power
Engineers Incorporated

PROJECT NO. 1361
ISSUED TO: ________

ALASKA POWER AUTHORITY

NORTHEAST TRANSMISSION INTERTIE PROJECT

JUNE 1989

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I. INTRODUCTION

I. INTRODUCTION

A single circuit electrical intertie was completed in 1985, interconnecting the Railbelt Utilities in the Anchorage area and the utilities in the Fairbanks area. The intertie is limited to 70 MW's of transfer capability with south to north transfers and a single contingency limitation. The Alaska Power Authority (APA) and the Railbelt Utilities have been interested in and have considered, as a part of the intertie, paralleling the existing 345kV-constructed/138kV-operated intertie to improve the reliability and transfer capability.

This report presents the results of a preliminary design, cost estimate and associated engineering, route selection, and permitting studies for a Northeast Transmission Line Intertie (N. E. Intertie) between Anchorage and Fairbanks. The proposed line route for the N. E. Intertie passes through the Glennallen area, interconnecting the Copper Valley system in the Railbelt interconnected system. Of the transmission line route alternatives set forth in this report, one route has been identified as a Suggested Route based upon results of electrical studies, environmental and permitting requirements, and cost estimates. Based on public comment, several recommended changes to the suggested route have been identified to mitigate impacts created by the suggested route location. This report includes the information and assumptions that were used in making the recommendation.

The Northeast Transmission Intertie Project report has been prepared by Power Engineers, Inc., of Hailey, Idaho, and Hart-Crowser, Inc., of Anchorage, Alaska, to satisfy the requirements of APA Contract No. 2800113.

II. PROJECT

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Alaska Power Authority (APA) desires to determine the basic information for constructing a Northeast Intertie, which would parallel the existing intertie between the Anchorage and Fairbanks area utilities. To evaluate the Northeast Intertie, preliminary design, cost estimate and associated engineering, route selection, and permitting studies for the various sections of line and stations comprising the proposed intertie have been performed as requested by APA.

System studies using load flow and transient stability analysis have been conducted and analyzed to determine design requirements and operating performance of the new line and its incorporation with the present intertie. Reactive compensation requirements for the transmission line are determined and locations identified for their installation. Alternate transmission line routes are defined with a route suggested to APA for more detailed study. A portion of the route will consist of existing transmission line facilities and the balance will be new facilities. The general route of the line is from Teeland Substation to the O'Neill Substation; to a new switching station at Gakona Jct.; to Jarvis Substation; to Carney Substation; and to the North Pole Substation.

The line section from Teeland Substation to O'Neill Substation will consist of the existing 115kV line with a new switchyard at O'Neill Tap. A new 230kV line will be designed and routed from O'Neill Substation to Jarvis Creek Substation via Glennallen (operation voltage will be 138kV). A new 138kV line is proposed between Carney Substation and North Pole Substation. A new substation will be required at Gakona and modifications will be required to the O'Neill Pumping Station No. 11, Jarvis Creek, Carney and North Pole Substations.

The system will operate at 115kV from Teeland to O'Neill Substation. At O'Neill Substation, the voltage is transformed to 138kV and the remainder of the Anchorage-Fairbanks transmission system operates at 138kV. The existing Anchorage-Fairbanks Intertie and the Northeast Intertie are connected at North Pole Substation.

The Maps on the following pages (Figures 1, 2, 3 and 4) show the Suggested Route for the Northeast Intertie.

III. EXECUTIVE SUMMARY

III. EXECUTIVE SUMMARY

This report presents the results of a preliminary design, cost estimate, and environmental impact study of a proposed new electrical transmission line intertie between Anchorage and Fairbanks, via Glennallen, and tying the Copper Valley Electric Association into the "Railbelt" interconnected transmission system. Transmission system studies consisted of a review of existing studies, meetings with all area utilities to determine operating problems, operating practices and other information necessary to evaluate the "Railbelt" interconnected transmission system. Transmission system analysis studies were conducted using load projections to the year 2008. To determine facilities requirements, the electrical system studies demonstrate that the proposed N.E. Intertie can transfer 150MW from O'Neill Tap to Anchorage to the Copper Valley System and Fairbanks.

Two transmission line route alternatives are identified, a Northwest Route and a Southeast Route. Both of these routes roughly parallel the Glenn Highway between the Matanuska Valley and Glennallen and the Richardson Highway between Glennallen and Delta Junction. A Suggested Route is selected for more detailed study. The criteria for selecting the Suggested Route is feasibility to obtain the right-of-way; the route does not have any environmental concerns which would prevent construction; permitting is feasible within a reasonable schedule; and the cost of construction is competitive with other routes. The Suggested Route is a combination of the Northwest Route and Southeast Route which roughly follow the Glenn and Richardson Highways.

The advantages of the Northeast Intertie are improved reliability of service to Fairbanks and the Copper Valley system, greater power transfer capability to Fairbanks, improved transient stability of the entire "Railbelt" interconnected transmission system, greater capacity to serve load for the Copper Valley System, and full utilization of the Solomon Gulch Hydro Facility. Disadvantages of the Northeast Intertie are large power and var flows in the Matanuska Electric Association (MEA) system resulting in greater MEA system losses and the possibility of outages in the MEA system caused by power swings during major system disturbances.

The cost estimate in 1989 dollars for the Suggested Route which includes 273 miles of 230kV transmission line operated at 138kV, 22 miles of 138kV transmission line, six substations (two new and four upgraded), and environmental and right-of-way costs is $156,190,399. The project schedule is estimated to be sixty (60) months from Notice to Proceed.

IV. SUMMARY & CONCLUSIONS

IV. SUMMARY AND CONCLUSIONS

The Northeast Intertie suggested routing basically follows the Glenn Highway East from O'Neill Substation near Sutton to Glennallen and then turns north and follows the Richardson Highway to Jarvis Creek Substation at Delta Junction. This portion of the Northeast Intertie is 273 miles constructed 230kV with double bundled ACSR conductor on steel towers. The 230kV line section between Glennallen and Gakona Junction Substation (approximately 12 miles) is double circuit. The second circuit is a 138kV line from Gakona Substation to Copper Valley's existing Pump Station 11 substation, tying into Copper Valley's 138kV transmission system. The Northeast Intertie connection to Fairbanks is completed with a 138kV tie between Carney Substation and North Pole Substation. This section of line is 22 miles and constructed with 795 ACSR conductor on wood poles.

The main considerations for the choice of the Suggested Route between O'Neill Substation and Jarvis Creek Substation were availability of right-of-way, aesthetics, environmental concerns and impacts, permitting, and cost of construction. For the Suggested Route, the right-of-way is considered to be feasible to obtain. There are no identified environmental concerns which would prevent construction or identified impacts which cannot be mitigated. Identified issues of significant concern to local area residents included aesthetics, health hazards of electrical fields and the need to obtain private property for the right of way. Alterations in the route to mitigate these concerns have been identified. Permitting is considered to be feasible within a reasonable schedule, and cost of construction is competitive with alternate routes considered.

Two new substations are required and upgrades of four existing substations are required. In the MEA system, a new switching station is required at O'Neill Tap to provide protection and sectionalizing of the 115kV transmission system which connects the O'Neill Substation end of the Northeast Intertie to Teeland Substation. At O'Neill Substation, a step-up transformer from 115kV to 138kV and associated line protection equipment is required. North of Glennallen, a new substation is planned at Gakona Junction. This substation will provide a connection to Copper Valley's 138kV transmission system at Pump Station 11 and provide distribution to

Copper Valley's loads in the Gakona area. At Jarvis Creek, Carney and North Pole substations, additional line protection equipment is required.

Electrical system studies of the proposed Northeast Intertie show that the intertie system, when operating at 138kV, can deliver 150 MW from O'Neill Tap to the Northeast Intertie. A static var system (SVS) of + 100 - 30 Mvar is required at Gakona Substation to provide voltage stability on the intertie. Fixed reactors are required at Gakona and Jarvis Creek substations for voltage control and line reactive compensation. Line outage studies show that a single line outage condition on the intertie or feeds to the intertie greatly decreases the intertie transfer capability. To prevent major system disturbances due to line outages, capacity upgrades are required on the existing Anchorage-Fairbanks Intertie and the transmission system from Teeland Substation to Point McKenzie Substation. Transient stability studies show that the Northeast Intertie improves stability of the Railbelt interconnected transmission system for faults on the Anchorage-Fairbanks intertie. When transfers are maintained within the 70 MW limit of the existing intertie, the transmission system remained stable for line faults conditions on the intertie. This improved stability will improve the reliability of electrical service to both Fairbanks and Anchorage.

The Northeast Intertie will also improve the stability of the Copper Valley system. Loss of the Solomon Gulch Hydro facility will have virtually no impact on the transmission system or the ability of Copper Valley to serve load. Service reliability of the Copper Valley system will be improved with the Northeast Intertie, and the interconnection will also allow sale of approximately fourteen million KWH of energy now being spilled annually at Solomon Gulch.

The MEA system will be impacted by the Northeast Intertie connection to O'Neill Substation. Both MW and Mvar flows thru the MEA system will increase losses in the system. Power swings during system disturbances on the intertie may cause outages in the MEA system. Reinforcement of the transmission system feeding Teeland Substation and upgrading the existing Anchorage Fairbanks Intertie to 150 MW transfer capability will decrease the impact of the Northeast Intertie on the MEA system. Further load flow and stability studies are required to define additional facility requirements.

The project schedule for the Northeast Intertie, from initiation to completion, is estimated to be sixty (60) months. This schedule period includes all aspects of the project. Actual construction schedules will be impacted by construction windows dictated by environmental concerns, which will be addressed and defined in the initial stages of the project. Construction costs for the project, which includes permitting, right-of-way acquisition, engineering, construction and construction management is $156,190,399.

Annual amortization
35 yrs @ 5.00% - $9,538,814 / .005 = 1,907,762,864 KWH's
.00

V. STUDIES

V. STUDIES

Introduction

This report documents the electric transmission system analysis study of the proposed Northeast (N.E.) Intertie transmission system between Anchorage and Fairbanks. This study was conducted to determine the impact of the N.E. Intertie on the existing utilities, defining both advantages and disadvantages of such an intertie. The proposed N.E. Intertie connects MEA's O'Neill Substation to GVEA's Jarvis Creek Substation via CVEA's Pump Station (PS) 11 Substation, located near Glennallen. This portion of the N.E. Intertie is to be constructed to 230kV and initially operated at 138kV. A second line between GVEA's Carney and North Pole Substations completes the N.E. Intertie. This portion of the N.E. Intertie is to be 138kV construction, operated at 138kV. Single-line diagrams of the two N.E. Intertie Transmission System Configuration Alternatives are shown in Figures 5 and 6.

A minor change in the configuration of the N.E. Intertie was made (as requested at the preliminary review meeting with the utilities) from the configuration used for the studies. The static var system (SVS) is now being installed at Gakona rather than Pump Station 11 (PS11) with the reactor which was originally installed at the Gakona Substation moved to the Glennallen Switch Station. Several sensitivity cases were run which showed the new configuration (as shown on the one-line diagrams) does not make significant change in the system operation. The write up of the studies reflect this change while the cases run are based on the original configuration.

The conclusions and recommendations of this study are based upon POWER's findings which were drawn from a review of prior transmission system studies, system operating data, projected system loading, projected generation schedules, load flow studies and transient stability studies. Specific results of the load flow and transient stability studies are presented in the Appendix II as one-line load flow diagrams and transient stability plots.

No other Railbelt system upgrades other than CEA's upgrades on the Kenai and the addition of the Bradley Lake Project have been included in this study.

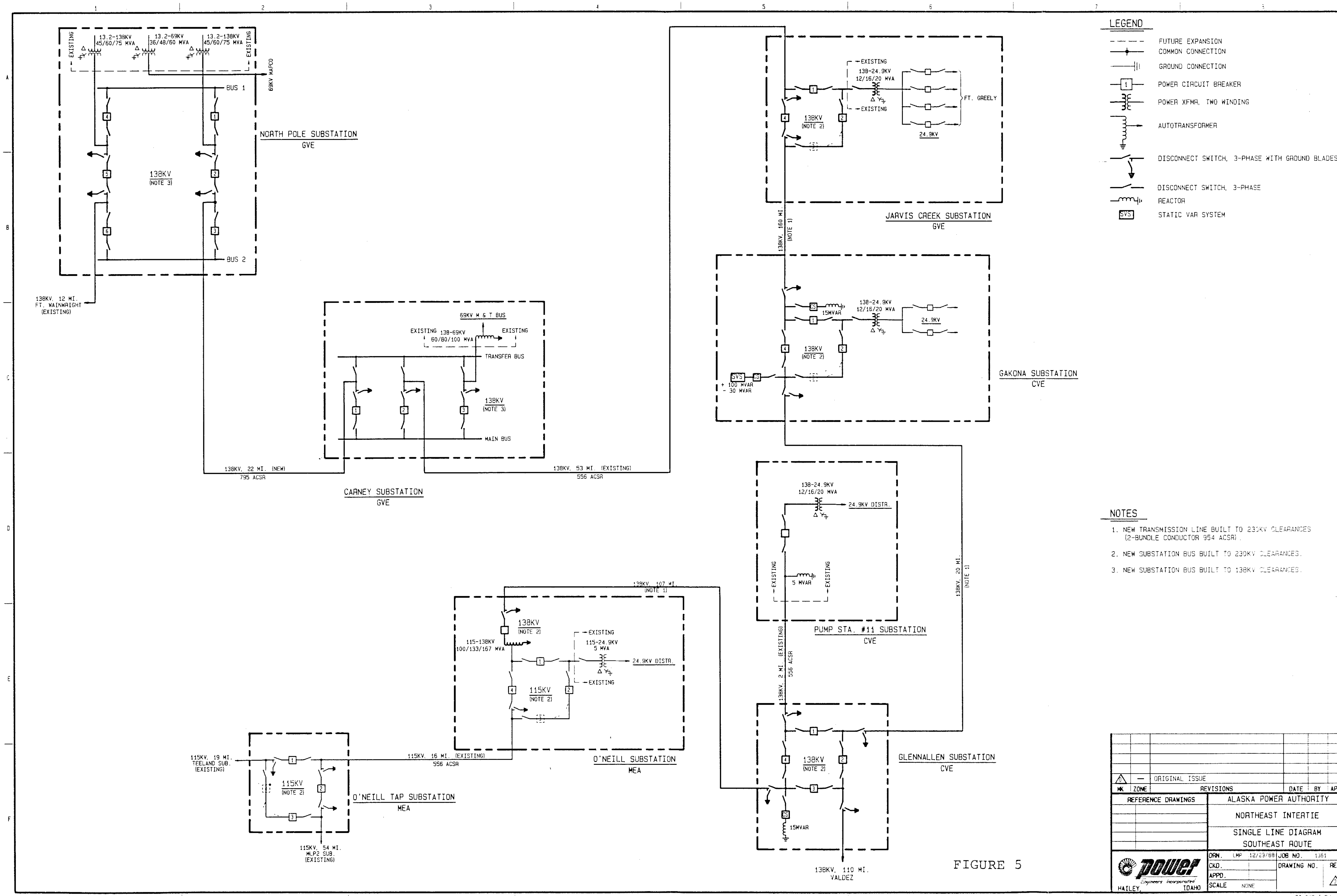
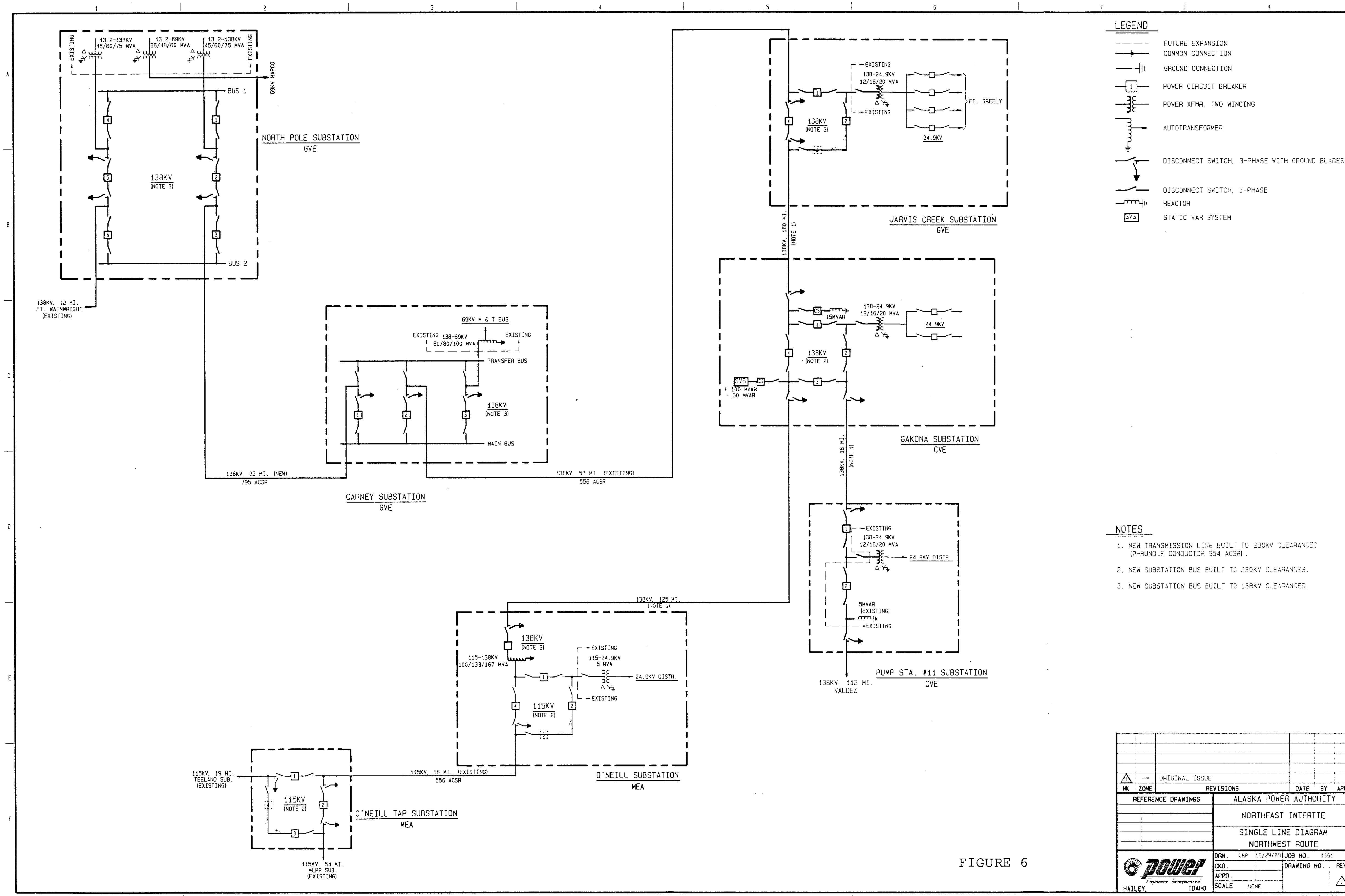

LEGEND
FUTURE EXPANSION
COMMON CONNECTION
GROUND CONNECTION
POWER CIRCUIT BREAKER
POWER XFMR, TWO WINDING
AUTOTRANSFORMER
DISCONNECT SWITCH, 3-PHASE WITH GROUND BLADES
DISCONNECT SWITCH, 3-PHASE
REACTOR
STATIC VAR SYSTEM
NOTES
1. NEW TRANSMISSION LINE BUILT TO 230KV CLEARANCES (2-BUNDLE CONDUCTOR 954 ACSR).
2. NEW SUBSTATION BUS BUILT TO 230KV CLEARANCES.
3. NEW SUBSTATION BUS BUILT TO 138KV CLEARANCES.
NORTH POLE SUBSTATION
GVE
13.2-138KV 45/60/75 MVA
13.2-69KV 36/48/60 MVA
13.2-138KV 45/60/75 MVA
EXISTING
69KV MAPCO
BUS 1
BUS 2
138KV (NOTE 3)
138KV, 12 MI. FT. WAINWRIGHT (EXISTING)
CARNEY SUBSTATION
GVE
69KV M & T BUS
EXISTING 138-69KV 60/80/100 MVA
TRANSFER BUS
MAIN BUS
138KV (NOTE 3)
138KV, 22 MI. (NEW) 795 ACSR
138KV, 53 MI (EXISTING) 556 ACSR
JARVIS CREEK SUBSTATION
GVE
138-24.9KV 12/16/20 MVA
FT. GREELY
24.9KV
138KV (NOTE 2)
138KV, 160 MI. (NOTE 1)
GAKONA SUBSTATION
CVE
15MVAR
138-24.9KV 12/16/20 MVA
24.9KV
138KV (NOTE 2)
SVS
+ 100 MVAR
- 30 MVAR
PUMP STA. #11 SUBSTATION
CVE
138-24.9KV 12/16/20 MVA
24.9KV DISTR.
5 MVAR
138KV, 20 MI. (NOTE 1)
138KV, 2 MI. (EXISTING) 556 ACSR
GLENNALLEN SUBSTATION
CVE
138KV (NOTE 2)
15MVAR
138KV, 110 MI. VALDEZ
O'NEILL SUBSTATION
MEA
138KV, 107 MI. (NOTE 1)
138KV (NOTE 2)
115-138KV 100/133/167 MVA
115-24.9KV 5 MVA
24.9KV DISTR.
115KV (NOTE 2)
115KV, 16 MI. (EXISTING) 556 ACSR
O'NEILL TAP SUBSTATION
MEA
115KV (NOTE 2)
115KV, 19 MI. TEELAND SUB. (EXISTING)
115KV, 54 MI. MLP2 SUB. (EXISTING)
ORIGINAL ISSUE
MK ZONE REVISIONS DATE BY APPD
REFERENCE DRAWINGS
ALASKA POWER AUTHORITY
NORTHEAST INTERTIE
SINGLE LINE DIAGRAM
SOUTHEAST ROUTE
power Engineers Incorporated
HAILEY, IDAHO
DRN. LMP 12/23/88
JOB NO. 1161
CKD.
APPD.
SCALE NONE
DRAWING NO.
REV

FIGURE 5



LEGEND
FUTURE EXPANSION
COMMON CONNECTION
GROUND CONNECTION
POWER CIRCUIT BREAKER
POWER XFMR, TWO WINDING
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DISCONNECT SWITCH, 3-PHASE WITH GROUND BLADES
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GVE
138KV, 160 MI. (NOTE 1)
15MVAR
+ 100 MVAR - 30 MVAR
GAKONA SUBSTATION
CVE
138KV, 18 MI. (NOTE 1)
24.9KV DISTR.
5MVAR (EXISTING)
PUMP STA. #11 SUBSTATION
CVE
138KV, 112 MI. VALDEZ
138KV, 125 MI. (NOTE 1)
115-138KV 100/133/167 MVA
115-24.9KV 5 MVA
115KV (NOTE 2)
O'NEILL SUBSTATION
MEA
115KV, 16 MI. (EXISTING) 556 ACSR
115KV, 19 MI. TEELAND SUB. (EXISTING)
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DRN. CKD. APPD. SCALE NONE
12/29/88
JOB NO.
DRAWING NO.
REV

FIGURE 6

Study Assumptions and Criteria

1. The N.E. Intertie transmission system consists of the following components:
   a. A 100/133/167MVA, 115-138kV, Z = 3%, autotransformer at O'Neill Substation.
   b. A 105-mile, two-conductor bundle, 954 ACSR transmission line, constructed 230kV, between O'Neill Substation and Glennallen Switch Station.
   c. An SVS is located at Gakona Substation for reactive compensation.
   d. A 20-mile, two-conductor bundle, 954 ACSR transmission line, constructed 230kV, between Glennallen Switch Station and a new substation at Gakona.
   e. A 160-mile, two conductor bundle, 954 ACSR transmission line, constructed 230kV, between Gakona and Jarvis Creek Substation.
   f. A 22-mile, 795 ACSR transmission line, constructed 138kV, between Carney Substation and North Pole Substation.

2. The entire N.E. Intertie is operated at 138kV.

3. The 115kV transmission line between Dow and Eklutna in the MEA system is closed on both ends. This forms a transmission path between Teeland Substation and MLP2 Substation.

4. In the year 2008, the system has the following upgrades:
   a. The Bradley Lake generation is on-line.
   b. The University Substation 138-115kV transformer is paralleled with an identical unit.
   c. A 69kV transmission tie line is between Tesoro and Beaver Substations.
   d. A ± 7Mvar SVS is installed at Daves Creek Substation for reactive support of the 115kV transmission line.
   e. The Quartz Creek Substation 115-69kV transformer is replaced with a 25MVA unit.

5. Generation Schedule guide is as follows:
   Summer Valley Loads -
   Hydro: Eklutna shutdown

	Bradley Lake shutdown Cooper Lake shutdown Solomon Gulch 12MW
Fairbanks:	Healy and Chena 5 on-line 15MW of cogen on-line in 10 to 20 years Import remainder from Anchorage
MLP:	Units 5, 6 and 7 on-line as required
CEA:	Beluga 5, 6, 7, 8 on-line Bernice 1 unit on-line
HEA:	Soldotna shutdown

Winter Peak Loads -

Hydro:	Eklutna maximum Bradley Lake maximum Cooper Lake maximum Solomon Gulch 4MW
Fairbanks:	Healy and Chena 5 near maximum 15MW of cogen on-line in 10 to 20 years Import up to limit of intertie Run North Pole when import is inadequate
MLP:	Units 5, 6, 7 on-line Units 4 and 8 added if needed to meet load
CEA:	Beluga 3, 5, 6, 7, 8 on-line Bernice as necessary to meet load
HEA:	Soldotna off currently, on in 10 to 20 years to meet load

6. Maximum line loading by conductor and voltage is assumed to be as follows:

Maximum conductor loading is based upon a conductor thermal rise of 50°C above 25°C ambient with a wind of 1.4 miles per hour.

Conductor ACSR	Ampacity AMPS	Line Load MVA		
		115kV	138kV	230kV
397	590	118	141	235
556	730	145	175	291
795	900	179	215	359
954	1060	211	253	422

7. Breaker clearing times are four cycles for the zone 1 near end faults and six cycles for zone 2 far end faults. This assumes transfer tripping on all lines.

Conclusions

Power transfer from Anchorage to Fairbanks is increased by the N.E. Intertie and service from the Railbelt interconnected power system is provided to the Copper Valley system. With all transmission lines in service, 150 MW can be transferred from Anchorage over the interties to Fairbanks and an additional 17 MW can be transferred to the Copper Valley system. None of the existing transmission lines or facilities ratings will be exceeded at this transfer level. An SVS of ± 30 Mvars is required in the vicinity of Glennallen for voltage stability.

Transferring 150 MW from O'Neill Tap over the N.E. Intertie will result in 140 MW delivered to Glennallen and 122 MW delivered to the Fairbanks system at Jarvis Creek. An SVS of approximately +100 Mvar -30 Mvar located in the vicinity of Glennallen is required for voltage stability. At this transfer level from O'Neill Tap to the N.E. Intertie, the 115kV line from O'Neill Tap to O'Neill Substation will be at 103% of rated capacity and the Teeland to O'Neill Tap 115kV line will be at 104% of rated capacity. The rated capacity is based upon 50° C conductor thermal rise above 25°C (77° F) ambient air temperature (summer conditions). It is assumed that a 150 MW transfer from O'Neill Tap will be a winter operating condition. For winter air temperature conditions, transferring 150 MW from O'Neill Tap to the N.E. Intertie will not exceed the Teeland to O'Neill Tap and the O'Neill Tap to O'Neill Substation 115kV line winter ratings. These lines will be near rated winter capacity which will result in high losses.

Although the N.E. Intertie, with a +100 Mvar-30 Mvar SVS at Glennallen, has a transfer capability of 150 MW from O'Neill Tap, the remaining Railbelt system does not have the capability to supply power at this level if any of the major interties to the N.E. Intertie are open. The maximum interchange capability of the existing intertie is approximately 70 MW. This limitation limits the single contingency line outage transfer from the standpoint of reliability. If more than 70 MW is being transferred and the N.E. Intertie trips out, rapid load shedding in the Fairbanks area would be required. For maximum system reliability, the existing intertie interchange capability should be increased to 150 MW transferred from Douglas. This would allow a single contingency outage of either intertie at a transfer level of 150 MW without interrupting service to Fairbanks and the Copper Valley system.

A single contingency line outage in the 115kV MEA transmission system will limit the N.E. Intertie transmission capability to approximately 70 MW. If the existing Anchorage-Fairbanks intertie capacity is upgraded to 150 MW transfer capability, an outage in the MEA 115kV transmission system should not cause an outage in Fairbanks. The power transfer to Fairbanks could be scheduled from the N.E. Intertie to the existing intertie without interrupting power to Fairbanks.

The most limiting line outage condition for the Anchorage-Fairbanks intertie is the Teeland-Pt MacKenzie 230kV line. An outage of this line will limit the transfer north from Anchorage to approximately 20 MW. This would result in islanding the Fairbanks and Copper Valley systems during heavy transfer conditions. Both systems would experience power outages until generation could be restored. Another transmission tie line between Pt MacKenzie and the Anchorage interties will be required to alleviate this condition.

Additional generation will be required in the Anchorage area prior to the year 2008 to meet a requirement of 150 MW transfer to Fairbanks or, a larger capacity tie line to the Kenai. The Kenai will have available generation with Bradley Lake on line. The spinning reserve requirement of the interconnected system must also be met which may require additional generation in the Anchorage area, a larger tie line to the Kenai, or a comprehensive system wide load shedding scheme. A combination of all three options is possible.

The N.E. Intertie will improve the reliability of service to the Fairbanks area by providing an alternate path for power transfer. Without the N.E. Intertie, a line outage between Teeland and Gold Hill Substations will result in Fairbanks being islanded, causing consumer outages. With the N.E. Intertie, islanding would not occur for transfer levels within the system ratings. Outage records indicate that twenty outages have occurred between Teeland and Gold Hill Substations since 1983. The N.E. Intertie will add approximately 285 miles of line exposure to the interconnected system. With the terrain and weather conditions in the area it is conceivable that several outages a year could occur. With both interties in service and operating within stable single line outage contingency transfers, faults on the N.E. Intertie will not decrease the intertie system reliability. Rapid fault clearing will be a requirement for the intertie to insure system reliability.

The Copper Valley system reliability will be improved with the N.E. Intertie. The system will be loop fed from both Anchorage-Fairbanks interties. A single contingency outage of either intertie will not cause an outage in the Copper Valley system. Also, loss of the Solomon Gulch hydro generator will not cause a major disturbance in the system. The new substation at Gakona will allow the Copper Valley system to provide power to other consumers in the area. The interconnection will also allow sale of approximately fourteen million KWH of energy now being spilled annually at Solomon Gulch.

Stability of the interconnected Railbelt power system and of the Copper Valley system will be improved by the N.E. Intertie. The N.E. Intertie will eliminate the islanding problem between Anchorage and Fairbanks when an outage occurs on the intertie. For the Copper Valley system, the N.E. Intertie will eliminate the problem of islanding Glennallen from the Solomon Gulch hydro generator when an outage occurs on the Glennallen-Valdez line.

In summary, the advantages and disadvantages of the N.E. Intertie being in service are:

Advantages

a. Greater transfer capability to Fairbanks.
b. Greater capacity for the Copper Valley system.
c. Improved transient stability of the entire Railbelt system for faults on the Anchorage-Fairbanks Intertie.
d. Improved reliability of service to Fairbanks.
e. Lower losses in the GVEA system.
f. Improved transient stability of the Copper Valley system for faults on the Glennallen-Valdez Intertie.
g. Improved reliability of service in the Copper Valley System.
h. Allow full utilization of Solomon Gulch Hydrogeneration output.

Disadvantages

a. Larger power and var flows in the MEA system.
b. Greater losses in the MEA system.
c. The possibility of outages in the MEA system caused by power swings during system disturbances.

Recommendations

It is recommended that additional system improvements be investigated in conjunction with the N.E. Intertie in order to derive full advantage of the N.E. Intertie capability. The recommended system improvement investigations are:

1. Improve the existing Anchorage-Fairbanks intertie transfer capability to be consistent with the N.E. Intertie and the desired system transfer requirements. The design of both interties should allow for an outage of either intertie without islanding Fairbanks.
2. Review the system load shedding scheme and provide improvements as necessary for stability during system disturbances.
3. Reinforce the transmission system between Pt MacKenzie and the existing and N.E. interties to provide greater capacity for the case of a line outage

contingency. Sufficient reinforcement should be provided to prevent the MEA transmission system from tripping on system power swings.

4. Investigate transfer tripping and rapid reclosing of all transmission lines involved in the transfer of power over the interties.
5. Investigate single pole tripping of critical lines involved in the intertie.
6. Coordinate all improvements into a system stability and reliability plan.

Engineering studies required for the detailed line and station design are:

1. Economic conductor size.
2. SVS optimization and placement.
3. Fixed reactive optimization and placement.
4. TNA to determine insulation coordination and switching requirements.
5. Critical clearing time of relaying.
6. Short circuit study.
7. Soils testing.

Discussion of Results

Load Flow Study

The load flow study of the Railbelt Utilities interconnected transmission system was performed on an Apollo computer using Electrocon International Power System Analysis (PSA) software. This is the same software used by the University of Alaska (U of A) who maintains the Railbelt Utility transmission system data base. The base data case for this study was provided by the U of A and labeled power flow case 87 PEAK 40 N.E II.

Present and projected loads were obtained from the utilities. These loads are summarized in Table 1 (see Section X-14) as winter peak and summer valley loads for each utility (Lawing refers to the Seward load). Current, 10-year, and 20-year projected loads are tabulated.

Generation schedules used for the load flow cases are given in Tables 2 thru 7. The term HW88 refers to Heavy Winter 1988 loads (winter peak), LS88 refers to Light Summer 1988 loads (summer valley). HW08 and LS08 refers to Heavy Winter and

Light Summer 2008 loads. The generation schedules are set for specific power transfers over the Anchorage-Fairbanks interties.

Load flow cases were run using the U of A base case modified to include the N.E. Intertie transmission system and the CVEA transmission system including Solomon Gulch hydrogenerators in Valdez. The load flow cases are listed at the end of this section for 1988 loads and for 2008 loads. The cases represent various import levels from Anchorage to Fairbanks with various line outage conditions that affect power flows in the existing and N.E. Anchorage-Fairbanks interties, and the transmission lines feeding these interties. Items noted in the comments in the load flow case listings are the flows on the Anchorage-Fairbanks interties, the reactive compensation requirement at Gakona Substation, and any line overload condition or undesirable system operating condition.

Using 1988 loads and transferring up to 100 MW on the interties, the only line that reached maximum loading was the Teeland-O'Neill line in Case 5. The SVS reactive requirements at Gakona varied from +25 Mvars to -53 Mvars. The maximum var flow into the MEA system was 25 Mvars. The transfer limit on the existing Anchorage-Fairbanks intertie is approximately 70 MW. Therefore, a 70 MW transfer limit was used for load flow cases involving outages of the N.E. Intertie.

Using 2008 winter loads, load flow cases were run transferring 70, 100 and 150 MW on the Anchorage-Fairbanks interties. Line overloading occurred on the MEA 115kV system for certain line outage conditions. No other line overloading occurred and no transformer overloading occurred. Maximum import from the Kenai into University Substation is approximately 68 MW. Generation scheduling was adjusted such that this import was not exceeded. This limitation from the Kenai required scheduling excessive generation from MLP and Beluga for the cases of 150 MW transfer to Fairbanks. The SVS reactive requirement at Gakona varied from +30 Mvar to -30 Mvar for all cases except the 150 MW transfer over the N.E. Intertie which required ±97 Mvar of reactive compensation.

High voltage occurred at PS 11 with the transmission line open from PS 11 to Gakona. A 15 Mvar reactor is required to bring the voltage within 5% of nominal. A 15 Mvar reactor will also be required at Gakona if the SVS is out of service and the GVEA system is fed radial from O'Neill.

System loss summaries are tabulated in Tables 8 through 16 for the U of A base case; the U of A base case with the N.E. Intertie; 1988 cases 2 HW88, 10 HW88 and LS88; and 2008 cases 1 HW08, 2 HW08, 13 HW08 and LS08. Losses are indicated by utility with the system total. Loss tabulations have not been included for line outage conditions.

The load flow study utilized the U of A data base. No attempt was made in the data base to adjust transformer tap to adjust voltage or var flow. During heavy winter loading, the capacitor bank at Soldotna was on-line. During light summer loading, all system reactors were on line and the Soldotna capacitor bank was off-line.

Load Flow Runs

1988 Loads

Case	Description	Comments	
2 HW88	102 MW Transfer to Fairbanks HW88 loads 100MW Transfer Generation Schedule	Existing Intertie N.E. Intertie P.S. 11 Compensation	37 MW 75 MW -8 Mvar
3 HW88	Same as Case 2 HW88 Outage Douglas - Teeland Line	Existing Intertie N.E. Intertie P.S. 11 Compensation Teeland - O'Neill MLP2 - O'Neill O'Neill Tap - O'Neill 21Mvar flow into MEA at O'Neill	0 MW 115 MW 25 Mvars 67 MW 53 MW 119 MW
4 HW88	Same as Case 2 HW88 Outage Teeland - Cottle Line	Existing Intertie N.E. Intertie P.S. 11 Compensation MLP2 - O'Neill	49 MW 63 MW -1 Mvar 114 MW
5 HW88	Same as Case 2 HW88 Outage MLP2 - Briggs Line	Existing Intertie N.E. Intertie P.S. 11 Compensation Teeland - O'Neill	42 MW 71 MW -6 Mvar 117 MW
6 HW88	Same as Case 2 HW88 72 MW Transfer to Fairbanks 72 MW Transfer Generation Schedule Outage O'Neill - P.S. 11 Line	Existing Intertie N.E. Intertie P.S. 11 Compensation	81 MW 0 MW -27 Mvar
7	Same as Case 6 HW88	Existing Intertie	72 MW

HW88	Outage P.S. 11 - Gakona Line	N.E. Intertie	7 MW
		P.S. 11 Compensation	-13 Mvar
		High Voltage at	
		Gakona 1.126 PU	
8	Same as Case 6 HW88	Existing Intertie	72 MW
HW88	Outage Gakona - Jarvis Line	N.E. Intertie	7 MW
		P.S. 11 Compensation	-13 Mvar
9	Same as Case 6 HW88	Existing Intertie	38 MW
HW88	Outage Solomon Hydro	N.E. Intertie	79 MW
		P.S. 11 Compensation	-7 Mvar
10	Same as Case 6 HW88	Existing Intertie	MW
HW88	No line outages	N.E. Intertie	MW
		P.S. 11 Compensation	Mvar
2	Same as Case 2 HW88	Existing Intertie	4 MW
LS88	17 MW Transfer	N.E. Intertie	12 MW
	to Fairbanks	P.S. 11 Compensation	-53 Mvar
	LS88 loads	0 Mvar flow into MEA at O'Neill	
	LS88 Generation Schedule		

Load Flow Runs
2008 Loads

Case	Description	Comments	
1 HW08	98 MW Transfer to Fairbanks HW08 loads 100 MW Transfer Generation Schedule	Existing Intertie N.E. Intertie P.S. 11 Compensation Daves Ck. to University Low voltage on this line. 0.93PU at Portage. 27Mvar flow into MEA at O'Neill.	37 MW 83 MW 2 Mvar 85 MW
2 HW08	56 MW Transfer to Fairbanks HW08 loads 56MW Transfer Generation Schedule	Existing Intertie N.E. Intertie P.S. 11 Compensation 24Mvar flow into MEA at O'Neill	22 MW 55 MW -15 Mvars
3 HW08	Same as Case 1 HW08 Outage Teeland - Douglas Line	Existing Intertie N.E. Intertie P.S. 11 Compensation Teeland - O'Neill	0 MW 123 MW 30 Mvar 113 MW
4 HW08	Same as Case 1 HW08 Outage Teeland - O'Neill	Existing Intertie N.E. Intertie P.S. 11 Compensation MLP2 - O'Neill	53 MW 66 MW 13 Mvar 141 MW
5 HW08	Same as Case 1 HW08 Outage MLP2 - O'Neill Line	Existing Intertie N.E. Intertie P.S. 11 Compensation Teeland O'Neill	42 MW 75 MW 6 Mvar 146 MW
6 HW08	Same as Case 2 HW08 Outage O'Neill - P.S. 11 Line	Existing Intertie N.E. Intertie P.S. 11 Compensation	79 MW 0 MW -19 Mvar

7 HW08	Same as Case 2 HW08 Outage P.S. 11 - Gakona Line	Existing Intertie N.E. Intertie P.S. 11 Compensation High voltage at Gakona 1.104PU	63 MW 12 MW -5 Mvar
8 HW08	Same as Case 2 HW08 Outage Gakona - Jarvis	Existing Intertie N.E. Intertie P.S. 11 Compensation	58 MW 16 MW -6 Mvar
9 HW08	Same as Case 2 HW08 Outage Solomon Gulch	Existing Intertie N.E. Intertie P.S. 11 Compensation	37 MW 84 MW 4 Mvar
10 HW08	Same as Case 1 HW08 Transfer 150 MW over N.E. Intertie Outage Teeland - Douglas Line HW08 loads 150MW Transfer Generation Schedule	Existing Intertie N.E. Intertie P.S. 11 Compensation Teeland-O'Neill Tap O'Neill Tap-O'Neill	0 MW 165 MW 97 Mvar 143 MW 174 MW
11 HW08	Same as Case 1 HW08 Outage Teeland - Pt MacKenzie Line	Existing Intertie N.E. Intertie P.S. 11 Compensation MLP2 - O'Neill	28 MW 92 MW 58 Mvar 258 MW
12 HW08	Same as Case 2 HW08 Outage Teeland - Pt MacKenzie Line	Existing Intertie N.E. Intertie P.S. 11 Compensation MLP2 - O'Neill	12 MW 59 MW 6 Mvar 172 MW
13	Same as Case 10 HW08 No line outages	Existing Intertie N.E. Intertie	51 MW 104 MW

		P.S. 11 Compensation	22 Mvar
		29Mvar flow into MEA at O'Neill	
2	Same as Case 1 HW08	Existing Intertie	2 MW
LS08	17 MW Transfer to Fairbanks	N.E. Intertie	35 MW
	LS08 loads	P.S. 11 Compensation	-30 Mvar
	LS08 Generatrion Schedule	9Mvars flow into MEA at O'Neill	

Transient Stability Study

Transient stability cases were run to determine the size requirement of the Gakona Substation SVS for system dynamic stability. The study was performed on an Apollo computer using Electrocon International PSA software. The transient stability base case was provided by the U of A. Machine data for Solomon Gulch and Bradley Lake generation was added to the U of A data base as was data for the Gakona Substation SVS. Typical hydrogenerator machine and exciter data was used for Solomon Gulch and Bradley Lake because actual data was not available. Typical data for the SVS was provided by Asea Brown Boveri Corporation.

The load flow case used for the stability study was Case 2 HW08. This case has peak winter loads and 70 MW Anchorage-Fairbanks interchange transfer. Heavy winter loads provide the most severe condition for stability. The 70 MW interchange transfer was used in order to not exceed the transfer capability of the existing Anchorage-Fairbanks Intertie.

Transient stability results for three case studies are included in the Appendix II. These three cases represent critical fault and line clearing conditions for the interconnected transmission system. The case descriptions and comments are summarized at the end of this section.

Case 1 stability study faults and opens the N.E. Intertie, shifting the total interchange power flow to the existing intertie. The stability model assumed that no other transmission lines would trip due to power swings. The system machine angles and bus voltages remained stable for this case. A voltage overshoot occurs at Gakona immediately following fault clearing. This overshoot is caused by the SVS control model. During the fault, the SVS control voltage is depressed causing the

SVS control to request maximum vars. When the voltage recovers following fault clearing, the vars produced by the SVS increase instantly. The SVS control can not respond this fast which results in a voltage spike. The SVS control recovers within a cycle. In an actual SVS, controls are included to prevent voltage spikes following fault clearing. This voltage spike occurs in each stability case but does not impact the results of the study because the duration of the voltage spike is extremely short. (approximately 2ms) An overshoot and recovery also occurs in the SVS's on the existing intertie. The recovery is longer due to longer control time constants. The recovery appears to be approximately three cycles.

Case 2 stability study faults and opens the Teeland-Pt Mackenzie 230kV transmission line which is the major interconnection between Beluga generation and the interties to Fairbanks. An outage of this line causes an overload of the MLP2-O'Neill line. The stability model assumes that no lines will trip due to power swings. This may be difficult to accomplish for the MLP2-O'Neill line. The steady state load flow case showed a 150 percent overload. If the MLP2-O'Neill line were to trip, the Fairbanks, Copper Valley, and MEA systems would be islanded from Anchorage. The stability of all of the Railbelt systems would be jeopardized if this occurred. For the case modeled, the machines angles and bus voltages remain stable. The SVS at Gakona swings from +30 to -10 Mvar.

Case 3 stability study faults and opens the Teeland-O'Neill tap line. Power flow on the N.E. Intertie flows through the MLP2-O'Neill tap line. The stability model assumes that no lines will trip due to power swings. The system disturbance results indicate that the MLP2-O'Neill tap line relaying could be designed with swing blocking to not trip for this disturbance case. For the case modeled, the machine angles and bus voltages remain stable.

Transient Stability Runs

Case	Description	Comments
1	Load Flow Case 2 HW08 56 MW Transfer to Fairbanks. Fault Gakona - Jarvis Line near Jarvis, clear Jarvis in 4 cycles, clear Gakona in 6 cycles, Gakona SVS ± 30 Mvar.	Voltage at Gakona 138kV bus reached approximately 1.25 PU when the Gakona end cleared. All generators remained stable.
2	Load Flow Case 2 HW08 56 MW Transfer to Fairbanks. Fault Teeland - Pt MacKenzie Line near Pt MacKenzie, clear Pt MacKenzie in 4 cycles, clear Teeland in 6 cycles, Gakona SVS ± 30 Mvar.	Voltage at Gakona 138kV bus reached approximately 1.2 PU when the Pt MacKenzie end cleared. O'Neill 115kV reached 0.89 PU for approximately 10 cycles (40 to 50 cycles). All generators remained stable.
3	Load Flow Case 2 HW08 56 MW Transfer to Fairbanks. Fault Lazellet - O'Neill Tap Line near O'Neill. Clear O'Neill Tap in 4 cycles, clear Teeland in 6 cycles, Gakona SVS ± 30 Mvar.	Voltage at Gakona 138kV bus reached approximately 1.1 PU when the Teeland end cleared. All generators remained stable.

VI. ROUTE SELECTION ALTERNATIVES

VI. ROUTE SELECTION ALTERNATIVES

In order to develop a transmission line route between the Matanuska Valley and Delta Junction, two major corridors and one sub-corridor were considered.

The first corridor is the general Glenn Highway - Richardson Highway corridor. This general corridor would follow the Glenn Highway eastward from Sutton to Glennallen, and then route north along the Richardson Highway to Delta Junction.

A second alternate is to follow the Anchorage-Fairbanks Intertie to Cantwell, following the Denali Highway to Paxon, and then north to Delta Junction. A line would have to run south from Paxon to Glennallen and Gakona Junction.

The third alternative is to route eastward along the Glenn Highway, north across the flat areas near Lake Louise, and eastward to Sourdough. This would also require a line south to Gakona Junction and Glennallen.

Considering these three alternatives within the context of cost, land availability, and environmental impact, the first alternative, Glenn Highway - Richardson Highway, has the least line length (hence less cost). In terms of environmental impacts, consideration of the Denali Highway as a scenic corridor precludes the use of the second alternative. The extensive wetlands in the area north of the Glenn Highway between Lake Louise and Glennallen and the use of this area as a significant swan nesting area make this an unfavorable choice. Distance from a major transportation corridor and the associated overland construction impacts would also make routing in this area less desirable.

It would appear that utilizing either of the second two alternatives would allow the line to be constructed primarily on state or federal lands. However, the need to connect either alternative back to Glennallen requires the crossing of privately held Ahtna land (native's land) in the Gakona Junction to Glennallen area. Therefore, no advantage, either in cost or ease of obtaining right-of-way, exists.

Therefore, routes which roughly parallel the Glenn and Richardson Highways were chosen for further study.

The main criteria used for the selection of a specific route were:

- Avoidance of areas with significant environmental impacts.
- Close proximity to transportation, or reasonable access for construction and maintenance.
- Avoidance of lands which might be difficult to obtain, or where it would be difficult to obtain a right-of-way permit.

Generally, routes were selected which avoided conflicts with major existing pipelines or proposed pipeline rights-of-way. A distance of 1/4 mile was used to separate the route from a pipeline, except for direct crossings.

When possible, the line routes were placed so that they avoided locations in which the line would provide an interruption to a scenic view. To accomplish this, routes were located to provide a rising backdrop, or the line was placed at a lower elevation from the location that the viewer would occupy. For the most part, the view would be from the highway corridor, but crossing the end of scenic lakes was also avoided. In relatively flat, treed areas, the line routes were placed more than a 1/4 mile from the highway corridor to minimize the visual disturbance.

Two main routes were chosen. One route was located north of the Glenn Highway, connecting to a route proceeding north of Glennallen on the west side of the Richardson Highway. This route has been named the Northwest Route. Similarly, a route which passes mainly to the south of the Glenn Highway was selected. This route connected to a route primarily to the east of the Richardson Highway and is named the Southeast Route.

Route Descriptions

Southeast Route

The Southeast Route begins at O'Neill Substation near Sutton and runs north of the Glenn Highway for a distance of 17 miles before it crosses to the south side. With the exception of a short stretch near Hicks Creek (Mile 33.5) and Caribou Creek (Mile 41 to 42), it remains on the south side.

For the first 6 miles, the route is at the same elevation as the highway. At Mile 6, it rises perpendicular to the slope of the terrace above and continues on the higher terrain above the highway for 11 miles until it crosses the highway at Mile 17. The route is very close to the highway and just above the Matanuska River from Mile 20 to 23. It passes south of Long Lake 3/4 mile from the highway and rejoins the highway at Mile 30. It passes very close to the highway near the Matanuska Glacier through an area of mixed ownership, including a recreation site. Mitigation of impacts at this location requires two highway crossings to place it on the north side of the highway for 2 miles which is necessary if this route is to be feasible.

The route continues within 1/4 mile of the highway on the south side until Mile 60 after which it is located 1/2 to 3/4 mile from the highway. There are variations to 1 mile south of the highway near Cache Creek, Mendeltna Lodge and Tazlina, as well as at Wood's Creek and Mile 102.75. Along all of this route, fairly gentle terrain will be crossed.

Near Tolsana Creek, the line has been routed to avoid the state recreation site. From Mile 108 to 115.5 the line would be 1/4 mile south of the highway but moves to more than a mile south of the highway near Glennallen. The route then angles southeasterly until it meets the 138kV line coming from Valdez. A switching station would be required at the line intersection, approximately one mile south of Pump Station 11. The Southeast Route goes northeast over relatively flat terrain, and then roughly parallels the Copper River north to Gakona Junction. It remains relatively close to the highway to Mile 168 near Hogan Hill and then varies from 1 mile to 3 miles east of the Richardson Highway to approximately Mile 200 just south of Summit Lake. The route traverses east of Summit Lake, north to Gunn Creek, across a broad deltaic river bed to Phelan Creek and follows the highway to Mile 218.3. It crosses the highway at this point avoiding an avalanche hazard area for 2.5 miles when it recrosses the highway. It remains very close to the highway until approximately Mile 241, at which point it traverses a relatively steep slope for several miles and then continues northward at elevation 3000 feet and then descends to elevation 2250 near the highway, finally crossing the highway at Mile 259 and continues on the west side of the highway into Delta Junction.

Both the Northwest and Southeast routes have private land in the area between the O'Neil Substation and the Matanuska Glacier. Otherwise, borough and state lands are crossed. Both routes traverse a length of native lands. The Southeast Route crosses several short parcels of Chickaloon land and, subsequently, 69.44 miles of Ahtna land east and north of Glennallen compared to 38.7 miles of Ahtna land for the Northwest Route. The Southeast Route has a more limited ownership than the Northwest Route in the Gakona Junction area, crossing private and village land. North of Sourdough, both routes are primarily on federal land, with the exception of a very short connection to the Jarvis Substation in Delta Junction.

Northwest Route

The Northwest Route is so named because it passes north of the Glenn Highway from Sutton to Glennallen and primarily west of the Richardson Highway. This route begins at the O'Neill Substation near Sutton and runs 3/4 to 1 mile north of the Glenn Highway on a higher terrace for the first 6 miles. It passes up the King River Valley to a point approximately 3 miles north of the highway and continues eastward from Mile 13 to 17 when it crosses the Chickaloon River. It then follows within 1/4 to 1/2 mile of the highway to Mile 35. In this stretch, it passes through very difficult terrain north of Long Lake in which it rises to over 1,000 feet above the highway near the lake. From Mile 35 to 41, it originally ran in the highway right-of-way, then follows Caribou Creek away from the highway several miles, finally following Squaw Creek eastward and coming to 1/4 mile from the highway at Tahneta Lake at Mile 57.5. A revision has been made to re-route away from the highway east of Caribou Creek. From Mile 57.5, it follows close to the highway on the north side until Mile 80. From Mile 80 to Glennallen, it remains more than 3/4 mile north of the highway diverging the greatest amount near Moose Lake (Mile 104) where it passes to the north of Moose Lake some 2 1/2 miles from the highway.

The line crosses over the pipeline north of Glennallen and turns almost directly northward. East of Gulkana airport, it passes on the western boundary of the Dry Creek State Recreation Site, very close to the pipeline corridor. The line has a connection to the proposed Gakona Junction Substation from the Gakona Junction Substation a second circuit or 115kV line runs back south to the pipeline crossing North of Glennallen. The 138kV line between the pipeline crossing and Gakona Junction Substation is on the same structures as the main line. From the pipeline crossing, the 138kV line continues south one mile to Pump Station 11 Substation. The line continues north from the Gakona Junction Substation paralleling the west side of the Gulkana River. The route crosses the Gulkana River immediately west of Sourdough and continues on the west side of the Richardson Highway until Mile 174 where it crosses to the east. It recrosses the highway just north of Meiers Lake and then crosses back to the east side at Mile 192.5. Just south of Summit Lake, the route crosses the highway directly east to west and follows the west side of Summit Lake to Isabel Pass. It remains west of the highway and the Alyeska Oil Pipeline by crossing the Delta River at Mile 215. The route recrosses the Delta River three more times in the next several miles ending up on the east side of Mile 238 where it also crosses the highway. It then follows the highway closely crossing it again at Mile 239 and finally at Mile 253 to remain on the west side into Delta Junction.

VII. SUGGESTED ROUTE

VII. SUGGESTED ROUTE

Suggested Route Description

The Suggested Route is one selected for more detailed study based on the initial route evaluation. This route is suggested because:

1. It is feasible to obtain the right-of-way.
2. It does not have any environmental concerns which would prevent construction, or impacts which cannot be mitigated.
3. Permitting is feasible within a reasonable schedule.
4. It is competitive from a cost of construction point of view.

The route from the O'Neill Substation to just east of Glennallen is identical to the Northwest Route described in Section VI, Route Selection Alternatives. At Glennallen, a change was made from the original alternatives in which the 230kV route crosses the pipeline and proceeds north to the proposed Gakona Junction Substation. From just east of the pipeline to the Gakona Junction Substation would be a double circuit line to accommodate the 138kV tie back to the Pump Station No. 11 Substation at Glennallen.

From the Gakona Junction Substation north, the line travels almost exactly northward until it reaches a point just south of the Gakona River. At this point, it departs from the original Northwest Route and crosses the Gakona River and connects to what was the original Southeast Alternative Route. From this point, which is approximately 2-1/2 miles south of Sourdough, the Suggested Route follows the Southeast Route to the Jarvis Creek Substation in Delta Junction,

Discussion of Suggested Route Selection

Several factors affect the choice of a Suggested Route for more detailed study. In the initial portion of the intertie between the O'Neill Substation and Glennallen, the main considerations are availability of right-of-way and aesthetics. In a direct comparison between the two routes, it is apparent that land ownership is less complicated and, therefore, right-of-way acquisition more likely to be accomplished in a reasonable time frame on the Northwest segment in this area.

Aesthetics were viewed primarily as the viewer would see it from the highway. However, the impact to the viewer was considered from recreational access areas and lakes. The Northwest segment afforded fewer highway crossings that the Southeast route. In fact, there are no crossings of the Glenn Highway between Sutton and Glennallen.

All other environmental factors were not significantly different, and cost for right-of-way use was estimated to be lower for the Northwest segment.

North of Glennallen, the western route was chosen because it offered a relatively simple tie-in to Gakona Junction by locating the proposed substation near the oil pipeline right-of-way and allowing the Copper Valley Electric Association to utilize existing or new right-of-way to run a line to Gakona Junction. The route in this area will have almost no visual impact, being located away from the highway.

The crossing was made at the Gakona River, south of Sourdough, because of the designation of Wild and Scenic Rivers for both the Gakona and Delta Rivers north of there. The route on the east side, which is an extension of the Southeast Route, has easier construction access and minimal aesthetic impacts compared to the Northwest Route in this area. Although three highway crossings are needed, in one case to avoid an avalanche hazard area at Rainbow Ridge, the visual impact of the line would be much less than the Northwest alternative. All other environmental, permitting, and right-of-way issues between Sourdough and Delta Junction were not significantly different enough to affect the choice.

Golden Valley Electric Association has identified a route between the North Pole Substation and the Carney Substation. This right-of-way follows section lines and contains several parcels of land belonging to the State of Alaska. In addition, there are two crossings of the Alyeska Pipeline.

The route leaves the North Pole Substation and crosses Section 21, T2S, R2E and from the point where it meets the south section line of Section 22, T2S, R2E, it follows the section lines approximately 27 miles to the Carney Substation. The total length of line is approximately 28 miles. The line will be 138kV, constructed on wood piles in a 30-foot right-of-way adjacent to a 50-foot section line easement.

The route stays to the west of the Richardson Highway for 16 miles and then crosses to the east side of the highway. It crosses the Alyeska Pipeline at Mile 25 and 27.3. The route has thirteen 90° corners and one 45° angle.

The GVEA route map and data sheets on the route and land ownership are contained in Exhibit V.

Cost Summary:

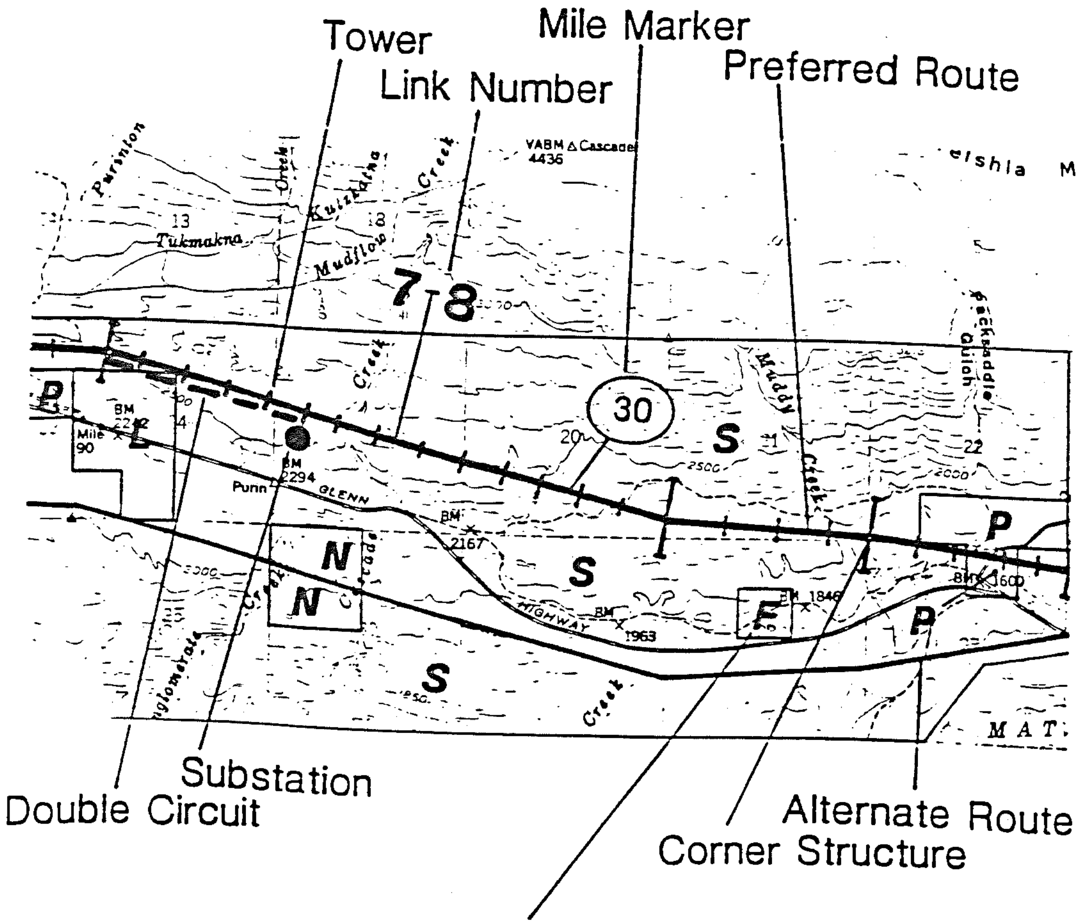
The Northeast Intertie cost for the Suggested Route is summarized as follows:

Environmental Costs	$	3,521,875.00
Right-of-Way Acquisition Costs		1,520,300.00
Transmission Line Costs		119,205,000.00
Station Costs		31,943,224.00
Total Cost	$	156,190,399.00

Route Map

(Suggested Route)

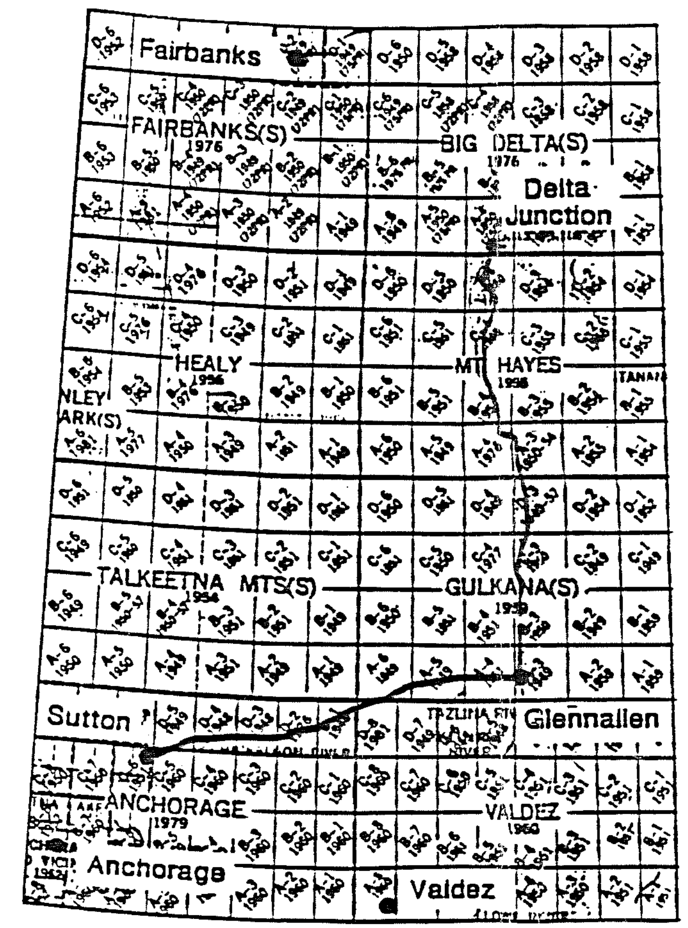
Map Symbol Key



Land Ownership Designation

F	US Government
N	Native
S	State of Alaska
M	Military
L	Local Government
P	Private
- - - -	**Recommended Mitigation**

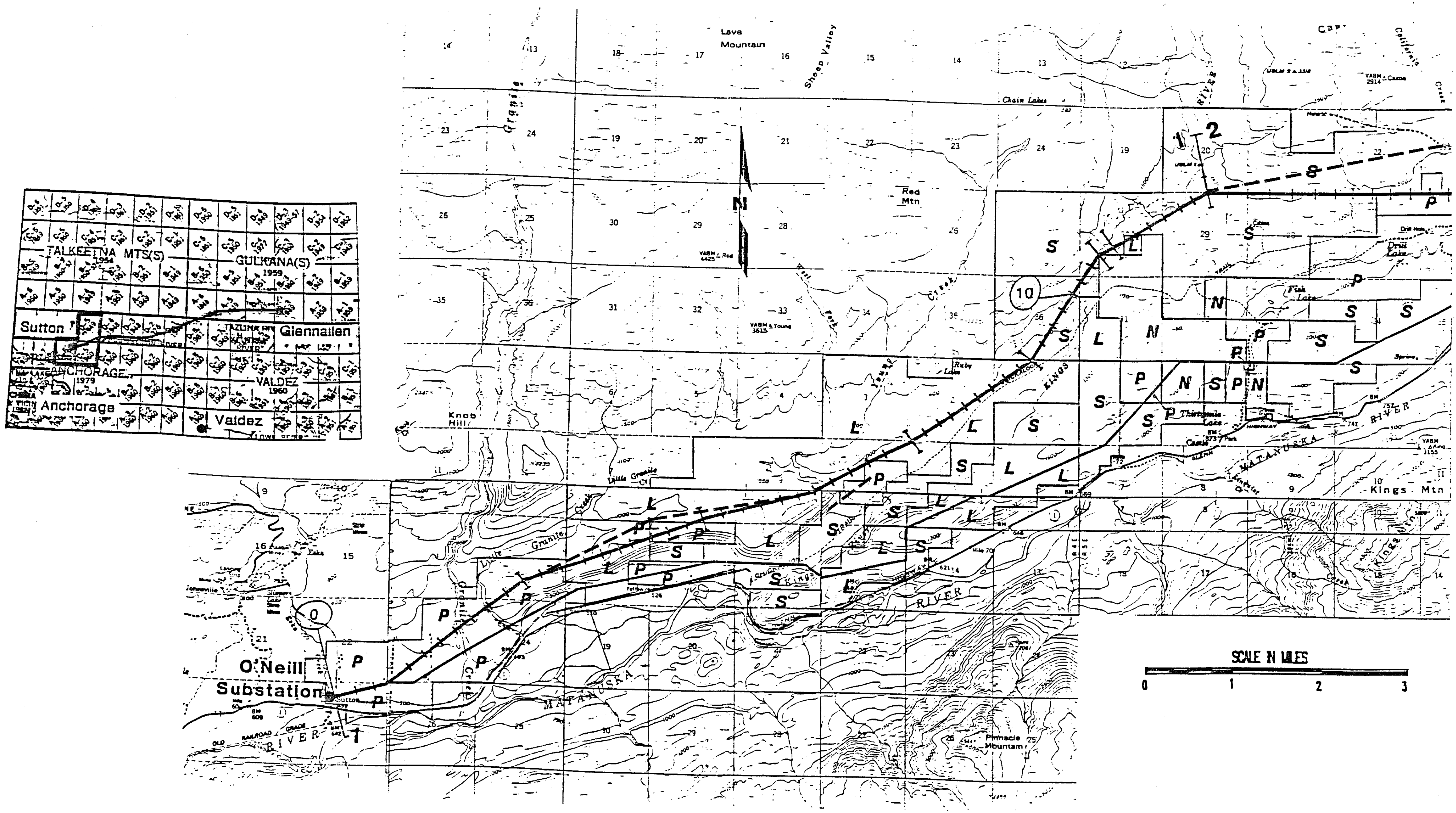
Route Location Key



Base maps: USGS 1:63360 Series

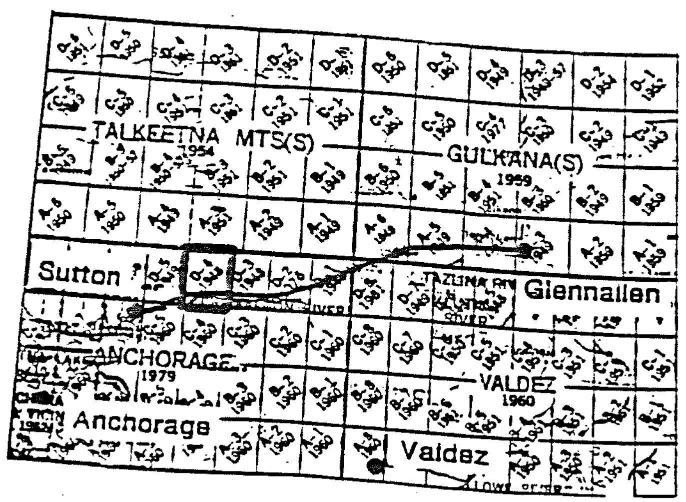
Route Map

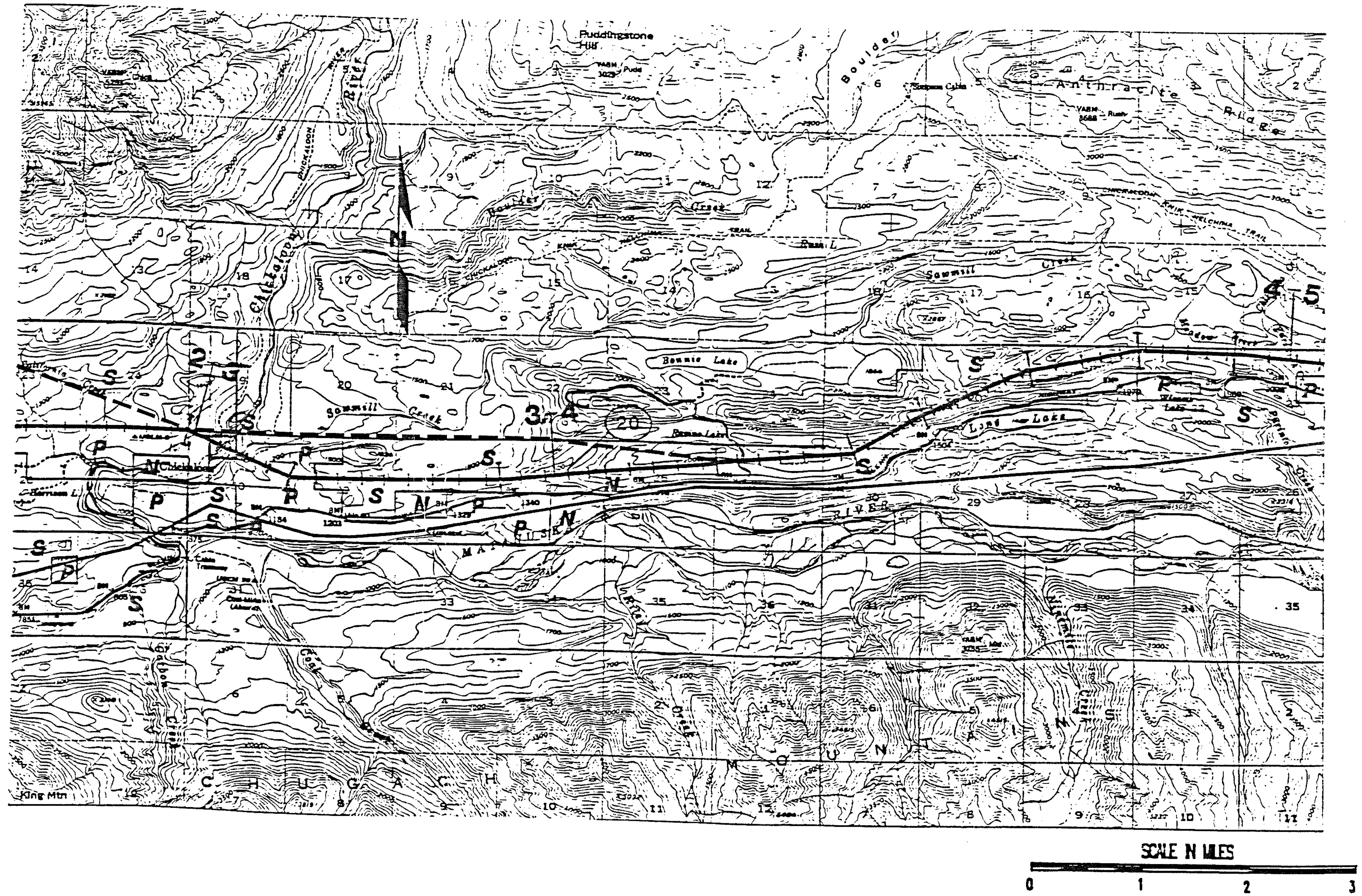
(Suggested Route)



Route Map

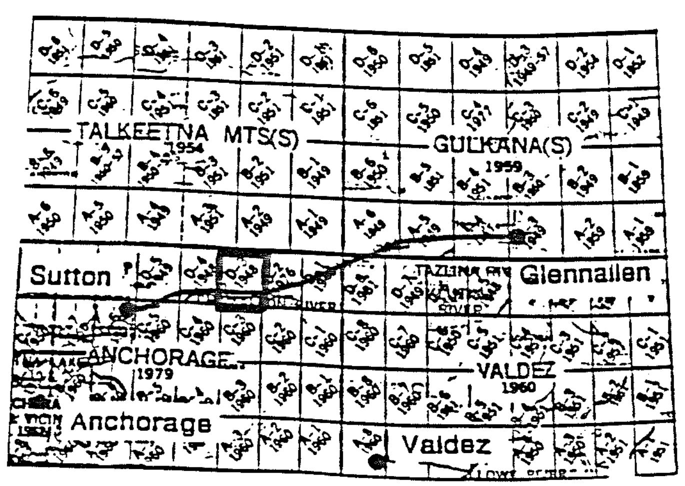
(Suggested Route)

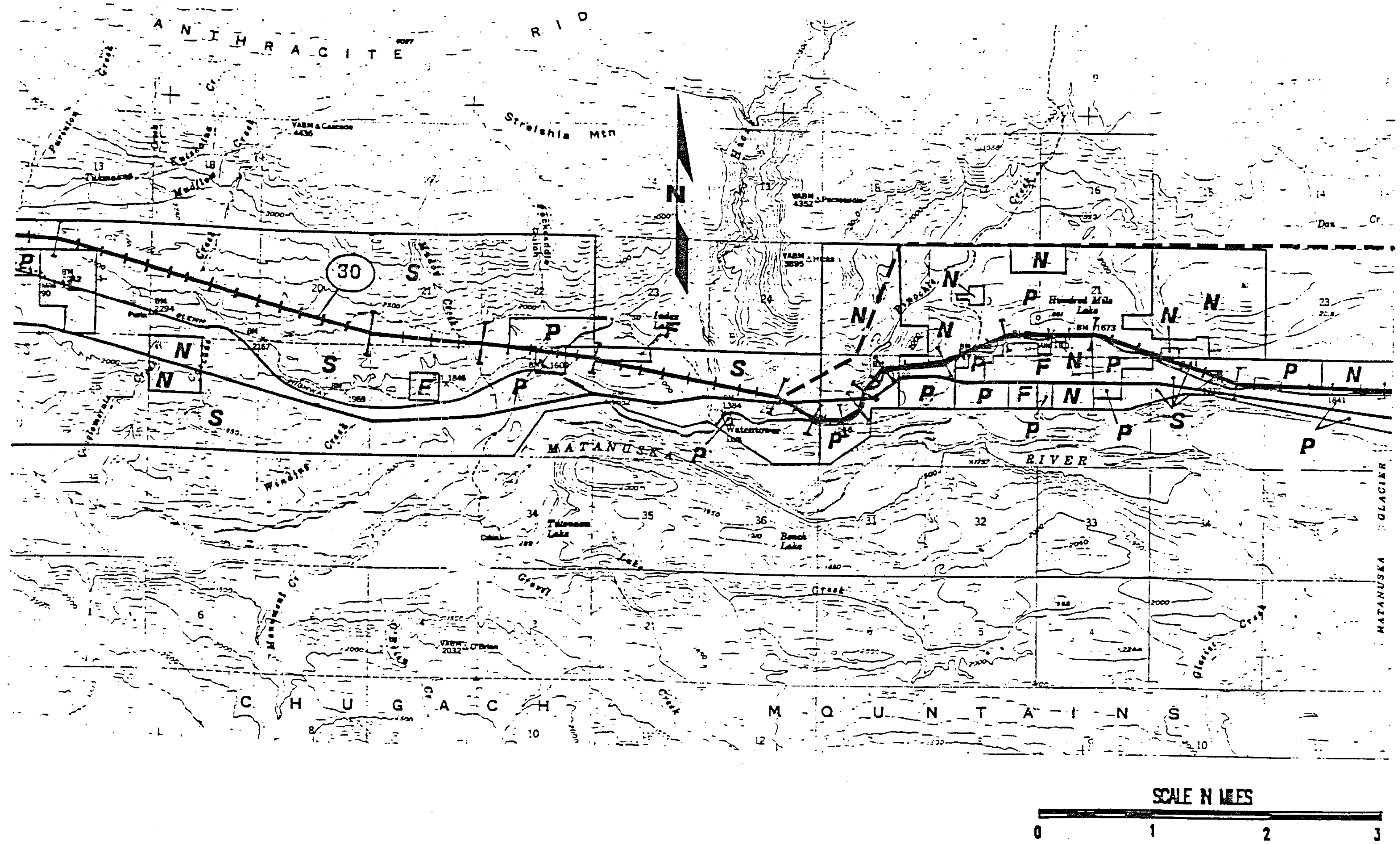




Route Map

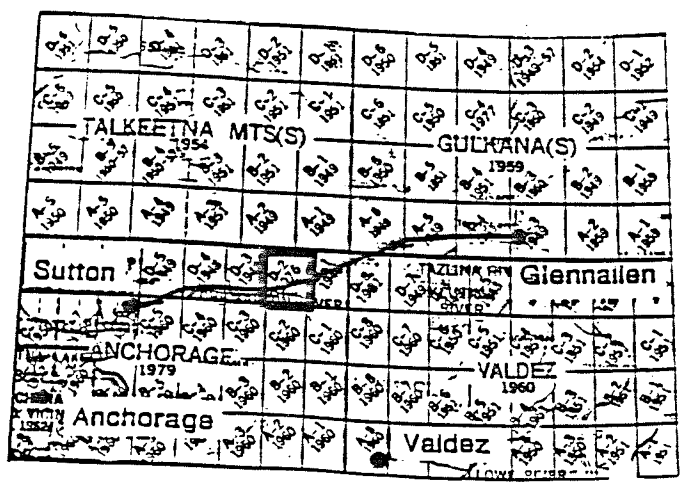
(Suggested Route)

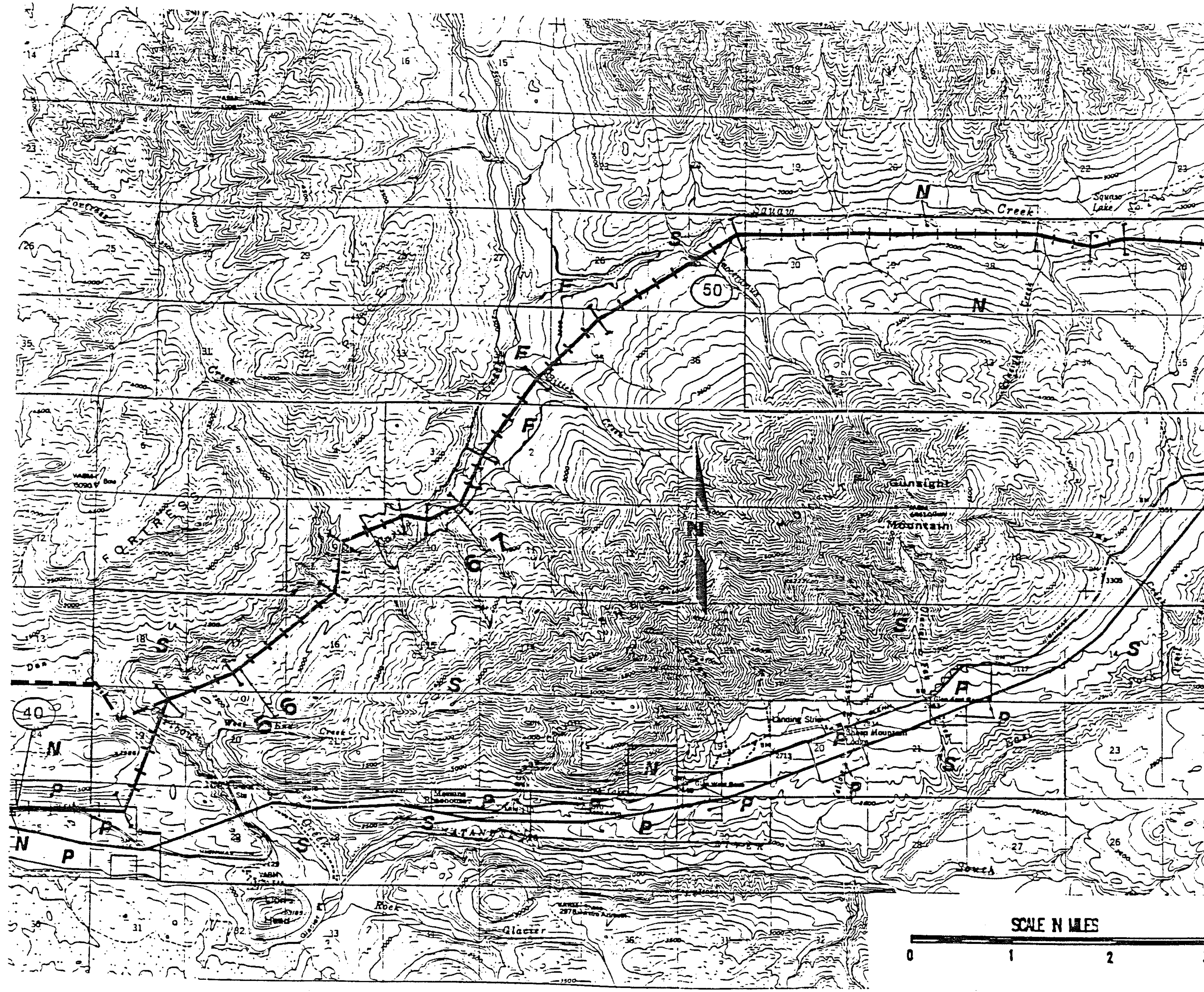




Route Map

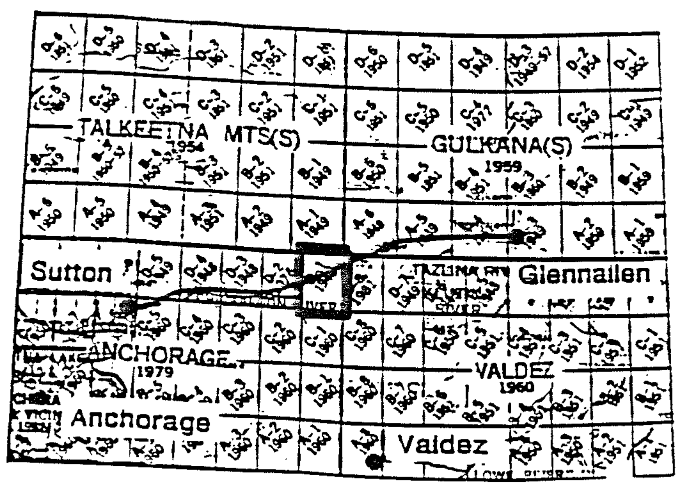
(Suggested Route)

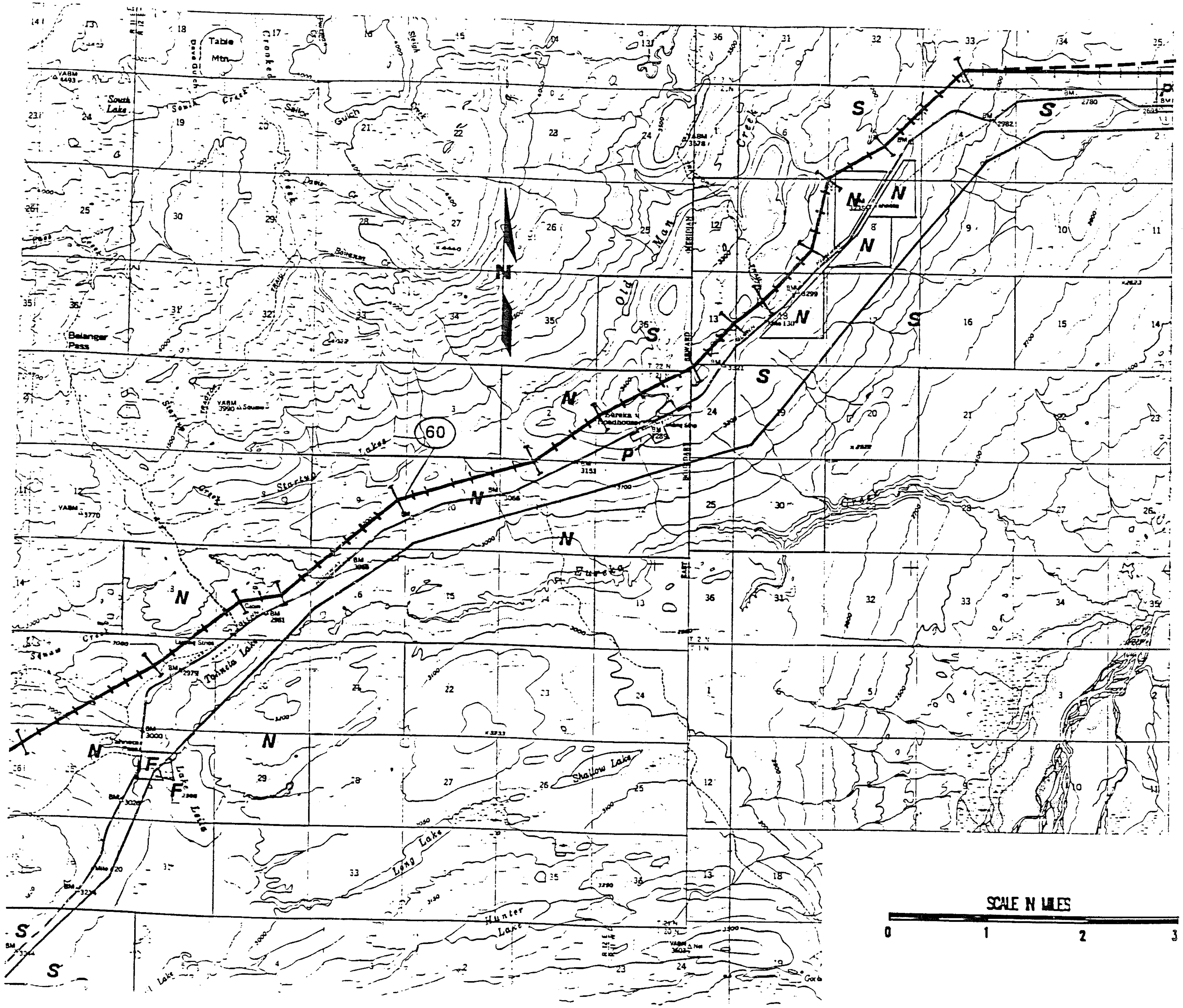




Route Map

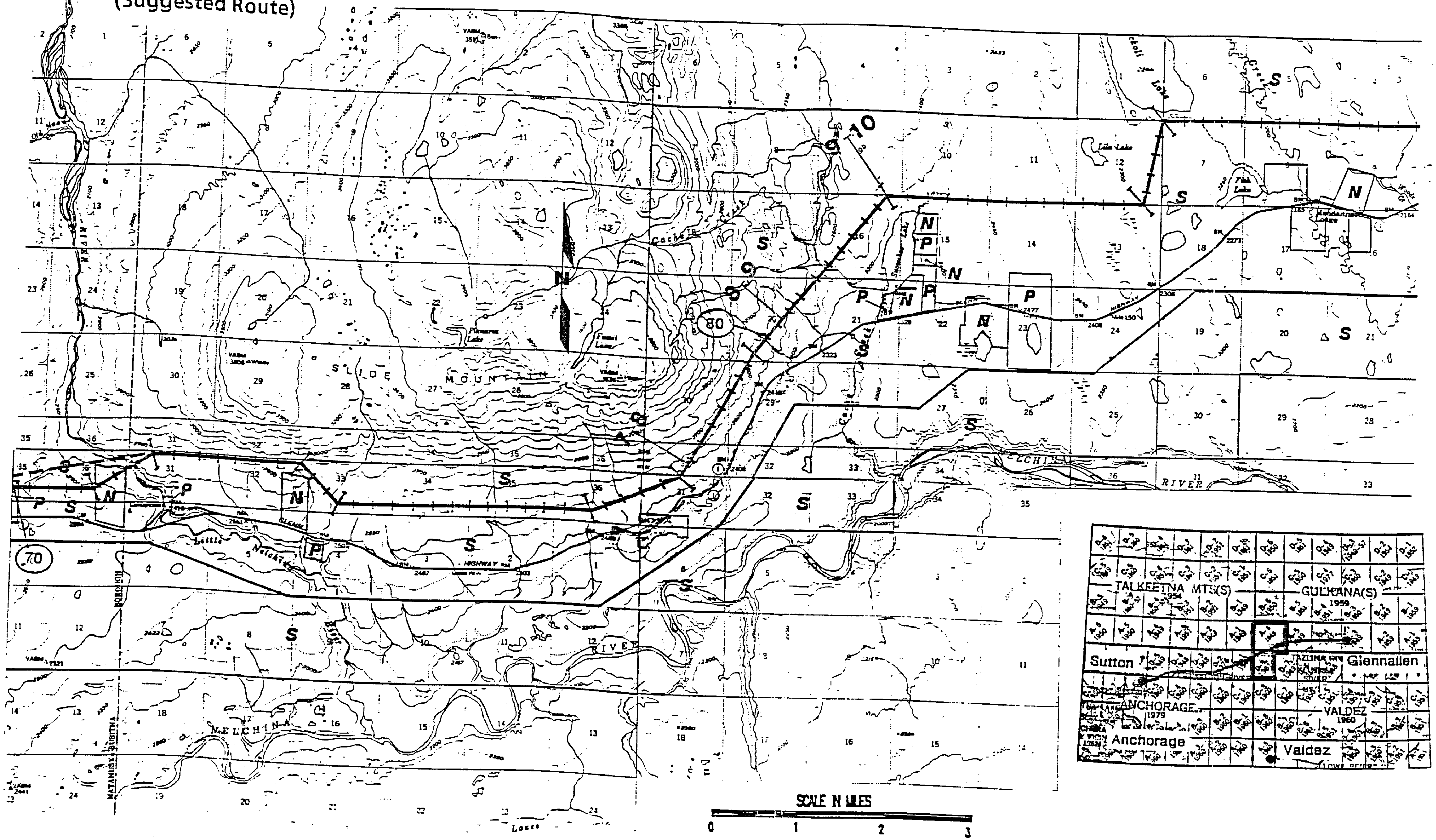
(Suggested Route)





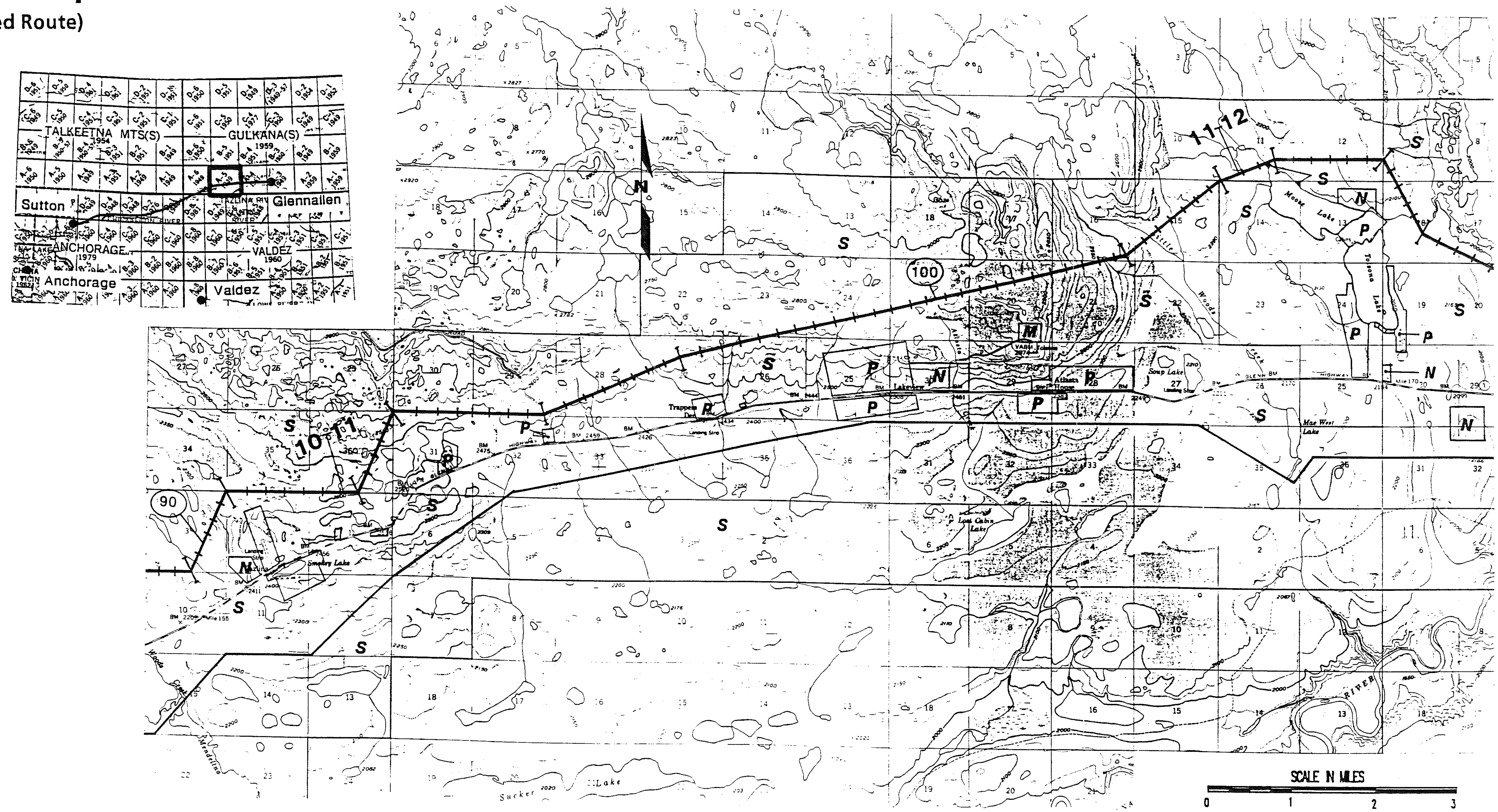
Route Map

(Suggested Route)



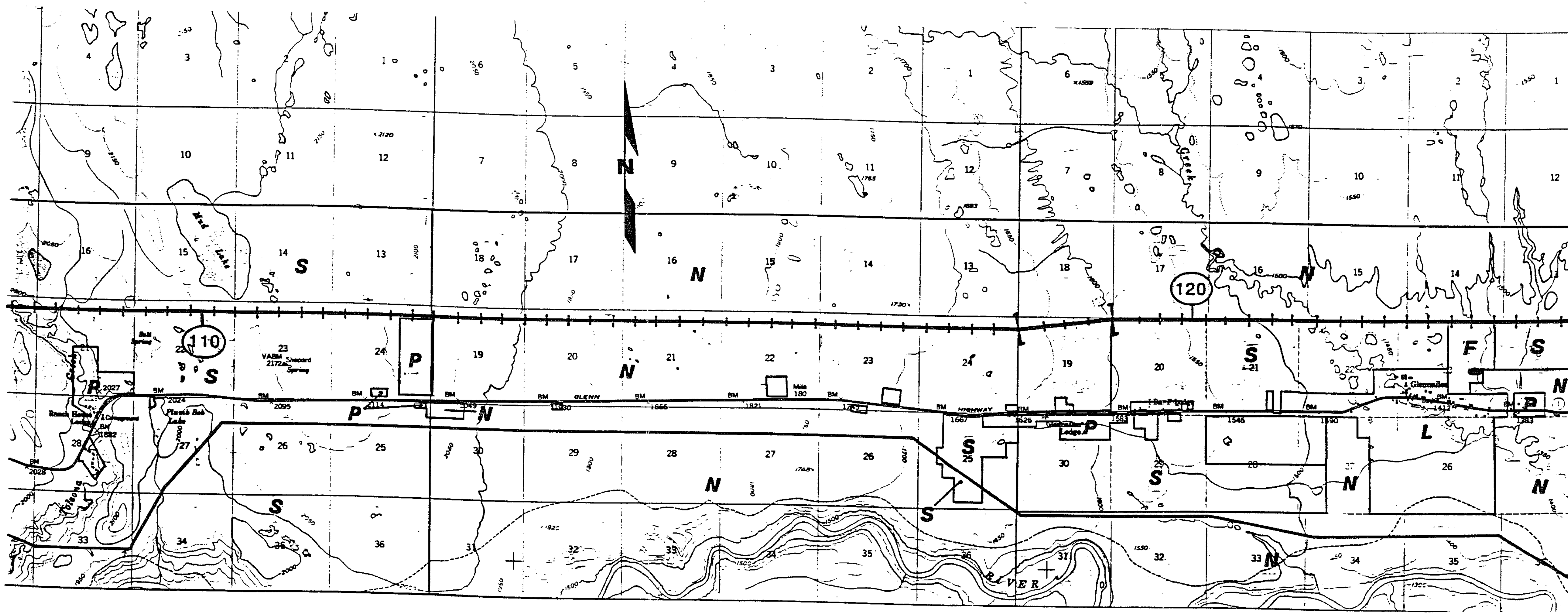
Route Map

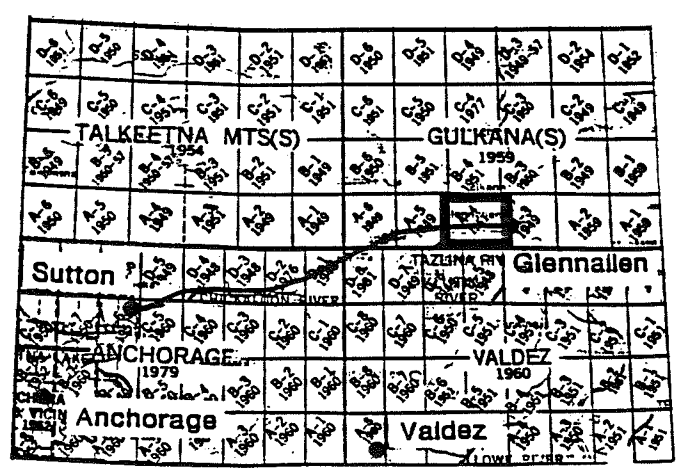
(Suggested Route)



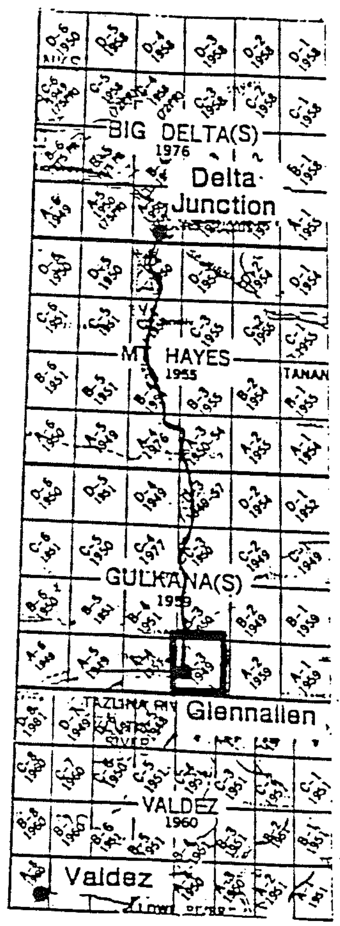
Route Map

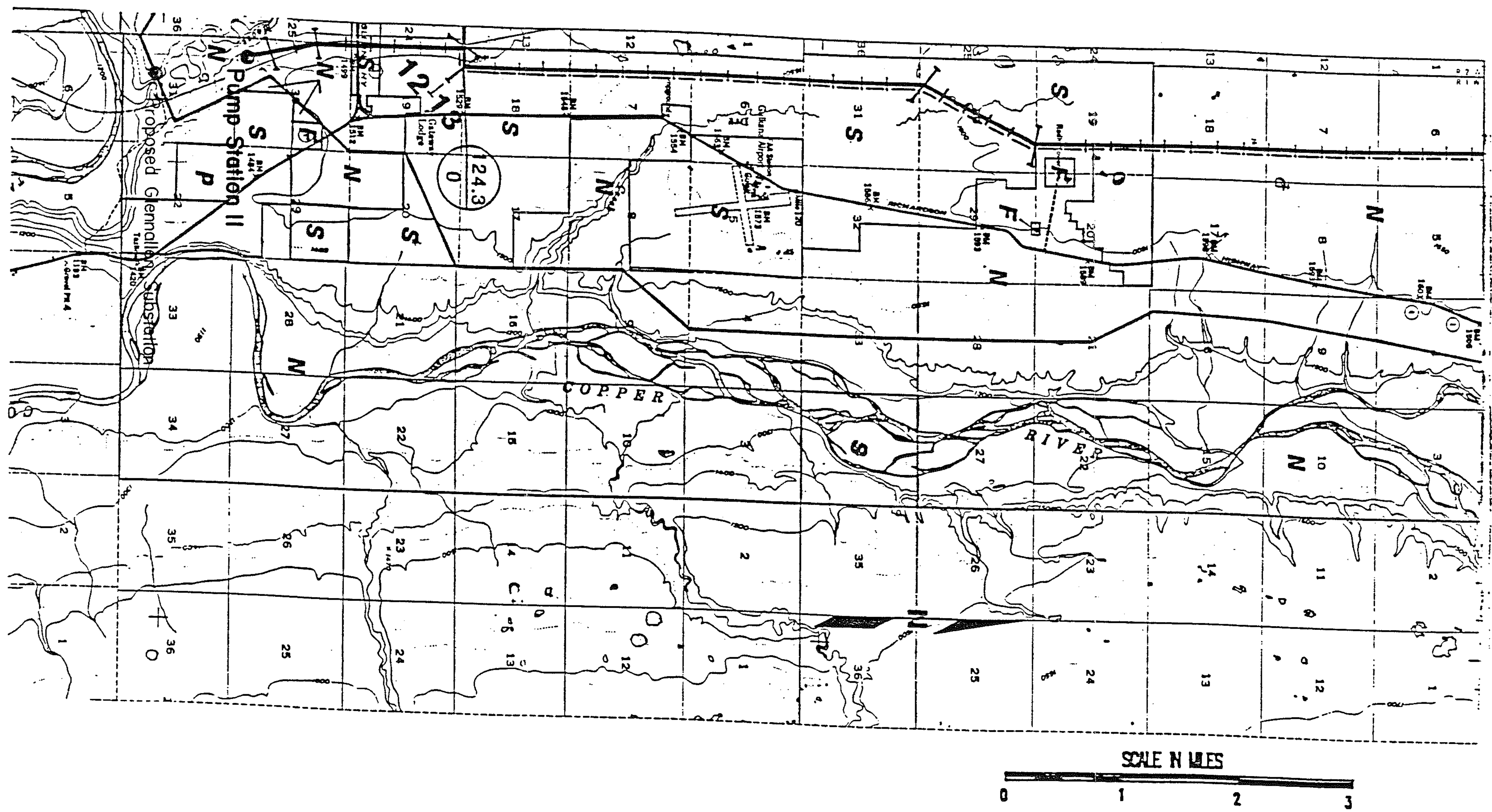
(Suggested Route)





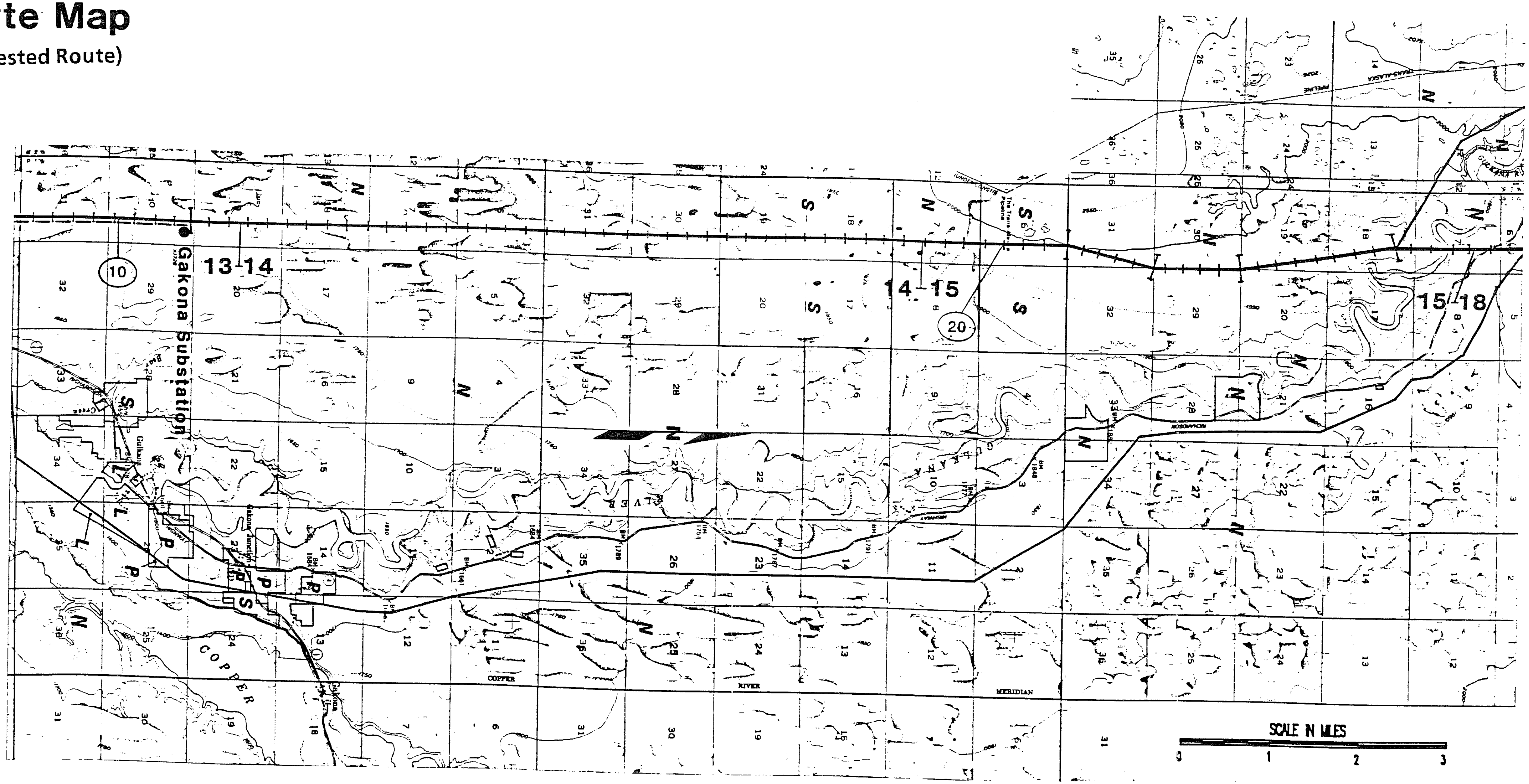
Route Map

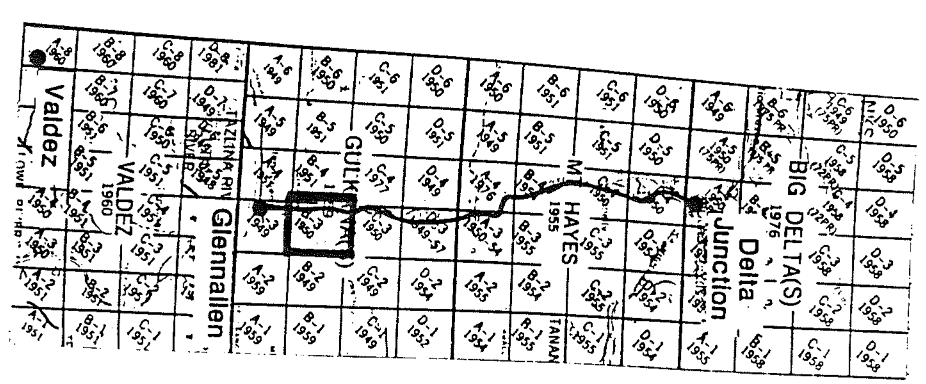

BIG DELTA(S)
1976
Delta Junction
MT HAYES
1955
GULKANA(S)
1959
Glennallen
VALDEZ
1960
Valdez


Pump Station II
Proposed Glennallen Substation
COPPER
RIVER
SCALE IN MILES
0
1
2
3

Route Map

(Suggested Route)





Route Map

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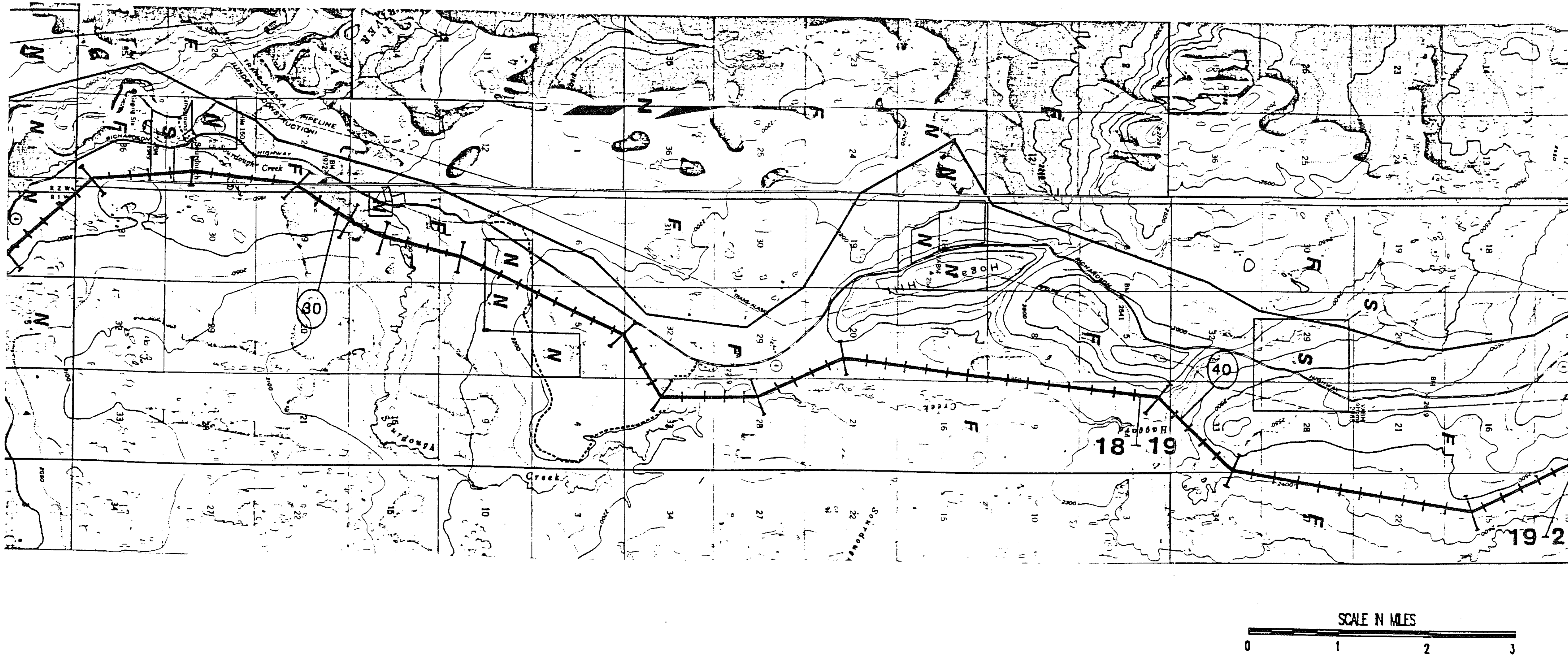

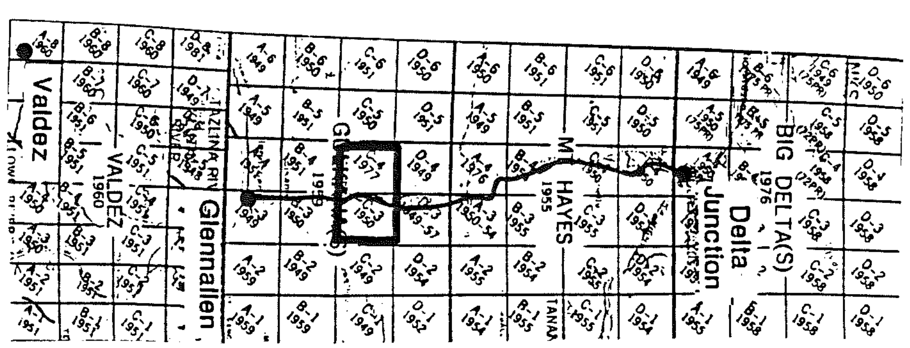

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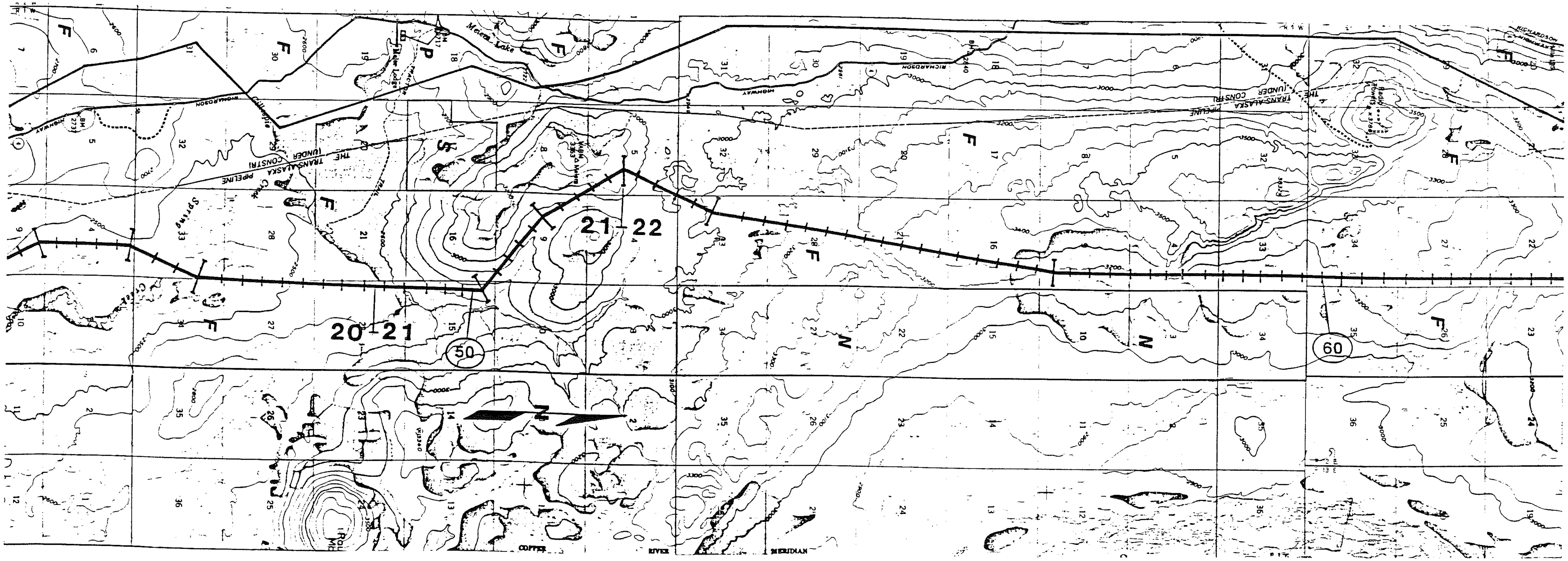

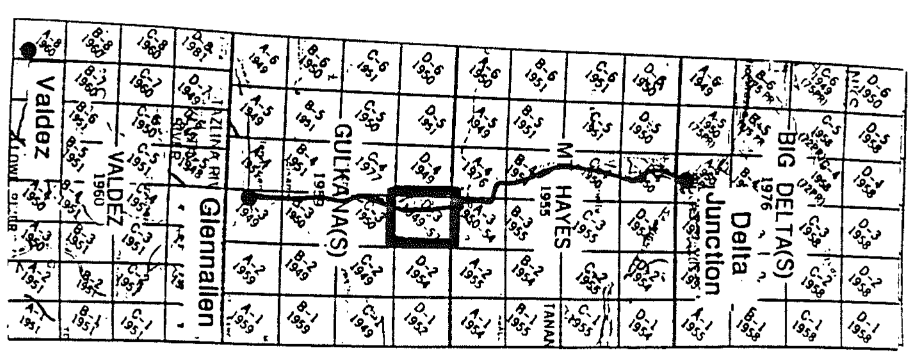

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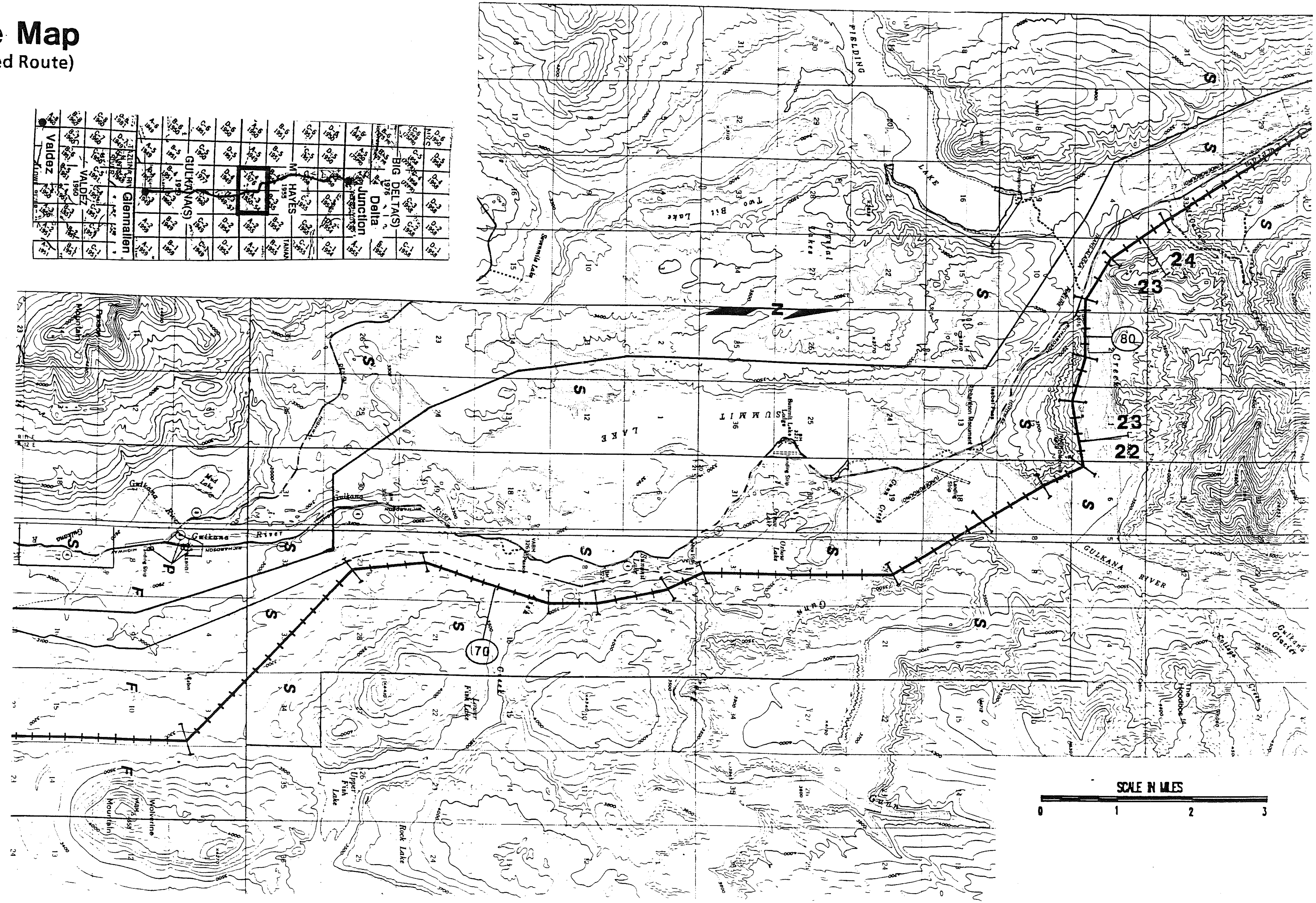

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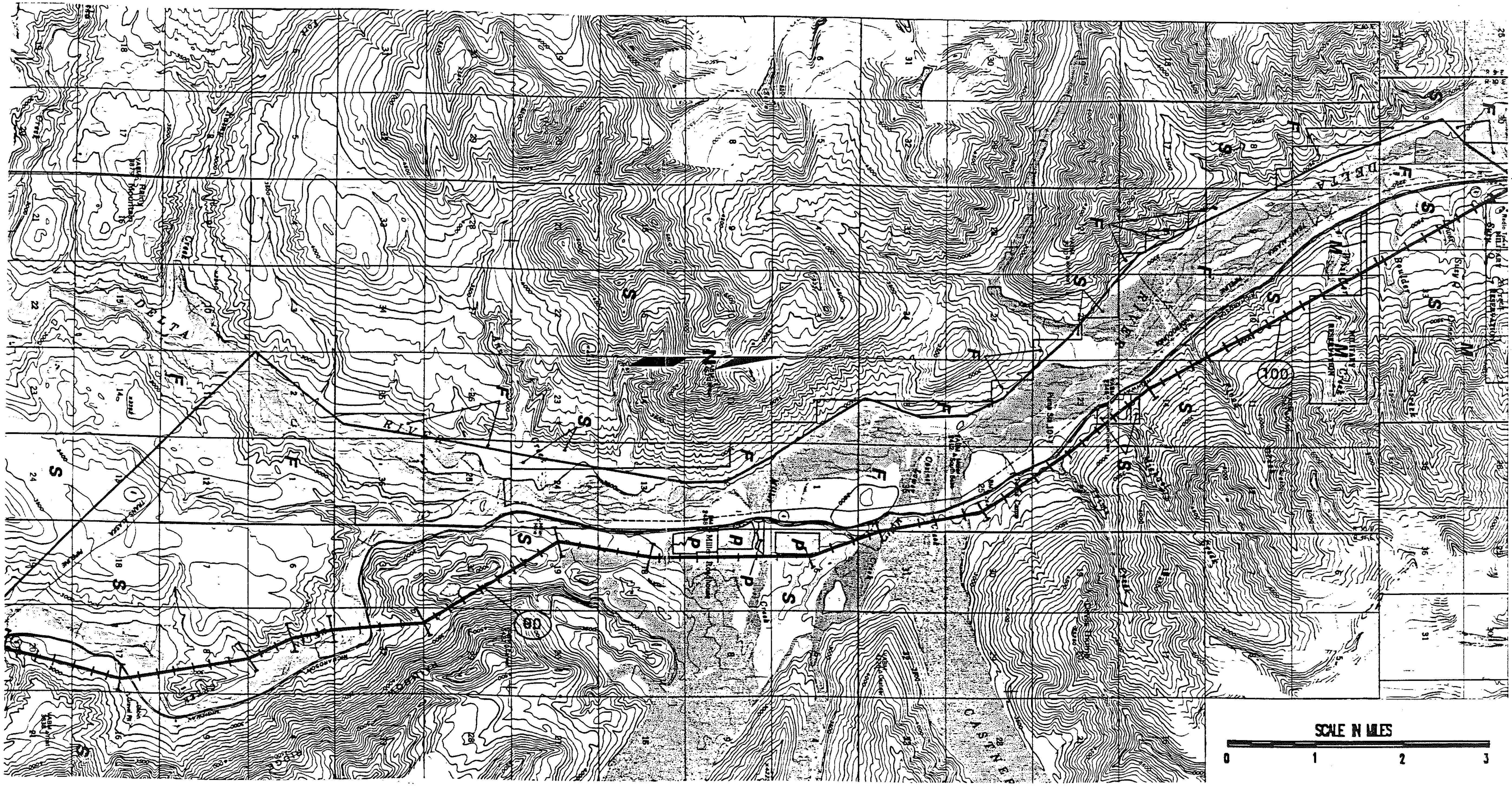

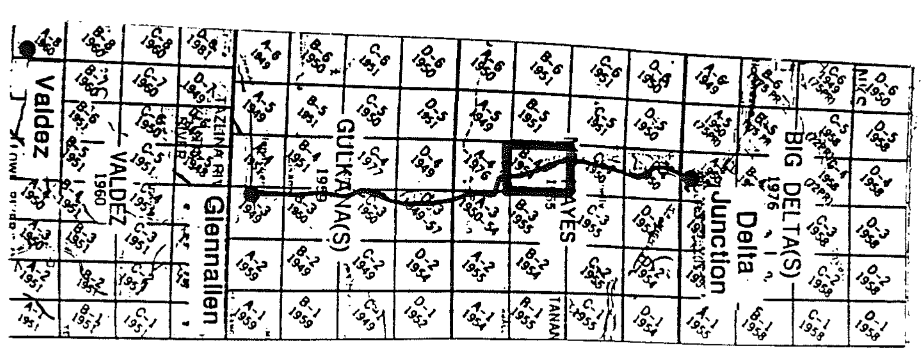

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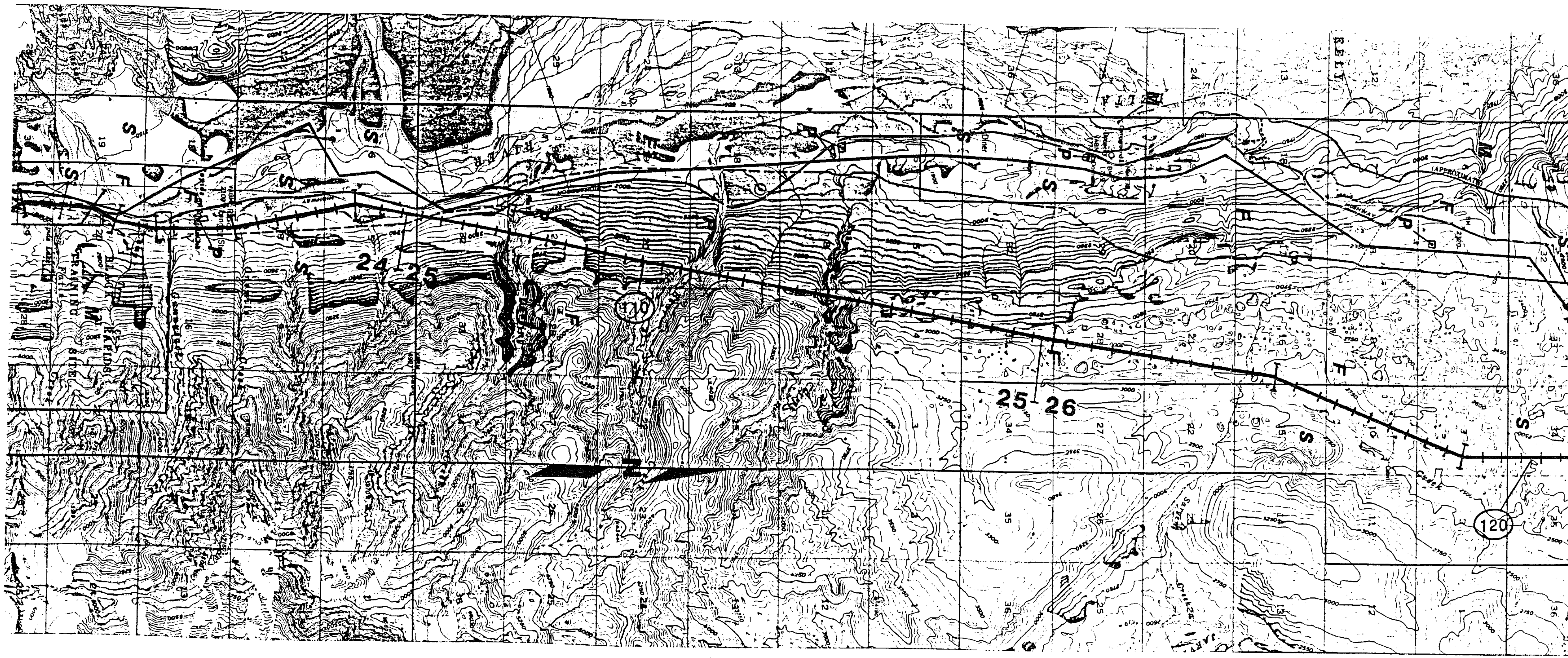

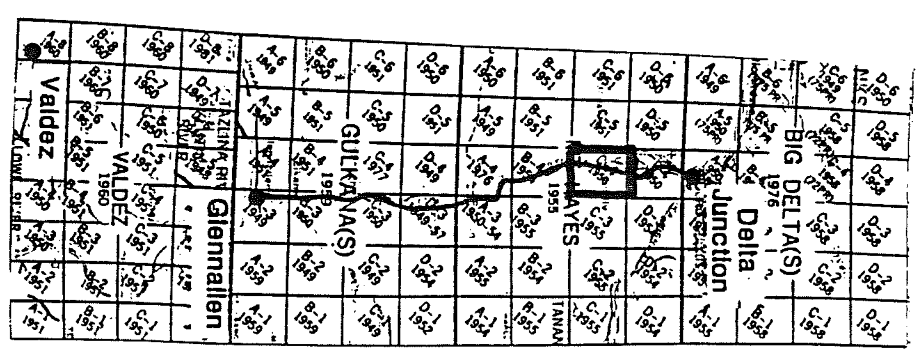

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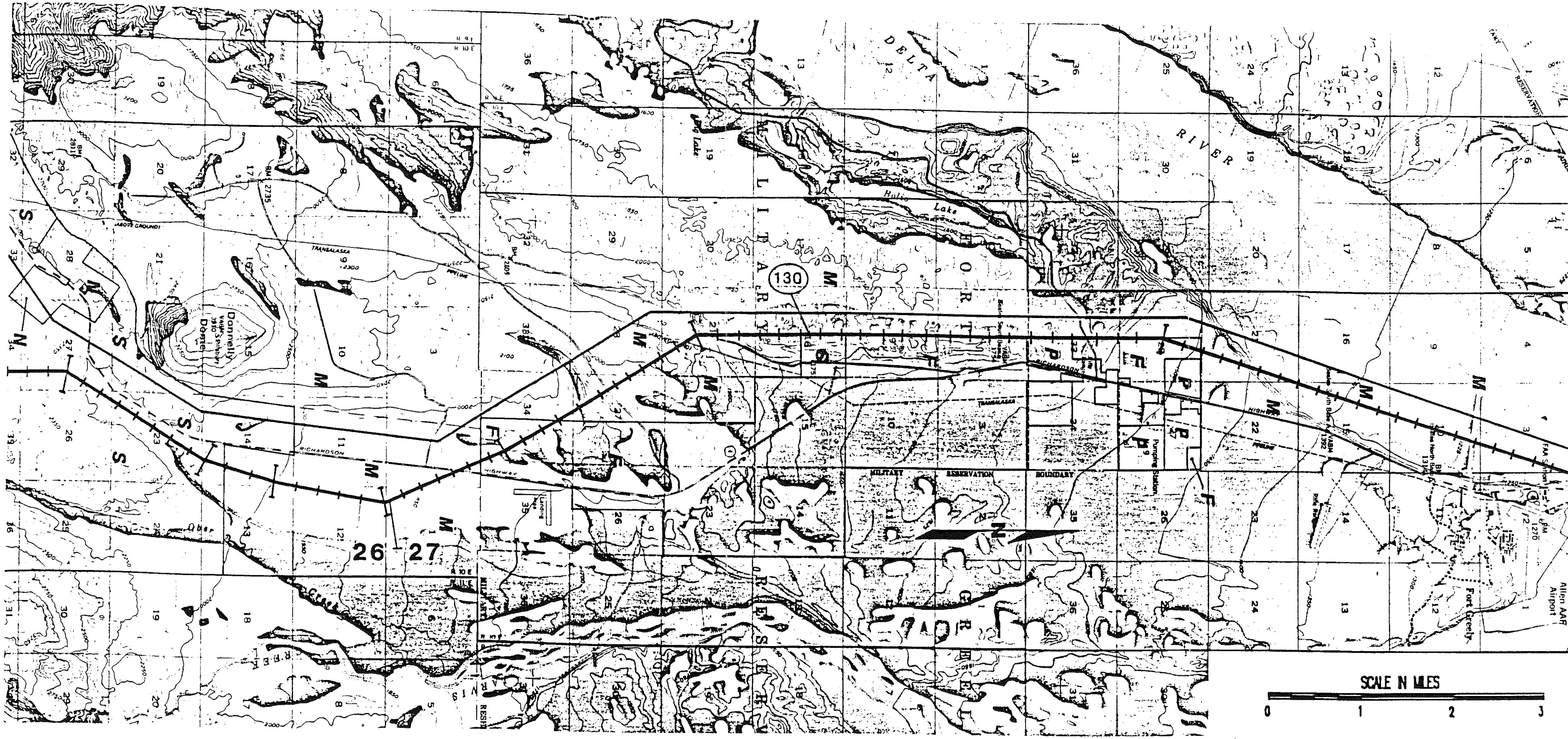

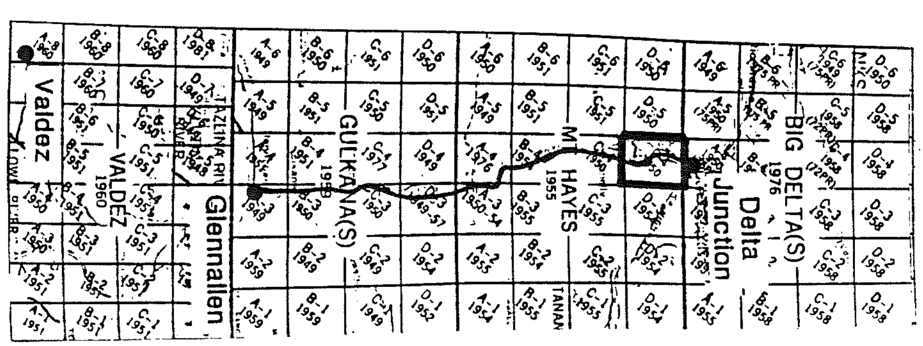

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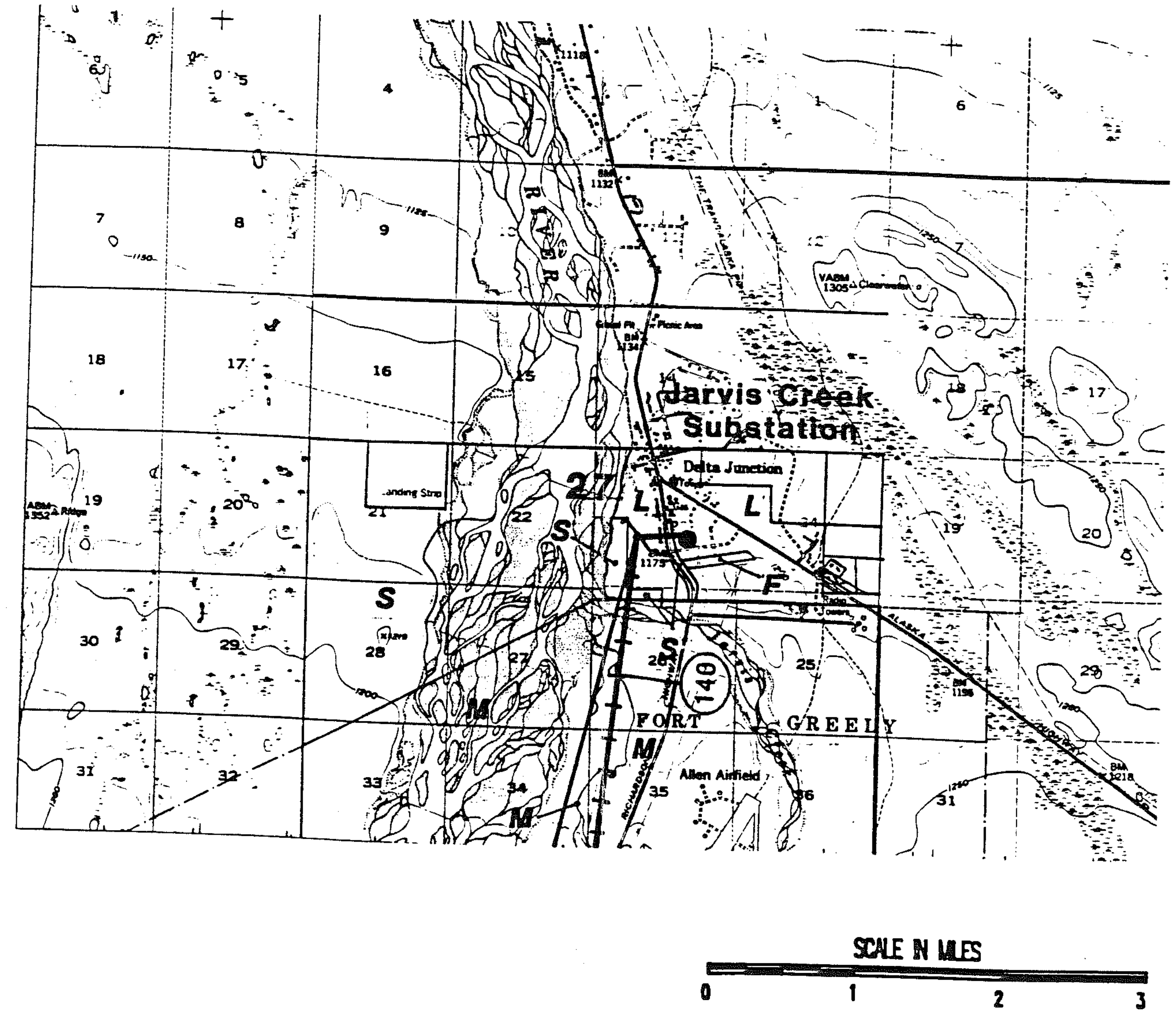

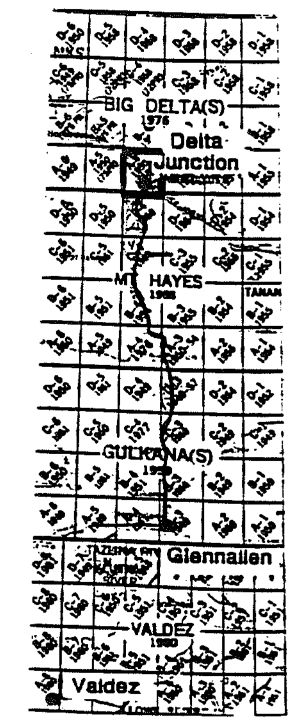

VIII. ENVIRONMENTAL EVALUATION ALTERNATE ROUTES

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Description Of Environmental Factors

Construction and operation of the proposed Northeast Transmission Line Intertie would affect various aspects of the natural and human environment. For purposes of comparing such effects among the two alternative routes, 12 environmental factors were selected for consideration. A description of each factor and the type of environmental resources potentially affected are presented below.

Water Quality

Freshwater systems can be adversely affected both directly (via cable stringing and foundation construction) and indirectly (via runoff and siltation from vegetation removal, access road construction, and other up-slope construction activities). The duration of these effects depends on soil and sediment characteristics, re-vegetation and re-colonization rates, and other factors.

Floodplains

Although transmission lines generally follow natural contours along valleys, floodplain crossings can occur. Although structures themselves will not impede flood flows, access embankments could impede flow and therefore should be avoided or removed following construction.

Land Cover

Transmission line construction may involve removal of vegetation within all or part of the right-of-way. During maintenance over the life of the project, vegetative growth must be controlled. In addition to the direct loss of a particular vegetative type, terrestrial habitat for birds and mammals may be altered, and certain species may be adversely affected. Other species that utilize more open habitats and the ecotone (transition between habitats) may benefit.

Wetlands

Wetlands are a specific land cover type protected by federal regulation. Wetlands can be adversely affected by construction of tower foundations, cable stringing, and up-slope land disturbance.

Fish and Wildlife

As noted, aquatic and terrestrial habitat can be altered as a result of transmission line construction. Population effects depend on the value of lost habitat, the ability of adjacent areas to support displaced fauna, and the ability of the habitat to replace itself. Effects are generally more pronounced in previously undisturbed areas. There is a potential for loss of birds due to collision with towers or conductors, which is discussed in the next section. This environmental factor focuses on species that are especially sensitive to human disturbance (such as caribou) or have sport or commercial value (such as salmon). Timing of use relative to the construction schedule is also important.

Threatened and Endangered Species

Construction activities can adversely affect endangered or threatened species, or species of special concern. Although these effects can usually be mitigated by pre-construction surveys and design modifications (including rerouting, as necessary), the mitigation process becomes more lengthy and costly as the potential for encountering these species increases.

Archeological and Historic Sites

The construction of transmission lines in undeveloped areas can adversely affect important archeological and historic sites and can interfere with cultural and religious uses of the environment. The magnitude of potential effects is related to the number and importance of such resources and activities in the route vicinity. However, specific impacts can generally be avoided or mitigated through appropriate preconstruction surveys and consultation with affected groups.

Land Use

The alteration of existing and planned land uses is an important environmental factor in transmission line route selection. This environmental factor focuses on public lands designed for a specific purpose (such as federal, state, and borough recreation and critical habitat areas), for which transmission line routing may present land use conflicts. It also addresses recreational and subsistence uses (fishing, hunting, boating, hiking, etc.) that are not limited to designated public lands.

Aesthetics

The presence of transmission facilities in undeveloped areas can adversely affect natural aesthetic values and scenic views. These impacts are unique because of the height of transmission towers and the lineal nature of alignments. The magnitude of the impacts are a function of the number of viewers and sensitivity of the environment. Particularly sensitive vantage points include scenic highways, lookouts, and waterways. Common mitigation measures include rerouting, design changes, and screening.

Social Impacts

Social impacts include temporary and long-term impacts on community infrastructure (such as need for additional public services), employment, and property values.

Construction

Although a number of the above factors address construction related effects, this factor focuses on air quality, waste disposal, and traffic disruption, all of which disturb the natural and human environment near the alignment. Dust from right-of-way clearing and emissions and noise from vehicles and equipment occur during construction. Timber and slash and right-of-way clearing and excavated soils must be disposed of. Traffic disruption can be minimized. The effects are generally temporary and local.

Operation

This factor focuses on electromagnetic interference, human health and safety, maintenance, and right-of-way interference. Electromagnetic interference from operation of 138kV or 230kV transmission line facilities is usually considered minor or insignificant. For voltages of 230kV and lower, ozone and noise generation during operation is not expected to be significant (Boies et al. 1979). These facilities can generate some noise and radio/TV interference in the immediate right-of-way, but the effects are not expected to be noticeable beyond 50 feet from the right-of-way (U.S. Dept. of Energy 1980). Human health was initially considered as a potential environmental factor. However, review of the literature indicates that electric field, magnetic field, and corona effects from transmission lines present no adverse health hazards. A U.S. Department of Energy (1982) review reported "the overall results of this research and the operating experience continues to indicate there is little reason for concern about potential long-term health effects from transmission lines." Further research into health hazards of high voltage transmission lines indicates a considerable number of published articles on the subject. To address these concerns further study was undertaken and is included in subsequent sections.

Ground level maintenance (facility inspection and mechanical vegetation control) can result in minor effects on wildlife populations. Finally, this factor considers the potential for increased accessibility to otherwise undisturbed areas and the resultant damage to vegetation, increased erosion, and harassment of wildlife.

Discussion of Environmental Factors

In the following discussion of environmental factors, the purpose is to present a summary of existing data, and to determine whether or not construction and operation of the Northeast Intertie would impact one route more than the other and what the major impacts would be. For most factors, there is sufficient information to determine whether or not an impact would occur but, in some cases, additional data will be required.

The route maps contain milepost numbers in 10-mile increments. Specific milepost locations referenced in this discussion are the angle tower locations where the transmission line changes direction.

Water Quality

The Northwest Route contains a total of 143 streams, of which 74 are located between Sutton and Glennallen, and 69 between Glennallen and Delta Junction. The Southeast Route contains a total of 124 streams, of which 60 are located between Sutton and Glennallen, and 64 between Glennallen and Delta Junction. The Northwest Route crosses nine glacial streams, including the Delta River (four times). The Southeast Route crosses 14 glacial streams, including Phelan Creek (three times). If wire stringing operations requiring stream crossings took place in winter, when streams were frozen, or if helicopters were utilized for cable stringing, there would be no impact on water quality. If streams were crossed during the open water season, impacts would generally be temporary and minor (short term increases in suspended sediment).

Installation of tower foundations on steep slopes can require the cutting of banks, which can result in increased sedimentation. This can be lessened by helicopter construction and by re-vegetation. Neither route would have a significant effect on water quality.

Floodplains

The Northwest Route crosses the Delta River four times, and all crossings are located in the Delta River floodplain. The Southeast Route crosses a glacial outwash floodplain between the Cantwell and Castner glaciers. On the Northwest Route, towers locations have been positioned outside the floodplain. On the Southeast Route, some towers will be located in the floodplain on pile foundations, but no fill would be required. Neither route would cause an impedance to floodflows.

Land Cover

The following general descriptions for each route were developed from vegetation maps (scale 1:1,000,000) in the Southcentral and Yukon Regional Profiles (Univ. of

Alaska, Arctic Environmental Information and Data Center, 1974, 1976). Detailed vegetation maps (scale 1:250,000) prepared by the Alaska Department of Natural Resources were used to examine major types of land cover crossed by the alternative routes.

Sutton to Glennallen - From Sutton to the confluence of Gravel Creek with the Matanuska River (near the Matanuska Glacier State Recreation Site) both routes are in the bottomland spruce-poplar forest. Then both routes continue toward Tahneta Lake through an upland spruce hardwood forest, and the Northwest Route passes through a moist tundra area north of Sheep Mountain. North of Tahneta Lake, both routes continue toward Glennallen through a lowland spruce-hardwood forest, with the exception of the three miles on either side of Tolsona Creek, which are characterized as bottomland spruce-poplar forest.

Glennallen to Delta Junction - West of Glennallen, the Southeast Route is within the bottomland spruce-poplar forest adjacent to the Copper River, and north of Gakona, it enters the lowland spruce-hardwood forest adjacent to the Gulkana River. The Northwest Route passes through approximately 15 miles of lowbush bog and muskeg before entering the lowland spruce-hardwood forest. Approximately 10 miles north of Sourdough, both routes enter the upland spruce-hardwood forest, and at the north end of Paxson Lake, both routes enter moist tundra. At Isabel Pass, both routes ascend into several miles of alpine tundra and barren ground, and then re-enter the moist tundra area until reaching the Delta River, approximately 10 miles south of Pump Station 10. The area adjacent to the Delta River consists of upland spruce-hardwood forest, but the surrounding area contains the alpine tundra and barren ground of the Alaska Range. As the Richardson Highway approaches the Donnelly Dome area and continues to Delta Junction, both routes descend into the lowland spruce-hardwood forest of the Tanana River basin.

Commercial and Non-commercial Forest (U.S. Bureau of Land Management, Alaska State Office, Div. of Pipeline 1973) - Between Glennallen and Delta Junction, the routes are located in areas adjacent to the Trans-Alaska pipeline system (TAPS) corridor. In the Copper River basin, the forest land traversed by the TAPS corridor is non-commercial, in which no more than 20 percent of the trees were estimated to be 12 feet tall or higher, with a minimum diameter of nine inches at the base. This forest is adjacent to the area between Glennallen and Sourdough, Richardson Highway MP 155 to 173, MP 175 to 178, and MP 182 to 185. There are no white spruce between Paxson and Phelan Creek, and the rest of the area contains very few trees.

In the Delta River valley, there are both commercial and non-commercial forests. In the commercial forest land, more than 20 percent of the trees are estimated to be 12 feet tall or higher, with a minimum diameter of nine inches at the base. The commercial forest land traversed by TAPS is adjacent to the area around the Castner Glacier, between Whistler Creek and the Black Rapids Training Site, and One Mile Creek and Ruby Creek. The non-commercial forest land is adjacent to the area between the south boundary of the Black Rapids Training Site and One Mile Creek, Ruby Creek and Richardson Highway MP 240, and Richardson Highway MP 252.5 to 257. North of the Donnelly Dome area, forest vegetation is continuous along the TAPS route to Delta Junction. Well drained forest uplands contain white spruce, white birch, aspen, and some black spruce. Flat, poorly drained forest areas contain small, scattered black spruce and larch.

Both routes would require approximately the same amount of clearing, and most of the area to be cleared would be in forested land. However, based on information developed for the TAPS line, most of the forest area is described as non-commercial. Neither route would have a significant effect on land cover.

Wetlands

As described in the previous section, the Northwest Route passes through a moist tundra area north of Sheep Mountain, and through approximately 15 miles of lowbush bog and muskeg north of Glennallen. Between the north end of Paxson Lake and the Delta River, both routes pass through moist and alpine tundra. Site-specific location of towers can minimize impacts and construction in certain areas may have to occur when the ground is frozen due to the amount of standing water present in the open water season. Neither route would have a significant effect on wetlands.

Fish and Wildlife

The following descriptions of significant fish and wildlife species present along each route were developed from maps and information prepared by the Alaska Department of Fish and Game's Habitat Division (1985a,b, 1986a,b,c,d). Additional references are cited in each section.

Fish - In the Matanuska drainage basin, both routes cross three anadromous fish streams, Granite Creek, Kings River, and Chickaloon River, which all contain chum, coho, king, and sockeye salmon. Resident species generally distributed throughout the area are arctic char, Dolly Varden, rainbow trout, and grayling. Arctic char and Dolly Varden are present in Granite Creek; arctic char, Dolly Varden, and rainbow trout are present in Kings River, and grayling are present in Hicks Creek (crossed by both routes) and Gunsite Creek (crossed by the Northwest Route).

In the Copper River drainage basin, both routes cross three anadromous fish streams: Mendeltna Creek, which contains king and sockeye salmon, and Tolsona Creek and the Gulkana River, which contain king, sockeye, and coho salmon and steelhead. Between Paxson Lake and Summit Lake, the Gulkana River (crossed by the Northwest Route) contains sockeye salmon, as does Fish Creek (crossed by the Southeast Route). Resident species generally distributed throughout the area are grayling, burbot, lake trout, arctic char and Dolly Varden. Grayling are present in the Little Nelchina River, Cache Creek, Mendeltna Creek, Tolsona Creek, Moose Creek, the Gulkana River, and Haggard Creek, which are crossed by both routes. Grayling are present in Dry Creek and Gunn Creek, grayling and rainbow trout are present in Sourdough Creek, and grayling and burbot are present in Fish Creek, which are all crossed by the Southeast Route. Grayling are present in Little Woods Creek and Gillespie Creek, and grayling and burbot are present in the Gulkana River between Paxson and Summit Lakes; these streams are all crossed by the Northwest Route.

In the Delta River drainage basin, there are no anadromous fish streams crossed by either route. Resident species include grayling and round whitefish; both are present in the Delta River (crossed by the Northwest

Route), and grayling are present in Miller Creek (crossed by the Southeast Route) and Jarvis Creek (crossed by both routes).

Birds - In Southcentral and Interior Alaska, the primary duck species present are surface-feeding ducks (dabblers), including mallard, pintail, green-winged teal, American widgeon, and northern shoveler, and diving ducks, including greater scaup, goldeneye (common and Barrow's), bufflehead, oldsquaw, scoter (white-winged, surf, and black), and red-breasted merganser. In Southcentral Alaska, primary dabbling species also include gadwall, and primary diving species include canvasback, harlequin, and common merganser. In Interior Alaska, primary diving species include lesser scaup and eider (Steller's, common, king, and speckled), and lesser numbers of dabblers, including gadwall, blue-winged teal, and European widgeon, and divers, including redhead, ring-necked duck, canvasback, harlequin, and merganser (hooded and common) are present.

Geese in Southcentral and Interior Alaska include the Canada (lesser and cackling), greater white-fronted, and snow goose. In Southcentral Alaska, dusky Canada and tule white-fronted goose are present, and in Interior Alaska, brant, Taverner's Canada, and emperor goose are present. Geese migrate along the Delta River.

Between Sutton and Caribou Creek, both routes pass through a corridor containing ducks and geese that is about three to four miles wide and extends on either side of the Glenn Highway and the Matanuska River. Between Caribou Creek and Tahneta Lake, ducks and geese are present along the upper Matanuska River and its tributaries on the south side of the Glenn Highway crossed by the Southeast Route, whereas they are not generally present in the area crossed by the Northwest Route north of Sheep Mountain.

Ducks and geese are present throughout the Copper River drainage basin to the north end of Summit Lake. The area crossed by both routes from Tahneta Lake on the Glenn Highway to Hogan Hill on the Richardson Highway is a known nesting area for both dabbling and diving species. Most of this area has been rated as being low-density breeding habitat, i.e. fewer than 25 nesting ducks and nine nesting geese per square mile, although the area east and south of Crosswind Lake is rated as medium-density breeding habitat, i.e. slightly more than 25 nesting ducks per square miles (U.S. Air Force 1986). Mendeltna Creek from Old Man Lake to the south side of the Glenn Highway is a known fall concentration area for dabblers.

North of the Alaska Range, ducks and geese are present in three areas crossed by both routes: between Ober Creek and the Richardson Highway south of Donnelly Dome; between Big Lake, Bolio Lake, and the Richardson Highway north of Donnelly Dome; and along the Delta River north of Fort Greely.

The Richardson Highway between Glennallen and Sourdough is utilized as a display area by sharptailed grouse (Hemming and Morehouse, eds. 1976).

Wildlife - Moose are present throughout the Matanuska River drainage basin. Between Sutton and Caribou Creek, both routes pass through a known winter concentration area extending from the north side of the river across the Glenn Highway in a corridor one to four miles wide. Immediately north of the wintering area is a known rutting concentration area in a corridor approximately a mile wide that parallels the Glenn Highway to Caribou Creek. The Northwest Route passes through this area between Pinochle Creek and Hundred Mile Lake.

Moose are present throughout the Copper River drainage basin, and they move through the TAPS corridor between Glennallen and Isabel Pass year-round (Hemming and Morehouse, eds. 1976). Both routes pass through known winter concentration areas between the Mendeltna and Tolsona Rivers, and the Gulkana and Gakona River drainage basins between Sourdough and Gillespie Creek. The Southeast Route passes through known winter concentration areas around the Nelchina River south of the Glenn Highway near Snowshoe Lake, from Glennallen to Gulkana in a two-mile wide corridor along the Copper River, and from Gulkana to Sourdough in an area that extends from the west side of the Gulkana River to the Gakona River drainage. Both routes extend through a known calving concentration area between the Mendeltna and Tolsona Rivers; the Northwest Route borders an area in the West and Middle Fork drainages of the Gulkana River west of the Richardson Highway between Sourdough and the northwest end of Paxson Lake, and the Southeast Route borders an area east of Roundtop Mountain and the Richardson Highway. Both routes pass through a known rutting concentration area extending eight miles west of Tolsona Lake immediately north of the Glenn Highway.

Moose are present throughout the Delta River drainage basin. Both routes pass through a known winter concentration area on either side of the Delta River and the Richardson Highway between Black Rapids and Big Delta.

Caribou are present throughout the Copper River drainage basin and on the south side of the Alaska Range. The entire area from Gunsight Mountain on the Glenn Highway to Meiers Lake on the Richardson Highway is a known winter concentration area. They migrate across the TAPS corridor from Glennallen to Isabel Pass between March 15 and May 15, and October 1 and January 1 (Hemming and Morehouse, eds. 1976). Caribou are present in an area east of the Delta River between Black Rapids and Donnelly Dome.

Dall Sheep are present in the Talkeetna Mountains, Sheep Mountain, and the Alaska Range. The proposed transmission line routes will be located in corridors at lower elevations where sheep are not generally present. However, low-flying aircraft or helicopters can disrupt lambing (U.S. Bureau of Land Management, Alaska State Office, Div. of Pipeline 1973).

There are brown bear concentrations between Paxson and Summit Lakes and between Upper Fish Lake and the mouth of Fish Creek in Summit Lake (Hemming and Morehouse, eds. 1986). Brown bear are present throughout the Delta River drainage basin. Along the Delta River north of Black Rapids, the Northwest Route passes through a known spring concentration area, and a known summer concentration area where bears feed on berries.

Bison are present from Black Rapids to Big Delta, they calve in an area that extends along the Delta River from Black Rapids to an area west of Pump Station 9, and they migrate across the TAPS corridor from March 15 to April 15 and July 15 to October 15 (Hemming and Morehouse, eds. 1976).

Although relatively few streams contain anadromous and resident fish, both routes pass through habitat supporting large numbers of birds and wildlife. There is a potential for loss of birds due to collision with towers or conductors, which is discussed in the next section. There is also a potential for electrocution; however, the wide spacing of the conductors on 230kV transmission lines (approximately 22 to 25 feet) virtually eliminates the possibility of a bird contacting two wires simultaneously. The primary mitigative measure during construction would involve timing for specific segments to avoid critical use periods. Construction windows required for anadromous fish stream crossings and recommended for critical wildlife periods are shown in Table 18.

Threatened and Endangered Species

The American peregrine falcon is designated an endangered species, whereas bald eagles and trumpeter swan are considered to be "species of concern". Both routes contain eagle nests, and exact nesting sites should be avoided. The potential for collisions of migrating birds with transmission lines is a major concern. The following descriptions of bald eagles and trumpeter swan were derived from maps and information prepared by the Alaska Department of Fish and Game's Habitat Division (1985b, 1986b). Information on peregrine falcon was obtained from the U.S. Fish and Wildlife Service.

Bald Eagle - Bald eagle nests are documented from Glennallen to Paxson along the Copper and Gulkana Rivers. The Southeast Route passes in the vicinity of two nests near the Copper River between Glennallen and Gakona, and one nest near the highway between Gakona and Sourdough. The Northwest Route passes by one nest at the Gulkana River near Sourdough, three nests between Sourdough and Paxson, and one nest where it first crosses the Delta River. During an October route reconnaissance trip, an eagle nest was observed on the south side of the Glenn Highway at MP 148.

The habitat maps should be considered representative, as U.S. Fish and Wildlife Service data shows that there are between 60 and 70 nesting pairs along the Gulkana River between Gulkana and Paxson. The nesting period is from late March until September 1. There are relatively few eagles between Isabel Pass and Delta Junction, as the Delta River is poor eagle habitat due to the lack of nest sites.

Trumpeter Swan - Trumpeter swan are present at Tatondan Lake, which is on the south side of the Matanuska River (Southeast Route Mile 34 from Sutton). They are distributed throughout the Copper River drainage basin, and the area from Snowshoe Lake on the Glenn Highway to Hogan Hill on the Richardson Highway is a known concentration area for nesting and brood rearing. It is considered high-density breeding habitat, and the population has increased; about 2,000 swan nest throughout the Nelchina Plateau, or about one or more nesting swan per square mile (U.S. Air Force 1986).

Trumpeter swan nest from breakup to mid-September. The U.S. Fish and Wildlife Service conducts surveys every five years, and the last survey was conducted in 1985. Exhibit 1 shows trumpeter swan nesting areas crossed by the routes. No nesting areas were documented north of Hogan Hill in the vicinity of the routes. The U.S. Fish and Wildlife Service believes that the Southeast Route between Glennallen and Sourdough would impact less nesting habitat than the Northwest Route.

Peregrine Falcon - U.S. Fish and Wildlife records indicate that the American peregrine falcon, an endangered species, migrates from east to west between Eureka Roadhouse and Sutton in spring, as do other raptors. There are no records of falcon nesting along the two routes, but this area, especially the portions away from the highways, is not normally surveyed.

Collisions - Collision potential was a major consideration in the environmental analysis of the proposed over-the-horizon backscatter radar (U.S. Air Force 1986), and, as the analysis was based on data from overhead transmission lines, the following information is relevant to this study. Collisions with overhead transmission lines are more likely to occur in poor lighting conditions and bad weather, including fog. The potential for collision increases when transmission lines cross migration corridors or breeding habitat, or when they are perpendicular to major flyways. Large-bodied birds (swan, raptors, and eagles) and birds with high wing loads (ducks) are the species most likely to be involved in collisions.

The area around Glennallen is a major migration corridor and contains breeding habitat for an estimated 20 to 25% of the world's trumpeter swan population. Younger birds, which have poor flight control, are more susceptible to collision. Collision potential can be reduced by alignments that avoid open water bodies, wetlands, river crossings, major flyways, and nesting sites and that parallel the prevailing wind direction and avoid areas of known ground fog. Visible markers can be placed on transmission lines.

In 1988, an avian field survey program was conducted to obtain detailed information on trumpeter swan and other species in the vicinity of the proposed backscatter radar site at Gulkana (Cooper et al. 1988). Investigators found that during peak migration (late April/early May), nocturnal movement was four times greater than movement during the day. Most swan, ducks, and geese flew higher than 100 feet above ground level during daylight hours on clear days, but flight altitude was significantly lower when the cloud ceiling dropped below 500 meters (1,641 feet).

The Southeast Route between Glennallen and Sourdough has a greater potential for encountering eagle nests, but it will pass by fewer trumpeter swan nesting areas than the Northwest Route between Glennallen and Sourdough. The Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service recommended against construction during the nesting period, between May 1 to mid-September. Both routes have a high potential for collisions, and the effect is considered to be significant. The results of the 1988 avian field survey program suggest that marking transmission lines would not reduce the collision potential during migration, as most movement occurs during the night. However, it could prove beneficial for localized movement during the nesting season. Although more towers may be required, presenting some additional barriers, hanging the conductors at heights below 100 feet reduces the potential for collision during migration.

Archeological and Historic Sites

The Alaska Heritage Resources Survey (AHRS) currently lists 154 cultural resource sites along the proposed transmission line corridor but not all are crossed by the two routes studied.

Known locations within and adjacent to the proposed routes tend to be clustered along existing highways and secondary roads. As reflected by the 26 references contained in the Appendix, most sites have been identified during project-specific archaeological surveys, and most of the projects have been lineal in nature (highways and pipelines). Site locations recorded away from the road are principally discoveries made during both project specific surveys and avocational or academic investigations. The AHRS also list includes the approximate locations of reported but unverified historic features.

Few intensive archaeological surveys have been conducted anywhere in the area crossed by the routes. Previous investigation strategies have focused on distinctive landforms and exposed surfaces. Consequently, the present understanding of cultural resources is based on data obtained from surface observations, such as lithic flake scatters at prehistoric hunting sites and structural remains at settlements associated with early historic period regional economic development.

A consideration of the types, settings, and distributions of known cultural resource sites suggests that the potential for encountering additional sites within either of the two proposed routes during construction is extremely likely. This is especially true for route sections that must of necessity pass through constricted valleys or across marshy areas where avoidance options are limited. Construction of either route would have an impact on archeological and historic sites, but the impact can be mitigated by pre-construction surveys and clearances. Mitigation is also possible during construction by moving final tower locations along the alignment to avoid sites discovered during construction.

Land Use

The routes traverse or are adjacent to areas of recreational and subsistence use. There are no national parks, forests, or refuges, but there are state and federal recreation sites and a state moose range. A state critical habitat area has been proposed for trumpeter swan protection, and there are two wild and scenic rivers. Scenic highway studies have been conducted.

Fishing - The Alaska Department of Fish and Game's Habitat Division (1985b, 1986d) has documented sport fishing streams. Kings River (both routes) is fished for salmon, arctic char, Dolly Varden, and rainbow trout. Mendeltna Creek (both routes) is fished for sockeye salmon and grayling. Sourdough Creek (Southeast Route) is fished for grayling and rainbow trout. Fish Creek (Southeast Route) and the Gulkana River between Paxson Lake and Summit Lake (Northwest Route) are fished for grayling and burbot. Grayling streams include Hicks Creek, the Little Nelchina River, Cache Creek, Moose Creek, Dry Creek (Southeast Route only), the Gulkana River, Gillespie Creek (Northwest Route only), Gunn Creek (Southeast Route only), the Delta River (Northwest Route only), and Miller Creek (Southeast Route only).

Hunting - Recreational hunting occurs throughout the area, and includes the following species (Battin 1987):

Moose - Nelchina and Upper Susitna Rivers (Unit 13), 840 moose harvested in 1984; Matanuska Valley (Subunit 14A), annual harvest of 500/year, including 340 bulls; Tanana Flats (Subunit 20A), harvest has been increasing since 1978.

Caribou- Nelchina herd (Units 13 and 14 except 14C), 1,700 hunters, including permit holders and subsistence users, harvest over 1,000 annually.

Bison - Delta area (Units 20A, 20D), over 11,200 hunters apply for 55 permits for one bison/permit.

Spruce grouse - Units 13 and 14, hunting mainly occurs from roads and trails.

Willow Ptarmigan - accessible by road, especially along the Richardson Highway from Glennallen to the Alaska Range and Black Rapids to Paxson.

Other species - other species harvested in the study area include black and brown bear, dall sheep, gray wolf, snowshoe hare, and waterfowl.

Subsistence - Activities include hunting, fishing, trapping, and berry harvesting, as well as use of wood for fuel and construction material and water for drinking and food processing. Although residents in all communities participate in these activities, communities adjacent to the routes are not economically dependent on these resources (McMillan and Cucarrese 1988, Stratton andGeorgette 1984, U.S. Bureau of Land Management and U.S. Army Corps of Engineers 1987). Delta Junction is not classified as a rural subsistence use area by the State Boards of Fish and Game. In Paxson, Chickaloon, Matanuska Glacier, Sheep Mountain, Lake Louise and Sourdough, the primary subsistence activity is hunting, whereas in Gakona, Gulkana, and Glennallen, the primary subsistence activity is fishing.

Public Lands - Most of the public lands traversed by the routes do not have specific designations, such as parks, forests, or refuges. The Alaska Department of Natural Resources, in cooperation with the Alaska Department of Fish and Game and the Matanuska Susitna Borough, has developed area plans for the Susitna, Copper, and Tanana basins. The plans contain management objectives and current and proposed land uses. Proposed expansions of existing recreation areas were considered in route selection and are discussed below. Other proposed uses, such as creation of new recreation sites or trails, have no time frame for implementation, and are not considered in the following discussion. However, proposed uses may have to be considered prior to granting of rights-of-way.

State Recreation Areas - There are seven existing sites managed by the Alaska Div. of Parks and Outdoor Recreation in the vicinity of the routes (Alaska Div. of Parks 1982a).

1. King Mountain State Recreation Site - This site is located on the south side of the Glenn Highway approximately 30 miles north of Palmer and 110 miles southwest of Glennallen. Both routes are on the other side of the highway, but the Southeast Route would be visible (see discussion under Aesthetics).

2. Bonnie Lake State Recreation Site - Located on the south side of Bonnie Lake, approximately one mile north of the Glenn Highway, this site is about 35 miles east of Palmer and 105 miles west of Glennallen. There is a proposal to transfer this site to the Matanuska-Susitna Borough. The Northwest Route crosses the access road, but it is below the point where the access road turns into the site.

3. Long Lake State Recreation Site - Long Lake is adjacent to the south side of the Glenn Highway about 40 miles east of Palmer and 100 miles west of

Glennallen. From west to east, the site encompasses both sides of the highway for about one mile and is immediately south of the highway for a mile. Proposed acquisition would expand the site one mile to the south, to the Matanuska River. The Northwest Route would be visible from the west end of the lake. The Southeast Route crosses through the proposed expansion.

4. Matanuska Glacier State Recreation Site - This site, located about 55 miles east of Palmer and 85 miles west of Glennallen, extends in an east-west direction on either side of the Glenn Highway for approximately one mile and south to the Matanuska River. The Southeast Route crosses the highway twice to avoid passing through this area. The Northwest Route, following the highway, passes through the area.

5. Little Nelchina State Recreation Site - This site is located on the Glenn Highway about 60 miles west of Glennallen and 80 miles northeast of Palmer. Proposed acquisition would expand the site from 20 acres to 640 acres (one square mile), encompassing an area approximately a mile long and one-half mile wide on either side of the Glenn Highway. Both routes are outside the area of proposed expansion.

6. Tolsona Creek State Recreation Site - This site is located about 13 miles west of Glennallen on the Glenn Highway. Both routes are near the site, and may be visible from the northern and southern ends of the site.

7. Dry Creek State Recreation Site - This site is located across the Richardson Highway from the Gulkana Airport. The Northwest Route is adjacent to the western border.

Federal Recreation Areas - There are two federal recreation areas managed by the U.S. Bureau of Land Management.

1. Sourdough Creek Campground - (Richardson Highway MP 147.6). The campground is adjacent to Sourdough Roadhouse National Historic Landmark, and it is located approximately half a mile downstream of the

Northwest Route Gulkana River crossing.

2. Paxson Lake Wayside - (Richardson Highway MP 179.4) Both routes are located on the east side of the highway. The Northwest Route would be visible from the wayside.

Matanuska Valley Moose Range - The Matanuska Valley Moose Range was established by the Alaska State Legislature in 1984. The management objective is to "maintain, improve and enhance moose populations and habitat and other wildlife resources of the area and to perpetuate multiple use of the area, including fishing, grazing, forest management, hunting, trapping, mineral and coal entry and development and other forms of public uses compatible with these purposes" (Alaska Dept. of Natural Resources, Alaska Dept. of Fish and Game, and Matanuska Susitna Borough 1985). The Northwest Route passes through this area for approximately six miles between the Kings River and the Chickaloon River. As right-of-way clearing can enhance moose habitat, the location of the route in this area would not have a significant impact.

Trumpeter Swan Critical Habitat Area - The Northwest Route crosses three miles of state land north of Glennallen that is being considered for designation as a critical habitat area for the protection of trumpeter swan. The area is currently managed to protect swan nesting habitat, as follows (Alaska Dept. of Natural Resources and Alaska Dept. of Fish and Game 1986). Overland access and other activities requiring permits are prohibited between May 1 and August 31 unless the Alaska Department of Fish and Game determines that the activity is compatible or the Alaska Department of Natural Resources determines that it is not feasible or prudent to prohibit the activity. In those cases, the Alaska Department of Fish and Game can require that activities be prohibited within one-quarter mile of current or potential swan nesting or staging ponds, marshes, or lakes.

Due to the amount of standing water present during this time period and the potential for encountering nesting sites, surveys would have to be conducted prior to the summer construction season. Construction in certain areas may have to occur when the ground is frozen. Options for reducing collision potential were previously discussed under Threatened and Endangered Species.

Wild and Scenic Rivers - The Northwest Route spans two wild and scenic rivers, the Gulkana River and the Delta River. U.S. Bureau of Land Management objectives would preclude construction in these areas unless it were demonstrated that no feasible alternatives were available.

Scenic Highways - The Alaska Land Use Council (1983) conducted a study to determine the desirability of creating a Denali National Scenic Highway between Denali National Park and Preserve and Wrangell St. Elias National Park and Preserve. In addition to the Denali Highway, the Richardson Highway was included. As there was overwhelming public opposition to a federal scenic highway designation, and as the Denali Highway can be managed for natural, scenic, and recreational values under existing federal and state authority, the study group recommended against including the highway in the national system. The Richardson Highway did not have sufficient adjacent federal land, and was therefore not appropriate for designation.

The area traversed by the proposed routes is utilized extensively for hunting, recreational and subsistence and fishing. Management objectives on state and federal lands are directed at protection of fish and wildlife and enhancement of recreational values. The Northwest Route crosses about six miles of the Matanuska Valley Moose Range, three miles of state land proposed as trumpeter swan critical habitat area, and two wild and scenic rivers. Both routes have been aligned outside of existing recreation sites. The major impact would be the effect on scenic values, which is discussed in the following section.

Aesthetics

A weathered steel X-tower is planned, except for single pole steel towers in either highway right-of-ways or for double circuit use. The brown, weathered steel is less visible against forested slopes and unforested, snow-free slopes. Lower towers with shorter spans can be used in areas with low trees. However, against snow covered, unforested slopes, the towers are highly visible.

The 48-inch diameter TAPS line was constructed in above- or below-ground modes, depending on soil conditions. In the above-ground mode, it is elevated between six and 15 feet (top height) above the ground by vertical supports. Due to its size, it presents a greater visual impact than an overhead transmission line at an equivalent distance, even though it is lower in profile. Its location relative to the proposed routes is noted in the discussion, and it is shown on the 1:63, 360 route maps as above-ground (solid line) or below-ground (dashed line).

Due to the level of concern expressed during agency contacts and in area management plans about protecting scenic values as seen from highways, this discussion focuses on the visibility of the routes from the Glenn and Richardson Highways.

Sutton to east side Chickaloon River - Both routes generally pass through wooded areas. From Sutton to the King River, the Northwest Route (NW Mile 2.6 to 6.8 from Sutton) is located on a high terrace behind a ridge and is not visible from the highway, and then it continues to the northeast and east in the vicinity of the Chickaloon trail (NW Mile 6.8 to 11.4 from Sutton). The Southeast Route (approximately SE Mile 3 to 5 from Sutton) is near the north side of the Glenn Highway behind homes. After crossing the King River, the Southeast Route (SE MP 6.3 to 7.5 from Sutton) ascends a hill for about a mile, and is visible from the Glenn Highway. It is also visible on the top of a ridge (SE Mile 13.7 from Sutton) from the King Mountain State Recreation Site. The Southeast Route is visible crossing both the Chickaloon River and the Glenn Highway (SE Mile 17.5 to 18.7 from Sutton).

East side Chickaloon River to west side Caribou Creek - Both routes generally continue through wooded areas, although the Northwest Route traverses several miles of bare slope (NW Mile 24.7 to 27 from Sutton). Between SE Mile 18.7 and 22 from Sutton, the Southeast Route is adjacent to the south side of the Glenn Highway, and it then extends through the proposed extension of the Long Lake State Recreation Site. It continues adjacent to the Glenn Highway (SE Mile 28.3 to 32 from Sutton) and crosses the highway twice (SE Mile 34, 36.5 from Sutton), as well as Hicks Creek. The Northwest Route is also visible where crossing Hicks Creek. From NW Mile 36.5 to 42.9 from Sutton, it was adjacent to the Glenn Highway, which passes through the Matanuska Glacier State Recreation Site but this route has been revised in the suggested route. The Southeast Route crosses the highway twice to pass north of the Matanuska

Glacier State Recreation Site, and then crosses twice more before crossing Caribou Creek.

West side Caribou Creek to Tahneta Lake - Both routes generally continue through wooded areas. The Southeast Route crosses Caribou Creek at SE Mile 44.3 from Sutton, and is more visible to north-bound traffic, where it can be seen adjacent to the highway east of Caribou Creek, than it is to south-bound vehicles descending toward the west side of Caribou Creek. It is adjacent to the south side of the highway between SE Mile 45.8 and 46.8, and 55 and 57.5 from Sutton. Otherwise it is a quarter mile south of the Glenn Highway. Between Glenn Highway MP 114.5 and 120, the Glenn Highway is above treeline, but the Southeast Route remains in the woods. The Northwest Route crosses Caribou Creek about 1.5 miles from the highway, and continues northeast and east around Sheep Mountain to Tahneta Lake. The Southeast Route is more visible in the Tahneta Pass area than the Northwest Route.

Tahneta Lake to Glennallen - Other than the area around Tahneta Pass, both routes generally continue through wooded areas. The terrain is generally flat, and trees are smaller, but both routes are one quarter mile or more from the highway. Both routes are adjacent to the Little Nelchina State Recreation Site, which is more heavily wooded, and the Tolsona Creek State Recreation Site. The Northwest Route crosses the Glenn Highway to access the substation at Pump Station 11. The routes are most visible where the highway ascends or descends perpendicular to the terrain, especially between Glenn Highway MP 134 and the Little Nelchina River (NW Mile 70.7 to 71.2; SE Mile 70.9 to 73.8 from Sutton). The area between Tolsona Creek and Glennallen has a very gradual change in elevation, so the routes are not as noticeable.

Glennallen to Gakona Junction - The Southeast Route crosses both the Richardson and Glenn Highways. It also crosses the Gulkana River, and would be visible to recreation users. The Northwest Route is adjacent to the west border of the Dry Creek State Recreation Site but not visible from the campground area.

Gakona Junction to Sourdough - The southwest route is one quarter mile or more from the Richardson Highway, and the terrain is generally flat and wooded. It is closest to the highway between SE Mile 27.7 and 30.9 from

Glennallen. The Northwest Route is about one mile east of TAPS in open terrain between NW Mile 7 and 23.3 from Glennallen.

Sourdough to Paxson - The Northwest Route is visible between Sourdough and Paxson and crosses the highway three times, at NW Mile 53, 57.5, and 62 from Glennallen. As shown on the 1:63-360 maps, the TAPS line is buried in a one-mile segment north of the Gulkana River at Sourdough, and it continues above ground for a three-mile segment, which is visible one half mile west of the Richardson Highway. In this area, the Northwest Route (NW Mile 33.3 to 37 from Glennallen) is located halfway between the TAPS line and the highway and the added visual impact would be minimal. The TAPS line is then buried, crosses the highway underground, and remains underground for 11 of the 13 miles around Hogan Hill. North of Hogan Hill, the above-ground segment of the TAPS line is generally more than one-half mile east of the Richardson Highway, and the Northwest Route north of NW Mile 62 is between the highway and TAPS, half a mile from each. North of SE Mile 40.7, the Southeast Route is more than a mile from the highway and east of the TAPS line.

Paxson to Black Rapids - The Northwest Route crosses the highway at NW Mile 74.5 from Glennallen, and the southeast crosses the highway twice at SE Mile 83.7 and 86.7 from Glennallen. There are no trees between Paxson Lake and Phelan Creek. The Northwest Route is visible on the west side of Summit Lake from both the Richardson and Denali Highways. Between the south end of Summit Lake through Isabel Pass to the Phelan Creek floodplain, the TAPS line is buried, except for a one-mile segment east of the Northwest Route and adjacent to Richardson Highway where it crosses Phelan Creek, and a five-mile segment east of NW Mile 90.1 to 95.5 from Glennallen. Both routes will be visible throughout this area, which extends approximately 15 miles. Both routes will be visible in the Delta River valley as it ascends into Black Rapids. The TAPS line is buried, except for a three-mile segment west of the Richardson Highway and east of the Northwest Route around the Castner Glacier.

Black Rapids to Delta Junction - North of Black Rapids, the Southeast Route is east of TAPS and more than a mile away from the Richardson Highway between SE Mile 106.7 and 120.7 from Glennallen, and it crosses the highway at SE Mile 126.7. The Northwest Route crosses the highway four times, at NW Mile 117, 118, 122, and 136 from Glennallen. Both routes are east of Donnelly Dome, whereas the TAPS line is on the west. North of Donnelly Dome, TAPS is buried to Delta Junction on the east side of the Richardson Highway, and both routes continue into Delta Junction on the west side. There are relatively few trees between Richardson Highway MP 247 and the low areas south of Delta Junction. However, once the lines reach the flat areas relatively thick stands of trees exist to heights of 30 to 40 feet.

The following visual impact zones were identified prior to TAPS construction (U.S. Bureau of Land Management, Alaska State Office, Div. of Pipeline 1973):

Richardson Highway MP 160 (Haggard Creek)
Gunn Creek to Isabel Pass
Richardson Highway MP 205 and 212 (Phelan Creek)
Richardson Highway MP 245 (State of Alaska wayside)

In the Denali National Scenic Highway study, the Alaska Land Use Council (1983) concluded that scenic resources along the Richardson Highway were of moderate value, as much of the highway is enclosed by the spruce/hardwood forest. The area around Paxson has high scenic value, with views of the Wrangell and Chugach Mountains and the Alaska Range. The Denali Highway has high scenic value, partly because there are few trees to obstruct views.

Between Sutton and Glennallen,the Northwest Route is less visible from the highway, with only one highway crossing, whereas the Southeast Route has seven crossings. Between Sourdough and Delta Junction, the Southeast Route is less visible with only three highway crossings, whereas the Northwest Route has eight crossings. Between Glennallen and Sourdough, the Northwest Route would not be visible from a highway, but it would be constructed in an open area, whereas the Southeast Route, adjacent to the highway, would be screened. The Southeast Route crosses the highway twice in this segment. Although TAPS presents a visual barrier, it is generally buried in the areas of greatest visual impact, and does not provide an effective screen.

Social Impacts

Construction of a transmission line is anticipated to require small work crews over short periods of time. It is unlikely that there would be a requirement for new housing, schools, or other services. Right-of-way clearing and equipment operation in tower placement and cable stringing could result in short-term employment opportunities for residents of communities in the vicinity of the route. Construction of either route would require installation of air navigation markers and updating of air navigation charts. The routes are aligned to avoid airstrips.

Construction

There would be no requirement for borrow sources, and excavated material from tower foundation placement, if any, would be left in place. Noise from construction vehicles would be minimal, as most of the line is more than half a mile from highways. Use of helicopters may generate more noise, but the duration would be short. Vehicle emissions would be minimal, but if brush were burned in place, there would be smoke for a short period of time. If brush were chipped, there would be no smoke. The Northwest Route would have nine highway crossings, and the Southeast Route, 12. However, traffic disruption would be minimal.

Operation

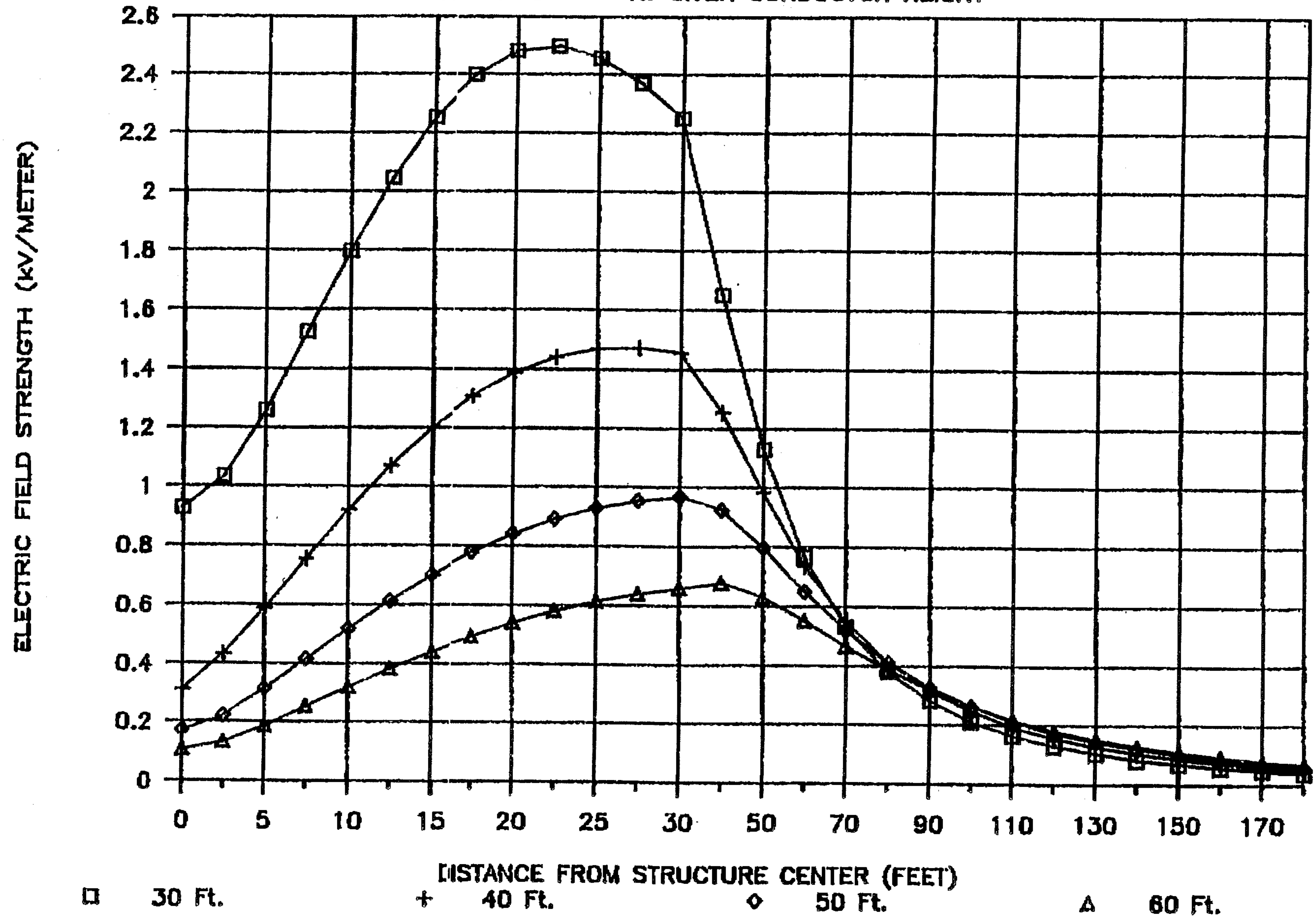
As discussed in the description at the beginning of this section, at voltages of 230kV or lower, electromagnetic interference is usually considered minor or insignificant. The following figures show the electric field strength and magnetic field strength produced by a 230kV transmission line. Various State requirements were reviewed. The most stringent guidelines would limit the field at the edge of the right of way to:

Electric Field Strength	1.6kv/m
Magnetic Field Strength	100mg

The Electric Field Strength and the Magnetic Field Strength are considerably below these maximum values at the edge of the 125 foot right of way as shown on the following Figures. These curves were developed for horizontally spaced conductors and the levels of Electrical Field Strength and Magnetic Field Strength at ground levels is obviously highest for conductors which are at the minimum height above the ground. At 250 feet from the center of the right of way, the level of Electric Field Strength and Magnetic Field Strength are insignificant and therefore, an attempt was made to maintain the center of the right of way 250 feet from buildings. Although a narrower right of way would be permissible with a single pole structure with the conductors vertically aligned, it was concluded that rerouting in the area along the highway near Glacier View, as shown on the route maps, would be advisable to mitigate any concerns relative to the close proximity to houses in this area.

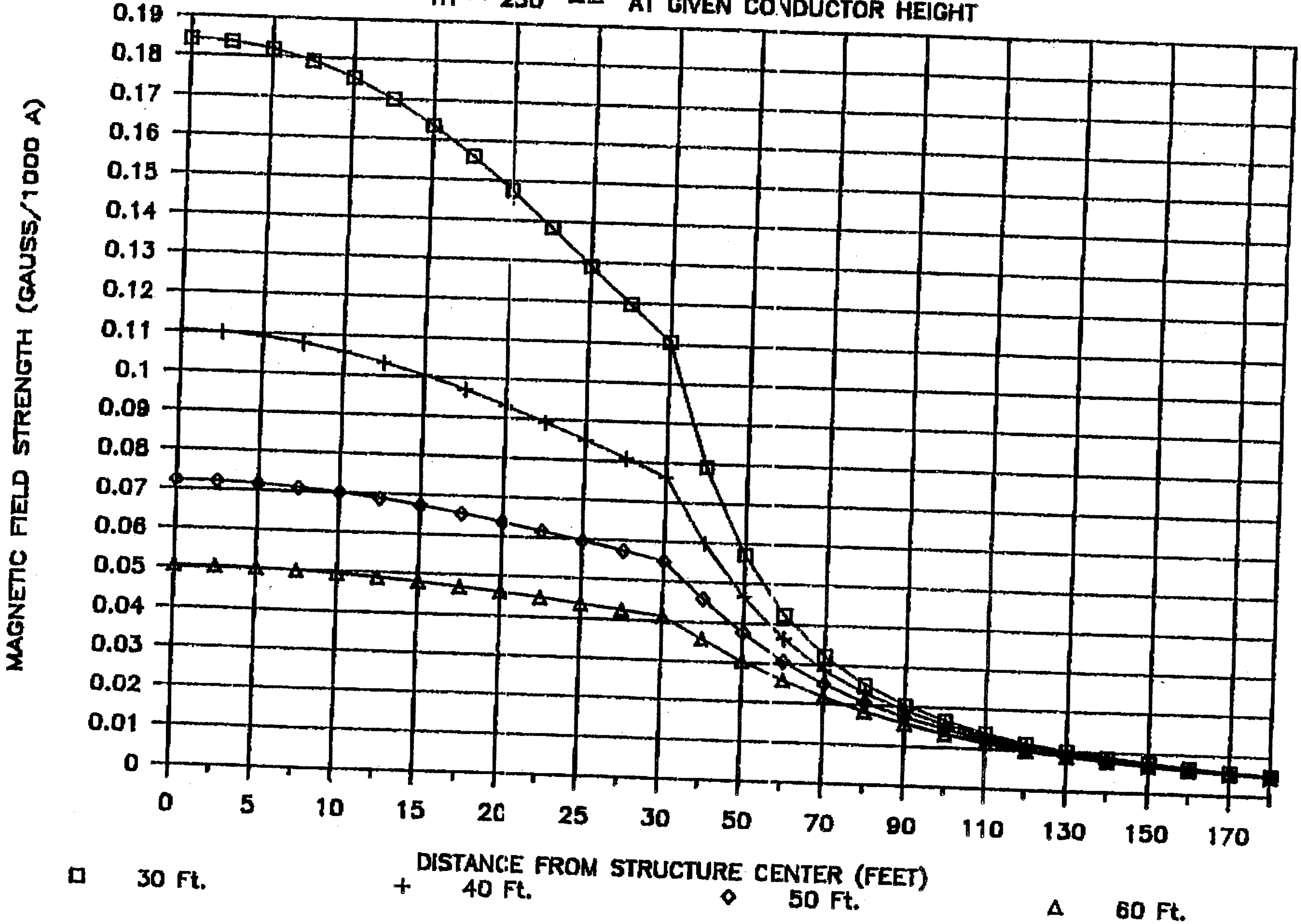
ELECTRIC FIELD STRENGTH

TH – 230 –– AT GIVEN CONDUCTOR HEIGHT



MAGNETIC FIELD STRENGTH

TH – 230 — AT GIVEN CONDUCTOR HEIGHT



Anticipated maintenance involves an inspection as often as every other month, and a more thorough inspection would be conducted less frequently. Inspections would be conducted from the air, with follow-up on the ground if problems were detected. When right-of-way maintenance requires vegetation control, the impact on wildlife utilizing the cleared right-of-way would be minor if manual methods were used.

Limiting right-of-way access is a potential problem. Portions of the right-of-way would receive public use. The potential for increased public use is greatest in areas where no trails currently exist and in popular hunting and fishing areas. Each landowner would have to be consulted for right-of-way requirements.

In summary, due to the proximity of the Northwest and Southeast Routes, most environmental factors would be equally impacted by either route. There would be no impact on water quality, floodplains, or fish from construction and operation of either route. There would be no social or construction impacts, and impacts from operation would be minor. There would be no significant impact on land cover. The Northwest Route crosses more wetlands than the Southeast Route, but there would be no significant impact if towers were sited carefully and if construction occurred in winter for those areas containing standing water.

Both routes pass through habitat supporting large numbers of birds and wildlife. The primary mitigative measure during construction would involve timing for specific segments to avoid critical use periods. The Northwest Route crosses more trumpeter swan nesting habitat than the Southeast Route between Glennallen and Sourdough, but the Southeast Route has a greater potential for encountering eagle nests. After the transmission line were constructed, there would be a potential for collisions. Studies conducted in 1988 documented that swan, geese, and ducks flew higher than 100 feet above ground level on clear days during migration. Reducing conductor height below 100 feet in migration and waterfowl use areas would reduce collision potential.

Archeological sites along the corridor containing both routes can be avoided by tower alignment. The area with the greatest potential for impact is between Paxson Lake and Donnelly Dome, where the corridor is in a restricted valley. The Northwest Route crosses six miles of the Matanuska Valley Moose Range, three miles of area proposed as a Trumpeter Swan Critical Habitat Area, and two wild and scenic rivers. The rivers could not be crossed unless no other feasible alternative were available.

The major impact encountered is the effect on scenic values. Between Sutton and Glennallen, the Northwest Route is less visible from the highway, with only one highway crossing. Between Sourdough and Delta Junction, the Southeast Route would be less visible, with three highway crossings. Between Glennallen and Sourdough, the Northwest Route would not be visible from the highway, but it would be in an open area, whereas the Southeast Route would be screened. The Southeast Route crosses the highway twice in this segment. From a visual perspective the Southeast Route is not acceptable.

To reduce visual impacts and avoid wild and scenic rivers, the route suggested for further study would follow the Northwest Route from Sutton to Glennallen, and the Southeast Route from Sourdough to Delta Junction. Between Glennallen and Sourdough, visual, waterfowl, and land management concerns should be evaluated further before either route is eliminated from consideration.

IX. ENVIRONMENTAL EVALUATION SUGGESTED ROUTE

IX ENVIRONMENTAL EVALUATION SUGGESTED ROUTE

A route was suggested for more detailed study. This route provides the most feasible right-of-way to acquire and permit while minimizing environmental impacts. It must be recognized that not all of the routes selected have the least environmental impact, when a significant part of the criteria for selection was the ease of obtaining the right-of-way. Using this process, the Northwest Route was selected until a point just south of Sourdough on the Richardson Highway. Due primarily to conflicts with the Gakona and Delta River north of Sourdough, and the less desirable visual effects of the Northwest Route in this area, it is proposed that the Suggested Route cross the Gakona River and follow the route on the east side of the Richardson Highway, north of Sourdough.

The route suggested for the detailed feasibility study crosses less than 5 miles of private land, some of which are coal leases, and 36.4 miles of Ahtna land.

Discussion of Environmental Factors - Suggested Route

Information on each environmental factor presented in Section VIII is discussed in more detail for the Suggested Route. The potential impact of constructing and operating these transmission facilities in the Suggested Route is assessed.

Water Quality

Based on examination of 1:63,360 maps, 132 stream crossings have been identified. Between Sutton and Glennallen, there would be 74, and between Glennallen and Delta Junction, there would be 57.

For all stream crossings, towers would be located with adequate setbacks from either side of stream banks. If the conductors were strung either after freeze up utilizing track-mounted cable stringing equipment (when stream beds would be protected by ice cover), or by helicopter, there would be no impact to water quality. If the conductors were strung during the open water season, cable stringing operations would be timed to avoid stream crossings during periods critical for fish utilization, as required by the Alaska Department of Fish and Game. In general, streams may be crossed after freeze up. If the streams were not frozen, there would be some disturbance of bottom sediments and temporary degradation of water quality. Degradation would be less evident in glacial streams. Buffers on either side of streams would prevent erosion or sediment flow into streams.

Site clearing would be required for the new substation near Gakona. As these project facilities would be located on relatively flat terrain, clearing operations would not result in significant erosion or sediment flow into streams.

Although there would be a short-term increase in sedimentation resulting from cable-stringing during the open water season, impacts on water quality are expected to be minor and temporary.

Floodplains

There are no floodplain crossings along the Suggested Route.

Land Cover

The right-of-way would be 125 feet wide. Clearing along the right-of-way would require the cutting of and removal of all trees in an area 50-feet wide, and additional clearing as necessary to maintain minimal electrical clearances.

Clearing required for the new right-of-way would have no significant impact on land cover, as most of the area is considered non-commercial forest. Once trees were cleared and cable stringing operations were complete, the remaining vegetation would be able to reestablish itself. Periodic clearing would be required.

Wetlands

The Suggested Route passes through a moist tundra area north of Sheep Mountain, and through approximately 15 miles of lowbush bog and muskeg north of Glennallen. Between the north end of Paxson Lake and the Delta River, it passes through moist and alpine tundra. Site-specific location of towers can minimize impacts, and construction in certain areas may have to occur when the ground is frozen, due to the amount of standing water present in the open water season. There would be no significant effect on wetlands.

Fish and Wildlife

Fish - The Alaska Department of Fish and Game's Habitat Division (1985b, 1986c,d) has identified the presence of anadromous fish in 7 streams crossed by the Suggested Route, and resident species in 17 streams. The U.S. Bureau of Land Management has data documenting resident species in Delta River tributaries (U.S. Bureau of Land Management and U.S. Army Corps of Engineers 1987). Granite Creek, Kings River, and Chichaloon River contain chum, coho, king, and sockeye salmon; Mendeltna Creek contains king salmon; Tolsona Creek and the Gulkana River contain steelhead and king, sockeye and coho salmon; and Fish Creek contains sockeye salmon.

A total of 27 streams contain resident species. Grayling are present in Hicks Creek, Gunsite Creek, the Little Nelchina River, Cache Creek, Mendeltna Creek, Little Woods Creek, Tolsona Creek, Moose Creek, the Gulkana River, Haggard Creek, Gunn Creek, Miller Creek, and Jarvis Creek. Dolly Varden and arctic char are present in Granite Creek, and Dolly Varden, arctic char, and rainbow trout are present in Kings River. Grayling and rainbow trout are present in Sourdough Creek, and grayling and burbot are present in Fish Creek. Grayling and whitefish are present in the following Delta River tributaries: Phelan Creek, Miller Creek, Castner Creek, Michael Creek, Flood Creek, Whistler Creek, Boulder Creek, Gunnysack Creek, Darline Creek, Bear Creek, and Ruby Creek.

There would be no significant construction impacts on fish during cable stringing operations. Stream crossings would be made either when ice is present, or during the open water season within construction windows required by the Alaska Department of Fish and Game. Granite Creek, Kings River, Chickaloon Creek, and the Mendeltna and Tolsona Rivers can be crossed between May 15 and July 15, and during winter when ice cover is present. The Gulkana River at Sourdough can be crossed from April 1 to mid-May. Haggard Creek can be crossed from November 1 to April 30, and Fish Creek and Gunn Creek can be crossed from mid-August to mid-May.

Birds - The distribution of ducks and geese, as documented by the Alaska Department of Fish and Game's Habitat Division (1985b, 1986b), was presented in Section VIII. The Suggested Route crosses an area in the Copper River basin rated as low-density breeding habitat, described as fewer than 25 nesting ducks and 9 nesting geese per square mile (U.S. Air Force 1986). Between Tahneta and the south side of the Gulkana River, the route would be constructed during winter, so there would be no interference with nesting activities. North of the Gulkana River to the area adjacent to Hogan Hill, construction could be timed to avoid the nesting period (between breakup and late June).

There is a potential for collision, especially in the Copper River basin, which is discussed in Threatened and Endangered Species.

Wildlife - The distribution of moose, caribou, dall sheep, brown bear, and bison, as documented by the Alaska Department of Fish and Game's Habitat Division (1985a, 1986a) and Hemming and Morehouse (eds. 1976) was presented in Section VIII. Moose are present along the entire route and move throughout the area year-round. Caribou are present in the Copper River basin, and migrate westerly between mid-March and mid-May, and easterly between early October and early January. Dall sheep are not present in the area crossed by the route. Brown bear are present throughout the Delta River drainage basin, and are concentrated between Upper Fish Lake and the mouth of Fish Creek. Bison are present between Black Rapids and Delta Junction, and they migrate westerly across the route from March 15 to April 15, and easterly from July 15 to October 15.

The Alaska Department of Fish and Game recommends that construction be timed to avoid peak caribou migration periods and that helicopter activity (if required) be restricted in the Alaska Range from early may to mid-June to avoid interference with dall sheep lambing.

Right-of-way clearing may increase moose habitat, and there should be no impact on caribou, brown bear, or bison habitat.

Threatened and Endangered Species

The American peregrine falcon, an endangered species, and the bald eagle and the trumpeter swan are considered "species of concern." Distribution of bald eagles and trumpeter swan, which as considered "species of concern," are present along the Suggested Route. Distribution of peregrine falcon, bald eagles and trumpeter swan was presented in Section VIII. A field survey would have to be conducted to identify exact nesting sites. An "off limits" protective perimeter could be established for each falcon and eagle nest if construction occurred during the nesting season. The route would cross an extensive trumpeter swan nesting area in the Copper River basin. The Alaska Department of Fish and Game and the U.S. Fish and Wildlife Service recommend that there by no construction activities during the trumpeter swans nesting period, May 1 to August 31.

As mentioned in Section VIII, collision potential is a major consideration, as the area around Glennallen contains breeding habitat for an estimated 20 to 25 percent of the world's trumpeter swan population. The Suggested Route generally would avoid open water bodies, but it would cross wetlands and the Gulkana River, a major migration corridor. As previously discussed, studies conducted in 1988 documented that swan, geese, and ducks flew higher than 100 feet above ground level on clear days during migration. Reducing conductor height below 100 feet in migration and waterfowl use areas would reduce collision potential.

Archeological and Historic Sites

Cultural resource sites in the vicinity of the Suggested Route listed by the Alaska Heritage Resources Survey (AHRS) are shown in Table 19. Transmission line construction will rely heavily upon vehicular transportation along a brushed access road. A winter-only use scenario will minimally require a reconnaissance level survey, while a summer use trail and/or other potentially ground disturbing activities will require some level of intensive systematic testing. The Alaska Office of History and Archaeology and the U.S. Interior Department will require consideration of non-direct construction impacts on cultural resources resulting from increased recreational use of an area, erosion, etc.

In addition to required federal and state archaeological surveys, the land-holding native corporations may initiate additional cultural resources compliance requirements. These have previously included some or all of the following: special fees and permits, review and approval of research designs, active participation in field investigations, extensive additional oral history and ethnohistoric research, establishment of research protocols, and mitigative monetary compensation.

The cost of cultural resources investigation and mitigation may be expected to be somewhat higher for this project than for comparable previous projects. This is directly attributable to the type of proposed construction, the potential for impacts to known sites within constricted areas, the probable discovery of sites during survey, an expanded survey area associated with potential long-term impacts (not only recreational use of the trails but also emergency summer use of a winter trail), and changing attitudes and requirements of native landholding corporate entities.

Pole locations could be adjusted to avoid specific sites, and alignments could be modified to avoid creating a right-of-way in an area containing a number of sites. In areas where right-of-way options are limited, sites could be cleared prior to construction. Personnel would be instructed not to vandalize or remove artifacts from any area.

Land Use

The Suggested Route would cross three miles proposed for inclusion in the Trumpeter Swan Critical Habitat Area. The area is currently managed to protect swan nesting habitat, as follows (Alaska Dept. of Natural Resources and Alaska Dept. of Fish and Game 1986). Overland access and other activities requiring permits are prohibited between May 1 and August 31 unless the Alaska Department of Fish and Game determines that the activity is compatible or the Alaska Department of Natural Resources determines that it is not feasible or prudent to prohibit the activity. In those cases, the Alaska Department of Fish and Game can require that activities be prohibited within one-quarter mile of current or potential swan nesting or staging ponds, marshes, or lakes.

The Suggested Route would avoid all of the state recreation sites described in Section VIII. It would cross the access road to Bonnie Lake State Recreation Site, and it would be located on the western border of Dry Creek State Recreation Site, but as previously discussed, there would be no impact. It would cross six miles of the Matanuska Valley Moose Range, and right-of-way clearing may enhance moose habitat. It would cross the Gulkana River downstream of the portion designated as a wild and scenic river. There is a potential for increased hunting and fishing due to access from right-of-way.

Aesthetics

Between Sutton and Glennallen, the Suggested Route is generally shielded from the Glenn Highway, and the only highway crossing would be in Glennallen, to access the substation adjacent to Pump Station 11. Between Glennallen and Sourdough, the Suggested Route would not be visible from the Richardson Highway, but it would be in an open area. The Suggested Route is generally screened from the highway between Sourdough and Paxson and Black Rapids and Delta Junction, although there are four highway crossings; but between Paxson and Black Rapids, it would be visible. The TAPS line is buried in most of this segment, and would not provide an effective screen.

The potential visual impact is the major environmental concern encountered in this study. It is probable that a detailed visual assessment would have to be conducted before state and federal landowners would grant right-of-way permits.

Social Impacts

Construction of a transmission line is anticipated to require small work crews over short periods of time. It is unlikely that there would be a requirement for new housing, schools, or other services. Right-of-way clearing and equipment operation in tower placement and cable stringing could result in short-term employment opportunities for residents of communities in the vicinity of the Suggested Route. Construction would require installation of air navigation markers and updating of air navigation charts. The final alignment would avoid airstrips.

Considerable public comments was made relative to the suggested route. All of the public comment is contained in Appendix I. For this purpose, the rerouting shown on the suggested route has been provided to mitigate these concerns.

The Northeast Intertie Concerned Residents proposed two alternative routes as shown in Appendix I. These routes were evaluated and the more favorable route, shown in the following figures, was developed further. It is apparent that this alternative could be constructed. The route is shorter than the suggested route over this segment, but is further from the highway in more difficult terrain, although some trail access is available. Based on these facts, it was concluded that the cost would be approximately the same as the suggested route over this segment. However, operational costs would be higher and access difficulty could cause serious problems if outages occurred during time when weather conditions restricted access.

Geological Conditions and Geological Hazards

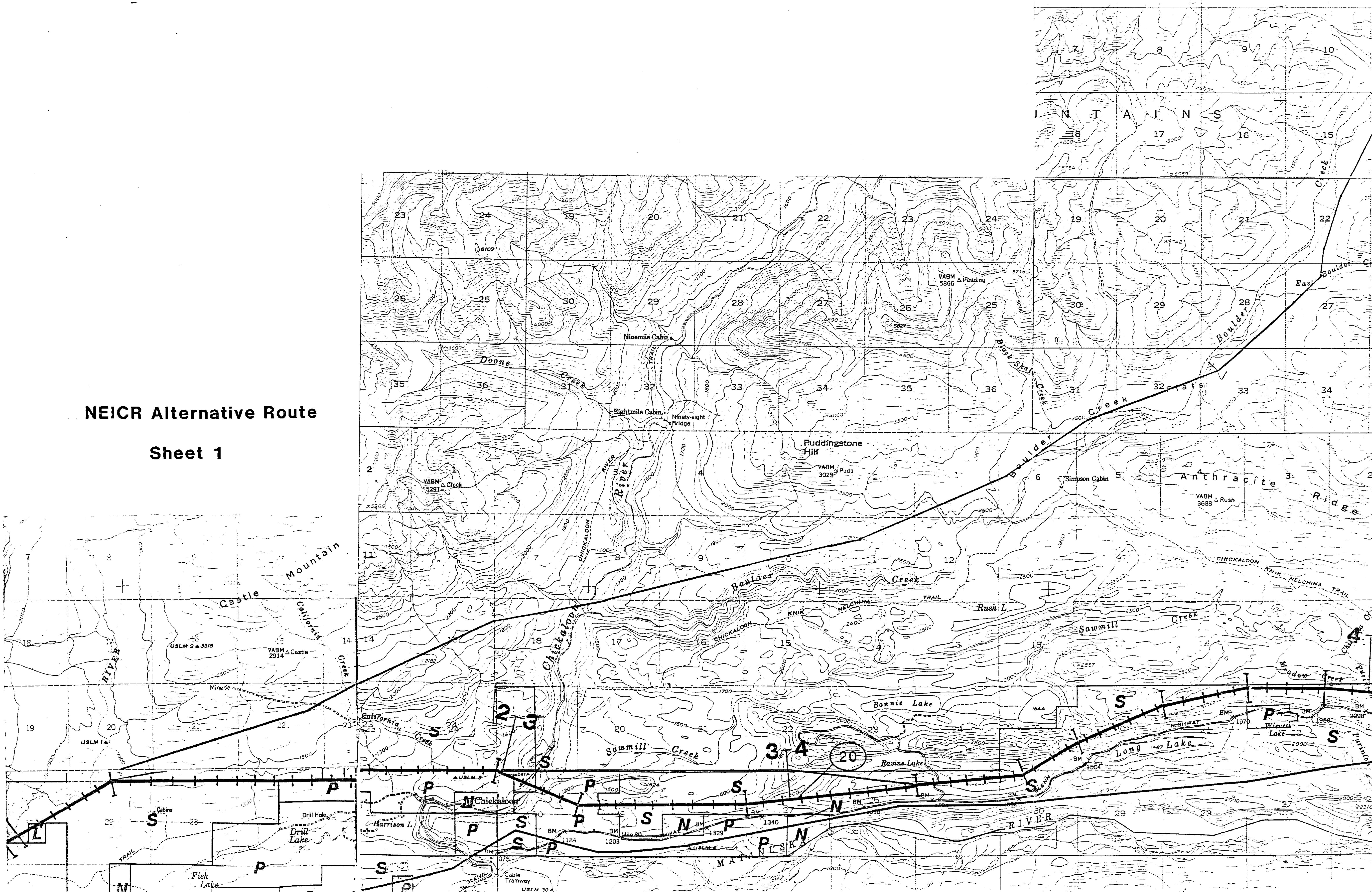
Geologic information for the preferred route was developed from State of Alaska Department of Natural Resources, Graphical Information Systems data. This data is a computerized compilation of aerial photography, LANDSAT data imagery and field verification data. This data is compiled at 1:250,000 scale. Geologic hazards were identified from the Trans-Alaska Pipeline Environmental Assessment Atlas (1973) along the Richardson Highway corridor and from review of aerial photographs in other areas.

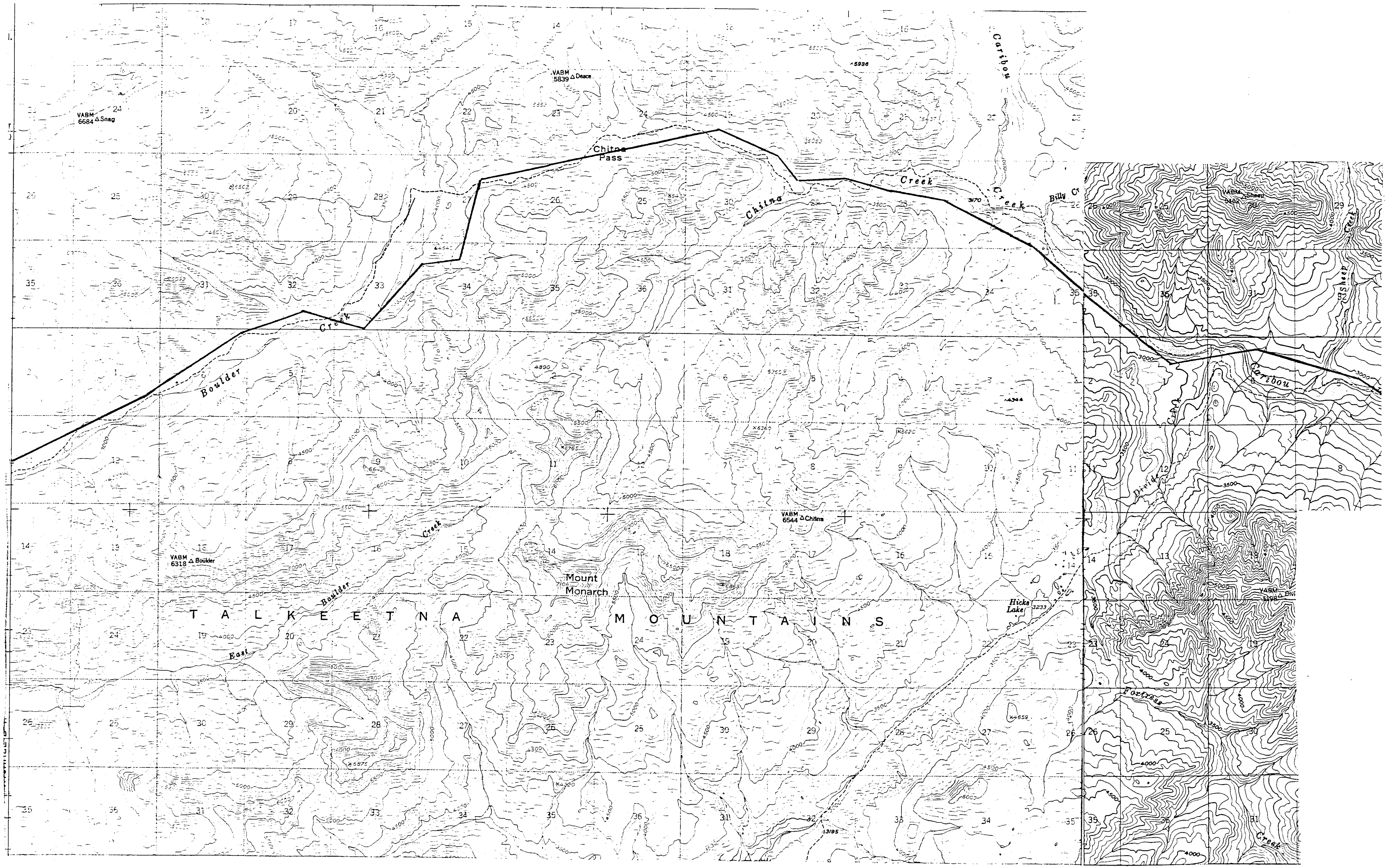
The Suggested Route begins at Sutton. The route follows the Matanuska Valley for approximately 41 miles. Geologic features in the Matanuska Valley are the product of several glacial advances. The surficial soils in the valley floor for the first 15 miles are predominantly glaciofluvial materials consisting of sands and gravels, forming braided channels, esker and other features typical of ice stagnation zones. Soil deposits in the area are moderately thick with some areas ice-scoured to result in bedrock exposures. Foundations in this area will be typically shallow piles in the sand and gravel deposits, with rock anchors in areas where bedrock is exposed.

Small avalanche chutes are present in the Talkeetna Mountains along this portion of the route. Mitigating potential problems associated with avalanche events in this area is a valley terrace between the mountains and route which dissipates downslope forces. Closures of the Glenn Highway associated with avalanches, land slides or other mass wasting in this area are rare.

NEICR Alternative Route

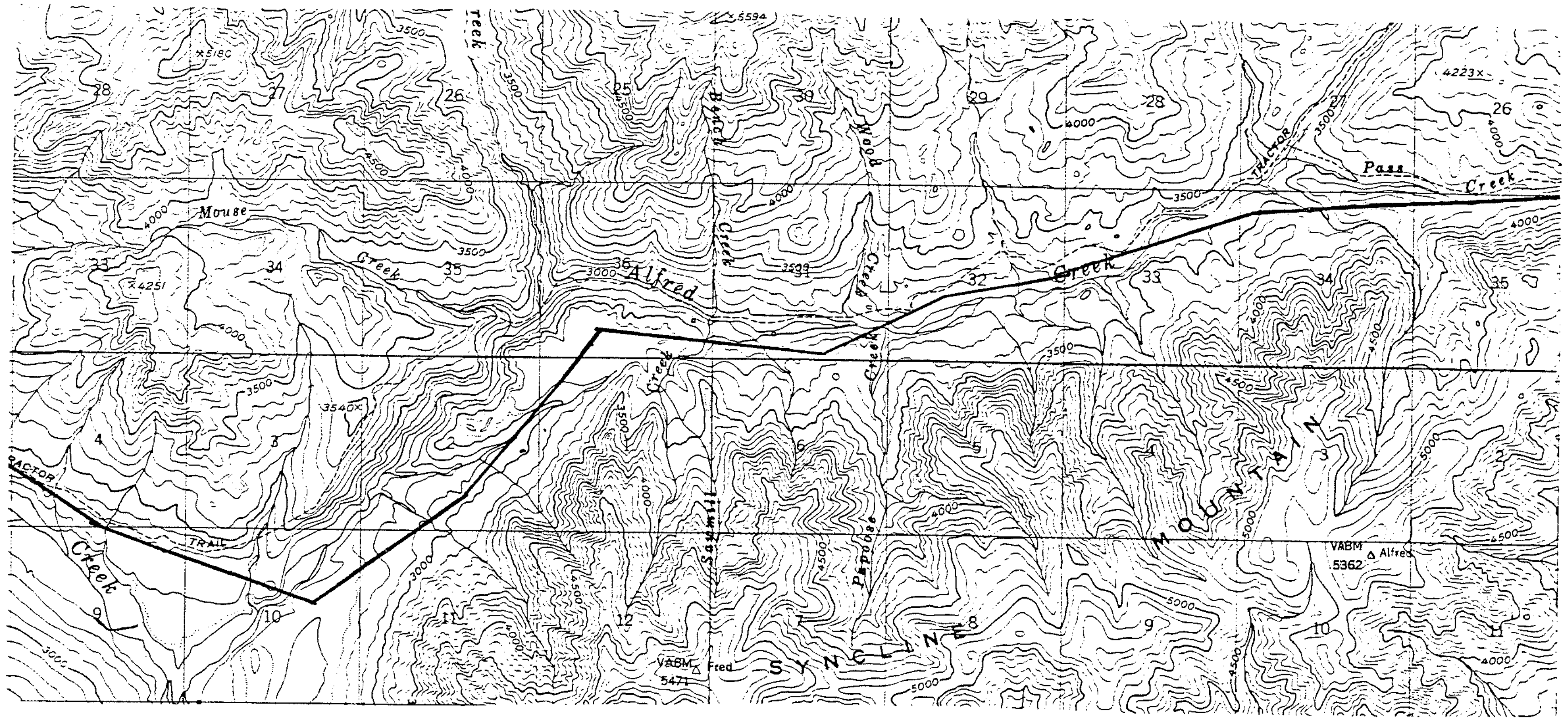
Sheet 1





VABM 6684 Snag
VABM 5839 Deace
Chitna Pass
Chitna Creek
Caribou
Billy Cr
Boulder Creek
Caribou
VABM 6544 Chitna
VABM 6318 Boulder
Mount Monarch
TALKEETNA MOUNTAINS
Hicks Lake
East Boulder Creek
Fortress
Creek

Sheet 2


Mouse Creek
Alfred Creek
Pass Creek
Sawmill Creek
Papoose Creek
TRACTOR TRAIL
MOUNTAIN
SYNCLINE
VABM 5362 Alfred
VABM 5471 Fred

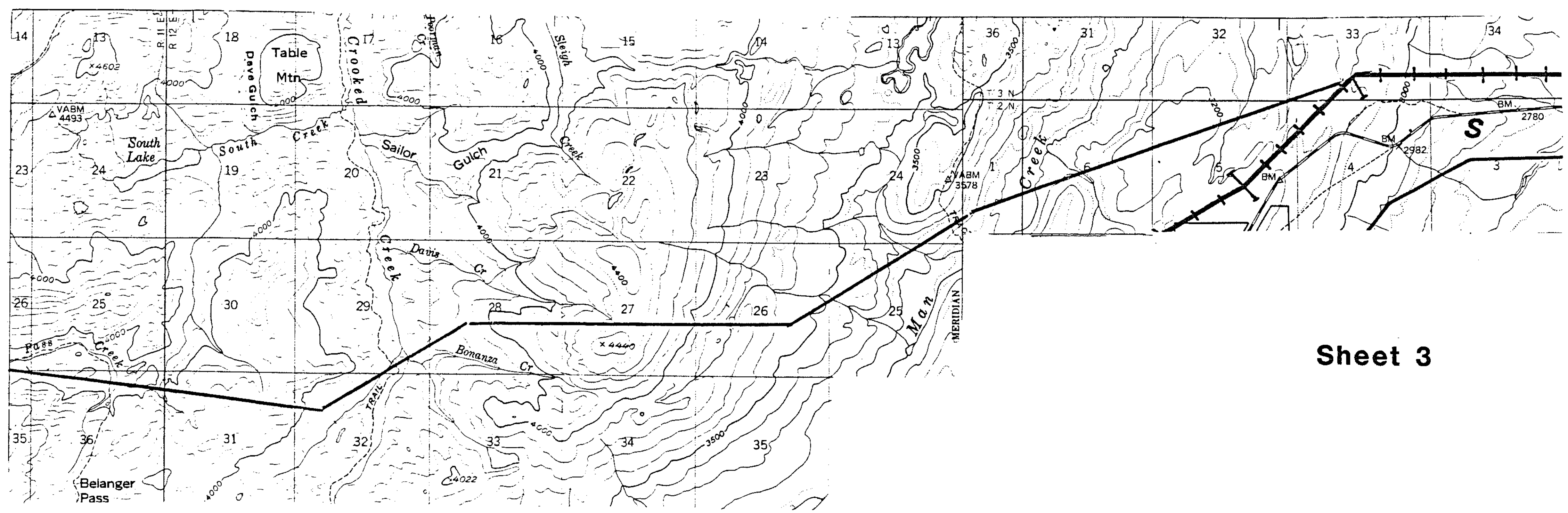


Table Mtn
Dave Gulch
Crooked Creek
South Creek
Sailor Gulch
South Lake
Sleigh Creek
Davis Cr
Bonanza Cr
Pass Creek
Belanger Pass
VABM 4493
VABM 3578
T 3 N
T 2 N
R 11 E
R 12 E
MERIDIAN

Sheet 3

From Chickaloon to Slide Mountain, the route crosses glacial drift associated with the Knik and prior Eklutna glacial advances. Soils in this area are anticipated to be poorly sorted and bedded fine and coarse grained soils. Much of this material has been glacially overridden, resulting in very dense soils. Foundations in this area are anticipated to be shallow piles. Streams entering the Matanuska Valley often flow through deep gorges in the areas from mile 25 to 40 which resulted from large flow during glacial retreat or from flow diversion around the main ice mass. Deeper plies (piles) of other lateral support may be necessary where inter-tower spans cross the larger gorges.

At Sheep Mountain, the route follows the Caribou and Squaw Creek Valleys around the north side of Sheep Mountain. This segment to Tahetna Lodge is approximately 15 miles. The route follows the eastern valley wall along Caribou Creek to a terrace along the south side of Squaw Creek. Soils in this area are reported to be a thin mantle of glacial till over shallow bedrock. Foundations in this area are anticipated to be shallow piles, however, rock anchors may be necessary in areas of thin over burden.

Beyond Slide Mountain, the route crosses a proglacial lake bed for the remaining 45 miles to Glennallen. Soils are generally fine-grained deposits, well bedded and sorted. Terrain in this area is relatively flat with numerous lakes and streams, forming a poorly developed drainage system. Areas covered by thick organic deposits are common. Sporadic discontinuous permafrost is found throughout this area, more commonly in areas of thicker organic deposits. Design of transmission line supports in this area must take into account high frost jacking forces typically developed due to seasonal freezing of fine-grained, high moisture soils. Deep pile foundations or multiple piles are anticipated for this segment of the route.

North of Glennallen, the route continues across the proglacial lake formation for 38 miles to Hogan Hill. North of Hogan Hill, the route rises out of the lake bed and crosses older glacial drift through the Alaska Range at Isabel Pass and into the Delta River System near route Mile 110. Soils through this segment of the route are the product of several advances of the numerous valley glaciers in this area and are anticipated to be dense, poorly sorted and bedded mixtures of silts. Deeper piles will be required in these areas. In many areas, especially through the Alaska Range, soil deposits will be thin to nonexistent, requiring rock anchor foundations.

In the Alaska Range, the route crosses two geotechnical hazards. At Rainbow Ridge (Mile 87), the route encounters a large avalanche zone. In this area, the line has been routed on the west side of Phelan Creek to minimize potential problems associated with this hazard. At Miller Creek (Mile 94) the route crosses the Denali Fault. Fault movement is anticipated to have minimal impact on the power line.

At Mile 110, the route enters the Delta River Basin, following the Delta River to Delta Junction. Soils in this area include glacial outwash and alluvial deposits, including sands and gravels, generally well bedded. Foundations in these materials will be shallow piles. Along the valley margins, older river terraces of ancient glacial drift are present. In some areas, eolian deposits overlay the river terraces. Where eolian deposits are thin, pile foundations will be used. In thicker eolian deposits, deep piles may be necessary to develop lateral support in the unconsolidated sands and silts.

Construction

There would be no requirement for borrow sources, and excavated material from tower foundation placement, if any, would be left in place. Noise from construction vehicles would be minimal, at most if the line is more than half a mile from highways. Use of helicopters may generate more noise, but the duration would be short. Vehicle emission would be minimal, but if brush were burned in place, there would be smoke for a short period of time. If brush were chipped, there would be no smoke. There would be a total of five highway crossings; however, traffic disruption would be minimal.

Operation

As discussed at voltages of 230kV or lower, electromagnetic interference is usually considered insignificant provided that no infringement into the right of way is permitted. This limits the levels to those found acceptable in states with the most stringent guidelines. In addition, the suggested route can be constructed so as to be 250 feet from any structure. Anticipated maintenance involves an inspection as often as every other month, and a more thorough inspection would be conducted less frequently. Inspections would be conducted from the air, with follow-up on the ground if problems were detected. When right-of-way maintenance requires vegetation control, the impact on wildlife utilizing the declared right-of-way would be minor if manual methods were used.

Limiting right-of-way access is a potential problem. Portions of the right-of-way would receive public use. The potential for increased public use is greatest in areas where no trails currently exist and in popular hunting and fishing areas. Each landowner would have to be consulted for right-of-way requirements.

X. LAND OWNERSHIP

X. LAND OWNERSHIP

Data for this land ownership evaluation were developed primarily from U.S. Bureau of Land Management (BLM) land status plats, with verification using State of Alaska Department of Natural Resources (DNR) land status plats for status verification in selected areas. It should be recognized that BLM plats indicate only the primary conveyance (i.e. conveyance from federal ownership to a state, local or private concern). Additional conveyances particularly from state to local government or private ownership may not be reflected in the data presented. For the purposes of this discussion, privately owned lands include homesite, mineral entry and trade and manufacturing site patents. Ownership parcels are indicated on the 1:63,360 scale route maps with notation as to ownership of each parcel in the vicinity of the analyzed routes.

From the O'Neill Substation at Sutton, the first 3.1 miles of the suggested alternative route cross privately owned lands including homesite and mineral entries. At Mile 3.1 the route crosses onto land conveyed to the Matanuska-Susitna (MatSu) Borough and remains on borough land for the next 6 miles, crossing one-half mile of private land at Mile 4.0. The route is primarily on state land for the next 25.6 miles, crossing private lands at Mile 14.5 (one-fourth mile) and Mile 17 (1 mile). The route also adjoins but does not encroach on private lands for 2.5 miles in this area (from Mile 14.0 to Mile 16.5).

For the next 6.3 miles, Mile 35 to 41, the lands adjacent to the route are either owned by the Cook Inlet Regional Corp (CIRC) or held privately. The suggested route was contained in the highway right of way. Following public comment, a suggested alternative of this route places the line on state and civil land, and minimizes conflicts with private ownership. The route departs further from the highway at Route-Mile 41.0 proceeding northeasterly across state lands along Caribou Creek. At Mile 45.5, the route enters federal lands withdrawn for public power projects in the Caribou Creek Valley for 2.9 miles. The route continues northeasterly on state lands in the Squaw Creek Valley for the next 2.3 miles.

At Route-Mile 50.2, the route encounters lands owned by the Ahtna Regional Corp. for the next 13.3. miles to the vicinity of the Eureka Roadhouse. At Mile 63, the route enters and remains primarily on state lands for the next 49.4 miles. Along this portion of the route, the alignment encroaches on a private parcel for approximately 1.4 mile at Mile 69.8 and crosses a Native Allotment parcel for 0.3 miles at Mile 71.

At Mile 112.4, approaching Glennallen, the route enters Ahtna lands for the next 7 miles. Lands in this area are predominantly owned by Ahtna, with small in holdings of state, and private lands in the vicinity of the Glennallen Lodge. At Mile 119.2, the route follows a section line for 5.2 miles, with Ahtna lands to the north and state and federal lands to the south, entering state land at Mile 124.3.

At this point, a two-way spur connects the proposed route to the existing substation at Pump Station 11. This spur is on state lands until it crosses the Glenn Highway, 1 mile south of the proposed route. The remainder of the spur crosses Ahtna lands for 0.9 miles to the substation.

The route north from Glennallen passes across state-owned land for 6.1 miles from the right angle at Mile 124.3. From this point, the route crosses Ahtna land for the next 21.5 miles to the vicinity of Sourdough. There are two parcels of state land along this segment of the route totaling 3 line miles in the area of Route-Mile 17.3 from Glennallen. From Sourdough to Paxson (40 route-miles), the route crosses primarily federal-owned lands in the control of the BLM. This segment includes a one-fourth mile length at Mile 27.6 from Glennallen near Sourdough which crosses state land, and a one-half mile length at Mile 31.75 from Glennallen which crosses a Native Allotment parcel. All mileages from the tie to Glennallen are measured from Glennallen.

From Paxson, the route is on state-owned land for 41.7 miles to approximately 4 miles north of Black Rapids Lake. The route crosses approximately 1 mile of military land north of Black Rapids Lake in this section of the route. At Mile 102.5, land ownership becomes federal for the next 9.8 miles. The route then crosses 6 miles of state land before encountering military lands near Donnelly Dome at Mile 123.7.

The remaining 17.5 miles from Donnelly Dome to within three-fourth mile of the Jarvis Substation cross military reservation and other lands withdrawn for military purposes. The route follows property boundaries with military land to the west, and state, federal and private lands to the east from Route-Mile 129.6 to 134.3 in this section of the route. Lands in the vicinity of the Jarvis Substation are predominantly under local or state control.

XI. PERMITS

XI. PERMITS

The final design, right-of-way procurements, and construction of the Northeast Intertie will require a number of federal, state, and local permits.

Following is a list of specific permits and their application:

PERMIT	REMARKS	TIME REQUIRED
Field Studies Permits		
Land Use Permit State of Alaska Dept. of Natural Resources	This permit will be required for any on-site investigation on state land	30 Days
Field Archeology Permit U.S. Fish & Wildlife Service	Required for any field studies	Prior to Conducting Work
Antiquities Permit National Park Service	Required if any objects of antiquity are gathered on federal lands during field studies.	Prior to Conducting Work
Cultural Resource Use Permit Bureau of Land Mgmt.	Assures that qualified persons are allowed to use public lands for archeological and historical investigations.	Prior to Conducting Work
Bureau of Land Mgmt.	For geotechnical and environmental studies on BLM-managed federal lands.	90 Days
Scientific Collecting Permit Alaska Dept Fish and Game	Required if any environmental studies require the collection of species.	Not Specified

PERMIT	REMARKS	TIME REQUIRED
Airplane Flight Paths Notice of Proposed Construction or Alteration Federal Aviation Administration	Required to determine whether or not structure will be a hazard to air navigation.	Prior to Construction
Life and Fire Safety Check Plan for the Construction and Occupancy of Buildings State of Alaska Department of Public Safety	Required for all buildings	Not Specified
Bureau of Land Mgmt.	Will have to demonstrate NEPA compliance. An EIS will probably be required.	Approximately 1 Year
Right-Of-Way Easement Department of Natural Resources Division of Land & Water Management	Required for the actual construction of a line across state land.	Approximately 6 Months
Encroachment Permit State of Alaska Department of Transportation and Public Facilities	Required for any encroachment across or along a highway.	Prior to Construction
Utility Permit State of Alaska Department of Transportation & Public Facilities	Required to locate line in state right-of-way	Prior to Construction
Fired and Unfired Pressure Vessels Inspections Alaska Department of Labor	For any construction or installation of pressure vessels	Prior to Use
Certificate of Reasonable Assurance (Water Quality Certification) Alaska Department of Environmental Conservation	In compliance with Section 401	Approximately 90 Days
Special Area Permit State of Alaska Department of Fish & Game	For any identified critical habitat	50 Days

PERMIT	REMARKS	TIME REQUIRED
Fish Habitat Permit State of Alaska Department of Fish & Game	To protect and conserve fish habitat in the state and for any bridge crossing of stream	50 Days
Oil Storage Facilities Oil Spill Prevention Containment & Counter-Measure (SPEC) Plans Environmental Protection Agency	Required for permanent facilities as well as during construction	Within Six Months of Operation
National Pollution Discharge Elimination System Permit to Discharge into Water	For either construction camps or permanent facilities	180 Days
Corps of Engineers	Structures in or affecting navigable waters.	120 Days
Construction Related		
Solid Waste Disposal Permit	For any construction camp	60 Days
Food Services Permit	Construction Camp	30 Days
Foreign Labor Requirements Alaska Dept. of Labor U.S. Dept. of Labor	Required for the hiring of aliens	Prior to Working
Burning Permit	For disposal of cleared material	5 Days
Certificate of Fitness Journeyman Linemen & Explosive Handlers Department of Labor	Required for persons engaged in construction of power transmission line work.	Prior to Working

Other permits which are not identified in the foregoing may be required as the project develops. This list is not intended to be comprehensive.

XII. PROJECT COSTS ALTERNATE ROUTES

PROJECT COST SUMMARY

Alternatives Routes

I. NORTHWEST ROUTING ALTERNATIVE - COST

Line Costs	$ 121,206,000.00
Station Costs	31,943,224.00
Environmental & Right-of-Way Costs	5,055,975.00
TOTAL COST	$ 158,205,199.00

II. SOUTHEAST ROUTING ALTERNATIVE - COST

Line Costs	$ 118,303,000.00
Station Costs	35,321,648.00
Environmental & Right-of-Way Costs	7,895,325.00
TOTAL COST	$ 161,519,973.00

III. SUGGESTED ROUTING ALTERNATIVE - COST

Combination of Routes	
Line Costs	$ 119,205,000.00
Station Costs	31,943,224.00
Environmental & Right-of-Way Costs	5,042,175.00
TOTAL COST	$ 156,190,399.00

NORTHEAST INTERTIE

ENVIRONMENTAL COST ESTIMATE

Geotechnical Investigation	$ 550,000.00
Environmental Studies	540,000.00
Field Support	712,500.00
Right-of-Way and Permits	360,000.00
Cultural Resources	900,000.00
	$ 3,062,500.00
Contingency 15%	459,375.00
	$3,521,875.00

RIGHT-OF-WAY ACQUISITION COSTS

Northwest Route	$ 1,334,000.00
Contingency	200,100.00
	$ 1,534,100.00
Southeast Route	$ 3,803,000.00
Contingency	570,450.00
	$ 4,373,450.00
Suggested Route	$ 1,322,000.00
Contingency	198,300.00
	$ 1,520,300.00

SUMMARY TRANSMISSION LINES

The cost summaries of the Southeast, Northwest, and Suggested Route are as follows:

ROUTE	COST
Northwest-O'Neill to North Pole	
- O'Neill to Glennallen	48,078,000
- Glennallen to Gakona	7,379,000
- Gakona to Jarvis	58,613,000
- Carney to North Pole (Wood Pole)	7,136,000
Total	**121,206,000**
Annual - O&M	1,818,000
Southeast-O'Neill to North Pole	
- O'Neill to Glennallen Switch Station	47,076,000
- Glennallen Switch Station to Gakona	5,205,000
- Gakona to Jarvis	58,886,000
- Carney to North Pole (Wood Pole)	7,136,000
Total	**118,303,000**
Annual - O&M	1,775,000
Suggested Route-O'Neill to North Pole	
- O'Neill to Crossover at Sourdough	61,570,000
- Crossover at Sourdough to Jarvis	50,499,000
- Carney to North Pole (Wood Pole)	7,136,000
Total	**119,205,000**
Annual - O&M	1,788,000

SOUTHEAST ROUTE
SUMMARY OF STATION COSTS

STATION	
O'Neill Tap Substation	$2,404,742
O'Neill Substation	4,551,332
Glennallen Substation	4,378,062
Pumping Station No. 11 Substation	-0-
Gakona Junction Substation	15,556,324
Jarvis Creek Substation	2,362,652
Carney Substation	2,463,668
North Pole Substation	3,604,868
Total	**$35,321,648**

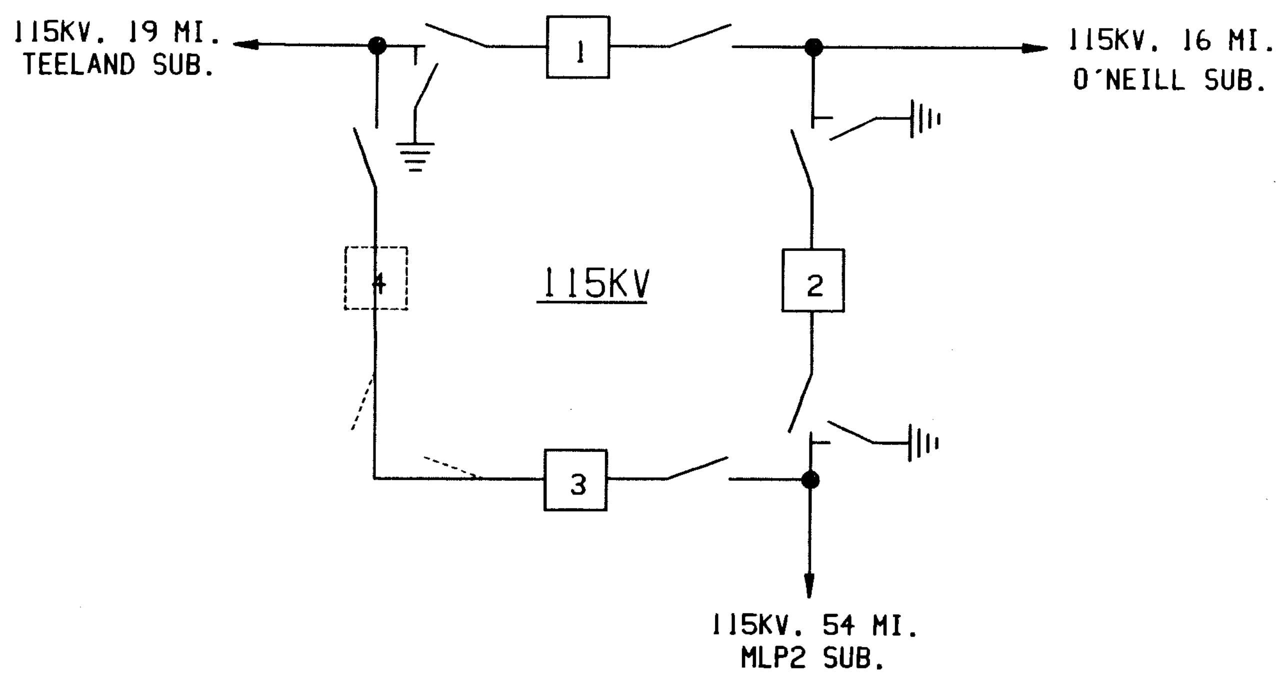
NORTHWEST ROUTE & SUGGESTED ROUTE
SUMMARY OF STATION COSTS

STATION		
O'Neill Tap Substation		$2,404,742
O'Neill Substation		4,551,332
Pumping Station No. 11 Substation		999,638
Gakona Junction Substation		15,556,324
Jarvis Creek Substation		2,362,652
Carney Substation		2,463,668
North Pole Substation		3,604,868
	TOTAL	$31,943,224

SUBSTATIONS - SOUTHEAST ROUTE DESIGN REQUIREMENTS AND COST ESTIMATES

SOUTHEAST ROUTE
O'NEILL TAP SUBSTATION
DESCRIPTION

O'Neill Tap Substation will be a new switching station located approximately mid-way between Teeland and O'Neill Substations on the existing 115kV line. The station will be constructed to 230kV spacing, but will be operated at 115kV until the line is converted to 230kV. Initial construction will be a 3-breaker ring bus, with provisions for expansion to a 4-breaker ring.



SOUTHEAST ROUTE

O´NEILL TAP SUBSTATION

MEA

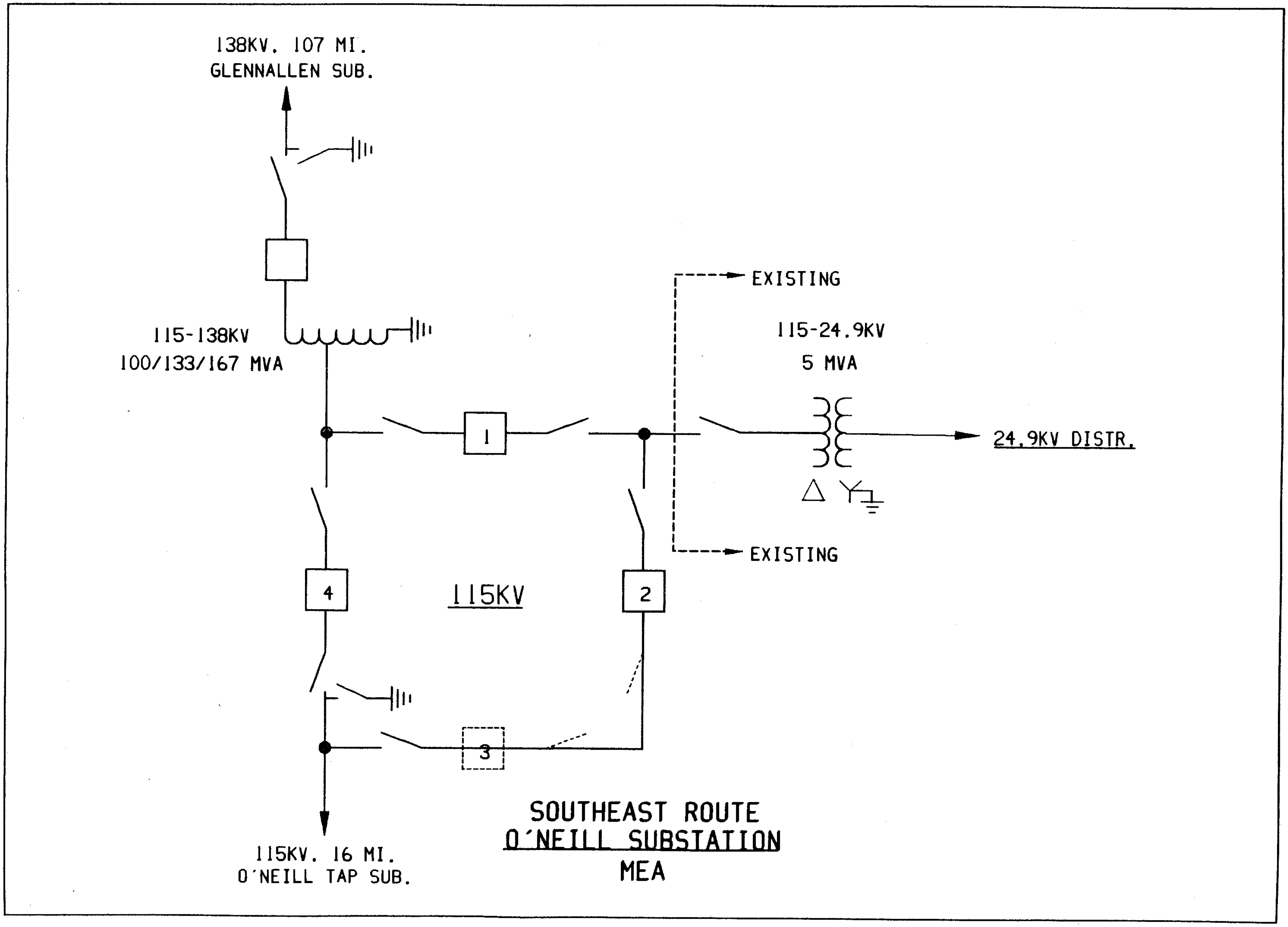
STATION: SOUTHEAST ROUTE O'NEILL TAP SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
STRUCTURES			
230kV Dead End Structure	2	$32,000	$64,000
230kV Switch Structure	6	10,000	60,000
230kV Voltage XFMR Structure	1	4,000	4,000
230kV Current XFMR Structure	2	4,000	8,000
230kV Arrester Structure	2	1,500	3,000
230kV Bus Support Structure	6	1,500	9,000
EQUIPMENT			
138kV Circuit Breaker	3	95,000	285,000
138kV 3Ø Switch	6	12,500	75,000
138kV Voltage XFMR	3	12,000	36,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	5	20,000	100,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	102,000	102,000
Install Equipment	L.S.	132,000	132,000
Foundations	L.S.	183,000	183,000
Furnish and install all other electrical work	L.S.	230,000	230,000
Testing	L.S.	20,000	20,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$1,714,000
Design (10%)			171,400
CM (7%)			119,980
Administration (5%)			85,700
		Subtotal	$2,091,080
Contingency (15%)			313,662
TOTAL - O'NEILL TAP SUBSTATION			$2,404,742

SOUTHEAST ROUTE
O'NEILL SUBSTATION
DESCRIPTION

The existing O'Neill Substation will be expanded with the addition of a 3-breaker 115kV Ring Bus (built for 230kV) and a 100/133/167 MVA, 115-138kV autotransformer on the Glennallen Substation line terminal (built for 230kV). The Ring Bus will be expandable to a 4-breaker configuration with the addition of one breaker, two disconnect switches and a line terminal. No outage would be required for the expansion.

The existing 115-24.9kV, 5 MVA transformer and the associated 24.9kV distribution will be fed from the ring bus and will not be changed.



SOUTHEAST ROUTE
O'NEILL SUBSTATION
MEA

STATION: SOUTHEAST ROUTE O'NEILL SUBSTATION

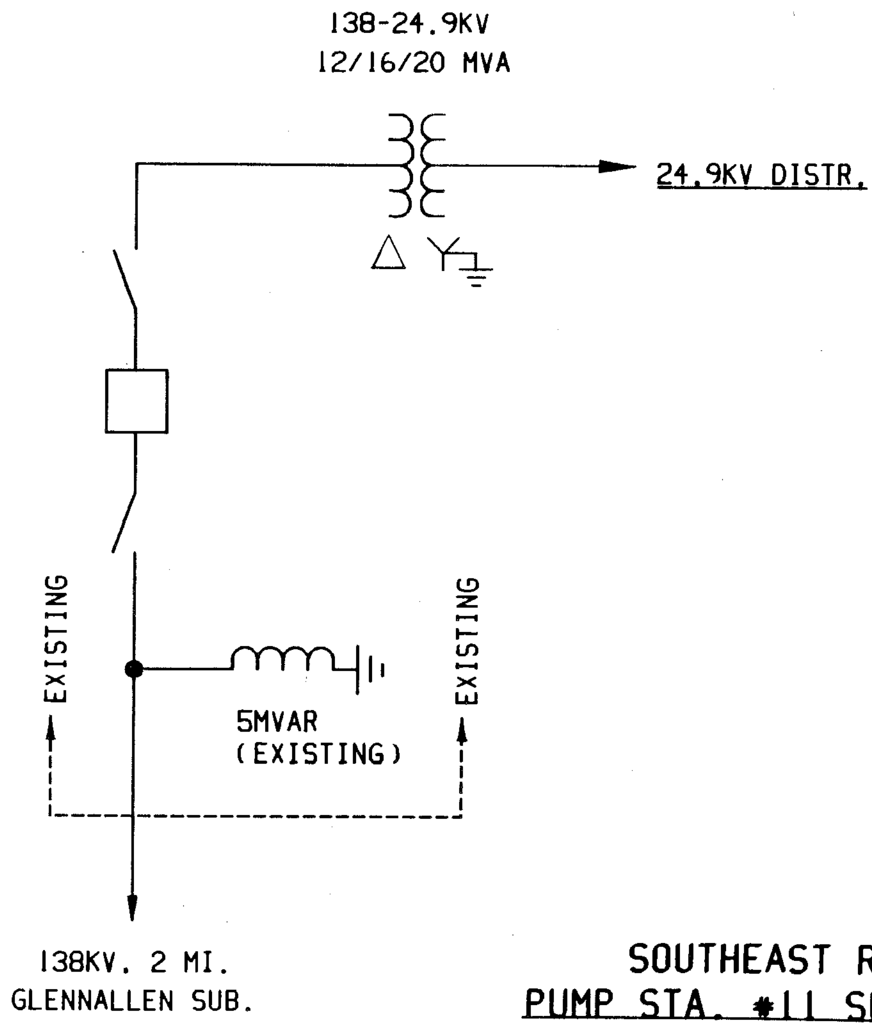
CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
STRUCTURES			
230kV Dead End Structure	1	$32,000	$32,000
230kV Switch Structure	1	10,000	10,000
230kV Current XFMR Structure	1	4,000	4,000
230kV Voltage XFMR Structure	1	4,000	4,000
230kV Dead End Structure	1	32,000	32,000
230kV Switch Structure	7	10,000	70,000
230kV Arrester Structure	2	1,500	3,000
230kV Bus Support Structure	12	1,500	18,000
230kV Current XFMR Structure	1	4,000	4,000
230kV Voltage XFMR Structure	1	4,000	4,000
EQUIPMENT			
138kV Circuit Breaker	4	95,000	380,000
138kV 3Ø Switch	8	12,500	100,000
138kV -115kV XFMR 100/133/167	1	1,200,000	1,200,000
138kV Voltage XFMR	7	12,000	84,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	6	20,000	120,000
SCADA & Communications	L.S.	50,000	50,000
Control Building	L.S.	36,500	36,500
Station Service	L.S.	8,500	8,500
Install Structures	L.S.	110,000	110,000
Install Equipment	L.S.	140,000	140,000
Foundations	L.S.	220,000	220,000

STATION: SOUTHEAST ROUTE O'NEILL SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
Furnish and install all other electrical work	L.S.	274,000	274,000
Testing	L.S.	32,000	32,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$3,244,000
Design (10%)			324,400
CM (7%)			227,080
Administration (5%)			162,200
		Subtotal	$3,957,680
Contingency (15%)			593,652
TOTAL - O'NEILL SUBSTATION			$4,551,332

SOUTHEAST ROUTE
PUMP STATION NO. 11 SUBSTATION
DESCRIPTION

Pump Station No. 11 Substation will not be modified. The existing 138kV line from Valdez will loop through the new Glennallen Substation about two (2) miles away and remain terminated at Pump Station No. 11 Substation.



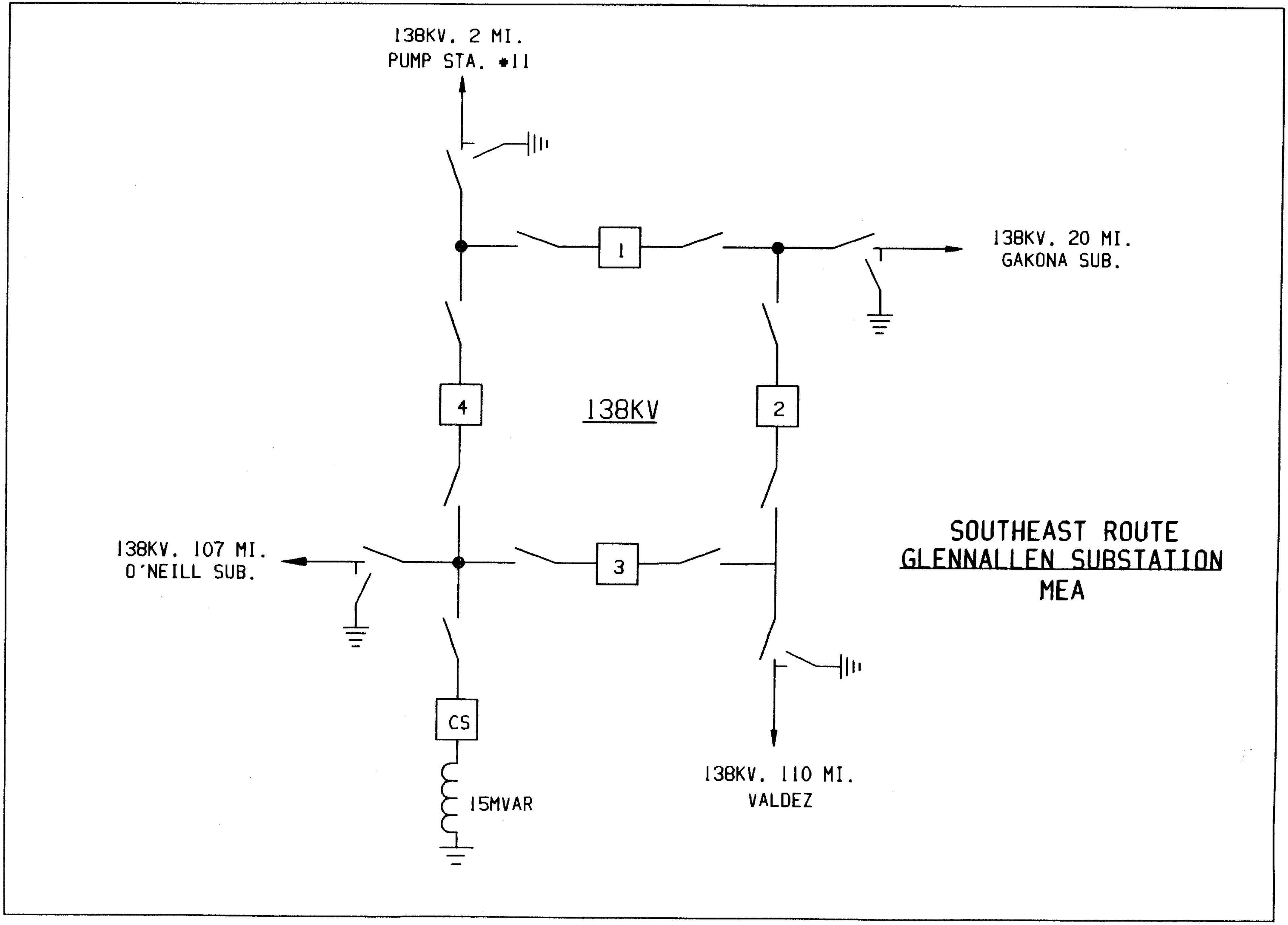
SOUTHEAST ROUTE
PUMP STA. #11 SUBSTATION
CVE

STATION: SOUTHEAST ROUTE PUMPING STATION NO. 11

This Substation is not affected in this option, and no cost estimate is necessary.

SOUTHEAST ROUTE
GLENNALLEN SUBSTATION
DESCRIPTION

Glennallen Substation will be a new switching station constructed approximately two miles south of Pump Station #11 Substation, to provide reactive transmission compensation and transmission line sectionalizing. The station will consist of a 4-breaker, 138kV Ring Bus (built to 230kV). A 15 Mvar reactor will be installed on the 138kV O'Neill line terminal and will be switched and protected by a circuit switcher. The other three 138kV line terminals will serve Gakona Substation, Pump Station #11 Substation, and Valdez Substation



SOUTHEAST ROUTE
GLENNALLEN SUBSTATION
MEA

STATION: SOUTHEAST ROUTE GLENNALLEN SUBSTATION

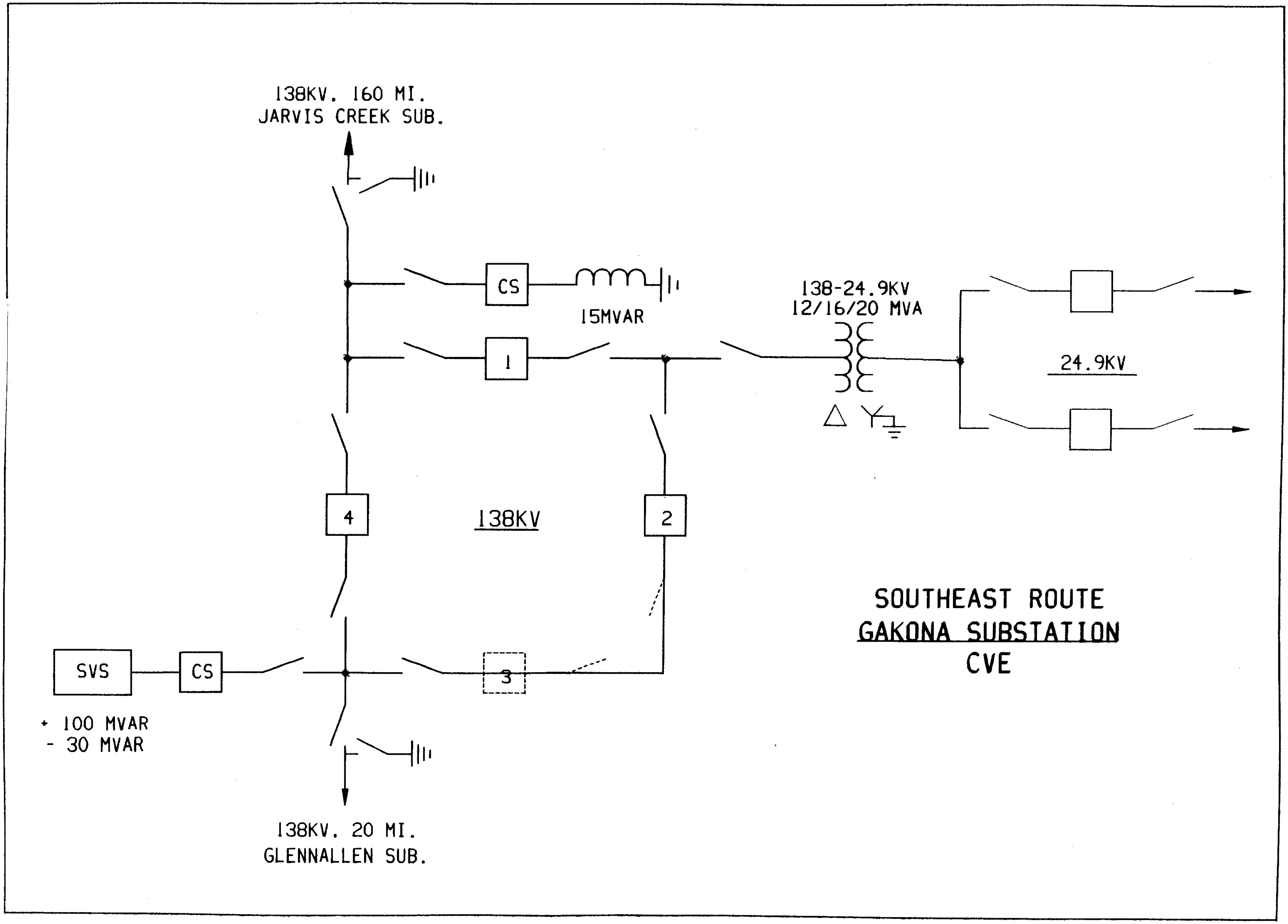
CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
STRUCTURES			
230kV Dead End Structure	4	$32,000	$128,000
230kV Switch Structure	13	10,000	130,000
230kV Arrester Structure	4	1,500	6,000
230kV Bus Support Structure	16	1,500	24,000
230kV Voltage XFMR Structure	2	4,000	8,000
230kV Current XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Reactor 15 Mvar	1	400,000	400,000
138kV Circuit Breaker	4	95,000	380,000
138kV Circuit Switcher	1	50,000	50,000
138kV 3Ø Switch	13	12,500	162,500
138kV Voltage XFMR	6	12,000	72,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	8	20,000	160,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	170,000	170,000
Install Equipment	L.S.	180,000	180,000
Foundations	L.S.	280,000	280,000
Furnish and install all other electrical work	L.S.	330,000	330,000
Testing	L.S.	39,000	39,000

STATION: SOUTHEAST ROUTE GLENNALLEN SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
Mobilization & Site Prep.	L.S.	390,000	390,000
		Subtotal	$3,120,500
Design (10%)			312,050
CM (7%)			218,435
Administration (5%)			156,025
Subtotal			3,807,010
Contingency (15%)			571,052
TOTAL - GLENNALLEN SUBSTATION			$4,378,062

SOUTHEAST ROUTE
GAKONA SUBSTATION
DESCRIPTION

A new substation will be constructed near the town of Gakona to provide local distribution, reactive transmission compensation, and transmission line sectionalizing. The station will consist of a 3-breaker, 138kV Ring Bus (built to 230kV) which can be easily expanded to a 4-breaker scheme. A 15 Mvar reactor will be installed on the 138kV Jarvis Creek line terminal and a 12/16/20 MVA, 138-12.47kV transformer with two 12.47kV feeders will be fed from a terminal on the Ring Bus. The third terminal will be the 138kV line to the new Glennallen Substation about 20 miles away. A static var system will be installed on the 138kV Glennallen Substation line terminal to obtain -30 + 100 Mvar of system reactive compensation.



SOUTHEAST ROUTE
GAKONA SUBSTATION
CVE

STATION: SOUTHEAST ROUTE GAKONA SUBSTATION

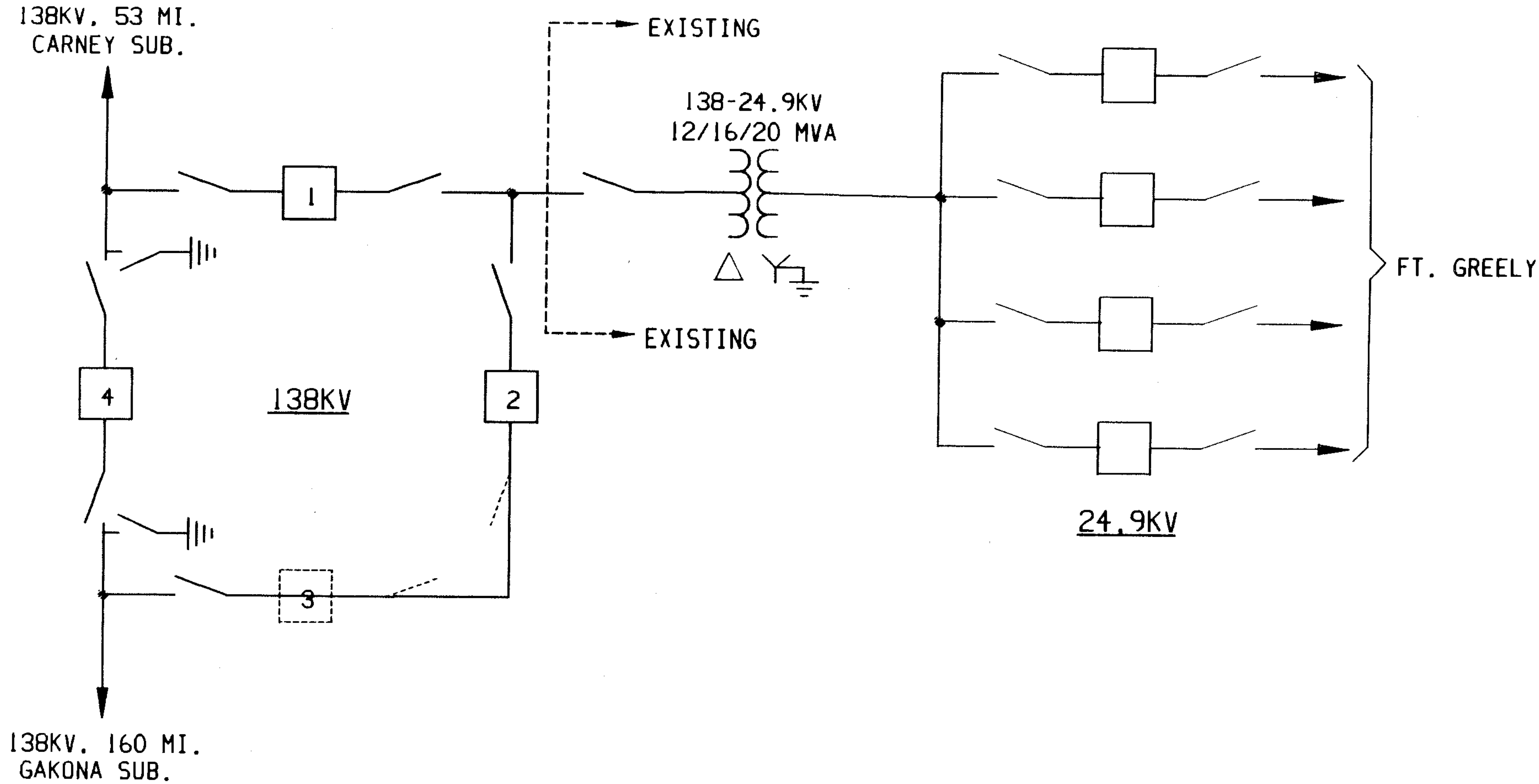
CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
STRUCTURES			
230kV Dead End Structure	3	$32,000	$96,000
230kV Switch Structure	14	10,000	140,000
230kV Arrester Structure	3	1,500	4,500
230kV Bus Support Structure	8	1,500	12,000
230kV Voltage XFMR Structure	3	4,000	12,000
230kV Current XFMR Structure	3	4,000	12,000
25kV Recloser Structure	2	2,000	4,000
EQUIPMENT			
138 - 24.9kV XFMR, 12/16/20 MVA	1	360,000	360,000
Static VAR System, -30 ± 100Mvar	1	7,500,000	7,500,000
138kV Reactor, 15 Mvar	1	400,000	400,000
138kV Circuit Breaker	4	95,000	380,000
138kV Circuit Switcher	2	50,000	100,000
25kV Recloser	2	30,000	60,000
25kV Switch	12	200	2,400
138kV 3Ø Switch	14	12,500	175,000
138kV Voltage XFMR	9	12,000	108,000
138kV Current XFMR	9	12,000	108,000
138kV Surge Arrester	9	6,000	54,000
Control Switchboards	10	20,000	200,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	110,000	110,000
Install Equipment	L.S.	170,000	170,000
Foundations	L.S.	239,000	239,000

STATION: SOUTHEAST ROUTE GAKONA SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
Furnish and install all other electrical work	L.S.	314,000	314,000
Testing	L.S.	42,000	42,000
Mobilization & Site Prep.	L.S.	390,000	390,000
		Subtotal	$11,087,900
Design (10%)			1,108,790
CM (7%)			776,153
Administration (5%)			554,395
		Subtotal	$13,527,238
Contingency (15%)			2,029,086
TOTAL - GAKONA SUBSTATION			$15,556,324

SOUTHEAST ROUTE
JARVIS CREEK SUBSTATION
DESCRIPTION

The existing Jarvis Creek Substation will be expanded to include a 3-breaker, 138kV Ring Bus (built to 230kV) expandable to a 4-breaker ring. Terminals will be provided for the Gakona and Carney transmission lines and a terminal will feed the existing 138 - 24.9kV, 12/16/20 MVA transformer and its associated 12.47kV feeders to Fort Greely.



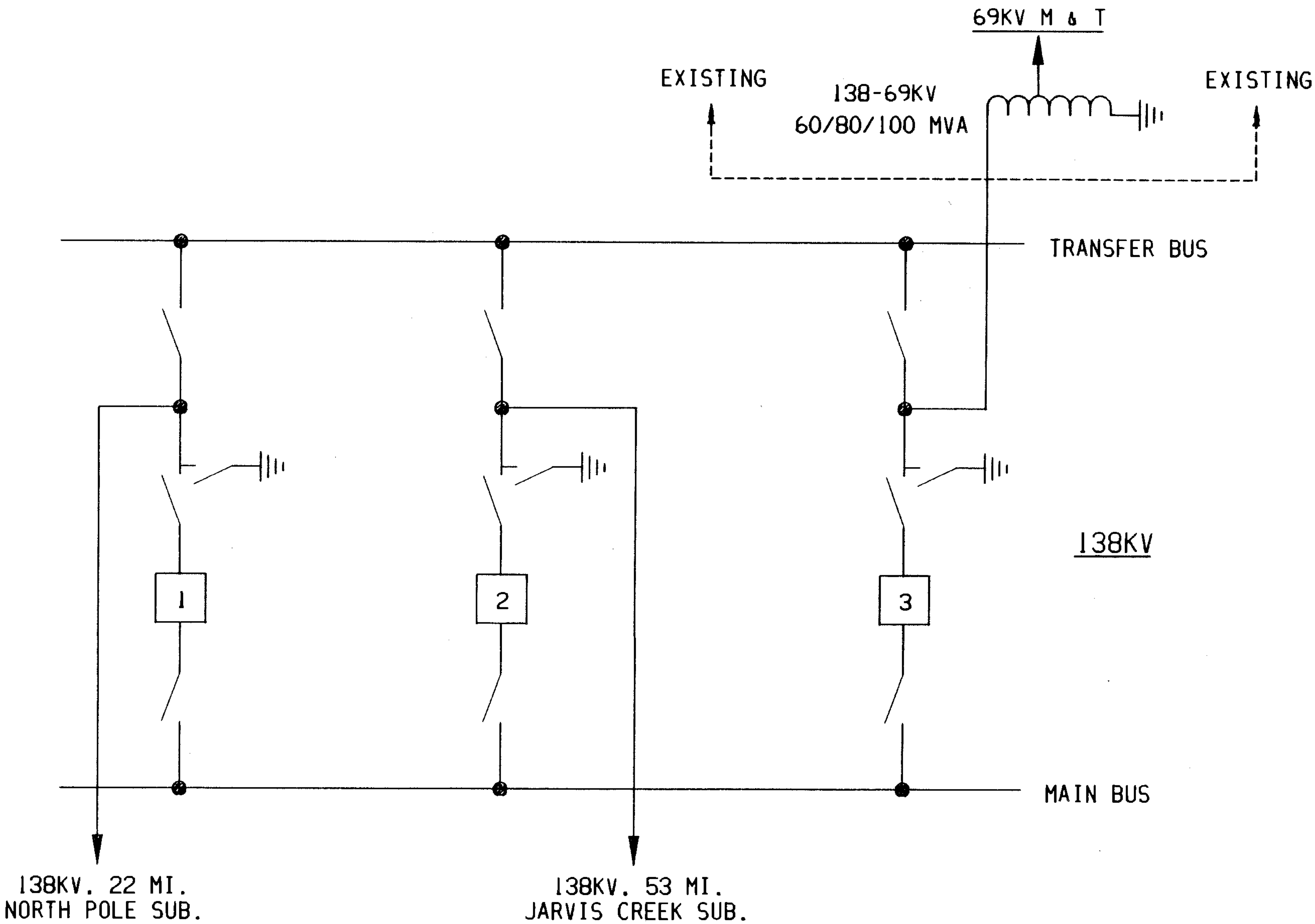
SOUTHEAST ROUTE
JARVIS CREEK SUBSTATION
GVE

STATION: SOUTHEAST ROUTE JARVIS CREEK SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
STRUCTURES			
230kV Dead End Structure	2	$32,000	$64,000
230kV Switch Structure	8	10,000	80,000
230kV Arrester Structure	2	1,500	3,000
230kV Bus Support Structure	8	1,500	12,000
230kV Current XFMR Structure	2	4,000	8,000
230kV Voltage XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Circuit Breaker	3	95,000	285,000
138kV 3Ø Switch	6	12,500	75,000
138kV Voltage XFMR	6	12,000	72,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	6	20,000	120,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	98,000	98,000
Install Equipment	L.S.	94,000	94,000
Foundations	L.S.	134,000	134,000
Furnish and install all other electrical work	L.S.	208,000	208,000
Testing	L.S.	20,000	20,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$1,684,000
Design (10%)			168,400
CM (7%)			117,880
Administration (5%)			84,200
		Subtotal	$2054,480
Contingency (15%)			308,172
TOTAL - JARVIS CREEK SUBSTATION			$2,362,652

SOUTHEAST ROUTE
CARNEY SUBSTATION
DESCRIPTION

Modifications will be made to the existing Carney Substation to construct a 138kV main and transfer bus scheme to provide terminals for the North Pole and Jarvis Creek transmission lines, and a connection to the existing 138 - 69kV, 60/80/100 MVA autotransformer, and associated 69kV main and transfer bus.



SOUTHEAST ROUTE
CARNEY SUBSTATION

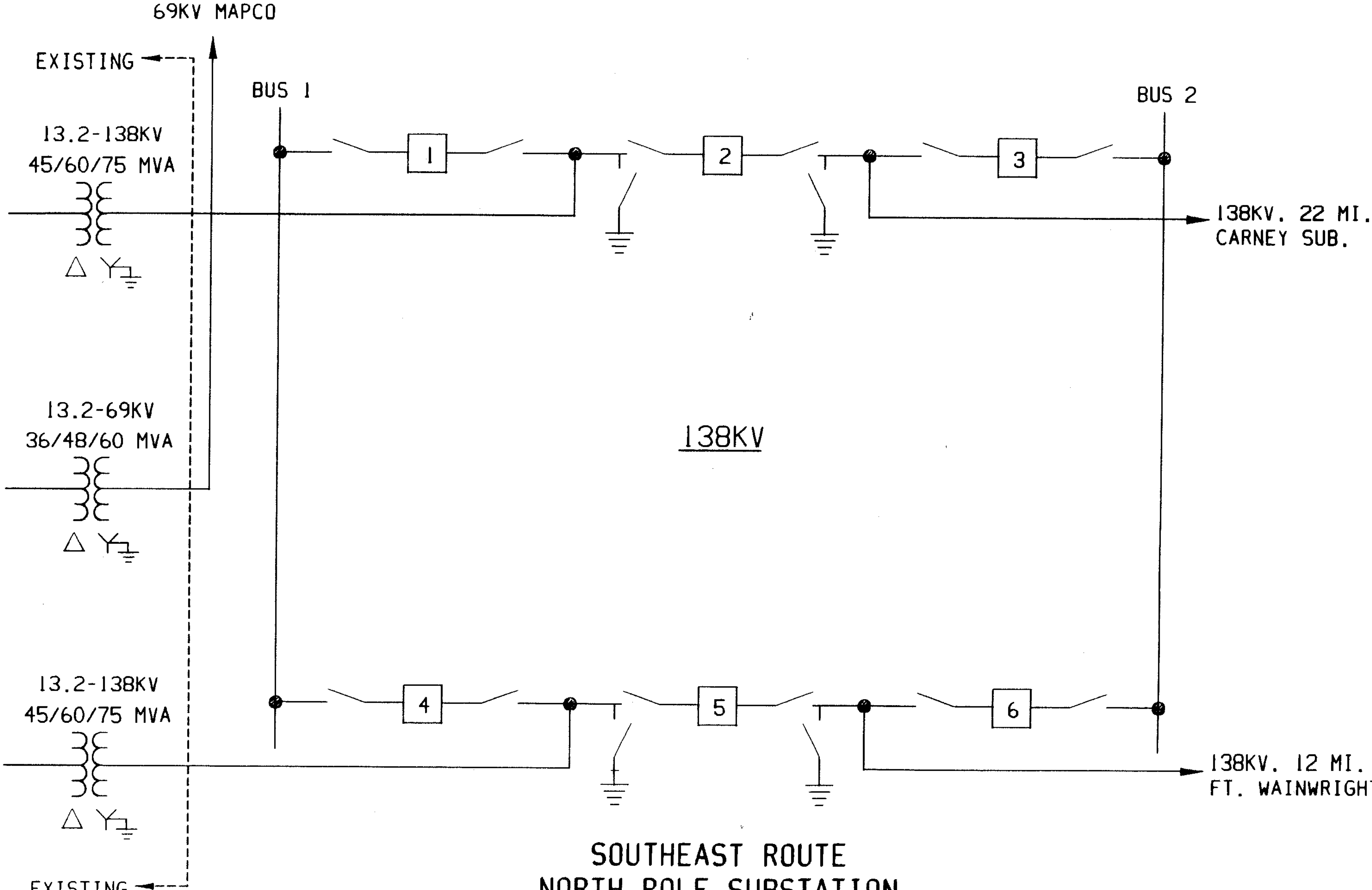
GVE

STATION: SOUTHEAST ROUTE CARNEY SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
STRUCTURES			
138kV Dead End Structure	2	$26,000	$52,000
138kV Switch Structure	9	8,000	72,000
138kV Arrester Structure	2	1,500	3,000
138kV Bus Support Structure	18	1,500	27,000
138kV Voltage XFMR Structure	2	4,000	8,000
138kV Current XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Circuit Breaker	3	95,000	285,000
138kV 3Ø Switch	9	12,500	112,500
138kV Voltage XFMR	6	12,000	72,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	4	20,000	80,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	124,000	124,000
Install Equipment	L.S.	114,000	114,000
Foundations	L.S.	211,500	211,500
Furnish and install all other electrical work	L.S.	234,000	234,000
Testing	L.S.	20,000	20,000
Mobilization & Site Prep.	L.S.	130,000	130,000
		Subtotal	$1,756,000
Design (10%)			175,600
CM (7%)			122,920
Administration (5%)			87,800
		Subtotal	$2,142,320
Contingency (15%)			321,348
TOTAL - CARNEY SUBSTATION			$2,463,668

SOUTHEAST ROUTE
NORTH POLE SUBSTATION
DESCRIPTION

A new 1-1/2 breaker 138kV bus will be added to the existing North Pole Substation to provide terminals for the Carney and Ft. Wainwright lines, and terminals for the two existing 13.2-138kV, 45/60/75 MVA generator step up transformers. The 1-1/2 breaker scheme is utilized to obtain the reliability and flexibility required at a generating plant substation.



SOUTHEAST ROUTE
NORTH POLE SUBSTATION
GVE

STATION: SOUTHEAST ROUTE NORTH POLE SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED CO[S]T
STRUCTURES			
138kV Dead End Structure	4	$26,000	$104,000
138kV Switch Structure	12	8,000	96,000
138kV Arrester Structure	2	1,500	3,000
138kV Bus Support Structure	16	1,500	24,000
138kV Voltage XFMR Structure	4	4,000	16,000
138kV Current XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Circuit Breaker	6	95,000	570,000
138kV 3Ø Switch	12	12,500	150,000
138kV Voltage XFMR	8	12,000	96,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	6	20,000	120,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	210,000	210,000
Install Equipment	L.S.	172,000	172,000
Foundations	L.S.	257,400	257,400
Furnish and install all other electrical work	L.S.	300,000	300,000
Testing	L.S.	40,000	40,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$2,569,400
Design (10%)			256,940
CM (7%)			179,858
Administration (5%)			128,470
		Subtotal	$3,134,668
Contingency (15%)			470,200
TOTAL - NORTH POLE SUBSTATION			$3,604,868

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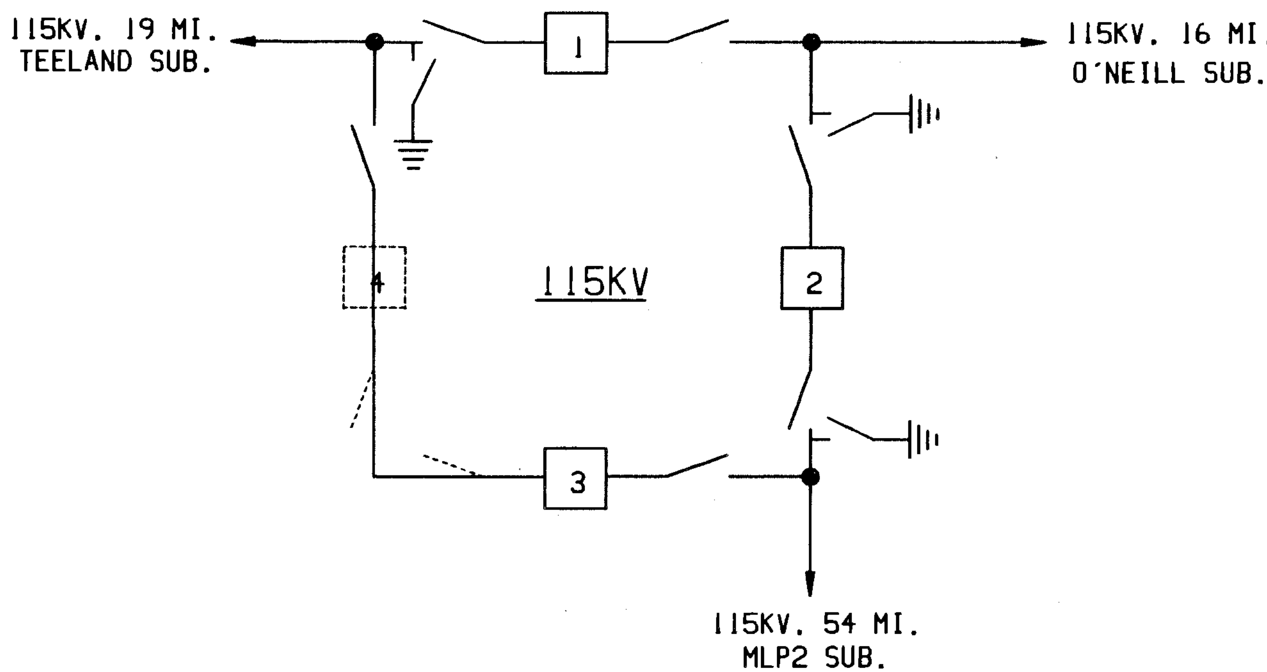
SOUTHEAST ROUTE
SUMMARY OF STATION COSTS

STATION		
O'Neill Tap Substation		$2,404,742
O'Neill Substation		4,551,332
Glennallen Substation		4,378,062
Pumping Station No. 11 Substation		-0-
Gakona Junction Substation		15,556,324
Jarvis Creek Substation		2,362,652
Carney Substation		2,463,668
North Pole Substation		3,604,868
	TOTAL	$35,321,648

SUBSTATIONS - NORTHWEST ROUTE DESIGN REQUIREMENTS AND COST ESTIMATES

NORTHWEST ROUTE
O'NEILL TAP SUBSTATION
DESCRIPTION

O'Neill Tap Substation will be a new switching station located approximately mid-way between Teeland and O'Neill Substations on the existing 115kV line. The station will be constructed to 230kV spacing, but will be operated at 115kV until the line is converted to 230kV. Initial construction will be a 3-breaker ring bus, with provisions for expansion to a 4-breaker ring.



NORTHWEST ROUTE

O´NEILL TAP SUBSTATION

MEA

STATION COST ESTIMATE

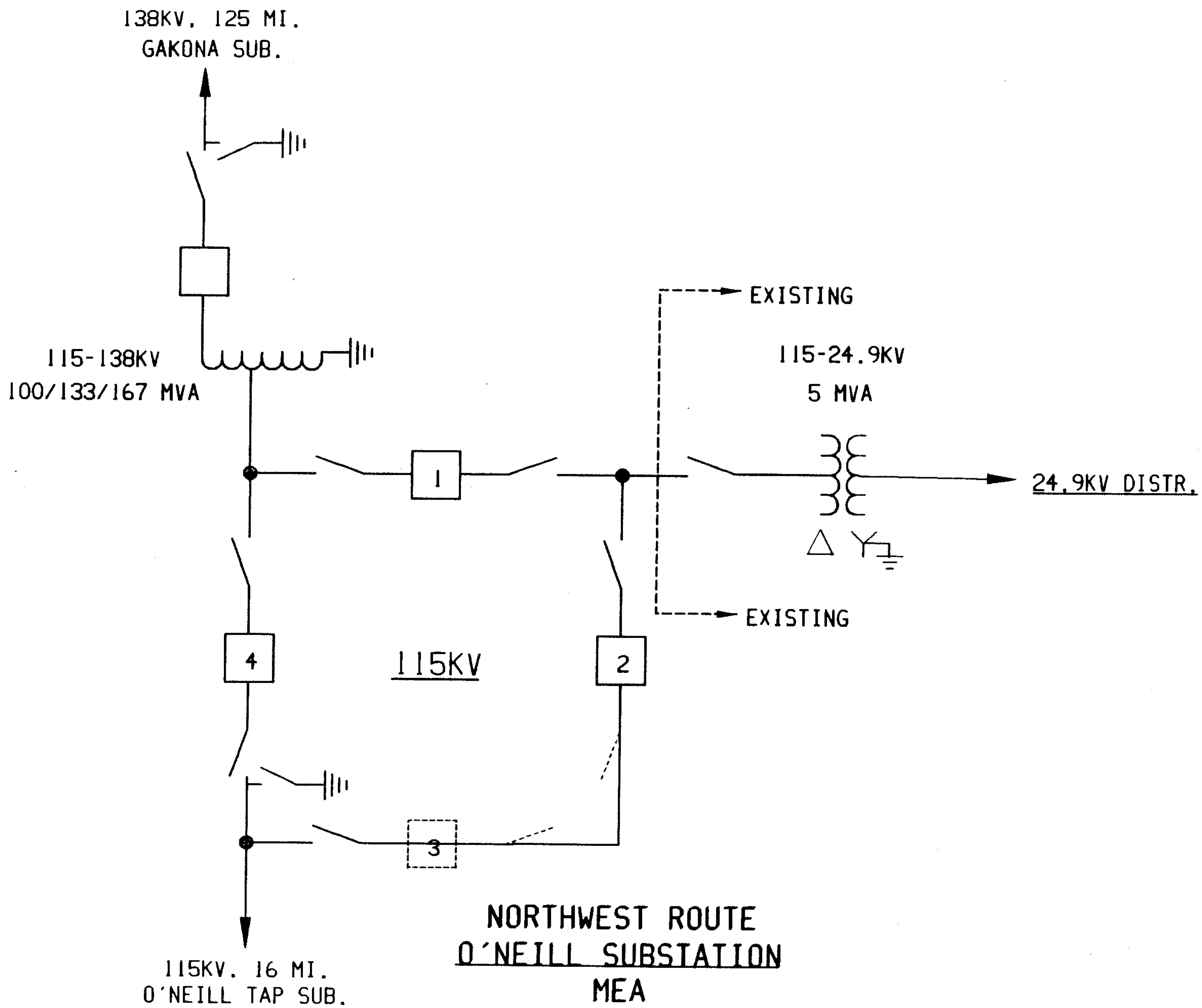
STATION: NORTHWEST ROUTE O'NEILL SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
STRUCTURES			
230kV Dead End Structure	2	$32,000	$64,000
230kV Switch Structure	6	10,000	60,000
230kV Voltage XFMR Structure	1	4,000	4,000
230kV Current XFMR Structure	2	4,000	8,000
230kV Arrester Structure	2	1,500	3,000
230kV Bus Support Structure	6	1,500	9,000
EQUIPMENT			
138kV Circuit Breaker	3	95,000	285,000
138kV 3Ø Switch	6	12,500	75,000
138kV Voltage XFMR	3	12,000	36,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	5	20,000	100,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	102,000	102,000
Install Equipment	L.S.	132,000	132,000
Foundations	L.S.	183,000	183,000
Furnish and install all other electrical work	L.S.	230,000	230,000
Testing	L.S.	20,000	20,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$1,714,000
Design (10%)			171,400
CM (7%)			119,980
Administration (5%)			85,700
		Subtotal	$2,091,080
Contingency (15%)			313,662
TOTAL - O'NEILL TAP SUBSTATION			$2,404,742

NORTHWEST ROUTE
O'NEILL SUBSTATION
DESCRIPTION

The existing O'Neill Substation will be expanded with the addition of a 3-breaker 115kV Ring Bus (built for 230kV) and a 100/133/167 MVA, 115-138kV autotransformer on the Gakona Substation line terminal (built for 230kV). The Ring Bus will be expandable to a 4-breaker configuration with the addition of one breaker, two disconnect switches and a line terminal. No outage would be required for the expansion.

The existing 115-24.9kV, 5 MVA transformer and the associated 24.9kV distribution will be fed from the ring bus and will not be changed.



NORTHWEST ROUTE
O'NEILL SUBSTATION
MEA

STATION: NORTHWEST ROUTE O'NEILL SUBSTATION

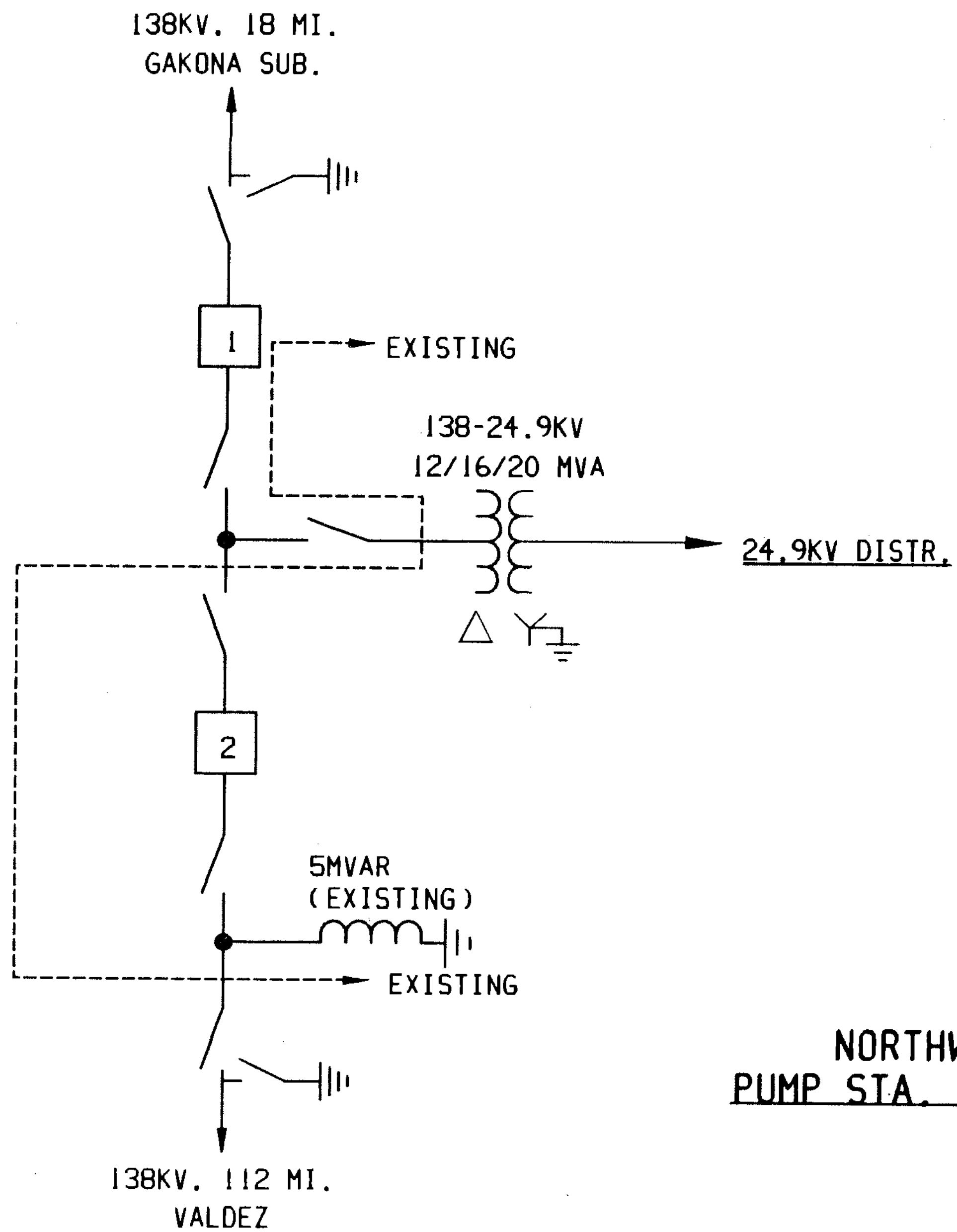
CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
STRUCTURES			
230kV Dead End Structure	1	$32,000	$32,000
230kV Switch Structure	1	10,000	10,000
230kV Current XFMR Structure	1	4,000	4,000
230kV Voltage XFMR Structure	1	4,000	4,000
230kV Dead End Structure	1	32,000	32,000
230kV Switch Structure	7	10,000	70,000
230kV Arrester Structure	2	1,500	3,000
230kV Bus Support Structure	12	1,500	18,000
230kV Current XFMR Structure	1	4,000	4,000
230kV Voltage XFMR Structure	1	4,000	4,000
EQUIPMENT			
138kV Circuit Breaker	4	95,000	380,000
138kV 3Ø Switch	8	12,500	100,000
138kV -115kV XFMR 100/133/167	1	1,200,000	1,200,000
138kV Voltage XFMR	7	12,000	84,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	6	20,000	120,000
SCADA & Communications	L.S.	50,000	50,000
Control Building	L.S.	36,500	36,500
Station Service	L.S.	8,500	8,500
Install Structures	L.S.	110,000	110,000
Install Equipment	L.S.	140,000	140,000
Foundations	L.S.	220,000	220,000

STATION: NORTHWEST ROUTE O'NEILL SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
Furnish and install all other electrical work	L.S.	274,000	274,000
Testing	L.S.	32,000	32,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$3,244,000
Design (10%)			324,400
CM (7%)			227,080
Administration (5%)			162,200
		Subtotal	$3,957,680
Contingency (15%)			593,652
TOTAL - O'NEILL SUBSTATION			$4,551,332

NORTHWEST ROUTE
PUMP STATION NO. 11 SUBSTATION
DESCRIPTION

Pump Station No. 11 Substation will be modified to add a 138kV breaker and line terminal for a new line to the new Gakona Substation. A line disconnect switch with grounding blades will be added to the existing 138kV line to Valdez.



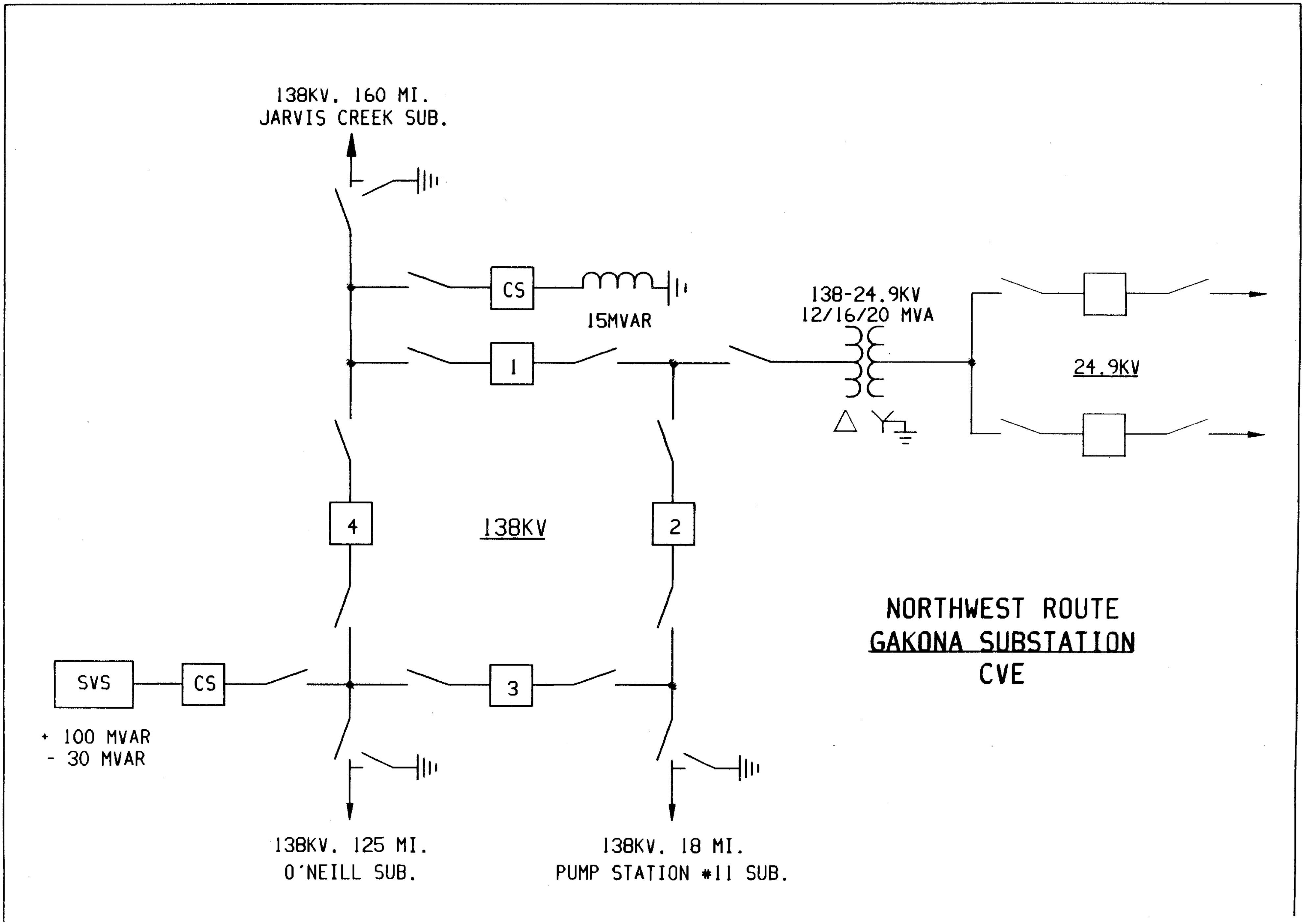
NORTHWEST ROUTE
PUMP STA. #11 SUBSTATION
CVE

STATION: NORTHWEST ROUTE PUMPING STATION NO. 11

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
STRUCTURES			
230kV Dead End Structure	1	$32,000	$32,000
230kV Switch Structure	3	10,000	30,000
230kV Arrester Structure	1	1,500	1,500
EQUIPMENT			
138kV Circuit Breaker	1	95,000	95,000
138kV 3Ø Switch	4	12,500	50,000
Surge Arrester	3	6,000	18,000
Control Switchboards	4	20,000	80,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	10,000	10,000
Install Equipment	L.S.	14,000	14,000
Foundations	L.S.	20,000	20,000
Furnish and install all other electrical work	L.S.	35,000	35,000
Testing	L.S.	32,000	32,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$712,500
Design (10%)			71,250
CM (7%)			49,875
Administration (5%)			35,625
		Subtotal	$869,250
Contingency (15%)			130,388
TOTAL - PUMPING STATION NO. 11			$999,638

NORTHWEST ROUTE
GAKONA SUBSTATION
DESCRIPTION

A new substation will be constructed near the town of Gakona to provide local distribution, reactive transmission compensation, and transmission line sectionalizing. The station will consist of a 4-breaker, 138kV Ring Bus (built to 230kV) and a 24.9kV distribution section. A 15 Mvar reactor will be installed on the 138kV Jarvis Creek line terminal and a 12/16/20 MVA, 138-12.47kV transformer with two 12.47kV feeders will be fed from a second terminal on the Ring Bus. The third terminal will be the 138kV line to Pump Station No. 11 and the fourth terminal will be the 138kV line to O'Neill Substation. A static Var system will be installed on the 138kV O'Neill line terminal to obtain ±30 Mvar of system reactive compensation.


138KV. 160 MI.
JARVIS CREEK SUB.
CS
15MVAR
1
138-24.9KV
12/16/20 MVA
24.9KV
4
138KV
2
NORTHWEST ROUTE
GAKONA SUBSTATION
CVE
SVS
CS
3
+ 100 MVAR
- 30 MVAR
138KV. 125 MI.
O'NEILL SUB.
138KV. 18 MI.
PUMP STATION #11 SUB.

STATION: NORTHWEST ROUTE GAKONA SUBSTATION

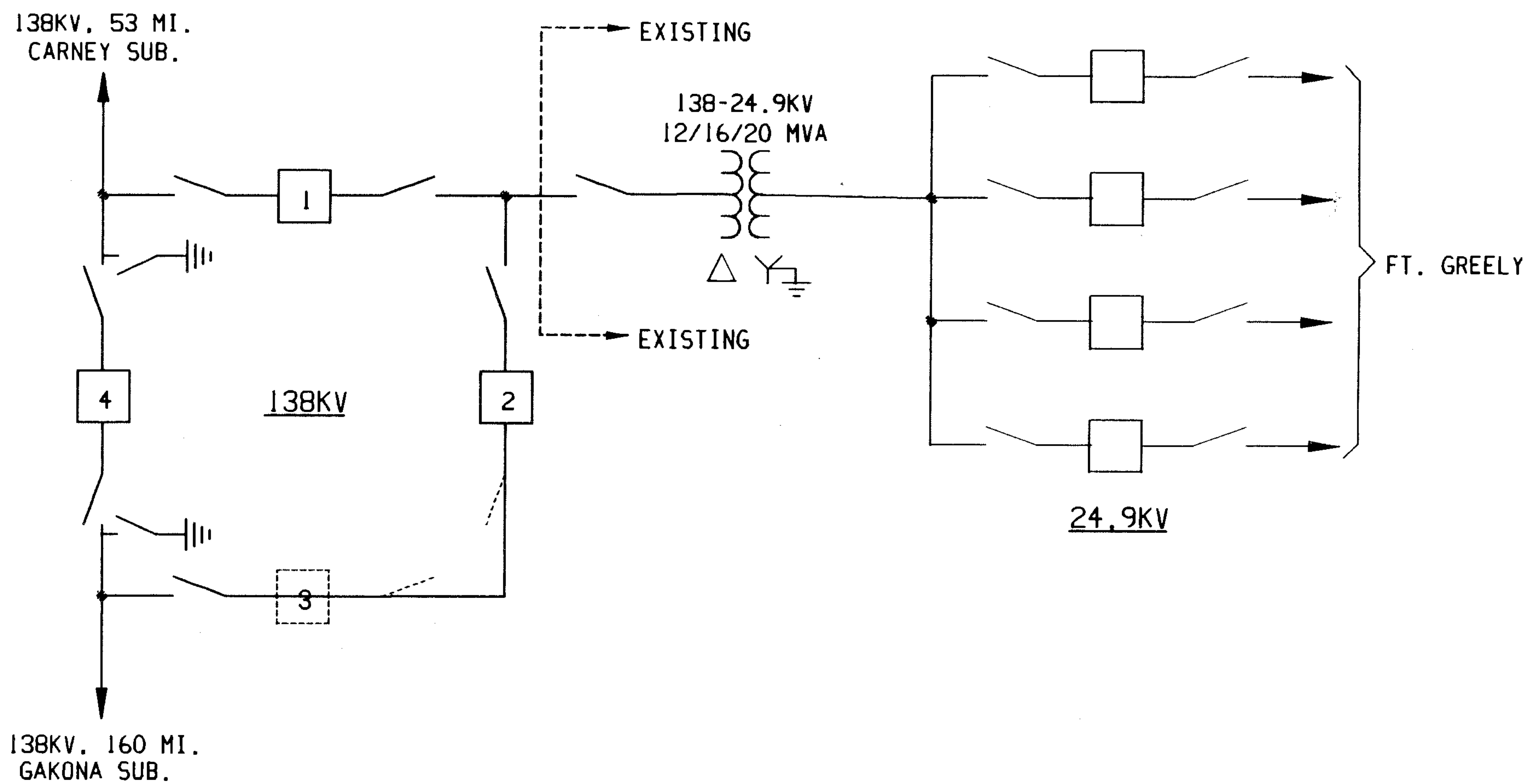
CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
STRUCTURES			
230kV Dead End Structure	3	$32,000	$96,000
230kV Switch Structure	14	10,000	140,000
230kV Arrester Structure	3	1,500	4,500
230kV Bus Support Structure	8	1,500	12,000
230kV Voltage XFMR Structure	3	4,000	12,000
230kV Current XFMR Structure	3	4,000	12,000
25kV Recloser Structure	2	2,000	4,000
EQUIPMENT			
138 - 24.9kV XFMR, 12/16/20 MVA	1	360,000	360,000
Static VAR System,-30 ± 100 Mvar	1	7,500,000	7,500,000
138kV Reactor, 15 Mvar	1	400,000	400,000
138kV Circuit Breaker	4	95,000	380,000
138kV Circuit Switcher	2	50,000	100,000
25kV Recloser	2	30,000	60,000
25kV Switch	12	200	2,400
138kV 3Ø Switch	14	12,500	175,000
138kV Voltage XFMR	9	12,000	108,000
138kV Current XFMR	9	12,000	108,000
138kV Surge Arrester	9	6,000	54,000
Control Switchboards	10	20,000	200,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	110,000	110,000
Install Equipment	L.S.	170,000	170,000
Foundations	L.S.	239,000	239,000

STATION: NORTHWEST ROUTE GAKONA SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS
Furnish and install all other electrical work	L.S.	314,000	314,000
Testing	L.S.	42,000	42,000
Mobilization & Site Prep.	L.S.	390,000	390,000
		Subtotal	$11,087,900
Design (10%)			1,108,790
CM (7%)			776,153
Administration (5%)			554,395
		Subtotal	$13,527,238
Contingency (15%)			2,029,085
TOTAL - GAKONA SUBSTATION			$15,556,324

NORTHWEST ROUTE
JARVIS CREEK SUBSTATION
DESCRIPTION

The existing Jarvis Creek Substation will be expanded to include a 3-breaker, 138kV Ring Bus (built to 230kV) expandable to a 4-breaker ring. Terminals will be provided for the Gakona and Carney transmission lines and a terminal will feed the existing 138 - 24.9kV, 12/16/20 MVA transformer and its associated 12.47kV feeders.



NORTHWEST ROUTE
JARVIS CREEK SUBSTATION
GVE

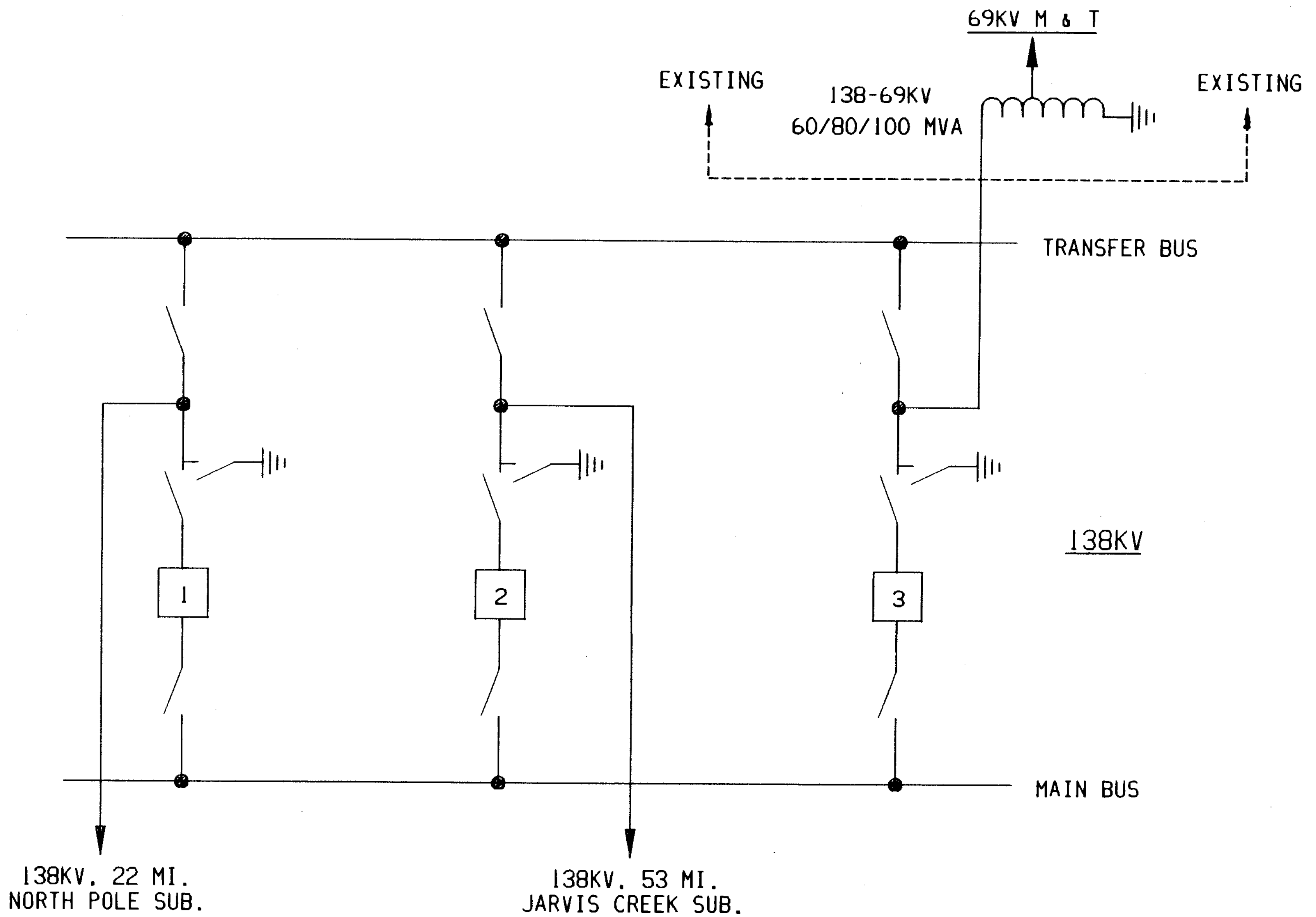
STATION COST ESTIMATE ISSUED: 12/88, REV.

STATION: NORTHWEST ROUTE JARVIS CREEK SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
STRUCTURES			
230kV Dead End Structure	2	$32,000	$64,000
230kV Switch Structure	8	10,000	80,000
230kV Arrester Structure	2	1,500	3,000
230kV Bus Support Structure	8	1,500	12,000
230kV Current XFMR Structure	2	4,000	8,000
230kV Voltage XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Circuit Breaker	3	95,000	285,000
138kV 3Ø Switch	6	12,500	75,000
138kV Voltage XFMR	6	12,000	72,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	6	20,000	120,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	98,000	98,000
Install Equipment	L.S.	94,000	94,000
Foundations	L.S.	134,000	134,000
Furnish and install all other electrical work	L.S.	208,000	208,000
Testing	L.S.	20,000	20,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$1,684,000
Design (10%)			168,400
CM (7%)			117,880
Administration (5%)			84,200
		Subtotal	$2,054,480
Contingency (15%)			308,172
TOTAL - JARVIS CREEK SUBSTATION			$2,362,652

NORTHWEST ROUTE
CARNEY SUBSTATION
DESCRIPTION

Modifications will be made to the existing Carney Substation to provide a 138kV main and transfer bus scheme to provide terminals for the North Pole and Jarvis Creek transmission lines, and a connection to the existing 138 - 69kV, 60/80/100 MVA autotransformer, and associated 69kV main and transfer bus.



NORTHWEST ROUTE
CARNEY SUBSTATION
GVE

STATION COST ESTIMATE

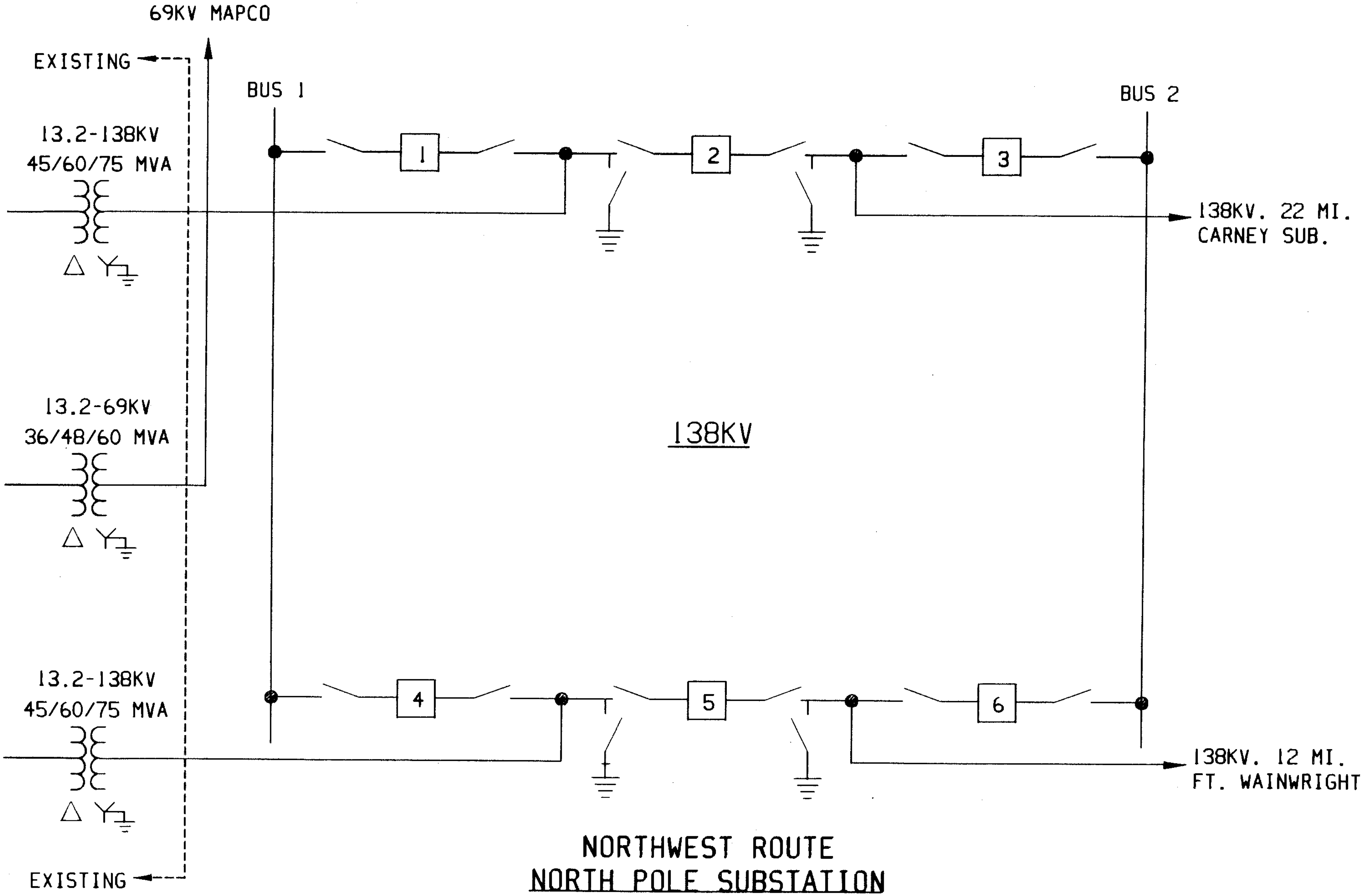
ISSUED: 12/88, REV. PAGE 1 OF 1

STATION: NORTHWEST ROUTE CARNEY SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COS[T]
STRUCTURES			
138kV Dead End Structure	2	$26,000	$52,000
138kV Switch Structure	9	8,000	72,000
138kV Arrester Structure	2	1,500	3,000
138kV Bus Support Structure	18	1,500	27,000
138kV Voltage XFMR Structure	2	4,000	8,000
138kV Current XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Circuit Breaker	3	95,000	285,000
138kV 3Ø Switch	9	12,500	112,500
138kV Voltage XFMR	6	12,000	72,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	4	20,000	80,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	124,000	124,000
Install Equipment	L.S.	114,000	114,000
Foundations	L.S.	211,500	211,500
Furnish and install all other electrical work	L.S.	234,000	234,000
Testing	L.S.	20,000	20,000
Mobilization & Site Prep.	L.S.	130,000	130,000
		Subtotal	$1,756,000
Design (10%)			175,600
CM (7%)			122,920
Administration (5%)			87,800
		Subtotal	$2,142,320
Contingency (15%)			321,348
TOTAL - CARNEY SUBSTATION			$2,463,668

NORTHWEST ROUTE
NORTH POLE SUBSTATION
DESCRIPTION

A new 1-1/2 breaker 138kV bus will be added to the existing North Pole Substation to provide terminals for the Carney and Ft. Wainwright lines, and terminals for the two existing 13.2-138kV, 45/60/75 MVA generator step up transformers. The 1-1/2 breaker scheme is utilized to obtain the reliability and flexibility required at a generating plant substation.



NORTHWEST ROUTE

NORTH POLE SUBSTATION

GVE

STATION: NORTHWEST ROUTE NORTH POLE SUBSTATION

CONSTRUCTION UNIT	QUANTITY	UNIT COST	EXTENDED COST
STRUCTURES			
138kV Dead End Structure	4	$26,000	$104,000
138kV Switch Structure	12	8,000	96,000
138kV Arrester Structure	2	1,500	3,000
138kV Bus Support Structure	16	1,500	24,000
138kV Voltage XFMR Structure	4	4,000	16,000
138kV Current XFMR Structure	2	4,000	8,000
EQUIPMENT			
138kV Circuit Breaker	6	95,000	570,000
138kV 3Ø Switch	12	12,500	150,000
138kV Voltage XFMR	8	12,000	96,000
138kV Current XFMR	6	12,000	72,000
138kV Surge Arrester	6	6,000	36,000
Control Switchboards	6	20,000	120,000
SCADA & Communications	1	50,000	50,000
Control Building	1	36,500	36,500
Station Service	1	8,500	8,500
Install Structures	L.S.	210,000	210,000
Install Equipment	L.S.	172,000	172,000
Foundations	L.S.	257,400	257,400
Furnish and install all other electrical work	L.S.	300,000	300,000
Testing	L.S.	40,000	40,000
Mobilization & Site Prep.	L.S.	200,000	200,000
		Subtotal	$2,569,400
Design (10%)			256,940
CM (7%)			179,858
Administration (5%)			128,470
		Subtotal	$3,134,668
Contingency (15%)			470,200
TOTAL - NORTH POLE SUBSTATION			$3,604,868

NORTHWEST ROUTE
SUMMARY OF STATION COSTS

STATION		
O'Neill Tap Substation		$2,404,742
O'Neill Substation		4,551,332
Pumping Station No. 11 Substation		999,638
Gakona Junction Substation		15,556,324
Jarvis Creek Substation		2,463,668
Carney Substation		2,362,652
North Pole Substation		3,604,868
	TOTAL	$31,943,224

TRANSMISSION LINE - DESIGN REQUIREMENTS AND COST ESTIMATES

DESIGN CRITERIA

The following transmission line cost estimates were developed for the Northeast Transmission Intertie. From route maps supplied by Hart Crowser two estimates were prepared for alternate line routes from O'Neill to Jarvis Substations and one route from Carney to North Pole Substations. The basic design assumptions used were as follows:

- NESC Heavy Loading District
- 1" Ice
- 100 mph Wind

The cost estimates were developed based on current vendor quotes for material in 1988 dollars. Quotes for steel structures were $1.20/lb for steel delivered to Anchorage. The price quoted for conductor delivered to Anchorage was $1.40/lb. The weights of the structures were based on previous POWER proposals and consultation with L. E. Myers and Valmont.

The average height of the guyed tubular X-frame and single pole tubular structures will be approximately 120 feet above the ground. This will net a span of approximately 1200 feet. For the wood pole section of line from Carney to North Pole Substations, the structures will be about 75 feet above the ground which yields a span of approximately 300 feet.

The Southeast Route will have approximately 1,020 tangent, 170 angle and 30 deadend structures while the Northwest Route will have approximately 1,000 tangent, 150 angle and 40 deadend structures. The section of line from Carney to North Pole will have approximately 370 tangent/light angle and 20 heavy angle/deadend structures.

To develop the cost estimates for the section of line from O'Neill and Jarvis Substation the cost estimates were broken into links based on the pile foundation requirements. From these different links, a cost summary for each section of line between substations was developed.

It should be noted that no right of way acquisition has been accounted for in the estimates.

SOUTHEAST ROUTE

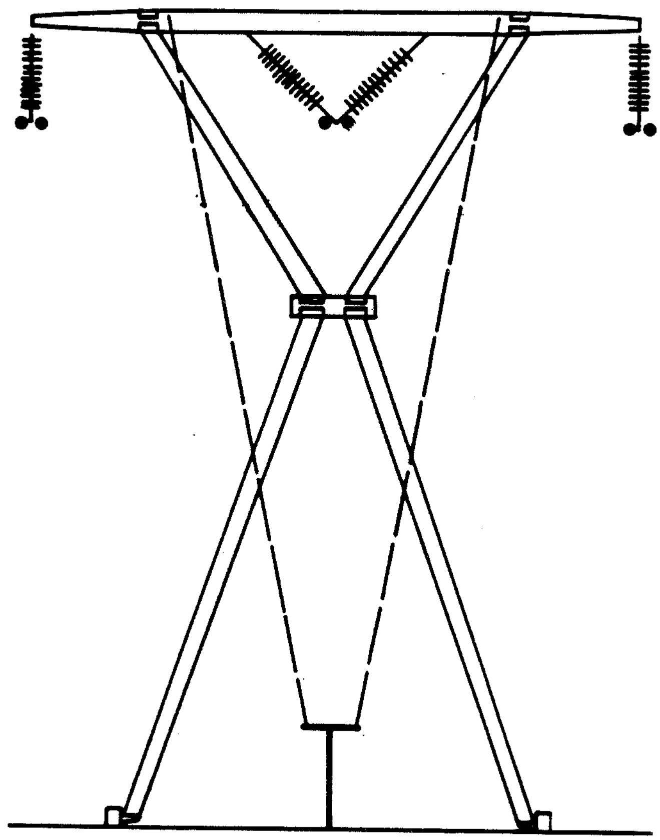
SOUTHEAST ROUTE - O'NEILL TO GLENNALLEN SWITCH STATION (125.5 miles)

The parameters assumed to generate the cost estimates for the transmission line from O'Neill to Glennallen Switch Station are as follows:

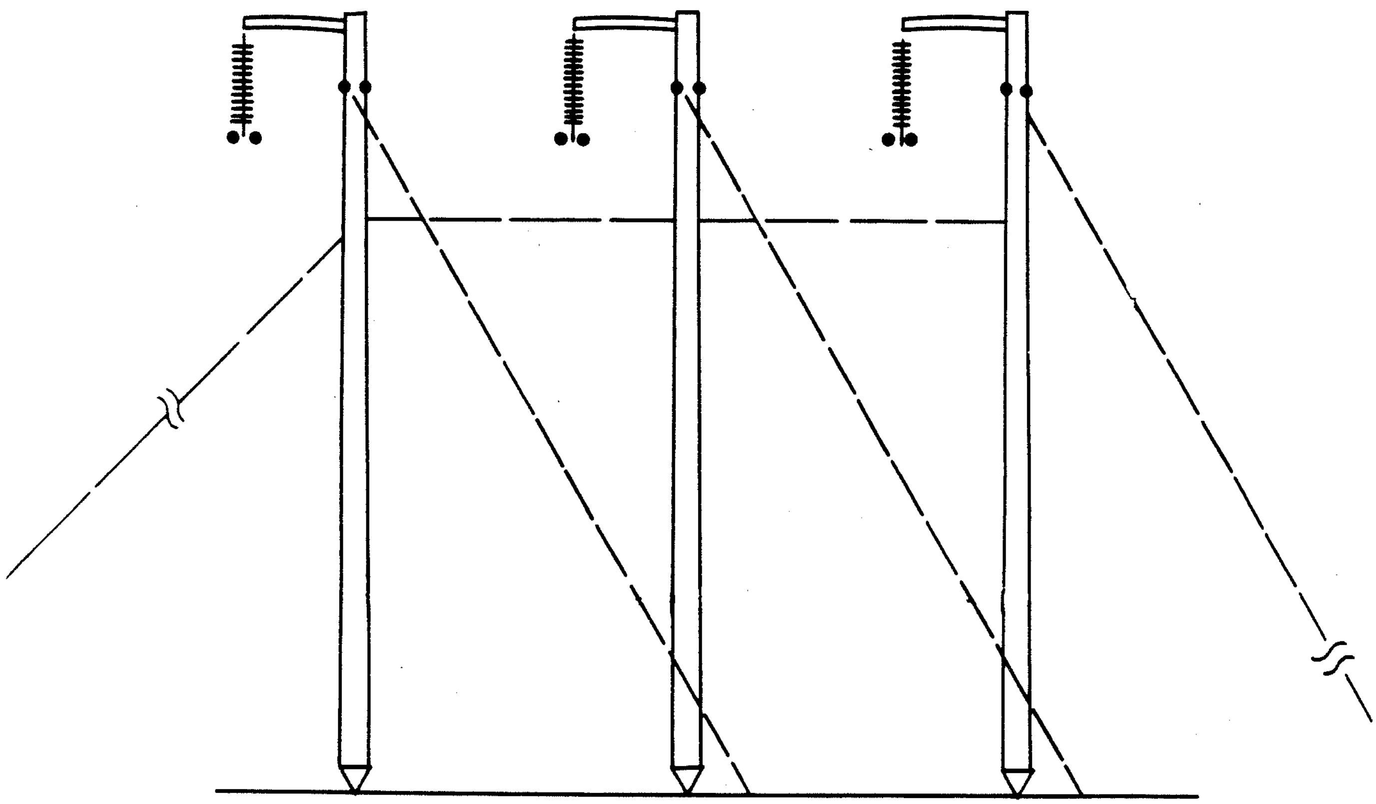
- Structure Type - Guy tubular steel X-frame - tangent
  - 3 pole guy tubular steel - angle & deadend
- Conductor Type - Double bundled "Rail" ACSR
- 230kV Insulation
- No OHGW

The type of foundation for each link is as follows:

Link 1	-	Pile
Link 2	-	Rock Anchor
Link 3	-	Pile
Link 4	-	Rock Anchor
Link 5	-	Pile
Link 6	-	Rock Anchor
Link 7	-	Pile
Link 8	-	Deep Pile
Link 9	-	Pile
Link 10	-	Deep Pile
Link 11	-	Pile
Link 12	-	Deep Pile
Link 13	-	Pile
Link 14	-	Deep Pile
Link 15	-	Pile



Tangent Structure



Angle Structure

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
O'NEILL SUB. TO GLENNALLEN SWITCH STA.
SOUTHEAST ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 1	7.25	$270,621	$1,962,000
LINK 2	9.75	$253,231	$2,469,000
LINK 3	15.00	$257,400	$3,861,000
LINK 4	3.50	$260,000	$910,000
LINK 5	7.90	$276,203	$2,182,000
LINK 6	1.00	$269,000	$269,000
LINK 7	35.95	$261,196	$9,390,000
LINK 8	3.00	$309,667	$929,000
LINK 9	1.00	$276,000	$276,000
LINK 10	9.00	$292,889	$2,636,000
LINK 11	3.00	$265,000	$795,000
LINK 12	4.00	$286,750	$1,147,000
LINK 13	1.00	$276,000	$276,000
LINK 14	17.30	$295,260	$5,108,000
LINK 15	6.80	$279,853	$1,903,000
SUB TOTALS	125.45	$271,925	$34,113,000
ENGINEERING 10%			$3,411,300
CONSTRUCTION MANAGEMENT 5%			$1,705,650
ADMINISTRATION 5%			$1,705,650
MOBILIZATION & DEMOBILIZATION 3%			$1,023,390
CONTINGENCY 15%			$5,116,950
TOTAL			$47,075,940
ANNUAL O&M 1.5%			$706,139

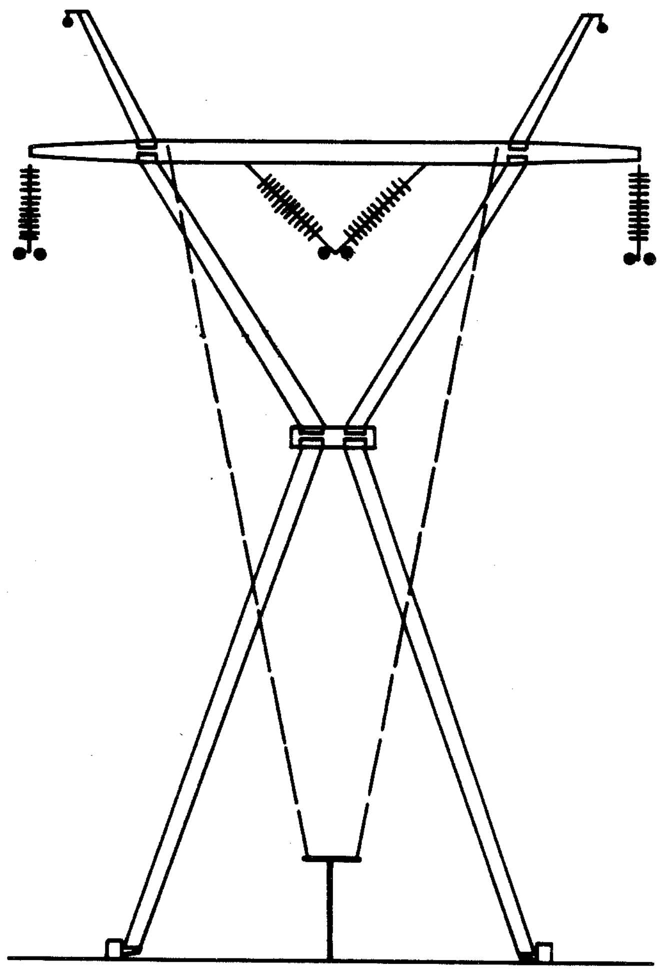
SOUTHEAST ROUTE - GLENNALLEN SWITCH STATION TO GAKONA (12.1 miles)

The parameters assumed to generate the cost estimates for the 230kV transmission line operated 138kV from the Glennallen Switch Station to Gakona Substation are as follows:

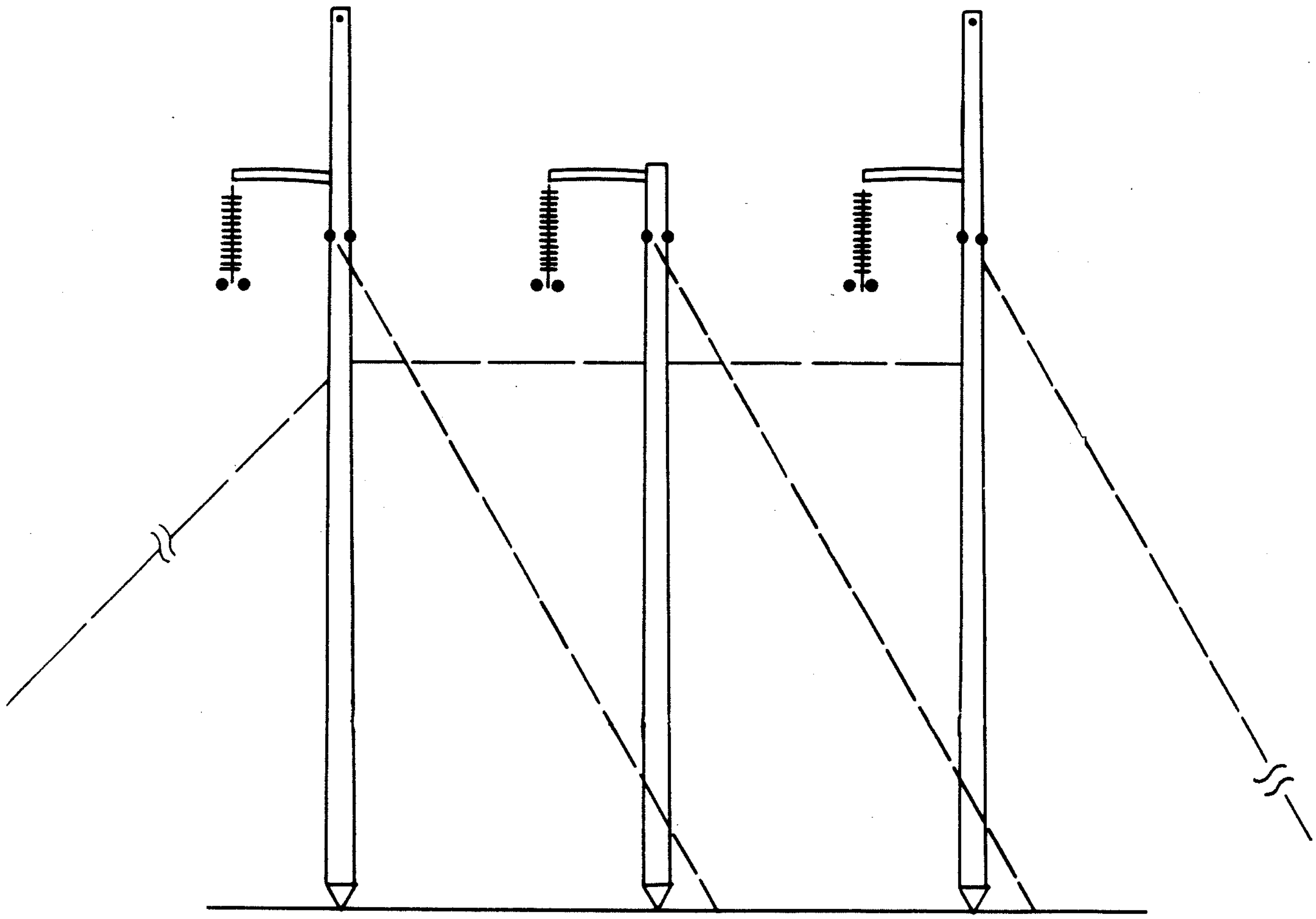
- Structure Type - Guy tubular steel X-frame - tangent
  - 3 pole guy tubular steel - angle & deadend
- Conductor Type - Double bundled "Rail" ACSR
- 230kV Insulation
- 3/8" E.H.S. OHGW

The type of foundation for each link is as follows:

Link 16 - Deep Piles



Tangent Structure



Angle Structure

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GLENNALLEN SWITCH STA. TO GAKONA JCT.
SOUTHEAST ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 16	12.05	$313,029	$3,772,000
SUB TOTALS	12.05	$313,029	$3,772,000
ENGINEERING 10%			$377,200
CONSTRUCTION MANAGEMENT 5%			$188,600
ADMINISTRATION 5%			$188,600
MOBILIZATION & DEMOBILIZATION 3%			$113,160
CONTINGENCY 15%			$565,800
TOTAL			$5,205,360
ANNUAL O&M 1.5%			$78,080

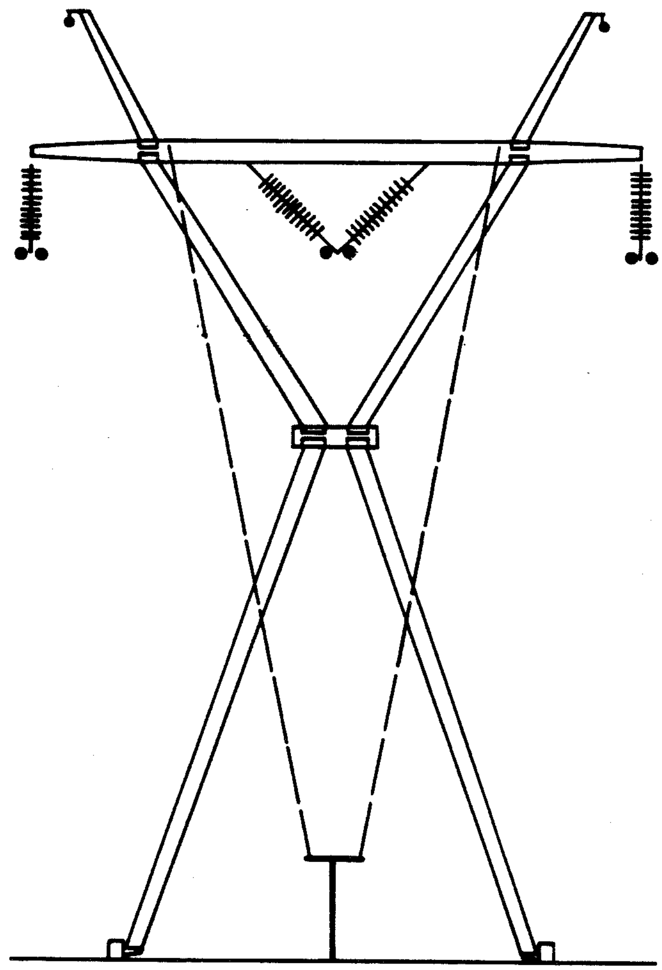
SOUTHEAST ROUTE - GAKONA SUBSTATION TO JARVIS SUBSTATION (135.7 miles)

The parameters assumed to generate the cost estimates for the 230kV transmission line operated 138kV from the Gakona Substation to Jarvis Substation are as follows:

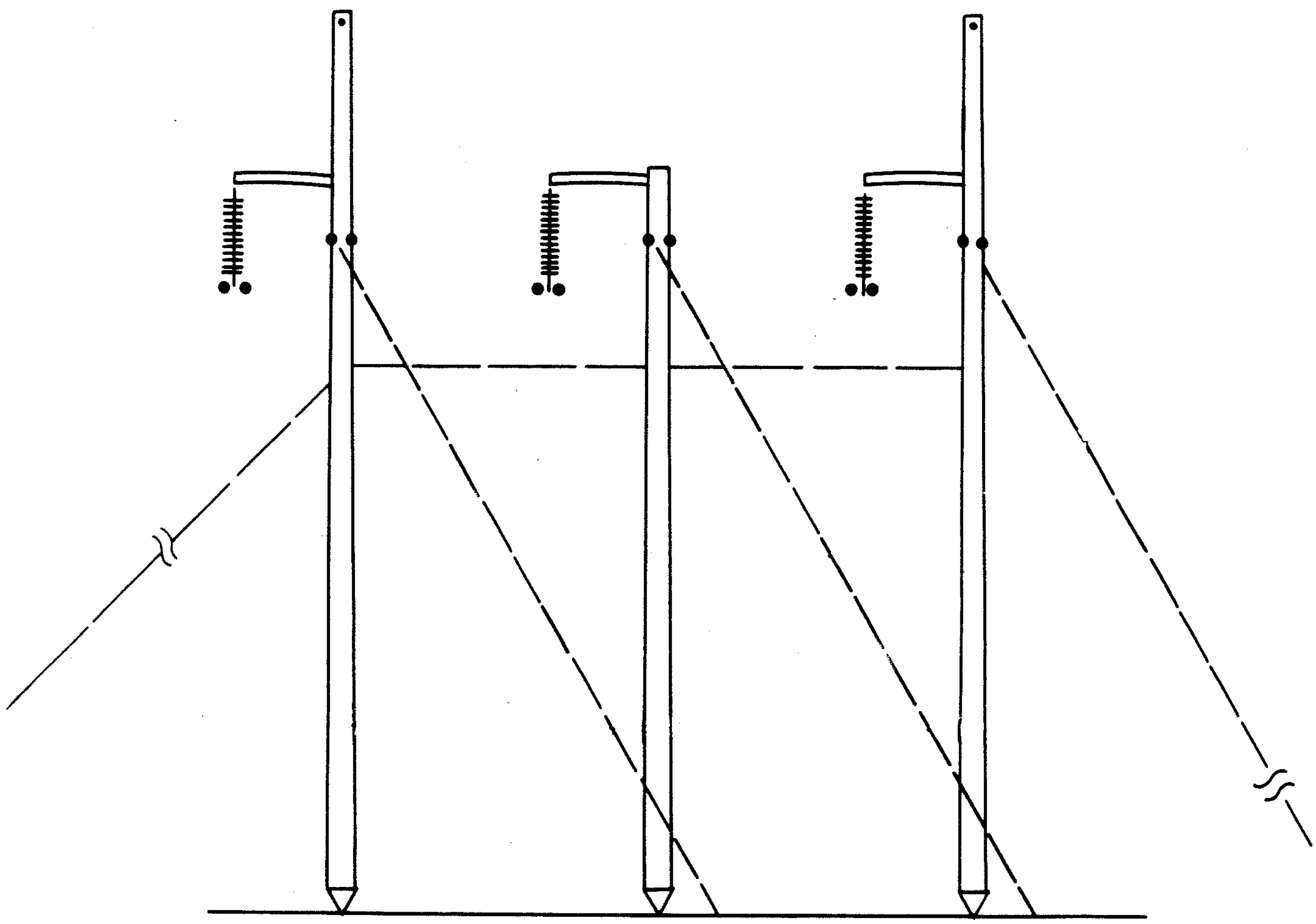
- Structure Type - Guy tubular steel X-frame - tangent
  - 3 pole guy tubular steel - angle & deadend
- Conductor Type - Double bundled "Rail" ACSR
- 230kV Insulation
- 3/8" E.H.S. OHGW

The type of foundation for each link is as follows:

Link 17	-	Piles
Link 18	-	Deep Pile
Link 19	-	Rock Anchor
Link 20	-	Multiple Pile
Link 21	-	Rock Anchor
Link 22	-	Pre-drilled Pile
Link 23	-	Rock Anchor
Link 24	-	Pre-drilled Pile
Link 25	-	Rock Anchor
Link 26	-	Pre-drilled Pile
Link 27	-	Pile



Tangent Structure



Angle Structure

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GAKONA JUNCTION TO JARVIS
SOUTHEAST ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 17	3.30	$281,818	$930,000
LINK 18	30.65	$313,801	$9,618,000
LINK 19	5.25	$276,381	$1,451,000
LINK 20	4.25	$340,706	$1,448,000
LINK 21	3.20	$277,188	$887,000
LINK 22	26.80	$334,179	$8,956,000
LINK 23	3.00	$276,667	$830,000
LINK 24	26.00	$333,731	$8,677,000
LINK 25	7.00	$265,286	$1,857,000
LINK 26	11.00	$340,636	$3,747,000
LINK 27	15.25	$280,000	$4,270,000
SUB TOTALS	135.70	$314,451	$42,671,000
ENGINEERING 10%			$4,267,100
CONSTRUCTION MANAGEMENT 5%			$2,133,550
ADMINISTRATION 5%			$2,133,550
MOBILIZATION & DEMOBILIZATION 3%			$1,280,130
CONTINGENCY 15%			$6,400,650
TOTAL			$58,885,980
ANNUAL O&M 1.5%			$883,290

NORTHWEST ROUTE

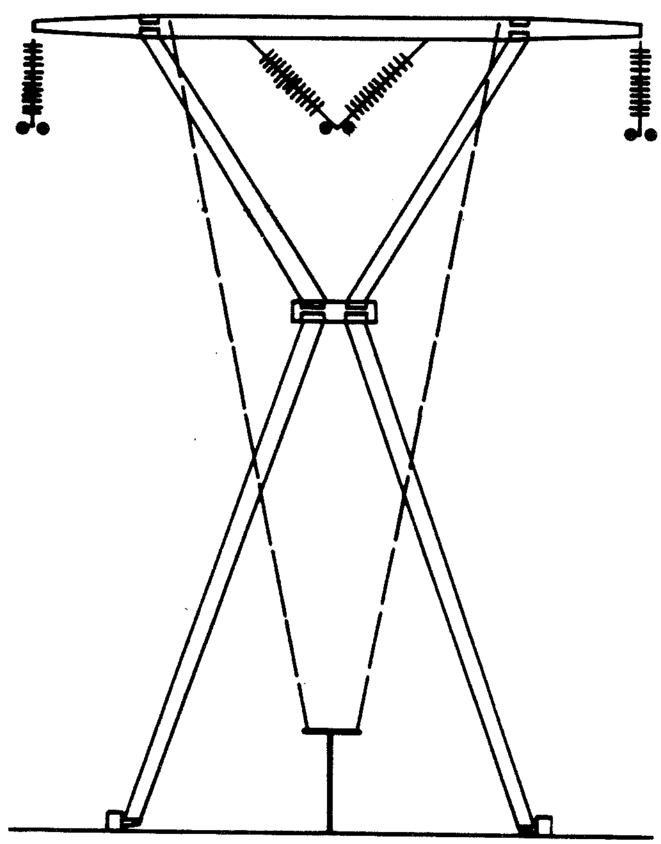
NORTHWEST ROUTE - O'NEILL TO GLENNALLEN (126.7. miles)

The parameters assumed to generate the cost estimates for the 230kV transmission line operated 138kV from the O'Neill to Glennallen are as follows:

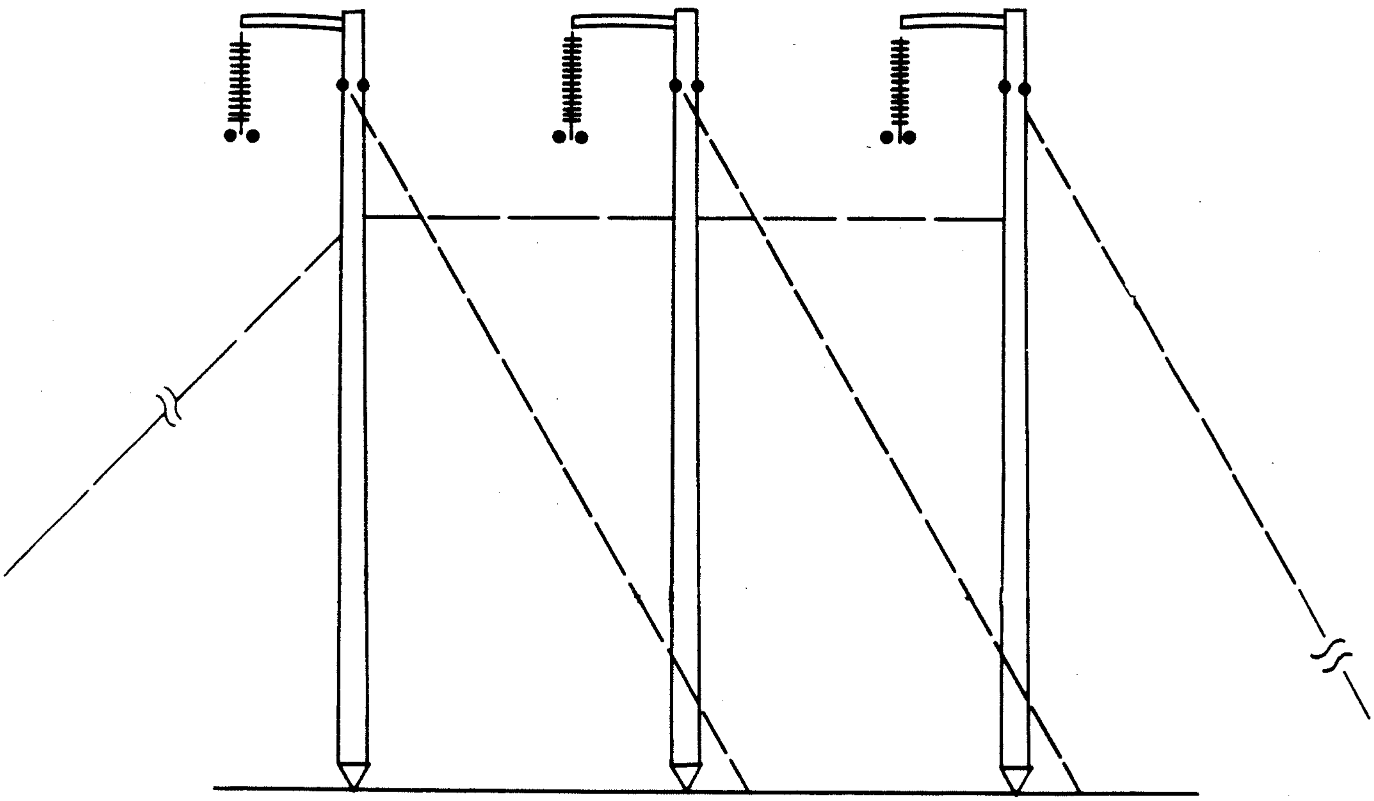
- Structure Type - Guy tubular steel X-frame - tangent
  - 3 pole guy tubular steel - angle & deadend
  - Single circuit self-supporting steel-tangent
- Conductor Type - Double bundled "Rail" ACSR
- 230kV Insulation
- No OHGW

The type of foundation for each link is as follows:

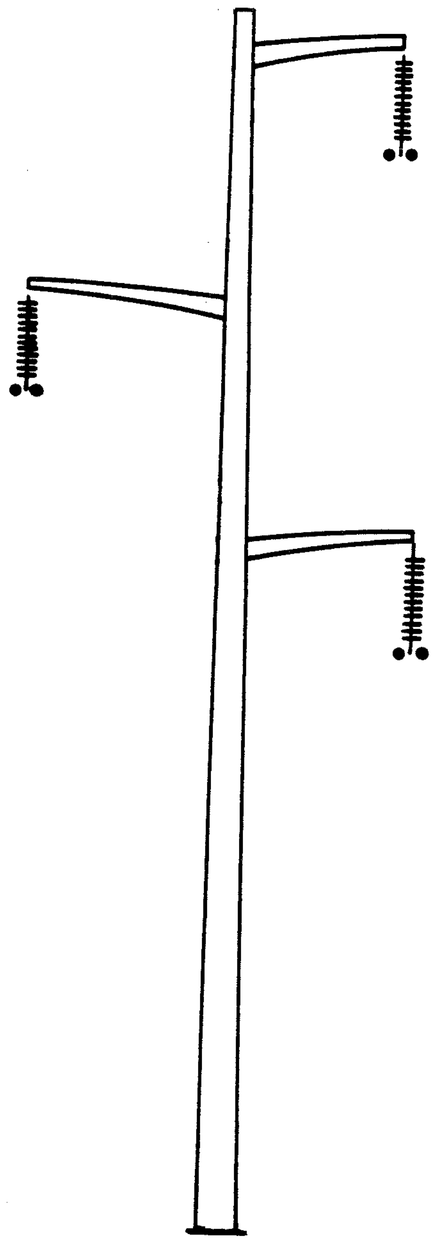
Link 1	-	Pile
Link 2	-	Rock Anchor
Link 3	-	Pile
Link 4	-	Rock Anchor
Link 5	-	Pile
Link 6	-	Rock Anchor
Link 7	-	Pile
Link 8	-	Rock Anchor
Link 9	-	Pile
Link 10	-	Deep Pile
Link 11	-	Pile
Link 12	-	Deep Pile
Link 12A	-	Deep Pile



Tangent Structure



Angle Structure



Single Circuit Tangent Pole

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
O'NEILL SUBSTATION TO GLENNALLEN
NORTHWEST ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 1	12.00	$265,500	$3,186,000
LINK 2	4.50	$246,889	$1,111,000
LINK 3	3.50	$263,429	$922,000
LINK 4	7.00	$250,429	$1,753,000
LINK 5	16.40	$278,354	$4,565,000
LINK 6	3.00	$292,667	$878,000
LINK 7	32.40	$265,710	$8,609,000
LINK 8	2.00	$259,000	$518,000
LINK 9	2.00	$257,500	$515,000
LINK 10	10.00	$296,900	$2,969,000
LINK 11	12.00	$258,000	$3,096,000
LINK 12	20.12	$294,831	$5,932,000
LINK 12A	1.80	$436,111	$785,000
SUB TOTALS	126.72	$274,929	$34,839,000
ENGINEERING 10%			$3,483,900
CONSTRUCTION MANAGEMENT 5%			$1,741,950
ADMINISTRATION 5%			$1,741,950
MOBILIZATION & DEMOBILIZATION 3%			$1,045,170
CONTINGENCY 15%			$5,225,850
TOTAL			$48,077,820
ANNUAL O&M 1.5%			$721,167

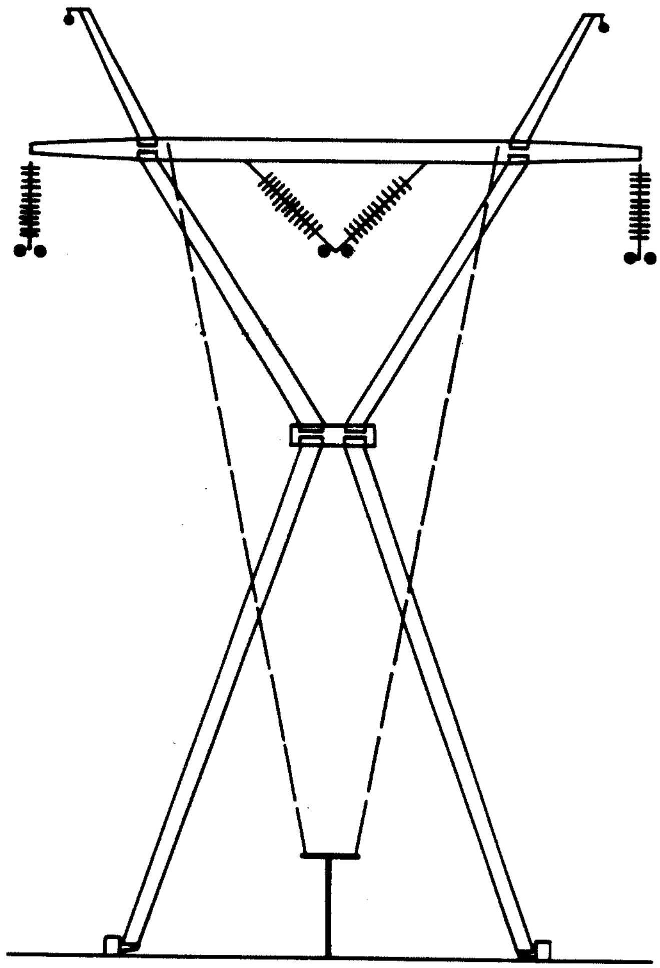
NORTHWEST ROUTE-GLENNALLEN TO GAKONA SUBSTATION (11.7miles)

The parameters assumed to generate the cost estimates for the 230kV transmission line operated 138kV from the Glennallen to Gakona Substation are as follows:

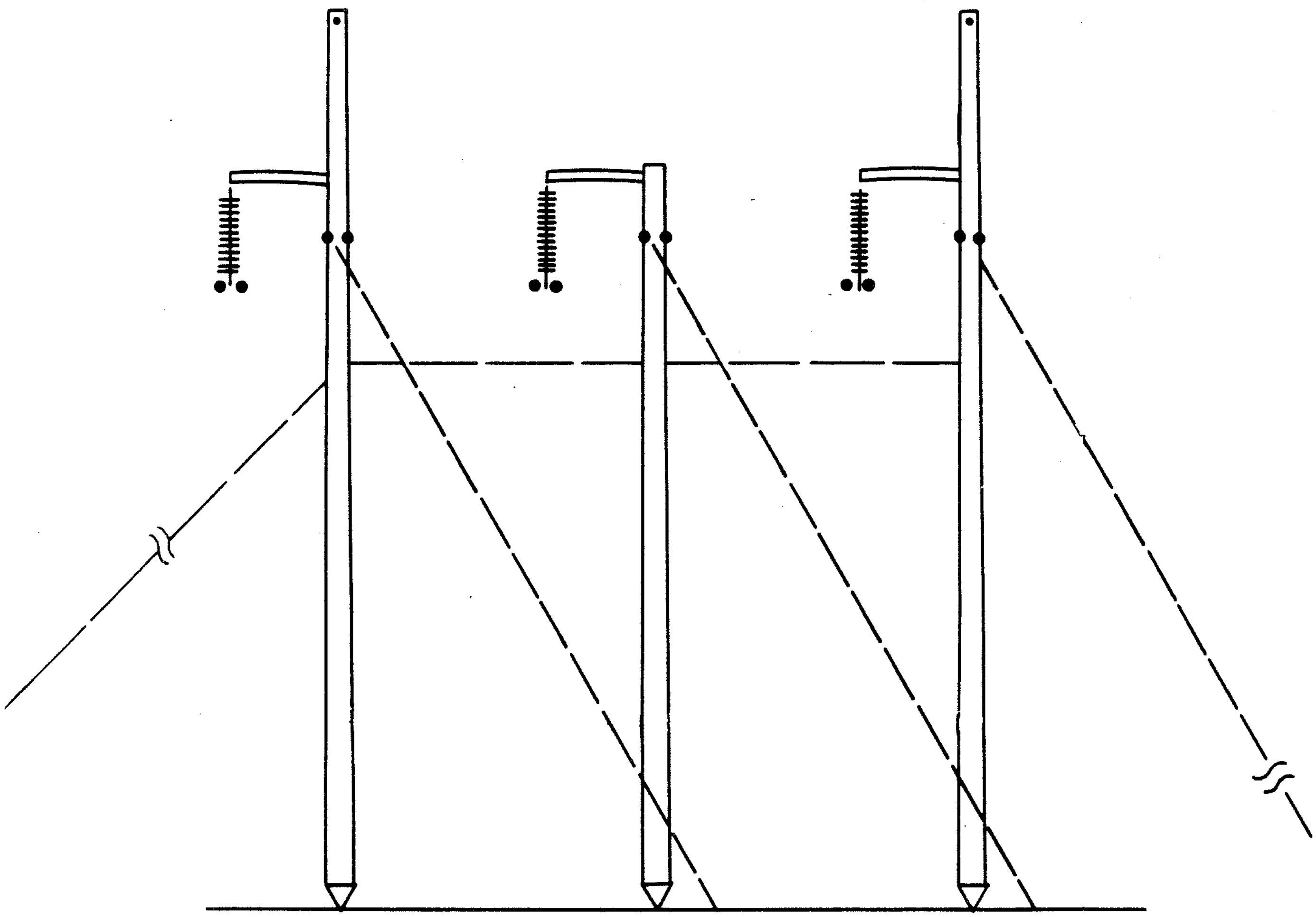
- Structure Type - Guy tubular steel X-frame - tangent
  - 3 pole guy tubular steel - angle & deadend
  - Double circuit self-supporting steel - tangent
- Conductor Type - Double bundled "Rail" ACSR
- 230kV Insulation
- 3/8" E.H.S. OHGW

The type of foundation for each link is as follows:

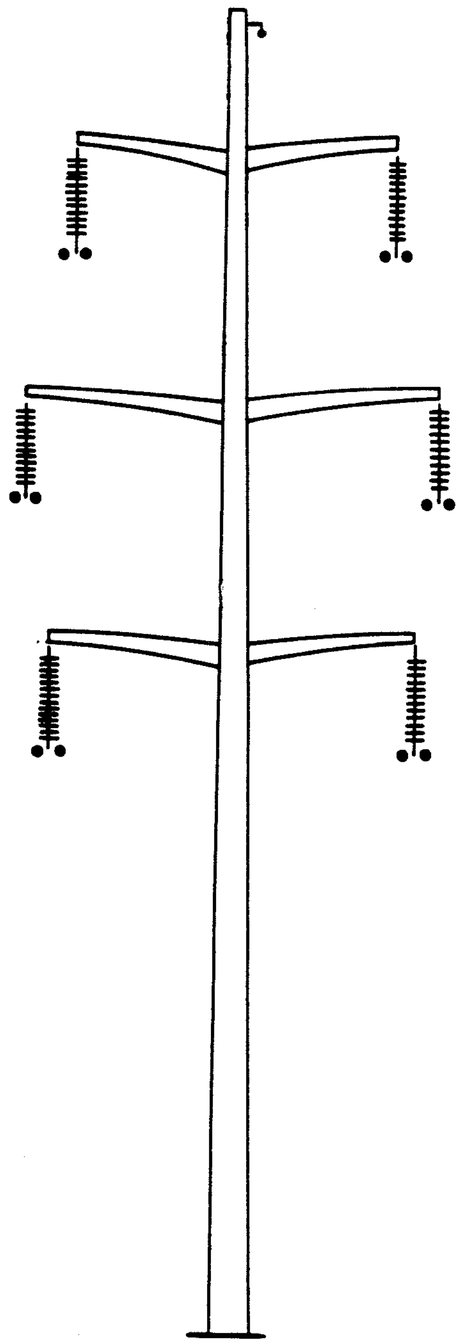
Link 13 - Deep Piles



Tangent Structure



Angle Structure



Double Circuit Tangent Pole

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GLENNALLEN TO GAKONA JCT.
NORTHWEST ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 13	11.70	$457,009	$5,347,000
SUB TOTALS	11.70	$457,009	$5,347,000
ENGINEERING 10%			$534,700
CONSTRUCTION MANAGEMENT 5%			$267,350
ADMINISTRATION 5%			$267,350
MOBILIZATION & DEMOBILIZATION 3%			$160,410
CONTINGENCY 15%			$802,050
TOTAL			$7,378,860
ANNUAL O&M 1.5%			$110,683

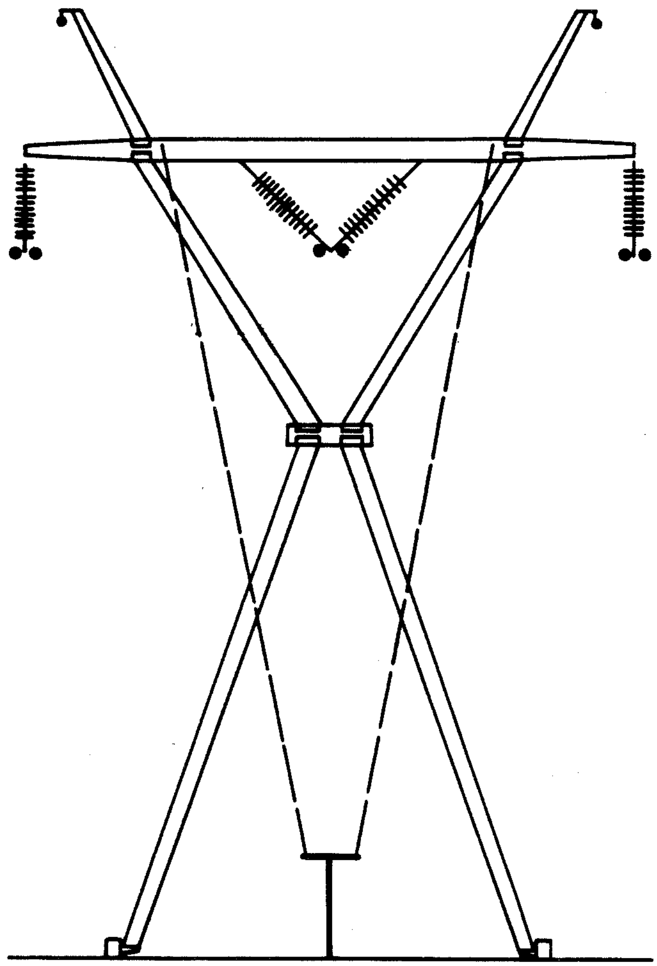
NORTHWEST ROUTE - GAKONA SUBSTATION TO JARVIS SUBSTATION (134.1 miles)

The parameters assumed to generate the cost estimates for the 138kV transmission line operated 138kV from the Gakona Substation to Jarvis Substation are as follows:

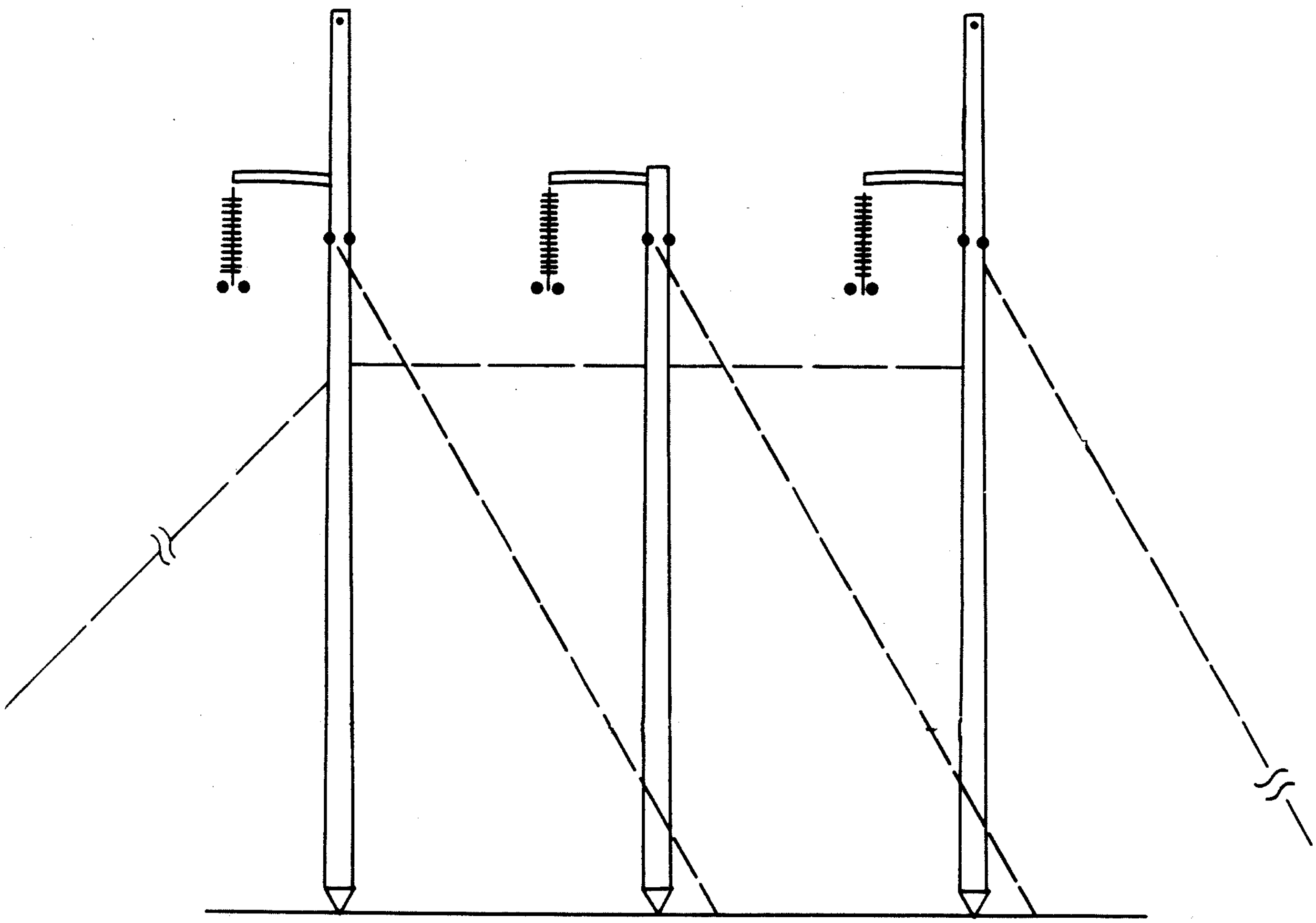
- Structure Type - Guy tubular steel X-frame - tangent
  - 3 pole guy tubular steel - angle & deadend
- Conductor Type - Double bundled "Rail" ACSR
- 230kV Insulation
- 3/8" E.H.S. OHGW

The type of foundation for each link is as follows:

Link 14	-	Deep Pile
Link 15	-	Multiple Pile
Link 16	-	Deep Pile
Link 17	-	Multiple Pile
Link 18	-	Deep Pile
Link 19	-	Pile
Link 20	-	Rock Anchor
Link 21	-	Pile
Link 22	-	Pre-drilled Pile
Link 23	-	Pile



Tangent Structure



Angle Structure

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GAKONA JUNCTION TO JARVIS
NORTHWEST ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 14	7.65	$311,765	$2,385,000
LINK 15	6.00	$340,833	$2,045,000
LINK 16	12.60	$316,508	$3,988,000
LINK 17	1.00	$367,000	$367,000
LINK 18	1.20	$336,667	$404,000
LINK 19	4.70	$281,277	$1,322,000
LINK 20	3.10	$283,548	$879,000
LINK 21	4.40	$285,455	$1,256,000
LINK 22	71.00	$332,239	$23,589,000
LINK 23	22.45	$277,862	$6,238,000
SUB TOTALS	134.10	$316,726	$42,473,000
ENGINEERING 10%			$4,247,300
CONSTRUCTION MANAGEMENT 5%			$2,123,650
ADMINISTRATION 5%			$2,123,650
MOBILIZATION & DEMOBILIZATION 3%			$1,274,190
CONTINGENCY 15%			$6,370,950
TOTAL			$58,612,740
ANNUAL O&M 1.5%			$879,191

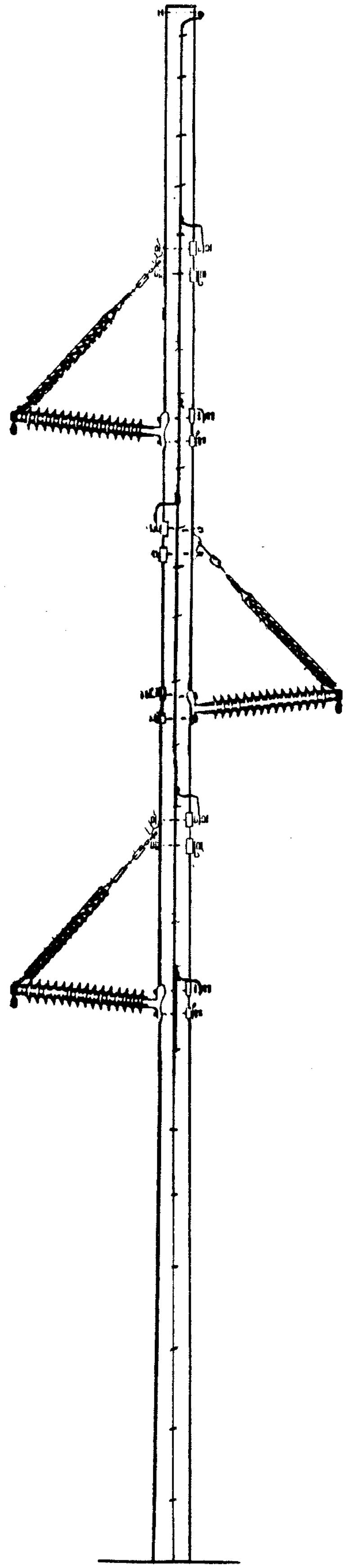
WOOD POLE ROUTE

CARNEY SUBSTATION TO NORTH POLE SUBSTATION (22 miles)

The parameters assumed to generate the cost estimates for the 138kV transmission line from the Carney Substation to North Pole Substation are as follows:

- Structure Type - Single pole wood - tangent angle & deadend
- Conductor Type - "Drake" ACSR
- 138kV Insulation
- 3/8" E.H.S. OHGW

Since the poles will be direct embedded no foundations will be required. It has been assumed that the poles will be buried one extra foot for the soil conditions.



TYPICAL TANGENT

(WOOD)

COST ESTIMATE BY LINK SUMMARY
138KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
CARNEY TO NORTH POLE
COMMON ROUTE SINGLE POLE WOOD

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 1 (WOOD POLE)	22.00	$235,045	$5,171,000
SUB TOTALS	22.00	$235,045	$5,171,000
ENGINEERING 10%			$517,100
CONSTRUCTION MANAGEMENT 5%			$258,550
ADMINISTRATION 5%			$258,550
MOBILIZATION & DEMOBILIZATION 3%			$155,130
CONTINGENCY 15%			$775,650
TOTAL			$7,135,980
ANNUAL O&M 1.5%			$107,040

TRANSMISSION LINES - SUGGESTED ROUTE

COST ESTIMATE DETAILS

COST ESTIMATE BY LINK SUMMARY
138KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
CARNEY TO NORTH POLE
COMMON ROUTE SINGLE POLE WOOD

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 1 (WOOD POLE)	22.00	$235,045	$5,171,000
SUB TOTALS	22.00	$235,045	$5,171,000
ENGINEERING 10%			$517,100
CONSTRUCTION MANAGEMENT 5%			$258,550
ADMINISTRATION 5%			$258,550
MOBILIZATION & DEMOBILIZATION 3%			$155,130
CONTINGENCY 15%			$775,650
TOTAL			$7,135,980
ANNUAL O&M 1.5%			$107,040

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
CROSSOVER AT SOURDOUGH TO JARVIS (SOUTHEAST ROUTE)
SUGGESTED ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 18 **SEE NOTE**	14.50	$308,309	$4,470,478
LINK 19	5.25	$276,381	$1,451,000
LINK 20	4.25	$340,706	$1,448,000
LINK 21	3.20	$277,188	$887,000
LINK 22	26.80	$334,179	$8,956,000
LINK 23	3.00	$276,667	$830,000
LINK 24	26.00	$333,731	$8,677,000
LINK 25	7.00	$265,286	$1,857,000
LINK 26	11.00	$340,636	$3,747,000
LINK 27	15.25	$280,000	$4,270,000
SUB TOTALS	116.25	$314,783	$36,593,478
ENGINEERING 10%			$3,659,348
CONSTRUCTION MANAGEMENT 5%			$1,829,674
ADMINISTRATION 5%			$1,829,674
MOBILIZATION & DEMOBILIZATION 3%			$1,097,804
CONTINGENCY 15%			$5,489,022
TOTAL			$50,499,000
ANNUAL O&M 1.5%			$757,485

** NOTE ** LINK 18 OF THE SOUTHEAST ROUTE WILL BE ROUGHLY HALF OF ITS LENGTH FOR THE SUGGESTED ROUTE.

COST ESTIMATE BY LINK SUMMARY
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
O'NEILL SUBSTATION TO CROSSOVER AT SOURDOUGH (NORTHWEST ROUTE)
SUGGESTED ROUTE

DESCRIPTION	MILES	COST PER MILE	TOTAL COST
LINK 1	12.00	$265,500	$3,186,000
LINK 2	4.50	$246,889	$1,111,000
LINK 3	3.50	$263,429	$922,000
LINK 4	7.00	$250,429	$1,753,000
LINK 5	16.40	$278,354	$4,565,000
LINK 6	3.00	$292,667	$878,000
LINK 7	32.40	$265,710	$8,609,000
LINK 8	2.00	$259,000	$518,000
LINK 9	2.00	$257,500	$515,000
LINK 10	10.00	$296,900	$2,969,000
LINK 11	12.00	$258,000	$3,096,000
LINK 12	20.12	$294,831	$5,932,000
LINK 12A	1.80	$436,111	$785,000
LINK 13	11.70	$457,009	$5,347,000
LINK 14	7.65	$311,765	$2,385,000
LINK 15	6.00	$340,833	$2,045,000
SUB TOTALS	152.07	$293,391	$44,616,000
ENGINEERING 10%			$4,461,600
CONSTRUCTION MANAGEMENT 5%			$2,230,800
ADMINISTRATION 5%			$2,230,800
MOBILIZATION & DEMOBILIZATION 3%			$1,338,480
CONTINGENCY 15%			$6,692,400
TOTAL			$61,570,080
ANNUAL O&M 1.5%			$923,551

SUMMARY: TRANSMISSION LINES COST ESTIMATE

SUMMARY TRANSMISSION LINES COSTS

The cost comparison of the Southeast, Northwest, and Suggested Route are as follows:

ROUTE	COST
Southeast-O'Neill to North Pole	
- O'Neill to Glennallen Switch Station	47,076,000
- Glennallen Switch Station to Gakona	5,205,000
- Gakona to Jarvis	58,886,000
- Carney to North Pole (Wood Pole)	7,136,000
Total	**118,303,000**
Annual - O&M	1,775,000
Northwest-O'Neill to North Pole	
- O'Neill to Glennallen	48,078,000
- Glennallen to Gakona	7,379,000
- Gakona to Jarvis	58,613,000
- Carney to North Pole (Wood Pole)	7,136,000
Total	**121,206,000**
Annual - O&M	1,818,000
Suggested Route-O'Neill to North Pole	
- O'Neill to Crossover at Sourdough	61,570,000
- Crossover at Sourdough to Jarvis	50,499,000
- Carney to North Pole (Wood Pole)	7,136,000
Total	**119,205,000**
Annual - O&M	1,788,000

TRANSMISSION LINES - SOUTHEAST ROUTE
COST ESTIMATE DETAILS

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 1 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	23	7,000	161,000	14,400	331,200	21,400	492,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	10,000	30,000	18,000	54,000	28,000	84,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	3	11,000	33,000	21,600	64,800	32,600	97,800
3 POLE GUYED STRUCTURE(DEAD END)	3	13,000	39,000	25,200	75,600	38,200	114,600
H-PILING, (PER STRUCTURE)	32	8,000	256,000	2,500	80,000	10,500	336,000
HARDWARE AND INSULATORS(TANGENT)	23	1,400	32,200	1,400	32,200	2,800	64,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	3	2,300	6,900	1,100	3,300	3,400	10,200
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	242	1,400	338,800	1,510	365,420	2,910	704,220
GROUNDING ASSEMBLY	32	210	6,720	110	3,520	320	10,240
R-O-W CLEARING	7.5	2,000	15,000	400	3,000	2,400	18,000

TOTAL COST FOR 7.25 MILES $1,962,000

COST/MILE $270,621

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 2 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	38	7,000	266,000	14,400	547,200	21,400	813,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	15,600	15,600	24,100	24,100
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	10,000	30,000	18,000	54,000	28,000	84,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,000	11,000	21,600	21,600	32,600	32,600
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25,200	25,200	38,200	38,200
ROCK ANCHORS, (PER STRUCTURE)	43	7,000	301,000	1,500	64,500	8,500	365,500
HARDWARE AND INSULATORS(TANGENT)	38	1,400	53,200	1,400	53,200	2,800	106,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	2,300	2,300	1,100	1,100	3,400	3,400
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	325	1,400	455,000	1,510	490,750	2,910	945,750
GROUNDING ASSEMBLY	43	210	9,030	110	4,730	320	13,760
R-O-W CLEARING	9.8	2,000	19,500	400	3,900	2,400	23,400

TOTAL COST FOR 9.75 MILES $2,469,000

COST/MILE $253,231

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 3 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	54	7,000	378,000	14,400	777,600	21,400	1,155,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	9	8,500	76,500	15,600	140,400	24,100	216,900
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	10,000	20,000	18,000	36,000	28,000	56,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25,200	25,200	38,200	38,200
H-PILING, (PER STRUCTURE)	66	8,000	528,000	2,500	165,000	10,500	693,000
HARDWARE AND INSULATORS(TANGENT)	54	1,400	75,600	1,400	75,600	2,800	151,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	9	1,700	15,300	1,400	12,600	3,100	27,900
HARDWARE AND INSULATORS(MEDIUM ANGLE)	2	1,900	3,800	1,100	2,200	3,000	6,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	499	1,400	698,600	1,510	753,490	2,910	1,452,090
GROUNDING ASSEMBLY	66	210	13,860	110	7,260	320	21,120
R-O-W CLEARING	15.0	2,000	30,000	400	6,000	2,400	36,000

TOTAL COST FOR 15 MILES $3,861,000

COST/MILE $257,400

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 4 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	11	7,000	77,000	14,400	158,400	21,400	235,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	3	8,500	25,500	15,600	46,800	24,100	72,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,000	22,000	21,600	43,200	32,600	65,200
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
ROCK ANCHORS, (PER STRUCTURE)	16	7,000	112,000	1,500	24,000	8,500	136,000
HARDWARE AND INSULATORS(TANGENT)	11	1,400	15,400	1,400	15,400	2,800	30,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	3	1,700	5,100	1,400	4,200	3,100	9,300
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	117	1,400	163,800	1,510	176,670	2,910	340,470
GROUNDING ASSEMBLY	16	210	3,360	110	1,760	320	5,120
R-O-W CLEARING	3.5	2,000	7,000	400	1,400	2,400	8,400

TOTAL COST FOR 3.5 MILES $910,000

COST/MILE $260,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 5 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	28	7,000	196,000	14,400	403,200	21,400	599,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	4	8,500	34,000	15,600	62,400	24,100	96,400
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	5	10,000	50,000	18,000	90,000	28,000	140,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25,200	25,200	38,200	38,200
H-PILING, (PER STRUCTURE)	38	8,000	304,000	2,500	95,000	10,500	399,000
HARDWARE AND INSULATORS(TANGENT)	28	1,400	39,200	1,400	39,200	2,800	78,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	4	1,700	6,800	1,400	5,600	3,100	12,400
HARDWARE AND INSULATORS(MEDIUM ANGLE)	5	1,900	9,500	1,100	5,500	3,000	15,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	263	1,400	368,200	1,510	397,130	2,910	765,330
GROUNDING ASSEMBLY	38	210	7,980	110	4,180	320	12,160
R-O-W CLEARING	7.9	2,000	15,800	400	3,160	2,400	18,960

TOTAL COST FOR 7.90 MILES $2,182,000

COST/MILE $276,203

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 6 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	4	7,000	28,000	14,400	57,600	21,400	85,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	15,600	15,600	24,100	24,100
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
ROCK ANCHORS, (PER STRUCTURE)	5	7,000	35,000	1,500	7,500	8,500	42,500
HARDWARE AND INSULATORS(TANGENT)	4	1,400	5,600	1,400	5,600	2,800	11,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	34	1,400	47,600	1,510	51,340	2,910	98,940
GROUNDING ASSEMBLY	5	210	1,050	110	550	320	1,600
R-O-W CLEARING	1.0	2,000	2,000	400	400	2,400	2,400

TOTAL COST FOR 1 MILE $269,000

COST/MILE $269,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 7 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	137	7,000	959,000	14,400	1,972,800	21,400	2,931,800
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	8	8,500	68,000	15,600	124,800	24,100	192,800
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	11	10,000	110,000	18,000	198,000	28,000	308,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,000	22,000	21,600	43,200	32,600	65,200
3 POLE GUYED STRUCTURE(DEAD END)	3	13,000	39,000	25,200	75,600	38,200	114,600
H-PILING, (PER STRUCTURE)	161	8,000	1,288,000	2,500	402,500	10,500	1,690,500
HARDWARE AND INSULATORS(TANGENT)	137	1,400	191,800	1,400	191,800	2,800	383,600
HARDWARE AND INSULATORS(LIGHT ANGLE)	8	1,700	13,600	1,400	11,200	3,100	24,800
HARDWARE AND INSULATORS(MEDIUM ANGLE)	11	1,900	20,900	1,100	12,100	3,000	33,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	1,196	1,400	1,674,400	1,510	1,805,960	2,910	3,480,360
GROUNDING ASSEMBLY	161	210	33,810	110	17,710	320	51,520
R-O-W CLEARING	36.0	2,000	71,900	400	14,380	2,400	86,280

TOTAL COST FOR 35.95 MILES $9,390,000

COST/MILE $261,196

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 8 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	11	7,000	77,000	14,400	158,400	21,400	235,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	3	11,000	33,000	21,600	64,800	32,600	97,800
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	14	13,000	182,000	5,000	70,000	18,000	252,000
HARDWARE AND INSULATORS(TANGENT)	11	1,400	15,400	1,400	15,400	2,800	30,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	3	2,300	6,900	1,100	3,300	3,400	10,200
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	100	1,400	140,000	1,510	151,000	2,910	291,000
GROUNDING ASSEMBLY	14	210	2,940	110	1,540	320	4,480
R-O-W CLEARING	3.0	2,000	6,000	400	1,200	2,400	7,200

TOTAL COST FOR 3 MILES $929,000

COST/MILE $309,667

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 9 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	5	7,000	35,000	14,400	72,000	21,400	107,000
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING, (PER STRUCTURE)	5	8,000	40,000	2,500	12,500	10,500	52,500
HARDWARE AND INSULATORS(TANGENT)	5	1,400	7,000	1,400	7,000	2,800	14,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	34	1,400	47,600	1,510	51,340	2,910	98,940
GROUNDING ASSEMBLY	5	210	1,050	110	550	320	1,600
R-O-W CLEARING	1.0	2,000	2,000	400	400	2,400	2,400

TOTAL COST FOR 1 MILE $276,000

COST/MILE $276,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 10 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	35	7,000	245,000	14,400	504,000	21,400	749,000
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	15,600	15,600	24,100	24,100
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	10,000	20,000	18,000	36,000	28,000	56,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,000	22,000	21,600	43,200	32,600	65,200
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	40	13,000	520,000	5,000	200,000	18,000	720,000
HARDWARE AND INSULATORS(TANGENT)	35	1,400	49,000	1,400	49,000	2,800	98,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	2	1,900	3,800	1,100	2,200	3,000	6,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	300	1,400	420,000	1,510	453,000	2,910	873,000
GROUNDING ASSEMBLY	40	210	8,400	110	4,400	320	12,800
R-O-W CLEARING	9.0	2,000	18,000	400	3,600	2,400	21,600

TOTAL COST FOR 9 MILES $2,636,000

COST/MILE $292,889

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 11 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	13	7,000	91,000	14,400	187,200	21,400	278,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING, (PER STRUCTURE)	14	8,000	112,000	2,500	35,000	10,500	147,000
HARDWARE AND INSULATORS(TANGENT)	13	1,400	18,200	1,400	18,200	2,800	36,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	100	1,400	140,000	1,510	151,000	2,910	291,000
GROUNDING ASSEMBLY	14	210	2,940	110	1,540	320	4,480
R-O-W CLEARING	3.0	2,000	6,000	400	1,200	2,400	7,200

TOTAL COST FOR 3 MILES $795,000

COST/MILE $265,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 12 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	16	7,000	112,000	14,400	230,400	21,400	342,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	15,600	15,600	24,100	24,100
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	18	13,000	234,000	5,000	90,000	18,000	324,000
HARDWARE AND INSULATORS(TANGENT)	16	1,400	22,400	1,400	22,400	2,800	44,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	134	1,400	187,600	1,510	202,340	2,910	389,940
GROUNDING ASSEMBLY	18	210	3,780	110	1,980	320	5,760
R-O-W CLEARING	4.0	2,000	8,000	400	1,600	2,400	9,600

TOTAL COST FOR 4 MILES $1,147,000

COST/MILE $286,750

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 13 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	5	7,000	35,000	14,400	72,000	21,400	107,000
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING, (PER STRUCTURE)	5	8,000	40,000	2,500	12,500	10,500	52,500
HARDWARE AND INSULATORS(TANGENT)	5	1,400	7,000	1,400	7,000	2,800	14,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	34	1,400	47,600	1,510	51,340	2,910	98,940
GROUNDING ASSEMBLY	5	210	1,050	110	550	320	1,600
R-O-W CLEARING	1.0	2,000	2,000	400	400	2,400	2,400

TOTAL COST FOR 1 MILE $276,000

COST/MILE $276,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 14 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	68	7,000	476,000	14,400	979,200	21,400	1,455,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	6	11,000	66,000	21,600	129,600	32,600	195,600
3 POLE GUYED STRUCTURE(DEAD END)	2	13,000	26,000	25,200	50,400	38,200	76,400
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	77	13,000	1,001,000	5,000	385,000	18,000	1,386,000
HARDWARE AND INSULATORS(TANGENT)	68	1,400	95,200	1,400	95,200	2,800	190,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	6	2,300	13,800	1,100	6,600	3,400	20,400
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	575	1,400	805,000	1,510	868,250	2,910	1,673,250
GROUNDING ASSEMBLY	77	210	16,170	110	8,470	320	24,640
R-O-W CLEARING	17.3	2,000	34,600	400	6,920	2,400	41,520

TOTAL COST FOR 17.3 MILES $5,108,000

COST/MILE $295,260

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 15 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	24	7,000	168,000	14,400	345,600	21,400	513,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	15,600	15,600	24,100	24,100
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	3	11,000	33,000	21,600	64,800	32,600	97,800
3 POLE GUYED STRUCTURE(DEAD END)	3	13,000	39,000	25,200	75,600	38,200	114,600
H-PILING, (PER STRUCTURE)	32	8,000	256,000	2,500	80,000	10,500	336,000
HARDWARE AND INSULATORS(TANGENT)	24	1,400	33,600	1,400	33,600	2,800	67,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	3	2,300	6,900	1,100	3,300	3,400	10,200
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	226	1,400	316,400	1,510	341,260	2,910	657,660
GROUNDING ASSEMBLY	32	210	6,720	110	3,520	320	10,240
R-O-W CLEARING	6.8	2,000	13,600	400	2,720	2,400	16,320

TOTAL COST FOR 6.8 MILES $1,903,000

COST/MILE $279,853

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 16 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	45	7,500	337,500	15,600	702,000	23,100	1,039,500
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	11,000	33,000	19,200	57,600	30,200	90,600
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,500	23,000	22,800	45,600	34,300	68,600
3 POLE GUYED STRUCTURE(DEAD END)	2	14,500	29,000	26,400	52,800	40,900	81,800
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	53	13,000	689,000	5,000	265,000	18,000	954,000
HARDWARE AND INSULATORS(TANGENT)	45	1,400	63,000	1,400	63,000	2,800	126,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	401	1,400	561,400	1,510	605,510	2,910	1,166,910
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	134	800	107,200	250	33,500	1,050	140,700
GROUNDING ASSEMBLY	53	210	11,130	110	5,830	320	16,960
R-O-W CLEARING	12.1	2,000	24,100	400	4,820	2,400	28,920

TOTAL COST FOR 12.05 MILES $3,772,000

COST/MILE $313,029

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 17 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	12	7,500	90,000	15,600	187,200	23,100	277,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	16,800	33,600	25,300	50,600
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	11,000	11,000	19,200	19,200	30,200	30,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
H-PILING, (PER STRUCTURE)	15	8,000	120,000	2,500	37,500	10,500	157,500
HARDWARE AND INSULATORS(TANGENT)	12	1,400	16,800	1,400	16,800	2,800	33,600
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	110	1,400	154,000	1,510	166,100	2,910	320,100
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	37	800	29,600	250	9,250	1,050	38,850
GROUNDING ASSEMBLY	15	210	3,150	110	1,650	320	4,800
R-O-W CLEARING	3.3	2,000	6,600	400	1,320	2,400	7,920

TOTAL COST FOR 3.3 MILES $930,000

COST/MILE $281,818

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 18 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	108	7,500	810,000	15,600	1,684,800	23,100	2,494,800
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	3	8,500	25,500	16,800	50,400	25,300	75,900
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	16	11,000	176,000	19,200	307,200	30,200	483,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	5	11,500	57,500	22,800	114,000	34,300	171,500
3 POLE GUYED STRUCTURE(DEAD END)	3	14,500	43,500	26,400	79,200	40,900	122,700
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	135	13,000	1,755,000	5,000	675,000	18,000	2,430,000
HARDWARE AND INSULATORS(TANGENT)	108	1,400	151,200	1,400	151,200	2,800	302,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	3	1,700	5,100	1,400	4,200	3,100	9,300
HARDWARE AND INSULATORS(MEDIUM ANGLE)	16	1,900	30,400	1,100	17,600	3,000	48,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	5	2,300	11,500	1,100	5,500	3,400	17,000
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	1,020	1,400	1,428,000	1,510	1,540,200	2,910	2,968,200
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	340	800	272,000	250	85,000	1,050	357,000
GROUNDING ASSEMBLY	135	210	28,350	110	14,850	320	43,200
R-O-W CLEARING	30.7	2,000	61,300	400	12,260	2,400	73,560

TOTAL COST FOR 30.65 MILES $9,618,000

COST/MILE $313,801

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 19 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	20	7,500	150,000	15,600	312,000	23,100	462,000
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	16,800	0	25,300	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	11,000	33,000	19,200	57,600	30,200	90,600
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,500	11,500	22,800	22,800	34,300	34,300
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
ROCK ANCHORS, (PER STRUCTURE)	24	7,000	168,000	1,500	36,000	8,500	204,000
HARDWARE AND INSULATORS(TANGENT)	20	1,400	28,000	1,400	28,000	2,800	56,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	2,300	2,300	1,100	1,100	3,400	3,400
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	175	1,400	245,000	1,510	264,250	2,910	509,250
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	59	800	47,200	250	14,750	1,050	61,950
GROUNDING ASSEMBLY	24	210	5,040	110	2,640	320	7,680
R-O-W CLEARING	5.3	2,000	10,500	400	2,100	2,400	12,600

TOTAL COST FOR 5.25 MILES $1,451,000

COST/MILE $276,381

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 20 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	15	7,500	112,500	15,600	234,000	23,100	346,500
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	11,000	0	19,200	0	30,200	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,500	23,000	22,800	45,600	34,300	68,600
3 POLE GUYED STRUCTURE(DEAD END)	1	14,500	14,500	26,400	26,400	40,900	40,900
H-PILING(MULTIBLE PILES), (PER STRUCTURE)	19	15,000	285,000	7,500	142,500	22,500	427,500
HARDWARE AND INSULATORS(TANGENT)	15	1,400	21,000	1,400	21,000	2,800	42,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	142	1,400	198,800	1,510	214,420	2,910	413,220
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	48	800	38,400	250	12,000	1,050	50,400
GROUNDING ASSEMBLY	19	210	3,990	110	2,090	320	6,080
R-O-W CLEARING	4.3	2,000	8,500	400	1,700	2,400	10,200

TOTAL COST FOR 4.25 MILES $1,448,000

COST/MILE $340,706

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 21 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	13	7,500	97,500	15,600	202,800	23,100	300,300
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	11,000	11,000	19,200	19,200	30,200	30,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
ROCK ANCHORS, (PER STRUCTURE)	15	7,000	105,000	1,500	22,500	8,500	127,500
HARDWARE AND INSULATORS(TANGENT)	13	1,400	18,200	1,400	18,200	2,800	36,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	107	1,400	149,800	1,510	161,570	2,910	311,370
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	36	800	28,800	250	9,000	1,050	37,800
GROUNDING ASSEMBLY	15	210	3,150	110	1,650	320	4,800
R-O-W CLEARING	3.2	2,000	6,400	400	1,280	2,400	7,680

TOTAL COST FOR 3.2 MILES $887,000

COST/MILE $277,188

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 22 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	98	7,500	735,000	15,600	1,528,800	23,100	2,263,800
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	6	8,500	51,000	16,800	100,800	25,300	151,800
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	8	11,000	88,000	19,200	153,600	30,200	241,600
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	3	11,500	34,500	22,800	68,400	34,300	102,900
3 POLE GUYED STRUCTURE(DEAD END)	3	14,500	43,500	26,400	79,200	40,900	122,700
H-PILING PRE DRILLED (PER STRUCTURE)	118	18,000	2,124,000	5,000	590,000	23,000	2,714,000
HARDWARE AND INSULATORS(TANGENT)	98	1,400	137,200	1,400	137,200	2,800	274,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	6	1,700	10,200	1,400	8,400	3,100	18,600
HARDWARE AND INSULATORS(MEDIUM ANGLE)	8	1,900	15,200	1,100	8,800	3,000	24,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	3	2,300	6,900	1,100	3,300	3,400	10,200
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	892	1,400	1,248,800	1,510	1,346,920	2,910	2,595,720
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	298	800	238,400	250	74,500	1,050	312,900
GROUNDING ASSEMBLY	118	210	24,780	110	12,980	320	37,760
R-O-W CLEARING	26.8	2,000	53,600	400	10,720	2,400	64,320

TOTAL COST FOR 26.8 MILES $8,956,000

COST/MILE $334,179

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 23 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	12	7,500	90,000	15,600	187,200	23,100	277,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	11,000	11,000	19,200	19,200	30,200	30,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
ROCK ANCHORS, (PER STRUCTURE)	14	7,000	98,000	1,500	21,000	8,500	119,000
HARDWARE AND INSULATORS(TANGENT)	12	1,400	16,800	1,400	16,800	2,800	33,600
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	100	1,400	140,000	1,510	151,000	2,910	291,000
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	34	800	27,200	250	8,500	1,050	35,700
GROUNDING ASSEMBLY	14	210	2,940	110	1,540	320	4,480
R-O-W CLEARING	3.0	2,000	6,000	400	1,200	2,400	7,200

TOTAL COST FOR 3 MILES $830,000

COST/MILE $276,667

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 24 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	96	7,500	720,000	15,600	1,497,600	23,100	2,217,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	9	8,500	76,500	16,800	151,200	25,300	227,700
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	6	11,000	66,000	19,200	115,200	30,200	181,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,500	23,000	22,800	45,600	34,300	68,600
3 POLE GUYED STRUCTURE(DEAD END)	2	14,500	29,000	26,400	52,800	40,900	81,800
H-PILING PRE DRILLED (PER STRUCTURE)	115	18,000	2,070,000	5,000	575,000	23,000	2,645,000
HARDWARE AND INSULATORS(TANGENT)	96	1,400	134,400	1,400	134,400	2,800	268,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	9	1,700	15,300	1,400	12,600	3,100	27,900
HARDWARE AND INSULATORS(MEDIUM ANGLE)	6	1,900	11,400	1,100	6,600	3,000	18,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	865	1,400	1,211,000	1,510	1,306,150	2,910	2,517,150
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	289	800	231,200	250	72,250	1,050	303,450
GROUNDING ASSEMBLY	115	210	24,150	110	12,650	320	36,800
R-O-W CLEARING	26.0	2,000	52,000	400	10,400	2,400	62,400

TOTAL COST FOR 26 MILES $8,677,000

COST/MILE $333,731

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 25 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	30	7,500	225,000	15,600	468,000	23,100	693,000
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	16,800	0	25,300	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	11,000	11,000	19,200	19,200	30,200	30,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
ROCK ANCHORS, (PER STRUCTURE)	31	7,000	217,000	1,500	46,500	8,500	263,500
HARDWARE AND INSULATORS(TANGENT)	30	1,400	42,000	1,400	42,000	2,800	84,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	232	1,400	324,800	1,510	350,320	2,910	675,120
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	78	800	62,400	250	19,500	1,050	81,900
GROUNDING ASSEMBLY	31	210	6,510	110	3,410	320	9,920
R-O-W CLEARING	7.0	2,000	14,000	400	2,800	2,400	16,800

TOTAL COST FOR 7 MILES $1,857,000

COST/MILE $265,286

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 26 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	42	7,500	315,000	15,600	655,200	23,100	970,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	16,800	33,600	25,300	50,600
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	4	11,000	44,000	19,200	76,800	30,200	120,800
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	2	14,500	29,000	26,400	52,800	40,900	81,800
H-PILING PRE DRILLED (PER STRUCTURE)	49	18,000	882,000	5,000	245,000	23,000	1,127,000
HARDWARE AND INSULATORS(TANGENT)	42	1,400	58,800	1,400	58,800	2,800	117,600
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	4	1,900	7,600	1,100	4,400	3,000	12,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	366	1,400	512,400	1,510	552,660	2,910	1,065,060
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	134	800	107,200	250	33,500	1,050	140,700
GROUNDING ASSEMBLY	45	210	9,450	110	4,950	320	14,400
R-O-W CLEARING	11.0	2,000	22,000	400	4,400	2,400	26,400

TOTAL COST FOR 11 MILES $3,747,000

COST/MILE $340,636

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 27 SOUTHEAST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	61	7,500	457,500	15,600	951,600	23,100	1,409,100
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	16,800	33,600	25,300	50,600
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	11,000	11,000	19,200	19,200	30,200	30,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,500	23,000	22,800	45,600	34,300	68,600
3 POLE GUYED STRUCTURE(DEAD END)	2	14,500	29,000	26,400	52,800	40,900	81,800
H-PILING, (PER STRUCTURE)	68	8,000	544,000	2,500	170,000	10,500	714,000
HARDWARE AND INSULATORS(TANGENT)	61	1,400	85,400	1,400	85,400	2,800	170,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	508	1,400	711,200	1,510	767,080	2,910	1,478,280
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	170	800	136,000	250	42,500	1,050	178,500
GROUNDING ASSEMBLY	68	210	14,280	110	7,480	320	21,760
R-O-W CLEARING	15.3	2,000	30,500	400	6,100	2,400	36,600

TOTAL COST FOR 15.25 MILES $4,270,000

COST/MILE $280,000

COST ESTIMATE
ALASKA POWER AUTHORITY
APA NORTHEAST INTERTIE
CARNEY TO NORTH POLE
138 KV WOOD TRANSMISSION LINE
SINGLE POLE WITH FUTURE/UB

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
WOOD POLE (TANGENT W/OHGW,80'- H1)	366	2,500	915,000	2,000	732,000	4,500	1,647,000
WOOD POLE(DEADEND/HEAVY ANGLE W/ OHGW 85'- H2)	22	3,000	66,000	2,300	50,600	5,300	116,600
HARDWARE AND INSULATORS(TANGENT)	366	1,000	366,000	3,300	1,207,800	4,300	1,573,800
HARDWARE AND INSULATORS(DEADEND/HEAVY ANGLE)	22	3,000	66,000	4,000	88,000	7,000	154,000
CONDUCTOR ASSEMBLY(DRAKE 795 AAC)	366	2,000	732,000	1,540	563,640	3,540	1,295,640
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	122	800	97,600	250	30,500	1,050	128,100
GROUNDING ASSEMBLY	388	210	81,480	110	42,680	320	124,160
RIGHT OF WAY CLEARING	22	6,000	132,000	0	0	6,000	132,000

SUBTOTAL

TOTAL COST 22 MILES $5,171,000

COST PER MILE 235,045

TRANSMISSION LINES - NORTHWEST ROUTE
COST ESTIMATE DETAILS

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 1 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	43	7,000	301,000	14,400	619,200	21,400	920,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	4	8,500	34,000	15,600	62,400	24,100	96,400
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	4	10,000	40,000	18,000	72,000	28,000	112,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,000	11,000	21,600	21,600	32,600	32,600
3 POLE GUYED STRUCTURE(DEAD END)	3	13,000	39,000	25,200	75,600	38,200	114,600
H-PILING, (PER STRUCTURE)	55	8,000	440,000	2,500	137,500	10,500	577,500
HARDWARE AND INSULATORS(TANGENT)	43	1,400	60,200	1,400	60,200	2,800	120,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	4	1,700	6,800	1,400	5,600	3,100	12,400
HARDWARE AND INSULATORS(MEDIUM ANGLE	4	1,900	7,600	1,100	4,400	3,000	12,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	2,300	2,300	1,100	1,100	3,400	3,400
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	384	1,400	537,600	1,510	579,840	2,910	1,117,440
GROUNDING ASSEMBLY	55	210	11,550	110	6,050	320	17,600
R-O-W CLEARING	12.0	2,000	24,000	400	4,800	2,400	28,800

TOTAL COST FOR 12 MILES $3,186,000

COST/MILE $265,500

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 2 NORTHWEST ROUTE

		LABOR		MATERIAL		LABOR AND MATERIAL	
UNIT DESCRIPTION	QUANTITY	UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	18	7,000	126,000	14,400	259,200	21,400	385,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	10,000	20,000	18,000	36,000	28,000	56,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
ROCK ANCHORS, (PER STRUCTURE)	20	7,000	140,000	1,500	30,000	8,500	170,000
HARDWARE AND INSULATORS(TANGENT)	18	1,400	25,200	1,400	25,200	2,800	50,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	144	1,400	201,600	1,510	217,440	2,910	419,040
GROUNDING ASSEMBLY	20	210	4,200	110	2,200	320	6,400
R-O-W CLEARING	4.5	2,000	9,000	400	1,800	2,400	10,800

TOTAL COST FOR 4.5 MILES $1,111,000

COST/MILE $246,889

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 3 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	13	7,000	91,000	14,400	187,200	21,400	278,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	15,600	31,200	24,100	48,200
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING, (PER STRUCTURE)	16	8,000	128,000	2,500	40,000	10,500	168,000
HARDWARE AND INSULATORS(TANGENT)	13	1,400	18,200	1,400	18,200	2,800	36,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	117	1,400	163,800	1,510	176,670	2,910	340,470
GROUNDING ASSEMBLY	16	210	3,360	110	1,760	320	5,120
R-O-W CLEARING	3.5	2,000	7,000	400	1,400	2,400	8,400

TOTAL COST FOR 3.5 MILES $922,000

COST/MILE $263,429

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 4 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR		MATERIAL		LABOR AND MATERIAL	
		UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	24	7,000	168,000	14,400	345,600	21,400	513,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	4	8,500	34,000	15,600	62,400	24,100	96,400
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	10,000	20,000	18,000	36,000	28,000	56,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,000	11,000	21,600	21,600	32,600	32,600
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
ROCK ANCHORS, (PER STRUCTURE)	31	7,000	217,000	1,500	46,500	8,500	263,500
HARDWARE AND INSULATORS(TANGENT)	24	1,400	33,600	1,400	33,600	2,800	67,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	4	1,700	6,800	1,400	5,600	3,100	12,400
HARDWARE AND INSULATORS(MEDIUM ANGLE)	2	1,900	3,800	1,100	2,200	3,000	6,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	2,300	2,300	1,100	1,100	3,400	3,400
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	232	1,400	324,800	1,510	350,320	2,910	675,120
GROUNDING ASSEMBLY	31	210	6,510	110	3,410	320	9,920
R-O-W CLEARING	7.0	2,000	14,000	400	2,800	2,400	16,800

TOTAL COST FOR 7 MILES $1,753,000

COST/MILE $250,429

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME & SINGLE STEEL POLE
LINK 5 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	36	7,000	252,000	14,400	518,400	21,400	770,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	3	8,500	25,500	15,600	46,800	24,100	72,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,000	11,000	21,600	21,600	32,600	32,600
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25,200	25,200	38,200	38,200
H-PILING, X-BRACE, (PER STRUCTURE)	42	8,000	336,000	2,500	105,000	10,500	441,000
SINGLE STEEL POLE STRUCTURE(TANGENT)	22	8,000	176,000	19,000	418,000	27,000	594,000
SINGLE STEEL POLE STRUCTURE(LIGHT ANGLE)	3	9,500	28,500	20,000	60,000	29,500	88,500
SINGLE STEEL POLE STRUCTURE(MEDIUM ANGLE)	4	11,000	44,000	22,000	88,000	33,000	132,000
SINGLE STEEL POLE STRUCTURE(HEAVY ANGLE)	1	12,500	12,500	25,000	25,000	37,500	37,500
SINGLE STEEL POLE STRUCTURE(DEAD END)	1	14,500	14,500	29,000	29,000	43,500	43,500
H-PILING, SINGLE POLE, (PER STRUCTURE)	31	10,000	310,000	3,500	108,500	13,500	418,500
HARDWARE AND INSULATORS(TANGENT)	58	1,400	81,200	1,400	81,200	2,800	162,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	6	1,700	10,200	1,400	8,400	3,100	18,600
HARDWARE AND INSULATORS(MEDIUM ANGLE)	5	1,900	9,500	1,100	5,500	3,000	15,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	546	1,400	764,400	1,510	824,460	2,910	1,588,860
GROUNDING ASSEMBLY	73	210	15,330	110	8,030	320	23,360
R-O-W CLEARING	16.4	2,000	32,800	400	6,560	2,400	39,360

TOTAL COST FOR 16.4 MILES $4,565,000

COST/MILE $278,354

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 6 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	9	7,000	63,000	14,400	129,600	21,400	192,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	15,600	15,600	24,100	24,100
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,000	11,000	21,600	21,600	32,600	32,600
3 POLE GUYED STRUCTURE(DEAD END)	3	13,000	39,000	25,200	75,600	38,200	114,600
ROCK ANCHORS, (PER STRUCTURE)	15	7,000	105,000	1,500	22,500	8,500	127,500
HARDWARE AND INSULATORS(TANGENT)	9	1,400	12,600	1,400	12,600	2,800	25,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	2,300	2,300	1,100	1,100	3,400	3,400
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	100	1,400	140,000	1,510	151,000	2,910	291,000
GROUNDING ASSEMBLY	15	210	3,150	110	1,650	320	4,800
R-O-W CLEARING	3.0	2,000	6,000	400	1,200	2,400	7,200

TOTAL COST FOR 3 MILES $878,000

COST/MILE $292,667

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 7 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR		MATERIAL		LABOR AND MATERIAL	
		UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	116	7,000	812,000	14,400	1,670,400	21,400	2,482,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	7	8,500	59,500	15,600	109,200	24,100	168,700
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	17	10,000	170,000	18,000	306,000	28,000	476,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	4	11,000	44,000	21,600	86,400	32,600	130,400
3 POLE GUYED STRUCTURE(DEAD END)	3	13,000	39,000	25,200	75,600	38,200	114,600
H-PILING, (PER STRUCTURE)	147	8,000	1,176,000	2,500	367,500	10,500	1,543,500
HARDWARE AND INSULATORS(TANGENT)	116	1,400	162,400	1,400	162,400	2,800	324,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	7	1,700	11,900	1,400	9,800	3,100	21,700
HARDWARE AND INSULATORS(MEDIUM ANGLE)	17	1,900	32,300	1,100	18,700	3,000	51,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	4	2,300	9,200	1,100	4,400	3,400	13,600
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	1,078	1,400	1,509,200	1,510	1,627,780	2,910	3,136,980
GROUNDING ASSEMBLY	147	210	30,870	110	16,170	320	47,040
R-O-W CLEARING	32.4	2,000	64,800	400	12,960	2,400	77,760

TOTAL COST FOR 32.4 MILES $8,609,000

COST/MILE $265,710

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 8 NORTHWEST ROUTE

		LABOR		MATERIAL		LABOR AND MATERIAL	
UNIT DESCRIPTION	QUANTITY	UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	8	7,000	56,000	14,400	115,200	21,400	171,200
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25.200	25,200	38,200	38,200
ROCK ANCHORS, (PER STRUCTURE)	9	7,000	63,000	1,500	13,500	8,500	76,500
HARDWARE AND INSULATORS(TANGENT)	8	1,400	11,200	1,400	11,200	2,800	22,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	67	1,400	93,800	1,510	101,170	2,910	194,970
GROUNDING ASSEMBLY	9	210	1,890	110	990	320	2,880
R-O-W CLEARING	2.0	2,000	4,000	400	800	2,400	4,800

TOTAL COST FOR 2 MILES $518,000

COST/MILE $259,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 9 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	9	7,000	63,000	14,400	129,600	21,400	192,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	0	13,000	0	25,200	0	38,200	0
H-PILING, (PER STRUCTURE)	9	8,000	72,000	2,500	22,500	10,500	94,500
HARDWARE AND INSULATORS(TANGENT)	9	1,400	12,600	1,400	12,600	2,800	25,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	67	1,400	93,800	1,510	101,170	2,910	194,970
GROUNDING ASSEMBLY	9	210	1,890	110	990	320	2,880
R-O-W CLEARING	2.0	2,000	4,000	400	800	2,400	4,800

TOTAL COST FOR 2 MILES $515,000

COST/MILE $257,500

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 10 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	39	7,000	273,000	14,400	561,600	21,400	834,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	10,000	0	18,000	0	28,000	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	5	13,000	65,000	25,200	126,000	38,200	191,000
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	44	13,000	572,000	5,000	220,000	18,000	792,000
HARDWARE AND INSULATORS(TANGENT)	39	1,400	54,600	1,400	54,600	2,800	109,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	5	3,200	16,000	3,800	19,000	7,000	35,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	333	1,400	466,200	1,510	502,830	2,910	969,030
GROUNDING ASSEMBLY	44	210	9,240	110	4,840	320	14,080
R-O-W CLEARING	10.0	2,000	20,000	400	4,000	2,400	24,000

TOTAL COST FOR 10 MILES $2,969,000

COST/MILE $296,900

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 11 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	47	7,000	329,000	14,400	676,800	21,400	1,005,800
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	15,600	31,200	24,100	48,200
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	10,000	30,000	18,000	54,000	28,000	84,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25,200	25,200	38,200	38,200
H-PILING, (PER STRUCTURE)	53	8,000	424,000	2,500	132,500	10,500	556,500
HARDWARE AND INSULATORS(TANGENT)	47	1,400	65,800	1,400	65,800	2,800	131,600
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	400	1,400	560,000	1,510	604,000	2,910	1,164,000
GROUNDING ASSEMBLY	53	210	11,130	110	5,830	320	16,960
R-O-W CLEARING	12.0	2,000	24,000	400	4,800	2,400	28,800

TOTAL COST FOR 12 MILES $3,096,000

COST/MILE $258,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 12 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	84	7,000	588,000	14,400	1,209,600	21,400	1,797,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	15,600	31,200	24,100	48,200
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	10,000	20,000	18,000	36,000	28,000	56,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,000	22,000	21,600	43,200	32,600	65,200
3 POLE GUYED STRUCTURE(DEAD END)	1	13,000	13,000	25,200	25,200	38,200	38,200
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	91	13,000	1,183,000	5,000	455,000	18,000	1,638,000
HARDWARE AND INSULATORS(TANGENT)	84	1,400	117,600	1,400	117,600	2,800	235,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	2	1,900	3,800	1,100	2,200	3,000	6,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	670	1,400	938,000	1,510	1,011,700	2,910	1,949,700
GROUNDING ASSEMBLY	91	210	19,110	110	10,010	320	29,120
R-O-W CLEARING	20.1	2,000	40,240	400	8,048	2,400	48,288

TOTAL COST FOR 20.12 MILES $5,932,000

COST/MILE $294,831

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 12A NORTHWEST ROUTE
PUMP 11 TAP SINGLE CIRCUIT

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	6	7,000	42,000	14,400	86,400	21,400	128,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	0	8,500	0	15,600	0	24,100	0
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	10,000	10,000	18,000	18,000	28,000	28,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,000	0	21,600	0	32,600	0
3 POLE GUYED STRUCTURE(DEAD END)	2	13,000	26,000	25,200	50,400	38,200	76,400
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	9	13,000	117,000	5,000	45,000	18,000	162,000
HARDWARE AND INSULATORS(TANGENT)	6	1,400	8,400	1,400	8,400	2,800	16,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	1,700	0	1,400	0	3,100	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	120	1,400	168,000	1,510	181,200	2,910	349,200
GROUNDING ASSEMBLY	9	210	1,890	110	990	320	2,880
R-O-W CLEARING	1.8	2,000	3,600	400	720	2,400	4,320

TOTAL COST FOR 1.8 MILES $785,000

COST/MILE $436,111

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
SINGLE STEEL POLE
LINK 13 NORTHWEST ROUTE(DOUBLE CIRCUIT)

UNIT DESCRIPTION	QUANTITY	LABOR		MATERIAL		LABOR AND MATERIAL	
		UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
SINGLE STEEL POLE STRUCTURE(TANGENT)	48	10,000	480,000	21,000	1,008,000	31,000	1,488,000
SINGLE STEEL POLE STRUCTURE(LIGHT ANGLE)	1	11,500	11,500	22,000	22,000	33,500	33,500
2 POLE STEEL STRUCTURE(MEDIUM ANGLE)	1	13,000	13,000	24,000	24,000	37,000	37,000
2 POLE STEEL STRUCTURE(HEAVY ANGLE)	1	14,500	14,500	29,000	29,000	43,500	43,500
2 POLE STEEL STRUCTURE(DEAD END)	2	17,000	34,000	33,500	67,000	50,500	101,000
H-PILING, (PER STRUCTURE)	53	13,000	689,000	5,000	265,000	18,000	954,000
HARDWARE AND INSULATORS(TANGENT)	48	1,400	67,200	2,800	134,400	4,200	201,600
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	2,500	2,500	2,800	2,800	5,300	5,300
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	3,000	3,000	2,200	2,200	5,200	5,200
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	3,300	3,300	2,200	2,200	5,500	5,500
HARDWARE AND INSULATORS(DEAD END)	2	4,500	9,000	7,600	15,200	12,100	24,200
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	779	1,400	1,090,600	1,510	1,176,290	2,910	2,266,890
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	130	800	104,000	250	32,500	1,050	136,500
GROUNDING ASSEMBLY	53	210	11,130	110	5,830	320	16,960
R-O-W CLEARING	11.7	2,000	23,400	400	4,680	2,400	28,080

TOTAL COST FOR 11.7 MILES $5,347,000

COST/MILE $457,009

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 13A NORTHWEST ROUTE
CLKONA JCT. TAP(DOUBLE CIRCUIT)

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
SINGLE STEEL POLE STRUCTURE(TANGENT)	0	10,000	0	21,000	0	31,000	0
SINGLE STEEL POLE STRUCTURE(LIGHT ANGLE)	0	11,500	0	22,000	0	33,500	0
2 POLE STEEL STRUCTURE(MEDIUM ANGLE)	0	13,000	0	24,000	0	37,000	0
2 POLE STEEL STRUCTURE(HEAVY ANGLE)	0	14,500	0	29,000	0	43,500	0
2 POLE STEEL STRUCTURE(DEAD END)	0	17,000	0	33,500	0	50,500	0
H-PILING, (PER STRUCTURE)	0	10,000	0	3,500	0	13,500	0
HARDWARE AND INSULATORS(TANGENT)	0	1,400	0	2,800	0	4,200	0
HARDWARE AND INSULATORS(LIGHT ANGLE)	0	2,500	0	2,800	0	5,300	0
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	3,000	0	2,200	0	5,200	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	3,300	0	2,200	0	5,500	0
HARDWARE AND INSULATORS(DEAD END)	0	4,500	0	7,600	0	12,100	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	0	1,400	0	1,510	0	2,910	0
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	0	800	0	250	0	1,050	0
GROUNDING ASSEMBLY	0	210	0	110	0	320	0
R-O-W CLEARING	0.0 0	2,000	0	400	0	2,400	0

TOTAL COST FOR 0 MILES $0

COST/MILE $0

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 14 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	29	7,500	217,500	15,600	452,400	23,100	669,900
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	4	8,500	34,000	16,800	67,200	25,300	101,200
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	11,000	0	19,200	0	30,200	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	1	14,500	14,500	26,400	26,400	40,900	40,900
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	34	13,000	442,000	5,000	170,000	18,000	612,000
HARDWARE AND INSULATORS(TANGENT)	29	1,400	40,600	1,400	40,600	2,800	81,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	4	1,700	6,800	1,400	5,600	3,100	12,400
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	255	1,400	357,000	1,510	385,050	2,910	742,050
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	85	800	68,000	250	21,250	1,050	89,250
GROUNDING ASSEMBLY	34	210	7,140	110	3,740	320	10,880
R-O-W CLEARING	7.7	2,000	15,300	400	3,060	2,400	18,360

TOTAL COST FOR 7.65 MILES $2,385,000

COST/MILE $311,765

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 15 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	21	7,500	157,500	15,600	327,600	23,100	485,100
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	11,000	22,000	19,200	38,400	30,200	60,400
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,500	23,000	22,800	45,600	34,300	68,600
3 POLE GUYED STRUCTURE(DEAD END)	1	14,500	14,500	26,400	26,400	40,900	40,900
H-PILING(MULTIBLE PILES), (PER STRUCTURE)	27	15,000	405,000	7,500	202,500	22,500	607,500
HARDWARE AND INSULATORS(TANGENT)	21	1,400	29,400	1,400	29,400	2,800	58,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	2	1,900	3,800	1,100	2,200	3,000	6,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	1	3,200	3,200	3,800	3,800	7,000	7,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	200	1,400	280,000	1,510	302,000	2,910	582,000
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	67	800	53,600	250	16,750	1,050	70,350
GROUNDING ASSEMBLY	27	210	5,670	110	2,970	320	8,640
R-O-W CLEARING	6.0	2,000	12,000	400	2,400	2,400	14,400

TOTAL COST FOR 6 MILES $2,045,000

COST/MILE $340,833

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 16 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	45	7,500	337,500	15,600	702,000	23,100	1,039,500
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	5	11,000	55,000	19,200	96,000	30,200	151,000
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	3	11,500	34,500	22,800	68,400	34,300	102,900
3 POLE GUYED STRUCTURE(DEAD END)	2	14,500	29,000	26,400	52,800	40,900	81,800
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	56	13,000	728,000	5,000	280,000	18,000	1,008,000
HARDWARE AND INSULATORS(TANGENT)	45	1,400	63,000	1,400	63,000	2,800	126,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	3	2,300	6,900	1,100	3,300	3,400	10,200
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	420	1,400	588,000	1,510	634,200	2,910	1,222,200
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	140	800	112,000	250	35,000	1,050	147,000
GROUNDING ASSEMBLY	56	210	11,760	110	6,160	320	17,920
R-O-W CLEARING	12.6	2,000	25,200	400	5,040	2,400	30,240

TOTAL COST FOR 12.60 MILES $3,988,000

COST/MILE $316,508

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 17 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR		MATERIAL		LABOR AND MATERIAL	
		UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	3	7,500	22,500	15,600	46,800	23,100	69,300
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	1	11,000	11,000	19,200	19,200	30,200	30,200
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
H-PILING(MULTIBLE PILES), (PER STRUCTURE)	5	15,000	75,000	7,500	37,500	22,500	112,500
HARDWARE AND INSULATORS(TANGENT)	3	1,400	4,200	1,400	4,200	2,800	8,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	1	1,900	1,900	1,100	1,100	3,000	3,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	34	1,400	47,600	1,510	51,340	2,910	98,940
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	12	800	9,600	250	3,000	1,050	12,600
GROUNDING ASSEMBLY	5	210	1,050	110	550	320	1,600
R-O-W CLEARING	1.0	2,000	2,000	400	400	2,400	2,400

TOTAL COST FOR 1 MILE $367,000

COST/MILE $367,000

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 18 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	4	7,500	30,000	15,600	62,400	23,100	92,400
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	16,800	33,600	25,300	50,600
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	11,000	0	19,200	0	30,200	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
H-PILING(EXTRA LENGTH), (PER STRUCTURE)	6	13,000	78,000	5,000	30,000	18,000	108,000
HARDWARE AND INSULATORS(TANGENT)	4	1,400	5,600	1,400	5,600	2,800	11,200
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	40	1,400	56,000	1,510	60,400	2,910	116,400
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	14	800	11,200	250	3,500	1,050	14,700
GROUNDING ASSEMBLY	6	210	1,260	110	660	320	1,920
R-O-W CLEARING	1.2	2,000	2,400	400	480	2,400	2,880

TOTAL COST FOR 1.2 MILES $404,000

COST/MILE $336,667

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 19 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	16	7,500	120,000	15,600	249,600	23,100	369,600
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	16,800	33,600	25,300	50,600
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	11,000	33,000	19,200	57,600	30,200	90,600
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
H-PILING, (PER STRUCTURE)	21	8,000	168,000	2,500	52,500	10,500	220,500
HARDWARE AND INSULATORS(TANGENT)	16	1,400	22,400	1,400	22,400	2,800	44,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	157	1,400	219,800	1,510	237,070	2,910	456,870
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	53	800	42,400	250	13,250	1,050	55,650
GROUNDING ASSEMBLY	21	210	4,410	110	2,310	320	6,720
R-O-W CLEARING	4.7	2,000	9,400	400	1,880	2,400	11,280

TOTAL COST FOR 4.7 MILES $1,322,000

COST/MILE $281,277

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 20 NORTHWEST ROUTE

		LABOR		MATERIAL		LABOR AND MATERIAL	
UNIT DESCRIPTION	QUANTITY	UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	11	7,500	82,500	15,600	171,600	23,100	254,100
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	0	11,000	0	19,200	0	30,200	0
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	0	11,500	0	22,800	0	34,300	0
3 POLE GUYED STRUCTURE(DEAD END)	2	14,500	29,000	26,400	52,800	40,900	81,800
ROCK ANCHORS, (PER STRUCTURE)	14	7,000	98,000	1,500	21,000	8,500	119,000
HARDWARE AND INSULATORS(TANGENT)	11	1,400	15,400	1,400	15,400	2,800	30,800
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	0	1,900	0	1,100	0	3,000	0
HARDWARE AND INSULATORS(HEAVY ANGLE)	0	2,300	0	1,100	0	3,400	0
HARDWARE AND INSULATORS(DEAD END)	2	3,200	6,400	3,800	7,600	7,000	14,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	104	1,400	145,600	1,510	157,040	2,910	302,640
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	35	800	28,000	250	8,750	1,050	36,750
GROUNDING ASSEMBLY	14	210	2,940	110	1,540	320	4,480
R-O-W CLEARING	3.1	2,000	6,200	400	1,240	2,400	7,440

TOTAL COST FOR 3.1 MILES $879,000

COST/MILE $283,548

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 21 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	15	7,500	112,500	15,600	234,000	23,100	346,500
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	2	8,500	17,000	16,800	33,600	25,300	50,600
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	2	11,000	22,000	19,200	38,400	30,200	60,400
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	1	11,500	11,500	22,800	22,800	34,300	34,300
3 POLE GUYED STRUCTURE(DEAD END)	0	14,500	0	26,400	0	40,900	0
H-PILING, (PER STRUCTURE)	20	8,000	160,000	2,500	50,000	10,500	210,000
HARDWARE AND INSULATORS(TANGENT)	15	1,400	21,000	1,400	21,000	2,800	42,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	2	1,700	3,400	1,400	2,800	3,100	6,200
HARDWARE AND INSULATORS(MEDIUM ANGLE)	2	1,900	3,800	1,100	2,200	3,000	6,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	1	2,300	2,300	1,100	1,100	3,400	3,400
HARDWARE AND INSULATORS(DEAD END)	0	3,200	0	3,800	0	7,000	0
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	147	1,400	205,800	1,510	221,970	2,910	427,770
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	49	800	39,200	250	12,250	1,050	51,450
GROUNDING ASSEMBLY	20	210	4,200	110	2,200	320	6,400
R-O-W CLEARING	4.4	2,000	8,800	400	1,760	2,400	10,560

TOTAL COST FOR 4.4 MILES $1,256,000

COST/MILE $285,455

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 22 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	268	7,500	2,010,000	15,600	4,180,800	23,100	6,190,800
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	18	8,500	153,000	16,800	302,400	25,300	455,400
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	13	11,000	143,000	19,200	249,600	30,200	392,600
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	6	11,500	69,000	22,800	136,800	34,300	205,800
3 POLE GUYED STRUCTURE(DEAD END)	7	14,500	101,500	26,400	184,800	40,900	286,300
H-PILING,PRE DRILLED (PER STRUCTURE)	312	18,000	5,616,000	5,000	1,560,000	23,000	7,176,000
HARDWARE AND INSULATORS(TANGENT)	268	1,400	375,200	1,400	375,200	2,800	750,400
HARDWARE AND INSULATORS(LIGHT ANGLE)	18	1,700	30,600	1,400	25,200	3,100	55,800
HARDWARE AND INSULATORS(MEDIUM ANGLE)	13	1,900	24,700	1,100	14,300	3,000	39,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	6	2,300	13,800	1,100	6,600	3,400	20,400
HARDWARE AND INSULATORS(DEAD END)	7	3,200	22,400	3,800	26,600	7,000	49,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	2,361	1,400	3,305,400	1,510	3,565,110	2,910	6,870,510
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	787	800	629,600	250	196,750	1,050	826,350
GROUNDING ASSEMBLY	312	210	65,520	110	34,320	320	99,840
R-O-W CLEARING	71.0	2,000	142,000	400	28,400	2,400	170,400

TOTAL COST FOR 71 MILES $23,589,000

COST/MILE $332,239

COST ESTIMATE
230KV TRANSMISSION LINE
APA NORTHEAST INTERTIE
GUYED TUBULAR X-FRAME
LINK 23 NORTHWEST ROUTE

UNIT DESCRIPTION	QUANTITY	LABOR		MATERIAL		LABOR AND MATERIAL	
		UNIT	SUBTOTAL	UNIT	SUBTOTAL	UNIT	SUBTOTAL
X-BRACED TUBULAR STRUCTURE(TANGENT)	90	7,500	675,000	15,600	1,404,000	23,100	2,079,000
X-BRACED TUBULAR STRUCTURE(LIGHT ANGLE)	1	8,500	8,500	16,800	16,800	25,300	25,300
3 POLE GUYED STRUCTURE(MEDIUM ANGLE)	3	11,000	33,000	19,200	57,600	30,200	90,600
3 POLE GUYED STRUCTURE(HEAVY ANGLE)	2	11,500	23,000	22,800	45,600	34,300	68,600
3 POLE GUYED STRUCTURE(DEAD END)	3	14,500	43,500	26,400	79,200	40,900	122,700
H-PILING, (PER STRUCTURE)	99	8,000	792,000	2,500	247,500	10,500	1,039,500
HARDWARE AND INSULATORS(TANGENT)	90	1,400	126,000	1,400	126,000	2,800	252,000
HARDWARE AND INSULATORS(LIGHT ANGLE)	1	1,700	1,700	1,400	1,400	3,100	3,100
HARDWARE AND INSULATORS(MEDIUM ANGLE)	3	1,900	5,700	1,100	3,300	3,000	9,000
HARDWARE AND INSULATORS(HEAVY ANGLE)	2	2,300	4,600	1,100	2,200	3,400	6,800
HARDWARE AND INSULATORS(DEAD END)	3	3,200	9,600	3,800	11,400	7,000	21,000
CONDUCTOR ASSEMBLY(RAIL 954 ACSR)	747	1,400	1,045,800	1,510	1,127,970	2,910	2,173,770
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	249	800	199,200	250	62,250	1,050	261,450
GROUNDING ASSEMBLY	99	210	20,790	110	10,890	320	31,680
R-O-W CLEARING	22.5	2,000	44,900	400	8,980	2,400	53,880

TOTAL COST FOR 22.45 MILES $6,238,000

COST/MILE $277,862

COST ESTIMATE
ALASKA POWER AUTHORITY
APA NORTHEAST INTERTIE
CARNEY TO NORTH POLE
138 KV WOOD TRANSMISSION LINE
SINGLE POLE WITH FUTURE/UB

UNIT DESCRIPTION	QUANTITY	LABOR UNIT	LABOR SUBTOTAL	MATERIAL UNIT	MATERIAL SUBTOTAL	LABOR AND MATERIAL UNIT	LABOR AND MATERIAL SUBTOTAL
WOOD POLE (TANGENT W/OHGW,80'- H1)	366	2,500	915,000	2,000	732,000	4,500	1,647,000
WOOD POLE(DEADEND/HEAVY ANGLE W/ OHGW 85'- H2)	22	3,000	66,000	2,300	50,600	5,300	116,600
HARDWARE AND INSULATORS(TANGENT)	366	1,000	366,000	3,300	1,207,800	4,300	1,573,800
HARDWARE AND INSULATORS(DEADEND/HEAVY ANGLE)	22	3,000	66,000	4,000	88,000	7,000	154,000
CONDUCTOR ASSEMBLY(DRAKE 795 AAC)	366	2,000	732,000	1,540	563,640	3,540	1,295,640
OHGW ASSEMBBLY(3/8 E.H.S.STEEL)	122	800	97,600	250	30,500	1,050	128,100
GROUNDING ASSEMBLY	388	210	81,480	110	42,680	320	124,160
RIGHT OF WAY CLEARING	22	6,000	132,000	0	0	6,000	132,000

SUBTOTAL

TOTAL COST 22 MILES	$5,171,000
COST PER MILE	235,045

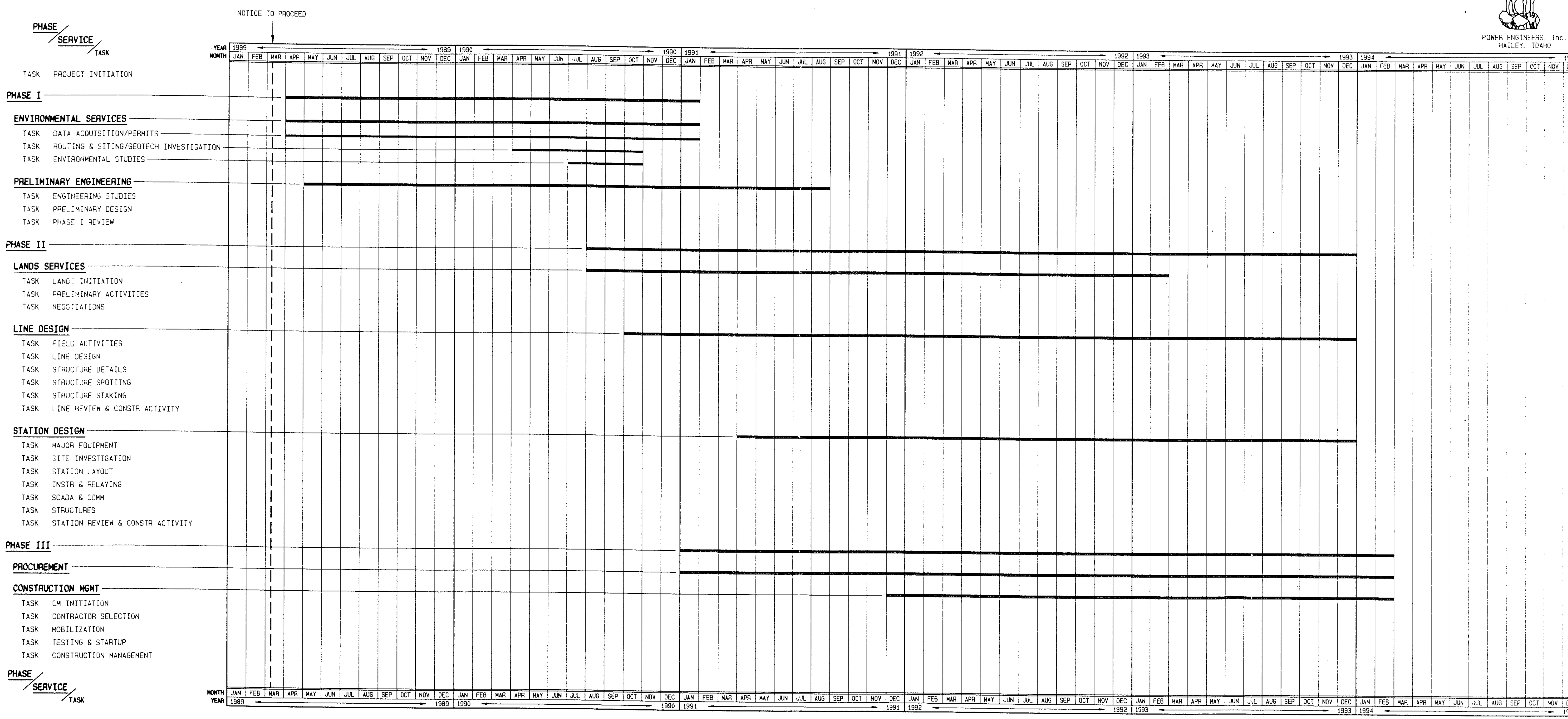
XIII. SCHEDULE

PROJECT SCHEDULE

ISSUED FEBRUARY 1989

ALASKA POWER AUTHORITY
NORTHEAST TRANSMISSION INTERTIE

POWER ENGINEERS, Inc.
HAILEY, IDAHO



XIV. TABLES

TABLE 1
LOAD SUMMARY BY UTILITY

		CURRENT				YEAR 10 PROJECTIONS				YEAR 20 PROJECTIONS			
UTILITY DESIGNATION		WINTER PEAK		SUMMER VALLEY		WINTER PEAK		SUMMER VALLEY		WINTER PEAK		SUMMER VALLEY	
		MW	MVAR	MW	MVAR	MW	MVAR	MW	MVAR	MW	MVAR	MW	MVAR
1	CEA	171.97	60.98	53.31	18.90	185.85	65.90	57.61	20.43	234.59	83.18	72.72	25.79
2	MLP	146.00	48.00	58.40	19.20	155.54	51.14	62.22	20.45	185.84	61.10	74.33	24.44
3	MEA	87.90	17.84	22.85	5.94	88.39	17.94	22.98	4.66	108.68	22.06	28.26	5.73
4	LAWING	6.00	1.20	3.78	0.76	8.11	1.62	5.11	1.02	8.81	1.76	5.55	1.11
5	HEA	85.51	24.54	50.45	14.48	80.67	23.15	47.59	13.66	86.14	24.72	50.82	14.59
6	GVEA	110.00	43.30	29.70	11.69	139.88	55.06	37.77	14.87	170.02	66.92	45.90	18.07
7	MUS	30.00	9.00	8.10	2.43	38.15	11.44	10.30	3.09	43.73	13.12	11.81	3.54
TOTAL WO/CVEA		637.38	204.86	226.60	73.40	696.59	226.26	243.58	78.19	837.81	272.87	289.40	93.27
8	CVEA	10.87	2.17	8.26	1.65	16.62	3.32	24.70	4.94	19.86	3.97	30.11	6.02
TOTAL W/CVEA		648.25	207.03	234.85	75.05	713.21	229.58	268.29	83.13	857.67	276.84	319.51	99.29

Table 2

Generation Schedule

Cases HW88 100MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga	282MW
Bernice Lake	72MW
Cooper Lake	16MW
AMLP Station 1 and 2	229MW
Eklutna	30MW
Bradley Lake	---
Solomon Gulch	4MW
Chena 5	18MW
Healy	22MW
North Pole	---
Co-Gen (Fairbanks)	---

Table 3

Generation Schedule

Cases HW88 72MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga	279MW
Bernice Lake	72MW
Cooper Lake	16MW
AMLP Station 1 and 2	193MW
Eklutna	30MW
Bradley Lake	---
Solomon Gulch	4MW
Chena 5	18MW
Healy	22MW
North Pole	33MW
Co-Gen (Fairbanks)	---

Table 4

Generation Schedule

Cases LS88 17MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga Bernice Lake Cooper Lake	184MW 27MW ---
AMLP Station 1 and 2	---
Eklutna Bradley Lake Solomon Gulch	--- --- 12MW
Chena 5	---
Healy North Pole Co-Gen (Fairbanks)	20MW --- ---

Table 5

Generation Schedule

Cases HW08 98MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga Bernice Lake Cooper Lake	304MW 54MW 16MW
AMLP Station 1 and 2	261MW
Eklutna Bradley Lake Solomon Gulch	30MW 116MW 4MW
Chena 5	20MW
Healy North Pole Co-Gen (Fairbanks)	25MW 60MW 15MW

Table 6

Generation Schedule

Cases HW08 70MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga	276MW
Bernice Lake	19MW
Cooper Lake	16MW
AMLP Station 1 and 2	261MW
Eklutna	30MW
Bradley Lake	116MW
Solomon Gulch	4MW
Chena 5	20MW
Healy	25MW
North Pole	105MW
Co-Gen (Fairbanks)	15MW

Table 7

Generation Schedule

Cases HW08 150MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga	324MW
Bernice Lake	54MW
Cooper Lake	16MW
AMLP Station 1 and 2	279MW
Eklutna	30MW
Bradley Lake	116MW
Solomon Gulch	4MW
Chena 5	20MW
Healy	25MW
North Pole	30MW
Co-Gen (Fairbanks)	15MW

Table 8

Generation Schedule

Cases LS08 17MW Transfer to Fairbanks

GENERATION	OUTPUT
Beluga	224MW
Bernice Lake	27MW
Cooper Lake	---
AMLP Station 1 and 2	27MW
Eklutna	---
Bradley Lake	---
Solomon Gulch	12MW
Chena 5	---
Healy	25MW
North Pole	---
Co-Gen (Fairbanks)	15MW

Table 9

Original U of A Database

Peak Load 40 MW North

AREA	GENERATION MW	GENERATION MVAR	LOAD MW	LOAD MVAR	LOSSES MW	INTERCHANGE MW	INTERCHANGE MVAR
CHUGACH	295	16	172	61	6.679	116	18
AMLP	181	68	146	48	0.712	34	-1
MEA	30	4	88	18	1.447	-58	-11
SEWARD	0	0	6	1	0.011	-5	0
HEA	40	7	86	25	2.324	-47	-17
GVEA	86	16	110	43	4.244	-27	8
FMUS	21	8	30	9	0.013	-8	5
TOTAL:	653	120	637	205	15.431	0	0

Table 10

Original U of A Database With The N.E. Intertie

	GENERATION		LOAD		LOSSES	INTERCHANGE	
AREA	MW	MVAR	MW	MVAR	MW	MW	MVAR
CHUGACH	300	1	172	61	6.908	121	2
AMLP	181	65	146	48	0.713	34	-3
MEA	30	4	88	18	2.323	-59	1
SEWARD	0	0	6	1	0.011	-5	0
HEA	40	7	86	25	2.321	-47	-17
GVEA	86	-1	110	43	1.968	-24	10
FMUS	21	7	30	9	0.013	-8	4
CVEA	4	-25	10	2	0.142	-5	5
TOTAL:	662	56	648	207	14.400	0	0

Table 11

APA - N.E. Intertie - Case 2 HW88

	GENERATION		LOAD		LOSSES	INTERCHANGE	
AREA	MW	MVAR	MW	MVAR	MW	MW	MVAR
CHUGACH	370	13	172	61	8.620	190	-5
AMLP	229	69	146	48	0.708	82	-4
MEA	30	9	88	18	4.982	-62	-11
SEWARD	0	0	6	1	0.011	-5	0
HEA	0	0	86	25	2.923	-87	-7
GVEA	22	13	110	43	7.141	-94	-5
FMUS	18	16	30	9	0.023	-11	13
CVEA	4	1	11	2	0.711	-7	24
TOTAL:	673	120	648	207	25.120	0	0

Table 12

APA - N.E. Intertie - Case 10 HW88

	GENERATION		LOAD		LOSSES	INTERCHANGE	
AREA	MW	MVAR	MW	MVAR	MW	MW	MVAR
CHUGACH	367	6	172	61	8.202	187	-7
AMLP	193	64	146	48	0.733	46	-6
MEA	30	7	88	18	2.805	-60	0
SEWARD	0	0	6	1	0.011	-5	0
HEA	0	0	86	25	2.922	-87	-7
GVEA	55	6	110	43	3.936	-58	6
FMUS	18	11	30	9	0.018	-11	7
CVEA	4	-18	11	2	0.368	-6	9
TOTAL:	667	75	648	207	18.994	0	0

Table 13

APA - N.E. Intertie - Case 2 LS88

AREA	GENERATION MW	GENERATION MVAR	LOAD MW	LOAD MVAR	LOSSES MW	INTERCHANGE MW	INTERCHANGE MVAR
CHUGACH	211	-67	53	19	5.037	153	10
AMLP	0	0	58	19	0.213	-58	-16
MEA	0	0	23	6	0.282	-22	20
SEWARD	0	0	4	1	0.004	-3	1
HEA	0	-4	50	14	0.692	-50	-8
GVEA	20	-21	30	12	1.895	-11	7
FMUS	0	0	8	2	0.004	-7	-2
CVEA	12	-23	8	2	0.184	4	-8
TOTAL:	243	-117	235	75	8.312	0	0

Table 14

APA - N.E. Intertie - Case 1 HW08

AREA	GENERATION MW	GENERATION MVAR	LOAD MW	LOAD MVAR	LOSSES MW	INTERCHANGE MW	INTERCHANGE MVAR
CHUGACH	374	88	235	83	21.649	118	-11
AMLP	261	100	186	61	0.786	74	12
MEA	30	13	109	22	6.516	-85	-19
SEWARD	0	0	9	2	0.026	-8	0
HEA	116	14	86	25	8.326	21	-17
GVEA	100	58	170	67	9.500	-78	-2
FMUS	20	23	44	13	0.056	-23	14
CVEA	4	3	20	4	0.919	-16	29
TOTAL:	905	299	858	277	47.778	0	0

Table 15

APA - N.E. Intertie - Case 2 HW08

AREA	GENERATION MW	GENERATION MVAR	LOAD MW	LOAD MVAR	LOSSES MW	INTERCHANGE MW	INTERCHANGE MVAR
CHUGACH	311	40	235	83	11.504	65	-14
AMLP	261	92	186	61	0.785	74	5
MEA	30	9	109	22	3.408	-81	-4
SEWARD	0	0	9	2	0.027	-8	0
HEA	116	14	86	25	7.416	22	-14
GVEA	145	13	170	67	5.590	-29	5
FMUS	20	15	44	13	0.046	-23	6
CVEA	4	0	20	4	0.511	-15	19
TOTAL:	887	182	858	277	29.285	0	0

Table 16

APA - N.E. Intertie - Case 13 HW08

AREA	GENERATION MW	GENERATION MVAR	LOAD MW	LOAD MVAR	LOSSES MW	INTERCHANGE MW	INTERCHANGE MVAR
CHUGACH	394	98	235	83	21.636	138	-11
AMLP	279	104	186	61	0.621	93	17
MEA	30	15	109	22	9.625	-88	-36
SEWARD	0	0	9	2	0.026	-8	0
HEA	116	14	86	25	7.974	22	-16
GVEA	70	79	170	67	13.749	-112	-5
FMUS	20	24	44	13	0.058	-23	15
CVEA	4	21	20	4	1.452	-16	42
TOTAL:	913	354	858	277	55.141	0	0

Table 17

APA - N.E. Intertie - Case 2 LS08

	GENERATION		LOAD		LOSSES	INTERCHANGE	
AREA	MW	MVAR	MW	MVAR	MW	MW	MVAR
CHUGACH	251	-58	73	26	6.443	172	-4
AMLP	27	3	74	24	0.319	-47	-21
MEA	0	0	28	6	0.999	-28	16
SEWARD	0	0	6	1	0.010	-5	0
HEA	0	0	51	15	0.519	-50	2
GVEA	40	-6	46	18	2.173	-7	11
FMUS	0	0	12	4	0.009	-11	-3
CVEA	12	-23	30	6	0.331	-17	1
TOTAL:	330	-85	319	99	10.803	0	0

9LUG 1361 (08/09/89)

TABLE 18
CONSTRUCTION WINDOWS
Recommended Construction Windows - Both Routes

	J	F	M	A	M	J	J	A	S	O	N	D
Sutton to Glennallen												
Waterfowl Nesting	o	o	o	o			o	o	o	o	o	o
Trumpeter Swan Nesting	o	o	o	o					/o	o	o	o
Glennallen to Isabel Pass												
Waterfowl Nesting	o	o	o	o			o	o	o	o	o	o
Eagle Nesting	o	o	o						o	o	o	o
Trumpeter Swan Nesting	o	o	o	o					/o	o	o	o
Caribou Migration	/o	o	o/		/o	o	o	o	o			
Dall Sheep Lambing (Alaska Range)	o	o	o	o			o	o	o	o	o	o
Isabel Pass to Delta Junction												
Waterfowl Nesting	o	o	o	o			o	o	o	o	o	o

Required Construction Windows - Anadromow Fish Stream Crossings

	J	F	M	A	M	J	J	A	S	O	N	D
Sutton to Glennallen												
Granite Greek Crossing	o	o	o	o	/o	o	o/				o	o
Kings River Crossing	o	o	o	o	/o	o	o/				o	o
Chickaloon River Crossing	o	o	o	o	/o	o	o/				o	o
Mendeltna River Crossing	o	o	o	o	/o	o	o/				o	o
Tolsona River Crossing	o	o	o	o	/o	o	o/				o	o
Moose Creek (both routes)	o	o	o	o							o	o
Glennallen to Isabel Pass												
Gulkana River (both routes)				o	o/							
Haggard Creek (both routes)	o	o	o	o						o	o	o
Gillespie Creek (NE route)	o	o	o	o						o	o	o
Fish Creek (SE route)	o	o	o	o	o/			/o	o	o	o	o
Gunn Creek (SE route)	o	o	o	o	o/			/o	o	o	o	o
Upper Gulkana River (NW route)	o	o	o	o	o/		/o	o	o	o	o	

o - Open for construction
o/ - Open for construction first half of month
/o - Open for construction second half of month

TABLE 19
KNOWN CULTURAL RESOURCE SITES
ALONG PROPOSED INTERTIE CORRIDOR

SOURCE	SITE NO.	NAME	DESCRIPTION
DIRECTLY CROSSED BY NW OR SE ROUTE			
Anchorage Quadrangle			
AHRS*	ANC-019	Matanuska Glacier Wayside	Prehistoric Site
	ANC-252	Bug Lake	Prehistoric Site
	ANC-255	-	File Not Located
Gulkana Quadrangle			
AHRS*	GUL-030	Xei Tcai bene'	Reported Ahtna settlement
	GUL-128	Gulkana River Site	Prehistoric Site
	XXX-005	Meier Roadhouse Trail	Historic summer and winter mining trail
Mt. Hayes Quadrangle			
AHRS	XMH-219	Timberline Roadhouse	Historic Site
	XMH-229	-	Prehistoric Site
	XMH-273	-	Prehistoric Site
DIRECTLY CROSSED BY SUGGESTED ROUTE			
Gulkana Quadrangle			
AHRS*	GUL-008	Dry Creek Wayside	Historic site
	GUL-054	Dry Creek Roadhouse	Historic Site
	XXX-001	Sourdough Trail Extension	Ahtna subsistence and historic mining trail
	XXX-002	WAMCATS	Military telegraph and transportation route
	XXX-003	Gulkana-Fish Lake Summer Trail	Historic Mining Trail
	XXX-004	Sourdough Trail	Historic Winter Mining Trail
	XXX-007	Paxson-Chistochina Trail	Historic Mining Trail
	XXX-008	Erueka Creek Trail	Historic Summer Mining Trail

SOURCE	SITE NO.	NAME	DESCRIPTION
Mt. Hayes Quadrangle			
AHRS	XMH-014	-	Prehistoric Site
	XMH-221	Gunnysack Creek	Prehistoric Site
	XMH-222	Miller Roadhouse	Historic Site
	XMH-224	Black Rapids Lodge	Historic Site
	XMH-227	Fish Creek	Prehistoric Site
	XMH-287	-	Prehistoric Site
	XMH-288	-	Prehistoric Site
	XMH-317	-	Prehistoric Site
	XMH-389	Yost Trail	Historic MIning Trail
	XMH-392	-	File Not Located
Big Delta Quadrangle			
AHRS	XBD-091	Jarvis Hearth	Prehistoric Site
IN POTENTIAL ACCESS ROAD ZONE FOR NW OR SE ROUTE			
Anchorage Quadrangle			
AHRS*	ANC-016	Eska Station	Associated with Matanuska RR
	ANC-017	Long Lake Wayside	Prehistoric Site
	ANC-041	Weiner Lake	Prehistoric Site
	ANC-256	Sutton Coal Washing Plant	Historic Structure and Settlement
	ANC-257	-	Collapsed Log Structure
	ANC-266	Long Lake	Prehistoric Site
	ANC-486	-	File Not Located
Gulkana Quadrangle			
AHRS*	GUL-056	Sourdough Roadhouse	Historic Site
	GUL-063	Woods Creek	Prehistoric Site
	GUL-064	Mendeltna River Crossing	Prehistoric Site
	GUL-071	Hogan Telegraph Station	Associated with WAMCATS
	GUL-077	Ringling Site	Prehistoric Village Site
	GUL-096	Ewan Cabin and Cemetery	Ethnohistoric Site
	GUL-131	Cuuyi ak're	Ethnohistoric Site

SOURCE	SITE NO.	NAME	DESCRIPTION
Mt. Hayes Quadrangle			
AHRS	XMH-019	-	Prehistoric Site
	XMH-230	Miller Roadhouse	Historic Site
	XMH-334	-	File Not Located

IN POTENTIAL ACCESS ROAD ZONE FOR SUGGESTED ROUTE

SOURCE	SITE NO.	NAME	DESCRIPTION
Anchorage Quadrangle			
AHRS*	ANC-005	Bridge No. 36	Historic Structure
	ANC-009	Chickaloon	Historic Community
	ANC-020	King Mountain Wayside	Collapsed Cabins
	ANC-094	Castle Station	Associated With Matanuska RR
	ANC-259	T.L. Cotter Grave	Marked With Log Cross
	ANC-260	Chickaloon Gravesite No. 2	Cemetery Associated With Historic Settlement
	ANC-261	Chickaloon Gravesite No. 1	Cemetery Associated With Historic Settlement
	ANC-262	-	Collapsed Cabin
Gulkana Quadrangle			
AHRS*	GUL-045	Meier's Roadhouse	Historic Site
	BUL-054	Dry Creek Roadhouse	Historic Site
	GUL-062	St. Nicholas Chapel	Historic Site
	GUL-069	Poplar Grove Roadhouse	Historic Site
	GUL-070	Our Home Roadhouse	Historic Site
	GUL-072	Paxson Radio Site	Prehistoric Site
	GUL-078	Hogan Hiss No. 1	Possible Early Prehistoric Site
	GUL-080	Gulkana River No. 1	Prehistoric Site
	GUL092	Haggard Creek	Historic Creek

SOURCE	SITE NO.	NAME	DESCRIPTION
	GUL-093	RCA Station Site	Prehistoric Site
	GUL-094	Gulkana Weir	Prehistoric Site
Mt. Hayes Quadrangle			
AHRS	XMH-021	-	Prehistoric Site
	XMH-022	-	Prehistoric Site
	XMH-218	Paxson Roadhouse	Historic Structure and Settlement
	XMH-223	Rapids Roadhouse	Historic Site
	XMH-229	-	Prehistoric Site
	XMH-252	Yardang Flint Station	Prehistoric Site
	XMH-253	-	Prehistoric Site
	XMH-335	-	File Not Located
	XMH-336	-	File Not Located
	XMH-337	-	File Not Located
	XMH-338	-	File Not Located
	XMH-339	-	File Not Located

TABLE 20
NORTHEAST INTERTIE
LAND OWNERSHIP
PREFERRED ROUTE ALTERNATIVE

TOWN	RANGE	M	SECTIONS	LAND OWNERSHIP
19N	03E	S	27,23,24,13	Homestead and Mineral Patents
19N	04E	S	18	Mat-Su Borough
19N	04E	S	17	Homestead Patent
19N	04E	S	8, 9, 10, 2, 1	Mat-Su Borough
20N	04E	S	36	State of Alaska
20N	05E	S	31, 30	State of Alaska, Mat-Su Borough
20N	05E	S	29, 20, 21, 22, 23, 24	State of Alaska
20N	05E	S	23 (SW 1/8)	Homestead Patent
20N	06E	S	30	Homestead and Mineral Patents
20N	06E	S	30 (NE 1/4 of NW 1/4)	State of Alaska
20N	06E	S	29, 28, 27, 26, 25	State of Alaska
20N	06E	S	29 (SW 1/4 of NW 1/4)	Homestead Patent
20N	07E	S	30 ,19, 20, 21, 22, 23, 24	State Selected-Tentatively Approved Village Selection Application
20N	08E	S	19, 20, 21, 27, 26, 25	State of Alaska
20N	08E	S	27(NW 1/4 of NE 1/4)	Homestead Patent
20N	09E	S	30,29, 30, 21, 27, 26, 25	State of Alaska DOT/PF R.O.W.
20N	10E	S	30, 19, 17, 16, 9, 10	State Selection
20N	10E	S	30 (S 1/2 of NW 1/4)	Homestead Patent
20N	10E	S	10, 3, 2	Federal Power Project Site
21N	10E	S	34	Federal Power Project Site
21N	10E	S	35, 26, 25	State Selection
21N	11E	S	30, 29, 28, 27, 26, 25, 24	Regional Corporation Selection Ahtna Corporation
21N	12E	S	19, 18, 17, 16, 9, 10, 11, 2, 1	Regional Corporation Selection Ahtna Corporation

TOWN	RANGE	M	SECTIONS	LAND OWNERSHIP
22N	12E	S	36	State Selection
02N	11W	C	24, 13	State Selection - Tentatively Approved
02N	10W	C	18, 7, 8, 5, 4	State Selection - Tentatively Approved
03N	10W	C	33, 34, 35, 36	State Selection - Tentatively Approved
03N	10W	C	35 (SW 1/4 of SE 1/4)	Homestead Patent
03N	10W	C	36 (Sw 1/4 of SW 1/4)	Native Allotment Application
03N	09W	C	31, 32, 33, 34, 35, 36	State Selection - Tentatively Approved
3N	09W	C	32,33	Native Allotment
03N	08W	C	31, 30, 20, 16, 10, 11, 12	State Selection - Tentatively Approved
03N	07W	C	7, 8, 9, 3	State Selection - Tentatively Approved
04N	07W	C	35, 36	State of Alaska
04N	06W	C	30, 29, 28, 27, 26, 25, 24	State Selection - Tentatively Approved
04N	05W	C	19, 20, 21, 15, 11, 12	State Selection - Tentatively Approved
04N	04W	C	18, 17, 20, 21, 22, 23, 24	State Selection - Tentatively Approved
04N	03W	C	18, 17, 16, 15, 14, 13,	Ahtna Regional Corporation
04N	02W	C	19, 17, 16, 15, 14, 13	Ahtna Regional Corporation
04N	01W	C	19, 18, 7, 6	State of Alaska and State Selections
04N	01W	C	30	Ahtna Regional Corporation
05N	01E	C	31, 30, 19	State of Alaska
05N	01E	C	18, 7, 6	Ahtna Regional Corporation
06N	01E	C	31, 30, 19, 18, 7, 6	Ahtna Regional Corporation
07N	01E	C	31, 30, 7	Ahtna Regional Corporation
07N	01E	C	19, 18, 6	Regional Corporation Selection/State Selection
08N	01E	C	31, 30, 19, 18, 7, 6	Ahtna Regional Corporation

TOWN	RANGE	M	SECTIONS	LAND OWNERSHIP
09N	02E	C	36, 25, 24	US Bureau of Land Management
09N	02W	C	24, 1336 (N 1/4)	State Selection - Tentatively Approved
09N	01E	C	19, 18, 7, 5	US Bureau of Land Management
09N	01E	C	7 (NW 1/4)	Native Allotment Application
10N	01W	C	32, 33, 28, 30, 17, 8	U.S. Bureau of Land Management
11N	01W	C	33,34,27,22, 15, 10, 9, 4	US Bureau of Land Management
12N	01W	C	33, 34, 27, 22, 15, 165, 9, 8, 5	US Bureau of Land Management
13N	01W	C	33, 28, 21, 16, 9, 4	US Bureau of Land Management
14N	01W	C	33	US Bureau of Land Management
22S	12E	F	34, 27, 22, 15, 10, 3	US Bureau of Land Management
21S	12E	F	33, 28, 29, 20, 17, 8, 5	State Selection - Tentatively Approved
20S	12E	F	32, 29, 20, 17, 18, 7, 6	State Selection - Tentatively Approved
20S	05W11E	F	1, 2, 3, 4	State Selection - Tentatively Approved
29S	11E	F	33, 28, 29, 20, 17, 8, 5	State Selection - Tentatively Approved
18S	11E	F	32, 29, 30, 19, 18, 7, 6	US Bureau of Land Management
17S	11E	F	36, 25, 24, 23, 14, 10, 3, 4	State Selection
17S	11E	F	23, 14	Homestead Patent
16S	10E	F	33, 32, 29, 20, 17, 8, 5	State Selection
16S	10E	C F	20, (1/2), 27 (SE 1/4)	Military Withdrawal
16S	10E	F	17	Homestead Patent
51S	10E	F	32, 29, 20, 17, 8, 9, 4	US Bureau of Land Management
14S	10E	F	33, 28, 21, 16	US Bureau of Land Management
14S	10E	F	15, 10, 3	State Selection - Tentatively Approved
13S	01E	F	34, 27, 26, 23, 14, (S 1/4)	State Selection - Tentatively Approved

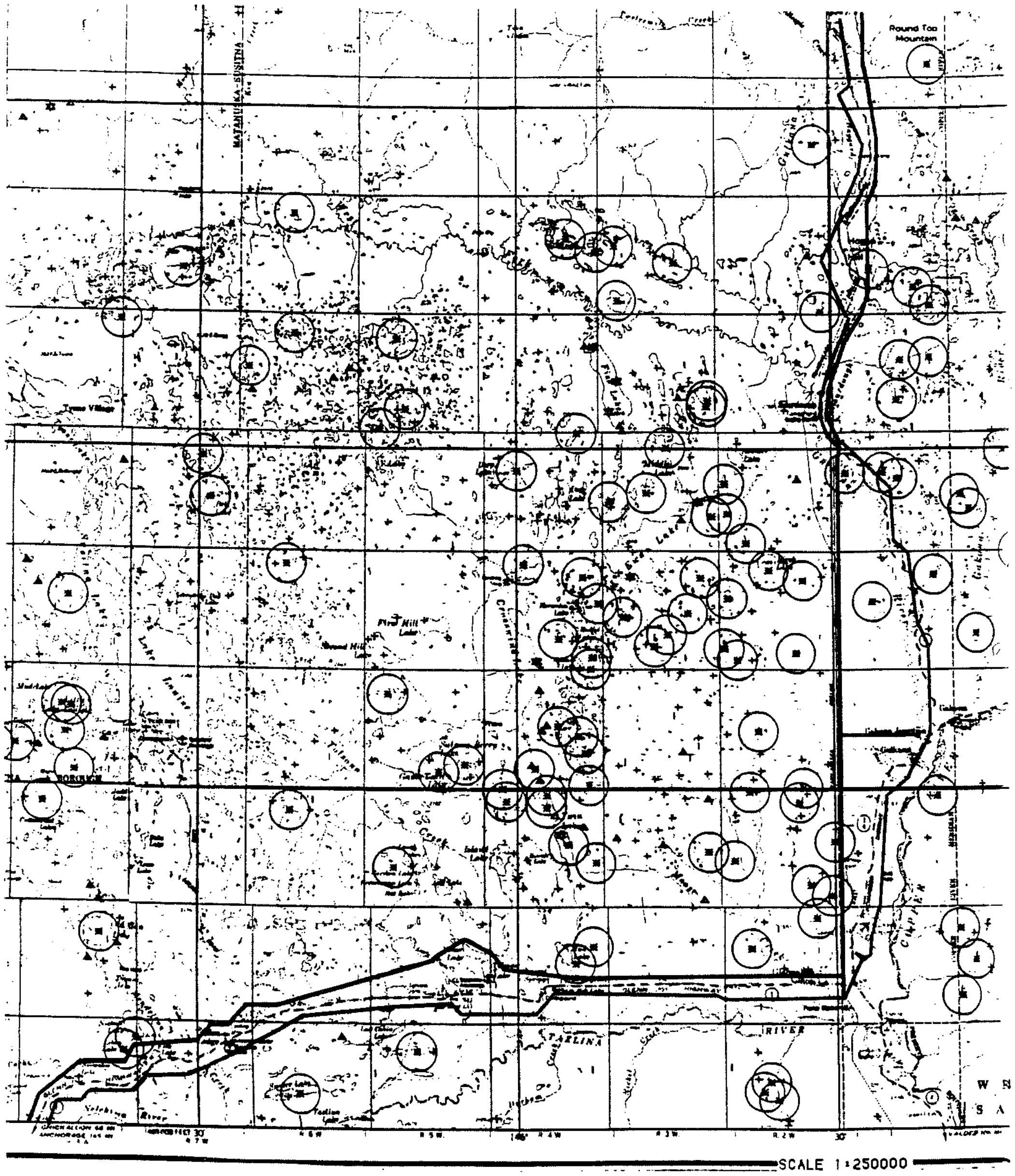
TOWN	RANGE	M	SECTIONS	LAND OWNERSHIP
13S	10E	F	143, 13, 12, 1, 2	Military Withdrawal
12S	10E	F	34, 9, 4	US Bureau of Land Management
12S	10E	F	27, 28, 21, 16	Military Withdrawal/State Selected
11S	10E	F	33, 28, 21, 15, 10, 3	Military Withdrawal
10S	10E	F	23, (S 1/4)	State of Alaska
10S	10E	F	23 (N 1/2 of S 1/2)	Delta Junction Municipal Reserve

XV. EXHIBITS

EXHIBIT I

EXHIBIT I

Trumpeter Swan Survey Data



SYMBOL KEY:
- i SINGLE ADULT
- + BREEDING PAIR
- X BROOD
- ⊡ NEST OR EGGS
- △ FLOCK (9 OR LESS)
- ✡ FLOCK (10 OR MORE)

BUFFER ZONE AROUND BROODS:
RADIUS = 1.00 MILES

DATE PLOTTED: 12/18/85

EXHIBIT II

EXHIBIT II

CULTURAL RESOURCES REFERENCES

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EXHIBIT III

EXHIBIT III

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AGENCY CONTACTS

Alaska Dept. of Environmental Conservation, Anchorage, Bob Flint.

Alaska Dept. of Fish and Game, Habitat Div., Anchorage, Gary Liepitz, Don McKay

Alaska Dept. of Fish and Game, Subsistence Div., Anchorage, Jim Fall

Alaska Dept. of Natural Resources, Div. of Land and Water Mangement, Area Office, Wasilla, Keith Quinteville

Alaska Dept. of Natural Resources, Div. of Parks, Anchorage, Nat Goodhue

Alaska Dept. of Transportation and Public Facilities, Planning Section, Anchorage, Roger Maggard

Alaska Railroad Corporation, Anchorage, Jack Swanson

Matanuska-Susitna Borough, Planning Dept., Palmer, Rod Schulling

U.S. Bureau of Land Management, State Office, Anchorage, Gene Terlin

U.S. Bureau of Land Management, Anchorage District Office, Mike Kasterin

U.S. Bureau of Land Management, Glennallen District Office, Larry Kajden, Dave Mushovic

U.S. Army Corps of Engineers, Regulatory Branch, Anchorage, Joel Ward

U.S. Fish and Wildlife Sercie, Western Alaska Ecological Services, Anchorage, Mike Amaral, Hank Hosking

EXHIBIT IV

EXHIBIT IV

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

STEVE COWPER, GOVERNOR

333 RASPBERRY ROAD
ANCHORAGE, ALASKA 99518-1599
PHONE: (907) 344-0541

January 25, 1989

Hart Crowser, Inc.
Attn: Mr. James D. Gill
Project Manager
2550 Denali Street, Suite 900
Anchorage, Alaska 99503

Dear Mr. Gill:

The Alaska Department of Fish and Game (ADF&G) has reviewed your proposed alternative route alignments for the installation of a 230 Kv transmission line from Sutton through Glennallen to Delta Junction. The following comments are provided for your consideration during the study of the feasibility of this project.

Fisheries Resources

Each of the two alternative routes would require numerous crossings of specified anadromous and resident fish streams. These streams have been identified in the Trans Alaska Pipeline (TAPS) and Trans Alaska Gas (TAGS) environmental impact analyses. The ADF&G recommends you review these documents for fish inventory information. Stream crossings for the construction of an aerial transmission line should pose minimal potential fisheries impacts. Any inwater work or crossings of specified anadromous fish streams will require a permit from the ADF&G pursuant to AS 16.05.870. Timing constraints to avoid affecting spawning anadromous fish or affecting migrating salmon may also be required depending on the methods of construction to be used.

Wildlife Resources

1. Sheep. Dall sheep occur at Sheep Mountain and from about Rainbow Mountain north to Ober Creek. The TAPS Wildlife Atlas (JFWAT) mapped lambing/nursery areas east of the Delta River above approximately the 3,500-ft. contour from Castner Glacier north to Ober Creek and west of the Delta above approximately the 2,500-ft. contour from Black Rapids Glacier north to Mount Pillsbury. Construction activity and aircraft flights should be restricted in the vicinity of

lambing and nursery areas from May 5 through June 20. This restriction should include: no minor ground activity within 1 mile; no major ground activity within 0.25 mile and no aircraft operations less than 0.5 mile horizontal or 1,000 feet AGL vertical. Any structures or other facilities associated with power line construction or operation should be located at least 1 mile from lambing areas. No habitat alteration should occur within 0.25 mile of lambing areas.

Another area where the proposed transmission line alternatives could adversely affect sheep is the proposed northern or western alignment alternative at Sheep Mountain. The valley between Fortress Ridge and Sheep Mountain is used extensively by sheep and caribou during fall and winter. The ADF&G would prefer the transmission line follow the existing highway corridor to avoid unnecessary impacts on sheep fall and winter range.

2. Bears. A known spring concentration area and berry-feeding concentration area for grizzly bears is traversed by the western route alternative from Darling Creek north to Donnelly. A human-carnivore interaction plan is required prior to construction to mitigate potential conflicts.

3. Moose. A known moose winter concentration area is traversed by both route alternatives from Darling Creek north to about TAPS Pump Station #9.

4. Caribou. The range of the Macomb Plateau Caribou Herd is traversed by both route alternatives from Darling Creek north to the communication site road north of Donnelly Dome. Both routes are within the range of the Nelchina Caribou Herd south of Cantwell Glacier and west to about Gunsight Mountain. The Hogan Hill area is a known caribou over wintering area. Spring and fall concentrations occur from south of Sourdough to Paxson Lake and at Eureka near Glennallen.

5. Bison. Bison are distributed along the route alternatives from Darling Creek north to the Delta terminus. Winter range is located at the north end and calving occurs at the south end of this distribution.

6. Waterfowl. Mapped waterfowl concentrations include the Bolio Lake area (north of Donnely Dome), the area between the Dome and upper Ober Creek, and the Summit Lake area. The Delta River is a goose migration area. From 150,000 to 200,000 lesser sandhill cranes migrate along the Tanana River valley (between the Alaska Range and Yukon-Tanana Uplands) in spring and fall, crossing the proposed transmission lines route primarily between Donnelly Dome and

Delta Junction. Additional intensive migratory bird use occurs in the vicinity of both transmission line alternative routes from Paxson Lake to Glennallen and west to the Little Nelchina River. The potential for bird strikes is great throughout for either route alternative.

7. Raptors. Golden eagle and peregrine falcon nesting has occurred in the Alaska Range east of the proposed routes and east of TAPS Isabel Camp, respectively. Again, bird strikes and electrocution of raptors must be considered and mitigated.

General Comments:

Summit Lake Area. The ADF&G recommends that the easterly route alternative be identified as the preferred alternative. The undeveloped area west of Summit Lake should be preserved for its scenic value and left unroaded.

Sutton to Glennallen. The ADF&G recommends the transmission line follow an alignment close to the Glenn Highway. This will provide ease in maintenance inspection and access and reduce aesthetic impacts and sheep and caribou disturbance.

Sincerely,

for Gary S. Liepitz
Habitat Biologist
Region II
Habitat Division
Telephone (907)267-2284

cc: A. Ott, ADF&G
K. Roberson, ADF&G
B. Tobey, ADF&G

Matanuska·Susitna Borough

P.O. BOX 1608, PALMER, ALASKA 99645-1608 • PHONE 745-9661

PLANNING DEPARTMENT

January 9, 1989

Ms. Linda Dwight
P.O. Box 112591
Anchorage, Alaska
99511

Re: Northeast Intertie

Dear Ms. Dwight:

We have the following staff comments relative to environmental concerns involved with the two routes proposed for the Northeast Intertie:

We would request that a substation or substations be included in the design of the project - sufficient to at least provide power to currently unserved areas along the route. This would apply specifically to the area between Miles 109 and 113.5 of the Glenn Highway, and to the Lake Louise area if a substation would facilitate the extension of electrical service to Lake Louise. By Resolution 88-060, the Borough Assembly has supported funding Copper Valley Electric Association through the Alaska Power Authority to extend electrical service to both of these areas (a copy of that resolution is enclosed).

The northern route, or that proposed to be north of the Glenn Highway would appear to be much less obtrusive into the viewshed along the Glenn. The portion of the Glenn Highway between Sutton and Glennallen affords spectacular views - especially to the south into the broad Matanuska valley.

Our Public Lands Division finds that no Borough-owned lands would be affected be either of the proposed alignments.

There are currently two community councils recognized by the Borough which would be affected by this project. They are the Sutton/Alpine Civic Club and the Chickaloon Community Council. Maps and the names and addresses of contact persons are enclosed. We have forwarded maps of the routes to each for comment, but have received none at this writing.

These councils should be kept advised of progress on this project.

Numerous trails would be involved with the proposed northern route. These trails are historically significant and are currently very important for access and recreational purposes. Most are associated with the historic Chickaloon-Nelchina trail system. The Borough is interested in seeing that easements or rights-of-way for these trails are preserved through any utility corridor that may be created through the area. We have enclosed maps showing the more significant trails of concern.

Our Cultural Resources Division is concerned with the protection of historical and archaeological sites in the Borough. Please find enclosed a copy of their memo on this subject. Please note their concluding concern that a cultural resources survey be completed for the routes.

This would appear to be a very worthwhile project. We appreciate the opportunity to comment and would like to continue to be involved in its development.

Sincerely,

Rodney Schulling

Rodney Schulling, Sr. Planner

RS/pmg1175

cc: John Duffy, Director of Planning

Matanuska·Susitna Borough

BOX 1608, PALMER, ALASKA 99645 • PHONE 745-9661

DEVELOPMENT SERVICES DEPARTMENT

MEMORANDUM

DATE: December 29, 1988

TO: Planning Division - Rodney Schulling

FROM: Cultural Resources - Vickie Cole

SUBJECT: Northeast Intertie

We have reviewed the proposed route alignments for the "Northeast Intertie" and have the following comments:

1. More detail of the proposed routes is needed in order to pinpoint the alignments in spatial relationship to known/recorded cultural resource sites along the routes.

2. The Northern route transects the following sections for which there are recorded sites -

T19N R3E Sec. 27	
Chickaloon Bunkhouse	Anc. 718
Sutton Indian Grave Yard	Anc. 255
Old Sutton Post Office	Anc. 016
Sutton Coal Washery	Anc. 256
T20N R5E Sec. 25	
Chickaloon Grave Site #2	Anc. 260
Chickaloon Grave Site #1	Anc. 261
Chickaloon Village and Grave Site	Anc. 562
Chit Ł'uu's House Site	Anc. 563
T21N R12E Sec. 1	
Eureka Roadhouse	Anc. 486

3. The Southern route crosses several sections which have recorded sites -

T19N R3E Sec. 27	
Chickaloon Bunkhouse	Anc. 718
Sutton Indian Grave Yard	Anc. 255
Old Sutton Post Office	Anc. 016
Sutton Coal Washery	Anc. 256

T19N R4E Sec. 17

King Mountain Wayside — Anc. 020

T19N R5E Sec. 5

Castle Station — Anc. 094

4. The Matanuska-Susitna Borough cultural resources inventory of sites is far from complete. Nearly 700 townships within the Borough have yet to be surveyed for sites. In view of the lack of collected data about sites within the proposed intertie routes, this Division requests that a cultural resources survey be completed for the routes before a final choice is made. This is especially important because the same basic route was used by Natives in pre-contact times and by early explorers, miners and trappers.

If there are any furthers questions please feel free to contact us.

Thank you for your cooperation in helping us to document Borough history.

Sincerely,

Vickie Cole

Vickie Cole, Chief
Division of Cultural Resources

MATANUSKA-SUSITNA BOROUGH

Resolution 88-060

A RESOLUTION OF THE ASSEMBLY OF THE MATANUSKA-SUSITNA BOROUGH SUPPORTING THE REQUEST OF COPPER VALLEY ELECTRIC ASSOCIATION FOR THE FUNDING OF TWO PROJECTS WITHIN THE BOROUGH.

WHEREAS, the Copper Valley Electric Association (CVEA) has requested that the Alaska Power Authority seek funds for two projects within the Matanuska-Susitna Borough - $250,000 for Phase II of the Sheep Mountain line extension and $1,500,000 for the extension of a power line into the Lake Louise area; and

WHEREAS, CVEA has completed Phase I of the Sheep Mountain project and has a balance of funds remaining from that project, which could be applied toward the completion of Phase II; and

WHEREAS, completion of the Sheep Mountain line extension would, in effect, complete the electrification of the entire length of the Glenn Highway within the Borough; and

WHEREAS, extension of electrical service to the Lake Louise area would provide conventional electric power to a currently unserved area of the Borough, and one that has significant economic development potential based upon its recreational assets; and

WHEREAS, the Borough's Planning Commission, through public hearings, including a teleconference in the areas

Reso 88-060

affected, has determined that there is a need and support for both of these projects; and

WHEREAS, while both of these projects are highly desirable, the completion of the Sheep Mountain Line Extension should have the higher priority if funds for both are not available;

NOW THEREFORE BE IT RESOLVED, that the Assembly of the Matanuska-Susitna Borough supports the request of the Copper Valley Electric Association for the funding through the Alaska Power Association of the completion of the Sheep Mountain Line Extension (from Mile 113.5 to Mile 109 of the Glenn Highway) and of the extension of electrical service to the Lake Louise area - both projects serving interests within the Matanuska-Susitna Borough;

BE IT FURTHER RESOLVED, that the Assembly recommends the Rail Belt Energy Fund as the source of funding for these projects; and

BE IT FURTHER RESOLVED, that the Assembly recommends that if both of these projects cannot be funded during the next legislative session, that the Sheep Mountain Line Extension be given priority for available funds, and that monies for the extension of service to the Lake Louise area be sought the following session.

Reso. 88-060

PASSED AND APPROVED by the Assembly of the Matanuska-Susitna Borough this 3rd day of May, 1988

Dorothy A. Jones

Dorothy A. Jones, Mayor

ATTEST:

Kristen L. Van Horden, for

Linda Dahl, Borough Clerk

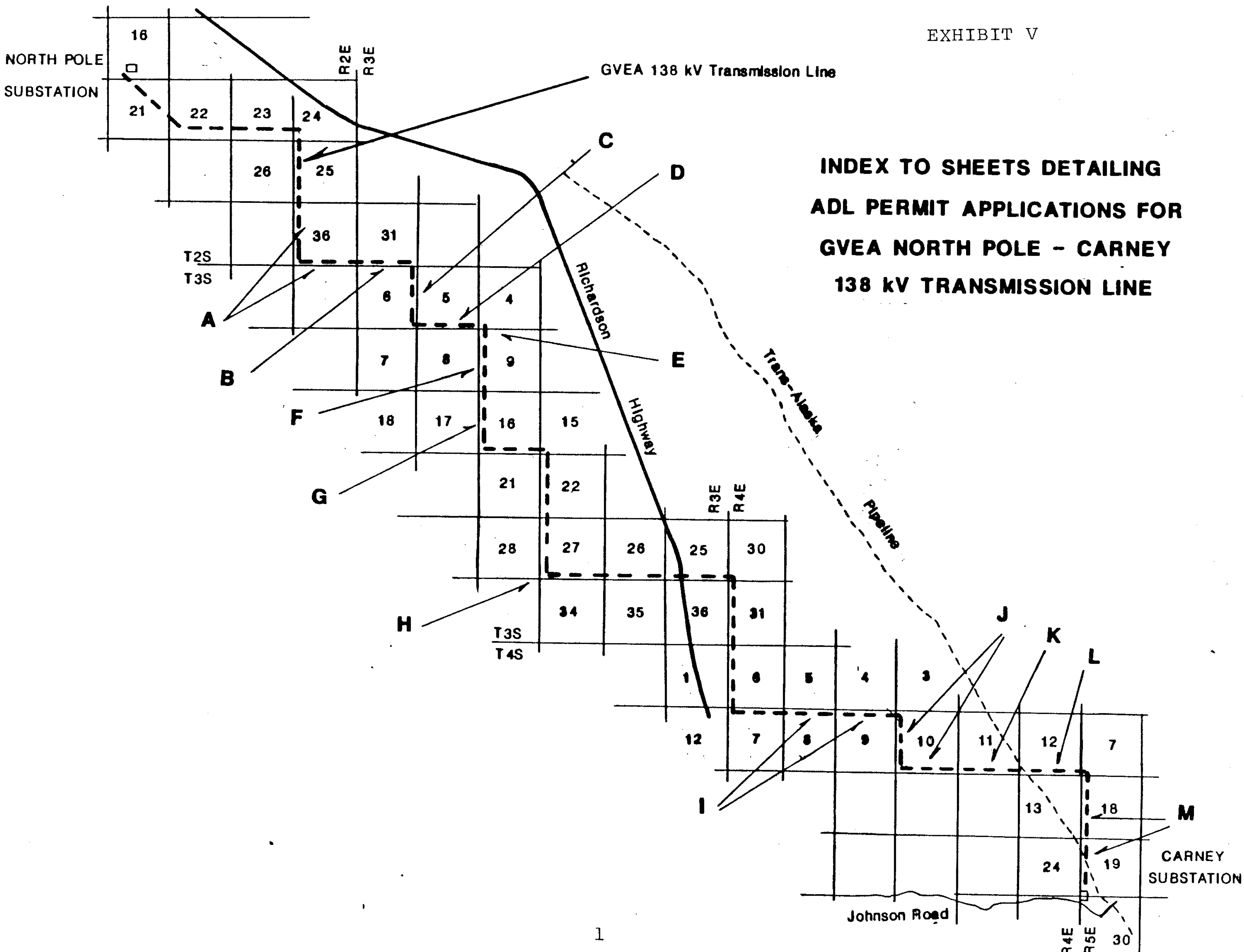
(SEAL)

Reso. 88-060

EXHIBIT V

EXHIBIT V

INDEX TO SHEETS DETAILING ADL PERMIT APPLICATIONS FOR GVEA NORTH POLE - CARNEY 138 kV TRANSMISSION LINE



EIELSON AG PARCEL 7006 ADL 408478

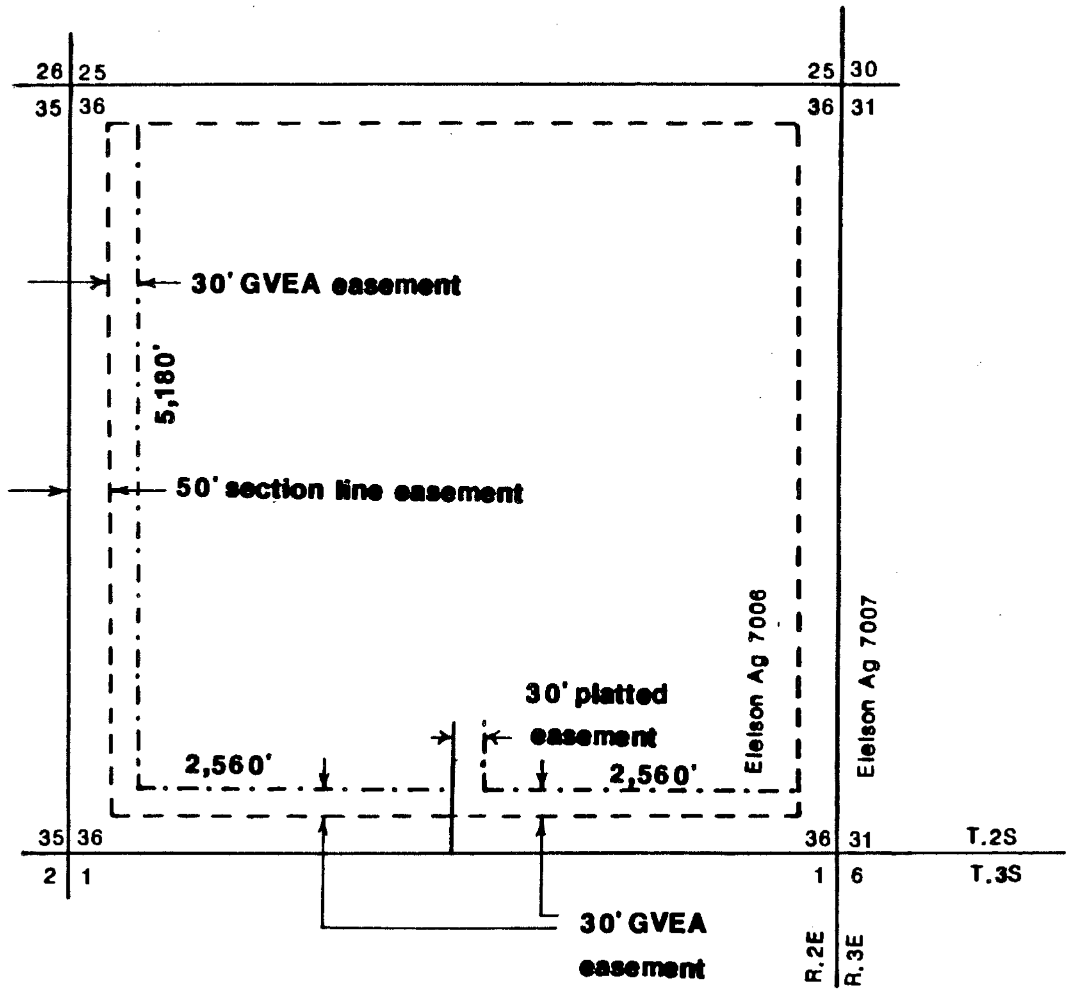
AND W1/2 SECTION 36, T.2S, R.2E, F.M.

Application for GVEA Permit

area = 7.09 acres

4" = 1 mile

(easements not to scale)

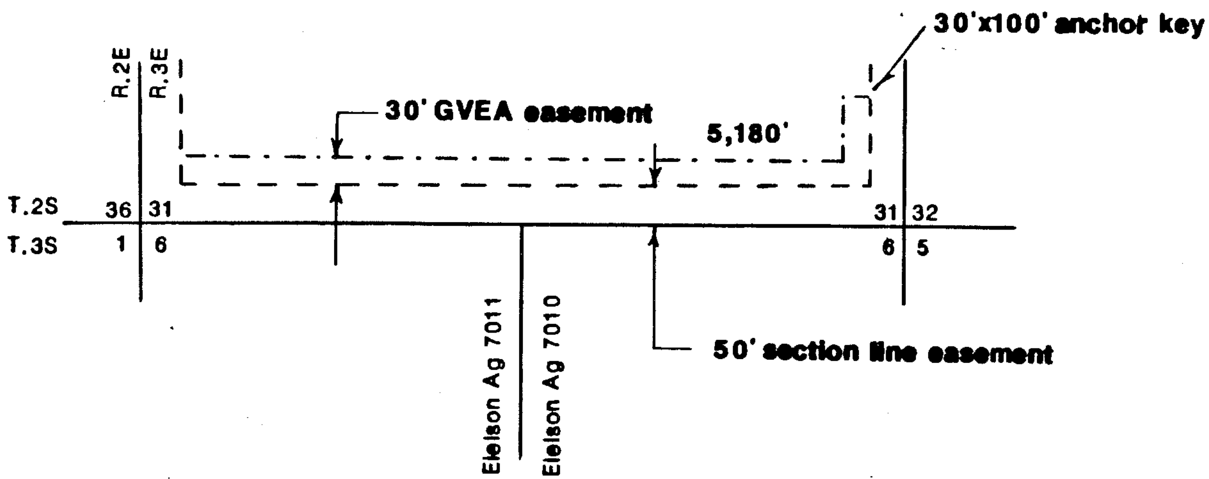


SHEET A

EIELSON AG PARCEL 7007
ADL 408479

Application for GVEA Permit
area = 3.62 acres

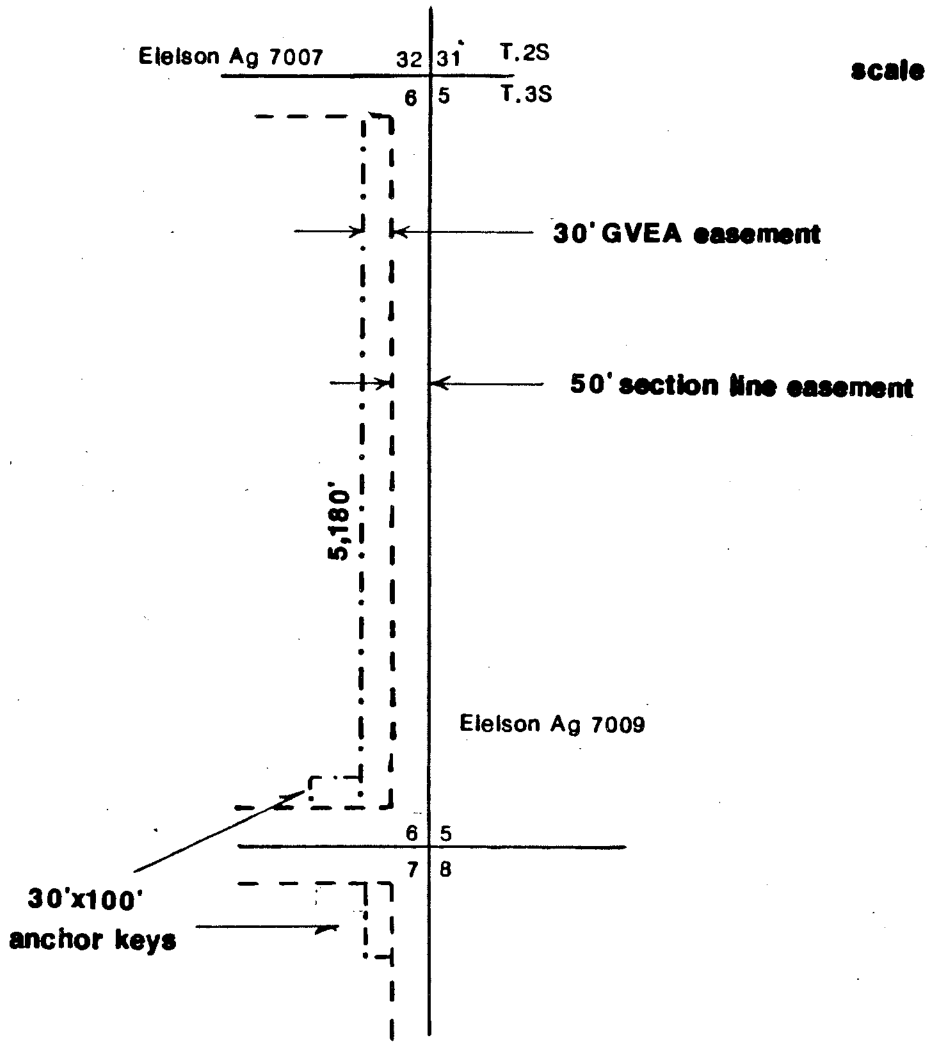
scale as dimensioned



SHEET B

EIELSON AG PARCEL 7012 ADL 408484
EIELSON AG PARCEL 7010 ADL 408482

GVEA Application for ADL Permit
area = 3.68 acres



SHEET C

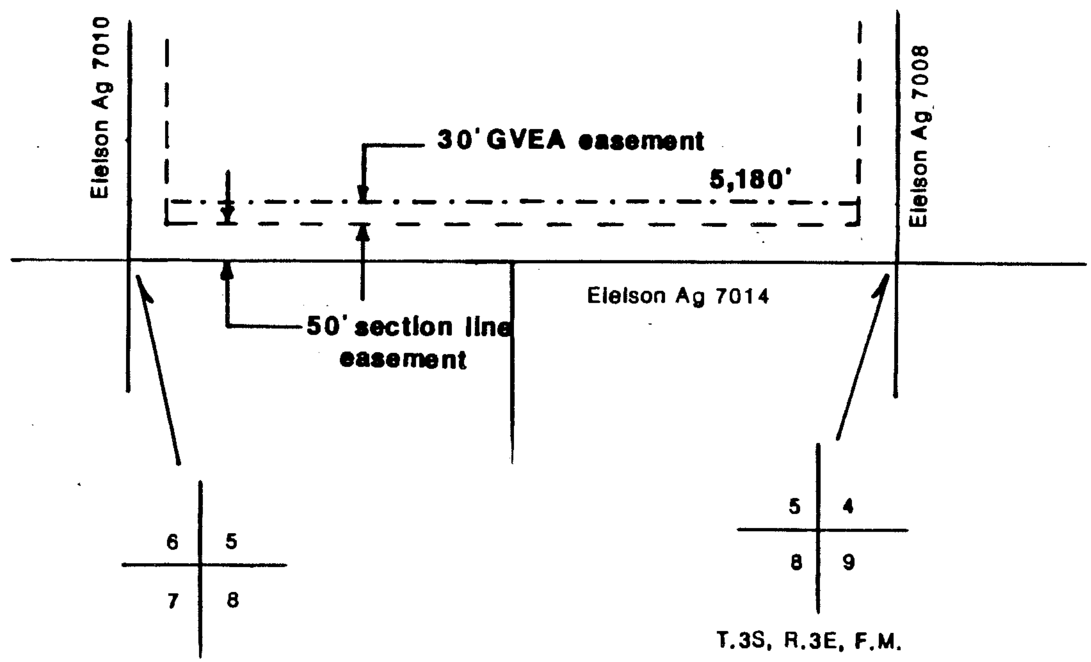
EIELSON AG PARCEL 7009

ADL 408401

Application for GVEA Permit

area = 3.57 acres

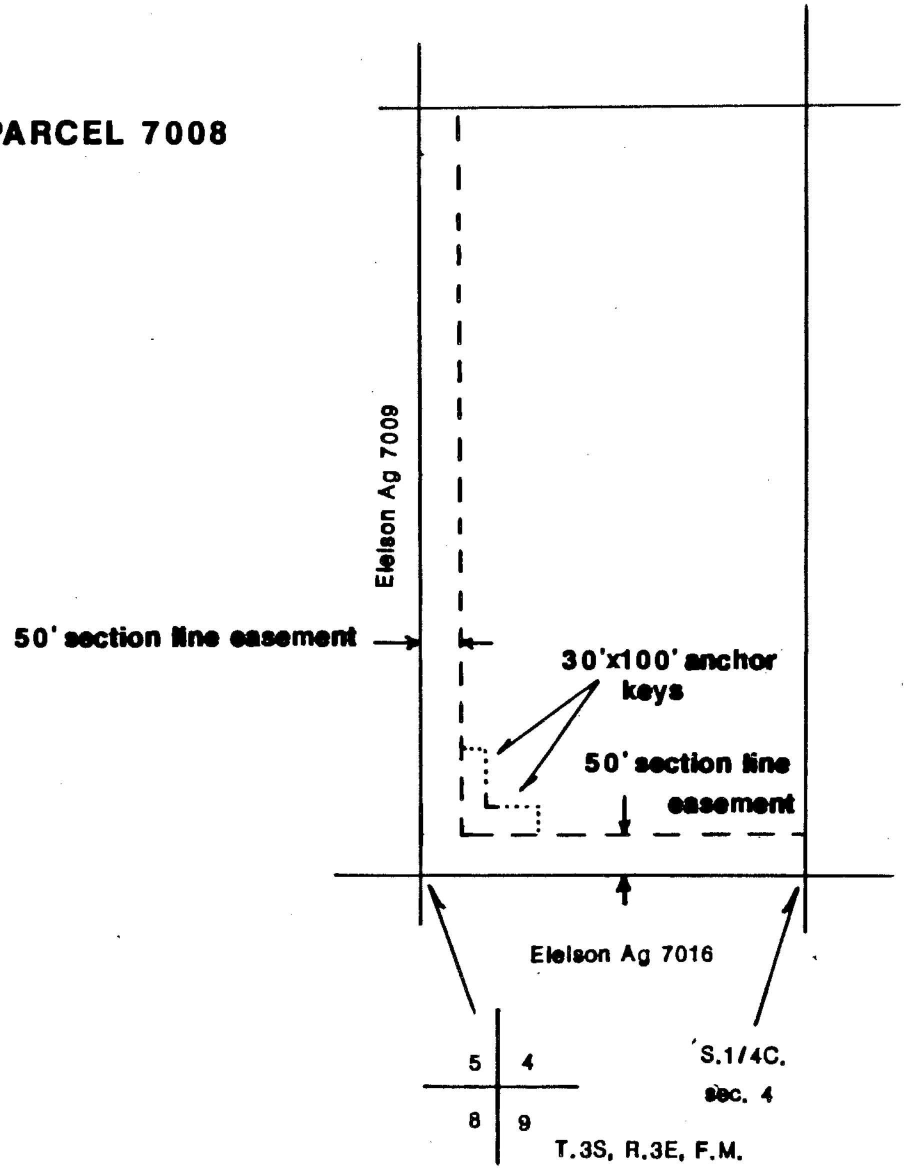
4" = 1 mile
(easements not to scale)



SHEET D

EIELSON AG PARCEL 7008

ADL 408480



Application for GVEA Permit

area = 0.14 acres

scale as dimensioned

SHEET E

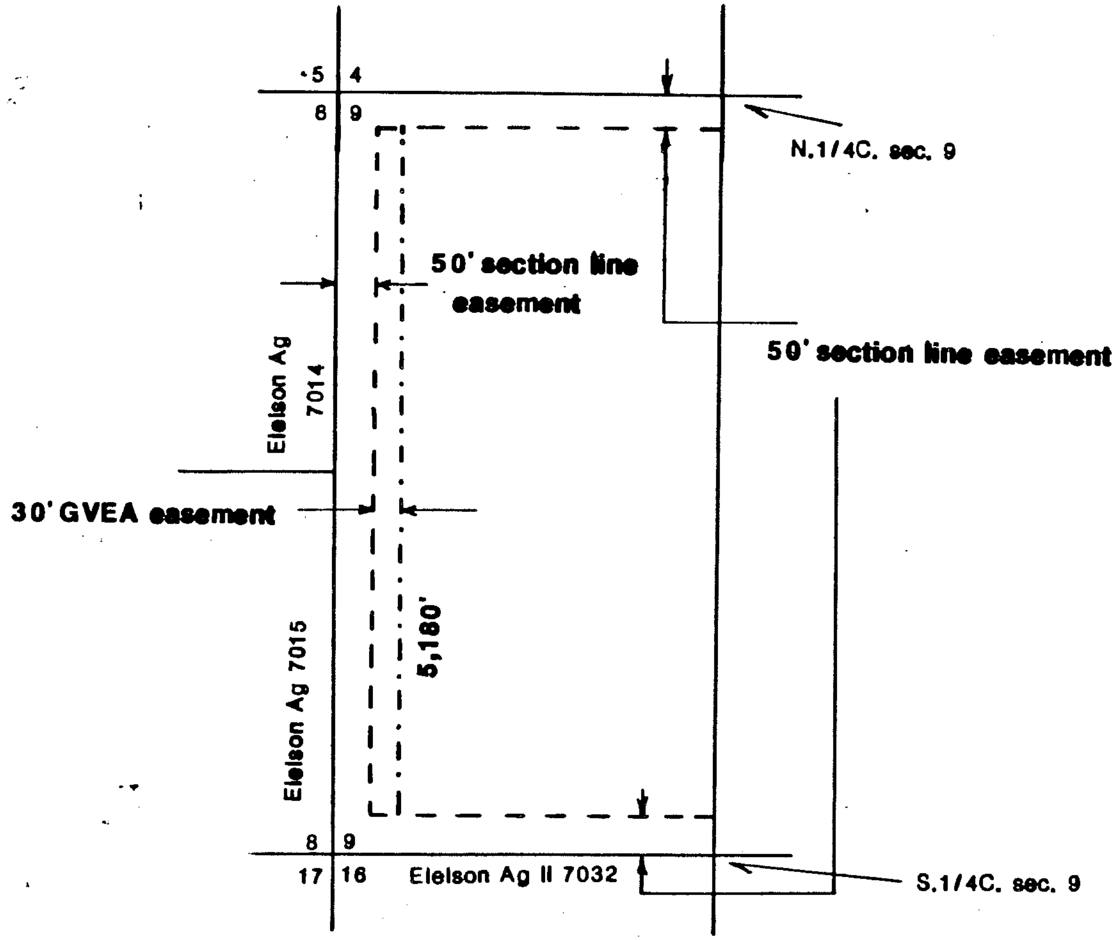
EIELSON AG PARCEL 7016

ADL 408488

Application for GVEA Permit

area = 3.57 acres

scale as dimensioned



SHEET F

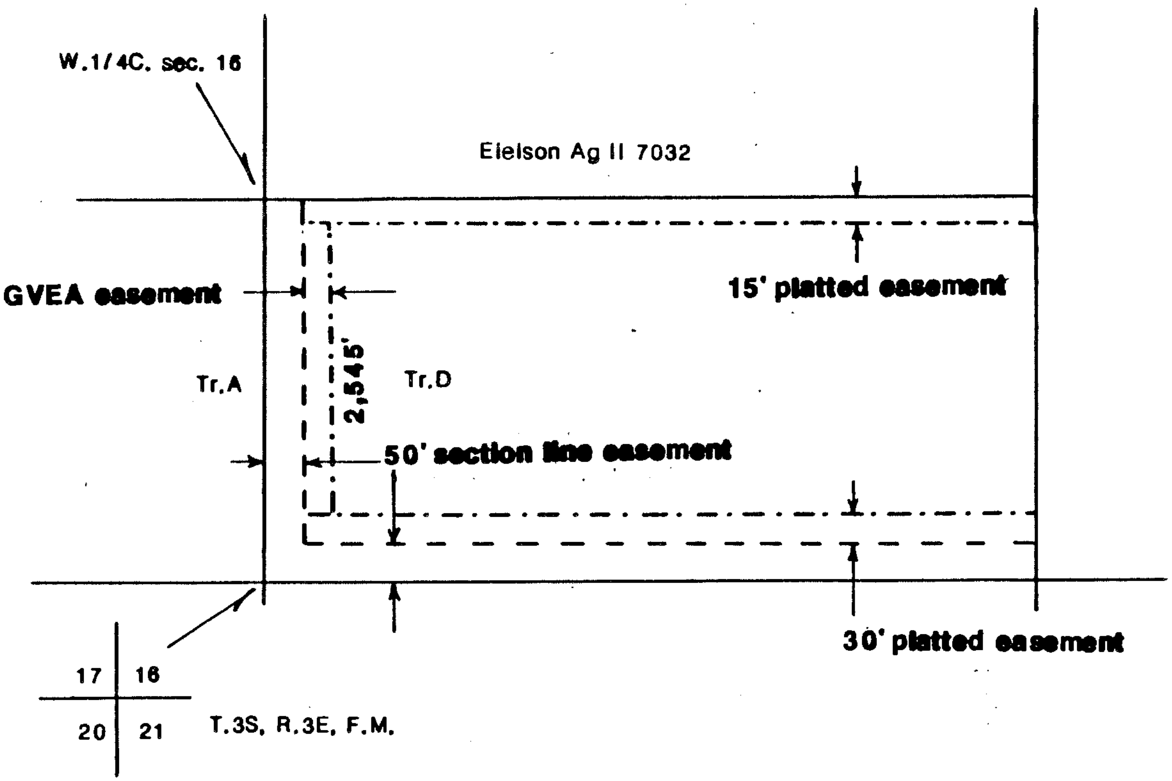
EIELSON AG II PARCEL 7033

ADL 411228

Application for GVEA Permit

area = 1.75 acres

scale as dimensioned



SHEET G

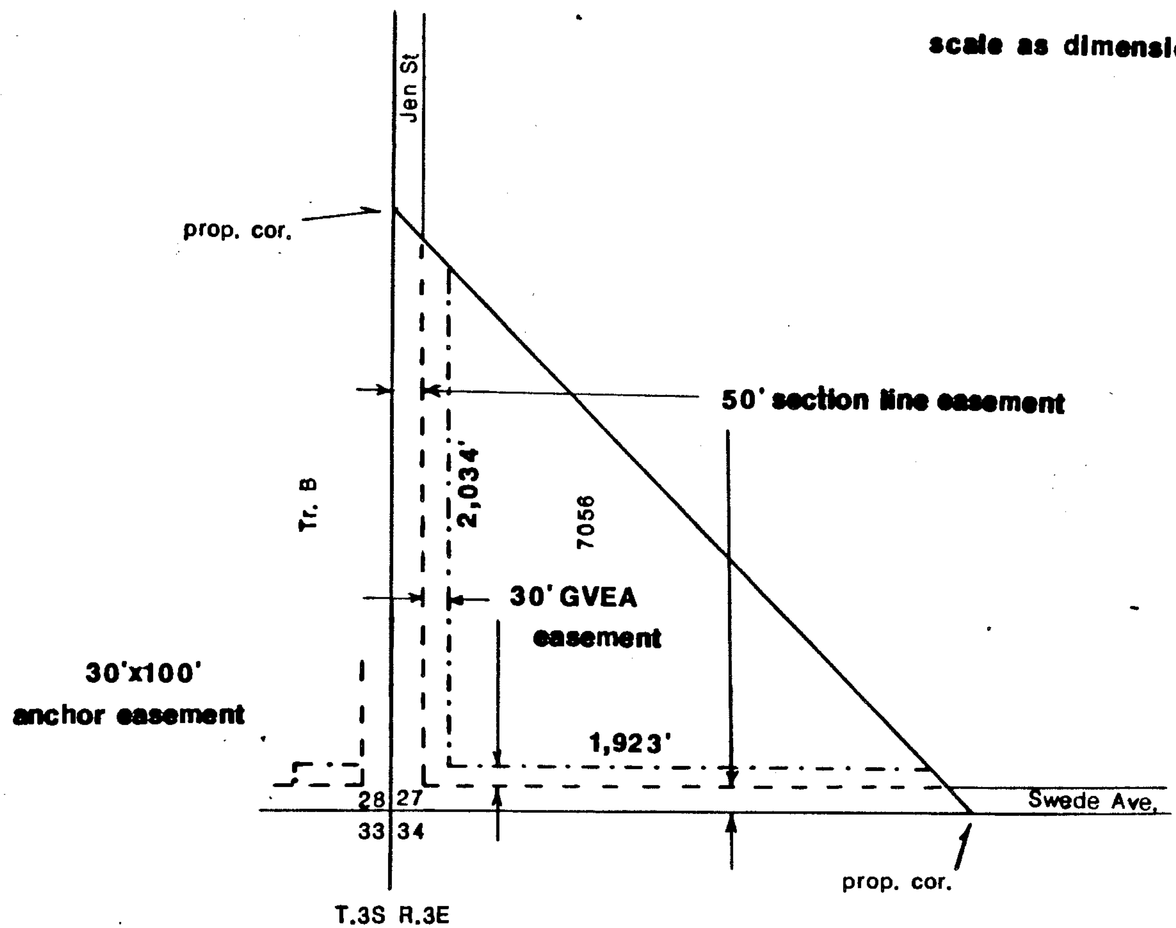
23 MILE SLOUGH PARCEL 7056 ADL 409425

23 MILE SLOUGH TRACT B

Application for GVEA Permit

area = 2.79 acres

scale as dimensioned



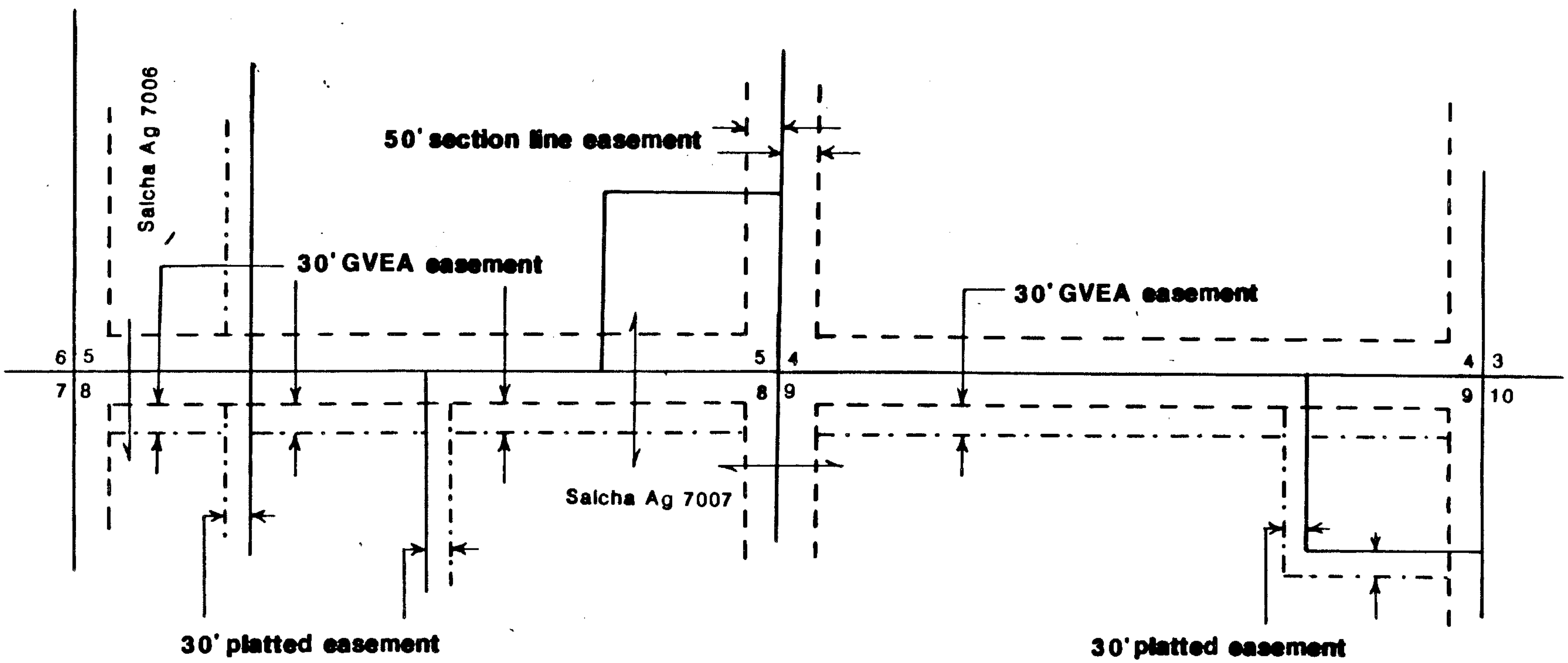
SHEET H

SALCHA AG PARCEL 7006
SALCHA AG PARCEL 7007, ADL 407085
NE1/4 NW1/4 Sec. 8
NE1/4 NE1/4 Sec. 9
T.4S, R.4E, F.M.

Application for GVEA Permit

area = 7.07 acres

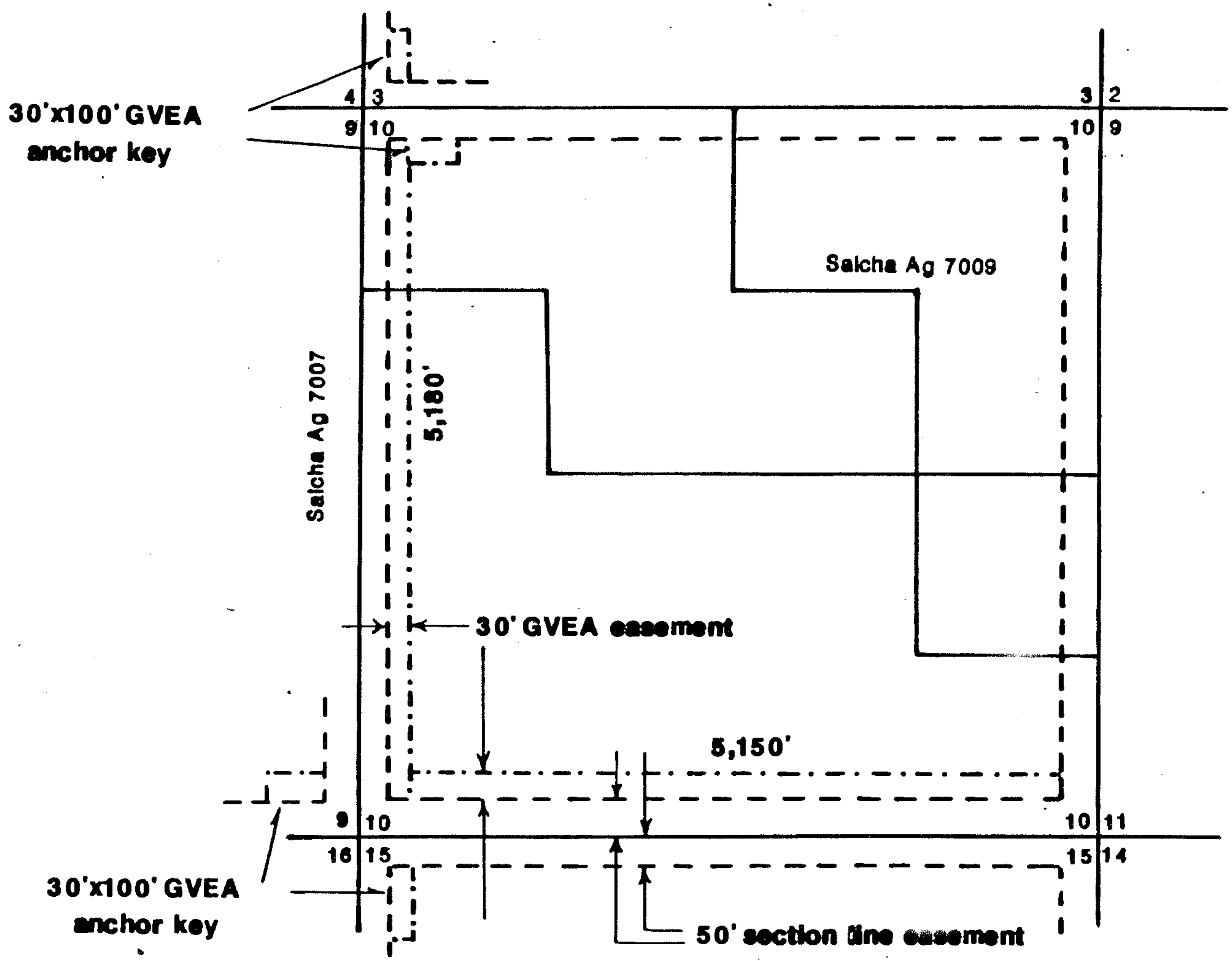
scale as dimensioned



SALCHA AG PARCEL 7008 ADL 407086
NW1/4 Section 10, T.4S, R.4E
SW1/4 Section 3, T.4S,R.4E
NW1/4 Section 3, T.4S, R.4E

Application for GVEA Permit
area = 7.37 acres

scale as dimensioned



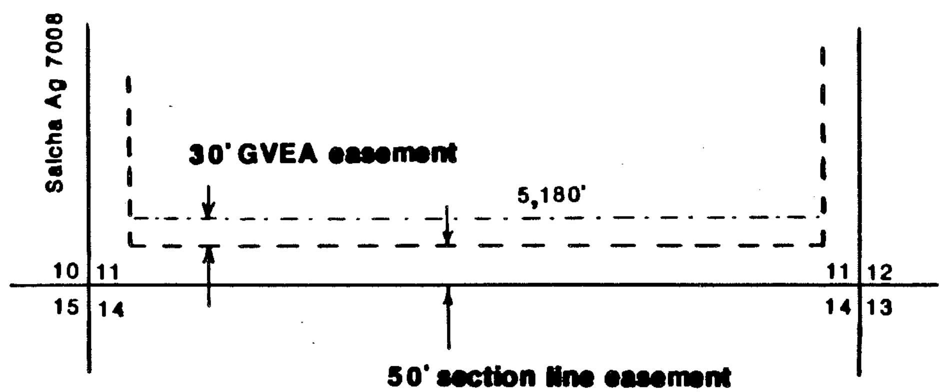
SHEET J

STATE LANDS SECTION 11, T.4S,R.4E, F.M.

Application for GVEA Permit

area = 3.57 acres

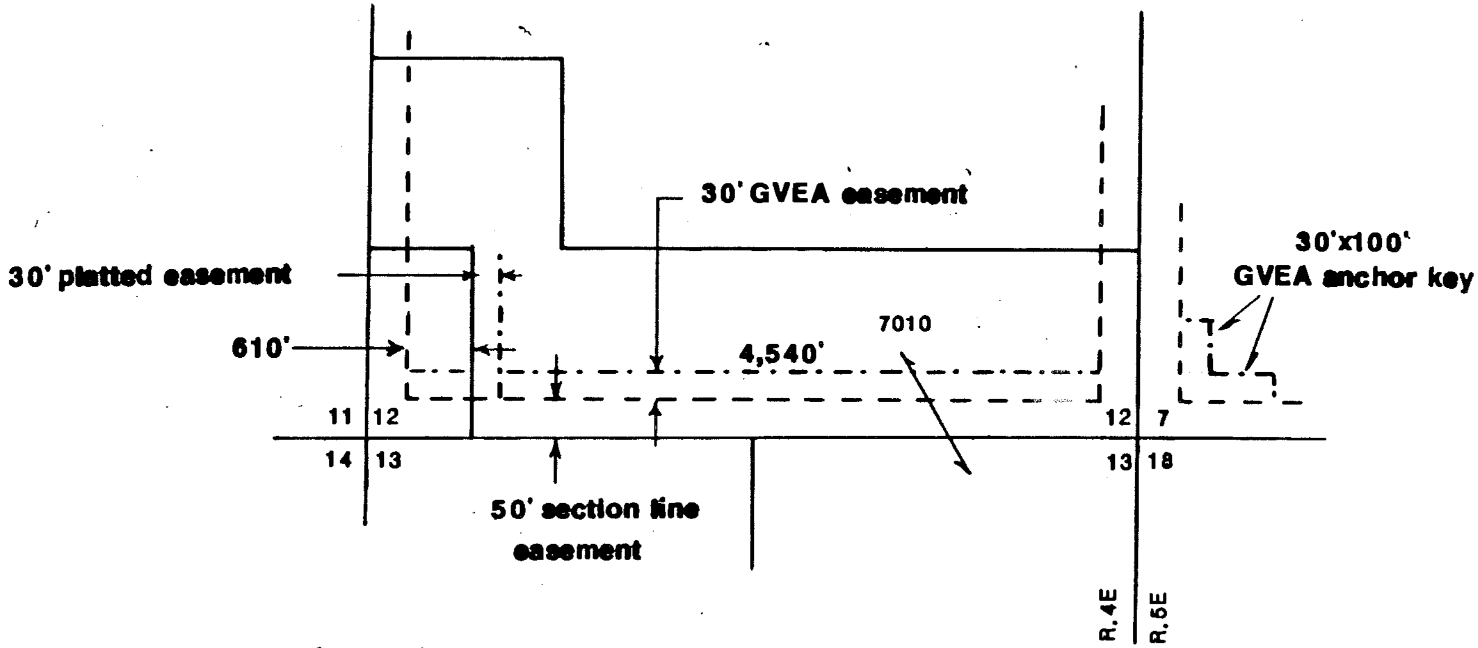
scale as dimensioned



SALCHA AG PARCEL 7010 ADL 407088
SW1/4 Section 12, T.4S, R.4E
SW1/4 Section T.4S, R.5E

Application for GVEA Permit

area = 3.66 acres

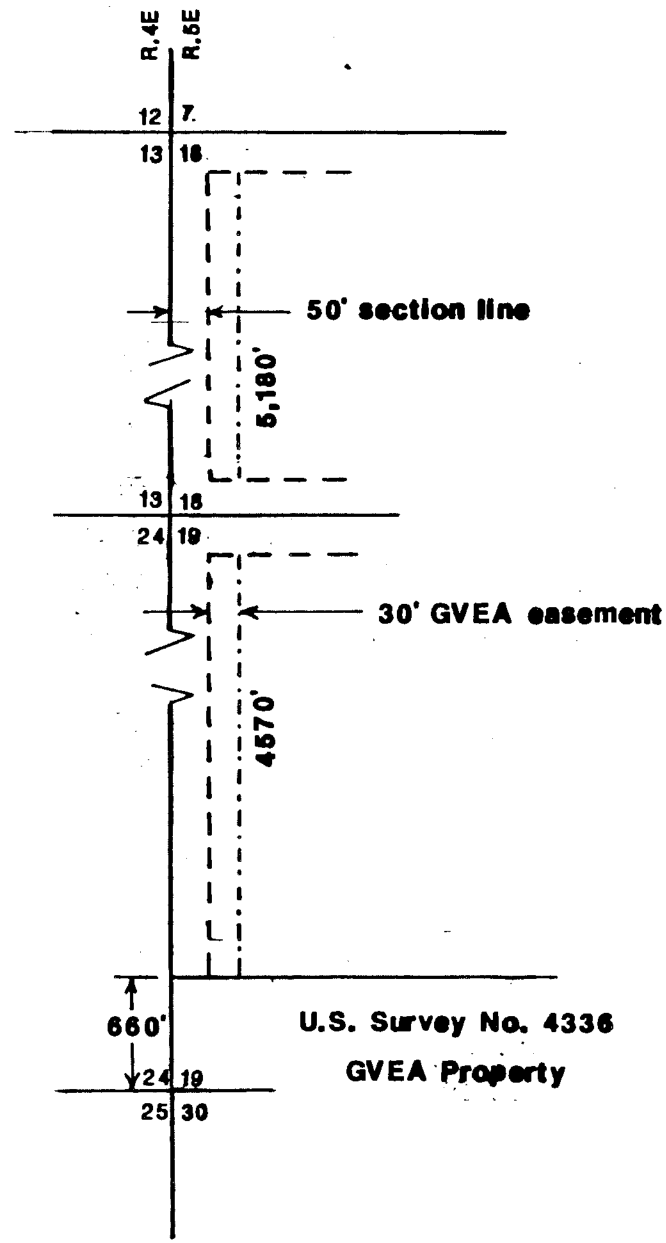


scale as dimensioned

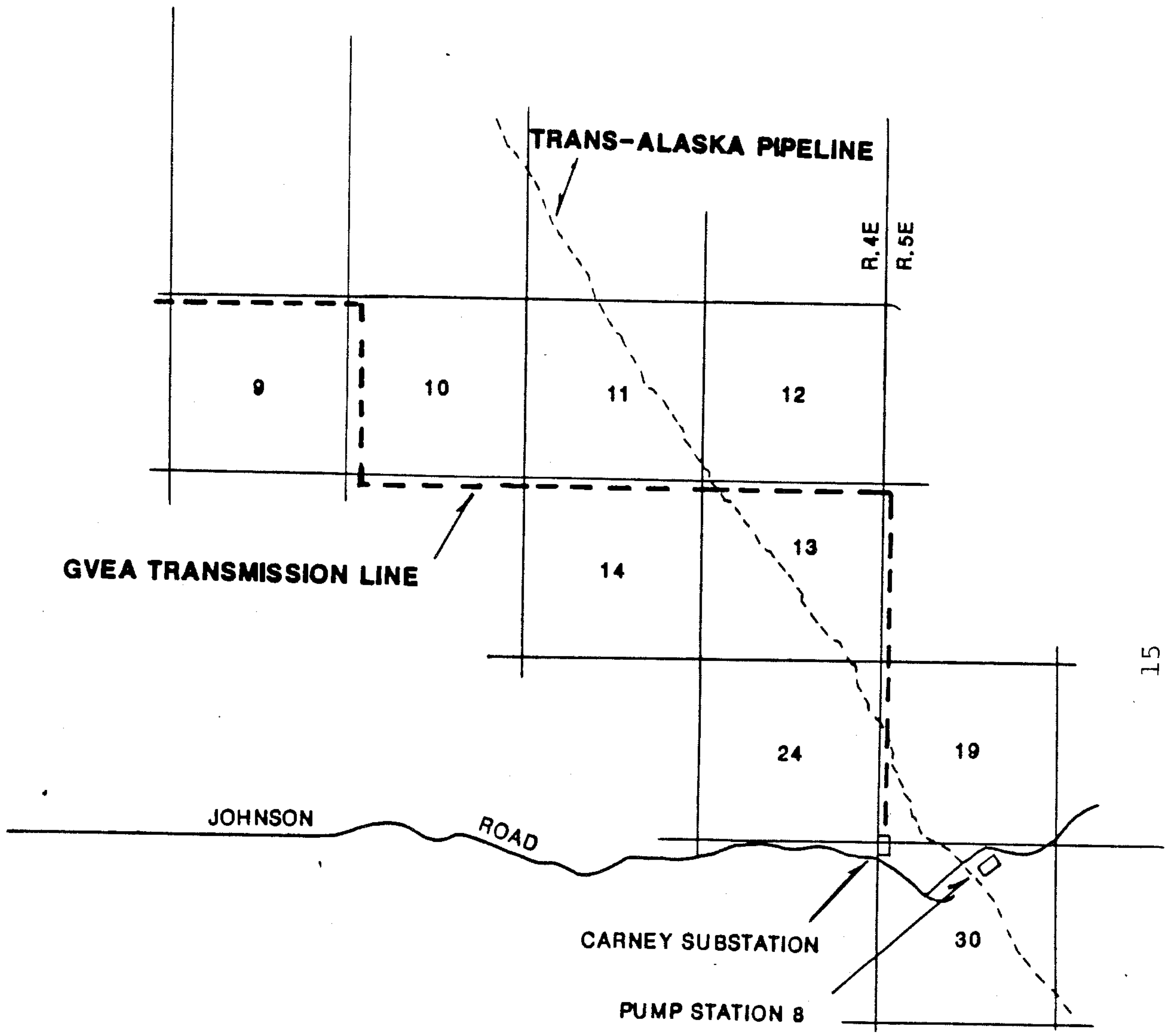
Section 18, 19, T.4S, R.5E

Application for GVEA Permit
area = 6.71 acres

scale as dimensioned

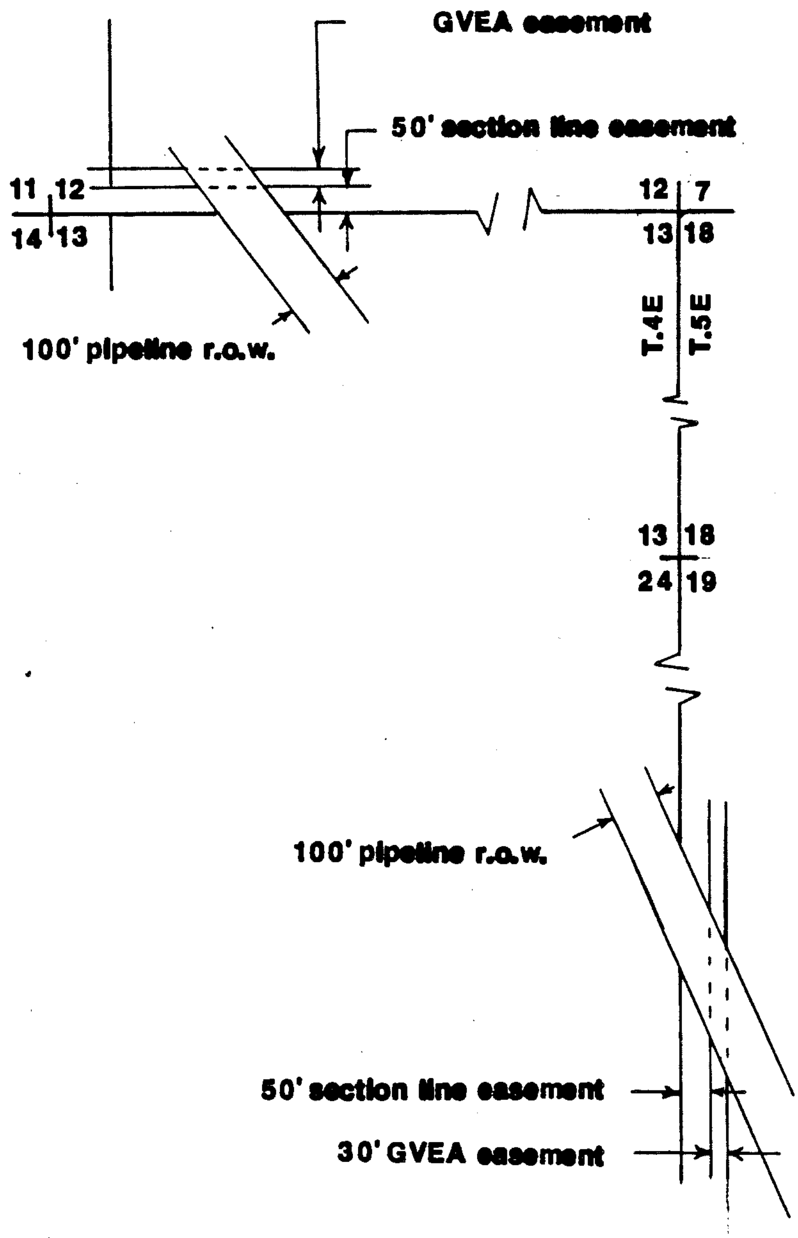


SHEET M


TRANS-ALASKA PIPELINE
R.4E
R.5E
9
10
11
12
GVEA TRANSMISSION LINE
14
13
24
19
JOHNSON
ROAD
CARNEY SUBSTATION
30
PUMP STATION 8

GVEA PERMIT APPLICATION ALYESKA PIPELINE CROSSING

Section 12, T.4S, R.4E, Section 19, T.4S, R.5E, F.M.



S.T.R.	Subdv.	Lot/Block	Owner	Address	EsmtReq	Grant?
16	ASLS 84-16	Tr.F	PetroStar, lessee to St.		Platted	
15,2S,2E			Doyon	Fairbanks		
21,2S,3E		TL 2100	Charles & Virginia Howard	PO 55263		
21,2S,2E		TL 2101	Jack Howard	PO 55263, NP 99705		
21,2S,2E		TL 2102	Jack Howard	PO 55263, NP 99705		
27,2S,2E		TL 2700	Army			
22,2S,2E		TL 2212	Bernard Parks	3135 Old Rich, Fbks 99		
25,2S,2E		TL 2500	State			
25,2S,2E		TL 2501	State			
6,3S,3E	Eielson Ag		Carolyn M. Howard	PO 55263, NP 99705		
36,2S,2E	Eielson Ag		Emory W. Bohanan	SR 20860, Fbks 99701		
31,2S,3E	Eielson Ag		Keith L. Malone	8531 E 4th Ave, Anch 9		
6,3S,3E	Eielson Ag		Valeda D. Blockcolsky	SR 20860, Fbks 99701		
5,3S,3E	Eielson Ag		Ralph L. VanReenan	SR 80371, Fbks 99701		
7,3S,3E	Eielson Ag		Wm.C. & Joyce Whipple			
8,3S,3E	Eielson Ag		Harold D. Worthen	PO 1121, Fbks 99707		
8,3S,3E	Eielson Ag		Perry D. Sebaugh	SR 2 Box 5850, Chugiak		
8,3S,3E	Eielson Ag		Larrry M. Petty	SR 60477, Fbks 99701		
4,3S,3E	Eielson Ag		Thomas L. Simon	SR 20860, Fbks 99701		
9,3S,3E	Eielson Ag		E. Musgrove & P. Paden	PO 2705, Fbks 99707		
17,3S,3E	Eielson Ag		Ruth E. Crick	SR 71206, Fbks 99701		
9,3S,3E	Eielson Ag		David I. Dicderson	1508 Fathom Dr.,Kenai		
9,4S,4E	Salcha Ag		State			
,8,9,4S,4E	Salcha Ag		Elaine C. Cederberg	2730 E 50th Ave, Anch		
10&15,4S,4E	Salcha Ag		Stuart J. Roberts	PO 81105 College 99708		
3&10,4S,4E	Salcha Ag		State			
12&13,4S,4E	Salcha Ag		State			
28,4S,4E	Salcha Ag		State			
26&27,4S,4E	Salcha Ag		North Pole Wood Products			
24,4S,4E	Salcha Ag		Glenda S. Field	1607 Kennedy, Fbks 997		
26&27,4S,4E	Salcha Ag		Shirley J. Ristow	SR 60727-A Fbks 99701		
35,4S,4E	Salcha Ag		Franklin L. Odonnell	SR 90507 Fbks 99701		
16,3S,3E	Eielson Ag II	Tr.B	Dennis A. Ulvestad	PO 622 Valdez 99686		
16&17,3S,3E	Eielson Ag II	Tr.A,D,C	Eugene E. Musgrove	PO 2705 Fbks 99707		
15,3S,3E	Eielson Ag II	Tr.A	Thomas W. Maher	PO 648 Fbks 99707		
22,3S,3E	Eielson Ag II	Tr.A	Brooks R. Smith	4433 kSan Ernesto #115		
21,3S,3E	Eielson Ag II	Tr.B,C,D	McGowan, Kathy Z.	SR 60367 Fbks 99701		
27,3S,3E	23 Mile Slough	Block 13	Forest B. McCahon Sr.	1580 Pioneer Way Fbks		
27,3S,3E	23 Mile Sough	L3,4B12	Harold E. Stahl			
27,3S,3E	23 Mile Slough	Tr.E & B16	Jean L. Petty	SR 60477 Fbks 99701		
27,3S,3E	23 Mile Slough	L1,2 B14,L1	Roberta L. Barnes	PO 81676 College 99708		
27,3S,3E	23 Mile Slough	L3B14,L2B15	Russel E. Crick	SR 71206 Fbks 99701		
27,3S,3E	23 Mile Slough	L1,2B12	Dave W. Crick	SR 71206 Fbks 99701		
27,3S,3E	23 Mile Slough	L1,2,3B11	Arden R. Bowne	PO 81210 Fbks 99708		
27,3S,3E	23 Mile Slough	L1,2B9	Dwayne H. Hofschulte	PO 55226 NP 99705		
27,3S,3E	23 Mile Slough	B10	Dwayne H. Hofschulte	PO 55226 NP 99705		
26,27,3S,3E	23 Mile Slough	L4B11,B6	Clair D. Markey	1200 Wildrose Fbks 997		
34,3S,3E	23 Mile Slough	B7	Frank C. Duncklee	PO 1822 Fbks 99707		
,3S,3E	23 Mile Slough	B5	Nina S.White	PO 55234 NP 99705		
35,3S,3E	23 Mile Slough	B4	Karen C. Bowne	PO 81210 Fbks 99708		
35,3S,3E	23 Mile Slough	B2,L1B3	William E. Blockcolsky			
35,3S,3E	23 Mile Slough	L2,3,4B3	Gary A. Schultz	PO 81481 College 99708		
35,3S,3E	23 Mile Slough	B1	Charles J. Champaine	SR 90336 Fbks 99701		

File: NorPolCarney
Report: NorPolCarney
Selection: Map # is not blank

S.T.R.	Map #	Owner	EsmtReq	Grant?
16,2S,2E	1	PetroStar	upgrade xst. line	platted
22,2S,2E	2	Army/Wainwright	upgrade xst line	
22,2S,2E	3	Army Corps Eng.	60',anc	
25,35,36,2S,2E	4	State	30' adj.S.L.,anc	
1,3S,2E	4	State	anc	
3,4,10,4S,4E	4	State	30' adj. S.L., 2 anc	
11,12,4S,4E	4	State	30' adj. S.L.	
5,4S,4E	4	State	30' adj. S.L.	
7,4S,4E	4	State	2 anc	
25,26,3S,3E	4	State	30' adj. S.L.	
31,2S,2E	4	State	30' adj. S.L.	
18,19,4S,4E	4	State	30' adj. S.L.	
5&8,4S,4E	4	State	30' adj. S.L.	
1,3S,2E	5		anc	
36,2S,2E	6	Bohanan/St	30' adj. S.L.	
31,2S,3E	7	Malone/St	30' adj. S.L.,anc.	
6,3S,3E	8	Howard/St		
6,3S,3E	9	Blockcolsky/St	30' adj. S.L.	
6,3S,3E	10	Windfall Properties	anc	
7,3S,3E	11	Whipple/St	anc	
5,3S,3E	12	VanReenan/St	30' adj.S.L.	
8,3S,3E	13	Geverance	30' adj. S.L.	
8,3S,3E	14	Sebaugh/St		
4,3S,3E	15	Blockcolksky/St	2 anc	
9,3S,3E	16	Musgrove & Paden/St	30' adj. S.L.	
8,3S,3E	17	Petty/St		
17,3S,3E	18	Crick/St		
16,3S,3E	19	Ulvestad/St	30' adj. S.L.	platted
16&17,3S,3E	20	Musgrove/St	30' adj. S.L.,anc	platted
21,3S,3E	21		anc	
15,3S,3E	22	Maher/St	2 anc	platted
22,3S,3E	23	Smith/St	30' adj. S.L.	platted
27,3S,3E	24	McCahon/St	30' adj. S.L./road	platted
27,3S,3E	24	Stahl/St	30' adj. S.L./road	platted
27,3S,3E	24	Petty/St	30' adj.S.L./road	
26,3S,3E	24	White/St	30' adj. road	platted
27,3S,3E	24	State	30' adj. S.L./road	platted
30,4S,5E	25	U.S. Air Force	2 anc	
6,4S,4E	26	Johnson/FNSB	30' adj. S.L./road	platted
7,4S,4E	28		30' adj. S.L./road	platted
7,4S,4E	29		30' adj. S.L./road	platted
6,4S,4E	27	Flodin/FNSB	30' adj. S.L./road	platted
5,8,9,4S,4E	30	Cederberg/St	30' adj.S.L., anc.	
10&15,4S,4E	31	Roberts/St	30' adj. S.L., anc.	
12,4S,5E	32	Alyeska	crossing	