate that site excavations will encounter groundwater. However, if groundwater is encountered, we anticipate that an internal system of ditches, sumpholes, and pumps will likely be adequate to temporarily dewater excavations.

Temporary Cut Slopes: All temporary soil slopes associated with site cutting or excavations should be adequately inclined to prevent sloughing and collapse. Temporary cut slopes in the soils observed on site should be no steeper than 1½H:1V, (horizontal to vertical) and should conform to Washington Industrial Health and Safety Act (WISHA) regulations.

Subgrade Compaction: Exposed subgrades for footings and floors should be compacted to a firm, unyielding state before new concrete or fill soils are placed. Any localized zones of looser granular soils observed within a subgrade should be compacted to a density commensurate with the surrounding soils. In contrast, any organic, soft, or pumping soils observed within a subgrade should be over-excavated and replaced with a suitable structural fill material.

Site Filling: Our conclusions regarding the reuse of onsite soils and our comments regarding wet-weather filling are presented subsequently. Regardless of soil type, all fill should be placed and compacted according to our recommendations presented in the Structural Fill section of this report. Specifically, building pad fill soil should be compacted to a uniform density of at least 95 percent based on American Society for Testing and Materials (ASTM D-1557).

Onsite Soils: We offer the following evaluation of these onsite soils in relation to potential use as structural fill:

- *Organic Soils*: Sod, topsoil and forest duff are *not* suitable for use as structural fill under any circumstances. Consequently, these materials can be used only for non-structural purposes, such as in landscaping areas.
- *Native Silty Sand and Silty, Sandy Fill:* The silty, sandy native soil and silty, sandy fill that is derived from native soil are both moisture sensitive and are not reusable when wet. They will be difficult or impossible to reuse during the rainy season. When near optimum moisture content, both soil types can be reused as structural fill.

Permanent Slopes: All permanent cut slopes and fill slopes should be adequately inclined to reduce long-term raveling, sloughing, and erosion. We generally recommend that no permanent slopes be steeper than 2H:1V. For all soil types, the use of flatter slopes (such as 2½H:1V) would further reduce long-term erosion and facilitate re-vegetation.

Slope Protection: We recommend that a permanent berm, swale, or curb be constructed along the top edge of all permanent slopes to intercept surface flow. Also, a hardy vegetative groundcover should be established as soon as feasible, to further protect the slopes from runoff water erosion. Alternatively, permanent slopes could be armored with quarry spalls or a geosynthetic erosion mat.

4.2 Spread Footings

In our opinion, conventional spread footings will provide suitable support for the proposed building if the subgrades are properly prepared. We offer the following comments and recommendations for purposes of footing design and construction.

Footing Depths and Widths: For frost and erosion protection, the base of all exterior footings should bear at least 18 inches below adjacent outside grades, whereas the base of interior footings need bear only 12 inches below the surrounding slab surface level. To reduce post-construction settlements, continuous (wall) and isolated (column) footings should be at least 18 and 24 inches wide, respectively.

Bearing Subgrades: We recommend that spread footings be based on dense, undisturbed, in situ native soils, which are found 1½ to 4 feet below existing site grades, or on structural fill bearing pads, compacted to a density of at least 95 percent (based on ASTM:D-1557), that extend down to dense native soils. If foundation construction occurs during wet conditions, it is possible that a geotextile fabric, placed between the bearing pad and native soils, will be necessary.

Lateral Overexcavations: Because foundation stresses are transferred outward as well as downward into the bearing soils, structural fill bearing pads placed under footings should extend horizontally outward from the edge of each footing. Therefore, a bearing pad that is 2 feet thick should also extend 2 feet outward from both the inside and outside footing edges.

Bearing Pressures: In our opinion, for static loading, footings that bear on properly prepared subgrades can be designed for a maximum allowable soil bearing pressure of 2,000 pounds per square foot (psf). A one-third increase in allowable soil bearing capacity may be used for short-term loads created by seismic or wind related activities.

Footing Settlements: Assuming that footings are based on medium dense or denser, undisturbed native soils, or on structural fill bearing pads that extend down to medium dense or denser native soil, we estimate that total post-construction settlement will not exceed 1 inch. Differential settlements for comparably loaded elements may approach one-half of the actual total settlement over horizontal distances of approximately 50 feet.

Footing Backfill: To provide erosion protection and lateral load resistance, we recommend that all footing excavations be backfilled on both sides of the footings and stemwalls after the concrete has cured. Either imported structural fill or non-organic onsite soils can be used for this purpose, contingent on suitable moisture content at the time of placement. Regardless of soil type, all footing backfill soil should be compacted to a maximum dry density of at least 90 percent based on ASTM D-1557.

Lateral Resistance: Footings that have been properly backfilled as recommended above will resist lateral movements by means of passive earth pressure and base friction. We recommend using an allowable passive earth pressure of 220 pcf (equivalent fluid weight) and a base friction coefficient of 0.35.

4.3 Slab-On-Grade Floors

In our opinion, soil-supported slab-on-grade floors can be used in the proposed structures if the subgrades are properly prepared. We offer the following comments and recommendations concerning slab-on-grade floors.

Floor Subbase: A 1-foot thick structural fill subbase appears to be needed under soil-supported slab-on-grade floors at the site, provided that the subbase subgrade can be surface compacted to a firm, non-yielding condition. If surface compaction to a firm, non-yielding condition is not possible, we recommend a 2 foot-thick subbase. All subbase soils should be compacted to a density of at least 95 percent (based on ASTM:D-1557).

Capillary Break and Vapor Barrier: To retard the upward wicking of groundwater beneath the floor slab, we recommend that a capillary break be placed over the subgrade. Ideally, this capillary break would consist of a 6-inch-thick layer of pea gravel or other clean, uniform, well-rounded gravel, such as "Gravel Backfill for Drains" per WSDOT Standard Specification 9-03.12(4), but clean angular gravel can be used if it adequately prevents capillary wicking. In addition, a layer of plastic sheeting (such as Crosstuff, Visqueen, or Moistop) should be placed over the capillary break to serve as a vapor barrier. During subsequent casting of the concrete slab, the contractor should exercise care to avoid puncturing this vapor barrier.

4.4 Drainage Systems

We offer the following recommendations and comments for drainage design for construction purposes.

Perimeter Drains: We recommend that the planned building be encircled with a perimeter drain system to collect seepage water. This drain should consist of a 4-inch-diameter perforated pipe within an envelope of pea gravel or washed rock, extending at least 6 inches on all sides of the pipe, and the gravel envelope should be wrapped with filter fabric to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 8 inches above the base of the perimeter footings.

Subfloor Drains: Based on site soil and groundwater conditions, we do not recommend the use of subfloor drains.

Discharge Considerations: If possible, all perimeter drains should discharge to a municipal storm drain, sewer system, or other suitable location by gravity flow. Check valves should be installed along any drainpipes that discharge to a sewer system to prevent sewage backflow into the drain system.

Runoff Water: Roof runoff and surface runoff water should *not* discharge into the perimeter drain system. Instead, these sources should discharge into separate tightline pipes and be routed away from the building to a storm drain or other appropriate location.

Grading and Capping: Final site grades should slope downward away from the building so that runoff water will flow by gravity to suitable collection points, rather than ponding near the building. Ideally, the area surrounding the building would be capped with concrete, asphalt, or low-permeability (silty) soils to minimize or preclude surface-water infiltration.

4.5 Asphalt Pavement

Since asphalt pavements will be used for the driveways and parking areas, we offer the following comments and recommendations for pavement design and construction.

Subgrade Preparation: All pavement subgrades should be proof-rolled with a loaded dump truck or heavy compactor. Any localized zones of yielding subgrades should be disclosed during this proof-rolling operation. Yielding subgrades should be overexcavated to a maximum depth of 12 inches and replaced with a suitable structural fill material. All structural fill should be compacted according to our recommendations given in the Structural Fill section. Specifically, the upper 2 feet of soils underlying pavement section should be compacted to at least 95 percent based on ASTM D-1557 and all soils below 2 feet should be compacted to at least 90 percent.

Pavement Materials: For the base course, we recommend using imported crushed rock such as Crushed Surfacing Base Course per WSDOT Standard Specification 9-03.9(3).

Conventional Asphalt Sections: A conventional pavement sections typically comprise an asphalt concrete pavement over a crushed rock base course. We recommend using the conventional pavement sections listed below.

	Minimum Thickness	
Pavement Course	**Parking Areas**	**Truck Traffic and Driveway Areas**
Asphalt Concrete Pavement	2 inches	3 inches
Crushed Rock Base	4 inches	6 inches

Compaction and Observation: All subbase and base course material should be compacted to at least 95 percent of the Modified Proctor maximum dry density per ASTM D-1557, and all asphalt concrete should be compacted to at least 92 percent of the Rice value per ASTM D-2041. We recommend that a representative of E3RA be retained to observe the compaction of each course before any overlying layer is placed. For the subbase and pavement course, compaction is best observed by means of frequent density testing. For the base course, methodology observations and hand-probing are more appropriate than density testing.

Pavement Life and Maintenance: No asphaltic pavement is maintenance free. The above described pavement sections present our minimum recommendations for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. Furthermore, a 20-year pavement life typically assumes that an overlay will be placed after about 10 years. Thicker asphalt and/or thicker base and subbase courses would offer better long-term performance, but would cost more initially; thinner courses would be more susceptible to "alligator" cracking and other failure modes. As such, pavement design can be considered a compromise between a high initial cost and low maintenance costs versus a low initial cost and higher maintenance costs.

4.6 Structural Fill

The term "structural fill" refers to any material fill placed under foundations, retaining walls, slab-on-grade floors, sidewalks, pavements, and other structures. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Typical structural fill materials include clean sand, gravel, pea gravel, washed rock, crushed rock, quarry spalls, controlled-density fill (CDF), lean-mix concrete (LMC), well-graded mixtures of sand and gravel (commonly called "gravel borrow" or "pit-run"), and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter or debris, nor any individual particles greater than about 6 inches in diameter.

Fill Placement: Generally, pea gravel, washed rock, quarry spalls, CDF, and LMC do not require special placement and compaction procedures. In contrast, clean sand, granulithic gravel, crushed rock, soil mixtures, and recycled materials should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical compactor.

Compaction Criteria: Using the Modified Proctor test ASTM D-1557 as a standard, we recommend that structural fill used for various onsite applications be compacted to the following minimum densities:

Fill Application	Minimum Compaction
Footing subgrade and bearing pad	95 percent
Foundation and subgrade wall backfill	90 percent
Slab-on-grade floor subgrade and subbase	95 percent
Pavement base and subbase	95 percent
Pavement subgrade (upper 2 feet)	95 percent
Pavement subgrade (below 2 feet)	90 percent

Subgrade Observation and Compaction Testing: Regardless of material or location, all structural fill should be placed over firm, unyielding subgrades prepared in accordance with the Site Preparation section of this report. The condition of all subgrades should be observed by geotechnical personnel before filling or construction begins. Also, fill soil compaction should be verified by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be evaluated as earthwork progresses.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the "fines" content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. For fill placement during wet-weather site work, we recommend using "clean" fill, which refers to soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the U.S. No. 4 Sieve.

5.0 RECOMMENDED ADDITIONAL SERVICES

Because the future performance and integrity of the structural elements will depend largely on proper site preparation, drainage, fill placement, and construction procedures, monitoring and testing by experienced geotechnical personnel should be considered an integral part of the construction process. Consequently, we recommend that E3RA be retained to provide the following post-report services:

- Review all construction plans and specifications to verify that our design criteria presented in this report have been properly integrated into the design;
- Prepare a letter summarizing all review comments (if required by Pacific County);
- Check all completed subgrades for footings and slab-on-grade floors before concrete is poured, in order to verify their bearing capacity; and
- Prepare a post-construction letter summarizing all field observations, inspections, and test results (if required by Pacific County).

6.0 CLOSURE

The conclusions and recommendations presented in this report are based, in part, on the explorations that we observed for this study; therefore, if variations in the subgrade conditions are observed at a later time, we may need to modify this report to reflect those changes. Also, because the future performance and integrity of the project elements depend largely on proper initial site preparation, drainage, and construction procedures, monitoring and testing by experienced geotechnical personnel should be considered an integral part of the construction process. E3RA is available to provide geotechnical monitoring of soils throughout construction.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report or any aspects of the project, please feel free to contact our office.

Sincerely,

E3RA, Inc.

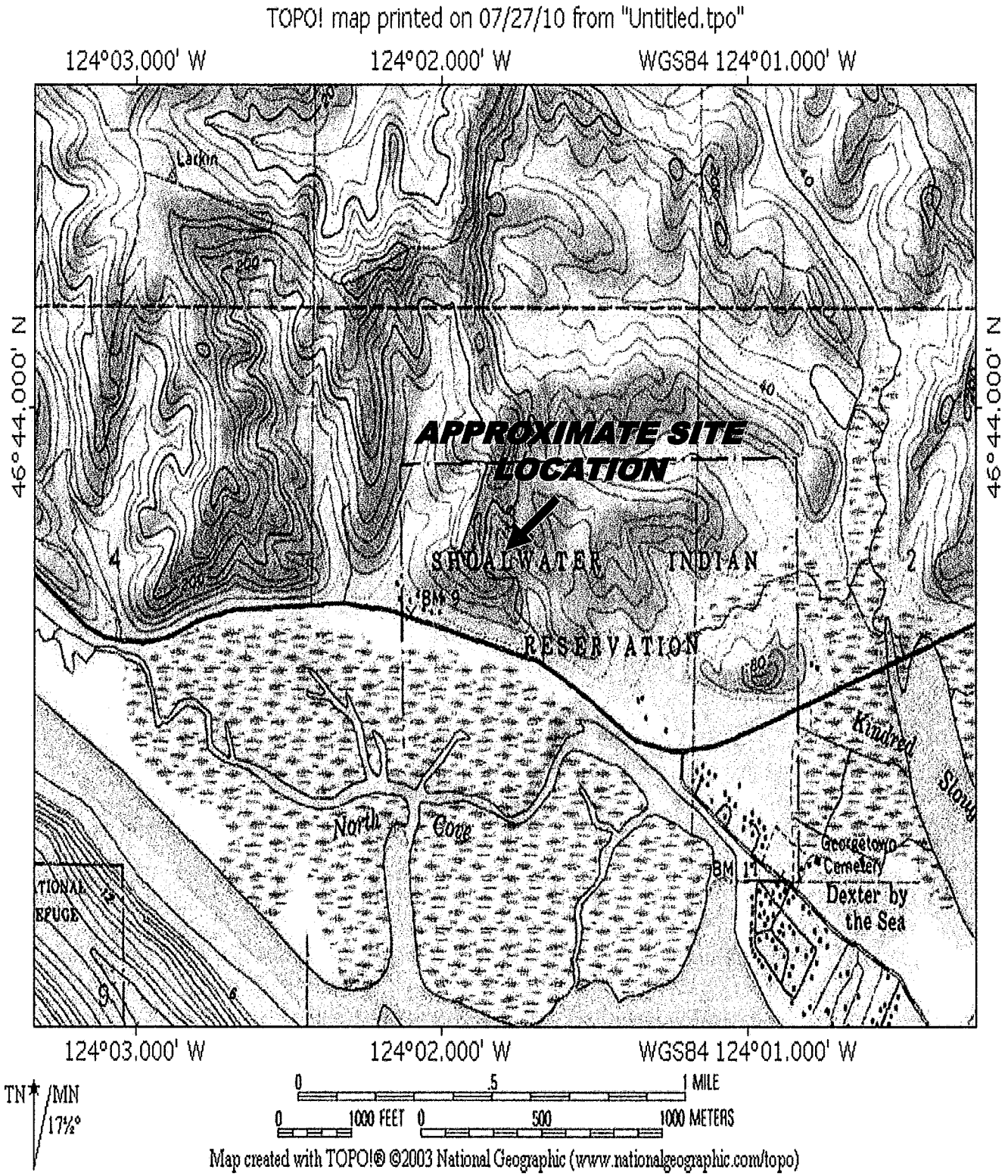
State of Washington Engineering Geologist 711 Licensed Geologist
Fred Ernest Rennebaum

JAMES E. BRIGHAM STATE OF WASHINGTON 20540 REGISTERED PROFESSIONAL ENGINEER
10124113

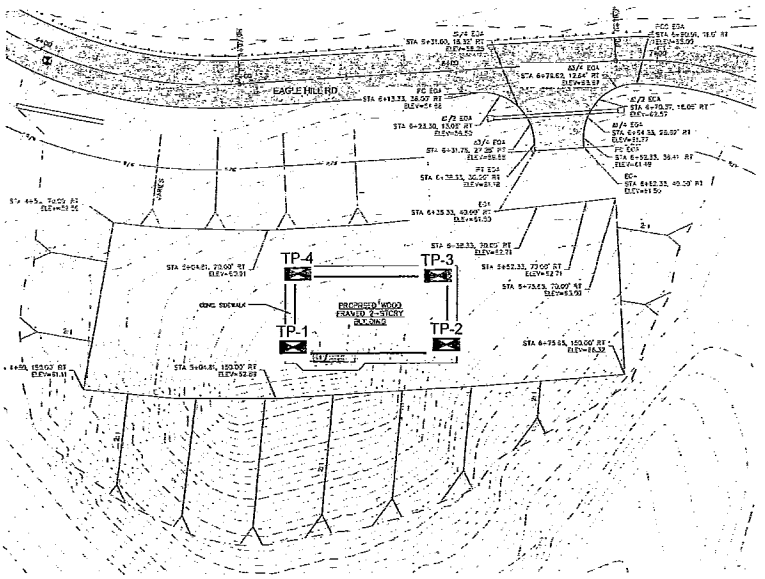
Fred E. Rennebaum, L.E.G.
Senior Geologist

James E. Brigham, P.E.
Principal Engineer

FER:JEB:jb
TACO\\Tacnew\f\2010 JOB FILES\T10065f Shoalwater Tribe - Eagle Hill Multi-Purpose Bldg\T10065f Shoalwater Multi-Purpose Building Report.doc



E3RA, Inc. **P.O. Box 44840** **Tacoma, WA 98448**	EAGLE HILL RD MULTI PURPOSE BUILDING TOPOGRAPHIC AND LOCATION MAP TOKELAND, WASHINGTON	**FIGURE 1** **T10065f**



TEST PIT LOCATIONS
TP-1

NOTE:
BOUNDARY AND TOPOGRAPHY ARE BASED ON MAPPING PROVIDED TO E3RA AND OBSERVATIONS MADE IN THE FIELD. THE INFORMATION SHOWN DOES NOT CONSTITUTE A FIELD SURVEY BY E3RA.

E3RA Inc.
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PROJECT:	Eagle Hill Road Willapa Bay Construction	
SHEET TITLE:	Site and Exploration Plan	
DESIGNER: CRL		JOB NO. T10065f
DRAWN BY: CRL		SCALE: None
CHECKED BY: JEB		FIGURE:2
DATE: Oct. 25, 2013		FILE: T10065.dwg

APPENDIX A
SOILS CLASSIFICATION CHART AND KEY TO TEST DATA

LOGS OF TEST PITS

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

	Modified California	RV	R-Value
	Split Spoon	SA	Sieve Analysis
	Pushed Shelby Tube	SW	Swell Test
	Auger Cuttings	TC	Cyclic Triaxial
	Grab Sample	TX	Unconsolidated Undrained Triaxial
	Sample Attempt with No Recovery	TV	Torvane Shear
CA	Chemical Analysis	UC	Unconfined Compression
CN	Consolidation	(1.2)	(Shear Strength, ksf)
CP	Compaction	WA	Wash Analysis
DS	Direct Shear	(20)	(with % Passing No. 200 Sieve)
PM	Permeability		Water Level at Time of Drilling
PP	Pocket Penetrometer		Water Level after Drilling(with date measured)

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Figure A-1

E³RA

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TEST PIT NUMBER TP-1

Figure A-2

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION ____ **TEST PIT SIZE** ____
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Southeast part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0		SM	1.5	(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
2.5		SM	3.0	(SM) Orange-tan silty sand (dense)

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 3.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 10/25/13 13:30 - \\TACNEWF\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

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TEST PIT NUMBER TP-2

Figure A-3

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION ____ **TEST PIT SIZE** ____
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Northeast part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
2.5		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
3.0		SM		(SM) Orange-tan silty sand (dense)
4.0				

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 4.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 10/25/13 13:30 - \\TACNEW\F\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

E³RA, Inc.

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TEST PIT NUMBER TP-3

Figure A-4

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION ____ **TEST PIT SIZE** ____
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Northwest part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
2.5		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
4.0		SM		(SM) Orange-tan silty sand (dense)
5.0				

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 5.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 10/25/13 13:30 - \\TACNEWF\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

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TEST PIT NUMBER TP-4

Figure A-5

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Southwest part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
2.5				
			3.5	
		SM	4.0	(SM) Orange-tan silty sand (dense)

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 4.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 10/25/13 13:30 - \\TACNEW\F\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

E3RA

Geotechnical Engineering Report

Shoalwater Bay Indian Reservation
Eagle Hill Road Multi Purpose Building
Criblock Retaining Wall
Tokeland, Washington

Submitted to:

Red Plains Professional, Inc.
Attention: Randy Hinderer
1499 SE Tech Center, Suite 290
Vancouver, Washington 98683

Submitted by:

E3RA, Inc.
PO Box 44840
Tacoma, Washington 98448

March 28, 2014
Revised April 23, 2014

Project No. T10065g

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APPENDIX B

Slope Stability Analysis

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E3RA

March 28, 2014
Revised April 23, 2014
T10065g

Red Plains Professional, Inc.
1499 SE Tech Center, Suite 290
Vancouver, Washington 98683

Attention: Randy Hinderer, Senior Civil/Managing Engineer

Subject: **Geotechnical Engineering Report**
Shoalwater Bay Indian Reservation
Eagle Hill Road Multi Purpose Building Criblock Retaining Wall
Tokeland, Washington

Dear Mr. Hinderer:

E3RA, Inc. (E3RA) is pleased to submit this report describing the results of our geotechnical engineering evaluation for the new retaining wall that will be built south-southwest of a planned Multi Purpose Building. The wall and new building will be built along Eagle Hill Road on Shoalwater Bay Tribal Lands in Tokeland, Washington. E3RA prepared a Geotechnical Report, dated July 27, 2010, for improvement of Eagle Hill Road and stabilization of site slopes and a report, dated October 24, 2013, for the construction of the Multi Purpose Building. .

This report has been prepared for the exclusive use of Red Plains Professional, Inc., the Shoalwater Bay Indian Tribe, and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice.

1.0 SITE AND PROJECT DESCRIPTION

The site was once an unstable hill. The upper part of the hill was recently removed and slopes modified to a stable configuration. As part of the stabilization process, the site was reduced in elevation by as much as 40 feet. The project site location is depicted on Figure 1.

Plans call for the construction of a new, two-story multi purpose building and associated paved roadways and parking areas on the site. In order to increase the level building area for the Multi Purpose Building, an approximately 200 foot long, 14-foot high crib lock-type retaining wall, aligned southeast to northwest, is planned southwest of the Multi Purpose Building pad and northeast of the Eagle Hill Road alignment. The top of the wall will be at an elevation of about 79 feet. The wall will retain a moderate to steep slope, and backfilling behind the wall will be sloped at about 3H:1V and will increase the construction area of the Multi Purpose Building and associated pavement.

2.0 EXPLORATORY METHODS

We explored surface and subsurface conditions at the project site for improvements along Eagle Hill Road on June 29, 2010 and for the planned Multi Purpose Building on October 16, 2013, when six test pit explorations were conducted. We also observed earthwork activities in the vicinity of the planned wall during the summer of 2013, when E3RA conducted several site visits during the stabilization of the unstable hill located in the vicinity of the planned wall and building.

We have attached the logs of our October 16, 2013 test pit explorations.

3.0 SITE CONDITIONS

The following sections present our observations, measurements, findings, and interpretations regarding, surface, soil, groundwater, seismic, and liquefaction conditions.

3.1 Surface Conditions

The site is comprised of a relatively level to gently sloping building area that measures a quarter to a third of an acre. Sloped terrain surrounds the building area. Generally, slopes adjacent to the building area to the north and east have not been modified. Slopes adjacent to the north reach a maximum of about 70 to 75 percent over an elevation change of 20 feet or so while adjacent slopes to the east average 50 percent or less over an elevation change of 5 to 20 feet. Slopes to the south rise 10 feet or so and have been recently graded down to about 2H:1V. Slopes to the southwest, where the retaining wall is planned, descend to the southwest to Eagle Hill Road and have been recently graded down to an average of about 2H:1V over an elevation change that varies over the length of the wall; from less than 10 feet at the northeast end of the wall alignment more than 30 feet at the southeast end of the wall alignment.

Recently graded slopes have been covered with coconut matting. Unmodified slopes, which have had vegetation removed but not stripped of duff and topsoil, have not been covered with matting.

Quarry spalls line a drainage ditch that is located at the toe of the graded slope on the west part of the site, where the slope toe meets Eagle Hill Road.

No vegetation grows on the site, which has recently been modified by grading.

Groundwater slowly seeps into the drainage ditch from the slope which the new wall will retain, at a geologic contact that is close to the subgrade elevation of the planned wall. The water seeps at a contact between upper, medium dense to dense silty sand and underlying hard silt.

3.2 Soil Conditions

Our onsite explorations conducted in 2010, 2013, and our observation of soils exposed during site this summer, indicated that soils near and above wall subgrade elevation consist of silty sand that, when undisturbed, is consolidated to a medium to dense condition. The upper most few feet behind much of the wall alignment consists of fill derived from native silty sand and consolidated to a loose to medium dense condition.

The logs of our October 2013 explorations are included in Appendix A.

During earthwork activities this past summer, when a hill was graded down to stabilize the area and create the building pad for the new building, a thick layer of hard silt was encountered at the approximate subgrade elevation of the planned wall, about 15 feet lower in elevation than the current elevation of the building site.

3.3 Groundwater Conditions

At the time of our site reconnaissance and subsurface explorations for the building pad (October 16, 2013), and during the summer earthwork activities, we observed very slow seepage at the toe of the graded slope southwest of the building area, near Eagle Hill Road. It is likely that the seepage is due to groundwater that is perched on the silt layer described in Section 3.2, Soil Conditions.

3.4 Seismic Conditions

Based on our analysis of subsurface exploration logs and our review of published geologic maps, we interpret the onsite soil conditions to generally correspond with site class D, as defined by Table 1613.5.2 of the 2012 *International Building Code (IBC)*.

Using 2012 IBC information on the USGS Design Summary Report website, Risk Category I/II/III seismic parameters for the site are as follows:

S_s = 1.423 g	S_{Ms} = 1.423 g	S_{DS} = 0.949 g
S_1 = 0.713 g	S_{M1} = 1.070 g	S_{D1} = 0.713 g

Using the 2012 IBC information, MCE_R Response Spectrum Graph on the USGS Design Summary Report website, Risk Category I/II/III, S_a at a period of 0.2 seconds is 1.42 g and S_a at a period of 1.0 seconds is 1.08g.

The Design Response Spectrum Graph from the same website, using the same IBC information and Risk Category, S_a at a period of 0.2 seconds is 0.95 g and S_a at a period of 1.0 seconds is 0.72 g.

3.5 Liquefaction Potential

Liquefaction is a sudden increase in pore water pressure and a sudden loss of soil shear strength caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose sand with fines (silt and clay) content less than about 20 percent are most susceptible to liquefaction. No easily liquefiable soils underlie the project site.

3.6 Wall Stability Analysis

We analyzed stability of the planned crib lock retaining wall under selected conditions. The following sections describe our method of analysis and present our results.

Stability analyses typically involve five basic slope parameters: (1) location and shape of the potential failure surface, (2) internal friction angle of the various soils, (3) cohesion of the various soils, (4) density of the various soils, and (5) location of the piezometric groundwater surface. Once all five parameters have been estimated, the critical slip surface and associated safety factor of a given slope can be calculated. A critical slip surface is defined as the most likely surface along which a soil mass will slide, and a safety factor is defined as the ratio of the sum of all moments resisting slope movement versus the sum of all moments tending to cause slope movement. Consequently, a slope that possesses a safety factor of 1 is on the verge of sliding, whereas a slope with a safety factor greater than 1 has some resistance to sliding. According to standard geotechnical engineering practice, a static safety factor of 1.5 and a seismic safety factor of 1.1 are considered the desirable minimum values for most slopes, but 1.25 and 1.01, respectively, are often regarded as acceptable values.

Stability conditions for the project site were analyzed by means of Bishop Circular Analysis. All calculations were performed utilizing the computer program SLOPE/W and are attached in Appendix B.

The density of the native silty sand was determined by laboratory testing conducted for our 2010 report. The other estimated values for internal friction angle and cohesion for site soils, as well as the density of the silt layer, are listed in Table 1.

We analyzed stability of the crib lock wall system generally along the alignment of Geologic Profile A-A.' Because a geologic contact between an upper layer of sandy silt and a lower layer of hard silt is at the approximate base elevation of the wall, we analyzed stability under two conditions. The first condition is with the wall based at the contact between the hard silt layer and the silty sand layer (Figure 3) and the second condition is with the wall based in the native silty sand layer, about 2 feet above the silty sand/hard silt contact (Figure 4).

Our analysis yielded a Seismic Factor of Safety of 1.1 and a Static Factor of Safety of 1.75 for the first condition and a Seismic Factor of Safety of 1.1 and a Static Factor of Safety of 1.77 for the second condition. Copies of our analyses for the first condition are attached as Appendix B.

TABLE 1
ESTIMATED PROPERTIES OF ONSITE SOILS FOR STABILITY ANALYSIS

Soil Type	Density (pcf)	Cohesion (psf)	Internal Friction Angle (degrees)
Loose to Medium Dense Fill (Silty Sand)	106	50	34
Medium Dense to Dense, Native Silty Sand	108	50	36
Hard Silt	100	426	24
Rock Base for Wall (if wall founded on silt layer)	130	0	40
Crib Lock Wall	130	N/A	N/A

4.0 CONCLUSIONS AND RECOMMENDATIONS

Plans call for the construction of an approximately 200 foot long, 14-foot high crib lock-type retaining wall, aligned southeast to northwest that is planned southwest of the Multi Purpose Building pad and northeast of the Eagle Hill Road alignment. The top of the wall will be at an elevation of about 79 feet.

- Retaining Wall: Based on our field explorations, research, and analyses, the proposed crib lock wall is feasible from a geotechnical standpoint.
- Retaining Wall Drainage: Groundwater drainage should always be provided behind a retaining wall and, because slow seepage is occurring near the base of the wall, it is especially important in this case. Proper drainage can be accomplished by placing a zone of sand and gravel containing less than 3 percent fines (material passing No. 200 sieve) against the wall. This drainage zone should be at least 24 inches wide (measured horizontally) and extend from the base of the wall to within 1 foot of the finished grade behind the wall. Smooth-walled perforated PVC drainpipe having a minimum diameter of 4 inches should be embedded within the sand and gravel at the base of the wall along its entire length. This drainpipe should discharge into a tightline leading to an appropriate collection and disposal system.

The following sections present our specific geotechnical conclusions and recommendations concerning site preparation and structural fill. The Washington State Department of Transportation (WSDOT) Standard Specifications and Standard Plans cited herein refer to WSDOT publications M41-10, *Standard Specifications*

for Road, Bridge, and Municipal Construction, and M21-01, *Standard Plans for Road, Bridge, and Municipal Construction*, respectively.

4.1 Site Preparation

Preparation of the project site should involve erosion control, temporary drainage, cutting, filling, excavations, and subgrade compaction.

Erosion Control: Before new construction begins, an appropriate erosion control system should be installed. This system should collect and filter all surface water runoff through silt fencing. We anticipate a system of berms and drainage ditches around construction areas will provide an adequate collection system. Silt fencing fabric should meet the requirements of WSDOT Standard Specification 9-33.2 Table 3. In addition, silt fencing should embed a minimum of 6 inches below existing grade. An erosion control system requires occasional observation and maintenance. Specifically, holes in the filter and areas where the filter has shifted above ground surface should be replaced or repaired as soon as they are identified.

Temporary Drainage: We recommend intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and contractor's methods, final decisions regarding drainage systems are best made in the field at the time of construction. Based on our current understanding of the construction plans, surface and subsurface conditions, we anticipate that curbs, berms, or ditches placed around the work areas will adequately intercept surface water runoff.

Site Excavations: Based on our explorations and previous site work, we expect that conventional earthwork machinery will adequately excavate site soils.

Dewatering: Some slow seepage is to be expected at the contact between the upper silty sand layer and the underlying silt layer. We anticipate that an internal system of ditches, sumpholes, and pumps will likely be adequate to temporarily dewater excavations.

Temporary Cut Slopes: All temporary soil slopes associated with site cutting or excavations should be adequately inclined to prevent sloughing and collapse. Temporary cut slopes in the soils observed on site should be no steeper than 1½H:1V, (horizontal to vertical) and should conform to Washington Industrial Health and Safety Act (WISHA) regulations.

Subgrade Compaction: Exposed subgrades should be compacted to a firm, unyielding state before new concrete or fill soils are placed. Any localized zones of looser granular soils observed within a subgrade should be compacted to a density commensurate with the surrounding soils. In contrast, any organic, soft, or pumping soils observed within a subgrade should be over-excavated and replaced with a suitable structural fill material. Because a silt layer underlies the site, care should be used when compacting in situ or fill soils near or within the silt layer; vibratory compaction methods are not recommended for surface compaction of the silt layer or for the first lift or two of fill placed over the silt layer.

Site Filling: Our conclusions regarding the reuse of onsite soils and our comments regarding wet-weather filling are presented subsequently. Regardless of soil type, all fill should be placed and compacted according to our recommendations presented in the Structural Fill section of this report. Specifically, building pad fill soil should be compacted to a uniform density of at least 95 percent based on American Society for Testing and Materials (ASTM D-1557).

Onsite Soils: We offer the following evaluation of these onsite soils in relation to potential use as structural fill:

- *Organic Soils*: Sod, topsoil and forest duff are *not* suitable for use as structural fill under any circumstances. Consequently, these materials can be used only for non-structural purposes, such as in landscaping areas.
- *Native Silty Sand and Silty, Sandy Fill:* The silty, sandy native soil and silty, sandy fill that is derived from native soil are both moisture sensitive and are not reusable when wet. They will be difficult or impossible to reuse during the rainy season. When near optimum moisture content, both soil types can be reused as structural fill.
- *Native Silt:* The native silt that underlies the site is extremely moisture sensitive and will be difficult to reuse under any conditions.

Permanent Slopes: All permanent cut slopes and fill slopes should be adequately inclined to reduce long-term raveling, sloughing, and erosion. We generally recommend that no permanent slopes be steeper than 2H:1V. For all soil types, the use of flatter slopes (such as 2½H:1V) would further reduce long-term erosion and facilitate re-vegetation.

Slope Protection: We recommend that a permanent berm, swale, or curb be constructed along the top edge of all permanent slopes to intercept surface flow. Also, a hardy vegetative groundcover should be established as soon as feasible, to further protect the slopes from runoff water erosion. Alternatively, permanent slopes could be armored with quarry spalls or a geosynthetic erosion mat.

4.2 Structural Fill

The term "structural fill" refers to any material fill placed under foundations, retaining walls, slab-on-grade floors, sidewalks, pavements, and other structures. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Typical structural fill materials include clean sand, gravel, pea gravel, washed rock, crushed rock, quarry spalls, controlled-density fill (CDF), lean-mix concrete (LMC), well-graded mixtures of sand and gravel (commonly called "gravel borrow" or "pit-run"), and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Soils used for structural fill should not contain any organic matter or debris, nor any individual particles greater than about 6 inches in diameter.

Fill Placement: Generally, pea gravel, washed rock, quarry spalls, CDF, and LMC do not require special placement and compaction procedures. In contrast, clean sand, granulithic gravel, crushed rock, soil mixtures, and recycled materials should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical compactor.

Compaction Criteria: Using the Modified Proctor test ASTM D-1557 as a standard, we recommend that structural fill used for various onsite applications be compacted to the following minimum densities:

Fill Application	Minimum Compaction
Retaining wall subgrade	95 percent
Retaining wall subbase	95 percent
Crib lock wall cell and backfill	Refer to Wall Design Plan Set

Subgrade Observation and Compaction Testing: Regardless of material or location, all structural fill should be placed over firm, unyielding subgrades prepared in accordance with the Site Preparation section of this report. The condition of all subgrades should be observed by geotechnical personnel before filling or construction begins. Also, fill soil compaction should be verified by means of in-place density tests performed during fill placement so that adequacy of soil compaction efforts may be evaluated as earthwork progresses.

Soil Moisture Considerations: The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the "fines" content (that soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. For fill placement during wet-weather site work, we recommend using "clean" fill, which refers to soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the U.S. No. 4 Sieve.

5.0 RECOMMENDED ADDITIONAL SERVICES

Because the future performance and integrity of the structural elements will depend largely on proper site preparation, drainage, fill placement, and construction procedures, monitoring and testing by experienced geotechnical personnel should be considered an integral part of the construction process. Consequently, we recommend that E3RA be retained to provide the following post-report services:

- Review all construction plans and specifications to verify that our design criteria presented in this report have been properly integrated into the design;
- Prepare a letter summarizing all review comments (if required by Pacific County);
- Check all completed subgrades for footings and slab-on-grade floors before concrete is poured, in order to verify their bearing capacity; and
- Prepare a post-construction letter summarizing all field observations, inspections, and test results (if required by Pacific County).

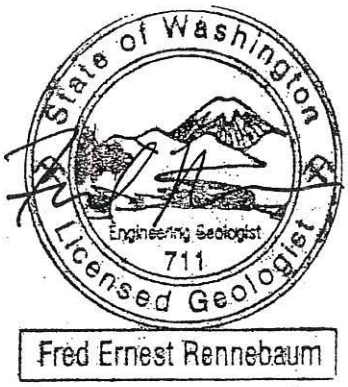
6.0 CLOSURE

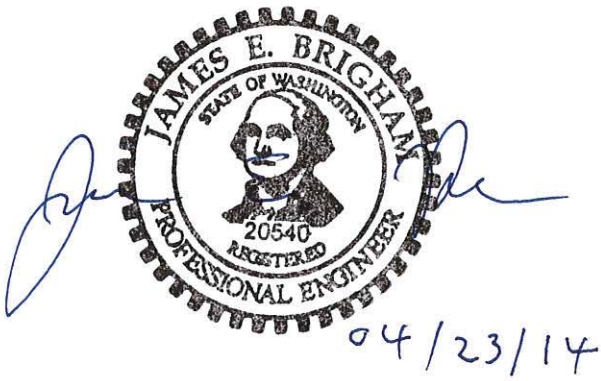
The conclusions and recommendations presented in this report are based, in part, on the explorations that we observed for this study; therefore, if variations in the subgrade conditions are observed at a later time, we may need to modify this report to reflect those changes. Also, because the future performance and integrity of the project elements depend largely on proper initial site preparation, drainage, and construction procedures, monitoring and testing by experienced geotechnical personnel should be considered an integral part of the construction process. E3RA is available to provide geotechnical monitoring of soils throughout construction.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report or any aspects of the project, please feel free to contact our office.

Sincerely,

E3RA, Inc.

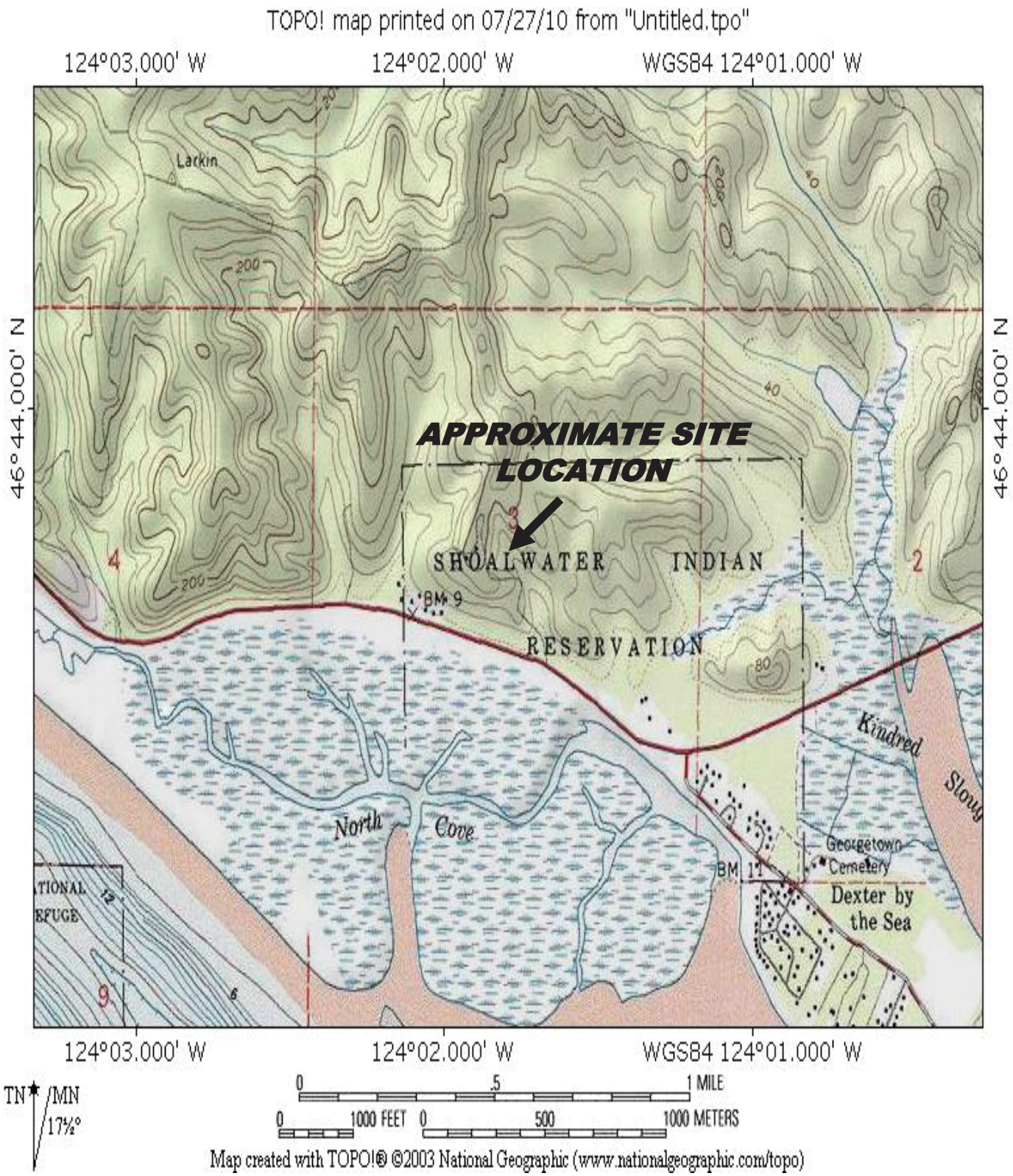




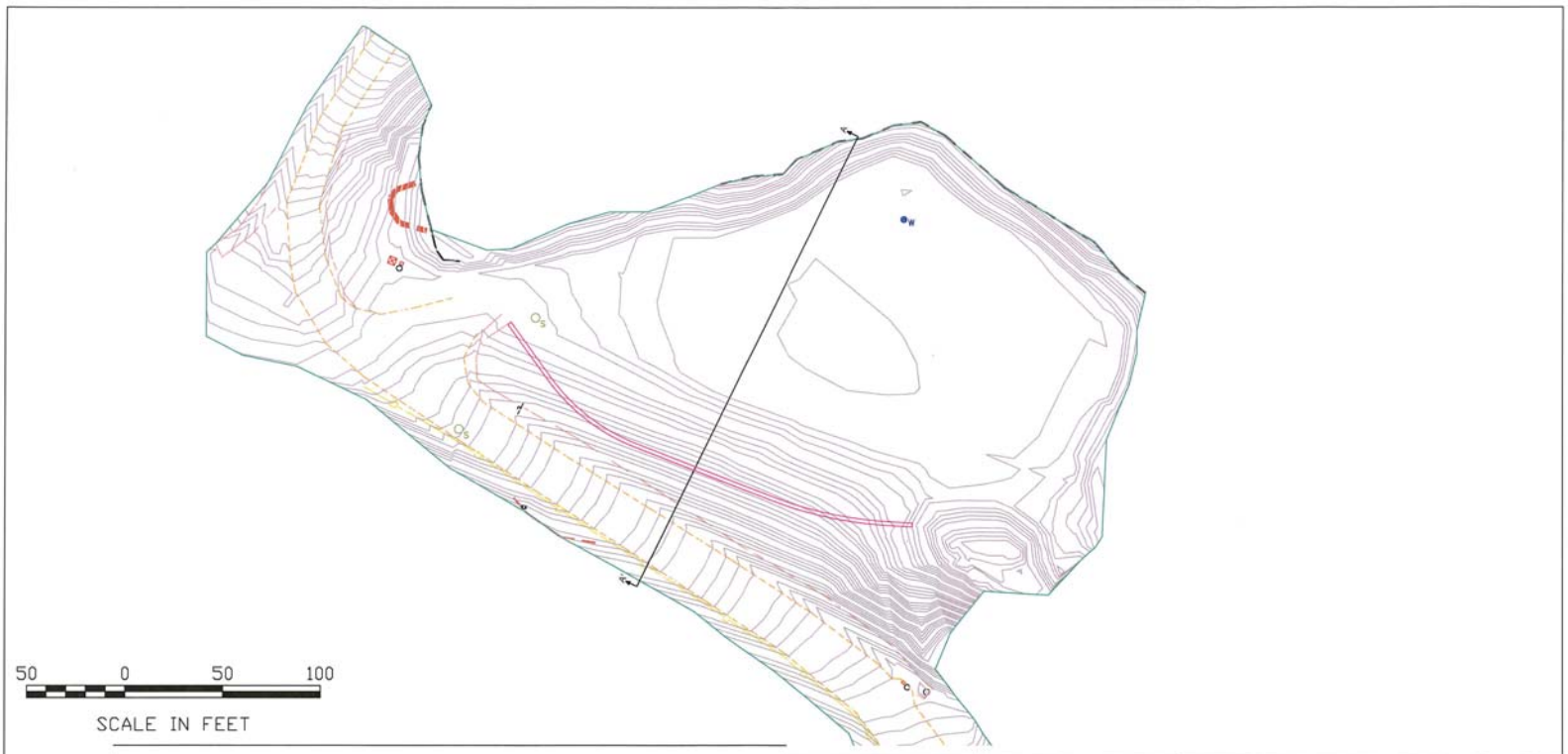
Fred E. Rennebaum, L.E.G.
Senior Geologist

James E. Brigham, P.E.
Principal Engineer

FER:JEB:jb
TACO\\Tacnew\f\2010 JOB FILES\T10065g Red Plains - Eagle Hill Retaining Wall\T10065g Shoalwater Retaining Wall Report.doc



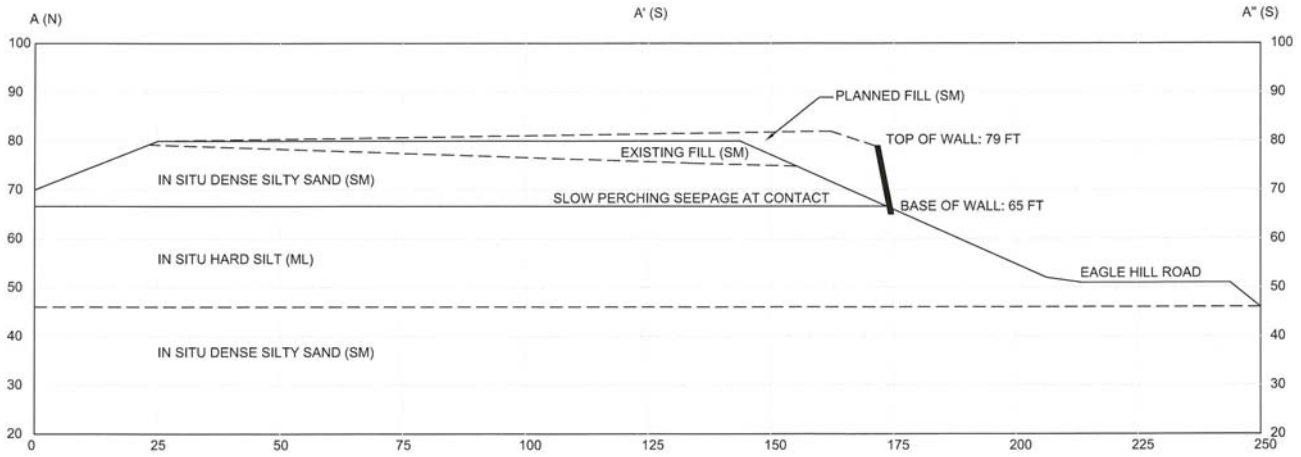
E3RA, Inc. **P.O. Box 44840** **Tacoma, WA 98448**	EAGLE HILL RD MULTI PURPOSE BLDG TOPOGRAPHIC AND LOCATION MAP TOKELAND, WASHINGTON	**FIGURE 1** **T10065g**



No.	Date	Revision	By

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
253-537-9400
253-537-9401 fax
www.e3ra.com

PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Site Plan	
DESIGNER:	JOB NO. T10065G
DRAWN BY: JRW	SCALE: AS SHOWN
CHECKED BY: FER	FIGURE: 2
DATE: Jan 14th, 2014	FILE: T10065.dwg



SCALE IN FEET

No.	Date	Revision	By

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
253-537-9400
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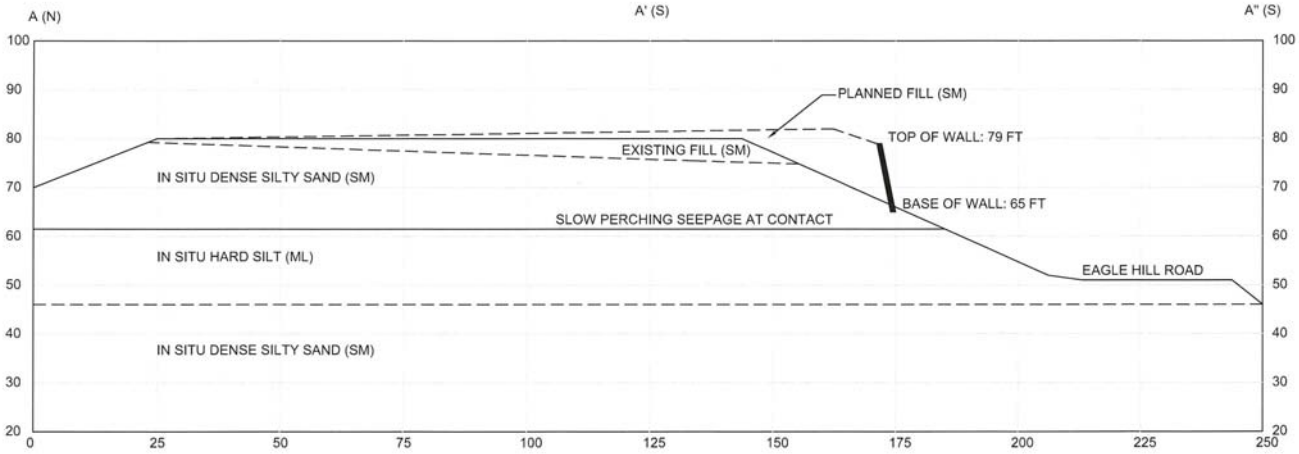
www.e3ra.com

PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Geologic Profile A-A" Silt Embed	
DESIGNER:	JOB NO. T10065G
DRAWN BY: JRW	SCALE: AS SHOWN
CHECKED BY: FER	FIGURE: 3
DATE: Jan 14th, 2014	FILE: T10065.dwg



SCALE IN FEET

No.	Date	Revision	By

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
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PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Geologic Profile A-A" Sand Embed	
DESIGNER:	JOB NO. T10065G
DRAWN BY: JRW	SCALE: AS SHOWN
CHECKED BY: FER	FIGURE: 4
DATE: Jan 14th, 2014	FILE: T10065.dwg

APPENDIX A

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

LOG OF TEST PITS

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

	Modified California	RV	R-Value
	Split Spoon	SA	Sieve Analysis
	Pushed Shelby Tube	SW	Swell Test
	Auger Cuttings	TC	Cyclic Triaxial
	Grab Sample	TX	Unconsolidated Undrained Triaxial
	Sample Attempt with No Recovery	TV	Torvane Shear
CA	Chemical Analysis	UC	Unconfined Compression
CN	Consolidation	(1.2)	(Shear Strength, ksf)
CP	Compaction	WA	Wash Analysis
DS	Direct Shear	(20)	(with % Passing No. 200 Sieve)
PM	Permeability		Water Level at Time of Drilling
PP	Pocket Penetrometer		Water Level after Drilling(with date measured)

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Figure A-1

E3RA

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TEST PIT NUMBER TP-1

Figure A-2

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Southeast part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
1.5				
		SM		(SM) Orange-tan silty sand (dense)
2.5				
3.0				

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 3.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 3/28/14 09:24 - \\TACNEWF\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

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TEST PIT NUMBER TP-2

Figure A-3

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Northeast part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
2.5		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
3.0		SM		(SM) Orange-tan silty sand (dense)
4.0				

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 4.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 3/28/14 09:24 - \\TACNEWF\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

E3RA, Inc.
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Telephone: 253-537-9400
Fax: 253-537-9401

TEST PIT NUMBER TP-3

Figure A-4

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Northwest part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
2.5				
4.0				
		SM		(SM) Orange-tan silty sand (dense)
5.0				

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

Bottom of test pit at 5.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 3/28/14 09:24 - \\TACNEWF\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

E3RA, Inc.
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Fax: 253-537-9401

TEST PIT NUMBER TP-4

Figure A-5

CLIENT Shoalwater Bay Indian Tribe
PROJECT NAME Multi Purpose Building
PROJECT NUMBER T10065f
PROJECT LOCATION Tokeland, Washington
DATE STARTED 10/16/13 **COMPLETED** 10/16/13
GROUND ELEVATION **TEST PIT SIZE**
EXCAVATION CONTRACTOR Owner-Operator
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
AT TIME OF EXCAVATION ---
LOGGED BY FER **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES Southwest part planned building
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0				
2.5		SM		(SM) Tan silty sand (loose to medium dense, moist to wet) (Fill)
3.5		SM		(SM) Orange-tan silty sand (dense)
4.0				

Test pit terminated due to refusal on large boulder
No caving observed
No groundwater seepage observed

The depths on the test pit logs are based on an average of measurements across the test pit and should be considered accurate to 0.5 foot.

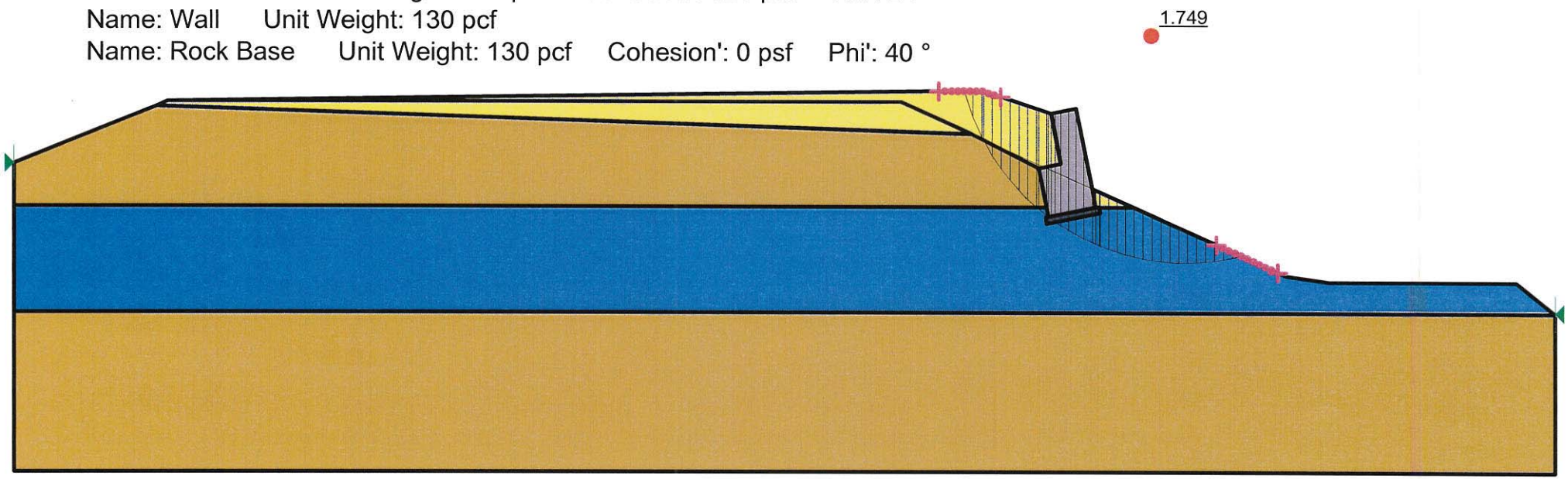
Bottom of test pit at 4.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 3/28/14 09:24 - \\TACNEWF\2010 JOB FILES\T10065F SHOALWATER TRIBE - EAGLE HILL MULTI-PURPOSE BLDG\T10065F TEST PITS.GPJ

APPENDIX B

SLOPE STABILITY ANALYSIS

Name: Fill Unit Weight: 106 pcf Cohesion': 50 psf Phi': 34 °
Name: Silty Sand Unit Weight: 108 pcf Cohesion': 50 psf Phi': 36 °
Name: Hard Silt Unit Weight: 100 pcf Cohesion': 426 psf Phi': 24 °
Name: Wall Unit Weight: 130 pcf
Name: Rock Base Unit Weight: 130 pcf Cohesion': 0 psf Phi': 40 °



Slope Stability

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File Information

Revision Number: 52
File Version: 8.2
Tool Version: 8.12.3.7901
Date: 1/29/2014
Time: 11:44:27 AM
File Name: 1silt embed - wide base - 3 ft embed.gsz
Directory: C:\Users\Jeff\Desktop\E3RA\Eagle Hill\
Last Solved Date: 1/29/2014
Last Solved Time: 12:44:46 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: (none)

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Fill

Model: Mohr-Coulomb
Unit Weight: 106 pcf
Cohesion': 50 psf
Phi': 34 °
Phi-B: 0 °

Silty Sand

Model: Mohr-Coulomb
Unit Weight: 108 pcf
Cohesion': 50 psf
Phi': 36 °
Phi-B: 0 °

Hard Silt

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 426 psf
Phi': 24 °
Phi-B: 0 °

Wall

Model: High Strength
Unit Weight: 130 pcf

Rock Base

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 40 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (150, 35.82211) ft
Left-Zone Right Coordinate: (160, 34.88715) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (195, 11.04013) ft
Right-Zone Right Coordinate: (205, 6.56001) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 24) ft
Right Coordinate: (250, 0) ft

Points

	X (ft)	Y (ft)
Point 1	25	34
Point 2	156.8936	35.9226
Point 3	168.1135	32.1827
Point 4	166.131	23.345
Point 5	143.75	34
Point 6	23.1432	33.2573
Point 7	155.2601	28.8435
Point 8	0	24
Point 9	174.7803	20.0984
Point 10	0	17.039
Point 11	206.25	6
Point 12	213.2813	5
Point 13	243.75	5
Point 14	250	0
Point 15	0	0
Point 16	250	-26
Point 17	0	-26
Point 18	172.2	33
Point 19	169.737	24.066
Point 20	167.7	15.5
Point 21	175.3922	17.0388
Point 22	167.392	17.039
Point 23	167.21	15.402
Point 24	175.945	17.137
Point 25	176.141	16.156
Point 26	167.406	14.421
Point 27	175.965	17.039
Point 28	181.61	17.039

Regions

	Material	Points	Area (ft²)
Region 1	Fill	6,1,5,7	359.33
Region 2	Rock Base	26,23,20,21,24,25	8.9597
Region 3	Hard Silt	27,28,11,12,13,14,15,10,22,20,23,26,25,24	3,569.8
Region 4	Silty Sand	17,15,14,16	6,500
Region 5	Wall	4,19,3,18,9,21,20,22	97.253
Region 6	Fill	9,21,24,27,28	9.4834
Region 7	Fill	7,4,19,3,2,1,5	270.58
Region 8	Silty Sand	7,4,22,10,8,6	2,221.8

Current Slip Surface

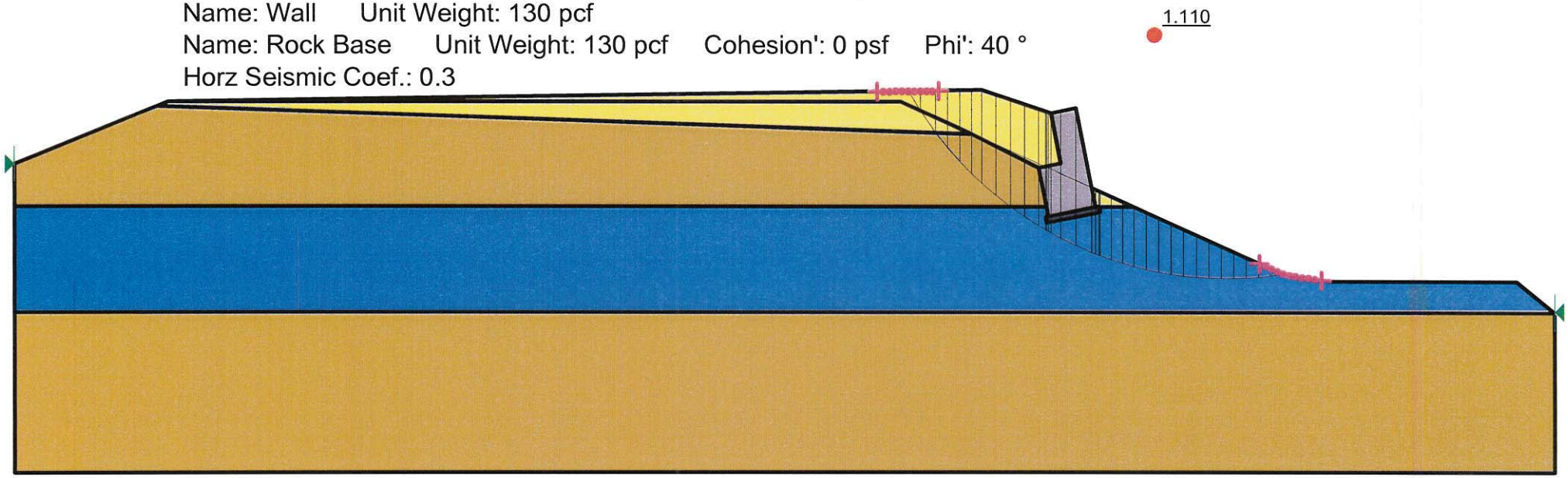
Slip Surface: 244
F of S: 1.749
Volume: 414.24867 ft³
Weight: 45,657.569 lbs
Resisting Moment: 1,442,753.3 lbs-ft
Activating Moment: 824,805.21 lbs-ft
Resisting Force: 33,218.97 lbs
Activating Force: 19,001.171 lbs
F of S Rank: 1
Exit: (199, 9.2480823) ft
Entry: (154.06707, 35.881398) ft
Radius: 37.007557 ft
Center: (189.90289, 45.120103) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	154.7737	33.706501	0	46.378402	31.282627	50
Slice 2	156.18697	29.960056	0	216.40583	145.96757	50
Slice 3	157.02338	28.137249	0	318.63554	214.92239	50
Slice 4	157.87362	26.637472	0	395.72724	287.51267	50
Slice 5	159.31455	24.328992	0	536.65011	389.89913	50
Slice 6	160.75547	22.34691	0	669.92585	486.72962	50
Slice 7	162.1964	20.610358	0	796.13063	578.42276	50
Slice 8	163.63733	19.069518	0	915.77603	665.35023	50
Slice 9	165.07825	17.691055	0	1,029.2946	747.82632	50
Slice 10	165.96486	16.898078	0	1,086.5235	483.75143	426
Slice 11	166.7615	16.251737	0	1,193.8922	531.55507	426
Slice 12	167.54449	15.630701	0	1,318.9445	587.23191	426
Slice 13	167.90524	15.361141	0	1,353.0705	1,135.361	0
Slice 14	168.46858	14.954891	0	1,447.1794	1,214.3277	0

Slice 15	169.28033	14.396058	0	1,634.4208	727.69103	426
Slice 16	170.35275	13.706325	0	1,797.2851	800.20287	426
Slice 17	171.58425	12.972248	0	1,935.0929	861.55885	426
Slice 18	172.84508	12.286249	0	1,726.1753	768.54276	426
Slice 19	174.13522	11.647253	0	1,141.4805	508.21985	426
Slice 20	175.08625	11.209705	0	808.98979	360.18546	426
Slice 21	175.6786	10.956778	0	787.68383	350.69944	426
Slice 22	176.053	10.802018	0	780.12869	347.33567	426
Slice 23	176.82463	10.508193	0	779.60308	347.10165	426
Slice 24	178.19188	10.021782	0	796.32505	354.54676	426
Slice 25	179.55912	9.5946338	0	807.30093	359.43353	426
Slice 26	180.92638	9.2246298	0	812.42694	361.71578	426
Slice 27	182.33458	8.9022598	0	813.23976	362.07767	426
Slice 28	183.78375	8.629341	0	809.30859	360.3274	426
Slice 29	185.23292	8.4156456	0	798.39048	355.46634	426
Slice 30	186.68208	8.2601419	0	780.16102	347.35007	426
Slice 31	188.13125	8.1620942	0	754.22201	335.80127	426
Slice 32	189.58042	8.1210451	0	720.08706	320.60341	426
Slice 33	191.02958	8.1368043	0	677.1626	301.49222	426
Slice 34	192.47875	8.2094448	0	624.72251	278.14438	426
Slice 35	193.92792	8.3393042	0	561.8739	250.16238	426
Slice 36	195.37708	8.5269925	0	487.5105	217.05366	426
Slice 37	196.82625	8.773407	0	400.24779	178.2018	426
Slice 38	198.27542	9.0797544	0	298.33139	132.82569	426

Name: Fill Unit Weight: 106 pcf Cohesion': 50 psf Phi': 34 °
Name: Silty Sand Unit Weight: 108 pcf Cohesion': 50 psf Phi': 36 °
Name: Hard Silt Unit Weight: 100 pcf Cohesion': 426 psf Phi': 24 °
Name: Wall Unit Weight: 130 pcf
Name: Rock Base Unit Weight: 130 pcf Cohesion': 0 psf Phi': 40 °
Horz Seismic Coef.: 0.3



Slope Stability

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File Information

Revision Number: 63
File Version: 8.2
Tool Version: 8.12.3.7901
Date: 1/29/2014
Time: 11:37:54 AM
File Name: 3silt embed - wide base - 3 ft embed - seis.gsz
Directory: C:\Users\Jeff\Desktop\E3RA\Eagle Hill\
Last Solved Date: 1/29/2014
Last Solved Time: 12:38:36 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Slope Stability

Kind: SLOPE/W
Method: Spencer
Settings
- Lambda
  - Lambda 1: -1
  - Lambda 2: -0.8
  - Lambda 3: -0.6
  - Lambda 4: -0.4
  - Lambda 5: -0.2
  - Lambda 6: 0
  - Lambda 7: 0.2
  - Lambda 8: 0.4
  - Lambda 9: 0.6
  - Lambda 10: 0.8
  - Lambda 11: 1
- PWP Conditions Source: (none)

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2,000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

Fill

Model: Mohr-Coulomb
Unit Weight: 106 pcf
Cohesion': 50 psf
Phi': 34 °
Phi-B: 0 °

Silty Sand

Model: Mohr-Coulomb
Unit Weight: 108 pcf
Cohesion': 50 psf
Phi': 36 °
Phi-B: 0 °

Hard Silt

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 426 psf
Phi': 24 °
Phi-B: 0 °

Wall

Model: High Strength
Unit Weight: 130 pcf

Rock Base

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 0 psf
Phi': 40 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (140, 35.67634) ft
Left-Zone Right Coordinate: (150, 35.82211) ft
Left-Zone Increment: 10
Right Projection: Range
Right-Zone Left Coordinate: (202, 7.90405) ft
Right-Zone Right Coordinate: (212, 5.18223) ft
Right-Zone Increment: 10
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (0, 24) ft
Right Coordinate: (250, 0) ft

Seismic Coefficients

Horz Seismic Coef.: 0.3
Ignore seismic load in strength: No

Points

	X (ft)	Y (ft)
Point 1	25	34
Point 2	156.8936	35.9226
Point 3	168.1135	32.1827
Point 4	166.131	23.345
Point 5	143.75	34
Point 6	23.1432	33.2573
Point 7	155.2601	28.8435
Point 8	0	24
Point 9	174.7803	20.0984
Point 10	0	17.039
Point 11	206.25	6
Point 12	213.2813	5
Point 13	243.75	5
Point 14	250	0
Point 15	0	0
Point 16	250	-26
Point 17	0	-26
Point 18	172.2	33
Point 19	169.737	24.066
Point 20	167.7	15.5
Point 21	175.3922	17.0388
Point 22	167.392	17.039
Point 23	167.21	15.402
Point 24	175.945	17.137

Point 25	176.141	16.156
Point 26	167.406	14.421
Point 27	175.965	17.039
Point 28	181.61	17.039

Regions

	Material	Points	Area (ft^2)
Region 1	Fill	6,1,5,7	359.33
Region 2	Rock Base	26,23,20,21,24,25	8.9597
Region 3	Hard Silt	27,28,11,12,13,14,15,10,22,20,23,26,25,24	3,569.8
Region 4	Silty Sand	17,15,14,16	6,500
Region 5	Wall	4,19,3,18,9,21,20,22	97.253
Region 6	Fill	9,21,24,27,28	9.4834
Region 7	Fill	7,4,19,3,2,1,5	270.58
Region 8	Silty Sand	7,4,22,10,8,6	2,221.8

Current Slip Surface

Slip Surface: 298
F of S: 1.110
Volume: 628.06249 ft^3
Weight: 67,938.837 lbs
Resisting Moment: 2,992,796.3 lbs-ft
Activating Moment: 2,696,200.9 lbs-ft
Resisting Force: 45,388.686 lbs
Activating Force: 40,913.734 lbs
F of S Rank: 1
Exit: (205.8201, 6.1926002) ft
Entry: (145, 35.749228) ft
Radius: 59.313024 ft
Center: (196.71051, 64.801901) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	145.9552	34.166688	0	33.436492	22.553198	50
Slice 2	148.15094	30.811854	0	159.05148	107.28158	50
Slice 3	150.36959	27.814125	0	291.98796	212.14167	50
Slice 4	152.3258	25.484527	0	416.06737	302.29064	50
Slice 5	154.282	23.378529	0	543.90062	395.16693	50
Slice 6	156.07685	21.608349	0	664.19878	482.56866	50
Slice 7	158.056	19.840656	0	778.20166	565.3966	50
Slice 8	160.3808	17.940153	0	896.34158	651.23027	50
Slice 9	162.69015	16.235569	0	1,008.2664	448.90913	426
Slice 10	164.98405	14.705761	0	1,117.7102	497.63666	426
Slice 11	166.6705	13.662474	0	1,232.9935	548.96407	426

Slice 12	167.301	13.293606	0	1,313.8019	584.94229	426
Slice 13	167.546	13.154686	0	1,356.1091	603.77867	426
Slice 14	167.90675	12.952869	0	1,386.808	617.44668	426
Slice 15	168.92525	12.407533	0	1,523.8846	678.47713	426
Slice 16	170.9685	11.3836	0	1,758.5966	782.97764	426
Slice 17	173.49015	10.241076	0	1,394.4469	620.84774	426
Slice 18	175.08625	9.5722158	0	876.05864	390.04644	426
Slice 19	175.6786	9.3438119	0	859.57557	382.7077	426
Slice 20	176.053	9.202502	0	854.22532	380.32561	426
Slice 21	177.0525	8.8495645	0	859.61153	382.72371	426
Slice 22	178.8755	8.2419002	0	884.90897	393.98686	426
Slice 23	180.6985	7.698888	0	905.70546	403.24605	426
Slice 24	182.61875	7.196531	0	924.5155	411.62082	426
Slice 25	184.63626	6.7399885	0	940.77095	418.85821	426
Slice 26	186.65377	6.3566359	0	950.84806	423.34483	426
Slice 27	188.67128	6.0450387	0	954.26213	424.86487	426
Slice 28	190.68879	5.8040586	0	950.42302	423.15559	426
Slice 29	192.7063	5.6328317	0	938.60612	417.89437	426
Slice 30	194.7238	5.5307528	0	917.9134	408.68138	426
Slice 31	196.74131	5.4974643	0	887.22075	395.01613	426
Slice 32	198.75882	5.5328503	0	845.10608	376.26547	426
Slice 33	200.77633	5.637034	0	789.75032	351.6195	426
Slice 34	202.79384	5.8103806	0	718.7996	320.0302	426
Slice 35	204.81135	6.0535028	0	629.17133	280.12512	426

Eagle Hill Road
Criblock Retaining Wall
Tokeland, Washington

Sheet Index

Sheet Number	Sheet Title
1	TITLE SHEET AND INDEX
2	SITE PLAN
3	ELEVATION
4	DETAILS
5	NOTES #1
6	NOTES #2
7	NOTES #3

Prepared for:

RED PLAINS PROFESSIONAL, INC
1499 SE TECH CENTER, SUITE 290
VANCOUVER, WASHINGTON

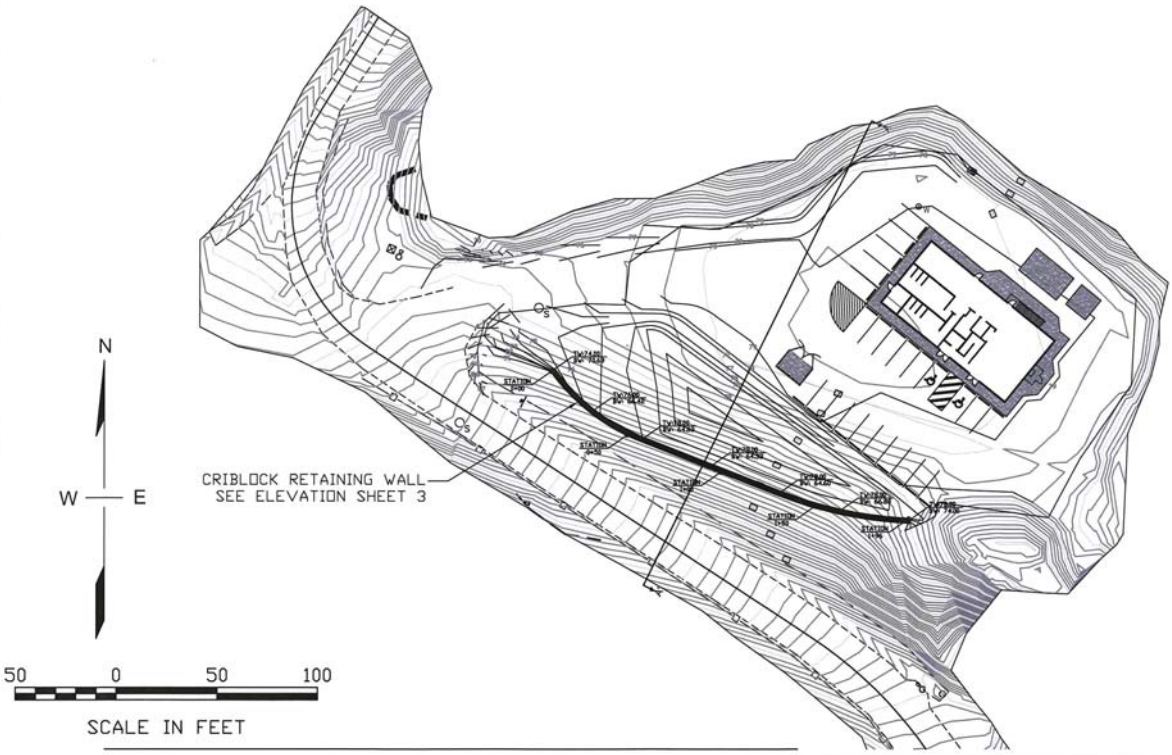
Call 2 Working Days Before You Dig
1-800-424-5555
Utilities Underground Location Center

No.	Date	Revision	By

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
253-537-9400
253-537-9401 fax
www.e3ra.com

JAMES E. BRIGHAM
STATE OF WASHINGTON
20540
REGISTERED
PROFESSIONAL ENGINEER
03/27/14

PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Title Sheet	
DESIGNER: JRW	JOB NO. T10065G
DRAWN BY: JRW	SCALE:
CHECKED BY: DMW	SHEET: 1
DATE: Mar 27, 2014	FILE: T10065G.dwg



50 0 50 100

SCALE IN FEET

NOTES:

1. TOPOGRAPHIC SURVEY DATA RECEIVED FROM RED PLAINS PROFESSIONAL, INC., ON JAN 31, 2014.

2. CONTRACTOR TO FIELD VERIFY ALL GRADES BEFORE CONSTRUCTION.

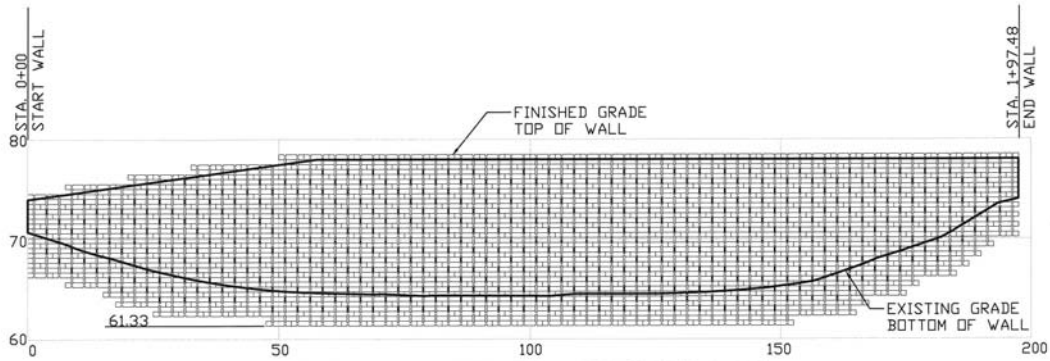
3. CALL BEFORE YOU DIG: 1-800-424-5555

No.	Date	Revision	By
0	4/8/2014	UPDATED TOPO	JRW

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
253-537-9400
253-537-9401 fax
www.e3ra.com

JAMES E. BRIGHAM
STATE OF WASHINGTON
20540
REGISTERED
PROFESSIONAL ENGINEER
04/23/14

PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Site Plan	
DESIGNER: JRW	JOB NO. T10065G
DRAWN BY: JRW	SCALE: 1" = 50'
CHECKED BY: DMW	SHEET: 2
DATE: Mar 27, 2014	FILE: T10065G.dwg



ELEVATION: CRIBLOCK RETAINING WALL
SCALE: 1" = 10'

20 0 20 40

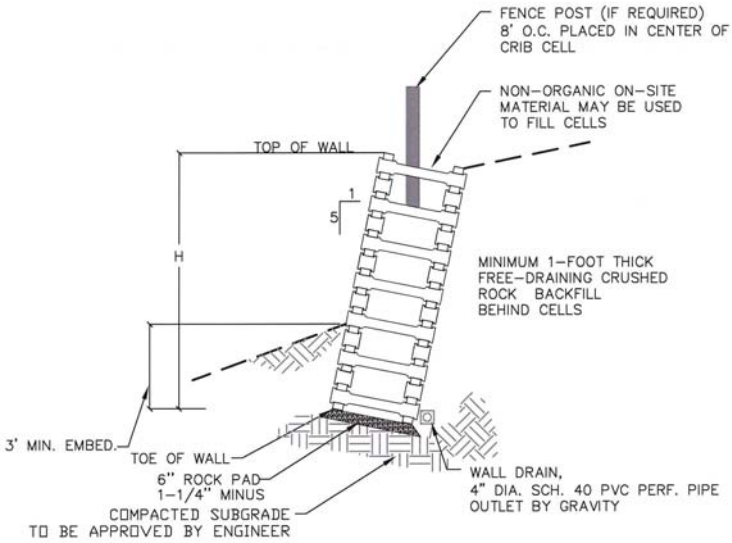
SCALE IN FEET

No.	Date	Revision	By

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
253-537-9400
253-537-9401 fax
www.e3ra.com

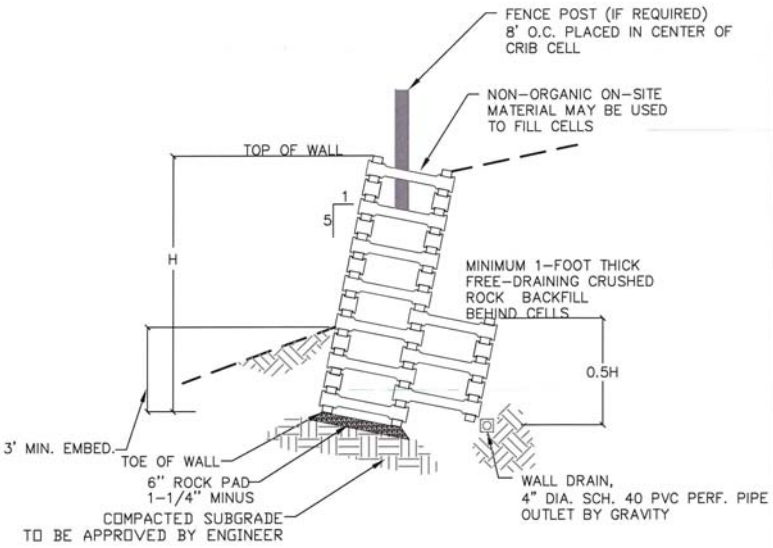
JAMES E. BRIGHAM
STATE OF WASHINGTON
26540
REGISTERED
PROFESSIONAL ENGINEER
3/27/14

PROJECT:	Eagle Hill Road Tokeland, Washington		
SHEET TITLE:	Wall Layout Details		
DESIGNER:	JRW	JOB NO.	T10065G
DRAWN BY:	JRW	SCALE:	1" = 20'
CHECKED BY:	DWM	SHEET:	3
DATE:	Mar 27, 2014	FILE:	T10065.dwg



DETAIL: TYPICAL ONE-CELL CRIBLOCK WALL

SCALE: 1" = 5'



DETAIL: TYPICAL TWO-CELL CRIBLOCK WALL

SCALE: 1" = 5'

NOTES:

1. TWO-CELL CRIBLOCK WALL SHALL BE USED ON PORTIONS OF THE WALL THAT ARE 8 FEET AND HIGHER

No.	Date	Revision	By

E3RA Inc.
PO Box 44840
Tacoma, WA 98448
253-537-9400
253-537-9401 fax
www.e3ra.com

JAMES E. BRIGHAM
STATE OF WASHINGTON
20540
REGISTERED
PROFESSIONAL ENGINEER
03/27/14

PROJECT:	Eagle Hill Road Tokeland, Washington
SHEET TITLE:	Wall Layout Details
DESIGNER: JRW	JOB NO. T10065G
DRAWN BY: JRW	SCALE: 1" = 5'
CHECKED BY: DMW	SHEET: 4
DATE: Mar 27, 2014	FILE: T10065.dwg

GENERAL NOTES
'CRIBLOCK' CONCRETE CRIB-TYPE RETAINING WALL

DESIGN CRITERIA

ANGLE OF INTERNAL FRICTION = 34 DEGREES
VEHICULAR SURCHARGE = 0 PSF
UNIT WEIGHT OF BACKFILL MATERIAL = 106 PCF
DRAINED SOIL CONDITIONS

FOUNDATION

CRIB WALL DESIGN IS BASED ON DESIGN PARAMETERS PROVIDED BY RED PLAINS PROFESSIONALS DATED 1/31/14. CRIB WALLS ARE TO BE SUPPORTED ON COMPETENT NATIVE SOILS OR WEATHERED ROCK WITH THE BEARING CAPACITIES AS NOTED IN THE SCHEDULE 11/S1.1. ADEQUATE SOIL BEARING CAPACITIES AND SUBGRADE CONDITIONS SHALL BE VERIFIED BY THE GEOTECHNICAL OR WALL ENGINEER PRIOR TO STARTING WORK. SUBGRADE PREPARATION, DRAINAGE PROVISIONS, EXCAVATION SLOPES AND OTHER RELEVANT SOILS CONSIDERATIONS SHALL BE IN ACCORDANCE WITH THE SOILS REPORT.

CRIB WALL STRUCTURE-GENERAL DESCRIPTION

A SINGLE DEPTH CRIB WALL SHALL CONSIST OF A THREE DIMENSIONAL GRID OF CONCRETE MEMBERS, WITH THE EXPOSED FACE INCLINED BACK INTO THE RETAINED SOIL AT A SLOPE OF 5 VERTICAL TO 1 HORIZONTAL. EXPOSED FRONT FACE HORIZONTAL MEMBERS OF THE GRID ARE TERMED "FRONT STRETCHERS". NONSTANDARD STRETCHERS THAT MAY BE NECESSARY TO COMPLETE THE WALL ARE TERMED "CLOSERS". HORIZONTAL MEMBERS OF THE REAR BURIED FACE, TERMED "BACK STRETCHERS", SHALL BE SET PARALLEL TO THE "FRONT STRETCHERS". THE TWO OPPOSING FACE MEMBERS SHALL INTERCONNECT BY TRANSVERSE MEMBERS, TERMED "HEADERS", SUCH THAT THE OVERALL WALL THICKNESS IS NOT LESS THAN 4 FEET. ADDITIONAL SPACERS BETWEEN THE STRETCHERS IN THE FONT AND REAR GRIDS ARE TERMED "FALSE HEADERS". HEADERS SHALL BE PERPENDICULAR TO THE FACE OF THE WALL. THE SYSTEM SHALL PERMIT CONSTRUCTION OF MULTI-DEPTH CRIB WALL BY ADDITION OF ONE OR MORE ADDITIONAL GRIDS OF STRETCHERS, PARALLEL TO THE FACE, TO BE INSTALLED BEHIND THE SINGLE DEPTH CRIB AND INTER-CONNECTED TO THE GRID IN FRONT OF IT WITH THE SAME INTERLOCKING HEADERS.

CRIB WALL INFILL-GENERAL DESCRIPTION

THE SPACE BETWEEN THE FACE AND THE BACK OF THE WALL SHALL BE FILLED WITH ON-SITE NATIVE SOILS, COMPACTED TO 90% OF MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D1557. COMPACTION SHALL BE DONE WITHOUT DISPLACEMENT OF CRIB WALL MEMBERS.

MATERIALS

CEMENT:
CEMENT SHALL CONFORM TO THE REQUIREMENTS OF ASTM C150 AND SHALL BE STORED AND HANDLED SO THAT IT IS PROTECTED AGAINST DETERIORATION OR CONTAMINATION AT ALL TIMES. CEMENT SHALL BE EITHER TYPE III OR TYPE II AS APPROPRIATE.

AGGREGATE:
FINE AND COARSE AGGREGATES SHALL COMPLY WITH THE REQUIREMENTS OF ASTM C33. AGGREGATES FAILING TO MEET THIS SPECIFICATION BUT WHICH HAVE BEEN SHOWN BY SPECIAL TEST TO PRODUCE CONCRETE MEETING REQUIREMENTS OF "QUALITY OF CONCRETE" MAY BE USED. SEE ALSO "DESIGN MIX".

WATER:
WATER SHALL BE POTABLE AND FREE FROM ANY SUBSTANCES DELETERIOUS TO CONCRETE OR REINFORCEMENT.

ADMIXTURES:
UNDER NORMAL PRODUCTION METHODS ADMIXTURES ARE NOT USED. HOWEVER, AIR-ENTRAINING ADMIXTURES, IF USED, SHALL COMPLY WITH ASTM C260. CHEMICAL ADMIXTURES SUCH AS WATER REDUCING ADMIXTURES, RETARDING ADMIXTURES, ACCELERATING ADMIXTURES, WATER-REDUCTION AND RETARDING ADMIXTURES, AND WATER REDUCING AND ACCELERATING ADMIXTURES, IF USED SHALL COMPLY WITH ASTM C494.

REINFORCEMENT:
STEEL REINFORCEMENT SHALL CONFORM TO ONE OF THE FOLLOWING ASTM STANDARDS AS APPROPRIATE: A615, A616 OR A617. YIELD STRENGTH OF STEEL SHALL BE 60,000 PSI MINIMUM. THE REINFORCEMENT SHALL BE FREE FROM DAMAGE AND CONTAMINATION. IT SHALL BE CLEAN AND FREE FROM ALL LOOSE MILL SCALE, DUST, LOOSE RUST, AND COATINGS SUCH AS PAINT AND OIL IMMEDIATELY BEFORE USE IN CONCRETE.

DESIGN MIX

A QUALIFIED MATERIALS LABORATORY SHALL PREPARE A DESIGN SPECIFYING RELATIVE QUANTITIES OF CEMENT, WATER, AGGREGATE AND ADMIXTURES NECESSARY TO OBTAIN REQUIRED MINIMUM CONCRETE STRENGTH AND DURABILITY. MANUFACTURER MAY USE HIS OWN DESIGN MIX WHICH HAS BEEN TESTED AND PROVEN TO MEET THE STRENGTH REQUIREMENTS. THIS MIX DESIGN SHALL BE SPECIFIC TO THE AGGREGATES IN USE AND SHALL BE AVAILABLE FROM THE MANUFACTURER.

No.	Date	Revision	By

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JAMES E. BRIGHAM
STATE OF WASHINGTON
20540
REGISTERED
PROFESSIONAL ENGINEER
03/27/14

PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Notes 1	
DESIGNER: JRW	JOB NO. T10065G
DRAWN BY: JRW	SCALE:
CHECKED BY: DMW	SHEET: 5
DATE: Mar 27, 2014	FILE: T10065.dwg

QUALITY OF CONCRETE

DRY MIX CONCRETE:
CONCRETE FOR USE IN DRY-MIX PRESS PROCESS OR NORMAL WET-MIX PROCESS SHALL YIELD AN END PRODUCT WITH A MINIMUM CONCRETE COMPRESSIVE STRENGTH AT 28 DAYS OF 3,000 PSI, OR 2,400 PSI AT 7 DAYS.

MANUFACTURE OF UNITS

TOLERANCE FOR INDIVIDUAL UNITS:
THE LENGTH OF HEADERS, STRETCHERS AND CLOSER SHALL BE WITHIN +/- 1/8 INCH OF THE DESIGN VALUE. THE WIDTH OF ALL UNITS SHALL BE WITHIN +/- 1/8 INCH OF THE APPROVED DESIGN VALUE.

FORMED SURFACES

THE SIDES OF THE UNITS WHICH BEAR AGAINST OTHER UNITS SHALL BE CONSTRUCTED SO THAT THE FINISHED UNITS WILL MEET THE TOLERANCES SPECIFIED IN "TOLERANCES FOR INDIVIDUAL UNITS" AND SO THAT THE UNITS MAY BE STRIPPED WITHOUT DAMAGE TO THE CONCRETE.

REINFORCING STEEL

PLACING REINFORCEMENT:
REINFORCEMENT SHALL BE PLACED AND MAINTAINED IN THE DESIGN POSITIONS WITHIN +/- .50 INCH, BUT WITHOUT REDUCING THE MINIMUM COVER SPECIFIED.

CONCRETE COVER TO REINFORCEMENT:
THE MINIMUM COVER TO REINFORCING STEEL SHALL BE 1-1/4 INCHES, IN ACCORDANCE WITH ACI 318.

MARKING

EACH "PALLET" OF BLOCK SHALL BE INDIVIDUALLY MARKED WITH ITS DATE OF MANUFACTURE. SUCH MARKING SHALL BE OF SUFFICIENT DURABILITY TO WITHSTAND A MINIMUM OF 12 MONTHS EXPOSURE TO THE ELEMENTS.
TESTING AND INSPECTION

ACCEPTABILITY OF THE CRIBWALL UNITS WILL BE DETERMINED ON THE BASIS OF COMPRESSION TESTS AND VISUAL INSPECTION. THE PRECAST UNITS SHALL BE CONSIDERED ACCEPTABLE REGARDLESS OF CURING AGE WHEN COMPRESSION TEST RESULTS INDICATE STRENGTH WILL CONFORM TO 28-DAY SPECIFICATION. THE CONTRACTOR OR HIS SUPPLIER SHALL FURNISH FACILITIES AND PERFORM ALL NECESSARY SAMPLING AND TESTING IN AN EXPEDITIOUS AND SATISFACTORY MANNER. UNITS SHALL BE CONSIDERED ACCEPTABLE FOR PLACEMENT IN THE WALL WHEN 7-DAY STRENGTHS EXCEED 65% OF 28-DAY REQUIREMENTS.

ACCEPTANCE OF UNITS ON SITE

ALL UNITS SHALL BE SUBJECT TO FINAL ACCEPTANCE ON SITE. WHERE THE CONTRACT INCLUDES THE CONSTRUCTION OF THE WALL, IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THAT ALL UNITS ARE ERECTED IN AN UNDAMAGED CONDITION.

THE PROJECT ENGINEER'S REPRESENTATIVE MAY CARRY OUT SUCH TESTS OR MEASUREMENTS AS HE/SHE THINKS FIT TO SATISFY HIMSELF/HERSELF THAT THE UNITS DELIVERED TO THE SITE ARE EQUAL IN QUALITY TO THE APPROVED DESIGN. WHERE THESE TESTS ARE OF A DESTRUCTIVE NATURE AND UNITS PROVE ACCEPTABLE, THE COST OF THE UNITS AS DELIVERED TO THE SITE OF TESTING WILL BE AN ADDITIONAL CHARGE TO THE CONTRACT.

CONSTRUCTION

CRIBWALL CONSTRUCTION SHALL BE IN REASONABLY CLOSE CONFORMITY TO THE LINES, GRADES, DESIGN AND DIMENSIONS SHOWN ON THE PLANS AND AS ESTABLISHED BY THE PROJECT ENGINEER BY MEANS OF SURVEYED STAKING.

EXCAVATION

A BENCH OF EXCAVATION TO SOUND MATERIAL SHALL BE MADE FOR THE BASE OF THE CRIBWALL. UNLESS SHOWN OTHERWISE ON THE PROJECT PLANS, THE BENCHES SHALL BE HORIZONTAL IN THE LINE OF THE WALL AND HAVE A FALL OF 1 IN 4 FROM THE FRONT TO THE BACK OF THE EXCAVATION.

FINISHED BASE EXCAVATION TO WITHIN 0.5 INCHES OF BASE ELEVATION SHALL INCLUDE VERTICAL STEPS WHERE PLANS INDICATE BASE OF WALL IS TO STEP.

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PROFESSIONAL ENGINEER
03/27/14

PROJECT: Eagle Hill Road Tokeland, Washington	
SHEET TITLE: Notes 2	
DESIGNER: JRW	JOB NO. T10065G
DRAWN BY: JRW	SCALE:
CHECKED BY: DMW	SHEET: 6
DATE: Mar 27, 2014	FILE: T10065.dwg

CRIBWALL CONSTRUCTION

THE CRIBWALL UNITS SHALL BE HANDLED AND PLACED IN SUCH A MANNER THAT NO DAMAGE IS CAUSED TO THE SEATING AREAS.

THE FIRST COURSE OF UNITS SHALL BE STRETCHERS (OR CLOSURES) UNLESS SHOWN OTHERWISE ON THE DRAWING. CARE SHALL BE TAKEN IN THE PLACEMENT TO ENSURE FIRM BEDDING AGAINST THE BASE SOIL.

THE CRIBWALL SHALL BE PLACED IN HORIZONTAL LIFTS. THE CRIBWALL UNITS SHALL BE PLACED IN A UNIFORM PATTERN AS SHOWN ON THE DRAWINGS OR AS APPROVED BY THE ENGINEER. WALLS SHALL BE PROVIDED WITH BACK STRETCHERS FOR THE FULL HEIGHT OF THE WALL, EXCEPT THE TOP COURSE. REFER TO "CRIBLOCK" STANDARD PLANS.

THE TOP COURSE SHALL CONSIST OF FULL HEADERS ONLY. NO BACK STRETCHERS ARE REQUIRED ON TOP COURSE.

CORNERS:
WHERE WALLS JOIN AT AN ANGLE, IT MAY BE NECESSARY TO SAW-CUT STRETCHERS TO PROVIDE A NEATLY JOINED CORNER. WALLS GREATER THAN 5 COURSES HIGH MAY REQUIRE SPECIAL TREATMENT OF HEADERS.

BACKFILLING

MATERIAL:
UNLESS OTHERWISE SPECIFIED IN THE SOILS REPORT, BACKFILL MATERIAL SHALL CONSIST OF EITHER A CRUSHED ROCK OR A FREE DRAINING GRANULAR SOIL WITH LESS THEN 5% FINES OF THE CHARACTERISTICS NOTED IN THE "DESIGN CRITERIA". BACKFILL SHALL BE REASONABLY FREE FROM ORGANIC AND OTHER DELETERIOUS MATERIALS.
BACKFILL MATERIAL WITHIN THE WALL SHALL BE COMPACTED TO EFFECTIVELY RESIST WIND AND RAIN EROSION. COHESIVE SOILS SHALL NOT BE USED.

PLACING:
CARE SHALL BE TAKEN NOT TO DISTURB THE ALIGNMENT OF THE UNITS DURING BACKFILLING AND COMPACTION OPERATIONS. THE AREAS BEHIND AND ABOVE THE CRIBWALL SHALL BE BACKFILLED TO THE FINISHED CONFIGURATION SHOWN ON THE PROJECT PLANS, TAKING CARE TO INSURE THAT DRAINAGE IS DIVERTED FROM GOING OVER THE FACE OF THE WALL.

COMPACTION:
UNLESS OTHERWISE SPECIFIED BY THE SOILS REPORT, COMPACTION WITHIN THE CRIBBING FRAMEWORK SHALL BE A MINIMUM OF 90% RELATIVE COMPACTION PER ASTM D1557. FOR SINGLE-DEPTH WALLS AND FOR THE FRONT CELL OF MULTIPLE-DEPTH WALLS, COMPACTION TESTS SHALL BE TAKEN AT THE CENTER OF THE CRIB CELL, APPROXIMATELY ONE-THIRD OF THE DISTANCE FROM BACK STRETCHER TO FRONT STRETCHER. FOR ALL OTHER CELLS OF MULTIPLE-DEPTH WALLS, TESTS SHALL BE TAKEN CENTERED IN THE CELL. COMPACTION OF MATERIALS BEHIND THE WALL SHALL BE PER THE SOILS REPORT OR AS DIRECTED BY THE SOILS ENGINEER.

EROSION CONTROL

MEASURE MUST BE TAKEN TO PREVENT EROSION BOTH DURING AND AFTER CONSTRUCTION. RUNOFF MUST BE CHANNELED OR DIVERTED FROM THE BACK SLOPE OF THE WALL TO PREVENT THE SURFACE WATER FROM WASHING OUT THE FILL MATERIAL. THIS IS THE RESPONSIBILITY OF THE OWNER UNLESS OTHERWISE SPECIFIED IN THE CONTRACT DOCUMENTS.

METHOD OF MEASUREMENT AND PAYMENT

FINISHED WALL WILL BE FIELD-MEASURED AND PAYMENT WILL BE BASED ON THE TOTAL SURFACE AREA OF THE WALL FACE (ON THE SLOPE) MEASURED FROM THE BASE OF THE WALL, INCLUDING ALL BURIED PORTIONS, TO THE TOP OF THE WALL TIMES THE WALL LENGTH AT EACH CHANGE IN ELEVATION.

SPECIAL INSPECTION REQUIRED

IT IS REQUIRED, AS A CONDITION OF THESE STRUCTURAL CALCULATIONS, THAT:

1. A MEMBER OF THE WALL SYSTEMS NORTHWEST, INC. OR E3RA STAFF FIELD INSPECT AND APPROVE THE CONSTRUCTION OF THIS CRIBWALL PROJECT. WALL SYSTEMS NORTHWEST, INC. WILL NOT ACCEPT ANY RESPONSIBILITY FOR ANY CRIBWALL PROJECT DESIGNED AND/OR CONSTRUCTED WITHOUT WRITTEN FINAL APPROVAL FROM A WALL SYSTEMS NORTHWEST, INC. STAFF MEMBER. CONTRACTOR LICENSE NUMBER: WALLSSN875BQ, 1299 156TH AVE NE #150 - BELLEVUE, WA 98007, (425)-864-8846 - (425)-747-5892 FAX.

2. THE GEOTECHNICAL OR WALL ENGINEER SHALL VERIFY THE ADEQUACY OF FOUNDATION SUBGRADE CONDITIONS PRIOR TO PLACEMENT OF THE CRIB.

UTILITIES

CONTRACTOR SHALL LOCATE AND FIELD VERIFY LOCATIONS OF EXISTING AND NEW UTILITIES PRIOR TO CRIB WALL CONSTRUCTION. PROVIDE A MINIMUM OF 4" OF BACKFILL BETWEEN UTILITIES AND "CRIBLOCK" CONCRETE MEMBERS.

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