Geotechnical Engineering Report

Skokomish Indian Tribe - Recycle & Transfer Building Replacement
80N Tribal Center
Skokomish, WA 98584
Parcel No. 42111-41-60010

February 28, 2025

prepared for:

AHBL, Inc.
Attention: Scott Kaul, P.E., LEED AP
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MGI Project Z0762

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APPENDIX A

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February 28, 2025

AHBL, Inc.
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Attention: Scott Kaul, P.E., LEED AP
Associate Principal

Subject: Geotechnical Engineering Report
Skokomish Indian Tribe - Recycle & Transfer Building Replacement
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MGI Project Z0762

Dear Mr. Kaul:

Migizi Group, Inc. (MGI) is pleased to submit this report describing the results of our geotechnical engineering evaluation of the recycle & transfer building replacement currently proposed adjacent to the Skokomish Tribal Center in Mason County, WA.

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

1.0 SITE AND PROJECT DESCRIPTION

The project site consists of a previously developed, 3.78-acre parcel, situated immediately northeast of the intersection between Fish House Rd & N Tribal Center Rd, towards the southeast corner of the census-designated place (CDP) of Skokomish, in Mason County, WA, as shown on the enclosed Topographic and Location Map (Figure 1). The project area is roughly rectangularly shaped, being elongated from north to south and occupied by various structures and pavements associated with the Skokomish Tribal Center. Amongst these were two buildings utilized for recycling and transfer services towards the southeast corner of the complex. These structures have recently been demolished due to poor condition. Topographically, the project area is relatively level, with minimal grade change observed over its full extent.

Improvement plans involve the clearing/stripping/grading of the subject property and the erection of two pre-engineered metal buildings to provide recycling and transfer services. Supplementary asphalt pavements will also be added to provide access to these structures. Site produced stormwater will be retained onsite if feasible.

2.0 EXPLORATORY METHODS

We explored surface and subsurface conditions at the project site on January 31, 2025. Our exploration and evaluation program comprised the following elements:

- Surface reconnaissance of the site,
- Three test pit explorations (designated as TP-1 through TP-3) advanced on January 31, 2025, and
- A review of published geologic and seismologic maps and literature.

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

TABLE 1
APPROXIMATE LOCATIONS AND DEPTHS OF EXPLORATIONS

Exploration	Functional Location	Termination Depth (feet)
TP-1	Northeast corner of proposed improvement area	7
TP-2	East-central portion of proposed improvement area	7
TP-3	Southeast corner of proposed improvement area	7

The specific numbers and locations of our explorations were selected in relation to the existing site features, under the constraints of surface access, underground utility conflicts, and budget considerations.

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

2.1 Test Pit Procedures

Our exploratory test pits were excavated with a rubber-tracked mini-excavator operated by an excavation contractor under subcontract to the client. A geologist from our firm observed the test pit excavations, collected soil samples, and logged the subsurface conditions.

The enclosed test pit logs indicate the vertical sequence of soils and materials encountered in the test pits, based on our field classifications. Where a soil contact was observed to be gradational or undulating, our logs indicate the average contact depth. We estimated the relative density and consistency of the in-situ soils by means of the excavation characteristics and the stability of the test pit sidewalls. Our summary logs also indicate the approximate depths of any sidewall caving or groundwater seepage observed in the test pit. The soils were classified visually in general accordance with the system described in Figure A-1, which includes a key to the exploration logs. Summary logs of our explorations are included as Figures A-2 through A-4.

3.0 SITE CONDITIONS

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

3.1 Surface Conditions

As previously indicated, the project site consists of a previously developed, 3.78-acre parcel, situated immediately northeast of the intersection between Fish House Rd & N Tribal Center Rd, towards the southeast corner of the census-designated place (CDP) of Skokomish, in Mason County, WA. The project area is roughly rectangularly shaped, being elongated from north to south and occupied by various structures and pavements associated with the Skokomish Tribal Center. Amongst these were two buildings utilized for recycling and transfer services towards the southeast corner of the complex. These structures have recently been demolished due to poor condition. Within the footprint of the these now removed structures is pea gravel, previously utilized as capillary break material, and concrete rubble, remnants from the demolished slabs/footings. The proposed improvement area is bound on the north and west by existing Skokomish Tribal Center facilities, and along the east by a communal athletic field.

Topographically, the project area is relatively level, with minimal grade change being observed to its extent. A slight dip in grade is observed from west to east, towards the aforementioned athletic field. Vegetation onsite is limited to lawn grasses and scattered brush along the margins of the proposed improvement area.

At the time of our site visit, ponding was observed along the base of the athletic field immediately east of the proposed improvement area. No other hydrologic features were observed on site such as seeps, springs, ponds, or streams, nor was there evidence of surface hydrology present. The course of the Skokomish River is approximately 1,500 feet east of the project area.

3.2 Soil Conditions

We observed subsurface conditions through the advancement of three test pit explorations along the east side of the proposed improvement area. In general, explorations revealed relatively consistent subgrade conditions, consisting of a thin surface cap of topsoil, underlain by native alluvial soils, which ranged in composition from fine silty sand to gravel with fine to coarse sand. In general, native alluvial soils became cleaner and coarser with depth. More fine-grained deposits were observed at near surface elevations, transitioning to fine to medium sand, and ultimately gravels. Gravel deposits were encountered at depths of 3 ½ to 4 feet below existing grade. Gravelly alluvial soils were observed through the termination of all of our test pit explorations, a maximum depth of 7 feet below existing grade. Alluvial soils, as encountered onsite, were observed in a loose to very loose in situ condition, with extensive caving being observed during the course of our test pit explorations.

Native soil is directly associated with the geologically recent meandering of the Skokomish River channel as well as archaic flood plain deposits. Holocene alluvium is typically described as being poorly consolidated beds of silts, sands, and some gravel, which can range from fine to coarse grained silts and sands. Intermittent beds of peat have been observed elsewhere in the valley, but not on this site directly.

In the *Geologic Map of the Skokomish Valley and Union 7.5-minute Quadrangles, Mason County, Washington*, as prepared by the Washington State Department of Natural Resources (WSDNR) (2011), the project site is mapped as containing Qoa, or relict Holocene-aged alluvium. The National Cooperative Soil Survey (NCSS) for the Mason County Area, classifies soils onsite as Sr – Skokomish silt loam, 0 to 3 percent slopes. These soil series typically range in composition from sandy loam to stratified gravelly sand and are directly associated with flood plain deposits from the Skokomish River. Our field observations generally correspond with the site classifications prepared by both the WSDNR and NCSS. An excerpt from the mapping is presented as Figure 3 below.

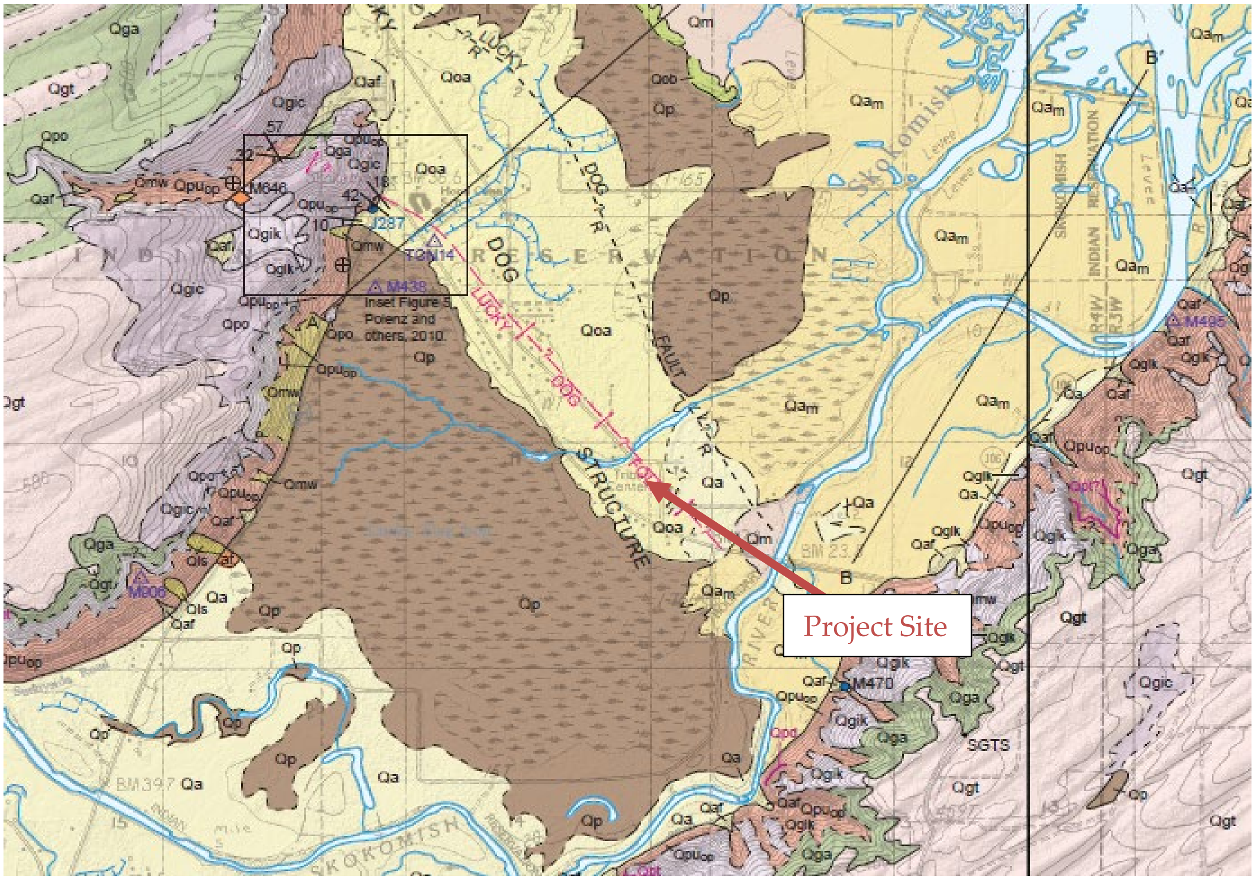

Figure 3. Excerpt from the Geologic Map of the Skokomish Valley and Union 7.5-minute Quadrangles, Mason County, Washington (2011)

The enclosed exploration logs (Appendix A) provide a detailed description of the soil strata encountered in our subsurface explorations.

3.3 Groundwater Conditions

At the time of our initial reconnaissance and subsurface explorations (January 31, 2025), we encountered groundwater in all our test pit explorations, which extended to a maximum depth of 7 feet below existing grade. Groundwater levels ranged from 21 to 24 inches below existing grade. Given the fact that our explorations were conducted towards the middle of what is considered the rainy season across Western Washington (November 1 to March 31), water levels should not rise much higher than that which we observed. Groundwater levels will fluctuate with localized geology and precipitation levels. In addition, due to the loose and saturated nature of the alluvial silty sands and sands observed in test pits, shallow groundwater may result in rapid seepage, which can be observed as "flowing sands", in deeper open trench line excavations for utilities.

3.4 Liquefaction Potential

Liquefaction is a sudden increase in pore water pressure and a sudden loss of soil shear strength caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose, fine to medium sands with a fines (silt and clay) content of less than about 20 percent are most susceptible to liquefaction below the water table. The alluvial soils encountered beneath the project area, when saturated, should be considered a moderate to high risk for liquefaction and would likely liquefy during a large-scale seismic event, which could result in post-construction settlement. Recommendations for foundation subgrade preparations contained in this report would help mitigate some of this risk.

The *Mason County Seismic Soils & Liquefaction Risk Map*, as prepared by Bridgewater Consulting, dated July 10, 2017, similarly classifies the site as having a moderate to high risk for soil liquefaction during a large-scale seismic event, as shown below (page 6).

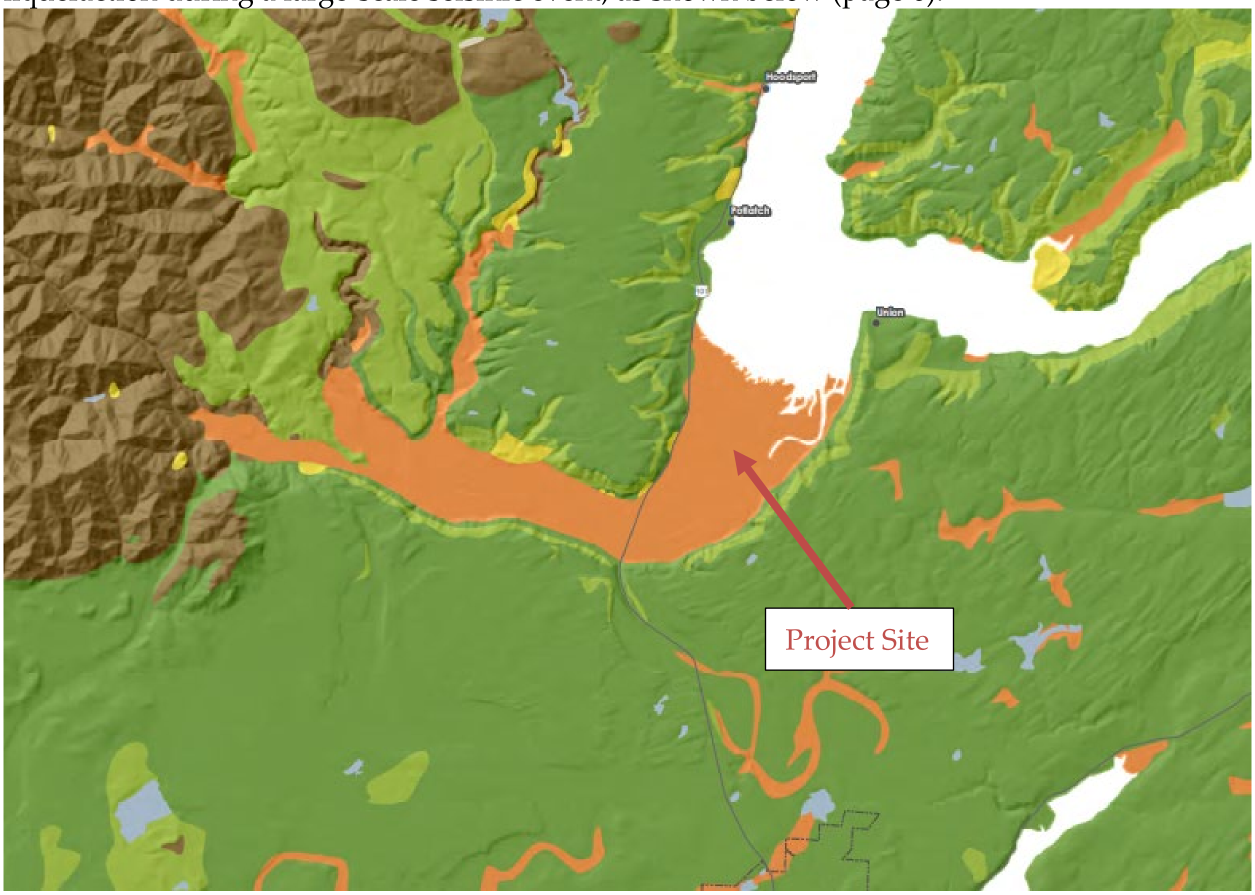

Figure 4. Excerpt from the Mason County Seismic Soils & Liquefaction Risk Map (2017)

3.5 Seismic Conditions

The site is in the Puget Sound basin, which has experienced several earthquakes. A detailed description of the regional seismicity is beyond the scope of this report; however, previous regional earthquakes can be split into two general categories: 1) large earthquakes with a moment magnitude greater than 8.0 ($M_W > 8.0$) and 2) modest size earthquakes with a moment magnitude generally less than 7.25 ($M_W < 7.25$). In all cases, the thickness of the soil between the bedrock and the ground surface can change (usually amplify) the seismically induced ground motions and therefore the inertial loads acting on surface structures.

"Site Class" is a classification system used by the International Building Code (IBC) and ASCE 7 to provide some insight to the potential for ground motion amplification. The site class is based on the properties of the upper 100 feet of the soil and rock materials at the site per ASCE 7-16 Section 11.4.8, a ground motion hazard analysis or site-specific response analysis is required for:

1. All structures on Site Class F sites.
2. All seismically isolated structures and structures with damping systems on sites with S_1 greater than or equal to 0.6.
3. All structures on Site Class E sites with S_s greater than or equal to 1.0.
4. All structures on Site Class D and E sites with S_1 greater than or equal to 0.2.

Because the site soils are likely to liquefy during design seismic shaking, this site is classified as Site Class F and ASCE 7-16 Section 11.4.8 requires a site-specific response analysis be performed unless one of the three Section 11.4.8 exceptions and/or the exception to ASCE 7-16 20.3.1.1 applies. For example:

- Exception 1 to 20.3.1 – If the fundamental vibration period of the structure is equal to or less than 0.5 seconds, then site response analysis is not required, and the Site Class may be taken as Site Class D (Stiff Soil) and the corresponding design response spectrum can be derived from Figure 11.4-1, Table 11.4-1 and Table 11.4-2.
- Exception 3 of Section 11.4.8 – If on Site Class E/F sites S_1 is greater than or equal to 0.2 and structure's period 'T' is greater than or equal to T_s (as defined in the code) and the equivalent static force procedure is used for design, then site response analysis is not required.

Typically, Exception 3 of Section 11.4.8 is more restrictive than Exception 1 to Section 20.3. We recommend that the applicability of these exceptions and the structural design procedure to be used be determined by the structural engineer.

If the structural engineer determines Exception 1 to 20.3.1 applies, we recommend the design seismic values provided in Table 2 (below) be used.

TABLE 2
SEISMIC DESIGN PARAMETERS

Parameter	Value	Basis
Site Class	D – Stiff Soil	Site specific data
S_S	1.559	seismicmaps.org
F_a	1 [A]	seismicmaps.org
S_{MS}	1.559	$= F_a \cdot S_S$
S_{DS}	1.039	$= {}^2/_3\, S_{MS}$
S_1	0.587	seismicmaps.org
F_V	1.713 [B, C]	2018 IBC
S_{M1}	1.01 [B, C]	$= F_V \cdot S_1$
S_{D1}	0.670 [B, C]	$= {}^2/_3\, S_{M1}$
PGA	0.672g	seismicmaps.org
PGA_M	0.739g	seismicmaps.org
T_0	-- [C]	Not applicable
T_S	-- [C]	Not applicable
T_L	16 sec	seismicmaps.org

Notes:
A. Use the value provided unless the simplified design procedure of ASCE 7 Section 12.14 is used. If this occurs, please contact our office for more information.
B. Based on Table 1613.2.3(2) of the 2018 IBC – An ASCE 7-16 Chapter 21 analysis has not been performed.
C. More detailed seismic design criteria are available upon request. Please contact MGI for more information.

3.6 Infiltration Conditions

As indicated in the *Soil Conditions* section of this report, the project area is underlain by massive alluvial deposits ranging in composition from fine silty sand to gravel with fine to medium sand. This material was relatively consistent through the termination of our explorations, with the more granular counterpart being the predominant soil type. Typically, these soil conditions would appear amenable to stormwater retention. However, given the shallow groundwater levels observed over the course of our evaluation, we believe that infiltration is not feasible for this project. Site produced stormwater should be collected and diverted to an existing stormwater system along N Tribal Center Rd if feasible or managed through dispersion or other appropriate means.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Improvement plans involve the clearing/stripping/grading of the subject property and the erection of two pre-engineered metal buildings to provide recycling and transfer services. Supplementary asphalt pavements will also be added to provide access to these structures. Site produced stormwater will be retained onsite if feasible. We offer the following recommendations:

- Feasibility: Based on our field explorations, research and evaluations, the proposed structures and pavements appear feasible from a geotechnical standpoint.

- Foundation Options: Over-excavation of spread footing subgrades to a depth of 3 to 5 feet and construction of structural fill bearing pads will be necessary for foundation support of the proposed recycling and transfer services structures. If foundation construction occurs during wet conditions, it is likely that a geotextile fabric and/or a packed layer of quarry spall rock, placed between bearing pads and native soils, will also be necessary. Recommendations for spread footing are provided in Section 4.2.

- Floor Options: Based on explorations across the site, we recommend that floor sections be over-excavated to a minimum depth of 2 feet, then placement of suitable and properly compacted structural fill as a floor subbase. We do not anticipate that adequate bearing soil will be encountered within the top 5 feet, and we foresee the need for imported and compacted granular fill subbase. Recommendations for slab-on-grade floors are included in Section 4.3. If floor construction occurs during wet conditions, it is likely that a geotextile fabric and/or a packed layer of quarry spall rock, placed between bearing pads and native soils, will also be necessary. Fill underlying floor slabs should be compacted to 95 percent (ASTM:D-1557).

- Pavement Sections: It is our understanding that proposed improvements will also entail the introduction of supplementary access road towards the southeast corner of the Skokomish Tribal Center property. We recommend a conventional pavement section comprising an asphalt concrete pavement over a crushed rock base course over properly prepared (compacted) subgrade or granular subbase. Given the relative loose/very loose condition of native onsite soils, we recommend an over-excavation in proposed asphalt areas of 2 feet, with the placement and compaction of a suitable structural fill subbase.

  All soil subgrades below 2 feet should be thoroughly compacted then proof-rolled with a loaded dump truck or heavy compactor during dry weather. Any localized zones of yielding subgrade disclosed during this proof-rolling operation should be over-excavated to a depth of 12 inches and replaced with suitable structural fill material.

- Infiltration Conditions: Given the shallow groundwater levels observed over the course of our evaluation; we believe that infiltration is not feasible for this project. Site produced stormwater should be collected and diverted to an existing stormwater system along N Tribal Center Rd if feasible or managed through dispersion or other appropriate means.

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

4.1 Site Preparation

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

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

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

Clearing and Stripping: After surface and near-surface water sources have been controlled, sod, topsoil, and root-rich soil should be stripped from the site. Our explorations and field observations indicate that the organic horizon can reach thicknesses upwards of 4 inches across regions that have not already been stripped. Stripping is best performed during an extended period of dry weather.

Site Excavations: Based on our field explorations, we anticipate that excavations will encounter loose/very loose sandy, gravelly alluvial soils. This material can be easily excavated utilizing standard excavation equipment.

Dewatering: We anticipate that site excavations will encounter groundwater at shallow depths during periods of extended precipitation. In addition, if excavations of trench lines are left open for an extended period of time, rapid seepage of groundwater may be observed. If groundwater is encountered during the course of regular earthwork activities, we anticipate that an internal system of ditches, sump holes, and pumps will be adequate to temporarily dewater shallow excavations. For deeper excavations well below the water table, extensive dewatering equipment, such as well points may be necessary.

Temporary Cut Slopes: At this time, final designs and construction sequencing have not been completed. To facilitate project planning we provide the following general comments regarding temporary slopes:

- All temporary soil slopes associated with site cutting or excavations should be adequately inclined and covered in plastic sheeting to prevent sloughing and collapse,

- Temporary cut slopes in site soils should be no steeper than 1½H:1V, and
- Temporary slopes should conform to Washington Industrial Safety and Health Act (WISHA) regulations.

These general guidelines are necessarily somewhat conservative (steeper temporary slopes may be possible). As the project progresses, temporary grading plans are developed, final site features are better defined, and a contractor is engaged, MGI may modify these general guidelines to allow steeper slopes.

<u>Subgrade Compaction</u>: Exposed subgrades for the foundations of the planned structures should be compacted to a firm, unyielding state before new concrete or fill soils are placed. Any localized zones of looser granular soils observed within a subgrade should be compacted to a density commensurate with the surrounding soils. In contrast, any organic, soft, or pumping soil observed within a subgrade should be over-excavated and replaced with a suitable structural fill material. All soil subgrades below 2 feet should be thoroughly compacted then proof-rolled with a loaded dump truck or heavy compactor during dry weather.

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

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

- *<u>Surficial Organic Soil and Organic-Rich Topsoil</u>:* Where encountered, surficial organic soils, like duff, topsoil, root-rich soil, and organic-rich fill soils, are *not* suitable for use as structural fill under any circumstances, due to high organic content. Consequently, this material can be used only for non-structural purposes, such as in landscaping areas.
- *<u>Alluvial Fine to Medium Sand</u>*: Where encountered, and if properly segregated from its siltier counterpart, the native fine to medium sands are a possible source of structural fill. This material type is relatively impervious to moisture content variations and can be reused in most weather conditions.

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

<u>Slope Protection</u>: We recommend that a permanent berm, swale, or curb be constructed along the top edge of all permanent slopes to intercept surface flow. Also, a hardy vegetative groundcover should be established as soon as feasible, to further protect the slopes from runoff water erosion.

Alternatively, permanent slopes could be armored with quarry spalls or a geosynthetic erosion mat.

4.2 Spread Footings

In our opinion, conventional spread footings will provide adequate support for the proposed recycling and transfer services structures, if the subgrades are properly prepared. Due to the loose/very loose soils that underlie the site, over-excavation of spread footing subgrades, to a depth of 3 to 5 feet, and the construction of structural fill bearing pads, will be necessary for foundational support of the new structures. We offer the following comments and recommendations for spread footing design.

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

Bearing Subgrades: Footings should bear on medium dense or denser, undisturbed native soils or properly compacted structural fill which bears on undisturbed medium dense to very dense native soils. Structural fill bearing pads, 3 to 5 feet thick and compacted to a density of at least 95 percent (based on ASTM: D-1557), should underlie spread footings for the proposed construction. If foundation work occurs during wet conditions, it is possible that a geotextile fabric, placed between the bearing pad and native soil, will be necessary. Refer to the *Structural Fill* section of this report.

In general, before footing concrete is placed, any localized zones of loose soils exposed across the footing subgrades should be compacted to a firm, unyielding condition, and any localized zones of soft, organic, or debris-laden soils should be over-excavated and replaced with suitable structural fill. Structural fill bearing pads should be compacted to a density of at least 95 percent (based on ASTM: D-1557).

Lateral Over-excavations: Because foundation stresses are transferred outward as well as downward into the bearing soils, all structural fill placed under footings should extend horizontally outward from the edge of each footing. This horizontal distance should be equal to the depth of placed fill. Therefore, placed fill that extends 3 feet below the footing base should also extend 3 feet outward from the footing edges.

Subgrade Observation: All footing subgrades should consist of firm, unyielding, native soils or structural fill materials that have been compacted to a density of at least 95 percent (based on ASTM:D-1557). Footings should never be cast atop loose, soft, or frozen soil, slough, debris, existing uncontrolled fill, or surfaces covered by standing water.

Bearing Pressures: In our opinion, for static loading, footings that bear dense, properly prepared bearing pads can be designed for maximum allowable soil bearing pressures listed in the following table:

Bearing Pad Thickness (feet)	Allowable Bearing Pressure (psf)
3	1,500
4	2,000
5	2,500

A one-third increase in allowable soil bearing capacity may be used for short-term loads created by seismic or wind related activities.

Footing Settlements: Assuming that structural fill soils are compacted to a dense or denser state, we estimate that total post-construction settlements of properly designed footings bearing on properly prepared subgrades will not exceed 1 inch, under static conditions. Differential settlements for comparably loaded elements may approach one-half of the actual total settlement over horizontal distances of approximately 50 feet.

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

Lateral Resistance: Footings that have been properly backfilled as recommended above will resist lateral movements by means of passive earth pressure and base friction. We recommend using an allowable passive earth pressure of 225 psf and an allowable base friction coefficient of 0.35 for both soil types.

4.3 Slab-On-Grade Floors

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

Floor Subbase: For the proposed recycling and transfer services structures, we recommend over-excavation of slab-on-grade floor subgrades to a minimum depth of 1.5 feet, then placement of properly compacted structural fill as a floor subbase. If floor construction occurs during wet conditions, it is likely that a geotextile fabric and/or compacted layer of quarry spall rock, placed between the structural fill floor subbase and native soils, will be necessary. All subbases should be compacted to a density of at least 95 percent (based on ASTM:D-1557).

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

4.4 Drainage Systems

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

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

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

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

4.5 Asphalt Pavement

It is our understanding that proposed improvements will also entail the introduction of supplementary access road towards the southeast corner of the Skokomish Tribal Center property. We offer the following comments and recommendations for pavement design and construction.

Subgrade Preparation: After removal of any organics underlying proposed areas of pavement, we recommend a conventional pavement section comprising an asphalt concrete pavement over a crushed rock base course over a properly prepared (compacted) subgrade or a granular subbase. Given the relative loose/very loose soil conditions observed across the site, we recommend the over-excavation of 24 inches of the existing subgrade material underlying the proposed pavement sections and replacement with a suitable structural fill subbase. We recommend limiting the subgrade preparation to times of dry weather.

All soil subgrades below 24 inches should be thoroughly compacted, then proof-rolled with a loaded dump truck or heavy compactor. Any localized zones of yielding subgrade disclosed during this proof-rolling operation should be over excavated to an additional maximum depth of 12 inches and replaced with suitable structural fill material. All structural fills should be compacted according to our recommendations given in the *Structural Fill* section. Specifically, the upper 2 feet of soils underlying pavement section should be compacted to at least 95 percent (based on ASTM D-1557), and all soils below 2 feet should be compacted to at least 90 percent.

Pavement Materials: For the base course, we recommend using imported crushed rock, such as "Crushed Surfacing Top Course" per WSDOT Standard Specification 9-03.9(3). If a subbase course is needed, we recommend using imported, clean, well-graded sand and gravel such as "Ballast" or "Gravel Borrow" per WSDOT Standard Specifications 9-03.9(1) and 9-03.14, respectively.

Conventional Asphalt Sections: A conventional pavement section typically comprises an asphalt concrete pavement over a crushed rock base course. We recommend using the following conventional pavement sections:

Pavement Course	**Minimum Thickness**		
	Driveways	**Access Roads**	**Areas subjected to Heavy Traffic**
Asphalt Concrete Pavement	3 inches	4 inches	5 inches
Crushed Rock Base	6 inches	8 inches	10 inches
Granular Fill Subbase (if needed)	12 inches	16 inches	20 inches

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

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

4.6 Structural Fill

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

Materials: Typical structural fill materials include clean sand, gravel, pea gravel, washed rock, crushed rock, well-graded mixtures of sand and gravel (commonly called "gravel borrow" or "pit-run"), and miscellaneous mixtures of silt, sand, and gravel. Recycled asphalt, concrete, and glass, which are derived from pulverizing the parent materials, are also potentially useful as structural fill in certain applications. Import soils used for structural fill should not contain any organic matter or debris, nor any individual particles greater than 4 inches in diameter.

Fill Placement: Clean sand, gravel, crushed rock, soil mixtures, and recycled materials should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical compactor.

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

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

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

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

5.0 RECOMMENDED ADDITIONAL SERVICES

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

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

6.0 CLOSURE

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

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

Respectfully submitted,

MIGIZI GROUP, INC.

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02/28/25

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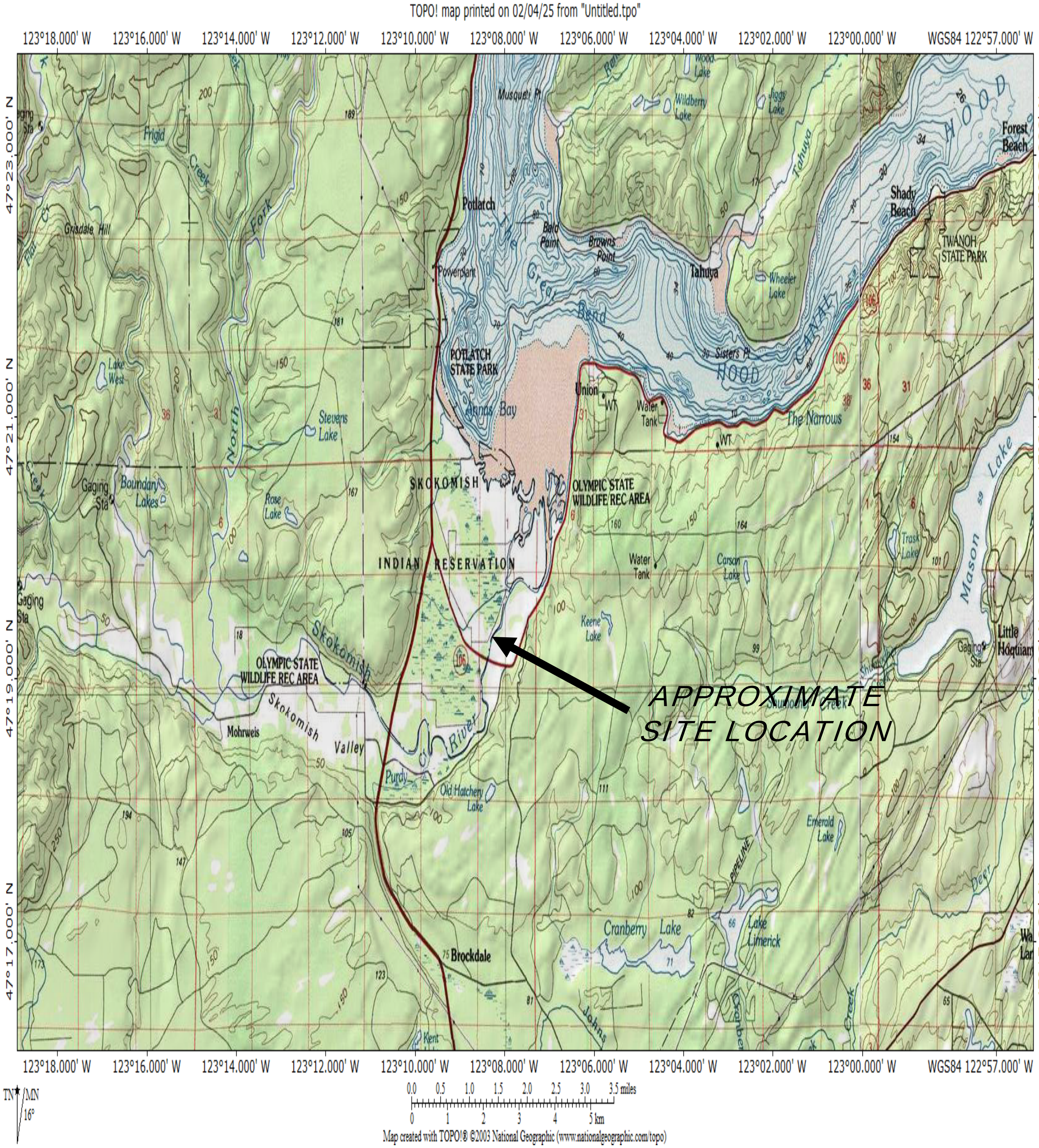
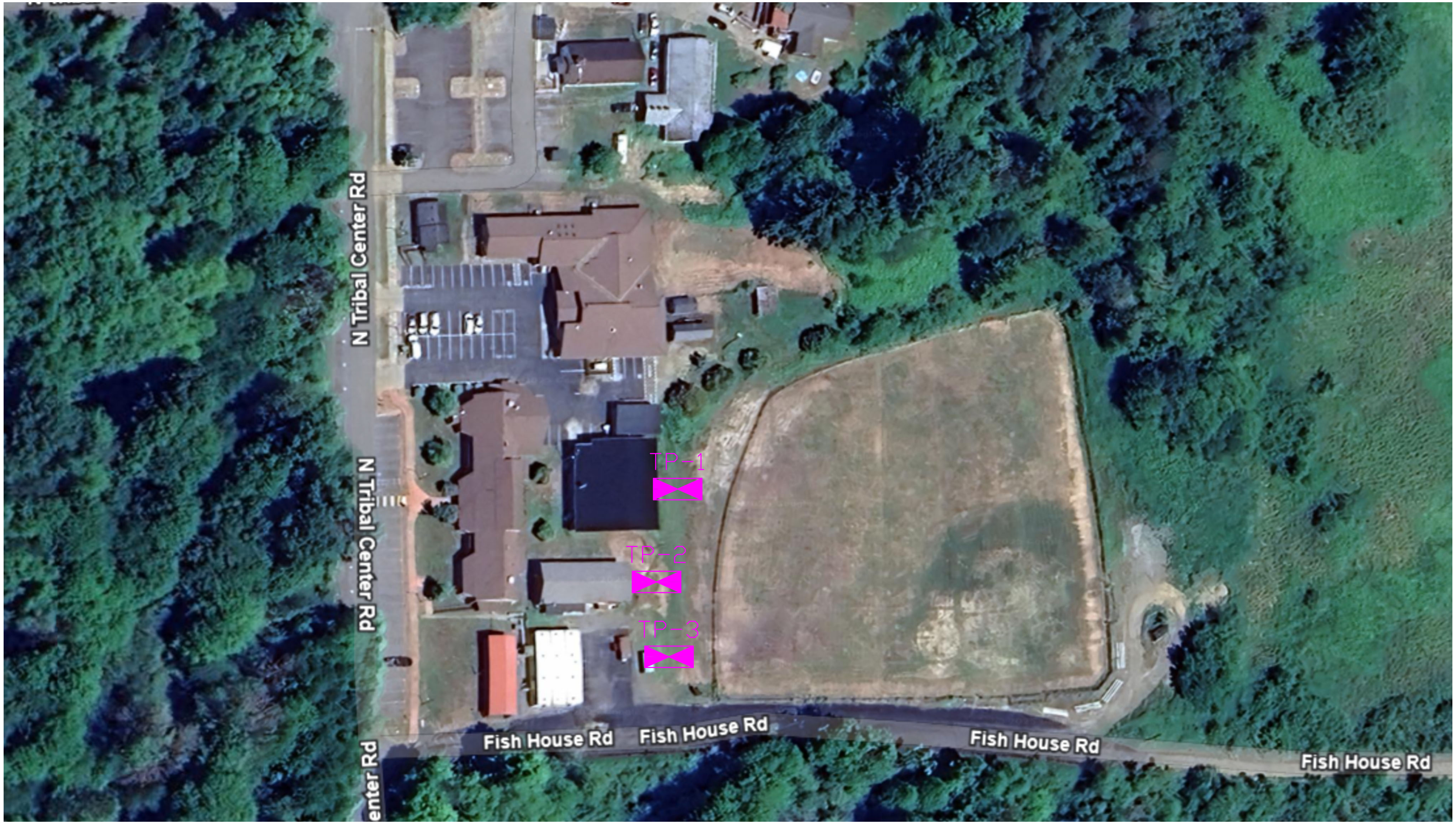


MIGIZI GROUP	Location **80 North Tribal Center Rd Skokomish, WA 98584**	Job Number **Z0762**	Figure **1**
P.O. Box 44840 Tacoma, WA 98448	Title **Topographic and Location Map**		Date **02/06/25**



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TEST PIT LOCATION

TP-1

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

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PROJECT:	80 North Tribal Center Skokomish, WA 98584		
SHEET TITLE:	Site and Exploration Plan		
DESIGNER:	RVCB	JOB NO.	Z0762
DRAWN BY:	RVCB	SCALE:	NTS
CHECKED BY:	JEB	FIGURE:	2
DATE:	Feb. 06, 2025	FILE:	Fig2.dwg

APPENDIX A
SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

TEST PIT LOGS

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

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

SOIL CLASSIFICATION CHART AND KEY TO TEST DATA

Figure A-1

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TEST PIT NUMBER TP-1

Figure A-2

CLIENT AHBL, Inc.
PROJECT NAME Skokomish Indian Tribe - Recycle & Transfer Bldg.
PROJECT NUMBER Z0762
PROJECT LOCATION 80 N Tribal Center, Skokomish, WA 98584
DATE STARTED 1/31/25 **COMPLETED** 1/31/25
GROUND ELEVATION 18 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Paulman Excavating
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber Track Mounted Excavator
∇ **AT TIME OF EXCAVATION** 2.00 ft / Elev 16.00 ft Rapid seepage.
LOGGED BY ZLL **CHECKED BY** JEB
AT END OF EXCAVATION ---
NOTES
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0.0 – 0.2				Sod and Topsoil	17.8
0.2 – 1.5		SP-SM		(SP-SM) Gray/brown fine to medium sand with silt and gravel (Loose, Wet)	16.5
1.5 – 2.0 ∇		SM		(SM) Light brown silty fine sand (Loose, Wet) Alluvium	16.0
2.0 – 4.0		SP-SM		(SP-SM) Dark gray fine to medium sand with silt and gravel (Very Loose, Wet) Observed flowing sands	14.0
4.0 – 7.0		GP-GM		(GP-GM) Gray gravel with silt and fine to coarse sand (Loose, Wet) Alluvium	11.0

Depth scale: 0.0, 2.5, 5.0

Severe trench caving between 2 to 7 feet observed.
Rapid groundwater seepage observed at 2 feet; observed flowing sands.

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

Bottom of test pit at 7.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 2/4/25 16:09 - C:\USERS\JESSICABIZAK\DESKTOP\TEST PITS AND BORINGS - GINT\Z0762\Z0762 TEST PITS.GPJ

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TEST PIT NUMBER TP-2

Figure A-3

CLIENT AHBL, Inc.		**PROJECT NAME** Skokomish Indian Tribe - Recycle & Transfer Bldg.	
PROJECT NUMBER Z0762		**PROJECT LOCATION** 80 N Tribal Center, Skokomish, WA 98584	
DATE STARTED 1/31/25	**COMPLETED** 1/31/25	**GROUND ELEVATION** 18 ft	**TEST PIT SIZE**
EXCAVATION CONTRACTOR Paulman Excavating		**GROUND WATER LEVELS:**	
EXCAVATION METHOD Rubber Track Mounted Excavator		∇ **AT TIME OF EXCAVATION** 2.00 ft / Elev 16.00 ft Rapid seepage.	
LOGGED BY ZLL	**CHECKED BY** JEB	**AT END OF EXCAVATION** ---	
NOTES		**AFTER EXCAVATION** ---	

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0.0				0.3	Sod and Topsoil	17.8
		SP		3.5	(SP) Dark gray fine to medium sand with trace gravel (Very Loose, Wet) Alluvium ∇ Observed flowing sands	14.5
2.5						
5.0		GP		7.0	(GP) Dark gray gravel with fine to coarse sand (Loose, Wet) Alluvium	11.0

Severe trench caving between 2 to 7 feet observed.
Rapid groundwater seepage observed at 2 feet; observed flowing sands.

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

Bottom of test pit at 7.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 2/4/25 16:09 - C:\USERS\JESSICABIZAK\DESKTOP\TEST PITS AND BORINGS - GINT\Z0762\Z0762 TEST PITS.GPJ

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TEST PIT NUMBER TP-3

Figure A-4

CLIENT AHBL, Inc.	**PROJECT NAME** Skokomish Indian Tribe - Recycle & Transfer Bldg.
PROJECT NUMBER Z0762	**PROJECT LOCATION** 80 N Tribal Center, Skokomish, WA 98584
DATE STARTED 1/31/25 **COMPLETED** 1/31/25	**GROUND ELEVATION** 18 ft **TEST PIT SIZE**
EXCAVATION CONTRACTOR Paulman Excavating	**GROUND WATER LEVELS:**
EXCAVATION METHOD Rubber Track Mounted Excavator	**AT TIME OF EXCAVATION** 2.00 ft / Elev 16.00 ft Rapid seepage.
LOGGED BY ZLL **CHECKED BY** JEB	**AT END OF EXCAVATION** ---
NOTES	**AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0.0				0.3	Sod and Topsoil	17.8
		SM		1.8	(SM) Gray/brown silty fine sand (Loose, Wet) Alluvium	16.3
2.5		SP		3.5	(SP) Dark gray fine to medium sand with trace gravel (Very Loose, Wet) Alluvium Observed flowing sands	14.5
5.0		GP		7.0	(GP) Dark gray gravel with fine to coarse sand (Loose, Wet) Alluvium	11.0

Severe trench caving between 2 to 7 feet observed.
Rapid groundwater seepage observed at 2 feet; observed flowing sands.

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

Bottom of test pit at 7.0 feet.

COPY OF GENERAL BH / TP LOGS - FIGURE.GDT - 2/4/25 16:09 - C:\USERS\JESSICABIZAK\DESKTOP\TEST PITS AND BORINGS - GINT\Z0762\Z0762 TEST PITS.GPJ