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SURFICIAL GEOLOGY OF THE U.S. COAST GUARD RESERVATION, KODIAK, ALASKA

by

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This report has not been reviewed for technical content (except as noted in text) or for conformity to the editorial standards of DGGS.

Alaska Division of Geological and Geophysical Surveys

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SURFICIAL GEOLOGY OF THE U.S. COAST GUARD RESERVATION, KODIAK, ALASKA

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INTRODUCTION

Project Description

Multidisciplinary geologic studies of the U.S. Coast Guard Reservation in Kodiak, Alaska, were undertaken in 1988 in response to a request by the U.S. Geological Survey (USGS) Water Resources Division. This report summarizes the results of surficial-geologic mapping and soils investigations. Concurrent studies by the Alaska Division of Geological and Geophysical Surveys (ADGGS), reported separately, include bedrock geology (Solie and Reifenstuhl, 1989), seismic-refraction profiling (Allely, 1989), and bedrock-geotechnical properties (Brown, 1989).

Goals of the surficial-geologic studies were (1) to map in detail the areal distribution of unconsolidated deposits and bedrock exposures in the study area at 1 in. = 1,000 ft and 1 in. = 500 ft scales (fig. 1), (2) to describe physical characteristics of the deposits, (3) to provide stratigraphic sections of the deposits, (4) to provide maps of photolineaments, and (5) to assess potential geologic hazards.

Previous Studies

Several reconnaissance geologic maps of Kodiak Island have been prepared (Martin, 1913; Capps, 1937; Moore, 1967); many topical reports, most of which pertain to bedrock stratigraphy, sedimentation, and tectonic histories of the island and adjacent areas, are also available (for example, Moore, 1969 and 1975; Moore and Bolm, 1977; Nilsen and Moore, 1979). Reports published by ADGGS pertain to the general geology and resources (McGee, 1973; Kienle and Turner, 1976; Lyle and others, 1978), and to engineering geology (Updike, 1983).

Karlstrom (1969) provided a general summary of Quaternary geology and history of Kodiak Island, but specific geologic mapping of surficial deposits and photolineaments has not been done on any part of the island. Agricultural-soils mapping has been completed at a regional scale on all of Kodiak Island (Rieger and others, 1979), and in more detail on northeastern Kodiak Island (Rieger and Wunderlich,

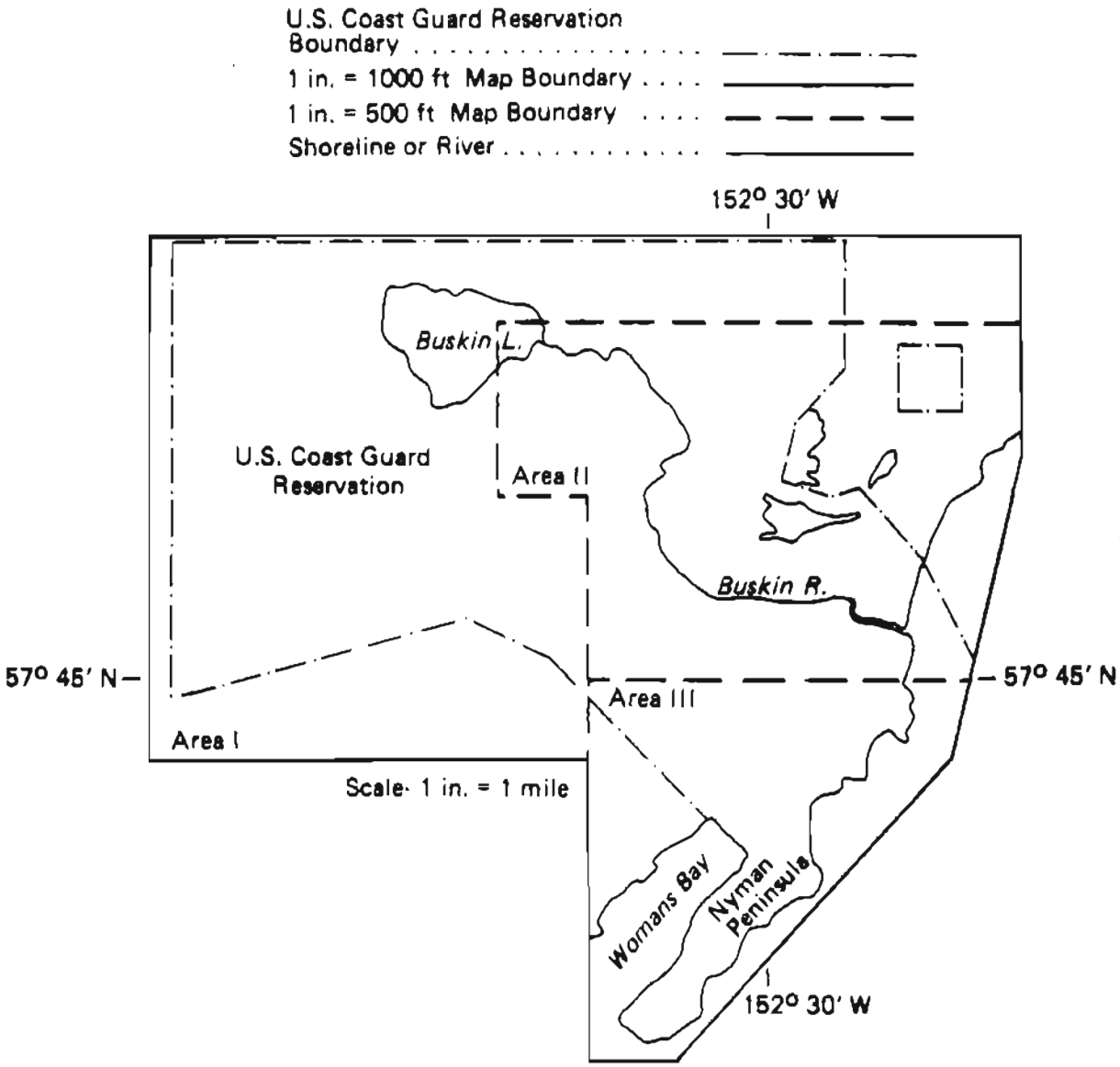

Figure 1. Location map of study area and index of areas shown on plates. Area I includes Areas II and III.

1960), including land inside the Coast Guard Reservation (Cox and Young, 1980). Geotechnical studies have been performed in conjunction with facilities development on the reservation, providing subsurface data for numerous boreholes, wells, and test pits (pl. 2 and 3).

GEOLOGIC SETTING

Early studies by Martin (1913) and Capps (1937) revealed similarities in geology and structural trend between the Kodiak islands group and the Kenai Peninsula on the mainland of southcentral Alaska. Cretaceous marine sedimentary rocks of the Kodiak Formation (Moore, 1969) underlie the entire study area. The Kodiak Formation is part of a belt of deformed turbidite deposits of the Chugach terrane, which extends for about 1,000 miles along the Gulf of Alaska margin (Plafker and others, 1977). These deposits were accreted against older rocks of the Peninsular terrane as a result of collision between the North American and Pacific plates and complexly deformed, probably before early Paleocene time (about 60 million yr ago; Davies and Moore, 1984; Sample and Moore, 1987). The rocks are primarily thin-bedded graywacke (dark gray mudstone and sandstone), shale, and slate; the beds are typically isoclinally folded and tilted to near vertical, with a strike of N30°E to N40°E (Solie and Reifenstuhl, 1989).

Quaternary geology

Stratigraphic and geomorphic evidence suggest that three major glaciations occurred on Kodiak Island during middle- to late-Pleistocene time, separated by long periods of complete deglaciation. During the first of these glaciations, ice from Shelikof Strait completely or nearly completely covered the island. The last two major glaciations, in early- and late- Wisconsin time (about 50,000 to 80,000 yr ago and 10,000 to 30,000 yr ago), covered all but a small area (refugium) of southwestern Kodiak Island (Karlstrom, 1969; Coulter and others, 1965). The present topography and surficial deposits are largely results of the last major glaciation. Within the study area, a discontinuous layer of till up to about 15 ft thick mantles ice-scoured bedrock.

Following deglaciation, other surficial processes soon began to modify the glacial topography and deposits. Streams incised narrow canyons in bedrock highlands, and produced alluvial fans and flood-plain deposits of silt, sand, and gravel over till and bedrock in lowland valleys. Weathering and mass

wasting produced talus deposits, scattered debris fans and landslides, and a thin colluvial cover over bedrock at high elevations.

Although deformation responsible for the present bedrock structure occurred prior to early Paleocene, tectonism and volcanism have continued to dramatically affect Kodiak Island through Quaternary time. A ubiquitous feature of surficial deposits on Kodiak Island is a layer of pale brown lithic volcanic ash, generally about a foot thick, which lies immediately beneath the modern organic soil layer and is commonly exposed. Source of the ash was the 1912 eruption of Novarupta, near Mt. Katmai on the Alaska Peninsula (Griggs, 1922; Curtis, 1968). The rugged, drowned coastline of the entire Kodiak archipelago is probably a result of continued periodic subsidence during major megathrust earthquakes. Although the great Alaska earthquake was centered about 250 miles to the northeast, Kodiak was devastated by at least 10 tsunamis and the island subsided tectonically more than 5 ft (Kachadoorian and Plafker, 1967).

METHODS OF INVESTIGATION

Preparation of Topographic Base Maps

Prior to this study, topographic base maps and aerial photographs existed at different scales for some parts of the study area, but were not available for the entire area at the required scales (1:12,000 and 1:6,000). Through the services of a private photogrammetry company, new stereo color aerial photography was obtained for the entire study area at a scale of about 1:12,000. The company established local survey control and used the new aerial photographs to produce orthophoto and contour topographic maps for the three areas indicated in Figure 1. The contract required this mapping to conform to national mapping standards. The aerial survey was performed on September 30, 1988, and the maps were delivered in December, 1988. The orthophoto and contour topographic maps were combined to produce base maps for Plates 1-7, and for bedrock-geologic maps (Solie and Reifenstuhl, 1989). The maps were also submitted to the USGS Water Resources Division for use in hydrologic studies.

Geologic Investigation

Available literature and data were reviewed to obtain an overview of the geology of the study area and to identify areas where data were lacking. A considerable amount of geotechnical borehole data exist

for developed areas of the Coast Guard Reservation (plates 2 and 3), but very little data existed in other portions of the area on which to base surficial-geologic maps.

Field investigations were conducted August 15 - 27, 1988 to obtain first-hand observations of materials encountered by other workers in boreholes, wells, and test pits, and to collect new data in other parts of the study area. Access was primarily by four-wheel-drive vehicle along existing roads or by hiking short distances from the roads. A helicopter was used for two days to reach areas inaccessible by road.

Data collection consisted primarily of observing and sampling exposures of surficial deposits in road cuts, stream cuts, and excavations, and by digging shallow test holes with a shovel and hand auger. Stratigraphic sections were recorded, noting (1) depth from top of section to top and bottom of layers, (2) color, firmness, texture, structure, and fabric of sediment in each layer, (3) probable origin, (4) presence of organic matter, outsize clasts, or excess moisture, (5) depth to bedrock, and (6) where visible, lateral or vertical variations in these characteristics. A small number of samples was collected for textural analyses, water content, and radiocarbon dating. Photographs were taken of some sections to aid further interpretation at the office.

Observations of surficial deposits were made at 153 locations in the study area (plate 1). Field notes for these locations are included in Appendix A, and results of laboratory analyses are presented in Appendix B.

Geologic contacts and photolineaments were drawn by interpreting the September, 1988, stereo aerial photographs. Field notes, laboratory analyses, and existing subsurface information aided this interpretation. Results of photointerpretation were transferred to the base maps, and additional information on bedrock exposures (Solie and Reifenstuhl, 1989) was incorporated (plates 4 - 7).

DESCRIPTION OF SURFICIAL DEPOSITS

Topography of the Buskin River valley and Nyman Peninsula is dominated by glacially scoured, rounded bedrock hills with elevations less than 300 ft. The bedrock consists primarily of deformed and slightly metamorphosed gray sandstone and shale (Solie and Reifenstuhl, 1989). Overlying the bedrock is a nearly continuous layer of lodgement till of varying thickness, generally less than 15 ft and averaging about 3 ft thick (Plates 4 - 6). Where till is absent, bedrock may be exposed or is overlain by organic-rich

silt, volcanic ash, or a vegetation and soil mat, or a combination of these. A typical complete section, from bottom to top, consists of bedrock, till, organic-rich silt, volcanic ash, and the modern vegetation and soil mat (appendix A). Where the contact between bedrock and till can be observed, the bedrock surface is commonly grooved or striated, or both.

The organic-rich silt layer commonly present between the till and volcanic ash probably represents a long period of loess (eolian silt) deposition and soil development following deglaciation. Radiocarbon ages of organic matter in this layer range from 5,850 ± 95 to 1,710 ± 75 yr b.p., but loess deposition probably encompassed a longer period than indicated by these dates. Glass shards similar to those in the 1912 volcanic-ash layer are common in the loess, and indicate that ash from distant volcanos often mixed with the airborn material.

Lateral variations in the thickness of overburden in areas marked Qgt (till) and Qcgt (colluvium and till) on the geologic maps (plates 4 - 6) are considerable over distances as short as several feet; it is not possible to map these variations without very detailed field work. The presence or absence of till over bedrock is generally not recognizable in aerial photographs, partly because of the ubiquitous cover of loess and volcanic ash. In some places, till is thickest at the crest of a hill, and thins or is absent at the flanks and in valleys. In other areas, till is absent at the crest and thickens along the flanks.

Where unweathered, lodgement till (deposited beneath a moving glacier) is very firm and has very low permeability (probably less than 0.0001 cm/sec; Lambe and Whitman, 1969). In the study area, till consists of gray clay, sand, pebbles, cobbles, and rare boulders in widely varying proportions. Scattered till stones on the ground surface, probably weathered from the till or melted out of stagnant ice during glacial retreat, reach lengths of 4½ ft. Where weathered, the till is locally friable and washed of some fine material to a maximum depth of about 2 ft, but permeability is still low. Permeability of the overlying loess loam is also low, probably less than 0.001 cm/sec.

The volcanic ash is very uniform and friable, similar in texture to fine- to medium-grained beach sand (0.074 to 0.5 mm; appendix B). In contrast to beach sand, however, which contains very rounded grains from abrasion in the surf, grains of the volcanic ash are angular to very angular. Many of the grains are lithic fragments and mineral crystals, largely of quartz and feldspar, but the ash also contains a

high concentration of very angular and irregular transparent glass shards. Angularity of the grains produces an interlocking framework, which probably results in lower permeability than beach sand, although still moderate to high (greater than 0.001 cm/sec).

Along the eastern margin of Buskin Lake are some deposits of glacial outwash and ice-contact deposits (plates 4 and 6). These deposits indicate that the glacier terminus remained here briefly during its final retreat. Local timing of this retreat is not known; the oldest radiocarbon age obtained in deposits overlying till in the study area was 5,850 ± 95 yr b.p. (plate 6), but this is not considered a closely limiting minimum age on retreat of glacial ice. On the nearby Alaska Peninsula, radiocarbon dates indicate a general warming accompanied by deglaciation about 9,000 to 10,000 yr ago (Detterman, 1986).

At higher elevations along the mountain sides, till is thinner, less continuous, and locally less firm, more friable, and more permeable than till on the lower hills and valley bottom. Till is commonly absent and instead bedrock is either exposed or covered by a thin layer of colluvium, organic-rich silt, volcanic ash, or a combination of the three (plate 7). Till is dominant at lower elevations; colluvium is dominant at higher elevations. No ice-marginal features are visible to indicate a clear upper limit to the extent of till. Some small depressions in the highlands contain water-retransported silt, sand, gravel, or volcanic ash.

Large areas of artificial fill are present in the study area, particularly in the vicinity of the support center and airport (plates 5 and 6). For mapping purposes, these deposits have been divided into two categories, compacted and uncompacted fill. Compacted fill underlies structures, roads, parking areas, storage areas, and aircraft runways. Uncompacted fill includes mounds or ridges used as protective barriers for storage tanks and fuel pumps, shelters for aircraft tiedowns, and spoil piles.

For detailed descriptions of individual geologic units, see Plates 4 - 6.

LANDSLIDES

Several landslide deposits resulting from slumps and slides of till or bedrock were mapped in the study area (plates 4 - 6). These slides appear inactive, and may have occurred shortly after retreat of glacial ice exposed the steep valley walls. A large slump deposit and numerous headwall scarps on the southeast side of Old Womens Mountain adjacent to the Coast Guard harbor (plate 6) are evidence of

deep-seated landslide activity some time in the past. Although surface rock falls continue to occur along the road, there is no clear evidence of recent movement of the landslide deposit or adjacent rock mass below the scarps. A comprehensive account of effects of the great Alaska earthquake of 1964 (Kachadoorian and Plafker, 1967) contains a detailed summary of effects of compaction, fissuring, and tsunami runup near the harbor but makes no mention of landslide movement along this adjacent slope. With exception of the active surface rock-fall area, slope features observed on aerial photographs taken September 30, 1988 are identical to those observed on photographs taken July 3, 1951, indicating that there have been no major changes in 37 years and confirming that the 1964 earthquake had little or no effect. Additionally, there is no appreciable toe bulge at the base of the slope and no anomaly in the shape of the floor of the harbor as shown on the nautical chart of Womens Bay. These observations suggest that the landslide deposit is old, but its exact age is unknown. Although it appears unlikely that the slide is active, reactivation cannot be ruled out.

LINEAMENTS

Bedrock lineaments were mapped by interpreting stereo aerial photographs collected September 30, 1988. Most of the mapped lineaments (plates 4,5, and 7) are believed to be fracture zones or faults, marked by linear troughs or breaks in slope that continue across bedding. Where major differences in hardness and erodibility of beds produce prominent ridges and troughs, numerous closely spaced lineaments parallel to bedding or cleavage are visible on the aerial photographs, particularly in the northeastern and east-central parts of Area I (plate 7). However, only the most prominent of these bedding lineaments were mapped.

Density of photolineaments is greatest in highlands in the northeastern and southwestern parts of the study area (plate 7). Because fracture lineaments are naturally more visible in bedrock areas, this does not necessarily indicate any real differences in density of fractures.

Mapped photolineaments do not show any strong trends in orientation. Aside from the NE-SW trend of some lineaments, probably associated with bedding, only weak trends oriented roughly N-S and E-W are visible (plate 7). Interestingly, there is no apparent trend in lineament orientation parallel to

the most common orientation of fractures visible at outcrop scale, which is NW-SE, or perpendicular to bedding (Solie and Reifenstuhl, 1989).

SUMMARY

Surficial deposits of lowland areas of the U.S. Coast Guard Reservation in Kodiak are characterized by a thin, nearly continuous layer of firm, gray, cobbly till overlying glacially scoured bedrock. A thin layer of organic-rich silt typically overlies the till, or overlies bedrock where till is absent. A nearly continuous layer of uniform, pale brown, fine- to medium-grained volcanic ash from the 1912 eruption of Novarupta, near Mt. Katmai, covers the entire sequence and is the parent material for most of the modern soil. The ash is locally retransported where exposed. Exposed bedrock knobs or scoured surfaces are common where the surficial sediments have been removed by erosion. Deposits of stream-channel sand and gravel are common along the Buskin River, and overbank deposits of silt and sand overlie till or gravelly stream deposits in inactive flood plains.

Scoured bedrock on upland slopes is overlain by very thin, discontinuous till or colluvium, which is in turn typically overlain by organic-rich silt. Till and organic-rich silt are dominant at lower elevations, and colluvium is dominant at higher elevations. Volcanic ash covers these slopes as well, but is more commonly eroded and retransported than in the lowland areas.

Erosion and mass wasting have modified particularly the steep upland areas since deglaciation. Streams have incised narrow canyons in the bedrock and have deposited alluvial fans at the base of the slopes. Rock weathering and mass wasting have developed talus deposits on the upper slopes, and instability of rock and surficial deposits on steep slopes has resulted in several landslides. The landslides do not appear to be active.

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APPENDIX A

Field Notes and Stratigraphic Columns

KODIAK COAST GUARD BASE MAPPING PROJECT Aug. 16-27, 1988
Field notes - R.A. Combellick and M.A. Belowich
Alaska Division of Geological & Geophysical Surveys
All sections measured from top in inches.

8-16-88 Nyman Peninsula

88RC1 - Knoll adjacent to gas station
Artificial fill overlying bedrock. Bluff height 308" (25'8"). Top of bedrock at 103" (8'8").

0-205"	Fill - silty, sandy gravel with pebbles, cobbles, boulders of angular bedrock and a few tillstones (subrounded, striated). Fill was deposited on bedrock to form protective ridge surrounding fuel pumps.
205-308+	Bedrock.

88RC2 - Cut slope behind two white fuel tanks on NW side of peninsula. Height of bluff 581" (48.4').

0-3"	Veg/root mat.
3-9	Very dark brown (10YR2/1) organic-rich sandy silt with roots.
9-12	Very dark reddish-brown (7.5YR2/2) organic-rich sandy silt with roots.
12-581+	Artificial fill, same as in 88RC1; largest boulder (tillstone) 29".

88RC3 - Hill behind steam building. Bedrock exposure with discontinuous thin layer of till, ash, soil, & fill. Two sections, 88RC3A and 88RC3B.

88RC3A (see cross section)
Total height 167" (13.9')

0-9"	Fill- Very angular phyllite and sand.
9-15	Very dark brown (10YR2/2 wet) to very dark red brown (5YR2.5/2 wet) organic-rich sandy silt with some roots, some pebbles.
15-17	Very pale brown (10YR7/4) very well sorted fine volcanic ash; grains very angular to subrounded; abundant glass.
17-32	Dark reddish brown (5YR3/3 to 5YR2.5/2) organic-rich silt with some roots & plant fragments and a few pebbles to 2".
32-48	Poorly sorted clay, silt, sand, & gravel (till?); pebbles angular to rounded, max. size 1½"; moderately firm, color brown (10YR5/3) to gray (7.5YR5/0).
48-167+	Bedrock.

88RC3B (see cross section)
Total height 173" (14.4')

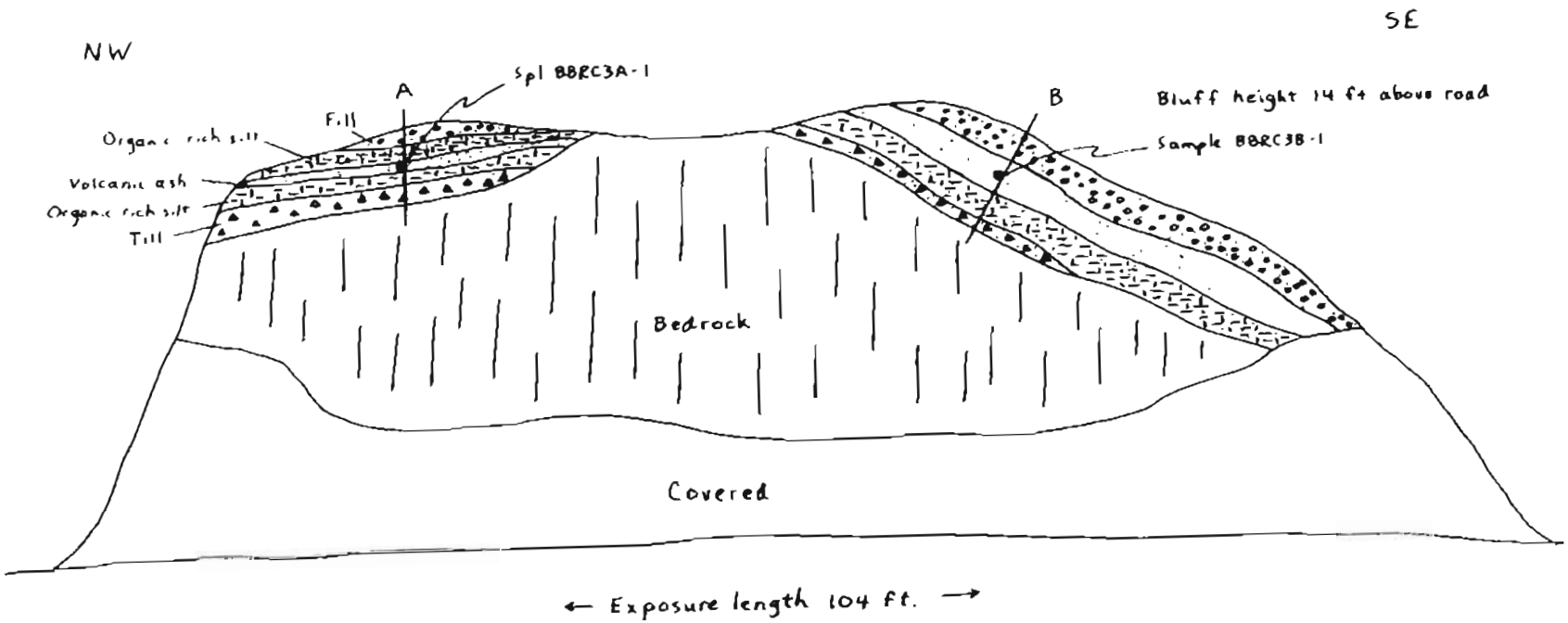
0-28"	Fill- Sandy gravel with clay and pebbles/cobbles of angular phyllite and occasional tillstones.
28-40	Volcanic ash- fine-grained, well sorted sand, steep planar cross beds dipping SE. Buff white to pinkish white layers. Some plant fragments. **Spl 88RC3B-1**
40-50	Dark reddish brown organic-rich silt.
50-55	Till(?)- sandy/silty pebble gravel with some clay; reddish gray. Could be till or regolith.
55-173+	Bedrock.

Volcanic ash appears to be deposited like a dune on the lee side (SE) of the ridge; thin and medium grained on windward side (proximal to source), thicker and fine grained on lee side (away from source).
Photos 88081601, 88081602, 88081603 - pan of section from NW to SE (left to right).

88RC4 - Low (5') bluff across from main dock. Total height from road level 67" (5'7").

0-2"	Gray organic-rich silty sand with roots (soil developed on volcanic ash).
2-8	Very well sorted fine to medium grained volcanic ash; light yellow brown (10YR6/4).
8-18	Dark brown (10YR2/2)(bottom) to very dark brown (10YR3/3)(top) organic-rich sandy silt. Becomes sandier downward.

Station 88RC3



Schematic cross section

Not to scale

18-26	Gray (7.5YR4/0 wet) poorly sorted clayey, sandy gravel with some pebbles & cobbles; medium firm; cobbles (tillstones) to 9".
26-67+	Phyllite.

88RC5 - Bedrock bluff opposite end of diagonal pier. Bluff height 211" (17.6').

0-5"	Veg/root mat.
5-15	Volcanic ash- medium grained, pale reddish brown to very pale brown; thickness varies 0-42" along exposure.
15-22	Dark brown organic-rich silt with some roots.
22-44	Gray pebbly clay; medium firm; pebbles to 4".
44-211+	Phyllite.

Photos **88081604**: Section- ash over organic-rich silt over till.
88081605: Polluted creek at RC5.
88081606: Toppling failure in phyllite adjacent to RC5 (NE).

88RC6 - Adjacent to corner of building.

0-4"	Veg/root mat.
4-11	Volcanic ash.
11-20	Dark brown organic-rich silt.
20-44	Pebbly, silty sand; pebbles to 5" (till?).
44-?	Bedrock.

Probably a small moraine with ash deposited on it.

88RC7 - Meadow SW of Peninsula Lake. Dug 2' pit with shovel.

0-1"	Moss, root mat.
1-3	Brown organic-rich fine sand (soil developed on ash).
3-8	Volcanic ash, medium grained.
8-24+	Unknown thickness below ash. Clean phyllite gravel, subrounded to rounded plates. Pre-Katmai beach deposit?. Clasts are generally 1/2" to 2". **Spl 88RC7-1**

8-17-88 - Nyman Peninsula - steady rain, wind

88RC8 - High bedrock bluff with till & fill cover (48" total cover). Till contains abundant clay and pebbles to 3", rounded to very angular. Bluff height 469" (39').

0-4"	Veg/root mat.
4-22	Fill - loose gravelly sand, pebbles to 2".
22-24	Organic-rich sandy silt (dark brown).
24-26	Medium-grained volcanic ash, varies 1-2" thick.
26-33	Dark brown organic-rich silt, some roots.
33-48	Till - gray pebbly sandy mud, pebbles to 3".
48-469+	Bedrock.

88RC9 - Near steam plant in fuel farm. Bluff height 176" (14.7').

0-2"	Peat and organic-rich silt with roots.
2-5	Medium-grained ash, discontinuous.
5-10	Dark brown organic-rich sandy silt w/pebbles.
10-176+	Bedrock.

88RC10 - Tank farm; 6' high road cut in till. Gray very poorly sorted mud, sand, and gravel. Tillstones to 15" scattered on surface. Pebbles rounded to angular, up to 4". Firm.

88RC11 - Gravel fill over buried tank.

88RC12 - Shovel pit about 40' east of USGS A68 (abandoned), 100' east of A68A. Ash/soil over till. 18" total depth.

0-2"	Dark brown peat and organic rich silt with roots.
2-4	Pale brown medium-grained ash.
4-11	Dark brown organic-rich silt with pebbles and cobbles to 6".
11-18+	Olive gray pebbly, sandy mud (till); pebbles to 1".

88RC13 - 7' high bluff behind tank near USGS A62.

0-14"	Fill
14-18	Pale brown ash.
18-19	Brown organic-rich silt.
19-79+	Till, cobbles to 8".

88RC14 - 4' section near USGS A84.

0-6"	Peat, abundant roots.
6-7	Volcanic ash.
7-11	Brown peat with roots.
11-24	Dark reddish brown organic-rich sandy silt.
24-48+	Firm gray till, mud to cobbles.

Abundant large tillstones to 21" on surface, may be artificially placed.

88RC15 - Exposure in fuel farm.

0-2"	Veg/root mat.
2-7	Medium-grained ash.
7-15	Dark brown (top) to dark reddish-brown (bottom) organic-rich silt.
15-29	Very poorly sorted mud, sand, & gravel to 1". Firm, gray to brownish gray. **Spl 88RC15-1** in middle of unit (about 22").
29-67+	Bedrock.

Exposure shows variable thickness of surficial cover over bedrock from about 6" of ash & soil over bedrock to ash & till for entire section.

Photo 88081701 of section.

88RC16 - Small (5' high) bedrock outcrop adjacent to large tank.

0-2"	Veg/root mat with dark brown organic-rich silt.
2-8	Medium-grained pale pinkish brown ash.
8-12	Dark brown organic-rich silt.
12-60+	Bedrock.

88RC17 and 88RC18 - Shallow (1') shovel pits at end of tank farm. No volcanic ash.

0-2"	Veg/roots and organic-rich silt.
2-12+	Till - pebbly, sandy mud with pebbles to 2" or larger.

88RC19 - Shallow shovel pit in meadow, 1' deep.

0-2"	Veg/root mat.
2-12+	Sandy gravel, gray, poorly sorted but fairly clean (trace clay); angular pebbles to 3", probably fill. Spl **88RC19-1**.

88RC20 - Small section on southeast side of ridge top near end of Nyman Peninsula.

0-2"	Vegetation & root mat.
2-9	Volcanic ash, fine to medium grained, very pale brown (10YR7/3), abundant roots. **Spl 88RC20-1**.

9-11	Very dark brown to dark brown (7.5YR3/4), rootlets, organic-rich clayey silt.
11-22+	Till, dark brown (10YR3/3), sandy, pebbles to 1".

Photos 88081702 and 88081703 of section.

88RC21 - Near satellite dish on NW side of ridge.

0-3"	Veg/root mat.
3-8	Organic-rich sandy silt with roots.
8-9	Discontinuous medium to coarse ash.
9-24	Dark brown organic-rich silt with some roots and worms.
24-26+	Firm gray till.

88RC22 - Shovel pit about 50' east of USGS A75. Total depth 23".

0-1"	Veg/root mat.
1-2	Dark brown organic-rich sandy silt.
2-3	Medium-grained ash.
3-10	Dark brown organic-rich silt
10-23	Dark reddish brown organic-rich silt.
23-24+	Till?

88RC23 - Shovel pit in basin near end of peninsula. Total depth 25".

0-1"	Veg/root mat.
1-9	Fine-grained ash; top 5" pale brown, lower 3" light gray.
9-18	Very pale brown ash, fine to medium grained (coarsest at base, fining upwards). Bottom 5" pale brown. Lower part probably primary ash fall; upper part may be retransported. Sharp contact with underlying unit. **Spl 88RC23-2**
18-25+	Very dark brown to black peat. Very small phyllite fragments. **Spl 88RC23-1**

88RC24 - Small bluff cut.

0-2"	Veg/peat.
2-6	Volcanic ash.
6+	Dark gray clean gravelly medium to coarse sand.

Possibly a disturbed section; no till; lower unit contains angular to well-rounded pebbles of phyllite. No bedding or fabric. Loose ash & soil may have slumped down over fill (?).

88RC25 - 10' high exposure near fitness trail.

0-1"	Veg/roots.
1-10	Dark brown to dark reddish brown organic-rich sandy silt. Discontinuous fine to medium ash unit to 1" thick about 3" from top of unit. Abundant roots, few pebbles.
10-45	Till- Light olive gray w/pebbles, sand; moderately firm.
45-119+	Bedrock.

88RC26 - Shovel pit, 18" deep.

0-1"	Veg/roots.
1-3	Dark brown organic-rich silty sand with abundant roots.
3-5	Medium to coarse ash.
5-14	Dark brown organic-rich silt with some roots.
14-18+	Till.

88RC27 - Shallow pit.

0-2"	Vegetation & roots.
2-3	Medium-grained ash with organics.
3-9	Dark brown organic-rich silt with roots.
9-16+	Gray till, cobbles to 4".

8-18-88 - Barometer Mountain (helicopter)

Photo 88081801 from knoll below Barometer Mt. looking NE (Buskin Lake)

88RC28 - 1650' elevation on ridge above Buskin Lake down from top of Barometer Mountain. Talus- angular to very angular pebbles, cobbles, and boulders of fine-grained graywacke to 35" (median 10"). Ash at base of talus slope is up to 13" thick, medium grained, grains rounded to subangular; probably retransported down talus slope.

Photo 88081802 of ash at base of talus.

88RC29 - Bedrock knob at 1520' elev. with thin (< 1') coarse colluvial cover of coarse angular rock and discontinuous ash up to 3' thick.

88RC30 - 20" deep shovel pit on small flat spot (small depression) at 1420' elevation.

0-2"	Veg/roots/soil.
2-7	Volcanic ash, medium grained, faint layering, subrounded grains, probably retransported.
7-20	Dark brown organic-rich sandy mud.
20-21+	Rock colluvium.

88RC31 - Bare, light colored flat closed basin at approx. 1300' elevation. Basin is about 150'x75'. Shovel pit to 36"; water table at 29".

0-36"	Volcanic ash, horizontally bedded, very fine to medium grained, pinkish pale brown to pale brown. Lower 12" has about 10% dark grains, possibly phyllite fragments. **Spl 88RC31-1** at 20".
36-37+	Rock colluvium.

Photo 88081803 of pit.
Photos 88081804 and 88081805 - views SW of ash surface. Ridge bounding depression on north (right) is bedrock. Primary joint set is 313°, 88°N. Foliation 54°, 88°NW.

88RC32 - Small bedrock ridge at about 1150'. Joints 294°, 82°NE; foliation 51°, 79°NW. Fine-grained sandstone. Slopes are rocky colluvium with thin (inches) soil cover and discontinuous thin ash.

88RC33 - Bedrock outcrop at 1080'. Rounded bedrock surfaces, possibly due to glacial scour. If so, this location may be approximate ice limit. Rock is fine-grained graywacke.

88RC34 - Rock-cored ridge at 1050' elevation. Joints 337°, 87°W; foliation 52°, 84°NW. Joints very widely spaced; only 2 joints in outcrop.

88RC35 - North-facing slope below bedrock ridge at 900' elevation. Shovel pit 22" deep.

0-2"	Moss/roots.
2-5	Grayish brown (salt & pepper) medium-grained ash.
5-12	Pale brown ash, medium grained fining up to fine grained.
12-22	Dark brown organic-rich sandy silt.
22-23+	Angular rock colluvium to 10" (median 3").

88RC36 - Bedrock-cored mound with flat area at 800' elevation. Rock is scoured subhorizontal. Possibly glacially scoured. Surrounding slopes are soil covered, heavily vegetated with grasses, moss, and occasional spruce and alder. Section on south-facing slope behind ridge.

0-2"	Veg/root mat.
2-6	Volcanic ash, light pale brown.
6-19+	Organic-rich silt, dark brown, containing cobbles to 6", subangular to subrounded, contains roots.

88RC37 - Shovel pit on knoll at 720' elevation. 22" TD in small clearing.

0-2"	Veg/root mat.
2-4	Volcanic ash, pale brown, medium grained.
4-6	Very fine brown silty sand, minor organics.
6-8	Very dark brown organic-rich mud.
8-17	Very dark reddish brown (oxidized) fine silty sand with minor organics.
17-22+	Gray pebbly, silty sand (till); pebbles to 2½".

This is highest elevation yet at which till was observed.

88RC38 - Shovel pit at 660' elevation.

0-2"	Veg/roots.
2-7	Medium-grained volcanic ash.
7-10	Very dark brown organic-rich silt.
10-22	Dark reddish brown sandy silt with some organics.
22-24+	Till; gray pebbly silty sand.

88RC39 - Bedrock ledge at 1360' elevation. Possibly glacially scoured. Part of break in slope that continues eastward along contour. May be ice limit, but no evidence of moraine or other till. Bedrock is planed off subhorizontal but still angular; no visible scour features. Discontinuous soil cover around exposures is 3" to 12" soil and ash over angular colluvium. Ash 2-6" thick over thin dark brown soil over colluvium. Bedrock fine to medium grained, thin to medium bedded graywackes.

Foliation: 39°, 86°NW. Joints 300°, 56°SW and 302°, 89°NE.

88RC40 - Knoll in cirque above Devil's Creek at 1150' elevation. Bedrock cored. Shovel pit on north side of knoll, 24"TD.

0-1"	Veg/roots (grass).
1-8	Fine to medium-grained light brown volcanic ash.
8-24+	Dark brown and dark reddish brown organic-rich sandy silt with abundant organics.

Surface of cirque floor is about 95% soil and vegetation cover (overlying several inches of ash) and 5% bedrock outcrops. Surface is littered with occasional boulders to 48", probably glacially transported. Rocks are highly weathered--no evidence of glacial scour; generally rounded but foliation weathered out into ridges.

88RC41 - Small knoll at 1040' elevation in lower part of cirque. 15" deep shovel pit at crest. Probably a moraine.

0-2"	Veg/root mat.
2-4	Very pale brown medium-grained ash.
4-8	Very dark brown organic-rich sandy silt.
8-15+	Dark brown, very poorly sorted sand and gravel with minor silt and clay. Very angular to subrounded pebbles and cobbles to 11", median size 2".

Photo 88081805 - View NW of low moraine at 88RC41 (in front of helo).
Photos 88081806, 88081807 - View SE across gully of till exposed in stream cut (not possible to work section). Boulders to about 2'.

88RC42 - Upper cirque level below Erskin Mountain.
Rounded and grooved rock outcrops (40%) and tundra (60%) littered with angular rock rubble. Median cobble size about 8". Largest boulders about 36". Steep slopes bounding cirque are partially vegetated talus.

Photo 88081808 - Deep grooves in bedrock.
Photos 18081809, 18081810 - Views SE and E out cirque (1810 shows Barometer Mountain).

88RC43 - Flat mesa above road near Devil's Creek, slightly outside map boundary.

0-3"	Veg/root mat.
3-19	Very pale brown volcanic ash. Medium grained at bottom, grading to fine grained at top.
19-21+	Dark brown pebbly sandy silt (till?).

88RC44 - Lower hillside above Devil's Creek.
Water table at surface (or surface runoff); too wet to do section.
Estimate 6" volcanic ash over organic-rich silt.

8-19-88 - Upper Buskin Valley (helicopter)

88RC45 - Shovel pit near top of knob at 600' elevation in NW corner of map area. Rounded, hummocky terrain.

0-2"	Veg/root mat.
2-3	Very pale brown fine to medium grained ash.
3-10	Very dark brown organic-rich sandy silt.
10-18+	Till; very poorly sorted pebbly, silty sand; very angular to subrounded pebbles & cobbles to 7". Color grayish brown (2.5Y5/2).

Photo 88081901

88RC46 - Rounded knoll at 400' elevation. Shovel pit.

0-2"	Veg/root mat.
2-11	Volcanic ash; medium grained at bottom grading to fine grained at top. Very pale brown to light reddish brown; dark brown in upper 2" from organic content.
11-21	Dark brown organic-rich sandy silt with plant fragments and bark.
21-24+	Weathered till, dark brown pebbly silt with abundant organics and very angular to subrounded pebbles to 3".

88RC47 - Depression in hummocky terrain at 220' elevation. Shovel pit to 38".

0-2"	Veg/root mat.
2-12	Volcanic ash.
12-30	Organic-rich sandy silt, very dark brown; at 27", reddish brown sandy silt.
30-33	Organic-rich, brown sandy silt. Spl 88RC47-1 for minimum age of deglaciation and maximum age of overlying silt (loess?).
33-38+	Weathered till with cobbles to 4".

88RC48 - Shovel pit at top of hill at 530' elevation. Probably a moraine.

0-2"	Veg/root mat.
2-4	Medium-grained volcanic ash.
4-11	Organic-rich sandy silt, dark brown, with occasional cobbles to 7".
11-17+	Till; brownish gray pebbly, silty sand.

88RC49 - Shovel pit on north side of moraine knob at 320' elev. near short spur road.

0-2"	Veg/root mat.
2-9	Medium-grained volcanic ash.
9-24	Brown organic-rich sandy silt. Upper 2" dark brown soil horizon.
24-27+	Gray brown pebbly, silty sand (till) with very angular to subrounded pebbles and cobbles to 5".

88RC50 - Small cut at end of short spur road near abandoned pallets and apparent barrel dump site (reddish water nearby with oil sheen). Elevation 280'.

0-4"	Vegetation/root mat and soil, dark brown.
4-7	Pale brown volcanic ash, medium grained, contains lenses of gray ash (some dark grains).
7-9	Very dark brown organic-rich silt with roots and sticks.

9-18 Dark brown to reddish brown organic-rich sandy silt with subrounded pebbles to 2.5".
18-24+ Brown, firm till. Grayish brown, pebbly, silty sand with occasional cobbles to 5".
Photo 88081902 of section.
(end of helo work for today--ceiling too low)

88RC51 - Artificial exposure at large KEA substation. Total height 22', with about 2' Quaternary over phyllite.

0-3"	Veg/root mat.
3-12	Volcanic ash, medium to coarse at base fining up to fine grained at top.
12-15	Very dark brown organic-rich sandy silt.
15-24	Till; brown, pebbly, sandy silt with some organics.
24-29	Weathered bedrock regolith.
29-268+	Phyllite.

88RC52 - Seacliff below station 88RC27. Very steep; unable to measure section. Approximate section:

0-72"	Sandy gray till. Cobbles to about 2 ft.
72+	Bedrock.

88RC53 - Cut by access road to antennas near south end of runway 36.

0-2"	Veg/root mat.
2-5	Medium grained volcanic ash.
5-20	Very dark brown organic-rich sandy silt with roots & pebbles. **Spl 88RC53-1** basal peat for minimum age of deglaciation.
20-24	Till; Grayish brown dense mud, sand, and gravel; high silt content, some clay. **Spl 88RC53-2**.
24+	Phyllite (?), smoothed by ice scouring. Two sets of grooves up to ¼" deep, 1" wide, azimuths 32° and 42°. Grooves are nearly parallel to foliation (48°, near vertical) but clearly not controlled by foliation. Appears to indicate ice flow nearly perpendicular to source of ice up Buskin River valley, possibly from Women's Bay instead.

Photos 88081903 and 88081904 showing grooves in bedrock. Pen parallel to one set of grooves.

88RC54 - Top of hill SW of south end of runway 36. Scoured bedrock. Vertical foliation planed off to smooth surface flush with the ground. Numerous striations subparallel to foliation ($30\text{-}40^{o}$).

8-20-88 - Weather clear.

88RC55 - Road cut in Coast Guard base subdivision. 70" cut, all bedrock with thin (2-4") soil cover. Portions of bedrock surface are scoured.

88RC56 - 32" cut next to subdivision road in CG base. Cut is in low rounded ridge trending parallel to road. Surface of hill is littered with tillstones to 19" (moraine?).

0-2"	Vegetation/root mat.
2-5	Medium-grained volcanic ash, variable thickness.
5-8	Light brown to brown silty fine sand with some organics.
8-16	Brown to rust silty fine sand with abundant roots.
16-19+	Brown pebbly, silty sand (weathered till?); pebbles to 5".

88RC57 - Cut in bedrock across nose of ridge in road cut next to ballfield on CG base. Section measured at crest. Bluff height 10' above road.

0-3"	Veg/roots/soil.
3-5	Volcanic ash.
5-12	Weathered till(?); brown pebbly silty sand with a few subrounded pebbles to 1½".
12-120+	Bedrock.

88RC58 - 93" bluff at west corner of elementary school on CG base.

0-2"	Dark brown veg/roots/soil.
2-7	Medium-grained ash, fining upwards to fine grained.
7-9	Very dark brown organic-rich silty sand with subrounded pebbles to 1".
9-19	Dark brown, loose, pebbly, silty fine sand with abundant organics & roots. Angular to subrounded pebbles to 1½".
19-31	Dark reddish brown, loose, silty, pebbly fine sand. Angular to well rounded pebbles to 5". Abundant roots.
31-45	Grayish brown, very poorly sorted mud, sand, & gravel (till). Becomes denser downward and more grayish. Angular to well rounded pebbles and cobbles to 6".
45-93+	Bedrock. Scoured with apparent grooves parallel to foliation and bedrock ridge (NE-SW).

Photo 88082001 of section; trowel on bedrock surface.

88RC59 - Small (44") exposure adjacent to DOT maintenance building NW of Buskin River bridge.

0-2"	Veg/root mat.
2-11	Mixed, crudely layered pale pinkish brown volcanic ash and organics with abundant roots & plant fragments. Ash is fine to medium grained.
11-15	Medium to coarse grained very pale brown volcanic ash.
15-18	Dark brown organic-rich sandy silt.
18-23	Brown sandy silt with some disseminated organics and angular to subrounded pebbles to 2½" (weathered till?).
23-42	Till; grayish brown to gray, moderately firm, silty sand. Color grades downward to gray. Very angular to subrounded pebbles and cobbles to 10".
42-44+	Bedrock; fine-grained graywacke.

88RC60 - 28-ft high bedrock knob east of midpoint of runway 36 on airport. Too high and steep to measure section. Approximate section, described from top of hill:

0-65"	Till; moderately firm, grayish brown (10YR5/2), very poorly sorted mud, sand & pebble/cobble gravel. Very angular to well-rounded pebbles, cobbles, & boulders to 29". Several bedrock knobs in area, capped with 0 to about 6 ft of till at crests. Median cobble size about 3". Approx. 20% of cobbles are striated or faceted. Unit weathers to dark gray (7YR4/0) on surface. Tillstones sticking out of outcrop are oriented 10-50°.
65-336+	Bedrock.

88RC61 - Thin section over thinly bedded turbidites at sea bluff about 200 yd south of runway 28. Seacliffs around airport all have none to several feet of soil and till over bedrock.

0-3"	Veg/root mat.
3-13	Fill and soil; unsorted and partially washed angular to subrounded pebbles and cobbles in soil matrix; abundant root material.
13-14	Volcanic ash, pale brown, medium grained.
14-25	Dark brown silty sand with angular to subrounded pebbles to 5" (weathered till).
25-89+	Bedrock.

88RC62 - Seacliff exposure about 200 yd north of east end of runway 28. Total height 154" (12.8') from high-water mark. Section is mixed fill, volcanic ash and till of varying thickness:

0-24"	Compacted fill, looks like till; very poorly sorted mud, sand, & gravel with cobbles to 12".
24-96+	Compacted, intermixed volcanic ash and dark brown pebbly, silty sand.

88RC63 - Face of tiedown cutout on north side of runway 25. All fill. Pebbly, silty sand with pockets of ash. Loose, no bedding.

88RC64 - Quarry at west end of airport. Total bluff height 426" (35.5').

0-44"	Loose pebbly sand (fill).
44-49	Fine- to medium-grained volcanic ash, fining upwards.

49-51	Dark brown organic-rich sandy silt with some roots and plant fragments.
51-54	Dark reddish brown organic-rich silt with some roots and plant fragments.
54-56	Grayish brown sandy silt.
56-60	Reddish brown organic-rich sandy silt.
60-67	Olive gray silty fine sand.
67-71	Pebbly, sandy mud (till); grayish brown, pebbles to 2".
71-426+	Bedrock.

88RC65 - Road cut east of terminal along perimeter access road; 12 ft high.

0-18"	Artificial fill; flat surface. Sand, gravel, & cobbles.
18-32	Pale pinkish brown to very pale brown fine- to medium-grained volcanic ash with 3" finer pinkish layer in middle.
32-40	Dark brown organic-rich sandy silt.
40-52	Olive to brown well sorted fine to medium sand with minor silt; pebbly at bottom.
52-64	Very dark brownish gray, well sorted gravelly sand. Clean, clasts very angular to subangular. No visible internal bedding. Max. clast size 1/2".
64-112	Interbedded clean sandy gravel and gravelly coarse sand. Very angular to subrounded pebbles to 4". Dark brownish gray (Munsell black, 7YR2/0).
112-134	Dark brownish gray clean, firm sand. Medium to coarse at base with minor silt, to fine to medium grained at top.
134-144+	Till? Angular to subrounded cobbles.

Section could be stratified drift. Located well above river level on side of ridge.
Photo 88082002 - section.

8-22-88 - Upper Buskin Valley (helicopter)

88RC66 - Top of knob at 370' elevation above Buskin Lake to south. Shovel pit 17" deep.

0-3"	Vegetation & root mat mixed with brown silty sand.
3-14	Medium-grained volcanic ash, fining upwards to fine grained.
14-17	Dark brown organic-rich sandy silt; contains abundant very angular pebbles & cobbles of phyllite.
17+	Bedrock or colluvium.

No till observed; apparently a bedrock-cored knob.

88RC67 - Flat spot just below 88RC66 at 320' elevation. Shovel pit 20" deep. Probably moraine.

0-2"	Veg/root mat.
2-8	Medium grained volcanic ash.
8-14	Very dark brown organic-rich sandy silt.
14-20+	Dark brown organic-rich sandy silt with abundant roots; also abundant pebbles & cobbles, angular to subrounded to 8".

88RC68 - Rounded knob at 220' elevation about 100 yd south of power line pole south of Buskin Lake. Shovel pit 19" deep.

0-3"	Veg/root mat.
3-4	Medium-grained volcanic ash.
4-15	Dark brown organic-rich sandy silt with abundant roots.
15-19+	Dark brown silty fine sand with abundant roots and abundant subangular pebbles & cobbles to 8". Probably morainal till.

Photo 88082101 showing cobble sizes.

88RC69 - Crest of sloping ridge at 300' elevation south of Buskin Lake. Shovel pit 39" deep.

0-3"	Veg/root mat.
3-11	Fine-grained ash grading upwards to medium-grained ash.

11-23	Very dark brown to dark brown organic-rich sandy silt. **Spl 88RC69-1** for minimum age of underlying loess or ash unit.
23-25	Strong brown (7YR5/6) silty fine sand (loess or older volcanic ash?). **Spl 88RC69-2.**
25-29	Very dark brown organic-rich sandy silt with occasional pebbles. **Spl 88RC69-3** for maximum age of overlying loess or ash unit and minimum age of deglaciation.
29-37	Dark brown sandy silt with abundant organics and a few pebbles.
37-39+	Till; firm gray poorly sorted mud, sand, & gravel. Pebbles to 1" or larger (limited sample obtained).

88RC70 - Top of low knob at 130' elevation just above road southwest of Buskin Lake. Shovel and hand-auger section to 39".

0-1"	Veg/roots.
1-3	Brown volcanic ash with abundant roots.
3-18	Volcanic ash; very pale brown to pinkish brown, medium to coarse grained (at bottom) to fine grained (at top). **Spl 88RC70-1** at 15", medium to coarse volcanic ash.
18-25	Very dark brown to dark reddish-brown organic-rich sandy silt.
25-38	Brown organic-rich silt with minor sand and occasional pebbles.
38-39+	Till; gray pebbly, sandy mud. Pebbles to 1".

88RC71 - Near top of rounded knoll at about 300' elevation west of Buskin Lake. Shovel pit 23" deep.

0-1"	Veg/root mat.
1-6	Volcanic ash, medium grained.
6-17	Very dark brown to black organic-rich sandy silt.
17-23+	Dark brown organic-rich pebbly sandy silt (weathered till). Angular to subrounded pebbles and cobbles to 5".

88RC72 - Top of knoll at 590' elevation near west edge of map area. Shovel pit south of small pond.

0-2"	Veg/root mat.
2-4	Medium-grained volcanic ash.
4-10	Very dark brown organic-rich sandy silt with abundant roots and some angular pebbles to 3".
10-14+	Brown pebbly sand with minor silt. Very angular to subrounded pebbles & cobbles to 6". Morainal till?

88RC73 - Floodplain west of Buskin Lake. Shovel pit to 26".

0-2"	Moss and root mat.
2-13	Volcanic ash, medium to fine grained (fining upwards).
13-26+	Gray pebbly mud and coarse sand with trace silt, washed. Sandy grains angular to very angular; pebbles angular to rounded, cobbles to 7". Too coarse for sample.

Photo 88082202.

88RC74 - 50 ft downslope from bedrock outcrops on knoll at 650' elevation, northeast of antenna farm. 28" shovel pit.

0-3"	Veg/root mat, mixed with ash.
3-10	Volcanic ash; medium grained at base, grading to fine at top.
10-14	Very dark brown to black peat or very organic-rich silt with abundant roots.
14-26	Dark brown silty fine sand with abundant angular pebbles to 2".
26-28	Grayish-brown silty, sandy mud with some pebbles.
28+	Till; grayish brown (probably thin over bedrock).

Water table at 20", rising. Tops of knolls in vicinity are bedrock in place. Overburden is thin to nonexistent on hilltops but thickens downslope. Pit just 10 ft above this on had till at 8" below thin ash & soil and bedrock at 12".

88RC75 - Shovel pit in saddle at 900' elevation near north edge of map area.

0-2"	Veg/root mat.
2-15	Volcanic ash, medium grained at bottom grading to fine at top.
15-21+	Organic-rich sandy silt with abundant pebbles and boulders. Angular to very angular clasts to 10" (Morainal till).

88RC76 - Road cut along side road in trees south of runway 25, about 30 ft below top of hill.

0-2"	Veg/root mat.
2-3	Medium-grained volcanic ash.
3-7	Dark brown organic-rich sandy silt with abundant angular to subrounded pebbles to 2".
7-14	Grayish-brown, poorly sorted mud, sand, & gravel, loose and moist; pebbles to 3" (weathered till).
14-30+	Till; brownish-gray, firm, poorly sorted mud, sand and gravel. Subrounded to very angular cobbles to 4" suggest that bedrock is within several inches.

Hillside has many small bedrock exposures visible through vegetation. Hill surface is littered with boulders to 10", subangular to rounded.

88RC77 - Road cut along side road south of runway 25. 73" high from road.

0-1"	Veg/root mat.
1-8	Volcanic ash, graded medium grained at base to fine grained at top. Very pale brown to pinkish brown.
8-20	Very dark brown to reddish brown organic-rich (more at top) silty sand with abundant subrounded to angular pebbles to 3". Abundant roots.
20-36	Weathered till; grayish brown, loose to firm. Very poorly sorted pebbly, muddy sand with occasional cobbles to 10".
36-51+	Till; gray, very firm, very poorly sorted mud, sand, & gravel. Cobbles to at least 6". Unknown depth to bedrock, but probably shallow (exposures nearby). Tillstones to 10" littering surface.

88RC78 - High road cut on south side of highway, 1 mi northwest of CG base entrance. Section 25.8 ft high.

0-3"	Veg/root mat.
3-10	Fill and soil mix; cobbles angular, size to 5", unsorted.
10-28	Volcanic ash; medium to coarse grained at base, fining upward to fine grained. Very pale brown to pinkish brown. Some darker lenses due to localization of black detrital material. Some organics and roots.
28-37	Very dark brown (at top) to reddish brown (at bottom) pebbly, silty sand; more organic rich at top.
37-57	Weathered till; grayish brown, poorly sorted mud, sand, and gravel, loose; rounded to angular pebbles and cobbles to 8".
57-99	Till; gray, poorly sorted mud, sand, and gravel, getting firmer toward base. Angular to subrounded pebbles and cobbles to 5".
99-105	Dark gray to black weathered bedrock.
105-310+	Bedrock.

88RC79 - Road cut with large tillstone boulder opposite 88RC78.

0-42	Fill; very poorly sorted, loose gravelly sand. Very angular to rounded cobbles and boulders to 12". No bedding.
42-60	Firm gray till; very poorly sorted mud, sand, and gravel. Most cobbles and boulders are 12" or smaller, but one large striated tillstone is on surface of cut and appears to be part of the till layer. Boulder has long dimension of 4½ ft. Photo 88082203.
60-116	Fractured bedrock.
116-164	Covered.
164	Base of road fill.

88RC80 - High road cut on west side of highway about ½ mi north of CG base entrance. Total height 313" (26.1') from base of road fill. Height to till/bedrock contact 107". No ash here, but thin layer in cut farther south. Boulders to 14". Thickness measured at thickest point at crest of hill. Thins to zero at north flank of hill.

0-206" Till.
206-313+ Phyllite.

Photos:
88082204 - View north of till/bedrock contact.
88082205 - Mike Belowich measuring section.
88082206 - View west of section from road.
88082207 - View east of section across road.

8-23-88 Old Womens Mountain and magazine area

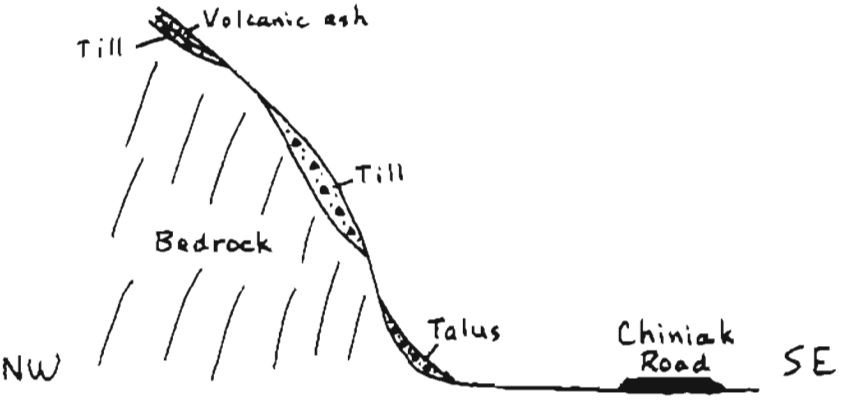
88RC81 - Gravel pit on hillside above highway above Women's Bay dock. Measured section is at northeast end. Thicknesses were estimated due to inaccessibility of part of outcrop.

0-2"	Veg/root mat.
2-6	Volcanic ash; medium grained, pale brown.
6-8	Dark brown organic-rich sandy silt (soil horizon).
8-32	Landslide (debris flow) deposit.
32-33	Dark brown organic-rich sandy silt (soil horizon).
33-56	Landslide (debris flow) deposit.
56-57	Dark brown organic-rich sandy silt (soil horizon).
57-61	Landslide (debris flow) deposit.
61-62	Volcanic ash (?).
62-78	Landslide (debris flow) deposit.
78-86	Volcanic ash (?). **Spl 88RC81-1**
86-600+	Old, large landslide (debris flow) deposits.

Exposure is up to about 50 ft high near NE end. Appears to cut alluvial/colluvial cone (debris-flow) deposits. Material is very poorly sorted gray silty sandy gravel. Clasts are very angular to subangular. Median size about ½", maximum 2 ft. Deposit is crudely bedded and shows crude pebble imbrication consistent with downslope transport to southeast. Several springs emanate from about mid-height (about 20 ft above base), downslope from feeder channels. Two major stages of debris flows appear to be represented: An older, major episode prior to an older ash(?), then a less extensive, thinner flow prior to the 1912 ash deposition. The 1912 ash overlies all of the deposits, indicating that no major debris flows have occurred since 1912. Minor gravity sliding is indicated by a wedge of debris-flow material in which the beds have been truncated on all margins. The sliding occurred between the older and younger ash episodes. **Photo 88082301** shows wedge between ash layers.
Photos 88082302 to 88082307 - Panorama of exposure from SW to NE. Photos 88082305 to 88082307 show younger flow deposit, bounded by ash units, at base of younger debris cone.

Gravel excavations are undercutting slope and causing small debris flows to occur in the saturated deposits. The material periodically fails from the cut face and flows out onto level ground (**Photos 88082308 to 88082310**). **Photo 88082311** - Mike Belowich taking section.

88RC82 - High slope-failure cut along highway at Women's Bay. Section too high and steep to measure. Section consists of bedrock in low and upper portions with till in the middle. Probably a ledge carved out by glacier and filled with till. Till shows crude horizontal bedding and large (up to 3 ft) tillstones oriented NE-SW, indicating probable ice flow to northeast, parallel to exposure.
Photos 88082312 to 88082316 of exposure.



88RC83 - Small cut along trail up Old Women's Mountain.

0-2"	Veg/root mat.
2-13	Volcanic ash, medium grained at bottom grading upwards to fine grained at top.
13-15	Dark brown organic-rich sandy silt with pebbles to 1".
15-35	Dark gray, loose, very poorly sorted mud, sand, and gravel with subrounded to angular clasts to 12".
35+	Bedrock.

Shallow bedrock exposed all along trail.

88RC84 - Road exposure near Devil's Creek bridge. Maximum 4 ft till over bedrock at crest, thinning to no till along flanks. Tillstones to 15". See cross section.

88RC85 - Small shallow slope failure in weathered till(?) on hillside visible from short side road next to Devil's Creek. Inaccessible. Depth to bedrock unknown. No ash visible.

88RC86 - Devil's Creek canyon. Flat surface about 10ft above creek. Could be terrace, but covered with fill (not able to dig pit). Fill is coarse sand & gravel with very angular clasts to 5".

88RC87 - High road cut along curve south of west end of runway 7. Total height about 30 ft. Maximum 6 ft of till covered by thin ash (max. 6") over bedrock. Cross section similar to 88RC84 (till thickest at crest).

88RC88 - Surficial exposure along Burma Road.

0-3"	Veg/root mat.
3-8	Medium grained volcanic ash.
8-18	Dark brown organic-rich sandy silt with pebbles to 1".
18-24	Silty fine sand with a few pebbles; dark brown to grayish brown.
23-33	Reddish brown silty fine sand with a few pebbles.

33-51+ Weathered till; firm grayish-brown to reddish brown fine sandy silt with abundant pebbles and cobbles to 7".

Numerous tillstones to 15" on ground surface. Unknown depth to bedrock, although bedrock is exposed in road about 15 ft below level of exposure.

Photo 88082317 of exposure (photo did not turn out).

88RC89 - Short spur road above Burma Road.

0-6" Volcanic ash.

6+ Weathered till.

Tillstones on surface to 12". Depth to bedrock unknown.

Photo 88082318 looking NE.

Burma Road: numerous bedrock exposures in road, some along roadside. Numerous tillstones scattered along a few sparsely vegetated areas above road. All exposures show 4-6" volcanic ash. Largest tillstone observed on surface is 3½ ft.

88RC90 - Basin along Burma Road below Barometer Mt. Unknown thickness. Retransported ash & soil submerged in 2-3 ft of water.

88RC91 - 15" section on loop road above Burma Road above airport.

0-4" Veg/root mat.

4-13 Volcanic ash, medium grained at base grading upwards to fine grained at top.

13-15+ Very dark brown organic-rich sandy silt; no pebbles.

88RC92 - Large open exposure above Burma Road along loop trail. Very angular rock rubble littering surface over reddish brown pebbly mud. Possibly debris-flow deposits. Small stream washes down surface here. Many cottonwoods(?) around margin are stripped and tilted downhill. Angular rubble and slippery pebbly mud overly firm sandy gravel with crude bedding and very angular pebbles. Open area does not appear on 1984 photos. Area may be slump (area uphill not disturbed).

Photos 88082319 to 88082321 of exposure.

88RC93 - Exposure in small slump scarp at intersection of Burma Road and Magazine Road.

0-3" Veg/root mat.

3-7 Volcanic ash; medium grained at base, fining upward to fine grained at top.

7-12 Very dark brown organic-rich sandy silt with small pebbles.

12-30 Dark brown to reddish brown silty fine sand with angular to subrounded pebbles to 3".

30-72+ Till; silty gravelly sand, brownish gray, angular to subrounded pebbles to 5"; saturated at base.

Depth to bedrock unknown. Tillstones in slump to 27" (several boulders).

Photo 88082322 of exposure.

88RC94 - Road cut on road around south perimeter of magazine area.

0-3" Veg/root mat.

3-15 Brown organic-rich silty fine sand; abundant roots and pebbles to 3/4".

15-26 Brown to reddish brown silty, pebbly fine sand; very angular pebbles to 4".

26-32 Gray very poorly sorted pebbly medium to coarse sand with minor silt; very angular pebbles to 3". Weathered colluvium?

32+ Bedrock.

88RC95 - Small road cut about 100 yd east of 88RC94. Top of section is base of spruce tree.

0-24" Volcanic ash.

24-38 Washed, black medium to coarse sand with angular to subrounded pebbles to 3½". Origin unknown.

38-? Till; very firm, gray, poorly sorted gravelly, silty sand; very angular to subrounded pebbles to 1".

88RC96 - Floodplain deposits in Buskin River on inside meander bar.
Poorly sorted coarse sandy gravel. Sand grains are very angular to subrounded. Pebbles and cobbles are angular to rounded. Median size about 1/2". Maximum length 8". Dominant pebble shape is prolate spheroid (flat, rounded). Lithologies mostly graywacke.

8-24-88 Magazine area and upper Buskin Valley

88RC97 - Small road cut on hillside just inside gate to magazine area.

0-3"	Vegetation/root mat.
3-6	Medium to coarse volcanic ash.
6-13	Very dark brown to brown organic-rich sandy silt with abundant roots and very angular to subangular pebbles to 5".
13-31	Till or colluvium; loose at top to firm at base. Very poorly sorted, muddy, gravelly sand. Dark grayish brown at top to brownish gray at bottom. Cobbles to 4", very angular to angular.
31+	Bedrock.

88RC98 - High (37 ft) exposure of bedrock and till in road cut in magazine area.

0-3"	Veg/root mat.
3-5	Medium-grained volcanic ash.
5-13	Dark brown to black organic-rich sandy silt with abundant roots; very angular pebbles to 3".
13-20	Yellowish brown mud with minor pebbles and organics.
20-62	Till; olive gray, firm, pebbly sandy mud with angular to subrounded pebbles and cobbles to 6½".
62+	Bedrock.

88RC99 - Marsh at outlet of shallow pond. Shovel pit 20" deep. Water table at or near surface.

0-4"	Veg/root mat.
4-12	Volcanic ash, medium to coarse grained.
12-20+	Peat, high ash content (silty), dark brown to black.

88RC100 - 6 ft section behind magazine building.

0-3"	Veg/roots.
3-7	Volcanic ash, medium grained.
7-18	Very dark brown to reddish brown (color change downward) organic-rich silty fine sand with abundant roots and very angular pebbles to 6".
18-28	Till; grayish brown, firm, pebbly, silty sand. Very angular to subrounded pebbles to 5".
28-85+	Bedrock.

88RC101 - Backhoe cut on northeast side of low hill.

0-7"	Moss, grass, and roots.
7-17	Medium- to coarse-grained volcanic ash.
17-42	Dark brown to reddish brown organic-rich sandy mud with minor very angular to subrounded pebbles to 4".
42-76	Grayish brown till; firm pebbly sandy mud with very angular to subrounded cobbles to 6".
76+	Bedrock.

88RC102 - Road cut in magazine area.

0-3"	Grass/root mat.
3-12	Volcanic ash; medium grained at base to fine grained at top. Very pale brown at bottom, pinkish brown at top.
12-28	Very dark brown organic-rich sandy silt at top to dark brown organic-rich mud at base. Abundant very angular to angular pebbles to 4". Abundant roots.

28-53	Till; firm grayish brown pebbly silty sand. Very angular to subrounded pebbles to 3½".
53+	Bedrock.

88RC103 - 52" section in small stream cut next to entrance to empty bunker.

0-2"	Veg/root mat.
2-15	Fill; mixed volcanic ash & gravel.
15-23	Volcanic ash; fine grained at top graded to medium grained at bottom. Strongly rust colored.
23-32	Very dark brown to brown organic-rich mud with minor sand, abundant roots, and minor angular pebbles to 1". Colluvium?
32-52+	Dark gray, poorly to well sorted pebbles and medium to coarse sand. Angular to rounded pebbles to 3". Origin unknown. Fluvial? **Spl 88RC103-1** at 48".

88RC104 - Section next to bunker at end of road at SE margin of Buskin Lake

0-3"	Grass, moss, and root mat.
3-21	Sand & gravel fill with roots. Cobbles to 10". Moist.
21-84+	Dark gray (where wet; light gray where dry) coarse sandy gravel; no silt. Poorly sorted. Angular to well rounded pebbles to 7". Crude subhorizontal bedding and pebble imbrication. Sand and granules very angular to subangular. Fluvial. Pebbles generally lying parallel to bedding.

Photo 88082401 of section.

88RC105 - Southeast shoreline of Buskin Lake.
Beach consists of angular pebbles to 1". At this station, large boulders are deposited on the beach. Boulders are angular to well rounded, up to 3½' maximum dimension. Trees growing in deposits; lichens on boulders. No matrix (possibly winnowed by waves). Could be nose of landslide deposit(?).

88RC106 - Shovel pit in small flat area near road intersection.

0-2"	Grass and moss root mat.
2-9	Medium-grained volcanic ash.
9-21	Dark brown (black near surface) organic-rich sandy silt with some roots and pebbles (minor).
21-22+	Till; very firm, gray, pebbly, muddy sand. Not able to dig further. Largest pebble observed 2" (subangular).

88RC107 - Shovel pit in flat area near Larsen Bay Road; 43" deep.

0-3"	Veg/root mat.
3-14	Volcanic ash; medium to fine grained, coarse grained at base.
14-26	Dark brown to black organic-rich silt; some roots near top.
26-39	Dark yellowish brown (10YR3/6) silt with minor clay. **Spl 88RC107-1** at 32". Upper 1" of this horizon is strongly rust colored (dark red, 2.5YR3/6).
39-43+	Till; gray pebbly sandy mud; firm & wet. Angular to subrounded pebbles to 1½". Larger pebbles probably present.

88RC108 - Exposure 33 ft high in magazine area.

0-3"	Moss, grass, and root mat.
3-6	Medium-grained volcanic ash.
6-13	Dark brown organic-rich silty sand with roots and angular pebbles to 1½".
13-25+	Pebbly, silty sand. All pebbles are very angular and platy. Dark gray. Linear/planar fabric. Colluvium?

Appears to be fractured/weathered bedrock or colluvium. Entire exposure is angular pebbles and cobbles, fairly dense (firm). Possibly a rock slide or toppling failure overlain with soil and ash.

88RC109 - Shovel pit (32") in flat area east of antenna near Buskin Lake.

0-1"	Veg/root mat.
1-12	Volcanic ash; medium grained at bottom grading to fine grained at top.
12-20	Very dark brown organic-rich sandy silt.
20-29	Dark yellowish-brown silt with minor sand.
29-32+	Till; gray pebbly, sandy mud with subrounded pebbles to 3½".

88RC110 - Gravel pit at outlet of debris chute below golf course.
Deposit apparently fed by intermittent torrential stream. Gray gravelly coarse sand. Sand and pebbles very angular, platy. Cobbles and boulders very angular to subrounded. Largest boulder 32". Strong pebble imbrication in bed and in sections along margin consistent with flow toward lake.
Photos 88082402, 88082403.

88RC111 - Shovel pit in meadow next to spur road to gravel pit.

0-2"	Veg/root mat.
2-10	Volcanic ash; medium grained at base grading upward to fine grained at top.
10-15+	Dark gray, gravelly coarse sand; sand is very angular; pebbles very angular to subrounded (platy); max. pebble size 4", but larger pebbles probably present.

88RC112 - Exposure on hillside at west end of golf course.

0-1"	Veg/root mat.
1-10	Volcanic ash; medium grained at base grading upward to fine grained at top.
10-23	Dark brown to reddish-brown organic-rich sandy silt with abundant roots and minor pebbles to 3½" near bottom.
23-28+	Till; firm, olive gray, pebbly, sandy mud; pebbles angular to subrounded to 3".

Vegetation removed and gullies have formed in ash from runoff.

88RC113 - 6-ft road cut along Larsen Bay Road west of Buskin Lake.

0-6"	Vegetation, root mat, and fill.
6-12	Volcanic ash; medium grained at base grading upward to fine grained at top.
12-16	Very dark brown (black at top) organic-rich silt.
16-31	Reddish-brown silt with minor angular to rounded pebbles to 1½"; minor organics.
31-72+	Till; Firm, very poorly sorted mud, sand, and gravel; very angular to rounded pebbles to 4". Large (21") boulder at 57".

Depth to bedrock unknown.

8-25-88 Antenna farm and northeast portion of map area

88RC114 - Hill above Comm Sta building; small road cut.

0-2"	Veg/root mat.
2-7	Medium-grained volcanic ash.
7-13	Loose, pebbly, muddy sand with abundant roots. Subangular to rounded pebbles to 5". Weathered till.
13-23	Till; firm, pebbly, muddy sand with subangular to rounded pebbles to 6".
23+	Bedrock.

Bedrock also poking through surface on hillside near exposure.

88RC115 - 24-ft high road cut on road to CommSta.

0-4"	Vegetation, roots, and organic-rich pebbly silt; several large roots.
4-5	Thin medium-grained volcanic ash, discontinuous.
5-9	Weathered till; loose, organic-rich pebbly, muddy sand; pebbles very angular to subangular to 2".
9-27	Till; firm gray pebbly, muddy sand with angular to subrounded clasts to 9".
27-281	Covered to road level; depth to bedrock unknown.

88RC116 - Low road cut near west end of antenna farm.

0-3"	Veg/root mat.
3-18	Volcanic ash; medium grained at base grading upward to fine grained at top. Well sorted.
18-21	Very dark brown organic-rich sandy silt with angular to subrounded pebbles to 1" and abundant roots.
21-33+	Loose, grayish-brown, poorly sorted, silty, sandy pebble gravel. Angular to subrounded clasts to 6". Minor clay. Not bimodal like till. Possibly fluvial (outwash?). Depth to till or bedrock unknown.

88RC117 - Road cut in antenna farm.

0-8"	Volcanic ash; medium grained at base grading upward to fine grained at top.
8-19	Very dark brown to strong brown silt with minor pebbles to 3"; organic rich with roots in upper 3".
19-23	Grayish-brown, loose, pebbly, silty sand; pebbles to 1".
23-65	Till; gray, firm, poorly sorted silt, sand, and gravel. Angular to rounded clasts to 15".

88RC118 - Cut in vegetated hillside above antenna 5.

0-3"	Veg/roots; grass, moss, horsetails.
3-8	Volcanic ash; medium grained at base grading upward to fine grained at top. Very pale brown; top two inches pinkish brown.
8-15	Dark brown, organic-rich, loose, sandy silt with angular pebbles to 2"; weathered till.
15-27	Till; gray, firm, very poorly sorted mud, sand, and gravel; angular to subrounded clasts to 15".
27+	Covered (vegetation and surface slough).

88RC119 - Shovel pit near antennas 2/3. Flat area between hills, adjacent to small high hill.

0-3"	Vegetation and roots mixed with dark brown organic-rich volcanic ash.
3-10	Volcanic ash; medium grained at base grading upward to fine grained at top.
10-18	Very dark brown to dark brown organic-rich sandy silt with some roots.
18-21	Gray silty clay, possibly lacustrine or overbank deposits.
21-25	Gray, gravelly, silty, medium to coarse sand; probably fluvial. Pebbles are very angular to rounded to 3"; loose. Pebbles are mostly platy and oriented mostly horizontally.

88RC120 - Small (31") road cut below V canyon near north edge of area II.

0-2"	Vegetation and roots mixed with peat and volcanic ash.
2-8	Volcanic ash; medium grained at base grading upward to fine grained at top.
8-12	Dark brown to black silty peat with abundant roots.
12-19	Brown to reddish-brown organic-rich sandy silt with abundant roots.
19-24	Weathered till; grayish brown to brown, loose to moderately firm mud, sand, and gravel.
24-31+	Till; very firm, gray mud, sand, and gravel with minor tillstones to 8".

88RC121 - Hillside or terrace cut next to bunker at end of road below canyon.

0-3"	Veg/root mat.
3-9	Volcanic ash; medium grained at base grading upward to fine grained at top. Top half pale pinkish brown, bottom half very pale brown.
9-13	Dark reddish-brown organic-rich sandy silt with roots.
13-18	Olive gray mud with minor sand and pebbles to 1".
18-48+	Dark gray poorly sorted but clean, very loose, coarse sandy gravel. Most gravel very angular to subangular. Median size ½". Minor larger subangular to rounded clasts to 6". One angular clast at least 10". Could be terrace deposit. Faint crude bedding and pebble imbrication.

88RC122 - Shovel/auger pit on antenna field access road between Buskin Lake and large antenna.

0-3"	Veg/root mat.
3-10	Volcanic ash; medium grained at base grading upward to fine grained at top.

10-18	Dark brown organic-rich sandy silt with roots; no pebbles.
18-30	Reddish brown silty fine sand with subrounded pebbles to 1".
30-36	Clean, gray, loose, medium to coarse sand; well sorted.
36-52+	Clean, gray, poorly to moderately sorted, gravelly coarse sand. No silt or clay. Sand very angular to angular, gravel angular to rounded to about 2". Spl 88RC122-1 at 50". Looks fluvial.

88RC123 - Small (29") section over bedrock at outcrop near red lake. Top of section is about 6 ft above fill surface.

0-5"	Vegetation and root mat with dark brown peat.
5-9	Volcanic ash; medium grained at base grading upward to fine grained at top.
9-13	Dark brown organic-rich sandy silt with abundant roots.
13-29	Till(?); gray pebbly, muddy sand. Very angular to subrounded pebbles to 5". Loose to moderately firm.
29-72+	Bedrock.

88RC124 - Outcrop with thin surficial section at NE corner of lower KEA substation. Base of section is at fill surface in substation.

0-3"	Veg/root mat.
3-10	Volcanic ash; medium grained at base grading upward to fine grained at top.
10-26	Very dark brown to reddish brown (middle) organic-rich sandy silt (less organics in middle); some large subangular cobbles to 9". Weathered till?
26-42	Till; gray loose to firm (downward) grayish brown to gray pebbly muddy sand.
42-146+	Bedrock.

Till gets thicker where bedrock surface is lower. Bedrock surface is scoured.

88RC125 - Top of small hill above subdivision.

0-6"	Fill; angular pebbles, sand, and silt.
6-12	Dark brown to reddish brown organic-rich silt.
12-14+	Till(?); Olive gray pebbly mud. Probably thin over bedrock. Bedrock is at surface about 100 ft south.

88RC126 - Road cut southeast of sanitary landfill

0-4"	Veg/root mat.
4-8	Medium-grained volcanic ash, very pale brown.
8-10	Dark brown organic-rich sandy silt with angular pebbles to 1".
10-117+	Till; gray, very firm, pebbly, muddy sand with angular to rounded clasts to 9". Top 12" loose and grayish brown.

88RC127 - Exposure of scoured bedrock and small section on hillside southwest of Lake Louise.

0-2"	Modern vegetation and roots.
2-11	Disturbed layer, possibly fill; mixed volcanic ash and organic-rich silt, roots, and pebbles.
11-17	Clean medium-grained volcanic ash. Spl 88RC127-1 for density (in film can).
17-25	Dark brown to reddish-brown organic-rich sandy silt with a few pebbles. No sand near top.
25-30	Till; gray, firm, very poorly sorted mud, sand, and gravel.
30+	Scoured bedrock. Large (tire size) grooves oriented 125° (305°), consistent with ice flow from Buskin valley. Small (1/8 to 1/4") grooves same orientation.

Photos 88082501 to 88082505.

88RC128 - Vertical bedrock exposure in road cut at north end of Lake Louise. Estimated height 35 ft. Too steep to measure section. Approximate section:

0-6"	Vegetation/root mat and soil
6-12	Volcanic ash

12-36	Till.
36-420+	Bedrock.

88RC129 - Cut along power line north of Lake Louise. Total height 62".

0-4"	Veg/root mat.
4-9	Volcanic ash; medium grained at base grading upward to fine grained at top.
9-12	Very dark brown organic-rich sandy silt; abundant roots and a few pebbles.
12-17	Reddish brown sandy silt with minor organics.
17-62+	Till; olive gray at top (6") to gray, very firm, silt, sand, and gravel with minor clay. Angular to subrounded cobbles to 5½".

88RC130 - Road cut west of main substation; 73" high section.

0-4"	Veg/root mat.
4-10	Volcanic ash; medium grained at base grading upward to fine grained at top.
10-14	Dark brown organic-rich sandy silt with abundant roots and minor angular pebbles to ½".
14-18	Reddish brown sandy silt with minor organics and angular pebbles to 2".
18-73+	Till; gray, firm, poorly sorted mud, sand, and gravel; angular to subrounded cobbles to 9".

Depth to bedrock unknown.

88RC131 - Small section over scoured bedrock in trail to Pillar Mountain, just above substation.

0-4"	Moss/root mat.
4-20	Mixed volcanic ash and dark brown sandy silt with organics and roots and a few cobbles to 6" (disturbed zone).
20-26	Volcanic ash; medium grained at base grading upward to fine grained at top.
26-31	Dark brown to black peat and organic-rich silt with a few roots; no pebbles.
31-35	Dark reddish-brown organic-rich sandy silt, no pebbles.
35-39	Grayish-brown, pebbly, sandy silt; angular pebbles to 6½".
39-45	Till; gray, very firm, very poorly sorted mud, sand, and gravel with pebbles to 4".
45+	Scoured bedrock.

8-26-88 Road cuts along main highway

88RC132 - High road cut on southeast side of main highway south of intersection of road to wildlife refuge. Too high and steep to measure section. Estimated total height 50 ft. Approximate section at crest of hill where till is thickest:

0-12"	Volcanic ash.
12-60	Till.
60-~600+	Bedrock.

88RC133 - Bedrock exposure on southeast side of main highway north of access road to wildlife refuge. Estimated total height 40 ft; all bedrock except one small pocket about 1 ft deep and 5 ft wide filled with till. Otherwise surface is bedrock.

88RC134 - Thick till exposure on west side of main highway. Moraine? Total height 24 ft (288").

0-3"	Veg/root mat.
3-12	Very pale brown to pale pinkish brown volcanic ash, medium grained at base graded to fine grained at top.
12-13	Very dark brown organic-rich sandy silt with roots.
13-22	Dark yellowish-brown, fine sandy silt with some organics and abundant roots. Very friable. No pebbles observed.
22-32	Yellowish-brown to grayish-brown weathered till. Very poorly sorted silt, sand, and gravel with abundant rounded cobbles and boulders (tillstones) to 23". Very loose. Matrix supported.

32-288+ Thick, gray, firm till. Very poorly sorted silt, sand, and gravel at top to pebbly sandy mud at base. Angular to rounded tillstones on surface (eroded out of exposure) range to max. 22". Continues to road level.

Largest tillstones are in weathered till near surface (22-32" unit). Depth to bedrock unknown.

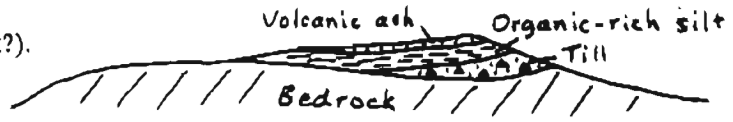
88RC135 - Road cut on west side of main road across from lake. Approx. 30' section of till and ash.

0-4" Veg/root mat.
4-10 Volcanic ash.
10-27 Very dark brown to strong brown clayey silt with numerous pebbles and cobbles. Upper 4-6" is very dark brown and organic rich. Angular to subrounded cobbles to 11". Numerous swallow nests.
27-43 Grayish brown, wet, loose, weathered till; very poorly sorted silt, sand, and gravel with minor clay. Very angular to subrounded cobbles (minor) to 12" (tillstone morphology). Matrix supported.
43-360+ Gray, wet, very firm till; pebbly, muddy sand at top to pebbly sandy mud at base. Dripping water from surface runoff. Very hard (like concrete) under surface cover. Faceted, striated boulders to 35".

Depth to bedrock unknown, but bedrock surface is exposed at road level in exposure about 100 north.

88RC136 - Road cut adjacent to 88DNS352. Small section of till draped on hillside; maximum 6 ft thick over bedrock. At thickest point, section consists of approx. 6" volcanic ash, 12" soil, and rest till over bedrock. Top is about 40 ft above road. See cross section.

0-6" Volcanic ash.
6-18 Soil (organic-rich sandy silt?).
18-72 Till.
72+ Bedrock.



88RC137 - Road cut on east side of highway near north edge of study area. Total height 27 ft.

0-4" Veg/root mat mixed with organic-rich volcanic ash.
4-8 Medium-grained volcanic ash.
8-18 Very dark brown organic-rich sandy silt and silty peat with abundant roots.
18-22 Dark reddish-brown sandy silt with some organics and roots and minor small (½") pebbles.
22-32 Weathered till; loose to moderately firm, grayish-brown, pebbly, muddy sand; very angular to rounded tillstones to 6". Gradational with lower unit.
32-252 Brownish gray to gray, very firm till; pebbly, muddy sand at top with pebbles to 3". Pebbly, sandy mud at base.
252-324+ Bedrock, mostly covered.

88RC138 - Very thin (4") till over bedrock in quarry exposure.

0-2" Veg/root mat.
2-6 Till; pebbly, muddy sand, loose to moderately firm, subangular pebbles to 2".
6-60+ Bedrock.

Overburden is maximum 1 ft thick on bedrock. Exposure is 10 ft high at section location, to about 25 ft high maximum.

88RC139 - Road cut along road between Lake Catherine and Lake Louise.

0-4" Very dark brown veg/root mat with organic-rich volcanic ash and peat.
4-6 Very pale brown volcanic ash, fine grained.
6-9 Rusty or pale pinkish brown fine-grained volcanic ash.
9-11 Pale brown medium- to fine-grained volcanic ash.
11-14 Chocolate brown (very dark brown to black) organic-rich silt with minor clay and some roots.
14-20 Dark reddish brown sandy silt with scattered pebbles to 2".
20-33 Weathered till; brownish-gray, moderately firm, very poorly sorted silt, sand, and gravel with minor clay. Subrounded cobbles (tillstones) to 6", mostly 1-2". Matrix supported.

33-240+ Very firm till; gray to steel gray, very poorly sorted silt, sand, and gravel with minor mud, grading downward to pebbly sandy mud, steel gray.

Depth to bedrock unknown. Largest tillstone weathered out on surface is 38" long and rounded.

88RC140 - Terrace (?) exposure next to Buskin River across from hotel.

0-38" Fill; disturbed volcanic ash, soil, sand, and gravel.

38-44 Volcanic ash; medium grained at base grading upward to fine grained at top.

44-47 Very dark brown organic-rich silty sand with roots and some pebbles to 3/4".

47-50 Reddish-brown pebbly silt with roots and angular pebbles to 2½".

50-58 Grayish-brown to reddish-brown, very loose, clean, pebbly sand with no mud. Angular to rounded pebbles to 6". Fluvial(?).

58-268+ Clean interbedded pebbly sand and gravelly coarse sand. Dark gray to brownish gray. Angular to rounded cobbles to 11".

Terrace surface is 22' above river level.

8-26-88 Surficial sections by M.A. Belowich - campground area north of airport.

88RC141 (88MB1)

0-3" Veg/root mat.

3-6 Mixed medium-grained volcanic ash, organics, and roots.

6-19 Brown organic-rich silty sand with angular pebbles and cobbles to 5" and abundant root material.

19-38 Till; grayish-brown, poorly sorted, pebbly, sandy mud grading downward to pebbly sand; angular to subrounded pebbles and cobbles to 6". Loose at top, firm at bottom.

38+ Bedrock; foliation 30°, 37°NW on top of knob overlooking Buskin River.

88RC142 (88MB2) - Shovel pit.

0-3" Veg/root mat.

3-10 Volcanic ash; medium grained at base grading upward to fine grained at top.

10-17 Dark brown organic-rich sandy silt with angular to subrounded pebbles to ½" and abundant roots.

17-31 Reddish-brown silty sand with some organics; large angular to very angular cobbles to 12".

31-35+ Grayish brown, loose, muddy, pebbly sand with some organics; angular to subrounded cobbles to 6". Weathered till.

Bedrock or unweathered till not observed here, although at bottom of holes extensive flat rocks were encountered, stopping digging, but may mean that rocks are at bedrock surface.

88RC143 (88MB3)

0-3" Veg/root mat.

3-9 Medium-grained ash.

9-13 Dark brown organic-rich sandy silt with angular to very angular pebbles to 2" and abundant roots.

13-22 Reddish brown to brown silty sand with angular to very angular pebbles to 1½".

22-24+ Till; gray, poorly sorted mud, sand, and gravel with angular pebbles to 1".

88RC144 (88MB4)

0-1" Veg/root mat.

1-13 Fill.

13-19 Volcanic ash; medium grained at base grading upward to fine grained at top. Pale brown at base, pinkish brown at top.

19-25 Dark brown organic-rich sandy silt with some roots; minor angular pebbles to 1/4".

25-41 Reddish brown to brown silty sand with interbedded thin rust- colored zones; minor organics and angular pebbles to 3".

41-44+ Till; gray, pebbly, sandy mud with angular to subrounded pebbles to 1".
Tillstones in vicinity to 8".

88RC145 (88MB5)

0-3"	Veg/root mat.
3-9	Volcanic ash; medium grained at base grading upward to fine grained at top. Very pale brown at base, pinkish brown at top.
9-18	Very dark brown organic-rich sandy silt with some roots and angular to very angular pebbles to 1½".
18-21	Reddish-brown silty sand with angular pebbles to 1" and abundant roots.
21-29	Till; grayish brown, muddy, pebbly sand, poorly sorted. Angular to subrounded pebbles to 1½".
29+	Bedrock.

88RC146 (88MB6)

0-4"	Veg/root mat.
4-8	Volcanic ash, pale brown, medium grained.
8-16	Dark brown organic-rich silty sand with abundant roots and angular to subrounded pebbles to 3".
16-111+	Till; brownish gray to gray, poorly sorted mud, sand, and gravel; firm at top to very firm at bottom. Angular to subrounded pebbles and cobbles to 7".

Abundant tillstones in nearby ditch to 14".

Surficial sections by D.N. Solie

88DNS218 - Small outcrop behind pale green water tank. Organic mat covers outcrop, virtually nothing else for cover.

88DNS230 - South-facing bowl between Erskine and Barometer Mountains. Light tan volcanic ash fills a small pond next to outcrop; ash is at least several inches thick.

88DNS244 - Wide lumpy ridge in northeast corner of study area. The 'lumps' are caused by bedrock which is elongate along bedding direction; crops out on tops of most knobs.

88DNS283 - Small outcrop in bushes behind bunker in antenna farm. About 4 cm (1½") of ash under several cm of organic mat (moss). Can't see any till on the bedrock. Approximate section (RAC):

0-2"	Veg/root mat.
2-4	Volcanic ash.
4+	Bedrock.

88DNS284 - Tiny road cut outcrop on east side of road in antenna farm. Approximate section:

0-1"	Organic mat.
1-2	Volcanic ash.
2-8	Brown soil.
8-16+	Till with subrounded cobbles up to 1 ft long.

88DNS346 - On point in Lake Louise. Approximate section:

0-2"	Organic layer
2-13	Tan volcanic ash.
13-20	Dark brown soil.
20+	Bedrock, roughly 5' thick exposed.

No till at this section, except one subrounded tillstone about 4" diameter on bedrock surface.

88DNS350 - Beach exposure north of mouth of Buskin River.

0-1"	Organic mat.
1-7	Volcanic ash; fine to medium grained at bottom, fine grained at top. Light buff color.
7-13	Very dark brown organic-rich sandy silt; contains angular pebbles and cobbles to 10" max. size. clasts are dark gray siltstone and very fine-grained sandstone.
13-19	Grayish-brown, very poorly sorted, pebbly, sandy mud; angular to subrounded pebbles to 3".
19-35+	Very firm gray till; very poorly sorted pebbly, sandy mud. Angular to subrounded pebbles to 3".

Depth to bedrock is unknown, but estimated from nearby bedrock surface depth is about 5 ft from top of section. Bedrock exposure below is about 6 ft.

88DNS351 - Under power line across road off west side campground road.

0-3"	Organic mat; moss and grass.
3-5	Light buff (pale brown), sandy, silty very fine-grained volcanic ash.
5-12	Light brownish-tan, sandy, silty, very fine grained volcanic ash.
12-16	Light buff volcanic ash, medium to fine grained, fines upward slightly though not well sorted.
16-31	Very dark brown organic-rich soil, silt, and clay with small amount of sand, especially in lower part. Rounded cobbles to 6".
31-45	Poorly sorted till, loosely packed, continuum in color from brown at top to grayish-brown at bottom. Pebbly, sandy mud with angular to subrounded pebbles to 3".
45-53+	Very firm gray till, very poorly sorted, but volumetrically more pebbles and sand than silt or clay, even at top. Pebbles mostly around 1", but up to max. of 5" seen.

Depth to bedrock not known. No exposed outcrops below this station.

88DNS352 - Road cut across from 'Campground Lake' north of 88RC135. Bedrock surface slopes up to north here. Till comprises entire section south of here; bedrock comprises entire section in exposure immediately to the north.

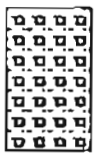
0-3"	Organics; vegetation & roots, mixed with dark brown volcanic ash.
3-6	Volcanic ash, medium grained, pale brown and well sorted.
6-8	Very dark brown peat and organic-rich sandy silt.
8-20	Dark brown to reddish-brown sandy silt; organic rich with abundant roots in top 3". Minor small pebbles.
20-30	Grayish-brown to brown, pebbly, sandy mud. matrix supported, firm. Very angular to angular pebbles up to 5".
30-78	Till; Brownish-gray at top grading into gray below upper 12". Very firm, very poorly sorted mud, sand, and gravel. Angular to subrounded pebbles and cobbles to 7".
78+	Bedrock.

On slope, maximum cobble tillstone up to 11". Total section 6½ ft to bedrock. Surface of bedrock about 15 ft above road level.

STRATIGRAPHIC SECTIONS

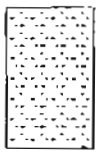
Key to patterns

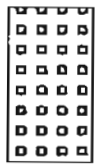

Surface root mat

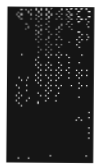

Sand & gravel


Peat


Morainal till


Volcanic ash

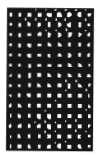

Clean gravel

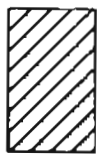

Organic-rich silt


Artificial fill


Mud (clay, silt, or sandy silt)

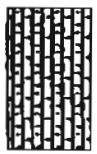

Lodgement till (firm pebbly, sandy mud)


Organic-rich sand

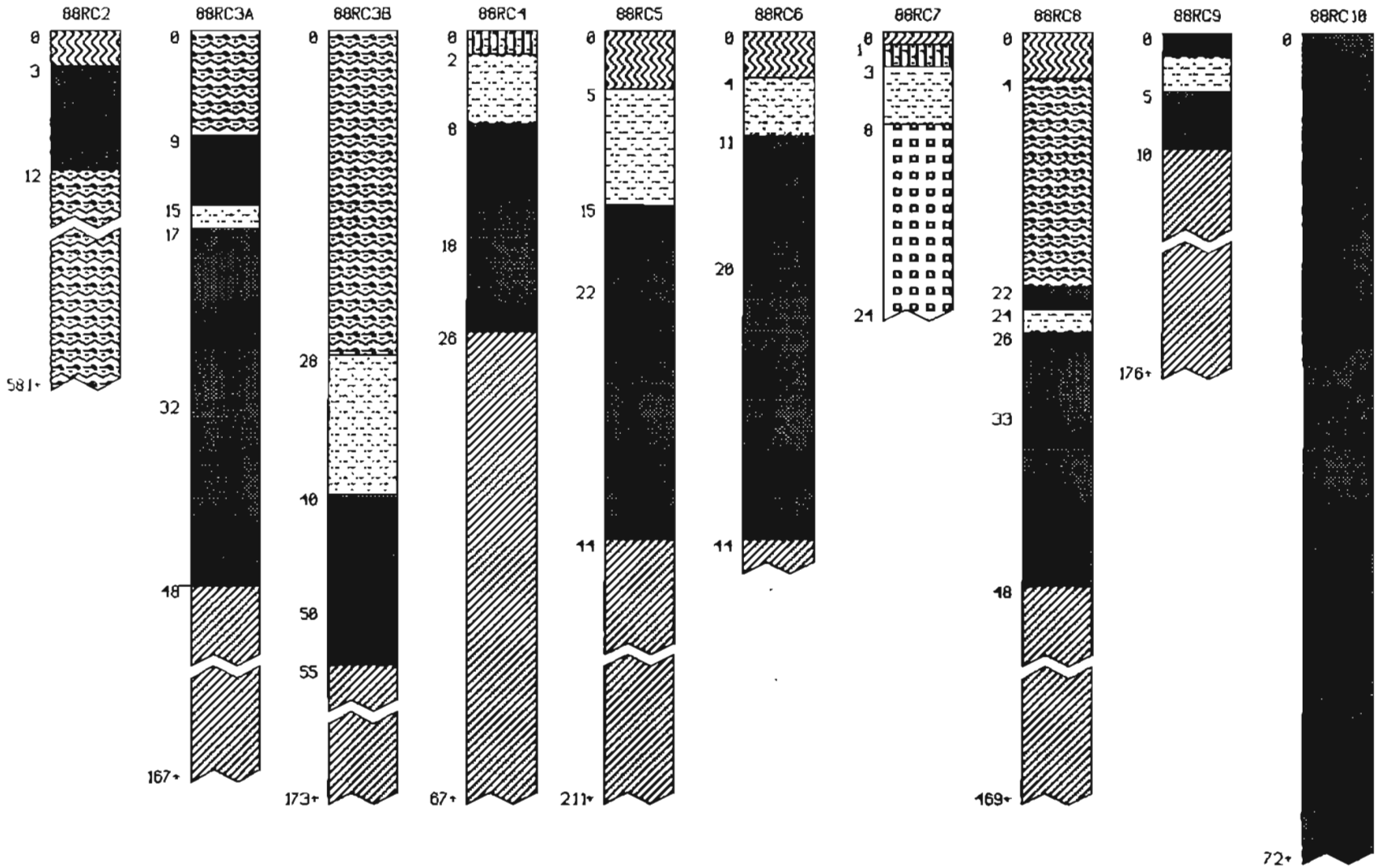

Weathered bedrock


Sand or silty sand


Loose pebbly mud

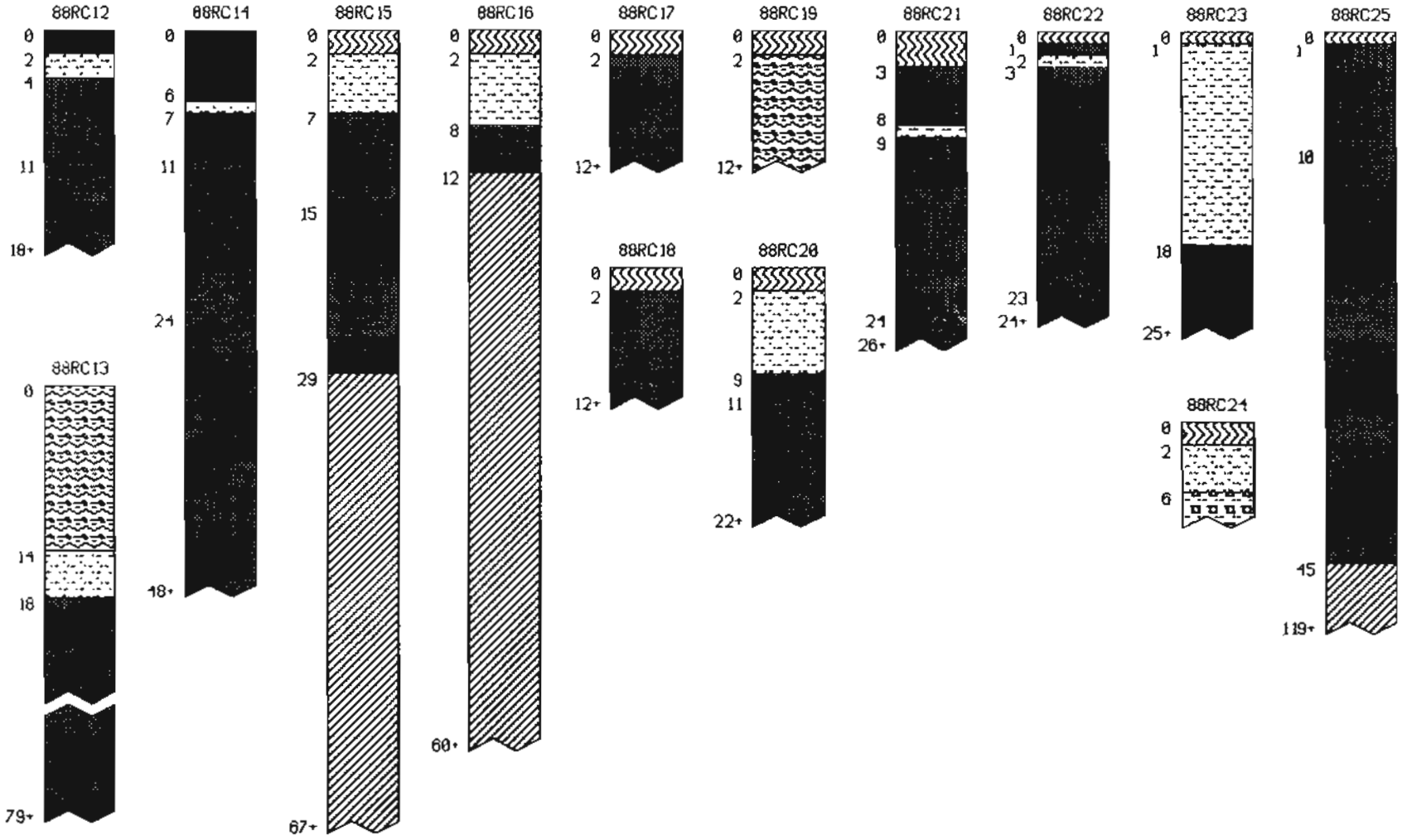

Organic-rich volcanic ash


Bedrock



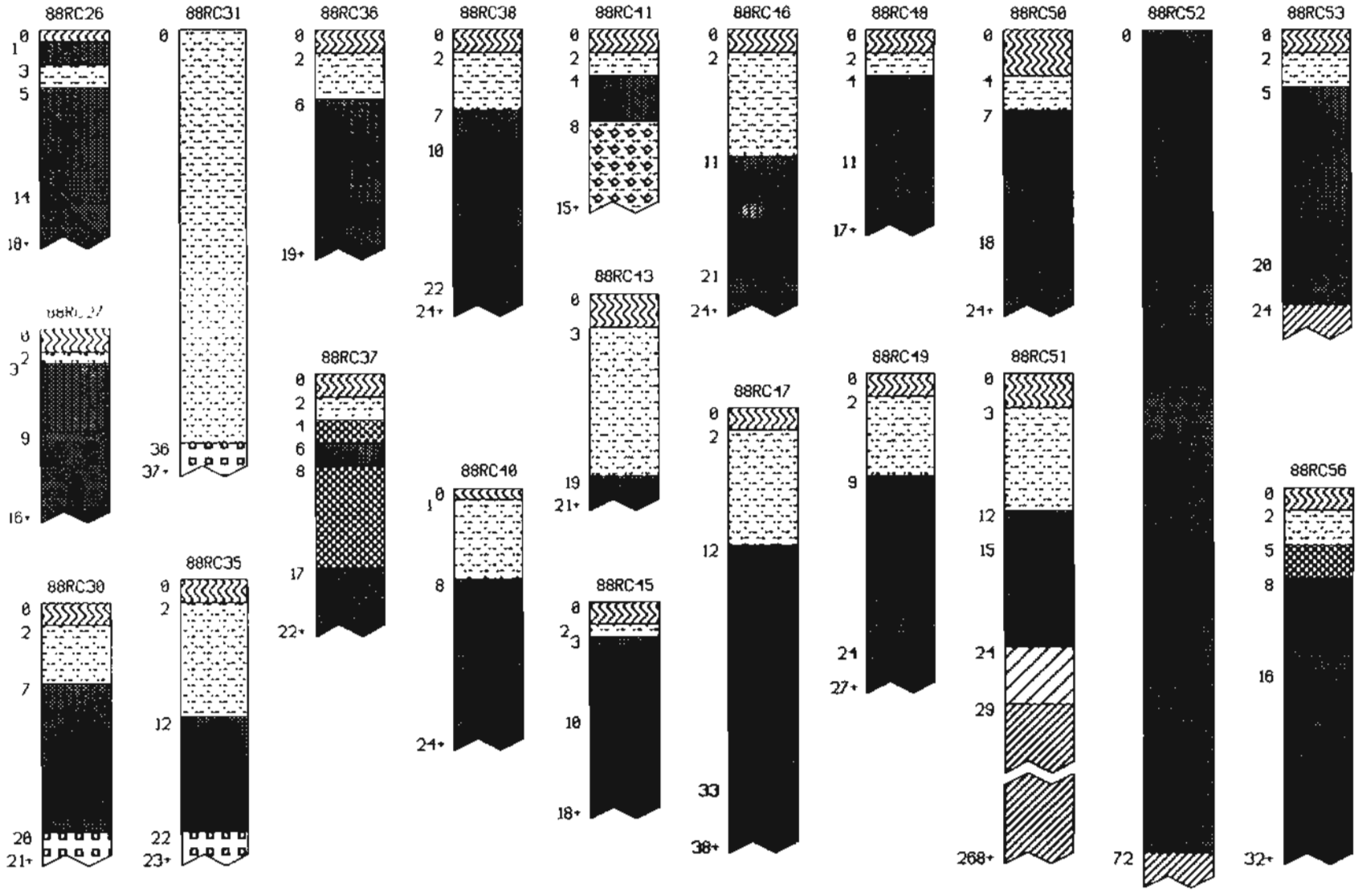
Stratigraphy of surficial deposits.
U.S. Coast Guard Reservation, Kodiak, Alaska.

For locations, see Plate 1.
Depths below ground surface (inches).



Stratigraphy of surficial deposits,
U.S. Coast Guard Reservation, Kodiak, Alaska

For locations, see Plate 1.
Depths below ground surface (inches).



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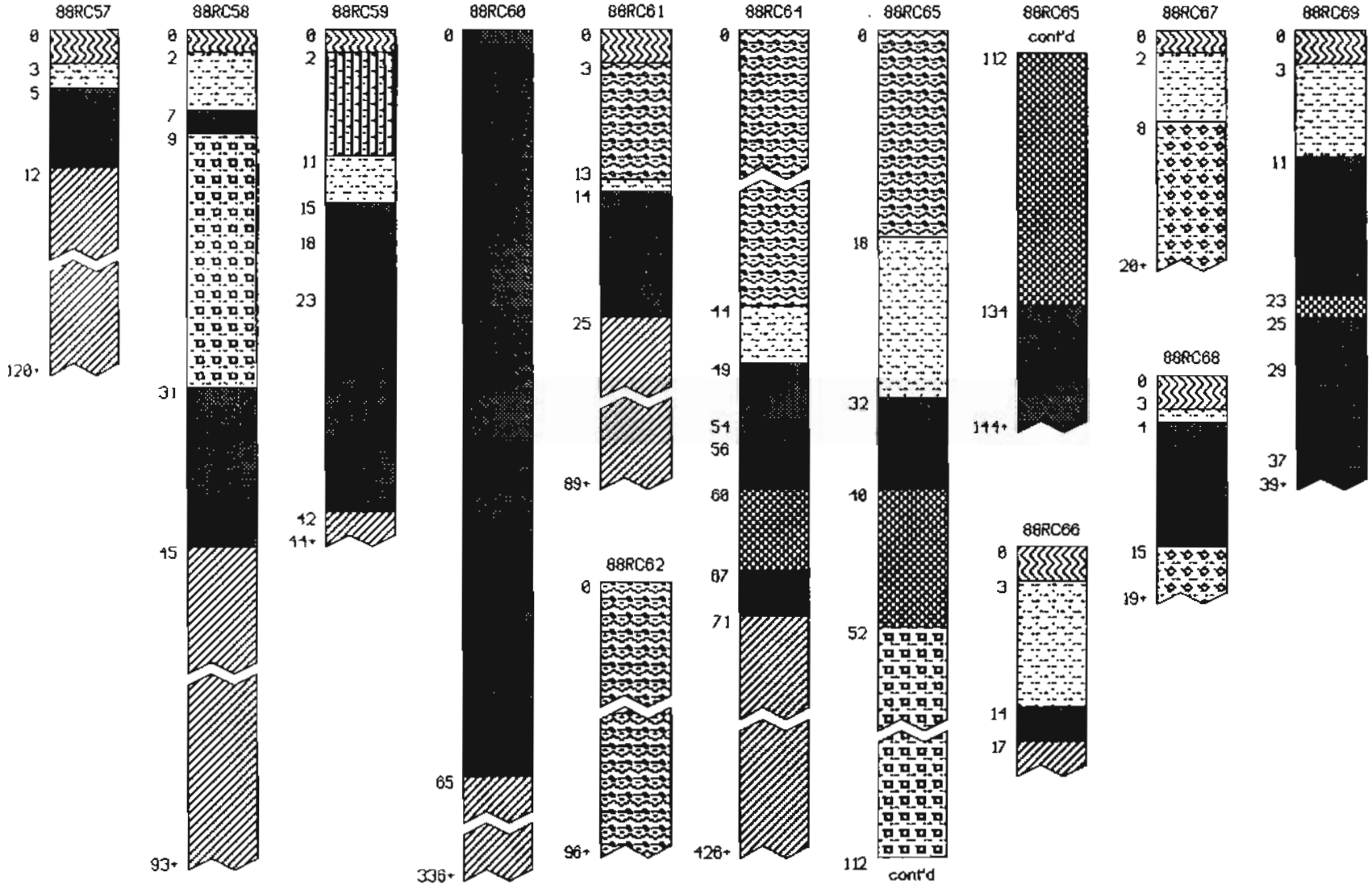
U.S. Coast Guard Reservation, Kodiak, Alaska

For locations, see Plate 1.
Depths below ground surface (inches).



Stratigraphy of surficial deposits,
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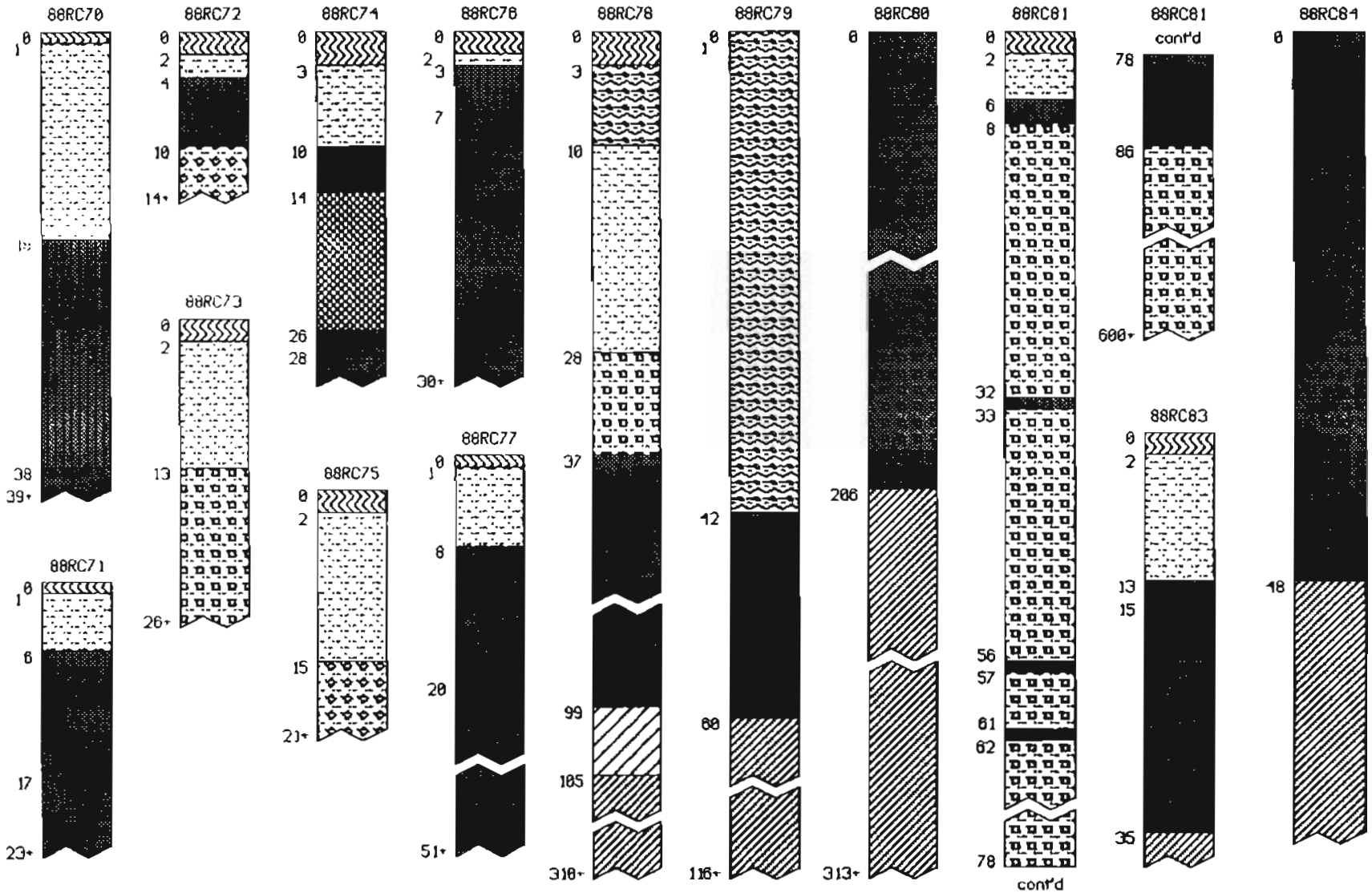
For locations, see Plate 1.
Depths below ground surface (inches).



Stratigraphy of surficial deposits,
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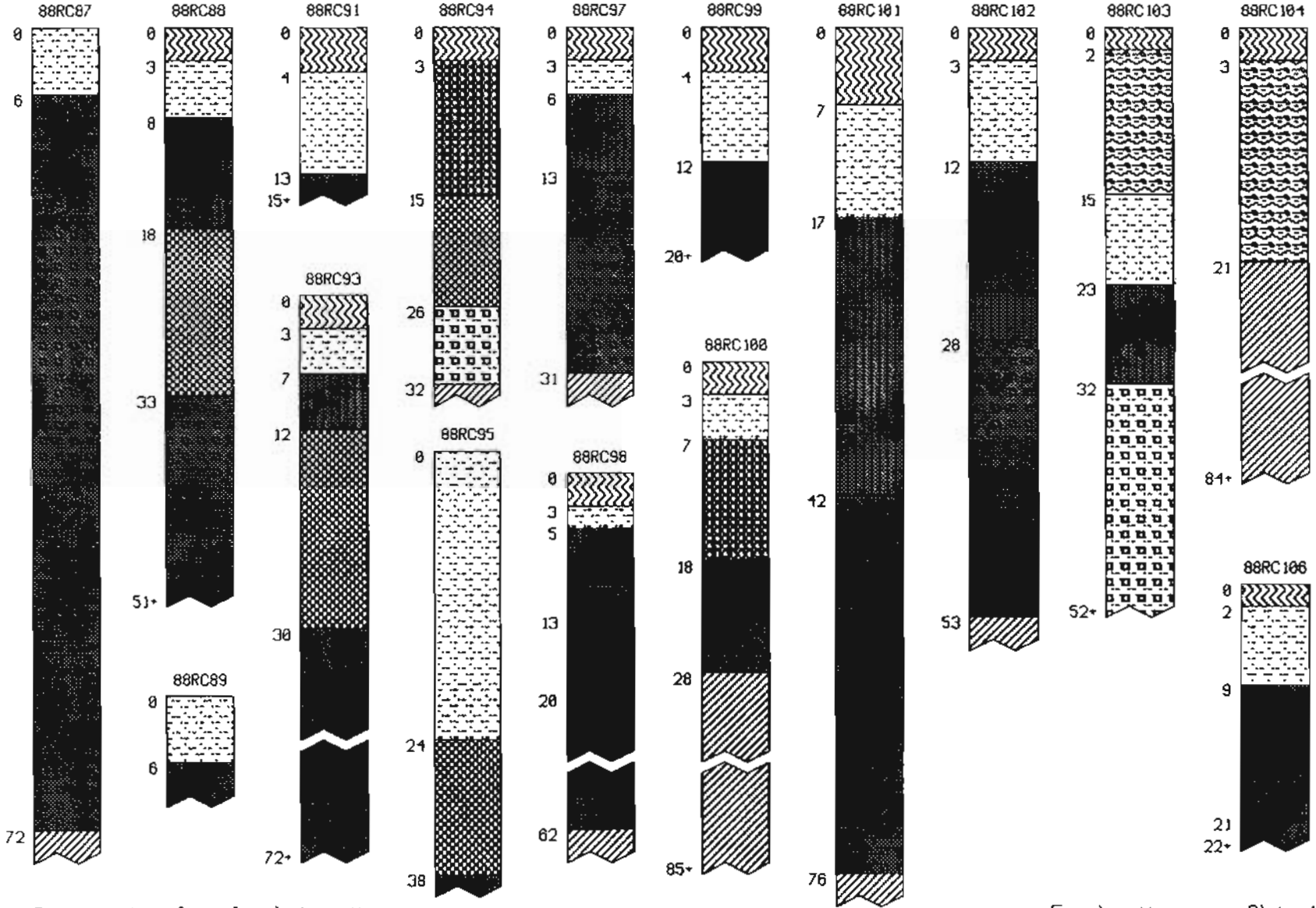
For locations, see Plate 1.
Depths below ground surface (inches).



Stratigraphy of surficial deposits.
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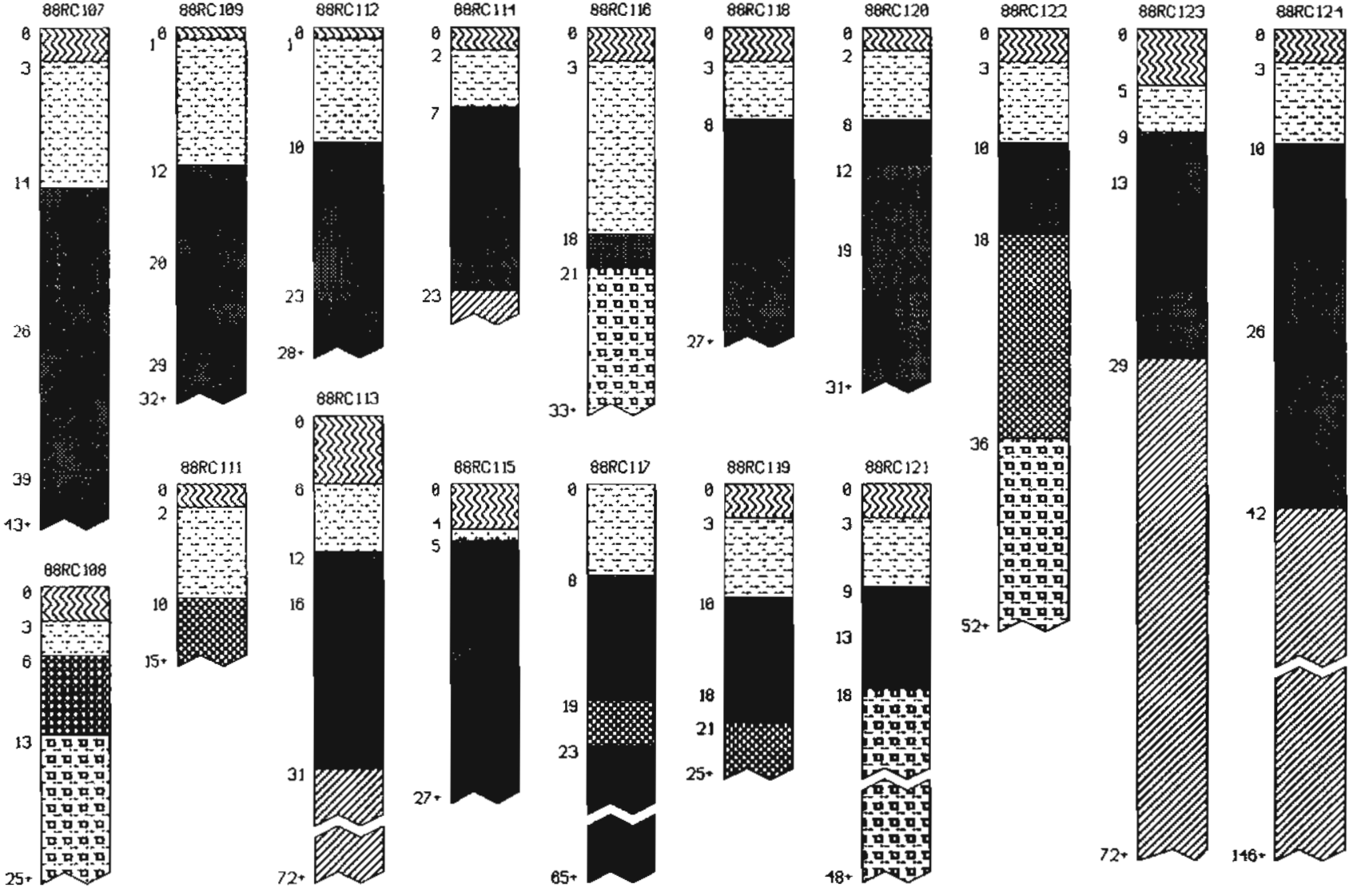
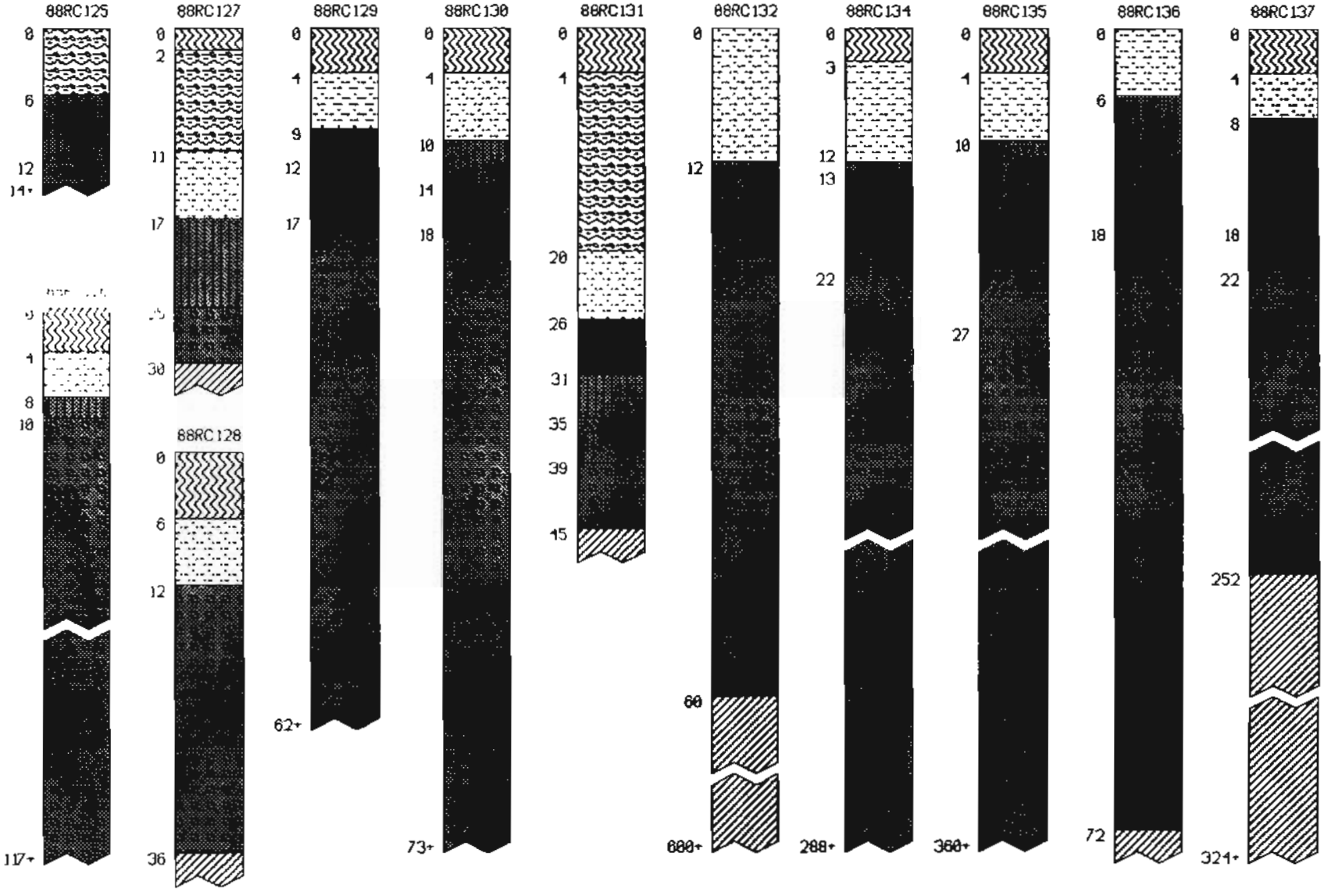
For locations, see Plate 1.
Depths below ground surface (inches).



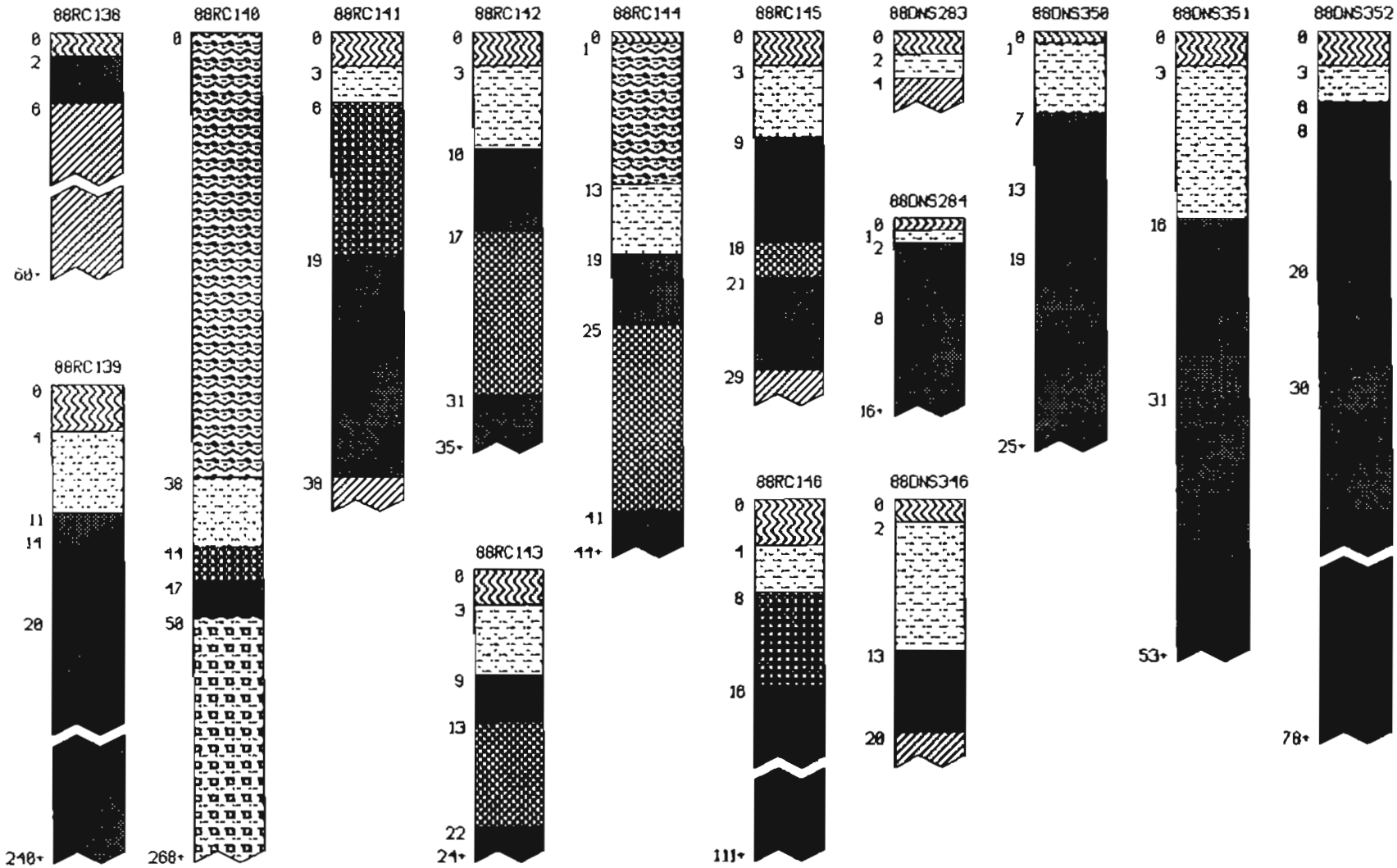
Stratigraphy of surficial deposits,
U.S. Coast Guard Reservation, Kodiak, Alaska

For locations, see Plate 1.
Depths below ground surface (inches).



Stratigraphy of surficial deposits,
U.S. Coast Guard Reservation, Kodiak, Alaska

For locations, see Plate 1.
Depths below ground surface (inches).



Stratigraphy of surficial deposits.
U.S. Coast Guard Reservation, Kodiak, Alaska

For locations, see Plate 1.
Depths below ground surface (inches).

APPENDIX B

Grain-size Analyses

KODIAK COAST GUARD BASE MAPPING PROJECT
Grain-size analyses
Samples collected by R.A. Combellick
Aug. 16-27, 1988

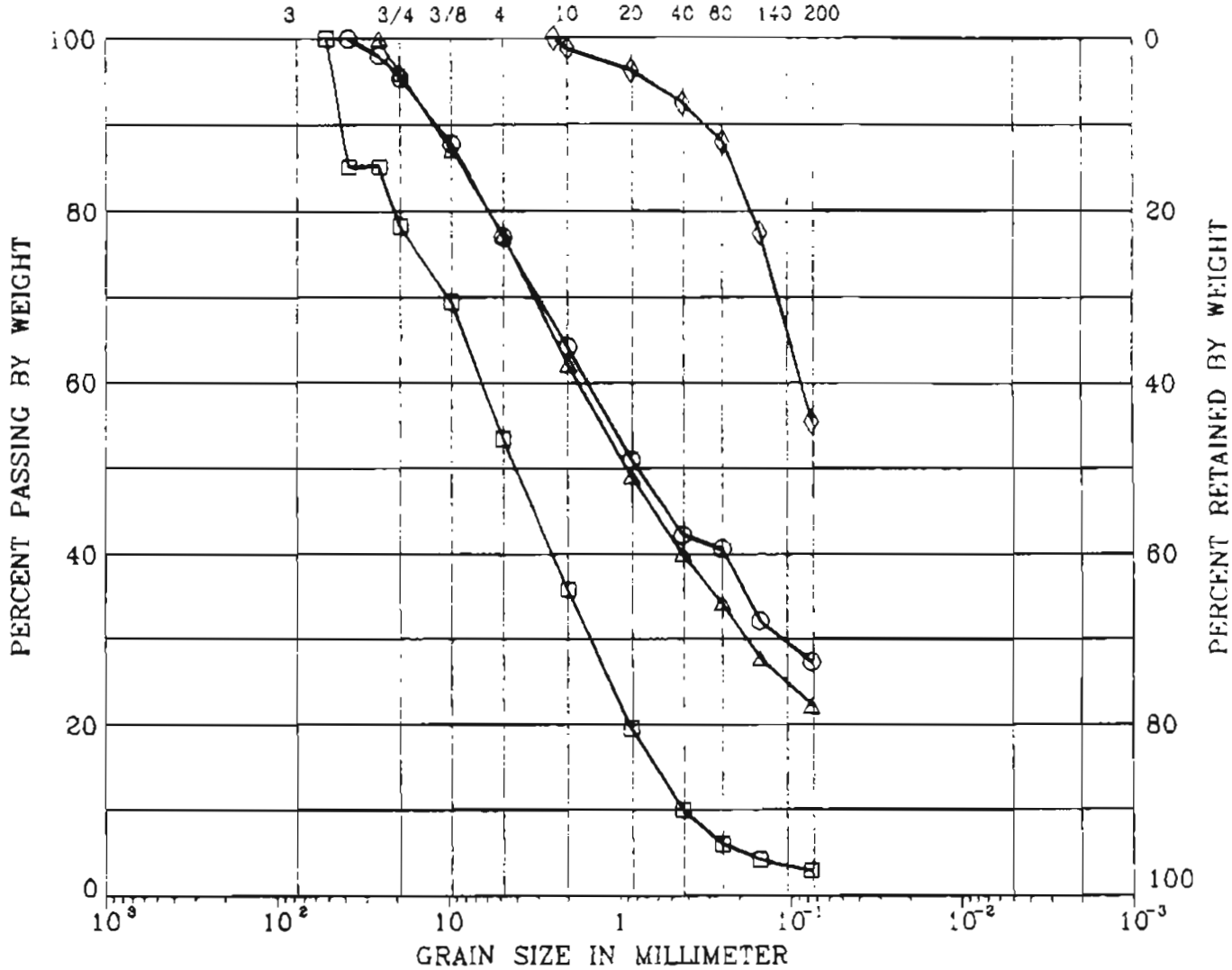
Sieve no.	Size (mm)	88RC3B-1 Volc. ash Weight % Passing	88RC15-1 Till Weight % Passing	88RC19-1 Fill Weight % Passing	88RC23-2 Volc. ash Weight % Passing	88RC31-1 Volc. ash Weight % Passing
3	75.0	100.0	100.0	100.0	100.0	100.0
1	25.0	100.0	98.0	85.1	100.0	100.0
3/4	19.0	100.0	95.4	78.1	100.0	100.0
3/8	9.50	100.0	87.8	69.3	100.0	100.0
4	4.75	100.0	76.9	53.3	100.0	100.0
10	2.00	99.7	64.1	35.7	100.0	100.0
20	0.85	99.7	51.0	19.6	100.0	100.0
40	0.425	98.7	42.3	9.9	96.0	96.9
60	0.250	76.8	40.5	6.0	65.4	60.9
100	0.150	31.6	32.1	4.2	26.4	18.2
200	0.075	15.2	27.3	3.0	14.1	4.0
GRAVEL (> 4.75 mm)		0.0	23.1	46.7	0.0	0.0
SAND (0.074 to 4.75 mm)		84.8	49.6	50.3	85.9	96.0
SILT/CLAY (< 0.074 mm)		15.2	27.3	3.0	14.1	4.0

Sieve no.	Size (mm)	88RC53-2 Till Weight % Passing	88RC69-2 Loess Weight % Passing	88RC70-1 Volc. ash Weight % Passing	88RC103-1 Fluvial Weight % Passing	88RC122-1 Fluvial Weight % Passing
3	75.0	100.0	100.0	100.0	100.0	100.0
1	25.0	100.0	100.0	100.0	100.0	97.0
3/4	19.0	95.9	100.0	100.0	97.9	91.0
3/8	9.50	87.1	100.0	100.0	96.7	76.6
4	4.75	77.2	100.0	100.0	95.6	61.6
10	2.00	62.1	98.7	100.0	92.6	46.9
20	0.85	49.0	96.2	99.6	79.8	31.4
40	0.425	39.9	92.5	95.6	51.3	16.9
60	0.250	34.1	88.1	59.2	23.1	8.5
100	0.150	27.7	77.4	22.0	10.3	4.4
200	0.075	22.3	55.4	11.0	3.9	2.2
GRAVEL (> 4.75 mm)		22.8	0.0	0.0	4.4	38.4
SAND (0.074 to 4.75 mm)		54.9	44.6	89.0	91.7	59.4
SILT/CLAY (< 0.074 mm)		22.3	55.4	11.0	3.9	2.2

See Plate 1 for locations and Appendix A for stratigraphic positions.
Analyses performed by Shannon & Wilson, Inc., Fairbanks, Alaska.

UNIFIED SOIL CLASSIFICATION

COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN INCHES			U.S. STANDARD SIEVE No			HYDROMETER



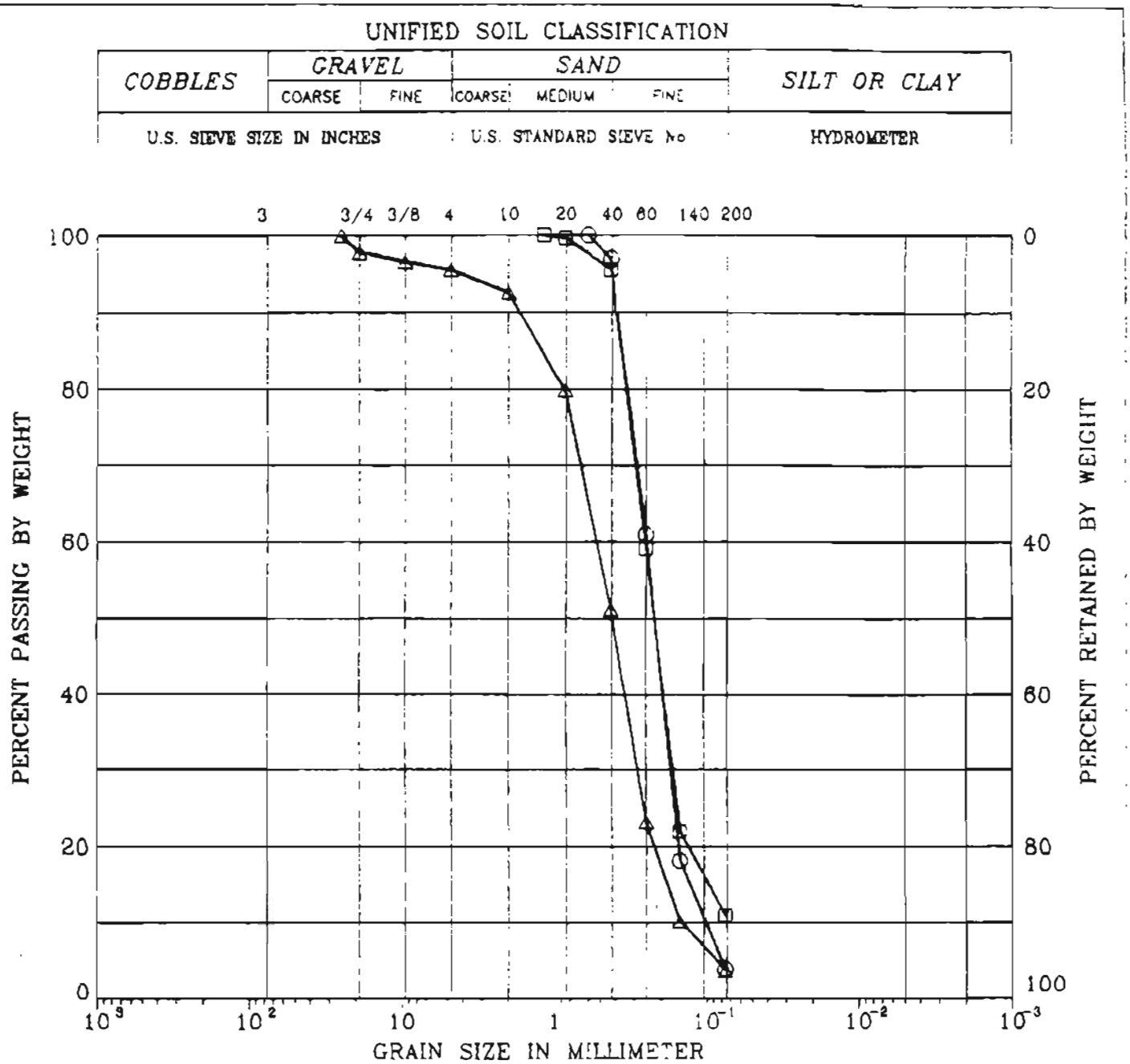
SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	15-1				KODIAK 15-1
□	19-1				KODIAK 19-1
△	53-2				KODIAK 53-2
◇	69-2				KODIAK 69-2

Remark : DNR-DGGS

Project No. K-7094 | KODIAK MATERIALS INVESTIGATION

Shannon & Wilson, Inc.
Geotechnical Consultants

GRAIN SIZE DISTRIBUTION Figure No.



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	31-1				KODIAK 31-1
□	70-1				KODIAK 70-1
△	103-1				KODIAK 103-1

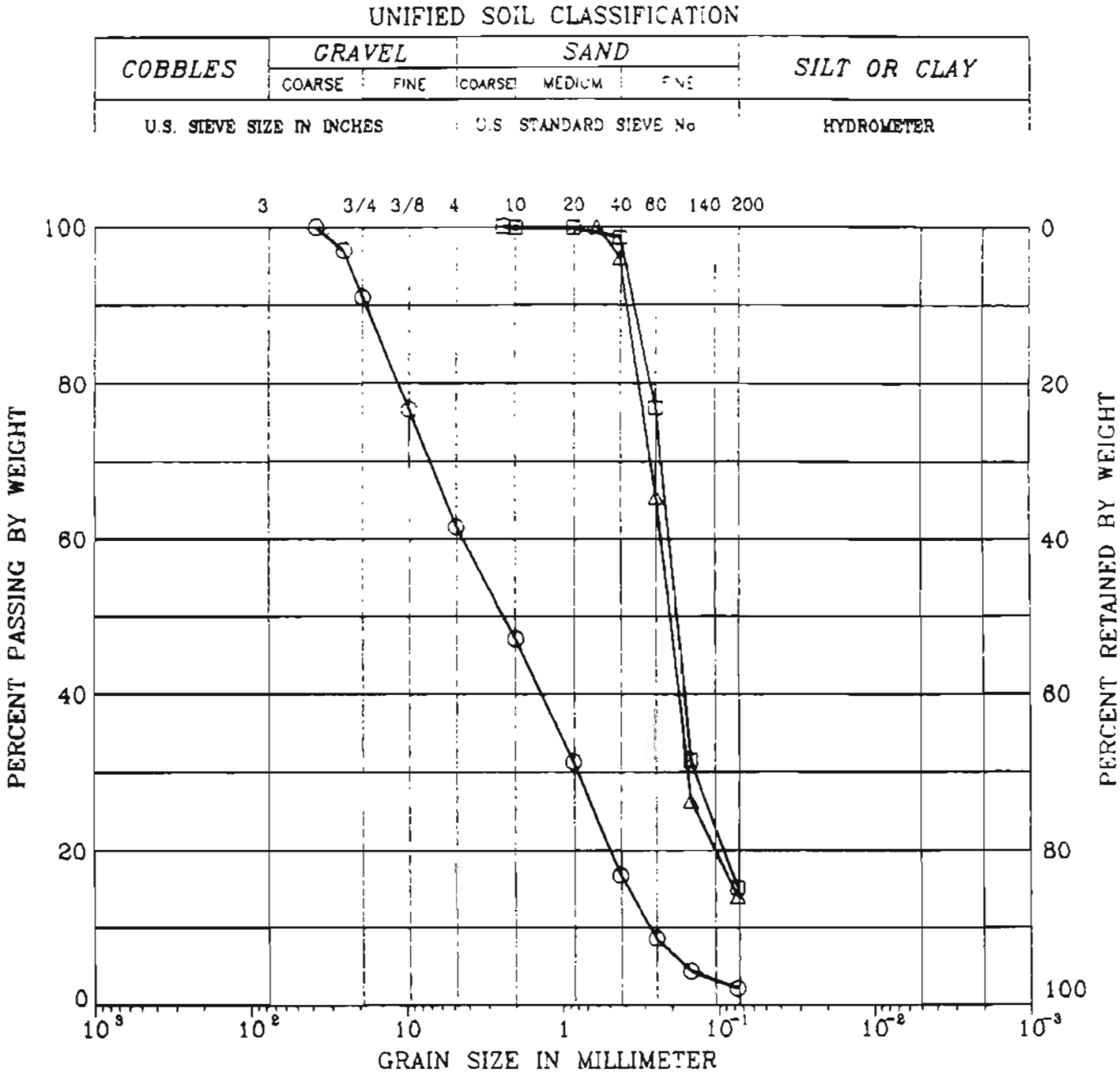
Remark : DNR-DGGS

Project No. K-7094 KODIAK MATERIALS INVESTIGATION

Shannon & Wilson, Inc.

Geotechnical Consultants

GRAIN SIZE DISTRIBUTION **Figure No.**



SYMBOL	BORING	DEPTH (ft)	LL (%)	PI (%)	DESCRIPTION
○	122-1				KODIAK 122-1
□	3B-1				KODIAK 3B-1
△	23-2				KODIAK 23-2

Remark : DNR-DGGS

Project No. K-7094	KODIAK MATERIALS INVESTIGATION
Shannon & Wilson, Inc. Geotechnical Consultants	GRAIN SIZE DISTRIBUTION Figure No.