Appendix M
Preliminary Haul Route
Recommendation for Snohomish County
Smith Island Estuary Restoration Project

October 4, 2013

Prepared for:
Snohomish County
3000 Rockefeller Avenue
Everett, WA 98201

Submitted to:
Greg Laird, Principal Engineer
Otak, Inc.
10230 NE Points Dr., Suite 400
Kirkland, WA 98033

Prepared by:
Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, WA 98103
October 4, 2013

Otak, Inc.
10230 NE Points Drive, Suite 400
Kirkland, WA 98033

Attn: Mr. Greg Laird

RE: HAUL ROUTE RECOMMENDATION FOR SMITH ISLAND ESTUARY RESTORATION PROJECT, SNOHOMISH COUNTY, WASHINGTON

The following preliminary letter report provides geotechnical and civil design information related to haul routes and access for the 60 percent design of the Smith Island Estuary Restoration project. The information in this report is to be used in developing the site plans and specifications considering the poor soil and access conditions at the project site.

EXECUTIVE SUMMARY

Access and haul routes are key construction elements for the Smith Island Estuary Restoration Project which involves setting back a 6,500-foot-long levee and restoring up to 375 acres of tidal marsh. Existing roads and access at the project site are limited. The levee setback construction will be in areas consisting of poor, saturated soils, which limits construction access.

This design report includes the following recommendations:

- **Construct a formal haul route and access route along the landward side of the levee using geotextile reinforcement and crushed rock subgrade and surfacing materials.**
- **Allow limited haul route and limited access on existing roads, two-track areas, ditch fill zones, and the waterward toe of the levee using low impact and biodegradable (hog-fuel) and appropriate construction equipment for wet and soft soil areas. Access and hauling will be prohibited beyond these allowable hauling areas to protect marsh restoration areas.**
- **Allow for some access and driving on the new setback levee embankment and include in the contract specifications criteria for replacing damaged, pumping levee embankment soils.**
- **Require off-road equipment with oversized tires or tracks suitable for working and traveling in extremely soft soil conditions. This type of equipment will be necessary for the ditch fills, tidal channel excavation and levee removal operations.**
This haul route design recommendations letter was developed very early in the design phase of the project (January through March 2013) prior to finalization of the geotechnical design report and the project design plans. Since that time, several access and haul route recommendations have been included in the design plans. Also, the design has changed in some instances, and recommendations provided in this report may no longer be relevant. The reader should refer to the most recent set of 60 percent design plans, issued in August 2013, to see if haul route recommendations in this letter are relevant to the current design plans.

INTRODUCTION

Construction of the new levee setback and breach of the existing levee will require planning and construction of multiple temporary haul routes at the Smith Island estuary restoration site. This letter provides an assessment of existing haul routes, and recommendations for proposed haul routes and construction methods for project construction. Ultimately, the haul route plan will be the construction contractor’s responsibility, with performance requirements and project limitations set forth in the contract specifications.

The site is a relatively flat farm area that was historically a tidal marsh. Based on the Geologic and Hydrologic Field Investigation Report prepared by Snohomish County Department of Public Works (October 2012), near-surface soils consist of very loose to loose, moist to wet, fine-grained organic silt; silt; clayey silt; and peat with local discontinuous lenses of moist to wet, very fine to fine sand (Younger Alluvium). The organic silt surface soils range in depth from about 5 to 10 feet below grade.

The project site along the levee setback and restoration areas is low in elevation, on the order of 4 to 6 feet (NAVD88). Surface soils at the site have been observed to have high moisture contents and are expected to be saturated at times.

The near-surface soils are characterized as having low shear strengths and will rut and pump under vehicle and equipment traffic loads, decreasing the effectiveness of construction operations. Therefore, we recommend the access and haul routes be constructed using stabilization methods necessary to accommodate construction access on the site.

The site has a variety of existing roads that range from unimproved, two-track access roads used for farm equipment to improved access roads with crushed rock surfacing used by maintenance
vehicles. The existing roads will not likely withstand the projected number of trips planned for construction by oversized and fully loaded vehicles. Temporary access and haul roads will need to be constructed and maintained throughout the project.

**EXISTING ACCESS ROADS**

Existing access roads at the site are shown in Figure 1. The Interstate-5 (I-5) frontage road, the Horse Farm access road, and the Hima Farms access roads are assumed they will not be available for construction use. The remaining roads could be used for construction access. The following summarizes the existing roads available for construction use, with information regarding the observed road condition and potential access needs along each route.

**12th Street NE**

The primary access to the site is 12th Street NE. The road is a two-lane, gravel road approximately 800 feet east of I-5, owned by the City of Everett. The pavement extends to 51st Avenue NE, where there is a gate that provides access to the existing levee. This road will be used as primary access to the site. Several access points will be needed from 12th Street NE to the project site, and will likely include access to:

- The proposed levee setback
- Segment H1
- 51st Avenue NE

Collaborative plans between Snohomish County and the City of Everett show the new levee crossing 12th Street NE and extending south to the Waste Water Treatment Plant.

**Segment H1**

Segment H1 is an existing, unimproved two-track farm road located about 1,900 feet east of the I-5 frontage road. Access to the road is through a locked gate on 12th Street NE. For discussion, Segment H1 will be divided into north and south sections, divided by the existing concrete slab-on-grade located west of the roadway. The south section of Segment H1 appears to be used more frequently than the north section. The durability of Segment H1 is unknown and will likely deteriorate with heavy equipment access. In order to be used effectively as a heavy equipment and haul route access, the Segment H1 route will need to be improved.
Segment H2

Segment H2 is an existing, two-track road on the east side of Tidal Channel “B” and the new setback levee alignment. We probed the soil using a steel T-probe and performed shallow shovel excavations along Segment H2. These limited explorations indicate that this segment has been improved by placement of a thin layer of quarry spalls over the ground surface. It appears that the quarry spalls have mixed with the native silty soil and that a geotextile separation fabric was not placed over the ground prior to quarry spall placement. In our opinion, Segment H2 is a logical place for access and hauling to the north portion of the site. The road will likely deteriorate with frequent use and require improvements and maintenance.

Segment H3

Segment H3 is an existing, improved road with crushed rock surfacing that extends from the north end of the Hima Farm road, and heads north to the existing levee, near the Tidal Channel “A” tidegate. The road embankment consists of a thin layer of quarry spalls mixed with native silty soil and that a geotextile separation fabric was not placed over the ground prior to quarry spall placement.

Segment H3 was recently rough-graded. A new culvert was installed with ballast backfill at the north end of the road. This culvert connects a toe ditch along the existing levee to Tidal Channel “A.” Segment H3 is located east of the new levee setback alignment and is a logical location for access, transport, and as a haul route loop. However, Segment H3 is located in the proposed marsh restoration area and we recommend rock removal be included as part of the restoration design plans, otherwise a rock road will remain in the marsh restoration area and limit habitat function and establishment of native marsh vegetation. The road will likely deteriorate with frequent use and require improvements and maintenance.

Existing Levee Access Road

The existing levee access road runs along the top of the existing levee on the east and north limits of the project site. The road is accessed from the south through the gate at the intersection of 51st Avenue and 12th Street NE. The road can also be accessed from the north at the north end of Segment H3 access road. The existing levee access road will be used during breaching of the existing levee and to access project activities near the east side of the site (such as filling ditches or restoration work). Access along this roadway will be necessary to perform
the north levee breach, and to salvage levee embankment material and to salvage existing rock protection along the northern sections of the existing levee. Rock and soil salvaged from the existing levee breach areas is available to the construction contractor for reuse in the project or salvage.

The existing levee access road is primarily covered with grass and has fairly deep tire ruts. The road is approximately 10 to 14 feet wide and may require widening to accommodate construction equipment. A short portion of the road near the Tidal Channel “A” breach area has crushed road surfacing material that was placed as part of the Army Corps of Engineers levee repair project. We performed limited shallow shovel excavations in the road surfacing material and observed about 4 inches of subangular, well-graded gravel over about 2 inches of 3-inch minus quarry spalls. Crushed rock was also observed on the existing levee access road east of the intersection of 12th Street NE and 51st Avenue NE, extending to where the road bends to the north. Shallow shovel excavations were not performed at this location and the depth of material is unknown.

This road will likely be subject to fewer passes of construction equipment than the access roads used for new levee construction, but pose construction risks related to the removal and regrading of soils from the breach zones. The Contractor should be made responsible for all temporary access and hauling conditions along the existing levee and breach zones, including maintenance and repair such that they complete the grading as required in the plans. The Contractor should be required to submit a levee and dike breach and removal plan showing how they plan to access, excavate, and haul materials from the existing levee, including materials, repair contingencies, and use of tracked equipment that can transport soils in soft soil conditions.

**51st Avenue NE**

51st Avenue NE extends from a gate at 12th Street NE, northward approximately 3,500 feet. The southern 1,200 feet of the road may have crushed rock subgrade material, although there currently is no evidence of crushed rock on the surface. The northern section of 51st Avenue NE is an unimproved, grass two-track road. Currently, this road provides access to Snohomish County groundwater monitoring well W-08. 51st Avenue NE may provide access for ditch filling and restoration activities at the site. The roadway may degrade under construction traffic. The Contractor should be made responsible to define what types of improvements,
stabilization, surfacing, maintenance, and inclusion of rock removal requirements for marsh restoration are needed to complete the project using the 51st Avenue NE access route.

HAUL ROUTE OPTIONS AND RECOMMENDATIONS

New Setback Levee Construction

The project will require the use of existing roads and the possible construction and use of new haul routes. In reviewing haul route options for the new setback levee construction, we considered the following project criteria: (1) existing access road proximity, (2) marsh restoration protection (i.e., reduction of impacts to the marsh), and (3) new levee structure protection.

Proximity to New Setback Levee

Segments H1, H2, and H3 have various proximities to the new setback levee.

Segment H1 does not directly follow the new setback levee. Direct access to the setback levee will likely be needed from Project Station 8+00 to 22+00. Segment H1 may provide a secondary access route; however, Segment H1 is in the restored marsh area. Marsh area road construction equipment will likely be limited to off-road vehicles and tracked equipment and marsh area road fill may be limited to hog-fuel. We recommend, instead, including an improved road along the levee setback (on the landward side of the levee using geotextiles and rock fill) rather than improve the existing Segment H1 access using hog-fuel to protect the marsh area. This would require design plans show the haul route along the existing levee, and the H1 segment would be shown as no access, or limited access.

Existing road Segment H2 travels along the landward side of the new setback levee from about Station 22+00 to 50+00, and is a logical location for building an access road. Segment H2 could be used as an improved access route along the entire length of the setback levee, or along portions of the setback levee where the existing Segment H2 road pulls away from the new levee construction. Rock and geotextile improvements may be left in place as part of construction. This recommendation should be confirmed with the levee horizontal drain and drainage trench design to confirm that compacted quarry spalls resulting from construction access will function as required to provide adequate seepage and drainage protection for the levee. Existing road Segment H3 does not directly follow the new setback levee. Segment H3 may provide a
secondary access route; however, Segment H3 is in the restored marsh areas. The existing
Segment H3 route may be useful as a construction turnaround; however, rock materials are not
suitable for restoration of the marsh and will likely need removal as part of the marsh restoration
work. We recommend that the existing Segment H3 rock surfacing materials be removed prior
to breaching of the existing levee and restoration of the marsh. We recommend construction of a
primary route be constructed along the landward side of the levee setback between Station 50+00
to 63+00.

**New Setback Levee Access Roads Construction and Marsh Protection Areas**

Construction of the levee setback structure and construction within the marsh restoration areas
(on the waterward side of the levee) require consideration of the type of equipment to be used,
probable construction methods, and access and haul routes that will be allowed for the project.
Placement of crushed rock materials and geotextiles to construct access roads within the marsh
areas are not aligned with project restoration objectives, unless removed from the project area
after construction. To reduce the volume of rock placed in the marsh restoration areas, we
recommend limitations on access including a requirement for the use of oversized, off-road
vehicles and tracked equipment and only allowing environmentally sensitive road improvements
such as hog-fuel surfacing. If access roads need to be improved to the marsh restoration areas,
we recommend that the specifications be written to allow the Contractor to use hog-fuel and
salvaged wood chips and debris as roadway surfaces. An example of acceptable hog-fuel
temporary access road in the marsh restoration area is shown in Figure 2. We recommend that
the specifications not allow the addition of crushed rock or gravel materials for haul route
surfacing in the marsh areas, and that the specifications require removal and restoration of haul
routes with existing crushed rock surfaces.

The required depth of hog-fuel placed over native subgrade to develop access roads is primarily
a performance-based decision depending upon the Contractor’s earthwork and hauling plans.
This requirement should be made the Contractor’s responsibility in the contract specifications.
Access roads and haul routes in the marsh restoration areas will likely require maintenance
during construction. The Contractor may elect in their earthwork and haul route plans to not
invest in hog-fuel for additional marsh access or haul road protection. If this is the case, then the
Contractor should be required in the contract specifications for all equipment access, hauling,
towing of stuck vehicles, maintaining the schedule and restoration of damaged areas.
For bidding and engineering opinion of probable cost comparison purposes, we recommend assuming that the depth of hog-fuel placed for each access road is 4 feet and that each temporary haul route is 15 feet wide. The exact length of temporary access haul roads needed in the marsh restoration areas is unknown. The Contractor will likely limit the amount of hog-fuel (or other stabilization measures) applied on the site to save costs. However, the costs for temporary access (hog-fuel stabilization or equipment towing) will need to be included as a portion of the work for the separate bid items listed with temporary access roads including ditch fills, marsh restoration features, and the existing levee breaches.

The cost associated with marsh area temporary access and haul road improvements using hog-fuel depends on the total amount of hog-fuel materials and temporary access improvements and/or towing, and the additional equipment needed to complete the project on schedule. If hog-fuel is imported, we estimate that the unit price could be as much as $15 to $25/Cubic Yard (CY).

There are numerous trees on site that may die due to restoration efforts and may be removed as part of the restoration aspects of the project. We recommend that the Contractor be allowed to set up a chipping and mulching operation on the site and produce hog-fuel in an attempt to lower costs. This would require identifying which trees on the site are available for removal and salvage and use as project hog-fuel. Buse Lumber is nearby and may also be able to provide material at a price less than is typical for sites farther from hog-fuel sources.

In our estimate, we assumed a lower cost option could be identified with a hog-fuel material price of $5 to $10/CY (Tables 2 and 3). The estimated quantities of hog-fuel materials needed were based on an assumption of a single access route, 5,500 feet long, 15 feet wide, with an initial placement of 2 feet of hog-fuel material and then repaired with an additional 1 foot of hog-fuel for maintenance. The access route would then be decommissioned, scarified, and graded and seeded with native marsh vegetation. In our estimate, temporary access roads with removal and decommission in the marsh areas would be in excess of $300k using the access configuration listed above. Considering these costs, contractors will likely limit the use of hog-fuel and improvements and utilize off road and tracked equipment to the extent possible. Allowing reuse of trees and debris could help with costs. Temporary access and haul route costs in the marsh areas will need to be accounted for in the bids, and the construction contractor should be made fully responsible for maintaining access and moving material across the site.
given the access and haul route constraints. This can be accomplished by including temporary access and hauling as part of the ditch fill and marsh restoration features bid item measurement and payment descriptions, and described in the temporary facilities section of the specifications. It can be reasonably anticipated that the costs for access and hauling in the marsh areas will likely create variability in certain bid items. The Contractor may load these costs differently for different bid items.

**New Setback Levee Embankment Construction and Fill Zone Protection**

Travel and access on the new setback levee should be limited. The contract specifications should specify restrictions that limit the potential damage to the embankment and compacted fill. Limited travel on the levee embankment will be necessary and should be allowed.

Construction of the new levee embankment will require hauling, placement, and compaction of levee fill material. The new levee will likely be constructed with moisture-sensitive, fine-grained soil. If levee fill is placed or traveled on during wet weather, or when moisture contents are high, the compacted embankment material may yield, deflect, and begin pumping during compaction or when loaded with heavy construction equipment. Therefore, depending on subgrade and fill conditions, hauling over the new levee compacted fill areas should be limited. Limitations on use and access of the levee embankment for access and construction should be clearly stated in the construction contract documents and specifications. The contract specifications should make it the Contractor’s responsibility to limit damage to compacted fills and to perform work as necessary to remove and replace work damaged by Contractor operations. The specifications should be written such that the field observer and construction administrator have defined contractual criteria and enforcement mechanisms by which to quantify damage and to enforce repairs to levee embankment fills. The following are example text that could be included in the contract specifications execution sections for managing setback levee compacted fill access and associated damage. These example sections should be edited as deemed appropriate by the County and the project team during development of the contract specifications.

*Levee Foundation and Fill Soils Pumping Conditions*

*Due to the high fines content and potential for pumping soils, the following conditions and criteria shall be adhered to for observing soils pumping, acceptable levels of pumping, and response actions that are required for the Contractor to provide in order to limit soils pumping and damage to the levee embankment compacted fills.*
Native Foundation Soils

Excessive Soil Pumping – Excessive soil pumping is defined as observed deformation of underlying native soils and sinking of large wheeled equipment more than 6 inches deep. If this condition is observed, the Contractor shall stop work activities in areas causing pumping soil conditions. Allow time for soils to heal and pore pressures to dissipate by working on other sections of the levee. Schedule impacts and the cost of embankment repair and replacement are borne by the Contractor. Geotextile reinforcements are included in the embankment design and shall be placed to bridge and protect native foundation materials prior to embankment material placement to reduce pumping conditions.

Levee Fill Soils

Minimal Soil Pumping – Minimal soil pumping is defined as spongy soil conditions whereby wheeled equipment and vehicles sink less than 3 inches deep, measured from the top of driving surface soil next to the tire to the bottom of tire tread. This will be an acceptable level of pumping and work activities may continue with close observation of soil conditions.

Moderate Soil Pumping – Moderate soil pumping is defined as spongy soil conditions whereby wheeled equipment and vehicles sink between 3 to 6 inches deep, measured from the top of driving surface soil next to the tire to the bottom of tire tread. When this condition occurs, the Contractor shall stop work activities on pumping soils and allow time for soils to heal and pore pressures to dissipate. Disking, reconditioning, and recompack of the soils in place, or removal and replacement of the embankment soils, will be performed as needed to repair damaged areas. Schedule impacts and the cost of embankment repair and replacement are borne by the Contractor.

Excessive Soil Pumping – Excessive soil pumping is defined as a deformation of soil whereby wheeled equipment and vehicles sink more than 6 inches deep, measured from the top of driving surface soil next to the tire to the bottom of tire tread. When this condition occurs, the Contractor shall stop work activities on pumping soils. The Contractor shall repair damage soils by removing damaged soils, and replacing and compacting with properly conditioned soils. Schedule impacts and the cost of embankment repair and replacement are borne by the Contractor.

Another protective mechanism for levee embankment fills is to provide specifications that would limit the potential for pumping conditions to occur. An example would be to limit the allowable moisture content and include specification language such as “compacted materials should result in a dense and unyielding condition.”
In our estimate, we assume that the Contractor will need to replace or repair 10 to 20 percent of the levee setback materials due to damages from heavy equipment damage, or other issues related to compacted embankment material conditions.

**New Levee Construction and Land Side Access Routes (Option 1)**

Option 1 would require the Contractor to construct improved and engineered access and haul routes on the landward side of the new setback levee. This option would reduce the risk of project delays and Contractor operation impacts associated with damages to the setback levee embankment and problems (such as towing of vehicles) on Contractor-designed access roads. Option 1, as presented here, is an owner-designed access and haul route for inclusion with the project plans and specifications. This option is preferred by the County.

Access and haul routes landward of the setback levee do not have the same construction restrictions and limitations as the access roads located on marsh restoration areas. We estimate the landward access road would be an approximately 30-foot-wide road west of the levee setback toe, with a drainage trench running along the west side of the access road. After levee construction is complete, the access road could remain as a permanent feature for future use as a service and maintenance road along the proposed levee toe trench.

Existing soil in the area of the proposed new access and haul route is potentially unstable for the anticipated construction loads. We recommend improving the stability of the access and haul route using imported gravel placed on separation and reinforcement geosynthetics, i.e., geotextiles and geogrids along the landward side of the levee (Exhibit 2).

Trucks and equipment should be driven in the middle of the stabilized road. Turnouts and passing lanes may be necessary. A typical recommended roadway section is shown in Exhibit 2, Detail 1. Our road embankment material design recommendation is based on 13,500 passes with a loaded John Deere D300-II articulated truck (or equivalent) and assumes 3 inches of allowable rut. Because of subgrade soil strength variability, weather, and vehicle operations, ruts that develop may exceed 3 inches after repetitive use on the access and haul route. These ruts should be filled-in periodically by adding specified road material. The ruts should be filled with material added to the rut and not be filled in by grading the roadway surface. In our experience, depending on the Contractor’s equipment, methods, and operations, the full roadway fill depth of the compacted subbase material may need replacement, along the entire length of
road, at least once during the course of the project. We recommend that this landward side access road be included in the construction contract for bidding purposes. The Contractor should be required to maintain the road throughout the life of the project and finish the road at the end of construction.

Our opinion of probable construction cost associated with constructing this landward side access and haul route is $1.3M to $1.7M (Table 1), depending upon the volume of material replacement necessary for the roadway to meet final grading specifications. Actual quantities and costs could vary higher or lower than the estimates.

**New Levee Construction and Land Side Access Routes (Option 2)**

Option 2 would allow the Contractor to use an unimproved access and haul route with oversized vehicles, working during dry weather, and the random placement of rock and other stabilization measures for construction access along the landward side of the levee setback (Table 3). The construction access route would be a temporary facility, incidental to levee construction, and the responsibility of the Contractor. At the end of construction, a permanent access road and haul route may be constructed, depending upon the need for such a feature and per the County’s decision to include.

Option 2 has the potential to provide construction cost savings to the project, but may also increase risks to the project schedule, budget, and/or Contractor operations. These risks include potential damage to the roadway, difficulty in enforcement and requiring repair by the Contractor, possible immobile vehicles, and/or project shut downs and delays due to weather. If access is not available to standard highway style haul trucks, then the embankment import fill and erosion protection rock may need to be double-handled with transfers from haul trucks to off-road dump trucks. This would be an additional cost that would likely result in higher import unit prices.

Another risk for Option 2 is that the Contractor would likely try to use the new setback levee compacted fill embankment as an access and haul route. Access on the compacted fills could cause damages and require replacement.

The cost associated with a landward side haul route using oversized equipment and little to no improvements has not been estimated. One potential cost that can be calculated is the
double-handling of material, at approximately $2.00/CY. For 150,000 CY of import and rock erosion protection material, an additional $300,000 of import double-handling costs would be borne by the Contractor and passed through to the owner. In addition, the lack of construction access and haul routes pose additional risks for cost increases due to weather delays and poor soil conditions. The potential project claim risk costs (Contractor construction costs and County and Consultant costs) for construction claims could potentially be large, with costs unknown at this time. It is likely that the double-handling costs and the potential weather and schedule claim costs for not having a road could be on the order of a formal road construction cost. Double-handling and risk costs associated with potential claims could be similar in cost as compared to an improved access road on the landward side of the levee. If this scenario were to happen, the costs might get paid to the Contractor, without the benefit of actually constructing an improved access route.

**Ditch Fills with Access Across Soft Marsh Areas**

Existing ditches are proposed to be filled with on site-generated materials. The location of the ditch fills is spread across the site and expansive. Construction of improved access and haul routes to the ditch locations is unlikely to be practical or cost-effective. The Contractor should be advised to expect soft soil conditions, and be required by the specifications to use appropriate methods and equipment to haul, deliver, and place ditch fill materials without access road improvements. The cost of the access to ditch fills and restoration features should be included in the unit price, measurement, and payment items.

**Existing Levee Breaches**

The existing levee is currently proposed to be breached in two locations: the North Breach and East Breach. It is likely that the Contractor will need to excavate and haul materials some distance to fill ditches that are not near the breach locations. It is likely unfeasible and not cost-effective to construct an improved access route along the existing levee breach areas. The Contractor should be required to provide access using off-road and tracked equipment, provide grading and access repairs, and provide hog-fuel and other stabilization features in order to remove and salvage existing levee fill materials from the breach areas.
SUMMARY OF RECOMMENDATIONS

In summary, Shannon & Wilson’s recommendations for access roads and haul routes at the Smith Island estuary restoration site include the following:

- An improved access and haul route located along the landward side of the new setback levee would be beneficial in reducing uncertainty in bids and reducing potential weather and schedule-related delay claim risks, costs, and change orders. We recommend including this feature in the project plans and specifications. It will reduce risks related to import hauling and potential schedule and weather delays and potential claims.

- Travel and access on the new setback levee embankment fills should be allowed, and strict performance criteria should be included in the contract specifications.

- Access and haul routes constructed in marsh areas should not use crushed rock, aggregate, or gravel materials that would require removal after project completion due to environmental concerns in the marsh. We recommend the County consider specifying that the Contractor use off-road and tracked vehicles and allow use of environmentally sensitive materials, such as hog fuel, for marsh area access improvements. Access and haul routes should be limited to the extent necessary and the limits of construction clearly shown on the plans. Otherwise, it could be anticipated that the contractor will drive equipment across broad areas of the marsh. We recommend a twenty foot buffer along the margins of breach excavations and ditch fills and the proposed interior restoration features. Costs for towing and yarding of construction equipment should be anticipated and included in the appropriate bid items. The schedule should also accommodate these types of typical delays. We also recommend the Contractor remove existing access road crushed rock and gravel materials from the marsh as part of the construction contract.

LIMITATIONS

This letter report was prepared for the exclusive use of Otak and Snohomish County and other members of the design team for specific application to the design of the Smith Island Estuary Restoration Project as it relates to the haul route and access as discussed in this letter report. The data contained in this letter report are based upon site conditions as they existed at the time this letter report was prepared, and upon existing field, soil, drainage and groundwater conditions. Within the limitations of the scope, schedule, and budget, the data presented in this letter report were collected and presented in accordance with generally accepted professional engineering practice in this area at the time this letter report was prepared. No warranty, express or implied, is made.
We assume that the survey data and modeling output provided by others has been accurately developed calibrated and that it comprises reliable information to perform the analysis. S&W cannot make claims regarding the correctness or accuracy of these models and data provided by others. Facts and conditions referenced in this letter report may change over time. Facts and conditions set forth here are applicable as described only at the time this letter report was written. We believe that the conclusions stated here are factual, but no guarantee is made or implied.

This letter report was prepared for the exclusive use of Otak and Snohomish County and its representatives and in no way guarantees that any agency or its staff will reach the same conclusions as S&W.

Sincerely,

SHANNON & WILSON, INC.

David R. Cline, P.E.
Senior Associate

MXR:DRC/mxr

Enc: References
   Table 1 – Preliminary Opinion of Probable Construction Cost, Smith Island Restoration Project – Landward Side Access Haul Route
   Table 2 – Preliminary Opinion of Probable Construction Cost, Smith Island Restoration Project – Option 1 – Marsh Restoration Areas
   Table 3 – Preliminary Opinion of Probable Construction Cost, Smith Island Restoration Project – Option 2 – Marsh Restoration Areas
   Figure 1 – Access and Haul Routes
   Figure 2 – Haul Route Sections

c: Bob Aldrich, Snohomish County
REFERENCES

## TABLE 1 - PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
**SMITH ISLAND RESTORATION - LANDWARD SIDE ACCESS HAUL ROUTE**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Item Cost</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Clearing and Grubbing</td>
<td>3.8</td>
<td>AC</td>
<td>$7,125.00</td>
<td>$27,360.00</td>
<td>RS Means 311010.10-0160</td>
</tr>
<tr>
<td>2.0</td>
<td>Geogrid BX1500 or equivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Material cost (assumes 30% overlap)</td>
<td>28,600</td>
<td>SY</td>
<td>$4.00</td>
<td>$114,400.00</td>
<td>(Per SRB and White Cap Supplier Cost)</td>
</tr>
<tr>
<td>2.2</td>
<td>Labor Cost</td>
<td>28,600</td>
<td>SY</td>
<td>$0.25</td>
<td>$7,150.00</td>
<td>RS Means 313219.16.1510</td>
</tr>
<tr>
<td>3.0</td>
<td>Geofabric Mirafi 140NC or equivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Material cost (assumes 30% overlap)</td>
<td>28,600</td>
<td>SY</td>
<td>$0.80</td>
<td>$22,880.00</td>
<td>White Cap Construction Supplies</td>
</tr>
<tr>
<td>3.2</td>
<td>Labor Cost</td>
<td>28,600</td>
<td>SY</td>
<td>$0.25</td>
<td>$7,150.00</td>
<td>RS Means 313219.16.1510</td>
</tr>
<tr>
<td>4.0</td>
<td>Crushed Rock (Initial Placement)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Import and Haul (1.15 Compaction Factor)</td>
<td>14,056</td>
<td>CY</td>
<td>$30.00</td>
<td>$421,666.67</td>
<td>Fisher Slough bid Tabs</td>
</tr>
<tr>
<td>4.2</td>
<td>Spreading &amp; Compaction</td>
<td>14,056</td>
<td>CY</td>
<td>$10.00</td>
<td>$140,555.56</td>
<td>Fisher Slough bid Tabs</td>
</tr>
<tr>
<td>5.0</td>
<td>Maintenance (100% Replacement)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Import and Haul (1.15 Compaction Factor)</td>
<td>14,056</td>
<td>CY</td>
<td>$30.00</td>
<td>$421,666.67</td>
<td>WSDOT Standard Item Inquiry</td>
</tr>
<tr>
<td>5.2</td>
<td>Spreading &amp; Compaction</td>
<td>14,056</td>
<td>CY</td>
<td>$10.00</td>
<td>$140,555.56</td>
<td>RS Means 312323.17.0020</td>
</tr>
</tbody>
</table>

**Equipment, Labor, and Material Costs** $1,303,384.44  
**Taxes (9.5%)** $123,821.52  
**Subtotal Cost** $1,427,205.97  
**Contingency (20%)** $285,441.19  
**Total Cost** $1,712,647.16
# Table 2 - Preliminary Opinion of Probable Construction Cost

## Smith Island Restoration - Option 2 - Marsh Restoration Areas

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Item Cost</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Hog Fuel (Bark or Wood Chip Mulch)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Import and Haul (15ft x 2ft x 5,000ft)</td>
<td>15,690</td>
<td>LCY</td>
<td>$ 5.00</td>
<td>$ 78,450.00</td>
<td>WSDOT Standard Item Inquiry</td>
</tr>
<tr>
<td>1.2</td>
<td>Placement and Spreading</td>
<td>15,690</td>
<td>LCY</td>
<td>$ 2.26</td>
<td>$ 35,459.40</td>
<td>RS Means 312323.17.0020</td>
</tr>
<tr>
<td>2.0</td>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Import and Haul Additional Fill (assumes 50% of original fill)</td>
<td>7,845</td>
<td>LCY</td>
<td>$ 5.00</td>
<td>$ 39,225.00</td>
<td>WSDOT Standard Item Inquiry</td>
</tr>
<tr>
<td>2.2</td>
<td>Placement and Spreading</td>
<td>7,845</td>
<td>LCY</td>
<td>$ 2.26</td>
<td>$ 17,729.70</td>
<td>RS Means 312323.17.0020</td>
</tr>
<tr>
<td>3.0</td>
<td>Haul Route Restoration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Scarifying &amp; Grading</td>
<td>8,333</td>
<td>SY</td>
<td>$ 2.26</td>
<td>$ 18,833.33</td>
<td>RS Means 312323.17.0020</td>
</tr>
<tr>
<td>3.2</td>
<td>Seeding</td>
<td>0.17</td>
<td>AC</td>
<td>$ 10,000.00</td>
<td>$ 1,721.76</td>
<td></td>
</tr>
</tbody>
</table>

| | | | | | | |
| | | | | | | |

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Item Cost</th>
<th>Other Information</th>
</tr>
</thead>
</table>

| Equipment, Labor, and Material Costs | $ 191,419.20 |
| Taxes (9.5%) | $ 18,184.82 |
| Subtotal Cost | $ 209,604.02 |
| Contingency (20%) | $ 41,920.80 |
| **Total Cost** | **$ 251,524.82** |
## TABLE 3 - PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST
### SMITH ISLAND RESTORATION - OPTION 1 - MARSH RESTORATION AREAS

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Units</th>
<th>Unit Cost</th>
<th>Item Cost</th>
<th>Other Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Hog Fuel (Bark or Wood Chip Mulch)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Import and Haul (15ft x 2ft x 5,000ft)</td>
<td>15,690</td>
<td>LCY</td>
<td>$10.00</td>
<td>$156,900.00</td>
<td>WSDOT Standard Item Inquiry</td>
</tr>
<tr>
<td>1.2</td>
<td>Placement and Spreading</td>
<td>15,690</td>
<td>LCY</td>
<td>$2.26</td>
<td>$35,459.40</td>
<td>RS Means 312323.17.0020</td>
</tr>
<tr>
<td>2.0</td>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Import and Haul Additional Fill</td>
<td>7,845</td>
<td>LCY</td>
<td>$10.00</td>
<td>$78,450.00</td>
<td>WSDOT Standard Item Inquiry</td>
</tr>
<tr>
<td>2.2</td>
<td>Placement and Spreading</td>
<td>7,845</td>
<td>LCY</td>
<td>$2.26</td>
<td>$17,729.70</td>
<td>RS Means 312323.17.0020</td>
</tr>
<tr>
<td>3.0</td>
<td>Haul Route Restoration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Scarifying &amp; Grading</td>
<td>8,333</td>
<td>SY</td>
<td>$2.26</td>
<td>$18,833.33</td>
<td>RS Means 312323.17.0020</td>
</tr>
<tr>
<td>3.2</td>
<td>Seeding</td>
<td>0.17</td>
<td>AC</td>
<td>$10,000.00</td>
<td>$1,721.76</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Equipment, Labor, and Material Costs</strong></td>
<td></td>
<td></td>
<td></td>
<td>$309,094.20</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Taxes (9.5%)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$29,363.95</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td>$338,458.15</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Contingency (20%)</strong></td>
<td></td>
<td></td>
<td></td>
<td>$67,691.63</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$406,149.77</strong></td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 1 - ACCESS AND HAUL ROUTES
Smith Island Restoration
FIGURE 2 - HAUL ROUTE SECTIONS

Smith Island Restoration

HAUL AND ACCESS ROAD STABILIZATION (LANDWARD SIDE)

HAUL AND ACCESS ROAD STABILIZATION (WATERWARD SIDE)

LEGEND:

1. HAUL ROUTE (30' WIDE)
2. PERMANENT ACCESS (QUARRY SPALLS/GEOTEXTILE STABILIZED SUBGRADE)
3. NEW TOE DRAIN DITCH
4. EXISTING TIDAL CHANNEL
5. HAUL ROUTE IMPROVED SUBGRADE ROAD WIDTH (LAND SIDE)
6. HAUL ROUTE IMPROVED SUBGRADE ROAD WIDTH (WATER SIDE)