INVESTIGATIONS IN THE STORELV AREA, EAST GREENLAND*

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One of the principal reasons for selecting the Storelv area for a detailed investigation was the fact that photo-interpretation by the U. S. Geological Survey for Air Force Cambridge Research Center during 1957 had shown that area to be one of the most promising potential airfield sites in East Greenland. Dr. Thor N. V. Karlstrom did the photo-interpretation around Storelv and delimited potential runway sites, working almost entirely with aerial photos taken when the ground was snow-covered; our field work showed that his interpretations and conclusions were essentially correct, and as a result our principal investigations were along the 11,500-foot runway site suggested by Karlstrom. However, we feel that a slightly more favorable orientation for an unprepared airstrip could be located in the immediate vicinity with only a small amount of additional fieldwork; our efforts to find a better orientation were hampered by an early snowfall during our second night in the area.

The 11,500-foot proposed airstrip is located near the center of the large peninsula north of Kejser Franz Josephs Fjord, in the broad lowland that lies at the juncture of Hudson Land, Moskusokselandet, Gauss Halvø, and Hold With Hope. The site is approximately midway between the heads of Loch Fyne and Moskusoksefjord; the northwest end of the runway, near our campsite and cache, is about 4 miles west of Loch Fyne and 4 miles northeast of Moskusoksefjord (this point is located at about latitude 73° 40'20"N, longitude 22°03'30"W).

The Storelv site lies on the air route between Mesters Vig and Nord, approximately 106 statute miles (92 nautical miles) from Mesters Vig and 562 statute miles (488 nautical miles) from Nord. It also lies on a direct air route between Nord and Keflavik, Iceland, being approximately 670 statute miles (582 nautical miles) from Keflavik. Therefore, the site is easily accessible to planes flying along the east coast of Greenland between Nord and either Mesters Vig or Keflavik; it seems well situated to be an emergency alternate for Mesters Vig, as it is closer to that station than any other established airfield.

From Mesters Vig the ATKA approached the Storelv site with little difficulty by way of the inner fjord route (Kong Oscars Fjord - Sofia Sund - Kejser Franz Josephs Fjord); this inner fjord region is generally navigable from July to September even though the mouths of the fjords are frequently blocked by pack ice, so that ships reaching Mesters Vig could normally proceed to Storelv with little difficulty.

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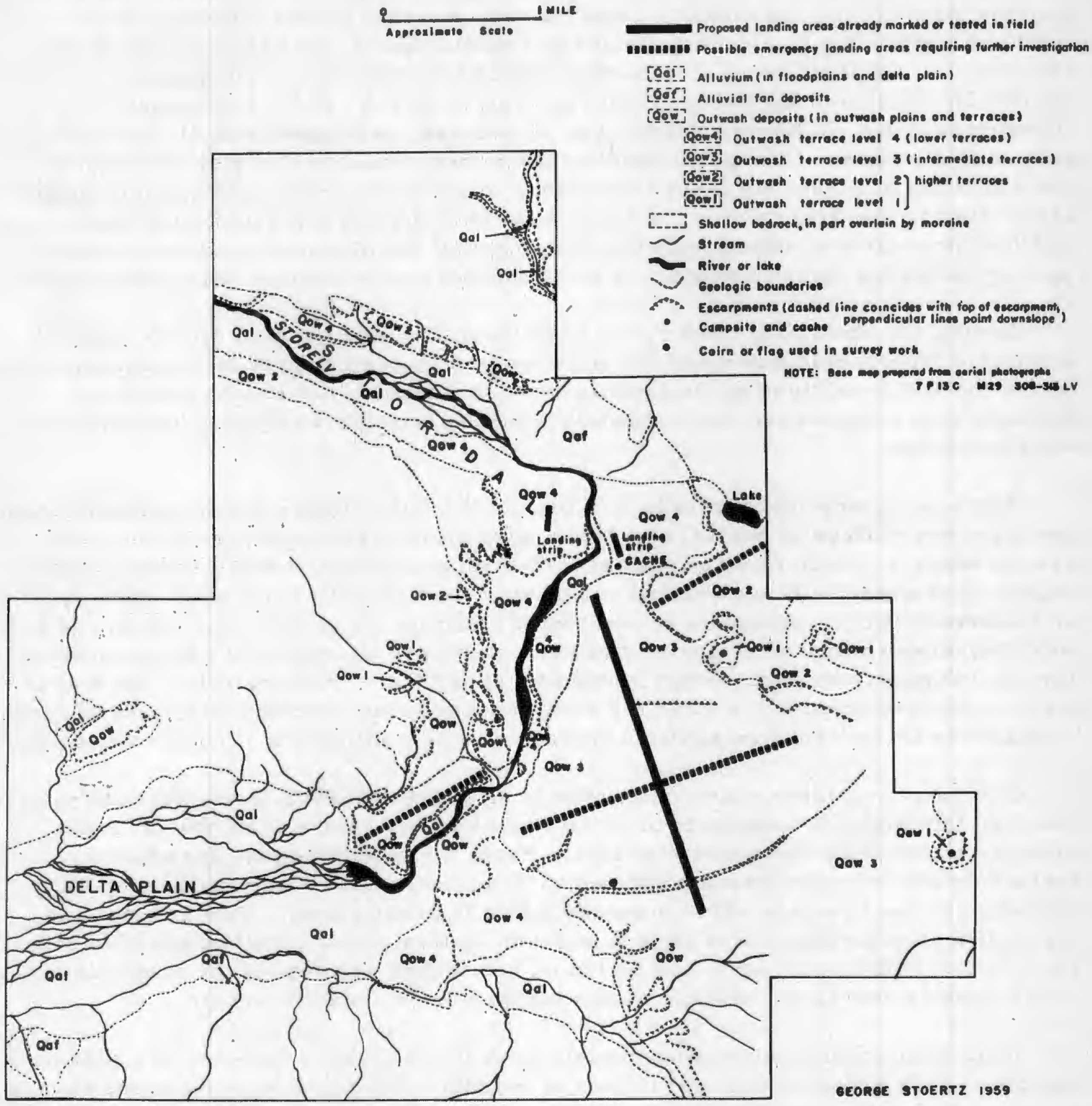


Fig. 1. Preliminary surficial geologic map of the Storelv area, East Greenland, showing location of possible landing sites.

The ATKA anchored in MacKenzie Bugt, about 20 miles from the site area; an alternative approach for future operations from ships in the area might be through Moskusoksefjord, the head of which is within 4 miles of the site. An initial reconnaissance of the area was made by helicopter on August 30, in order to evaluate the runway site and locate a campsite near water. On the following day a field party including five geologists and one civil engineer was transported to the site and the campsite set up (the party included Ole Skaerbo, Civil Engineer; Stanley N. Davis and L. Robert Satin, geologists with A. I. N. A.; Joseph H. Hartshorn, Allan N. Kover, and George E. Stoertz, geologists with U. S. G. S.). Only four members of the party (Davis, Satin, Skaerbo, and Stoertz) intended to remain at the site, but fog forced the others to spend the first night at the campsite also. During the first day orange flags were placed along the center line of the 11,500-foot proposed runway with the assistance of the helicopter, and two short landing strips for logistic support of the field party were located near the campsite.

During the remaining week in the area (Sept. 1-7) the party of four completed a detailed topographic survey of the 11,500-foot proposed runway site, sampled and tested the soil conditions of the landing area, and made a preliminary surficial geologic map of the area. Unfortunately a 5-inch snowfall on Sept. 2 hampered the work somewhat.

The landing area at Storelv is in a broad, low valley that extends eastward from the narrower valleys of Stordal and Moskusoksefjord. The principal river in the area is Storelv, which flows southeastward through Stordal, a steep-sided glacial valley, then abruptly bends southward and westward into the delta plain at the head of Moskusoksefjord. Along its lower course, Storelv is bordered by a series of outwash terraces composed of gravel and sand; there are at least five prominent terrace levels, ranging from about 6 feet to 200 feet above the level of Storelv. Several of these terraces are possible sites for emergency aircraft landings and could be made suitable for more intensive aircraft operations with a minimum of construction effort.

The most prominent outwash terrace is at an intermediate level, forming bluffs about 40 feet high for a distance of two miles along the east side of Storelv and a distance of one mile along the west side. From the bluff which borders Storelv, these outwash deposits extend southeastward for more than 3 miles, forming an exceedingly level plain of about 8 square miles in areal extent. Two orientations for 10,000-foot landing strips have been found on this plain. Another possible site for a 4,500-foot landing area is situated on a detached segment of the same plain, which forms a prominent terrace northwest of Storelv, near its mouth.

Another prominent outwash terrace, about 100 feet above Storelv, occupies an extensive area around the southeast end of Stordal. Segments of at least one square mile in areal extent are found on both sides of Storelv near the point where it turns southward. Both of these afford possible sites for at least 4,000-foot landing areas.

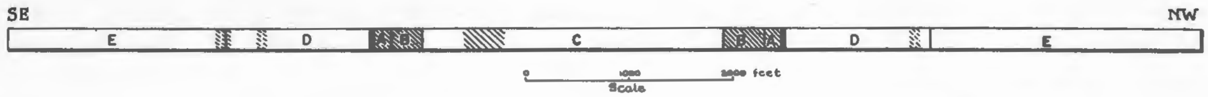
Along the last six miles of its course Storelv is bordered by low terraces at various levels, mostly less than 40 feet above the river level. Unlike the higher and more prominent outwash terraces, the lower terraces within the valley of Storelv are discontinuous and often not accordant in level on opposite sides of the valley. These terraces are composed predominantly of gravel and sand similar or identical to the outwash deposits underlying the higher terraces; however, the lower terraces are not well suited for long landing strips because approaches are generally restricted by the valley sides and because otherwise flat areas are generally broken by low terrace scarps. On the other hand, there are numerous good sites for landing strips less than 1,000 feet in length; for this purpose the lower stream terraces seem better suited than the higher terraces because the lower and more recent terraces tend to have a thinner mantle of soft silt and vegetation and less pronounced and less frequent microrelief features such as tussocks, hummocks, frost cracks, and mounds. As a result, the best areas for landing a light plane on the unimproved ground surface in summer were found to be on low terraces only about 18 feet and 6 feet above the level of Storelv.

The floodplain of Storelv is composed largely of gravel and sand very similar to the outwash deposits exposed in the terrace scarps which border it. Storelv still carries some glacial meltwater from the glaciers of Hudson Land. In areas where the floodplain is wide enough to be considered as a site for aircraft landings, the river is braided and the floodplain traversed by numerous shallow channels and frequent scarps one or two feet high. These would prevent aircraft landings on the natural surface throughout the year. The same is true of the river floodplain shown in the south-central part of the map area.

The valley floor at the head of Moskusoksefjord is an extensive delta plain about 3 miles long and 1 1/2 miles wide. It is composed largely of silt and sand, with some gravel concentrated where Storelv and other streams enter the plain. In summer the area is too soft to support aircraft landings safely, but when the ground is frozen or snow covered there are numerous smooth areas favorable for aircraft operations. One of these is in a northwest-southeast direction near the northeastern border of the plain starting from the base of the 40 to 55-foot outwash terrace and extending about 5,000 feet to the northwest.

There is a large alluvial fan on the north side of Stordal near the point where Storelv turns southward; here streams draining the south slope of Nordhoeks Bjaerg debouch onto the lowland of Stordal. The fan is composed largely of gravel, cobbles, and boulders and is traversed by numerous radiating distributary channels from 1 to 6 feet deep, frequently with raised edges or levees of cobbles and pebbles.

The lowland is bounded on the north, west, and south by low hills which are underlain at shallow depths by bedrock, generally covered by a thin mantle of ground moraine and wind-blown silt. The terrain of these areas varies from hummocky to gently rolling with occasional glacial erratic boulders scattered over the surface. There are a few low morainal ridges, for example near the center of the map area immediately west of the outwash deposits. Uphill from the gently rolling terrain the slopes are concave upward and become gradually steeper, passing into steep bedrock mountain slopes of Nordhoeks Bjaerg in Hudson Land to the north, Salevebjaerg in Moskusokselandet to the west, and Ladderbjaerg in Gauss Halvø to the south. To the west and northwest the bedrock is principally gneiss of Precambrian age; to the south and northeast the rock is chiefly basalt of Tertiary age. The contact between basalt and gneiss probably runs across the lowland from northeast to southwest in the general vicinity of Storelv where the river follows a northeast-southwest trend; the only rock outcrop found in the lowland



SYMBOL	RECOMMENDED USE FOR EMERGENCY LANDINGS IN THE SUMMER SEASON	AVERAGE THICKNESS OF SILT MANTLE, INCHES				
I	RECOMMENDED TOUCH-DOWN POINTS	6-7	7½-8½	10	10½	12½
A	BEST TOUCH-DOWN AREAS	6½-7				
B	GOOD TOUCH-DOWN AREAS					
C	RUNWAY AREA	11				
D	EMERGENCY OVERRUN AREAS	12				
E	DANGER AREAS - NOT SUITABLE WITHOUT CONSTRUCTION (SOUTH END TOO ROUGH, NORTH END TOO SOFT)	16				
\\\\\\\\	PARKING, TURN-AROUND, OR WARM-UP AREAS	7½				
∴∴∴	EMERGENCY TURN-AROUND AREAS	9				

Fig. 2. Recommended use of proposed airstrip near Storelv for emergency landings, showing variations in thickness of the silt mantle.

Fig. 3. View along the proposed landing area showing typical surface when ground is snow covered, looking southeast from the northwest corner of the proposed landing site, Storelv area, East Greenland. 5 Sept. 1959.

is basalt, exposed near the narrows of Storelv, about 1 1/2 miles southwest of the campsite and cache. The lower slopes of the basalt mountains are characterized by parallel bedrock terraces defended by successive flows of basalt; these are especially well developed east of Loch Fyne, on the west side of Hold With Hope, and are also visible at the southeastern end of Nordhoeks Bjaerg. Slopes in the gneiss areas are generally steep, and planes of gneissic foliation are plainly visible from the air or on aerial photographs since small streams and gulleys are oriented along them.

Over much of the outwash area is a thin mantle of wind-deposited silt and fine sand. Apparently much of this material was deposited by winds blowing out of Stordal. Near the northwest end of the runway this mantle averages 31 inches deep; it thins progressively along the runway, averaging 10 inches deep over the central 4,000 feet, and only 7 inches deep in the southeasternmost 1,000 feet.

The most prominent outwash terrace in the Storelv area is near the centerline of the proposed runway. Where the terrace is being actively eroded by Storelv and other streams a section of up to 40 feet of outwash gravel and sand is exposed. Test pits were dug at several locations in the edge of the terrace as well as other locations near the runway; field and laboratory work included soil sampling and identification, sieve analysis, moisture content determination, and ground temperatures down to frozen ground. A typical test pit in the edge of the outwash terrace at the northwest end of the runway exposed 3 to 6 inches of vegetation and organic material over about 2 feet of silty fine sand (soil type SM), which in turn overlay poorly graded outwash gravel (soil type GP). Other horizons in the outwash are composed of poorly graded sand (soil type SP), but the outwash as a whole appears well graded, containing a good proportion of all grain sizes from medium sand to cobbles; the outwash deposits are a good source of sand and gravel for construction. In test pits a short distance back from the edge of the terrace, the silty sand mantle is at least 3 feet deep and extends down to frozen ground which lies at a depth of about 3 feet.

Figure 4 is a view along the centerline of the proposed runway area near its midpoint. The northwestern 10,200 feet of the runway are essentially smooth, but broken by three low escarpments from 2 to 5 feet high and with slopes of 10% to 15%, which would require grading. However, an area 5,500 feet long in the center of the 11,500-foot strip (from 4,000 to 9,500 feet from the northwest end) is nearly free of microrelief features and would allow emergency landings by aircraft with ground runs up to 5,000 feet long. The only significant microrelief features in this area are two frost cracks which cross the runway diagonally (5,400 and 9,100 feet from the northwest end); these are 3 to 6 feet wide and have raised edges about 6 inches high. A test pit dug across one crack showed that under the raised edges of the crack the outwash gravel is only 3 inches deep, while under the center it is 12 inches deep; in the surrounding region the depth to outwash gravel averages 9 inches. In the test pit, frozen ground was found 3 feet below the center of the crack and 3-1/2 to 4 feet below the raised edges (i. e., a nearly level surface).

The surface of the runway is covered by hemispherical mounds or tussocks from 6 to 12 inches in diameter and 2 to 6 inches high. In most areas the tussocks would make landings hazardous by planes with small tires unless the ground was

Fig. 4. View along the proposed landing area showing typical surface in summer, looking south-southeast (S 15°E) along the centerline of the proposed landing site near its midpoint. Storelv area, East Greenland. 1 Sept. 1959.

snow covered; a 6-inch snowfall is usually sufficient to smooth out the irregularities in badly tussocked areas and to permit safe ski-landings by light planes.

Tussocks tend to be larger and better developed on the higher outwash terraces. On the lower terraces less than 40 feet above the floodplain of Storelv there are several areas over 750 feet long in which tussocks are small enough to permit safe landings by planes with small tires.

In general, the vegetation mat that covers nearly all possible landing sites in the Storelv area is an aid to aircraft operations since it affords some support in areas of soft soil and would probably permit one or two traverses by aircraft in otherwise untrafficable areas. The shearing strength of the turf cannot be adequately measured by cone penetrometer since the point easily penetrates the porous mat by displacing, rather than breaking, vegetation fibers, while an airplane tire would first compress the vegetation and then be supported until the fibers were torn apart.

Areas lacking vegetation include windswept areas and steep slopes, such as the edges of outwash terraces. In addition, floodplains, alluvial fans, and the delta plain at the head of Moskusoksefjord are largely devoid of vegetation, although some of the higher parts of these landforms have a thin vegetation cover.

On September 2 a snowfall of about 5 inches hampered soil work and surficial geologic mapping. Soil penetrometer tests that had been planned were made impractical by the initial fall of wet snow that saturated the upper layer of soil. Prior to the snowfall these tests were made invalid by freezing of the upper 1/2 to 3/4 inch of soil. By September 6 areas of standing water had frozen to a depth of 2 to 3 inches, but the main channel of Storelv remained unfrozen. Storelv and its tributaries are a good source of drinking water. In winter, water could probably be obtained from a lake located 1 mile northeast of the campsite. Water samples for chemical analysis were collected from streams and lakes by Stanley Davis.

A detailed topographic survey of the 11,500-foot runway site was conducted almost entirely while the ground was snow-covered. The surveying was accomplished largely by Ole Skaerbo, Robert Satin, and Stanley Davis, using a Wild T-2 Theodolite. A strip 500 feet wide was surveyed from 25 theodolite stations spaced 500 feet apart along the center line of the runway. Results of this survey will permit accurate calculation of the amount of cut and fill required to improve the natural runway surface. Construction work would be required principally in the southeasternmost 1,300 feet of runway, where a shallow stream channel is incised 6 feet below the general level of the surface; pending final results of the survey, it is estimated that this gulley would require about 6,000 cubic yards of fill to permit utilization of the southeastern 1,300 feet of runway.

Work was terminated on September 7. A Dornier DO-27, owned jointly by the Northern Mining Company at Mesters Vig and the Royal Greenland Trade Department, made two trips to Storelv to transport the party and essential equipment to Mesters Vig. Food, fuel, stoves, and other excess gear were left in a tent at the campsite. The plane landed near the campsite on a strip 750 feet long and 50 feet wide marked with orange flags. On September 9 the party left East Greenland via Flugfelags Island Viscount.

In summary, it is concluded that the Storelv area affords several potential sites for emergency aircraft landings for planes with ground runs up to 5,000 feet (such as a C-124 or C-130) and at least one favorable site for hasty construction of a very long runway. It is estimated that with a small amount of additional field work a field party could locate a 4,000-foot airstrip near Storelv, having an average depth of only 6 inches to firm outwash gravel, a maximum depth of only 10 to 12 inches, and having relief and microrelief conditions at least as favorable as the proposed 11,500-foot runway. One of the most promising sites is oriented in a northeast-southwest direction, crossing the proposed runway near the southeast end.