SOIL INDEX PROPERTIES AND RADIOCARBON AGES OF THE HAINES-TAKSHANUK MOUNTAINS-CHILKAT PENINSULA AREA STATEMAP PROJECT, SOUTHEAST ALASKA

Jillian A. Nicolazzo, Margaret M. Darrow, and Sandra L. Walser

Raw Data File 2024-27

Photograph showing a distinct contact between two soil layers in the Haines area.
The trowel is 24.5 centimeters (9.6 inches) long.

2024
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SOIL INDEX PROPERTIES AND RADIOCARBON AGES FOR THE HAINES-TAKSHANUK MOUNTAINS-CHILKAT PENINSULA AREA STATEMAP PROJECT, SOUTHEAST ALASKA

Jillian A. Nicolazzo[1], Margaret M. Darrow[2], and Sandra L. Walser[1]

INTRODUCTION

In response to the deadly December 2, 2020, landslide in Haines, Alaska, Alaska's Geologic Mapping Advisory Board endorsed mapping the Haines area. The project includes an area of approximately 777 square kilometers (300 square miles) and produced a 50,000-scale bedrock and surficial geologic map of the Haines-Takshanuk Mountains-Chilkat Peninsula area of Southeast Alaska (Larsen, 2024). This data release is part of that larger project and includes sample location (station) descriptions and test results from soil samples collected from 24 stations. Testing included moisture content, sieve analysis, Atterberg limits, hydrometer readings, specific gravity, and radiocarbon ages for selected soil samples. Digital data are available as comma-separated value (.csv) files from doi.org/10.14509/31415.

METHODS

Sample Collection and Preparation

In August of 2023, field teams from the Alaska Division of Geological & Geophysical Surveys (DGGS) and the University of Alaska Fairbanks (UAF) collected soil samples at selected field station locations (fig. 1). We recorded location information using GPS-enabled tablets running Esri's ArcGIS Field Maps app, with a reported horizontal error of approximately 5 to 10 meters (Truskowski and others, 2024). Latitude and longitude are reported in the WGS 1984 Web coordinate system. We collected samples from road cutbanks, material sites, exposures along stream channels, debris flow deposits, and small test pits that we dug. At some locations, we collected a series of samples vertically down an exposure to sample different soil strata. We sealed soil samples in plastic bags or aluminum tins for storage and transport.

Sample identification numbers are the same as station numbers in locations where we only collected one sample. Where we collected multiple samples, sample identification numbers consist of the station number plus an additional letter. In general, samples collected specifically for moisture content testing were stored in sealed aluminum tins and assigned the letter "A". Bulk samples collected at these same locations were stored in plastic bags and assigned the letter "B". Station and soil descriptions are provided in Appendix A.

[1] Alaska Division of Geological & Geophysical Surveys, 3354 College Road, Fairbanks, AK 99709

[2] Department of Civil, Geological, and Environmental Engineering, University of Alaska Fairbanks, P.O. Box 755900, Fairbanks, AK 99775-5900

We submitted selected soil samples to the Frozen Soil Testing (FROST) Laboratory at the University of Alaska Fairbanks (UAF) for index property testing. Testing included 19 moisture contents, 20 sieve analyses, 21 Atterberg limits, 7 hydrometer readings, and 13 specific gravities. Soils were classified using the Unified Soil Classification System (USCS) and, for reference, the appropriate USCS soil classification charts are provided in Appendix B. Five organic samples were first air-dried and cleaned of their soil matrix, and then packaged, sealed, labeled, and shipped to Beta Analytic in Miami, Florida, for radiocarbon dating. Three of the five samples were a few millimeters to a centimeter in length, resembled rootlets, and were collected from sand deposits. We also tested one piece of charred wood from a sand deposit, and a bivalve shell fragment from an uplifted marine clay deposit.

Analytical Methods

The FROST Laboratory is a teaching and research facility. Dr. Margaret Darrow, professor of geological engineering, organized and supervised the testing. Tests were performed in accordance with the following standards and are noted in the data dictionary:

- ASTM D854-14 Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
- ASTM D2216-19 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D2487-17e1 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soils Classification System)
- ASTM D4318-17e1 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D6913M-17 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D7928-21e1 Standard Test Methods for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis

Beta Analytic is ISO/IEC 17025:2017 accredited and uses the accelerator mass spectrometry technique for conventional radiocarbon ages. This technique includes pretreating and isolating the material to be analyzed, converting the material to elemental carbon, after which the resulting graphite powder is ionized, accelerated, and the carbon isotopes are separated and counted based on their mass (Beta Analytic, 2024). The ratio of C^{14}/C^{13} is calculated and compared to measurements made on standards with known ratios to determine the age of the material relative to the year 1950 (yrs BP). The ages were then calibrated using the Calib Rev 8.1.0 program (Stuiver and Reimer, 1993), the IntCal20 calibration curve for terrestrial samples (Reimer and others, 2020), and the Marine20 calibration curve for shells (Heaton and others, 2020). The calibrated radiocarbon ages represent the 2-sigma (σ) probability distribution in years before 1950 rounded to the nearest whole year. The calibrated ages are included in the accompanying csv file. One date was too recent for the IntCal20 curve and is reported as <250 BP.

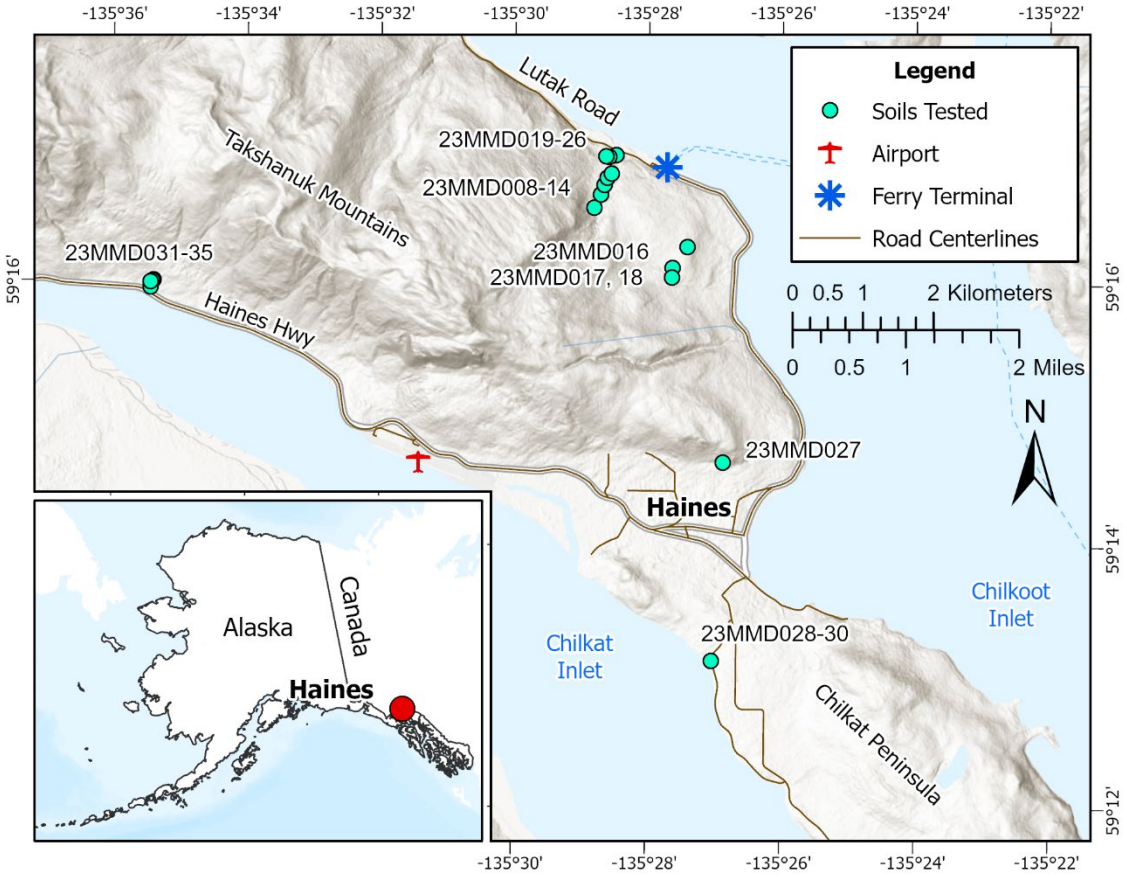

Figure 1. Area map showing field station locations where soil samples were collected for testing.

ACKNOWLEDGMENTS

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Appendix A. Sampled Station Descriptions

Station ID:	23MMD008	Date Visited:	20 Aug. 2023
Latitude, Longitude:	59.27639, -135.48015	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	194 m		

Site Description: Head scarp and body of debris flow; occurred in ice-contact deposit with stratification visible in left flank

Sample(s) From: Soil matrix in right flank of head scarp area

Soil Stratigraphy: 0 to >20 m (est.) White-gray, poorly graded gravel with sand and with cobbles and boulders (tonalite)

Figure A1. Images of 23MMD008 sample location: (**A**) sampled soils from right flank; (**B**) left flank near head scarp demonstrating stratified soils (indicated by yellow ellipse).

Station ID:	23MMD009	Date Visited:	20 Aug. 2023
Latitude, Longitude:	59.27807, -135.47857	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	182 m		
Site Description:	Area of uplifted beach deposits		
Sample(s) From	0.5 m below ground surface at bottom of test pit		

Soil Stratigraphy:	0 – 0.18 m	Brown organic mat
	0.18 – 0.24 m	White, silty sand
	0.24 – 0.50 m	Brown-orange, silty sand; iron oxidized, contains magnetite

Figure A2. Near-surface soil stratigraphy from 23MMD009 test pit.

Station ID:	23MMD010	Date Visited:	20 Aug. 2023
Latitude, Longitude:	59.27930, -135.47764	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	143 m		

Site Description: Head scarp and body of debris flow; occurred in ice-contact deposit

Sample(s) From: Soil matrix 1.5 m below ground surface in the head scarp exposure

Soil Stratigraphy:
0 – 0.3 m Brown organic mat
0.3 – 1.5 m Brown-orange, poorly graded sand with gravel; iron oxidized
1.5 to >10 m (est.) White-gray, poorly graded sand with gravel; contains cobbles up to 0.3 m in diameter (mostly tonalite clasts)

Figure A3. Images of 23MMD010 sample location: (**A**) looking north at soil exposed across the head scarp area; (**B**) stratigraphy in head-scarp exposure.

Station ID:	23MMD011	Date Visited:	20 Aug. 2023
Latitude, Longitude:	59.28008, -135.47699	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	126 m		
Site Description:	Area of uplifted beach deposits		
Sample(s) From	0.45 m below ground surface		

Soil Stratigraphy:

0 – 0.10 m	Dark brown organic mat
0.10 – 0.18 m	White-gray, silty sand
0.18 – 0.24 m	Red-brown, silty sand; iron oxidized
0.24 – 0.45 m	Alternating red-brown and white, silty sand layers
0.45 – 0.65 m (bottom of hole)	White, silty sand; gravel and cobble clasts up to 0.65 m in diameter

Figure A4. Near-surface soil stratigraphy from 23MMD011 test pit.

Station ID:	23MMD012, 013, 014	Date Visited:	20 Aug. 2023
Latitude, Longitude:	59.28020, -135.47694	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	68 m		

Site Description: Left flank of debris flow

Sample(s) From: samples taken at ~0.5 m below ground surface
23MMD012: Black organic well graded sand with silt (for radiometric dating)
23MMD013: Dark gray silty sand with gravel
23MMD014: Gray Poorly graded sand with silt and gravel (matrix of debris flow)

Soil Stratigraphy: (depths from bottom of organic mat):

0 – 0.27 m	Dark gray silty sand with gravel, cobbles
0.27 – 0.50 m	Black organic well graded sand with silt, interlayered with iron-oxidized non-organic soil
0.50 - 0.65 m (bottom of hole)	Gray poorly graded sand with silt and gravel, cobbles

Figure A5. Left flank of debris flow where samples 23MMD012 – 014 were collected.

Station ID:	23MMD016	Date Visited:	21 Aug. 2023
Latitude, Longitude:	59.27142, -135.45695	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	155 m		
Site Description:	Uplifted beach deposit		
Sample(s) From	0.29 m at bottom of test pit		
Soil Stratigraphy:	0 – 0.13 m 0.13 – 0.29 m (bottom of hole)	Dark brown organic mat Gray poorly graded gravel with silt	

Figure A6. Near-surface soil stratigraphy from 23MMD016 test pit.

Station ID:	23MMD017	Date Visited:	21 Aug. 2023
Latitude, Longitude:	59.26877, -135.46058	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	148 m		
Site Description:	Head scarp of paleolandslide, down-dropped head covered in hydrophytic vegetation with standing water		
Sample(s) From	Gray poorly graded sand with gravel exposed 1.7 m below top of head scarp		

Figure A7. Images of 23MMD017 sampling location: (**A**) sampled area in vegetated head scarp; (**B**) hydrophytic vegetation with standing water on head of paleolandslide.

Station ID:	23MMD018	Date Visited:	21 Aug. 2023
Latitude, Longitude:	59.26755, -135.46069	Field Crew:	Margaret Darrow and Sandra Walser
Approx. Elev.:	131 m		
Site Description:	Landslide in valley wall; exposure of varves (silty clay and sand), overlying gravel; uplifted marine deposits		
Sample(s) From	Gray sandy silty clay with gravel in exposed stratigraphy in landslide; bedding strike/dip160°/13° right hand rule		

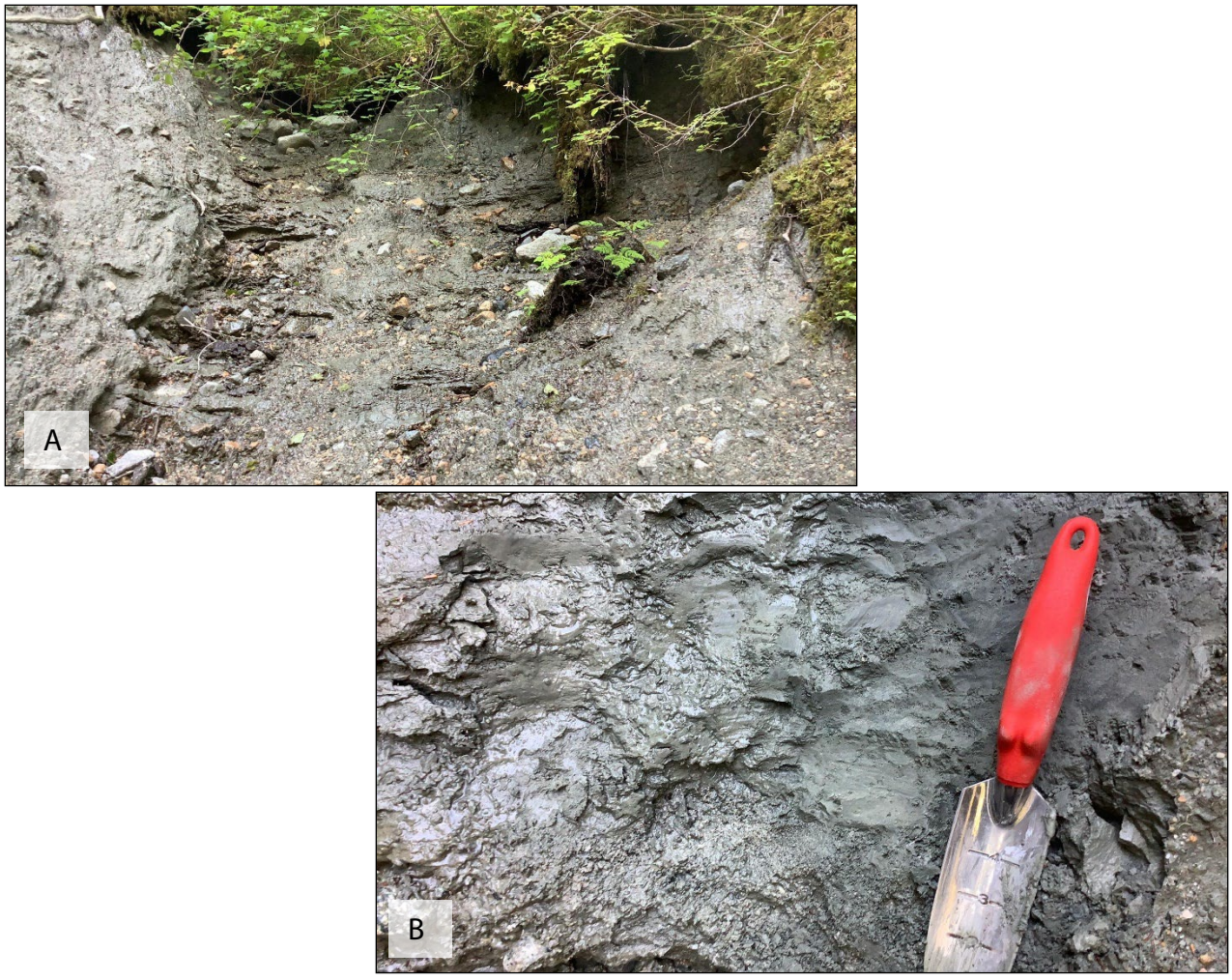

Figure A8. Images of 23MMD018 sampling location: (**A**) looking towards the head scarp of the landslide area with exposed bedding within drainage; (**B**) cleaned exposure of interbedded silt and sand.

Station ID:	23MMD019, 020, 021, 022	Date Visited:	22 Aug. 2023
Latitude, Longitude:	59.28308, -135.47476	Field Crew:	Margaret Darrow and Jillian Nicolazzo
Approx. Elev.:	24 m		

Site Description: Alluvial fan covering uplifted marine deposits; exposed in gravel pit

Sample(s) From (depths estimated from tape draped from access road in gravel pit):
23MMD019A and B: Gray poorly graded sand at 2.95 m, saturated
23MMD020A and B: Gray silty sand at 3.0 m
23MMD021: Organic poorly graded sand with gravel at ~2.0 m
23MMD022: wood at ~0.7 m

Soil Stratigraphy: (depths estimated from measuring tape draped from access road in gravel pit):

0 – 0.70 m Dark brown poorly graded sand with gravel and cobbles (cobbles predominately diorite), contains buried wood/roots

0.70 – 1.45 m White-gray sand with cobbles and boulders

1.45 – 2.15 m Brown-red organic material, with tree roots wrapped around cobbles

2.15 – 2.43 m Gray sand, interbedded with brown-red oxidized layers

2.43 – 2.83 m Gray poorly graded sand with gravel

2.83 – 2.95 m Gray poorly graded sand (saturated, flowing during field visit)

2.95 – 4.0 m Gray silty sand (bottom of exposure); bedding strike/dip 305°/21° right hand rule

Figure A9. Images of 23MMD019 sampling location: (**A**) base of described stratigraphy with saturated sand (mid-photograph) over uplifted marine deposits; (**B**) organic-rich horizon.

Station ID:	23MMD025, 026	Date Visited:	22 Aug. 2023
Latitude, Longitude:	59.28282, -135.47651	Field Crew:	Margaret Darrow and Jillian Nicolazzo
Approx. Elev.:	59 m		

Site Description: Upper portions of alluvial fan from 23MMD019; exposed in gravel pit

Sample(s) From 23MMD025: Organic poorly graded sand with gravel ~1.15 m below ground surface at top of alluvial fan; bedding strike/dip 285°/06° right hand rule

23MMD026: Silty sand below 23MMD025; bedding strike/dip 235°/20° right hand rule

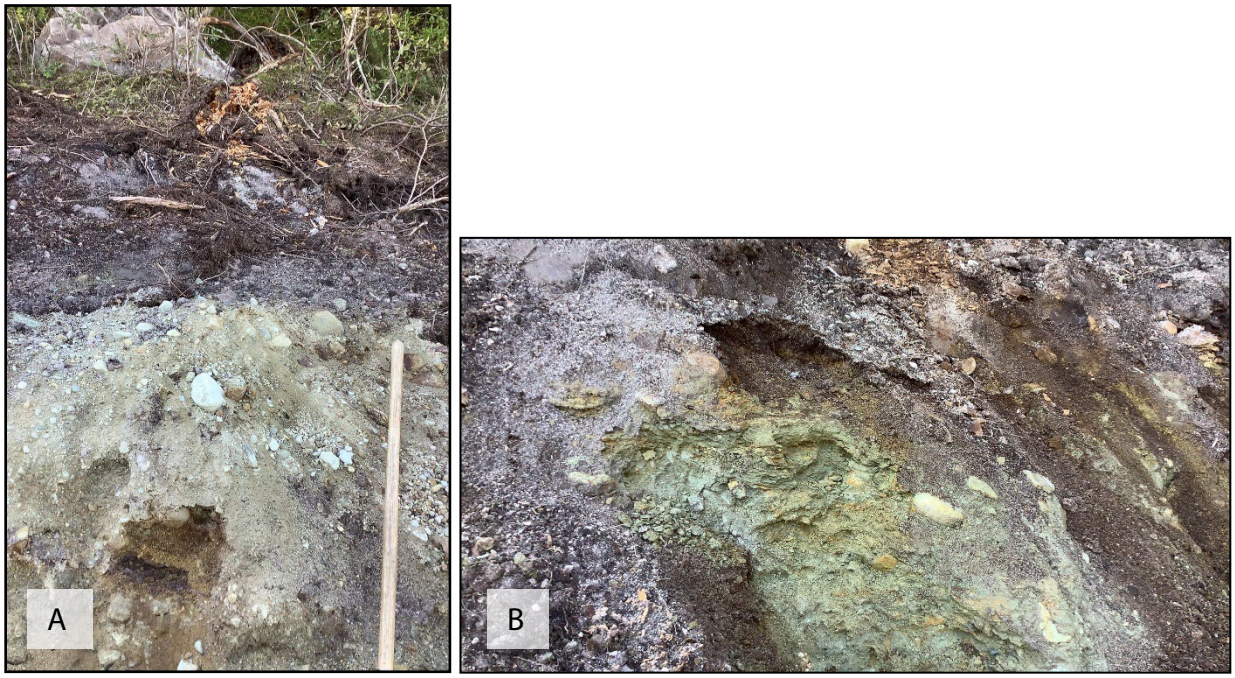

Figure A10. Images of (**A**) 23MMD025 and (**B**) 23MMD026 sampling locations.

Station ID:	23MMD027	Date Visited:	22 Aug. 2023
Latitude, Longitude:	59.24399, -135.44776	Field Crew:	Margaret Darrow and Jillian Nicolazzo
Approx. Elev.:	94 m		
Site Description:	Material site at base of south side of Mount Ripinski		
Sample(s) From	Poorly graded sand with silt and gravel (stratified talus) in cut slope of material site		

Figure A11. Sampled stratified talus.

Station ID:	23MMD028, 029, 030	Date Visited:	24 Aug. 2023
Latitude, Longitude:	59.21880, -135.45037	Field Crew:	Margaret Darrow and Jillian Nicolazzo
Approx. Elev.:	14 m		

Site Description: Cut slope of private driveway

Sample(s) From: 23MMD028A: 2.7 m below ground surface
23MMD029A and B: 4.2 m below ground surface in blue-gray silty clayey sand
23MMD030A and B: 2.0 m below ground surface in brown well graded sand with gravel

Soil Stratigraphy:

0 – 0.3 m	Organic mat
0.3 – 2.3 m	Brown well graded sand with gravel (uplifted beach deposits)
2.3 – 4.2 m (bottom of hole)	Silty clayey sand (light gray 2.3 – 3.0 m, medium gray 3.0 – 3.5 m, blue-gray 3.5 – 4.2 m; uplifted marine deposits); bivalves collected from 4.2 m

Figure A12. Image of stratigraphic section, including uplifted beach deposits and marine deposits.

Station ID:	23MMD031, 032	Date Visited:	24 Aug. 2023
Latitude, Longitude:	59.26591, -135.59055	Field Crew:	Margaret Darrow and Jillian Nicolazzo
Approx. Elev.:	26 m		

Site Description: Cut slope in material site; exposure contains contact between possible debris flow deposit with basal orange-brown organic, root-bearing layer, which truncated stratified glacio-fluvial sediments

Sample(s) From
23MMD031: 0.9 m below ground surface in gray silty sand with gravel; debris flow; bedding strike/dip 154°/24° right hand rule
23MMD032: 1.2 m below ground surface in gray poorly graded sand with gravel; stratified glacio-fluvial deposit; bedding strike/dip 151°/34° right hand rule

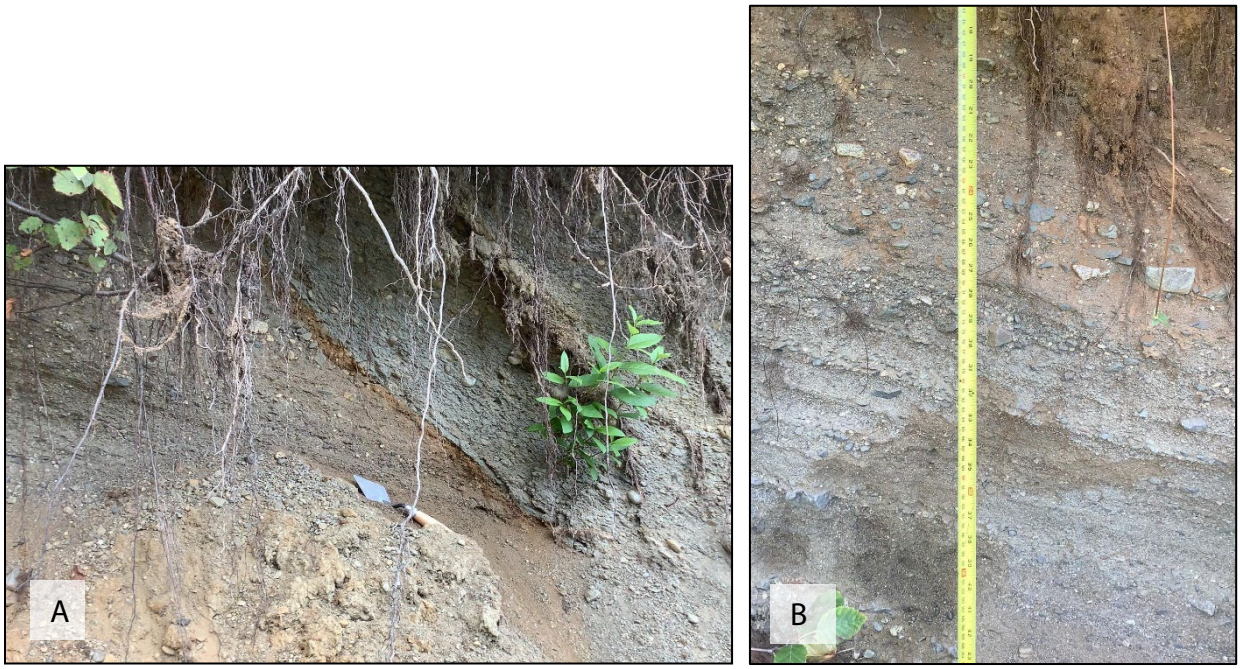

Figure A13. Images of sample locations: (**A**) debris flow truncating fluvial deposits at iron-oxidized contact; (**B**) stratified fluvial deposits.

Station ID:	23MMD033	Date Visited:	24 Aug. 2023
Latitude, Longitude:	59.26680, -135.58979	Field Crew:	Margaret Darrow, Jillian Nicolazzo, and Sandra Walser
Approx. Elev.:	66 m		
Site Description:	Cut slope at top of material site, containing colluvium		
Sample(s) From	Well graded sand with gravel (colluvium) at top of material site		

Figure A14. Image of colluvium sample location at the top of the material site.

Station ID:	23MMD034	Date Visited:	24 Aug. 2023
Latitude, Longitude:	59.26669, -135.59008	Field Crew:	Margaret Darrow, Jillian Nicolazzo, and Sandra Walser
Approx. Elev.:	59 m		
Site Description:	Cut slope near top of material site; exposure contained glacial till stratigraphically below surficial colluvium and above stratified glacio-fluvial deposits		
Sample(s) From	Gray silty sand with gravel (glacial till)		

Figure A15. Image of glacial till sample location near the top of the material site.

Station ID:	23MMD035	Date Visited:	24 Aug. 2023
Latitude, Longitude:	59.26656, -135.59050	Field Crew:	Margaret Darrow, Jillian Nicolazzo, and Sandra Walser
Approx. Elev.:	44 m		

Site Description: Recently cleared cut slope in working portion of material site

Sample(s) From: Glacial till and ice-contact deposits

Soil Stratigraphy: (depths from switchback cut into slope):

0 – 3.05 m	Gray poorly graded gravel with sand (glacio-fluvial deposits, stratified)
3.05 – 7.35 m	(--covered--)
7.35 – 16.8 m	Gray well graded sand with silt and gravel, minor stratification (glacial till and ice-contact deposits)

Figure A16. Image of middle section of the material site.

APPENDIX B. UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) CHARTS

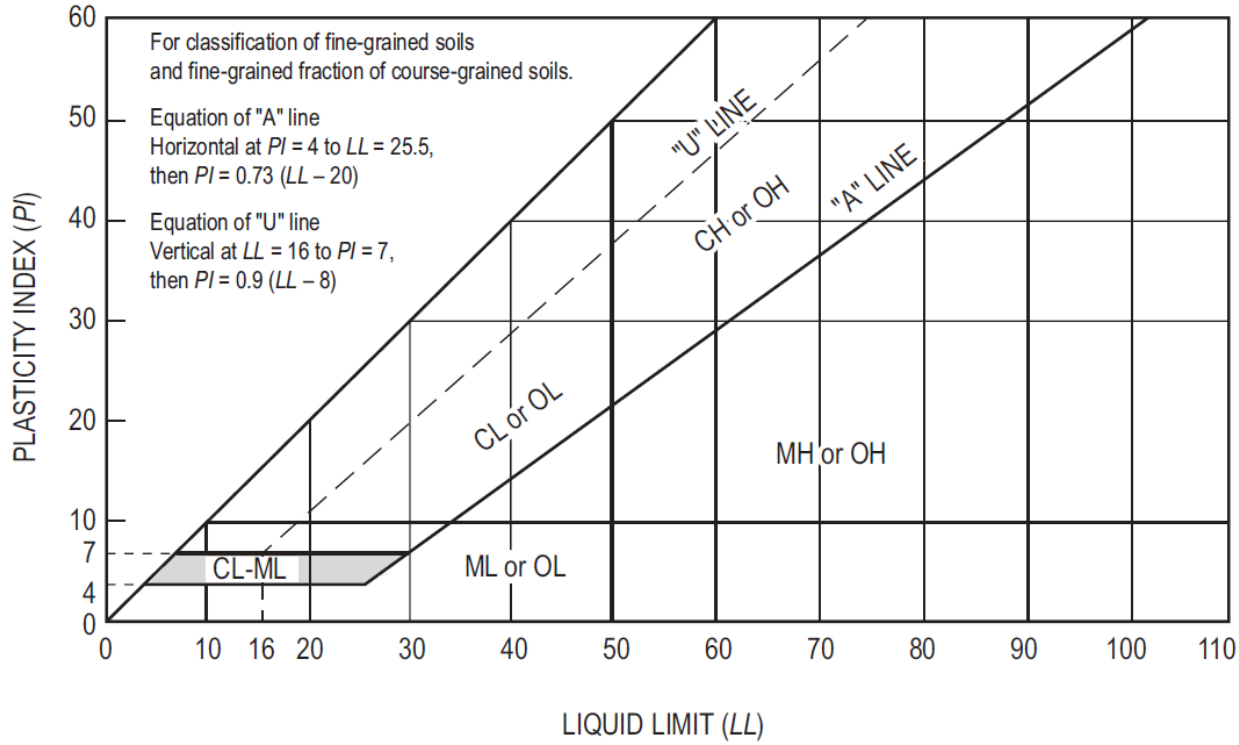

Figure B1. USCS Plasticity Chart (ASTM D2487)

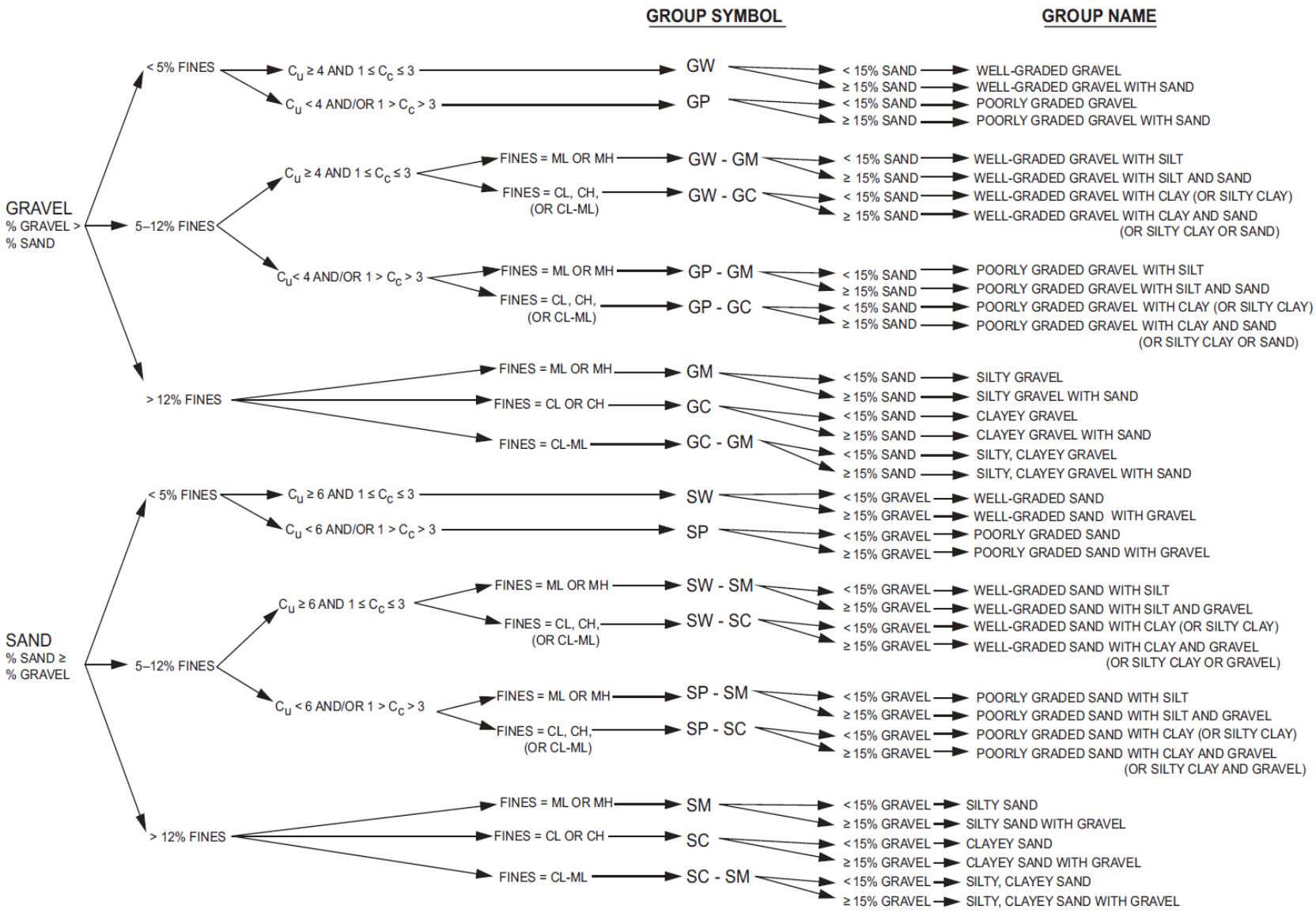

Figure B2. Flow chart to determine the Group Symbol and Group Name for coarse-grained soils (ASTM D2487)

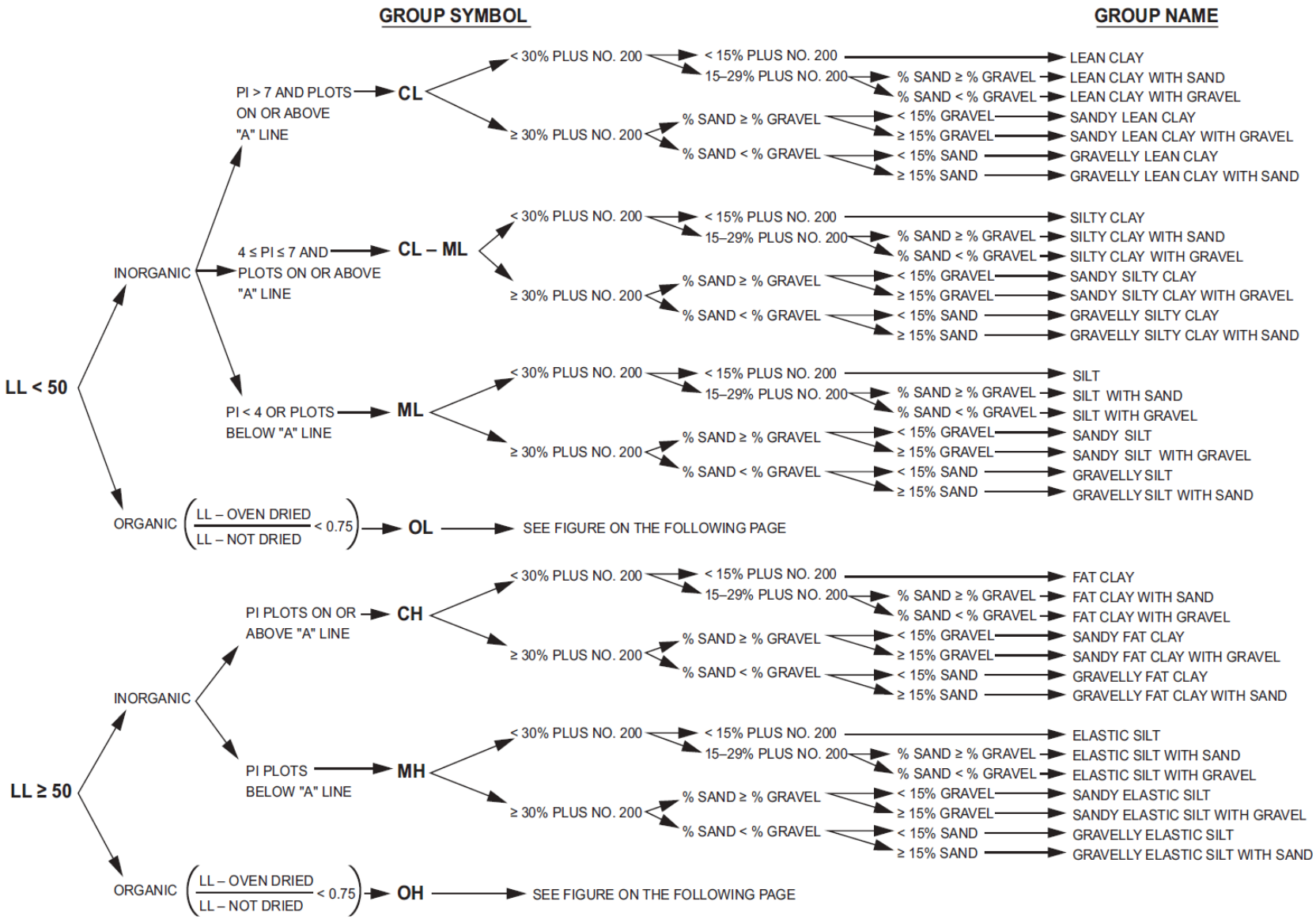

Figure B3. Flow chart to determine the Group Symbol and Group Name for fine-grained soils (ASTM D2487)