ALASKA

Eklutna PROJECT

. . . to serve 25% of all Alaskans

DEPARTMENT OF THE INTERIOR
JULIUS A. KRUG · SECRETARY

BUREAU OF RECLAMATION
MICHAEL W. STRAUS · COMMISSIONER

OCTOBER 1948

In reply refer to:

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WASHINGTON 25, D. C.

Attention: 737

January 7, 1949

The Secretary

of the Interior.

Sir:

This is my report on a plan for the development of the potential Eklutna Project near Anchorage, Alaska, for the purposes of developing the hydroelectric power and recreational potentialities of Eklutna Lake. My report is based on the attached report of the Chief of the Alaska Investigations Office of the Bureau of Reclamation, dated October 1, 1948. I concur in the plan proposed in that report, and adopt it and the recommendations contained therein.

The recommended plan calls for the construction of a low dam to raise the level of Eklutna Lake by two feet; recreational facilities at the lake; a tunnel 4½ miles long leading from the lake through the mountain to the north; a penstock 1,250 feet long; a power plant of 30,000 kilowatts installed capacity at the base of the mountain; and transmission lines to conduct the energy to load centers in the vicinity of the City of Anchorage and in the Matanuska Valley.

The primary function of the project would be the production of electrical energy---energy which is urgently needed for military and industrial uses, and for meeting normal growth in domestic loads in the vicinity of the project. In addition to the firm power which would be produced to serve the aforementioned loads, a large amount of secondary power would also be produced and would be available for industrial uses and, if needed, for irrigation pumping during a portion of each year. The recreational facilities which are proposed to be built by the National Park Service as part of the project would provide an urgently needed outlet in this rapidly expanding area.

The total estimated cost of the project, taking into consideration Alaskan differentials and price levels prevalent in October 1948 is $21,580,900 of which $20,365,400 is for the power features of the project and is reimbursable. In the event that extraordinary protection of the plant from attack by air is recommended by the Alaskan military command, the increased cost of the "protected type" installation over the installation shown in the report should be non-reimbursable. The remaining $1,215,500, the National Park Service's estimate of the cost of providing the recreational facilities at Eklutna Lake should be non-reimbursable. The reimbursable project cost could be returned to the Government during a 52-year repayment period with interest at 3% by revenues secured from the sale of power.

Since the area in which the Eklutna Project is to be built is known to be mineralized, it is possible that its construction--particularly the tunneling operation--might permit the recovery of valuable minerals, proceeds from the sale of which should be used to offset a portion of the reimbursable costs of the project.

Construction of the Eklutna Project at the earliest practicable time is highly desirable. Inasmuch as the recommended plan of development has engineering feasibility and as all reimbursable costs would be repaid in full to the Federal Government, I recommend that the Eklutna Project be authorized for construction as recommended by the Chief of the Alaska Investigations Office.

I recommend further that you adopt this report as your report on the Eklutna Project, Alaska, and that you authorize me, in your behalf, to transmit copies of the report to other affected Federal Agencies and the Governor of Alaska for their comments, prior to transmittal of the report to the President, and, subsequently, to the Congress.

Respectfully yours,

/s/ Michael W. Straus

Commissioner.

Approved and adopted: January 18, 1949

/s/ J. A. Krug

Secretary of the Interior

Enclosure 785

50688

UNITED STATES DEPARTMENT OF THE INTERIOR

JULIUS A. KRUG, Secretary

EKLUTNA PROJECT

ALASKA

BUREAU OF RECLAMATION

Michael W. Straus, Commissioner

ALASKA INVESTIGATIONS OFFICE

Joseph M. Morgan, Chief

Juneau, Alaska
October, 1948

REPORT OF THE CHIEF
ALASKA INVESTIGATIONS OFFICE

and

SUBSTANTIATING MATERIALS

REPORT OF THE CHIEF

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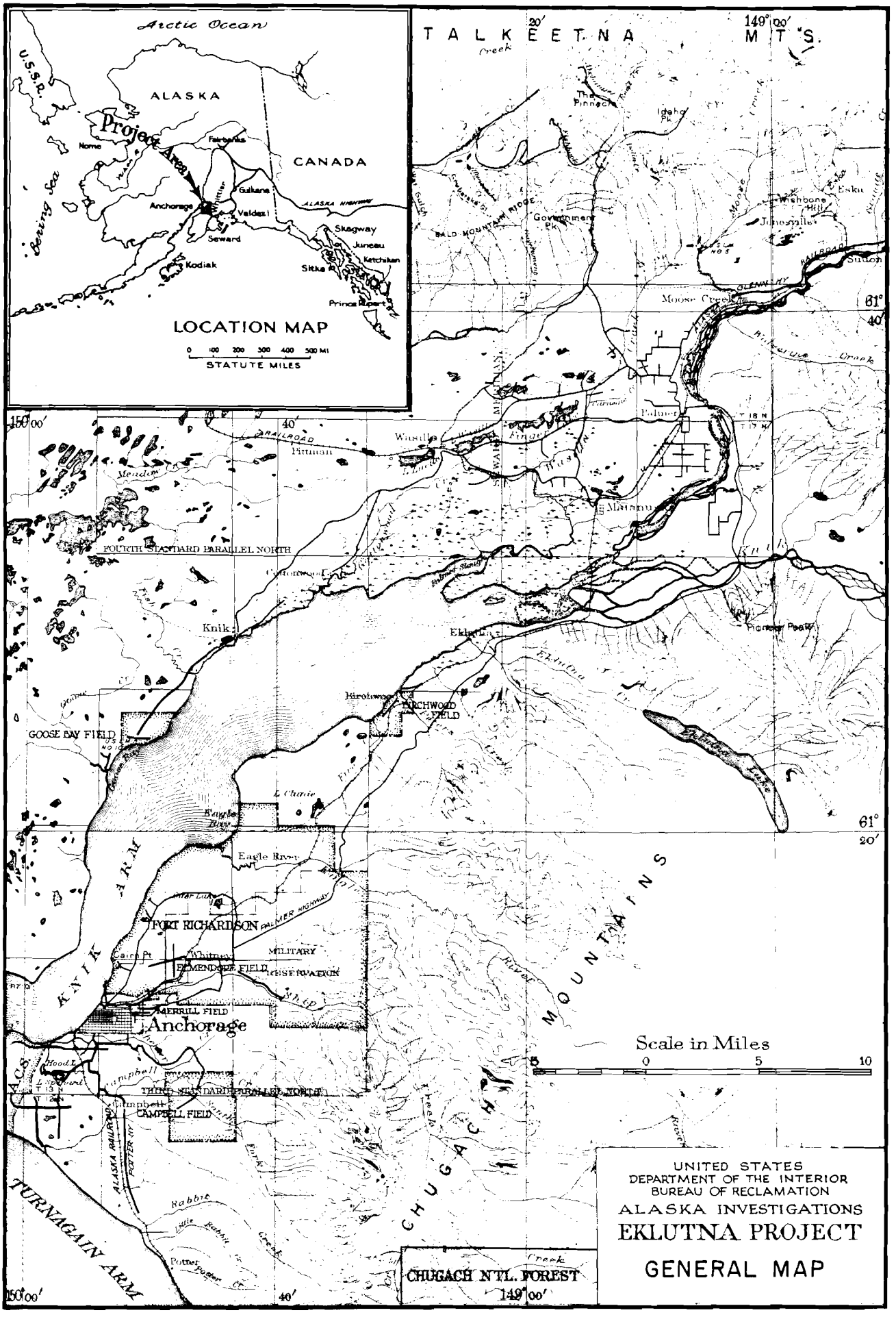

Arctic Ocean
U.S.S.R.
ALASKA
Project Area
CANADA
Bering Sea
Nome
Fairbanks
Anchorage
Gulkana
Valdez
Seward
Skagway
Juneau
Ketchikan
Sitka
Kodiak
Prince Rupert
ALASKA HIGHWAY
LOCATION MAP
0 100 200 300 400 500 MI
STATUTE MILES
TALKEETNA MTS.
149° 00'
20'
Creek
The Pinnacle
Idaho Pk
Government Pk
BALD MOUNTAIN RIDGE
Wishbone Hill
Eska
Sutton
Moose Creek
GLENN HY
61° 40'
Palmer
Wasilla
Pittman
Meadow
Matanuska
FOURTH STANDARD PARALLEL NORTH
Knik
Eklutna
Pioneer Peak
Birchwood
BIRCHWOOD AIRFIELD
GOOSE BAY FIELD
L. Charlie
Eagle River
KNIK ARM
FORT RICHARDSON
PALMER HIGHWAY
MILITARY
Cairn Pt
Whitney
ELMENDORF FIELD
MERRILL FIELD
Anchorage
Campbell
THIRD STANDARD PARALLEL NORTH
CAMPBELL FIELD
ALASKA RAILROAD
FOSTER HY
TURNAGAIN ARM
Rabbit
Potter
CHUGACH MOUNTAINS
Scale in Miles
5 0 5 10
CHUGACH NTL. FOREST
150° 00'
40'
149° 00'
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA INVESTIGATIONS
EKLUTNA PROJECT
GENERAL MAP

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Alaska Investigations Office
Juneau, Alaska

October 1, 1948

To: The Commissioner, Bureau of Reclamation

From: Chief, Alaska Investigations Office, Juneau, Alaska

Subject: Report on the Eklutna Project, Alaska

Transmittal

1. Herein is my report on the potential development of the Eklutna Project near Anchorage, Alaska. Substantiating Materials are appended to this report. Project benefits would exceed project cost in the ratio of 1.7 to 1.00. All monies necessary for construction would be repaid to the Federal Government with interest at 3% within 52 years. I recommend that you approve this project. The power shortage in the project area is so acute as to constitute an emergency. The people of Alaska are hopeful for early Departmental action and Congressional consideration leading to authorization of the project and appropriation of construction funds in the current Fiscal Year.

Authority for the Report

2. This report is authorized to be made by virtue of the Interior Department Appropriation Act, for the fiscal year 1949, which provided $150,000 to be expended by the Bureau of Reclamation on Alaskan investigations "for engineering and economic investigations, as a basis for legislation, and for reports thereon, relating to projects for the development and utilization of the water power resources of Alaska..."

Cooperation and Acknowledgement

3. Federal, Territorial and local agencies, assisted in the investigation of the project, thereby making possible a comprehensive and coordinated report. Of especial value were data collected by the Geological Survey and the City of Anchorage. Need for the project and preliminary evaluated benefits that would result from authorization and construction have been studied by the following agencies, and their reports included in the Substantiating Materials: Alaska Native Service, Alaska Railroad, Alaska Road Commission, Bureau of Land Management, Bureau of Mines, Fish and Wildlife Service, Geological Survey and National Park Service, all of the Department of the Interior; Alaska Agricultural Experiment Stations, Rural Electrification Admin-

istration of the Department of Agriculture; Civil Aeronautics Administration of the Department of Commerce; Commander-in-Chief of the Alaska Command of the Department of National Defense; Federal Power Commission; Territorial Government of Alaska, and the City of Anchorage.

History and Settlement

4. Although the Eklutna Project area was first visited by traders and trappers in the late 1700's and slight settlement commenced following the purchase of Alaska in 1867, it wasn't until the United States Government started construction of the Alaska Railroad in 1915 that settlement advanced to any degree. At that time the townsite of Anchorage was laid out, and the city has since grown rapidly as headquarters for the railroad and many other government agencies, as well as the supply and trading center for large outlying areas. The establishment of the military base at Fort Richardson, near Anchorage, has had a tremendous influence upon the community in recent years. Anchorage had a population of 3,495 in 1939, with current estimates placing it between 19,000 and 35,000. Growth has been so rapid in the past few years that an accurate estimate is impossible.

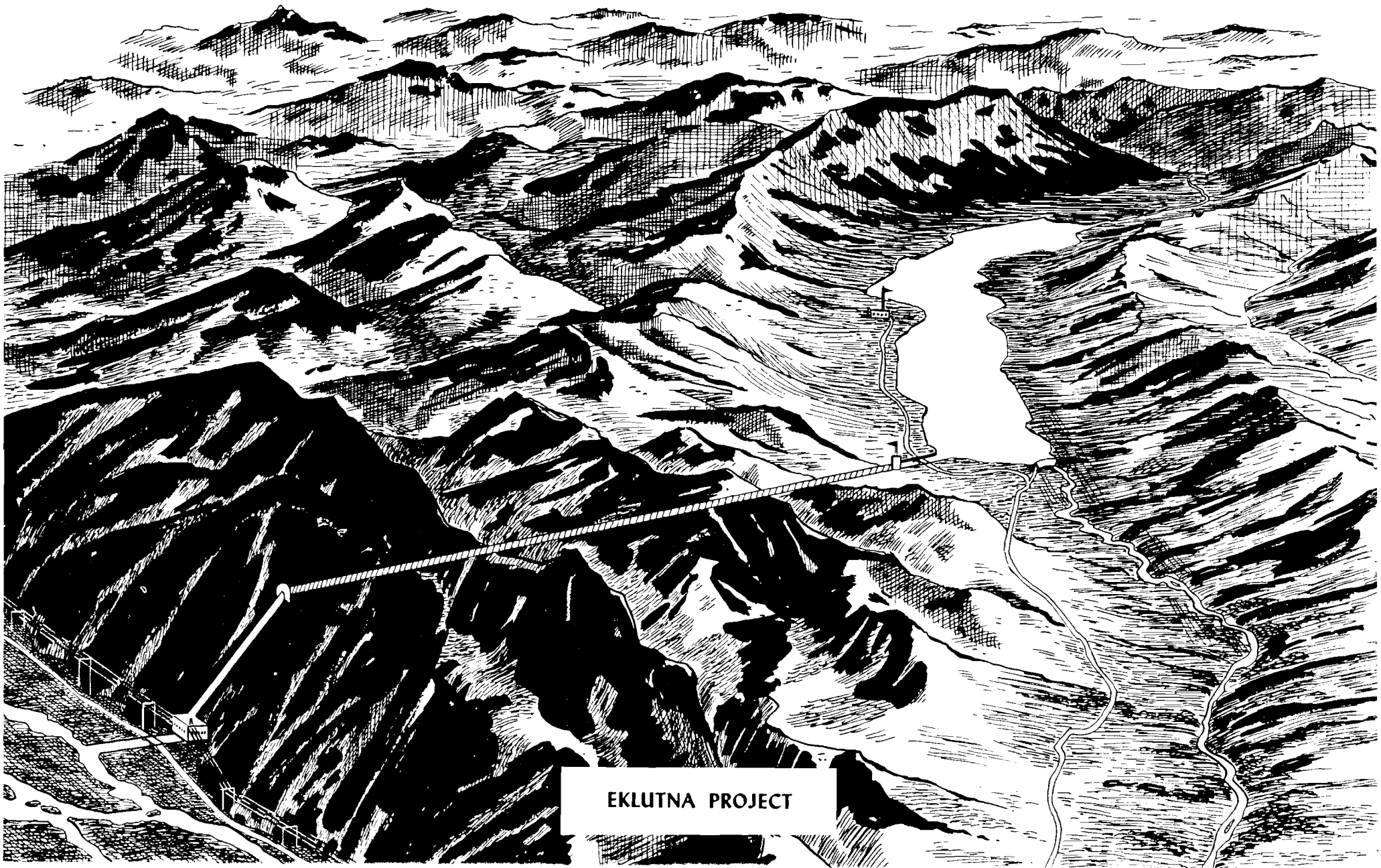
5. The other center of activity in the area is in the Matanuska Valley, some 50 miles northeast of Anchorage. Its headquarters and supply center is the town of Palmer. The area is essentially of agricultural significance. Settlement began here in the early days of the development of Alaska also, but not until the government settlement program in 1935, under the Rural Rehabilitation Corporation, did large scale development take place. Also in the Matanuska area are the Matanuska coal fields at Jonesville, and the Willow Creek mining district, where gold lode mining takes place.

6. It is also difficult to estimate the population of the Matanuska Valley, but it is thought that there are about 400 farms, with more than 4,500 people now residing in the valley. The town of Palmer probably has about 1,000 residents.

Location and Major Project Features

7. The project is in the south-central sector of the main land mass of Alaska. Eklutna Lake is nestled in the Chugach mountain range, at an elevation of 868 feet, and at a point approximately midway between the Matanuska Valley to the north and the City of Anchorage to the south. The lake is reached by a 10-mile access road from the Anchorage-Palmer highway, at a point about 26 miles north of Anchorage. The lake is roughly seven miles long by one mile wide, and has a maximum depth of 200 feet.

8. The project would involve the construction of a dam as may be seen in the illustration to raise the lake level two feet; a tunnel


EKLUTNA PROJECT

four and one-half miles long leading from the lake through Goat Mountain; a penstock 1,250 feet long to the power plant. The power plant would be located at the base of the Chugach Mountains on a narrow strip of land between the mountains and the sea. It would have an installed capacity of 30,000 kilowatts. Transmission lines would be constructed to conduct the energy to the population centers of the City of Anchorage, Matanuska Valley, Fort Richardson Army Base and Elmendorf Airfield.

Climate

9. With a record high temperature of 92 degrees and a record low of -37 degrees, the Eklutna area has a wide temperature range. It, however, has never experienced the low temperatures that are felt at such places as Fairbanks and elsewhere in north and central Alaska. The annual precipitation varies between 14 and 16 inches, classifying the section as semi-arid. The precipitation is heaviest during the late summer months. The growing season in the Matanuska Valley averages 108 days a year.

Purposes to be Served

10. Eklutna Project would serve the multiple purposes of power production, irrigation and recreation. However, the primary purpose of the project would be the production of electrical energy needed now within the immediate area, or which it is known will be needed by the time the project could be completed. A large amount of non-firm power would also be produced which would be available for agricultural and industrial use during six months of the year. Present local power production facilities are not adequate to meet the demands and production costs are excessive, hence additional hydroelectric power at a reasonable rate would encourage further settlement and expand the industrial development of the area.

Power Market Areas and Loads

11. Careful study of load growth during recent years in the area and review of known future construction programs leads to the conclusion that military and civilian power requirements would absorb the full capacity and output of the proposed Eklutna power plant by 1954. If this hydroelectric development is not constructed promptly, the only means of avoiding future power shortages in the area will be the provision of additional steam or diesel generating capacity, which not only results in higher costs for power, but rapidly consumes and dissipates irreplaceable mineral fuels.

Irrigation

12. It has been proven by scattered experiments in the vicinity of the Eklutna Project that irrigation of crops is feasible and results in

a substantial increase in crop production. Due to the semi-arid condition of the area and to the fact that most of the precipitation occurs in the late summer months, irrigation could be carried out considerably more extensively than is now the case. Eklutna Lake would not be diverted for this use due to its colloidial content and distance from centers of agricultural development, but water in those areas is generally plentiful. Lack of low-cost power for pumping purposes has been the major stumbling block. No farmer can afford to install a pumping system with power shortages imminent and under present power costs. The Eklutna Project would help alleviate this problem.

Recreation

13. Recreational facilities at present are limited, there being a great need for further development. Development of Eklutna Lake as a recreation center in conjunction with the hydroelectric project would be highly desirable. If the area were to be maintained in its primitive state as far as possible, its abundant wildlife and scenic splendor would provide a major attraction. Facilities for meals, lodging and year-round sports, including boating, hiking, camping, skiing and skating, would give the residents of the entire area as well as tourist recreational advantages which are now almost totally lacking.

14. Since Eklutna Lake is roughly halfway between the centers of population at Anchorage and Palmer, any recreational development would be within easy reach of residents of the entire area. Thousands of troops stationed at permanent military bases in the area would welcome development of recreational potentialities of Eklutna Lake.

Industry and Economic Conditions

15. Industry in the area includes agriculture, livestock raising, gold mining in the Willow Creek district, coal mining in the Matanuska district, several small lumber mills, fishing in Cook Inlet south of Anchorage with canneries located both along the inlet and at Anchorage, trapping and fur farming. Anchorage thrives as the trading, supply and recreational center for the area, with all the trades, services, stores and comforts to be found in a city of similar size in the United States. The tourist business is of growing importance, as is the guiding and outfitting of hunting and fishing parties. The air transportation business is often referred to as the city's leading industry, with planes arriving from and departing to the States and the Orient, as well as the entire Territory.

16. Construction, with nearby Fort Richardson still expanding and with a large backlog of civilian demand, is still booming. Projects now under way or scheduled for the near future will add to this activity. They include: a three-year rehabilitation program for the Alaska Railroad, the construction of the International Airport and

a 400-bed hospital for the Alaska Native Service at Anchorage, the construction of a road connecting Anchorage with the Kenai Peninsula, a resumption of large-scale construction at Fort Richardson involving 28 million dollars, and the hard-surfacing of the Anchorage-Palmer road.

17. In the past, the region has been largely dependent upon government payrolls, supplemented by commercial establishments, fishing, farming, mining and trapping. Government agencies which have headquarters or offices at Anchorage include the Alaska Railroad, the Civil Aeronautics Administration, the United States Weather Bureau, Bureau of Mines, Bureau of Land Management, Fish and Wildlife Service, the Alaska Road Commission, the Alaska Highway Patrol.

18. With World War II came a boom in military construction and a resulting increase in civilian population and activity in Anchorage. It is estimated that for every job created in the construction business another position was created among supporting businesses in town. If government payrolls ceased overnight, Anchorage and vicinity would experience a serious economic blow. There is a great need for further development of privately-owned industries.

19. The deterrent to such development has been high costs. Nearly everything which Alaskans need must at present be shipped in from the States. Freight rates are among the highest in the world and contribute to an abnormally high cost of living. This high cost of living, and hence production, discourages new industries, which depresses further domestic expansion. The lack of a large population coupled with the lack of goods for export, in turn results in continued high freight rates. Alaskans on the whole have enjoyed prosperous times over the last eight years, and there are enough large projects now on the agenda to assure a high level of employment for the next three years, but the lack of a basic economy capable of supporting a growing population will be a serious problem if not remedied. To this end sufficient electric power at reasonable rates could be a major catalyst.

20. The area is served by all four modes of transportation: land, air, sea and rail. While ocean going boats dock at Seward and at Whittier, south of Anchorage on the Kenai Peninsula, some can and do come into Anchorage during the ice-free months. The Alaska Railroad travels through Anchorage and the Matanuska Valley enroute to Fairbanks in the Interior. Aside from numerous roads in and about the centers of population, a highway extends from Anchorage through the Matanuska Valley and on to the Interior road system, including the Alaska Highway to the States. Bus service is available within the towns and over the highway system. Both Anchorage and Palmer have airports and air transportation is available to various points in the States, the Orient and throughout the Territory. Alaskans are among the most air-minded people in the world, and air transportation is highly developed.

Plan of Development

21. The recommended plan for the development of Eklutna Project calls for the construction of a concrete gravity type dam including supporting buttress to replace an existing structure now owned by the City of Anchorage. The dam would be constructed to elevation 879.5 which is four feet above the maximum lake level during floods. The length of the dam would be 329 feet with concrete wing-walls extending out 48 feet on the left side and 50 feet on the right making a total structural length of 427 feet. The spillway crest at elevation 870 would be 190 feet in length and without control gates. The spillway is designed for a maximum discharge of 7,500 cubic feet per second when the lake surface is at elevation 875.5.

22. The major portion of the water entering Eklutna Lake would be diverted through a nine-foot diameter tunnel entering Goat Mountain and extending for a distance of nearly four and one half miles to the Knik River side of the mountain range. Nearing the tunnel outlet a concrete surge tank would extend up through the mountain. At the mouth of the tunnel a steel penstock 6½ feet in diameter and 1,250 feet long would intercept the tunnel flow and convey the water down the mountain side to the power plant. The average operating head at the power plant would be approximately 820 feet.

23. The power plant located at the base of Goat Mountain directly below the tunnel outlet near mile 34 on the Anchorage-Palmer highway would have an installed capacity of 30,000 Kw. It would be necessary to construct a canal, and a short reinforced concrete bridge where the canal would pass beneath the Anchorage-Palmer highway, to convey the tailwater from the power plant to the Knik River approximating a distance of 2,000 feet. Military considerations may require that the plant be a "protected type" installation.

24. The plan of operation purports to draw the lake level down a maximum of 40 feet to elevation 830 feet. There is in the lake at least 200,000 acre-feet of space below elevation 830 which is considered sufficient dead storage space to provide for silt accumulation and a useful life to the reservoir far in excess of 100 years. The capacity of the reservoir between elevations 830 and 870 would be 123,000 acre-feet and would facilitate the storage of sufficient water to produce a firm output of 100 million kilowatt-hours. Secondary energy would exceed 40 million kilowatt-hours during an average year run-off, plus approximately 3.5 million kilowatt-hours to be generated at the existing Eklutna plant from spills and inflow below the proposed dam.

25. Geological investigations disclosed that the foundation and abutment materials in the proposed damsite area are interbedded

glacial, lake and stream deposits ranging from tight clay to permeable gravel and boulders. Similar engineering-geologic weaknesses have been met and successfully corrected in many previous Bureau projects. In this instance also, they can be successfully dealt with by accepted methods of foundation treatment. The construction of a low dam to raise the existing lake level from elevation 868 to 870 is geologically and economically feasible.

26. The canal gate and tunnel comprising the reservoir intake will require excavation and construction operations in overburden materials similar to those at the damsite. The major portion of these operations would be carried on below groundwater table.

27. The four and one-half mile rock tunnel would be bored through moderately fractured sandstone, andesitic and similar rock types. Some large flows of groundwater are anticipated and at least one major and a large number of minor broken and crushed zones are present. Soft, "squeezing" ground would be encountered locally and it is estimated that 2,000 lineal feet of the total tunnel length would require strong, continuous supports; moderate to very light supports would be adequate for the remainder of the tunnel length. No serious difficulties are anticipated in the tunnel operations, provided adequate geologic investigations are concluded as a guide for design and construction procedures.

28. Ample quantities of the natural construction materials required for the Eklutna Project can be located within economic hauling distances.

29. Transmission facilities would consist of two 115 to 161 kilovolt wood pole lines; one extending from the Eklutna 30,000 Kva. substation, a distance of 34 miles to the City of Anchorage; and the other line to a point on the Palmer-Wasilla road about four miles west of Palmer, a distance of 12 miles from the Eklutna power plant and substation. Initially these lines will be operated at 57 kilovolts to facilitate service to the four 1,500 Kva. recently constructed substations of the City of Anchorage. Provision is made for a 5,000 Kva. substation to supply Fort Richardson Army Base and Elmendorf Airfield electric service and a 2,000 Kva. substation for the Alaska Railroad.

Costs

30. The estimated cost of construction of the project, taking into consideration Alaskan differentials and present price levels, is $20,365,400. This includes the acquisition of the existing Eklutna power generating facility or alternate arrangements that may be made to provide for the most efficient coordinated operation of the two plants. The purchase price paid by the City of Anchorage in October, 1943 for the existing Eklutna plant, the diesel plant and transmission

system was $1,100,000. Bonds now outstanding total $865,000 as of September 1, 1948. The project cost as shown does not include an amount of $1,215,500, estimated by the National Park Service as the cost of providing the recreational facilities at Eklutna Lake.

31. The estimated annual cost of operation and maintenance for the project, exclusive of recreational facilities, is $158,300. The estimated annual replacement costs total $72,600. Recreational replacement costs are not included in any of these operating costs.

32. There follows a progress chart showing tentatively a schedule by calendar years for design and construction with estimates of funds required from fiscal year 1949 and extending through to the completion of the project in 1954.

Benefits

33. The direct benefits which are the revenues to be received from the sale of power are estimated to be $1,015,200 annually during the 50-year period of analysis. In addition, to these direct benefits there would be indirect benefits in the form of savings to power purchasers and increased income to distributors and to consumers through the increased use of electric power. The savings to power purchasers have been estimated at $748,500 annually, and due to lack of data and the urgency of completing this study no estimate has been made of the increased income to distributors and final consumers. The direct benefits plus the measured indirect benefits total $1,763,700 annually. The annual costs for amortization of the initial cost of the project at 3% in 50 years plus O&M and replacement have been estimated at $1,022,400. The ratio between the total measured benefits and costs for this power project is therefore 1.7 to 1. In addition to the power benefits that are measurable in monetary terms there are recreational benefits which the National Park Service indicates are twice as much as the total annual costs for recreational facilities.

Allocation of Estimated Costs

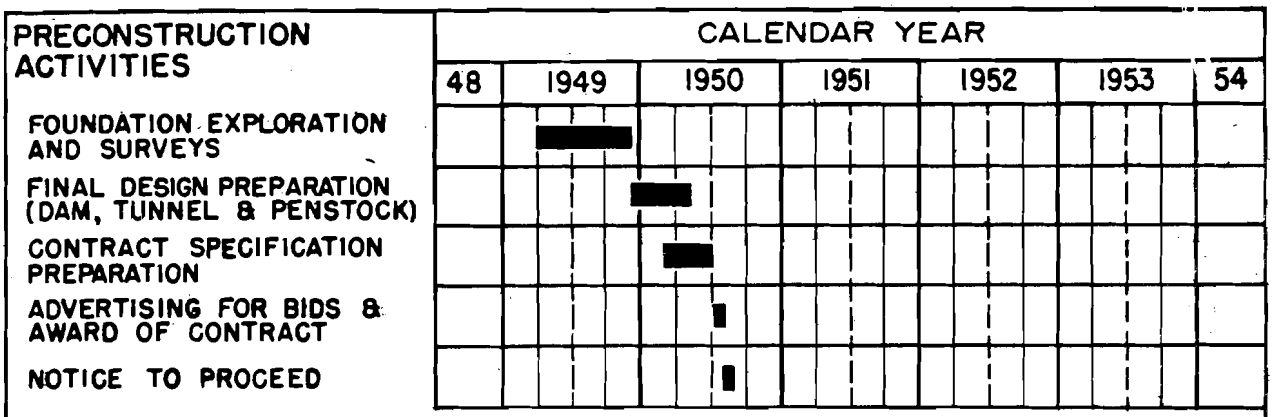
34. The estimated construction cost of the proposed facilities is $21,580,900, of which $20,365,400 is for the dam, power plant and related facilities, and $1,215,500 is for provision of recreational facilities. The ratio of benefits to costs for the power facilities is estimated to be 1.7, while the National Park Service has advised the Bureau that the benefits from recreational facilities may be considered as equal to twice the estimated costs of the recreational facilities, or a benefit-cost ratio of 2.0. However, due to the fact that the lake already exists and is at least as useful for recreation as it would be as a result of the construction and operation of the dam, the only project costs which might be allocated jointly to recreation and power would be the cost of the road. Since the estimated cost of the road which would serve both purposes is only about one-half of one percent of the estimated cost of the project,

it is clear that an allocation of cost materially exceeding the actual cost of the recreational facilities does not appear warranted in this case. The total cost of the power and related features of the project, $20,365,400, is therefore tentatively allocated as reimbursable, and is assumed to be all interest-bearing until investigations now in progress disclose the exact amount of power facilities to be reserved for irrigation pumping. The estimated costs of the recreational features recommended herein, $1,215,500, are allocated to recreation and would be non-reimbursable.

Repayment of Reimbursable Costs

35. Reimbursable project cost of $20,365,400 would be returned to the Government during a 52-year repayment period with interest at three percent. Revenue source would be the sale of 96 million kilowatt-hours of firm energy for 8.5 mills per kilowatt-hour and

EKLUTNA PROJECT
SCHEDULE FOR DESIGN & CONSTRUCTION
WITH ESTIMATES OF FUNDS REQUIRED



ESTIMATES OF ANNUAL APPROPRIATIONS NECESSARY TO PERMIT EFFICIENT CONSTRUCTION

FISCAL YEAR					
1949	1950	1951	1952	1953	1954
$ 229,000	$2,400,000	$5,000,000	$ 5,500,000	$ 5,736,000	$ 1,500,400

47279

Note: Only construction items requiring most time are shown. All other work can be done within time indicated

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

41.5 million kilowatt-hours of secondary energy for 4.8 mills per kilowatt-hour each average year.

Conclusions

36. It is concluded that:

A. Construction of Eklutna Project as outlined herein is highly desirable for the following reasons:

(1) The use of electric power in the power market area is expanding so rapidly that new installations of hydroelectric power plants are needed as quickly as possible to meet the emergency requirements of existing loads and to permit the establishment of new industries to support increases in population and economic development.

(2) The recommended plan of development has engineering feasibility.

(3) All reimbursable costs would be repaid in full.

(4) The favorable benefit-cost ratio, 1.7 to 1, indicates the economic desirability of the project from the national standpoint.

B. In the event that a protected type power plant installation is required for military security, the plant would be designed in accordance with plans furnished by the Department of National Defense, and the additional cost of such an installation should be non-reimbursable.

C. The cost of planning, construction, operation and maintenance of the recreational facilities should be non-reimbursable.

Recommendations

37. It is recommended:

A. That the Eklutna project, consisting of the following principal works:

Eklutna Dam, Reservoir, Tunnel, and Power Plant,
Transmission Facilities, and appurtenant works

be authorized for construction, operation, and maintenance by the Secretary of the Interior, through the Bureau of Reclamation, in accordance with the general plans set forth in this report, but subject to such modifications, omissions, or additions as the Commissioner of Reclamation, with the approval of the Secretary of the Interior, may find necessary or desirable from time to time to accomplish the objectives of the project; and

B. That the recreation facilities of the Eklutna Project be authorized for construction, operation, and maintenance by the Secretary of the Interior, through the National Park Service, in accordance with the general plan set forth in this report, but subject to such modifications, omissions, or additions as the Director of the National Park Service, with the approval of the Secretary, may find necessary or desirable from time to time to accomplish the objectives of the project: Provided, That prior to commencement of construction of such facilities the Secretary shall secure satisfactory assurances that an appropriate local or territorial agency will take over the operation and maintenance of the recreational facilities within a reasonable period after completion of their construction.

Joseph M. Dodge

UNITED STATES DEPARTMENT OF THE INTERIOR

JULIUS A. KRUG, Secretary

BUREAU OF RECLAMATION

MICHAEL W. STRAUS, Commissioner

SUBSTANTIATING MATERIALS

EKLUTNA PROJECT

ALASKA

SUBSTANTIATING MATERIALS

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CHAPTER I

L A N D O F O P P O R T U N I T Y

In the northwest corner of the North American continent, at one point only 56 miles distant from Russian Siberia, lies the Territory of Alaska, America's last frontier. With an area of 586,400 square miles and containing vast stores of untapped natural resources, it is today's land of opportunity for thousands of Americans seeking new horizons. Equally important is its position as back-door guardian of the United States in the event of attack from the Far East or over the polar regions.

At the gateway to the main land mass of Alaska stands Anchorage, its largest and fastest growing city. Forty-eight miles northeast of Anchorage is the Matanuska Valley, Alaska's most productive agricultural region. High up in the Chugach Mountains, halfway between these two centers of activity, Eklutna Lake nestles amidst the spectacular setting of nature at its best.

PHYSICAL GEOGRAPHY

The Eklutna Project area lies in the south-central portion of the main body of Alaska and is usually referred to as Westward Alaska. From north to south it includes the Willow Creek mining district, the Matanuska Valley, the lands bordering Knik Arm between Palmer and Anchorage, and the Anchorage area south to Turnagain Arm. It is bounded on the north and west by the sea and the Alaska Range of mountains and on the east by the Chugach and Talkeetna Mountains. Anchorage, the largest city in Alaska and the supply center for this area, lies 1400 airline miles northwest of Seattle.

The Indian village of Eklutna, from which the lake - and hence the project - gets its name, lies 26 miles northeast of Anchorage by rail and highway. It is the location of a vocational school for natives operated by the Alaska Native Service.

Physical Features

Geologically, the district is a continuation of the continental Pacific Mountain system, whose parallel ranges can be traced through British Columbia into Alaska. The particular sector under discussion embodies two large flat areas, one a valley floor and the other a coastal plain. Mountains and the sea almost isolate these two areas from each other but they are connected by a narrow strip of land which is bordered on one side by Knik Arm, and on the other by rugged mountains.

In the southern of the two areas is Anchorage, located on a bluff

overlooking Cook Inlet, which is an extension of the Gulf of Alaska. Anchorage is bounded to the north, south and west by the sea. Back of the city a low, flat plain extends to the Chugach Mountain Range, which roughly covers a quarter-circle from northeast to southeast. These mountains are, for the most part, steep and rugged, though free of snow during the summer months. The area thus enclosed by the mountains and the sea totals about 75 square miles and it is mostly covered by a dense growth of small birch and spruce, interspersed with many lakes and ponds.

Northeast of Anchorage, the mountains come down to meet the sea, and from there almost to Palmer the highway and railroad cling to a narrow strip of land. On this road at Mile 26 from Anchorage is Eklutna Village, and branching off to the right is the side road climbing up to Eklutna Lake.

Forty-eight miles by highway northeast of Anchorage, at the head of Knik Arm, is the beginning of the Matanuska Valley. It is roughly 50 miles long by 16 miles wide, and almost completely surrounded by the Alaska, Talkeetna and Chugach mountain ranges. Through its floor run the Matanuska and Knik Rivers. Most of the Valley is covered by a dense growth of birch and spruce, many of which are a foot or more in diameter. It is estimated that roughly half the land in the Valley may be suited to farming, while portions of the foothills are considered suitable for the grazing of livestock. In the northeastern sector are the Matanuska coal fields, while to the northwest is the Willow Creek mining district.

Climate

The climate is fairly uniform and presents what might be called the average in Alaska, being warmer than the Interior and cooler than Southeast Alaska in winter. For those who think of Alaska as a frozen land, it is well to note that Anchorage is sometimes warmer in winter than many places in the United States:

City	Years Record	Maximum Temperature	Minimum Temperature
Anchorage, Alaska	29	92	-37
Butte, Montana	40	100	-52
Salt Lake City, Utah	40	105	-20
Cheyenne, Wyoming	40	100	-38
St. Paul, Minnesota	36	104	-41
Detroit, Michigan	40	105	-24
Chicago, Illinois	40	105	-23
Lake Placid, New York	30	94	-39
Hanover, New Hampshire	40	101	-37

The precipitation is about that of Salt Lake City, and averages between 14 and 16 inches annually, most of it falling during the late

summer months. The Eklutna Project area is classified as semi-arid. Winds are generally light, although during certain periods severe winds are experienced, which damage buildings and erode unprotected fields. The prevailing wind is from the southeast, and consequently it is the high mountains to the south and east which get the heavy precipitation. The humidity is relatively light. There is no permafrost (permanently frozen ground) except at higher elevations in the surrounding mountains.

Due to the northern latitude, the days are short in winter and long in the summer, which accounts partially for the rapidity with which produce grows during the warm months.

Summaries of climatic statistics follow in tabular form for Anchorage and Palmer, headquarters of their respective districts:

	Anchorage	Palmer
Temperature		
January, average	11.2	12.6
July, average	57.0	57.7
Maximum recorded	92	91
Minimum recorded	-37	-36
Precipitation, average inches	14.56	15.45
Killing frost		
Last in spring	May 23	May 26
First in fall	Sept. 13	Sept. 11
Growing season, days	113	108
Hours possible sunshine, first day each month, hours and min.		
January	5:42	5:21
February	7:45	7:33
March	10:22	10:19
April	13:19	13:22
May	16:08	16:19
June	18:41	19:03
July	19:14	19:40
August	17:12	17:27
September	14:21	14:25
October	11:32	11:30
November	8:39	8:29
December	6:15	5:58

SETTLEMENT

History

The waters of Cook Inlet were first explored by Russian traders in the late 1700's and by Captain James Cook, the Englishman, at about the same time. In unsuccessfully seeking an elusive passage, the latter gave Turnagain Arm its name. The first to travel the land to any extent were fur seekers and later occasional prospectors. After the United States purchased the Territory from Russia in 1867, commercial fishing in the Inlet commenced. Gold discovered in the vicinity of Cook Inlet in 1880 attracted some people, but there was no stampede.

Following the great gold strikes of the Yukon, Nome and Fairbanks regions, permanent settlers began coming to Alaska, some of them settling along the shores of Cook Inlet or Knik Arm, others in what is now called the Matanuska Valley. Those interested in coal, which had been discovered in commercial quantities in the Matanuska Valley, and in a short year-round route to the Interior, began planning a railroad. The Alaska Central started construction north from Seward and in 1914 the Federal government took it over and continued building toward Fairbanks.

Anchorage began to flourish when it was made headquarters for the railroad under construction and a planned townsite was laid out. Upon completion of the road in 1923, offices and maintenance shops were permanently located in Anchorage, and many of the construction workers stayed to settle the townsite. Anchorage has ever since been expanding, with its growth closely associated with that of farming, mining, fishing, construction, transportation, and federal agencies.

Two events have combined in recent times to boost the growth of the project area. In May, 1935, 200 families from the drought-stricken Midwest were transported to Alaska by the government-directed Alaska Rural Rehabilitation Corporation and settled on the land, giving the Matanuska Valley its first large group of settlers. Some of these settlers were incompetent for the hard work of farming in Alaska, but their place has been taken by newcomers eager to succeed in the new land. The Valley has enjoyed a steady growth both in population and in agricultural developments which are now firmly established.

Prior to 1940, the only permanent military establishment in Alaska consisted of a small garrison at Chilcoot Barracks, near Haines in southeastern Alaska. With the advent of World War II, the United States was forced to hurriedly arm and defend the Territory, and huge defense projects were undertaken. Thousands of workers were rushed north to construct (among others) the large military

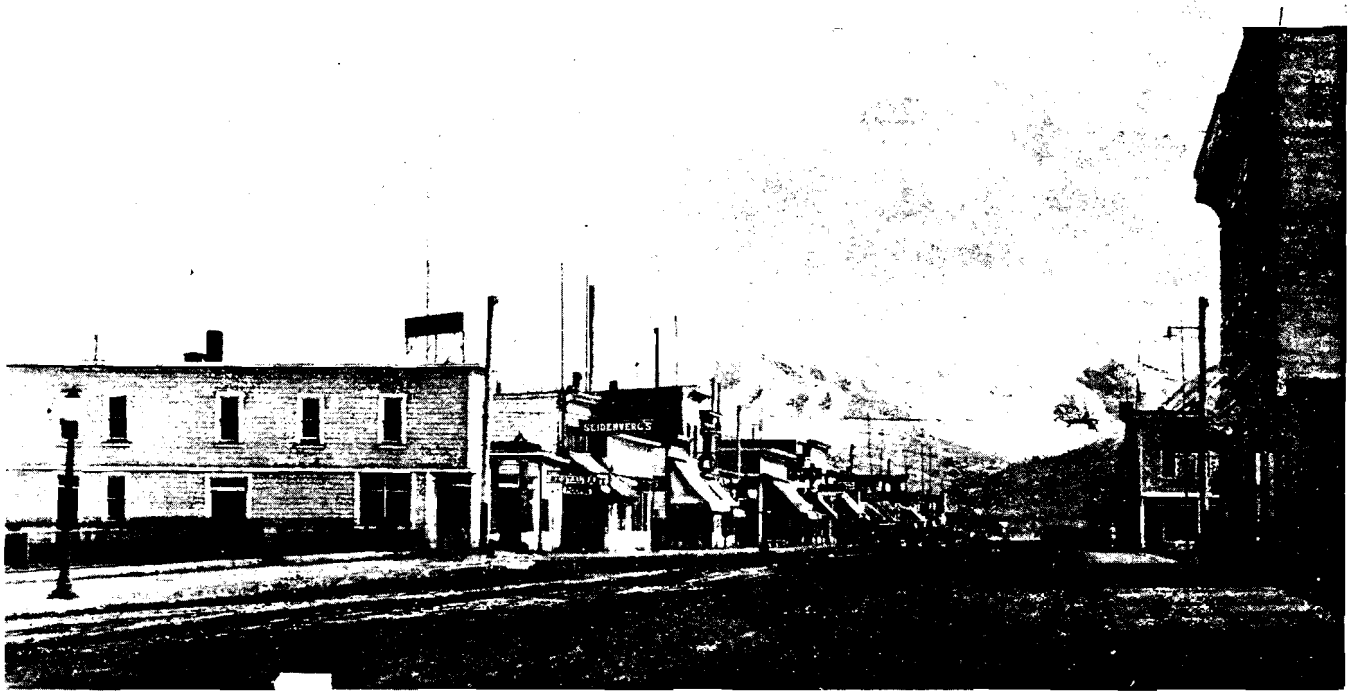
base, near Anchorage, which embodies Fort Richardson and Elmendorf Field. It is estimated that every job at the Fort resulted in the creation of another in town. Unlike other places which have similarly boomed, Anchorage has managed to consolidate its rapid expansion. The history of our western United States is filled with instances of military and trading outposts growing to prosperous metropolitan centers. Salt Lake City is adjacent to century-old Fort Douglas and Sacramento is literally built around Sutter's Fort, now a museum. Anchorage is now tending to parallel that same sequence of development and has already reached the stage where it supports satellite agricultural and suburban communities.

Thus the history of the area is one of steady and at times rapid growth, based to a large extent upon government expenditures, but with a healthy background of permanence and steady development of industry and natural resources. Particularly as regards agriculture, it is certain that an expanding population will provide greater local markets and a resulting added incentive to production.

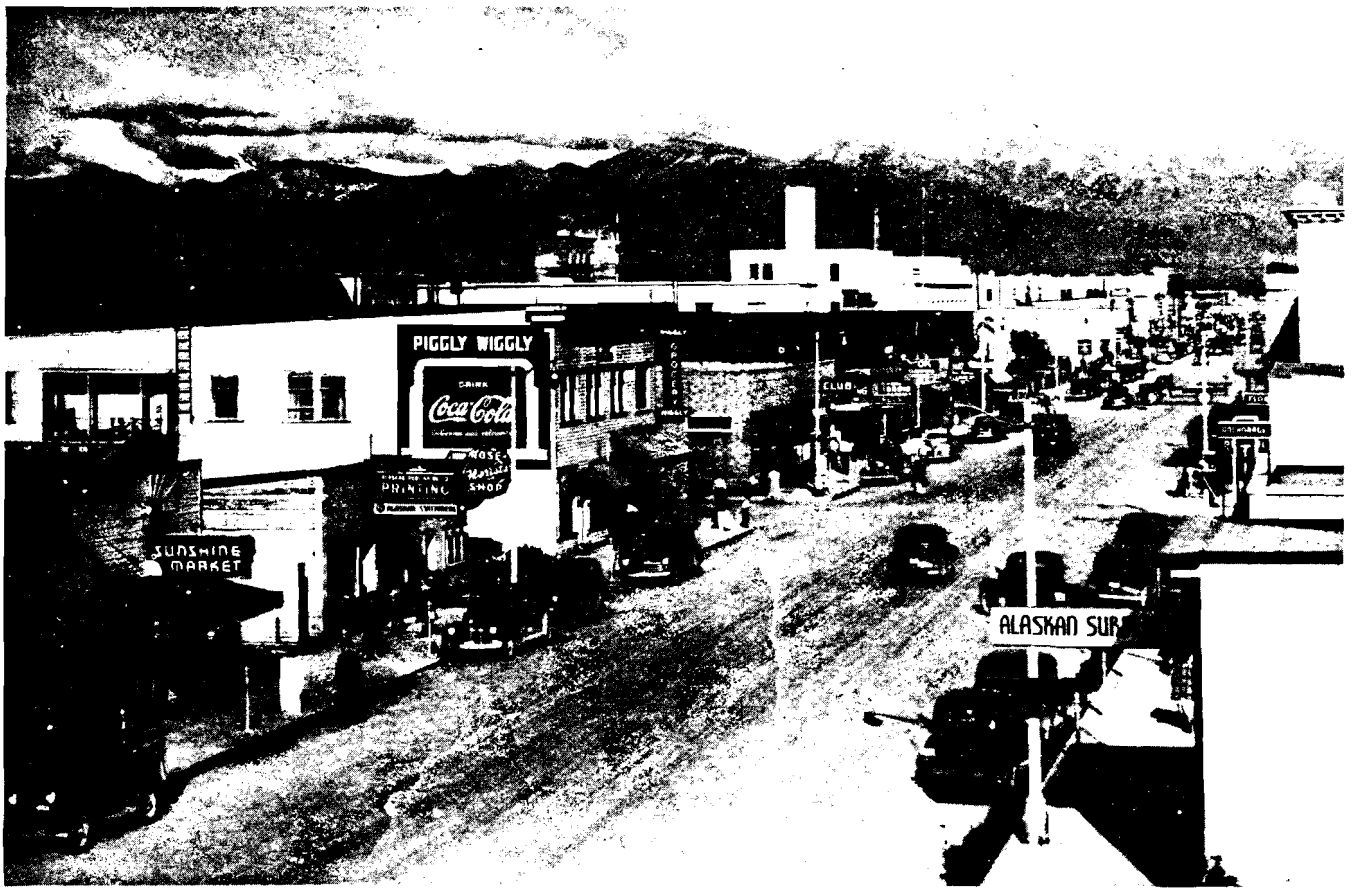
Population

At the time of the 1939 census, Anchorage had a permanent population of 3,495. In July, 1948, the Department of the Interior estimated the present population at 19,000, a growth during the last eight years amounting to an amazing 570%. Postmaster H.E. Brown estimates the present population at 30,000 to 35,000. All these figures include the adjacent suburbs of Mountain View and Senard, but do not include the military population of Fort Richardson, which can be considered as permanent, though subject to variation. It seems certain that the population trend in the Anchorage area will continue upward for a number of years, particularly after considering the number of new large scale developments under way or scheduled for the near future.

It is equally difficult to guess at the present population of the Matanuska Valley, due to the many scattered farms and absence of any recent surveys. In 1939, Palmer, the largest town, had 150 residents, but now the figure is between 500 and 1000. Wasilla is estimated at upwards of 200, and there are numerous smaller centers of population. In 1943, the population of the Valley was estimated at 2,250. At that time, there were about 250 farms, 144 of which had been established by the Rehabilitation Corporation at the time of the colonization project. It is thought that there are about 400 farms now, and while it is not known for certain, estimates for the population of the entire valley run as high as 4,500. Farming has been conclusively proven possible and profitable, where hard work, perseverance and sufficient capital are applied; hence with additional suitable lands available and an expanding market nearby, further population growth seems inevitable.



ANCHORAGE CONTINUES TO GROW BY LEAPS AND BOUNDS. PICTURED ABOVE IS FOURTH AVENUE, IN 1934 (ABOVE) AND 1947 (BELOW).



ECONOMIC DEVELOPMENT

Anchorage serves as Territorial headquarters for Alaska Railroad, Civil Aeronautic Administration, Weather Bureau, Alaska Communications System, and many other government agencies. It is headquarters for the Third Judicial Division. Many other Federal and Territorial bureaus have offices here, such as Fish and Wildlife Service, Bureau of Land Management, Alaska Road Commission, Territorial Highway Patrol, and others.

Fort Richardson is Command Headquarters for all armed forces in Alaska, and it provides a major payroll for Anchorage. Present, and future construction at the Fort will mean much to the community.

Anchorage is a hub of transportation facilities of all types. The air transportation industry in particular is fast becoming of major importance.

It is the trading and supply center for such diverse activities as hunting, trapping and fishing over a huge area, farming and coal mining in the Matanuska Valley, gold mining in the Willow Creek District, farming and homesteading on the Kenai Peninsula, and commercial fishing in Cook Inlet. Two fish canneries are located at Anchorage.

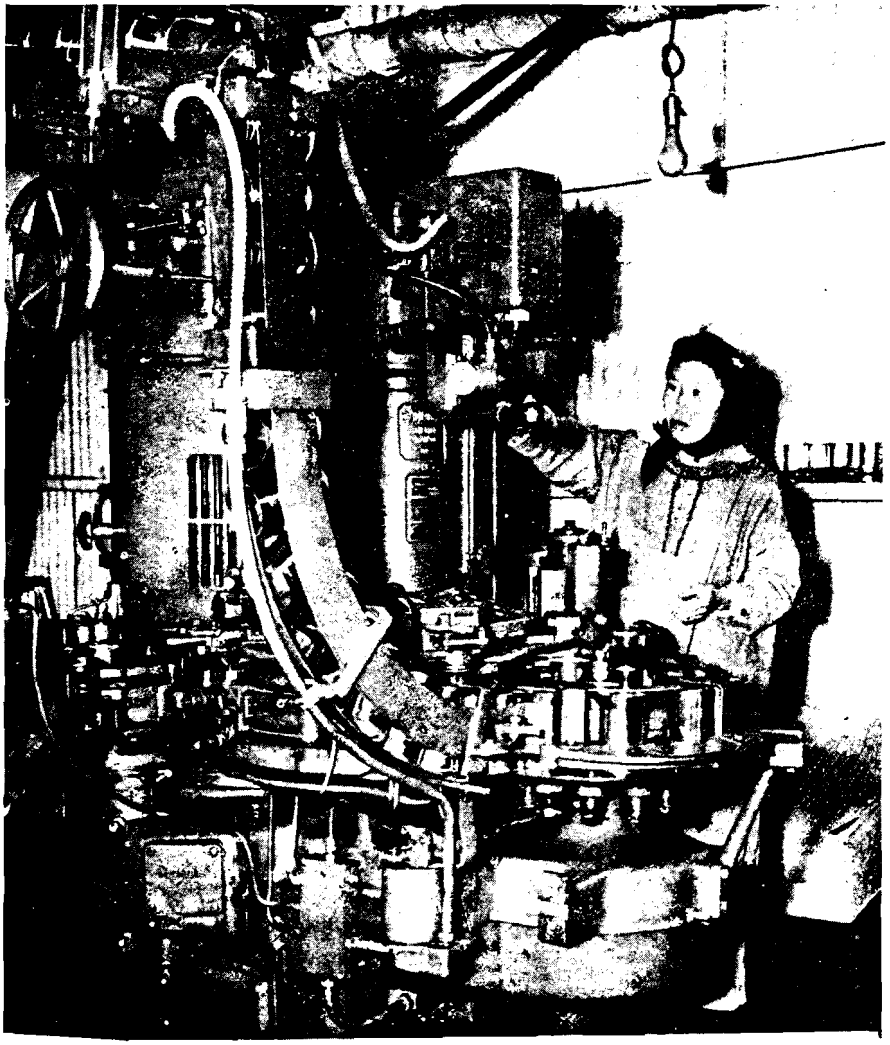
Projects already under way or scheduled for the near future will do much to further develop this thriving community, already the largest in Alaska. The Alaska Railroad's $50 million rehabilitation program is well under way. Originally scheduled for five years, it has been stepped up so as to be completed by 1950.

Engineering has been started on the new International Airport, for which Congress has appropriated $8 million, with completion scheduled for 1950 or 1951.

Work is to be started next year on a $6 million 400-bed hospital for the Alaska Native Service.

Construction has started on an all-important road which will at long last give Anchorage a highway connection with the Kenai Peninsula, which is an unsurpassed hunters' paradise and contains farmlands of growing importance. More than 160,000 acres in the vicinity of the town of Kenai have been withdrawn recently in anticipation of a government-sponsored settlement program. The Interior Department was appropriated $11,373,000 for the construction of this road, which will probably be ready for use by the fall of 1949.

The Alaska Road Commission is to hardsurface the road connecting Anchorage and the Matanuska Valley next summer, which will greatly expedite traffic between the two areas.



THE CATCHING AND CANNING OF SALMON IS A LOCAL INDUSTRY OF CONSIDERABLE IMPORTANCE.

Not to be outdone, citizens of Anchorage at three separate elections recently authorized the issuance of $4,825,000 in bonds to finance civic improvements, including a new gravity water system, new and additional sewers, a new and greatly enlarged dial telephone system, street paving and more power lines.

To carry on the expansion of nearby Fort Richardson, Congress has appropriated $28,192,375. Work has been at a virtual standstill this year due to the lack of funds, but will be resumed on a large scale in the spring of 1949. In and about Anchorage there is a large backlog of civilian construction, and this can be expected to increase as the population continues to expand. A proposed cement plant in the vicinity of McKinley Park could greatly expedite construction of all types.

In the Matanuska Valley are coal fields, served by a highway and a branch line of the Alaska Railroad. In 1947, more than 362,000 tons of coal were mined in Alaska, a large part of which came from the Matanuska coal fields. The Army and the Alaska Railroad are big consumers. The coal is of high quality, and studies are being made to determine the feasibility of establishing a briqueting plant, to produce coal briquets, oil and by-products.

In the western section of the Valley is the important Willow Creek mining district, the scene of many gold lode operations. If the price of gold is raised, or the cost of mining goes down, increased activity in this area is expected.

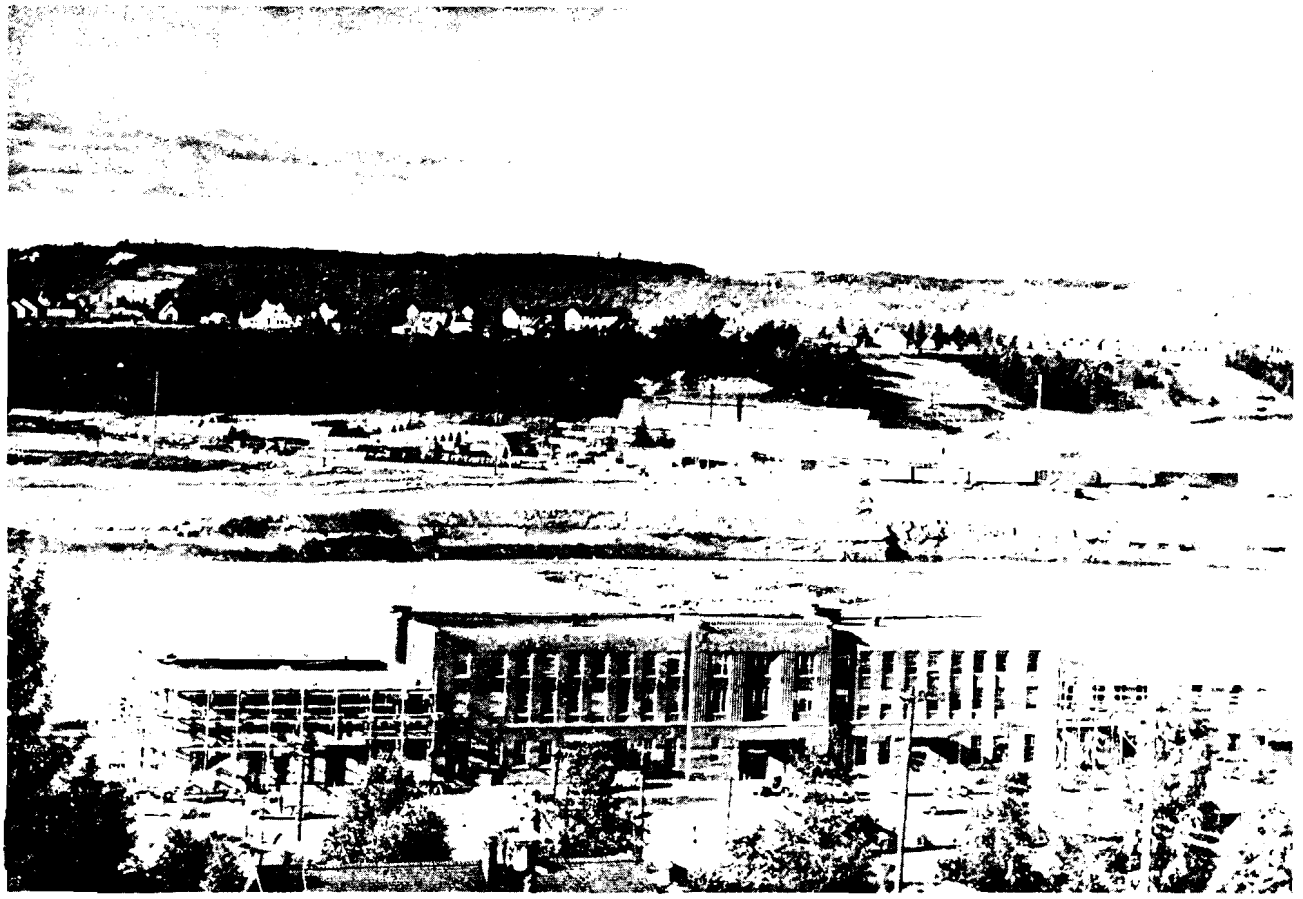
Transportation

Eklutna Project area is served by air, highway, railroad, and to some extent, sea transportation. The 48-mile Palmer Highway connects Anchorage and the Matanuska Valley, north of which the Glenn Highway gives access to the Interior road system and the Alaska Highway. In both areas there are access roads too numerous to mention, though there is great need for further development. The Alaska Railroad travels from the seaports of Whittier and Seward on the Kenai Peninsula, through Anchorage and the Matanuska Valley, and on north to Fairbanks.

There are some 12 non-scheduled and 2 scheduled airlines flying between Anchorage and Seattle. Two lines fly directly between Anchorage and midwestern United States. Anchorage is a stop on the great-circle route to the Orient, utilized by Northwest Airlines, with several foreign countries planning to enter the trade. Planes from Anchorage travel to all corners of the Territory, serving the Aleutian Islands, the Bristol Bay fishing area, the Interior, Kenai Peninsula, various mining and trapping areas, as well as Palmer in the Matanuska Valley, which has its own thriving airport. In a land where the people are more air minded than any other place on earth and where

DURING BUSY MONTHS, ANCHORAGE'S MERRIL FIELD (ABOVE)
WITNESSES MORE LANDINGS AND TAKEOFFS THAN NEW YORK'S LA GUARDIA

ANCHORAGE'S EXPANDING RAILROAD DEPOT (BELOW), WITH ALASKA
RAILROAD SHOPS AND LIVING QUARTERS IN THE BACKGROUND



there is an average of more than one plane to every 40 persons, air transportation is of major importance.

Anchorage has a harbor of sorts, although it freezes up during the winter. Most ships dock either at Seward or Whittier on the Kenai Peninsula, although Army transports, oil tankers, some fishing vessels and others come directly to Anchorage. A Port Commission is studying possible further development.

The Anchorage Transit System operates 18 coaches on the city streets. Busses also travel between communities on the highway system. Connections can be made to the States over the Alaska Highway.

Anchorage and Palmer have telephone systems, although both localities are finding it hard to keep up with demand.

Land Uses

In general, land use is confined to agriculture in the Matanuska Valley and mining in the Matanuska Coal fields and the Willow Creek gold mining district. The latter have been discussed previously.

Farming on a large scale is as yet unknown in Alaska, due to the great difficulty and high cost of clearing the land, erecting the necessary buildings and obtaining supplies and help. In the Matanuska Valley it is estimated that there are about 9,000 acres of farmland cleared and about twice that much more available. The only crops which do not do well are hot-weather crops, such as corn, squash, cucumbers, tomatoes and melons, (although many of these are being grown successfully in greenhouses) and tree fruits. Potatoes are successfully produced, as well as cabbages, cauliflower, parsnips, celery, rutabagas, turnips, carrots, beets, chard, peas, radishes, lettuce, string beans, rhubarb, onions and spinach. Oats, barley and wheat are grown, and bush fruits produce abundantly. Extensive trials and experimental work have not yet developed perennial lagoons adapted to the area, and this has handicapped livestock production somewhat.

Hogs, beef cattle and sheep, as well as goats, poultry and rabbits all do well in the Valley, although winter feeding is expensive. Dairying is becoming increasingly popular due to the high prices of fluid milk relative to production costs and relative to the prices from alternative farm enterprises.

Use of the land is definitely on the increase and much expansion is possible before the available markets will be satisfied. Although costs are tremendously high, thus making it impossible for farmers to expand rapidly, their produce does enjoy a sort of protective tariff due to the high shipping costs from the United States.

In addition to that done in the Matanuska Valley, there is some farming in the vicinity of Anchorage, although general conditions are not quite so favorable and less land is available. In most in-

POTATOES ARE RAISED EXTENSIVELY NEAR ANCHORAGE (ABOVE) AND THE MATANUSKA VALLEY.

LIVESTOCK RAISING IS OF INCREASING IMPORTANCE (BELOW)

stances this consists of truck or general farming on a small scale, usually in conjunction with livestock raising or dairying.

Irrigation

Since there is a deficiency of precipitation in the Eklutna Project area during the growing season, irrigation on the farms in the Matanuska Valley and the Spenard agricultural area would be beneficial. A case in point is the Spring of 1948 during which the most severe drought conditions since 1931 were recorded in the Eklutna Project area. The drought figured in the loss of a considerable portion of the garden crops of the Matanuska Valley. The average yield could be greatly increased by adequate irrigation. Irrigation by electric pumps is now being used only experimentally at several of the Matanuska Valley farms; both sprinkler and row irrigation are being tried, primarily on vegetable crops, and although pasture irrigation has not been tried, it may have some value in dairying.

Other Water Uses

The only use of water for hydroelectric power production in the project area is the existing small plant near the village of Eklutna, owned and operated by the Anchorage Public Utilities. The plant has an installed capacity of 2-1000 kw generators which operate under a static head of 232 feet. Water released from Eklutna Lake flows down Eklutna Creek about 8 miles to the power plant forebay at the diversion dam, where it is diverted through an 1800 foot tunnel at elevation 258.6 feet to the penstocks and powerhouse.

The Anchorage municipal water supply is Ship Creek, which flows from the Chugach Mountains, along the edge of the city and empties into Cook Inlet. The present supply is inadequate, but it is planned to pipe water from an Army-constructed dam located further upstream through a larger main than now exists. Due to the lack of water lines in some sections of the city and outlying areas many people have their own wells.

The danger of floods in the region is not great, with the exception of unique Lake George at the headwaters of Knik River in the Matanuska Valley. The lake is formed each year from melting glaciers all around it, the lower end being dammed by the side of Knik Glacier. When the water reaches a depth of 300 to 400 feet the dam gives way and the lake thunders down into Knik River, raising its level from six to eight feet. A recent innovation is the dynamiting of the ice jam as water piles up, so as to avoid the sudden emptying procedure.

Undeveloped Resources

Alaska abounds in undeveloped natural resources, and the area under consideration is no exception, although it is already the most populated section of Alaska. The difficulty in such development at present is that in most instances present labor costs would be so high as to make the venture unprofitable.

Considerable expansion in the Matanuska coal fields is possible

with known deposits. An increase in coal demand for industrial and home use, which will undoubtedly accompany the present rapid growth in population, could bring this about.

Gold mining is limited by the cost of extracting the ore. There are known additional deposits which cannot be mined at present due to this factor.

Many metallic and non-metallic ores are known to exist in the Territory, but sufficient prospecting has never been done due to the age-old attraction of placer and lode gold mining. As prospecting is increased and production costs reduced, it is certain that many minerals will be mined commercially in the Eklutna Project area.

Although the trees in this part of Alaska are unsuited to lumber or pulp production for the most part, large stands of birch and other woods could be utilized for specialty products. The Talkeetna Birch Products Company has recently been formed to enter this field.

Little further increase in the catching and canning of salmon in this area is possible without seriously endangering the supply. However, other types of fish, shell-fish or other ocean dwellers could be caught and processed. The establishment of cold storage plants, in particular, is encouraging further endeavors in this field.

The wildlife and scenery of the area offers prolific opportunities for development of the tourist trade. With the recent opening of the Alaska Highway to tourists and the increase in air and sea transportation facilities, it is expected that thousands annually will want to see the magnificent panorama in Alaska. Many more will want to enjoy its unsurpassed hunting and fishing. There is much which can be done to develop facilities, while at the same time conserving wildlife and preserving the natural beauty of the land. Entertainment-starved residents of Anchorage and the Matanuska Valley, as well as tourists, would welcome recreational development at Eklutna Lake.

ECONOMIC NEEDS

Alaska, the Eklutna Project area in particular, is growing rapidly and on a firm basis but its needs are still great if it is to become the substantially populated land it could be. In brief, the problem is this: At present, Alaska must import from the United States nearly everything it consumes. Because of the relatively small and scattered centers of population and the absence of backhaul, steamship companies charge freight rates which are among the highest in the world. These transportation costs make for high prices in Alaska, the resulting high cost of living discourages local industry, and the two combined discourage further settlement.

Alaska badly needs anything which will lower the cost of local production, hence stimulating home industry and further settlement. Tied in with this is the need for industries providing year-round employment. At present, nearly all the large Alaskan industries, being of an "out-of-doors" nature, are seasonal. Construction, fishing and canning, mining, lumbering and agriculture all flourish only during the summer months. Trapping takes place only during the winter, but does not give employment to many.

Adequate low-cost power is high on the list of necessities. Under present conditions no large consumer of electrical power could possibly locate in the area and hope to have his finished goods compete in either the Alaskan or United States markets. Farmers could better supply local markets with lower-cost produce in larger quantities through the benefits of a developed irrigation program as soon as power is available in sufficient quantities at lower rates than those in effect. The benefits to be derived from more and lower-cost power, both to individual and industrial consumers, are inestimable.

Present power facilities in the project area are insufficient to supply every day needs. More than 3,000 people just outside the city limits of Anchorage are without electric service for their newly constructed homes. In the city the demand is so great that circuit breakers are alternately opened on various sections of the power system, thereby plunging entire areas into darkness. When there are no lights, no hot water, no way to prepare hot meals and electrically operated heating systems fail there is human suffering in Alaska. The Eklutna Project is an economic solution.

INVESTIGATIONS AND REPORTS

Eklutna power potentialities have long been recognized. The site has been investigated by individuals, consulting engineering firms and the City of Anchorage. In January, 1947 the Geological Survey began the collection of basic data and in February, 1948 three reports were issued, namely: "Preliminary Report on Water Power Resources of Eklutna Creek, Alaska"; "Reconnaissance Report on Geology of Eklutna Lake Dam Site and Conduit Route Near Anchorage, Alaska"; and "Preliminary Report on the Geology Along the Route of a Proposed Tunnel To Develop Power from Eklutna Lake, Alaska". These basic data collected by Geological Survey have been utilized extensively by the Bureau of Reclamation.

The City of Anchorage and the Rural Electrification Administration collaborated with the Bureau of Reclamation in the investigation of the Eklutna Project. Field surveys were started by the Bureau in July, 1948 and the work has been executed at a very rapid pace because of the urgency for the project.

The task would have been impossible to accomplish in the short period of time allotted except that all Federal, Territorial and local agencies gave splendid cooperation. Of especial value were data supplied by Geological Survey, Alaska Railroad, Alaska Road Commission, Office of Indian Affairs, Bureau of Land Management, Bureau of Mines, Fish and Wildlife Service, all of the Department of the Interior; Alaska Agricultural Experiment Stations and Rural Electrification Administration of the Department of Agriculture; Civil Aeronautics Administration of the Department of Commerce; Alaskan Command of the Department of National Defense; Federal Power Commission; Territorial Government; and the City of Anchorage.

CHAPTER II

P L A N O F D E V E L O P M E N T

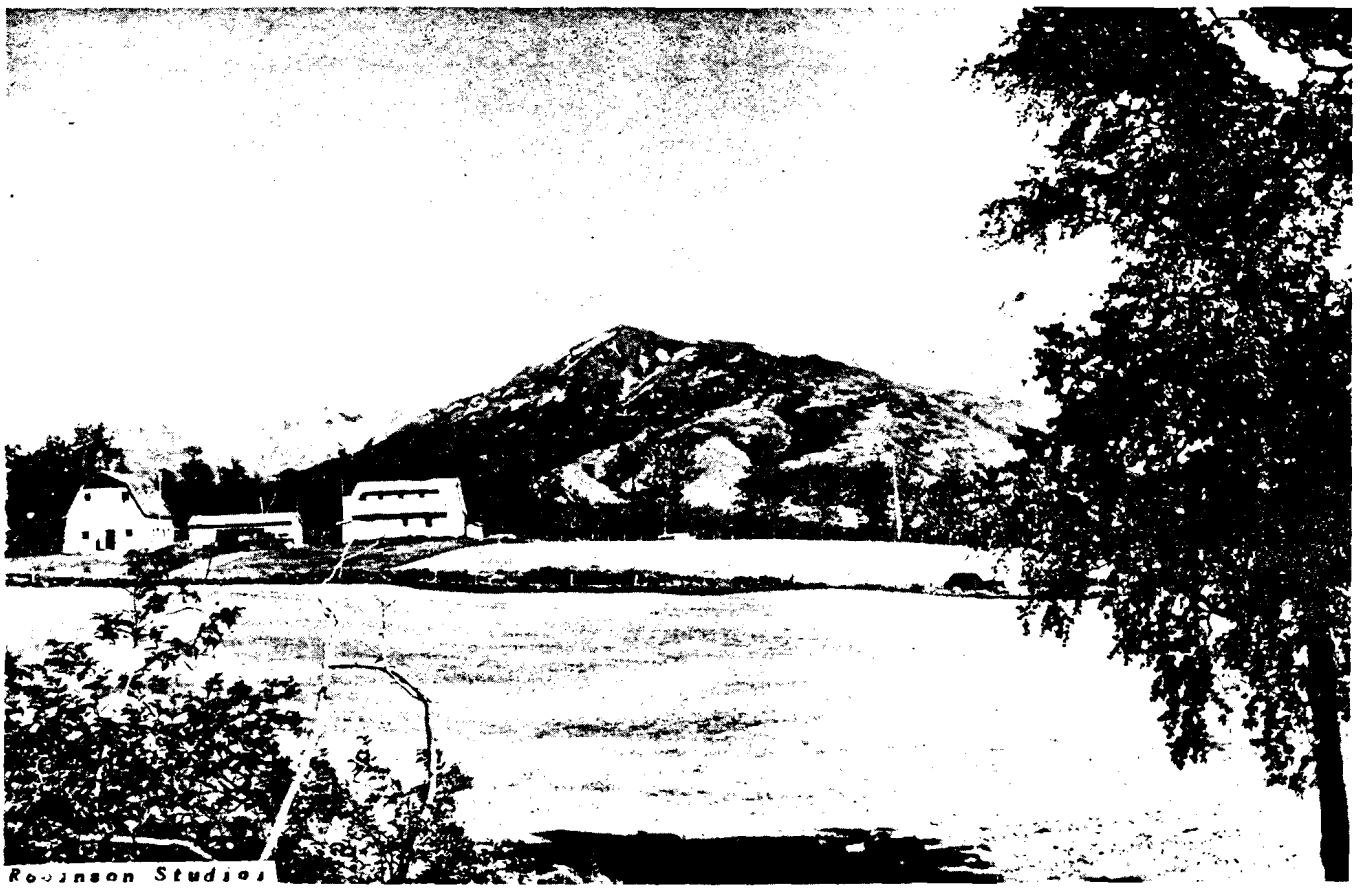
The project would serve the multiple purpose of power production, irrigation and recreation. It all revolves around the development of Eklutna Creek, geographically located about midway between Anchorage and Palmer.

Nature was kind. A glacier retreating up Eklutna Valley left behind a natural dam across the creek. Eklutna Lake, a body of water seven miles long and 200 feet deep, was thus created. Fortunately, the lake lies 868 feet above the sea with only a narrow mountain intervening. Power could be produced by the simple plan of a tunnel through the mountain, a penstock down the mountain side and a power plant at tidewater level. To protect nature's dam against any flood that might over-top, cut or scour it, a concrete spillway is planned.

In winter time when inflow of water to the lake almost ceases, of during drought years, power-water would be drawn from lake storage. Placement of the tunnel inlet below the natural lake surface would make this possible. Excessive flows during summer months or during years of heavy runoff would replenish the supply of stored water. A tunnel would be driven through Goat Mountain to the Knik Arm side, a distance slightly less than four and one-half miles. From the tunnel outlet, the water would be conveyed downward through a steel pipe six and one-half feet in diameter to the power plant. Tentative location of the plant is on the Anchorage-Palmer highway near mile-post 34. The installed capacity of the plant would be 30,000 kilowatts. Transmission lines, one north to Matanuska Valley and another south to Anchorage would be necessary together with substation facilities. Although the lines would be designed for ultimate operation at a higher voltage, initial operation would be at only 57,000 volts.

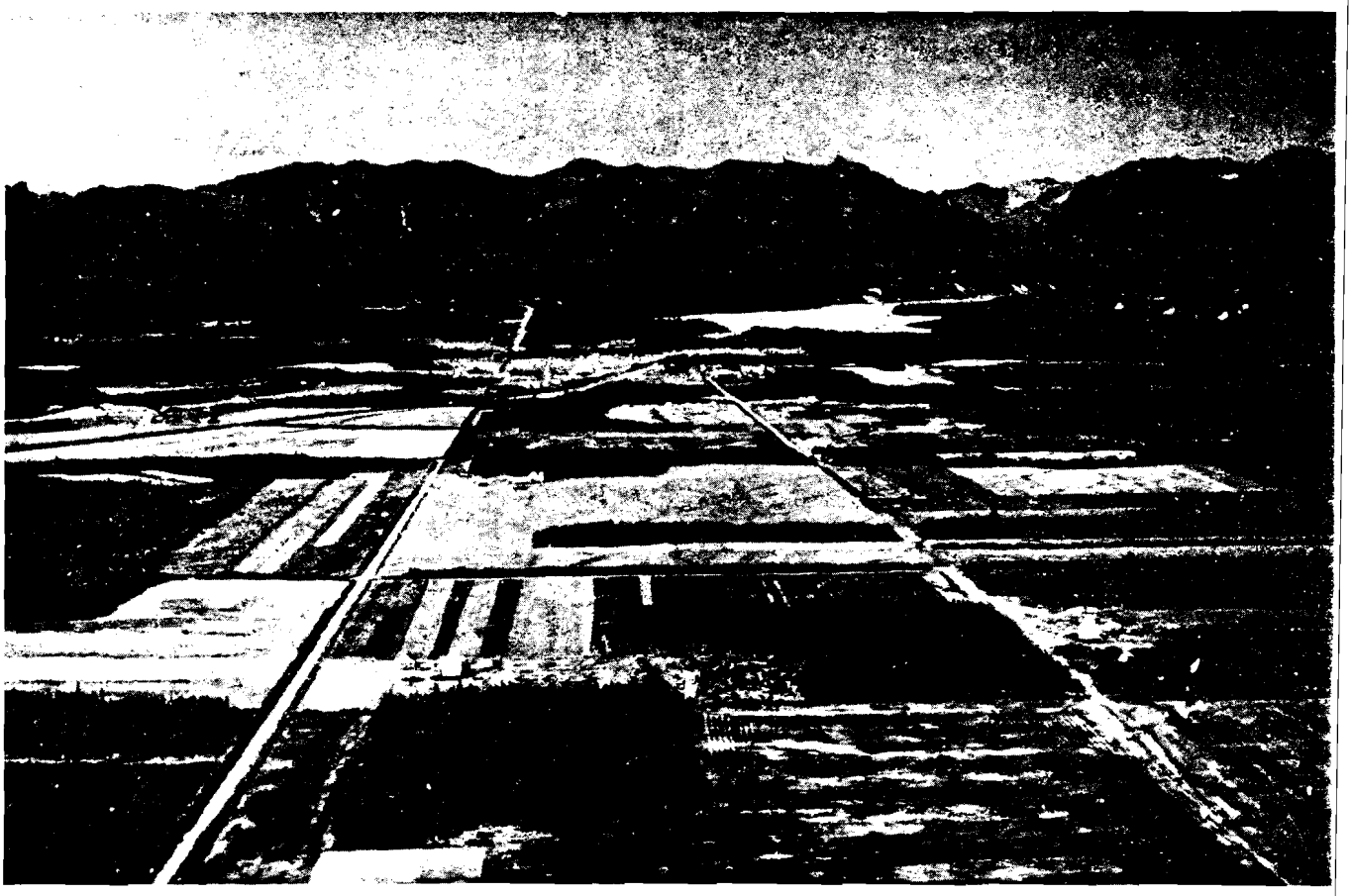
Firm energy available for normal use would total 100 million kilowatt-hours annually. Secondary energy, available only during certain hours, and increasing and decreasing during seasons of high and low lake levels, would total more than 40 million kilowatt-hours in the average year. In addition, secondary energy would be produced at the existing plant when water is available from spills from the lake and run-off from the 20 square miles of drainage area below the new dam.

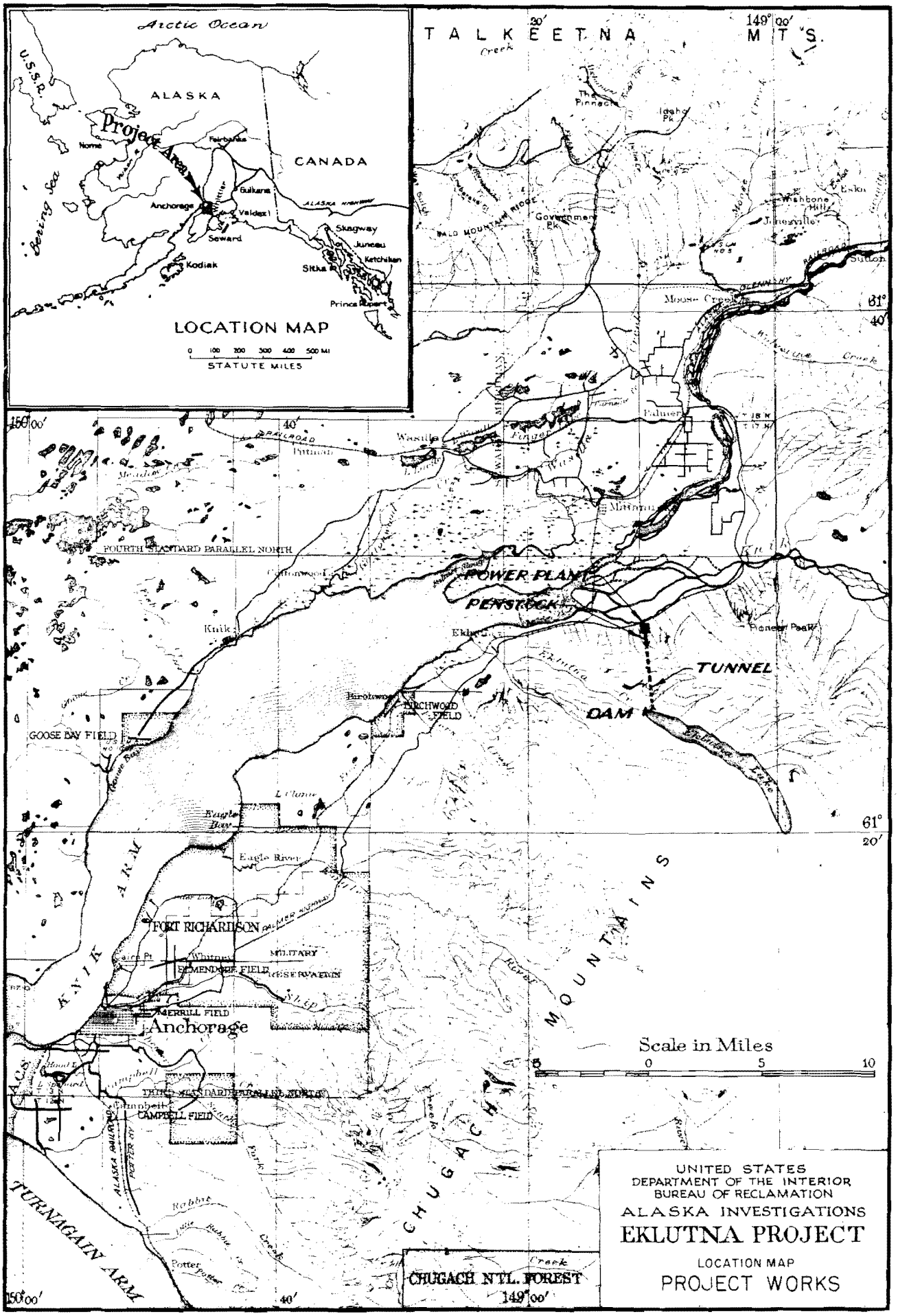
Irrigation is a requisite to any over-all plan of development in this semi-arid region. Experimental irrigation conducted in the area has demonstrated the amazing yields possible on irrigated truck farms. One such experiment on a relatively large acreage of potatoes in the Anchorage area resulted in an increased yield of three and one-half tons per acre as compared with an adjoining non-irrigated field. The increase in gross crop benefit exceeded $250 per acre.



TYPICAL HOMESTEAD IN THE MATANUSKA VALLEY.

A SECTION OF THE MATANUSKA VALLEY, WITH THE TOWN OF PALMER IN THE BACKGROUND. (BELOW)




Arctic Ocean
U.S.S.R.
ALASKA
Project Area
CANADA
Bering Sea
Nome
Fairbanks
Anchorage
Valdez
Gulkana
Seward
Skagway
Juneau
Ketchikan
Sitka
Kodiak
Prince Rupert
LOCATION MAP
0 100 200 300 400 500 MI
STATUTE MILES
TALKEETNA MTS.
149° 00′
30′
61° 40′
61° 20′
150° 00′
40′
Talkeetna
Creek
The Pinnacle
Government Pk.
Wishbone Hills
Sutton
Moose Creek
Palmer
Wasilla
Matanuska
Knik
Eklutna
Pioneer Peak
FOURTH STANDARD PARALLEL NORTH
POWER PLANT
PENSTOCK
TUNNEL
DAM
Eklutna Lake
Birchwood
BIRCHWOOD FIELD
GOOSE BAY FIELD
Eagle Bay
Eagle River
Knik Arm
FORT RICHARDSON
MILITARY RESERVATION
ELMENDORF FIELD
MERRILL FIELD
Anchorage
Campbell
CAMPBELL FIELD
Turnagain Arm
Rabbit Creek
Potter
CHUGACH MOUNTAINS
CHUGACH NTL. FOREST
Scale in Miles
5 0 5 10
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA INVESTIGATIONS
EKLUTNA PROJECT
LOCATION MAP
PROJECT WORKS

Plan of Development

Irrigation has a definite place in the Eklutna Project plan by utilization of the low-cost power which will be available for pumping. The extent of potential irrigation benefits cannot be determined until studies now under way by several governmental agencies are concluded. Eklutna Project secondary energy would be used to pump irrigation water each spring during the usual dry season and to continue pumping throughout the growing season in those years when summer rains fail to materialize.

Recreational facilities would be provided at Eklutna Lake. Planning and, after prior agreement with a territorial or local agency for permanent management, development and interim administration of such facilities would be under the National Park Service.

This is the plan of development that has finally evolved. Former plans have been investigated and discarded for various reasons. As an example, the construction of a series of dams down the canyon to develop Eklutna Creek below the lake would be economically infeasible because of the distance to impervious material in the stream-bed and abutments. Another plan previously investigated would have involved a conduit from the lake to a point down the creek near the diversion works of the existing plant. The conduit route is on unconsolidated material with steep slopes and cut by deep side ravines. Further, climatic conditions would most likely preclude winter operation unless the conduit was buried deeply, which would involve construction in highly unfavorable ground and through suspected underground pockets of perma-frost. All such plans stem from a natural desire to salvage and continue operation of the small existing power plant. However, rehabilitation and enlargement of this plant to take the full regulated flow of Eklutna Creek would be almost as costly as new construction and would only develop 27 percent of the power potentiality between the lake and the sea. It is contemplated that this existing plant will be utilized in coordination with the proposed new plant whenever water is available.

Another plan investigated for comparison and discarded was the construction of a steam plant. The cost of production of power in a new steam plant, of capacities which would be considered as alternative to the Eklutna plant, is conservatively estimated at approximately 12.0 mills per kilowatt hour plus transmission costs.

For the evaluation of indirect benefits in this report, an approximate figure of 13.5 mills per kilowatt hour was used as the alternate cost of producing energy from steam in this area of Alaska.

Development of the Eklutna Project is only a stepping-stone toward realization of a full grown regional economy. The project is the first stage of a much larger plan for development of water resources in the fast growing and promising railbelt, extending from Seward on Kenai Peninsula through Anchorage and the Matanuska Valley over the Alaska range and on to Fairbanks in the Interior. The capacity of Eklutna Project would be fully utilized as soon as it is completed, and studies

are not under way to augment the proposed system with development of the water resources of Kenai Peninsula, Matanuska, Susitna and Nenana Rivers. This is the reason for including in the Eklutna Project a transmission line constructed for ultimate operation of 115,000 to 161,000 volts, whereas initially only 57,000 volt operation is required. The ultimate operating voltage gradient has not been definitely established. There are many small communities to be served along the route of the proposed transmission line, necessitating tapping the line at many points. It is assumed that the REA Cooperatives now serving rural areas will provide electric services to these communities in which case the adoption of the higher voltage for the line is decidedly preferable from an operating standpoint. Eklutna Project is definitely an integrated part of a coordinated and comprehensive plan for conservation and development of the abundant natural resources of the railbelt area.

CHAPTER III

D E S I G N S A N D E S T I M A T E S

Design of project features entails no unusual engineering problem of major proportions. Many factors peculiar to Alaska influence estimated project costs. Climatic conditions likely to be experienced during construction, length of time to receive overseas shipments, shipping costs, availability of Alaskan materials, labor supply, wages and many other factors have been taken into consideration.

GEOLOGIC CONDITIONS

Most of the basic geological data was secured from two excellent geologic field studies and reports prepared by personnel of the Geological Survey. The subject reports are: "Reconnaissance Report on Geology of Eklutna Lake Dam Site and Conduit Route near Anchorage, Alaska" By A.F. Bateman, Jr., (Field work during May, June and July, 1947 - unpublished report dated August, 1947, Great Falls, Montana); "Preliminary Report of the Geology Along the Route of a Proposed Tunnel to Develop Hydroelectric Power from Eklutna Lake, Alaska" by F.F. Barnes, (Field examination made in June, 1947 - unpublished report bound with the Bateman report).

The studies conducted by engineers and geologists of the Geological Survey during May, June, and July, 1947 were supplemented by preliminary drill hole and test pit exploration carried out by the Anchorage Public Utilities during the same period. The cooperative investigation included:

A. The preparation of geologic maps and sections illustrating the data and interpreted geologic relationships in the Eklutna Valley and the damsite area, as well as along the tentative routes of the conduit and tunnel lines.

B. Two drill holes, six test pits and five side-hill trenches, including geologic logs.

C. Twenty-two measured and described geologic sections along the course of Eklutna Creek.

Reconnaisance field examinations, including a careful review of all available data, were made by Bureau of Reclamation personnel during July and August, 1948. During this period two additional drill holes were completed by the Anchorage Public Utilities.

General Geology

Eklutna Valley is a steep-sided, trough-like, glaciated valley

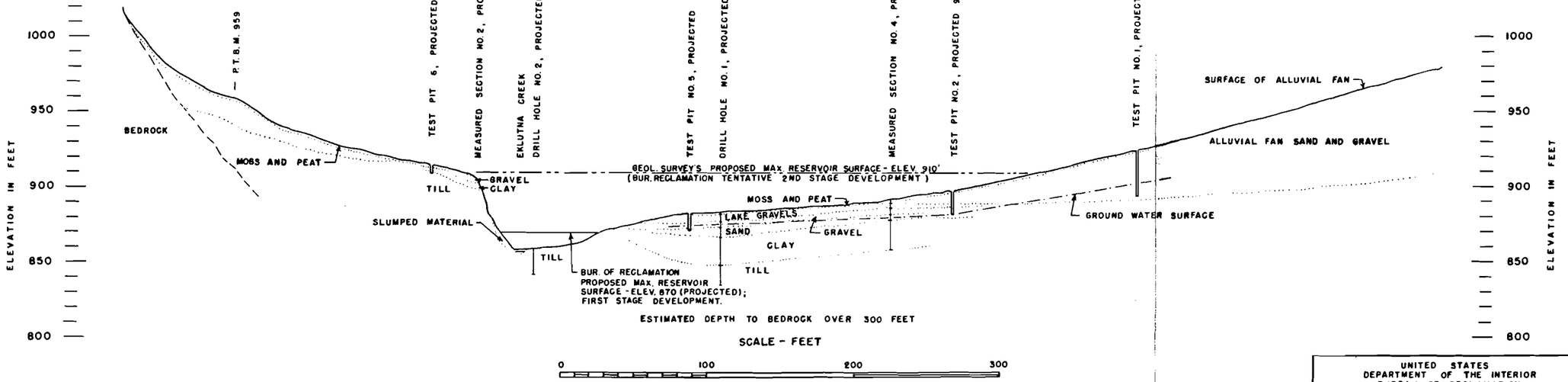
EKLUTNA BASIN

about 23 miles long, trending northwesterly on the west flank of the Chugach Mountains. The upper levels of the valley present extensive exposures of bedrock covered with a discontinuous veneer of rock debris and cut by many sub-parallel ravines tributary to the main valley. The topographic expression is the result of weathering and erosion by running water in an area of severe, cold climatic conditions; accordingly, the upper portion of the valley transverse cross section is typically "V-shaped". In contrast, at lower elevations the bedrock slopes have been smoothed and steepened, the lower ends of ridges cut off and the lower portion of the valley cross-section rounded out to a "U-shaped", trough-like section. Such topographic modifications are the typical result of valley glaciation. In this instance they were caused by the powerful abrasive action of the Eklutna Glacier, which formerly extended down the full length of the valley to its junction with the main valley of the Knik River.

The bedrock floor of the valley is completely hidden by Eklutna Glacier, Eklutna Lake, and thick deposits of silt, sand and gravel released as the glacier front melted back up the valley to its present position. The remnants of Eklutna Glacier are now restricted to the upper seven miles of the valley. Eklutna Creek, supplied by meltwater from the glacier, flows down the valley for about four and three-fourths miles to the head of Eklutna Lake. Through this distance, the creek flows in a mesh of braided channels over a wide deposit of material released by melting ice and carried down-valley by the creek.

Eklutna Lake extends for about seven miles down the valley and is flanked on both sides by glacial deposits, alluvial fans, talus and the steep rock slopes of the valley. The actual shores of the lake consist of rock debris released by the glacier and in part transported by former side-glacial streams. The bulk of such deposits, locally terraced, exist chiefly on the northeast side of the lake. Alluvial fans and extensive talus slopes, representing the material derived by the normal weathering and erosion of bedrock at higher elevations, have been built out over the surface of the glacial deposits. Bedrock is actually exposed at lake level at only one point on the left, or southwest, shore near the bend in the lake. Soundings reveal that the lake has a relatively flat bottom, with a maximum depth of about two hundred feet below the maximum (controlled) level of the lake surface, at elevation 868.

From the lower end of the lake down the valley to its junction with the main valley of the Knik River, the bedrock trough gouged out by the glacier is filled with glacial debris to a general elevation of about 900 feet to 1000 feet. The upper end of this unconsolidated glacial fill forms the natural dam which creates Eklutna Lake. Since the retreat of the glacier, Eklutna Creek has excavated a narrow, inner gorge through the fill of glacial debris. The gorge ranges from a depth of about fifty feet or less adjacent to the lake



NOTE;

GEOLOGIC SECTION ADAPTED FROM A.F. BATEMAN, JR., "RECONNAISSANCE REPORT ON GEOLOGY OF EKLUTNA LAKE DAM SITE AND CONDUIT ROUTE NEAR ANCHORAGE, ALASKA," U.S. GEOL. SURVEY (UNPUBLISHED REPORT) GREAT FALLS, 1947, FIGURE 7.

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EKLUTNA PROJECT

GEOLOGIC SECTION NEAR LAKE OUTLET

DRAWN:	A.E.J.	SUBMITTED:	
TRACED:	W.L.K.	RECOMMENDED:	
CHECKED:	A.E.J.	APPROVED:	

ANCHORAGE, ALASKA 9-3-48

to over five hundred feet about five miles downstream. About six and tnree-quarters miles below the lake outlet the creek has cut through the unconsolidated, glacial overburden into bedrock. A short distance further downstream, in the vicinity of the concrete diversion dam constructed by the Anchorage Public Utilities, the creek has cut a narrow gorge into bedrock to a depth of approximately four hundred feet.

Damsite

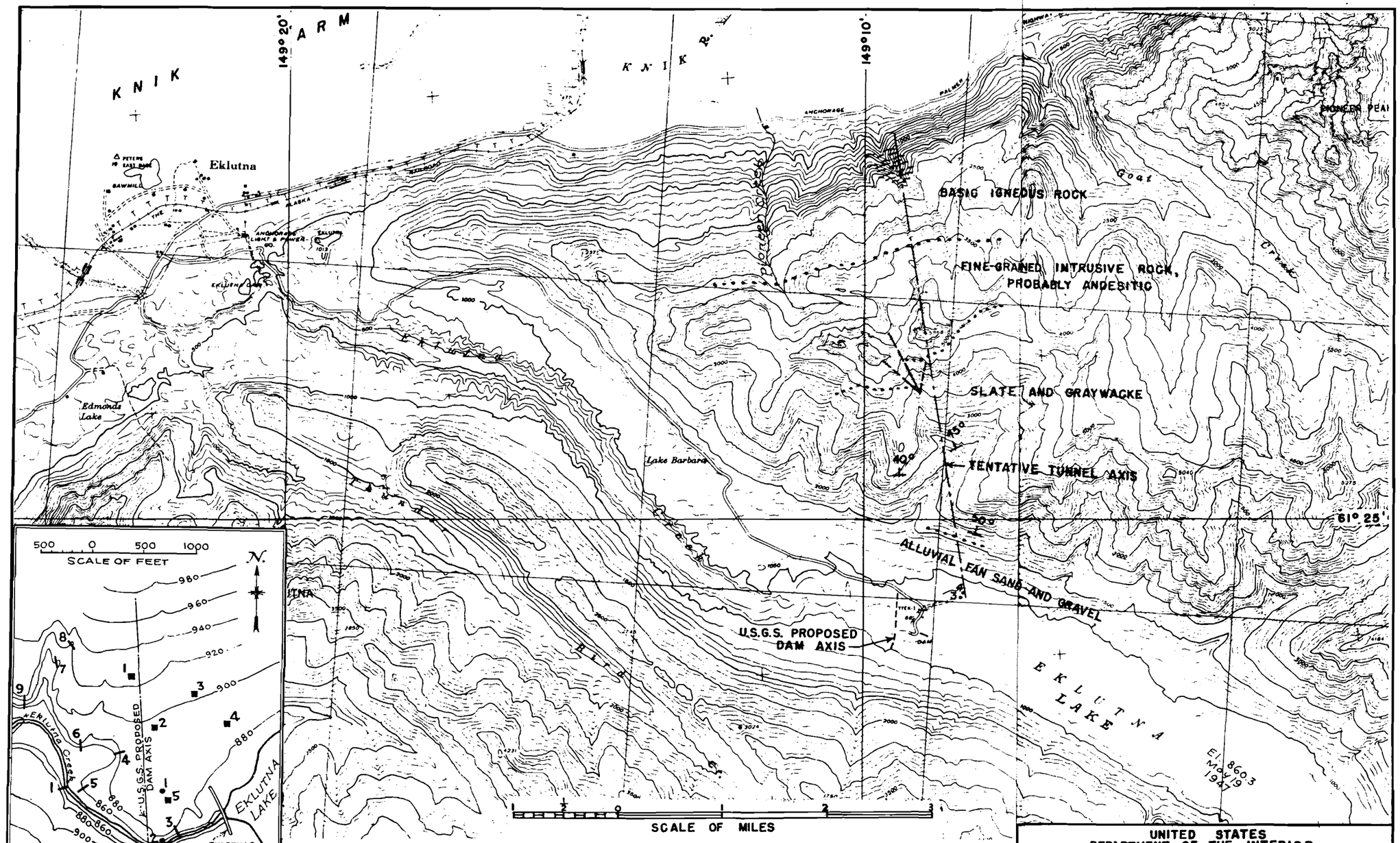
The axis for the damsite is through the existing low earth dike, concrete outlet works and spillway constructed by the Anchorage Public Utilities. In general, the foundation in the damsite area consists of an intermixed clay and sand strata. This material is a glacial deposit and semi-impermeable.

Intake Structure and Tunnel Geology

According to the present plans, the tunnel intake structure would be situated a moderate distance north of the shore line at the northeast corner of the lake; reservoir water would reach the gate structure via an open canal and a tunnel section. The construction of the canal and an initial section of the tunnel required to reach bedrock would involve excavation of unconsolidated deposits. They consist of alluvial fan and talus debris underlain by interstratified beds ranging from silt, sand and gravel to till and possibly lake clays.

In this connection, an exploration churn drill hole was completed 494 feet northeasterly from the lake shore on the tentative intake line. The hole penetrated: silt, sand, gravel and boulders - depth 0' to 44'; silty sand and fine gravel - 44' to 113'. Water losses determined by a few open-end casing tests were very low. On the basis of this data it is presumed that tunnel construction difficulties in overburden would not be unduly serious. However, a major portion of the excavation and construction operations would be carried out below the level of the groundwater table in relatively unconsolidated materials which might exhibit a wide range in physical make-up, permeability and stability. Consequently, large flows of water and potentially unstable excavations may be encountered; more definite statements on such problems can be based only on the results of detailed subsurface exploration.

In the general area of the intake structure, the bedrock profile on the north side of the valley slopes steeply down beneath the glacial fill and slopewash; at the edge of the lake, bedrock is believed to be in excess of 150 feet below the ground surface. Thus, the foundation of the intake structure would consist of overburden rather than bedrock; the location considered most suitable would de-



EXPLANATION

- ..... CONTACT BETWEEN ROCK TYPES
- — — — FAULT
- ~~~~ SHEAR ZONE
- ⟋ 40° STRIKE AND DIP OF FOLIATION AND BEDDING

NOTE:- GEOLOGY ADAPTED FROM MAP BY F. F. BARNES, "PRELIMINARY REPORT OF THE GEOLOGY ALONG THE ROUTE OF A PROPOSED TUNNEL TO DEVELOP HYDROELECTRIC POWER FROM EKLUTNA LAKE, ALASKA," U.S. GEOL. SURVEY, 1947 UNPUBLISHED).

BASE, EKLUTNA QUADRANGLE, U.S. ARMY.

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ALASKA INVESTIGATION OFFICE

EKLUTNA PROJECT

TOPOGRAPHY AND RECONNAISSANCE GEOLOGY OF PROPOSED TUNNEL LOCATION

DRAWN:	A.E.J.	SUBMITTED:	
TRACED:	W.L.K.	RECOMMENDED:	
CHECKED:	A.E.J.	APPROVED:	

ANCHORAGE, ALASKA 9-3-48

pend upon determination of the subsurface bedrock profile, the sequence, permeability and quality of the overburden strata as well as upon equally important nongeologic factors.

From the intake structure, water would pass through a tunnel running northeasterly for a distance of about four and one-half miles, through the high rock ridge approximately under the east peak of Goat Mountain, which separates the Eklutna Valley from the deeper main valley of the Knik River. The tunnel would consist of a short section (estimated length 1300 feet) in overburden and the remainder in rock of the following general types:

A. Sedimentary strata belonging to the shale and sandstone (graywacke) groups, some of which have been metamorphosed sufficiently to develop the characteristics of slate and argillite. These materials would be encountered chiefly at the intake end of the tunnel.

B. Igneous rocks, akin to andesite in composition, in the middle section of the tunnel.

C. Basic igneous rocks similar to gabbro and pyroxenite, and altered rocks such as serpentine at the powerhouse end of the tunnel. The rocks are fine-to-medium-grained, dark-colored and tough, except where softened or otherwise modified by alteration.

Reconnaissance examinations have revealed that all of the rocks which would be encountered in the tunnel are moderately to severely fractured. Several faults, shear zones and numerous areas of close-spaced fractures and softened, altered rock are visible in the slopes of the mountain along the tentative tunnel line. Similar conditions are anticipated at tunnel level.

In general, the tunnel would be wet, and large flows of groundwater would be encountered locally, as the tunnel heading crosses severely jointed or faulted zones. Such conditions might seriously impede the planned progress of construction operations unless advance precautions are taken.

The total length of the tunnel is about 22,000 feet. Of this distance, present evidence indicates that about 5% of the tunnel would require liner plates, 75% would require steel rib support, and 20% would stand

unsupported. In making the estimates it has been assumed that completion of the tunnel would include continuous concrete lining.

In its central portion the proposed tunnel would approach depths of 4000 to 4500 feet beneath the mountain top. In view of this, and since the area must be described as seismically active, it is inevitable that severe pressures would be encountered at these depths. "Heaving", "squeezing " or "swelling" rock would undoubtedly be experienced where the tunnel excavation cross faults, severely crushed and broken areas, or zones in which the rock has been softened by alteration. "Rock bursts" might occur in the slightly to moderately-jointed sections. In the more troublesome portions of such sections, close-spaced, heavy steel sets or continuous liner plates, which would ultimately become a part of the concrete lining, may be required in order to maintain the designed tunnel cross section.

On the basis of the reconnaissance geologic examinations, no especially serious difficulties in the tunnel boring operations are anticipated. Existing techniques of design and construction, applied by engineers experienced in tunnel problems, would be adequate. It is assumed, of course, that detailed engineering geologic investigations along the tunnel line and in the powerhouse and intake areas would serve to define the approximate magnitude, character and location of troublesome conditions and areas which the design and construction engineers must prepare to meet. Such investigations would be an essential prerequisite to the design studies and to the successful completion of the tunnel with a minimum cost and delay. The investigations should include detailed surface geologic mapping along the tunnel line and, where the depth of cover will permit, supplementary subsurface exploration by test shafts, drifts and diamond drilling.

Power Plant Geology

On the Knik River or power plant side of the ridge to be pierced by the tunnel, the rock slopes plunge steeply to the level of the broad, flat surface created by the silt, sand and gravel deposits of the Knik River. These deposits consist of interbedded strata ranging from silty clay to sand and gravel and could be developed to serve as a suitable foundation for the power plant structure and switchyard facilities. Borings and related field and laboratory tests would be required to reveal the structure and stability of these deposits and permit the design of the most suitable pile, spread footing or mat-type of foundation. The penstock, power plant and switchyard should be given adequate protection from damage by snow and rock slides originating on the steep mountain slope. In this connection additional subsurface investigations to supply more detailed information on the foundation geology will be essential to the preparation of specification designs.

Construction Materials

An unlimited supply of sand and gravel can be found in the terraces and lowlands lying at the base of the mountain slopes on the south

shore of Knik Arm and Knik River. The deposits could be opened at a large number of points along the main highway from Eklutna Village to and beyond the proposed power plant area. The sand and gravel consists predominately of physically sound, subangular fragments of rock types similar to those described for the proposed tunnel line. Judging from field examinations of the gravel deposits and of concrete made from comparable material, the sand and gravel would be suitable for the concrete required in the Eklutna development.

Thick strata of sand and gravel are exposed at a number of points along Eklutna Creek below the damsite, but in many instances the depth of stripping required to remove the overlying unsuitable material would preclude economic operation. Detailed field examiniations may reveal areas where such cover is thin, or locate deposits on the surface of the glacial fill now obscured from view by dense vegetation.

The material in the alluvial fan lying on the right side of the valley northeast of the existing dam is highly angular in shape and contains a large proportion of flat fragments of slate and graywacke. For the same reasons the terraced glacial deposits which extend eastward between the lake and the north wall of the valley are considered objectionable as sources of concrete aggregate. Small amounts of good quality concrete have been made from unscreened, pit-run glacial gravel found in the Eklutna Valley. The possible content of andesitic, phyllitic and argillitic rock types in both the Eklutna Valley and Knik River deposits will necessitate a careful petrographic examination to determine whether or not low-alkali cement is essential.

Summary - Conclusions

Geologic data bearing on the proposed Eklutna Hydroelectric Development was assembled by the Geological Survey in cooperation with the Anchorage Public Utilities. This data has been studied and supplemented in field reviews made by Bureau of Reclamation personnel and the following conclusions have been reached:

A. The proposed Eklutna Project, involving the construction of a low dam at the outlet of Eklutna Lake to raise the natural lake surface 10 feet, a tunnel four and one-half miles long, a surge tank, penstock and power plant, is geologically feasible.

B. The reconstruction of the existing low dam and raising the reservoir surface from elevation 868 to elevation 870 is geologically, and economically feasible, provided the natural weaknesses of the existing foundation are corrected by minor repairs and appropriate dam design. In this connection, additional subsurface investigations to supply more detailed information on the foundation geology will be essential to the preparation of specification designs.

C. The construction of the reservoir intake, tunnel and power plant is geologically feasible.

D. The reservoir intake, including the approach canal and about 1300 feet of tunnel, will require excavation operations in glacial and stream deposits similar to those at the damsite. The major portion of the excavation will be below the groundwater surface in materials of moderate permeability, but some strata of high permeability are anticipated and additional borings and tests will be required to define these conditions more accurately.

E. The four and one-half mile rock portion of the tunnel would be excavated in moderately fractured sandstone, (graywacke), andesitic and basic rocks (with the latter locally serpentinized) and would cross at least one major and a large number of minor broken, crushed, or severely altered zones or faults. Soft, "squeezing" ground as well as large groundwater flows would be encountered locally since the central portion of the tunnel would approach depths of 4000 to 4500 feet beneath the mountain top.

No especially serious difficulties in the tunnel boring operations are anticipated, provided detailed geologic investigation and interpretation of subsurface conditions would be accomplished in advance of construction. Existing techniques of design and construction applied by engineers experienced in tunneling problems would be adequate.

F. In the area of the power plant, the foundation of the power plant structure and appurtenant facilities would consist of stream deposits of silt, sand and gravel. The power house penstock, and appurtenant structures must be protected against damage by snow and rock slides.

G. Ample quantities of the concrete aggregate, riprap rock and earth materials required for the Eklutna development could be located within an economic hauling distance of the areas of use.

DESIGN AND CONSTRUCTION PROBLEMS

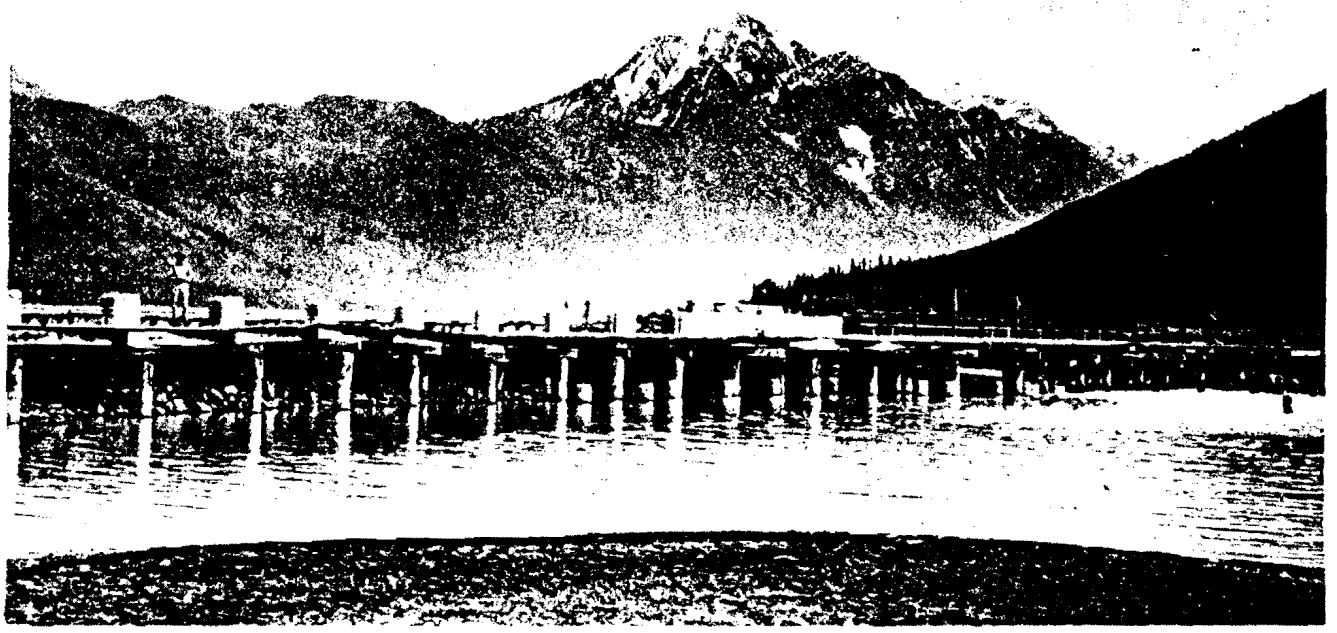
Accessibility

Palmer Highway, an improved gravel road from Anchorage north, is adjacent to the power plant site, but Eklutna Lake is eight miles off the highway. The present unimproved road from the Palmer Highway to the lake is steep, narrow and a hazard to travel. This road would require improvements and some new construction. A new road to the tunnel's outlet portal above the power plant would be required for construction purposes. Although the portal is close to the Palmer Highway, the difference in elevation is about 800 feet.

The Alaska Railroad parallels the Palmer Highway to within three and one-half miles of the power plant site where it suddenly veers across Knik Arm. At this point there is ample room for a railroad

SPILLWAY CROSSING

SPILLWAY DOWNSTREAM (BELOW)



siding thus making rail transportation very convenient for construction requirements.

A permanent government camp at the power plant and accommodations for construction workers at both the dam and the tunnel outlet would be needed. Housing constructed at the power plant site would become the permanent town for power plant operation and maintenance personnel.

Rights-of-way

Project works would be located on land now owned by the City of Anchorage or on Public Domain, with the exception of transmission lines that would require easements across privately owned property in suburban Anchorage.

Design Floods

Eklutna Creek is not subject to floods in the usual sense of rain floods. The runoff during November to April is relatively small, depending on temperatures. Flows usually increase from May through August, the peak flow coming either in July or August. The runoff is mostly a snow melt, which is accelerated by either abnormally high temperatures or in rare instances by the occurrence of warm rains on the snow. The maximum flow at the diversion dam as estimated by the Anchorage Public Utilities for the period 1930 to 1947 was 3,100 c.f.s., and this occurred in 1944. An analysis of peak flows for record years by the "California method" indicates that the peak discharge of 3,100 second-feet in 1944 had a frequency of once in forty years and that a peak of 4,000 second-feet might be expected about once in one hundred years. However, there are insufficient points in the curve on which to adequately draw conclusions. The spillway would be designed to pass 7,500 cubic feet per second.

Diversion During Construction

Diversion of Eklutna Creek would be required during the construction of the dam. The diversion would be made after completion of the tunnel and power plant.

The municipal power plant for the City of Anchorage generates its power from Eklutna Creek. This plant would be operated at full capacity until it was replaced by the new plant, and subsequently operated for the generation of secondary power.

The flow would be diverted into the tunnel by excavating the remaining open cut section of the intake structure; this section being left in place to serve as a coffer dam during the excavation of the tunnel.

Two separate upstream coffer dams would be required for dam

construction. The spillway unit would be constructed before interrupting flow through the present dam gates. This would allow passage of excess water over and above tunnel diversion capacity and lake storage requirements.

Construction Period

A minimum of four years would be required for the construction of this project. The rate of construction would be dependent upon the rate at which appropriations of funds were made by Congress, and upon the conditions in the labor and materials markets at the time of construction. If construction funds are made available for the last three months of the current fiscal year, $229,000 could be expended. An economical rate of construction during fiscal year 1950 would require an appropriation of at least $2,400,000. Succeeding appropriations should be geared to a construction schedule set up following final design of the structures.

PROJECT WORKS

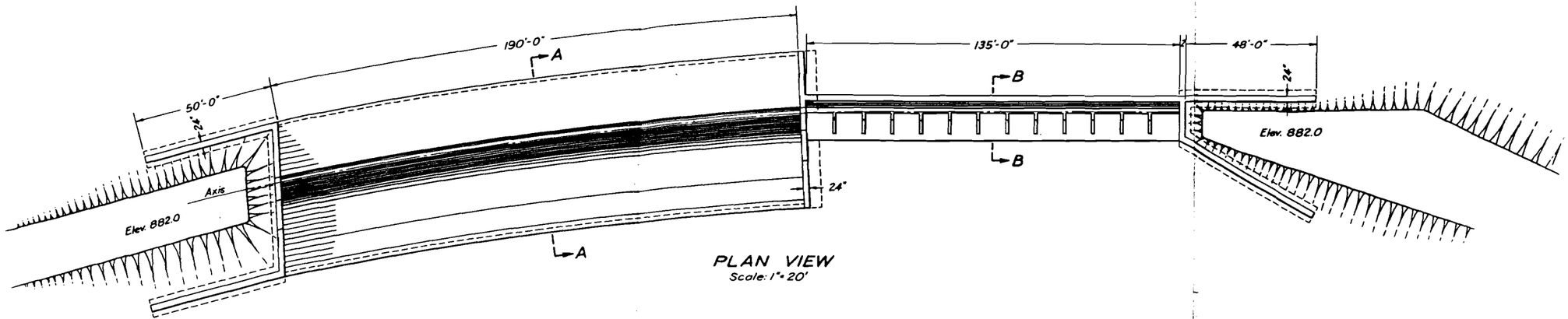
Preliminary study indicates that a concrete gravity type dam with supporting buttress to replace the existing structure would be best suited for the Eklutna Lake Site. However, further data on foundation conditions, flood flow records and other investigational studies may require modifications of the preliminary plans for this structure.

The dam would be constructed to elevation 879.5, four feet above the maximum lake water surface during floods. Height of the dam above stream bed would be 20 feet; and the length of the dam with spillway would be 329 feet. Concrete wing walls would extend out from the main structure an additional 48 feet on the left side and 50 feet on the right side making a total structural length of 427 feet.

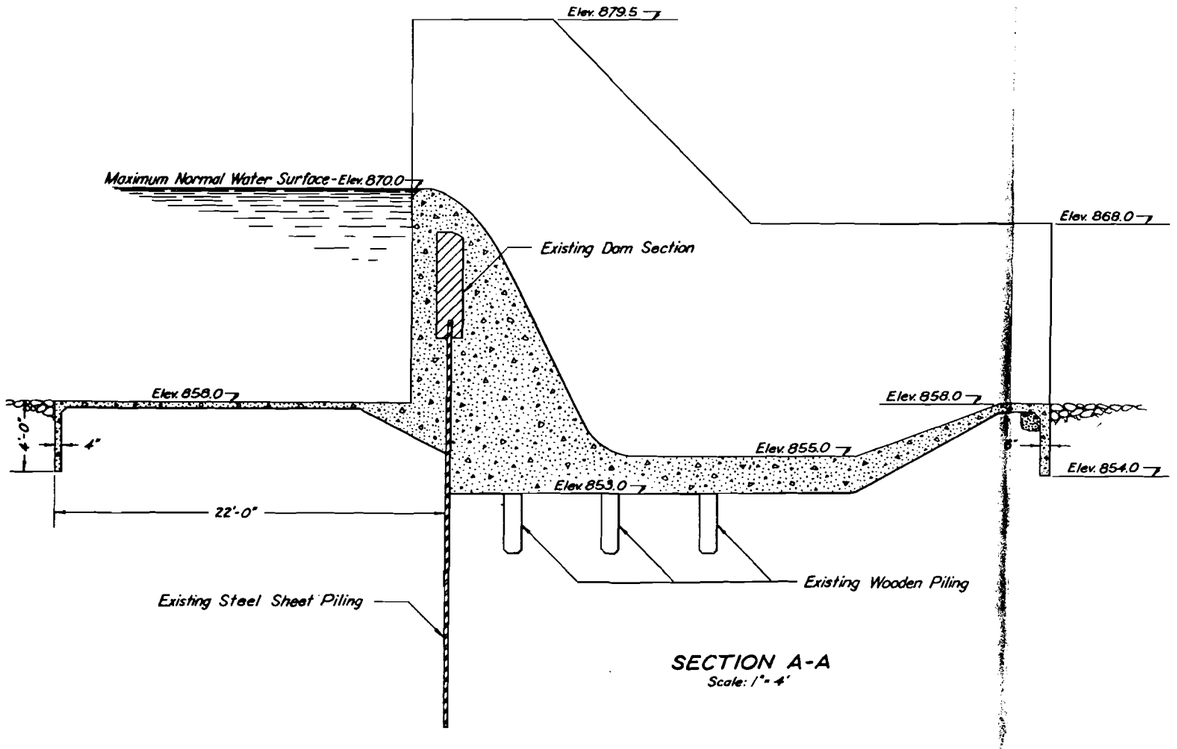
The spillway would be designed to discharge 7,500 cubic feet per second at maximum water surface elevation 875.5. The crest of the spillway would be at elevation 870. It would be 190 feet wide with no control gates.

Construction of the dam and spillway would involve 2,200 cubic yards of concrete, 1,000 cubic yards of excavation and 2,000 cubic yards of compacted fill.

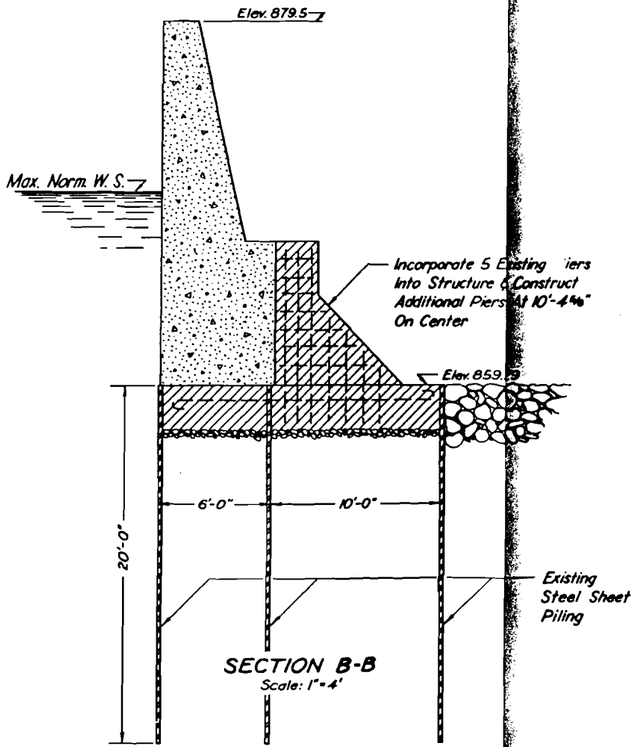
The major portion of water entering Eklutna Lake would be diverted through a nine-foot diameter circular lined tunnel for power development. The invert elevation of this tunnel would be 830 feet. A trash rack structure for the tunnel would be located in an open cut 400 feet from the present lake shore line. The cut would be ex-



PLAN VIEW
Scale: 1"=20'



SECTION A-A
Scale: 1"=4'



SECTION B-B
Scale: 1"=4'

ESTIMATED QUANTITIES

Concrete	2,200 Cu.Yds.
Steel	200,000 lbs.

UNITED STATES
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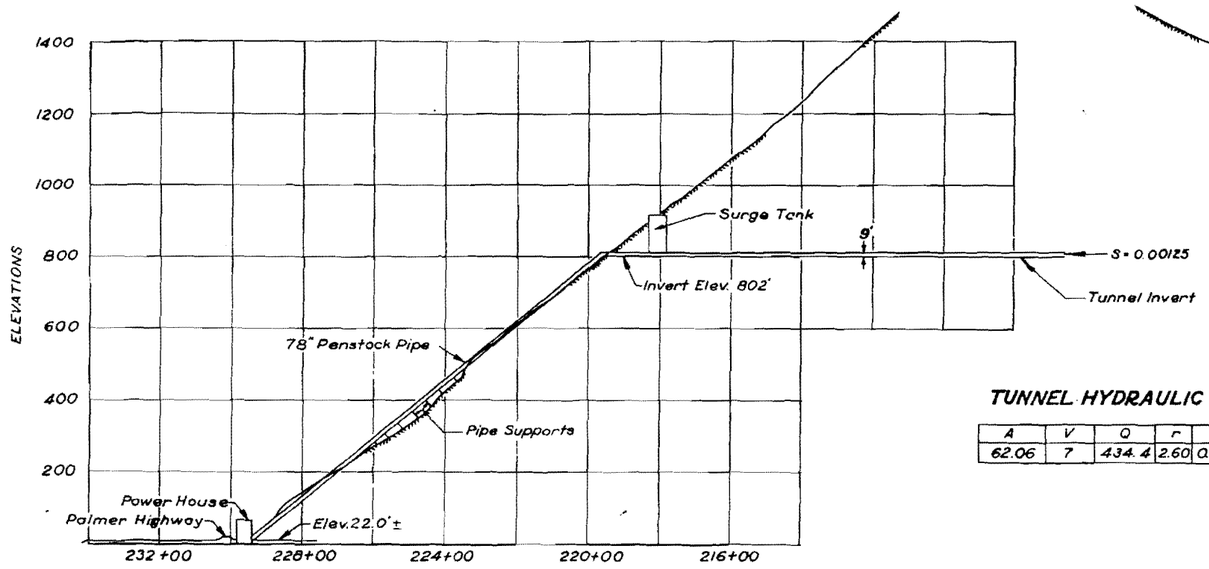
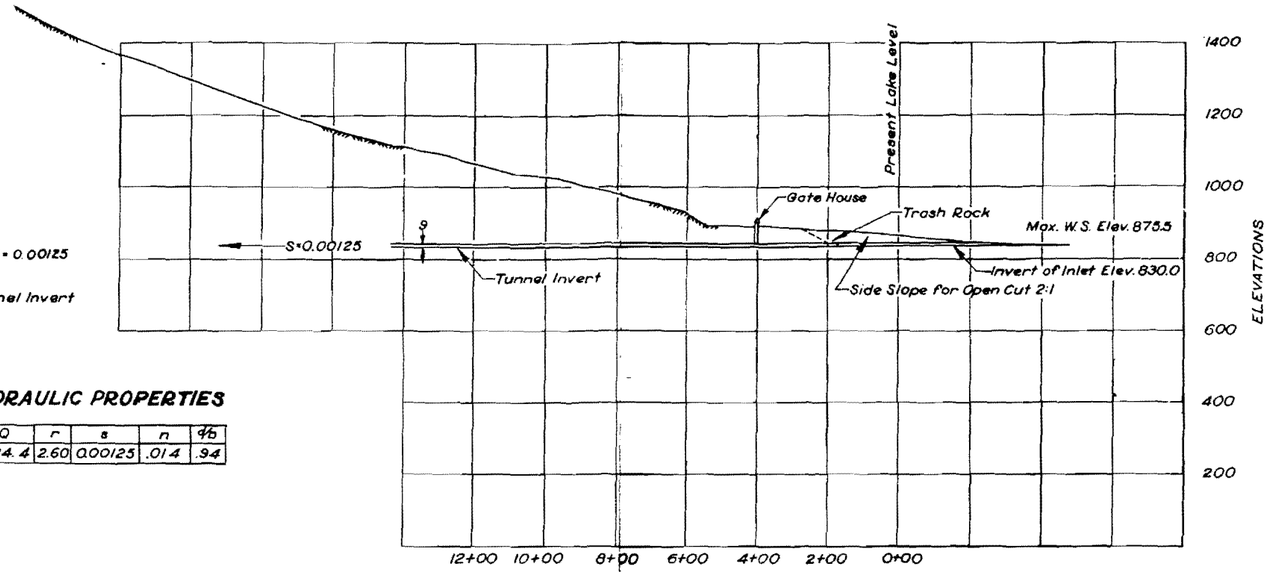
BUREAU OF RECLAMATION
ALASKA INVESTIGATIONS

EKLUTNA PROJECT
PRELIMINARY DESIGN
DAM & SPILLWAY

DRAWN D.L.R. SUBMITTED D. L. Roberts
TRACED G.B.G. RECOMMENDED
CHECKED APPROVED



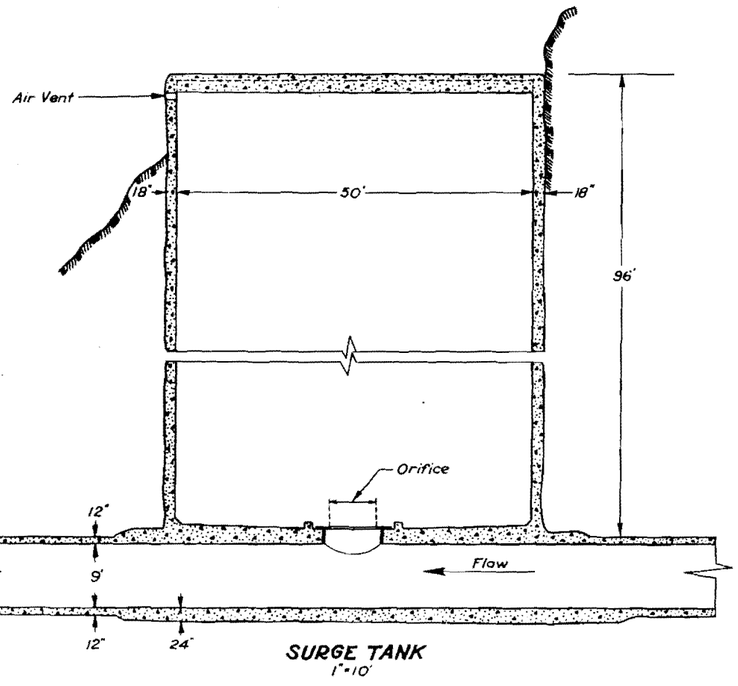
PROFILE AT TUNNEL OUTLET



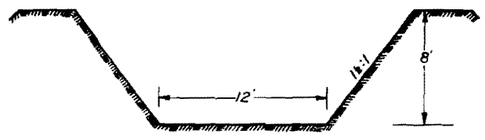
PROFILE AT TUNNEL INLET

TUNNEL HYDRAULIC PROPERTIES

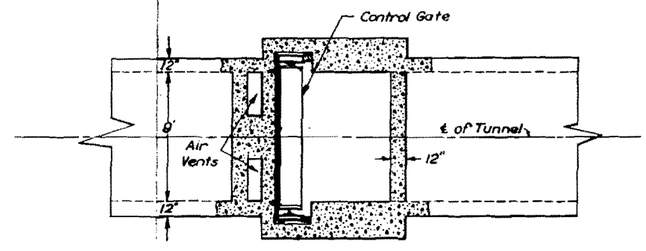
A	V	Q	r	s	n	%
62.06	7	434.4	2.60	0.00125	.014	.94



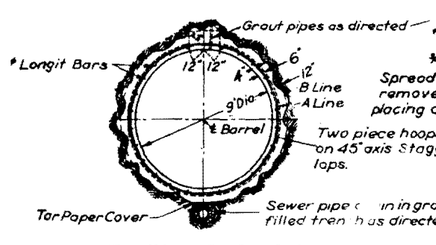
SURGE TANK
1"=10'



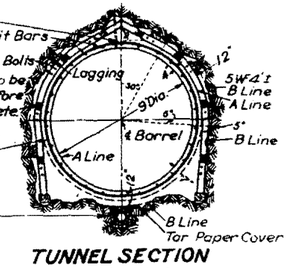
TAIL WATER CANAL
Scale 1"=5'



PLAN OF GATE WELL
Scale 1"=5'



TUNNEL SECTION
UNSUPPORTED
No Scale

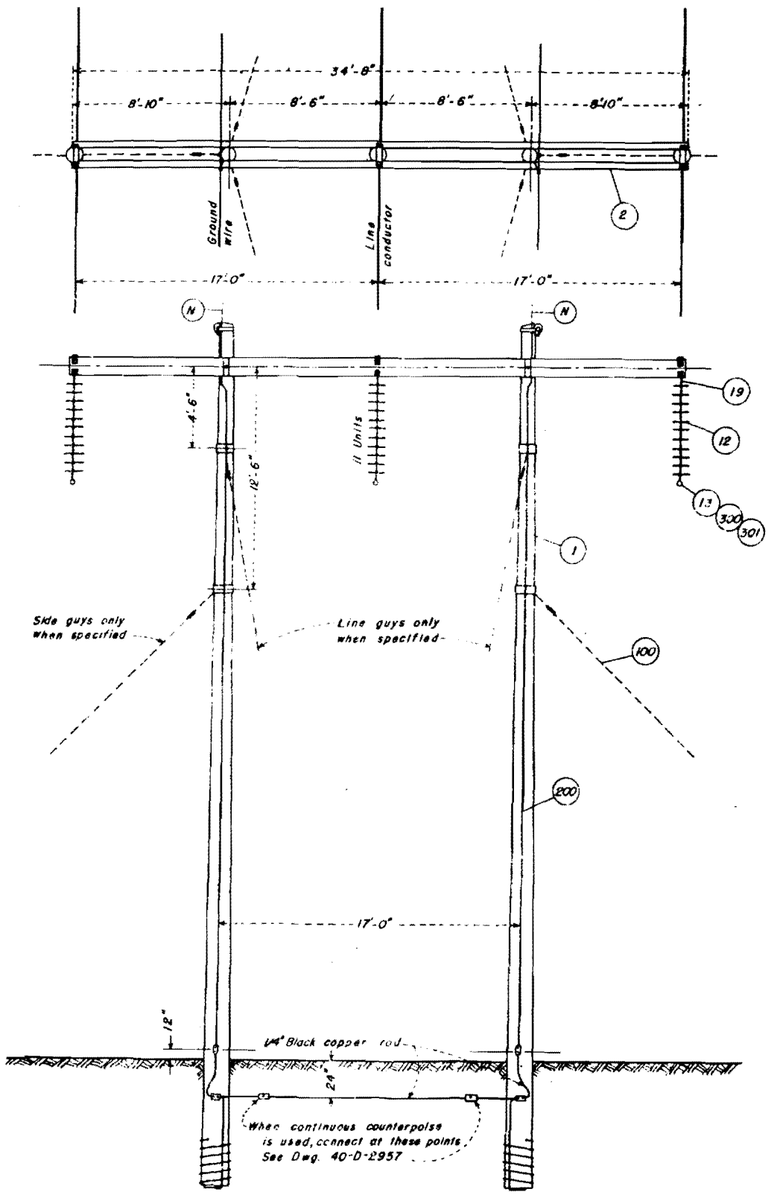


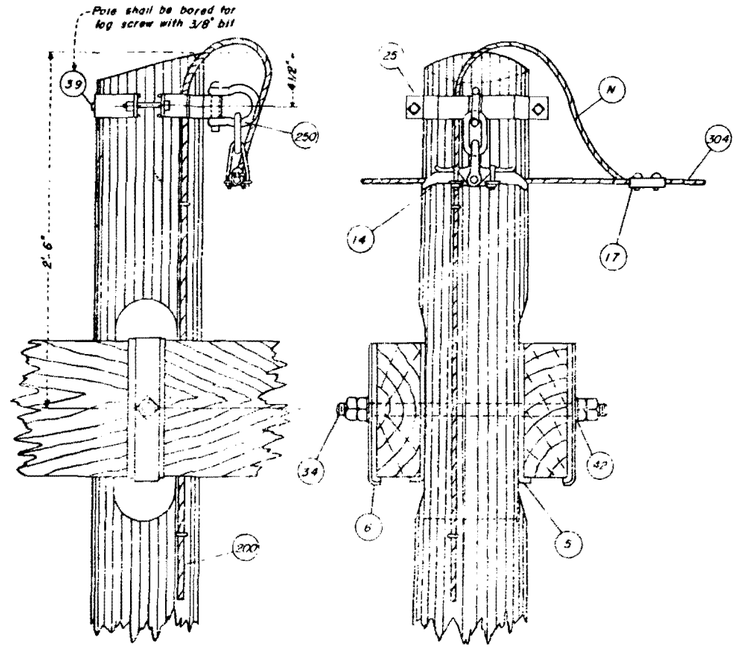
TUNNEL SECTION
SUPPORTED
No Scale

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA INVESTIGATIONS

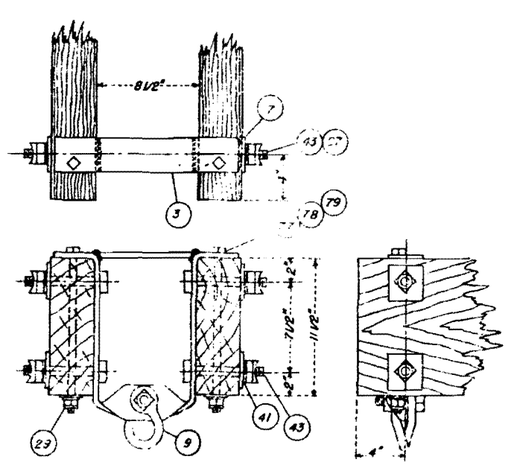
EKLUTNA PROJECT
DIVERSION TUNNEL
AND POWER HOUSE

DRAWN D.L.R. SUBMITTED D. L. Roberts
TRACED E.J.J. RECOMMENDED R. R. Gilmore
CHECKED APPROVED

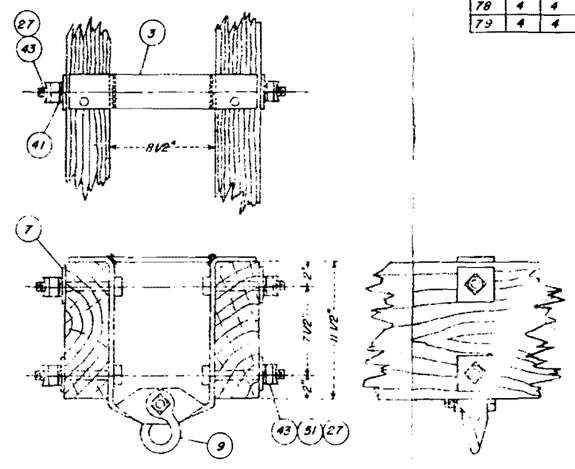




POLE ATTACHMENT ASSEMBLY



END PHASE ASSEMBLY



CENTER PHASE ASSEMBLY

161 K.V.A.
LIST OF MATERIAL

ITEM NO.	QUANTITY PER STRUCTURE: WITH OVERHEAD GRD. WIRE	QUANTITY PER STRUCTURE: WITHOUT OVERHEAD GRD. WIRE	DESCRIPTION
1	2	2	Pole, see structure list for pole height and type of guying
2	2	2	Cross arm, 3 3/4" x 11 1/2" x 34'-8" drilled per Dwg. 40-D-2920
3	3	3	Phase fitting, Dwg. 40 D-3664, B = 8 1/2"
5	4	4	Flat gain plate, Dwg. 40-D-3664
6	4	4	Ribbed tie plate, Dwg. 40-D-3664
7	12	12	3" x 3" x 1/4", flat square washer
9	3	3	Suspension clevis, Dwg. 40-D-3664
12	33	33	Insulator discs, 10" x 5 3/4" spacing, Dwg. 40-D-2808
13	3	3	Conductor suspension clamp with socket fitting
14	2	omit	Suspension clamp with 2 1/4" link, for overhead ground wire
17	2	omit	Clamp, galvanized steel, for 5/16" to 3/8" steel strand
19	3	3	Suspension hook, Dwg. 40-D-3182
25	2	2	Pole top band less shackle, Dwg. 40-D-2938
25a	2	omit	Shackle for pole top band, Dwg. 40-D-2938
27	12	12	Locknut for 5/8" bolt
29	4	4	Locknut for 1/2" bolt
34	2	2	Double arming bolt 7/8" x 22", use extra nuts for locknuts
39	2	2	Lag screws, 1/2" x 4 1/2"
41	12	12	Spring lock washer for 5/8" bolt
42	4	4	Spring lock washer for 7/8" bolt
100 Series			Guying material. For details and material required, see Dwg. 40-D-2958 or 2969
200 Series			Grounding material. For details and material required see Dwg. 40-D-2957, 2970 or 3689
300	–	–	Conductor
301	3	3	Sets of armor rods and clips for A.C.S.R. only.
304	–	omit	Overhead ground wire.
43	12	12	Machine bolt, 5/8" x 6", 1 nut
77	4	4	Machine bolt, 1/2" x 13" 1 nut
78	4	4	Spring lock washer for 1/2" bolt
79	4	4	2" x 2" x 1/8" flat square steel washer

(N) When overhead ground wires are not installed extend 5/16" strand 2'-6" above pole top band.

NOTE

Ground wire to be located on pole above cross arm so as to avoid being chafed by ground wire clamp.

REFERENCE DRAWINGS

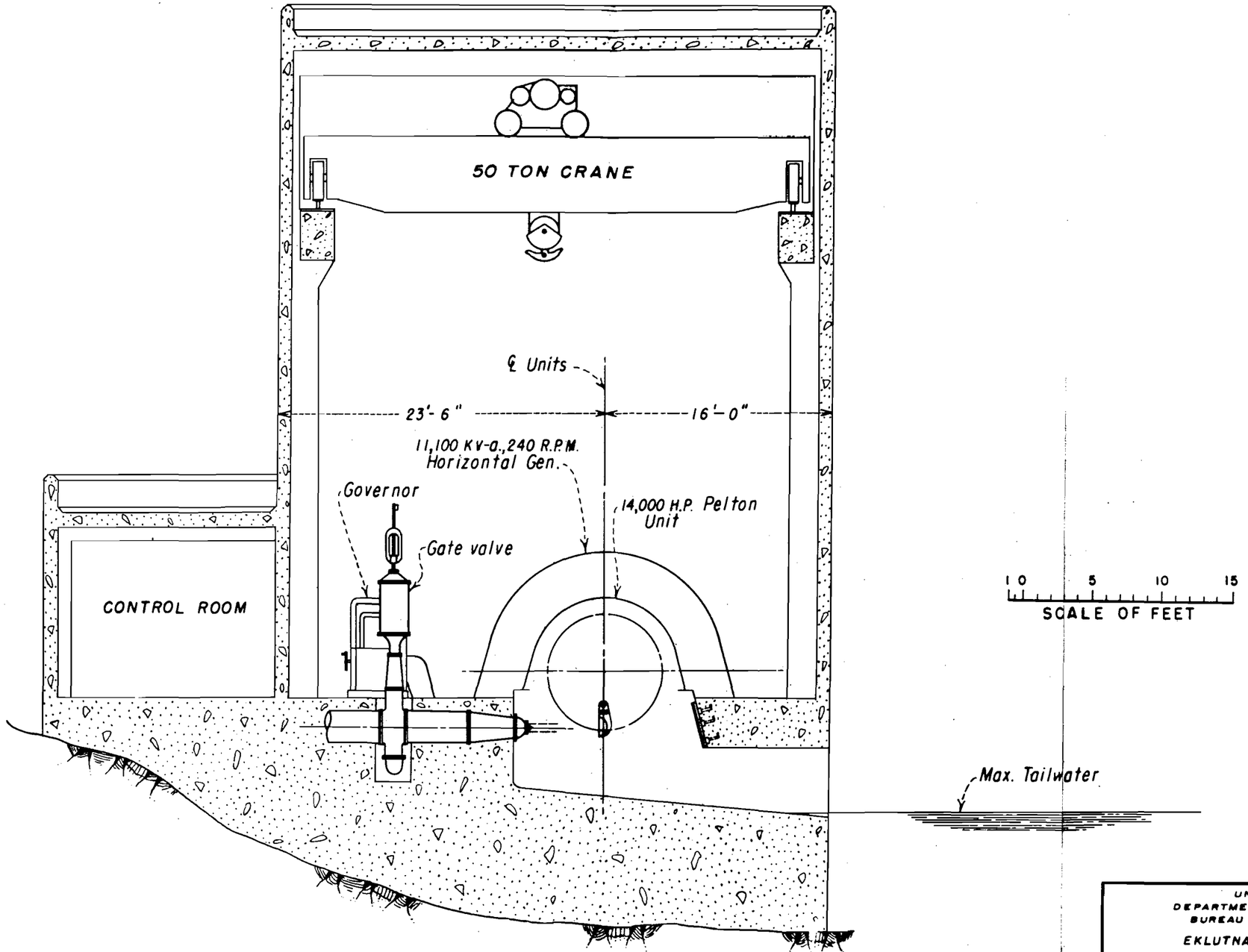
GUYING DETAILS (WITH OVERHEAD GROUND WIRE)	40-D-2958
GUYING DETAILS (WITHOUT OVERHEAD GROUND WIRE)	40-D-2969
GROUNDING AND COUNTERPOISE DETAILS (WITH OVERHEAD GROUND WIRE)	40-D-2957
GROUNDING DETAILS (WITHOUT OVERHEAD GROUND WIRE)	40-D-2970
POLE DRILLING AND GAINING DETAILS	40-D-2939
GROUNDING DETAILS (WITH OVERHEAD GROUND WIRE)	40-D-3689

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA INVESTIGATIONS

EKLUTNA PROJECT

TYPICAL TRANSMISSION LINES

DRAWN: L.M.A.
TRACED: W.L.K.
CHECKED:
SUBMITTED:
RECOMMENDED:
APPROVED:
BUREAU, ALASKA 20 SEPT. 1946



TRANSVERSE SECTION

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

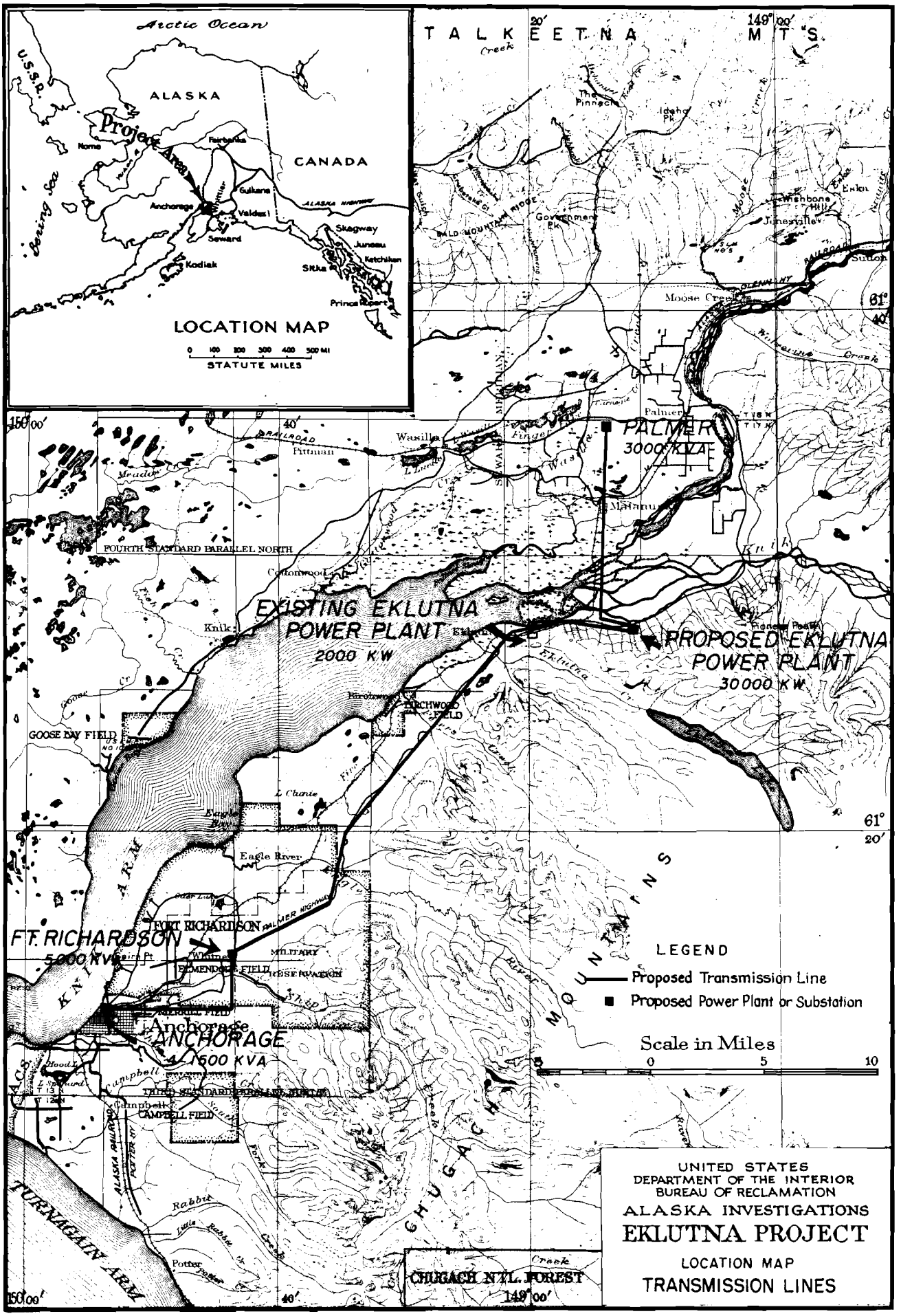
EKLUTNA PROJECT-ALASKA

TYPICAL POWER PLANT SECTION

DRAWN. J.R.D. SUBMITTED .....
TRACED P.V. RECOMMENDED .....
CHECKED ..... APPROVED .....

DENVER, COLO - 9-15-48

Job No. 8-585-18-00-9004


Arctic Ocean
U.S.S.R.
ALASKA
CANADA
Project Area
Nome
Fairbanks
Anchorage
Valdez
Seward
Kodiak
Skagway
Juneau
Ketchikan
Sitka
Prince Rupert
Bering Sea
LOCATION MAP
0 100 200 300 400 500 MI
STATUTE MILES
TALKEETNA MTS.
PALMER
3000 KVA
EXISTING EKLUTNA
POWER PLANT
2000 KW
PROPOSED EKLUTNA
POWER PLANT
30000 KW
FT. RICHARDSON
5000 KVA
ANCHORAGE
4-1500 KVA
FOURTH STANDARD PARALLEL NORTH
THIRD STANDARD PARALLEL NORTH
GOOSE BAY FIELD
TURNAGAIN ARM
KNIK ARM
CHUGACH MOUNTAINS
CHUGACH NTL. FOREST
LEGEND
Proposed Transmission Line
Proposed Power Plant or Substation
Scale in Miles
0 5 10
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
ALASKA INVESTIGATIONS
EKLUTNA PROJECT
LOCATION MAP
TRANSMISSION LINES

tended into the lake for 500 feet to elevation 830. A reinforced concrete gate house, provided with a slide gate, would control the flow of water into the tunnel at the inlet. The tunnel would be concrete lined, 22,000 feet in length, and would have a slope of 0.00125.

On the opposite side of the mountain and near the discharge end of this tunnel would be a concrete surge tank. This surge tank would extend up through the mountain.

At the tunnel's mouth, a 78" steel penstock, 1,250 feet long, would intercept the tunnel flow and convey it down the mountain side to a power plant. The average head at the power plant would be about 820 feet. The maximum static head would be 858 feet.

The power plant would be located at the base of the mountain and directly below the tunnel outlet. The installed capacity would consist of three 10,000 Kw. generators.

A canal would be constructed to convey the tailwater from the power plant to the Knik River. It would be necessary to construct a reinforced concrete bridge at the point where the canal would cross the Palmer Highway.

Transmission facilities would consist of two wood-pole lines, one extending southwest from the plant switchyard to Anchorage and the other extending north to a point on the Palmer-Wasilla road about four miles west of Palmer. Both lines would be designed for ultimate operation at 115,000 to 161,000 volts, with a view to incorporating them into a future Seward-Fairbanks backbone transmission line.

The 34-mile Eklutna-Anchorage line would be initially operated to deliver energy at 57,000 volts, to permit utilization of four recently installed 1500 Kva. unit-type substations in the City of Anchorage, which are designed to receive energy at 33,000 or 57,000 volts. The 12-mile Eklutna-Palmer line would likewise be initially operated at 57,000 volts, with a transformer installation at Palmer Substation which would reduce the voltage to 12,000 volts for supplying the Matanuska Electric Association

Allowance has been made in the cost estimate for a 30,000 Kva., 161,000 volt substation to supply the City of Anchorage, a 5,000 Kva. substation for Fort Richardson and 2,000 Kva. substation to serve the Alaska Railroad. Design details of these substations will depend upon results of future negotiations with the respective agencies.

The National Park Service proposes development of the recreational potentialities of the Eklutna Lake area. The development would include two miles of road beyond the tunnel intake portal, campground with a minimum of 50 individual campsite, picnic areas along the lake shore, comfort stations for picnic and campground areas, a boat pier, airplane

landing float and finger floats for boats, a minor sports area, and parking areas at scenic points, a lodge, centrally located on the lakeshore would be equipped with a minimum of ten guest rooms, a lounge, coffee shop, related facilities and help's quarters. Trails would be constructed along the lakeshore; a ski area would be developed with a hut having a warming room, snack bar and lockers, and a rope tow for the ski slope; a toboggan slide would be provided as would a skating hut equipped with heating facilities. An administrative area would have an office and employees' residences, equipment storage building, shop and utility structures, utility system for all needs, including water system, sewerage disposal system and power distribution lines, walks, terraces and landscaping. Detail description of the development is in the National Park Service section of the Appendices to this report.

COST ESTIMATES

The total estimated reimbursable cost of this project, including investigations, surveys, cost of construction, operation and maintenance during construction, acquisition or alternate arrangements for the existing Eklutna plant, rights-of-way, easements and the purchase of any needed operating equipment is $20,365,400.

The estimated annual cost of operation and maintenance for all project works except recreational facilities is $158,300. This includes the dam, tunnel and appurtenant works, penstocks, power plant, switchyard, substations, transmission lines, roads, operators' colony and all incidental works necessary to project operation. The estimated annual replacement cost of all project works except recreational facilities is $72,600.

The total estimated non-reimbursable cost of recreational facilities as planned by the National Park Service is $1,215,000.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

EKLUTNA PROJECT, ALASKA

PRELIMINARY ESTIMATE

NO.	ITEM	UNIT	QUANTITIES	UNIT COST	COST	COST TOTAL
1	DAM					
	Excavation	C.Y.	1,000	$1.00	$1,000	
	Diversion of creek	L.S.		L.S.	5,000	
	Dike fill	C.Y.	2,000	2.00	4,000	
	Concrete	C.Y.	2,200	90.00	198,000	
	Reinforcing steel	lbs.	200,000	.18	36,000	
						$ 244,000
2	TUNNEL INLET					
	Diversion of creek	L.S.		L.S.	2,000	
	Common excavation	C.Y.	65,000	1.50	97,600	
	Trashrack structure	L.S.		L.S.	30,000	
						129,600
3	GATE STRUCTURE					
	Excavation	C.Y.	300	50.00	15,500	
	Concrete	C.Y.	75	90.00	6,800	
	Gate and guides	lbs.	25,000	.50	12,500	
	Miscellaneous items	L.S.		L.S.	1,000	
						35,800
4	TUNNEL					
	Excavation	C.Y.	86,400	42.00	3,628,800	
	Concrete lining	C.Y.	30,750	80.00	2,460,000	
	Liner plates	lbs.	685,000	.225	154,000	
	Steel rib supports	lbs.	2,475,000	.225	557,000	
	Timber	M.b.m.	1,250	300.00	375,000	
	Reinforcing steel	lbs.	1,980,000	.18	356,400	
	Drainage	L.F.	22,000	7.00	154,000	
						7,685,200
5	SURGE TANK					
	Excavation	C.Y.	7,360	50.00	368,000	
	Concrete	C.Y.	1,350	90.00	121,500	
	Reinforcing steel	lbs.	285,000	.18	51,300	
						540,800
6	PENSTOCK					
	Excavation	C.Y.	2,400	6.50	15,600	
	Supports (concrete and steel)	L.S.		L.S.	12,600	
	Reinforcing steel	lbs.	21,000	.18	3,800	
	78 inch pipe	lbs.	870,500	.35	305,000	
						337,000
7	POWER HOUSE					
	Bldg, mech. equip. & improvements	L.S.		L.S.	1,905,000	
						1,905,000
8	POWER TRANSMISSION					
	Transm., sw. yds., substa. & lines	L.S.		L.S.	3,303,000	
						3,303,000
9	TAIL RACE					
	Excavation	C.Y.	6,000	2.00	12,000	
	Bridge	L.S.		L.S.	12,400	
						24,400
10	ROADS					
	Improvements - present access rd. - Eklutna L.	L.S.	10 mi.	10,000	100,000	
	North portal road	L.S.	1.5 mi.	L.S.	50,000	
						150,000
11	OPERATING COLONY					
	Housing	L.S.		L.S.	200,000	
						200,000
	SUB TOTAL					14,554,800
	Contingencies, R/W & other costs				2,901,600	
						17,456,400
	Investigations and surveys				637,000	
	Design and specifications				727,000	
	Supervision of construction				1,273,000	
	Admin. and general expense				272,000	
	TOTAL ESTIMATED COST					$20,365,400

47279

CHAPTER IV

W A T E R - P O W E R

Eklutna Creek heads in the Chugach Mountains and flows generally north and west to empty into Knik Arm of Cook Inlet. The basin ranges from sea level to 8000 feet in elevation. One main glacier, several smaller ones and hanging ice fields still remain in the drainage area. The total area of active ice fields is six and two-tenths square miles. The basin encompasses 172 square miles of which 119 square miles are tributary to Eklutna Lake.

WATER RESOURCES

Precipitation

Records of precipitation and temperatures are available at the following stations in the vicinity. These stations are on the west side of the Chugach Mountains.

Station	Elevation (feet)	Period of Record
Anchorage	40	1916 to date
Matanuska	166	1916 to date
Eklutna Power Plant	27	May 1941 to date
Eklutna Lake	882	June 1946 to date

The prevailing wind direction in Southeastern Alaska is from the southeast and moisture laden air is brought in from that direction. The Chugach Mountains, with elevations running as high as 18,000 feet at Mt. St. Elias, deflect these winds to the southwest. The chain of mountains forming the backbone of the Kenai Peninsula shelter the stations at Anchorage and Eklutna, as they are on the lee side of the mountains. The mean annual precipitation on the Anchorage side of the Kenai Peninsula, at Anchorage and Eklutna, is approximately 15 inches. Stations at Whittier, Cordova, and Valdez, which lie east of the Kenai Peninsula and on the south slope of the main Chugach Mountains, record annual precipitations as high as 180 inches with the mean annual at Cordova approximately 145 inches and at Valdez 60 inches.

There are no weather stations above 882 feet in elevation in the Eklutna Creek basin or vicinity. However, it appears that the moisture laden air masses coming in from the southeast rise on striking the mountains, and condense with precipitation resulting. The Eklutna Basin catches that portion carried over the top of the mountains before condensation ceases. The situation is analogous to that prevailing on the east slope of the Rocky Mountains.

Stream Flow Records

Geological Survey established a staff gage on Eklutna Creek at the outlet of Lake Eklutna in November, 1946. Readings are taken twice daily by the gate tender for Anchorage Public Utilities. A provisional record of flows for the water year ending September 30, 1947 has been prepared by Geological Survey. Records of gage heights as reported by the gate tender were taken from records at the existing Eklutna power plant and applied against the provisional rating curve used for 1947, to thus extend the record of actual flows at the lake to the present date. The runoff given in Table 1 reflects water passing out of the lake and shows effect of regulation in the lake. The record of flows thus obtained is as follows:

TABLE 1

RECORDED DISCHARGE EKLUTNA CREEK
AT EKLUTNA LAKE OUTLET

Month	1947 Runoff 1,000 A.F.	1947 Flow Average cfs.	1948 Runoff 1,000 A.F.	1948 Flow Average cfs.
Oct.	-	-	17.6	286
Nov.	8.6	145	8.1	136
Dec.	8.9	145	8.6	139
Jan.	6.2	101	7.8	126
Feb.	4.9	88	8.6	149
Mar.	5.5	90	8.0	130
Apr.	5.1	86	7.4	124
May	4.7	76	8.9	145
June	26.9	452	29.3	481
July	67.9	1101	58.5	950
Aug.	53.6	886	-	-
Sept.	22.5	377	-	-

The existing Eklutna power plant was first placed in operation in 1929 and need for winter storage was early recognized. According to a report written in 1940 by Anton Anderson, Consulting Engineer, the original dam was made on top of the glacial muck with brush, clay, moss, logs, lumber and rocks. When water in the lake raised four or five feet, it was found that the slightest leaks under or around the dam dissolved the glacial muck and soon allowed the lake flow to escape. Later, interlocking wood piling, fabricated on tne job, was driven across the mouth of the overflow channel to a depth of twelve to sixteen feet below water level. The upper ends of the piles were allowed to protrude three to four feet above the original level of the lake. Excess water spilled over the tops of the piles. To remove stored water in the winter

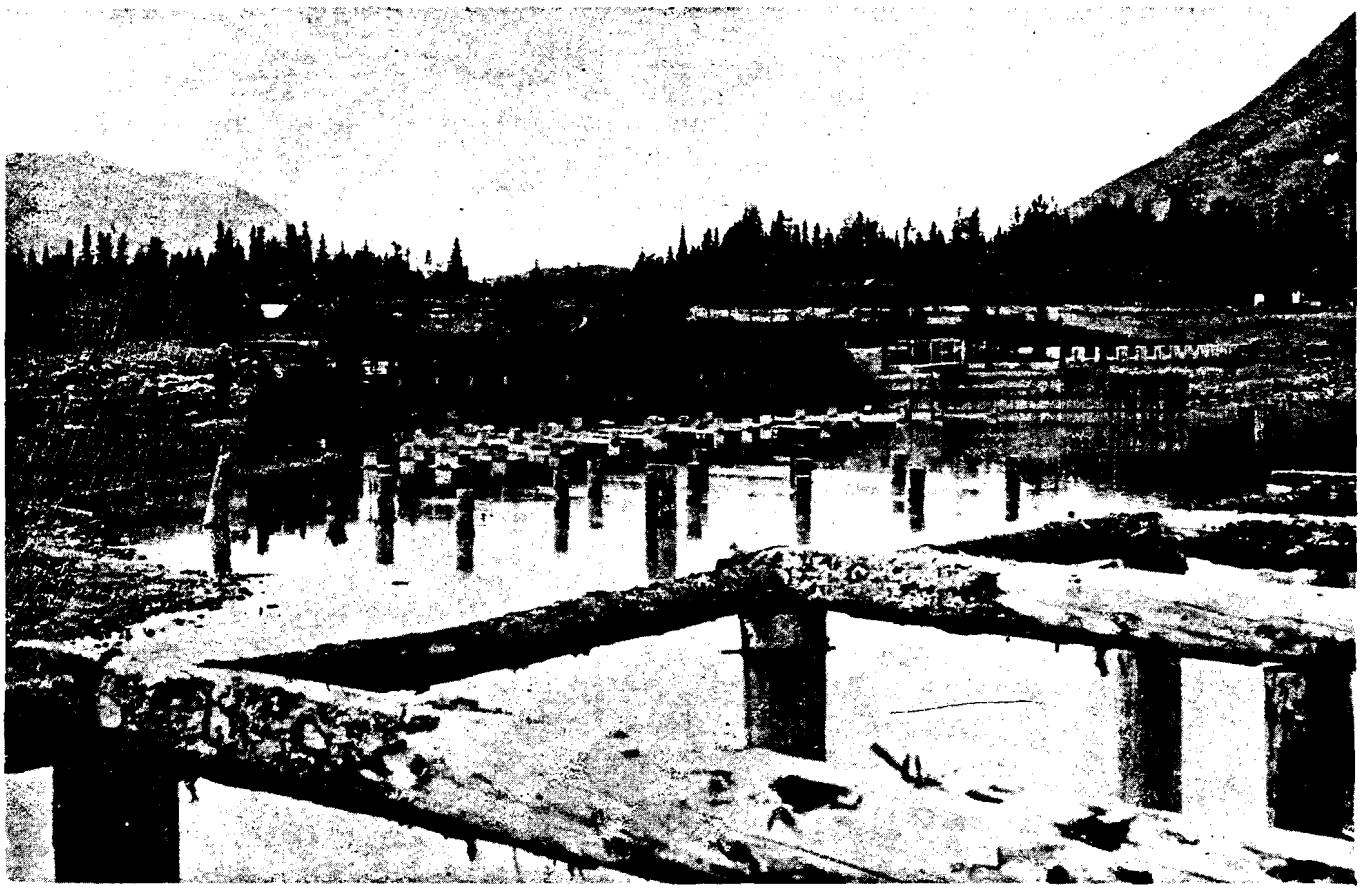
and spring, sections of the piling were progressively removed until all stored water had been drawn from the lake.

In the fall of 1939, the present outlet structure was built. It consists of 15 open bays, each 10 feet wide, which may be flashboarded to elevation 871, and 19 gates, each six feet six inches high by five feet wide, to control the discharge. The method of operation has been to pass all summer flows as long as believed possible and yet fill the lake storage on the tail of the summer flood. This is done to avoid having water standing against the dam any longer than is necessary and to avoid as nearly as possible having any water actually spill over the overflow section of the dam. Records of use of change of storage in the reservoir are shown on curves on file in Anchorage Public Utilities office for the period from November, 1942 to present. No record of storage used or quantity accumulated is available for the period prior to that time.

Estimates of Eklutna Creek flow downstream at the concrete arch dam, which diverts water to the present power plant, have been made since 1929 by Anchorage Public Utilities. Three elements of flow enter into the estimate of total flow passing the diversion dam as made by the Utilities. The first is a record of power generation converted into average second-feet of flow through use of a factor, which is "one acre foot run through the plant will develop 182 KWH of power." The second element in the estimate is leakage through the sluice gate. Sediments accumulate behind the diversion dam and are periodically sluiced. It is estimated that approximately 300,000 cubic yards of sediment are removed annually. The gate is not in first class working condition and on occasion, after the sluicing operation, trees have been stuck in the gate which later have had to be shot out. The leakage has varied from year to year based on gate condition, but has been estimated by the Utilities as averaging between 5 and 20 cubic feet per second. The third element in the estimate is the amount of water spilling over the crest of the diversion dam. The basis for the estimate is a theoretical rating curve for discharge over the crest, based on weir formula. The number of bays through which water is being spilled must also be taken into account.

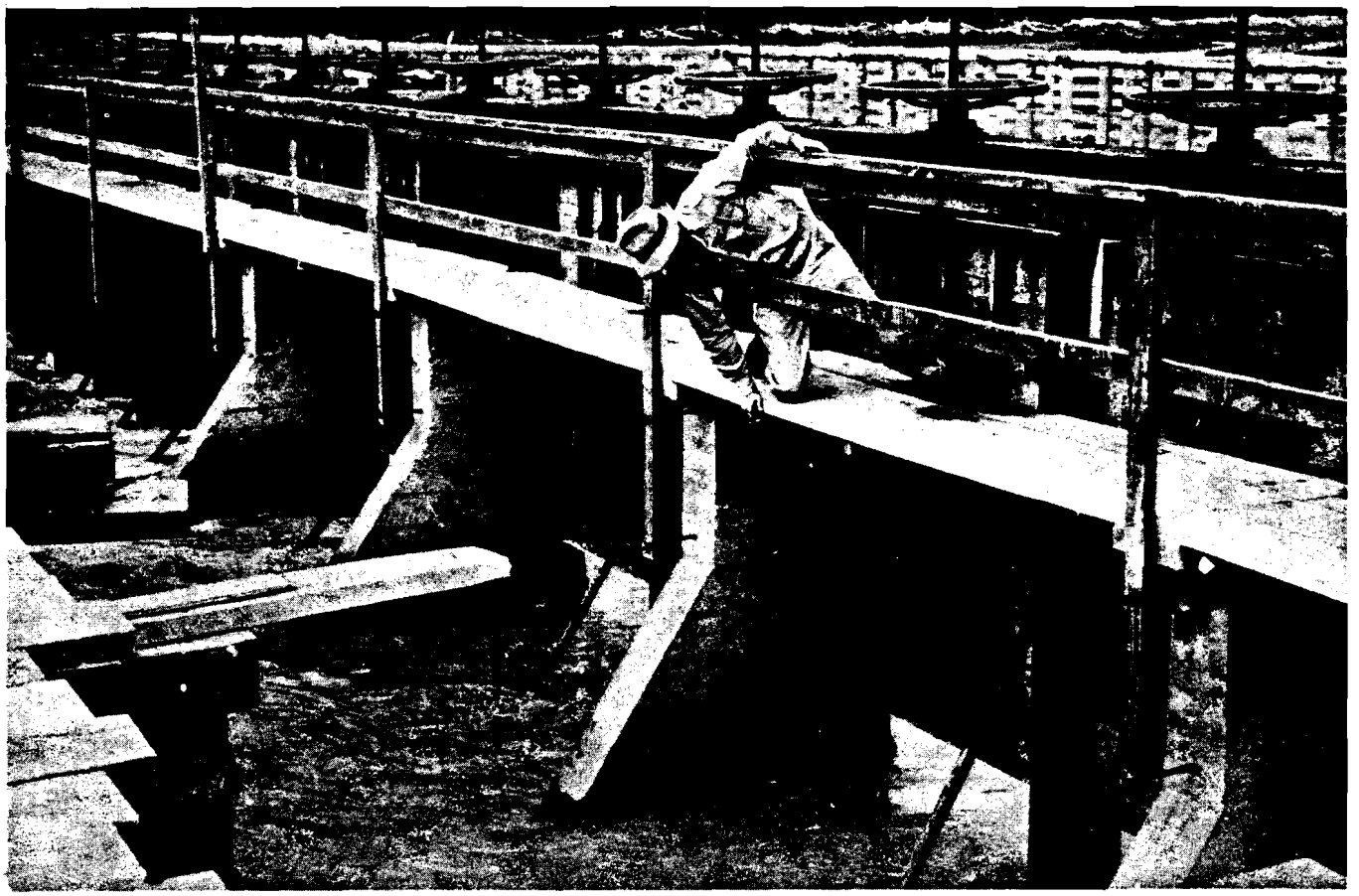
For the period from October 1929 to November, 1945, daily records of power generation were made. Estimates of gate leakage and spill over the crest were made every three days when a plant operator visited the diversion dam. The records are such that it is difficult to check the past estimates, primarily as to spills, and it can only be hoped that proper corrections were applied to convert gage heights to discharges considering the number of bays through which water was spilling.

In November, 1945, a Bristol type long distance recorder was



DAM CONTROL GATES

GATE STRUCTURE (BELOW)



installed in Eklutna Power House. The pressure cell is mounted in the tunnel about 1500 feet below the diversion dam. Through experience, the pressure at this point in the tunnel has been correlated with head on crest of the dam. To convert the head as so deduced to discharge, it is still necessary to make proper corrections to compensate for the number of bays through which water is spilling. Daily estimates of discharge are on file in Anchorage Public Utilities office for the period from November, 1945, to-date.

Determination of Runoff Eklutna Creek

The discharge of Eklutna Creek at the outlet of the lake as it would have occured without storage regulation for the years 1939 to date is shown in Table 2. The actual flows as determined by the Geological Survey and corrected for change of storage, are used for the period of record. The balance is estimated from the flow estimates made by Anchorage Public Utilities.

To make the estimates, the average daily discharge for each month as reported by Anchorage Public Utilities was converted to acre-feet for the month. For those years in which any record of use of storage was available, a correction was made to convert the flow as reported into a natural flow, or flow that would have been experienced had there been no regulation by storage. For those years when only a record of storage use was available, and no record of time or rate of accumulation was available, the amount of storage in the fall was arbitrarily assumed to have been accumulated in one or more months during the season when high flows were being experienced.

Flows as estimated at the power plant and those obtained by the record at Eklutna Lake outlet for the period of concurrent record were examined. The period of such concurrent record was too short for any definite conclusions on relationship between the two records. However, as 20 square miles of drainage are tributary to the diversion dam below Eklutna Lake, it is reasonable to expect that the flows at the diversion dam should always be greater than at the lake. The differences between recorded flows at the lake and estimated flows at the diversion dam for the period of concurrent record were used as a guide for arbitrarily decreasing the past estimates of flows made for the diversion dam. The amount of decrease applied varied from month to month, depending on the size of the flow estimated at the diversion dam, but ranged from 200 to 10,000 acre-feet in any month.

It was recognized that the above method was quite arbitrary, but it was used as being the best available. Geological Survey did make a few miscellaneous stream flow measurements in 1912 and 1913 in this area of Alaska. No further stream gaging was done until 1946 when the gage was established on Eklutna Creek. Consequently, there are no long-term stream runoff records available which might logically

TABLE 2

RUN-OFF OF EKLUTNA CREEK AT EKLUTNA LAKE OUTLET 1/

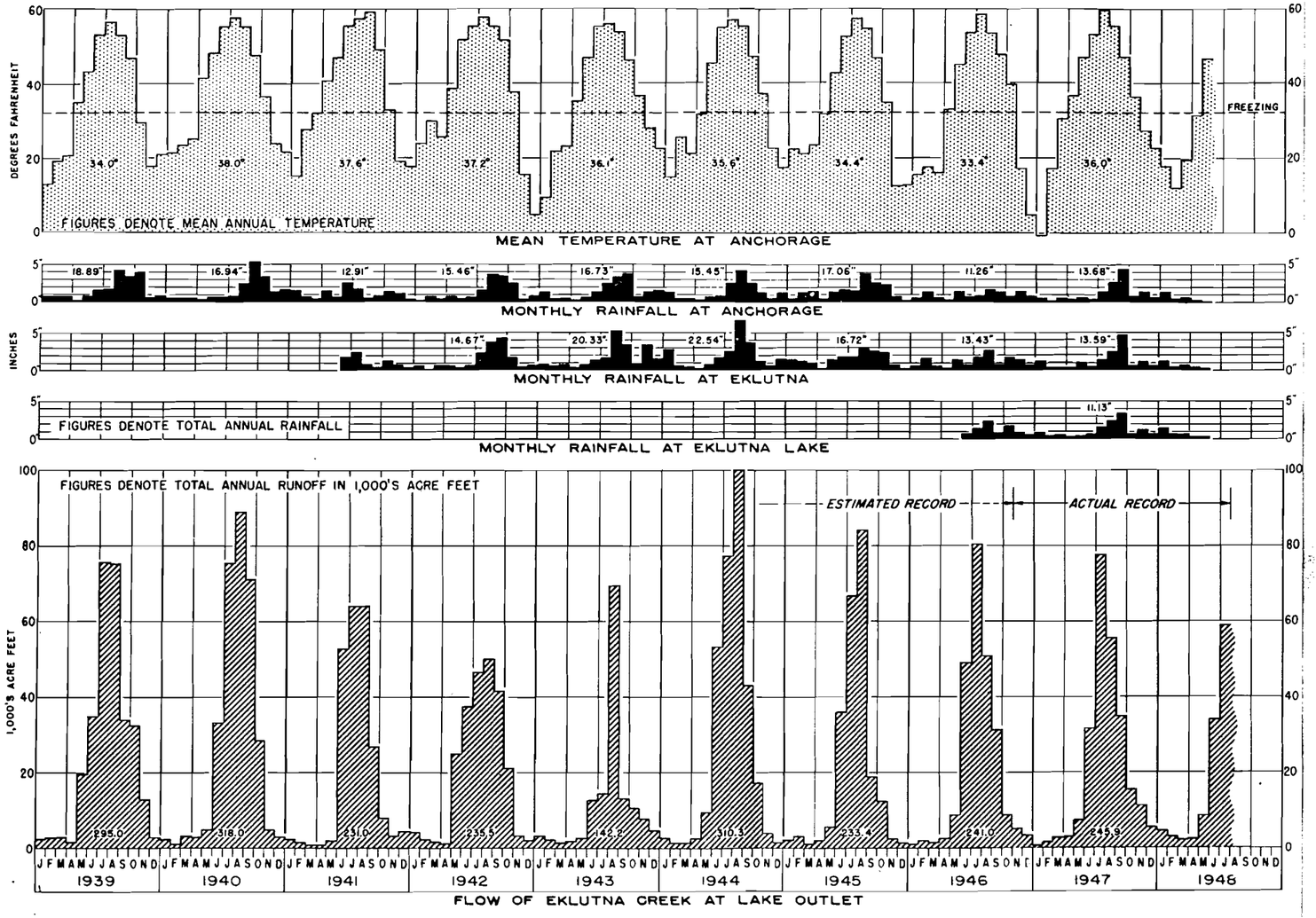
(Drainage Area 119 Square Miles)

Unit 1,000 A.F.

Water Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1939	20.6	12.1	5.5	2.1	2.4	2.6	1.2	19.6	34.7	75.5	75.1	34.0	285.4
1940	32.2	12.8	2.8	2.1	1.1	2.9	2.9	4.5	33.2	75.6	89.0	70.6	329.7
1941	28.3	4.7	3.1	2.2	1.8	1.4	1.3	1.9	52.6	64.0	64.0	26.8	252.1
1942	8.1	3.3	4.1	4.0	2.0	1.8	1.1	24.8	37.7	46.4	50.0	41.7	225.0
1943	21.0	3.0	2.0	2.9	2.0	1.5	1.9	2.7	12.2	14.1	69.4	13.1	145.8
1944	10.3	7.9	4.2	2.4	1.2	1.5	2.2	9.6	53.3	77.0	100.0	41.4	311.0
1945	17.0	3.5	1.2	2.0	2.7	0.9	1.9	5.4	36.0	66.5	84.0	18.3	239.4
1946	12.2	2.2	1.3	0.9	1.8	1.2	2.1	8.2	48.6	80.2	50.4	30.8	239.9
1947 2/	8.5	5.3	3.0	0.2	1.6	2.8	2.6	7.1	31.5	77.8	55.4	34.2	230.0
1948	15.8	11.4	5.5	4.3	2.7	2.1	2.1	8.5	33.9	58.5			

1/ Data are for natural run-off that would have occurred had there been no regulation by storage.

2/ Data are estimated October, 1939 to and including October, 1947.



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EKLUTNA PROJECT
ALASKA

RELATIONSHIP OF RAINFALL TO ESTIMATED RUNOFF EKLUTNA CREEK

be used for correlation. An attempt was made to use longer precipitation and temperature records as a basis for verifying the flows estimated by the Utilities. There is no apparent relationship between flows as recorded or estimated and either Anchorage temperature or precipitation. Other precipitation records were inspected, such as those for Valdez and Cordova, for possible relationships with Eklutna Creek flows, but either such records have too much discontinuity to be of value or no relationship could be discovered.

In the one complete year of record at Eklutna, the flow totaled 230,000 acre feet. This is equivalent to a runoff of 1,930 acre-feet per square mile or a runoff depth of three feet. It is probable that the runoff depth results from a total precipitation in the basin of at least five feet.

A further factor which no doubt influences runoff to at least the same extent as rainfall is the mean temperature. Eklutna Creek has six and two-tenths square miles of active glacier area and it is possible that even with above normal rainfall, the runoff may be low if mean temperatures through the summer are subnormal, so that a less than average amount of snow storage is melted in the runoff season. It is also thought that the rate of melting is probably more closely related to mean daily temperature than maximum temperature. If the minimum temperature drops below freezing, melting ceases and flows started in the warm part of the day freeze. There is also a lag the following day in the start of the melting. If the mean temperature remains relatively high and above freezing, melting once started may continue. Records of precipitation and temperature at high elevations would be of great value in further studies of water supply for Eklutna Creek and other Alaskan streams.

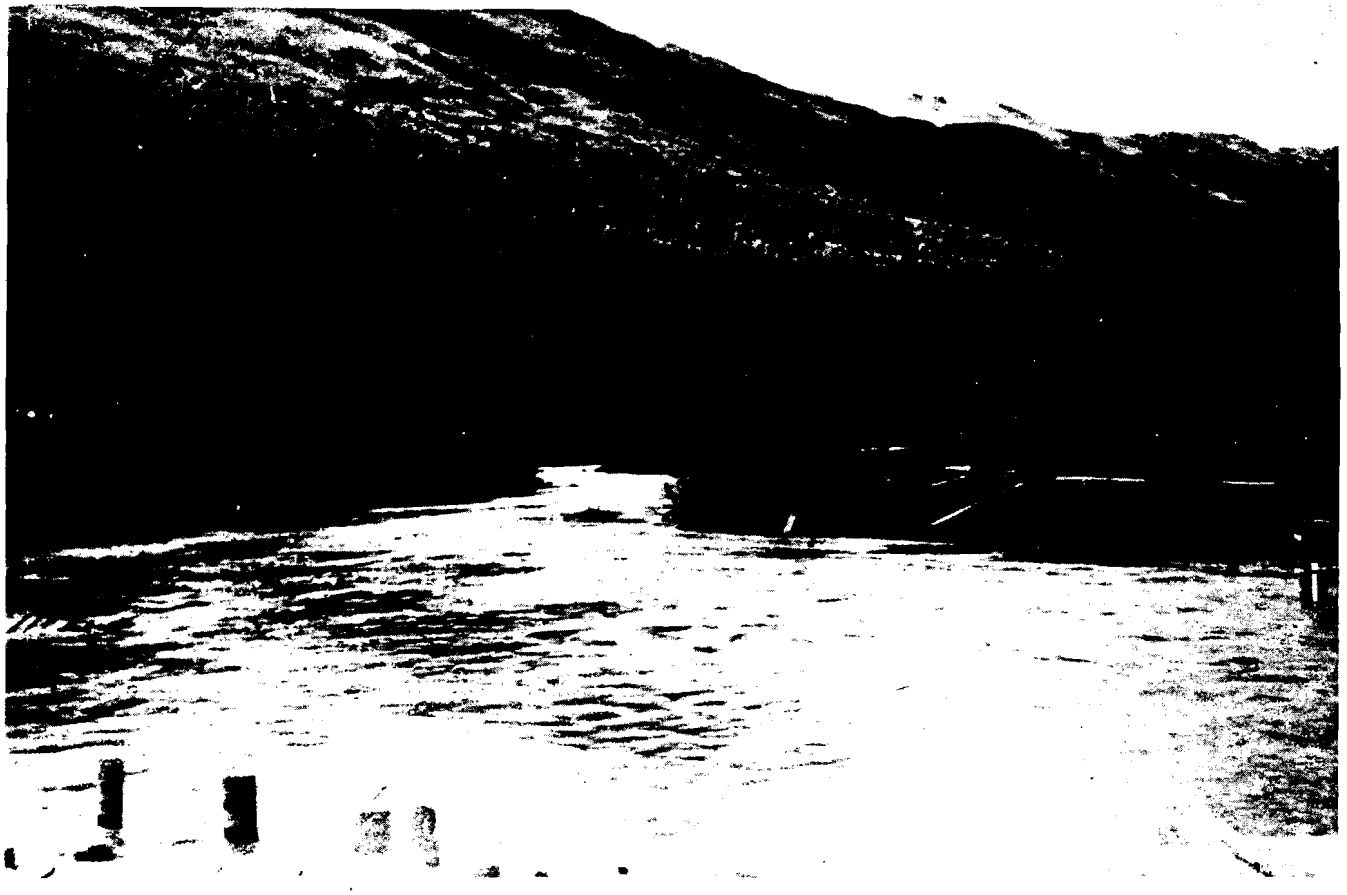
Periods of Study

The following comparison is offered as indicative of trends as to maximum and minimum runoffs which might be expected and to show how the period of study compares with a long-term average of precipitation records.

	Anchorage	Valdez
Length of Record (Minor gaps included)	1916-1947	1910-1947
Mean rainfall for length of record	14.56	60.25
Mean rainfall for 1939-1947	15.50	60.6
Lowest on Record 1938	10.46	
Lowest on Record 1919		39.12
Highest on Record 1939	18.89	
Highest on Record 1929		83.39

LAKE STORAGE

RIVER CHANNEL BELOW GATES (BELOW)



There is no apparent direct relationship between rainfall at Anchorage or Valdez and runoff at Eklutna Lake. The period of study used is 1939-1947. However, from these precipitation records, this period of study appears to be slightly above the long-term mean. Estimates of runoff as made by Anchorage Public Utilities show the years 1942 and 1943 to be the lowest in the period since 1929. These critical years fall within the period of study; reservoir capacity required for firm power generation is estimated from the requirements for those years.

Sedimentation

It is recognized that glaciers contribute great amounts of sediments to the streams, and glacier-fed streams are easily recognized by their milky color. In the case of Eklutna Creek, the snout of the main glacier is approximately four and one-half miles upstream from the upper end of the lake. The channel from the glacier to the lake is aggrading, and the evidence indicates that the bulk of the coarse material is being deposited in the form of a delta at the head of the lake. Suspended sediments are carried into the lake and a small portion are deposited on the lake floor. A very large portion of the suspended sediments is carried on through and out of the lake, as evidenced by the milky color of the water below the dam.

The plan of development for Eklutna Lake would not allow the lake to be drawn down below elevation 830. There is at least 200,000 acre-feet of space in the lake below elevation 830 which is considered as dead storage and would be available for silt accumulation. Inasmuch as the bed load is being largely depositied on the alluvial flats above the lake and in the delta, and a high percentage of the suspended matter is carried on through the lake, the 200,000 acre-feet of available dead storage should provide ample capacity to allow a useful reservoir life far in excess of 100 years, without encroachment on the active storage space.

Reservoir Evaporation

Inasmuch as the lake is now an open water surface subject to evaporation, and the records of inflow as used in the study are based on flows at the outlet of the lake which reflect past evaporation from the lake surface, no further correction was made for evaporation from the lake in this study.

WATER RIGHTS

The land surrounding the Eklutna Lake is wholly public domain. Riparian rights for the use of the waters of Eklutna Creek were acquired by the construction of the original power plant in 1929,

when the plant was first placed into commercial service. There has been no one in the past or at present making use of any streams, glaciers, or inflows to Lake Eklutna or any portion of the outflow from the Lake except the existing Eklutna power plant which is owned and operated by the City of Anchorage.

The Anchorage Public Utilities has Federal Power Commission license Number 350 covering the use of the present power plant and storage in Eklutna Lake. The present dam provides storage in the lake from elevation 860 to 868 or a volume of 25,000 acre-feet. Water is released from the lake and allowed to flow eight miles down Eklutna Creek to a dam where the water is diverted into an 1800 foot tunnel leading to a penstock. The power plant is located at the end of the penstock, with a static head of 235 feet available. The plant uses a maximum of approximately 140 second-feet.

The Eklutna Project plan contemplates diversion of water from Eklutna Creek Basin to the Knik Arm. Except for spills, which would be utilized at the existing plant, no water would be released from the lake to Eklutna Creek. This plan would greatly reduce the generation capability of the existing plant, and in many months of the year, when there is a very little inflow below the lake, the present plant would not be able to generate any power.

No other uses are made of Eklutna Creek water. Maintenance of a live stream for fish life is not necessary. There is so much suspended matter in the water that few if any fish inhabit the stream.

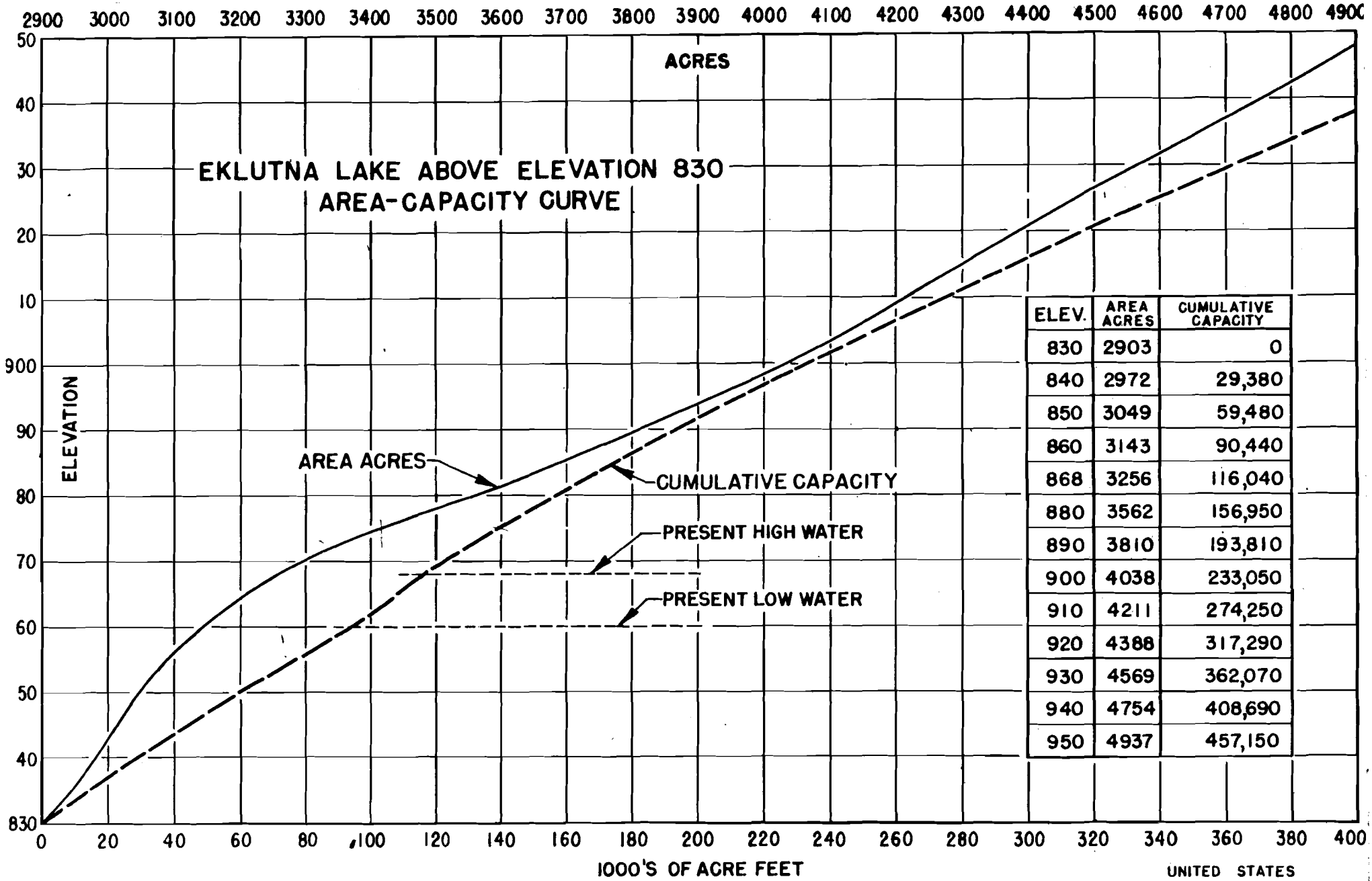
POTENTIAL POWER PRODUCTION

The Reservoir

In order to generate firm power on the Eklutna Project, storage is essential. The bulk of the stream runoff occurs during the months of June, July, August and September, which period coincides with the period of least demand for power. Storage water would normally be used for power generation during the balance of the year. Adequate storage would be available in the lake without materially raising the present high water line. The outlet tunnel would be placed so that the invert would be at elevation 830.0, and the present dam and outlet works rehabilitated to make the high water line at elevation 870.0, as contrasted to a present high water line of 868.0. Capacity of the reservoir between elevations of 830 feet and 870 feet would be 123,000 acre-feet.

Reservoir Releases

The Eklutna Project water releases would be made only for the purpose of power generation. The load curve for future average conditions has been estimated by smoothing the historical load curve experienced in the years 1939 and 1947. The derivation is as follows:



ELEV.	AREA ACRES	CUMULATIVE CAPACITY
830	2903	0
840	2972	29,380
850	3049	59,480
860	3143	90,440
868	3256	116,040
880	3562	156,950
890	3810	193,810
900	4038	233,050
910	4211	274,250
920	4388	317,290
930	4569	362,070
940	4754	408,690
950	4937	457,150

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Month	1939		1947		Smoothed Curve Percent
	KWH	Percent	KWH	Percent	
Jan.	456,100	9.9	2,368,100	9.0	9.5
Feb.	378,200	8.2	2,035,000	7.8	8.0
Mar.	368,100	8.0	2,073,200	7.8	8.0
Apr.	338,800	7.3	1,993,200	7.5	8.0
May	331,200	7.2	2,005,500	7.5	7.5
June	316,900	6.9	2,017,900	7.6	7.5
July	352,200	7.5	1.949,400	7.4	7.5
Aug.	386,400	8.1	2,095,600	7.9	8.0
Sept.	370,700	7.9	2,133,400	8.0	8.0
Oct.	415,300	9.0	2,466,600	9.3	8.5
Nov.	440,500	9.5	2,574,800	9.7	9.5
Dec.	485,800	10.5	2,803,200	10.5	10.0
Total	4,638,200	100.0	26,515,900	100.0	100.0

Reservoir releases required each month were computed as the amount of water required to meet the portion of the annual load curve for that month after considering the average net power head available for that month.

Power Head

The average generation of firm power would require discharges between 200 and 300 second-feet, with discharges of over 300 second-feet used only for a few hours at peak demands. An average head loss for the intake, tunnel and penstock has been calculated to be 20 feet.

Tailwater would enter Knik Arm at a point very close to where the Knik River enters Knik Arm of the sea and at approximately the highest point reached by high tides. The tidal range at Anchorage is approximately 30 feet. The elevation of the point at tailwater discharge in relation to mean sea level has not been firmly established, but it would be at an elevation from 18 to 25 feet above mean sea level. Tentatively the elevation has been taken to be 20 feet. No tidal interference is expected at that elevation. Tailwater would be conveyed from the power plant to Knik Arm by a canal 2,000 feet long. The invert of the small after-bay immediately below the turbines would be at an elevation of 27 feet.

The net power head for various flows with reservoir full would be as follows:

Discharge (second-feet)	Reservoir Elevation (feet)	Tailwater Elevation (feet)	Head Loss in System (feet)	Net Head (feet)
200	870.0	31.0	9.6	829.4
300	870.0	32.2	21.9	815.9
400	870.0	33.5	37.1	799.4
500	870.0	34.8	57.7	777.5

As the average operation would require releases of 200 to 300 second-feet, the average net head for full reservoir conditions has been taken as 820 feet for purposes of computing power generation.

Installed Power Plant Capacity

The power plant structure would be designed for three units of 10,000 kilowatts each.

Reservoir Operation and Energy Output

A study of hypothetical reservoir operation was made resulting in an annual firm generation of 100,000,000 kilowatt-hours, distributed according to a load curve as follows:

Month	Load Curve Percent of Annual Load	Firm Energy Output (Kilowatt-hours)
October	8.5	8,500,000
November	9.5	9,500,000
December	10.0	10,000,000
January	9.5	9,500,000
February	8.0	8,000,000
March	8.0	8,000,000
April	8.0	8,000,000
May	7.5	7,500,000
June	7.5	7,500,000
July	7.5	7,500,000
August	8.0	8,000,000
September	8.0	8,000,000
	100.0	100,000,000

Table 3 is a summary by water-year of operation of the 123,000 acre-foot reservoir to produce 100,000,000 kilowatt-hours of firm energy distributed by months according to the load curve. The table also shows the quantity of secondary energy that would be produced by the proposed plant.

TABLE 3

SUMMARY RESERVOIR OPERATION

Year Ending Sept.30	Inflow (1,000 A.F.)	Release (1,000 A.F.)	Minimum Reservoir Content (1,000 A.F.)	Spill (1,000 A.F.)	Annual Energy Output (kilowatt-hours)	
					Firm	Secondary
1939	285.4	254.0	35.9	31.4	100,000,000	67,800,000
1940	329.7	239.0	38.6	90.7	100,000,000	58,000,000
1941	252.1	239.1	25.8	13.0	100,000,000	54,600,000
1942	225.0	224.9	32.4	0.1	100,000,000	47,800,000
1943	145.8	145.8	32.2	0.0	100,000,000	15,600,000
1944	311.0	234.8	27.9	76.2	100,000,000	35,500,000
1945	239.4	195.1	45.9	44.3	100,000,000	35,700,000
1946	239.9	212.2	42.6	27.7	100,000,000	39,700,000
1947	230.0	212.9	41.6	17.1	100,000,000	40,400,000
MEAN	250.9	217.5	35.8	33.4	100,000,000	43,900,000*

* In addition 3,500,000 kilowatt-hours of secondary energy will be generated at the existing Eklutna plant from spills and inflow below the proposed dam.

During the period prior to completion of the project, additional data will be collected, and more refined studies of reservoir operation will be carried out to permit a more accurate analysis of power production.

CHAPTER V

POWER SUPPLY AND MARKETS

Power is precious in the project area. Black-outs are frequent, the price is high and many homes have no electric service. Some consumers have emergency stand-by units. The market far exceeds the supply.

PAST AND PRESENT POWER REQUIREMENTS

Electricity has been a critical commodity in the project area since 1941. The principal producer of power for civilian use is the Anchorage Public Utilities, operated by the City of Anchorage. The city not only supplies itself but also delivers power at wholesale to the Alaska Railroad and the Matanuska Electric Association. The latter is a rural electric cooperative with approximately 112 miles of distribution lines in agricultural areas of the Matanuska Valley and in the community of Palmer.

Power production of the Anchorage Public Utilities system increased five hundred and seventy percent from 1939 to 1947. Its only economical power source is the existing Eklutna hydroelectric plant, which in 1947 was able to supply just over half of the system's annual kilowatt-hour production. Most of the remaining production came from a steam-electric source, at which costs of operation per kilowatt-hour of generation were in excess of the average revenue per kilowatt-hour.

Early Power Sources

During the early years of its existence, when Anchorage was primarily a construction headquarters for the Alaska Railroad, electricity for domestic and commercial uses was provided from a 900-kilowatt steam-driven generating plant located adjacent to the railroad shops and operated by the railroad. That plant is still in existence, but is so obsolete and expensive to operate that it has not been run for about 10 years except for occasional intermittent operation during peak-load periods in 1945 and 1946.

After the city became incorporated, responsibility for distribution of electricity to consumers within its boundaries was assumed by the municipal government. In 1927 the city entered into a contract for wholesale purchase of electricity from the Anchorage Light and Power Company. The company then proceeded with construction of the present Eklutna hydroelectric plant with initial installation of a single 1,000 kilowatt generator. The Eklutna plant was first placed in service in 1929, and a second 1,000 kilowatt generator was added in 1935. This power is being transmitted to Anchorage over a single-circuit, wood-pole 33,000 volt line.

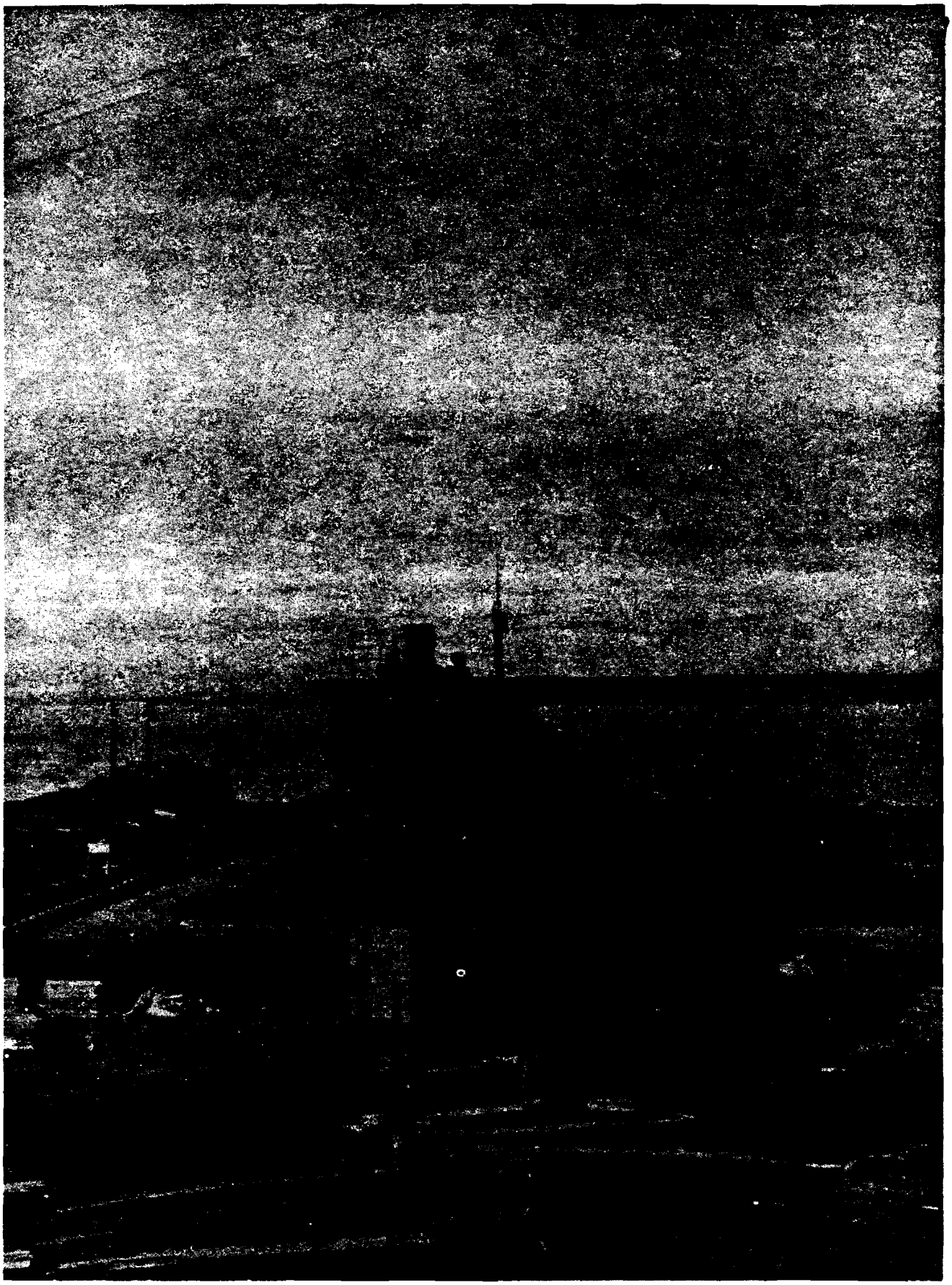
In 1937 the Anchorage Light and Power Company installed a 700 kilowatt diesel-driven generating unit at the Anchorage end of its 33,000 volt line, and at about the same time the Alaska Railroad shut down its steam-electric generating plant and began purchasing power from the Anchorage Light and Power Company.

Shortly thereafter, large-scale expansion at nearby military establishments brought about rapid increases in population and electrical load. At the outbreak of war in 1941, the Anchorage Light and Power Company was attempting to finance expansion of its facilities to serve the increasing loads. The company apparently failed in those efforts, with the result that its properties were purchased by the City of Anchorage in 1943 and are now operated under the name of The Anchorage Public Utilities, as an agency of the municipal government engaged in producing and transmitting electricity. Power distribution within and adjacent to the city is still a municipal function, but operations and accounting of the distribution organization are kept entirely separate from those of The Anchorage Public Utilities.

Military authorities, being unable to secure an adequate supply of power from Anchorage Light and Power Company to serve rapidly expanding activities on the Fort Richardson reservation, were forced to provide power generation at the Fort sufficient for its entire requirements. This generation now consists of several steam and diesel units, at dispersed locations but all connected to one distribution system, which in turn is now interconnected with Anchorage Public Utilities system at a substation on the Eklutna-Anchorage 33,000 volt line. An interchange pooling arrangement is already in effect between Anchorage Public Utilities system and Fort Richardson, but is utilized only in emergencies.

In 1945 the electric load in Anchorage increased to the point where demand exceeded supply. A second diesel-driven generator of 600 kilowatt capacity was hastily installed by Anchorage Public Utilities in February, 1946, and attempts were made to operate the Alaska Railroad's steam plant during peak load periods. Because of deteriorated condition of boilers, the steam plant proved undependable. It became necessary to "dump load" occasionally on distribution circuits when system demand exceeded the aggregate of safe overload capacity of Anchorage Public Utilities' own plants, plus the relatively small additional generation which could be contributed by the Alaska Railroad and by Fort Richardson.

As the power supply situation grew progressively worse, Anchorage Public Utilities in 1947 leased - and the next year purchased - the stern half of a wrecked ocean-going tanker, the "Sackett's Harbor", and has since been utilizing its boilers and generating equipment as a power plant. Operating personnel have found that the dependable capacity of this installation is



THE 'SACKETT'S HARBOR', THE BEACHED STERN HALF OF A TANKER IS A TEMPORARY SOURCE OF POWER FOR ANCHORAGE.

approximately 3,000 kilowatts under present conditions of operation. Improvements to its cooling-water system are contemplated, by which it is hoped to increase its firm capacity to 3500 kilowatts, and its capacity for short-time daily peak loads to about 4,000 kilowatts. Such additional peak capacity will be of material value during the winter of 1948-1949, but will most assuredly be a costly expedient.

In August, 1948, the power supply situation in Anchorage again became so critical that a bond issue to purchase another 1,000 kilowatt diesel-driven generator was approved by the voters as a "stop-gap" expedient.

Rural Electric Distribution

On October 14, 1941, Anchorage Light and Power Company entered into a contract with the Matanuska Electric Association, a cooperative financed by the Rural Electrification Administration, to furnish power up to a demand of 250 kilowatts, making delivery at the Eklutna plant. Early in 1942, the cooperative placed in service a line from the Eklutna plant to the community of Palmer, with distribution circuits to farms and homes throughout nearby areas of the Matanuska Valley. As of April, 1948, the Association was operating 112 miles of pole lines, all well-built and well-maintained.

In addition to the rapidly-growing unincorporated community of Palmer and nearby farms, the Association now serves the small community of Wasilla about 12 miles west of Palmer. Service is also being furnished to several resorts and recreational enterprises.

The Matanuska Electric Association is solely dependent for its power supply on Anchorage Public Utilities. Its monthly maximum demand had increased to 370 kilowatts in January, 1948, and is expected to reach at least 450 kilowatts in the winter of 1948-1949. In the last 18 months (January 31, 1947 to July 31, 1948) the number of customers served by the Association increased from 396 to 514.

Complete details of load and revenue growth on the Association's system since its original formation are not available, as nearly all its records were destroyed by fire in May, 1948. However, sufficient information is available to show that its present power requirements average about 100,000 kilowatt-hours per month, or 1,200,000 kilowatt-hours per year.

Isolated Power Facilities

Approximately 14 miles from Palmer is the Jonesville coal mine, which operates a 300-kilowatt steam-electric generating unit and three 75-kilowatt "Caterpillar" diesel-electric generators. In addition, the mine has one or two sizeable steam-driven air compressors. Because of high labor costs, coal is much more valuable

at mouth-of-mine here than in the continental United States. The mine burns its own coal in firing the steam boilers, but uses diesel fuel which probably comes from California refineries in operating its diesel-electric generators.

In suburban Anchorage are two small utility properties, namely the Inlet Power and Light Company and the Mountain View Power Company. Both companies have several portable or semi-portable diesel generating units in sizes of 100 kilowatts or smaller. Additional units are being added at intervals of a few months as the load increases.

Area Power Production Capacity Versus Load Requirements

Generating capacity presently available for civilian uses in the area within a 40-mile radius of Eklutna (excluding small portable generators operated solely for the needs of their owners) may be summarized as follows:

a. Interconnected system of Anchorage Public Utilities:

Eklutna Hydro Plant	2,000 Kw.
Anchorage Diesel Plant	1,300 Kw.
Sackett's Harbor (Steam)	3,500 Kw.
Alaska Railroad (Steam)	900 Kw.
	7,700 Kw.

b. Not Interconnected:

Jonesville Coal Mine	525 Kw.
Inlet Power and Light Co. and other small diesel plants	800 Kw. (estimated)

Since the Alaska Railroad's steam plant is shut down and is of doubtful capability, the maximum capacity now available on the interconnected system, exclusive of Fort Richardson generation, probably does not exceed 6,800 Kw.

Anchorage Public Utilities does not have metering facilities by which its coincidental system demand can be accurately determined. Mr. C. A. Wilson, Superintendent, has estimated the 1947 demand at approximately 5300 kilowatts and that the 1948 peak will be "at least 6300 kilowatts." Other estimates have ranged as high as 8300 kilowatts for the 1948 December peak. It is obvious that the peak demand will very closely approach, and is likely to exceed, the system capacity. Temporary assistance might come from Fort Richardson or the Alaska Railroad's old steam plant, but neither source can be relied upon. The city voters have just approved purchase of additional diesel generating equipment in an effort to avoid power outages during the coming winter. This is the same sort of crisis that was faced in 1945, only three years ago, and

POPULATION HITS 19,000,

Expect Division To Top 114,000 In Four Years

Interior Department Releases Computations For Alaska Development

Population of Anchorage was set at 19,000 with prospects of growing during the next four years as the hub of an area comprised of 74,000 to 114,000 persons, it was disclosed today by the Interior Department at Washington, D. C.

City Manager Warns Against Winter Danger

Distribution System Useless Without Unit, Wilson Tells Public

City officials today called for approval of a new diesel generating plant which would carry the city over the impending "dark ages" this winter. The election will be held tomorrow.

Steam Plant Discussed

Spenard Needs Large Plant

600 Families Seek Power From Assn.

Find Water In Power Vessel

Shutdown Needed To Repair Bulkhead

City officials were rudely handed a preview of what might happen to Anchorage electric generating facilities this winter

Charles A. (Whitey) Wilson, electrical superintendent, said that the city would save $7,500 a month now by installing the sub-stations. He said the power consumed in the city had jumped 44 percent in two years, and that the Sackett's Harbor plant would be too small a power plant for the city's needs by next Christmas.

Power Failure Puzzles City

Power Needed

Sackett's May Run Out Of Fuel Oil

As an oil field strike cut down Alaska's fuel deliveries, City officials warned today that there is grave danger that the generating plant in the Sackett's Harbor will run short of fuel this winter.

The ship is the major source of power for the City of Anchorage.

Study Of Power Rates Is Ordered

Both he and Mr. Odsather made it clear they intend to "keep trying" for a solution to what has been called the city's

Next in order are Fairbanks, 8,500 and Ketchikan, 7 ... 2,000; Nome ... with 1,500 ... Altogether 12 places 1,000 or ... eight in ...

Additional legislation ... propriations will be ... Congress to ... gram, so the ... erans and ... be going ... next few ... assurance ... tunities, adequate ... decent housing ... homesteads ...

"Power ... veloped, forest ... available for ... timber, and ... tlers aided ... tablishing permanent ... businesses and ...

Joseph T. Flakne, Interior Department ... Branch, ... Press ...

whites. In ... 59,278, and ...

Flakne said ... of women probably ... creased measurably since ... when there were 43,000 ... and 29,521 ...

such crises will continually recur until a substantial source of hydroelectric power is developed in the area.

POWER RATES

A domestic consumer in Anchorage pays a high price for electricity, as shown by the following tabulation:

Monthly Kilowatt-hours Purchased	Average Cost per Kilowatt-hour
50	7.9¢
100	6.93¢
250	5.73¢
1,000	3.94¢*

*Includes 300 kilowatt-hours at controlled water heating rate.

Power for domestic use in Anchorage is by far more costly than in comparable cities in the western United States. Commercial electric rates are also contrastingly high. Revenue from sales to the Alaska Railroad averaged 2.8 cents per kilowatt-hour in 1947. There are no published rates for large industrial loads, but power is sold at wholesale to the Matanuska Electric Association at 2 cents per kilowatt-hour.

Palmer and surrounding areas are supplied with power by the Matanuska Electric Association at rates in general only a little higher than those in Anchorage. For farm and home consumers using 1,000 kilowatt-hours or more per month, the Matanuska rate is about the same as the Anchorage rate.

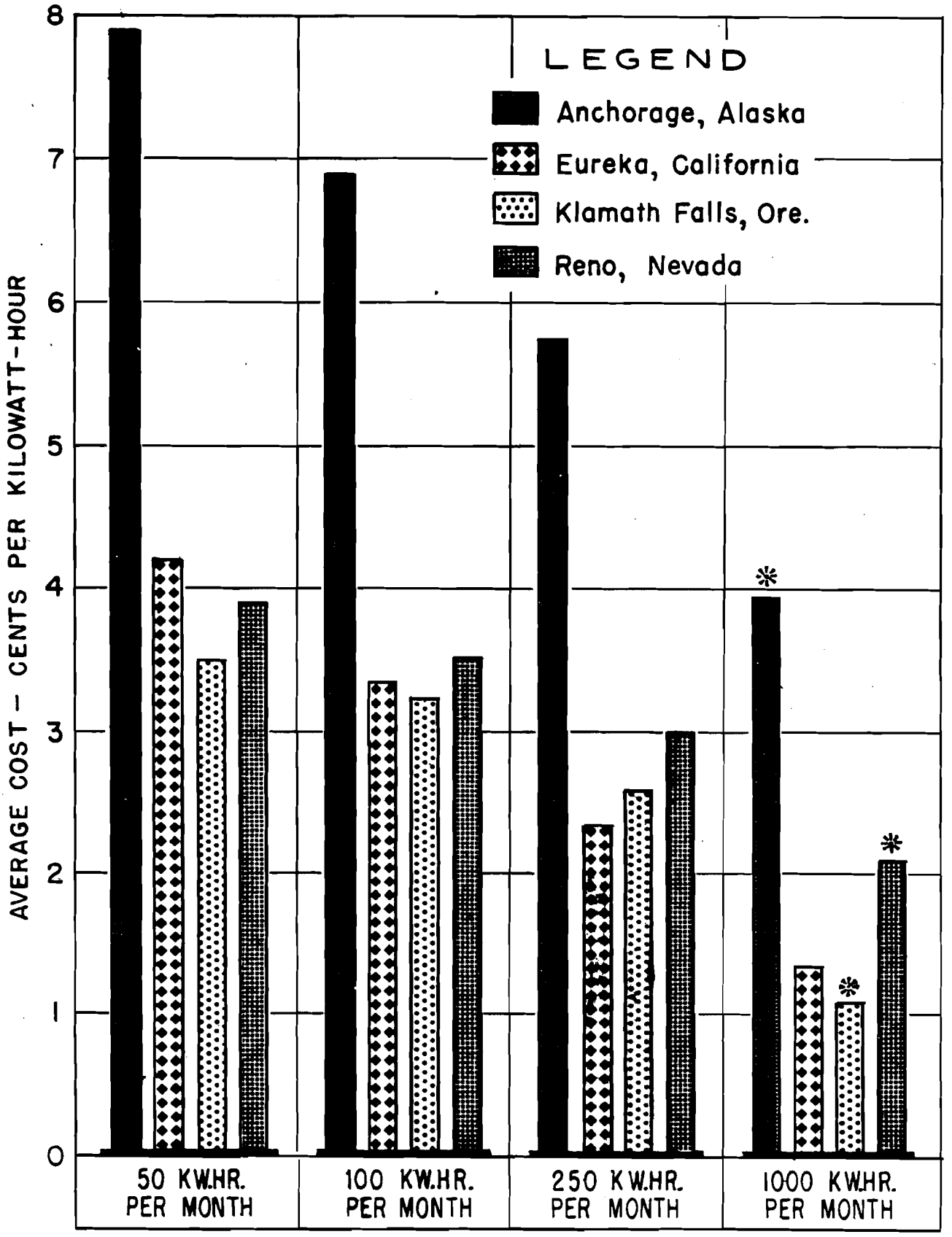
FUTURE POWER REQUIREMENTS

Load Growth and Population Increase

A significant fact is that electric load growth in Anchorage is increasing at almost exactly the same rate as population. From 1939 to the present the increase has been about 570 percent.

Although there are many modern homes and apartments in Anchorage, the construction of housing has failed to keep pace with the demand. Consequently there are people scattered throughout the city who are living in partially-completed houses, old frame houses which show marked evidence of depreciation, or in furnished rooms where no cooking is permitted. Despite high costs of cement, lumber and other materials and scarcity of skilled labor, construction of permanent homes is booming.

COMPARATIVE COSTS OF ELECTRICITY ON DOMESTIC RATES



* includes 300 KWHR at controlled water heating rate

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Each time a family moves from a substandard house into modern quarters, and each time a business or industrial enterprise moves into a new or renovated building, an increment of electric load is added. Permanent-type buildings and improvements in Alaska are very seldom abandoned. Their usage may change and their ownership may pass from Government to private, or vice versa, but it is not the nature of Alaskans to let such things remain unused. Completion of new large-scale construction is usually followed by a short and temporary lull as construction workers depart, but the people who operate and occupy the improved facilities always arrive in the community soon afterward. It can be regarded as a certainty that if the military agencies in future years should vacate some of the permanent-type buildings at Fort Richardson, some other government or private agency would be quick to appropriate the space for other uses.

Where rapid population growth occurs, electric load increases tend to occur first in commercial and domestic loads. However, the mere presence of more people and larger trading centers in an area provides a greater market for agricultural produce, encourages dairying and truck-gardening, and gradually tends to balance and stabilize the local economy.

Opportunities For Agricultural Load-Building

In the opinion of the local representative of the Rural Electrification Administration, development of the proposed Eklutna Project could provide power at sufficiently lower cost to permit rates on the Matanuska Electric system to be cut in half, which would immediately encourage the purchase of such high-use equipment as electric ranges and water heaters, as well as encourage the use of power for irrigation pumping.

Irrigation by electric pumps is already being used experimentally at several farms in the Anchorage-Matanuska area. Both sprinkler and row irrigation are being tried, primarily on vegetable crops. Pasture irrigation has not been tried, but may have some value in dairying. There appears to be a definite opportunity for sale of irrigation pumping equipment as soon as power is available in sufficient quantities at lower rates than those now in effect.

Electric water heaters are already in use at several dairies, but there is no record of electric sterilizers of the type used in the West Coast States. The water heaters now in use are small, some of only 10-gallon capacity. Lower power rates would be a quick incentive to more water heater load.

One significant item in the Palmer area is that practically every home has a small greenhouse in which are grown tomatoes and

other vegetables which will not mature outdoors before the first autumn frost. Flowers are also similarly grown. The extent to which electricity is already used for greenhouse heating is not known, but it seems likely that soil heating cable or incandesent lamps are being used in numerous instances. This is a load which would tend to peak in the early morning hours and offers possibilities for improving system load factor. Electric space heating, other than greenhouses, may have some possibilities in Palmer, but must compete in cost with coal available nearby.

Matanuska Electric Association load requirements have been increasing at the rate of at least 20% annually. How long this present growth rate will continue is difficult to prophesy, but a demand of 2,000 kilowatts with annual sales of 10 to 12 million kilowatt-hours by 1958, exclusive of potential mining loads, appears entirely possible.

Power for Mining

If hydroelectric power could be made available, at a cost which would justify extension of a three-phase line from Palmer to the Jonesville coal mine and still permit the sale price per kilowatt-hour to be competitive with the mine's cost of generation, here is a 500 kilowatt load to be had for the asking. Comparative cost figures are not available at this writing, but there appears a definite probability that the coal mine operators are prospective purchasers of power from the Eklutna Project.

It is likely that lower-cost power may revive other smaller or more costly mining operations in the coal-bearing areas immediately surrounding Matanuska Valley and in the Willow Creek mining district, where hard-rock gold mining on a large scale was once quite profitable but in recent years has been practically dormant because of high labor costs. Several traces of tungsten have been found in the Willow Creek District, and availability of low-cost power would undoubtedly encourage further development and exploration for minerals in that area.

Extension of its lines into the mining areas is under consideration by the Matanuska Electric Association, which anticipates that a possible additional demand of at least 1500 kilowatts could be acquired thereby. This figure includes the Jonesville coal mine and is sufficiently high to allow for serving various small mining operations and a possible custom mill in the Willow Creek area.

Representatives of the Bureau of Mines have pointed out that a marked saving to small producers would result from milling their ores locally and shipping out concentrates, as against the expensive practice of shipping out sacked ore to Seattle or elsewhere for treatment. The speculative element in establishment of a

ANNUAL REQUIREMENTS – MILLIONS OF KILOWATT HOURS

180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958

CALENDAR YEARS

1948 VALUES ESTIMATED FROM RECORDS OF ANCHORAGE PUBLIC UTILITIES FOR FIRST 7 MONTHS, PLUS INFORMATION OBTAINED FROM R.E.A. REPRESENTATIVE AND OTHER LOCAL SOURCES.

VALUES FOR 1944-1947 INCLUSIVE TAKEN FROM RECORDS OF ANCHORAGE PUBLIC UTILITIES.

ESTIMATES FOR 1949-1958 INCLUSIVE, BASED ON STUDY OF ALL AVAILABLE RECORDS AUGMENTED BY PERSONAL INSPECTION OF THE AREAS INVOLVED.

MILITARY ESTABLISHMENTS

ESTIMATED NEEDS OVER AND ABOVE ENERGY PRODUCED INCIDENTAL TO HEATING PLANT OPERATION — SUBJECT TO CONFIRMATION BY MILITARY AUTHORITIES.

METAL MINES

COAL MINES

SUBURBAN AREA TO BE SERVED BY CHUGACH ELECTRIC ASSOCIATION

INCLUDING NEW C.A.A. INTERNATIONAL AIRPORT. (AREA ESTIMATED TO CONTAIN 700 UNSERVED DOMESTIC AND COMMERCIAL LOADS AS OF 1948 PLUS 500 DOMESTIC AND COMMERCIAL LOADS SERVED BY INLET LIGHT & POWER COMPANY.)

STATION USE & TRANSMISSION LOSSES

MATANUSKA ELECTRIC ASSOCIATION (EXCLUDING MINING LOADS)

ALASKA RAILROAD

DOMESTIC, COMMERCIAL & INDUSTRIAL LOADS SERVED BY CITY OF ANCHORAGE.

UNITED STATES
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EKLUTNA PROJECT
ALASKA

LOAD GROWTH ANCHORAGE-PALMER AREA 1949-1958 INCLUSIVE

custom mill would be materially reduced by availability of commercial power, avoiding investment in a steam or diesel-driven power plant.

Annual kilowatt-hour requirements for metal mining loads are subject to wide fluctuations. It is estimated that 14,000,000 kilowatt-hours annually will be required for existing and potential mining and milling operations if low-cost power is made available.

Suburban Development South and East of Anchorage

South and east of Anchorage there are approximately 40 square miles of suburban area which are undergoing rapid development. Suburban expansion beyond this area is balked by boundaries of the Chugach National Forest and by military reservations. Within this area is to be constructed the new C.A.A. International Airport with an estimated 1952 power requirement of 1,000,000 kilowatt-hours annually and ultimate requirements of perhaps twice that amount.

As of midsummer 1948, electricity was being served to approximately 800 consumers in the area and estimates prepared by a local consulting engineer for the Rural Electrification Administration indicated approximately 700 potential customers awaiting electric service. Of the 800 consumers now being served, approximately 300 receive service from the Anchorage City distribution system or from the Mountain View Power Company, which is arranging to purchase power wholesale from the Anchorage system as a replacement for present generation by two small portable-type diesel units.

Most of the remaining 500 consumers are served by the Inlet Power and Light Company, which operates several small diesel generating units.

The Chugach Electric Association, a rural electric cooperative, has been formed, with the intent of taking over the Mountain View Power Company, the Inlet Power and Light Company, and one or two other generating installations serving small neighborhood loads, thereafter interconnecting them and extending lines to the new C.A.A. Airport and throughout the presently unserved suburban areas. Some negotiations have been conducted relative to the Chugach Cooperative purchasing power at wholesale from Anchorage Public Utilities. As this is written (August, 1948), consideration is being given to installation of a 3,000 kilowatt diesel plant as an alternative. Engineers familiar with local conditions have predicted that the load in this area might grow by 1953 to a total demand of about 4,000 kilowatts and total annual sale of about 25 million kilowatt-hours.

If the airport load is excluded, this optimistic forecast would still indicate a load growth approaching one thousand percent in five years. It seems doubtful whether capital, materials and labor will be forthcoming to achieve such a rapid growth in an area which is primarily suburban residential and where no large housing projects are planned. However, mere continuance of present growth rate would result in a load increase of approximately the magnitude suggested (including the Airport load) over a 10-year period.

Markets for Non-Firm Hydro Power

Considerable quantities of energy will be available at times from the proposed Eklutna power plant, in excess of the firm production of 100 million kilowatt-hours annually. There appears to be considerable market for non-firm energy in the Anchorage area as "fuel replacement".

The City of Anchorage has been serving approximately 700 domestic water heaters, with time-clock control, at an "off-peak" rate. However, it is understood that consideration is being given to raising that rate, or possibly suspending it entirely, until the power supply situation becomes less critical. Marketing of non-firm power has received little consideration in the Anchorage area in recent years because there has been practically none to sell.

An inquiry has already been received as to availability of non-firm power from the proposed Eklutna Project for electro-chemical manufacturing.

Assured New Loads

That there will be substantial load growth in the immediate future is a certainty. Entirely aside from a rapid population growth the following projects are under consideration for construction in the near future:

A. New shop building, extensions to general office building and other improvements now under construction by the Alaska Railroad, which will double the railroad's present annual power requirements of 3,000,000 kilowatt-hours.

B. New office building under construction by the Alaska Road Commission.

C. New International Airport, estimated to cost 8 million dollars, for which funds have been appropriated and construction to start shortly.

D. New 400-bed Alaska Native Service Hospital, scheduled for construction in the near future in Anchorage.

E. New hotel at Palmer, expected to open in the autumn of 1948.

F. A newly completed 94-room addition to the Westward Hotel in Anchorage.

G. An electric furnace installation, privately owned, for reclaiming scrap metal from railroad and military installations, with initial power requirement of 1,000 kilowatts and service already applied for.

Recognizing that such load growth is inevitable and that Anchorage Public Utilities may be unable to cope with it, the Alaska Railroad is considering the protection of its own operations by installing new generating facilities, with a total nameplate capacity of 3200 kilowatts (1500 kilowatts steam-driven and 1700 kilowatts diesel-driven). The railroad's consulting engineer, in a letter dated June 28, 1948, estimated this new equipment would permit the railroad to serve its own power needs through 1950, with sufficient additional capacity to supply the proposed Alaska Native Service Hospital and "a small surplus of energy, even at peaks, which might be available to the City of Anchorage." In subsequent discussions, railroad engineers have indicated that less investment in such fuel-consuming generating facilities would be necessary if development of additional hydroelectric power is expedited.

The railroad's purchases from Anchorage Public Utilities for the year ending March 31, 1948 amounted to 3,217,960 kilowatt-hours. Removal of this load from Anchorage Public Utilities system, even though it might be accomplished, would not even begin to offset the present costly "Sackett's Harbor" generation. By the time installation of such generating facilities by the railroad could be accomplished, or shortly thereafter, known new loads will more than absorb the "small surplus available to the City of Anchorage". It is plainly evident that even if the railroad does install all the generators included in its tentative plans, there exists a need for hydroelectric development.

Even thought it be assumed that the Alaska Railroad becomes self-sufficient with respect to power supply in 1950 and thereafter, and that Fort Richardson continues to be self-sufficient in that respect, Anchorage Public Utilities will still be the sole, and probably inadequate, source of supply for all other power users in the Anchorage-Palmer-Matanuska area. Rate reductions on the Anchorage system and the Matanuska Electric system will be out of the question and rate increases may become necessary.

The stern half of "Sackett's Harbor" tanker has proven to be a very expensive power source and is presently operating at a deficit. Accounting audit of Anchorage Public Utilities for the fiscal year

ended Marh 31, 1948 showed the "Sackett's Harbor" produced in that period 10,906,600 kilowatt-hours, or 42.72% of total system power production, at an operating and maintenance cost of 282,062.66 or more than 2.5 cents per kilowatt-hour. Fuel oil costs alone amounted to 1.42 cents per kilowatt-hour, and the price of fuel oil has subsequently undergone further increase.

After allowing for administrative expense, depreciation and amortization, the accountant's report showed a net loss of $130,687.79 on the "Sackett's Harbor" operations, or more than 1 cent loss at per kilowatt-hour generated, based on an average system revenue of approximately 2.5 cents per kilowatt-hour of production. Recent increases in fuel oil prices and contemplated increases in production capacity will combine to further increase this deficit.

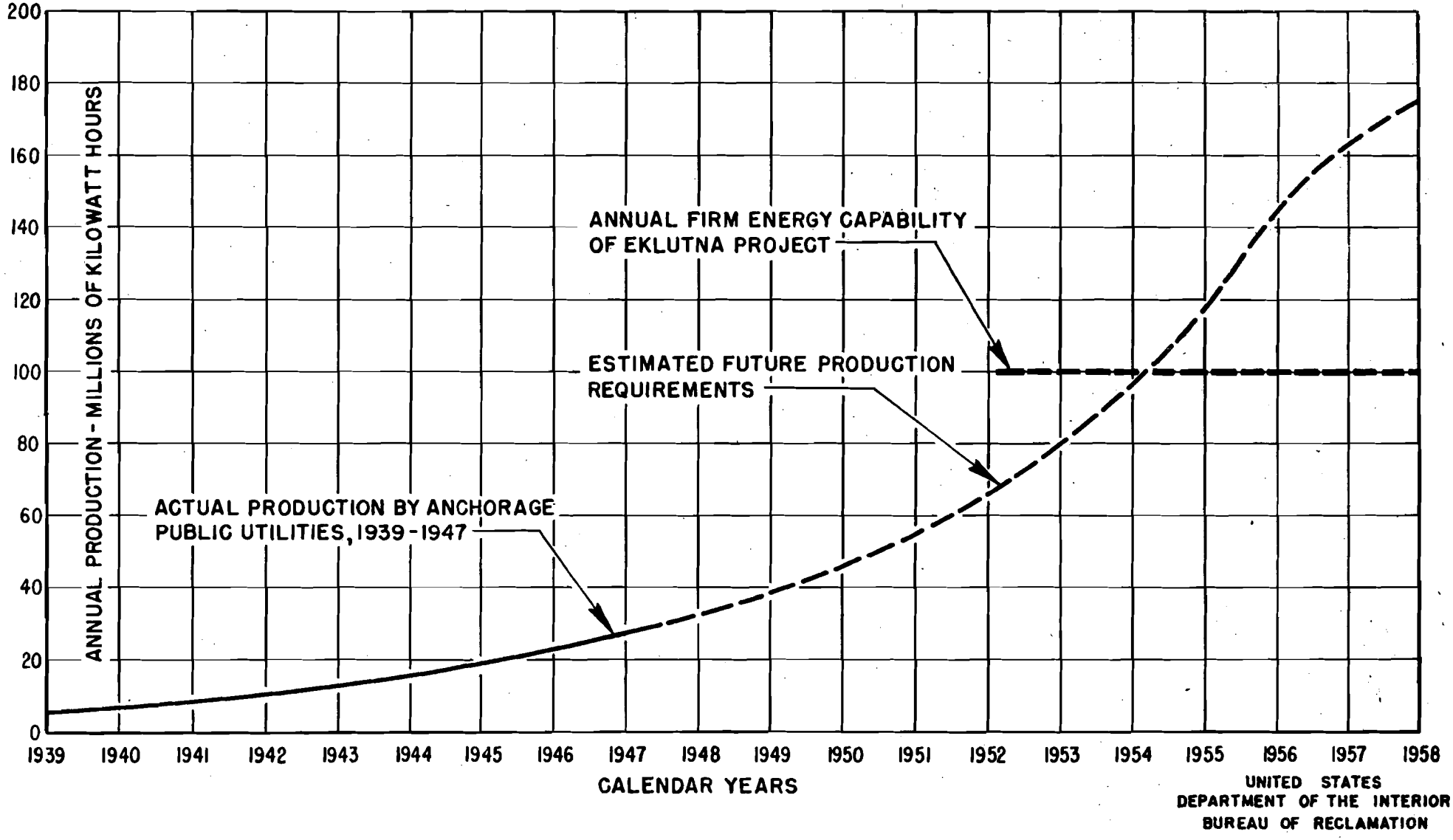
In contrast, the present Eklutna hydroelectric plant produced 13,340,819 kilowatt-hours, or 52.25% of the total system production, with a net income, after depreciation and $96,000 allowance for bond redemption, of $128,512.73. It is thus obvious that there exists urgent need for a hydroelectric power source to replace the makeshift steam plant, to the extent of at least 11 million kilowatt-hours annually, irrespective of any future load growth whatever.

In addition to future civilian power requirements, planning for development of hydroelectric resources in Alaska must include some allowance for power use at military establishments, at least to the extent that their needs cannot be economically met by power generation incidental to operation of central steam heating plants. Details of military power requirements are not public information for obvious reasons. However, based on discussions with informed personnel of the armed services, it appears advisable to tentatively earmark approximately twenty percent of the potential firm power output of Eklutna for use at military establishments. A statement by the Commander-in-Chief for Alaska is reproduced in the Appendices of this report.

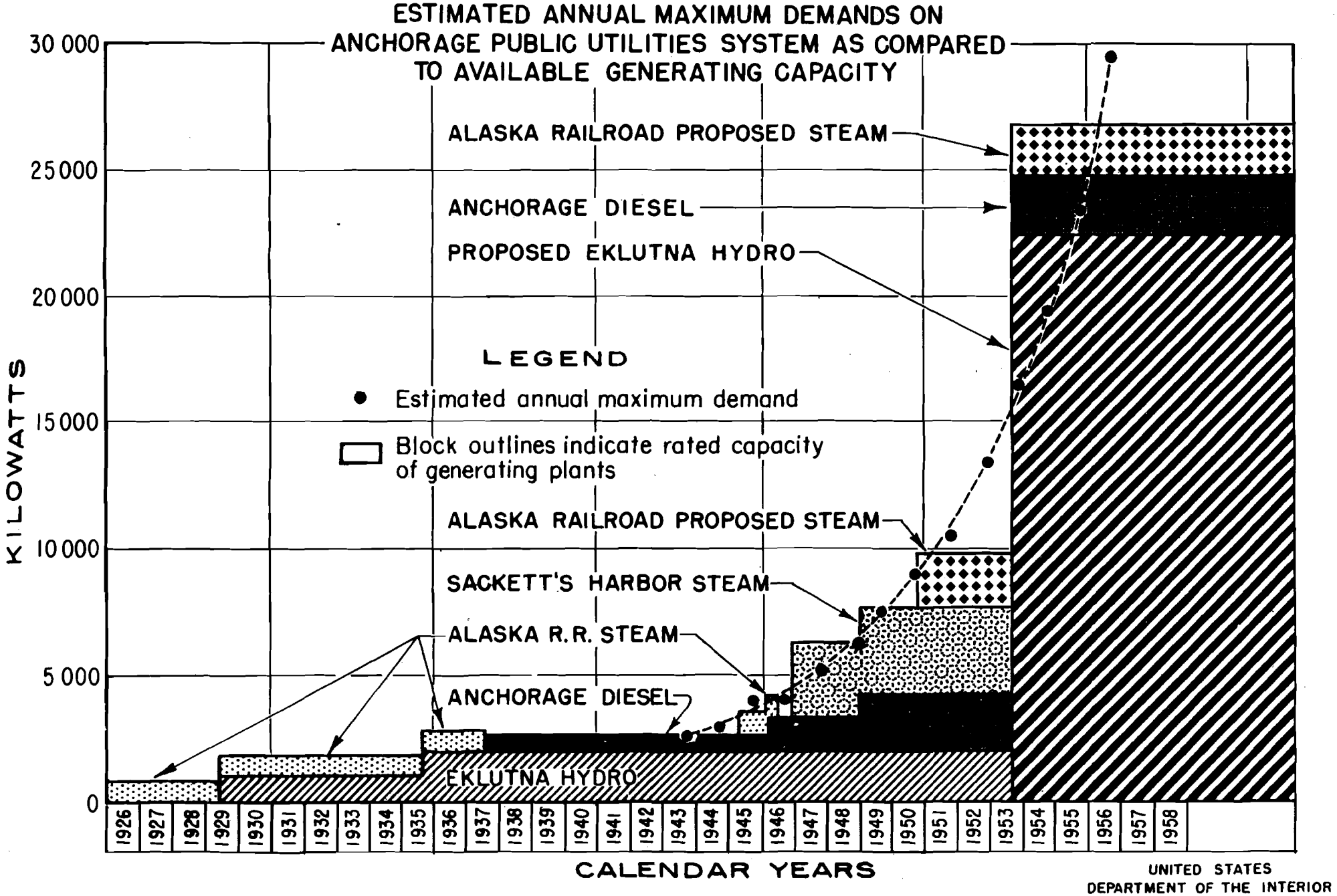
Adding together the anticipated civilian power requirements and the assumed requirements for military agencies, in the area within a 40-mile radius of Eklutna, results in a minimum total production requirement of 120 million kilowatt-hours annually by 1955.

If the Alaska Railroad proceeds with installation of its steam-electric generating capacity as indicated, or some other agency installs an equivalent amount, and construction of the proposed Eklutna Project is promptly authorized, it may be possible to meet increased power demands as they occur. Delay in <u>any</u> of these proposed installations may bring about an extended period of power rationing in the Eklutna Project area.

PRODUCTION REQUIREMENTS FOR ELECTRICITY IN THE ANCHORAGE - PALMER AREA OF ALASKA 1939 TO 1958



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION


ESTIMATED ANNUAL MAXIMUM DEMANDS ON
ANCHORAGE PUBLIC UTILITIES SYSTEM AS COMPARED
TO AVAILABLE GENERATING CAPACITY
30 000
25000
20000
15000
10000
5 000
0
KILOWATTS
ALASKA RAILROAD PROPOSED STEAM
ANCHORAGE DIESEL
PROPOSED EKLUTNA HYDRO
LEGEND
Estimated annual maximum demand
Block outlines indicate rated capacity of generating plants
ALASKA RAILROAD PROPOSED STEAM
SACKETT'S HARBOR STEAM
ALASKA R.R. STEAM
ANCHORAGE DIESEL
EKLUTNA HYDRO
1926
1927
1928
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1958
CALENDAR YEARS
UNITED STATES
DEPARTMENT OF THE INTERIOR

Other Load Possibilities

The forecast of load growth does not take into account the possibility of any large industrial power load such as an electrochemical plant, a smelter or some other large power-using enterprise materializing in the project area. It does not allow for any load which might be added by extending transmission lines toward Whittier, Seward or points on the Kenai Peninsula. It completely ignores the possible use of electricity for early summer irrigation pumping in the Matanuska and Spenard areas, which is already being tried experimentally.

Urgent Need for More Power

After a careful appraisal of all known factors, based upon a series of personal interviews and inspections throughout the area, the following conclusions regarding the precarious power supply situation in the project area are inescapable:

A. Present power production capacity on Anchorage Public Utilities system will probably be inadequate for the winter of 1948-1949. Even after allowing for occasional assistance from the Fort Richardson generating facilities, and assuming that every effort will be made to expedite installation of the new diesel-driven generator, it is quite likely that demand at times will exceed supply.

B. A power market will be ready and waiting to absorb the firm output from the proposed Eklutna Project in 1953, or just as soon as the power plant and transmission lines can be built.

C. If the Eklutna Project is not constructed promptly, recurring power shortages in the area are inevitable, unless electric rates are raised sufficiently to permit construction and sustained operation of steam or diesel-driven generating facilities without financial loss. Either rationing of power or increasing the already high electric rates will be detrimental to future business prosperity and will tend to place a "ceiling" on further improvement of living and health standards in the area.

D. In addition to immediate construction of the proposed Eklutna Project, rapid growth of power loads in the area makes imperative a systematic long-term plan for further hydroelectric power developments to meet the demand growth after 1955.

CHAPTER VI

R E C R E A T I O N

It is felt that recreational facilities should be developed at Eklutna Lake in connection with the Eklutna Project. An editorial in the Anchorage Daily Times of September 2, 1948 clearly indicates the need for such development:

"One of the fascinating by-products of the proposed Federal development of hydro-electric facilities at Eklutna is that of recreational facilities.

"It is entirely possible and feasible to make the magnificent valley cradling the lake a hub of weekend outings, family and group picnics, summer boating and fishing, a tourist attraction and a winter sports area.

"It is possible because the physical environment has everything necessary for such an enjoyable spot.

"It is feasible because similar projects have been carried forward in connection with power developments in the States. No new precedent is involved and Federal officials should encounter little difficulty in getting approval of governmental agencies.

"Development of Eklutna Lake as a recreational area has been the subject of conversations in Anchorage for many years. When the power site was owned privately, the officers of the company saw the potentialities and planned for eventual development.

"In the early 1930's, before there was a road to the Lake, the late Frank Reed, whose foresight and vision led to the establishment of the power project, brought back glowing tales of the beautiful scenery and picturesque lake. He made many trips to the lake before there was even a trail, packing his camp equipment on his back.

"When the power company completed the present road that runs nine miles from the power plant to the upper dam, the Eklutna Lake area attracted many motorists. Picnics became common and the splendor of the area was widely known locally.

"Today, although the road is still a one-way track most of the way and the grades are more than are considered desirable, the lake is attracting more and more Alaskans who enjoy the beauty of rugged mountains, colorful vegetation, sparkling water and all the thrills that come with a visit into this comely area.

"Fishermen work the mouths of the streams on the lake shore.

Boaters take their small craft to Eklutna and buzz its length beneath the rugged peaks and in view of glaciers. Often mountain sheep and bears can be spotted from the shores or boats.

"Under Federal development it is likely that the Bureau of Reclamation could obtain the cooperation of the National Park Service in a modest investment that would make the area a great asset to the Territory.

"The 36-mile drive from Anchorage would be a pleasant Sunday afternoon venture for families, visitors and sportsmen.

"A small lodge would furnish overnight accomodations for those who don't have their own camping equipment. Concessionaires could operate a fleet of small boats for rent, and the privileges of this wonderland would be opened to all comers.

"Improvements to the road from the main highway would be made in connection with the power development. Watchmen are already stationed at Eklutna in connection with the municipal power facilities. The recreational development would require only a small investment and the operating costs would be self-liquidating from the fees paid for the use of the facilities.

"Anchorage residents have never been able to finance the project. But it becomes a simple operation in connection with the Federal development."

With the Eklutna Project area roughly half way between the centers of population of Anchorage and the Matanuska Valley, and with existing facilities at a minimum, one can be certain that any recreational development at Eklutna would serve residents of the entire area to a high degree.

The present population of the Matanuska Valley is about 4,500 and that of Anchorage between 19,000 and 35,000. The change has been so swift since the time of the last census that the Census Bureau has declined to make an estimate.

Recreational facilities at Eklutna Lake could most likely be justified if for no other purpose than for the use of the thousands of military personnel stationed in the area.

The lack of recreational facilities is of great concern locally. When attempts have been made to promote events such as fairs, fireworks displays and athletic contests the attendance has been remarkable. People are eager for entertainment of any kind and will drive many miles over rough roads to attend a function they know in advance will be mediocre.

MUCH CAN BE DONE IN ALASKA TO CONSERVE AND DEVELOP
NATURAL RESOURCES FOR RECREATIONAL PURPOSES

Recreation

Existing facilities consist almost entirely of movie theaters, bowling alleys or baseball diamonds in the centers of population. Anchorage has a small development at a nearby lake for summer use, but it is neither adequate nor has it the available area or natural beauty of Eklutna Lake. The general absence of playground facilities in a healthy environment for children is a serious matter, but the necessary funds to remedy the situation are not available.

Previous experience has shown that such development in conjunction with a hydroelectric program can be highly successful. Shasta Reservoir in California, where construction is even now scarcely complete, is rapidly becoming a year-round recreation center. Strict control has been exercised by the National Park Service and the Forest Service to insure that no unsightly shacks are constructed and that recreational facilities are operated in a safe and sanitary manner.

It is recommended that the Eklutna Lake area be maintained as far as possible in its primitive state, as a sanctuary for wildlife and to preserve its natural beauty. While there are few, if any, fish in the lake, game known to abide in the area include mountain sheep, goats, numerous black bear, a few grizzly bear, moose, lynx, rabbits and squirrels. These animals could provide a major attraction if left unmolested. The cutting of wood should be strictly regulated, and an effort made to prevent unsightly construction, signs or rubbish disposal.

The problem of the construction and maintenance of a suitable access road, would be automatically solved by development of the Eklutna Project.

National Park Service has surveyed the area and planned the facilities that should be provided. A detailed statement has been prepared by the National Park Service, and is included in the Appendices to this report. In brief, the principal features would be provision of camping and picnic grounds, roads, trails, parking areas, ski tow, and a lodge equipped with guest rooms, a lounge and coffee shop.

CHAPTER VII

FINANCIAL ANALYSIS AND BENEFITS

The estimated cost of Eklutna Project is $20,365,400 which represents the reimbursable cost of the power features. In addition, $1,215,500 is the non-reimbursable cost of recreational facilities.

FINANCIAL ANALYSIS

The reimbursable investment is assumed to be all interest bearing until investigations now in progress disclose the exact amount of power facilities to be reserved for irrigation pumping. At that time a reallocation can be made between interest bearing and non-interest bearing reimbursable investment. Present financial studies are predicated on the assumption that during a 52-year period all the original reimbursable investment would be repaid in full to the Federal government with interest at three percent.

Energy deliveries in each average year would total 96 million kilowatt-hours of firm energy and 41.5 million kilowatt-hours of secondary energy. The market would absorb all the firm energy as soon as the project is completed at a delivered wholesale rate of 8.5 mills per kilowatt-hour. Likewise all secondary energy would be absorbed by the market at a rate of 4.8 mills per kilowatt-hour. Annual power revenues would average $1,015,200; operation, maintenance and overhead would average $158,300 and provision for replacement $72,600, resulting in an annual net operating revenue of $784,300. At the conclusion of the 52-year repayment period, there would be a cash surplus of $729,217.

Another financial study revealed that if delivered wholesale price of firm energy is lowered to 7.0 mills and secondary energy to 3.75 mills, and the interest rate on unpaid balance is lowered to 2.5 percent, the repayment period would be about 78 years.

EKLUTNA PROJECT - ALASKA

POWER SYSTEM - AVERAGE RATE AND REPAYMENT STUDY

Year of Study	Fiscal Year	Sale of Electrical Energy Millions of KWH			Operating Revenues Sale of Electrical Energy			Revenue Deductions			Net Operating Revenues	Income Deductions Repayment of Power Investment		Unpaid Balance of Investment at End of Year	Earned Surplus cumulative
		Firm	Non-Firm	Total	Firm (8.5 Mills)	Non-Firm (4.8 Mills)	Total	Operation Maintenance & Overhead	Provision for Replacement	Total		Interest Payments Power-3%	Principal Payments Power		
														20,365,400	0
1	1954	96	41.5	137.5	$ 816,000	$ 199,200	$1,015,200	158,300	$ 72,600	$ 230,900	$ 784,300	$ 610,962	173,338	20,192,062	
2	55											605,762	178,538	20,013,524	
3	56											600,404	183,894	19,829,630	
4	57											594,889	189,411	19,640,219	
5	58											589,207	195,093	19,445,126	
6	59											583,354	200,946	19,244,180	
7	1960											577,325	206,975	19,037,205	
8	61											571,116	213,184	18,824,021	
9	62											564,721	219,579	18,604,442	
10	63											558,133	226,167	18,378,275	
11	64											551,348	232,952	18,145,323	
12	65											544,360	239,940	17,905,383	
13	66											537,161	247,139	17,658,244	
14	67											529,747	254,553	17,403,691	
15	68											522,111	262,189	17,141,502	
16	69											514,245	270,055	16,871,447	
17	1970											506,143	278,157	16,593,290	
18	71											497,799	286,501	16,306,789	
19	72											489,204	295,096	16,011,693	
20	73											480,351	303,949	15,707,744	
21	74											471,232	313,068	15,394,676	
22	75											461,840	322,460	15,072,216	
23	76											452,166	332,134	14,740,082	
24	77											442,202	342,098	14,397,984	
25	78											431,940	352,360	14,045,624	
26	79											421,369	362,931	13,682,693	
27	1980											410,481	373,819	13,308,874	
28	81											399,266	385,034	12,923,840	
29	82											387,715	396,585	12,527,255	
30	83											375,818	408,482	12,118,773	
31	84											363,563	420,737	11,698,036	
32	85											350,941	433,359	11,264,677	
33	86											337,940	446,360	10,818,317	
34	87											324,550	459,750	10,358,567	
35	88											310,757	473,543	9,885,024	
36	89											296,551	487,749	9,397,275	
37	1990											281,918	502,382	8,894,893	
38	91											266,847	517,453	8,377,440	
39	92											251,323	532,977	7,844,463	
40	93											235,334	548,966	7,295,467	
41	94											218,865	565,435	6,730,031	
42	95											201,902	582,398	6,147,632	
43	96											184,430	599,870	5,547,761	
44	97											166,434	617,866	4,929,894	
45	98											147,898	636,402	4,293,491	
46	99											128,806	655,494	3,637,996	
47	2000											109,141	675,159	2,962,836	
48	01											88,886	695,414	2,267,421	
49	02											68,024	716,276	1,551,144	
50	03											46,535	737,765	813,378	
51	04											24,403	759,897	53,479	0
52	05	96	41.5	137.5	816,000	199,200	1,015,200	158,300	72,600	230,900	784,300	1,606	53,521		729,173
		4,992	2,158	7,150	$42,432,000	$10,358,400	$52,790,400	$8,231,600	$3,775,200	$12,006,800	$40,783,600	$19,689,027	$20,365,400		$729,173

BENEFITS

The tangible power benefits attributable to the project would amount to an average of $1,763,700 annually over a 50-year period. The total power benefits are made up of those which would accrue by virtue of the production of usable electrical energy at the new Eklutna power site and those resulting from partial operation of the present plant. For the purpose of this report, the benefits readily susceptible to monetary evaluation will be discussed as (1) direct benefits resulting from the sale of all power attributable to the old and new Eklutna power plants with a coordinated plan of operation and (2) indirect benefits that would result from savings in cost to wholesale consumers such as REA Cooperatives, Government agencies, and municipal utilities. Other indirect benefits such as savings to ultimate consumers, from use of electrical energy in the production of goods, and from project expenditures have not been evaluated due to the urgency for preparing this report in a very short time.

Direct Power Benefits

The revenues that would be received from the sale of electrical energy constitute the direct power benefits attributable to the Eklutna Project.

The average amount of power produced over a 50-year period would be 100,000,000 kilowatt-hours of firm energy and in excess of 43.5 million kilowatt hours of secondary energy. After allowing for transmission losses the average annual salable firm power would be 96,000,000 kilowatt-hours at 8.5 mills per kilowatt-hour and 41.5 million kilowatt-hours of secondary energy at 4.85 mills per kilowatt-hour. The annual revenues from the sale of power would amount to $1,015,200 which represents the direct power benefits.

Indirect Power Benefits

The indirect power benefits from the Eklutna Project, are estimated to amount to an average of $748,500 annually over a 50-year period. For the reason noted previously in this chapter, the only indirect benefit evaluated is the savings to wholesale consumers. These benefits would result from the sources indicated in the following paragraphs.

Future military power needs in the project area are being evaluated by Alaskan Command Headquarters and the Anchorage District Engineer's office. Based on discussions with personnel of the military services, it is believed that their operations could advantageously use at least 20 million kilowatt-hours annually of Eklutna power, and that in so doing a cost saving of at least 5 mills per

kilowatt-hour (as against a minimum cost of production in steam plants) would be achieved. This would amount to an annual saving of $100,000 or $5,000,000 in a 50-year period.

Non-military Federal agencies would also benefit substantially by construction of this project. Perhaps the greatest benefits accruing to such agencies would be those received by the Civil Aeronautics Administration and the Alaska Railroad, both of which are substantial power users and both of which attach considerable importance to reliability and continuity of power supply. Availability of power at 8.5 mills per kilowatt-hour would have saved the Alaska Railroad approximately $60,000 on its three million kilowatt-hour purchases in the calendar year 1947. This disregards the expected doubling of power consumption by the railroad within the next five years which would increase the railroad's annual saving from $60,000 to about $110,000 or a total saving in 50 years of $5,500,000.

Upon completion of the new International Airport, Civil Aeronautics Administration power requirements in the Anchorage area will also be about 3 million kilowatt-hours a year. It is safe to assume that if the Eklutna Project is built, annual power costs borne by C.A.A. in the Anchorage area would be decreased by at least $50,000, as against what they will be if power must be obtained from steam or diesel plants.

Other Federal agencies would benefit directly by lower costs of electricity. The Alaska Native Service, the Post Office Department, the Weather Bureau and numerous other Federal agencies require substantial amounts of electricity for operating their offices and establishments in the Anchorage area. It is estimated that total savings to these other Federal agencies, on their costs of purchased power, would be at least $10,000 annually or $500,000 in 50 years.

The community of Anchorage, in addition to the Federal Treasury would be tremendously benefited by lower-cost power. In the fiscal year ending March 31, 1948, Anchorage Public Utilities produced 10,906,600 kilowatt-hours in its Sackett's Harbor steam plant, at an average cost of approximately 37.0 mills per kilowatt-hour. When power from the proposed Eklutna plant becomes available, the City of Anchorage would be able to increase its available supply of electricity by about 37 million kilowatt-hours annually at <u>no additional expense whatever</u>. This net increase of 37 million kilowatt-hours annual production amounts to nearly 150% of total energy produced by all plants on Anchorage Public Utilities system in the year ending March 31, 1948. Benefits to the community of Anchorage would consist of:

Financial Analysis and Benefits

A. Increasing its annual power supply to nearly 250 percent of present value at no increase in annual cost.

B. Over and beyond that increase, making available substantial additional amounts of power at 8.5 mills, - approximately half the cost of power production in the present small Eklutna hydro plant.

Even though present production costs on Anchorage Public Utilities system be disregarded (as perhaps being abnormally high) it appears reasonable to assume that Eklutna power delivered to the city, in quantities up to 75 million kilowatt-hours annually, at a price of 8.5 mills per kilowatt-hour, would result in a net saving to the city of at least 5 mills per kilowatt-hour as against production from any other available source. This would mean a total saving of $375,000 annually, or $18,750,000 over a 50-year period.

Substantial savings would also accrue to residents of the Matanuska Valley, served by the Matanuska Electric Association. At a power cost of 8.5 mills per kilowatt-hour, as against the actual present price of 2 cents per kilowatt-hour, a direct cash saving of almost $13,000 would have accrued to the Matanuska Electric Association in 1947 and potential savings in future years will be much greater. A 50% reduction in electric rates in the Matanuska Valley could occur when the new Eklutna plant is placed in service. Assuming average purchases of 5 million kilowatt-hours annually for the first 10 years, and 10 million kilowatt-hours annually for the next 40 years, at a saving of 1.15¢ per kilowatt-hour, (8.5 mills versus present 2-cent) results in a total saving of $103,500 each year or $5,175,000 in 50 years.

Estimated measurable annual benefits resulting from the reimbursable portion of the investment are summarized as follows:

POWER BENEFITS (average annual)

Direct.....		$1,015,200
Indirect		
Federal military establishments.....	$100,000	
Alaska Railroad.....	110,000	
Civil Aeronautics Administration.....	50,000	
Alaska Native Service and Miscellaneous Federal Agencies.....	10,000	
Savings to City of Anchorage.....	375,000	
Savings to Matanuska Electric Assoc.	103,500	
		748,500
Total annual monetary benefits evaluated.....		$1,763,700

Financial Analysis and Benefits

Aside from the benefits which may be easily evaluated in dollars and cents, there are other benefits, of which perhaps the most important is improved service continuity on the interconnected power system of the Project area. Sizable industries cannot be expected to locate in Anchorage as long as power is served on an "if, as and when" basis, with unscheduled interruptions likely to occur at any time. Private capital simply will not take the risk.

COMPARISON OF COSTS AND BENEFITS

Total Estimated Project Cost	$20,365,400
Annual Cost of Amortization in 50 years at 3%	791,500
Annual Operation and Maintenance	158,300
Annual Replacement	72,600
Total Annual Costs	$ 1,022,400
Total Annual Benefits	$ 1,763,700

The benefits would exceed the cost of the project to the nation in the ratio of 1.7 to 1.0.

In addition to the power benefits that are measurable in monetary terms there are recreational benefits which the National Park Service indicates are twice as much as the total annual costs for recreational facilities.

CHAPTER VIII

POTENTIAL PROJECT EXTENSIONS

There are potential project extensions to the basic plan of development. However, any major additions to the project that may be found feasible in subsequent investigations will be submitted as a separate project extension report. Two such extensions are now under investigation, namely, the construction of a dam at the lake outlet to raise the lake surface about 50 feet and the potential diversion of Thunder Bird Creek into Eklutna Lake.

The feasibility of a dam to materially raise the level of the Eklutna Lake is doubtful. Interbedded glacial lake and stream deposits constitute the foundation materials in the proposed damsite areas. Permeability, bearing capacity, and perma-frost conditions are the chief geologic weaknesses influencing the suitability of these materials as the foundation for a dam appreciably higher than that now proposed. Detailed field explorations and laboratory testing, with special attention to the investigation of perma-frost and related conditions and their influence on design and construction problems, must be accomplished before an adequate and reliable evaluation of the foundation's engineering geologic characteristics can be obtained. Dependent upon the availability of funds and drilling equipment, this investigation work will be accomplished beginning in the spring of 1949. At present, judging from the surface geologic investigations and the reconnaissance drilling which has been completed, the site is highly questionable. If the investigation program discloses unexpectedly favorable conditions and it is determined by coordinated engineering studies that the construction of a higher dam is economically feasible, the cost of such a dam would necessarily be borne by increased revenues resulting from increased head of water on the power plant and from increased lake storage.

Thunder Bird Creek, a tributary of Eklutna Creek, joins the main stem at a low elevation near Knik Arm. Upstream where it runs parallel to Eklutna Lake, the runoff could be made tributary to the lake by construction of a tunnel approximately 1.3 miles long and a canal of 0.4 miles. The economics of such a diversion and the actual amounts of water which might be diverted will be further investigated.

It is assumed that, unless the Department of National Defense wishes otherwise, an ordinary commerical-type power plant would be built at Eklutna. If military authorities wish the plant to be of a protected type it is assumed that non-reimbursable funds would be available. The Bureau of Reclamation has given careful study to a design plan involving a complete underground installation of surge tank, penstock, generating equipment, switchyard and all appurtenant facilites.

Potential Project Extensions

Subsurface development of the power plant would involve the excavation of rooms and galleries in bedrock. Generally speaking, bedrock is at or close to the surface of the entire mountain slope on the Knik River side; bedrock is exposed at numerous points along the base of the slope immediately adjacent to the south side of the Anchorage-Palmer highway from Mile 33.95 to Mile 34.45. Geologic conditions of jointing, faulting and groundwater, as well as design and construction problems, would be the same as for the tunnel line except that no "squeezing" ground would be expected. The rooms would be lined, with adequate provision for grouting and draining back of the lining. Since the rock mass is assumed to be at least moderately fractured, the width of roof span would be held to a minimum to avoid excessive cost in providing adequate roof support. The choice of the exact location for the subsurface power plant development which presents the best balance of geologic, engineering, defense and cost factors could be accomplished by the same investigation methods applied to the tunnel line.

A P P E N D I C E S

COOPERATING INTERESTS

Federal * Territorial * Local

COOPERATING INTERESTS

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RESOLUTION NO. 507

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF ANCHORAGE:

That the City of Anchorage will when requested by the Bureau of Reclamation, Department of the Interior, call a special election pursuant to the provisions of Sub-paragraph "Twentieth" of Section 2383, Compiled Laws of Alaska, 1933, to determine whether or not the City of Anchorage shall sell to said Bureau as agent for the United States Government, the existing Eklutna power generating facility, at Eklutna, Alaska, at a price to be mutually agreed upon by the City of Anchorage and said Bureau and to be stated on the ballot at said election. This resolution is made because the City has been advised that it will take an expenditure of more than fifteen million dollars to develop the Eklutna generating plant to its ultimate capacity; that the sum is beyond the ability of the City to raise; that the future of the City of Anchorage and its vicinity demands a source of low cost power in order to assist in the development and growth of the City and adjacent areas.

Introduced September 1, 1948 and passed under suspension of the rules September 1, 1948.

Z. J. Loussac
Mayor, City of Anchorage.

ATTEST:-

S E A L

B. W. Boeke, City Clerk
City of Anchorage.

TERRITORIAL GOVERNMENT OF ALASKA

Office Of The Governor

A letter to the Bureau of Reclamation from the office of the Governor of Alaska, dated September 8, 1948, stated: "...we are most anxious that additional power be produced to take care of the existing and anticipated requirements in the Anchorage area."

DEPARTMENT OF THE INTERIOR

Alaska Railroad

The Alaska Railroad has grown up hand-in-hand with the city of Anchorage and has shared in the discomfort caused by inadequate power.

The railroad depends entirely on the city for electrical energy and hence is earnestly concerned with the development of Eklutna and the subsequent availability of low-cost power. Anchorage is disrupted by a war-time and post-war boom, and cannot possibly hope to develop the Eklutna watershed by itself.

The railroad is in the midst of a $50,000,000 rehabilitation program which relies, to a considerable extent on sufficient electrical power. For 1948 in the Anchorage area alone, the railroad will use well over three and one half million kilowatt-hours of power. This figure is based on the present rate of consumption. The 1948 power bill will cost the railroad about $100,000.

A short summing up of the history of Anchorage and the power business is useful here. The railroad "fathered" the city. In 1915, the town started as a railroad construction tent town. It was natural, therefore, that the railroad in 1916 owned the first electrical generating and distribution system in Anchorage. Energy was at first purchased from the railroad which operated a steam power plant to generate electricity for the railroad shops and buildings.

The Anchorage Light and Power Company was set up in 1923 when the city was incorporated. The Eklutna watershed was immediately investigated. Construction on a hydroelectric plant was started in 1928 and was finished in 1929.

The original ARR generating plant of 750 kilowatts supplied both the city and the railroad up until 1929. Then the Anchorage Light and Power Company built the 1,000-kilowatt plant at Eklutna and the ARR's steam generating system was discontinued.

In 1932, the Anchorage Light and Power Company installed another 1,000-kilowatt generator at Eklutna. Subsequently it installed a 450-kilowatt diesel generator. In 1942, the City of Anchorage bought the power utilities for $1,100,000 and installed another 450-kilowatt diesel generator the next year to take care of the growing power load. In 1947, the city bought the "Sackett's Harbor", the after-half of a tanker, with generating capacity of 3,300 kilowatts.

The total generating capacity in Anchorage at present is 6,500 kilowatts, six times the amount of power furnished in 1929 and still grossly insufficient for the burden.

The railroad's consumption of power clearly points out its interest in a substantial power system.

In 1934, the ARR used three-quarters of a million kilowatt-hours, which cost some $20,000. From 1934 to 1943, the power consumed jumped about 30% in dollar value, and over 100% in quantity. This is so because the railroad pays the city on a sliding scale. Rates are as follows:

The first 50,000 kilowatt-hours cost three and two tenths cents per kilowatt-hour; the next 20,000 cost three and one tenth cents; the next 20,000 three cents; the next 20,000 two and nine tenths cents; the next 20,000 two and eight tenths cents; anything over this amount costs two and seven tenths cents per kilowatt-hour. The railroad is allowed 12,500 kilowatts for heating at one cent per kilowatt-hour.

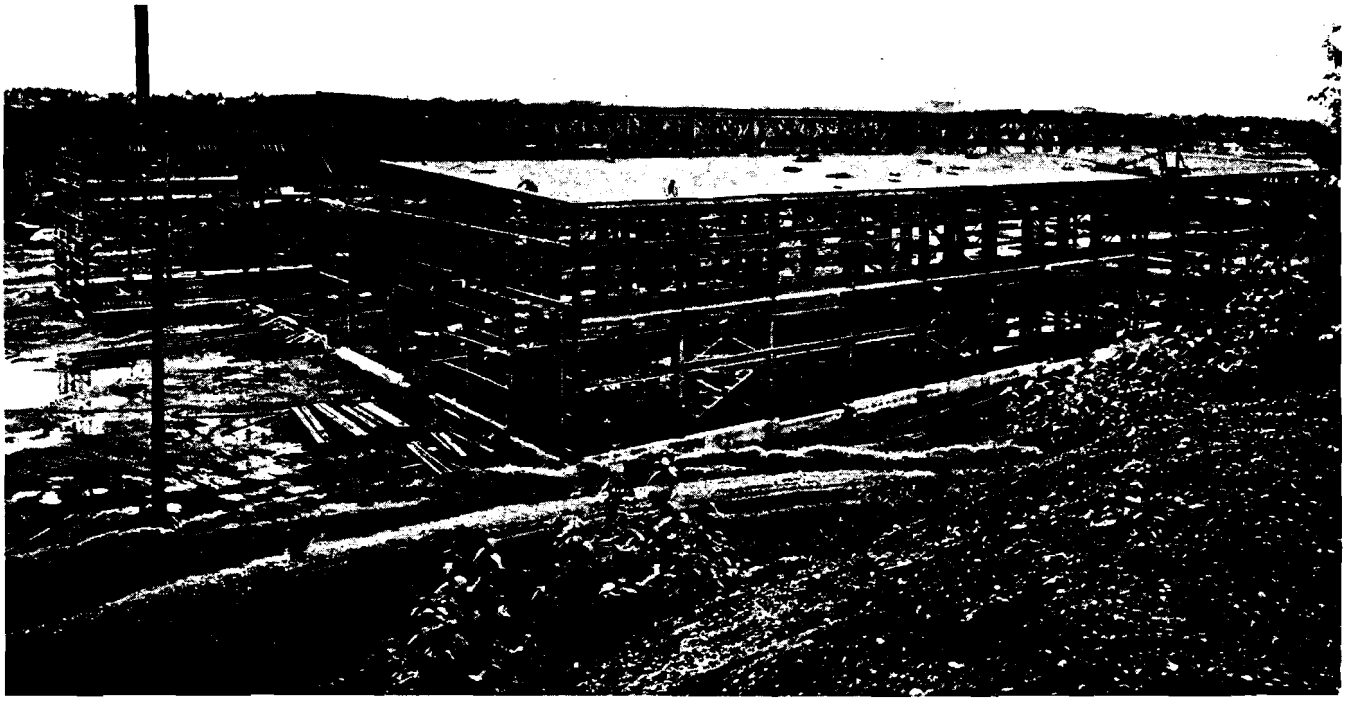
In 1944, the ARR used 2,200,583 kilowatt-hours, costing $46,692.36. In 1947, the railroad consumed 3,091,300 costing $86,455.95.

Energy consumption so far this year is 19 to 20 percent higher than consumption of power in the same period for 1947.

Confronted by these figures, the railroad is naturally anxious to obtain power that is low-cost and plentiful. This is why the ARR strongly supports the Bureau of Reclamation plan to develop Eklutna to the maximum.

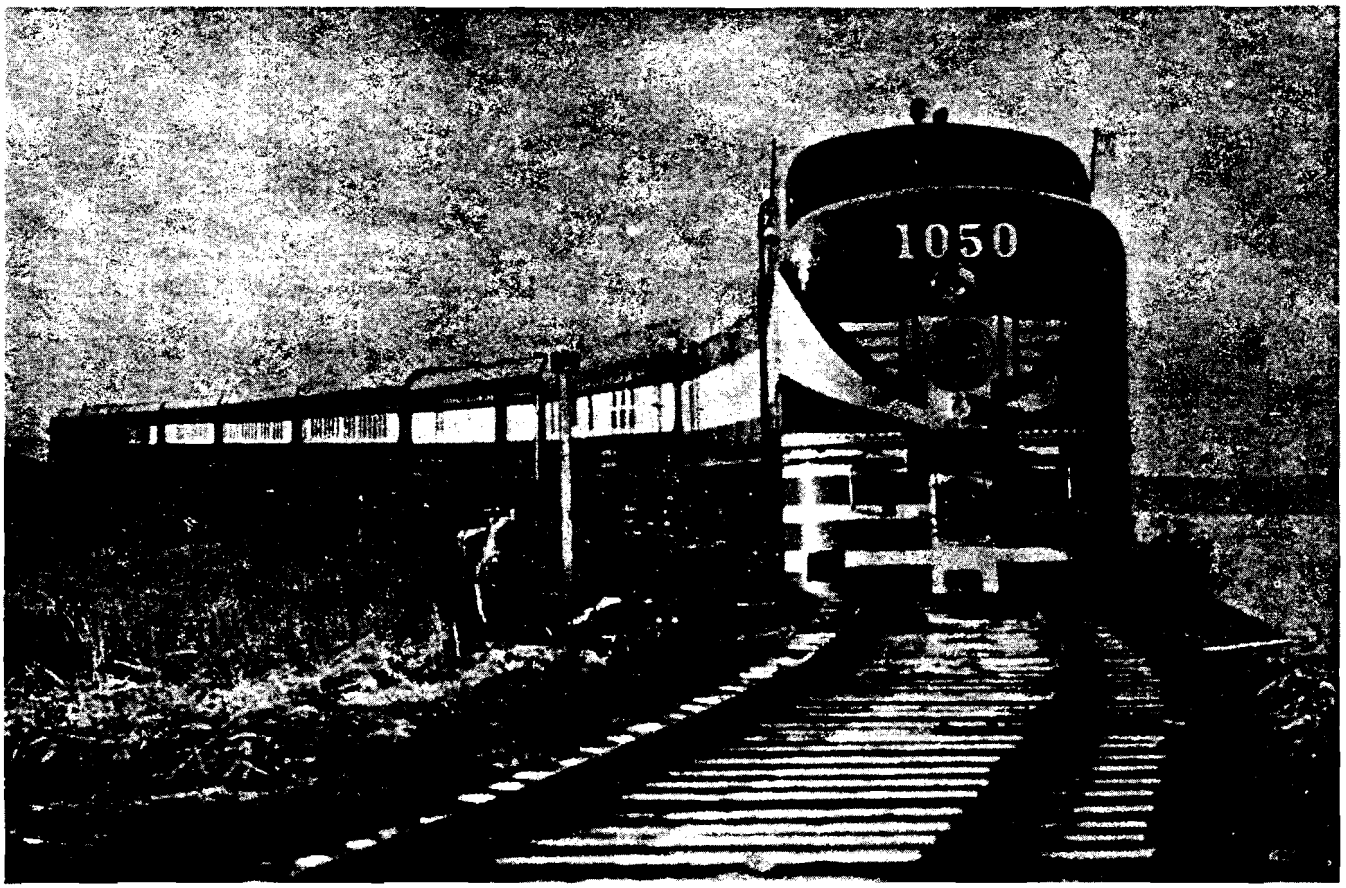
Low-cost power means new industries can grow up in Alaska. The growth of industry - so far slow to develop in Railbelt Alaska - will, in turn, benefit the railroad because it will bring with it an increase in business for the railroad. With a rehabilitated right-of-way and new rolling stock, the ARR will be in a position to handle promptly more business.

Reliance on the Anchorage electrical generating and distributing system is risky. The city frequently suffers "brownouts". In past winters, power has been cut off in the railroad shops and in employees'



THE ALASKA RAILROAD IS UNDERGOING A $50 MILLION REHABILITATION PROGRAM. SHOWN ABOVE ARE SHOPS UNDER CONSTRUCTION AT ANCHORAGE. THE ALASKA RAILROAD'S NEW STREAMLINER, THE AURORA, (BELOW) PART OF A PROGRAM TO MODERNIZE THE LINE AND IMPROVE SERVICE.

ARR Photo



homes. This disruption is costly and often a hazard, particularly when the weather is below zero. The small ARR stand-by plant, consisting of two 50-kilowatt generators, is grossly inadequate to furnish the power load required.

Brownouts shake the morale of employees. Warnings have issued regularly from the Anchorage City Council that power rationing can be expected again this winter as consumption of energy steadily climbs, and the amount available remains the same.

To overcome the power problem, the railroad management has contemplated bringing a surplus "packaged" power plant from Carlsbad, New Mexico. A two-way proposal is now being considered. The plan envisions putting up a 3,900-kilowatt steam power plant, if the Eklutna Project isn't realized. If the Eklutna development moves ahead, the railroad then plans only to install a 1,700-kilowatt standby plant. This alternate generating plant can take over in case of emergency as an excellent standby facility.

Erecting the 1,700-kilowatt plant instead of the 3,900-kilowatt steam plant would save the railroad roughly $500,000, Alaska Railroad engineers estimate. Thus the railroad has a direct immediate concern with Eklutna's development.

For these cogent reasons, the railroad management, therefore, supports the Bureau of Reclamation power project since it will assure the area plentiful low-cost power. Low-cost energy will, in turn, encourage new industries which will use the railroad's facilities.

The time factor is vital. Delay in providing adequate low-cost power means delay in the development of the Railbelt. This loss will be felt by the ARR.

Similarly, the proposal to develop new power sites in the Kenai area and the upper Susitna Valley are encouraging to the ARR. Both regions are served by the railroad.

DEPARTMENT OF THE INTERIOR

Alaska Road Commission

The Alaska Road Commission, which has maintained the present access road to Eklutna Lake, has informed the Bureau of Reclamation that it "has no objection to the proposed relocation or reconstruction of this road". The construction referred to would be a necessary part of the proposed Eklutna Project, and its costs have been included in the overall project estimate. The Road Commission has further

stated that it "will be responsible for the maintenance of the resultant road".

DEPARTMENT OF THE INTERIOR

Bureau of Land Management

Unified land, water, and power resources development is as applicable to the Anchorage area as any other habitable land. The basic things people live by here are much the same as elsewhere, the soil and water, the forests and grass lands, the fish and game, and minerals in the earth. The benefits of a balanced development of resources might be even more significant in this raw north area than in most other regions. Greater industrial utilization could certainly be made of the minerals, forests, fish, and other natural resources of the region if more and lower-cost power were developed. It is believed that small scale agriculture would become more productive and dependable if economical supplementary irrigation could be more generally practiced. Additional farm lands on the public domain might well be brought into production if low-cost power were available to aid its development and utilization. With extension of power lines, development of new home lands would undoubtedly be facilitated on the outskirts of Anchorage. Public and community services could be more easily modernized and expanded and the military security of the area strengthened. All this and the less tangible social benefits would surely heighten the settlement opportunities on public lands about Anchorage.

In the hinterlands of Anchorage approximately 60,800 acres have been classified as to their suitability for agricultural use. Such area classification was made to provide a guide to settlement and public land administration. The land has been classified into three types, namely: (1) Suitable for Alaskan general farming with local limitations, (2) Principally suitable for grazing or limited forage crop production, and (3) Unsuitable for agricultural use at present. The land types were mapped as accurately as the existing field information permitted. Within some type boundaries were included areas too small to map separately that actually belonged in another land class.

Approximately 16,314 acres were classified as suitable for Alaskan general farming with local limitations. Lands in this class mainly occupy glacial outwash material and hence are predominantly smooth to gently rolling. The soils range for the most part from very fine sandy loam to silt loam and with good management including application of farm manure, fertilizer, and lime are well adapted to the production of potatoes, small grains, forage crops, and the vegetables and berries

common to the area. Approximately 19,630 acres were classified as principally suitable for grazing or limited forage crop production. Land in this class comprises mainly strongly sloping glacial moraines and associated alluvial ridges and hummocks. Much of this land lies toward the east along the northwestern slopes of the Chugach Mountains at elevations of 500 to nearly 1,000 feet. Soils in this land type are generally similar to those described above except that depth to coarse sand and gravel is generally 12 inches or less. Because of excessive slopes, high elevation, or shallow soils the land is considered to be principally valuable for grazing although the value of the land for such use in its present state is low since it supports little grass. Small and scattered tracts within these areas with deeper soils, leveler slopes, and lower elevations are suitable for forage and other crop production. Close to 24,856 acres were classified as unsuitable for agricultural use at present as they are too swampy or rough and broken for cultivation or grazing use.

There were nearly 1,500 acres of vacant and unappropriated public land available for settlement in the Anchorage area on September 1, 1948. Practically all of this land, however, has been classified as unsuitable for agricultural use at present. If restoration of the military reservation lands lying east and southeast of Anchorage proceeds according to present plans there will be about 16,000 acres of additional land made available to entry. Of this total, about 1,700 acres have been classified as suitable for Alaskan general crop production with local limitations, about 8,800 acres as principally suitable for grazing or limited forage crop production, and 5,500 acres as unsuitable for agricultural use at present.

In the narrow coastal lowland which lies along Knik Arm at the base of the high and rugged Chugach Mountains north of Anchorage between the Fort Richardson Military Reservation proper on the south and the Eklutna Industrial School Reserve on the north, there are an estimated 26,500 acres of land. Settlement in this entire area is sparse and most of it is confined to the lands adjacent to the east side of the Palmer Highway. Almost three-fourths of this area has been withheld from entry since the war pending restoration of those lands temporarily withdrawn for military purposes. Exclusive of the 1,614 acres embraced in the small military reservation about the Birchwood Airfield, there is a total of almost 18,000 acres which may become available for settlement if land restorations proceed as presently planned. Only cursory information is available as to the use suitabilities of these lands but it is estimated that possibly as much as one half could be utilized for agricultural purposes or for small tracts for home, business, camp, cabin, and recreation sites.

In visualizing the future of irrigation in the Anchorage area primary consideration must be given to its economic feasibility. Small scale supplementary irrigation, especially application of water

at critical periods of the growing season has apparently been successful on a few farms in the region. Although the annual rainfall is adequate, it is not distributed with regularity from year to year or frequently in sufficient amount in early stages of the growing season. Fortunately, available water and agricultural soils occur side by side in most areas. There have been no field experiments, however, concerning the practical problems of efficient occasional application of irrigation water and the economics of supplemental irrigation about Anchorage. Future field investigations by the Bureau of Reclamation appears justifiable to determine the physical and economic feasibility of potential supplemental irrigation.

Approximately 1,600 acres in the vicinity of Anchorage which will eventually be released from the military reservation have been classified for small tract purposes. This land will provide approximately 700 lots ranging in size from one and one-quarter acres to five acres for lease and sale for business, home, cabin, camp, and recreation sites. Such uses of these lands, and there is dire need, would create a considerable additional market for electricity from an Eklutna Power Project.

DEPARTMENT OF THE INTERIOR

Bureau of Mines

A wide variety of activities relating to mines and minerals is conducted by the Bureau of Mines. Of particular interest are the studies of the use of power in extracting minerals now being conducted in a new electro-development laboratory at Albany, Oregon. Smaller laboratories are maintained at Seattle and Pullman, Washington. The former is concerned with coal and non-metallic minerals, and at the latter, specialized work is conducted on processes for the production of magnesium. Other activities include the production of helium, coal-mine inspections and investigations, fuel testing, mineral economic studies, investigation of mine accidents and development of means to prevent them, studies to improve mining methods and the preparation of minerals, and investigations to eliminate conditions harmful to health in the mineral industries.

If hydro-electric power could be made available at a cost which would justify extension of a three-phase line from Eklutna to the Jonesville and other coal mines in the Matanuska coal field, and still permit the sale price per kilowatt-hour to be competitive with the mine's cost of generation, this project would materially aid in furthering the economic development of the coal mines in this area. It appears a definite probability that the coal mine operators are prospective purchasers of power from the Eklutna project.

It is likely that lower-cost power may revive other smaller or more costly mining operations in the coal-bearing areas immediately

surrounding Matanuska Valley and in the Willow Creek mining district, where hard-rock gold mining on a large scale was once quite profitable, but in recent years has been practically dormant because of high labor and material costs. Tungsten has been found in the Willow Creek district, and availability of low-cost power would undoubtedly encourage further development.

Extension of its lines into the mining areas is under consideration by the Matanuska Electric Association, which anticipates that a possible additional demand of at least 1,500 kilowatts could be acquired thereby. This figure includes the Jonesville coal mine and is sufficiently high to allow for serving various operations and a possible custom mill in the Willow Creek area.

Representatives of the Bureau of Mines believe that a marked saving to small producers would result from milling their ores locally and shipping out concentrates as against the expensive practice of shipping out sacked ore to Seattle or elsewhere for treatment. The speculative element in establishment of a custom mill could be materially reduced by availability of commercial power avoiding investment in a steam or diesel-driven power plant.

Annual kilowatt-hour requirements for metal mining loads are subject to wide fluctuations, but an estimate of 14,000,000 kilowatt-hours annually for existing and potential mining and milling operations appears conservative.

As the work of the Bureau of Reclamation progresses, it would be advisable that the Bureau of Mines keep a close watch for appearances of any lode deposits.

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

In a letter to the Bureau of Reclamation dated September 9, 1948 Clarence J. Rhode, Regional Director of the Fish and Wildlife Service in Alaska, has stated: "The principal game in the Eklutna Lake area consists of Dall sheep, mountain goats, a few black bear and an occasional grizzly bear. Inasmuch as this area is accessible by plane from Anchorage, and would be heavily hunted by Anchorage residents, the Alaska Game Commission created some years ago a Game Refuge, in which the lake is included. That particular area affords some of the most beautiful scenery and natural game habitat to be found anywhere in Alaska. I think it is highly doubtful that this Service would ever wish to remove the area from the Game Reserve now in effect, as the lake can be reached by a fifteen-minute flight from

Anchorage, and it would be a matter of only one season until most of the game would be killed or driven from the area."

In referring to the proposed plan to raise the lake level two feet, Mr. Rhode said: "...inasmuch as no salmon or game fish are involved, we can see no possibility of your proposal being harmful to wildlife interests."

The Fish and Wildlife Service recommends the maintenance of the Eklutna Lake area in its primitive state, and "would be favorable to any plan which would provide additional protection to the wildlife and its habitat around Eklutna Lake".

DEPARTMENT OF THE INTERIOR

Geological Survey

The following is an account and abstract of investigations on Eklutna Lake, Alaska, by the United States Geological Survey:

During January, 1947, the Anchorage Public Utilities completed plans for making an underwater survey of Eklutna Lake in order to determine the amount of storage that could be developed by drawing the lake level below its natural low water stage. The Geological Survey was asked to provide a representative who would act in an advisory capacity. Mr. Arthur Johnson, District Engineer, Water & Power Division, Conservation Branch, was assigned to be this representative. He arrived in Anchorage on February 15, 1947, and accompanied the field crew making the survey from February 17 to March 1. The survey made at that time consisted of taking sufficient soundings and determining their locations to develop a map showing underwater contours to a depth of at least 50 feet below lake level. The resulting map was drawn on a scale of 1:4,800 (1 inch = 400 feet) and showed the shore line, elevation 868, and 10 foot underwater contours down to and including the 800 foot contour.

Mr. Johnson, as a result of his observations during the above mentioned survey, recommended that the Geological Survey extend the investigations on Eklutna Lake in order to determine the feasibility of developing the Eklutna Lake storage site by the construction of a dam at the lake outlet and raising the lake above, rather than drawing it below, its natural level. His recommendations were approved and the following program was carried out.

A map was made showing Eklutna Lake and shore up to the 950 foot contour. This map was on a scale of 1:12,000 (1 inch = 1,000 feet) with ten foot contours. This map incorporated the results of the

underwater survey. An area from the lake outlet downstream about one half mile and up to the 950 foot contour was mapped on a scale of 1:4,800 (1 inch = 400 feet) with ten foot contours. This map was made to determine the most favorable site for a dam from the standpoint of topography and also serve as a base map for the geologic study of the site. Eklutna Creek was mapped from the lake outlet downstream four miles on a scale of 1:24,000 (1 inch = 2,000 feet) with a 20 foot contour interval. The results of the above surveys have been published as a set of maps entitled "Plan, Eklutna Lake, Alaska, Dam Site". The set consists of three sheets, two of which show the lake and the third sheet shows the dam site area and Eklutna Creek.

A geologic examination was made of the dam site area by Mr. A.F. Bateman, Jr., Geologist, Mineral Classification Division, Conservation Branch, and of a proposed diversion tunnel route by Dr. F.F. Barnes, Geologist, Alaskan Section, Geologic Branch. Following the above mentioned field work the following reports were prepared.

Preliminary Report On
Water Power Resources
of
Eklutna Creek, Alaska
by
Arthur Johnson
August, 1947

Reconnaissance Report on Geology of
Eklutna Lake Dam Site and Conduit Route Near
Anchorage, Alaska
by
A. F. Bateman, Jr.
August, 1947

Preliminary Report On The Geology Along The Route Of A
Proposed Tunnel To Develop Power From
Eklutna Lake, Alaska
by
F. F. Barnes
July, 1947

The three foregoing reports were opened to public inspection by press notice dated February 15, 1948. Copies are on file at Room 3214 Federal Works Agency Building, Washington, D.C.; 410 Federal Building, Tacoma, Washington, and the Anchorage Public Utilities office, Anchorage Alaska.

Eklutna Lake is about seven miles long and a mile in width at the widest part. The area at normal high water level, elevation 868, is 3,260 acres. The sides both above and below lake level are fairly steep. The area of the 950 contour above the proposed dam site is 4,940 acres and the area of the sub-surface 800 contour is 2,700 acres. The lake has a maximum depth of about 200 feet in the upper half and then decreases gradually toward the lower end. The lower half mile is comparatively shallow. Regulation of the lake through a range of between 40 and 50 feet will provide sufficient storage to regulate the flow of Eklutna Creek. The available data at the time Mr. Johnson prepared his report indicated that a flow of 300 second-feet could be made available continuously and 350 second-feet for 50% of the time. This data was considered somewhat uncertain but subsequent information obtained at the gaging station below the lake outlet shows that the above figures for discharge are fairly reliable. With these figures for discharge, and assuming development by a tunnel rather than a conduit following the Eklutna Creek valley, about 15,000 K.W. can be developed 100 percent of the time and about 18,000 K.W. 50 percent of the time.

The proposed dam site, located about 400 feet below the outlet of Eklutna Lake, is considered suitable for a dam of flexible earth-embankment type of sufficient height to regulate the lake. Bed rock at the site is very deep and the dam would rest on glacial deposits of till, clay, sand and gravel, and on deposits of lake-shore and alluvial fan gravels. The geologic conditions in the area of the right abutment are imperfectly known at this time and may make necessary a long, deep cut-off extending for an unknown distance beyond the north end of the dam. An exploration program of drilling and test pits must be carried out before the conditions of the site can be fully evaluated.

The proposed tunnel for diverting water from Eklutna Lake northwestward to the valley of the Knik River would be about 4.5 miles long, the exact length depending on the route selected. Such a tunnel would encounter three general classes of bedrock, viz.; interbedded slate and graywacks; a fine grained intrusive rock, probably andesitic in composition; and a variety of basic intrusive rocks, locally highly sheared and serpentinized. The region in which the tunnel would be located has been subjected to strong deformative stresses, as shown by the numerous sheared and complexly folded zones. The affects of this deformation may be expected in all types of rock at tunnel depth in the form of joints, faults, and shear zones. No unusual geologic conditions were encountered that would indicate that the construction of the proposed tunnel would be unfeasible.

The investigations by the Geological Survey shows the general information relating to water supply, storage, power available, and the geologic conditions that would be encountered in any construction

program. This information serves as a starting point for the more detailed and complete investigations that are necessary before any definite plans, designs and estimates can be made by whatever agency or company contemplates development of the project. In this particular instance the Bureau of Reclamation is carrying on the more detailed investigations and studies and in so doing has used the information prepared by the Geological Survey as the starting point for its own work. This is an example of proper cooperation between agencies of the Interior Department, all working toward the common goal of the best use of the nation's natural resources.

DEPARTMENT OF THE INTERIOR

National Park Service

Upon the request of the Bureau of Reclamation and in accordance with inter-bureau agreement, the National Park Service submits this report on recreational potentialities of the proposed Eklutna Project.

On August 19, Mr. Alfred C. Kuehl, a Special Representative of the National Park Service, accompanied Mr. J.M. Morgan, Chief of the Alaska Investigations Office, Bureau of Reclamation, on an inspection of the area.

Summary of findings, conclusions and recommendations:

1. It is recommended that the recreational potentialities of the Eklutna Project be developed if the project is considered favorably by the Congress.

2. Recommend that further study of the recreational potentialities and a comprehensive planning analysis be undertaken preparatory to the preparation of detailed plans.

3. Recommend that development of the recreational facilities be under the supervision of the National Park Service.

4. Subject to approval by the Director of the National Park Service, it is recommended that administration of the recreational area be under the National Park Service until such time as the Territory of Alaska can assume the responsibility through the creation of a Territorial Park System properly financed for the purposes.

GENERAL DESCRIPTION OF AREA

Eklutna Lake is located high in the mountains of the Chugach Range overlooking the Knik Arm of Cook Inlet. It is approximately

36 miles by highway north of Anchorage, Alaska and 22 miles south of Palmer, Alaska, the heart of the Matanuska Valley farming settlement. The lake is accessible by means of a secondary mountain road 10 miles in length extending westerly from the Anchorage-Palmer highway, a major link in the Territorial highway system.

Purposes and Operation

Since 1932, the lake has supplied water for the development of a limited amount of power which is consumed by the City of Anchorage. A low 10 foot dam was originally constructed across the end of the lake. From a collecting basin at a lower level, the water is carried by penstock to a generating plant at the base of the mountain range. This plant, although originally constructed by private enterprise, was purchased by the City of Anchorage in 1943.

The purpose of the Eklutna Project is to expand the system to provide adequate power for the city, its outlying communities, the town of Palmer, the Matanuska Agricultural region, the Willow Creek mining district and the Matanuska coal fields.

It is proposed to increase the height of the present dam approximately 4 feet. This increase will not affect the overall size of the lake to any great extent due to the gradient of the shore line.

The lake is approximately seven miles long and varies in width from 3,500 feet to one mile. Maximum lake elevation will be 870 feet above sea level and will be subjected to a maximum drawdown of 40 feet. Any maximum drawdown will probably occur during the month of April. Water will be carried through diversion tunnel and penstock through the mountains, a distance of 22,000 feet to a generating plant to be located at the base of the mountain range near the highway.

Physical Characteristics

The lake is of glacial origin, created and supplied by an unnamed glacier which has receded to a point high above the lake level. The extent of the glacier which remains is about six and two-tenths square surface miles. There are other unnamed glaciers of greater significance within the immediate vicinity in the surrounding mountains, all of which add greatly to the scenic quality of the area. Scenic values are fine, in that the lake is completely surrounded by rugged mountains which rise as much as 7,000 feet above the surface of the lake. There are a number of alluvial fans of large proportion which terminate abruptly at the water's edge.

The lower mountain slopes above the lake level are covered with a good stand of spruce, aspen, black cottonwood and some birch trees.

The undercover consists principally of native shrubs, moss and ground cover plants.

Lake water is glacial, containing colloidial silt in sufficient quantity to cause a slight milky coloration.

The approach from the main highway to the lake parallels in a general way the Eklutna Creek. It is extremely scenic and from a number of points the Knik Arm of Cook Inlet can be seen.

Land Status

The lake, its adjacent lands and land upon which the present works are located, are owned by the City of Anchorage. An agreement between the city and the Bureau of Reclamation states that all the land is to be turned over to the Federal Government upon initiation of the proposed project. All lands surrounding those described are part of the public domain. The exact extent of land withdrawals necessary for the project has not been determined but there are 172 square miles in the basin of which 119 square miles are tributary to Eklutna Lake.

Climate

The climate of the region corresponds somewhat with the conditions that prevail in many of the north central states. Over a 29 year record period, the maximum low temperature in the Anchorage area was -37°, and the maximum high temperature 92°. The January average was 11.2°, and the July average 57°.

Precipitation averages 14.56 inches per annum, most of which falls within the late summer months. Killing frosts occur as late as May 23 and early in September. There are 113 growing days, and the possible sunlight hours on June 1 are 18:41, July 1, 19:14, and January 1, 5:42.

Climatic conditions of the region are conducive to wholesome outdoor recreation.

Present Recreational Use of Eklutna Lake

No recreational facilities have been provided at the site, although the area has proved exceedingly popular for picnicking, camping, boating, and sightseeing. It is reported that as many as 400 persons have visited the area on a week-end day and that the usual daily week-end visitation is more than 200 persons. There have been times when every available shore campsite within reach by automobile has been occupied. Many persons transport their small boats to the lake for a week-end of boating.

Historical and Archeological Investigation

In view of the remoteness of the area and the geological conditions, it is questioned whether any historical or archeological significance prevails.

RECREATIONAL NEEDS OF THE REGION

The region to be benefitted by this project is distinctly lacking in recreational facilities. Nowhere in this part of Alaska have comprehensive recreational facilities been developed. Considering that this project's recreational potentialities can be available to approximately 25 percent of Alaska's population, there can be little doubt as to its value. The need for well planned facilities for the use of the military personnel of the area cannot be denied.

There is a population of approximately 30,000 persons who reside within a 25 mile radius of Eklutna Lake. A substantial increase in population is inevitable if the increase of the past eight years is any criteria. The population of Anchorage has increased more than 500 percent during this period.

Alaska has been unable to develop recreational areas for its population due principally to the lack of funds. Heretofore, only minor developments have been provided in the forest areas of Southeastern Alaska.

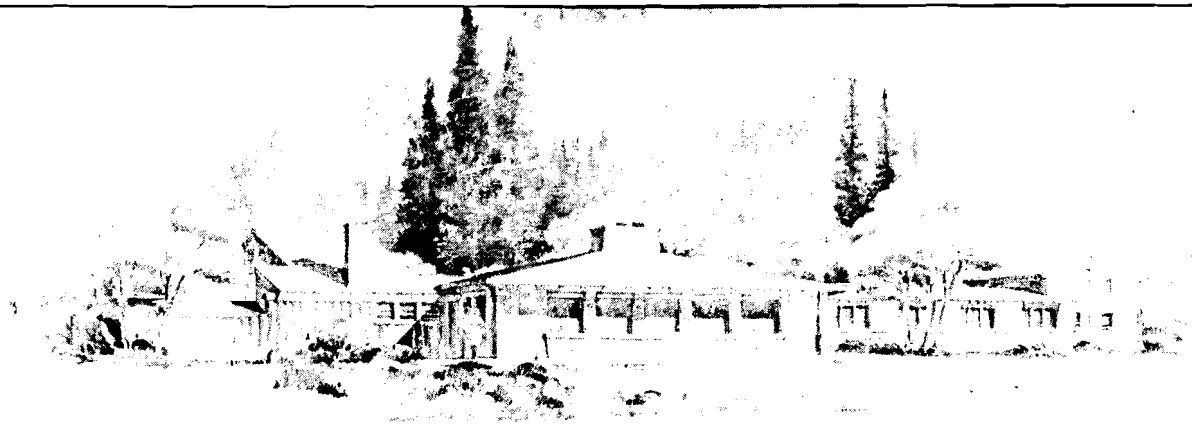
A recent report of the Subcommittee on Resource Policy of the Interagency Committee on the Development of Alaska, through its study, strongly recommends the development of Alaska's recreational resources and recognizes the urgent need as well as its effect upon the economy of the Territory.

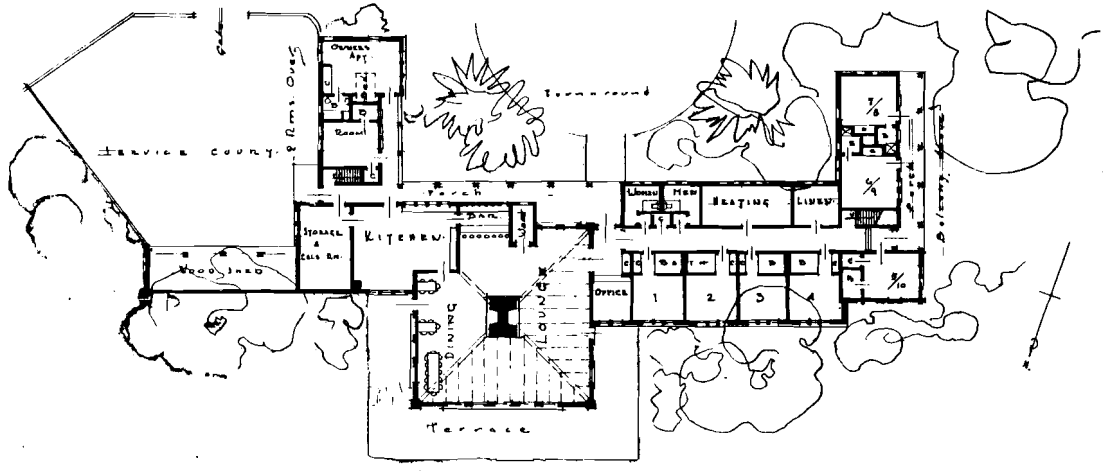
RECOMMENDED RECREATIONAL DEVELOPMENT

In view of the close relationship of this project to the centers of population, and its physical attributes, it appears that its development would serve best for day, week-end, tourist and organized camping uses.

Completion of a permanent high standard road to the area as proposed for the Eklutna Project will make it easily accessible. Because of the airmindedness of Alaskans and the great number of privately owned planes that are equipped with pontoons in the Anchorage area, it can be expected that many persons will use this method of transportation. The waters of the lake are suitable for amphibious plane operation.

The land available for recreational development is limited due




Terrace
Kitchen
Dining
Lounge
Office
Heating
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Terrace

to topographical conditions. Some of that which now is available will be despoiled for certain uses due to construction activities. Attention is called to the results that may occur through the dumping of material excavated from the diversion tunnel. This operation will probably leave large waste piles which if graded to a level may be put to some use. Further study would reveal these possibilities.

The lake contains no fish of consequence due to the colloidal silt content of the water, but the surrounding area contains considerable wildlife. The proposed recreational area should be closed to hunting.

Facilities that should be provided for recreation as revealed by this initial investigation are camping, picnicking, sightseeing, boating, overnight accommodations, limited minor sports, hiking and winter sports such as skiing, skating, and tobogganing.

ESTIMATED COST OF RECREATIONAL DEVELOPMENTS

A more detailed breakdown and approximate cost of providing for these uses follows, but a comprehensive planning study would be necessary to accomplish a conclusive analysis.

1. Two miles of road extending from diversion tunnel along the north shore	$ 50,000
2. Campground with minimum of 50 individual campsites equipped with tables, stoves, garbage receptacles and water system	38,500
3. Picnic areas along lakeshore drive equipped with tables, shelters, stoves and parking space	35,000
4. Comfort stations for picnic and campground areas	25,000
5. Boat pier	32,000
6. Airplane landing float and finger floats for boats	24,500
7. Minor sports area, horseshoes, archery, etc.	15,000
8. Parking areas at overlooks, lodge and ski area	70,000
9. Lodge, centrally located on lakeshore equipped with minimum 10 guest rooms, lounge, coffee shop, related facilities and help's quarters	250,000

10. Trails along lakeshore - 5 miles.....	18,000
Winter Sports Facilities	
11. Ski hut with warming room, snack bar, lockers, etc.	40,000
12. Rope tow for ski slope.....	25,000
13. Toboggan Slide.....	30,000
14. Skating hut equipped with heating facilities....	22,500
Administrative Area	
15. Office and employees' residences.....	100,000
16. Equipment storage building, shop and utility structures.....	80,000
17. Utility system for all uses, including water system, sewerage disposal system and power distribution lines.....	150,000
18. Walks, terraces and landscaping.....	50,000
Total estimates cost	$1,055,500
Plans and supervision.....	160,000
	$1,215,500

The National Park Service is strongly of the opinion that, due to the many intangibles involved, there is no satisfactory method of estimating monetary benefits from recreational developments. On a judgment basis, however, the recreational benefits at the Eklutna Project have been estimated to be double the recommended expenditures of $1,215,500 for the proposed recreational facilities.

RECOMMENDED PLAN OF ADMINISTRATION AND OPERATION

1. It is recommended that upon approval by the Director, the National Park Service be designated as the Federal agency to administer, maintain and protect the proposed recreational area until such time as the Territory of Alaska can, through creation of a Territorial Park System, assume the responsibility.

2. It is recommended that operation of revenue producing facilities such as the lodge, skiing facilities, boat rental, sale of gasoline and other services be operated by private enterprise on a concession contract fee basis under regulations established by the Secretary of the Interior and the National Park Service.

RECOMMENDED FURTHER STUDY AND PLANNING

If construction of the Eklutna Project is favorably considered by the Congress, it is recommended that a comprehensive planning study be undertaken, and that master plans and detailed plans be prepared for the recreational developments with funds allotted for the purpose.

DEPARTMENT OF THE INTERIOR

Office of Indian Affairs

The Office of Indian Affairs has a direct interest in the Eklutna area through the operation and maintenance of the Eklutna Indian Reserve (containing the Eklutna Vocational School), and the construction and operation of the planned 400-bed hospital to be located at Anchorage. The following are excerpts from a letter to the Bureau of Reclamation by Don C. Foster, General Superintendent of the Office of Indian Affairs;

"There is already a power shortage in the Anchorage area. We believe that the economical solution is the installation of a new Eklutna hydroelectric plant. This would not in any way, so far as we can see, conflict with the present Eklutna Indian Reserve.

"The Alaska Native Service construction program includes considerable development in the Anchorage area. Plans are now geing prepared for a 400-bed hospital to be located at Anchorage. The electrical demand for this hospital is estimated at 150 Kw. to 180 Kw. The long range plans also call for the rebuilding of Eklutna Vocational School which would have a maximum demand of approximately 120 Kw.

"Your efforts to improve the power situation for the Anchorage area are appreciated."

U. S. DEPARTMENT OF AGRICULTURE

Agriculture in Alaska will develop along with industry, mining, recreation, fisheries and other commercial activities. As the population grows, there will be need for increased agricultural production. Especially in the immediate future it can be anticipated that military food requirements will remain high.

But there must be a very fine balance maintained between the rate of agricultural development and industrial development. Payrolls for industrial workers in population concentrations are necessary if there is to be a market for Alaska agricultural products. The number of Army personnel at Alaskan bases and Army policy with respect to procurement of those food products which can be produced in Alaska, will be of primary immediate importance in the rapidity and stability of agricultural development.

Need for Electric Power

As agricultural development proceeds in the areas suitable therefor, there should be a substantial increase in the demand for power provided rates are reasonable. At the start the average farm family will have a minimum of power equipment for which electric energy will be required. It may be five to six years before the individual farmsteads are developed sufficiently to afford the use of electric energy on an extensive scale, unless it is available at a very low rate. Low cost electricity is of great importance for a satisfactory home in Alaska, whether in the country or in the city, because of the long winters with short days.

Canning, storing, and quick-freezing of agricultural products will all require electric power. A favorable purchasing policy by the Army plus the increase in civilian population concentrated in the larger towns of the Territory will give an increased market for both fresh frozen and processed agricultural products. Home locker systems and walk-in units will require more power.

Because of the short growing season it is necessary to have greenhouses in order to start some vegetables for early planting as soon as the soil is ready. These greenhouses need low-cost electric power for both effective heating and lighting. Newly developed methods for grain and feed drying also depend upon electric power.

Commercial greenhouses in farming areas for production of early vegetable plants, out of season vegetables, and for flowers can become a considerable industry, especially near centers of population, if low cost electric energy for heating and lighting is available. Establishment of processing plants either on a small farm scale or on a large commercial scale cannot be anticipated unless ample power at low rates is available.

Because of lack of power, the Matanuska Valley farming community has not been able to make full use of electric equipment and rationing of power will be necessary this winter. The Spenard area outside the city limits of Anchorage and other rural areas are now asking for power distribution. The rates beginning at ten cents per kilowatt-hour and progressing downward on a sliding scale to a minimum of three cents per kilowatt-hour are expensive even for ordinary household use. No industry can afford such rates if the products they manufacture or process come in competition with similar products manufactured or processed in the States where low power rates are available.

The growth of a sound agricultural economy in Alaska and the rapidity of its development are closely linked with low cost transportation, increased industrial and commercial development, and availability of abundant electric energy of constant voltage and at low cost.

Irrigation of Crops in Alaska

Some irrigation is practiced by a few farmers on an individual farm basis primarily for truck crops. Not too much is known at the present time about irrigation in Alaska either as to its economic or its agronomic and soils aspects. Both experience and research in irrigation in Alaska are very limited.

No doubt there is an important place for some irrigation on some farms. In some seasons the natural rainfall is adequate for crop production. In other seasons, however, the normal rainfall, especially in the spring, may be inadequate for getting crops off to a good start. Because of the short growing season, getting crops off to a good start as well as providing them with adequate moisture during seasons of short precipitation is essential. Thus irrigation, even in relatively small amounts may result in substantial benefits where the soils are good and where the other necessary practices are carried out. Without use of good varieties of crops, adequate fertilization, and other good management and cultural practices, irrigation is not likely to prove satisfactory. On the economic side, a continuation of current relatively high Alaska farm commodity price levels if coupled with reduced pumping and equipment costs would greatly stimulate "wider trial" of irrigation possibilities in Alaska. Power rates for pumping in Alaska are now greatly in excess of those prevailing in the States.

Although present knowledge is too limited for adequate appraisal of the future value of irrigation, there is little reason to believe that it will be either large scale or extensive; rather it will likely continue to be on a small, individual farm basis, or possibly on the basis of small groups of farms using a cooperative water supply. Most of the water will likely be obtained by pumping, primarily from wells but possibly in some cases from nearby streams or lakes. So far, experience

has been nearly all with sprinkler systems, which are particularly adaptable for use where supplementation of natural rainfall is desirable. Because of the nature of the soils, it would not likely be practicable to attempt much leveling or ridging for furrow, border or flood irrigation.

In the Matanuska Valley wells for household and livestock use, drilled by the Alaska Rural Rehabilitation Corporation in 1935, 1936, and later, are from 12 feet to 300 feet in depth. These wells were all drilled with four inch bits and cased with four inch casing. Water in some of the deeper wells rose in the casing from 60 to 150 feet when the water vein was tapped. In some wells the flow was strong but in other wells there was scarcely enough for household and livestock use. The conditions, therefore, are not uniform. There may be places in or near some farms where small impoundments or farm reservoirs would be practicable for the light irrigation needed.

The situation is more difficult in the Tanana Valley where wells pass through layers of permafrost (ever-frozen deep soil). Difficulty has been encountered in keeping the wells from freezing if they are not pumped at regular intervals of from three to four hours, day and night. At the Fairbanks Agricultural Experiment Station, which is on the edge of the depositional soil area overlaying the flood plain, a well 110 feet was drilled. Several days elapsed before the pump pipe was placed in the well. Meantime ice had formed in the casing. A steam boiler with thawing point attached to a hose was necessary to clear the ice so that the pump pipe could be lowered into the bottom of the well.

Groundwater research is needed in Alaska, especially near Fairbanks and other potential agricultural areas having permafrost. Water supply for farm homes and livestock in such areas is already critical both as to quantity and potability.

Rural Electrification in Alaska

Rural electrification progress in Alaska is being seriously hampered by shortage of power and by the high cost of producing electricity. The situation is particularly acute in south-central Alaska where additional agricultural development is possible and where an extensive program of rural electrification has been planned.

Of most immediate importance in this area is the development of Eklutna Lake as a source of hydro-electric power, and the construction of transmission facilities between Anchorage and Palmer. Ultimately, if Alaskan rural people are to enjoy the abundance of low-cost electric power on which the development of the Territory heavily depends, other favorable hydro-electric sites need to be developed and transmission facilities must be provided.

The Rural Electrification Administration promotes rural electrification by making loans to local business enterprises which construct and operate rural power systems and repay their Federal loans out of operating revenues. In Alaska REA has made loans to six borrowers, all of them rural electric cooperatives owned and directed by the consumers they serve. Headquarters of these cooperatives are at Palmer, Kodiak, Homer, Fairbanks, Juneau and Anchorage. Borrowers that would be benefited immediately by the development of Eklutna Lake as a power source are the Matanuska Electric Association of Palmer and the Chugach Electric Association of Anchorage.

The Matanuska Electric Association received its first REA loan in 1941, energized its distribution system in January 1942, and is now supplying electric power to the community of Palmer and to approximately 250 farms in the Matanuska Valley. It has additional loan funds available sufficient to serve 70 more consumers as soon as new lines can be constructed. Many more homesteaders are ultimately expected in the area and will require electric power.

The Chugach Electric Association is the newest of the REA borrowers in Alaska. It was organized in 1947 to serve approximately 1,500 families living in the Anchorage area but outside the Anchorage city limits. These prospective users of electricity cannot be served by the Anchorage municipal system because the city lacks adequate generating facilities and has insufficient capital to extend its present system. The Chugach Electric Association has received an REA loan for electric distribution facilities but is still without an assured source of power for the new system it plans to build.

Power Problems in the Anchorage Area: The only present sources of power for both urban and rural users in the area of Anchorage and the Matanuska Valley are the generating facilities of the City of Anchorage. These facilities are critically inadequate. The Anchorage power system, originally designed to serve a population of approximately 3,500 people, is now serving an estimated population of 20,000. As a result, the city has been forced to ration power to users, and interruptions and blackouts have occurred.

Dependence on this inadequate power source has brought serious problems to the REA-financed Matanuska Electric Association. The power which the cooperative distributes to its members is purchased from the city under a contract which limits the cooperative to 450 kva sub-station capacity. This limitation seriously restricts the use of electricity that may be made by the members. The system was energized during the war when electric appliances and equipment were not available. Now the Association is forced to discourage its members from adding power-consuming

equipment, such as water heaters, ranges, washers and motors, in order not to exceed the permissible power load. This restriction limits the value of electric service to the cooperative's members. It is also a limitation on the revenues on which the cooperative depends for the repayment of its REA loans.

In addition to the shortage situation, the Matanuska Electric Association must pay high rates for wholesale energy. The wholesale rate paid by the Association is 2 cents per kilowatt-hour — more than double the average wholesale rate paid by REA borrowers in the States. As a result the cost of electric energy to Matanuska Valley consumers is high. A typical user pays an average bill of $25 to $35 per month to operate an electric water heater, deep well pump, electric range, electric washing machine, and small household appliances.

The Chugach Electric Association, of course, has an even more severe power problem since it has no assured source of power at all. As matters stand, its only alternatives are to attempt to get power from the hard-pressed City of Anchorage, or to request a loan from REA to finance its own generating facilities. Either of these alternatives will mean relatively high-cost power.

REA financing of generation and transmission facilities in Alaska will probably be necessary in serving isolated rural sections, but it represents no solution to the problem of over-all power development in the area. Generation of power in small plants is essentially a high-cost operation. Alaska needs a coordinated electric power development program to provide low-cost power for the Territory's rapidly expanding industrial, military and rural needs. Such a program is, of course, beyond the scope of the REA program.

Future Development Possibilities in the Anchorage Area: If abundant low-cost power can be made available to the REA borrowers in the Anchorage area, there are real possibilities for the development of agriculture and associated industries. Matanuska Valley farmers are at present using only an average of 140 kilowatt-hours of electricity per month. If abundant low-cost power were available, estimates based on experience in the States indicate that average use would rise sharply — perhaps to 1,000 kilowatt-hours per month within a very short time.

Low-cost electric power could do much to relieve Valley farmers of their present dependence on the hazards of weather. The Valley farmers, for instance, suffer severe losses as a result of rain during the grain and hay harvesting season. Economical operation of electrically powered individual grain dryers could hold this to a minimum. Spring and summer drought is a constant threat to root and vegetable crops of Valley farmers. Low-cost power is essential for pump irrigation. Economical use of soil-heating cable installations would enable Valley farmers to

to get an early start with tomatoes, cucumbers, and other garden products. These are only a few of the scores of uses Valley farmers would make of electricity if power costs encouraged all-electric operation.

Low-cost power would also encourage the establishment of basic industries along the lines of REA borrowers in Alaska to supplement the agricultural development and thus assist in providing a well-rounded economy for the area. For example, power at low rates would help re-opening and operation of gold mines which since the war have either remained shut down or have curtailed their operations because of high production costs or inability to obtain sufficient electric power. Coal mining operations would probably be revived in the Matanuska Valley if the mines could be electrified. Consideration is being given to the installation of a coal briquet plant which would require a low-cost source of power. Woodworking industries have been studying the possibilities of the Matanuska Valley. The assurance of low-cost adequate power would be an important stimulant to the development of commerce and industry in the area between Anchorage and Palmer.

The ultimate contribution that the REA program can make to developing and stabilizing the economy of Anchorage, the greater Anchorage area and the Matanuska Valley depends almost entirely upon the maintenance of adequate and dependable electric service at a cost consumers can afford to pay.

DEPARTMENT OF COMMERCE

Civil Aeronautics Administration

When the Civil Aeronautics Administration established headquarters in Anchorage, Alaska, nine years ago we were faced with the problem of either constructing our own power facilities here or negotiating with the local municipal authorities for the purchase of power from an already inadequate generating and distribution system. Due to conditions beyond our control, namely the necessity for immediate service together with the fact that we were definitely compelled to purchase and install our own plants at our isolated stations throughout the Territory, we welcomed and took the only logical course open to us and negotiated for service from the Anchorage municipality. Further, it was our desire to utilize Government dollars to sponsor and encourage the development of commercial power generating and distribution systems. This arrangement, in a sense, amounted to a subsidy as the CAA advanced the money for necessary line construction with a gradual retirement of Government investment through slightly reduced rates on electrical energy.

Overloads on the local electrical system developed with increased population in the area and were a constant source of trouble to us, particularly in the early years of operation. There were frequent outages, many of which occurred for relatively long periods of time. This not only disrupted our airways communications system but threw our general offices in darkness, slowing down office operations which resulted in a general loss of efficiency and lowering of employee morale. This constant outage problem had a still greater effect on lowering of employee morale in the homes. Many residences are dependent upon a constant source of electrical energy for cooking, operating of their oil heating furnaces, water and lights. This situation still exists to a certain extent and we are warned by local city officials that it may become a most serious problem this coming winter.

It was necessary for our organization to install two 75 kw. stand-by generators in the Federal Building to assure us of reasonably continuous service, and to prevent the loss of service to the Government of about 250 employees during the winter months when outages occurred in the commercial power source. Other stand-by units were installed at the Remote Receiver Site and at Merrill Field for the same reason but mainly to permit continuous service to aircraft using local air navigation facilities which would be endangered through interruption for any cause. Often these auxiliary plants were compelled to remain in operation during hours of darkness or until the peak loads were passed.

The charge for our commercial electrical energy has been abnormally high, the rates varying from 10¢ downward to 4¢ per kilowatt-hour. Our present yearly load in the Anchorage area is approximately 1,805,400 kilowatt-hours. With the construction of the new International Airport near Anchorage which we anticipate will be in operation (although only

partially completed) in late 1949, our power load increase is expected to be 400,000 kilowatt-hours annually. At present only one international airline, Northwest Airlines, is operating through here on a scheduled air carrier basis. We can easily anticipate that by 1952 one or two additional United States carriers will be operating to the Orient through Anchorage with the possibility of three or four additional foreign lines. The new airport power load alone might easily reach an annual 1,000,000 kilowatt-hours peak by 1952.

Local municipal authorities have been faced with so many problems in this rapidly growing community that they have had neither the time, the finances nor the qualified engineering personnel to establish an adequate and efficient electrical generation and distribution system nor can we foresee when the time will ever come that existing situations can be profitably remedied. Their present plans call for a bond election on August 27th to purchase and install a small 1,000 kw. diesel engine unit. The entire Anchorage system is cluttered up with several of these small generating plants, all of which are required to carry present peak loads and none of which is capable of carrying the off peak load alone. Efficiency, therefore, is unknown and impossible in the city's method of operation.

The possibilities offered by the Bureau of Reclamation in the development of available water power in the general area surrounding Anchorage for relatively low-cost power generation are most encouraging. The outlay of capital required is far beyond the resources of the City of Anchorage so no objections should be voiced by its citizens to such a plan. Rather they should and doubtless will welcome the program being recommended as a relief from the burden which has been stifling the growth and development of this community. The city administration can then devote its time and energy to other problems so necessary to be correctly solved in a new community and leave the power problem in the hands of trained engineers.

Aviation is not a passing fancy. It is here to stay. It has already taken its place in the front ranks of world commerce. Particularly is this true in Alaska where aviation has long since become the Territory's one outstanding means of transportation. However, the success of aviation is dependent upon an adequate and reliable supply of uninterrupted electrical energy to operate and maintain the many aids to our Federal Airways Service. This point we wish to make quite clear. There must be no "if's", "and's" or "but's". The service must be sufficient, of a constant voltage and always available.

The proposed new sites for water power development, namely the Eklutna Project, the upper Susitna River and in the Kenai area should prove to be of great value, not only to those districts and to our CAA stations along the general transmission route, but to the community in and about Anchorage which already is over twice the size of the next largest city in the Territory of Alaska in spite of its existing deplorable power system.

FEDERAL POWER COMMISSION

The proposed project would, to a large degree, supersede existing Project Number 350, licensed to the Anchorage Public Utilities System, owned by the City of Anchorage. The existing licensed Project Number 350 consists of a storage dam and reservoir at Eklutna Lake, a diversion dam about 70 feet high on Eklutna River about three miles above its mouth, a water conduit about 2,800 feet long, comprising an intake structure, a tunnel and penstock, a powerhouse and appurtenant equipment with an installed capacity of 2,000 Kw. in two units, and step-up equipment and transmission line from the powerhouse to the City of Anchorage.

The following comments are based on a rather hasty review of the report, and consequently we may desire to modify them, at least in part, after a more intensive study:

1. The report contains no mention of any specific authorization for the study of the project and preparation of the report thereon.

2. The ability of the City of Anchorage, or other private capital rather than the Government to finance and construct the project, is not covered.

3. The report contains no material on alternative hydroelectric projects that might be constructed in the vicinity to serve the area, perhaps more economically than the proposed Eklutna Project.

4. An alternative site, if available for development, would be cheaper by the cost of the existing project which may be as high as $800,000, and would not impair the usefulness of the existing project of 2,000 Kw. installed capacity.

5. The report contains no material on the possibility of developing additional head and power on Eklutna River, above the existing project, thereby saving the existing project. This might be a cheaper development.

6. The cost of the tunnel accounts for about 40% of the cost of the project. Should unfavorable ground be encountered, the estimated cost of the tunnel might be doubled. Trouble on the construction of the dam might increase the cost of the project considerably.

7. It appears that more study should be given to the dependable flow that might be developed at Eklutna Lake and to the choice of the installed capacity.

8. A benefit-cost ratio of 2.66 is computed for the project in the report. The computation of benefits is based on total savings to consumers, plus surplus earned by the project over and above financial

requirements during the amortization period. In determining costs, only the capital cost of the project is considered. This method of calculating the benefit-cost ratio differs considerably from accepted practice. We should like to suggest that in lieu of the method used, that a computation be made of equated average-annual costs during amortization period, and that these costs be related to benefits. Benefits should be measured by the cost of power from the next-available alternative source, which in this case could be a steam plant of approximately 22,500-Kva. capacity.

9. The rights of the City of Anchorage will have to be extinguished in favor of the Government. We believe that this might be done by licensee making application to the Commission for transfer of license to the Government, or by making an application for surrender or termination of license. In any case, it is likely that the Commission would have to make a finding of the amount which the Government should pay for the project, and formally provide for the extinguishment of the license.

10. The Federal Power Commission is at present making a power-market survey of Alaska, and from preliminary investigations it appears that there is a serious power shortage in Anchorage and vicinity. It is apparent from this investigation that additional power facilities, relatively substantial in amount, should be constructed at Anchorage in the immediate future.

If after further study of the project, we have further comments to offer, we will write you. We appreciate having an opportunity to review this report in the formative stage.

HEADQUARTERS ALASKAN COMMAND
OFFICE OF THE COMMANDER-IN-CHIEF
FORT RICHARDSON, ALASKA

2 September 1948

Bureau of Reclamation
Department of the Interior
Juneau, Alaska

Dear Sir:

The Alaskan Command Headquarters is familiar with the general objectives of the Eklutna Hydro-Electric Project. It recognizes that subject project is intended primarily for development of civilian economy in the Anchorage-Matanuska Valley Area. However, due to its potential value for military purposes, the Alaskan Command is in sympathy with a proposal for early action by Congress in order that construction may be undertaken at an early date.

This headquarters foresees a need at Fort Richardson and Elmendorf Field for a considerable portion of the power which will be developed at Eklutna.

The Alaskan Command assures you of a desire to cooperate fully with the Bureau of Reclamation in the development of this project.

Sincerely,

N. F. TWINING
Lt Gen, USAF
Commander-in-Chief