ALASKA DIVISION OF GEOLOGICAL &
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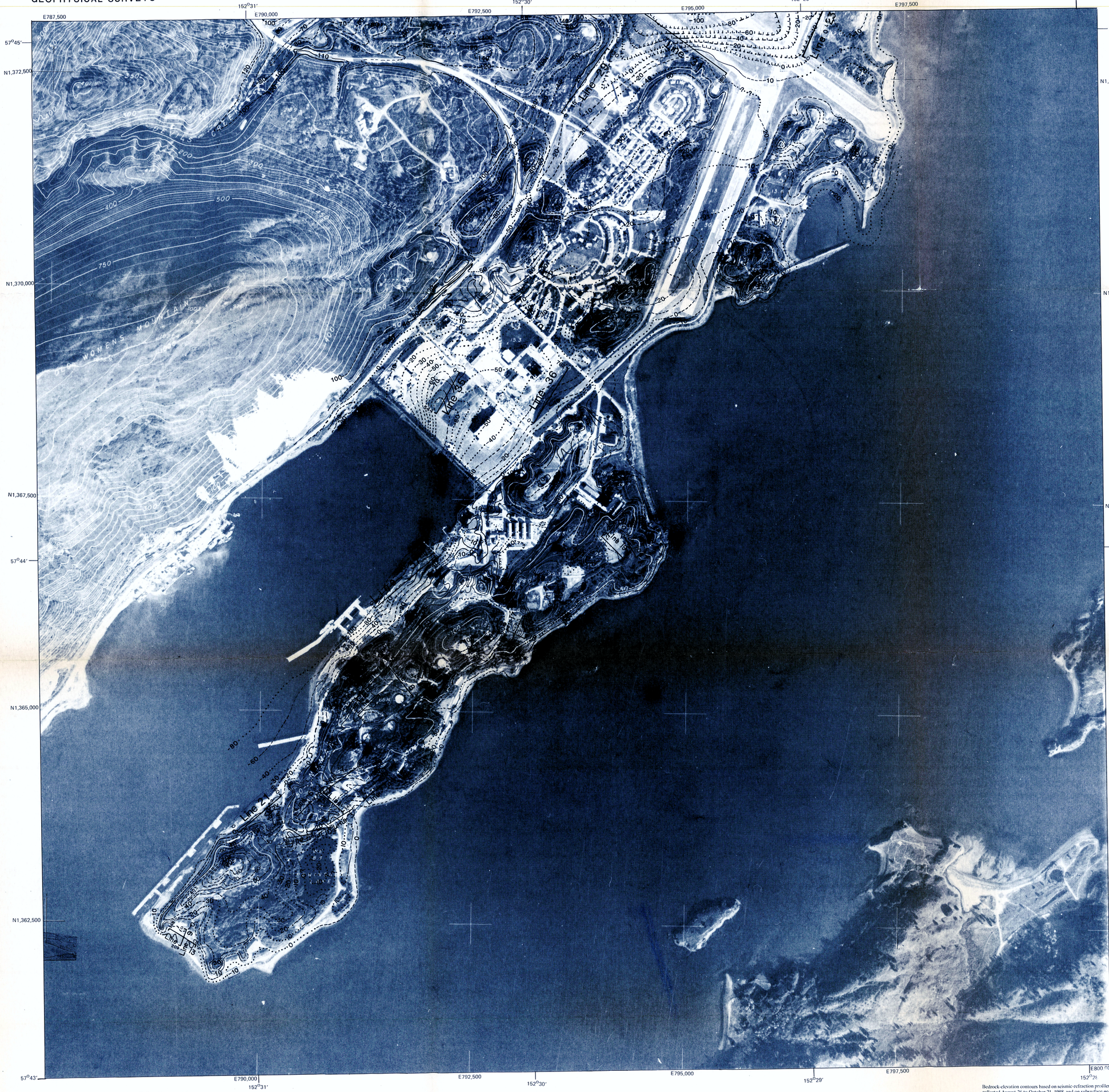

Base prepared photogrammetrically by Walker-Alaska Aerial Surveys, Inc. from aerial photography taken Sept. 30, 1988.

SCALE: 1:6,000

500 0 500 1000 1500 2000 2500 FEET

100 0 100 200 300 400 500 600 METERS

CONTOUR INTERVAL 10 AND 20 FEET
DATUM: MEAN LOWER LOW WATER

STRUCTURE CONTOUR MAP OF THE BEDROCK SURFACE, AREA III
U.S. COAST GUARD RESERVATION, KODIAK, ALASKA

by

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EXPLANATION

This map shows structure contours of the bedrock surface on the Kodiak Coast Guard Reservation beneath the support center area and on Nyman Peninsula, as interpreted from surface and subsurface data from numerous sources (see Data Sources). A primary source of data for this study comprised a suite of 39 seismic-refraction lines with a total length of 26,246 ft, surveyed from August 26 to October 21, 1988. Seismic profiling was conducted to discern the number, thicknesses, interface depths, and probable composition of nonlithified surficial deposits, the presence of saturation, and configuration and elevation of the buried bedrock surface. Seismic-refraction data were analyzed (see accompanying text) using the SIPT program (Scott and others, 1972; Scott, 1973 and 1977). Where present, nearby geologic information was used to confirm interpreted acoustic-layer thicknesses, lithologies, water levels, and bedrock depths. P-wave velocities of surficial deposits (nonlithified alluvial or glacial materials overlying the bedrock surface) were comparable to velocities measured in similar materials on the Alaska Peninsula and Unalaska Island (Allely, 1986; Reeder and others, 1984). Interpreted seismic-line profiles are presented in detail in Appendix A of the accompanying report. This map covers the southeastern one-third of the entire study area, and includes Nyman Peninsula, Old Woman's Bay, St. Paul Harbor, Old Women's Mountain, the area of the Coast Guard support center, the elementary-school area, and the southeast end of the airport runway system. The northeastern portion of the study area shown on plate 1 borders this map to the north (see figure 1 of report).

The map shows locations of 26 seismic refraction lines. On Nyman Peninsula, 22 survey lines were sited in, around, and downgradient of known or suspected fuel spills and contamination sites. The goal was to map surficial deposits and bedrock channels and divides that could influence the migration of subsurface contaminants. To define the thin, nonlithified layers and shallow, highly irregular bedrock topography, geophone spacings were close (15-30 ft) for high resolution. In other areas where bedrock was relatively deep, longer lines (544-1,410 ft) with geophone spacings of 25-75 ft were used. On these lines, nonlithified deposits showed as thicker acoustic layers. These areas include the shoreline along line 37 on the northwest side of the peninsula, the basin beneath lines 35 and 36, the bedrock trough adjacent to line 29, and the edge of the basin northeast of line 31.

Other sources of data for this study consisted of a variety of surface and subsurface geologic information (see Data Sources). Nearly 1,000 points of surface and subsurface data were compiled over the entire study area. Depths to top of bedrock and till, static water levels, and bottom of holes not reaching bedrock were converted to elevations relative to mean sea level. In most cases, reported elevation control was used. For pre-1964 Department of Navy studies, elevations were adjusted to or taken from this base map to remove possible effects of land subsidence resulting from the March 27, 1964 great Alaska earthquake, or altered ground surface. Most pre-1964 reported elevations were higher than on this base by an average of 6-8 ft; a few discrepancies were greater than 15 ft. In the U.S. Dept. of Navy (1958) study, some reported surface elevations near the south end of the north-south runway were 6-12 ft lower. These areas have probably been artificially filled.

Geologic data gathered from explorations near seismic lines were used to confirm interpretations of depths to acoustic layer interfaces (top of alluvium, saturated zones, till, and bedrock), and inferred composition of nonlithified deposits. See Combellick (1989, plates 2 and 3) for a compilation of subsurface data from most sources. Compiled seismic and geologic bedrock data were used to generate elevation contours of the bedrock surface.

The entire study area is underlain by part of the Cretaceous Kodiak Formation. Rock types in this area consist of thin- to medium-bedded dark gray to black graywacke sandstone, siltstone, shale, and slate; with local mudstone and conglomerate. Beds are typically isoclinally folded and tilted to near vertical, striking N30°E to N40°E (Solie and Reifenstuhl, 1989). The 8,000-ft-long, 1,000-1,800-ft-wide Nyman Peninsula follows this trend. The central part of the peninsula consists of glacially rounded, bedrock-cored elongate knobs and ridges 50-100 ft above sea level, separated by bedrock saddles 300-700 ft wide. Along either side of the axis lie small topographic plateaus. Overburden thickness on knobs and ridges and in saddles is variable, typically ranging from 5-20 ft. Where till is absent, bedrock is often exposed at the surface. Small bedrock exposures are numerous because of irregular bedrock topography. Bedrock is also exposed in 5- to 40-ft-high sea cliffs along St. Paul Harbor, and in numerous revetments excavated for building sites and roadways around the peninsula perimeter.

On Nyman Peninsula, many small-scale features are interpreted on the buried bedrock surface: rounded, elongate knobs 200-500 ft wide and 400-1,000 ft long originating from local highs and the peninsula divide; and small local depressions of varying size. Only a few significant bedrock depressions exist on the peninsula, ranging from zero to over 90 ft below sea level. Local erosional irregularities of the bedrock surface may result from the effects of variations in lithology, structure, or weathering.

East of line 36, a bedrock saddle below sea level separates the peninsula highland from several bedrock knobs to the northeast. Northwest of line 36, a deep bedrock trough, bordered on three sides by bedrock highs, slopes southwestward to more than 90 ft below sea level beneath line 35.

Southeast of the north-south runway are two clusters of elongate bedrock knobs, one near the runway intersection and the other near its south end. Bedrock is reported to be only a few feet below the airfield surface near the runway (Skafelstad, 1988 and 1989). Centerline boreholes 500-1,800 ft south of the runway intersection indicate that bedrock is 5-10 ft below the surface (Ottley, 1983). Along the southern 800 ft of the runway, bedrock is 30-40 ft below the surface. A bedrock trough 600 ft long skirts the west side of the knob east of the end of the runway.

West of the runway, a northeast-trending bedrock-cored ridge is over 90 ft high at its northeast end. Between this ridge and the foothills to the northwest lies a small northeast-trending valley along line 29. The axis of the bedrock trough underlying this valley plunges from an elevation of 20 ft at its southwest end to -80 ft at the northeast end. Here the trough opens northeastward into the broad bedrock low centered beneath the airfield (see Plate 1).

A discontinuous till layer generally less than 5-10 ft thick mantles bedrock over much of Nyman Peninsula. Fifteen of the 22 lines on the peninsula showed intermediate acoustic velocities indicative of till, but only nine detected sufficient thickness over enough line length to model a till layer. In at least six other lines, till is probably present as a hidden layer, but undetected due to insufficient thickness or velocity contrasts. Where till is encountered in nearby wells and boreholes, models that do not account for a possible thin till layer show a large disparity between low overburden velocities and high bedrock velocities. Calculation of maximum possible hidden-layer thickness, based on Redpath (1973, p. 19-24), indicates that where present, an unseen till layer may result in total overburden thickness up to 50% greater than modeled. In most cases, this amounts to only a few feet. Where a hidden layer is suspected, bedrock-contour positions have been adjusted to be more consistent with surrounding borehole data.

In most places on Nyman Peninsula, till is thin enough that, despite variable thicknesses, its surface generally mirrors bedrock topography. Large thicknesses of till near bedrock highs could shift drainage divides; irregular thickening where draped into bedrock channels may create ground-water dams. Because overburden thickness can change markedly over several feet, a very high sampling density is required to detect and define such microfeatures. Elsewhere, till varies in thickness and occurrence. It is thin to absent in boreholes on the bedrock highs surrounding the north-south runway. A few feet of till may be present on the housing-covered ridge. Very little till is seen in boreholes for the administration building, where stream alluvium was recorded, or the new hospital explorations, which encountered very shallow bedrock.

The large basins contain greater thicknesses of till and overlying alluvial deposits than the bedrock highs. Beneath line 37 on the northwest side of the peninsula, the second acoustic layer is 60-90 ft thick and probably consists of till and glaciofluvial deposits. Beneath line 35, the top of the till surface is 0-7 ft below sea level. Till thickness ranges from 45 ft under the northeast end of the line to more than 90 ft below the southwest end. At the head of this bedrock trough, till thins out against bedrock highs. Near the southeastern border of this bedrock basin, till is not indicated by line 36. The second acoustic layer is probably saturated gravel with some sand and silt, ranging from 9 ft thick at the southwest end of the line to 36 ft thick at the northeast end. In the bedrock trough underlying the valley adjacent to line 29, till ranges from 80 ft thick at the northeast end of the valley to 30 ft thick 500 ft upvalley to the southwest, and thins out against the valley walls.

Overlying till throughout the study area, a discontinuous layer consisting of various types of glacially-derived alluvium, colluvium, and loess (windblown silt) is present, consisting of clays, silts, silty sands, gravels, or cobble gravels. Wells and seismic sections show this layer to be 5-25 ft thick. It is generally thin or absent atop bedrock highs, and thickens into bedrock lows. On and around Nyman Peninsula, on bedrock highs, and in small upland drainages, this layer is derived from reworking of underlying till or deposition of loess. The layer shows considerable variation in composition and thickness over lateral distances less than 100 ft, as shown by boreholes. Seismic velocities of this acoustic layer often displayed marked variation over the length of a short survey line.

Overlying alluvial deposits, buried soil and peat horizons are common, buried by ash from the 1912 eruption of Novarupta. Soil and peat deposits are usually 0.5-1.5 ft thick. In flat topographic lows near tidewater, explorations encountered peat layers up to ten feet thick. Peat was also observed mixed with silt in accumulations 10-20 ft thick; these may be artificial fill. The ash layer, virtually continuous, is usually less than 1 ft thick. Scattered windblown ash deposits 2-4 ft thick were observed in surface exposures. The ash layer, with or without underlying peat, serves as a distinctive marker bed which delineates the 1912 ground surface. In filled areas it has been observed at burial depths up to 15 ft. In undisturbed areas it is overlain by little or no soil, and present-day vegetation mat.

MAP SYMBOLS

Bedrock elevations were determined using vertical control from numerous sources. Surface elevations along seismic-refraction lines were determined using surveyed USGS well elevations where available, or were estimated from the topographic base. Available geologic data and elevation control were used to determine subsurface stratigraphic elevations, with the exception of pre-1964 Navy data (discussed above).

Contour intervals are 10 ft in areas with sufficient data density, and 20 ft in areas of sparse data coverage, or where the bedrock surface slopes steeply. Contour intervals of 5 ft are used in areas of high data density, where bedrock surfaces are complex, or relatively flat.

—— 30 —— **Bedrock-elevation contour.** Contour elevations where determined from surface exposures, nearby boreholes, wells, or test pits where bedrock was encountered, and from seismically interpreted bedrock elevations where confirmed by geologic data.

- - - 45 - - - **Bedrock-elevation contour -- approximately located.** Contour locations where determined from seismic-refraction data unsupported by nearby geologic control, trends in the bedrock surface near areas with depth control, or minimum overburden thicknesses determined by test pits, boreholes, or wells that did not encounter bedrock.

· · · · 120 · · · · · **Bedrock-elevation contour -- location inferred.** Contour locations unsupported by local control. Based on closest bedrock exposures, subsurface data points, and trends.

· ? · · · 250 · · · ? · **Questionable bedrock-elevation contour.** Suggests probable nature of the bedrock surface position outside areas of depth control, where interpretation of bedrock morphology is speculative.

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