



City of Tigard

FINANCE AND INFORMATION SERVICES
Qualification-Based Request for Proposal (RFP)

ADDENDUM #1

DERRY DELL CREEK AT 118TH COURT STREAMBANK STABILIZATION AND OUTFALL REPAIR ENGINEERING, STREAM RESTORATION, AND CONSTRUCTION MANAGEMENT SERVICES

Bids Due: Tuesday, November 15, 2016

Addendum Issue Date: Thursday, November 10, 2016

Submit Bids To: City of Tigard – Contracts & Purchasing Office
Attn: Joe Barrett, Sr. Management Analyst
13125 SW Hall Blvd.
Tigard, Oregon 97223

Direct Questions To: Joe Barrett, Sr. Management Analyst
Phone: (503) 718-2477
Email: joseph@tigard-or.gov

The attached additional information is provided for this Request for Proposal.

- Pre-Proposal Questions and Answers (Along with Attendance Sign-In Sheet)
- Summary Letter Report from Shannon & Wilson, Inc.



City of Tigard Memorandum

To: Attendees
From: Carla Staedter
Re: Derry Dell Creek at 118th Court Stream Stabilization and Outfall Repair
Date: November 2, 2016

Attendees:

Listed below are questions and responses cataloged during the Pre-QBS submittal meeting conducted on November 2 at 3:30 PM.

- Are there any trail plans above 118th and any width or accessibility requirements need to be analyze?
No trails are planned above 118th.
- Are studies needed for the entire length of stream from 118th to 115th?
Will be dependent on consultant fees. Approximately 120k is budgeted for consulting fees. The wetland report to be done at the project area.
- Are the bridge crossings and exposed culvert a part of the project?
No.
- What is involved at the upper end of the project above 118th Court?
Work to include repairing existing outfall and stabilizing adjacent bank.
- Who maintains the existing stream corridor within this section (118th to 115th)?
Clean Water Services is currently doing vegetation management. City owns and maintains the stream corridor.
- Will there be any CWS buffer credits available?
Clean Water Services buffer regulations will need to be met for the project.
- Does the design need to consider a fish passage?

No, there is an existing blockage downstream that would prevent any upstream fish passage. However, coordinating with ODFW to confirm is advised.

- Are there any mitigation easements that exist at the project location?

No.

- Is there any opportunity to divert stormwater runoff upstream?

This will be dependent on the stormwater master plan that is in progress. The creek runs year round so for construction assume managing the creek as part of dewatering.

- When will the stormwater master plan be completed?

June 2017

- How is this project being funded?

Through the City's stormwater and sanitary sewer fund.

- Has there been any previous DSL/Corps coordination?

No, coordination will need to be done by consultants.

- How is the relationship with the existing property owner at the slide location?

The relationship is neither good or bad with the property owner immediately above the slide. The upstream neighbor has been in contact with the City and is concerned.

- When did the upstream development occur?

In the immediate project area, development occurred in the 1970s. Further upstream on Bull Mt, the majority was completed in the late 1990s.



Pre-Proposal Meeting Sign-in Sheet

Derry Dell Creek at 118th Court Stream Stabilization and Outfall Repair
November 2, 2016

Name	Company	Phone #	Email address
Dave Hawkins	Shannon + Wilson	503-210-4781	djh@shannwil.com
David Gorman	Ecological Engineering	503-704-6013	dgorman@heranet.com
Greg Berge	HEUBERSON	503-699-8999	greg@hendersondesign-build.com
Casey Storey	DAVID EATERS ASSOCIATES	503-499-0480	COSTO@DEAINC.COM
Phil Duntzman	WHPacific Inc.	503-372-3562	pduntzman@whpacific.com
Laura Herbon	LH Landscape Arch	(971)404-8919	laura@herbonlandscape.com
Dan Schall	AmeC Foster Wheeler	503-639-3400	daniel.schall@amec.fw.com
Seth Jelen	"	"	seth.jelen@
Michael Rafferty	otak	503-887-2497	michael.rafferty@otak.com
Crystal Ginnell	Biohabitats	971-645-7370	cgrinnell@biohabitats.com
Ivy Watson	HHP R	503-875-4392	ivyw@hhpr.com
Kent Snyder	HHP R	503-221-1131	Kent@hhpr.com
Chris Beatty	"	"	Chris@hhpr.com
John Christiansen	AKS Eng	503-563-6151	johnc@aks-eng.com

February 12, 2016

City of Tigard Public Works
Attn: Lori Faha, PE
13125 SW Hall Boulevard
Tigard, Oregon 97223

**RE: SUMMARY LETTER REPORT
13800 SW 118TH COURT LANDSLIDE EMERGENCY RESPONSE
AND DERRY DELL CREEK HAZARD RECONNAISSANCE
TIGARD, OREGON**

Dear Ms. Faha:

This letter report summarizes the findings and recommendations of our emergency response to the reactivation of the landslide at 13800 SW 118th Court and our hazard reconnaissance of the Derry Dell Creek channel between SW 118th Court and SW 115th Avenue. The letter report also summarizes our evaluation of conceptual alternatives and associated cost estimates to mitigate the landslide at 13800 SW 118th Court.

Our scope of services included an initial emergency response site visit, completed December 29, 2015, to evaluate the landslide, a follow up hazard reconnaissance of the 13800 SW 118th Court landslide area and Derry Dell Creek channel between SW 118th Court and SW 115th Avenue, hand auger and probe explorations of the landslide area debris field, an evaluation of conceptual landslide mitigation alternatives, and production of this letter report, summarizing our findings and recommendations, including our opinion, regarding the level of urgency to mitigate the landslide and address geologic hazards within the Derry Dell Creek channel.

BACKGROUND INFORMATION

Shannon & Wilson, Inc., previously performed a geologic evaluation of the landslide at 13800 SW 118th Court, under subcontract to WHPacific, Inc., and we were part of a design team lead by ESA Vigil-Agrimis that responded to a City of Tigard (the City) request for proposals to evaluate improvements to Derry Dell Creek between SW 118th Court and SW 115th Avenue. Our findings and recommendations to mitigate the landslide at 13800 SW 118th Court were

detailed in our Geotechnical Investigation Report, submitted to WHPacific and dated March 31, 2009; Shannon & Wilson emailed you a copy of this letter on December 29, 2015. The Shannon & Wilson and ESA Vigil-Agrimis proposal to evaluate improvements to Derry Dell Creek between 118th Court and SW 115th Avenue was provided to the City in March 2014.

PROJECT UNDERSTANDING

We understand that the mitigation measures recommended in our March 31, 2009, report for 13800 SW 118th Court were not implemented, and improvements were limited to the City extending downspouts to the Derry Dell Creek channel. We also understand that the City awarded the Derry Dell Creek improvement project to the Shannon & Wilson and ESA Vigil-Agrimis team in 2014, but a contract for services was not provided, and the project was postponed.

The City was informed by a neighboring resident that a portion of the landslide at SW 118th Court had slid into Derry Dell Creek during heavy rains in mid-December 2015. At your request, Shannon & Wilson made a site visit with you and several other City Public Works staff on December 29, 2015, to observe the landslide. During the site visit, Shannon & Wilson staff notified you that the landslide has increased in size since our 2009 evaluation, and there is a high risk that it may expand into the backyard of the 13800 SW 118th Court residence. Based on site observations, we concluded it would be difficult to access the landslide area with heavy equipment from SW 118th Court and that access from Derry Dell Creek trail is more favorable but may require environmental permitting to work near the creek channel.

During the site visit, we also discussed the condition of Derry Dell Creek between 118th Court and SW 115th Avenue, and Public Works staff members informed us that conditions have worsened in that area over the last few years. We understand that the City of Tigard Capital Improvement Plan has scheduled construction of improvements to Derry Dell Creek for 2019 but is considering advancing that schedule if necessary to address hazards and repair the landslide. Due to access constraints, we understand that landslide repair at SW 118th Court may be delayed until work on Derry Dell Creek also occurs.

We understand that the goal of this project is to evaluate possible mitigation alternatives that would reduce the risk or prevent further landslide encroachment of the property line and the adjacent residential house located at 13800 SW 118th Court as well as limiting or eliminating the

risk of landslide debris fouling or damaging the creek channel. We also understand the City would like us to provide our opinion of urgency to mitigate the landslide and address hazards so that mitigation alternatives, cost, and construction schedule may be evaluated.

SITE RECONNAISSANCE

SW 118th Court

A geologic reconnaissance of the landslide at 13800 SW 118th Court was performed by David Higgins, a Shannon & Wilson Engineering Geologist, on December 30, 2015. A Site Plan of the landslide at 13800 SW 118th Court is shown in Figure 1. We were accompanied on the reconnaissance by Theresa Reynolds, the City of Tigard Wastewater Operations Supervisor. A previous reconnaissance of the landslide was performed by Shannon & Wilson February 12, 2009, and a summary of observations is included in our 2009 report. The residence at 13800 SW 118th Court is a two-level ranch style home with the upper level at street grade, and a lower level which daylight to the backyard. The backyard is level, and extends approximately 25 feet from the house to a point near the east property line. A 5-foot high concrete block privacy wall had been constructed by the homeowner on city property just beyond the property line. An iron gate is positioned in the wall near the southeast property corner. According to a survey made by WHPacific in 2009, the wall crosses about 5 feet over the property line into City property near the gate. A water feature with an electric pump is built into a rockery structure against the privacy wall at the extreme southeast corner of the yard. The wall is not plumb and is leaning outward several inches in the downslope direction.

The backyard lawn surface was very moist at the time of our reconnaissance. The surface felt soft underfoot and our feet sunk into the surface when walking across. Three corrugated plastic drain pipes were observed exiting the ground behind the wall. Two pipes were suspended in the air and bowed down, crossing below the landslide scarp. One pipe was embedded in the debris. One of the suspended pipes was observed to be leaking water into the landslide debris field. It is not clear what the pipes were connected to, but as part of our 2009 study, during our first visit to the site on November 18, 2008, the homeowner, Mrs. Klettke, told us that the previous owner had installed the drain pipes to drain the back lawn.

During our February 12, 2009, reconnaissance we observed that the landslide had occurred just behind the concrete block privacy wall near the southeast property corner as shown in Figure 1. The head scarp was located several feet below the gate at 13800 SW 118th Court and extended to the south below the neighboring property at 13830 SW 118th Court. At the nearest point, the head scarp was about 4 feet from the south gate post and 9 feet from the property boundary at 13800 SW 118th Court. The head scarp was approximately 12 feet from the property boundary at 13830 SW 118th Court at the nearest point. A series of ground cracks and slumps were observed in soil behind the head scarp, which extended the active slide area to about 2 feet away from the wall. The slide was approximately 20 feet wide at the head scarp and about 40 feet wide at the toe. The slide was approximately 45 feet in length from the top of the head scarp to the toe of the slide debris near the creek channel. The slide appeared to have been a debris slump forming a prominent bench in the mid-portion of the slide area, about 5 to 7 feet below the rim of the head scarp. The bench was the upper surface of a debris mound that, having failed from its original position, settled at the edge of the creek.

During our recent December 30, 2015, reconnaissance we observed that the northern half of the landslide had recently failed as a debris flow landslide, increasing the overall size of the landslide to approximately 35 feet wide at the head scarp and about 50 feet wide at the toe as shown in Figure 1. The northern portion of the head scarp has retrogressed upslope and is now 1 foot away from the gate and wall. In the recent failure area in the north half of the landslide, the head scarp has retrogressed upslope and the prominent bench debris mound that had been 5 to 7 feet below the rim of the head scarp (as described in our February 12, 2009 reconnaissance) has slid away as a debris flow landslide, forming a debris field that extends into the creek channel. It appears that much of the soil debris has been washed down stream. The remaining landslide debris extends from the head scarp to the creek channel and appears to mound immediately adjacent to the creek. The neighbor located at 13830 SW 118th Court told us that the recent debris flow occurred a couple weeks prior to our December 30, 2015, reconnaissance.

During our December 30, 2015, reconnaissance we observed that the recent debris flow landslide is 10 to 20 feet wide, occupying the northern half of the overall landslide. The head scarp of the recent debris flow as shown in Figure 1 is near vertical, 12 to 13 feet high, 10 to 12 feet wide, and is within 1 foot of the gate. We also observed that there are now ground cracks on

the uphill side of the gate in the backyard of the residence at 13830 SW 118th Court, about 1 foot from the wall. There are several inches of separation between a concrete pad at the base of the gate and the wall. There are several cracks in the wall that were not present during our February 12, 2009, reconnaissance and the wall appears to now be leaning several inches further out of plumb than what had been observed in 2009. The entire length of the wall, parallel with the eastern property boundary, was observed to be leaning during both our 2009 and 2015 reconnaissance. The hillside below the wall is covered with blackberries and we have not observed landslides elsewhere on the hillside beyond what is identified in Figure 2 or our 2009 report. Both bearing failure and downslope creeping ground movements are possible within the soft fill soils encountered by our 2009 boring B-1, performed at the top of the hill slope.

Based on our surface observations, there is a risk that additional landslide failures in the northern half of the landslide at 13800 SW 118th Court could occur at any time and encroach into the backyard of the residence at 13800 SW 118th Court. The condition and extents of the southern half of the landslide below the neighboring property at 13830 SW 118th Court appears similar to what we observed in 2009. This portion of the landslide appears less active and it is set back further from the property line; therefore, there is a lower risk that the landslide will encroach into the property at 13830 SW 118th Court. The December 2015 debris flow landslide at 13800 SW 118th Court was caused by excess water from surface and near surface drainage originating from record-setting December rainfall. Surface grading and the block wall in the backyard of the residence at 13800 SW 118th Court funnel rainwater surface runoff toward the gate, which is located above the center of the December 2015 landslide area.

Derry Dell Creek

A brief reconnaissance of the Derry Dell Creek channel between SW 118th Court and SW 115th Avenue was performed by David Higgins, a Shannon & Wilson Engineering Geologist, on December 30, 2015. David performed a previous site walk of the same portion of the creek channel in March 2014 during Derry Dell Creek proposal preparation. Derry Dell Creek flows through a relatively shallow and narrow canyon, approximately 20 to 30 feet below adjacent residential properties. The canyon walls in some areas are very steep, and soils within the canyon are highly erodible. At several locations, the creek has slumping banks and channel

incisions, eroding into the toe of the canyon slopes and creating unstable conditions. The landslide at 13800 SW 118th Court occurred on the west side of the canyon and another landslide is known to have occurred immediately opposite on the east side of the canyon in the backyard of a residence at SW Fairview Court that has been repaired. Creek channel incision is also potentially threatening stilt foundations of two homes located on SW Fairview Lane and a garage structure of a home on the west side of SW 115th Avenue, just south of Derry Dell Creek. These structures are not in imminent danger of damage but continued channel erosion and incision could threaten stability near foundations in the future. There are also several stormwater outfall pipelines entering the canyon, creating erosion and causing bank instability. The City has identified one eroded outfall location west of 118th Court, and we observed several other eroded outfalls during our reconnaissance. Between our March 2014 site walk and cursory December 2015 reconnaissance, based on surface observations, channel incision and outfall erosion appears to have worsened slightly but does not appear to be imminently threatening stability of the canyon walls or adjacent structures.

HAND AUGER AND PROBE EXPLORATIONS

The subsurface exploration program was performed January 8, 2016, and consisted of a hand auger boring and several soil probe explorations. The purpose of the explorations is to determine the approximate thickness of the landslide debris below the head scarp. A Shannon & Wilson geologist performed the hand auger boring and soil probe explorations in the landslide debris field between the head scarp and the Derry Dell Creek channel. The hand auger location is shown in Figure 1 and was advanced to a depth of 3.5 feet, using a 3-inch diameter hand auger tool. We collected representative disturbed soil samples from the cuttings at selected depths, and maintained a log of the materials encountered. The hand auger encountered organic silt landslide debris to a depth of 1.4 feet, overlying intact native silt. The hole was backfilled with the remaining excavated material. All samples were sealed to retain moisture and returned to our laboratory for additional examination and storage. A 4-foot long, half-inch diameter steel probe was used to probe the debris soil throughout the debris field. The soil debris was found to be 1 foot thick near the head scarp and approximately 4 feet thick at the toe near the creek channel. The average thickness was found to be approximately 3 feet thick.

CONCEPTUAL MITIGATION ALTERNATIVES

The landslide at 13800 SW 118th Court has significantly increased in size since our 2009 reconnaissance, explorations, and geotechnical report, which recommended an H-pile retaining wall with lightweight backfill to mitigate the landslide. At the time of our 2009 report, our scope of services was limited to protecting the properties at 13800 and 13830 SW 118th Court and the City was not planning improvements to Derry Dell Creek between SW 118th Court and SW 115th Avenue at that time. Since our 2009 report, the City has become increasingly concerned with erosion and stability of the Derry Dell Creek canyon and included channel and outfall improvement construction in the City of Tigard Capital Improvement Plan for 2019. Considering planned channel improvements, landslide mitigation alternatives should now consider protection of the stream channel and future channel improvements in addition to protection of adjacent properties. Mitigation alternatives may now also consider that heavy equipment may be able to access and mitigate the landslide during construction of stream channel improvements and be included under the same environmental permits. Previous mitigation alternatives included in our 2009 report only considered construction access from SW 118th Court between neighboring house structures.

Mitigation alternatives may consist of minor drainage improvements, temporary stabilization, and/or permanent stabilization measures. Drainage improvements and temporary stabilization measures, if used, will be limited to the more active portion of the landslide below 13800 SW 118th Court and should be undertaken immediately to minimize further degradation of the slope. Drainage improvements and temporary stabilization measures are generally intended as interim measures, and could reduce the risks associated with the slope failure extending into the backyard of neighboring private properties, and may limit further degradation of existing landslide. However, drainage improvements may only provide a slight reduction of risk while temporary stabilization measures may significantly improve stability and reduce risk but cannot assure that the landslide will remain in its current condition and not eventually encroach onto adjacent properties. Most permanent stabilization measures require significant time for planning, design, and construction and may require environmental permitting. Permanent measures are generally designed to provide long-term stability with minimal maintenance. Drainage improvements and temporary and permanent stabilization measures are discussed below.

Based upon our site reconnaissance and our slope stability evaluations, it is our opinion that temporary or permanent slope stabilization measures cannot assure the stability of the existing

masonry wall above the head of the landslide because of the masonry wall's proximity to the existing slope failure and the fact that it is already leaning. Also, the existing condition of the wall may be difficult to maintain during construction of permanent slope stabilization measures.

Drainage Improvements

Drainage improvement measures should be intended to restrict the infiltration of water into the slide area as much as possible. They are intended to reduce the risk of additional landslide failures by increasing drainage but do not stabilize or strengthen the ground within or adjacent to the landslide. Drainage improvements could include the following:

- Fix the leaking drainage line and reroute drainage lines so that they are supported and have positive drainage and are extended to the creek.
- Cover the slope with heavy-duty plastic sheeting; the plastic should be attached securely to the ground at the base of the wall and extend to the wetland boundary; the sheeting should be weighted down with sand bags to keep it secured in place. It will be necessary to clear blackberries from the slide area in order to place the plastic sheeting.
- Install an approximately 20-foot long shallow subsurface interceptor drain, centered on the gate, in the 5-foot wide area of City property on the uphill side of the wall. The interceptor drain should be 2 feet deep below ground surface and run parallel with the wall, with hard-piped drainage down the hillside and an outlet near the creek channel. It may consist of a drainage geotextile lined trench filled with crushed drain rock that extends to the ground surface, and a perforated pipe at the base. The perforated pipe should be connected to the hard-piped drainage, which may daylight near the top of the slope and be tight-lined down the face of the hillside.

Plate Pile Temporary Stabilization

Plate piles could be installed above the head scarp on both sides of the masonry wall to increase stability of the backyard of the residence at 13830 SW 118th Court and reduce the risk of the landslide failing into the back yard. The drainage improvements discussed above would be implemented in addition to plate pile installation to further reduce the risk of additional landslide

failures. Plate piles may consist of 20-foot long, 3-inch diameter steel pipe piles, with a ¼-inch steel plate welded to the top of the pile. The plates are generally 1 foot wide and 3 to 4 feet long. The plate piles are driven into the ground with a small pneumatic hammer. An air compressor would be set up in SW 118th Court and equipment and supplies would be hand carried with access between the houses. Up to three staggered rows of plate piles may be installed, with 3 to 4 feet of spacing between centers of piles. Based on the 2009 WHPacific survey, it may be possible to install two rows of piles on City property without encroaching onto the neighboring private property. The two rows may not increase stability to the same level as three rows but may still be considered if encroachment onto private property is not allowed or preferred. The combination plate piles and drainage improvements will significantly increase stability of intact soils above the landslide and decrease the risk of additional landslide failures extending into backyard. However, these measures are intended only to increase stability and reduce risk until permanent stabilization measures can be constructed. Plate piles stabilization does not achieve a factor of safety required by building code. They do not assure that additional landslide movement will not occur or that no portion of the landslide will encroach into the backyard of the residence.

Retaining Wall Permanent Stabilization

A retaining wall could be constructed on City property between the property line and the creek to retain the bank and create a barrier beyond which the slope would not recede. The wall could be constructed using soldier piles and lagging and may also require tieback anchors, depending on the design. Construction access could be made from SW 118th Court. Piles would be founded in intact soil, below the creek bottom, and could be installed from the top of the bank such that in-water or environmental work permits would not be necessary. Costs for wall construction, as described above, would be relatively high compared to other mitigation alternatives.

In our opinion, the soldier pile wall may be composed of H-piles and would extend approximately 50 feet, aligned approximately 15 feet east of, and parallel to, the property boundary. The upper loose/soft landslide debris may be excavated from the back slope along the wall alignment. Once the piles are installed, lagging is fitted between the steel H-piles and backfill material is placed behind the wall (often concurrently). The lagging may consist of wood planks, metal sheets, or reinforced concrete sections. The freeboard height of the wall will contain the upper slope material by transferring any earth pressures through the wall backfill.

Below the toe of the retaining wall, arching of soil between the piles would provide suitable retention of the ground.

The wall may include the use of lightweight backfill behind the wall in order to reduce lateral earth pressure on the wall and in order to use an economical structural pile section without the need for tie-back anchors. The lightweight backfill may include pumice rock, geofoam, cellular foam concrete, or other available materials. An additional advantage to using lightweight backfill is that the wall could be constructed within the City of Tigard property and avoids needing tiebacks that may extend below adjoining properties.

The H-pile retaining wall does not stabilize the landslide on the downhill side of the wall or protect the creek channel. The intent of this stabilization measure is limited to supporting the upper slope and preventing additional ground movement from encroaching onto the private properties. However, removal of downslope landslide debris and reconstruction of the creek bank to the base of the retaining wall could be performed during future construction of Derry Dell Creek channel improvements.

Rock Buttress Permanent Stabilization

A rock buttress is a potentially cost-effective landslide stabilization alternative that both protects adjacent properties and prevents landslide debris from fouling or damaging the creek channel. The stabilization design involves removal of the existing landslide debris and reconstructing the slope using rock fill to the full extent of the landslide buttressing adjacent properties. The buttress would likely consist of a stone embankment fill with a maximum slope angle of 1.5H:1V. All loose eroded soil and wood debris should be removed from below the buttress down to native undisturbed intact soil. The sloping surface of the intact native surface should be benched with a step pattern prior to placement of Stone Embankment buttress material fill, with maximum dimension of 15 inches. Construction costs could be low to moderate compared to other permanent stabilization options.

There are three scenarios under which a rock buttress may be constructed:

1. Constructed as part of Derry Dell Creek channel improvement construction under the same mobilization and environmental permit, and accessed from Derry Dell Creek.

2. Constructed independently with environmental permitting in place, allowing work in the Derry Dell Creek channel and access from Derry Dell Creek. It may or may not be possible to obtain emergency environmental permitting to construct the buttress this year.
3. Constructed independently, outside of the Derry Dell Creek channel, in a manner that does not require environmental permitting. This may require access from 118th Court between neighboring houses and/or from the Derry Dell Creek canyon and may include use of specialized equipment such as cranes, conveyors, and temporary bridges. Even with use of specialized equipment, we are not certain that all environmental permitting requirements can be avoided.

CONCEPTUAL MITIGATION ALTERNATIVES COMPARISON

A summary of conceptual stabilization alternatives and approximate construction cost estimate ranges are provided in Table 1.

TABLE 1: AREA A CONCEPTUAL ALTERNATIVES

Mitigation Alternatives	Advantages	Disadvantages	*Construction Cost Estimate Range
Drainage Improvements	<ul style="list-style-type: none"> ▪ No new construction ▪ Minimal impact to private property ▪ Low cost 	<ul style="list-style-type: none"> ▪ Does not stabilize the landslide or upslope property ▪ Potential larger magnitude of future landslide failure into backyard ▪ Periodic maintenance is required ▪ Does not mitigate safety hazard in backyard 	<ul style="list-style-type: none"> ▪ Less than \$5,000
Plate Pile Temporary Stabilization	<ul style="list-style-type: none"> ▪ Low impact to private property ▪ Potential to construct entirely within City property if required ▪ Increases stability and allows time for permanent stabilization to be constructed ▪ Partially mitigates safety hazard in backyard ▪ Moderate cost 	<ul style="list-style-type: none"> ▪ Nominal stabilization that does not meet required factor of safety ▪ To achieve optimal results permanent piles may be installed on private property in the residential backyard ▪ Periodic maintenance of drainage improvements is required ▪ Requires specialty contractor 	<ul style="list-style-type: none"> ▪ \$20,000 to \$30,000

Retaining Wall Permanent Stabilization	<ul style="list-style-type: none"> ▪ Stabilized within City property with minimal impact to private property and disturbance or creek channel ▪ Permanent stabilization meeting required factor of safety ▪ Construction access from SW 118th Court ▪ No environmental permitting required ▪ No periodic maintenance ▪ Stabilization protecting private property can be constructed before next wet season 	<ul style="list-style-type: none"> ▪ Relatively high cost ▪ Does not mitigate landslide on downslope side of retaining wall ▪ Does not protect the creek channel fouling or damage due to future landslide debris ▪ Requires specialty contractor 	<ul style="list-style-type: none"> ▪ \$125,000 to \$175,000
Rock Buttress Permanent Stabilization	<ul style="list-style-type: none"> ▪ Permanent stabilization meeting required factor of safety ▪ Stabilizes entire landslide within City property and protects creek channel from fouling or damage due to future landslide debris ▪ No periodic maintenance ▪ May be constructed as part of creek channel improvements ▪ Low to moderate cost if constructed with environmental permitting allowing creek access ▪ Resists future creek bank scour ▪ Does not require a specialty contractor 	<ul style="list-style-type: none"> ▪ If accessed from Derry Dell Creek it may be several years before construction depending on environmental permitting and Derry Dell Creek improvement schedule ▪ May have environmental restrictions ▪ Construction difficult if not accessed from Derry Dell Creek with significant impacts to private property during construction ▪ Potential high cost if not accessed from Derry Dell Creek and constructed using specialized equipment to avoid environmental permitting 	<ul style="list-style-type: none"> ▪ Scenario (1) \$60,000 to \$90,000 if constructed during creek improvement construction ▪ Scenario (2) \$70,000 to \$110,000 if constructed independently with environmental permits allowing work in creek channel ▪ Scenario (3) \$150,000 to \$230,000 if constructed independently outside of the flood plain in area not requiring environmental permits

*Note: Construction cost estimates are provided for relative cost comparison of mitigation alternatives only and do not include permitting costs or final design and construction support costs. If prevailing wage applies construction costs may increase 30 percent.

RECOMMENDATIONS

In our opinion, the residential house at 13800 SW 118th Court is not at risk to be damaged by the landslide under the current conditions. However, we recommend that slope stabilization measures should be taken to reduce or eliminate the potential for continued encroachment of the landslide failure into the private residential properties. In our opinion, an additional landslide

failure could occur at any time dependent on weather conditions and there is a high risk that the failure could damage the back yard of 13800 SW 118th Court. An additional landslide failure could eventually also threaten or damage the neighboring back yard of 13830 SW 118th Court. There is a high risk that soil debris from each landslide failure will reach the Derry Dell Creek channel and the soil debris could foul or damage the creek. With each passing year there will be a higher risk of landslide damage to upslope private properties and the creek channel. If the entire area of the landslide failure is not stabilized prior to or during construction of Derry Dell Creek channel improvements, the channel improvements could be damaged by landslide debris.

Within the Derry Dell Creek channel, between SW 118th Court and SW 115th Avenue, we have not observed areas where private properties or the City sewer system are in imminent risk of damage from creek channel incision or outfall erosion. However, there is a risk that continued channel incision and outfall erosion could damage private properties or the City sewer prior to 2019 construction of Derry Dell Creek channel improvements. We recommend that the creek improvement construction schedule be advanced to reduce the risk of future damage. Prior to channel improvement construction we recommend that the City routinely monitor channel incision and outfall erosion particularly during the wet season. Special attention should be made where sewer manholes and pipelines are exposed, as well as the stilt foundations of two homes located on SW Fairview lane and the garage structure of a home on the west side of SW 115th Avenue just south of Derry Dell Creek.

In our opinion, the drainage improvements discussed above should be implemented immediately to the landslide below 13800 SW 118th Court. During the remainder of the wet season, the condition of the landslide should be monitored by the City on a weekly basis. If permanent stabilization consisting of a retaining wall or rock buttress is to be constructed this summer, the additional temporary stabilization measures discussed above may not be warranted due to the 6-foot setback of the property line from the current head scarp and a slight reduction of risk due to implementation of drainage improvements. The next landslide failure may not reach the property line and it may be possible to rapidly implement temporary stabilization prior to a successive failure extending beyond the property boundary. However, we cannot assure that the next landslide failure will not extend beyond the property line or that temporary stabilization can be installed in time to prevent additional damage. If permanent stabilization consisting of a retaining wall or rock buttress is not to be constructed this summer, we recommend installing temporary stabilization measures consisting of plate piles as soon as permissions can be obtained

from the property owner and the contractor can be mobilized. After installation of the temporary stabilization measures the permanent stabilization should be designed and constructed as soon as possible. If the permanent stabilization is to be constructed as part of the Derry Dell Creek improvements project, we recommend moving up the Derry Dell Creek improvement project ahead of the current 2019 schedule.

Based upon the comparisons summarized in Table 1, our current opinion is that the rock buttress is the preferred alternative due to relatively lower construction cost, simple construction that does not require a specialty contractor, stabilization of the entire landslide, protection of the creek channel from landslide debris, and resistance to creek bank erosion. Additional geotechnical recommendations and a civil engineer will be needed to advance final design and develop final bid documents.

LIMITATIONS

The above observations, opinions, and recommendations are based solely on brief visual surface observation of the site and explorations and findings of our 2009 Geotechnical Report. The above does not represent a comprehensive geologic or geotechnical assessment of slope stability within the current subject area of the 118th Court landslide or Derry Dell Creek channel. No explorations or engineering analysis have been performed to evaluate conditions of the Derry Dell Creek channel. Slope stability analysis of the landslide and recommendations included in our 2009 report do not include changes to the site or landslide that have occurred since 2009 and are no longer relevant. Recommendations in our 2009 report should not be used for final design. Cost estimate ranges provided for construction of landslide mitigation measures are approximate and do not include permitting costs or final design and construction support costs. They are provided solely for a relative comparison of construction costs and we do not guarantee that actual construction costs will fall within the ranges specified. Based upon the conceptual evaluation reported herein, we will prepare a scope of work and cost estimate to further evaluate stability and to advance the design of landslide mitigation alternatives.

This report was prepared for the exclusive use of the City of Tigard. It does not represent a warranty of surface or subsurface conditions. Within the limitations of the scope, schedule, and budget, the observations and recommendations presented in this report are compiled and presented in accordance with generally accepted professional geotechnical engineering and

Ms. Lori Faha, PE
City of Tigard Public Works
February 12, 2016
Page 15 of 15

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engineering geology principles and practice in this area at the time this report was prepared. We make no warranty, either express or implied.

Shannon & Wilson, Inc., has prepared a document, "Important Information About Your Geotechnical/Environmental Report," to assist you and others in understanding the use and limitations of our report. This document is included at the end of this report.

Sincerely,

SHANNON & WILSON, INC.

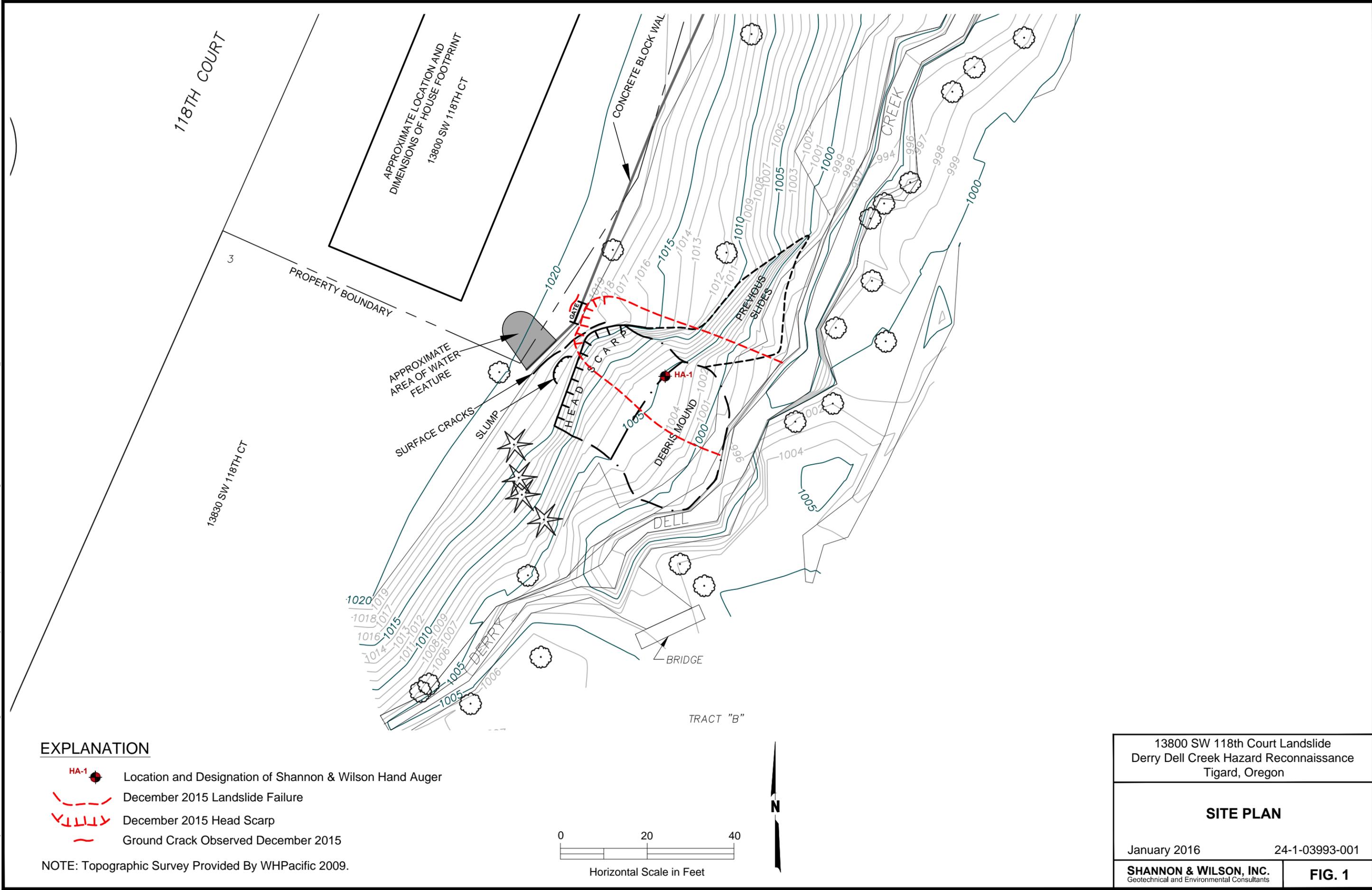


David J. Higgins, CEG
Associate | Engineering Geologist

DJH/RPP: aeb

Enclosures: Site Plan, Figure 1
Important Information About Your Geotechnical/Environmental Report

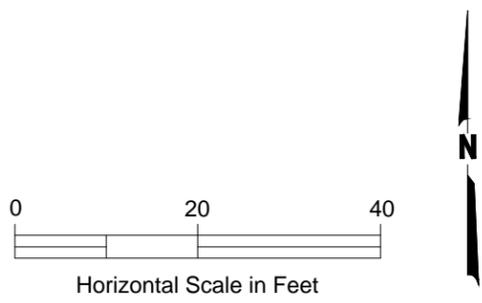
Risheng "Park" Piao
Vice President



EXPLANATION

-  Location and Designation of Shannon & Wilson Hand Auger
-  December 2015 Landslide Failure
-  December 2015 Head Scarp
-  Ground Crack Observed December 2015

NOTE: Topographic Survey Provided By WHPacific 2009.



13800 SW 118th Court Landslide Derry Dell Creek Hazard Reconnaissance Tigard, Oregon	
SITE PLAN	
January 2016	24-1-03993-001
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. 1



Date: February 12, 2016

To: Lori Faha, PE
City of Tigard Public Works

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland