PROSPECTUS

AND

GENERAL ENGINEERING REPORT

ALASKA CEMENT COMPANY

QUARRIES LOCATED AT SELDOVIA and
PORT GRAHAM, ALASKA

PLANT LOCATED AT HOMER, ALASKA

OFFICES AT ANCHORAGE, ALASKA

September 1945

PREFACE

A number of favorable factors prompted the choice of Homer, Alaska for construction and operation of a portland cement plant. The community of Homer is primarily engaged in farming and developing additional farming lands; within this area are thousands of acres of rich agricultural land that only awaits settlement and development to become the largest and richest farming area of the territory. The Homer area is adjacent to and a part of the immense Kenai Peninsula agricultural district that is also in the process of settlement and development. A manufacturing plant so situated as to be backed by an immense farming country has a very good chance of success from this business alone. Cost of living in an agricultural section is always certain to be lower, and a large percent of the employees of a manufacturing plant located in such an area are sure to become more or less interested in farming and purchase and development of their own farms and homes. A manufacturing company whose employees are constructing and developing their own homes and who are actively engaged in agriculture to a limited extent are certain to be more contented and permanent than those living in company houses or renting apartments. Labor and union disputes can be reduced to a minimum by having every employee occupied in his spare time developing his own home and community. The several hundred people living in the Homer Area and following the chosen profession of farming are at the present time having a rather tough job to develop their lands and homes and still maintain a livelihood, because there is no payroll in the community. Location of a manufacturing plant in this area would establish a fair-sized payroll, and many of the present population would find either permanent or part-time jobs directly or indirectly with the Company.

Homer, Alaska enjoys one of the better climates of the Territory; the summers are warm and fairly clear, while the winters are more mild and lack the deep snow coverage experienced in some other sectors of Alaska. Being situated on Katchemak Bay and sheltered from the Gulf of Alaska and Cook Inlet, high winds are not experienced in this area. The waters of Katchemak Bay and Cook Inlet at this point are ice-free, insuring year-around water transportation.

Additional roads planned for immediate construction within the Territory include road connections to link Homer with the balance of the Territorial road system. This will make Homer a tide-water terminus of the road system, and undoubtedly a substantial percent of interior Alaska freight and passenger traffic will flow through this port. The Homer Spit is the only deep-water anchorage on the north shore of Katchemak Bay.

Location of the manufacturing plant of the Alaska Cement Company on Homer Spit allows ocean-going ships, as well as barges and trucks to load cement directly from the plant and transport it to all parts of Alaska and perhaps to the Orient. With the plant so situated, all raw materials need be barged only a few miles, unloaded directly into the plant, manufactured

into finished portland cement, and reloaded into barges, ships, or trucks and distributed to the points of use. A manufacturing site so favorably located with reference to its supply of raw materials is very much to be desired. Raw materials, limestone, clay, chert, shale, and coal are all available on tide-water within a few miles of the plant site. These are the primary materials needed for manufacture of portland cement, and make up almost 100 percent of the raw products.

A brief summary of the manufacturing process of portland cement will help one to visualize the strategic location of a cement manufacturing plant on Homer Spit, Alaska. The Cement and Concrete handbook published by the Portland Cement Association is quoted in part:

> "Portland cement, the basic ingredient of concrete, -- one of our most widely used structural materials -- is manufactured under exacting laboratory control. Its manufacture is a complicated process of transforming common inert materials into a finely powdered, chemically active substance. When mixed with water, the product is plastic for a short time, during which it can be placed easily into forms and molded into useful shapes and structures ranging from sidewalks to massive dams and buildings. It then hardens, attaining strength and durability exceeding that of many natural stones. Portland cement is composed of a mixture of lime, silica, alumina, iron oxide, gypsum, and a trace of other ingredients, with lime and silica composing 80 to 90 percent of the mass. Most common among the materials used in its manufacture are limestone, shells, chalk, shale, clay, and blast-furnace slag. Limestone, the most common source of calcium in cement, is first quarried and fed through crushers capable of handling pieces of rock as large as a piano. The first crushing reduces the rock to a more uniform size with the top size of around six inches. The rock then goes to small gyratory crushers or to hammer mills for reduction to 1-1/2 inch size or smaller. The crushed limestone is now fed into the grinding mills with other raw materials in correctly proportioned amounts where all ingredients are intimately mixed and ground to powder finer than flour. This powder is then heated to a temperature approximating 2,700 degrees F., when it approaches the melting point -- "incipient fusion" -- in scientific terms. This process takes place in huge cylindrical steel kilns from 8 to 14 feet in diameter and from 100 to 400 feet long. Kilns, lined with fire brick, are mounted with the long axis inclined slightly from the horizontal. Finely ground material is fed into the higher end. At the lower end of the kiln is a roaring blast of flame, produced by burning powdered coal, oil, or natural gas under forced draft.

"As the material progresses through the kiln, certain elements are driven off in the form of gases. The remaining elements unite to form a new substance with its own physical and chemical characteristics. This new substance is the "clinker", formed in balls about the size of marbles. Clinker is discharged at the lower end of the kiln white hot, and must cool before going to the grinders. In some plants it is cooled by quenching with water, or by air forced upward through the mass. When cool, the clinker is conveyed into a series of grinding machines and ground to a powder that will pass a screen containing 40,000 openings to the square inch -- a sieve so fine that it will hold water. During the grinding, a very small percentage of gypsum is added. This is done to regulate the early hardening period of cement when mixed with water. Some 80 separate operations are necessary to produce portland cement. Each step is checked by chemical and physical tests, in plant laboratories. Before it is shipped, the cement is further analyzed to insure its conforming to one of the standard specifications of the American Society for Testing Materials and of the United States Government."

Raw materials for the Alaska Cement Company are located on tide-water within sight of the manufacturing plant site. Over half a million tons of limestone is contained in one dike sixteen miles from the plant site; chert and chale in unlimited quantities are spread over an area ten to twenty miles from the plant site; clay in sufficient quantity is available four miles from the plant site; and millions and millions of tons of coal lies five to ten miles from the site of the plant. Gypsum, which comprises only a fraction of one-percent of the raw materials used, is available on tide-water a few hundred miles from the plant site, although a closer supply is being investigated.

By use of low-cost barge transportation for raw materials and finished product, the wholesale selling price of portland cement can be reduced to a fraction of its present price. By making a substantial reduction in the selling price of cement, more cement will be used in initial construction of structures and roads, and permanent buildings and roads within the Territory will be the result.

I GENERAL DESCRIPTION: It is proposed that a Portland cement plant be constructed on tide-water at Homer, Alaska, manufacturing Portland cement for use in all parts of Alaska. The plant will have a capacity of 600 barrels of cement per day, which figure is sufficient to care for the normal needs of the Territory for the next five to ten years; capacity of the plant could then be doubled by addition of only a few pieces of equipment and at a very nominal cost. Shipment of cement from this plant to the Orient is a possibility that will depend largely upon Asiatic reconstruction plans; and manufacturing phases shall be operated on a year-around basis, establishing a much needed constant payroll in the Territory.

Limestone for operation of the plant will be secured from Gray Cliff, located approximately one mile north of Seldovia, Alaska, and sixteen miles by water from the cement manufacturing site at Homer. Since the limestone deposit is located on tide-water, transportation can be economically effected by low-cost barging. Clay for admixture to the limestone to produce the proper chemical ratio for manufacture of cement will be obtained in quantity four miles from the manufacturing site, and transported by truck to the storage area at the plant site, as a good road is already constructed between these points. Coal will be obtained from either the Sal-Tide Coal Mine located on tide-water, five miles from the plant site and just across Katchemak Bay, or from the Homer Cliff Coal Mines, located seven miles from the plant site and served by an existing road between the two points. Gypsum will be obtained either from Seattle or from Chichagof Island, just west of Juneau, Alaska. Proportionate cost of this raw material will have little effect on the cost of the finished product as only two percent is required in Portland cement. Exploratory work by the Company is being done at this time to locate a closer supply of gypsum.

It is planned that finished cement will be transported in bulk by company barges to central distribution points in Alaska and rerouted by rail and truck to the smaller markets throughout the Territory. It is estimated that all phases of the Company's activities will directly employ 150 to 200 persons on a full year-around schedule; of course, if capacity of the plant is increased at a later date, the number of employees will be increased accordingly, supplying more steady jobs for people in Alaska.

II LIMESTONE: Limestone to the extent of approximately 500,000 tons is contained in the "Industrial Lime Lode No. 1" located by Parker A. Lyle and Charles B. Abbott on June 21, 1945. This lode claim is situated on tide-water 300 feet from a tide-water slough which will be dredged for barge docking. (Refer to enclosures 6, 7, 8 and 9) The extent of the limestone deposit is 1040 feet in length, 65 feet in height, 25 feet wide at the top, and 50 feet wide at the bottom; surface coverage of the deposit varies from only a few inches to about a foot in thickness on the crest of the ledge rendering expense of stripping almost negligible. The deposit is striated and twisted considerably, so primary blasting can be held to a very low level. In a number of exploratory pits blasted out of the limestone, primary blasting seemed to also accomplish secondary blasting as the

rock shattered quite completely. It is planned to use a one-yard electric operated power shovel and a five ton truck in the quarry to haul to the primary crusher storage bins located near the barge dock. Samples of the limestone submitted to Pittsburg Testing Laboratory showed the following analysis:

	Sample No. 1	Sample No. 2
Silica	0.74%	2.10%
Alumina	0.93%	1.31
Iron Oxide	0.13	0.18
Calcium Carbonate	96.31	91.98
Magnesium Carbonate	1.30	1.43
Loss on Ignition (Other than carbon dioxide, i. e. organic matter, water, etc.)	0.59	3.00
	100.00%	100.00%

Report on the limestone from laboratory of Allis-Chalmers is quoted:

> "We have investigated the possibility of making cement from the materials, the analyses of which were submitted. Our calculations indicate that a high grade portland cement clinker could be made from these materials using approximately 3-1/2 parts of limestone to one part of clay."

Samples of limestone submitted to Territory of Alaska Department of Mines, Assay Office, Anchorage, Alaska indicated the following:

Composite of samples 2626 through 2637, assay No. 2639:

CALCIUM	36.9
as $Ca\ Co_3$	91.9
MAGNESIUM	1.6
as $Mg\ Co_3$	5.8
MIXED OXIDES ($R_2\ O_3$)	0.3
SILICA	0.28

Tests conducted by the same agency on twelve different samples showed the following percent of silica: 0.30; 0.20; 0.32; less than 0.05; less than 0.05; 0.13; 0.07; 0.09; 0.10; 0.11; 0.13; 0.23. The low silica content makes this limestone especially adapted to coal-mine dusting in Alaska. The Territorial Department of Mines is very anxious to enforce coal-mine dusting at the present time, but the present high price of lime delivered to the mines makes it almost prohibitive. The Department of

Mines has stated that if prices of limestone is reduced sufficiently, mine dusting will become mandatory in all coal mines in the Territory. Lime for mine dusting can be quarried, milled, and distributed by the Company for approximately one-half of the present price in the Territory, along with the manufacture and distribution of portland cement. This will open a new field in the Territory, and will help materially in utilizing the capacity of the Company's plant and transportation facilities.

Another use for limestone quarried and milled by the Company is for agricultural purposes. The soils of Alaska suitable for agricultural purposes, namely Homer, Matanuska Valley, and Nenana Valley are highly acidic and require a large percent of lime to neutralize the soil for agricultural purposes. A large amount of lime is required per acre and the price must necessarily be low per ton as it is an added expense over and above figured costs of farming; in order to insure a low cost per acre treated, the lime must be produced and distributed locally. The Alaska Cement Company can quarry, mill, and distribute agricultural lime at a very low figure, because no additional equipment or labor above that necessary for cement production is required.

The number of tons of lime used annually for coal-mine dusting and for agricultural purposes in the Territory cannot be accurately estimated, as none is being used at the present time, and a substantial reduction in cost of lime will have to be effected before either use gains momentum. Undoubtedly the quantity used will be sufficient to materially increase plant production and lower production costs of portland cement.

Although the amount used is comparably smaller, lime will be manufactured by the Company for plaster morter; manufacture of lime for this purpose will not materially effect the production or lower the over-all production cost of the plant, but it will provide this product at a much lower price, and help establish a constant low price on basic permanent building materials in the Territory.

III CHERT DEPOSITS: In the immediate vicinity of the limestone deposit at Seldovia and in the nearby Port Graham area are located almost boundless deposits of shale and chart, either or both of which can be blended with pure limestone to produce portland cement. Refer to enclosure No. 1. It is planned to use mixtures of these materials to lengthen the effective life and capacity of the cement business in Alaska. Using limestone only, the Gray Cliff deposit of limestone would be exhausted in 25 years of full production of the plant, (600 barrels per day), but by mixing proportions of shale and chert with the limestone, known deposits of raw materials will be available for 75 to 100 years continuous operation of the plant. All shale and chert can be obtained at tidewater permitting low-cost barge transportation to be utilized for this raw material. Claims have not been filed on chert or shale at the present date, as the extent of the deposits and the occurrence in this area are

so common that it is thought not necessary to file any definite locations at this time; practically all of the deposits are upon public domain located at tide-water.

IV CLAY DEPOSITS: Clay suitable for admixture to limestone to manufacture portland cement exists in ample quantity in numberous areas at Homer, Alaska. Refer to enclosure No. 1. The Company controls a 377 acre tract of land, 138 acres of which are patented, ten miles by road and five miles by barge from the plant-site; all this acreage is underlaid with a thick strata of clay suitable for manufacture of portland cement when properly mixed with limestone. The Company is negogiating for the purchase of a 100 acre tract heavily underlain with a fine grade of clay just four miles from the plant-site by road. It will be necessary to remove only a light coverage of a few inches to a foot of topsoil to expose the deposit of clay, and a one-half yard power-shovel and one dump truck will supply all the clay needed for the cement plant. Between this clay deposit and the plant-site a good road is already constructed and in use. Only 20 to 25 tons of clay is required per day to maintain full capacity of the plant, provided pure limestone and clay is used for manufacture of cement; if chert and shale is used with limestone, the quantity of limestone used will be materially reduced and admixture of clay will not be necessary. If chert or shale is used as an admixture to the limestone, equipment used in the clay pit will be transferred to quarrying chert or shale. Analysis prepared by the Pittsburg Testing Laboratories indicate the following structure of the clay in this area:

Silica	57.40%
Alumina	17.85
Iron Oxide	6.15
Titanium Oxide	0.60
Calcium Oxide	3.20
Magnesium Oxide	2.97
Alkalies	2.87
Sulphuric Anhydride	0.03
Loss on Ignition	8.50

Laboratories of Allis Chalmers made a favorable report on the clay, as well as on the limestone, excerpt from their report being contained in the limestone deposit description.

V COAL SUPPLY: Coal for use in the rotary kiln and in the boilers of the steam-electric power plant is of major consideration, as it must be of a suitable quality for use in both types of equipment. The amount used each day will approximate 60 to 75 tons per day if full-capacity operation is maintained. Coal will be used to generate electric power for the plant, power for the dock machinery, and lights for the plant, working area, and the dock. Waste steam from the high-speed steam turbines will be used to heat the buildings of the plant and perhaps the housing area adjacent to the plant. Coal can be obtained from either or both of two locations in the

immediate vicinity, that is, the Homer Cliff Coal Mines or the Sal-Tide Coal Mine, in both of which the majority of stock is owned and controlled by members of the Alaska Cement Company. It is planned, however, to mine coal from the Homer Cliff Coal Mines, located seven miles from the cement plant-site. Refer to enclosure No. 10 and 11. A fair road connects this location with the plant-site, and one large truck similar to a ten-yard diesel driven dump truck will supply ample coal to operate the plant at capacity. The exact route of the present road was, about the turn of the century, used by the Cook Inlet Coal Company as a railroad bed seven miles in length over which to haul coal. Homer Spit at that time was being used as a coaling station for ocean-going ships plying these waters.

Although a railroad did exist here at one time, it is thought that construction and use of a railroad would be superfluous, as one modern truck will care for the entire needs of the plant at much less expense. Development of this mine will be started at an early date to supply local needs and prepare for larger mining operations. The Homer Cliff Coal Mines Company has machinery and trackage on hand in Alaska for development and operation of the mine, therefore, no delay will be encountered in starting mining operations. Mr. Evan Jones, one of the leading and best known coal operators in the Territory, is a one-third owner of this coal company and will be personally in charge of the coal mining operations. The coal properties controlled by the Homer Cliff Coal Mines Company are known to contain in excess of 20,000,000 tons of marketable coal, with 12,500,000 tons of this amount being contained in one 6' 4" seam which will be developed first. Controlling stock in this mine is owned by members of the Alaska Cement Company. Samples of coal from this property has been tested by various laboratories, some of which are listed: Allis-Chalmers Laboratories reported

> "The analysis of the coal indicates that it is suitable for burning portland cement clinker within a rotary kiln".

Pittsburg Testing Laboratories returned an analysis of:

	Air Dried	Dry Basis
Moisture	12.49%	-
Volatile Matter	39.38	45.00%
Fixed Carbon	40.38	45.14
Ash	7.75	8.86
BTU per pound	9,809	11,209
Fusion Temperature of Ash	2010° F	

Analysis conducted by the Department of Commerce, Bureau of Mines, Anchorage, Alaska indicated the following data:

	Air Dried	As Received	Moisture Free	Moisture and Ash Free
Moisture	7.3	20.7	-	-
Volatile Matter	46.9	40.2	50.7	53.3
Fixed Carbon	41.3	35.3	44.5	46.7
Ash	4.5	3.8	4.8	-
British Thermal Units	11,115	9505	11,985	12,595

Records indicate that this coal excells other commercial coals being mined and sold in Alaska, as the ash content is extremely low; coal being marketed from the Matanuska Coal Fields runs around 18 to 24 percent ash, while the BTU content remains about the same.

The Sal-Tide Coal Mine is a very recent discovery of bituminous coal in Alaska. One tract of mining property being worked at the present time by this company contains 1140 acres and indications are that a very fine grade of coal can be marketed from this mine at a very low production cost. The Sal-Tide Coal Mine is in a protected location on tide-water in Eldred Passage, five miles from the cement plant. The transportation of the coal could, therefore, be effected at a very low cost by use of Company barges. The majority of stock in this company is also owned and controlled by members of the Alaska Cement Company.

VI GYPSUM: Gypsum is the only raw material not controlled by the Company, but this is of minor consideration as only 2% gypsum is required in the finished portland cement, or at full capacity of the plant, about 800 tons of gypsum per year. It is planned that gypsum will be transported by Company barge either from Seattle, Washington or from Chicagof Island, west of Juneau, Alaska. The large deposit of very good quality gypsum on Chicagof Island has been mined and shipped to the States at various interims since about 1910, and mining was again resumed about a year and a half ago. Because of the limit on yearly need of the cement plant, it is thought expedient to purchase gypsum from an operative mining company specializing in this product, rather than to develop a new site. However, a smaller gypsum deposit located near Wasilla, Alaska, about eight miles from tide-water and about 20 miles from Anchorage, Alaska is being investigated by the Alaska Cement Company as a safeguard and possible future development.

VII PLANT AND ADDITIONAL EQUIPMENT:

Quarry Equipment: Opening of the limestone quarry will be one of the first undertakings of the company. The quarry will be located one mile from the city limits of Seldovia, Alaska. Refer to enclosure No. 9. Dredging and enlarging the natural channel opening into the tide-water slough near the limestone deposit will form an excellent barge docking and terminal site; approximately 20,000 c.y. of gravel will have to be dredged to form the barge terminal and ways, but only 5,000 c.y. will be necessary to open the docking site and commence loading barges with limestone. It is estimated that a dragline mounted on a light barge could dredge this

port in ten days. Since very little material will be landed at this site, it is proposed that large rock-storage bunkers for the limestone be constructed on piling at the docking site, as indicated on enclosure No. 9. A fine-rock storage bunker of 500 tons capacity is deemed sufficient to supply barges arriving at the bunkers. This bunker will load into the barges by gravity, with a loading speed of well over 200 tons per hour, which will allow barges to load within a few minutes. It is proposed that barges of 100 to 150 tons capacity be used for hauling all limestone and chert. The 500 ton rock storage bunker will be filled by a 24" x 193' rubber conveyor, delivering directly from the hammer mill and rotary screen. The hammer mill will be fed from a 400 ton capacity bunker located on the brow of a steep bank near the docking site. The primary rock storage bunker will be filled by a 15" x 36" jaw-crusher located on the brow of the hill, supplied by trucks hauling from the quarry pit. The capacity of the jaw-crusher is 45 tons of 4" material per hour. Crushing of the 4" material to 3/8" diameter by the hammer mill will be carried on only during the evening hours, as the hammer mill requires 150 HP to operate, and only 250 HP will be available at this site for all operations. The quarry will contain a one-yard electric driven power-shovel, and it is considered that only one shift a day will be required to keep ahead of milling schedule. One or two six-yard dump trucks will be used to transport material from the limestone quarry to the primary rock crusher and storage; at the start of quarrying operations it is thought that one truck will prove sufficient because the total round trip haulage is only a few hundred feet from the quarry to the rock storage. As all equipment, with the exception of the dump-trucks, will be electrically operated, it will be necessary to install a 250 KW diesel-electric generator near the dock site to supply power and light. Diesel storage tanks will be located near the dock site and filled from the barges as they arrive from the plant site to load limestone.

After the barges load fine lime rock from the bunkers at the dock-site near Seldovia, Alaska, they will proceed on a sixteen-mile water trip to the wharf at Homer Spit, Alaska. The cement plant site is approximately two hundred feet from the wharf at Homer Spit, and the fine-rock will be pumped from the barge to the storage bins in the plant by means of a Fuller-Kinyon rock pump. One rock-pump unit has a capacity of 150 tons per hour, so approximately one hour will be required to unload each barge, thereby greatly reducing the normal unloading time and permitting increased active transportation of raw materials.

Cement Plant Equipment: It is proposed that a portland cement plant of 600 barrels per day capacity be constructed at the SE extrimity of the Homer Spit, Alaska, the only location on the North side of Katchemak Bay where deep-water anchorage is available, as indicated by enclosure No. 4. Title to the land required for the proposed plant site and housing area is pending in the General Land Office, Washington, D. C. Charles B. Abbott, a member of the Company, filed a Soldiers Additional Homestead Application April 1, 1943 for a tract of land on the end of Homer Spit.

A 35' x 80' wharf which accomodates Alaska steamers is located near the proposed plant site. This wharf was built by the Homer Civic League, and is now owned, maintained, and operated by the Homer Cooperative Association, Inc., a corporation of farmers and fishermen of Homer, Alaska. Construction of the cement plant will not interfere with the present or future program of the Coop. The development of this area proposed by the Alaska Cement Company will, in fact, benefit the Coop organization and others by making available such facilities as water, bulk fuel oil, power, and other advantages of a planned industrial development. Land needed by the Coop to construct a cold-storage plant, future cannery, and other buildings as required, will be leased by Mr. Abbott at no cost to the Coop when title to the property is granted. Use of the present wharf by the Company will be limited to preliminary shipments and receipt of equipment and building materials for the plant; a U-shaped dock will be constructed as shown on Exhibit No. 3 for exclusive use of the Company as soon as practical, using concrete piling and decking to demonstrate practicability and promote the use of concrete in permanent wharf and dock construction in the Territory.

The cement manufacturing plant will be constructed in the location shown so that efficient use of either or both docks will be possible. Negotiations have been carried on for over a year for purchase of the Orofino, Idaho cement manufacturing plant of the Washington-Idaho Lime Products Company, Spokane, Washington. This plant has been inspected a number of times by two members of the Company, and it has been found that the plant is well suited to the needs of the Company. Pending actual sale of the plant, it is impractical to prepare and submit a finished plant layout, but a general plant layout is enclosed as Exhibit No. 4. The Orofino, Idaho plant has a rated and actual capacity of approximately 200,000 barrels of portland cement per year. With the addition of another kiln, and tube-mill, and a very few pieces of other smaller equipment, the output of this plant could be doubled. This would permit handling larger markets, such as the Orient if future diplomatic relations develop favorably. There is an enormous amount of reconstruction to be done on the Asiatic Continent, as well as new construction of industries, utilities, roads, and housing.

It is not thought expedient to itemize completely all equipment of the Orofino, Idaho plant until negotiations have been completed for actual purchase. A complete list of all equipment, condition, and general description is on file in the offices of the Company, Anchorage, Alaska. Practically all of the operating personnel of the Orofino plant, and especially the technical men have signified their intentions of transferring with the plant to Alaska. These employees would be extremely helpful in dismantling, transporting, and installing the equipment at a new plant site. Undoubtedly a tremendous amount of initial difficulty, time, and expense would be saved by allowing the operating personnel to accompany the plant. Operation of the plant in Alaska will create a number of jobs for local Alaskan workers, as coal mining, transportation, sales, and

office routine will employ approximately three times the number of employees as the manufacturing plant.

The plant layout shows a raw material storage building for limestone, clay, chert, coal, and clinker, served from the wharf by a Fuller-Kinyon rock pumping system. The F-K system will pump the 3/8" diameter limestone from the hold of the barges directly to the storage bins through a six-inch steel pipe, saving a large amount of labor and use of trucks and cranes. Coal and clay will be dumped from trucks into large hoppers flush with the grade of the plant, conveyed to the top of the storage building, and distributed within the building by a 24" rubber belt and tripper. Clinker will be handled from the Kiln by means of a pan conveyor as the clinker will still retain a portion of its heat from the Kiln, and use of rubber-belt conveyors is not practical over a long period of use. Gypsum will also be unloaded from barge transportation at the wharf by means of the Fuller-Kinyon pumping system used for unloading limestone; instead of being pumped into bins in the raw material storage building, it will be by-passed into a concrete silo for storage.

Movement of all other raw materials within the storage building will be handled by means of an overhead travelling crane of 3/4 yard capacity; this crane will travel on steel rails on each side of the storage building and cover the entire length of the building, 325 feet. Raw materials will be dumped into hoppers that feed into the grinding mills. The coal hopper will feed both the kiln and the power-plant, with a steel pipe conveying the pulverized coal from the pulverizer and drier to the burning end of the kiln and to the boilers in the power plant. The 7' x 7-1/2' x 125' kiln, the coal pulverizer and drier, the dust-collector, the induced-draft fan, and the clinker-cooler will be housed within a 20' x 250' building, known as the kiln house. The slurry tanks and blending tanks will be located in a building adjacent to the kiln house and heated in cold weather by excess heat from the kiln, thereby preventing freezing of the slurry in periods of continued cold weather. All grinding mills will be located within a single building, so that one miller may care for them, and also making grinding arrangements more simplified. Within this same room will be located mixers and pumps for slurry, as well as for the finished product. Adjacent to the milling room is the silo for storage of gypsum, which will be added to the clinker as it starts through the final milling before becoming finished portland cement. The portland cement will be pumped from the finish grinding mill to 20' diameter storage silos between the plant and the dock. Loading of portland cement will be handled directly from the storage tanks to tanks located on the barges, or into the hold of ocean-going vessels; for those customers who desire cement delivered in paper or cloth sacks, the cement will be pumped from the silos to the packing plant on the dock, and sacked for loading by conveyor belt, or by means of slings and cranes. All cement delivered to the terminals at Anchorage, Kodiak, Valdez, or Juneau, and possibly the Orient, will be in bulk, and sacked only at time of delivery to the customer. It is planned that sacking equipment will be installed at each bulk terminal,

thereby facilitating movement of the finished product and lowering cost of transportation and storage.

Negotiations for purchase of an excess power plant have been carried on for a period of over a year with Mr. Kimsey Robinson, President of Washington Water Power Company, Spokane, Washington, but to date a satisfactory power plant is not carried on the surplus list of this company. Surplus equipment of this, as well as other western states utilities companies, is being checked to determine if a suitable power plant can be located. In the process of investigation, several power plants of 1500 KW capacity have been found in the Western States, and all of these are available for immediate sale. Army and Navy surplus stock is also being investigated for the Company, and some plants of suitable size and design have been found. Latest word from manufacturers indicate that new plants can be obtained within four months of time the order is submitted. The total connected power load at the cement manufacturing plant will approximate 1200 HP, with slightly over half of this figure being the peak load; therefore, it is deemed advisable to install two boilers and turbine units of 750 KW rating, and supplemented with a standby 200 KW diesel-electric generating unit of Fairbanks-Morse make. By this arrangement, it will be possible to hold one boiler and turbine as a standby and use the diesel-electric unit only a short period each day to supplement the 750 KW steam unit that is being operated. This method will also make it possible to shut down both boilers and turbines and still continue to keep the kiln operating by means of the 200 KW diesel-electric generator, giving a very flexible arrangement of power for the manufacturing plant. This power set-up will permit routine blow down of boilers and repairs to equipment without seriously affecting operations.

Since the peak power demand for the plant will usually be in excess of actual demands for 24 hour operation of the equipment, it is thought that approximately 150 KW of electrical power could be made available for sale. Sale of this amount of power would almost pay for total operation of the power plant, and would make the plant manufacturing costs less than if no excess power were sold. No definite commitments have been made on sale of electrical power, but perhaps it would be advantageous to the Company to offer for sale all excess power that could be sold at the plant site, as long as it did not involve construction and maintenance of distribution lines.

The Rural Electrification Administration, St. Louis, Missouri, now has a representative in the Alaska Field for the purpose of contacting local groups of farmers who have sought information in regard to ways and means for obtaining loans for rural electrification development. Their Engineer spent several days in the Kenai Peninsula, in September, making his headquarters at Homer. This representative has indicated that R. E. A. would be favorable to having the local electric cooperative, if organized, purchase power from the Alaska Cement Company at rates to be agreed upon by all concerned. Such an arrangement would enable the small electric distribution cooperative to obtain adequate power without making an investment in generating equipment.

Water for domestic, fire, and manufacturing purposes will be required to the extent of 50 gallons per minute, and can be obtained from wells drilled at the plant site on Homer Spit and stored in a 20' diameter water

tower located adjacent to the plant. If water from wells located on the Spit is found to be insufficient for manufacturing purposes, sea-water will be used for this purpose as no difficulty will be experienced from its use in slurry mixing. Use of sea-water will, of course, be limited to manufacturing use if necessary; domestic and fire requirements being obtained from drilled wells. Arrangements are now being made to start drilling operations on the southeast end of the Homer Spit; geological formations indicate that no difficulties will be encountered in obtaining fresh water from deep wells, as long as steel casing is used for the first one hundred feet or until the first clay stratum is pierced.

It is planned to transport all equipment from Seattle to the plant site by means of Company barges, making a substantial saving in transportation costs, and making equipment unloading much easier, as the barges can be beached at high-tide and heavy equipment unloaded onto the beaches by means of tractors and tractor-cranes. Before any equipment arrives, foundations will be poured from shop-drawings, so that the kiln and grinding mills, as well as the 200 KW diesel-electric power unit can be installed immediately. By installing these pieces of heavy equipment immediately, operation of the plant can be started and a supply of clinker can be built up as a surplus. Power from the 200 KW generator can also be used for operation of power tools and lighting while building the balance of the plant, so that the plant can be again put into operation with as little loss of time as possible. As soon as work starts on construction of the manufacturing plant, it is planned that the quarry development will also be started, along with construction of the barge terminals at Anchorage, Kodiak, Valdez, and Juneau. Extensive storage of finished cement at the bulk terminals will be limited to Anchorage, as this port is not ice-free, and it will be necessary to carry a larger amount in storage at this point. Concrete storage silos will be constructed at each terminal, Juneau with a storage of 5000 barrels, Valdez with a like storage, Anchorage 20,000 barrels, and Kodiak with storage capacity of 10,000 barrels, as it is expected that ocean-going vessels will take on cement cargo from Kodiak for the Aleutian Islands, Bering Sea Area, and the Seward Peninsula. If it is found advisable to increase storage capacity of any terminal, additional silos will cost very little, as docking, piping, and sacking facilities can be used as installed for the original storage.

VIII TRANSPORTATION: The bulk of the transportation of both raw products and finished products will be effected through the medium of low-cost barge transportation. All raw materials are situated on tide-water and all are located at fairly-well protected anchorages, so very little difficulty will be encountered in loading and unloading the barges. Barges are to be loaded with raw materials by gravity means from timber hoppers located at docking facilities, thereby minimizing the time for loading and allowing the barges to put most of their time in travelling with a so called pay-load. A large timber bin for limestone, coal and clay will occupy most of the deck of those barges designed to carry these

materials. Unloading of the barges will be by means of a Fuller-Kinyon Unloader, which is a large gravel pump built into a small tractor affair, handling limestone, coal, and various materials up to 1 - 1/2" diameter at the rate of 150 tons per hour. The material is pumped through steel pipes to the storage area, as long as it is within 1500 feet from the vessel being unloaded. Only one man is required to operate one of the Unloaders. It is estimated that one fully loaded barge of 100 to 150 tons capacity making one trip per day will be sufficient to transport all limestone needed to keep the plant operating at capacity. One extra 150 ton barge would be desirable, as it could be used at a later date to haul chert from the Port Graham deposits, and also to transport coal from the Sal-Tide Coal Mines and from the Homer Cliff Coal Mines when sea bunkers are erected at this mine. The additional 150 ton barge could also be used to help build a stockpile of limestone at the manufacturing plant site to insure steady and uninterrupted operation of the plant.

For transportation of the finished portland cement, as well as raw gypsum, barges of 400 ton capacity are desirable due to the length of trips and the rougher water encountered between points. These larger barges are to have living quarters for the crew, as all trips will be of more than a day's duration. Instead of constructing open timber bins on the decks of the larger barges, it is planned to install three steel tanks horizontally across the deck, one end fitted with six-inch hose connections for F-K pumps and hinged to the deck of the barge, so that when the barge is docked for unloading, the banks can be inclined to allow the contents to flow to the lower end. The other end of the tanks will be fitted with cable and hoist mechanism so that the tank can be inclined at an angle of about 20 degrees to allow cement or gypsum to flow to the lower end; since it will be impractical to incline tanks to full angle of repose of contents, it is planned that small electric vibrators be mounted on the lower side of each tank to insure delivery of full contents of the tanks. Size of the steel tanks will be 10' x 30', three of which will have a capacity of 466 tons of cement when fully loaded and packed, so loading of 400 tons net would be quite simple. Tanks will be filled through three man-holes on the upper side of the tank, all man-holes fitted with gaskets and water-proof covers so cement will not be harmed by water even in the roughest seas. Since only a portion of the barge decks will be occupied by the three tanks, the balance of the deck will be available for hauling equipment, building materials, machinery, or other raw materials should this become necessary at any time; this will allow actual transportation problems to be solved more easily through flexibility of rolling stock and show a reduction in transportation costs. It is planned that each of the large barges will be equipped with F-K cement pumps, so that unloading can be started as soon as the barges dock and the delivery hose is connected to the pumps, thereby minimizing time consumed at the docks. Each of the larger barges will be manned by a double crew so transportation can be maintained on a 24 hour a day basis, using the more expensive equipment to the utmost of its productiveness.

Transportation of cement from the Anchorage barge terminal to Fairbanks will be effected by the Alaska Railroad in both bulk and bags. Transportation from the Valdez terminal will be handled by private truckers on contract, hauling to Fairbanks and way points; the majority of this cement will be shipped in paper bags, allowing the trucks to be also used for other hauling. All long-distance hauling of cement in smaller quantities will be contracted whenever possible to permit initial cost of transportation equipment to be held to a minimum figure, and also to reduce the annoyance of details connected with minor shipments.

It is tentatively planned that a bulk-delivery truck will be operated from each major terminal, serving the local area only. Elevated steel storage bins will be installed by the Company for all major users of bulk cement, and Company trucks will deliver the bulk product to the bins. This will make a substantial saving to each major user of bulk cement, as he will not be required to employ help to rip and empty bags of cement; it will also make a saving to the Company, inasmuch as approximately ten cents per barrel can be saved by bulk deliveries. The saving in cost of bags could be applied to purchase of additional bulk bins, thereby increasing the value of the Company as a whole.

Local truck hauling of raw materials has been covered elsewhere in this report.

IX ECONOMIC JUSTIFICATION: Practically all private, Federal and Territorial construction in Alaska has been temporary, inflamable, wood-frame structures. There are a few federally financed buildings that are modern, fire-proof concrete structures, but the number of these is definitely small. The Territory is comparatively young and little planning and building for permanency has been done, but the absence of permanent building is due primarily to the extremely high cost of the main permanent building material, portland cement.

The cost of portland cement in Anchorage, which is located on tide-water, is now $9.70 per barrel retail, or $2.45 per bag. This cost when compared with the usual price of $0.70 to $1.00 per sack retail in the Rocky Mountain States, explains in a large sense the reason for absence of permanent concrete construction in the Territory of Alaska. Undoubtedly new permanent construction, as well as replacement of obsolete structures with new permanent concrete building, would result from immediate lowering of the selling price of portland cement. Due to limited funds for construction, and high cost of cement in Alaska, a number of construction jobs have been done in a manner compareble almost to negligence of safety to the public. Numerous abutments for steel bridges have been made of timber, or log and gravel fill, even with the engineering knowledge that they will have to be replaced in a fery few years, or perhaps after the first course of high water. The arterial road system of Alaska is continually being severed in the spring of each year by bridges washing out, causing a cessation of traffic from points within the Territory. This is only one instance of the need for more permanent construction in Alaska.

Every few years the newspapers devote headlines to a conflagration that has burned out an entire business section of some city in Alaska; permanent fire-proof construction would once and for all end the danger that still threatens every city and town in the Territory, and would also mean a great reduction in insurance rates and a direct saving to the citizens of Alaska.

The general price of portland cement in bags in the States is around $2.26 per barrel at the plant site, in large lots. While it will be remembered that labor costs in Alaska have consistently been above those in the States, there appears to be no reason why the facilities of the Alaska Cement Company could not eventually produce and sell for this same figure; most plants in the States have long rail hauls not only for the coal, gypsum, but the finished product. Some plants hauling all or part of these materials a distance of six or seven hundred miles still show an operating profit. The proposed location of the Alaska Cement Company plant on tide-water, along with location of all raw materials on tide-water and the proposal that all products be handled by low-cost barge transportation insures a low manufacturing and distributing cost, in spite of higher labor costs. Cement shipped to Alaska from the States is bought at the plant site for $2.26 per barrel, but the price is increased with each handling. The freight rate from Seattle to Seward, Alaska is 4.40 per barrel, or almost double the original cost of the product at the plant site. Added to this is rail freight from plant to dock, docking fee at point of shipment, docking and longshoreman fee at point of landing, and rail transportation from Seward or Whittier to locations in Alaska where the cement is used. Very little cement is used at either of the two landing points, so rail freight must be added to practically every sack of cement landed in Alaska. By the time a sack of cement arrives at its point of sale or use in Alaska, there is barely enough margin left to form an incentive for a building material or hardware store to handle the product, especially in view of the fact that broken or wet bags of cement may mean that he will sell portland cement at a loss.

A sack of cement contains 94 pounds of cement plus the weight of the sack, and there is no "fool-proof" method yet devised to handled sacked cement except by slow, laborious, and expensive hand labor, so a large percent of the selling price is tied up in hand labor costs. For that reason, the plans of the Company have always been to handle the cement in bulk and by means of cement pumps either through all the cycles of its transportation, storage, sale, and use, or at least up to the time of its actual sale and disposal to the customer.

It is thought that the price of portland cement from the Alaska Cement Company delivered to the consumer or sales organizations could be reduced considerably immediately, and as use of cement increases, the price could be further reduced from time to time, until a selling price comparable to the Rocky Mountain States could be effected. If at a later date the combined sales to Alaska and perhaps the Orient were great enough to allow

expansion of the manufacturing plant, the cost of portland cement in Alaska could be lowered to a point below the Rocky Mountain States.

The full capacity of the plant proposed by the Company is 200,000 barrels per year, operating 24 hours a day for 360 days of the year. Initial production planning, however, is based on 60% capacity, or 120,000 barrels per year.

Although security measures prevent disclosure of the amount used by the Armed Forces for maintenance of bases in Alaska, perhaps the 120,000 barrel per year figure could be increased if the needs of the Armed Forces warranted. An unofficial estimate of the population of Alaska is 80,000, transients not included; while the Portland Cement Association has compiled no record of the per capita use in Alaska, it is presumed that it would be comparable to the Pacific Coast States which have a per capita use of about 1.5 barrels per year. Alaska with a population of 80,000 people would therefor use 120,000 barrels of cement per year; cognizance has been taken of the fact that within large isolated or uninhabited areas of Alaska no building is carried on at any time of the year, and none is planned, but by far the main population is concentrated in the coastal areas where normal construction is in progress and much more is planned for the immediate and distant future. The mere fact that Alaska is a new country and is just starting to build permanently, along with the need for hydro-electric developments, surfaced street and road construction would indicate that the per capita use might be even higher than estimated.

The remarks of a recent Congressional Committee investigating the roads of the Territory indicated that they were in favor of hard surfacing the roads in Alaska. Engineering data assembled from runway construction by the Army within the Territory definitely indicates that portland cement concrete is the very best surfacing for construction in the Territory; the maintenance cost is almost negligible compared to other surfaces such as macadam or asphalt. Data gathered and releases by the Portland Cement Association show that the average cost for maintaining a mile of concrete roadway in the States if $97.18 per year compared to $342.87 for bituminous macadam, and $541.42 for water bound macadam; all roads in Alaska are at present water bound macadam.

Indications of permanent population of Alaska point to a gradual but definite increase. The more people who come to the Territory, the more cement will be used, so that in five to ten years, by conservative estimates, the total output of the cement plant as proposed would be required by Alaska construction.

One of the most justifiable reasons for locating a portland cement manufacturing plant in Alaska is that it will set the precedent for other manufacturing concerns to locate here, and it will directly provide year-around jobs for a large number of Alaskan residents. Lowering cost of cement will be an incentive for more building of a permanent nature,

indirectly employing a large number of people in construction work which is very much needed within the Territory. The approximate number of steady employees of the Company as now proposed and the departments in which they will be employed is as follows:

Lime Quarry and Crushing (Same crew to alternate on chert quarrying)	10	
Clay Pit and Hauling to Plant	4	
Manufacturing Plant	40	
Barge Transportation	28	
Truck Transportation (Finished Product)	4	
Cement Storage Terminals	12	
Office and Engineering Personnel	20	
Total employed by the Company		118
Coal mining, washing, and transportation (Not by Company)		40
Total Number of Employees Directly Employed by Operation of Alaska Cement Company		158

X FINANCIAL REVIEW: Due to the changes expected with the ending of the War in the Pacific, it is now impossible to make a comprehensive and exact review of the financial arrangements necessary for purchase, erection, and operation of the plant as proposed, but it can be expected that cost of labor and materials will be substantially reduced in the near future, further insuring the success of the plant. Furthermore, much equipment and rolling stock will no doubt be released by the Armed Forces, some of which is well adapted to use of the Company, and can be obtained at discount price. Inasmuch as changing location of the plant from the States to Alaska means considerable alteration in plant design and operation, considerable heavy equipment used by the Armed Forces and constructing agencies could be used at the proposed plant site; it is hoped that barges, steam power plants, diesel power plants, diesel operated dump trucks, oil storage tanks, steel buildings, power-shovels, miscellaneous building materials, and personnel buildings can be obtained from excess stock in Alaska and on the Pacific Coast, thereby lowering initial cost and reducing time required to have the plant in operation.

A general sub-classified breakdown of plant costs is shown below, and more detailed breakdown is on file:

Cement Plant (Orofino, Idaho)	$ 139,142
Dismantling and loading above	15,000
Freight on above, Orofino to Seattle	10,000
Power Plant, Steam, 1200 KW	200,000
Freight on above	10,000
Diesel Power, 2 - 250 KW	40,000
Freight on same	3,000
Plant buildings	130,000
Plant Machinery Installation and Utility System	80,000
Storage Silo Construction at Plant	20,000
Additional Equipment (Heavy trucks, loaders, pumps, etc.)	65,000
Plant and Quarry Docking Systems	45,000
Dredging at Lime Quarry and at Anchorage Storage Terminal	10,000
Barges (2 ea. 150-ton; 2 ea. 400-ton, self-propelled)	200,000
Barge Terminals and Storage (Anchorage, Kodiak, Valdez, and Juneau)	80,000
Local Distribution Equipment (Trucks and Bins)	20,000
Housing for Plant Employees - 14 units	70,000
Initial Operating Capital	120,000
20% Contingencies and Misc. Engineering	251,428
TOTAL CAPITAL REQUIRED	$1,508,570

Real estate, mineral properties, and mineral rights owned or controlled by members of the Company which are required for development and operation

of the plant will be granted to the Company at no cost. Services of the three professional engineers who are members of the Company will be offered gratus for use in General engineering and supervision of construction of the plant.

It is planned that capital required to purchase and erect plant and facilities ready for full-time production of 200,000 barrels of portland cement per year, and distribution and sale of same could be paid back over a period of ten years; this schedule is based on a pre-war peacetime normal sales of 120,000 barrels per year. If additional permanent defenses are constructed in Alaska during years following the War, or should a cement market with the Orient be established, the amortization period would be shortened correspondingly. Careful investigation indicates that portland cement can be manufactured in the proposed plant, distributed by Company barges, and distributed to towns and cities on the Alaskan coast for a net cost of $2.00 per barrel; a wholesale selling price of $4.00 per barrel delivered to the consumer on the Coast would realize a gross profit of $2.00 per barrel. Using the potential figure of 120,000 barrels per year, this would show a gross profit of $240,000 per year; $150,000 would be applied to the amortization of the initial loan and $60,000 would be applied to pay the interest, leaving a net profit of $30,000 which could be used to extend the market or modernize the plant. Profit distribution could be deferred until directors of the Company deem advisable, or until the plant is completely modernized and amortized. After amortization of the loan, wholesale selling price of portland cement from this plant could be further reduced, as constant modernization of the plant and methods of production would reduce the manufacturing and distribution costs per barrel, and increased sale of cement would bring the plant up to peak production with a correspondingly reduced manufacturing cost.

See Page 14

If manufacturing and distribution costs, by any chance, amount to more than the $2.00 per barrel as figured, or if the total yearly sales do not approximate 120,000 barrels per year to start with, the price of portland cement delivered to the seacoast towns and cities could be wholesaled at say $5.00 per barrel and return a gross profit of $3.00 per barrel. Even this price would be several dollars a barrel less than the people of Alaska have been paying and still are paying for portland cement. Allowing a gross profit of $3.00 per barrel, interest and amortization would be guaranteed with ample allowance for contingencies.

XI GENERAL SUMMARY: The foregoing report on a proposed portland cement plant for Alaska has been based and compiled from data obtained from numerous field trips and studies by members of the Company. Complete engineering and design work must necessarily follow these studies. It is believed, however, that sufficient factual and statistical data has been presented to prove the economic justification for the construction and operation of a cement plant in Alaska.

The resultant benefits to the Territory of such an undertaking are numerous. Permanent construction has a direct bearing on the future of

Alaska. Building materials for permanent and fire-proof structures, as well as roads, docks, airports, hydro-electric developments, etc., must be made available at reasonable prices to stimulate this type of construction and provide more year-around jobs. Due to the weight of portland cement, handling and freight rates will continue to be high on cement shipped into the Territory. Manufacture and distribution of portland cement locally will do much to lower the price of the commodity, to encourage building of a permanent nature, and to permit more building to be done within the Territory for the same expenditure.

Location of the plant and all raw materials on tide-water, and with the bulk of the population in Alaska situated along the coastal areas, low-cost barge transportation will permit production and distribution costs to be maintained at a minimum.

Establishment of a basic-industry manufacturing plant in this portion of Alaska will undoubtedly encourage location of other manufacturing plants such as brick, clay products, wood-pulp and paper, wood-working, fur-processing, meat processing and storage, quick-freeze and storage, fish products, coal processing, smelters, and numerous other plants of different types. Addition of industries within the Territory will make Alaska more self sufficient and easier to defend in case of any future aggressions by other nations.

The weather in the coastal regions of Alaska is favorable to operation of manufacturing plants, as it is quite comparable to the weather of the manufacturing area of the United States, the northern states. All ports to be used, except Anchorage, are free of ice the entire year.

Without Government financial aid, it is doubtful if construction of a portland cement plant in the Territory of Alaska could be effected without a lengthy interim of waiting for power and transportation development throughout the Territory. Cost of constructing the proposed plant of the Alaska Cement Company appears comparably high with the cost of like plants in the United States because the Company necessarily is required to supply its own power requirements and means of transportation of both raw materials and finished product. Although power development and water transportation is ordinarily amortized on a long-term basis of 25 to 40 years, it is planned that power plant, transportation media, and manufacturing plant of the Alaska Cement Company can be amortized over a period of ten years or less.

November 23, 1960

COPY

Mr. Charles V. Abbott

Homer, Alaska

Dear Mr. Abbott:

Re: Alaska Cement Company Prospectus

I wish to thank you for sending the above data to me through Wiley D. Robinson several months ago.

As I had been away most of the summer season on field work, and was out of circulation for the past six weeks, it was only today that I went through and studied the Alaska Cement Company's 1945 prospectus. The information contained therein was of interest, especially with regard to the analyses of the raw materials that are required for a cement plant.

It is my present plan to spend some time in your district as soon as weather conditions permit next spring. I look forward to contacting you and discussing various potential mineral raw materials in that region.

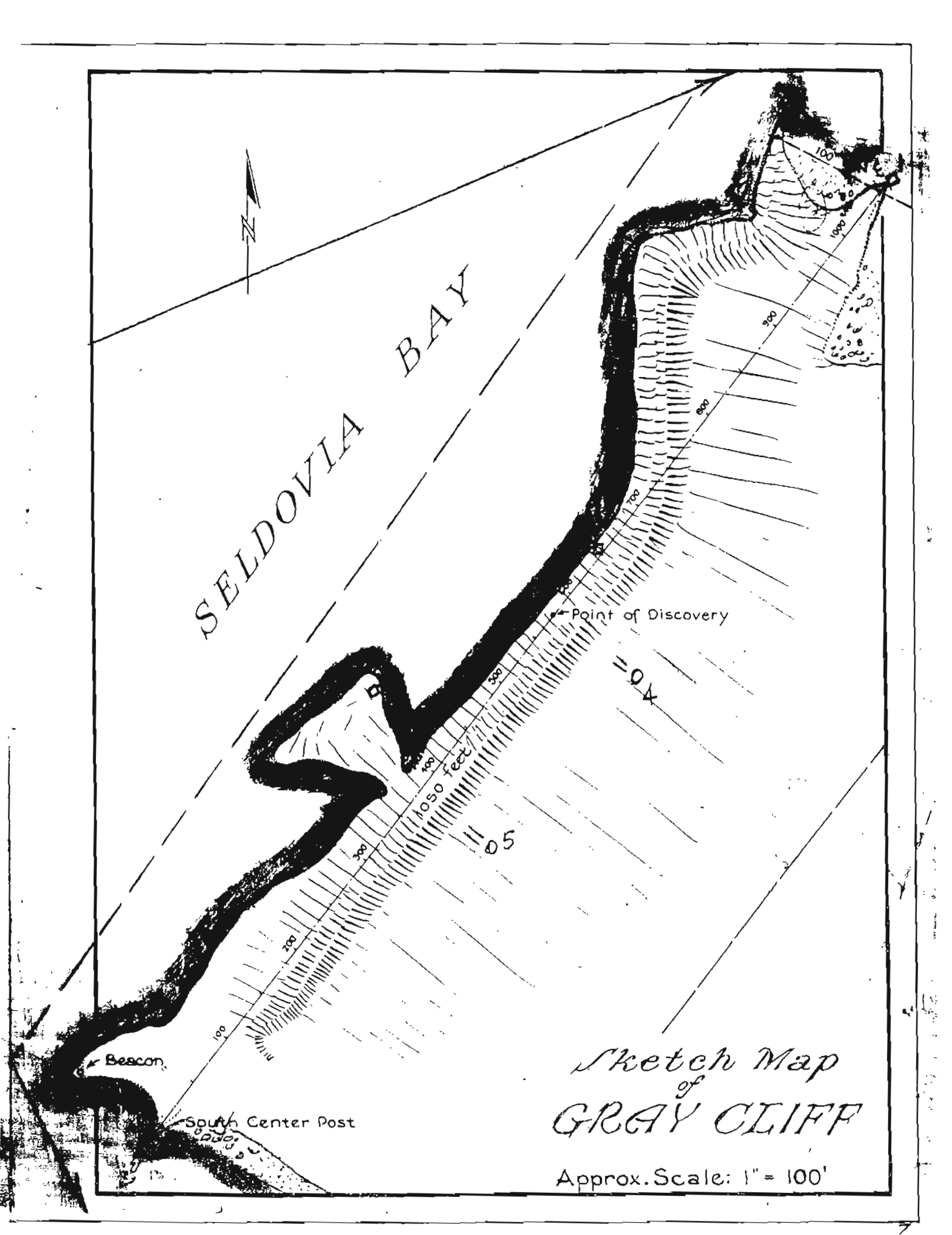
Enclosed you will find the prospectus on the Alaska Cement Company.

Very truly yours,

MWJ:bb

Encl.

MARTIN W. JASPER
Mining Engineer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