Chapter Three

CIVIL WORKS IN ALASKA, 1946-75

Throughout World War II, the Seattle District retained jurisdiction over what remained of a civil works program in wartime. This arrangement continued after the war as the civil works mission remained in Seattle's hands when the new Alaska Engineer District was created in 1946. This situation endured until 1949 when the Alaska District assumed responsibility for civil works, an arrangement that has persisted to the present.

The civil works mission of the Corps in Alaska during the three decades following the end of the second World War has had a number of important dimensions. Over the first 20 years or so of this period, civil work consisted largely of the resumption, continuation, and completion of navigation and flood control efforts first set on foot by the Juneau and Seattle Districts before the war. At the same time, however, the Engineers' mission in this area was undergoing a slow expansion into relatively new areas, a process which began with the Flood Control Act of 1948. Up to that time, the Juneau and Seattle Districts had more or less responded to civil problems as they were made known by local interests in one form or another. The 1948 statute directed the Corps of Engineers to undertake a comprehensive survey of Alaska's water resources. The Engineers were to "survey rivers and harbors in Alaska, with a view to determining the advisability of improvements in the interests of navigation, flood control, hydroelectric power, and related water uses." The comprehensive studies produced in response to this charge have provided the foundation on which the Alaska District has moved beyond early navigation and flood control projects to the wider realm of water resources management including riverbank protection, beach erosion work, flood plain studies, and the development of multipurpose projects involving the generation of hydroelectric power.[1]

The following narrative concentrates on those civil works projects brought to completion by the end of 1974. In addition it treats the extraordinary efforts undertaken by the District in response to the two great Alaskan natural disasters of the sixties--the Good Friday Earthquake of 1964, and the Fairbanks flood of 1967. Finally, it is concerned with a project of immense magnitude and considerable controversy, a project which in the end did not make it off the drawing board--the proposal for the construc-

tion of a hydroelectric dam in Rampart Canyon.

NAVIGATION IMPROVEMENTS

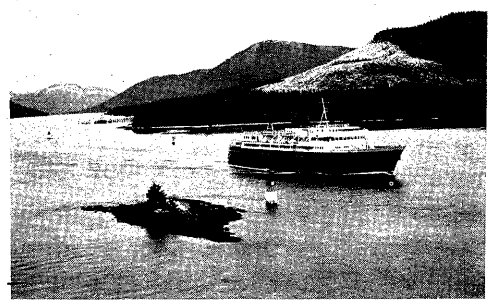
SOUTHEASTERN ALASKA. *Ketchikan* began as a fish cannery site in Southeastern Alaska in 1887. It later became a supply center during the gold rush period in the later 1890's and has long been regarded as a port of entry, the first city reached in Alaska enroute from Seattle. Ketchikan is located on the mountainous island called Revillagigedo; it sits along Tongass Narrows, a deep 12-mile-long waterway which is part of the scenic Inside Passage.

In 1927, the Juneau District Engineer submitted a survey report in which he indicated that he had examined the possibility of harbor development at several sites near the city.[2] He concluded that the best site was at the mouth of Ketchikan Creek, where a small boat harbor could be built for about $272,000. The project was justified on the grounds that the lack of safe moorage for the fishing boats in the area resulted in extensive damage during the severe storms which occasionally visited the area. Insufficient cargo handling facilities caused many fishermen to take their catches elsewhere, chiefly Prince George, B.C.

In 1930, Congress authorized a project involving the dredging of an 11 acre small boat basin. Three years later, under the direction of the Seattle District, the basin was completed at a cost of $225,000.[3]

Following the war, investigations and public hearings held by the Seattle District in 1946 and the Alaska District in 1951 established that boat traffic had grown to such an extent that it exceeded the capacity of the original basin. In 1954, Congress authorized another basin to be built at Bar Point, a few miles northwest of the first harbor. This project called for dredging a basin of 780,000 square feet and the construction of two rock breakwaters topped by concrete walls. The Alaska District directed the completion of this second basin between November 1957 and November 1958 for a total cost of $1,380,472. When finished it provided safe accommodation for an additional 520 boats.[4]

Wrangell Narrows is a slender 21-mile passage on the regular route of vessels running to southeastern Alaska from ports on the Pacific Coast of the U.S. and Canada. It will be recalled that the survey of Wrangell Narrows carried out in 1902-03 was the first to be undertaken by the Corps in the territory. That report revealed that, over the entire route between Seattle and Skagway, only in the Narrows were depths deficient for the safe passage of large vessels.[5] Despite



the merits of facilitating navigation in the Narrows, high cost estimates forced the improvement program to be laid aside for over twenty years.

Finally, in March 1925, Congress authorized clearance work in the Passage with the proviso that no more than $500,000 could be spent without further specific authorization. [6] This restriction prevented removing all the offending shoals in the channel. Preliminary work began in March 1926; the seagoing dredge *W. T. Russell* starting dredging in May of that year, and the project was brought to completion in 1928. No sooner had the project been completed than there appeared an immediate need for redredging. In 1933-34, the Seattle District supervised the blasting and removal of thousands of yards of rock. In 1939, the Chief of Engineers recommended modification of the project to provide a channel 300 feet wide and 24 feet deep, the straightening of the channel alignment, and the dredging of an anchorage basin adjacent to the channel near Anchor Point. But Congress authorized no more than maintenance dredging and the intervention of World War II prevented implementation of the project. [7]

After the war (in 1946) the Seattle District made a condition survey. It completed plans and specifications for the project in 1947 and issued contracts that same year. The work was delayed at the outset owing to the destruction of the contractor's dredge by fire. But by June 1951, the 300 foot wide channel was completed with the improved alignment. No further work was done in the 1950's owing to the higher priorities of the defense construction program. The Alaska District completed field surveys and subsurface investigations in February 1962, that led to the award of a new contract for the dredging of the Anchor Point basin. This work was finally completed in May 1963. [8] Altogether, over the years, the Federal Government has spent $3.5 million dollars (including $137,000 spent in the thirties under the National Industrial Recovery Act) in improving and maintaining the channel in Wrangell Narrows. [9]

The town of *Wrangell* began as a stockade built by the Russians occupying Wrangell Island in 1834. Soon after the United States purchased Alaska in 1867, an Army post was established there. The town is located about 30 miles south of Petersburg, about midway between Ketchikan and Juneau.

Local residents approached the Engineers for help in the 1920's. Their principal problem was the "Stikine wind," a strong cold northern wind that descends from the valley of the nearby Stikine River. When the wind was at its fiercest, boats were driven ashore or into each other or both. This made Wrangell unattractive for winter harboring and many boatsmen went elsewhere when the fishing season ended. An original survey of the harbor conditions was made in 1920. A year later, the Juneau District submitted another report noting that the harbor was visited annually by about 250 boats and served as the main distribution point for the region. It was a port

of call for most steamers plying the Inside Passage and the base of operations for shallow-draft vessels serving the communities up the nearby Stikine River going into Canada. [10]

The District urged the construction of a breakwater reaching out in an easterly direction from the north tip of Point Shakesti to give a sheltered anchorage for boats in the southern portion of Wrangell Harbor. It was estimated this could be accomplished for about $50,000. Congress authorized the project in 1922 and it was completed in 1926. [11]

The Juneau District took a second look at Wrangell in 1930. An investigation and public hearing revealed the need for dredging the anchorage area to expand it from 5 to 15 acres so as to accommodate the local and visiting fishing boats. Taking the expanded use into account, the District Engineer recommended dredging a basin 400 by 600 feet in size for a further cost of $56,000. Congress approved this project and by September 1936, the city had its enlarged mooring basin south of the original breakwater. [12]

At a public hearing in Wrangell in 1938, local interests requested further improvement to serve the growing community. Residents asked that another small boat harbor be dredged, proposing the establishment of an eight-acre basin in the tideflat area between Shakes Island and the Wrangell waterfront, with a connecting channel between the future basin and the existing one. A rock mound breakwater along the reef north of the island was to protect the new harbor from northerly weather.

After reviewing these proposals, the Seattle District found the cost to be too high in view of the economic benefits and proposed a limited plan with a much smaller basin. The District Engineer also recommended that local interests be required to participate in improvements by installing more floats and moorings. [13] The Board of Engineers approved this plan in 1939 but as in the case of the Narrows, the war and the requirements of the post-war military construction program delayed the project throughout the forties and early fifties. Seventeen years after the Board's approval, dredging began on a new harbor in 1956. A year later, in March 1957, Wrangell possessed a new harbor (without the breakwater north of Shakes Island) at a cost of $544,000. [14]

The fishing town of *Petersburg* lies on Mitkof Island at the north entrance of Wrangell Narrows, and is about midway between Ketchikan and Juneau. The settlement began as a salmon cannery and sawmill in 1897. In 1931, the Juneau District Engineer surveyed the harbor. In his report he noted that all U.S. commercial vessels in the Alaska trade made Petersburg a regular port of call. The larger vessels, however, had to discharge and accept cargo by lighter because of shallow depths off the several docks. Small bergs of glacier ice often were carried into the area with flooding tides, but not to the extent of becoming a serious hazard.

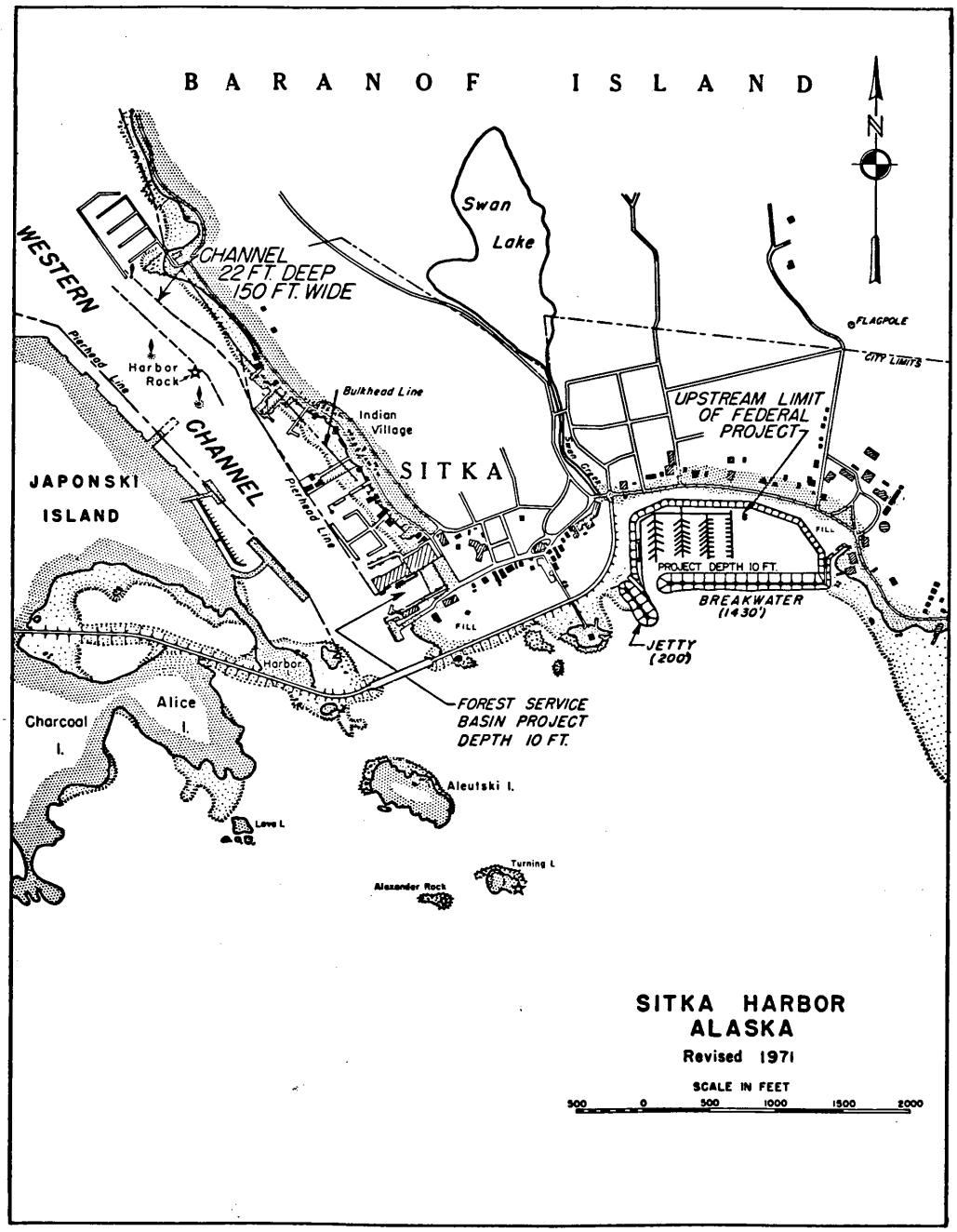
The Juneau District Engineer recommended dredging a small boat basin and a channel out from the docks. The Chief of Engineers forwarded the study to the Secretary of War in October 1932 with the suggestion that local interests should pay $8,000 toward the estimated cost of $102,000.[15] Congress authorized the project in 1935 and by January 1937 it was completed. Unfortunately, the basin could accommodate only 75 boats and the resultant overcrowding generated a fire hazard. The Seattle District reexamined the area in 1939 and recommended a modification of the project to enlarge the basin. But Congress authorized no action on this proposal until 1945. Both the Seattle and Alaska Districts examined the project further and it was not until 1956 that work actually began. When the work was finished a year later, the new harbor provided moorage for 300 boats engaged in shrimp and salmon fishing.[16]

Sitka is located on the west coast of Baranov Island at a site established by Alexander Baranov in 1804. After the purchase of Alaska in 1867, the town served as the center of American administration in the Territory until Juneau was established as the capital in 1900. The Juneau District made the first survey of the harbor at Sitka in 1928 and 1929. The District Engineer recommended that the harbor be improved by widening to 150 feet, straightening the channel fronting on the port, and removing Indian Rock, an obstruction to small boats. Without the channel improvement, steamships had to anchor in the eastern channel and transfer passengers to shore by small boat or lighter, a hazardous proposition except in fair weather.[17]

In 1937, the Seattle District produced a report illustrating the need for a small boat basin for the protection of the growing fishing fleet. Two possible sites appeared to be feasible--Crescent Bay, on Baranof Island, and Japonski Island Lagoon. The District Engineer favored the second site which he felt could be improved by dredging and the construction of five short breakwaters. These would connect several small islands south of Japonski Island and provide a protective rim around the dredged area. The District Engineer believed that this project would cost about $160,000, about half of the expected cost of dredging and building two breakwaters in the shallow cove of Crescent Bay.[18]

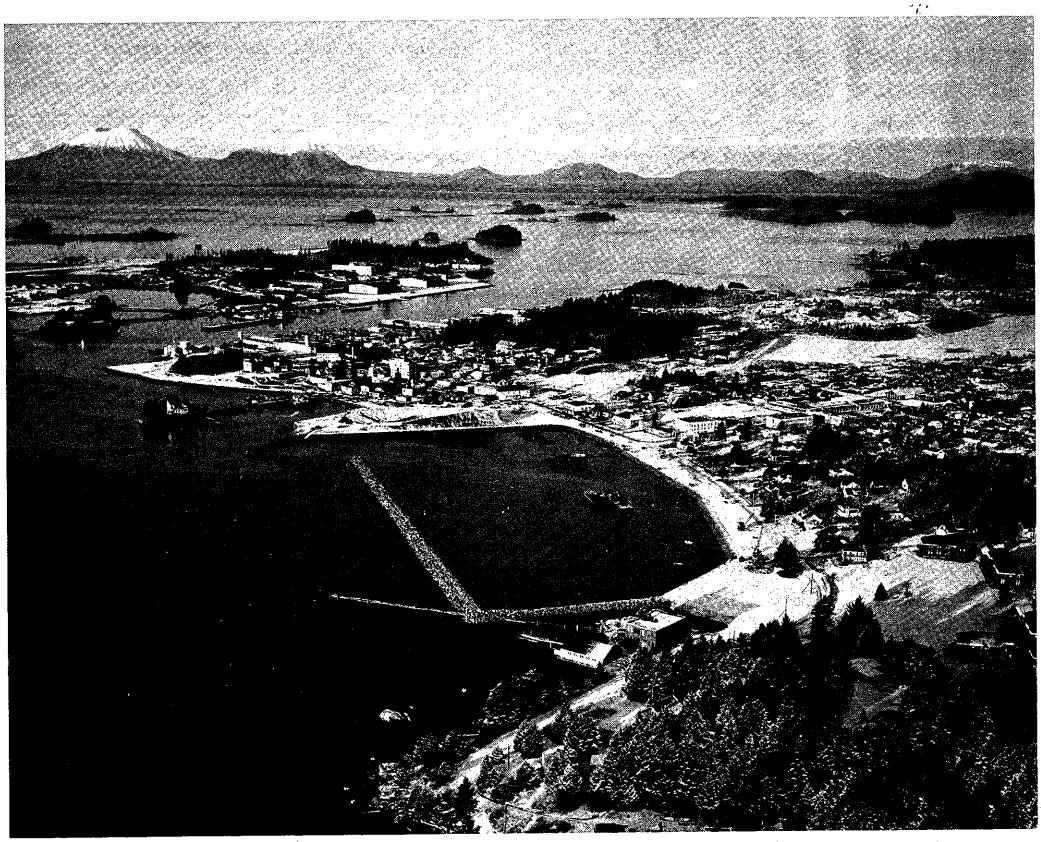
The proposal for widening the channel and removing the obstructions in the channel were approved and completed in 1937. That summer, Congress also approved the basin in Japonski Island Lagoon. In 1938, the Navy announced plans to develop a seaplane base in the area requiring realignment of the breakwaters to extend four short sections southeastward from Japonski to Harbor and Aleutski Islands. The object of this modification, approved by Congress in 1940, was to provide a "protected reach" for naval plane operation.

During World War II, Japonski Island became an exclusively military in-



Crescent Harbor is at right, with Sheldon Jackson College campus northeast of the harbor. Swan Lake (center) was the source of ice blocks cut by the Russians before 1867 for shipment to their California colony, Fort Ross.

stallation. All non-military operations were forbidden on that side of the channel. These conditions prompted the mayor of Sitka to consider switching the project from Japonski Island to Jamestown Bay. No firm decision on this proposal emerged from a public hearing held in February 1942, but in March of that year the Seattle District received a petition from a local group requesting that the Engineers return to consideration of the Crescent Bay site. In June 1943, the Seattle District decided to concentrate on construction of a basin at that site to be protected by two breakwaters. The District estimated that the entire project would cost about $335,000.[19] Congress authorized the project in 1945 but did not appropriate funds for the preparation of plans and specifications until 1956. Opposition to the Crescent Bay site grew up in the late fifties and led to a reconsideration in the period between 1958 and 1960. This review, including public hearings, involved a new look at Jamestown Bay and examination of conditions near Griffith Island northwest of the city.



Sitka, formerly New Archangel when it was the capital of Russian America. In 1965 Crescent Harbor (center) was under construction. At upper left is Mount Edgecumbe, a "dead" volcano.

Resistance to the Crescent Bay project was headed by the Board of National Missions of the United Presbyterian Church on behalf of Sheldon Jackson Junior College. The principal objections related to the change in appearance and use of the waterfront which would follow on its improvement for navigational use. Finally, the project went ahead following a referendum and the formal withdrawal of opposition from Sheldon Jackson. In June 1964, the Alaska District awarded a contract for the new basin, and breakwaters. When these tasks were completed in December 1965, Sitka possessed a 15-acre small boat basin protected by breakwaters which could accommodate 500 boats. An attractive park was developed along the harbor using as a foundation the earth deposited there during the dredging. Including work done on the nearby Forest Service basin, the Corps has spent over $1.6 million on improvements for navigation in the Sitka area. [20]

The city of *Juneau* began in 1880 as a mining community. In 1900, it became the center of federal government activity in the territory. When the Engineers examined the harbor needs of the area in the early thirties, Juneau had a population of about 5,000 and served as the supply and transfer point for about a dozen mining and canning settlements in the vicinity. The Seattle District found that the strong winds rushing down Gastineau Channel often endangered small boats and made navigation difficult for steamers nudging their way between the little vessels in their approach to the wharves. The District Engineer recommended the construction of an 11 ½ acre boat and float plane basin protected by two rock mound breakwaters. [21]

At the same time local interests in Douglas, the small community just across Gastineau Channel, also indicated a desire for a new harbor. As the Alaska Road Commission had recently completed the construction of a bridge across the Channel (1935) the Seattle District Engineer believed that one harbor could serve both communities.

Congress authorized the Juneau project in 1937 and the dredging and construction of the breakwaters was completed by December 1939. As the area grew in the forties and fifties, it became evident that additional safe moorage was needed. The Alaska District surveyed the condition of the harbor in June 1960, and recommended the construction of a second small boat basin. Hydrographic surveys and predesign investigations took place between November 1961 and February 1962. The Alaska District's design of the breakwater was novel in its extension of a wall of planking supported by steel piling placed on top of the rock mound. The plank wall, designed to resist 100 mph "Taku" winds, was intended to lessen the structural weight of a breakwater that had to be built on soft soils. Dredging for the basin was finished in March 1963, and the main breakwater was finished in February 1964. At that point the total costs of providing Juneau with the two small boat harbors came to $1,381,000. [22]

The proposal for a separate harbor for *Douglas* surfaced again in the mid fifties. In view of increased boat traffic the Alaska District reversed the position taken by the Corps in the thirties and recommended the construction of a small boat basin. Congress authorized a project in 1958 which involved the dredging of a five acre boat basin protected by a rock jetty on the north shore of Juneau Island just off the Douglas waterfront. The contractor completed the breakwater work in June 1962 and the basin was finished in the same year at a total cost of $282,000.[23]

Gastineau Channel is the waterway that lies between Juneau and Douglas, a channel that extends about eighteen miles from Stephens Passage to Auke Bay. The channel has been busy since gold mining started here in the early 1880's. It has historically provided direct access to important fishing grounds north of the two cities. In the mid-1970's, more than a thousand commercial fishing and recreational vessels are berthed in the Juneau-Douglas area.

The most difficult navigational problem in the channel has been shoaling. When the Juneau District examined the area in the early twenties it found a bar formed of sedimentary glacial deposits at the northwest sector of the channel. This bar required a 15-mile diversion trip around the south end of Douglas Island. Under difficult conditions this trip often proved to be quite dangerous. In 1928, the Juneau District recommended the dredging of a channel 75 feet wide through the bar. However, the Board of Engineers did not concur in the proposal. In 1939, the Juneau Chamber of Commerce requested that the channel be dredged and the spoil used to extend the local airfield. In 1941, the Seattle District repeated the original request for dredging and this second request received a more favorable response from the Board of Engineers. Unfortunately, the war intervened and the requirements of the national defense program forced the deferral of the project.[24]

The original cost estimate for dredging the channel was $120,000; by 1946 it had risen to $547,000. The estimate rose in succeeding years: $800,000 in 1948, $978,000 in 1953, and $1,150,000 in 1958. Hydrographic surveys and predesign investigations made in October 1958 resulted in lowering the estimate to about $610,000, and on the basis of that figure, the Alaska District awarded a contract in April 1959. After some initial delays (the contractor's barge sank) the job was finished by July 1960 for a total cost of about $760,000.[25]

After the completion of the project shoaling continued to be a difficulty and before long it closed the waterway. It is a problem for which no permanent solution that is economically feasible has yet been found.[26]

Skagway was founded in 1897 shortly after gold was discovered near Dawson in Canada where the Klondike River joins the Upper Yukon.

Gastineau Channel. Douglas is at lower left. Juneau is at center, right, and below it is the "tailing" pile from the major gold mine.

Skagway, called the "Gateway to the Golden Interior," was a base of operations for thousands of prospectors headed over White Pass bound for the Klondike. In 1899, Skagway was the largest community in Alaska with a population over 10,000 persons. Its major function for over half a century has been to serve as the ocean terminus of the narrow gauge White Pass and Yukon Route, the railway which struggles over the mountains to connect with Whitehorse in the interior.

The Seattle District examined and surveyed Skagway Harbor in 1936-37 with a view to improving navigation there. The survey revealed that the Skagway River brought down large quantities of debris, sand, and gravel to the harbor, building up the delta and causing shoals. The single usable wharf, belonging to the White Pass railway, was threatened by the shoaling. Furthermore, the streambed had built itself up in successive flood seasons to an elevation on the west side of the valley higher than that occupied by the city on the east side.[27]

The Seattle District recommended construction of a rock mound breakwater across the tide flats to divert the river away from the improved section of the harbor, and a rock and brush training dike some 6,700 feet in length along the river's left bank to keep it from overflowing into Skagway and across the shoreward end of the wharf. Local interests also requested the dredging of a small boat basin next to the breakwater, but the District Engineer did not find the expense justified by the benefits. The recommended dike and breakwater were completed in 1940 at a cost of $62,200.[28]

When the Seattle District Engineer reviewed conditions in the harbor in 1941, he found it silting up badly. Large commercial vessels were having difficulty maneuvering. In view of the harbor's growing strategic value to national defense, the District Engineer recommended that the original project be modified to permit dredging to be done at the face of the wharf. He also recommended the dredging of a small boat basin. Neither of these recommendations were acted upon.

The District Engineer examined the harbor again in 1944 and 1945. Recent flooding had damaged the dike and breakwater and their restoration and strengthening was needed to preserve the city and its harbor. He repeated the earlier request for the small boat basin and the dredging along the face of the wharf. In 1945, Congress authorized the wharf dredging and the small boat basin on the condition that local interests construct and maintain a 200 foot breakwater for the basin's protection. At the same time, the Chief of Engineers urged the adoption of extensive reconstruction and expansion of the original dike and breakwater in the interest of flood control, a task he estimated would cost about $438,000. Congress authorized this proposal in the Flood Control Act of 1946.[29]

No funds were appropriated either for the dike improvements or the small

boat basin and the only work done for the next 10 years was in the form of office studies, project drawings, and predesign investigations. In 1951, the Alaska District contributed to a combined civil-military effort that resulted in some improvements to the dikes, the widening of the channel and the raising of the bridge. Then in 1969 Congress finally appropriated the funds for the small boat basin and the wharf dredging, and these facilities were completed in the same year. But the cost estimates for the river diking and breakwater reconstruction continued to rise until 1963 when it was decided that the possible benefits of the project were outweighed by the costs. The Alaska District has continued to provide emergency flood control help and has continually monitored conditions in the harbor but the major flood control project proposed by the Chief of Engineers in 1945 has been placed on the inactive list.[30]

Skagway River enters Taiyà Inlet at the port city.

In addition to its navigation work in the larger settlements of southeastern Alaska, the Corps has historically been active in a number of smaller and less well-known places in the region. For example, it has worked to improve navigation in the *Stikine River*, and through Neva Strait, Rocky Pass, and Dry Pass. The Stikine River flows 230 miles from British Columbia across the Panhandle of Alaska out into Sum-

ner Strait just north of Wrangell. In the last quarter of the 19th century, prospectors gained access to the Cassiar Mining District via the Stikine River which is navigable for about 150 miles. When the Seattle District Engineer first surveyed the river in the 1930's, he found that it served as the only means to transport cargo and passengers to the inhabitants of the basin. The principal hindrance to safe navigation were snags, and he proposed periodic operations for the removal of those obstructions. Congress adopted this proposal in 1935 but appropriated no funds until 1937.[31] Work began that year and was continued annually until the war. Following the war river conditions were so favorable that no regular snagging was deemed necessary until 1957 when the periodic service was resumed on a regular basis.[32]

Neva Strait has historically been used by vessels running between Sitka and ports to the north. Its use was restricted to small boats for the most part. Larger vessels had to go 27 miles further, on a more exposed route around Kruzof Island, to call at the same ports. Over the years boat traffic increased and the Strait was increasingly used as a passage through which to tow log rafts. In 1949, the Seattle District produced a comprehensive study of navigation problems in southeastern Alaska in which it identified Neva Strait as a bottleneck that ought to be improved, particularly in *Whitestone Narrows*.[33] The District Engineer recommended removal of rocks and shoals in order to provide a 200-foot channel in the Strait. Congress approved the project in 1954 and a District contractor began and completed the work in 1959.[34] The result was an improved channel permitting passage of all commercial vessels serving Sitka at all but extremely low tides.

Following the completion of the initial project in 1959, the District undertook followup surveys which showed the need for further widening of Whitestone Narrows. It also appeared that new work was required in *Sergius Narrows* at the north end of Neva Strait. The increase in traffic of heavier and longer ships, including the state's ferries, made improvement necessary in the interests of convenience and safety.

In August 1968, Congress authorized extending Whitestone Narrows from 200 to 300 feet in width. In Sergius Narrows, the Corps was authorized to contract for a channel 24 feet deep and 450 feet wide.

In 1970 the Corps of Engineers Nuclear Cratering Group (later redesignated the Explosive Excavation Research Office), supported by the Alaska District Engineer, initiated plans for an "instant clearing" system of excavating Sergius. Hydrographic and topographic surveys were made by the District's Survey Branch to determine places where explosive charges could be used for rock removal. The test plan contemplated small detonations to make emplacement holes for large charges. The cratering effect to be achieved from the latter was expected

to eliminate the slow and possibly more expensive process of dredging debris that would come from the usual drilling and blasting.

The engineering teams met with representatives of the Coast Guard, the U.S. Forest Service, the Alaska Department of Fish and Game, and the State's Marine Transportation Department. This group carried out a series of trial shots which proved the feasibility of this procedure. The Fish and Game Department preferred the new method to conventional drilling, blasting, and clearing away of debris, all of which required more working time in the area. However, all of this planning came to naught. When the bids were advertised, no contractor offered to use the new method. The project was brought to completion in 1972 by conventional methods.[35]

Rocky Pass is a narrow, rock-strewn waterway between Kupreanov and Kuiu Islands. It is a route commonly used by tugs, fishing vessels, cannery tenders, and log rafts. Before Engineer improvements, there were numerous obstacles, and shallow waters forced boatmen to keep to a tight schedule of operations keyed to tidal conditions. The Alaska District examined the channel in the early fifties and proposed widening and deepening the most difficult passages as well as the removal of the principal obstructions. Congress approved this project in 1954 and a Corps contractor cleared the channel in 1958.[36]

Dry Pass is a short waterway between Prince of Wales Island and Kosciusko Island used principally for small boat traffic and the movement of log rafts. The Juneau District surveyed the waterway in 1928 and recommended dredging a channel 60 feet wide and 6 feet deep through the most difficult section of the passage. The District Engineer believed the project could be accomplished for about $79,000. Congress appropriated the money and the project was completed in 1937. Eleven years later in 1948, the Seattle District re-examined the area and recommended a modification of the original project to provide a channel 12 feet deep and 70 feet wide. The Division Engineer approved the project on the condition that a proposed pulp mill at Ketchikan was established. This proviso was added to ensure that economic benefits would balance the costs of the enlarged project. However, in 1954 Congress authorized the project without the proviso and it was completed in 1959 at a total cost of $884,686.[37]

Metlakatla is a Tsimshian Indian community on Annette Island which had its start in 1887 as a Church of England mission relocated from British Columbia. In 1891, Congress established the entire island as an Indian reservation. When the Seattle District first examined the area in 1936 it did not recommend improvement of the local facilities in light of the costs involved. However, the Bureau of Indian Affairs in the Interior Department requested a second survey. The Seattle District accomplished this in 1938 and recommended the development of a small boat harbor at an estimated

cost of about $160,000. The local Tribal Council had offered to contribute $40,000 from the Annette Island Indian Trust Fund toward the cost of the improvement. The District Engineer proposed dredging a small basin 170 to 500 feet in area protected by a 900-foot breakwater. This, in his view, would be sufficient to protect local boats from the frequent and severe onshore winds. However, as in so many other cases we have examined, the war forced the deferral of the project. Congress approved it in 1945, but no funds were forthcoming for 10 years. The construction finally occured during 1956 at a total cost of about $325,000. [38]

Metlakatla, community on Annette Island, southeastern Alaska.

Elfin Cove is a sparsely populated little harbor of refuge for small vessels working the fishing grounds of Cross Sound north of Chichagof Island due west from Juneau. As the cove served an important function as emergency shelter, the Seattle District proposed in 1940 to provide deepened and widened approach channels to the natural boat basin. No work was done during the war but Congress approved the project in 1945. Ultimately the funds were appropriated in 1957 and the Corps contractor completed the necessary work in 1958. As a result of this work, fishing vessels now have good all-tide access to a large protected basin that can accommodate 300 small boats. [39]

Pelican Harbor, a small fishing village on Chichagof Island, is located on Lisianski Inlet about 120 miles west from Juneau. When the Engineers first examined the place, it was an extremely busy fishing center; local freezing plants handled nearly 4 million pounds of fish there in 1948. In 1954, Congress authorized dredging a

250,000 square foot moorage basin and the construction of a protecting breakwater 1,000 feet long. Within a relatively short time the funds were appropriated and the Corps contractor finished the basin and the breakwater in March 1958 at a total cost of $370,000. [40]

Craig is a small fishing community located on the west coast of Prince of Wales Island. Like so many other southeastern communities, it received attention to its harbor needs from the Corps before World War II. In 1939, the Seattle District Engineer recommended dredging an approach channel and the erection of a breakwater, a task he estimated would cost about $80,000. Congress authorized the project in 1945 but no work was done until 1957. Then the Corps contractor opened up a channel 225 feet wide, 700 feet long, to a depth of 11 feet. This completed improvement offered safe moorage to about 105 commercial fishing vessels at a total cost of $377,000, well above the 1939 estimate. [41]

THE GULF OF ALASKA AND PRINCE WILLIAM SOUND. There are four significant harbors on the Gulf of Alaska and Prince William Sound. Three of these--Seward, Whittier, and Valdez--have served or now are serving as ports with transportation connections to the interior. The fourth--Cordova--once functioned as the port for the Copper River and Northwestern Railway and the mining operations that it serviced, but now is largely confined to fishing activities.

Seward lies at the head of Resurrection Bay, an 18-mile long indentation from the Gulf of Alaska, in which strong winds and rough waters are common. The Juneau District conducted a preliminary examination and survey of the area in 1926 and 1927. The reports indicated a need for a port of refuge for fishing boats working the excellent halibut grounds of Portlock Banks, some 40 miles south of the bay. While Seward was the ocean terminus of the Alaska Railroad, it lacked small boat handling facilities.

The District Engineer recommended dredging an area of 207,000 square feet to a depth of 12.5 feet and protecting it with a 580 foot long breakwater. Under Engineer supervision, these improvements were built during fiscal years 1931 and 1932 at a cost of $103,200. [42] Members of the community, however, argued that the improvements provided no protection from north winds and floating ice. In 1933, the House Committee on Rivers and Harbors requested the Seattle District to examine the finished project for possible improvements.

The District examined two new plans but found insufficient economic justification for either of them. The Board of Engineers did not concur, however, and recommended that the Chief of Engineers adopt the first of the two plans developed by the District--the construction of a 950-foot-long rubble mound breakwater on the north side of the basin. The Chief of

Contractor dredge working on Seward's new harbor following the 1964 earthquake.

Engineers forwarded this proposal to the House Committee with a favorable endorsement. Congress authorized the project in 1935 and it was completed in the fall of 1937. In 1949, the Alaska District re-examined the area and determined that 20 percent of the original basin had become too shallow as a result of shoaling. This report led to maintenance dredging in 1951 and improvement of the north breakwater in 1954. [43]

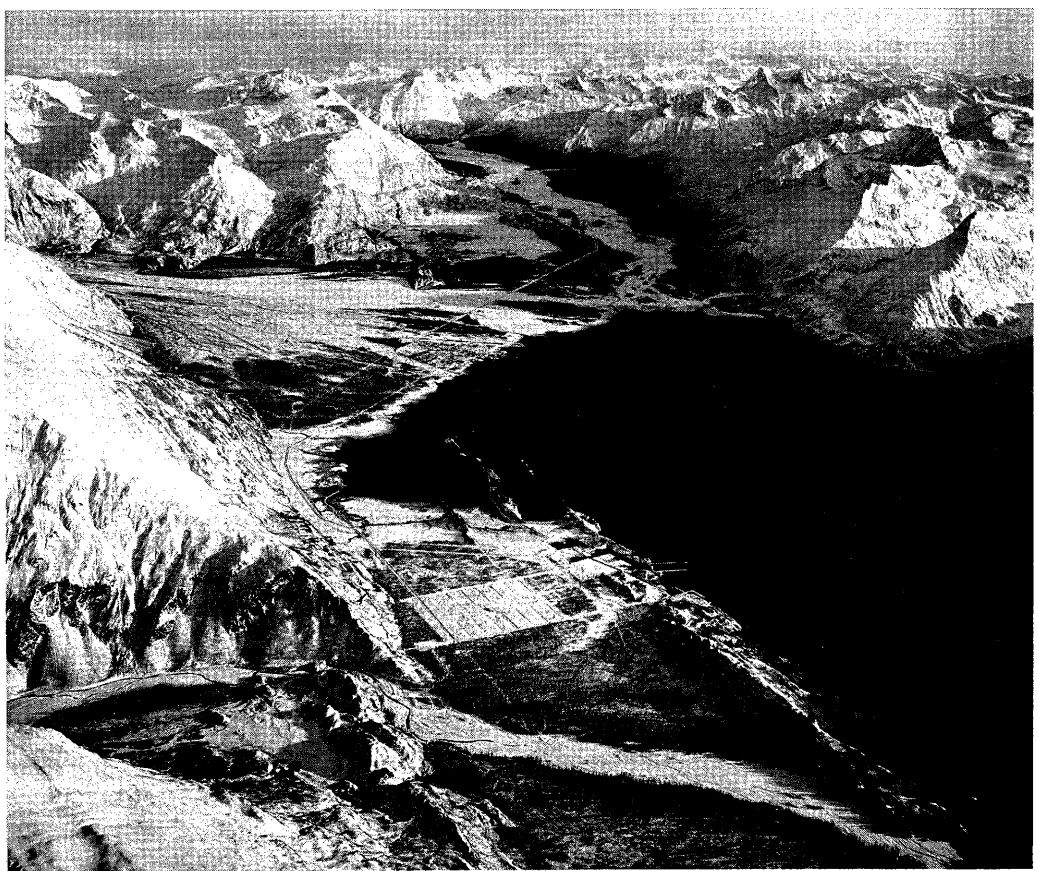
At a public meeting held in Seward in November 1963, the Alaska District presented a plan for increasing the size of the small boat harbor. Before this proposal made any headway, the earthquake of March 1964 destroyed the small boat basin and lowered the shoreline, requiring new construction at a different location. This was done in 1964 and 1965 with funds provided by the Office of Emergency Planning. The new boat basin was 17 acres in size with a 15-foot-deep entrance channel. Two rock-mound breakwaters, each over 1,000 feet long, were erected to protect the moorage. This new facility provided berthing and anchorage for about 465 commercial fishing and pleasure craft, at a total cost of about $1,328,000. [44]

The Spanish explorer Don Salvador Fidalgo explored areas of Prince William Sound in 1790; he applied the name Valdes to the expansive, deep, ice-free bay on which is situated the modern city and harbor of *Valdez*, the port from which North Slope Alaskan oil will be exported. The city was originally developed on the delta of Valdez Glacier where it served as a supply point for gold seekers going over the glacier to central Alaska in the 1890's. Another settlement grew up about four miles west of Valdez on the north shore of the bay and at the mouth of Mineral Creek. This town was platted in 1911 as Port Valdez. However, this community did not prosper and was soon reduced to a few householders. It was at Valdez at the head of the bay that the Seattle District Engineer made his first examination and survey in 1936-37. [45] As the terminus of the Richardson Highway, the report judged Valdez to be "one of the principal ports in Alaska." The District Engineer recommended improvement of the harbor by dredging a small boat and seaplane basin in the tideflat area between the two main commercial wharves; it also recommended diverting a small creek from the basin site. Congress adopted the proposal in 1938 and the dredging was done under contract in 1939 at a cost of $52,400. [46] In 1947, the Seattle District examined the harbor, found dangerous shallows, and recommended maintenance dredging. This was accomplished in 1951 at a cost of $36,400, an exercise which returned the basin to its original project depth. [47]

In 1954, Congress authorized construction of a rock and gravel breakwater 475 feet long, plus two pile breakwaters, each 490 feet long, to partially close the west side of the basin. In the design stage, one breakwater was extended and the other deleted from the project altogether. Under

Alaska District supervision, the construction was carried out in 1957 at a cost of $116,000. [48]

The 1964 earthquake completely destroyed Engineer improvements in Valdez. Commercial wharves and waterfront businesses subsided when the face of the delta on which these and other facilities had been built slipped into deep water. Further downward movement of the entire delta plain appeared to be possible. It was decided to completely relocate the city to the area of the old Port Valdez townsite at Mineral Creek about four miles to the west of the damaged site. As part of the rehabilitation, the Corps contracted to build a new small boat basin, a project which was completed by June 1965. As in the case of Seward, this effort was a joint project of the Corps of Engineers and the Office of Emergency Planning. The latter agency contributed more than a million dollars to the support of the new project. When completed, the new basin provided berthing and anchorage for 250 boats. [49]



Neat street pattern of "new" Valdez (lower center) was laid out near Mineral Creek (foreground) following the 1964 earthquake. The former city, on the Valdez Glacier delta, is seen (upper center) on the Richardson Highway leading to Fairbanks.

The 1964 earthquake also damaged another harbor in the Prince William Sound area. *Cordova* is located near the mouth of the Copper River and is now largely a fishing town. In its early history it served as the port from which the Guggenheim interests shipped copper ore in the first two decades of this century. Congress initially authorized a survey of the town's harbor needs in 1927 and eight years later it sanctioned the construction of an 8.3 acre mooring basin with two protecting breakwaters. This project was completed in 1938 at a cost of about $254,000. [50]

The great earthquake damaged the docks extensively and raised the land, making the basin fairly useless. Some $669,000 was spent to rehabilitate the premises during the period 1964-68. In addition, the Alaska District expanded the mooring area and added yet another breakwater. Under the District's supervision, the harbor also was deepened, all at a cost of approximately $587,000. [51]

COOK INLET AND KODIAK ISLAND. *Anchorage* is now the largest city in Alaska and the most important port in the state. The original townsite was chosen by the Federal Government in 1912 as the spot for a campsite to be used in support of the construction of the Government railroad between Seward and Fairbanks. The Alaska Engineering Commission brought freight up Cook Inlet to the mouth of Ship Creek where it was lightered ashore. In order to facilitate freight handling railroad workers built a dock, but after the completion of the railroad in the early twenties, the dock became idle. Siltation and the extreme tidal ranges in the Inlet seemed to preclude any major port development. However, during World War II, when traffic became congested at Seward, the military rehabilitated the dock for use in delivering supplies to Fort Richardson and the interior.

In 1947, Congress directed the Corps of Engineers to examine the possibility of building a port on Fire Island with a causeway connecting it to Anchorage. The engineering studies undertaken at that time indicated that the most feasible area for locating a port was the general area of the old AEC dock, by now commonly referred to as the "Army" or "Ocean" dock.

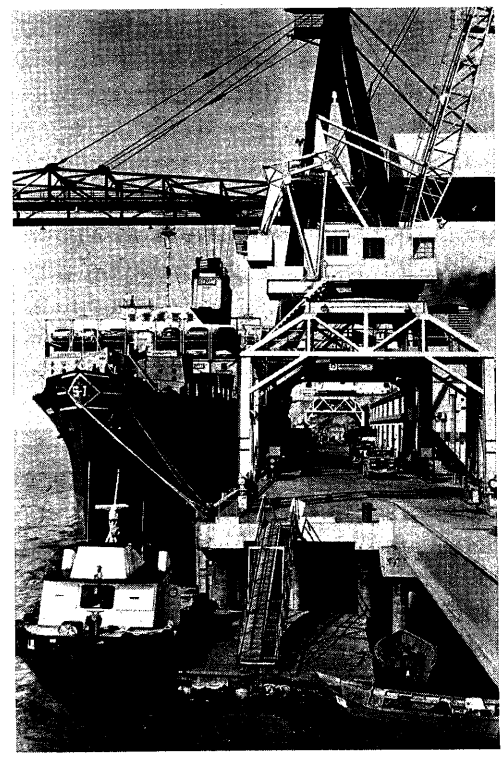
In January 1950, the Alaska District Engineer produced a comprehensive report on the Cook Inlet region. While acknowledging the problems of heavy siltation, ice floes, currents, and extreme tidal ranges, the District Engineer believed the construction of deep water port facilities would benefit not only the civilian economy of the area but the national defense as well. [52] He recommended extending the existing old dock by 1,420 feet, and dredging the harbor area to provide a depth of 35 feet below mean lower low water adjacent to the wharf. He also proposed building two jetties to protect these improvements. The District estimated that the initial phase of development

would cost about $3.5 million.[53] The Division Engineer and the Board of Engineers for Rivers and Harbors supported this recommendation.

By the time the project had passed through the process of review (it was but one item in a larger package involving the entire Cook Inlet region) nearly four years passed. When the Board of Engineers sent their approval through to the Chief of Engineers in November 1953, the cost estimate had risen to more than $5 million and the jetties had been stricken from the design.

In the meantime, local civic leaders took independent action. In 1952, the Anchorage Port Commission employed G.T. Treadwell, a consultant for the Seattle Port Authority, to make a preliminary study. He found that the port was feasible from an engineering standpoint and he believed that it would pay for itself. Treadwell's work was expanded and reinforced by more studies undertaken in 1955. However, one of these studies noted that there was opposition to the development of a deep-water port in Anchorage in view of the large federal investment in Seward, Whittier, and the Alaska Railroad.[54]

The Anchorage Port Commission urged the Corps to dredge the harbor as an assist to navigation at the existing port site. In response, the Alaska District recommended (in 1956) the Federal purchase of a small dredge for use in bringing the harbor bottom along the old dock to the 35-foot level. This was to be done without any major construction on the old dock. The Senate approved the bill containing the project but it failed in the House. Two years later, Congress allowed the District to conduct a preauthorization study of possible improvements to the harbor. The report concluded that the originally recommended development--the extension of the dock, the dredging, and the construction of the jetties--would cost about $4.8 million.



Port of Anchorage, 1968.

However, no federal funds were forthcoming, and the City of Anchorage pressed ahead on its own. In 1958, it sold general obligation and revenue bonds in order to build a port terminal north of the old Ocean Dock.

This project was completed and opened for business in 1961. In the meantime, the Alaska District proceeded with its proposals for dredging the harbor. Plans and specifications were ready for bid advertisement when the great earthquake struck in March 1964. This brought the dredging project to a halt. The old dock was entirely wrecked and the Anchorage waterfront subsided 3.6 feet. As the earthquake had seriously damaged the facilities at Seward and Whittier, pressure increased on the new Anchorage facilities. The City built a temporary petroleum pier in 1964 between the Municipal Dock and the old Ocean Dock. This was done with funds from the Federal Disaster Act under the supervision of the Alaska District. Unfortunately, heavy ice floes in the winter of 1964-65 ruined this temporary arrangement.

In March 1965, the voters of the city approved a new bond sale for the construction of permanent petroleum facilities in addition to an expansion of the city dock. In June 1965, the Corps began an expanded program of maintenance dredging to serve the harbor area. The District's proposal to build protecting jetties was put aside as they were now thought to be unnecessary. Emergency dredging under District supervision began in 1966. In addition to dredging, the District also undertook the removal of a portion of the old Ocean Dock that had become a hazard to navigation in the harbor. [55]

In summary, while the major burden for the construction and development of the modern deep-water port facilities at Anchorage was largely assumed by municipal authorities, the work of monitoring the condition of the harbor and maintaining it by dredging was handled by the Alaska District. This work had, by 1974, cost about $1,984,512.

The City of *Seldovia* is located on a bay named Zaliv Seldevoy by a Russian naval officer in 1852. The name meant "herring bay" and it reveals why it has remained an active settlement. In 1938-39, the Seattle District surveyed the harbor and found the approach obstructed by a rock pinnacle. In addition, the harbor was not deep enough to accommodate vessels operating in the coastal trade. At a public hearing held in August 1938, local interests requested two improvements: the removal of the pinnacle and the dredging of a small boat basin, with the spoil to be used in such a way as to form an aircraft landing field. The Seattle District believed that the basin was not economically justified and the plan for developing an airstrip not practical. But the District Engineer did support the removal of the pinnacle and the provision of a channel 300 feet wide and 24 feet deep. This work was to be contingent upon the construction of a suitable public wharf by local interests. [56] This proposal went to Congress in April 1940, but as in so many other cases World War II intervened to prevent action. Congress authorized the project in 1945, but the priorities of the post-war military construction program forced the Seattle District, and its successor

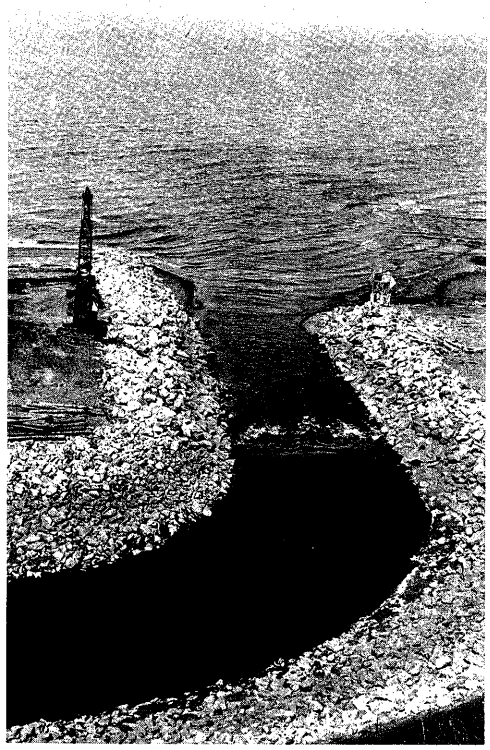
the Alaska District, to further defer the project.

When the Alaska District returned to the problem in 1958-59, the project was modified to add the small boat basin originally requested in the late thirties. Two breakwaters for the protection of the moorage area also were included. Over the long interval since the Seattle District's first examination of the area, local interests had constructed an acceptable extension to their wharf facilities. [57]

Unfortunately, the 1964 earthquake lowered Seldovia's coastal geography by about 3.5 feet. This had the effect of deepening the basin but it also left the breakwaters too low. The District undertook rehabilitation that summer and fall by raising the breakwaters to a height sufficient for protection of the moorage. Including the rehabilitation of the breakwaters, the Engineers have supervised the expenditure of about a million dollars to improve Seldovia's waterfront and harbor. [58]

About 150 years ago, the Russian-American Company placed superannuated employees at *Ninilchik*, midway on the west coast of the Kenai Peninsula, as something of a forced retirement colony. For decades, local fishermen used the mouth of the Ninilchik River--which flows into Cook Inlet--as a harbor. Unfortunately, the entrance to the river was restricted at low tide by a coal reef. Boats often had to lay by outside awaiting favorable tide conditions. In bad weather this was dangerous, as the mouth of the river was the only haven along a 75-mile stretch of the coast.

The Alaska District Engineer's comprehensive *Interim Report #2* (1950) recommended the development of a basin 320 feet long and 150 feet wide near the mouth of the river. He also recommended the construction of a new river entrance by excavating a 400-foot channel 50 feet wide through the spit which lies at the mouth of the river parallel to the coast line. He believed this could be done for about $125,000. [59] This proposal was approved through all the necessary authorities with no design change. By the time it was sent to Congress,



Narrow entrance to Ninilchik's little harbor is over a coal reef.

however, the estimated cost had risen to about $176,000 for the initial construction outlay. Congress approved the project in 1956 and authorized funds for its completion in 1961. In that year, a Corps contractor dredged out 82,300 yards of material from the basin site and new channel, and placed 4,500 yards of gravel for slope protection. [60]

The project was subsequently plagued by riverbank erosion and basin sedimentation problems. In June, 1966, the Corps contracted for emergency work involving the realignment of the entrance channel and the construction of a timber groin (a protruding wall to divert the current of the river) on its south side. Unfortunately, this groin was destroyed by tidal action in the fall of 1966.

The next year, the District contracted for improvements that included a southward diversion of Ninilchik River away from the basin, which was dammed off by a dike. An access road was provided on the top of the dike, enabling vehicles to get onto the spit. The project provided rock jetties to maintain the alignment of the entrance channel; it also worked to discourage erosion of the spit beach between the inlet and the basin by the use of metal barrel beach protection.

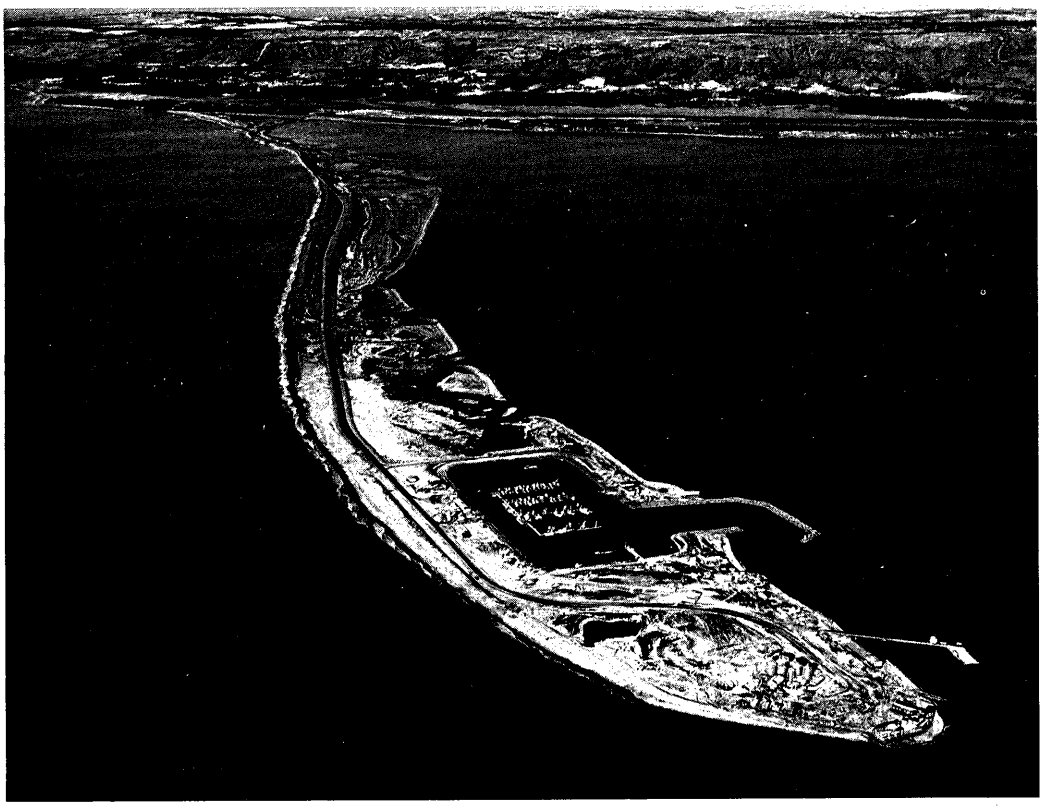
In April 1969, a District contractor realigned the river to prevent more erosion and embarked on yet another program of improvement to protect the beach by the use of sandbags and metal drums. This work was completed in August 1970. [61] In sum, all the improvements, repairs, studies, corrections, realignments, and maintenance work done over the years between 1959 and 1971 have cost the Federal Government slightly over a million dollars.

The City of *Kenai* (a fortified Russian post in 1791) sits on the right bank of the Kenai River where it flows into Cook Inlet. The mouth of the river has been used since Russian days as a boat basin. The Alaska District's 1950 *Interim Report* urged improvement of the moorage basin by altering the bar at the mouth of the river. [62] Congress did not authorize this particular project, but the District nonetheless undertook snagging and clearing operations near the mouth of the stream in 1964 (under the terms of Section 3 of the 1945 Rivers and Harbors Act). [63]

The City of *Homer* is located on the Cook Inlet on the Kenai Peninsula shore at the south end of the Sterling Highway. A settlement was established here in 1895, not far from where Russians had mined coal 140 years earlier. The Seattle District reviewed a proposal to establish an anchorage near the town in 1937 and recommended against any improvement at that time. In 1945, the House Rivers and Harbors Committee called for a second examination of the proposal. In 1950, the Alaska District proposed (again in the *Interim Report*) the construction of a small boat basin on the north shore of Homer Spit, a narrow 4.5-mile-long finger of land that juts into Kachemak Bay. The District en-

visaged a basin about 800 feet west of the city dock which could be created by constructing a 850-foot L-shaped breakwater and excavating a basin within the protected area. Space for 80 boats would thus be provided at an estimated cost of about $353,000.[64]

providing a basin for some 70 boats.[65] But winter storm damage occurred again, requiring further repairs to the breakwater and the side slope of the basin. Before that work could be done, the 1964 earthquake struck and ruined not only the previous Engineer



Homer Spit and small boat harbor, 1966. City of Homer in background.

Under the 1958 Rivers and Harbors Act, the District made hydrographic surveys and subsurface investigations. Contracts were subsequently let and the construction work began in 1961. Unfortunately, heavy winter seas washed out part of the unprotected breakwater core, requiring much additional effort. Finally, the work was finished in September 1962,

improvements but the dock as well.

Between 1964 and 1966, the District undertook a program of temporary and permanent repairs involving the restoration of the breakwaters and the expansion of the harbor. When completed in March 1965, the new mooring basin was much enlarged; it could accommodate up to 200 commercial

fishing and oil company work vessels. All of this was accomplished for the rather substantial total sum of $2,114,000, a figure which included nearly $1,000,000 from the Office of Emergency Planning. [66]

Old Harbor is a fishing village located on the southern shore of Kodiak Island about 50 miles to the southwest of the city of Kodiak. It is situated near what is believed to have been the first permanent Russian settlement in Alaska established by Grigorii Shelekhov in 1784. The seismic waves generated by the 1964 earthquake nearly destroyed the village but by 1966 recovery was well underway. That same year Congress adopted a project for a small anchorage under the terms of Section 107 of the Rivers and Harbors Act of 1960. The Alaska District Engineer contracted to have a basin dredged (200 by 700 feet in area) with a 600-foot-long entrance channel. The project also involved the building of an earth-filled dike 1,250 feet long on the northwest side of the basin to divert a fresh water stream from the basin area. During the design stage, a 240-foot groin constructed with rock-filled gabions (wire baskets) was included to protect the entrance from shoaling. Practically all of the work was accomplished in the summer and fall of 1967. [67]

At the conclusion of this work, Old Harbor residents possessed a secure place for mooring 40 resident and transient commercial fishing vessels, all at a cost of $370,000. In 1971, the District carried out a further program of improvement involving the raising of the rock gabion groin and dredging the entrance channel. [68]

The City of *Kodiak* is the oldest continuously occupied white settlement in Alaska. Alexander Baranov moved his Russian settlement to the Kodiak site from Three Saints Bay near Old Harbor. Kodiak is now the only major harbor lying between Seward and Dutch Harbor in the Aleutian Chain; in addition, it is an important fishing and fish processing center. At the direction of the Board of Engineers, the Juneau District first examined navigation problems in this area in 1930. This was done in response to a request from local officials asking widening of the North Channel between the municipal center and Near Island and the removal of Cyane Rock, an obstruction in that channel.

After examining the situation in 1931, the Juneau District Engineer recommended dredging a 200-foot channel to a depth of 22 feet. This work was to be contingent on the community's construction of a cold storage plant to ensure an increase of local fish processing capacity sufficient to attract fishing boats harboring elsewhere at greater cost and less convenience and safety. [69] Congress adopted the project in 1935, but by 1939 the terms of local cooperation had not been complied with. The depression had reduced fish prices and construction financing was extremely difficult to secure. At the same time, however, the Seattle District foresaw an improvement in the economy ow-

ing to the impending establishment of a naval base at Womans Bay, some six miles west of the City. Accordingly, the Seattle District recommended proceeding with the project while abandoning the requirements for local contributions. Congress alloted $70,000 for the project (revised in 1940) which was to be executed under contract in November and December 1941. However, the war intervened and the improvements were deferred with the exception of emergency dredging done under naval contract in 1942.[70]

New floats in the new post-earthquake Kodiak harbor.

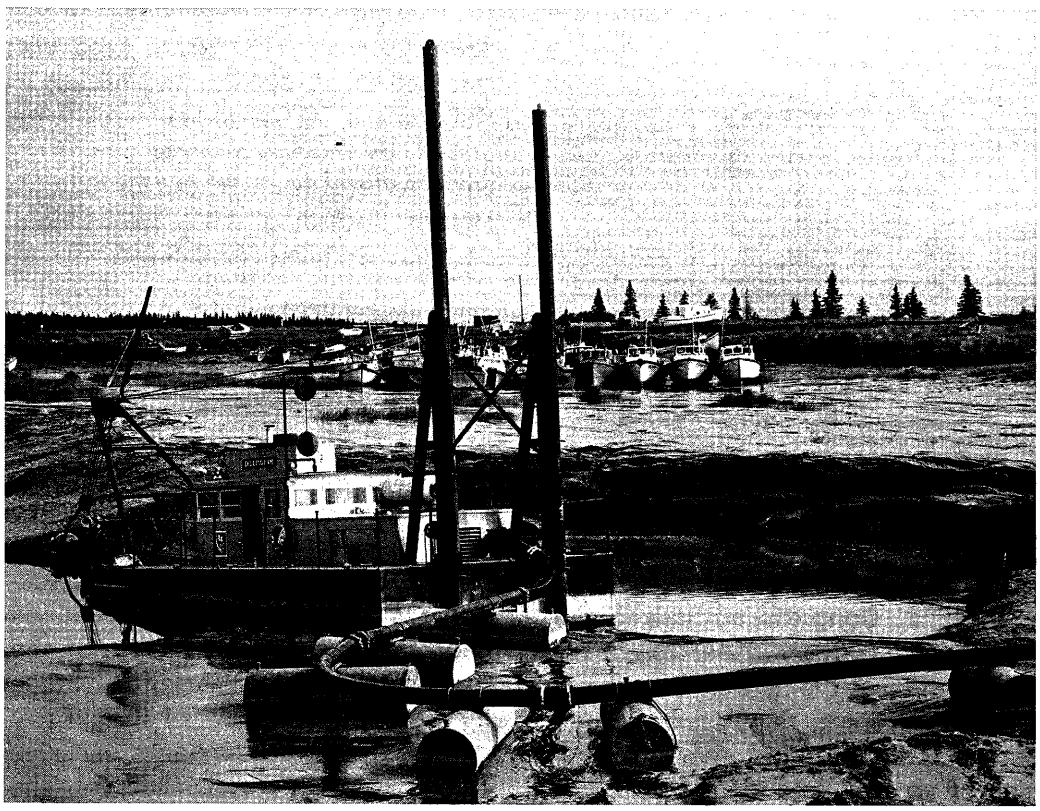
In 1945, Congress authorized the Seattle District to undertake a reexamination of the harbor. On the basis of this report, the Alaska District recommended in 1951 the construction of an 11.7-acre small boat basin and two protecting rock breakwaters. The District completed the original channel dredging project in fiscal years 1955 and 1956. The next year, the District completed the plans and specifications for the small boat basin. By July 1958, a District supervised contractor completed the basin providing moorage for 200 boats at a cost of $1,160,000.[71]

Kodiak was one of the cities hardest hit in the 1964 earthquake; it suffered a land subsidence of 5.6 feet in addition to great damage along the waterfront including the newly constructed small boat harbor. As in other cases, the subsidence had one beneficial effect--it made the harbor deeper. Rehabilitation of the harbor under District supervision has cost about $594,000 since 1964. Both breakwaters had to be repaired and raised; in the process, 70,000 tons of rock were added. By the end of fiscal year 1971, total federal investment in Kodiak Harbor (including the rehabilitation) had reached nearly $2,000,000.[72]

King Cove lies on the southwest coast of the Alaska Peninsula about 650 miles from Anchorage. The village of King Cove is situated on a spit of land lying between a deepwater cove and a shallow lagoon. Kodiak is 450 miles to the northeast; Dutch Harbor lies 175 miles in the opposite direction. Ten miles to the northwest, on Cold Bay, one finds the site of the former Thornbrough Army Air Force Base. The inhabitants of King Cove are largely the descendants of native Aleuts and early Russian settlers. The fishing industry and its related services constitute their complete livelihood.

The Alaska District arranged to hold a public hearing there in August 1964. It was found that the principal difficulty faced by small boats was a lack of sheltered anchorage. Getting over shoals into the shallow lagoon was a problem for even the smallest shallow draft boats. Vessels tied to exposed pilings and the local cannery dock were especially vulnerable to winter winds. Frequent losses from storms made boat insurance rates very high and repair costs were expensive because of the remote location of the village.

Under an Act of August 13, 1968, Congress authorized the District to dredge an anchorage basin 11 acres in size and 15 feet deep. In addition, an entrance channel was to be dredged to the same depth. Preconstruction planning got underway in 1971 and the project was completed and turned over to the community in 1974. Material dredged from the small boat basin was used to construct a 200-foot rock groin to protect the entrance channel. In addition, the District contractor built a 1,500-foot training dike to deflect tidal flows that would otherwise damage the improvement.[73]



The Corps dredge at Dillingham has an annual silt-removal problem.

WESTERN ALASKA. *Dillingham* is a fishing village located near the confluence of Nushagak Bay and Nushagak River in the northeastern end of Bristol Bay. The Alaska District undertook a study of the harbor needs of this community in 1953. In July 1958, Congress authorized permanent harbor improvements based on this study. The project, sited along Scandinavian Creek just west of the community, provided for a 230,000-square-foot small boat basin with a depth of 2 feet above MLLW (mean lower low water) along the creek. An entrance channel 1,100 feet long and 40 feet wide at the bottom in the creek was to be headed with a sheet-pile sill across the basin outlet. This would ensure a mooring depth of at least 5 feet at all times.[74]

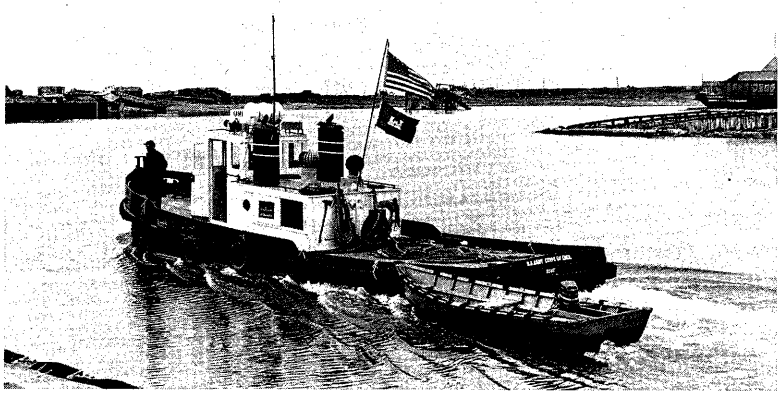
Work started in August 1960, but was interrupted from November to January 1961 by freezing conditions. At this point, the project design was adjusted to include a rock sill with adjacent scour-protection blankets. The sill was partially finished by the end of the 1961 construction season, but winter icing subsequently removed some of it and the basin silted up again. By July 1962, the District had redredged the harbor and almost completely restored the rock sill.[75]

This initial project did not cure Dillingham's problems; the basin continued to require regular and extensive maintenance. Condition surveys by the District revealed the need for redredging the basin and the provision of a structure across the entrance channel to reduce siltation during the winter months. The Corps then took steps to secure their own dredge to handle harbor maintenance, a purchase which was authorized in May 1968. This dredge, delivered with its support equipment at a cost of $158,000, started operations in June 1969. Since that time it has regularly worked to keep Dillingham harbor clear of excess tide-borne sediment and has made possible the safe moorage of about 100 fishing vessels as well as the accommodation of another 100 private boats often used to haul supplies to settlements on Nushagak Bay and River.[76]

The *Naknek River* is a stream running between Naknek Lake and Kvichak Bay. It gained importance at the outset of World War II when the Civil Aeronautics Administration (now the FAA) contracted for construction of a landing field at King Salmon. The village of Naknek lies two miles up the river from the bay, and King Salmon village is located 14 miles further on. The river varies in width from some 500 feet in the upper section to more than a mile at its mouth. Kvichak Bay is an arm of the famous salmon rich Bristol Bay in southwestern Alaska.

Supplies for building the airfield here in 1941-42 (King Salmon Air Force Station, Naknek Air Base, and now King Salmon Airport) had to be lightered up the stream. Oceangoing vessels anchored 6 miles off the river mouth and cargo was barged in to the construction site. In 1954, the Alaska District produced another com-

prehensive *Interim Report* (#5) covering rivers and harbors in southwestern Alaska. This document pointed out the importance of the river for the movement of supplies in support of construction activities at the Air Force Station and recommended the improvement of navigation by the removal of hazardous rocks in the stream. [77] The District made preauthorization studies in 1959 and awarded a contract for the work in April 1960. Blasting and removal of the offending rocks was completed in October 1960 at a cost of some $15,400.[78]



The District's tug YAMHILL in Nome Harbor.

It will be recalled that the Engineers first began work on the harbor at *Nome* in 1917. This project was brought to completion in 1923 at a cost of some $270,000. But the work of the Corps was by no means completed as storms from the Bering Sea and silt from the Snake River required constant maintenance of the improvements. In an effort to meet the maintenance problem, the Corps procured a small clamshell dredge (the *Arctic*), a tugboat (the *Carpenter*), and two scows. That equipment was kept in constant use each summer removing an annual average of 17,000 yards of silt from the basin and the channel. In 1964, the old equipment was replaced by the dredge *Gilpin*, the tug *Yamhill*, and two new steel scows.

Other problems still remained, however. Over the years, winter storms tore out portions of the beach and did great damage in the community. In 1947-48, Congressional hearings were held to examine a project involving the construction of a 3,350-foot rock mound seawall to protect the waterfront and the city. The District and Division Engineers, the Beach Erosion Board, and the Board of Engineers for Rivers and Harbors all felt that the estimated expenditure of some $1,837,000 for the wall was not justified in view of the benefits to be gained. Nonetheless, Congress authorized construction of the seawall on several grounds. Nome was one of the most northerly outposts of the United States, it served as the supply center for a vast area of the region,

Federal property needed protection, and damage to Nome would deprive the adjacent Air Force Station of its supporting facilities. [79]

Under supervision of the Alaska District, a rubble mound seawall was built during the years 1949-51 to serve as a bulwark against the storms of Norton Sound, at a cost of just over $1,000,000. Since that time the District has undertaken several further improvements and modifications: the construction of 1,700 feet of upstream timber revetments, the dredging of a turning basin, the refacing of the timber revetments with sheet steel pile, and repair of the original jetties in 1965. Nome's yearly contribution of $2,500 (established in 1917) has been paid regularly since 1923. Between that year and 1974, local contributions totaled $127,500 while the Federal Government (through the Corps of Engineers) has spent $4,552,000 in navigation and shore protection projects (including maintenance). [80]

FLOOD CONTROL PROJECTS

It will be recalled from Chapter I that the Corps began flood control work in Alaska before World War II. The diversion of *Lowell Creek* at Seward was the first completed flood control project in Alaska. Before this project was finished, Seward frequently suffered severe damages from the flooding of Lowell Creek, a stream which flowed through the heart of the community. In 1927, the Congress authorized the Alaska Road Commission to build a rock-filled dam to divert the stream to a timber flume running through the town. This project was completed in 1929. When the Alaska Road Commission was transferred to the Department of the Interior in 1932, the Corps of Engineers assumed responsibility for maintenance and further development of the project. In 1936, the Seattle District examined the condition of the original project and decided on a substantial modification. This new project, which Congress approved in 1937, envisaged the construction of a new 400-foot-long tunnel through Bear Mountain, a tunnel through which the stream would flow into Resurrection Bay. Work began in 1940, but a portion of the project was temporarily suspended in 1940 owing to the pressures of the war. Ultimately the Seattle District brought the new project to a satisfactory conclusion in 1945. [81]

The Alaska District's primary responsibility in connection with the project has been the periodic monitoring of the condition of the tunnel and the performance of emergency repairs. In 1969, it became apparent that the condition of the tunnel had deteriorated to the point where a blockage was threatened, thereby endangering both the diversion dam and the city itself. The District immediately undertook an emergency rehabilitation project which restored the condition of the tunnel at a cost of about $93,000. [82]

The second major flood control project undertaken by the Engineers before the war was *Moose Creek Butte*

Dike, located about 25 miles east of Fairbanks. The basic function of this project was to control the Chena Slough, a channel of the Tanana River which bisects Fairbanks and Fort Wainwright, by diverting it into the Tanana. The Seattle District began their examination of the project in 1935, Congress approved it in 1938, and work began in 1940. A rock dam was built out from the foot of the butte and extended to the right bank of the Tanana. Subsequently, the Alaska Road Commission relocated the highway to run along the top of the dike. It is estimated that this project, substantially completed by 1944, has over its life prevented about four million dollars worth of flood damage in the area. [83]

In 1967, the Alaska District began a second project to handle the problems of flood control in the Fairbanks area. In November 1966, the District inspected the silty *Chena River*; a year later, after the August flood had subsided, the District undertook a second examination and found increasingly dangerous conditions. Under a contract let by the District (under Section 14 of the Flood Control Act, 1946), some $70,000 in Federal funds were spent for rock riprapping in two locations. These reinforcements (installed in the fall of 1967) prevented the waters from cutting back the banks of the river and destroying several city streets and utility installations. [84]

However, these completed tasks were but mere expedients in the light of the widespread problem of flood control in the combined flood plains of the merging valleys of the Tanana and Chena Rivers. A more substantial and enduring cure for this difficulty is the District's Chena River Lakes project, a topic which is discussed in detail in Chapter IV.

Juneau, the Alaskan capital, has often been subjected to the destructive flooding of *Gold Creek*, a fast-running glacial stream that dashes through the city to empty into Gastineau Channel. For example, the flood of 1918 emerged with so much force that it washed away 15 homes, destroyed a bridge, severely damaged a hospital, and spread over 55 acres of the small area occupied by the city. In 1934 and 1935, a WPA project established a definite channel for the stream from its mouth to the Calhoun Avenue Bridge by lining the sides of the channel with cemented rubble. A flood in 1943 breached those revetments and only back-breaking efforts by civilians and soldiers prevented considerable property damages. Still another flood three years later damaged the channel lining. In September 1948, the creek went on a rampage again. The paved stone revetment failed and the bank eroded; the streambed was lowered as a result and the revetment footings were undercut. [85]

In 1949, the Seattle District devised a plan to correct the problem. The project included improvements to the alignment and grades of the channel, paving its bottom with stone two feet in depth, and putting ten-inch-thick reinforced concrete on the sides. The estimated cost was $331,000, of which

local interests were to contribute $20,000.

The Board of Engineers concurred in the project, Congress authorized it, and the Alaska District completed it in 1957-58 at a cost of $456,000 in Federal funds. Topographic surveys and subsurface explorations by the District in October 1961 showed the need for more improvement. A year later, the District rehabilitated the channel lining, constructed a stilling basin, and placed heavy stone for protection at the head of the channel. Under a new contract awarded in 1967 and costing about $90,000, the channel was repaired again, the heading works were improved, and a source of debris eliminated.[86]

Gold Creek cuts through Juneau (from top of photo). Small boat harbor is next to bridge connecting with Douglas.

Hyder, originally named Portland City, was established in 1907 at the confluence of the Salmon River and the head of Portland Canal. The international border between the United States and Canada runs down the Canal. When the Juneau District Engineer first examined the harbor in 1925, he did not recommend any improvements in the interests of navigation. However, a second survey done in 1931 identified a need for a 4,334-foot dike in front of Hyder to confine flooding to the opposite side of the river. This project involved the rehabilitation of 680 feet of existing dike previously constructed by local interests and other agencies, including the Bureau of Public Roads and the Territorial Road Commission. The Juneau District recommended that local or Territorial offices contribute some $7,000 to the initial cost of $53,000, and $200 annually to the maintenance of the facility. The Division Engineer agreed that the improvement was worthwhile but recommended that local interests make a one-time contribution of $24,000. [87]

Congress adopted the Juneau District's original proposal in June 1934. The Seattle District completed the dike work in 1935, and the adjacent flood plain was cleared as a relief measure using Civil Works Administration funds. [88]

In 1954, responsibility for operation and maintenance was transferred to the Territorial Government. Two years later, however, the Corps returned to the problem when Congress authorized the construction of a 1,000-foot-long levee. This addition was subsequently placed on the inactive list.

In December 1961, Summit Lake drained beneath Summit Glacier into the Salmon River, and in the process created unusual flood conditions that wiped out 1,500 feet of the original dike and damaged the remainder. The District supervised reconstruction of the dike in the fall of 1962 at a cost of about $140,000 and the project was transferred to the State of Alaska's Department of Public Works for operation and maintenance. [89]

In addition to these major projects, the Corps also undertook three smaller efforts in the area of flood control--Aniak, Big Delta, and Talkeetna. Aniak is a small village of some 210 persons which sits on the south bank of the Kuskokwim River in western central Alaska. Founded in 1910, it began as a trading site supporting mining operations up the Tuluksak and Aniak Rivers. A levee built by local residents was heavily damaged by flooding in 1968. The levee was rebuilt in 1968-69 in a joint effort involving Federal and State funds in addition to locally contributed labor. [90]

The District also worked to protect *Delta Junction*, located near the confluence of the Delta and Tanana Rivers. In 1965, in cooperation with the State and local interests, the District did some channel clearing and constructed seven rock groins in order to control the Delta River, which in constantly eating away at its banks, threatened the Richardson Highway. [91]

Talkeetna is a small town located at Mile 227 (from Seward) on the Alaska Railroad. It serves as the communications and supply base for the numerous climbing parties that ascend Mount McKinley, North America's highest peak. Flooding in the community has occurred several times during spring runoffs of the Talkeetna River and the powerful Susitna River which it joins nearby. The principal problem has occurred along the left bank of the Talkeetna River about 1,300 feet south of the Alaska Railroad embankment. Here the river runs very close to the settlement. In June 1942, a flood inundated part of the community; still another serious flood occurred in 1949. In addition, over the years, the riverbank was cut away substantially, resulting in the destruction of some homes. In 1951 (under the authority of Section 14 of the Flood Control Act, 1946), the District supervised the construction of a 1,000-foot natural timber and brush fascine along the left bank below the railroad bridge. This has had the effect of stabilizing the bank to prevent further erosion. A permanent facility constructed from stone was authorized by the Flood Control Act of 1958, but no further work has been done. [92]

The area around the junction of the Klutina and Copper Rivers has long suffered from too much water at spring runoff time. Under terms of the 1948 Flood Control Act this area became the site of a flood control project. Preauthorization studies of possible control measures were made by the District during the period between 1965 and 1967 at a cost of $5,000. These studies found that 4,400 feet of levee was needed along the north bank of the Klutina to protect the developed area of *Copper Center* and the northerly approach to the Klutina River bridge. Such improvements were approved and in April 1968 the District received $20,000 for preconstruction planning. In 1969 and 1970, the District completed and received approval of the plans and specification for the project; Congress authorized the project and appropriated the funds. At that point, however, an Interior Department "land freeze" held up any further progress on the project. However, this constraint was ultimately removed and the District's contractor undertook construction of the levee which was completed in 1972. [93]

One project that deserves attention, largely for its interesting experimental aspects, is the District's attempt to control river bank erosion at *Galena* on the Yukon. The airfield located there serves the Galena and Campion Air Force Stations. The chief difficulty is that the Yukon gulps large quantities of soil from its banks, especially at floodtime. At spring breakup, huge chunks of ice tear at any protection that man builds to prevent the erosion. During the sixties, the District spent over $2.5 million on erosion control projects to keep the airfield from being washed away. The Engineers have used rock slope protection, sheet steel piling and hundreds of gravel-filled drums and sandbags.

Gravel-filled drums behind sheet steel piling were one form of bank erosion control tried at Galena on the Yukon, 1964.

Two additional and very interesting methods have been tried. In the winter of 1963-64, when the temperature dropped below -60 F. and the ice on the river was more than five feet thick, a District contractor spread 40,000 cubic yards of rock on the surface of the ice in a ribbon 100 feet wide and a half mile long. Then the ice was blasted by dynamite and the rock settled to "pave" the river bottom and hence stabilize the toe of its slope.

The second method has been the installation of devices known as "freeze probes." These thermopiles, invented by Erwin Long of the Alaska District, are intended to keep the river bank frozen solid like the permafrost bed which underlies the whole area. The probes are installed to a depth of about 40 feet. They each contain encapsulated propane gas which has a low vapor point. When warmed, it changes from liquid to gas and rises in the capsule tube to the surface where the heat is expelled. The gas then condenses, gathering at the base of the probe as a liquid to repeat the cycle again when subjected to warming. These devices have contributed considerably to stabilizing the bank. [94]

THE RAMPART CANYON DAM PROJECT

The proposal to construct a dam in Rampart Canyon, located about 100 miles northwest of Fairbanks, has been perhaps the most controversial project in which the Alaska District has been involved. The District first began to consider the possibility of building a power dam in the general area when it undertook the preparation of *Interim Report #7, Yukon and Kuskokwim River Basins*, in the early fifties. In 1959, a District official revealed the general outlines of the proposal to a Fairbanks audience. It involved the construction of a concrete gravity dam 1,300 feet long and 500 feet high, developing a usable head of about 440 feet of water, with a regulated flow of 118,000 cubic feet per second. The dam would impound enough water to warrant an installed capacity of 4,760,000 kilowatts, or two and one-half times the capacity of Grand Coulee Dam. The reservoir would cover an area of about 10,700 square miles, or 40 times the storage at Lake Mead behind Hoover Dam. Its expanse would exceed that of Lake Erie and would produce more power than any hydroelectric installation in the nation, if not the world.[95]

While the *Interim Report* was being prepared, the Senate Public Works Committee, at the urging of Senator Gruening, directed the Corps to make a separate full scale report on the capabilities of a project at Rampart. The Alaska congressional delegation pushed through a bill in 1959 appropriating funds for a feasibility study.

Public debate, much of it quite vigorous, began to appear in 1960. During the decade of the sixties, Rampart

Site of possible Rampart Dam and hydroelectric project, Yukon River.

received as much nationwide attention as the proposed 780-mile trans-Alaska pipeline did in the early seventies, and for much the same reasons: concern for wildlife management and the effect of the project upon the natural environment. The dam proposal was studied and restudied by various groups from a number of different perspectives. The variety of opinion on one fundamental aspect of the subject can be illustrated by the following example. An early statement by an industrial consultant to the Bonneville Power Administration asserted that the market for power in the State would surpass even the amounts that Rampart Dam would be able to supply.[96] Almost simultaneously, the Interior Department's Commissioner of Reclamation announced that Rampart's capacity would be "far in excess of present or near-future market requirements under any normal load growth forecast."[97]

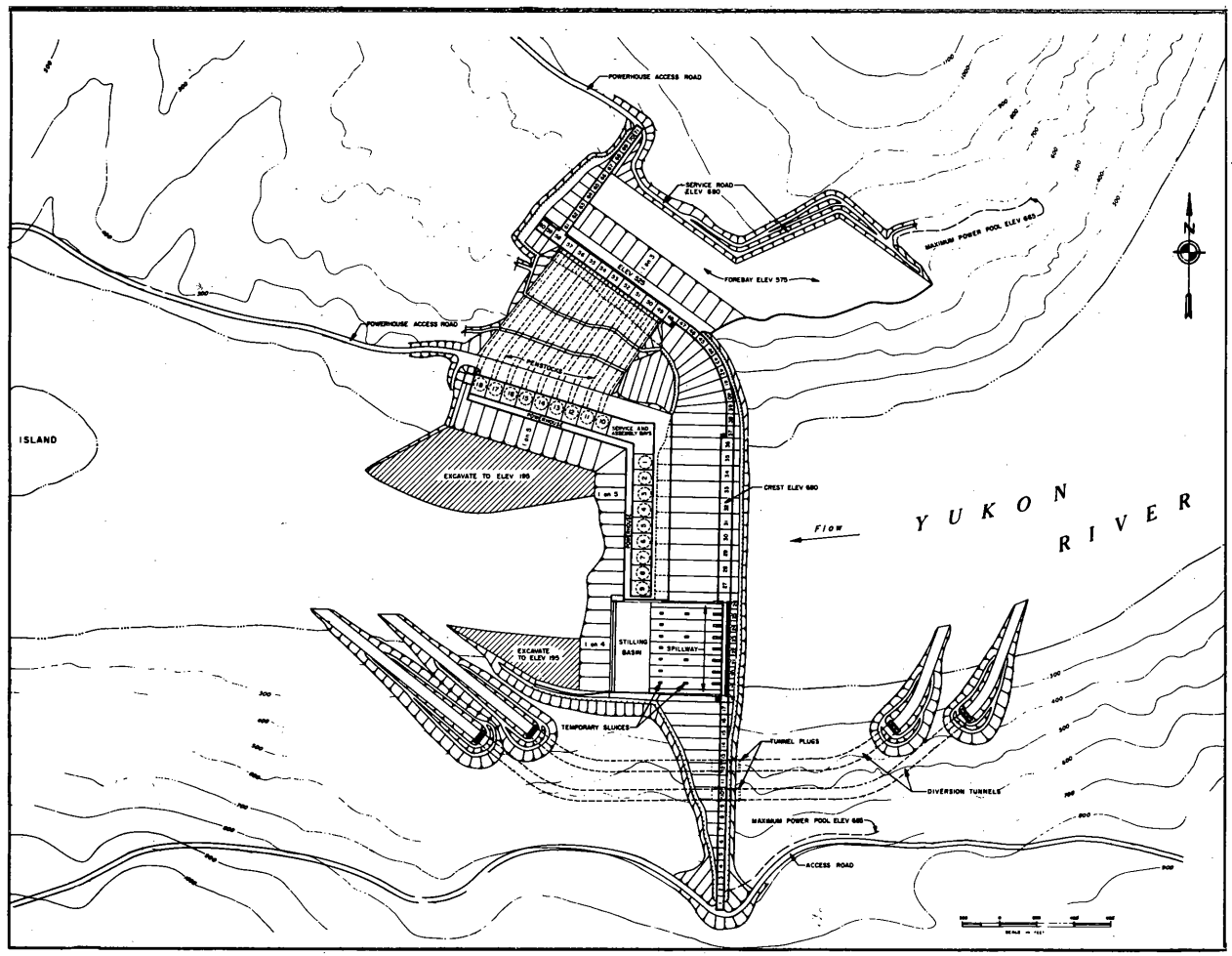
In February 1961, the North Pacific Division formed a Rampart Dam Advisory Board comprised of prominent Alaskans, engineers, economists, educators, and power experts to counsel the District Engineer on the development and review of economic studies for the proposed project. Two months later, the District contracted with the Development and Resources Corporation of New York to make a broad survey of the economic effects of the project and to determine if it would be in the interests of Alaska and the United States to develop a large block of low-cost power at the proposed site.

The Alaska District also began exploratory drilling in foundation rock in the canyon early in 1961. Workmen from the District drove a caterpillar tractor 30 miles through the woods from Eureka under Arctic conditions to reach the Yukon where that stream was entered by Texas Creek. The tractor pulled a sled bearing a little trailer house that served as the crew's temporary quarters during the trek and at the river. The bulldozer then cleared a runway on the frozen river to accommodate cargo aircraft of a commercial line and the Alaska Air National Guard. The District men then drilled through about five feet of ice to secure their samples.[98]

The District Engineer presented a report on the results of the drilling to the Fairbanks Chamber of Commerce. In that address, he outlined the District's fundamental attitude toward the project:

". . . no amount of good rock at the site, or other favorable construction factors can of themselves prove Rampart's feasibility. Nor does the Corps of Engineers desire to build Rampart Dam merely because it *can* be built--if that proves to be the case. We must know that there will be a market for the power; that what can be produced can be used to benefit Alaska and the Nation . . . it must be a wise investment . . .industry must be the main consumer."[99]

In March 1962, the Development and Resources Corporation study was released. It showed that "abundance



A concept of Rampart Dam and hydroelectric plant.

of low-cost power from the proposed Rampart Dam . . . could result in the 49th state becoming the center of a basic industrial complex oriented toward the electroprocessing of vital metals such as aluminum." The firm concluded that the project "would be financially beneficial to the United States as a whole." The plant would generate enough power--at one of the lowest cost rates in the world--to supply the average electrical needs of ten million homes. [100]

In addition to the Corps and its consultants, several other agencies participated in studies bearing on the feasibility of the project. The U.S. Fish and Wildlife Service performed a big-game count in the proposed reservoir area; it also undertook the tagging and counting of anadromous fish (those that go from salt water up clear streams to spawn) in the Yukon and its tributaries. The Bureau of Indian Affairs conducted a population count and property valuation study of the few small native villages located within the reservoir area. The U.S. Geological Survey did stream gauging for hydrologic studies, and the U.S. Bureau of Mines started a search of records of mineral resources in the area which might be affected.

In the fall of 1962, the Alaska District began preliminary design of the concrete dam. In 1963, District representatives held informational meetings in several villages that would likely have to be relocated, explaining the plan and answering questions about relocation and means of compensation for lands and existing improvements. Early in 1965, the Interior Department completed its field study report and transmitted it to Congress. It contained generally favorable opinions with the exception of the portion supplied by the Fish and Wildlife Service. The Service stressed the harmful effects of construction and water impoundment on wildlife; it estimated that the work to offset the major damage would cost about $580 million. Apart from this estimate, the Department of the Interior believed the whole project would cost about $2 billion. [101]

Early in 1966, the National Resources Council of America, a private organization, produced a report that resulted in considerable publicity. The Council stated that it could not recommend authorization of construction "at this time," on the grounds that there was insufficient economic justification. It referred to Rampart as "the most expensive gamble ever suggested in hydroelectric development." [102]

In the summer of 1967 the Interior Department announced that it could not support the construction of the dam. Despite this position, the Alaska District continued to gather material, including new cost figures on variations in dam heights, reservoir levels, and powerhouse facilities. The District produced its final report in May 1971; it was approved by the North Pacific Division in June and then forwarded to the Chief of Engineers. In the report, the District pointed out that it had studied at least 20 possible

plans for construction and operation of the proposed facility. It said, "From the standpoint of economic efficiency, the most feasible plan has a benefit to cost ratio of near unity (0.96 to 1). However, current and rising rates of interest on Federal investments, and rising construction costs would further reduce that ratio." [103] In short, in the District's view, the project had foundered on the very problem the District Engineer had identified 10 years earlier. The dam was a feasible engineering project, it was not a "wise investment."

This District's report did, however, hold open the possibility of future reconsideration of the project if the demand for power or the costs of alternative sources of energy should rise appreciably in the future. With that, the Rampart file was closed, but not locked.

MAJOR EMERGENCY OPERATIONS

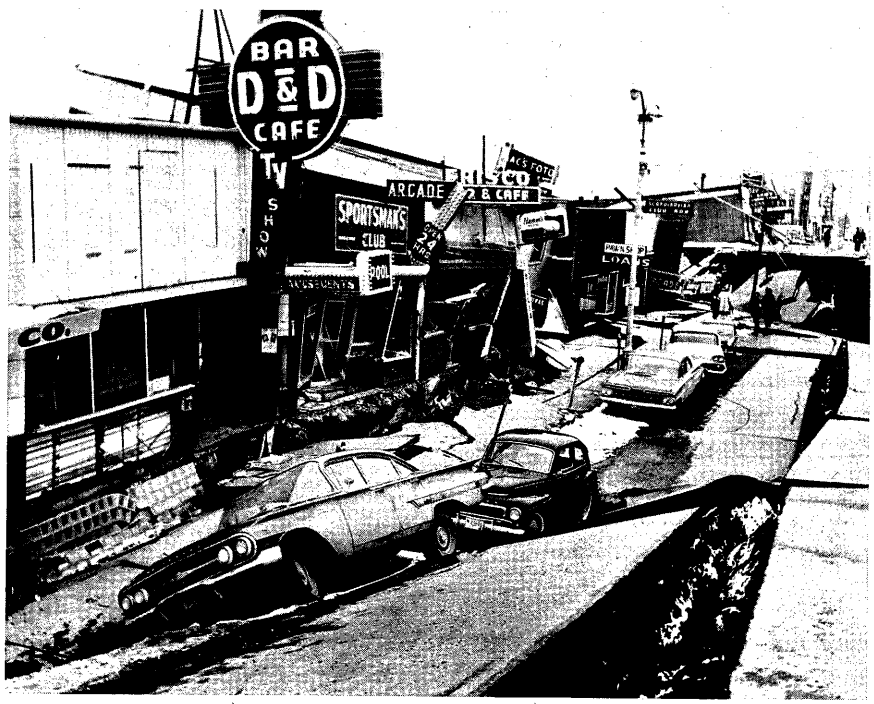
One of the important historic functions of the Corps of Engineers has been the provision of aid in times of natural disaster. In the period between 1946 and 1971, the Alaska District was deeply involved in the major recovery efforts following two such disasters--the 1964 earthquake and the 1967 flood in Fairbanks and Nenana.

Alaskans are not unacquainted with earthquakes. Tremors have been frequent enough over the years to be taken as a matter of course, at least that was the case until Friday, 27 March 1964. At about 5:36 P.M. on that day, an earthquake rocked and jarred Alaska like no other in the recorded history of North America. It had a magnitude of 8.4 to 8.6 on the Richter scale, releasing twice as much energy as the quake that destroyed San Francisco in 1906. The epicenter of the quake was located about 80 miles from Anchorage and 40 to 45 miles west of Valdez in Prince William Sound.

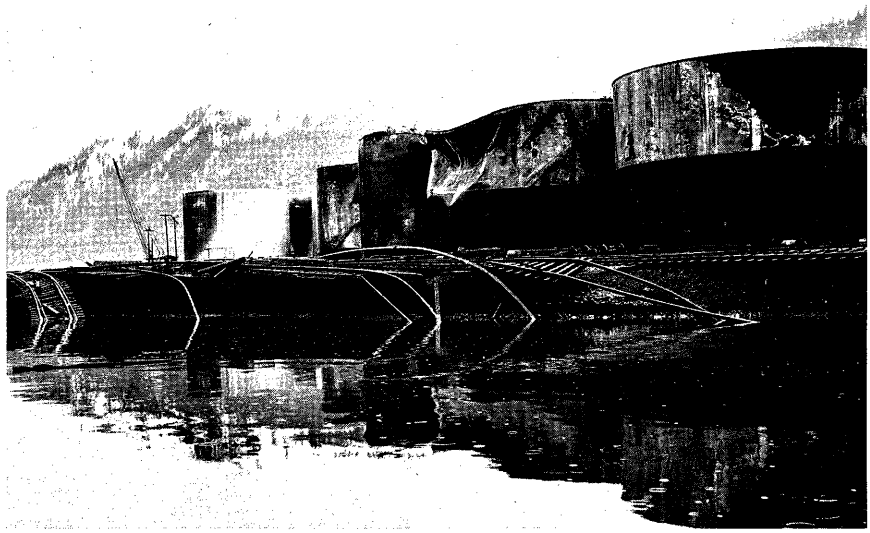
Alaska suffered great damage to property but relatively few lives were lost considering the magnitude of the disturbance. Geologists have determined that the earthquake tilted an area of at least 52,000 square miles in southcentral Alaska. East of an imaginary line drawn from the southeast coast of Kodiak Island to the western portion of Prince William Sound, land masses were thrust up as much as 33 feet in some areas. To the west of this imaginary line the land in some places sank as much as eight feet. Subsidence and uplift of highways and rail lines near the coast disrupted transportation. Navigable waterways and harbors were damaged, along with port facilities in some communities.

Most inland damage was caused by landslides, ground subsidence, and fissures resulting from violent ground motion. Damage in the coastal area generally resulted from submarine landslides, slide-induced waves, and tsunami effects. Tsunamis (seismic sea waves) swept along not only the Alaskan coast but as far south as Cali-

Earthquake damage, Turnagain residential area, Anchorage.



Earthquake damage, central business district, Anchorage.



Harbor-front damage in Seward, 1964 earthquake.

Earthquake cracks in Anchorage-Seward Highway near Portage, 1964.

fornia as well. Only Alaska's relatively low population density prevented catastrophic loss of life.[104]

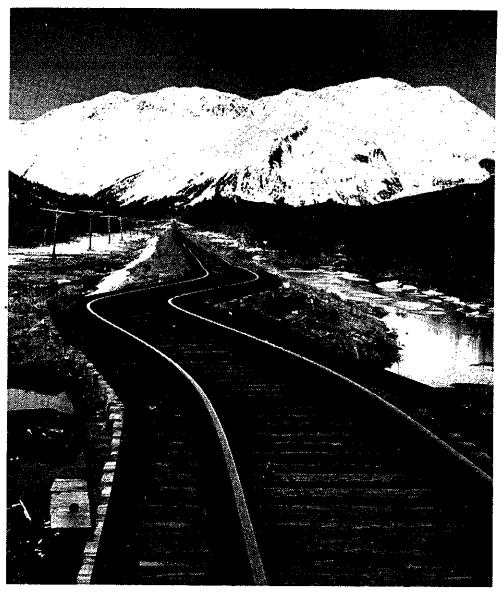
The greatest property damage occurred in the following seven population centers:[105]

1. Anchorage and vicinity. Major destruction from landslides, ground subsidence, and fissures occurred in the central business district, in the Turnagain Heights residential section, and the Government Hill area adjoining Elmendorf Air Force Base. The city dock and port terminal facilities were heavily damaged; the old Army or Ocean Dock was totally demolished.

Department store collapsed in Anchorage.

2. Cordova. Here the earthquake produced an uplift of about six feet with local fracturing of the ground surface. The town also suffered from a seismic wave that floated boats and houses, destroyed pier and dock facilities, and damaged canneries.

3. Homer. The settlement suffered moderate damage in the downtown area, but a six-foot subsidence occurred toward the outer end of Homer Spit. The city dock was ruined and much property damaged on the Spit. The small boat harbor virtually disappeared.



Earth movement twisted rails near Whittier.

4. Kodiak. Little damage actually occurred during the earthquake except for subsidence of one of the breakwaters in the harbor. Unfortunately, the tsunamis following the quake caused major loss of life and property. In the repeated wave assaults, 25 people were killed, the boat harbor and 157 dwelling units destroyed, 40 percent of the business district ruined, three of the four canneries lost, the city dock damaged, and 77 fishing boats destroyed, damaged, or missing.

5. Seldovia. Structural damage was light here, but the area subsided

more than three feet, putting the fishing community's canneries and waterfront activities at the mercy of high tides and storm wave action. A breakwater was needed immediately, plus the raising or relocation of many structures and utilities.

6. Seward. Submarine slides and seismic waves destroyed Seward's industrial area along the waterfront. The seismic shocks ruptured the petroleum storage tanks and turned a half mile of waterfront into a holocaust. Petroleum offloading facilities, canneries, the municipal dock, the railroad dock, and other business located along the water were destroyed. The submarine landslides caused subsidence of about 4,000 feet of the waterfront, and a 30-foot-high seismic wave was generated by the earthquake. Between the quake itself and the seismic wave, the industrial area was completely ruined.

7. Valdez. The old city was located on a glacial outwash plain at the head of Valdez Bay. Ground shocks cracked buildings, opened fissures in the streets, and ruptured waterlines and sewerlines. The most catastrophic event experienced in the area was caused by a submarine slide and the resultant waves which virtually destroyed the waterfront structures, the small boat harbor, the fuel storage terminal, and half of the downtown business area. The submarine slide that destroyed the waterfront area was estimated to be about 4,000 feet long and 600 feet wide. A hydrographic survey of the waterfront area after the slide showed that the water depth at the dock face had increased from 35 feet to 110 feet.

The general predicament facing the residents of these communities was the destruction of, or damage to, public utilities--primarily water and sanitary sewerlines, electric power and the telephone networks. Loss of telephone communications prevented the transmission of messages reporting losses, requests for assistance, and issuance of instructions.

Two other situations bearing heavily on recovery and rehabilitation tasks were the severe damage to port facilities (especially in Anchorage and Seward) and damages to rail and highway routes. The best example of road damage was the condition of the Seward Highway. In a fairly short stretch of road, 22 bridges had collapsed and numerous snow slides choked the route. The Alaska Railroad was greatly hurt, primarily in Anchorage and along the line to Seward. The trestle over Twenty-Mile River failed, while others were knocked out of alignment. Large areas subsided along Knik and Turnagain Arms, and at Portage the quake left the railbed some seven feet lower than before the catastrophe. In total, the damage to public and private property amounted to approximately $300 million.

The Corps of Engineers, in association with the Office of Emergency Planning, very quickly moved to help the communities in distress. The OEP asked the Corps to assist in restoring,

repairing, and where necessary, replacing publicly owned facilities knocked out by the earthquake. Less than 10 hours after the calamity, the District was notified that south-central Alaska would be designated a disaster area and it was directed to proceed immediately with disaster support action.

The District sent emergency teams in light aircraft to check on all Kenai Peninsula communities and to make damage assessments in Anchorage. The District also organized resident engineer offices in Anchorage, Valdez, and Seward and project offices in Cordova and Kodiak. These offices contracted for debris clearance, demolition, and emergency repairs to sewers, water supplies, communications, and power distribution systems such as were necessary for minimum standards of health, safety, and conduct of business. In addition to the Alaska District's personnel, some 65 engineers, organized into emergency disaster teams, were sent to Alaska from the Walla Walla, Seattle, and Portland Districts to develop specific projects and make cost estimates for projects requiring more deliberate design.

It was decided that all earthquake restoration design would be done by architect-engineers, the wartime expedient that had been used by the Alaska District in the earliest phases of its military construction mission. In this capacity, the District retained the firm of Metcalf and Eddy, who in their turn assembled a group of engineers under the supervision of Brig. Gen. B.B. Talley, USA (Ret.). Talley's construction experience in Alaska during World War II and his knowledge of Alaskan conditions were very helpful assets.[106]

The District also hired a consultant on soils mechanics and foundations to augment the District's own staff in the area of soils studies. The studies required the drilling of holes--150 or so borings--and testing samples taken from various localities including the slide areas of Anchorage, Seward, and Valdez. The firm's report of 28 August 1964 explained that in Anchorage, the strong ground motion waves from the shear stresses generated by the earthquake were the principal causes of failure in the areas consisting predominantly of Bootlegger Cove Clay.[107]

The District also put out contracts in small successive increments as much as possible to allow the maximum participation by local bidders. This approach permitted the Corps and the architect-engineer firm to produce bidding documents in a shorter amount of time than would have been required had large segments of the work been included in one contract. It was an effective way of increasing needed employment and channeling as much of the restoration work as possible to the hard-hit local residents. This was important as one of the major problems in every community, particularly in the smaller ones, was the serious disruption of the local economy.

Top priority in the rehabilitation program was given to the restoration

of water and sewer systems. Irrigation pipes connected to the usable mains were laid above the ground. Then garden hoses were used to link the pipes to houses. This created a temporary water supply system while permanent repairs were hurried along in order to finish before the Alaskan winter arrived.[108]

Soils investigation in Anchorage showed that stabilization of the major slide areas was needed, not only to restore those areas to use, but to protect adjacent property from future damage. The Fourth Avenue slide area was stabilized by use of a buttress system. This was done under a $5,000,000 contract supervised by the District. Buttressing a ten-block area involved the excavation of about 600,000 cubic yards of unsuitable dirt, sand, and clay, A third of it, plus another 500,000 yards brought from outside the city, were used in regrading the slope after drains were installed to control subsurface water. When finished, the hill was seeded, provided with parking lots, and made reusable for commercial buildings under certain load restrictions. With that sector stabilized, the central business district lots on the south side of Fourth Avenue gained safety from downslope movement in any future large earthquake.[109]

The Alaska District also supervised some experiments in soil stabilization in the Turnagain residential subdivision after the scores of ruined dwellings had been removed and the land graded. Included among the experiments was an attempt to stabilized underlying clay by electro-osmosis. In that test, 22 railroad rails were driven into the earth as probes, and through them direct current was introduced at varying voltages and amperages. Another experiment involved the development of "sand wells" (large deep holes filled with sand) to aid the drainage of underground waters.[110]

At Kodiak, both the Navy and the Corps of Engineers participated in restoration work. The OEP asked the Navy Bureau of Yards and Docks (through nearby Kodiak Naval Station) to do the debris removal and emergency repairs to public utilities, streets, and buildings. The Corps handled debris removal and the restoration of the inner harbor facilities. In addition, the Engineers became involved in the design and construction of the downtown business district which had been so badly damaged.[111]

The damage on Seward's waterfront was so devastating that merely cleaning up the debris cost more than $3 million. With the support of the OEP, the District undertook the reconstruction of the small boat basin, the city dock, and associated facilities. For the Alaska Railroad, the District designed and supervised construction of a new dock suitable for berthing two 600-foot vessels.[112]

There were two major recovery phases in Valdez. Under OEP sponsorship, the District made interim repairs to restore some services while decisions were made on the question

of relocating the city. Work was done on the utilities, school, hospital, and docking facilities. When arrangements were made to relocate Valdez to the old Mineral Creek site, the Corps took on the task of designing and constructing the waterfront facilities, streets and utilities, the municipal building, and two schools. [113]

In January 1968, nearly four years after the disaster, the Alaska District released an *After Action Report* that contained the following tally of the costs of earthquake recovery work that fell under its jurisdiction: [114]

Debris Removal	$ 4,495,000
Repairs to Buildings and Structures	27,755,000
Repairs to Utilities and Streets	50,071,000
Repairs of Coastal Installations	27,101,000
Repairs to Airfields	718,000
Total.....	$110,140,000

Throughout the recovery effort, the District placed high priority on the restoration of services and facilities before winter set in. The Anchorage work program best exemplifies the speed with which this very complex and demanding work was carried out. Reconstruction expenditures in the Anchorage area, authorized by OEP, and administered and supervised by the Alaska District, averaged a million dollars a month for the first year after the disaster. Of the 64 contracts let in restoration work here, some 48 were completed in 12 months. It should be noted that the District carried out the enormous burden of cleaning up and rehabilitation in addition to carrying out its $30,000,000 regular construction program.

THE FAIRBANKS AREA FLOOD OF 1967

Fairbanks suffered the worst flood in its history in August 1967. It was a $75 million disaster for the civilian sector; $9.5 million at the adjacent Army post, Fort Wainwright. Fairbanks began as a trading post on a riverbank in 1901 and it subsequently just grew, without long range planning, in a flood plain.

It will be recalled that the Corps had constructed Moose Creek Butte Dike during World War II in order to control the Chena Slough. In the fifties, the District developed a second flood control project for the area, (see the discussion of Chena River Lakes in Chapter IV). After some revisions, the project was nearly ready for public scrutiny when disaster struck in August 1967.

Usually, during spring breakup, the Chena and the Tanana rise as snow melts and ice chunks start moving downstream. In 1967 the ordinary problem was compounded by heavy summer rains. In July, repeated rains first caused serious flooding in Nenana, about 45 miles southwest from Fairbanks. By the morning of 14 August, the Chena was a foot over flood stage at Fairbanks; it peaked at nearly seven feet over flood stage the following day. [115]

Chena River flooding Fairbanks, 1967.

Thousands of sandbags were filled and put in place, ineffectively in many places, as roads, bridges, and railroads went out. Rescues by Army helicopters, trucks, and boats were frequent. City hospital patients were moved to Bassett Army Hospital on Fort Wainwright. Some 4,000 persons were evacuated in one day from the city to higher ground in the College (University of Alaska) area. Altogether in Fairbanks and Nenana, about 18,000 people had to retreat to emergency shelters.

As in the case of the earthquake emergency, the Corps worked with state and local government to set priorities for recovery work. The District concerned itself primarily with the restoration of public utilities and transportation facilities. Corps inspectors examined bridges, structures, and communications in both the civilian and military communities. The District arranged for the shipment of three transformers to Clear AF Station to aid in providing power for Nenana. It also furnished equipment, made aerial surveys, and repaired roads. The District supervised debris removal, the operation of the city dump, the hiring of emergency help for utility system restoration. It worked on fire and police facilities, city hall, the health center, schools, and Fairbanks International Airport.

When the District awarded the 69th recovery contract on 22 September 1967, the total expenditure for flood repair at Fairbanks and Nenana had reached $4,587,000. Related costs brought the total to more than $7,000,000, most of which was funded through the Office of Emergency Planning.[116]

In October 1967, the Alaska State Legislature passed a joint resolution recognizing the Engineers' prompt and energetic efforts to alleviate the damage and hardships. It commended the Corps' "tireless services and leadership" in the performance of its emergency relief mission.

SUMMARY AND CONCLUSION

When the Alaska Engineer District was first established it had no civil works mission; after its assumption of responsibilities in this area it was principally concerned with projects begun in one form or another before the outbreak of the second World War. The great bulk of this work had been set aside during the war and was then further delayed by the higher priorities

of the military construction mission in the post-war years. But whatever the delays, the positive work of the District is clear. It has made a tremendous contribution to the Alaskan economy by providing for safe navigation and moorage for water-borne commerce and the fishing and logging industries.

Secondly, while the District's work in the civil area was largely dominated by navigation works (chiefly small boat harbors), in the early sixties it began to expand into large flood control projects and the development of hydroelectric power, of which the Rampart project was only the most controversial example. In addition, the work of the District rested upon *comprehensive* examination and planning for the use of Alaskan water resources. This last point cannot be stressed too much; it can best be illustrated by turning to a brief examination of the District's mission as it stands in the mid-1970's.

Footnotes for Chapter Three

1. The important comprehensive studies are as follows: USACE, North Pacific Division, *Interim Report #1, Southeastern Alaska*, (1952), printed as *House Document 501*, 83rd Congress, 2nd Session, 1954.

USACE, Alaska District, *Interim Report #2, Cook Inlet and Tributaries*, (1950), printed as *House Document 34*, 85th Congress, 1st Session, 1957.

USACE, Alaska District, *Interim Report #3, Copper River and Gulf Coast,* (1950), printed as *House Document 182*, 83rd Congress, 1st Session, 1953.

USACE, North Pacific Division, *Interim Report #4, Tanana River Basin*, (1951), printed as *House Document 137*, 84th Congress, 1st Session, 1955.

USACE, Alaska District, *Partial Interim Report #5, Kodiak Harbor,* (1951), printed as *House Document 465,* 83rd Congress, 2nd Session, 1954.

USACE, Alaska District, *Interim Report #5, Southwestern Alaska*, (1954), printed as *House Document 390*, 84th Congress, 2nd Session, 1957.

USACE, Alaska District, *Interim Report #6, Northwestern Alaska*, (1957), printed as *House Document 99*, 86th Congress, 1st Session, 1959.

USACE, Alaska District, *Interim Report #7, Yukon and Kuskokwim River Basins*, (1962), printed as *House Document 88*, 2nd Session, 1964.

USACE, Seattle District, *Report of Partial Preliminary Examinations and Interim Survey of Rivers and Harbors in Alaska*, (1949), printed as *House Document 414*, 83rd Congress, 2nd Session, 1954.

USACE, Alaska District, *Review of Interim Report #2, Hydroelectric Power, Bradley Lake*, (1960), printed as *House Document 455*, 87th Congress, 2nd Session, 1962.

2. *House Document 113*, 70th Congress, 1st Session, 1927.

3. *ARCE*, 1933, p. 1199.

4. *ARCE*, 1959, pp. 1890-92.

5. *ARCE*, 1904, pp. 3656-70.

6. The report on which the authorization is based is *House Document 179*, 67th Congress, 2nd Session, 1922.

7. *ARCE*, 1929, pp 1857-58; *ARCE*, 1939, pp. 2064-66; *House Document 260*, 76th Congress, 1st Session, 1939.

8. *ARCE*, 1964, pp. 1765-66.

9. USACE, Alaska District, *Project and Index Maps*, (1974), p. 27.

10. *House Document 161*, 67th Congress, 2nd Session, 1922.

11. *ARCE*, 1926, pp. 1749-50.

12. *ARCE*, 1937, pp. 1583-84.

13. *House Document 284*, 76th Congress, 1st Session, 1939.

14. *ARCE*, 1957, pp. 1811-12.

15. *House Document 483*, 72nd Congress, 2nd Session, 1932.

16. USACE, Alaska District, *Project and Index Maps*, (1974), p. 26.

17. *House Document 108*, 71st Congress, 1st Session, 1929.

18. *House Document 268*, 75th Congress, 1st Session, 1937.

19. *ARCE*, 1945, pp. 2291-93.

20. *ARCE*, 1966, pp. 1676-77; Alaska District, *Project and Index Maps*, (1974), p. 23.

21. *House Document 249*, 75th Congress, 1st Session, 1937.

22. *ARCE*, 1964, pp. 1594-95.

23. *ARCE*, 1963, p. 1763.

24. *House Document 325*, 77th Congress, 1st Session, 1941.

25. *ARCE*, 1961, p. 1984; see also *ARCE*, 1946, 1948, 1953, and 1958.

26. A model study of the shoaling problem was undertaken by the Corps Hydraulic Laboratory at Vicksburg, Mississippi: F.A. Herrmann, Jr., *Navigation Channel Improvement, Gastineau Channel, Alaska: Hydraulic Model Investigation*, (Vicksburg, 1972).

27. *House Document 547*, 75th Congress, 3rd Session, 1938.

28. *ARCE*, 1945, pp. 2294-95; *ARCE*, 1946, pp. 2499-2500.

29. *ARCE*, 1948, p. 2905.

30. USACE, North Pacific Division, *Water Resources Development*, (Portland, 1975), p. 31.

31. *ARCE*, 1938, pp. 1892-93; *House Document 210*, 72nd Congress, 1st Session, 1932; USACE, Alaska District, *Project and Index Maps*, (June 1974), p. 28.

32. *ARCE*, 1958, pp. 1824-25.

33. USACE, Seattle District, *Report of Partial Preliminary Examination and Interim Survey of Rivers and Harbors in Alaska*, (Seattle, 1949), pp. 88-92.

34. *ARCE*, 1959, pp. 1900-01.

35. *ARCE*, 1972, pp. 40-8, 40-9.

36. *ARCE*, 1959, pp. 1888-89.

37. *ARCE*, 1960, pp. 1902-03.

38. *ARCE*, 1956, pp. 1837-38.

39. *ARCE*, 1959, pp. 1883-84.

40. *ARCE*, 1959, pp. 1884-5.

41. *ARCE*, 1958, pp. 1826-27.

42. *ARCE*, 1931, pp. 1986-87; *ARCE*, 1934, pp. 1202-03.

43. *House Document 109*, 70th Congress, 1st Session, 1927; *ARCE*, 1938, pp. 1901-02; *Rivers and Harbors Commission Document 3*, 74th Congress, 1st Session, 1934.

44. *ARCE*, 1965, pp. 1570-71.

45. *House Document 415*, 75th Congress, 2nd Session, 1937.

46. *ARCE*, 1938, p. 1900; *ARCE*, 1940, p. 2074.

47. *ARCE*, 1952, p. 2289.

48. *ARCE*, 1958, pp. 1818-19.

49. *ARCE*, 1965, pp. 1573-74.

50. *ARCE*, 1938, pp. 1899-1900; *House Document 33*, 73rd Congress, 2nd Session, 1934.

51. *ARCE*, 1967, pp. 1620-21; *ARCE*, 1968, p. 1224.

52. *House Document 34*, 85th Congress, 1st Session, 1957, pp. 126-28. (Interim Report #2).

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54. Coverdale and Colpitts, *Report to the Anchorage Port Commission on Port Development*, (New York, 1956); Tippet, Abbot, McCarthy, and Stratton, *Development Plan for the Port of Anchorage*, (New York, 1956). The note on opposition is in the Coverdale and Colpitts report, pp. 29-30.

55. *ARCE*, 1965, pp. 1559-60; *ARCE*, 1966, pp. 1665-66; *ARCE*, 1967, pp. 1619-20.

56. *House Document 702*, 76th Congress, 3rd Session, 1940.

57. *ARCE*, 1962, pp. 2016-17.

58. *ARCE*, 1965, pp. 1568-69.

59. *House Document 34*, 85th Congress, 1st Session, 1957, p. 88.

60. *ARCE*, 1962. p. 2015.

61. *ARCE*, 1970, pp. 1202-03.

62. *House Document 34*, 85th Congress, 1st Session, 1957, 98-99.

63. *ARCE*, 1964, p. 1606.

64. *House Document 34*, 85th Congress, 1st Session, 1957, pp. 90-91.

65. *ARCE*, 1963, pp. 1755-56.

66. *ARCE*, 1965, pp. 1562-63.

67. *ARCE*, 1967, 1624-5; *ARCE*, 1968, p. 1227.

68. *ARCE*, 1972, 40-7, 40-8.

69. *House Document 208*, 72nd Congress, 1st Session, 1932.

70. *ARCE*, 1935, p. 1571; *ARCE*, 1942, p. 2022.

71. *ARCE*, 1959, 1881-82.

72. *ARCE*, 1965, p. 1566.

73. *ARCE*, 1973, 40-6, 40-7.

74. *House Document 390*, 84th Congress, 2nd Session, 1957, pp. 77-81.

75. *ARCE*, 1963, pp. 1753-54.

76. *ARCE*, 1970, pp. 1200-01.

77. *House Document 390*, 84th Congress, 2nd Session, 1957, pp. 81-84.

78. *ARCE*, 1961, pp. 1978-79.

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81. *House Document 154*, 75th Congress, 1st Session, 1937; *ARCE*, 1941, pp. 2040-42; *ARCE*, 1948, pp. 2313-14.

82. *ARCE*, 1969, p. 1240.

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84. *ARCE*, 1968, p. 1231.

85. *House Document 54*, 82nd Congress, 1st Session, 1951, pp. 13-14, 21.

86. *ARCE*, 1958, 1831-32; *ARCE*, 1959, pp. 1893; *ARCE*, 1968, pp. 1230-31.

87. *House Document 228*, 72nd Congress, 1st Session, 1932.

88. *ARCE*, 1936, p. 1578.

89. *ARCE*, 1963, p. 1769.

90. *ARCE*, 1969, p. 1240; *ARCE*, 1970, p. 1206.

91. *ARCE*, 1966, p. 1682.

92. *ARCE*, 1952, p. 2303.

93. *ARCE*, 1973, p. 40-11.

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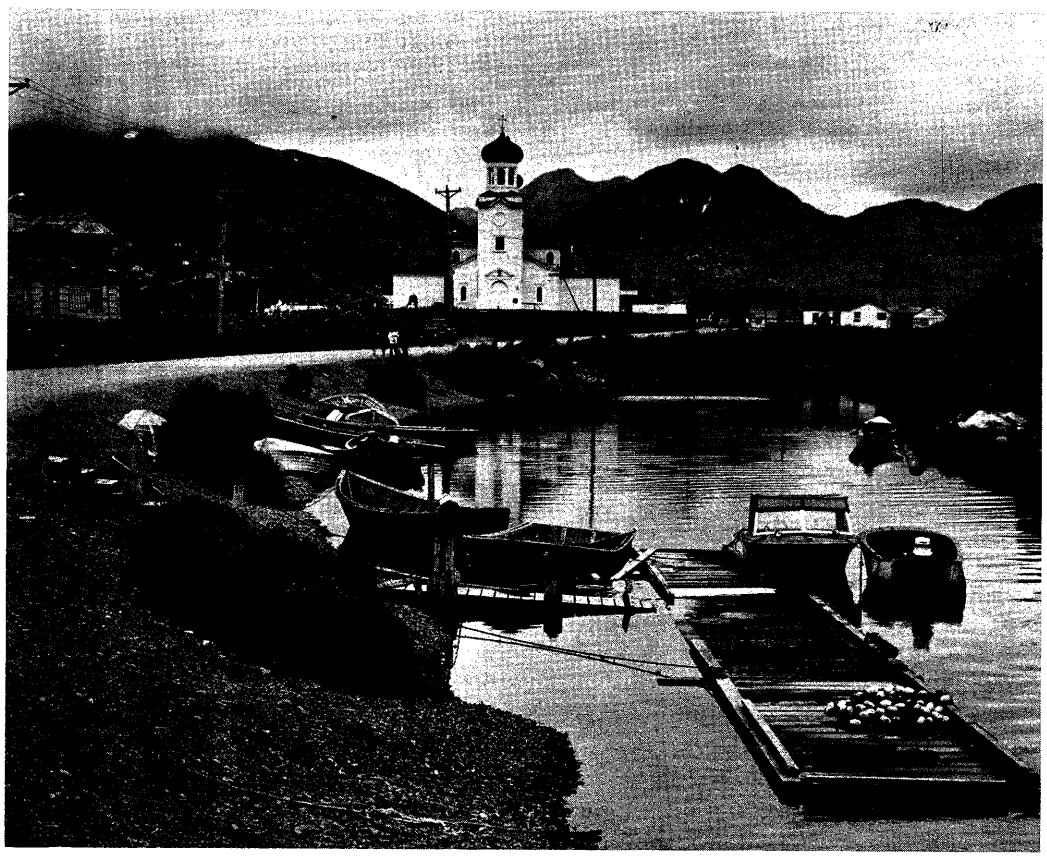
112. *Ibid.*, p. 43.

113. *Ibid.*, p. 45.

114. *Ibid.*, p. 52.

115. USACE, Alaska District, *Termination Report: Flood of the Tanana River Basin, August 1967,* (Anchorage, 1968), pp. 12-13, 18-20.

116. "Corps of Engineers Activities in Recovery from the Tanana River Flood of August 1967," (summary paper dated 22 Sep 67) in ADL-HF, 1967.



Russian church at Dutch Harbor, Aleutian Islands.