RED
1943

SURVEY REPORT
T.C.A & WESTERN RAILROAD
(from Dunbar to Nulato
(U.S. War Dept.)

8. Description of located line.

a. Fairbanks Division: A map of the line in this division together with a condensed profile is reproduced on page 25 of this report. A brief description of the alignment, grades, materials encountered and other physical characteristics affecting construction and operation, follows:

(1) Dunbar to Roughtop - Milepost 0 to Milepost 68. In the first 30 miles of this section, the line traverses the Minto flats, a low, swampy terrain only slightly above flood stage level of the Tanana River. The route across these flats is direct, the alignment essentially tangent and the grade is practically flat. Numerous low trestles are required and grading will be almost entirely by side borrow. It is possible that the fastest and most economical construction may be by temporary trestle of 4-pile bent design and train hauled fill. This is a zone of permanent ground frost, broken with dikes of unfrozen material, but the limits of perpetual frost cannot be determined at this time. These data will dictate the construction methods to be followed. From Milepost 30 to Milepost 40, the line ascends the western rim of the Minto flats on light grades and side hill development in good ground. It then crosses a shallow valley and climbs to the summit of the divide between the Tanana and Yukon Rivers, at Milepost 68, the end of the section. The alignment throughout is excellent and grades are below the allowable maximum. Suitable ballast material and borrow for train haul fill may be obtained between Mileposts 30 and 60.

Very little usable timber is found along the route from Dunbar to Milepost 30, but westerly from this point to the end of the section, timber of size and quality suitable for ties and piling may be obtained in sufficient quantities within 5 miles of the line. Grading can be accomplished with no rock work but some frozen ground will be encountered, necessitating careful selection of borrow and long haul. Snow conditions will not seriously affect operation as there are no indications of slides over the line and the depth of snow on the level increases from about 18 inches at Dunbar to a maximum of 40 inches at Roughtop summit.

(2) Roughtop to Tanana, Milepost 68 to Milepost 125. From Roughtop summit, the location makes use of maximum gradients and curvature in its descent to the Yukon River crossing, Milepost 87. Navigation interests have requested a minimum vertical clearance of 65 feet above high water for any fixed structure over the Yukon River, and this has been complied with in the bridge design. After crossing the Yukon, the line follows down the right limit of the river, departing from the river bank for short distances where more favorable terrain or better bridge sites over cross-drainages are found. Alignment and grade from the Yukon River crossing to Tanana are satisfactory for the service intended. Considerable rock work is required in the first 35 miles of this section,

but the western portion of the section is almost entirely in common material. Piling and tie timber, sufficient for construction needs, is found adjacent to the line except in the immediate vicinity of the village of Tanana, where cutting for fuel and local building has depleted the stand. The line is located above the ice break-up level of the Yukon, as indicated by vegetation and tree scars. The snowfall in this portion of the line decreases from a maximum of about 40 inches at Roughtop summit to approximately 24 inches at Tanana. There is no evidence of snow slides in the vicinity of the located line. However, grading in the canyon section near the east approach of the Yukon bridge may so change the slopes that a small amount of shedding may be found necessary.

(3) Tanana to Birches, Milepost 125 to Milepost 175. The line, throughout this section, continues down the right limit of the Yukon River on light grades and easy curvature. The materials to be handled in grading operations are essentially loam and gravel, although areas of frozen ground must be traversed. Several minor tributaries of the Yukon River are crossed, the largest being the Tozitna River. Pile or frame trestle design is considered satisfactory for all crossings in this section. The ground cover is moss and nigger-heads, and the timber is willow with occasional groves of poplar, aspen and spruce. Stands of spruce along the cross-drainages will supply the construction requirements in this section of

the line. The maximum depth of snow amounts to about 24 inches on the level, but drifting is noted in over-breaks and small gulches.

(4) Birches to Melozi, Milepost 175 to Milepost 240. This section of the line is similar to the previous section in grade, alignment, materials and vegetation, although somewhat heavier grading is required due to the greater number of cross-drainages entering the Yukon through deeply incised channels. Approximately 7 miles east of the Melozitna crossing, the line turns away from the Yukon up the Melozitna Valley to a suitable crossing of the Melozitna River. This river is one of the larger tributaries of the Yukon River and will require truss span design for a railroad bridge. The gradient of the stream is quite steep and it is not considered navigable, although the clearances provided by this location and the bridge design are adequate for small river boats.

(5) Melozi to Nulato Forks, Milepost 240 to Milepost 340. From the crossing of the Melozitna River, the line continues up the valley for a distance of 2 miles to the mouth of Grayling Creek, then turns westerly up this drainage to the Grayling - Whakatna Divide. Grayling Creek follows a narrow, crooked valley and several crossings of the stream are required. The ascent is made by maximum grade and heavy curvature. The grading along the Grayling, although

not excessively heavy, entails considerable rock work. Crossings will be effected by pile or frame trestle.

Whakatna Creek is a slow, meandering stream, its upper reaches flowing in an open valley several miles wide, terminating in the Koyukuk flats. The line descends with easy grades and light curvature. The grading is light cut and fill work of earth and gravel. Moss and nigger-heads cover the bottom and the creek is fringed with spruce. Tie and construction timber is available on the adjacent side hills.

From the lower Whakatna to the proposed crossing of the Koyukuk River, the line traverses the Koyukuk flats. This terrain is swampy, pitted with lakes, and traversed by sloughs and small, meandering streams. The tree growth is willow with small stands of stunted spruce. The ground cover is moss in the timber and nigger-head vegetation in the swamps and meadows. Grading quantities are light; the roadbed being embankment from side borrow or long haul.

The line as staked crosses the Koyukuk River at a point nine miles below the mouth of Denny Creek. The river here is about 800 ft. wide, and the approach from the East over low bottom land. A relocation of the crossing to a site immediately above the mouth of Denny Creek where more stable bank conditions were observed is indicated. This river is normally a slow, sluggish stream, and excepting the spring breakups when ice jams and incidental floods occur, the crossing should present no maintenance difficulties. The river is navigable and navigation interests have requested a vertical clearance of 25 feet.

From the Koyukuk crossing, the line ascends Denny Creek to the divide between Denny Creek and the East Fork of the Nulato River. Use of maximum grades and 10-degree curves are necessary to surmount this summit. The valley is timbered with medium-size spruce. Materials encountered in grading operations are believed to be common.

b. Nome Division: A condensed plan and profile of the line in the Nome Division is shown on page 32. The physical characteristics of the roadway are described by sections, as follows:

(1) Nulato to the divide, Milepost 340 to Milepost 390. Beginning near the confluence of the East and North Forks of the Nulato River, approximately 9 miles north of the village of Nulato on the Yukon River, the line ascends the valley of the North Fork, in a southwesterly direction, to the divide. The valley to within 5 miles of the divide is covered with small spruce and patches of dense brush along the river. A few rock points, earth and some conglomerate material entail medium construction on light grades and easy curves with long connecting tangents. In the vicinity of the summit, short sections of heavy work will be encountered in developing the grade on a curved line. This portion is above the timberline and it is

subject to severe winds with snow up to an average depth of 60 inches, on permanently frozen ground. High water prevails during the late spring run-off. Indications are that the river changes channel frequently, requiring some corrective measures to avoid fill washouts and lessen maintenance costs. There are no evidences of snow slides, although the valley is surrounded by steep, jagged slopes and numerous tributary canyons. Considerable spruce timber, up to 18 inches in diameter, exists and is suitable for construction purposes. All crossing structures can be pile or frame bent construction, since none of the streams are navigable or subject to heavy ice floes.

(2) Divide to Portage (Golovin Hill), Milepost 390 to Milepost 566. The descent from the summit is made down one of the many small forks of the Shaktolik River through barren, permanently frozen ground, to the timberline on the upper Shaktolik, where the valley widens. The line over this section is curved and on maximum grade, encountering medium work with many drainage structures. Following the valley, the line continues to descend on a moderately curved line, with many long tangents, through light work, to the vicinity of Christmas Mountain, where a small summit is crossed into the Ungalik River Valley. The crossing is made on favorable terrain on good alignment and short maximum grades, through medium construction.

Entering the barren Ungalik valley, the line swings sharply to a northerly course on a light ascending grade, with long tangents to a small divide, separating the Ungalik and Inglutalik Rivers. Practically all the Ungalik valley is composed of frozen ground with few rolling knolls of solid rock and ample deposits of suitable fill and ballast material.

Continuing north the line descends to the Inglutalik River, on a curved line employing short sections of maximum grade, through stable material, involving medium work. After crossing the Inglutalik River, the line parallels the coast line of Norton Bay to a crossing of the Koyuk River near the village of Koyuk. This section is practically all tangent on nearly flat grades over barren, permanently frozen ground, with no evidence of rock or stable material. Elevated fills and trestles are planned over this section. The area is somewhat like the Ungalik valley with slight snowfall and severe winds.

After crossing the Koyuk River the line turns west and traverses timbered, stable land. The line over this section is composed of long tangents, rolling grades, interspersed with short sections of curved line around points along the coast line.

Entering the Kwiniuk River valley the line ascends to the Golovin Portage on favorable alignment and light grades to within a short distance of the summit, from which point a curved line with maximum grade is employed in developing the ascent. The line traverses favorable terrain with considerable rock work along the river.

Between the Koyuk River and the Kwiniuk headwaters there is a limited supply of spruce timber, easily accessible, for many construction purposes.

The average snow depth between the Koyuk and the head of the Kwiniuk is around 48 inches with very little evidence of drift. From the head of the Kwiniuk, which is also the timber line, to the Golovin summit, the snow depth averages 60 inches with continuous terrific winds due to the exposure to the Bering Sea, Norton Sound and the barren Darby Mountain foothills to the north.

All major structures in this section can be of pile or frame construction except over the Koyuk River, which should have sufficient clearances to permit the passage of small river craft. The Koyuk is navigable to Dime Landing, a distance of approximately 25 miles.

None of the many rivers in this section show any indication of sudden break-up, probably due to the slight fall and the fact that all freeze nearly solid, causing floodwaters from tributaries to overflow the main rivers and gradually melt the ice.

(3) Portage to Junction, Milepost 566 to Milepost 667. Descending from the Portage on maximum grade and a curved line to the Fish River Valley, the line turns to a northwesterly direction, continuing to a crossing of the Fish River, near its confluence with the Niukluk, thence up the Niukluk, passing through Council

to the American River, where the line turns nearly west to Iron Creek. The route up the Fish River Valley and westerly to Iron Creek is composed of long tangents with light, undulating grades, encountering intermittent frozen and stable ground, involving extremely light construction. Except for a few scattering spruce between White Mountain and Council, the land is barren and isolated, broken only by the tailings left from gold dredges at numerous places. Elevated grades will be swept free of snow, which averages 30 inches in depth.

At Iron Creek, the little-used, narrow-gauge Seward Peninsula Railroad is encountered, and following its general course, the line skirts the south shore of Salmon Lake, and turns south over a small drainage divide into the headwaters of the Nome River, the end of the section. Since the alignment and grade of the Seward Peninsula Railroad is low standard, and there is little value in the construction work already performed, no attempt was made to adopt its roadbed. The line between Iron Creek and Nome River is similar to the preceding section and involves extremely light construction, mostly over permanently frozen ground. All structures may be of pile or frame construction, since none of the rivers or streams show any dangerous ice or flood condition.

The Fish and Niukluk Rivers are navigable to small river craft as far inland as Council.

(4) Junction to Teller, Milepost 667 to Milepost 730. This section is uniform throughout. It is barren, frozen ground

with numerous dikes of conglomerate material. Several large deposits of material suitable for ballast or borrow are found along the line or adjacent thereto. Curves are generally easy with long, connecting tangents and light, undulating grades. Construction is classified as light.

The section is swept by high, variable winds and the average depth of snow is 30 inches. Nome is situated directly south of the beginning of this section, and is the southern terminus of the narrow-gauge (36-inch) track, which has been in use for many years as a means of light transportation to the Kougarok country, some 100 miles to the north.

The few bridges required on this section can be of pile or frame construction, since the streams and rivers are small and of low velocity and present no serious ice conditions.

The western end of the survey ties into the yard limit of the Teller Harbor Development, which is covered elsewhere in this report.

9. Principal Waterways.

a. The limited development of transportation routes in the interior of Alaska has necessitated that maximum use be made of water transportation. This traffic is handled by boats ranging in size from larger stern-wheel river steamers, 200 feet in length, to poling boats. The distance traversed in the transportation of freight by water route frequently exceeds the air line distances by as much as 400 percent.

b. The principal waterways so used are the Yukon, Tanana, Koyukuk, Koyuk, and Fish Rivers. The largest river steamers operate on the Yukon and Tanana, requiring vertical clearances of not less than 60 feet under fixed structures. Smaller river steamers are used on the Koyukuk, necessitating a clearance of at least 20 feet. All other streams are navigable by small power skiffs, which have a maximum height above waterline of less than 8 feet. This limited clearance is provided to insure safety of the structure regardless of navigation requirements. The type of structure proposed for each crossing is indicated on the profiles and shown in detail in Appendix "G."

c. Flood stages and ice conditions vary with the several streams and not infrequently with different reaches of the same stream. A brief description of the characteristics of the major streams crossed by this location follows:

(1) Yukon River: The ice break-up in the Yukon River generally occurs during May, and freeze-up to an extent prohibiting navigation develops by October 15. High water stages follow the break-up and continue until late July, after which the water stage gradually lowers until the freeze-up. The high waters occurring immediately following the break-up affect the location of the line to the greatest degree, since ice jams in canyon sections may raise the water level above the normal high water stage for short periods of time. The locators have been guided in this determination by

ice scars on timber and information secured from native Indians and trappers.

(2) Molozitna River: This river is not a navigable waterway. It heads in the mountains 150 miles northeast of the crossing, and falls through canyon sections in the lower 50 miles above its confluence with the Yukon. It is fed by extensive snow fields below elevation 1000, in the reach immediately above the canyon sections, hence early flood stage develops, causing heavy floes of ice in the lower river. This condition dictates a bridge design with large vertical clearance and a minimum of intermediate support.

(3) Koyukuk River: The Koyukuk River is one of the principal tributaries of the Yukon. It has its source in the Endicott Mountain range some 400 miles northeast of its mouth. It is navigable for small river boats in the lower 200 miles, and in this reach is sluggish and follows a meandering course through a wide valley. Based on information secured from local residents, the ice break-up in the Koyukuk does not present any serious menace to a bridge structure at the site contemplated, as the ice rots away in the lower river before flood stage, and the ice floes from the upper reaches are reduced to slush ice before reaching the mouth.

(4) Koyuk River: The Koyuk River empties into the shallow north portion of Norton Bay and is generally free of ice a short time before the bay is open for navigation, approximately May 15. It is sluggish and navigable inland for 25 miles to Dimes Landing,

from which point it rapidly diminishes and divides into scores of tributary streams from which come the early run-offs causing the lower Koyuk to flood over its low banks, accelerating the melting of the ice mass. This transition from a river frozen solid to free water occurs during a period of six weeks to two months, without noticeable scouring of its earth banks.

There are no evidences of ice or flood action in this waterway that would unduly menace the stability or permanence of a railroad bridge of conventional design.

(5) Fish River: The line crosses the Fish River near its confluence with the Niukluk, a southeasterly flowing tributary of equal size. Both of these waterways are navigable for shallow-draft poling boats and barges, although use is made only of the Niukluk, above the confluence, as far inland as the Council gold dredging area.

Both rivers are in well-defined channels of sufficient size to carry all run-off waters without danger of floods. Considerable scouring is noticeable at river turns, but no channel changing is evident.

Slow disintegration of the ice mass, caused by overflows, is the normal spring break-up, and the rivers are free of ice generally by the first week in May.

materially reduced by the use of oil and the flexibility of oil-fired steaming is particularly well-adapted to a railroad having the grade characteristics of the route from Dunbar to Teller.

b. The adoption of Nenana on the Alaska Railroad as the initial division point for the western extension is favored. In the event that the rail system is extended eastward from the Alaska Railroad, it is improbable that any appreciable tonnage will enter the rail system from Fairbanks and carloadings that may so originate can be set out at Dunbar and picked up by west-bound trains. The Nenana yards can be enlarged and the existing facilities augmented to meet the requirements of a rail division point, as well as a secondary rail-to-river transfer point, more readily and economically than the construction of a division yard on the less desirable site at Dunbar. Nenana is so situated that it would also serve as the initial division point for the Transcanadian Alaska Railway in the event that construction of the eastern line is undertaken, thus avoiding duplication of these facilities.

The location of the intermediate division points has been selected as follows:

Tanana	Milepost 125
Whakatna	Milepost 270
Shaktolik	Milepost 422
Golovin	Milepost 582

11. Roadway standards. The standards adopted for the construction of a railroad from Dunbar to Teller are selected with a view to rapid construction and in general are the minimum

requirements for the service specified. Improvements after the line has been opened to traffic are indicated. This is customary practice in railroad construction but, in this case, the first stage of construction is standardized in order to secure uniformity in rapid construction.

a. Clearing and grubbing: The width of right-of-way for the purpose of estimating quantities has been taken as 200 feet. Trees will be cut at ground line in light fill sections where the ground line is less than 2 feet below sub-grade and where greater, not to exceed the diameter. Suitable material for crossways, ties, piling and culvert timber will be trimmed and piled on the right-of-way. Borrow pits for ballast or embankment materials and all excavation where the cutting is less than 5 feet will be cleared and stripped of unsuitable material prior to excavation. The burning of debris will not be permitted on those portions of the right-of-way where the grade is supported by filled section over perpetually frozen ground. It is the intention of the specifications to preserve the maximum possible insulation under such embankments.

b. Grading: Width of roadway has been taken as 16 feet in cuts and 14 feet for fills. Side slopes of 1:1 in common excavation, ½:1 in rock excavation, and 1½:1 in embankment are considered satisfactory for the materials encountered. Although the extent of perpetually frozen ground traversed cannot be accurately determined by a location survey conducted in the dead of winter, it is known that this condition obtains over a considerable portion of the line and a supported grade rather than a balanced cut and fill grade is advocated. This procedure is also warranted in order to minimize and facilitate snow removal. Through cuts are avoided where possible and sidehill cuts are daylighted.

Standard drawings applicable to this feature of construction are:

Title	Seattle District File
Clearance diagram	N-192-5-10
Standard roadbed	N-192-5-11

These drawings are included in Appendix G.

c. Bridges, trestles and culverts: Sufficient suitable timber for piling and culvert construction can be obtained along the Tanana and Yukon Rivers as far west as the divide between the Yukon Valley and Norton Sound. West of this divide the timber is too limited in quantity and size for piling, necessitating either line transportation from the eastern portion of the route or water haul from Seattle or southwestern Alaska ports. With the exception of the Yukon crossing, all major bridges will be of timber truss design on pile or rock-filled log crib supports. Where navigation, ice, drift or flood conditions do not require large clearances, pile or frame trestle design has been adopted. The elements of each crossing structure, as indicated on the profiles accompanying this report, are in accordance with standards designed by this office to minimize the use of critical materials. These standards, included in Appendix O, are as follows:

Title	Seattle District File
Standard log culvert 3' x 3'	N-192-5-1
Standard log culvert 5' x 8'	N-192-5-2
Standard log culvert 4' x 4'	N-192-5-3
Standard log track box 6'-0" x 2'-6"	N-192-5-4
Standard log track box 4'-6" to 9'-2" x 2'-8" to 5'-4"	N-192-5-5
Standard log track box - bill of timber	N-192-5-5
Standard log track box - bill of iron	N-192-5-5
Standard Framed Track Box	N-192-5-6
Int. 4-pile trestle bent on tangent	N-192-5-20
Int. 5-pile trestle bent on tangent	N-192-5-21
Int. 5-pile trestle bent on curve	N-192-5-22
End trestle bent and bulkhead	N-192-5-23
Pile or frame trestle - deck plan	N-192-5-24
4 or 5 pile or frame trestle - side elevation	N-192-5-25
Water barrel platform for standard trestles	N-192-5-26
Sidewalks for standard trestles	N-192-5-27
72' Timber pony span - E-45 stress sheet	N-192-5-40
72' Timber pony span - E-45 truss assembly	N-192-5-41
96' Timber pony span - E-45 stress sheet	N-192-5-42
96' Timber pony span - E-45 truss assembly	N-192-5-43
108' Timber deck span - E-45 stress sheet	N-192-5-44
108' Timber deck span - E-45 truss assembly	N-192-5-45
144' Timber deck span - E-45 stress sheet	N-192-5-46
144' Timber deck span - E-45 truss assembly	N-192-5-47
126' Timber thru span - E-45 stress sheet	N-192-5-48
126' Timber thru span - E-45 truss assembly	N-192-5-49
144' Timber thru span - E-45 stress sheet	N-192-5-50
144' Timber thru span - E-45 truss assembly	N-192-5-51
Truss bearings adjacent timber spans, E-45	N-192-5-52
Timber truss details - rods and shoes	N-192-5-53
Timber truss details - splice plates, washers, etc.	N-192-5-54
Timber truss details - concrete bearing blocks	N-192-5-55
Timber truss details - concrete bearing blocks	N-192-5-56
Timber truss details - concrete bearing blocks	N-192-5-57

The design of the Yukon crossing was prepared by an architect-engineer employed by the district engineer to investigate the foundations and submit plans for a steel bridge. These plans have been reviewed by the district engineer and are believed to represent the most satisfactory bridge design for this crossing. The plan is included with this report in Appendix G. In accordance with instructions from the Office, Chief of Engineers, steel bridges are designed for Cooper's E-50 loading and all timber structures are planned for E-45 loading.

d. Ties, rail and track-laying: The limited stands of usable tie timber along the route will supply approximately 90 percent of the initial requirements from Dunbar to Milepost 400 and not to exceed 20 percent of the remaining line. It is expected that 960,000 ties must be imported from southeastern or southwestern Alaska or Seattle. In order to secure the maximum yield from the local timber supply, the use of second grade ties, to a minimum size of 6" x 7" x 8', will be allowed in construction but future replacements should be made with Number 1 ties. Tie plates will not be used except on curves of over 4 degrees. To compensate for the lower standard of ties used and the elimination of tie plates, it is intended to lay track with 3,000 ties per mile. The service to be provided by this railroad dictates the use of extremely heavy rail, if continued operation at specified tonnage is contemplated. It is assumed, however, that this traffic will be intermittent and not maintained for a period of more than three years following completion and under these conditions, rail of 70-pound section is considered suitable.

e. Ballasting and surfacing: The data secured during the course of the winter survey just completed are not conclusive in the matter of ballast supply. Gravel ballast will be used but some crushing of oversize in workable deposits may be required. The floor of the Yukon Valley for a considerable depth is generally composed of materials too fine for ballast. Deposits of stream gravel in the beds of cross-drainages discharging from the mountains at the limits of the valley floor will yield excellent material but in limited quantities and will necessitate long hauls. The coastal regions of the Seward Peninsula are underlain with gravel but the gradation is poor and thawing may be necessary for recovery. Maximum use will be made of dredge tailings from past mining operations but long haul is involved. A further investigation of the gravel supply, made during the summer months, may reveal additional ballast sources, but for purposes of this estimate, a mean haul of 30 miles is assumed. A ballast section, providing 6-inch depth between sub-grade and base of tie has been adopted. (Reference Appendix G, file N-192-5-11.)

f. Yards and sidings: For the service to be provided, train movements will generally be through to destination. A siding and passing track has been sited at approximately 10-mile intervals with some additional trackage at water stations. Yards at division points will provide in addition to passing tracks, house and utility spurs, limited trackage for the repair and storage of rolling stock. Turnouts from the main line will be made with No. 9 rigid frogs and No. 7 turnouts will be used in the yards. Yard and siding installations have been standardized insofar as possible, details of which are shown in Drawing No. N-192-5-18, "Division and Siding Layouts," in Appendix "G." The mileposts, division points, water stations and sidings are as follows:

Milepost	Name	Description
-20.0	Nenana	Division point.
0.0	Dunbar	Water tank, section house, siding.
10.0	Un-named	Siding.
20.0	"	Section house and siding.
30.0	"	Siding.
38.8	Summit Lake	Water tank, section house, siding.
59.5	New York Creek	Section house and siding.
69.6	Rough Top	Siding.
82.3	Dicky Creek	Water tank, section house, siding.
95.3	Indian Jordan	Siding.
104.5	Schieffelin Creek	Section house and siding.
116.2	Un-named	Siding.
125.3	Tanana	Division point.
138.0	Tozitna River	Siding.
148.0	Lancaster Creek	Section house and siding.
158.5	Illinois Creek	Siding.
170.0	Birches	Water tank, section house and siding
180.0	Un-named	Siding.
192.5	"	Section house and siding.
201.5	"	Siding.
210.0	Kokrines	Water tank, section house, siding.
220.0	Un-named	Siding.
229.4	"	Section house and siding.
240.5	Melozitna River	Water tank and siding.

Milepost	Name	Description
250.6	Un-named	Section house and siding.
260.0	Whakatna Creek	Siding.
270.0	Whakatna	Division point.
280.0	Un-named	Siding.
289.5	"	Section house and siding.
300.0	"	Siding.
310.0	Koyukuk River	Water tank, section house, siding.
320.0	Denny Creek	Siding.
330.0	Tunnel	Section house and siding.
340.38	Un-named	Siding.
350.0	"	Water tank, section house, siding.
360.0	"	Siding.
370.0	"	Section house and siding.
380.0	"	Water tank, section house, siding.
390.2	Summit	Siding.
400.0	Shaktolik River	Section house and siding.
410.0	Un-named	Siding.
421.6	Shaktolik	Division point.
432.5	Summit	Siding.
444.6	Ungalik River	Section house and siding.
458.4	Summit	Siding.
472.5	Un-named	Water tank and siding.
485.0	Koyuk Village	Section house and siding.
500.0	Sadd Creek	Water tank, section house, siding.
510.0	Un-named	Siding.
520.0	"	Section house and siding.
530.0	"	Siding.
540.0	"	Water tank, section house, siding.
560.0	"	Section house and siding.
570.1	"	Siding.
581.85	Golovin	Division point.
590.0	Un-named	Siding.
602.0	Fish River	Section house and siding.
611.1	Council Village	Siding.
620.5	Niukluk River	Water tank, section house, siding.
630.0	American River	Siding.
640.4	Un-named	Section house and siding.
650.6	Pilgrim River	Siding.
660.0	Jete Creek	Water tank, section house, siding.
670.2	Short Creek	Siding.
681.5	Sinuk River	Section house and siding.
691.2	Un-named	Siding.
699.5	"	Water tank, section house, siding.
710.0	"	Siding.
720.0	"	Siding.
729.86	Teller	Division point

g. Stations and buildings: There are no stands of timber along the route suitable for production of native lumber and all materials for buildings must be imported. Standard Theater of Operations and Mobilization type buildings have been adopted, with minor modifications where necessary, as the most economical and satisfactory designs for use on this project. The type of building in each location is indicated on the yard and siding plans referred to in paragraph 11 f above.

h. Engine service facilities: In accordance with the recommendations contained in paragraph 10 of this report, engine service facilities are designed on the basis of oil-fired steam locomotive operation. Water tanks are installed at approximately 40-mile intervals, but all other engine service facilities are located at division points, in accordance with standard plans.

(1) Divisional sheds and shops will conform to standard Theater of Operations type design, file T/O 24.1, reproduced in Appendix G.

(2) Turntables: Wyes or loop tracks for the turning of locomotive or other rail equipment will be provided at all intermediate division points. A turntable and roundhouse of conventional design are included in the plan of terminal development at Teller.

(3) Ash pits are not required for oil-burning locomotives and are not included in the plan of construction.

(4) Fuel stations: Tender capacity of oil-burning

locomotives is adequate for any engine stage on this line and fuel stations are therefore located at division points only. Storage will be provided in two concrete tanks of 85,000 gallons capacity each, located below ground level and adjacent to the engine sheds to facilitate heating and pumping the oil.

(5) Water tanks: An elevated wooden tank of 50,000 gallons capacity has been designed, based on the general design of similar installations on the Alaska Railroad. The supporting structure of this tank is inclosed to house the pumping and heating installation necessary for cold weather operation. The design of this tank is shown in Appendix G.

(6) Sand houses will be located on the fueling spur at each division point and will be constructed in accordance with plan, Appendix G.

(7) Oil houses: Tankage for lubricating oils is not contemplated in the present plans for this railroad. The use of drums is considered satisfactory and these drums can be stored in the engine sheds or in temporary sheds adjacent thereto.

i. <u>Train service installations:</u>

(1) Way stations and section houses: The use of motor cars for section gang transportation will permit the adoption of 10-mile section lengths. In order to simplify building construction and the provision of utilities, double section houses at 20-mile intervals or alternate sidings will be erected. These buildings will also include an agent's office for train control. In addition to section crews and dispatchers' agents, quarters

will be available for water station operators at alternate section houses. These buildings are modified Mobilization type company administration buildings.

(2) Division buildings: Office buildings, personnel quarters, mess halls, infirmaries, freight sheds and shops of Mobilization and Theater of Operation design are to be provided at division points in accordance with the plans referred to in paragraph 11 f.

(3) Track scales: The Alaska Railroad has installed a car weighing scale in the Nenana yards.

(4) Ice houses: Instead of the usual type of ice house located in the yards for servicing refrigerator cars, it is recommended that ice be kept in cut and cover type storage of log and sod constructions near the lake from which the ice is harvested. Delivery can be made as required by truck and the cars serviced from an elevated platform. The capacity of ice storage vaults should be 200 tons. No standard design has been prepared for this construction.

(5) Telephone and telegraph: The district engineer has been furnished a copy of a secret letter from the Commanding General, Western Defense Command, to the Chief of Staff, file 676.1 (Sig), dated December 10, 1942, wherein the immediate construction of a telephone and teletype circuit between Fairbanks and Teller, closely following the route of this

location, is recommended. Data on the railroad location have been furnished officers of the Signal Corps for use in this connection. In order to avoid duplication of these installations, minimum requirements for railroad operation are planned. It is believed that satisfactory service can be provided by a 2-wire division system. The use of tripods rather than poles for supporting land lines has been found preferable by the Alaska Railroad, both from a standpoint of economy and speed of erection. Tripod construction is shown on drawing, file N-192-5-33, Appendix G.

(6) Signals and miscellaneous: The installation of rail racks, mileposts, signal and traffic control boards will be made by maintenance-of-way forces and are not included in the initial construction program. The design of these several standards will conform to drawings included in Appendix G.

12. River rail transfer terminal.

a. In conformance with the directive a river rail transfer point is proposed at Tanana on the North bank of the Yukon River at the confluence of the Yukon and Tanana Rivers. For the purpose of expediting freight movements during the construction period and for emergencies after the line is built, a second rail to water transfer terminal is proposed at Nulato. The terminal at Nulato will be served by a spur from the main line, a distance of approximately 8.6 miles. These transfer facilities will permit delivery of freight from the rail line to the South bank of the Yukon River and augment freight movement in the Yukon River Valley. As previously mentioned, such a terminal served by the Alaska Railroad now exists at Nenana on the Tanana River. Rail to water transfer terminals will be of tremendous aid in shipping construction materials, and upon completion of the railroad remain as reserve or additional facilities for freight movements along the Yukon in the event the railroad is over-burdened or rendered temporarily inoperative.

b. Steamers and barges plying the Yukon and its tributaries are relatively small, the maximum size of barge being 170 feet by 40 feet, with a draft of 60 inches. The maximum size of river steamers is approximately 200 feet by 35 feet, with a draft requirement of 72 inches. The rail to water transfers are designed to accommodate the local vessels. Such additional craft as may be constructed to operate in this area will doubtless be similar as to over-all dimensions. The transfer of rail freight to river barges or steamers will be made from wharfs constructed along the river banks. The banks at Tanana and Nulato afford an excellent opportunity for this type of a terminal. The wharfs are to be of untreated timber, supported by pile bents and carry the necessary railway tracks to permit and afford a minimum of handling from car to barge. Two stiff-leg derricks 600 feet apart adjacent to the wharf face provide equipment for lifting cargo from wharf to barge, or from barge to wharf. Dependent upon the lift or demand, cargo transfer may also be accomplished by railway derrick cars or cranes. In the event the volume of any type of commodity, such as oil drums, piling, or timber, necessitates special equipment, additional facilities can be quickly constructed beyond the derrick locations.

c. Ample provisions for both covered and open storage are contemplated back of the wharf and wharf tracks. Storage areas provided by the transfer plan are as follows:

9,000 square feet, covered storage
85,000 square feet, open storage
9,000 linear feet of track

These areas can be increased by expansion without interfering with transfer operations. Special storage space such as for petroleum products or perishable food stuffs has not been provided. The transfer layout and construction details are represented on Drawing No. N-192-5-64, shown in Appendix G. This plan is schematic in its concept and applicable to both Tanana and Nulato.

13. Pipe line design.

a. The instructions contained in the directive relative to pipe line delivery of oil to Teller are amplified by letter from the Chief of Engineers, January 7, 1943, file CE 617 (U.S.-Canada-Alaska)C.M. 25145. This letter directs that provision be made for transferring 50,000 tons of petroleum products per month by pipe line from Tanana to Teller. These data are insufficient for accurate design, as the proportions and nature of the several products should be known. However, the district engineer assumes that light diesel oil will be the heaviest petroleum product so delivered without heating, and has adopted the characteristics of this oil for design purposes. It is further assumed that the line will be used only during the 5-month navigation season, and that deliveries may be scheduled to permit transfer of heavier oils during midsummer when dilution or limited heating will provide viscosities equivalent to those used for design purposes. It is recommended that the required transfer of 50,000 tons per month be effected in 85 percent of the elapsed time, thus allowing approximately 5 days each month for plant and line maintenance, change-overs, and other lost time factors. The hourly delivery rate under these conditions is therefore 550 barrels. The temperature range over the entire line during the period considered will vary from 32 to 90 degrees Fahrenheit, and the mean temperature of the oil will probably not exceed 60 degrees Fahrenheit. Based on these assumptions, an 8-inch line with pumping stations at 40-mile intervals is proposed.

b. The transfer of 550 barrels per hour of an oil, having a viscosity of 50 seconds Saybolt Universal, through an 8-inch line, will require pumping plants at 40-mile intervals capable of handling 385 gallons per minute against a 700-foot head. From a standpoint of operating heads, capacity and rotative speeds, it has been found that the multi-stage centrifugal pump is more flexible and better adapted to the variable requirements of this service than the displacement type. A 4-stage, 8-inch centrifugal pump, directly connected to a 130 horsepower diesel engine operating at 1,600 R.P.M., satisfies these requirements, and is adopted in the design.

c. The type of oils under consideration are of such low viscosity that they will remain in a liquid state during the winter months, and may be retained in the line, thus obviating the need for draining and the provision of storage along the line for its capacity of 180,000 barrels.

d. To facilitate transportation of materials and erection of the pipe line, it is recommended that this feature of the project be deferred until grading and track-laying are complete. The pipe should be laid on the railroad sub-grade outside the ballast section or 6 feet from centerline of track and supported on bridges or through structures as a bracket line in any suitable location consistent with the clearance requirements of the railroad. For stability on earthwork sections, the pipe line will be supported on 10-inch by 10-inch posts set into the roadbed at intervals of 60 feet with tops at profile grade. Expansion bends will be installed at intervals of 3,000 feet to compensate for the small variations in pipe length during the operation season. However, shut-off valves and flange connections will be provided midway between the expansion bends in order that the line may be broken to allow for the extreme contraction of the winter months.

e. The plan above outlined is followed in the preparation of the estimates for this feature of the project. Detailed design and specifications will be prepared when more data are available on the exact nature of the stock to be handled, and the line supply at Tanana.

14. Plan of construction.

a. Port Teller: The district engineer favors the negotiation of a construction contract for all terminal facilities in the port area, including the railroad yards and shops. The work is confined to a very limited area, necessitating careful coordination of the several operations. For this reason, the entire port development should be awarded to one contracting firm.

The design of the piers as floating structures, dictated by ice conditions in the waterway, affords marked advantages in the construction of the entire project. The pontoons can be cast in Seattle or Portland under favorable working conditions, and towed to Port Clarence, fully loaded with plant and construction materials. This procedure will effect a considerable reduction in the number of employees required at Teller, eliminate the need for temporary wharves, and permit unloading of plant and materials directly onto the beach line. This element of the port facilities is considered to be first priority in the construction program, and complete plans are being prepared for the immediate undertaking of this phase of the work. All other design has been limited to basic plans with only sufficient detail for determination of quantities. The initial construction in the field that must be undertaken immediately upon authorization of the project consists of grading the terminal yard and the rock-filled approach to the piers. Prefabrication of buildings and other installations to the maximum extent possible is contemplated, as this procedure will reduce congestion at the site, effect a saving in transportation of plant and materials, and insure earlier completion.

The following estimates of labor, materials and plant, required for the construction of the terminal, by stages, are believed to be sufficient to satisfy the requirements of this basic report. Detailed plans and specifications of the concrete pontoons, basic plans for second priority features, and a breakdown of the material lists, in accordance with the Controlled Materials Plan, are being prepared, and will be forwarded upon completion to the Chief of Engineers, together with similar data on the rail line, as a supplementary report, about May 31, 1943.

(1) Labor: The estimated amount of manpower required for the terminal construction, in 1,000-man day units, is broken down as follows:

b. Railway: Cost and time of construction of a railroad line between Dunbar and Teller along the projected route will only be reduced to the minimum provided full advantage is taken of water transportation. The line is in close proximity to navigable waterways for approximately 60 percent of its total length and the intervening sections between waterways can be served therefrom by relatively short supply routes or by end construction. The Yukon River, Tanana River and Norton Sound are open to navigation from May 15 to October 15. The plan of operations, as well as the estimates of plant, labor, cost and time of construction herein set forth, are based on the assumption that the project will be authorized immediately and that advantage may be taken of the entire navigation season of 1943.

For construction purposes, the railroad will be covered by two grand divisions conforming to the location divisions. The Fairbanks or eastern division will be served by the waterways of the Yukon drainage. The western or Nome division can be supplied generally from the coast of the Seward Peninsula either directly or by means of existing access roads from the coast.

It is assumed that a rail transportation system must be developed to 50 percent of its ultimate capacity, for use during the navigation season of 1944, to correspond to the port facilities provided by that time. Under these conditions, a period of approximately 400 days can be taken as the construction term for the basic requirements of a usable military railroad.

If the project is initiated on or before the opening of navigation in 1943, the necessary plant, materials and supplies can be distributed readily over the entire line and construction pushed during the summer season to such an extent that line transportation and useful work will be possible during the winter of 1943-44. Sufficient surfacing and ballasting can be done during the early spring of 1944 to open the line for limited freight service through to Teller early in the navigation season of 1944.

(1) Labor: The extremely low temperatures prevailing in this district, from December 1 to February 15, prevent effective outside work during this period. However, the stage of construction reached by December 1 should permit proper utilization of labor on the less exposed features of the project and the labor requirements are therefore based on a full 400 days as follows:

1,000-Man Day Units

	Fairbanks	Nome	Total
District office and engineering ..	32	28	60
Clearing and grubbing	117	81	198
Grading	1,200	780	1,980
Telephone and telegraph	35	31	66
Ties, timbers, etc.	70	49	119
Bridges and culverts	140	60	200
Track-laying	32	34	66
Surfacing and ballasting	48	51	99
Transportation and supply	90	68	158
Camps, buildings, miscellaneous ..	40	35	75
TOTALS	1,804	1,217	3,021
Assuming 400 days for completion = x 2.5	4,500 men	3,000 men	7,500 men

(2) Materials: Construction materials available from the vicinity of the route will be limited to timber and ballast material. Timber stands are believed sufficient to furnish approximately 55 percent of the requirements of posts and culvert materials. The remaining 45 percent must be imported from Southeastern Alaska, the lower Yukon or other locations of suitable timber. The Seward Peninsula, where the timber deficiency is pronounced, is accessible to water-borne transportation.

Strength requirements of trestle stringers and Howe truss members preclude the use of soft, native woods, necessitating importation of Douglas fir timbers for these uses.

It will be necessary in some sections to augment available ballast gravel with crushed rock. Ballast requirements can be secured with an average haul of 30 miles or less.

No materials other than those common to railroad construction will be required. Throughout the design, use of critical materials has been avoided wherever possible.

The general plan will be to import initially only those materials essential to completion of a rail connection. After access by rail is obtained, materials for the completion of roadway structures, engine service facilities, and line accessories may be moved in by train haul.

The quantities of major construction materials are listed below:

In Tons (2,000 Lb.)	Fairbanks Division	Nome Division	Total
Rail, 70-pound	45,100	51,700	96,800
Track fittings	4,700	5,500	10,200
Structural steel	8,000	0	8,000
Cement	4,250	280	4,530
Telegraph and telephone	210	240	450
Hardware, misc. iron products	440	640	1,080
Explosives	950	1,280	2,230
Douglas fir timber ...	2,150	4,075	6,225
Ties (imported)	0	48,000	48,000
TOTALS	65,800	111,715	177,515

(3) Plant: The adoption of a supported grade line over a great portion of the line, and the necessity of obtaining fill materials from unfrozen borrow pits insofar as possible results in long hauls which can best be handled by train haul. Skeleton track with standard 70-pound rail will support light industrial-type locomotives and small dump cars, without detriment to the rail. Earthwork in sidehill sections can be handled by $1\frac{1}{4}$-cubic yard shovels sidecasting with the assistance of tractor bulldozers. Use of large railroad shovels with adequate power will reduce the amount of blasting required in handling the considerable amounts of rock and frozen earth that will be encountered. For this reason shoo-fly grading in these portions of the line will be resorted to. A relatively small number of tractor-cat wagon units will be required for those sections of more nearly balanced earthwork having short hauls. Floodlight units with portable generator sets will be useful for extending

the working day if construction is carried through the winter season. Their greatest value will be at points of concentrated work such as culverts, trestles, bridges, borrow pits, sawmills.

The short tunnels encountered on the line can be holed through well within the time allowed for grading operations, and no special tunneling equipment will be required. The Yukon River bridge, of major size, with spans of 784 feet, 672 feet and 784 feet, will require derricks, concrete plant and other equipment not needed elsewhere on the line. The remaining stream crossings will be accomplished by trestles or wooden Howe trusses requiring only pile drivers of conventional drop hammer type, skid derricks, and the usual small tools.

The major items of construction plant required for construction of the railway line are as follows:

	Fairbanks Division	Nome Division	Total
10-ton diesel locomotives	24	20	44
6-cubic yard dump cars, standard gauge	120	110	230
3/4-cubic yard shovels, crawler	14	16	30
$1\frac{1}{4}$-cubic yard shovels, crawler	12	6	18
Tractor-bulldozers	30	40	70
Tractors	50	35	85
Cat wagons, 8-cubic yard	25	25	50
Compressors, 105-500 c.f.m. ...	20	30	50
Drills, blast hole and wagon ..	6	5	11
Sawmills	5	2	7
Pile drivers	2	4	6
Rock crushers	4	4	8
Concrete mixers, 1-cubic yard .	3	1	4
Steel erection derricks, 50-ton	2	0	2

(4) Transportation: Of the total length of 730 miles, approximately 440 miles are adjacent to, or readily accessible from the Yukon River or the Bering Sea. This fact greatly simplifies the problem of access to the line, permitting attack by construction forces at a great number of points.

Transportation of materials, equipment, and supplies is feasible over the Yukon River in winter or summer, but shipment by water to the Seward Peninsula section is limited to the open navigation season. For the purpose of estimating transportation plant, it has been assumed that construction work will be initiated at such time that full advantage may be taken of water shipment.

It is expected that existing barge and towboat equipment on the Yukon must be supplemented by construction of additional units. The number of units to be built may be kept to a minimum if certain major items of construction material such as timbers, gasoline and oils are made into rafts for movement downriver to the point of use. The rafts, in addition, could carry other construction materials. Small watercraft, powered by inboard or outboard motors, would be satisfactory for steering such rafts. Other small, fast boats will prove valuable for messenger service and transportation of supervisory personnel between points along the river.

Items for construction between the headwaters of the Shaktolik and Teller can be shipped by ocean vessel direct to

Seward Peninsula harbors. A few well-protected harbors are available to light-draft vessels, but larger vessels must stand offshore and transfer their cargoes by lighters. Local lighterage and tugboat equipment may be augmented by the transfer of additional equipment from other coastal ports.

The general plan for construction of inland sections will be to advance the rail as rapidly as possible from the point of access in order that the majority of overland hauling may be by work-train. A few tractor-trailer units will be needed to supply construction forces working ahead of the end of steel.

Roads in the territory traversed by the route are very few and will be of only minor value during construction. Exceptions to this general condition are the roads from Manly Hot Springs to Eureka and the Seward Peninsula Railway. Construction items may be moved to Manly Hot Springs on the Tanana River and then to Eureka by road, permitting construction to proceed from this point to the Yukon River crossing, and back across the difficult Minto Flats section. The established transfer facilities at Nome and the narrow-gauge Seward Peninsula Railway from Nome to Iron Creek will provide an access route to the line in the central portion of the Seward Peninsula.

Numerous winter sled roads and frozen waterways will permit tractor-train delivery of small amounts during the winter season.

Air transport, utilizing the extensive network of airports along the route, can be an effective means of moving in personnel and supplies, and will be utilized.

The tonnage of construction items to be handled is as follows:

	Fairbanks Division	Nome Division	Total
Equipment	5,170	4,800	9,970
Materials	67,000	111,715	178,715
Supplies	25,630	21,120	46,750
TOTALS	97,800	137,635	235,435
Needed First			
3 Months	28,400	33,470	61,870

The transportation plant needed to perform this movement is approximately as follows:

	Fairbanks Division	Nome Division	Total
Towboats, 250-horsepower diesel, 80-ton load capacity	10	0	10
Barges, 150-ton	14	0	14
Tractors	16	13	29
Track-type trailers, 20-ton	16	13	29
Crawler cranes, 10-ton	5	5	10
Cargo trucks, 5-ton .	10	6	16
Planes, single-motor, 4--6 place	2	2	4
Planes, freight, (2,000-pound capacity minimum) ...	2	3	5
Locomotives, 10-ton diesel	8	7	15
Cars, flat, standard-gauge, 10-ton	56	50	106

(5) Estimated Quantities: The following estimate of construction quantities is for the railway only and is exclusive of the port terminal yard, river-rail transfers, and the pipe line. The figures are based on preliminary study of field data and may be subject to minor adjustment after completion of the detailed plans and profiles.

Miles of track:	
Main line	730 miles
Yards and sidings	57 "
Total	787 "
Clearing:	
Light	7,873 acres
Medium	8,173 "
Total	16,046 "
Excavation:	
Unclassified	17,105,530 cubic yards
Rock	1,707,350 " "
Total	18,812,880 " "
Tunnels	5 only
(Total underground)	6,300 linear feet
Bridges:	
Steel (Yukon River):	
784-foot span	2
672-foot span	1
Timber truss:	
144-foot span	18
126-foot span	2
108-foot span	10
96-foot span	5
72-foot span	5
Trestle, pile and frame	53,459 linear feet
Culverts	1,294 each
Ties	2,361,000 each
Rail and fittings (70-pound rail)	107,000 tons
Surfacing and ballasting	787 miles
Telephone and telegraph (2-wire system)	730 miles

Buildings:

Water tanks	20 each
Sand houses	5 "
Fuel oil storage units	5 "
Engine shed and shops	5 "
Car repair shops	5 "
Division office buildings	5 "
Division freight houses	5 "
Mess halls	5 "
Barracks	30 "
Recreation buildings	10 "
Post exchanges	5 "
Infirmaries	5 "
Officers' quarters	5 "
Section houses (double)	31 "

(6) Estimated Cost: The many intangible factors involved in this construction make it impossible to determine the probable cost with any degree of accuracy. One of the greatest uncertainties affecting cost is in the classification of earthwork. Every effort was made to properly evaluate surface indications in the determination of the probable extent of ledge rock and permanent frost. The data secured under the conditions of this survey are not conclusive and are subject to considerable error. An examination of the materials encountered must be made during the summer months for verification or reclassification. The type of labor, time of initiation of construction, and transportation facilities available are assumptions which, if erroneous, would greatly change the actual cost.

Considering these variable factors, the estimated cost shown below must be regarded chiefly as an index of the magnitude of the job.

a.	**Clearing:**		
	Medium - 8,173 acres @ $100	$817,000	
	Light - 7,873 " @ $ 50	394,000	
	TOTAL		$ 1,211,000
b.	**Grubbing and ground cutting:**		
	1,600 acres @ $200		320,000
c.	**Grading:**		
	Unclassified - 17,105,530 cubic yards @ $1.50	$25,658,000	
	Rock - 1,707,350 cubic yards @ $2.25	3,842,000	
	TOTAL		29,500,000
d.	**Tunnel excavation:**		
	6,300 linear feet @ $200		1,260,000
e.	**Bridges (foundations included):**		
	Steel - Yukon River crossing		5,000,000
	Wood -		
	144-foot span, 18 @ $35,000	$630,000	
	126-foot span, 2 @ $30,000	60,000	
	108-foot span, 10 @ $26,000	260,000	
	96-foot span, 5 @ $23,000	115,000	
	72-foot span, 5 @ $17,000	85,000	
	TOTAL		1,150,000
f.	**Trestles, pile and frame:**		
	53,459 linear feet @ $35		1,871,000
g.	**Culverts:**		
	1,294 each @ $150		194,000
h.	**Ties:**		
	2,361,000 @ $1.25		2,951,000
i.	**Rail and fittings:**		
	96,800 tons @ $100	$9,680,000	
	10,200 " @ $110	1,122,000	
	TOTAL		10,802,000
j.	**Track-laying:**		
	787 miles @ $1,500		1,180,000
k.	**Surfacing and ballasting:**		
	787 miles @ $3,000		2,361,000
l.	**Telephone and telegraph:**		
	Tripods, 40/mile - 730 miles @ $500	$365,000	
	2-wire system - 730 " @ $250	182,500	
	Station equipment - 6 @ $4,000	24,000	
	TOTAL		572,000

m. Buildings:

Water tanks	- 20 @ $ 8,000	... $160,000		
Sand houses	- 5 @ 1,500	... 7,500		
Fuel oil storage	- 5 @ 2,500	... 12,500		
Engine shed and shops	- 5 @ 80,000	... 400,000		
Car repair shops	- 5 @ 20,000	... 100,000		
Division office buildings	- 5 @ 15,000	... 75,000		
Division freight houses	- 5 @ 6,000	... 30,000		
Mess halls	- 5 @ 15,000	... 75,000		
Barracks	- 30 @ 3,800	... 114,000		
Recreation buildings	- 10 @ 3,000	... 30,000		
Post exchanges	- 5 @ 3,800	... 19,000		
Infirmaries	- 5 @ 10,000	... 50,000		
Officers' quarters	- 5 @ 4,800	... 24,000		
Section houses (double)	- 31 @ 8,500	... 263,500		
TOTAL			....	$ 1,360,000

n. Transportation system:

150-ton river barges - 14 @ $10,000	140,000	
250-horsepower river towboats - 10 @ $35,000	350,000	
TOTAL		490,000

T O T A L $60,222,000

c. River-Rail Transfer: Construction of the river-rail transfer terminals may be carried on concurrently with railroad construction in the vicinity and with the regular construction equipment and crews. The labor required for the construction of each terminal is estimated at 8,000 man days. The quantities of materials needed are shown on Drawing N-192-5-64 in Appendix "G".

The cost of constructing one terminal is estimated as follows:

Warehouses (two, 60'x150')	$ 55,000
Timber frame wharf	73,000
Stiffleg derricks (two each)	15,000
Surfacing open storage area	27,000
Trackage	40,000
TOTAL	$210,000

d. Pipe Line: As stated in paragraph 13, no detailed design of the pipe line can be made until information is furnished as to the type of product to be handled. On the basis of the present preliminary study, the construction of the pipe line is estimated to require approximately 200,000 man days of labor.

An 8-inch pipe line from Tanana to Teller, a rail distance of 635 miles, will require approximately 34,000 tons of line pipe, 18 pumping units with buildings and appurtenances, including appropriate block and check valves, 520 tons of steel for pipe anchors, hangers, and miscellaneous hardware.

As construction of the pipe line is not contemplated until after completion of the rail connection, transportation of materials will be by rail. Construction plant likewise will be largely obtained from units previously used in construction of the railroad. Additional machinery required would be limited to welding and pipe-wrapping equipment.

The cost of the pipe line is estimated at $11,000,000 for line and anchors, and $500,000 for pumping equipment, making a total estimated cost of roughly $11,500,000.

15. Order of Prosecution. a. The general plan of attack may be outlined as follows:

(1) Develop transportation system for efficient handling of men, machinery, and materials.

(a) Utilize water transportation to the greatest extent possible. Where overland haul is necessary, keep track-laying close to the head of construction so that tractor and truck hauling can be kept to a minimum.

(b) Construct barges, towboats for Yukon River travel and concrete pontoon piers for immediate use at Port Clarence. Secure lighterage equipment for transfer at Seward Peninsula ports.

(c) Improve river-to-rail facilities at Nenana and construct wharfs at Tanana and Nulato.

(2) Initiate work at those points which are critical as to completion time or require summer construction.

(a) The permissible construction period, because of water conditions, for the Yukon River bridge, is from August to April. Most of the materials should be moved to the site before the river freeze-up.

(b) Dredging of the slips and approaches at Port Clarence must be done during the first summer. It likewise is desirable to build the mole and pier heads at the same time.

(c) Sections of light earthwork which cannot be done during the frozen period.

(3) Start that construction which will give greatest progress toward completion of the rail connection as a whole.

(a) Construction from Dunbar and Eureka to provide rail access to the tunnels and bridge at Mile 87 by Fall.

(b) Construction both ways from Tanana utilizing the unloading facilities at that point.

(c) Construction from several points along the Yukon River where light earthwork and use of shoo-flies, or temporary track, will result in greatest number of miles of track laid while rail and materials can be brought in by water shipment. Particular sections are Birches to Tanana, Whakatna Creek Valley, and the lower Nulato River.

(d) Similar construction on Seward Peninsula with initial bases at Moses Point, Council, Iron Creek, and Teller.

(4) Postpone as much as is practical of work that can be performed in winter for winter construction.

(a) Tunnels at Yukon River crossing, Schieffelin Creek, Denny Creek summit, and Six Mile Point (near Koyuk) can be done during the winter.

(b) Sections of heavy rock and earthwork can be done through the winter. The tonnage of rail and other materials required in these sections will be considerably less than that required for the faster work scheduled for summer, and will be in line with the reduced capacity of the transportation system under winter conditions. Efforts should be concentrated first on the heaviest cuts. Where large borrow pits capable of being kept open in cold weather are obtainable, construction of fills across marshy sections can best be done during the winter. Settlement of the fill which may occur later can be corrected with train-hauled material.

(c) Periods of severe weather should not be so protracted as to seriously interfere with progress on bridge and trestle erection, telephone line and building construction.

(d) Logging activities for tie and lumber production can be carried on at maximum rate.

(5) During second summer season, connect up uncompleted sections and proceed with installation of operating accessories, surfacing and ballasting.

16. Summary. a. The average mile for this route may be described as having 3,380 feet of tangent and 1,900 feet of curved track. Of the 25,800 cubic yards of excavation, 2,300 cubic yards will be rock, 8,500 cubic yards are expected to be permanently frozen material, and 15,000 cubic yards will be common excavation. Most of the mile will be on fill of which 65 percent will be obtained from borrow pits. There will be 73 linear feet of pile trestle and two culverts. The maximum grade westbound will be 1.5 percent and eastbound 2 percent. The maximum curve is 16 degrees.

b. The labor force required for the construction of this project in a 400-day period may be summarized as follows:

	1st Season	2nd Season	Average
Port	2,100	900	1,500
Railway	8,800	6,200	7,500
River-Rail Terminals..	160	0	80
Pipe Line	0	600	300
Totals	11,060	7,700	9,380

c. The summary below lists quantities of certain materials required for the various parts of the job. The list includes only major items of critical materials and does not include materials which can be obtained from local sources.

Item	Unit	Port	Railway	River Terminals	Pipe Line	Total
Steel products .	Tons	9,175	116,630	520	34,520	160,845
Ties	Each	82,000	960,000	3,400	0	1,045,400
Lumber and timbers	M.B.M.	9,440	4,980	600	0	15,020
Explosives	Tons	1,200	2,230	0	0	3,430
Copper wire and products	Tons	188	450	0	0	638
Cement	Bbls.	54,400*	24,100	0	600	79,100

d. Items of construction plant which are likely to be critical because of type or quantity are summarized below. Equipment for building the pipe line has been omitted because its construction following completion of the railroad will permit transfer of ample equipment from the previous work. Likewise no equipment has been shown for the river-rail transfer points as they will be built concurrently with the railway and the construction machinery is included in the railroad list.

(*Foot-Note: Includes 30,000 barrels for pontoons which will be fabricated in the United States.)

Item	Port	Railway	Transportation System	Total
Tractors	24	155	29	208
Cat wagons, 8-cubic yard		50		50
Tractor-trailers, 20-ton			29	29
Shovels, crawler, $3/4$-$1\frac{1}{2}$ cubic yard	12	48		60
Trucks, dump, 8-cubic yard ..	60			60
Trucks, cargo, 5-ton	20		16	36
Concrete mixers	2	4		6
Rock crushers	1	8		9
Compressors, 100-500 c.f.m. .	15	50		65
Blast hole drills		11		11
Locomotives, 10-ton diesel ..		44	15	59
Cars, 6-cubic yard, dump		230		230
Cars, 10-ton, flat			106	106
Dredge, dipper	1			1
Barges, river			14	14
Towboats and tugboats	6		10	16
Pile drivers		6		6
Sawmills		7		7
Planes			9	9

e. The efficiency of the transportation system in delivering the items of construction equipment and materials where and when needed is a critical factor in meeting the schedule set up. It should be noted that in addition to the problem of transportation on the job is the problem of transportation to the job. The entire tonnage for the port and 390 miles of railroad in the Seward Peninsula is to be brought to the job by ocean vessel, while a combination of oversea and overland movement is required for the Fairbanks Division. Completion of the project in the scheduled time, therefore, is dependent on the assignment of sufficient tonnage of ocean vessels to perform the overseas movement, and the improvement of the Alaska Railroad or other interior communication to a degree sufficient to meet the needs for overland movement.

The summary below shows the tonnage (weight tons) to be moved by the several routes:

Transport Route	Port	Railway	Pipe Line	Total
Total Job Requirements				
Ocean shipment	37,021	235,435	34,520	306,976
Alaska Railroad	0	97,800	16,070	113,870
Yukon River	0	72,800	16,070	93,870
Requirements first 3 months				
Ocean shipment	15,660	61,870	0	77,530
Alaska Railroad	0	28,400	0	28,400
Yukon River	0	25,000	0	25,000

f. The project cost is summarized as follows:

Port	$ 23,187,000
Railway	60,222,000
River-Rail Transfer	420,000
Pipe Line	11,500,000
Sub Total	$ 95,329,000
Engineering and supervision (5 percent)	4,766,000
Sub Total	$100,095,000
Contingencies (15 percent)	15,014,000
Sub Total	$115,109,000
District and Division Overhead (7 percent)	8,058,000
ESTIMATED TOTAL COST	$123,167,000

17. Acknowledgments. The District Engineer wishes to acknowledge the aid furnished by the National Resources Planning Board in studies of the contiguous area; by the 29th Engineers in preparation of maps; by the Northwest Service Command for

securing planes; the Air Transport Command for initial transportation service; and the Alaska Defense Command for furnishing subsistence supplies when shipments were delayed. The services furnished by these agencies aided materially in the completion of the survey and in the compilation of the information presented in this report.

The District Engineer particularly wishes to commend the personnel who accomplished this survey, at considerable personal risk and discomfort, for their courage and tenacity in completing this assignment.

R. Park.

R. Park,
Colonel, Corps of Engineers,
District Engineer.

C O N T E N T S

The following report, submitted at the request of the U. S. District Engineer, Seattle, Washington, presents a review and summarization of known information about the resources and transportation facilities in the tributary area of the surveyed railroad route from Dunbar on the Alaska Railroad to the deep water harbor at Teller, over 700 miles to the west. This summarized information, it is felt, will be helpful as a background for the consideration of the detailed location survey and for the various decisions that will have to be made with respect to the authorization and construction of the proposed line -- although, it is understood, such decisions will rest primarily on military factors. In addition, since it was found that the problems of transportation in the area immediately tributary to the proposed route could not be appraised properly without some consideration of the routes feeding into the area from outside, one section of the report points briefly and in a general way to these larger aspects of transportation to and within Alaska.

The contents of the report are:

I. Towns and Settlements Along the Route.[1]

That part of Alaska in which the Trans-Canadian Alaska Railroad, Alaska Division, is being located is very sparsely inhabited. In April 1942 it was estimated that the area tributary[2] to this Dunbar-Teller route contained 16,730 permanent inhabitants, a density of about .125 persons per square mile. This compares with a density of .03 persons per square mile for the main part of Alaska excluding the more heavily populated southeastern panhandle. Since the official census was taken in October 1939, the increase in population of the area has been about 5 percent. Of the estimated 16,730, the number living in cities and villages was 12,202.

Within the tributary area population is concentrated in the Fairbanks district and the Nome district. In 1939 persons in the Fairbanks census district numbered 5,692; in the Nome census district, 3,462. The remainder of the population is strung out along the routes of trade and transportation, chiefly the Yukon, Tanana, Koyukuk, and Koyuk Rivers, the Alaska Railroad, the Richardson Highway, and the Bering Sea and Arctic Ocean coasts.

In 1942, within the tributary area, there were 6,012 whites and 6,190 natives living on a permanent basis in towns and villages. The remaining 4,528, mostly natives, are scattered widely over the area and live in small groups. Of the natives nearly all those living west of 159° or 160° Longitude are Eskimos, while those living to the east are Indians. The natives migrate frequently from place to place within the area as they follow better hunting, fishing, and trapping. A considerable portion of the white population moves to and from the area each year, coming in during the spring for the summer mining season and leaving again in the autumn. It has been estimated that during the peak months of 1942 approximately 3,000 whites should be classified as additional temporary residents who have, for the most part, come into the Fairbanks and Nome gold mining districts from the States. Men in the armed services are not included in any of the foregoing classifications.

Since the outbreak of war in the Pacific the population pattern in the area has changed markedly. Families and dependents of men in the armed services and of men, not Alaskans, working on military installations have been evacuated to the greater safety of the States. In

1/ Data for this section are gathered from: U. S. CENSUS reports (especially that of 1940, taken in Alaska in October, 1939); INHABITED PLACES IN ALASKA, National Resources Planning Board, Region 10, Portland, Oregon, revised October 15, 1942; and conversations with government officials and others who are familiar with the area.

2/ By tributary area is meant the area shown on the attached maps, bounded approximately by Big Delta, Fort Yukon, Kotzebue, Wales, Unalakleet, and Healy.

addition many civilians have withdrawn, especially from the more exposed Seward Peninsula. The military population of the area, though large, participates only to a limited extent in the ordinary economic and social life of the area.

The only two cities, Fairbanks and Nome, lie more or less at opposite ends of the tributary area, neither one being located directly on the surveyed railroad route. In the vicinity of both Fairbanks and Nome are quite a number of towns and settlements, lying in their respective gold mining districts, and generally accessible by means of road, tramway, or waterway. The remaining towns and settlements are scattered along the main transportation routes, leaving large blocks of land in the area virtually uninhabited.

1. On and Near the Route.

The route of Trans-Canadian Alaska Railroad, Alaska Division, has its eastern terminus at Dunbar, where junction is made with the Alaska Railroad. Dunbar, in the past, has consisted only of a railroad section house, several shacks, and a few natives at certain times of the year. Northwest of Dunbar and located on the Tanana River in the marshy Minto Lakes region is Minto, a permanent settlement of 147 natives and several whites. The typical placer gold mining camps of Eureka and Glen hum with activity during the mining season and are left almost deserted during the long winters. These camps are provided with bunk-houses and other buildings which might be used in connection with the building and operation of a railroad. Near Eureka are several hot springs such as the ones at Hutlinana Creek. Although there is no permanent settlement at Yukon Rapids, the site selected for crossing the Yukon River, temporary native fish camps are usually established at these rapids during the summer. In the summer of 1942, however, these natives went to Tanana to work on the airfield.

Tanana, located at the confluence of the Tanana and Yukon Rivers, had an estimated permanent population in 1942 of 45 whites and 245 natives. Recently Tanana has been the chief transfer point between upper Yukon and lower Yukon River traffic. Supplementing the ordinary native pursuits a large Civil Aeronautics Administration air field, an Office of Indian Affairs native hospital, and an Episcopal mission make Tanana one of the more important trading centers in the Yukon Valley. Kallands, Birches, and Moose Point (sometimes called Mouse Point) are small native fish camps in summer, but have no year-round population. Near Kallands is a small gold placer. Kokrines, with an estimated total population in 1942 of 86 among whom are several whites or half-whites, with an O.I.A. native school, and with a small trading post, is a typical Yukon River village. Hot Springs (usually called Hot Springs Landing and sometimes called Harner's Hot Springs) is a small native fish camp and, during the summer season, an occasional landing point for river boats.

Along that portion of the Yukon River which the railroad route follows, Ruby is one of the most important trading centers, as well as the only town situated on the south bank across the river from the rail route. In 1942 the estimated permanent population of Ruby consisted of 75 whites and 180 natives. During the months of May to October, approximately 75 additional whites make their headquarters in the town or at nearby mines. In addition to being a mining center and the river port for the Poorman mining section to which it is connected by road, Ruby has a C.A.A. radio range station, a commercial air field, a Territorial school, a small sawmill, a number of traders, and several U. S. government officials. Melozi, Lewis, and Louden on the north bank of the Yukon River between Ruby and Galena are abandoned, and except for the occasional establishment of a native fish camp remain uninhabited the year round. Galena is the location of a large new C.A.A. air field which, now nearing completion, will continue to dominate the activity of the village. The civilian population in 1942, when most of the work was done on the air field, was estimated to be 7 whites and 85 natives living permanently in Galena, and 50 whites and 300 natives making their homes there during the construction season from May through September. The village of Koyukuk at the mouth of the Koyukuk River had in 1942 an estimated population of 5 whites and 31 natives. During the warmer months about 80 additional natives come to Koyukuk for fishing and trading. Nulato, at the confluence of the Nulato River with the Yukon, is an important trading center. The head of trading on the Yukon before 1867 during the period of Russian ownership of the Territory, Nulato is now the transshipment point from Yukon River boats to overland portage westward to Norton Sound. A good-sized Catholic school, a number of government officials, and several busy traders are to be found in Nulato. According to estimates, Nulato in 1942 had 28 white inhabitants and 150 natives on a permanent basis, and an influx of about 30 natives for the months of June to October.

Between Nulato on the Yukon River and the Koyuk River on Norton Bay there are no settlements whatsoever in the near vicinity of the railroad route. Dime Landing, about 15 miles up the Koyuk River and approximately at the point at which the railroad route crosses that river, is not a permanent settlement but merely a small mining camp in summer. Haycock, about 8 miles north of Dime Landing by road, is a center for a number of gold placer mines, and has a Territorial school. The estimated 1942 permanent population of Haycock is 15 whites and 20 natives. Koyuk, at the mouth of the Koyuk River about 15 miles south of Dime Landing, had an estimated population of 4 whites and 103 natives in 1942. The natives in this typical Seward Peninsula village engage in hunting, trapping, fishing, reindeer herding, and to a limited extent, gardening. A number of them have worked at the mines near Dime Landing and Haycock, and have had some experience in handling mechanical equipment. There is an O.I.A. school at Koyuk. At Moses Point is located an important new C.A.A. air field on the military and civil airway between Fairbanks and Nome. Elim, with an estimated 1942 population of 1 white and 105 natives, is a native village with an economy similar to that of Koyuk. A small amount of black spruce suitable for rough construction lumber is to be found near Elim. Golovnin (also spelled Golovin and Golofnin), with an estimated 4 whites and 107 natives, is located at the head of Golovnin Bay and, besides Teller, is the only harbor northwest of Bristol Bay which could be developed for use by ocean-going ships without the necessity of lightering. River scows ply the Niukluk between Golovnin and Council, and limited small boat repair facilities exist at Golovnin. A telephone line operated by the Alaska Road Commission connects Golovnin, Council, and Nome. Several warehouses, a reindeer butchering plant and an O.I.A. school give Golovnin a rather impressive number of buildings. Golovnin natives, in addition to carrying on the traditional native pursuits of hunting, fishing, and reindeer herding, have had some experience in working for wages. The Office of Indian Affairs operates a large boarding school for vocational training of Eskimos at White Mountain. The population estimate for 1942 was 10 whites (teachers in the school), 48 permanent natives, and 148 temporary natives during the months October through April when school was in session. During the summer months many White Mountain natives work in the gold mines in the Council district. The village is served by river transportation and an air field. In connection with the school the O.I.A. maintains an electric light plant, 2 river boats, a bulldozer, and various other equipment. Council, at the head of river navigation on the Niukluk River, is the center of a well developed placer gold mining district. With an estimated permanent population of 32 whites and 11 natives in 1942, Council expanded during the mining season of that year by about 25 whites and 15 natives. Iron Creek, where the surveyed route meets the Nome-Shelton tramway, is an abandoned mining settlement.

Teller, located on a spit between Port Clarence and Grantley harbor, is the western terminus of the proposed railroad route. Actually the route reaches salt water at Cape Riley on Port Clarence several miles below Teller, at which point ocean vessels can make close enough into shore that lightering or even much dredging will be unnecessary. Teller itself had an estimated permanent population in 1942 of 10 whites and 100 natives, while Teller Mission located on the shore of Port Clarence about 5 miles northwest of Teller had 5 whites and 98 natives. During the months of May to October about 8 additional whites and 85 natives are to be found in the area. As a trading and transportation center Teller has 2 trading posts, several warehouses, a landing field on the beach, a 12-mile road leading south to the Bartholomew mining camp, a deep water harbor, an inland water route through Grantley Harbor and Imuruk Basin to Igloo on the Kuzitrin River. Between Teller and Teller Mission is a large reindeer corral, and also a butchering and cold storage plant. Teller is the most important settlement west of Nome.

In addition to the towns and settlements listed above, there are quite a number of shelter cabins spread along the general route of the railroad between Dunbar and Teller.

Although some of the places mentioned are not right on the route which has been surveyed, in no case is the settlement more than a few miles from the route.

2. In the Tributary Area.

In the center of the eastern portion of the tributary area is the town of Fairbanks which had in 1942 an estimated permanent population of 3,800. In previous years about 1,200 additional persons came to Fairbanks, mostly from the States, for the mining season which lasts from May to October. Fairbanks is the northern terminus of the Alaska Railroad, the Richardson Highway, and the new Alaska Highway from Dawson Creek in British Columbia; and is also the hub of a system of radiating airways. A famous mining camp for over 40 years, Fairbanks remains the chief outfitting and servicing point for interior Alaska, where placer gold mining is the leading industry. Nenana, with an estimated permanent population of 250 whites and 75 natives in 1942, which increased seasonally by about 205 during the months April to September, has long been the chief transshipment point for rail and river navigation serving the entire Yukon and Tanana basins. The town is equipped with wharves and warehouses along the Tanana River bank capable of handling fairly large tonnages. About 20 miles south of Nenana is Kobe where the recently surveyed route for a 1,600 mile railroad from Prince George, British Columbia, makes a junction with the Alaska Railroad. Another 35 miles south of Kobe, on a short spur of the Alaska Railroad, lie the Healy River coal fields. Healy and Suntrana, with an estimated total population in 1942 of 155, are the two settlements in this district.

Between Dunbar and Tanana are a number of settlements, such as Tofty and American Creek, which are based on gold mining. Manly Hot Springs (often called simply Hot Springs) is on the north bank of the Tanana River about 20 miles by road south of Eureka. A variety of activities are centered here, including several fur farms, a small sawmill, a good air field and local flying service, some remarkable hot springs which make possible the growing of such crops as sweet corn, tomatoes, melons and cucumbers. There is excellent hunting in the nearby hills. Estimated permanent population in 1942 was 50 whites and 45 natives, with an additional 50 whites during the mining season. About 30 miles above the Yukon crossing on the Yukon River is the placer mining center of Rampart, which had a 1942 population of 27 whites and 60 natives. The site of an abandoned experimental farm, the vicinity of Rampart offers excellent agricultural land on which a wide variety of vegetables, grains, hays, and grasses can be grown. Above Rampart and easily accessible by river during the open navigation season are Stevens, Beaver, and Fort Yukon.

Along the Yukon between Tanana and Nulato most of the settlements of any importance are on the river. Poorman, in the heart of a rich mining district, is about 50 miles south of Ruby by road. A number of settlements, such as Hughes, Arctic City, and Allakaket are located on the upper reaches of the Koyukuk River, but cannot be considered as within the immediate tributary area. About 30 miles down the Yukon from Nulato is the native village of Kaltag which, though having an estimated population in 1942 of 3 whites and 135 natives, has been declining in recent years. Fishing, trading, trapping, and transportation by river boat and airplane account for most of Kaltag's economic activity. Far below Kaltag on the river are the villages of Anvik, Holy Cross, Paimut, Marshall, and others.

West of the Yukon River-Norton Sound divide at the mouth of the Unalakleet River is Unalakleet which in 1942 had a population estimated at 22 whites and 347 natives. Among residents of this village are 14 Lapps who were brought to Alaska many years ago to assist in instructing the Alaska natives in the herding of reindeer. Between Unalakleet and Kaltag is a well-used trail, and also a telephone line. A C.A.A. landing field, an O.I.A. school, and a trading post are to be found in Unalakleet. There are facilities for lightering to and from ocean steamers. Up the coast from Unalakleet is the village of Shaktolik (also spelled Shaktoolik) which in 1942 had an estimated population of 3 whites and 136 natives. Hunting, trapping, fishing, and reindeer herding dominate the economic life of Shaktolik as they do of nearly all the native villages on Bering Sea and the Arctic coast. Quite a number of these natives have had limited experience working with mechanical equipment and for wages. On the land immediately back from the beaches at Shaktolik, Unalakleet, and other similar locations on Norton Sound it has been demonstrated many times that vegetable gardening can be carried on successfully. Ungalik, near the mouth of the Ungalik River, is now abandoned. Solomon, on the coast between Nome and Golovnin and having an estimated population in 1942 of 2 whites and 125 natives, is a typical native village with a landing field. It is connected by road with Nome to the west and with Bonanza Creek to the north.

The center of economic and social activity in the western part of the tributary area is Nome. As headquarters of the Fourth Judicial Division, Nome is the seat for offices of several governmental agencies including the Reindeer Service, Alaska Road Commission, Office of Indian Affairs, General Land Office, Coast Guard, and a number of Territorial agencies, as well as the District Court. By virtue of the gold deposits on the beaches and nearby creeks, Nome has had a colorful history of gold rushes, and remains today with its mammoth electrically driven dredges the focal point of most gold mining activities on the Seward Peninsula. Administration and direction of the reindeer industry, second only to mining in importance on the Peninsula, is centered in Nome. As the center of overland transportation, Nome is well served by commercial airlines and, during the ice-free season in Bering Sea, by both coastwise motor vessels and ocean steamers from Seattle. In 1942 the estimated population of Nome was 750 whites and 500 natives. During the mining season, June to October, about 500 additional persons reside in Nome, while about 200 natives come to

Nome during the same months primarily to market their ivory and fur products and to seek work. Nome, like Fairbanks, has modern facilities such as schools, a hospital, essential public utilities, warehouses, cold storage space, and other items which make for a livable small city. Mary's Igloo (also called Old Igloo) and Igloo (sometimes called New Igloo) several miles to the west are native villages in the Kuzitrin River Valley and have a combined population of about 132, nearly all of whom are natives. Each of these villages has a trading post and an O.I.A. school. The natives engage in hunting, fishing, and reindeer herding. The Catholic Mission in nearby Pilgram Springs closed down in the fall of 1941, so that now there are only about 60 natives living in the village. Shelton, near Bunker Hill Crossing which is the northern terminus of the tramline running north from Nome, is a small mining camp active only during the mining season. In the area north from Shelton to Taylor a number of gold mining camps similar to the one at Shelton are distributed. Beyond Teller at the westernmost tip of Seward Peninsula is the village of Wales, a scant 60 miles across Bering Strait from the mainland of Siberia. Tin City near Wales is a small tin mining camp.

On the northern side of Seward Peninsula are a number of substantial native villages, ranging in population from 100 to 300 natives plus a handful of whites, including Shishmaref, Deering, Kiwalik, Candle, and Buckland. In the Selawik and Kobuk River valleys are several other similar villages: Noorvik, Kiana, Shungnak, Kobuk, Selawik. Kotzebue, on a long peninsula extending out into Kotzebue Sound, with a total population in 1942 of 400 to 600 depending on the time of year, is the chief settlement of northwest Alaska north of Nome.

3. Future Possibilities.

If it is decided to build the railroad from Dunbar to Teller, a number of strategic points may be expected to develop as relatively important communities. These are: (1) Dunbar, where the Dunbar-Teller line makes a junction with the Alaska Railroad; (2) Tanana, at the confluence of the Yukon and Tanana Rivers, a logical transshipment point for tonnage coming down the Yukon River from Whitehorse; (3) Galena, where the railroad route passes within a few miles of an important new C.A.A. air field and where river traffic coming down the Yukon or Koyukuk Rivers may be transshipped to rail for hauling over the divide to Seward Peninsula (Koyukuk, Nulato, or some other place near where the rail leaves the river might be developed as alternatives to serve this latter purpose); (4) Moses Point, the site of another large new C.A.A. air field; (5) Golovnin, after Teller the best harbor north of Bristol Bay, which would be the logical port to serve as an alternative to Teller; (6) the point at which the narrow gauge tramline from Nome meets the Dunbar-Teller line; and (7) Teller, the port at the western terminus of the line.

In addition to these places the various division points on the prospective railroad will provide the basis for limited development of the locations chosen. Tentatively, division and subdivision points might be located approximately 100 miles apart at the following places: (1) Dunbar, (2) Tanana, (3) across the Yukon River from Ruby, (4) near Nulato, (5) near Koyuk, (6) Council, and (7) Teller. Each division point would be equipped with yards, fueling station, sanding house, and repair and maintenance facilities, and would give employment to some 100 to 200 men on a military railroad. At intervals of 8 or 10 miles between division points small crews would probably be stationed for maintenance and operating purposes.

II. Navigable Waterways.[3]

Although the navigable inland waterways which might be used in connection with the Dunbar-Teller railroad are few in number, they are of considerable importance.

1. Yukon System.

Both the upper Tanana and the upper Yukon Rivers provide access to the eastern portion of the proposed railroad route. From Fairbanks, the northern terminus of the new Alaska Highway, and from Nenana on the Alaska Railroad, equipment and supplies for use in construction of the railroad could be shipped on river boats down the Tanana and the Yukon. Between Fairbanks and Tanana village the railroad route is easily accessible from the Tanana River; at Minto where the rail route is close to the river bank; by way of the Tolovana River on which small boats and rafts can ply; by means of a road leading from Manly Hot Springs north to Eureka and Glen which are near the rail route. From Nenana down the Tanana and Yukon as far as Marshall, the Alaska Railroad has for many years operated a number of vessels, the largest of which now running is the "Nenana" (1,028 tons). Only much smaller boats are able to operate safely above Nenana.

From Whitehorse, Yukon Territory, the northern terminus of the White Pass and Yukon Route Railroad, and also on the new Alaska Highway, the Lewes and Yukon Rivers are navigable to Tanana and below. The White Pass and Yukon Route has long operated steamships from Whitehorse to Tanana and Nenana, although in 1943 that company has expected to operate only as far as Fort Yukon or Beaver. The largest boat at present in service has a capacity of 250 tons and, like all the others, is shallow draft. Many of the boats push sizeable barges. By this route materials to be used in constructing the Yukon crossing bridge could be shipped to the bridge site, and also, if desired, much of the steel rail could be shipped in for that portion of the line as far west as Nulato.

From the Yukon crossing above Tanana to the vicinity of Nulato the railroad route parallels the Yukon River, and is never more than a few miles from the north bank, thus affording many points of easy access. The Koyukuk is navigable as far north as Alatna for shallow draft river boats. The lower reaches of this river are wide and deep enough so that steel for the Koyukuk crossing bridge (about 15 miles above the mouth) could be carried by barge to the bridge site.

The navigable portions of the Yukon and Tanana River systems

[3] See map, RELATED TRANSPORTATION ROUTES. For information on water routes in the larger North Pacific area which would be used in supplying the Dunbar-Teller railroad area from the south see accompanying diagram and table showing feeder lines to the T.C.A. Railway-Western Extension.

can also be reached by way of the sea route across the gulf of Alaska through Unimak Pass, through Bering Sea, and up the Yukon River.

2. Seward Peninsula.

Seward Peninsula is most easily reached by the open sea route, with landings at Nome (2,300 miles from Seattle), Teller, Golovnin, Unalakleet, and other coastal settlements. Only at Teller and Golovnin are extensive lighterage operations unnecessary. For many years this area has been served by the Alaska Steamship Company operating vessels from Seattle, and by a number of small motor launches plying the coastal waters between St. Michael and Kotzebue. Statistics for 1936 show that 22 steamers and 44 motor vessels, having a total net weight of 84,114 registered tons, carried 21,265 tons of freight valued at $4,796,622 into and out of Nome harbor, by far the most important port in the area. Of this, coastwise shipments amounted to 1,637 tons.

In case the open sea route is cut or is deemed too risky, shipments can be made down the Yukon River to Marshall, thence to St. Michael, Unalakleet, Golovnin, Nome, Teller, and other points.

A number of navigable rivers on Seward Peninsula reach into the railroad route. The Koyuk River is navigable for small boats as far as Dime Landing, thus permitting water shipment of bridge steel or timber to the Koyuk crossing. By means of the long established route from Golovnin through Golovnin Sound and up the Niukluk River, 20- to 40-ton flat boats are able to reach Council which is on the rail route. This river, as well as others on Seward Peninsula, is more easily navigable in the spring of the year just after the break-up. For 50 miles east from Teller through Grantley Harbor, Imuruk Basin, and up the Kuzitrin River flat boats are able to navigate successfully.

Other rivers which might be used to a limited extent, but only after overcoming such obstacles as rapids, shallow passages, or jutting rocks, are the Shaktolik, Ungalik, Inglutalik, Tubutulik, and Sinuk. On the basis of present information, none of these rivers should be counted on to be of much assistance in the building of the railroad.

Water transportation in the area tributary to the rail route is for a limited ice-free season only. In the Yukon-Tanana river system the average length of the navigation season is 20 weeks, from late May to early October. The beginning and ending of the open season, as well as its length, varies slightly from year to year. After the freeze-up the larger rivers of interior Alaska have some limited use as tractor and sled roads, although frequently the ice is too rough to permit efficient operation.

The navigation season in Bering Sea and Norton Sound extends approximately from June 1 to October 31, varying by a week or two from year to year. The ports on the southern shore of Seward Peninsula are also open for about this length of time. By use of ice breakers the season could be extended for about one month.4/

4/ For a more detailed description of navigation difficulties in Bering Sea and of the port facilities on Seward Peninsula see: CONFIDENTIAL REPORT, RECONNAISSANCE FOR RAILROAD OR HIGHWAY WEST OF FAIRBANKS, U. S. Engineer Area Office, Anchorage, Alaska, prepared under the direction of Lt. Col. B. B. Talley, C. E., officer in charge, Alaska Construction, by Capt. James D. Bush, Jr., C. E., June 15, 1942.

III. Roads and Trails. 5/

1. Existing Roads

The truck or wagon roads of the tributary area may conveniently be divided into two groups: (1) that radiating from Fairbanks, and (2) that scattered over Seward Peninsula.

With Fairbanks as the hub: the Richardson Highway leads south 371 miles to Valdez (and, connecting near Copper Center with the Glen Highway, to Anchorage and the Matanuska Valley); the initial grade of the new Alaska Highway leads from its junction with the Richardson Highway at Big Delta 1600 miles southeast to Whitehorse, Watson Lake, Fort Nelson, Fort St. John, and Dawson Creek where it connects by rail with the main transportation systems of Canada and the United States; the Steese Highway leads northeast 163 miles to Circle on the Yukon River; a road leads northwest 71 miles to Livengood. In addition there is a well developed local network of roads serving the various mining camps in the vicinity of Fairbanks. Fairbanks is now connected by road with Anchorage and Whitehorse-Dawson Creek on a year round basis, the other major highways in the region being closed to traffic during the long winter season. Equipment, materials, and supplies for use in construction of the Dunbar-Teller railroad could be hauled to Fairbanks over either the Alaska Highway or the Richardson and Glen Highways from Anchorage, as well as the Alaska Railroad.

The road running north from Manly Hot Springs on the Tanana River to Eureka and Glen would provide access to the rail route. This road, like most in interior Alaska, is used only during the mining season, but could probably be kept open through the winter with special care.

A number of sled or tractor roads supplement the truck roads. From Dunbar to Minto and Hot Springs a serviceable sled road parallels the river, and from Hot Springs to Tanana is a good truck and sled road. From Eureka north to Rampart on the Yukon above the railroad crossing is another sled road. Particularly useful in winter these sled roads might be of greatest value in hauling heavy rail over the hard packed snow to various points on the rail line.

On Seward Peninsula a number of unconnected road systems are to be found; one in each of the major mining districts. Altogether there are about 250 miles of wagon or truck roads, over 100 miles of

5/ See map, RELATED TRANSPORTATION ROUTES. For information on the roads in the larger North Pacific area which would be used in supplying the Dunbar-Teller railroad area from the south see accompanying diagram and table showing feeder lines to the T. C. A. Ry. — Western Extension.

sled roads, as well as 80 miles of tramway. A fairly extensive road network serves the rich gold mining district immediately north of Nome. The Solomon-Council gold area is linked with Nome by an improved wagon and sled road. The sled road from East Fork, about 12 miles north of Solomon, across to Council has recently been improved by miners to the extent that during part of the year it can be used by trucks. A 12 mile road leads south from Teller to the Bartholomew mining camp. Other short roads exist in the Candle-Deering district on the northern side of the Peninsula, in the Koyuk district between Haycock and Dime Landing, the York district at the western tip of the Peninsula, and the Kougarok district between Shelton and Taylor which in turn is linked with Nome by a tramway.

2. Trails

Within the tributary area of the railroad route are several thousand miles of trails suitable for dog teams in winter and pack trains in summer. On Seward Peninsula alone there are approximately 1,000 miles of trails. For the most part these trails follow broad river valleys, narrow stream courses, beach lines, sometimes crossing open country, and nearly always taking advantage of low divides and other favorable aspects of the terrain. The Yukon River drainage and the Seward Peninsula area are connected by two overland trails; one formerly much used, going over a low divide from Kaltag to Unalakleet, and the other from Alatna on the upper Koyukuk over a divide into the Kobuk River valley and on west to Kotzebue.

3. Possible Connections and Extensions

Quite a number of short access roads would be needed to facilitate construction of a railroad from Dunbar to Teller. Most of these would be roads several miles in length leading from navigable waterways — the Tanana and Yukon Rivers, and the Norton Bay-Bering Sea coast — into the railroad right-of-way. Many of these roads would be temporary and needed only during the period of construction of the railroad. However, improved permanent roads should be built to link the railroad with a point on the north bank of the Yukon opposite Ruby, with the Galena airport, with the Moses Point airport, and with the road running north from Solomon into the Casadepaga River valley.

The tramway between Nome and Shelton (actually between Nome and Bunker Hill Crossing a few miles east of Shelton) should either be relocated in many sections, regraded, and ballasted — in short, rebuilt — at least as far north as Iron Creek where the railroad route first meets the tramway, or should be replaced by a good truck road. In recent years the tram line has hauled 500 to 1,000 tons a year, a typical "train" being made up of a gas engine mounted on a flat car pulling two or three cars and loaded 10 tons on each freight car and 5 tons on the engine car. Several trucks with steel wheels are owned and used by the United States Smelting, Refining, and Mining Company and by the Alaska Road Commission. This tramline, purchased by the Army Engineers in 1942, is unballasted and has many steep grades and sharp curves. Even with the additional equipment brought in by the Engineers the tramway would have to be reconstructed extensively before it could be of maximum use in hauling large quantities of steel rails and ties into the Dunbar-Teller railroad route. Careful consideration should, accordingly, be given to the truck road, to replace the tramway, and not only to give access to the proposed railroad route but to connect Nome with the road already existing between Shelton and Taylor.

Several longer road connections and extensions should be considered in order to fill in the overland transportation pattern and to insure greater security by providing alternative outlets. Most important of these is a road connection between the Dunbar-Teller railroad route and Unalakleet which is an alternative port on Norton Sound some 235 miles nearer Fairbanks than is Teller. This connection might be made by way of Nulato, Kaltag, and over a low divide (800 feet) by way of a well-worn portage trail to Unalakleet, or by way of the South Fork of the Nulato River and the Unalakleet River, making use of a gently sloping 1700 foot pass.

Other road connections and improvements, less relevant to the construction of the Dunbar-Teller railroad, but important in terms of the future security and development of the area are: (1) a road from Teller eastward to Shelton; (2) improvement of the sled road connecting East Fork, north of Solomon, with Council so that it can be used freely by trucks; (3) a road from Haycock north to the Candle-Kiwalik-Deering area, thereby joining the north side of the Peninsula with the railroad on the south side; (4) a road from Teller northwestward to Wales, should either military strategy or more extensive development of the tin mining properties near Tin City warrant its construction; (5) establishment of a truck road from Dunbar to Tanana by way of Minto, Hot Springs, and Tofty by improving the sled road portions of the route; and finally (6) a road from the Dunbar-Teller railroad route to Bethel by way of Ruby-Poorman-Ophir-Flat-Crooked Creek-Akiak, or by way of some other route which would not necessitate a Yukon River ferry or ice crossing.

IV. Airports and Sites. 6/

As in the case of other forms of transportation in the area tributary to the Dunbar-Teller railroad route, air routes radiate from Fairbanks in the eastern portion and Nome in the western, and accordingly most of the airports in the area are grouped around these two centers. Strung out between these two cities along the direct air route, which is roughly the same as the surveyed railroad route, are a number of other airfields, large and small.

The largest commercial airline company operating between Fairbanks and Nome is Pan American Airways which for several years has scheduled three flights a week. In addition two or three other commercial lines have been running over this route in recent years. The military aviation route from Fairbanks to Nome, with major intervening fields at Tanana, Galena, and Moses Point, is now being used heavily.

Converging on Fairbanks, with its improved municipal airport, as well as the military airport at nearby Ladd Field, are air routes from Whitehorse, Anchorage, Bethel, Wiseman, Fort Yukon, and Dawson, as well as Nome and numerous other smaller places. The chief military routes from Fairbanks lead to Whitehorse and Edmonton, Anchorage, Bethel, and Nome and are now being flown not only by the Army and Navy, but also by a number of commercial airline companies operating under government contract.

With Nome as the focal point two commercial airlines maintain services to various points on Seward Peninsula. Other airline companies are based in Kotzebue, Deering, and Taylor. These outfits, like similar ones elsewhere in Alaska, do not, as a rule, operate on definite schedules, but rather by special contract or charter. Owning altogether about 20 to 25 planes, the five local companies on Seward Peninsula had an investment in 1939 of $166,000 in planes, hangars, and other equipment.

In all of interior Alaska airplane travel and freighting is highly seasonal, being concentrated in the warmer months of May to November. Operation during the other months is perfectly feasible, the relative inactivity of winter being due to lack of demand. Until recently the business of these small airlines has consisted mostly of carrying miners and mining equipment and supplies into and out of nearby mining camps.

6/ See map, RELATED TRANSPORTATION ROUTES, on which only the more important airways are shown. For information on airways and airports in the larger North Pacific area which would be used in supplying the Dunbar-Teller railroad from the south see accompanying diagram and table showing feeder lines to the T.C.A. Ry. — Western Extension.

The airfields in the tributary area vary all the way from large, modern military fields with concrete runways, to small, roughly leveled landing strips suitable only for light single-motored planes during favorable seasons. During the ice-free months pontoon type planes are used extensively on the rivers, lakes, and protected inlets; while during the cold months planes with ski-type landing gear are able to land on almost any level snow-packed strip from which the brush has been cleared.

V. Tie and Trestle Timber. 7/

That portion of the tributary area lying east of the divide separating the Yukon River and Norton Sound may be described as one having a light forest cover, principally in the river valleys and on the nearby slopes, but not at elevations of much over 1,500 feet. Since no timber cruising or type mapping has been done in the area, most of the information on timber resources has to be drawn from less "scientific" sources.

Light rainfall, usually 10 to 16 inches annually, long severe winters, and short, rather hot summers characterize the region which is bounded on the south by the Alaska Range and extends north and west to the Arctic tundra and grassland. In this vast interior timber area, which abounds in river valleys and wet flat lands, birch and spruce are the predominant types -- black and white spruce, and Alaska white birch. Site differences determine which type is dominant; in general black spruce tends to dominate except on the large tracts of burnt-over lands. Along the river bottoms such species as black cottonwood, balsam poplar, scattered tamarack (also known as larch), aspen, and willow are found.8/ As the distance away from the stream beds increases the forests become more sparse and open, especially on the poorer soils, at higher altitudes, and on the more exposed sites. Nearly all the usable timber is confined to the meander belts of the major streams.

West of Nulato along the railroad route there is practically no timber that might be used in connection with the construction of a railroad. Indeed, except for a sparse, thin stand of the spruce-birch type in the upper Nulato River valley, and in the valleys of the rivers draining into Norton Bay and Golovnin Sound, this whole area is treeless. The ground cover except on the rocky hill tops is tundra, which is composed of approximately 30 percent lichens, 25 percent sedges, 25 percent shrubs, and 20 percent grasses, weeds, and mosses, with scattered occurrences of dwarfed spruce and other trees. The wet, boggy tundra comprises chiefly cotton sedges, low shrubs and lichens, and is found along the shore and in the stream bottoms; whereas the dry tundra, running more to larger shrubs, grasses, weeds and black sedges, occurs on the better drained slopes. At higher elevations the tundra cover becomes less dense, and the proportion of lichens and grasses increases.

The densest stands of timber are in the Tanana River valley between Tanana village and Big Delta and in the Yukon River valley

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7/ See map, LOCATION OF RESOURCES, GENERALIZED.

8/ See: FOREST AND FUNGUS SUCCESSION IN THE LOWER YUKON VALLEY, by Dow V. Baxter and Frank H. Wadsworth, especially pp. 15-18, for discussion of types and species, growth characteristics, succession, diseases, etc.

in the Birch Creek-Beaver-Fort Yukon flats. Below Beaver in the Yukon valley forest growth thins out within 10 to 25 miles of the river bank. The valleys of the major Yukon and Tanana tributaries such as the Koyukuk, Melozitna, Chandalar, Porcupine, Tolovana, Chatanika, Chena, and Salcha Rivers also are fairly heavily wooded for some distance above their mouths. In addition to these areas timber in the upper Yukon valley as far inland as Whitehorse is accessible by raft to the long central portion of the railroad route. Also ties and lumber from the forests of Southeast Alaska, British Columbia, and the Pacific Northwest states could be drawn on by way of the Inside Passage and rail, river, or highway to the Dunbar-Teller route or by way of Seward or Whittier and the Alaska Railroad.

The usable spruce and birch in the Yukon-Tanana basin averages about 10 to 15 inches D.B.H. (diameter at breast height), although even the usable stands would have to be culled.9/ In certain areas where growth conditions are especially favorable, such as the vicinity of Fort Yukon, trees running up to 25 inches D.B.H. have been observed that are sound except for a few feet of stump rot. Interior spruce, unless it is over-mature, or has been attacked by insects, is usually sound. On the other hand most of the sound birch is small; possibly 50 percent of the birch of sufficient size for use in construction of a railroad would prove to be defective due chiefly to heart rot near the butt.

The chief need is a suitable tie timber which grows near the railroad route. Of all the species occuring in interior Alaska tamarack makes the best tie, taking all relevant factors into account, but unfortunately there is little of it of sufficient size. Black spruce is too small under most conditions to be of use as a tie timber. Cottonwood makes a poor tie unless it is treated and well protected with tie plates.

Alaska white birch is strong, hard, and much of it is of sufficient size, but has the drawbacks of being slow-growing, consequently heavy, and of being susceptible to quick decay. White spruce, although lighter, easier to handle, and more resistant to decay, is less strong and might not be able to withstand spike kill and plate damage quite as well. Neither birch nor white spruce withstands spike removal or other similar mechanical strains without deleterious effects. Both the birch and the white spruce can be utilized untreated and may be expected to last from 3 to 5 years. Both would need the protection of metal tie plates.

9/ On rate of growth see ibid. and "Alaska's Interior Forests," by J. D. Guthrie, in JOURNAL OF FORESTRY, 20:363-73, 1922. Diameter growth of spruce near Fairbanks averages 1.2 inches during a 10 year period.

Of all the untreated woods used for ties on the Alaska Railroad hewn mountain hemlock has proved most serviceable, but unfortunately it is not found north of the Alaska Range. If it is not required that all of the ties be cut along the line of the Dunbar-Teller railroad, some Douglas fir (coastal type) could be shipped in from the fir forests of southern British Columbia and the Pacific Northwest states, or hemlock (mountain or western type) or Sitka spruce could be obtained from southeastern or south-central Alaska.

A composite rating taking into account various properties (static bending, impact bending, compression parallel and perpendicular to the grain, and side hardness) which make for good tie timber lists a number of woods as follows:10/

Douglas fir (coast type)	100.0
Mountain hemlock	118.8
ALASKA WHITE BIRCH	103.1
Sitka spruce (Tongass)	89.7
Western hemlock	83.6
Sitka spruce (Chugach)	81.9
WHITE SPRUCE	81.5
Englemann spruce	63.1

Despite the fact that a really high grade tie timber in sufficient quantity is not to be found within the area accessible from the railroad route, nevertheless it is generally agreed by those persons familiar with the area that sufficient usable spruce and birch is available as far west as Nulato to furnish all the cross ties that would be required for that portion of the line.

Assuming 3,250 cross ties to the mile 11/, the Dunbar-Nulato portion of the line would require about 1,200,000 cross ties (8" by 9") which, at 35 board feet to the tie, would be the equivalent of 42 million board feet. This number of ties could probably be secured from the timbered areas reasonably close to the streams. Assuming only 30 ties to the acre, 40,000 acres would be needed. Actually 50 and even 100 sound ties, including both birch and spruce, could undoubtedly be cut from many of the more densely wooded acres.

Since there are no facilities available in the area for

10/ From unpublished manuscript TIE SUPPLY FOR THE ALASKA RAILROAD by R. R. Robinson, U. S. Forest Service, Alaska. See also: Markwardt, L. J., COMPARATIVE STRENGTH PROPERTIES OF WOODS FOR CROSS TIES, U. S. Dept. of Agriculture, Forest Products Laboratory, mimeographed report.

11/ A median estimate. The Alaska Railroad uses a rough average of 3,200 cross ties per mile.

treating ties and since all possible speed would be necessary in pushing the railroad line through to Teller, it is assumed that untreated ties would have to suffice, at least for several years until more permanent ones could be laid. The ties could be hewn by hand by tie cutters operating ahead of construction or could be sawn by portable saw mills which are moved along with construction. To supply those portions of the line which parallel navigable streams the portable mill could advantageously be mounted on a raft and floated along with construction. Then, of course, the streams could be used for rafting the logs, or even the ties themselves. Spruce rafts satisfactorily, but some of the birch logs might sink. Small stationary saw mills are now located at Manly Hot Springs, Ruby, Koyukuk, and Nulato. For more than 40 years wood along the navigable rivers has been cut for use by the wood-burning steamboats. At certain points the cutters have worked as far back from the Yukon River as 40 miles in their search for suitable wood.

Local wood has long been used for general construction purposes in the area. Spruce, if properly dried, probably makes the best rough building lumber, although birch is also used quite widely for building purposes. As piling to support the rails in swampy ground, spruce can be found of sufficient length (30 feet to 40 feet) and no doubt would prove satisfactory. Untreated spruce piling would, of course, be subject to fairly rapid deterioration, and would have to be replaced continually. Cottonwood, sometimes used for construction lumber, is large enough but has the disadvantage of drying out so rapidly that it is subject to considerable warping and pulling. Cottonwood piling has been used successfully to support the Seward docks, and seems to stand up under driving better than spruce.

Although enough lumber for general construction of sheds, warehouses, platforms, bunkers, etc. could undoubtedly be procured from nearby forests, bridge timbers, switch ties, and other heavy lumber would have to be shipped in from outside the area — probably from southeast Alaska, British Columbia, or the Douglas fir forests of the Pacific Northwest States.

VI. Coal and Oil[12]

1. Coal

In the area immediately tributary to the Dunbar-Teller railroad route there are a number of coal deposits, most of them small, little known, widely scattered, and used only for local purposes. These outcroppings are to be found along the rivers, especially along the Yukon below Nulato[13], near Rampart[14], in the Ruby district[15], and west of Eagle[16]. From each of these areas small amounts of lignitic or sub-bituminous coal have been taken at various times in the past. Judging from that coal which has been mined and the general geology of this whole part of the Yukon valley, coal from these deposits could not be used very successfully in steam locomotives.

Beyond the immediate tributary area, but still within fairly easy access of the railroad route are several important known coal reserves as well as the developed coal mines:

1. In the Healy River valley in the northern foothills of the Alaska Range and on a short spur line of the Alaska Railroad are the largest coal mines in Alaska. Coal in this section is high-grade lignite to bituminous and occurs in a 1900 foot thick coal-bearing formation consisting of 23 separate beds of thicknesses ranging up to 45 feet. Most of the estimated 9 billion tons of reserves in the Nenana coal field, which includes the Healy mines and extends from the Nenana River eastward to the Bonnifield district, are too low in heating value and too fragile for rough handling to meet the competition of better grades[17]. The Healy River Coal Company supplies coal to the mining companies which operate the large placer dredges in the Fairbanks area, as well as to most other users in interior Alaska. Existing mines are able to produce about 300 tons a day at the present time, although during the 1942-43 winter, operations came almost to a standstill until a serious fire could be brought under control. Mining is carried on from an adit, all the coal which has been mined so far being taken from above the adit level. This field has produced over 70,000 tons of coal a year

12/ See map, LOCATION OF RESOURCES, GENERALIZED.

13/ A GEOLOGICAL RECONNAISSANCE IN SOUTHEASTERN SEWARD PENINSULA AND THE NORTH BAY-NULATO REGION, by Philip S. Smith and H. M. Eakin, U.S.G.S. Bulletin 449, pp. 136-141.

14/ MINERAL DEPOSITS OF THE RAMPART AND HOT SPRINGS DISTRICTS, by J. B. Mertie, U.S.G.S. Bulletin 844-D, pp.223-224.

15/ MINERAL DEPOSITS OF THE RUBY-KUSKOKWIM REGION, by J. B. Mertie, U.S.G.S. Bulletin 864-C, p. 224.

16/ ALASKA COAL AND ITS UTILIZATION, by Alfred H. Brooks, U.S.G.S. Bulletin 442-J, p. 60.

17/ See: GEOLOGY OF THE ALASKA RAILROAD REGION, by Stephen R. Capps, U.S.G.S. Bulletin 907, pp. 193-196.

in recent years, and during the past 15 years has yielded over 750,000 tons18/.

Healy River coal is not customarily used as a steaming coal in the locomotives of the Alaska Railroad, although coal of the same general characteristics is used by railroads running across Montana, the Dakotas, and Alberta19/.

2. In the Matanuska River valley in south-central Alaska near Anchorage and also on a spur line of the Alaska Railroad is the Matanuska coal field which may be divided into three coal areas: (1) the valley floor of the Matanuska River, west of the mouth of Hicks Creek, which contains bituminous coal of various grades; (2) Anthracite Ridge on the southern flank of the Talkeetna Mountains between Boulder Creek and Hicks Creek; and (3) the northeastern lignitic field drained by the Matanuska River headwaters.20/

The several mines now in operation are located in the first of these major area divisions, and produce a good grade of bituminous coal. In the eastern part of this division, mostly north of the Matanuska River, in the vicinity of Chickaloon and King Creeks the coal is soft, fragile, burns well, tends to cake, and is friable.21/ In the western part of the vicinity of Eska and Tsadaka creeks are deposits of a similar character except for being somewhat harder and brighter. Most of this coal is accessible and makes a good steam coal and even coking coal. The Alaska Railroad, which maintains its own mine at Eska, uses coal from the Jonesville and Moore Creek portion of the Matanuska field in its locomotives.22/

East of the developed mining area in the Matanuska valley and lying between Anthracite Ridge and the Matanuska River is a coal field about 7 miles long and 4 miles wide which contains a dozen or

18/ Ibid.

19/ For further information on the Nenana coal field see: THE NENANA COAL FIELD by G. C. Martin, U.S.G.S. Bulletin 664.

20/ GEOLOGIC RECONNAISSANCE IN THE MATANUSKA AND TALKEETNA BASINS, by Sidney Paige and Adolph Knopf, U.S.G.S. Bulletin 327, pp. 40-63.

21/ A RECONNAISSANCE OF THE MATANUSKA COAL FIELD, by G. C. Martin, U.S.G.S. Bulletin 289, pp. 18-32.

22/ The Eska Creek coal deposits consist of over 20 coal beds each having a thickness of over 3 feet. In this whole Chickaloon formation the coal is generally a highly volatile bituminous which is friable, does not check quickly, and has a bright luster when mined. It varies from 10 percent to 25 percent in ash content. See: THE ESKA CREEK COAL DEPOSITS, MATANUSKA VALLEY, by Ralph Tuck, U.S.G.S. Bulletin 880-D.

more different beds of low rank anthracite to bituminous which range in thickness from a few inches to 8 feet.23/ Further exploration has revealed that the most promising 20 acres contains an estimated 750,000 tons of anthracite which is folded, faulted, shattered to some extent, and with inclusions of bone and shale. Other broken and irregular but workable beds in the district probably contain several million tons of bituminous coal. Chemical analyses have shown that these coals have no appreciable advantage over the more accessible deposits being mined in the western part of the valley.24/

3. At several other points along the Alaska Railroad there are coal deposits of the Healy type. The Nenana River valley contains many beds of lignite up to 30 or 35 feet in thickness. At Montana Creek, near McKinley Park station, there is a small coal mine in operation and apparently a large reserve of fairly good bituminous awaiting development.

In addition to these accessible coal areas it should be noted that coal occurs in many other sections of Alaska. The more important of these which might be drawn on are:

1. In the lower Susitna River valley and in the Yentna and Skwentna River valleys are scattered deposits of medium lignite some of which have been mined for limited local use.25/

2. On the basis of occasional outcroppings and careful geological reconnaissance, it can be surmised that large reserves of lignitic coal exist in the Bonnifield region east of the Alaska Railroad between the Tanana valley and the northern flank of the Alaska Range. The Wood River basin is estimated to contain more than 160 million tons, while Tatlanika and Dry Creek basins also show evidence of large deposits.26/

3. In the Curry district outcroppings of poor to medium lignite occur on several of the nearby creeks. These deposits are dark brown in color, light in weight, very woody, and tend to disintegrate quickly on exposure to weather.27/

23/ See PROGRESS OF SURVEYS IN THE ANTHRACITE RIDGE DISTRICT, by R. W. Richards and G. A. Waring, U.S.G.S. Bulletin 849-A.

24/ See GEOLOGY OF THE ANTHRACITE RIDGE COAL DISTRICT, by G. A. Waring, U.S.G.S. Bulletin 861.

25/ See THE SOUTHERN ALASKA RANGE, by S. R. Capps, U.S.G.S. Bulletin 862, p. 95.

26/ See THE BONNIFIELD REGION, by S. R. Capps, U.S.G.S. Bulletin 501, pp. 54-62.

27/ THE CURRY DISTRICT, by Ralph Tuck, U.S.C.S. Bulletin 857-C, pp. 139-140.

4. Beds of lignite occur in the Kantishna district in the Teklanika, Toklat, and Kantishna basins. These beds are an extension of the large Nenana field which includes the developed Healy River mines.28/

5. At the present time the coal resources of northwestern Alaska, though great, remain virtually untouched. The main types of deposits may be distinguished on the basis of geologic age: (1) Mississippian coals found in the Cape Lisburne region; (2) Upper Cretaceous coals occurring principally in a broad belt north of the Brooks Range especially in the Colville River valley; and (3) Tertiary coals found principally in the Kobuk River valley but also in other more or less isolated tracts.29/

The Cape Lisburne coal beds apparently do not extend over any considerable area, and because of their complicated structure much of which is broken or crushed, they would be difficult to mine. A few tons of coal from these deposits were once used at the Point Hope whaling station as well as in small heating stoves. In this area 2,600 tons were mined between 1880 and 1924.30/

Of the second type, Upper Cretaceous, tremendous amounts of coal are indicated especially near Corwin and in the Kukpowruk River valley. For instance near Corwin in the measured sections alone are 34 coal beds that represent an aggregate thickness of more than 135 feet of coal, and in the Kukpowruk district each of the 69 measured beds is at least 3 feet thick and the largest is 20 feet thick.31/ As far as can be judged from the meager evidence this coal is not badly faulted or broken.

The following quotation is illustrative of some of the possibilities and difficulties which would be confronted in attempting to obtain coal from these Arctic shore deposits:

28/ THE KANTISHNA REGION by S. R. Capps, U.S.G.S. Bulletin 687, pp. 109-113.

29/ An excellent discussion of what is known about coal in Northwestern Alaska is contained in: GEOLOGY AND MINERAL RESOURCES, NORTHWESTERN ALASKA, by Philip S. Smith and J. B. Mertie, Jr., U.S.G.S. Bulletin 815, pp. 290-320. Contains also summary results of analyses of coal samples taken from many different locations. See also: U.S.G.S. Bulletin 278; U.S.G.S. Professional Paper 20.

30/ A RECONNAISSANCE OF THE POINT BARROW REGION by Sidney Paige, W. T. Foran, and James Gilluby, U.S.G.S. Bulletin 772, pp. 26-32.

31/ U.S.G.S. Bulletin 815 cited above, pp. 317-318.

"The principal outcrops of coal on Kukpowruk River lie between 5 and 7 miles from the coast, in a region of low relief. Shallow-draft barges could convey this coal to the coast, and a harbor for a 400-ton schooner could be made within the lagoon at the mouth of Kukpowruk River. The coal at Wainwright Inlet lies 8 to 16 miles from the coast. Shallow draft barges could be used to convey this coal to the coast also. Considerable dredging would be necessary to afford good berthage for anything larger than launches."[32]

The Tertiary coals of the Kobuk River valley seem to be in scattered small deposits of rather low grade and of use only for local enterprises and heating.

If further investigation should find the coal, located close to the coast, to be satisfactory for use in steam locomotives, it would be quite feasible to mine at such places as Cape Lisburne, Corwin, and in the Kukpowruk River valley throughout most of the year, shipping the coal down the coast to Teller during the 2 or 3 summer months of open navigation.

2. Oil

Although no petroleum is known to exist in the area immediately tributary to the proposed railroad route, there are several known occurrences which might be drawn on:

1. Development of an oil field in the vicinity of Fort Norman in the Mackenzie River valley is now in the process of being greatly expanded by the drilling of additional wells.[33] Recent development work in the field has been most encouraging. A pipeline to connect this field with Whitehorse is under construction. Refining facilities capable of producing high octane aviation gasoline are to be installed at Whitehorse and Fort Norman. From Whitehorse the oil could be transported to the Tanana-Nulato section of the railroad route by river barge or barrel rafts during the twenty-weeks ice-free season, or it could be trucked to Fairbanks over the new highway, or finally it could be piped to Skagway at the head of the Inside Passage through a pipeline now nearing completion and then taken to the westward in ocean-going tankers. Laying of a pipe line from Whitehorse to Fairbanks or Tanana would, of course, permit oil from the Norman field to be delivered all the way by pipe line to the proposed railroad.

2. In northern Alaska the large U. S. Naval Oil Reserve No. 4 may contain extensive oil pools which can be tapped sometime in

32/ U.S.G.S. Bulletin 772, cited above, p. 32. In the vicinity of Wainwright Inlet about 3,500 tons were mined prior to 1925, for use primarily in heating.

33/ According to Dr. Charles Camsell, Canada's Deputy Minister of Mines and Resources, the field is 40 miles long and 20 wide.

the future.[34] Seepages have been observed at Cape Simpson, near Wainwright Inlet, and at numerous other places scattered over the Arctic slope. The best geological evidence leads to the conclusion that widely occurring oil shale has supplied extensive pools, many of them within reach of a drill and without too great a burden of overlying rock. The Cape Simpson prospects, situated only a few miles from the coast, seem to hold the most promise judging from present evidence.

The most serious obstacle to further exploration of these fields and their rapid development is their geographic isolation. At present there are no established lines of communication to and from the Cape Simpson area except for an occasional ship to Barrow in the short summer navigation season. In addition to being ice-bound for ten months out of the year this recently formed Arctic littoral offers no harbor facilities. Ships have to stand several miles off shore while goods are lightered back and forth. If further investigations should warrant intensive development, it would probably be necessary to construct an oil pipeline from the Cape Simpson area (or whatever area should be chosen for exploitation) south over the Brooks Range to some point on the Dunbar-Teller railroad route in order to insure a steady, uninterrupted supply of oil.

34/ See: GEOLOGY AND MINERAL RESOURCES OF NORTHWESTERN ALASKA, Philip S. Smith and J. B. Mertie, Jr., U.S.G.S. Bulletin 815, pp. 274-290. Contains results of tests of Cape Simpson oil samples.

VII. Water Power and Supply

Very little can be said in regard to water power in the area tributary to the Dunbar-Teller railroad route. As far as is known no studies or surveys have been made by government agencies or anyone else.

The vast Yukon-Tanana valley is for the most part flat, filled with many sloughs and ox-bow lakes, and these great rivers are fed in turn by a number of large streams which themselves meander through broad flat valleys. Along the few stretches of the Yukon where bluffs or hills rise up close to the river's edge, there are no major streams. In their upper reaches the tributary streams characteristically flow in deep, narrow channels, between cut-banks, with almost none of the gravel bars so prevalent in the valley floors of the larger streams. However these upper reaches where the stream flows and elevations are such that water power sites might be developed are too far from the prospective railroad line to be of much use. 35/

On the Norton Sound-Bering Sea drainage there are numerous power locations on the streams flowing down from the Darby, Bendeleben, and Kigluaik (Sawtooth) Mountains. None of these streams have been surveyed from the point of view of power development, but the surveys of water supply and stream flow made in connection with the need of the placer gold mining industry for a plentiful supply of water indicate that small amounts of hydroelectric power could be generated at many sites. That such installations would be economic is doubtful.

Securing water in sufficient quantity and of adequate quality for use in the boilers of steam locomotives should not be too difficult. The placer mines and other mines in the Fairbanks and Nome areas have long grappled with the difficulties of ensuring a plentiful water supply. Since all of the gold mines in the railroad area have been closed by War Production Board order (except for the very small ones), their sources of water supply can now be utilized for railroad purposes. In addition, along the route are to be found numerous clear running streams, the water of which could for the most part be used untreated as is done at most points on the Alaska Railroad.

35/ One grandiose scheme has been suggested by which the Yukon River would be dammed at the rapids near Rampart, thereby forming a gigantic reservoir flooding the Beaver-Fort Yukon Flats, and thus providing the head for the generation of huge amounts of electric power.

VIII. Industrial and Agricultural Development

The area through which the projected railroad would pass is still largely wilderness. Population is exceedingly sparse, and, except for trails, there is no overland communication between the eastern and western portions of the area. Consequently, industrial development has so far been slight, and agriculture, aside from the grazing of reindeer, has been limited to a few small farms in the vicinity of Fairbanks and occasional gardens in other settlements. In contrast to earlier frontier regions of North America the initial development and settlement was not primarily agricultural in nature. Instead, mining -- more particularly gold mining -- has been the spearhead. The first trails, later the rough sled and tractor roads, and finally the air routes were pioneered primarily in order to provide access to gold-mining properties. Trapping, some fishing, reindeer herding, and trading, in addition to limited agriculture and industry, comprise the remaining economic activities.36/

The area tributary to the railroad route may be divided into three parts: the Fairbanks district, Seward Peninsula, and the relatively undeveloped "in-between."

1. Fairbanks District.

Fairbanks is in the heart of the most highly developed gold placer district in Alaska, most of the larger operations being within a radius of 25 miles of the town. The immediate Fairbanks district in 1940 furnished over 57 percent of all the placer gold produced in the whole Yukon region of Alaska, and approximately 38 percent of the placer gold production of all Alaska. In 1940 the value of placer gold produced in the Fairbanks district was $7,315,000; in 1939 it was $5,041,000. In 1940 the Alaska part of the Yukon Basin as a whole, including Fairbanks district, produced $12,727,000 in placer gold; in 1939 produced $10,810,000.37/ Total employment in 1940 in placer mines in the Fourth Division, which is, roughly, the same as the Yukon Basin, was 2,864; while in 1939 it was 2,600.38/

Lode gold mine production in the Fairbanks district in 1940 was only 15,914 fine ounces, valued at $557,000.39/

36/ See map, LOCATION OF RESOURCES, GENERALIZED for approximate location of various natural resources in the tributary area.
37/ MINERAL INDUSTRY OF ALASKA IN 1940, by Philip S. Smith, U.S.G.S. Bulletin 933-A, p. 38.
38/ REPORT OF THE COMMISSIONER OF MINES of the Territory of Alaska for the biennium ended December 31, 1940, p. 44.
39/ MINERAL INDUSTRY OF ALASKA IN 1940, cited above, p. 15.

Other minerals produced in small quantities in the eastern portion of the tributary area are antimony, tungsten, tin, lead, silver, and coal.

Although the Tanana-Yukon area has been explored and prospected more thoroughly than any other part of interior Alaska, it may yet contain valuable deposits the locations of which are at present unknown. The proposed railroad would stimulate prospecting by providing much cheaper and more reliable transportation to portions of this district, and would also make possible the shipment of ores and concentrates to mills outside of the mining area.

While mining is the only major industry in the Fairbanks district, there are several definitely minor enterprises, including several small sawmills and a variety of trade and servicing businesses.

Although immense tracts of land scattered through the Tanana and Yukon River valleys are undoubtedly capable of growing crops and can be classified as potential agricultural land, the actual acreage at present under cultivation is exceedingly small.[40] The lowest estimated area of available farming land in the region comprising the bottom lands of the lower Tanana River, the highlands and the bottom lands of the Yukon River to the north is 4,500,000 acres, and includes much of the best farming land in Alaska. In the more accessible Tanana valley alone are about 640,000 acres of land suitable for agricultural purposes. Yet in 1942 the number of acres in the Tanana valley actually under cultivation was less than 1,000, and most of that confined to the immediate vicinity of Fairbanks. Agricultural employment in the valley for 1940 has been estimated at a mere 100.

Climatic and soil conditions are favorable for the production of a wide range of grains and vegetables. As a rule gently sloping hillsides with southern exposure prove most satisfactory for cultivation. The exceptionally long days near the summer solstice compensate for the short growing season of 50 to more than 100 days. Average rainfall in the Fairbanks district is 12 inches per year, half of which falls during the frost-free season. Average July temperature is 60 degrees.

Hay, grain, and potatoes are the most important crops grown in the Tanana valley. Potatoes are the chief cash crop with yields averaging 4 to 7 tons per acre and prices from $2.50 to $5.00 per hundred pounds. Hardy varieties of oats, wheat, and barley have proved

40/ For recent summary of available literature see: BIBLIOGRAPHY AND ABSTRACTS ON THE SUBJECT OF AGRICULTURE IN ALASKA, by George Sundborg, National Resources Planning Board, Juneau, Alaska, 1942.

the most successful grains. A wide variety of root and leafy green vegetables can be grown in the valley, including carrots, beets, onions, lettuce, cabbage, cauliflower, rutabagas, radishes, and many others. Several local dairy farms producing for the local market have been established near Fairbanks.

The chief limiting factor to further development of agriculture in this area is the small size of the market. As the population increases and as the market area is extended, agriculture may be expected to expand proportionately. The proposed railroad should do much to extend the market of the Fairbanks producing area, and to encourage small-scale truck farming at other favorable places, such as Manly Hot Springs.

2. Seward Peninsula.

A distinct sub-region in itself, Seward Peninsula is separated from the rest of Alaska by an uninhabited, untravelled belt, stretching east and west, roughly, from Nulato to the Koyuk River. Like the Fairbanks district at the eastern end of the proposed railroad route, the chief industry on Seward Peninsula is gold mining. In 1940 the gold placers of Seward Peninsula and northwestern Alaska produced $4,475,000, of which 78 percent was mined by dredges. In 1939 the production figure was $3,600,000.[41] Employment in the gold placer mines of this area in 1940 was 1,028; and 1,169 in 1939.[42] Although the district in the immediate vicinity of Nome, with its concentration of large electric dredges, is the leading gold-producing area on Seward Peninsula, considerable mining is carried on in the Kougarok, Fairhaven, Council, Koyuk, Bluff, Solomon, and Port Clarence districts.

Near Tin City at the western tip of Seward Peninsula are occurrences of mineral cassiterite in placer form. This deposit produced, in 1940, 104,000 pounds of metallic tin valued at $52,000. The record production of 372,000 pounds valued at $202,300 was obtained in 1937. As the leading tin-mining area under the American flag, this part of Seward Peninsula produced 3,398,000 pounds of metallic tin valued at $1,635,800 from 1902 to 1940. Further geological exploration, now being accelerated as a result of the war demand for strategic minerals, may reveal new opportunities for development.

Other minerals found on Seward Peninsula are platinum, in the Koyuk River valley, lead, and coal, especially in the Kiwalik River drainage.

From the point of view of the natives, the most important

41/ MINERAL INDUSTRY OF ALASKA IN 1940, pp. 38, 55-63. Contains a recent discussion of mineral industry and outlook for Seward Peninsula.

42/ REPORT OF THE COMMISSIONER OF MINES of the Territory of Alaska for the biennium ending December 31, 1940, p. 44.

economic activity on Seward Peninsula is the reindeer industry, which involves raising, herding, slaughtering, and distributing reindeer products, chiefly meat and hides.43/ The maximum capacity of the Seward Peninsula reindeer ranges in 1940 was estimated to be 141,700 deer, while the total number actually on the ranges was 97,844, owned by 1,372 natives. The distribution was such, however, that certain ranges were overstocked and certain understocked. An estimated 17,812 deer are needed annually to meet the food and skin needs of the region. In 1940 the value of meat and skins came to $117,321, of which $95,902 represented that used by the natives themselves.

An Act of Congress passed in 1937 provided for the purchase of all reindeer owned by white persons. The entire industry is now administered exclusively for the benefit of the natives. In attempting to secure for the natives a reasonably complete self-sufficient economy, reindeer husbandry will have to provide the chief items of clothing and food.

One of the reasons why the export of reindeer meat has never amounted to much 44/ is that by the time the deer are prime in October, the last boat of the season is ready to leave Nome. A railroad giving year round service to Seward Peninsula would provide a steady, dependable outlet for shipments of at least a modest amount of reindeer products.

Other industries on Seward Peninsula include fur farms (especially fox and mink); trapping of fur-bearers (which provided over $75,000 in income for natives in 1939); some fishing for salmon and herring; native arts and crafts (including skin-sewed fur clothing and footwear, ivory carving, baskets, dolls, snowshoes, etc., which yielded, in 1939, through the Office of Indian Affairs marketing service, articles valued at $67,005); and various trade and service enterprises.

Agriculture on Seward Peninsula is non-existent except for a few vegetable gardens near some of the villages. Greatest success with hardy vegetables has been recorded at Unalakleet, Shaktolik, and Pilgrim Springs.

3. Intermediate Area.

In the tributary area between the Fairbanks district and Seward Peninsula development is confined almost entirely to the Yukon River valley and a few scattered gold-mining districts, such as near

43/ For a brief, well-rounded discussion of the reindeer industry of Seward Peninsula see: PRELIMINARY ECONOMIC SURVEY OF THE SEWARD PENINSULA AREA, Alaska Planning Council, 1940, pp. 41-57.

44/ Although in 1940 the Bering Unit alone (area including Teller, Igloo, Wales, Shishmaref, and Deering) shipped out 107,931 pounds of meat.

Poorman and in the Koyukuk River valley. The lumber and fuel which can be obtained easily from the spruce-birch forests growing in the river valleys, the salmon which ascend the main rivers each year, the local trapping and hunting, a few small vegetable gardens, in addition to transportation and trading, provide the economic basis for the native villages which are strung out along the Yukon. Except for these valleys, the country in between Fairbanks and Seward Peninsula is largely unknown. How much mineral wealth -- gold, silver, antimony, tungsten, platinum, and other minerals -- may be hidden in this wilderness only further geological and mineral surveys can reveal.

Conclusions

It is difficult to predict future developments in the area tributary to the Dunbar-Teller railroad route. The backbone of the economy of the area, at least up to the present time, has been gold mining. Supporting this have been mining for other minerals, trapping, fishing, local agriculture, trading, and, among the natives, reindeer-herding and arts and craft work.

Fairbanks and Nome, by far the largest towns in the area, have, since the great gold rushes of 40 years ago, been supply bases for vast hinterlands and centers of trade and transportation. In the pattern of military developments which has emerged since 1939, Fairbanks and Nome have retained their strong positions.

In October of 1942, gold mining in Alaska, as in the States, was virtually suspended by order of the War Production Board. Construction of army bases, civilian and military airfields, and other military installations has held the Alaska economy at a boom level.

In the post-war period, after the construction boom has passed, gold mining may be expected to reassert its position -- at least partially. To this will be added a greatly expanded transportation industry, largely an outgrowth of the military transportation system now being established in the region. Airways, highways, pipelines, rivers, and railroads will each have their roles to play in providing access to interior Alaska and fitting into the developing transportation network of the whole North Pacific area.

While it would be over-optimistic to anticipate any very great agricultural or industrial development in the tributary area, a certain limited amount can be expected along the route (especially if the railroad should be built) based on the increase in population and the cheaper, more reliable transportation service. Local agriculture supplying to an increasing extent the tributary area itself and the establishment of metallurgical processing plants seem to offer the best hope of success.

Assuming that in peace time about 5 tons per year per capita would have to be shipped to interior Alaska, the present population in the service area of the proposed Dunbar-Teller railroad (i.e., west of the Fairbanks district) would require some 40,000 tons per year. On the basis of an average haul of 400 miles, this would amount to 16,000,000 ton miles. These estimates include foodstuffs, clothing, machinery, hardware, building materials, automotive equipment, and various other commodities; but do not include petroleum products for servicing the new airfields or fuel for the proposed railroad. Further mining, agricultural, and transportation developments, with the attendant increase in population, would raise the tonnage estimates materially. However, it must be stressed that ordinary peace time economic development, while it would benefit greatly as a result of the railroad, cannot "justify" its construction. Certainly, a rail line from Dunbar to Teller, passing through or near Tanana, Galena, Moses Point, and connected with Nome by a spur rail line or improved road, would solve the problem of supplying these major airfields.

IX. Relation of Dunbar-Teller Railroad to Transportation Pattern of North Pacific Area.

In order to appraise the probable usefulness of a railroad running westward from Dunbar to the deep water harbor at Teller on the coast near Bering Strait it is necessary to consider the whole pattern of transportation routes in the North Pacific area, stretching from northwestern United States to the western tip of Alaska less than 60 miles from Siberia. Especially, it is necessary to consider the question: will the various routes leading to Dunbar and Fairbanks deliver enough tonnage, over and above that consumed east and south of these points, to justify construction of the railroad to Teller? A glance at the accompanying sketch map would seem to indicate quite clearly that the Dunbar-Teller line is not sufficiently buttressed and fed by secure, dependable land transportation routes from the south and east. Particularly in view of the fact that the Alaska Railroad has, during the winter of 1942-1943, been carrying only about 35,000 tons a month, and in view of the difficulties of hauling large tonnages to Fairbanks by means of low-standard highways and by means of the upper Yukon River, the Dunbar-Teller railroad appears in some respects to be stuck way off by itself in the wilderness.

Two approaches to this problem can be taken, each of which will shed light on the possible solutions as well as the difficulties. First, on the basis of past experience, how great a tonnage can be expected to flow into Fairbanks and Dunbar for shipment on to Teller by the various available routes? Second, assuming that a fixed amount, say 220,000 tons per month is to be shipped to Teller over the proposed railroad, how may this load be distributed over the routes feeding into Fairbanks and Dunbar?

1. On the Basis of Past Experience.

The following table attempts to estimate the tonnage of goods (military or civilian) which can be carried, on the basis of present facilities and known plans, to Fairbanks and Dunbar for through-shipment to Teller. In this way the tonnage prospects for the Dunbar-Teller extension can be appraised.

The estimates in Table 1 have been worked out primarily on the basis of the esperience so far gained in the operation of the various routes. In each case the estimates assume ample equipment for reasonably efficient operation — taking full account of the difficulties and delays due to severe cold, storms, break-up conditions, muskegs, organizational problems, etc. — after the various extensions and improvements now under construction or definitely planned for the near future have been completed.

Table 1. Maximum Tonnages Which Can Be Carried to the Proposed Dunbar-Teller Railroad by Various Routes.

Routes to Fairbanks and Dunbar	To Fairbanks and Dunbar—for shipment on to Teller*			
	Summer operation (tons per month)		Winter operation (tons per month)	
1. Alaska Railroad—from Whittier, Seward, Anchorage	20,000		10,000	
2. Richardson Highway—from Valdez, Anchorage	10,000		5,000	
3. Alaska Highway—from Dawson Creek	50,000		20,000	
4. Haines Cut-off—Alaska Highway	50,000		20,000	
5. W.P.&Y. Railway—Alaska Highway	5,000		5,000	
6. W.P.&Y. Railway—Yukon River to Tanana	10,000		none	
Sub-Total	145,000		60,000	
7. (Inside Passage—barges, ships (to Haines, Skagway		65,000		25,000
(Inside Passage—barges, ships (to Excursion Inlet		30,000		15,000
8. Pipeline—Fort Norman, Whitehorse, Fairbanks	40,000		40,000	
Total	185,000		100,000	

*Assuming ample equipment, maximum operation after extensions and improvements now under construction or projected have been completed. No account is taken in this table of tonnage hauled over the various routes which is not destined to Fairbanks and Dunbar for shipment to Teller. Estimates based on conversations with officials, reports and other sources.

Considering the various routes shown in Table 1:

1. Alaska Railroad. During each of the last few months of 1942, the Alaska Railroad carried about 35,000 tons to all points on its line. Only a small part of this was shipped through to Fairbanks. This entire tonnage was consumed in the railroad belt of Alaska for military and civilian purposes. With the opening of the new port of Whittier in the spring of 1943, it has been estimated that the line will be able to increase the tonnage handled by 20 percent, to 42,000 tons per month, using only present equipment. On the basis of this performance, the estimates in Table 1 of 20,000 tons per month in summer and 10,000 tons per month in winter to Dunbar for shipment on to Teller is high and assumes more efficient use of existing facilities than heretofore.

2. Richardson Highway. During the summer of 1942 about 800 tons a day were trucked out of Valdez over the Richardson Highway, for the most part loaded in $2\frac{1}{2}$ or 3-ton trucks, each carrying 7 or 8 tons. Heavier loads or larger trucks, experience has shown, tend to break down the road. With some improvements in the road, especially in the section from Valdez over Thompson Pass, this figure of 800 tons per day could probably be increased to 1,500 tons per day, which is about the capacity of the Valdez terminal facilities. To haul 1,500 tons, nearly twice as many trucks would be required. In 1942, the Richardson Highway remained open from May 1 to November 20, and this probably represents the average length of season during which the highway can be kept open for effective operation. Assuming conservatively that 1,000 tons per day (or 30,000 tons per month) can be hauled out of Valdez, it is estimated in Table 1 that of this, 10,000 tons per month would reach Fairbanks consigned for Teller. By using the new Glen Highway between Anchorage and Copper Center a through-road from Anchorage to Fairbanks was kept open at all times during the winter of 1942-1943. In winter time when the Richardson Highway is not cleared for through-traffic, limited use could undoubtedly be made of this alternative road connection between the coast and the interior.

3. Alaska Highway from Dawson Creek. Late in 1942 this new 1,600-mile pioneer road was opened for through traffic from Dawson Creek at the northern terminus of the Northern Alberta Railroad to Fairbanks. By late 1943 it is expected to have been improved to a standard 2-lane gravel road. So far, insufficient experience has been accumulated to warrant very accurate estimates as to its carrying capacity. About 50,000 tons per month in summer and 20,000 tons per month in winter for shipment on to Teller seem to be reasonable estimates for the next year or two.

4. Haines Cut-Off. This road, which will meet the main Alaska Highway at Champagne, is expected to be completed by September 1, 1943. Although designed for year-round operation, it is still difficult to estimate the average monthly tonnage it will be able to handle. On the basis of experience on the Richardson Highway and other roads in Alaska and northern Canada, the estimates contained in Table 1 seem reasonable; that is, 50,000 tons per month during the summer months from Haines to Fairbanks destined ultimately for Teller, and 20,000 tons per month during winter. With 50,000 tons per month originating at Dawson Creek and another 50,000 tons per month originating at Haines, both destined for Fairbanks, that portion of the Alaska Highway would be subjected to double duty and would, therefore, have to be improved accordingly. Unfortunately, within this section from Kluane Lake to the Alaska-Yukon boundary lie the stretches most difficult to keep open.

5. White Pass and Yukon Railroad-Alaska Highway. In the past year the best performance of the 112-mile narrow gauge railroad

from Skagway to Whitehorse was 4,000 tons per week. During several intensely cold weeks in December 1942, operations declined almost to zero. The operation of the railroad is now under the control of the U. S. Army. Additional locomotives and rolling stock plus improved organization of the barge line to Skagway and the railroad from there to Whitehorse may be expected to result in the handling of larger tonnages in the future. It is estimated in Table 1 that 5,000 tons per month over this route might reach Fairbanks bound for Teller.

6. White Pass and Yukon Railroad-Yukon River to Tanana. During each week of about a 20-weeks' season of open navigation the upper Yukon waterway, using the boats and barges at present on the river, should be able to carry 500 tons from Whitehorse down to Tanana (or some lower point) for trans-shipment to Teller by rail. During the remainder of the year, this river route would be closed to traffic completely. During the open season of 1942 about 18,000 tons were shipped down the upper Yukon from Whitehorse, destined mainly for the Dawson, Mayo, and other mining districts. Because of the difficulty in obtaining workmen and mining equipment, it is estimated that 8,000 tons (or less) down the river will meet the local needs in 1943, thus leaving surplus shipping space to carry goods to a junction with the proposed railroad at Tanana.

7. Barge Line. A barge line on the Inside Passage from Seattle and Prince Rupert to Haines, Skagway and Excursion Inlet is now in the process of being developed. At the present time, existing tow boats and barges, if used to the fullest extent, will carry to Haines, Skagway, and Excursion Inlet about 5,000 tons per month from Seattle, and 43,000 metric tons per month from Prince Rupert, making a total of 48,000 metric tons per month.45/ As additional equipment is provided and as additional dock facilities are installed, especially at Haines, Skagway, and Excursion Inlet, these figures will be increased. Cargo carried in steamships will probably continue to augment that carried by barges.

In order to meet the estimated effective carrying capacities of the routes from Whittier, Seward, Anchorage, Haines, and Skagway to Fairbanks, the Inside Passage route will have to be able to handle 95,000 tons per month in the summer season and 40,000 tons per month in winter, as shown in Table 1. Some of the trans-shipment burden which might be expected to fall on Excursion Inlet will undoubtedly continue to be borne by Juneau. No account is taken here of the vast additional barge, tow boat, and dock facilities which will be needed to handle shipments to Kodiak, Dutch Harbor, and other points to the westward.

Table 2 shows military cargo shipped in 1942 from Seattle, Prince Rupert, and Juneau to various ports of discharge in Alaska and

45/ One metric ton is equal to 2204.6 pounds. All figures in Table 1 are in short tons.

the amounts forwarded from these ports to Fairbanks.

Table 2. Military Shipments by Water Routes to Various Alaska Ports — 1942.

Port of Loading	Port of Discharge	Total tons discharged (in metric tons)	Tons forwarded to Fairbanks (in metric tons)
Seattle	Skagway	64,213	981
Prince Rupert	Skagway	58,273	
Juneau	Skagway	887	
		123,373	
Seattle	Valdez	33,185	124
Juneau	Valdez	495	
		33,680	
Seattle	Seward	164,578	41,795
Prince Rupert	Seward	1,603	
Juneau	Seward	2,178	2,178
		168,359	
Seattle	Anchorage	132,638	8,342
Seattle	Nome	100,704	
Juneau	Nome	978	
		101,682	53,420

Source: Seattle Port of Embarkation, Confidential Report.

8. Pipe Line. Through the pipe line from Skagway to Whitehorse, gasoline is already being delivered to Whitehorse. The pipe line from the Norman fields, the development of which is now being intensified, is under construction. When completed, it is estimated that it will deliver large amounts of petroleum products (gasoline, fuel oil, Diesel oil) each month to Whitehorse. By extending the pipe line from Whitehorse on to Fairbanks, oil and gasoline could be piped all the way from the wells to the proposed railroad. In Table 1, it is assumed that 40,000 tons per month of gasoline and oil will be piped to Fairbanks. Of course, in case the pipe line is not continued on to Fairbanks, then gasoline and oil will have to be supplied to Interior Alaska by other means, and the totals of Table 1 will be 40,000 tons less in both summer and winter, thereby throwing an additional burden on the heavily taxed Alaska Highway and the other routes to the Interior.

9. Total by all routes. The totals shown in Table 1 — 185,000 tons per month in summer and 100,000 tons per month in winter —

which might be shipped to Fairbanks and Dunbar for further shipment to Teller are, if anything, probably too high, even though the items making up the totals are estimated largely on the basis of past experience.

2. On the Basis of an Assigned Load.

Whereas Table 1 has been built up out of the past experience and the future prospects of the transportation routes, and takes as its point of departure what under favorable conditions can actually be done, the estimates contained in the accompanying route diagram with attached table -- Transcanadian-Alaska Railway, Western Extension: Feeder Transportation Lines -- are predicated on the necessity of delivering by the various routes available 220,000 tons per month to Fairbanks and Dunbar for shipment over the proposed railroad line to Teller. If the objective is to carry this amount of tonnage from Dunbar to Teller by rail, then that load will have to be distributed over the access routes to Fairbanks and Dunbar roughly as shown in the diagram.

This chart was made to provide an over-all but roughly proportionate view of the whole problem of channeling traffic to the western railroad extension, from bases of supply in the United States and Canada and through various indicated means of transportation, in sufficient volume to justify the expenditure of effort, labor and materials involved in the construction and operation of this proposed rail link.

The analysis starts with the assumption that something like 220,000 tons per month would be a logical load for a military railroad of this character. Assuming nominal amounts that will be required for supplying various way points, it then proceeds to approximations of the loads that would be imposed on the various transportation routes from the primary supply bases. These calculations do not take into account the proposal to construct the Transcanadian-Alaska continental trunk line from Prince George on the Canadian National Railway.

With the limited data available as to tonnage needs of various points in Alaska and as to present and proposed capacities of transportation and terminal facilities, it is difficult to give more than a summary indication of the problem and the ways in which it may be solved.

Looking at the problem of transportation in the North Pacific area as a whole and at the problem of feeder routes for the Dunbar-Teller route in particular, as shown in the accompanying diagram, several difficulties stand out clearly:

1. The feeder lines to Fairbanks and Dunbar are many and complicated. There is no single, truly reliable, overland route connecting with the main transportation network of southern Canada and the United States. There is no through route to Fairbanks that does not involve at least one trans-shipment from one type of carrier to

another, and most of the routes involve two or more trans-shipments. A breakdown at one section of any one of these routes would throw the whole interrelated system out of gear; a bottleneck at one transfer point or dock would upset the whole balance. One route, for instance, would involve the following trans-shipments: At Prince Rupert, from railroad to barge; at Skagway, from barge to railroad; at Whitehorse, from railroad to highway; at Fairbanks, from highway to railroad.

2. The overland routes involving highways cannot be counted on for uninterrupted year-round service. The winters are severe. Temperatures of minus 50° and below, which are not uncommon, are likely to freeze up equipment and reduce traffic almost to a standstill. During the break-up in April and May, roads like the new Alaska Highway will undoubtedly be closed to through trucking for a period totalling a month or so.

On the basis of the very rough analysis contained in the diagram and table, it appears that it would be difficult to deliver to the Teller line an effective volume of traffic without the continental rail connection. The quantities that would have to be moved over the long Alaska-Canada highway and over the water routes are very large considering the nature of these facilities and the state of their development. In the case of the longer highway routes especially, extensive improvements in the roadways and large numbers of men in maintenance and operating forces would be required to step up carrying capacities to the orders of magnitude shown on the chart.

3. The most serious bottleneck, as can readily be seen in the diagram, is the Inside Passage from Prince Rupert north. The present capacity (March 1943) of the docks and transit sheds at Juneau, Excursion Inlet, Skagway, and Haines is 51,375 metric tons, with additional capacity of 11,340 metric tons at Juneau and 150,000 metric tons at Excursion Inlet under construction and due to be completed by mid 1943. The amount which will have to be shipped up the Inside Passage, according to the estimates contained in the diagram, is 290,000 tons per month. Tow boat and barge equipment available at present (March 1943) is capable of delivering 48,000 metric tons per month to Juneau, Skagway, Haines, and Excursion Inlet. In these calculations no allowance is made for the tonnage of goods, military and civilian, which might be barged to Excursion Inlet, and there transshipped for Kodiak, Dutch Harbor, and other points to the westward.

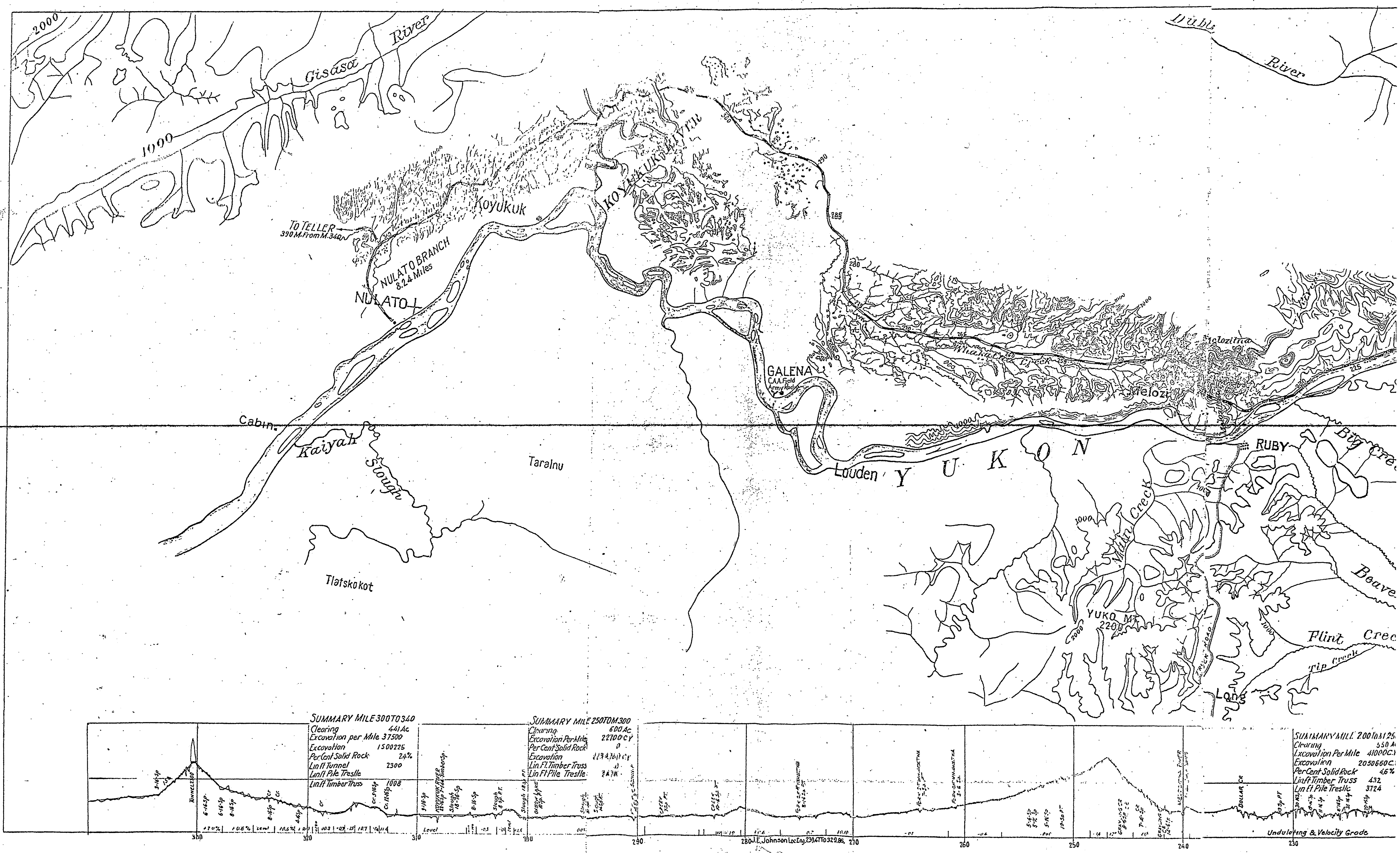
Obviously the main reliance in the whole transportation scheme is placed squarely on the Inside Passage barge line. Steamships are precious and should be reserved for ocean duty. And yet the Inside Passage transportation line itself might under certain adverse conditions be cut, at least temporarily. In that event the tonnage reaching Fairbanks would dwindle quickly to a small trickle.

These various difficulties and weaknesses in the transportation pattern, as it is now developing, point to the need for consolidation, simplification, and improvement of the various connecting lines between the States (and southern Canada) and interior Alaska. The danger is that a broad gauge, fairly heavy-duty railroad extending west from Dunbar to Teller will be insecurely linked with the supply base in the States. The simplest solution to this problem would be to construct the Transcanadian-Alaska Railway from Prince George on the Canadian National Railway to Kobe south of Fairbanks on the Alaska Railroad. Since a most advantageous route making use of the long, straight Rocky Mountain trench has already been located, construction, if decided upon, could be launched promptly. Such a railroad would establish a secure, inland, year-round route to interior Alaska.46/ It, along with its western extension to Teller, would provide all-rail transportation from such points as Prince George, Edmonton, Seattle, and Chicago to Fairbanks and Teller, and would eliminate the necessity for piecemeal patching of inferior lines of access and for time-consuming trans-shipments.

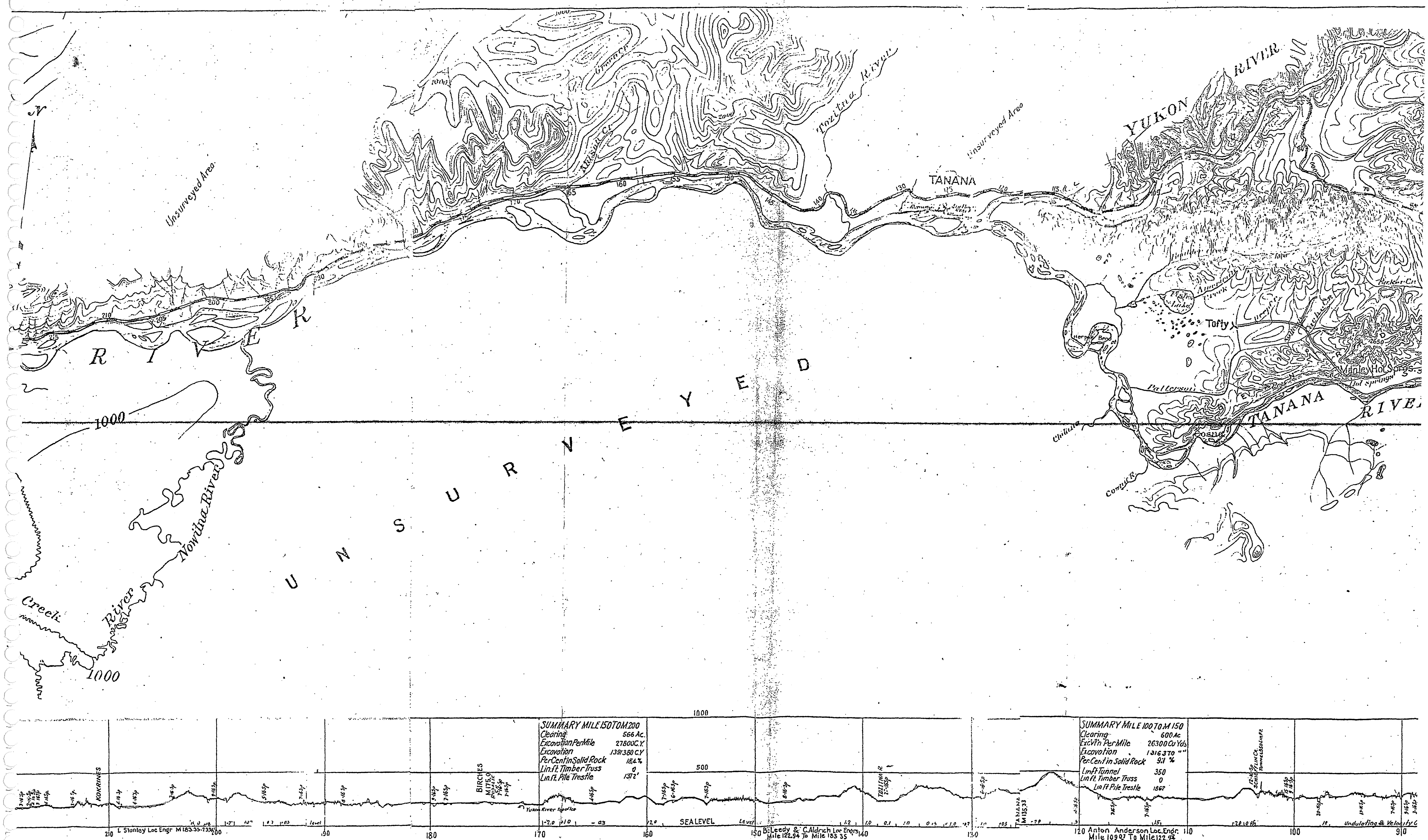
The decision as to whether to construct a railroad from Dunbar on the Alaska Railroad to the deep-water harbor at Teller will be based entirely, it is understood, on military necessity. Although this report has been concerned chiefly with the population resources and transportation facilities of the area tributary to the proposed Dunbar-Teller route, it is not intended as an effort to justify construction of the railroad in terms of the resource development to which it might conceivably lead. On the contrary, post-war developments, on the basis of present knowledge of the mineral and other resources of the area, will at the most justify a much smaller investment in a road from Fairbanks to Teller.

The point to be emphasized, however, is that whether for wartime or for peacetime purposes, a transportation chain is only as strong as its weakest link and can only deliver as much as its least effective section can handle. A railroad from Dunbar to Teller must be supported and supplied by adequate and certain feeder lines; otherwise, its construction might prove to be a misdirection of effort and a waste of critical labor and materials.

46/ As pointed out in the supplementary report, LONG-TERM ECONOMIC JUSTIFICATION OF A TRANSCANADIAN-ALASKA RAILROAD, October 8, 1942, submitted by this office in connection with the TCA-Prince George-Kobe location report, such a rail line would have great long-range values in terms of both the security and the economic development of the North Pacific Region.



Cisasa River
2000
1000
Dubli River
Koyukuk
KOYUKUK RIVER
TO TELLER
390 Mi. From M. 340
NULATO BRANCH
8.24 Miles
NULATO
Cabin
Kaiyah Slough
Taralnu
Tlatskokot
GALENA
C.A.A. Field
Army Radio
Louden
YUKON
Melozitna
RUBY
Big Creek
Beaver
Flint Creek
Tip Creek
Long
Main Creek
YUKO MT.
2200
TRUCK ROAD
SUMMARY MILE 300 TO 340
Clearing 441 Ac
Excavation per Mile 37500
Excavation 1500225
Per Cent Solid Rock 2.4%
Lin ft Tunnel 2300
Lin ft Pile Trestle
Lin ft Timber Truss 1008
SUMMARY MILE 250 TO M 300
Clearing 600 Ac
Excavation Per Mile 22700 C Y
Per Cent Solid Rock 0
Lin. Ft. Timber Truss 0
Lin Ft Pile Trestle
SUMMARY MILE 200 To M 25
Clearing 550 A
Excavation Per Mile 41000 C.
Excavation 2050660 C.
Per Cent Solid Rock 4.6%
Lin ft Timber Truss 432
Lin Ft Pile Trestle 3724
TUNNEL 2300
KOYUKUK RIVER
Slough
DOLLAR CR
Level
Undulating & Velocity Grade
300
320
310
300
290
280
270
260
250
240
230
J.E. Johnson Loc. Eng.


N
Unsurveyed Area
Unsurveyed Area
Tozitna River
Mason Cr.
TANANA
YUKON RIVER
R I V E R
UNSURVEYED
Nowitna River
River
Creek
1000
1000
Harper Bend
Tofty
Manley Hot Springs
Hot Springs
Patterson
TANANA RIVER
Chitana
Cosna
Cosna R.
2650
SUMMARY MILE 150 TO M.200
Clearing 566 Ac.
Excavation Per Mile 27800 C.Y.
Excavation 1391380 C.Y.
Per Cent in Solid Rock 18.4%
Lin.ft. Timber Truss 0
Lin.ft. Pile Trestle 1372'
SUMMARY MILE 100 TO M 150
Clearing 600 Ac
Exc'v't'n Per Mile 26300 Cu Yds
Excavation 1316370 " "
Per Cent in Solid Rock 9.1 %
Lin ft Tunnel 350
Lin ft. Timber Truss 0
Lin ft Pile Trestle 1867
1000
500
KOKRINES
BIRCHES
TOZITNA R.
TANANA M135.33
Yukon River Top of Ice
SEA LEVEL
210
200
190
180
170
160
150
140
130
120
110
100
90
L. Stanley Loc Engr M183.35-233
B. Leedy & C. Aldrich Loc Engrs Mile 122.94 To Mile 183.35
Anton Anderson Loc. Engr. Mile 109.97 To Mile 122.94
Undulating & Velocity

WAR DEPARTMENT
CORPS OF ENGINEERS

T.C.A & WESTERN R.R.
LOCATION SURVEY
FAIRBANKS DIVISION

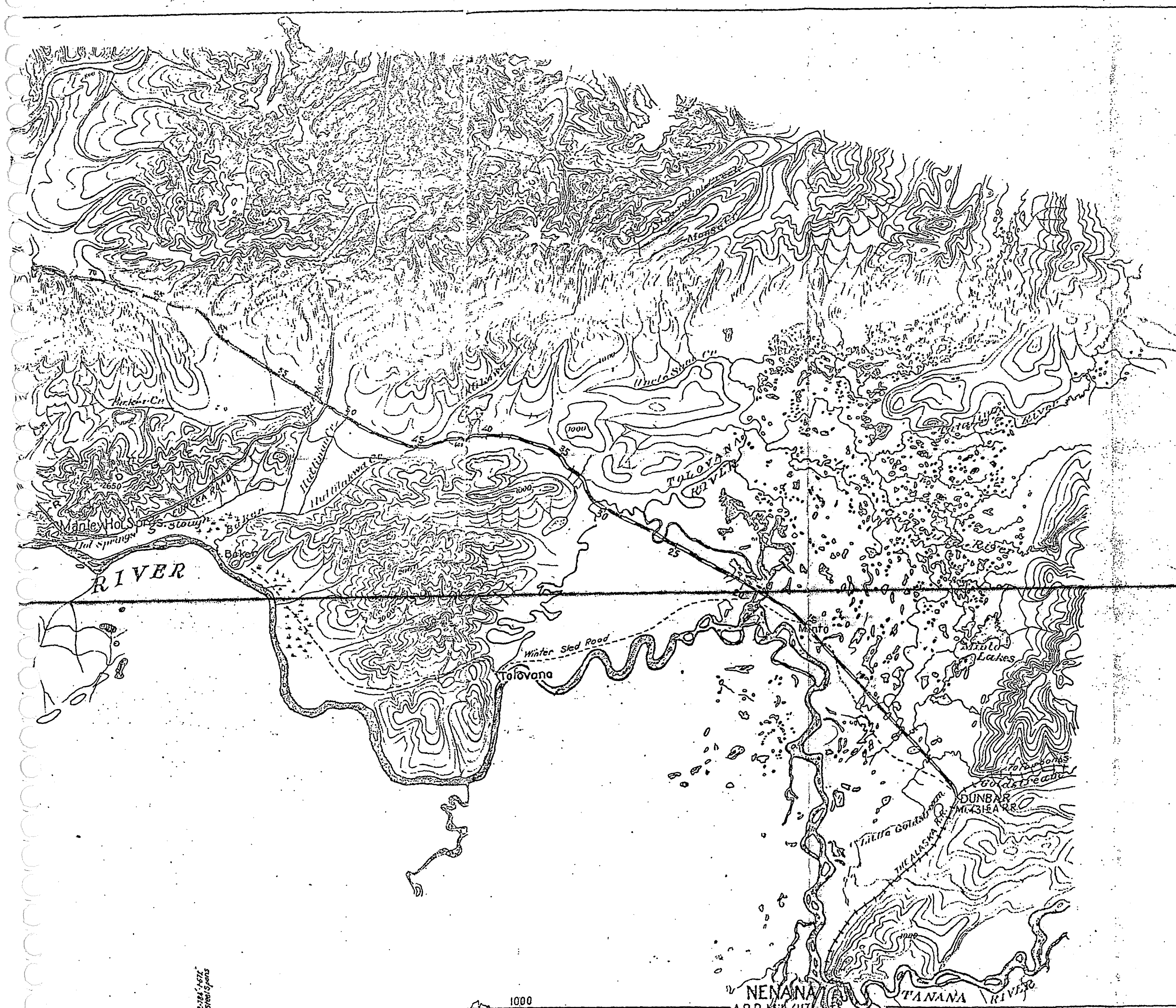
DUNBAR TO NULATO
MILE 0 TO MILE 340.4

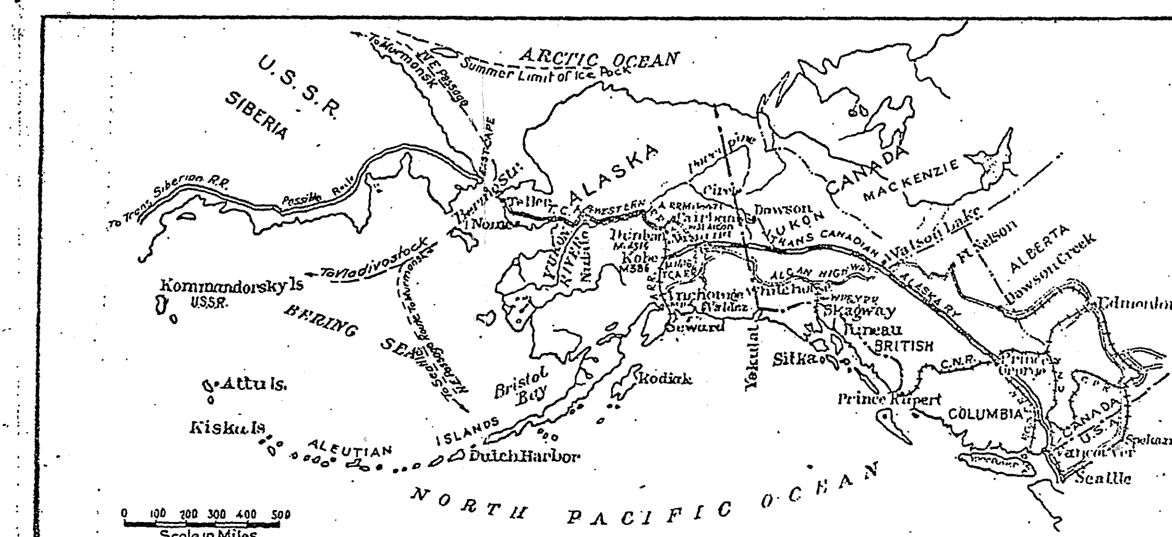
Survey begun Nov 28 1942 Completed March 31st 1943

0 5 10 15
Scale

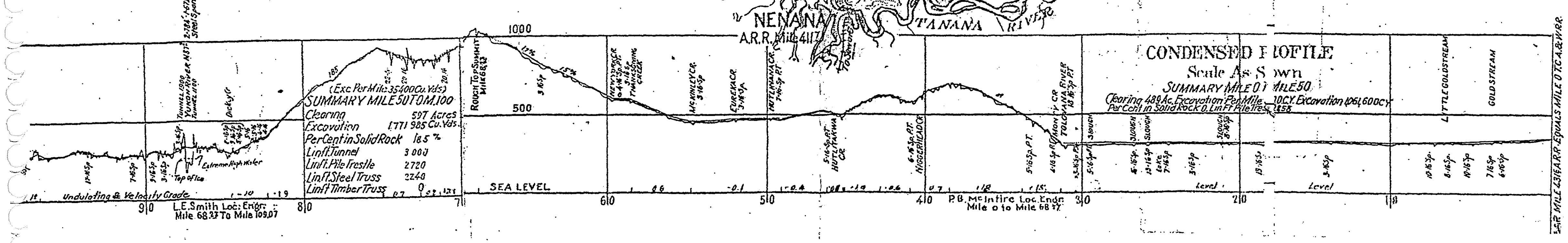
U.S. Engineer Office, Seattle, Wash., April 24th 1943.

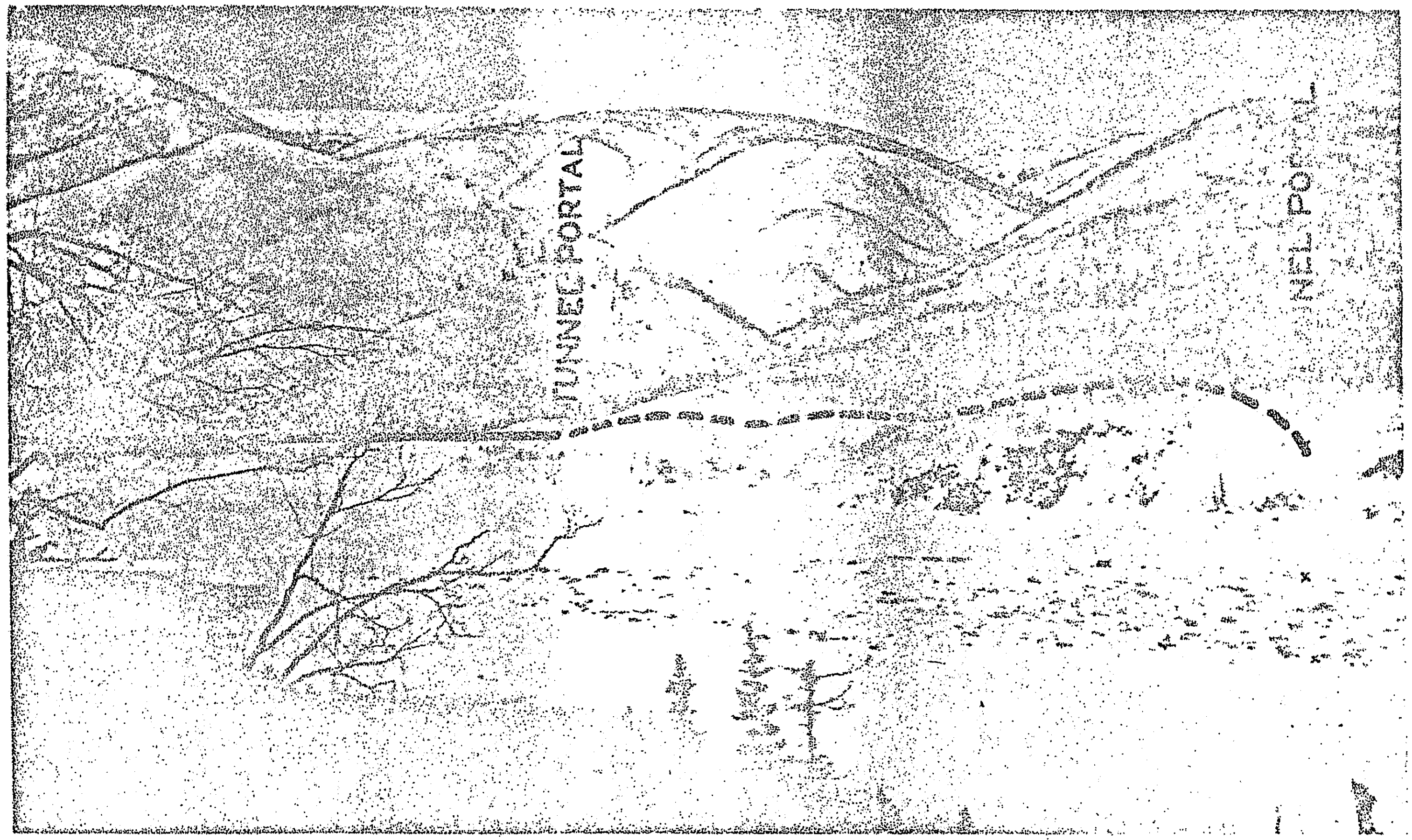
Drawn Prepared ... Engineer
Recommended ... Col. Corps of Engineers
Traced
Submitted ... Principal Engineer
Checked
Approved ... Col. Corps of Engineers & Dist Engr.



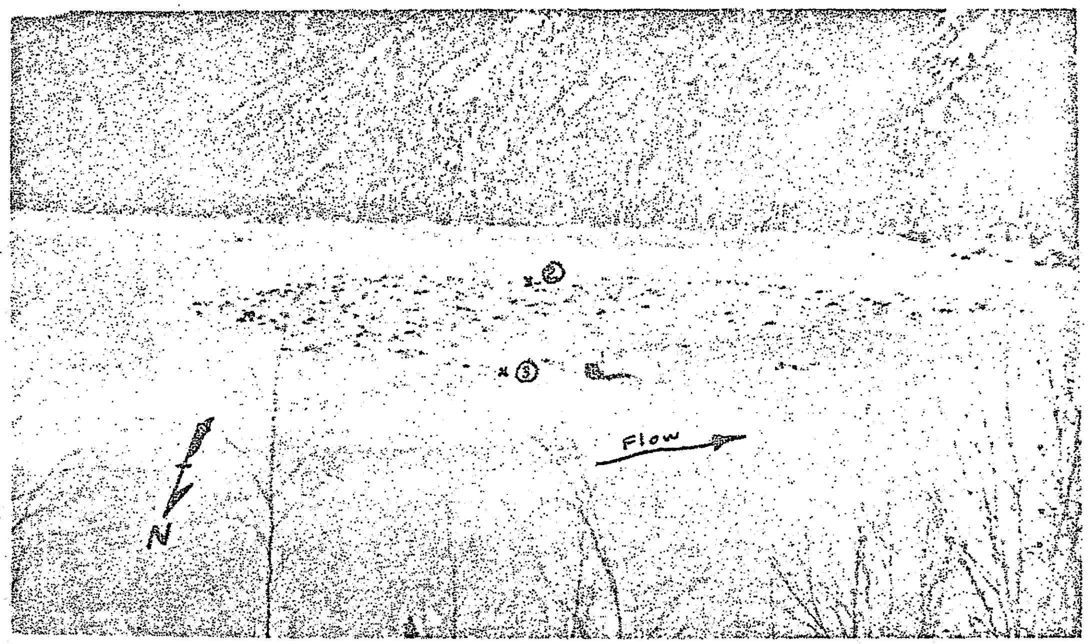


KEY MAP

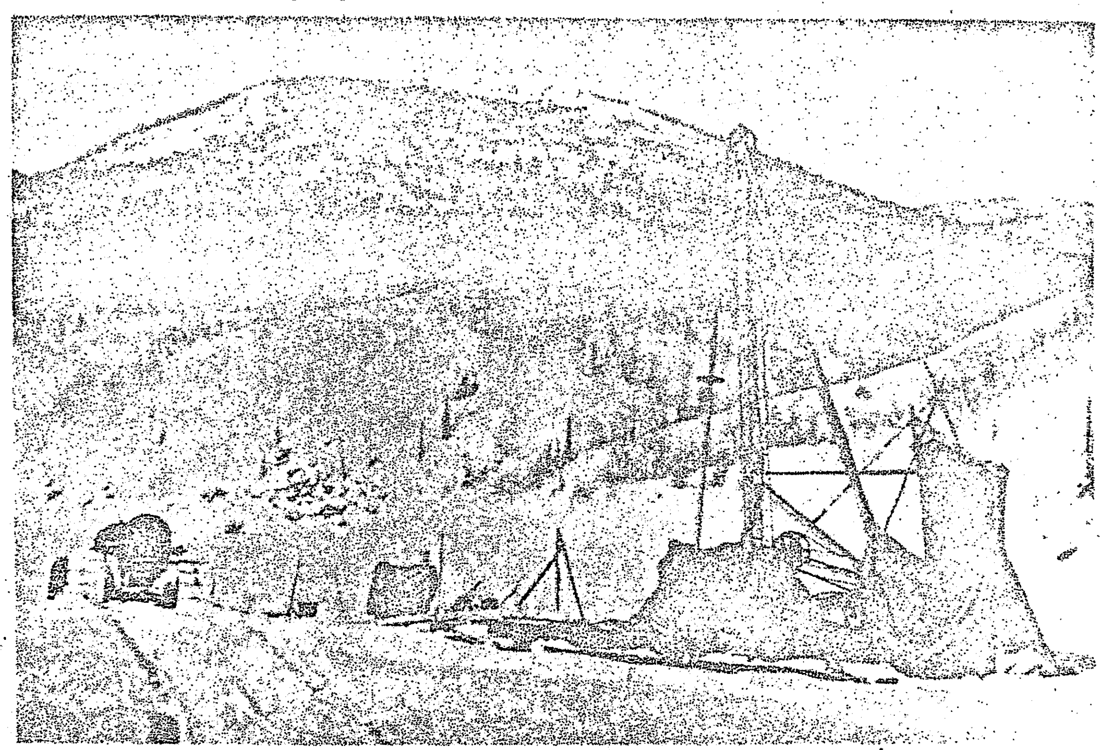




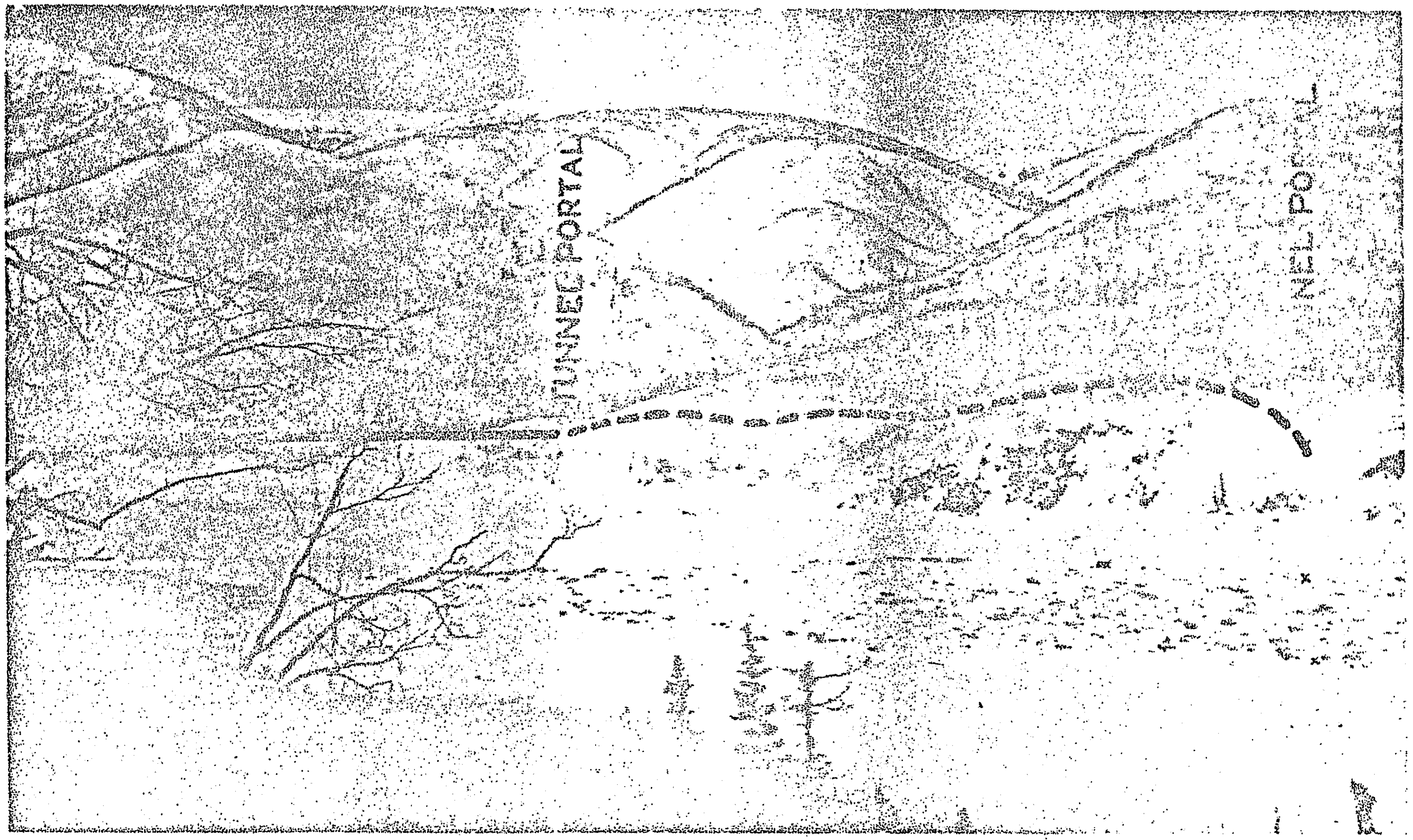
View of North bank at Yukon River Crossing, Mile 37. Crosses indicate bank end of bridge and pier locations. Approaches to the bridge will be through tunnels in the granite banks. The line to Tanana is indicated on the picture. The scale may be estimated by the drill and wannigans in the center distance.



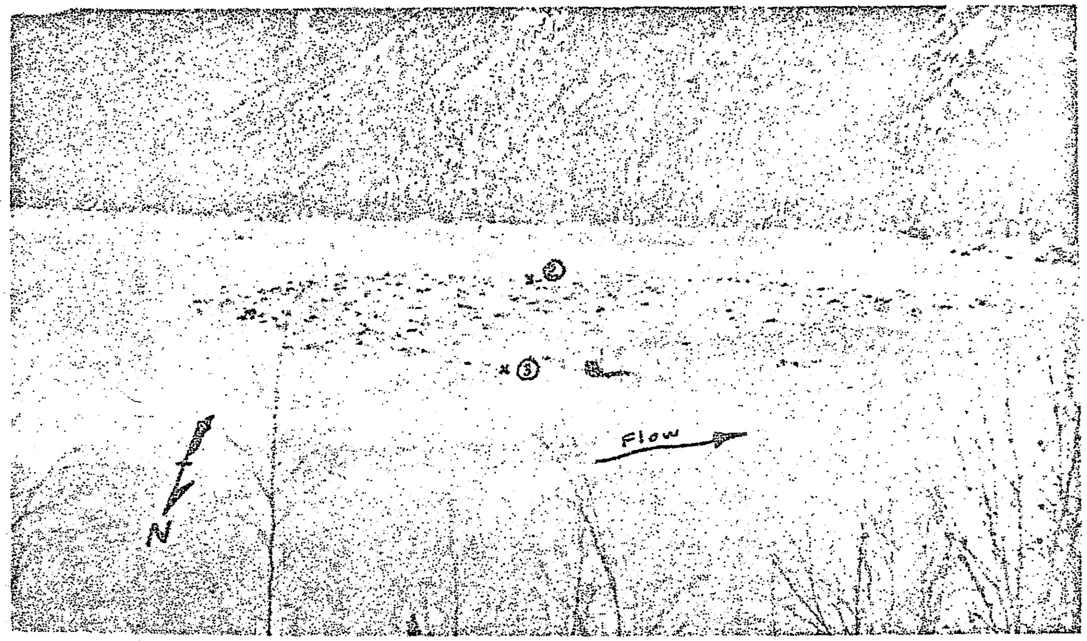
View from North bank Yukon River of crossing site. Crosses at 2 and 3 indicate pier locations and at 1, the bankhead of the bridge. A navigation clearance of 65 will be provided. The island is 1200 ' long and 800 ' maximum width. Span lengths of 784,672 & 784 feet respectively are proposed.



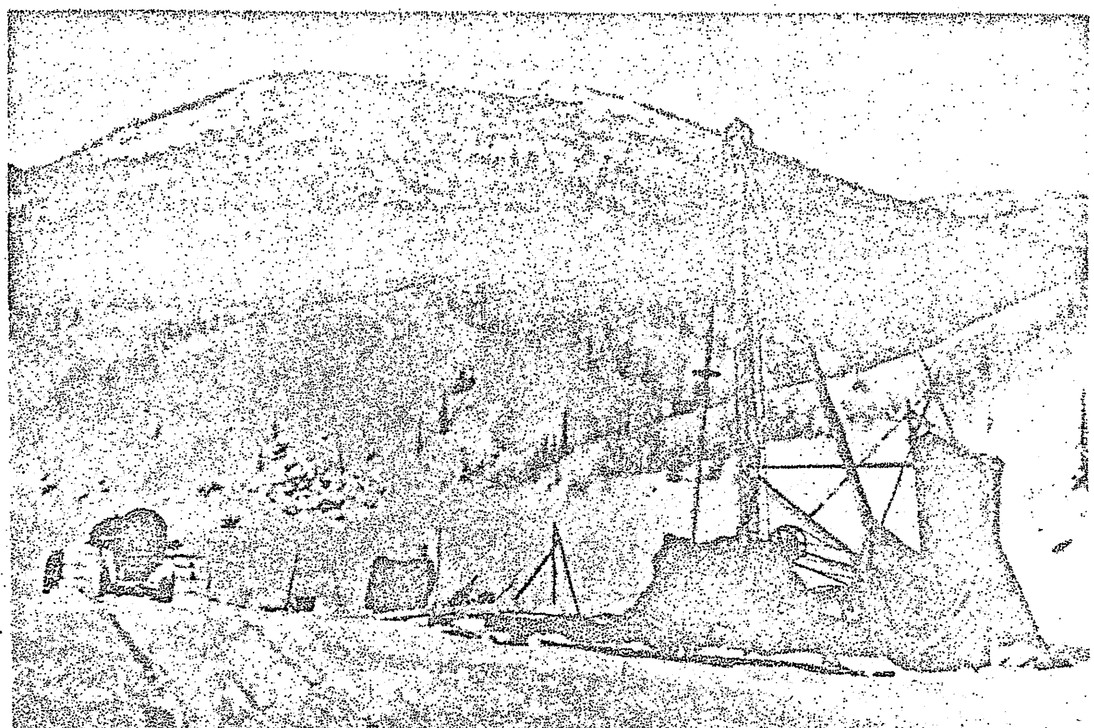
5 " Fairbanks Exploration drill testing granite foundation rock at site of Yukon Rapids bridge. Investigation was conducted by the architect-engineer.



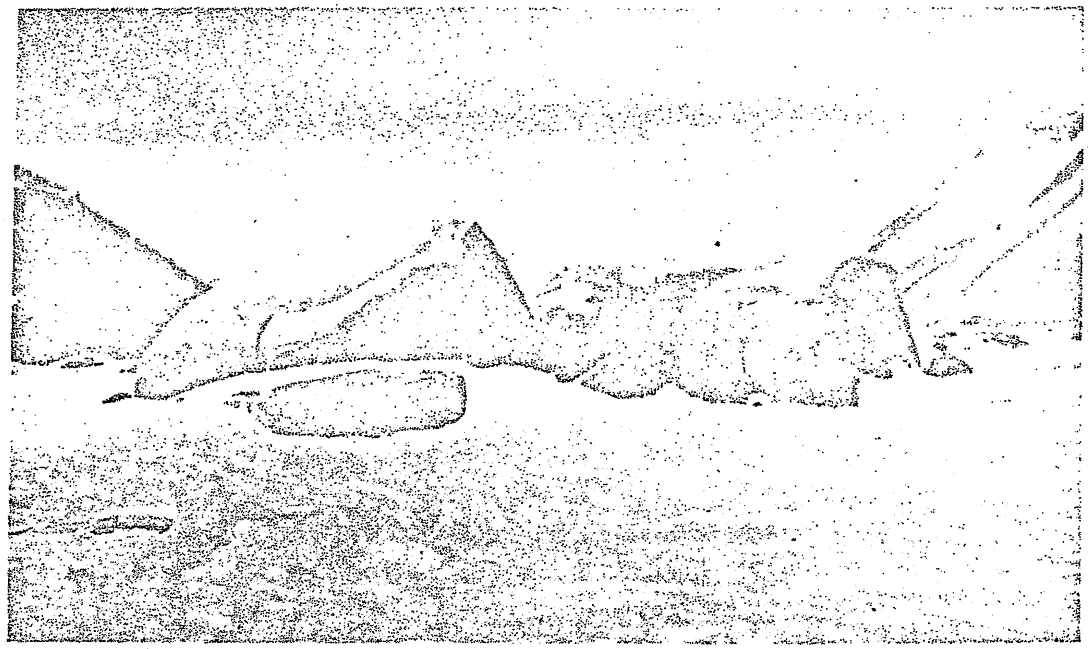
View of North bank at Yukon River Crossing, Mile 57. Crosses indicate bank end of bridge and pier locations. Approaches to the bridge will be through tunnels in the granite banks. The line to Tanana is indicated on the picture. The scale may be estimated by the drill and wannigans in the center distance.



View from North bank Yukon River of crossing site. Crosses at 2 and 3 indicate pier locations and at 1, the bankhead of the bridge. A navigation clearance of 65 will be provided. The island is 1200 ' long and 800 ' maximum width. Span lengths of 784,672 & 784 feet respectively are proposed.

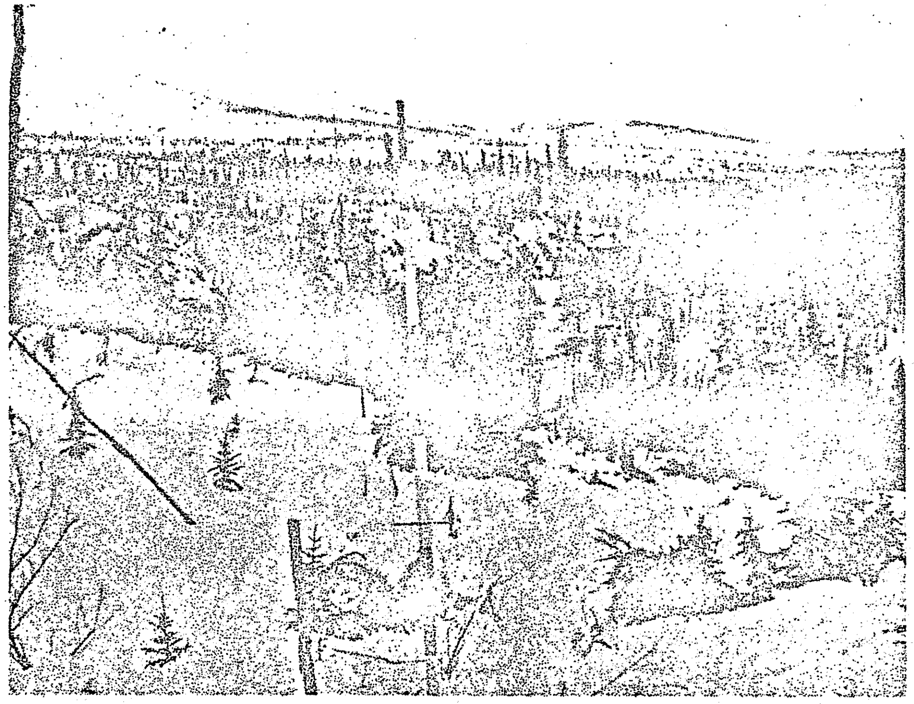


5 " Fairbanks Exploration drill testing granite foundation rock at site of Yukon Rapids bridge. Investigation was conducted by the architect-engineer.



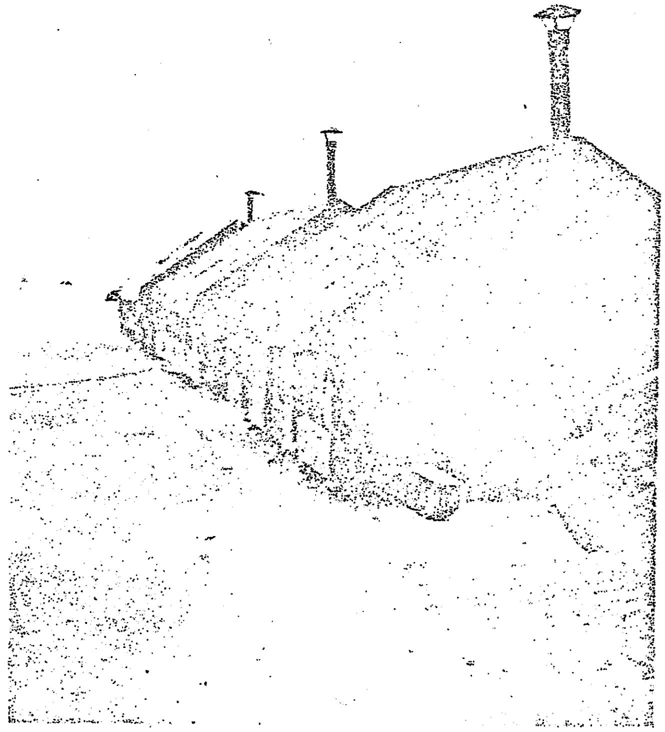
Boulders on island of Yukon crossing site. The boulders are believed to be fragments of the underlying native granite. Surface of the island is normally 10 ' above river level, but is submerged at flood stages.

Dog team bringing in supplies for field party. Two parties relied entirely on dog teams for transportation. Remainder of parties used tractors for moving camp, but had one or more dog teams for communication.

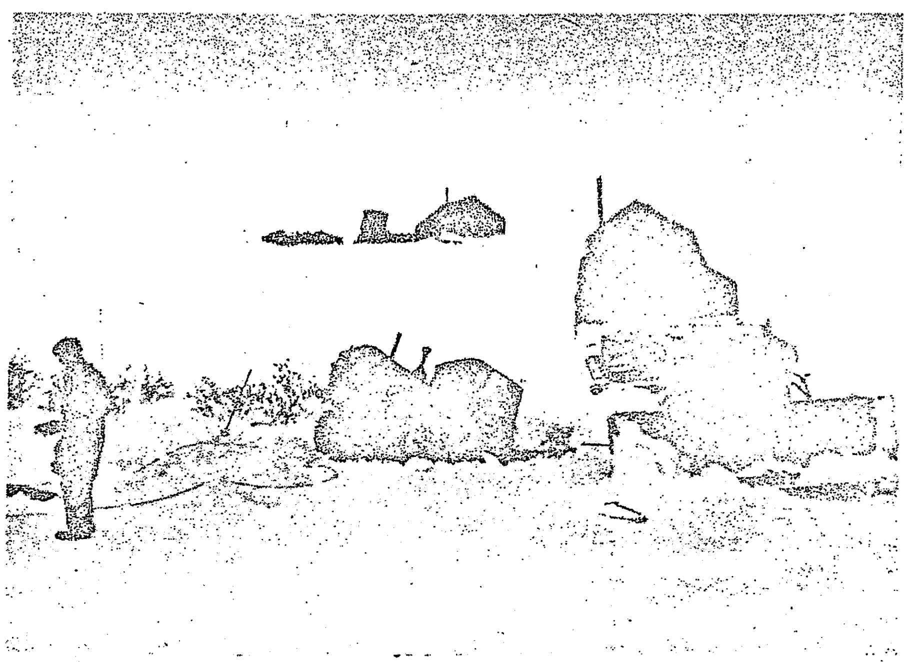


Looking Northeast from Mile 348, down Nulato River Valley. Line shows in center of picture. Timber shown is light, but scattered thickets of usable timber may be found elsewhere in this valley.

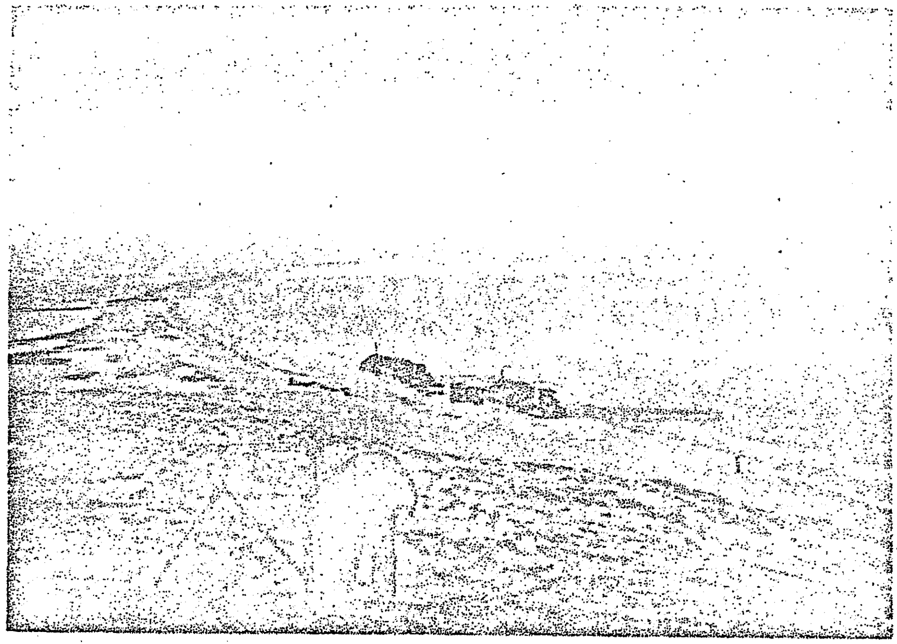
Mile 340. Example of heavy timber stand in lower Nulat River Valley. Trees are principally spruce.



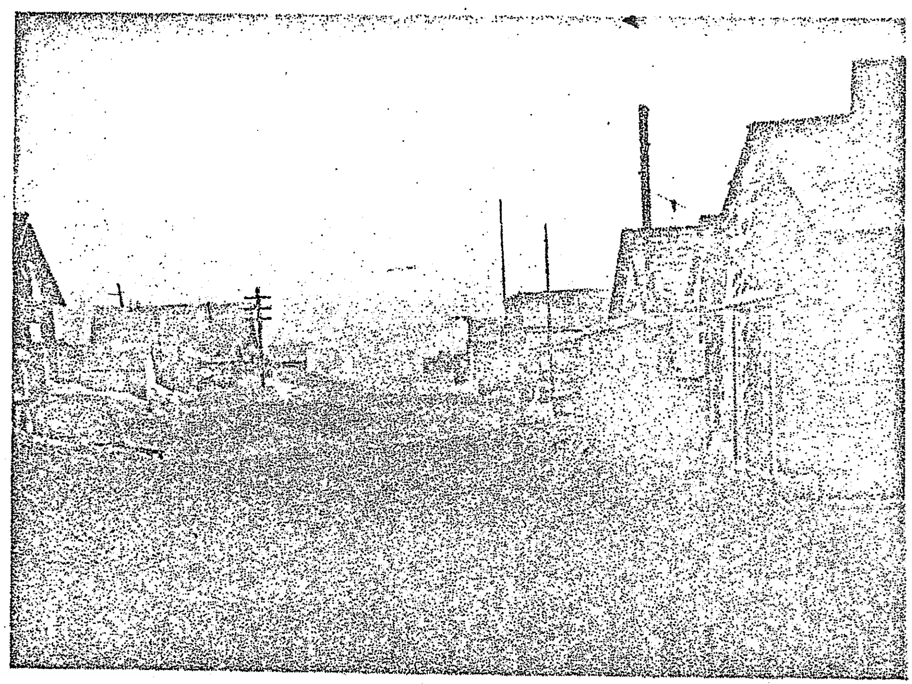
Parties running up to 4 miles of line per day required a mobile type of camp. Tents mounted on sled runners with oil stove heat proved satisfactory even in temperatures as low as -60°.



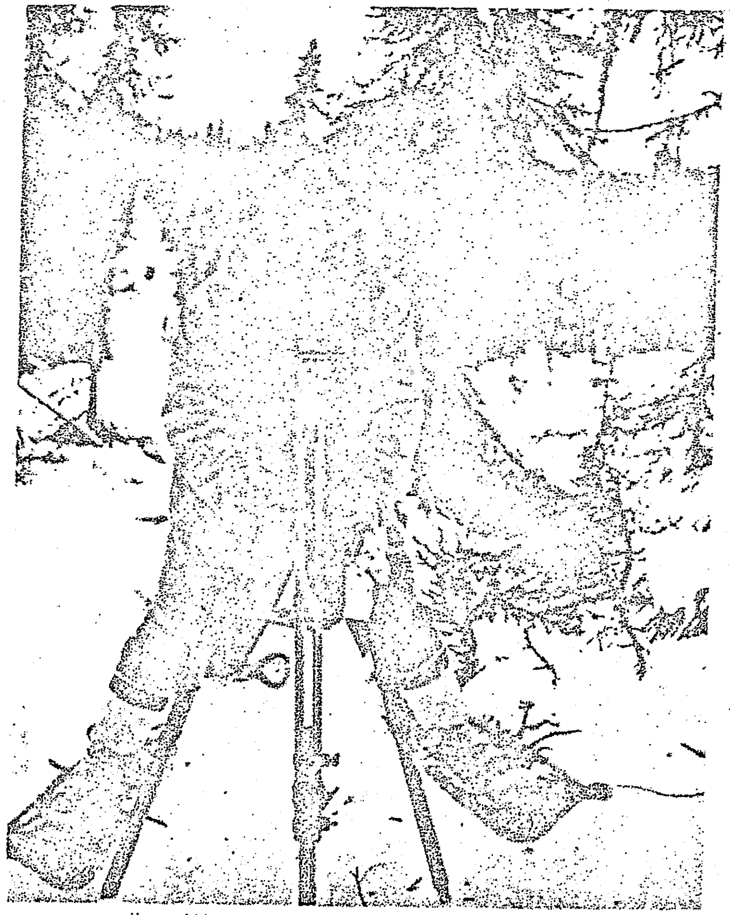
A typical mishap. Attempting to cross the Stewart River, Mile 675, both tractors broke through river ice. Efforts of entire crew succeeded in extricating outfit by 8:00 P.M. that night. Temperature $- 20^{\circ}$.



Looking Southwest from Mile 726. Bay to the right is the South end of Port Clarence. The sand spit enclosing the bay may be in left center and extending to the right distance.



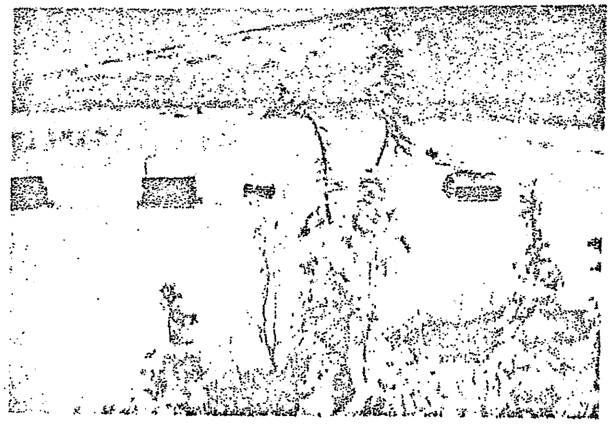
Main street of Teller. Typical of small villages along the route. Terminus of line is 7½ miles South of here.

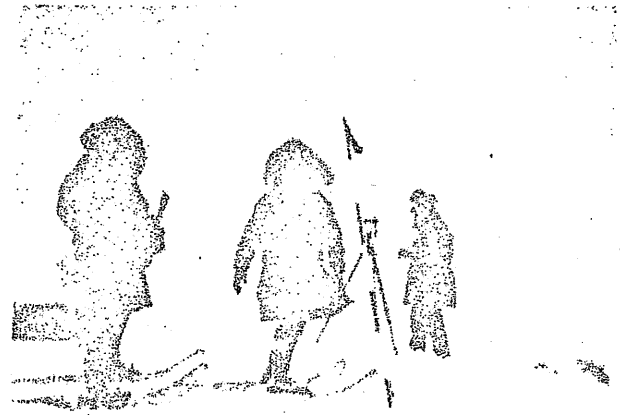


Setting up over hub. Line in background

Axe-men clearing line.

Typical members of locating parties at work. To protect against the extreme Arctic weather, special clothing was required, much of which was obtained from Eskimo natives or improvised by party members.





Views of the river valleys tributary to Norton Bay showing type of vegetation and terrain. Picture in lower left shows niggerhead country.