SOUTHEAST ALASKA

GRAVITY BASE STATION NETWORK

by

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by

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Introduction

In the spring of 1968 the author released a preliminary compilation (Barnes, 1968) of the descriptions and principal facts for about 300 Alaskan gravity base stations. This is the first supplement to that report and describes about 200 additional or redescribed base stations established in southeast Alaska during 1968 and 1969. The earlier report was one result of reconnaissance surveys made between 1958 and 1967 for the preparation of a gravity map of the whole state (Barnes, 1969) and was prepared to provide datum control for more detailed surveys being initiated by commercial and university groups. The earlier surveys were concentrated in the central and northern parts of the state, but the 1968 base station report also included preliminary data for a few base stations in other parts of the state. This supplement is the first result of a southeast Alaska gravity survey which involved about 3500 new gravity stations and which was largely supported by funds from the Army Map Service (AMS Project order No. 3-68).

The tables at the end of this supplement should be used as a replacement for the table on page A1 of the 1968 report. That initial page included all our then available southeast Alaska base stations and also was used as one indicator of the gravimetry scale which

controlled USGS gravity surveys in central and northern Alaska. The southeast Alaska panhandle includes a sufficiently large range of gravity values to make meter calibration a significant factor in establishing a base station network, and checks of meter calibrations were an important part of the investigation. Furthermore, recent cooperation with the Army Map Service and with Warren Air Force Base made possible a very thorough comparison between the calibrations of Geological Survey gravimeters and the gravimetry scales and datums used for other government surveys and base-station networks. Initially this comparison seemed to suggest some discrepancies either in datum or in meter calibration between USGS surveys and those of the Department of Defense, but these discrepancies were later satisfactorily explained by misunderstandings concerning the identifications and locations of some important base stations.

Thus, neither the datum nor the gravimetry scale used in this report have changed significantly between this supplement and the 1968 Alaskan base station report. Brief discussions of calibration and datum are included merely to summarize important new supplementary information. Similarly, much of the other information in the text of the 1968 report also applies to the new southeast Alaska base station network and will not be repeated in this supplement. A few procedures have been improved, and the extensive use of marine transportation in the southeast Alaska gravity survey caused some changes in operational procedures which will be briefly

discussed. Unless changed procedures are mentioned, the reader may assume that discussions in the 1968 report also apply to this supplement.

Gravimetry scale and meter calibrations

The original calibration and datum standards for the 1968 Alaskan gravity base network were provided by Behrendt (1961) and by Woollard and Rose (1963), who listed all observed gravities to the nearest 0.1 mgal. However, modern gravimeters are read to about 0.01 mgal so that roundoff errors using the Woollard-Rose standard could cause calibration uncertainties of at least one part in 10,000 whenever a meter was checked between gravity stations differing by less than 500 mgals. Furthermore, the scatter or standard deviation between various long-distance airplane ties is usually measured in tenths of milligals (Behrendt, 1962). Multiple ties in opposite directions provide average values, which have proven much more accurate than individual ties. However, such data accumulate slowly during the course of normal trips to and from field areas.

When the 1968 Alaskan base station report was published, the Geological Survey's two LaCoste geodetic meters (G-17 and G-8) had been used for ten measurements of the gravity differences between San Francisco, Seattle and Alaska, plus several ties between other stations on the Woollard and Rose network. Both meters had also made two traverses of the North American Mid-continent Gravimeter Calibration Range (abbreviated as "NAMGCR") between Denver and Point Barrow. On

this Range their calibrations could be checked against a relative standard which reported gravity values to the nearest 0.01 mgal, which was provided by C. A. Whalen of the 1st Geodetic Survey Squadron of Warren Air Force Base (personal communication, June 7, 1967). The combined data suggested that the calibration of the USGS geodetic meters G-17 and G8 had generally been determined to better than 1½ parts in 10,000 except in the gravity interval between Calgary and Great Falls, which also included the value at Seattle. In this gravity interval there was a suggestion of an irregularity in the calibration curve of meter G-17, which could amount to 3 parts in 10,000 and explain discrepancies in the tie between Seattle and southeast Alaska of 0.1 to 0.2 mgal.

Receipt of some of the preliminary results (Whalen, written communication, June 1967) from phase II of the project to establish a U.S. National Gravity Base Net (Schwimmer and Rice, 1969) added some additional discrepancies at Seattle. The new data were not completely consistent with either the Woollard and Rose (1963) data nor with previous Geological Survey data. However, the discrepancies could be explained by various combinations of calibration uncertainties, datum uncertainties, or station-reoccupation uncertainties, and the relative importance of each type of uncertainty was successively examined.

During the following 1968 summer, Geological Survey meters G-17 and G-8 were each checked three more times against Whalen's data for NAMGCR between Fairbanks and Denver. These new data greatly reduced

the possibility of a calibration-curve uncertainty for meter G-17 in the Calgary-Great Falls or Seattle gravity range. Furthermore, in the fall of the same year the Geological Survey was loaned LaCoste geodetic gravimeter G-115, which the U.S. Army Map Service considered their best calibrated meter. This meter reached Alaska at the end of the field season and was used to check gravity differences on the important Juneau-Fairbanks-Anchorage triangle and also the differences established for the mountain calibration loops near Fairbanks and Anchorage, (Barnes, 1968 and Barnes and others, 1969). The results were almost perfectly consistent with previous measurements made with Geological Survey gravimeters G-17 and G-8 in Alaska. Gravimeter G-115 was then used to check gravity differences established by Geological Survey gravimeters in California, and again very good agreement was obtained (Oliver and others, written communication, January 1969). Also in the fall of 1968, gravimeter G-115 was checked against other USGS meters on new mountain calibration loops, which were established in Washington and Oregon, and which were designed to provide additional checks against the calibration-curve irregularities that had been suspected for gravity ranges near Seattle. Once again no significant variation was found between the results obtained with meter G-115 and with meters of the Geological Survey after application of their standard correction factors. A final check to eliminate another source of possible meter error was the stablishment of a series of closely spaced stations on the Skeggs Point mountain calibration loop

near Menlo Park. Repeated checks of many meters over the 10 to 16 mgal intervals on this calibration loop suggested that none of the meters were subject to errors of "screw circularity" greater than 0.02 mgal unless it increased significantly in other gravity or latitude ranges. The author is thus quite confident that the LaCoste geodetic meters used in Alaska should provide data consistent (within 1 part in 10,000 for meter G-17, and within 2 parts in 10,000 for G-8) with Whalen's 1967 data for the North American Mid-Continent Calibration Range and for the U.S. National Gravity Base Net.

However, the standards of gravimetry are continuing to improve and new data suggest that an increased scale correction of about 5 parts in 100,000 may be desirable to make G-17 and many USGS mountain calibration loops completely consistent with the NAMGCR standard. Furthermore, measurements of the absolute gravities (Hammond and Faller, 1971, and C. T. Whalen, written personal communication, Oct. 6, 1970) suggest that the 2,947.74 mgal gravity difference between Houston and Fairbanks should be closer to 2,947.99 mgal, which represents an additional correction of about 1 part in 10,000. This new adjustment will probably be included in the forthcoming World Gravity Net (Szabo, 1966), but such new corrections will not be incorporated into the Alaskan network until that new World Standard is published.

Datum

The datum for both the 1968 and present Alaskan base station reports was determined in 1963, when the author decided that the most frequently occupied and perhaps best determined airport gravity station in Alaska was at Fairbanks International Airport. This airport is a short

distance from the most frequently occupied Alaskan pendulum station in the Geophysical Institute at College, Alaska. The station at the International airport was at the base of the east I-beam in the waiting room and was numbered "WA 279" by Woollard and Rose (1963) and given the mnemonic name "FBKI" for the Alaskan base station network (Barnes, 1968). Woollard and Rose (1963, p. 87) gave an observed gravity value of 982,246.4 mgals for this station and this was assumed to be 982,246.40 mgals as datum for the Alaskan network. When the author visited Fairbanks in July 1970, the airport terminal was being rebuilt and the station could no longer be recognized by its old description. A better new description will probably be: "In service corridor along north side of cafeteria and at base of column that forms a protusion near center of the south corridor wall." The USGS gravity marker, (Barnes, 1968) had been covered by wall-board and will not be replaced until sometime after the reconstruction is completed.

During measurements along the NAMGCR (Whalen, written communication June 1967), the Air Force group had used the base of a nearby I-beam, which will probably not be concealed by the current terminal reconstruction. The station is now best described as "East end of Fairbanks International Airport Lobby at base of I-beam opposite cafeteria entrance and north of stairs to control tower." A USGS gravity marker was placed on the base of this I-beam in July 1970, but it may not survive the reconstruction. This station is called "FBKK" in the USGS Alaskan gravity network and was numbered "23147K"

by the Air Force. On the USGS datum, this station has an observed gravity of 982,246.39 mgals, but the NAMGCR value for the station was 982,246.48 mgals (G. T. Whalen, written communication, 1967). However, at two other stations in the Fairbanks area the Alaskan gravity datum was 0.08 mgal less than the NAMGCR datum, and this value is considered the best difference between the two datums.

The relationship of the Alaskan datum to that of the new U.S. National Gravity Base Network (abbreviated USNGBM) (Schwimmer and Rice, 1969) at first seemed to involve some problems and in part caused the calibration investigations summarized in the previous section of this report. Datum for the USNGBN was a value of 980,118.00 mgals for pendulum station A in the Department of Commerce at Washington, D.C. where Woollard and Rose (1963, p. 21 and p. 43) had used a value 980,118.8 mgals for the same station, which they had identified as "U337." The latter value had been determined by Woollard (1950) on the basis of ties to the Potsdam network, but the USNGBN used the older value chosen by Duerksen (1949), which received additional support from later studies of Woollard (1963). Both datums will have to be revised when new determinations of absolute gravity are completed for the new World Gravity Net (Szabo, 1966). Further corrections to ties between eastern and western United States caused the difference between the new USNGBN and the NAMGCR to be -0.97 mgals at Denver (J. E. Larue, written communication to D. L. Plouff, 25 March 1969; and C. E. Whalen personal communication, 11 January 1971). Because the difference between the

Alaskan datum and the NAMGCR datum has been previously shown to be 0.08 mgal at Fairbanks, the difference between the Alaskan datum and the USNGBN datum should be -0.89 mgal.

The previous Alaskan gravity base station report (Barnes, 1968) listed one station at Seattle Airport to establish the southern end of the Alaskan network, and this station was also included in the preliminary data received for the USNGBN (Whalen, 1967) for stations near the Pacific Coast. This station was located on USC&GS bench mark "S&TA" (its USGS gravity station name) at the base of the flagpole in front of the air terminal and was numbered "15772J" by the Air Force. The observed gravity given for the station in Barnes (1968) was 980,776.36 mgals, and if this were corrected by -0.89 mgal to obtain the USNGBN value the result would be 980,775.47 mgals, whereas Whalen's (1967) data had given 980,775.46 mgals. This agreement is considered excellent confirmation of the original accuracy of the gravimetry scale used by the Geological Survey in Alaska. The more recent data from ties to southeast Alaska suggest that a slightly lower value is also consistent with the data, and 980,776.35 mgals is now considered the gravity value at the S&TA station, although adjustments of ± 0.02 are still possible. The correction of -0.89 mgal is thus accurate at Fairbanks, Denver and Seattle and should correct all well-established Alaskan base stations to the USNGBN datum.

Several types of evidence suggest that the station "S&TA" is the best spot to compare the datums of the Alaskan gravity base net and the USNGBN. This station was not included in the Woollard and Rose

(1963) network, but it was probably the most frequently occupied station at the airport. A preliminary draft of a report by the Air Force Cambridge Research Laboratories (L.G.D. Thompson, C.S Hawkins and R. M. Perry, written communication April 1962) described the station and stated that it was also the Coast and Geodetic Survey station. The Army Map Service (T.H. Nilsen, oral communication, Jan. 1969) considered it the most important station at the Seattle Airport and used the USNGBN value of 980,775.46 mgals as the datum for the State of Washington gravity base net. Finally, the Geological Survey occupied this station more than any other Seattle station on its trips between San Francisco and the Alaskan survey areas.

However, this well established station (bench mark S&TA) has already been destroyed by new construction, as have all but one of the remaining stations at the airport. The one remaining undamaged station is called "SEA 1" and is best described as: "Seattle-Tacoma International Air Terminal, on floor beneath a USGS gravity marker (which may have now been removed) on the wall opposite the base of the stairs, which lead to the employee's cafeteria from a door near the left rear of the Braniff ticket counter." This station was tied four times to the flagpole bench mark "S&TA" before new highway construction destroyed the latter station. It is now considered the best place to tie the USGS Alaskan gravity network to the contiguous United States gravity network.

No attempt has been made to change the Alaskan gravity datum from a value determined by Woollard and Rose (1963) even though considerable effort has been made to tie it to the USNGBN datum. The forthcoming World Gravity Net (Szabo 1966) will include the results of new measurements of absolute gravity (Hammond and Faller, 1971). Preliminary results of these measurements (C. T. Whalen, written communication, Oct. 1970) suggest that the USNGBN datum may be lowered by 13 to 15 mgals. The final Alaskan adjustment will be delayed until the publication of that World Gravity Net.

Comparisons with other datums

The data provide a basis for comparisons with other gravity surveys which have been published or learned about after preparation of the previous Alaskan report (Barnes, 1968) and the initiation of the new Southeast Alaskan gravity surveys. One of these new reports (Woollard and others, 1969) updates parts of the Woollard and Rose (1963) airport network in the contiguous United States and reports observed gravities to the nearest 0.01 mgal. This report continues to use the old datum but states that the difference between it and the USNGBN datum should be 0.84 mgal, instead of 0.89 mgal, which was determined for the Alaskan datum by comparisons with the NAMGCR at Fairbanks and Denver. It thus suggests that the initial assumption of assigning the Alaskan datum as 982,246.40 instead of 982,246.4 (Woollard and Rose, 1963) at Fairbanks Airport (FBKI) involved a roundoff error of 0.05 mgal which is now the difference between the datums. The report also gives an observed gravity of 979,986.95 mgals for a

station at San Francisco airport, where the Alaska data indicate an observed gravity of 979,986.99 mgals. It thus suggests that the Alaskan difference is 0.04 mgal at the other end of the gravity scale and provides additional support for the meter calibrations.

Another recent report (Rice, 1969) included 36 stations established by the Coast and Geodetic Survey in the vicinity of Glacier Bay and many more stations in the area affected by the 1964 Alaskan earthquake. The datum for this network was an earlier pendulum measurement at Anchorage (Rice 1952) and seems to be about 1.02 $\pm$ 0.04 mgal lower than the USGS Alaskan datum at Anchorage. The principal USC&GS base station at Anchorage bench mark "CAA terminal" had been destroyed when the report (Rice, 1969) was published and the datum difference was established by ties to the pendulum station and to two other Anchorage stations, but there is sufficient scatter in the measurements to justify additional comparisons. The principal USC&GS base stations at Juneau and Bartlett Cove in southeast Alaska have not yet been occupied by the Geological Survey, but comparisons at two of the Juneau stations established by Thiel and others (1958) suggest that in southeast Alaska the USC&GS datum may be 1.15 $\pm$ 0.05 mgal lower than the new USGS Alaskan datum. However, exact reoccupation of these old Thiel and others (1958) stations is difficult because airport modification has altered their descriptions. Any additional gravity field work in southeast Alaska will adjoin more of the USC&GS survey and a better datum comparison will be attempted.

Comparison with the old Thiel and others (1958) datum can be made at six reoccupied stations in southeast Alaska, and at all stations the USGS datum is 0.8 $\pm$ 0.08 mgal higher than the 1958 datum. The Woollard and Rose (1963) network provided both the datum and scale for the USGS Alaskan network and has been shown to agree within a 0.05 mgal roundoff precision at both Fairbanks and Seattle. However, in southeast Alaska the Woollard and Rose (1963) measurements seem to be about 0.1 mgal lower than the USGS network at both Juneau and Annette Island.

Three ties between Juneau and the airport pendulum station at Whitehorse averaged -17.95 $\pm$ 0.05 mgal and provided another tie to the NAMGCR datum and to the Canadian base network. The Juneau-Whitehorse difference between the USGS and NAMGCR datum was 0.07 mgal and essentially identical to the 0.08 mgal difference established at Fairbanks. Information from the Canadian Dominion Observatory (P. J. Winter, personal communication, June 24, 1968) suggests that at Whitehorse the Canadian datum is 0.08 mgal below the USGS Alaskan datum and 0.15 mgal below the NAMGCR datum. However, Canadian measurements at several stations in the Alaskan Interior, range from 0.1 to 0.6 mgal above the USGS measurements at the same stations, and the suggested discrepancies will probably not be explained until further information is received from Canada.

Data scatter in large-interval gravity measurements

However, even with well established meter calibrations, and good datum control at each end of the survey, considerable difficulty was encountered in obtaining reproducible gravity differences over the large range of gravity values between the contiguous United States and Alaska. For example, the standard deviation in twenty USGS gravity ties between San Francisco and Seattle was 0.18 mgal. This deviation may seem large, but it is almost identical to the 0.17 mgal deviation determined by Behrendt (1962) for a series of measurements with similar meters between many stations in the United States. The data obtained enroute to and from Alaska probably included a larger number of measurements over essentially similar gravity intervals than Behrendt's data, and examination of these Alaskan ties has revealed some systematic errors, and thus improved the interpretation of the data.

There is a definite tendency for meters to record different measurements enroute to Alaska than on the southbound return to San Francisco. The best evidence for this type of discrepancy comes from the G-17 data between Seattle and Fairbanks, on which there is a standard deviation of 0.30 mgal for 8 ties over a 1470 mgal difference. However, three differences measured on southward trips average 0.58 mgals more than five differences measured on northward trips, and the standard deviation of both the southern and northward trips considered individually is only 0.10 mgals. Similar comparisons are evident for almost all of the Alaskan data that involve long north or south

airplane flights. Various explanations for this systematic difference were considered. First, aircraft vibration as a source of meter drift was well established by Canadian investigators (Hamilton and Brule, 1967). However, the differences observed enroute to and from Alaska suggested a drift that was both more systematic and of opposite sign from the drift observed by Canadians. Second, tests were made to determine whether these gravimeters required much time to recover from travel vibration or to adjust to large changes in gravity. However, readings made a few minutes, a few hours, or a few days after arrival in Fairbanks, Anchorage or other northern cities, have not differed significantly after tidal corrections. Initiation of field work within a few days of arrival in a new area usually provided opportunities for vibrations, drift and tares which eliminated most possibilities for determining whether the differences between north and south trips could be reduced by a very slow adjustment (lasting several weeks) following arrival in a new area. Indeed, the available data suggest that large tares (0.2 to 0.5 mgals) may be more frequent in the first few weeks following arrival in a new area than at any other period in a field season. Third, the meter's manufacturer (L. J. LaCoste, written communication, Dec. 28, 1970) suggested that the most probable explanation for the north-south discrepancy is a hysteresis in the meters' lever system which causes it to read differently after large positive or negative changes of the dial. Tests in our laboratory have confirmed that for

the USGS meters, this effect has the correct magnitude to explain the results enroute to and from Alaska. The hysteresis is smaller in newer meters, and these meters have also given more consistent results on the few trips they have made to and from Alaska.

On aircraft flights covering smaller gravity intervals in Alaska, the differences between northward and southward ties are smaller than the standard deviations of individual data groups which include only traverses in one direction. For example, the data between Anchorage and Fairbanks include four northward traverses which average only 0.02 mgal more than the three southward traverses. The northward average is influenced by one high, erratic measurement which may be best explained by "vibration drift." Nevertheless, the Anchorage-Fairbanks data are typical of the other shorter-distance aircraft ties in Alaska, none of which show statistically significant differences between northward and southward traverses. Similarly, very few significant drifts have been observed with these meters on short, light-aircraft loop traverses to obtain field data and base-station control. Nevertheless, the scatter in all data sets is large and suggests unexplained, random, or unrecognized-systematic errors. For example, even when the southward and northward ties of individual meters are considered as separate data groups, the aircraft gravity measurements between Seattle and San Francisco (perhaps the largest data set) still show a standard deviation of more than ± 0.10 mgal, which is significantly larger than the standard deviations of near ± 0.02 mgal achieved on mountain calibration loops (Barnes and others, 1969).

In view of all these factors and instrument uncertainties, multiple ties in opposite directions and involving more than one meter, seem to be an essential requirement for establishing a good base-station network. A satisfactory adjustment of the southeast Alaskan base-station data seems to have been achieved by emphasizing multiple measurements of the short-duration, small-gravity-interval ties. However, these data have also been matched to multiple measurements of the large gravity intervals between major cities, and these multiple measurements have included both northward and southward measurements with two to four meters, which probably have calibrations that vary within the uncertainty range of about 1 part in 10,000. The fact that the results seem consistent with data from the NAMGCR (Whalen, 1967 personal communication, June 7, 1967) provide good support both for the meter calibrations and the adjustment procedures. The prime base stations in the major cities of southeast Alaska should now be established to better than ± 0.05 mgal relative to the Alaskan datum and scale.

Field Procedures

The Southeast Alaska base station network basically consists of a primary and a secondary system. The primary system consists of stations, which are connected by multiple (generally more than five) aircraft ties plus a few marine ties, and which are located in the cities of Ketchikan, Wrangell, Petersburg, Sitka, Juneau, Haines, Skagway, Yakutat and Cordova (marked by large circles in the map on Figure 1). Several stations are available in most of these cities, and each station is marked by either a USGS gravity marker or USC&GS tidal bench mark. Most gravity

measurements between these cities have been made in the course of routine travel between survey areas and operations. Only a couple of trips have been made for the specific purpose of establishing the primary base network. Most city networks include stations at one or more principal buildings, the small boat harbor and the airport. All of these station locations have been photographed and diagrammed. The new airports at Wrangell and Petersburg were being built during establishment of the gravity network, and the stations at these new airports are temporary. Similarly, improvements at the Sitka and Cordova airports have already destroyed some previously established stations.

The secondary network consists of stations established for drift and survey control during the small-boat operations, which obtained most of the field data. Such stations were established in almost all harbors where the supporting vessel anchored for overnight stops or midday rendezvous with the skiffs. Two skiffs and two LaCoste gravimeters were used for most of the field work so almost all of the secondary base stations are automatically connected by at least two ties to each of two nearby base stations, but some of these traverses may include a day's field work and resultant opportunities for drift and tares. Many of the secondary base stations were, however, also used as common points where traverses and loops intersected, so they are tied to more than two nearby base stations. Finally, light aircraft were used at various times during the field work to obtain additional ties between the primary network and selected stations

in the secondary network. Most of these flights were loops of short duration and the results obtained on them were emphasized in the adjustment.

Most of the traverses which established the secondary network involved use of skiffs, which pounded and vibrated very badly during the many fast traverses in rough water. Tares and vibration drift are thus more common in these data than in the LaCoste data obtained using riverboats, light aircraft and wheeled vehicles in other parts of Alaska. However, in most of southeast Alaska a large enough number of repeated readings were obtained at most base stations to reveal tares and large vibration drift. Thus the precision of most of the adjusted station values should be close to ±0.10 mgal. The standard deviation of a large sampling of the differences between individual readings and adjusted values was about ±0.05 mgal. In a few areas, however, transportation, weather problems, and failures to complete the survey net limited the number of reoccupations, and the base values may be more poorly established. The most probable examples of such uncertainty are the base stations in Christian and Frederick Sounds, where large sections of station data are still missing, and where future field plans will include completion of the coverage and additional base station ties. Smaller possibilities for uncertainty also exist in the northern Portland Canal and southern Sumner Straits, which may be briefly revisited.

All station locations in the secondary network are marked by USGS gravity markers, USC&GS tidal bench marks, or triangulation

markers. Very few of these station locations have been diagrammed but most have been photographed. Tidal bench marks were used as much as possible for these stations, even though many are either difficult to reach or poorly located for reproducible gravity measurements. However, tectonic or isostatic processes seem to be actively changing elevations in Southeast Alaska (Hicks and Shofnos, 1965), and study of the gravity changes which may accompany such processes may be scientifically interesting (Barnes, 1966). The effort to locate the most-frequently occupied gravity stations at places where elevation changes can be most easily determined, therefore, seemed justified. However, many of these tidal bench marks are located for easy access to tidal guages and thus tend to be close to steep and rocky shorelines, where the gravitational effects of nearby water masses and their tidal variations could be significant (Rice, 1969). The maximum error caused by this effect is slightly over 0.1 mgal for a tidal change of twenty feet and a station on the top of a straight, vertical cliff, or 45° conical island. Normal tidal ranges are smaller in southeast Alaska, and most shorelines have gentler slopes, so the probable error is significantly smaller. Furthermore, observers tried to place all gravity stations where local terrain effects would be minimal, and thus picked the tidal bench marks which were least influenced by such tidal variations of nearby water masses.

Data Processing

All gravity base station data were processed by a Fortran computer program that provides tidal corrections, reduces LaCoste factory calibration data and provides for a large variety of input base-station

data. The program has the facility to make drift corrections, but these were only applied to data obtained on loops with Worden meters. Examination of much field and calibration-loop data has convinced many members of the Geological Survey that LaCoste gravimeters very seldom drift linearly; and that reading changes are more frequently the result of small tares, for which adequate corrections are not obtained by assuming consistent drift rates. If gravity differences between base stations are measured more than twice, as they were throughout the Alaskan network, the best differences are obtained by averaging the results of multiple ties after previously eliminating the small amounts of data in which significant tares or misreadings are evident. The computer program for reducing the data prints both the observed gravity at each station and its difference from any of as many as five specified base readings. It also calculates gravity differences between successive stations and compares calculated gravities to previously established gravities. The latter comparisons quickly indicate tares, misreadings or badly established stations. A plotter routine is part of the program and provides the analyist with various types of drift and calibration-error graphs.

Averaging and adjustment of the various station differences after they have been calculated by the Fortran computer program has been done by desk calculator. A least-square adjustment by computer would provide a quicker adjustment if a suitable program were available, but might tend to overemphasize erroneous readings or tares. In southeast Alaska the adjustment has proved slow and laborious, but much of the difficulty and delay was caused by early misinterpretation of the USNGBN data at the Seattle end of the net.

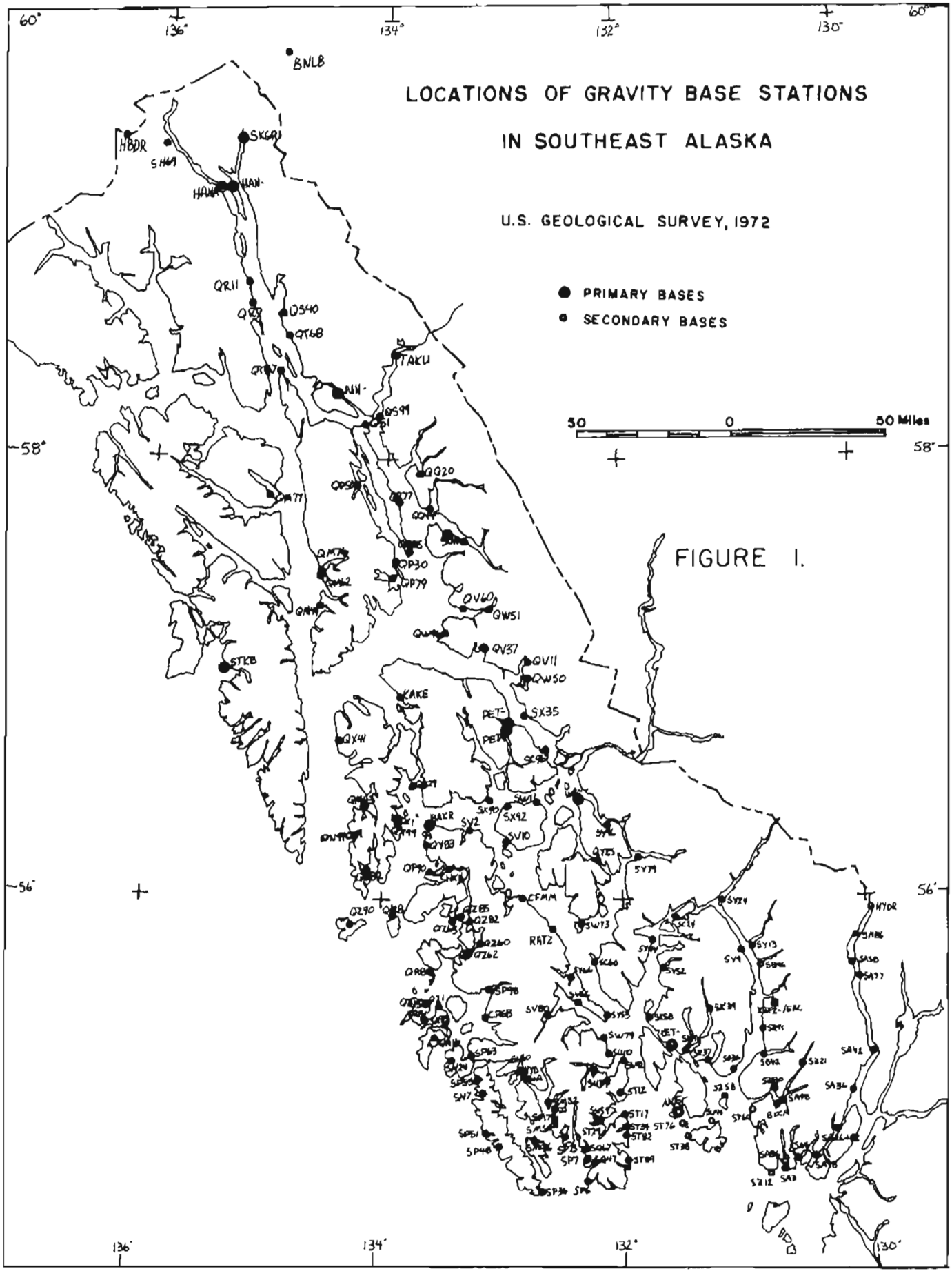
LOCATIONS OF GRAVITY BASE STATIONS
IN SOUTHEAST ALASKA
U.S. GEOLOGICAL SURVEY, 1972
PRIMARY BASES
SECONDARY BASES
50
0
50 Miles
60°
58°
56°
136°
134°
132°
130°
BNLB
HBDR
SKGR
HAN
TAKU
KAKE
PET
BAKR
RATZ
CFMM
FIGURE 1.

TABLE 1

PRIMARY

ALASKAN GRAVITY BASE STATIONS

KETCHIKAN, ANNETTE, WRANGELL

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
KETP	Ketchikan Post Office, on east side of steps to north (main) entrance, below fire-hose spigot and above a USGS gravity marker						6/69 9/70
	981,543.84	18	55° 20.50'	131° 38.43'	+2.0	+1.4	6+
KETA	Ketchikan, Alaska airlines office, across road towards rock cliff; on curb below USGS marker on power pole						6/69 9/70
	981,543.67	16	55° 20.73'	131° 39.45'	+1.3	+0.7	6+
KETB	Ketchikan shopping area, in alley south of Dock St., on pavement beneath USC&GS TBM No. 30 on wall of Tongass Hardware Store						6/68 9/70
	981,544.25	18	55° 20.48'	131° 38.52'	+2.5	+1.9	3
KETC	Ketchikan Coast Guard station, at gate end of concrete retaining wall, along S. side of admin. parking lot of USC&GS TBM No. 37						6/68 9/70
	981,542.22	27	55° 19.96'	131° 37.38'	+1.9	+1.0	2
ANET	Annette Island, Alaska airlines terminal, on gravel in field enenclosure and below USGS marker on power pole						7/70 9/70
	981,527.52	119	55° 02.29'	131° 34.60'	-20.9	-16.8	8
ANEW	Annette Island, Western Airlines Terminal, on concrete ramp below USGS marker next to garage door						7/70 9/70
	981,527.61	119	55° 02.20'	131° 34.60'	-20.8	-16.7	6
SK11	South of Ketchikan, at Hole-in-the-wall harbor, at top of steps on SW corner of concrete slab and above marker						8/68 9/70
	981,534.48	36	55° 19.08'	131° 31.12'	-3.7	-4.9	4
SK58	North of Ketchikan at Clover Pass Resort, on NW corner of concrete base of boat winch, and above USGS marker						8/68 9/70
	981,552.64	15	55° 28.42'	131° 48.68'	-0.7	-1.2	6
WRAB	Wrangell Post Office, across road and on top of rock ledge, above USC&GS TBM No. 6						6/69 9/70
	981,614.51	31	55° 28.85'	132° 23.20'	-21.7	-22.8	4+
WRNA	Wrangell Seaplane terminal, at west door of white office building, on ground below USGS marker						6/69 9/70
	981,611.64	15	56° 25.47'	132° 21.50'	-21.4	-21.9	4+
WRAT	Wrangell harbor, island boat float entrance, east of Totem pole and Indian bldg., on ground below USGS marker on power pole						6/69 9/70
	981,615.64	12	56° 27.95'	132° 22.71'	-20.5	-21.1	4+
WRNT	Wrangell new airport, below steps to new temporary trailer office, on ground below USGS marker						6/69 9/70
	981,615.45	60	56° 29.12'	132° 22.64'	-18.5	-20.5	3+

TABLE 2
PRIMARY
ALASKAN GRAVITY BASE STATIONS
PETERSBURG AREA, PORT BAKER, SUMDUM & SITKA

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
PETH	Petersburg harbor entrance, on SE corner of Main and E Streets Jct., on sidewalk above USGS marker						9/69 9/70
	981,659.01	16	56° 48.82'	132° 57.30'	-6.3	-6.9	8+
PETA	Petersburg seaplane terminal, in Alaska Airline hanger, on SW corner of concrete foundation						6/69 9/70
	981,659.60	10	56° 46.87'	132° 58.21	-3.6	3.9	6+
PETN	Petersburg new airport, at base of wood steps to Alaska Airlines office and on dirt below USGS marker						6/69 10/70
	981,652.40	100	56° 58.40'	132° 56.12'	-4.8	-8.2	2
PETP	Petersburg Post Office, on south side of entrance, on board sidewalk over USGS marker						6/68 10/70
	981,658.93	16	56° 48.76'	132° 57.23'	-6.1	-6.7	
PETT	Petersburg Trading Union, store entrance on sidewalk, on top of USC&GS TBM No. 1						6/69 9/70
	981,658.91	16	56° 48.83'	132° 57.33'	-6.4	-7.0	6
PET 6	Petersburg Press building, in Chevron gas station parking area, on gravel below USC&GS TBM No. 6						6/68 9/70
	981,658.97	16	56° 48.70'	132° 58.32'	-6.1	-6.7	2+
SX44	Petersburg road, at northwest corner of Blind River bridge and on road surface						6/68 9/70
	981,654.97	11	56° 36.90'	132° 49.33'	+5.7	+5.3	2+
SC 92	Petersburg road end (1968), west of Summit Island, on gravel below USGS marker on post						6/68 9/70
	981,628.62	19	56° 35.84'	132° 32.90'	-17.9	-18.6	2+
SC 69	Duncan Sound at U.S. Communications landing site, below N. support of roof above gas pumps, on concrete above USGS marker						6/68 9/70
	981,666.89	16	56° 45.40	133° 13.25'	+6.4	+5.9	2+
BAKR	Port Baker, near seaplane float, on rock below and east of elevated walk to Larsen home and above USGS marker						9/69 9/71
	981,638.15	7	56° 21.25'	133° 37.17'	+10.2	+10.0	5
QY 75	Port Baker, SW corner of harbor, on flat rock 10 yds. E of walk to Zieske home, on USC&GS TBM No. 3						9/69 9/71
	981,638.05	7	56° 21.13'	133° 37.38'	+10.3	+10.0	3
SUMD	Endicott Arm, Sumdum Anchorage, at SE door of abandoned shack, on ground below USGS marker						9/69 11/70
	981,702.20	17	57° 40.38'	133° 28.48'	-33.7	-34.3	5+
STKB	Sitka airport, across road and NE of new terminal, on base of airport beacon and above USGS marker						6/69 9/70
	981,708.26	19	57° 03.12'	133° 21.75'	-33.8	-34.4	5+

TABLE 3
PRIMARY

ALASKAN GRAVITY BASE STATIONS

JUNEAU, HAINES, SKAGWAY, YAKUTAT, CORDOVA

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
JUNL	Juneau airport terminal, near lobby entrance and in corner below stairs to restaurant, on floor below USGS marker						7/70 9/70
	981,767.78	20	58° 21.68'	134° 34.94'	-23.7	-24.4	14
JUNA	Juneau airport terminal, in concourse to field and below first windows out from waiting room, on floor below USGS marker						6/70 9/70
	981,767.92	18	58° 21.68'	134° 34.94'	-23.1	-24.0	10+
JUNB	Juneau, Alaska state office building, on SW side of main entrance steps, on granite block at column and above USC&GS TBM 14						8/69 9/70
	981,750.37	78	58° 18.15'	134° 24.50'	-31.1	-33.7	6
JUND	Juneau, at F street entrance of SE Alaska Instructional Materials Center, at SW base of stairs and on concrete above USGS marker						7/70 9/70
	981,753.62	17	58° 18.33'	135° 25.41'	-33.8	-34.3	4+
JUNH	Juneau, at Douglas hanger of Livingston Copters, at base of northeast door facing water and below USGS marker						8/69 9/70
	981,760.72	20	58° 19.93'	134° 29.80'	-28.5	-29.2	3+
JUN3	Juneau, at Auk Bay Post Office, at west end of door on concrete platform beneath mail slot						8/69 9/70
	981,778.04	21	58° 23.13'	134° 39.35'	-15.0	-15.9	3
QT68	Juneau Road's north end, 2.3 miles north of Eagle R. & 1/2 mile SE of Benjamin Is., on rock above USGS marker						8/69 9/70
	981,794.16	9	58° 34.56'	134° 53.42	-15.5	-15.9	2+
HANA	Haines airport, near northwest end of runway and on north corner of concrete warmup pad						8/69 9/70
	981,837.59	16	59° 14.85'	135° 31.80'	-25.4	-26.0	5+
HANP	Haines post office, on concrete curb at base of power pole, in front of windows and below USGS marker						8/69 9/70
	981,845.18	55	59° 14.02'	135° 26.75'	-13.1	-14.9	6 +
HAND	Haines small boat harbor, across road from walkway to floats, on concrete curb below USGS marker on power pole						8/69 9/70
	981,847.30	25	59° 14.10'	135° 26.40'	-13.9	-14.7	25
SKGR	Skagway railroad station, at entrance to ticket office, and at SW end of step, on concrete below USGS gravity marker						8/69 10/71
	981,774.57	22	59° 27.26'	135° 18.98'	-104.3	-105.1	3+
YAKA	Yakutat airport, at first building NW of Alaska Airlines terminal, outside NW end of fuel truck door, on pavement above USGS marker						7/69 8/71
	981,836.82	33	59° 30.53'	139° 40.09	-45.4	-46.5	10+
YKTA	Yakataga airport, at SE end of runway near middle of SE side of red storage building, on gravel below USGS marker						6/68 8/71
	981,906.00	12	60° 04.93'	142° 28.93'	-24.1	-23.5	3
CRDW	Cordova Federal airport, at field entrance to terminal (relocated in 1969), on NW side of steps and on apron pavement below USGS marker						6/69 8/71
	981,957.43	50	60° 29.61'	145° 28.39'	-0.3	-2.0	3+

TABLE 4

SECONDARY

ALASKAN GRAVITY BASE STATIONS

PORTLAND CANAL, PEARSE CANAL, & NAKAT BAY

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
NYDR	Hyder, on road to Stewart at U.S. boundary marker in rear of stone guard house, on concrete monument base above USGS marker						6/68 7/71
	981,471.76	12	55° 54.75'	130° 00.96'	-118.8	-119.2	2+
SA66	Glacier Point, in cove at SW corner of point, on low rounded ledge above USGS marker						6/68 7/71
	981,480.62	11	55° 49.31'	130° 06.50'	-102.4	-102.8	2+
SA58	Cliff Point, on rock outcrop about 20 yards north of navigation light and above USGS marker						6/68 7/71
	981,481.95	7	55° 40.90'	130° 07.49'	-89.4	-89.6	2+
SA42	Portland Canal elbow, opposite Hattie Island, 5 yds. north of monument 5-16, on rocks above USGS marker						6/68 7/71
	981,478.94	8	55° 17.49'	129° 59.57'	-59.5	-59.8	2+
SA36	Sandfly Bay, east shore, about ½ mile north of point, on flat rocks 2 feet east of USGS marker on ledge						6/68 7/71
	981,484.77	1	55° 09.20'	130° 08.80'	-42.7	-42.8	2+
SA26	Hidden Point on rocky point about a half mile NE of Hidden Inlet entrance, on low boulder, on top of USGS marker						6/68 7/71
	981,477.79	8	54° 56.92'	130° 19.10'	-31.7	-31.9	2+
SA82	Gwent Cove at Hidden Inlet cannery, at northeast entrance to abandoned engine room, on concrete threshold above USGS marker						6/68 7/71
	981,480.20	11	54° 56.76'	130° 19.92'	-28.6	-29.0	3
SA18	Pearse Canal, at Edward Passage, ¼ mile east of Akeku Point, at NE corner of flat rocks and above USGS marker						8/68 12/70
	981,487.39	7	54° 50.06'	130° 29.52'	-12.5	-12.7	3
SA4	Willard Inlet entrance, on point north of Just Is., in small cove on W side of point, on low rock near top of beach, above USGS marker						8/68 6/70
	981,490.89	10	54° 49.15'	130° 37.95	-0.4	-0.7	3
SA86	Nakat Harbor, 0.6 mile S of Surprise Point, on N end of small point, in cove on top of highest ledge and above USGS marker						6/68 12/70
	981,502.10	11	54° 48.63'	130° 43.29'	-4.7	-4.3	11
SA3	Port Tongass, in cove near abandoned cabin site, S of small point, at crest of beach and at base of bushes above USGS marker						8/68 12/70
	981,503.07	10	54° 46.46'	130° 44.00'	+8.5	+8.2	3+
SZ12	Fox Island, in cove on N side of island and near old piles, west of high ledge, at top of beach and on top boulder above USGS marker						6/68 12/70
	981,510.58	15	54° 45.87'	130° 50.69'	+17.5	+16.9	3+

TABLE 5
SECONDARY

ALASKAN GRAVITY BASE STATIONS

REVILLAGIGEDO PASSAGE & VICINITY

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
BOCA	Boca de Quadra, near S end of E side of Gannet Island, at N end of point forming small cove, on rock summit & above USGS marker						8/68 12/70
	981,515.09	7	55° 04.28'	130° 47.79'	-4.9	-5.1	4+
SZ21	Boca de Quadra, 6 miles S of N end of W shore, in low rocky point at creek mouth, on rock ledge near grass and above USGS marker						6/68 7/71
	981,501.36	12	55° 15.80'	130° 33.79'	-34.4	-34.8	2
SZ30	Boca de Quadra, 0.6 miles N of Kestrel Is., at ruins of cannery, on flat rock north of pilings and above USC&GS TBM No. 3.						6/68 7/71
	981,518.37	7	55° 06.92'	130° 47.82'	-5.6	-5.8	3+
ST60	Kah Shakes Cove, north shore, outside broad mouth of Creek, on flat rocky ledge above USC&GS TBM No. 2 (1932)						6/68 7/71
	981,518.60	6	55° 02.60'	130° 58.89'	+1.0	+0.8	4+
SU94	Felice Strait, N of southwest end of Cat Island, on N end of smaller island, on flat rocks and above USC&GS TBM No. 1						6/68 7/71
	981,525.40	6	55° 01.69'	131° 16.19'	+9.0	+8.8	3+
ST76	Felice Strait, on N end of Hotspur Is. and SW of small islet, above USGS marker and probably near unfound USC&GS TBMs						6/68 8/71
	981,529.90	8	55° 00.05'	131° 31.64'	+16.1	+15.8	3+
ST38	Percy Islands, on largest and northwest island, in S end of long narrow cove, on NW side on low boulder and above USGS marker						6/68 8/71
	981,537.00	7	54° 57.24'	131° 35.98'	+27.0	+26.8	2+
SZ58	Mary Island, N end of Giant Point, on top of largest boulder on point, above USC&GS triangulation station brass bolt						6/68 12/70
	981,525.46	11	55° 06.78'	131° 12.40	+2.2	+1.9	3+
SB36	Alava Bay, at N end of large central island, on flat topped ledge below cedar boughs, and above USC&GS TBM No. 2.						6/68 12/70
	981,543.50	13	55° 13.67'	131° 08.00'	+10.8	+10.4	2+
SZ37	Thorne Bay, on small rocky island in SW side of entrance to Moth Bay, on rocky ledge near crest of SE point and above USGS marker						6/68 12/70
	981,531.05	10	55° 16.19'	131° 20.03'	-5.5	-5.9	2+
SK39	Carroll Inlet, on E shore 0.7 mi. S of Calamity Creek, on S side of point and W side of beach, on top of ledge & above USGS marker						8/68 9/70
	981,544.59	7	55° 31.17'	131° 18.90'	-13.3	-13.6	2

TABLE 6
SECONDARY
ALASKAN GRAVITY BASE STATIONS
BEHM CANAL & VICINITY

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
SB42	Smeaton Bay entrance, near SE corner of Carp Island, inside small cove, on high ledge forming point and above USGS marker						8/68 12/70
	981,524.95	12	55° 17.91'	130° 53.15'	-13.8	-14.2	4+
SZ91	Winstanley Island, southern of two large coves on E shore, on top of highest rock in cove (awash at highwater) on USC&GS TBM No. 1						6/68 12/70
	981,528.35	7	55° 24.95'	130° 54.08	-41.8	-42.3	3+
KEF2	Rudyerd Bay, near center of W shore of Punchbowl Cove. 60 yds. S of waterfall, at base of big cedar & below hard-to-find USGS marker						6/68 12/70
	981,516.80	12	55° 32.04'	130° 47.91'	-14.9	-42.3	4+
/EAC	Rudyerd Bay, near center of W shore of Punchbowl Cove, 70 yds. S of creek & waterfall, on boulder & above USC&GS station "EACH 2"						6/68 12/70
	981,516.91	11	55° 32.04'	130° 47.91'	-41.8	-42.3	3+
SB96	Walker Cove, S side of entrance, on Ledge point and above USC&GS Reference Mark 1						6/68 12/70
	981,523.37	11	55° 42.45'	130° 53.51'	-50.0	-50.4	1+
SY 9	Portage Cove, S side of entrance and NW of small beach, on crest of very high and rounded ledge, above USGS marker on rock						6/68 12/70
	981,536.45	10	55° 46.23'	131° 02.87'	-42.1	-42.5	2
SY13	Chickamin River, S side of mouth and 1.0 mi. NW of Trap point, on largest flat boulder on small point, and above USGS marker						6/68 12/70
	981,526.93	8	55° 47.58'	130° 56.38'	-53.9	-54.2	3+
SY24	Burroughs Bay, in small cove in SE shore (opposite Grant Cr.), on SE corner of beach, on small boulder below logs & above USGS marker						6/68 12/70
	981,531.14	10	56° 00.34'	131° 10.19'	-67.4	-67.7	3
SC24	Bell Island Resort, on south corner of walk leading to swimming pool, on concrete above USGS marker						8/68 9/70
	981,549.05	21	55° 55.86'	131° 33.89'	-42.0	-42.7	4+
SY44	Spacious Bay, in small cove on N end of Snail Point, on E shore of cove, amongst trees, on small boulder and above USGS marker						6/68 12/70
	981,526.76	11	55° 49.25'	131° 46.40'	-20.2	-20.5	3
SY52	Traitor's Cove, S side of entrance & SE of channel rocks, on beach below logged area, on low dark-colored, pyramidal rock						8/68 12/70
	981,555.87	7	55° 41.41'	131° 41.62'	-16.4	-16.7	2

TABLE 7
SECONDARY

ALASKAN GRAVITY BASE STATIONS

CLARENCE STRAIT, ERNEST SOUND & TRIBUTARIES

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
SY53	Kasaan Peninsula, easterly point 0.5 mile SW of Streets Island, on rocks above USGS marker						6/68 7/71
	981,569.24	10	55° 28.28'	132° 08.68'	-15.7	-15.3	3+
SY66	Tolstoi Bay, W side, 1 mile S of entrance, S of island, on W side of rock islet, and above USGS marker						6/68 7/71
	981,580.50	12	55° 39.22'	132° 26.29'	-11.7	-11.3	3+
SC60	Meyers Chuck harbor, in SW corner, 30 yds. S of public pier, on large boulder near trees and above U.S. Land Office mark "2573"						6/68 7/71
	981,575.65	12	55° 44.40'	132° 15.25'	-0.4	-0.8	5+
SY79	Bradfield Canal entrance, on S shore, on small point 0.5 mile W of mark "Rap" on rocks at W side of cove & above USGS marker						6/69 8/71
	981,579.58	10	56° 12.19'	131° 52.10'	-35.5	-35.8	2+
QY25	Zimovia Islets, on W point of largest island (½ mi. SW of village), on flat rock 10 ft. N of navigation light & above USGS marker						6/69 8/71
	981,601.77	13	56° 11.07'	132° 12.72'	-21.1	-12.4	2
SY96	Eastern passage, on broad point 1.5 mile SE of Channel Island, on top of USC&GS triangulation station "Venus"						6/69 7/71
	981,602.35	11	56° 20.89'	132° 08.29'	-24.7	-25.1	2+
SW73	Onslow Island's NE corner, (1.2 mi. N of W point of Eagle Is.), 6 yds. from yellow sign, on large outcrop & above USGS marker.						6/68 8/71
	981,600.04	13	55° 53.45'	132° 20.39'	+11.4	+11.0	2+
RATZ	Ratz harbor, SW shore in abandoned logging camp, at SE corner of power house, on concrete door step and above USGS marker						6/68 7/71
	981,614.45	15	55° 52.76'	132° 35.94'	+26.8	+26.4	3
CFMM	Coffman cove, on E shore, at logging camp's main garage, outside SW entrance and above USGS marker on concrete.						6/68 7/71
	981,610.45	17	55° 00.64	132° 49.72	$26.8	+26.4	3
SV10	Bushy Island, in cove on N side and S of small island, at NW corner of northernmost house, on ground below USGS marker on pile						6/68 8/71
	981,635.27	9	56° 16.51'	132° 58.49'	$14.1	+13.8	2+
SV2	Red Bay, east side of entrance, on east side of Pine Point, on rocks at base of pole believed to be triangulation staff						6/69 8/71
	981,643.34	13	56° 20.20'	133° 16.29'	+17.4	+17.0	2+
SX92	Zarembo Is., St. John Hbr., on SE corner of Southerly Island, trees above steep, rock shoreline & read above USC&GS TBM No. 1						9/69 9/71
	981,646.14	10	56° 26.50'	132° 57.85'	+11.1	+10.8	6
SW11	Zarembo Is., N edge, 0.6 mile E of stream at Craig Pt. at triangulation station "Off", and on rock between station & navigation light						6/68 8/71
	981,631.65	15	56° 27.42'	132° 42.85'	-4.0	-4.5	2
SX90	Little Level Island, NE point about 0.1 mile SE of islet, on low rock dike and above USC&GS TBM No. 1						6/69 8/71
	981,653.30	7	56° 27.80'	133° 05.90'	$16.3	+16.0	2+

TABLE 8
SECONDARY
ALASKAN GRAVITY BASE STATIONS
SOUTHEAST PRINCE OF WALES ISLAND

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
SV66	Kasaan, near S end of old cannery, behind wood buildings, & N of metal bldg., on 6x12' concrete block & above USC&GS TBM No. 5.						8/68 8/71
	981,574.70	17	55° 32.18'	132° 23.66'	+16.3	+15.7	3+
SV80	Twelvemile Arm of Kasaan Bay, on N shore of Hollis Anchorage & N of W end of entrance island, on rocky ledge above USC&GS TBM No. 3.						6/68 8/71
	981,564.95	8	55° 28.77'	132° 38.41'	+10.5	+10.2	2
SW79	Kasaan Bay entrance, on Island Point, west of USC&GS station "Chop", on sloping ledge where island becomes hidden, & above USGS marker						6/68 8/71
	981,567.95	7	55° 22.40'	132° 10.29'	+22.4	+22.2	2
SU10	Clover Bay, northernmost corner of cove N of King Is., on fourth small point W of stream and above USC&GS TBM No. 1						8/68 8/71
	981,559.00	8	55° 18.13'	132° 09.54'	+19.5	+19.2	5
SV92	Cholmondeley Sound, east side of entrance and SE of "N. Chasina" triangulation station, on large rock and above USGS marker						6/68 8/71
	981,546.60	10	55° 16.72'	132° 01.10'	+9.3	+9.0	10
SU34	Cholmondeley Sound, NW side of Dora Bay and east side of island, on rocks above VABM "Seal"						6/68 8/71
	981,542.40	8	55° 13.59'	132° 14.25'	+9.4	+9.1	2
ST12	Port Johnson, Dolomi Bay's NW corner, about 55 yds. SE of old boat house, on small grassy point and above USC&GS TBM No. 1 on rock						6/68 8/71
	981,539.05	10	55° 07.90'	132° 03.13'	+14.2	+13.9	2+
ST17	Moira Sound, Menefee Inlet, second point to NE from southernmost corner, on highest ledge and above USC&GS TBM No. 2						6/68 8/71
	981,536.82	9	55° 01.58'	132° 00.59'	+20.9	+20.6	2
ST29	Moira Sound, West Arm, on SE point of small island which is on N side of entrance to narrow part of arm, on rocks & above USGS marker						6/68 8/71
	981,531.00	13	54° 59.80'	132° 13.66'	+17.8	+17.4	3
SU59	Moira Sound, point on south side of Kegan cove, on top of large rock outcrop and above USGS marker						6/68 8/71
	981,531.25	13	55° 00.98'	132° 09.50'	+16.51	+16.1	3+
ST34	Ingraham Bay, on island 0.1 mile NW of small point on S side of entrance, at SW corner of island, on ledge above USC&GS TBM No.3						8/68 8/71
	981,537.20	9	54° 58.65'	131° 59.79'	+25.4	+25.1	5+
ST82	Hidden Bay, south shore, on E side of cove which is E of bend in Bay, on offshore ledge and above USC&GS TBM No. 1						7/68 8/71
	981,537.45	8	54° 56.45'	131° 59.85'	+28.7	+28.4	2+
ST89	Gardner Bay, on south-shore point which forms innermost anchorage, on rocks on south side of cement block which holds USC&GS TBM No.4						7/68 8/71
	981,530.57	11	54° 49.70'	132° 59.41'	+31.5	+31.2	2+
SP 6	Minnie Bay, on small beach in NE corner of Bay, at highwater line and on black rock above USC&GS TBM No. 5						7/68 8/71
	981,521.75	7	54° 43.54'	132° 18.10'	+31.2	+31.0	4+

TABLE 9
SECONDARY

ALASKAN GRAVITY BASE STATIONS

CORDOVA BAY

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
HYDB	Hydaburg, on N side of piles supporting oil-storage tanks, on grey rock outcrop and above USC&GS TBM No. 1						8/68 12/69
	981,554.05	11	55° 12.05'	132° 49.31'	+23.4	+23.1	5+
HYDA	Hydaburg about 60 yds. S of the oil tanks and cannery dock, on rocky point, on large flat boulder, and above USC&GS TBM No. 3						7/68 8/71
	871,554.32	8	55° 12.01'	132° 49.30'	+23.5	+23.2	5+
SN60	Natzuhini Bay, 0.9 mile E of North Pass entrance, on E point of small island, on rock 50 ft. from trees & above USC&GS TBM No. 1.						7/68 8/71
	981,550.68	8	55° 14.00'	132° 52.00'	+17.1	+16.8	3
SM52	Hetta Inlet, on S shore of Mud Bay and S of small wooded islet, on rocks and above USC&GS TBM No. 3						7/68 8/71
	871,534.95	6	55° 04.90'	132° 37.91'	+14.0	+13.8	2
SM79	Nutkwa Inlet, on SE corner of Keete Island, on crest of south-trending finger reef, and above USC&GS TBM No. 3						7/68 8/71
	981,537.15	8	55° 02.85'	132° 34.62'	+13.9	+13.6	2
SM50	Mabel Island, E shore about 110 yds. S of northeast corner of island, on steep ledge beneath trees and above USC&GS TBM No. 1						7/68 8/71
	981,530.55	10	55° 00.00'	132° 35.50'	+16.9	+16.6	3
SM46	Long Island, Dova Bay, E shore of inner bay, about 0.2 mile S of channel, below a reseeded fallen tree, on rocks above USGS marker.						8/68 8/71
	981,526.40	6	54° 54.95'	132° 43.90'	+19.5	+19.3	6
SP25	Kassa Inlet, center one of 3 islands on S side of entrance, center of its E shore, on rock outcrop beneath trees & above USC&GS TBM No.1						7/68 8/71
	981,539.93	7	54° 55.65'	132° 31.41'	+31.2	+31.9	3
SQ67	Hunter Bay, on N shore and midway between N arm and cannery ruins, on rock outcrop near trees and above USC&GS TBM No. 2						7/68 8/71
	981,527.87	6	54° 52.35'	132° 19.29'	+24.7	+24.5	4+
SP7	Tah Bay, on S shore of S entrance and 0.35 mile SE of Anchor Is., where shore bends to SE, on rock outcrop above USC&GS TBM No. 4						8/68 8/71
	981,522.50	7	54° 49.68'	132° 19.99'	+23.1	+22.9	3+
SQ47	Hessa Inlet, NE corner of inlet, on point E of island, at end of white beach, on light-colored rock above USGS marker						7/68 8/71
	981,527.59	10	54° 49.19'	132° 14.47'	+29.3	+28.9	2

TABLE 10
SECONDARY
ALASKAN GRAVITY BASE STATIONS

CAPE MUZON TO CRAIG

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
SP36	Cape Muzon, near Kalgan site, on SW corner of sandbar W of small islands, on large gray boulder above USGS marker						7/68 8/71
	981,516.80	15	54° 40.50'	132° 40.30'	+30.3	+30.8	3+
SP48	Gooseneck Harbor's SE cove, on wooded islet SE of longest island, on rocks at NE end of islet, and above USC&GS TBM No. 2.						7/68 8/71
	981,531.05	8	54° 53.32'	133° 00.24'	+26.6	+26.4	3
SP50	Forrester Island, Eagle Harbor, 110 yds. N of landing, on narrow shelf of small cliff and above USC&GS TBM No. 1						7/68 8/71
	981,541.60	15	54° 49.68'	133° 31.60'	+43.1	+42.6	2
SP51	Waterfall Bay, in cove on N side of island, on summit of rock ledge W of waterfall, near trees and above USGS marker						8/68 8/71
	981,535.07	12	54° 57.09'	133° 06.61'	+25.7	+25.3	3+
SN7	Sea Otter Harbor, Hook arm, on western of two points on S shore of Channel Island, on outcrop at tip of point & above USGS marker						7/68 8/71
	981,541.95	7	55° 07.57'	133° 09.94'	+17.9	+17.5	2
SP55	Bob's Bay, 1.2 miles E of Diver Point about 120 yds. SE of prominent point where shoreline curves to SE, on ledge at USC&GS TBM No. 3						7/68 8/71
	981,558.96	9	55° 11.35'	133° 12.55'	+29.1	+28.9	2
SP63	Ulloa Channel at Waterfall Cannery, S of main building & W of walk serving cabins, on 5-foot boulder & above USC&GS TBM No. 2						7/68 8/71
	981,570.25	9	55° 17.74'	133° 14.44'	+31.1	+31.4	6+
SN24	Port Santa Cruz, on SE shore of N arm and ½ mile from head of bay on small point forming cove, on steep ledge & above USC&GS TBM No. 1						6/69 8/71
	981,569.10	6	55° 16.89'	133° 24.60'	+31.2	+31.0	2
QA16	Port Asuncion, SW end of port, between offshore islets and on crest of ledge islets, on rocks above USGS marker						6/69 9/71
	981,575.25	7	55° 22.34'	133° 33.25'	+29.9	+29.6	2+
QZ13	Noyes Island, SW corner of Kelly Cove, on beach below 2 shacks, on large stone and above USGS marker						6/69 9/71
	981,584.85	6	55° 27.57'	133° 38.45'	+31.9	+31.7	2+
SN39	Port Real Marine, SE corner of Pine Island, on large flat ledge and above USGS marker						6/69 8/71
	981,581.84	9	55° 26.20'	133° 27.18'	+31.1	+30.8	2+
CRGB	Craig, on beach E of cannery, 10' seaward of boardwalk and 50'W of walk to oil dock, on low boulder above USC&GS TBM No. 8						6/69 12/70
	981,567.62	5	55° 28.65'	133° 09.04'	+13.1	+12.9	5+

TABLE 11
SECONDARY
ALASKAN GRAVITY BASE STATIONS

CRAIG TO POINT BAKER

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
SP98	Klawak Inlet, on narrow islet off N end of Peratovich Island, on E end and deep-channel side of island, above USC&GS TBM mark "CHAN"						6/69 9/71
	981,572.53	4	55° 35.80'	133° 06.70'	+7.9	+7.8	5+
QZ 1	Lulu Island, Point Santa Gertrudis, on E side of northernmost cove, on flat rock ledge above USGS marker						6/69 10/71
	981,584.83	10	55° 31.78'	133° 31.13'	+26.3	+26.0	2+
QZ15	Noyes Is., Steamboat Bay cannery, on highest ~ ck on beach S of wharf, about 45 yds, from southernmost cabin, on USC&GS TBM No. 1						6/69 9/71
	981,590.15	7	55° 31.99'	133° 38.18'	+31.0	+30.8	2+
QA08	Gulf of Esquibel, Anguilla Island, 0.5 mile W of Garita rock, on N side of bight in W shore of bay, on rocks above USC&GS TBM No. 1						6/69 9/71
	981,600.08	6	55° 40.97'	133° 35.19'	+28.4	+28.2	2+
QZ62	Junction of Karheen and Tuxekan Passages, 1 mi. SW of Kauda Pt. on northern of two rock islets, on USC&GS TBM mark "MARS No. 1"						6/69 9/71
	981,602.63	6	55° 46.19'	133° 17.03'	+26.6	+26.4	2
QZ60	Tuxekan Pass, 0.9 mile SE of Staney Is., on E point of wooded island, on rocks above USC&GS TBM No. 1						6/69
	981,606.45	6	55° 48.17'	133° 10.61'	+24.7	+24.4	2
QZ82	Tuxekan Pass and S end of El Capitan Pass, on small wooded island 165 yds. W of larger wooded island, on SE shore above USC&GS TBM No. 1						9/69 9/71
	981,612.90	7	55° 55.40'	133° 17.18'	+21.0	+20.8	2
QZ65	Orr Island, in Cyrus Cove, on SE shore of N arm, on second beach NW from E arm, on large rock below trees, on USGS marker						9/69 9/71
	981,616.21	7	55° 55.21'	133° 24.63'	+24.5	+22.3	5+
QZ85	El Capitan Island at New Tokeen, 10 ft. SW of NW corner of boardwalk between store and fuel pier, on boulder & USC&GS TBM No. 2						9/69 9/71
	981,614.15	8	55° 56.19'	133° 19.49'	+21.3	+21.0	2+
QZ90	Coronation Island, W shore of Aats Bay, on rocks off NE end of southernmost cove, on top of ledge above USGS marker						6/69 9/71
	981,648.15	10	55° 53.43'	134° 15.37'	+59.3	+59.0	2+
QM08	Sumner Strait, Pole Anchorage, near middle of W shore on prominent ledge point, on crest of rock above USC&GS TBM No. 1 (1937)						9/69 9/71
	981,626.07	11	55° 57.36'	133° 48.60'	+31.8	+31.4	3
QP90	Shakan Bay, S side of entrance and 0.8 mile SE of Station Island Light, on offshore islet, on outcrop near grass & on USC&GS TBM No. 1						9/69 9/71
	981,626.44	11	56° 08/50'	133° 36.70'	+16.8	+16.4	3
SHKN	Shakan Strait at El Capitan Passage, on rocky point 55 yds. NE of islet and station "Dead", on USC&GS TBM No. 1						9/69 9/71
	981,617.71	8	56° 08.90'	133° 27.60'	+7.0	+6.8	3+
QY83	Hole-in-the-Wall entrance, on NW shore, 250 yds. NE of entrance, on shelf in steep rock wall and above USC&GS TBM No. 3						9/69 9/71
	981,631.85	8	56° 20.82'	133° 38.34'	+4.5	+4.3	3

TABLE 12
SECONDARY
ALASKAN GRAVITY BASE STATIONS

KUIU & KUPREANOF ISLANDS, AND FREDERICK SOUND

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
QB29	Keku Strait at Monte Carlo Island, 0.15 mile S of NE corner and 20 yds. SE of gravel beach on rocky ledge & above USC&GS TBM No. 7						6/69 10/71
	981,658.55	7	56° 31.97'	133° 46.01'			
QX 1	Reid Bay, on NE corner of northern end of island in entrance, on offshore rock at end of shoal and above USC&GS TBM No. 1						6/69 9/71
	981,640.85	9	56° 23.31'	133° 52.89'			1+
QY99	Reid Bay, on E side of southern cove ¼ mile S. of station "POM", on small islet and above USGS marker						6/69 9/71
	981,638.85	9	56° 21.60'	133° 52.00			2+
QN82	Affleck Canal, Kell Bay, 1 mile from SE entrance point and off NW corner of island and S side of islet with 2 trees on USC&GS TBM No 1						9/69 10/71
	981,650.90	7	56° 08.94'	134° 08.05'	+40.2	+39.9	4
QN99	Port Malmesbury, 2½ miles from Pt. Harris, and ¼ mile SW of entrance to best anchorage, on low & overhanging ledge above USC&GS TBM No.1						9/69 10/71
	981,656.65	7	56° 18.39'	130° 14.25'	+32.7	+32.4	4
QM43	Tebenkof Bay, Mary-Francis (Orel) Anchorage, at NW corner of long island, on E side on steep ledge & above unmarked USC&GS TBM No.1?						9/69 10/71
	981,652.70	10	56° 25.04'	134° 07.89'	+19.9	+19.5	4
QX41	Washington Bay, W of old cannery and tank, 6 ft. SE of SE building piling, near water, on rock surface above USGS marker						9/69 9/71
	981,689.88	6	56° 43.53'	134° 21.47'	+30.9	+30.7	5
KAKE	Keku Strait, 1½ miles S of Kake, at crab cannery (not fish cannery), on rock on N side of cannery and above USGS marker						9/69 10/71
	981,699.20	10	56° 57.53'	133° 54.51'	+21.3	+21.0	3+
QW96	Cleveland Passage, SE shore, 215 yds. S of ruins of Cape Fanshaw cannery dock, on conical boulder with remains of USC&GS TBM No. 1						7/69 11/71
	981,703.10	6	57° 12.52	133° 30.23'	+4.2	44.0	3
QV37	Farragut Bay, S arm, NW tip of point on S side of Francis Anchorage, at grass line, on boulder above USGS marker						7/69 11/71
	981,689.45	6	57° 08.74'	133° 10.33'	-4.2	-4.4	2
QV11	Thomas Bay, Scenery cove, on N shore point which forms bend of cove, on rock above USGS marker(?)						7/69 9/71
	981,645.45	10	57° 04.60'	132° 48.60'	-42.2	-42.5	3
QW50	Thomas Bay, shoreline E of Spray Island and about ¼ mile S of Cascade Creek falls, on 5-foot boulder above USC&GS TBM No. 2						7/69 11/71
	981,639.80	10	57° 00.00'	132° 46.86'	-41.5	-41.8	2
SX35	Frederick Sound, McDonald Islands, on S point of smaller western island, on mossy rocks SW of largest tree and above USGS marker						7/69 8/71
	981,640.62	16	56° 50.71'	132° 49.61'	-27.3	-27.8	16
SC96	Frederick Sound, Coney Island, on N side and on rounded rock above USGS marker						6/69 1/72
	981,634.75	12	56° 41.66'	132° 38.57'	-21.1	-21.5	

TABLE 13
SECONDARY
ALASKAN GRAVITY BASE STATIONS

STEPHENS PASSAGE-PORT HOUGHTON TO TAKU INLET

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
QW51	Port Houghton, S shore and E end, about ¼ mile W of tidal flat, on large rounded outcrop above USGS marker						7/69 11/71
	981,675.75	11	57° 19.91'	133° 07.16'	-32.7	-33.1	4
QV60	Port Houghton, SW side of entrance, on westernmost island and Point Walpole on VABM "WAL"						7/69 11/71
	981,707.42	19	57° 18.32'	133° 31.15'	+1.8	+1.2	2
QP79	Gambier Bay, on shore W of cannery ruins, 12 feet E of NE corner of water-tank, cribbing near trees and above USC&GS TBM No. 5						9/69 10/71
	981,723.05	11	57° 29.01'	133° 57.65'	+2.1	+1.7	4
QP30	Seymour Canal, SW side of entrance, on north end of point which forms narrow N-S cove, on ledge at E side above USGS marker						9/69 10/71
	981,722.06	8	57° 32.87'	133° 56.06'	-4.2	-4.5	3
QP50	Seymour Canal, on Windfall Is., 0.3 mile SW of north end, in bight on large, reddish boulder and above USGS marker						9/69 10/71
	981,734.52	13	57° 53.56'	134° 16.02'	-19.7	-20.2	4
QQ85	Glass Peninsula, 1½ miles NE of S end, on rocky point above VABM "HUGH"						9/69 10/71
	981,725.92	12	57° 35.09'	133° 48.03'	-3.2	-3.6	4
SUMD	Endicott Arm, Sumdum Anchorage, at SE door of abandoned shack and on ground below USGS marker						9/69 11/71
	981,702.20	17	57° 40.38'	133° 28.48'	-33.7	-34.3	64
QQ44	Tracy Arm entrance, N of Harbor Island, on shore NW of offshore rocks, on rock outcrop near SW end of beach & on USGS marker						9/69 10/71
	981,719.05	14	57° 47.39'	133° 38.20'	-26.7	-27.2	3
QR77	Glass Peninsula, SW of Midway Island on Pt. Glass, on rounded rocks about 1 foot S of VABM "Glass" and on USGS marker						9/69 11/71
	981,734.73	11	57° 48.44'	133° 53.93'	-12.7	-13.1	3
QQ20	Port Snettisham, S shore of Gilbert Bay, on rocky point W of tidal flat; on prominent, white, quartz outcrop and on USGS marker						9/69 9/71
	981,731.60	14	57° 56.77'	133° 42.71'	-26.9	-27.4	4
QS 1	Stephens Passage, opposite S end of Gastineau Channel, on False Arden Pt., on rocks NW of small bight and above USGS marker						8/69 10/71
	981,754.82	18	58° 10.02'	134° 12.21'	-21.2	-21.8	3
QS99	Taku Inlet, S shore of entrance, ½ mile E of Greely Pt., on beach W of stream on outcrop at base of small cliff & on USGS marker						9/69 10/71
	981,738.87	12	58° 13.42'	134° 03.45'	-42.3	-42.7	2
TAKU	Taku Lodge, at NE end of building, on concrete foundation of air window to basement, and above USGS marker						9/69 10/70
	981,708.21	38	58° 29.51'	133° 56.35'	-92.2	-93.5	2

TABLE 14

SECONDARY

ALASKAN GRAVITY BASE STATIONS

NORTH CHATHAM STRAIT, LYNN CANAL & VICINITY

STAT.	LOCATION DESCRIPTION						DATES OF LAST OCCUP. & ADJ.
	OBS. GRAV.	ELEV.	LATITUDE	LONGITUDE	F.A.A.	B.A-2.67	TIES
QM44	Admiralty Island, Chaik Bay's N corner, on N side of Village Point and S end of crescent-shaped beach, on rock outcrop & USGS marker						9/69 10/71
	981,715.35	12	57° 20.50'	134° 34.33'	+6.1	+5.7	2
QM62	Killisnoo Island, E end, 20 ft. SW of point E of cannery ruins, on outcrop 8 ft. S of trees & above USC&GS TBM No. 4						9/69 10/71
	981,733.15	12	57° 28.10'	134° 33.85'	+13.5	+13.1	4
QM76	Angoon Harbor. seaplane dock near Dranell home, at S end of dock, on concrete slab and above USGS marker						9/69 10/71
	981,732.80	10	57° 29.83'	134° 34.25'	+10.6	+10.3	2+
QM77	Chichagof Island, Freshwater Bay, Pavlof Harbor, point E of stream mouth, on SW rock outcrop and above USGS marker						9/69 10/71
	981,767.65	8	57° 50.52'	135° 01.84'	+17.1	+16.1	4
QT87	Point Retreat, on SW side of and below lighthouse dock, on top of unused concrete pile (2nd from cliff) and on USGS marker						9/69 10/71
	981,783.56	10	58° 24.67'	134° 57.16'	-13.0	-13.3	3
QS40	Berner's Bay, on point W of Echo Cove, at NW corner of barn, on ground below USGS marker (stamped "SLEM")						8/69 10/71
	981,790.15	22	58° 40.78'	134° 56.09'	-26.9	-27.7	2
QR 7	William Henry Bay, E shore and 0.35 mile S of entrance point, at tree line S of old dock piling & on outcrop above USC&GS TBM No.2						8/69 9/71
	981,782.75	12	58° 42.79'	135° 13.89'	-37.9	-38.4	4
QR11	Lynn Canal, W shore 2 miles N of Endicott River, on sloping rock point and above triangulation station "CAMP"						9/69 10/71
	981,783.20	27	58° 48.81'	135° 16.20'	-44.4	-45.2	2
SH69	Haines Highway, at junction of Moose Valley Road in NE corner of intersection, on gravel at edge of roadbeds (unmarked)						8/69 10/71
	981,786.60	262	59° 25.40'	136° 00.70'	-67.3	-76.2	2
HBDR	Haines highway, at Yukon Territory boundary, on ground below bronze						9/68 9/70
	981,745.11	812	59° 27.03'	136° 21.68'	-59.1	-86.8	2
BNLB	White Pass & Yukon Railway, at Bennet Lake station, NE of main terminal building, on ground at SW corner of small building						8/69 9/71
	981,655.99	2155	59° 50.80'	134° 59.70'	-53.2	-126.6	2

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Index of Base Station Localities

Note: Most references are to bases described in the tables which are referenced by TABLE NUMBERS. Stations mentioned only in the text are referenced by page numbers which are indicated by the letter 'p.'. The index includes a few names of larger waterbodies and islands which may be omitted from the station descriptions and text, but which should help the user find stations in a generalized area which interests him.

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