LTNO 4532

Enclosure 1
II

Susitna Hydroelectric Project No. 7114
Schedule B, Supplemental Information

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EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 2 (p. E-3-96, para. 3)

Provide the depth-of-passage criteria used in the analysis of Slough 9 that led to the conclusion of unrestricted access at flows over 18,000 cfs but acute access problems at flows less than 12,000 cfs. Provide quantitative biological criteria for suitable water depths in sloughs for access and spawning.

Response

Entrance conditions that exist at the mouth of Slough 9 for mainstem discharges between 10,000 and 20,000 cfs at Gold Creek are provided in Table 4 (p. 21) of the report: "Preliminary Assessment of Access by Spawning Salmon to Side Slough Habitat above Talkeetna" by Trihey (1982).

Table 4. Entrance conditions at the mouth of Slough 9 for various mainstem flows at Gold Creek and sloughflow of 3 cfs (Trihey, 1982).

Mainstem Discharge (cfs)	Slough 9 WSEL (ft)	Passage Reach A Average Depth (ft)	Passage Reach A Reach Length (ft)	Passage Reach B Average Depth (ft)	Passage Reach B Reach Length (ft)
10,000	589.50	0.1	125	0.20	280
12,000	589.90	0.4	125	0.20	240
14,000	590.35	0.85	125	0.20	200
16,000	590.85	1.35	125	0.25	140
18,000	591.25	1.75	125	0.30	80
20,000	591.60	2.10	125	0.50	[illegible]
22,000	591.90	2.40	125	0.6	10

Recommended passage depths for successful upstream migration of adult salmon are provided by:

Thompson, K. 1972. Determining streamflows for fish life. In: Proceedings Instream Flow Requirements Workshop, Pacific Northwest River Basins Commission, Vancouver, Washington p. 31-50.

Reiser, D. W., and T. C. Bjornn. 1979. Habitat requirements of anadromous salmonids. U. S. Forest Service General Technical Report PNW-96. Portland, Oregon. 54 pp.

Data from these reports can be summarized as follows:

EXHIBIT E

3. Fish, Wildlife, and Botancial Resources - Aquatic Resources

Comment 1 (p. E-3-92, para. 2, 3)

Provide criteria that require use of cold (4°C) deepwater releases through diversion tunnels in the second summer of Watana filling. Provide reasoning why warmer surface water cannot be used when it will, according to Table E-3.25, Plate F-17, and Figure C.1, be accessible to the outlet facilities.

Response

The analysis for reservoir filling is based on flows for average hydrologic conditions and thereby a reservoir Elevation of 2027 is predicted for July of the second year. The outlet facilities are designed to operate with the intake water passage adequately submerged. Not to operate in this manner would entrap air and the free flow condition could cause cavitation along the steeply sloping reach of the water passage. Operation of this type generally is only permitted during initial filling of the outlet facility water passage while the valves are closed and inflow is controlled by the intake gates.

Until the intake water passage is submerged the only outlet for downstream discharge will be through the diversion tunnel. It is anticipated that only 4°C water will be available to this tunnel.

If the hydrologic conditions are above average and the reservoir filling occurs more rapidly than estimated, a reservoir level in the summer of the second year may be reached which will enable the safe use of the outlet facility.

Minimum depth criteria for successful upstream migration of adult salmon and trout (Reiser and Bjornn, 1979).

Species	Depth (ft)
Fall chinook	.8
Spring chinook	.8
Summer chinook	.8
Chum salmon	.6
Coho salmon	.6
Pink salmon	.6
Sockeye salmon	.6

Using this information, it would appear that the threshold for passage of chum, sockeye, and pink salmon (the key species of concern in the sloughs at this time) through the 125 foot length of Reach A would be between a mainstem discharge of 12,000 and 14,000 cfs because it is within this range that the 0.6 foot depth is exceeded. By the same reasoning, passage through Reach B might be negligible or impossible for the flows because the 0.6 foot depth is not available. Trihey (personal communication) has stated that the 0.6 foot depth criteria for successful upstream migration of chum salmon by Thompson and Reiser and Bjornn is too restrictive for this particular application. It is Trihey's opinion, based on field experience and knowledge of Slough 9, that adult chum salmon could successfully pass into Slough 9 through water 0.3 feet deep provided that the reach length does not exceed 100 feet.

Field observations by ADF&G (1983) have confirmed this observation and have shown that, "upstream passage into Slough 9 by adult chum does not appear restrictive at either passage reach A or B when mainstem discharges are 18,000 cfs or higher. At this discharge, passage at reach A is no longer an

obstacle, having an estimated depth of 1.75 feet . . . and passage Reach B increases slightly in depth (from 0.20 to 0.30 feet) and decreases greatly in length (from 280 feet to 80 feet)."

On August 24, 1982, when mainstem discharge at Gold Creek was 12,500 cfs and no appreciable backwater zone was observed at the entrance of the slough, several chum salmon were observed grounded in shallow water near the entrance to the slough (passage reach A) as well as at passage reach B. . .

"Mainstem conditions ranged between 12,200 and 13,300 cfs during the five days preceding these observations (USGS 1982). The limited number of chum salmon (20 total) observed above passage reach B, indicated that even during poor access conditions, blockage was not complete."

In response to the second part of this question, ADF&G is currently making analyses on the 1982 field data to ascertain the criteria for suitable water depths in sloughs for access and spawning.

From the data, it can thus be stated that the access criteria from Thompson and Bjornn are generally valid for extended reaches (>100') but that depths as low as .02 to 0.3 can be crossed with greater difficulty, if shorter distances and low velocities are presented.

Attached Tables 4-B-18 and 4-B-19 show information on depth and velocities utilized for spawning at four slough sites for three species. This data is from ADF&G (1983). In summarizing these tables for the range of flows observed, the following are apparent:

SUMMARY OF DEPTHS AND VELOCITIES UTILIZED BY SLOUGH SPAWNING SALMON IN THE SUSITNA RIVER

Species	N	Range of Depths Utilized (ft)	Range of Velocity Utilized (ft/sec)
Chum	133	0.2 - 2.60	0.00 - 1.10
Sockeye	47	0.5 - 2.80	0.00 - 0.80
Pink	3	0.3 - 0.80	0.20 - 0.80

As additional studies are completed, this data will be continually refined, but the general range will be expected to be similar.

References

Alaska Dept. of Fish and Game. 1983. Susitna Hydro Aquatic Studies Phase II Basic Data Report.

Appendix Table 4-B-18. Depths (ft) and velocities (ft/sec) associated with chum salmon redds in four sloughs at three discharges (Q, cfs) in 1982.

		Depth				Velocity			
		Q_1*	Q_2**	Q_3***	Average	Q_1*	Q_2**	Q_3***	Average
Slough 8A	$\bar{x}$	0.67	0.72		0.79	0.03	0.36		0.30
	Range	0.30-1.30	0.20-1.60		0.20-1.60	0.00-1.45	0.05-0.72		0.00-1.45
	N	26	11		37	26	11		37
	Q (cfs)	4	7			4	7		
Slough 9	$\bar{x}$	1.24	1.27		1.25	0.13	0.16		0.14
	Range	0.30-2.40	0.40-2.10		0.30-2.4	0.05-0.40	0.00-0.78		0.00-0.78
	N	28	20		48	28	20		48
	Q (cfs)	3	8			3	8		
Slough 11	$\bar{x}$		1.21	1.33	1.28		0.13	0.45	.32
	Range		0.60-2.20	0.55-2.10	.55-2.20		0.00-0.61	0.05-1.00	0.00-1.00
	N		6	9	15		6	9	15
	Q (cfs)								
Slough 21	$\bar{x}$		1.02		1.02		0.22		0.22
	Range		0.40-2.60		0.40-2.60		0.00-1.10		0.00-1.10
	N		33		33		33		33
	Q (cfs)		5				5		

*Q_1 = 25-26 August

**Q_2 = 2-7 September

***Q_3 = 20 September

***Q_3 = 20 September

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Table 4-B-19. Depths (ft) and velocities (ft/sec) associated with pink salmon and sockeye salmon redds in three sloughs at three discharges (Q, cfs) in 1982.

PINK SALMON

		Depth				Velocity			
		Q_1*	Q_2**	Q_3***	Average	Q_1*	Q_2**	Q_3***	Average
Slough 8A	$\bar{x}$	0.30			0.30	0.80			0.80
	Range	-			-	-			-
	N	1			1	1			1
	Q	4			4	4			4
Slough 9	$\bar{x}$	0.68			0.68	0.25			0.25
	Range	0.55-0.80			0.55-0.80	0.20-0.30			0.20-0.30
	N	2			2	2			2
	Q	3			3	3			3

SOCKEYE SALMON

		Depth				Velocity			
		Q_1*	Q_2**	Q_3***	Average	Q_1*	Q_2**	Q_3***	Average
Slough 9	$\bar{x}$	0.5			0.5	0.05			0.05
	Range	-			-	-			-
	N	1			1	1			1
	Q	7			7	7			7
Slough 11	$\bar{x}$	0.85	1.51	1.48			0.00	0.23	.22
	Range	-	0.75-2.80	0.75-2.80			-	0.00-0.80	0.00-0.80
	N	1	22	23			1	22	23
	Q	-	-	-			-	-	-

*Q_1 = 25-26 August

**Q_2 = 2-7 September

***Q_3 = 20 September

3A-2-7

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 3 (p. E-3-110, para. 3; p. E-3-111, para 2; p. E-3-115, para. 2)

Provide documentation, quantitative if possible, from other hydroelectric projects in glacial areas that decreased open water turbidity and reduced silt load downstream of Watana will improve benthic production and thus fish rearing.

Response

Specific information on the effects of reduced open water turbidity and reduced silt load on benthic production below dams in glacial systems was not found. There was information available in the literature on the effects of sediment on benthic production in general and the effects of hydroelectric development on benthic production below dams that can be used to consider what effects decreased turbidities and silt loads downstream of Watana might have on benthic production.

Sediment loads can impact benthic invertebrate populations (i.e., diversity, composition, abundance, and biomass in several ways (Table 1). First, sediment loads can indirectly affect invertebrates by directly impacting primary production. Excessive amounts of bed load material can remove attached algae by grinding and dislodgement (e.g., Iwamoto et al. 1978; Sorenson et al. 1977). In addition, strong linkages exist between light levels reaching the stream bottom, primary production, and production of invertebrates (Ward and Stanford 1979; Hynes 1970; Murphy et al. 1981). Decreased turbidity results in increased light penetration, increased photosynthetic activity, and ultimately an increase in the amount of vegetation (e.g., Fredeen 1977; Hynes 1970). Aquatic plants act to increase invertebrate production by

enhancing oxygen content of the water, converting inorganic to organic material, as a source of food, and as cover (e.g., Hynes 1970; Ward and Stanford 1979).

Second, both suspended and deposited sediments can directly affect benthic populations. Deposits of sand and silt in the interstices of the substrate reduce accessibility of microhabitats and limit intragravel waterflow, thus impacting invertebrate populations (Cordone and Kelly 1961; Iwamoto et al. 1978; Sorenson et al. 1977). In particular, the composition of fines less than 0.850 mm diameter may be especially significant (Iwamoto et al. 1978). Suspended solids can affect respiratory surfaces and/or dislodge invertebrates (Iwamoto et al. 1978).

High suspended and deposited sediment loads may, therefore, have a detrimental effect on invertebrate production. Consequently, one would predict that a reduction in turbidity and sediment should typically enhance benthic production. However, although there are studies available which show that changes in the faunal composition, diversity, biomass, and/or abundance of the benthos occurs in areas downstream of impoundments (e.g., Geen 1974; Ward 1976; Ward and Stanford 1979), it is difficult to determine from these studies the specific effects of reduced sediment loads. This is because the complicating effects of altered thermal regimes, long-term and short-term flow fluctuations, changes in the water chemistry of reservoirs, and changes in current velocity make it difficult to isolate the effects of sediment. Often one factor may act to increase production (e.g., decreased sediment loads) while another factor acts to decrease production (e.g., extreme short-term flow fluctuations). For example, Spence and Hynes (1971a) found that changes in the species composition of the benthos occurred below a dam on the Grand River in Ontario, Canada. They attributed these changes to an increased growth of attached algae that favored species that live and feed

on these algae, temperature changes, and an increase in particulate organice matter. There is one instance (the South Saskatchewan River, Lake Diefenbaker) where increased water clarity in the river below the dam was apparently the major factor responsible for increased production of attached aquatic plants which in turn caused a replacement in black fly species composition (Fredeen 1977).

Thus, an increase in invertebrate production that occurs due to a reduction in sediment load, may enhance the rearing potential of the existing habitat and subsequently production of fish, assuming: 1) that other changes (e.g., alterations in temperature regimes, short-term flow fluctuation, competition) do not negate the effect of the sediment reduction; and 2) that the invertebrate species that are benefited are food items of fish species of concern.

Changes in fish populations below dams have been documented in a number of instances (e.g., Spence and Hynes 1971b; Ward and Stanford 1979) and include changes in faunal composition, diversity, and abundance. However, specifically linking changes in invertebrate populations with changes in fish populations has proven difficult.

References

Bjornn, T. C. and others. 1977. Transport of granitic sediment in streams and its effects on insects and fish. Office of Water Res. and Tech., Compl. Rep., Project B-036-IOA. 44 pp.

Cordone, A. J. and D. W. Kelley. 1961. The influence of inorganic sediment on the aquatic life of streams. Calif. Fish and Game 47: 189-228.

Fredeen, F. G. H. 1977. Some recent changes in black fly populations in the Saskatchewan River system in western Canada coinciding with the development of reservoirs. Can. Water Resource J. 2(3-4): 90-102.

Geen, G. H. 1974. Effects of hydroelectric development in western Canada on aquatic ecosystems. J. Fish. Res. Board Can. 31: 913-927.

Hill, D. M. 1972. Stream faunal recovery after manganese strip mine reclamation. Phd Dissertation, Virginia Polytechnic University.

Hynes, H. B. N. 1970. The ecology of running water. University of Toronto Press. 555 pp.

Iwamoto, R. N., E. O. Salo, M. A. Madej, and R. L. McComas. 1978. Sediment and water quality: A review of the literature including a suggested approach for water quality criteria. Univ. Wash., Fish. Res. Inst., EPA 910/9-78-048, Seattle, WA.

Murphy, M. L. C. P. Hawkins, and N. H. Anderson. 1981. Effects of canopy modification and accumulated sediment on stream communities. Trans. Am. Fish. Soc. 110: 469-478.

Rosenberg, D. and A. P. Wiens. 1978. Effect of sediment on macro benthic invertebrates in a northern Canadian river. Water Res. 12: 753-763.

Spence, J. A. , and H. B. N. Hynes. 1971a. Differences in benthos upstream and downstream of an impoundment. J. Fish Res. Board Can. 28: 35-43.

Spence, J.A. and H.B.N. Hynes. 1971b. Differences in fish populations upstream and downstream of a mainstream impoundment. J. Fish. Res. Board Can. 28:45-46.

Sorenson, D. L., M. M. McCarthy, E. J. Middlebrooks, and D. B. Parcella. 1977. Suspended and dissolved solids effects on freshwater biota: A review. Ecol. Res. Series, Env. Protect. Agency, EPA-600/3-77-042. 64 pp.

Ward, J. V. 1976. Effects of flow patterns below large dams on stream benthos: a review, p. 235-253. In J. F. Orsborn and C. H. Allman [ed.], Instream flow needs. Am. Fish. Society.

Ward, J. and J. A. Stanford [eds.]. 1979. The ecology of regulated streams. Plenum Press, New York. 398 pp.

TABLE 1. SOME SEDIMENT EFFECTS ON AQUATIC MACROINVERTEBRATES (DATA FROM BJORNN ET AL. 1977; HILL 1972; ROSENBERG AND WIENS 1978; SORENSON ET AL. 1977).

Organism(s)	Effect	Concentration	Source of Suspended Solids	Comment
Mixed populations	Lower summer Populations		Mining Area	
Mixed Populations	Reduced populations to 25%	261-390 ppm (Turbidity)	Log dragging	
Mixed Populations	Densities 11% of normal	1000-6000 ppm		Normal populations at 60 ppm
Mixed Populations	No organisms in the zone of settling	>5000 ppm	Glass manufacturing	Effect noted 13 miles downstream
Chironomus & Tubificidae	Normal fauna replaced (Species Selection)		Colliery	Reduction in light reduced submerged plants
Cheumatopsyche (Net spinners)	Number reduced	(High concentations)	Limestone quarry	Suspended solids as high as 250 mg/l
Tricorythoides	Number increased		Limestone Quarry	Due to preference for mud or silt
Mixed Population	90% increase in drift	80 mg/1	Limestone Quarry	
Mixed Populations	Change in density	40-200 JTU	Manganese Strip mine	Also caused changes in diversity

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TABLE 1 (Cont'd)

Organism(s)	Effect	Concentration	Source of Suspended Solids	Comment
Mixed Population (included Oligochaetes Plecoptera, Chironomids)	Decrease in Abundance Caused by by Increased Drift	1.38-1.58 kg/m^2 of channel bottom		
Insects, benthic	Decrease of 1/2 in density	>2/3 cobble imbeddedness		Bedload sediment
Insects, drifting	No change	>2/2 cobble imbeddedness		Bedload sediment

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 4 (p. E-3-112)

Provide documentation of successful egg incubation, as well as overwintering in areas downstream of hydropower reservoirs where glacial silt loads and turbidity continue into winter months, e.g., below Eklutna Lake.

Response

Evidence of successful salmon incubation in areas below hydroelectric reservoirs where glacial silt loads and turbidity continue into winter is available for Eklutna Lake. In 1982, the Cook Inlet Aquaculture Association (CIAA) began construction of a hatchery near the powerhouse of the Eklutna Dam. This hatchery utilizes water from the tailrace of the powerhouse. Turbidity measurements in Eklutna Lake near the intake for the powerhouse in January and February 1983 ranged from 11 to 54 NTU's (pers. communi; B. Jokela; R & M Consultants, Inc; Anchorage, AK), depending on where samples were taken. As a part of the feasibility study for the hatchery, tests were conducted to determine how successful egg incubation and initial juvenile rearing would be using the turbid, glacial waters. The 1979, 1980, and 1982 broods of chum and 1981 and 1982 broods of coho were tested. While there was considerable variability associated with these tests, egg-to-fed fry survivals were considered to be quite good (pers. communi; T. Mears; CIAA; Cordova, AK). For example, egg-to-newly emerged chum fry survival ranged up to 98 to 99% whereas survival from emergence to a doubling in weight was up to 95 to 96%. Variability in survival estimates were considered to be due in large part to handling and other hatchery-type procedures (T. Mears, CIAA).

The information sources we examined did not include data on overwintering in areas below reservoirs where silt loads and turbidity continued into winter.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 5 (p. E-3-113, para. 3)

Provide your quantitative estimate and analysis of changes in growth rates and outmigration times of juvenile salmon in the Susitna mainstem and major side channels that could result from altered annual temperature and flow regimes such as those given in Figures E.2.174 through E.2.183, E.2.193, and E.2.194 and others if justified. Do for Watana and Devil Canyon scenarios.

Response

The growth rates and outmigration times will not be a simple function of temperature and flow. Instead, they will also be a function of other factors such as turbidity and food availability (Graybill, et al. 1979). If it is assumed that all other factors except temperature and flow are constant, the following comments can be made:

Growth Rates

Flow would not be expected to affect growth rates because as flows change, fish will seek alternate habitats. The extent of the change in aquatic habitat, due to the proposed project, is currently being assessed by the Alaska Department of Fish and Game (ADF&G) and the Arctic Environmental Information and Data Center (AEIDC) through field and modelling efforts. The results of these studies will not be available until late 1983. We will provide the FERC with these reports at that time.

Temperature can significantly affect growth rates but little information is available on growth of juvenile salmon at the projected temperatures, particularly at temperatures less than 5°C. Therefore, the APA has funded studies by the U.S. Fish and Wildlife Service, which are currently nearing completion, to analyze the potential effects of temperature on incubation and early development of chum and sockeye salmon. These studies will not be completed until approximately September 15 1983. We will provide the FERC with a report on those studies at that time.

Outmigration Times

Flow is not expected to affect the time when initiation of outmigration occurs, but will potentially affect the rate of downstream migration. Studies by ADF&G are being completed this field season (1983) to address the flow versus outmigration rate question. A report on these studies will be made available to FERC when the studies are completed.

Temperature may be expected to affect the time when initiation of outmigration occurs due to alteration in growth rates. The changes that occur will be examined as part of the U.S. Fish and Wildlife study previously mentioned.

References

Graybill, J. P., R. L. Burgner, J. C. Gislason, P. E. Huffman, K. H. Wyman, R. G. Gibbons, K. W. Kurko, Q. J. Stober, T. W. Fagnan, A. P. Stayman, and D. M. Eggers. 1979. Assessment of the reservoir-related effects of the Skagit Project on downstream fishery resources of the Skagit River, Washington. Univ. of Wash. College of Fisheries. Contr. No. FRI-UW-7905.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 6 (p. E-3-120, para.2)

Provide a species list of important resident finfish and shellfish in Upper Cook Inlet. Indicate the most dominant species and any species of commercial value.

Response

Upper Cook Inlet can generally be characterized as a harsh environment for any fish or shellfish species. The reasons for this are:

1. High turidity, which essentially eliminates light penetration.
2. Heavy siltation due to input from glacially-fed rivers, subtidal erosion, and swift and variable currents. The silt is rapidly deposited and eroded on a continuing basis and colonization by shellfish is difficult.
3. Ice, which disrupts habitat by freezing to the surface sediment during low tide, then lifting the sediment with the ice during high tide and;
4. Low and rapidly changing salinity.

(U.S. Army Corps of Engineers 1979).

At present, no important resident fish or shellfish are identified for Upper Cook Inlet. The definition of important in this context is defined as a species of recreational or commercial value with the Upper Cook Inlet area.

Although Dolly Varden (Salvelinus Malma), larval herring (Clupea harengus pallasi), halibut (Hippoglossus stenolepis), starry flounders (Platichthys stellatus), Pacific tomcod (Microgadus proximus), lemon sole (Parophrys vetulus), stickleback (Gasterosteus aculeatus), and humpback whitefish (Coregonus pidschian) may be present, no significant fisheries presently exist for these species, presumably because they are present in such low numbers. According to the Corps of Engineers (1979) "demersal fish probably occur in very low populations due to severe environmental conditions and lack of food." Shellfish are also scarce or non-existant, probably also due to the harsh environmental conditions. For example, the Corps of Engineers (1979), in samples taken near Anchorage, only found a few specimens (two) of Macoma balthica, a small estuarine clam that is too small to be of commercial or recreational value.

Upper Cook Inlet is primarily used by anadromous species (including five species of salmon, eulachon, bering cisco) as a migration route to and from fresh water spawning areas. Of these species, the salmon are considered the most important due to their commercial value (little or no recreational fishing for salmon occurs in Upper Cook Inlet except near the mouths of clear small tributaries). A commercial set net fishery for salmon exists in Upper Cook Inlet.

References

U.S. Dept. of the Army, Corps of Engineers. 1979. Volume 3 Water Quality, Knik Arm-Upper Cook Inlet. Prepared in conjunction with the Municipality of Anchorage.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 7 (p. E-3-128, para. 1)

Provide references from other projects or from experimental studies that form the basis for the statement that turbidity and siltation of the Susitna River from gravel mining in the riverbed and tributaries for Watana and Devil Canyon Dams will not result in adverse impacts to fish.

Response

References From Other Projects

References or experimental studies from other projects such as described by Woodward-Clyde (1980) would not be directly applicable to the Susitna River. Therefore, we discuss proposed procedures to be used at the project dam sites in the following paragraphs.

Siltation and turbidity from gravel mining activities could cause impacts to fish if these activities are not properly planned or controlled. The primary borrow sites from the Watana Development are considered to be D, L, E and I (See Figure E.2.131 in the License Application). Other sites have been abandoned because of environmental reasons, economic or engineering constraints, or are now being considered only as backup sites. Quarry Site L is located wholly within the proposed reservoir. With careful removal of the vegetative and organic layers, the absence of work in the river channel and no tributaries in the immediate area, no siltation problems are

envisioned at this site. At Borrow Site D, all runoff will be collected and directed towards settling ponds prior to discharge into Deadman Creek or the Susitna River. No work is scheduled in or immediately adjacent to Deadman Creek, and therefore, no significant erosion control problems are anticipated.

Instream mining of Borrow Sites E and I will be scheduled for the summer (May-September) when high sediment and turbidity levels in the Susitna River already exist. Mining will begin in Site I, just upstream of a natural rock weir (see Figure E.2.135 in the License Application). By developing this section first and continuing upstream into E it is believed that the pool created behind the weir will serve as a settling pond for future upriver instream work. No activities, particularly at Site E and I will occur between October and May. Stockpiling of borrow material and dry excavation in berm areas will eliminate the need for instream gravel mining activities during this period.

Assuming a one percent loss in material to the river at sites I and E during the summer construction period, there would be about a 4 percent increase in suspended sediment load over 1982 levels. Stockpiling of gravel will alleviate the need for wet excavation during winter when the impact from siltation to incubating eggs would be greatest. As a result of the proposed scheduling of activities, impacts will be minimized. However, it is inevitable that there will be some increases in suspended sediments and turbidity during winter, but these will be short term and localized and there is no known spawning in the river just downstream of the Watana site. Downstream from Talkeetna, turbidity and suspended sediment levels should remain essentially the same as baseline conditions.

Primary sites for the Devil Canyon Dam include Borrow Sites G, K, and D. Potential impacts for gravel mining at sites G and K are expected to be minimal since no instream work is currently planned. Site D is the same site used for development of Watana Dam. Potential impacts at this site, as previously described, are expected to be avoided or minimized by erosion control procedures.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 3 (p. E-3-110, para. 3; p. E-3-111, para 2; p. E-3-115, para. 2)

Provide documentation, quantitative if possible, from other hydroelectric projects in glacial areas that decreased open water turbidity and reduced silt load downstream of Watana will improve benthic production and thus fish rearing.

Response

Specific information on the effects of reduced open water turbidity and reduced silt load on benthic production below dams in glacial systems was not found. There was information available in the literature on the effects of sediment on benthic production in general and the effects of hydroelectric development on benthic production below dams that can be used to consider what effects decreased turbidities and silt loads downstream of Watana might have on benthic production.

Sediment loads can impact benthic invertebrate populations (i.e., diversity, composition, abundance, and biomass in several ways (Table 1). First, sediment loads can indirectly affect invertebrates by directly impacting primary production. Excessive amounts of bed load material can remove attached algae by grinding and dislodgement (e.g., Iwamoto et al. 1978; Sorenson et al. 1977). In addition, strong linkages exist between light levels reaching the stream bottom, primary production, and production of invertebrates (Ward and Stanford 1979; Hynes 1970; Murphy et al. 1981). Decreased turbidity results in increased light penetration, increased photosynthetic activity, and ultimately an increase in the amount of vegetation (e.g., Fredeen 1977; Hynes 1970). Aquatic plants act to increase invertebrate production by

enhancing oxygen content of the water, converting inorganic to organic material, as a source of food, and as cover (e.g., Hynes 1970; Ward and Stanford 1979).

Second, both suspended and deposited sediments can directly affect benthic populations. Deposits of sand and silt in the interstices of the substrate reduce accessibility of microhabitats and limit intragravel waterflow, thus impacting invertebrate populations (Cordone and Kelly 1961; Iwamoto et al. 1978; Sorenson et al. 1977). In particular, the composition of fines less than 0.850 mm diameter may be especially significant (Iwamoto et al. 1978). Suspended solids can affect respiratory surfaces and/or dislodge invertebrates (Iwamoto et al. 1978).

High suspended and deposited sediment loads may, therefore, have a detrimental effect on invertebrate production. Consequently, one would predict that a reduction in turbidity and sediment should typically enhance benthic production. However, although there are studies available which show that changes in the faunal composition, diversity, biomass, and/or abundance of the benthos occurs in areas downstream of impoundments (e.g., Geen 1974; Ward 1976; Ward and Stanford 1979), it is difficult to determine from these studies the specific effects of reduced sediment loads. This is because the complicating effects of altered thermal regimes, long-term and short-term flow fluctuations, changes in the water chemistry of reservoirs, and changes in current velocity make it difficult to isolate the effects of sediment. Often one factor may act to increase production (e.g., decreased sediment loads) while another factor acts to decrease production (e.g., extreme short-term flow fluctuations). For example, Spence and Hynes (1971a) found that changes in the species composition of the benthos occurred below a dam on the Grand River in Ontario, Canada. They attributed these changes to an increased growth of attached algae that favored species that live and feed

on these algae, temperature changes, and an increase in particulate organice matter. There is one instance (the South Saskatchewan River, Lake Diefenbaker) where increased water clarity in the river below the dam was apparently the major factor responsible for increased production of attached aquatic plants which in turn caused a replacement in black fly species composition (Fredeen 1977).

Thus, an increase in invertebrate production that occurs due to a reduction in sediment load, may enhance the rearing potential of the existing habitat and subsequently production of fish, assuming: 1) that other changes (e.g., alterations in temperature regimes, short-term flow fluctuation, competition) do not negate the effect of the sediment reduction; and 2) that the invertebrate species that are benefited are food items of fish species of concern.

Changes in fish populations below dams have been documented in a number of instances (e.g., Spence and Hynes 1971b; Ward and Stanford 1979) and include changes in faunal composition, diversity, and abundance. However, specifically linking changes in invertebrate populations with changes in fish populations has proven difficult.

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TABLE 1. SOME SEDIMENT EFFECTS ON AQUATIC MACROINVERTEBRATES (DATA FROM BJORNN ET AL. 1977; HILL 1972; ROSENBERG AND WIENS 1978; SORENSON ET AL. 1977).

Organism(s)	Effect	Concentration	Source of Suspended Solids	Comment
Mixed populations	Lower summer Populations		Mining Area	
Mixed Populations	Reduced populations to 25%	261-390 ppm (Turbidity)	Log dragging	
Mixed Populations	Densities 11% of normal	1000-6000 ppm		Normal populations at 60 ppm
Mixed Populations	No organisms in the zone of settling	>5000 ppm	Glass manufacturing	Effect noted 13 miles downstream
Chironomus & Tubificidae	Normal fauna replaced (Species Selection)		Colliery	Reduction in light reduced submerged plants
Cheumatopsyche (Net spinners)	Number reduced	(High concentations)	Limestone quarry	Suspended solids as high as 250 mg/l
Tricorythoides	Number increased		Limestone Quarry	Due to preference for mud or silt
Mixed Population	90% increase in drift	80 mg/l	Limestone Quarry	
Mixed Populations	Change in density	40-200 JTU	Manganese Strip mine	Also caused changes in diversity

TABLE 1 (Cont'd)

Organism(s)	Effect	Concentration	Source of Suspended Solids	Comment
Mixed Population (included Oligochaetes Plecoptera, Chironomids)	Decrease in Abundance Caused by by Increased Drift	1.38-1.58 kg/m^2 of channel bottom		
Insects, benthic	Decrease of 1/2 in density	>2/3 cobble imbeddedness		Bedload sediment
Insects, drifting	No change	>2/2 cobble imbeddedness		Bedload sediment

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 4 (p. E-3-112)

Provide documentation of successful egg incubation, as well as overwintering in areas downstream of hydropower reservoirs where glacial silt loads and turbidity continue into winter months, e.g., below Eklutna Lake.

Response

Evidence of successful salmon incubation in areas below hydroelectric reservoirs where glacial silt loads and turbidity continue into winter is available for Eklutna Lake. In 1982, the Cook Inlet Aquaculture Association (CIAA) began construction of a hatchery near the powerhouse of the Eklutna Dam. This hatchery utilizes water from the tailrace of the powerhouse. Turbidity measurements in Eklutna Lake near the intake for the powerhouse in January and February 1983 ranged from 11 to 54 NTU's (pers. communi; B. Jokela; R & M Consultants, Inc; Anchorage, AK), depending on where samples were taken. As a part of the feasibility study for the hatchery, tests were conducted to determine how successful egg incubation and initial juvenile rearing would be using the turbid, glacial waters. The 1979, 1980, and 1982 broods of chum and 1981 and 1982 broods of coho were tested. While there was considerable variability associated with these tests, egg-to-fed fry survivals were considered to be quite good (pers. communi; T. Mears; CIAA; Cordova, AK). For example, egg-to-newly emerged chum fry survival ranged up to 98 to 99% whereas survival from emergence to a doubling in weight was up to 95 to 96%. Variability in survival estimates were considered to be due in large part to handling and other hatchery-type procedures (T. Mears, CIAA).

The information sources we examined did not include data on overwintering in areas below reservoirs where silt loads and turbidity continued into winter.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 5 (p. E-3-113, para. 3)

Provide your quantitative estimate and analysis of changes in growth rates and outmigration times of juvenile salmon in the Susitna mainstem and major side channels that could result from altered annual temperature and flow regimes such as those given in Figures E.2.174 through E.2.183, E.2.193, and E.2.194 and others if justified. Do for Watana and Devil Canyon scenarios.

Response

The growth rates and outmigration times will not be a simple function of temperature and flow. Instead, they will also be a function of other factors such as turbidity and food availability (Graybill, et al. 1979). If it is assumed that all other factors except temperature and flow are constant, the following comments can be made:

Growth Rates

Flow would not be expected to affect growth rates because as flows change, fish will seek alternate habitats. The extent of the change in aquatic habitat, due to the proposed project, is currently being assessed by the Alaska Department of Fish and Game (ADF&G) and the Arctic Environmental Information and Data Center (AEIDC) through field and modelling efforts. The results of these studies will not be available until late 1983. We will provide the FERC with these reports at that time.

Temperature can significantly affect growth rates but little information is available on growth of juvenile salmon at the projected temperatures, particularly at temperatures less than 5°C. Therefore, the APA has funded studies by the U.S. Fish and Wildlife Service, which are currently nearing completion, to analyze the potential effects of temperature on incubation and early development of chum and sockeye salmon. These studies will not be completed until approximately September 15 1983. We will provide the FERC with a report on those studies at that time.

Outmigration Times

Flow is not expected to affect the time when initiation of outmigration occurs, but will potentially affect the rate of downstream migration. Studies by ADF&G are being completed this field season (1983) to address the flow versus outmigration rate question. A report on these studies will be made available to FERC when the studies are completed.

Temperature may be expected to affect the time when initiation of outmigration occurs due to alteration in growth rates. The changes that occur will be examined as part of the U.S. Fish and Wildlife study previously mentioned.

References

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EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 6 (p. E-3-120, para.2)

Provide a species list of important resident finfish and shellfish in Upper Cook Inlet. Indicate the most dominant species and any species of commercial value.

Response

Upper Cook Inlet can generally be characterized as a harsh environment for any fish or shellfish species. The reasons for this are:

1. High turidity, which essentially eliminates light penetration.
2. Heavy siltation due to input from glacially-fed rivers, subtidal erosion, and swift and variable currents. The silt is rapidly deposited and eroded on a continuing basis and colonization by shellfish is difficult.
3. Ice, which disrupts habitat by freezing to the surface sediment during low tide, then lifting the sediment with the ice during high tide and;
4. Low and rapidly changing salinity.

(U.S. Army Corps of Engineers 1979).

At present, no important resident fish or shellfish are identified for Upper Cook Inlet. The definition of important in this context is defined as a species of recreational or commercial value with the Upper Cook Inlet area.

Although Dolly Varden (Salvelinus Malma), larval herring (Clupea harengus pallasi), halibut (Hippoglossus stenolepis), starry flounders (Platichthys stellatus), Pacific tomcod (Microgadus proximus), lemon sole (Parophrys vetulus), stickleback (Gasterosteus aculeatus), and humpback whitefish (Coregonus pidschian) may be present, no significant fisheries presently exist for these species, presumably because they are present in such low numbers. According to the Corps of Engineers (1979) "demersal fish probably occur in very low populations due to severe environmental conditions and lack of food." Shellfish are also scarce or non-existant, probably also due to the harsh environmental conditions. For example, the Corps of Engineers (1979), in samples taken near Anchorage, only found a few specimens (two) of Macoma balthica, a small estuarine clam that is too small to be of commercial or recreational value.

Upper Cook Inlet is primarily used by anadromous species (including five species of salmon, eulachon, bering cisco) as a migration route to and from fresh water spawning areas. Of these species, the salmon are considered the most important due to their commercial value (little or no recreational fishing for salmon occurs in Upper Cook Inlet except near the mouths of clear small tributaries). A commercial set net fishery for salmon exists in Upper Cook Inlet.

References

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EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 7 (p. E-3-128, para. 1)

Provide references from other projects or from experimental studies that form the basis for the statement that turbidity and siltation of the Susitna River from gravel mining in the riverbed and tributaries for Watana and Devil Canyon Dams will not result in adverse impacts to fish.

Response

References From Other Projects

References or experimental studies from other projects such as described by Woodward-Clyde (1980) would not be directly applicable to the Susitna River. Therefore, we discuss proposed procedures to be used at the project dam sites in the following paragraphs.

Siltation and turbidity from gravel mining activities could cause impacts to fish if these activities are not properly planned or controlled. The primary borrow sites from the Watana Development are considered to be D, L, E and I (See Figure E.2.131 in the License Application). Other sites have been abandoned because of environmental reasons, economic or engineering constraints, or are now being considered only as backup sites. Quarry Site L is located wholly within the proposed reservoir. With careful removal of the vegetative and organic layers, the absence of work in the river channel and no tributaries in the immediate area, no siltation problems are

envisioned at this site. At Borrow Site D, all runoff will be collected and directed towards settling ponds prior to discharge into Deadman Creek or the Susitna River. No work is scheduled in or immediately adjacent to Deadman Creek, and therefore, no significant erosion control problems are anticipated.

Instream mining of Borrow Sites E and I will be scheduled for the summer (May-September) when high sediment and turbidity levels in the Susitna River already exist. Mining will begin in Site I, just upstream of a natural rock weir (see Figure E.2.135 in the License Application). By developing this section first and continuing upstream into E it is believed that the pool created behind the weir will serve as a settling pond for future upriver instream work. No activities, particularly at Site E and I will occur between October and May. Stockpiling of borrow material and dry excavation in berm areas will eliminate the need for instream gravel mining activities during this period.

Assuming a one percent loss in material to the river at sites I and E during the summer construction period, there would be about a 4 percent increase in suspended sediment load over 1982 levels. Stockpiling of gravel will alleviate the need for wet excavation during winter when the impact from siltation to incubating eggs would be greatest. As a result of the proposed scheduling of activities, impacts will be minimized. However, it is inevitable that there will be some increases in suspended sediments and turbidity during winter, but these will be short term and localized and there is no known spawning in the river just downstream of the Watana site. Downstream from Talkeetna, turbidity and suspended sediment levels should remain essentially the same as baseline conditions.

Primary sites for the Devil Canyon Dam include Borrow Sites G, K, and D. Potential impacts for gravel mining at sites G and K are expected to be minimal since no instream work is currently planned. Site D is the same site used for development of Watana Dam. Potential impacts at this site, as previously described, are expected to be avoided or minimized by erosion control procedures.

The second major potential source of suspended sediments is the processing of embankment material and deposition of soil material. Most of this material will be moved from the process plant by truck or belt conveyer and used to selectively backfill portions of the borrow area by placing the material at a depth to avoid entrainment in the river.

The waste water will be directed into a series of settling ponds. Considerable silt will settle out in the ponds immediately after discharge, hence control of the discharge end will be necessary to spread the material. Silt will be settled by passing the water through additional settling ponds before discharging into the river.

In summary, although increased turbidity and suspended sediments will potentially occur at certain sites, proper planning and controls will be implemented to avoid or minimize impact. These measures will include: 1) no instream work at certain sites; 2) timing of work to coincide with peak turbidities and sediment loads in the Susitna; and 3) operating in the summer before active spawning is occuring and storing materials for winter use; and, 4) effective sedimentation and erosion control procedures will be used.

References

Woodward-Clyde Consultants, Inc. 1980. Gravel removal studies in Arctic and Subarctic Floodplains in Alaska. U.S. Fish and Wildlife Service, FWS/OBS-80/08.

3. Fish, Wildlife and Botanical Resources - Aquatic Resources

Comment 8 (p. E-3-130, para. 6; p. E-3-187, para. 6)

Provide water quality criteria used to determine suitability of Devil Canyon and Watana reservoirs for fish production, especially for the decision to stock and manage rainbow trout only in Devil Canyon reservoir.

Response

The intent of the proposed stocking plan, particularly for rainbow trout, will be to support a quality fishery. Water quality in both reservoirs was considered to be within acceptable limits for fish production (i.e., parameters such as pH, dissolved oxygen, and temperatue would all be within a range that would support fish production). Therefore, water quality criteria were not the most important factor in determining the suitability of either reservoir for fish production. The controlling factor, instead, was the drawdown schedule for Watana, which, because of its timing and magnitude, would create a habitat that is not conducive to supporting a quality fishery. The timing and less extensive drawdown schedule for Devil Canyon Reservoir will be more favorable to a quality fishery. High relative turbidities in large portions of the Watana Reservoir could also make this a less attractive quality fishery. In addition, to drawdown schedule, another important factor for not proposing to introduce rainbow trout to Watana was that this would expand the range of this species into the upper basin whereas an introduction to Devil Canyon would limit this expansion.

It is anticipated that a grayling fishery will develop in Watana (and Devil Canyon) Reservoirs at the mouths of tributaries discharging into the reservoir.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 9 (p. E-3-164)

Provide references to studies at other sites where spring flows were manipulated at the time of ice breakup in order to stimulate outmigration of salmon fry.

Response

No information was found specifically documenting the manipulation of flows at ice breakup to stimulate outmigration of fry. Although flows are commonly manipulated at hydroelectric projects (e.g., Columbia River) to benefit fisheries resources, the major reason for manipulating flows is typically to assist passage. A review of the literature suggests that flows including timing, duration, and speed, are important to the outmigration of juvenile salmonoids. Downstream travel times of juveniles are often directly related to flows and more fish will often migrate at higher flows. Data from Raymond (1968, 1969, 1979) and Bentley and Raymond (1976) in the Columbia River suggest that: 1) the higher the water velocity, the higher the rate of chinook and steelhead migration; 2) river impoundment reduced the river velocity and migration rate of the salmonoid juveniles to approximately one-third that of free-flowing sections; and 3) river impoundment has significantly decreased juvenile chinook survival (from 80-90% prior to construction of several dams to 33% following completion of the dams), partially because of migration delays.

On several small streams of western Washington studied by Sieler et al. (1981), the outmigration pattern of coho is often closely related to the pattern of spring flows. On the Fraser River of British Columbia, reduced discharges during seaward migration tends to reduce the survival of sockeye and pink salmon (Anon 1971). Cannon (personal comm.) concluded that Sacramento River flows in excess of 20,000 cfs in the winter appear necessary for successful migration of chinook fry into the Sacramento River estuary. Raymond (1979) suggests that the downstream migrations of juvenile steelhead generally coincide with maximum river discharge. The frequency and flows necessary to "flush" all fry into the estuary was not established, however. Studies by Hoar (1951) suggest that: 1) chum and pink fry outmigrate in the swiftest currents; and 2) sudden elevations of water levels speeded up the downstream movement of coho smolts.

References

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Bentley, W. W. and H. L. Raymond 1976. Delayed migrations of yearling chinook since completion of Lower Monumental and Little Goose dams in the Snake River. Trans. Am. Fis[illegible]c. 105: 422-424.

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EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 10 (p. E-3-170, para. 5)

Provide operating criteria for determining how the selective withdrawal capabilities of the multi-level intakes to the Watana and Devil Canyon powerhouses will be controlled to attain pre-established thermal objectives for fish populations.

Response

The multi-level intake (Exhibit F, Plates F-24 and F-62) consist of several sets of shutters capable of withdrawing water from various depths of the reservoir. The shutters are adjusted for reservoir elevation to allow withdrawal of water meeting a predetermined temperature. The operating criteria to achieve these temperatures will be reviewed by the various resource agencies. The steps for achieving these temperatures will be:

1) Sensors near each set will detect the water temperatures at distinct levels in the reservoir.

2) The shutters will be adjusted to allow for the mix of water needed to provide the predetermined temperature as closely as possible.

3). A temperature sensor in the draft tubes will be used to verify downstream releases.

During summer, warmer reservoir water will usually be withdrawn from the surface through the intake facility and the set of shutters near the surface will generally be used. In this way, warmer waters will be passed downstream. In winter, the colder surface water will be withdrawn to provide the coldest possible water downstream. Overall, this results in the intake closest to the surface being used. However, upon occasion, deeper intakes will be used to provide water temperatures closer to preproject values. In the Watana/Devil Canyon Operation, the releases from both dams will both be coordinated to reach the predetermined temperatures downstream of Devil Canyon.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 11 (p. E-3-178)

Provide the data and analytic procedure used to determine the maximum estimated spawning habitat (approximately 245,000 ft^2) required by salmon spawning in sloughs upstream from Talkeetna in 1981 and 1982.

Response

The data and analytical procedure used was from several sources and can be summarized as follows:

Step 1. Peak slough spawning counts for sockeye, chum, and pinks from ADF&G for 1981 and 1982 were used. These years recorded peak returns into Cook Inlet and thus reflect the upper range of expected counts.

Step 2. These counts were converted to total estimated numbers of spawning fish as described in Table E.3.12 (see copy attached).

Step 3. Additional information was factored in the analysis as follows:

Species	Average Sex Ratio (Male to Female) 1981	1982
Sockeye[1]	1:1.3	1.5:1
Chum[1]	1:1	1:1
Pink	1:1	1:1

1/ From ADF&G (1983)

Spawning Habitat per redd (sq. ft.)

Sockeye[1/]	72
Chum[2/]	81
Pink[3/]	6.3

Step 4. The following assumption was made:

A. For a conservative analysis, it was assumed that there is no overlap in the area used as spawning habitat among the three species.

B. The highest value for spawning area of the two years was used for further analysis.

Step 5. The calculations were as follows:

Sockeye

A.

Year	Total Estimate	Male:Female Ratio	No. Redds
1981	2315	1:1.3	1308
1982	1402	1.5:1	561

B.

Year	No. Redds	X	Area Per Redd	=	Total Area
1981	1308		72 ft^2		94,176 ft^2
1982	561		72 ft^2		40,392 ft^2

[1/] From Foerster (1968) and Bell (1980)
[2/] From Hale (1981)
[3/] From Bell (1980)

Chum

A. Year	Total Estimate	Male:Female Ratio	No. Redds
1981	3526	1:1	1763
1982	3674	1:1	1837

B. Year	No. Redds	X	Area Per Redd	=	Total Area
1981	1763		81 ft^2		142,803 ft^2
1982	1837		81 ft^2		148,797 ft^2

Pinks

A. Year	Total Estimate	Male:Female Ratio	No. Redds
1981	28	1:1	14
1982	735	1:1	368

B. Year	No. Redds	X	Area Per Redd	=	Total Area
1981	14		6.3 ft^2		88.2 ft^2
1982	368		6.3 ft^2		2318.4 ft^2

Using the highest number from each year, the total was calculated as follows:

$$\begin{array}{r} 94{,}176\ ft^2 \\ 148{,}797\ ft^2 \\ 2{,}318\ ft^2 \\ \hline 245{,}291\ ft^2 \end{array}$$

This total was rounded off to 245,000 $ft.^2$ as an approximation.

References

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TABLE E.3.12: ESTIMATED NUMBER OF SLOUGH SPAWNING SOCKEYE, CHUM AND PINK SALMON IN SLOUGHS BETWEEN DEVIL CANYON AND TALKEETNA, 1981 TO 1982[1]

Slough	River Mile	Sockeye 1981	Sockeye 1982	Chum 1981	Chum 1982	Pink 1981	Pink 1982
1	99.6	0	0	6	0	0	0
2	100.4	0	0	30	0	0	0
3B	101.4	2	0	0	0	0	0
3A	101.9	9	0	0	0	1	0
5	107.2	0	0	0	2[a]	0	0
6A	112.3	1	0	11	2	0	35[a]
8	113.2	0	0	480	0	25	0
8D	121.8	0	0	0	23[a]	0	0
8C	121.9	0	2	0	75	0	0
8B	122.2	0	5	1	80[a]	0	0
Moose	123.5	0	8	167[a]	65	0	9
A	124.6	0	0	140[a]	0	0	0
A	124.7	0	0	60	0	2	0
8A	125.1	191	133	620[a]	748	0	28
B	126.3	0	9	0	73	0	32[a]
9	128.3	14	6	260[a]	420	0	32
9B	129.3	203	1	190	5	0	0
9A	133.3	3	1	207	173	0	0
10	133.8	0	0	0	2	0	0
11	135.3	1762	1131	765	732	0	276
13	135.7	0	0	5	0	0	0
15	137.2	0	0	1	1	0	135
16	137.3	10	0	3	0	0	0
17	138.2	49	0	94	21[a]	0	0
19	139.7	2[a]	0	3	1	0	1
20	140.1	64	106	16	30[a]	0	133
21	141.0	0	0	457	1222	0	64[a]
21A	145.5	0	0	10	2	0	0
Estimated Total		2315	1402	3526	3674	28	735

1981 Estimated Total: 5869 slough spawning salmon.
1982 Estimated Total: 5811 slough spawning salmon.

[1] Total numbers estimated by calculating the area under the curve formed from plotting number of live salmon in sloughs versus the date and dividing by the average estimated stream life (as in Bell, 1980). The estimated stream life was 12 days for sockeye, 10 days for chum and 7 days for pinks (Bechtel Civil and Minerals, Inc., 1983).

In some cases the peak live count exceeded the calculated total count. These are indicated by "a" and the peak live count is used.

EXHIBIT E

3. Fish, Wildlife and Botanical Resources - Aquatic Resources

Comment 12 (p. E-3-179)

Provide the current work plan for the Aquatic Program for 1983 and 1984.

Response

The work plan for the Susitna Hydro Project Aquatic Program is provided for the period July 1, 1983 to June 30, 1984 (FY 1984). There are two main components to this program: 1) improvement of baseline data bases and refinement of impact evaluations; and 2) mitigation planning. The study elements of the impact evaluation efforts include lower river (Talkeetna to Cook Inlet), middle river (Talkeetna to Devil Canyon), and access road and transmission line. Elements of the mitigation planning efforts include the potential grayling hatchery, habitat modification, and monitoring. Attached tables 1 to 6 provide a general description of these elements. Tables 7 to 10 are a detailed description of the study elements of each major subcontractor of the Aquatic Program for FY 1984, including objectives, tasks, sampling strategy, data output, and data use. Some program specifics may be modified in resposne to agency consultations, updated data analyses, and other factors. Figure 1 presents a general model of how information and models are utilized to evaluate impacts and plan mitigation. In Figures 2 to 17, we have diagrammed conceptually how the specific data that we expect to be collected will be integrated with models (and other necessary data) to evaluate and assess specific potential impacts (e.g., adult salmon access to sloughs, juvenile rearing in tributary mouths).

The Aquatic Program for the July 1, 1984 to December 31, 1984 period will be based primarily on the results of 1983-1984 studies, agency consultations, and other inputs as appropriate. We anticipate that the following will be part of the 1984 program:

1) Impact evaluations and baseline data collection.
   a) Access road and transmission line corridor studies.
   b) Effects of post project flows, temperature, and water quality.
   c) Baseline data collection

2) Mitigation planning.
   a) Habitat modification
   b) Grayling mitigation
   c) Monitoring

TABLE 1: BASELINE DATA COLLECTION & IMPACT EVALUATIONS

STUDY ELEMENT: LOWER RIVER STUDIES (COOK INLET TO TALKEETNA)

INVESTIGATORS: HARZA-EBASCO: R & M: USGS: UNIDENTIFIED SUBCONTRACTORS

DATA COLLECTION	DATA ANALYSIS	IMPACT EVALUATION	END RESULTS
Aerial Photography	Preliminary Flow Evaluations	Magnitude of Change for each aspect	Position paper on hydrologic relationships
Groundtruthing (Cross Sections)	Temperature Modelling		Positon paper on ice processes
Fish Habitat Descriptions	Water Balance Modelling		Position paper on bedload sediment transport
Fish Distribution	Ice Processes Synthesis		Evaluation of effects on fish habitats
Bedload/Suspended Sediment	Review Available Data: Fish Populations, Fish Habitats		Assess effects to navigation
Ice Observations	Fish Habitat Ground Truthing		Determine need for future studies

34-12-3

TABLE 2: BASELINE DATA COLLECTION & IMPACT EVALUATIONS

STUDY ELEMENT: MIDDLE RIVER STUDIES (TALKEETNA TO DEVIL CANYON)

INVESTIGATORS: HARZA-EBASCO: ADF&G: R & M: AEIDC

DATA COLLECTION	DATA ANALYSIS	IMPACT EVALUATION	END RESULTS
Fish Abundance, dist	Fish Abundance Estimates	Simulation Modelling Reservoir Operation	Incremental Analysis Reports
Fish migration rates	Fish Distribution Summary	Reservoir Temp.,& Ice	Open Water season
Fish numbers	Juvenile Salmonid Survival Summary	Instream Hydraulics, Temp. and Ice	Ice covered season
Habitat	Juvenile Salmonid Outmigration Timing	Water Balance	
Available Preferred, Utilized	IFG Type Incremental Analysis	Ground Water	Verification of Model elements
Hydrologic Data	Oregon Method Incremental Analysis	Bedload/Suspended Sediment Transport	Habitat Map
Velocity	Sag Tape Method	Fish Habitat	Ice Observations Report
Depth	Correlate Habitat vs. Distribution	Quantitative Impact Assessment - Fish & Aquatic Habitat	Document & Verify Models
Substrate	Distributions of Habitat Types		Position paper on Water Quality
Discharge	Ice Process Analyses		Position paper on Gas Supersaturation
Thalweg & Cross sections			
WSEL			
Temperature			
Relationships to main-stem discharge			
Groundwater			
Ice Processes Front Locations Thickness Break-up Jams			

3A-12-4

3A-12-5

TABLE 3: BASELINE DATA COLLECTION & IMPACT EVALUATIONS

STUDY ELEMENT: ACCESS AND TRANSMISSION LINE

INVESTIGATORS: R & M: SUBCONTRACTORS

DATA COLLECTION	DATA ANALYSIS	IMPACT EVALUATION	END RESULTS
Hydrologic Data Depth Gradient Discharge Velocity pH Turbidity Substrates	Synthesize Hydrologic data Fish habitat Descriptions	Magnitude & Change	Transmission Line Impact Report Access Road Impact Report
Fish Data Species Present Relative Abundance Movements			

TABLE 4. Mitigation planning
Study Element: Grayling Hatchery
Investigators: H/E, WCC, ADF&G

APPROACH	INFORMATION REQUIREMENTS	RESULTS OF ASSESSMENT
FEASIBILITY LEVEL PLANNING FOR FACILITY	ANALYSIS OF MAGNITUDE OF LOST POPULATIONS	FEASIBILITY LEVEL DETERMINATION OF HATCHERY
LITERATURE REVIEW OF FISH CULTURE AND TECHNOLOGY	DOCUMENT EXPERIENCE IN ARCTIC GRAYLING CULTURE	IMPLEMENTATION PLAN
DEMONSTRATION PROJECT	FACILITY SITING STUDY	
ALTERNATIVE OPTIONS ANALYSIS	ARCTIC GRAYLING CULTURE INFORMATION	
DETERMINE NUMBER OF FISH TO BE MITIGATED FOR	BASELINE DATA ON GRAYLING POPULATION	

3A-12-6

3A-12-7

Table 5. Mitigation planning
Study Element: Structural Habitat Modification
Investigators: H/E, ADF&G, WCC

APPROACH	INFORMATION REQUIREMENTS	RESULTS OF ASSESSMENT
FEASIBILITY LEVEL STUDY	SLOUGH HYDROLOGIC & BIOLOGIC DATA	RECOMMENDED MITIGATION PLAN
SLOUGH MODIFICATION DEMONSTRATION	° PRODUCTIVE SLOUGHS ° UNPRODUCTIVE SLOUGHS	
° MODIFICATION		NEGOTIATED
° MONITORING	RESULTS OF INCREMENTAL FLOW ANALYSIS	MITIGATION PLAN
	° IFG	
	° SUSITNA SIMULATION MODELING	

3A-12-8

Table 6. Mitigation Planning
Study Element: Monitoring Programs
Investigators: ADF&G, H/E, Subcontractors

APPROACH	INFORMATION REQUIREMENTS	RESULTS OF ASSESSMENT
BASELINE CONDITIONS	DATA COLLECTION	EVALUATION OF IMPACT ASSESSMENT & MITIGATION PLAN IMPLEMENTATION
TIME-SERIES SUMMARIZATION	° Fish distribution and abundance	
STATISTICAL EVALUATION	° Habitat data	
	° Migration and movements	
	° Hydrologic data	
	REPRESENTATIVE SPECIES	

TABLE 7 (CONT'D.)

STUDY	OBJECTIVES	TASKS	KEY SPECIES	SAMPLING LOCATION(S)	GEAR/ METHOD	VARIABLES COLLECTED	DATA OUTPUT	DATA USE
Resident & Juvenile Anadromous Fisheries	1) Establish baseline data on resident & juvenile anadromous fish. 2) Determine relationships of environmental parameters to resident & juvenile anadromous fish.	1) Determine the utilization and preference of various seasonal habitats by resident & juvenile fish. 2) Estimate numbers of residents and juvenile anadromous salmonids. 3) Estimate timing of emergence & outmigration of juvenile anadromous salmonids.	Chinook, Coho, Pink, Sockeye & Chum salmon. Rainbow trout, Burbot	Key Areas for Emergence studies will be: -Sloughs 6A,8A,9, 11, 20, 21. -Side Channels at RM 136.7 & 137.3 Key areas for outmigrant studies will be: -Talkeetna fishwheel camp. - Sloughs 6A,8A,9, 11, 20, 21. - Side channels at RM 136.7 & 137.3. Juvenile Anadromous Habitat Study Sites include: -Sloughs 20, 21, 11, 9, 8A, 19, 6A. -Indian River, Fourth of July Creek, Moose slough, McKenzie Ck., Lane Creek, Chase Ck., Whiskers Ck., Jack Long Creek & Portage Creek. -Six mainstem sites between RM 77 & 142.	-Gears to be used include: °trotlines, °electrofishing gear, °gill and hoop nets, °beach seines °radiotelemetry equipment, °flow measuring instruments, °water quality measuring instruments, °pre-emergent fry and egg pump, °dip net °inclined plane traps at Talkeetna. °fish traps for sloughs mouths.	-Relative timing, abundance & numbers of fish. -Environmental parameters including flow, temperature, turbidity, depth, velocity, substrate, and cover.	-Relative abundance & population estimates at specific habitats. -Habitat relationships between environmental parameters & fish. -Timing of emergence & outmigration rates.	-Relative abundance & population estimates will be used to refine existing knowledge on habitat & distribution. This will also be used to establish baseline conditions prior to project development. -Relationships among fish abundance, habitat, populations numbers, timing of emergence and outmigration will be established. Much of this information will be collected in coordination with the ADF&G Aquatic Habitat and Instream Flow Studies Group who will analyze this information for input to the AEIDC model.

3A-12-1C

TABLE 7. PROGRAM ELEMENTS FOR ADF&G FOR THE PERIOD JULY 1, 1983 TO JUNE 30, 1984.

STUDY	OBJECTIVE(S)	TASKS	KEY SPECIES	SAMPLING LOCATION(S)	GEAR/ METHOD	DATA OUTPUT	DATA USE
Aquatic Habitat & Instream Flow Studies	1) Evaluate & quantify the relationship between mainstem discharge & the availability & utilization of side channel & slough habitats for passage, spawning, incubation, outmigration & rearing of anadromous & resident fish. 2) Evaluate & quantify the utilization & availability of tributary mouth habitats for salmon spawning & resident fish rearing at various combinations of mainstem & tributary discharges. 3) Identify, evaluate & quantify the ranges of habitat conditions utilized & available at various discharge levels for salmon spawning & resident fish rearing in selected tributaries.	1) Perform instream flow studies (primarily IFG but also the Oregon method, & Sag Tape method) at selected sloughs, side channels & tributary mouths & mainstem sites 2) Perform additional baseline hydrological & water quality characteristics of mainstem, side channel, slough, & tributary habitats as they relate to mainstem discharge.	Chum Salmon, Chinook " , Coho " , Pink " , Sockeye " ,	-Sloughs 8A, 9, 21. -Portage Creek, Indian River, & Fourth of July Creek(if possible). -Side channels associated with slough 10 & 11. & 4th of July Creek.	Flow measurement equipment, thermographs, temperature probes, substrate analysis equipment, hydrolab (a multi-parameter water quality measuring equipment, survey equipment, & stage measurement gear.	-Fish habitat preference curves. -Weighted usable area for: Sloughs, Side Channels, Tributary Mouths -Stage discharge relationships for sloughs, side channels, & tributary mouths vs. mainstem.	This data will be directly used by AEIDC as part of their modelling. The key area of use will be in developing relationships between flow & temperature and habitat. Additional factors that will be considered are substrate, turbidity, & cover.

3A-12-9

TABLE 7 (Cont'd.)

STUDY	OBJECTIVES	TASKS	KEY SPECIES	SAMPLING LOCATION(S)	GEAR/ METHOD	VARIABLES COLLECTED	DATA OUTPUT	DATA USE
Anadromous Adults	1) Determine Escapement of Adult Salmon	1) Survey sloughs & stream index areas. 2) Identify sloughs & streams utilized by adults. 3) Provide index salmon counts. 4) Determine mean stream life. 5) Operate fish wheels at Yentna, Sunshine, Talkeetna, & Curry stations.	Chinook salmon, Coho " Pink " Sockeye " Chum "	Susitna River below Devil Canyon including tributaries	-Fishwheels to capture fish for tagging & enumeration. -Visual observation of fish in spawning areas.	-Numbers of fish observed. -Locations of fish observed. -Mark/recapture ratio. -Temperature, flow, turbidity.	-Escapement numbers. -Timing of runs. -Relationship of environmental variables to timing and migration.	-Escapement values will be used to establish pre-project numbers and for use in post-project monitoring

3A-12-11

TABLE 8. PROGRAM ELEMENTS FOR WOODWARD-CLYDE CONSULTANTS FOR THE PERIOD JULY 1, 1983 TO JUNE 30, 1984.

PROGRAM	OBJECTIVES	KEY SPECIES	LOCATIONS	DATA COLLECTED	OUTPUT	DATA ANALYSIS	DATA USE
Mitigation Planning	1) Evaluate & quantify mitigation techniques. 2) Prepare specific plans & planning documents for specific mitigation techniques.	Chum, Sockeye, Grayling	Sloughs, and side channels, & tributaries in impoundment area.	- - -	Detailed mitigation plans.	- - -	For planning of mitigation due to impacts caused by post project operations.

3A-12-12

3A-12-13

TABLE 9. PROGRAM ELEMENTS FOR R & M CONSULTANTS FOR THE PERIOD JULY 1, 1983 TO JUNE 30, 1984.

STUDY	OBJECTIVES	TASK	LOCATIONS	DATA OUTPUT	DATA USE
Field Data Index	Continue data indexing of hydrologic & meteorologic data within the Susitna River Basin.	To continue updating hydrologic & climatological data collected within the Susitna Basin.	- - -	A field data index will be updated every (6) months.	This central storage of data is needed for reference and access to prior data.
Climate/Snow Data Collection	Acquire baseline meteorological data for engineering & environmental studies within the Susitna Basin.	-Collect meteorological data. -Conduct snow surveys	-Watana Damsite -Devil Canyon Damsite -Eklutna Lake -Entire Susitna Basin(snow surveys)	-Information will include air temps, wind speed, wind direction, relative humidity, precipitation, solar radiation, peak wind gust, dew point temps, & long wave radiation. -Snow data & water supply information.	To assist engineering & environmental studies programs with baseline & informational needs.
Glacial Lake Temperature	To obtain meteorological, hydrological & limnological data from a deep lake in order to calibrate the DYRESM 1-dimensional reservoir temperature model.	-Stream gage major tributaries. -Collect meteorological information. -Collect water quality samples.	-Eklutna Lake, near Anchorage	Data on: 1) Temperate(water&air) 2) Turbidity 3) Conductivity 4) Light extinction 5) Stream flow 6) Precipitation 7) Vapor pressure 8) Cloud cover	The data will be used to calibrate the DYRESM 1-dimensional temperature model.

TABLE 9 (CONT'D.)

STUDY	OBJECTIVES	TASK	LOCATION	DATA OUTPUT	DATA USE
Ice Observations/ Thickness, Freeze up, & Break up	-To document ice jams, water velocities, erosion & scour during freeze-up & break-up. -To provide supporting meteorological & streamflow data .	Fly aerial reconnaissance on freeze-up & break-up & make observations.	Susitna River from Kosina Crk. to Cook Inlet with specific emphasis on: - Talkeetna, Chulitna & Susitna confluence. -Confluence to Devil Canyon. -Devil Canyon up-stream.	-Edge of ice -Rate of down-stream progression. -Location of open leads. -Percentage ice cover. -Ice jam locations -Water temperatures -Meteorological data. -Photographs of ice effects.	This data will be used to calibrate the DYRESM Model. The data will be used by Harza-Ebasco & AEIDC to predict impacts due to ice formation & break-up. Also, to better document flooding & staging combinations.
Glacier Studies	-Investigate changes in water supply available from glaciated portions of the basin	-Perform glacier reconnaissance surveys.	Glaciers in Susitna Basin.	-Data will include information on glacial contributions to water supply -Historical flow records will be adjusted for any mass wasting & accumulation of glaciers.	Data will be used by the engineers in the mass balance water model & by AEIDC in their aquatic impact assessment report.

3A-12-14

TABLE 9. (CONT'D.)

STUDY	OBJECTIVES	TASK	LOCATION	DATA OUTPUT	DATA USE
Slough Hydraulic Processes	-Define relationship between mainstem water surface elevations & upwelling rates in Sloughs 8A,9, & 11. -Define the relative contributions of seepage water & of local surface water to the water balance between Talkeetna & Devil Canyon. -Document the influence of a mainstem ice cover on upwelling rates in selected side Sloughs between Talkeetna & Devil Canyon.	Obtain water surface elevations. Obtain seepage rates Obtain flow rates at Slough 8A, 9, 11, & 21	Sloughs 8A, 9, 11, & 21	-Upwelling rates -Seepage rates -Local surface runoff.	This information will be used by ADF&G for their aquatic habitat modelling efforts & by AEIDC in their aquatic impact assessment.
Slough-Side Channel Sediment processes	-To define pre-project sediment regimes of representative sloughs & side channels & to predict post-project sediment conditions.	Collect sediment data at selected loughs at various flows.	To be determined but in coordination with ADF&G. Probable candidates are 8A & 9 Sloughs.	Prediction of existing & post project sediment conditions.	These predictions will be used by ADF&G in their aquatic habitat modelling efforts. AEIDC will use this for their aquatic impact model.

3A-18-17

TABLE 9. (CONT'D.)

STUDY	OBJECTIVES	TASK	LOCATION	DATA OUTPUT	DATA USE
Stream Gaging	-To obtain baseline water flow data in support of other programs (i.e., aquatic habitat-assessment) & modeling efforts by ADF&G and AEIDC.	-Obtain continuous summer and winter streamflow data at selected sites.	-Susitna River at Watana, Deadman Crk., & Indian River (summer streamflow measurements). -Watana, Deadman, & Tsusena Creeks (winter streamflow measurements). -Discharge data for Sloughs 8A, 9A, & 11	-Streamflow records.	-Data will be used by ADF&G in its aquatic habitat analysis & by AEIDC in its impact assessment model.
Lower Susitna Morphological Assessment	Conduct reconnaissance, ground truthing, & interpretation of physical differences in the Susitna River below Talkeetna caused by differences in flows.	-Perform aerial overflights at various flow levels to determine response of aquatic habitat to flow variations.	-Lower Susitna downstream of Talkeetna.	-Aerial photos of lower river -Data on wetted surface area, wetted perimeter, depths, overtopping of berms, velocities, & bed material.	-The data will be used by Harza/Ebasco and one of its subcontractors to determine the potential project's potential impacts on the lower river.

3A-12-16

3A-12-17

TABLE 10. PROGRAM ELEMENTS FOR AEIDC FOR THE PERIOD JULY 1, 1983 TO JUNE 30, 1984.

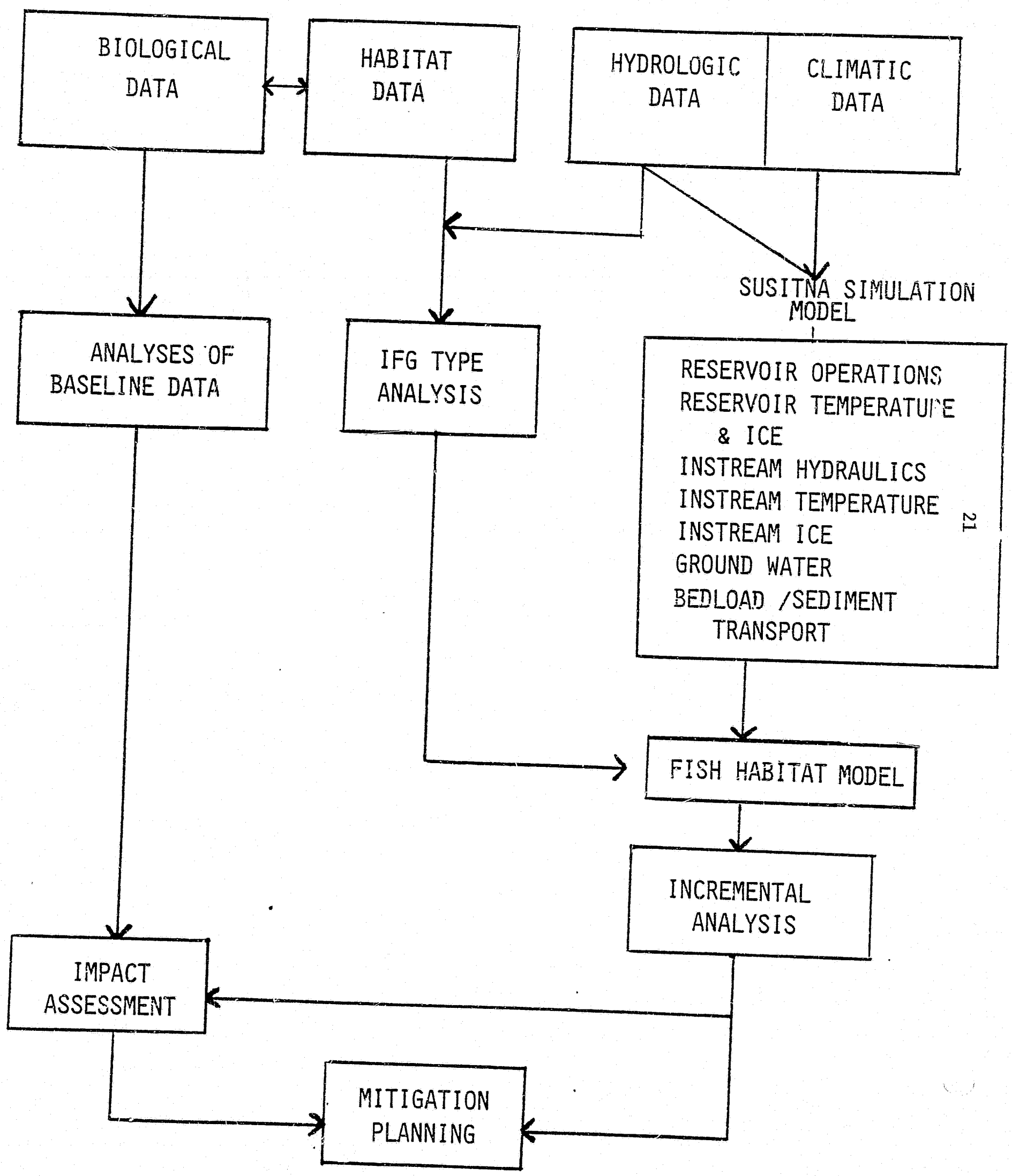
STUDY	OBJECTIVES	TASKS	KEY SPECIES	LOCATION	DATA OUTPUT	DATA USE
Aquatic Habitat Relationships & Modelling	1) To develop the relationships between mainstem discharge & fish habitats in sloughs, side-channels, mainstem & tributary mouths. 2) Define impacts from the flow/habitat relationships. 3) Develop relationships between temperature & fish use of habitats.	1) Consolidate various models & sources of data* info on overall system model that will be able to define changes in aquatic habitat at various operating flow regimes.	Chinook, Coho, Pink, Chum, Sockeye.	Project impact area.	1) The primary output will be a working model that will predict the impacts to the aquatic environment at a given flow. 2) Using this model, AEIDC will develop a report on these incremental impacts.	1) The output from the model will be used to: a) determine the significance of impacts, b) plan mitigation and c) negotiate streamflows.

* These models and data sources include:

a) historical basin flows;
b) reservoir operations parameters;
c) release schedules;
d) reservoir operations model;
e) in-reservoir release flows and temperatures;
f) reservoir release flows and temperatures;
g) groundwater models;
h) basin water balance model;
i) instream temperature model;
j) basin-wide stream flow and temperature regimes;
k) tributary and mainstem biological and physical habitat data;
l) slough and side channel biological and physical habitat data; &
m) ice and sediment models;
n) flow vs. habitat relationships.

FIGURE 1

AQUATIC STUDIES PROGRAM
STUDY ELEMENTS
AND INFORMATION FLOW



3A-12-10

EVALUATION OF ADULT SALMON ACCESS TO SLOUGHS FOR SPAWNING.

LOCATIONS OF ANALYSIS: Detailed on Slough 8A, 9, 11 and 21

Additional Data On Whiskers Creek Sloughs 6A, 16B, 20 and 22

3A-12-19

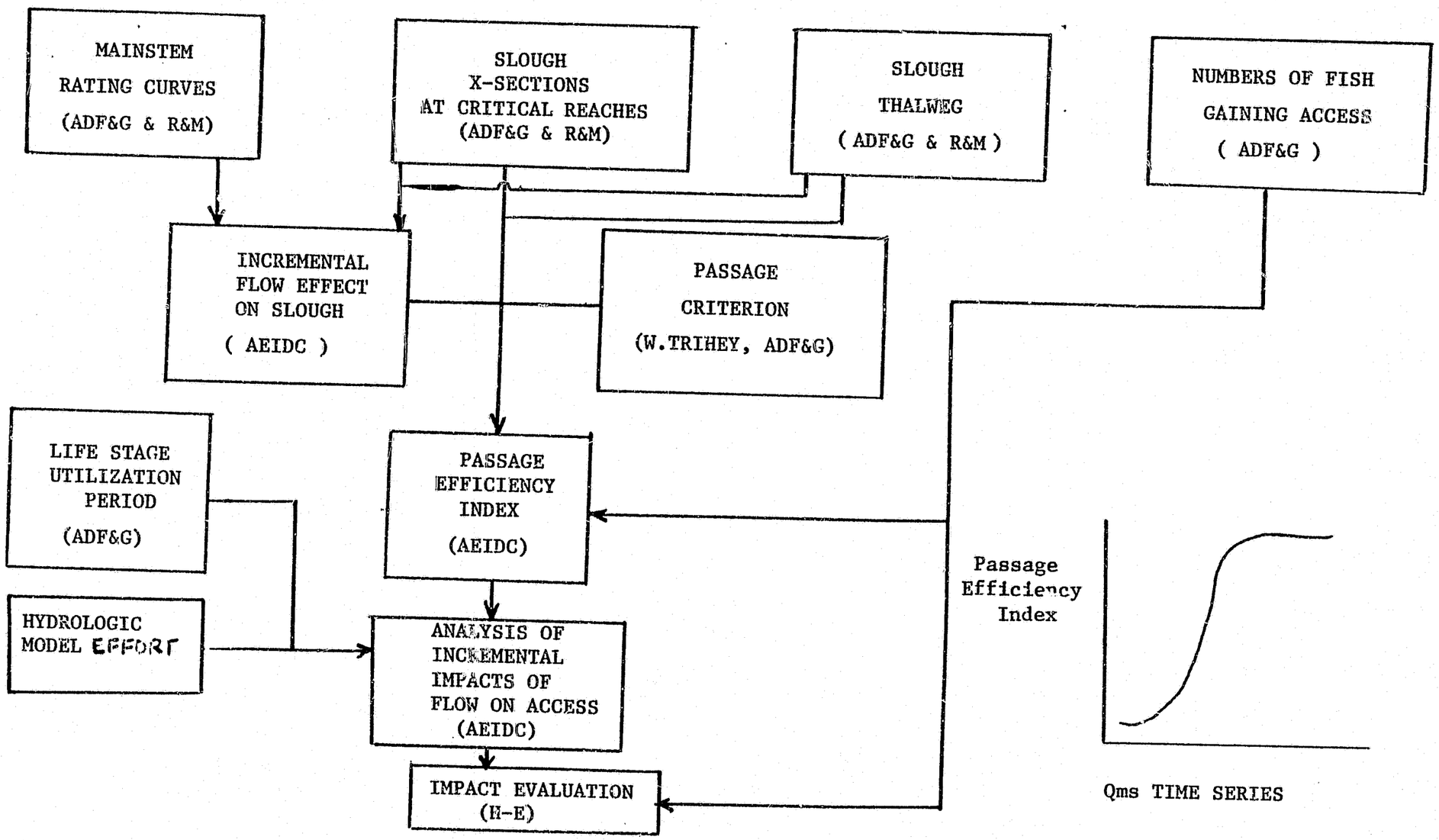
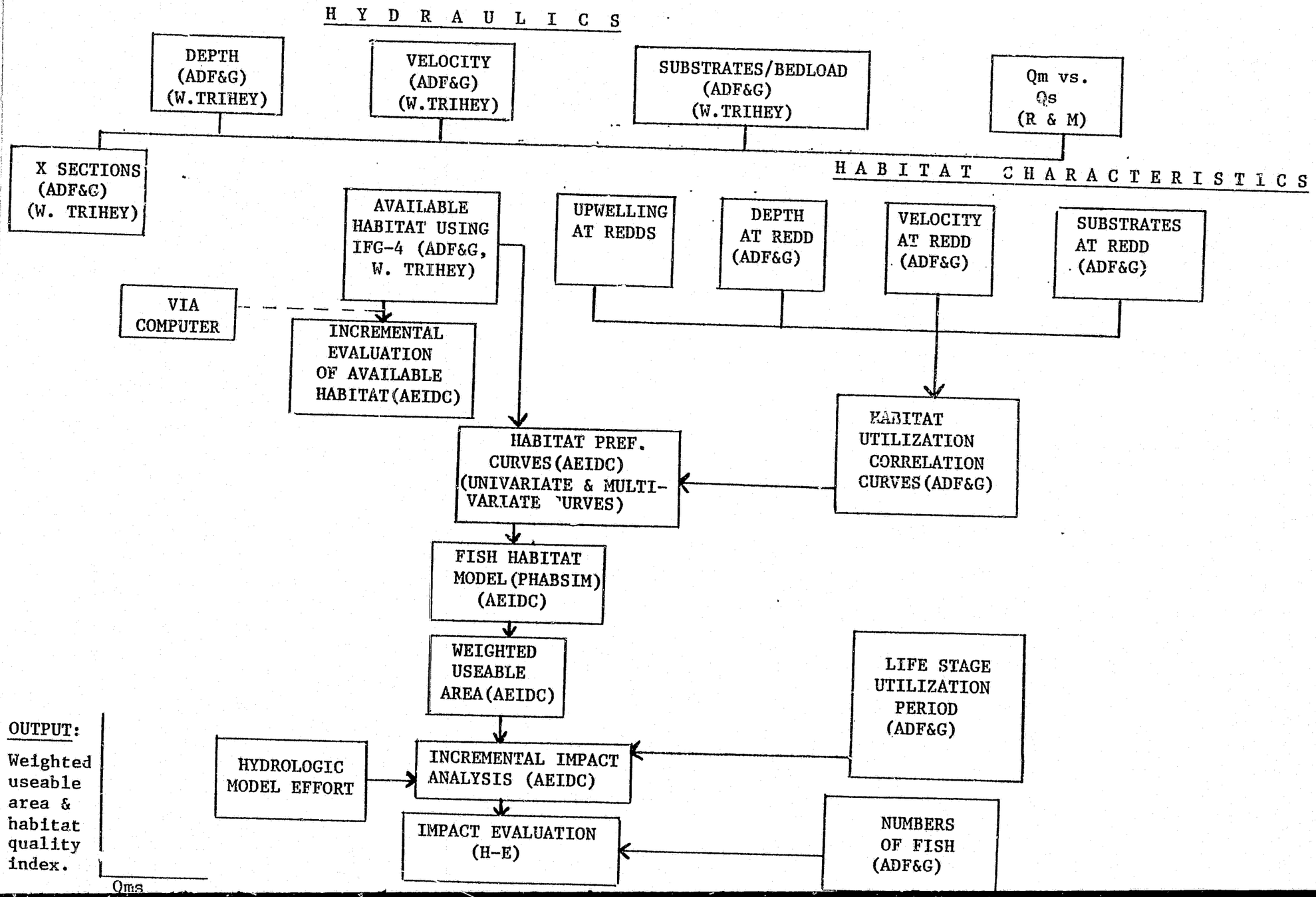


FIGURE 3

EVALUATION OF ADULT SALMON

SPAWNING HABITAT IN SLOUGHS

LOCATION OF ANALYSES: SLOUGHS 8A, 9, 11, 21



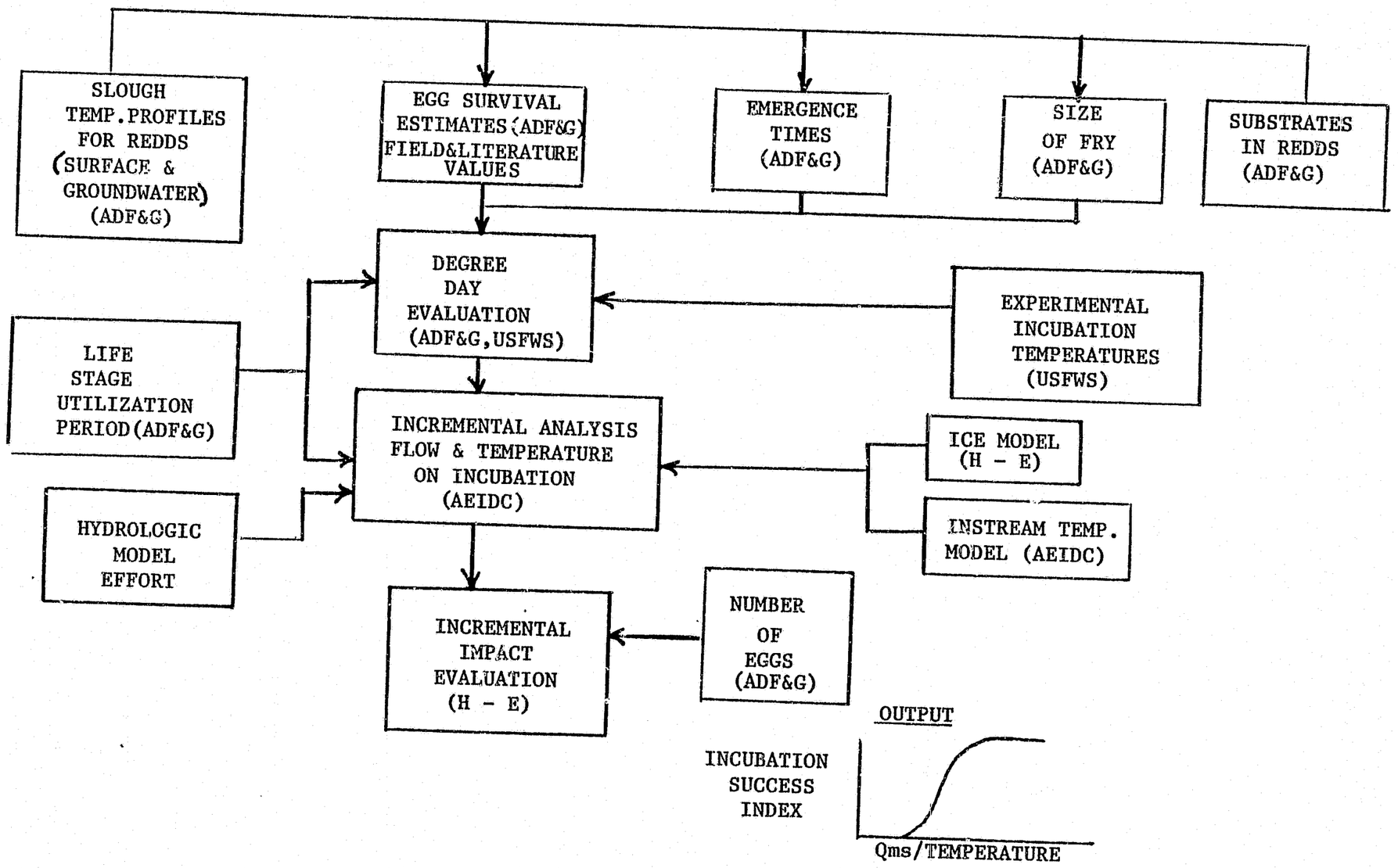
37-12-

FIGURE 4

EVALUATION OF INCUBATION IN SLOUGHS

LOCATIONS OF ANALYSES: SLOUGH 8A, 9, 11, 21

LABORATORY: U.S.F.W.S.



37-12-21

FIGURE 6
FIGURE 5
EVALUATION OF JUVENILE REARING IN SLOUGHS
LOCATIONS: SLOUGHS 8A, 9, 11, 21, 6A, WHISKERS CREEK, 16B, 20, 22

3A-12-22

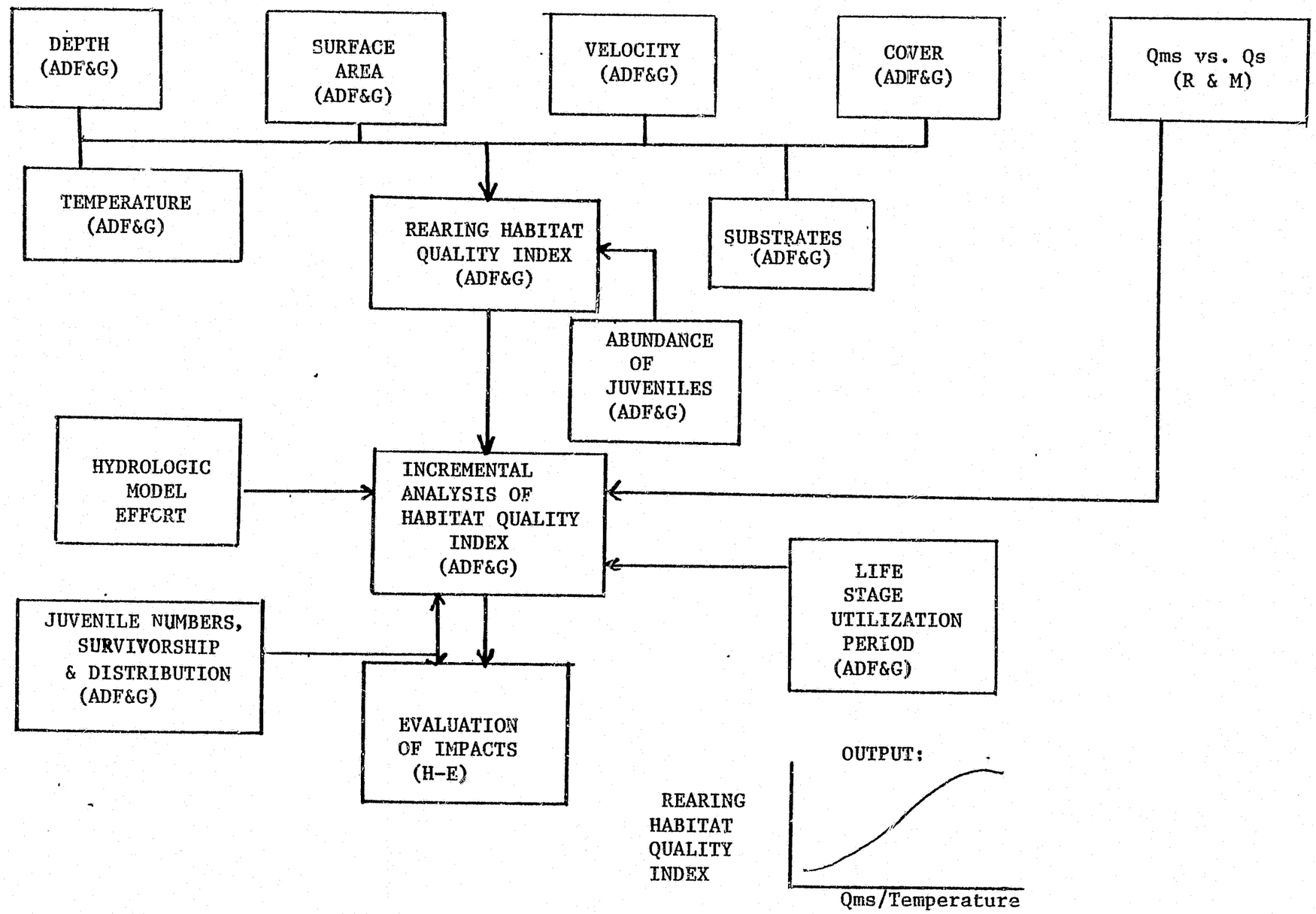


FIGURE 6
EVALUATION OF OUTMIGRATION OF
JUVENILES FROM SLOUGHS

LOCATIONS OF ANALYSES: SLOUGHS 8A, 9, 11, 21

3A-12-22

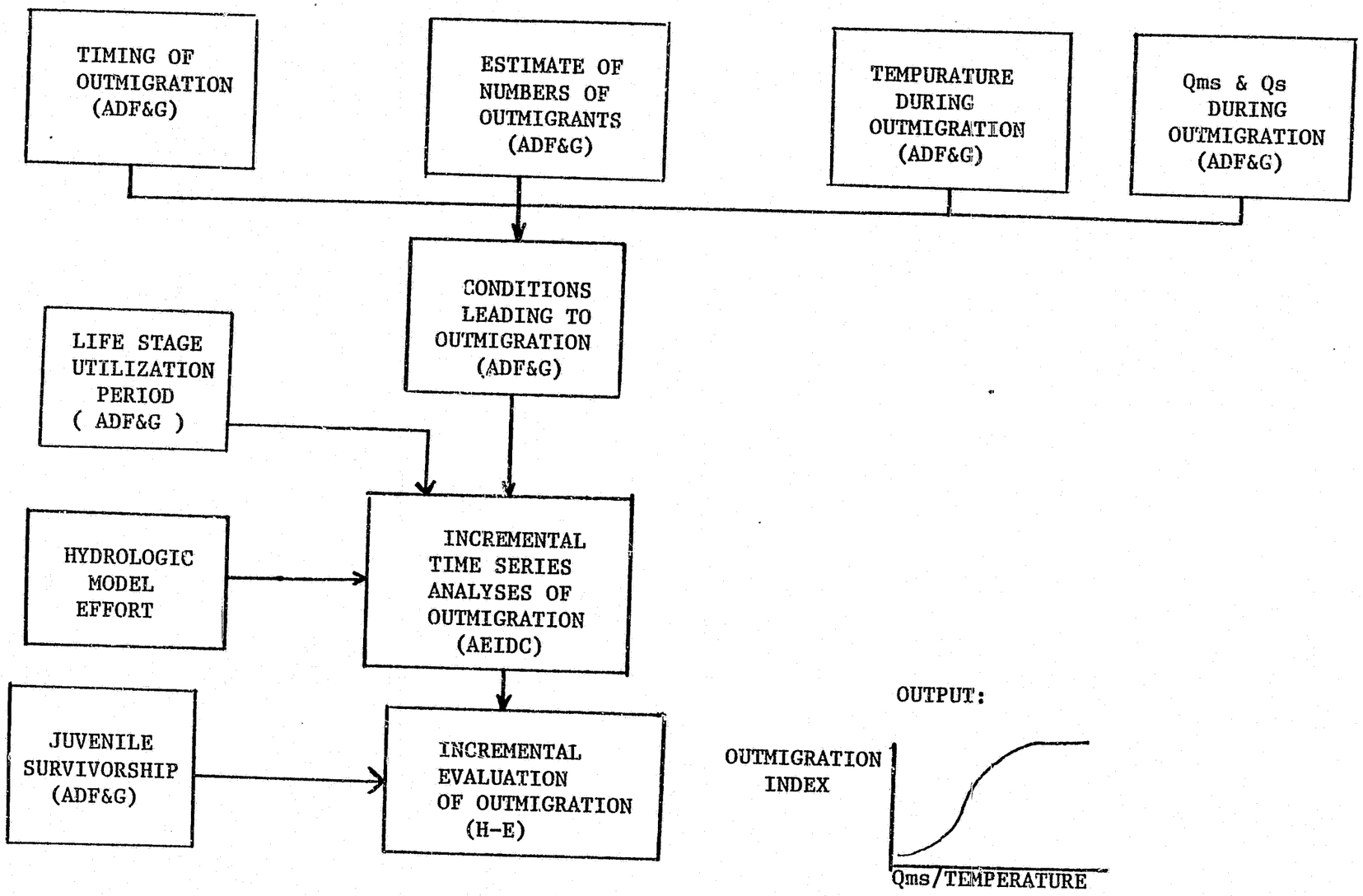


FIGURE 7

EVALUATION OF SPAWNING HABITAT
IN SIDE CHANNEL

37-12-27

LOCATIONS: DETAILED: D/S OF SLOUGH 21 and D/S of SLOUGH 11

ADDITIONAL: U/S OF SLOUGH 11, NEAR SLOUGH 10, AT RM 114 AND MOUTH OF 4TH OF JULY CREEK

HYDRAULIC CHARACTERISTICS (D/S SLOUGH 21 AND D/S OF SLOUGH 11)

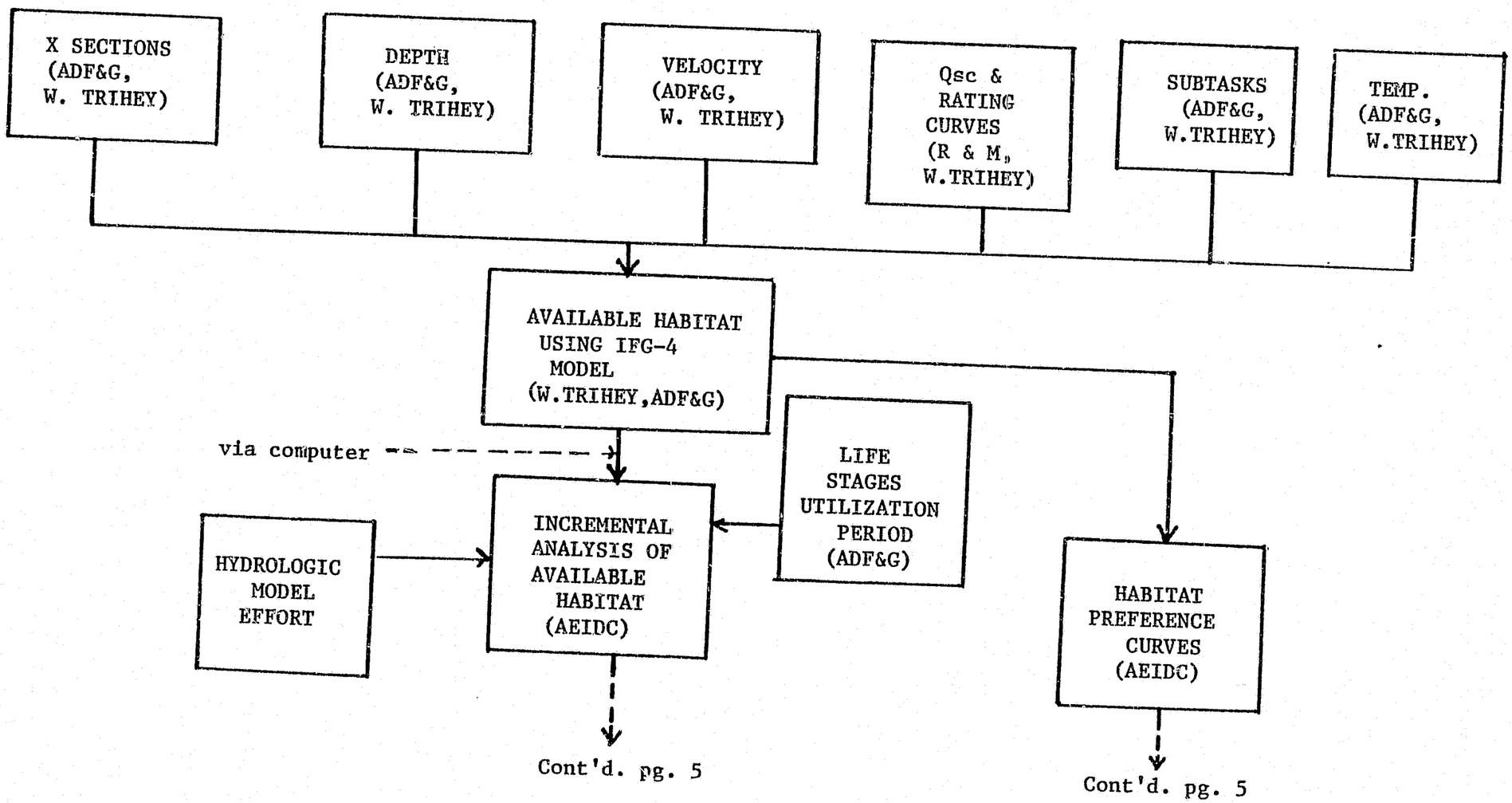
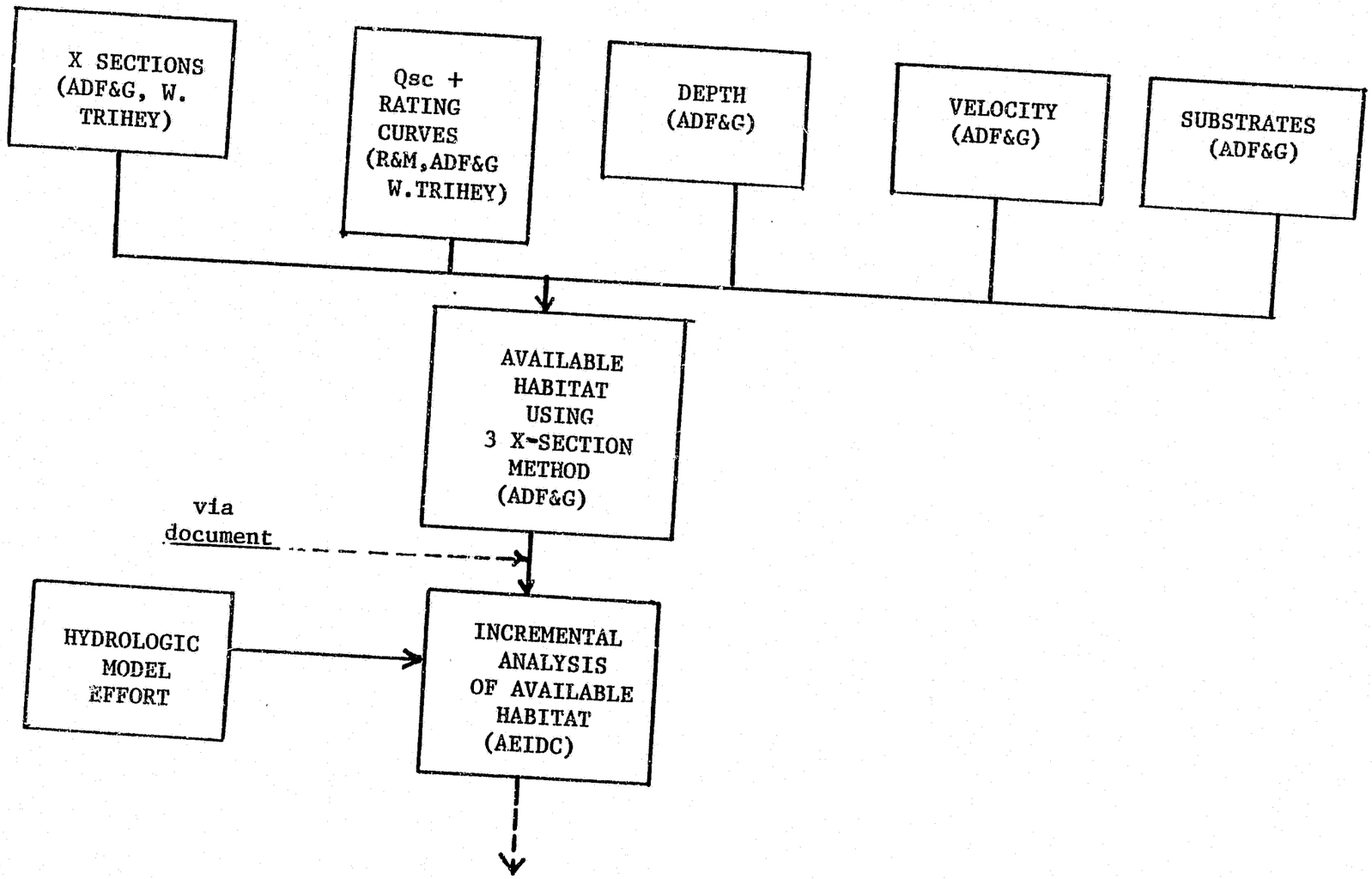


FIGURE 1
SPAWNING IN SIDE CHANNEL (CONT'D.)

HYDRAULIC CHARACTERISTICS (U/S OF SLOUGH 11 AND NEAR SLOUGH 10)

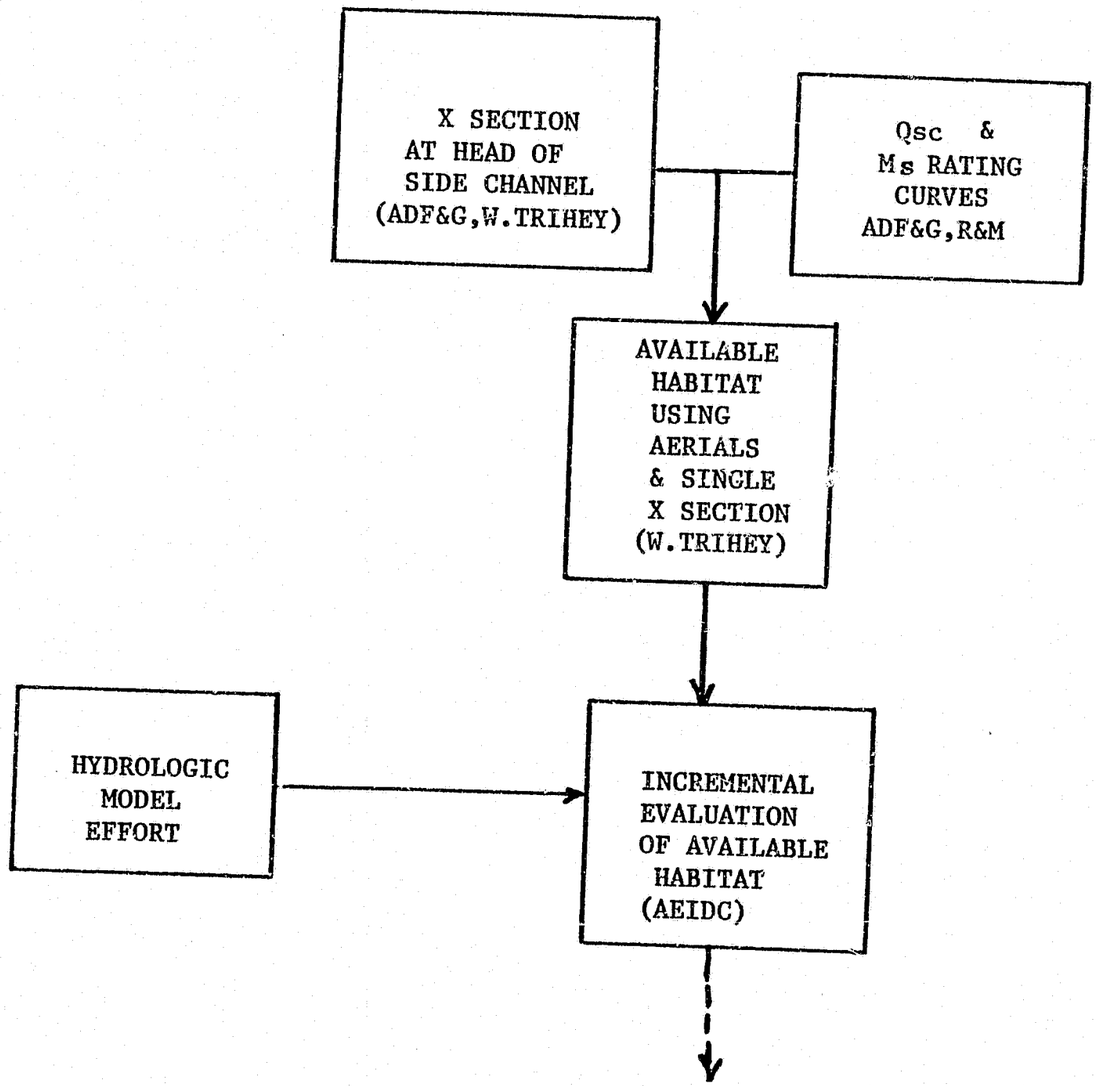
3A-12-24



Cont'd. pg. 5

FIGURE 7
SPAWNING IN SIDE-CHANNELS
HYDRAULIC CHARACTERISTICS (AT R&M 114)

JA-12-25



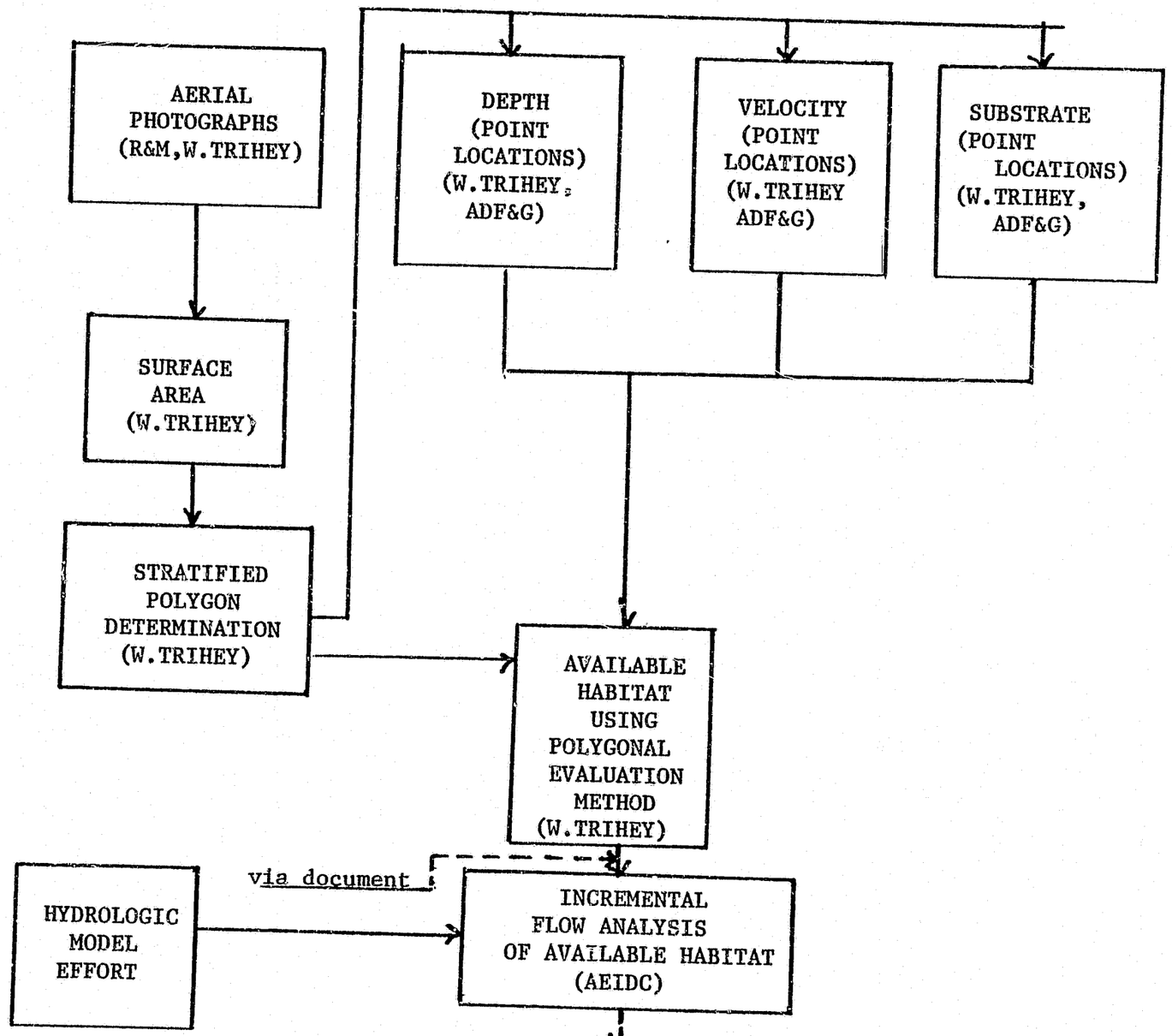
Cont'd. pg. 5

FIGURE 7

SPAWNING IN SIDE CHANNEL

HYDRAULIC CHARACTERISTICS (SIDE CHANNEL COMPLEX AT MOUTH OF 4TH OF JULY CRK.)

3A-12-26

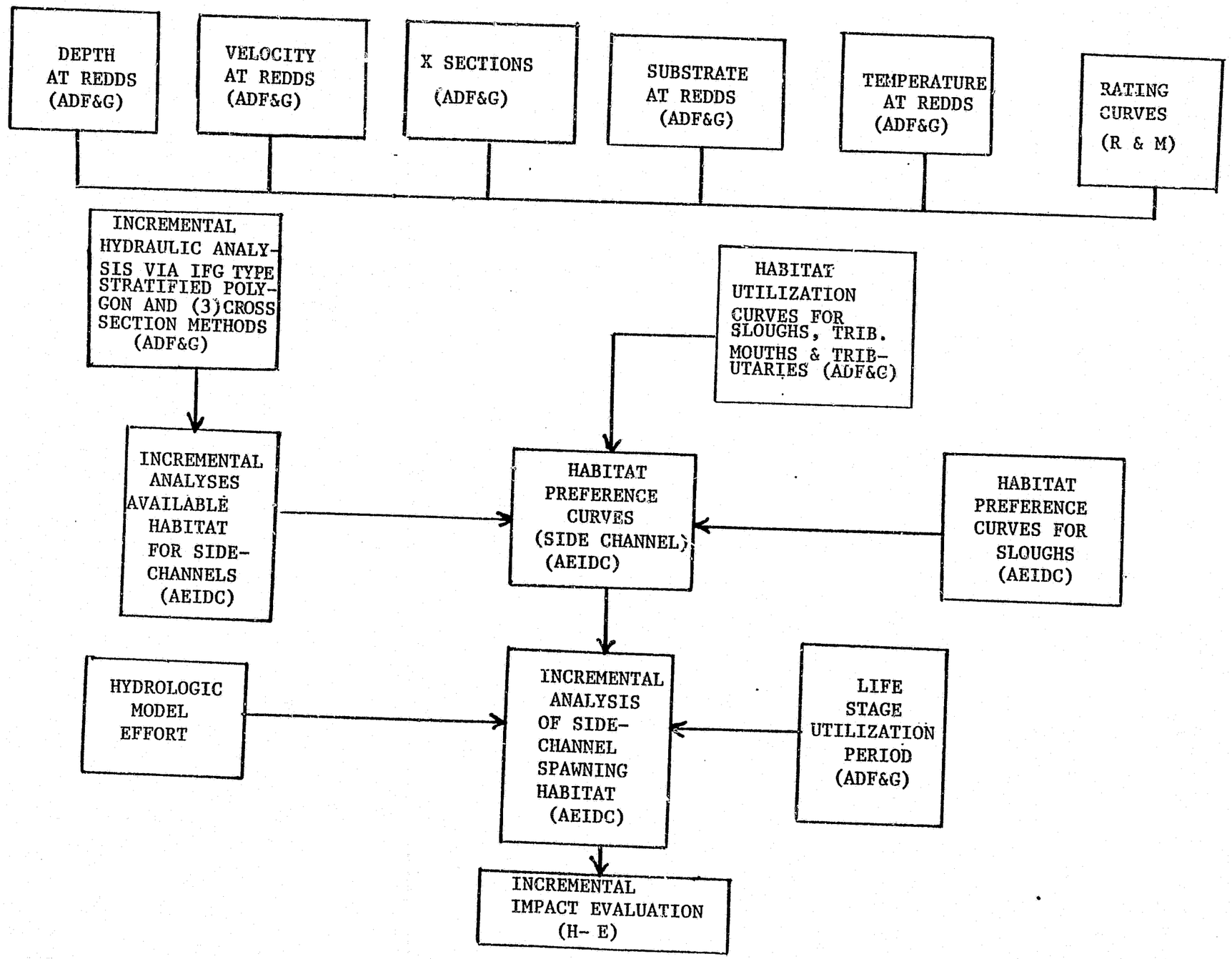


ont'd. pg. 5

FIGURE 7

SPAWNING HABITAT IN SIDE CHANNELS

LOCATIONS: DETAILED: DOWNSTREAM OF SLOUGH 21, DOWNSTREAM SLOUGH 11.
ADDITIONAL: UPSTREAM OF SLOUGH 11, NEAR SLOUGH 10, RM 114, MOUTH OF 4TH OF JULY CREEK

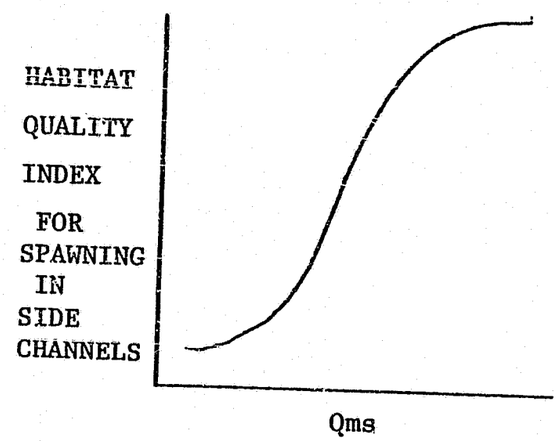


3A-12-27

FIGURE 7
SPAWNING IN SIDE CHANNELS
SIDE CHANNEL EVALUATION

3A7-12-28

OUTPUT:



TIME SERIES ANALYSIS

FIGURE 3
INCUBATION IN SIDE-CHANNELS
LOCATIONS: SLOUGHS 8A, 9, 11, 21

3A-12-29

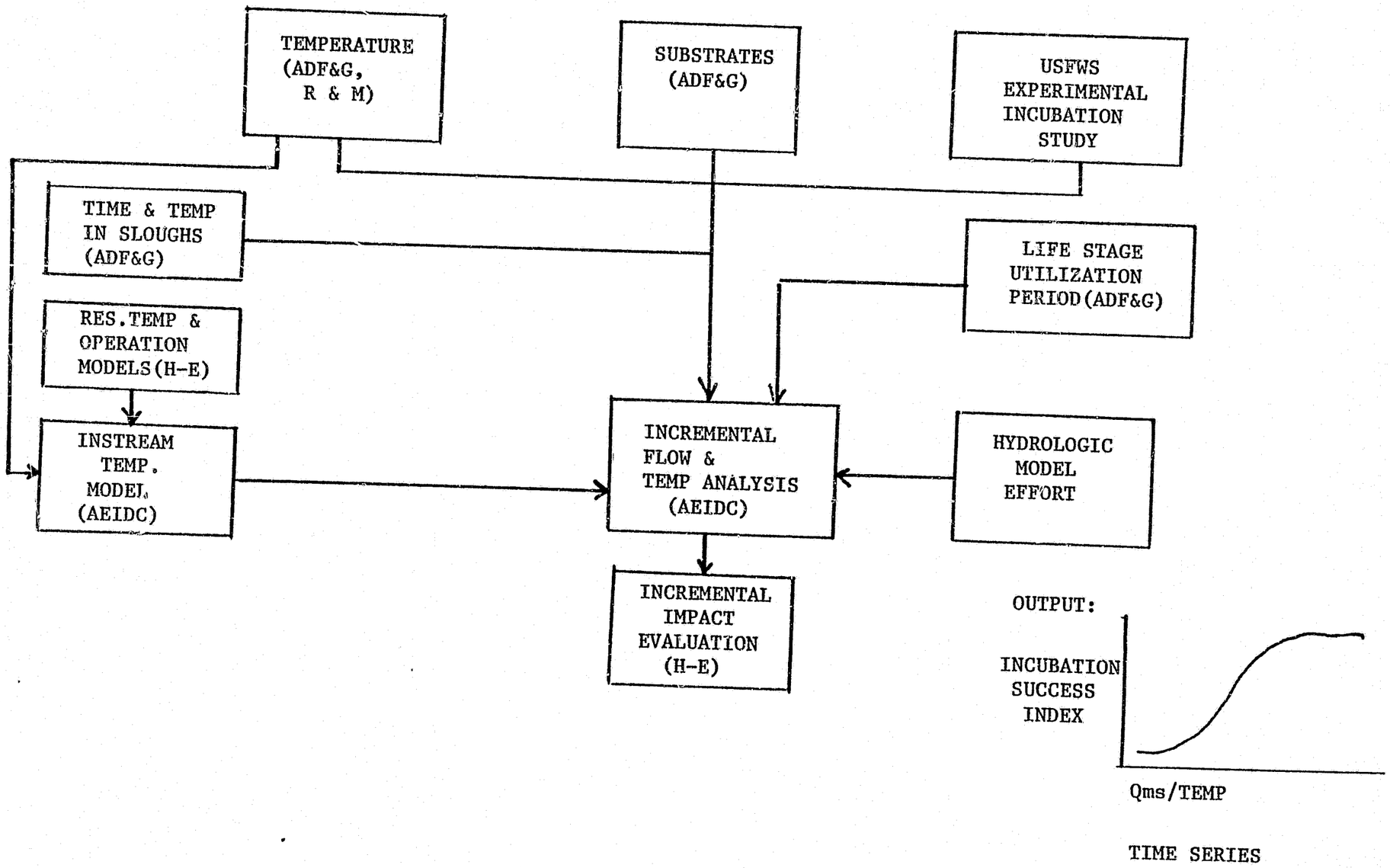


FIGURE 9

SIDE-CHANNEL REARING EVALUATION

LOCATIONS: D/S SLOUGH 21, D/S SLOUGH 11, U/S SLOUGH 11, NEAR SLOUGH10, RM 114, MOUTH OF THE 4TH OF JULY CREEK

37-12-30

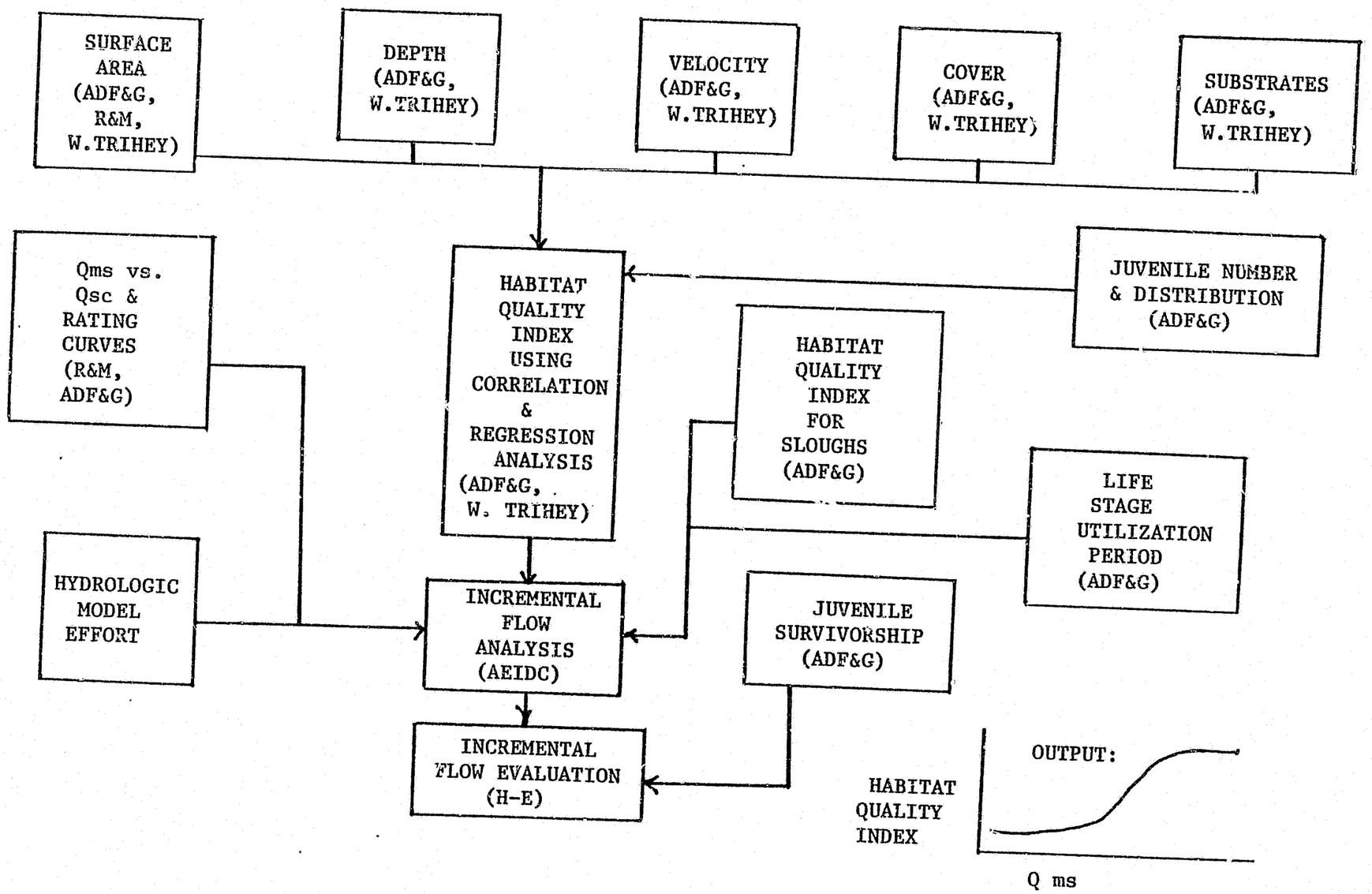
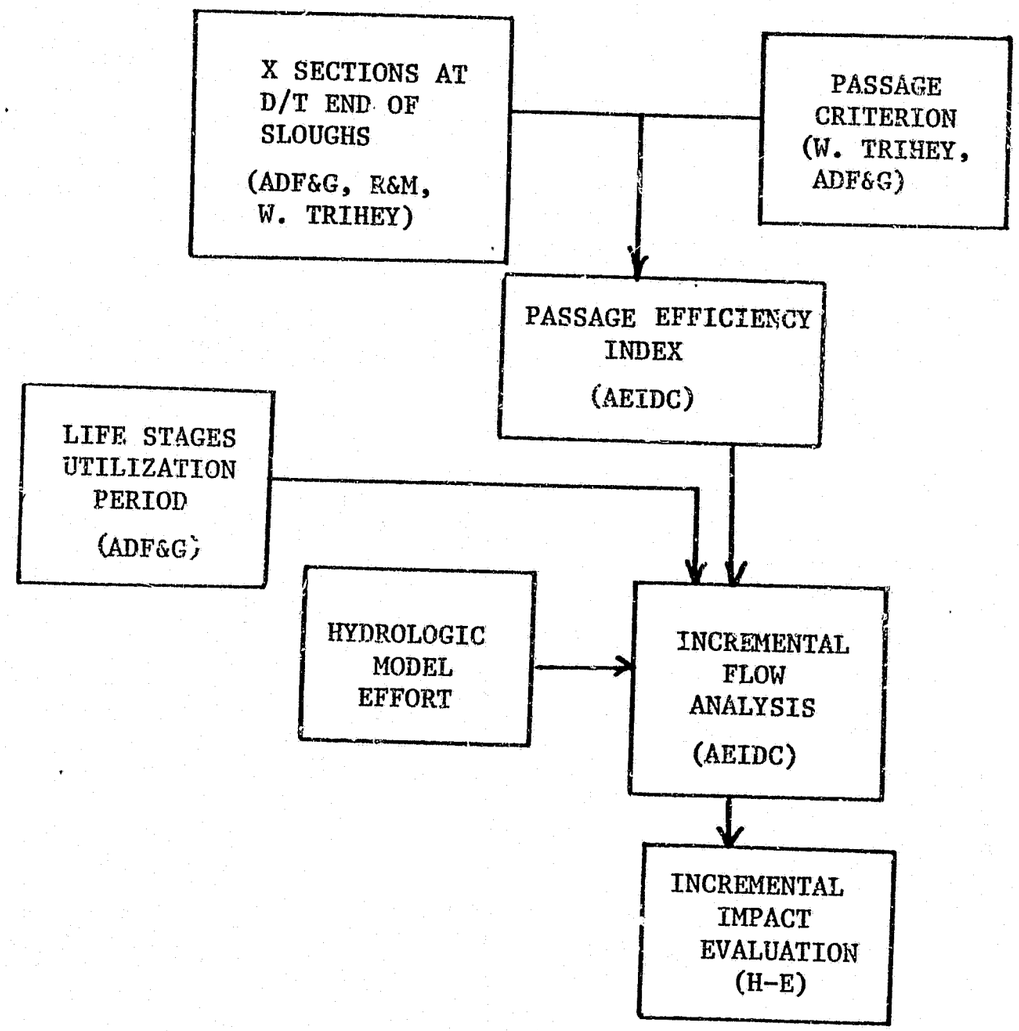


FIG 10
EVALUATION OF SIDE-CHANNELS FOR

ACCESS BY ADULT SALMON & RESIDENT SPECIES.

LOCATIONS: D/S OF SLOUGH 21 IN COMPLEX
D/S OF SLOUGH 11
U/S of SLOUGH 11 NEAR SLOUGH 10 AT RM 114
(MOUTH OF THE 4TH OF JULY CREEK)



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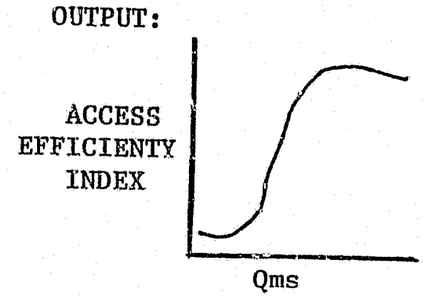


37-12-31

EVALUATION OF TRIBUTARY MOUTH ACCESS BY ADULT SALMON

LOCATIONS INDIAN RIVER AND PORTAGE RIVER

3A-12-32

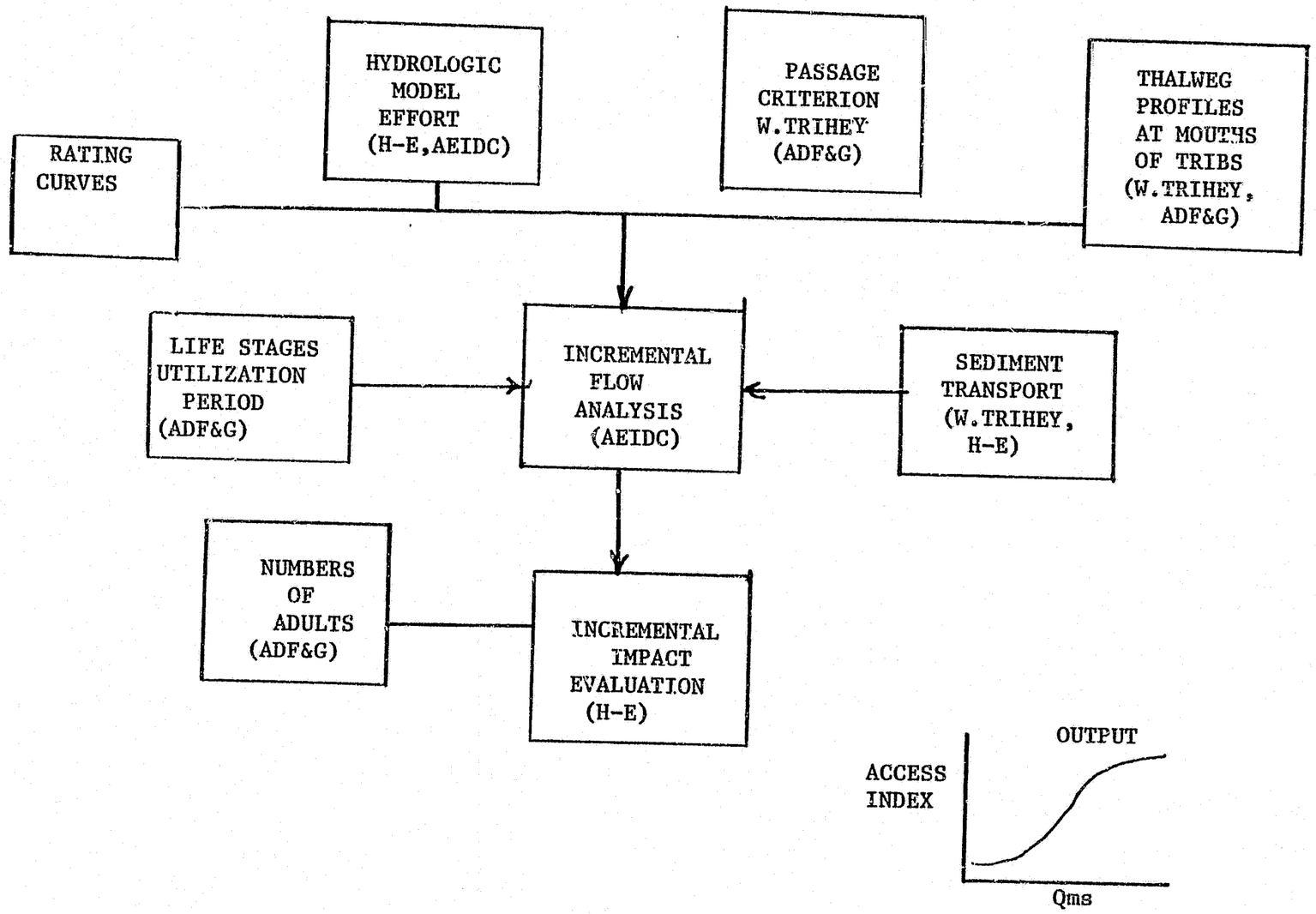


FIGURE 12

EVALUATION OF TRIBUTARY MOUTH SPAWNING HABITAT LOCATIONS: MOUTHS OF INDIAN RIVER AND PORTAGE RIVER

3A-12-33

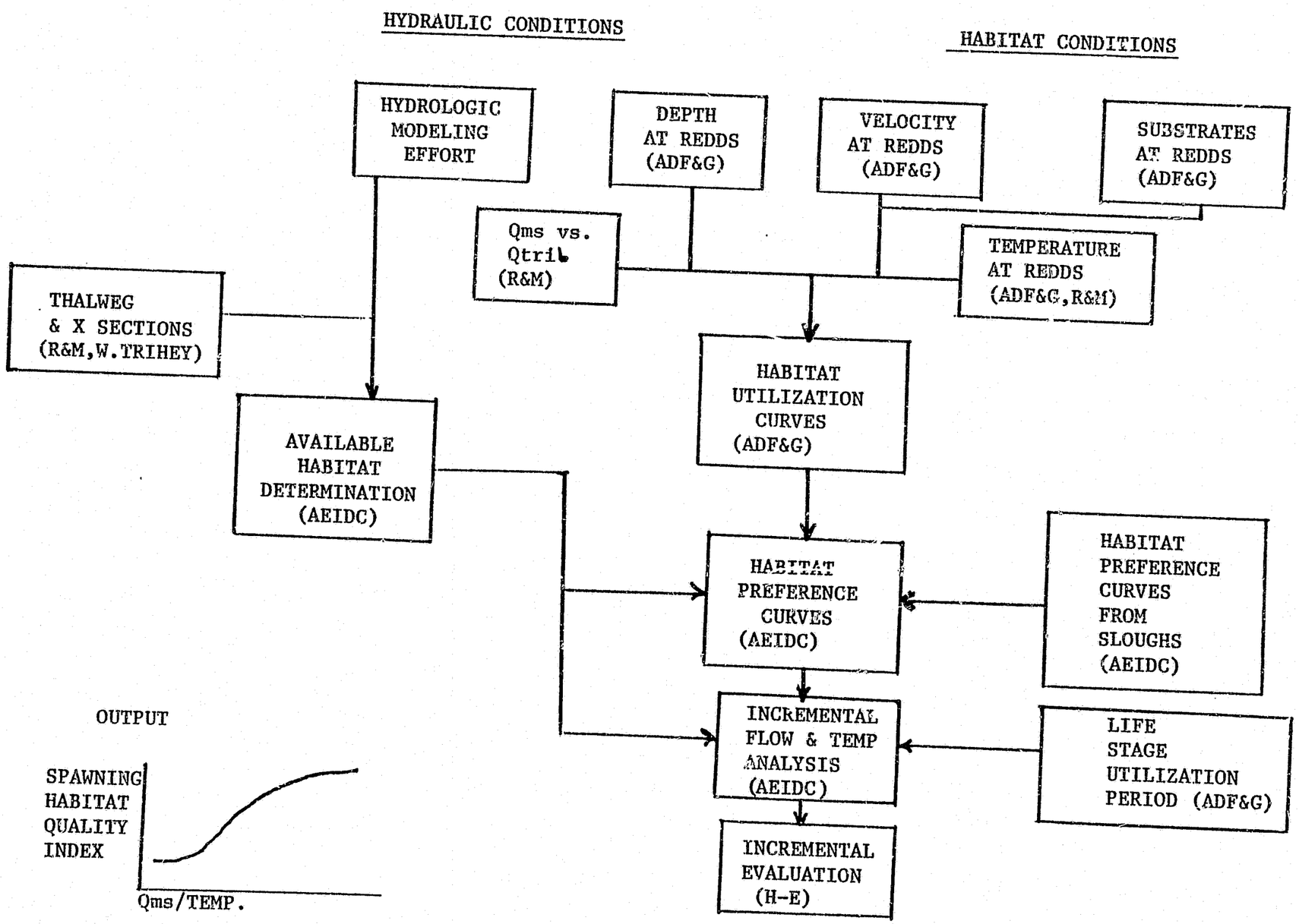
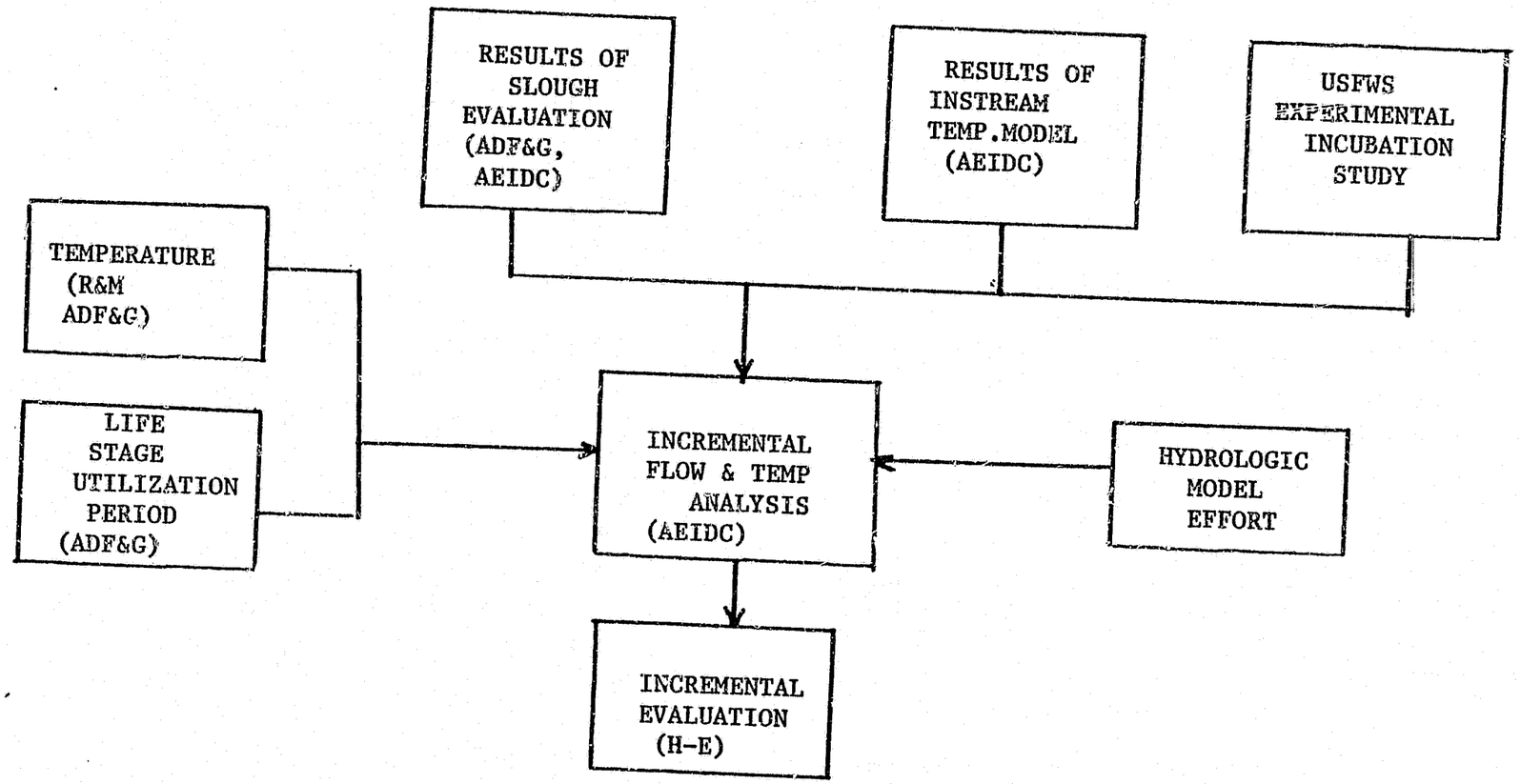


FIGURE 13

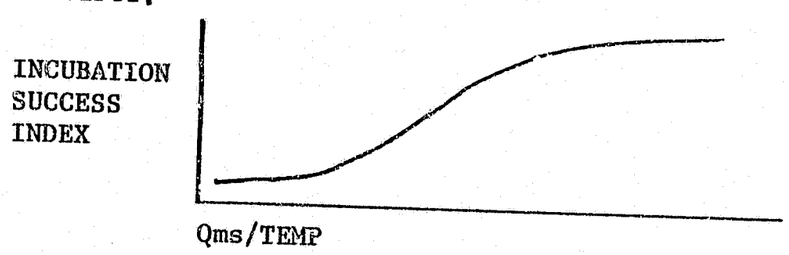
EVALUATION OF INCUBATION AT TRIBUTARY MOUTHS

LOCATIONS: INDIAN RIVER & PORTAGE RIVER

3A-12-34



OUTPUT:

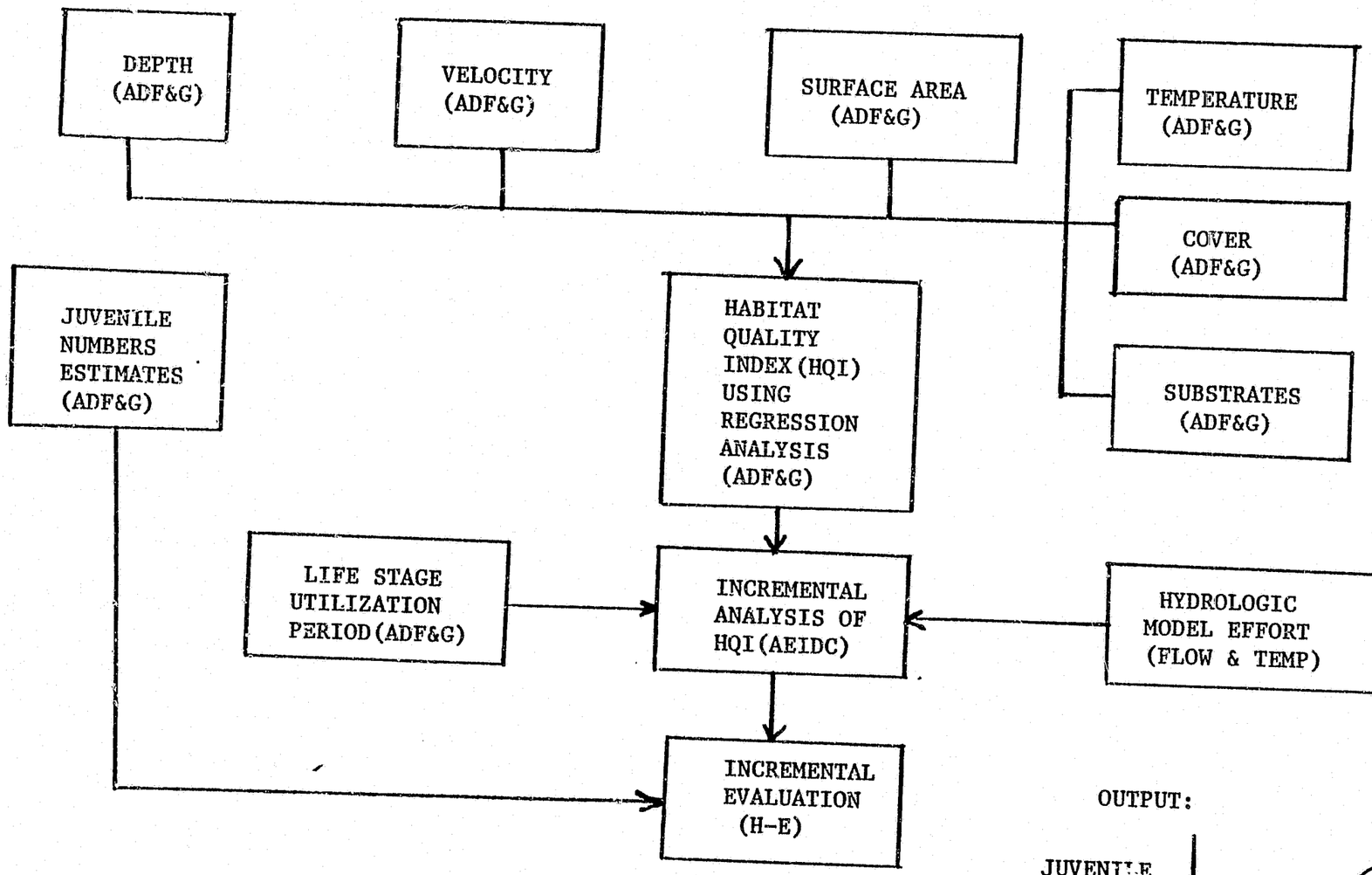


TIME SERIES

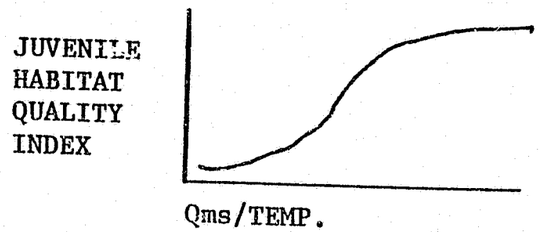
FIGURE 14

EVAL ON OF REARING AT TRIBUTARY MOUTHS

LOCATIONS: MOUTHS OF INDIAN RIVER, PORTAGE RIVER, 4TH OF JULY CREEK, LANE CREEK



OUTPUT:



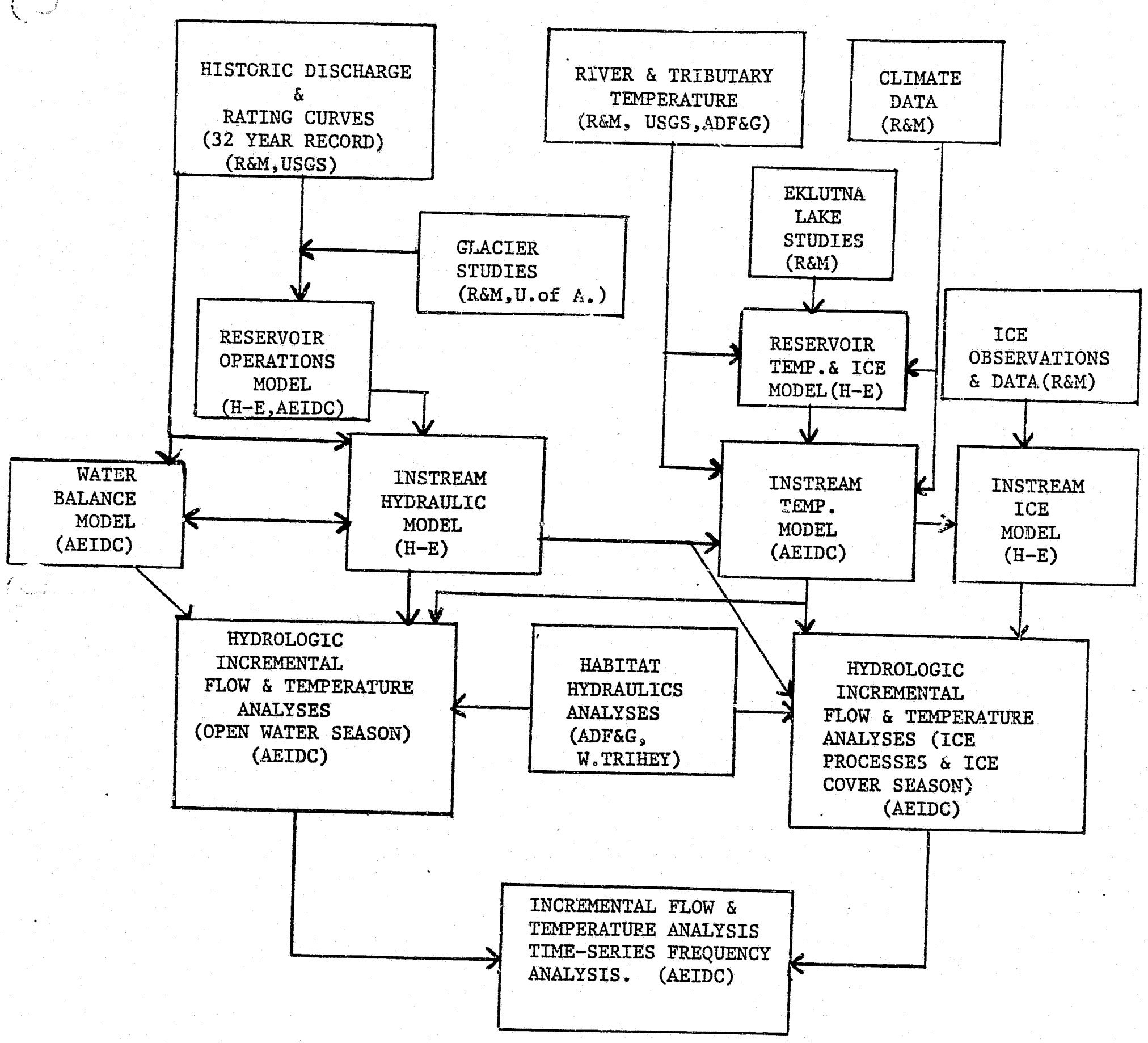
TIME SERIES

3A-12-35

FIGURE 15

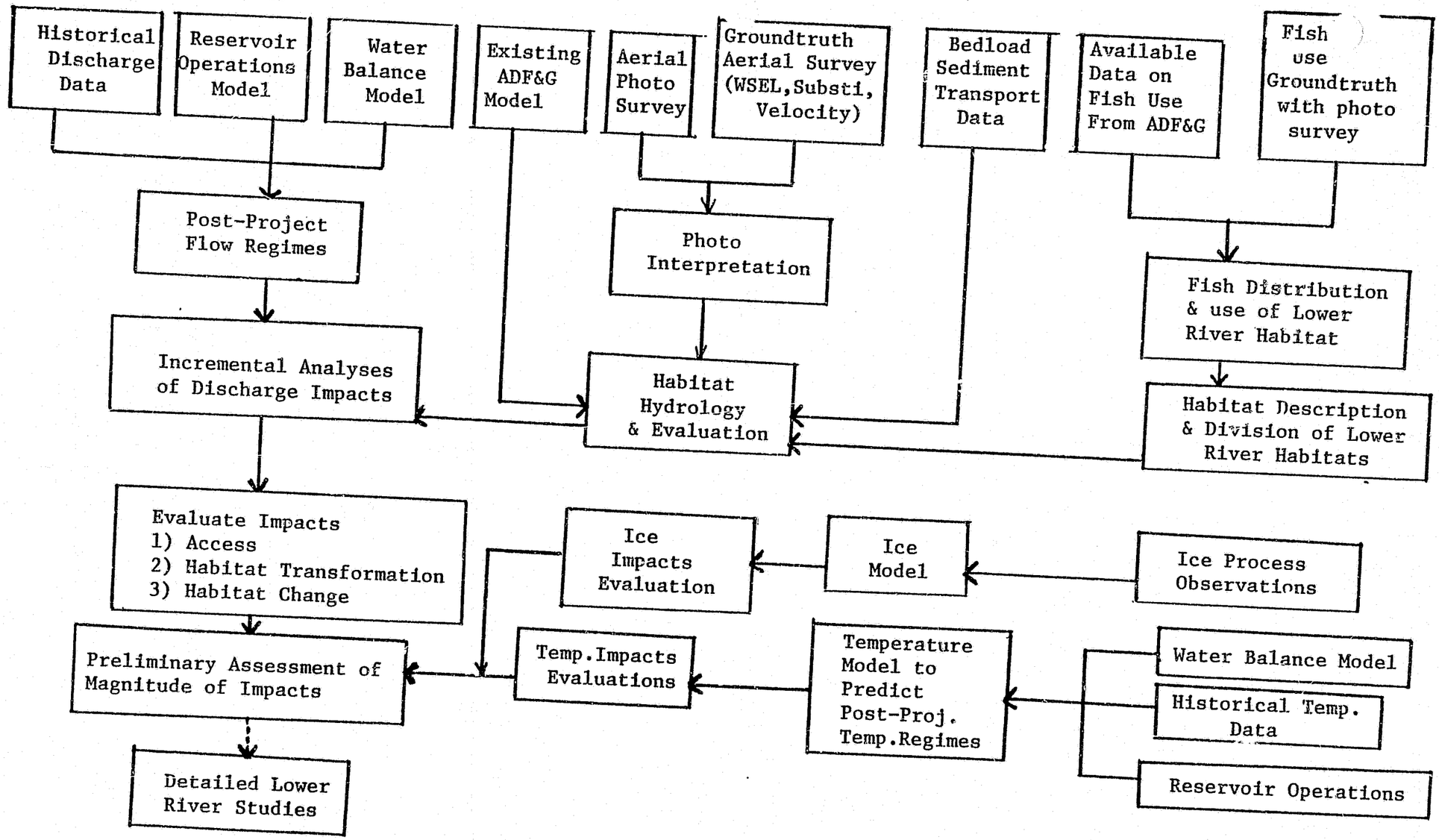
OVERVIEW OF HYDRAULOGIC MODELING EFFORT FOR IMPACT ANALYSES

LOCATION: SUSITNA RIVER BASIN (AFFECTED AREAS)



3A-12-36

FIGURE 15
LOWER RIVER STUDIES



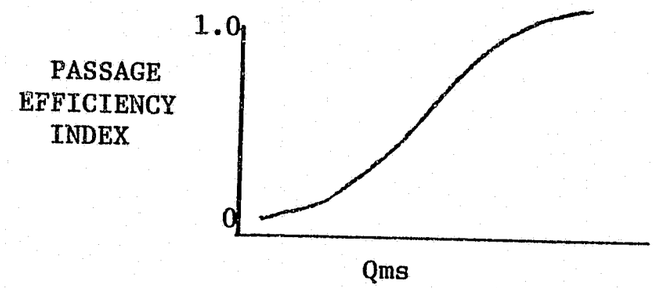
37-12-37

EXAMPLE OF OUTPUT OF INCREMENTAL ANALYSES

SLOUGHS

CHUM SALMON

ACCESS



MATRIX OF CHANGES IN INDEX BETWEEN PRE AND POST PROJECT (CASE C)

FLOW REGIMES VS. FLOWS

YEAR /	MONTH (LIFE STAGE UTILIZATION PERIOD)				
	June	July	Aug.	Sept.	Oct.
1	$\pm i$	$\pm i$	$\pm i$		
2	$\pm i$	$\pm i_2$	$\pm i_2$		
3	$\pm i_3$	$\pm i_3$	$\pm i_3$		
:	+	:	:		
:	|	:	:		
n	$\pm i_n$	$\pm_n$	$\pm i_n$		

NEGOTIATION GOAL:

Change flows to minimize number and magnitude of minus values

NOTE:

This may be translated to number of fish entering slough at time period.

3A-12-38

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 13 (Table E-3.8)

Provide an evaluation of or reference that describes the correlation between helicopter surveys versus on-foot surveys as methods for estimating chinook salmon escapement (number live and dead).

Response

There are several sources available that provide information useful in comparing helicopter and on-foot surveys. It is apparent from this information that there are considerable sources of variability associated with both methods that influence their reliability and, consequently, any comparison of the two techniques. These include the nature of the stream (terrain, vegetation, height of trees, cover such as cut banks), timing of runs (long versus short timing), stream life of fish being counted, water clarity, weather, number of fish to be counted, aircraft type, pilot, and observer (Bevan 1961; Cousens et al. 1982; Gilbert 1968; Neilsen and Geen 1981). Cousens et al. (1982) site work by Eicher of the USFWS in Alaska that suggests on-foot surveys are best in clear small, narrow streams because the angle of observation available to ground observers is best in these systems. Conversely, aerial live counts are typically most reliable when fish are more evenly distributed in shallow, clear waters such as in river mouths, broad streams, or shallow lakes (Cousens et al. 1982).

Consequently, counts by either technique will vary depending on the circumstances associated with each study. On the Harrison and Bear rivers of British Columbia, annual helicopter surveys are conducted by DFO personnel during the peak of the chinook run. About 85 to 90% of the spawning population is thought to be present at the peak and about 95% of these fish are expected to be enumerated (Cousens et al. 1982). For the Clemens Creek, B.C., sockeye population, agreement to within 15% of a mark/recapture estimate was obtained using visual estimates made by foot surveys (Cousens et al. 1982). Fixed- wing aerial counts of pink salmon in central British Columbia at the peak of spawning are considered to be accurate to within ±20% of the fish present. These peak counts are considered to under estimate total escapement, however (Cousens et al. 1982). An IPSFC study of sockeye spawning in the Chilko River in 1969 found that the estimated peak count of sockeye by helicopter was 5% greater than the peak value obtained by mark/ recapture techniques. It should be noted that counts were obtained under ideal conditions with experienced observers. Neilsen and Geen (1981) found that helicopter counts of chinook spawning in the Morice River, B.C., were slightly greater than counts obtained from photographs; a correction factor of .96 was applied to aerial counts. Beach counts of spawning sockeye by helicopter and boats can be very close because the fish can be readily observed. In Kennedy Creek, B.C., helicopter and boat counts of visible spawning sockeye were within 3% of each other (Cousens et al. 1982).

Two other sourves of information relevent to comparing helicopter and on-foot surveys were not available for inclusion in this response (personal comunication, W. Lifton, Woodward-Clyde Consultanta, Anchorage, Ak; personal comunication, M. Nelsen, ADFG, COMFISH Division, Dillingham, AK). As soon as the data is available (Lifton, August; Nelson, September), it will be sent to FERC.

References

Bevan, D. E. 1961. Variability in aerial counts of spawning salmon. J. Fish. Res. Board Can. 18:337-348.

Cousens, B. F., G. A. Thomas, C. G. Swann, and M. C. Healey. 1982. A review of salmon escapement estimation techniques. Can. Dept. Fish and Aquatic Res., Tech. Rep. No. 1108. 122 pp.

Gilbert, J. R. 1968. Surveys of sockeye salmon spawning populations in the Nushagak District, Bristol Bay, Alaska, 1946 - 1958. Univ. of Wash. Publications in Fisheries, Vol. 3.

Neilsen, J. D. and G. H. Geen. 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Trans. Amer. Fish Soc. 110: 554-556.

References

Bevan, D. E. 1961. Variability in aerial counts of spawning salmon. J. Fish. Res. Board Can. 18:337-348.

Cousens, B. F., G. A. Thomas, C. G. Swann, and M. C. Healey. 1982. A review of salmon escapement estimation techniques. Can. Dept. Fish and Aquatic Res., Tech. Rep. No. 1108. 122 pp.

Gilbert, J. R. 1968. Surveys of sockeye salmon spawning populations in the Nushagak District, Bristol Bay, Alaska, 1946 - 1958. Univ. of Wash. Publications in Fisheries, Vol. 3.

Neilsen, J. D. and G. H. Geen. 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Trans. Amer. Fish Soc. 110: 554-556.

References

Bevan, D. E. 1961. Variability in aerial counts of spawning salmon. J. Fish. Res. Board Can. 18:337-348.

Cousens, B. F., G. A. Thomas, C. G. Swann, and M. C. Healey. 1982. A review of salmon escapement estimation techniques. Can. Dept. Fish and Aquatic Res., Tech. Rep. No. 1108. 122 pp.

Gilbert, J. R. 1968. Surveys of sockeye salmon spawning populations in the Nushagak District, Bristol Bay, Alaska, 1946 - 1958. Univ. of Wash. Publications in Fisheries, Vol. 3.

Neilsen, J. D. and G. H. Geen. 1981 Enumeration of spawning salmon from spawner residence time and aerial counts. Trans. Amer. Fish Soc. 110: 554-556.

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 14 (Table E.3.17)

Provide estimates for each tributary listed in this table of the total length of tributary presently utilized by Arctic grayling.

Response

Arctic grayling overwinter in larger rivers, lakes, and some springs. In the spring, they make a prespawning migration to large unsilted rivers, bog streams, and lake inlets or outlets. Following spawning in these areas, they make a postspawning migration to other areas either upstream or in lakes to feed. In fall they return to their overwintering habitat (Tack 1980). Thus, any of the tributaries in the Susitna impoundment area could be utilized by grayling unless a barrier prevents their migration.

Studies on Arctic grayling in Susitna tributaries by ADF&G (1983) have concentrated on areas downstream of the proposed impoundment elevation. However, given the life history information and the general broad distribution of grayling, particularly in the summer feeding period, the following estimates can be made about the distances utilized by grayling in tributaries listed in Table E.3.17:

1. Fog Creek - this creek has a migration barrier (a turbulent white water area) between one and two miles upstream of the PIE (ADF&G 1983). However, because grayling are present upstream of this barrier, the entire approximately 20 miles of this stream can be presumed to be utilized by grayling. It is suspected that these upstream grayling may overwinter in the Fog Lakes system.

2. Tsusena Creek - this creek has a high falls at approximately river mile (RM) 3.1 which is 2.7 miles upstream of the PIE. This falls is a barrier to upstream migration (ADF&G 1983). It is presently unknown if grayling are found above this barrier. If present, the total length of Tsusena Creek (approximately 30 miles) would be potentially utilized.

3. Deadman Creek - This creek has a high falls at RM 3.1 which is about 0.4 miles above the PIE. This fall acts as a barrier to upstream migration (ADF&G 1983). It is known that grayling exist in this drainage upstream of this falls and, therefore, it can be assumed that the entire 40 mile length of Deadman Creek is potentially utilized.

4. Watana Creek - the East or main fork (with an approximate length of 23 miles from the source to the confluence with the Susitna) and the West Fork (with an approximate distance of 12 miles from its source to the confluence with the East Fork) could be utilized by grayling. A small waterfall located on the East Fork approximately one mile upstream of the confluence with the West Fork may be a periodic barrier, depending on discharge (ADF&G 1983), because grayling have been found above this barrier.

5. Kosina Creek - this creek is approximately 35 miles long. Grayling have been observed in two of the major tributaries, Terrace and Gilbert Creeks, and in lower Kosina Creek (ADF&G 1983). Although it is unknown if grayling are present throughout the drainage, it is suspected, based on the known distributions, that they would likely be found to the upstream reaches.

6. Jay Creek - a deep, narrow canyon immediately above the PIE on Jay Creek may inhibit upstream movement. However, grayling have been found above this canyon which indicates that upstream migration is possible and that the entire 20 miles of Jay Creek may be utilized. In addition, tributaries may also be utilized.

7. Goose Creek - grayling have been found in the lower reaches of this stream and the remainder of the stream has a similar habitat . Therefore, although unverified, it is believed that grayling utilize the entire length (approximately 20 miles) of this stream.

8. Oshetna River - the Oshetna is a major tributary to the Susitna that is approximately 50 miles long. Grayling are known to utilize the lower portion (2.2 miles) of the river (ADF&G 1983) and, therefore, it is assumed, although unverified, that they may utilize the entire drainage including major tributaries.

References

Alaska Dept. Fish and Game. 1983. Susitna Hydro-aqquatic Studies Phase II basic data report. Volume 5: Upper Susitna River impoundment studies, 1982.

Tack, S.L. 1980 Migrations and distributions of Arctic grayling, Thymallus arcticus (Pallas) in interior and Arctic Alaska, Alaska Dept. Fish and Game, Vol. 21 Fed. Aid in Fish Restoration.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Aquatic Resources

Comment 15 (Figures E.3.8 and E.3.9)

Provide population estimates and percentages of adult salmon migrating past the Sunshine Station (see Figures E.3.8 and E.3.9) that enter the Talkeetna River, the Chulitna River, or stay in the Susitna River between the Sunshine Station and the Talkeetna Station.

Response

Most fish encountered in the reach between the Sunshine Station and the Talkeetna Station are migrating to spawning areas and do not stay in this reach for any extended period of time.

No studies have been performed to estimate the escapement into the Chulitna and Talkeetna Rivers. The reason for this has been that no potential project effects are anticipated on these stocks once they are in these river systems. Therefore, population estimates by river system are not available, but a combined estimate is. Given the above information, the following estimates can be made:

ESTIMATED COMBINED ESCAPEMENT TO TALKEETNA AND CHULITNA RIVERS[1]

Species	Numbers		Percentage of Escapement Passing Sunshine Station Which Comprise Combined Talketna and Chulitna Escapement	
	1981	1982	1981	1982
Chinook	---[2]	38,700	---	78%
Sockeye	128,200	147,900	96%	98%
Coho	16,500	40,600	83%	89%
Chum	242,200	380,900	92%	89%
Pink	47,200	370,000	95%	84%

[1]These numbers are the difference between the escapement estimates for Sunshine and Talkeetna Stations.

[2] --- Indicates no estimate made

These estimates assume that the mainstem spawning in this reach by chums is relatively small and therefore is not considered.

References

Alaska Dept. of Fish and Game. 1983. Susitna Hydro Aquatic Studis Phase II Basic Data Report.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resouces -
Terrestrial Botanical Resources

Comment 1 (p. E-3-195, para. 3)

Provide an estimate of the amount and kinds of timber currently removed from the project area for subsistence use.

Response

Timber currently removed from the project area for local use primarily includes logs for building construction and firewood. Total consumption of wood for both uses is insignificant, especially in the case of logs for building construction.

Based on a Fairbanks survey, 4 cords of birch or spruce are used annually by dwellings that are heated primarily by wood (Laroe, S. 1981. Fuel wood utilization in the Fairbanks-North Star Borough. Prepared for Interior Woodcutters Assoc., P. O. Box 73762, Fairbanks, Alaska, 99707). According to Chapter 9 - Land Use (Table E.9.3), there are approximately 109 structures within 18 miles (30 km) of the Susitna River between Gold Creek and the Tyone River including 4 lodges involving 21 structures. About 19 of these structures are not currently used and only about 12 of the structures are inhabited year-round. In addition, most of the seasonally-inhabited structures are not inhabited during winter. Based on these factors, local use of timber in this approximately 3000-square mile (7800 square km) area is estmated to be less than 200 cords per year. Most of this timber use consists of paper birch and white and black spruce.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources
Terrestrial Botanical Resources

Comment 2 (p. E-3-202, para. 4)

Estimate the average elevational limit for trees in the project area (and/or estimate the range for tree line).

Response

The average elevational limit for trees in the project area (i.e., black and white spruce, paper birch, trembling aspen, and balsam poplar) is 3200 ft (975 m) (McKendrick et al. 1982, p. 27), ranging from about 2800 ft to 3500 ft (850 m to 1050 m) (see Figure E.3.38 in the License Application). Black and white spruce are the most frequent species at or near treeline. The deciduous trees, paper birch and trembling aspen, generally occur below 2300 feet (700m) and balsam poplar stands are found only on the floodplain.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 3 (p. E-3-206, para. 1)

Indicate whether the percentage of total area covered by open spruce is 1% as stated in this paragraph or 7% as shown in Table E.3.51.

Response

The percentage of the Watana and Gold Creek watersheds covered by open spruce forest is 7%, as stated in Table E.3.51. The text (p. E-3-206) was incorrect.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources -
Terrestrial Botanical Resources

Comment 4 (p. E-3-208, para. 4 to p. E-3-210, para. 1)

Define sedge-shrub tundra and mat and cushion/sedge-grass tundra as used in Tables E.3.51 and E.3.52.

Response

Mat and cushion/sedge-grass tundra as used in Table E.3.51 and Figure E.3.38 is a mapping complex, where sedge-grass tundra and mat and cushion tundra vegetation types are interspersed. The individual units of these types are too small to map separately, so a complex designation was used.

Sedge-shrub tundra, as used in Table E.3.52 and Figures E.3.39, E.3.40, and E.3.41, is a vegetation type with a sedge-grass understory and a willow shrub layer. Species composition is similar to that shown in Table E.3.62, but with more cover due to the shrub layer.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 5 (p. E-3-219, para. 5 to p. E-3-220, para. 1)

Indicate (e.g., as in Table E.3.87) how the vegetation types that were used by Commonwealth Assoc. (1982) and presented in Table E.3.79 correlate with the vegetation types used by McKendrick et al. (1982).

Response

The following is a comparison between Commonwealth Assoc. (1982) vegetation classifications and those of Viereck and Dyrness (1980) as used by McKendrick et al. (1982).

Commonwealth Assoc.	Viereck and Dyrness
moist tundra	mesic sedge grass
wet tundra	wet sedge grass
alpine tundra	herbaceous alpine
bottomland spruce/poplar	mixed forest, conifer forest
upland spruce/hardwood	mixed forest, conifer forest, deciduous forest
lowland spruce/hardwood	mixed forest, conifer forest
shrubland	tall shrub, low shrub
low brush, muskeg bog	low shrub

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 6 (p. E-3-221, para. 4)

Provide clarification of the statements concerning modified mapping of wet sedge-grass and black spruce forest as wetlands in the Healy-to-Fairbanks and Willow-to-Cook Inlet transmission corridors. Were all the areas covered by these vegetation types considered wetlands, or were portions of each type selected on the basis of defined criteria?

Response

All of the areas mapped as wet sedge-grass tundra or black spruce forest (Figures E.3.48 through E.3.52) were mapped as sensitive areas in the biological constraint maps of the transmision corridor prepared by TES and Acres American (1982, modified from McKendrick et al. 1982). These areas were considered as wetlands and/or potential permafrost areas in the constraint maps. These maps were not used in the application. The original corridor vegetation maps, prepared by McKendrick et al. (1982), were used for all vegetation type calculations. The wetland areas, calculated in response to Comment 12, were also obtained directly from the McKendrick et al. (1982) mapping by correlating the Viereck and Dyrness (1980) vegetation types with Cowardin et al. (1979) wetland types as was done for other wetland area calculations in the project area.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 7 (p. E-3-225, para. 2; p. E-3-240, para. 2; p. E-3-244, para. 3; p. E-3-245, para.3; p. E-3-246, para. 5; p. E-3-247, para. 2-4; p. E-3-252, para. 5; p. E-3-253, para. 1; p. E-3-270, para. 1; p. E-3-280, para.5)

Check and correct, as necessary, all calculations of land areas to be impacted or mitigated. Discrepancies have been found within tables (e.g., Table E.3.83 totals for impoundment and for shrubland over the entire Watana facility) and between the text and calculations made from the tables. For example, on p. E-3-225 total direct vegetation removal due to Watana construction is given as 16,582 ha, but this figure should take into account the 2128 ha of unvegetated area; on p. E-3-245, the percentage of total wetlands occupied by palustrine forested areas is not consistent with calculations made from Table E.3.82. Indicate whether unvegetated or disturbed areas were included in the calculations for vegetation removals and whether unvegetated rocky areas were treated differently than river, lake, or ice areas.

Response

All figures of areas to be impacted or mitigated have been checked and recalculated, and some have been re-measured. Tables E.3.79, E.3.80, E.3.83, E.3.84, E.3.85, and E.3.86 required corrections. The revised tables are attached, as are relevant portions of the text that subsequently required modification. Unvegetated areas were not included in the calculations for vegetation removals, but disturbed areas were included. Unvegetated rocky areas were not treated differently from river, lake, or ice areas.

TABLE E.3.79: AREAS OF DIFFERENT VEGETATION TYPES TO BE CROSSED (REVISED) BY WILLOW-TO-HEALY TRANSMISSION CORRIDOR*

Cover Type	Hectares	Acres	Percent of Total
Moist tundra	58.5	144.5	3.8
Wet tundra	116.4	287.6	7.5
Alpine tundra	25.9	64.1	1.7
Bottomland spruce-poplar forest	83.9	207.3	5.4
Upland spruce-hardwood forest	455.8	1126.2	29.3
Lowland spruce-hardwood forest	236.7	585.0	15.2
Shrublands	443.9	1097.0	28.5
Low brush, muskeg bog	134.7	322.8	8.6
Total	1,555.8	3,844.5	100.0

*Calculated from data in Table 22 from Commonwealth Associates (1982). The values here represent the widening of the corridor to 91 m (300 ft) from the 33 m (110 ft) given by Commonwealth Associates (1982). Thus, the areas presented here represent a corridor width of 58 m (190 ft).

TABLE E.3.80: AREAS OF EACH VEGETATION TYPE TO BE CROSSED BY WATANA-TO-GOLD CREEK TRANSMISSION CORRIDORS AND (REVISED) PERCENT TOTAL* FOR WATANA AND GOLD CREEK WATERSHEDS

	Watana to Devil Canyon**			Devil Canyon to Gold Creek***		
Vegetation Type	ha	acres	%*	ha	acres	%*
Forest	18.6	45.9	0.0	187.1	462.4	0.1
Woodland white spruce	8.7	21.5	0.0	24.6	60.8	0.0
Woodland black spruce	1.2	2.9	0.0	-	-	-
Open black spruce	-	-	-	3.9	9.7	0.0
Open birch	-	-	-	3.0	7.3	0.3
Closed birch	-	-	-	4.9	12.2	1.5
Closed mixed	8.7	21.5	0.1	150.7	372.4	0.9
Shrubland	291.4	720.2	0.0	-	-	-
Open tall	41.7	103.1	0.1	-	-	-
Closed Tall	65.5	161.8	0.1	-	-	-
Birch	105.4	260.6	0.3	-	-	-
Willow	13.3	32.9	0.1	-	-	-
Low (mixed)	65.5	161.8	0.0	-	-	-
Tundra	109.5	270.6	0.0	15.8	38.9	0.0
Wet sedge-grass	-	-	-	15.8	38.9	0.3
Sedge-grass (mesic)	2.9	7.2	0.0	-	-	-
Sedge shrub	53.9	133.1	****	-	-	-
Mat and cushion	52.7	130.3	0.1	-	-	-
Total	419.5	1036.7	0.0	202.9	501.3	0.0

* Percent of total area of each vegetation type in entire Watana and Gold Creek watersheds, based on 1:250,000-scale mapping (McKendrick et al. 1982).
** Based on corridor width of 300 ft.
*** Based on corridor width of 510 ft.
**** Data not available for entire Watana and Gold Creek watersheds.

TABLE E.3.83: HECTARES OF DIFFERENT VEGETATION TYPES TO BE IMPACTED BY THE WATANA FACILITY COMPARED WITH TOTAL HECTARES OF THAT TYPE UPSTREAM OF GOLD CREEK IN THE SUSITNA WATERSHED AND IN THE AREA WITHIN 16 km OF THE SUSITNA RIVER* (MODIFIED FROM MCKENDRICK ET AL. 1982)

Vegetation Type	Dam and Spillways	Impoundment	Camp	Village	Airstrip	Borrow Areas[1] A	D	E	F	H	I	Total	Percent of Watershed Total For That Type	Percent of ~~16 km*~~ Area For That Type
Forest	34****	10784				181	53	180	81	451	34	11798	3.4	8.3
Woodland black spruce	8	3870				179	16			224		4297	2.6	6.8
Woodland white spruce		397						71	69			537	2.6	4.0
Open black spruce		2864								121	15	3000	3.2	10.6
Open white spruce		769				2		62	11			844	3.2	8.1
Open birch	1	325										326	33.7	21.8
Closed birch	13	460					5					478	148.0**	20.6
Closed balsam poplar		3										3	***	0.5
Open mixed	5	1337					32			106		1480	6.3	15.4
Closed mixed	7	759						47	1		19	833	5.2	6.3
Tundra		84				70	8					162	0.1	0.1**
Wet sedge-grass		84					8					92	1.9	2.6
Mat-and-cushion						70						70	0.1	0.1**
Shrubland	46	1674	63	62	17	81	224		199	38		2404	0.4	1.4
Open tall shrub	6	227				1						234	0.4	1.5
Closed tall shrub	17	287				1	12					317	0.4	2.0
Birch shrub	1	443	34	35	13	4	88		195			813	2.4	1.9
Willow shrub		66							4	17		87	0.9	1.0
Mixed low shrub	22	651	29	27	4	75	124			21		953	0.2	1.0
Herbaceous		45										45	***	250.0**
Unvegetated	13	2104		8		1	2					2128	0.9	7.9
Rock	1	59					2					62	0.1	0.4
River	12	2007										2019	13.8	47.7
Lake		38		8		1						47	0.2	0.8
Total	93	14691	63	70	17	333	287	180	280	489	34	16537	1.0	3.6

[1] Area given is above maximum impoundment fill level.
* An area 16 km (10 mi) on either side of the Susitna River from Gold Creek to the mouth of the Maclaren River.
** Hectares are apparently greater in the impact areas than for the entire basin, because the basin was mapped at a much smaller scale, and many of the stands did not appear at that scale.
*** Areas of this type were too small to be mapped at the scale at which the watershed was mapped.
**** 1 hectare = 2.471 acres.

3B-7-4

TABLE E.3 [illegible]1: HECTARES OF DIFFERENT VEGETATION TYP[illegible] TO BE AFFECTED BY THE DEVIL CANYON FACILITY COMPARED WITH TOTAL HECTARES OF THAT TYPE IN THE WATANA AND GOLD CREEK WATERSHEDS AND IN THE AREA WITHIN 16 km OF THE SUSITNA RIVER* (MODIFIED FROM MCKENDRICK ET AL. 1982).

Vegetation Type	Dam and Spillways	Impoundment	Camp	Village	Borrow**** Area K	Total	Percent of Watershed Total For That Type	Percent of 16 km* Area For That Type
Forest	16****	2289	36	39	119	2499	0.7	1.8
Woodland black spruce		133				133	0.1	0.2
Woodland white spruce		20				20	0.1	0.2
Open black spruce	4	300			11	315	0.5	1.1
Open white spruce		329				329	0.5	3.1
Open birch		57				57	5.9	3.8
Closed birch	3	430				433	134.1**	18.6
Open balsam poplar		6				6	***	***
Closed balsam poplar		8				8	***	1.4
Open mixed	7	279				286	1.2	3.0
Closed mixed	2	727	36	39	108	912	5.7	6.9
Tundra		11				11	0.0	0.0
Wet sedge-grass		11				11	0.2	0.3
Shrubland		70			18	88	0.0	0.1
Open tall shrub		2				2	0.0	0.0
Closed tall shrub		1				1	0.0	0.0
Birch shrub		49			18	67	0.2	0.2
Willow shrub		14				14	0.1	0.2
Mixed low shrub		4				4	0.0	0.0
Unvegetated	2	826			11	839	0.3	3.1
Rock		15				15	0.0	0.1
River	1	810				811	5.5	19.1
Lake	1	1			11	13	0.1	0.2
Total	18	3196	36	39	148	3437	0.2	0.7

* An area 16 km (10 mi) on either side of the Susitna River from Gold Creek to the mouth of the Macl[illegible]en River.

** Hectares of closed birch are apparently greater in the impact areas than for the entire basin, because the basin was mapped at a much smaller scale, and many of the closed birch stands did not appear at that scale.

*** Balsam poplar stands were too small to be mapped at the scale at which the watershed was mapped.

**** 1 hectare = 2.471 acres.

***** Borrow area G (not included) will consist of approximately 22 ha with stands of woodland and open black spruce, closed mixed forest, and open tall shrub.

3B-7-5

TABLE E.3.85: AREAS OF EACH VEGETATION TYPE TO BE CLEARED FOR ACCESS, (REVISED) AND PERCENT TOTAL* FOR WATANA AND GOLD CREEK WATERSHEDS

	Denali Highway to Watana (Road) **			Watana to Devil Canyon (Road) ***			Devil Canyon to Gold Creek (Railroad)****		
Vegetation Type	ha	acres	%	ha	acres	%*	ha	acres	%*
Forest	11.2	27.7	0.0	37.5	92.8	0.0	28.3	70.0	0.0
Woodland white spruce	-	-	-	5.7	14.2	0.0	-	-	-
Open white spruce	0.6	1.5	0.0	15.9	39.3	0.0	-	-	-
Woodland black spruce	1.8	4.4	0.0	-	-	-	-	-	-
Open black spruce	-	-	-	0.4	1.1	0.0	1.5	3.7	0.0
Open birch	-	-	-	-	-	-	0.6	1.5	0.1
Closed birch	-	-	-	0.9	2.2	0.3	-	-	-
Closed balsam poplar	-	-	-	-	-	-	0.3	0.7	*****
Open mixed	8.8	21.8	0.0	4.0	9.8	0.0	5.7	14.1	0.0
Closed mixed	-	-	-	10.6	26.2	0.1	20.2	50.0	0.1
Shrubland	181.3	448.0	0.0	103.7	256.3	0.0	0.0	0.0	-
Open tall	-	-	-	7.9	19.6	0.0	-	-	-
Closed tall	-	-	-	22.1	54.5	0.0	-	-	-
Birch (low)	78.9	194.9	0.2	44.6	110.2	0.1	-	-	-
Willow (low)	81.8	202.2	0.8	5.3	13.1	0.0	-	-	-
Mixed (low)	20.6	50.9	0.0	23.8	58.9	0.0	-	-	-
Tundra	61.7	152.6	0.0	21.6	53.4	0.0	0.8	2.0	0.0
Wet sedge-grass	12.3	30.5	0.3	4.4	10.9	0.1	0.8	2.0	0.0
Sedge-grass (mesic)	17.6	43.6	0.0	-	-	-	-	-	-
Sedge-shrub	-	-	-	7.5	18.5	*****	-	-	-
Mat and cushion	31.8	78.5	0.1	9.7	24.0	0.0	-	-	-
Rock	0.6	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	254.8	629.8	0.0	162.8	402.5	0.0	29.1	72.0	0.0

* Percent of total area of each vegetation type in entire Watana and Gold Creek watersheds, based on 1:250,000-scale mapping (McKendrick et al. 1982).
** Based on clearing width of 120 ft.
*** Based on clearing width of 90 ft.
**** Based on clearing width of 50 ft.
***** Data not available for entire Watana and Gold Creek watersheds.

TABLE E.3.86: AREAS OF DIFFERENT VEGETATION TYPES TO BE CROSSED BY TRANSMISSION CORRIDORS*

Vegetation Type	Healy to Fairbanks		Willow to Cook Inlet	
	ha	acres	ha	acres
Forest	1034.9	2557.0	387.6	957.7
Woodland spruce	47.5	117.4	57.4	141.7
Open spruce	554.5	1370.1	29.5	73.0
Closed spruce	16.2	40.1	56.8	140.3
Open deciduous	93.9	231.9	-	-
Closed deciduous	37.7	93.1	-	-
Closed birch	-	-	44.6	110.2
Woodland conifer-deciduous	9.3	22.9	-	-
Open conifer-deciduous	159.3	393.7	30.7	75.9
Closed conifer-deciduous	7.0	17.2	168.6	416.6
Open spruce/open deciduous**	5.2	12.9	-	-
Open spruce/wet sedge-grass/ open deciduous**	5.2	12.9	-	-
Open spruce/low shrub/wet sedge-grass/open deciduous**	99.1	244.8	-	-
Tundra	117.6	290.5	165.7	409.4
Wet sedge-grass	103.1	254.8	165.7	409.4
Sedge-grass (mesic)	6.4	15.7	-	-
Sedge-shrub	8.1	20.0	-	-
Shrubland	247.3	611.3	67.2	166.1
Low mixed shrub	214.9	531.1	67.2	166.1
Low shrub/wet sedge-grass**	32.4	80.2	-	-
Disturbed	7.0	17.2	5.2	12.9
River	20.9	51.5	-	-
Total	1427.7	3527.5	625.7	1546.1

* Calculated from Figures E.3.48-50 and E.3.51-52. Right-of-way width was adjusted to 91 m (300 ft) along the entire corridor.

** The Tanana Flats portion of the transmission corridor is an area of extremely complex mosaics of vegetation types. As a result, various complexes were recognized.

CHANGES IN THE TEXT OF THE BOTANICAL SECTION OF CHAPTER 3 RESULTING FROM CORRECTIONS OF BOTANICAL TABLES (the following sentences replace the corresponding sentences in the indicated paragraphs).

p.E-3-220, para. 1 Spruce hardwood forests cover half (49.9 percent) of the total area within the Willow-to-Healy transmission corridor. Upland spruce hardwood stands cover 1126 acres (456 ha), lowland spruce hardwood stands cover 585 acres (237 ha), and bottom land spruce hardwood stands cover 207 acres (84 ha). Shrublands are the next most predominant cover type (28.5 percent), occupying 1097 acres (444 ha).

p.E-3-220, para. 2 Almost 70 percent of the total area (1037 acres, 420 ha) within the Watana-to-Devil Canyon section of the transmission corridor is shrubland. Predominant vegetation types crossed include open tall shrubland (103 acres, 42 ha), closed tall shrubland (162 acres, 66 ha), low birch shrubland (261 acres, 105 ha), low mixed shrubland (162 acres, 66 ha), sedge-shrub tundra (133 acres, 54 ha), and mat and cushion tundra (130 acres, 53 ha). The Devil Canyon-to-Intertie (Gold Creek) section of the transmission corridor covers a total of 501 acres (203 ha), 372 acres (151 ha) of which is closed mixed forest. Smaller areas of woodland white spruce (61 acres, 25 ha) and wet sedge-grass tundra (39 acres, 16 ha) are also crossed.

p.E-3-225, para. 2 Construction of the Watana development will result in the direct removal of vegetation within an area of approximately 35,605 acres (14,409 ha) covering a range of elevations from 1400 to 2400 feet (430 to 730 m). In addition about 5,258 acres (2128 ha) of unvegetated areas will be inundated or developed. Within the dam, spillway, and impoundment areas about 36,531 acres (14,784 ha) will be disturbed by construction and clearing operations.

p.E-3-240, para. 2 Approximately 5700 acres (2305 ha) of forest and 170 acres (70 ha) of shrubland will be inundated or cleared for the dam, spillways, and impoundment area (Table E.3.84).

p.E-3-243, para. 2 Approximately 628 acres (254 ha) of primarily shrub and tundra vegetation will be cleared along a 44 mile (71 km) corridor for the Denali Highway-to-Watana access route (Table E.3.85).

p.E-3-243, para. 3 Construction of this road will entail clearing an additional 402 acres (163 ha) of roadway. A 12-mile (19 km) railroad extension between Devil Canyon and Gold Creek will be constructed on the south side of the Susitna River, removing an additional 72 acres (29 ha) of vegetation.

p.E-3-244, para. 3 Transmission corridors comprise a total of 10,460 acres (4233 ha) and will constitute another source of vegetation loss and/or disturbance (Tables E.3.79, E.3.80, and E.3.86). The transmission lines from Healy to Fairbanks cover a total of 3528 acres (1428 ha). Open spruce (1370 acres, 554 ha) constitutes the main vegetation type in the right-of-way. The Willow-to-Cook Inlet transmission corridor (total cover 1546 acres, 626 ha) will cross primarily closed conifer-deciduous forest (417 acres, 169 ha) and sedge-grass tundra (409 acres, 166 ha). The Willow-to-Healy transmission corridor (3844 acres, 1556 ha) is composed primarily of upland spruce-hardwood forest (1126 acres, 456 ha) and shrublands (1097 acres, 444 ha). Shrublands (720 acres, 291 ha), forest (511 acres, 206 ha), and tundra (310 acres, 125 ha) are included in the proposed right-of-way for the Watana-to-Gold Creek transmission corridor (total area 1538 acres, 622 ha).

p.E-3-245, para. 3 Far more potential wetland areas are included within the Watana development (30,717 acres, 12,431 ha) than within the Devil Canyon project area (4,216 acres, 1,706 ha) (Table E.3.82). The proportion of the area occupied by wetland types also differs within the two areas. Although potential palustrine forested areas occupy the greatest areal extent of wetland types in the Watana facility (66 percent of total potential wetland), this type occupies 48 percent of the potential wetlands to be affected by the Devil Canyon facility.

p.E-3-246, para. 5 Direct losses for the Watana project include 31,300 acres (12,667 ha) of vegetation for the dam, impoundment and spillway (5,231 acres, 2,117 ha of unvegetated area will also be disturbed). An additional 4,300 acres (1,742 ha) have been designated for use as camp, village, airstrip, and borrow areas. These potential losses account for only 1 percent of all vegetation in the Watana and Gold Creek basins, but 3.3 percent of the vegetation present in a 20 mile (32 km) wide area spanning the Susitna River from the mouth of the Maclaren River to Gold Creek.

p.E-3-247, Direct losses of vegetation for the Devil Canyon dam, spillway and impoundment areas will include 5,869 acres (2,386 ha) of forests, tundra, and shrubland. 2046 acres (828 ha) of unvegetated land will also be disturbed (Table E.3.84).

p.E-3-247, para. 3 The Watana access road will result in a loss of approximately 628 acres (254 ha) of mostly tundra and shrubland vegetation types. Additional losses of about 402 acres (163 ha) for access roads and 72 acres (29 ha) for rail will be required for access to the Devil Canyon facility.

p.E-3-247, para. 4 Of the total 10,460 acres (4,233 ha) of vegetation on right-of-way for transmission lines, only a small fraction will need be subject to initial clearing, since there will be no clearing of low shrub or tundra types.

p.E-3-252, para. 5 to p.E-3-253, para. 2 Without mitigation, construction of all project facilities would remove vegetation from a total of about 53,624 acres (21,701 ha) apportioned as follows:

	acres	hectares
- Dams and spillways	237	96
- Impoundments	36,959	14,957
- Camps	245	99
- Villages	250	101
- Airstrip	42	17
- Damsite borrow areas	4,292	1,737
- Access borrow areas	35	14
- Access routes	1,104	447
- Transmission corridors*	10,460	4,233

*Ground layer and soil will not be removed.

In addition 7,333 acres (2,968 ha) of unvegetated area will be disturbed. About 95 percent of this area is river channel within the impoundment areas.

Of this cumulative impact, vegetation removal resulting from dams and spillways, impoundments, access routes, and the Watana operational village will be permanent, accounting for about 70 percent (38,454 acres, 15,562 ha). The remaining 30 percent (15,170 acres, 6,139 ha) will allow application of the following range of mitigation options.

p.E-3-256, para. 4 The Denali Highway-to-Watana route will remove about 448 acres (181 ha) of shrubland and about 153 acres (62 ha) of tundra types, accounting for less than one percent of total shrubland or tundra in the Watana and Gold Creek watersheds (Table E.3.85). Only 1.5 acres (0.6 ha) of open white spruce forest will be affected, and the number of individual trees actually cut in this low density vegetation type will be statistically insignificant on a local or regional basis.

p.E-3-257, para. 2 About two-thirds (67 percent) of the route is shrubland (256 acres, 104 ha), about 20 percent is forest (93 acres, 38 ha) and 15 percent is tundra (53 acres, 22 ha) (Table E.3.85).

p.E-3-257, para. 3 The Devil Canyon-to-Gold Creek railroad route will traverse almost entirely closed mixed forest (about 50 acres, 20 ha) and open mixed forest (about 14 acres, 6 ha) (Table E.3.85).

p.E-3-258, para. 3 to p.E-3-259, para. 4 Low abundance vegetation types which will receive the greatest cumulative impact from construction of the impoundments and dams, access and transmission corridors, and all ancillary facilities, will be open and closed birch forest, and wet sedge-grass tundra (Tables E.3.80 and E.3.83-E.3.85). A cumulative total of 3221 acres (1303 ha) of open and closed birch forest could be affected by construction-related clearing between 1985 and 2002. Based on the 1:63,360-scale mapping of the 20-mile (32 km) strip along the Susitna River (the map showing the vegetation of the area in the greatest detail) (Table E.3.52), 34 percent of the total 9,444 acres (3,822 ha) of this vegetation type could be removed by construction. About 3,143 acres (1,272 ha) or 33 percent of the total coverage will be entirely removed by clearing of the impoundments (Tables E.3.83 and E.3.84). The remaining 78 acres (32 ha) will be selectively cleared as discussed further below.

The other low-abundance vegetation type within the Watana and Gold Creek watersheds to be affected by construction, wet sedge-grass tundra, will be crossed by access and transmission corridors (82 acres, 33 ha) (Tables E.3.80, E.3.85) and inundated by the impoundment areas (235 acres, 95 ha) (Tables E.3.83, E.3.84). Borrow Area D (Figure E.3.37) will potentially remove an additional 20 acres (8 ha) (Table E.3.83). The siting of all pads, buildings, and other structural facilities has entirely avoided this vegetation type. Therefore, a total of 337 acres (136 ha) of wet sedge-grass tundra will be potentially affected by construction between 1985 and 2002. This cumulative impact represents about 4 percent of the total 8,691 acres (3,517 ha) present within the 20-mile (32 km) strip mapped at 1:63,360 (Table E.3.52). Mitigative measures which will minimize drainage alterations in this wet vegetation type are discussed in Section 3.4.2(c).

In summary, siting of pads, buildings, the Watana airstrip, and other ancillary facilities has minimized clearing requirements for low-abundance vegetation types. As residual impact, the impoundments and access and transmission corridors will remove about 34 percent of the birch forest, and 4 percent of the wet sedge-grass tundra within the 20-mile (32 km) strip mapped at 1:63,360.

p.E-3-270, para. 1 In fact, as stated in Sections 3.3.4(a) and 3.3.6(a)(iv), the 10,460 acres (4,233 ha) required for transmission corridor rights-of-way will be cleared only to a limited extent, as explained in the following discussion.

p.E-3-274, para. 4 to p.E-3-275 para. 1

Of the approximately 53,624 acres (21,701 ha) potentially subject to vegetation removal on a cumulative basis, about 30 percent, or 15,170 acres (6,139 ha), will allow application of mitigation measures discussed above. Approximately 46 the percent of the total area covered by transmission corridors (4,812 acres, 1947 has, of the total 10,460 acres, 4,233 ha) will be left uncleared or partly cleared. In addition, use of side-borrow and balanced cut-and-fill techniques for construction of the access roads and railroad extension will protect up to 280 acres (112 ha) of vegetated area.

Using the two examples cited above, measures to minimize vegetation removal will conserve about 5,092 acres (2059 ha), or up to about 35 percent of the land area in question.

p.E-3-280, para. 5

In summary, rectification will restore vegetation to approximately 3,209 acres (1,299 ha) temporarily lost to ancillary facilities. This represents about 6 percent of the cumulative total land area affected by direct loss of vegetation during project construction and operation (53,624 acres, 21,701 ha).

p.E-3-282, para. 3 to p.E-3-282 para. 4

For the Susitna project, the cumulative area lost in this way will total about 38,454 acres (15,562 ha), with 36,959 acres (14,957 ha) covered by the impoundments. Actual acreages of vegetation types which will be removed were discussed previously and quantified in Tables E.3.83 and E.3.84.

From the preceeding options analysis, it is evident that measures for minimization, rectification and reduction of vegetation loss will apply, at most, to about 30 percent (15,178 acres, 6,139 ha) of the total area of vegetation which will be removed by the project.

CHANGES IN THE TEXT AND TABLES OF THE WILDLIFE SECTION OF CHAPTER 3 RESULTING FROM CORRECTIONS OF BOTANICAL TABLES (the following sentences replace the corresponding sentences in the indicated paragraphs).

p.E-3-461, para. 4 — Sentence 2. Should read. "About 26,647 acres (10,784 ha) of forest will be cleared."

p.E-3-463, para. 4 — Sentence 1. Should read: "An estimated 6175 acres (2499 ha) will be cleared within the Devil Canyon impoundment area and an additional 519 acres of forest (210 ha) will be used for operational areas, campsites and borrow sites."

p.E-3-476, para. 1 — Sentence 2. Should read: "The total area affected (8492 acres, 3437 ha) and the total percent of forested land affected (0.7 percent) are much smaller than in the Watana reservoir area."

p.E-3-498, para. 4 — Sentence 1. Should read: "Table E.3.166 indicates an order-of-magnitude estimate of 1,200 small to medium-sized breeding birds lost to the transmission line, less than 0.1 percent of the population within 16 km of the Susitna River between the Maclaren River and Gold Creek." (This correction supercedes the Acres errata of 29 March 1983.)

p.E-3-432, para. 4 — Sentence 1. Should read: "Based on the estimate of about one wolverine per 40,320 acres (163 km^2) derived in Section 4.2.1(g), the direct loss of over 40,846 acres (16,530 ha) caused by the Watana impoundment and facilities would lower the carrying capacity by about two wolverines."

p.E-3-441, para. 2

Sentence 2. Should read: "Using a figure of 11,798 ha of forest habitat lost to the Watana impoundment area, borrow sites, construction sites and camps, habitat supporting 100 marten (3.4 percent of the forested habitat in the Susitna watershed upstream from Gold Creek) would be lost."

Table E.3.144

Under Permanent Habitat Loss, Watana alone: the area affected by the access corridor should be changed from 192 to 255 ha. The area affected by the Access Corridor from Denali Highway to Watana should be changed from 192 to 255 ha. The area affected by the permanent village should be changed from 27 to 70 ha. The area affected by the permanent airstrip should be changed from 47 to 17 ha.

Under Permanent Habitat Loss, Devil Canyon: the area affected by the access corridor should be changed from 218 to 192 ha. The area affected by the access corridor from Watana to Devil Canyon should be changed from 189 to 163 ha.

Under Habitat Alteration and Temporary Habitat Loss, Watana alone: the area affected by the transmission corridor from Watana to Devil Canyon should be changed from 379.8 to 419 ha. The area affected by the transmission corridor from Devil Canyon to Gold Creek should be changed from 77.5 to 119 ha.

Under Habitat Alteration and Temporary Habitat Loss, Devil Canyon: the area affected by the transmission corridor from Watana to Devil Canyon should be changed from 209 additional to 0. The area affected by the transmission corridor from Devil Canyon to Gold Creek should be changed from 0 to 84 additional ha.

Table E.3.145 Under (2) Habitat Alteration and Temporary Habitat Loss--transmission corridor. Sentence should read: "Nearly all 152,000 ha of the corridor is likely to become winter habitat of reasonable quality to moose. No existing winter habitat will be made unusable. Corridor will be maintained in early succession throughout the life of the project." Next sentence should read: "Drifting snow is unlikely to be a significant factor in the 300-foot corridor and will not reduce forage availability."

Table E.3.151 Under (5) Increased Human Access-hunting and poaching. Sentence should read: "Much of the current harvest is illegal and the illegal harvest will increase in the absence of better control. Current legal harvest is unlimited (no bag limit) and harvest is likely to increase. The current annual take is 40-45% of the population.

3. Fish, Wildlife, and Botanical Resources -
Terrestrial Botanical Resources

Comment 10

Were meteorological measurements made in the vicinity of the proposed dam sites? If so, provide data on frequency of occurence of wind speed, stability class, and wind direction, and inversion depths.

Response

Meteorological measurements were made near the proposed sites. The Watana Climate Station was installed on April 8, 1980 about one mile north of the Susitna River about midway between Tsusena and Deadman Creeks. The Devil Canyon Climate Station was installed on July 17, 1980, on a ridge on the south bank of the Susitna River one-half mile downstream of the Devil Canyon dam site.

Four other climate stations were installed during July-August 1980 in the Upper Susitna basin. These include:

Susitna Glacier	Located at El.4,700 ft. near the confluence of four major glacier feeding the Susitna River mainstem.
Denali	Located about one mile east of the Susitna River on the left bank near Susitna Lodge.

Tyone River	Located about 5 miles east-southeast of the Susitna River on the left bank in the Tyone River drainage.
Kosina Creek	Located about 6 miles south of the Susitna River in the Kosina Creek drainage.

Climate data measured at each station include: air temperature, average wind speed, wind direction, peak wind gust, relative humidity, precipitation, and solar radiation. Snowfall amounts have been measured at Watana only and evaporation measurements have been taken daily during May-September at Watana begining in spring of 1981.

Available wind speed and direction frequency data for Watana and Devil Canyon Stations are included as pp. 3B-10-3 to 3B-10-140. Data on stability class and inversion depth frequency are not available.

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA
VOLUME 5 - WATANA STATION

MARCH 1982

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s14/n11

3B-10-3

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA

TABLE OF CONTENTS

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VOLUME 5	WATANA STATION
VOLUME 6	DEVIL CANYON STATION

s14/n13

3B-10-4

PROCESSED CLIMATIC DATA

VOLUME 5

WATANA STATION

APRIL 8, 1980 THRU SEPTEMBER 30, 1981

3B-10-5

s14/n2

The Watana Climate Station was installed on April 8, 1980 about one mile north of the Susitna River about midway between Tsusena and Deadman Creek. It is located on map Talkeetna Mountains (D-4) NW¼ Section 27, R5E, T32N, Seward Meridian. The data were collected using a Meteorology Research Incorporated (MRI) Digital Weather Station. Data thru June 30, 1981 were processed by MRI and all subsequent data by R&M Consultants. An explanation of the parameters measured is located at the back of this report.

m11/b5

3B-10-6

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING MAY , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.32	4.73	.32	0.00	0.00	0.00	0.00	5.37
NNE	.13	4.73	2.30	0.00	0.00	0.00	0.00	7.17
NE	.64	3.45	2.05	.06	0.00	0.00	0.00	6.21
ENE	.06	2.43	5.76	.51	.06	0.00	0.00	8.83
E	.32	2.11	3.71	1.98	.19	0.00	0.00	8.32
ESE	.38	1.54	1.28	1.34	.06	0.00	0.00	4.61
SE	.32	1.34	1.60	.19	0.00	0.00	0.00	3.45
SSE	.06	.77	.38	.06	0.00	0.00	0.00	1.28
S	.13	.96	.13	0.00	0.00	0.00	0.00	1.22
SSW	.32	.96	.45	0.00	0.00	0.00	0.00	1.73
SW	.58	4.67	7.93	.45	0.00	0.00	0.00	13.63
WSW	.32	7.36	12.41	.83	0.00	0.00	0.00	20.92
W	.51	3.39	4.22	.06	0.00	0.00	0.00	8.19
WNW	.32	1.47	.70	0.00	0.00	0.00	0.00	2.50
NW	.51	1.60	.06	0.00	0.00	0.00	0.00	2.18
NNW	.19	3.33	0.00	0.00	0.00	0.00	0.00	3.52
CALM								.90
TOTAL	5.12	44.85	43.31	5.50	.32	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

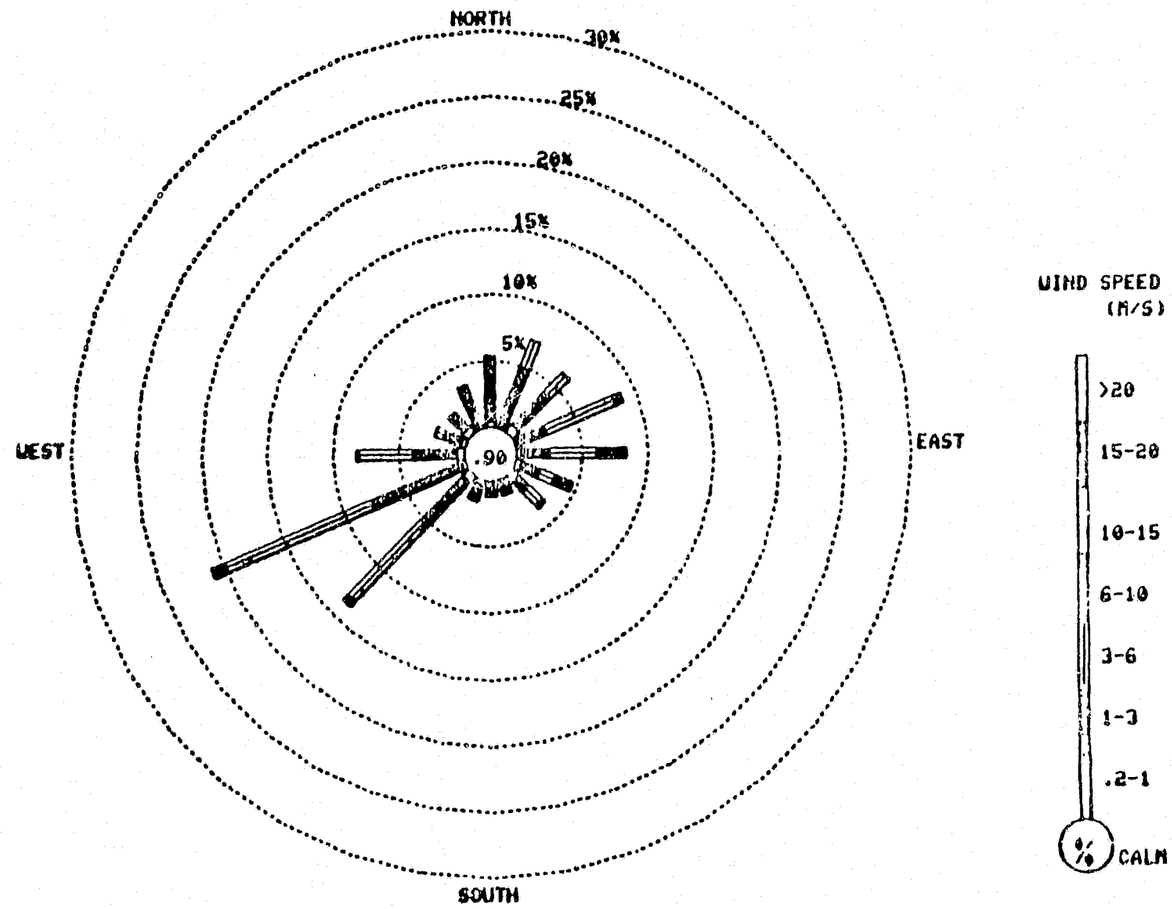
1563 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3-18-10-7

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

MAY, 1980



WIND ROSE PLOT

3B-10-8

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING JUNE , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.35	4.14	0.00	0.00	0.00	0.00	0.00	4.49
NNE	.85	2.10	.10	0.00	.05	0.00	0.00	3.10
NE	.70	2.55	1.00	0.00	0.00	0.00	0.00	4.24
ENE	.60	1.20	1.40	0.00	0.00	0.00	0.00	3.20
E	.80	1.05	.90	0.00	0.00	0.00	0.00	2.75
ESE	.75	1.30	0.00	0.00	0.00	0.00	0.00	2.05
SE	.40	.50	0.00	0.00	0.00	0.00	0.00	.90
SSE	.65	.70	0.00	0.00	0.00	0.00	0.00	1.35
S	.40	1.55	.05	0.00	0.00	0.00	0.00	2.00
SSW	.50	3.00	1.00	.10	0.00	0.00	0.00	4.59
SW	1.10	8.19	16.08	.55	0.00	0.00	0.00	25.91
WSW	.25	14.48	11.58	.20	0.00	0.00	0.00	26.51
W	.55	6.59	4.54	0.00	0.00	0.00	0.00	11.68
WNW	.20	1.65	.10	0.00	0.00	0.00	0.00	1.95
NW	.35	1.15	.45	0.00	0.00	0.00	0.00	1.95
NNW	.30	2.50	.20	0.00	0.00	0.00	0.00	3.00
CALM								.35
TOTAL	8.74	52.62	37.39	.85	.05	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

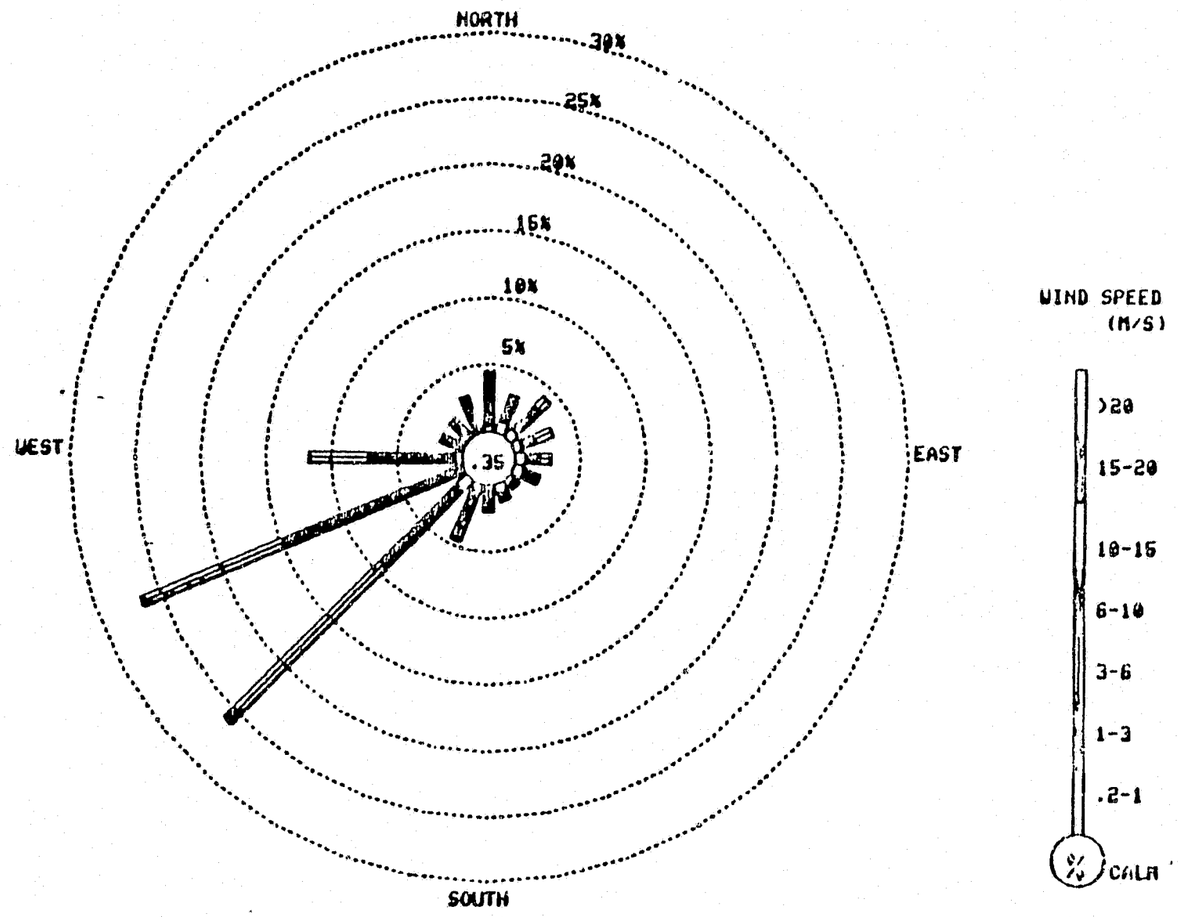
2003 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-9

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

JUNE, 1980



WIND ROSE PLOT

ND 1

3B-10-10

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING JULY , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.35	1.96	.03	0.00	0.00	0.00	0.00	2.34
NNE	.35	2.41	.35	0.00	0.00	0.00	0.00	3.11
NE	.63	2.48	1.36	0.00	0.00	0.00	0.00	4.48
ENE	.98	3.67	2.94	0.00	0.00	0.00	0.00	7.59
E	.59	2.62	.94	0.00	0.00	0.00	0.00	4.16
ESE	.63	2.03	.21	0.00	0.00	0.00	0.00	2.87
SE	.59	1.01	.03	0.00	0.00	0.00	0.00	1.64
SSE	.35	.84	0.00	0.00	0.00	0.00	0.00	1.19
S	.14	.87	0.00	0.00	0.00	0.00	0.00	1.01
SSW	.66	1.96	.66	.07	0.00	0.00	0.00	3.36
SW	.66	8.89	15.33	.66	0.00	0.00	0.00	25.54
WSW	.42	17.77	9.45	.52	0.00	0.00	0.00	28.17
W	.45	5.42	1.33	.10	0.00	0.00	0.00	7.31
WNW	.38	1.36	.14	0.00	0.00	0.00	0.00	1.89
NW	.35	1.26	.24	0.00	0.00	0.00	0.00	1.85
NNW	.24	2.97	.17	0.00	0.00	0.00	0.00	3.39
CALM								.07
TOTAL	7.80	57.56	33.21	1.36	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

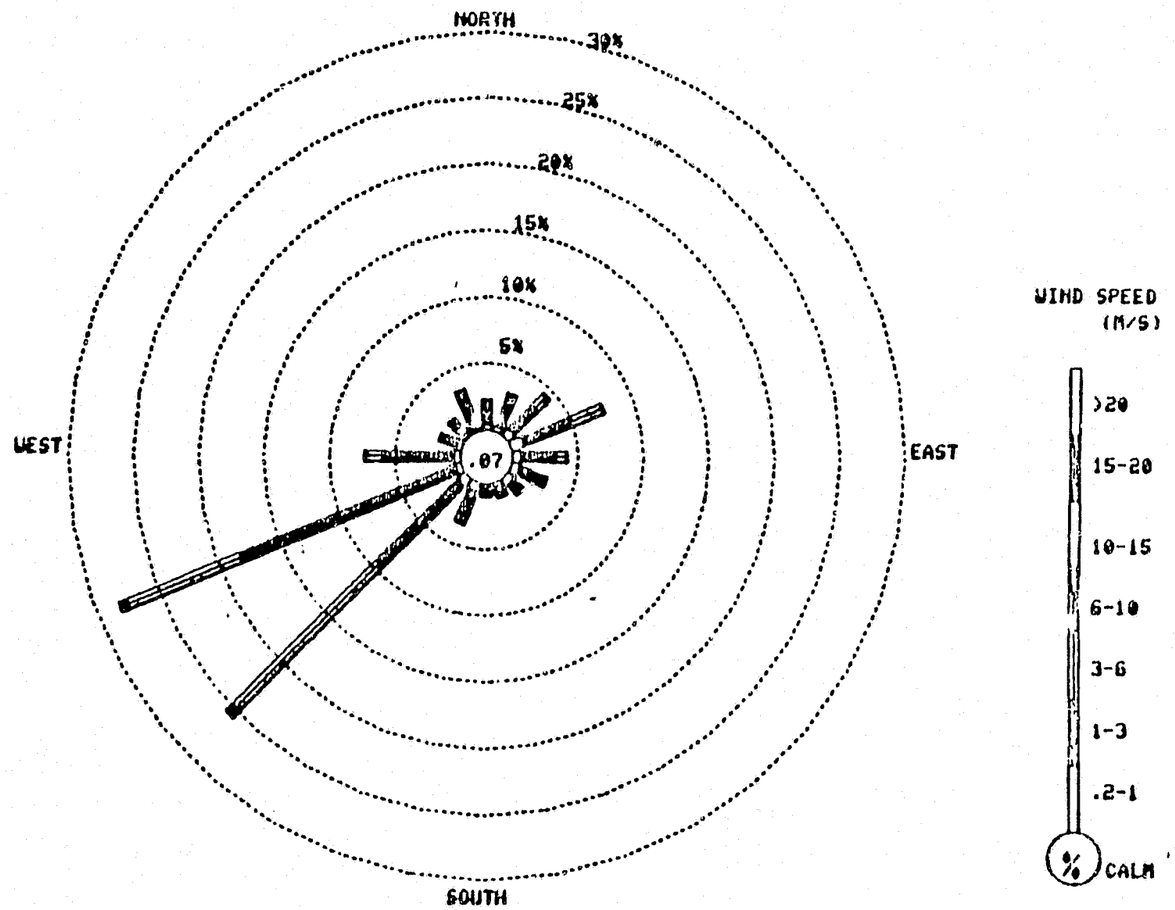
2858 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-11

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

JULY, 1980



WIND ROSE PLOT

38-10-12

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING AUGUST , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	1.61	0.00	0.00	0.00	0.00	0.00	0.00	1.61
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	1.61	0.00	0.00	0.00	0.00	0.00	0.00	1.61
ESE	1.61	0.00	0.00	0.00	0.00	0.00	0.00	1.61
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	3.23	0.00	1.61	0.00	0.00	0.00	0.00	4.84
SW	1.61	6.45	20.97	0.00	0.00	0.00	0.00	29.03
WSW	1.61	14.52	30.65	0.00	0.00	0.00	0.00	46.77
W	0.00	12.90	0.00	1.61	0.00	0.00	0.00	14.52
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALM								0.00
TOTAL	11.29	33.87	53.23	1.61	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

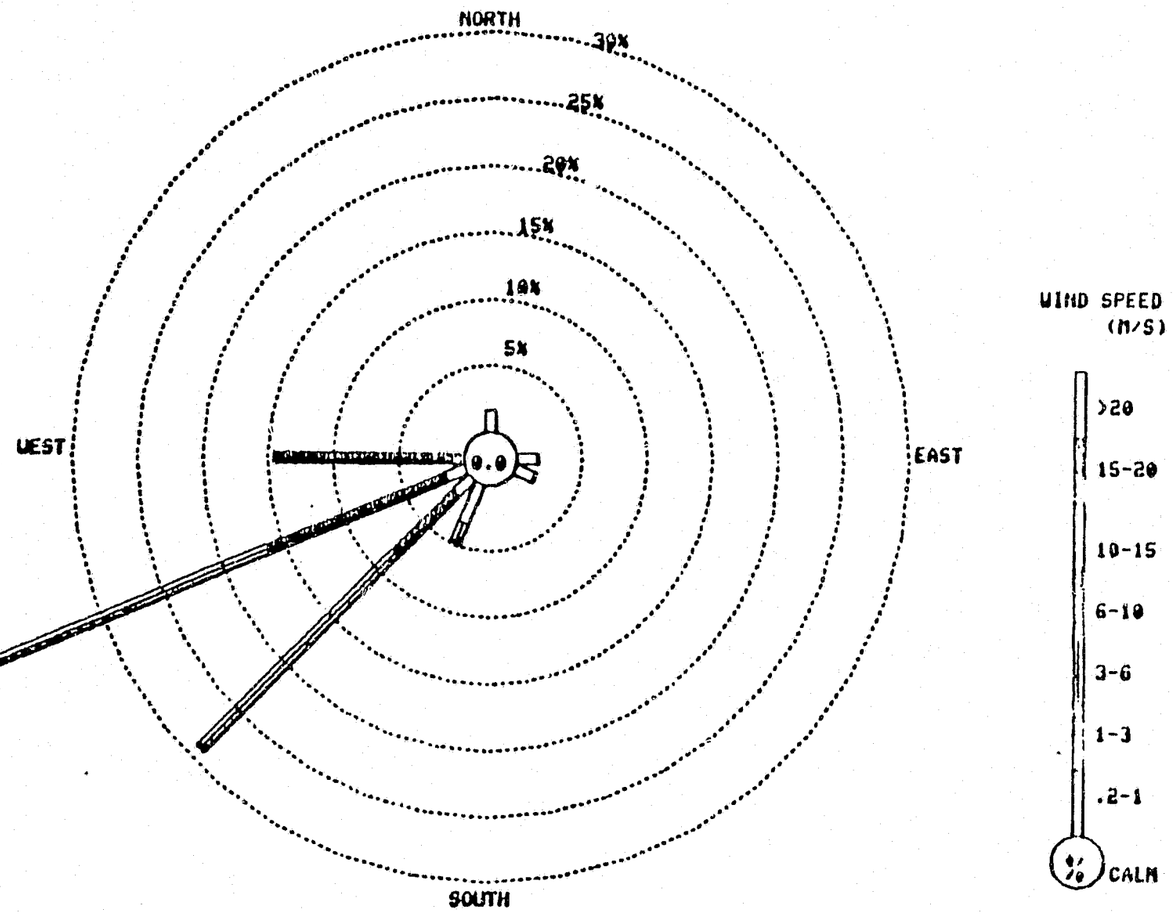
62 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-13

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

AUGUST, 1980



WIND ROSE PLOT

3B-10-14

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING SEPTEMBER , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.44	6.76	.82	0.00	0.00	0.00	0.00	8.02
NNE	.76	7.26	1.58	0.00	0.00	0.00	0.00	9.60
NE	1.01	8.52	4.48	.06	0.00	0.00	0.00	14.08
ENE	1.01	11.36	9.09	1.07	0.00	0.00	0.00	22.54
E	1.64	11.05	4.61	1.70	0.00	0.00	0.00	19.00
ESE	.69	6.12	1.39	.06	0.00	0.00	0.00	8.27
SE	.19	2.34	.06	0.00	0.00	0.00	0.00	2.59
SSE	.32	.76	0.00	0.00	0.00	0.00	0.00	1.07
S	.13	.69	0.00	0.00	0.00	0.00	0.00	.82
SSW	.25	.82	.06	0.00	0.00	0.00	0.00	1.14
SW	.06	1.26	.32	0.00	0.00	0.00	0.00	1.64
WSW	.19	1.01	.06	0.00	0.00	0.00	0.00	1.26
W	.38	.69	0.00	0.00	0.00	0.00	0.00	1.07
WNW	.44	.63	.32	0.00	0.00	0.00	0.00	1.39
NW	.32	.88	.25	0.00	0.00	0.00	0.00	1.45
NNW	.51	3.98	1.33	0.00	0.00	0.00	0.00	5.81
CALM								.25
TOTAL	8.33	54.14	24.37	2.90	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

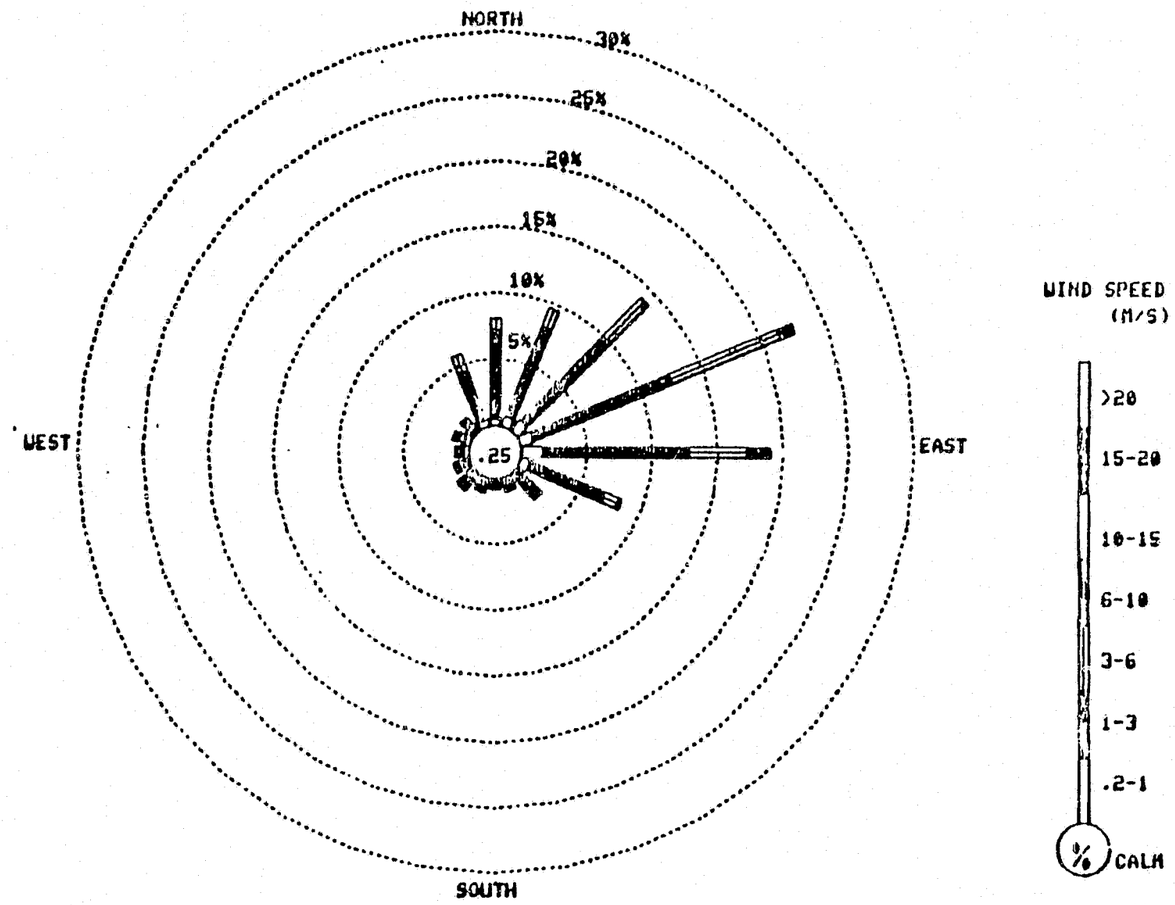
1584 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-15

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

SEPTEMBER, 1980



WIND ROSE PLOT

3B-10-16

WIN

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING OCTOBER , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.29	1.52	.22	0.00	0.00	0.00	0.00	2.03
NNE	.36	3.12	3.41	0.00	0.00	0.00	0.00	6.88
NE	.14	4.20	18.62	.72	0.00	0.00	0.00	23.70
ENE	.58	5.72	22.83	10.80	.07	0.00	0.00	40.00
E	.58	6.52	3.19	1.96	.07	0.00	0.00	12.32
ESE	.43	.80	.07	0.00	0.00	0.00	0.00	1.30
SE	.29	.07	0.00	0.00	0.00	0.00	0.00	.36
SSE	.14	0.00	0.00	0.00	0.00	0.00	0.00	.14
S	.29	.14	0.00	0.00	0.00	0.00	0.00	.43
SSW	.36	.14	0.00	0.00	0.00	0.00	0.00	.51
SW	.43	1.30	.22	0.00	0.00	0.00	0.00	1.96
WSW	.36	2.32	.43	0.00	0.00	0.00	0.00	3.12
W	.29	.29	.07	0.00	0.00	0.00	0.00	.65
WNW	.29	0.00	0.00	0.00	0.00	0.00	0.00	.29
NW	.36	0.00	0.00	0.00	0.00	0.00	0.00	.36
NNW	1.45	4.06	0.00	0.00	0.00	0.00	0.00	5.51
CALM								.43
TOTAL	6.67	30.22	49.06	13.48	.14	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

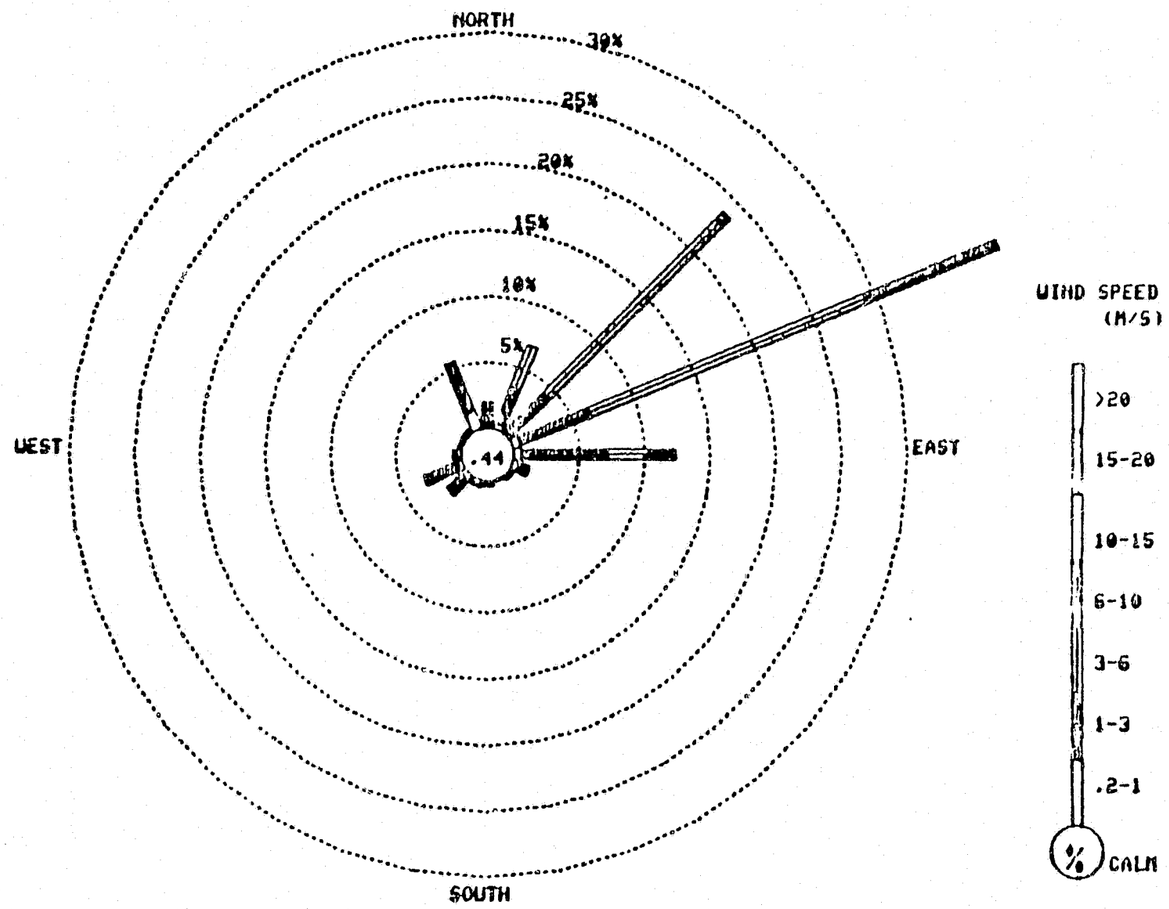
1380 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-17

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

OCTOBER, 1980



WIND ROSE PLOT

30-10-18

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING NOVEMBER , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.63	2.67	.35	0.00	0.00	0.00	0.00	3.65
NNE	.73	5.00	2.64	0.00	0.00	0.00	0.00	8.37
NE	1.01	7.74	22.22	.59	0.00	0.00	0.00	31.56
ENE	1.67	11.39	18.72	3.44	0.00	0.00	0.00	35.21
E	1.77	9.86	2.78	.03	0.00	0.00	0.00	14.44
ESE	.63	1.60	.63	0.00	0.00	0.00	0.00	2.85
SE	.07	.17	0.00	0.00	0.00	0.00	0.00	.24
SSE	.07	.03	0.00	0.00	0.00	0.00	0.00	.10
S	.07	.21	0.00	0.00	0.00	0.00	0.00	.28
SSW	.03	0.00	0.00	0.00	0.00	0.00	0.00	.03
SW	.17	0.00	0.00	0.00	0.00	0.00	0.00	.17
WSW	.10	.14	0.00	0.00	0.00	0.00	0.00	.24
W	.03	.10	0.00	0.00	0.00	0.00	0.00	.14
WNW	.10	.10	0.00	0.00	0.00	0.00	0.00	.21
NW	.21	.07	0.00	0.00	0.00	0.00	0.00	.28
NNW	.35	1.39	.28	0.00	0.00	0.00	0.00	2.01
CALM								.21
TOTAL	7.64	40.49	47.60	4.06	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

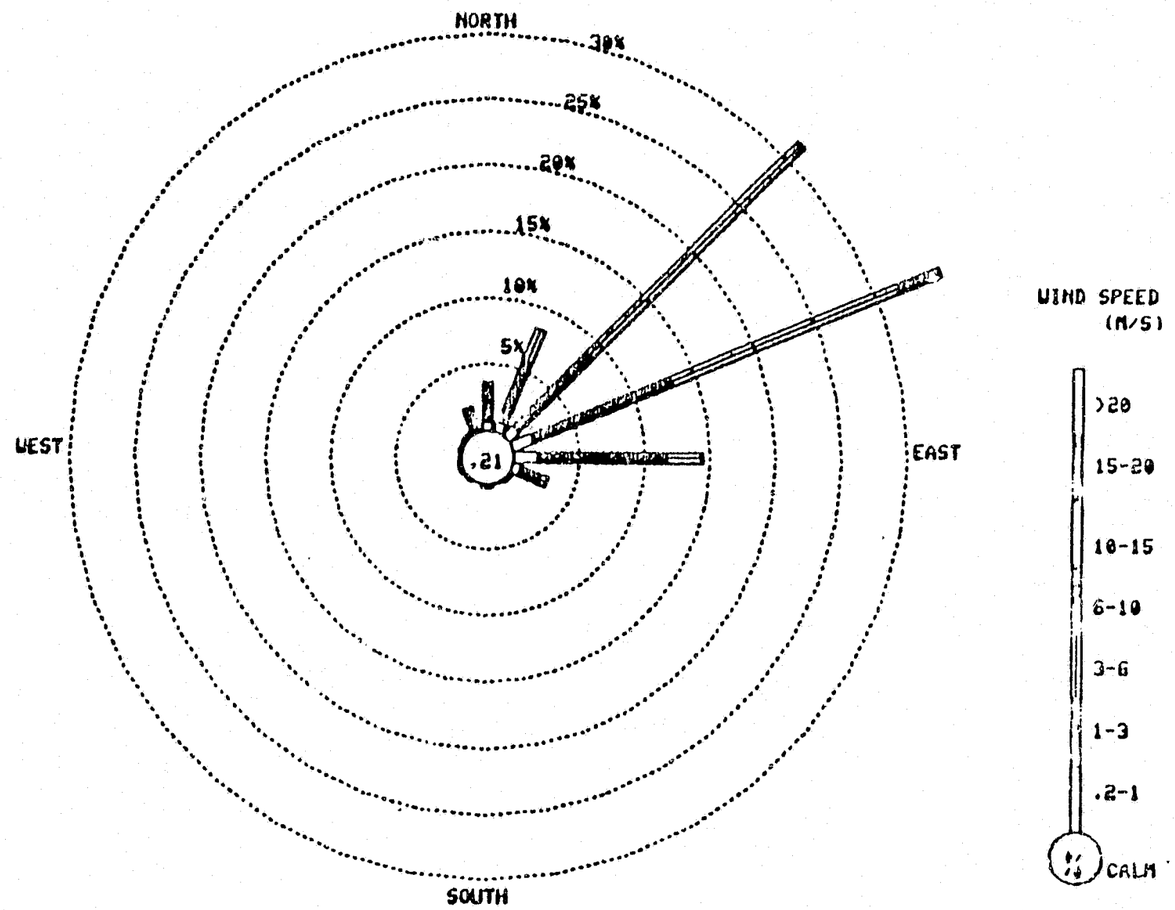
2880 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-19

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

NOVEMBER, 1980



WIND ROSE PLOT

38-10-20

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING DECEMBER , 1980

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.20	1.14	.07	0.00	0.00	0.00	0.00	1.41
NNE	.10	2.39	.97	0.00	0.00	0.00	0.00	3.46
NE	.27	5.11	3.63	1.51	0.00	0.00	0.00	10.52
ENE	.30	15.39	14.89	8.67	.03	0.00	0.00	39.28
E	.50	14.92	18.28	1.78	.07	0.00	0.00	35.55
ESE	.24	1.58	2.12	0.00	0.00	0.00	0.00	3.93
SE	.07	.17	0.00	0.00	0.00	0.00	0.00	.24
SSE	.10	.03	0.00	0.00	0.00	0.00	0.00	.13
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	.03	0.00	0.00	0.00	0.00	0.00	0.00	.03
WSW	0.00	.34	0.00	0.00	0.00	0.00	0.00	.34
W	.03	.47	0.00	0.00	0.00	0.00	0.00	.50
WNW	.07	.57	0.00	0.00	0.00	0.00	0.00	.64
NW	.07	.67	0.00	0.00	0.00	0.00	0.00	.74
NNW	.03	3.09	.10	0.00	0.00	0.00	0.00	3.23
CALM								0.00
TOTAL	2.02	45.87	40.05	11.96	.10	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

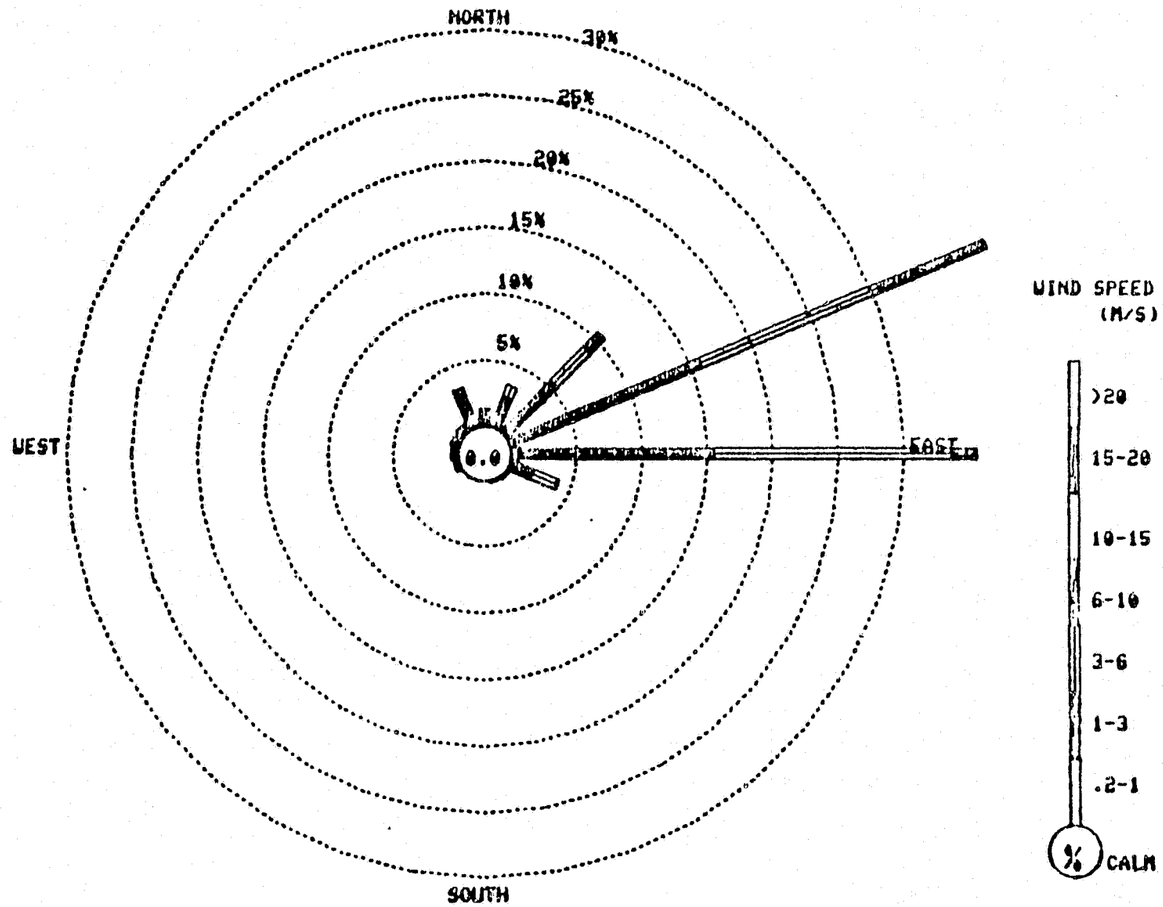
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-21

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

DECEMBER, 1980



WIND ROSE PLOT

3B-10-22

WIND

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING JANUARY , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.27	2.22	.74	0.00	0.00	0.00	0.00	3.23
NNE	.34	3.23	3.83	0.00	0.00	0.00	0.00	7.39
NE	.47	4.70	16.83	2.12	0.00	0.00	0.00	24.13
ENE	.81	8.10	17.54	15.42	.47	0.00	0.00	42.34
E	.97	9.01	3.46	2.96	.17	0.00	0.00	16.57
ESE	.27	.84	.27	0.00	0.00	0.00	0.00	1.38
SE	0.00	.07	0.00	0.00	0.00	0.00	0.00	.07
SSE	.20	.13	0.00	0.00	0.00	0.00	0.00	.34
S	.03	.13	0.00	0.00	0.00	0.00	0.00	.17
SSW	.03	.24	0.00	0.00	0.00	0.00	0.00	.27
SW	.17	.13	.10	.10	0.00	0.00	0.00	.50
WSW	.17	.87	.10	.34	0.00	0.00	0.00	1.48
W	.17	.37	0.00	.10	0.00	0.00	0.00	.64
WNW	.03	.13	0.00	0.00	0.00	0.00	0.00	.17
NW	.03	.37	0.00	0.00	0.00	0.00	0.00	.40
NNW	.07	.60	.27	0.00	0.00	0.00	0.00	.94
CALM								0.00
TOTAL.	4.03	31.15	43.15	21.03	.64	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

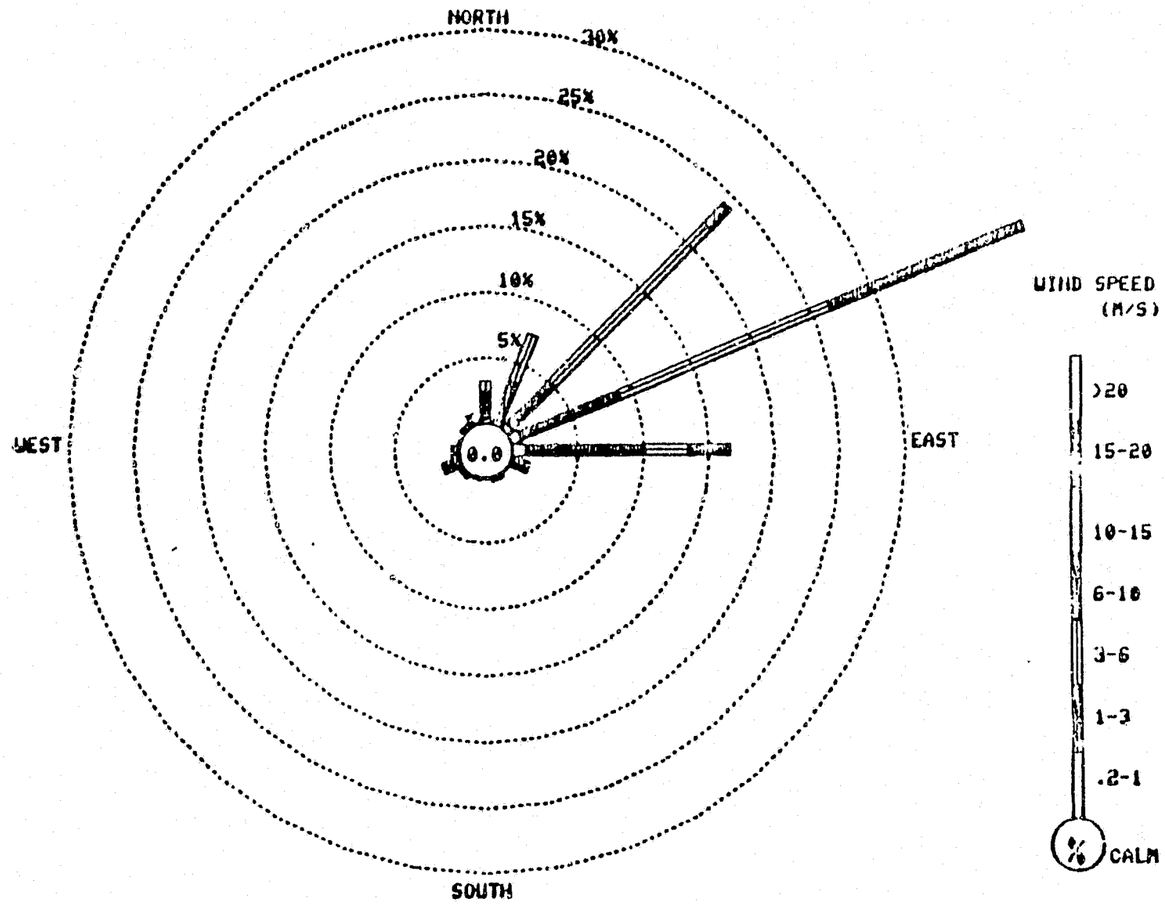
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-23

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

JANUARY, 1981



WIND ROSE PLOT

3B-10-24

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING FEBRUARY , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.28	2.34	0.00	0.00	0.00	0.00	0.00	2.62
NNE	.57	3.83	3.48	.07	0.00	0.00	0.00	7.94
NE	.78	4.82	14.11	1.77	0.00	0.00	0.00	21.49
ENE	1.35	7.73	13.26	4.75	.14	0.00	0.00	27.23
E	3.26	4.54	2.84	2.55	.21	0.00	0.00	13.40
ESE	1.63	1.77	.64	.07	0.00	0.00	0.00	4.11
SE	.50	.14	0.00	0.00	0.00	0.00	0.00	.64
SSE	.14	.14	0.00	0.00	0.00	0.00	0.00	.28
S	.14	.07	0.00	0.00	0.00	0.00	0.00	.21
SSW	0.00	.35	0.00	0.00	0.00	0.00	0.00	.35
SW	.35	1.49	.28	0.00	0.00	0.00	0.00	2.13
WSW	.71	2.27	.14	0.00	0.00	0.00	0.00	3.12
W	.64	.85	0.00	0.00	0.00	0.00	0.00	1.49
WNW	.50	.14	0.00	0.00	0.00	0.00	0.00	.64
NW	.21	0.00	0.00	0.00	0.00	0.00	0.00	.21
NNW	.50	.92	0.00	0.00	0.00	0.00	0.00	1.42
CALM								12.70
TOTAL	11.56	31.42	34.75	9.22	.35	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

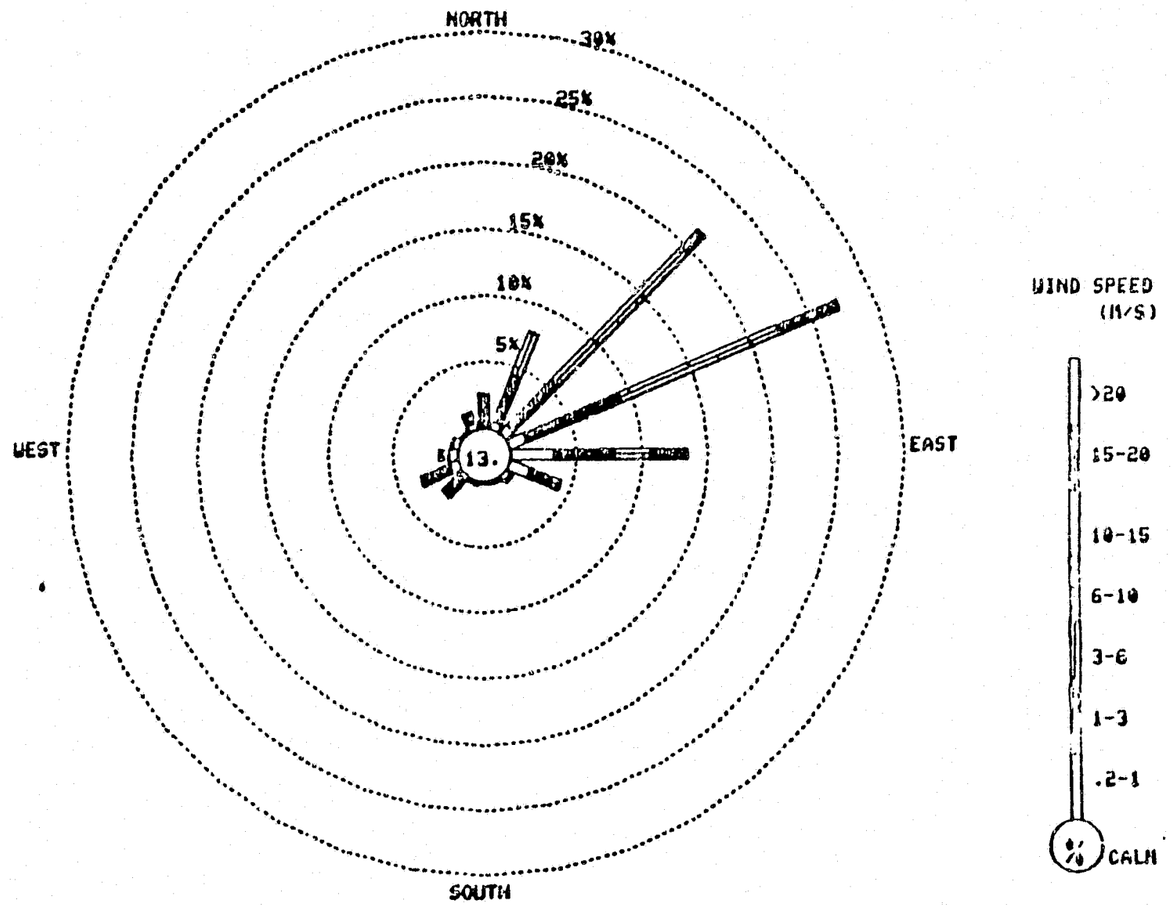
1410 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

38-10-25

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

FEBRUARY, 1981



WIND ROSE PLOT

38-10-26

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING MARCH , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.18	6.28	.67	0.00	0.00	0.00	0.00	7.12
NNE	.11	5.96	3.58	0.00	0.00	0.00	0.00	9.65
NE	.53	6.77	15.33	.84	0.00	0.00	0.00	23.47
ENE	.46	7.65	17.47	8.03	.14	0.00	0.00	33.74
E	.42	4.63	4.10	1.93	.07	0.00	0.00	11.15
ESE	.56	1.12	.53	.14	0.00	0.00	0.00	2.35
SE	.35	.07	0.00	0.00	0.00	0.00	0.00	.42
SSE	.21	.04	0.00	0.00	0.00	0.00	0.00	.25
S	0.00	.07	.04	0.00	0.00	0.00	0.00	.11
SSW	.11	.60	.04	0.00	0.00	0.00	0.00	.74
SW	.07	.56	.91	0.00	0.00	0.00	0.00	1.54
WSW	.21	1.30	.88	0.00	0.00	0.00	0.00	2.39
W	.35	1.19	0.00	0.00	0.00	0.00	0.00	1.54
WNW	.25	.46	0.00	0.00	0.00	0.00	0.00	.70
NW	.21	.49	0.00	0.00	0.00	0.00	0.00	.70
NNW	.11	3.23	.77	0.00	0.00	0.00	0.00	4.10
CALM								.04
TOTAL	4.10	40.41	44.30	10.94	.21	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

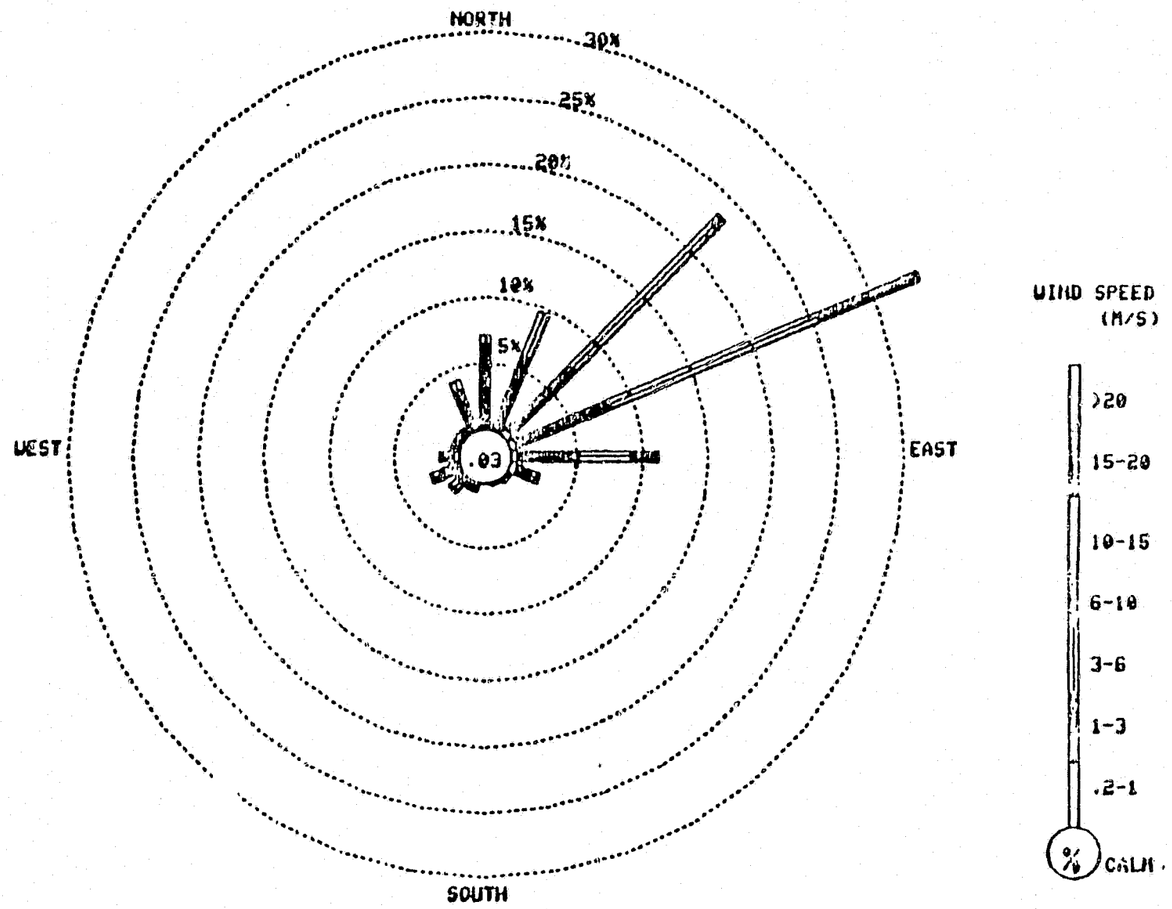
2851 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-27

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

MARCH, 1981



WIND ROSE PLOT

38-10-28

WINL

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING APRIL , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.45	8.89	1.15	0.00	0.00	0.00	0.00	10.49
NNE	.90	9.34	5.31	.03	0.00	0.00	0.00	15.59
NE	.80	7.57	9.44	.17	0.00	0.00	0.00	17.99
ENE	.87	7.19	9.86	1.15	0.00	0.00	0.00	19.06
E	.76	4.97	1.67	.21	0.00	0.00	0.00	7.60
ESE	.90	1.35	.56	.03	0.00	0.00	0.00	2.85
SE	.38	.35	.10	0.00	0.00	0.00	0.00	.83
SSE	.14	.10	0.00	0.00	0.00	0.00	0.00	.24
S	.24	.07	0.00	0.00	0.00	0.00	0.00	.31
SSW	.14	.28	.07	0.00	0.00	0.00	0.00	.49
SW	.21	.76	.94	.10	0.00	0.00	0.00	2.01
WSW	.14	1.28	2.33	.07	0.00	0.00	0.00	3.82
W	.63	1.88	1.08	0.00	0.00	0.00	0.00	3.58
WNW	.42	1.39	.73	0.00	0.00	0.00	0.00	2.53
NW	.38	2.57	.10	0.00	0.00	0.00	0.00	3.06
NNW	.66	8.30	.38	0.00	0.00	0.00	0.00	9.34
CALM								.21
TOTAL	8.02	56.28	33.72	1.77	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

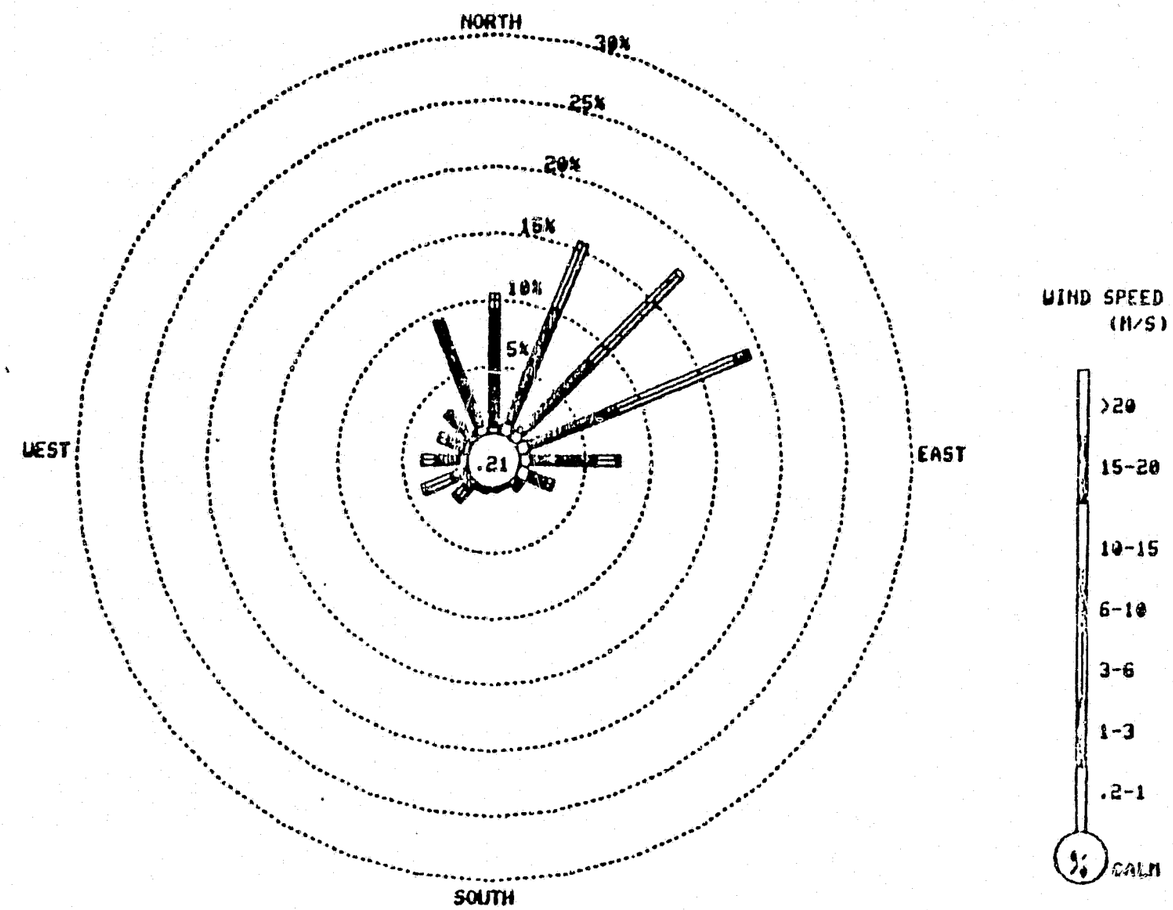
2880 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-29

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

APRIL, 1981



WIND ROSE PLOT

38-10-30

IND

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING MAY , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.37	4.30	.77	0.00	0.00	0.00	0.00	5.44
NNE	.30	3.93	1.88	.03	0.00	0.00	0.00	6.15
NE	.30	3.60	1.95	0.00	0.00	0.00	0.00	5.85
ENE	.60	3.86	4.64	.20	0.00	0.00	0.00	9.31
E	.84	3.97	3.66	.60	0.00	0.00	0.00	9.07
ESE	.87	3.29	1.34	.40	0.00	0.00	0.00	5.91
SE	.24	1.28	.20	.03	0.00	0.00	0.00	1.75
SSE	.34	.81	.03	0.00	0.00	0.00	0.00	1.18
S	.07	1.08	.13	0.00	0.00	0.00	0.00	1.28
SSW	.44	1.58	.87	0.00	0.00	0.00	0.00	2.89
SW	.37	4.64	8.87	.77	0.00	0.00	0.00	14.65
WSW	.60	9.41	5.61	.67	0.00	0.00	0.00	16.30
W	.44	5.85	1.85	.17	0.00	0.00	0.00	8.30
WNW	.71	1.78	.30	0.00	0.00	0.00	0.00	2.79
NW	.30	2.02	.44	0.00	0.00	0.00	0.00	2.76
NNW	.34	4.37	.47	0.00	0.00	0.00	0.00	5.17
CALM								1.21
TOTAL	7.12	55.75	33.03	2.89	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

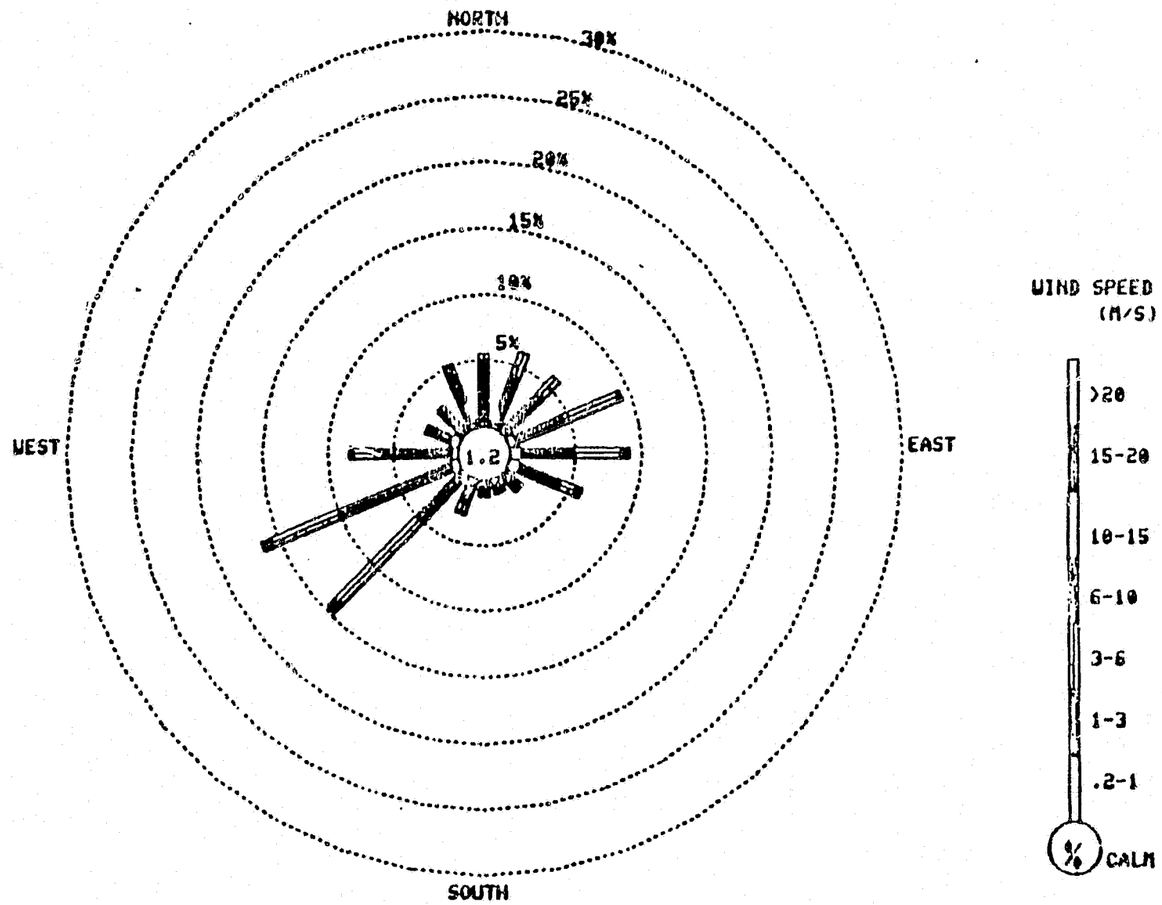
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-31

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

MAY, 1981



WIND ROSE PLOT

NO

B-10-32

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING JUNE , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.45	3.61	.38	0.00	0.00	0.00	0.00	4.44
NNE	.45	1.35	.38	0.00	0.00	0.00	0.00	2.19
NE	.42	1.35	.59	.03	0.00	0.00	0.00	2.40
ENE	.59	1.49	1.11	.03	0.00	0.00	0.00	3.23
E	.69	1.74	1.84	.07	0.00	0.00	0.00	4.34
ESE	.73	1.81	.76	.07	0.00	0.00	0.00	3.37
SE	.24	1.60	.28	0.00	0.00	0.00	0.00	2.12
SSE	.14	1.22	0.00	0.00	0.00	0.00	0.00	1.35
S	.35	1.42	.10	0.00	0.00	0.00	0.00	1.88
SSW	.24	1.74	2.43	.17	0.00	0.00	0.00	4.58
SW	.45	5.31	14.58	1.35	0.00	0.00	0.00	21.70
WSW	.52	13.72	14.10	.76	0.00	0.00	0.00	29.10
W	.52	5.83	2.08	.03	0.00	0.00	0.00	8.47
WNW	.24	2.12	.38	0.00	0.00	0.00	0.00	2.74
NW	.35	1.25	.24	0.00	0.00	0.00	0.00	1.84
NNW	.21	5.07	.35	0.00	0.00	0.00	0.00	5.63
CALM								.63
TOTAL	6.60	50.63	39.62	2.53	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

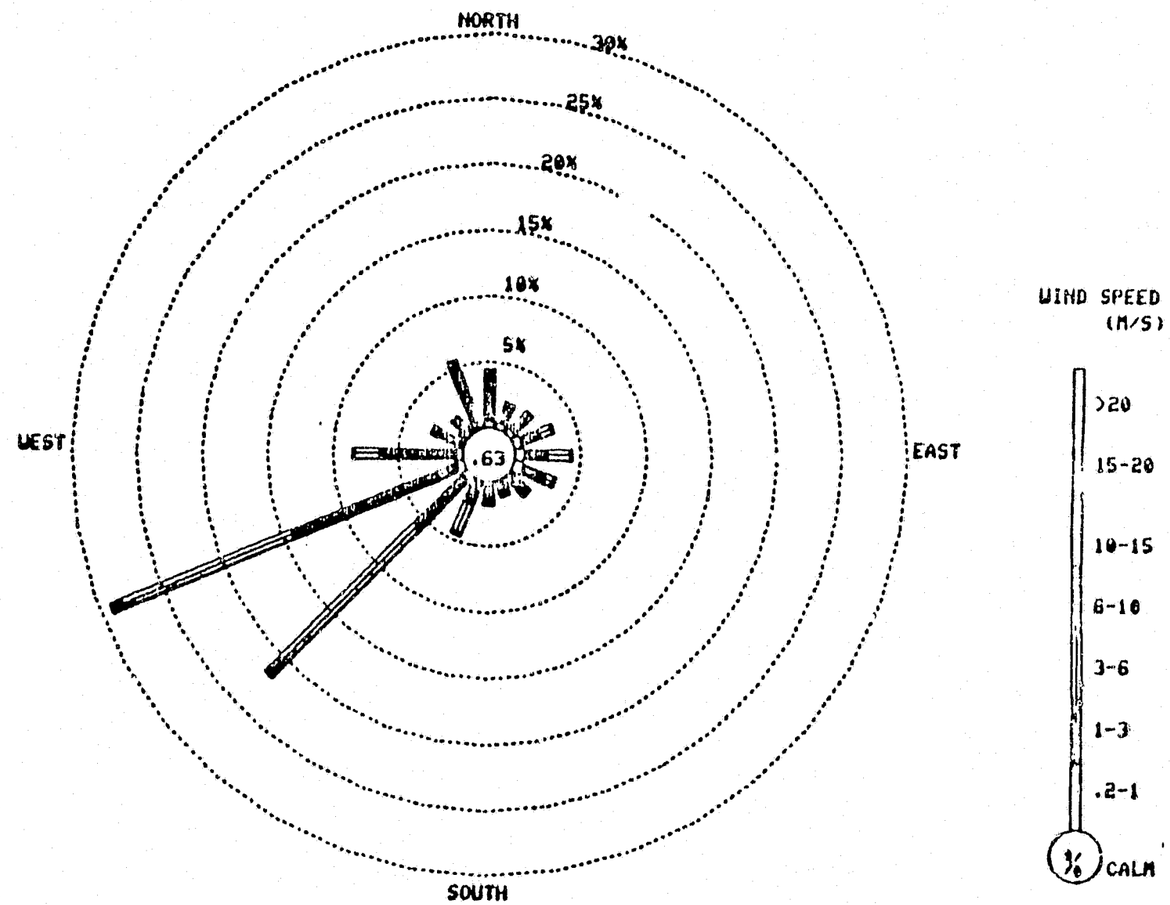
2880 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

38-10-33

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

JUNE, 1981



WIND ROSE PLOT

3B-10-34

****

R & M CONSULTANTS, INC.

CLIMATE DATA SUMMARIES
DOCUMENTATION

****

A. GRAPHICAL DATA PLOT

1. GRAPHICAL REPRESENTATION OF VALID RECORDED AND/OR COMPUTED DATA.

B. HOURLY PRECIPITATION SUMMARY TABLE

1. HOURLY PRECIPITATION VALUES ARE CALCULATED AS THE DIFFERENCE BETWEEN VALID CONSEQUTIVE HOURLY READINGS. WHEN EITHER OF THE HOURLY PRECIPITATION READINGS IS INVALID, NO VALUE IS REPORTED AND ZERO PRECIPITATION IS ASSUMED.
2. A NON-AUTOMATIC ROLL-OVER TO ZERO, AS WHEN THE TAPE IS CHANGED, MUST BE FLAGGED WITH A NEGATIVE ONE (-1) AS THE PRECIPITATION VALUE.

C. MONTHLY SUMMARY TABLE

1. MAXIMUM DAILY AND MONTHLY TEMPERATURES ARE DETERMINED FROM ALL VALID RECORDED TEMPERATURES.
2. MINIMUM DAILY AND MONTHLY TEMPERATURES ARE DETERMINED FROM ALL VALID RECORDED TEMPERATURES.
3. MEAN DAILY AND MONTHLY TEMPERATURES ARE DETERMINED FROM ALL VALID RECORDED TEMPERATURES. THE MEAN DAILY TEMPERATURE IS DETERMINED FROM THE MEAN OF THE MAXIMUM AND MINIMUM TEMPERATURES. THE MEAN MONTHLY TEMPERATURE IS DETERMINED FROM THE MEAN OF ALL REPORTED DAILY MEAN TEMPERATURES.
4. RESULTANT DAILY AND MONTHLY WIND DIRECTIONS AND SPEEDS ARE SUMMED VECTORIALLY FROM ALL VALID READINGS.
5. AVERAGE DAILY AND MONTHLY WIND SPEEDS ARE ARITHMETICALLY MEANED FROM ALL VALID READINGS.
6. MAXIMUM DAILY AND MONTHLY GUST SPEEDS ARE DETERMINED FROM ALL VALID READINGS. ASSOCIATED DIRECTIONS ARE THE RESULTANT DIRECTIONS FROM THE RECORDING INTERVAL IN WHICH THE PEAK INTERVAL GUST WAS OBSERVED.
7. PREVAILING DAILY AND MONTHLY DIRECTIONS ARE DETERMINED FROM ALL VALID READINGS. THE REPORTED VALUE IS THE MOST FREQUENT DIRECTION OBSERVED.
8. MEAN DAILY AND MONTHLY RELATIVE HUMIDITIES ARE DETERMINED FROM ALL VALID READINGS. (ARITHMETIC MEAN)
9. MEAN DAILY AND MONTHLY DEWPOINT TEMPERATURES ARE DETERMINED FROM ALL VALID READINGS. (ARITHMETIC MEAN) WHEN THE WIND SPEED IS LESS THAN 1 m/s, WHEN THE DEWPOINT CALCULATES TO A VALUE GREATER THAN THE RECORDED TEMPERATURE, WHEN OR THE DEWPOINT CALCULATES TO LESS THAN MINUS 47 DEGREES OR MORE THAN 27 DEGREES, THE DEWPOINT IS NOT USED.
10. DAILY AND MONTHLY PRECIPITATION VALUES ARE DETERMINED FROM ALL VALID READINGS.
11. DAILY AND MONTHLY SOLAR ENERGY VALUES ARE DETERMINED FROM ALL VALID

READINGS. DAILY SOLAR ENERGY IS DETERMINED BY AVERAGING THE RECORDED SOLAR INTENSITY AND CONVERTING THE UNITS. THE MONTHLY VALUE IS THE SUM OF THE DAILY VALUES.

D. THREE HOUR SUMMARY TABLES

1. THE TEMPERATURE REPORTED IS THE TEMPERATUPE RECORDED AT THE SPECIFIED TIME.
2. THE DEWPOINT TEMPERATUPE REPORTED IS THE DEWPOINT CALCULATED AT THE SPECIFIED TIME. DEWPOINTS ARE OMITTED WHEN THE WIND SPEED IS LESS THAN 1m/s, WHEN THE DEWPOINT IS CALCULATED TO A VALUE GREATER THAN THE RECORDED TEMPERATURE, OR WHEN THE DEWPOINT CALCULATES TO LESS THAN MINUS 47 DEGRESS OR MORE THAN 27 DEGREES.
3. THE RELATIVE HUMIDITY REPORTED IS THE HUMIDITY RECORDED AT THE SPECIFIED TIME.
4. THE WIND DIRECTION REPORTED IS THE THREE-HOUR VECTORIAL RESULTANT SUM OF DATA RECORDED UP TO THE SPECIFIED TIME.
5. THE WIND SPEED REPORTED IS THE THREE-HOUR VECTORIAL RESULTANT OF DATA RECORDED UP TO THE SPECIFIED TIME.
6. THE GUST DIRECTION REPORTED IS THE DIRECTION OF THE MAXIMUM GUST RECORDED DURING THE PRECEDING THREE-HOUR PERIOD.
7. THE GUST REPORTED IS THE MAXIMUM RECORDED DURING THE THREE-HOUR PERIOD
8. THE RADIATION REPORTED IS THE SOLAR RADIATION INTENSITY RECORDED AT THE SPECIFIED TIME.

E. WIND FREQUENCY SUMMARY TABLE

1. REPORTED DATA ARE DETERMINED FROM ALL VALID READINGS.

F. WIND ROSE GRAPHICAL PLOT

1. PLOT IS A GRAPHICAL REPRESENTATION OF THE WIND FREQUENCY SUMMARY TABLE.

G. GENERAL NOTES

1. THE FIRST DAY OF EACH MONTH MUST HAVE THE PRECEDING DAY'S LAST READING, AT 2400 HOURS, INSERTED AS THE FIRST READING OF THE FIRST DAY OF THE MONTH, AT 0000 HOURS, PRIOR TO RUNNING THE SUMMARY. THIS PROVIDES AN INITIAL VALUE FOR PRECIPITATION SUMMARY TABLE.
2. FLAGGED DATA IS NOT USED. WHEN AN ENTIRE LINE IS FLAGGED, NO DATA IN THAT LINE IS USED.
3. BAD DATA CAN BE USER-FLAGGED AS BEING BAD DATA BY REPLACING THE BAD DATA WITH THE VALUE '999'.
4. MISSING DATA IS ASSUMED TO BE BAD DATA.
5. IF A DATA LINE IS SHIFTED OVER AT ANY POINT, THE ENTIRE LINE WILL BE TREATED AS BAD DATA.
6. THE FOLLOWING ARE THE VALID DATA RANGES; DATA OUTSIDE THESE RANGES ARE NOT USED:

TIME :	0000 through 2400 - at specified time intervals.
TEMP :	-50 through +35
WIND :	0 through 99.9 and less than or equal to GUST
DIR :	0 through 360
RH :	0 through 99
PRCP :	0 through 99.8 & greater than last PRCP except in the case of an automatic roll-over. The difference between PRCPs cannot exceed 30mm. A '-1' implies a manual re-start.
SOL :	0 through 150
GUST :	0 through 99.9
BATT :	9 through 14.5

7. THE FOLLOWING ARE THE DIRECTION RANGES USED IN THE PREVAILING DIRECTION, WIND FREQUENCY AND WIND ROSE SUMMARIES:

DIRECTION	COMPASS HEADING
NORTH	350 through 11
NORTH-NORTHEAST	12 through 34
NORTHEAST	35 through 56
EAST-NORTHEAST	57 through 79
EAST	80 through 101
EAST-SOUTHEAST	102 through 124
SOUTHEAST	125 through 146
SOUTH-SOUTHEAST	147 through 169
SOUTH	170 through 191
SOUTH-SOUTHWEST	192 through 214
SOUTHWEST	215 through 236
WEST-SOUTHWEST	237 through 259
WEST	260 through 281
WEST-NORTHWEST	282 through 304
NORTHWEST	305 through 326
NORTH-NORTHWEST	327 through 349

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA
VOLUME 6 - DEVIL CANYON STATION

MARCH 1982

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Prepared by:

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5024 Cordova Street
Anchorage, Alaska 99503
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3B-10-38

s14/n12

PROCESSED CLIMATIC DATA

VOLUME 6

DEVIL CANYON STATION

JULY 17, 1980 THRU SEPTEMBER 30, 1981

s14/n1

3B-10-39

The Devil Canyon Climate Station was installed on July 17, 1980, on a ridge on the South bank of the Susitna River ½-mile downstream of the Devil Canyon damsite. It is located on map Talkeetna Mountains (D-5) SE¼ Section 32, R1E, T32N, Seward Meridian. The data were collected using a Meteorology Research Incorporated (MRI) Digital Weather Station. Data thru June 30, 1981 were processed by MRI and all subsequent data by R&M Consultants. An explanation of the parameters measured is located at the back of this report.

3B-10-40

m11/b2

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA

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VOLUME 1	SUSITNA GLACIER STATION
VOLUME 2	DENALI STATION
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VOLUME 4	KOSINA CREEK STATION
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VOLUME 6	DEVIL CANYON STATION

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING JULY , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	1.52	3.05	.15	.07	0.00	0.00	0.00	4.79
NNE	1.74	5.08	.80	0.00	0.00	0.00	0.00	7.62
NE	1.31	4.79	.15	0.00	0.00	0.00	0.00	6.24
ENE	.80	2.54	0.00	0.00	0.00	0.00	0.00	3.34
E	1.60	3.34	0.00	0.00	0.00	0.00	0.00	4.93
ESE	1.81	3.41	0.00	0.00	0.00	0.00	0.00	5.22
SE	3.05	3.05	0.00	0.00	0.00	0.00	0.00	6.10
SSE	4.14	2.47	0.00	0.00	0.00	0.00	0.00	6.60
S	3.63	1.45	0.00	0.00	0.00	0.00	0.00	5.08
SSW	2.03	.80	0.00	0.00	0.00	0.00	0.00	2.83
SW	2.98	1.23	.07	0.00	0.00	0.00	0.00	4.28
WSW	2.76	3.48	.29	0.00	0.00	0.00	0.00	6.53
W	1.52	6.10	0.00	0.00	0.00	0.00	0.00	7.62
WNW	1.74	9.87	.22	0.00	0.00	0.00	0.00	11.83
NW	1.74	9.14	1.02	0.00	0.00	0.00	0.00	11.90
NNW	1.60	2.83	.15	0.00	0.00	0.00	0.00	4.57
CALM								.51
TOTAL	33.96	62.63	2.83	.07	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

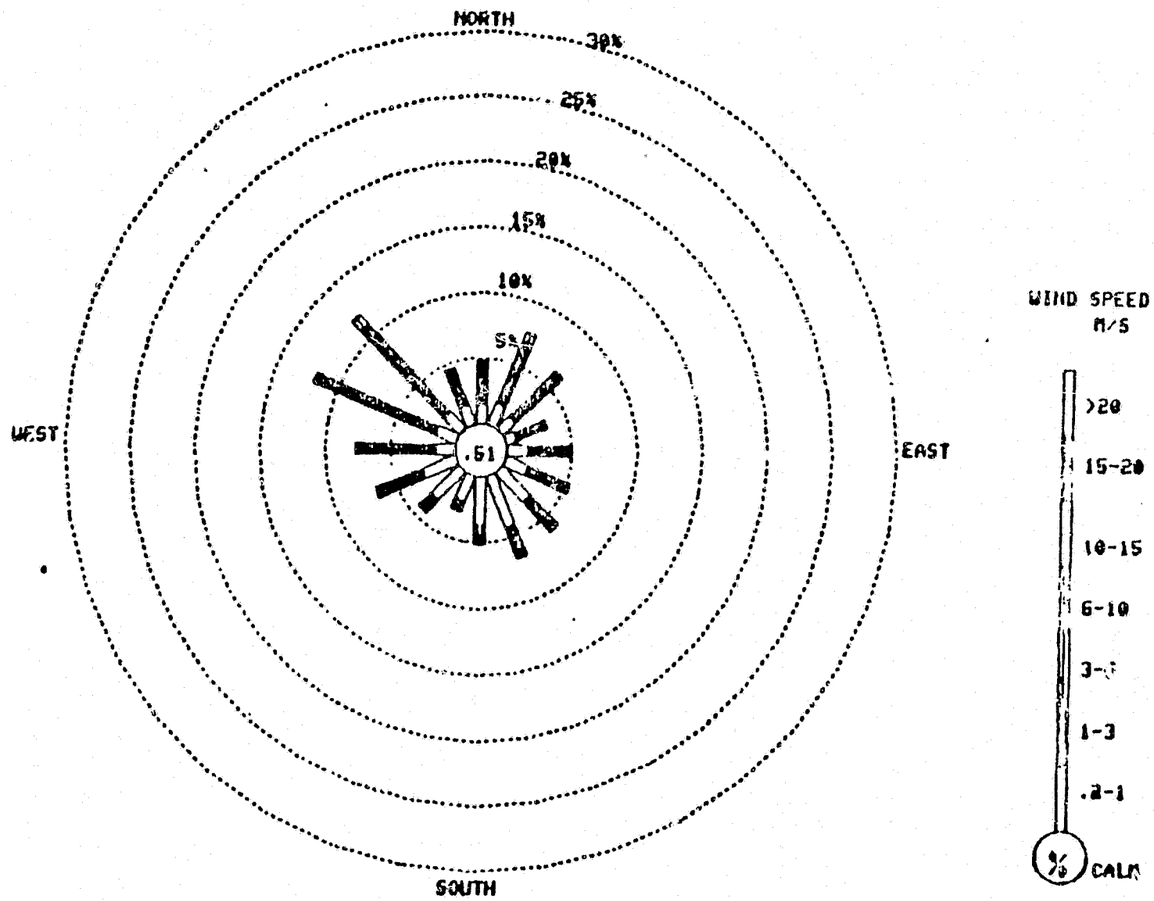
1378 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-42

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

JULY, 1980



WIND ROSE PLOT

3B-10-43

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING AUGUST , 1980

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	1.21	.57	.08	0.00	0.00	0.00	0.00	1.86
NNE	1.45	.57	0.00	0.00	0.00	0.00	0.00	2.02
NE	1.05	2.58	0.00	0.00	0.00	0.00	0.00	3.63
ENE	.73	2.75	0.00	0.00	0.00	0.00	0.00	3.47
E	.81	4.36	.32	0.00	0.00	0.00	0.00	5.49
ESE	2.75	4.68	.65	0.00	0.00	0.00	0.00	8.08
SE	2.26	2.50	0.00	0.00	0.00	0.00	0.00	4.77
SSE	4.28	1.62	0.00	0.00	0.00	0.00	0.00	5.90
S	3.96	1.86	0.00	0.00	0.00	0.00	0.00	5.82
SSW	2.58	.81	0.00	0.00	0.00	0.00	0.00	3.39
SW	3.47	1.29	0.00	0.00	0.00	0.00	0.00	4.77
WSW	2.26	3.23	0.00	0.00	0.00	0.00	0.00	5.49
W	2.75	6.38	0.00	0.00	0.00	0.00	0.00	9.13
WNW	2.26	12.84	.81	0.00	0.00	0.00	0.00	15.91
NW	1.70	11.71	1.78	0.00	0.00	0.00	0.00	15.19
NNW	2.67	1.70	.16	0.00	0.00	0.00	0.00	4.52
CALM								.57
TOTAL	36.19	59.45	3.80	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

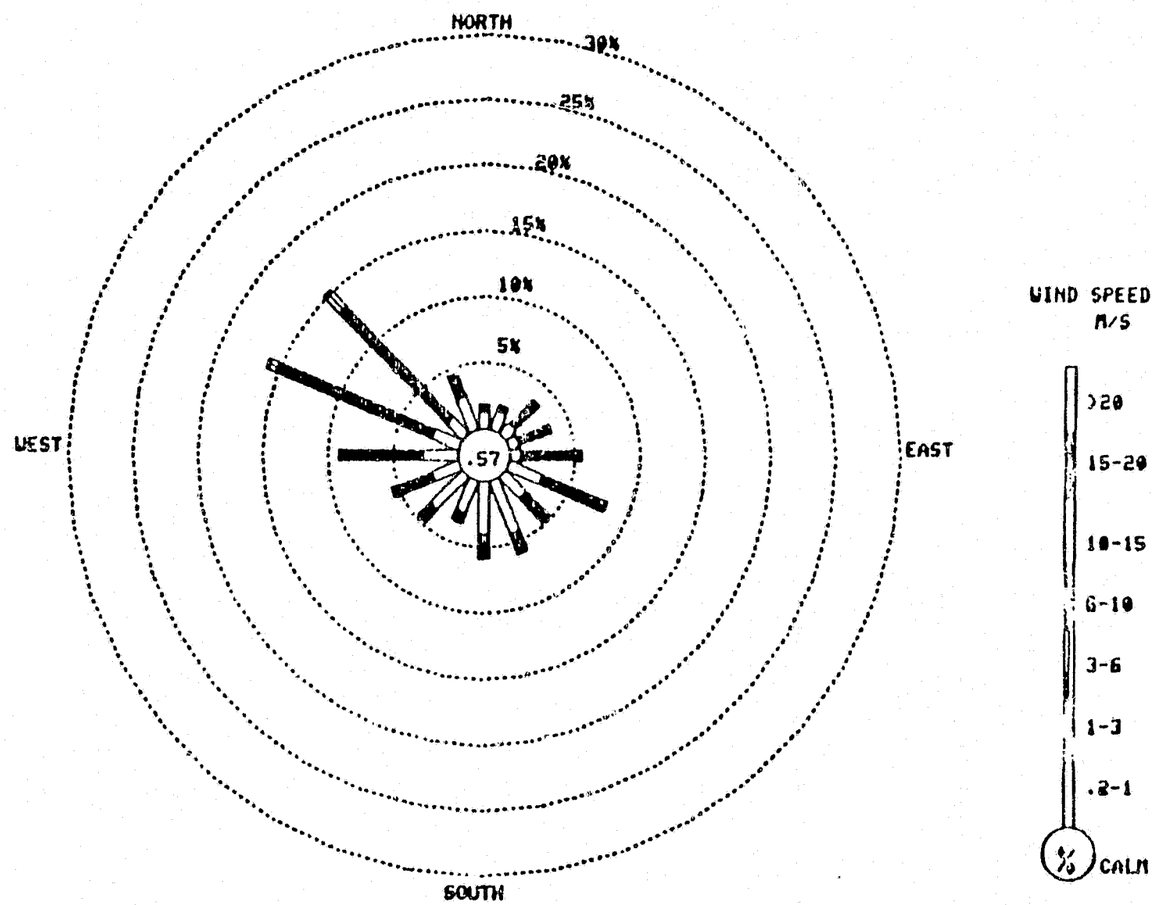
1238 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-44

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

AUGUST, 1980



WIND ROSE PLOT

38-10-45

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING SEPTEMBER , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CALM								0.00
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

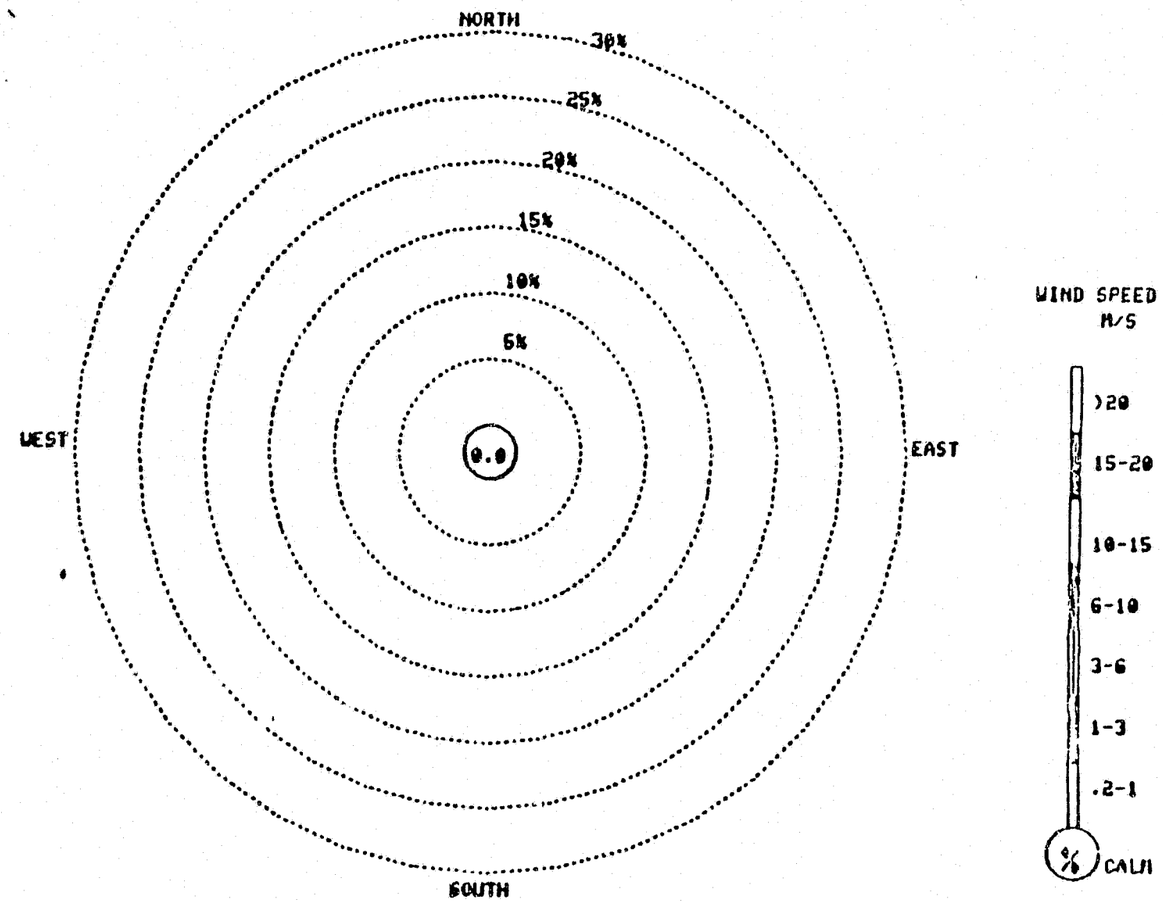
0 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-46

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

SEPTEMBER, 1980



WIND ROSE PLOT

38-10-47

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING OCTOBER , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.75	.07	0.00	0.00	0.00	0.00	0.00	.82
NNE	1.06	.51	0.00	0.00	0.00	0.00	0.00	1.57
NE	1.16	1.50	0.00	0.00	0.00	0.00	0.00	2.66
ENE	1.47	4.29	.03	0.00	0.00	0.00	0.00	5.79
E	1.67	8.76	1.16	.03	0.00	0.00	0.00	11.62
ESE	2.59	12.61	2.42	.03	.03	0.00	0.00	17.68
SE	1.70	10.66	.24	0.00	0.00	0.00	0.00	12.61
SSE	2.93	10.66	0.00	0.00	0.00	0.00	0.00	13.59
S	3.82	7.67	0.00	0.00	0.00	0.00	0.00	11.48
SSW	2.76	1.02	0.00	0.00	0.00	0.00	0.00	3.78
SW	1.74	.51	0.00	0.00	0.00	0.00	0.00	2.25
WSW	1.77	1.29	0.00	0.00	0.00	0.00	0.00	3.07
W	1.84	1.81	0.00	0.00	0.00	0.00	0.00	3.65
WNW	1.36	1.74	0.00	0.00	0.00	0.00	0.00	3.10
NW	.89	1.29	0.00	0.00	0.00	0.00	0.00	2.18
NNW	.55	.07	0.00	0.00	0.00	0.00	0.00	.61
CALM								3.54
TOTAL	28.04	64.46	3.85	.07	.03	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

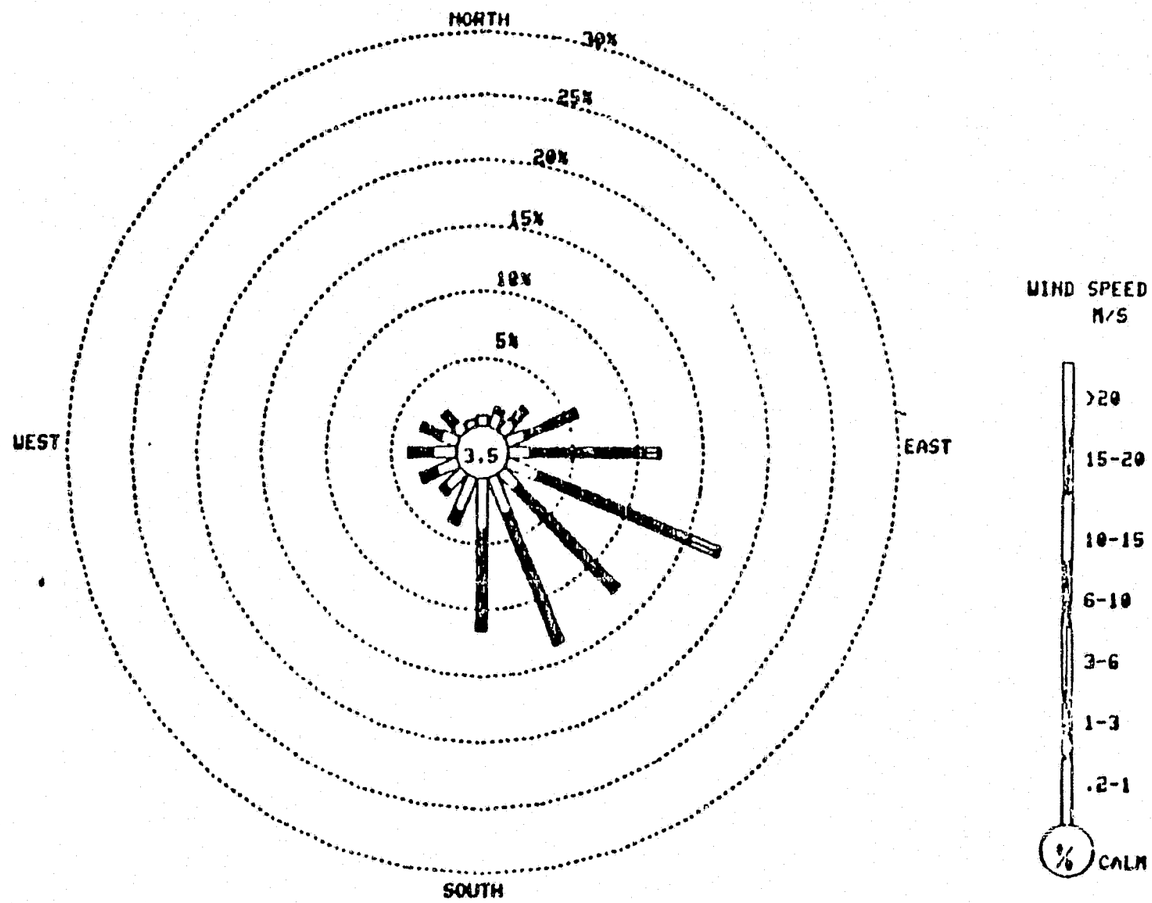
2935 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-48

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

OCTOBER, 1980



WIND ROSE PLOT

38-10-49

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING NOVEMBER , 1980

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.21	.04	0.00	0.00	0.00	0.00	0.00	.25
NNE	.59	.17	0.00	0.00	0.00	0.00	0.00	.76
NE	1.35	1.77	0.00	0.00	0.00	0.00	0.00	3.11
ENE	1.60	7.61	1.26	0.00	0.00	0.00	0.00	10.47
E	1.56	14.50	1.01	0.00	0.00	0.00	0.00	17.07
ESE	3.49	19.84	1.01	0.00	0.00	0.00	0.00	24.34
SE	3.40	18.54	.25	0.00	0.00	0.00	0.00	22.19
SSE	2.56	10.80	0.00	0.00	0.00	0.00	0.00	13.37
S	2.23	3.40	0.00	0.00	0.00	0.00	0.00	5.63
SSW	1.30	.25	0.00	0.00	0.00	0.00	0.00	1.56
SW	.42	0.00	0.00	0.00	0.00	0.00	0.00	.42
WSW	.13	.04	0.00	0.00	0.00	0.00	0.00	.17
W	0.00	.08	0.00	0.00	0.00	0.00	0.00	.08
WNW	.04	0.00	0.00	0.00	0.00	0.00	0.00	.04
NW	.08	0.00	0.00	0.00	0.00	0.00	0.00	.08
NNW	.13	0.00	0.00	0.00	0.00	0.00	0.00	.13
CALM								.34
TOTAL	19.08	77.05	3.53	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

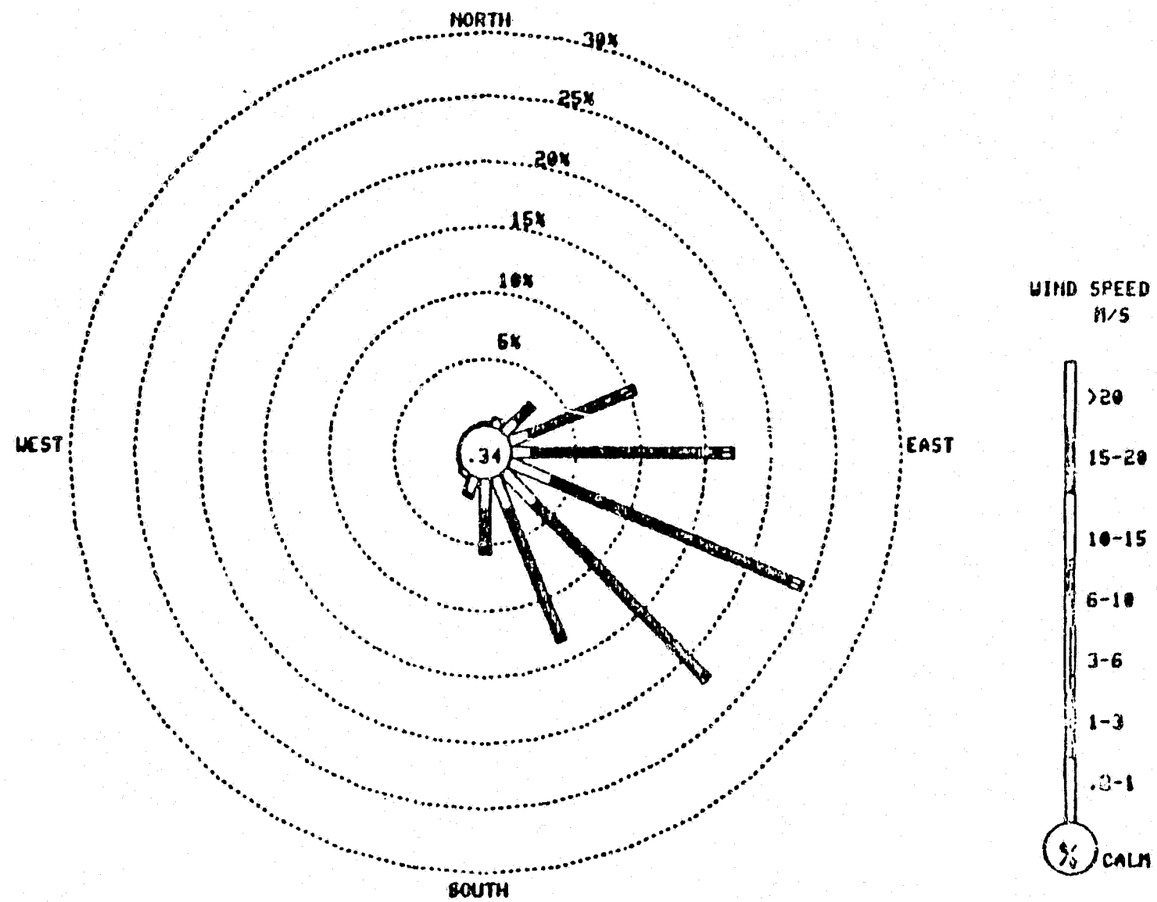
2379 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-50

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

NOVEMBER, 1980



WIND ROSE PLOT

3B-10-51

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING DECEMBER , 1980

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.13	.03	0.00	0.00	0.00	0.00	0.00	.17
NNE	.13	.17	0.00	0.00	0.00	0.00	0.00	.30
NE	.57	4.84	.03	0.00	0.00	0.00	0.00	5.45
ENE	1.58	13.95	2.35	0.00	0.00	0.00	0.00	17.88
E	2.45	16.74	2.08	0.00	0.00	0.00	0.00	21.28
ESE	2.05	18.55	3.29	0.00	0.00	0.00	0.00	23.90
SE	1.65	10.66	2.86	0.00	0.00	0.00	0.00	15.16
SSE	1.88	4.87	.81	0.00	0.00	0.00	0.00	7.56
S	1.34	1.24	.07	0.00	0.00	0.00	0.00	2.66
SSW	1.08	.40	0.00	0.00	0.00	0.00	0.00	1.48
SW	1.28	.17	0.00	0.00	0.00	0.00	0.00	1.45
WSW	.57	.50	0.00	0.00	0.00	0.00	0.00	1.08
W	.30	.37	0.00	0.00	0.00	0.00	0.00	.67
WNW	.27	.13	0.00	0.00	0.00	0.00	0.00	.40
NW	.07	.03	0.00	0.00	0.00	0.00	0.00	.10
NNW	.24	.03	0.00	0.00	0.00	0.00	0.00	.27
CALM								.20
TOTAL	15.60	72.71	11.50	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

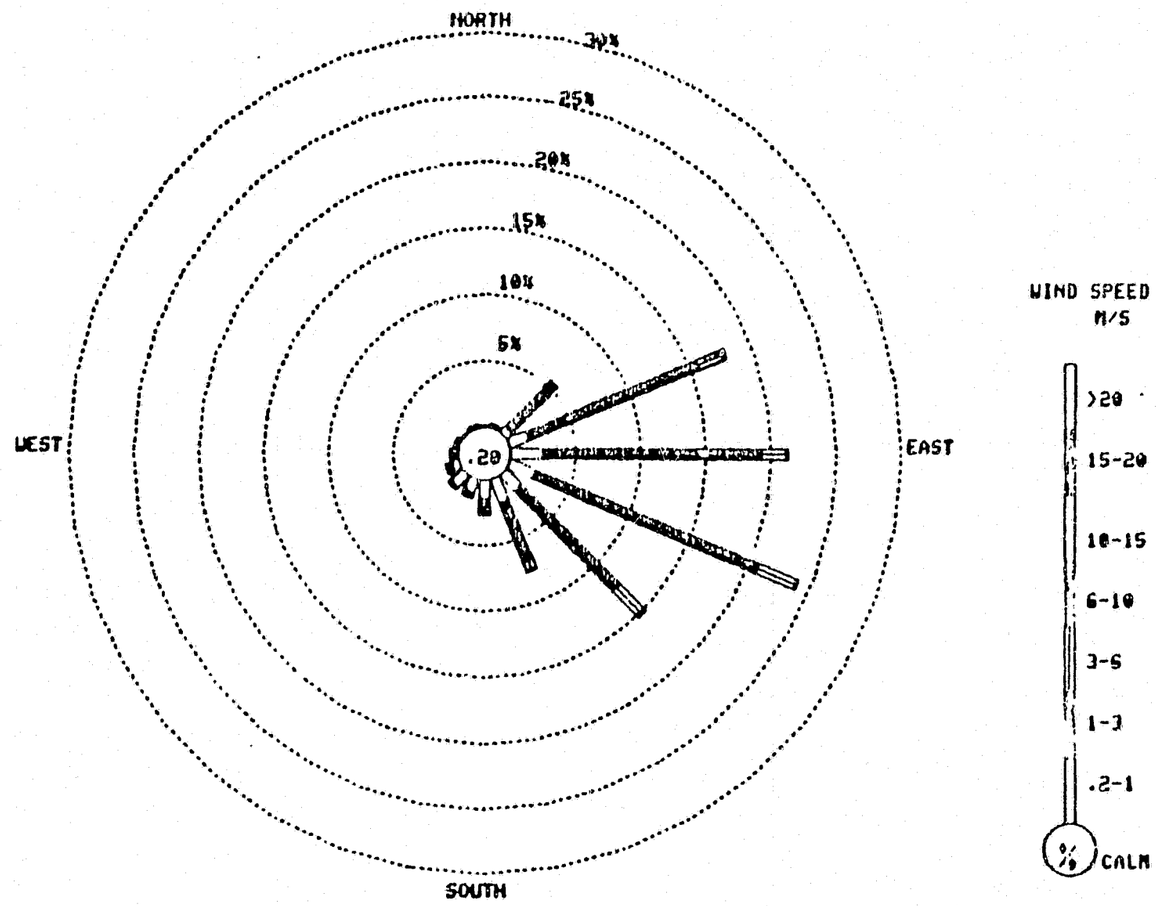
2975 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-52

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

DECEMBER, 1980



WIND ROSE PLOT

38-10-53

R&N CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING JANUARY , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.10	0.00	0.00	0.00	0.00	0.00	0.00	.10
NNE	.30	.10	0.00	0.00	0.00	0.00	0.00	.40
NE	1.01	.91	0.00	0.00	0.00	0.00	0.00	1.92
ENE	1.38	5.81	.17	0.00	0.00	0.00	0.00	7.36
E	1.78	11.16	1.11	0.00	0.00	0.00	0.00	14.05
ESE	2.62	18.15	2.92	0.00	0.00	0.00	0.00	23.69
SE	3.19	18.62	.44	0.00	0.00	0.00	0.00	22.24
SSE	3.16	10.52	0.00	0.00	0.00	0.00	0.00	13.68
S	2.79	5.48	0.00	0.00	0.00	0.00	0.00	8.27
SSW	2.32	1.08	0.00	0.00	0.00	0.00	0.00	3.39
SW	1.28	.30	0.00	0.00	0.00	0.00	0.00	1.58
WSW	.77	.30	0.00	0.00	0.00	0.00	0.00	1.08
W	.30	.60	0.00	0.00	0.00	0.00	0.00	.91
WNW	.17	.54	0.00	0.00	0.00	0.00	0.00	.71
NW	.10	.20	0.00	0.00	0.00	0.00	0.00	.30
NNW	.10	0.00	0.00	0.00	0.00	0.00	0.00	.10
CALM								.24
TOTAL	21.37	73.76	4.64	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

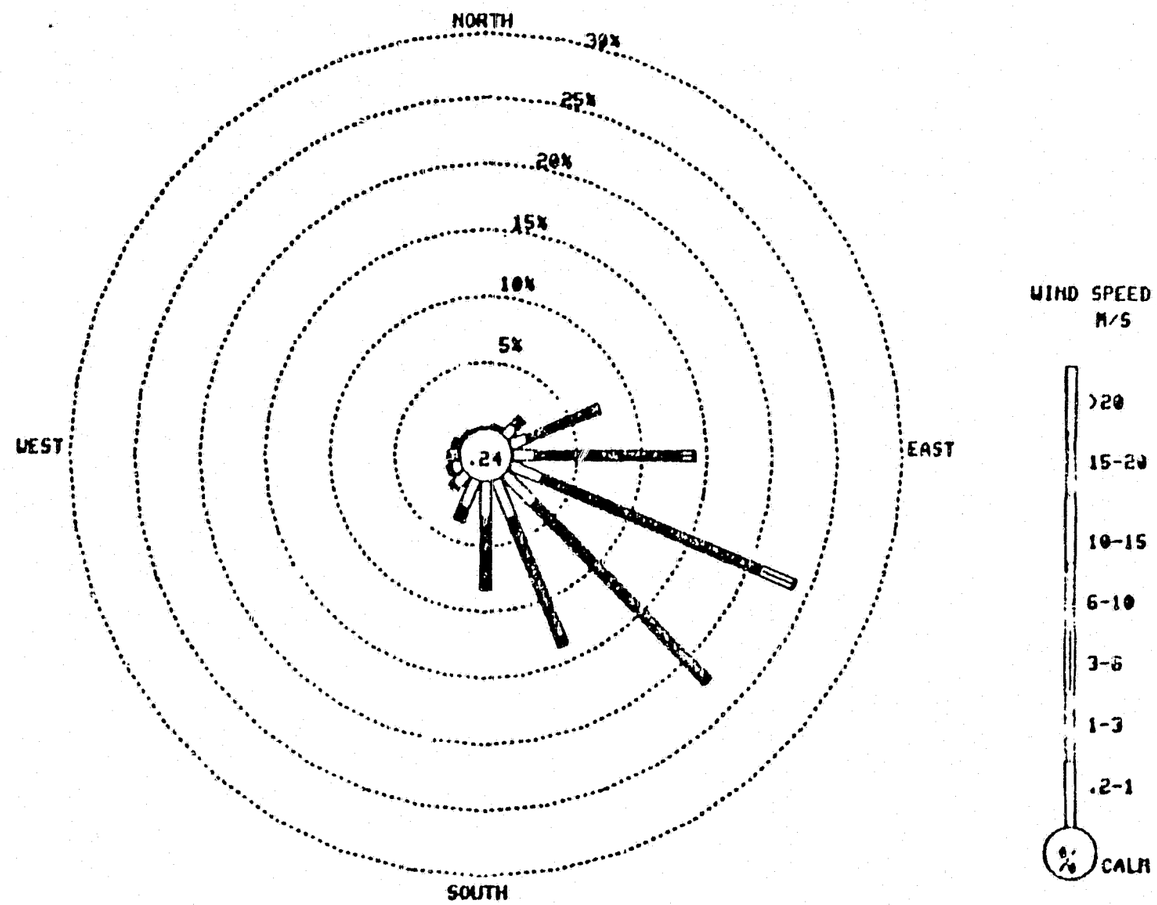
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-54

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

JANUARY, 1981



WIND ROSE PLOT

38-10-55

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING FEBRUARY , 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.31	.15	0.00	0.00	0.00	0.00	0.00	.46
NNE	1.08	.77	0.00	0.00	0.00	0.00	0.00	1.85
NE	2.77	3.39	0.00	0.00	0.00	0.00	0.00	6.16
ENE	5.24	12.17	0.00	0.00	0.00	0.00	0.00	17.41
E	5.39	13.71	1.08	0.00	0.00	0.00	0.00	20.18
ESE	2.77	13.56	2.16	0.00	0.00	0.00	0.00	20.49
SE	3.08	8.47	0.00	0.00	0.00	0.00	0.00	11.56
SSE	2.93	3.85	0.00	0.00	0.00	0.00	0.00	6.78
S	1.54	2.16	0.00	0.00	0.00	0.00	0.00	3.70
SSW	1.69	.31	0.00	0.00	0.00	0.00	0.00	2.00
SW	1.23	.31	0.00	0.00	0.00	0.00	0.00	1.54
WSW	.46	.46	0.00	0.00	0.00	0.00	0.00	.92
W	1.08	1.23	0.00	0.00	0.00	0.00	0.00	2.31
WNW	.46	.46	.15	0.00	0.00	0.00	0.00	1.08
NW	.15	.77	.15	0.00	0.00	0.00	0.00	1.08
NNW	.15	0.00	0.00	0.00	0.00	0.00	0.00	.15
CALM								2.31
TOTAL	30.35	63.79	3.54	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

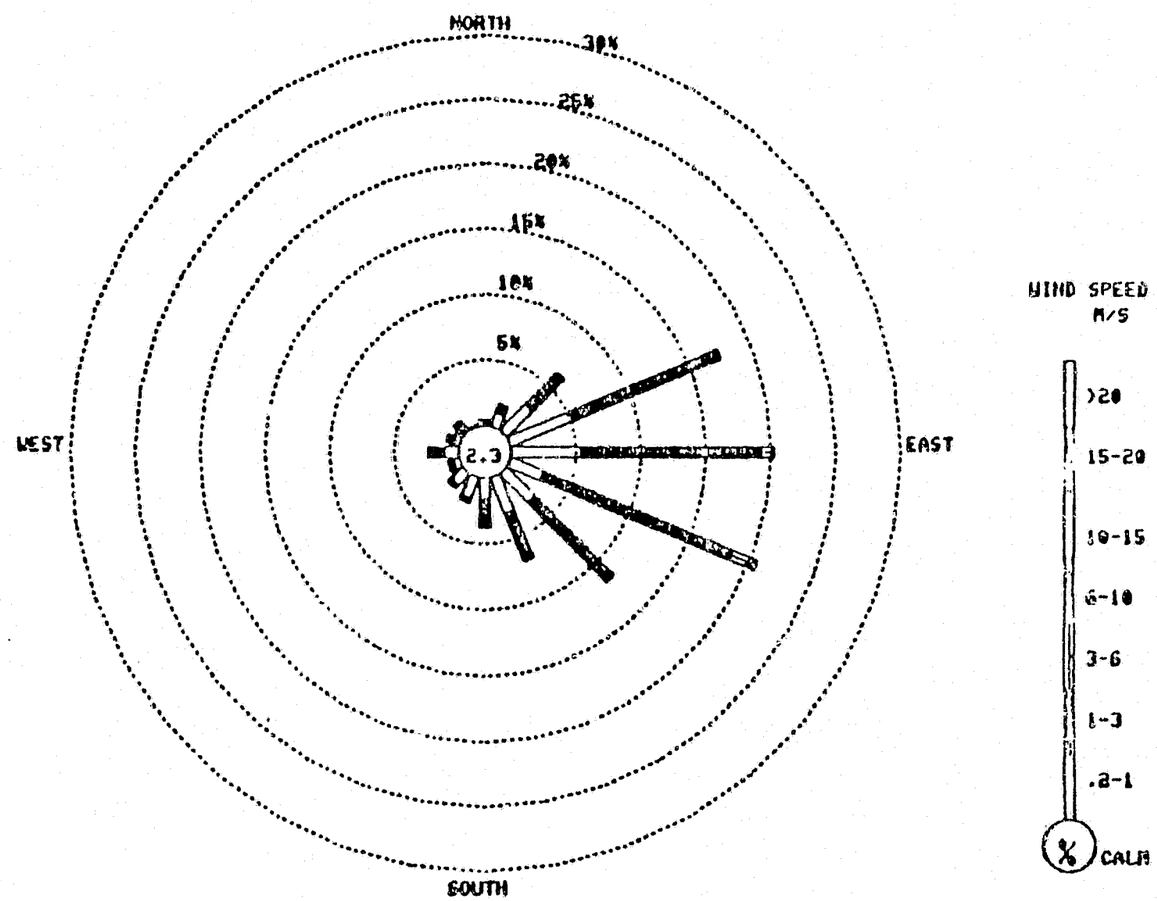
649 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-5c

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

FEBRUARY, 1981



WIND ROSE PLOT

38-10-57

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING MARCH , 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.07	.24	0.00	0.00	0.00	0.00	0.00	.31
NNE	.41	.82	0.00	0.00	0.00	0.00	0.00	1.23
NE	.75	3.69	.10	0.00	0.00	0.00	0.00	4.54
ENE	1.09	9.49	.56	0.00	0.00	0.00	0.00	11.16
E	1.23	13.65	1.13	0.00	0.00	0.00	0.00	16.01
ESE	1.26	15.90	2.76	0.00	0.00	0.00	0.00	19.93
SE	1.64	15.73	.14	0.00	0.00	0.00	0.00	17.51
SSE	2.15	8.60	.03	0.00	0.00	0.00	0.00	10.78
S	2.42	5.49	0.00	0.00	0.00	0.00	0.00	7.92
SSW	1.37	1.13	0.00	0.00	0.00	0.00	0.00	2.49
SW	.51	.38	0.00	0.00	0.00	0.00	0.00	.89
WSW	.61	.38	0.00	0.00	0.00	0.00	0.00	.99
W	.75	.82	0.00	0.00	0.00	0.00	0.00	1.57
WNW	.48	1.50	0.00	0.00	0.00	0.00	0.00	1.98
NW	.24	1.54	0.00	0.00	0.00	0.00	0.00	1.77
NNW	.38	.14	0.00	0.00	0.00	0.00	0.00	.51
CALM								.41
TOTAL	15.36	79.49	4.74	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

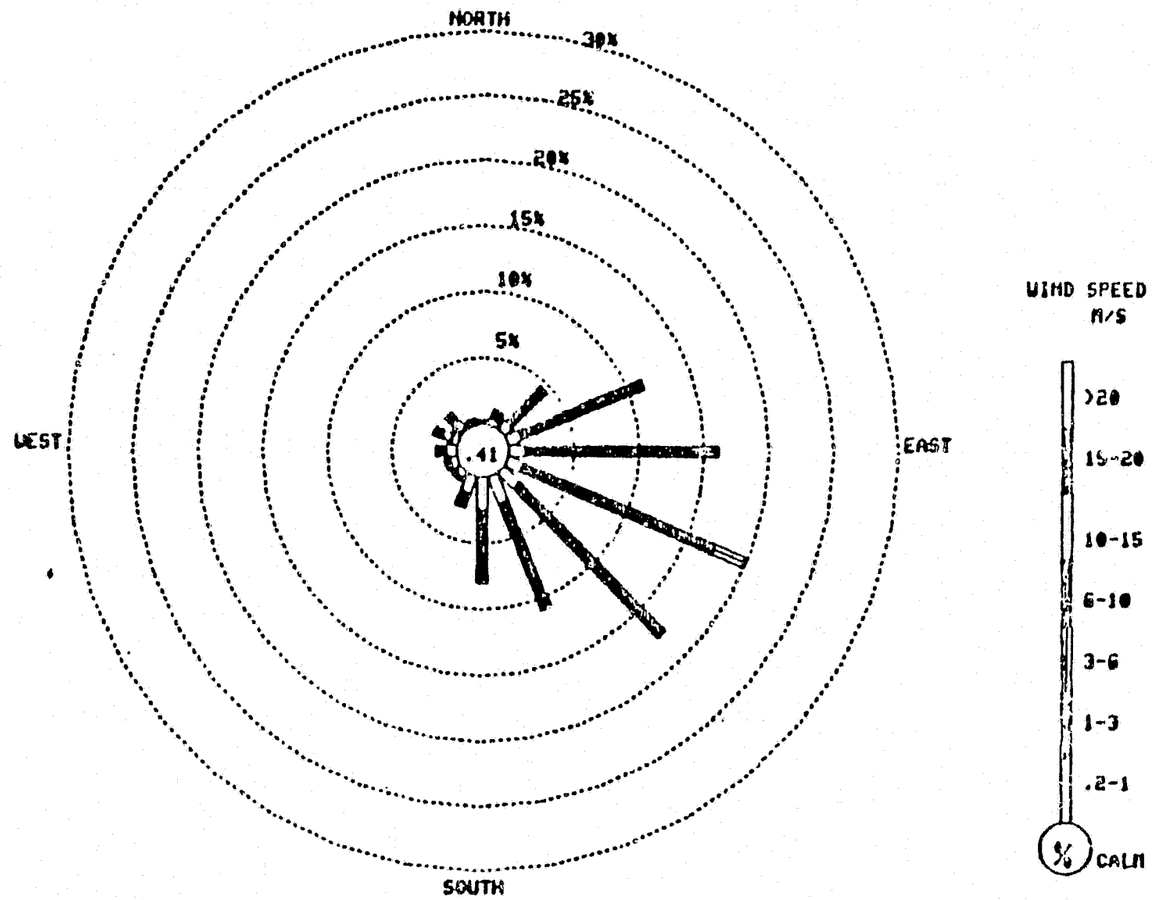
2930 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

38-10-58

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

MARCH, 1981



WIND ROSE PLOT

3B-10-59

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING APRIL , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	.31	.38	.03	0.00	0.00	0.00	0.00	.73
NNE	.70	2.96	.77	.07	0.00	0.00	0	4.50
NE	.84	8.57	1.01	0.00	0.00	0.00	0.	10.42
ENE	1.32	10.07	2.37	0.00	0.00	0.00	0.00	13.77
E	1.71	10.35	1.78	0.00	0.00	0.00	0.00	13.84
ESE	2.02	11.36	2.79	0.00	0.00	0.00	0.00	16.17
SE	1.64	7.70	.24	0.00	0.00	0.00	0.00	9.59
SSE	2.34	5.75	0.00	0.00	0.00	0.00	0.00	8.09
S	1.64	4.71	0.00	0.00	0.00	0.00	0.00	6.34
SSW	.91	2.72	0.00	0.00	0.00	0.00	0.00	3.62
SW	.52	3.28	0.00	0.00	0.00	0.00	0.00	3.80
WSW	.28	2.09	0.00	0.00	0.00	0.00	0.00	2.37
W	.28	1.60	0.00	0.00	0.00	0.00	0.00	1.88
WNW	.24	1.64	.03	0.00	0.00	0.00	0.00	1.92
NW	.14	1.22	0.00	0.00	0.00	0.00	0.00	1.36
NNW	.21	.91	0.00	0.00	0.00	0.00	0.00	1.12
CALM								.49
TOTAL	15.09	75.32	9.03	.07	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

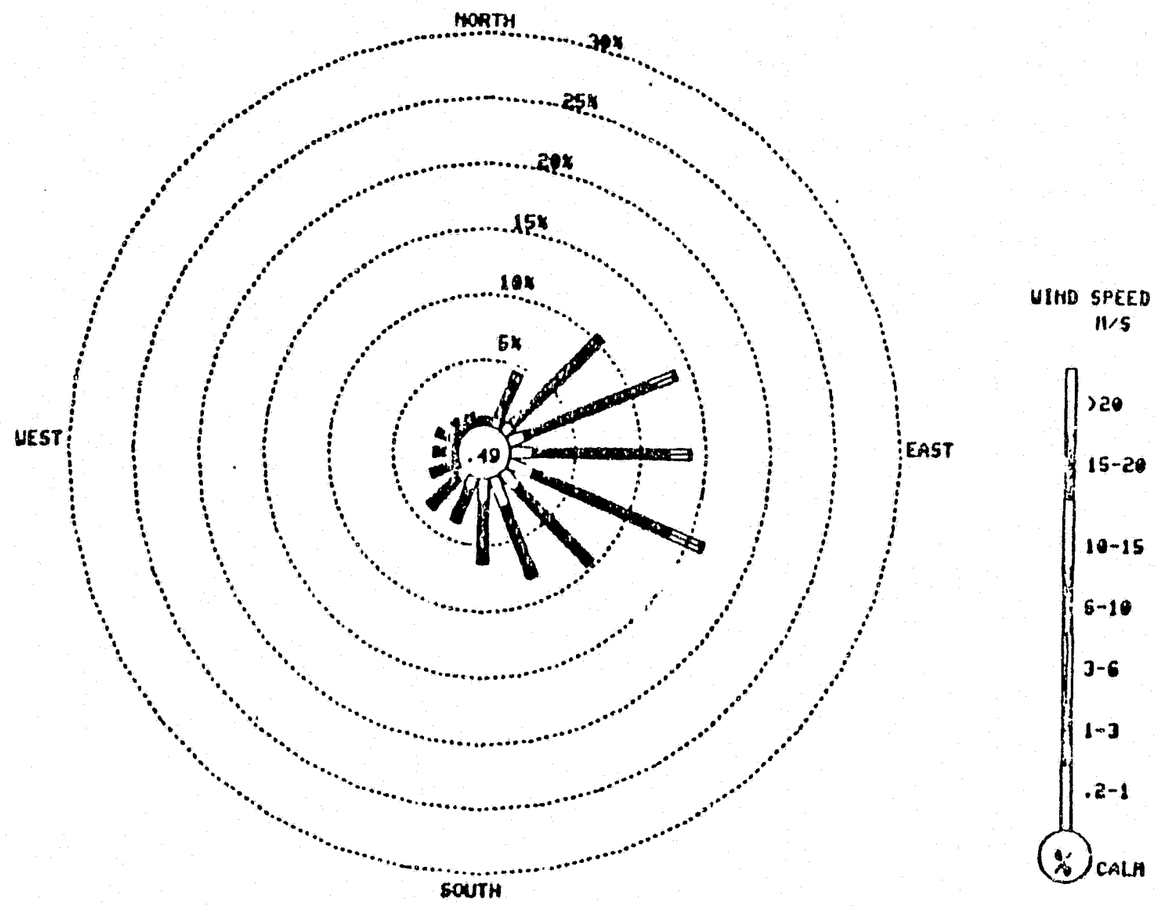
2869 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

38-10-60

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

APRIL, 1981



WIND ROSE PLOT

3B-10-61

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING MAY , 1981

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	1.08	1.75	.07	0.00	0.00	0.00	0.00	2.90
NNE	1.65	4.25	.57	0.00	0.00	0.00	0.00	6.48
NE	.88	4.42	.24	0.00	.03	0.00	0.00	5.56
ENE	.91	3.91	.47	0.00	0.00	0.00	0.00	5.30
E	1.32	4.55	.47	0.00	0.00	0.00	0.00	6.34
ESE	1.89	4.45	.34	0.00	0.00	0.00	0.00	6.68
SE	1.85	3.95	0.00	0.00	0.00	0.00	0.00	5.80
SSE	4.69	3.44	0.00	0.00	.03	0.00	0.00	8.16
S	4.42	2.77	0.00	0.00	0.00	0.00	0.00	7.18
SSW	2.39	1.48	0.00	0.00	0.00	0.00	0.00	3.88
SW	1.96	2.23	0.00	0.00	0.00	0.00	0.00	4.18
WSW	1.35	3.91	0.00	0.00	0.00	0.00	0.00	5.26
W	1.55	5.56	.24	0.00	0.00	.00	0.00	7.35
WNW	1.48	7.89	.51	0.00	0.00	0.00	0.00	9.88
NW	1.52	6.88	1.15	0.00	0.00	0.00	0.00	9.54
NNW	1.48	3.47	.24	0.00	0.00	0.00	0.00	5.19
CALM								.30
TOTAL	30.42	64.92	4.28	0.00	.07	0.00	0.00	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

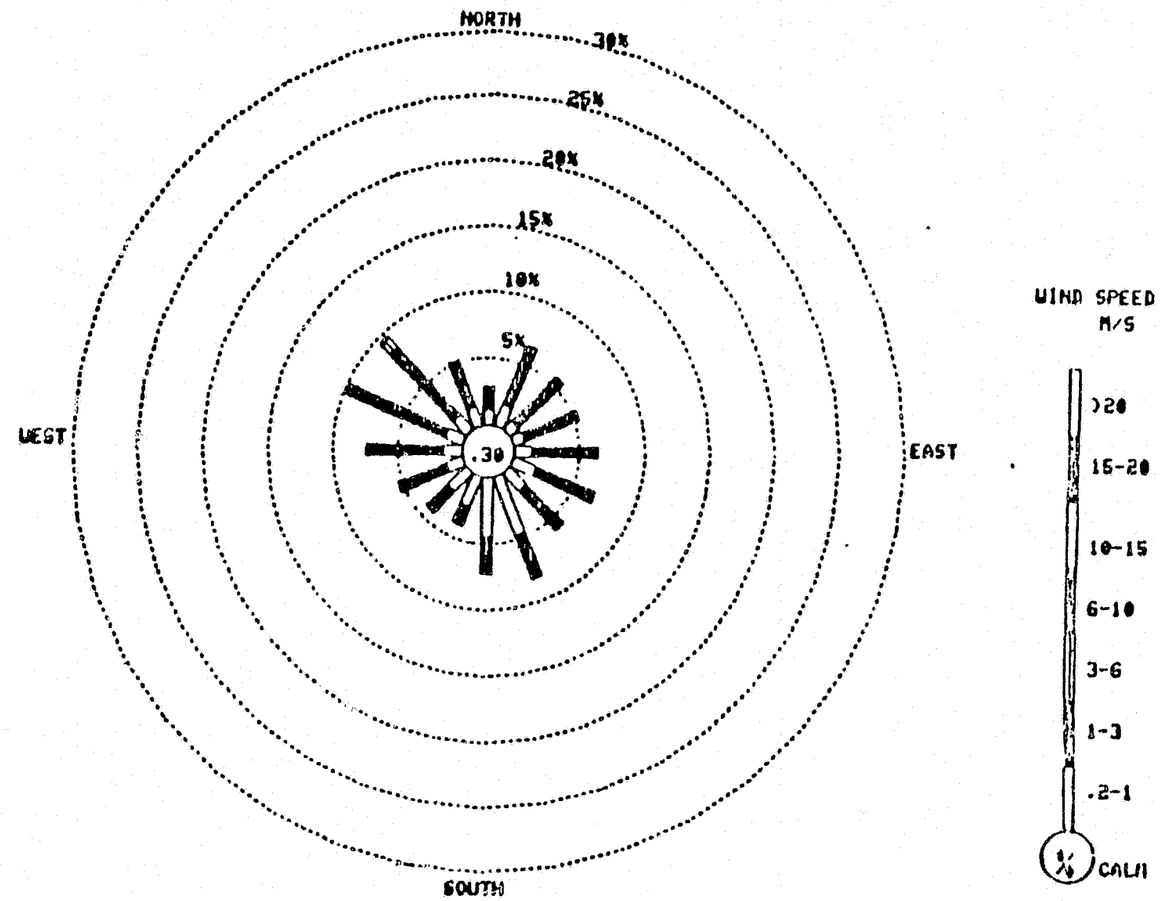
2965 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-62

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

MAY, 1981



WIND ROSE PLOT

38-1-23

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING JUNE , 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	GREATER THAN 20.0	TOTAL
N	1.36	2.37	.17	0.00	0.00	0.00	0.00	3.90
NNE	1.43	3.59	.31	0.00	0.00	0.00	0.00	5.33
NE	.77	2.68	.07	0.00	0.00	0.00	0.00	3.52
ENE	.63	1.78	0.00	0.00	0.00	0.00	0.00	2.40
E	.77	2.37	.03	0.00	0.00	0.00	0.00	3.17
ESE	1.36	2.75	.03	0.00	0.00	0.00	0.00	4.14
SE	1.85	2.72	0.00	0.00	0.00	0.00	0.00	4.56
SSE	2.75	2.06	0.00	0.00	0.00	0.00	0.00	4.81
S	3.34	2.58	0.00	0.00	0.00	0.00	0.00	5.92
SSW	3.27	1.22	0.00	0.00	0.00	0.00	0.00	4.49
SW	2.72	2.30	0.00	0.00	0.00	0.00	0.00	5.02
WSW	2.16	4.46	.03	0.00	0.00	0.00	0.00	6.65
W	1.95	8.22	.24	0.00	.07	0.00	0.00	10.48
WNW	1.43	11.39	.73	0.00	.03	0.00	0.00	13.58
NW	1.60	10.52	3.66	0.00	0.00	0.00	.03	15.81
NNW	1.22	4.14	.45	0.00	0.00	0.00	.03	5.85
CALM								.35
TOTAL	28.60	65.13	5.75	0.00	.10	0.00	.07	100.00

NOTE: ALL FREQUENCIES EXPRESSED IN PERCENT.

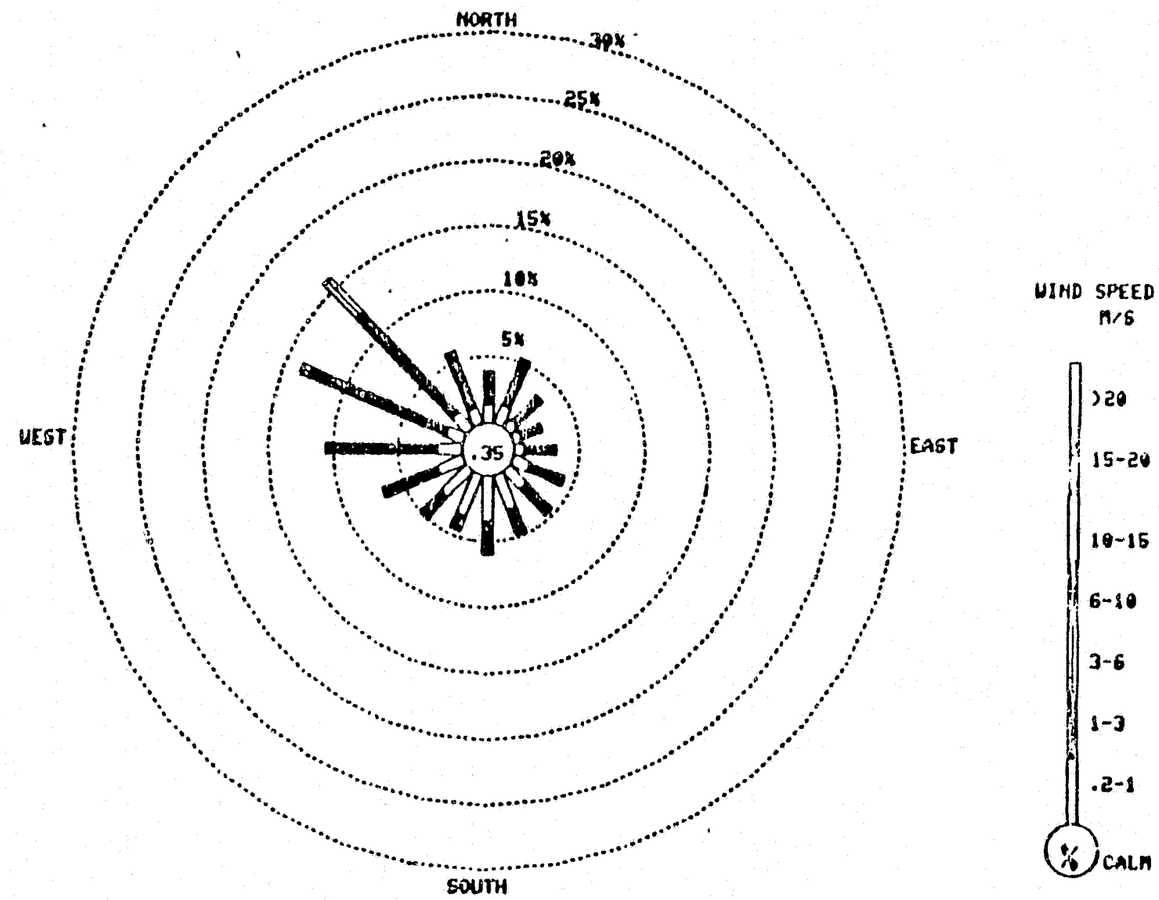
2871 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

3B-10-64

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

JUNE, 1981



WIND ROSE PLOT

3B-10-65

****

R & M CONSULTANTS, INC.

CLIMATE DATA SUMMARIES
DOCUMENTATION

****

A. GRAPHICAL DATA PLOT

1. GRAPHICAL REPRESENTATION OF VALID RECORDED AND/OR COMPUTED DATA.

B. HOURLY PRECIPITATION SUMMARY TABLE

1. HOURLY PRECIPITATION VALUES ARE CALCULATED AS THE DIFFERENCE BETWEEN VALID CONSEQUTIVE HOURLY READINGS. WHEN EITHER OF THE HOURLY PRECIPITATION READINGS IS INVALID, NO VALUE IS REPORTED AND ZERO PRECIPITATION IS ASSUMED.
2. A NON-AUTOMATIC ROLL-OVER TO ZERO, AS WHEN THE TAPE IS CHANGED, MUST BE FLAGGED WITH A NEGATIVE ONE (-1) AS THE PRECIPITATION VALUE.

C. MONTHLY SUMMARY TABLE

1. MAXIMUM DAILY AND MONTHLY TEMPERATURES ARE DETERMINED FROM ALL VALID RECORDED TEMPERATURES.
2. MINIMUM DAILY AND MONTHLY TEMPERATURES ARE DETERMINED FROM ALL VALID RECORDED TEMPERATURES.
3. MEAN DAILY AND MONTHLY TEMPERATURES ARE DETERMINED FROM ALL VALID RECORDED TEMPERATURES. THE MEAN DAILY TEMPERATURE IS DETERMINED FROM THE MEAN OF THE MAXIMUM AND MINIMUM TEMPERATURES. THE MEAN MONTHLY TEMPERATURE IS DETERMINED FROM THE MEAN OF ALL REPORTED DAILY MEAN TEMPERATURES.
4. RESULTANT DAILY AND MONTHLY WIND DIRECTIONS AND SPEEDS ARE SUMMED VECTORIALLY FROM ALL VALID READINGS.
5. AVERAGE DAILY AND MONTHLY WIND SPEEDS ARE ARITHMETICALLY MEANED FROM ALL VALID READINGS.
6. MAXIMUM DAILY AND MONTHLY GUST SPEEDS ARE DETERMINED FROM ALL VALID READINGS. ASSOCIATED DIRECTIONS ARE THE RESULTANT DIRECTIONS FROM THE RECORDING INTERVAL IN WHICH THE PEAK INTERVAL GUST WAS OBSERVED.
7. PREVAILING DAILY AND MONTHLY DIRECTIONS ARE DETERMINED FROM ALL VALID READINGS. THE REPORTED VALUE IS THE MOST FREQUENT DIRECTION OBSERVED.
8. MEAN DAILY AND MONTHLY RELATIVE HUMIDITIES ARE DETERMINED FROM ALL VALID READINGS. (ARITHMETIC MEAN)
9. MEAN DAILY AND MONTHLY DEWPOINT TEMPERATURES ARE DETERMINED FROM ALL VALID READINGS. (ARITHMETIC MEAN) WHEN THE WIND SPEED IS LESS THAN 1 m/s, WHEN THE DEWPOINT CALCULATES TO A VALUE GREATER THAN THE RECORDED TEMPERATURE, WHEN OR THE DEWPOINT CALCULATES TO LESS THAN MINUS 47 DEGREES OR MORE THAN 27 DEGREES, THE DEWPOINT IS NOT USED.
10. DAILY AND MONTHLY PRECIPITATION VALUES ARE DETERMINED FROM ALL VALID READINGS.
11. DAILY AND MONTHLY SOLAR ENERGY VALUES ARE DETERMINED FROM ALL VALID

READINGS. DAILY SOLAR ENERGY IS DETERMINED BY AVERAGING THE RECORDED SOLAR INTENSITY AND CONVERTING THE UNITS. THE MONTHLY VALUE IS THE SUM OF THE DAILY VALUES.

D. THREE HOUR SUMMARY TABLES

1. THE TEMPERATURE REPORTED IS THE TEMPERATURE RECORDED AT THE SPECIFIED TIME.
2. THE DEWPOINT TEMPERATURE REPORTED IS THE DEWPOINT CALCULATED AT THE SPECIFIED TIME. DEWPOINTS ARE OMITTED WHEN THE WIND SPEED IS LESS THAN 1m/s, WHEN THE DEWPOINT IS CALCULATED TO A VALUE GREATER THAN THE RECORDED TEMPERATURE, OR WHEN THE DEWPOINT CALCULATES TO LESS THAN MINUS 47 DEGRESS OR MORE THAN 27 DEGREES.
3. THE RELATIVE HUMIDITY REPORTED IS THE HUMIDITY RECORDED AT THE SPECIFIED TIME.
4. THE WIND DIRECTION REPORTED IS THE THREE-HOUR VECTORIAL RESULTANT SUM OF DATA RECORDED UP TO THE SPECIFIED TIME.
5. THE WIND SPEED REPORTED IS THE THREE-HOUR VECTORIAL RESULTANT OF DATA RECORDED UP TO THE SPECIFIED TIME.
6. THE GUST DIRECTION REPORTED IS THE DIRECTION OF THE MAXIMUM GUST RECORDED DURING THE PRECEDING THREE-HOUR PERIOD.
7. THE GUST REPORTED IS THE MAXIMUM RECORDED DURING THE THREE-HOUR PERIOD.
8. THE RADIATION REPORTED IS THE SOLAR RADIATION INTENSITY RECORDED AT THE SPECIFIED TIME.

E. WIND FREQUENCY SUMMARY TABLE

1. REPORTED DATA ARE DETERMINED FROM ALL VALID READINGS.

F. WIND ROSE GRAPHICAL PLOT

1. PLOT IS A GRAPHICAL REPRESENTATION OF THE WIND FREQUENCY SUMMARY TABLE.

G. GENERAL NOTES

1. THE FIRST DAY OF EACH MONTH MUST HAVE THE PRECEDING DAY'S LAST READING, AT 2400 HOURS, INSERTED AS THE FIRST READING OF THE FIRST DAY OF THE MONTH, AT 0000 HOURS, PRIOR TO RUNNING THE SUMMARY. THIS PROVIDES AN INITIAL VALUE FOR PRECIPITATION SUMMARY TABLE.
2. FLAGGED DATA IS NOT USED. WHEN AN ENTIRE LINE IS FLAGGED, NO DATA IN THAT LINE IS USED.
3. BAD DATA CAN BE USER-FLAGGED AS BEING BAD DATA BY REPLACING THE BAD DATA WITH THE VALUE '999'.
4. MISSING DATA IS ASSUMED TO BE BAD DATA.
5. IF A DATA LINE IS SHIFTED OVER AT ANY POINT, THE ENTIRE LINE WILL BE TREATED AS BAD DATA.
6. THE FOLLOWING ARE THE VALID DATA RANGES; DATA OUTSIDE THESE RANGES ARE NOT USED:

TIME :	0000 through 2400 - at specified time intervals.
TEMP :	-50 through +35
WIND :	0 through 99.9 and less than or equal to GUST
DIR :	0 through 360
RH :	0 through 99
PRCP :	0 through 99.8 & greater than last PRCP except in the case of an automatic roll-over. The difference between PRCPs cannot exceed 30mm. A '-1' implies a manual re-start.
SOL :	0 through 150
GUST :	0 through 99.9
BATT :	9 through 14.5

7. THE FOLLOWING ARE THE DIRECTION RANGES USED IN THE PREVAILING DIRECTION, WIND FREQUENCY AND WIND ROSE SUMMARIES:

DIRECTION	COMPASS HEADING
NORTH	350 through 11
NORTH-NORTHEAST	12 through 34
NORTHEAST	35 through 56
EAST-NORTHEAST	57 through 79
EAST	80 through 101
EAST-SOUTHEAST	102 through 124
SOUTHEAST	125 through 146
SOUTH-SOUTHEAST	147 through 169
SOUTH	170 through 191
SOUTH-SOUTHWEST	19[illegible] through 214
SOUTHWEST	21[illegible] through 236
WEST-SOUTHWEST	237 through 259
WEST	260 through 281
WEST-NORTHWEST	282 through 304
NORTHWEST	305 through 326
NORTH-NORTHWEST	327 through 349

3B-10-68

SUSITNA HYDROELECTRIC PROJECT

PROCESSED CLIMATIC DATA

OCTOBER 1981 THRU SEPTEMBER 1982

VOLUME 5

0650 - WATANA STATION

DECEMBER 1982

PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

ALASKA POWER AUTHORITY

3B-10-69

s8/t1

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA

VOLUME 5
0650 - WATANA STATION
OCTOBER 1981 - SEPTEMBER 1982

DECEMBER 1982

Prepared for:

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3B-10-70

s8/p2

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA

OCTOBER 1981 - SEPTEMBER 1982

VOLUME INDEX

VOLUME 1: 0610 - SUSITNA GLACIER STATION
VOLUME 2: 0620 - DENALI STATION
VOLUME 3: 0630 - TYONE RIVER STATION
VOLUME 4: 0640 - KOSINA CREEK STATION
VOLUME 5: 0650 - WATANA STATION
VOLUME 6: 0660 - DEVIL CANYON STATION
VOLUME 7: 0665 - SHERMAN STATION
VOLUME 8: 0700 - EKLUTNA LAKE STATION

3B-10-71

s8/t2

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

WATANA CLIMATIC DATA

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CLIMATE DATA SUMMARIES October 1981 - September 1982	10

3B-10-72

Acknowledgments

These climatic data were collected under contract to Acres American, Incorporated for the Alaska Power Authority's Susitna Hydroelectric Feasibility Study. The data recorders were Model 5100 Weather Wizards manufactured by Meteorology Research, Incorporated (MRI). All sensors were supplied by MRI. Field maintenance and data collection were performed by the hydrology staff of R&M Consultants, Incorporated. Data reduction and processing were performed by Lisa Fotherby, using computer programs developed by Mark Holmstrand. The computer hardware used was a Hewlett-Packard 9845 B system.

3B-10-73

s8/t

HISTORY OF WATANA STATION (0650)

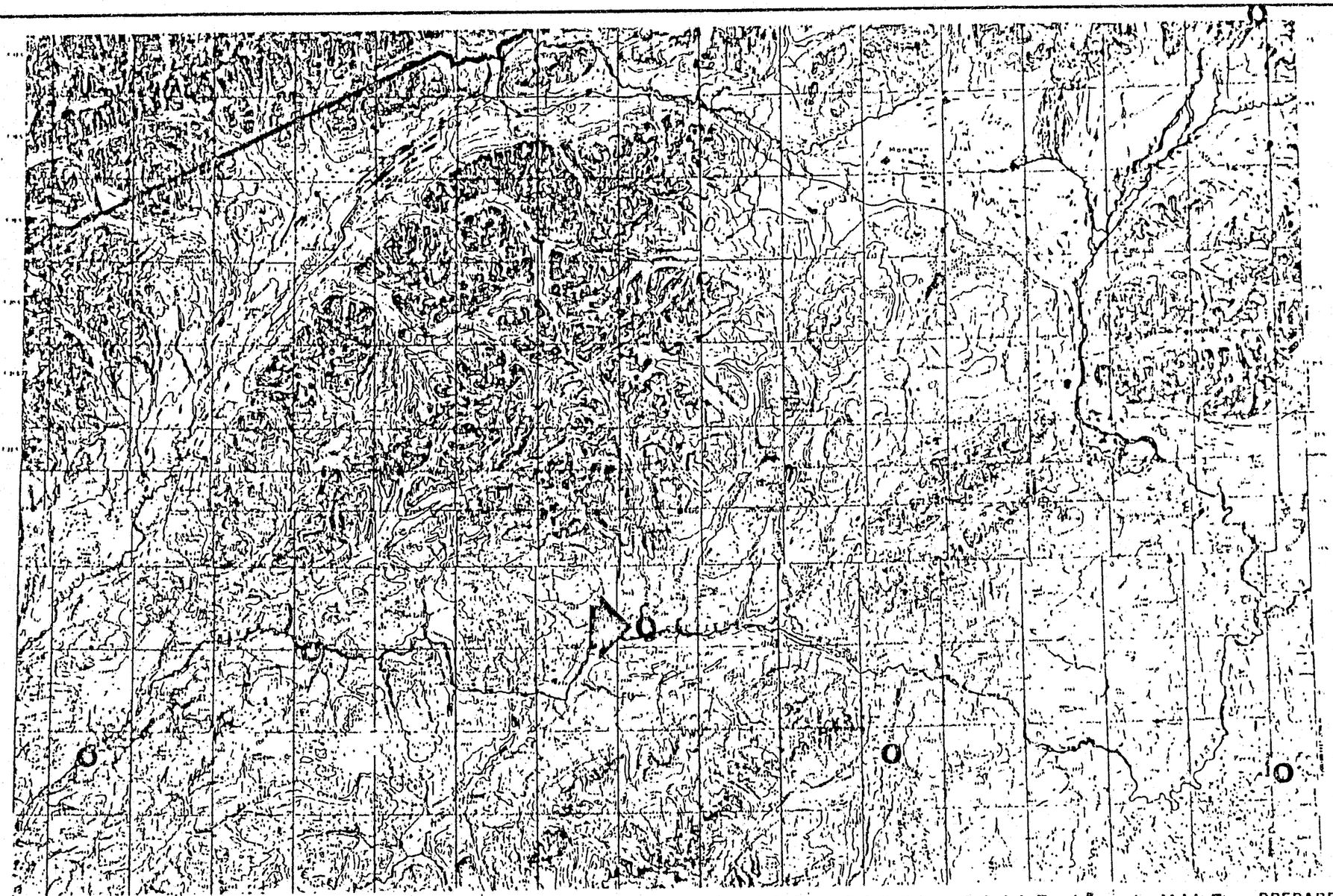
The Watana climate station is located about 100 yards from the Watana base camp and lies in an open, gradually sloping area. The elevation is approximately 2,200 feet above mean sea level. The Susitna River Mile at Watana Station is 184. Due to its proximity to camp, it was chosen as the initial experimental site for the Weather Wizards. The station began recording on April 8, 1980.

In this year's data (water year 1982), all relative humidity values have been deleted (see Interpreting Data). There are also no data for the month of February.

Previous data reports of this station are:

Processed Climatic Data
Volume 5
Watana Station
March 1982
For the period: April 1980 - September 1981

3B-10-74



PREPARED BY: USGS TALKEETNA MTS. AND HEALY QUADRANGLES APPROX. SCALE 1" = 1 MILE PREPARED FOR:

R&M CONSULTANTS, INC.

WATANA CLIMATE STATION

UPPER SUSITNA BASIN

: Station Location

ACRES

38-10-75

INTERPRETING DATA

Missing sections of data can bias or "throw off" the values listed as daily averages in the monthly summary. The user should be aware that daily solar radiation values are averages computed from whatever section of data for the day is available, whether it is extrapolated from a minimum time (night) or a maximum period (noon). The user is advised to become familiar with the methods of summation for each parameter. These are described in the section "Data Computation Standards".

The relative humidity sensors used in the Weather Wizards are printed circuit elements which sense changes in relative humidity by changes in impedance. The chemically treated surfaces of these sensors degrade with time, however, and at an individual rate. Therefore, monthly variations in relative humidity values can occasionally be noted. The variations usually appear as a decrease in the R.H. range for successive months at one station.

Blocks of R.H. readings have been completely eliminated from Watana (0650) and Glacier (0610) climate data. The deterioration patterns of the sensors at these stations were so severe as to make these data unreliable.

The relative humidity sensors will also occasionally transmit values over 100 percent. These values are a system malfunction, but are recorded and appear on the data printout as values less than 10 percent. Therefore, values under 10 percent should not be used for further computations.

Precipitation data from Watana (0650) have been reported for the entire year. The data are collected with a heated precipitation bucket which tests out at 43°F during an air temperature of 18°F. Precipitation data measured at the remaining stations are reported for April through September only. These stations do not have heated precipitation buckets so April, September and occasionally May, may only be partial or inaccurate measures of the actual precipitation for that month. This is due to Alaska's extended winters. There may be blowing snow in April, May, and September, which can not be accurately collected by the precipitation buckets without the aid of a Wyoming Wind Gage (Watana is the only precipitation Station equipped with a Wyoming Wind Gage). In addition, snow collected in the precipitation bucket may not melt until a sunny day two weeks later, thereby indicating a rainstorm on this sunny day.

3B-10-76

DATA COMPUTATION STANDARDS

Graphical Data Plot

Graphical representation of valid recorded and/or computed data.

Hourly Precipitation Summary Table

Hourly precipitation values are calculated as the difference between valid consecutive hourly readings. When either of the hourly precipitation readings is invalid, no value is reported and zero precipitation is assumed.

Monthly Summary Table

1. Maximum daily and monthly temperatures are determined from all valid recorded temperatures.

2. Minimum daily and monthly temperatures are determined from all valid recorded temperatures.

3. Mean daily and monthly temperatures are determined from all valid recorded temperatures. The mean daily temperature is determined from the mean of the maximum and minimum temperatures. The mean monthly temperature is determined from the mean of all reported daily mean temperatures.

4. Resultant daily and monthly wind directions and speeds are summed vectorially from all valid readings.

5. Average daily and monthly wind speeds are determined for all valid readings (arithmetic mean).

6. Maximum daily and monthly gust speeds are determined from all valid readings. Associated directions are the resultant directions from the recording interval in which the peak interval gust was observed.

7. Prevailing daily and monthly directions are determined from all valid readings. The reported value is the most frequent direction observed.

8. Mean daily and monthly relative humidities are determined from all valid readings (arithmetic mean).

9. Mean daily and monthly dewpoint temperatures are determined from all valid readings (arithmetic mean). Dewpoints are omitted when the wind speed is less than 1 m/s, when the dewpoint calculates to a value greater than the recorded temperature, or

3 B-10-77

when the dewpoint calculates to less than minus 47 degrees or more than 27 degrees.

10. Daily and monthly precipitation values are determined from all valid readings.

11. Daily and monthly solar energy values are determined from all valid readings. Daily solar energy is determined by averaging the recorded solar intensity and converting the units. The monthly value is the sum of the daily values.

Three Hour Summary Tables

1. The temperature reported is the temperature recorded at the specified time.

2. The dewpoint temperature reported is the dewpoint calculated at the specified time. Dewpoints are omitted when the wind speed is less than 1 m/s, when the dewpoint is calculated to a value greater than the recorded temperature, or when the dewpoint calculates to less than minus 47 degrees or more than 27 degrees.

3. The relative humidity reported is the humidity recorded at the specified time.

4. The wind direction reported is the three-hour vectorial resultant sum of data recorded up to the specified time.

5. The wind speed reported is the three-hour vectorial resultant of data recorded up to the specified time.

6. The gust direction reported is the direction of the maximum gust recorded during the preceeding three-hour period.

7. The gust reported is the maximum recorded during the three-hour period.

8. The radiation reported is the solar radiation intensity recorded at the specified time.

Wind Frequency Summary Table

1. Reported data are determined from all valid readings.

Wind Rose Graphical Plot

1. Plot is a graphical representation of the wind frequency summary table.

3B-10-78

General Notes

1. The following are the valid data ranges; data outside these ranges are not used:

   Time: 0000 through 2400 hours - at specified time intervals.

   Temperature: -50 through +35 °C

   Wind: 0 through 99.9 meters per second and less than or equal to GUST

   Direction: 0 through 360 degrees

   Relative Humidity: 0 through 99 percent

   Precipitation: 0 through 99.8 mm & greater than the last precipitation except in the case of an automatic roll-over. The difference between precipitations cannot exceed 30mm. A '-1' implies a manual re-start.

   Solar: 0 through 150 milliwatts/cm

   Gust: 0 through 99.9 m/sec

   Battery: 9 through 14.5 volts

2. Accuracy of the MRI (Meteorology Research, Inc.) sensors and processor are as follows:

   Temperature: ±1°C
   Wind Speed: ±0.5 meters per second
   Wind Direction: ±1% of full scale
   Relative Humidity: ±6%
   Precipitation: ±1% up to 76.2 mm/hr, ± 5 % from 76.2 mm/hr to 254 mm/hr
   Solar Radiation: ±5mw cm^{-2}
   Tape Recorder Error Rate: 1 bit in 10^7

3. The following are the direction ranges used in the prevailing direction, wind frequency and wind rose summaries:

3B-10-79

DIRECTION	COMPASS HEADING
NORTH	350 through 11
NORTH-NORTHEAST	12 through 34
NORTHEAST	35 through 56
EAST-NORTHEAST	57 through 79
EAST	80 through 101
EAST-SOUTHEAST	102 through 124
SOUTHEAST	125 through 146
SOUTH-SOUTHEAST	147 through 169
SOUTH	170 through 191
SOUTH-SOUTHWEST	192 through 214
SOUTHWEST	215 through 236
WEST-SOUTHWEST	237 through 259
WEST	260 through 281
WEST-NORTHWEST	282 through 304
NORTHWEST	305 through 326
NORTH-NORTHWEST	327 through 349

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING October, 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.89	3.40	.19	0.00	0.00	0.00	0.00	4.48
NNE	.9[illegible]	6.45	7.30	1.08	0.00	0.00	0.00	15.80
NE	1.04	6.22	22.84	2.36	0.00	0.00	0.00	32.46
ENE	1.51	6.30	10.86	6.53	0.00	0.00	0.00	25.19
E	1.20	3.98	1.35	.19	0.00	0.00	0.00	6.72
ESE	.73	1.51	.12	0.00	0.00	0.00	0.00	2.36
SE	.15	.15	0.00	0.00	0.00	0.00	0.00	.31
SSE	.15	.08	0.00	0.00	0.00	0.00	0.00	.23
S	.15	.08	0.00	0.00	0.00	0.00	0.00	.23
SSW	.27	.08	0.00	0.00	0.00	0.00	0.00	.35
SW	.19	.54	0.00	0.00	0.00	0.00	0.00	.73
WSW	.46	1.82	.97	0.00	0.00	0.00	0.00	3.25
W	.50	1.12	.39	0.00	0.00	0.00	0.00	2.01
WNW	.46	.43	0.00	0.00	0.00	0.00	0.00	.89
NW	.77	.27	0.00	0.00	0.00	0.00	0.00	1.04
NNW	.54	2.36	.23	0.00	0.00	0.00	0.00	3.13
CALM								.81
TOTAL	10.01	34.78	44.24	10.16	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2588 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

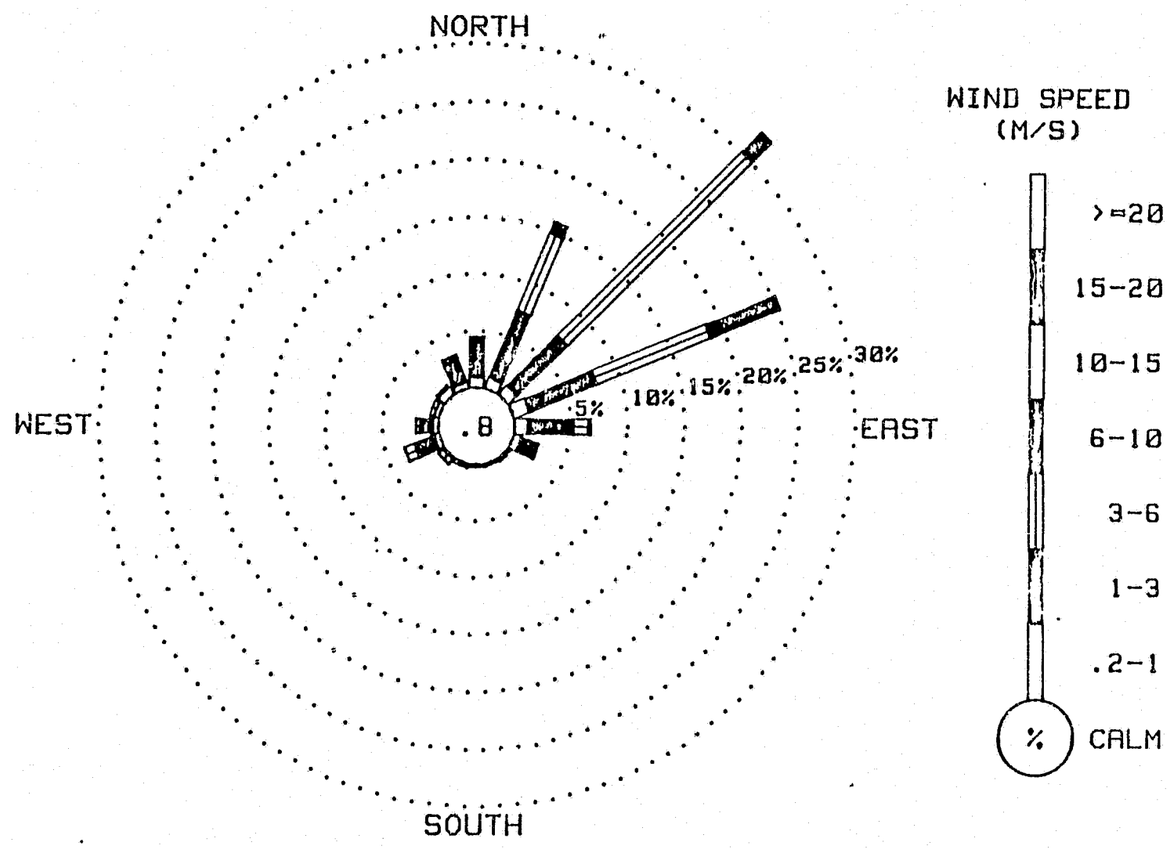
3B-10-81

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

October, 1981



WIND ROSE PLOT

38-10-82

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING November, 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.77	2.65	.77	.04	0.00	0.00	0.00	4.23
NNE	1.02	2.86	3.29	.17	0.00	0.00	0.00	7.34
NE	.98	3.80	16.05	6.28	0.00	0.00	0.00	27.11
ENE	1.49	7.56	10.59	11.44	.04	0.00	0.00	31.13
E	1.20	6.19	3.84	2.26	.21	0.00	0.00	13.71
ESE	.51	1.84	.17	.09	0.00	0.00	0.00	2.60
SE	.26	.21	0.00	0.00	0.00	0.00	0.00	.47
SSE	.09	.04	0.00	0.00	0.00	0.00	0.00	.13
S	.04	0.00	0.00	0.00	0.00	0.00	0.00	.04
SSW	.13	.13	0.00	0.00	0.00	0.00	0.00	.26
SW	.09	.17	1.49	.04	0.00	0.00	0.00	1.79
WSW	.34	.85	.98	0.00	0.00	0.00	0.00	2.18
W	.73	1.37	.09	0.00	0.00	0.00	0.00	2.18
WNW	.13	.51	0.00	0.00	0.00	0.00	0.00	.64
NW	.73	.47	0.00	0.00	0.00	0.00	0.00	1.20
NNW	.51	3.84	.21	0.00	0.00	0.00	0.00	4.57
CALM								.43
TOTAL	9.01	32.49	37.49	20.32	.26	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2342 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

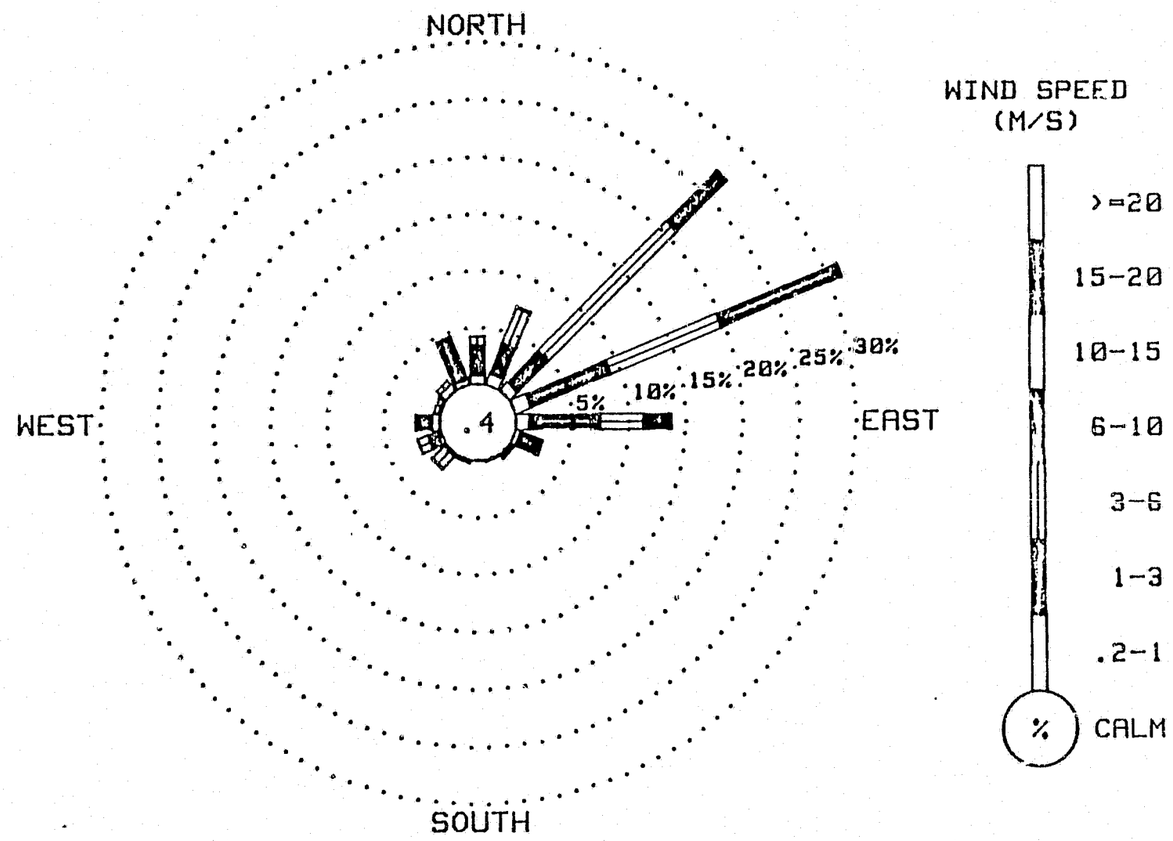
3B-10-83

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

November, 1981



WIND ROSE PLOT

38-10-84

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING December, 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.38	3.30	1.03	0.00	0.00	0.00	0.00	4.70
NNE	.34	3.64	2.61	.10	0.00	0.00	0.00	6.69
NE	.55	5.46	9.92	9.10	.03	0.00	0.00	25.06
ENE	.55	11.64	8.24	9.75	.79	0.00	0.00	30.96
E	.69	11.36	5.49	.65	.10	0.00	0.00	18.30
ESE	.55	1.82	.34	0.00	0.00	0.00	0.00	2.71
SE	.03	.10	0.00	0.00	0.00	0.00	0.00	.14
SSE	.14	.07	0.00	0.00	0.00	0.00	0.00	.21
S	.21	.07	0.00	0.00	0.00	0.00	0.00	.27
SSW	1.48	.82	0.00	0.00	0.00	0.00	0.00	2.30
SW	.14	.38	.55	0.00	0.00	0.00	0.00	1.06
WSW	.27	.69	.55	.03	0.00	0.00	0.00	1.54
W	.31	.45	0.00	0.00	0.00	0.00	0.00	.76
WNW	.27	.10	0.00	0.00	0.00	0.00	0.00	.38
NW	.38	1.17	0.00	0.00	0.00	0.00	0.00	1.54
NNW	.21	2.57	.41	0.00	0.00	0.00	0.00	3.19
CALM								.17
TOTAL	6.49	43.63	29.15	19.64	.93	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2913 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

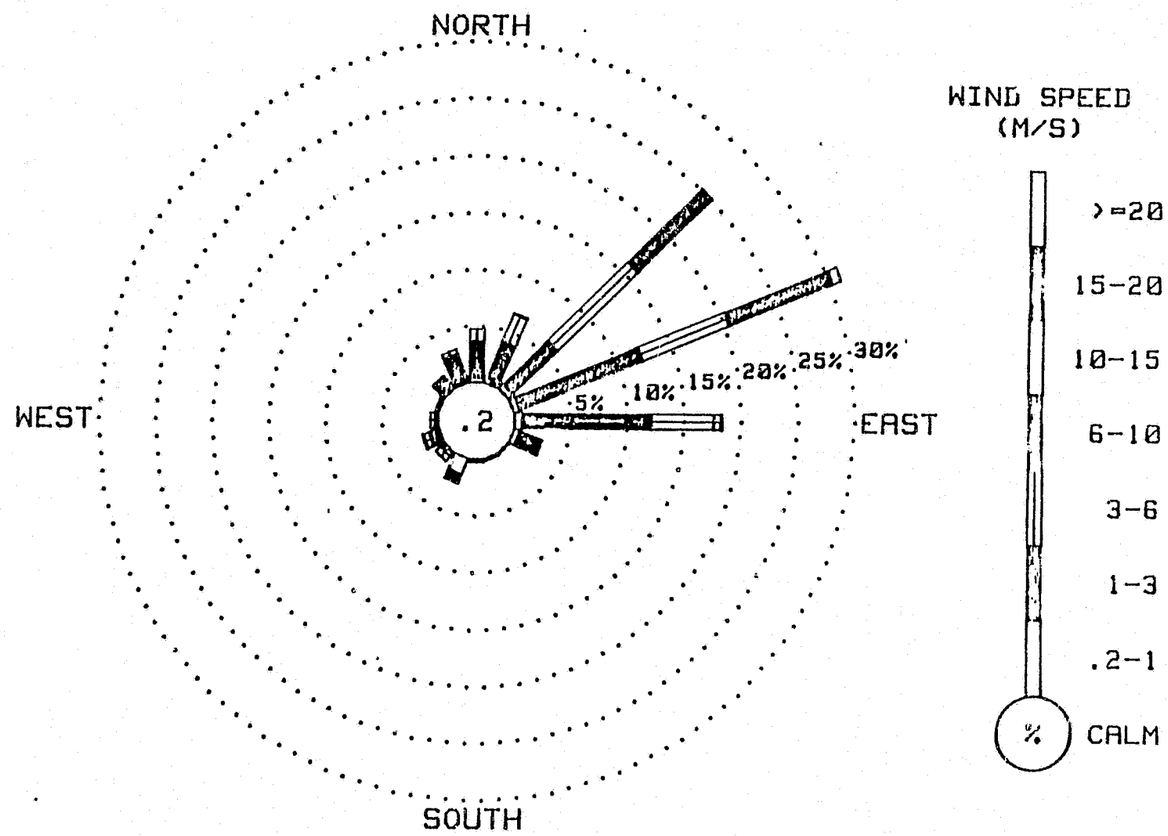
3B-10-85

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

December, 1981



WIND ROSE PLOT

3B-10-86

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING January, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.24	1.18	.38	0.00	0.00	0.00	0.00	1.79
NNE	.05	1.65	1.93	.28	0.00	0.00	0.00	3.91
NE	.19	6.55	4.43	11.31	.66	0.00	0.00	23.14
ENE	.38	14.00	12.02	9.61	1.56	0.00	0.00	37.56
E	.75	15.74	8.01	.57	0.00	0.00	0.00	25.07
ESE	.28	1.98	1.46	.09	0.00	0.00	0.00	3.82
SE	.05	.28	.24	0.00	0.00	0.00	0.00	.57
SSE	.19	0.00	0.00	0.00	0.00	0.00	0.00	.19
S	.05	0.00	0.00	0.00	0.00	0.00	0.00	.05
SSW	.05	0.00	.09	0.00	0.00	0.00	0.00	.14
SW	.14	.24	0.00	0.00	0.00	0.00	0.00	.38
WSW	.14	.28	.05	0.00	0.00	0.00	0.00	.47
W	.05	.05	0.00	0.00	0.00	0.00	0.00	.09
WNW	.19	.42	0.00	0.00	0.00	0.00	0.00	.61
NW	.09	.19	0.00	0.00	0.00	0.00	0.00	.28
NNW	.05	1.32	.57	0.00	0.00	0.00	0.00	1.93
CALM								0.00
TOTAL	2.87	43.87	29.17	21.87	2.21	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2122 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

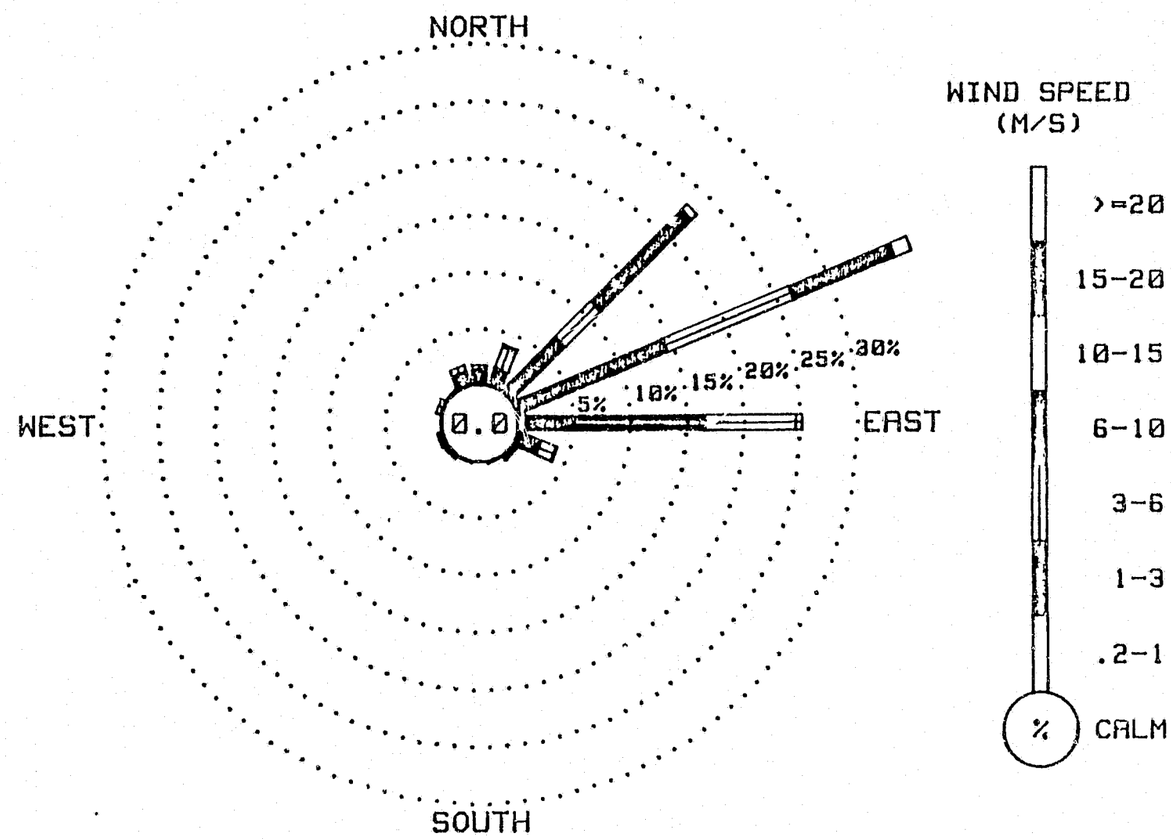
3B-10-87

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

January, 1982



WIND ROSE PLOT

38-10-88

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING March, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.39	2.67	4.50	.33	0.00	0.00	0.00	7.89
NNE	.26	6.26	12.91	1.50	0.00	0.00	0.00	20.93
NE	.26	5.93	15.58	1.76	0.00	0.00	0.00	23.53
ENE	.39	6.78	17.80	3.26	0.00	0.00	0.00	28.23
E	.72	4.37	2.80	0.00	0.00	0.00	0.00	7.89
ESE	.39	1.63	.46	0.00	0.00	0.00	0.00	2.48
SE	.26	.26	0.00	0.00	0.00	0.00	0.00	.52
SSE	.20	0.00	0.00	0.00	0.00	0.00	0.00	.20
S	.13	.33	0.00	0.00	0.00	0.00	0.00	.46
SSW	.07	.07	.07	.07	0.00	0.00	0.00	.26
SW	0.00	.26	.85	0.00	0.00	0.00	0.00	1.11
WSW	.07	.39	.91	0.00	0.00	0.00	0.00	1.37
W	.39	.39	.13	0.00	0.00	0.00	0.00	.91
WNW	.13	.39	0.00	0.00	0.00	0.00	0.00	.52
NW	.13	.26	0.00	0.00	0.00	0.00	0.00	.39
NNW	.13	2.48	.72	0.00	0.00	0.00	0.00	3.32
CALM								0.00
TOTAL	3.91	32.46	56.71	6.91	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
1534 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

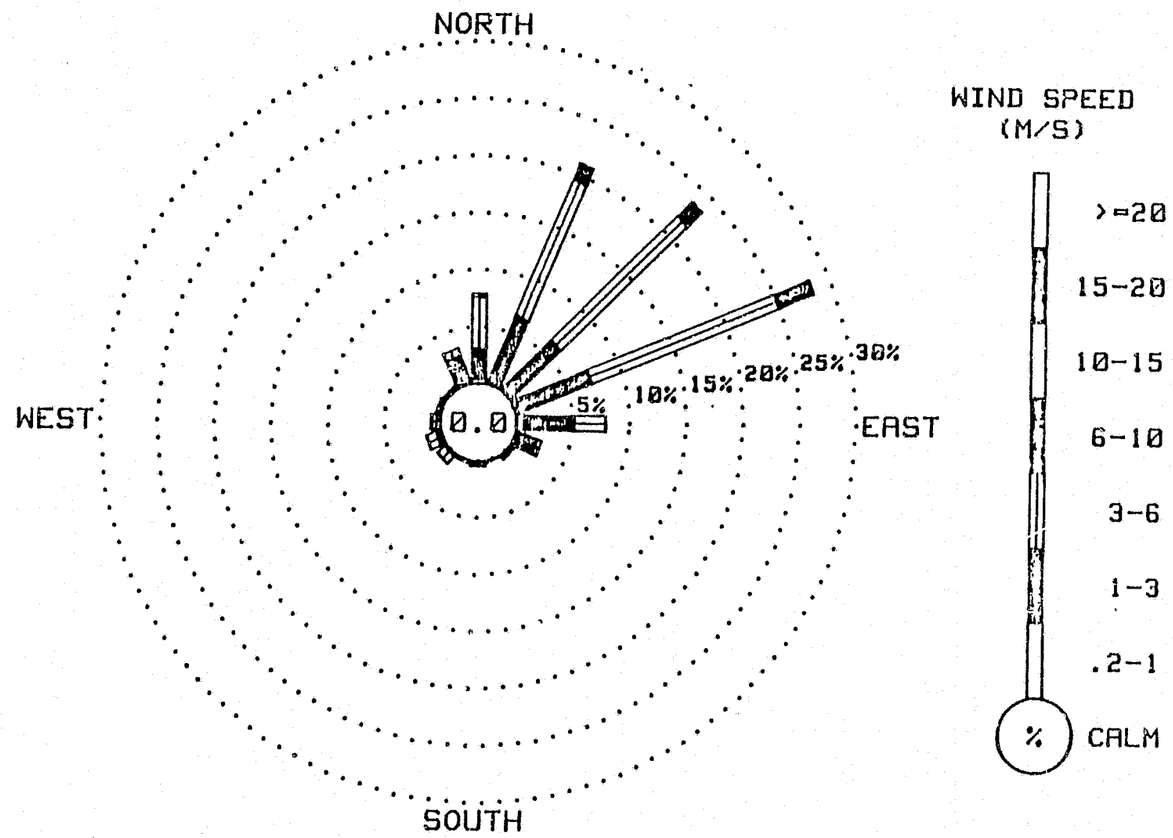
3B-10-89

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

March, 1982



WIND ROSE PLOT

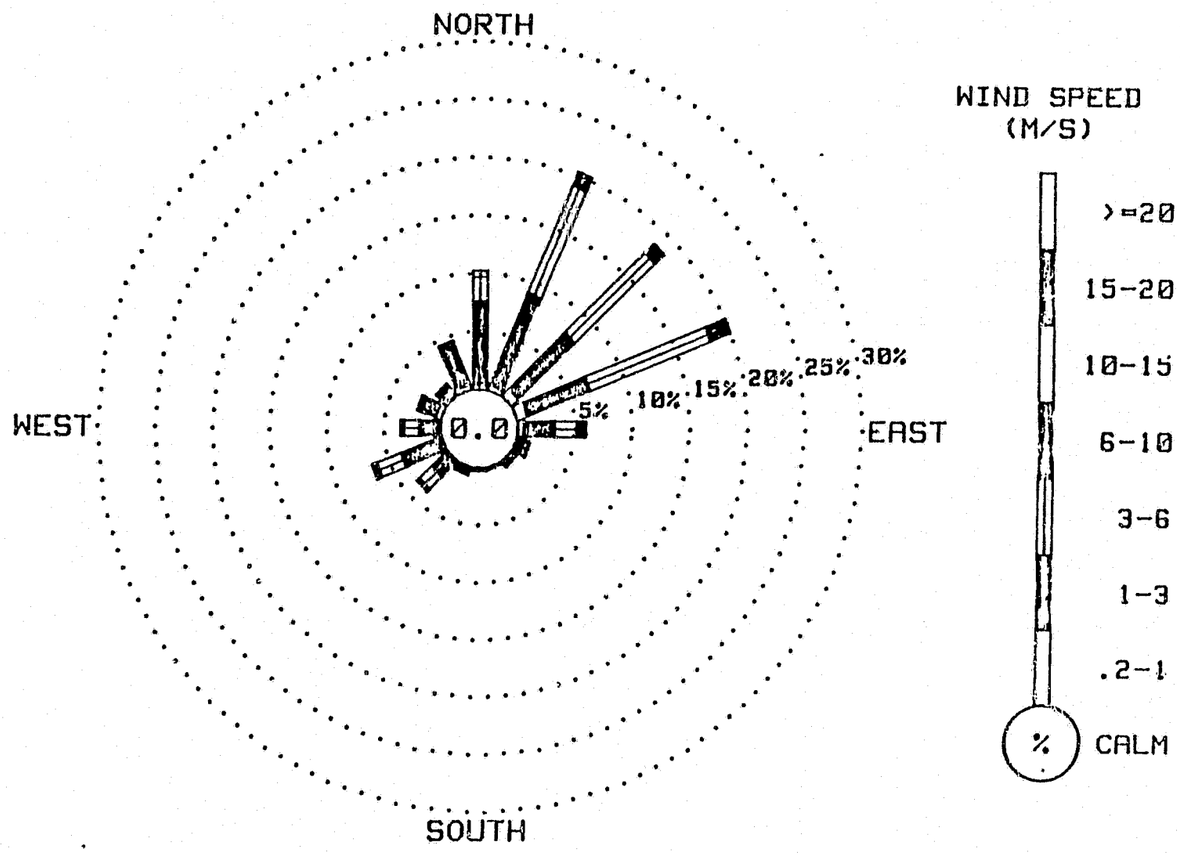
3B-10-90

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

April, 1982



WIND ROSE PLOT

38-10-91

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING May, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.97	8.57	2.67	0.00	0.00	0.00	0.00	12.21
NNE	.83	5.58	6.41	0.00	0.00	0.00	0.00	12.82
NE	.94	3.53	1.55	0.00	0.00	0.00	0.00	6.02
ENE	.97	3.39	2.77	0.00	0.00	0.00	0.00	7.13
E	.83	2.45	2.13	0.00	0.00	0.00	0.00	5.40
ESE	.40	1.98	.76	0.00	0.00	0.00	0.00	3.13
SE	.14	.50	.25	0.00	0.00	0.00	0.00	.90
SSE	.14	.36	.18	0.00	0.00	0.00	0.00	.68
S	.18	.72	.07	0.00	0.00	0.00	0.00	.97
SSW	.25	1.59	.50	0.00	0.00	0.00	0.00	2.34
SW	.36	4.47	4.57	.43	0.00	0.00	0.00	9.83
WSW	.65	8.36	5.37	.18	0.00	0.00	0.00	14.55
W	1.15	4.21	1.80	.04	0.00	0.00	0.00	7.20
WNW	.65	4.18	.86	0.00	0.00	0.00	0.00	5.69
NW	.68	2.81	.29	0.00	0.00	0.00	0.00	3.78
NNW	.83	5.40	.54	0.00	0.00	0.00	0.00	6.77
CALM								.54
TOTAL	9.98	58.11	30.73	.65	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2776 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

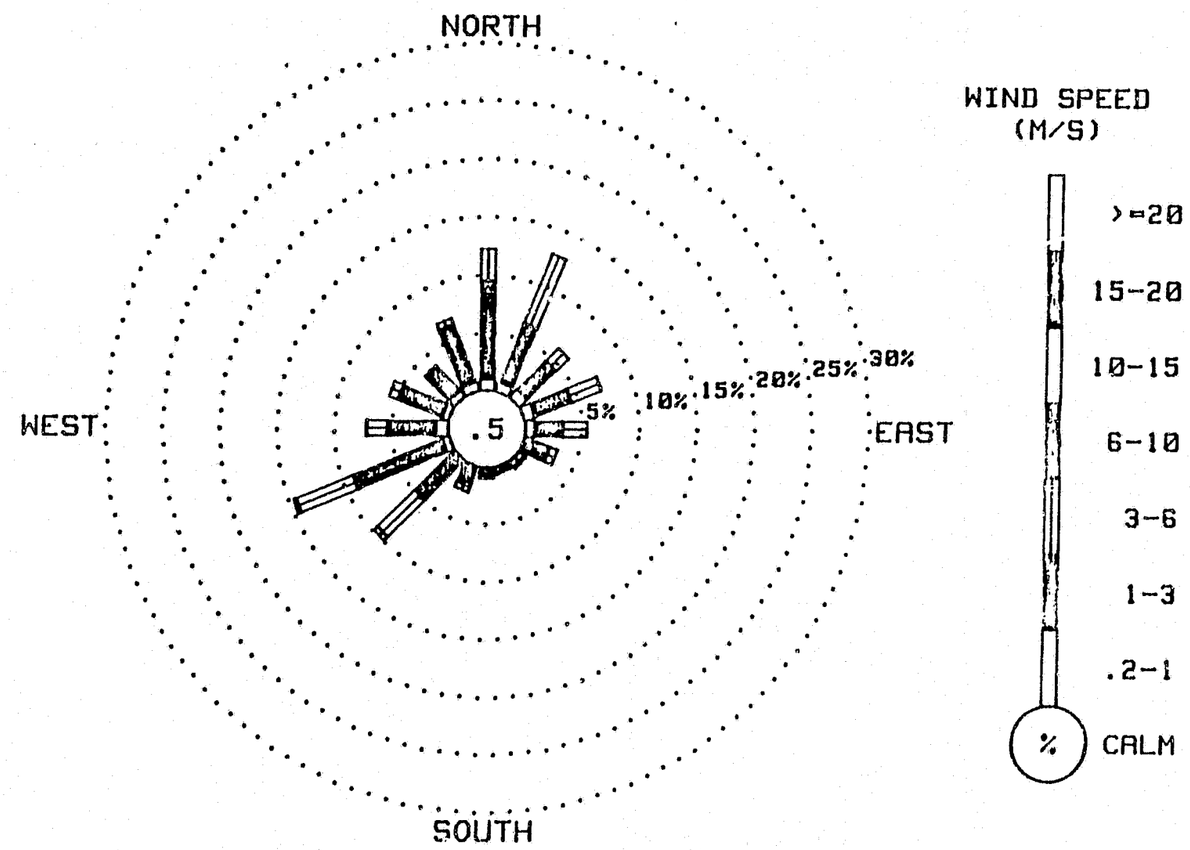
3B-10-92

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

May, 1982



WIND ROSE PLOT

3B-10-93

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING June, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.60	4.19	.10	.05	0.00	0.00	0.00	4.94
NNE	.75	3.10	.30	0.00	0.00	0.00	0.00	4.14
NE	1.05	1.80	.90	.05	0.00	0.00	0.00	3.79
ENE	.80	3.20	2.65	.10	0.00	0.00	0.00	6.74
E	.70	2.40	4.09	.85	0.00	0.00	0.00	8.04
ESE	.60	3.34	.80	.35	0.00	0.00	0.00	5.09
SE	.55	1.40	.50	0.00	0.00	0.00	0.00	2.45
SSE	.70	1.10	.15	.15	0.00	0.00	0.00	2.10
S	.30	.85	.25	0.00	0.00	0.00	0.00	1.40
SSW	.75	2.55	.70	0.00	0.00	0.00	0.00	3.99
SW	.80	5.29	7.74	.30	0.00	0.00	0.00	14.13
WSW	1.25	9.14	9.49	.65	0.00	0.00	0.00	20.52
W	1.15	4.84	2.60	.10	0.00	0.00	0.00	8.69
WNW	1.15	3.30	.65	.05	0.00	0.00	0.00	5.14
NW	.65	2.25	.25	0.00	0.00	0.00	0.00	3.15
NNW	.65	4.29	.25	.05	0.00	0.00	0.00	5.24
CALM								.45
TOTAL	12.43	53.02	31.40	2.70	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2003 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

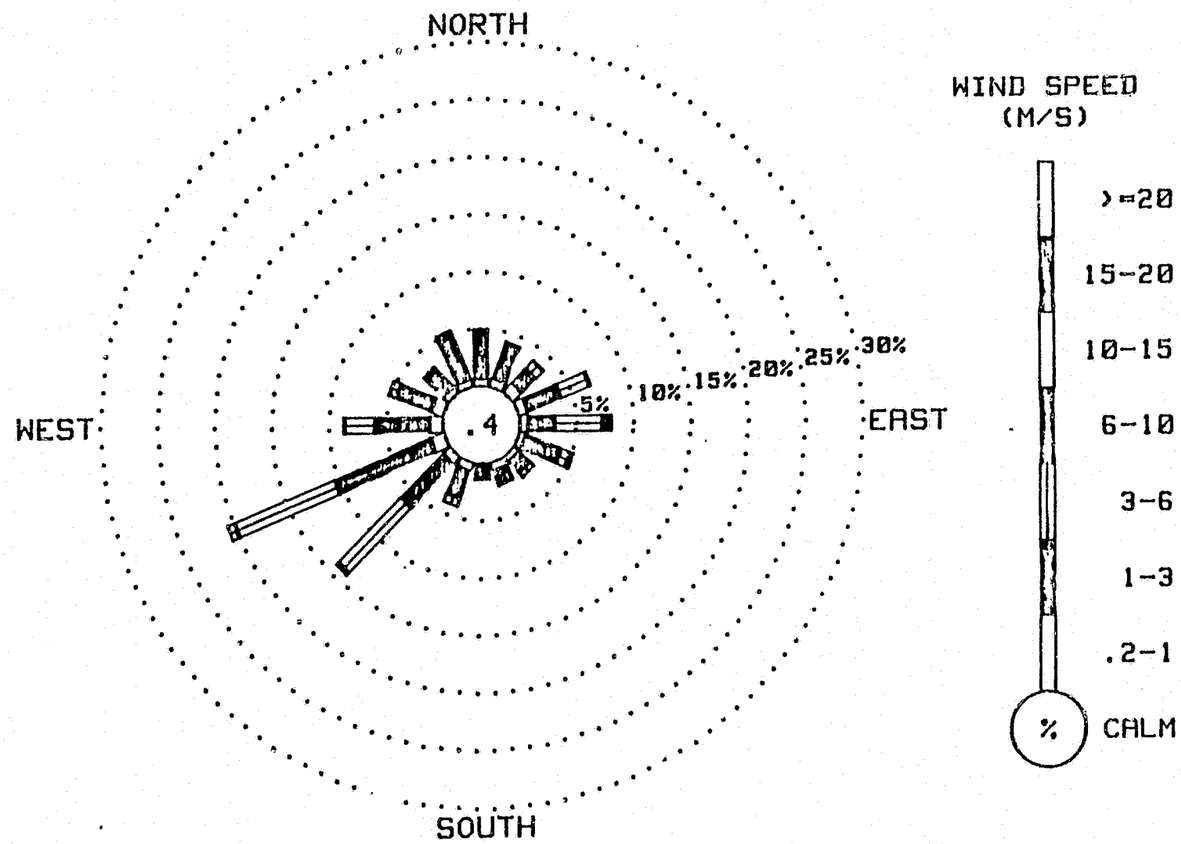
3B-10-94

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

June, 1982



WIND ROSE PLOT

38-10-95

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING July, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.74	2.05	.02	0.00	0.00	0.00	0.00	2.81
NNE	.44	1.43	.15	0.00	0.00	0.00	0.00	2.02
NE	.42	.91	.22	0.00	0.00	0.00	0.00	1.56
ENE	.67	1.46	1.01	0.00	0.00	0.00	0.00	3.14
E	1.23	2.52	.96	0.00	0.00	0.00	0.00	4.72
ESE	.62	3.46	.27	0.00	0.00	0.00	0.00	4.35
SE	.69	1.63	.02	0.00	0.00	0.00	0.00	2.35
SSE	.49	.96	.05	0.00	0.00	0.00	0.00	1.51
S	.44	.94	.10	0.00	0.00	0.00	0.00	1.48
SSW	.52	1.33	.91	0.00	0.00	0.00	0.00	2.77
SW	.47	4.27	1.90	.10	0.00	0.00	0.00	6.74
WSW	1.46	9.48	10.77	1.23	0.00	0.00	0.00	22.94
W	1.53	15.53	8.77	.47	0.00	0.00	0.00	26.30
WNW	1.06	8.94	2.67	.07	0.00	0.00	0.00	12.74
NW	.96	1.65	0.00	0.00	0.00	0.00	0.00	2.62
NNW	.57	1.06	0.00	0.00	0.00	0.00	0.00	1.63
CALM								.35
TOTAL	12.32	57.63	27.83	1.88	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
4050 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

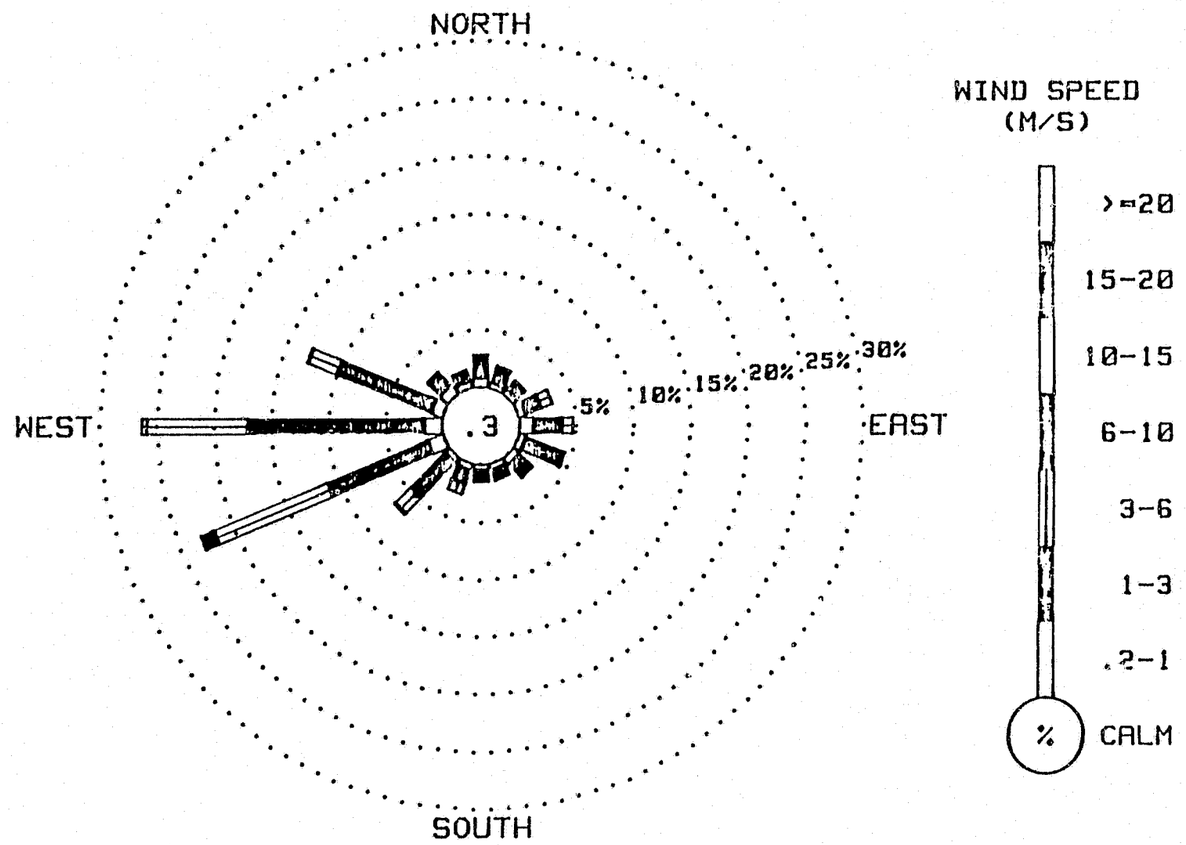
3B-10-96

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

July, 1982



WIND ROSE PLOT

3B-10-97

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING August, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.74	10.24	.77	0.00	0.00	0.00	0.00	11.75
NNE	.80	5.75	1.05	0.00	0.00	0.00	0.00	7.59
NE	1.05	3.41	1.00	0.00	0.00	0.00	0.00	5.46
ENE	1.17	3.87	1.59	0.00	0.00	0.00	0.00	6.63
E	1.14	3.41	.88	0.00	0.00	0.00	0.00	5.43
ESE	.74	3.53	.17	0.00	0.00	0.00	0.00	4.44
SE	.54	1.88	.03	0.00	0.00	0.00	0.00	2.45
SSE	.54	.74	0.00	0.00	0.00	0.00	0.00	1.28
S	.31	.85	0.00	0.00	0.00	0.00	0.00	1.17
SSW	.26	1.19	.06	0.00	0.00	0.00	0.00	1.51
SW	.54	2.36	.82	0.00	0.00	0.00	0.00	3.73
WSW	1.11	5.01	4.07	.03	0.00	0.00	0.00	10.21
W	1.05	13.48	5.29	0.00	0.00	0.00	0.00	19.82
WNW	1.45	8.99	1.93	0.00	0.00	0.00	0.00	12.37
NW	1.19	2.03	.06	0.00	0.00	0.00	0.00	3.33
NNW	.60	1.82	.09	0.00	0.00	0.00	0.00	2.50
CALM								.34
TOTAL	13.23	68.60	17.80	.03	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
3516 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

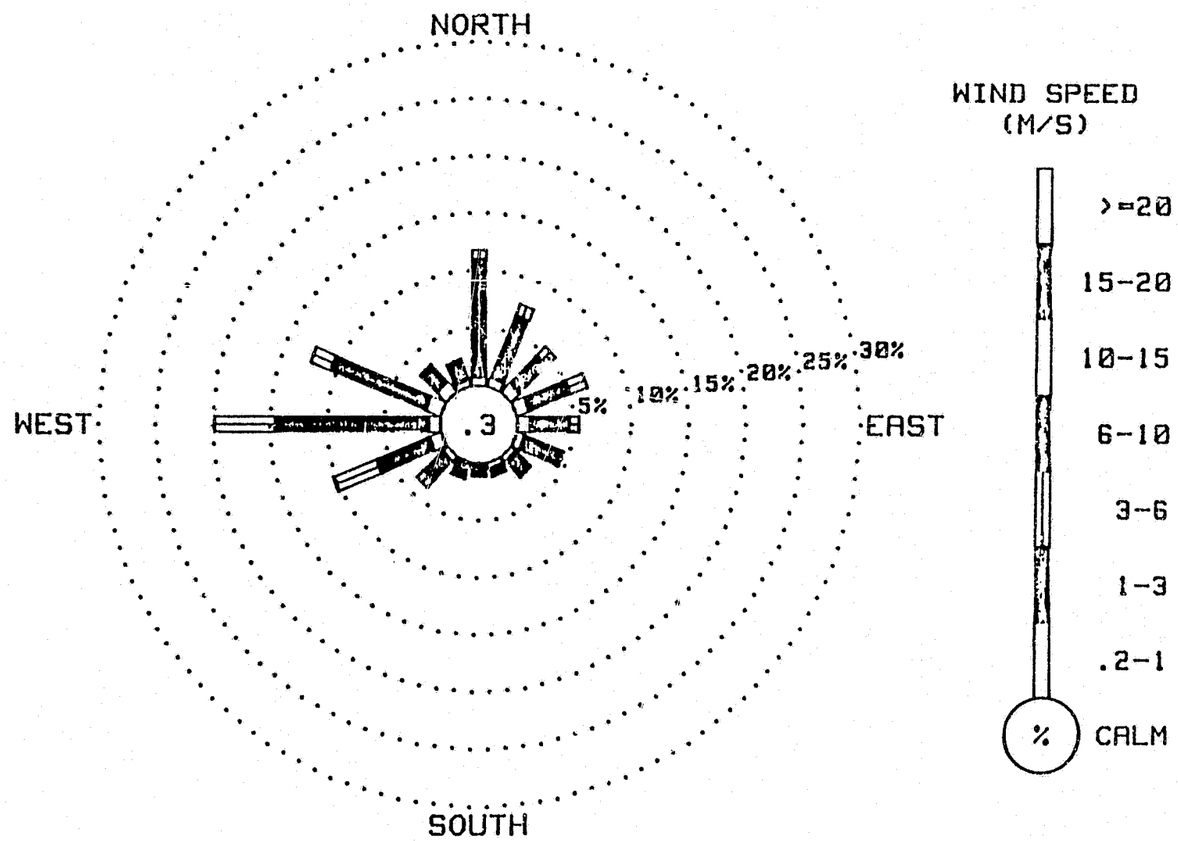
3B-10-98

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

August, 1982



WIND ROSE PLOT

38-10-99

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR WATANA WEATHER STATION
DATA TAKEN DURING September, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	1.48	7.01	.04	0.00	0.00	0.00	0.00	8.53
NNE	1.14	3.33	.08	0.00	0.00	0.00	0.00	4.55
NE	1.25	3.52	2.99	0.00	0.00	0.00	0.00	7.77
ENE	1.33	4.09	8.30	.72	0.00	0.00	0.00	14.44
E	1.93	5.15	7.84	2.39	0.00	0.00	0.00	17.32
ESE	1.82	4.09	.83	.08	0.00	0.00	0.00	6.82
SE	.87	1.74	.15	0.00	0.00	0.00	0.00	2.77
SSE	.30	.57	0.00	0.00	0.00	0.00	0.00	.87
S	.38	.30	.04	0.00	0.00	0.00	0.00	.72
SSW	.53	.38	.04	0.00	0.00	0.00	0.00	.95
SW	.49	.72	.15	0.00	0.00	0.00	0.00	1.36
WSW	.27	2.61	2.92	.15	0.00	0.00	0.00	5.95
W	1.06	8.87	2.88	.04	0.00	0.00	0.00	12.85
WNW	1.52	5.99	.53	0.00	0.00	0.00	0.00	8.03
NW	1.52	1.21	0.00	0.00	0.00	0.00	0.00	2.73
NNW	1.33	1.17	0.00	0.00	0.00	0.00	0.00	2.50
CALM								1.86
TOTAL	17.20	50.78	26.79	3.37	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2639 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

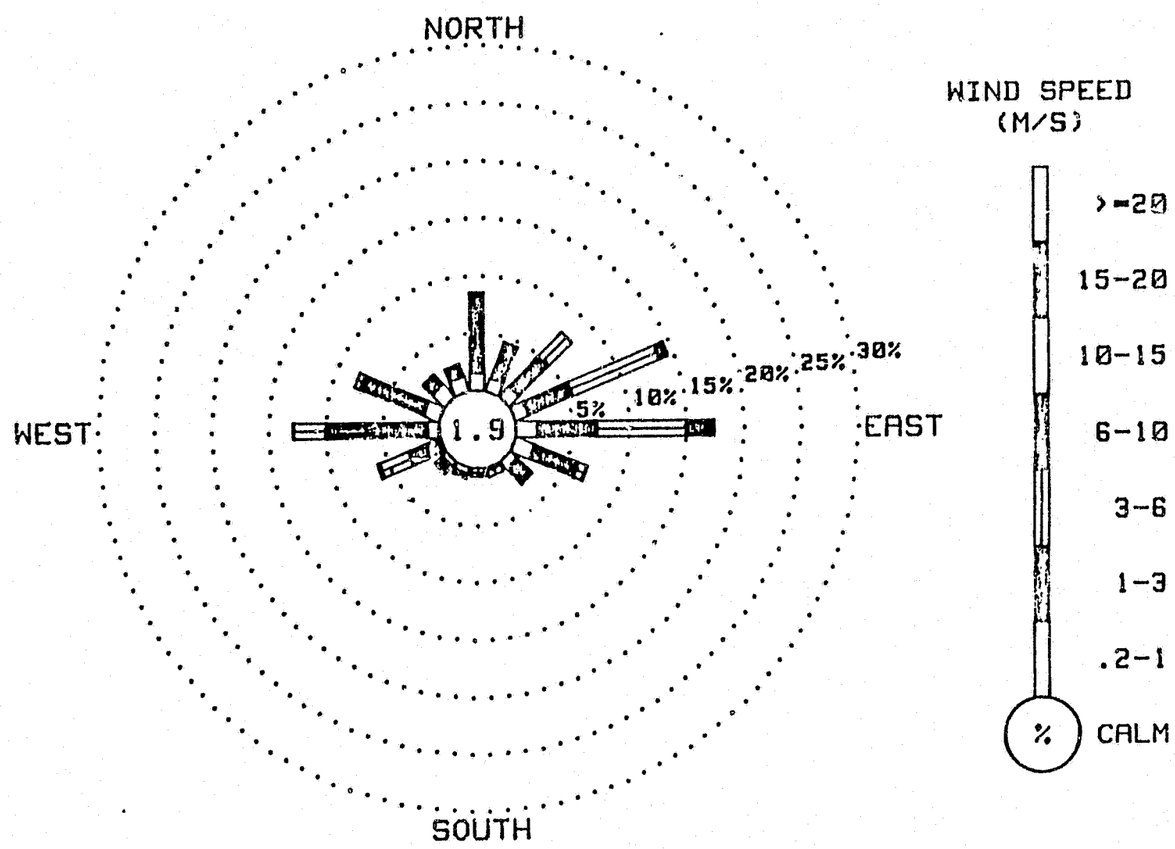
3B-10-100

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WATANA WEATHER STATION

September, 1982



WIND ROSE PLOT

3B-10-101

** Missing or bad data that has been deleted for various reasons (see STATION HISTORY, DATA COMPUTATION STANDARDS, or INTERPRETING DATA for an explanation).

3B-10-102

SUSITNA HYDROELECTRIC PROJECT

PROCESSED CLIMATIC DATA

OCTOBER 1981 THRU SEPTEMBER 1982

VOLUME 6

0660 - DEVIL CANYON STATION

DECEMBER 1982

PREPARED BY:

R&M CONSULTANTS, INC.

PREPARED FOR:

ACRES

ALASKA POWER AUTHORITY

3B-10-103

s9/v1

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA

VOLUME 6
0660 - DEVIL CANYON CLIMATE STATION
OCTOBER 1981 - SEPTEMBER 1982

DECEMBER 1982

Prepared for:

ACRES AMERICAN INCORPORATED
1000 Liberty Bank Building
Main at Court
Buffalo, New York 14202
Telephone (716) 853-7525

Prepared by:

R&M CONSULTANTS, INC.
5024 Cordova Street
Anchorage, Alaska 99502
Telephone (907) 279-0483

3B-10-104

s8/p2

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

TASK 3 - HYDROLOGY

PROCESSED CLIMATIC DATA

OCTOBER 1981 - SEPTEMBER 1982

VOLUME INDEX

VOLUME 1: 0610 - SUSITNA GLACIER STATION
VOLUME 2: 0620 - DENALI STATION
VOLUME 3: 0630 - TYONE RIVER STATION
VOLUME 4: 0640 - KOSINA CREEK STATION
VOLUME 5: 0650 - WATANA STATION
VOLUME 6: 0660 - DEVIL CANYON STATION
VOLUME 7: 0665 - SHERMAN STATION
VOLUME 8: 0700 - EKLUTNA LAKE STATION

3B-10-105

s9/v3

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON CLIMATIC DATA

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3B-10-106

Acknowledgments

These climatic data were collected under contract to Acres American, Incorporated for the Alaska Power Authority's Susitna Hydroelectric Feasibility Study. The data recorders were Model 5100 Weather Wizards manufactured by Meteorology Research, Incorporated (MRI). All sensors were supplied by MRI. Field maintenance and data collection were performed by the hydrology staff of R&M Consultants, Incorporated. Data reduction and processing were performed by Lisa Fotherby, using computer programs developed by Mark Holmstrand. The computer hardware used was a Hewlett-Packard 9845 B system.

3B-10-107

s9/v

HISTORY OF THE DEVIL CANYON CLIMATE STATION (0660)

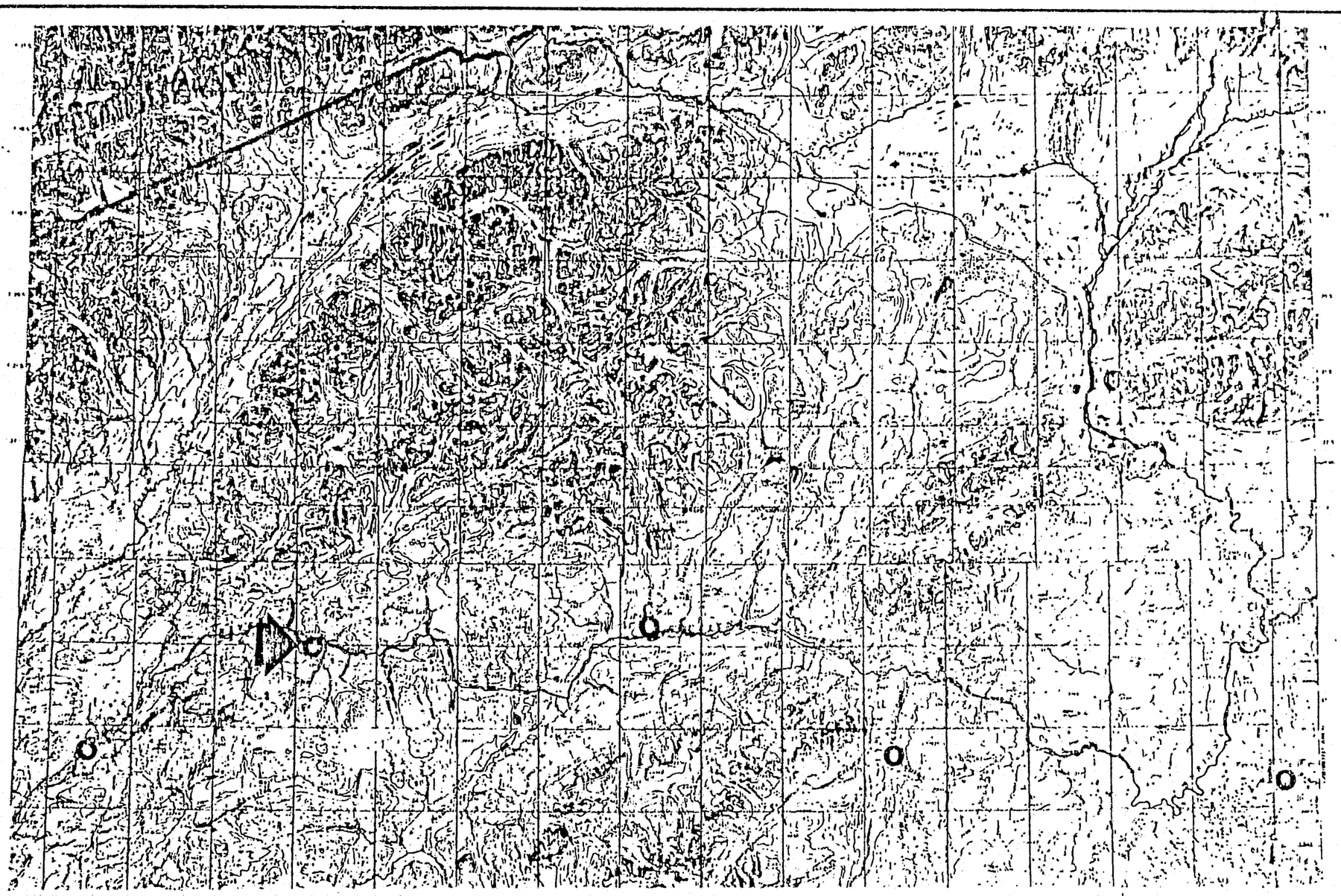
The Devil Canyon climate station was installed July 17, 1980. It is located 1/8-mile south of the Susitna River, adjacent to the proposed Devil Canyon damsite. A climate station at this location was desirable for satisfying transmission line, environmental and hydrology data requirements. It lies at a 1,500-foot elevation on a ridge within the plateau region, yet is close to the actual walls of the canyon. Devil Canyon Station is at Susitna River Mile 153.

There are no solar radiation data from March 2 through April 15, 1982 due to technical problems with the pyranometer. However, the remaining climate data are exceptionally clean with almost 100 percent retrieval.

Previous data reports of this station are:

Processed Climatic Data
Volume 6
Devil Canyon Station
March 1981
For the period: July 1980 thru September 1981

3B-1D-108



3B-10-109

PREPARED BY: USGS TALKEETNA MTS. AND HEALY QUADRANGLES APPROX. SCALE 1" = 1 MILE PREPARED FOR:

R&M CONSULTANTS, INC.

DEVIL CANYON CLIMATE STATION

UPPER SUSITNA BASIN

: Station Location

ACRES

INTERPRETING DATA

Missing sections of data can bias or "throw off" the values listed as daily averages in the monthly summary. The user should be aware that daily solar radiation values are averages computed from whatever section of data for the day is available, whether it is extrapolated from a minimum time (night) or a maximum period (noon). The user is advised to become familiar with the methods of summation for each parameter. These are described in the section "Data Computation Standards".

The relative humidity sensors used in the Weather Wizards are printed circuit elements which sense changes in relative humidity by changes in impedance. The chemically treated surfaces of these sensors degrade with time, however, and at an individual rate. Therefore, monthly variations in relative humidity values can occasionally be noted. The variations usually appear as a decrease in the R.H. range for successive months at one station.

Blocks of R.H. readings have been completely eliminated from Watana (0650) and Glacier (0610) climate data. The deterioration patterns of the sensors at these stations were so severe as to make these data unreliable.

The relative humidity sensors will also occasionally transmit values over 100 percent. These values are a system malfunction, but are recorded and appear on the data printout as values less than 10 percent. Therefore, values under 10 percent should not be used for further computations.

Precipitation data from Watana (0650) have been reported for the entire year. The data are collected with a heated precipitation bucket which tests out at 43°F during an air temperature of 18°F. Precipitation data measured at the remaining stations are reported for April through September only. These stations do not have heated precipitation buckets so April, September and occasionally May, may only be partial or inaccurate measures of the actual precipitation for that month. This is due to Alaska's extended winters. There may be blowing snow in April, May, and September, which can not be accurately collected by the precipitation buckets without the aid of a Wyoming Wind Gage (Watana is the only precipitation Station equipped with a Wyoming Wind Gage). In addition, snow collected in the precipitation bucket may not melt until a sunny day two weeks later, thereby indicating a rainstorm on this sunny day.

3B-10-110

DATA COMPUTATION STANDARDS

Graphical Data Plot

Graphical representation of valid recorded and/or computed data.

Hourly Precipitation Summary Table

Hourly precipitation values are calculated as the difference between valid consecutive hourly readings. When either of the hourly precipitation readings is invalid, no value is reported and zero precipitation is assumed.

Monthly Summary Table

1. Maximum daily and monthly temperatures are determined from all valid recorded temperatures.

2. Minimum daily and monthly temperatures are determined from all valid recorded temperatures.

3. Mean daily and monthly temperatures are determined from all valid recorded temperatures. The mean daily temperature is determined from the mean of the maximum and minimum temperatures. The mean monthly temperature is determined from the mean of all reported daily mean temperatures.

4. Resultant daily and monthly wind directions and speeds are summed vectorially from all valid readings.

5. Average daily and monthly wind speeds are determined for all valid readings (arithmetic mean).

6. Maximum daily and monthly gust speeds are determined from all valid readings. Associated directions are the resultant directions from the recording interval in which the peak interval gust was observed.

7. Prevailing daily and monthly directions are determined from all valid readings. The reported value is the most frequent direction observed.

8. Mean daily and monthly relative humidities are determined from all valid readings (arithmetic mean).

9. Mean daily and monthly dewpoint temperatures are determined from all valid readings (arithmetic mean). Dewpoints are omitted when the wind speed is less than 1 m/s, when the dewpoint calculates to a value greater than the recorded temperature, or

when the dewpoint calculates to less than minus 47 degrees or more than 27 degrees.

10. Daily and monthly precipitation values are determined from all valid readings.

11. Daily and monthly solar energy values are determined from all valid readings. Daily solar energy is determined by averaging the recorded solar intensity and converting the units. The monthly value is the sum of the daily values.

Three Hour Summary Tables

1. The temperature reported is the temperature recorded at the specified time.

2. The dewpoint temperature reported is the dewpoint calculated at the specified time. Dewpoints are omitted when the wind speed is less than 1 m/s, when the dewpoint is calculated to a value greater than the recorded temperature, or when the dewpoint calculates to less than minus 47 degrees or more than 27 degrees.

3. The relative humidity reported is the humidity recorded at the specified time.

4. The wind direction reported is the three-hour vectorial resultant sum of data recorded up to the specified time.

5. The wind speed reported is the three-hour vectorial resultant of data recorded up to the specified time.

6. The gust direction reported is the direction of the maximum gust recorded during the preceeding three-hour period.

7. The gust reported is the maximum recorded during the three-hour period.

8. The radiation reported is the solar radiation intensity recorded at the specified time.

Wind Frequency Summary Table

1. Reported data are determined from all valid readings.

Wind Rose Graphical Plot

1. Plot is a graphical representation of the wind frequency summary table.

3B-10-112

General Notes

1. The following are the valid data ranges; data outside these ranges are not used:

   Time: 0000 through 2400 hours - at specified time intervals.

   Temperature: -50 through +35 °C

   Wind: 0 through 99.9 meters per second and less than or equal to GUST

   Direction: 0 through 360 degrees

   Relative Humidity: 0 through 99 percent

   Precipitation: 0 through 99.8 mm & greater than the last precipitation except in the case of an automatic roll-over. The difference between precipitations cannot exceed 30mm. A '-1' implies a manual re-start.

   Solar: 0 through 150 milliwatts/cm

   Gust: 0 through 99.9 m/sec

   Battery: 9 through 14.5 volts

2. Accuracy of the MRI (Meteorology Research, Inc.) sensors and processor are as follows:

   Temperature: ±1°C
   Wind Speed: ±0.5 meters per second
   Wind Direction: ±1% of full scale
   Relative Humidity: ±6%
   Precipitation: ±1% up to 76.2 mm/hr, ± 5 % from 76.2 mm/hr to 254 mm/hr
   Solar Radiation: ±5mw cm^{-2}
   Tape Recorder Error Rate: 1 bit in 10^7

3. The following are the direction ranges used in the prevailing direction, wind frequency and wind rose summaries:

3B-10-113

DIRECTION	COMPASS HEADING
NORTH	350 through 11
NORTH-NORTHEAST	12 through 34
NORTHEAST	35 through 56
EAST-NORTHEAST	57 through 79
EAST	80 through 101
EAST-SOUTHEAST	102 through 124
SOUTHEAST	125 through 146
SOUTH-SOUTHEAST	147 through 169
SOUTH	170 through 191
SOUTH-SOUTHWEST	192 through 214
SOUTHWEST	215 through 236
WEST-SOUTHWEST	237 through 259
WEST	260 through 281
WEST-NORTHWEST	282 through 304
NORTHWEST	305 through 326
NORTH-NORTHWEST	327 through 349

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING October, 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	1.10	.15	0.00	0.00	0.00	0.00	0.00	1.25
NNE	1.69	.44	0.00	0.00	0.00	0.00	0.00	2.13
NE	2.57	1.62	0.00	0.00	0.00	0.00	0.00	4.19
ENE	2.42	4.22	0.00	0.00	0.00	0.00	0.00	6.64
E	2.94	8.30	.15	0.00	0.00	0.00	0.00	11.38
ESE	4.15	14.06	.66	0.00	0.00	0.00	0.00	18.87
SE	4.26	11.97	.07	0.00	0.00	0.00	0.00	16.30
SSE	5.47	8.37	0.00	0.00	0.00	0.00	0.00	13.84
S	5.80	5.62	0.00	0.00	0.00	0.00	0.00	11.42
SSW	3.49	1.17	0.00	0.00	0.00	0.00	0.00	4.66
SW	1.58	.33	0.00	0.00	0.00	0.00	0.00	1.91
WSW	.70	.55	0.00	0.00	0.00	0.00	0.00	1.25
W	.37	.88	0.00	0.00	0.00	0.00	0.00	1.25
WNW	.51	.95	0.00	0.00	0.00	0.00	0.00	1.47
NW	.29	.44	0.00	0.00	0.00	0.00	0.00	.73
NNW	.59	.15	0.00	0.00	0.00	0.00	0.00	.73
CALM								1.98
TOTAL	37.92	59.21	.88	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2724 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

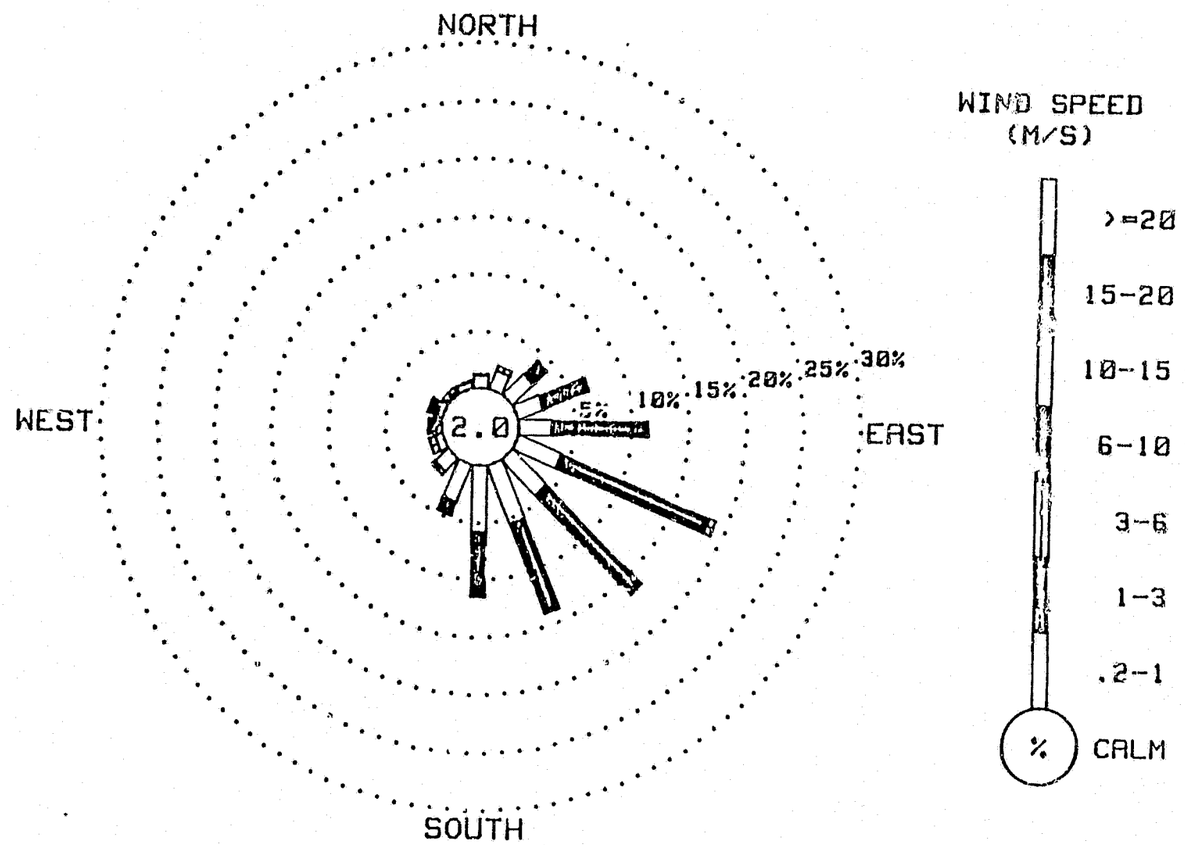
3B-10-115

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

October, 1981



WIND ROSE PLOT

3B-10-116

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING November, 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.40	.04	0.00	0.00	0.00	0.00	0.00	.43
NNE	.76	.25	0.00	0.00	0.00	0.00	0.00	1.01
NE	1.34	1.23	.11	0.00	0.00	0.00	0.00	2.68
ENE	1.67	6.81	.54	0.00	0.00	0.00	0.00	9.03
E	1.78	13.48	.87	0.00	0.00	0.00	0.00	16.13
ESE	2.54	15.73	3.33	.11	0.00	0.00	0.00	21.71
SE	2.83	14.24	1.63	0.00	0.00	0.00	0.00	18.70
SSE	2.28	9.42	.07	0.00	0.00	0.00	0.00	11.78
S	2.17	5.33	0.00	0.00	0.00	0.00	0.00	7.50
SSW	2.17	2.17	0.00	0.00	0.00	0.00	0.00	4.35
SW	1.30	.14	0.00	0.00	0.00	0.00	0.00	1.45
WSW	1.23	.11	0.00	0.00	0.00	0.00	0.00	1.34
W	.58	.29	0.00	0.00	0.00	0.00	0.00	.87
WNW	.29	.72	.11	0.00	0.00	0.00	0.00	1.12
NW	.29	.62	.25	0.00	0.00	0.00	0.00	1.16
NNW	0.00	.14	0.00	0.00	0.00	0.00	0.00	.14
CALM								.58
TOTAL	21.64	70.75	6.92	.11	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2759 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

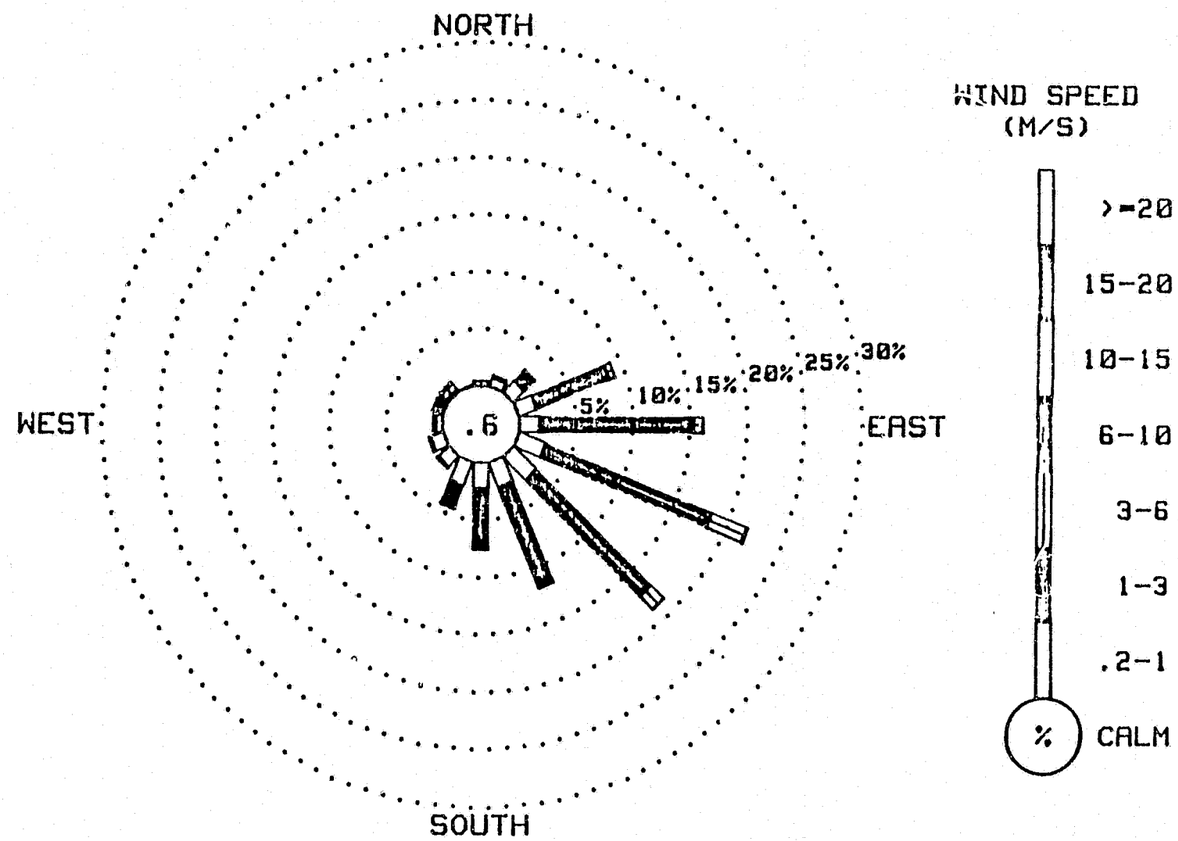
3B-10-117

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

November, 1981



WIND ROSE PLOT

3B-10-118

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING December, 1981

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.13	.03	0.00	0.00	0.00	0.00	0.00	.17
NNE	.30	.24	.00	0.00	0.00	0.00	0.00	.54
NE	1.95	4.74	.13	0.00	0.00	0.00	0.00	6.82
ENE	2.79	13.98	2.35	0.00	0.00	0.00	0.00	19.12
E	2.82	11.16	1.85	.03	0.00	0.00	0.00	15.86
ESE	2.65	13.47	2.99	0.00	0.00	0.00	0.00	19.12
SE	2.35	8.57	2.08	0.00	0.00	0.00	0.00	13.00
SSE	2.52	3.76	.07	0.00	0.00	0.00	0.00	6.35
S	1.31	.94	0.00	0.00	0.00	0.00	0.00	2.25
SSW	3.60	3.33	0.00	0.00	0.00	0.00	0.00	6.92
SW	2.12	.40	0.00	0.00	0.00	0.00	0.00	2.52
WSW	.77	.37	0.00	0.00	0.00	0.00	0.00	1.14
W	.40	.37	0.00	0.00	0.00	0.00	0.00	.77
WNW	.27	.64	0.00	0.00	0.00	0.00	0.00	.91
NW	.24	.81	0.00	0.00	0.00	0.00	0.00	1.04
NNW	.10	.13	0.00	0.00	0.00	0.00	0.00	.24
CALM								3.23
TOTAL	24.33	62.94	9.48	.03	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

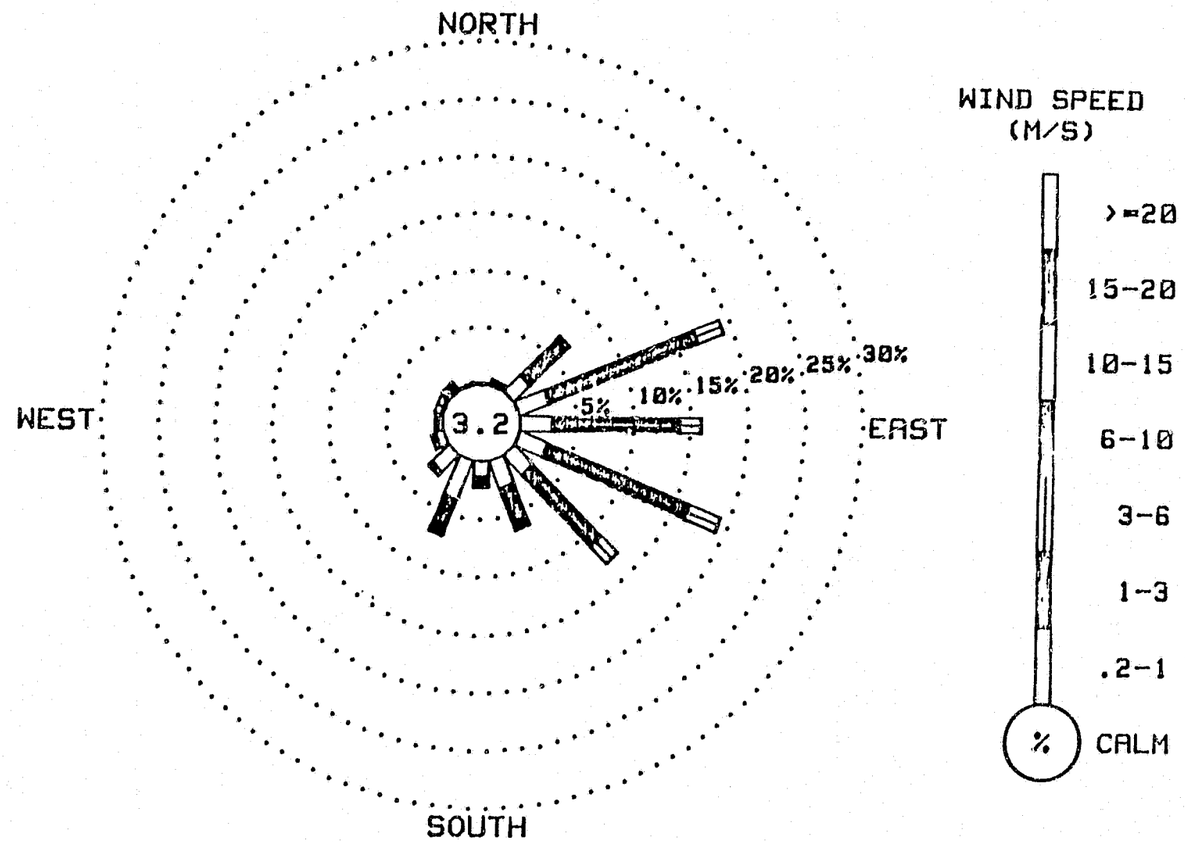
3B-10-119

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

December, 1981



WIND ROSE PLOT

3B-10-120

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING January, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.10	0.00	0.00	0.00	0.00	0.00	0.00	.10
NNE	.10	.17	.03	0.00	0.00	0.00	0.00	.30
NE	.30	4.37	.64	0.00	0.00	0.00	0.00	5.31
ENE	.57	11.56	4.33	0.00	0.00	0.00	0.00	16.47
E	.77	15.22	5.98	0.00	0.00	0.00	0.00	21.98
ESE	1.01	20.40	14.78	.03	0.00	0.00	0.00	36.22
SE	.74	7.43	4.40	0.00	0.00	0.00	0.00	12.57
SSE	.71	3.70	.34	0.00	0.00	0.00	0.00	4.74
S	.50	.87	0.00	0.00	0.00	0.00	0.00	1.38
SSW	.17	.03	0.00	0.00	0.00	0.00	0.00	.20
SW	.30	0.00	0.00	0.00	0.00	0.00	0.00	.30
WSW	.17	.03	0.00	0.00	0.00	0.00	0.00	.20
W	.10	0.00	0.00	0.00	0.00	0.00	0.00	.10
WNW	.07	0.00	0.00	0.00	0.00	0.00	0.00	.07
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	.03	.03	0.00	0.00	0.00	0.00	0.00	.07
CALM								0.00
TOTAL	5.65	63.81	30.51	.03	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

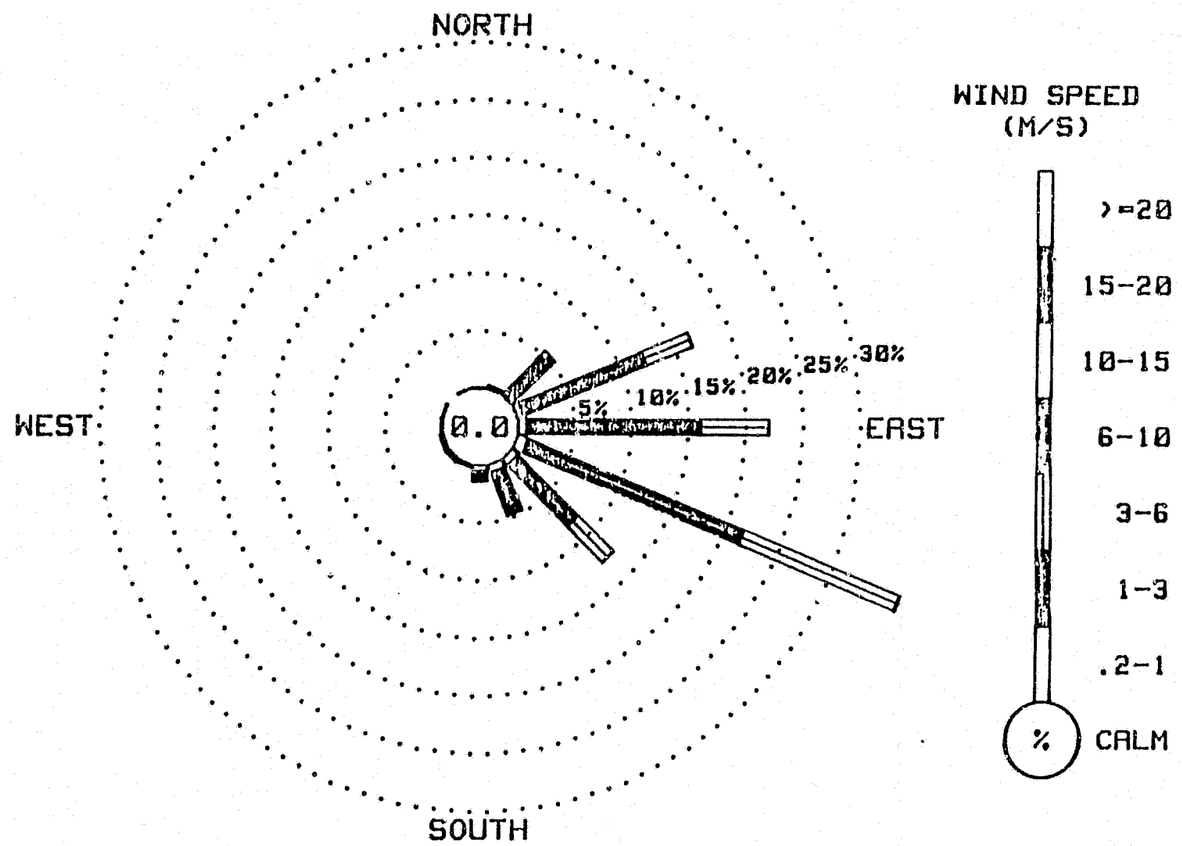
3B-10-121

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

January, 1982



WIND ROSE PLOT

38-10-122

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
IATA TAKEN DURING February, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.50	.15	.61	.23	0.00	0.00	0.00	1.49
NNE	.69	.65	.92	1.53	0.00	0.00	0.00	3.78
NE	.76	2.44	.46	0.00	0.00	0.00	0.00	3.67
ENE	1.07	7.14	1.22	0.00	0.00	0.00	0.00	9.43
E	1.72	13.22	.73	0.00	0.00	0.00	0.00	15.66
ESE	1.30	18.95	5.19	0.00	0.00	0.00	0.00	25.44
SE	1.45	12.30	2.75	0.00	0.00	0.00	0.00	16.50
SSE	1.53	6.53	.38	0.00	0.00	0.00	0.00	8.44
S	1.68	1.76	0.00	.04	0.00	0.00	0.00	3.48
SSW	.88	.61	.04	.04	0.00	0.00	0.00	1.57
SW	.57	.08	0.00	0.00	0.00	0.00	0.00	.65
WSW	.69	.19	0.00	0.00	0.00	0.00	0.00	.88
W	.65	.27	0.00	0.00	0.00	0.00	0.00	.92
WNW	.76	.27	.11	0.00	0.00	0.00	0.00	1.15
NW	.27	.31	.23	0.00	0.00	0.00	0.00	.80
NNW	.19	.23	.23	0.00	0.00	0.00	0.00	.65
CALM								5.50
TOTAL	14.71	65.09	12.87	1.83	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2618 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

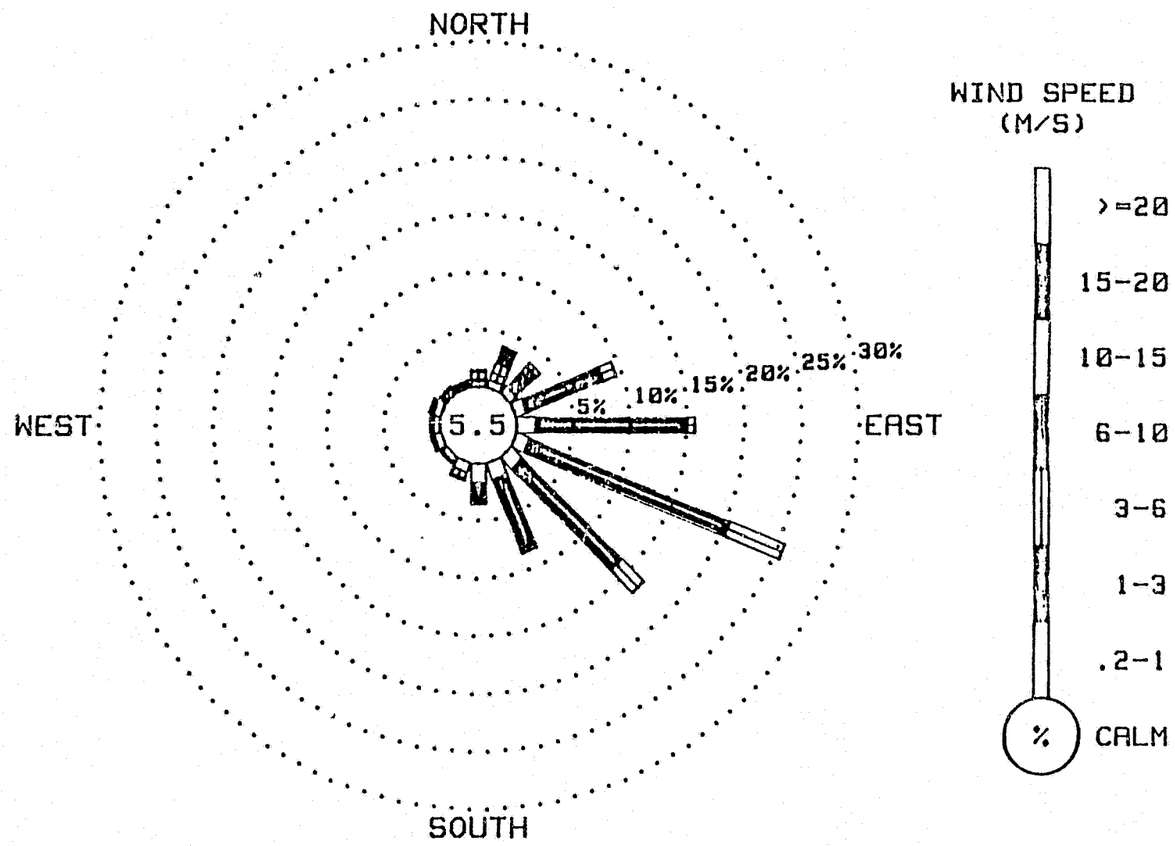
3B-10-123

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

February, 1982



WIND ROSE PLOT

38-10-124

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING March, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.79	.36	0.00	0.00	0.00	0.00	0.00	1.15
NNE	.93	1.22	1.25	.29	0.00	0.00	0.00	3.69
NE	1.61	3.66	.65	0.00	0.00	0.00	0.00	5.91
ENE	1.94	10.11	.47	0.00	0.00	0.00	0.00	12.51
E	2.54	14.87	.54	0.00	0.00	0.00	0.00	17.96
ESE	2.51	17.74	1.86	0.00	0.00	0.00	0.00	22.11
SE	2.01	9.86	2.01	0.00	0.00	0.00	0.00	13.87
SSE	1.54	3.62	.50	0.00	0.00	0.00	0.00	5.66
S	1.54	2.54	.07	0.00	0.00	0.00	0.00	4.16
SSW	1.72	.22	0.00	0.00	0.00	0.00	0.00	1.94
SW	.75	.18	0.00	0.00	0.00	0.00	0.00	.93
WSW	.50	.32	0.00	0.00	0.00	0.00	0.00	.82
W	.93	.75	.04	0.00	0.00	0.00	0.00	1.72
WNW	1.08	1.61	0.00	0.00	0.00	0.00	0.00	2.69
NW	.90	1.08	0.00	0.00	0.00	0.00	0.00	1.97
NNW	.82	.72	.04	0.00	0.00	0.00	0.00	1.58
CALM								1.33
TOTAL	22.11	68.85	7.42	.29	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2790 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

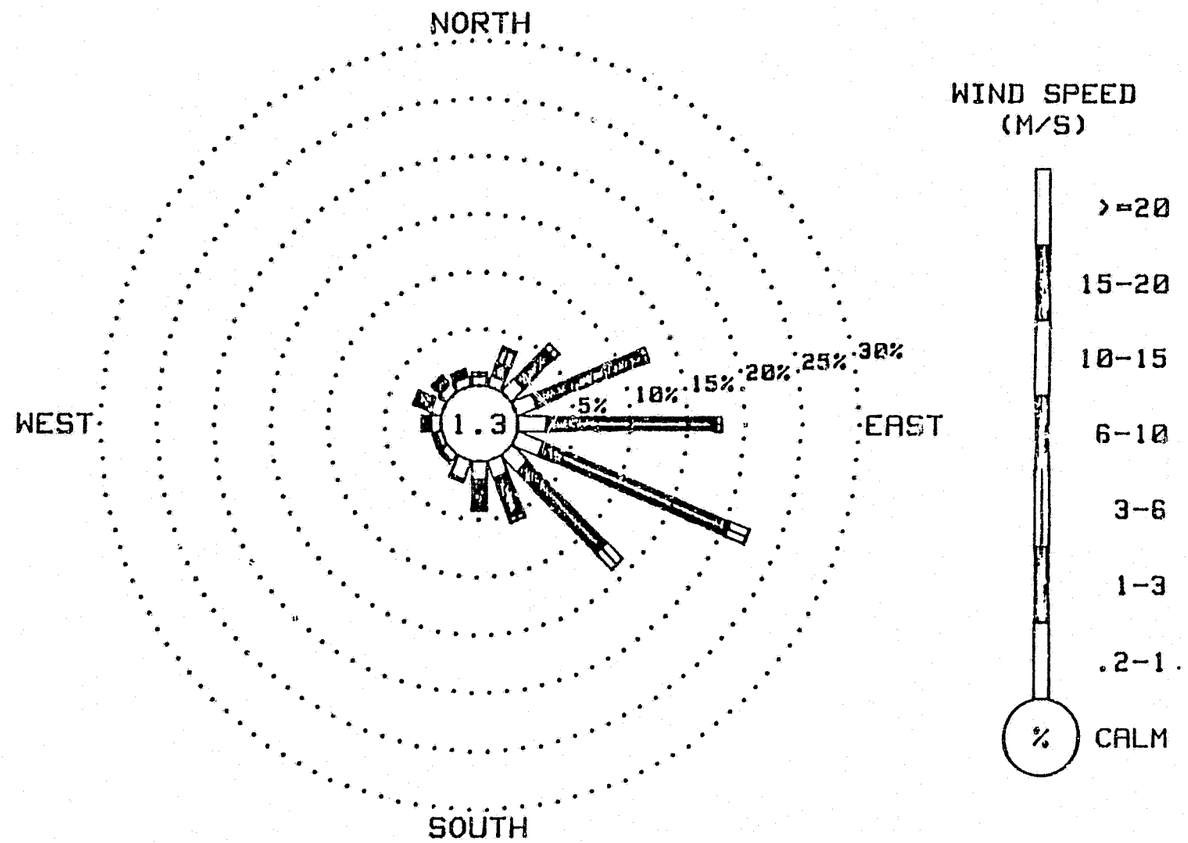
3B-10-125

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

March, 1982



WIND ROSE PLOT

38-10-126

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING April, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.90	.90	.24	0.00	0.00	0.00	0.00	2.05
NNE	1.22	2.60	3.33	.17	0.00	0.00	0.00	7.33
NE	1.56	5.21	.97	.07	0.00	0.00	0.00	7.81
ENE	1.01	7.57	.97	0.00	0.00	0.00	0.00	9.55
E	1.56	9.83	2.05	0.00	0.00	0.00	0.00	13.44
ESE	2.01	11.60	1.77	0.00	0.00	0.00	0.00	15.38
SE	1.56	9.51	.28	0.00	0.00	0.00	0.00	11.35
SSE	2.40	4.06	0.00	0.00	0.00	0.00	0.00	6.46
S	1.98	3.02	0.00	0.00	0.00	0.00	0.00	5.00
SSW	1.53	1.56	0.00	0.00	0.00	0.00	0.00	3.09
SW	.97	1.60	0.00	0.00	0.00	0.00	0.00	2.57
WSW	1.04	2.05	.07	0.00	0.00	0.00	0.00	3.16
W	.97	1.91	.10	0.00	0.00	0.00	0.00	2.99
WNW	.76	2.88	.31	0.00	0.00	0.00	0.00	3.96
NW	.45	2.74	.07	0.00	0.00	0.00	0.00	3.26
NNW	.59	1.49	.03	0.00	0.00	0.00	0.00	2.12
CALM								.49
TOTAL	20 [illegible]	68.54	10.21	.24	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2880 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

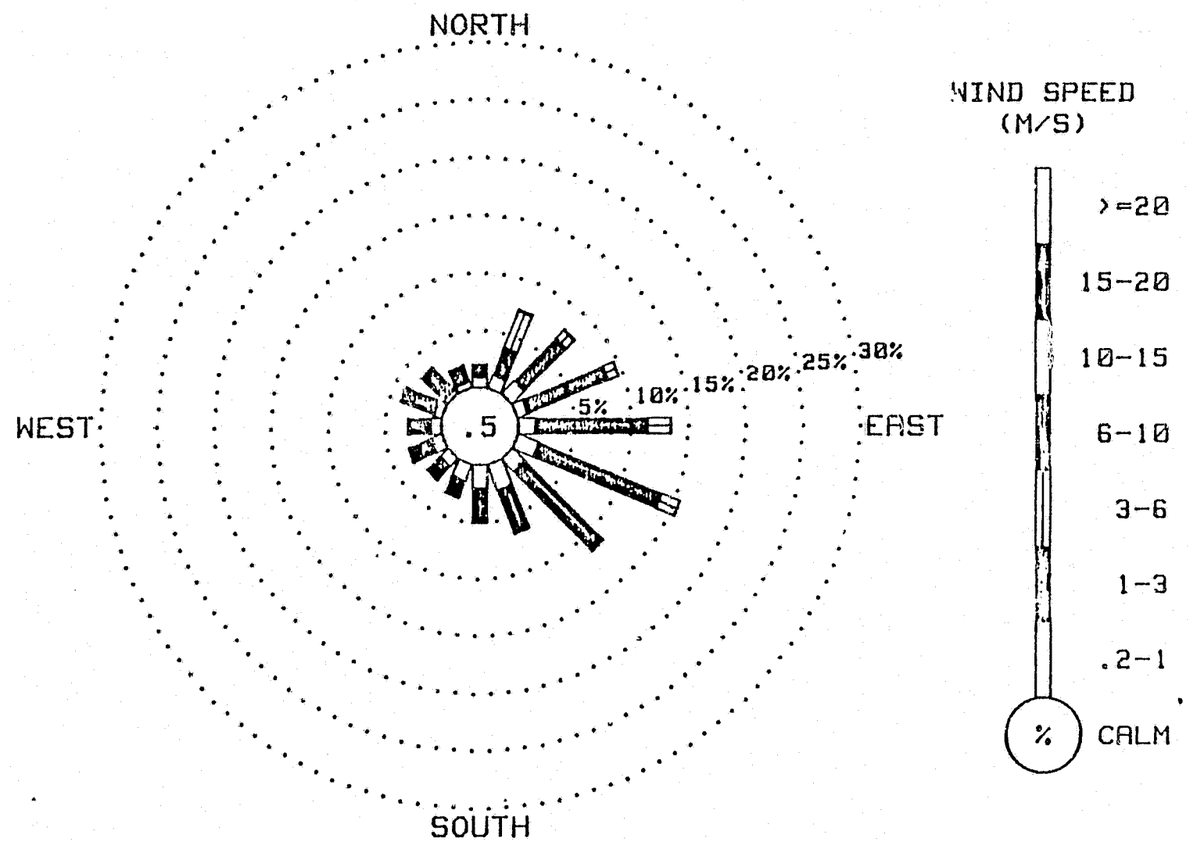
3B-10-127

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

April, 1982



WIND ROSE PLOT

38-10-128

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING May, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	1.24	2.18	.24	0.00	0.00	0.00	0.00	3.66
NNE	1.24	3.83	2.72	0.00	0.00	0.00	0.00	7.80
NE	.74	4.10	.74	0.00	0.00	0.00	0.00	5.58
ENE	1.11	2.49	.37	0.00	0.00	0.00	0.00	3.97
E	1.01	2.69	.13	0.00	0.00	0.00	0.00	3.83
ESE	1.44	3.19	.03	0.00	0.00	0.00	0.00	4.67
SE	1.95	4.50	.07	0.00	0.00	0.00	0.00	6.52
SSE	3.60	4.37	0.00	0.00	0.00	0.00	0.00	7.96
S	3.43	4.40	0.00	0.00	0.00	0.00	0.00	7.83
SSW	2.72	4.00	0.00	0.00	0.00	0.00	0.00	6.72
SW	2.49	4.44	0.00	0.00	0.00	0.00	0.00	6.92
WSW	2.18	4.17	.03	0.00	0.00	0.00	0.00	6.38
W	1.98	3.43	.03	0.00	0.00	0.00	0.00	5.44
WNW	1.28	6.52	.07	0.00	0.00	0.00	0.00	7.86
NW	1.61	6.79	.17	0.00	0.00	0.00	0.00	8.57
NNW	1.24	3.53	.10	0.00	0.00	0.00	0.00	4.87
CALM								1.41
TOTAL	29.27	64.62	4.70	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

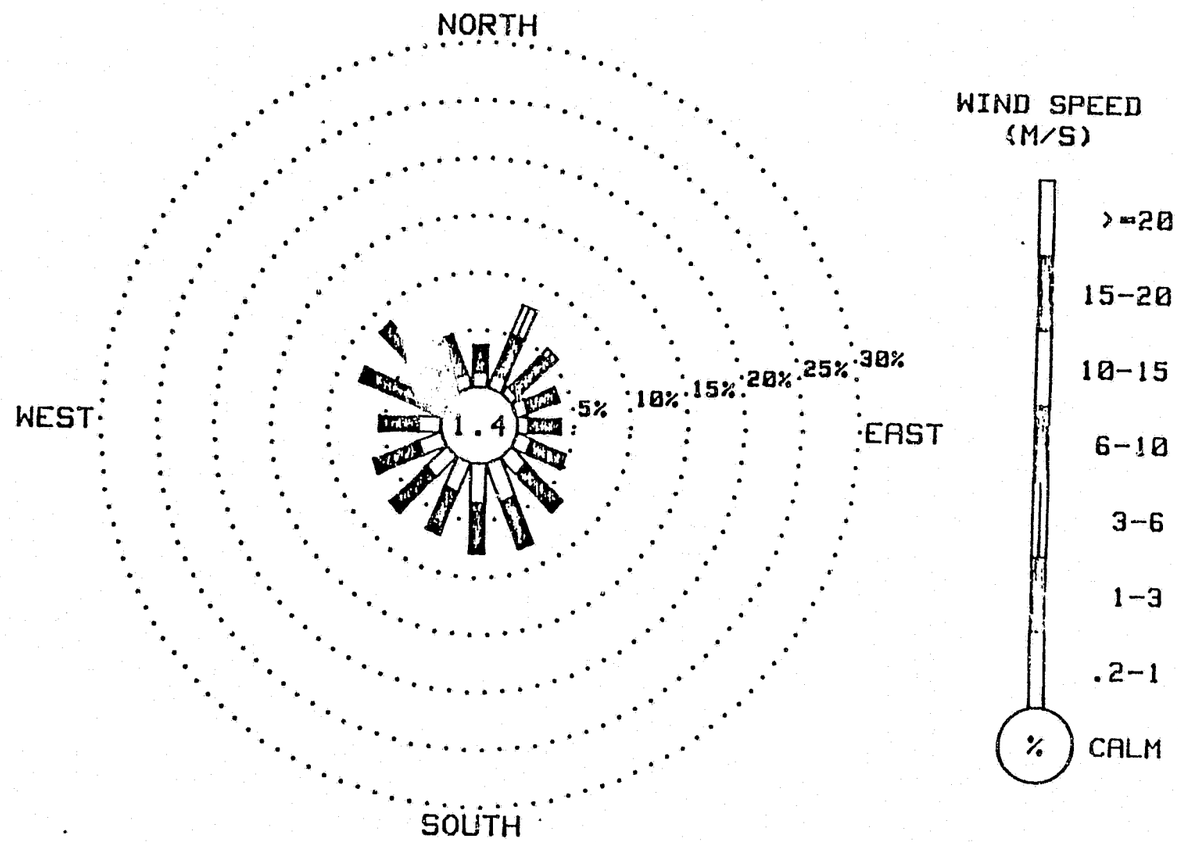
3B-10-129

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

May, 1982



WIND ROSE PLOT

3B-10-130

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING June, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	1.70	2.60	.03	0.00	0.00	0.00	0.00	4.34
NNE	1.53	3.51	.24	0.00	0.00	0.00	0.00	5.28
NE	.69	2.36	0.00	0.00	0.00	0.00	0.00	3.06
ENE	.83	2.15	.03	0.00	0.00	0.00	0.00	3.02
E	.76	2.88	.21	0.00	0.00	0.00	0.00	3.85
ESE	1.25	3.02	.28	0.00	0.00	0.00	0.00	4.55
SE	1.32	2.43	0.00	0.00	0.00	0.00	0.00	3.75
SSE	3.33	1.81	0.00	0.00	0.00	0.00	0.00	5.14
S	3.54	2.15	0.00	0.00	0.00	0.00	0.00	5.69
SSW	2.92	.87	0.00	0.00	0.00	0.00	0.00	3.78
SW	1.88	1.39	0.00	0.00	0.00	0.00	0.00	3.26
WSW	2.85	2.95	.14	0.00	0.00	0.00	0.00	5.94
W	2.47	6.42	.17	0.00	0.00	0.00	0.00	9.06
WNW	2.33	14.13	.73	0.00	0.00	0.00	0.00	17.19
NW	2.01	12.08	1.46	0.00	0.00	0.00	0.00	15.56
NNW	1.60	4.10	.28	0.00	0.00	0.00	0.00	5.97
CALM								.56
TOTAL	31.01	64.86	3.58	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2880 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

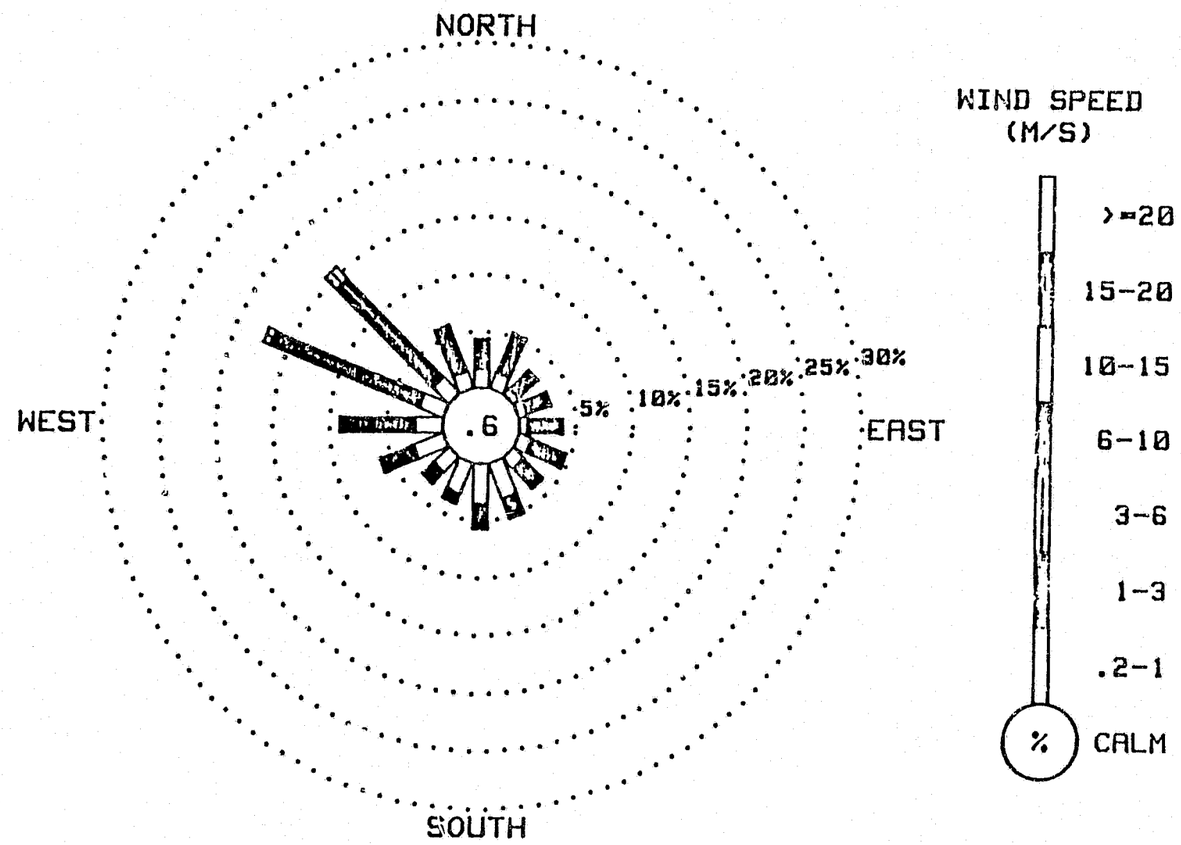
38-10-131

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

June, 1982



WIND ROSE PLOT

32-10-132

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING July, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	.91	1.61	0.00	0.00	0.00	0.00	0.00	2.52
NNE	1.11	2.35	.07	0.00	0.00	0.00	0.00	3.53
NE	.74	1.61	0.00	0.00	0.00	0.00	0.00	2.35
ENE	.64	1.24	0.00	0.00	0.00	0.00	0.00	1.88
E	.60	1.04	0.00	0.00	0.00	0.00	0.00	1.65
ESE	1.24	1.18	0.00	0.00	0.00	0.00	0.00	2.42
SE	1.61	1.51	0.00	0.00	0.00	0.00	0.00	3.13
SSE	2.35	1.81	0.00	0.00	0.00	0.00	0.00	4.17
S	2.79	1.44	0.00	0.00	0.00	0.00	0.00	4.23
SSW	2.82	.81	0.00	0.00	0.00	0.00	0.00	3.63
SW	3.29	1.85	0.00	0.00	0.00	0.00	0.00	5.14
WSW	3.90	3.16	0.00	0.00	0.00	0.00	0.00	7.06
W	4.23	7.96	.13	0.00	0.00	0.00	0.00	12.33
WNW	3.53	18.04	.74	0.00	0.00	0.00	0.00	22.31
NW	2.15	13.10	2.45	0.00	0.00	0.00	0.00	17.71
NNW	1.34	2.82	64	0.00	0.00	0.00	0.00	4.81
CALM								1.14
TOTAL	33.27	61.56	4.03	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

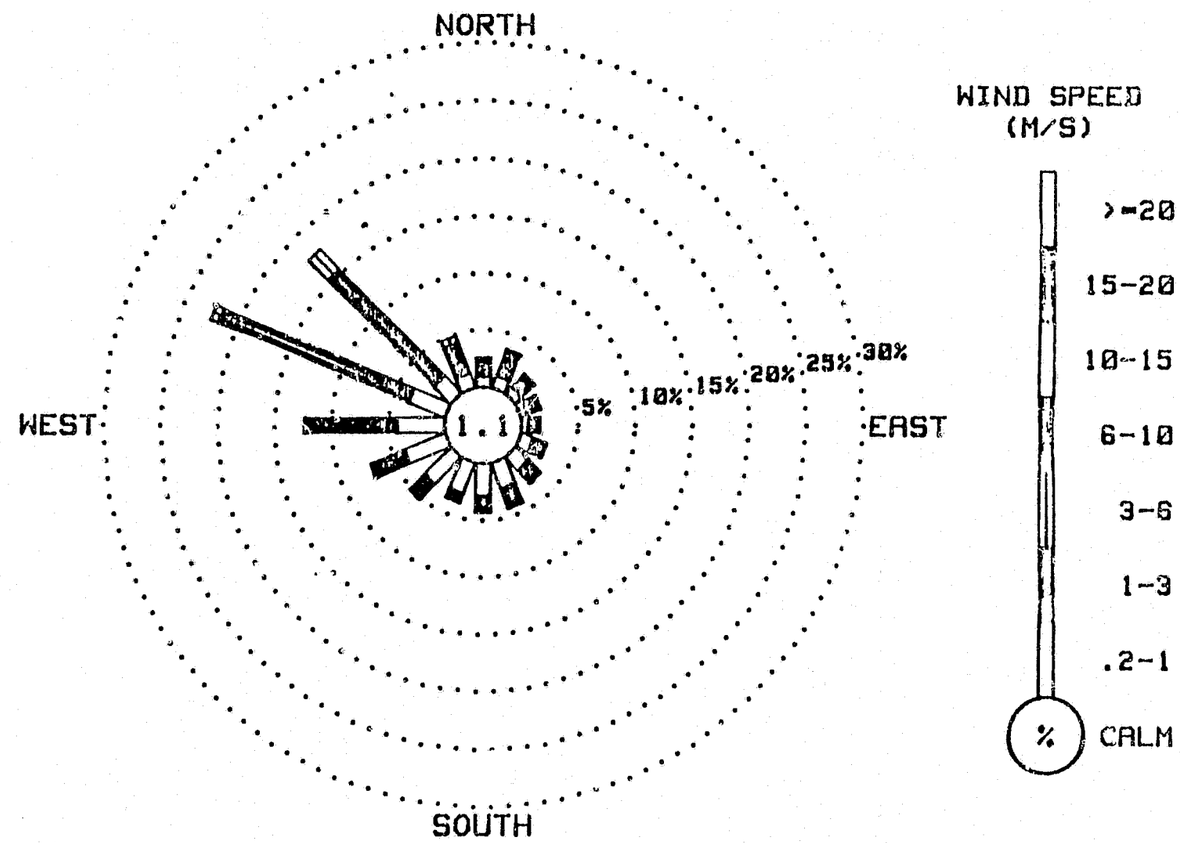
3B-10-133

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

July, 1982



WIND ROSE PLOT

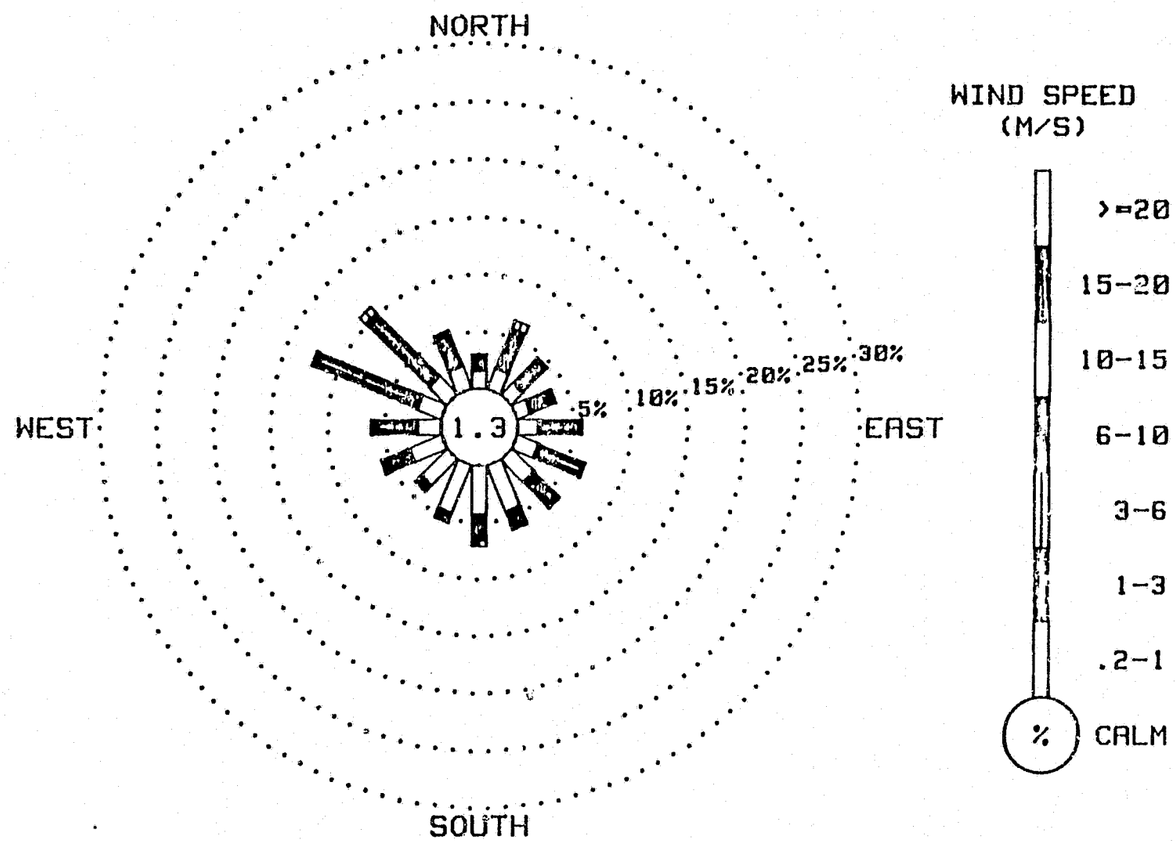
3B-10-134

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

August, 1982



WIND ROSE PLOT

38-10-135

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING August, 1982

DIRECTION	VELOCITY (M/S) 0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	1.48	1.44	.07	0.00	0.00	0.00	0.00	2.99
NNE	1.85	3.86	.77	0.00	0.00	0.00	0.00	6.49
NE	1.41	3.06	.03	0.00	0.00	0.00	0.00	4.50
ENE	1.28	2.39	0.00	0.00	0.00	0.00	0.00	3.66
E	1.81	3.83	.03	0.00	0.00	0.00	0.00	5.68
ESE	2.05	4.33	.10	0.00	0.00	0.00	0.00	6.49
SE	2.79	3.23	0.00	0.00	0.00	0.00	0.00	6.01
SSE	4.37	1.68	0.00	0.00	0.00	0.00	0.00	6.05
S	4.30	2.69	0.00	0.00	0.00	0.00	0.00	6.99
SSW	4.54	.84	0.00	0.00	0.00	0.00	0.00	5.38
SW	3.23	.74	0.00	0.00	0.00	0.00	0.00	3.97
WSW	3.06	2.65	0.00	0.00	0.00	0.00	0.00	5.71
W	2.05	4.10	0.00	0.00	0.00	0.00	0.00	6.15
WNW	2.28	9.85	.17	0.00	0.00	0.00	0.00	12.30
NW	2.18	7.90	.77	0.00	0.00	0.00	0.00	10.85
NNW	2.05	3.33	.13	0.00	0.00	0.00	0.00	5.51
CALM								1.28
TOTAL	40.73	55.91	2.08	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2976 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

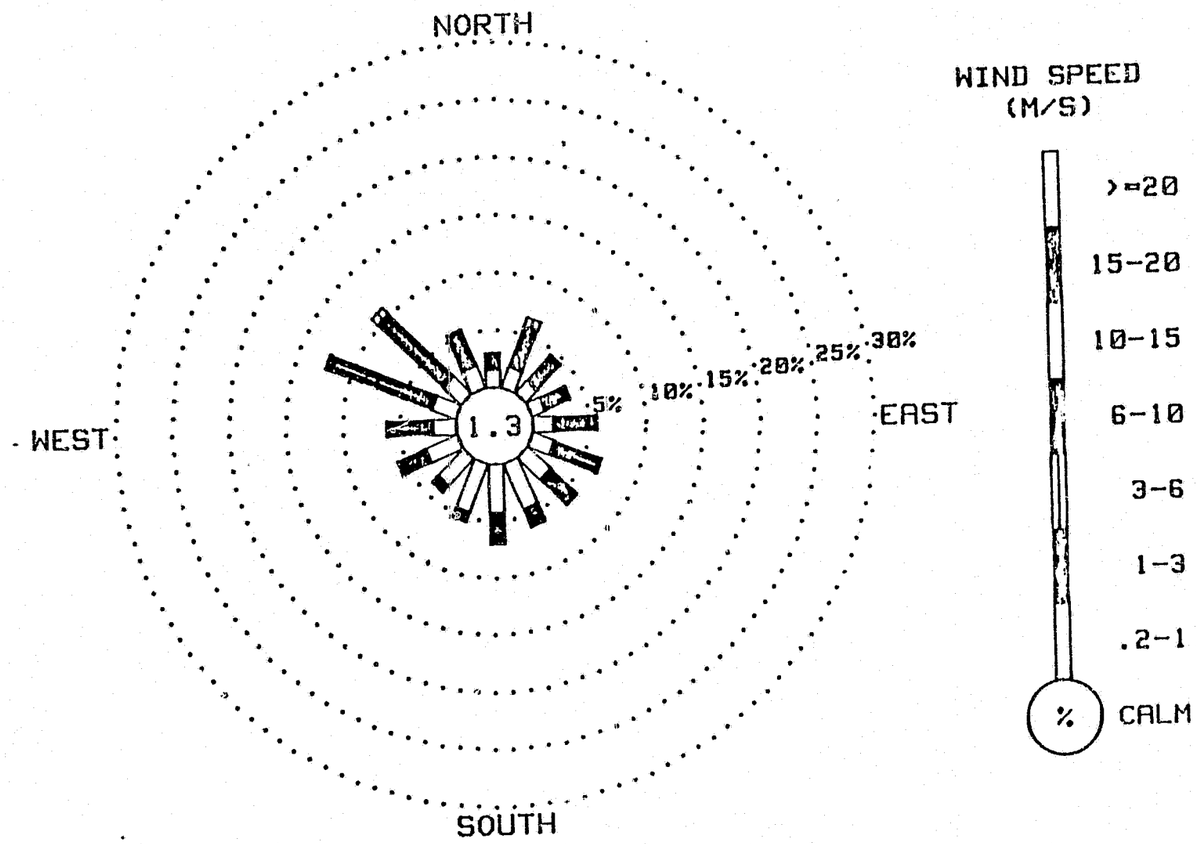
3B-10-136

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

August, 1982



WIND ROSE PLOT

38-10-137

R & M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

WIND FREQUENCY SUMMARY FOR DEVIL CANYON WEATHER STATION
DATA TAKEN DURING September, 1982

	VELOCITY (M/S)							
DIRECTION	0.2 TO 1.0	1.0 TO 3.0	3.0 TO 6.0	6.0 TO 10.0	10.0 TO 15.0	15.0 TO 20.0	20.0 OR GREATER	TOTAL
N	2.57	.31	.10	0.00	0.00	0.00	0.00	2.99
NNE	2.78	2.22	.38	0.00	0.00	0.00	0.00	5.39
NE	1.84	1.60	.03	0.00	0.00	0.00	0.00	3.47
ENE	2.40	3.86	.10	0.00	0.00	0.00	0.00	6.36
E	2.29	3.30	.97	0.00	0.00	0.00	0.00	6.57
ESE	3.79	4.97	.52	0.00	0.00	0.00	0.00	9.28
SE	4.45	3.16	.03	0.00	0.00	0.00	0.00	7.64
SSE	5.63	2.12	0.00	0.00	0.00	0.00	0.00	7.75
S	5.21	2.15	0.00	0.00	0.00	0.00	0.00	7.37
SSW	5.84	1.29	0.00	0.00	0.00	0.00	0.00	7.12
SW	4.27	1.08	0.00	0.00	0.00	0.00	0.00	5.35
WSW	3.37	3.09	0.00	0.00	0.00	0.	0.00	6.46
W	2.47	4.00	.24	0.00	0.00	0.00	0.00	6.71
WNW	1.95	4.97	.17	0.00	0.00	0.00	0.00	7.09
NW	2.36	1.88	.07	0.00	0.00	0.00	0.00	4.31
NNW	2.08	.73	.07	0.00	0.00	0.00	0.00	2.88
CALM								3.27
TOTAL	53.30	40.72	2.71	0.00	0.00	0.00	0.00	100.00

NOTE: ALL FREQUENCIES ARE EXPRESSED IN PERCENT
2878 VALID WIND OBSERVATIONS USED TO DEVELOP FREQUENCY SUMMARY

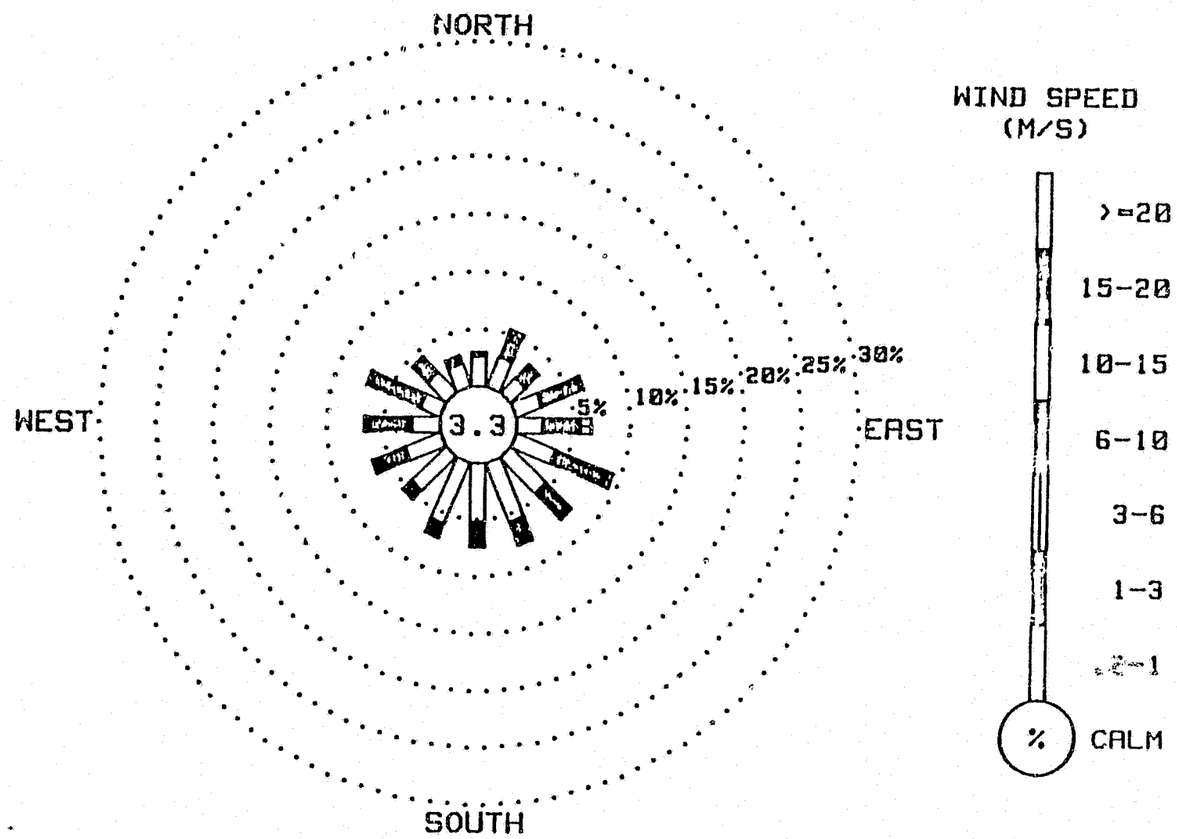
3B-10-138

R&M CONSULTANTS, INC.

SUSITNA HYDROELECTRIC PROJECT

DEVIL CANYON WEATHER STATION

September, 1982



WIND ROSE PLOT

3B-10-139

** Missing or bad data that has been deleted for various reasons (see STATION HISTORY, DATA COMPUTATION STANDARDS, or INTERPRETING DATA for an explanation).

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources -
Terrestrial Botanical Resources

Comment 11 (p. E-3-230, para. 2; p. E-3-242, para. 2)

Indicate whether the area affected by the drawdown zone has been included in estimates of direct vegetation removal due to the impoundments and/or in Tables E.3.83 and E.3.84. If not, provide estimates of the areas affected by drawdown for both Watana and Devil Canyon.

Response

Vegetation removal due to the impoundments (as presented in Tables E.3.83 and E.3.84) was calculated for maximum pool elevation, 2185 ft (666 m) for Watana, and 1455 ft (443.5 m) for Devil Canyon. The drawdown zone is thus included in the impoundment area estimates.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 12 (p. E-3-246, para. 2)

Provide estimates (using tables similar to Table E.3.82) of the number of hectares of different wetland types that will be crossed by each of the transmission corridors (including the Intertie) and areas that will be cleared for access.

Response

Attached are Tables 1 through 6 which provide estimates of the number of hectares of different wetland types that will be crossed by each of the transmission corridors (including the Intertie). Mapped vegetation types were converted to potential wetland classes (see Table E.3.81). Because the system of Cowardin et al. (1979) requires additional data on hydric soils and periodic ambient water conditions to characterize wetlands accurately the mapping indicates all areas which potentially qualify as wetlands under that system (see Section 3.2.3, Methods).

Access to the transmission towers will be provided by construction trails within the transmission corridors. Clearing for these trails will be necessary in areas where shrub vegetation would otherwise be left intact (see clearing specifications, pp. E-3-269 through E-3-274, and Figure E.3.85). This area is included in the attached tables and Tables E.3.79, E.3.80 and E.3.86 in the License Application; these tables estimate the area to be crossed by transmission corridors, not the area to be cleared for the corridors. Occasional trails will be necessary to allow access to construction trails within the right-of-way. The proximity of the Watana-to-Devil

Canyon access road will minimize these clearing needs in the project area. Also, access by balloon-tired and tread vehicles will be possible with little clearing, as much of the area is vegetated by low shrub or tundra.

TABLE 1

SUMMARY OF HECTARES OF POTENTIAL WETLAND TYPES[a] CROSSED BY TRANSMISSION ROUTES

Wetland Type	Willow-Healy[b]	Cook Inlet-Willow[c]	Healy-Fairbanks[c]	Watana-Devil Canyon[d]	Devil Canyon-Gold Creek[c]
Palustrine emergent	126	166	103	0	8
Palustrine scrub-shrub	243	67	255	172	0
Palustrine forested	501	389	902	1	31
Riverine	0	0	21	1	0
Total	870 ha	622 ha	1,281 ha	174 ha	39 ha

[a]Wetland types according to Cowardin et al. (1979)
[b]Transmission line corridor width - 58 m (190 ft).
[c]Transmission line corridor width - 91 m (300 ft).
[d]Transmission line corridor width - 64 m (210 ft).

TABLE 2

AREA OF POTENTIAL WETLAND TYPES TO BE CROSSED BY THE WILLOW-TO-HEALY TRANSMISSION CORRIDOR*

Vegetation Category	Hectares	Acrs	Cowardin Wetland Classification
Wet tundra	126	311	Palustrine emergent
Low brush/muskeg bog	137	339	Palustrine scrub-shrub
Shrubland	106	262	Palustrine scrub-shrub
Upland spruce - hardwood forest	168	415	Palustrine forested
Lowland spruce - hardwood forest	232	573	Palustrine forested
Bottomland spruce - poplar forest	101	248	Palustrine forested
Total	870	2148	

*Measured from Figure 14 in Commonwealth Assoc. (1982). Corridor width is the widening of the corridor to 91 m (300 ft) from the 33 m (110 ft) given by Commonwealth Assoc. (1982).

TABLE 3

AREA OF POTENTIAL WETLAND TYPES TO BE CROSSED BY THE WILLOW-TO-COOK INLET TRANSMISSION CORRIDOR*

Viereck & Dyrness Vegetation Category	Hectares	Acres	Cowardin Wetland Classification
Wet sedge grass tundra	166	409	Palustrine emergent
Low shrub	67	166	Palustrine scrub-shrub
Closed spruce	57	140	Palustrine forested
Open spruce	30	73	Palustrine forested
Woodland spruce	57	142	Palustrine forested
Closed mixed	169	416	Palustrine forested
Open mixed	31	76	Palustrine forested
Closed birch	45	110	Palustrine forested
Total	622	1,532	

*Measured from Figures E.3.51 and E.3.52. Corridor width - 91 m (300 ft).

TABLE 4

AREA OF POTENTIAL WETLAND TYPES TO BE CROSSED BY THE HEALY-TO-FAIRBANKS TRANSMISSION CORRIDOR*

Viereck & Dyrness Vegetation Category	Hectares	Acres	Cowardin Wetland Classification
Wet sedge grass tundra	103	255	Palustrine emergent
Wet sedge grass/low shrub	32	80	Palustrine scrub-shrub
Sedge-shrub tundra	8	20	Palustrine scrub-shrub
Low shrub	215	531	Palustrine scrub-shrub
Open spruce/low shrub/ wet sedge grass/open deciduous	99	245	Palustrine forested/ palustrine scrub-shrub
Open spruce/wet sedge grass/open deciduous	5	13	Palustrine forested/ palustrine scrub-shrub
Closed spruce	16	40	Palustrine forested
Open spruce	521	1,288	Palustrine forested
Woodland spruce	46	114	Palustrine forested
Closed deciduous	9	21	Palustrine forested
Open deciduous	80	197	Palustrine forested
Closed mixed	7	17	Palustrine forested
Open mixed	105	259	Palustrine forested
Woodland mixed	9	23	Palustrine forested
Open spruce/open deciduous	5	13	Palustrine forested
River	21	52	Riverine
Total	1,281	3,168	

*Measured from Figures E.3.48 through E.3.50. Corridor width - 91 m (300 ft). The Tanana Flats portion of the transmission corridor is an area of extremely complex mosaics of various vegetation types. As a result, various complexes were recognized.

TABLE 5

AREA OF POTENTIAL WETLAND TYPES TO BE CROSSED BY THE WATANA-TO-DEVIL CANYON TRANSMISSION CORRIDOR*

Viereck & Dyrness Vegetation Category	Hectares	Acres	Cowardin Wetland Classification
Sedge shrub tundra	29	72	Palustrine scrub-shrub
Birch shrub	96	236	Palustrine scrub-shrub
Willow shrub	13	33	Palustrine scrub-shrub
Low shrub	46	114	Palustrine scrub-shrub
Closed tall shrub	39	97	Palustrine scrub-shrub
Open tall shrub	23	56	Palustrine scrub-shrub
Woodland black spruce	1	3	Palustrine forested
Total	247	611	

*Measured from Figures E.3.39 and E.3.40. Corridor width - 91 m (300 ft).

TABLE 6

AREA OF POTENTIAL WETLAND TYPES TO BE CROSSED BY THE DEVIL CANYON-TO-GOLD CREEK TRANSMISSION CORRIDOR*

Viereck & Dyrness Vegetation Category	Hectares	Acres	Cowardin Wetland Classification
Wet sedge-grass tundra	14	34	Palustrine emergent
Open birch forest	4	10	Palustrine forested
Closed mixed forest	49	122	Palustrine forested
River	2	5	Riverine
Total	69	171	

*Measured from Figure E.3.39. Corridor width - 155 m (510 ft).

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 13 (p. E-3-256, para. 1)

Describe how partially or completely excavated borrow areas for the access roads will be rehabilitated.

Response

Planning for restoration will be incorporated into initial mining plans so that pit opening and operation methods optimize potential for pit restoration. Overburden will be stockpiled for use in restoration. In some sites the overburden may be over 3 feet (1m) in depth. If this much overburden is mixed with topsoil the topsoil, will be diluted, the deeper layers of overburden which will dominate the material to be stockpiled and redistributed over the site may provide a poor quality substrate for plant growth. In these cases surface material including the organic layer and topsoil (top 12 inches [30cm] of mineral soil) will be separated from any additional overburden and stockpiled separately.

When mining is completed in all or portions of the pit, sites will be final graded to create contours which blend into the landscape, including decreasing side slopes to 2:1 where possible. The surface will be scarified on contour to a minimum depth of 12 inches (30cm). This removes compaction caused by heavy equipment. Overburden and separated surface material will be spread over the entire area to be restored, and the surface will be scarified again to a depth of 12 inches (30cm). The immediate goal is to have a rough surface which will decrease runoff, increase infiltration and, on harsh sites, create favorable microsites for plant establishment and

and growth which are sheltered from wind and tend to collect moisture and fines. The ultimate goal of restoration is stablization of the sites and reestablishment of a mature native plant community. Unless needed for erosion control, grasses will not be planted because they are known to inhibit natural establishment and growth of more valuable herbaceous species of plants on many sites in Alaska.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 14 (p. E-3-259, para. 3)

Indicate how the area of wet sedge-grass tundra in the access and transmission corridors was calculated to be 195 ha using Tables E.3.80, E.3.85, and E.3.86, and indicate if the intertie (Table E.3.79) has been included in the calculations.

Response

See Response to Comment 7 in the Terrestrial Botanical Resources Section. The referenced tables and the corresponding text portion have been corrected.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 15 (p. E-3-271, para. 4)

Indicate whether, and in what situations, winter construction of transmission lines will be used as a mitigation measure (since the use of helicopter construction is not currently planned).

Response

Winter construction will be used where extensive stretches of wetlands or areas underlain by ice-rich soils are to be crossed and cannot be avoided by vehicles during construction. The only activities that may be conducted in these areas during the period when the ground surface is not frozen will be surveying, hand clearing of right-of-way vegetation, and other non-vehicular related activities. Additionally, winter or helicopter construction will be considered for use in areas with high erosion potential near important fish streams.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 16 (p. E-3-272, para. 2)

Indicate whether the use of balloon-tire or flat-tread vehicles as required for access to the Watana-to-Gold Creek corridor will also be required for the other transmission corridors.

Response

It is the Power Authority's intention to use construction trails for access to and within all transmission line corridors rather than standard construction roads, except where roads already exist or where project access roads will be built for other purposes. Construction trails will require the removal of tall vegetation, but will not require fill placement or removal of the organic layer except in local situations. In general, access along construction trails will be limited to flat-tread or ballon-tire vehicles.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources -
Terrestrial Botanical Resources

Comment 17 (p. E-3-274, para. 4, to p. E-3-275, para. 1)

Explain where the numbers in the examples in these two paragraphs came from; they do not correspond with previously stated numbers such as those on p. E-3-253.

Response

The referenced text portions have been corrected. See Response to Comment 7 in the Terrestrial Botanical Resources Section.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 18 (p. E-3-275, para. 3, to p. E-3-291, para. 3)

Provide a more detailed description of possible mitigation options for wetlands where avoidance cannot be used as the method of mitigation. For example, describe special construction methods that could be used in wetland areas, and provide examples of the techniques or methods that could be used to mitigate potential alterations to wetland drainage patterns.

Response

Construction methods that could be used to mitigate impacts to wetlands where avoidance is not possible include the following:

- Clearing and construction when the ground is frozen and ice roads can be used.
- Hand clearing.
- Avoiding slash disposal in wetlands.
- Placing fill material for roads or pads over original surface without stripping vegetation and organic layer.
- Utilization of geotechnical fabric to minimize need for stripping and reduce settlement.

- Working off existing fill.

Techniques or methods to mitigate potential alterations to wetland drainage patterns include the following:

- Conducting detailed field hydrologic assessments of quantity and direction of surface drainage.

- Installing sufficient numbers of culverts of adequate size and in the proper locations to prevent uphill ponding and downslope dewatering, to avoid erosion from lateral flow along embankments, and to minimize flow velocity and flow concentration in culverts.

- Installing culverts with sufficient camber to prevent settlement.

- Installing culverts low enough to intercept sheet flow.

- Installing steam pipes in culverts where icing is likely to occur.

- Monitoring after constuction to determine if additional or improved drainage structures are required.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Botanical Resources

Comment 19 (p. E-3-279, para. 1, to p. E-3-280, para. 4)

Provide examples of reclamation plans and procedures that could be used for various types of areas (e.g., slopes, flat areas) and major vegetation types.

Response

Specific reclamation plans are not prepared at the present time. However, there is a good understanding of the procedures which will be used. They are described in the following pages. Specific plans will be provided FERC at least one year prior to initiation of construction.

Reclamation planning assumes adequate civil engineering design for drainage and erosion control including culverts, plunge basins, ditch checks, channel lines, diversion levees, let-down structures, benches or stair-step grading on high cut slopes, and avoidance of high, steep backwalls in erodible material for borrow pits.

The major goals of reclamation will be stabilization, regeneration of native plant communities, and visual impact ameleoration. Procedures to promote natural regeneration will be similar for all vegetation types because of the following ecosystem characteristics:

Plant communities in the project area are subject to natural disturbance by fire, river erosion and deposition, mass wasting and frost action. Plant species in all vegetation types are adapted to colonization and regeneration following disturbance. If the rooting zone has not been removed almost all species present prior to disturbance except white and black spruce will resprout. In most areas disturbed by project construction, the substrate will be mineral soil, subsurface material or replaced overburden. On these sites the dominant species in the early successional stages colonize from seeds dispersed to the site and are similar in all vegetation types. Most of the cultivars of grasses and legumes which will be planted have already been tested throughout Alaska and are known to be suitable for revegetation for the range of site conditions in the project area. Two newer cultivars of native grasses (Poa glauca M. Vahl and Elymus Sibiricus L.) adapted to more specialized site conditions are now being tested.

Reclamation procedures will differ for different types of disturbed sites. Examples for several different types of sites are listed below.

Gravel Pads for Temporary Facilities

After removal of facilities and cleanup of areas, the gravel pad will be scarified to a minimum depth of 18 inches (46 cm). Stockpiled topsoil will be replaced over the site. With or without added topsoil, the surface material will be rough and friable. Sites will be fertilized with NPK fertilizer at a rate of 600 lb/acre. If rapid revegetation is desired for visual impact amelioration, the site may be planted with legumes and native grasses at a low seeding rate which will leave open space for establishment of native plants.

Temporary Roads

Drainage will be restored to as close to original condition as possible, including removal of culverts, breaching of road and restoration of stream channel and banks where appropriate. Roads will be scarified to a minimum depth of 18 inches (46 cm). Scarification will be on contour where slopes are greater than 5%. The road will be fertilized at 600 lb/acre. A grass/legume mixture will be planted if required to control erosion and ameliorate visual impact. Public access will be blocked. Seedlings and/or cuttings of mature plants may be planted where accelerated growth of a vegetative screen for visual impact is desired. Placement of a surface layer of material suitable for plant growth (topsoil or subsurface material with a high percentage of fines, preferably intermixed with organic material) may be necessary for vigorous growth of seedlings or cuttings.

Cut and fill slopes

Stair-step grading will be used where feasible for long, steep, erodible cut slopes. Cut and fill slopes which are not stair-step graded will be left with a rough surface, as rough slopes decrease erosion and provide microsites for plant growth. Slopes of 3:1 or less can be scarified perpendicular to the slope. If the surface is smooth and hard and scarification is not possible, slopes will be serrated. Cut and fill slopes will be fertilized and planted to a grass/legume mixture where required for erosion control.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resouces - Terrestrial Wildlife Resources

Comment 1 (p. E-3-311, para. 4)

Provide a complete description of criteria for stratifying census area into low, medium, and high density strata.

Response

Stratification is the partitioning of the survey area into several subunits called strata. The objective of stratification is to partition the survey area in such a way that moose densities are more similar within strata than among strata. The number of strata is based largely on the accuracy with which biologists are able to identify areas with homogenous densities of moose and is usually limited to 3 or 4 strata (e.g., high, medium, low, and zero moose density). The zero density stratum includes only those portions of the survey area that do not contain moose habitat, such as large lakes or glaciated mountains.

If several biologists participate in the census, each must have a similar concept of the moose density criteria for each stratum. The usual method used for calibrating each stratifier is to begin the initial stratification flight with all biologists in one aircraft until each person has a similar concept of the relative moose densities in the various strata and can assign the same stratum classification to areas of similar moose density. Stratification is based on a subjective evaluation of moose densities, based upon any clues that will give an idea of moose density within and between sample units. The following clues are used during stratification flights:

a) Prior knowledge of moose distribution based on previous surveys.

b) The number and distribution of moose seen during the stratification flight.

c) Density of moose tracks observed.

d) Quality and extent of moose habitat. Habitat clues are usually combined with direct observations of moose density to arrive at the final stratum classification. Habitat quality is usually based on a combined evaulation of the terrain (slope, aspect, elevation) and vegetation of the area. Where large expanses of a low density habitat type are encountered, a portion of the block of habitat may be stratified using direct observations of moose density and the remainder is then stratified using habitat only.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources -
Terrestrial Wildlife Resources

Comment 2 (p. E-3-337, para. 3)

Provide a schedule of when results from ongoing studies will be available.

Response

A report has been prepared on the referenced black bear studies. This report and the other big game study reports (dated April 1983) were transmitted to F.E.R.C. by letter from R. Mohn to W. Wakefield on May 31, 1983. Many of these studies are still ongoing and another report will be prepared during spring 1984.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Comment 3 (p. E-3-411, para. 1)

Provide an estimate of the numbers of moose using the mineral lick and the number of other licks used by the local moose population.

Response

Little is known about the ecological importance of natural mineral licks used by moose in Alaska. The results of one study conducted in Denali National Park indicated that licks may contribute an important source of sodium for moose in early summer, a period during which moose may physiologically enter a negative sodium balance. (Tankersley, N.G. 1981. Mineral lick use by Moose in the Central Alaska Range. Unpublished M.S. thesis, University of Alaska, Fairbanks.) It is not known whether individual moose habitually return to and use the same individual licks. Moose are generally more mobile and less patterned in their behavior than are Dall sheep, and are able to obtain large quantities of sodium and other nutrients from aquatic plants during summer and fall.

Moose have been sighted infrequently at the Jay Creek lick during aircraft overflights to observe Dall sheep use of the same lick. Intensive ground observations of the Jay Creek lick are presently being conducted, and evidence of all species observed using the lick will be recorded. An estimate of the number of moose visits to the Jay Creek lick during spring and early summer 1983 will be provided when the data become available. No mineral licks with intensive moose use are known to occur in the project area.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Comment 4 (p. E.3-450, para. 2)

Indicate the availability of bald eagles nest sites relative to food availability.

Response

In many regions, abundance of many raptors is limited by availability of nesting sites rather than food (Newton, I. 1979. Population Ecology of Raptors. Buteo Books, P. O. Box 481, Vermillion, SD 57069. 399 pp). Bald eagles, especially those nesting inland in southcentral and interior Alaska appear to be no exception. Bald eagles in the Susitna River drainage are dependent on the availability of appropriately sized and configured balsam poplar and white spruce for nesting locations. However, the vast majority of trees of these species that occur in the Susitna drainage are not suitable for nesting platforms (i.e., they do not meet various criteria required/preferred by nesting eagles). Mature balsam poplar trees, preferred by eagles for nesting, decrease in abundance as one proceeds upstream from the mouth. Few poplar trees of appropriate size and configuration occur in the middle basin. Therefore, the highest densities of eagles are observed along the lower reaches of the river.

The overall availability of food for bald eagles is believed to be greater than the availability of suitable nesting locations throughout the drainage, especially in its upper reaches. As one progresses upstream, the number of bald eagles and eagle nests declines markedly, well before the distribution of salmon declines. Other fish species, commonly preyed upon by bald eagles, occur in the middle basin region. Waterfowl, not especially

abundant in any part of the drainage, occur throughout much of the middle basin, where they may be more vulnerable as prey because they frequent lakes and ponds in more open terrain. Available information on the fish and bird resources of the Susitna drainage suggest that the prey base in the middle basin region is adequate to support larger numbers of bald eagles.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Comment 5 (p. E-3-494 to E-3-495)

Describe the potential for impacts of operating transmission lines on wildlife use of rights-of-way.

Response

As described on p. E-3-492 through E-3-499, the potential impacts of the transmission corridor on wildlife during the operation phase include: 1) habitat alteration, 2) periodic disturbance during maintenance and repair, 3) increased hunting and trapping due to improved access, and 4) hazards to large raptors and swans. Right-of-way maintenance will occur as needed to insure timely access in the event of a line breakage and to avoid damage to lines by wind-thrown trees. It is anticipated that right-of-way maintenance will occur at approximately 5- to 10-year intervals in most areas. Habitat alterations which occur during maintenance will be less severe than those which result from initial construction, comprising the return of recently developed medium and tall shrub to low or medium shrub categories (see Figure E.3.85). The maintenance of early successional habitat is likely to benefit moose and black bear and some small mammals and birds. The cleared transmission right-of-way will be used as a movement corridor by foxes and coyotes and will increase the availability of prey for those raptors and mammalian predators which feed on small mammals.

Disturbance is not anticipated to have more than transitory effects on most mammal species. Large mammals which are sensitive to disturbance may avoid the corridor during clearing operations. Small mammals, raptors, terrestrial birds, and waterfowl may suffer nest destruction and disturbance during

clearing operations. This would constitute a serious impact only for the less abundant raptor species. This impact is fully treated on p. E-3-497 and E-3-498.

No predictions can be made regarding the magnitude of increase in hunting and trapping due to access provided by the transmission right-of-way. Use of the corridors for access is expected to be greatest near roads, towns, and villages. Moose, black bear, marten, fox, coyote and beaver are the species most likely to be affected. Marten and beaver are the most susceptible to over-utilization.

Electrocution and collision hazards to large raptors and swans are treated on p. E-3-496 and E-3-497. It should also be noted that the proposed horizontal configuration of the conductors should minimize the potential for collisions compared with other configurations which create two or more levels of conductors. Additionally, although waterfowl occur in low to medium density along many corridor segments, no major waterfowl concentrations are crossed by the routes (Arctic Environment I Information and Data Center, 1973. Alaska regional profiles - southcentral and Yukon Regions. Sponsored by the State of Alaska in cooperation with the Joint Federal-State Land Use Planning Commission for Alaska).

Wildlife impacts resulting from the corona effect and electric or magnetic fields are also a theoretical possibility. However, no significant biologic effects on wildlife resulting from these phenomena have been documented (Lee et al. 1978. Electrical and biological effects of transmission lines: a review. USDOE, Bonneville Power Administration, BPA-BIO-78-1. Portland, Oregon, 75p.). Although at sufficiently high levels deleterious biologic effects may be produced, field strengths at which such effects may occur are significantly higher than the levels found beneath 500 k.V. lines (Lee et al. 1980).

The presence of the transmission line is unlikely to have measurable effects on wildlife use of rights-of-way aside from those identified here.

EXHIBIT E

3. Fish, Wildlife, an Botanical Resources - Terestrial Wildlife Resources

Comment 6 (p. E-3-499, para. 2)

Indicate the criteria for determining " ... sufficient magnitude to influence mitigation planning."

Response

The mitigation plan was developed for impacts likely to have population-level effects on important species in accordance with the approach outlined in Sections 1.2 and 1.3. The categorization of species importance was conducted as described in Section 4.1. In general, the prioritization of species and impacts determines the prioritization of mitigation. The procedure for prioritization (established by the Susitna Hydroelectric Project Fish and Wildlife Mitigation Policy, Alaska Power Authority 1982 and described more completely in Section 1) incorporates assessment criteria of the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service, other state and federal agencies, professional biologists of the University of Alaska and private consultants. Several factors are included in the evaluation of impact prioritization including: commercial, subsistence or other consumptive use of the resource, resource vulnerability, probability of occurrence of impact, duration of impact, and potential for producing population-level effects. The mitigation policies referenced in Section 1 and agency comments reviewed in Section 4.4.4 indicate that impacts on productivity and population size through changes in availability of habitat are of great concern. These criteria were used to identify target species and specific impacts requiring treatment in the application and in mitigation plans.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources
Terrestrial Wildlife Resources

Comment 8 (p. E-3-536, para. 4)

Indicate if mitigation by shifting the road alignment also includes avoiding the use of borrow material near the nest as well as other sensitive areas indentified in Figures E.3.80 and through E.3.82.

Response

Borrow material for the access road will not be obtained from any sensitive areas along Deadman Creek.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Comment 9 (p. E-3-540, para. 1)

Indicate if transmission lines were sited so as to reduce or avoid potential for collisions.

Response

The reduction or avoidance of collision potential was a factor considered in the siting of transmission lines (see Chapter 10). Among the environmental factors considered in the development of an environmental rating for the alternative corridors was the quality and quantity of waterfowl and raptor habitat crossed by each alternative corridor (see Tables E.10.21, E.10.22, and E.10.23). The potential for waterfowl and other bird collisions with the transmission lines along the proposed corridors is considered to be low and any mortality resulting from such collisions should be biologically insignificant (see p. E-3-496 and E-3-497 and response to Comment 5 of Chapter 3, Terrestrial Wildlife Resources).

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Coment 10 (Table E.3.71, E.3.83, and E.3.92)

Indicate which is the value to be used for the areal extent of low-mixed-shrubland.

Response

The areal extent of low mixed shrubland shown in Table E.3.92 (520,250 ha) is incorrect. The correct value is 515,655 ha. The value for the impoundment zones (1,853 ha) is correct. The latter value is the combined total of the areas for birch shrub (813 ha), willow shrub (87 ha), and mixed low shrub (953 ha) shown in Table E.3.83.

The areal extents of the other vegetation types shown in Table E.3.92 are also incorrect. A corrected version of Table E.3.92 is appended. As a result of these corrections, the winter carrying capacity estimate of 23,037 resident moose shown on p. E-3-307, para. 3, should read 24,006 resident moose.

TABLE E.3.92: WINTER CARRYING CAPACITY OF THE WATANA IMPOUNDMENT ZONE (INCLUDING ADJACENT PROJECT FACILITIES) AND SUSITNA WATERSHED UPSTREAM OF GOLD CREEK FOR MOOSE BASED ON THE BIOMASS OF TWIGS AVAILABLE IN WINTER (SEE TEXT AND APPENDIX EH FOR DETAILED EXPLANATION OF METHODS USED).

Vegetation Type (Level 3)	Area (ha)		Available Browse (kg/ha)	n	Twig Biomass ($kgx10^3$)		Moose Days		Winter Residents	
	Impoundment Zone	Basin			Impoundment Zone	Basin	Impoundment Zone	Basin	Impoundment Zone	Basin
Open coniferous forest	3,844	118,873	29.9	240	114.9	3,554.3	22,980	710,860	127.7	3,949.2
Woodland coniferous forest	4,834	188,391	10.0	45	48.3	1,883.9	9,660	376,780	53.7	2,093.2
Open deciduous forest	326	968	5.5	15	1.8	5.3	360	1,060	2.0	5.9
Open mixed forest	1,480	23,387	34.0	15	50.3	795.2	10,060	159,040	55.9	883.6
Low mixed shrubland	1,853	515,655	29.8	363	55.2	15,366.5	11,040	3,073,300	61.3	17,073.9
TOTALS				678	270.5	21,605.2	54,100	4,321,040	301	24,006

(Revised)

3W-10-2

EXHIBIT E

3. Fish, Wildlife, and Botanical Resouces - Terrestrial Wildlife Resources

Comment 11 (Table E.3.143)

Define the number in parentheses next to each species name.

Response

The number in parentheses next to each species name is the number of captures of that species per 100 trap nights at all stations combined. The column heading, (d_i) shoui read(Σd_i).

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Comment 12 (Table E.3.165 and Tables E.3.71, E.3.83, and E.3.84)

Indicate which values for areal extent of vegetation types are to be used.

Response

The values for areal extent of vegetation in Table E.3.165 are from Tables E.3.51, E.3.83, and E.3.84. Areas given in Table E.3.71 represent only Watana Watershed and do not include Gold Creek Watershed (provided in Table E.3.72). The relationship between bird habitat types and Viereck and Dryness (1980) vegetation types is shown in Table E.3.139.

EXHIBIT E

3. Fish, Wildlife, and Botanical Resources - Terrestrial Wildlife Resources

Comment 13 (Table E.3.165)

Define "total % of other projects".

Response

The heading should read: "Total % of Gold Creek and Watana Watersheds with both projects".

EXHIBIT E

5. Socioeconomics

Comment 1 (p. E-5-8, para. 4 through p. E-5-26, para. 1)

Provide data on the distribution of temporary and rental housing or lodging units throughout the project region. Provide date when supplemental information will be available.

Response

Most of the rental housing in the region is located in the greater Anchorage area. For example, in 1981, there were an estimated 65,771 housing units in the Municipality of Anchorage. Results of surveys conducted for Anchorage show that the proportion of total housing stock that was rental property from 1978-1981 ranged between 48 and 52 percent1/. Using 50 percent for this proportion, the number of rental units in Anchorage in 1981 is estimated at 32,886 units.

An estimate of the total number of rental units in the Mat-Su Borough may be made by applying an estimate of the proportion of rental housing to the total housing stock (8,582 in 1981). An estimate of this proportion was obtained in a 1981 Borough survey which showed that approximately 14 percent of all occupied units were rented2/. Applying this proportion to the total housing stock indicates that approximately 1,200 units were rental units Borough-wide.

1/ R.L. Polk and Company. 1981. Annual Review: Profiles of Change, Anchorage 1978-1981. Detroit, Michigan.

2/ Policy Analysis, Limited and Dr. Richard Ender. May 1980. Mat-Su Housing and Economic Development Study: Survey Findings. Anchorage, Alaska.

The remainder of this discussion describes the availability and distribution of rental housing in selected areas of the Mat-Su Borough, including lodges (which are often rented or leased on a long-term basis), but excluding hotels and motels. The information was collected through personal communication with community leaders and lodge operators and through the review of secondary data.

Local Impact Area

There are three lodges in the immediate vicinity of the projet site; i.e., Tsusena Lake, Stephan Lake, and High Lake. The new owners of Tsusena Lake Lodge plan to expand the facility and open it for commerical use. Stephan Lake Lodge (10 structures and 7 cabins) is commerically used for guided hunting and fishing activities. High Lake Lodge has nine structures that can accommodate 25 people.

Trapper Creek

Three businesses rent units in Trapper Creek. These include: Trapper Creek Trading Post (1 cabin), Moose Creek Lodge (10 rooms), and Green's Cash Lodge (5 rooms). In addition, there are four rental housing units. Furthermore, it is estimated that approximately 10-12 cabins have been vacated by the owners and are currently occupied by renters.

Talkeetna Vicinity

In the vicinity of Talkeetna there are several lodges, including: the Talkeetna Roadhouse (6 rooms) and the Swiss Alaska Inn (14 double rooms). In addition, between Talkeetna and Willow there are three other lodges; namely, Montana Creek Lodge (3 cabins), Sheep Creek Lodge (2 cabins and 1 trailer), and Pioneer Lodge (10 rooms).

Cantwell and Vicinity

There are two lodges in Cantwell: The Jack River Inn and the Reindeer Mountain Lodge (9 rooms). North of Cantwell, there are a number of lodges, including: the Jere-A-Tad Lodge (11 units), North Face Lodge (50 rooms), and the Healy Roadhouse (±10 rooms). In addition, there are several lodges near Denali National Park.

Houston

Houston contains only a small number of temporary or rental housing. For example, it is estimated that there are only three duplexes and one fourplex that are rental units, in addition to two businesses with rental apartments (one with two units and one with six units).

Palmer and Wasilla

In general, the majority of rental property in the Mat-Su Borough is in Palmer, Wasilla, and the surrounding area. However, rental housing data for the area are not readily available.

EXHIBIT E

5. Socioeconomics

Comment 2 (p. E-5-27 para. 1 through p. E-5-52, para. 4)

Provide a discussion of impacts related to development of the proposed project on Native Alaskans. Provide date when supplemental information will be available.

Response

The development of the proposed project would result in three general types of potential impacts to Native Alaskans: (1) social and lifestyle changes (affecting Native Alaskans living in the Local Impact Area); (2) increased employment and business opportunities for Native Alaskans living in the Railbelt region; and (3) effects of Native landholdings, especially those of the Cook Inlet Region, Inc.(CIRI) and the Ahtna, Inc. Regional Corporations, and the Chickaloon, Knik, and Tyonek Village Corporations. In addition, Ninilchik Village Corporation may be affected if CIRI conveys lands to this group. Similarly, the Gold Creek Native Group may be affected if they obtain Federal D-1 lands. Moreover, the Tyonek Village Corporation could be indirectly affected depending on the extent of fisheries impacts since the residents have subsistence fishing permits in Cook Inlet.

Social and Lifestyle Changes: Few Native Alaskan live in the Local Impact Area of the proposed project. For example, Cantwell, the only Native village in the impact area, had an estimated winter/summer population of 183 in 1982. Of this number, only approximately one-half were Natives. As discussed on pp. E-5-7 and E-5-8 of Chapter 5, Exhibit E of the License Application, social relationships between Natives and non-Natives in

Cantwell have been strained for several years. This strain is related to recent increase (e.g., dating from the completion of the Parks Highway in the mid-70's) in the number of non-Natives living in the community and competition for scarce jobs. In addition, land ownership patterns have also contributed to social friction in the community. Historically, the federal government controlled much of the land in the area, thus restricting the amount of land available for private landholdings. Nonetheless, homesteads have represented a large category of private non-Native land in the area. Friction in the community increased after enactment of the Alaska Native Claims Settlement Act in 1971. This act provided Native Alaskans in Cantwell with the opportunity to claim large amounts of land in and around Cantwell and to subsequently limit access to those areas.

It is anticipated that the project-related population influx into Cantwell will be mostly non-Native. This in-migration of non-Natives could exacerbate existing friction in the community and could cause the Natives in Cantwell to lose influence in the community. However, since Natives living in Cantwell are members of the Ahtna, Inc. Regional Corporation and therefore own much of the land in the immediate area (54,000 acres), they will be in a position to influence the size of the in-migrating population, since housing and private land available for development in the area are limited.

Employment and Business Opportunities: The project may provide increased employment opportunities to Native Alaskans throughout the Railbelt region. Nonetheless, because there will be competition with non-Natives for project-related construction jobs, and because hiring on state jobs generally occurs through labor unions, in the absence of special employment policies, the ability of Native Alaskans to obtain preferential employment on the project may be limted.

An example of an employment opportunity for Native Alaskans that is already occuring is the Ahtna, Inc. and the Knik Village Corporation joint venture that provides housekeeping and maintenance services for the current Susitna project field program.

Effects on Native Landholdings: The development of the proposed project would result in several potential impacts to Native land holdings, interim conveyed lands, and selected lands in the middle and upper Susitna basins, including the land area on both sides of the Susitna River and the area north of the river. First, it is anticipated that an access road to the site would increase the economic feasibility of Native land development. According to Ahtna, Inc. spokepersons, the corporation anticipates that the increased economic activity will induce residential and recreation development of its lands around Cantwell and the Denali Highway. Similarly, Cook Inlet Region, Inc. and the Chickaloon, Knik, Tyonek, and possibly the Ninilchik Village Corporations and the Gold Creek Native Group are expected to find that improved access to claimed interim conveyed lands on the south side of the Susitna River would increase the feasibility of developing mineral and recreational projects. At the same time, development of the proposed project would increase public access to the middle and upper Susitna basins. Currently the majority of non-Native users in this area are researchers, hunters, trappers, and fishermen. As permanent conveyance of landholdings from federal ownership to Native ownership ocurs, the Native regional and village corporations will begin controlling the use of those lands. In the absence of controls by the Native corporations or other control measures, the project's access route and, to a lesser extent the transmission corridor, would provide increased access and trespassing to those areas.

EXHIBIT E

5. Socioeconomics

Comment 3 (p. E-5-30, para. 2; p. E-5-38, para. 1; p.E-5-40, para. 5; p. E-5-64, para. 4)

Explain the discrepancy between the ratios of direct workers plus dependents to support workers plus dependents (3:1, 1:1, 4:1) and the multipliers used to generate population projections (ranging from 1:1.2 to 1:2.4).

Response

The differences in proportions on pp. E-5-30, E-5-38, and E-5-40 in Chapter 5, Exhibit E, of the License Application are in the ratio of direct population in-migration to support population in-migration, rather than in direct population to support population as stated in the comment. The multipliers on p. E-5-64 in Chapter 5 represent the ratio of total work force to direct work force used to project support employement, while another set of multipliers was used to project population in-migration related to direct and support employment.

Calculation of Project-Related Employment

Support (indirect) employment was projected using the multipliers on p. E-5-64 in Chapter 5. These multipliers were applied to on-site (direct) jobs that will be filled by persons who live in these communities and census divisions at the beginning of the project, and to on-site jobs that will be filled by workers who choose to relocate to the communities and census divisions. The total number of support jobs generated by on-site workers who settle off-site was calculated for each community and census division.

Some of the support jobs generated by the project will be filled by existing residents. The extent to which this occurs will vary among communities. For example, in Trapper Creek it is estimated that 70 percent of the project-related jobs will be filled by in-migrants. This is the principal reason that the ratio of direct population in-migration to support population in-migration is comparatively low: 1:1. In Talkeetna, it is estimated that 25 percent of the newly generated jobs will be filled by in-migrants, thus the ratio of direct population in-migration to support population in-migration is comparatively high: 4:1. Estimates of the percentage of sup port jobs that will be filled by in-migration to other communities and census divisions are shown on p. E-5-65 in Chapter 5.

A higher proportion of the direct work force as contrasted to the support work force is projected to in-migrate to the Local Impact Area since the majority of the project hiring is anticipated to occur in Anchorage and Fairbanks, the locations of trade union hiring halls. Additionally, many of the skills needed for the project will be specialized and unavailable among existing workers in the Local Impact Area. Project-induced support employment, which will result from the expansion of the existing retail trade and service sectors will provide employment opportunities for local residents.

Calculation of Project-Related Population

Population related to in-migrating workers was projected with a higher population multiplier for the direct work force than for the support work force. These multipliers were based on studies of construction worker demographics which indicate that the average household size for construction workers is larger than the average household size for the state as a whole, while the average household size of the support work force is similar to the average household size for Alaska[1/].

The reason the aggregate employment multipliers range from 1.2 to 2.4 is that they are place and time-specific; that is, some places have higher multipliers than others, and multipliers increase with time in each place. It was assumed that the multipliers would increase in size with time since this has been the historical trend for the state. As the state and its local economies continue to grow, locally produced goods and services will increasingly be substituted for imported goods and services, thereby resulting in higher aggregate employment multipliers.

1/ U.S. Army Corps of Engineers, Engineer Institute for Water Resources. June 1981. Construction Work Force. Fort Belvoir, Virginia.

EXHIBIT E

5. Socioeconomics

Comment 5 (p. E-5-37, para. 2)

Document that the state will assume responsibility for maintenance and winter plowing of the Denali Highway and maintenance of the project access road during and after project construction, whether or not the road is eventually closed to public access.

Response

The Alaska Power Authority has initiated discussions with the Alaska Department of Transportation and Public Facilities (DOT/PF) regarding maintenance and winter plowing of the Denali Highway and project access roads. At this time, discussions have been very preliminary. The ultimate objective of these discussions will be to execute a memorandum of understanding between DOT/PF and the Power Authority regarding maintenance of the Denali Highway and project access roads. FERC will be provided with copies of the memorandum of understanding and/or updates of discussions as they become available.

5. Socioeconomics

Comment 6 (p. E-5-39, para. 5, 6; p. E-5-42, para. 3, 4; p. E-5-48, para. 1, 2)

Discuss the conditions under which "a strain on this informal system" will be defined as occuring, as well as a plan or alternatives for who will provide these services. Provide date when supplemental information will be provided.

Response

The conditions under which a strain on informal medical and social service systems will occur in Trapper Creek, Talkeetna, and Cantwell cannot be established with certainty. As the population increases, the need for additional and more specialized health care will arise. At some point in the growth scenario a strain will occur. Exactly when this will happen depends on the size of the population increase, the socioeconomic characteristics of new and existing residents, and the communities' ability and desire to finance and support needed medical and social service systems. As indicated on p. E-5-39, E-5-42, and E-5-48 in Chapter 5, Exhibit E of the License Application, the proposed Susitna Project will cause the communities of Trapper Creek, Talkeetna, and Cantwell to grow more rapidly than the without-project scenario. It is possible that project-related in-migrants will have higher expectations for health services than current residents, who generally accept the scarcity of nearby medical care and social services as part of the rural lifestyle they have chosen. Thus, the project is expected to create a need for additional services in these communities at an earlier date than would occur without the project.

Additional health care could become available in the communities through development of alternatives, such as:

- Establishing a public health clinic to serve the northern part of the Mat-Su Borough as well as Cantwell.

- Expanding the present outreach program conducted by the Wasilla Health Care Center. (Currently, a public health nurse travels to Talkeetna, Trapper Creek, and Willow one day per month.)

- Establishing physician assistant clinics (such as the one located in Healy) where physician assistants work closely with licensed doctors in nearby cities.

Since these communities do not have local governing bodies, it is likely that the Mat-Su Borough and state agencies would be involved in the health care planning process in conjunction with input from local residents. The state or the Power Authority could assist the borough by sponsoring a feasibility study for health care provision in the northern part of the borough.

As part of the monitoring program, the Power Authority will select a set of indicators (such as numbers of admissions and discharges, hours spent on different types of services, client demographics, and number of clients by community) that will be tracked to determine any substantial increase in the need for social services due to the project. A program for health care monitoring and mitigation measures will be developed prior to initiation of project construction. This work will be developed with the assistance of appropriate social service agencies and local officials.

EXHIBIT E

5. Socioeconomics

Comment 8 (p. E-5-45, para. 2)

Provide an estimate of how many of the railhead construction workers would be employed at the Watana and Devil Canyon sites after the railhead facilities are completed.

Response

As estimated 36 railhead construction workers would be employed at the Watana and Devil Canyon sites after the railhead facilities are completed (Acres American, Inc., 1982).

EXHIBIT E

5. Socioeconomics

Comment 13 (p. E-5-63, para. 2 - 4)

Provide information on other projects proposed for the region during the same time period as this project.

Response

The attached table outlines other major potential developments in or affecting the Railbelt region, and presents their associated employment projections. These projects constitute the base case exogeneous employment assumptions for the Institute of Social and Economic Research's Man in the Arctic Program Economic Model (revised May 1983).

TABLE 1

SUMMARY OF BASE CASE EXOGENOUS EMPLOYMENT ASSUMPTIONS FOR MAP MODEL RAILBELT ECONOMIC STUDY

Assumptions	Description
Trans-Alaska Oil Pipeline	Operating employment remains constant at 1,500 through 2010.
North Slope Petroleum Development	Construction employment developing Prudhoe Bay and Kuparuk fields peaks at 2,400 in 1983 and 1986. Operating employment remains at 2,502 through 2010 for overall North Slope production.
Upper Cook Inlet Petroleum Production	Employment declines gradually beginning in 1983 so as to reach 50 percent of the 1982 level (778) by 2010.
Tertiary Recovery of North Slope Oil	Tertiary oil recovery project utilizing North Slope natural gas occurs in early 1990s with a peak annual employment of 2,000.
OCS Exploration and Development	The current OCS five-year leasing schedule calls for 16 OCS lease sales subsequent to October 1982, including the Beaufort, Norton, and St. George Sales, which have already taken place (Sales 71, 57, and 70). Development is

TABLE 1 (Cont'd)

SUMMARY OF BASE CASE EXOGENOUS EMPLOYMENT ASSUMPTIONS FOR MAP MODEL RAILBELT ECONOMIC STUDY

Assumptions	Description
	assumed to occur only in the Navarin Basin (1.14 billion barrels of oil) and the Beaufort Sea (6.1 billion barrels of oil). All other sales are assumed to result in exploration employment only.
Anchorage Oil Headquarters	Several oil companies establish regional headquarters in Alaska in mid-1980's.
Beluga Chuitna Coal Production	Development of 4.4 million ton/year mine for export beginning in 1994 provides total employment of 524.
Hydroelectric Projects	Employment peaks at 725 in 1990 for construction of several state-funded hydroelectric projects around the state.
U.S. Borax Mine	The U. S. Borax mine near Kethcikan is brought into production with operating employment of 790 by 1988.
Greens Creek Mine	Production from the Greens Creek Mine on Admiralty Island results in employment of 315 people from 1986 through 1996.

TABLE 1 (Cont'd)

SUMMARY OF BASE CASE EXOGENOUS EMPLOYMENT ASSUMPTIONS FOR MAP MODEL RAILBELT ECONOMIC STUDY

Assumptions	Description
Red Dog Mine	The Red Dog Mine in the Western Brooks Range reaches full production with operating employment of 448 by 1988.
Other Mining Activity	Employment increases from a 1982 level of 5,267 at 1 percent annually.
Agriculture	Moderate state support results in expansion of agriculture to employment of 508 in 2000.
Forest and Lumber Products	Employment expands to over 3,200 by 1990 before beginning to decline gradually after 2000 to about 2,800 by 2010.
Pulp Mills	Employment declines at a rate of 1 percent per year after 1983.
Commercial Fishing-Nonbottomfish	Employment levels in fishing and fish processing remain constant at 6,323 and 7,123 respectively.

TABLE 1 (Cont'd)

SUMMARY OF BASE CASE EXOGENOUS EMPLOYMENT ASSUMPTIONS FOR MAP MODEL RAILBELT ECONOMIC STUDY

Assumptions	Description
Commercial Fishing-Bottomfish	The total U.S. bottomfish catch expands at a constant rate to allowable catch in 2000, with Alaska resident harvesting employment rising to 733. Onshore processing capacity expands in the Aleutians and Kodiak census divisions to provide total resident employment of 971 by 2000.
Federal Military Employment	Employment remains constant at 23,323.
Federal Civilian Employment	Rises at 0.5 percent annual rate from 17,900 in 1982 to 20,583 by 2010.
Tourism Assumptions	Number of visitors to Alaska increases by 50,000 per year from 680,000 in 1982 to over 2 million by 2010.

EXHIBIT E

5. Socioeconomics

Comment 14 (p. E-5-70, para. 1 through p. E-5-78, para. 4)

Include the capacity of and impacts to lodges, other temporary lodging units, and trailer parks. Provide date when supplemental information will be provided.

Response

Capacity of Lodges and Trailer Courts

Table A presents a list of the lodges in the project vicinity and in the Wasilla to Houston, the Willow to Healy, and the Paxson to Cantwell areas. In addition, lodge capacity and other relevant information are presented where available. The total number of mobile home courts and spaces in communities in the Mat-Su Borough is shown in Table B.

Impacts on Lodges and Trailer Courts

Construction workers and their dependents will seek accommodations at lodges and spaces at trailer courts, especially at facilities located near the construction site and along the access corridor. It is also likely that construction worker demands will be highest during the summer months, when demands by tourists and recreationists will also be greatest. Thus, it is highly probable that construction workers will compete with tourists and recreationists for use of these facilities and that some portion of the tourists and recreationists will be displaced. Nonetheless, occupancy rates would increase for facility owners, and profits would rise as more revenues are available to cover fixed costs.

The ability of current owners and developers to meet increased demands will depend on their financial objectives, attitudes toward risk, entrepreneurial and managerial capabilities, and the economic and financial feasibilities of expanding existing facilities or constructing new facilities. One way to reduce risk to owners and developers would be the use of long- term leases. Some owners have indicated that they would be willing to remain open during the winter months, and/or expand their current facilities if occupancy rates were higher on average, particularly during the winter. Long-term leases would help assure owners of higher and more stable occupancy rates.

TABLE A

LOCATION	CAPACITY INDICATOR	COMMENT
Project Vicinity		
Stephan Lake Lodge	10 structures and seven cabins	Cabins used as outreach camps for hunts
Susena Lake Lodge	N.A	Lodge to be expanded and opened for commercial use
High Lake Lodge	9 structures with accommodations for 25	N.A.
Wasilla to Houston		
Huppies Road House	N.A.	N.A.
Klondike Inn	N.A.	N.A.
Willow Lodge	N.A.	N.A.
Big Lake Lodge	N.A.	N.A.
Willow to Healy		
Nancy Lake Marina Resort	N.A.	Cabins
Pioneer Lodge	10 single and double rooms	Full in summer; half full during winter
Sheep Creek Lodge	2 cabins and one trailer	One cabin has 3 beds, and the other has 1. Trailer used only for emergencies
Montana Creek Lodge	3 cabins	Usually full during summer
Talkeetna Roadhouse	6 rooms	Usually full on weekends
Fairview Inn	N.A.	N. A.
Chulitna Lodge	N.A.	N.A.
Swiss Alaska Inn	14 double rooms	N.A.
Moose Creek Lodge	N.A.	Cabins
Chulitna River Lodge	N.A.	N.A.

TABLE A (continued)

LOCATION	CAPACITY INDICATOR	COMMENT
Jack River Inn	N.A.	N.A.
Jere-A-Tad Lodge	11 units	Nine units with double and single bed each; 2 units with 1 double bed each. Plans to add 5 to 10 more units next year.
North Face Lodge	50 rooms	Closed during all and winter
McKinley Wilderness Lodge	N.A.	Cabins
Carlo Creek Lodge	N.A.	Cabins
Camp Denali	N.A.	Cabins
Healy Roadhouse	±10 rooms	N.A.
Reindeer Mountain Lodge	9 rooms	Plans to add 12 more rooms
Moose Creek Lodge	10 rooms	Each room has double bed
Trapper Creek Trading Post	1 cabin	Each room has double bed
Green's Cash Lodge	5 rooms	Plans for 5 more rooms
<u>Paxson to Cantwell</u>		
Paxson Lodge	N.A.	N.A.
Tangle River Inn	N.A.	N.A.
Maclaren River Lodge	2 cabins plus 7 rooms	Open only during summer
Southeast Susitna Lodge	N.A.	N.A.
Susitna Lodge	8 rooms	Open to public 1 July 1983.

TABLE A (continued)

LOCATION	CAPACITY INDICATOR	COMMENT
Gracious House	N.A.	N.A.
Adventures Unlimited	N.A.	N.A.

N.A. indicates information not available.

Source: Personal communication with lodge operators and community leaders. 1982-1983. By Frank Orth and Associates, Inc.

The Milepost: Alaska and Western Canada. 1983. Alaska North Publishing Company, Anchorage, Alaska.

Parks Highway: Anchorage to Fairbanks via Denali Park. 1983. Alaska Road and Recreation Maps, Anchorage, Alaska.

The Matanuska Valley: Southcentral Alaska. 1983. Alaska Northwest Publishing Company, Anchorage, Alaska.

TABLE B

COMMUNITY	NAME OF MOBILE HOME COURT	NUMBER OF SPACES
Wasilla	Caywood Court	3
	Creekside Trailer Court	8
	Beaulieu's	3
	Baxters	3
	Indian Hill	5
Palmer	Felzien's Trailer Court	33 (in two lots)
	Saxton's Court	3
	Loyer's Court	8
	Erickson's	5
Houston	Vienna Woods	48
Talkeetna	Jones (South of Talkeetna)	3

Source: Overall Economic Development Program, Inc. 1981.

EXHIBIT E

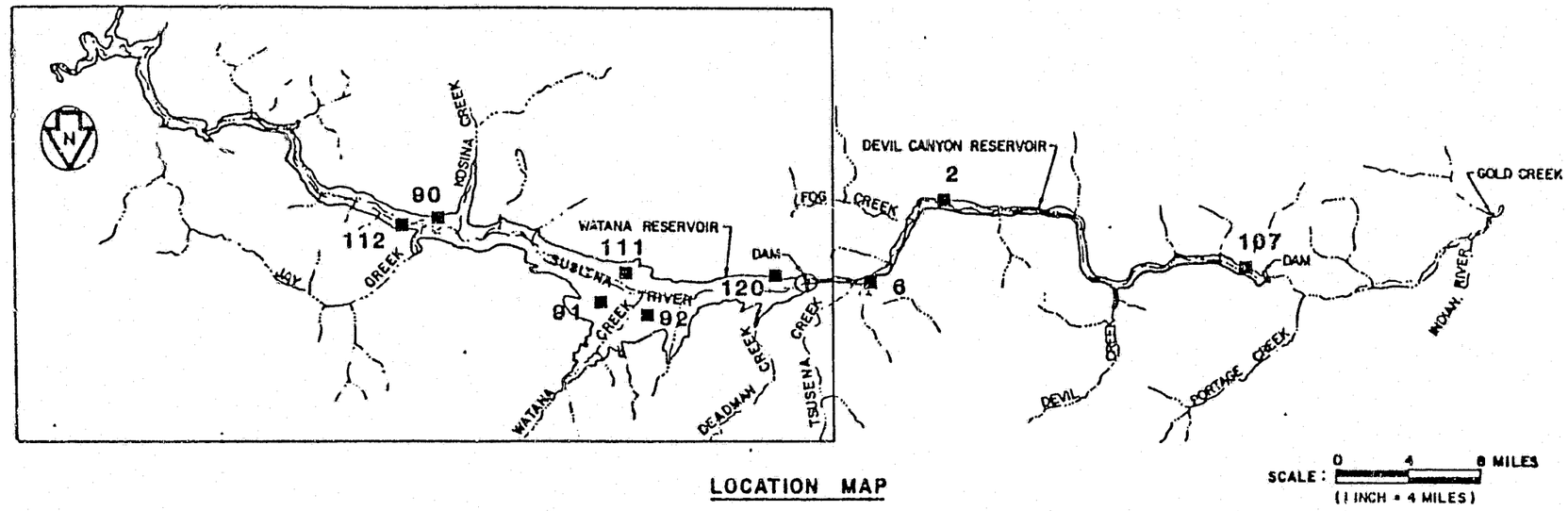
5. Socioeconomics

Comment 15 (p. E-5-78, para 6)

Provide information on the location and number of these isolated residences that would be displaced by the project. Provide date when supplemental information will be provided.

Response

As shown in the attached figure, the construction of the Watana Dam and impoundment will inundate six cabins, none of which are used as permanent residences. Of these, four are no longer used (#120, 92, 111, and 112); one is used on a temporary basis, but not maintained (#91); and one is used and maintained on a temporary basis (#90). Construction of the Devil Canyon Dam and impoundment will inundate three cabins. One of the three structures is currently used and maintained on a temporary basis (#2); the other two structures are no longer used (#6 and 107). The status of the use of each of these structures will be rechecked and verified prior to project construction.



5-15-2

INUNDATED STRUCTURES

SUSITNA HYDROELECTRIC IMPOUNDMENT AREA

EXHIBIT E

5 Socioeconomics

Comment 16 (p. E-5-79, para. 1)

Describe existing housing and commercial operations and potential project impacts along the proposed rail line. Describe the ongoing study of land improvements. Provide a date when this study and the supplemental information on housing and commercial operations will be provided.

Response

It is assumed that this request is for additional information on the transmission line (which is the subject of Exhibit E, Chapter 5, para. 1, p. E-5-79 of the License Application) rather than on the rail line as stated in the first sentence of Item #16. Housing, commercial operations, and other land uses along or near the proposed transmission line route are generally described on pp. E-9-20, E-9-21, and E-9-46 through E-9-51 in Chapter 9 of the License Application. Residential and commercial development along the Intertie portion of the proposed route are described in the environmental assessment of the Intertie project (Commonwealth Associates Inc. 1982). Further information on existing or potential improvements will be developed through additional transmission line studies, which have a tentative completion date of November 1983. Following the completion of these studies, there will be an additional opportunity to identify and avoid parcel-specific impacts during the right-of-way acquisition process.

EXHIBIT E

5. Socioeconomics

Comment 20 (p. E-5-102, para. 2; and p. E-5-104, para.5 through p. E-5-105, para. 1)

Describe the monitoring program and provide dates when data will be available.

Response

Project-induced impacts on local users of fish and wildlife in the project area will be monitored through the use of household surveys. (The details of these surveys are described in the response to Comments 29 and 34 under 5. Socioeconomics.)

Data on harvest patterns, levels, utilization and contribution of these harvests to residents' livelihoods and well-being will be collected in Cantwell, Trapper Creek, Talkeetna, and Paxson. In addition, McKinley, Gold Creek, Sherman, Curry, Chase, Chulitna, Canyon, Lane and the Hurricane/ Indian River subdivision may also be surveyed.

Guides and lodge operators in the project area will be surveyed annually. A survey questionnaire will be mailed to each guide and followed up by telephone, if necessary, in order to achieve an adequate response rate.

Data concerning business status (e.g., number of clients and fee structure), utilization, and ownership of capital and physical assets (cabins and airstrips), as well as attitudes of guides, lodge operators, and their clients will also be collected. These survey data will be analyzed, interpreted, and reported periodically beginning in November 1984. Project-induced impacts on guides and lodge operators will be assessed and appropriate mitigation measures will be formulated and implemented.

EXHIBIT E

5. Socioeconomics

Comment 21 (p. E-5-104, para. 5)

Provide estimates of the current level of permit violations and non-permit hunting, especially in accessible areas, and of effects of increased demand upon these levels.

Response

Although statistical summaries of hunting violations by local area are not available, an estimate of the number of citations issued in the field was obtained for Game Management Subunit 13E (see Response to Comment 24, Chapter 5 for map of Subunit). According to Sergeant L. Steele (Fish and Wildlife Protection, Department of Public Safety, Palmer, personal communication, June 14, 1883) and Lieutenant T. Jordan (Fish and Wildlife Protection, Department of Public Safety, Fairbanks, personal communication, June 17, 1983), 54 violations were cited in the field between Spring 1981 and Spring 1983 within Subunit 13E. In addition, a small number of violations were cited following an investigation (this number is believed to be less than 10). Most of the 54 violations dealt with the illegal harvest of big game (e.g., taking a black bear cub, taking a sublegal size moose, taking a moose out of season, taking a caribou without a permit). Moose hunters accounted for 30 of the violations, caribou hunters for 19, black bear for 4, and brown bear for 1. Most of these violations occured in or near accessible areas, primarily near the Denali Highway.

It is not possible to precisely estimate the number of hunting violations that go undetected. However, Lt. Jordan believed that about twice as many

violators go undetected as are detected if a helicopter is used for patrolling. Assuming this level of undetected violations for half the subunit and assuming a greater level of undetected violations for the remainder of the subunit (where a helicopter is not used), the total number of hunting violations during the last two years would have been about 200 to 300 or an average of 100 to 150 violations per year.

The effects of increased hunting demand on the level of hunting violations is difficult to speculate about. However, it is reasonable to assume that the number of violations will increase in proportion to the increase in sport hunters. Under this assumption, the present level of 100 - 150 violations in Subunit 13E per year would increase to 160 - 250 per year by the year 2000 without the Susitna Project or to 275 - 450 per year with the Susitna Project (based on projected increases in big game hunting demand given in Table E.7.13 of Exhibit E in the License Application).

EXHIBIT E

5. Socioeconomics

Comment 22 (p. E-5-110, para. 2)

Provide dates when these data will be available.

Response

An analysis of the resource and human use patterns will be prepared for Dall sheep, black bear, brown bear, and wolf and provided on September 1, 1983.

EXHIBIT E

5. Socioeconomics

Comment 23 (p. E-5-116, para. 4)

Relate doubling of hunter demand indicated in Table E.7.13 to current use of GMU 13E, the main area of impact.

Response

Moose harvest is currently regulated on a unit basis in GMU 13; subunits are treated similarly. Currently available data on moose populations justify similar treatment of subunits. Current limitations on harvest of moose in GMU 13 are designed to protect the productive segment of the population from harvest. This is because survey data have indicated a very low recruitment rate to the population. Studies of wildlife interactions (initiated prior to Susitna Hydro Project investigations in the Nelchina basin, and continued in the Susitna Hydro Studies) have revealed that predators are responsible for the low recruitment. Reduction in predator populations (predominantly brown bear and wolf) which are likely to result from increased access, increasing hunter demand and management for high ungulate harvests, may improve recruitment and increase the opportunity for harvest. However, in spite of any likely alteration of harvest regulations, the legal harvest is unlikely to approach current or future demand. Under the development scenario of the License Application, use of ubunit 13E may increase disporprotionately to other subunits. Most populations there may provide a larger proportion of total harvest than at present due to improved access. A significant reduction in moose numbers there might justify increased regulation of harvest in that subunit.

Impacts on user groups will vary. Increased use of Subunit 13E will reduce the quality of hunts conducted in that area. Guided hunts are likely to be fewer. However, subsistence hunters may benefit from easier access. Also, from the perspective of a hunter restricted to road and foot access, demand in Subunit 13E will increase considerably because large portions were totally unavailable prior to development. From the perspective of the trophy hunter or guide, demand in Subunit 13E is likely to decrease due to reduced quality of wilderness and greater harvest by subsistence users. In general, impacts of development on moose hunters will be positive, by opening a relatively inaccessible moose population to increased harvest. ORV hunters and hunters using small planes will experience greater competition from hunters restricted to road and foot access. Total harvest is likely to increase in Subunit 13E due to redistribution of the take and ever--increasing demand, at least until ADF&G determines that increased regulation is required to protect moose populations.

It should be pointed out that this entire discussion is complicated by consideration of land ownership. The future structure of land ownership and stewardship in the project area may play a more significant role in determining access to hunting areas than will the presence of the project. Upon permanent conveyance of selected Native landholdings, these lands will become private property. It is difficult to speculate on how these lands will then be used.

EXHIBIT E

5. Socioeconomics

Comment 24 (p. E-5-117, para. 2)

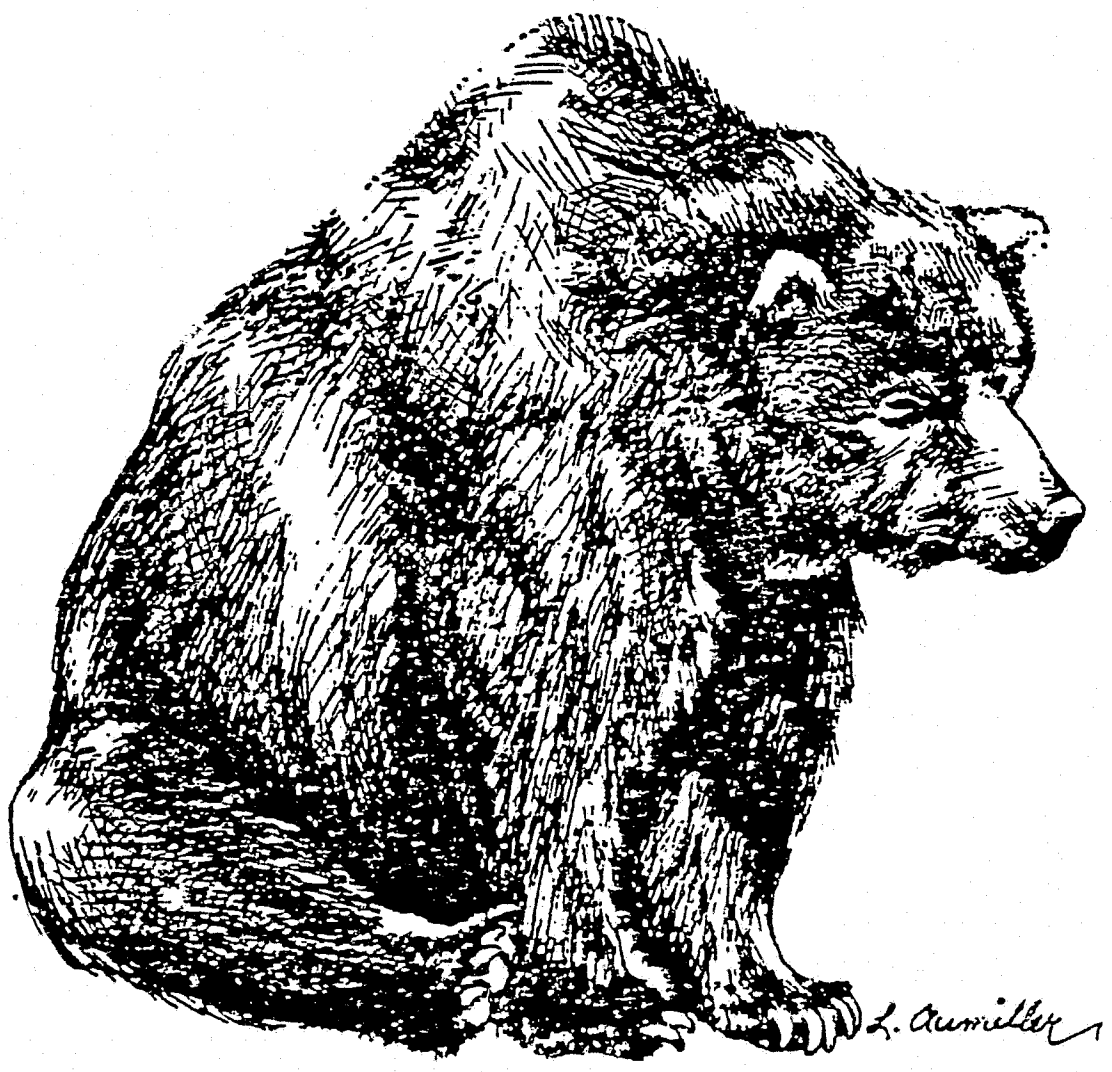
Present current ADFG management regulations for GMU 13.

Response

Attached are applicable sections of the most current management regulations for Game Management Unit (GMU) 13 ("ALASKA HUNTING REGULATIONS" for July 1, 1982 through June 30, 1983). These pages present regulations for each species of interest by GMU and Game Management Subunit. Details include open season dates and bag limits for each species and hunting area. A map showing the boundaries of GMU 13 is attached as page 5-24-14.

ALASKA
HUNTING REGULATIONS

No. 23



Regulations effective July 1, 1982 - June 30, 1983

Alaska Board of Game
Alaska Department of Fish and Game

5-24-2

GMU	Closed Area	Closed To	Page Number
20C*	Portion	Caribou hunting	43
20D*	Portion	Moose hunting	52
23	Chamisso Island Refuge	Hunting and trapping	31
20,24,26	Pipeline corridor	Big game hunting except by means of bow and arrow	29
26	Prudhoe Bay	Big game hunting	29
26B*	Dalton Highway	Moose hunting within 2 miles of highway	54
1-9, 11-16, 19-21 and 24-26*		Cormorant hunting	64
1-16, 19-21, and 24-25*		Snowy owl hunting	64
1-26*		Hunting of beaver, marmot, marten, mink, weasel, muskrat, land otter, squirrel (flying, parka or ground), ravens, magpies	57, 58, 59, 64

* Listed under Seasons and Bag Limits

5-24-3

ARTICLE 9.
HUNTING SEASONS AND BAG LIMITS.

5 AAC 81.310. APPLICATIONS OF SECS. 320-360 OF THIS CHAPTER. It is lawful to take game only in the game management units or portions of units open to such taking in accordance with the open seasons and bag limits prescribed in secs. 320-360 of this chapter. Bag limits and open seasons are based upon the regulatory year.

5 AAC 81.320. BIG GAME HUNTING. Following are the seasons and bag limits on big game, and the units or portions of units to which they apply:

Species and Units	Open Seasons	Bag Limits
(1) BEAR, BLACK* *(Including the cinnamon and blue-color phases)*		
Units 1(A), 1(D), 2, 4 and 5	Sept. 1-June 30	Two bears; however not more than any one may be a blue or glacier bear and the taking of cubs or females accompanied by cubs is prohibited.
Units 1(B), 1(C) and 3	Sept. 1-June 15	One bear; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 6	Sept. 1-June 30	
Units 7, 9 and 11-26 (except for that portion of 14(C) in Chugach State Park	No closed season	Three bears; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 14(C) in Chugach State Park	Day after Labor Day-May 20	One bear; however the taking of cubs or females accompanied by cubs is prohibited.
(2) BEAR, BROWN AND GRIZZLY*		
(Note: Persons who have taken a bear since July 1, 1979 are not eligible to take a bear during this regulatory year except in Units 12, 13 and 20(E).)		
Units 1, 2, and 3	Sept.15-May 31	Once bear every four regulatory years; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 4, Chichagof Island south and west of a line which follows the crest of the island from Rock Point (58°00'N, 136° 21'W), to Rogers Point (57° 35'N, 135°33'W) including Yakobi and other adjacent islands, Baranof Island south and west of a line which follows the crest of the island from Nismeni Point (57°34'N, 135°25'W), to the entrance of Gut Bay (56° 44'N, 134°38'W), including the drainages into Gut Bay and including Kruzof and other adjacent islands	Sept. 15-May 31	

* See bear sealing requirements, page 18.

HUNTING SEASONS AND BAG LIMTS (Continued)
BROWN BEAR (Continued)*

Species and Units	Open Seasons	Bag Limits
Remainder of Unit 4	Sept. 15-May 20	One bear every four regulatory years; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 5	Sept. 1-May 31	
Unit 6(B)	Sept. 1 - May 25	
Remainder of Unit 6	Oct. 10-May 25	
Unit 7	Sept. 10-Oct. 10 May 10-May 25	
Unit 8, that portion of Kodiak Island south and west of a line from Hidden Basin Creek to the mouth of Kizhuyak River, and Uganik and Amook Islands **	Oct. 25-Nov. 30 April 1-May 15	One bear every four regulatory years by drawing permit only; however the taking of cubs or females accompanied by cubs is prohibited. See 5 AAC 81. 055 and separate drawing permit hunt supplement.
Unit 8, that portion of Kodiak Island north and east of a line from the mouth of Hidden Basin Creek to the mouth of Kizhuyak River and including Spruce Island **	Oct. 1-Nov. 30 April 1-May 31	One year bear every four regulatory years by registration permit only; however the taking of cubs or females accompanied by cubs is prohibited. See 5 ACC 81.055 and separate registration permit hunt supplement.
Remainder of Unit 8 **	Oct. 25-Nov. 30 Apr. 1-May 15	
Unit 9(C), the drainages of the Naknek River only	Sept. 1-Oct. 31 May 1-June 30	
Remainder of Unit 9(C) and 9(A), 9(B) and 9(E)	No open season***	

***Board policy is that the season in this portion of Unit 9 will be open every other regulatory year. The season will be open during the 1983-84 regulatory year.

Unit 9(D), that portion south and west of a line from Moffett Point to the eastern side of the eastern entrance of Kinzarof Lagoon and north of a line from the base of Cape Glazenap to Frosty Peak thence to the mouth of Old Man's Lagoon	Oct. 7 - Oct. 31 May 10 - June 30	One bear every four regulatory years by registration permit only; however the taking of cubs or females accompanied by cubs is prohibited. See 5 AAC 81.055 and separate registration permit hunt supplement. Season may be closed by Emergency Order.

* See bear sealing requirements, page 18.

**See 5 AAC 81.180 for special sealing requirement.

HUNTING SEASONS AND BAG LIMITS (Continued)
BROWN BEAR (Continued)*

Species and Units	Open Seasons	Bag Limits
Remainder of Unit 9(D)	No open season	
Unit 10 (Unimak Is. only)	Oct. 1-Oct. 21 May 10-May 25	One bear every four regulatory years by drawing permit only; however the taking of cubs or females accompanied by cubs is prohibited. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 11	Sept. 1-Oct. 31 Apr. 25-May 25	One bear every four regulatory years; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 12	Sept. 1-June 10	One bear; however the taking of cubs or females accompanied by cubs is prohibited. Bears taken in these units are not to count against the one bear every 4 years bag limit in other units; statewide bag limits shall not exceed 1 bear annually.
Unit 13	Sept. 1 - May 31	
Unit 14(A) and 14(C), except that portion of 14(C) in Chugach State Park.	Sept. 1-Oct. 10	One bear every four regulatory years; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 14(B)	Sept. 1-Oct. 31 May 10-May 25	
Unit 14(C) in Chugach State Park.	No open season	
Unit 15	Sept. 1-Oct. 10 May 10-May 25	One bear every four regulatory years; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 16	Sept. 1 - Oct. 31 May 10 - May 25	
Unit 17	Oct. 7-Oct. 21 May 10-May 25	
Unit 18, 19(A), 19(C) and 19(D)	Sept. 10-Oct. 10 May 10-May 25	

* See bear sealing requirements, page 18.

BROWN BEAR (Continued)*

Species and Units	Open Seasons	Bag Limits
Remainder of Unit 25(A)	Sept. 1 - Oct. 31 May 10 - May 31	One bear every four regulatory years by drawing permit only; however the taking of cubs or females accompanied by cubs is prohibited. 38 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 25(B) and (D)	Sept. 1-Oct. 10 May 10-May 25	One bear every four regulatory years; however the taking of cubs or females accompanied by cubs is prohibited.
Unit 25(C)	Sept. 1- Nov. 30 Apr. 1-May 31	
Remainder of Unit 26(A)	Sept. 1-Oct. 31 May 10-May 31	One bear every four regulatory years by drawing permit only; however the taking of cubs or females accompanied by cubs is prohibited. 48 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 26(B)	Sept. 1-Oct. 31 May 10-May 31	One bear every four regulatory years by drawing permit only; however the taking of cubs or females accompanied by cubs is prohibited. 16 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 26(C)	Sept. 1-Oct. 31 May 10-May 31	One bear every four regulatory years by drawing permit only; however the taking of cubs or females accompanied by cubs is prohibited. 10 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.

* See bear sealing requirements, page 18.

BIG GAME HUNTING (Continued)

Species and Units	Open Seasons	Bag Limits
(4) BISON		
Units 11, 13, 19 and 20	July 1-June 30	One bison every 5 regulatory years by permit only. Up to 200 drawing permits or an unlimited number of registration permits will be issued. See 5 AAC 81.055 and separate drawing and registration permit hunt supplements.
(5) CARIBOU		
(Note: Bull caribou refers to any male caribou.)		
Unit 7	Aug. 10-Oct. 31	One caribou by drawing permit only; 150 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 8	No closed season	No limit
Units 9(A), 9(B) and 17	Aug. 10 - Sept. 5 Dec. 1 - Mar. 31	Three caribou; however no more than one may be taken per day, nor may more than one caribou be taken from Aug. 10 - Sept. 5.
Unit 9(C), 9(D) and 9(E)	Aug. 10-Mar. 31	Four caribou; however not more than one caribou may be taken from Aug. 10 - Oct. 31.
Unit 10, except Unimak and Adak Islands	No closed season	No limit
Unit 10, Unimak Island only	Aug. 10-Mar. 31	Four caribou
Unit 10, Adak Island only	July 1 - June 30	Four caribou; season may be closed by Emergency Order.
Unit 11	Aug. 10-Sept. 30	One caribou by drawing permit only. 350 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Units 12 and 20(D), those portions lying north of the Alaska Highway, and Unit 20(E)	Aug. 10 - Sept. 20 Dec. 1 - Feb. 28	Two bulls; however caribou taken during the period Dec. 1 -Feb. 28 must be antlerless; season will be closed by Emergency Order if estimated harvest exceeds 500 bull caribou.
Remainder of Unit 12	Sept. 1 - Sept. 15	One bull caribou

HUNTING SEASONS AND BAG LIMITS (Continued)
CARIBOU (Continued)

Species and Units	Open Seasons	Bag Limits
Units 13 and 14, except 14(C)	Residents: Aug. 20 - Sept. 20 Jan. 1 - Mar. 31	One caribou by permit only, however only antlerless caribou may be taken between Jan. 1 and Mar. 31. 1750 permits will be issued by drawing, including 450 subsistence permits. Subsistence permits not allocated in the drawing may be issued on a first-come, first-served basis to persons meeting the hunt requirements, beginning Nov. 1. The number of registration subsistence permits shall not exceed the number of subsistence permits undersubscribed by drawing. See 5 AAC 81.055 and separate drawing and registration permit hunt supplement.
	Nonresidents: No open season	
Unit 14(C)	No open season	
Unit 15	No open season	
Unit 16	Aug. 10-Oct. 31	One caribou
Unit 18, that portion south of Yukon River	Feb. 1-Feb. 28	One caribou
Remainder of Unit 18	Feb. 1-Mar. 31	One caribou
Unit 19(A)	Aug. 10-Sept. 30 Nov. 1-Feb. 28	Two caribou
Unit 19(B)	Aug. 10-Mar. 31	Two caribou; however no more than one may be taken per day, nor may more than one caribou be taken from Aug. 10 - Oct. 31.
Unit 19(C)	Aug. 10-Oct. 31	One caribou
Unit 19(D), that portion south and east of the Kuskokwim River	Aug. 10-Sept. 30 Nov. 1-Jan. 31	One caribou
Remainder of Unit 19(D) and Unit 14	Aug. 10-Sept. 30	One caribou

HUNTING SEASONS AND BAG LIMITS (Continued)
CARIBOU (Continued)

Species and Units	Open Seasons	Bag Limits
Unit 20(A) and that portion of 20(C) lying east of the Nenana River	Aug. 10 - Sept. 30 Dec. 1 - Mar. 31	One caribou by drawing permit from Aug. 10 - Sept. 30; 175 permits will be issued, up to 30 of which will be issued to nonresidents. Antlered caribou may be taken from Dec. 1 - Mar. 31 by registration permit. A total of 500 caribou may be taken. See 5 AAC 81.055 and separate drawing and registration permit hunt supplements.
Units 20(B) and 25(C)	Aug. 10-Sept. 20	One bull
Unit 20(C), that portion lying west of the Nenana River	No open season	
Unit 20(D), that portion lying south of the Alaska Highway	Aug. 10 - Sept. 30	One bull by drawing permit only; 140 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 20(F)	Aug. 10-Sept. 30	One caribou
Units 22(A), 22(B), 23, 24 and 26(A)	July 1 - Apr. 30	Five caribou, additional caribou may be taken by registration permit. See 5 ACC 81.055 and separate registration permit hunt supplement.
Units 22(C), 22(D), 22(E)	No open season	
Units 25(A), 25(B), 25(D) and 26(C)	July 1-Mar. 31	Five caribou; however not more than two caribou may be transported from these units per regulatory year.
Unit 26(B)	Aug. 10-Oct. 15 Feb. 15-Apr. 15	Three bulls

HUNTING SEASONS AND BAG LIMITS (Continued)
MOUNTAIN GOAT (Continued)

Species and Units	Open Seasons	Bag Limits
Unit 1 (C), that portion draining into Lynn Canal, Stephens Passage and Taku Inlet between Antler River and Taku Glacier	Oct. 1 - Nov. 30	One goat by registration permit only. See 5 AAC 81.055 and separate registration permit hunt supplement.
Remainder of Unit 1(C)	Aug. 1 - Nov. 30	
Unit 1(D), that portion east of Taiya Inlet and River between Chilkoot Trail and White Pass and Yukon Railroad	Oct. 1 - Oct. 15	
Unit 1(D), that portion lying north of the Katzehin River and east of the Haines Highway	Sept. 15 - Nov. 30	
Remainder of Unit 1(D) and Units 4 and 5	Aug. 1 - Dec. 31	
Unit 6(B) and that portion of Unit 6(A) lying west of Seal River and Bering Glacier	Sept. 1 - Dec. 31	
Unit 6(D), that portion of the mainland between Cape Fairfield and Tiger Glacier and Units 7 and 15	Aug. 10 - Sept. 30	One goat by drawing permit only; 350 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
	Oct. 15 - Nov. 30	One goat by registration permit only. See 5 AAC 81.055 and separate registration permit hunt supplement.
Remainder of Unit 6	Aug. 1 - Jan. 31	One goat by registration permit only. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 8	Sept. 1-Oct. 31	One goat by drawing permit only; 57 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 11	Sept. 1-Dec. 31	One goat by registration permit only. See 5 AAC 81.055 and separate registration permit hunt supplement.
Units 12 and 13	No open season	
Unit 14 (except that portion of Unit 14(C) within Chugach State Park)	Aug. 10 - Nov. 30	One goat by drawing permit only; 100 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement

HUNTING SEASONS AND BAG LIMITS (Continued)
BIG GAME HUNTING (Continued)

Species and Units	Open Seasons	Bag Limits
Unit 14(C) within Chugach State Park	No open season	

(9) MOOSE

Species and Units	Open Seasons	Bag Limits
Unit 1(A)	Sept. 15-Oct. 15	One bull
Unit 1(B), south of LeConte Glacier	Sept. 15-Oct. 15	One bull
Unit 1(B), north of LeConte Glacier	Oct. 1-Oct. 31	One bull
Unit 1(C) except Berners Bay	Sept. 15-Oct. 15	One bull
Unit 1(C), Berners Bay drainages only	Sept. 15-Oct. 15	One bull by drawing permit; up to 25 permits may be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 1(D)	Sept. 15-Sept. 30	One bull
Units 2, 3 and 4	No open season	
Unit 5(A), except Nunatak Bench	Oct. 15 - Nov. 15**	One bull by registration permit; up to 50 bulls may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 5(A), Nunatak Bench	Nov. 15 - Feb. 15**	One moose by registration permit; up to 10 moose may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 5(B)	Sept. 1-Oct. 31**	One bull by registration permit; up to 25 bulls may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 6(A)	Sept. 1 - Dec. 31**	One moose by registration permit; up to 20 antlerless moose may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 6(B)	Aug. 20-Sept. 15**	One moose by registration permit; up to 35 antlerless moose may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.

*See 5 AAC 81.075(a)(6) for transportation restriction.

**Season subject to closure by Emergency Order.

HUNTING SEASONS AND BAG LIMITS (Continued)
MOOSE (Continued)

Species and Units	Open Seasons	Bag Limits
Unit 6(C)	Sept. 6 - Sept. 15**	One bull moose by registration permit. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 6(D)	Sept. 1-Sept. 30	One bull
Unit 7, that portion drained by Resurrection Creek downstream from Rimrock and Highland Creek (including Palmer Creek)	No open season	
Unit 7, the Placer River drainages and that portion of Placer Creek (Bear Valley) outside the Portage Glacier closed area and Unit 14(C) within the Twentymile River drainages	Sept. 1-Sept. 20	One moose by drawing permit only; 30 permits for antlered moose and 15 permits for antlerless moose will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Remainder of Unit 7	Sept. 1-Sept. 10	One bull
Unit 8	No open season	
Unit 9(A)	Sept. 5-Sept. 25	One bull
Unit 9(B) and 9(C), except the drainage of the Naknek River	Sept. 5-Sept. 25 Dec. 1-Dec. 31	One moose; however antlerless moose may be taken only from Dec. 1 - Dec. 31.
Unit 9(C), that portion draining into the Naknek River	Sept. 5 - Sept. 25 Dec. 1 - Dec. 31**	One moose; however antlerless moose may be taken by registration permit only. Permits are valid from Dec. 1 - Dec. 31. See 5 AAC 81.055 and separate registration permit hunt supplement.
Unit 9(D)	No open season	
Unit 9(E)	Sept. 10-Sept. 20 Dec. 1-Dec. 31	One moose; however antlered moose must have an antler spread of at least 50 inches or three brow tines on one of the antlers and antlerless moose may be taken only from Dec. 1 - Dec. 31.
Unit 11	Sept. 1-Sept. 20	One bull
Unit 12	Sept. 1 - Sept. 20	One bull
Unit 13	Sept. 1-Sept. 20	One bull having an antler spread of at least 36 inches or at least three brow tines on at least one of the antlers

**Season subject to closure by Emergency Order.

8-24-5

HUNTING SEASONS AND BAG LIMITS (Continued)
MOOSE (Continued)

Species and Units	Open Seasons	Bag Limits
Unit 14(A)	Sept. 1-Sept. 20	One moose; however antlerless moose may be taken by drawing permit only. 400 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 14(B)	Dec. 15 - Feb. 15*	One moose by drawing permit only. 50 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 14(B), that portion lying west of a line beginning 3 miles up the Talkeetna River from Talkeetna, and extending southward 3 miles east of and parallel to the Talkeetna and Parks Highways to the Subunit boundary at Willow Creek	Sept. 1 - Sept. 30	One moose; however antlerless moose may be taken by drawing permit only. 100 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Remainder of Unit 14(B)	Sept. 1-Sept. 30	One moose, provided that antlerless moose may be taken only from Sept. 10-Sept. 20.
Unit 14(C), that portion known as the Fort Richardson Management Area (5 AAC 81.238(2))	Sept. 1 - Sept. 30**	One moose, by registration permit and by bow and arrow only. Up to 15 moose may be taken, at the Department's discretion. See 5 AAC 81.055 and separate registration permit hunt supplement.
	Dec. 1 - Feb. 28	One moose by drawing permit only. Up to 40 permits will be issued at the discretion of the Department. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 14(C), that portion known as the Anchorage Management Area (5 AAC 81.238(4))	Dec. 1 - Mar. 31**	One moose by registration permit only. Up to 50 moose may be taken. This hunt is discretionary, depending on winter conditions. Methods of take may be limited. See 5 AAC 81.055 and separate registration permit hunt supplement.
Remainder of Unit 14(C), except the Twentymile River drainages	Day after Labor Day-Sept. 20	One bull

**Season subject to closure by Emergency Order.

Species and Units	Open Seasons	Bag Limits
Remainder of Unit 25(B)	Sept. 10-Sept. 30 Nov. 1-Nov. 15	One bull
Unit 25(C)	Sept. 5-Sept. 15	One bull
Unit 25(D)	Sept. 10-Sept. 20 Nov. 1-Nov. 10	One bull
Unit 26(B), that portion within two miles of the Dalton Highway	No open season	
Remainder of Unit 26	Sept. 1-Dec. 31	One moose

(10) MUSKOXEN

Unit 18, Nunivak Island	Bulls Aug. 1-Sept. 20	One bull by drawing permit; 5 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
	Feb. 15-Mar. 15	One bull by drawing permit; 25 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
	Cows Residents Sept. 1-Sept. 20 Feb. 1-Mar. 15	One cow by registration permit only; 40 cows may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
	Nonresidents Aug. 1-Sept. 20 Feb. 15-Mar. 15	One cow by drawing permit only; 5 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 18, Nelson Island	Feb. 15 - Mar. 15	One bull by registration permit; 25 bulls may be taken. See 5 AAC 81.055 and separate permit hunt supplement.
Unit 26, that portion within the Arctic National Wildlife Refuge	Residents: Mar. 1 - Mar. 31	One bull by drawing permit; 5 permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
	Nonresidents: No open season	

5-24-9

Species and Units	Open Seasons	Bag Limits

(11) SHEEP, MOUNTAIN OR DALL

Units 6, 7, 9, 11, 14(B), 15, 16, 17 and 19	Aug. 10-Sept. 20	One ram with 7/8 curl horn or larger.
Units 12, 13 and 20, that portion known as the Tok Management Area (5 AAC 81.238, Management Areas)	Aug. 10 - Sept. 20	One ram with full (4/4) curl horn or larger, every four regulatory years, by drawing permit only. 120 permits will be issued. See 5 AAC 81.055 and separate permit hunt supplement.
	Sept. 25-Oct. 30	One ewe sheep by registration permit only; 20 ewe sheep may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
Remainder of Units 12, 13 and 20 (except that portion known as the Delta Controlled Use Area and the Glacier Mountain Controlled Use Area)	Aug. 10-Sept. 20	One ram with 7/8-curl horn or larger.
Units 13 and 20, that portion known as the Delta Controlled Use Area (see 81.237, Controlled Use Areas)	Aug. 10-Sept. 20	One ram with 7/8 curl horn or larger, by drawing permit only. 150 permits will be issued; however only 75 permits will be issued for the period Aug. 10 -Aug. 25, and only 75 permits will be issued for the period Aug. 26 - Sept. 20. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 14(A)	Aug. 10-Sept. 20	One sheep; rams must have 7/8 curl horn or larger and ewes may be taken only by drawing permit. 10 ewe sheep permits will be issued. See 5 AAC 81.055 and separate drawing permit hunt supplement.
Unit 14(C)	Day after Labor Day-Sept. 30	One ram with 7/8 curl horn or larger by drawing permit only. 120 permits will be issued; however only 60 permits will be issued for the period Day after Labor Day — Sept. 18 and only 60 permits for the period Sept. 19 -Sept. 30. See 5 AAC 81.055 and separate permit hunt supplement.

HUNTING SEASONS AND BAG LIMITS (Continued)
SHEEP (Continued)

Species and Units	Open Seasons	Bag Limits
Unit 20, that portion known as Glacier Mountain Controlled Use Area (5 AAC 81.237, Controlled Use Areas)	Aug. 10-Sept. 20*	One ram with 7/8-curl horn or larger.
Unit 23	Residents of GMU 23 who permanently reside north and west of the Noatak River: Aug. 1 - Apr. 30	One sheep, by registration permit only; 50 sheep may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
	All other hunters: Aug. 10-Sept. 20	One ram with 7/8-curl horn or larger.
Units 25(A) and 26(C)	Aug. 10 - Sept. 20 Oct. 1 - Apr. 30	One ram with 7/8 curl horn or larger during the Aug. 10 -Sept. 20 season. Three sheep by registration permit only during the Oct. 1 - Apr. 30 season; a total of 50 sheep may be taken in this hunt; however the permits for this hunt may be limited to only portions of Units 25(A) and 26(C). See 5 AAC 81.055 and separate registration permit hunt supplement.
Remainder of Unit 25	Aug. 10 - Sept. 20	One ram with 7/8 curl horn or larger.
Units 24, 26(A) and 26(B), those portions with The Gates of the Arctic National Park and Preserve	Residents whose permanent residence is within The Gates of the Arctic National Park and Preserve:** Aug. 1 - Apr. 30	Three sheep by registration permit only; 50 sheep may be taken. See 5 AAC 81.055 and separate registration permit hunt supplement.
	All other hunters: Aug. 10 - Sept. 20	One ram with 7/8-curl horn or larger.
Remainder of Units 24, 26(A) and 26(B)	Aug. 10 - Sept. 20	One ram with 7/8 curl horn or larger.

*From 12:01 a.m., August 5 to 12:01 a.m., September 21, no motorized vehicles may be used to transport hunters, hunting gear, or game within the Glacier Mountain Controlled Use Area.

**For further information on eligibility for hunting on National Park land, contact the National Park Service.

5-24-10

HUNTING SEASONS AND BAG LIMITS (Continued)
BIG GAME HUNTING (Continued)

Species and Units	Open Seasons	Bag Limits

(12) WOLF

Refer to fur animal hunting, seasons and bag limits.

(13) WOLVERINE

Refer to fur animal hunting, seasons and bag limits.

FUR ANIMAL HUNTING

Species and Units	Open Seasons	Bag Limits

5 AAC 81.330. FUR ANIMAL HUNTING. Following are the seasons and bag limits for fur animals, and the units or portions of units to which they apply:

(Note: shooting of fur animals for which there is no open hunting season may be allowed under trapping regulations. Consult Trapping Regulations 5 AAC 84.060.)

(1) BEAVER

Units 1 through 26	No open hunting season	

(2) COYOTE

Units 1 through 26 except that portion of Units 14(C) in Chugach State Park	Sept. 1-Apr. 30	Two coyotes
Unit 14(C) in Chugach State Park	Day after Labor Day-Apr. 30	Two coyotes

(3) FOX, ARCTIC

(Including white or blue color phases)

Unit 10	No closed season	No limit
Units 9 and 17	Dec. 1-Mar. 15	No limit
Units 18, 22, 23 and 26	Sept. 1-Apr. 30	Two foxes

Species and Units	Open Seasons	Bag Limits

(4) FOX, RED

(Including cross, black or silver color phases)

Units 1 through 26, except 21(D) and that portion of Unit 14(C) in Chugach State Park	Sept. 1-Feb. 15	Two foxes
Unit 14(C) in Chugach State Park	Day after Labor Day-Feb. 15	Two foxes
Unit 21(D)	Nov. 1-Feb. 15	Two foxes

(5) LYNX*

Units 1 through 26 except that portion of Unit 14(C) in Chugach State Park	Sept. 1-Mar. 31	Two lynx
Unit 14(C) in Chugach State Park	Day after Labor Day-Mar. 31	Two lynx

* See lynx sealing requirements, page 18.

(6) MARMOT

Units 1 through 26	No open hunting season	

(7) MARTEN

Units 1 through 26	No open hunting season	

(8) MINK AND WEASEL

Units 1 through 26	No open hunting season	

(9) MUSKRAT

Units 1 through 26	No open hunting season	

(10) OTTER, LAND

Units 1 through 26	No open hunting season	

(11) MINK AND WEASEL

Species and Units	Open Seasons	Bag Limits

(12) RACCOON

Units 1 through 26	No closed season	No limit

(13) SQUIRREL

(flying, parka or ground)

Units 1 through 26	No open hunting season	

(14) SQUIRREL

(red)

Units 1 through 26 except that portion of Unit 14(C) in Chugach State Park	No closed season	No limit
Unit 14(C) in Chugach State Park	No open hunting season	

(15) WOLF*

Units 1 through 5	No closed season	No limit
Units 6 through 11	Aug. 10-Apr. 30	Two wolves
Units 12, 13 and 19 through 26.	Aug. 10-Apr. 30	No limit
Unit 14 (other than Chugach State Park) and Units 15 through 18	Aug. 10-Apr. 30	Four wolves
Unit 14(C) in Chugach State Park	No open season	

(16) WOLVERINE*

Units 1 through 5	Nov. 10-Feb. 15	One wolverine
Units 6 through 26 except for that portion of Unit 14(C) in Chugach State Park	Sept. 1-Mar. 31	One wolverine
Unit 14(C) in Chugach State Park	No open season	

*Wolves and wolverine are classified as both big game and as fur bearers. The Alaska Hunting Regulations apply if they are taken under a hunting license (see 5 AAC 81.072, 81.075 and 81.330); the Alaska Trapping Regulations apply if they are taken under a trapping license (see 5 AAC 84.060 and 84.270).

* See wolf and wolverine sealing requirements, page 18.

Species and Units	Open Seasons	Bag Limits	Possession Limit

5 AAC 81.340. SMALL GAME HUNTING. Following are the seasons and bag limits on small game, and the units or portions of units to which they apply:

(1) GROUSE

(Spruce, blue, ruffed and sharptail)

Units 1, 2, 4, 5, 6	Aug 1-May 15	Five a day	10
Unit 3, Mitkof Island only, within ¼ mile of the Highway System	Sept. 1-May 15	Five a day	10
Remainder of Unit 3	Aug. 1-May 15	Five a day	10
Units 7, 9, 11, 13 through 19, and 21 through 26 except for Unit 14(C) and 25(C).	Aug. 10-Apr. 30	Fifteen a day	30
Units 12, 20 and 25(C)	Aug. 10-Mar. 31	Fifteen a day	30
Unit 14(C)	Day after Labor Day-Apr. 30	Five a day	15
Unit 8	No open season		

(2) HARE AND RABBIT

(snowshoe and arctic)

Units 1 through 5	Sept. 1-Apr. 30	Five a day	
Units 6 through 26 except for Unit 14(C)	No closed season	No limit	
Unit 14(C)	Day after Labor Day-Apr. 30	Five a day	

(3) PTARMIGAN

(willow, rock or whitetail)

Units 1 through 6	Aug. 1-May 15	Twenty a day	40

Species and Units	Open Seasons	Bag Limits	Possession Limit
Units 7 through 19, and 21 through 26, except for Units 14(A), 14(C) and 25(C).	Aug. 10-Apr. 30	Twenty a day	40
Unit 14(A)	Aug. 10-Apr. 30	Ten a day	20
Unit 14(C)	Day after Labor Day-Apr. 30	Ten a day	20
Units 20 and 25(C), the portions within five miles of AK Route 6 (Steese Hwy.), and AK Route 5 (Taylor Hwy. both to Eagle and the Alaska-Canada boundary).	Aug. 10-Mar. 31	Twenty a day	40
Remainder of Units 20 & 25(C)	Aug. 10-Apr. 30	Twenty a day	40

WATERFOWL (including snipe and cranes) HUNTING. Following are the seasons and bag limits on waterfowl and the units and portions of units to which they apply:

(4) WATERFOWL

(a) Ducks

(Except sea ducks)

Units 1-4	Sept. 1-Dec. 16	Seven a day	21
Units 5-7, 9, 14-16 and 10 (Unimak Is. only).	Sept. 1-Dec. 16	Eight a day	24
Units 8 and 10 (except Unimak Island)	Oct. 8-Jan. 22	Seven a day	21
Units 11-13 and 17-26	Sept. 1-Dec. 16	Ten a day	30

(b) Sea Ducks *(eiders, scoters, old squaw, harlequin)* and Mergansers

Units 1-7, 9, 10 (Unimak Island only) and 11-26.	Sept. 1-Dec. 16	Fifteen a day	30
Units 8 and 10 (except Unimak Island)	Oct. 8-Jan. 22	Fifteen a day	30

Species and Units	Open Seasons	Bag Limits

5 AAC 81.360. UNCLASSIFIED GAME HUNTING. Following are the seasons and bag limits on unclassified game, and the units or portions of units to which they apply.

(1) BATS, SHREWS, RATS, MICE AND PORCUPINES

Units 1 through 26 except for that portion of 14(C) in Chugach State Park	No closed season	No limit
Unit 14(C) in Chugach State Park	No open season	

(2) CORMORANTS*

Units 10, 17, 18, 22 and 23	No closed season	No limit
Remainder of Alaska	No open season	

* Federal Regulations prohibit cormorant hunting except when used for food. Contact U.S. Fish and Wildlife Service for further information.

(3) CROWS

Units 1 through 26	Mar. 1-Apr. 15	Forty per day
	Sept. 1-Nov. 17	Forty per day

(4) RAVENS**

Units 1 through 26	No open season

** Nothing in these regulations prohibits a person from taking ravens in defense of property.

(5) SNOWY OWLS*

Units 17, 18, 22, 23 and 26	No closed season when utilized for food	No limit
Remainder of Alaska	No open season	

* Federal Law prohibits hunting of snowy owls, except for food. Contact U.S. Fish and Wildlife Service for further information regarding taking, or possession of skins.

(6) MAGPIES

Units 1 through 26	No open season

5-24-13

5 AAC 81.370. EMERGENCY TAKING. Nothing in these regulations prohibits a person from taking game for food during the closed season in case of dire emergency. Whenever it is reasonable to do so, all edible portions of the meat of an animal so taken must be salvaged, and all portions surplus to the alleviation of the dire emergency shall be surrendered to the state.

5 AAC 81.375. TAKING GAME IN DEFENSE OF LIFE OR PROPERTY. (a) Nothing in this chapter prohibits a person from taking game in defense of life or property provided that:

(1) The necessity for the taking is not brought about by harassment or provocation of the animal or an unreasonable invasion of the animal's habitat;

(2) The necessity for taking is not brought about by the improper disposal of garbage or a similar attractive nuisance; and

(3) All other practicable means to protect life and property are exhausted before the game is taken.

(b) Game taken in defense of life or property is the property of the state. Persons taking such game are required to salvage immediately the meat, or in the case of black bear, wolf, wolverine and coyote, the hide must be salvaged and immediately surrendered to the state. In the case of brown, grizzly or polar bear, the hide and skull must be salvaged and surrendered to the state immediately. The department must be notified of such taking immediately and a written report giving the circumstances of the taking of game in defense of life or property must be made to the department within 15 days of such taking.

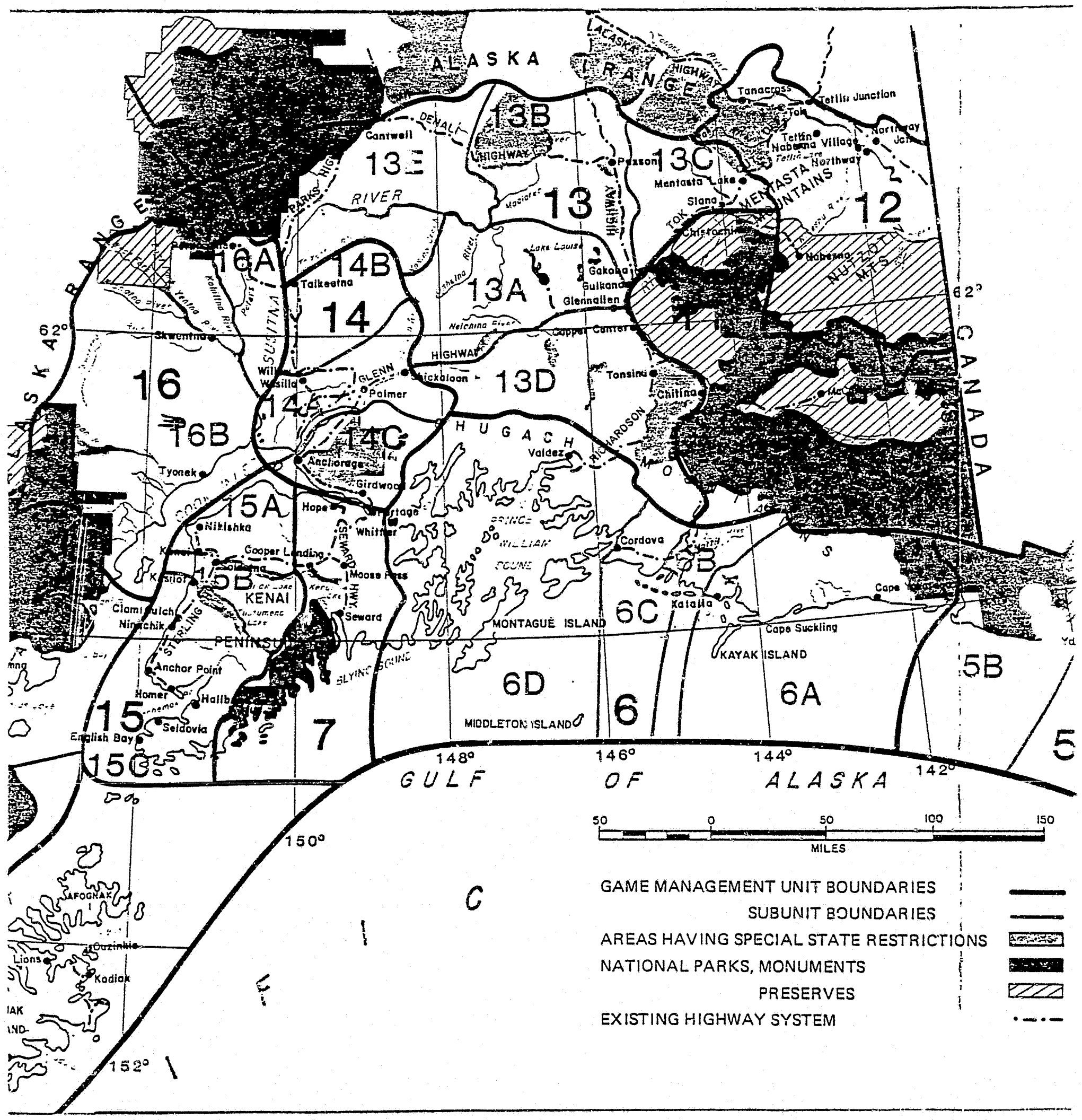
(c) As used in this section, "Property" is limited to:

(1) dwelling, whether permanent or temporary;

(2) aircraft, boats, automobiles, or other means of conveyance;

(3) domesticated animals; and

(4) other property of substantial value necessary for the livelihood or survival of the owner.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Paxson
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DENALI HIGHWAY
PARKS HIGHWAY
RIVER
Talkeetna
Skwentna
Willow
Wasilla
Palmer
GLENN HIGHWAY
Sheldon
Copper Center
Tonsina
Chitina
Valdez
HUGACH
RICHARDSON
Anchorage
Girdwood
Tyonek
Hope
Whittier
Cordova
Niniltna
Cooper Landing
Moose Pass
Seward
KENAI
PENINSULA
Clam Gulch
Ninilchik
Anchor Point
Homer
Halibut
Seldovia
English Bay
MONTAGUE ISLAND
MIDDLETON ISLAND
KAYAK ISLAND
Cape Suckling
Katalla
Cape
NUTZOTIN MTS
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GULF OF ALASKA
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Kodiak
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MILES
GAME MANAGEMENT UNIT BOUNDARIES
SUBUNIT BOUNDARIES
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NATIONAL PARKS, MONUMENTS
PRESERVES
EXISTING HIGHWAY SYSTEM

5-24-14

5. Socioeconomics

Comment 25 (p. E-5-120, para. 4 through p. E-5-121, para. 3)

Indicate impacts to trapping activity because of increased accessibility provided by project roads and structures.

Response

The price of pelts and the abundance of the species are probably the major factors in cycles of harvest statistics of most furbearers. All changes in trapping activity will be modified by fluctuations in fashion and subsequently in pelt prices. The intensity of harvest in any area is also affected by accessibility. From the perspective of economic impacts to the trapping industry, improved access is likely to be a positive impact, increasing the total harvest at least until species populations decline; but individual trappers presently using the area are likely to suffer from increased competition.

Currently, harvest of furbearers in Alaska is poorly regulated. Although individual trappers may be quite territorial in establishing and defending traditional trap lines, no regulations exist to protect either the trapper or the resource from increased competition. Improved access, in conjunction with lucrative pelt prices and an easily trapped furbearer population are likely to have significant negative impacts on both the user group and wildlife populations as more people are attracted to the harvest opportunities provided.

In the Canadian Yukon, traplines are registered and ownership is established. This system also allows careful management of furbearer populations. In the absence of such a system, trappers in Alaska do not like to discuss the location of trap lines, and altercations between established trappers and novitiates are frequent; no means of monitoring harvests on a local, or even regional basis, are available. In addition, information voluntarily provided by trappers on the number of pelts sold or traded in the state is questionable because of the sensitivity of the subject of income and taxation. Questionnaires on trapping activity are, therefore, likely to provide suspect information on location and size of harvest, or even the number of trappers operating in an area.

The situation does not lend itself to an informed discussion of impacts. Competition at the present appears low; trapping in the Susitna basin appears not to be particularly lucrative due to poor access and low pelt prices for the most easily trapped species. With this scenario, improved access alone is not likely to severely impact current users. In reality, the total number of trappers operating in the area must be considered an unknown and the increased accessibility provided by the project will increase the difference between the estimated harvest and the actual take. However, some qualitative predictions can be made. The increased local population during construction and increased access during operation will increase the number of casual and serious trappers operating in the area and conflicts between new and traditional trappers are likely. In the face of increased value of pelts of easily trapped species (beaver, marten and muskrat), there is a potential for severe impacts to traditional users and possible depletion of the resource. Novice trappers are unlikely to pursue or successfully take significant numbers of individuals of difficult to trap species. In the meantime, total harvest is likely to increase, at least until such time as furbearer numbers are sufficiently reduced to affect harvest.

It should be pointed out that this entire discussion is complicated by consideration of land ownership. The future structure of land ownership and stewardship in the project area may play a more significant role in determining access to trapping areas than will the presence of the project. Upon permanent conveyance of selected Native landholdings, these lands will become private property. It is difficult to speculate on how these lands will then be used.

EXHIBIT E

5. Socioeconomics

Comment 26 (p. E-5-125)

Identify options for reducing impacts to the fish/wildlife user group.

Response

Mitigation options for fish, game, and furbearer users address the following potential impacts: (1) fish and wildlife population reductions, (2) changes in distribution of fish and wildlife, (3) increased access, and (4) decreased access on public lands. These impacts may result in (a) loss of remote character of area, (b) increased user competition, and (c) more restrictive State of Alaska hunting and fishing regulations.

Mitigation options are complicated by two factors: First, increased access can be viewed as a benefit to new users, but is generally perceived as an adverse impact by current users (Section 3.7). Also the impact of imminent transfer of large tracts of land within the project area to private ownership will complicate and may overshadow project-related impacts if these lands are restricted or closed for public use.

Mitigation measures for impacts of users of fish, game, and furbearers include the following: (1) Reductions in fish, game, and furbearer populations will be avoided, minimized, rectified, reduced, or compensated by the mitigation plans presented in Sections 2.4, 3.4, and 4.4 of Chapter 3. Habitat loss and animal disturbance will be mitigated in siting and design of facilities, construction practices, and scheduling. Fish populations will be maintained by maintaining or increasing habitat productivity and

through propagation facilities, if necessary. Loss of big game carrying capacity, particularly for moose, will be mitigated by compensation through improvement of habitat in adjacent areas or in downstream areas if sufficient area is not available near the impoundments.

(2) Distribution of animals will shift from areas where habitat is lost to adjacent areas of improved habitat. The impact on users will be mitigated by selection of habitat improvement areas to minimize changes in animal distribution. Changes in distribution and the effects of these changes on users will be modified to the extent feasible.

(3) To reduce impacts to existing users the access road will be closed to public use during construction and construction workers will not be permitted to utilize project facilities, including roads, for hunting or trapping. The State of Alaska may utilize several mitigation options to further reduce the impact of increased access to current users, including: (a) keeping the access road closed after project construction; (b) prohibiting hunting, fishing and/or trapping within a specified distance of the road, and (c) prohibiting the use of off-the-road vehicles on or from project facilities for the purpose of hunting, trapping, or all uses.

EXHIBIT E

5. Socioeconomics

Comment 27 (p. E-5-125)

Describe procedures that will be followed in optimizing the resolution among conflicting interests for mitigating impacts to recreation, fish/wildlife users, and the fish/wildlife supply.

Response

It is the Power Authority's intent to resolve conflicting interests among user groups by using the existing fish and game management structure within the Department of Fish and Game's and the Power Authority's capabilities. The Power Authority will continue on its own initiative, with consultation and review by agencies, to formulate and to execute plans to avoid, minimize or compensate for project induced impacts where Power Authority action is the primary factor. The Power Authority will assist, as requested, the Department of Fish and Game in the execution of studies and the preparation of draft managment plans. Action with respect to management plans eminate from the Boards of Fish and Game. These are independent boards composed of members appointed by the governor and confirmed by the legislature. They set policy, objectives, confirm management plans and establish seasons, bag limits, and other harvest regulations. The two Boards conduct their business in public meetings and incorporate public comments in their desision-making process. It is the role of the Boards of Fish and Game to balance conflicting demands for the fish and game resources with available supplies and other management objectives. Allocation of fish and game resources is carried out by these Boards and represents the State's process of optimization.

The Power Authority will:

- Meet with representatives of Alaska Department of Fish and Game (ADF&G) and other management agencies to discuss the appropriate plan of action.

- Request ADF&G to prepare a statement of current management objectives, and their current management plan during the construction phase (copy of letter is attached).

- Assist ADF&G in formulating a recommended set of policies for fish/game resources in the area with the intent of presenting a draft statement of objectives and policies to the fall 1983 joint meeting of the Boards of Fish and Game. These Boards would include comments from user groups in the process of adopting or modifying a statement of objectives.

- Support ADF&G in the development of draft management plans for the construction phase of the project. Draft plans would be available for the use of the Boards in the fall of 1984, allowing plans to be in place by spring of 1985.

- Combine the Fish and Wildlife Management and Recreation Plans into an overall Resource Utilization Master Plan which will be submitted to FERC and other appropriate agencies for comment.

- Incorporate agency comments, and using this master plan, direct fish and wildlife utilization activities during construction of the project.

During plan development, field sampling and reporting activities will continue with regards to fish/game supply and users. Data collected will be incorporated into the draft and final plans as appropriate. After installation, the master plan will be reviewed annually by the Power Authority and

appropriate agencies in light of the data collected through monitoring programs described in Exhibit E, Sections 2.6 and 4.4 of Chapter 3, 4.5 of Chapter 5, and 6.2 of Chapter 7 (also see responses to Comments 20, 29, and 34 of Chapter 5). Based on this review the plan will be revised and updated as appropriate.

Two years prior to initiation of project operation. The Power Authority will request ADF&G and the Boards of Fish and of Game to undertake a comparable process addressing the development of management objectives and regulations for the operational phase of the project.

ALASKA POWER AUTHORITY

334 WEST 5th AVENUE - ANCHORAGE, ALASKA 99501

Phone: (907) 277-7641
(907) 276-0001

July 1, 1983
Susitna File No. 6.14.2

Commissioner Don Collinsworth
Alaska Department of Fish & Game
P.O. Box 3-2000
Juneau, Alaska 99802

SUBJECT: Fish & Game Management Objectives in the Susitna Hydroelectric Project Area.

Dear Commissioner Collinsworth:

The Susitna Hydroelectric Project has assembled a substantial body of information on fish and wildlife resources in the project area. This information includes baseline data, impact analysis and proposed mitigation plans, and has been provided to your Department and other interested agencies and persons in the form of the Application for License submitted to the Federal Energy Regulatory Commission on February 28, 1983. Numerous supporting reports are also available.

The next phase of the process moves the project from the study and application phase to the point at which construction may begin. During this phase, design and construction planning is carried out and specific management programs prepared and put-in-place in anticipation of mobilization for construction.

Richard Fleming, Alaska Power Authority, Gary Lawley, Bill Hutchinson from Harza-Ebasco Susitna Joint Venture, met with Carl Yanagawa, Karl Schneider, Don McKay, Dave Watsjold, and Ron Stanek of the Alaska Department of Fish & Game on June 12, 1983, to discuss management planning in the project region. It was decided that a cooperative program should be undertaken in which Alaska Department of Fish & Game (ADF&G) would prepare those portions relating to existing or proposed regulations and the Alaska Power Authority, or its contractors, would undertake the analysis of project relative impart and the identification of mitigation and management opportunities. The product of their discussion is this possible schedule of activities:

1. Review current management objective and regulations (summer of 1983).

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5-27-4

2. Propose management objectives and policies (for submission to joint meeting of the Boards of Fish and of Game, fall 1983).

3. Prepare Fish & Game Management plans and draft regulations for the construction phase of the Susitna Hydroelectric Project (for submission to the Boards, winter 1984/85).

4. Regulations in places, summer 1985, one year prior to on set of construction activity.

The Power Authority, by this letter, requests your Department's participation with the Power Authority in these planning activities.

Please let me know how I or my staff may be of any assistance in this matter. Thank you for your assistance.

Sincerely,

For Eric P. Yould
Executive Director

cc: Commissioner Dick Lyon, Juneau
Commissioner Ester Wunnicke, Juneau
Richard Logan, ADF&G, Anchorage
Karl Schneider, ADF&G, Anchorage
Carl Yanagawa, ADF&G, Anchorage
Tom Trent, ADF&G, Anchorage
D. Glasscock, H-E, Anchorage
William Wakefield II, FERC, Washington, D.C.

EXHIBIT E

5. Socioeconomics

Comment 29 (p. E-5-126, para. 3)

Describe studies and monitoring program and give dates when data will be available.

Response

The purpose of the socioeconomic monitoring program is to provide timely and accurate information on indicators of key socioeconomic conditions for the impact management system. Existing impact projections will be updated from the monitoring effort. As part of this program, the Power Authority will continue to collect quantitative and qualitative data relating to socioeconomic characteristics of the work force and area communities. The following information will be included:

Work Force -
- Numbers of workers by labor category
- Worker's place of origin
- Worker's places of permanent and temporary residence
- Marital status
- Number and age of worker's dependents
- Attitudinal information

Community -
- Population
- Housing
- Households
  - Employment
  - Income
- Persons per household
- Fish and wildlife harvest patterns, levels, and utilization

Facilities and services -

- Water supply and sewage treatment
- Solid waste
- Law enforcement
- Fire protection
- Health care
- Education
- Public recreation facilities
- Transportation (including traffic)

Fiscal conditions

Businesses

Attitional information

The criteria for selecting communities to be monitored include: (1) the magnitude of potential impacts to the community, and (2) the anticipated capability of the community to respond to impacts without assistance. The following communities will be monitored: Cantwell, Trapper Creek, Talkeetna, Healy, and Paxson. In addition, McKinley, Gold Creek, Sherman, Curry, Chase, Chulitna, Canyon, Lane, and the Hurricane/Indian River subdivision will also be surveyed, if they meet the above criteria.

Information sources for the work force and each community will include secondary (or published) data and primary (or survey) data. Secondary data will be obtained from documents produced by state and local government agencies, the Power Authority, the Power Authority's contractors, and other relevant entities. Primary data (as described above) will be collected through surveys of workers, businesses, and households. Local governments and other entities may assist with date collection and compliation for the communities, while contractors may assist with data collection and compilation for construction workers.

For both the community and work force surveys, a random sampling procedure will be used. The survey instrument will be a standardized questionnaire. The survey methodology (i.e., face-to-face interview, telephone interview, or mailout/drop-off and pick-up) has not been determined. The responses will be coded and entered into computer files for analysis. The data will be collected periodically (as necessary) beginning in the year preceding construction and continuing through the construction period.

Actual conditions in communities, as reflected by the data collected, will be compared to impact projections. Any significant differences or substantial adverse impacts may require mitigative action. Impact projections will be updated from the monitoring effort (e.g., data collected from surveys and secondary sources). An impact projection model will be used to analyze the data from the communities and to interact effectively with a small monitoring effort. The model may be updated easily as monitoring proceeds.

Information on baseline conditions in small communities and places will be provided in order to establish socioeconomic conditions in the communities and places that are most likely to be significantly affected. Community surveys will begin in the fall of 1983 and will be conducted annually until one year prior to project construction. Beginning at that time and extending through the construction period, the surveys will be conducted on a semi-annual basis in order to more accurately assess project-related changes. Community reports will be prepared within one month of the completion of each survey. Worker surveys will be conducted at appropriate times during the projects construction phase. The impact projections and assessments, which will be updated from this monitoring effort, will be available on an annual basis beginning in December 1983.

EXHIBIT E

5. Socioeconomics

Comment 30 (p. E-5-128, para. 2 - 5)

Provide specific plans for adjusting project schedules with reference to other projects; timing of workforce demand; leave, shift, and shift rotation schedules.

Response

Adjusting the schedule of the proposed Susitna project with reference to other projects, timing work force demand, and adjusting leave, shift, and shift rotation schedules will not be part of the Susitna project's mitigation plan because the project's construction schedule will be inflexible due to economic and logistical factors. Project related activities will be scheduled, to the extent possible, to minimize fluctucations of the work force. Therefore, Sections 4.4.1(a) and 4.4.1(b) on p. E-5-128 of Chapter 5, Exhibit E of the License Application should be deleted.

EXHIBIT 3

5. Socioeconomics

Comment 33 (p. E-5-132, para. 3)

Indicate specifically how thresholds of "inadequately met demand" and of cost-effectiveness of mitigation measures will be determined.

Response

In communities where significant numbers of construction workers will settle, information concerning present capacities of and demands on local systems will be available periodically through the socioeconomic monitoring program. This information will be used to determine whether system capacities have been surpassed as a result of project construction, or if these capacities are projected to be surpassed. Where there are current projected capacity shortfalls attributable to project construction, mitigation measures will be revised, or new measures will be developed to help eliminate the shortfalls. For any given shortfall, alternative mitigation measures will be developed and the costs of implementing each measure will be determined. The measure that is anticipated to provide an adequate response at the lowest cost will be identified. Through this procedure, the most cost-effective mitigation measure will be selected.

For example, consider a community where demand for education as a result of both natural growth and the in-migration of construction workers and their dependents is projected to exceed supply. Assume that the ninety new students expected the next year will require the equivalent of three classrooms, three teachers, and other related educational needs. First, the amount of temporary and permanent demand will be estimated. These estimates, along with local government planning standards and the input of local officials,

will help guide the development of mitigation measures. In this example, neither new classrooms nor a school should be built if the demand is largely short term. Instead, bussing, double shifts, and temporary classroom space would be investigated as potential mitigation measures. Once alternative mitigation measures are developed, the measure that will adequately reduce the shortfall attributed to the project at the lowest implementation cost will be selected.

EXHIBIT E

5. Socioeconomics

Comment 34 (p. E-5-133, para. 5; p. E-5-134, para. 6)

Provide descriptions of data and methods of data collection and analysis to be used in monitoring and updating impact assessments. Provide dates supplemental information on the monitoring plan and assessment will be provided.

Response

The purpose of the socioeconomic monitoring program is to provide timely and accurate information on indicators of key socioeconomic conditions for the impact management system. Existing impact projections will be updated from the monitoring effort. As part of this program, the Power Authority will continue to collect quantitative and qualitative data relating to socio-economic characteristics of the work force and area communities. The following information will be included:

Work Force -
- Numbers of workers by labor category
- Worker's place of origin
- Worker's places of permanent and temporary residence
- Marital status
- Number and age of worker's dependents
- Attitudinal information

Community -
- Population
- Housing
- Households
  - Employment
  - Income
  - Persons per household
  - Fish and wildlife harvest patterns, levels, and utilization

Facilities and services -

- Water supply and sewage treatment
- Solid waste
- Law enforcement
- Fire protection
- Health care
- Education
- Public recreation facilities
- Transportation (including traffic)

Fiscal conditions

Businesses

Attitional information

The criteria for selecting communities to be monitored include: (1) the magnitude of potential impacts to the community, and (2) the anticipated capability of the community to respond to impacts without assistance. The following communities will be monitored: Cantwell, Trapper Creek, Talkeetna, Healy, and Paxson. In addition, McKinley, Gold Creek, Sherman, Curry, Chase, Chulitna, Canyon, Lane, and the Hurricane/Indian River subdivision will also be surveyed, if they meet the above criteria.

Information sources for the work force and each community will include secondary (or published) data and primary (or survey) data. Secondary data will be obtained from documents produced by state and local government agencies, the Power Authority, the Power Authority's contractors, and other relevant entities. Primary data (as described above) will be collected through surveys of workers, businesses, and households. Local governments and other entities may assist with data collection and compilation for the communities, while contractors may assist with data collection and compliation for construction workers.

For both the community and work force surveys, a random sampling procedure will be used. The survey instrument will be a standardized questionnaire. The survey methodology (i.e., face-to-face interview, telephone interview, or mailout/drop-off and pick-up) has not been determined. The responses will be coded and entered into computer files for analysis. The data will be collected periodically (as necessary) beginning in the year preceding construction and continuing through the construction period.

Actual conditions in communities, as reflected by the data collected, will be compared to impact projections. Any significant differences or substantial adverse impacts may require mitigative action. Impact projections will be updated from the monitoring effort (e.g., data collected from surveys and secondary sources). An impact projection model will be used to analyze the data from the communities and to interact effectively with a small monitoring effort. The model may be updated easily as monitoring proceeds.

Information on baseline conditions in small communities and places will be provided in order to establish socioeconomic conditions in the communities and places that are most likely to be significantly affected. Community surveys will begin in the fall of 1983 and will be conducted annually until one year prior to project construction. Beginning at that time and extending through the construction period, the surveys will be conducted on a semi-annual basis in order to more accurately assess project-related changes. Community reports will be prepared within one month of the completion of each survey. Worker surveys will be conducted at appropriate times during the projects construction phase. The impact projections and assessments, which will be updated from this monitoring effort, will be available on an annual basis beginning in December 1983.

EXHIBIT E

5 Socioeconomics

Comment 35 (p. E-5-137, para. 3)

Provide date information will be available on the study of the possible new location for the permanent townsite.

Response

Information on the study of the possible new location for the permanent townsite will be available on June 30, 1984. Preliminary findings should be available November 30, 1983.

EXHIBIT E

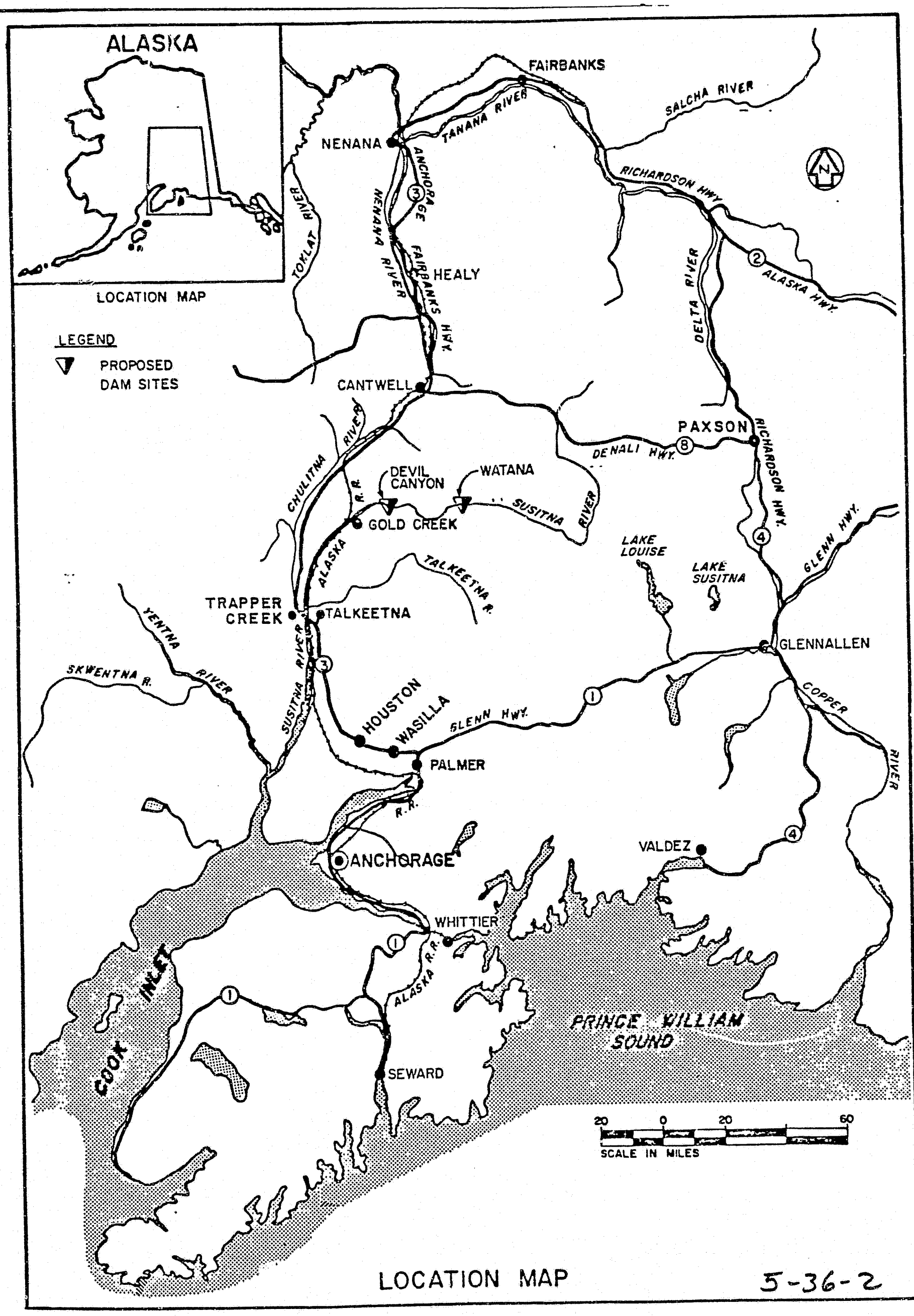
5 Socioeconomics

Comment 36 (Figure E.5.1)

Provide a map showing major transportation routes plus all communities referred to in this chapter (e.g., Wasilla, Trapper Creek, which do not appear on other maps in the application).

Response

The attached map shows major transportation routes and all communities referenced in Chapter 5, Exhibit E of the License Application.



LOCATION MAP 5-36-2

EXHIBIT E

5. Socioeconomics

Comment 37 (p. E-5B-3, para. 6 through p. E-5B-4, para. 1)

The standards of 25 students per class for primary schools and 20-22 for secondary schools for the Borough are not the same ones which appear on Tables 5.B.1, p. E-5B-7. Identify which were used.

Response

The local standards of 25 students per class for primary schools and 20-22 students per class for secondary schools were used in the analysis for the Mat-Su Borough. Attached is a corrected version of Table 5.B.1 (from Chapter 5, Exhibit E of the License Application) that reflects these standards.

TABLE 5.B.1: SUMMARY OF PUBLIC FACILITY AND SERVICE STANDARDS FOR SELECTED COMMUNITIES IN THE LOCAL IMPACT AREA

	Palmer	Wasilla	Houston	Trapper Creek	Talkeetna	Total Mat-Su Borough	Cantwell
Water Supply							
Average Water Supply & Treatment (gpd per capita)	120-150	120-150	--	--	--	--	--
Sewage Treatment							
Sewage Treatment (average gpd per capita)	150	--	--	--	--	--	--
Solid Waste Disposal							
Landfill Requirements (acres per 1,000 population)	.11-.21	.11-.21	.11-.21	.11-.21	.11-.21	.11-.21	.11-.21
Education							
Maximum Primary School-Age Children to Teacher Ratio	25	25	--	25	25	25	15
Maximum Secondary School-Age Children to Teacher Ratio	20-22	20-22	--	--	--	20-22	15
Teacher to Support Staff Ratio	8:1	8:1	8:1	8:1	8:1	8:1	--
Health Care							
Desired Hospital Bed Occupancy Rate	--	--	--	--	--	55%	--
Law Enforcement							
Police Officers (officers per thousand population)	1.5	--	--	--	--	1.0	1.0
Parks and Recreation							
Playgrounds (acres per 1000 dwelling units)	3.9	3.9	3.9	--	--	--	--
Neighborhood Parks (acres per thousand dwelling units)	3.3	3.3	3.3	--	--	--	--
Community Park (acres per thousand dwelling units)	--	--	--	--	--	4.8	--

EXHIBIT E

5. Socioeconomics

Comment 38

Responses to Alaska Department of Natural Resources Letter of January 13, 1983:

a. Comment 9 Provide references of TAPS studies reviewed.
b. Comment 10 Provide description of how impact model will be updated and dates when updates will be available.

Response

Item #38a.

The following documents concerning the impacts of the Trans-Alaska Pipeline were reviewed:

Alaska Department of Community and Regional Affairs. July 1973. Pipeline Corridor Smaller Communities Survey. Juneau, AK.

Alaska Department of Community and Regional Affairs, Division of Community Planning. February 1976. Report of FY75 Trans-Alaska Pipeline Impact Expenditures by State and Local Governments. Juneau, AK.

Alaska Department of Labor, Research and Analysis Section. April 21, 1971. "TAPS Construction and Its Impact on the Alaskan Economy" in Economic Analysis. Volume I, Issue Two.

Fairbanks North Star Borough, Community Information Center. 1978-1980. Community Information Quarterly. Various issues. Fairbanks, AK.

Fairbanks North Star Borough, Community Information Center. 1980-1981. The Energy Report. Various issues. Fairbanks, AK.

Fairbanks North Star Borough, Community Information Center. 1980-1981. Community Research Quarterly, A Socioeconomic Review. Various issues. Fairbanks, AK.

Fairbanks Town and Village Association for Development, Inc. January 1979. Community Facilities Summaries. Fairbanks, AK.

Fairbanks Town and Village Association for Development, Inc. April 8-9, 1978. A Report of the Upper Tanana Regional Forum on the Impact of Construction and Operation of the Al-Can Gas Pipeline. Fairbanks, AK.

Fairbanks Town and Village Association for Development, Inc. Interior Development District Association. September 1980. The Overall Economic Development Program for the Economic Development District of Alaska. Fairbanks, AK.

Fisson, S., Moore, D., and Quisenberry, C. 1977. Energy Costs, Consumption and Impacts in Fairbanks. Fairbanks North Star Borough, Fairbanks, AK. Impact Information Center -Special Report No. 5.

Fisson, Sue and Cindy Quisenberry. 1977. Impact Information Center Final Report. Fairbanks North Star Borough, Fairbanks, AK. Chapters 3, 7, 8, 10, 12, and 13.

Forrest, Marilynn. July 1979. Fairbanks Cost of Living Update. Fairbanks North Star Borough, Community Information Center. Fairbanks, AK. Special Report No. 5.

Human Resources Planning Institute. November 1974. Manpower and Employment Impact of the Trans-Alaska Pipeline. Volume II, Technical Report. Prepared for United States Department of Labor, Manpower Administration, Region X. Seattle, WA.

Pistoll, Lynn. October 13, 1978. "An Oil Pipeline Employment Multiplier and Post Construction Residuals in Employment" in Issues and Commentary. Alaska Department of Labor, Research and Analysis Section.

Dixon, Mim. 1978. What Happened to Fairbanks? Social Impact Assessment Series. Westview Press, Inc. Boulder, CO.

Item #38b

The impact model has been changed in order to enhance its capability to efficiently conduct a variety of sensitivity analyses based on different project scenarios. Specifically, the model which was comprised of over 100 data files on 30 microcomputer diskettes, was converted to a Wang VS45 mini-computer. The basic assumptions and methodologies of the model have not and will not change.

Baseline (without project) and with-project projections will be updated using revised assumptions and new data, as appropriate. Information from the "Need for Power" studies and data from surveys conducted in local communities will be included in these updates. Ranges of impact estimates, in addition to best estimates, will be provided and made available to community planners. The updates of the baseline and with-project projections and impact assessments will first be available in December, 1983. For specific details on the manner in which data will be developed for the purposes of updating the impact model, refer to the response to Comment 29 for Chapter 5 (Socioeconomics).

EXHIBIT E

5. Socioeconomics

Comment 39 Responses to Alaska Department of Fish and Game Letter of January 13, 1983: Chapter 5, Specific Comments.

a. G-5-001 E-5-6/1 Provide description of study methods and plan, data on the "importance of the natural resource harvest to the local impact area" to be collected in 1983 "through interviews with residents of selected communities," and date when data will be available.

b. G-5-008 E-5-68 and G-5-107 E-5-71/5 Provide data that will be collected on fish and wildlife user groups in Cantwell and other communities in the project region, and indicate date when these data will be available. Provide description of study plan and methods.

Response

Project-induced impacts on local users of fish and wildlife in the project area will be monitored through the use of household surveys. Data on harvest patterns, levels, and utilization and the contribution of these harvests to residents' livelihoods and well-being will be collected in Cantwell, Trapper Creek, Talkeetna, and Paxson. In addition, McKinley, Gold Creek, Sherman, Curry, Chase, Chulitna, Canyon, Lake, and the Hurricane/Indian River subdivision may also be surveyed. Data will be collected during the fall of 1983 and will be available on a periodic basis beginning December 1983. A random sample survey procedure will be used with the

survey instrument being a standardized questionnaire. The specific survey methodology (i.e., face-to-face interview, telephone interview, or mailout/drop-off and pick-up) has not been determined. Survey responses will be coded and entered into computer files for analysis. These data will provide baseline information. Moreover, they will be subsequently used to update impact projections. Data from future surveys will be compared with the baseline date and impact projections in order to update the projections and develop new or revised mitigation measures, if necessary.

In addition to the household surveys, project area guides and lodge operators will be surveyed. A questionnaire will be mailed to each guide and followed up by telephone, if necessary, in order to achieve an adequate response rate. Data concerning business status (e.g., number of clients and fee structure), utilization, and ownership of capital and physical assets (cabins and airstrips), as well as attitudes of guides, lodge operators, and their clients will also be collected. These survey data will be analyzed, interpreted, and reported periodically beginning in November 1984. Project-induced impacts on guides and lodge operators will be assessed and appropriate mitigation measures will be formulated and implemented, if necessary.

EXHIBIT E

6. Geological and Soil Resources

Comment 2 (p. E-6-3)

If known, provide the geologic names of the stratigraphic units in the area.

Response

No geologic names have been assigned to the stratigraphic units in the project area. The area has been mapped at a reconnaissance scale of 1;250,000 by Csejtey et al. (1978). In the attached table, the stratigraphic units as defined in the license document are cross-referenced with the map units as defined by Csejtey et al. (1978).

Reference

Csejtey B. Jr. W.H. Nelson, D.L. Jones, N.J. Silberling, R.M. Dean, M.S. Morris, M.A. Lanphere, J.G. Smith, and M.L. Silberman. 1978. Reconnaissance Geologic Map and Geochronology, Talkeetna Mountains Quadrangle, Northern Part of Anchorage Quadrangle, and Southwest corner of Healy Quadrangle, Alaska. U.S. Geological Survey, Open File Report 78-558A. 62 p.

TABLE 1
STRATIGRAPHIC UNITS

Geology	Map Symbol[1/]	Unit[1/]	Age[1/]
Felsic and Mafic Volcanic Extrusive Rocks	Tv	Undifferentiated Volcanic Rocks	Paleocene to Miocene
	Tim	Hypabyssal Mafic Intrusives	Paleocene to Miocene
Tertiary Age Plutonic Rocks	Tsmg	Schist, Migmatite, and Granite	Paleocene Intrusive and Metamorphic age
	Tbgd	Biotite Granodiorite	Paleocene, Eocene (?)
	Tkgr	Granitic Rocks, Undivided	Cretaceous and Tertiary
Turbidite Sequence of Argillite and Graywacke	Kag	Argillite and Lithic Graywacke	Lower Cretaceous
Jurassic Plutonic Rocks	Jgd	Granodiorite	Middle to Upper Jurassic
	Jtr	Trondhjemite	Upper Jurassic
	Jam	Amphibolite	Lower to Middle Jurassic
Triassic Metavolcanic and Sedimentary Rocks	Trv	Basaltic Metavolcanic Rocks	Upper Triassic
Upper Paleozoic Rock Sequence	Pzu	Basltic to Andesitic Metavolcanogenic Rocks	Pennsylvanian(?) and Early Permian

1/After Csejtey et al. 1978.

EXHIBIT E

6. Geological and Soil Resources

Comment 3 (p. E-6-4, para. 4)

Complete the last sentence in the paragraph.

Response

The sentence should read as follows:

> As a consequence of the repeated glaciation, the Susitna and Copper River basins are covered by varying thicknesses of till and lacustrine deposits.

EXHIBIT E

6. Geological and Soil Resources

Comment 5 (p. E-6-15)

Document any studies that describe the origin of "the Fins" feature. Describe any investigations underway to discover other unidentified shear zones beneath the other incised portions of the relict channel. Indicate the scope of these investigations, provide summaries of these findings, and estimate completion dates for those studies.

Response

"The Fins" feature is primarily a northwest trending zone of shearing and alteration that has been delineated on the north abutment of the Susitna River just upstream of the diversion tunnel entrance. The shearing occurs in diorite and diorite porphyry rocks believed to be Paleocene in age (Csejtey et al. 1978). The zone has been tentatively extrapolated to an altered and sheared outcrop approximately two miles to the northwest on Tsusena Creek. The extension of this feature to the northwest is inferred from seismic refraction lines which show low seismic velocities (10,000 to 12,700 fps) in bedrock and coincides with a topographic low in the bedrock surface. The delineation of "the Fins" feature farther to the northwest of Tsusena Creek and southeast of the Susitna River proved to be inconclusive as the areas are mantled by glacial drift (Acres American, 1982.)

No studies have been undertaken to specifically determine the origin of "the Fins" feature. The sutdy of the feature by Woodward-Clyde Consultants (1981, 1982) determined that it is a fault at the Susitna River but that its relation to faulting at Tsusena Creek is questionable. Woodward-Clyde (1982) concluded that the faulting and shearing at Tsusena Creek appeared to be associated with the intrusive events rather than due to displacement along a fault zone. Therefore if the shearing at Tsusena Creek is believed

to be a continuation of "the Fins" feature, the analogy that the shearing is a consequence of the intrusive events would likely apply. The feature was classified as a fault without recent displacement, therefore it does not affect consideration of seismic ground motion or surface rupture potential at the damsite.

No further investigations specifically designed to delineate unidentified shear zones beneath the Watana Relict Channel are anticipated. Any further shearing identified beneath the relict channel area would be further upstream away from the damsite and any civil structures. Geologic mapping of the entrance and exit area to the relict channel are planned to further evaluate the seepage potential of the unconsolidated deposits which fill the channel. At the same time, any shearing associated with the areas will be identified and documented during the investigation.

Geologic mapping and trenching of the relict channel entrance and exit areas are planned for during the FY85, Summer Exploration program. The trenching of these areas may be deferred until the following winter program depending on the size of the construction equipment used. The results of the geologic mapping program will be completed in November 1984, whereas the trenching program will either be completed in November 1984 or May 1985.

References

Acres American, Inc. 1982. Susitna Hydroelectric Project, 1982 Supplement to the 1980-81 Geotechnical Report. Prepared for the Alaska Power Authority.

Csejtey, B., Jr., Nelson, W.H., Jones, D.L., Silberling, N.J., Dean, R.M., Morrio, M.S., Pamphere, M.A., Smith, J.G., and Silberman, M.L., 1978. Reconnaissance Geologic Map and Geochronology, Talkeetna Mountains Quadrangle, Northern Part of Anchorage Quadrangle, and Southwest Corner of Healy Quadrangle, Alaska. U.S. Geological Survey. Open File Report 78-558A. 62 p.

Woodward-Clyde Consultants. 1980. Interim Report on Seismic Studies for Susitna Hydroelectric Project. Prepared for Acres American, Inc.

Woodward-Clyde Consultants. 1982. Final Report on Seismic Studies for Susitna Hydroelectric Project. Prepared for Acres American, Inc.

EXHIBIT E

6. Geological and Soil Resources

Comment 6

Describe in greater detail the presence of stress relief joints 100 feet back from the Devil Canyon damsite gorge walls and the large detached rock blocks measuring 25 by 50 feet on the left abutment as described in the Acres American 1982 Geotechnical Report Volume 1 (e.g., depth of joints, probability of failure of block during maximum intensity quake, probably seiche effects).

Response

Stress relief joints are present on both abutments of the Devil Canyon damsite. These joints are associated with three joint sets; a northwest set with a dip near vertical (I), a northeast set which dips moderately to the southeast (II), and a northeast set with moderate to steep dips to the northwest (III).

Joint Set II includes joints parallel and subparalled to the bedding/foliation planes. These joints are subparallel to the slopes on the right abutment. In a few places just above river level open joints were observed. These may be a result of stress relief and/or slumping of blocks due to erosion at river level. On the left abutment, these joints result in overhanging cliffs along the canyon rim.

On the left abutment evidence of stress relief is common in two directions. In the general area of the thrust block, four northwest trending open joints were mapped. These joints are up to 12" wide and have been traced up to 180 feet. Beyond 180 feet either the joints are tight or the overburden is of sufficient thickness to preclude any further tracing of the horizontal extent of the joints. These joints are parallel to and extend back from the

cliff face up to a distance of 80 feet. The spacing of these four joints range from 17 to 27 feet. During the mapping of the left abutment cliff face with technical climbers, an attempt was made to trace the joints vertically. The open joints were observed to extend up to 55 feet down along the canyon face and had a 10 foot spacing. Although there is some uncertainty as to the depth of the open joints, they are expected to be open down to 50 to 60 feet.

Approximately 300 feet downstream of the dam centerline, on the left abutment, a northeast trending depression approximately 400 feet long and 10 feet deep was mapped. This depression which is subparallel to the valley trend is up to 50 feet back from the canyon edge. Many of the blocks to the canyon side of the depression are loose and appear to have slumped. The depression and loose blocks appear to be associated with joint sets II and III.

It appears that the northerly exposure of the left abutment slope is conducive to increased physical weathering of the rock slope by frost action. Further investigations of the extent of the open joints and the depth to sound rock are necessary. It is planned that the open jointed rock will be excavated down to a depth where the joints are tight or where the joints can be treated by grouting. All loose and detached blocks of rock along the canyon wall will be removed or rock bolted and/or grouted. For more information on the treatment of the rock abutment see Volume 5 of the Feasibility Report, Appendix B5 which deals with the Arch Dam Analysis.

EXHIBIT E

6. Geological and Soil Resources

Comment 7 (p. E-6-25)

Estimate the number of hectares expected to be affected by each type of slope failure for each reservoir.

Response

As stated in Exhibit E Section 3.3.2, an evaluation of the slope conditions was made to delineate potentially unstable slopes in the reservoirs. Segments of the reservoir shoreline were classified by one or more slope models as to the type of slope conditions which might occur over at least a portion of the shoreline area.

To estimate the total number of hectares of beaching and each type of slope failure in the reservoirs the following procudure was used:

(1) Determine the total number of hectares between the probable maximum flood and maximum drawdown reservoir levels.

(2) Determine the number of hectares of each reservoir rim segment and categorize according to the slope condition. This would give a worse case situation.

(3) Determine a reasonable estimate of the number of hectares of each slope condition within each segment of the reservoir shoreline based on current slope instability, slope angle and topography, and type of soils or surface materials.

Within each segment of the reservoir shoreline, the percentage of the total area affected by the identified slope condition as well as the effect of the other slope processes on the area where evaluated (see Table 1). It was assumed that an area having the potential for sliding would be susceptible to some beaching and flow slides. The criteria used provided a standard guideline for evaluating each slope condition systematically over both reservoirs. In Table 2, estimates of the number of hectares of each slope condition for the Watana Reservoir are presented for two cases. The first case represents the total area of the reservoir shoreline covered under each slope condition in Figures E.6.22 through E.6.45 which could be considered a worse case situation. Using the same figures for the second case, each segment of the reservoir shoreline was evaluated to ascertain the likelihood and portion of that area which would be affected by the designated slope condition, using Table 1 criteria as a guideline. The results for the Watana Reservoir indicate that much of the area having the potential for block sliding will be affected to a large extent by beaching. The areal extent affected by each slope condition will change according to the percentages used in Table 1, but it is believed that the figures presented provide a reasonable estimate.

For informational purposes, a large block slide in the Watana Creek drainage occurred sometime during the fall of 1982. It was estimated as having a volume of approximately 1.44×10^6 cubic meters and lies within the confines of the proposed Watana Reservoir.

For the Devil Canyon Reservoir, the shoreline will be affected by two factors: the minimal fluctuation of the reservoir level and a drawdown zone which is primarily in contact with bedrock and/or low angle slopes. The estimates for the area covered by each slope condition for both cases is provided in Table 2. The results are indicative of the limited extent to which the reservoir shoreline is comprised of materials susceptible to slope instability.

For more detailed information of the breakdown and distribution of each slope condition in both the Watana and Devil Canyon Reservoirs, see Table 3 and 4 of this response.

TABLE 1

EVALUATION OF POTENTIAL SLOPE CONDITION - REASONABLE ESTIMATE

Current Slope Instability	Flows & Slides % 1/	Flows in Breaching Areas % 1/	Flows in Slide Areas % 1/
None	--	0 - 10	10
Slight	10	10	25
Moderate	25	25	30
High	40	40	35

1/Percentage of Slope Area Under the Specified Slope Condition

TABLE 2

SUMMARY OF POTENTIAL RESERVOIR RIM SLOPE CONDITIONS

Model	Case I		Case II	
	No. of Hectares	Percent of Total	No. of Hectares	Percent of Total
Watana Reservoir				
Beaching (I)	3,331.1	56.5	4,313.4	71.0
Flow Slides (II)	957.6	16.2	1,172.6	19.3
Block Slides (III)	92.2	1.6	80.8	1.3
Block Slides (IV)	1,515.5	25.7	511.8	8.4
Devil Canyon Reservoir				
Beaching (I)	894.0	95.0	912.1	96.9
Flow Slides (II)	29.9	3.2	22.4	2.4
Block Slides (III)	0.0	0.0	0.0	0.0
Block Slides (IV)	17.1	1.8	6.6	0.7

TABLE 3

WATANA RESERVOIR
ESTIMATE OF SLOPE CONDITIONS

Location Rivermile	Areal Extent of Slope Condition (hectares) Drawdown Zone	Above Drawdown Zone	Current Instability	Estimate of Slope Condition[1] (hectares) I	II	III	IV
185-186	32.5	55.8	Slight	80.2	8.0		
	26.1	4.6	None-slight	24.9	5.8		
186	75.5	76.6	Mod-High	127.1	10.0		15.0
Deadman Ck.	11.6	13.9	Slight	3.7	6.4		2.5
	10.5	1.0	Slight	10.0	1.5		
186-187.5	87.8	11.1	Slight	63.1	24.7		
187-188	132.9	N/A	None	132.9			
188-191	217.9	N/A	Slight	202.9	15.0		
	170.9	1.0	Slight	111.7	43.0		17.2
192-197.5	154.9	4.6	None	138.9	16.0		
	108.7	13.9	Mod-High	16.7	42.9		49.1
	66.9		None	60.2	6.7		
	111.5	7.0	Slight	70.0	29.6		11.9
Watana Ck. mouth	1321.9		None-Slight	1255.8	66.1		
Ck. @RM 192	235.9	16.7	None	210.6	25.3		
Watana Ck.	95.1		Slight	76.1	9.5		9.5
	32.6	18.6	Moderate	12.8	19.8		
	148.8	55.3	Moderate	37.0	61.0		50.8
	151.0	39.8	Mod-High		76.3	76.3	
198-204	314.3	N/A	None	298.6	15.7		
	79.0	2.6	None	70.8	8.2		
	111.3	19.9	Slight	65.4	32.8		13.1
	74.3	13.4	Moderate	39.5	26.3		21.9
	69.7	14.6	Moderate	23.3	25.3		21.1
	20.9	N/A	None	16.7	2.1		
205-211	93.4	1.0	Slight	85.1	9.3		
	29.3	5.5	Slight	17.1	8.7		3.5
	55.3	25.5	Slight	27.0	20.2		8.1
	179.2	23.2	Slight	67.9	60.7		50.6
	179.2	9.2	None	141.5	37.7		
	34.8	15.1	None	17.3	12.5		5.0

[1]Refer to Table 2 for description of I, II, etc.

TABLE 3 (continued)

WATANA RESERVOIR
ESTIMATE OF SLOPE CONDITIONS

Location Rivermile	Areal Extent of Slope Condition (hectares) Drawdown Zone	Above Drawdown Zone	Current Instability	Estimate of Slope Condition[1] (hectares) I	II	III	IV
211-217	60.4	2.2	Slight	54.1	6.3		
	89.2	12.1	Slight-Mod	53.8	25.3		10.1
	109.6	27.4	Mod-High	6.8	48.0		54.8
	29.0	5.8	High	1.2	13.0		13.9
217-219.5	54.1	1.0	None	48.7	5.4		
	3.0	1.5	None	2.0	0.5		
	49.7	39.5	None-Slight	31.9	8.9		8.9
	29.3	11.1	Moderate	9.1	10.1		10.1
220-226	163.3	8.8	Slight	146.1	17.2		
	113.8		High	68.3	45.5		
	67.0	35.3	Slight	43.5	16.8		6.7
	3.5		None	3.0	0.5		
226-230	60.4	5.8	High	37.2	23.2		
	72.5		None	68.9	3.6		
	75.9	55.7	Moderate	38.0	39.5		26.3
	7.0	4.6	Slight	7.0	4.6		
230-238	29.7	7.0	Slight-High	15.0	14.7		
	37.6	20.9	None-High	5.4	17.6		14.6
	118.5	78.0	Slight	20.3	49.1		49.1
	11.4	8.1	None	7.4	2.0		2.0
	137.2	32.5	High	77.8	59.4		
	33.4	11.6	None	28.9		4.5	
	101.0	32.5	Moderate-High	34.2	33.4		33.4

[1]Refer to Table 2 for description of I, II, etc.

TABLE 4

DEVIL CANYON RESERVOIR
ESTIMATE OF SLOPE CONDITIONS

Location Rivermile	Areal Extent of Slope Condition (hectares) Drawdown Zone	Above Drawdown Zone	Current Instability	Estimate of Slope Condition[1] (hectares) I	II	III	IV
152	6.8	N/A	None	6.8			
152-153	11.7	N/A	None	11.7			
	8.7	N/A	None	8.7			
153-159	60.6	N/A	None	60.6			
	94.2	N/A	None	94.2			
159-165.5	48.5	N/A	None	48.5			
	52.4	N/A	None	52.4			
166-168	14.8	N/A	None	14.8			
	20.3	N/A	None	20.3			
	17.7	N/A	Slight	15.9	1.8		
168-174	48.4	N/A	None	48.4			
	52.4	N/A	None	52.4			
174-179	127.8	N/A	None	121.4	6.4		
	76.5	N/A	None	76.5			
	16.5	N/A	Slight	8.2	1.7		6.6
	12.2	N/A	None	11.0	1.2		
179-182	226.1	N/A	None	214.8	11.3		
	27.4	N/A	None	27.4			
182-184	18.1	N/A	None	18.1			

[1]Refer to Table 2 for description of I, II, etc.

EXHIBIT E

6. Geological and Soil Resources

Comment 9 (p. E-6-30 para. 4)

Provide estimates of the amount of piping of the relict channel north of the Watana site exit point on Tsusena Creek that may be expected as a result of seepage. Discuss the nature of future investigations to assess the seepage problem and the criteria to be used in determining mitigation measures.

Response

The possibility of significant seepage or piping through the buried channel area is remote, even without any remedial measures. This is primarily because of the long seepage path (±7000 ft.) and flat hydraulic gradient(±6%).

Recently constructed contour maps, based on all the underground information accumulated to date, indicate a wide entrance channel or channels on the upstream side. On the downstream side, the data suggests a relatively narrow exit face into the Tsusena Creek area. Based on this information it is evident that any one of several technical solutions could be installed to positively control seepage and preclude the possibility of any piping. It is also evident that the need for control measures is significantly reduced as the reservoir level is lowered.

Field pumping tests will be conducted in the future to obtain overall permeability values for the relict channel area. The lack of this type of information at this time in no way impedes design progress or compromises project feasibility. Proven technical solutions exist which would at reasonable cost, positively control seepage and thereby, prevent piping.

Present planning is to utilize an underground adit with interceptor drains for cost estimate purposes. Detailed design studies will include other solutions or combinations of alternatives.

Future investigations, in addition to the field pumping tests, to assess the buried channel underground conditions, include additional borings with geophysical logging. Side hill trenches will be excavated at both the entrance and exit faces to obtain a better idea of the surficial covering materials as well as the channel deposits themselves.

The criteria considerations to be used in determining the remedial measures include the following:

Technical

A technically sound design will be developed based on accepted theory and practical experience from other projects.

Cost

Sufficient funds will be expended to provide adequate information for a practical sound design.

Constructability

Future investigations will utilize to the extent possible personnel and equipment normally required on a major earthwork project.

Environmental

The project will give emphasis to alleviating or minimizing permanent damage to the landscape. The area will be returned as near as practically possible to the original conditions prior to any investigations.

EXHIBIT E

6. Geological and Soil Resources

Comment 10. (p. E-6-34)

Estimate the potential for slope failure and erosion to extend beyond the project boundries. Identify areas where this may be most likely to occur and estimate the number of hectares to be affected.

Response

The project boundaries used in evaluating the potential for slope failure and erosion beyond the project boundary limits are those which are amended to the FERC License Application on April 12, 1983 by Acres American, Inc.

In the evaluation of slope failure and erosion outside the project boundaries, only those associated with or a consequence of the reservoir impoundment and operation were considered. As exists presently, soliflucton, skin flows and minor rock sliding will occur on various slopes above the reservoir in soils susceptable to instability.

The primary slope conditions which may extend beyond the project boundaries are skin flows and slides. Slope failure associated with these processes could result in the continuous degradation of the shoreline.

Based on the current slope stability, slope angle, and the types of soil or rock comprising the slopes, a reasonable estimate of the area affected by slope failure was ascertained (see Table 1). Table 2 lists the areas and gives an estimate of the portion of that area which may be susceptible to slope failure and erosion (Plates G19, 23, 24, 25, and 27). In the Watana Reservoir, approximately 111 hectares outside the project boundary may be

affected by slope failure, of which approximately 27 and 14.8 hectares will result in skin flows and block slides, respectively. In the Devil Canyon Reservoir there is only one area of concern that has been identified. This is a possible old slide at river mile 175 that has an area of approximately 70 hectares, of which all or part may fail after reservoir impoundment (see Plate G11, attached).

TABLE 1

EVALUATION OF POTENTIAL SLOPE CONDITION - REASONABLE ESTIMATE

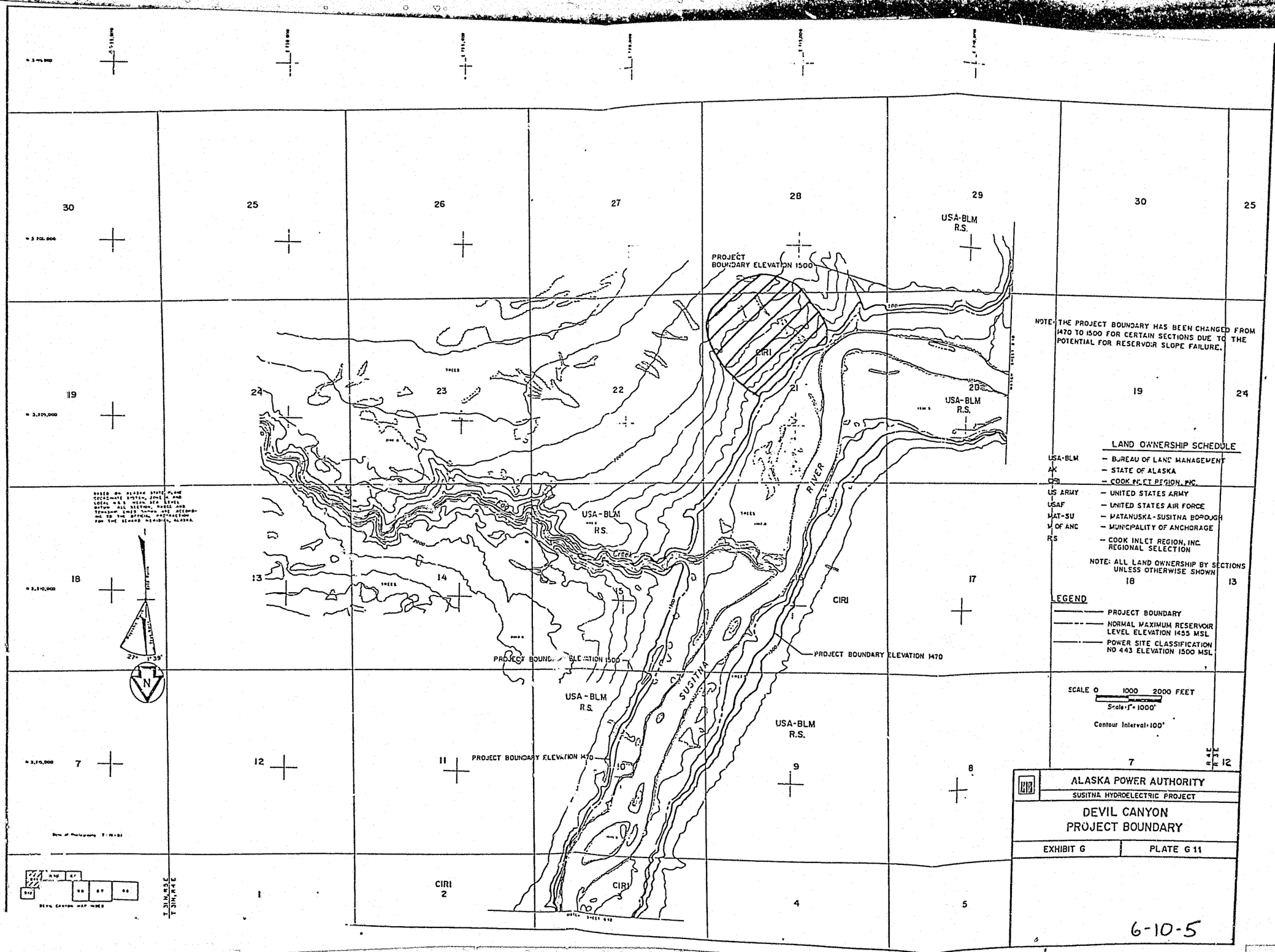
Current Slope Instability	Flows & Slides 1/ %	Flows in Beaching Areas 1/ %	Flows in Slide Areas 1/ %
None	-----	0 - 10	10
Slight	10	10	10
Moderate	25	25	30
High	40	40	35

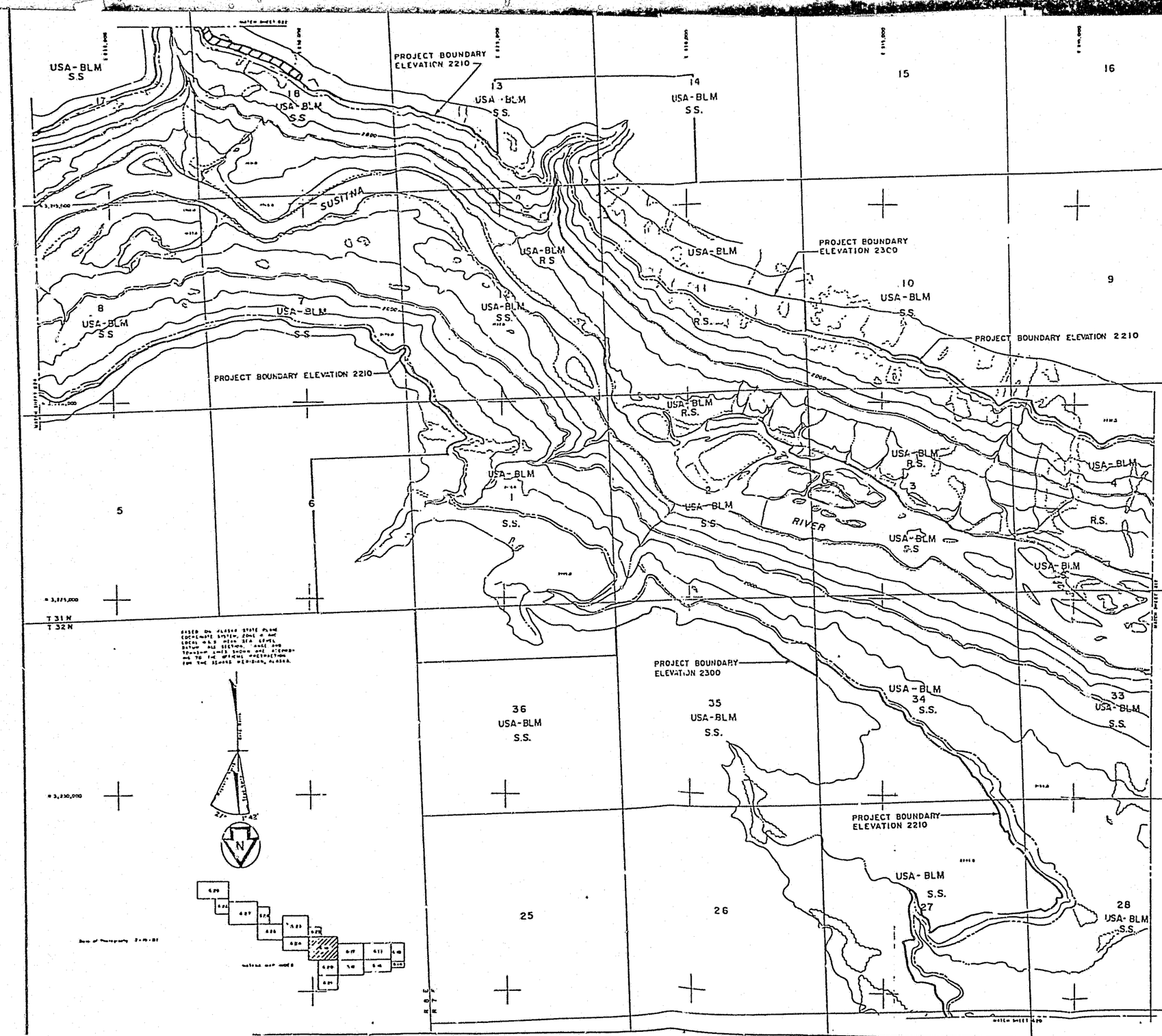
1/ Percentage of Slope Area Under the Specified Slope Condition

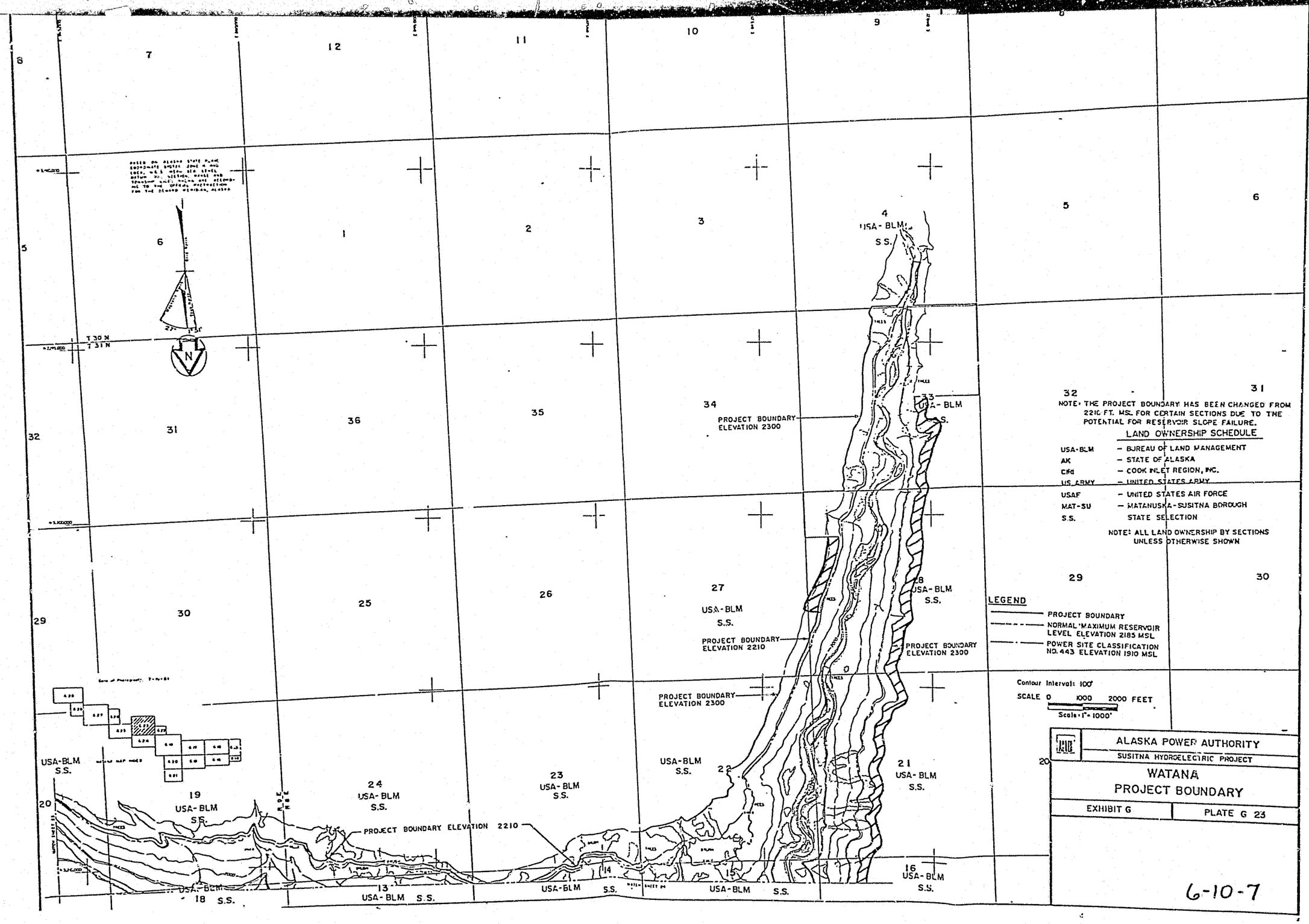
TABLE 2

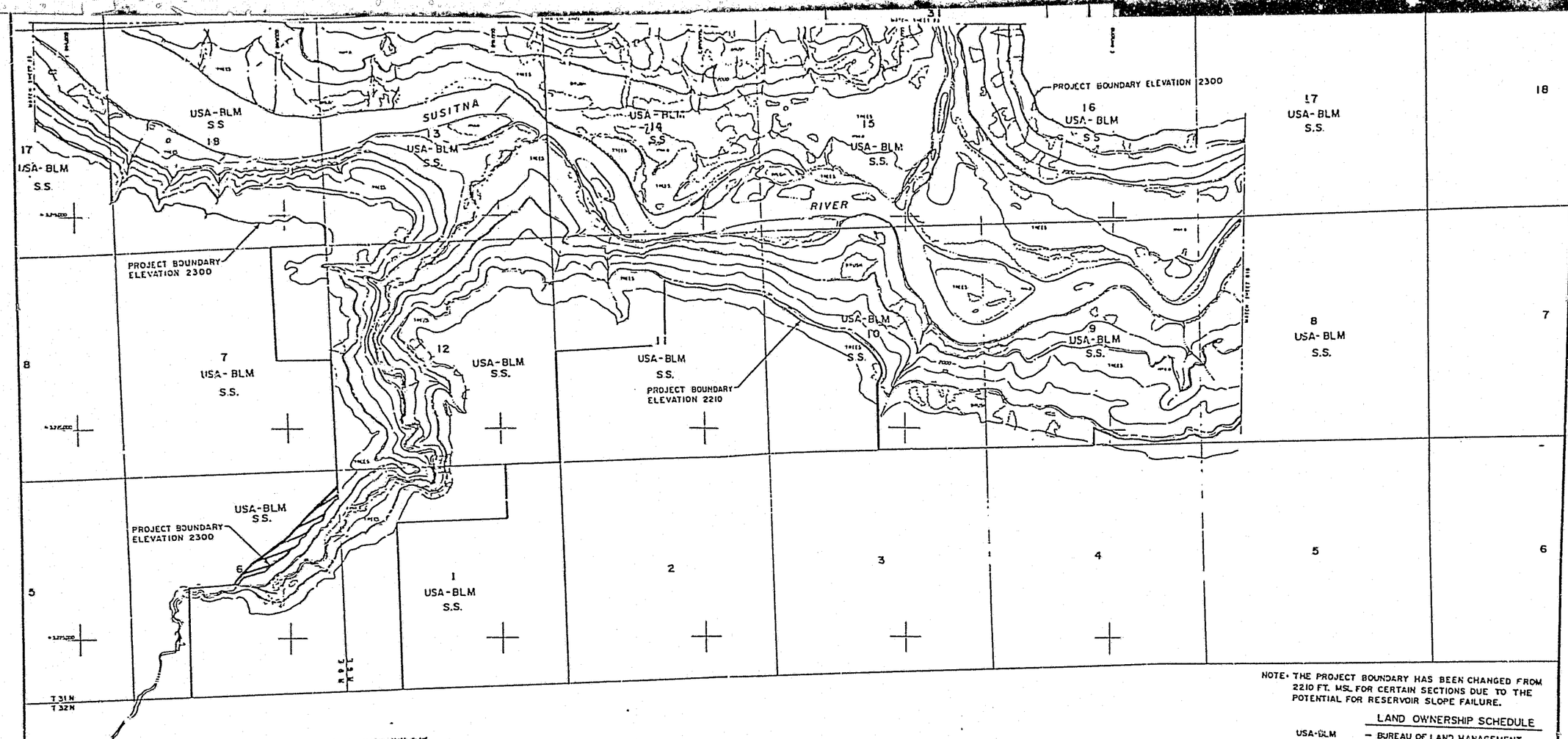
AREAS OF POTENTIAL SLOPE INSTABILITY
BEYOND THE PROJECT BOUNDRIES

RIVER MILE	TOTAL AREA hectares	CURRENT SLOPE INSTABILITY	ESTIMATE OF SLOPE CONDITIONS IN HECTARES I	II	III	IV
WATANA RESERVOIR						
203-204	4.2	Moderate	1.1			
Jay Creek	6.5	None	0.7			0.7
Kosina Creek	39.9	Slight			10.0	4.0
215-217	25.5	Slight			6.4	2.6
220-223	35.3	Slight			8.8	3.5
DEVIL CANYON RESERVIOR						
175	69.4	High				69.4


30
25
26
27
28
29
30
25
19
24
23
22
21
20
19
24
18
13
14
15
17
13
7
12
11
10
9
8
7
12
1
CIRI
2
4
5
USA-BLM
R.S.
CIRI
PROJECT
BOUNDARY ELEVATION 1500
PROJECT BOUNDARY ELEVATION 1500
PROJECT BOUNDARY ELEVATION 1470
PROJECT BOUNDARY ELEVATION 1470
SUSITNA
RIVER
NOTE: THE PROJECT BOUNDARY HAS BEEN CHANGED FROM 1470 TO 1500 FOR CERTAIN SECTIONS DUE TO THE POTENTIAL FOR RESERVOIR SLOPE FAILURE.
LAND OWNERSHIP SCHEDULE
USA-BLM – BUREAU OF LAND MANAGEMENT
AK – STATE OF ALASKA
CIRI – COOK INLET REGION, INC.
US ARMY – UNITED STATES ARMY
USAF – UNITED STATES AIR FORCE
MAT-SU – MATANUSKA-SUSITNA BOROUGH
M OF ANC – MUNICIPALITY OF ANCHORAGE
RS – COOK INLET REGION, INC. REGIONAL SELECTION
NOTE: ALL LAND OWNERSHIP BY SECTIONS UNLESS OTHERWISE SHOWN
LEGEND
PROJECT BOUNDARY
NORMAL MAXIMUM RESERVOIR LEVEL ELEVATION 1455 MSL
POWER SITE CLASSIFICATION NO 443 ELEVATION 1500 MSL
SCALE 0 1000 2000 FEET
Scale: 1" = 1000'
Contour Interval: 100'
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
DEVIL CANYON
PROJECT BOUNDARY
EXHIBIT G
PLATE G 11
6-10-5


12
USA-BLM S.S
PROJECT BOUNDARY ELEVATION 2210
USA-BLM S.S
USA-BLM S.S.
USA-BLM S.S.
SUSITNA
USA-BLM R.S
USA-BLM
PROJECT BOUNDARY ELEVATION 2300
USA-BLM S.S.
USA-BLM R.S.
USA-BLM S.S
RIVER
USA-BLM R.S
USA-BLM R.S.
USA-BLM R.S.
USA-BLM S.S.
USA-BLM S.S.
USA-BLM S


12
PROJECT BOUNDARY ELEVATION 2300
PROJECT BOUNDARY ELEVATION 2210
PROJECT BOUNDARY ELEVATION 2300
PROJECT BOUNDARY ELEVATION 2300
PROJECT BOUNDARY ELEVATION 2210
USA-BLM S.S.
NOTE: THE PROJECT BOUNDARY HAS BEEN CHANGED FROM 2210 FT. MSL FOR CERTAIN SECTIONS DUE TO THE POTENTIAL FOR RESERVOIR SLOPE FAILURE.
LAND OWNERSHIP SCHEDULE
USA-BLM – BUREAU OF LAND MANAGEMENT
AK – STATE OF ALASKA
CIRI – COOK INLET REGION, INC.
US ARMY – UNITED STATES ARMY
USAF – UNITED STATES AIR FORCE
MAT-SU – MATANUSKA-SUSITNA BOROUGH
S.S. STATE SELECTION
NOTE: ALL LAND OWNERSHIP BY SECTIONS UNLESS OTHERWISE SHOWN
LEGEND
PROJECT BOUNDARY
NORMAL MAXIMUM RESERVOIR LEVEL ELEVATION 2185 MSL
POWER SITE CLASSIFICATION NO. 443 ELEVATION 1910 MSL
Contour Interval: 100'
SCALE 0 1000 2000 FEET
Scale: 1" = 1000'
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
WATANA
PROJECT BOUNDARY
EXHIBIT G
PLATE G 23
6-10-7

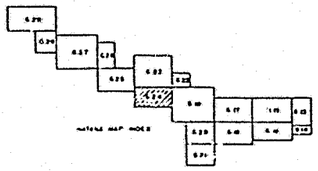


NOTE: THE PROJECT BOUNDARY HAS BEEN CHANGED FROM 2210 FT. MSL FOR CERTAIN SECTIONS DUE TO THE POTENTIAL FOR RESERVOIR SLOPE FAILURE.

LAND OWNERSHIP SCHEDULE

USA-BLM	– BUREAU OF LAND MANAGEMENT
AK	– STATE OF ALASKA
CIR	– COOK INLET REGION, INC.
US ARMY	– UNITED STATES ARMY
USAF	– UNITED STATES AIR FORCE
MAT-SU	– MATANUSKA-SUSITNA BOROUGH
S.S.	– STATE SELECTION

NOTE: ALL LAND OWNERSHIP BY SECTIONS UNLESS OTHERWISE SHOWN



LEGEND

- PROJECT BOUNDARY
- NORMAL MAXIMUM RESERVOIR LEVEL ELEVATION 2185 MSL
- POWER SITE CLASSIFICATION NO. 443 ELEVATION 1910 MSL

SCALE 0 1000 2000 FEET
Scale. 1" = 1000'

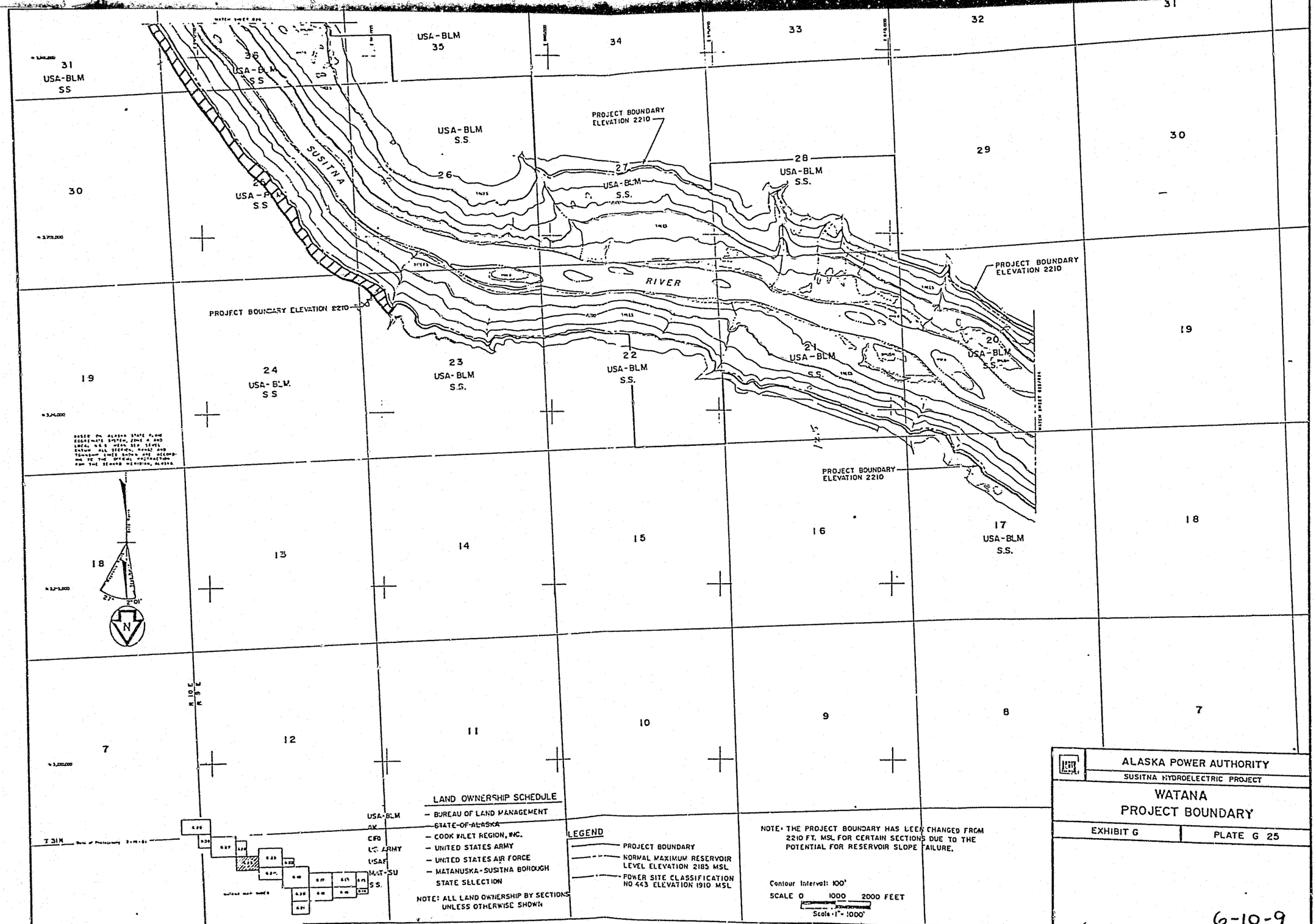
Contour Interval: 100'

ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

WATANA
PROJECT BOUNDARY

EXHIBIT G | PLATE G 24

6-10-8


SUSITNA
RIVER
PROJECT BOUNDARY ELEVATION 2210
USA-BLM S.S.
USA-BLM
31
30
29
28
27
26
25
24
23
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T 31N
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R 9E
N
LAND OWNERSHIP SCHEDULE
USA-BLM – BUREAU OF LAND MANAGEMENT
AK – STATE OF ALASKA
CIRI – COOK INLET REGION, INC.
U.S. ARMY – UNITED STATES ARMY
USAF – UNITED STATES AIR FORCE
M-S-SU S.S. – MATANUSKA-SUSITNA BOROUGH STATE SELECTION
NOTE: ALL LAND OWNERSHIP BY SECTIONS UNLESS OTHERWISE SHOWN
LEGEND
PROJECT BOUNDARY
NORMAL MAXIMUM RESERVOIR LEVEL ELEVATION 2185 MSL
POWER SITE CLASSIFICATION NO 443 ELEVATION 1910 MSL
NOTE: THE PROJECT BOUNDARY HAS BEEN CHANGED FROM 2210 FT. MSL FOR CERTAIN SECTIONS DUE TO THE POTENTIAL FOR RESERVOIR SLOPE FAILURE.
Contour Interval: 100'
SCALE 0 1000 2000 FEET
Scale: 1" = 1000'
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
WATANA
PROJECT BOUNDARY
EXHIBIT G
PLATE G 25
6-10-9

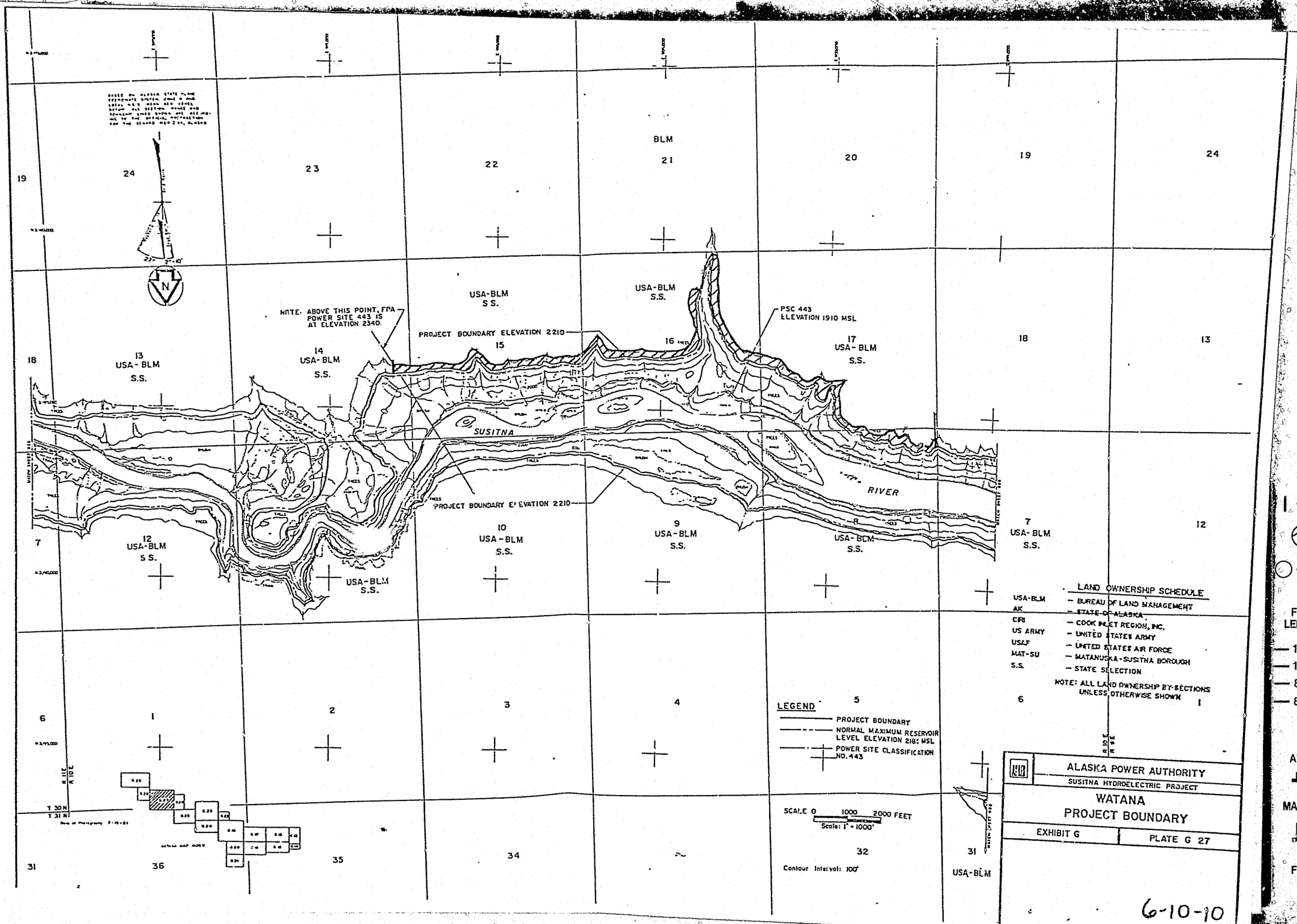
BLM
NOTE: ABOVE THIS POINT, FPA POWER SITE 443 IS AT ELEVATION 2340.
PROJECT BOUNDARY ELEVATION 2210
PSC 443 ELEVATION 1910 MSL
USA-BLM S.S.
SUSITNA
RIVER
LAND OWNERSHIP SCHEDULE
USA-BLM — BUREAU OF LAND MANAGEMENT
AK — STATE OF ALASKA
CRI — COOK INLET REGION, INC.
US ARMY — UNITED STATES ARMY
USAF — UNITED STATES AIR FORCE
MAT-SU — MATANUSKA-SUSITNA BOROUGH
S.S. — STATE SELECTION
NOTE: ALL LAND OWNERSHIP BY SECTIONS UNLESS OTHERWISE SHOWN
LEGEND
PROJECT BOUNDARY
NORMAL MAXIMUM RESERVOIR LEVEL ELEVATION 2185 MSL
POWER SITE CLASSIFICATION NO. 443
SCALE 0 1000 2000 FEET
Scale: 1" = 1000'
Contour Interval: 100'
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
WATANA
PROJECT BOUNDARY
EXHIBIT G
PLATE G 27
6-10-10

EXHIBIT E

6. Geological and Soil Resources

Comment 12 (p. E-6-40)

Provide the criteria whereby the mitigation measures to reduce the leakage through the relict channel will be chosen. Provide an analysis of the impacts of these alternative measures.

Response

A detailed relict channel underground explorations program was completed in early 1983. This program provided additional data on the physical characteristics of the materials along with information on the continuity of horizons. Appraisals of this data indicates the potential for significant seepage is very remote, assuming no control measures are instituted.

Evaluations with conservative assumptions for gradient (± 6%), resulting from a 2185 pool elevation, along with generous assumptions for permeability and area of influence, indicate the total quantity of underseepage to be in the range of 50 cfs.

The criteria to be used in determining remedial measures to control and safely dissipate such small quantities of water will be simply to provide designs which are technically sound, cost effective and environmentally acceptable.

Technical solutions include, but are not limited to, the following:

1. Upstream entrance face blanketed with relatively impervious material.

2. Downstream exit face covered by a filter - toe drain combination.

3. Cutoff accomplished by grouting permeable layers.

4. Adit header system with interceptor drains.

Although the undergound adit with interceptor drains is presently planned for costing purposes, the adopted remedial measure developed during final design might be any one or a combination of the technical solutions listed above. The impacts resulting from the alternative measures will be minimal. From an environmental standpoint, none of the solutions will be particularly significant. Solutions 1 and 3 will leave no visible changes to the landscape. Solutions 2 and 4 will be minutely visible in the downstream area bordering Tsusena Creek. Should the decision be to control rather than cut off underseepage, there will be a natural springs environment.

EXHIBIT E

6. Geological and Soil Resources

Comment 14 (p. E-6-41)

If the excavation of the buried channel area is required, estimate the amounts of additional borrow material that would be required and indicate which borrow areas would be used.

Response

The concept for instituting a relict channel liquefaction barrier, based on a top of dam at elevation 2210, involves approximately 200,000 cubic yards of compacted fill. This volume, which would be obtained from borrow area "D", is based on 1:1 side slopes with a 20 foot inverted crown width. The alignment for the upside-down dike would extend in a N.E. - S.W. direction for a distance of ±5000 feet across the potentially affected buried channel area. The depth of excavation required to rest the fill on unit "G" glacial till would vary from 10 to 65 feet with an average depth of about 20 feet.

Underground information compiled to date indicates the buried channel area is filled with outwash, glacial till, and lacustrine deposits. Initial evaluations indicated concern in regard to the upper E and F outwash deposits because they did not appear dense enough to resist liquefaction.

Based on information gained during the winter 1983 exploration program, the relict channel as a whole (including the E and F units) appears to be very dense. The data indicates penetration resistance to be high in all areas except in the very thin surficial layers and in unit "G" at depths ranging from 70 to 90 feet. Based on grain-size and Atterberg limit tests, unit "G" was found to be cohesive, which would account for the lesser penetration resistance.

Since dense noncohesive soils or stiff cohesive soils are not conducive to liquefaction, settlement or seismic instability, problems are not considered prevalent in the relict channel area. Therefore, there are presently no plans to excavate and build freeboard dike fill as a precaution against liquefaction.

EXHIBIT E

7. Recreational Resources

Comment 1 (p. E-7-12, para. 6)

Provide documents and other available information supporting the conclusion that the middle Susitna River Basin is unsuitable for inclusion in the State Park System.

Response

Attached is the most recent documentation of the Alaska Department of Natural Resources, Division of Parks' position regarding all recommended additions to the state parks system during the next ten years[1/]. The middle Susitna River Basin was not included in these recommendations. According to state parks' personnel, the Susitna River Basin was considered as part of this 1982 plan, even though it was not selected. It should be noted, however, that the Division of Parks did recommend that Lake Louise (to the southeast), Tyone River (to the east), and Talkeetna River (to the southwest) be considered[2/]. In addition, the state land classifications discussed in Exhibit E, Chapter 9, pp. E-9-9 and E-9-10 of the license application identify the resource value of all state land which has been patented and classified within the project area. None of the state lands in the project area have been labeled "public recreation".

1/ Alaska Department of Natural Resources, Division of Parks. February 1982. Alaska State Park System: Southcentral Region Plan.

2/ Wiles, Jack. September 1982. Personal communication.

ALASKA STATE PARK SYSTEM;

SOUTH CENTRAL REGION PLAN

Department of Natural Resources' Land Management and the Alaska State Park System

The Alaska Department of Natural Resources is manager of state-owned surface and subsurface natural resources, except for fish and wildlife. The department's long-term management goals and objectives are spelled out in the Statewide Natural Resources Plan prepared by the department's Division of Research and Development, Land and Resource Planning Section. To ensure compliance with these management objectives, specific land-use decisions made by the department must be within the context of that plan.

The Alaska Division of Parks developed the Alaska State Park System: Statewide Framework to further define the department's goals and policies with regard to the management — as state park units — of state-owned lands with recreational, natural and cultural values.

This document, the Alaska State Park System: Southcentral Region Plan, contains the recommendations for acquisition, planning, development and management — over the ten-year period from 1982-1992 — of state park units in Southcentral Alaska. The plan was developed within the scope of the Statewide Framework and in keeping with the Statewide Natural Resources Plan.

ALASKA DEPARTMENT OF NATURAL RESOURCES

ALASKA STATE PARKS

7-13

ALASKA STATE PARK SYSTEM: SOUTHCENTRAL REGION PLAN

Prepared by Park Planning Section
Alaska Division of Parks
Department of Natural Resources
February 1982

This project was supported through funds provided by the Coastal Zone Management Act of 1972, as amended through the Coastal Energy Impact Program, administered by the office of Coastal Zone Management, National Oceanographic and Atmospheric Administration, U.S. Department of Commerce, and administered for the State of Alaska by the Department of Community and Regional Affairs.

7-1-4

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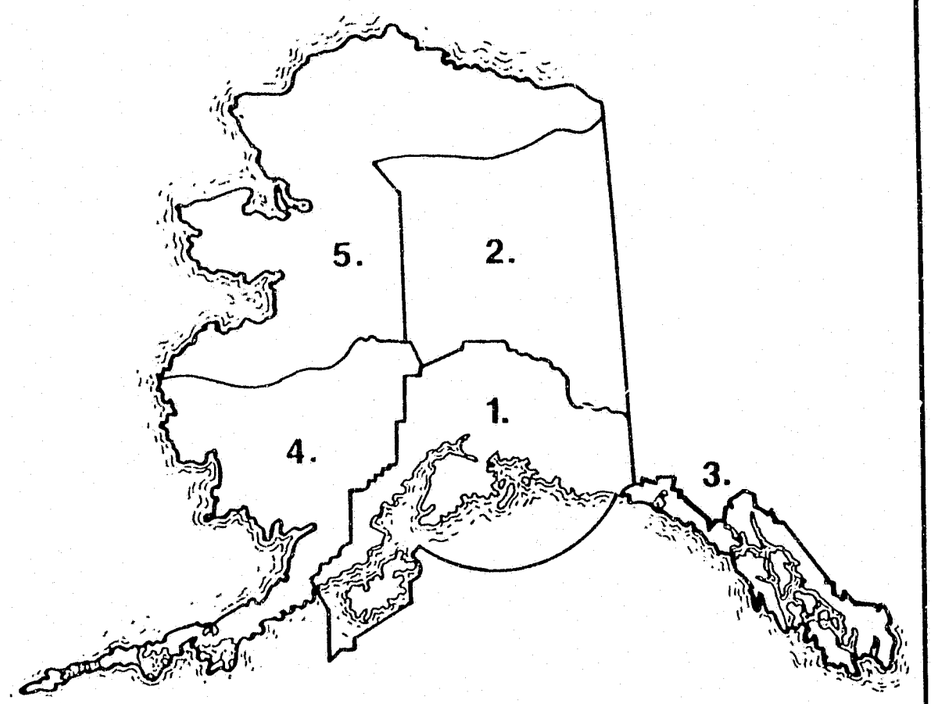
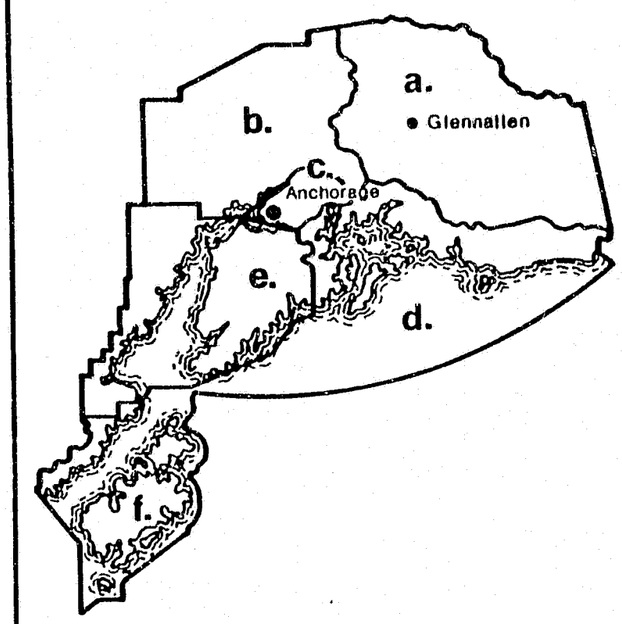
FIGURE 1. State Park Planning Regions



1. Southcentral
2. Interior
3. Southeast
4. Southwest
5. Northwest/Arctic

FIGURE 2.
Southcentral Planning Subregions



a. Copper Basin
b. Matanuska - Susitna Valley
c. Anchorage
d. Prince William Sound
e. Kenai
f. Kodiak Islands

Introduction

Purpose and Scope

This document -- the Alaska State Park System: Southcentral Region Plan -- is the first of five regional plans to be prepared by the Division of Parks.

This specific regional plan is intended to provide guidance for the acquisition, planning, development and management of the State Park System units in Southcentral Alaska for the next ten years. Due to difficulty in accurately forecasting changes in population, land ownership and use, preferred outdoor recreational activities and other factors, updating of this plan may be necessary before 1992.

Prior to reviewing any of the regional plans, it is suggested that the reader first review the Alaska State Park System: Statewide Framework. A copy of this document may be obtained from
Park Planning Section
Alaska Division of Parks
619 Warehouse Ave., Suite 210
Anchorage, AK 99501
Phone (907) 274-4676

The Statewide Framework contains the overall goals and policies for the State Park System, definitions of the eight types of state park units and guidelines for the acquisition, planning, development and management of park system units within each planning region.

NOTE: The terms recreation and recreational will be used broadly in this document to encompass outdoor recreational, cultural, educational and scientific resources and public uses of these resources.

Regional Planning Process

All regional plans are prepared in accordance with the Alaska State Park System: Statewide Framework goals and policies. The regional planning process is shown in Figure 3. The established State Park System planning regions, and the order in which regional plans will be prepared are as follows: (see Figure 1).

1. Southcentral Region
2. Interior Region
3. Southeast Region
4. Southwest Region
5. Northwest/Arctic Region

This regional planning process was utilized during the preparation of the Southcentral Region Plan. In doing so, six subregions were established within the Southcentral Region: (see Figure 2).

- Copper Basin
- Matanuska-Susitna Valley
- Anchorage
- Prince William Sound
- Kenai
- Kodiak Islands

To the extent possible, subregional boundaries were defined to

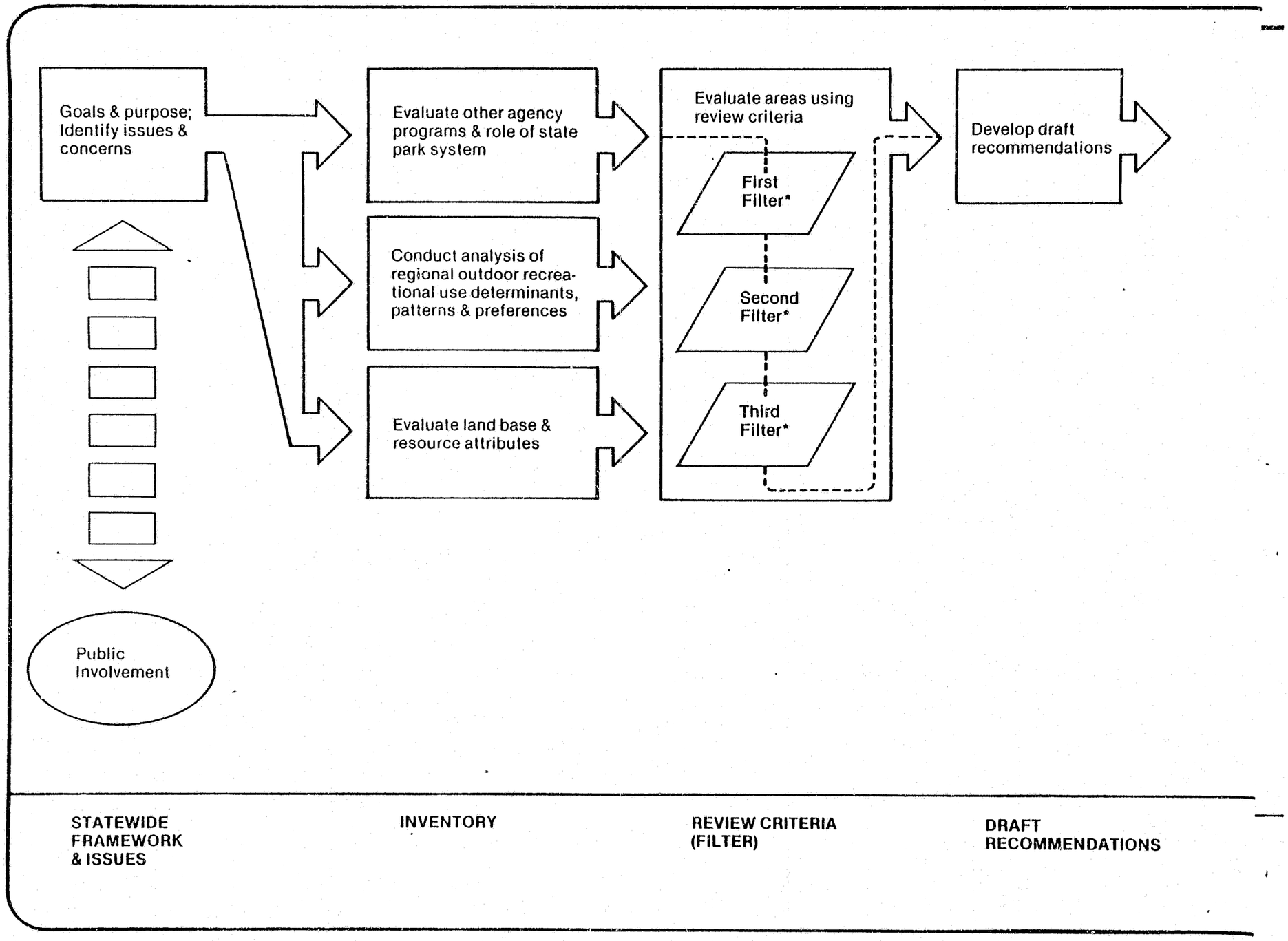
- more clearly identify important subregional issues within the region;
- recognize distinct characteristics of the region;
- utilize existing borough or municipal boundaries where practical;
- facilitate data handling and public involvement

The Southcentral Region planning process included

1. identification of regional and subregional issues and concerns;

7-1-8

FIGURE 3. Regional Planning Process



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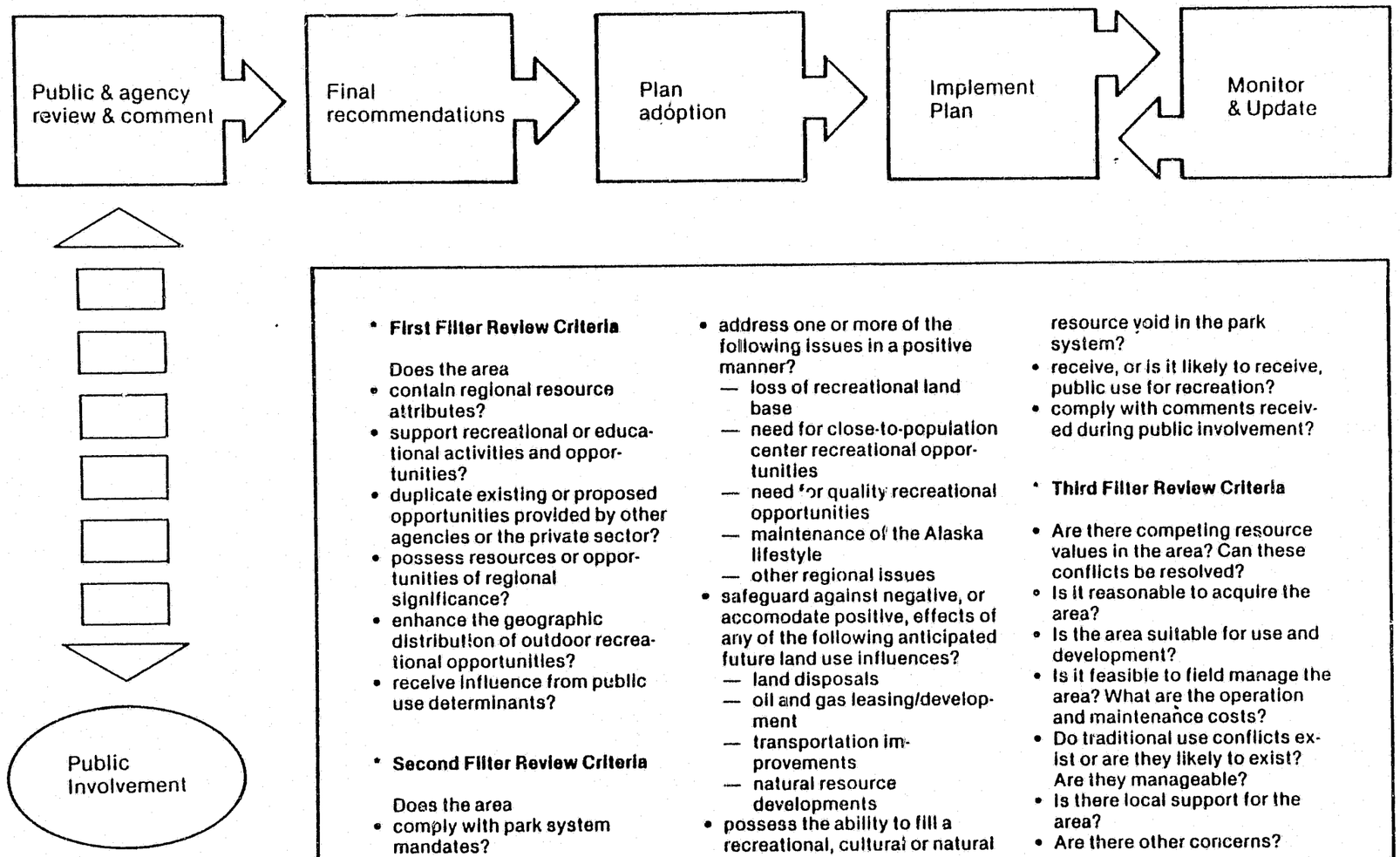

- **First Filter Review Criteria**

  Does the area
  - contain regional resource attributes?
  - support recreational or educational activities and opportunities?
  - duplicate existing or proposed opportunities provided by other agencies or the private sector?
  - possess resources or opportunities of regional significance?
  - enhance the geographic distribution of outdoor recreational opportunities?
  - receive influence from public use determinants?

- **Second Filter Review Criteria**

  Does the area
  - comply with park system mandates?
  - address one or more of the following issues in a positive manner?
    - — loss of recreational land base
    - — need for close-to-population center recreational opportunities
    - — need for quality recreational opportunities
    - — maintenance of the Alaska lifestyle
    - — other regional issues
  - safeguard against negative, or accomodate positive, effects of any of the following anticipated future land use influences?
    - — land disposals
    - — oil and gas leasing/development
    - — transportation improvements
    - — natural resource developments
  - possess the ability to fill a recreational, cultural or natural resource void in the park system?
  - receive, or is it likely to receive, public use for recreation?
  - comply with comments received during public involvement?

- **Third Filter Review Criteria**

  - Are there competing resource values in the area? Can these conflicts be resolved?
  - Is it reasonable to acquire the area?
  - Is the area suitable for use and development?
  - Is it feasible to field manage the area? What are the operation and maintenance costs?
  - Do traditional use conflicts exist or are they likely to exist? Are they manageable?
  - Is there local support for the area?
  - Are there other concerns?

REVIEW | FINALIZE PLAN | ADOPT PLAN | IMPLEMENT PLAN | UPDATE

7-1-10

2. incorporation of a high level of public involvement;
3. evaluation of the provision of public, outdoor recreational opportunities by federal agencies, state agencies, local governments and the private sector;
4. determination of public outdoor recreational use patterns and preferences through review of recreational survey data, public meeting testimony and other sources;
5. determination of outdoor recreational attributes of the region (i.e., features that attract recreational use);
6. identification of the principal determinants of outdoor recreational use patterns (i.e., highways, airports, harbors, population centers, etc.);
7. evaluation of potential park system units using the review criteria in Figure 3;
8. development of recommendations in view of items 1-6 above, for
   a. additions or deletions of lands to or from existing park units,
   b. establishment of new park units through legislative or administrative action,
   c. general use and development concepts for each park unit through the management and site planning processes, and identification of the most appropriate unit title, and
   d. areas requiring further study;
9. identification of management implications of recommendations made in 8 above; and
10. determination of priority of each recommended action.

Public Involvement

In May 1981, the Division of Parks held public meetings in ten communities to gather comments and to identify concerns regarding the State Park System in Southcentral Alaska. Meetings were held in Homer, Soldotna, Seward, Glennallen, Valdez, Cordova, Talkeetna/Willow, Palmer, Anchorage and Kodiak. Informal settings were provided to allow the 103 participants to voice their opinions and concerns. Included among the concerns expressed were

- need for more developed facilities within existing state park units, state recreation areas and state trails;
- establishment of a state river program;
- more access to water bodies;
- improved management of existing park units; and
- cooperative management agreements with different agencies (i.e., to provide facilities, pick up litter, stock fish, maintain trails, etc.).

Figure 4 shows the concerns expressed at public meetings in more detail. Participants at the meetings were asked to complete survey questionnaires to help identify specific public concerns.

Because of the generally small attendance figures at the initial series of public meetings, it was decided to seek the public's comments on the draft plan's recommendations via a mail-back survey brochure rather than a second series of meetings. The brochures outlined the goals and policies of the State Park System as well as the definitions of and criteria for state park units, and then listed the proposed recommendations of the draft plan.

The brochures were made available to the public at key locations in each of the ten communities where public meetings had been held previ-

7-1-1

ously. Those attending the earlier meetings were sent personal copies of the survey brochure. The full range of media was employed to draw attention to the availability of the survey brochures and to urge public comment by mailing back the return-postage-paid questionnaires.

Responses, in many cases, were translated directly into recommendations and incorporated into the plan for final publication. A summary of results from the mail-back brochure is located in the recommendations chapter of this report.

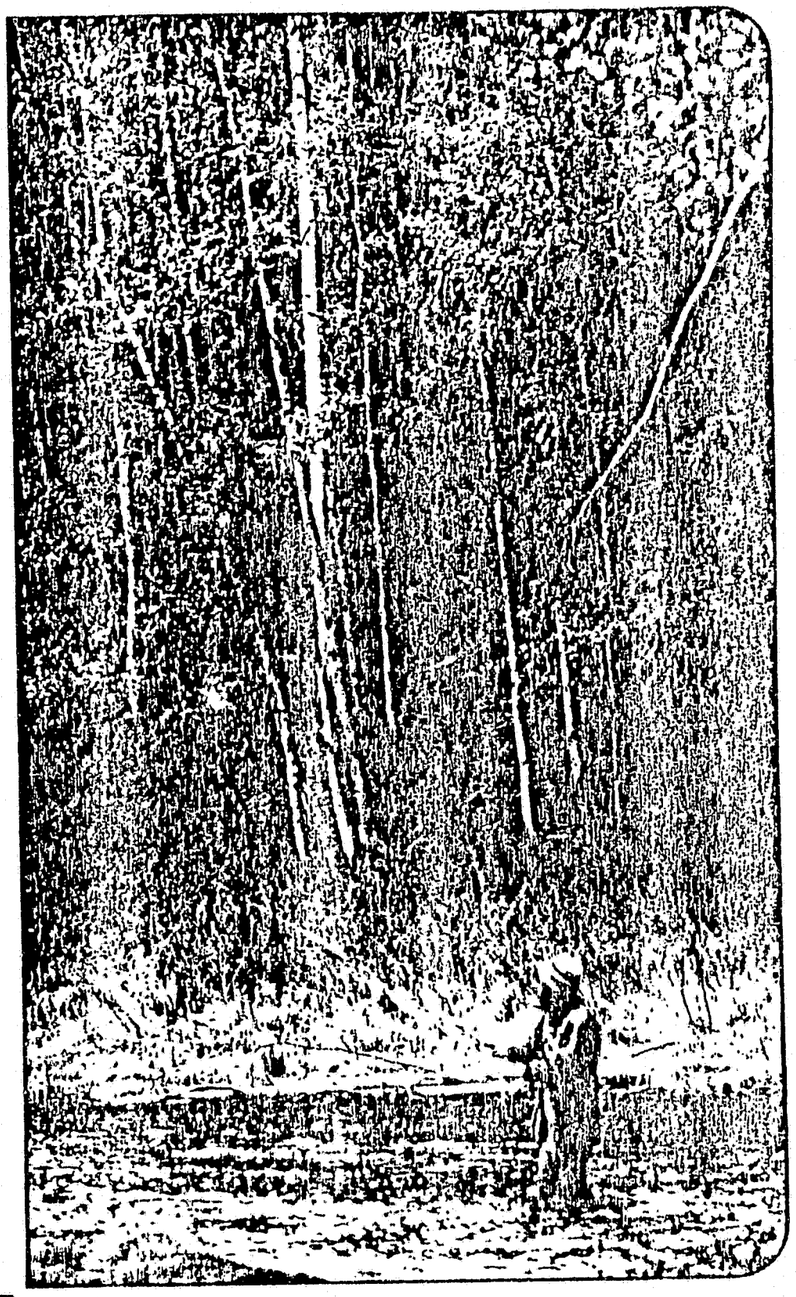

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FIGURE 4. Concerns Expressed at Public Meetings

HOMER

- need for development of Kachemak Bay State Park, including public boat access, trails and campgrounds
- need for State Preserves
- need for development of areas such as Cottonwood and Eastland Creeks SRA
- need to provide trail-related opportunities

GLENNALLEN

- need to develop, through interagency coordination, a trail system in Copper Basin
- need to coordinate agency litter removal at highway turn-outs
- need to identify and manage state easements across Native land
- need to develop a canoe trail system near Lake Louise
- need to develop state park units to provide a diversity of outdoor recreational activities — including family-oriented use
- desire to establish State Recreation Rivers

VALDEZ

- desire to establish a Mineral Creek Canyon SRA
- desire to convey the Valdez Glacier Wayside to the City of Valdez
- need to establish a marine park system in Valdez Arm and Prince William Sound
- need to develop trail opportunities

CORDOVA

- desire to establish a Mt. Eccles SRA
- desire to establish a marine park system in Prince William Sound
- desire to establish an Alaska trail system
- need to coordinate state agency management for efficiency of operations
- need to work with Native corporations to maintain areas open to public use

WILLOW - TALKEETNA

- need to establish more developed state recreational areas to correct problems at overused salmon fishing streams
- desire to establish modern camping facilities with electrical plug-ins and sewage disposal
- need to use interagency coordination to solve litter problem
- desire to establish a trail system with overnight shelters, particularly within Denali State Park
- desire to keep the power line out of Denali State Park and the highway's visual corridor
- desire not to develop Tokositna project
- desire to provide Alaska lifestyle parks with opportunities to experience homesteading

PALMER

- need to expand management of existing state park units — more staff, developed facilities, and longer seasons
- desire to develop Eklutna Lake area (within Chugach State Park)
- desire to develop some modern campgrounds
- desire to stock lakes in Nancy Lake SRA and enhance fisheries in the Matanuska-Susitna Valley
- need to coordinate agency efforts to pick up litter
- desire to preserve berrypicking areas
- desire to establish trails, including equestrian
- a need for borough to execute recreational powers

ANCHORAGE

- desire to provide smaller amounts of wilderness zone since federal government supplies so much
- need to develop existing facilities and expand management capabilities
- desire to protect access to rivers and establish State Recreation Rivers
- desire to establish State Historic Parks
- desire to establish State Trails

KODIAK

- desire, as a first priority, to establish state park units along island road system to include ocean beaches (including Myrtle and Roslyn Creeks, Buskin River, Pillar Mountain, Pasagshak River)
- need to develop existing state park units and expand management
- desire to develop marine park sites (Woody Island and Hidden Basin)
- desire to develop trails
- desire to establish designated camping sites on grazing leases
- desire to acquire management rights to Cape Chiniak from Koniag, Inc

SOLDOTNA

- no public attendance

SEWARD

- minimal public attendance

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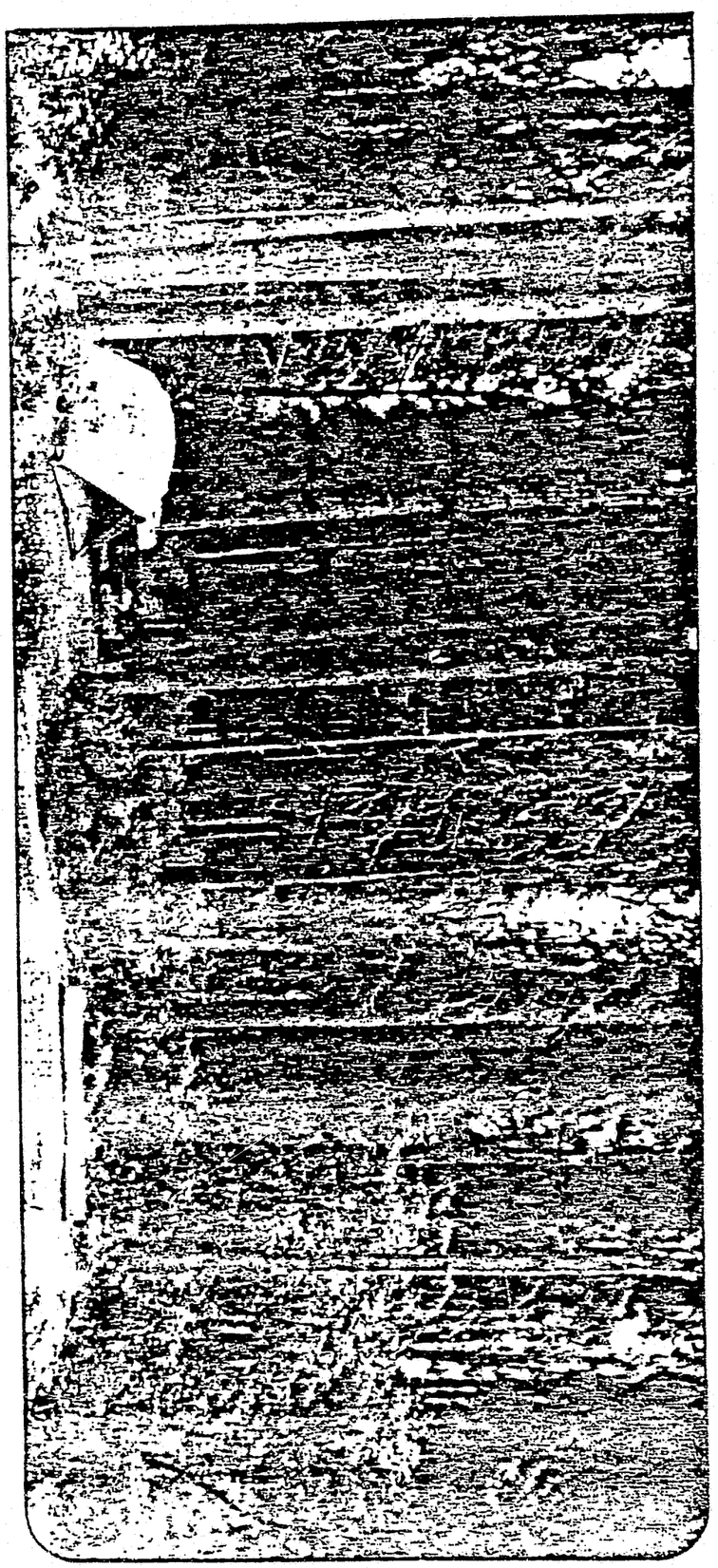

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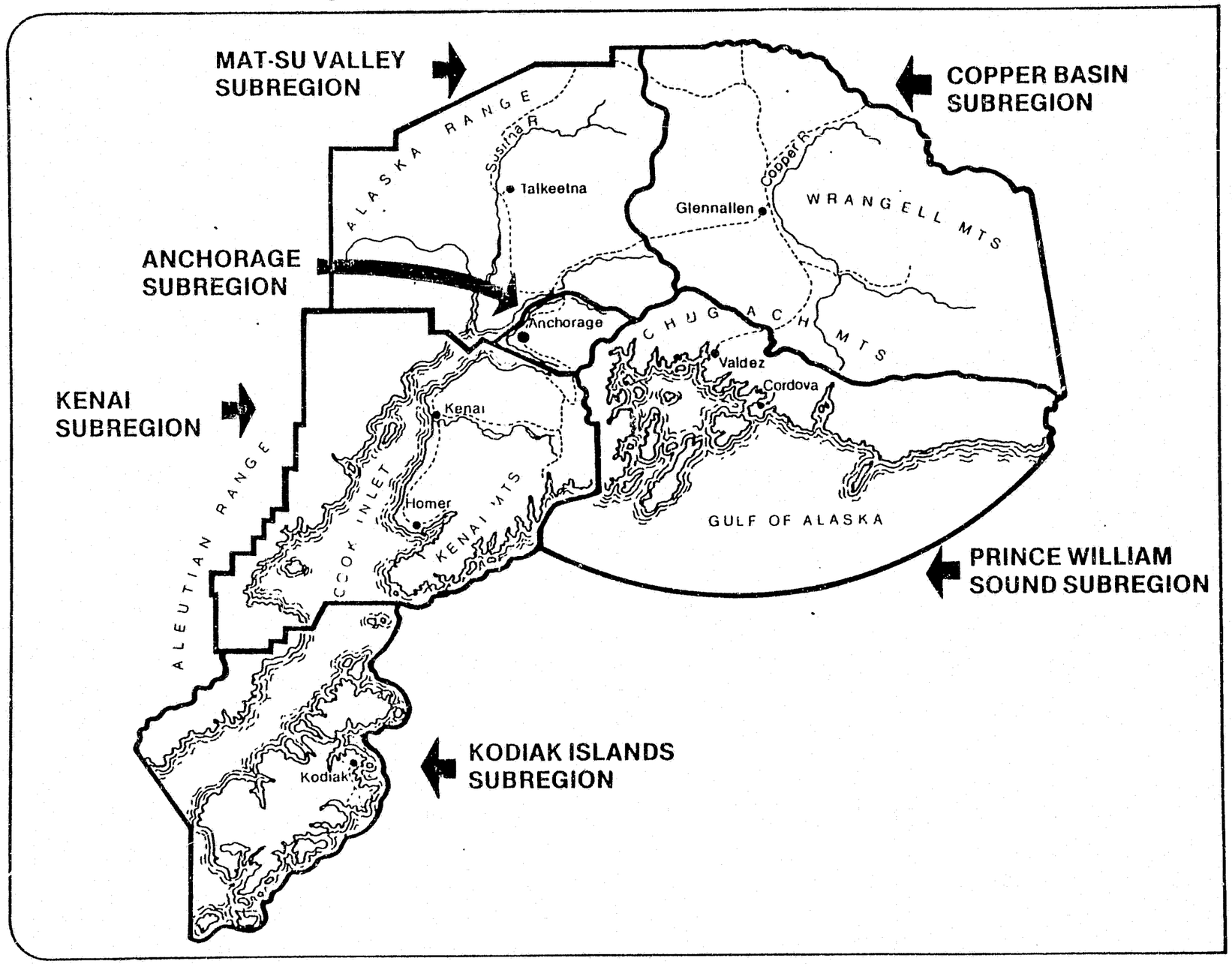
FIGURE 5. Southcentral Region



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Regional Overview

The Southcentral Region extends from the hydrographic divide of the Alaska Range on the north, the Matanuska-Susitna Borough boundary on the west, Kodiak Island to the south and the Alaska/Canada border on the east (see Figure 5). The large diversity of landscapes and resources in Southcentral Alaska offers a variety of outdoor recreational, natural, educational and cultural opportunities. The region abounds with ocean shorelines, freshwater lake systems, free-flowing rivers, massive mountains, glaciers the size of states, numerous species of wildlife, a variety of landscapes and rich cultural histories. This diversity of outdoor environments makes the region attractive to recreationists.

Physiography

Each of the six subregions contains specific characteristics which attract outdoor recreationists. The Copper Basin Subregion is noted for its open expanse with views of impressive mountain ranges that are separated by lowlands and intersected by large river systems. The Matanuska-Susitna Valley Subregion is comprised of spruce-hardwood forests, river valleys and easily-accessible routes to the tundra and mountainous areas. The Anchorage Subregion portrays the stark contrasts of the largest city in the state, the ocean shoreline and a large, accessible alpine environment. The Kenai Subregion has exposed ocean beaches and shorelines, large freshwater lake systems and extensive glaciated mountain ranges. Prince William Sound Subregion possesses fjords, tidewater glaciers, islands, Sitka spruce and western hemlock forests (more typical of Southeast Alaska), and numerous sheltered bays. The Kodiak Islands Subregion contains the state's largest island, is strongly influenced by the Pacific Ocean, and has grasslands similar to those found on the Aleutian Islands, surf-pounded ocean beaches and abundant marine life.

Climate

There are three climatic zones in the Southcentral Region. The southern and coastal portions of the region, which are greatly influenced by water, are in the maritime zone. Here, temperatures are generally mild, winds are persistent, and precipitation is generally in the form of heavy rain. Inland and northwards, the Anchorage and Matanuska-Susitna Valley Subregions are in the transition zone with warm summer temperatures and winter temperatures that are milder than in the continental zone. Amounts of precipitation in this zone vary. The northern and eastern parts of the Southcentral Region are in the continental zone, known for its extreme high and low temperatures and low levels of precipitation.

Population

More than half the state's residents live in the Southcentral Region. The largest city in the state, Anchorage, has 173,017 residents. It is centrally located and serves as the region's service center. Other large population centers in the subregion are Kodiak, Valdez and Kenai. The remaining residents live in communities with fewer than 3,000 people, on rural homesites or in the bush.

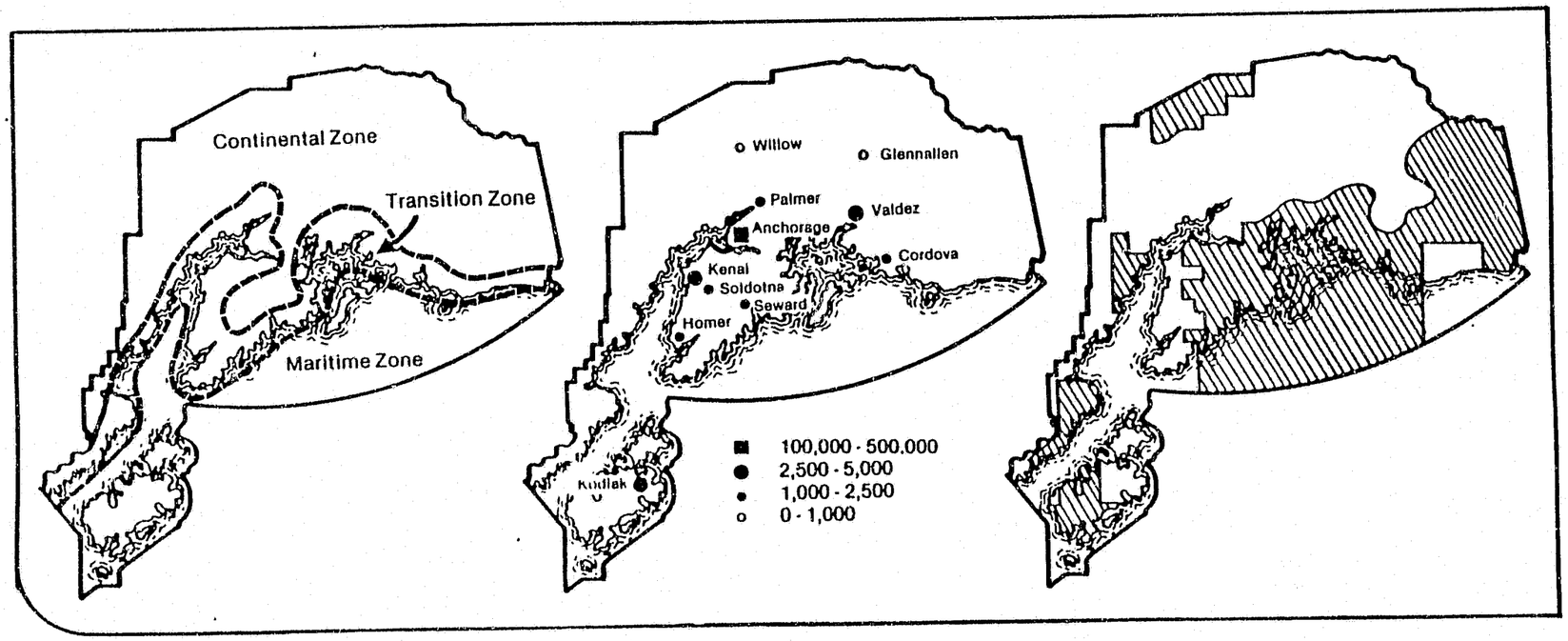
7-1-16

Land Ownership

Federally-owned lands within the Southcentral Region are generally large, remote parcels of land. State lands are generally closer to highways and located near valleys and rivers. In the Matanuska-Susitna Valley and Copper Basin Subregions, there are larger areas of state-owned land in remote locations. Private lands are often located near transportation routes. Native corporation selections, pursuant to Alaska Native Claims Settlement Act, occur in the region on lands neighboring villages and frequently along rivers. Lands selected by municipalities, like state lands, are also closer to highways and population centers.

Economy

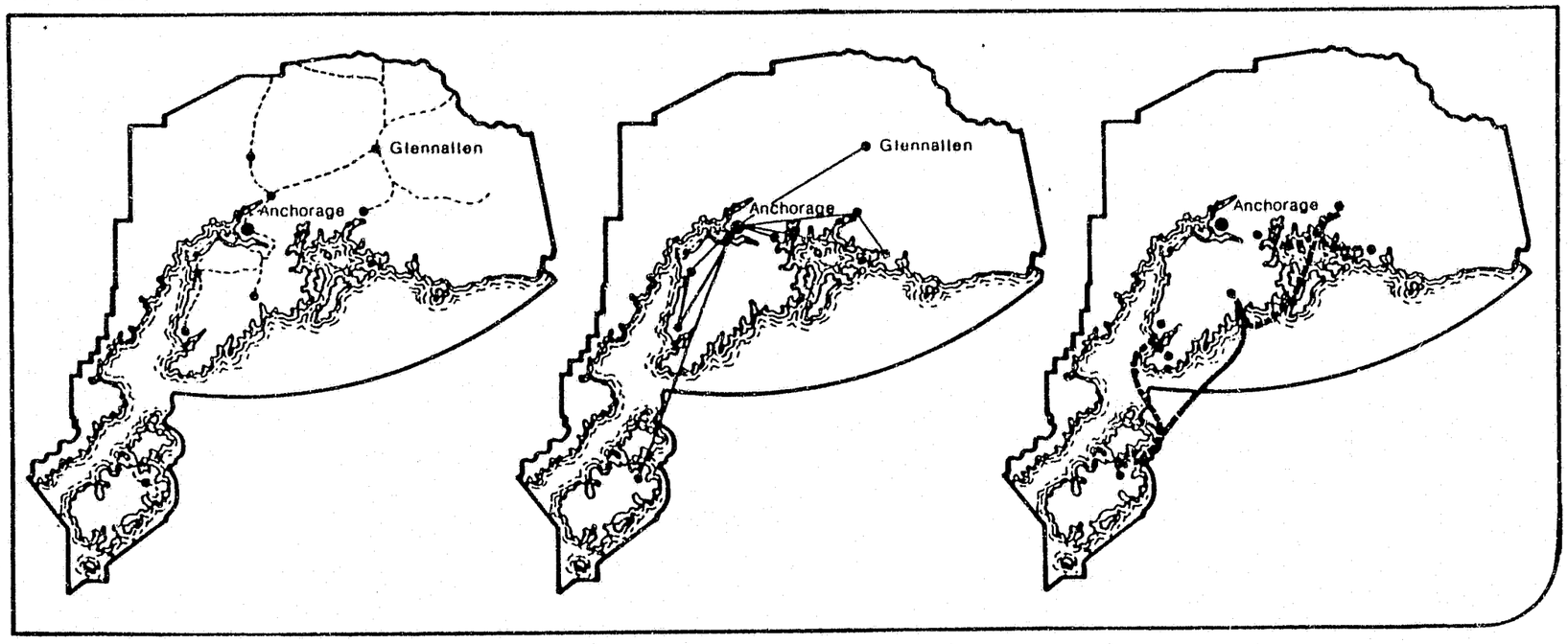
The Southcentral Region's economy is based on support services, commercial fishing, mining, forestry, petroleum, tourism and private business. The growth trends in the economy are primarily natural-resource-development related. Recreation and tourism have shown steady growth within the region. As of 1981, tourism was rated as the state's second most important industry supporting the economy. In the Matanuska-Susitna Valley Subregion, tourism is the number one industry. Regional economies will improve as tourism attractions, including recreational opportunities, become more available in Southcentral Alaska.



CLIMATIC ZONES POPULATION FEDERALLY-OWNED LANDS

Transportation

The Southcentral Region also contains the state's most developed transportation system. The region is inter-connected by paved highways and graveled secondary roads providing good access to many areas. There is also an extensive system of airports -- ranging in size and sophistication from the Anchorage International Airport to surfaced or graveled strips, to numerous gravel bars and water bodies which permit access by small planes. The Alaska Railroad services a portion of the region as does the Alaska Marine Highway (ferry) System. With this developed public transportation system, the region offers the most easily-accessible outdoor recreational opportunities in the state.



ROAD SYSTEM AIRWAY SYSTEM MARINE HIGHWAY SYSTEM

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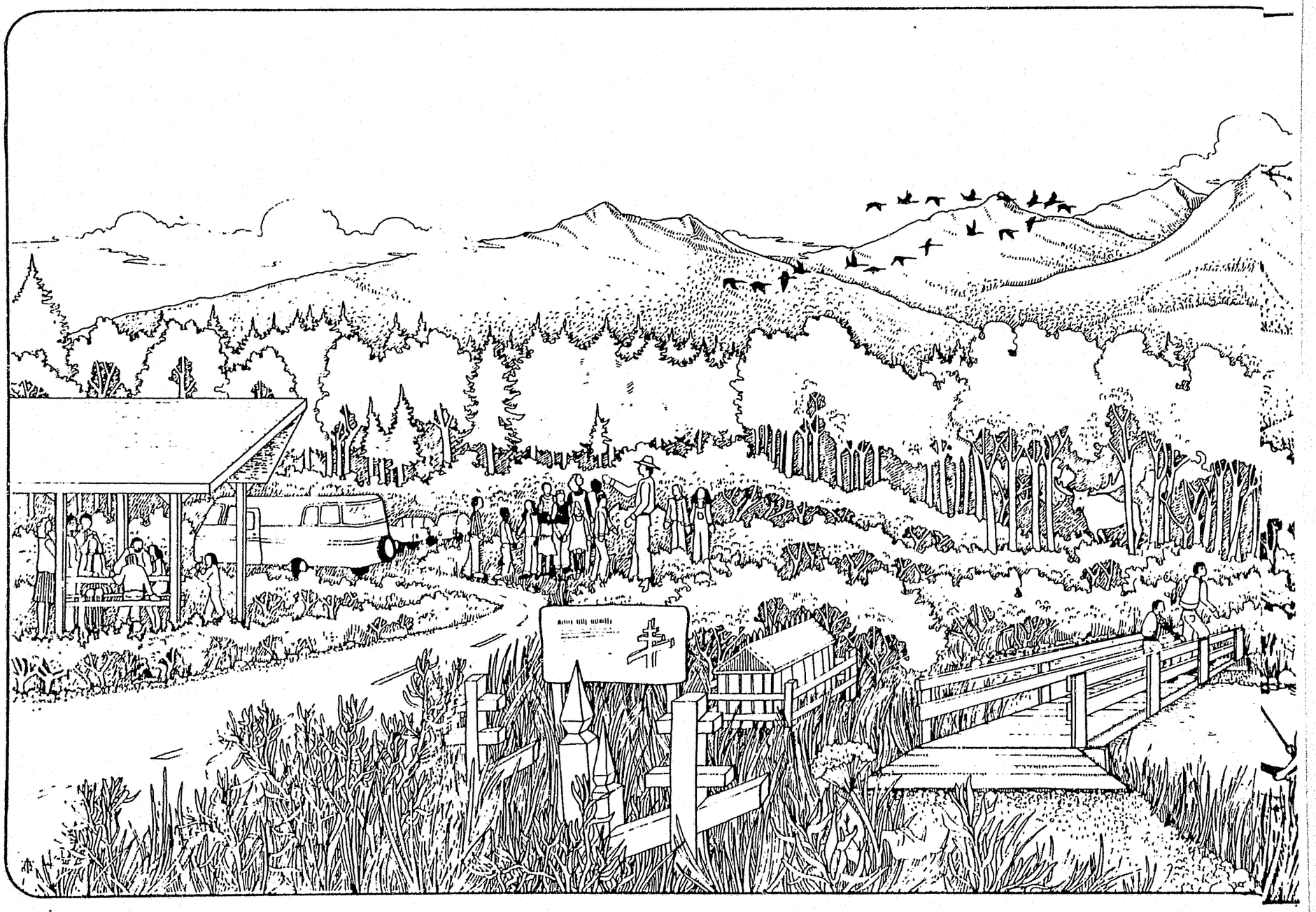

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Factors Influencing Participation in Outdoor Recreation

Recreational Attributes

Outdoor recreational attributes are those natural and cultural resource values which support, or have the potential to support, outdoor recreational activities. Throughout the Southcentral Region, the great diversity of physiography, climate, cultural events and sites, and other attributes provides a variety of opportunities.

Land Forms

Southcentral Alaska displays a variety of landforms. These include ocean shorelines, bogs, grassy hillsides, forested valleys, ice fields, and rugged peaks.

The region abounds with spectacular and accessible mountain ranges: The Alaska Range, containing Mt. McKinley (Denali) -- the highest peak in North America -- is covered with rivers of glaciers flowing for miles; the Wrangell-St. Elias Range is representative of volcanic formations; the Chugach and Kenai mountains are similar to the Alaska Range, containing glaciers, ice and snow year-round. The Kodiak Mountains are representative of grassy mountains found on the Aleutian Chain. The sunken mountains, or fjords, of Prince William Sound and portions of the Kenai and Kodiak coastline are notable land form features along this portion of the region's coastline.

Water Bodies

Water is an important natural resource attribute for outdoor recreational activities and water-based recreational opportunities in the Southcentral Region. Miles of ocean shoreline encourage saltwater-related activities such as beachcombing, fishing and boating. A multi-

7-1-2

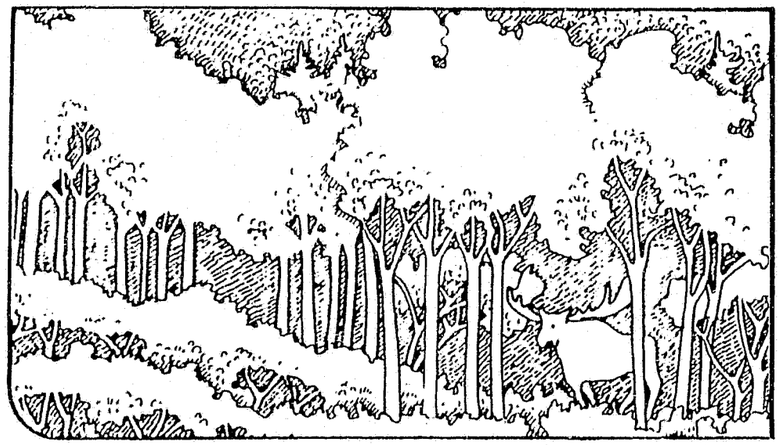
tude of freshwater lake systems and free-flowing rivers -- both clear and silt laden -- offers recreational activities such as fishing, rafting, canoeing, kayaking, motorboating and sailing. Water bodies also provide an important setting for camping, picnicking and hiking.

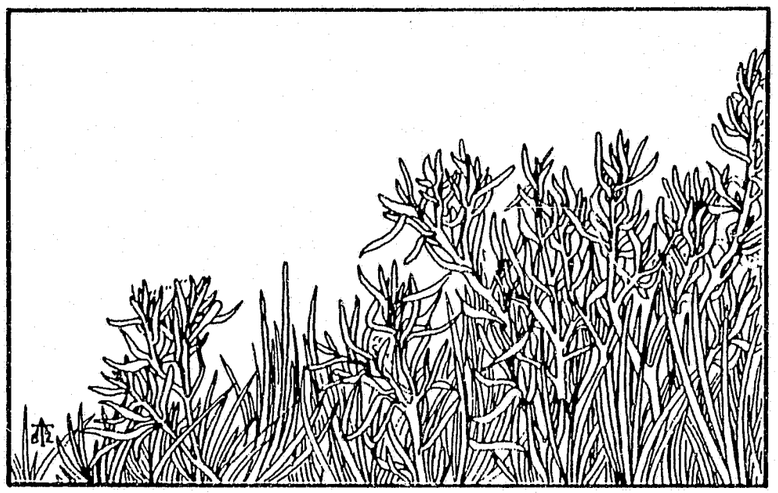
Scenic Values

Southcentral Alaska's varied topography provides scenic values which, when coupled with accessibility provided by the highway system, are important recreational attributes. Driving for pleasure is one of Alaska's most popular recreational activities.

Open Space

The Southcentral Region contains vast areas of undeveloped lands which support dispersed types of recreational activities. Although close-to-home open space is decreasing due to land development and ownership changes, there are still many opportunities throughout the region to hike, ski, backpack, hunt, fish, gather wild foods and view wildlife.





Plant Life

Vegetation is abundant and varied in Southcentral Alaska. Gathering wild plants for food is a favorite Alaska recreational activity associated with natural resources. Throughout the region, people gather berries, mushrooms, parsley, rose hips and other plants. Plants are also the subject of both amateur and professional botonists and photographers.

Wildlife

Alaska is one of the few places in the nation where people still have opportunities to view a variety of wildlife, to hunt for game and to catch salt- and fresh-water fish. Many tourists and recreationists come to Alaska in search of these wildlife-related recreational activities. The number of hunting and fishing licenses sold per capita in the state is double that of any other state. Fishing is one of the most popular outdoor recreational activities in Southcentral Alaska.

7-1-21

Cultural, Scientific and Educational Opportunities

Alaska's history and cultures are of great interest to the public. Investigating a region's history is considered by many to be an important recreational activity. Historical and cultural resources in Southcentral Alaska make possible such investigation through interpretive displays, museums, historical sites and other similar efforts.

Natural resources within Southcentral Alaska can and do support a wide variety of scientific research activities. A diversity of plants and animal species, geological formations, minerals, fossils and other natural resource values offer opportunities for research or natural-science-related outdoor activities.

Southcentral Alaska's abundant natural and cultural resources also have educational value. People of all ages can continue to learn about the state through guided programs in the out-of-doors as well as through classes and literature. A knowledgeable citizenry can more readily appreciate the complexities of resource values and management issues.

Recreational Use Determinants

The locations of recreational, natural and cultural resources are the primary determinants of outdoor recreational opportunities. However, the extent to which the public makes use of the opportunities is based, in part, on recreational use determinants such as transportation systems, location and size of population centers, availability of outdoor recreational facilities, land ownership and public access policies, individual disposable income and available leisure time, visibility of public information regarding available opportunities and technological changes in outdoor recreational opportunities.

Transportation System

Southcentral Alaska's transportation network -- including highways, air routes, the railroad and the ferry system -- provides access to a large variety of outdoor recreational opportunities for residents and visitors. As the transportation routes improve or expand in the region, so will the outdoor recreational, cultural, scientific and educational opportunities.

Population Centers

Population base is an important determinant of public use of recreational opportunities. The central location and size of the region, its industrial development and an improved job market are some of the factors which are creating an increase in the population of Southcentral Alaska. As the population base grows, more people will choose to participate in a greater variety of recreational, cultural, scientific and educational experiences. The increased number of users will also place increased pressures on existing facilities and create demands for new types of facilities and improvement of existing ones. Concentrations of population growth in communities such as Anchorage, Kenai, Wasilla and Valdez will result in an increased demand for weekend recreational opportunities within two to four hours driving time of those communities.

Outdoor Recreation Facilities

To a large degree, the level of use an area receives is dependent on the provision of outdoor recreational facilities. Most people prefer developed campgrounds and picnic areas which provide sanitation facilities and which are patrolled by rangers or other law enforcement personnel. Although areas without these services (such as Montana Creek in the Matanuska-Susitna Valley or several Kenai Peninsula salmon fishing streams) receive high levels of use, public use could increase if such services were provided at these sites.

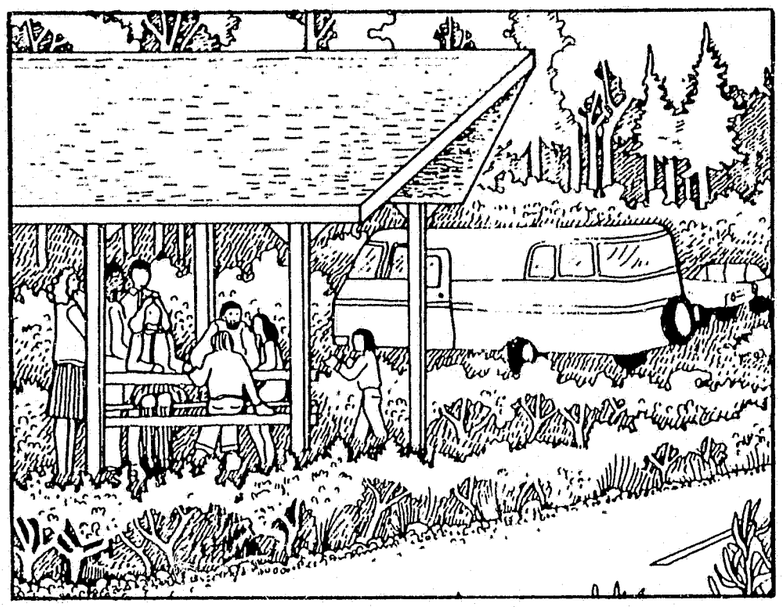
Income and Leisure Time

Although the cost of living is high in Alaska, residents may also have more available money to spend on leisure activities due to generally higher income levels in the state. Such leisure expenditures include purchasing equipment and gasoline for travel.

Alaskans' work schedules tend to be quite varied. Some residents may only work three or four days a week, while others work 14 days, then take 14 days off. The flexibilities of work schedules frequently allow residents opportunities to participate in recreational activities for longer periods of time.

Public Information

Information available to the public on outdoor recreational opportunities can be an important determinant of outdoor recreational use. This information may be in the forms of park brochures, travel publications, magazine articles or



conversations among friends. As a new recreational opportunity is discovered and the word spreads, public use of an area can double or triple without any significant changes in other use determinants.

Technological Changes

As new types of recreational activities are developed or improved upon, more opportunities become available to the public. New activities, such as motorized hang gliders and driving hovercrafts, are becoming increasingly popular in the region. Improved equipment, such as plastic kayaks and three-pin mountaineering ski bindings, expands the concept of existing sports. Improved skill levels of participants, coupled with technological improvements, will continue to expand outdoor recreational opportunities.

7-1-2

Outdoor Recreational Preferences

The outdoor recreational activities in which Southcentral Alaska residents participate, and those activities in which they would like to participate more often, are important in determining the proper role of the Alaska State Park System in meeting recreational demands in Southcentral Alaska (see Figure 6).

In order to determine priorities among new and existing state park units, the role the State Park System plays in providing recreational opportunities and whether the state is meeting the recreational needs of Alaska residents in the Southcentral region, it is important to consider the following:

- recreational activities in which people currently participate;
- recreational activities in which people would like to do more often;
- reasons for not participating more;
- residents' favored recreational activities;
- types of activities for increased provision and management by the state.

The data presented in Figures 6, 7, 8, and 9 are from a Statewide household survey conducted in 1979. Basic analysis of this data for the Southcentral region has been completed by Clark and Johnson, and the Alaska Division of Parks, and is abstracted here. For more complete information on this survey and its results, the reader is referred to Clark and Johnson (1981), and the Alaska Outdoor Recreation Plan, 1981. Other data are cited as necessary.

FIGURE 6. Southcentral Alaska Resident Outdoor Recreation Data

A. Activities in which adults most frequently participate (analysis by Clark and Johnson)

driving for pleasure
walking/running for pleasure
fishing
audience for outdoor sports
tent camping
motorboating
bicycling
cross-country skiing
target shooting
recreational vehicle camping

(Based on responses by adults participating in the 1979 Alaska Public Survey)

B. Activities in which adults would like to participate more often (analysis by Clark and Johnson)

fishing
camping (general, tent)
hunting
motorboating
hiking
alpine skiing
flying
driving for pleasure
recreational vehicle camping
bicycling

C. Activities rated as favorite by adults (analysis by Alaska Division of Parks)

fishing
tent camping
walking/running for pleasure
hunting
motorboating
beachcombing
playing softball/baseball
cross-country skiing
alpine skiing
bicycling

The top ten activities listed for "what people are doing," "what they would like to do more often", and "what their favorite activities are" can be found in Figure 6.

Recreational activities for the Southcentral Region show fishing, driving for pleasure, winter-related activities and water-related activities as most popular. In evidence of the popularity of fishing, it is noted that sport-fishing license sales have risen 40 percent in the six years since 1975, while the population of the state has remained fairly stable. There were 206,832 sport-fishing licenses sold in 1980; of these 132,103 were sold to Alaska residents.

Use of accessible fishing streams has also increased. User days on the Little Susitna River climbed from 6,000 in 1977 to 21,000 in 1979. There has also been a substantial increase in user days at Montana Creek, now considered by the Alaska Department of Fish and Game to be the most heavily fished stream in the upper Cook Inlet region. On the Kenai Peninsula, Anchor River, Deep Creek, Ninilchik River and the Kenai River receive heavy recreational use.

This increased use has created overcrowding and over-use conditions at existing facilities on the Kenai Peninsula and in the Matanuska-Susitna Valley. These conditions have also led to the public trespassing on private land to engage in outdoor recreational pursuits. The need for expansion of existing sites, or the acquisition of new sites to disperse use and accommodate the increased interest in fishing as a recreational activity, is apparent.

Driving for pleasure is a favorite recreational activity among Alaskans (see Figure 8). Although State Parks is not directly responsible for providing opportunities for this recreational activity, it is one in which people participate while driving to various State Park System units. Driving for pleasure is also rated highly among those activities participated in by visitors to the state. The state park units associated with the state's primary road system serve to accommodate this favorite recreational activity.

There has been a rapid increase in participation and interest in winter related activities in the Southcentral Region since the Statewide Comprehensive Outdoor Recreation Plan recreational survey in 1976. Cross-country skiing, snowmachining, dogmushing, ice hockey and snowshoeing are some favored winter activities. The limited daylight hours generally hamper activities, limiting them to weekends or to places close to population centers. The sale of winter recreational equipment has increased substantially. In the 1979 Alaska Public Survey, 39 percent of the respondents indicated they owned cross-country skiis, while 23 percent owned downhill skiis, 22 percent owned snowmachines, 12 percent owned ice skates and 5 percent had snowshoes.

With Southcentral Alaska's many lakes, streams and miles of marine shoreline, water-oriented recreational activities and opportunities would appear to be abundant. However, in some situations, legal public access to water is a problem because of private property along waterways.

The number of boaters in the region has increased substantially. Sales of boating equip-

7-1-2

FIGURE 7. Reasons Given for Not Participating More Often in Desired Activities

not enough time	72%
inappropriate weather	40%
places too crowded	39%
costs too much	32%
transportation too expensive	30%
lacking proper equipment	29%
no access by car	29%
not enough locations	27%
seasons closed	23%
cannot locate	20%
lack of proper facilities	15%
family can't/won't participate	15%
other	15%

(1979 Alaska Public Survey - analysis by Clark and Johnson)

ment at local Anchorage sporting goods stores increased significantly in the late 1970's. Membership in the Knik Kanoers and Kayakers of Anchorage rose nearly 100 percent in 1981. The number of persons on waiting lists for marine boat moorages is great, with people waiting as long as two years to obtain a slip. To meet water-oriented recreational needs, the acquisition and development of river, lake and marine park units is necessary.

Even though the overall participation rates for outdoor recreational activities in the state are high, there are various reasons why people do not participate more often in desired activities. These responses can be found in Figure 7.

FIGURE 8. Average Number of Times per Year a Southcentral Region Adult Participates in a Given Activity

driving for pleasure	18.3
walking/running for pleasure	13.3
bicycling	12.5
freshwater fishing	7.5
motorboating	5.3
motorcycling/other summer ORV	5.1
cross-country skiing	5.0
playing baseball/softball	4.8
sledding/tobagganing	4.5
snowmobiling/other winter ORV	4.4
swimming	4.1
audience for sports/entertainment	3.8
tent camping	3.6
outdoor tennis/badminton	3.5
target shooting	3.3
recreational vehicle camping	3.1
kayaking/canoeing	3.1
hiking with pack	2.9

(1979 Alaska Public Survey - analysis by Alaska Divison of Parks)

The Alaska Division of Parks has little direct control over the elimination of many of these obstacles. It can, however, provide -- in cooperation with local governments -- areas close to home which offer recreational opportunities for the public.

In 1980, there were more than one-half million visitors to the state; it is estimated that, by 1985, there will be more than one million visitors to Alaska each year. This is an increase of 10 to 15 percent each year (Alaska Division

of Tourism, 1977). In 1980, tourism visitor days within state park units totaled 400,000, and the Alaska Division of Parks estimates that tourist user days will increase to 700,000 in 1985. The top recreational activities of visitors to the state include driving for pleasure/ sightseeing, camping, hiking and sportfishing (Alaska Division of Tourism, 1977).

Thirty-seven percent of the respondents to advertisements for the 1979 Worlds of Alaska, a state-sponsored travel publication, said they wanted information on recreational experiences "off the beaten track" but close to major destination points. Travel for pleasure is generally occurring during the months of June, July and August. The average stay of visitors to the state is two to three weeks. During the winter months, one third of the visitors to Alaska come strictly for pleasure. The automobile is the most widely used method of transportation within the state by tourists. Ninety-five percent of the state park units in Southcentral Alaska can be reached by private automobile. Therefore, visitors to the state can use the State Park System, and their outdoor recreational use preferences are, thus, a concern of the Alaska Division of Parks.

Interpretation of the public preference survey for Southcentral Alaska and its implications for the State Park System indicates that recreational preference and participation rates favor expansion of traditional recreational opportunities such as fishing, hiking and camping. Trends in recreational use show an increase in trail-related activities, winter sports, use of road-accessible areas, water-based activities and areas which provide diversities of recreational opportunities in proximity to population centers (see Figure 9).

FIGURE 9. Outdoor Recreational Features for which there is a Desired Increase

NON-URBAN

fishing
facilities (minimum)
water access
hunting areas
footpaths/trails
ORV trails
overnight lodging
paved roads
facilities (maximum)
unpaved roads
playgrounds
lawns/beaches
logging roads

STATE MANAGEMENT

roadside campgrounds/picnic areas
remote cabins
hiking trails
developed recreational areas
boat-accessible areas
backpacking campsites
community parks
plane-accessible areas
canoeing/kayaking/rafting areas
well-accessed areas
historic sites
wilderness areas

(1979 Alaska Public Survey - analysis by Clark and Johnson)

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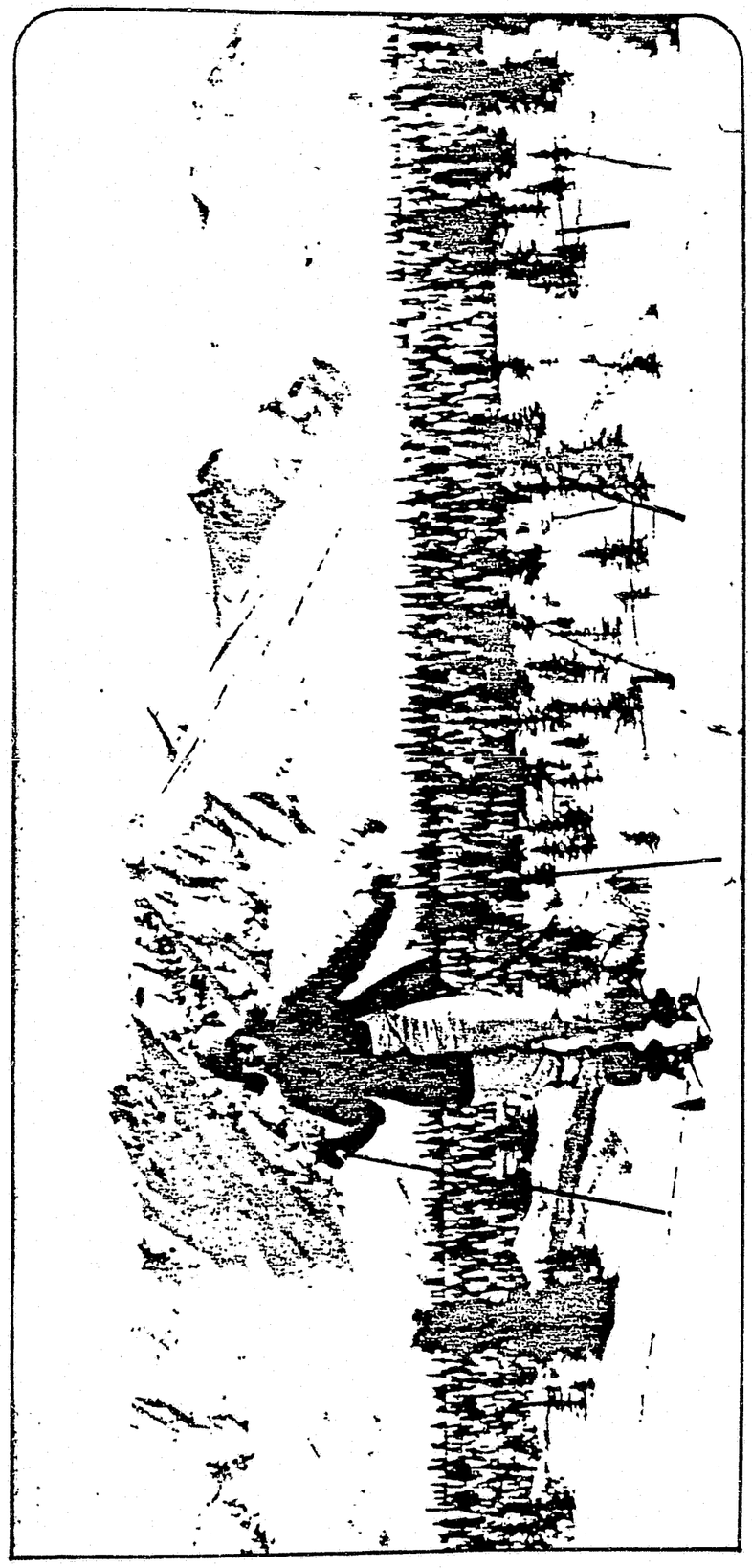

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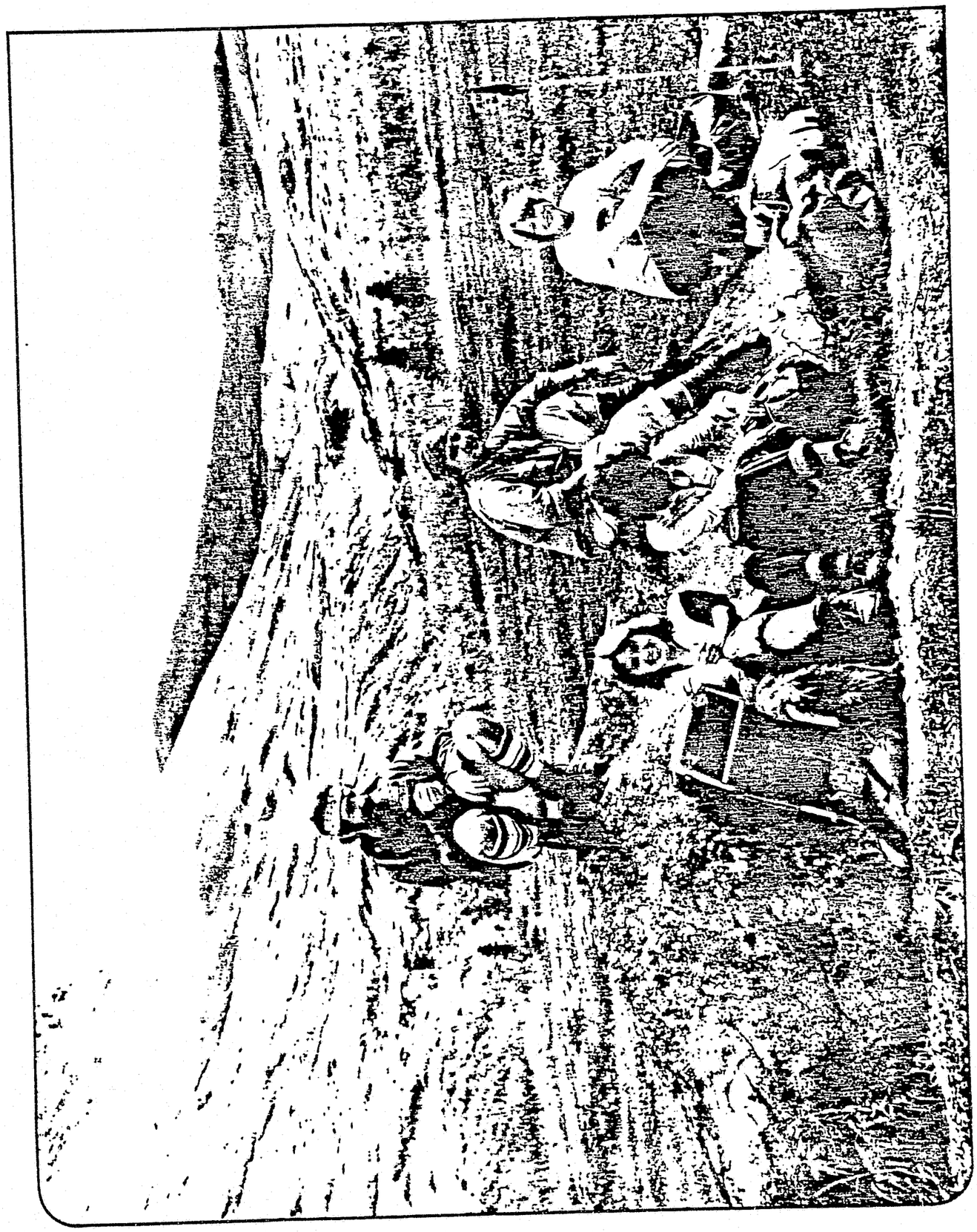

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Without positive action for protection, provision and enhancement of public recreational opportunities, there will be a dramatic reduction of these opportunities during the coming decade. This potential loss of public recreational opportunities, in terms of both quality and quantity, can be viewed through six regional outdoor recreational issues. These issues relate specifically to the Southcentral Region and were defined through comments presented at public, interagency, and State Park System staff meetings; analysis of the Alaska Outdoor Recreation Plan, 1981; through the review of publications; and through the identification of those topics receiving public attention in the media as well as attention on the part of government agencies and elected officials. These region-wide issues -- evaluated in conjunction with the regional attributes, public use determinants, and outdoor recreational use patterns and preference data -- lead to the development of the recommendations in this plan. After discussion of each issue, a strategy is presented with which the Division of Parks will address and/or resolve the issue.

ISSUE: Increase in Recreational Demand

Throughout Southcentral Alaska there has been an increase in the demand for outdoor recreational opportunities. With changes in the public use determinants -- such as increased population -- people are requesting that more recreational opportunities be available and accessible to them year-round. Alaska Division of Parks' use statistics indicate lengthening seasons for both summer and winter activities. Intensity of use is also increasing. For example, recreational use on the Little Susitna River in the Matanuska-Susitna Valley Subregion increased three-fold from 1977 through 1979. Increased year-round use of facilities in the Kenai Subregion is also occurring. Contributing to the increased demand for recreational opportunities are the variable schedules Alaskans have for recreating and the fact that visitors are spending an average of 14 days per person in the state. These longer periods of leisure time provide people with opportunities to choose a greater variety of activities in which they may actively participate. It is not uncommon to observe, at mid-week, large crowds at key fishing streams during major salmon runs, or people on extended stays at state park units.

Greater vehicle fuel costs will have minimal effect on overall recreational demand. Several studies conducted in other states show that, while total travel distances have been reduced, the amount of time spent by individuals in recreational pursuits has stayed the same or increased. In general, people are taking fewer long and weekend trips and are focusing on areas closer to home.

STRATEGY

Expand the level of development and intensity of management at existing State Park System units. Acquire, develop and staff new state park units within the region.

ISSUE: Impact of Anchorage Resident Recreational Use on Nearby Subregions

Anchorage is the largest city in the state and is centrally located on the highway and railbelt

7-1-30

systems. As such, it is the service center for the Southcentral Region and is the point-of-entry for many visitors to Alaska.

Many of Anchorage's residents participate in outdoor recreational activities outside city limits, thus causing great fluctuations in recreational use in the other subregions. Approximately half the weekend recreational use occurring in the Kenai and Matanuska-Susitna Valley Subregions is that of Anchorage residents and/or visitors based out of Anchorage.

Trespassing, litter, highway congestion and competition for fish and wildlife are primary concerns expressed by local residents of these two subregions. In areas such as Deep Creek and Ninilchik, these problems have been related to overcrowded, underdeveloped and understaffed state park units. However, in many areas these problems are also occurring on other public or private lands.

Concern has been expressed by some local residents that developing new park units and facilities will only attract more "outsiders." Other local residents have suggested higher levels of staffing and management or the provision of new park units to disperse the use.

STRATEGY

Acquire additional lands, where approprate, and intensify development and management at existing park units where spillover use is adversely impacting local residents and the environment. Where possible, acquire and develop new park units to disperse use. Provide undeveloped buffers of park land between park users and adjoining private landowners. The Alaska Division of Parks should also cooperate with other agencies to increase law enforcement capabilities in park units. Through public information efforts, park users should be encouraged to respect private property of local residents.

ISSUE: Close-to-Home Opportunities

The need for diverse outdoor recreational and cultural opportunities close to population centers is currently a key issue, and it will become even more important in the future. The high price of gasoline and increasing demand for recreational opportunities create a need for recreational opportunities within proximity of major population centers.

People in Southcentral Alaska are still willing to travel as much as two to four hours from their homes to participate in activities of their choice. But as the gasoline and oil prices continue to increase, and if the supply of petroleum resources decreases, this willingness to travel longer distances may change. Higher fuel prices may force people to spend more time near their homes.

While millions of acres of federal lands have been reserved for park purposes, these lands are, for the most part, remote and, thus, far beyond convenient access by the average citizen or by visitors to the state. For every individual who floats the Noatak River in the Brooks Range, a hundred will visit Alexander Creek in the Matanuska-Susitna Valley Subregion and a thousand, the Kenai River. For every individual who visits the historic Kennicott Mines in

7-1-31

the Wrangell-St. Elias National Park and Preserve, a thousand will visit Independence Mine State Historic Park in Hatcher Pass in the Matanuska-Susitna Valley Subregion.

STRATEGY

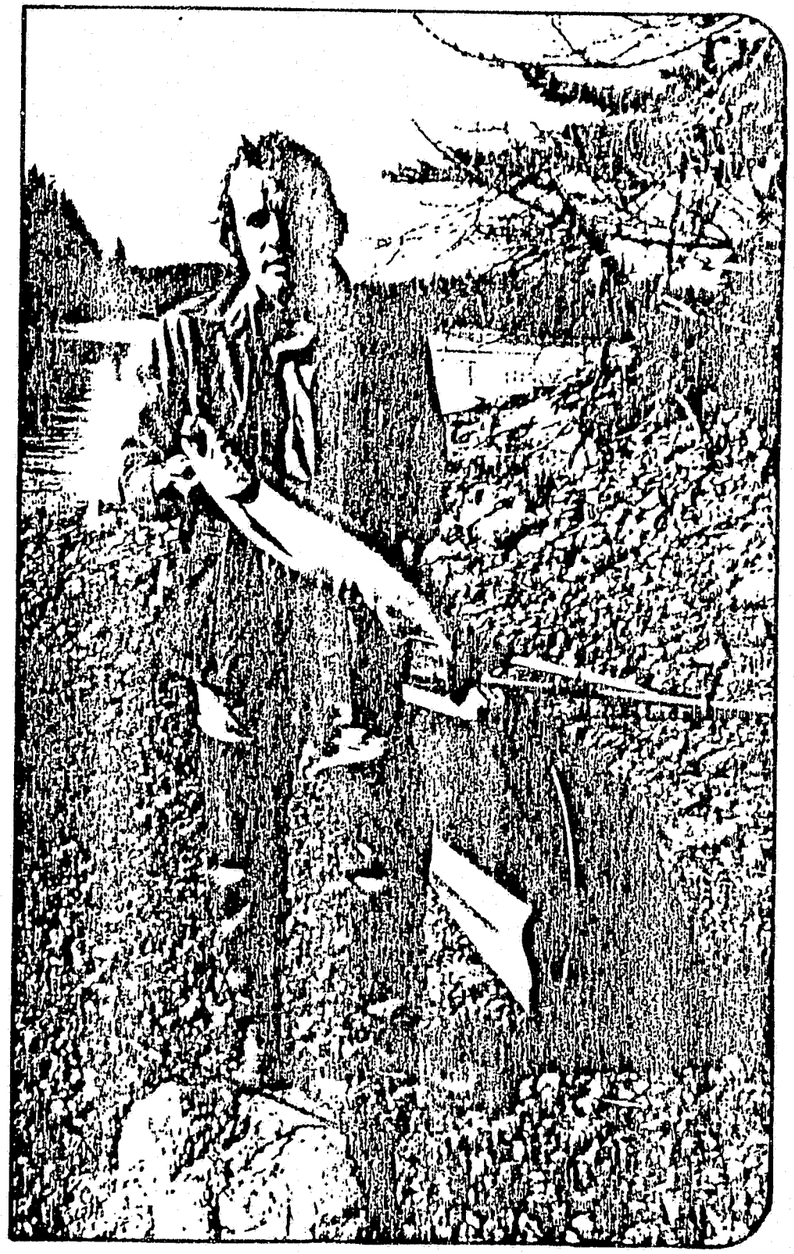
The Alaska State Park System will acquire, develop and manage state park units to provide a diversity of recreational opportunities within proximity of the population centers of the Southcentral Region.

ISSUE: Maintaining the Recreational Land and Water Base

The potential for dramatic reduction of the recreational, cultural, scientific and educational opportunities in Southcentral Alaska has been created by the following:

- sale and disposal to private individuals of hundreds of thousands of acres of public land by state and local governments;
- conveyance of 44 million acres of public land into private ownership through the Alaska Native Claims Settlement Act;
- transfer of state lands to municipalities through the Municipal Entitlement Act;
- commitment of state and federal lands to other resource uses which may depreciate or restrict the quality and quantity of recreational opportunities currently available;
- subdivision and development of private lands, after which public recreational use may no longer be allowed.

These changes in land ownership patterns and development have created major changes in the region's traditionally used public land base.



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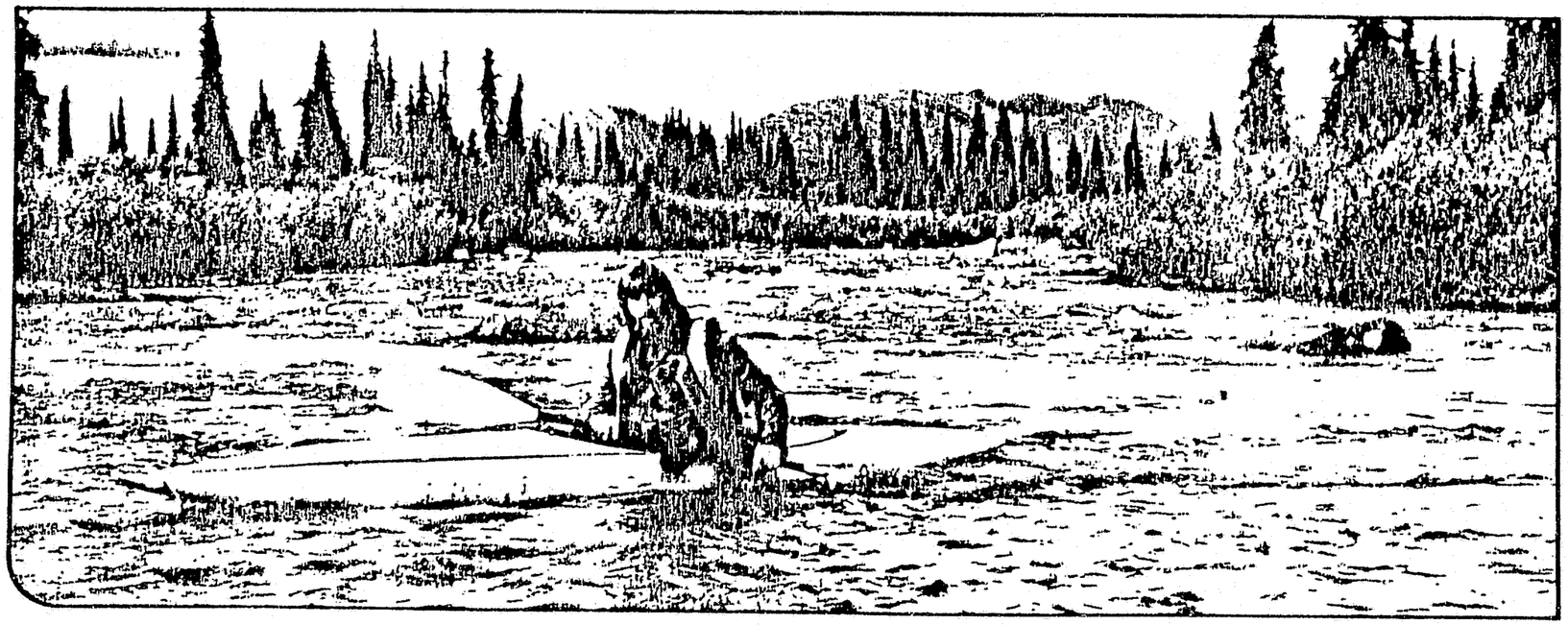
Less than a decade ago, people in Southcentral Alaska could go almost anywhere in the region to participate in an unlimited variety of outdoor recreational activities. Today these opportunities are diminishing because public lands are going into private ownership. In addition, development of formerly vacant, unused private land in key locations is blocking access to public areas, eliminating existing outdoor recreational opportunities and resulting in serious conflicts. Trespass situations are occurring on private lands which the public has traditionally used for outdoor recreational purposes. This trespass recreation is becoming a major concern to private landowners as the number of outdoor recreationists and use on private lands increase.

In many areas of Southcentral Alaska, critical parcels of public land are being converted to private ownership. In some instances, a one-acre parcel of privately-owned land can be the key access to hundreds of acres of public land. Without public access, outdoor recreational opportunities can be greatly reduced if not lost. A possible problem is the transfer of 44 million acres of federally-owned public land to Native corporations as authorized in the Alaska Native Claims Settlement Act. An issue has arisen as to whether public access easements being reserved across these lands are adequate to meet long-range public needs. These lands were selected and are being conveyed from federal public domain, general state-selected and tentatively approved lands, state parks and



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the national forest system to Alaska Native regional and village corporations and to individuals as Native allotment lands. Many of these selected parcels were integral parts of existing public recreational areas. In the Southcentral Region, more than 60,000 acres of land within Chugach and Kachemak Bay state parks have been selected by Native corporations. In Kachemak Bay State Park, the 20,000-acre selection affects a significant portion of the park's coastline. In Chugach State Park, the selection of 40,000 acres removes entire valleys which are critical for outdoor recreational activities. This selection effectively blocks access to an additional 90,000 acres of public land. In both cases, key access locations are no longer in public ownership, thus blocking hundreds of thousands of acres of land for public recreational opportunities.

Public access to water bodies is another recreational concern. Ownership of the submerged beds of navigable waters within the state is guaranteed to the State of Alaska by the Statehood Act. However, there is still disagreement between the state and federal governments as to the definition of navigability and, thus, to ownership. In order to guarantee public access to and along these water bodies, the state must retain ownership of the submerged lands even if surrounding lands are conveyed into private ownership. Until navigability criteria are agreed upon, and navigability determinations are made by the courts, this access remains in question if the lands go to private ownership and the owner chooses to prohibit or restrict public use.

As public recreational use is displaced from some of these lands, pressures on existing public lands will increase. Present outdoor recreational opportunities will decrease on lands not included within parks, forests or refuges as population increases, development of lands occurs, wild lands diminish and portions of the public land base are turned over to the private sector. As de facto wild lands gradually are converted to other uses -- such as residential development, farming, logging, mining and industrial development -- recreational uses which are now well dispersed over these lands will become more concentrated on remaining lands. Public outdoor recreational opportunities will depend increasingly upon lands that are set aside and developed for public recreational purposes.

STRATEGY

The Division of Parks must identify key areas for inclusion of the State Park System to help meet the need for maintaining a public recreational land base.

ISSUE: Maintaining the Alaska Recreational Lifestyle

Participation in outdoor recreational activities closely associated with the natural setting (i.e., fishing, exploring historical structures, camping, etc.) has always been a major part of the Alaska lifestyle. The Alaska Public Survey (1979) noted that, in Southcentral Alaska, "to be self reliant" and "recreation opportunities" were the most frequently given reasons for coming to or staying in Alaska. As recently as 1978, an Alaska congressman circulated a questionnaire to which 91 percent of the respondents indicated that one of the things they loved most about Alaska was the opportunity to

7-1-34

enjoy recreation in wild and undeveloped country. It is, in part, the responsibility of the state to insure that the reasons for which people made, or continue to make, Alaska their home are not lost in the years to come. The availability of high quality outdoor recreational experiences must be perpetuated and enhanced throughout the state.

Outdoor recreational experiences that relate to natural resources and which are unique to the Alaska lifestyle should remain available to the public. Hunting, fishing, viewing wildlife, wild food gathering, trapping, gold mining and dog mushing are examples of these experiences. Even with on-going development, Alaskans still enjoy some of the finest wildland, outdoor recreational opportunities in the United States.

STRATEGY

It is recognized that State Park System units in and of themselves cannot insure the maintenance of adequate areas to protect the Alaska lifestyle. However, to the greatest extent possible, areas of traditional recreational use should be established as units of the State Park System.

ISSUE: Loss of Cultural Resources

One outdoor recreational activity enjoyed by many is the exploration of historic villages, mining towns, Russian forts, etc., while learning about Alaska's prehistory, history and various cultures. Cultural resources are being lost or damaged at a significant rate as historic and cultural sites are being developed for uses other than historic preservation. Some of these areas are also in private ownership and thus outside the scope of public management. There is a need to protect the remaining cultural resources on public lands. When adequately protected, stabilized, rehabilitated and interpreted, they then provide opportunities for outdoor-oriented recreational experiences.

STRATEGY

State Historic Parks and Sites, as a means of protecting cultural resources, should be established to preserve and interpret Southcentral Alaska's cultural heritage.

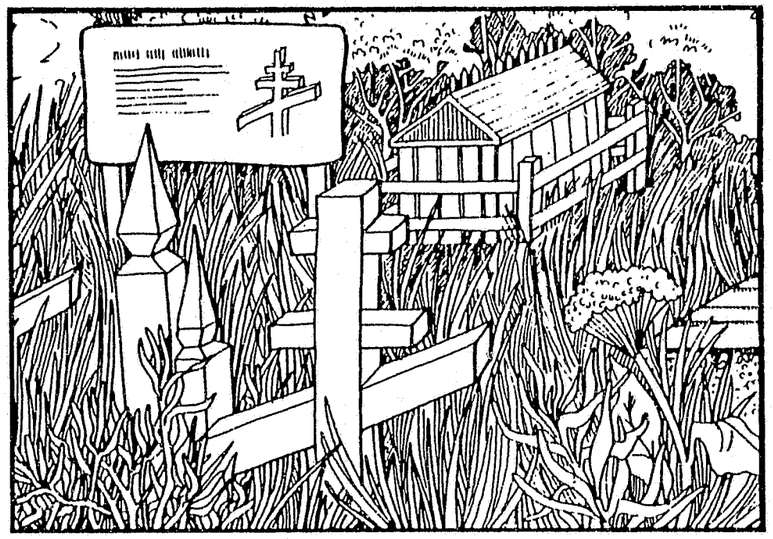

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FIGURE 10. Outdoor Recreation Responsibilities of Federal Agencies

Federal Agency	Land Management Responsibilities Supporting Outdoor Recreation	Areas Within The South-central Region	Types of Outdoor Recreational Opportunities Provided
National Park Service	manages areas of national significance with natural, scenic, cultural and recreational values	Denali National Park and Preserve, Kenai Fjords National Park, Wrangell-St. Elias National Park and Preserve, Lake Clark National Park and Preserve, Katmai National Park and Preserve	dispersed activities; limited developed facilities
U.S. Fish and Wildlife Service	manages land within national wildlife refuges primarily for the protection and maintenance of wildlife habitat and species; uses that do not conflict with habitat and species are generally allowed	Kenai National Wildlife Refuge, Alaska Maritime National Wildlife Refuge, Kodiak National Wildlife Refuge, Texedni National Wildlife Refuge.	dispersed activities; developed campgrounds, cabins, trails and other facilities
U.S. Forest Service	manages national forest lands for multiple uses (outdoor recreation, range, timber, watershed, and wildlife purposes)	Chugach National Forest	dispersed activities; developed campgrounds, cabins, trails and other facilities
Bureau of Land Management	manages public resource lands for multiple uses; provides for recreational facilities and access to lands under its authority	Denali Highway area, Tiekel River area, Bering Glacier area, Portage Flats area	dispersed activities; limited developed facilities
Department of Defense	manages military reservation lands	Ft. Richardson, Elmendorf Air Force Base	limited general public use; dispersed activities and some developed facilities

7-1-37

Regional Role of the State Park System

Existing Outdoor Recreational Opportunities

The lands in Southcentral Alaska are managed by a number of public agencies and by the private sector. Each entity has a somewhat different role in providing outdoor recreational, cultural, scientific and educational opportunities. Through evaluation of the State Park System's role, it became clear that some opportunities which the Alaska Division of Parks could provide were already being provided by other entities. Certain types of public use opportunities are already provided in a portion of the region, while other public uses are neglected. A review of areas, management responsibilities and the types of recreational opportunities provided by public entities was conducted to help identify more specifically the types of opportunities which should be provided by the Alaska Division of Parks. This review was used to help fulfill outdoor recreation-related needs of the public. Figures 10 and 11 summarize the roles of federal and state agencies in providing outdoor recreation opportunities. Local recreation is oriented towards use of public school facilities and community park sites. Private recreation is service-oriented in areas where there is a concentration of recreational use, or is directed towards special interest groups with a limited clientele (i.e., fly-in guided services and remote wilderness lodges).

The Alaska State Park System Today

As of January 1982, there were 82 park units in the Alaska State Park System. The Southcentral Region contains 53 of the existing units.

Figures 12 and 13 show the types of park units by acreage and number of units. The overall system has an abundance of State Recreation Sites, and the majority of acreage is within the three State Parks. On a subregional basis, primary development of the park system has occurred in those areas closest to Anchorage (the largest concentration of the state's population) and along the state highway system within the Southcentral Region.

Prior to recommending additions or deletions of existing unit types or acquisition and development of new sites, the Southcentral Region was evaluated according to the flowchart and criteria listed in Figure 3. Subregional use preferences and patterns and the roles of the other entities in providing opportunities were carefully evaluated. In some subregions, where the Alaska State Park System is catagorizing nearly all its units as State Recreation Sites, other agencies are providing the diversity of opportunities necessary to fulfill the regional needs.

Subregional recommendations have been developed to represent significant resource values of statewide and regional importance; to provide a diversity of outdoor recreational, cultural, scientific and educational opportunities; and to represent the eight units of the State Park System, based on previous information and data.

A compilation of the number of Southcentral state park units recommended for 1982-1992, which includes existing, proposed and future considered units, is shown in Figure 14.

7-1-38

FIGURE 11. Outdoor Recreation Responsibilities of State Agencies

State Agency	Land Management Responsibilities Supporting Outdoor Recreation	Areas Within The South-central Region	Types of Outdoor Recreational Opportunities Provided
Department of Natural Resources Division of Parks	manages all State Park System lands	53 state park units including Denali State Park, Chugach State Park, Nancy Lake State Recreation Area, Captain Cook State Recreation Area, Kachemak Bay State Park	dispersed opportunities; developed facilities
Department of Natural Resources Division of Land and Water	manages general land holdings of the state	the majority of state lands in the region	generally, undeveloped open space
Department of Fish and Game	manages fish and game; coordinates habitat and species management efforts with appropriate federal, state, and local land-managing agencies; acquires critical habitat; manages the non-game program; shares management responsibility for state game refuges with the Division of Land and Water	critical habitat areas, sanctuaries, and state game refuges, including Potter Point, Goose Bay, Palmer Hay Flats, Susitna Flats, Trading Bay	fish- and game- related outdoor recreational activities, including hunting, fishing, viewing of wildlife and photography
Department of Transportation and Public Facilities	manages highway rights-of-way, airport lands and sites for DOT/PF facilities	all major highways and roads within the region	roads providing access to outdoor recreational opportunities; scenic overlooks; rest areas; developed bicycle trails; pullouts; and cultural/historic signs

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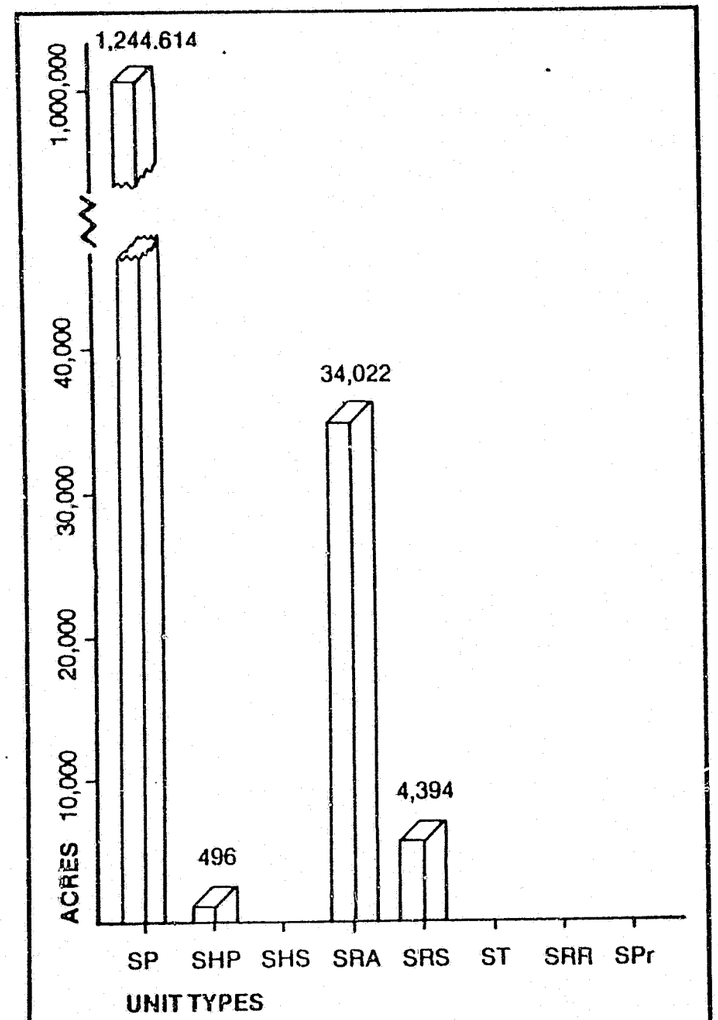
FIGURE 12.
Number of Acres per State Park Unit Type



NOTE: Existing unit acreage only. Acreage figures not available for proposed/future considered units.

FIGURE 13.
Number of Units per State Park Unit Type

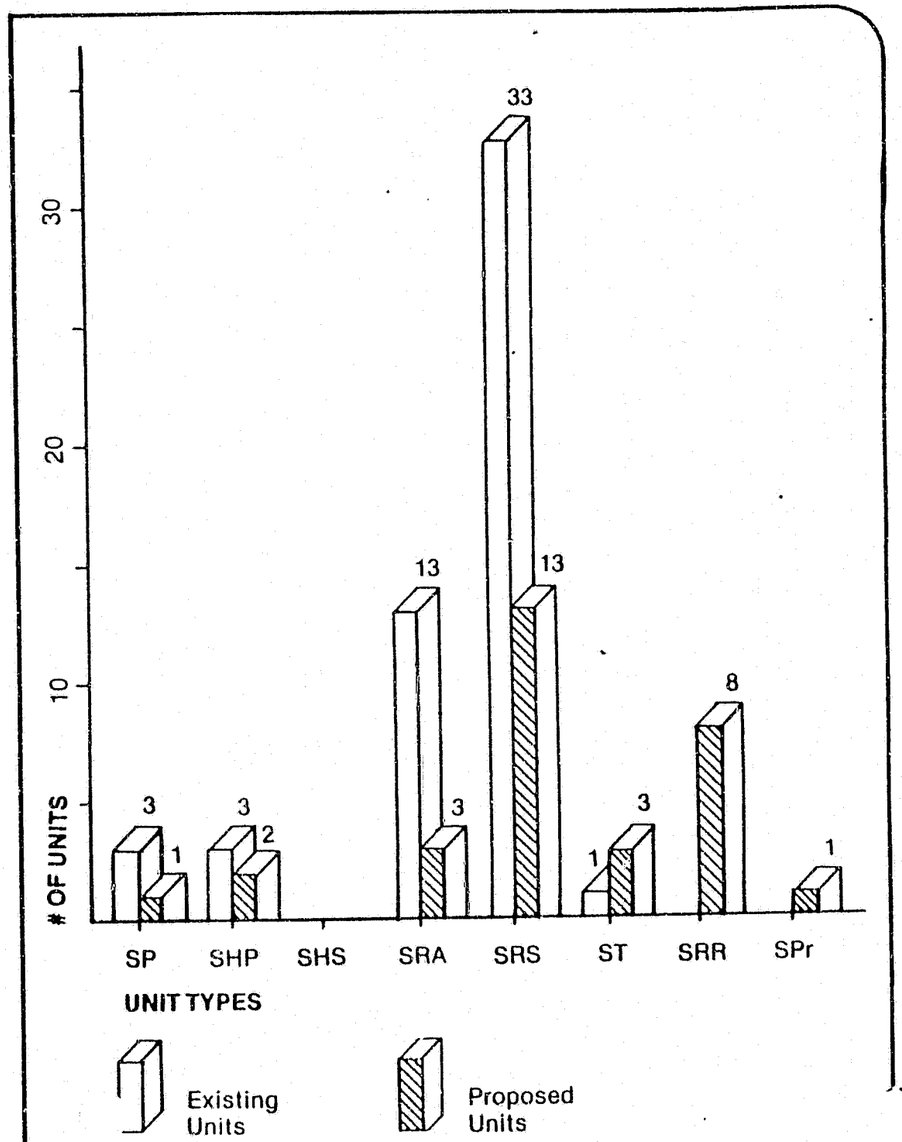


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FIGURE 14. Numbers of Southcentral State Park Units 1982 - 1992

SUBREGION	Existing	Proposed	Future Considerations	Total
Copper Basin	8	2	4	14
Mat-Su Valley	16	12	2	30
Anchorage	3	—	—	3
Prince William Sound	2	1	2	5
Kenai	21	13	2	36
Kodiak Islands	3	4	3	10
Total	53	31	13	98

State Park System Future Alternatives

Alternatives Considered

Based upon the preceding evaluation of the regional role of the State Park System, three alternative courses of action for the park system -- for the next ten years -- were developed. Following is a discussion of these alternatives.

A.
MAINTAIN AND UPGRADE EXISTING STATE PARK UNITS WHERE NEEDED.
This alternative reflects a conscious decision that the cost of expanding the State Park System, despite its gaps in accommodating all needs, is not a priority at this time. Recreational opportunities not adequately represented within the State Park System could be met by other state and federal agencies, the private sector, local governments or through land management practices.

In alternative A it is recognized that the state has a good park system which meets the basic needs of its citizens and visitors. However, it is not responsive to recreational demands on non-park lands, does not designate future park units, nor does it meet needs beyond those which can be accommodated by existing park units. The idea of "maintaining what you've got" represents an acceptable, short-term approach for meeting basic park needs.

B.
MAINTAIN, UPGRADE AND EXPAND EXISTING STATE PARK UNITS WHERE NEEDED AND DESIGNATE NEW UNITS TO MEET EXISTING RECREATIONAL DEMAND.
This alternative recognizes the social, economic, and land-use factors influencing outdoor recreation and the need for active management of recreational resources and activities. It represents a response to the influence of demand and to changes in recreational use patterns. As demand grows, existing park units must be expanded and new units designated if the State Park System is to continue to meet public need. The future availability of a recreational resource, however, is not considered at this time.

7-1-41

Park units will be designated to meet current needs rather than the forecasts and projections of demand and use.

C.
MAINTAIN, UPGRADE AND EXPAND EXISTING STATE PARK UNITS WHERE NEEDED, DESIGNATE NEW UNITS TO MEET EXISTING AND PROJECTED RECREATIONAL DEMAND AND PROVIDE FOR ADEQUATE REPRESENTATION OF THE SOUTHCENTRAL REGION'S SIGNIFICANT RECREATIONAL, NATURAL, CULTURAL, EDUCATIONAL, AND SCIENTIFIC RESOURCES.

This alternative determines what elements are missing from the present State Park System. Under the best of circumstances, the park system must not only meet existing needs, but also be able to reserve lands for future needs and opportunities. In Alternative C an attempt is made to take a look at how well existing state park units meet regional recreation needs and the natural, cultural, scientific and educational values which are represented within the system. Representation of types of recreational opportunities within the system is based on the provision of recreational opportunities by other entities, changes in land use and development, availability of recreational resources, other resource allocations, and those factors influencing public recreation. Alternative C is an aggressive approach to bringing existing state park units up to a level of management and development to meet unsatisfied demand and to provide adequate resource protection and visitor safety. At the same time, the state recognizes the importance of protecting and reserving those public lands necessary for meeting both existing demands and future needs. For an analysis of alternatives by unit types and implementation costs, see Figures 15 and 16.

Preferred Alternative

Alternative C was selected by the Alaska Division of Parks as the preferred alternative, the one most responsive to the needs of the public for a viable and diverse State Park System in the Southcentral Region. Also recognized in this alternative is the lead role of the state and particularly the Division of Parks in providing recreational opportunities and protecting natural and cultural resource values in the region. The preferred alternative will be put into effect in a series of phases.

FIGURE 15. Analysis of Alternatives by Unit Type

SUBREGION	Number of Units			State Park			State Historic Park			State Historic Site			State Recreation Area			State Recreation Site			State Trail			State Recreation River			State Preserve		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Copper Basin	8	10	14	—	—	—	—	—	—	—	—	—	1	—	3	7	7	8	—	1	1	—	1	2	—	—	—
Mat-Su Valley	16	28	29	1	1	1	1	2	2	—	—	—	3	4	6	10	12	12	1	2	2	—	6	6	—	—	—
Anchorage	3	3	3	1	1	1	—	—	—	—	—	—	—	—	—	2	2	2	—	—	—	—	—	—	—	—	—
Prince William Sound	2	3	5	—	—	—	—	—	—	—	—	—	—	—	1	2	3	3	—	—	1	—	—	—	—	—	—
Kenai	21	34	36	1	1	1	1	2	2	—	—	—	9	11	12	10	18	18	—	1	1	—	—	—	—	1	1
Kodiak Islands	3	7	10	—	1	2	1	1	1	—	—	—	—	1	2	2	4	5	—	—	—	—	—	—	—	—	—
Southcentral Region Total	53	84	97	3	4	5	3	5	5	—	—	—	13	16	24	33	46	48	1	4	5	—	7	8	—	1	1

Alternative A: existing units
Alternative B: existing and proposed units
Alternative C: existing, proposed and future considered units

T-1-43

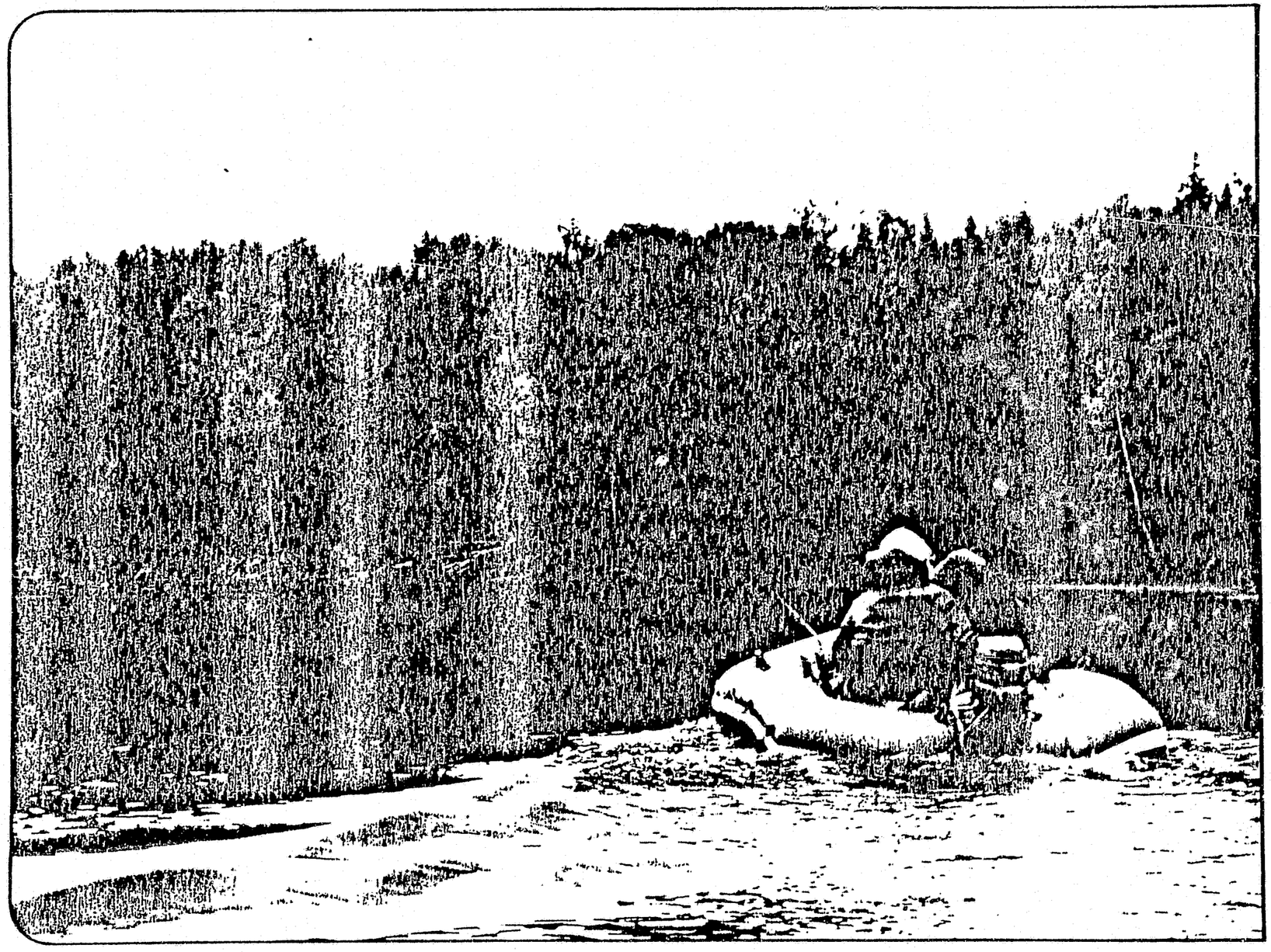
FIGURE 16. Analysis of Alternatives by Implementation Costs[1]

Alternatives[4]	Staffing[2]						Operations & Management (x $1,000)			Visitor Services (x $1,000)			Development[3] (x $1 million)		
	A		B		C										
	S	P	S	P	S	P	A	B	C	A	B	C	A	B	C
Copper Basin Subregion	4	0	6	2	8	3	49	68	75	33	46	48	1.1	1.8	2.1
Mat-Su Valley Subregion	11	4	16	6	18	7	125	321	376	82	320	344	10.4	19.4	22.2
Anchorage Subregion	5	11	5	11	8	12	183	256	281	111	160	176	5.3	11.3	16.6
Prince William Sound Subregion	0	0	6	2	6	3	0	30	60	0	32	55	0	.7	1.4
Kenai Subregion	9	1	12	4	13	4	144	182	208	97	120	136	9.0	10.4	11.8
Kodiak Islands Subregion	0	1	5	2	5	3	13	60	80	9	40	73	0	1.4	2.2
Southcentral Region Total	20	17	50	27	58	32	514	917	1080	332	718	832	25.8	45.0	56.3

S: seasonal
P: permanent
Alternative A: existing units
Alternative B: existing and proposed units
Alternative C: existing, proposed and future considered units

1. Cost figures are in 1981 dollars with no adjustments for inflation or contingency factors
2. Staffing includes filed staff only (field supervisors, rangers, maintenance workers, laborers). It does not include youth employment, YACC, or YCC programs
3. Development does not include acquisition costs, equipment costs, or special project costs. Figures only include basic level of services and facilities.
4. Figures for Alternative A represent fiscal year 1982 budget and CIP catalog
5. These figures are estimates for **full** implementation of alternatives and therefore would be lower for partial or phased implementation.

7-144



7-1-45

15

Public Response to Draft Recommendations

A brochure questionnaire was sent to various communities throughout the Southcentral Region to give respondents the opportunity to comment on draft recommendations for existing, proposed, and future considerations of State Park System units.

Respondents were asked to comment on whether or not the Alaska Division of Parks should be putting more effort into existing or proposed/future park system units. A preference for placing more effort into existing park system units was expressed by 42 percent of respondents, while 30 percent preferred that more effort be placed on proposed park units. Eleven percent said that effort should be placed on both existing and proposed park units. Seventeen percent of the respondents said neither or did not respond.

When asked if they agreed with Alaska Division of Parks' choices of recommended areas for state park units, both existing and proposed, 51 percent of the respondents agreed, 28 percent disagreed, and 21 percent did not respond. Respondents were also asked if they agreed with the recommendations made for each state park unit. Forty-five percent agreed, while 27 percent disagreed, and 28 percent did not respond.

Respondents were asked to prioritize the recommendations for both existing and proposed/future units in each subregion. Following is the first priority listed by the most respondents.

EXISTING - First priority (top three)

- COPPER BASIN SUBREGION
  Lake Louise SRA
  Little Nelchina SRS
  Worthington Glacier SRS
- MATANUSKA-SUSITNA VALLEY SUBREGION
  Denali SP
  Independence Mine SHP
  Matanuska Glacier SRS
- ANCHORAGE SUBREGION
  Chugach SP
- PRINCE WILLIAM SOUND SUBREGION
  Blueberry Lake SRS
  Valdez Glacier SRS
- KENAI SUBREGION
  Kachemak Bay SP
  Iditarod Trail
  Caines Head SRA - Morgan's Landing SRA (tie)
- KODIAK ISLANDS SUBREGION
  Fort Abercrombie SHP
  Pasagshak SRS
  Buskin River SRS

PROPOSED/FUTURE - First priority (top three)

- COPPER BASIN SUBREGION
  Nelchina-Tazlina SRR
  Susitna Lake-Tyone River SRA
  Eagle ST
- MATANUSKA-SUSITNA VALLEY SUBREGION
  Hatcher Pass SRA
  Talkeetna SRR
  Montana Creek SRS
- ANCHORAGE SUBREGION
  (There were no proposed or future recommendations for this subregion.)

7-1-46

- PRINCE WILLIAM SOUND SUBREGION
  Marine Park System
- KENAI SUBREGION
  Kenai River (Proposed Additions)
  St. Augustine Island SPr
  Homer Spit
- KODIAK ISLANDS SUBREGION
  Woody Island SRS
  Cape Chiniak SRA
  Shuyak Island SP

When asked should additional public outdoor recreational opportunities be provided by either the state government or local governments, eight percent of the respondents said local government, 22 percent said state, 45 percent said both, 15 percent said neither and 10 percent did not answer the question. Respondents were then asked if they supported an increase in recreational opportunities and services if it meant increased costs. Eighty percent of the respondents favored an increase in opportunities despite increased costs, while eight percent did not and 12 percent did not answer the question. Respondents were next asked whether these costs should be funded by legislative appropriations, user fees or both. Thirty-two percent favored legislative appropriations, nine percent user fees, 53 percent legislative appropriations and user fees and six percent did not answer the question.

The public was given a space on the brochure/response form to say exactly what they thought about the park system. Following are some of the comments received:

- Acquire land before lost.
- State doesn't need any land.
- The state should take responsibility and control of all lands that the state is entitled to under the U.S. Constitution and the equal footing act.
- I think your recommendations stink; parks have put thousands of farmers, miners, loggers, etc., out of business . . . most produce 0 for this countries (sic) economy or G.N.P.
- More rangers are needed on the Kenai.
- Access to Matanuska Glacier.
- Access to Eagle River.
- Work on what you have . . . there are as many proposed units as existing ones. Are you satisfied with what you are doing with what you already have?
- Kenai Peninsula is overdeveloped now.
- Please acquire as much new land as possible - FAST . . . your agency should be ten times larger in manpower and budget.
- I want to see something happening with Kachemak Bay State Park.
- Develop more access with less (sic) facilities.
- No campground or tourist facilities over two acres.
- The state park system is designed and run by people with a wilderness preservation mentality.
- Transferring recreation areas to local government is a false method of economizing.
- Good job.
- I am very disappointed to see you are not significantly expanding the State Trail System.
- Generally you are on the right track. You should be putting more effort and dollars into trails.
- I think it is a well thought out plan that will meet a variety of recreational needs.

7-1-47

- The total number of proposals is a bit ambitious.
- You are typical blind bureaucrats building up your phony dynasties and wasting Alaska's resources to pleasure the urbanites here. . ..
- How many times do you have to survey the public to get the idea recreation development is the game, not preservation and wilderness?
- Generally, I think your department is doing a good job. Campgrounds are clean and well maintained. I use them a lot and appreciate it.

Final Recommendations

Implicit in the recommendations for the State Park System is a need for meeting unsatisfied recreational demands; recognition that significant cultural and natural resources should be protected and managed; acknowledgement that the State Park System should respond to those issues affecting the recreational land base; and the need for the park system to be responsive to regional and subregional attractions and to population and land base changes.

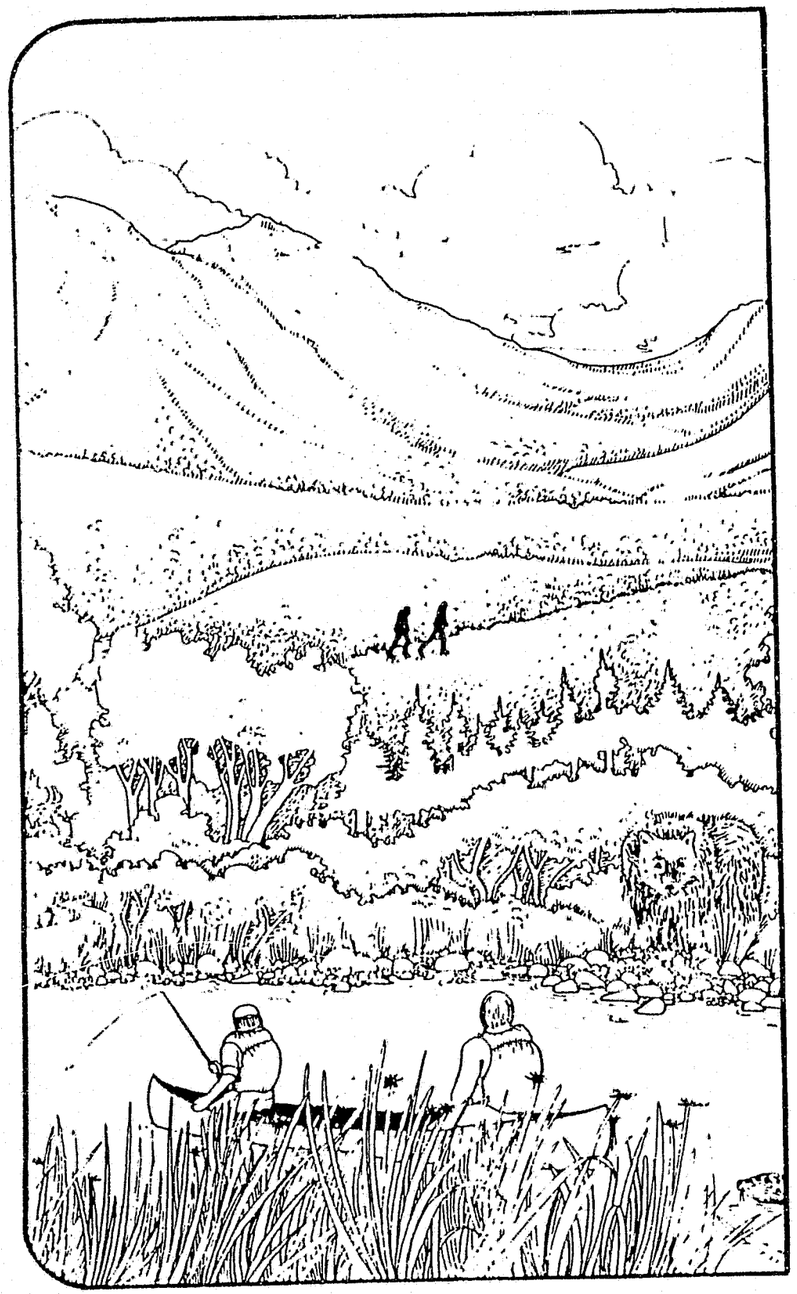
The identification of areas for inclusion in the State Park System includes only those areas which meet state park criteria as defined in the Alaska State Park System: Statewide Framework. The proposed and existing park units in this plan are identified in recognition of the state's commitment to outdoor recreational, cultural and natural resource protection through the park system. Other state lands which have important public recreational resources will continue to be managed by the Division of Land and Water Management as part of a multiple-use management program, with public recreation as a primary element, or will be incorporated into private land use. These lands will not, however, be part of the state's park system. The designation of areas within the State Park System is balanced by other agencies and the private sector, the commitment and designation of other lands in the state for resource development and private land ownership.

To the citizen and visitor to the state, a balanced State Park System is one which contain park units that represent the State's significant recreational, natural, cultural, scientific and educational resources, and contains those areas that meet the outdoor recreation needs being expressed by the public. The following are considered as important elements for representation in the Southcentral Region State Park System:

1.
Road system and other transportation-related influences which provide access to natural and cultural resource attractions to and recreational opportunities. Roadside recreational sites are well represented within the State Park System in the Southcentral Region, and the emphasis should be on upgrading or expanding existing units as well as providing new units in response to anticipated demands in the future.

2.
Rivers are a key recreational attraction in Alaska and particularly in the Southcentral Region. There is a real need to include in the park system a representation of the region's significant recreational and free-flowing rivers.

7-1-48



3.
Lake systems associated with a diversity of upland recreational opportunities are in short supply and are inadequately represented in the Southcentral Region of the State Park System. The Nancy Lake lake system is one of the few lake systems represented which provide for a diversity of recreational opportunities.

4.
Trails are of increasing importance to the public. Trail-related activities have shown the greatest increase in recreational use of any single outdoor recreational activity. A system of designated historic and recreational trail corridors is poorly represented in the South-central Region.

5.
The cultural/historical character of Alaska is a major feature of interest to Alaskans and visitors. Representation of significant cultural and historic features provides a means of preserving Alaska's heritages and forges a link in Alaska's sense of identity. Within the Southcentral Region of the State Park System, only three state historic parks are currently represented.

6.
Coastal areas and the marine environment of the state represent some of Alaska's real natural "jewels." Coastal areas on the Kenai Peninsula are represented by several small recreation sites and Kachemak Bay State Park. Kodiak Island and Prince William Sound areas offer some of the most significant examples of the state's coastal environment and should be represented within the State Park System.

7.
Alpine environments, representing the scenic

7-1-45

and spectacular character of Alaska, provide a diversity of recreational opportunities. Chugach, Kachemak Bay and Denali state parks are important examples of such environments within the Southcentral Region. Other areas such as Hatcher Pass, Gunsight Mountain, Mt. Susitna and Keystone Canyon/Thompson Pass, offer outstanding opportunities to round out the park system.

8.
User interests in key recreational, cultural, and natural features, as expressed through public preferences and participation rates, provide a real measure of the adequacy of the State Park System in meeting recreational demands. Thus, proximity of areas to population centers, the degree of accessibility, the diversity of experiences provided, the availability of leisure time, traditional recreational use habits and new activities, and other influences must be considered heavily in designing a well-balanced State Park System in cooperation with other agencies, local governments and the private sector.

In recommending those areas which should be represented within the Southcentral Region of the State Park System, it is not necessary that the system represent all things to all people or represent fully all elements listed above. Certain features will be best represented by other public and private programs. The approach taken has been to look for gaps in the regional representation of recreational, natural, cultural, scientific and educational resources with significance and to identify potential park units in consideration of park system criteria.

Following are recommendations for existing and proposed State Park System units within the Southcentral Region, organized by subregion. Preceding each subregional list of recommendations is a review of the subregion's character, and its issues, public preferences and recreational opportunities. Collectively, the subregional recommendations comprise the recommendations for the Alaska State Park System in Southcentral Alaska and are intended to provide a balanced State Park System within the region.

Listing of phases will also be shown with each recommendation to identify the priority of the time frame for acquisition, planning, development and management of state park units. Consideration will first be given to Phase I recommendations followed by Phase II, then Phase III.

NOTE: Acreage figures listed in the recommendations are approximate, since exact figures will be derived at the time of purchase.

These are the recommendations as they appear at the time of publication. All recommendations may change once a park management plan is developed for the unit.

7-1-50

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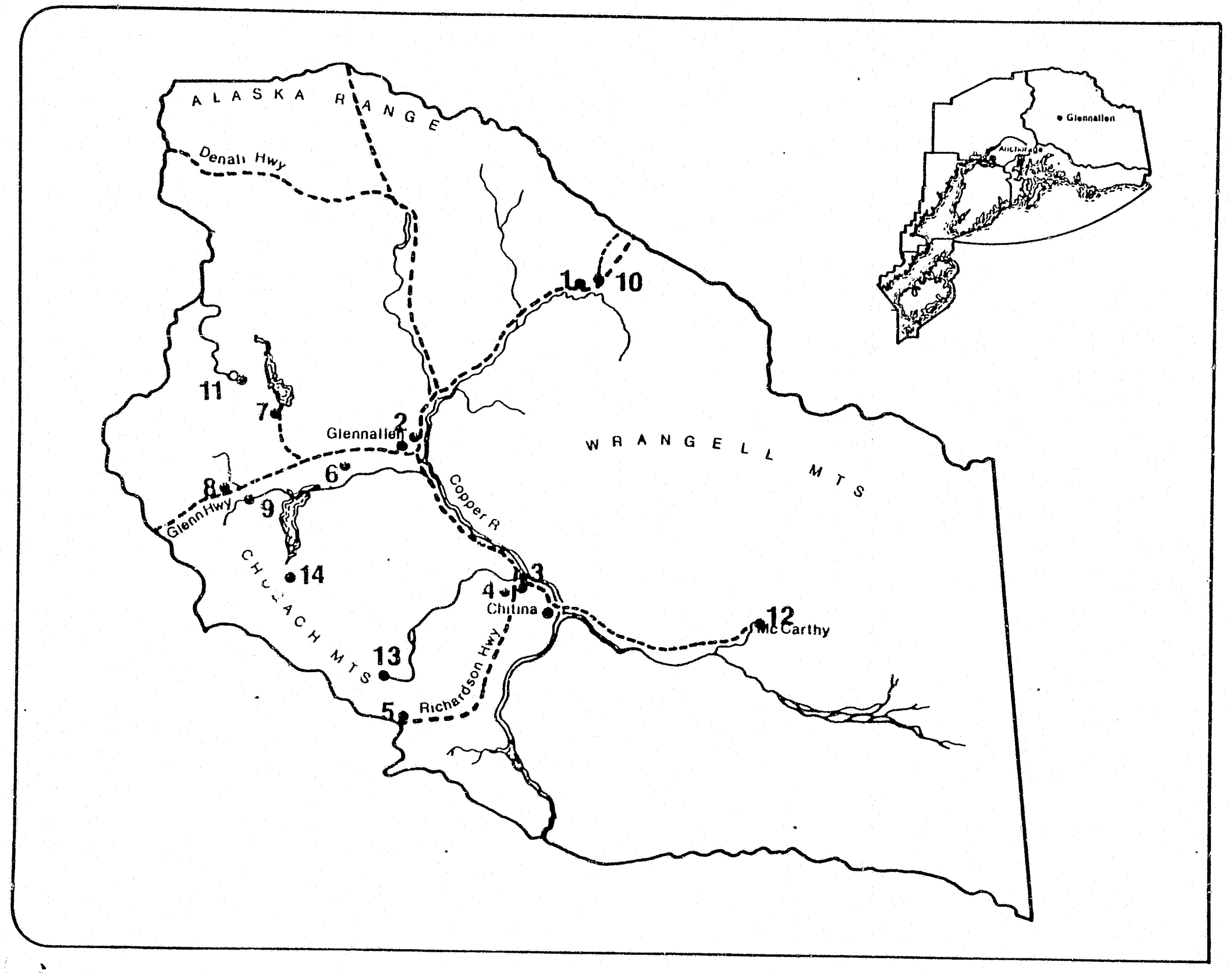
These are the recommendations as they appear at the time of publication. All recommendations may change once a park management plan is developed for the unit.

7-1-51


ALASKA RANGE
Denali Hwy
WRANGELL MTS
Glennallen
Copper R
Glenn Hwy
CHUGACH MTS
Richardson Hwy
Chitina
McCarthy
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Glennallen
Anchorage

7-1-52

1. Porcupine Creek SRS
2. Dry Creek SRS
3. Squirrel Creek SRS
4. Little Tonsina SRS
5. Worthington Glacier SRS
6. Tolsona Creek SRS
7. Lake Louise SRA.
8. Little Nelchina SRS
9. Nelchina-Tazlina SRR
10. Eagle ST
11. Susitna Lake-Tyone River SRA
12. McCarthy SRS
13. Tonsina SRR
14. Tazlina Lake SRA

ISSUES
- extensive private land ownership adjacent to primary road system
- no local, organized government with recreational responsibility
- undeveloped tourism potential

PUBLIC REFERENCES
- maintain rural lifestyle
- minimize impact of tourism/recreation on local residents
- provide river and trail-oriented recreational activities
- continue access to public lands for hunting and fishing
- provide more family-oriented recreational areas
- seek cooperative management of recreational opportunities

OTHER AGENCIES AND THE PRIVATE SECTOR PROVIDING RECREATIONAL OPPORTUNITIES
- National Park Service: Wrangell-St. Elias National Park & Preserve - dispersed, backcountry
- Bureau of Land Management: Gulkana River, Denali Highway - dispersed, backcountry
- Private: guiding services and lodges, limited recreational/commercial developments and fee areas

SUBREGION CHARACTERISTICS
- expansive landscape
- recreational opportunities suitable for winter
- accessible lakes and streams
- fish and wildlife
- access to public lands
- scenic attractions
- historic/cultural resources

STATE PARK REPRESENTATION
- EXISING: limited small recreational sites along the primary road system to serve the traveling public
- NEEDED: river and trail units, recreational areas with a diversity of opportunities, family recreational opportunities, cooperative management of roadside recreation

7-1-53

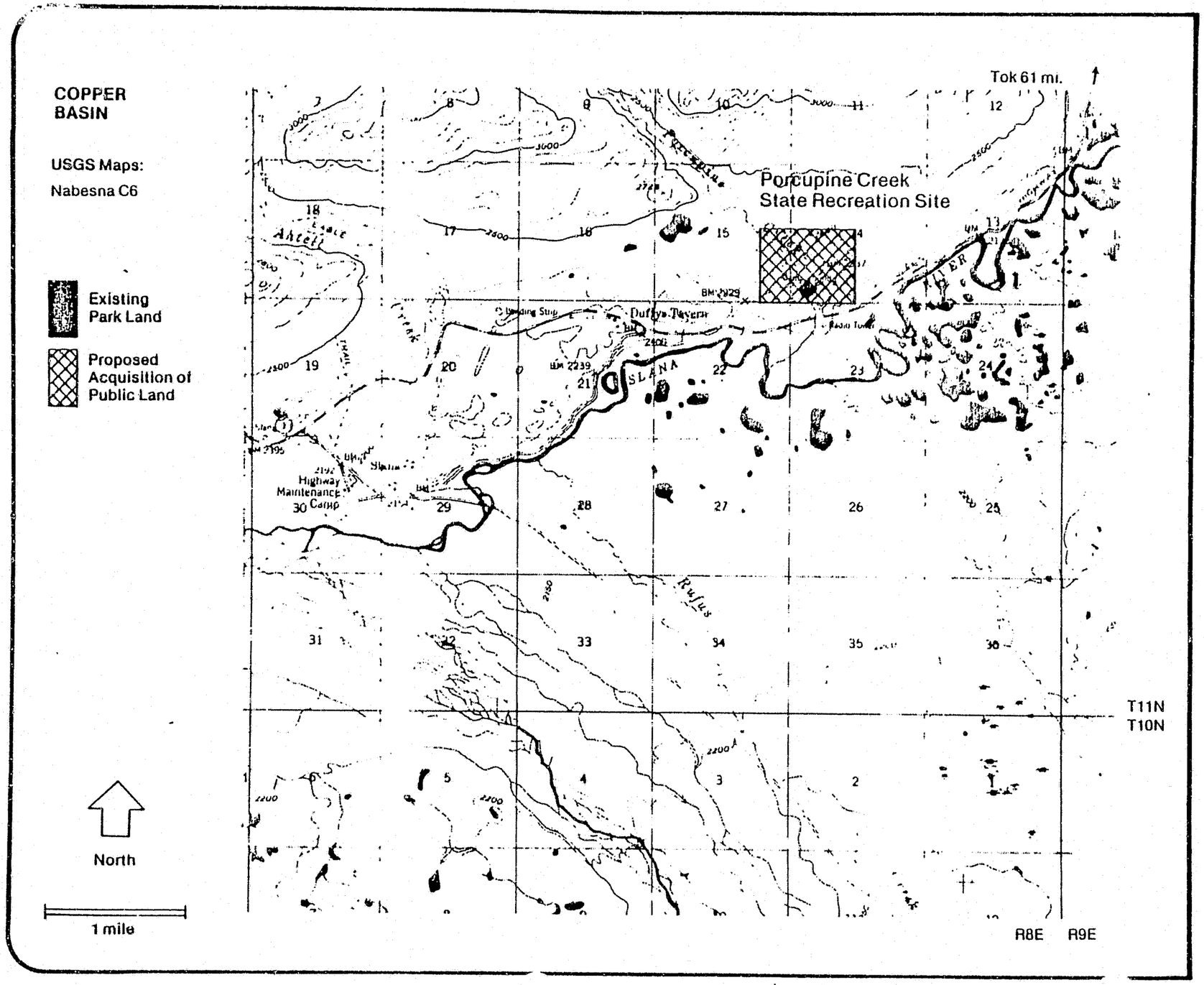
Copper Basin Subregion Recommendations

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Porcupine Creek State Recreation Site (existing)	50	III I	Acquisition: if management continues, obtain 240 acres of adjoining state land by administrative action Special Management Considerations: determine cost effectiveness of maintaining the area
Dry Creek State Recreation Site (existing)	51	I	Special Management Considerations: monitor walk-in camping use
Squirrel Creek State Recreation Site (existing)	52	I III III	Acquisition: resolve land ownership Planning: prepare management plan Development: implement management plan
Little Tonsina State Recreation Site (existing)	53	III	Special Management Considerations: enact management practices to minimize bear problems
Worthington Glacier State Recreation Site (existing)	54	II I I	Acquisition: obtain by administrative action, 480 acres of adjoining state land of glacier terminus Development: complete currently funded development projects Special Management Considerations: expand visitor information program
Tolsona Creek State Recreation Site (existing)	55	II III	Planning: prepare management plan to include relocation of campground and develop trail system Development: revegetate existing site and implement management plan
Lake Louise State Recreation Area (existing)	56	II I I I	Acquisition: obtain 300 acres of federal surplus lands and Boy Scout property by administrative action Planning: prepare feasibility study to evaluate adjoining lands for recreational opportunities Development: complete currently funded development projects Special Management Considerations: work cooperatively h local landowners

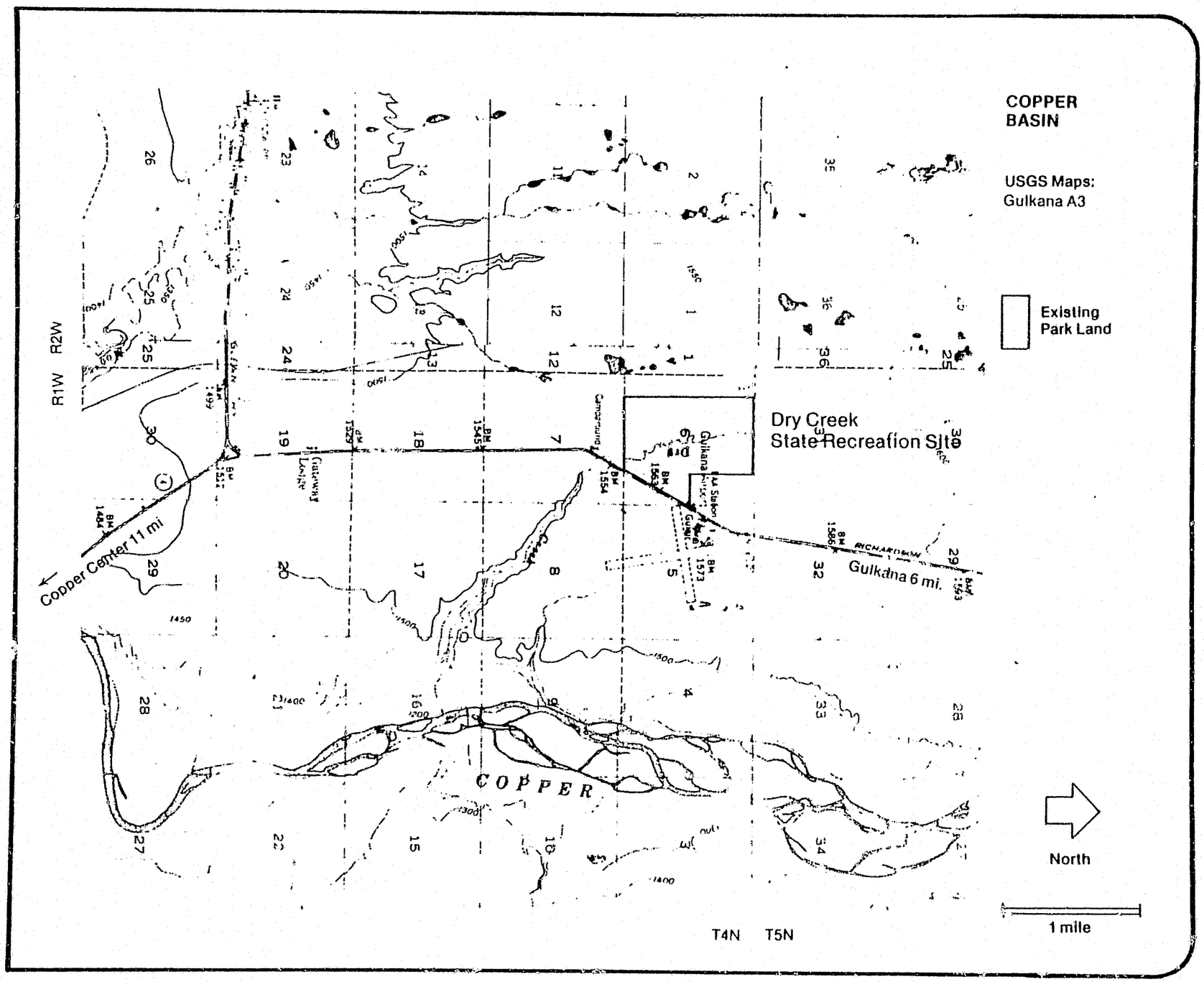
UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Little Nelchina State Recreation Site (existing)	57	I	Acquisition: obtain 620 acres of state land by administrative action
		I	Planning: prepare management plan
		I	Development: implement management plan
		I	Special Management Considerations: cooperate with the Alaska Department of Fish and Game on Nelchina Basin land management planning
Nelchina-Tazlina State Recreation River (proposed)	58	I	Acquisition: seek legislative designation and work cooperatively with Ahtna Corporation
		I	Planning: prepare river management plan
		I	Development: implement management plan and work cooperatively with DOT/PF on highway boat launch
		I	Special Management Considerations: establish staffing and work cooperatively with Ahtna Corporation and ADF&G
Eagle State Trail (proposed)	58	II	Acquisition: locate and designate trail; negotiate cooperative management agreements
		II	Planning: prepare trail management plan
		III	Development: implement trail management plan
		II	Special Management Considerations: work cooperatively with private landowners
Susitna Lake-Tyone River State Recreation Area (future consideration)	59		These areas may be included as units of the State Park System depending on recreational needs, use preferences and upon available funding.
McCarthy State Recreation Site (future consideration)	59		
Tonsina State Recreation River (future consideration)	59		
Tazlina Lake State Recreation Area (future consideration)	59		

7-1-55

PORCUPINE CREEK SRS

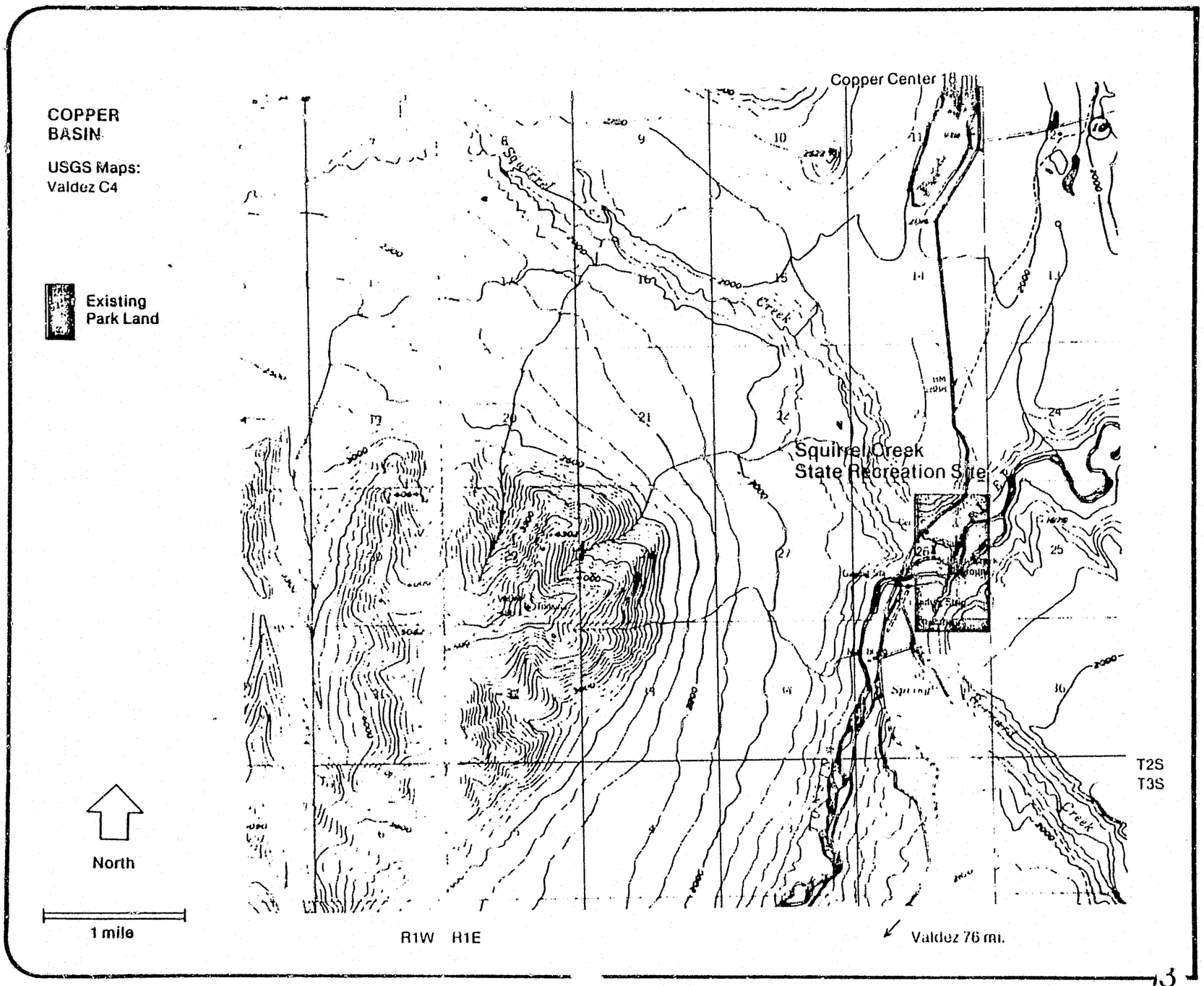


7-1-56

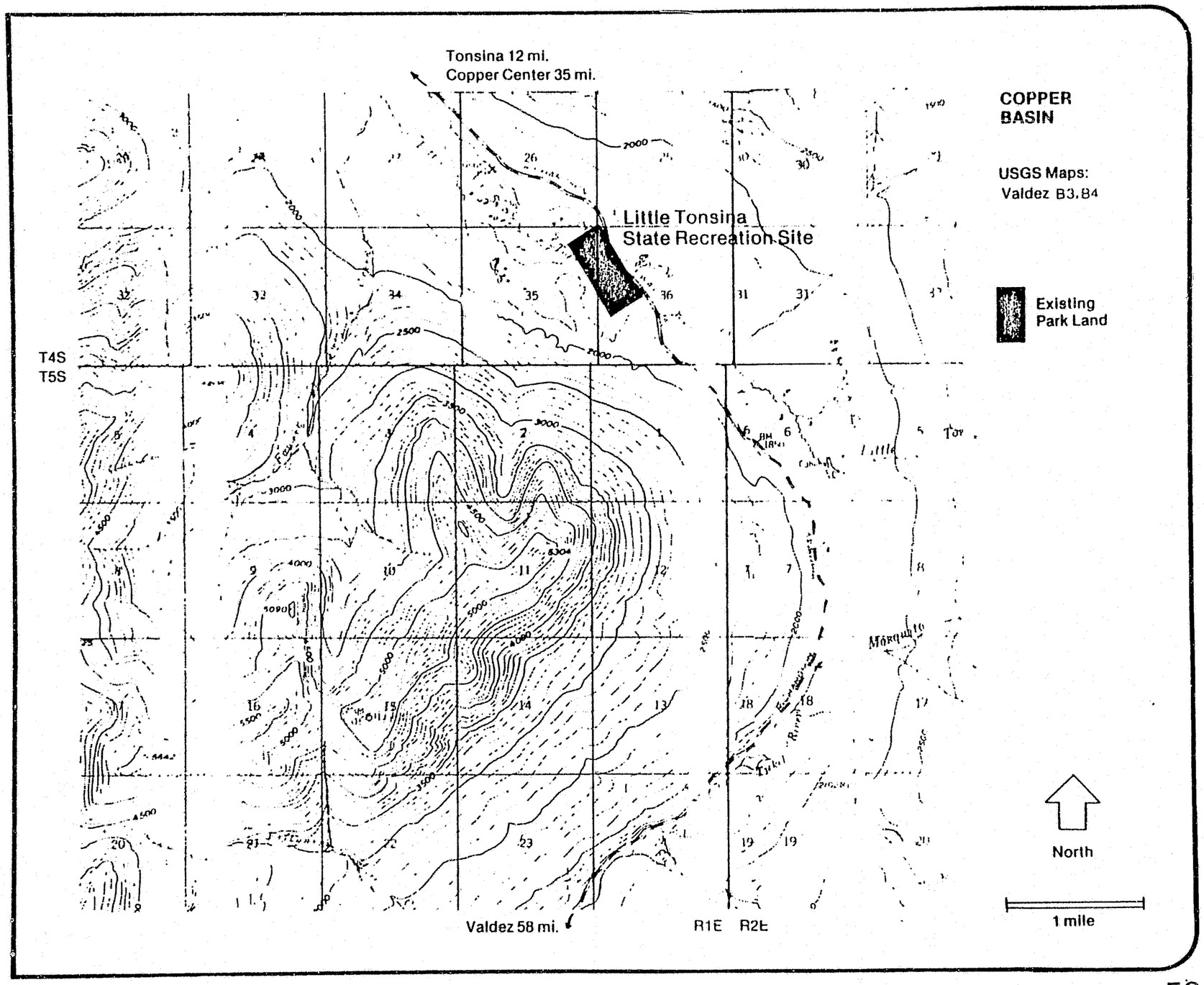

COPPER BASIN
USGS Maps: Gulkana A3
Existing Park Land
Dry Creek State Recreation Site
Copper Center 11 mi
Gulkana 6 mi.
RICHARDSON
COPPER
R1W R2W
T4N T5N
North
1 mile

7-1-57

SQUIRREL CREEK SRS



7-1-58


Tonsina 12 mi.
Copper Center 35 mi.
COPPER BASIN
USGS Maps:
Valdez B3,B4
Little Tonsina
State Recreation Site
Existing
Park Land
T4S
T5S
North
1 mile
Valdez 58 mi.
R1E
R2E

7-1-59

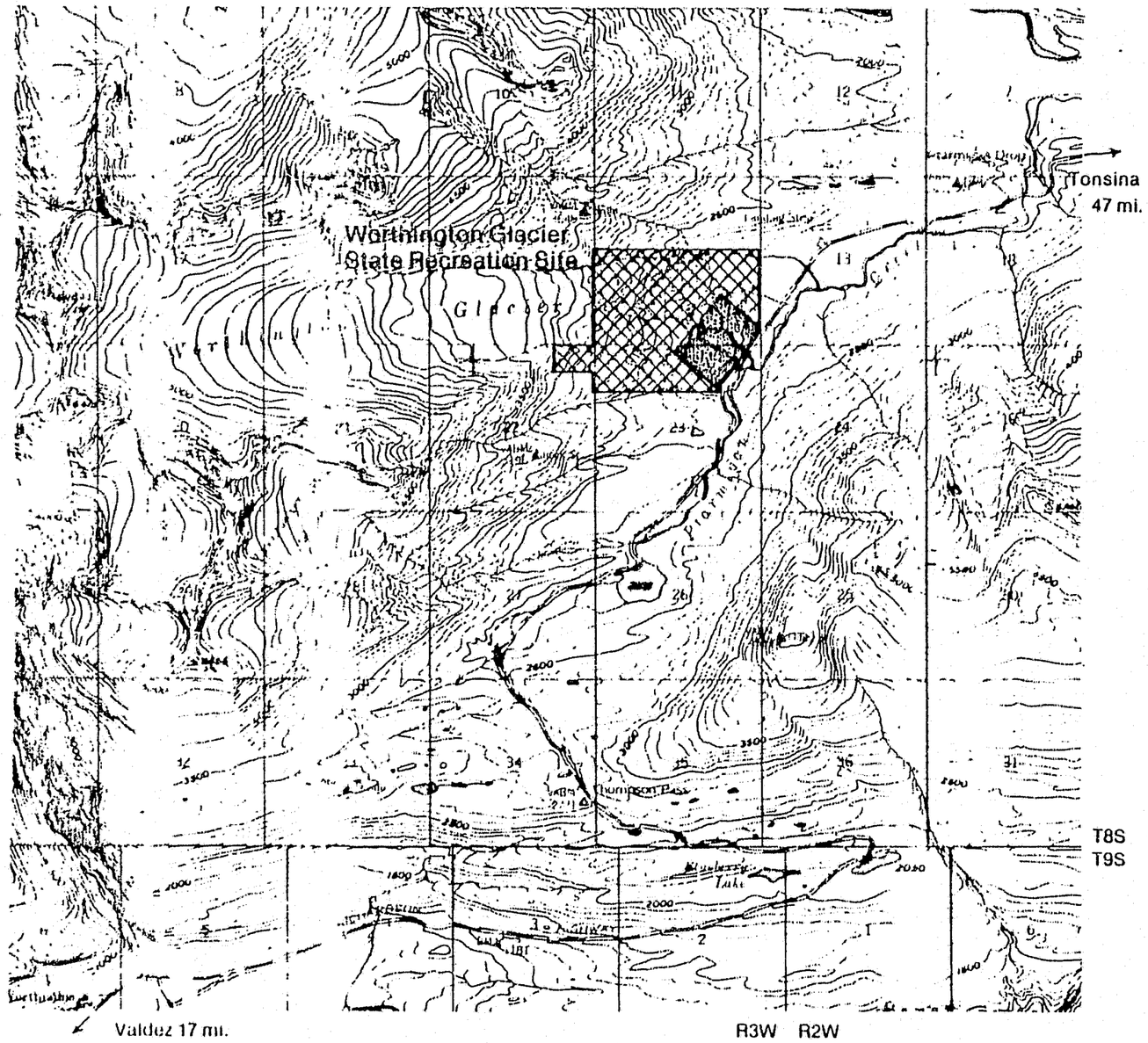
WORTHINGTON GLACIER SRS

COPPER BASIN

USGS Maps:
Valdez A5

Existing Park Land

Proposed Acquisition of Public Land



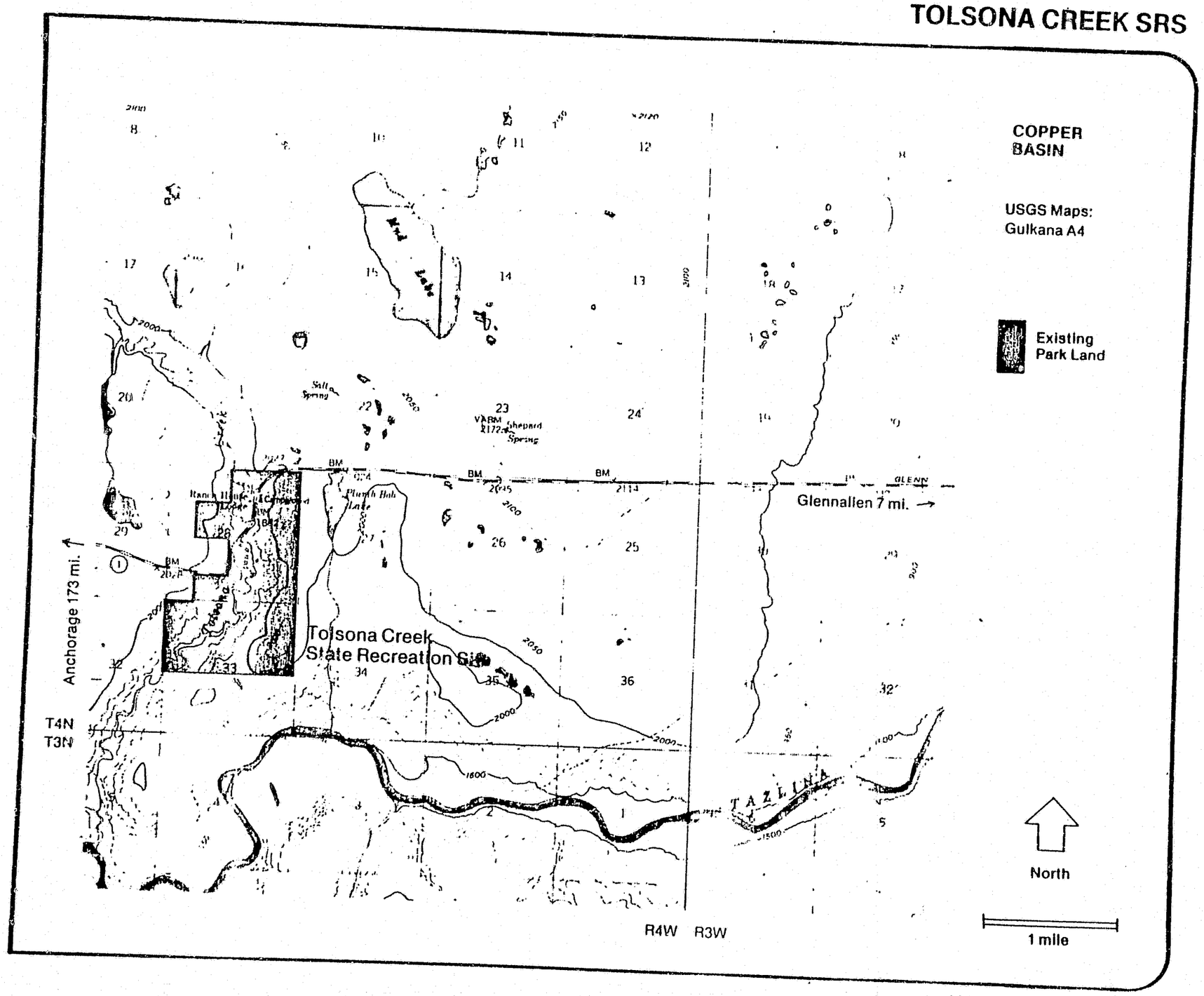
North

1 mile

7-1-60

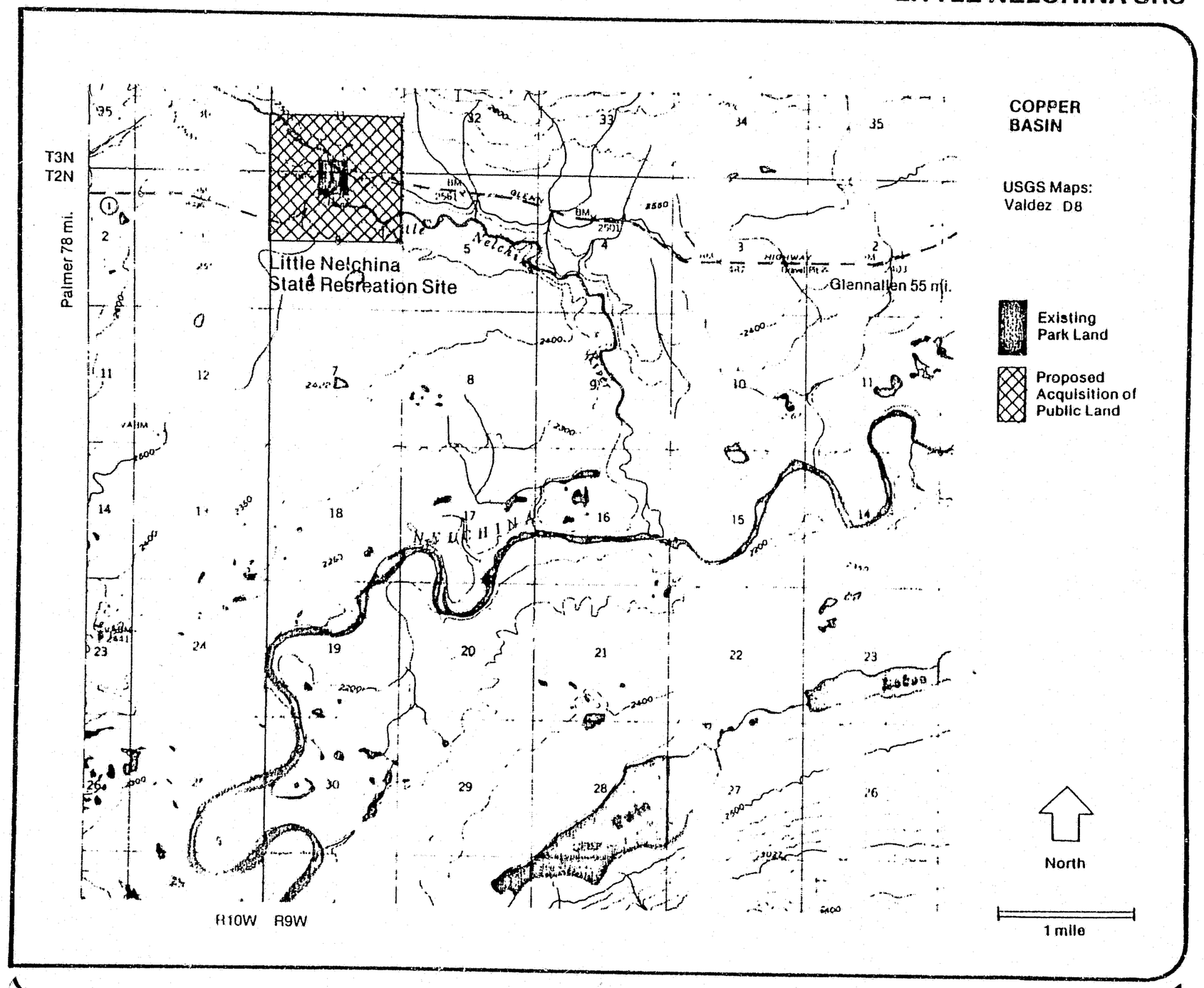
5

TOLSONA CREEK SRS



7-1-61

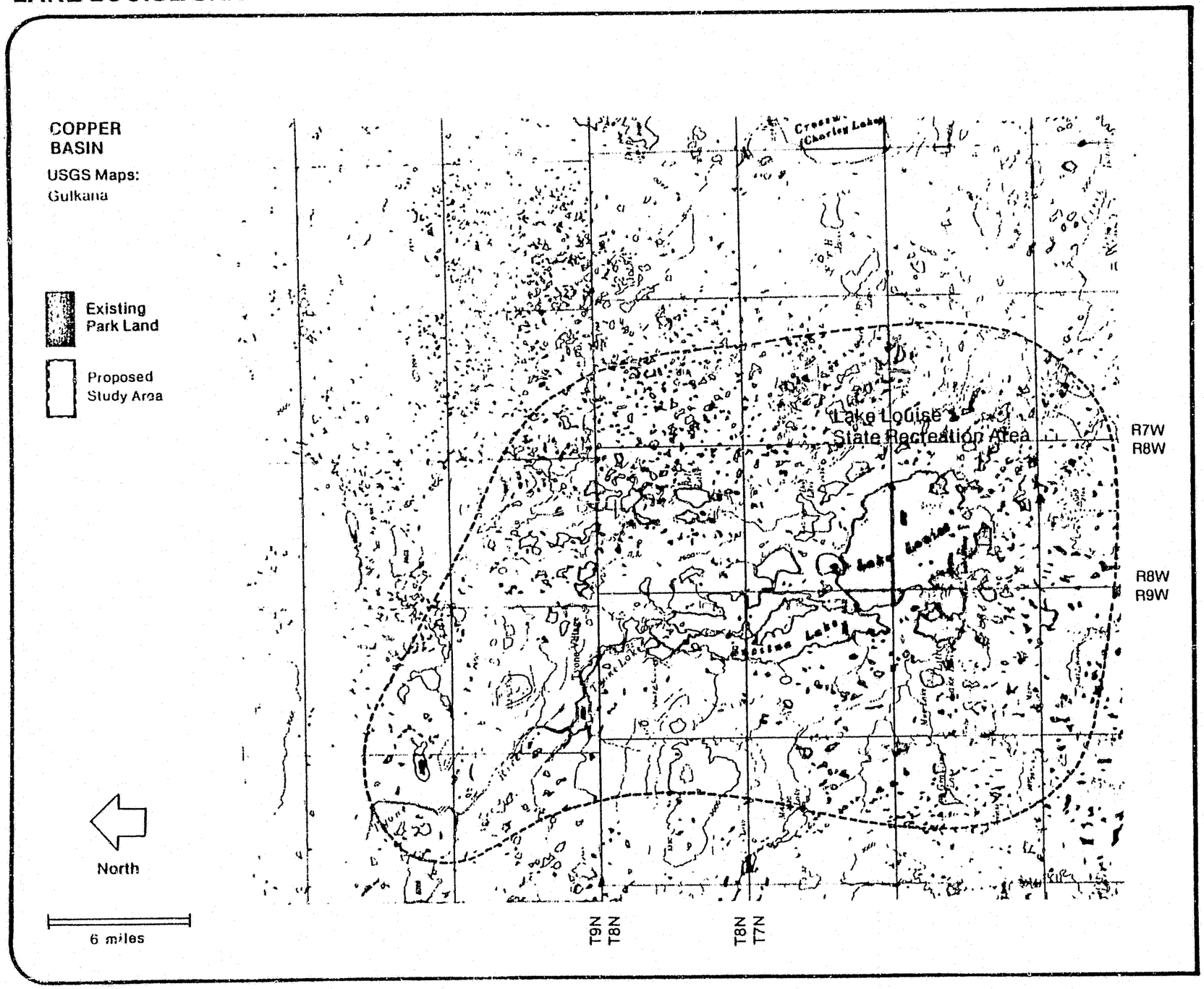
LITTLE NELCHINA SRS



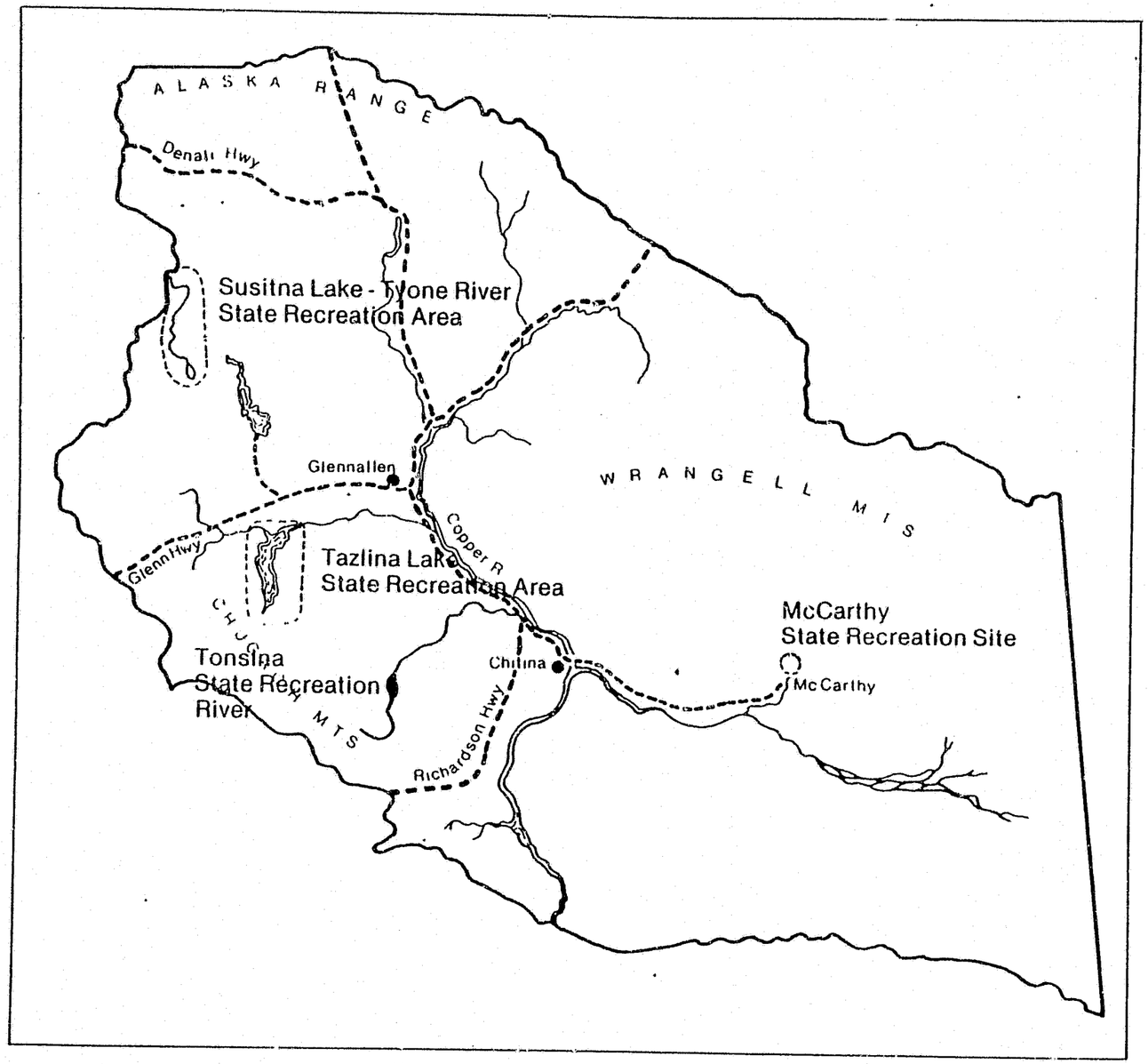
7-1-92

5

LAKE LOUISE SRA

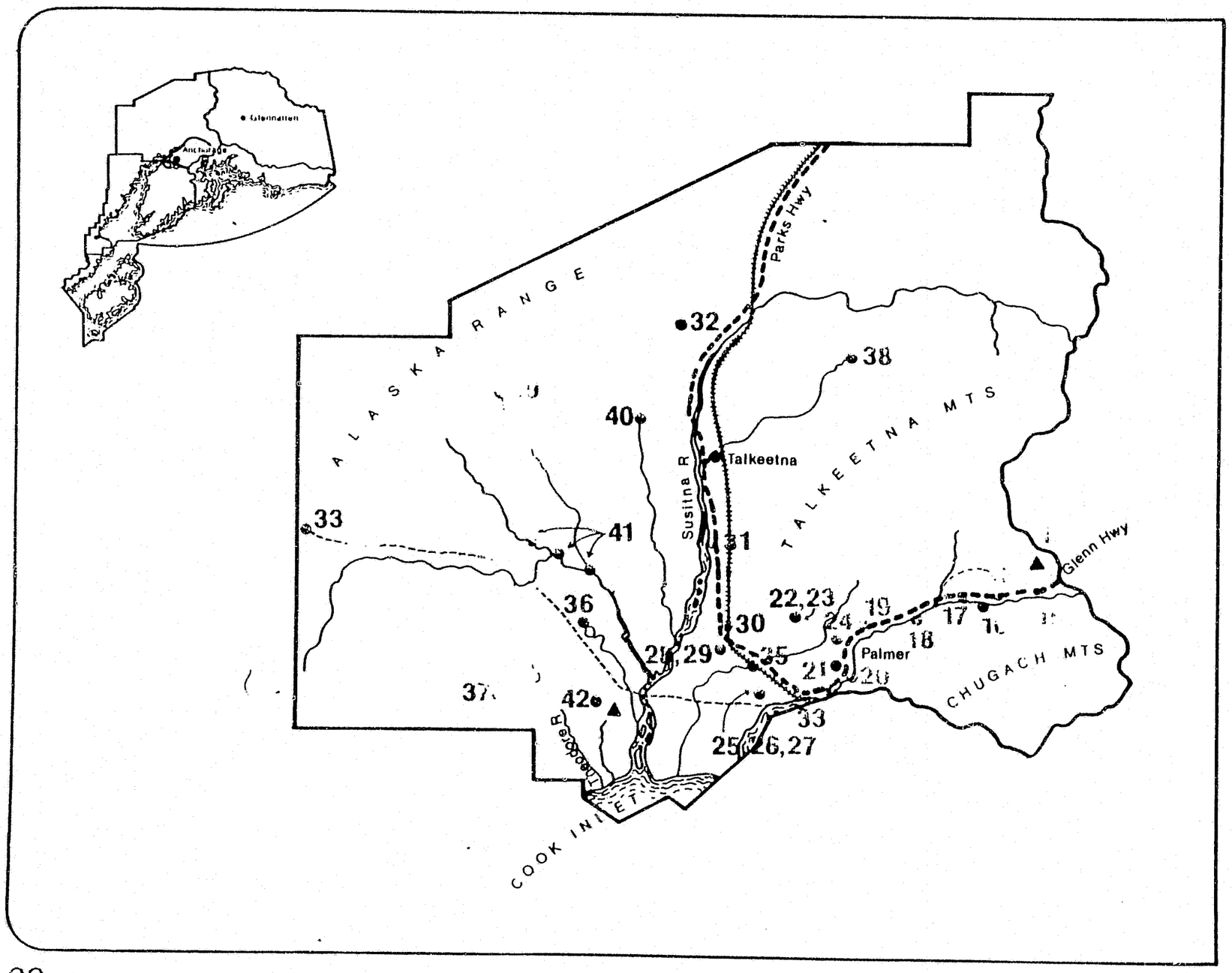


7-1-63



COPPER BASIN

7-1-64


Fairbanks
Anchorage
ALASKA RANGE
Parks Hwy
32
38
40
Talkeetna
Susitna R
TALKEETNA MTS
33
41
31
Glenn Hwy
22,23
19
36
30
24
17
18
Palmer
29
35
21
20
CHUGACH MTS
37
42
33
25
26,27
Knik R
COOK INLET

7-1-65

60

15. Matanuska Glacier SRS
16. Long Lake SRS
17. Bonnie Lake SRS
18. King Mountain SRS
19. Moose Creek SRS
20. Matanuska Valley Colony Farm SHP
21. Kepler-Bradley SRA
22. Independence Mine SHP
23. Hatcher Pass SRA
24. Finger Lake SRS
25. Rocky Lake SRS
26. Big Lake (East) SRS
27. Big Lake (South) SRS
28. Nancy Lake SRS
29. Nancy Lake SRA
30. Willow Creek SRA
31. Montana Creek SRS
32. Denali SP
33. Iditarod Trail
34. Chickaloong ST
35. Little Susitna SRR
36. Alexander Creek SRR
37. Talachulitna SRR
38. Talkeetna SRR
39. Lake Creek SRR
40. Kroto Creek SRR
41. Yentna River SRSs
42. Mt. Susitna SRA
43. Gunsight Mountain SRA

ISSUES
- rapid transfer of accessible public lands to private ownership
- overcrowding of existing recreational areas and facilities
- impact of recreational area users on local residents and their properties
- tourism development potential

PUBLIC PREFERENCES
- develop trail and river programs
- expand and upgrade existing recreational facilities
- provide close-to-home recreational opportunities
- minimize adverse public recreation impacts
- seek cooperative agency management of recreational opportunities
- provide Alaska lifestyle opportunities
- borough needs to execute recreational authority

OTHER AGENCIES AND THE PRIVATE SECTOR PROVIDING RECREATIONAL OPPORTUNITIES
- State: Palmer Hayflats, Susitna area, and Goose Bay state game refuges - dispersed, undeveloped recreation
- National Park Service: Denali NP - campgrounds and dispersed recreation
- Borough: some dedicated park areas
- Community: some local park and recreational programs and facilities
- Private: guiding services, commercial recreational developments

SUBREGION CHARACTERISTICS
- accessible alpine areas
- accessible lakes and rivers
- variety of landforms and vegetation
- cultural/historic resources
- fish and wildlife

STATE PARK REPRESENTATION
- EXISTING: historic park, fresh water lake system, large natural areas, small roadside campgrounds
- NEEDED: trial and river units, alpine areas, access to fishing streams, dispersal of fishing pressures, complete implementation of Denali Park Management Plan developments

7-1-66

Matanuska-Susitna Valley Subregion Recommendations

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Matanuska Glacier State Recreation Site (existing)	68	I	Development: complete implementation of existing site plan
Long Lake State Recreation Site (existing)	69	II	Acquisition: seek addition, by legislative designation, of state lands to the south
		II	Planning: prepare management plan associated with the Glenn Highway realignment
		II	Development: implement management plan development phases; rehabilitate and landscape
Bonnie Lake State Recreation Site (existing)	69	II	Acquisition: seek transfer to the borough for local recreational purposes
		III	Planning: tie into the Chickaloon Trail system and upper Bonnie Lake
		III	Development: revegetate and landscape
King Mountain State Recreation Site (existing)	70	III	Planning: define floodplain hazards through management plan
		III	Development: evaluate effectiveness and need for flood control measures
Moose Creek State Recreation Site (existing)	71	II	Acquisition: add, by administrative action, 160 acres of uplands and river corridor
		III	Planning: as part of the management plan, assess impact of the Glenn Highway realignment
		I	Development: implement existing site plan
Matanuska Valley Colony Farm State Historic Park (proposed)	72	II	Acquisition: obtain private land (40 acres)
		II	Planning: prepare management plan to identify cultural resource values
		III	Development: develop working farm with historical setting
		III	Special Management Considerations: consider cooperative management options with private individuals

7-1-67

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Kepler-Bradley State Recreation Area (existing)	72	I	Acquisition: obtain 230 acres of public and private land pursuant to legislative direction; obtain cooperative agreement with the University of Alaska
		I	Planning: prepare management plan
		I	Development: implement management plan
Independence Mine State Historic Park (existing)	73	II	Acquisition: seek legislative addition of adjoining state land to encompass upper Fishhook Creek watershed
		I	Planning: complete management plan to identify historic preservation and visitor use opportunities
		I	Development: stabilize, restore adaptively for reuse or arrest decay, based upon management plan
		I	Special Management Considerations: protect historic resources; establish visitor information program
Hatcher Pass State Recreation Area (proposed)	74	I	Acquisition: seek park unit legislative designation based upon results of a cooperative interagency study
		I	Planning: participate in cooperative interagency planning team to establish land use allocations
		I	Development: develop according to the management plan
Finger Lake State Recreation Site (existing)	75	III	Acquisition: seek transfer to the borough for community recreational purposes
		III	Development: rehabilitate and upgrade facilities
		III	Special Management Considerations: relocate state park headquarters now in unit
Rocky Lake State Recreation Site (existing)	76	III	Acquisition: seek transfer to the borough for community recreational purposes
		II	Development: rehabilitate and upgrade facilities
		III	Special Management Considerations: consider concession operation

7-1-68

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Big Lake (East) State Recreation Site (existing)	76	III	Acquisition: seek transfer to the borough for community recreational purposes
		II	Development: rehabilitate and upgrade facilities
		III	Special Management Considerations: consider concession operation
Big Lake (South) State Recreation Site (existing)	76	III	Acquisition: seek transfer to the borough for community recreational purposes
		II	Development: rehabilitate and upgrade facilities
		III	Special Management Considerations: consider concession operation
Nancy Lake State Recreation Site (existing)	77	III	Planning: follow Nancy Lake State Recreation Area Management Plan
Nancy Lake State Recreation Area (existing)	77	I	Acquisition: obtain key inholdings on willing-seller basis (150 acres); obtain cooperative agreement with the borough for trail corridor on north boundary
		I	Planning: complete update of management plan
		I	Development: implement development phases of management plan
		I	Special Management Considerations: expand winter recreational opportunities and staffing
Willow Creek State Recreation Area (existing & proposed)	78	I	Acquisition: seek cooperative agreement with the borough for lands along the creek by legislative designation
		I	Planning: complete management plan
		I	Development: upgrade existing site; complete engineering feasibility study from road to river mouth with additional facilities
		I	Special Management Considerations: address river management problems

7-1-69

C1

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Montana Creek State Recreation Site (proposed)	79	II	Acquisition: obtain (145 acres) private and public lands according to legislative direction
		II	Planning: prepare management plan
		II	Development: develop according to management plan
		II	Special Management Considerations: cooperate with Alaska Department of Fish & Game to disperse use pressures
Denali State Park (existing)	80	III	Acquisition: seek legislative addition of Indian River; work with the Bureau of Indian Affairs on Native allotment acquisition and easements; evaluate state park boundary adjustment on the Parks Highway
		I	Planning: complete feasibility study of the Tokositna Project to include Curry Ridge; update management plan
		I	Development: complete trail program and management plan development phases
		II	Special Management Considerations: consider joint management agreements with the National Park Service; staff visitor information services at Byers Lake
Iditarod Trail (existing)	81	I	Acquisition: follow Iditarod Trail Plan recommendations
		I	Planning: adoption of Iditarod Trail Plan
		I	Development: implement Iditarod Trail Plan
		I	Special Management Considerations: work cooperatively with trail council - Iditarod Race Committee and private citizens
Chickaloon State Trail (proposed)	81	I	Acquisition: seek legislative designation of trail corridor
		I	Planning: prepare trail management plan
		II	Development: determine priorities of segments and implement trail management plan
		II	Special Management Considerations: establish a trail management council

7-1-70

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Little Susitna State Recreation River (proposed)	81	I	Acquisition: seek legislative designation of river corridor
		I	Planning: prepare river management plan
		II	Development: develop according to river management plan
		I	Special Management Considerations: work cooperatively with private landowners
Alexander Creek State Recreation River (proposed)	81	I	Acquisition: seek legislative designation of a river corridor
		I	Planning: prepare river management plan
		II	Development: develop according to river management plan
		II	Special Management Considerations: work cooperatively with private landowners
Talachulitna State Recreation River (proposed)	81	I	Acquisition: seek legislative designation of a river corridor
		I	Planning: prepare river management plan
		II	Development: develop according to the river management plan
		II	Special Management Considerations: work cooperatively with private landowers and the Alaska Department of Fish & Game
Talkeetna State Recreation River (proposed)	81	I	Acquisition: seek legislative designation of a river corridor
		I	Planning: prepare river management plan
		II	Development: develop according to river management plan
		II	Special Management Considerations: work cooperatively with private landowners
Lake Creek State Recreation River (proposed)	81	I	Acquisition: seek legislative designation or a river corridor
		I	Planning: prepare river management plan

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
		II	Development: develop according to river management plan
		II	Special Management Considerations: work cooperatively with private landowners
Kroto Creek State Recreation River (proposed)	81	I	Acquisition: seek legislative designation of a river corridor
		I	Planning: prepare river management plan
		II	Development: develop according to river management plan
		II	Special Management Considerations: work cooperatively with private landowners
Yentna River State Recreation Sites (proposed)	81	II	Acquisition: obtain (1800 acres) access sites by administrative action
		II	Planning: prepare management plan
		III	Development: implement management plan
Mt. Susitna State Recreation Area (future consideration)	82		These areas may be included as units of the State Park System depending on recreational needs, use preferences and upon available funding.
Gunsight Mountain State Recreation Area (future consideration)	82		

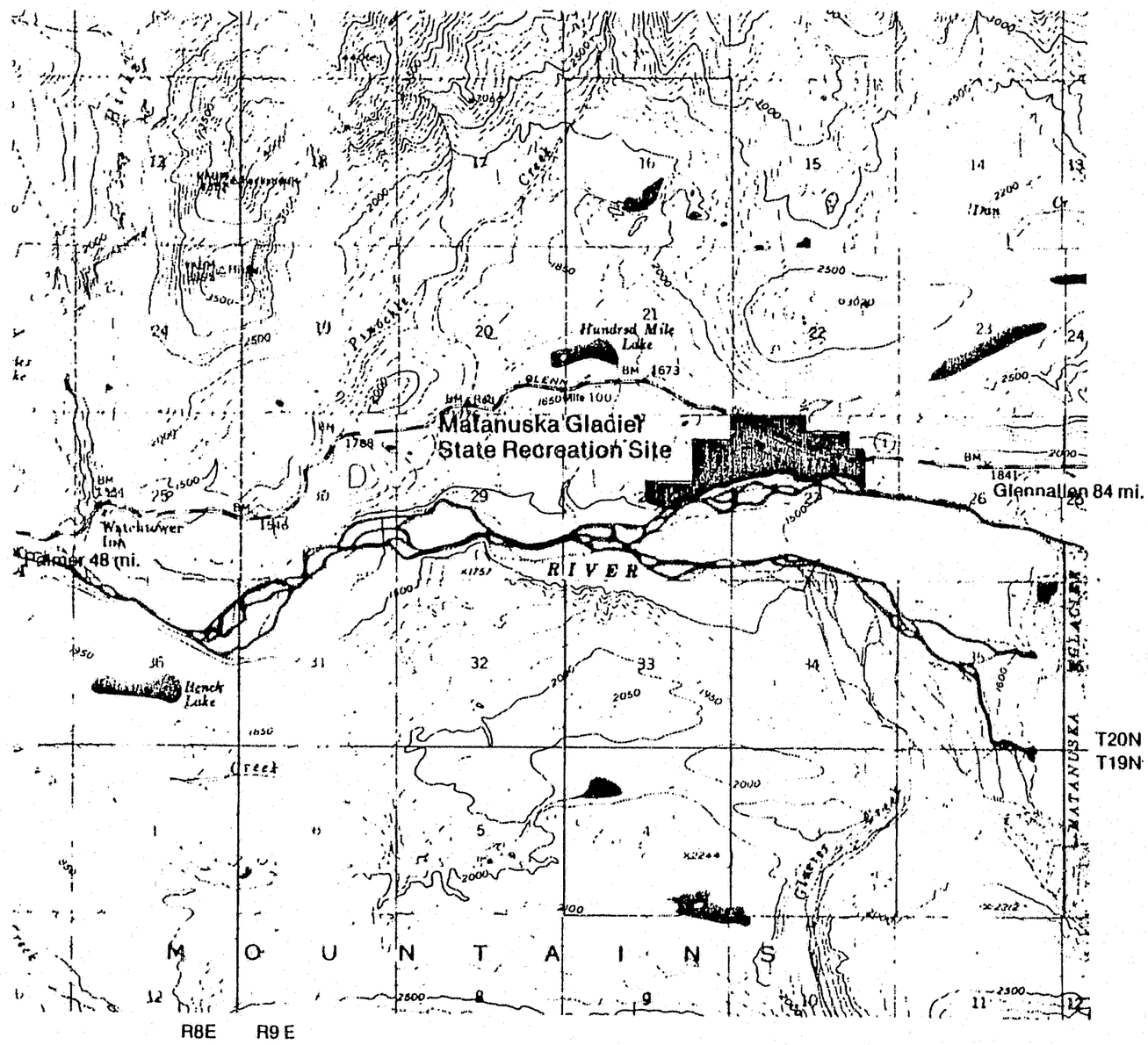
7-1-72

MATANUSKA GLACIER SRS

MAT-SU VALLEY

USGS Maps:
Anchorage D3

Existing Park Land

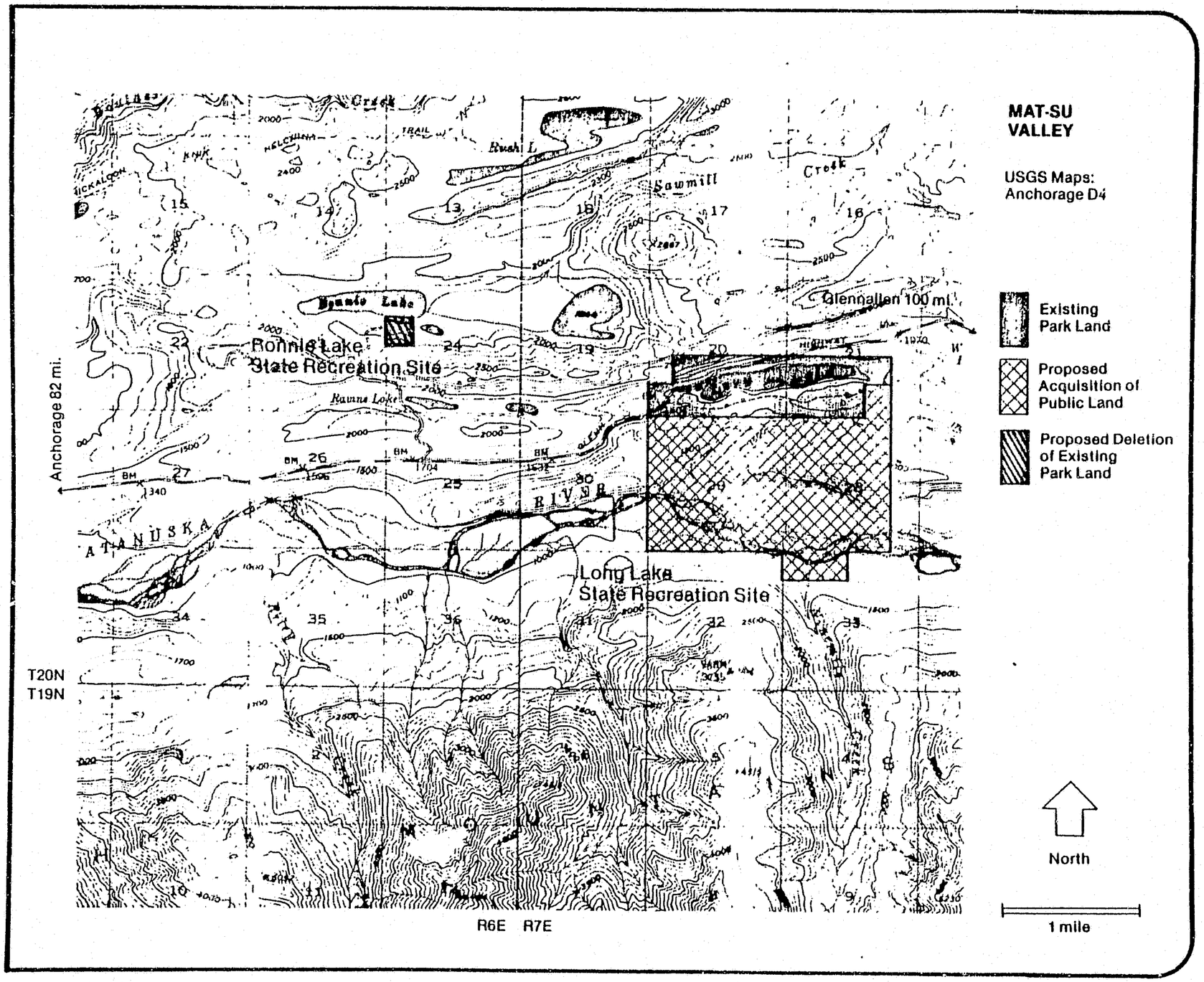


North

1 mile

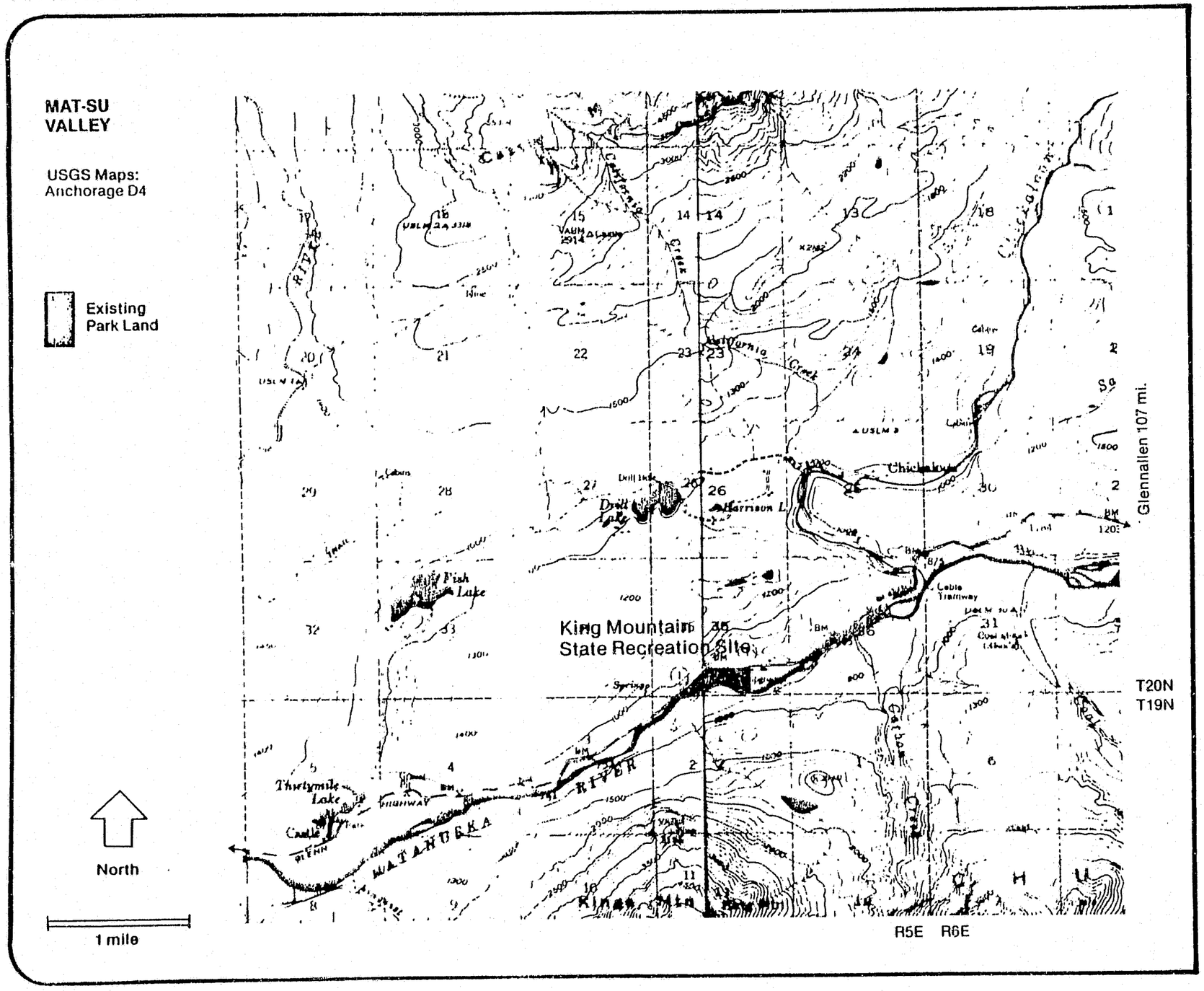
7-1-73

LONG LAKE SRS/BONNIE LAKE SRS



7-1-74

KING MOUNTAIN SRS



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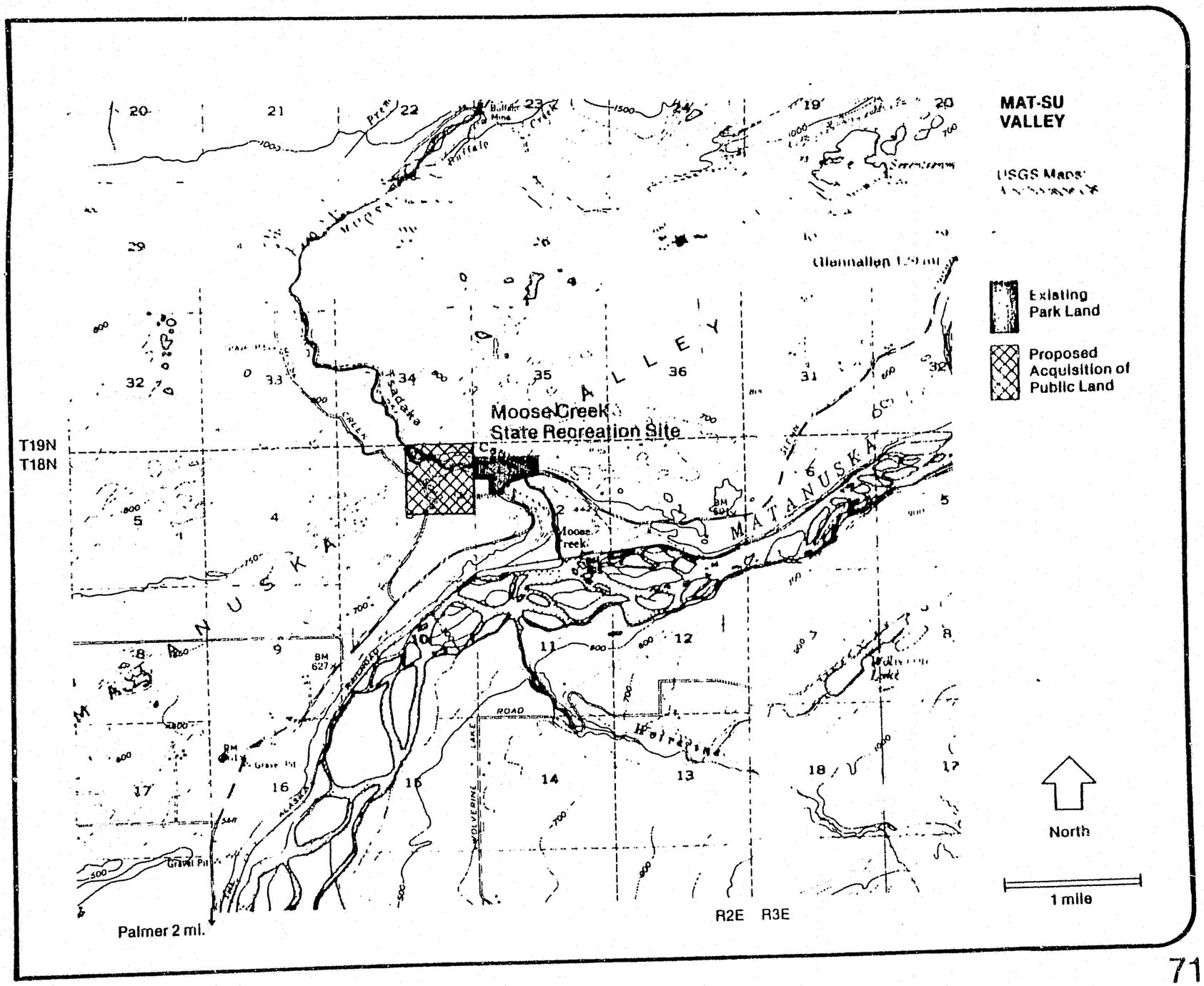
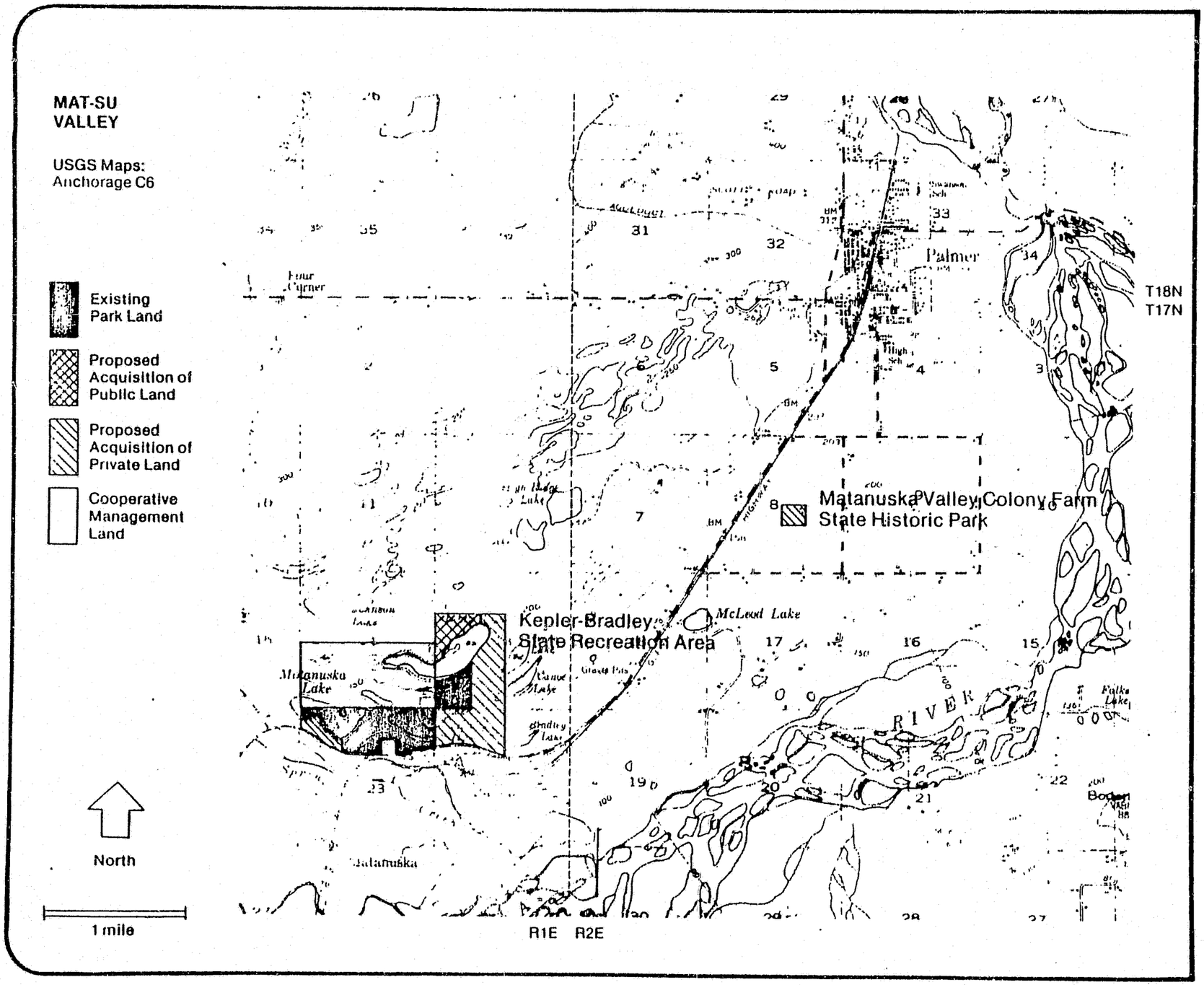

MAT-SU VALLEY
USGS Maps
Existing Park Land
Proposed Acquisition of Public Land
Moose Creek State Recreation Site
T19N
T18N
R2E R3E
Palmer 2 mi.
North
1 mile
MATANUSKA
VALLEY
Glennallen

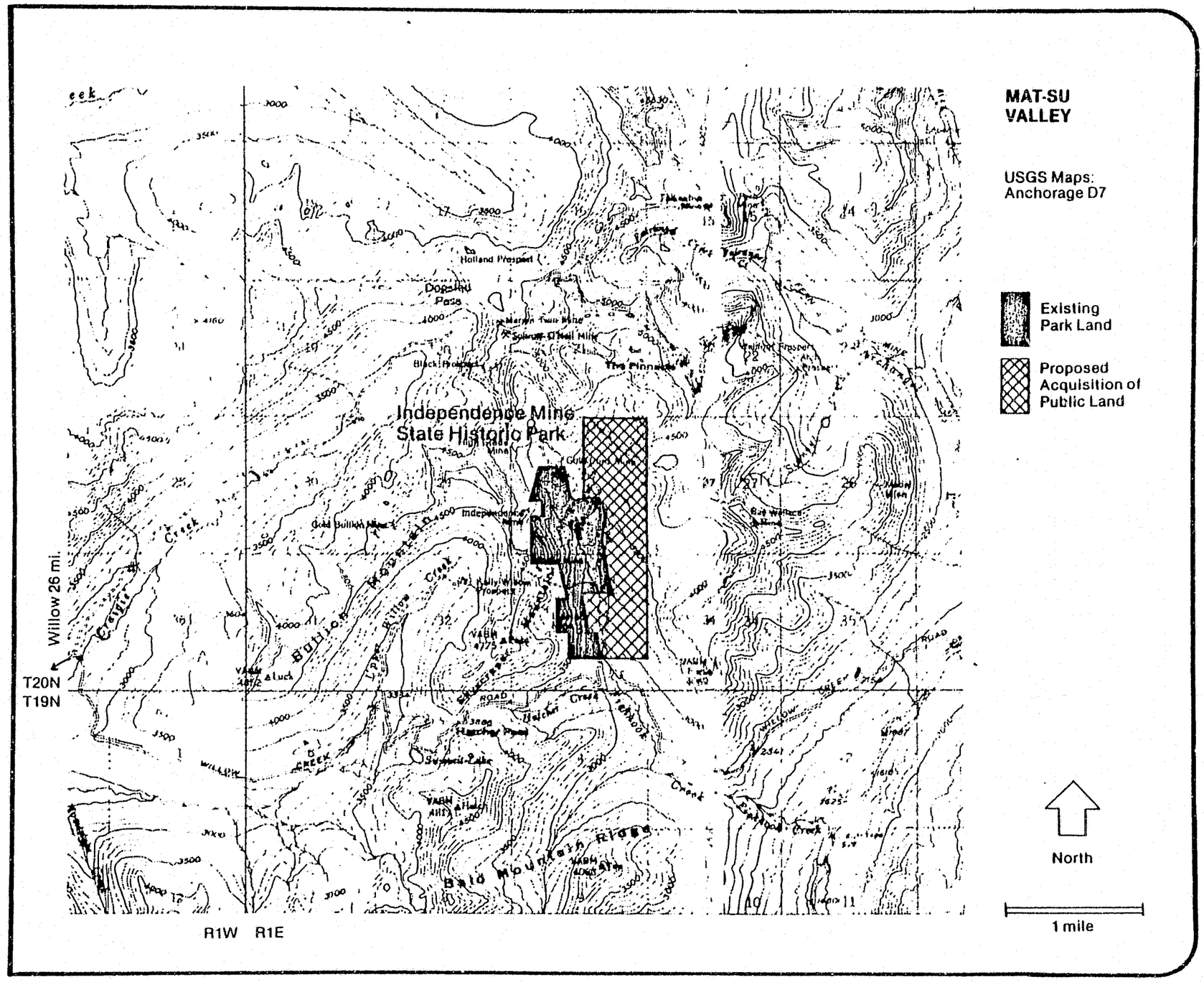
7-1-76

MATANUSKA VALLEY COLONY FARM SHP/KEPLER-BRADLEY SRA



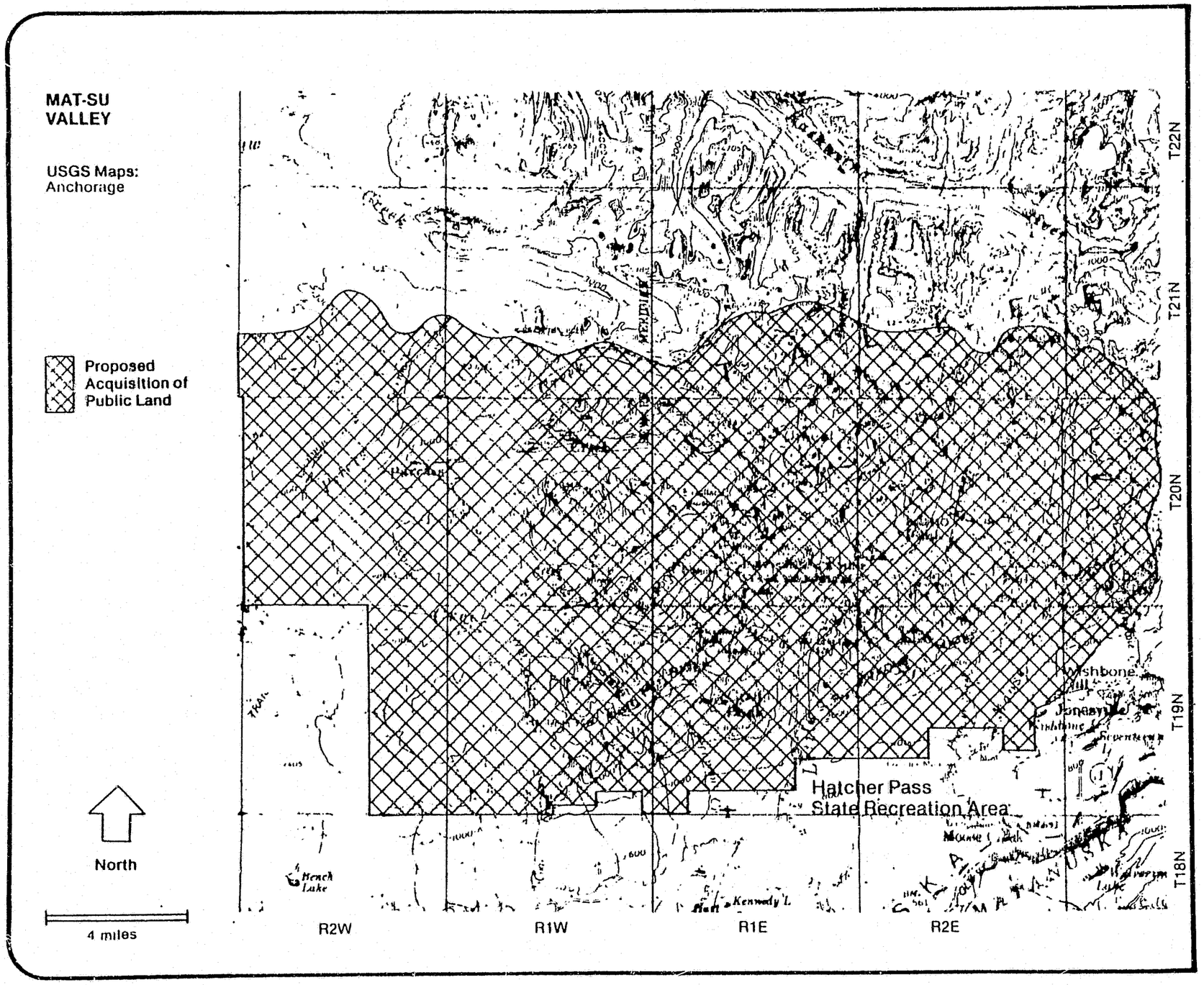
7-1-77

INDEPENDENCE MINE SHP



7-1-78

HATCHER PASS SRA



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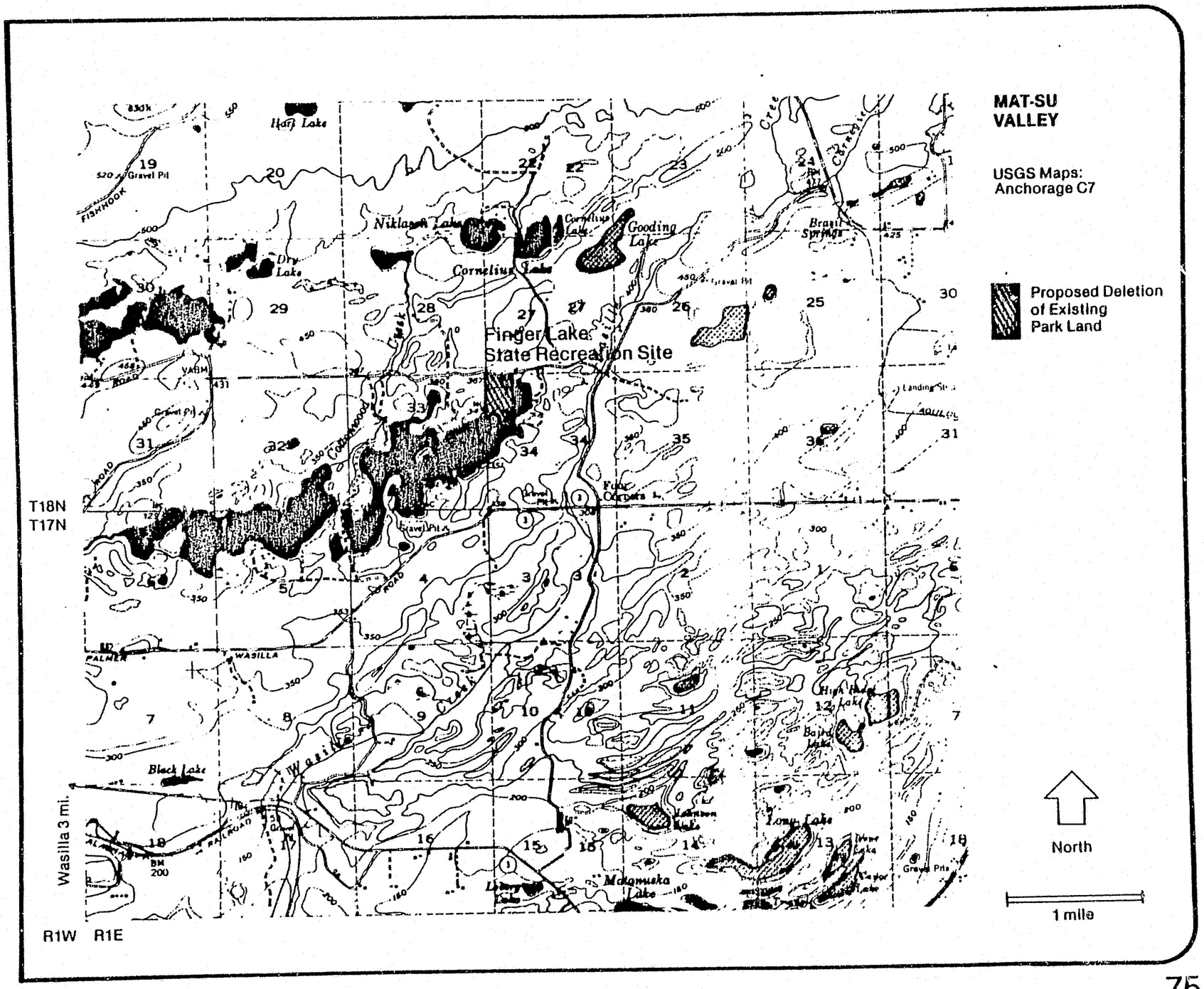
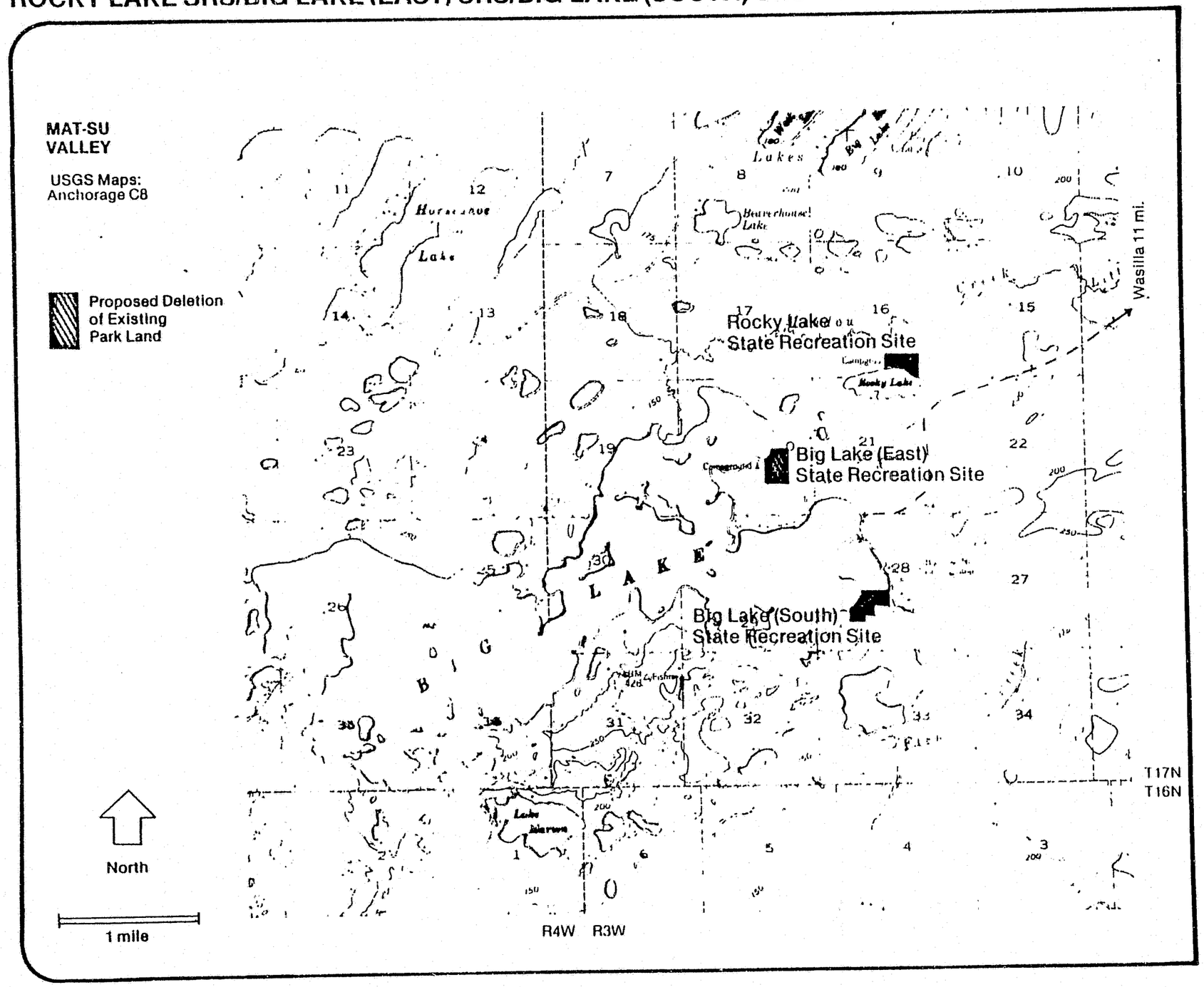

MAT-SU VALLEY
USGS Maps: Anchorage C7
Proposed Deletion of Existing Park Land
Finger Lake State Recreation Site
Half Lake
Niklason Lake
Cornelius Lake
Gooding Lake
Dry Lake
Brazil Springs
Black Lake
Matanuska Lake
Long Lake
Bajra Lake
T18N
T17N
R1W
R1E
Wasilla 3 mi.
FISHHOOK
WASILLA
PALMER
Gravel Pit
North
1 mile

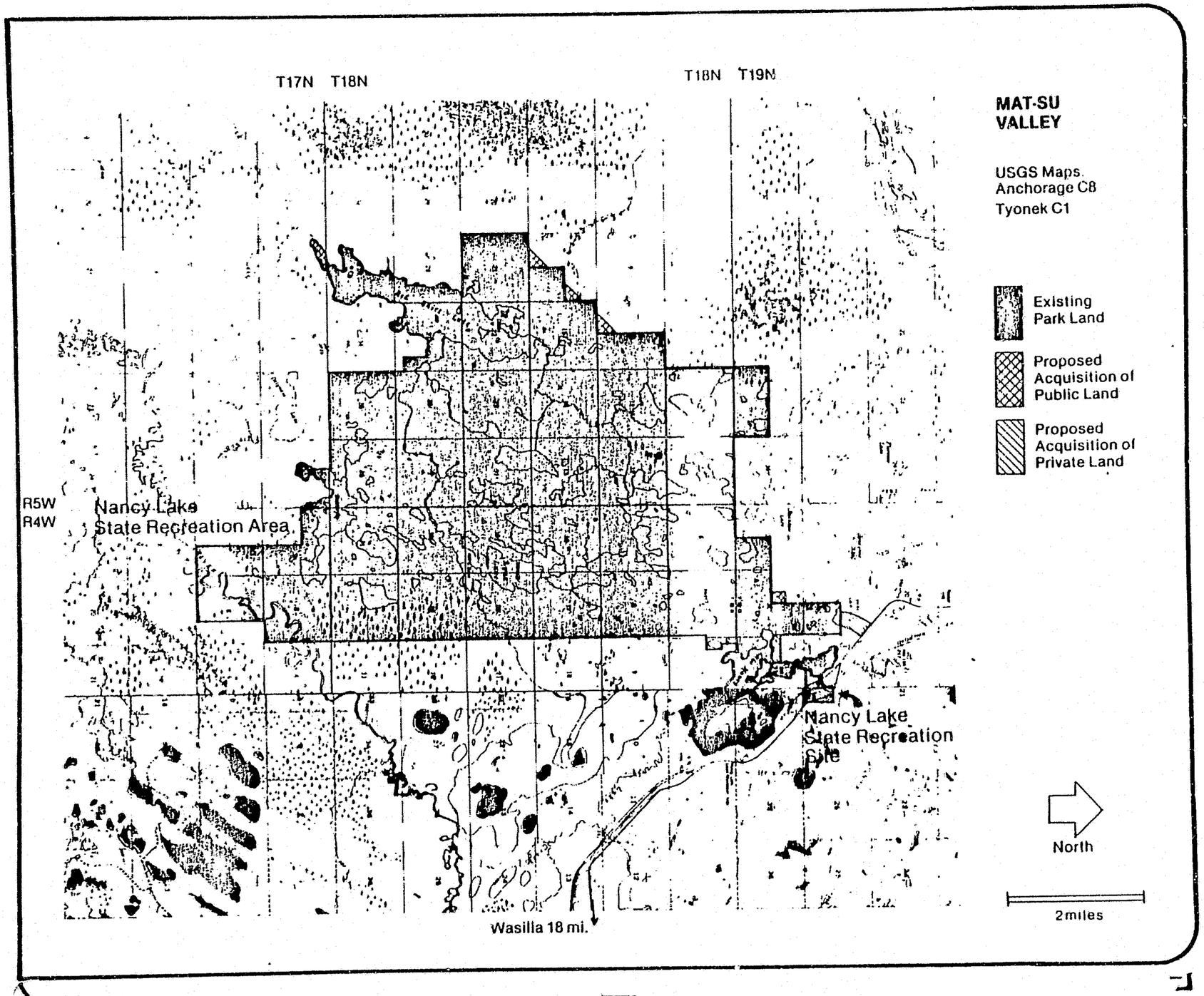
7-1-80

ROCKY LAKE SRS/BIG LAKE (EAST) SRS/BIG LAKE (SOUTH) SRS



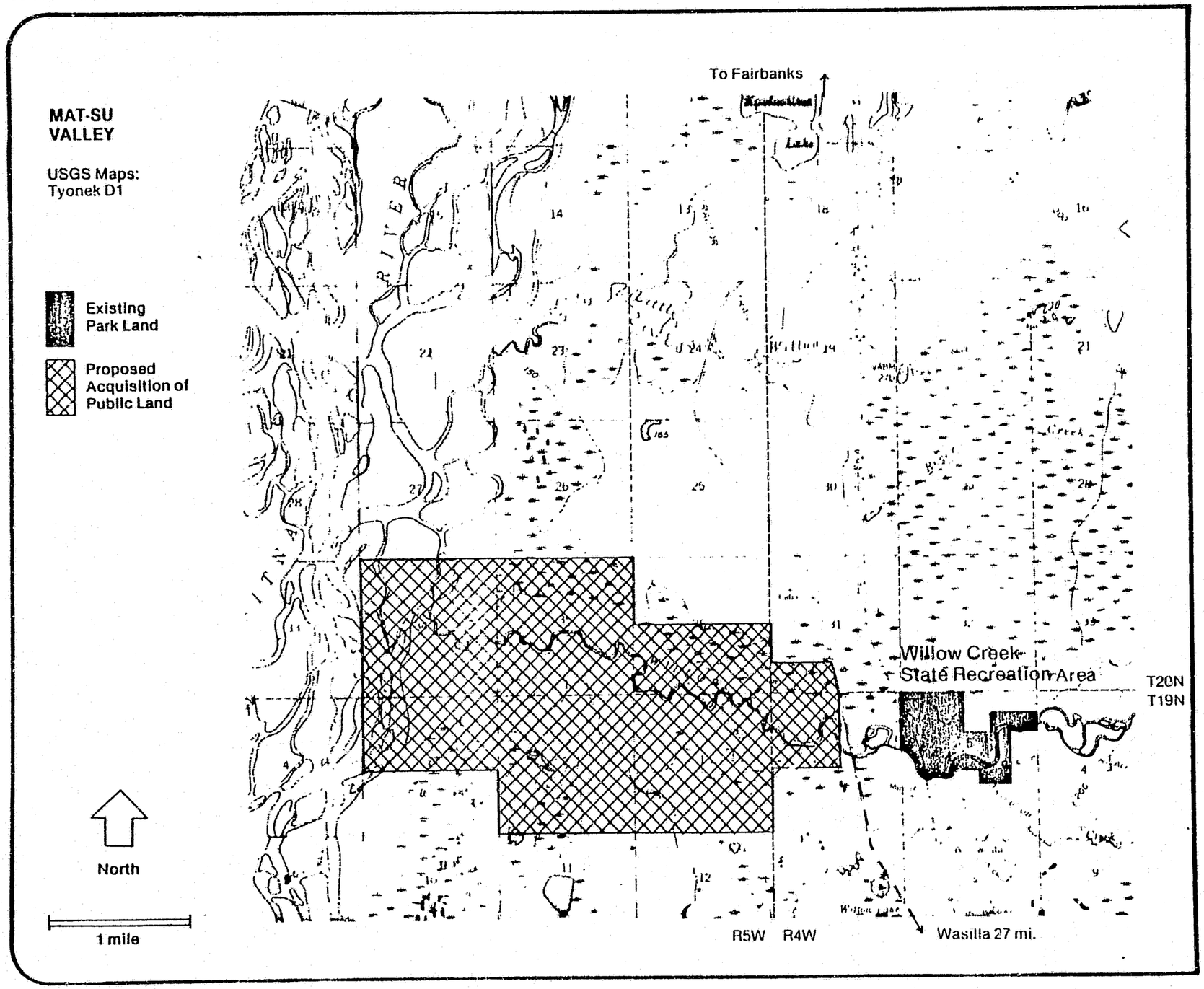
7-1-81

NANCY LAKE SRA/NANCY LAKE SRS



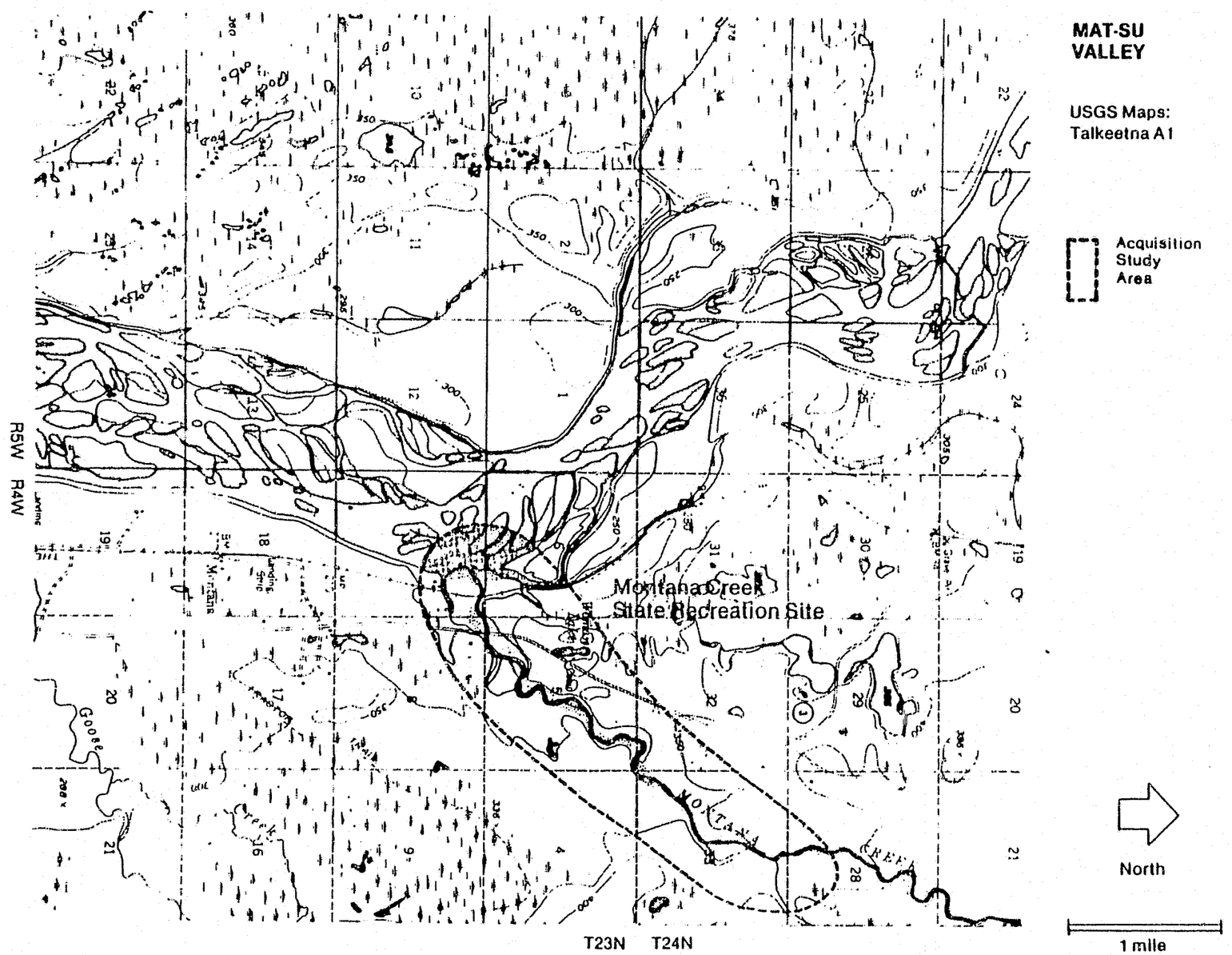
7-1-82

WILLOW CREEK SRA



7-1-83

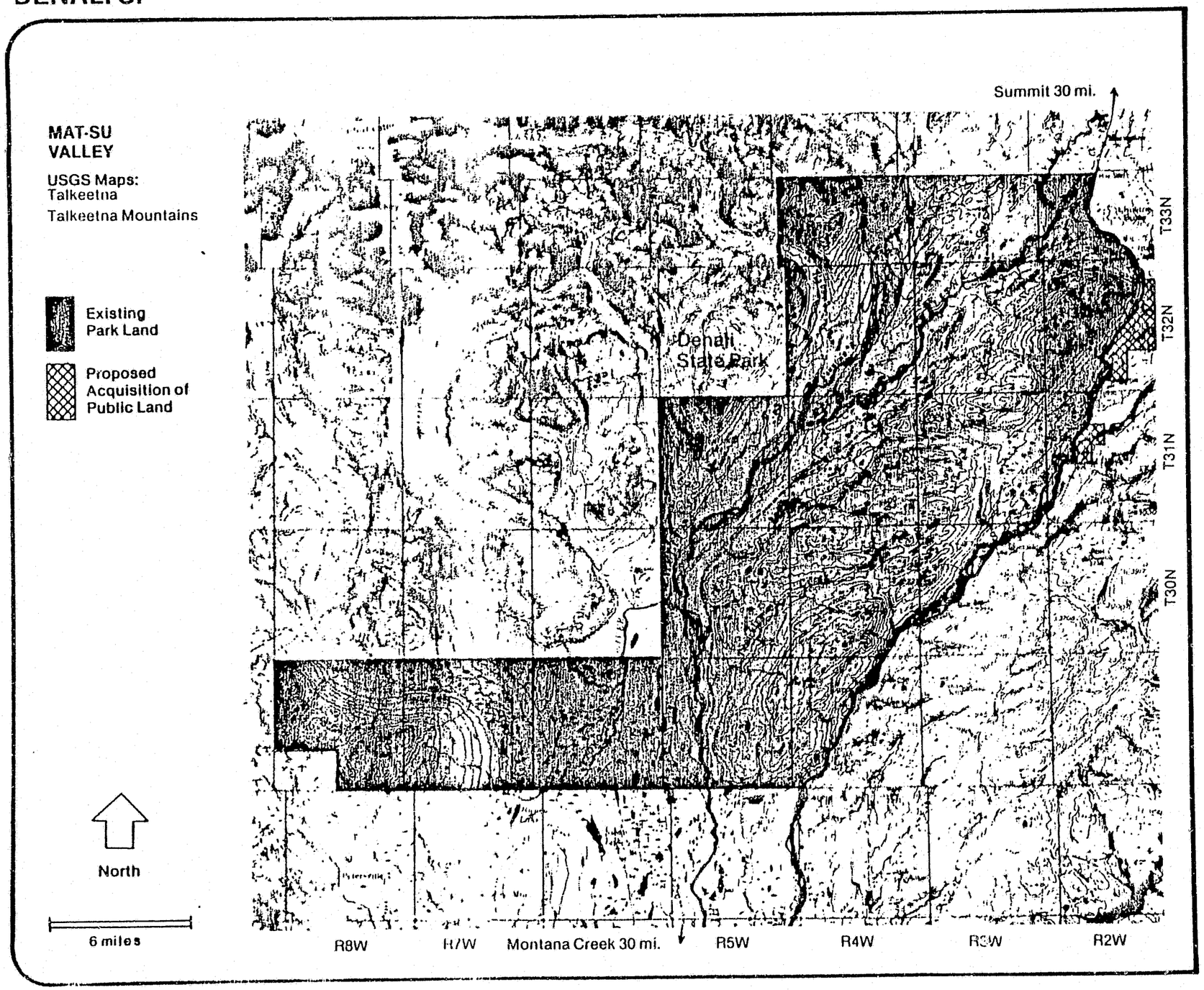
MONTANA CREEK SRS



7-1-84

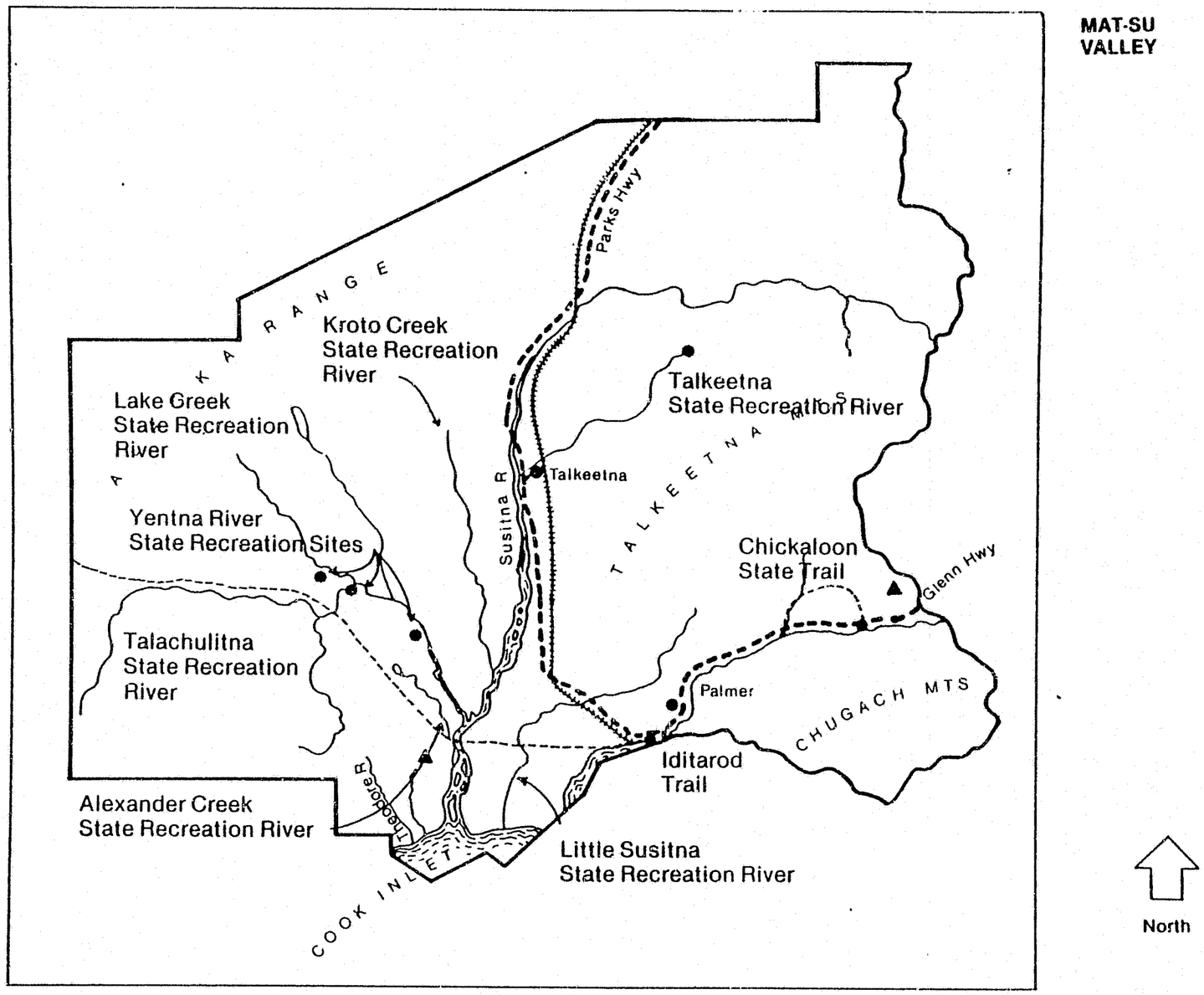
7

DENALI SP



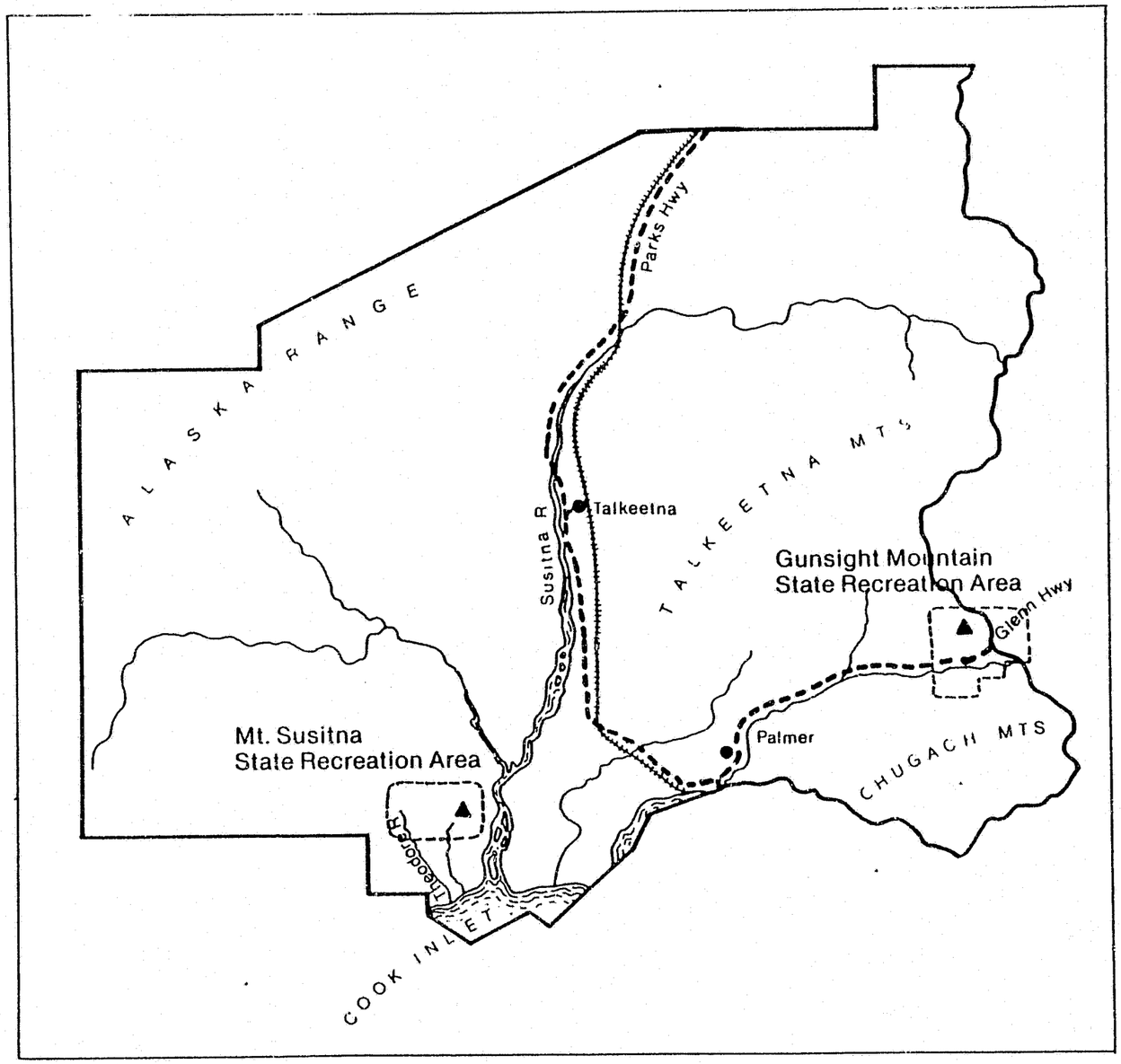
7-1-85

STATE RECREATION RIVERS & STATE TRAILS



7-1-86

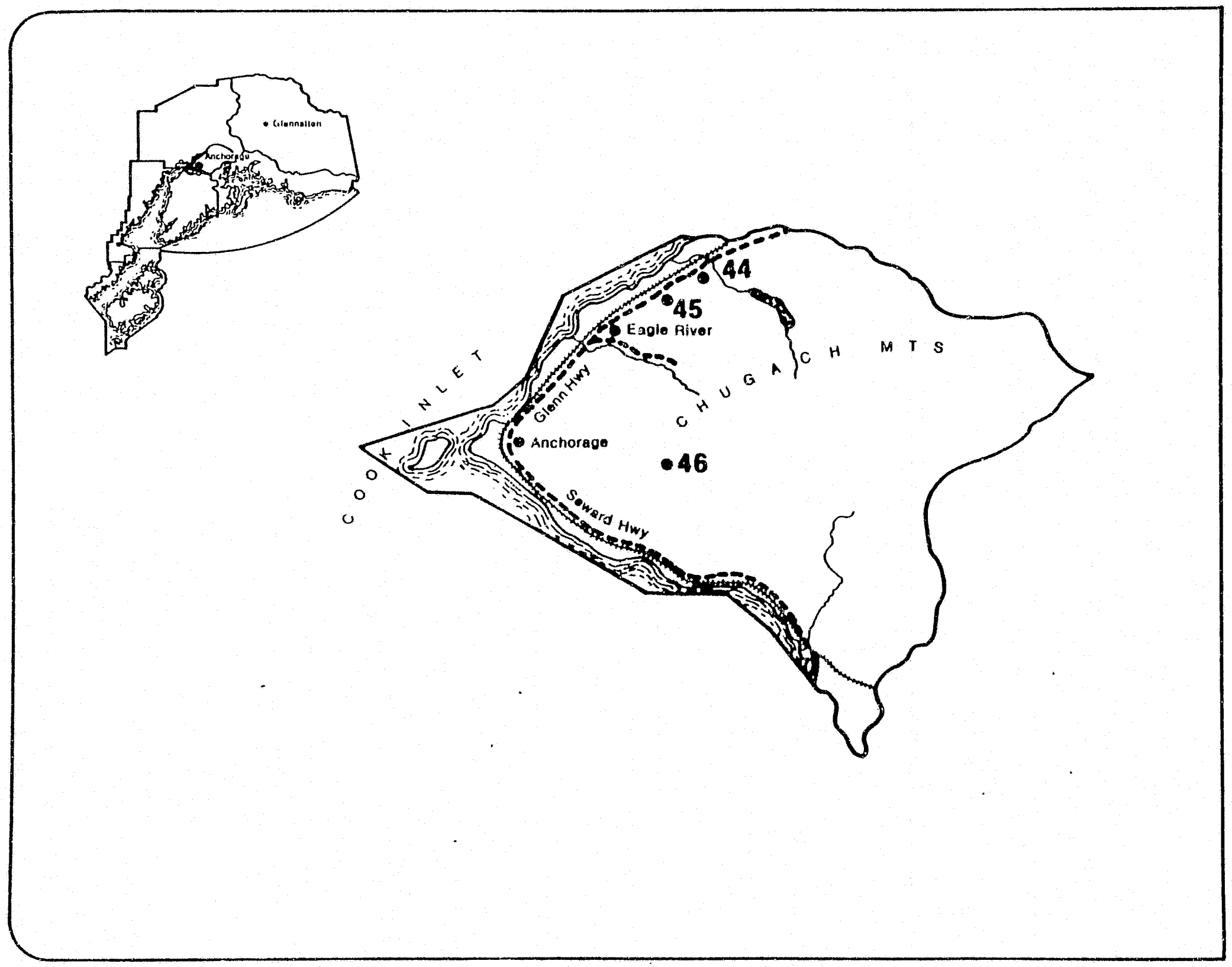
MAT-SU VALLEY



7-1-87

7-1-88

83


Glennallen
Anchorage
44
45
Eagle River
CHUGACH MTS
COOK INLET
Glenn Hwy
Anchorage
46
Seward Hwy

7-1-89

44. Mirror Lake SRS
45. Peters Creek SRS
46. Chugach SP

ISSUES
- recreation dependent on community facilities of Chugach State Park, Chugach National Forest
- limited, accessible overnight-destination attractions
- native selections within north ½ of Chugach State Park
- dependence on out-of-subregion recreational opportunities

PUBLIC PREFERENCES
- desire for trail-related summer/winter activities
- provide driving for pleasure/day-use pursuits
- improve boating opportunities
- expand existing recreational facilities and staff

AGENCIES AND THE PRIVATE SECTOR PROVIDING RECREATIONAL OPPORTUNITIES
- Forest Service: Chugach National Forest (Portage and Alyeska) - dispersed, backcountry recreation
- Private: commercial alpine skiing developments, guiding services charter pilots
- Bureau of Land Management: Portage Flats - dispersed recreation, open space
- State: Potter Marsh State Game Refuge - open space, wildlife habitat
- Community: Campbell Tract - extensive local park and recreational programs
- Military: Fort Richardson and Elmendorf AFB - limited recreational opportunities, controlled access

SUBREGION CHARACTERISTICS
- accessible alpine environment
- scenic attractions
- stream valleys
- whitewater river
- coastal marshes/tidelands

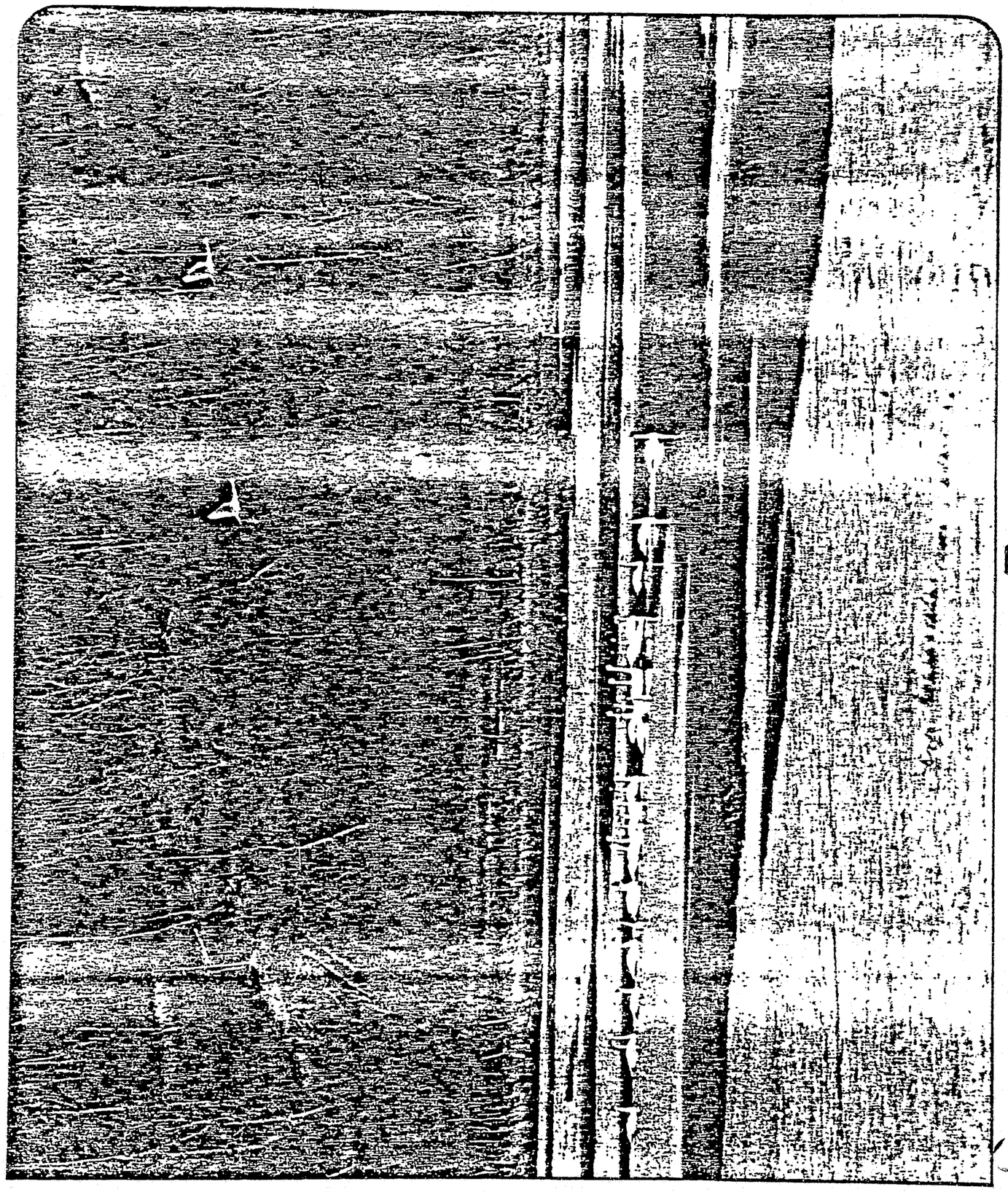
STATE PARK REPRESENTATION
- EXISTING: alpine environment, day-use pursuits
- NEEDED: expanded diversity of recreational opportunities, develop river and trail units/opportunities, develop overnight facilities, expand existing facilities and staff

7-1-90

Anchorage Subregion Recommendations

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Mirror Lake State Recreation Site (existing)	88	I	Acquisition: convey management and restricted title to the Municipality of Anchorage
Peters Creek State Recreation Site (existing)	88	I	Acquisition: convey management and restricted title to the Municipality of Anchorage
Chugach State Park (existing)	89	I	Acquisition: complete land exchange with Eklutna; seek management rights of the California Creek trail; implement management plan boundary adjustments and acquisition of key private inholdings
		I	Development: continue phased development of management plan
		I	Special Management Considerations: maintain resource inventory and monitor visitor use; work with Eklutna and military to maintain Eagle River corridor and public access to Eagle River

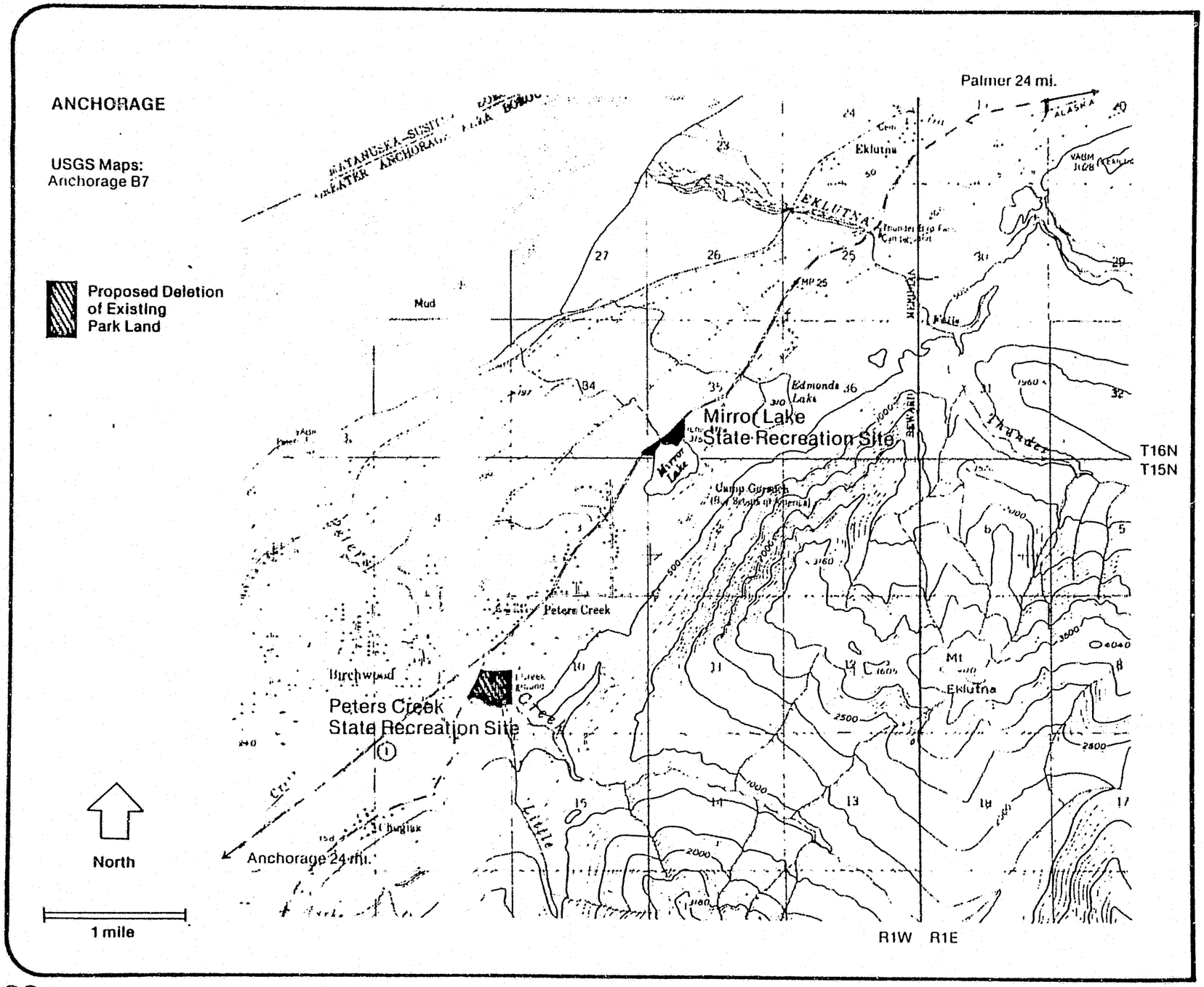
7-1-91



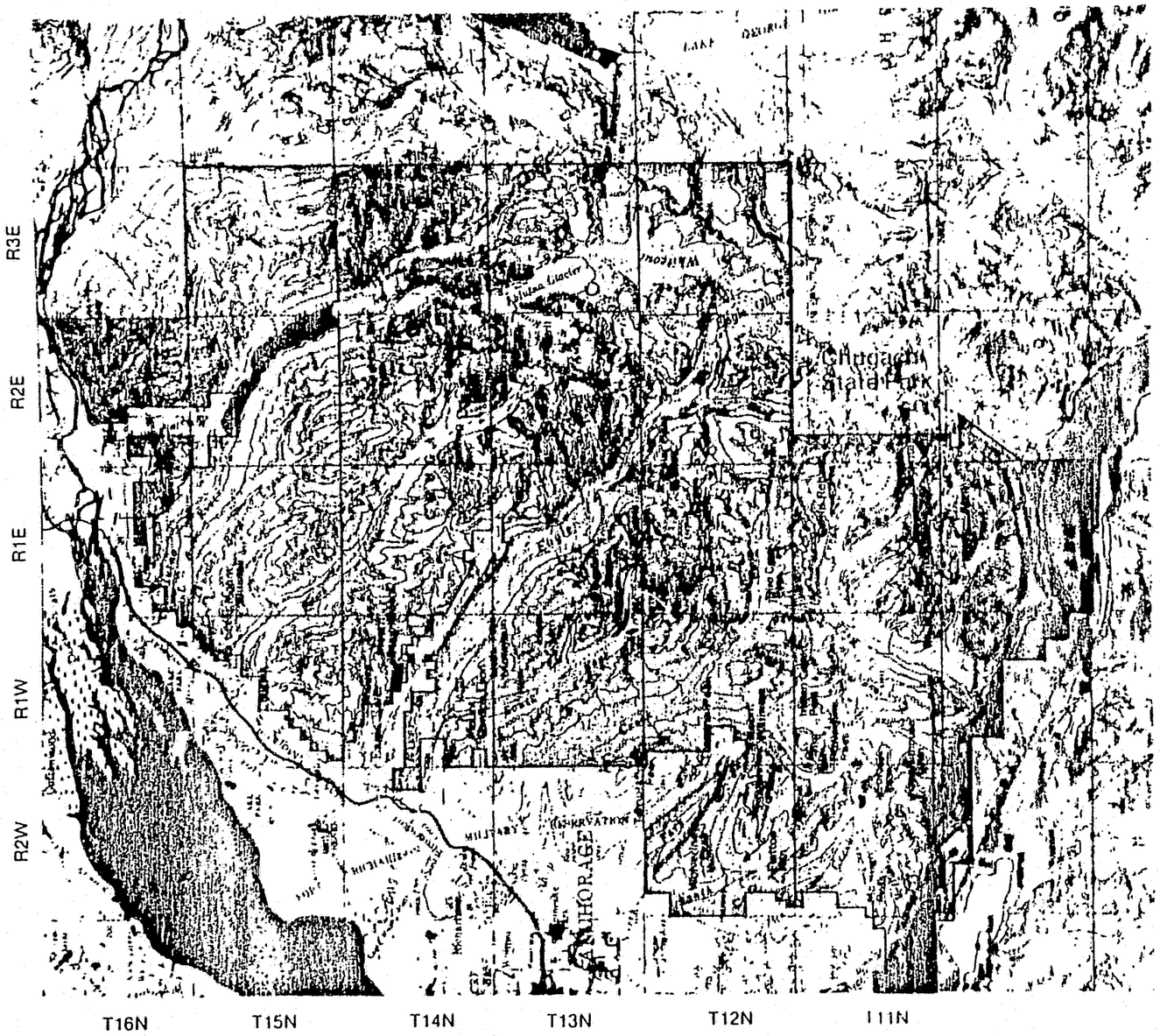
87

7-1-92

MIRROR LAKE SRS/PETERS CREEK SRS



7-1-93



ANCHORAGE

USGS Maps:
Anchorage, Seward

Existing Park Land

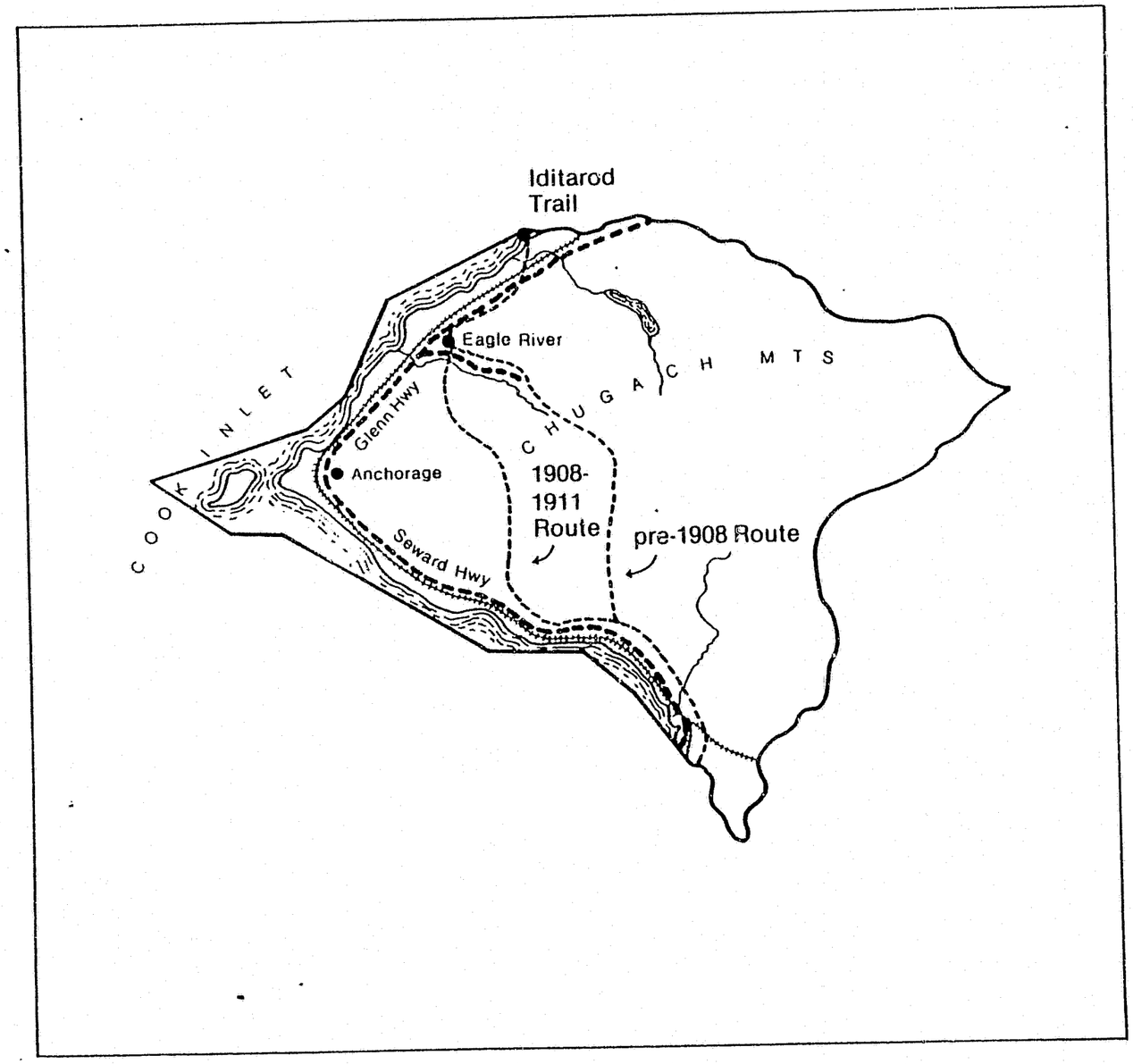
North

6 miles

7-1-94

STATE TRAILS

ANCHORAGE

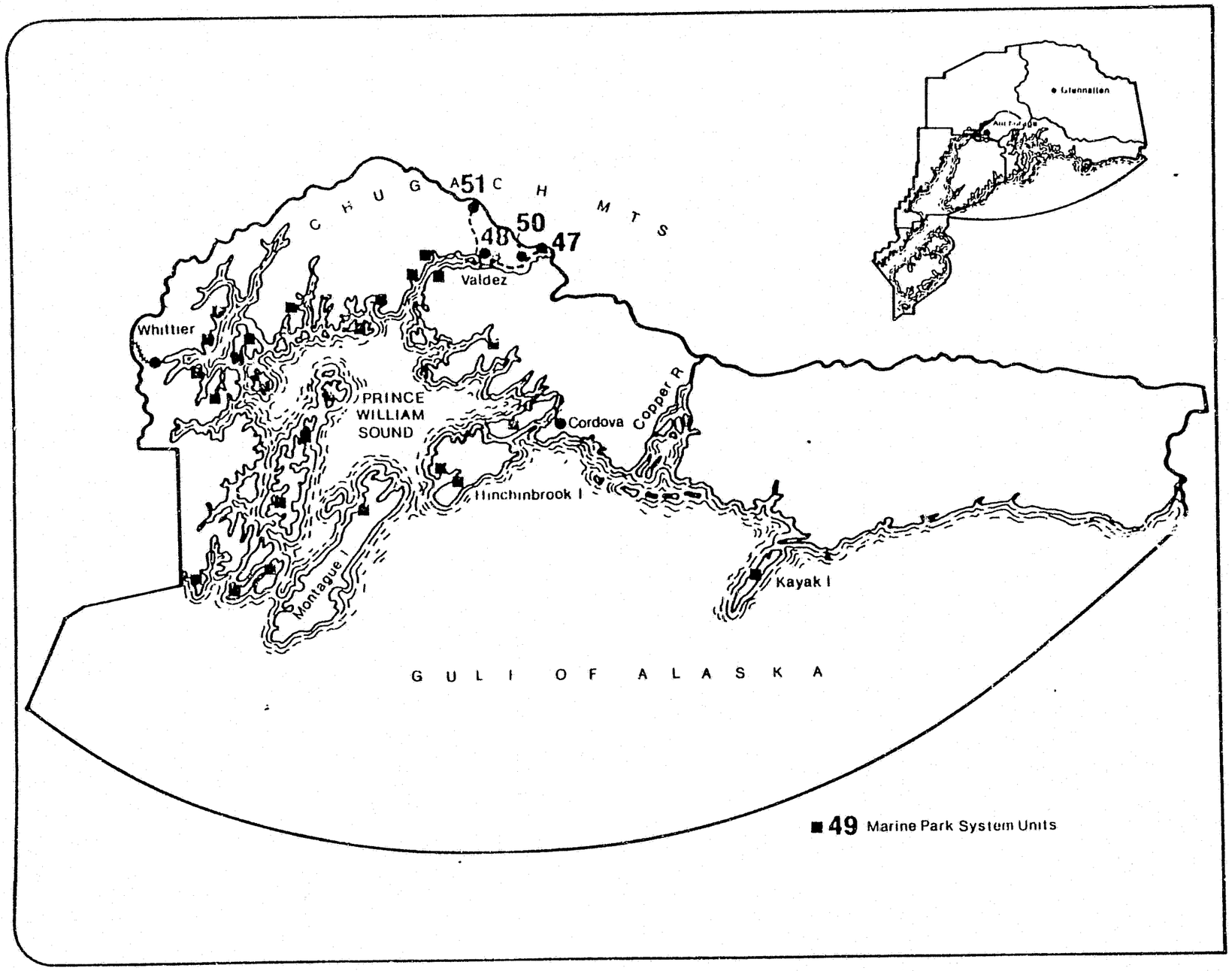


North

7-1-95

8 9 1 6 0

7-1-96


CHUGACH MTS
51
50
48
47
Valdez
Whittier
PRINCE WILLIAM SOUND
Cordova
Copper R
Hinchinbrook I
Montague I
Kayak I
GULF OF ALASKA
49 Marine Park System Units

7-1-97

47. Blueberry Lake SRS
48. Valdez Glacier SRS
49. Prince William Sound Marine Park System
50. Keystone Canyon SRA
51. Mineral Creek ST

ISSUES
- Native land claims
- state land selections and management tourism/recreational development
- access
- cooperative/management of recreational opportunities

PUBLIC PREFERENCE
- maintain wilderness character
- provide a diversity of boating opportunities
- provide public-use facilities
- limit development/services
- develop trail opportunities
- establish recreation uses

OTHER AGENCIES AND THE PRIVATE SECTOR PROVIDING RECREATIONAL OPPORTUNITIES
- U.S. Forest Service: Chugach National Forest - dispersed recreation, cabins
- Private: guiding services, boat charters/rentals, lodges, community recreational developments
- State: marine highway system - water-related recreation opportunities
- Community: park and recreational programs in Valdez and Cordova

SUBREGION CHARACTERISTICS
- marine coastal environment
- numerous sheltered bays
- tidewater glaciers
- diverse marine wildlife
- cultural resources
- scenic
- pristine wilderness

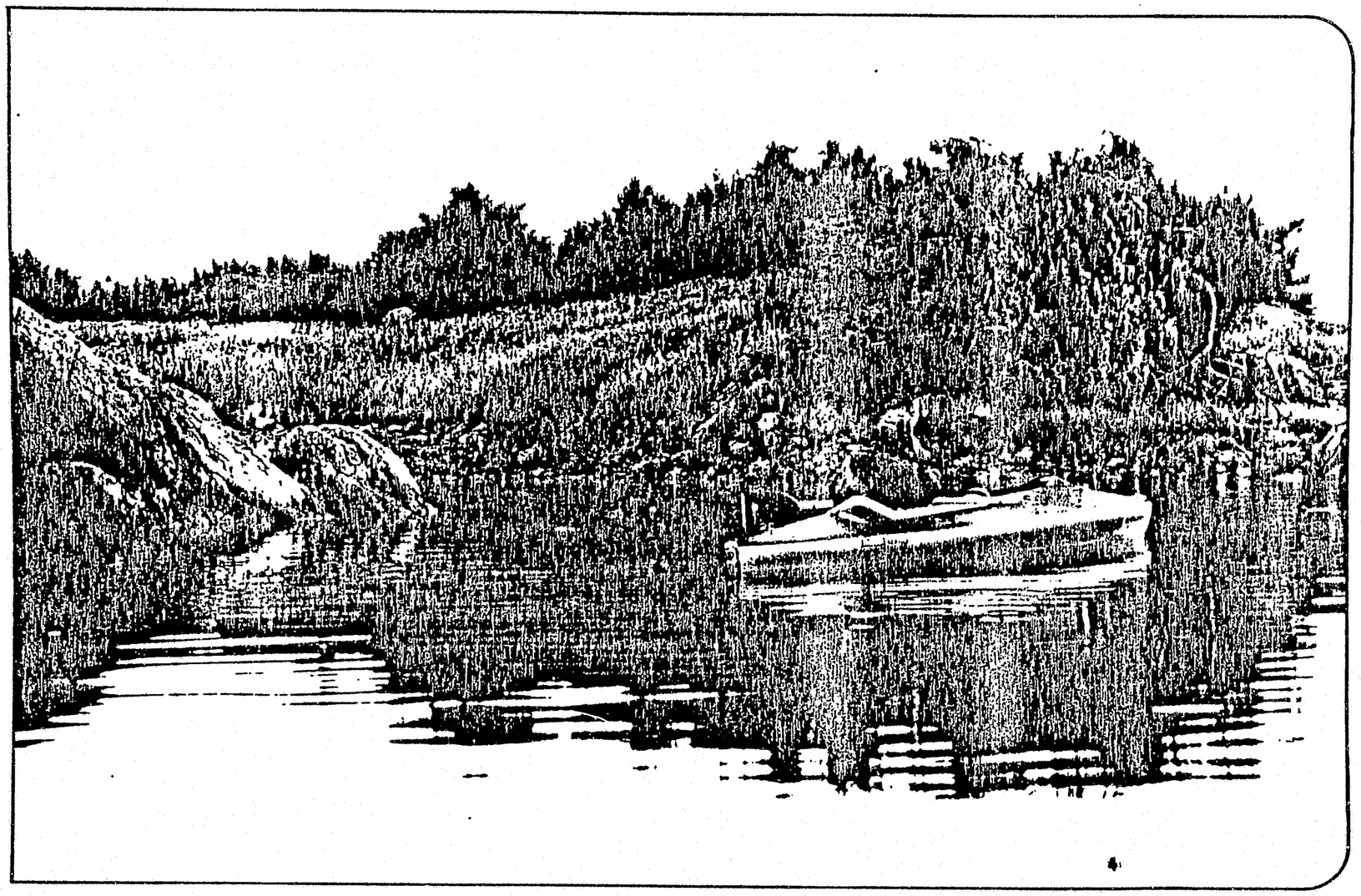
STATE PARK REPRESENTATION
- EXISTING: two road accessible sites on the Richardson Highway
- NEEDED: regional recreational, cultural and tourism-related opportunities such as marine sites, recreational areas and trails

7-1-98

Prince William Sound Subregion Recommendations

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Blueberry Lake State Recreation Site (existing)	96	I	Acquisition: obtain addition of 192 acres of state land by administrative action
		III	Planning: prepare management plan
		I	Development: complete currently-funded development projects
Valdez Glacier State Recreation Site (existing)	97	I	Acquisition: transfer to the City of Valdez
Prince William Sound Marine Park System (proposed)	98	I	Acquisition: seek legislative designation and cooperate with the U.S. Forest Service
		I	Planning: prepare management plan
		I	Development: implement management plan
		I	Special Management Considerations: work cooperatively with the USFS
Keystone Canyon State Recreation Area (future consideration)	99		These areas may be included as units of the State Park System depending on recreational needs and preferences and upon available funding.
Mineral Creek State Trail (future consideration)	99		

7-1-99



7-1-100

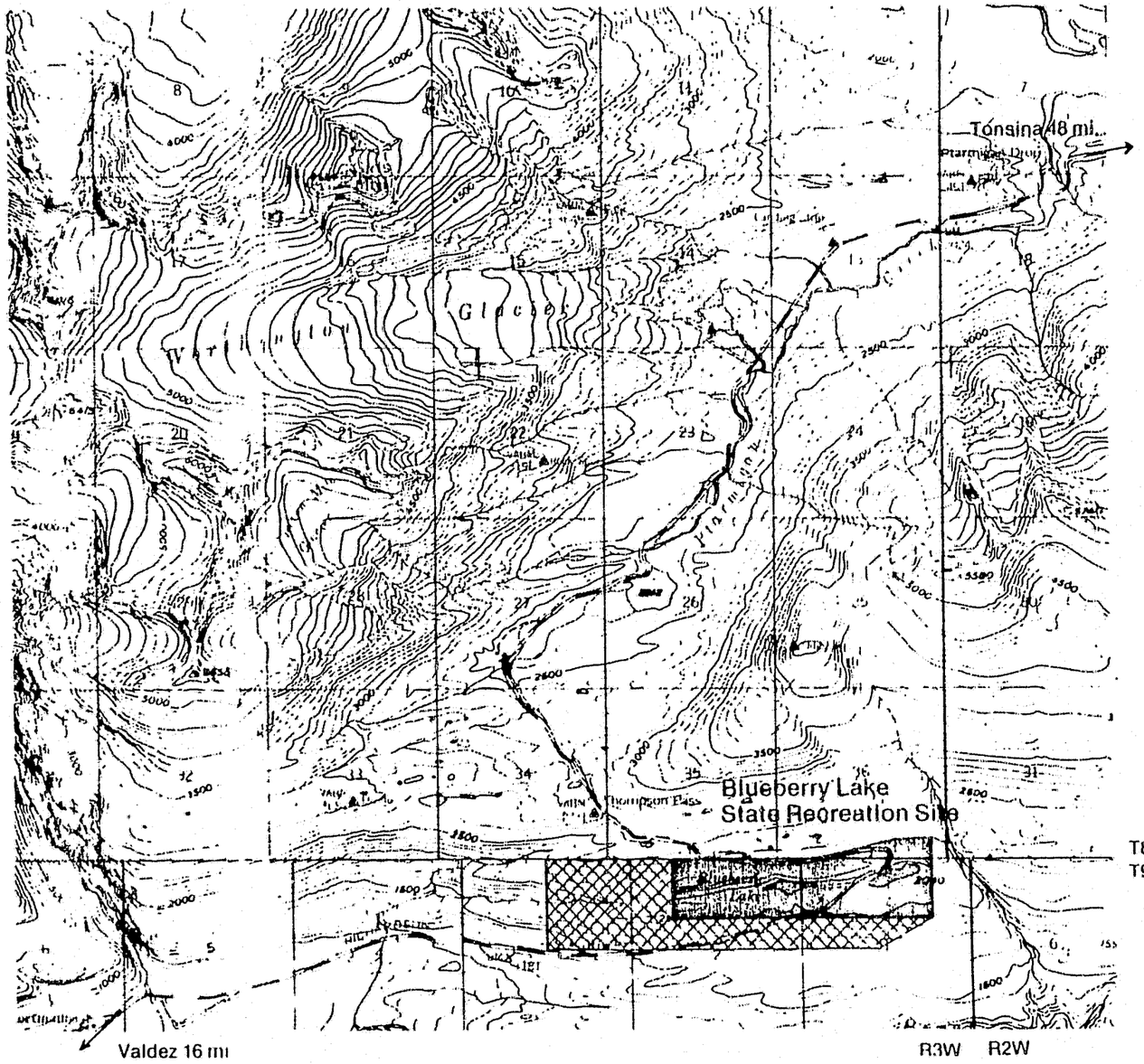
BLUEBERRY LAKE SRS

PRINCE WILLIAM SOUND

USGS Maps:
Valdez A5

Existing Park Land

Proposed Acquisition of Public Land

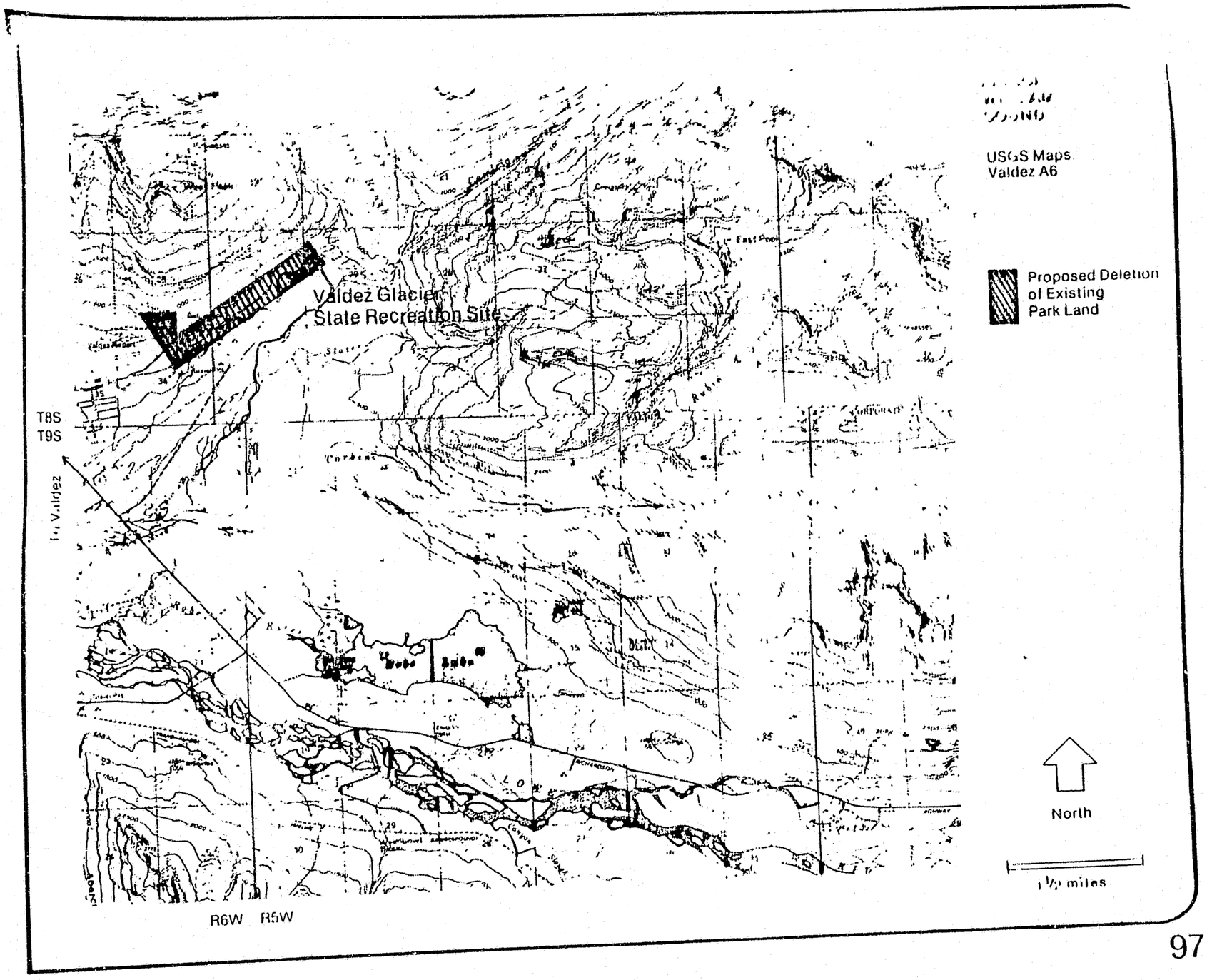


North

1 mile

7-1-101

90


Valdez Glacier
State Recreation Site
T8S
T9S
R6W R5W
USGS Maps
Valdez A6
Proposed Deletion
of Existing
Park Land
North
1½ miles

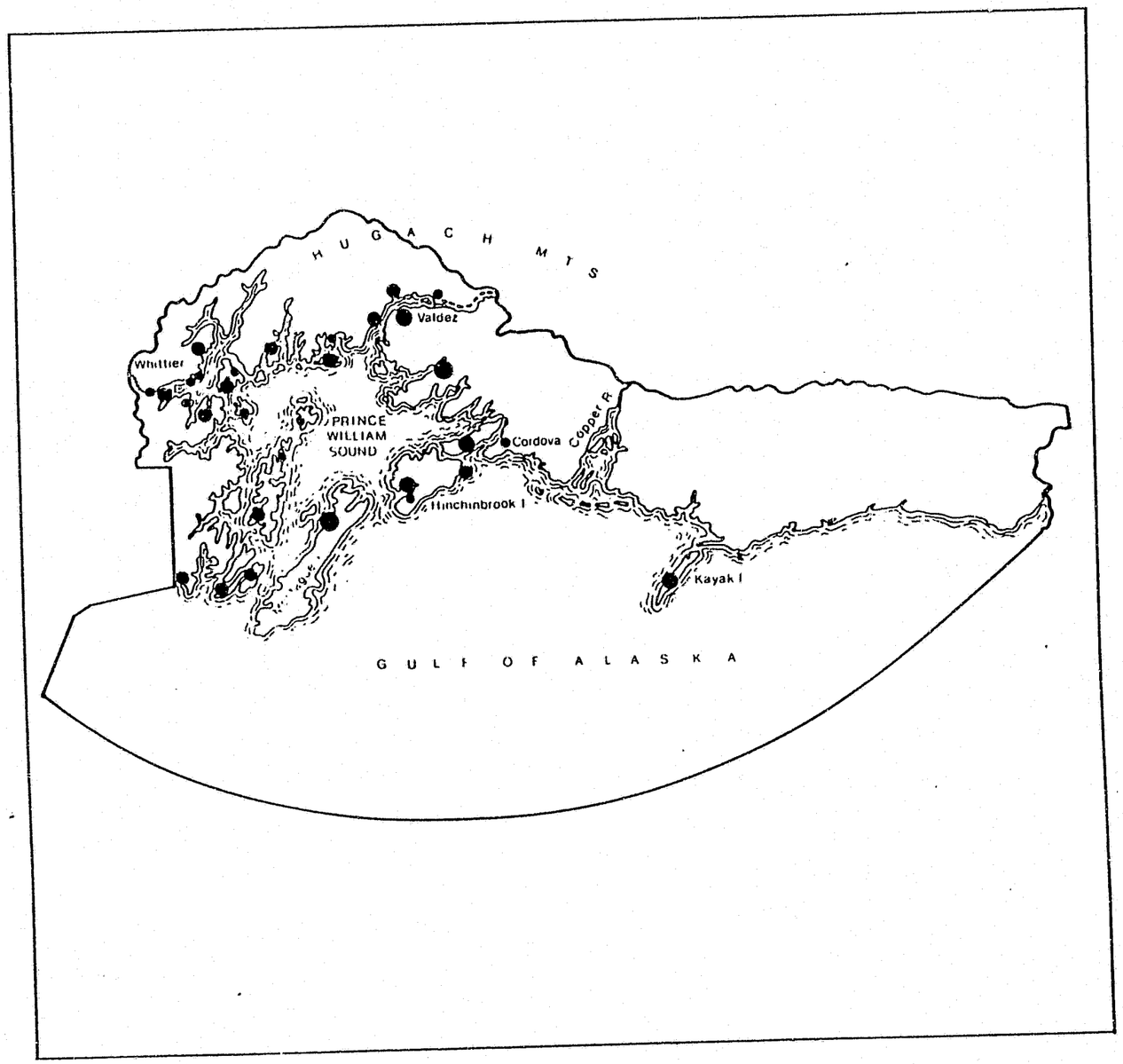
7-1-102

PRINCE WILLIAM SOUND MARINE PARK SYSTEM

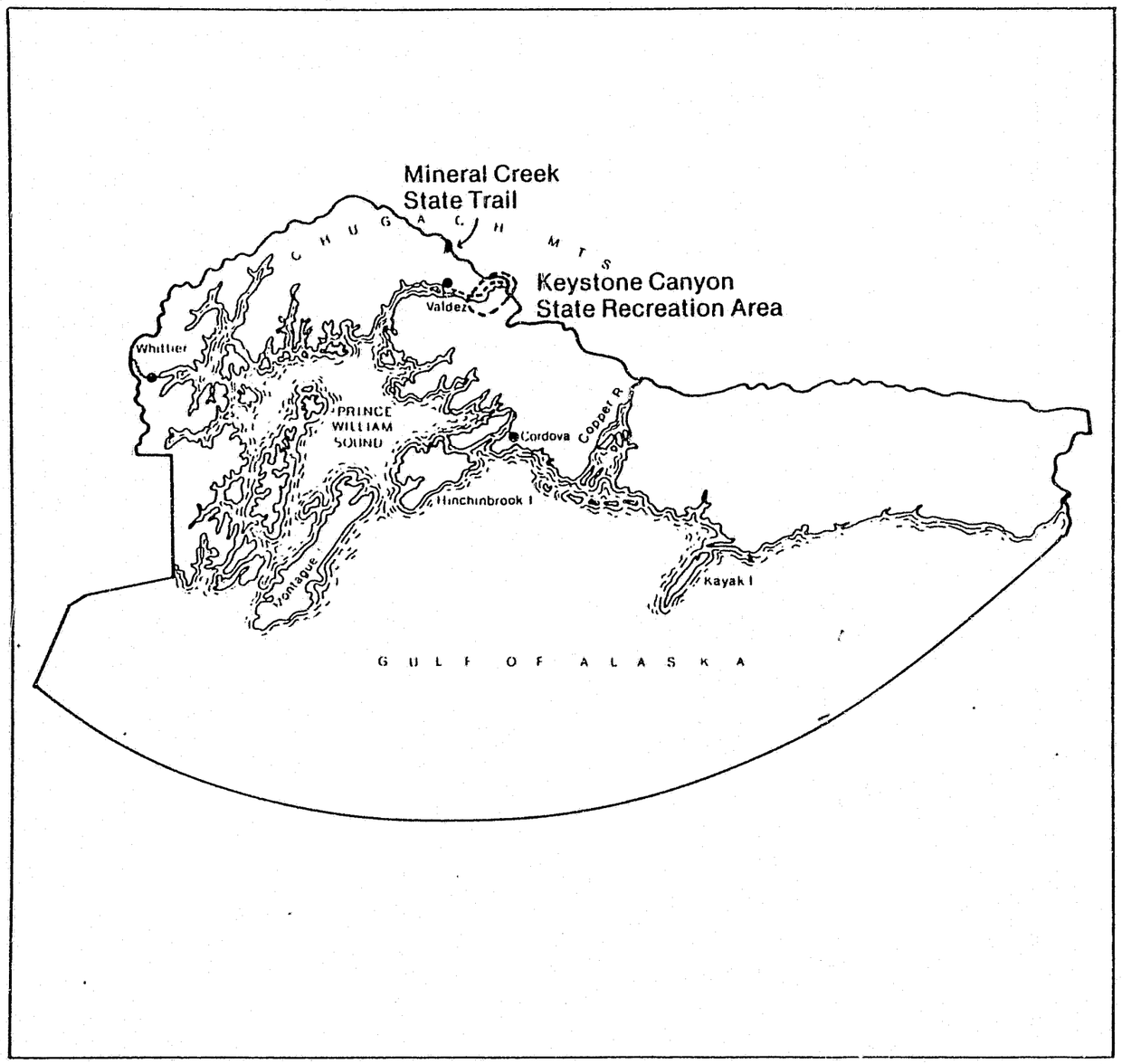
PRINCE WILLIAM SOUND

Proposed Marine Park System Units

Potential Marine Park System Units



North

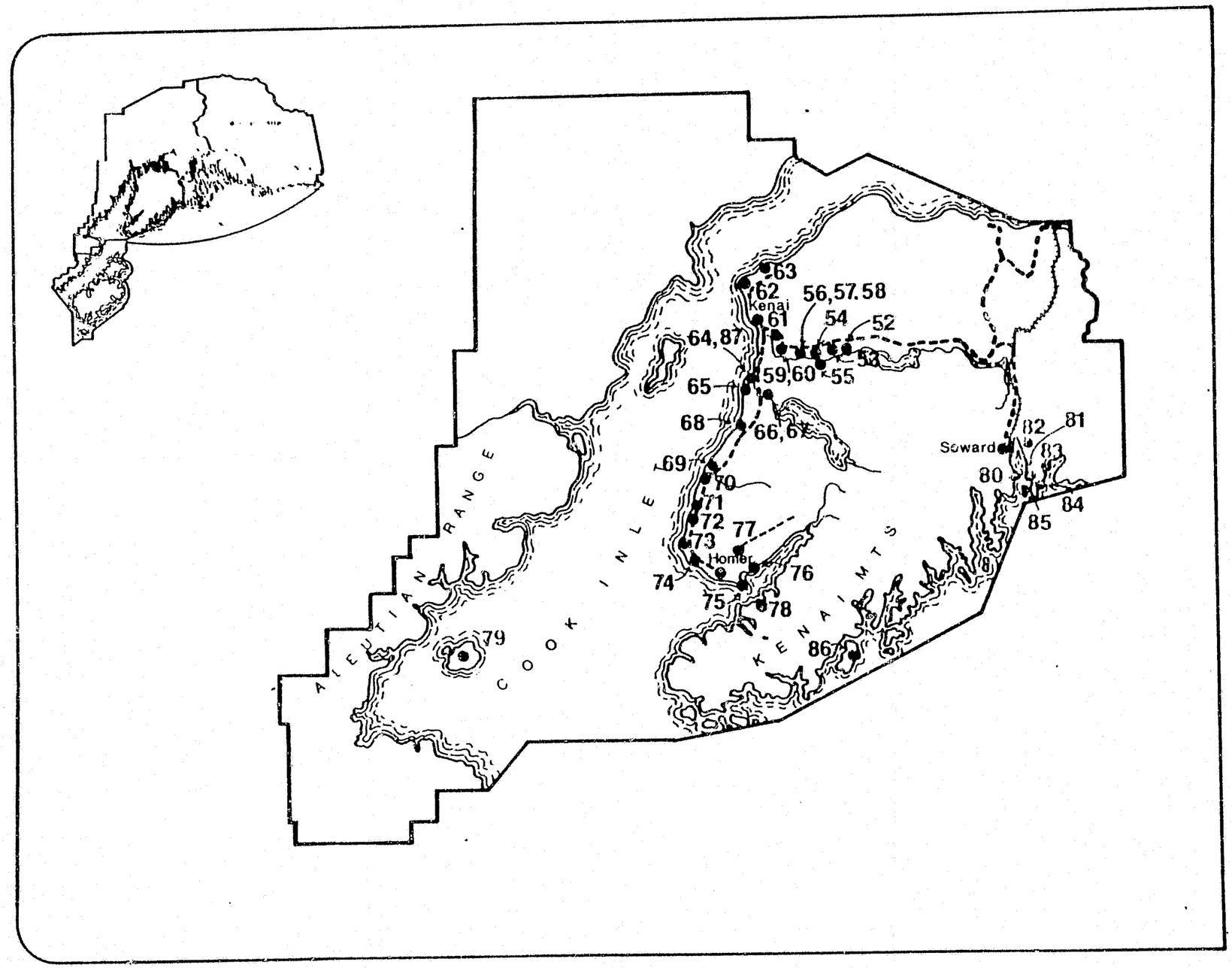


PRINCE
WILLIAM
SOUND

North

7-1-104

0 0 1 1 6 8



7-1-105

52. Kenai Keys SRA
53. Bing's Landing SRS
54. Izaak Walton SRS
55. Nilnunqa SHP
56. Scout Lake SRS
57. Morgan's Landing SRA
58. Funny River SRS
59. Kenai River Islands SRSs
60. Lower Kenai River SRSs
61. Stikok SRS
62. Bernice Lake SRS
63. Captain Cook SRA
64. Georgievsk Redoubt SHP
65. Cohoe Beach SRS
66. Kasilof River SRS
67. Johnson Lake SRA
68. Clam Gulch SRA
69. Ninilchik SRA
70. Deep Creek SRA
71. Stariski SRS
72. Whiskey Gulch SRS
73. Anchor River SRA
74. Anchor River SRS
75. Homer Spit
76. Cottonwood-Eastland SRA
77. Boxcar Hills ST
78. Kachemak Bay SP
79. St. Augustine Island SPr
80. Caines Head SRA
81. Thumbs Cover SRS
82. Fourth of July Creek SRS
83. Safety Cove SRS
84. Driftwood Bay SRS
85. Sunny Cove SRS
86. Nuka Island
87. Mouth of the Kasilof River SRA

ISSUES
- heavy use pressures at road accessible recreational sites
- impacts of recreational users on local residents and their properties
- Native land claims within Kachemak Bay State Park reducing access and recreational opportunities
- general lack of public lands along lakes, streams and beaches

PUBLIC PREFERENCES
- expand and develop existing facilities
- provide access to beaches, rivers and lakes
- disperse and accommodate fishing demand
- provide greater level of public services

OTHER AGENCIES AND THE PRIVATE SECTOR PROVIDING RECREATIONAL OPPORTUNITIES
- U.S. Forest Service: road-accessible lakes, forest, alpine areas; backcountry cabins and dispersed recreation
- National Park Service: Kenai Fjords National Park, Lake Clark National Park and Preserve - wilderness
- U.S. Fish and Wildlife Service: Kenai National Wildlife Refuge, Tuxedni National Wildlife Refuge and Alaska Marine National Wildlife Refuge - dispersed backcountry opportunities, wildlife habitat, wilderness
- Private: guide services, private recreational developments
- Community: park and recreational programs within most cities

SUBREGION CHARACTERISTICS
- accessible coastal environment
- freshwater lakes and rivers
- fish and wildlife
- Kachemak Bay marine and mountain environment
- glaciated mountains

STATE PARK REPRESENTATION
- EXISTING: road accessible areas to major salmon streams, Kachemak Bay coastal/mountain environment
- NEEDED: established trails, developed units to disperse use, provide diversity of year-round recreational opportunities; development of Kachemak Bay State Park

7-1-106

Kenai Subregion Recommendations

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Kenai Keys State Recreation Area (existing)	110	III	Acquisition: cooperate with ADF&G on joint use of Fish & Game site
		I	Planning: include as part of the Kenai River State Park Units Management Plan; cooperate in planning with Kenai National Wildlife Refuge
		I	Development: develop according to management plan; include access point and potential for day-use and overnight facilities
		II	Special Management Considerations: work closely with private landowners to minimize recreational impacts
Bings Landing State Recreation Site (existing)	111	I	Acquisition: complete acquisition of 100 acres of state land through administrative action
		I	Planning: include as part of the Kenai River State Park Units Management Plan; determine level of use, appropriate scale and means of accommodating use
		I	Development: rehabilitate site and initiate new development according to management and site plans
		I	Special Management Considerations: maintain quality of the river frontage
Izaak Walton State Recreation Site (existing)	111	I	Planning: include as part of the Kenai River State Park Units Management Plan; assess existing impacts and protection of site values
		I	Development: rehabilitate existing campground; relocate or eliminate campsites in conflict with archaeological sites
		I	Special Management Considerations: establish cultural zone in eastern portion of the site and provide interpretive facilities
Nilnunqa State Historic Park (existing)	111	I	Planning: include as part of the Kenai River State Park Units Management Plan; develop an historic preservation plan; establish archaeological investigations

7-1-107

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
		II	Development: develop interpretation opportunities
		I	Special Management Considerations: protect the archaeological site, minimize recreational impacts and provide interpretation of the cultural resources
Scout Lake State Recreation Site (proposed)	112	I	Acquisition: obtain 134.5 acre parcel from the Boy Scouts of America pursuant to legislative direction, seek administrative addition of state lands (30 acres), obtain a cooperative management agreement with the borough
		III	Planning: prepare management plan
		III	Development: implement management plan
Morgan's Landing State Recreation Area (existing)	112	I	Acquisition: complete scheduled acquisition of the 40 acre private parcel and seek cooperative management of acreage to the west with Cook Inlet Region, Inc.
		I	Planning: include as part of the Kenai River State Park Units Management Plan
		I	Development: develop as a regional park destination for year-round recreational use
		I	Special Management Considerations: use portion of the unit as district headquarters and visitor center
Funny River State Recreation Site (existing)	112	I	Acquisition: obtain 80 acres of private and state land
		I	Planning: include as part of the Kenai River State Park Units Management Plan; assess impact of improved access to the area
		II	Development: provide river access and upland development
Kenai River Islands State Recreation Sites (existing)	113	III	Acquisition: no scheduled acquisition; however, if the opportunity arises, and where appropriate, obtain additional undeveloped islands on the Kenai River

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7-1-108

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Lower Kenai River State Recreation Sites (existing)	113	I	Planning: include as part of the Kenai River State Park Units Management Plan; define site character and biological values and sensitivities
		III	Development: assess development potential through the management planning process
		III	Special Management Considerations: maintain open-space and habitat values
Slikok State Recreation Site (existing)	113	I	Acquisition: obtain Federal surplus property (35 acres); seek management rights to portion of CIRI land in Section 24
		I	Planning: include as part of the Kenai River State Park Units Management Plan
		III	Developments: develop according to management plan
Bernice Lake State Recreation Site (existing)	114	II	Planning: include as part of the Kenai River State Park Units Management Plan
		III	Development: develop according to management plan
Captain Cook State Recreation Area (existing)	115	II	Acquisition: seek to transfer via AS 38.315 to North Kenai Park and Recreation Service Area (Kenai Peninsula Borough)
		III	Acquisition: obtain spit (10-20 acres) at mouth of the Swanson River and adjust state park boundaries to the east; seek cooperative management agreement with the borough
		III	Planning: update management plan; assess performance of existing facilities
		III	Development: implement management plan
Georgievsk Redoubt State Historic Park (proposed)	116	II	Acquisition: locate historic site of fort and obtain management rights to the lands
		II	Planning: prepare archaeological survey and management plan
		III	Development: depict historic site through visitor information techniques

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
		III	Special Management Considerations: protect historic site character
Cohoe Beach State Recreation Site (proposed)	117	I	Acquisition: obtain 385 acres of state land through administrative procedure; seek a cooperative agreement with the Kenai Borough and Alaska DOT/PF
		II	Planning: prepare management plan
		II	Development: implement adaptive reuse of the existing gravel pit and implement the management plan
Kasilof River State Recreation Site (existing)	117	III	Planning: maintain mix of vehicle parking and camping; prepare management plan
		III	Development: rehabilitate site
Johnson Lake State Recreation Area (existing)	117	II	Development: implement existing site development plan
		III	Special Management Considerations: monitor walk-in campground use
Clam Gulch State Recreation Area (existing)	118	II	Acquisition: obtain 300 acres of state land through administrative action and acquire land along Sterling Highway
		I	Planning: consider destination, extended day uses and prepare management plan
		I	Development: expand facilities and diversity of uses, upgrade services, and pave road. Implement management plan
		III	Special Management Considerations: extend management capability to beach areas
Ninilchik State Recreation Area (existing)	119	I	Acquisition: seek cooperative management agreement with Ninilchik Native, Inc. for lands in Section 35; seek cooperative agreement with landowers along Ninilchik River and obtain small parcel of private land (7 acres) above highway bridge

011-1-2

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Deep Creek State Recreation Area (existing)	119	I	Planning: incorporate recreation design into boat harbor development; relate beach area to uplands
		I	Development: develop uplands for camping; seek cooperative effort with Army Corps of Engineers on harbor development
		I	Special Management Considerations: phase-out campground facility development at the beach
		I	Acquisition: obtain cooperative agreement with borough and obtain 60 acres of private land on both sides of access road
		I	Planning: relate beach area to uplands through management plan
		I	Development: implement management plan
		I	Special Management Considerations: protect wetlands and minimize user conflicts
Stariski State Recreation Site (existing)	120	III	Development: rehabilitate
Whiskey Gulch State Recreation Site (proposed)	120	I	Acquisition: obtain 320 acres of state lands through administrative action; cooperative management agreement with the university; obtain private land and land from Alaska DOT/PF
		II	Planning: prepare management plan
		II	Development: implement management plan
		II	Special Management Considerations: consider establishing vehicle use zones on beach
Anchor River State Recreation Area (existing)	121	I	Acquisition: obtain 4 acres of private lands near river mouth and the Old Sterling Highway and day use access sites
		I	Development: implement existing site plan

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Anchor River State Recreation Site (existing)	121	I	Special Management Considerations: phase-out management responsibility for the rifle range
Homer Spit (proposed)	122	I	Acquisition: seek cooperative agreement with the City of Homer; obtain 50 acres of private lands
		I	Planning: seek joint mangement plan with the City of Homer
		I	Development: develop campground and headquarter site
		I	Special Management Considerations: consider establishing a campground user fee
Cottonwood-Eastland State Recreation Area (proposed)	123	I	Acquisition: seek legislative establishment; obtain 270 acres of private lands on a willing-seller basis
		II	Planning: complete management plan
		II	Development: implement management plan
Boxcar Hills State Trail (proposed)	129	III	Acquisition: seek legislative establishment
		III	Planning: prepare management plan
		III	Development: implement management plan
		II	Special Management Considerations: coordinate planning with U.S. Fish & Wildlife Service
Kachemak Bay State (and Wilderness) Park (existing)	124	I	Acquisition: complete land exchange with Seldovia Natives, Inc.; acquire inholdings where appropriate; consider dock site at Bear Cove and trail easements into park; acquire Aurora Lagoon and Halibut Cove Natural Areas from the Bureau of Land Management
		I	Planning: reevaluate existing management plan in coordination with the Kachemak Bay State Park Citizens Advisory Board
		I	Development: begin phased development based on approved management plan
		I	Special Management Considerations: address management issues; establish full-time staffing

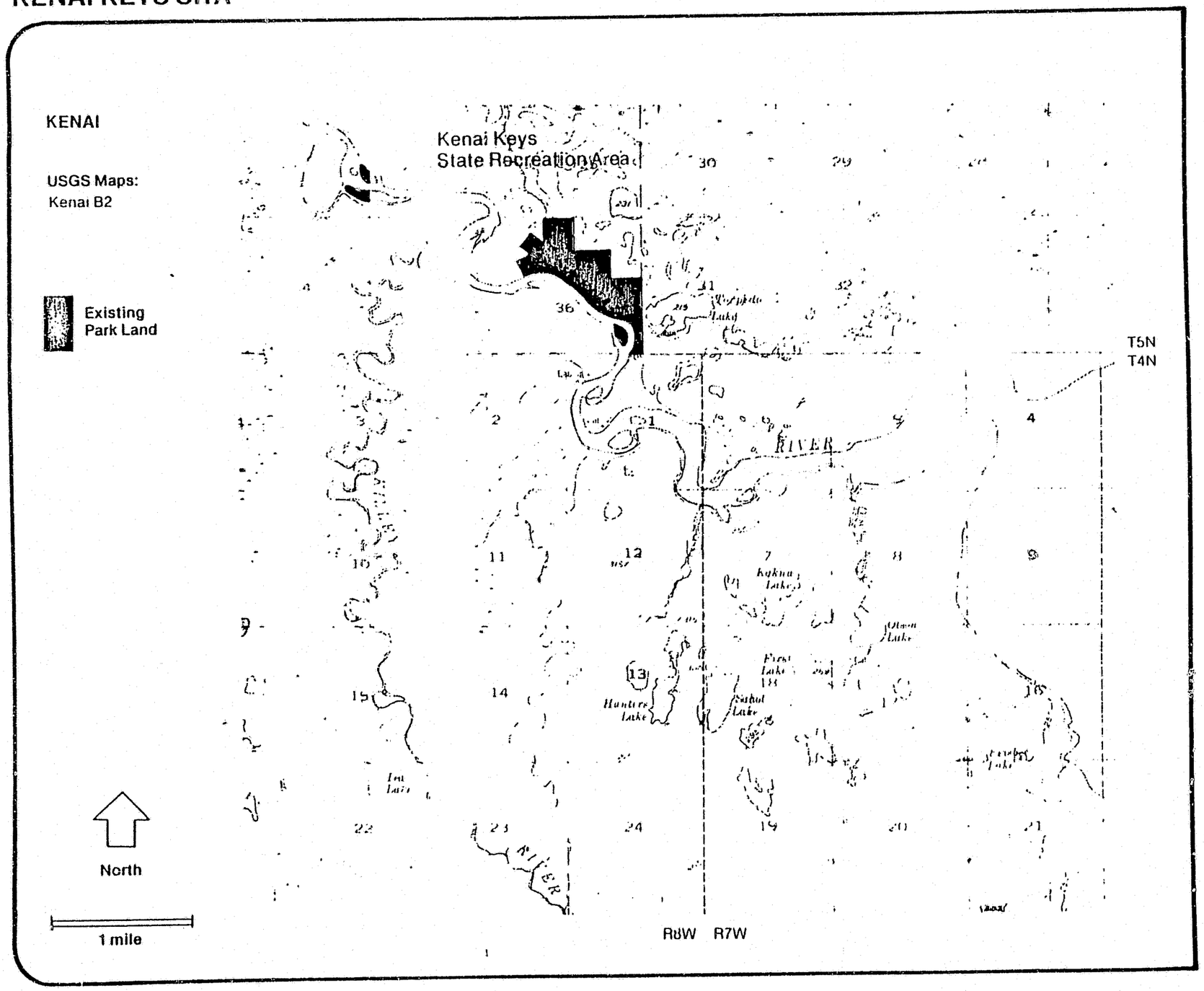
7-1-12

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
St. Augustine Island State Scientific Preserve (proposed)	125	I	Acquisition: seek legislative establishment of a State Scientific Preserve
		I	Planning: establish criteria for scientific investigations and develop management plan
		II	Development: implement management plan
		II	Special Management Considerations: monitor use
Caines Head State Recreation Area (existing)	126	I	Acquisition: obtain 550 acres of state land by administrative action for trail corridor from Tonsina Point
		I	Planning: complete management plan
		I	Development: phase development of shoreline and marine access, continue historic restoration; provide visitor information program
		I	Special Management Considerations: establish full-time staff, youth employment and consider a cooperative visitor information center in Seward
Thumbs Cove State Recreation Site-Marine Park System (proposed)	126	I	Acquisition: include in Prince William Sound Marine Park legislation
		II	Planning: prepare management plan
		II	Development: implement management plan
		II	Special Management Considerations: work cooperatively with private landowners
Fourth of July Creek State Recreation Site-(proposed)	127	I	Acquisition: establish area through legislative action; work cooperatively with the City of Seward
		II	Planning: integrate recreation into regional tourism development
		II	Development: consider visual prominence of four hanging glaciers
		II	Special Management Considerations: maintain visual quality

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Safety Cove State Recreation Site-Marine Park System (proposed)	128	I	Acquisition: include in Prince William Sound Marine Park legislation
		II	Planning: prepare management plan
		II	Development: implement management plan
		II	Special Management Considerations: work cooperatively with private landowners
Driftwood Bay State Recreation Site-Marine Park System (proposed)	128	I	Acquisition: include in Prince William Sound Marine Park legislation
		II	Planning: prepare management plan
		II	Development: implement management plan
		II	Special Management Considerations: work cooperatively with private landowners
Sunny Cove State Recreation Site Marine Park System (proposed)	128	I	Acquisition: include in Prince William Sound Marine Park legislation
		II	Planning: prepare management plan
		II	Development: implement management plan
		II	Special Management Considerations: work cooperatively with private landowners
Nuka Island (future consideration)	130		These areas may be included as units of the State Park System depending on recreational needs, use preferences and upon available funding.
Mouth of the Kasilof River State Recreation Area (future consideration)	130		

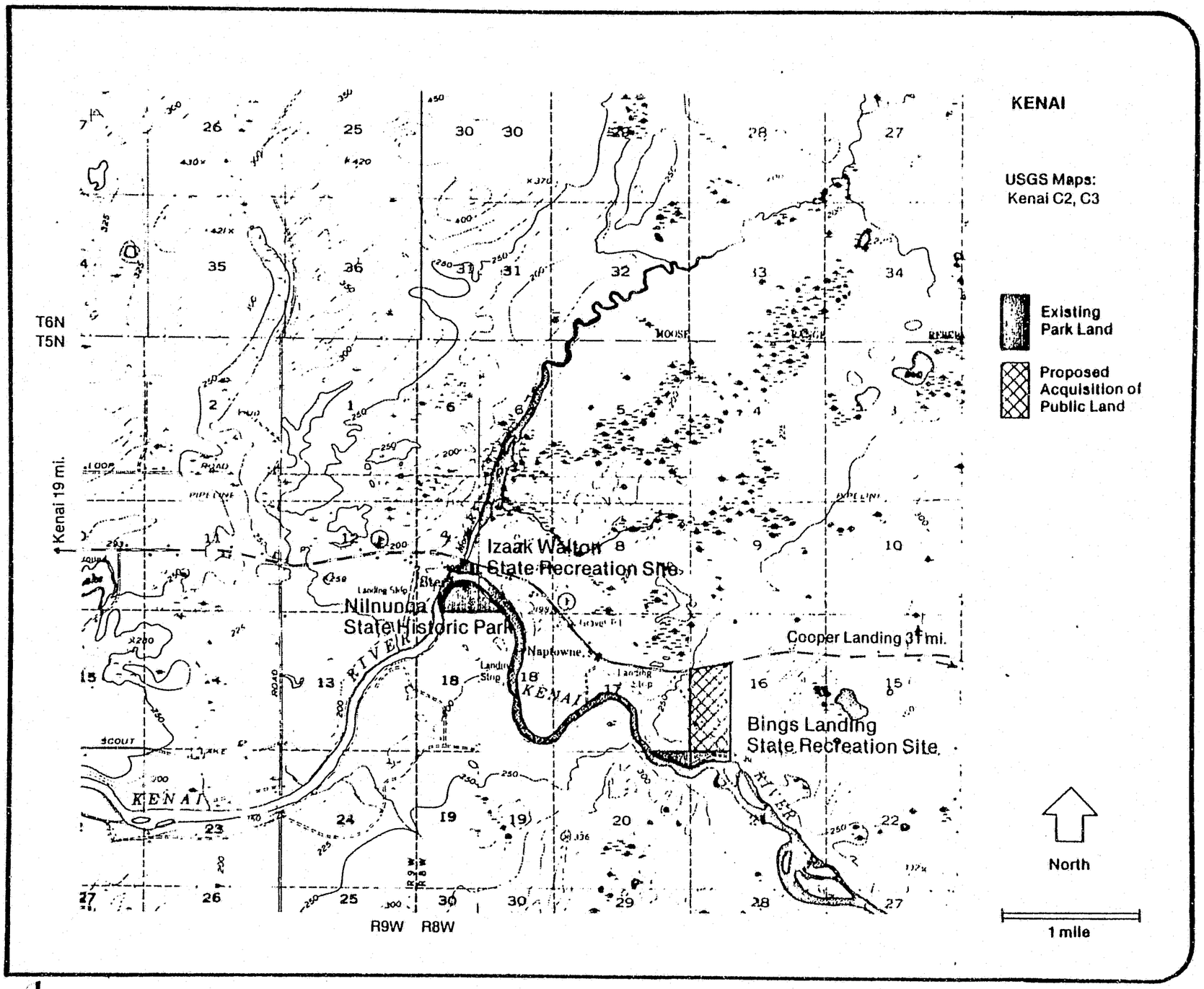
7-1-114

KENAI KEYS SRA

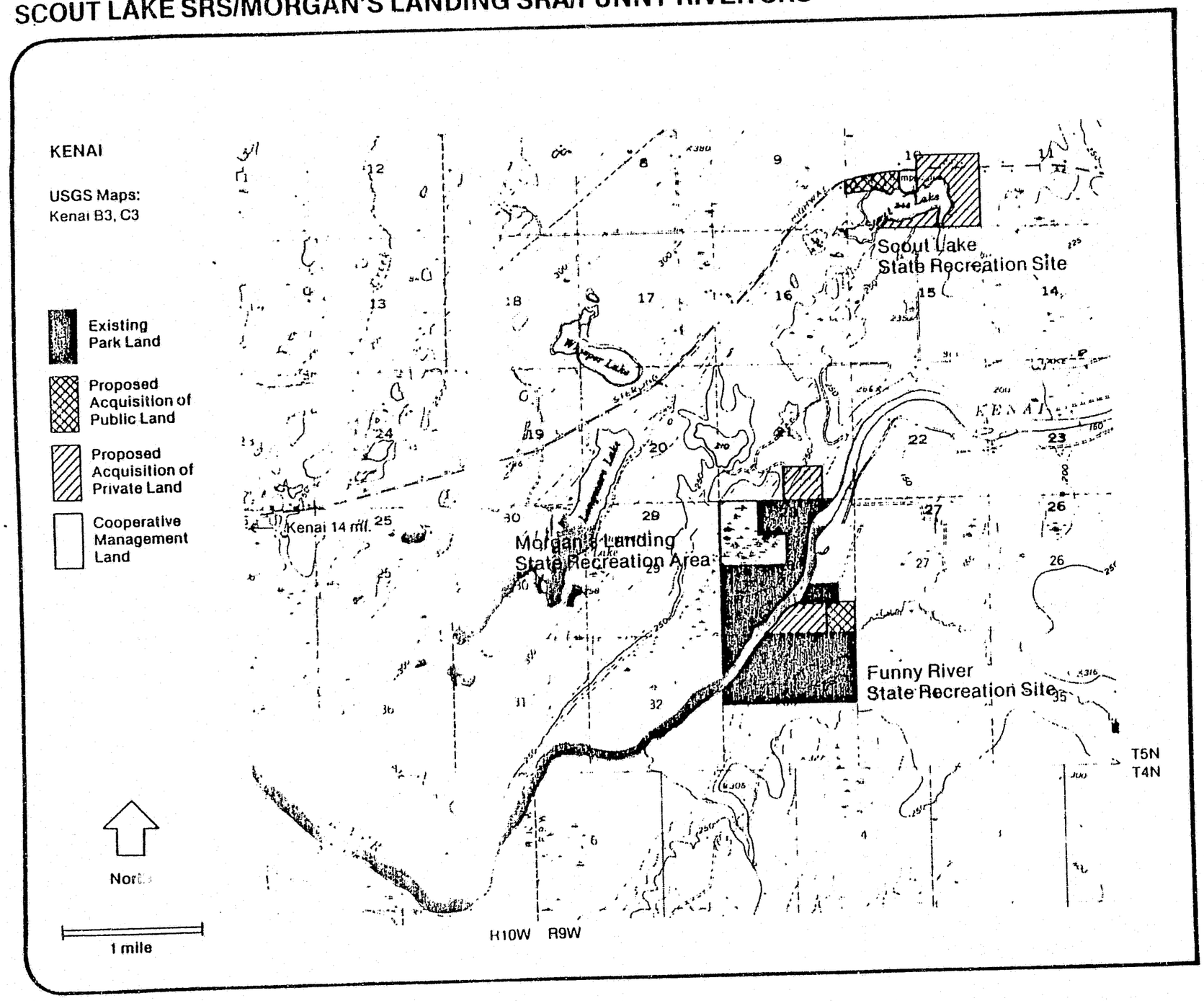


7-1-115

BINGS LANDING SRS/IZAAK WALTON SRS/NILNUNQA SHP

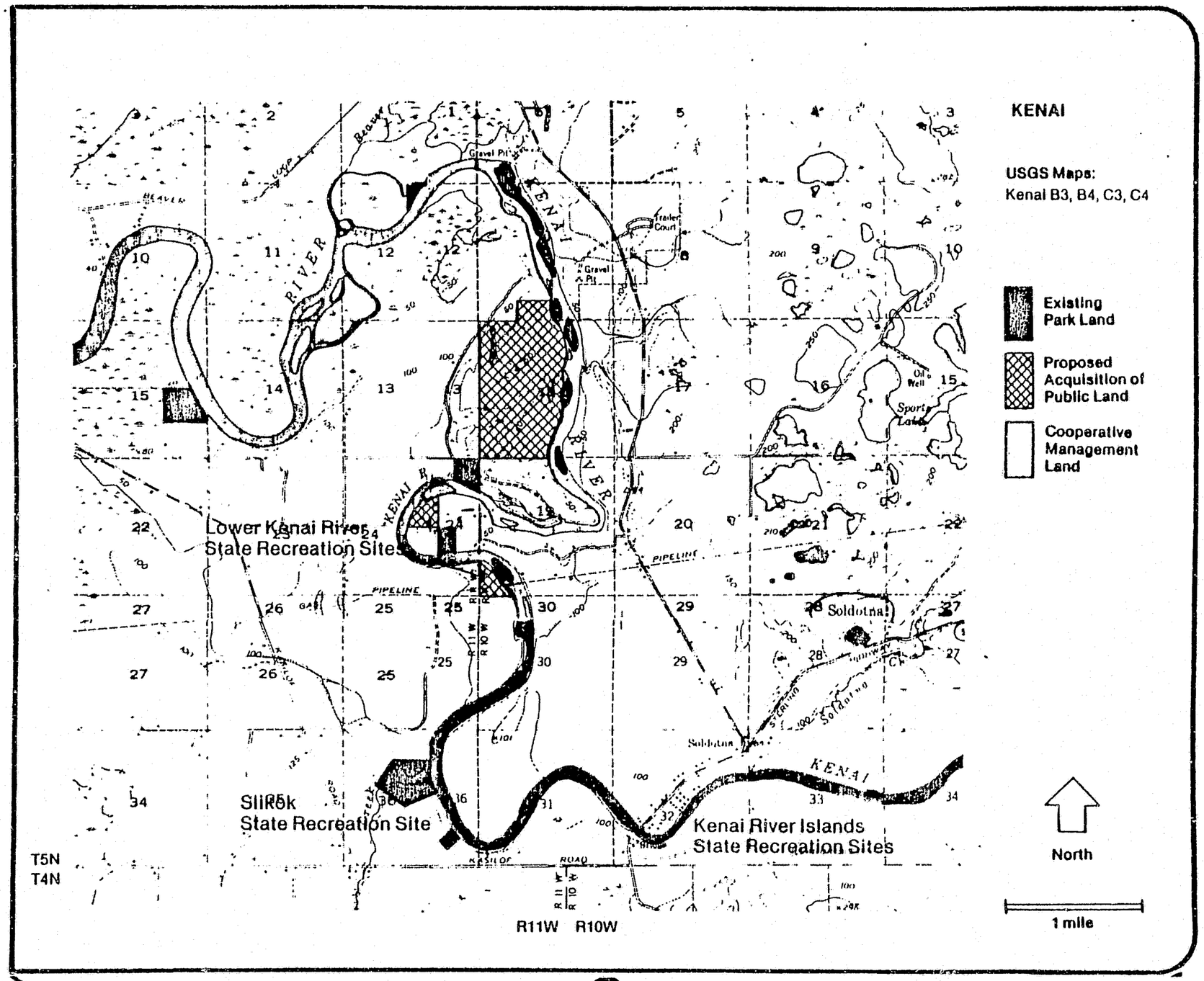


SCOUT LAKE SRS/MORGAN'S LANDING SRA/FUNNY RIVER SRS



7-1-117

KENAI RIVER ISLANDS SRS/LOWER KENAI RIVER SRS/SLIKOK SRS



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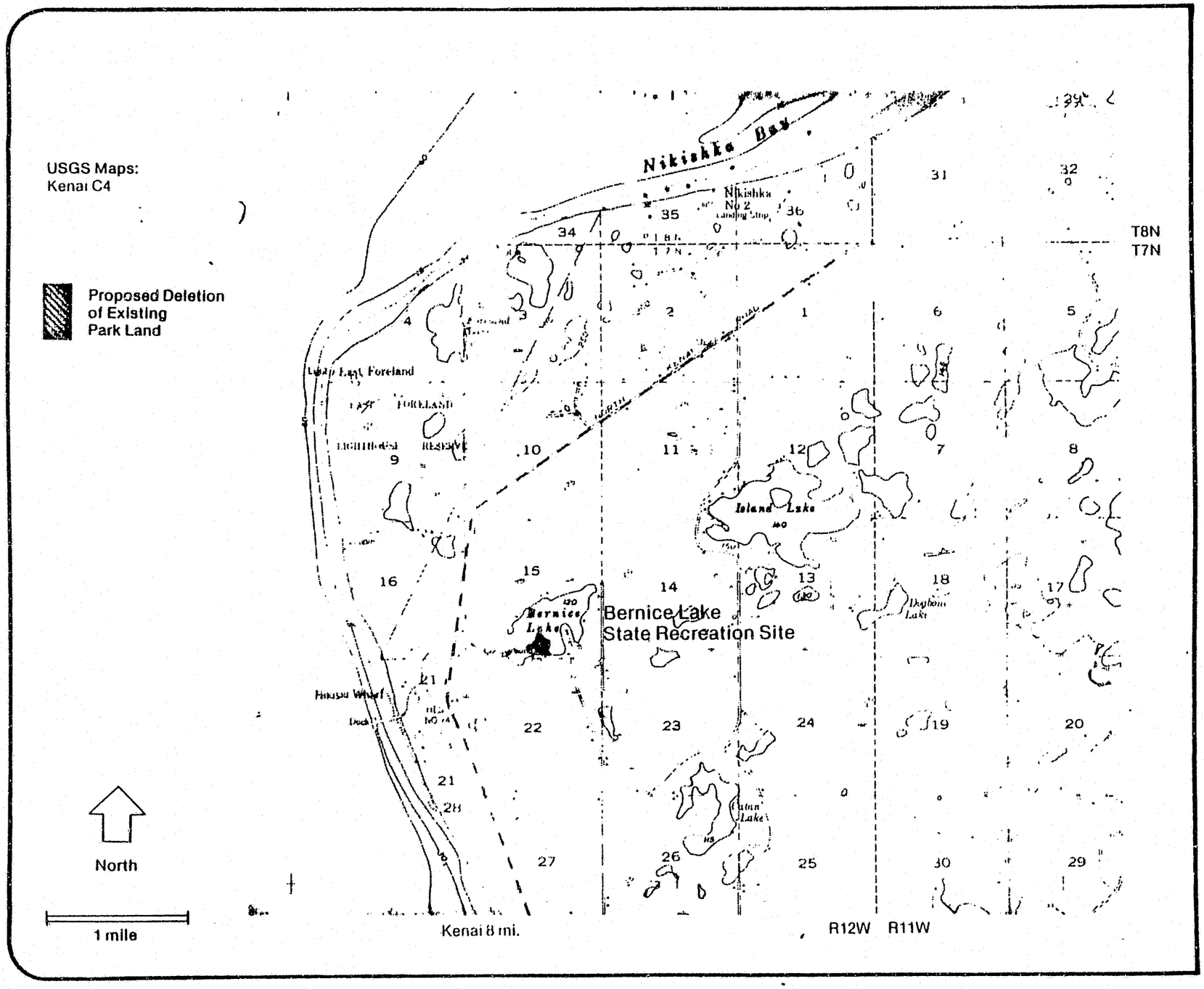
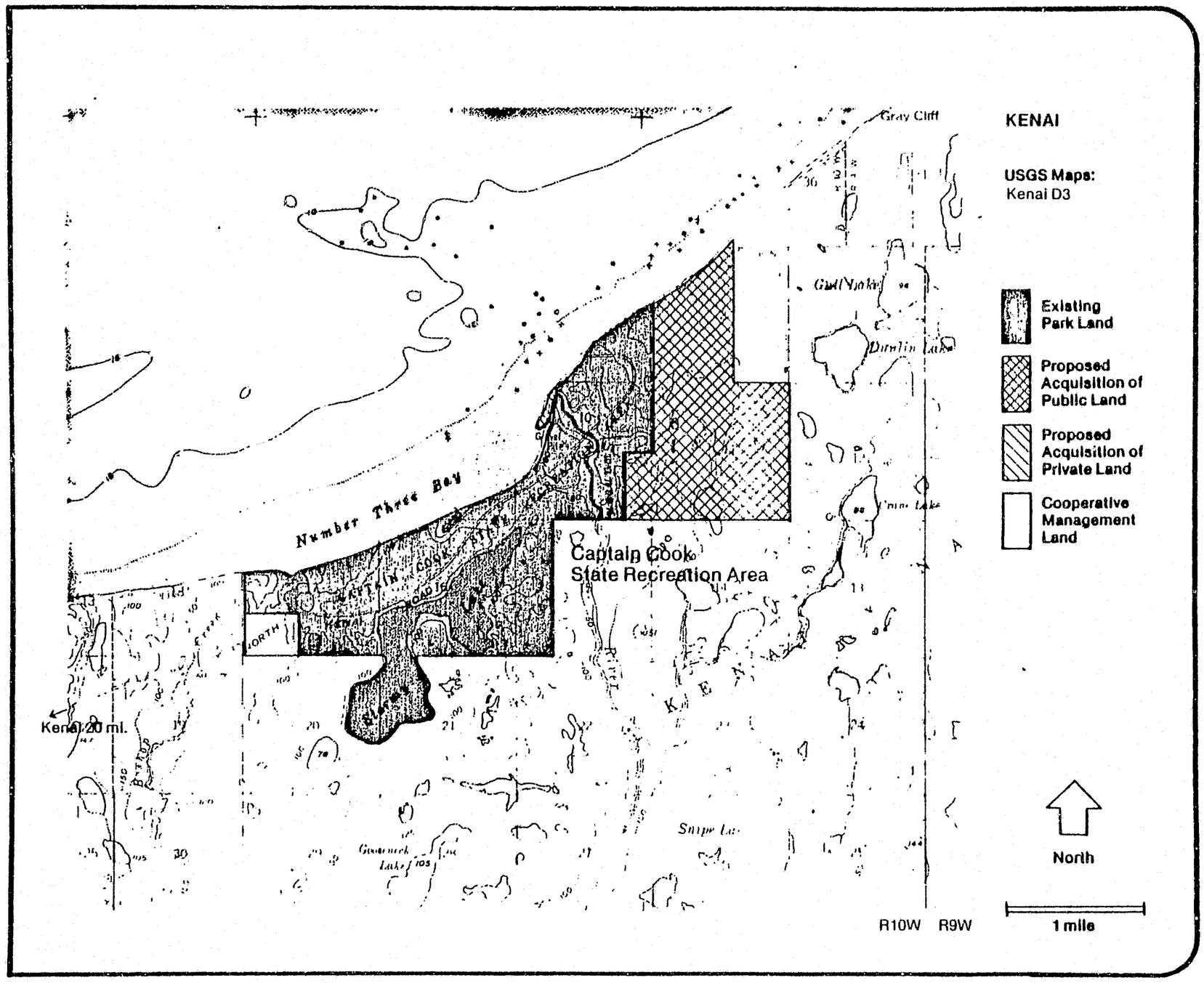
BERNICE LAKE SRS



7-1-119

CAPTAIN COOK SRA



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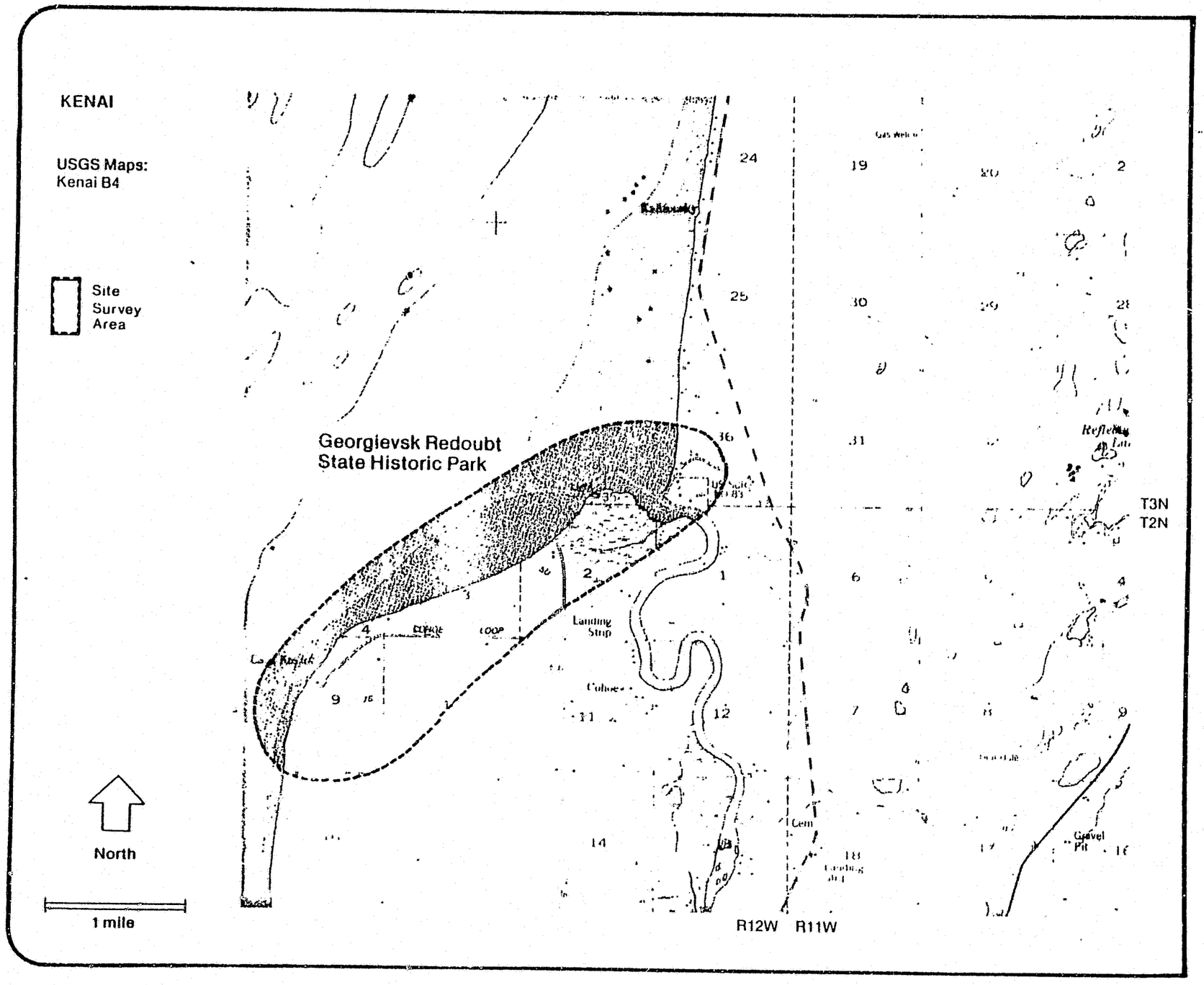
GEORGIEVSK REDOUBT SHP



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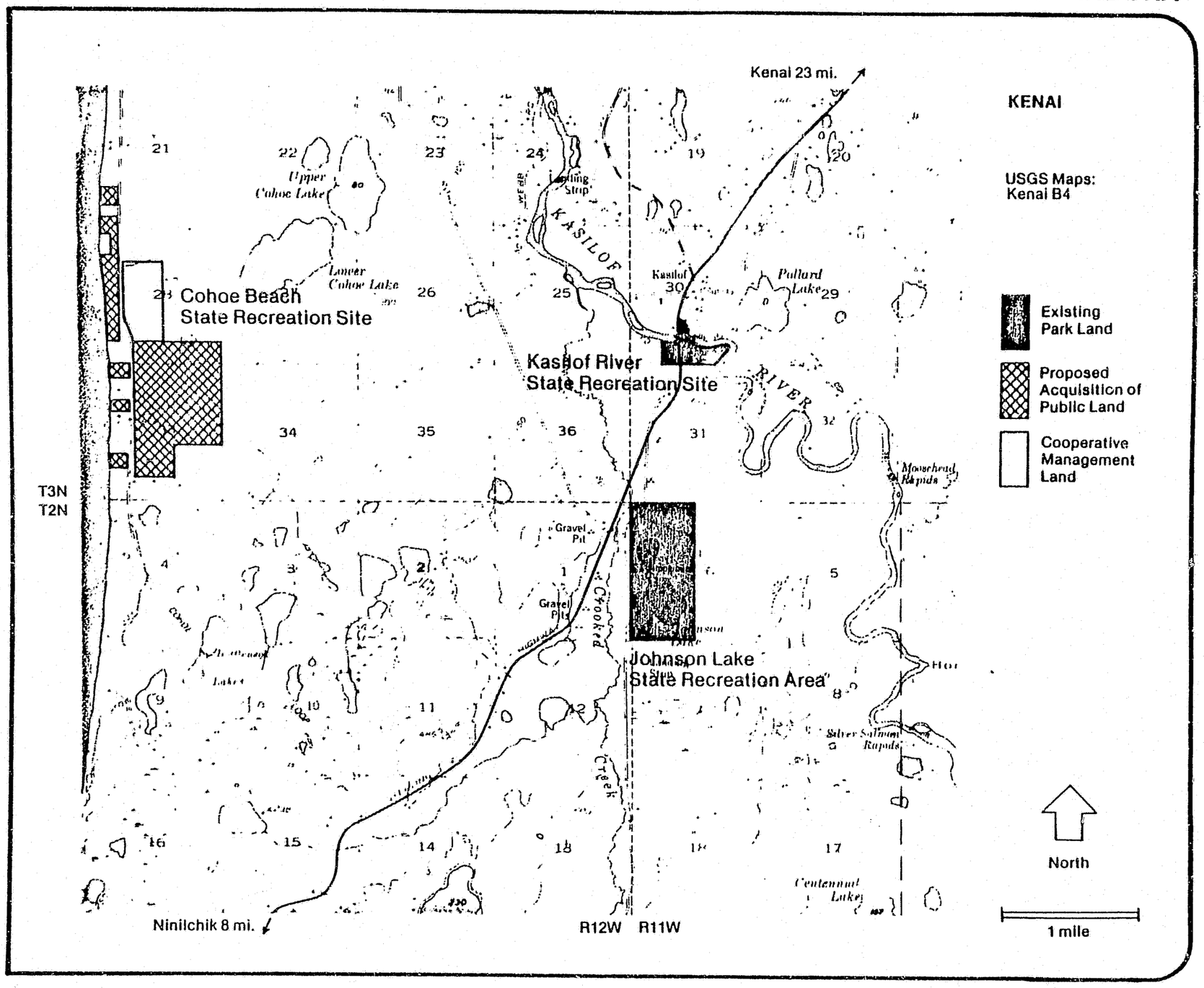
COHOE BEACH SRS/KASILOF RIVER SRS/JOHNSON LAKE SRA



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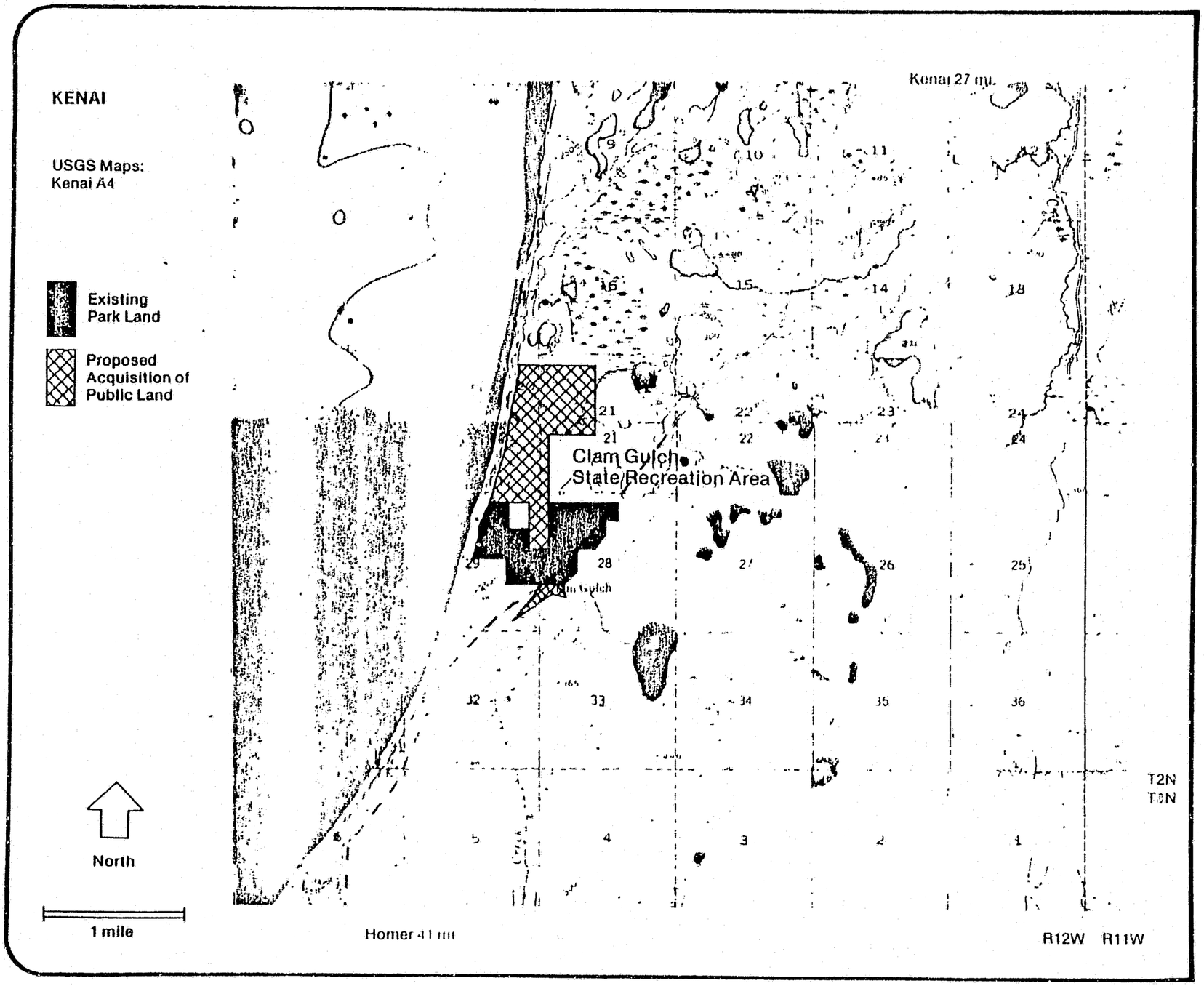
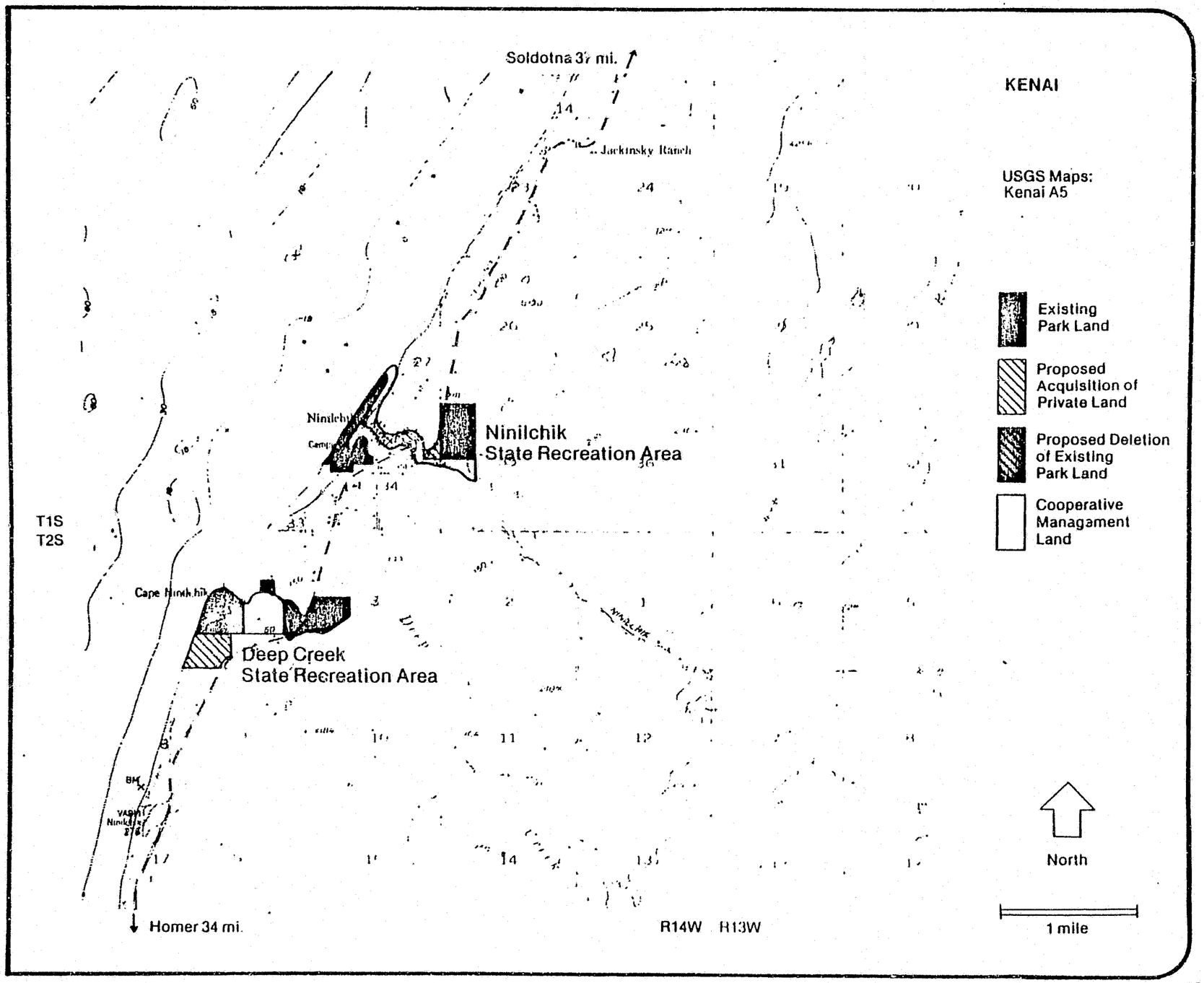
CLAM GULCH SRA



NINILCHIK SRA/DEEP CREEK SRA



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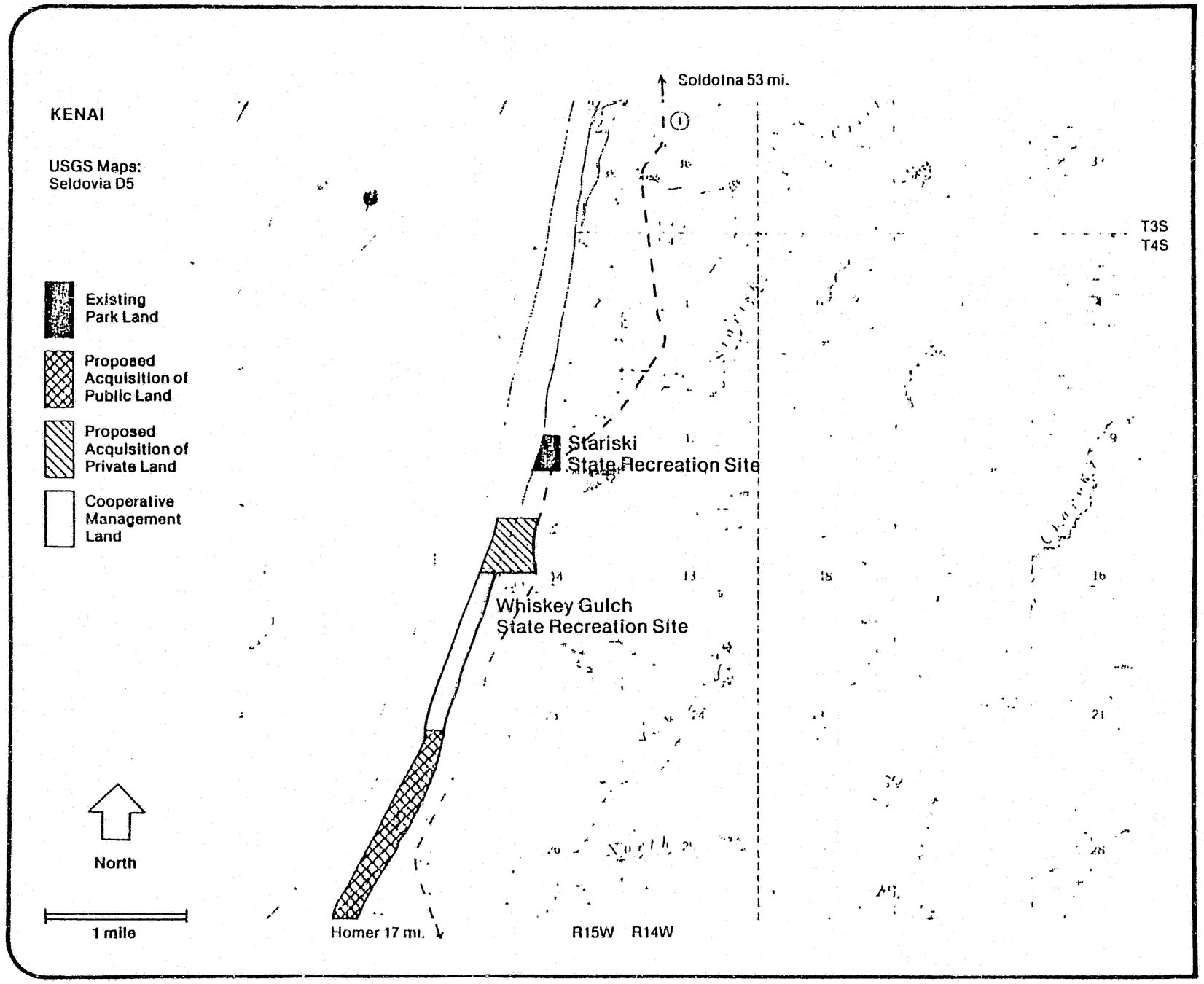
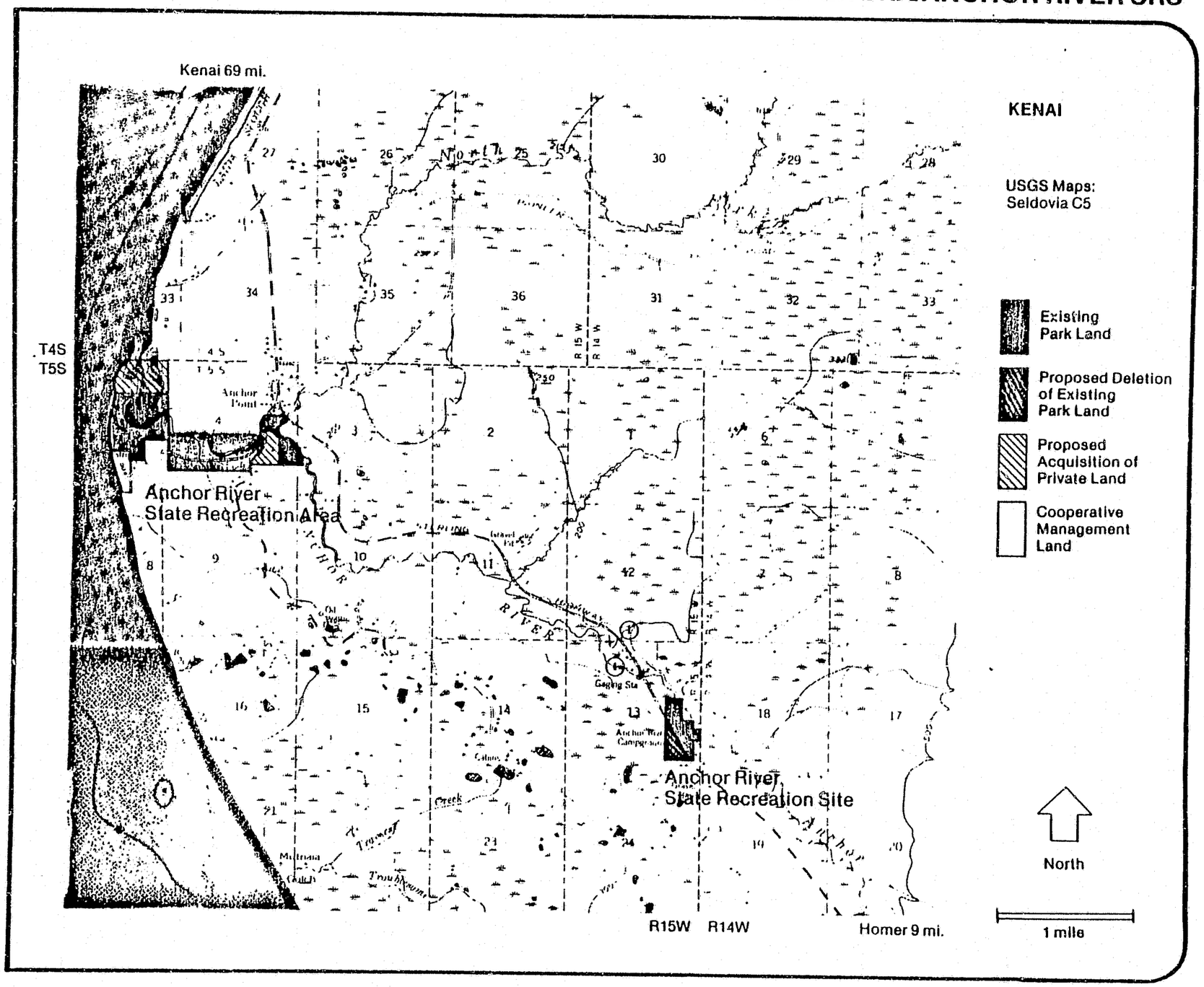
STARISKI SRS/WHISKEY GULCH SRS



7-1-125

ANCHOR RIVER SRA/ANCHOR RIVER SRS



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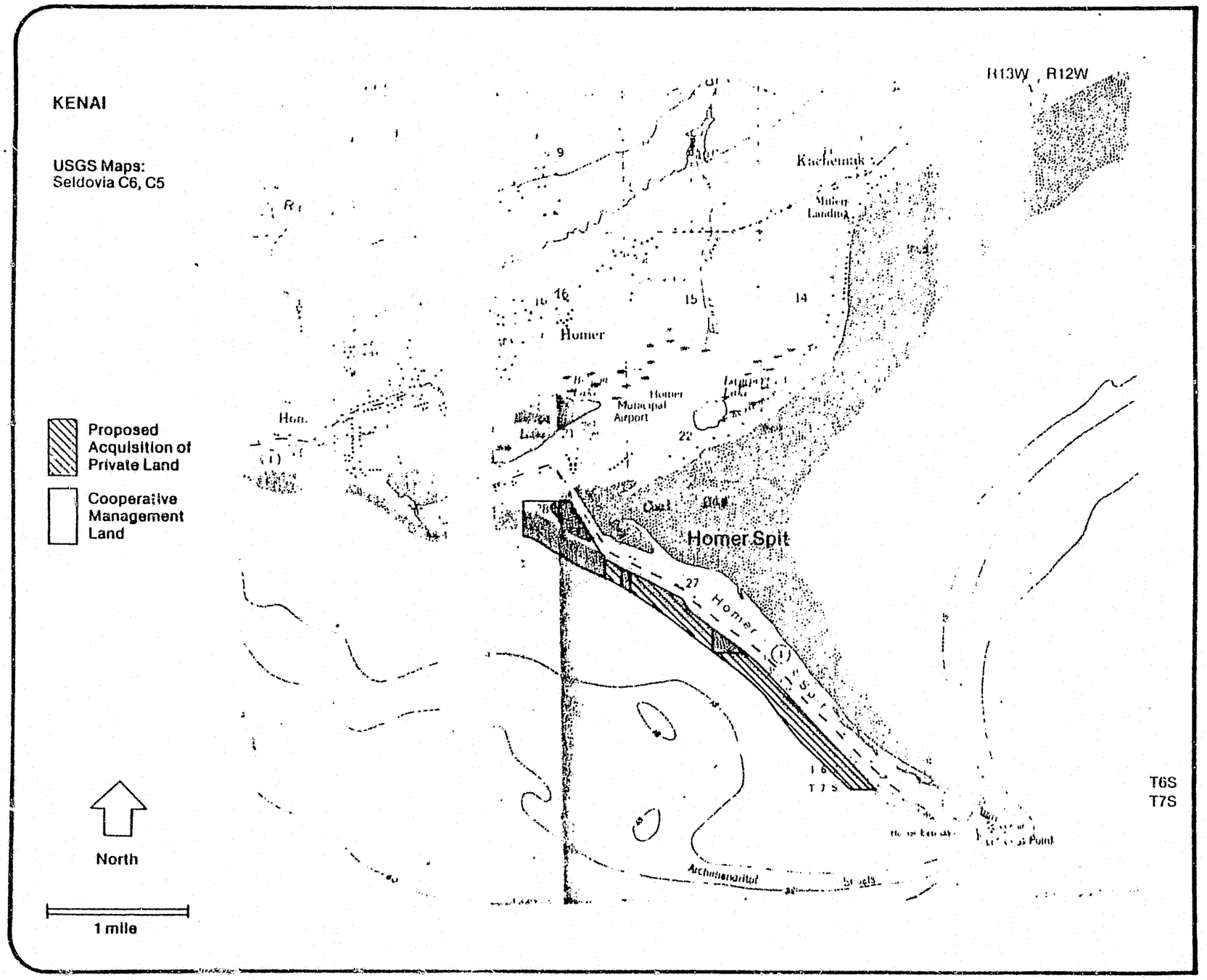
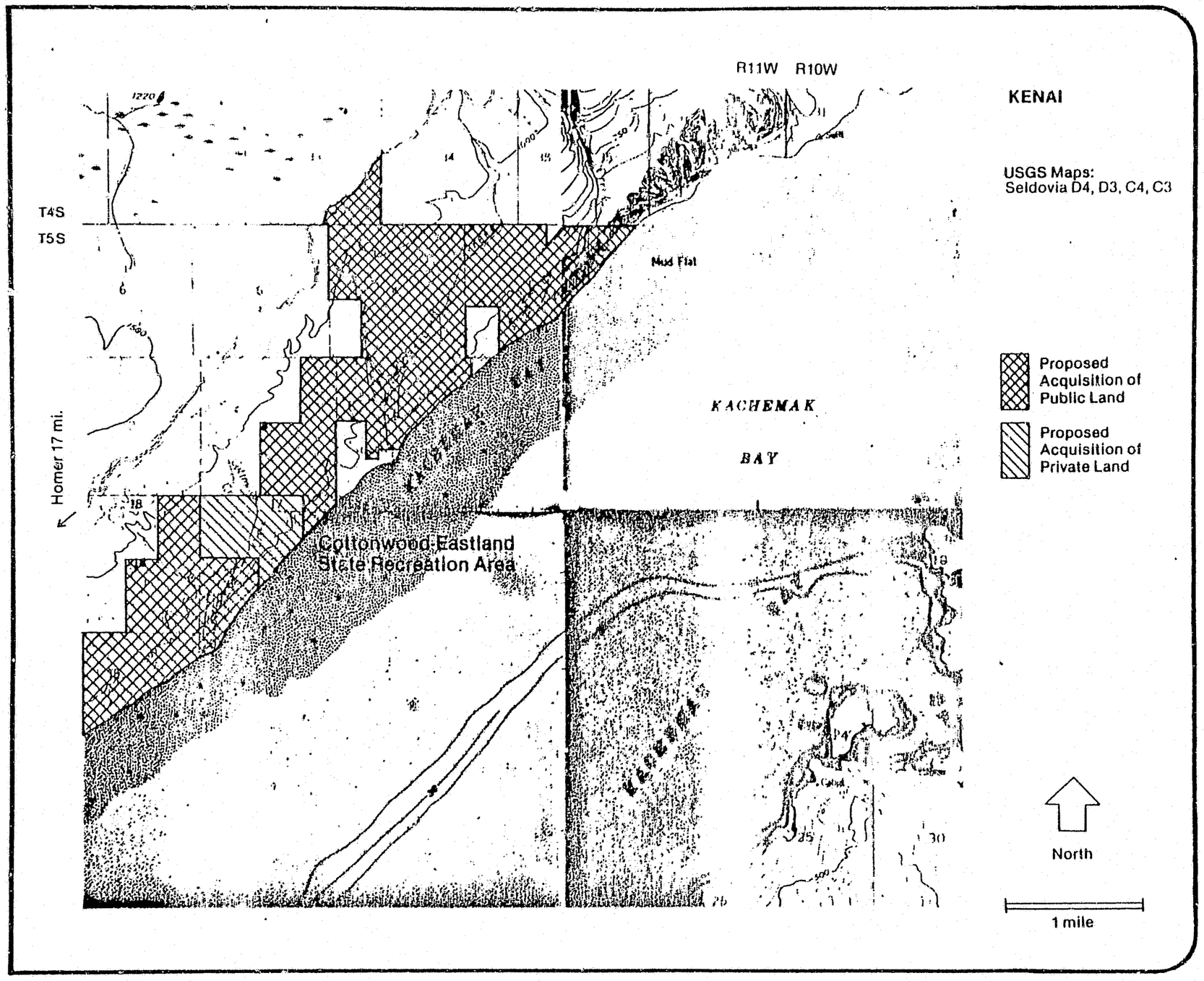
HOMER SPIT



7-1-127

122

COTTONWOOD-EASTLAND SRA



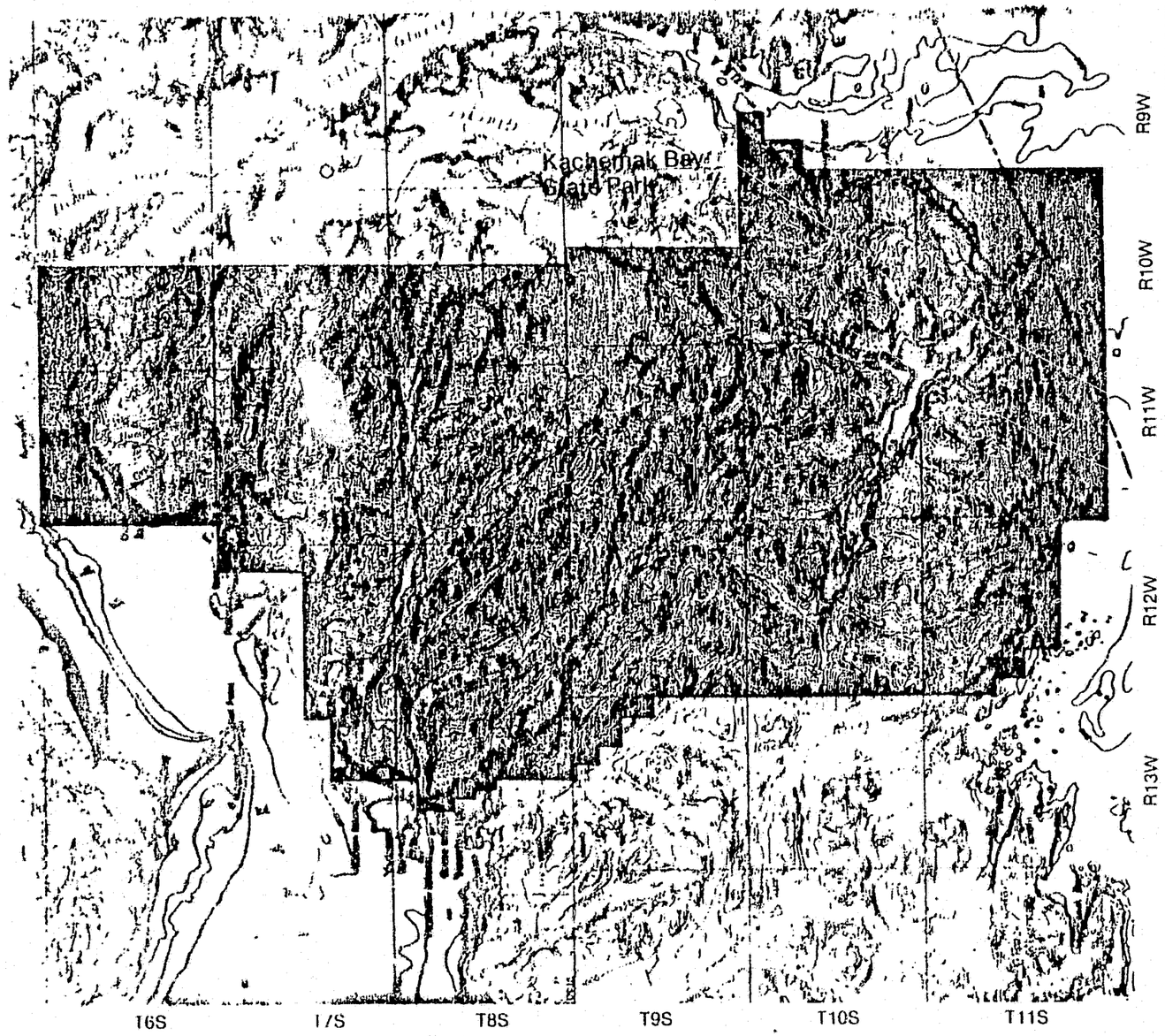
7-1-128

KACHEMAK BAY SP

KENAI

USGS Maps:
Seldovia

Existing
Park Land

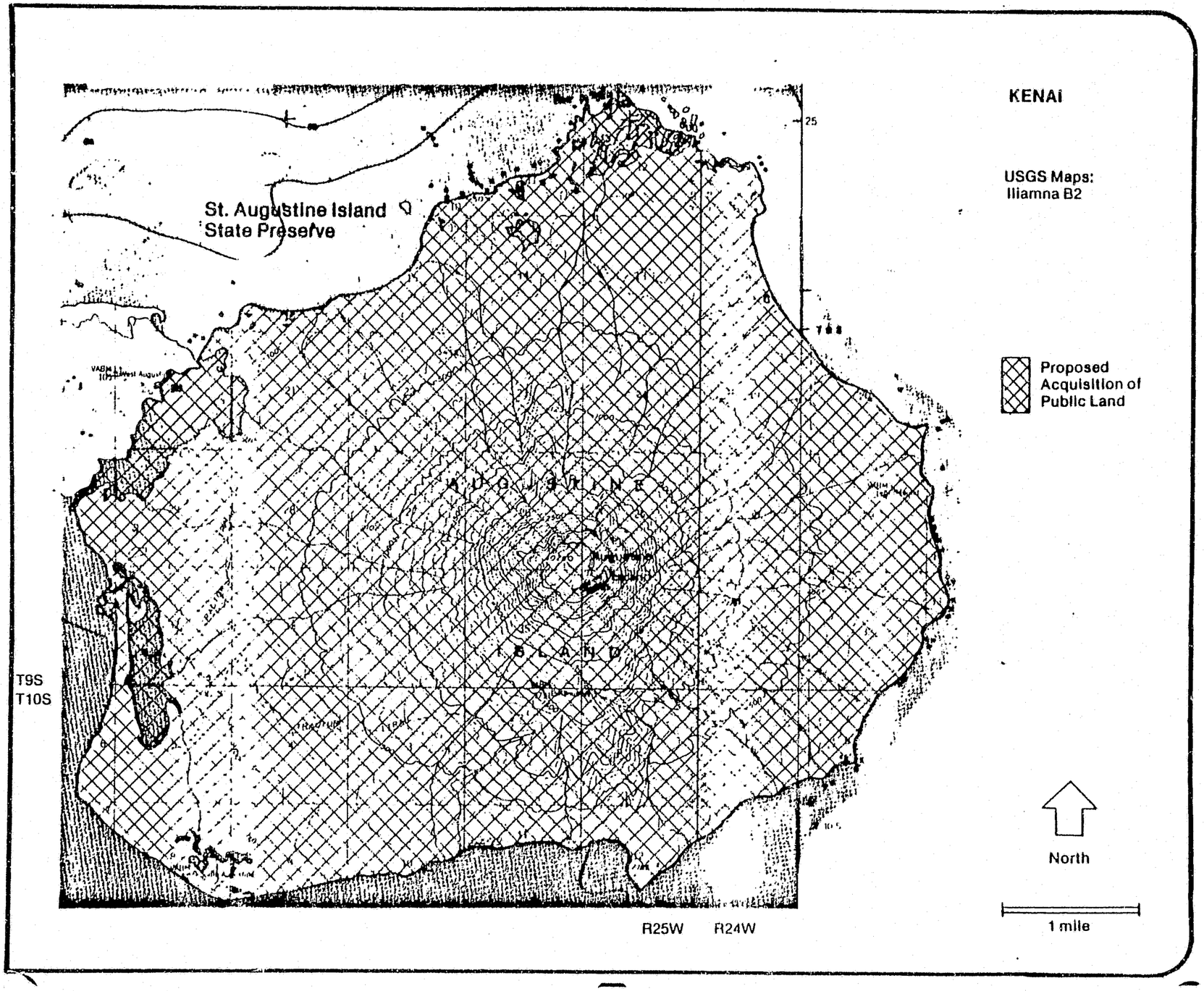


North

6 miles

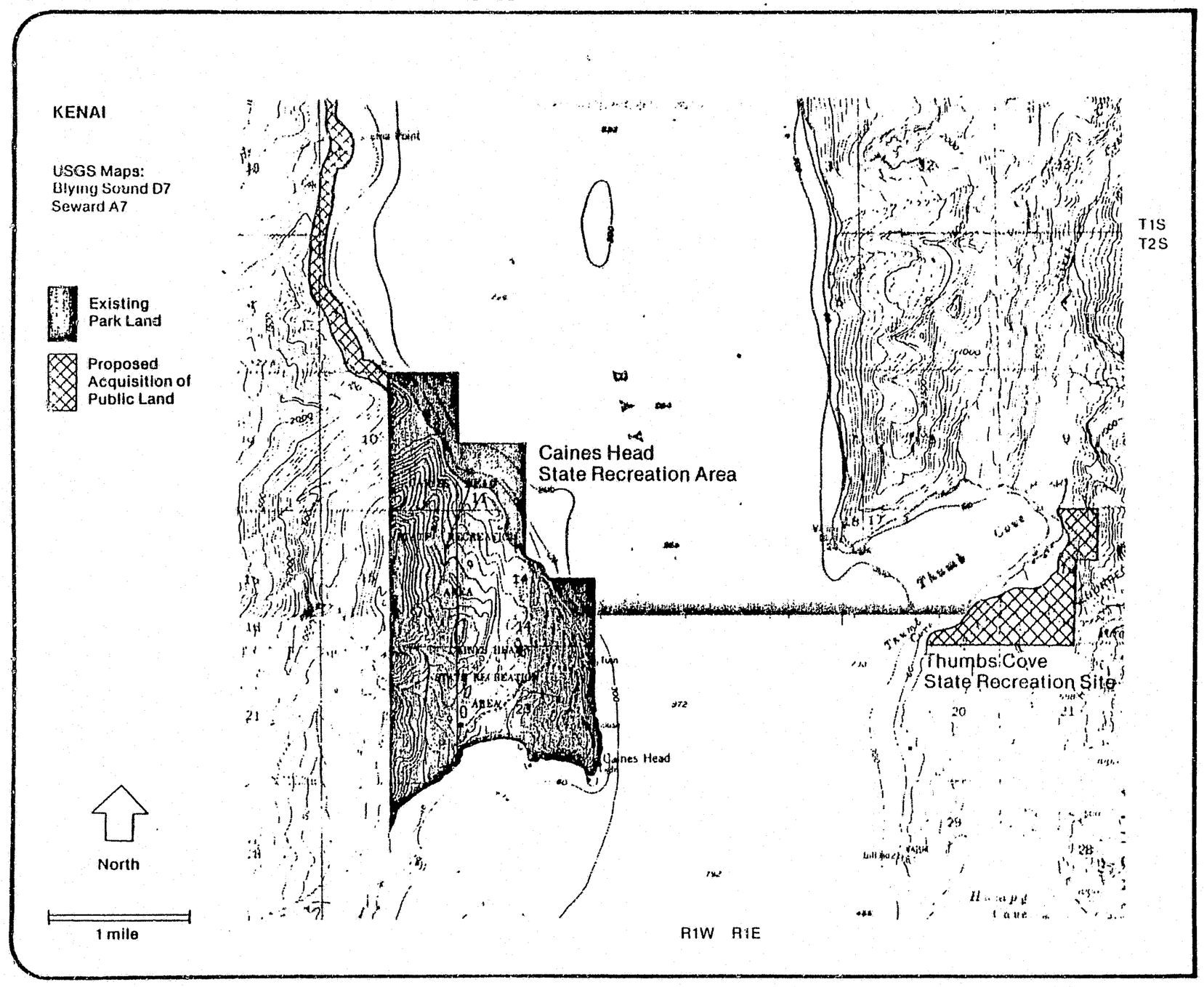
7-1-129

ST. AUGUSTINE ISLAND SPr



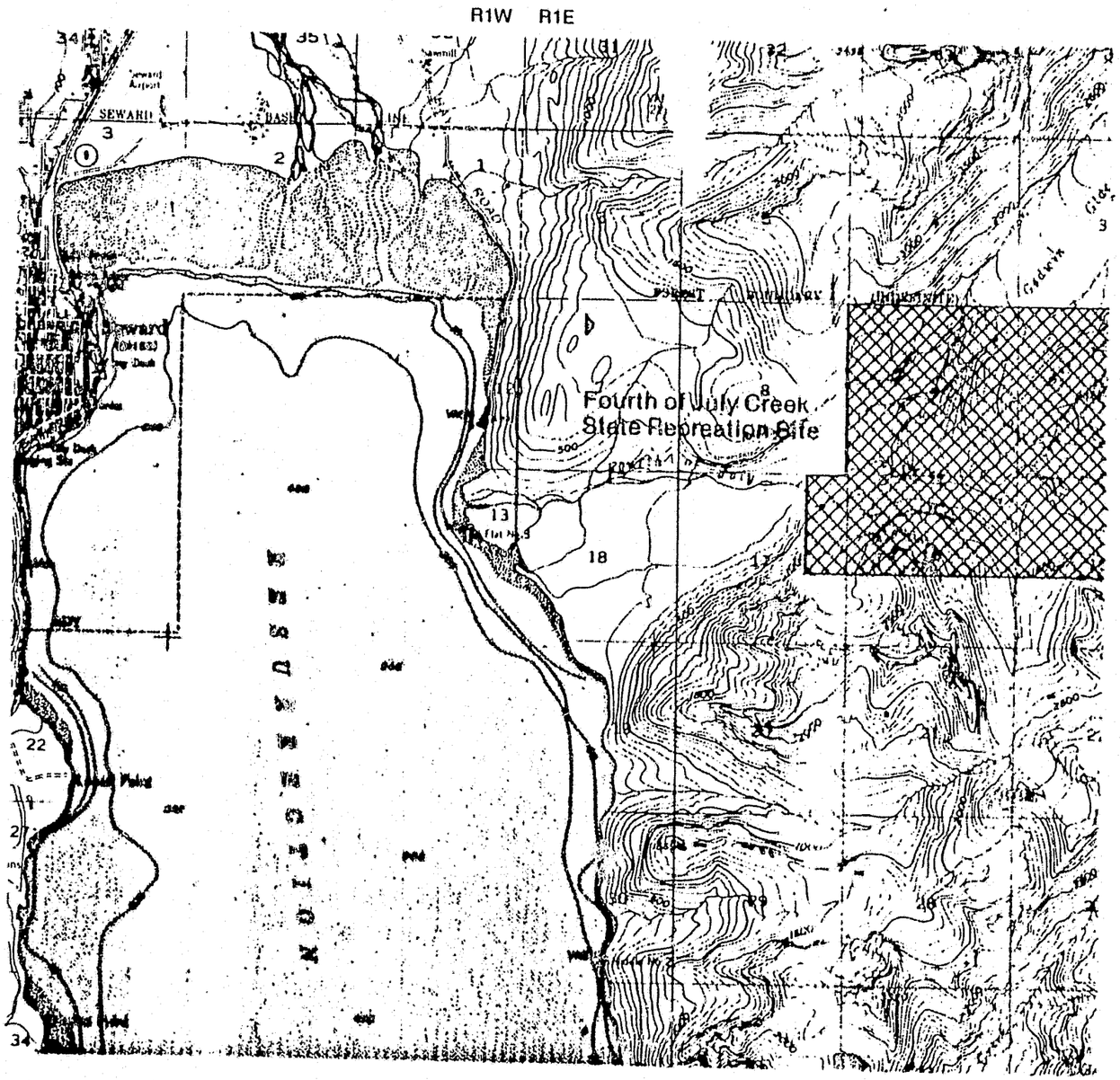
7-1-130

CAINES HEAD SRA/THUMBS COVE SRS



7-1-131

FOURTH OF JULY CREEK SRS



USGS Maps:
Seward A7, A6

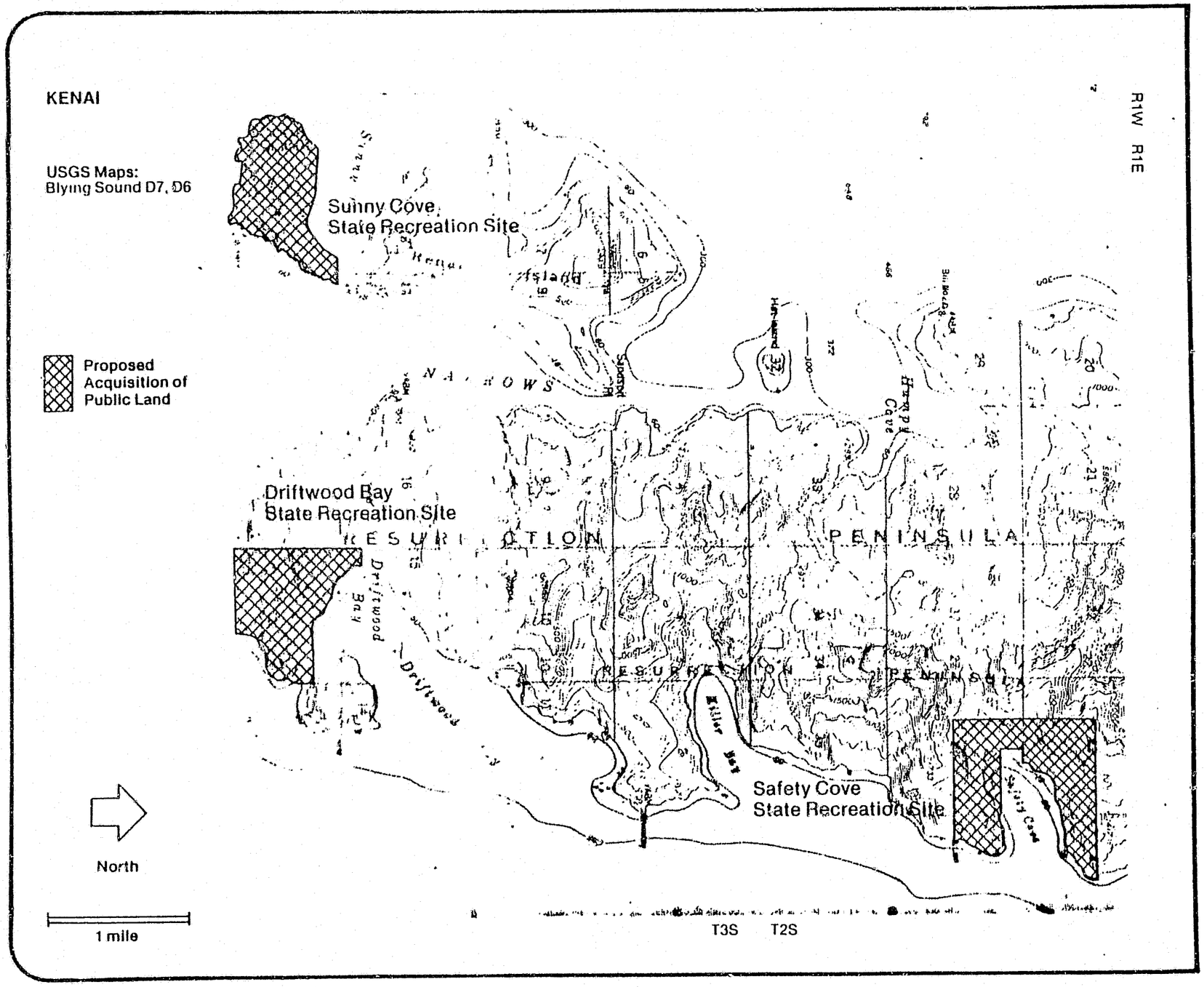
Proposed Acquisition of Public Land

North

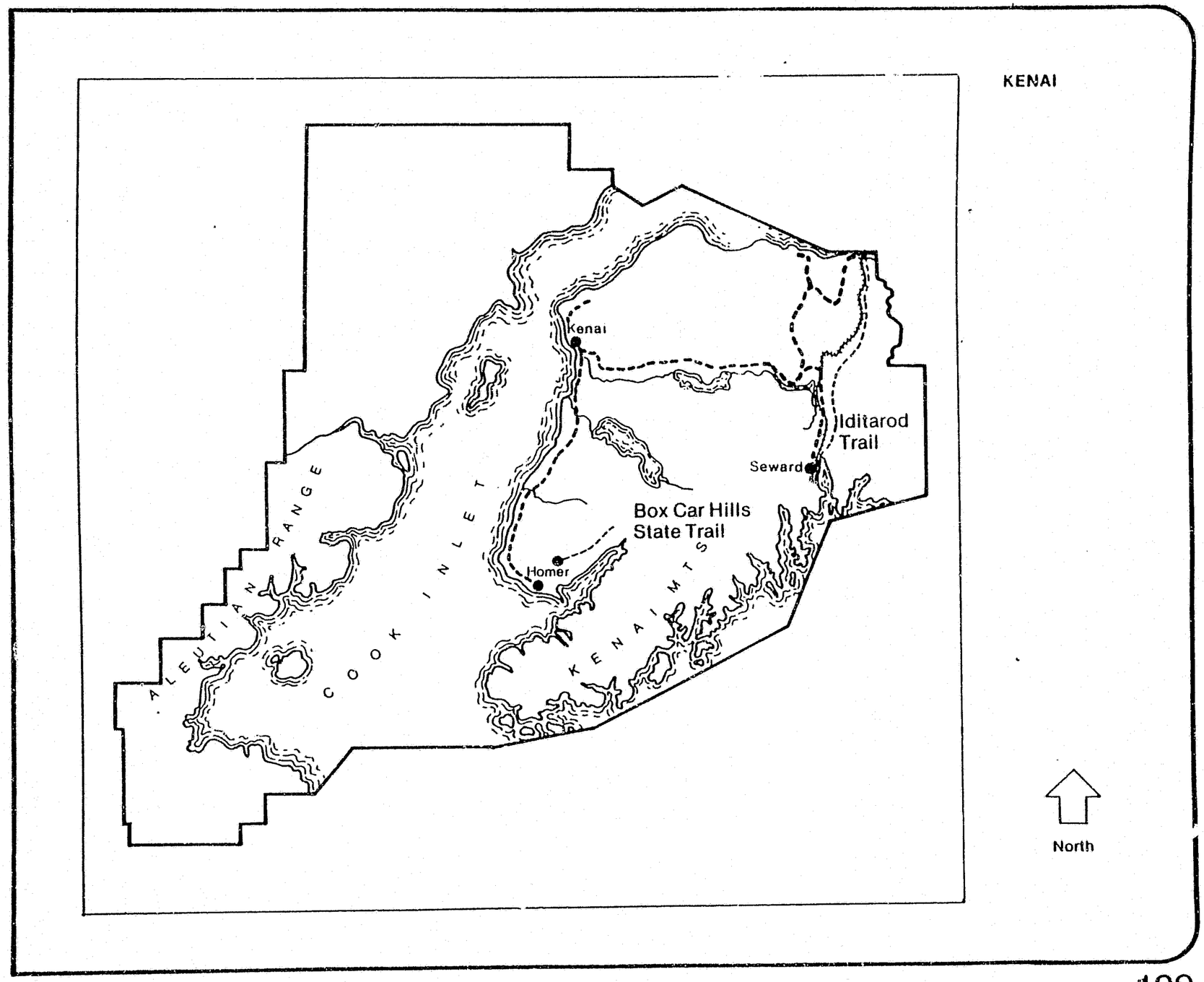
1 mile

7-1-132

SAFETY COVE SRS/DRIFTWOOD BAY SRS/SUNNY COVE SRS



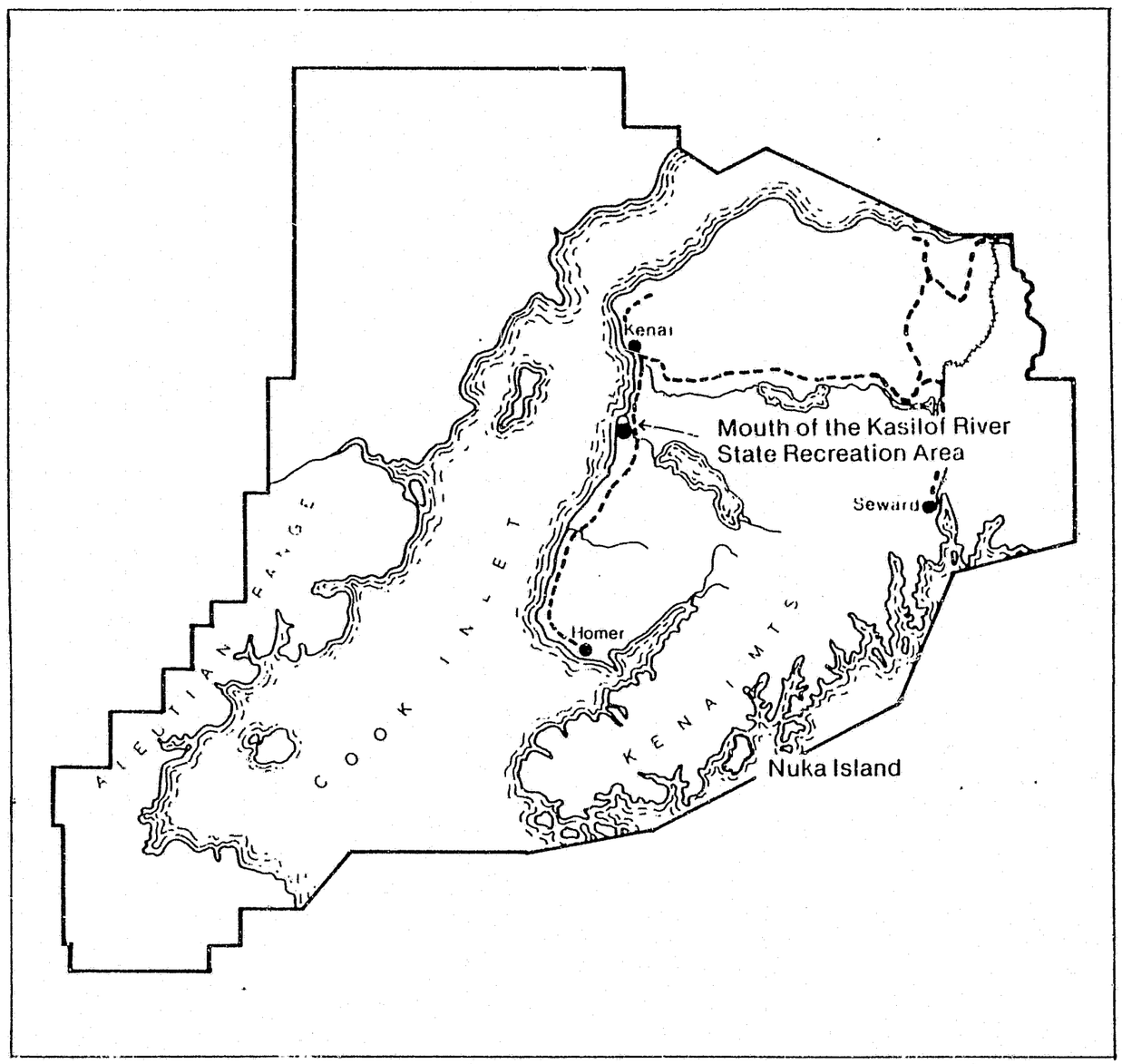
7-1-132


KENAI
Kenai
Iditarod
Trail
Seward
Box Car Hills
State Trail
Homer
ALEUTIAN RANGE
COOK INLET
KENAI MTS
North

7-1-134

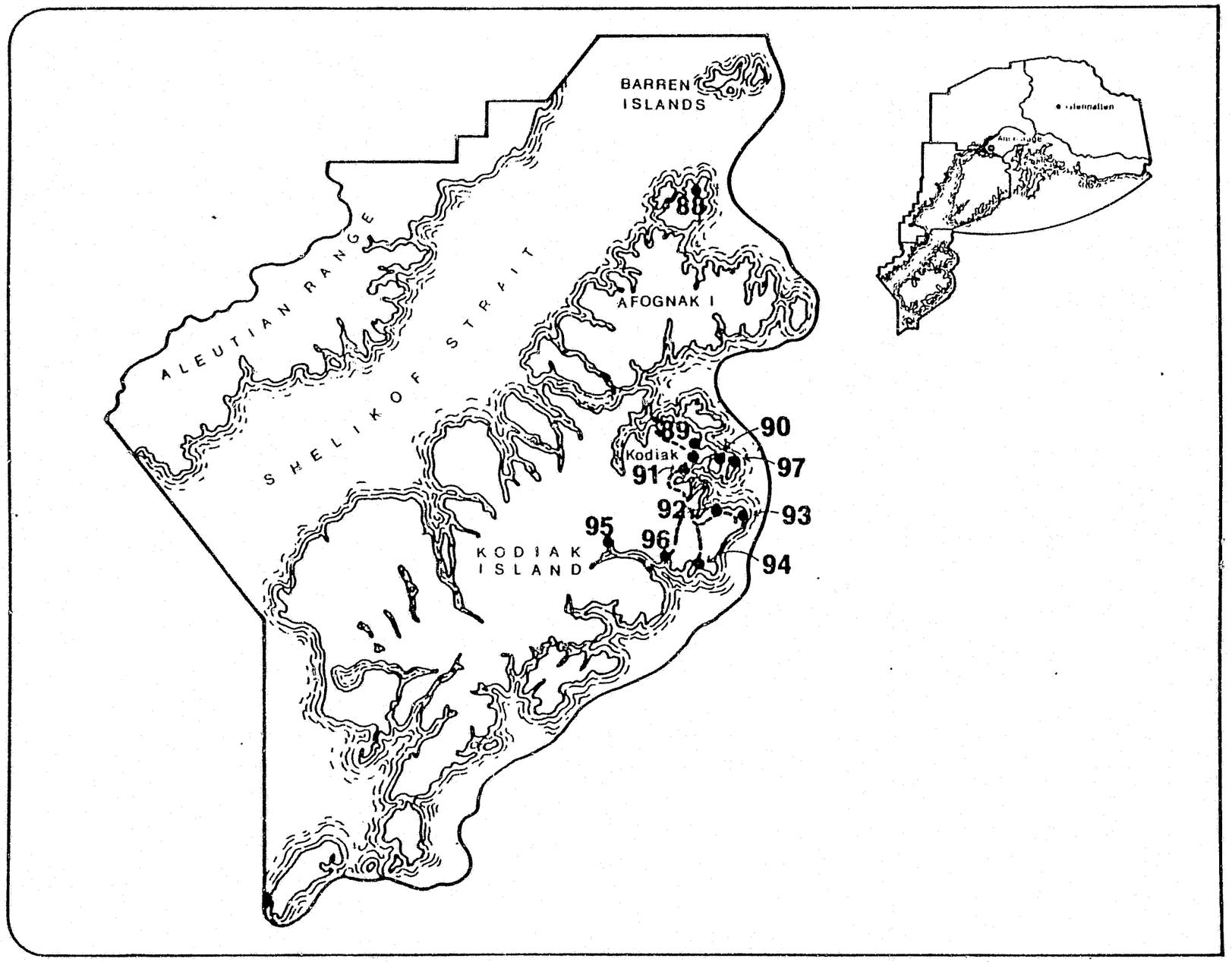
FUTURE CONSIDERATIONS

KENAI



North

7-1-135


BARREN ISLANDS
88
AFOGNAK I
ALEUTIAN RANGE
SHELIKOF STRAIT
89
90
Kodiak
91
97
92
93
95
96
94
KODIAK ISLAND

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88. Shuyak Island SP
89. Fort Abercrombie SHP
90. Woody Island SRS
91. Buskin River SRS
92. Roslyn Beach SRS
93. Cape Chiniak SRA
94. Pasagshak SRS
95. Hidden Basin SRA
96. Saultry Cove SRS
97. Long Island SP

ISSUES
- lack of public recreation developments
- limited public lands along road system
- need for access across private lands to public lands

PUBLIC PREFERENCE
- develop road-accessible recreational facilities
- preserve coastal character
- maintain public access
- develop marine park sites

OTHER AGENCIES AND THE PRIVATE SECTOR PROVIDING RECREATIONAL OPPORTUNITIES
- U.S. Fish & Wildlife Service: Kodiak Island National Wildlife Refuge - remote backcountry pursuits, boat-oriented hunting
- Private: lodges, guiding services and charters
- U.S. Coast Guard: public recreational land base
- Community: school-related recreational programs

SUBREGION CHARACTERISTICS
- coastal influence of Pacific Ocean and beaches
- forest and grasslands, sheltered bays
- historic Native and Russian cultures and World War II remains

STATE PARK REPRESENTATION
- EXISTING: examples of World War II and coastal environments
- NEEDED: representation of coastline recreational diversity, road-accessible areas, Russian and Native history and marine park sites

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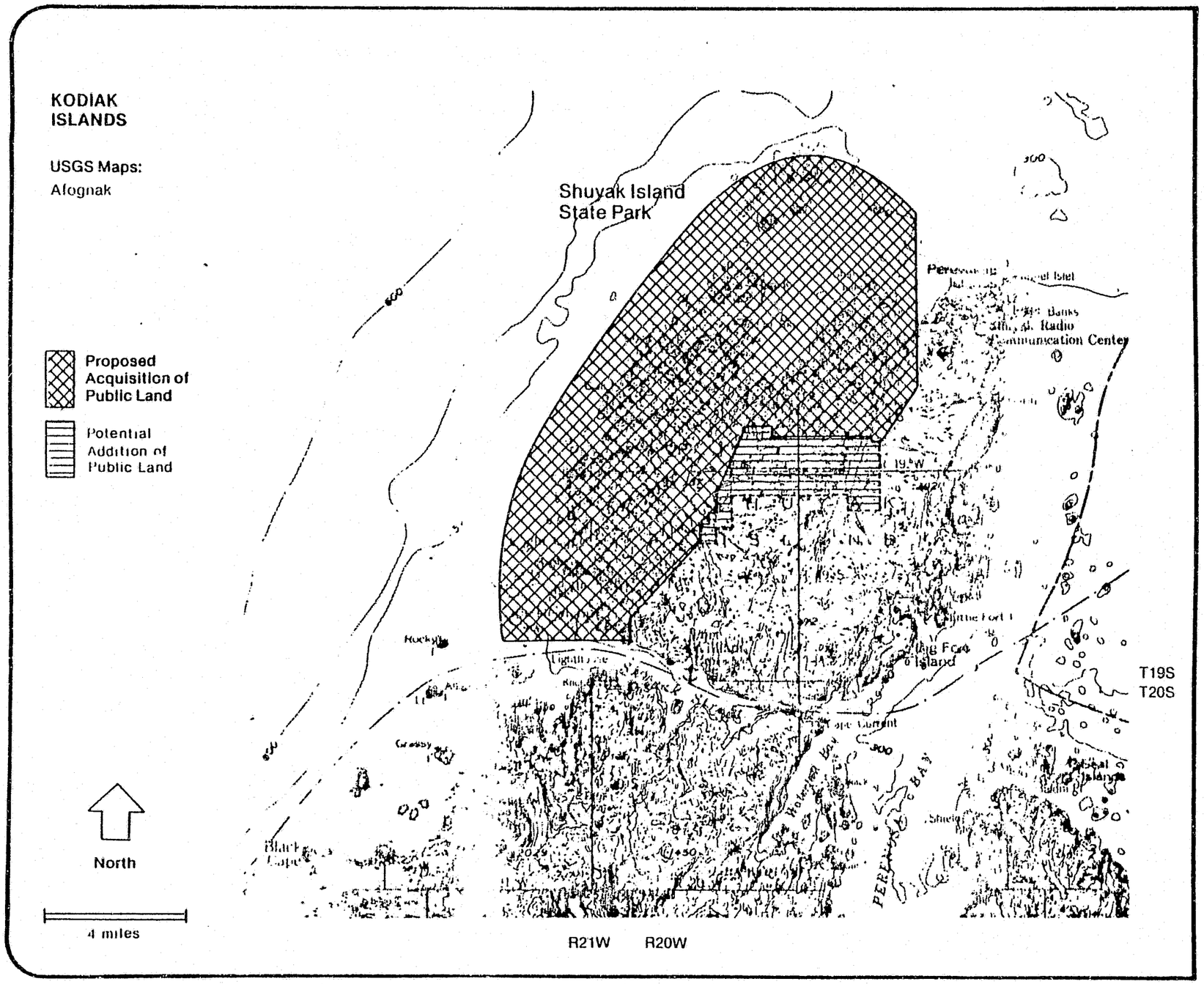
Kodiak Islands Subregion Recommendations

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Shuyak Island State Park (proposed)	136	I	Acquisition: cooperate with Kodiak Island Borough to obtain legislative establishment of area as a State Park
		II	Planning: prepare management plan; define access points and modes of access
		III	Development: implement management plan
		III	Special Management Considerations: establish staffing, visitor services and information program
Fort Abercrombie State Historic Park (existing)	137	II	Planning: update management plan
		II	Development: implement existing site plan
		I	Special Management Considerations: protect cultural features from recreational impact
Woody Island State Recreation Site (proposed)	138	I	Acquisition: obtain 80 acres by administrative action
		II	Planning: prepare management plan
		II	Development: implement management plan
Buskin River State Recreation Site (existing)	138	II	Acquisition: obtain cooperative agreement for parcel near entrance
		III	Planning: consider future expansion needs and develop management plan
		I	Development: implement existing site plan
Roslyn Beach State Recreation Site (proposed)	139	II	Acquisition: obtain 600 acres by administrative action
		II	Planning: prepare management plan
		II	Development: implement management plan
Cape Chiniak State Recreation Area (proposed)	139	III	Acquisition: obtain 1800 acres by purchase or exchange, or obtain a management agreement with Koniag, Inc.
		III	Planning: prepare management plan
		III	Development: implement management plan

UNIT	MAP PAGE #	PHASE	RECOMMENDATIONS
Pasagshak State Recreation Site (existing)	140	III III I	Acquisition: obtain joint use agreement with the Bureau of Land Management and grazing lease-holders for Pasagshak Point and Narrow Cape area Planning: prepare management plan for expanded area Development: implement existing site plan and develop existing funded projects
Hidden Basin State Recreation Area (future consideration)	141		These areas may be included as units of the State Park System depending on recreational needs, use preferences and upon available funding.
Saultry Cove State Recreation Site (future consideration)	141		
Long Island State Park (future consideration)	141		

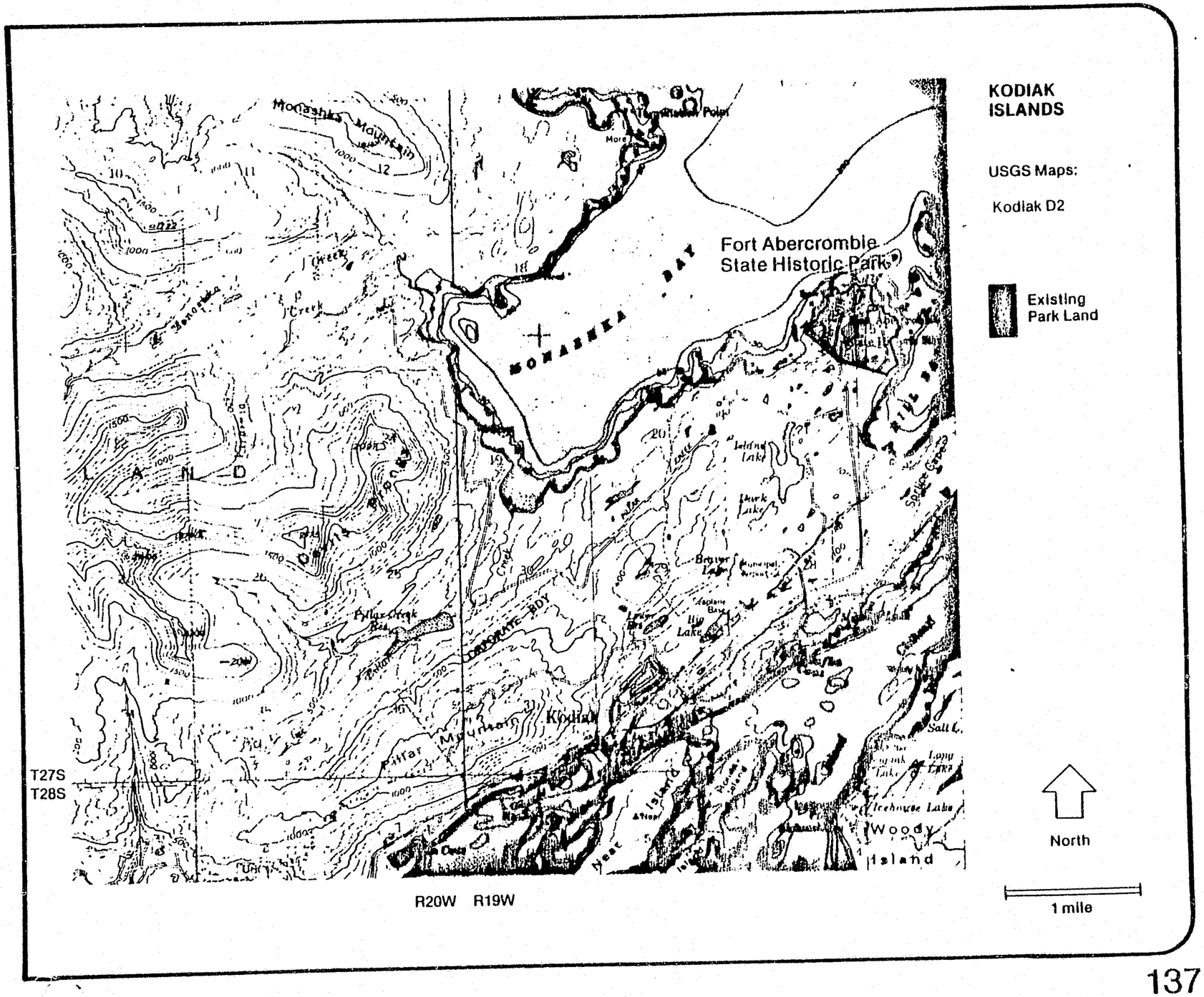
7-1-140

SHUYAK ISLAND SP



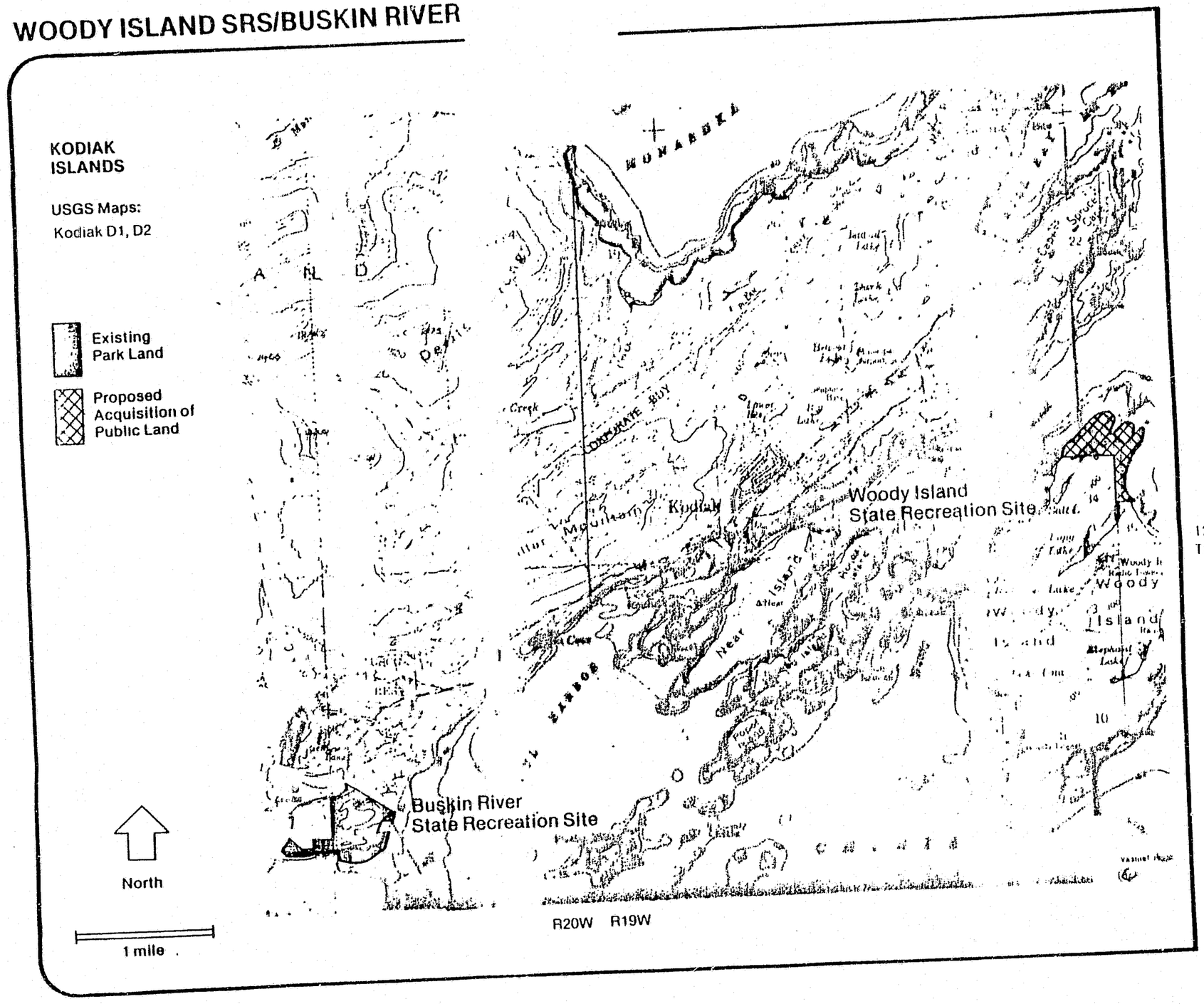
7-1-14

FORT ABERCROMBIE SHP



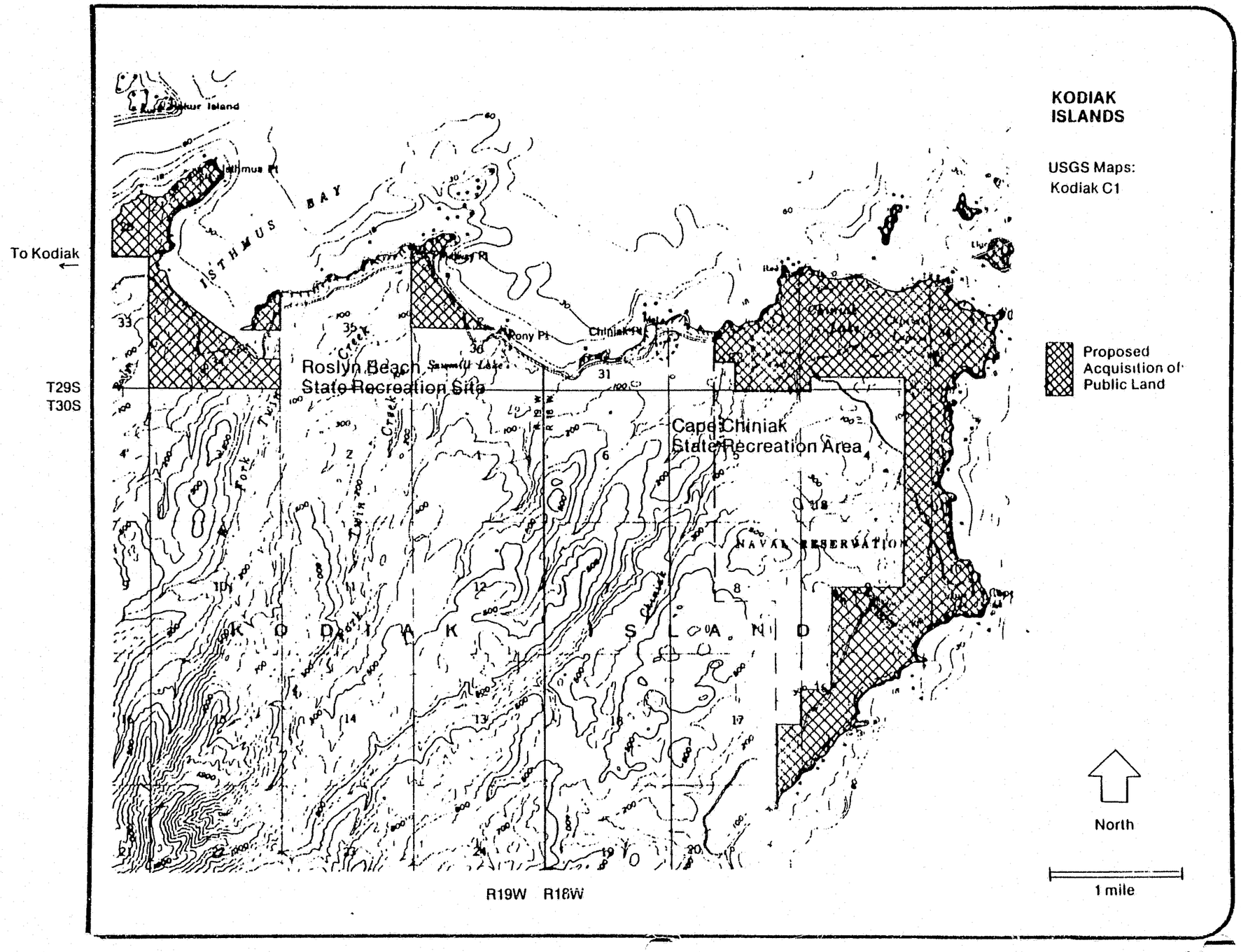
7-1-142

WOODY ISLAND SRS/BUSKIN RIVER



7-1-143

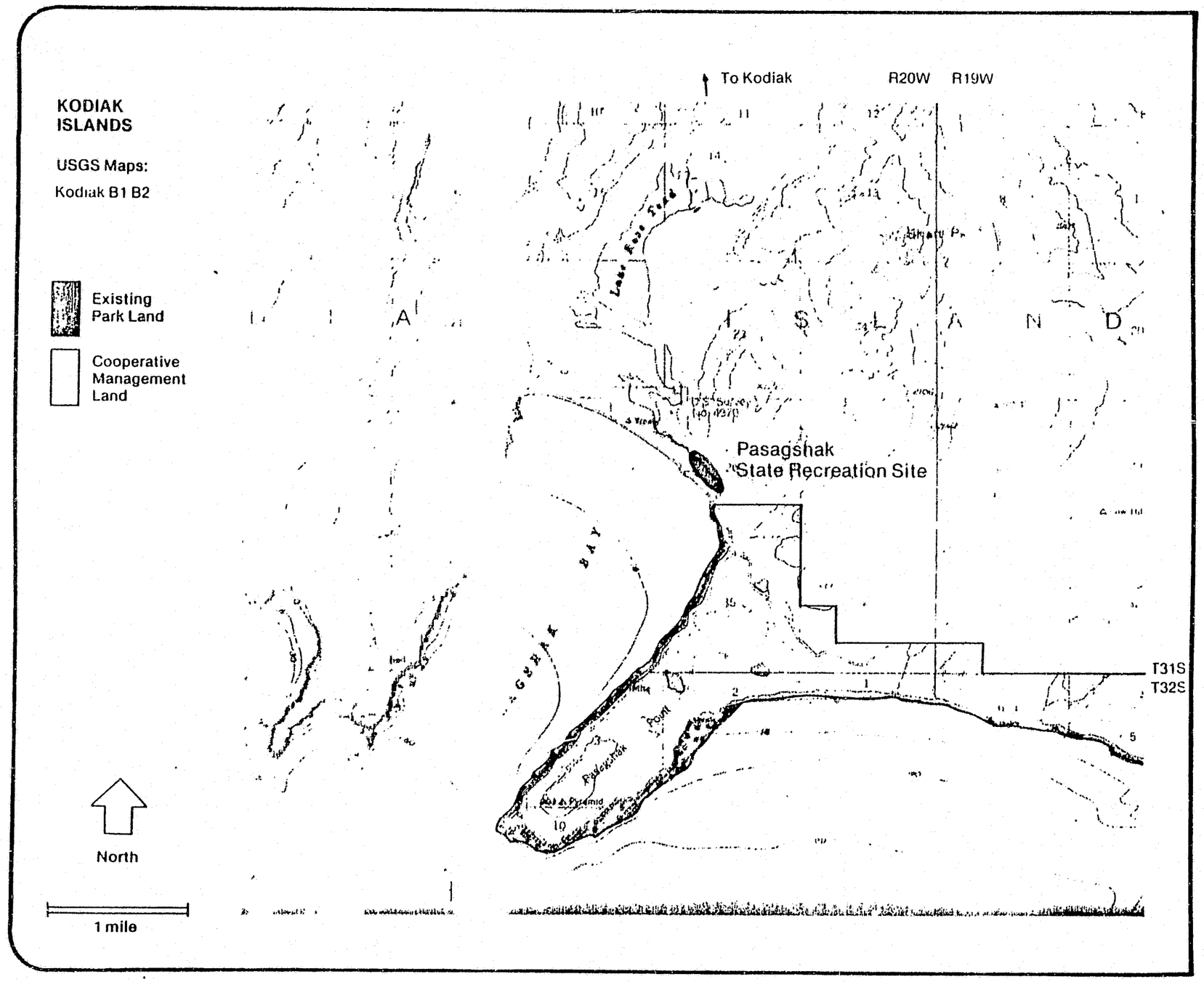
ROSLYN BEACH SRS/CAPE CHINIAK SRA



7-1-144

1

PASAGSHAK SRS



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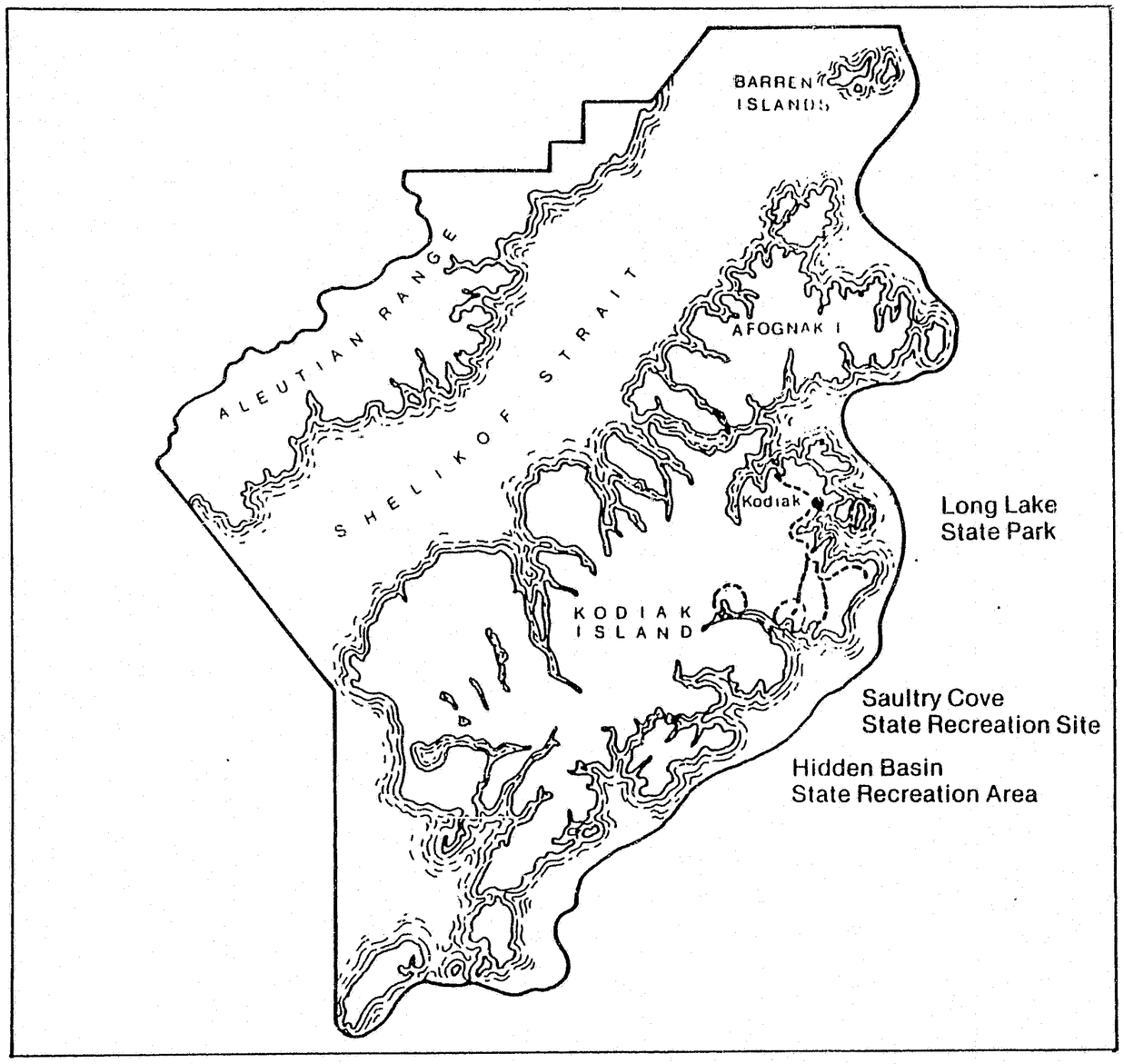

KODIAK
ISLANDS
BARREN
ISLANDS
ALEUTIAN RANGE
SHELIKOF STRAIT
AFOGNAK I
Kodiak
Long Lake
State Park
KODIAK
ISLAND
Saultry Cove
State Recreation Site
Hidden Basin
State Recreation Area
North

7-1-146

7-1-147

Methods

The Alaska Division of Parks will use various methods to implement the recommendations of this plan.

Land acquisitions: State-owned lands may be added to the State Park System through legislative or administrative action. Alaska Statute 38.05.300. requires action by the legislature in situations where land proposed for addition to the park system exceeds 640 acres. The Division of Parks will work cooperatively with the Department of Natural Resources' Office of the Commissioner, the State's Office of the Governor, the Legislature and various interest groups to secure legislative establishment of park units greater than 640 acres. Park units of a size equal to or less than 640 acres may be established by administrative action by the Department of Natural Resources. Legislative designation is preferred over administrative action. Inter-agency land management agreements (ILMA's) will be used as necessary to facilitate management and in accordance with the Department's Statewide Natural Resource Plan.

Acquisitions of private land need to be carefully evaluated and planned. Because of the expense to the state of acquiring fee simple title to private lands, less-than-fee acquisitions may be utilized when resource protection and public use goals can be met. Funds for the acquisition of private lands will come from a small, legislative capital improvements appropriation. Should the federal government reestablish funding for the Land and Water Conservation Fund, grants for the acquisition of park lands could also be obtained from this source. Where rapid action is needed to acquire a key parcel of private land, and state funds are unavailable, the division will consider working with groups such as the Trust for Public Lands which can acquire land. Acquisition will be pursued on a willing-seller basis utilizing standard appraisal practices.

In some situations, cooperative Agreements for Recreation and Conservation (ARC's) may suffice to secure an adequate interest in a parcel of land to meet public-use and resource-protection goals. This method of acquisition is most commonly used when the land is owned by another government entity or a quasi-public organization, although the state may enter into agreements with private landowners.

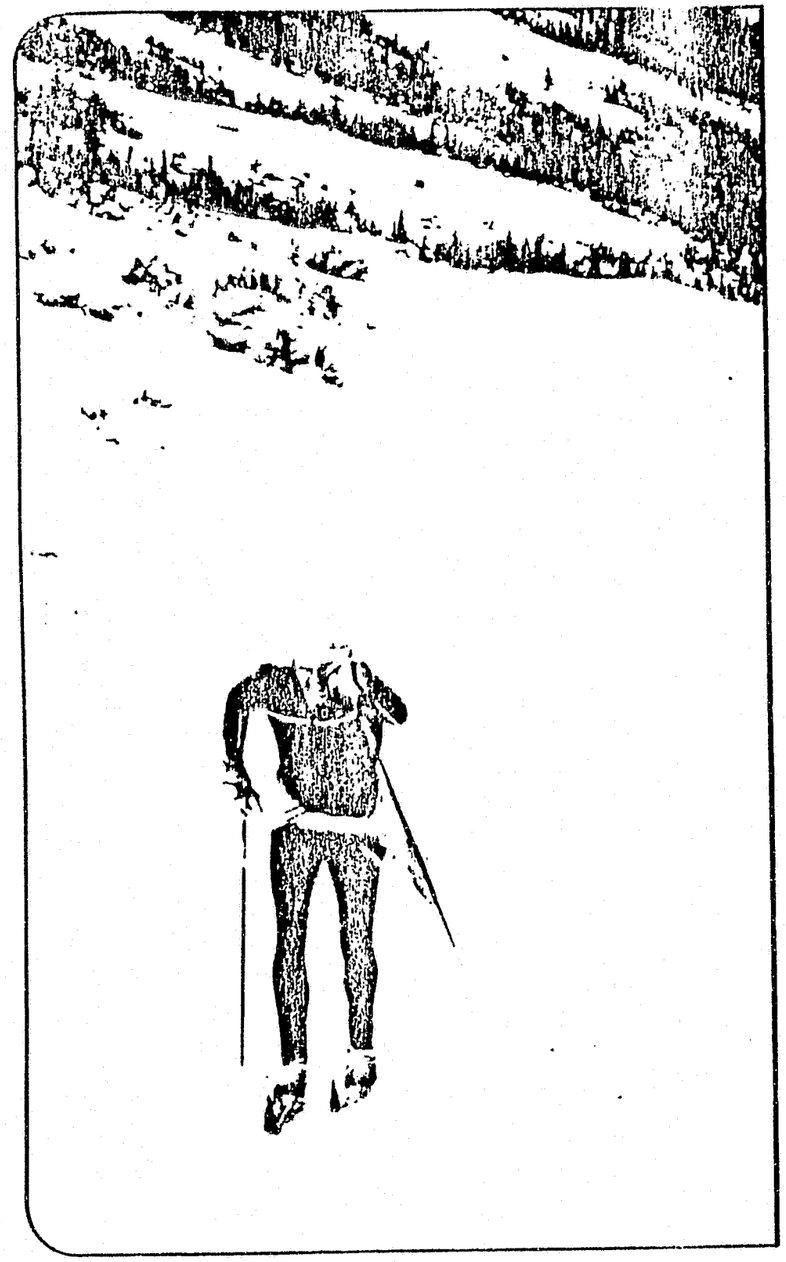
Planning

Additional planning -- necessary to implement park development and management recommendations -- will involve the preparation of management and site development plans. Management plans are prepared to serve as long-range plans for the management of lands, public use, and resources of a park unit. Site development plans are prepared to provide a detailed design for the construction of recreational facilities within a park unit. Funding for the necessary planning activities to implement the recommendations of this report will be dependent upon legislative appropriations in either the operating or capital improvement budgets.

Development

Development of a number of existing and proposed park units is recommended within the Southcentral region. However, due to the lack of a current management plan for many of these

7-1-148



units, the exact nature of the proposed facilities are unknown at this time. Once management plans have been completed, funds for development of park facilities will be sought through the division's annual submission, to the state administration and legislature, of a six-year capital improvement budget.

Management

Securing adequate funding for the management of park unit lands and facilities is important to insure park resources are adequately protected, facilities are well maintained and public safety services are available to park users. Fiscal notes need to be included with funding requests to the legislature for capital improvements. As new park units are acquired, staff will be needed to provide supervision and management of park lands. Leaving new parks unstaffed frequently leads to complex management problems due to unmanaged public use. The allocation of district staff should be reassessed annually, particularly as new areas and facilities are added.

Phasing

Each recommendation of this plan has been assigned to a I, II or III phase of implementation. The recommendations are relisted in this section by phase to facilitate implementation of the plan. Each phase represents the priority of the time frame for acquisition, planning, development and management of state park units. Consideration will be first given to Phase I recommendations, followed by Phase II, then Phase III.

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ACQUISITION

Phase I

Squirrel Creek SRS
Little Nelchina SRS
Nelchina-Tazlina SRR
Kepler-Bradley SRA
Hatcher Pass SRA
Nancy Lake SRA
Willow Creek SRA
Chickaloon ST
Little Susitna SRR
Alexander Creek SRR
Talachulitna SRR
Talkeetna SRR
Lake Creek SRR
Kroto Creek SRR
Iditarod Trail
Mirror Lake SRS
Peters Creek SRS
Chugach SP
Blueberry Lake SRS
Valdez Glacier SRS
Prince William Sound-
Marine Park System
Bings Landing SRS
Scout Lake SRS
Morgan's Landing SRA
Funny River SRS
Lower Kenai River SRSs
Cohoe Beach SRS
Ninilchik SRA
Deep Creek SRA
Whiskey Gulch SRS
Anchor River SRA
Homer Spit
Cottonwood-Eastland SRA
Kachemak Bay SP
St. Augustine Island SPr
Caines Head SRA
Thumbs Cove SRS
Fourth of July Creek SRS
Safety Cove SRS
Driftwood Bay SRS
Sunny Cove SRS
Shuyak Island SP
Woody Island SRS

Phase II

Worthington Glacier SRS
Lake Louise SRA
Eagle ST
Long Lake SRS
Bonnie Lake SRS
Matanuska Valley
Colony Farm SHP
Moose Creek SRS
Montana Creek SRS
Independence Mine SHP
Yentna River SRSs
Bernice Lake SRS
Captain Cook SRA
Georgievsk Redoubt SHP
Clam Gulch SRA
Roslyn Beach SRS
Buskin River SRS

Phase III

Porcupine Creek SRS
Finger Lake SRS
Rocky Lake SRS
Big Lake (East) SRS
Big Lake (South) SRS
Denali SP
Kenai Keys SRA
Kenai River Islands SRSs
Cape Chiniak SRA
Pasagshak SRS

PLANNING

Phase I

Lake Louise SRA
Little Nelchina SRS
Nelchina-Tazlina SRR
Kepler-Bradley SRA
Independence Mine SHP
Hatcher Pass SRA
Nancy Lake SRA
Willow Creek SRA
Denali SP
Chickaloon ST
Little Susitna SRR
Alexander Creek SRR
Talachulitna SRR
Talkeetna SRR
Lake Creek SRR
Kroto Creek SRR
Prince William Sound-
Marine Park System
Kenai Keys SRA
Bings Landing SRS
Izaak Walton SRS
Nilnunqa SHP
Morgan's Landing SRA
Funny River SRS
Kenai River Islands SRSs
Lower Kenai River SRSs
Slikok SRS
Clam Gulch SRA
Ninilchik SRA
Deep Creek SRA
Homer Spit
Kachemak Bay SP
St. Augustine Island SPr
Caines Head SRA
Iditarod Trail

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Phase II

Tolsona Creek SRS
Eagle ST
Long Lake SRS
Matanuska Valley
    Colony Farm SHP
Montana Creek SRS
Yentna River SRSs
Georgievsk Redoubt SHP
Cohoe Beach SRS
Whiskey Gulch SRS
Cottonwood-Eastland SRA
Thumbs Cove SRS
Fourth of July Creek SRS
Safety Cove SRS
Driftwood Bay SRS
Sunny Cove SRS
Shuyak Island SP
Fort Abercrombie SHP
Woody Island SRS
Roslyn Beach SRS

Phase III

Squirrel Creek SRS
Bonnie Lake SRS
King Mountain SRS
Moose Creek SRS
Nancy Lake SRS
Blueberry Lake SRS
Scout Lake SRS
Captain Cook SRA
Kasilof River SRS
Buskin River SRS
Cape Chiniak SRA
Pasagshak SRS

DEVELOPMENT

Phase I

Worthington Glacier SRS
Lake Louise SRA
Little Nelchina SRS
Nelchina-Tazlina SRR
Matanuska Glacier SRS
Moose Creek SRS
Kepler-Bradley SRA
Independence Mine SHP
Hatcher Pass SRA
Nancy Lake SRA
Willow Creek SRA
Denali SP
Iditarod Trail
Chugach SP
Blueberry Lake SRS
Prince William Sound-
    Marine Park System
Bings Landing SRS
Izaak Walton SRS
Morgan's Landing SRA
Clam Gulch SRA
Ninilchik SRA
Deep Creek SRA
Anchor River SRA
Homer Spit
Kachemak Bay SP
Caines Head SRA
Buskin River SRS
Pasagshak SRS
Kenai Keys SRA

Phase II

Long Lake SRS
Big Lake (East) SRS
Big Lake (South) SRS
Montana Creek SRS
Chikcaloon ST
Little Susitna SRR
Alexander Creek SRR
Talachulitna SRR
Talkeetna SRR
Lake Creek SRR
Kroto Creek SRR
Nilnunqa SHP
Funny River SRS
Cohoe Beach SRS
Johnson Lake SRA
Whiskey Gulch SRS
Cottonwood-Eastland SRA
St. Augustine Island SPr
Thumbs Cove SRS
Fourth of July Creek SRS
Safety Cove SRS
Driftwood Bay SRS
Sunny Cove SRS
Fort Abercrombie SHP
Woody Island SRS
Roslyn Beach SRS

Phase III

Squirrel Creek SRS
Tolsona Creek SRS
Eagle ST
Bonnie Lake SRS.
King Mountain SRS
Matanuska Valley
    Colony Farm SHP
Finger Lake SRS
Rocky Lake SRS
Yentna River SRSs
Scout Lake SRS
Kenai River Islands SRSs
Lower Kenai River SRSs
Slikok SRS

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Captain Cook SRA
Georgievsk Redoubt SHP
Kasilof River SRS
Stariski SRS
Shuyak Island SP
Cape Chiniak SRA

SPECIAL MANAGEMENT CONSIDERATIONS

Phase I

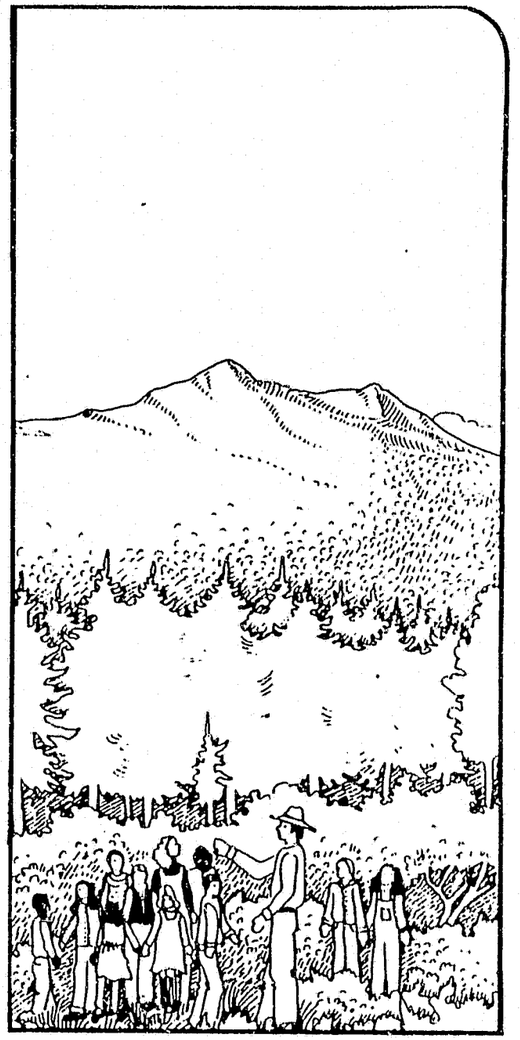
Porcupine Creek SRS
Dry Creek SRS
Worthington Glacier SRS
Lake Louise SRA
Little Nelchina SRS
Nelchina-Tazlina SRR
Independence Mine SHP
Nancy Lake SRA
Willow Creek SRA
Little Susitna SRR
Iditarod Trail
Chugach SP
Prince William Sound-
Marine Park System
Bings Landing SRS
Izaak Walton SRS
Nilnunqa SHP
Morgan's Landing SRA
Ninilchik SRA
Deep Creek SRA
Anchor River SRA
Anchor River SRS
Homer Spit
Kachemak Bay SP
Caines Head SRA
Fort Abercrombie SHP

Phase II

Eagle ST
Montana Creek SRS
Denali SP
Chickaloon ST
Alexander Creek SRR
Talachulitna SRR
Talkeetna SRR
Lake Creek SRR
Kroto Creek SRR
Kenai Keys SRA
Whiskey Gulch SRS
St. Augustine Island SPr
Thumbs Cove SRS
Fourth of July Creek SRS
Safety Cove SRS
Driftwood Bay SRS
Sunny Cove SRS

Phase III

Little Tonsina SRS
Matanuska Valley
Colony Farm SHP
Finger Lake SRS
Rocky Lake SRS
Big Lake (East) SRS
Big Lake (South) SRS
Kenai River Islands SRSs
Georgievsk Redoubt SHP
Johnson Lake SRA
Clam Gulch SRA
Shuyak Island SP



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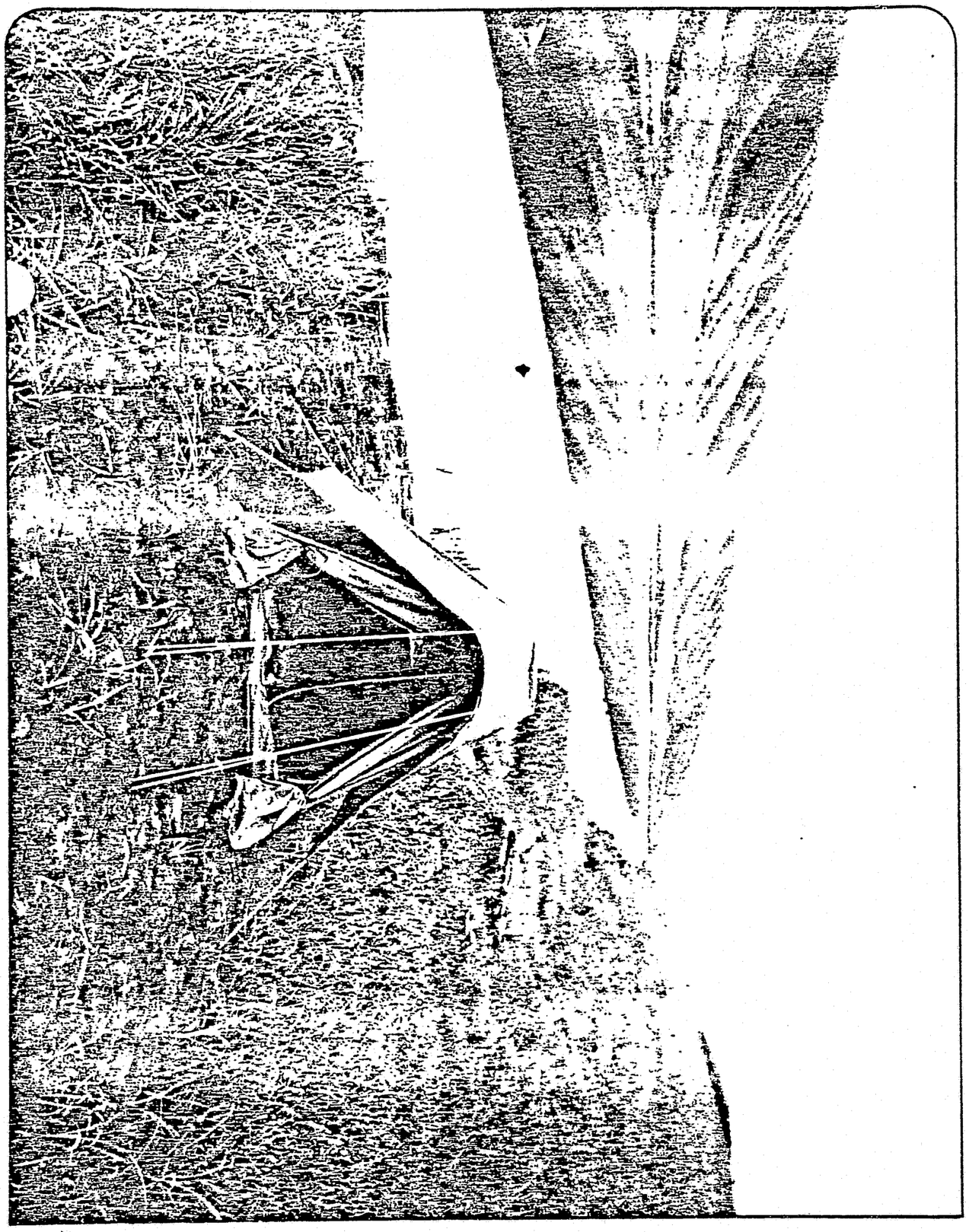
7-1-153



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Index of Units

RECOMMEN-DATION Page #	MAP Page #	UNIT TITLE (existing, proposed and future considerations)
66	81	Alexander Creek SRR
106	121	Anchor River SRA
107	121	Anchor River SRS
104	114	Bernice Lake SRS
64	76	Big Lake (East) SRS
64	76	Big Lake (South) SRS
102	111	Bings Landing SRS
107	129	Boxcar Hills ST
94	96	Blueberry Lake SRS
62	69	Bonnie Lake SRS
134	138	Buskin River SRS
108	126	Caines Head SRA
134	139	Cape Chiniak SRA
104	115	Captain Cook SRA
65	81	Chickaloon ST
86	89	Chugach SP
105	118	Clam Gulch SRA
105	117	Cohoe Beach SRS
107	123	Cottonwood-Eastland SRA
106	119	Deep Creek SRA
65	80	Denali SP
109	128	Driftwood Bay SRS
48	51	Dry Creek SRS
49	58	Eagle ST
63	75	Finger Lake SRS
134	137	Fort Abercrombie SHP
108	127	Fourth of July Creek SRS
103	112	Funny River SRS
104	116	Georgievsk Redoubt SHP
67	82	Gunsight Mountain SRA
63	74	Hatcher Pass SRA
135	141	Hidden Basin SRA
107	122	Homer Spit

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RECOMMEN-DATION Page #	MAP Page #	UNIT TITLE (existing, proposed and future considerations)
65	81,90,129	Iditarod Trail
63	73	Independence Mine SHP
102	111	Izaak Walton SRS
105	117	Johnson Lake SRA
107	124	Kachemak Bay SP
105	117	Kasilof River SRS
102	110	Kenai Keys SRA
103	113	Kenai River Islands SRSs
63	72	Kepler-Bradley SRA
94	99	Keystone Canyon SRA
62	70	King Mountain SRS
67	81	Kroto Creek SRR
66	81	Lake Creek SRR
48	56	Lake Louise SRA
49	57	Little Nelchina SRS
66	81	Little Susitna SRR
48	53	Little Tonsina SRS
135	141	Long Island SP
62	69	Long Lake SRS
104	113	Lower Kenai River SRSs
62	68	Matanuska Glacier SRS
62	72	Matanuska Valley Colony Farm SHP
49	59	McCarthy SRS
94	99	Mineral Creek ST
86	88	Mirror Lake SRS
65	79	Montana Creek SRS
62	71	Moose Creek SRS
103	112	Morgan's Landing SRA
67	82	Mt. Susitna SRA
109	130	Mouth of Kasilof River SRS
64	77	Nancy Lake SRA
64	77	Nancy Lake SRS
49	58	Nelchina-Tazlina SRR

LS1-1-7

RECOMMEN-DATION Page #	MAP Page #	UNIT TITLE (existing, proposed and future considerations)
102	111	Nilnunqa SHP
105	119	Ninilchik SRA
109	130	Nuka Island
135	140	Pasagshak SRS
86	88	Peters Creek SRS
48	50	Porcupine SRS
94	98	Prince William Sound Marine Park System
63	76	Rocky Lake SRS
134	139	Roslyn Beach SRS
109	128	Safety Cove SRS
135	141	Saultry Cove SRS
103	112	Scout Lake SRS
134	136	Shuyak Island SP
104	113	Slikok SRS
48	52	Squirrel Creek SRS
106	120	Stariski SRS
108	125	St. Augustine SPr
109	128	Sunny Cove SRS
49	59	Susitna Lake-Tyone River SRA
66	81	Talachulitna SRR
66	81	Talkeetna SRR
49	59	Tazlina Lake SRA
108	126	Thumbs Cove SRS
48	55	Tolsona Creek SRS
49	59	Tonsina SRR
94	97	Valdez Glacier SRS
106	120	Whiskey Gulch SRS
64	78	Willow Creek SRA
48	54	Worthington Glacier SRS
134	138	Woody Island SRS
67	81	Yentna River SRSs

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EXHIBIT E

7. Recreational Resources

Comment 2 (p. E-7-17, para. 5)

No structures are apparent in Figures E.7.6, E.7.7, and E.7.8. Are the structures referred to those that are shown in Figure E.7.4?

Response

The structures referred to in para. 5 of p. E-7-17 in Chapter 7, Exhibit E of the License Application are shown in Figure E.7.4 in Chapter 7.

Therefore, the last sentence of para. 5 on p. E-7-17 should read as follows:

> Those structures being utilized for recreational activities are located in Figure E.7.4.

EXHIBIT E

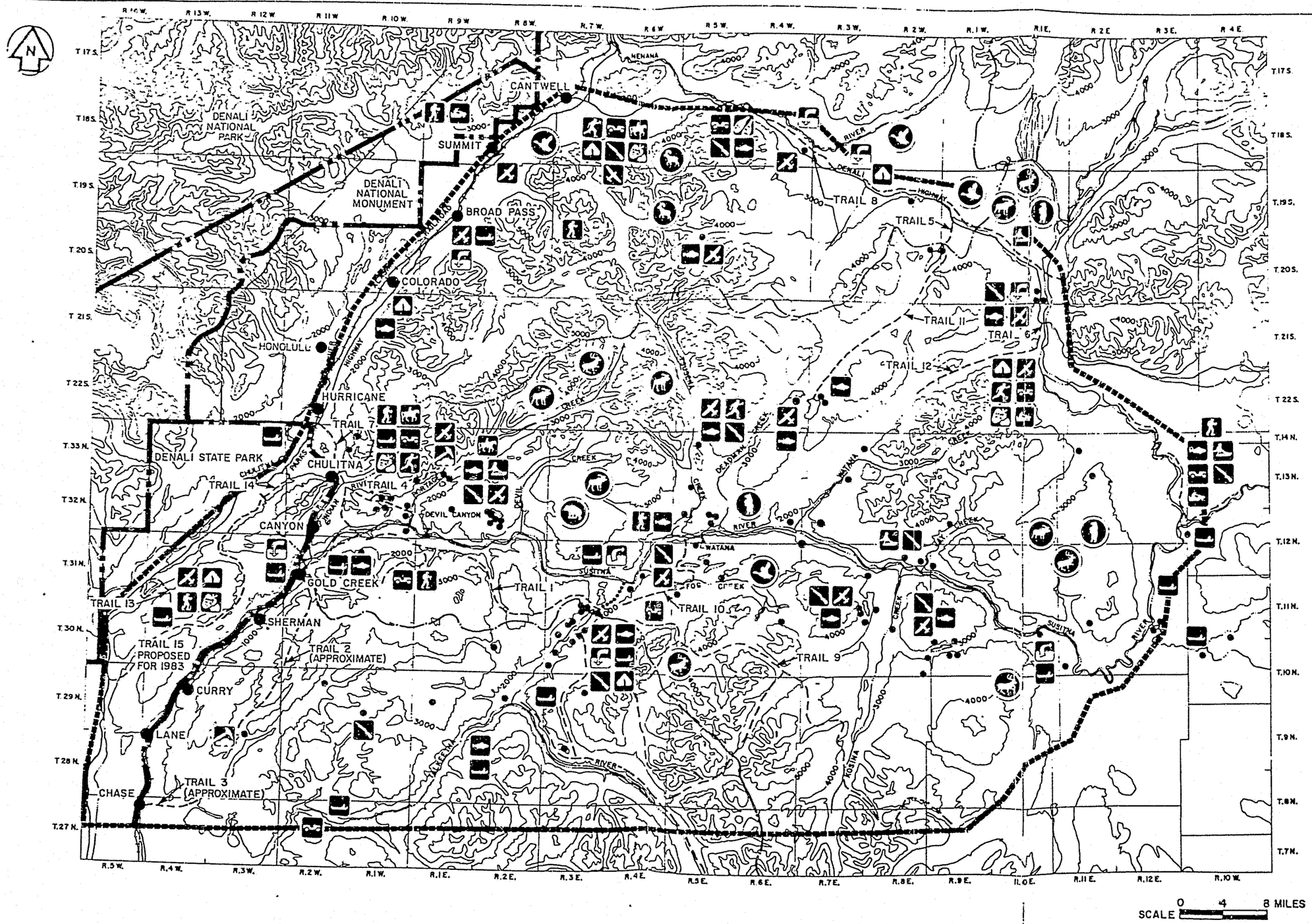
7. Recreational Resources

Comment 3 (p. E-7-18, para. 4)

Verify that there are 11 structures at High Lake Lodge; e.g., seven structures are shown in Table E.9.5 and indicate the presence of nine structures and two cabin foundations at High Lake Lodge. Information concerning structures as presented in Figure E.9.9 and Table E.9.5 should be compared and the discrepancies corrected. For example, the Tsusena Lake Lodge is located more than five miles from Tsusena Lake.

Response

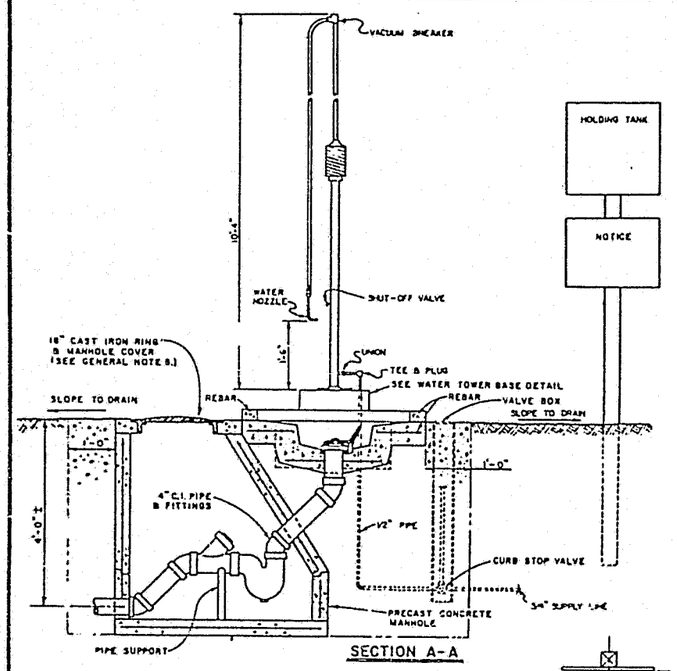
The correct number of structures in the High Lake Lodge area is eleven (nine buildings and two cabin foundations) as indicated in Table E.9.5 in Chapter 9, Exhibit E of the License Application. In contrast to Chapter 9, the recreation discussions in Chapter 7 consider only structures that are presently used or are suitable for use. Foundations are not included, nor are any collapsed structures. Therefore, for the purposes of Chapter 7, only the nine buildings in the High Lake Lodge area would be considered. With regard to mapping variations between Figures E-9-9 and E-7-4, as indicated in the legend for Figure E-7-4, the dot clusters shown in Figure E-7-4 represent building clusters rather than individual structures. Attached is a revised version of Figure E-7-4 that corrects discrepancies between Figure E-7-4 and Figure E-9-9.



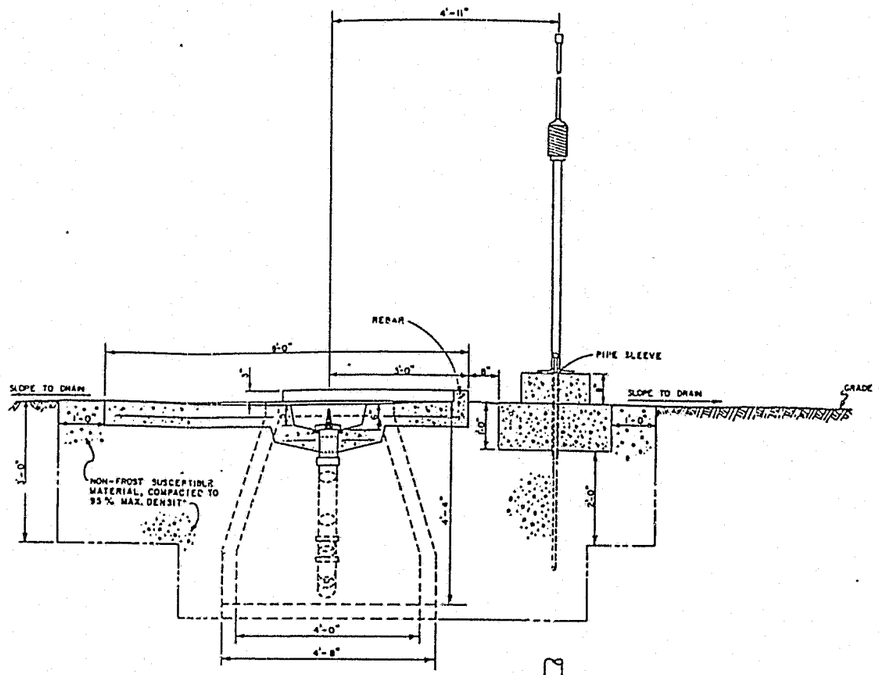
EXISTING RECREATION REVISED JUNE 1983

(Revised)
FIGURE E.7.4

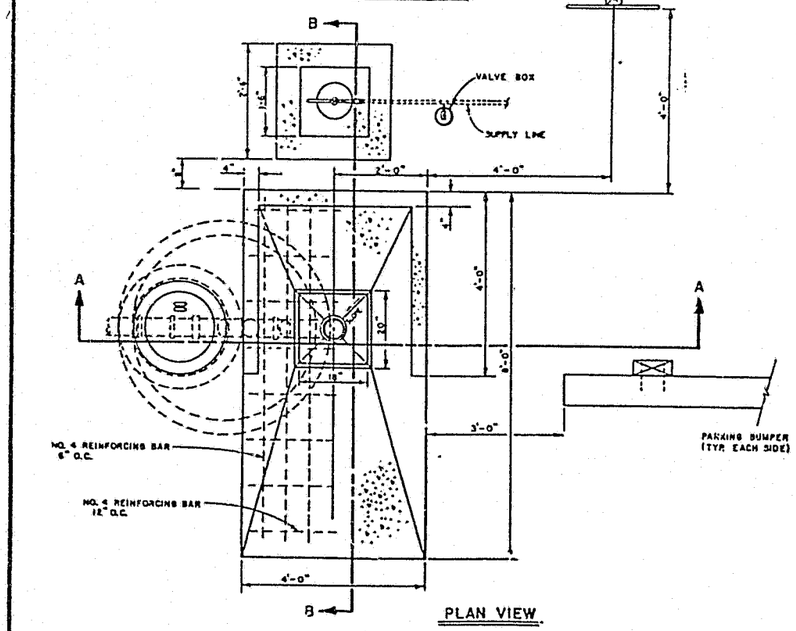
FOLD LENGT
12
11
8.5
8
AUTO
MANUA
FEED



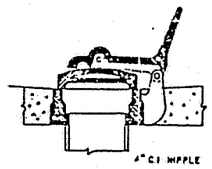
SECTION A-A



SECTION B-B

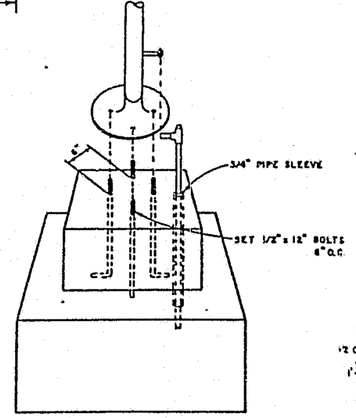


PLAN VIEW



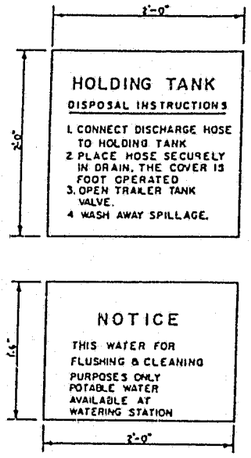
HATCH DETAIL

SCALE: 3" = 1'-0"



WATER TOWER BASE DETAIL

SCALE: 1 1/2" = 1'-0"



SIGN DETAIL

SCALE: 1 1/2" = 1'-0"

SIGN NOTES

1. SIGN MATERIAL 3/4" HIGH DENSITY PLYWOOD S-1-S.
2. FINISH WITH 2 COATS WHITE EXTERIOR ENAMAL
3. HEADING LETTERS SIZE 2" - BLACK TEXT LETTERS SIZE 1", BLACK.
4. CENTER MESSAGE WITH BALANCED LAYOUT
5. 4" x 4" x 10' POST TREATED WITH PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-1381).
6. SIGN POST TO BE PLACED IN HAND DUG OR AUGERED HOLE & BACKFILLED W/BORROW TYPE A & COMPACTED IN 6" LIFTS.

GENERAL NOTES

1. WATER TOWER MODEL S-1-3/8 ROMFORT MFG CO. DAUFALD, WIS. 53065
2. ELEVATE SLAB TO ACCOMODATE DRAINING AWAY FROM SLAB.
3. DRAIN HATCH COVER NO. 50-0011-00 ASSOCIATED CAMPGROUND SYSTEMS P.O. BOX 2258 CORONA, CALIF 91720
4. DEPTH OF DRAIN PIPE & ELEVATION OF DRAIN FITTINGS TO BE DETERMINED BY THE ENGINEER.
5. MANHOLE COVER & RING TO BE 18" DIA., CONVEX, SIDEWALK TYPE, SIMILAR OR EQUAL TO OLYMPIC FOUNDRY # 5774.
6. TO DRAIN SYSTEM, SHUT OFF SUPPLY LINE & OPEN CURB STOP VALVE & WATER TOWER VALVE.

WATER SUPPLY MATERIALS

1/2 CU. YD.	CONCRETE
4	1/2" x 12" L BOLTS W/ NUT & LOCK WASHER
1'-9"	3/4" I.D. PIPE SLEEVE
1	WATER TOWER
1	1/2" GALV. STEEL UNION
1	1/2" GALV. STEEL TEE
1	1/2" GALV. STEEL PLUG
1	1/2" GALV. STEEL 90° ELBOW
6'	1/2" GALV. STEEL PIPE
1	3/4" CURB STOP VALVE WITH 3' HANDLE
1	4" x 4' 0" VALVE BOX W/ COVER
AS REQ'D	3/4" GALV. STEEL WATER SUPPLY PIPE
1	1/2" x 3/4" x 3/4" GALV. TEE

SEWAGE DISPOSAL MATERIALS

1 CU. YD.	CONCRETE
7	#4 REBAR 7'-6" LONG
11	#4 REBAR 3'-6" LONG
1	HATCH WITH COVER
1	4" CAST IRON NIPPLE, 8" LONG
1	4" x 2'-0" CAST IRON PIPE
4	4" — 45° CAST IRON ELBOW
AS REQ'D	4" DIA. CAST IRON PIPE
1	4" DIA. C.I. P-TRAP W/CLEANOUT
1	4" DIA. C.I. 45° LATERAL W/PLUG
1	48" x 36" CONC. PRECAST MANHOLE CONE
1	18" DIA. C.I. RING & MANHOLE COVER
2	PARKING BUMPERS (P-3)
1	DOUBLE SIGN W/ POST & ATTACHMENTS
15 YD.	SELECT AGGREGATE MATERIAL
1	48" x 12" CONC. MANHOLE RISER

NO	REVISION	DATE	APPVD.
3	CHANGED DRAIN VALVE SYSTEM	3-17-82	I.D.
2	ADDED DRAIN CLEANOUT SYSTEM	5-27-82	I.D.
1	CHANGED STAIN TO PREPACO OIL BASE STAIN	6-15-78	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

SCALE: 3/4" = 1'-0" & NOTED

SANITARY DUMP STATION

DRAWN MJ
CHECKED J.F.S.
APPROVED
DATE

SHEET 1 OF 1 SHEETS

U-3

7-12-2

EXHIBIT E

7. Recreational Resources

Comment 4 (p. E-7-19, para.1)

Provide copies of any regulations developed by BLM for management of public trails located on local lands selected by Native Corporations. Are the six easements identified in the study area shown in Figure E.7.4? If not, provide a map showing locations of the easements.

Response

Item #4

At the present time, the BLM does not have any adopted or finalized plans for the management of public trails located on lands selected by Native Corporations[1/]. The six easements discussed on p. E-7-19 of Chapter 7, Exhibit E of the License Application, have not been formalized. A "Notice of Proposed Easements" was published in 1979 and is currently being updated. According to BLM personnel, the revised notice will be published in July of 1983[2/]. The notice and location map will be provided to FERC at that time (as Supplemental Attachment 7-4). The general locations of the trails under consideration are shown on Figure E.7.4 in Chapter 7.

[1/] Ted Stevenson, Bureau of Land Management, Alaska State Office, Division of Resources. June 1983. Personal communication.

[2/] Steve Durkee, Bureau of Land Management, Glennallen Resource Area. June 1983. Personal communication.

EXHIBIT E

7. Recreational Resources

Comment 5 (p. E-7-30, para. 2, p. E-7-97, para. 4, p. E-3-422, para. 3)

Provide an explanation of the basis for anticipating that all game hunting by project personnel would be prohibited and provide a rationale as to how such a prohibition would be justified and enforced.

Response

The Power Authority does not intend to prohibit all game hunting by project personnel nor does it have the legal jurisdiction to do so. In addition, the Power Authority does not have any legal jurisdiction over hunting on public or private lands adjacent to project boundaries. However, in order to avoid the impact of local overharvests of game species during construction, the Power Authority intends to: prohibit public access via the project road or airfield; prohibit employees and their families from using project access roads, temporary construction or logging roads, and other project facilities for hunting or trapping; provide data from monitoring programs to the Alaska Department of Fish and Game (ADF&G) to assist in making appropriate recommendations concerning hunting and trapping regulations to the Board of Game; and fully support the regulations pertaining to hunting and trapping that are established by the Board of Game and the Land Management agencies in the project area. Special harvest regulations potentially instituted by the Board of Game may include the prohibition of all hunting within five miles of project roads, facilities, and construction activities as has been done at the Prudhoe Bay oil field and along the haul road to Prudhoe Bay. Other actions that the Board of Game may take are discussed on pp. E-3-519 and E-3-520 of Exhibit E.

The Power Authority has the legal jurisdiction to implement these measures and will make it its policy to do so. The justification for their implementation is to avoid local overharvests of game animals during the construction period and to assure worker safety. Enforcement of these measures would be conducted by the project security force. ADF&G enforcement personnel and the Alaska State Troopers would handle the enforcement of Board of Game regulations.

EXHIBIT E

7. Recreational Resources

Comment 6 (p. E-7-34, para. 3)

Specify target dates for completion of studies and submission of the recreation development plan for transmission line corridors.

Response

Subsequent investigation indicates that specific recreation development within the transmission corridor is not likely to be needed, and a separate recreation plan for the corridor will not be prepared. Existing and planned recreation in the area affected by the project transmission system is being evaluated in the summer of 1983 as part of ongoing transmission studies. A report on these activities will be available in November 1983. One element of the corridor and route slection process was avoidance of potential impacts to existing and planned recreation areas. A significant portion of the corridor would be located in areas with existing or planned recreation alternatives, such as off-road vehicle and foot trails, indicating that demand for recreational use of the corridors would not be great. Moreover, in more remote areas recreational access to the corridors must be balanced with other land use management objectives. As the transmission studies continue, the Power Authority will work with agencies and the public to develop an access polity for the transmission corridors, and to identify specific sites or areas along the corridors where recreational concerns require special managment actions.

EXHIBIT E

7. Recreational Resources

Comment 7 (p. E-7-44, para. 8)

Provide details demonstrating how this calculated recreation demand [Section 3.2.3(a)] was factored into development of the Recreation Plan, as presented in Section 5. For example, which of the proposed recreation sites would be required to satisfy demand at the year 2000? How would visitation to visitors centers at dam sites be factored into demand estimates?

Response

The selection of capacities and facility types for the recreation plan was based directly on the gross demand estimates and specific activity preferences developed in the recreation demand study. Following the determination of appropriate uses, carrying capacity, and potential visitor demand for each site, demand calculations and phasing criteria were used to group the selected recreation opportunities/improvements into phases (see pp. E-7-69 through E-7-95 and E-7-105). This parallel development of recreation demand and recreation improvements allowed for flexibility in the recreation plan. In addition, the plan acknowledges that recreation activity will not occur exclusively within the sites or areas designated for development, but that it will also be dispersed at various levels throughout the entire study area shown in Figure E.7.6.

Demand figures were used to develop both the planned overall capacity for the entire study area and the type and capacity of specific recreation improvements. In general, the visitation capacity of all sites proposed

for development in Phases I-V (exclusive of Watana Townsite and facilities at the two damsites) totals approximately 34,300 visitor days per year. The estimated demand without the project in the year 2000 is 12,540 visitor days (see Table E.7.13 and pp. E-7-41 through E-7-47); the estimated demand with the project is 43,520 visitor days, for a difference (attributable to the project) of 30,980 visitor days. The proposed five-phase recreation plan is therefore sized to meet the projected above-trend demand, with surplus capacity of 3,320 visitor days to accommodate excess demand above the projected level. Because the capacity for Phases I-IV is 22,365 visitor days, all of these sites plus 8,615 visitor days of capacity from Phase V would be required to meet the projected year 2000 demand. The mix of proposed facilities and the specific needs the facilities are planned to serve, are designed to correspond to the projected general demand levels for individual activities.

Because of the distance from major population centers and travel routes, and the nature of the facility as a tourist attraction, potential visitors to the damsite visitors' centers were considered as part of other site activity demand estimates. Thus, it was assumed that visitors to the facility would also participate in recreation opportunities such as camping, picnicking, and hiking.

EXHIBIT E

7. Recreational Resources

Comment 8 (p. E-7-67, para. 2)

A. Provide a copy of the 1974 document by the U.S. Department of Agriculture that was used as a basis for calculating carrying capacity of the various recreation sites.

B. Also provide details as to how the methodology presented in the document was "modified" for use in calculations of carrying capacity as presented.

Response

A. Attached is a copy of the document (Recreation Opportunity Inventory & Evaluation, June 1974, U.S. Department of Agriculture, Forest Service, Northern Region) that was used as a basis for calculating carrying capacity of the various recreation sites.

B. The recreation capacity formula (as described on p. 13 of the 1974 U.S. Department of Agriculture document) was designed to be used primarily in forested and mountainous areas. Because most of the potential recreation activity for the Susitna project is located in a tundra environment, the criteria for determining the Recreation Experience Unit (REU) was expanded to reflect much larger encounter zones. For example, the encounter zone for a trail in the Susitna area is generally considered to be one mile in each direction in contrast to much shorter distances in forested areas. This is the only deviation from the forest service carrying capacity formula.

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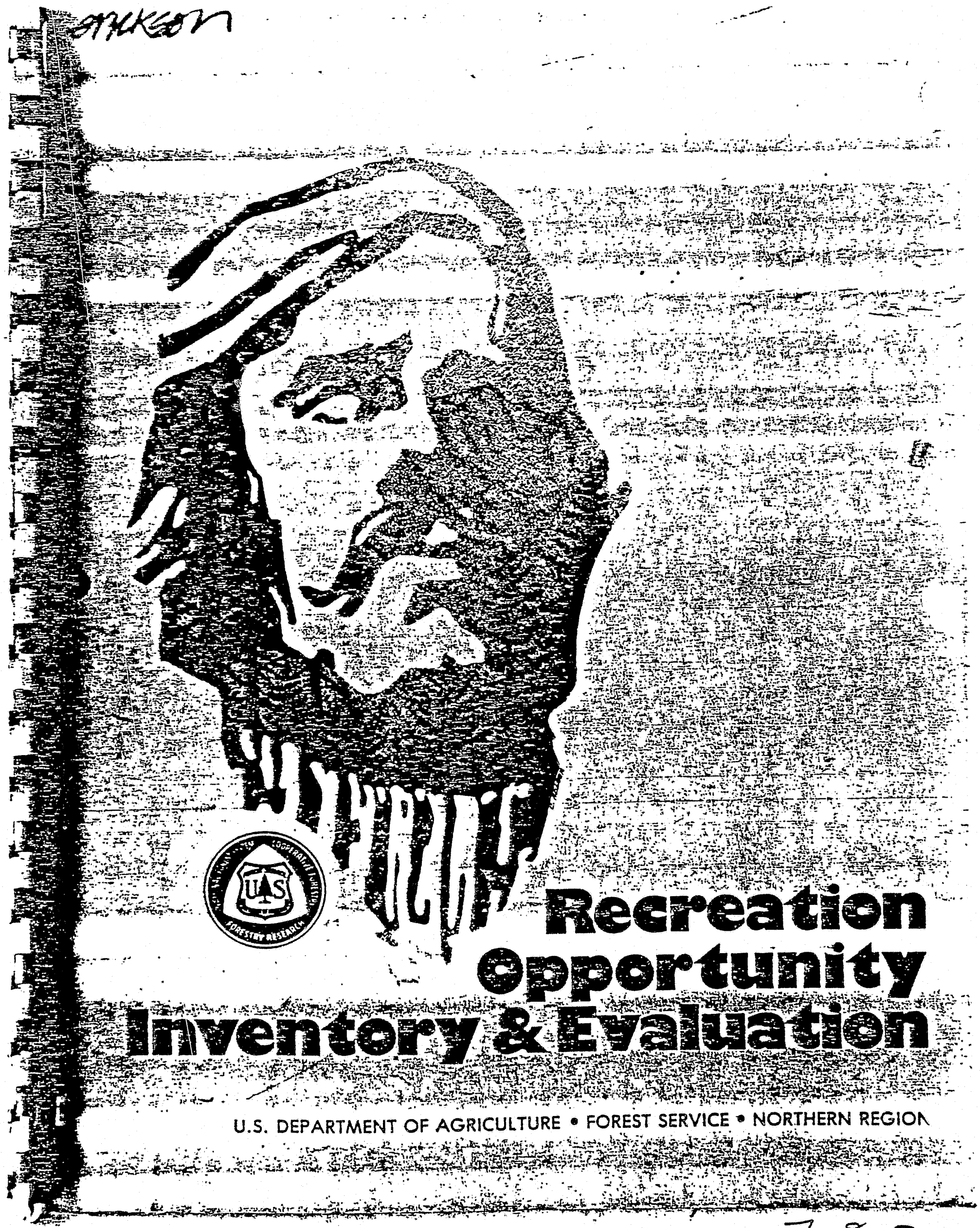

Recreation Opportunity Inventory & Evaluation

U.S. DEPARTMENT OF AGRICULTURE • FOREST SERVICE • NORTHERN REGION

7-8-2

Recreation Opportunity Inventory & Evaluation

RECREATION AND LANDS
DIVISION OF NATURAL RESOURCE
NORTHERN REGION
R-1 74 006
JUNE, 1974

7-8-3

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Foreword

This recreation inventory system is designed to provide recreation opportunities data that are useful in land use planning. It identifies the primary characteristics of the Forest land base that are determinants of the kinds of recreation opportunities that are available to the public. It identifies how the land base can be used for recreation purposes.

It focuses first upon people's preferences and then upon the recreation settings that people may use to gain satisfactions for these preferences.

The data is adaptable for use in broad land allocation. When combined with long-range demand projections of how the land base should be used for recreation, the inventory can provide National Forest land managers a basis for formulating long-range land use programs that are sensitive to the recreation values of the land.

The logic, procedures, and evaluations designed into this system have not been totally validated and may be debated. This is as it should be, for assumptions about people's orientations toward a number of environmental intangibles are necessarily incorporated in the method. If the method acts as a catalyst for investigating these assumptions and if a better method of including environmental intangibles in planning efforts results, then the efforts that went into developing this method will have been worthwhile.

This recreation inventory system is adapted from that developed in 1973 by Rai Behnert, Forest landscape architect on the Northern Region's Beaverhead National Forest.

7-8-5

Introduction

"The demand for natural uses of National Forest lands is growing. In line with the increasing urbanization of America's public, the Nation's forests are being more and more looked upon for their experience output potential rather than their commodity output potential. In consequence, the need for a greater balance between natural and consumptive land uses on the National Forest becomes evident." (1)

National Forests are rich in outdoor recreation opportunities. Their many streams and lakes, the variety and abundance of fish and wildlife, relatively primitive character, and the often superlative esthetic qualities of the landscape confirm this observation.

Simple acknowledgement of these attributes is insufficient for land use planning. More precise definitions of the recreation opportunities of the Forests are required. This is essential so that they may be weighed against other land use values when determining how the use of the Forests can best benefit people.

The basic purpose of this inventory of recreation opportunities is designed to:

1. Provide more precise definitions of recreation opportunities.
2. Provide a method for itemizing and evaluating, in an extensive fashion, the primary characteristics of the Forest land base that are determinants of the kinds of recreation opportunities available to the public.

The inventory is composed of three interrelated parts. The first part results in a definition of current recreation opportunities in the qualitative sense. Discrete units of land are characterized and evaluated to determine the degree of recreation opportunity they hold in relation to each other.

The second part defines current recreation opportunities in the quantitative sense. These same units of land are characterized and evaluated to establish recreation visit capacity estimates in relation to possible recreation management objectives (options).

The third part defines means of predicting how current recreation opportunities could be altered, both qualitatively and quantitatively, due to changes in land unit characteristics that could result from various land use practices.

These three parts are correlated with inventory premises, criteria, and procedures based on recreational research, other recreation inventory methods, and personal observation. The three parts satisfy the defined planning data needs for extensive planning purposes.

In the documentation that follows, the above subjects are discussed in detail. The objective is to foster an understanding of the logic for this inventory method, how it is applied, and how the data it provides may be utilized.

7-8-6

Planning Data Needs

7-8-7

Providing opportunities for recreation in the National Forests is one of the multiple use management objectives established in the Multiple Use-Sustained Yield Act of 1960 (Public Law 86-517). To provide recreation opportunities requires the allocation of land, money and manpower. These allocations must be based on knowledge of the kind of recreation opportunities Forest visitors want and the kinds of settings required to provide these opportunities.

Frequently land managers do not have adequate information about the supply of recreation opportunities under their administration or how the supply of recreation opportunities has changed . . . or can change . . . as the result of various land use practices.

Land managers need the following data to adequately plan for long-range provision of recreation opportunities in harmony with the provision of other land use benefits:

QUALITATIVE DEFINITIONS

1. QUALITATIVE DEFINITIONS of recreation opportunities currently available because of the land's existing characteristics.

QUANTITATIVE DEFINITIONS

2. QUANTITATIVE DEFINITIONS (estimates) of number of people who can take advantage of available recreation opportunities without diminishing the quality of the recreation experiences that are sought after.

RESPONSE ESTIMATES

3. RESPONSE ESTIMATES of how the available recreation opportunities supply would respond to the possible effects of various land use practices (i.e., increases or decreases in qualitative and quantitative terms).

The qualitative and quantitative definitions are needed to gain an understanding of the present conditions that exist on the Forest. This is a necessary precursor to the planning effort and the management decisions that will stem from it. They serve to identify the relative attractiveness of the land base for recreation uses. Land managers must know what is being supplied presently before they can gauge how adequate or inadequate the supply may be in relation to expected recreation opportunity demands. They need to know which types of recreation preferences the land base is capable of satisfying currently and which it is not. The differences in the degree to which existing opportunities can satisfy such preferences must also be known to guide eventual land use allocations . . . which may act to increase, decrease, or maintain the supply of recreation opportunities over time.

The response estimates are needed in sensitizing the land manager to the various management options that may result in land use allocations affecting recreation opportunities. Intercompatibility between options must be recognized and understood in order to anticipate probable consequences of management decisions.

The response estimates will be used by the administrator in determining where the continued application of a recreation opportunity management option . . . or application of the option in new areas . . . will be feasible and beneficial.

These recreation opportunity data must also be compatible with the analysis methods used in the total land use planning process. To be compatible they need to be presented in the following formats:

"One of the greatest voids in available data is a description of the recreation resources, including measurement of the quality of land and water to provide recreation opportunities. Also, we simply cannot do effective planning without some measurement of the capacity, both social and physical, of these lands and waters to provide quality recreation."

Prausa, 1971

"Planning for outdoor recreation must reflect people's differing and changing outdoor recreation preferences."

Outdoor Recreation
A Legacy for America

7-8-8

Mapped data. Preferably on 1-inch-to-the-mile scale. This facilitates comparisions with other mapped data in necessary geographical analysis for suitability, feasibility, and intercompatibility analysis in the total planning process.

Visitor days (VD). Should be used as the basic unit of measure in preparing quantitative definitions. This facilitates comparisons with the recreation portion of the Land Use Demands anaylsis and the present National Forest recreation use estimation procedures.

Time context. Response estimates of how the available recreation opportunities supply would vary due to the possible effects of various land use practices (i.e., increase or decrease in qualitative and quantitative terms).

7-8-9

Inventory Logic

7-8-10

RECREATION MOTIVATIONS

This inventory and evaluation method is designed to meet the stated planning data needs. The design was developed by focusing, first, upon people's recreation preferences and, then, upon the recreation settings people may use to satisfy these preferences.

From research findings and observation, it is known that people seek outdoor recreation to satisfy certain psychological and emotional needs (2, 3, 4,). Outdoor recreation motivations include (5):

- To escape temporarily one's everyday lifespace
- To replenish or restore adaptive energies
- To share a pleasant experience with others
- To maintain a social identity
- To collect status symbols
- To apply and develop a skill
- To explore

Anaylsis of the motivations indicates that many different activities, in many different settings, can serve to meet a variety of outdoor recreation needs. National Forests provide visitors with outdoor recreation opportunities for a wide variety of activities including these:

- Hiking
- Snowmobiling
- Picnicking
- Nature Study
- Hunting
  - big game
  - game birds
  - water fowl
- Backpacking
- Car Camping
- Downhill Skiing
- Cross-country Skiing and snowshoeing
- Trapping
- Visitation
- — Historical Areas
  - Interpretive Exhibits
- Nature Photography
- Collecting
  - rocks, minerals and fossils
  - Flora (berries, mushrooms, etc.)
  - Artifacts (arrowheads, chips, etc.)
  - Animal remains (Antlers, etc.
- Observing wildlife
- Swimming
- Viewing scenery
- Driving and sightseeing from car
- Competitive games (football, etc.)
- Climbing (Mountains, rocks, etc.)
- Water Skiing
- Motorized Racing
  - snow vehicles
  - land vehicles
  - water vehicles
- Quiet Boating (rowboats, rafts, canoes)
- Non-competitive games
- Organized activities
  - resort vacationing
  - Scouting
  - guided tours
  - attending talks and programs
- Backcountry camping
- Spelunking
- Fishing
- Etc.

Attempting to identify all the opportunities in engaging each recreation activity would be a monumental task. Instead, people's general recreation preferences for different kinds of recreation settings, and the conceptually related activities that may be carried on within them are utilized.

People exhibit different orientations in selecting recreation settings and recreation activities. People demonstrate different recreational preferences in satisfying their recreational motivations. All of the different preferences constitute a recreation preferences specturm. For Forest-based recreation, these differences range from setting preferences that

"The manager and planner must, in order to better serve their public, understand the visitors, their motivations, their attitudes and perceptions and plan for these."

Sholer, 1971

7-8-11

are completely natural and are frequented by few people to highly developed settings frequented by many people.

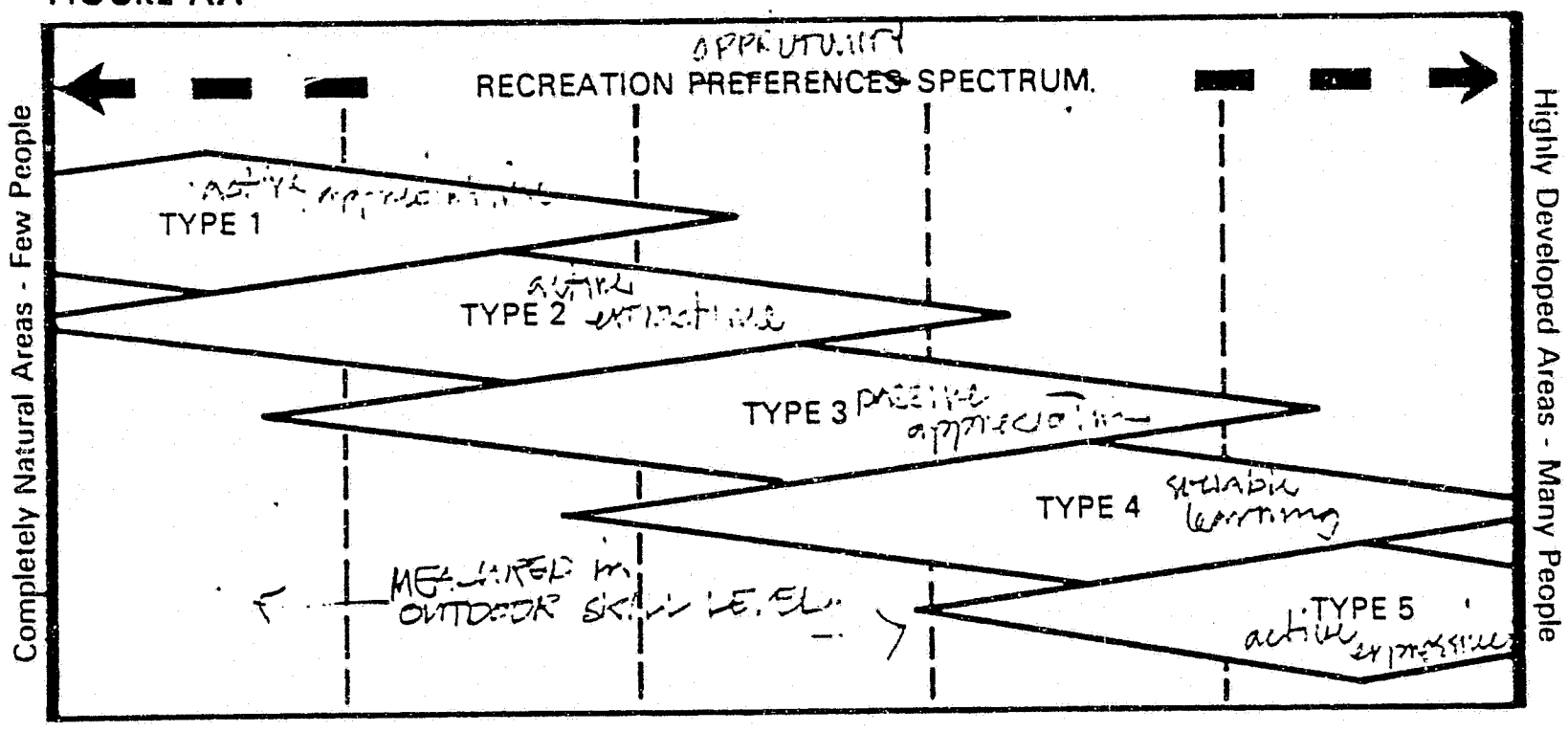
RECREATION PREFERENCES TYPES

Recreation preferences types are the differing general choices people exhibit, or may potentially exhibit, in their selection of recreation setting and recreation activities to satisfy their recreational motivations. They are overlapping portions of the total recreation preferences spectrum that the public may express demands for. A realistic identification of the existing supply of recreation opportunities can be created by dividing the recreation preferences spectrum into five distinctive recreation preferences types, and describing these types in terms that can be related to the characteristics of the Forest.

"We know that all recreationists do not perceive the environment in the same way; what is a quality recreational experience to one may be entirely undesirable to another."

Lime and Stankey, 1971

FIGURE AA



Patterned after, and adopted from, studies by Hendee, Gale, and Catton, 1971 (6); Bond and Whittaker, 1971 (3); and Scholer, 1971 (7), the five distinctive recreation preferences types utilized in this inventory are:

TYPE I — ACTIVE-APPRECIATIVE

Orientations toward using natural, unmodified environment for the appreciation and understanding of natural phenomena; as a source of intellectual and/or physical challenges; for seeking solitude; and for esthetic stimulations.

Setting Preferences: Places which contain interesting and/or challenging natural phenomena, that are highly stimulating to the senses, free of pollutants, far from modern human influences, inaccessible to motorized vehicles, and, generally, devoid of people.

Activity Preferences: Pursuits requiring high levels of self-reliance and outdoor skills such as mountain climbing, boat travel (canoe, kayak), backpacking (and associated pursuits such as seeing natural scenery, nature study and photography, camping, etc.), ski touring, spelunking etc.

7-8-12

TYPE II — ACTIVE-EXTRACTIVE

Orientations toward using natural or semi-primitive environment in searching for and extraction of indigenous fish and or game species, rocks, minerals, edible plants, etc., and for enjoyment of the physical surroundings in which such extractable objects are found.

Setting Preferences: Places which contain numerous extractable objects and other interesting natural phenomena, that are highly stimulating to the sense, free of pollutants, somewhat removed from most human influences, somewhat difficult to access with conventional motor vehicles and in which few people will be encountered.

ACTIVITY PREFERENCES: Pursuits such as hunting (various animal species), fishing (various kinds), collecting (e.g., rocks, minerals, edible plants), etc., that require a moderate to high degree of outdoor skills.

TYPE III — PASSIVE-APPRECIATIVE

Orientations toward using semi-primitive, lightly developed areas for relaxing in natural surroundings; as a source of tranquility and freedom from tension; and for esthetic stimulation.

Setting Preferences: Places which contain interesting natural phenomena (especially water bodies) and or rudimentary comfort and convenience facilities, that are stimulating to the senses, free of pollutants, somewhat removed from human influences, offering fairly easy access with conventional motor vehicles, and in which uncrowded conditions (relatively few people) prevail.

Activity Preferences: Low-stress (emotional, physical) pursuits . . . such as vehicle-oriented camping (small campgrounds or roadside), picnicking, pleasure driving, casual hiking, pleasure boating, etc., . . . that require only moderate outdoor skills.

TYPE IV — SOCIABLE-LEARNING

Orientations toward using moderately developed areas and surrounding environment for intentional social and interaction and group learning experiences.

Setting Preferences: Places which contain developments that facilitate social interaction with other recreationists and or interesting features that can act as foci for learning experiences, that are easy to access with conventional motor vehicles, virtually free of pollutants; and in which the presence of other people is expected.

Activity Preferences: Pursuits fostering interaction with others such as resort vacationing, camping (moderate to large campgrounds), attending talks and programs, visiting exhibits and local interest features, group nature study, organization sponsored activities (Scouting, summer camps), etc., that require minimal outdoor skills.

TYPE V — ACTIVE-EXPRESSIVE

Orientations toward using highly-developed areas for social interactions with many other people and for pursuits which allow for the expression of learned physical abilities.

Setting Preferences: Places which contain developments that facilitate active sports; with easy access with conventional motor vehicles; virtually free of pollutants; and in which numerous other people are expected.

Activity Preferences: High physical and emotional stress pursuits, such as water skiing, downhill skiing, field sports, racing (land, water or snow vehicles), etc., that require virtu-

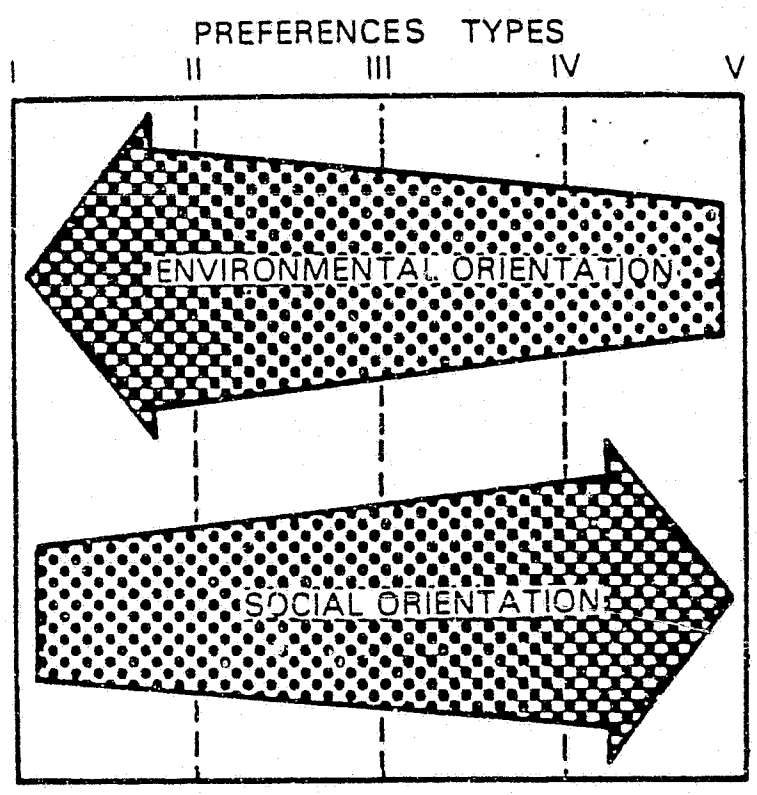
7-8-13

ally no outdoor skills, but do require moderate to high level sport skills

As is implied in Fig. AA, the five different types do not divide the total recreation preferences spectrum in a discrete fashion. They overlap one another. The setting and activity preferences of one type may partially satisfy some of the setting and activity preferences of other types.

When preference types are analyzed, two general orientation patterns are discernable. First: an orientation toward interaction with the natural environment, which ranges from weak in Type V activities to strong in Type I activities. Second: an orientation toward seeking social contact with others, ranges from weak in Type I activities to strong in Type V activities. Research findings, which identify recreationist characteristics and preferences, attest to the general existence of such patterns. (2, 3, 8, 9)

Preference types encompass this interest continuum and may be used as definers of the range of recreation opportunities the public may demand. Therefore, it is in terms of these Types that the Recreation opportunities are inventoried and evaluated.



RECREATION OPPORTUNITIES

Recreation opportunities are defined as favorable environmental and social circumstances that can satisfy the visiting public's various recreation preferences. Their existence, and the degree to which they can satisfy preferences, is assumed to be dependent upon the characteristics of the recreation setting. The recreation opportunities exist independent of demand; they exist whether or not people choose to take advantage of them.

The kind of recreation opportunities defined by this inventory in qualitative, quantitative, and response estimate terms, are those that can satisfy the five recreation preferences types detailed above. The setting preferences are the "cornerstones" for each type. A basis for deriving the planning data needs is created by rewording the definitions in terms of recreation setting characteristics that can be inventoried and then matching them in a systematic manner against the inventoried characteristics of actual recreation settings.

Before this matching process can begin, however, recreation settings and their characteristics which qualify settings for recreation opportunities must first be described. (10)

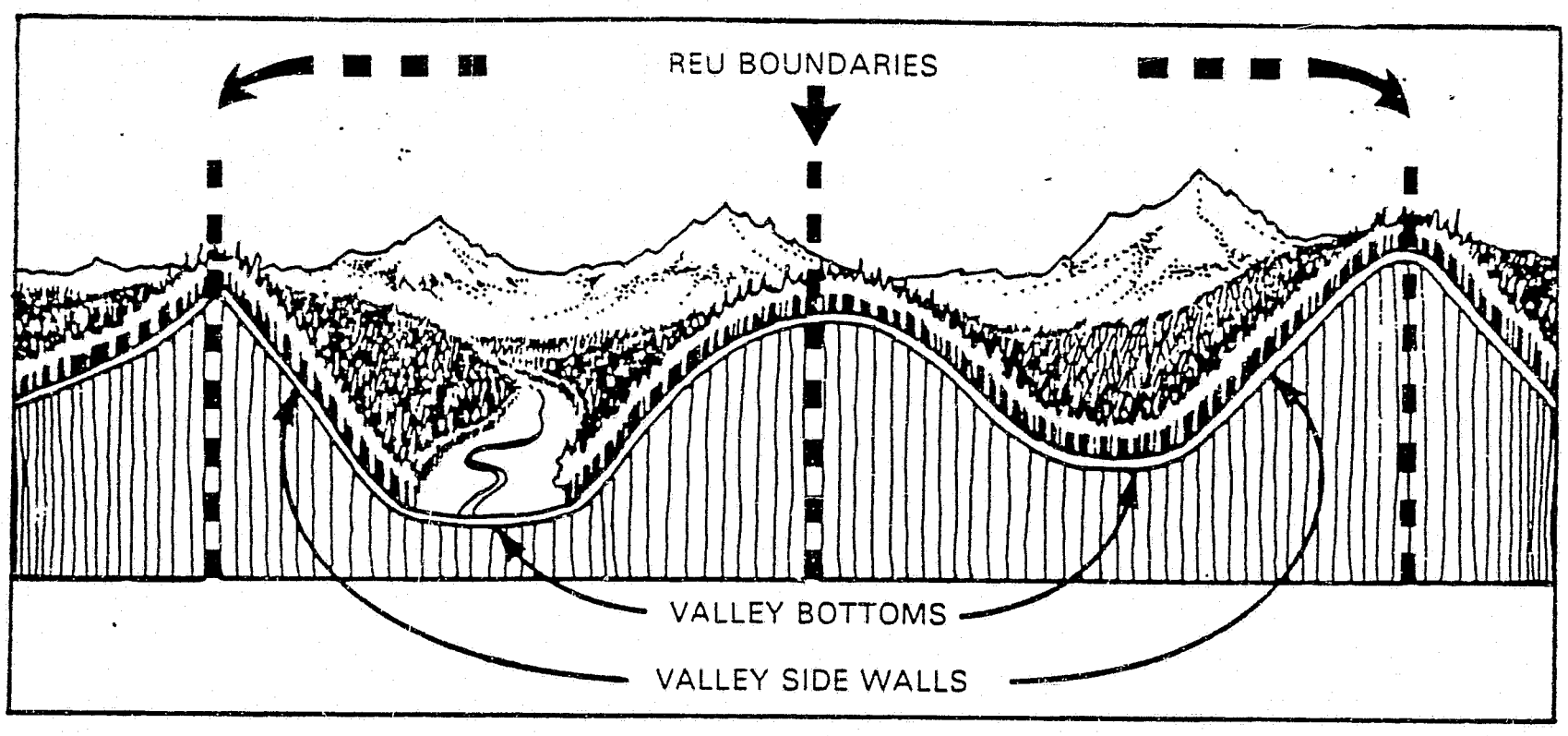
RECREATION SETTINGS

The Forest land base is an aggregation of recreation settings (discrete portions of the Forest land base) when viewed from an outdoor recreation standpoint. While engaging in recreation pursuits, people relate to these settings through their senses and identify the experiences they gain with them. They impart a sense of place upon visitors. These units of land are called Recreation Experience Units (REUs).

The approximate boundaries of the settings are delineated in accordance with certain mapping criteria (see Inventory Procedures). Due to the mountainous terrain that is charact-

7-8-14

exists in much of the Northern Region Forest. most of these REUs are well defined settings with wall planes and floor planes (e.g. valley sidewalls and bottoms. They tend to correspond closely with small watershed drainage basins.



The REUs permit differentation of recreation opportunities from place to place in qualitative terms, and provide foci for the determination of the quantitative definitions (visitation capacity estimates). They are also considered as logical recreation management units.

REU mapping covers all of the Forest land base as well as some strongly related lands in other ownerships. It is assumed that all land areas contain some degree of recreation opportunity to satisfy at least one or more of the recreation preferences types.

RECREATION EXPERIENCE UNIT CHARACTERISTICS

The setting preferences for each recreation preferences type refer to places, interesting features, recreation developments, degrees of sensual stimulation, access, distance, levels of pollution, and encountering other people as the setting variables. The degree to which recreation opportunities satisfy all five types of recreation preferences in individual REUs will depend upon the existence of, and/or qualities of, such variables within the unit. To describe the actual characteristics that exist, each REU is inventoried in terms of five major variables:

A. Attractive Features
B. Accessibility
C. Remoteness
D. Visual Resource Characteristics
E. Discord Elements

The general definitions of these REU characterisitcs are as follows:

Attractive Features (A)

are the special natural and cultural attributes to which people may be drawn in their recreation pur-

sets. The number, kind, and relative significance of the attractive features in an REU can have an important bearing on the recreation opportunities the unit holds for each preferences type.

Accessibility (B)
refers to the kind of travel facilities that lead to and are contained in an REU and that act as the determinants of the mode of travel that may be used to access the unit.

Remoteness (C)
refers to the distances from the geographical center of an REU to various kinds of travel facilities not contained in the unit. These distances are indicators of how difficult or easy it may be to access the unit.

Visual Resource Characteristics (D)
refer to the composite of the REUs visible phenomena that acts as the determinant of how visually stimulating the unit may be.

Discord Elements (E)
refer to persistent forms of contamination characteristics that are readily evident to the senses (e.g., polluted water, disagreeable odors, loud noises, etc.).

In addition to the above, Visitation Capacity Elements are certain characteristics that are utilized in the estimation of REU visitation capacities for each of the preference types. They are unit variables such as acres, miles of travel facilities, recreation facilities design capacities, etc., that are combined with preference types constants to calculate REU congestion limits.

These characteristics address the stated setting preferences variables. Places are, of course, the REUs themselves; interesting features and recreation developments are included under attractive features; degrees of sensual stimulation are addressed by the visual resource characteristics; access by accessibilty; distance by remoteness; and levels of pollution by discord elements. Encountering other people is addressed by the visitation capacity elements (in conjunction with the preference types constants).

The Inventory Procedures section describes the methods employed to inventory these characteristics, and includes the various subvariables of the characteristics that are considered and related to the inventory criteria.

RECREATION OPPORTUNITIES SUPPLY QUALITIES

To qualitatively define the supply of recreation opportunities currently available to the public, the inventoried characteristics of each mapped REU are matched against the setting preferences of each recreation preferences type. Top, pg.9

Each REU is, in effect, rated to determine the degree to which it matches the stated setting preferences of each type. This is accomplished by assigning sets of positive or negative rating values (numbers) to all the REU characteristics that have been selected for inventory. These rating values are empirically derived. They are intended to reflect the degree to which each REU characteristic contributes to , or detracts from, the preferred or optimal recreation settings for each preferences type. The actual rating values that are used, along with instructions for how they are used, are listed in a set of tables in the Data Evaluation Procedures section.

"The needs and motivations of recreationists vary considerably; so do recreational areas. We must strive to match the two; if we fail to do so, individual recreation areas will tend to become homogenous, lacking the variability and diversity needed in a recreation complex. We cannot please everyone everywhere."

Lime and Stankey, 1971

"The most critical research challenge lies not only in developing hypothetical models of human response to amenity stimuli . . . but more important, in quanitfying the satisfaction values of those amenities."

Shafer and Moeller, 1971

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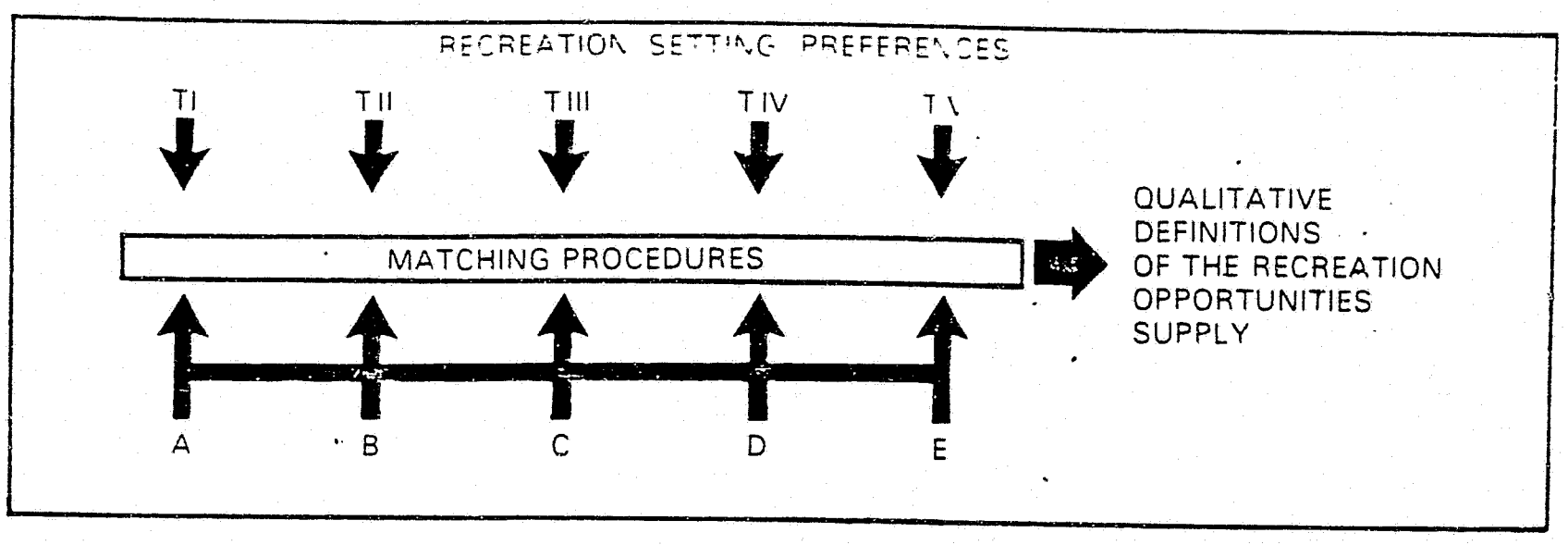

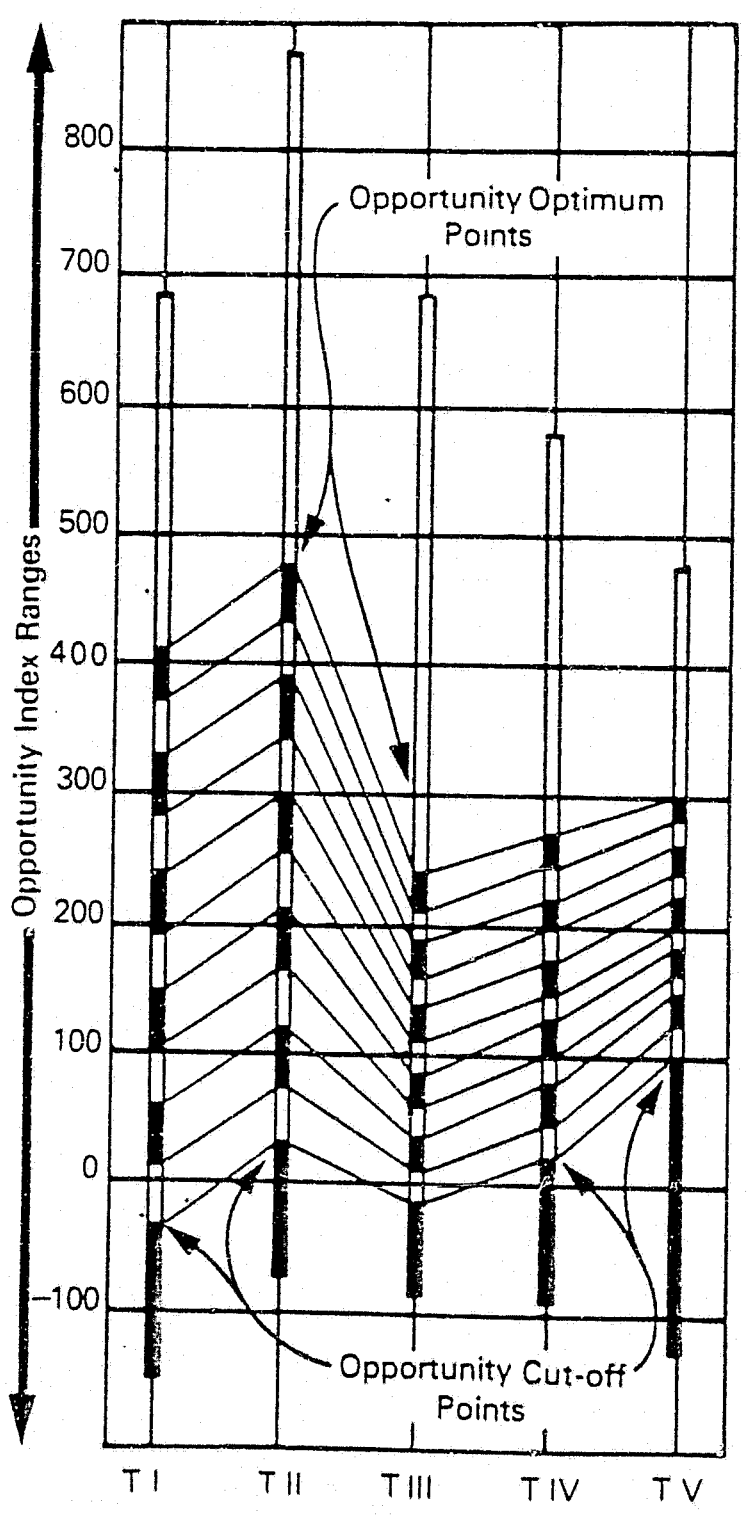

The compiled inventory data for each REU is systematically matched with the rating values in these tables to determine various numerical Recreation Opportunity Indexes. These Indexes are the value totals that result from the matching procedure. They are generated in accordance with the following formula:

$$+A \pm B \pm C + D - E = \text{Recreation Opportunity Index} \Big/ \text{Each Preferences Type}$$

Where:
- A = Attractive Features variables value ratings
- B = Accessibility variables value ratings
- C = Remoteness variables vaule raings
- D = Visual Resource variables value ratings
- E = Discord Elements variables value ratings

The five Opportunity Indexes that are generated for each REU integrate the inventoried data variables of each REU. They indicate the degree of opportunity each REU holds to satisfy the five recreation preferences types (i.e., the higher the Index, the greater the degree).

The Indexes for each of the mapped REU's become meaningful as qualitative definers of the available recreation opportunities supply when they are categorized into Recreation Opportunity Classes. These Classes place the Opportunity Indexes on a common comparison base. They are established by estimating where the opportunity cut-off points (minimums) and opportunity optimums (maximums) lie along the total opportunity index ranges that can be generated for each preference type and then dividing these estimated ranges by the desired number of opportunity classes. This allows for the analysis of a generated opportunity index in terms of whether it represents an actual opportunity and how close to the defined optimum it may be.

After all the REU's within the planning area have been inventoried and rated, a qualitative appraisal of the available recreation opportunities supply can be conducted. The supply can be characterized in terms of:

a. The number of REU's in each Recreation Opportunity Class for each Preferences Type.
b. The number of acres in each Recreation Opportunity Class for each Preferences Type.

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c. The geographical distribution of the REU's in each Opportunity Class for each Preferences Type

What this approach attempts to do is to interpret the qualitative meanings of the inventoried REU characteristics on the basis of the differing orientations toward physical environment that are described for the five recreation preferences types. It assumes that the environmental characteristics (natural and cultural) of any REU are the primary determinants of the degree of recreation opportunities that exist. It also assumes that these degrees of opportunity can vary in direct proportion to the changes in environmental characteristics that can be effected. In application, it would treat the presence of a two wheel drive road, for example, in an REU as a detriment to Type 1 and, to a lesser extent, Type 2 recreation opportunities. Conversely, it would treat the same road as an asset to Type 3, 4, and 5 recreation opportunities. If the road were to be closed, a rise in opportunity would be registered for Types 1 and 2, while Types 3, 4 and 5 would register progressively greater declines. Thus a road (or any other REU characteristic) is not automatically 'good' or 'bad' for recreation; how it may be perceived is dependent upon the recreation preferences of people.

"The quality of recreation experience depends largely on the quality of the recreation environment . . ."

Shafer and Moeller, 1971

RECREATION OPPORTUNITIES SUPPLY QUANTITIES

To Quantitatively define the supply of recreation opportunities that is currently available to the public, the inventoried Visitation Capacity Elements of each mapped REU are utilized to generate estimates of how many people can take advantage of the supply without substantially diminishing the quality of the experiences that are sought after.

These estimtes are based on the assumption that there are points of diminishing returns in gaining recreation satisfactions. If the number of people taking advantage of the recreation opportunities of any particular area (e.g., an REU) exceed certain levels, feelings of congestion will result. (11) The points at which these feelings of congestion become intense enough to cause the aggregate recreation satisfactions of all visitors to decline may be called the Social Visitation Capacity levels of an REU.

Note that Visitation Capacity levels are referred to. Capacity can be judged only in light of the possible management objectives for a given area. These objectives must define what type of recreation opportunities the area is to provide. Without definitive objectives, it is not possible to estimate the visitation capacity for any location or to manage for it.(12) Who's preferences are to be satisfied must be known. If, therefore, the potential to manage an area in several different ways exists, several different Visitation Capacity levels will also exist.

The five Recreation Preferences Types that were defined earlier offer a basis for estimating the differing Visitation Capacity levels that may be characteristic of any particular REU. If the preferences that were described are to be satisfied, certain sets of management objectives are implied. These objectives, as well as examples of management actions that could be taken to realize them, are incorporated in the following Recreation Management Options:

"The goal of maximizing user satisfaction for a given geographic area can only be met if we provide a spectrum of opportunities that meets the diverse and often conflicting tastes of the public."

Lime and Stankey, 1971

RECREATION — TYPE I: (Active-Appreciative)
Provide recreation opportunities for forest visitors with

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orientations toward using natural, unmodified environment for the application and understanding of natural phenomena as a source of intellectual and or physical challenges, for seeking solitude; and for esthetic stimulation; by providing recreation settings (REU's) which contain interesting and or challenging natural phenomena, that are highly stimulating to the senses, free of pollutants, far from modern human influences, inaccessible to motorized vehicles and generally devoid of people.

Possible Management Actions:

a. Rehabilitate developed land to a natural state (e.g., close roads, remove facilities, etc.).
b. Restrict mode of travel within settings to foot or horse traffic.
c. Limit visitation when it begins to exceed the T-I Social Visitation Capacities (GAOT and/or yearly) that have been estimated for the settings (or their Physical Carrying Capacities . . . whichever is reached first).

RECREATION — TYPE II: (Active-Extractive)

Provide recreation opportunities for Forest visitors with orientations toward using natural or semi-primitive environment for the search for and extraction of indigenous fish and/or game species, edible plants, rocks, minerals, etc., and for enjoyment of the physical surroundings in which such extractable objects are found, by providing recreation settings (REU's) which contain numerous extractable objects and other interesting natural phenomena, that are highly stimulating to the senses, free of pollutants, well removed from most human influences, somewhat difficult to access with conventional motor vehicles and in which few people will be encountered.

Possible Management Actions:

a. Rehabilitate developed land to a semi-private state.
b. Construct trails, rudimentary (4-WD) roads, primitive campsites, etc., in undeveloped settings.
c. Limit visitation when it begins to exceed the T-II Social Visitation Capacities (GAOT and/or yearly) that have been estimated for the settings (or their Physical Carrying Capacities . . . whichever is reached first.

RECREATION — TYPE III: (Passive-Appreciative)

Provide recreation opportunites for forest visitors with orientations toward using semi-primitive or lightly developed areas for relaxing in natural surroundings; as a source of tranquility and freedom from tension; and for esthetic stimulation, by providing recreation settings (REU's) which contain interesting natural phenomena (espcially water bodies) and/or rudimentary comfort and convenience facilities, that are stimulating to the senses, free of pollutants, somewhat removed from human influences, fairly easy to access with conventional motor vehicles, and in which uncrowded conditions (relatively few people) prevail.

Possbile Management Actions:

a. Construct trails, forest roads, small scale campgrounds, picnic grounds, etc., in stimulating, undeveloped settings.
b. Limit visitation when it begins to exceed the T-III Social Visitation Capacties (GAOT and/or yearly) that have been estimated for developed settings (or their Physical Carrying Capacities . . . whichever is reached first).

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RECREATION — TYPE IV: (Sociable-Learning)

Provide recreation opportunities for forest visitors with orientations toward using moderately developed areas and the surrounding environment for intentional social interaction with others and as a focus for participating in group learning experiences, by providing recreation settings (REU's) which contain development that facilitate social interaction with other recreationists and/or interesting features that can act as foci for learning experiences, that are easy to access with conventional motor vehicles, virtually free of pollutants, and in which the presence of other people is expected.

Possible Management Actions:

a. Preserve and develop interesting natural and cultural attractions to provide foci for learning experiences and social interactions.
b. Construct forest roads, moderate to large campgrounds, picnic grounds, etc.
c. Induce private individuals to develop resorts, organizational sites, and other operator maintained facilities.
d. When visitation begins to exceed the T-IV Social Visitation Capacities (GAOT and/or yearly) that have been estimated for developed settings, add further developments to increase their Capacities (to the limit of their Physical Carrying Capacities . . . if necessary).

RECREATION — TYPE V: (Active-Expressive)

Provide recreation opportunities for forest visitors with orientations toward using highly developed areas for social interactions with many other people and for popular pursuits which allow for the expression of learned physical abilities, by providing recreation settings (REU's) which contain developments that facilitate active sports, that are easy to access with conventional motor vehicles, virtually free of pollutants, and in which the presence of numerous other people is expected.

Possible Management Actions:

a. Construct modern forest roads, large scale modern campgrounds, etc.
b. Induce private individuals to develop winter sports sites, public services, and other operator maintained facilities.
c. When visitation begins to exceed the T-V Social Visitation Capacities (GAOT and/or yearly) that have been estimated for developed settings, add further developments to increase their Capacities (to the limit of their Physical Carry Capacities . . . if necessary).

These five Management Options define the type of recreation opportunities that may be provided. To apply the options calls for qualitative definitions of the available recreation settings. How these definitions are generated has already been described.

The Options also call for, and act as a focus for, the estimation of the Social Visitation Capacities of the mapped REU's. The primary purpose of such estimates is to roughly gauge how many visitor days the forest land base is currently capable of supplying to satisfy forest visitors in relation to their differing recreation preferences. This will allow for a quantitative comparison of the available recreation opportunity supply with the current and projected demands for such opportunities. Judgements about how adequate the available supply is to meet current and projected demands can then be

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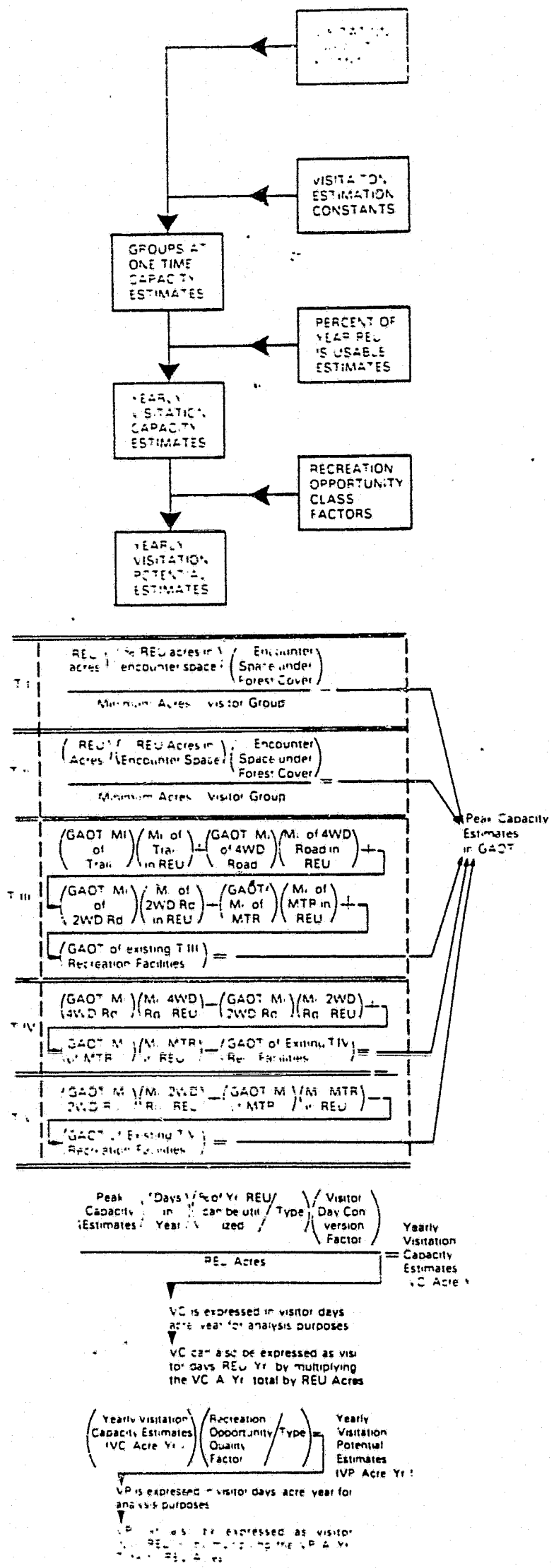

made. These judgements, in turn, will aid in the structuring of Land Use Planning Alternatives and, ultimately, in the determination of how the land base will be allocated to provide the required recreation opportunities.

Great accuracy in the estimation of Visitation Capacities is not a goal. Reasonable, reproducible estimates and straight forward estimation procedures are. How accurate the estimates are can only be gauged by the responses of the visiting public. People will indicate when the Visitation Capacities of the REU's they use have been reached. (11) If the estimtates have been either understated or overstated, they can be revised accordingly when such feedback is received. The estimates serve as a starting point for the definition of realistic Visitation Capacities. They are speculations about when the actual Visitation Capacities will be reached.

The estimation procedures that are employed actually result in three interrelated Visitation Capacity descriptors: Groups At One Time (GAOT) estimates, Yearly Visitation Capacity (VC) estimates, and Yearly Visitation Potential (VP) estimates.

The GAOT estimates address the question: "How many groups of people can an REU accommodate at any one time before its peak Visitation Capcity for each Preferences Type is exceeded?" They are calculated by combining the inventoried Visitation Capacity Elements of an REU with estimation Constants that have been derived for each of the five Preferences Types. This combining operation is accomplished by utilizing five simple (GAOT) estimation formulas that integrate the Elements and Constants in set fashions. The use of such formulas assures that the estimates can be analyzed and reproduced.

Groups of people are used to express (GAOT) estimates for three reasons. First, feeling of congestion are assumed to stem from encountering strangers rather than from interactions among persons that are engaging in recreation pursuits together. Second, most people engage in recreation pursuits in numbers of two or more. Thirdly, groups, which are treated as if they were individual persons in the subsequent yearly VC estimates calculations, hedge against day-night length of stay, weekend-weekday visitation probability differentials and thus keep VC estimates realistic. (Group size is limited to a maximum of four persons in Preferences Type I &II and five persons in Preferences Type III,IV, & V for calculation purposes.)

The yearly VC estimates address the question: "In light of the number of visitor groups that it can accomodate at any one time, how many visitor days of recreational use would reasonably describe the yearly Visitation Capacity level of an REU for each Preferences Type?"

They are calculated by multiplying the (GAOT) estimates by the estimated number of days per year that an REU could be used for each Preferences Type. These totals are then multiplied by a constant to convert them into the Visitor Day units of measure that are required to meet the Planning Data Needs.

The yearly VP estimates address the question: "In light of its yearly Visitation Capcity levels and its Qualitative Definitions (i.e., Recreation Opportunity Class ratings), how many visitor days of recreational use would reasonably describe the yearly Visitation Potential of an REU for each Preferences Type?" They are calculated by multiplying the VC estimates by ten percent of the respective Recreation Opportunity Class ratings that have been generated for the REU.

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The Visitation Potential estimates are necessary since the analysis procedures that are used in the Planning Process call for the representation of the Forest's recreation values in visitor day terms. The Visitation Capacity estimates alone are insufficient for this purpose because they do not incorporate setting quality considerations. They are not sensitive to the fact that recreationists will utilize high quality recreation settings before turning to equally available but poorer quality ones when given the choice. The VP estimates do incorporate these considerations and are therefore regarded as the most logical Quantitative Definitions of the recreation opportunities supply to use for analysis purposes. They are one way of synthesizing the quantitative and qualitative recreation opportunity supply definitions.

The actual estimation procedures for generating the GAOT, VC, and VP quantitative definitions are described further in the Data Evaluation Procedures section. After the GAOT, VC and VP estimates for all the REU's within the planning area are completed, a quantitiative appraisal of the available recreation opportunities supply can be conducted. The supply can be characterized in terms of:)

a. The approximate total peak Visitation Capacity, yearly Visitation Capacity, and yearly Visitation Potential of the Forest land base for each Recreation Preferences Type.
b. The number of REU's that would be required to maintain the current or altered Visitation Capcity levels for each Preferences Type (or the acreage total that these REU's constitute).
c. The geographical locations of the REU's to assess their relative values for each Preferences Type on the basis of the Visitation Potential estimates.

The Recreation Management Options also call for the estimation of the Physical Carrying Capacities of the mapped REU's. Such Capacities are defined as the amount and character of recreation use beyond which the physical resource will be unacceptably altered. (13) Despite their importance as land management guides, no direct attempts are made to estimated these capacities in this inventory method.

It is felt that meaningful Physical Carrying Capacity estimates can only be derived from detailed case by case, field studies. Managing an REU within its Physical Carrying Capacity will require special data regarding the nature of the physical impacts that recreationists are causing and specific management actions to mitigate such impacts. Since the data this inventory seeks to provide is aimed at the Long Range Strategic Planning level and not a finite management concerns, the estimation to these Capacities is deferred for subsequent planning levels (Short Range Planning and Implementation Planning).

RECREATION OPPORTUNITY SUPPLY RESPONSE ESTIMATES

The Qualitative and Quantitative definitions of the recreation opportunities supply are based on the inventory and evaluation of existing environmental characteristics. The inventory postion measures the existing characteristics in terms of number, kind and qualities. The evaluation portion attaches weights and values to the inventoried characteristics so they may be systematically integrated into Recreation Opportunity Indexes and Classes, GAOT estimates, yearly VC

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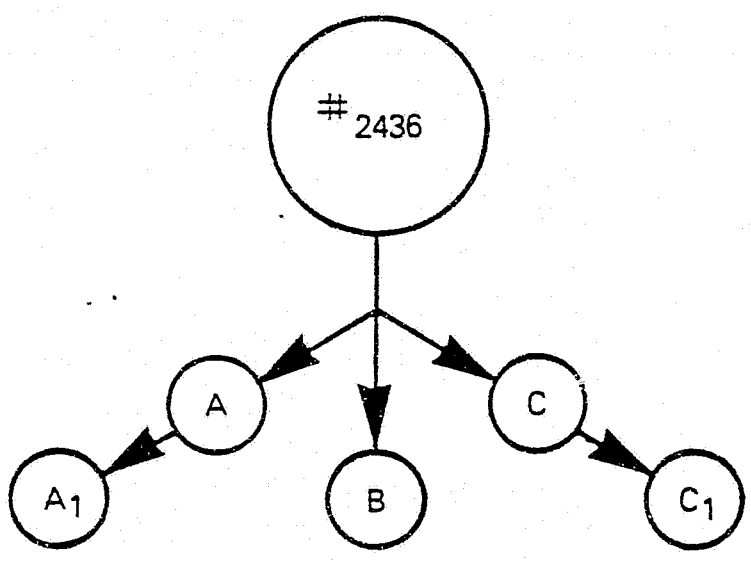
MANAGEMENT OPTION



POSSIBLE MANAGEMENT ACTIONS

estimates and yearly VP estimates. If, for instance an REU is characterized by a Recreation Opportunity Index of 153, a consequent Recreation Opportunity Class of 7, a GAOT of 11.25, a yearly VC of 6159 visitor days, and a yearly VP of 4311 visitor days for the satisfaction of Type III Recreation Preferences, it is because of the unique combination of environmental characteristics that exist in the REU. Should the number, kind and qualities of the REU's existing characteristics change for some reason, its Qualitative and Quantitative opportunity definitions will also change.

Response Estimates are predictions of how much recreation opportunities are likely to change if the environmental characteristics of the mapped REU's are altered. They are a means of alerting land managers to what the consequences of applying the various Land Mangement Options are (for timber, range, watershed, wildlife, recreation, wilderness, and other types of Forest management).

Each Management Option is composed of a set of possible management actions (e.g., road building, timber harvest, recreation facility construction, etc.) which can change the existing environmental characteristics of the mapped REU's to differing extents. The changes that would result if an Option were applied on the land base can alter the existing recreation opportunities supply. Options which include actions that will increase Accessibility and lessen Remoteness will tend to increase opportunities for satisfying Type III, IV and V Recreation Preferences. Conversely, they will generally decrease opportunities for satisfying Type I and II preferences. Options which include actions that will impair Visual Resource characteristics, remove Attractive Features, or increase the occurrence of discord element will decrease opportunities for the satisfaction of all the Preferences Types. Options that will respectively enhance, add, or lower the occurrence of these variables will increase opporuntities for all of the Types. How the Options affect the Visitation Capacity Elements will also result in increases and decreases in the recreation opportunities supply.

Not all of the environmental changes that could result from the application of such Management Options are of a permanent nature. Their potential for altering the existing recreation opportunities supply is directly proportional to how long they remain in existence. Consequently, they must be presented in terms of how long they are expected to last and how the intensity of their effects will vary through time. This is accomplished by presenting the Response Estimates that are needed for planning purposes in the form of Output Timestreams. Output Timestreams describe the flow of outputs or commodities that result from the application of a given Management Option. They are year-by-year predicitions of the precentage increases or decreases in outputs that are expected to occur if an Option is applied on the land base. These percentage increases or decreases are referenced to the output levels that are being sustained under present management conditions.

The five Visitation Potential estimates that are generated for each REU serve to describe the present condition output levels. The Timestreams show how the aggregate VP of REU's with similar environmental characteristics is expected to change if the application of each Management Option is actualized on them. The percentage changes that are expected to occur are calculated in the same fashion that the definitions of the existing recreation opportunities supply are (i.e., existing VP estimates). The only difference is that VP estimates are generated for hypothetical REU characteristics

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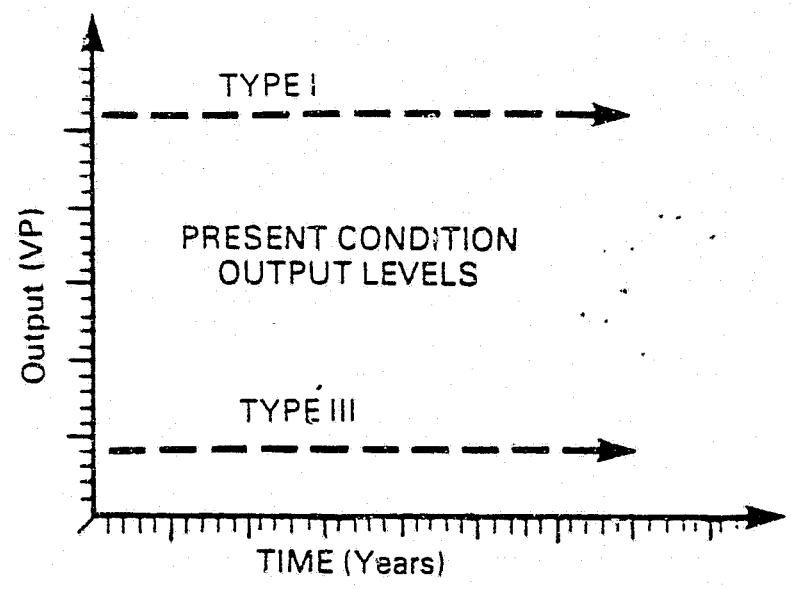
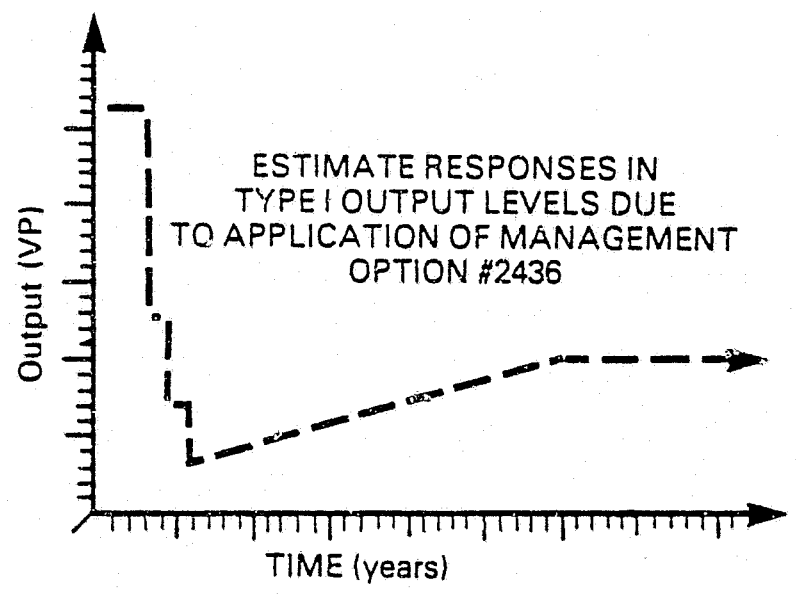
rather than actual ones. The different hypothetical VP estimates that could result from the application of each Management Option, in combination with predictions of how long they may be sustained, are used to structure the timestreams.

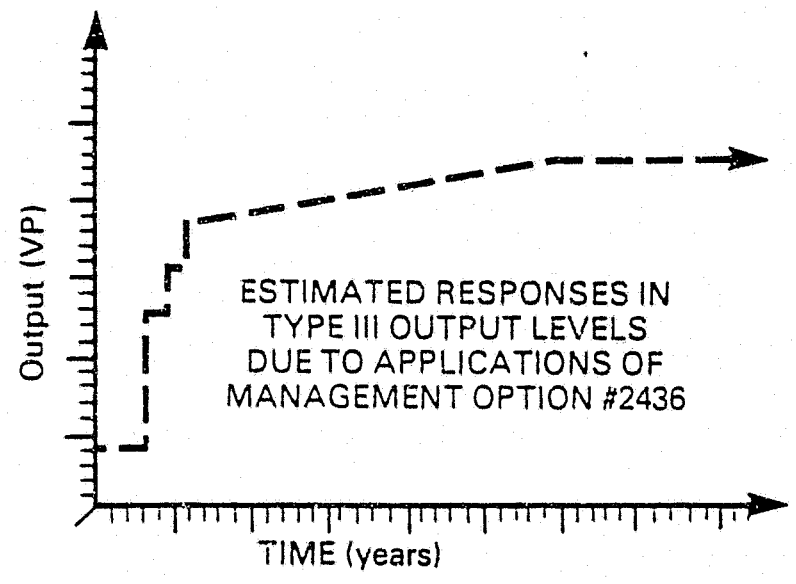
After Timestreams for all the management options that can affect existing environmental characteristics have been structured, an appraisal of how the existing recreation opportunities supply could be changed can be conducted. Such an appraisal can yield an appreciation of:

a. How many visitor days of Visitation Potential for the satisfaction of each Recreation Preferences Type could be gained or lost due to the application of each Management Option.
b. How long and to what degree such gains or losses will be sustained.
c. The inherent compatibilities and incompatibilities that exist between the various Management Options.

RESPONSE ESTIMATE TIMESTREAMS







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Inventory Procedure

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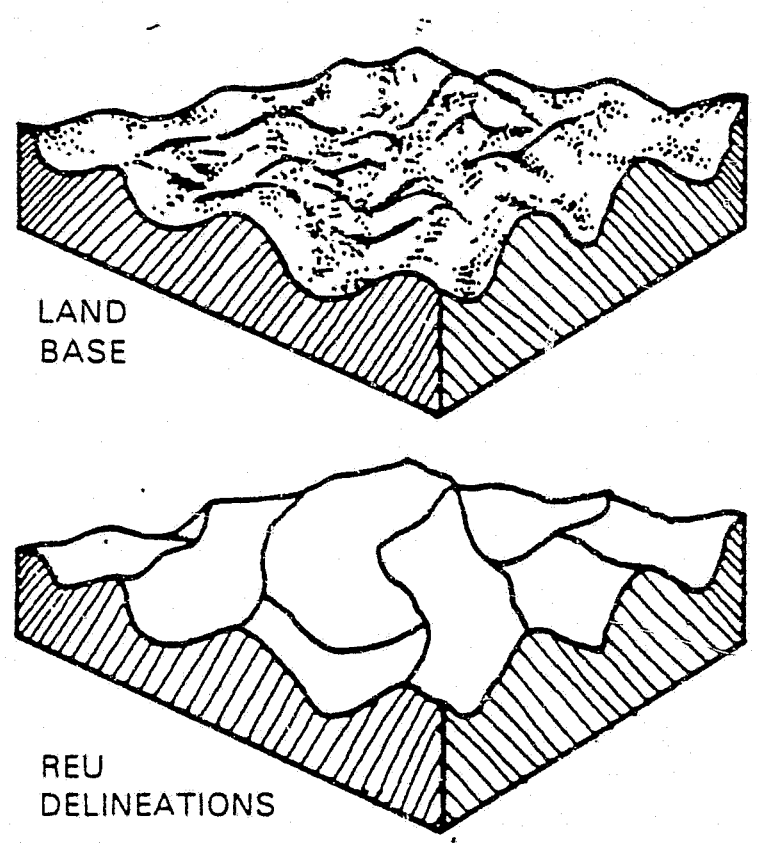

RECREATION EXPERIENCE UNIT MAPPING

Recreation Experience Units (REUs) are the discrete portions of the Forest land base to which people relate while engaging in Forest outdoor recreation. They are called Recreation Experience Units because it is within these land units visitors gain outdoor recreation experiences.

The Forest land base is an aggregation of recreation experience units. The purpose of REU mapping is to:

1. Create a basis for planning and management, by recognizing them as distinct entities.
2. Create bounds for inventorying their characteristics and estimating their visitation capacities.
3. Create a means for analyzing and differentiating in a more or less discrete manner the existing recreation opportunities supply.

REU CRITERIA

Spatial definition refers to the three dimensional concave elements of the geomorphic base or vegetative enclosure, or a combination of both. It is determined by floor (e.g., valley bottoms) and wall (e.g., ridges) planes and is distinguished by the absence of overhead enclosure. The maximum expression of spatial definition can be expected with the observer on the bottom of the space (on the floor plane) and adjacent to some part of its vertical enclosing surface ,pg.18

REUs that result from the above delineations are generally in excess of one square mile, but less than ten square miles. In many cases, however, REUs may be somewhat smaller or larger, depending upon terrain and/or vegetative variables.

The procedure for mapping the Recreation Experience Units are as follows:

1. A familiarization with the actual Forest terrain characteristics by extensive aerial and ground level reconnaissance.
2. Utilizing vertical, black and white aerial photographs (with a scale of 1:63, 630, that allow for adequate comprehension of general geomorphic and vegetative patterns) in conjunction with a good quaility steroscope, REU boundaries are delineated on the photographs directly (Fig. A) in accordance with the preceding and following criteria:
   a. When viewed stereoscopically, the forest land base (which is usually highly dissected) is revealed as a mosaic of major, adjoining spaces. Delineations that represent more or less distinct separations between spaces are drawn by visualizing how recreationists may relate to these spaces when within them. Such delineations usually follow major wall plane elements such as valley ridgelines, terrain characteristics, and other geologic portals, vegetation, directional changes etc.
   b. REU sizes should be in accord with the previously stated mapping purpose. Too much attention to minor sub-spaces, as well as not enough attention to fairly well defined spaces, will not result in proper REU delineations. A reasonable degree of mapping accuracy is desirable, for REUs are defined in the degree of current and possible future attractiveness they may hold as well as the maximum visitation capacities for any of the Preferences Types.
3. The REU delineations on the aerial photographs are transferred to a 1"/mile forest base map. (If the map accurately depicts the topographic features, this may be accomplished without the aid of a K.E.K. plotter or similar transfer de-

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vices (Fig B)

4 The REUs are given individual number designations for ease in identity and location. (Fig. B)

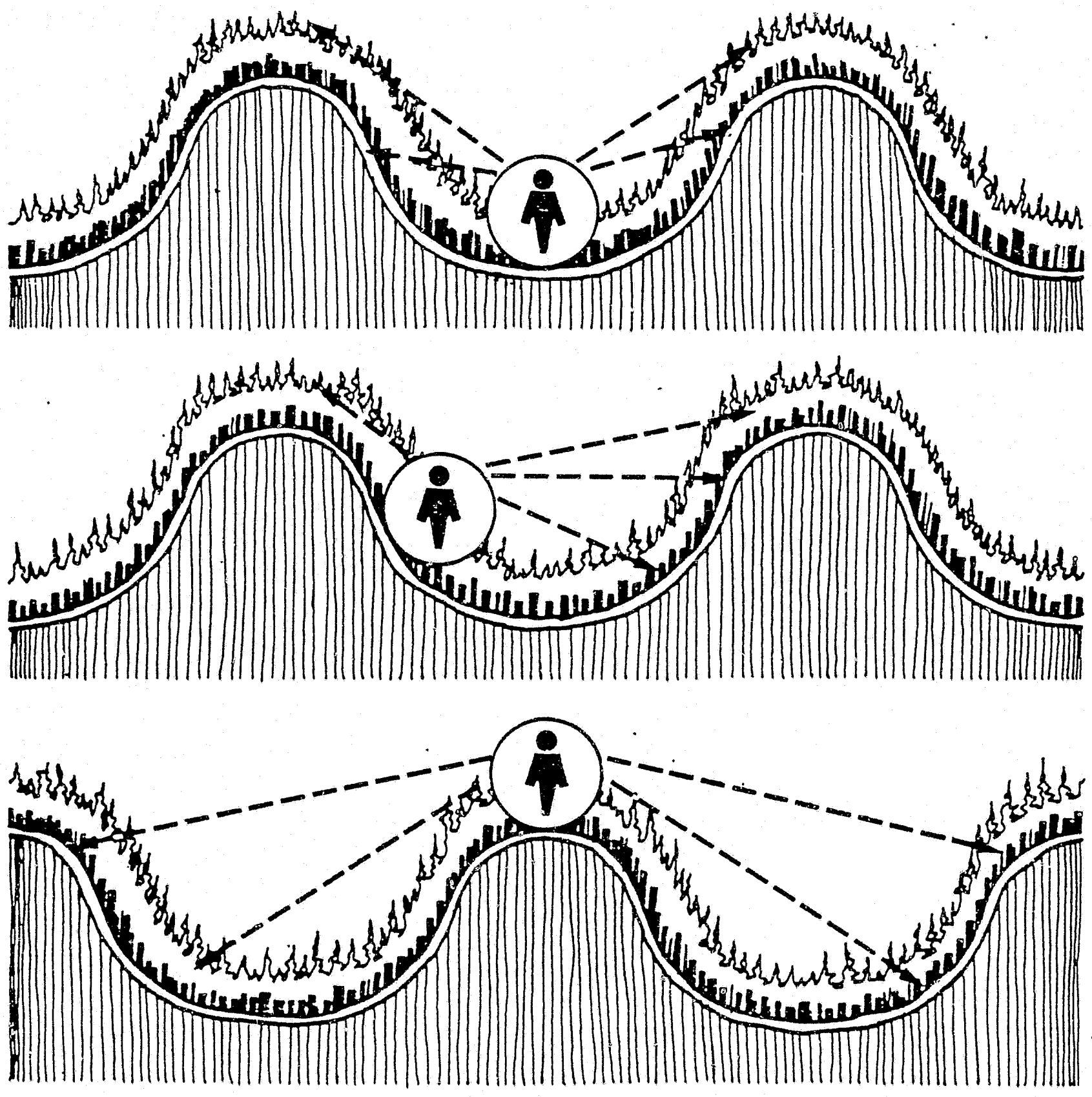

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FIGURE A

AREAL PHOTOGRAPH WITH REU DELINEATIONS.
(SCALE: 1:63,360)

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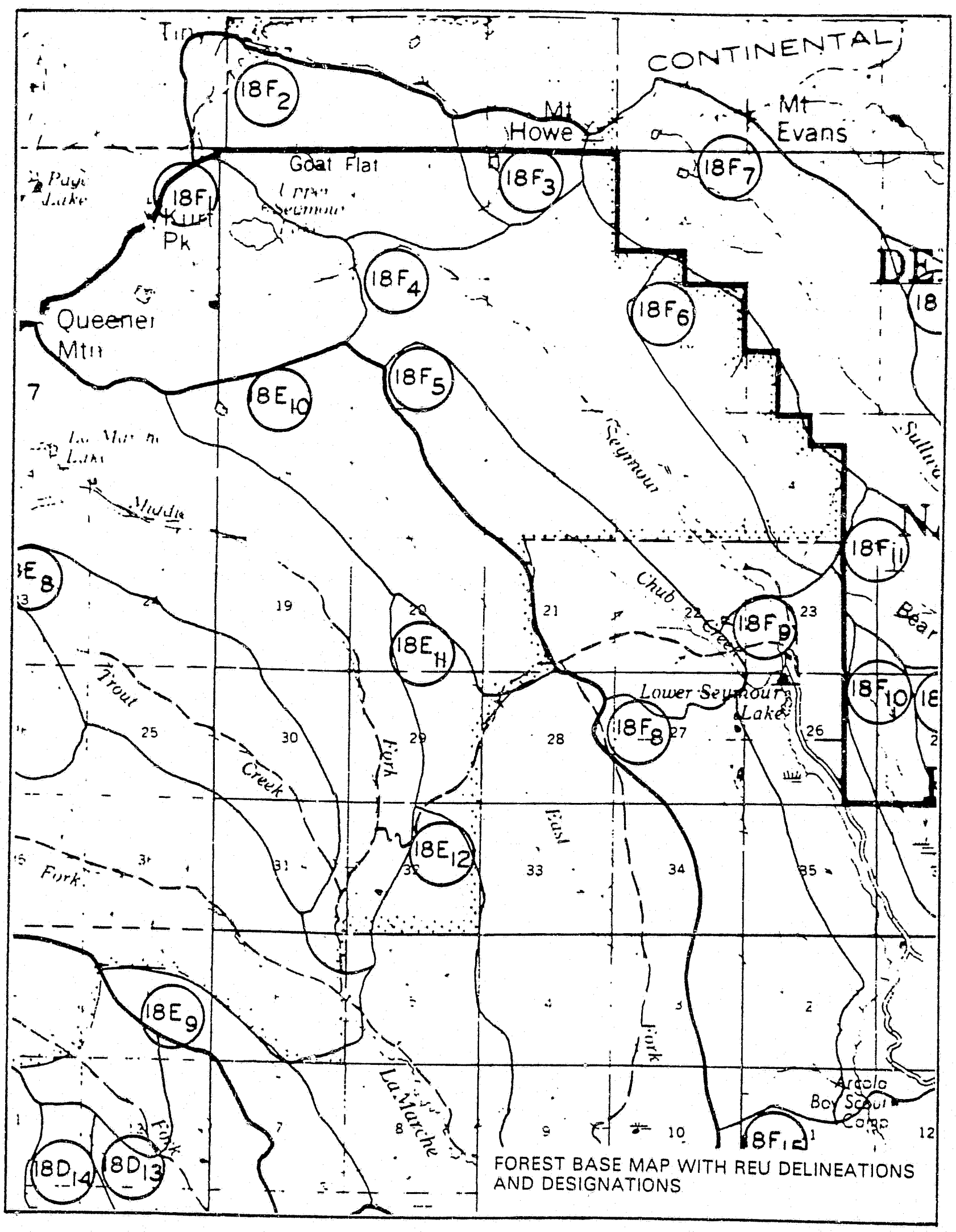
FIGURE B



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DEFINITIONS

Attractive features are the natural and cultural attributes of the land base to which people may be drawn in their recreation pursuits. The number, kind, and relative significance of the attractive features that are contained in a Recreation Experience Unit can have a significant bearing on the degree of recreation opportunity the unit holds for each of the Preferences Types.

Natural features are the products of natural processes; cultural features are the products of man's actions. The descriptions of the attractive features that have been selected for inventory and appraisal are as follows:

NATURAL FEATURES

Mountain Peaks. Distincitive, more or less abruptly rising, portions of the land's surface that offer climbing challenges; usually, although not necessarily, above timber line.

Geological Interest Sites. Portions of the land's surface which contain geological features that may be of interest for their esthetic qualities, as foci for recreation activities, and/or their educational values in relation to the earth's history and development. Examples: gorges, hogbacks, balanced rocks, lava flows, dikes, caves, well defined cirques, glacial striae, hanging, valleys, horns, landslides, striking moraines or alluvial fans, rock spires, potholes, rock glaciers, large cliffs (scarps), sinkholes, large talus slopes, water gaps, volcanic necks, etc.

Rock/Mineral Collection Sites. Portions of the land's surface on which interesting rock or mineral specimens that may be searched for and collected are known to occur. Examples: agates, garnets, quartz crystals, placer gold, petrified wood, fossils, etc.

Lakes. Naturally occurring, standing water bodies of various size (larger than ponds) that may be of interest as foci for recreation activities.

Rivers/Streams. Naturally occurring, moving water bodies of various sizes (or orders) that may be of interest as foci for recreation activities.

Big Game Hunting Habitats. Portions of the land's surface on which big game animals are known to occur and may be legally hunted. Examples: elk, deer, moose, antelope, mountain goat, black bear, etc.

Small Game Hunting Habitats. Portions of the land's surface on which small game animals are known to occur and may be legally hunted. Examples: rabbits, squirrels, etc.

Waterfowl Hunting Habitats. Portions of the land's surface (wetlands) on which waterfowl are known to occur and may be legally hunted. Examples: ducks, geese, etc.

Upland Bird Hunting Habitats. Portions of the land's surface on which upland birds are known to occur and may be legally hunted. Examples: grouse, pheasants, etc.

Fishing Habitats. Lakes, reservoirs or the portions of rivers or streams in which various fish species are know to occur and which may legally be fished. Examples: trout, grayling, whitefish, etc.

Wildlife Observation Areas. Portions of the land's surface where various terrestrial and/or aquatic wildlife species are known to occur in fairly restrictive habitats, either seasonally or permanently. Examples: bird nesting areas, mountain goat habitat, beaver ponds, fish habitats, deer winter range, etc.

7-8-30

Special Water Features. Waterfalls, ponds, permanent snowfields, hot springs and pools, ice caves, etc., that may be of interest for their esthetic qualities or as foci for recreation activities.

Botanical Interest Sites. Portions of the land's surface on which plant specimens or communities that may be of interest for their esthetic qualities or educational values are known to occur. Examples: groves of very large trees, locally rare plants, oldest or largest representatives of individual plant species, outstanding wildflower areas, etc.

Flora Gathering Areas. Portions of the land's surface on which edible plants are known to occur in sufficient quantities to warrant gathering. Examples: mushrooms, berries, nuts, succulents, etc.

CULTURAL FEATURES

Archeological Interest Sites. Portions of the land's surface containing evidence of use by aboriginal American Indians. Examples: Indian campsites, areas containing artifacts (e.g., arrowhead, tools, etc.), burial grounds, buffalo jumps, known travel routes, etc.

Historical Interest Sites. Portions of the land's surface containing evidence of past events and/or practices which have a significant contribution to the broad patterns of our history. Examples: Explorer travel routes, battlefields, settlers' cabins, early mines, etc.

Reservoirs. Man impounded, standing water bodies of various sizes (larger than ponds) that may be of interest as foci for recreation activities.

Campgrounds. Developed sites with various types of facilities to accommodate tent and/or recreation vehicle oriented camping activities.

Swimming Facilities. Developed sites with facilities to accommodate swimming activities. Examples: developed beaches, bathhouses, swimming pools, etc.

Boating Facilities. Developed sites with facilities to accommodate boating activities. Examples: boat launching ramps, marinas, etc.

Winter Sports Sites. Developed sites with facilities to accommodate winter sports activities. Examples: downhill ski areas, ice skating, snowmobile courses, etc.

Public Visitor Centers. Developed sites with facilities to provide educational and informational services to the visiting public, usually free of charge. Examples: indoor interpretive exhibits, etc.

Commercial Public Service Sites. Facilities and services developed to accommodate the recreation public for a profit. Examples: guest ranches, resorts, motels, etc.

Organization Sites. Facilities developed by various organizations to serve the recreation needs of their memberships. Examples: chruch group camps, Boy Scout camps, etc.

Tours: Self-guided. Interpretive facilities developed along selected trails or roads to aid the public in the understanding of natural features, land management practices, etc. Examples: signs, location markers, coordinated pamphlets, etc.

7-8-31

FIGURE C

SIGNIFICANCE RATING CRITERIA

Since many of the mapped attractive features may be alike in kind, but not alike in their individual qualities, they are assigned a high, medium or low rating to account for their relative significance. The basis for these empirical ratings is the following set of significance criteria:

NATURAL FEATURES

ATTRACTIVE FEATURES	RATINGS	CRITERIA
Mountain Peaks	High Medium Low	Judgmental: based on National, Regional, or local signifance.
Geological Interest Sites (NFRS Form 23)	High	Excellent and/or abundant features, capable of withstanding considerable public use.
	Medium	Good and/or abundant features, capable of withstanding some public use.
	Low	Few features and/or fragile and easily destroyed.
Rock Mineral Collection Sites	High Medium Low	Judgmental: based on the known distribution, type, and rarity of the rock/mineral deposits throughout the planning area.
Lakes	High Medium Low	Judgmental: based on size, water clarity, pollution (chemical, physical, bacterial, color), depth, etc.
Rivers/Streams	High Medium Low	6th order or greater streams 4th or 5th order streams 2nd or 3rd order streams
Big Game Hunting Habitats	High	High game population for each species; high hunter success and satisfaction; based on Department of Fish and Game records.
	Medium	Moderate game population for each species, hunter success, and satisfaction; based on Department of Fish and Game records.
	Low	Low game population for each species hunter success, and satisfaction, based on Department of Fish and Game records.
Small Game Hunting Habitats	High Medium Low	Same as for Big Game
Waterfowl Hunting Habitats	High Medium Low	Same as for Big Game.
Upland Bird Hunting Habitats	High Medium Low	Same as for Big Game.
Fishing Habitats	High	Supports high fish populations, or moderate populations of unusual species (i.e., steelhead, grayling, etc.), high fisherman success and satisfaction, based on Department of Fish and Game records.
	Medium	Supports moderate fish populations or low populations of unusual species, moderate fisherman success and satisifaction, based on Department of Fish and Game records.

7-8-32

(NATURAL FEATURES cont.)

FIGURE C (cont

ATTRACTIVE FEATURES	RATINGS	CRITERIA
	Low	Supports low fish populations, fisherman success and satisfaction, based on Department of Fish and Game records.
Wildlife Observation Areas	High Medium Low	Judgmental: based on the distribution and type of wildlife, and the known probability of observation on a recurring basis.
Special Water Features	High Medium Low	Judgmental: based on size, significance (i.e., National, Regional, Local prominence), esthetic quality, etc.
Botanical Interest Sites	High Medium Low	Judgmental: based on the distribution, rarity, and esthetic quality.
Flora Gathering Areas	High Medium Low	Known occurrence areas. Some harvesting occurring. Very low or no harvesting occuring.

CULTURAL FEATURES

Archaeological Interest Sites (NFRS Form 24)	High	Excellent and/or abundant evidence, capable of withstanding considerable public use, capable of preservation.
	Medium	Good and/or abundant evidence, capable of withstanding some public use, some preservation capability.
	Low	Scattered, meager, or deteriorated evidence, limited public interest, subject to despoilment through public use.
Historical Interest Sites (NFRS Form 25)	High	Excellent and/or abundant evidence capable of withstanding considerable public use, capable of preservation, preservation conditions, and originality retention excellent.
	Medium	Good and/or abundant evidence, capable of withstanding some public use, preservation condition and originality retention good, some capability of preservation.
	Low	Scattered, meager, or deteriorated evidence, limited public interest, subject to despoilment through public use, low capability of preservation.
Reservoirs	High Medium Low	Judgmental: based on size, fluctuation during recreation season, water clarity, depth, etc.

7-8-33

FIGURE C cont.

ATTRACTIVE FEATURES	RATINGS	CRITERIA
Campgrounds	High	Development Scale 4 and 5. (FSM 2331.11c — 3)
	Medium	Development Scale 2 and 3. (FSM 2331.11c — 3)
	Low	Development Scale 1. (FSM 2331.11c — 3)
Picnic grounds	High	Development Scale 4 and 5. FSM 2331.11c — 3)
	Medium	Development Scale 2 and 3. (FSM 2331.11c — 3)
	Low	Development Scale 1. (FSM 2331.11c — 3)
Swimming Facilities	High	Developed sandy beach (above and below water line) bathhouse, marker buoys.
	Medium	Developed sandy beach (with some stone and gravel), marker buoys.
	Low	Used but not developed, no facilities.
Boating Facilities	High	Paved ramp, docking, sewage disposal, parking area, toilet facilities.
	Medium	Paved or gravel ramp parking area (with or without toilet facilities).
	Low	Soil or undeveloped ramp, no parking area, no toilet facilities.
Winter Sports Sites (Northern Region Guidelines for Ski Area Inventory and Planning)	High	Nationl market area.
	Medium	Regional market area.
	Low	Local market area.
Public Visitor Sites	High Medium Low	Judgmental: based on subject matter, National, Regional, local significance, etc
Commercial Public Service Sites	High Medium Low	Judgmental. National, Regional, local clientele, social and recreational facilities available, etc.
Organization Sites	High Medium Low	Judgmental: social, recreational, and educational opportunities, facilites available, etc.
Tour Self-Guided	High Medium Low	Judgmental: based on subject matter, availability, etc.

7-8-34

INVENTORY AND APPRAISAL PROCEDURES

1. Review all available data sources. Forest base maps, USGS Quadrangles, aerial photographs, previous inventories, (RIM, NFRS, etc.), local knowledge (Ranger District and S.O. personnel, private organizations and individuals, etc.), field inventories, etc.
2. Utilizing the Attractive Features Inventory Data Form, Figure D, register all known features. Designate by actual numbers of features :i.e., if two campgrounds, mark two; it three big game species, mark 3). Using significance criteria, Fig. C, mark in appropriate column.
   (a) H — High
   (b) M — Medium
   (c) L — Low
   It is possible to have one or more significance rating for similar features. (See example in appendix).
3. After a thorough review of available data sources, a map (which shows REU dimensions) is prepared to depict the geographical distribution of the known attractive features in the area under study. Small circles, for natural features, and squares, for cultural features, of different colors are used to symbolize the various attractive features where they occur. (Figs. E & F).
4. Symbols for features that are common to more than one REU (e.g., mountain peaks) are located so that they straddle the appropriate REU boundaries. Symbols for features that are a part of only a particular REU are located within the Unit's boundaries.
   Rivers/streams and big game, small game, waterfow and upland bird hunting habitats are not symbolized on this map. The former are accounted for on a stream order map. The latter are treated as general qualitites of an REU as a whole rather than of any particular portion.

7-8-35

FIGURE D

ATTRACTIVE FEATURES INVENTORY DATA FORM

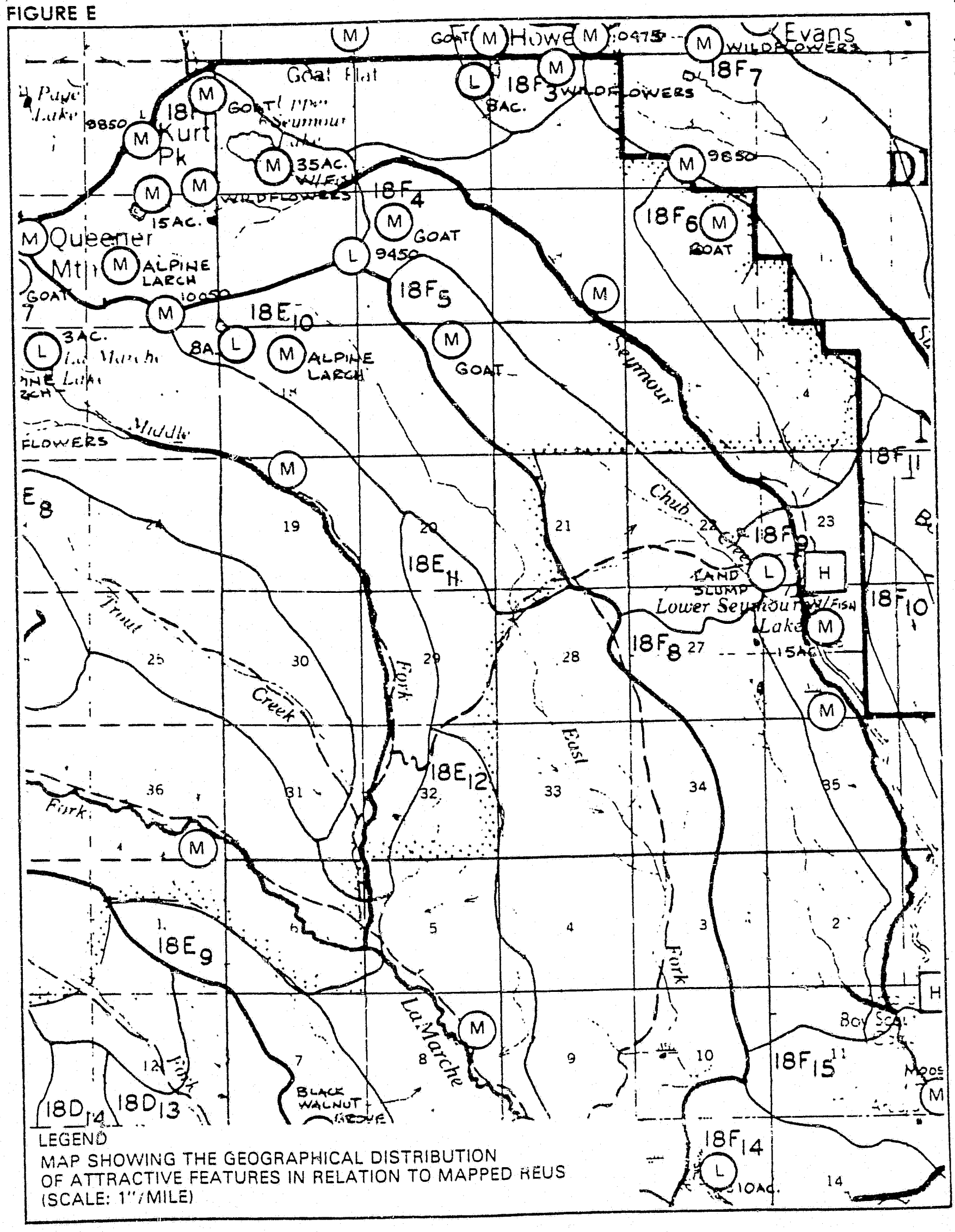
RECREATION EXPERIENCE UNIT DESIGNATION _____

INVENTORIED BY _____ DATES: _____

	SIGNIFICANCE RATINGS	H	M	L	NOTATIONS
NATURAL FEATURES					
	MOUNTAIN PEAKS				
	GEOLOGICAL INTEREST SITES				
	ROCK MINERAL COLLECTION SITES				
	LAKES				
	RIVERS & STREAMS				
	BIG GAME HUNTING HABITATS				
	SMALL GAME HUNTING HABITATS				
	WATERFOWL HUNTING HABITATS				
	UPLAND BIRD HUNTING HABITATS				
	FISHING HABITATS				
	WILDLIFE OBSERVATION AREAS				
	SPECIAL WATER FEATURES				
	BOTANICAL INTEREST SITES				
	FLORA GATHERING AREAS				
CULTURAL FEATURES	ARCHEOLOGICAL INTEREST SITES				
	HISTORICAL INTEREST SITES				
	RESERVOIRS				
	CAMPGROUNDS				
	PICNIC GROUNDS				
	SWIMMING FACILITIES				
	BOATING FACILITIES				
	WINTER SPORTS SITES				
	PUBLIC VISITOR CENTERS				
	COMMERCIAL PUBLIC SERVICE SITES				
	ORGANIZATION SITES				
	TOURS - SELF GUIDED				

7-8-36

FIGURE E



LEGEND
MAP SHOWING THE GEOGRAPHICAL DISTRIBUTION
OF ATTRACTIVE FEATURES IN RELATION TO MAPPED REUS
(SCALE: 1"/MILE)

7-8-37

FIGURE F

ATTRACTIVE FEATURES

LEGEND:

		COLOR NO.*
NATURAL FEATURES	MOUNTAIN PEAKS	323 ½
	GEOLOGICAL INTEREST SITES	352 ½
	ROCK MINERAL COLLECTION SITES	332
	LAKES	320
	RIVERS AND STREAMS	THESE FEATURES ARE NOT SYMBOLIZED ON THIS MAP. RIVERS AND STREAMS ARE ACCOUNTED FOR ON A STREAM ORDER MAP. THE REST ARE TREATED AS GENERAL QUALITIES OF AN REU AS A WHOLE.
	BIG GAME HUNTING HABITATS	
	SMALL GAME HUNTING HABITATS	
	WATERFOWL HUNTING HABITATS	
	UPLAND BIRD HUNTING HABITATS	
	(M) FISHING HABITATS	350
	WILDLIFE OBSERVATION AREAS	343
	SPECIAL WATER FEATURES	323
	(L) BOTANICAL INTEREST SITES	353
	FLORA GATHERING AREAS	325 ½
CULTURAL FEATURES	ARCHAEOLOGICAL INTEREST SITES	324
	[L] HISTORICAL INTEREST SITES	321 ½
	RESERVOIRS	320
	CAMPGROUNDS	325
	PICNIC GROUNDS	323 ½
	[M] SWIMMING FACILITIES	320
	BOATING FACILITIES	350
	WINTER SPORTS SITES	354
	PUBLIC VISITOR CENTERS	323
	COMMERCIAL PUBLIC SERVICE SITES	322
	[H] ORGANIZATION SITES	343
	TOURS - SELF GUIDED	353

NOTE:

THE H.M.L. DESIGNATIONS IN THE SYMBOLS INDICATE THE RELATIVE SIGNIFICANCE RATINGS OF ATTRACTIVE FEATURES (HIGH, MEDIUM OR LOW).

*COLOR NUMBERS ARE FOR DIXON BEST PENCILS

7-8-38

ACCESSIBILITY AND REMOTENESS INVENTORY

DEFINITIONS

Accessibility refers to the kind of travel facilities that lead to, and are contained in, an REU (Recreation Experience Unit) and that act as the determinants of the mode of travel that may be used.

Remoteness refers to the distances from the geographical center of an REU to the various kinds of travel facilities that are not contained in the unit. These distances are indicators of difficulty or ease of access to a unit.

INVENTORY PROCEDURES

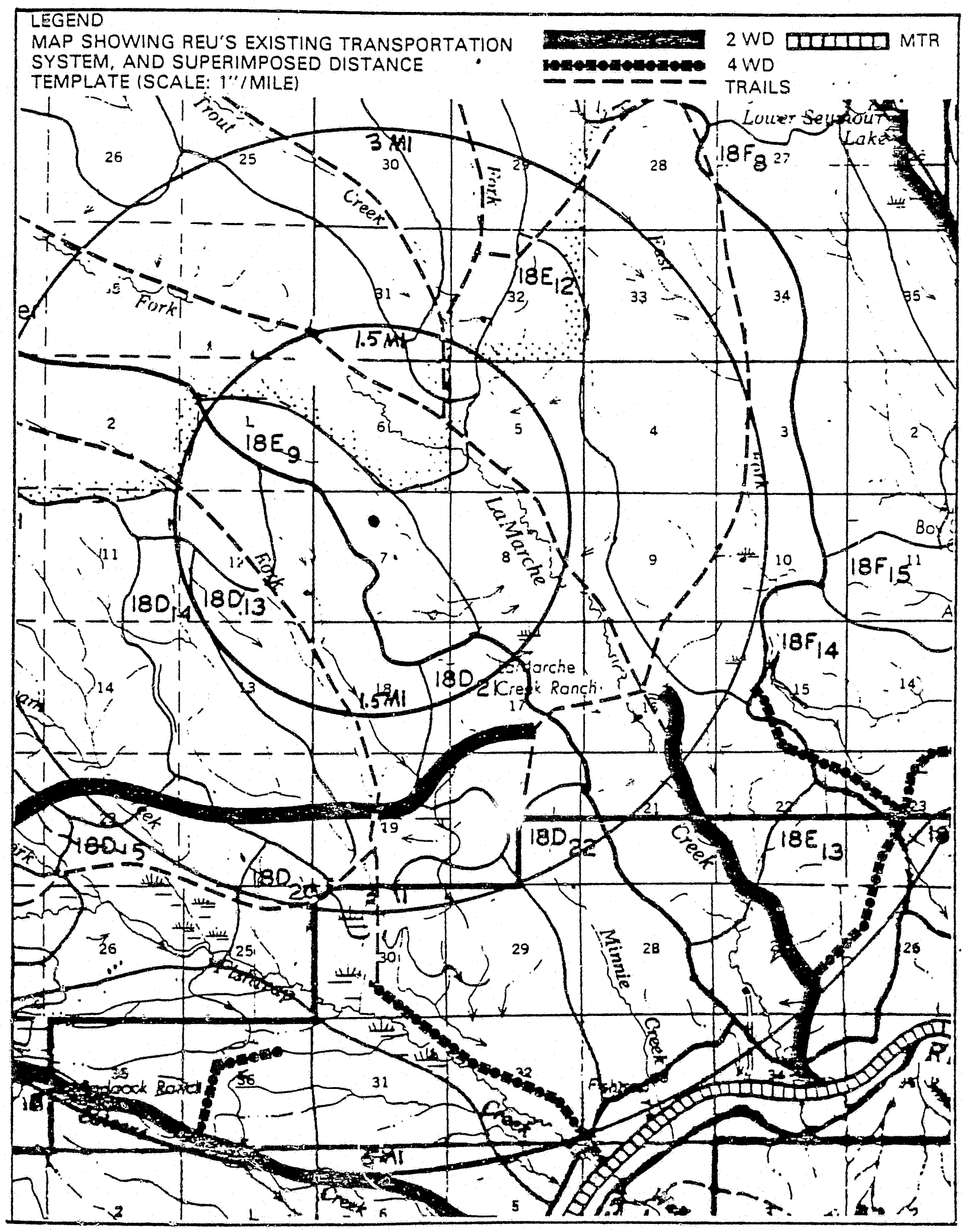
1. A map of the existing transportation systems is prepared for the area under study. The following types of travel facilities, color coded for easy recognition, are included on this map: (Fig. G)
   - Designated Trails
   - 4-wheel drive roads — (Road not negotiable by ordinary 2-WD passenger vehicles)
   - 2-wheel drive roads — (single lane paved; single lane or double lane unpaved)
   - major travel routes — (double lane paved or greater; e.g. State highways)

   (To allow for remoteness measurements, the transportation system is delineated to a distance of about 6 or 7 miles from the boundaries of the study area.)

2. The Recreation Experience Unit (REU) map is positioned on top of the transportation system map. Utilizing the Accessibility and Remoteness Characteristics inventory data form (Fig. H), the kind of travel facilities that are contained in each individual REU are noted by simple check marks (✓). The approximate lengths of the travel facilites within the Forest boundaries are notated as data for preparing visitation capacity estimates.
3. A Distance Template is prepared on fairly stiff, clear plastic material by drawing concentric circles (1.5 miles, 3 miles and 5 miles from the center) to scale with the transportation system and REU maps. Using the template is a rapid and expedient approach. Those wishing greater accuracy may take the time to figure the estimated distance to access the REU.
4. With the REU map positioned on top of the transportation system map, (Fig. G), the center point of the distance template is located at the geographical center of each REU and the approximate distances are determined for each Unit to the kind of travel facilities that are not contained in the unit (e.g., if an REU contains a 4-WD road, determine its distance from the nearest 2-WD road and major travel route; if an REU contains a 2-WD road, determine its distance from the nearest major travel route; if an REU contains a major travel route, remoteness is nil or zero). Indicate distances in the remoteness portion of the Accessibility and Remoteness Characteristics Inventory data form, (Fig. H), by means of simple check marks (✓).

7-8-39

FIGURE G



7-8-40

FIGURE H

ACCESSIBILITY AND REMOTENESS CHARACTERISTICS – INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

INVENTORIED BY: _____ DATE: _____

ACCESSIBILITY

✓	KIND OF TRAVEL FACILITIES CONTAINED IN REU	APPROXIMATE LENGTHS* (in miles) OF TRAVEL FACILITIES CONTAINED IN REU
	NONE	N A
	TRAILS	
	4-WHEEL DRIVE ROADS	
	2-WHEEL DRIVE ROADS	
	MAJOR TRAVEL ROUTES	

*PORTIONS THAT ARE WITHIN THE FOREST BOUNDARIES

REMOTENESS

✓	DISTANCE FROM GEOGRAPHICAL CENTER OF REU TO THE NEAREST ROADS THAT ARE NOT CONTAINED IN THE UNIT.
	≥ 3 MILES FROM NEAREST 4-WHEEL DRIVE ROAD
	≥ 1.5 MILES FROM NEAREST 4-WHEEL DRIVE ROAD
	≤ 1.5 MILES FROM NEAREST 4-WHEEL DRIVE ROAD
	≥ 5 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≥ 3 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≥ 1.5 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≤ 1.5 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≥ 5 MILES FROM NEAREST MAJOR TRAVEL ROUTE
	≥ 3 MILES FROM NEAREST MAJOR TRAVEL ROUTE
	≥ 1.5 MILES FROM NEAREST MAJOR TRAVEL ROUTE
	≤ 1.5 MILES FROM NEAREST MAJOR TRAVEL ROUTE

(≥ EQUAL OR GREATER THAN ≤ EQUAL OR LESS THAN)

NOTES

_____

_____

7-8-41

VISUAL RESOURCE CHARACTERISTICS INVENTOR.

DEFINITION

Visual Resource Characteristics refer to the visible composite of basic terrain variations, geological features, water features, vegetative patterns and land use effects in and REU and which act as the determinants of how visually stimulating the unit may be.

INVENTORY PROCEDURES

1. The appropriate aerial photographs with REU delineations are first assembled for the land area that is under study.
2. The designations of the REUs are entered on individual Visual Resource Characterisitcs inventory data forms (Fig. I).
3. Each REU of the study area is carefully analyzed in conjunction with the Visual Resource Evaluation Criteria (The Mountains, Fig. J, The High Plains, Fig. K). These criteria act as a standard against which the actual visible characteristics of each REU can be measured. By using these same criteria for each unit, a basis for comparing the relative visual stimulation potentials of all the units is created.

The following steps must be followed in utilizing these criteria:

a. Each REU is evaluated for each of the five criteria categories. The visible characteristics of each REU must be compared with these categories to determine which of their respective sub-categories best describe the REU characteristics.

b. After this has been determined, the one rat number that is most indicative of the degree to which th sub-category description matches with REU realities is entered on the inventory data form, (Fig. I), as a rating sub-total.

c. Step b. is repeated until a rating sub-total for each criteria category has been determined. These are then summed up on the data form. The sum may range from a minimum of 0 to a maximum of 68. This sum is called the probability of visual appeal index. (The greater the index, the greater the probability of visual appeal.)

NOTE: In following these steps, attention must be focused on what is visible. Perceptual biases toward what is visible (e.g., slope is hard to climb; I know that lake has no fish; lots of bugs in this REU; etc.) must be excluded.

4. A map showing REUs may be prepared to depict the visual appeal of the area under study. (Fig. L)

7-8-42

FIGURE I

VISUAL RESOURCE CHARACTERISTICS — INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

INVENTORIED BY: _____ DATE: _____

#	CRITERIA CATEGORIES	RATING SUBTOTALS
1	BASIC TERRAIN VARIETY	+
2	GEOLOGIC FEATURE VARIETY	+
3	WATER FEATURES VARIETY	+
4	VEGETATIVE PATTERN VARIETY	+
5	LAND USE EFFECTS	
	PROBABILITY OF VISUAL APPEAL INDEX →	

NOTES

7-8-43

FIGURE J

THE MOUNTAINS
Extensive Appraisal Criteria

VISUAL RESOURCE EVALUATION CRITERIA –

No.	Criteria	Rating
1.	Basic Terrain Variety	
	a. Unit characterized by highly varied terrain; (dramatic slope gradient and relief differneces typical); dominated by massive, angular forms, sharp edge definitions; strong figure-ground contrasts, (i.e., figure: peaks; ground; sky).	24 22 20
	b. Unit characterized by moderately varied terrain; (moderate slope gradient and relief differences typical); dominated by fairly massive, rounded forms; moderate edge definitions; moderate figure-ground contrasts.	16 14 12
	c. Unit characterized by more or less uniform terrain; (few significant slope gradient or relief differences); predominately gently sloping forms; subtle, edge definitons, weak figure-ground contrasts.	8 6
2.	Geologic Features Variety	
	a. Unit characterized by numerous large and/or highly significant geologic features; (large cliffs, massive rock formations, craggy peaks and/or ridges, chasms, gorges, etc., are typical examples); major figure objects which tend to dominate other objects of the visual field.	14 12
	b. Unit characterzied by moderately significant geologic features; (minor cliffs and rock formations are typical examples); these figure objects tend toward co-dominance with other objects of the visual field.	10 8 6
	c. Unit characterized by minor (or no) geologic features; (large boulders, rock spires, etc., are typical examples); these features (if present) are usually subordinate to other objects of the visual field.	4 2
3.	Water Features Variety	
	a. Unit characterized by numerous and/or highly significant water features; groups of lakes, large lakes (or reservoirs), large marshes, rivers, large streams, large permanent (or semi-permanent) snowfields, large waterfalls, etc., are typical examples); major figure objects which tend to dominate other objects of the visual field.	18 16 14
	b. Unit characterized by moderately significant water features; (small lakes or ponds, marshes, moderate sized streams, small waterfalls, etc., are typical examples); these figure objects tend toward co-dominance with other objects of the visual field.	12 10 8 6
	c. Unit characterized by minor (or no) water features; (minor streams (1st or 2nd order), small marshy areas, springs, etc., are typical examples) these features (if present) are usually subordinate to other objects of the visual field.	4 2

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4.	Vegetative Pattern Variety	
	a. Unit characterized by highly varied vegetative pattern; (presence of many major plant cover types typical); strong mass texture due to variations in plant cover types form properties; natural forest openings and/or isolated forest patches' (or tree peninsulas) appear as distinct entities due to sharp edge definition; forest openings and/or patches' are major figure objects which may dominate or be co-dominate with other objects of the visual field.	12 10
	b. Unit characterized by moderately varied vegetative pattern; (presence of few major plant cover types typical); moderate mass texture due to variations in plant cover types form properties; natural forest openings and/or isolated fores 'patches' appear as indistinct entities due to subtle edge definition; forest openings and/or 'patches' tend toward co-dominance or subordination with other objects of the visual field.	8 6
	c. Unit characterized by uniform vegetative pattern; (presence of only one major cover type typical); low mass texture due to lack of variation in plant cover type form properties; few or no natural forest opeings and/or isolated forest patches' (very indistinct if presnet); vegetative cover tends to be ground in relation to the visual field.	4 2
5.	Land Use Effects	
	a. Unit characterized by the absence of discordant land use effects; existing land use effects, if discernible, are in harmony with the natural objects of the visual field.	0
	b. Unit characterized by the presence of moderately discordant land use effects; these effects tend toward co-dominance with the natural objects of the visual field.	−4 −8
	c. Unit characterized by the presence of highly discordant land use effects; these effects tend to dominate the natural objects of the visual field.	−12

NOTES:

1. The terms that are employed in these criteria are defined in the Northern Region Forest Landscape Management Handbook. (14)

2. The use of the criteria should be limited to mountainous, primarily wildland areas. They are intended to act as a comparsion basis for land areas that are basically similar in character.

7-8-45

FIGURE

THE HIGH PLAINS
Extensive Appraisal Criteria

VISUAL RESOURCE CHARACTERISTICS —

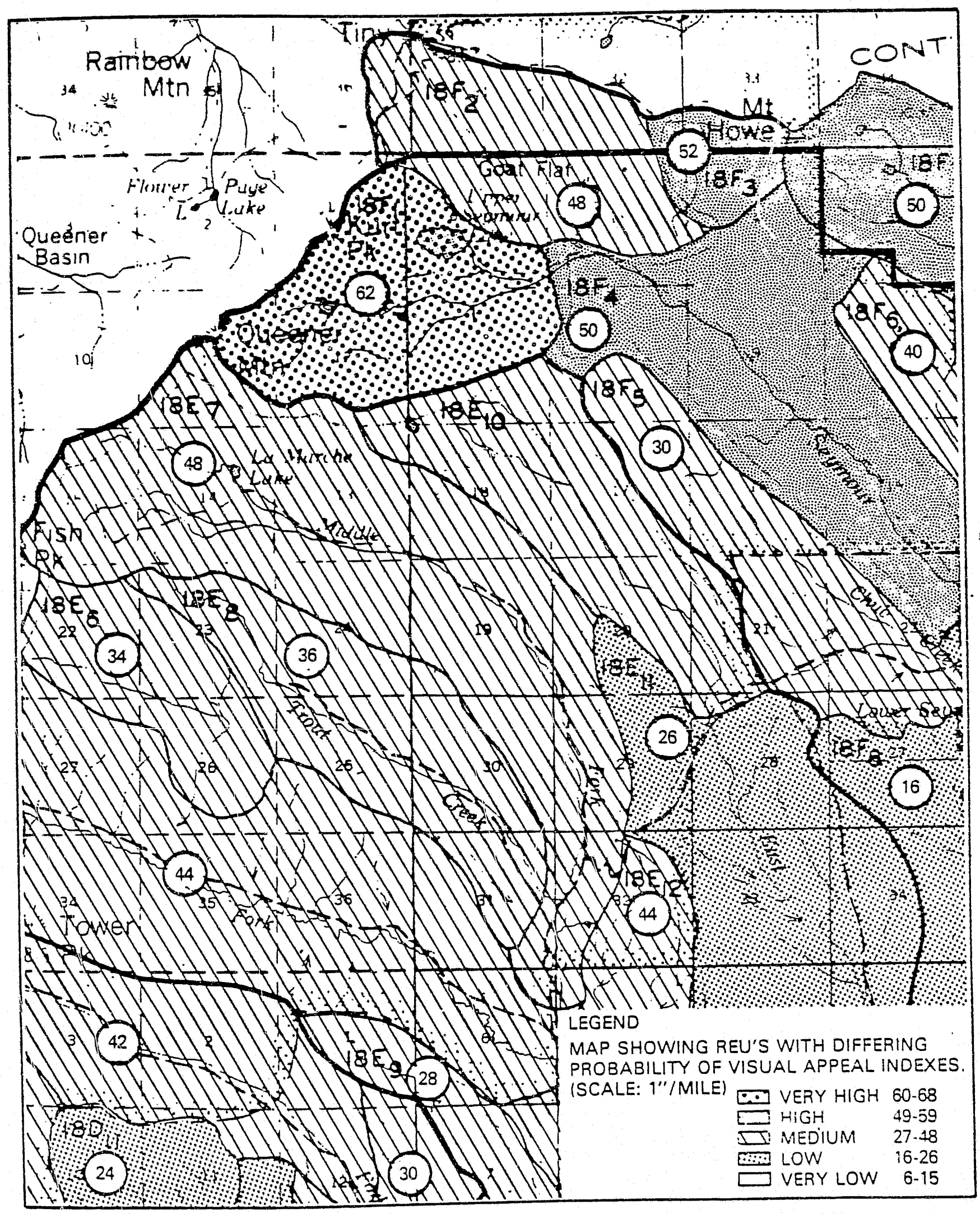
No.	Criteria	Rating
1.	Basic Terrain Variety	
	a. Unit characterized by highly varied terrain; (dramatic slope gradient and relief differences typical); dominated by wasting escarpments, sharp crests, angular forms, terracing, and sharp breaks; strong figure-ground contrasts.	24 22 20
	b. Unit characterized by moderately varied terrain; (moderate slope, gradient, and relief differences typical); dominated by modereate edge definitions, rounded forms; moderate figure-ground contrasts.	16 14 12
	c. Unit characterized by more or less uniform terrain; (few significant slope gradient or relief differences); predominately gently sloping forms; subtle edge definitions; broad open plains; weak figure-ground contrasts.	8 6
2.	Geologic Features Variety	
	a. Unit characterized by numerous large and/or highly significant geologic features; (large cliffs, bluffs, measas, buttes, chasms, patterns of clays interlaced with beds of sandstone or isolated concretions, etc., are typical examples); major figure objects which tend to dominate other objects of the visual field.	18 16 14
	b. Unit characterized by moderately significant geologic features; (minor cliffs, bluffs, mesas, buttes, chasms, and soil patterns are typical examples); these figure objects tend toward co-dominance with other objects of the visual field.	12 10 8
	c. Unit characterized by minor (or no) geologic features; (large boulders, rock spires, etc., are typical examples); these features (if present) are usually subordinate to other objects of the visual field.	6 4 2
3.	Water Feature Variety	
	a. Unit characterized by a highly significant water feature; (lakes, rivers, large streams are typical examples); these figure objects tend toward dominance with other objects of the visual field.	14 12
	b. Water characterized by moderately significant water features; (small lakes, ponds, streams are typical examples); these figure objects tend toward co-dominance with other objects of the visual field.	10 8 6
	c. Unit characterized by minor (or no) water features; (minor and intermittent streams, marshy areas, springs, etc., are typical examples); these features (if present) are usually subordinate to other objects of the visual field.	4 2

7-8-46

4.	Vegetative Pattern Variety	
	a. Unit characterized by highly varied vegetative pattern (presence of major plant cover types typical); strong texture due to variations in plant cover types; isolated tree patches appear as distinct entities due to sharp edge definitions; patches are major figure objects which may be dominate or be dominate with other objects of the visual field.	12 10
	b. Unit characterized by moderately varied vegetative pattern (presence of minor plant cover type typical); moderate texture due to variation in plant cover types; patches appear as indistinct entities due to subtle edge definition; patches tend toward co-dominance or subordination with other objects of the visual field.	8 6
	c. Unit characterized by uniform vegetative pattern (presence of only one major type typical); vegetative cover tends to be ground in relation to other objects of the visual field.	4 2
5.	Land Use Effects	
	a. Unit characterized by the absence of discordant land use effects; existing land use effects, if discernible, are in harmony with the natural objects of the visual field.	0
	b. Unit characterized by the presence of moderately discordant land use effects; these effects tend toward co-dominance with the natural objects of the visual field.	−4 −8
	c. Unit charcterized by the presence of highly discordant land use effects; these effects tend to dominate the natural objects of the visual field.	−12

7-8-47

FIGURE L



LEGEND

MAP SHOWING REU'S WITH DIFFERING PROBABILITY OF VISUAL APPEAL INDEXES. (SCALE: 1"/MILE)

VERY HIGH	60-68
HIGH	49-59
MEDIUM	27-48
LOW	16-26
VERY LOW	6-15

7-8-48

DISCORD ELEMENTS INVENTORY

DEFINITION

Discord Elements refers to the persistent, readily evident to the senses, forms of contamination that may be characteristic of an REU. The main kinds of discord elements are:

1. Air pollution (e.g., foul odors, smoke, dust, etc.).
2. Noise pollution (e.g., noise emanating from road traffic, mining operations, intensive recreation areas, logging operations, industrial plants, construction projects, etc.).
3. Water pollution (e.g., persistent siltation, unpotable water, noxious chemicals, oil, etc.)
4. Miscellaneous (e.g., livestock fecal matter, etc.)

INVENTORY PROCEDURES

1. The designations of the REUs that are to be evaluated are entered on individual Discord Elements inventory data forms (Fig. M).
2. The discord element impact level that characterizes the REU is notated (✓) and described on the data form. The criteria for each level are:

   Level I — No discord elements are known to exist in the unit.

   Level II — The discord elements that do exist are likely to to be of minor consequence to most recreationists that visit the unit.

   Level III — The discord elements that exist are pervasive enough to be of moderate concern to the recreationists that visit the unit.

   Level IV — The discord elements that exist are pervasive enough to be disconcerting to recreationists that visit the unit.

   Level V — The discord elements that exist are pervasive enough to cause recreationists to temporarily avoid the unit.

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FIGURE M

DISCORD ELEMENTS CHARACTERSITCS – INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

INVENTORIED BY: _____ DATE: _____

✓	DISCORD ELEMENTS IMPACT LEVELS	DISCORD ELEMENTS DESCRIPTIONS
	LEVEL I: NONE	N/A
	LEVEL II: MINOR	
	LEVEL III: MODERATE	
	LEVEL IV: HIGH	
	LEVEL V: SEVERE	

NOTES

7-8-50

VISITATION CAPACITY ELEMENTS INVENTOR

DEFINITION

Visitation Capacity Elements refer to the physical characteristics that are utilized in the estimation of REU Social Visitation Capacities. They are the REU variables such as size, percent of encounter space, percent of forest cover, type and length of travel facilities, design capacities of recreation developments, and percent of year usable that are combined with certain estimation constants to calculate REU congestion limits.

PROCEDURE

Visitation Capacity Elements — Inventory Data Form Figure N.

1. Calculate REU acreage of all land within the National Forest boundary.
2. Calculate percentage of acreage in encounter space. Encounter spaces are those portions of the land base which are topographically suitable and which people normally use in their pursuits of recreation. They are the valley floors, ridge tops, and other suitable terrain areas where encounters with other groups usually occur. Express this acreage as a decimal.
3. Calculate percentage of the Encounter Space which is in forest cover. Express this acreage as a decimal.

4-7. Calculate the miles of access. Express in terms of trails, 4-WD, 2-WD, and major travel roads. Include all portions lying within the National Forest boundary.

8. Calculate the PAOT for existing Recreation Facilities. This information is available on RIM Basic Address Record. Determine PAOT for facilities located on private lands.
   For items a. and b. use the development scale shown on RIM Basic Address Record to determine which preference type the camp or picnic ground should be listed under. For campgrounds, use Development Scales 2 and 3 for T-III and Development Scales 4 and 5 for T-IV and T-V. For picnic sites use Development Scales 2-5 for T-III and Development Scales 4 and 5 for T-IV and T-V.
   For the remaining categories c through i; the same PAOT is shown for all preference types. The PAOT is not recorded in the blanked-out spaces as these facilities have virtually no attractive force in relation to the preference type Sum the PAOT's for each type and divide by 5 to convert to GAOT.
9. Calculate percentage of year each REU may be used for Preference Type. This information is obtained from RIM Basic Address Record for several categories. The remaining is calculated on judgmental basis. Express the time factor as decimals.

FIGURE N

VISITATION CAPACITY ELEMENTS — Inventory Data Form

Recreation Experience Unit Designation: _____

Inventoried By: _____ Date: _____

1. REU Acreage (Portion lying w/in Forest Boundary) N.F._____; Other _____

2. % of REU Acreage in Encounter Space_____(Express as Decimal)

3. % of Encounter Space in Forest Cover_____(Express as Decimal)

4. Miles of trail within REU_____
5. Miles of 4-WD road within REU_____
6. Miles of 2-WD road within REU_____
7. Miles of MTR road within REU_____

(Portion of REU lying w/in Forest Boundary)

8. PAOT Estimates for Existing Recreation Facilities: (RIM)

	T-III	T-IV	T-V
a. Campgrounds			
b. Picnicgrounds			
c. Swimming Facilities			
d. Boating Facilities			
e. Winter Sports Sites			
f. Public Visitor Centers			
g. Commercial Public Service Sites			
h. Organization Sites			
i. Other			
PAOT SUMS			
Divide PAOT Sums by 5 to convert number of people to groups of people (GAOT) →			
	(8-1)	(8-2)	(8-3)

9. % of Year REU May be Used for Each Preferences Type: (RIM)

TI _____ TII _____ TIII _____ TIV _____ TV _____ (Express as Decimals)
(a) (b) (c) (d) (e)

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Data Evaluation Procedure

7-8-53

QUALITATIVE DEFINITION

The rating values in the following tables are intended to reflect the Recreation Experience Unit (REU) characteristics preferences for each recreation preference type. By comparing the completed data forms for each mapped REU, in accord with the following listed instructions on the Rating Values Tables, various numerical rating value subtotals can be established for each preference type.

The sums of the subtotals may then be analyzed to isolate the rating extremes (i.e., highest and lowest sums) and to establish the desired means (i.e., recreation opportunity classes) for the total number of REUs that have been analyzed.

The numbers are used as a means of approximating the degree of value that each of the subvariables may have as a characteristic of an REU in relation to each of the preference types.

1. Attractive Features — Instructions contained on Table III.
2. Accessibility — Instructions contained on Table IV.
3. Remoteness — Supplemental Instructions — Table V.

In the column titled REU Characteristics Subvariables, every possible combination of remoteness notations that could be recorded on the accessibility and remoteness characteristics data form is represented. The shaded blocks on the rating values tables correspond to the possible check marks (✓) on the data forms. These possible combinations have been ordered to reflect a progression from most remote to least remote (i.e., an REU that is more than 3 miles from a 4-WD road, more than 5 miles from a 2-WD road and more than 5 miles from a major travel route is most remote; an REU less than 1.5 miles from a major travel route is least remote).

In utilizing the rating values tables, search for the combination that matches with the remoteness classes combination that has been recorded on the data form for each REU and record the corresponding rating values on the current recreation opportunity indexes form. If, for instance, an REU containing a trail is less than 1.5 miles from a 4-WD road, more than 3miles from a 2-WD road, and more than 3 miles from a major travel route, the rating values of 30 (T I), 2 (T II), −18 (T III), −24 (T IV), and −47 (T V) should be recorded. If, an REU containing a 4-WD road is more than 1.5 miles from a 2-WD road and less than 1.5 miles from a major travel route, the rating values of −30 (T I), 16 (T II), 28 (T III), 30 (T IV) and 24 (T V) should be recorded. If, an REU containing a 2-WD road is more than 5 miles from a major travel route, the rating values of −34 (T I)., 14 (T II), 30 (T III), 33 (T IV) and 28 (T V) should be recorded.

Note that REUs containing no travel facilities or trails will have three remoteness notations (✓) and will therefore be matched to the possible combinations that range from 47 to 0 in the Type I rating values.*1 REUs containg 4-WD roads will have 2 notations and will therefore be matched to the combinations that range from −2 to −32 in the Type I rating values.*1 REUs containing 2-WD roads will have one notation and will therefore be matched to the combinations that range from −34 to −46 in the Type I rating values.*1

REUs containing major travel routes are given rating values of zero for each Preferences Types for the following reasons:

*1 Or corresponding rating values for the other Preferences Types

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A. Accessibility and remoteness are closely interrelated. Remoteness is basically a qualification of an REUs accessibility. Note that the rating values for trails, 4-WD roads and 2-WD roads are also the means (or average values) of the corresponding remoteness rating values ranges for each Preferences Type for this reason (e.g., trails equals 25 for T I in accessibility which is the approximate mean of 47 to 0 for T I in remoteness).

B. No travel facilities or major travel routes are accessibility extremes. In the case of REUs containing no travel facilities, rating values for accessibility are assigned to differentiate them from REUs containg trails. Thus the sum of the rating values for accessibility and remoteness will always be more extreme in such REUs than in REUs containing trails. In the case of the REUs containing major travel routes, they are the least remote of all since major travel routes are the ultimate points of reference for remoteness. The rating values for accessibility for REUs containing major travel routes reflect this condition. They are the sum of the accessibility rating values for 2-WD roads plus the (least) remoteness rating values and the next logical value progression for the remoteness rating values (e.g., T I: −40 (accessibility) + (−46) + (−4 *2) remoteness = −90).

4. Visual Resource — Instructions contained on Table VI.
5. Discordant Elements — Instructions contained on Table VII.

The value totals that result from the above procedures are called Recreation Opportunity Indexes. The indexes for any one REU become meaningful only when they are compared to the indexes of other REUs. Ideally then, the indexes for all the REUs for the total planning area should be determined before these comparisons are made. This will allow for the accurate definition of the relative degrees of recreation opportunity that may be said to characterize any particular REU.

6. Current Recreation Opportunity Indexes — Extensive Appraisal Summary. Table VIII. The values determined in steps 1-5 above are entered on Table VIII. These values are summed up to arrive at the Recreation Opportunity Index for each Preferences Type. Referring to Table II, the Recreation Opportunity Class is determined and noted next to the Recreation Opportunity Index for each Preferences Type.

If, for instance, the highest and lowest indexes for each Preferences Type for all the REUs in a planning area were as follows:

TABLE I

PREFERENCES TYPES	T-I	T-II	T-III	T-IV	T-V
HIGHEST INDEXES	+410	+490	+240	+280	+300
LOWEST INDEXES	−40	+30	−10	+20	+100
TOTAL INDEX POINT SPREADS	450	460	250	260	200

*2. Logical value in −34, −38, −42, −46 progression for T I (refer to remoteness rating values tables).

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and ten recreation opportunity classes were desired for planning purposes, then by simple division each recreation opportunity class will have the following index point spreads:

TABLE II

PREFERENCES TYPES		T-I	T-II	T-III	T-IV	T-V
HIGHEST →	10	+365 → +410	+444 → +490	+215 → +240	+254 → +280	+280 → +300
	9	+320 → +364	+398 → +443	+190 → +214	+228 → +253	+260 → +279
	8	+275 → +319	+352 → +397	+165 → +189	+202 → +227	+240 → +259
	7	+230 → +274	+306 → +351	+140 → +164	+176 → +201	+220 → +239
DEGREE OF RECREATION OPPORTUNITY	6	+185 → +229	+260 → +305	+115 → +139	+150 → +175	+200 → +219
	5	+140 → +184	+214 → +259	+90 → +114	+124 → +149	+180 → +199
	4	+95 → +139	+168 → + 213	+65 → + 89	+98 → +123	+160 → +179
	3	+50 → +94	+122 → +167	+40 → +64	+72 → +97	+140 → +159
	2	+5 → +49	+76 → +121	+15 → +39	+46 → +71	+120 → +139
LOWEST →	1	−40 → +4	+30 → +75	−10 → +14	+20 → +45	+100 → +1

Thus, if an REU had the following set of indexes: T I: 196, T II: 431, T III: 153, T IV: 167, and T V: 110, they would now be meaningful since they can be ranked in relation to the indexes of other recreation experience units. NOTE: The opportunity indexes for any one Preferences Type for an REU are only compared with the opportunity indexes of the same Preferences Type for any other REUs. Comparing the indexes for Type I with those for Type IV for the same or differing REUs, for example, is meaningless. The opportunity classes for any one Preferences Type for an REU may be compared with the opportunity classes of any other Preferences Types within the same or any other REUs.

7-8-56

TABLE III

REU CHARACTERISTICS VARIABLES	REU CHARACTERISTICS SUBVARIABLES	SUBVARIABLE RATING VALUES RELATIVE TO EACH PREFERENCES TYPE														
		TYPE I			TYPE II			TYPE III			TYPE IV			TYPE V		
	SIGNIFICANCE RATINGS	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
ATTRACTIVE FEATURES	* NATURAL FEATURES: MOUNTAIN PEAKS	30	20	10												
	GEOLOGICAL INTEREST SITES	20	10	5	10	5	3	20	10	5	40	25	15			
	ROCK/MINERAL COLLECTION SITES	10	5	3	30	20	10	10	5	3	40	25	15			
	LAKES	30	20	10	30	20	10	40	25	15	30	20	10	30	20	10
	RIVERS / STREAMS	20	10	5	20	10	5	20	10	5	10	5	3	10	5	3
	BIG GAME HUNTING HABITATS				50	35	20									
	SMALL GAME HUNTING HABITATS				30	20	10									
	WATERFOWL HUNTING HABITATS				30	20	10									
	UPLAND BIRD HUNTING HABITATS				40	25	15									
	FISHING HABITATS	10	5	3	50	35	20	20	10	5						
	WILDLIFE OBSERVATION AREAS	20	10	5	10	5	3	20	10	5	30	20	10			
	SPECIAL WATER FEATURES	20	10	5	10	5	3	20	10	5	20	10	5			
	BOTANICAL INTEREST SITES	20	10	5	10	5	3	20	10	5	40	25	15			
	FLORA GATHERING AREAS	10	5	3	20	10	5	10	5	3	10	5	3			
	CULTURAL FEATURES: ARCHEOLOGICAL INTEREST SITES	20	10	5				20	10	5	40	25	15			
	HISTORICAL INTEREST SITES	20	10	5				20	10	5	40	25	15			
	RESERVOIRS	20	10	5	30	20	10	40	25	15	30	20	10	30	20	10
	CAMPGROUNDS				5	10	20	20	50	35	50	35	20	40	25	15
	PICNIC GROUNDS							10	30	20	20	10	5	10	5	3
	SWIMMING FACILITIES							5	20	10	20	10	5	30	20	10
	BOATING FACILITIES				0	5	3	5	20	10	20	10	5	30	20	10
	WINTER SPORTS SITES													100	70	40
	PUBLIC VISITOR CENTERS										50	35	20	20	10	5
	COMMERCIAL PUBLIC SERVICE SITES										40	25	15	40	25	15
	ORGANIZATION SITES										40	25	15	20	10	5
	TOURS-SELF GUIDED							20	10	5	30	20	10			

INSTRUCTIONS:

– SELECT THE SETS OF VALUES OR EACH PREFERENCE TYPE THAT CORRESPOND WITH THE ATTRACTIVE FEATURES AND THEIR SIGNIFICANCE RATINGS THAT HAVE BEEN NOTED ON THE ATTRACTIVE FEATURES INVENTORY DATA FORM FIG C

– WHERE MORE THAN ONE OF THE SAME KIND OF FEATURES (I.E. THREE MOUNTAIN PEAKS, ONE OF WHICH IS HIGHLY SIGNIFICANT AND TWO OF WHICH ARE OF MODERATE SIGNIFICANCE) ARE NOTED, ADD AND OR MULTIPLY THE NUMBER OF FEATURES TO/BY THE APPROPRIATE VALUES LISTED IN THE TABLES TO THE LEFT. (E.G. THE TOTAL FOR THE THREE PEAKS WOULD BE 70).

– SUM AND/OR NOTE THE VALUES FOR THE INVENTORIED ATTRACTIVE FEATURES FOR EACH PREFERENCES TYPE AND PLACE IN APPROPPIATE SQUARE ON EXTENSIVE APPRAISAL SUMMARY FORM. TABLE VIII. SUM VALUES FOR EACH PREFERENCE TYPE TO ARRIVE AT ATTRACTIVE FEATURE SUBTOTAL.

NOTES:

– THE NUMERICAL VALUES STATED TO THE LEFT ARE REFLECTIVE OF THE FEATURES ABILITIES TO 'DRAW' OR ATTRACT RECREATIONISTS TO THE REU THEY MAY BE CONTAINED IN. FIVE SETS OF NUMBERS ARE GENERALLY USED TO INIDCATE THE RELATIVE VALUES OF THE FEATURES FOR EACH TYPE. THESE ARE:

50	35	20
40	25	15
30	20	0
20	10	5
10	5	3

MOST ATTRACTIVE FORCE LEAST

– (FEATURES THAT HAVE VIRTUALLY NO ATTRACTIVE FORCE IN RELATION TO EACH PREFERENCES TYPE HAVE BEEN SHADED.)

7-8-57

TABLE IV

REU CHARACTERISTICS VARIABLES	REU CHARACTERISTICS SUBVARIABLES		SUBVARIABLE RATING VALUES RELATIVE TO EACH PREFERENCES TYPE				
			TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
ACCESSIBILITY	KIND OF TRAVEL FACILITIES CONTAINED IN REU	NONE	+30	−5	−15	−30	−50
		TRAILS	+25	+10	−10	−20	−40
		4 WHEEL DRIVE ROADS	−20	+25	+15	+10	0
		2 WHEEL DRIVE ROADS	−40	+5	+20	+35	+50
		MAJOR TRAVEL ROUTES	−90	−10	+20	+50	+130

INSTRUCTIONS

– SELECT THE SET OF VALUES FOR EACH PREFERENCE TYPE THAT CORRESPONDS WITH THE LARGEST TRAVEL FACILITY THAT HAS BEEN NOTED ON THE ACCESSIBILITY INVENTORY DATA FORM. FIG. G

– PLACE THESE VALUES FOR EACH PREFERENCE TYPE IN THE APPROPRIATE SQUARES ON THE EXTENSIVE APPRAISAL SUMMARY FORM. TABLE VIII.

– THE NUMERICAL VALUES STATED TO THE LEFT ARE REFLECTIVE OF THE SETTING PREFERENCES STATED EARLIER.

85-9-7

TABLE V

REU CHARACTERISTIC VARIABLES	REU CHARACTERISTIC SUBVARIABLES												SUBVARIABLE RATING VALUES RELATIVE TO EACH PREFERENCE TYPE				
REMOTENESS	DIST TO 4WD ROADS			DIST TO 2WD ROADS			DIST TO MAJOR TRAVEL RTS.			TYPE I	TYPE	TYPE III	TYPE IV	TYPE V
	3 MI	1.5 MI	1.5 MI	5 MI	3 MI	1.5 MI	5 MI	3 MI	1.5 MI					
MOST REMOTE										47				
										46	-8			
										45		-24		
										44				
										43	-6			
										42			-28	-52
										41				
										40	-4			
										39		-21		
										38				
										37	-2			
										36				
										35				
										34	0			
										33		-18		
										32				
										31	2			
										30			-24	-47
										29				
										28	4			
										27		-15		
										26				
										25	6			
										24				
										23				
										22	8			
										21		-12		
										20				
										19	10			
										18			-20	-42
										17				
										16	12			
										15		-9		
										14				
										13	14			
										12				
										11				
										10	16			
										9		-6		
										8				
										7	18			
										6			-16	-37
										5				
										4	20			
										3		-3		
										2				
										1	22			
										0				
										-2	24	0	-12	-32
										-4	26	2	9	-28

POSSIBLE REMOTENESS CLASS COMBINATIONS

REMOTENESS CONT'D	DIST TO 4WD ROADS			DIST TO 2WD ROADS			DIST TO MAJOR TRAVEL RTS			TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
	3 MI	1.5 MI	1.5 MI	5 MI	3 MI	1.5 MI	5 MI	3 MI	1.5 MI					
										-6	28	4	-6	-24
										-8	30	6	-3	-20
										-10	32	8	0	-6
										-12	34	10	3	-2
										-14	32	12	6	-8
										-16	30	14	9	-4
										-18	28	16	12	0
										-20	26	18	15	4
										-22	24	20	18	8
										-24	22	22	21	12
										-26	20	24	24	16
										-28	18	26	27	20
										-30	16	28	30	24
										-32	14	30	33	28
										-34	12	32	36	32
										-38	6	34	46	44
										-42	0	16	36	56
LEAST REMOTE										-46	-6	8	26	68

INSTRUCTIONS: – SELECT THE SET OF VALUES FOR EACH PREFERENCE TYPE THAT CORRESPONDS WITH THE COMBINATION OF REMOTENESS CLASSES THAT HAVE BEEN NOTED ON THE REMOTENESS INVENTORY DATA FORM FIG G

SEE SUPPLEMENTAL INSTRUCTIONS

PLACE THESE VALUES FOR EACH PREFERENCE TYPE IN THE APPROPRIATE SQUARES ON THE EXTENSIVE APPRAISAL SUMMARY FORM TABLE VIII

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TABLE VI

REU CHARACTERISTICS VARIABLES	REU CHARACTERISTICS SUBVARIABLES	SUBVARIABLE RATING VALUES RELATIVE TO EACH PREFERENCES TYPE				
		TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
VISUAL RESOURCE CHARACTERISTICS	PROBABILITY OF VISUAL APPEAL INDEXES					
	0	0	0	0	0	0
	2	5	4	3	2	1
	4	10	8	6	4	2
	6	15	12	9	6	3
	8	20	16	12	8	4
	10	25	20	15	10	5
	12	30	24	18	12	6
	14	35	28	21	14	7
	16	40	32	24	16	8
	18	45	36	27	18	9
	20	50	40	30	20	10
	22	55	44	33	22	11
	24	60	48	36	24	12
	26	65	52	39	26	13
	28	70	56	42	28	14
	30	75	60	45	30	15
	32	80	64	48	32	16
	34	85	68	51	34	17
	36	90	72	54	36	18
	38	95	76	57	38	19
	40	100	80	60	40	20
	42	105	84	63	42	21
	44	110	88	66	44	22
	46	115	92	69	46	23
	48	120	96	72	48	24
	50	125	100	75	50	25
	52	130	104	78	52	26
	54	135	108	81	54	27
	56	140	112	84	56	28
	58	145	116	87	58	29
	60	150	120	90	60	30
	62	155	124	93	62	31
	64	160	128	96	64	32
	66	165	132	99	66	33
	68	170	136	102	68	34

INSTRUCTIONS:

- SELECT THE SET OF VALUES FOR EACH PREFERENCE TYPE THAT CORRESPONDS WITH THE PROBABILITY OF APPEAL INDEX THAT HAS BEEN NOTED ON THE VISUAL RESOURCE INVENTORY DATA FORM. FIG. H

- PLACE THESE VALUES FOR EACH PREFERENCE TYPE IN THE AP PROPRIATE SQUARES ON THE EXTENSIVE APPRAISAL SUMMARY FORM TABLE VIII

TABLE VII

REU CHARACTERISTICS VARIABLES	REU CHARACTERISTICS SUBVARIABLES	SUBVARIABLE RATING VALUES RELATIVE TO EACH PREFERENCES TYPE				
		TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
DISCORD ELEMENTS	DISCORD LEVELS					
	LEVEL I : NONE	0	0	0	0	0
	LEVEL II : MINOR	-20	-15	-10	-7	-5
	LEVEL III : MODERATE	-30	-25	-20	-15	-10
	LEVEL IV : HIGH	-40	-35	-30	-25	-15
	LEVEL V : SEVERE	-60	-50	-40	-30	-20

INSTRUCTIONS:

– SELECT THE SET OF VALUES FOR EACH PREFERENCE TYPE THAT CORRESPOND WITH THE DISCORD LEVELS THAT HAVE BEEN NOTED ON THE DISCORD ELEMENTS INVENTORY DATA FORM. FIG. L.

– PLACE THESE VALUES FOR EACH PREFERENCE TYPE IN THE APPROPRIATE SQUARES ON THE EXTENSIVE APPRAISAL SUMMARY FORM: TABLE VIII

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TABLE VIII

CURRENT RECREATION OPPORTUNITY INDEXES – EXTENSIVE APPRAISAL SUMMARY FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

NATIONAL FOREST: _____

APPRAISED BY: _____ DATE: _____

REU CHARACTERISTICS VARIABLES		RECREATION PREFERENCE TYPES														
		T-I			T-II			T-III			T-IV			T-V		
ATTRACTIVE FEATURES		H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
NATURAL FEATURES	MTN. PEAKS															
	GEOLOGICAL INT. SITES															
	ROCK MIN COLLECTION SITE															
	LAKES															
	RIVERS STREAMS															
	B. GAME HUNT. HABITATS															
	S. GAME HUNT. HABITATS															
	WATERFOWL HUNT. HABITATS															
	U. BIRD HUNT. HABITATS															
	FISHING HABITATS															
	WILDLIFE OBSERV. AREAS															
	SP. WATER FEATURES															
	BOT. INT. SITES															
	FLORA GATHER. AREAS															
CULTURAL FEATURES	ARCH. INT. SITES															
	HIST. INT. SITES															
	RESERVOIRS															
	CAMPGROUNDS															
	PICNIC GROUNDS															
	SWIM. FACILITIES															
	BOAT FACILITIES															
	WINTER SPORTS SITES															
	PUB VIS CENTERS															
	COM PUB SERV SITES															
	ORG SITES															
	TOURS S GUIDED															
	SUBTOTALS →															
	ACCESSIBILITY →															
	REMOTENESS →															
	[illegible] →															
	[illegible] →															
	[illegible] →															

7-8-61

DEFINITION

The inventoried Visitation Capacity Elements of each REU are utilized to generate estimates of how many people can take advantage of the supply without substantially diminishing the quality of the experiences that are sought after. These estimates are derived from the following formulas:

PROCEDURE PEAK CAPACITY ESTIMATES IN GAOT

T-1

$$\frac{(\text{REU ACRES})(\text{\% REU Acres in Encounter Space})(\text{\% Encounter Space Under Forest Cover})}{(\text{Minimum Acres/Visitor Group*})} = \text{PCE}$$

1. REU Acres - From visitation Capacity Elements - Iventory Data Form, Fig. N, Item 1.
2. %REU in Encounter Space - From Inventory Data Form, Fig., N. Item 2.
3. % Encounter Space under Forest Cover - From Inventory Data Form, Fig. N., Item 3.
4. Minimum Acres/Visitor Groups - From Visitation Capacity/Potential Estimation Constants, Table IX, Item10
5. Record PCE on Visitation Capacity Estimates - Summary Data Form, Fig. O

T-II

$$\frac{(\text{REU ACRES})(\text{\% REU Acres in Encounter Space})(\text{\% Encounter Space under Forest Cover})}{(\text{Minimum Acres/Visitor Group*})} = \text{PCE}$$

1. As in the first formula, the data is obtained from the Inventory Data Form, Fig. N., Item 1, 2, and 3, and the Estimation Constants, Table IX, Item 11.
2. Record PCE on Visitation Capacity Estimates — Summary Data Form, Fig. O.

T-III

$$(\text{GAOT/Mi. of Trail})(\text{Mi. of Trail in REU}) + (\text{GAOT/Mi. of 4WD Road})(\text{Mi. of 4WD Road in REU}) + (\text{GAOT/Mi. of 2WD Rd.})(\text{Mi. of 2WD Rd. in REU}) + (\text{GAOT Mi of MTR})(\text{Mi. of MTR in REU}) + (\text{GAOT of existing T-III Recreation Facilities}) \quad \text{PCE}$$

* - Maximum of four people

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1. GAOT Mi. of Trail — From Estimation Constants, Table IX, Item 12.
2. Mi. of Trail in REU — From Inventory Data Form, Fig. N., Item 4.
3. GAOT/Mi. of 4WD Road - From Table IX, Item 13.
4. Mi. of 4WD Raod in REU - From Fig. N, Item 5.
5. GAOT/Mi. of 2WD Rd. - From Table IX, Item 14.
6. Mi. of 2WD Rd. in REU - From Fig. N, Item 6.
7. GAOT/Mi.of MTR — From Table IX, Item 15.
8. Mi.of MTR in REU — From Fig. N., Item 7.
9. GAOT of existing T-III Recreation Facilities — From Fig. N., Item 8-1.
10. Record PCE on Summary Data Form, Fig. O.

T-IV

$$\left(\begin{matrix}\text{GAOT/Mi.}\\ \text{4WD Rd.}\end{matrix}\right)\left(\begin{matrix}\text{Mi. 4WD}\\ \text{Rd/REU}\end{matrix}\right)+\left(\begin{matrix}\text{GAOT/Mi.}\\ \text{2WD Rd.}\end{matrix}\right)\left(\begin{matrix}\text{Mi. 2WD}\\ \text{Rd/REU}\end{matrix}\right)+\left(\begin{matrix}\text{GAOT/Mi.}\\ \text{of MTR}\end{matrix}\right)\left(\begin{matrix}\text{Mi. MTR}\\ \text{in REU}\end{matrix}\right)+\left(\begin{matrix}\text{GAOT of Existing T-IV}\\ \text{Rec. Facilities}\end{matrix}\right)=\text{PCE}$$

1. As in the formula for T-III, the data is obtained from the Estimation Constants, Table IX, Items 16, 17, 18 and Inventory Data Form, Fig. N., Items 5, 6, 7.
2. GAOT of Existing T-IV Rec. Facilities — From Fig. N., Item 8-2.
3. Record PCE on Summary Data Form, Fig. O.

T-V

$$\left(\begin{matrix}\text{GAOT/Mi.}\\ \text{2WD Rd.}\end{matrix}\right)\left(\begin{matrix}\text{Mi. 2WD}\\ \text{Rd./REU}\end{matrix}\right)+\left(\begin{matrix}\text{GAOT/Mi.}\\ \text{of MTR}\end{matrix}\right)\left(\begin{matrix}\text{Mi. MTR}\\ \text{in REU}\end{matrix}\right)+\left(\begin{matrix}\text{GAOT of Existing TV}\\ \text{Recreation Facilities}\end{matrix}\right)=\text{PCE}$$

1. As in the formulas for T-III and T-IV, the data is obtained from Table IX, Items 19, 20, and Fig. N., Items 6, and 7.
2. GAOT of existing T-V Rec. Facilities — From Fig. N, Item 8-3.
3. Record PCE on Summary Data Form, Fig. O.

YEARLY VISITATION ~~POTENTIAL~~ capacity ESTIMATES (VP/ACRE/YR.) IN GAOT

$$\frac{\left(\begin{matrix}\text{Peak Capacity}\\ \text{Estimates}\\ \text{(PCE)}\end{matrix}\right)\left(\begin{matrix}\text{Days}\\ \text{in}\\ \text{Year}\end{matrix}\right)\left(\begin{matrix}\text{\% f Yr. REU}\\ \text{can be}\\ \text{utilized}\end{matrix}\Big/\text{Type}\right)\left(\begin{matrix}\text{Visitor Day}\\ \text{Conversion}\\ \text{Factor}\end{matrix}\right)}{\text{(REU ACRES)}}=\text{VC}$$

VC is expressed in Visitor days acre/year for analysis purposes.

VC can also be expressed as visitor days REU Yr. by multiplying the VC. A/YR. total by REU Acres.

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1. PCE — From Summary Data Form, Fig. O.
2. Days in year — From Estimation Constants, Table IX, Item 21.
3. Percent of Yr. REU can be utilized — From Inventory Data Form, Fig. N., Item 9, for each Preferences Type.
4. Visitor Day Conversion Factor — From Table IX, Item 22.
5. REU Acres — From Fig. N., Item 1.
6. Record VC on Summary Data Form, Fig. O., in terms of visitor days/acre/year in Column (VD/A/Yrs.).
7. Multiply Item 6 (VC) above by REU Acres to arrive at Visitor Days/REU/Year (VD/REU/Yr.) Record on Fig. O.

The Formula is utilized to determine the yearly Visitation Capacity Estimates for each Recreation Preferences Type.

YEARLY VISITATION POTENTIAL ESTIMATES (VP/ACRE/YR.) IN GAOT

$$\left(\begin{array}{l}\text{Visitation}\\ \text{Capacity}\\ \text{Estimates (VC)}\end{array}\right)\left(\begin{array}{l}\text{Recreation}\\ \text{Opportunity}\\ \text{Quality}\\ \text{Factor}\end{array}\Big/\text{Type}\right) = \text{VP}$$

VP is expressed in visitor days/acre/year for analysis purposes.

VP can also be expressed as visitor days/REU/Yr. by multiplying the VP/A/Yr. Total by REU Acres.

1. VC — From Summary Data Form, Fig. O.
2. Recreation Opportunity Quality Factor — From Table IX, Item 23. These are the Recreation Opportunity Classes derived in Table II for each Preferences Type, shown on Table VIII, and expressed as a decimal.
3. Record VP on Summary Data Form, Fig. O, VP is expressed in Visitor Days/Acre/Year (VD/A/Yr.).
4. Multiply Item 3 (VP) by REU acres to arrive at Visitor Days/REU/Year (VD/REU/Yr.). Record on Fig. O.

The formula is utilized to determine the yearly Visitation Potential Estimates for each Recreation Preferences Type.

7-8-64

TABLE IX

VISITATION CAPACITY/POTENTIAL ESTIMATION CONSTANTS

	CONSTANT DESCRIPTION	CONSTANT UNITS	CONSTANT DERIVATION SOURCES
10	T–I MIN.A PARTY	250 A VISITOR GROUP	AGGREGATION OF REPORTED RECREATION USE DENSITIES FOR WILDERNESS AND PRIMITIVE AREAS FOR CY 1970 (W.O. SOURCE BASED ON RIM STATISTICS).
11	T–II MIN. A./PARTY	100 A./VISITOR GROUP	1971 HUNTING SURVEY REPORT FOR AREA 319; JIM COLE, DEERLODGE NAT'T FOREST AND JOHN ORMISTON, MONTANA DEPT. F & G; FEB. 1972; AREA 319 HUNTING STATISTICS FOR 1972 AND 1973.
12	T–III GAOT/MI. OF TRAIL	1 VISITOR GRP./MI.	SEE ACCOMPANYING DERIVATION RATIONALE IN APPENDIX
13	T–III GAOT/MI. OF 4-WD RD.	.4 VISITOR GRP./MI.	
14	T-III GAOT/MI. OF 2-WD RD.	.2 VISITOR GRP./MI.	
15	T–III GAOT/MI. OF MTR	.24 VISITOR GRP./MI.	
16	T–IV GAOT/MI. OF 4-WD RD.	.6 VISITOR GRP./MI.	
17	T–IV GAOT/MI. OF 2-WD RD.	.33 VISITOR GRP./MI.	
18	T–IV GAOT/MI. OF MTR	.4 VISITOR GRP./MI.	
19	T–V GAOT/MI. OF 2-WD RD.	.465 VISITOR GRP./MI.	
20	T–V GAOT MI. OF MTR	.57 VISITOR GRP.. MI.	
21	DAYS IN YEAR	365	N/A
22	VISITOR DAY CONVERSION FACTOR	2.0 VISITOR DAYS	RIM HANDBOOK: FSH 2309. 11; (124.11 . . . 2).
23	RECREATION OPPORTUNITY QUALITY FACTOR	1 0,.9. 8. 7..6, .5,.4,.3,.2, 1	RECREATION OPPORTUNITY CLASS IN DECIMAL. TABLE II

7-8-65

FIGURE O

VISITATION CAPACITY ESTIMATES — SUMMARY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

CALCULATED BY: _____ DATE: _____

VISITATION ESTIMATES		RECREATION PREFERENCES TYPES				
		TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
PEAK CAPACITY ESTIMATES (GAOT)						
YEARLY VISITATION CAPACITY ESTIMATES	VD/A / YR.					
	VD/REU/YR.					
YEARLY VISITATION POTENTIAL ESTIMATES	VD/A/YR.					
	VD/REU/YR.					

NOTES:

7-8-66

SUMMARY MATRIX

The inventoried data is used to quantitatively and qualitatively determine the recreation opportunities for the five Preferences Types and allows for the integration of this recreation information with other resource data.

The values and visitation estimates are the condition ratings at the time of the inventory. Manipulating management actions within an REU will change these values and estimates. Proposed management actions can be analyzed prior to implementation to determine what effect the actions may have upon the recreational values for each Preference Type in an REU.

TABULATION PROCEDURE

The inventoried data, value ratings, and visitation estimates are tabulated on one document (Summary Matrix, Table X) for a planning area or unit.

1. Planning Unit Name and REU Identification Name or Number.
2. Acres. From Figure N show National Forest acreage on top line and other ownership on bottom line.
3. Attractive Features. Transfer actual numbers of features from Inventory Data Form, Figure D.
4. Travel Facilities. Place check(s) in appropriate box as shown on Inventory Data Form, Figure H.
5. Remoteness Class. Place check (s) in appropriate box as shown on Inventory Data Form, Figure H.
6. Visual Resource. Transfer visual appeal index rating from Inventory Data Form, Figure I.
7. Discordant Elements. Place check in appropriate box as shown on Inventory Data Form, Figure M.
8. Recreation Opportunity Indexes. Transfer opportunity index figures for each Preferences Type from Extensive Appraisal Form, Table VIII.
9. Preference Type Evaluation. Transfer Recreation Opportunity Class value figure for each Preferences Type from Extensive Appraisal form, Table VIII.
10. Peak Capacity Estimates in GAOT. Transfer figures for each Preferences Type from Summary Data Form, Figure O.
11. Yearly Visitation Capacity Estimates in GAOT. Transfer figures for each Preferences Type from Summary Data Form, Figure O.
12. Yearly Visitation Potential Estimates in GAOT. Transfer figures for each Preferences Type from Summary Data Form, Figure O.

7-8-67

RESPONSE ESTIMAT

Response estimates are predictions of how much recreation opportunities are likely to change if the environmental charcteristics of the mapped REUs are altered. They are a means of alerting land managers to what the consequences of applying the various Land Management Options are (for timber, range, watershed, wildlife, recreation, wilderness, and other types of Forest management).

Each Management Option is composed of a set of possible management actions (e.g., road building, timber harvest, recreation facility construction, etc.) which can change the existing environmental characteristics of mapped REU's to differing extents. The changes that would result if an option were applied on the land base can alter the existing recreation opportunities supply.

Let's assume that a timber harvest is planned and that it would directly affect the physical characteristics of three REU's. The qualitative definitions of the current recreation opportunities that exist in these units are given as follows:

REU DESIGNATION	RECREATION PREFERENCES TYPES									
	TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS
14 E_3	94	3	318	7	99	5	54	2	0	0
14 E_4	87	3	293	6	102	5	56	2	2	0
14 E_5	89	3	298	6	124	6	59	2	4	0

The expected effects of the proposed timber sale (i.e., increased accessibility, lessened remoteness, lower probability of visual appeal, impairment of elk hunting habitat, and temporary noise and air pollution) will cause the current opportunities to vary as follows:

REU DESIGNATION	RECREATION PREFERENCES TYPES									
	TYPE I		TYPE II		TYPE III		TYPE IV		TYPE V	
	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS	OPP. INDEX	OPP. CLASS
14 E_3	44	2	242	5	67	4	31	1	−13	0
14 E_4	−9	1	179	4	[illegible]	5	37	[illegible]	00	0
14 E_5	11	2	239	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

7-8-68

These changes in recreation opportunity qualities will affect the yearly visitation potential of the REU's. As determined in the Quantitative Definition, their current visitation potentials are estimated to be:

REU DESIGNATION	RECREATION PREFERENCES TYPES				
	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL
14 E_3	1810 RVD	3832 RVD	3400 RVD	146 RVD	0 RVD
14 E_4	1428 RVD	2750 RVD	4925 RVD	173 RVD	0 RVD
14 E_5	204 RVD	434 RVD	300 RVD	29 RVD	50 RVD

*** — Portion that is within the Forest boundary.

During the 3-5 years prior to the completion of all phases of the sale, their visitation potentials are estimated to be:

REU DESIGNATION	RECREATION PREFERENCES TYPES				
	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL	YEARLY VISITATION POTENTIAL
14 E_3	905 RVD	2737 RVD	2480 RVD	73 RVD	0 RVD
14 E_4	474 RVD	1833 RVD	4925 RVD	109 RVD	0 RVD
14 E_5	102 RVD	310 RVD	350 RVD	20 RVD	58 RVD

The cumulative effects of the timber sale upon the existing supply of recreation opportunities in the general sale area will be:

1. A 57% loss in visitation potential for satisfying Type I preferences.
2. A 30% loss in visitation potential for satisfying Type II preferences.
3. A 7% loss in visitation potential for satisfying Type III preferences.
4. A 30% Loss is visitation potential for satisfying Type IV preferences.
5. A small increase (58 RVD's) in visitation potential for satisfying Type V preferences.

7-8-69

These are not permanent effects. After the 3-5 years that will be necessary to complete all phases of the sale (i.e. road construction, harvesting, slash piling and curing, slash burning, etc.), the probability of visual appeal is expected to rise as cutting units become revegetated, the noise and air pollution will cease, and the impairment of elk hunting habitat will gradually lessen. These qualitative improvements will act to increase the lowered visitation potentials that resulted from the sale.

7-8-70

Glossary

7-8-71

BROAD LAND ALLOCATION: Long-range land use program formulation.

CULTURAL FEATURES: Products of man's action.

~~DEGREE OF~~ RECREATION OPPORTUNITY: Relative numerical rating of the Recreation Opportunity Classes.

ENCOUNTER SPACE: Those portions of the land base which are topographically suitable and which people normally use in their pursuits of recreation.

ESTIMATION CONSTANTS: The values established to help determine the recreation visitation capacity estimates.

GAOT: Groups at one time. Most people engage in recreation pursuits in numbers of two or more. Group size is limited to a maximum of four persons in Preferences Types I and II, and five persons in Preferences Types III, IV, and V.

LAND MANAGEMENT OPTIONS: Sub-categories of major land uses such as recreation, timber management, etc., that describe management intents in use intensity and actual use practice terms.

LAND USE PLANNING: Formulating courses of action that effectively contribute to the multiresource use and environmental protection of National Forest lands.

LAND USE PLANNING ALTERNATIVES: Formulating a choice of reasonable management actions for a given unit of land.

MANAGEMENT ACTIONS: Implementing activities such as road building, timber harvesting, recreation facility construction, etc., which can change the existing environmental characteristic of an REU to differing extents.

MANAGEMENT OBJECTIVES: End result, goals, targets, an end to be achieved; a future condition or result to be accomplished.

MANAGEMENT OPTIONS: Individual or combinations of various management actions.

NATURAL FEATURES: Products of non-man-caused processes.

NFRS: National Forest Recreation Survey.

PAOT: People at one time.

PHYSICAL CARRYING CAPACITY: When congestion and use becomes intense enough to cause excessive deterioration and damage to the point where the physcial environment is unacceptably altered.

QUALITATIVE DEFINITIONS: The value of existing recreation opportunities on National Forest lands.

QUANTITATIVE DEFINITIONS: The number of people who can take advantage of available recreation opportunities without diminishing the quality of the recreation experiences that are sought after.

~~RATING VALUES~~: A set of values assigned to the characteristic subvariables to determine the degree of recreation satisfaction one may experience while pursuing his recreation preference.

RECREATION CHARACTERISTICS: Natural and cultural attributes, sensual stimulation, access, remoteness, and pollution encounters to which people may be drawn in their recreation pursuits.

~~RECREATION EXPERIENCE UNITS~~ (REU): Discrete portions of the Forest land base to which people relate while engaging in Forest outdoor recreation.

RECREATION MOTIVATIONS: The basic reasons for which people engage in outdoor recreation pursuits.

RECREATION OPPORTUNITIES: Favorable environmental and social circumstances that can satisfy the visiting public's various outdoor recreation preferences.

7-8-72

RECREATION OPPORTUNITY CLASS: Numerical rating values which determine the qualitative rating for each recreation Preferences Type.

RECREATION OPPORTUNITY INDEXES: Numerical rating value subtotals resulting from the Qualitative Evalution.

* RECREATION PREFERENCES: Orientations that people exhibit in their selection of recreation settings and recreation activities for satisfying recreation motivations.

* RECREATION SETTINGS: Discrete portions of the Forest land base when viewed from an outdoor recreation standpoint.

RESPONSE ESTIMATES: Predictions of how much recreation opportunities are likely to change if the environmental characteristics of an REU are altered.

RIM: Recreation Information Management.

SOCIAL VISITATION CAPACITY: The point at which feelings of congestion become intense enough to cause the aggregate recreation satisfaction of all visitors to decline.

SPATIAL DEFINITION: The three-dimensional concave elements of the geomorphic base or vegetative enclosure, or a combination of both.

TIMESTREAMS: The duration of effect that may occur to the recreation environment as a result of management actions on the land base.

VISITATION CAPACITY: The number of people that can take advantage of the supply of recreation opportunity without substantially diminishing the quality of the experience that is sought after.

VISITATION CAPACITY ELEMENTS: The physical characteristics that are utilized in the estimation of REU Social Visitation Capacities.

VISITOR DAYS (VD): One visitor day equals 12 hours. (One person for 12 hours, or 12 people for one hour, or any combination thereof.)

YEARLY VISITATION CAPACITY (VC): The number of visitor days that an acre of land or an REU could reasonably accommodate annually for each Preferences Type.

YEARLY VISITATION POTENTIAL (VP): Considering the yearly VC and the Qualitative Definitions, the number of visitor days an acre of land or an REU could reasonably accommodate annually for each Preferences Type.

7-8-73

Literature Reviewer

7-8-74

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7-8-75

Appendices

7-8-76

FIGURE D

ATTRACTIVE FEATURES — INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION _____

INVENTORIED BY: _____ DATES: _____

SIGNIFICANCE RATINGS	H	M	L	NOTATIONS
MOUNTAIN PEAKS			1	ROUGH PEAK
GEOLOGICAL INTEREST SITES				
ROCK/MINERAL COLLECTION SITES		1		GOLD PANNING IN STREAM
LAKES	1			
RIVERS & STREAMS			1	
BIG GAME HUNTING HABITATS		2	1	M- MOOSE & DEER L-ELK
SMALL GAME HUNTING HABITATS			1	
WATERFOWL HUNTING HABITATS			1	
UPLAND BIRD HUNTING HABITATS		1		
FISHING HABITATS	1			TROUT IN LAKE & STREAM
WILDLIFE OBSERVATION AREAS				
SPECIAL WATER FEATURES			2	SMALL WATER FALLS
BOTANICAL INTEREST SITES				
FLORA GATHERING AREAS		1		SOME HARVESTING OF MUSHROOMS
ARCHEOLOGICAL INTEREST SITES				
HISTORICAL INTEREST SITES				
RESERVOIRS				
CAMPGROUNDS		1		10 F.U.
PICNIC GROUNDS				
SWIMMING FACILITIES				
BOATING FACILITIES		1		
WINTER SPORTS SITES				
PUBLIC VISITOR CENTERS				
COMMERCIAL PUBLIC SERVICE SITES				
ORGANIZATION SITES				
TOURS - SELF GUIDED				

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FIGURE

ACCESSIBILITY AND REMOTENESS CHARACTERISTICS — INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

INVENTORIED BY: _____ DATE: _____

ACCESSIBILITY

✓	KIND OF TRAVEL FACILITIES CONTAINED IN REU	APPROXIMATE LENGTHS* (in miles) OF TRAVEL FACILITIES CONTAINED IN REU
	NONE	N/A
	TRAILS	
	4-WHEEL DRIVE ROADS	
✓	2-WHEEL DRIVE ROADS	2½ MILES (SINGLE LANE GRAVEL)
	MAJOR TRAVEL ROUTES	

*PORTIONS THAT ARE WITHIN THE FOREST BOUNDARIES

REMOTENESS

✓	DISTANCE FROM GEOGRAPHICAL CENTER OF REU TO THE NEAREST ROADS THAT ARE NOT CONTAINED IN THE UNIT.
	≥ 3 MILES FROM NEAREST 4-WHEEL DRIVE ROAD
	≥ 1.5 MILES FROM NEAREST 4-WHEEL DRIVE ROAD
	≤ 1.5 MILES FROM NEAREST 4-WHEEL DRIVE ROAD
	≥ 5 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≥ 3 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≥ 1.5 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
	≤ 1.5 MILES FROM NEAREST 2-WHEEL DRIVE ROAD
✓	≥ 5 MILES FROM NEAREST MAJOR TRAVEL ROUTE
	≥ 3 MILES FROM NEAREST MAJOR TRAVEL ROUTE
	≥ 1.5 MILES FROM NEAREST MAJOR TRAVEL ROUTE
	≤ 1.5 MILES FROM NEAREST MAJOR TRAVEL ROUTE

(≥ EQUAL OR GREATER THAN: ≤ EQUAL OR LESS THAN)

NOTES:

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FIGURE I

VISUAL RESOURCE CHARACTERISTICS — INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

INVENTORIED BY: _____ DATE: _____

#	CRITERIA CATEGORIES	RATING SUBTOTALS
1	BASIC TERRAIN VARIETY	+ 20
2	GEOLOGIC FEATURE VARIETY	+ 14
3	WATER FEATURES VARIETY	+ 12
4	VEGETATIVE PATTERN VARIETY	+ 6
5	LAND USE EFFECTS	− 4
	PROBABILITY OF VISUAL APPEAL INDEX →	48

NOTES

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FIGURE

DISCORD ELEMENTS CHARACTERSITCS -- INVENTORY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

INVENTORIED BY: _____ DATE: _____

✓	DISCORD ELEMENTS IMPACT LEVELS	DISCORD ELEMENTS DESCRIPTIONS
✓	LEVEL I: NONE	N/A
	LEVEL II: MINOR	
	LEVEL III: MODERATE	
	LEVEL IV: HIGH	
	LEVEL V: SEVERE	

NOTES

7-8-80

FIGURE N

VISITATION CAPACITY ELEMENTS – Inventory Data Form

Recreation Experience Unit Designation: _____

Inventoried By: _____ Date: _____

1. REU Acreage (Portion lying w/in Forest Boundary) N.F. 9000 ; Other 3000

2. % of REU Acreage in Encounter Space .25 (Express as Decimal)

3. % of Encounter Space in Forest Cover .5 (Express as Decimal)

4. Miles of trail within REU 4
5. Miles of 4-WD road within REU 2
6. Miles of 2-WD road within REU 1
7. Miles of MTR road within REU .5

(Portion of REU lying w/in Forest Boundary)

8. PAOT Estimates for Existing Recreation Facilities: (RIM)

	T-III	T-IV	T-V
a. Campgrounds	90	—	—
b. Picnicgrounds	15	15	15
c. Swimming Facilities	—	—	—
d. Boating Facilities	10	10	10
e. Winter Sports Sites			1000
f. Public Visitor Centers		—	—
g. Commercial Public Service Sites		—	—
h. Organization Sites		—	—
i. Other	—	—	—
PAOT SUMS:	115	25	1025
Divide PAOT Sums by 5 to convert number of people to groups of people (GAOT) →	23	5	205
	(8-1)	(8-2)	(8-3)

9. % of Year REU May be Used for Each Preferences Type: (RIM)

TI .3 (a.) TII .85 (b.) TIII .6 (c.) TIV .6 (d.) TV .6 (e.) (Express as Decimals)

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TABLE VIII

CURRENT RECREATION OPPORTUNITY INDEXES – EXTENSIVE APPRAISAL SUMMARY FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

NATIONAL FOREST: _____

APPRAISED BY _____ DATE: _____

REU CHARACTERISTICS VARIABLES			RECREATION PREFERENCE TYPES														
			T-I			T-II			T-III			T-IV			T-V		
			H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
ATTRACTIVE FEATURES	NATURAL FEATURES	MTN. PEAKS			10												
		GEOLOGICAL INT. SITES															
		ROCK MIN. COLLECTION SITE		5			20			5			25				
		LAKES	30			30			40			30			30		
		RIVERS, STREAMS			5			5			5			3			3
		B. GAME HUNT. HABITATS					70	20									
		S. GAME HUNT. HABITATS						10									
		WATERFOWL HUNT. HABITATS						10									
		U. BIRD HUNT. HABITATS					25										
		FISHING HABITATS	10			50			20								
		WILDLIFE OBSERV. AREAS															
		SP. WATER FEATURES			10			6			10			10			
		BOT. INT. SITES															
		FLORA GATHER. AREAS		5			10			5			5				
	CULTURAL FEATURES	ARCH. INT. SITES															
		HIST. INT. SITES															
		RESERVOIRS															
		CAMPGROUNDS					10			50			35			25	
		PICNIC GROUNDS															
		SWIM. FACILITIES															
		BOAT FACILITIES					5			20			10			20	
		WINTER SPORTS SITES															
		PUB. VIS. CENTERS															
		COM. PUB. SERV. SITES															
		ORG. SITES															
		TOURS - S. GUIDED															
SUBTOTALS			+75			+261			+155			+118			+78		
ACCESSIBILITY			−40			+ 5			+20			+35			+50		
REMOTENESS			−34			+12			+32			+36			+32		
VISUAL RESOURCE			+120			+96			+72			+48			+24		
DISCORD ELEMENTS			0			0			0			0			0		
RECREATION OPPORTUNITY INDEXES & CLASS			121 (4)			374 (8)			279 (10)			237 (9)			184 (5)		

7-8-82

FIGURE O

VISITATION CAPACITY ESTIMATES – SUMMARY DATA FORM

RECREATION EXPERIENCE UNIT DESIGNATION: _____

CALCULATED BY: _____ DATE: _____

VISITATION ESTIMATES		RECREATION PREFERENCES TYPES				
		TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V
PEAK CAPACITY ESTIMATES (GAOT)		6	15	28.12	7.93	205.52
YEARLY VISITATION CAPACITY ESTIMATES	VD/A / YR.	.11	.78	1.03	.29	7.50
	VD/REU/YR.	1320	9360	12,360	3480	90,000
YEARLY VISITATION POTENTIAL ESTIMATES	VD/A/YR.	.03	.62	.72	.26	3.75
	VD/REU/YR.	360	7440	8640	3120	45,000

NOTES:

7-8-83

TI MIN. ACRES PARTY CONSTANT DERIVATION RATIONALE

GIVENS: — THE SIZES (IN ACRES) AND REPORTED RECREATION USE DENSITIES (IN VISITOR DAYS) OF 11 WILDERNESS UNITS.

EXAMPLES OF REPORTED RECREATION-USE DENSITIES FOR WILDERNESS AND PRIMITIVE AREAS FOR CY . . . 1970

(SELECTED FROM EXPECTED HIGH DENSITY USE WILDERNESS UNITS)

NAME OF UNIT	SIZE (ACRES)	TOTAL REPORTED USE CY 1971	VISITOR-DAYS USE PER ACRE
DESOLATION	63,000	298,800	4.7
SAN GORGONIO	36,000	94,100	2.8
MISSION MOUNTS.	73,000	9,600	.13
TETON	563,000	118,700	.20
RAWAH	26,000	17,200	.66
BOUNDARY WATERS	1,029,000	1,515,000	1.5
STRAWBERRY MTN.	32,000	22,600	.8
THREE SISTERS	196,000	193,500	.9
EAGLE CAP	220,000	135,000	.6
MINARETS	109,000	303,100	2.7
JOHN MUIR	500,000	825,300	1.6

— The total reported use spanned a 100 day use season, on the average.

— One days equals two visitor days.

ASSUMPTIONS — Wilderness recreation use parallels Type I recreation use:

The current (1970) reported use rates for the above listed wilderness units, when averaged, approximate their aggregate esthetic visitation capacity

7-8-84

TRAVEL FACILITIES PAOT MILE
CONSTANTS DERVIATION RATIONALE

GIVENS:

The rate of encounter for visitor groups spaced at one mile intervals while traveling at a speed of 2 miles/hour in opposite directions on a given trail is 4/hour.

The rate of enounter for vehicles spaced at one mile intervals while traveling at a speed of:

a. 10 miles/hour in oppostie directions on a given 4WD road is 20/hour
b. 30 miles/hour in opposite directions on a given 2WD road is 60/hour
c. 50 miles/hour in opposite directions on a given major travel route is 100/hour

ASSUMPTIONS:

People travel at a speed of:

a. 2 miles/hour while hiking on trails
b. 10 miles/hour while driving on 4-WD roads
c. 30 miles/hour while driving on 2-WD roads
d. 50 miles/hour while driving on Major Travel Routes

4-WD roads and most forest 2-WD roads are of single lane construction; major travel routes are of double lane construction and, therefore, have twice the inherent vehicle/mile capacity of 2-WD roads.

People expect to encounter fewer other people on trails than on 4-WD roads; fewer on 4-WD roads than on 2-WD roads; fewer on 2-WD roads than on major travel routes.

Forest visitors who wish to gain satisfacions for Type III preferences desire to encounter fewer other people than those wishing to gain satisfactions for Type IV V and preferences.

The maximum time that people will continously travel is 4 hours.

People normally travel in groups of two or more when engaging in recreation pursuits (e.g., hiking, pleasure driving, travel to particular recreation settings).

FIND:

The maximum number of visitor groups accommodated per mile of travel facility over a given time period while still maintaining conditions (i.e., group encounter frequency levels) that will satisfy Types III, IV and V recreation preferences.

7-8-85

METHOD: Calculate the total number of encounters that any one visitor group would be subject to over a 4 hour period (based on the above givens):

Type of Travel Facility	Calculated Enounter Rate, Hr.	Number of hrs. in period	Total Encounters Per Period
Trail	4	4	16
4-WD Road	20	4	80
2-WD Road	60	4	240
Major Travel Rt.	100	4	400

a. Based on the givens and the assumptions, estimate the maximum number of encounters per time period that will maintain conditions for satisfying Type III IV and V recreation preferences:

PREFERENCES TYPE	KIND OF TRAVEL FACILITY	MAXIMUM ENCOUNTERS PER PERIOD
TYPE III	TRAIL → 8	(1 encounter every 30 min.)
	4-WD ROAD → 16	(1 encounter every 15 min.)
	2-WD ROAD → 24	(1 encounter every 10 min.)
	MTR → 48	(1 encounter every 5 min.)
TYPE IV	4-WD ROAD → 24	(1 encounter every 10 min.)
	2-WD ROAD → 40	1 encounter every 6 min.)
	MTR → 80	(1 encounter every 3 min.)
TYPE V	2-WD ROAD → 56	(1 encounter every 4.3 min.)
	MTR → 112	(1 encounter every 2.1 min.)

b. Based on the step b. estimates, calculate the maximum number of visitor groups that can be accommodated per mile of travel facility at any one time (GAOT*):

ANSWER:

PREFERENCES TYPES	KIND OF TRAVEL FACILITY	GAOT/MI. ESTIMATE
	TRAIL →	1 visitor group/mile
	4-WD ROAD →	.4 visitor group/mile
	2-WD ROAD →	.2 visitor group/mile
	MTR →	.24 visitor group/mile
TYPE IV	4-WD ROAD →	.6 visitor group/mile
	2-WD ROAD →	.33 visitor group. mile
	MTR →	.4 visitor group/mile
TYPE V	2-WD ROAD →	465 visitor group mile
	MTR →	57 visitor group mile

*Assuming a one hour "at one time" duration.

7-8-86

Formula: $\left(\begin{array}{l}\text{Time Between}\\ \text{encounter in}\\ \text{minutes.}\end{array}\right)\left(\begin{array}{l}\text{Speed} -\\ \text{in mi.}\\ \text{per min.}\end{array}\right) = \begin{array}{l}\text{Minimum group}\\ \text{spacing at}\\ \text{outset - in miles}\end{array} \rightarrow \dfrac{1\text{ mile}}{\begin{array}{l}\text{minimum group}\\ \text{spacing at outset}\\ \text{in miles}\end{array}} = \begin{array}{c}\text{GAOT} \cdot \text{mi}\\ \text{Estimate}\end{array}$

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7-8-87

FIND: The minimum number of acres that are required to provide a satisfying Type I recreation experience.

METHOD:

a. Sum acreages of all units listed (2,847,000 acres)

b. Sum total reported uses for all units listed (3,530,700 VD)

c. Divide total acres by total use to find the seasonal visitor day density per acre (.8 VD/A/Season)

d. Disaggregate seasonal usage by dividing .8 VD/A/Season by the season length (100 days x 2 = 200 VD)

$$\left(\frac{.8}{200} = .004\right)$$

e. Divide .004 into 1.0 to find the minimum number of acres.

ANSWER: 250 acres/visitor group. (Max. of 4 people/group)

T II

MIN. ACRES/PARTY CONSTANT DERIVATION RATIONALE

GIVENS:

- Area 319 is comprised of approximately 133,000 acres.
- The number of hunter trips on opening day that were recorded are: 1361 in 1971
  1647 in 1972
  1189 in 1973
- Individuals normally hunt with one or more other hunters.
- The general feeling (statistically based) is that hunting pressure is high in area 319.

ASSUMPTIONS:

- Area 319 is being used at, or very nearly at, its esthetic visitation capacity on the opening day of the elk and deer hunting season.
- Area 319 is typical of the physical characteristics of other portions of the Forest that are used for elk and deer hunting.

FIND:

- The minimum number of acres that are required to provide a satisfying hunting experience.

METHOD:

- Divide the average number of opening day hunter trips for the years1971,72 and 73 into the total number of acres that comprise area #319.

ANSWER

100 acres. visitor group
(Max.of 4 people/group)

7-8-88

EXHIBIT E

7. Recreational Resources

Comment 9a (p. E-7-69, Section 5.4.1)

Compare information common to Section 5.4.1 through Section 5.4.5, Section 6.1.6, Tables E.7.17 and E.7.18, and Figures E.7.7 through E.7.17 and correct all discrepancies with respect to (1) phasing of development, (2) proposed facilities to be provided, and (3) estimated costs of "recreation plan project features".

Response

Item #9a

SECTION 5.4 REVISIONS

The recreation sites listed on p. E-7-69 of Chapter 7, Exhibit E of the License Application should read as follows:

Phase One - Watana Construction Phase

Key Letter	Name
E	Brushkana Campground
D	Tyone Confluence with Susitna
B	Butte Creek/Susitna River
A	Middle Fork-Chulitna River
C	Watana Townsite (part of Project Facility Program)
F	Portal Entry

Phase Two - Watana Implementation Phase

O	Watana Damsite
U	Watana Townsite (part of Project Facility Program)
H	Tsusena Creek
I	Tsusena Butte
L	Deadman/Big Lake
J	Clarence Lake
K	Watana Lake

Phase Three - Devil Canyon Construction

G	Mid-Chulitna/Deadman Mountain

Phase Four - Devil Canyon Operation

Q	Devil Creek
S	Devil Canyon Damsite
R	Mermaid Lake

Phase Five - To Be Developed Only If Demand Requires

T	Soule Creek
M	Southern Chulitna Mountains
N	Fog Lakes

Future Additions - To Be Considered Through Demand Monitoring

P	Stephan Lakes
W	Rehabilitation Sites

Section 5.4.1(a)(v) on p. E-7-70 should read as follows:

Twenty-five new campsites similar to the existing development, with .025-mile (0.4 km) circulation road for proposed site, 3 toilet facilities, and other equipment.

Section 5.4.2(a)(v) on p. E-7-77 should read as follows:

Parking, 20 cars;
Exhibit building (3,000 sq. ft.);
- Souvenir shop;
- Museum;
- Restrooms; and
- Food service.

Interpretive trail;
Four picnic sites; and
One bulletin board.

Note: Powerhouse tour headquarters to be located on north side of dam at operations headquarters.

Section 5.4.2(c)(v) on p. E-7-79 should read as follows:

Two shelters, one trailhead, three parking spaces, and 20 miles (32 km) of primitive trail development.

Section 5.4.2(d)(v) on p. E-7-80 should read as follows:

Primitive trail development, 4 miles (6.4 km);
Trailhead, with 6 parking spaces; and
Two to four undesignated campsites.

Section 5.4.2(e)(v) on p. E-7-81 should read as follows:

Primitive trail development, 4 miles (6.4 km);
Five to six undesignated campsites; and
Trailhead, with 6-space automobile parallel parking.

Section 5.4.2(f)(v) on p. E-7-83 should read as follows:

Primitive trail development, 9 miles (14.4 km) and signage.

Section 5.4.2(g)(v) on p. E-7-84 should read as follows:

Primitive trail development, 3 miles (4.8 km);
Two to three undesignated campsites; and
1 footbridge.

Section 5.4.3(a)(v) on p. E-7-85 and E-7-86 should read as follows:

Ten parking spaces, 15 miles (24 km) of trail, one trailhead and 2-4 primitive campsites.

Section 5.4.4(a)(v) on p. E-7-87 should read as follows:

Primitive trail development, 9 miles (14.4 km);
1 trailhead, 5 parking spaces, 1 bench, and signage.

Section 5.4.4(b)(v) on p. E-7-88 should read as follows:

One shelter;
Visitor center (5,000 sq. ft.);
- Food service;
- Dam exhibit
- Souvenir shop; and
- 1 single vault latrine.

Eight picnic sites;
Fifteen parking spaces;
Interpretive trail (0.5 miles);
Signage; and
Three benches.

SECTION 6.1.6 REVISIONS

Section 6.1.6 on pp. E-7-107 through E-7-109 should read as follows:

6.1.6 - Elements of the Recreation Plan According to Their Phases of Development

(a) Phase One (Sites E, D, B, C, A, F)

E	Brushkana Camp	0.25 miles (0.4 km) of road; 25 campsites; 3 single vault latrines; 1 bulletin board; 8 trash cans; and 1 water well.
D	Tyone River Confluence with Susitna	1 shelter.

B	Butte Creek/Susitna	1 boat launch at Susitna Bridge.
C	Watana Townsite	Temporary camp and town facilities.
A	Middle Fork Chulitna River	2 overnight shelters; 25 miles (41 km) primitive trail; trailhead; trash cans; bulletin board; signage; and 6 parking spaces.
F	Portal Entry	Explanatory entry sign; and 2-3 car pullout.

(b) <u>Phase Two (Sites O, U, H, I, L, J, K)</u>

O	Watana Damsite Visitor Center	20 parking spaces; 3,000 sq. ft. visitor exhibit building with food service, souvenir shop, museum, and 2 single vault latrines; 1 interpretive trail; 4 picnic sites; and 1 bulletin board.
U	Watana Townsite (Phase Two)	2 miles (3.2 km) of primitive trail to Tsusena Falls; trailhead; and parking.
H	Tsusena Creek	2 shelters; 20 miles (32 km) of primitive trail to Tsusena Falls; 1 trailhead; and 3 parking spaces.
I	Tsusena Butte	4 miles (6.4 km) of primitive trail; 1 trailhead; 6 parking spaces; and 2-4 capacity primitive camp.

6/1 - Phasing

L	Deadman/Big Lake	1 trailhead; 5-6 capacity primitive campsite; 4 miles (6.4 km) of primitive trail; and 6 parking spaces.
J	Clarence Lake	9 miles (14.4 km) of primitive trail; and signage
K	Watana Lake	3 miles (4.8 km) of primitive trail; 2-3 capacity primitive campsite; and 1 foot bridge.

(c) Phase Three (Site G)

G	Mid-Chulitna Mountains Deadman Mountain	1 trailhead; 15 miles (24 km) of primitive trail; 2-4 capacity primitive campsite; and 10 parking spaces.

(d) Phase Four (Sites Q, S, R)

Q	Devil Creek Drainage	1 trailhead; 5 parking spaces; 9 miles (14.4 km) of trail; 1 bench; and signage.
S	Devil Canyon Damsite Visitor Center	1 shelter; 5,000 sq. ft. visitor center with dam exhibit, food service, souvenir shop, and 1 single vault latrine; 8 picnic sites; 15 parking spaces; 0.5 miles (0.8 km) of trail; signage; and 3 benches.

R	Mermaid Lake	8 campsites; 1 shelter; 2 single vault latrines; 1 water well; 1 bulletin board; 5 garbage cans; and signage.

(e) Phase Five - To be developed only if demand requires (Sites T, M, N, P, W).

T	Soule Creek	8 miles (12.8 km) of primitive trail; 5-6 capacity primitive campsite; 1 trailhead; and 5 parking spaces.
M	Southern Chulitna 3 Mountains	3 miles (4.8 km) of primitive trail; capacity primitive campsite; 1 trailhead; and 3 parking spaces.
N	Fog Lakes	15 miles (24 km) of primitive trail; 15 unit campground; 1 single vault latrine; 15 parking spaces; 1 trailhead; and signage.
P	Stephan Lake	5 miles (8 km) of primitive trail; 5 campsites, semi-primitive; signage; and canoe boat ramp.
W	Rehabilitation Sites	As appropriate.

FIGURE REVISIONS

Figure E-7-6

The location designated "Phase 1 & 2, C-Watana Townsite", should read as follows:

C/U - Watana Townsite Phase 1 & 2

The location designated "Phase 5, P - Stephan Lake" should read as follows:

Future Addition, P - Stephan Lake

Figure E-7-7

The facilities list for E-Brushkana Camp should read as follows:

25 campsites
0.25 miles (0.4 km) road
3 single vault latrines
1 bulletin board
8 trash cans
1 water well

The facilities list for F-Portal Entry should read as follows:

1 entry sign
2-3 car pull-out

Figure E-7-8

The facilities list for O-Watana Damsite and Visitor Center should read as follows:

20 parkings spaces
3,000 sq. ft. visitor building
2 single vault latrines
1 interpretive trail
4 picnic sites
1 bulletin board

Figure E-7-9

The facilities list for I-Tsusena Butte should read as follows:

4 miles (6.4 km) trail
1 trailhead
6 parking spaces
2-4 undesignated campsites

Figure E-7-10

The facilities list for L-Deadman and Big Lake list should read as follows:

1 trailhead
6 parking spaces
4 miles (6.4 km) trail
5-6 undesignated campsites

Figure E-7-11

The facilities list for K-Watana Lake should read as follows:

3 miles (4.8 km) trail
1 footbridge
2-3 undesignated campsites

Figure E-7-12

The facilities list for G-Mid-Chulitna Mountains, Deadman Mountain should read as follows:

10 parking spaces
15 miles (24 km) trail
1 trailhead
2-4 primitive campsites

Figure E-7-13

The facilities list for S-Devil Canyon Damsite should read as follows:

1 shelter
5,000 sq. ft. building
8 picnic sites
1 single vault latrine
15 parking spaces
0.5 miles (0.8 km) trail
Signage
3 benches

TABLE REVISIONS

Table E-7-17 should read as follows:

TABLE E.7.17: ESTIMATED CAPITAL COSTS FOR THE SUSITNA HYDROELECTRIC PROJECT RECREATION PHASES

Capital Costs 1982 Dollars	
Phase One	$ 673,866
Phase Two	904,789
Phase Three	127,432
Phase Four	910,197
Total Facilities	$2,616,284*

*These estimates are based upon January 1, 1982 cost figures.

TABLE E.7.18 REVISION

TABLE E.7.18: ESTIMATED COSTS OF PROPOSED RECREATION PLAN PROJECT FEATURES*

*Does not include potential phase 5 and future additions

Recreation Setting		Facilities	1982 Unit Cost	1982 Total Cost	Facility Total	Phase Total
PHASE ONE						
E	Brushkana Camp	0.25 miles of road	$386,400/mi	$ 96,600	$	$
		25 campsites	9,047	226,175		
		3 single vault latrines	9,157	27,471		
		1 bulletin board	762	762		
		8 trash cans	157	1,256		
		1 water well	19,040	19,040	371,304	
						371,304
D	Tyone/Susitna	1 shelter	17,920	17,920		
					17,920	
						389,224
B	Butte Creek/ Susitna River	1 boat launch	44,800	44,800		
					44,800	
						434,024
A	Middle Fork - Chulitna River	2 shelters	17,920	35,840		
		25 miles of trail	7,238	180,950		
		6 auto parking	1,810	10,860		
		1 trailhead (Trash cans, bulletin board, signs)	762	762		
					228,412	
						662,436
C	Watana Townsite	Not included in Recreation Costs	NA	NA	NA	
F	Portal Entry	Entry sign	6,000	6,000		
		2-3 car pull-out	1,810	5,430		
					11,430	
						673,866

TABLE E.7.18 REVISION (continued)

Recreation Setting	Facilities	1982 Unit Cost	1982 Total Cost	Facility Total	Phase Total
PHASE TWO					
O Watana Damsite Visitor Center	20 parking spaces	$ 1,810	$ 36,200	$	$
	3,000 sq.ft. building	$120/sq ft	360,000		
	2 single vault latrines	9,157	18,314		
	1 interpretive trail	$5/sq ft	50,000		
	4 picnic sites	2,027	8,108		
	1 bulletin board	439	439		
				473,061	
					473,061
U Watana Townsite	Not included in Recreation Program Costs	NA	NA		
H Tsusena Creek	20 miles of trail	7,238	144,760		
	2 shelters	17,920	35,840		
	1 trailhead	762	762		
	3 parking spaces	1,810	5,430		
				186,792	
					659,853
I Tsusena Butte	4 miles trail	7,238	28,952		
	1 trailhead	762	762		
	6 parking spaces		10,860		
	2-4 undesignated campsit	NA	NA		
				40,574	
					700,427
L Deadman/Big Lake	1 trailhead	762	762		
	4 miles of trail	7,238	28,952		
	6 parking spaces	1,810	10,860		
	5-6 primitive campsites	NA	NA		
				40,574	
					741,001
J Clarence Lake	9 miles of trail	7,238	65,142		
	Signage	300	300		
				65,442	
					806,443
K Watana Lake	3 miles of trail	7,238	21,714		
	1 footbridge	15,052	15,052		
	2-3 primitive campsites	NA	NA		
				36,766	
					843,209

TABLE E.7.18 REVISION (continued)

Recreation Setting	Facilities	1982 Unit Cost	1982 Total Cost	Facility Total	Phase Total
PHASE THREE					
G Mid-Chulitna/ Deadman Mountain	10 parking spaces	1,810	18,100	$	$
	15 miles trail	7,238	108,570		
	1 trailhead	762	762		
	2-4 primitive campsites	NA	NA		
				127,432	
					127,432
PHASE FOUR					
Q Devil Creek	1 trailhead	762	762		
	5 parking spaces	1,810	9,050		
	1 bench	320	320		
	Signage	300	300		
	9 miles of trail	7,238	65,142		
				75,574	
					203,006
S Devil Canyon Damsite	1 shelter	17,920	17,920		
	5,000 sq.ft. building	120/sq ft	600,000		
	8 picnic sites	2,027	16,216		
	1 single vault latrine	9,157	9,157		
	15 parking spaces	1,810	27,150		
	0.5 mile of trail	7,238	3,619		
	Signage	1,000	1,000		
	3 benches	320	960		
				676,022	
					879,028
R Mermaid Lake	8 campsites	9,047	72,376		
	1 shelter	17,920	17,920		
	2 single vault latrines	9,157	18,314		
	1 water well	19,040	19,040		
	1 bulletin board	439	439		
	5 garbage cans	140	700		
	Signage	200	200		
				128,989	
					1,008,017

TOTAL Construction Cost Phases 1-4, 1982 $ $2,525,092

Notes: Assumes no land acquisition costs for unappropriated state or federal lands nor land acquisition costs for private land.

EXHIBIT E

7. Recreational Resources

Comment 10 (p. E-7-97, para. 3)

Indicate if the proposed airfield will be available for general public use during project construction and/or operation.

Response

Access policies and regulations for the proposed airfield cannot be finalized until the necessary implementing agreements have been developed. At this time, it is the intension of the Power Authority to limit the use of the airfield during the construction period to project-related construction activities, thereby restricting general public access. While the policy for the operation period is less certain, it is anticipated that the airfield will continue to be closed to the public. This policy would facilitate the use of the airfield for project-related activities, while helping limit and control dispersed public use areas around the major project facilities. Safety-related and emergency landings would, of course, be permitted.

The Power Authority intends to consult with the resource management agencies, adjacent land managers and owners, and the public during the concluding years of project construction and to develop an access plan addressing access road, airfield, and reservoir use. The Power Authority and management agencies would prepare management plans for approval by FERC. In the dynamic arena of Alaska land use planning, it is appropriate to re-examine management plans just prior to the conclusion of construction.

EXHIBIT E

7. Recreational Resources

Comment 11 (p. E-7-101, para. 3)

Provide target dates for finalizing plans and submission of information relative to Phase Two engineering design specifications, final site selection, and site-specific data for all Phase-One recreation developments identified in the Recreation Plan.

Response

These planning activities are scheduled to begin in late 1985 with target completion dates extending into 1987. Most of the site-specific information will be developed through the preparation of a recreation master plan (for Phase One development), which is scheduled for completion by September 30, 1985. The master plan will provide final site selection and site-specific planning information. With the exception of the Watana Townsite (Site C) facilities, design of the Phase One recreation facilities will utilize existing design standards of the Alaska Department of Natural Resources, Division of Parks, and will be completed during early 1986. Development of these sites will begin at the commencement of the 1986 construction season. Preparation of design specifications for facilities at the Watana Townsite is scheduled to occur during 1986. The first portion of the townsite construction is scheduled for 1987.

EXHIBIT E

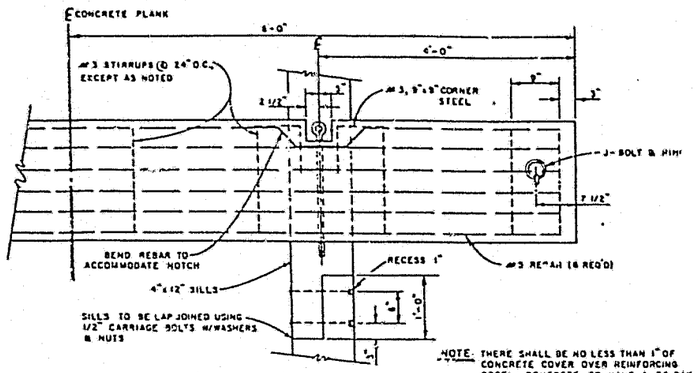
7. Recreational Resources

Comment 12 (p. E-7-101, para. 5)

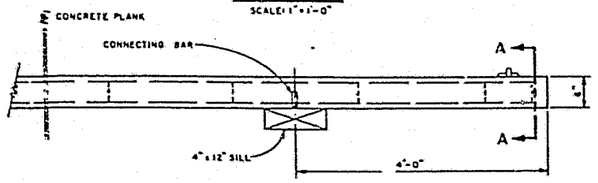
Provide "typical or similar facility design standards for the Susitna project", as proposed in the text.

Response

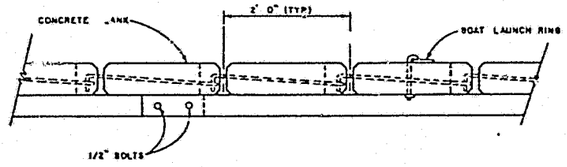
Attached are copies of design standards used by the Alaska Department of Natural Resources, Division of Parks for their facilities. These are intended to be used as the recreation facility design standards for the Susitna project.



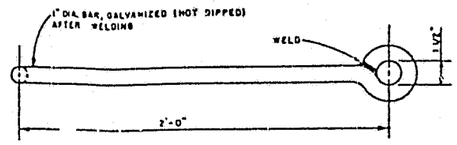
PLAN VIEW
SCALE: 1" = 1'-0"



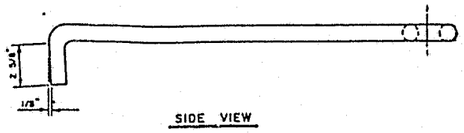
ELEVATION
SCALE: 1" = 1'-0"



TYPICAL PLANK ASSEMBLY
SCALE: 1" = 1'-0"

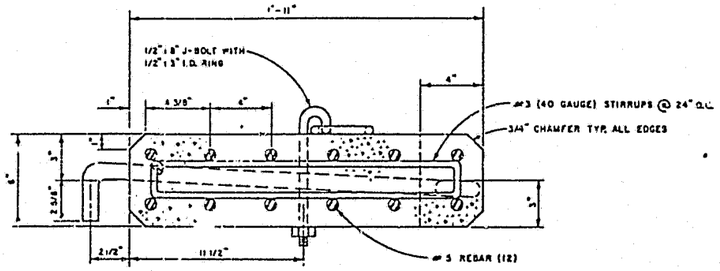


TOP VIEW



SIDE VIEW

CONNECTING BAR
SCALE: 3" = 1'-0"



SECTION A-A
SCALE: 3" = 1'-0"

GENERAL NOTES

1. REBAR TO BE WIRE TIED TO STIRRUPS.
2. NUMBER OF PLANKS PER INSTALLATION TO BE DETERMINED BY SITE LOCATION.
3. GRADE BREAK IN RAMP INSTALLATION TO BE PLACED AT ESTIMATED HIGH WATER LEVEL DURING USE PERIOD.
4. SPACES BETWEEN PLANKS AND SILLS TO BE FILLED WITH SELECT FILL MATERIAL.
5. FILTER CLOTH (IF USED) SHALL BE APPLIED OVER PREPARED SURFACE AND SILLS PRIOR TO PLANK INSTALLATION.
6. CONCRETE SURFACE TO BE ROUGH BROOM FINISH (1/4" DEEP STRIATIONS).
7. TWO PLANKS TO HAVE BOAT LAUNCH RINGS INSTALLED ON EACH END. PLANKS TO BE LOCATED ABOVE HIGH AND LOW WATER LINES, AS SHOWN.

MATERIALS LIST

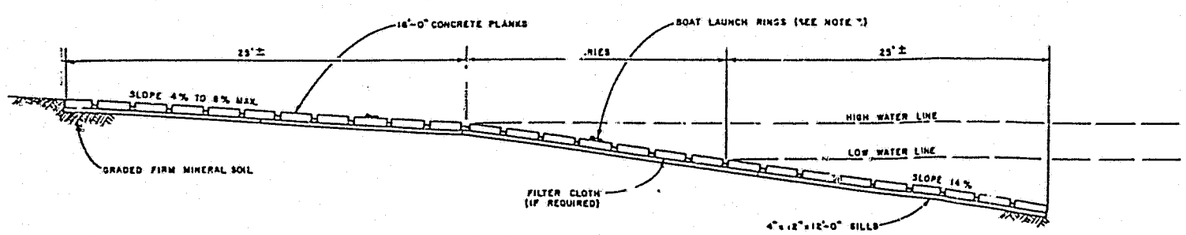
SILLS FOR 48 FEET OF RAMP

10 — 4"x12"x12'-0" #1 STRUCTURAL JOISTS & PLANKS DOUGLAS FIR, S-DRY, ROUGH, PRESSURE TREATED W/COAL TAR CREOSOTE IN ACCORDANCE WITH A.W.P.A. STANDARD C-2 AND A.W.P.A. STANDARD LP-22, WITH A MINIMUM NET RETENTION OF 10 LBS. PER CU. FT.

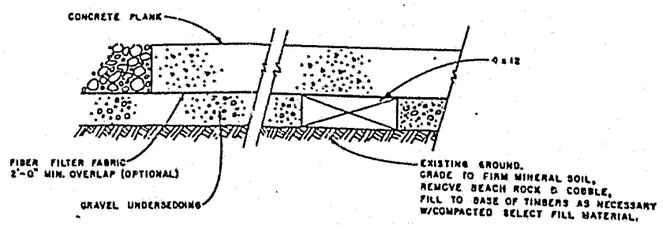
12 — 1/2"x12" ZINC CHROMATE STEEL CARRIAGE BOLTS W/NUTS & WASHERS

MATERIALS FOR 24 PLANKS

176 L.F. — 1" STEEL RODS
1400 L.F. — #5 REBAR
672 L.F. — #3 REBAR (STIRRUPS)
14 CU.YDS. — CONCRETE
48 — #3, 9"x9" CORNER STEEL
4 — 1/2"x8" GALV. J-BOLTS W/NUTS & WASHERS
4 — 1/2"x3" I.D. GALV. STEEL RINGS



TYPICAL INSTALLATION
NOT TO SCALE



TYPICAL CROSS SECTION DETAIL
SCALE: 1 1/2" = 1'-0"

NO.	REVISION	DATE	APPROVED
1	REVISED & UPDATED DWG., INCREASED SIZE OF PLANKS	9-15-82	T.D.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS — STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

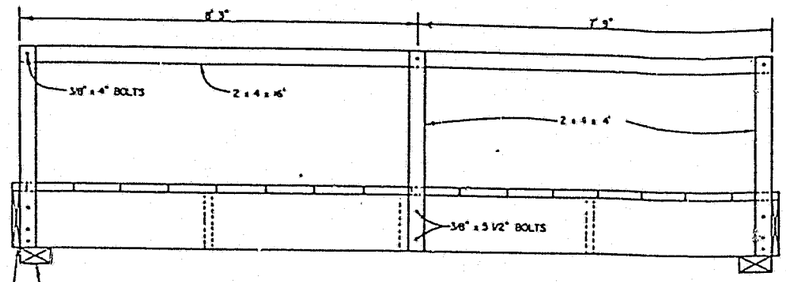
SCALE: 1" = 1'-0" & NOTED

CONCRETE BOAT RAMP

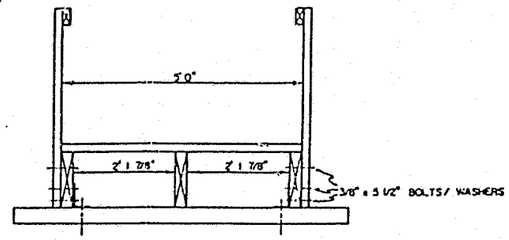
DRAWN T.D.
CHECKED
APPROVED
DATE 9-15-82

SHEET W-1 OF SHEETS

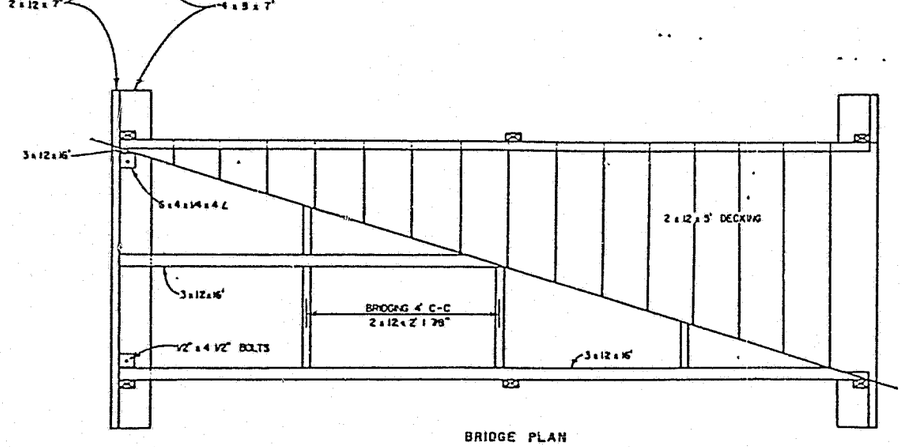
7-12-3



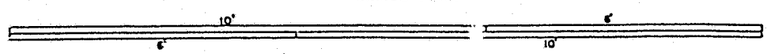
ELEVATION



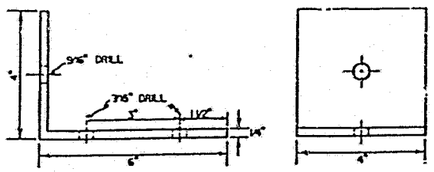
END



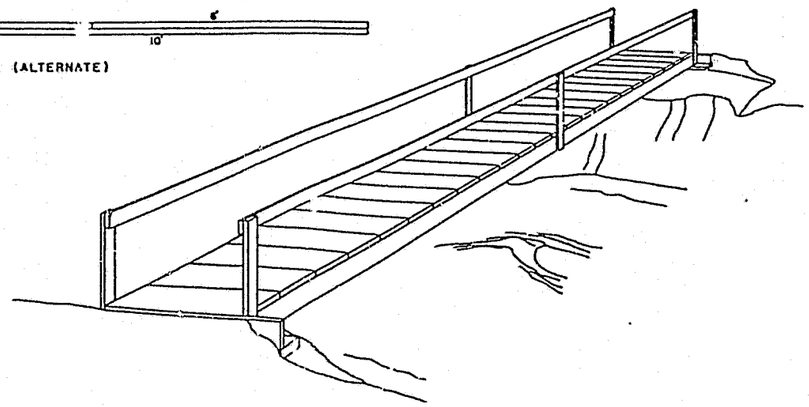
BRIDGE PLAN



DETAIL— LAMINATED BEAM (ALTERNATE)



FOUNDATION ANGLE
SCALE: 1" = 2"



GENERAL NOTES

1. THE BRIDGE SHOULD BE AT LEAST TWO FEET ABOVE HIGH WATER
2. ATTACH FOUNDATION ANGLES TO FOUNDATION PLATE PRIOR TO SETTING.
3. FOUNDATION PLATES SHOULD SIT ON GRAVEL OR A PLACED ROCK FOUNDATION
4. IF THE FOUNDATION IS UNSTABLE, DRILL AND DRIVE TWO 3/4" x 4' STEEL BARS THROUGH THE FOUNDATION PLATE
5. EACH BRIDGING IS CONNECTED TO THE STRINGERS WITH FOUR TYPE C TRIP-L-GRIP ANCHORS
6. MAXIMUM SAFE LOAD:
   100 lb per sq. ft or
   60 lb per. sq. ft and two moose
7. ALL WOOD SHALL BE DOUGLAS FIR, S-DRY.
8. ALL WOOD SHALL BE PRESERVATIVE TREATED WITH PENTACHLOROPHENOL IN ACCORDANCE WITH AWPI STANDARD LP-77 AND AWPA STANDARD P-8 WITH A MINIMUM NET RETENTION OF 50 LBS. PER CU. FT
9. ALL HARDWARE SHALL BE GALVANIZED OR CADMIUM PLATED STEEL.
10. ALL DECKING SHALL BE INSTALLED WITH A 1/4" CLEAR SPACING

MATERIALS LIST

LUMBER

S4S—"SELECT STRUCTURAL"—STRUCTURAL LIGHT FRAMING

6	2 x 4 x 4'
2	2 x 4 x 16'

ROUGH—"SELECT STRUCTURAL"—JOISTS AND PLANKS

17	2 x 12 x 5'
6	2 x 12 x 2' 1 7/8"
2	2 x 12 x 7'
3	3 x 12 x 16'
2	4 x 8 x 7'

HARDWARE

4	6 x 4 x 14 x 4 L
24	TYPE C, TRIP-L-GRIP WITH NAILS
12 LB	20d COMMON NAILS
6	3/8 x 4 MACHINE BOLT W/ NUT AND WASHERS
16	3/8 x 5 1/2 MACHINE BOLT W/ NUT AND WASHERS
4	1/2 x 4 1/2 MACHINE BOLT W/ NUT AND WASHERS

LAMINATED BEAM ALTERNATE

1. GLUE FULL CONTACT FACE OF ADJOINING BOARDS
2. NAIL ADJOINING BOARDS USING 10d NAILS
3. SPLICE BOARDS AS INDICATED IN DETAIL

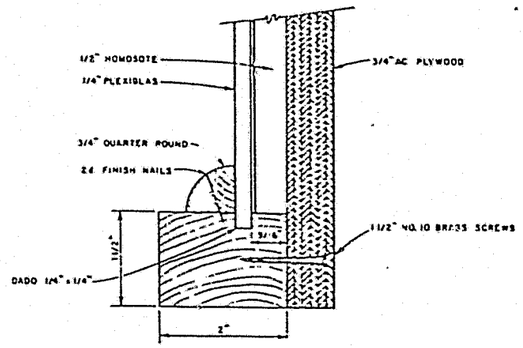
MATERIAL LIST

S4S - SELECT STRUCTURAL - JOISTS

6	2 x 12 x 10'
3	2 x 12 x 12'

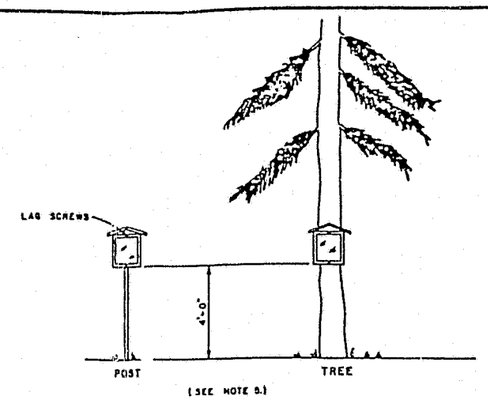
DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS — STATE OF ALASKA	DESIGN & CONSTRUCTION SECTION	SCALE: NONE	16' TRAIL BRIDGE	DRAWN M CHECKED J.R. APPROVED DATE SHEET E-2 OF 1 SHEETS

7-17-10



DETAIL B

SCALE 1" = 1"

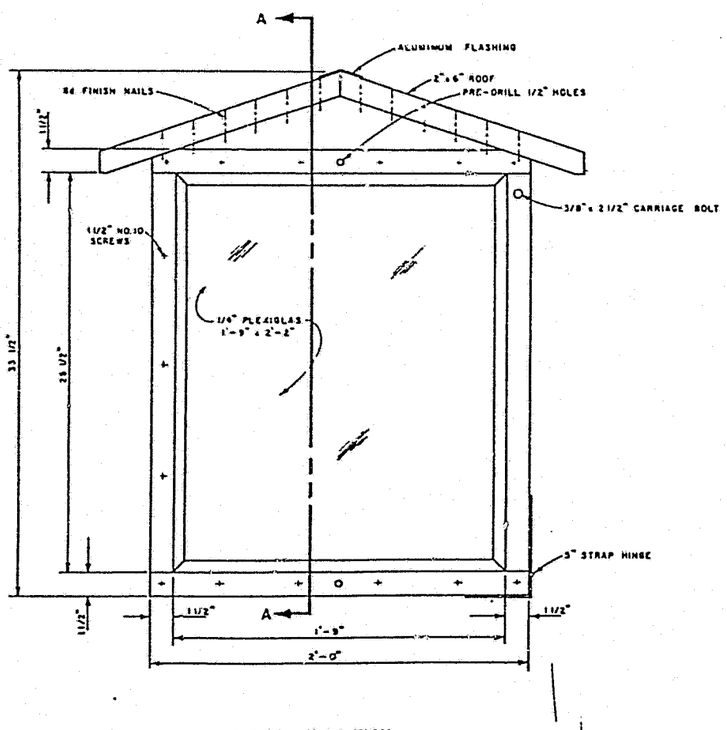


TYPICAL MOUNTING

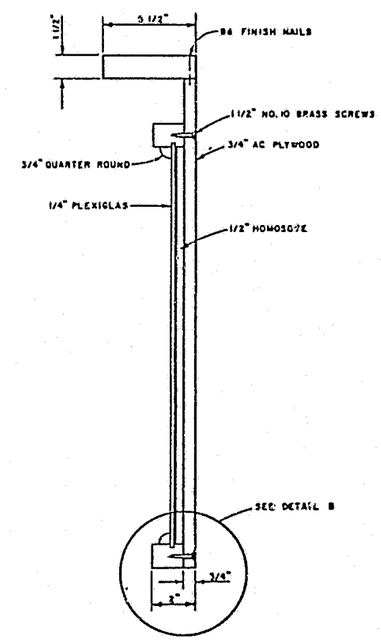
NOT TO SCALE

GENERAL NOTES

1. ALL LUMBER SHALL BE DOUGLAS FIR, S-DRY.
2. TWO COATS PREPACO OIL BASE STAIN ON ALL WOOD (RUSSETT 63-138).
3. HARDWARE SHALL BE GALVANIZED.
4. TWO COATS OFF-WHITE LATEX PAINT ON HOMOSOTE. (ONE SIDE ONLY).
5. FOR MOUNTING ON POSTS OR LOGS SEE STANDARD DWG. S-8.



FRONT ELEVATION



SECTION A-A

BILL OF MATERIALS

LUMBER

9 FT. — 1 1/2" x 2" CLEAR
3 FT. — 2" x 6"
2'-0" x 2'-8" — 3/4" AC PLYWOOD
8 FT. — 3/4" QUARTER ROUND

HARDWARE

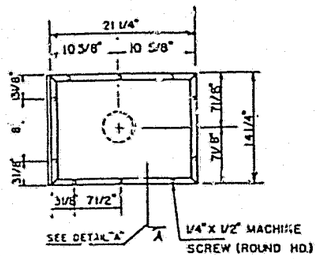
1 — 1 1/2" x 3" STRAP HINGE
1 — 3/8" x 2 1/2" CARRIAGE BOLT
24 — 1 1/2" NO.10 FLATHEAD BRASS SCREWS
1'-9" x 2'-1 1/2" — 1/2" HOMOSOTE
1'-8" x 2'-2" — 1/4" PLEXIGLAS
1/4 LB. — 84 GALVANIZED FINISH NAILS
4" x 6" — 24 GAUGE ALUMINUM SHEET METAL
1/4 LB. — 26 GALVANIZED FINISH NAIL

MISCELLANEOUS

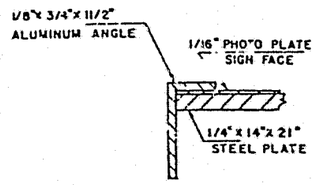
1 QT. — PREPACO OIL BASE STAIN
1 PT. — OFF WHITE LATEX PAINT

DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS — STATE OF ALASKA	DESIGN & CONSTRUCTION SECTION	SCALE: 1/4" = 1" & NOTED	TRAIL BULLETIN BOARD	DRAWN T.D. CHECKED APPROVED DATE 7-16-82	SHEET 1 S-7 OF 1 SHEETS

7-12-5



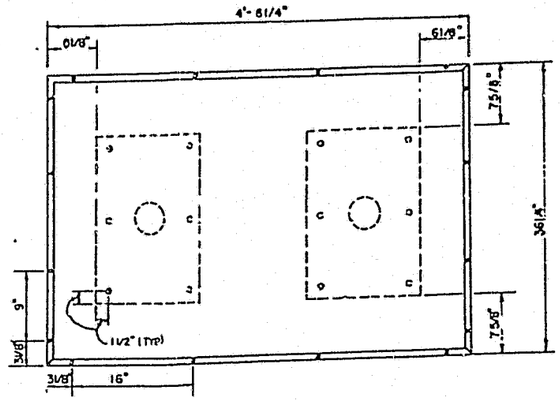
PLAN



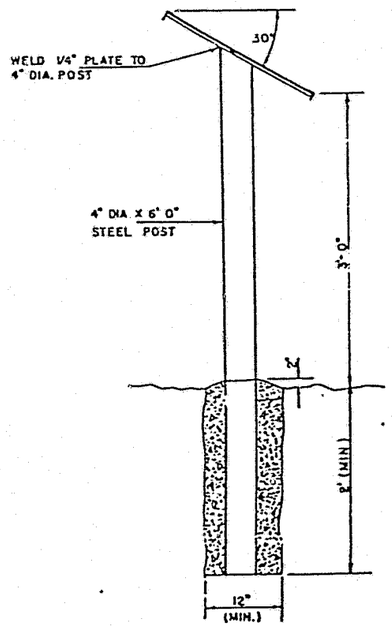
DETAIL A

GENERAL NOTES

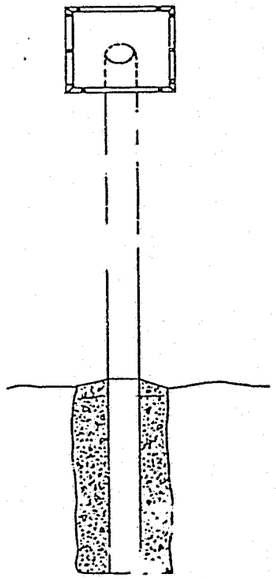
1. USE EPOXY GLUE TO SECURE PHOTO PLATE SIGN TO STEEL BACK PLATE
2. FASTEN ALUMINUM ANGLE FRAME TO BASE PLATE AFTER GLUING SIGN TO BASE.
3. DRILL & TAP HOLES IN BACK PLATE TO RECEIVE FRAME SCREW
4. SIGN SHALL BE ADEQUATELY BRACED FOR 24 HRS. AFTER PLACING CONCRETE.
5. PAINT EXPOSED SECTION OF PIPE & PLATE WITH RUSTOLEUM BROWN PAINT.



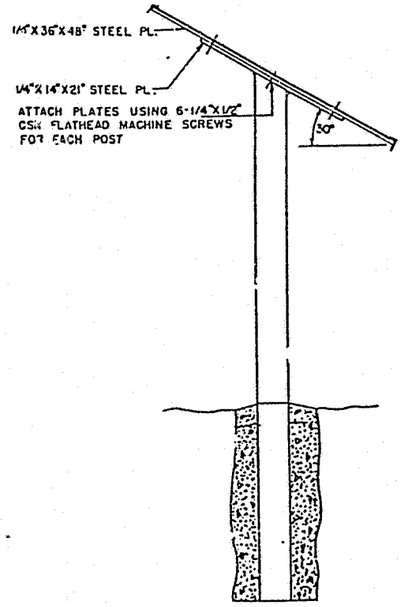
PLAN



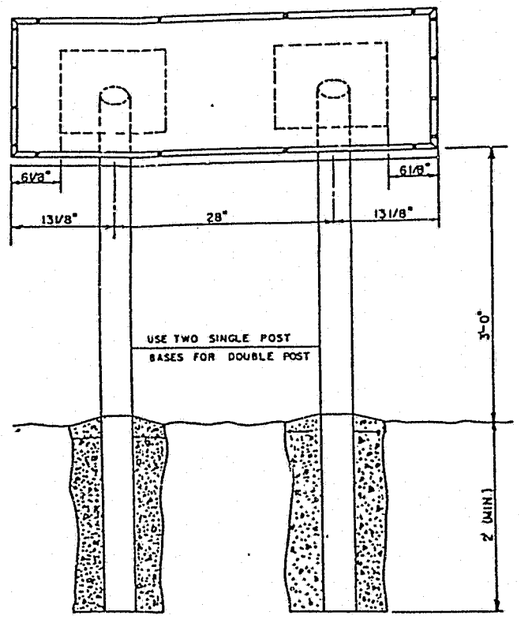
SIDE VIEW



ELEVATION



SIDE VIEW



ELEVATION

MATERIAL LIST

SINGLE POST INSTALLATION

1 ea	4" DIA X 6' STEEL POST
2 ea	1/4" X 14" X 21" STEEL PLATE
5 ft	1/8" X 3/4" X 1 1/2" ALUMINUM ANGLE
10 ea	1/4" X 1/2" MACHINE SCREW (ROUND HD., ST STL.)
1/2 c.f.	CONCRETE

DOUBLE POST INSTALLATION

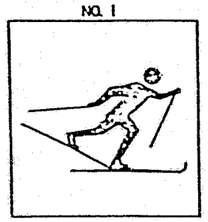
2 ea	4" DIA X 6' STEEL POST
2 ea	1/4" X 14" X 21" STEEL PLATE
1 ea	1/4" X 36" X 54" STEEL PLATE
15 ft.	1/8" X 3/4" X 1 1/2" ALUMINUM ANGLE
12 ea	1/4" X 1/2" MACHINE SCREW (FLATHD., CSK.)
16 ea	1/4" X 1/2" MACHINE SCREW (ROUNDHD.)
3 c.f.	CONCRETE

5-6

DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS STATE OF ALASKA	PARK DEVELOPMENT	NO SCALE	STANDARD INTERPRETIVE SIGN INSTALLATION	DRAWN / CHECKED / APPROVED / DATE April 4/75 — SHEET S-8 OF SHEETS

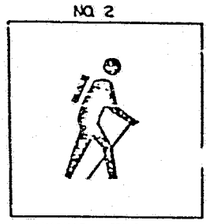
7-12-6

NO. 1



CROSS COUNTRY SKI TRAIL

NO. 2

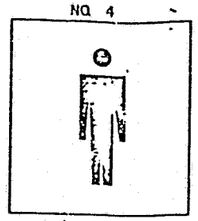


HIKING TRAIL

NO. 3

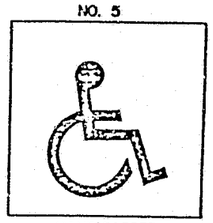
WOMEN'S RESTROOM

NO. 4

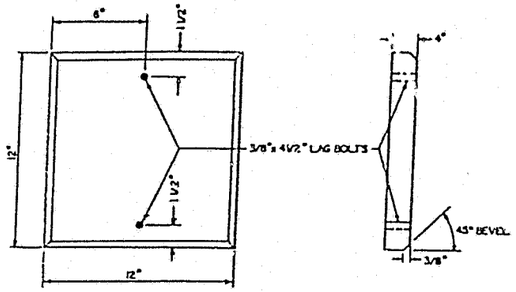


MEN'S RESTROOM

NO. 5

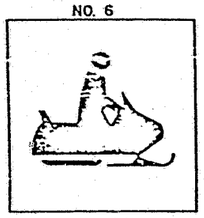


HANDICAPPED



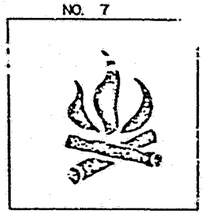
SIGN PLATE

NO. 6



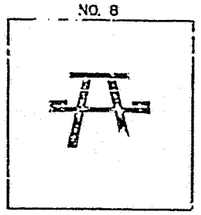
SNOWMOBILING

NO. 7



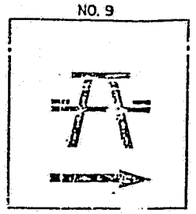
CAMPFIRE

NO. 8



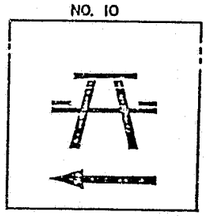
PICNIC AREA

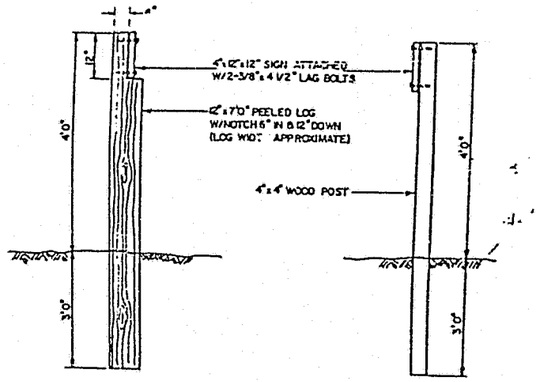
NO. 9



W/DIRECTIONAL ARROW

NO. 10

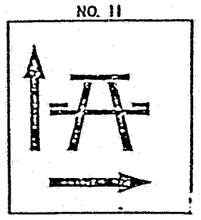




LOG POST

4"x4" WOOD POST

NO. 11



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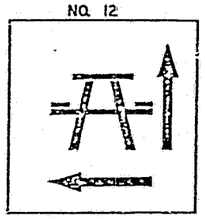
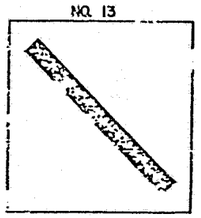


NO. 13



INDICATES ACTIVITY IS PROHIBITED
(CAN BE USED WITH ANY SYMBOL)

GENERAL NOTES

1. ALL LUMBER SHALL BE DOUGLAS FIR, S-DRY, S4S.
2. ALL BURIED PORTIONS OF SIGNPOST SHALL BE PRESERVATIVE TREATED WITH PENTACHLOROPHENOL IN ACCORDANCE WITH AWPI STANDARD LP-77 AND AWPA STANDARD P-8 WITH A MINIMUM NET RETENTION OF 50LBS PER CU FT.
3. ROUTED PORTION OF SIGN PLATE TO BE PAINTED WITH TWO COATS WHITE EXTERIOR ENAMEL.
4. THE "ACTIVITY PROHIBITED" ACCESSORY SYMBOL TO BE PAINTED WITH TWO COATS RED EXTERIOR ENAMEL.
5. SIGN PLATE AND POSTS TO BE PAINTED WITH EITHER TWO COATS FLOOD CWE CLEAR WOOD FINISH FOR EXTERIOR WOOD OR TWO COATS PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-138)
   NOTE: RUSSETT STAIN SHOULD BE USED FOR SIGNS WHICH ARE TO BE VIEWED FROM A VEHICLE.
6. ALL HARDWARE SHALL BE GALVANIZED.

MATERIALS LIST

LUMBER ------ 1- 2"x 12"x 12"
1-12" (APPROX DIAM) x 7'0" PEELED LOG OR 4"x4"x 7'0"

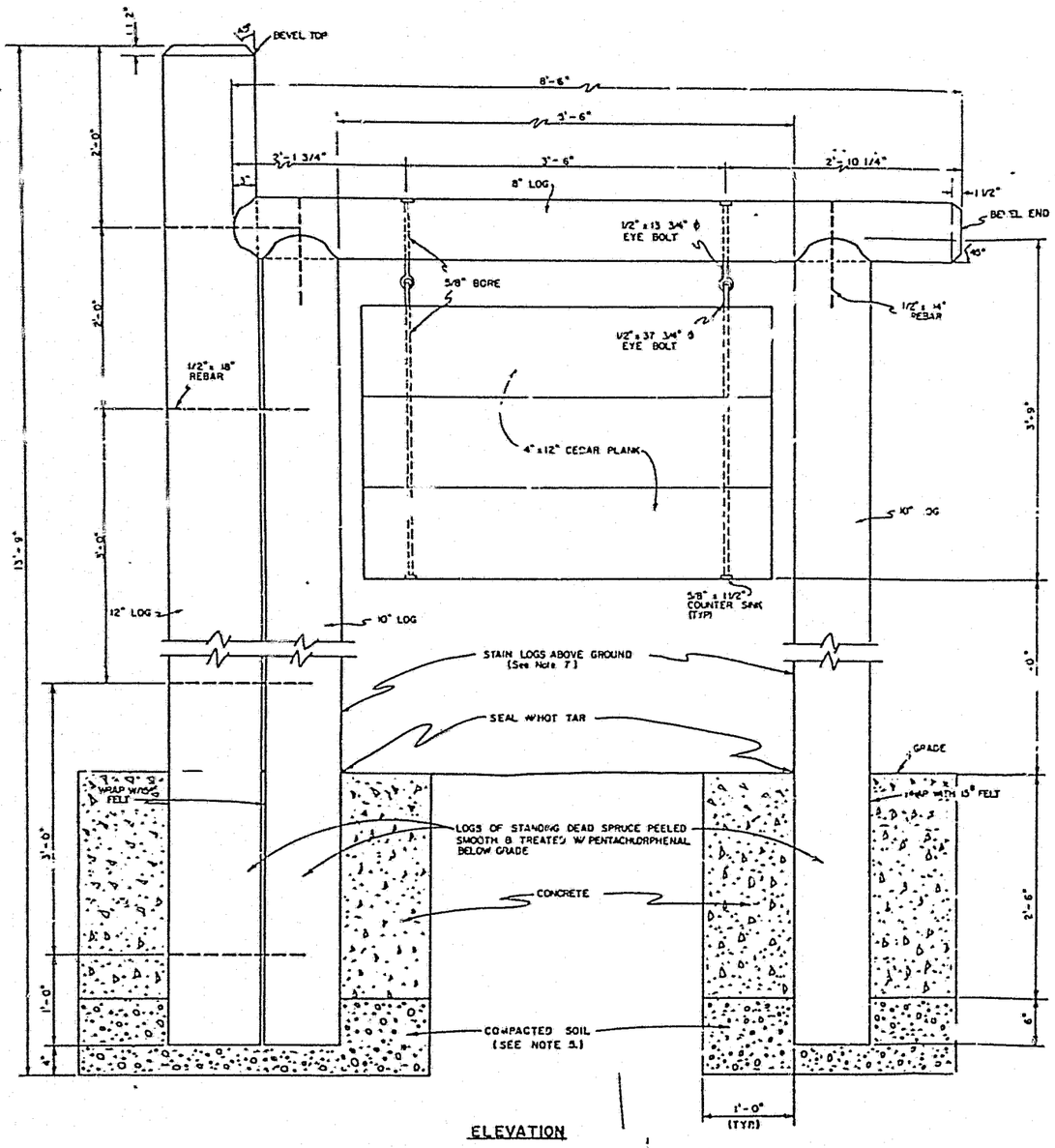
HARDWARE ---- 2- 3/8"x 4 1/2" LAG BOLTS

MISCELLANEOUS -- WHITE EXTERIOR ENAMEL
RED EXTERIOR ENAMEL (WHEN PROHIBITIVE ACCESSORY PLATE IS USED)
1/2 PINT- FLOOD CWE CLEAR WOOD FINISH FOR EXTERIOR WOOD OR PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-138)

5-5

DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS — STATE OF ALASKA	PARK DEVELOPMENT SECTION	SCALE AS NOTED	STANDARD WOOD SIGNS SYMBOLS	DRAWN R.F.M. CHECKED JHP APPROVED JHP DATE 11-14-77	SHEET 1 5-7A OF 1 SHEETS

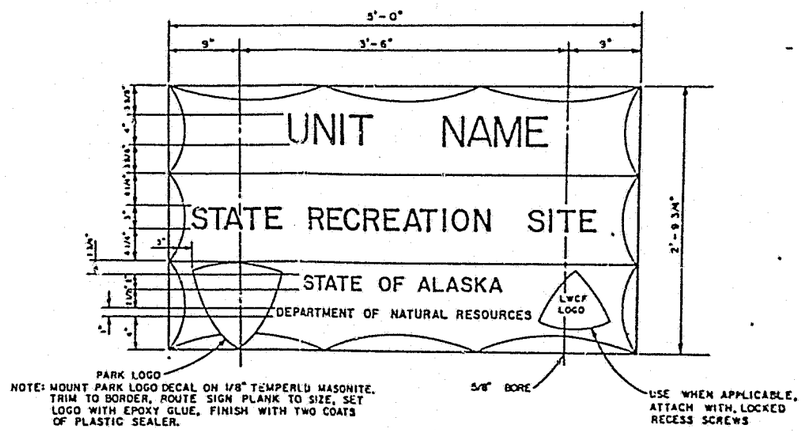
7-12-7



ELEVATION

NOTES

1. SIGN TO BE ROUTED BOTH SIDES AND PLACED AS SHOWN ON THE DRAWING.
2. ROUTED LETTERS TO BE STANDARD GOTHIC 5/16" DEEP & PAINTED W/ WHITE EXTERIOR ENAMEL – 2 COATS REQUIRED.
3. STAIN 4 x 12 CEDAR PLANK W/ PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-138) STAIN – 2 COATS REQUIRED.
4. HAND CHAMFER EDGES 1/2" x 2" AS SHOWN ON THE DRAWING BELOW.
5. SET LOG POSTS IN 6" OF COMPACTED SOIL PRIOR TO POURING CONCRETE.
6. SIZE OF LETTERS MAY VARY WITH WORD LENGTHS.
7. STAIN LOGS W/PREPACO OIL BASE STAIN (RUSSETT 63-138) - 2 COATS REQUIRED.



NOTE: MOUNT PARK LOGO DECAL ON 1/8" TEMPERED MASONITE. TRIM TO BORDER, ROUTE SIGN PLANK TO SIZE, SET LOGO WITH EPOXY GLUE, FINISH WITH TWO COATS OF PLASTIC SEALER.

SIGN

NO	REVISION	DATE	APPVD
5.	REVISED NOMENCLATURE ON SIGN	11-18-82	T.O.
4.	REVISED SIZE OF SIGN	8-22-82	T.O.
3	ADDED NOTES & MISC.	4-15-82	
2.	ADDED CONCRETE SUPPORT, LWCF LOGO	9-15-81	
1	CHANGED STAIN TO PREPACO OIL BASE STAIN	6-1-76	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

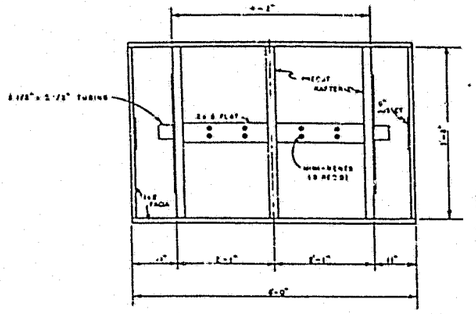
SCALE: 1/2" = 1' 0"

RECREATION SITE
ENTRANCE SIGN

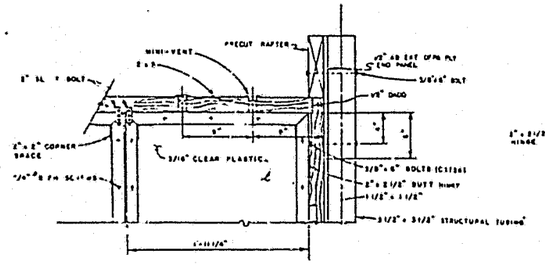
DRAWN MJ
CHECKED JEG
APPROVED
DATE

SHEET 1
S-3
OF 1 SHEETS

7-12-8

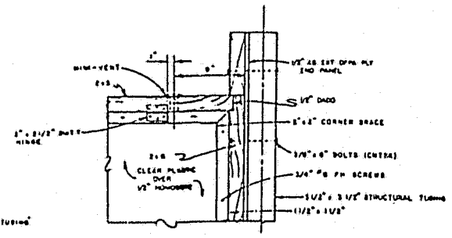


ROOF FRAMING PLAN



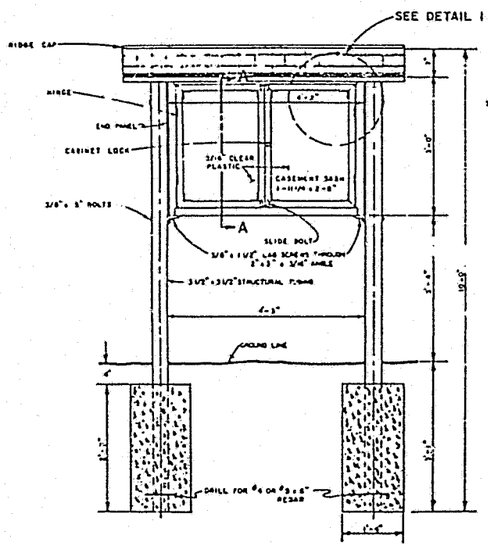
DETAIL I (FRONT)

SCALE: 1 1/2" = 1'-0"

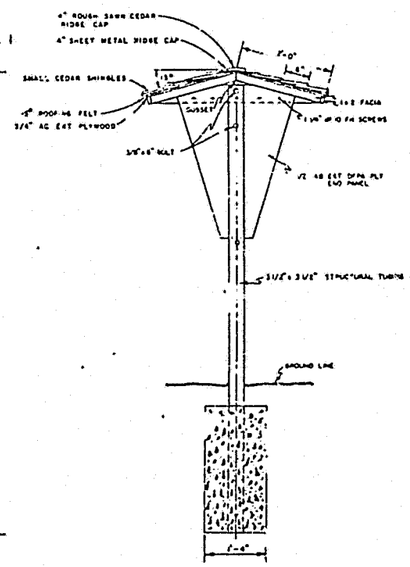


DETAIL I (BACK)

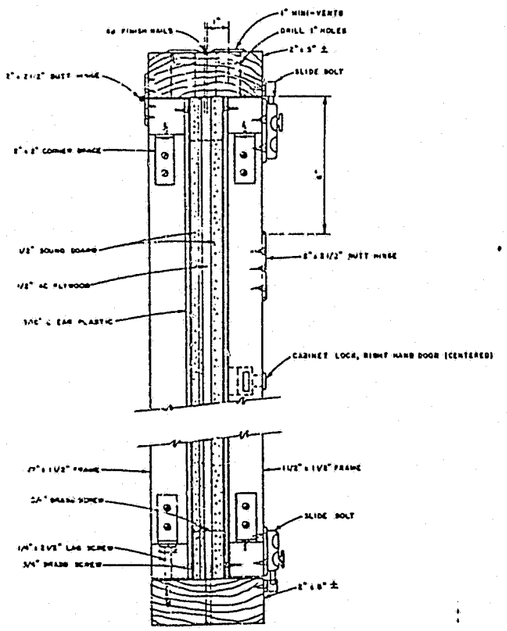
SCALE: 1 1/2" = 1'-0"



FRONT ELEVATION

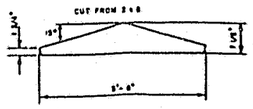


END ELEVATION

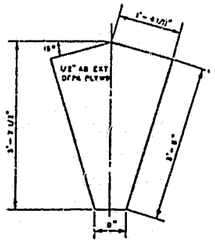


SECTION A-A

SCALE: 3/8" = 1'-0"



RAFTER PATTERN



END PANEL PATTERN

GENERAL NOTE

1. ALL LUMBER SHALL BE DOUGLAS FIR, S-DRY, S4S.
2. TWO COATS PREPACO OIL BASE STAIN ON ALL WOOD
3. TWO COATS OFF-WHITE LATEX PAINT ON HOMOSOTE.
4. ALL HARDWARE SHALL BE GALVANIZED, BRASS, OR CADMIUM PLATED STEEL.

MATERIALS LIST

LUMBER

"CONSTRUCTION"—BOARD

5	1 1/2" x 1 1/2" x 8' CLEAR
1	1" x 2" x 8' CLEAR
1	1" x 2" x 12' CLEAR

"SELECT STRUCTURAL"—STRUCTURAL LIGHT FRAMING

2	2" x 3" x 8'
2	3 1/2" x 3 1/2" x 10' STRUCTURAL TUBING

"SELECT STRUCTURAL"—JOISTS AND PLANKS

1	2 x 8 x 12'

PLYWOOD

1	1/2" x 4' x 4' AB EXT. DFPA PLY
2	3/4" x 4' x 8' AC EXT. DFPA PLY

HARDWARE

48	#8 x 3/4" BRASS F.H. SCREWS		
8	#10 x 1 1/4" FH SCREWS		
2	1/4" x 2 1/2" LAG SCREWS W/ WASHER	2	3/8" x 5" BOLTS
4	2" SLIDE BOLT	4	3/8" x 6" BOLTS
2	2" x 2 1/2" BUTT HINGE W/ SCREWS	2	2" x 3" x 3/16" ANGLES
1	7/8" TUMBLER CABINET LOCK	2	NO. 4 OR 5 x 6" REBAR
1/4 LB.	3/4" ROOFING NAILS	12	2" x 2" FLAT CORNER BRACE W/SCREWS
1/4 LB.	1" SHINGLE NAILS	8	1" MINI-VENTS W/SCREEN
1/2 LB	6d COMMON NAILS		
1/2 LB	16d COMMON NAILS		
1	4" x 6' x 16 GA. METAL RIDGE CAP (BROWN)		

MISCELLANEOUS

1/2 GAL.	PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-134)
1 QT	OFF-WHITE LATEX PAINT
2	1/2" x 2'-8" x 3'-10" HOMOSOTE
1	3/16" x 2'-8" x 3'-10" CLEAR PLASTIC
5	CU. FT CONCRETE
2	3/16" x 1'-11 1/4" x 2'-8" CLEAR PLASTIC
1	BUNDLE SMALL CEDAR SHINGLES
12'	15# ROOFING FELT
6'	4" ROUGH SAWN CEDAR RIDGE CAP

NO.	REVISION	DATE	APPVD
5	ADDED VENTS	9-17-82	LG.
4	REVISED & CLARIFIED DIMENSIONS	8-11-82	TO
3	REVISED CABINET & ROOF	4-3-82	TO
2.	CHANGED TO METAL SUPPORTS SET IN CONCRETE	7-14-81	
1	CHANGED STAIN TO PREPACO OIL BASE STAIN	6-15-76	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS — STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

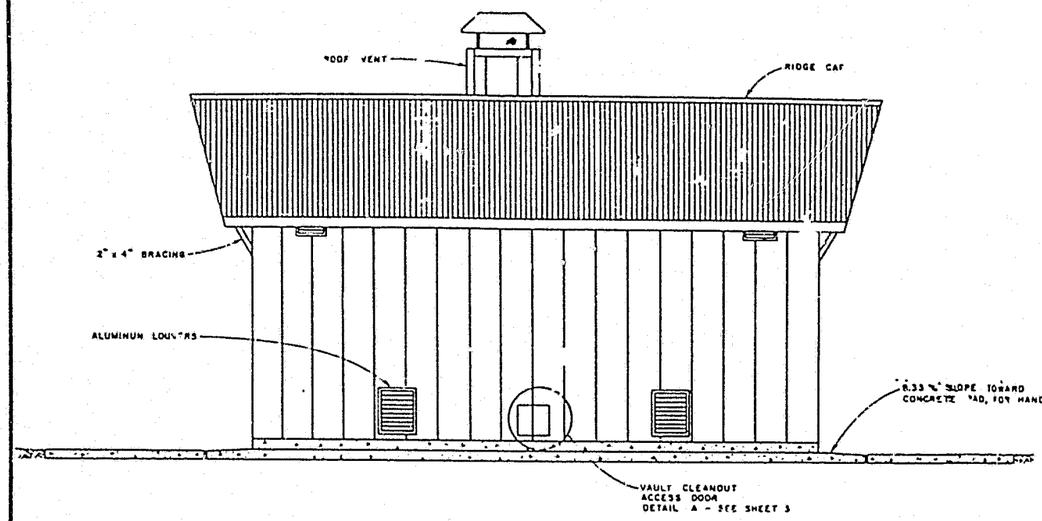
SCALE: 3/4" = 1' 0"

BULLETIN BOARD

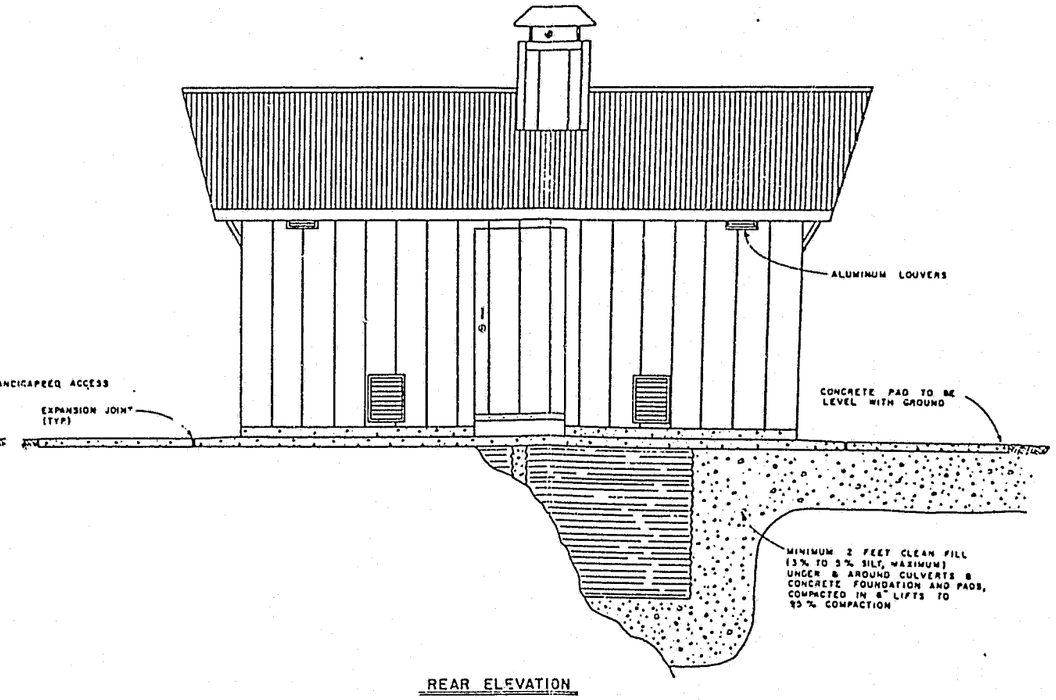
DRAWN M.
CHECKED J.E.S.
APPROVED
DATE

SHEET 1
S-1
OF 1 SHEETS

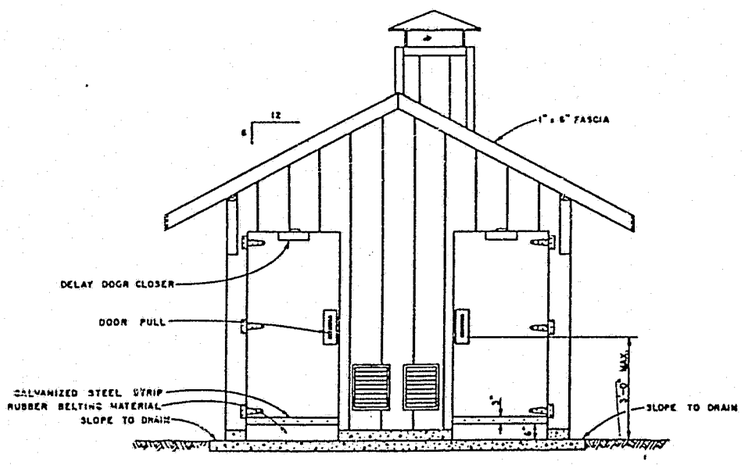
7-12-9



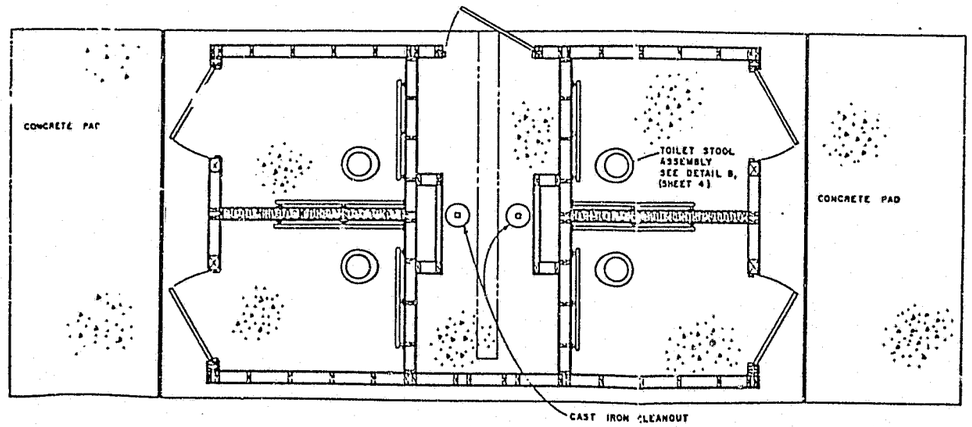
FRONT ELEVATION



REAR ELEVATION



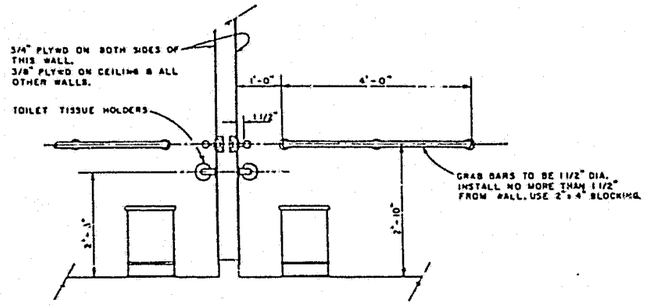
RIGHT SIDE ELEVATION



FLOOR PLAN

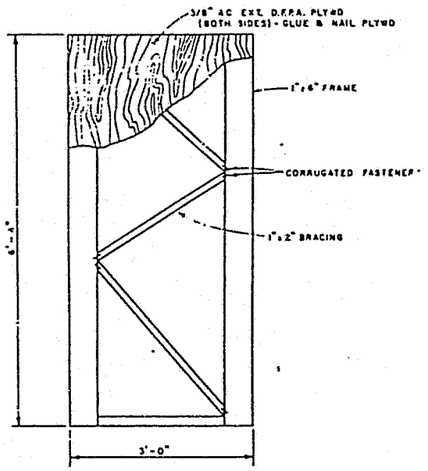
DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS — STATE OF ALASKA	DESIGN & CONSTRUCTION SECTION	SCALE: 1/2" = 1'-0"	DOUBLE VAULTED TOILET WITH ENCLOSED ATTIC	DRAWN T.O. CHECKED D.M. APPROVED DATE 5-21-92	SHEET 1 R-8 OF 4 SHEETS

7-12-10



INTERIOR ELEVATION

NOT TO SCALE



DOOR DETAIL

SCALE: 1" = 1'-0"

GENERAL NOTES:

1. ALL WOOD SHALL BE DOUGLAS FIR, S-DRY, S4S.
2. ALL FRAMING TO BE MADE FROM 2x4'S, UNLESS OTHERWISE INDICATED.
3. SOLE PLATES SHALL BE PRESERVATIVE TREATED WITH PENTACHLOROPHENOL, IN ACCORDANCE WITH A.W.P.A. STANDARD C14-77 & A.W.P.A. STANDARD P-8 WITH A MINIMUM NET RETENTION OF .50 LBS. PER CU.FT.
4. A SILICONE GROUT SHALL BE PLACED AT THE FOLLOWING LOCATIONS
   a. STOOL FLANGES TO FLOOR
   b. AROUND VENT DUCTING AT FLOOR CONNECTION & STUBS AT CEILING CONNECTION
   c. PARTITION WALLS ADJACENT TO VENT
   d. SKYLIGHTS TO CEILING
   e. ROOF JACK TO ROOF
   f. INSIDE WALLS TO CEILING
5. FINISHED GROUND PROFILE SHALL BE FLUSH WITH ENTRANCE DECK OR PAD SURFACE AT FRONT OF BUILDING TO ACCOMODATE WHEELCHAIR TRAFFIC.
6. DIVIDER WALL TO BE COVERED WITH 3/4" A-C EXT. D.F.P.A. PLYWOOD; CEILING AND INTERIOR WALLS TO BE COVERED WITH 3/8" A-C EXT D.F.P.A. PLYWOOD.
7. INTERIOR WALLS AND CEILING TO BE SEALED AND PAINTED WITH 2 COATS OF EXT. WHITE, SEMI-GLOSS ENAMEL.
8. ATTIC AREA SHALL BE SEALED AS TIGHT AS POSSIBLE.
9. EXTERIOR OF BUILDING TO BE COVERED WITH T1-11 SIDING WITH 8" GROOVES, & STAINED WITH PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-138), 2 COATS REQ'D.
10. CLOSED CELL SPONGE WEATHERSTRIPPING 1/2" WIDE x 1/4" THICK TO BE STAPLED ON DOOR JAMB AS A SOUND DEADENER.

MATERIALS LIST

LUMBER

6 – 1"x2"x16 FT. (DOOR STOPS FRAMING, ROOF VENT TRIM, DOOR BRACING)
8 – 1"x3"x 8 FT. (LOUVER & SKYLIGHT FRAMING)
4 – 1"x4"x 8 FT. (FASCIA)
6 – 1"x4"x 14 FT. (FASCIA, FILLER STRIPS, & DOOR CONSTRUCTION)
2 – 1"x6"x 14 FT. (ROOF NAILERS)
6 – 1"x6"x 16 FT. (ROOF NAILERS)
2 – 1"x6"x 18 FT. (ROOF NAILERS)

36 – 2"x4"x7'-6 1/2" (WALL FRAME STUDS-CUTER)
24 – 2"x4"x 8 FT. (RAFTERS)
12 – 2"x4"x 8'-0" (CEILING JOISTS)
4 – 2"x4"x 6 FT. (PLATES)
2 – 2"x4"x 14 FT. (PLATES)
2 – 2"x4"x 16 FT. (PLATES)
2 – 2"x4"x 16 FT. (TREATED SOLES)
12 – 2"x4"x 18 FT. (NAILERS, SPACERS, ROOF VENT & MISC. BLOCKING & FORMS)
1 – 2"x10"x 5 FT. (TREATED; DIVIDER WALL)
1 – 2"x10"x 8'-4" (DIVIDER WALL)
1 – 2"x10"x 16 FT. (DIVIDER WALL)
2 – 2"x12"x 10 FT. (HEADERS)
1 – 2"x 6" x 18 FT. (RIDGE POLE)

2 – 4"x4"x 6'-3" (DOOR FRAMING)
2 – 4"x6"x 6'-3" (DOOR FRAMING)

PLYWOOD

19 – 3/8" x 4 FT. x 8 FT. AC EXT. D.F.P.A.
3 – 3/4" x 4 FT. x 8 FT. AC EXT D.F.P.A.
9 – 3/8" x 4 FT. x 8 FT. T1-11 D.F.P.A. (8" GROOVES)

HARDWARE & MISCELLANEOUS

1 – 5'x 5'x 16 GA. CULVERT W/2 2/3" x 1/2" CORRUGATIONS
18 – 1/2" x 8" ANCHOR BOLTS
330 FT. - #3 REBAR
1 – 8"W x 30"L x 10" HIGH 24 GA. GALV. DUCTING
1 – 8"W x 30"L x 8'-4" HIGH 24 GA. GALV. DUCTING
10 LBS. - 1 3/4" ROOFING NAILS W/NEOPRENE WASHERS
20 LBS. - 6d GALV. FINISH NAILS
20 LBS. - 16d GALV. COMMON NAILS
2 – 12"H x 12" W LOUVER ASS'Y (McM-C # 2049K14 OR EQUAL)
4 – 18"H x 14" W LOUVER ASS'Y (McM-C # 2049K17 OR EQUAL)
2 – TISSUE HOLDERS (ACME)
2 – 3" HAT/COAT HOOKS
1 – CAST IRON CLEANOUT (OLYMPIC FOUNDRY # 3513)
2 – FOREST TOILET STALL ASS'Y (HANDICAPPED) (REHCO)
.37 YDS. - TYPE 3 CEMENT (SULFATE RESIST)
3.50 YDS. - STANDARD CEMENT
6 – TUBES SILICONE GROUT
6 – 8" T-TYPE HEAVY DUTY DOOR HINGES (McM-C # 1530A43 OR EQUAL)
2 – 10" H.D. ADJUSTABLE DOOR SPRINGS (McM-C # 1474A19 OR EQUAL)
2 – 1/4" THICK x 8" x 36" RUBBERIZED DECKING
2 – 1/8" x 2" x 36" GALV. STEEL STRAPS
10 – 1/4" x 1 1/2" LAG BOLTS
2 – DOOR PULLS (McM-C # 1404A11 OR EQUAL)
4 – MAGNETIC DOOR CATCH (McM-C # 1101A12 OR EQUAL)

16 FT. – 1/4" THICK x 1/2" WIDE WEATHERSTRIPPING
4 – 1/2" O.D. x 4 FT. LONG GRAB BARS W/CENTER & END MOUNTS
4 – 14" x 20" REINFORCED RIGID VINYL WINDOWS
16 3/4 FT. – CORRUGATED RIDGE CAP
18 SHEETS – 2'x5' HEAVY DUTY CORRUGATED FIBERGLASS ROOFING
60 FT. – CORRUGATED RUBBER ROOFING FILLER STRIP
2 – HOOK & EYE (McMASTER-CARR #1779A13)
1 – 3 1/2'x 2' GALV. SHEET METAL (24 GA.) FOR ROOF VENT
12 FT. – 10" WIDE GALVANIZED FLASHING
1 – 8" x 7 FT. METAL INSECT SCREENING
75 SQ. FT. – BLACK BUILDING PAPER
110 SQ. FT. – 4" FIBERGLASS INSULATION (UNFACED)
2 – 1/2" x 4" x 10 FT. EXPANSION JOINT

8 GAL. – WOOD SEALER
5 GAL. – PREPACO OIL BASE STAIN (RUSSETT 63-138)
5 GAL. – WHITE EXT. SEMI-GLOSS ENAMEL PAINT
4 GAL. – CONCRETE SEALER
4 GAL. – BLACK BITUMINOUS ASPHALT PAINT (McMASTER-CARR #7748T2)

NO.	REVISION	DATE	APPROVED
1	UPDATED DRAWING, NOTES & MATERIALS	6-2-82	T.D.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

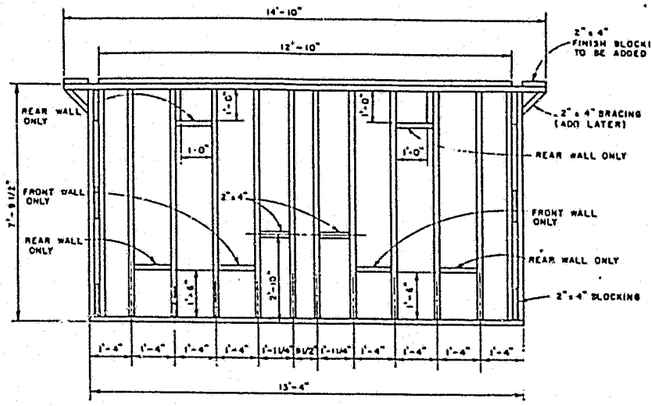
SCALE: NOTED

SINGLE VAULTED TOILET WITH ENCLOSED ATTIC

DRAWN T.D.
CHECKED
APPROVED
DATE 4-15-82

SHEET 3
R-7
OF 3 SHEETS

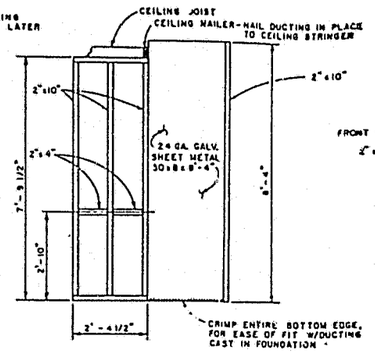
7-12-11



FRONT & REAR WALL ELEVATION

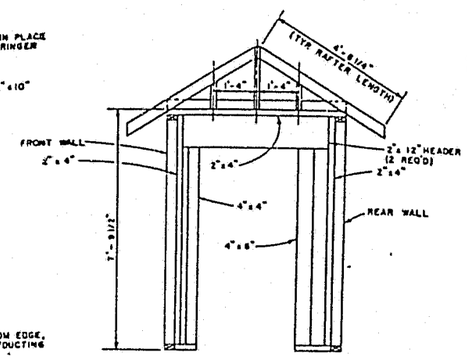
SCALE: 1/2" = 1'-0"

NOTE: CONSTRUCT ENTIRE WALL OF 2"x4"



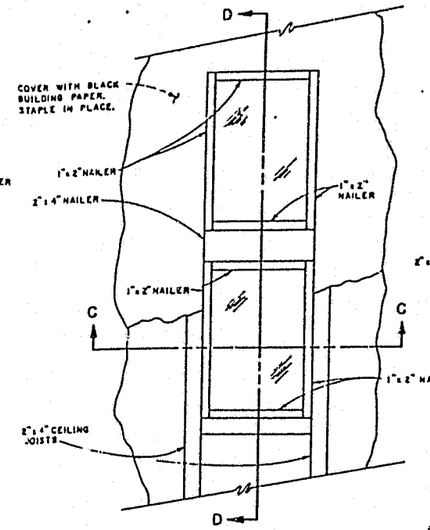
INTERIOR WALL ELEVATION

SCALE: 1/2" = 1'-0"



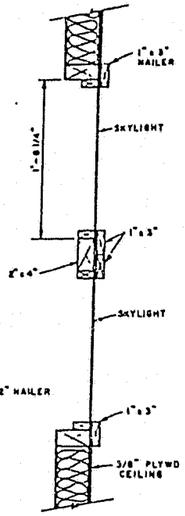
END WALL ELEVATION

SCALE: 1/2" = 1'-0"



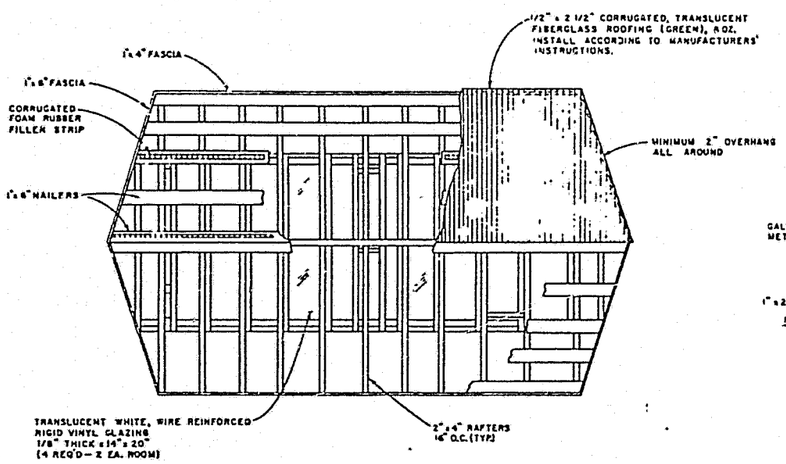
ATTIC VIEW OF SKYLIGHT

NOT TO SCALE



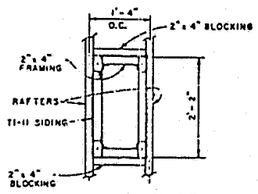
SECTION D-D

NOT TO SCALE



ROOF & ATTIC VIEW

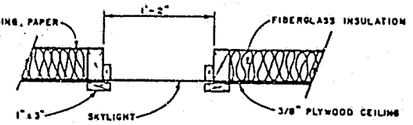
NOT TO SCALE



VENT PLAN VIEW

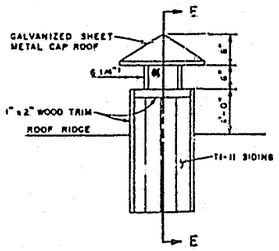
NOT TO SCALE

NOTE:
FABRICATE VENT CAP OUT OF GALVANIZED SHEET METAL. PRIME & PAINT WITH RUSTOLEUM PAINT (MATCH TRIM).



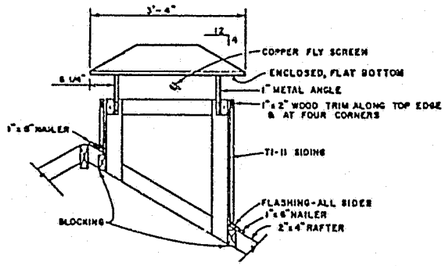
SECTION C-C

NOT TO SCALE



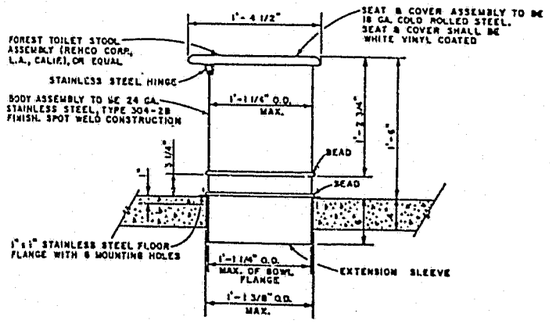
EXTERIOR END VIEW

NOT TO SCALE



SECTION E-E

NOT TO SCALE



SECTION B-B

(ROTATED 90° COUNTER CLOCKWISE)

NOT TO SCALE

NO.	REVISION	DATE	APPROVED
1	UPDATED DRAWING	6-2-82	ED.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS — STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

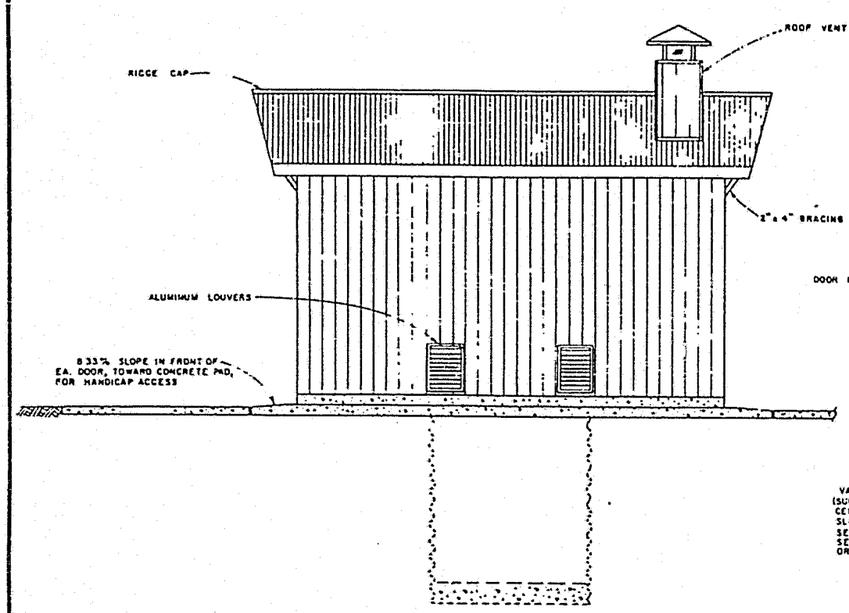
SCALE: 1/2" = 1'-0" & NOTED

SINGLE VAULTED TOILET WITH ENCLOSED ATTIC

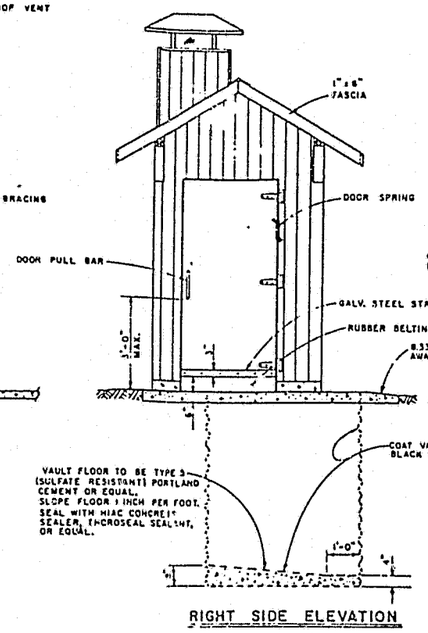
DRAWN T.D.
CHECKED
APPROVED
DATE 4-15-82

SHEET 2
R-7
OF 3 SHEETS

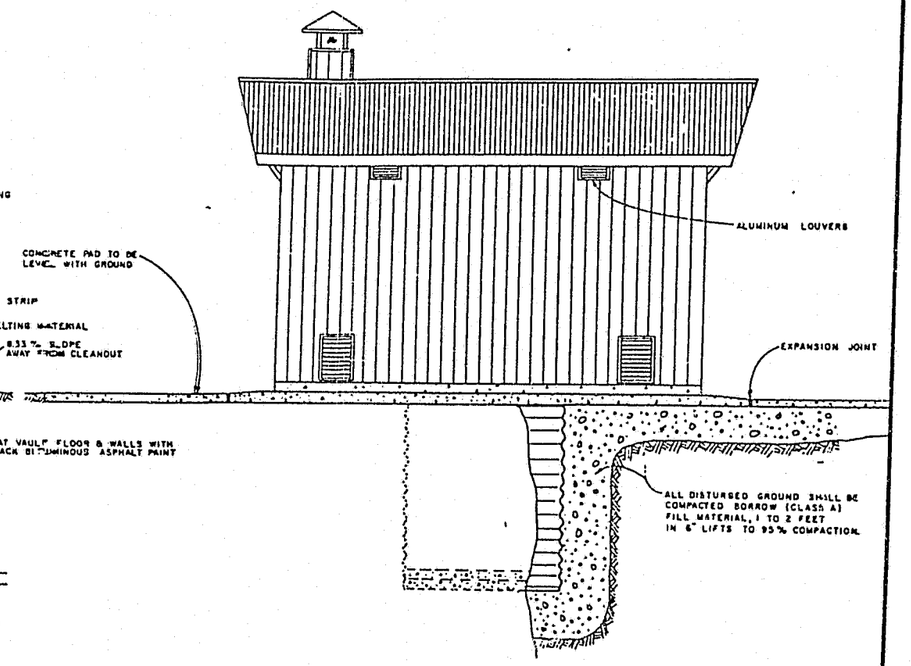
7-12-12



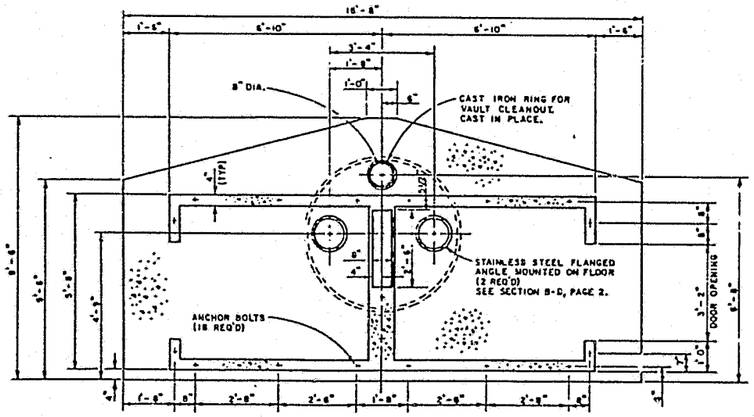
FRONT ELEVATION

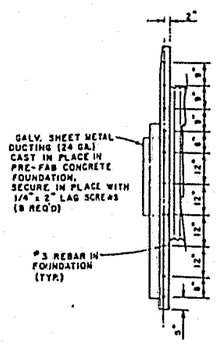


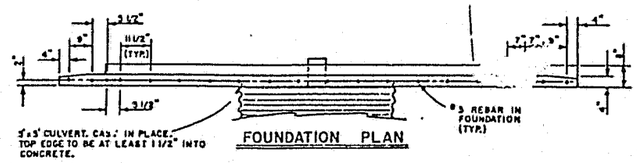
RIGHT SIDE ELEVATION



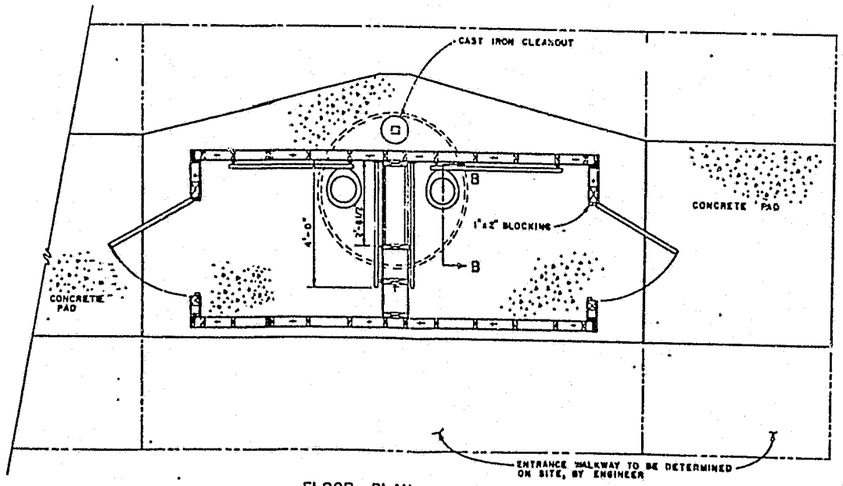
REAR ELEVATION







FOUNDATION PLAN



FLOOR PLAN

NO.	REVISION	DATE	APPROVED
1	UPDATED DRAWING	6-2-82	T.D.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

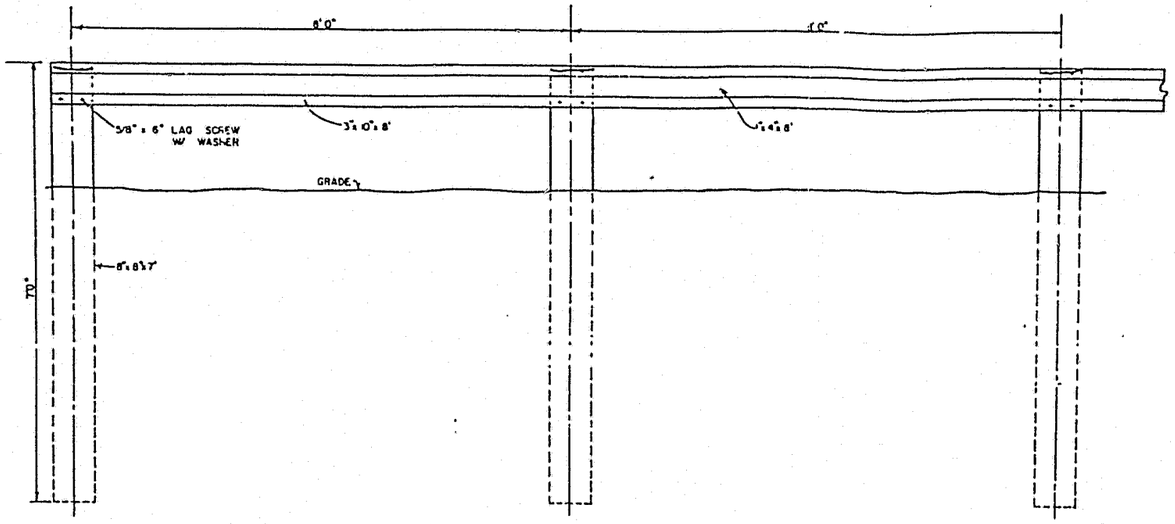
SCALE 1/2" = 1'-0"

SINGLE VAULTED TOILET WITH ENCLOSED ATTIC

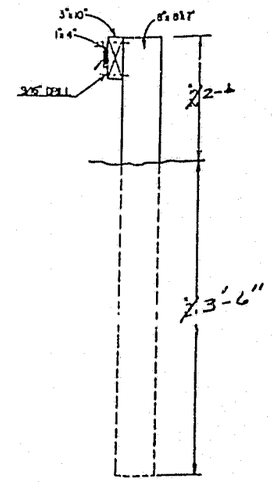
DRAWN T.D.
CHECKED
APPROVED
DATE 4-15-82

SHEET 1
R-7
OF 3 SHEETS

7-12-13



SAFETY GUARD RAIL



END SECTION

NOTES

1. ALL WOOD EXCEPT 1"x4"S SHALL BE PRESERVATIVE TREATED WITH PENTACHLOROPHENOL IN ACCORDANCE WITH AWPA STANDARD LP-77 AND AWPA STANDARD P-8 WITH A MINIMUM NET RETENTION OF 50 LBS PER CU FT.

2. 1"x4"x8' PAINTED WHITE-FASTENED W/ 60 GALV. NAILS STAGGERED 12" O.C. OR "SCOTCHLITE" REFLECTIVE DELINEATOR, H-19, 3271 YELLOW.

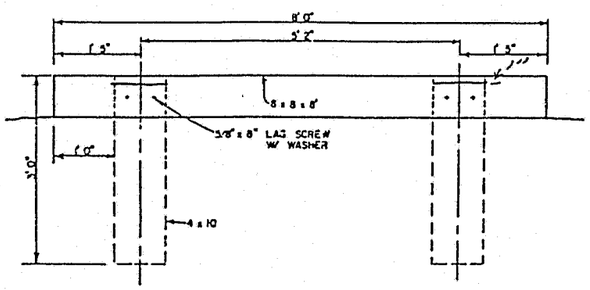
MATERIAL LIST

SAFETY GUARD RAIL

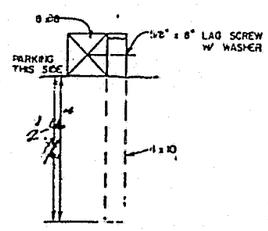
1	1	3"x10"x8' RAIL
2.	1	8"x8"x7' POST
3	1	[illegible]
4	4	5/8"x6" GALVANIZED LAG SCREW W/WASHER

PARKING BUMPER

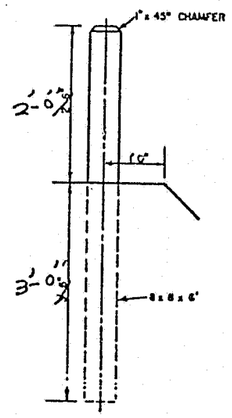
1	1	8"x8"x8'
2	1	4"x10"x6'
3	4	5/8"x6" LAG SCREW/ WASHER



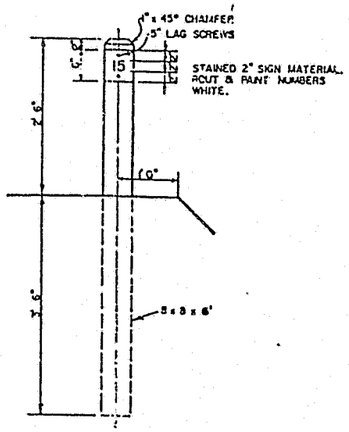
PARKING BUMPER



END SECTION



GUARD POST



GUARD POST & SPACE NUMBER

NO	REVISION	DATE	APPVD.
L	CHANGED LENGTH OF GUARD POSTS	4-18-77	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

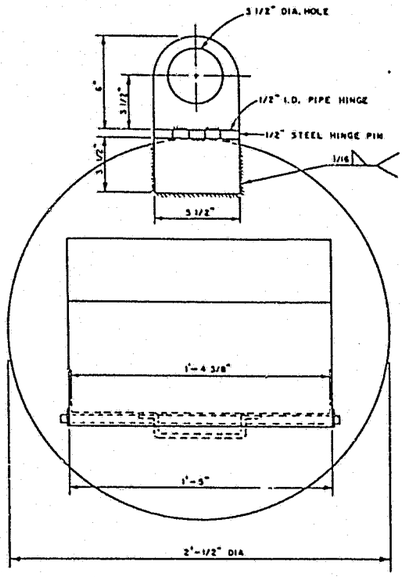
DESIGN & CONSTRUCTION SECTION

SCALE: 1" = 10'

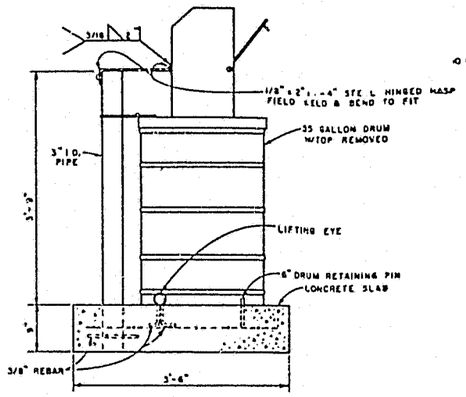
BARRIER
~~SAFETY GUARD RAIL~~
PARKING BUMPER LOG
GUARD POST, NUMBER POST

DRAWN
CHECKED J.F.S.
APPROVED
DATE

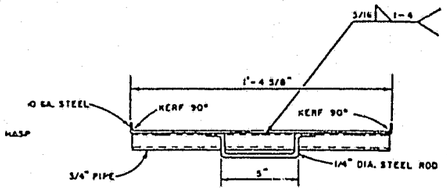
SHEET 1
P-3
OF 1 SHEET



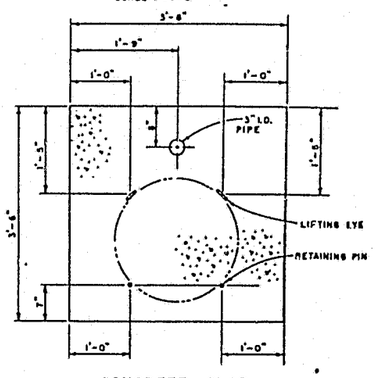
TOP VIEW



INSTALLATION
SCALE: 1" = 1'-0"



DOOR DETAIL
SCALE: 1" = 1'-0"



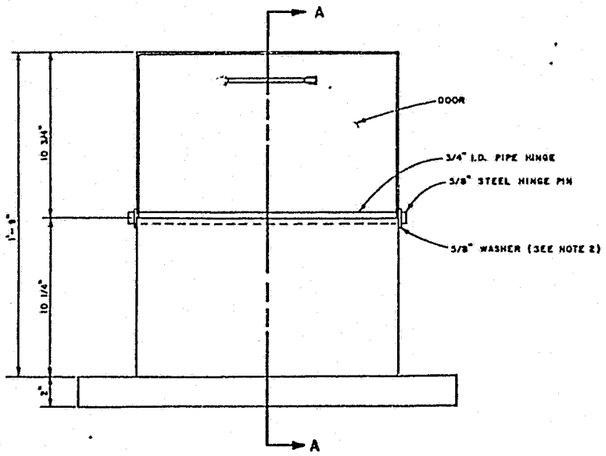
CONCRETE SLAB
SCALE: 1" = 1'-0"

GENERAL NOTES

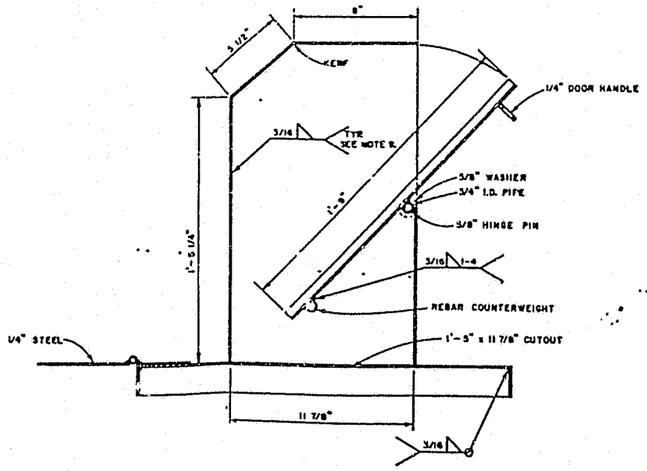
1. SHEET STEEL TO BE 10 GAUGE (1/8") SHEET.
2. WASHERS TO BE WELDED EACH SIDE TO DOOR PIN.
3. USE BOTTOM PLATE CUTOUT (1'-3" x 11 7/8") AS FRONT PLATE.
4. HEAT & WELD 2" STRIP TO OUTSIDE OF BOTTOM PLATE.
5. LIFTING EYES ARE 3/8" REBAR FOR LIFTING CONCRETE SLAB & HOLDING DRUM IN PLACE.
6. DRUM RETAINING PINS TO EXTEND 1 1/2" ABOVE SLAB.
7. PLACE TOP ON DRUM & WELD HINGED HASP LEVEL.
8. PRIME ALL EXPOSED METAL WITH RUSTOLEUM # 960 ZINC CHROMATE, & THEN PAINT WITH RUSTOLEUM # 956 ORANGE.
9. ALL WELDS TO BE 3/16 FILLET.

BILL OF MATERIALS

1 SHEET — 10 GA. STEEL (3'-0" x 6'-0")
18 INCHES — 3/4" I.D. IRON PIPE
6 INCHES — 1/2" I.D. IRON PIPE
4 FT. 6 INCHES — 3" I.D. IRON PIPE
1 — 1/4" x 3 1/2" x 10" STEEL
10 INCHES — 1/4" STEEL ROD
8 INCHES — 1/2" STEEL ROD
18 INCHES — 5/8" STEEL ROD
2 — 5/8" STEEL WASHERS
43 FT. — 3/8" REBAR (#3)
1/3 CU. YD. — CONCRETE
1 QT. — RUSTOLEUM # 960 ZINC CHROMATE PAINT
1 QT. — RUSTOLEUM # 956 ORANGE PAINT



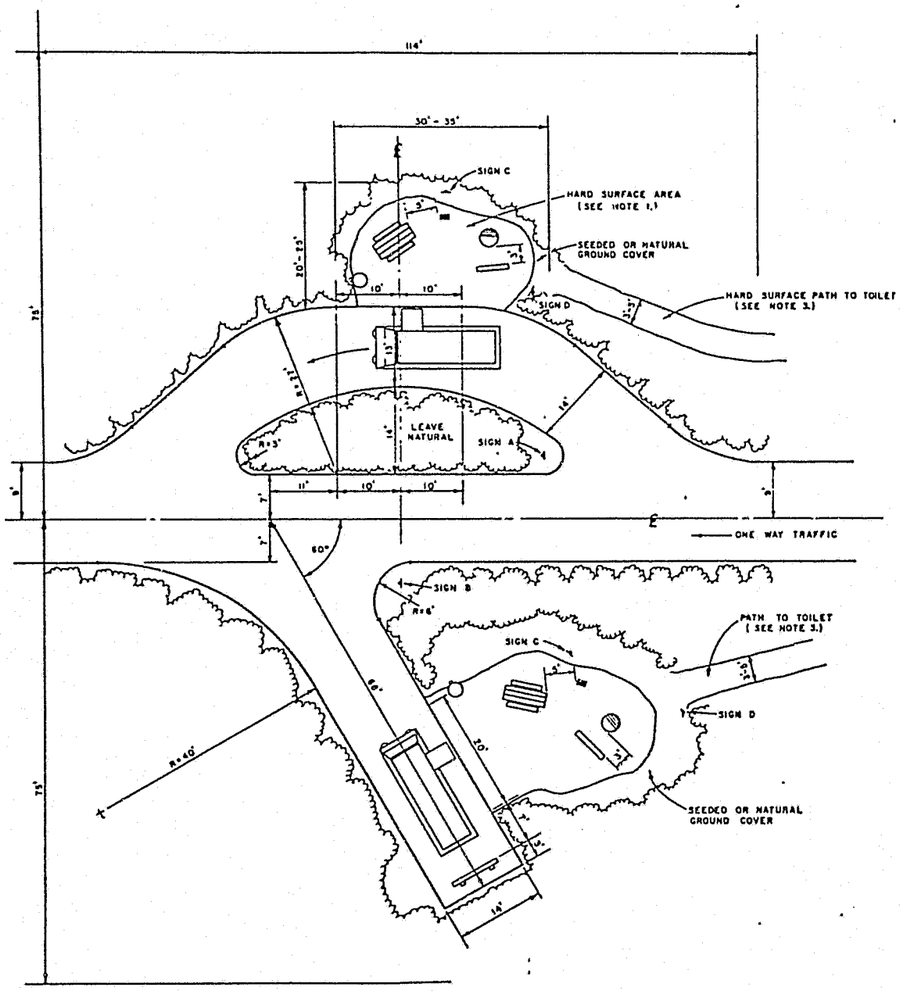
FRONT VIEW

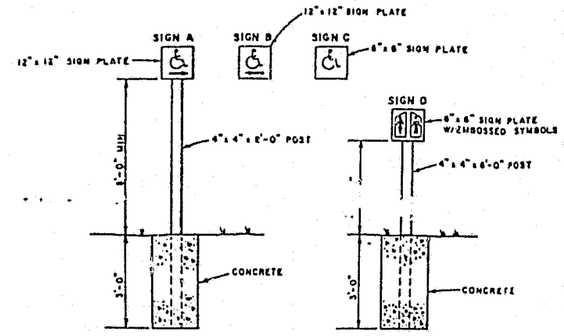


SECTION A-A

DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS — STATE OF ALASKA	DESIGN & CONSTRUCTION SECTION	SCALE: 1/4" = 1" & NOTED	BEARPROOF GARBAGE CAN	DRAWN E.D. CHECKED D.T. APPROVED DATE 8-3-02	SHEET 1 C-17 OF 1 SHEETS

7-12-15



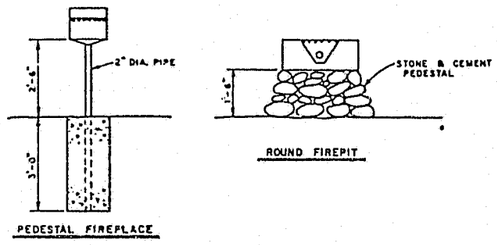


TYPICAL SIGN INSTALLATIONS

SCALE: 1/2" = 1'-0"

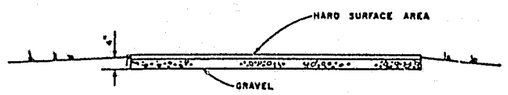
GENERAL NOTES

1. HARD SURFACE AREAS MAY BE ASPHALT, CEMENT, OR A CATIONIC SLOW SETTING EMULSION, AS DETERMINED BY THE ENGINEER.
2. ORIENTATE FIREPLACES SO FRONT IS TOWARD PREVAILING WINDS.
3. PATH TO TOILET SHOULD BE 3' TO 5' WIDE & NOT OVER 150' TO 200' DISTANCE. PATH WILL BE CLEARED OF ALL BRANCHES, ROCKS, ETC.
4. SIZE OF CAMPSITE, & VEGETATION TO BE CLEARED, WILL BE DETERMINED BY THE ENGINEER
5. PREPARE HARD SURFACE AREAS BY REMOVING APPROXIMATELY 4" OF TOPSOIL & REPLACING WITH COMPACTED, UNWASHED GRAVEL.



TYPICAL FIREPLACE INSTALLATIONS

SCALE: 1/2" = 1'-0"



HARD SURFACE AREA CROSS SECTION

NOT TO SCALE

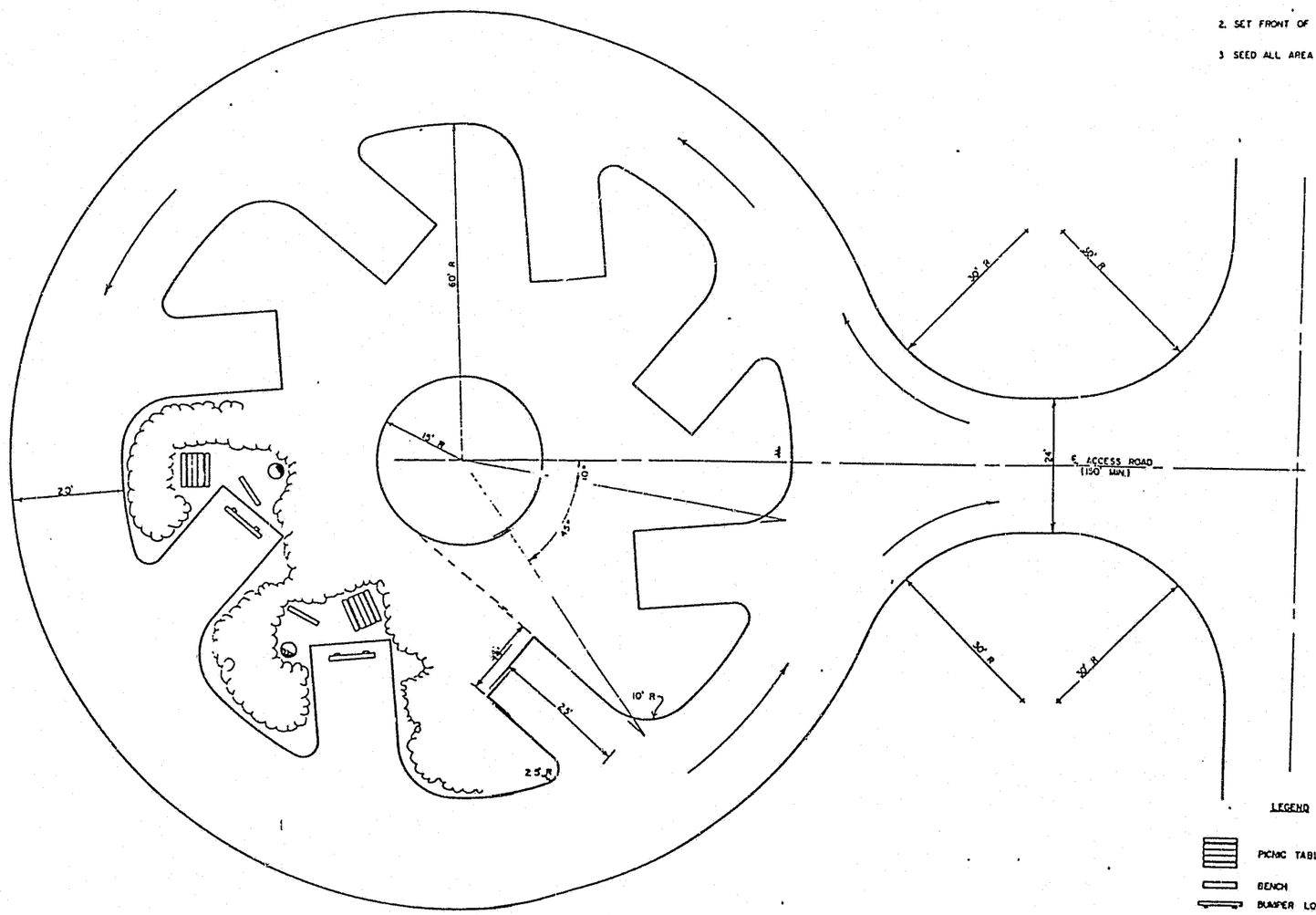
LEGEND	STANDARD DRAWING NO.
PICNIC TABLE	C-1
BENCH	C-2
BUMPER LOG	P-3
FIREPIT	C-4
PEDESTAL FIREPLACE	C-5
SIGN	S-6
TRASH RECEPTACLE	NONE

DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS STATE OF ALASKA	DESIGN & CONSTRUCTION SECTION	SCALE: 1" = 10' & NOTED	TYPICAL HANDICAPPED CAMPSITES	DRAWN T.O. CHECKED D.M. APPROVED DATE 8-6-82	SHEET 1 C-16 OF 1 SHEETS

7-12-16

NOTES

1. CLEAR SPACES AS DIRECTED BY THE ENGINEER
2. SET FRONT OF FIREPLACE AWAY FROM PREVAILING WINDS
3. SEED ALL AREA NOT COVERED WITH GRAVEL.



LEGEND

- PICNIC TABLE
- BENCH
- BUMPER LOG
- ROUND FIREPIT
- TRAFFIC SIGN

NO.	REVISION	DATE	APPROVED
1	REVISED & UPDATED DRAWING	8-31-82	CD

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS — STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

SCALE: 1" = 10'

DAISY CAMPSITE

DRAWN MJ
CHECKED JPR
APPROVED
DATE

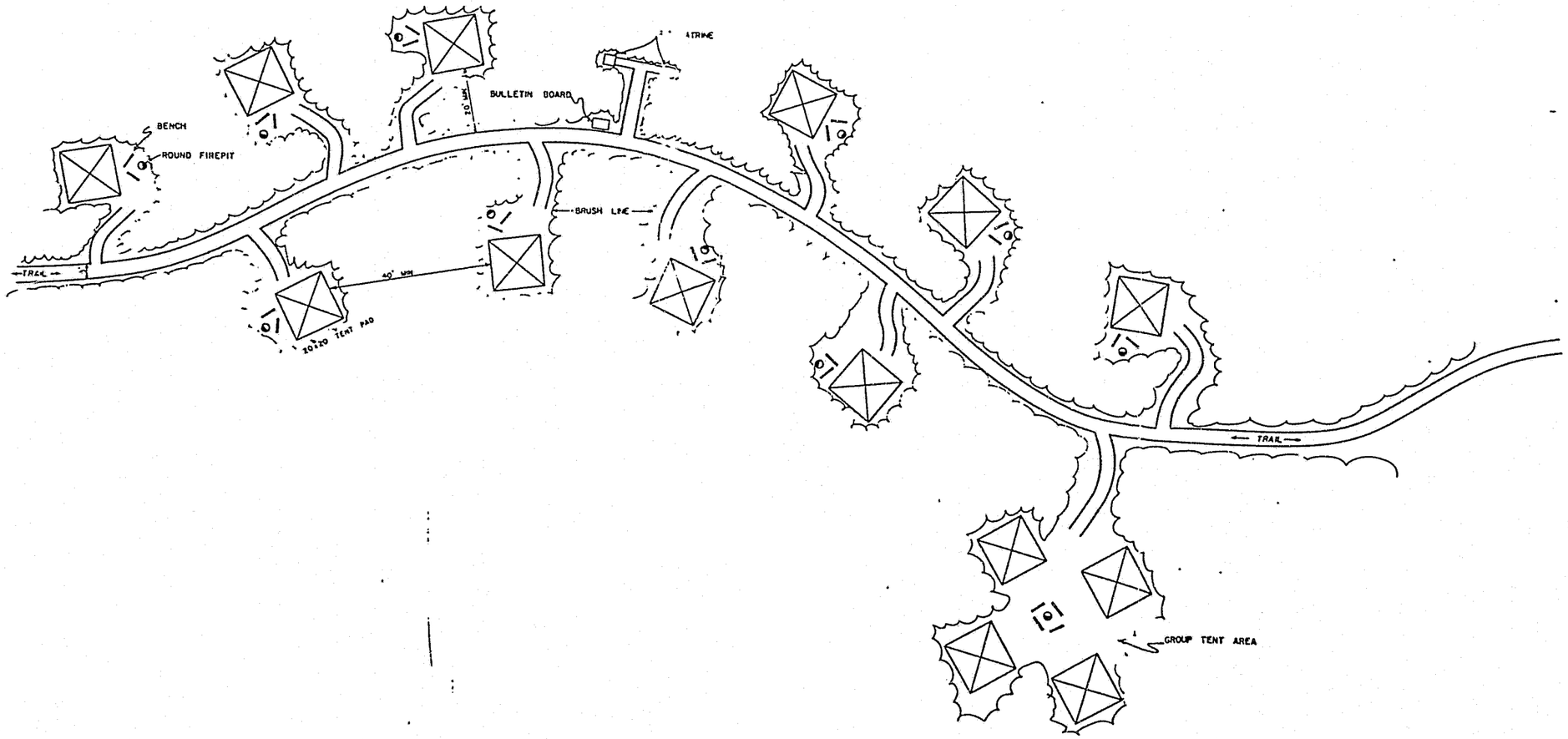
SHEET 1 OF 1 SHEETS

C-13

7-17-77

GENERAL NOTES

1. STANDARD PICNIC TABLES WILL BE INSTALLED IF SITE IS SUCH THAT MAINTENANCE COULD BE ACCOMPLISHED.
2. MINIMUM CLEARING TO BE DONE TO ESTABLISH SITE DEVELOPMENT.
3. ALL DIMENSIONS ARE MINIMUM – FACILITIES TO BE CONSTRUCTED TO CONFORM TO SITE.



NO.	REVISION	DATE	APPROVED
1	REVISED TYPE OF FIREPIT	8-18-82	ED.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

NOT TO SCALE

CONCEPT
REMOTE CAMPING AREA

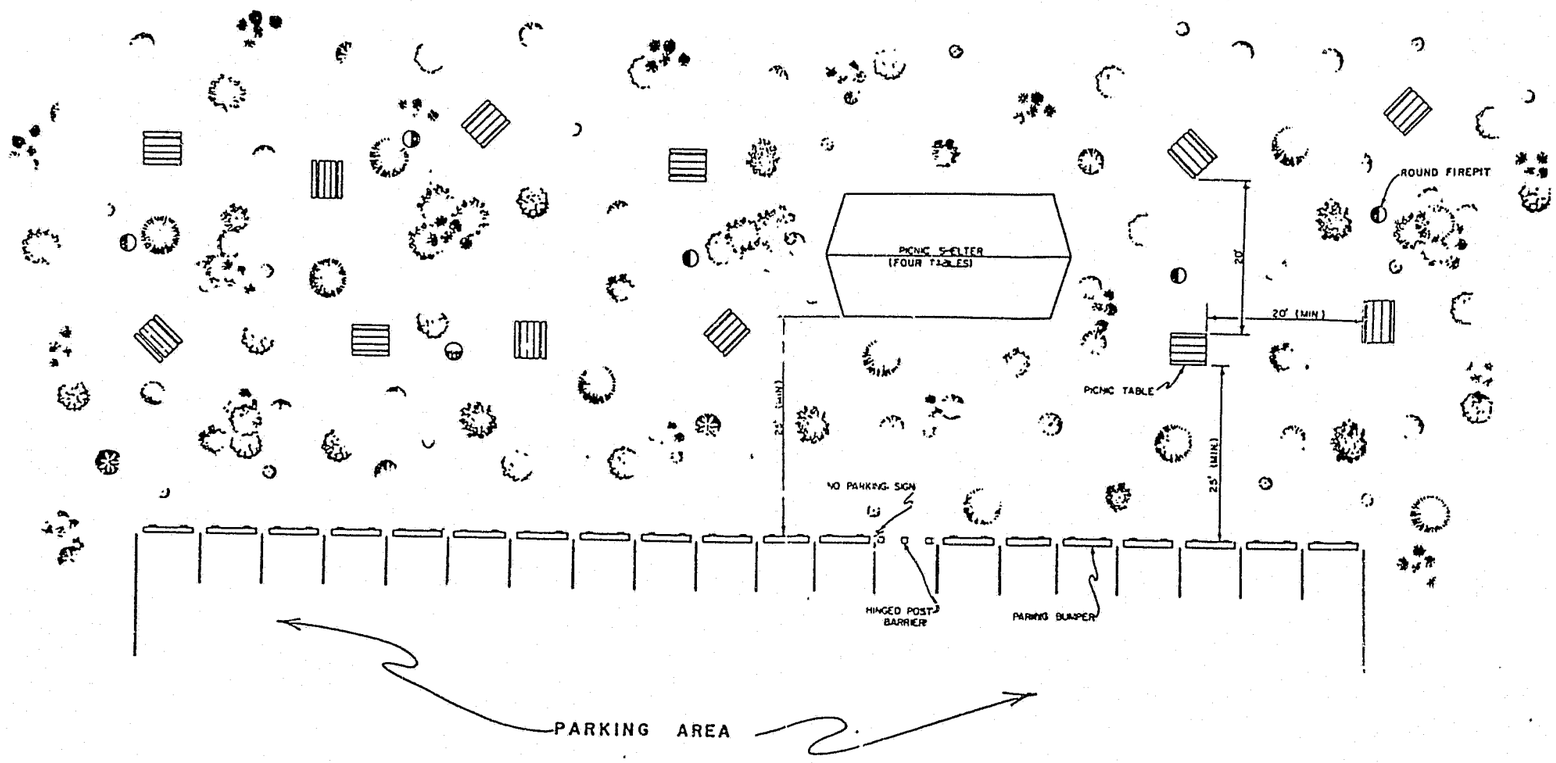
DRAWN VMC
CHECKED J.K.S.
APPROVED
DATE

SHEET 1
C-11
OF 1 SHEETS

7-17-18

GENERAL NOTES

1. ALL DIMENSIONS ARE MINIMUM.
2. INSTALL ONE GARBAGE CAN ASS'Y FOR TWO PICNIC TABLES.
3. TWO PICNIC TABLES WILL SHAPE A PEDESTAL TYPE FIREPLACE.
4. PROVIDE PARKING AREA COMPATIBLE WITH SITE – MINIMUM-ONE SPACE PER TABLE.
5. SIX PICNIC TABLES IN SHELTER.
6. SITE DEVELOPMENT SHALL INCLUDE:
   1 BULLETIN BOARD
   2 DOUBLE VAULTED LATRINE
   3 POTABLE WATER SUPPLY
   4 INFORMATION SIGNING



NO.	REVISION	DATE	APPROVED
1	REVISED & UPDATED DRAWING	8-31-82	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

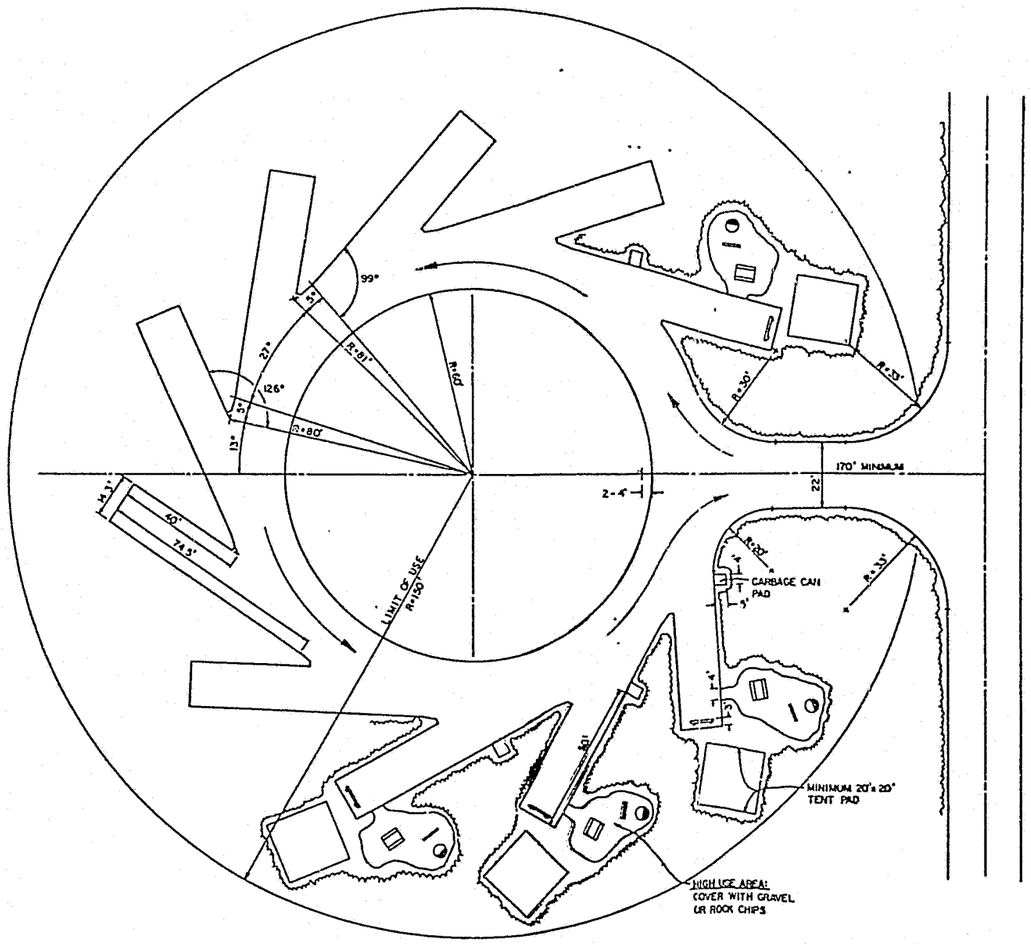
DESIGN & CONSTRUCTION SECTION

SCALE: 1" = 10'

CONCEPT
PICNIC AREA

DRAWN
CHECKED
APPROVED
DATE

SHEET 1
C-10
OF 1 SHEETS



LEGEND

- PICNIC TABLE
- BENCH
- BUMPER LOG
- ROUND FIREPIT
- TRAFFIC SIGN

NOTES

1. CLEAR SPACES AS STAKED OR DIRECTED BY THE ENGINEER.
2. SET FRONT OF FIREPLACE AWAY FROM PREVAILING WIND.
3. SEED ALL DISTURBED AREAS INCLUDING CUT & FILL SLOPES.
4. COVER TENT AREA WITH 6" TOPSOIL AND CROWN 3" BEFORE SEEDING.
5. WHEN PULL THROUGH CAMPSITES ARE NOT PROVIDED FOR ELSEWHERE IN THE PARK AREA, PARKING PADS MAY BE CONSTRUCTED AN ADDITIONAL 10 FEET IN LENGTH TO ACCOMMODATE TRAILERS.

NO.	REVISION	DATE	APPROVED
1	REVISED TYPE OF FIREPIT, REMOVED GUARD POSTS	8-31-82	T.D.

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

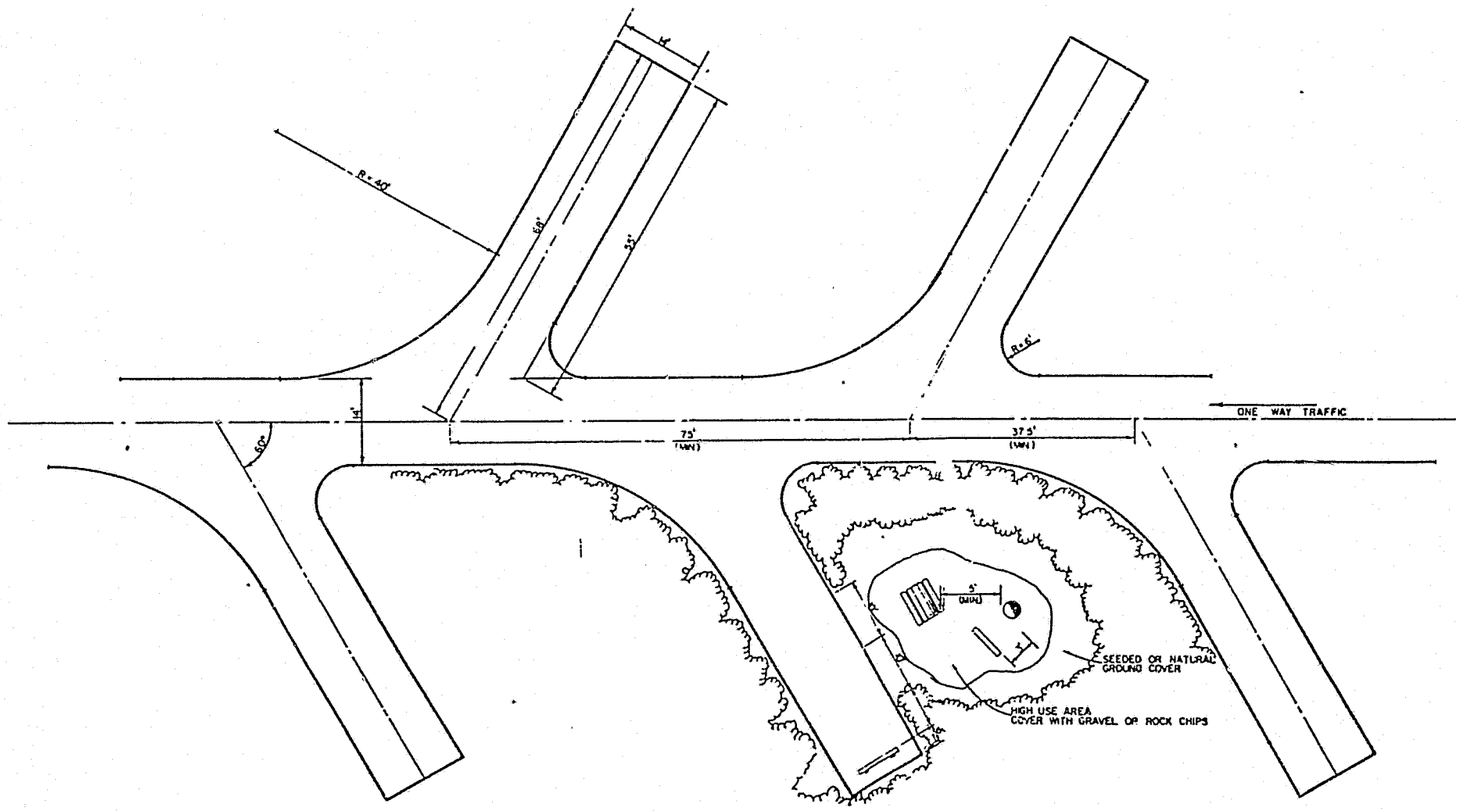
SCALE 1"=20 FEET

60' R. CUL-DE-SAC CAMPSITE

DRAWN REK
CHECKED
APPROVED
DATE 4-8-77

SHEET 1
C-9A
OF 1 SHEETS

7-17-70



NOTES

1. CLEAR SPACES AS DIRECTED BY THE ENGINEER.
2. SET FRONT OF FIREPLACE AWAY FROM PREVAILING WINDS.
3. PROVIDE TENT PAD IF OPEN SPACE IS AVAILABLE.
4. GUARD POSTS DEPENDENT UPON VEGATATION MAXIMUM NUMBER INDICATED
5. GRADE TO DRAIN AWAY FROM DEVELOPMENT

LEGEND

- PICNIC TABLE
- BENCH
- BUMPER LOG
- ROUND FIREPIT

NO	REVISION	DATE	APPVD.
2	REVISED TYPE OF FIREPIT	8-17-82	L.O.
1	REMOVED BUMPER LOGS, GUARD POSTS, ETC.	11-17-81	FN

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

SCALE: 1" = 10'

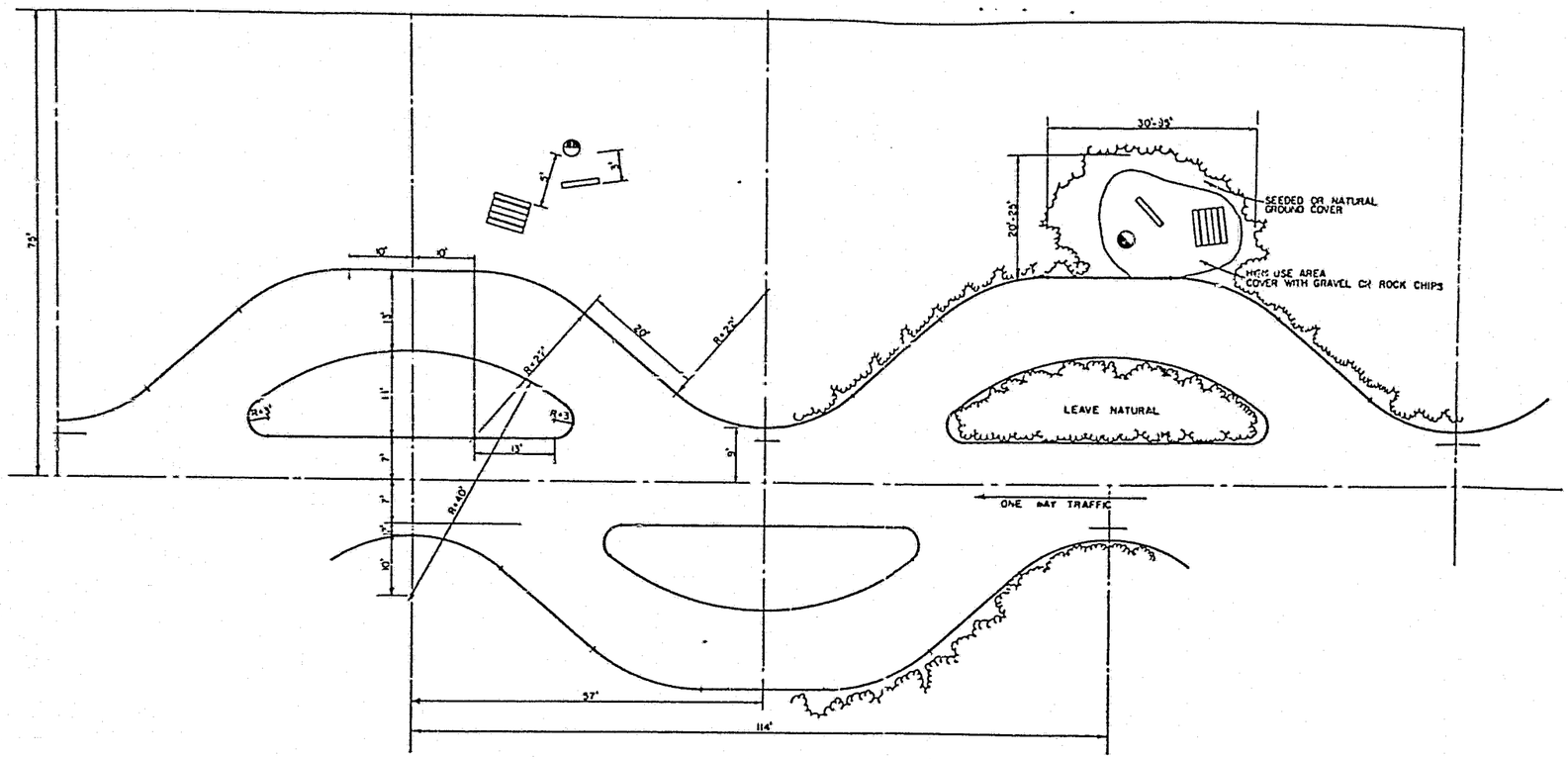
BACK IN SPUR CAMPSITE

DRAWN M.J.
CHECKED J.A. Logan
APPROVED
DATE

SHEET 1 OF 1 SHEETS

C-7

712-21



NOTES

1. CLEAR SPACES AS DIRECTED BY THE ENGINEER
2. SET FRONT OF FIREPLACE AWAY FROM PREVAILING WINDS
3. PROVIDE TENT PAD IF OPEN SPACE IS AVAILABLE
4. GUARD POSTS DEPENDENT UPON VEGATATION MAXIMUM NUMBER INDICATED
5. GRADE TO DRAIN AWAY FROM DEVELOPMENT

LEGEND

PICNIC TABLE

BENCH

ROUND FIREPIT

NO	REVISION	DATE	APPVD.
2	REVISED TYPE OF FIREPIT	8-17-82	LD
1.	REMOVED BUMPER LOGS, GUARD POSTS, ETC.	7-10-81	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

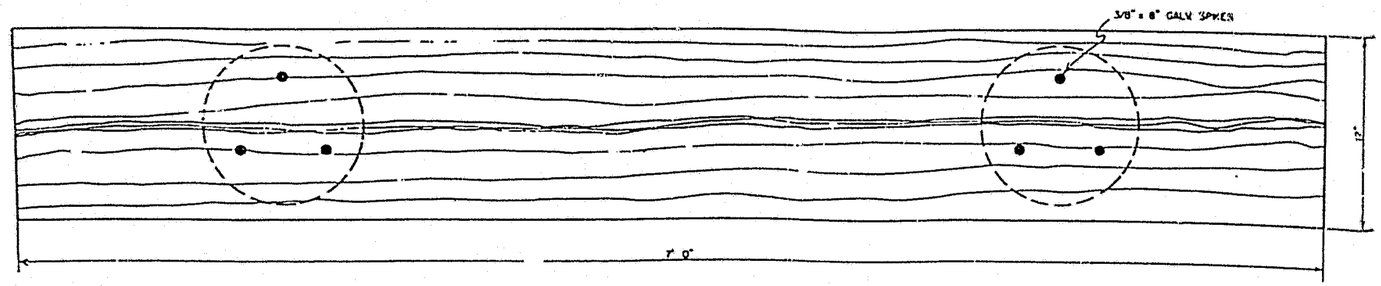
SCALE: 1" = 10'

PULL THRU CAMPSITE

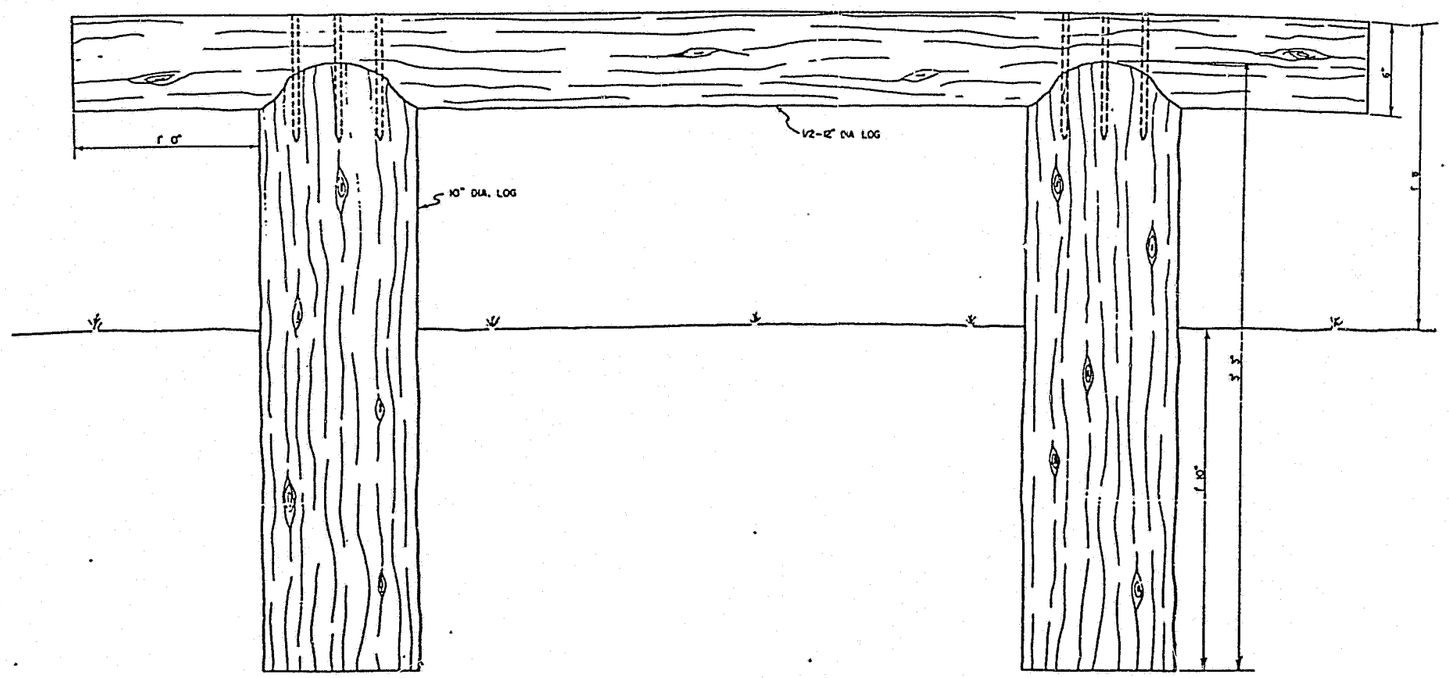
DRAWN MJ
CHECKED J & Logan
APPROVED
DATE

SHEET 1
C-6
OF 1 SHEETS

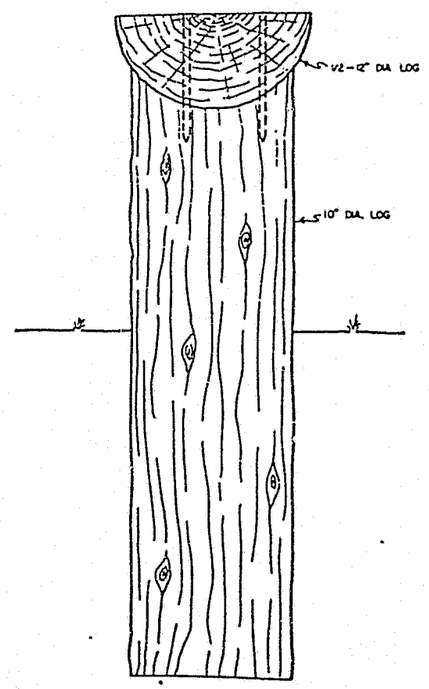
7-12-22



TOP VIEW



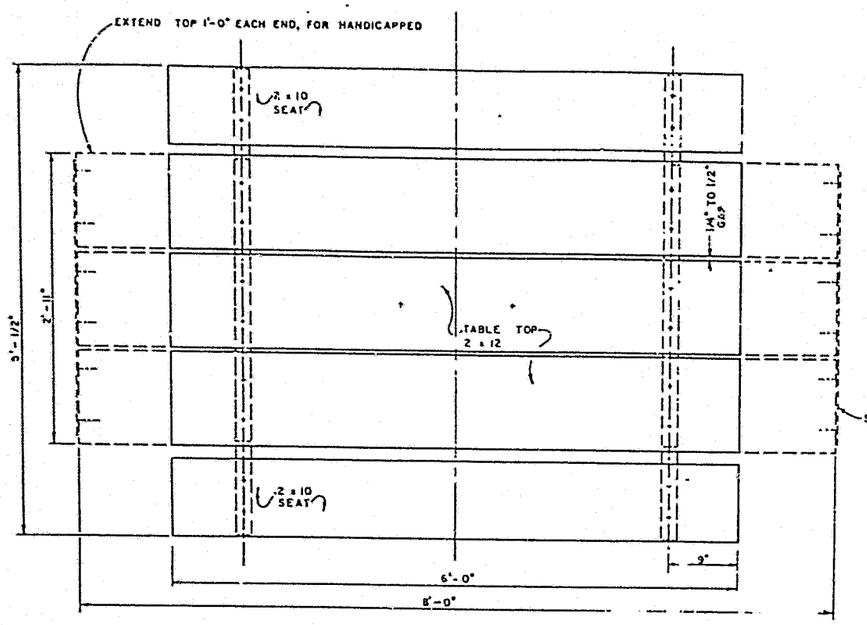
SIDE VIEW



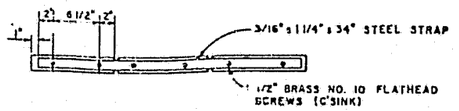
END VIEW

C-3

DEPARTMENT OF NATURAL RESOURCES DIVISION OF PARKS STATE OF ALASKA	PARK DEVELOPMENT	SCALE: 3" = 1' 0"	LOG BENCH	DRAWN BY CHECKED J.F.S. APPROVED DATE 7-17-73	SHEET 1 OF 1 SHEETS ~~07~~

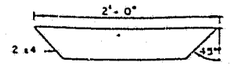


PLAN

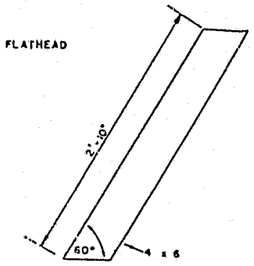


END STRAP

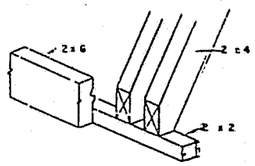
HANDICAPPED TABLE TOP ONLY



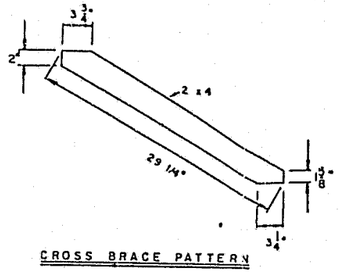
CENTER BRACE PATTERN



LEG PATTERN



DETAIL A



CROSS BRACE PATTERN

GENERAL NOTES

1. ALL WOOD SHALL BE DOUGAS FIR, S-DRY, S4S
2. ALL WOOD SHALL BE PRIMED WITH ONE COAT PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-138)
3. INSIDE EDGES TO BE GIVEN SECOND COAT BEFORE SUBASSEMBLY.
4. FIELD PAINTING WILL BE TOUCHUP AND ONE COAT APPLICATION TO TOP OF SEATS AND TABLE
5. ALL HARDWARE SHALL BE GALVANIZED OR CADMIUM PLATED STEEL
6. BOLT HOLES FOR SEAT SUPPORT TO BE SHOP DRILLED
7. 1/2" x 45° CHAMFER ON TABLE & BENCH TOP

MATERIALS LIST

LUMBER

"SELECT STRUCTURAL"-STRUCTURAL LIGHT FRAMING

1	2 x 2 x 6'
1	2 x 4 x 12'
1	2 x 4 x 6'

"SELECT STRUCTURAL"- JOISTS AND PLANKS

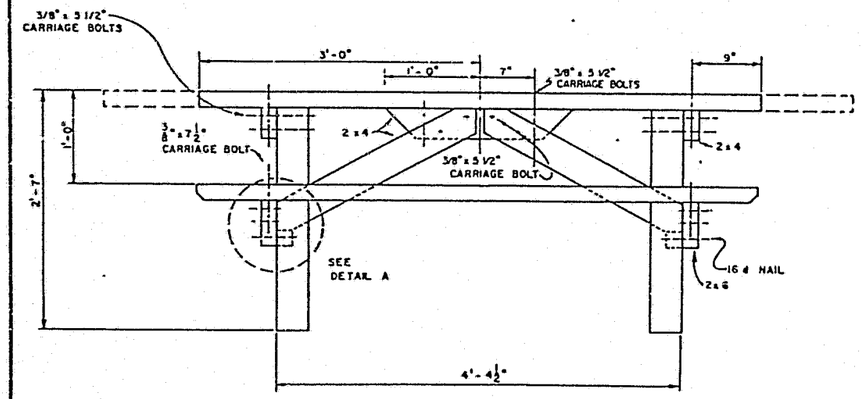
1	2 x 6 x 10'
1	2 x 10 x 12'
1	2 x 12 x 8'
1	4 x 6 x 12'

HARDWARE

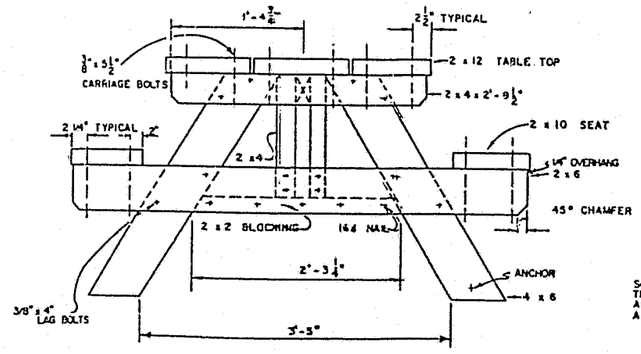
26	3/8 x 5 1/2 CARRIAGE BOLTS W/ NUT & WASHERS
8	3/8 x 7 1/2 CARRIAGE BOLTS W/ NUT & WASHERS
4	5/16 CABLE CLIPS
8	3/8 x 4 LAG BOLTS WITH WASHERS
2	5/16 x 1 1/2 MACHINE BOLTS W/ NUT & WASHERS
2	3/8" x 5" EYE BOLTS W/NUT & WASHERS
2	3/16 x 1 1/4" x 34" STEEL STRAP (FOR HANDICAPPED ONLY)
12	1 1/2" BRASS NO. 10 FLATHEAD SCREWS
8 FT	5/16 GALVANIZED CABLE
1/2 LB.	16 d NAILS

MISCELLANEOUS

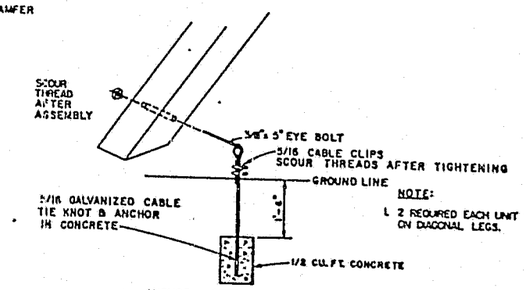
1 GAL. PREPACO OIL BASE SOLID COLOR STAIN (RUSSETT 63-138)
1/2 CU. FT. CONCRETE



SIDE ELEVATION



END ELEVATION



ANCHOR DETAIL
NOT TO SCALE

NOTE:
1. 2 REQUIRED EACH UNIT LOCATE ON DIAGONAL LEGS.

NO.	REVISION	DATE	APPVD.
4	UPDATED DRAWING	8-16-82	TO
3	EXTENDED TABLE TOP 1'-0" EA. END, ADDED STL. STRAP	3-[illegible]-82	TO
2.	CHANGED LENGTH OF TABLE LEGS	7-10-81	
1	CHANGED STAIN TO PREPACO OIL BASE STAIN	5-15-75	

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF PARKS
STATE OF ALASKA

DESIGN & CONSTRUCTION SECTION

SCALE: 1 1/2" = 1'-0"

PICNIC TABLE

DRAWN RAY EAKON
CHECKED J.F.S.
APPROVED
DATE

SHEET 1 C-1 OF 1 SHEETS

7-12-24

EXHIBIT E

7. Recreational Resources

Comment 13 (p. E-7-101, para. 5; p. E-7-110, para. 4; p. E-7-113, para. 3)

Copies of any existing agreements, as well as any future arrangements between the applicant and cooperating entities relative to implementation of the proposed recreation plan, must be submitted to the Federal Energy Regulatory Commission.

Response

Copies of future arrangements between the Power Authority and cooperating entities relative to implementation of the proposed recreation plan will be submitted on a timely basis to the Federal Energy Regulatory Commission by the Power Authority. At this time, no formal agreements are in existence.

EXHIBIT E

7. Recreational Resources

Comment 14 (p. E-7-105, para. 1)

Aside from APA, the Division of Parks, and directly affected land owners, specify how other local residents would be involved in decisions concerning scheduling and implementation of increased recreational developments.

Response

Development of the required agreements, policies, and regulations for implementation of the proposed recreation plan is scheduled for the latter half of 1983, culminating in a recreation implementation report in December 1983. Community involvement in these efforts will be encouraged through the Susitna Public Participation Program, which has provided information to local communities on all aspects of the project for the past 3 years. This program established a forum and channels for local community members to provide their ideas and preferences as the development prodceeds. The recreation implementation report will establish specific mechanisms for obtaining additional agency and community involvement during the recreation development period and will describe this particular decision-making process in more detail.

EXHIBIT E

8. Aesthetic Resources

Comment 1 (p. E-8-30, para. 1; to p. E-8-31, para. 4)

Indicate if the four natural features of Clear Valley (p. E-8-22), Watana Creek Falls, Watana Lake (p. E-8-24), and Tyone River are considered exceptional in relation to the project area. If so, describe them in the Exceptional Natural Features Section 5.2; include photos in the appendix, and show their locations on Figure E.8.5.

Response

During the final evaluation of the project area's natural features, Clear Valley, Watana Creek Falls, Watana Lake, and Tyone River were eliminated from the exceptional natural features identified on pp. E-8-30 and E-8-31 in Chapter 8, Exhibit E of the License Application. Thus, the text should be revised as follows:

(1) Page E-8-22, line 13: Remove the reference to "4. *Clear Valley".

(2) Page E-8-24, line 21: Remove the reference to "12. *Watana Lakes."

Watana Creek Falls and Tyone River were not listed on the Landscape Character Type charts. Therefore, their reference does not need to be deleted.

EXHIBIT E

8. Aesthetic Resources

Comment 2 (p. E-8-33, para. 1-8)

Provide a brief description (e.g., viewer vantage point, viewing distance, number of potential viewers, duration of view) of those significant views that are indicated on Figure E.8.8 and mentioned in the charts of Appendix 8.F. Provide a similar level of information for the transmission line corridor, including the intertie.

Response

The following example indentifies the types of view considerations that are delineated in Figure E.8.8 of Chapter 8, Exhibit E of the License Application. Additional information on views along the transmission line corridor is included in Part 2 of the response to Aesthetics Comment 7.

VIEW CONSIDERATIONS

Observer Position:	Access Road Recreation Sites Other Project Facilities
View Duration: (a function of rate of movement and points opportunity)	50 miles per hour for specific distance Walking for specific distance Stationary observation at major destination
Distance:	Foreground: 0 to 1/2 mile Middle ground: 1/2 to 2 miles Background: 2 miles and beyond Panoramic (all of the above)

Potential Viewers:	Vehicular travelers Off-road recreational users Town residents Power plant workers Dam site visitors
Proposed Facilities which will be seen	Dams Damsite facilities Reservoirs Transmission lines and ancillary facilities Access roads Railroad Trails and trailheads

The remainder of this response provides view consideration information for the thirty views identified in Figure E-8-8 (see attached version of this figure). This information is keyed to the attached Maps 1-5.

SIGNIFICANT NORTH/SOUTH ACCESS ROAD VIEWS (Map 1)

1. Nenana River Valley and Alaska Mountain Range

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for ±3 miles
Potential Viewers:	All vehicular traffic traveling north
Distance:	Panoramic
Facilities Seen:	Access road (foreground)

2. View of Butte Landmark

Observer Position:	Access Road
View Duration:	Seen at 50 miles per hour for ±6 miles
Potential Viewers:	All vehicular traffic traveling north
Distance:	Middle ground
Facilities Seen:	Access road fore-middle-ground

3. Panoramic View of Clear Water Mountains

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for 4 miles
Potential Viewers:	Vehicular traffic
Distance:	Panoramic
Facilities Seen:	None

4. Views up small drainage ways into the Chulitna Mountains

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for ±3 miles or during stops at road pull-offs with trail heads
Potential Viewers:	Vehicular traffic/hikers
Distance:	Drainage way, fore-middle ground, Chulitna Mountains background
Facilities Seen:	Trailheads, trails

5. Panoramic View of Talkeetna Mountains

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for ±4 miles
Potential Viewers:	Vehicular traffic
Distance:	Foreground, Big/Deadman Lakes Middle ground, Watana Reservoir Background, Talkeetna Mountains
Facilities Seen:	Access road and reservoir

6. Deadman Creek

Observer Position:	Access road or road pull-off
View Duration:	Seen at 50 miles per hour for ±6 miles or at stationary pull-offs
Potential Viewers:	Vehicular traffic
Distance:	Foreground
Facilities Seen:	None

7. Tsusena Butte

Observer Position:	Access road or town site
View Duration:	Seen at 50 miles per hour for ±10 miles or stationary/destination
Potential Viewers:	Access road users and town residents
Distance:	Middle ground
Facilities seen:	None

8. Tsusena Drainage

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for 2.5 miles
Potential Viewers:	Access road users
Distance:	Mid- to background
Facilities seen:	Access road, foreground

SIGNIFICANT WATANA AREA VIEWS (Map 2)

9. Townsite Views

Observer Position:	Watana townsite
View Duration:	Stationary/destination
Potential Viewers:	Town residents
Distance:	Fore- to middle ground
Facilities seen:	Dam, damsite facilities, reservoir

10. Watana Reservoir

Observer Position:	Damsite
View Duration:	Stationary/destination
Potential Viewers:	Damsite workers, visitors
Distance:	Foreground through background
Facilities seen:	Power plant facilities, dam, and reservoir

11. Downstream Watana Views

Observer Position:	Damsite
View Duration:	Stationary/destination
Potential Viewers:	Damsite workers, visitors
Distance:	Fore- to middle ground views of facilities Background views of river valley
Facilities seen:	River borrow areas and powerhouse road, middle ground Power facilities and transmission lines, foreground

12. Fog Lakes area

Observer Position:	Damsite
View Duration:	Stationary/destination
Potential Viewers:	Damsite workers and visitors
Distance:	Middle to background
Facilities seen:	Visitors facilities

13. Transmission Lines

Observer Position:	Damsite
View Duration:	Stationary short-term and destination
Potential Viewers:	Damsite workers and visitors
Distance:	Fore- to middle ground
Facilities seen:	Transmission lines and switchyard (silhouetted)

14. Watana Site

Observer Position:	Access road above facilities
View Duration:	Seen at 50 miles per hour for ±2 miles
Potential Viewers:	Damsite workers and visitors
Distance:	Middle to background
Facilities seen:	Damsite facilities, the dam, and reservoir

SIGNIFICANT EAST/WEST ROAD VIEWS (Map 3)

15. Transmission Corridor Crossing

Observer Position:	Access road immediately under the line
View Duration:	Seen at 50 miles per hour for ±200 feet
Potential Viewers:	East/west road users
Distance:	Foreground
Facilities seen:	Transmission towers and corridor

NOTE: This crossing occurs at a sharp angle and minimizes the length of view duration.

16. Transmission Corridor Crossing

Observer Position:	Access road immediately below facility
View Duration:	Seen at 50 miles per hour for ±200 feet (crossing)
Potential Viewers:	East/west road users
Distance:	Fore- to middle ground
Facilities seen:	Transmission corridor and towers

NOTE: This crossing is very oblique, causing a much greater length of corridor to be prominent at the crossing as well as along the uphill side of the east/west road.

17. Talkeetna Mountains and Susitna River Valley

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for ±5 miles
Potential Viewers:	East/west road users
Distance:	Panoramic
Facilities seen:	None

18. Devil Creek Drainage

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for one mile
Potential Viewers:	East/west road users
Distance:	Middle to background
Facilities seen:	Transmission line (uphill side)

19. High Lake

Observer Position:	Access road
View Duration:	Seen at 50 miles per hour for ±2 miles of stationary pull-off
Potential Viewers:	High Lake visitors, road users
Distance:	Middle ground to background
Facilities seen:	None

SIGNIFICANT DEVIL CANYON VIEWS (Map 4)

20. Reservoir

Observer Position:	Damsite
View Duration:	Stationary/destination
Potential Viewers:	Damsite workers, visitors
Distance:	Fore- to middle ground; reservoir extends to background
Facilities seen:	Dam, damsite facilities, and reservoir

21. Saddle Dam

Observer Position:	Damsite
View Duration:	Stationary
Potential Viewers:	Damsite workers, visitors
Distance:	Middle ground
Facilities seen:	Saddle dam and associated facilities

22. Devil Canyon Bridge

Observer Position:	Bridge surface
View Duration:	Seen at 30 miles per hour for ±1 miles
Potential Viewers:	Visitor center visitors and damsite workers
Distance:	Fore to middle ground
Facilities seen:	Power plant outfall, transmission line corridor

23. Devil Canyon (downstream view)

Observer Position:	Dam top (800 feet and higher)
View Duration:	Stationary
Potential Viewers:	Damsite visitors and workers
Distance:	Fore- to middle ground
Facilities seen:	Power facilities, power access roads, and dry river bed

SIGNIFICANT OFF-ROAD VIEWS (Map 5)

24. Alaska Range and Chulitna River Valley

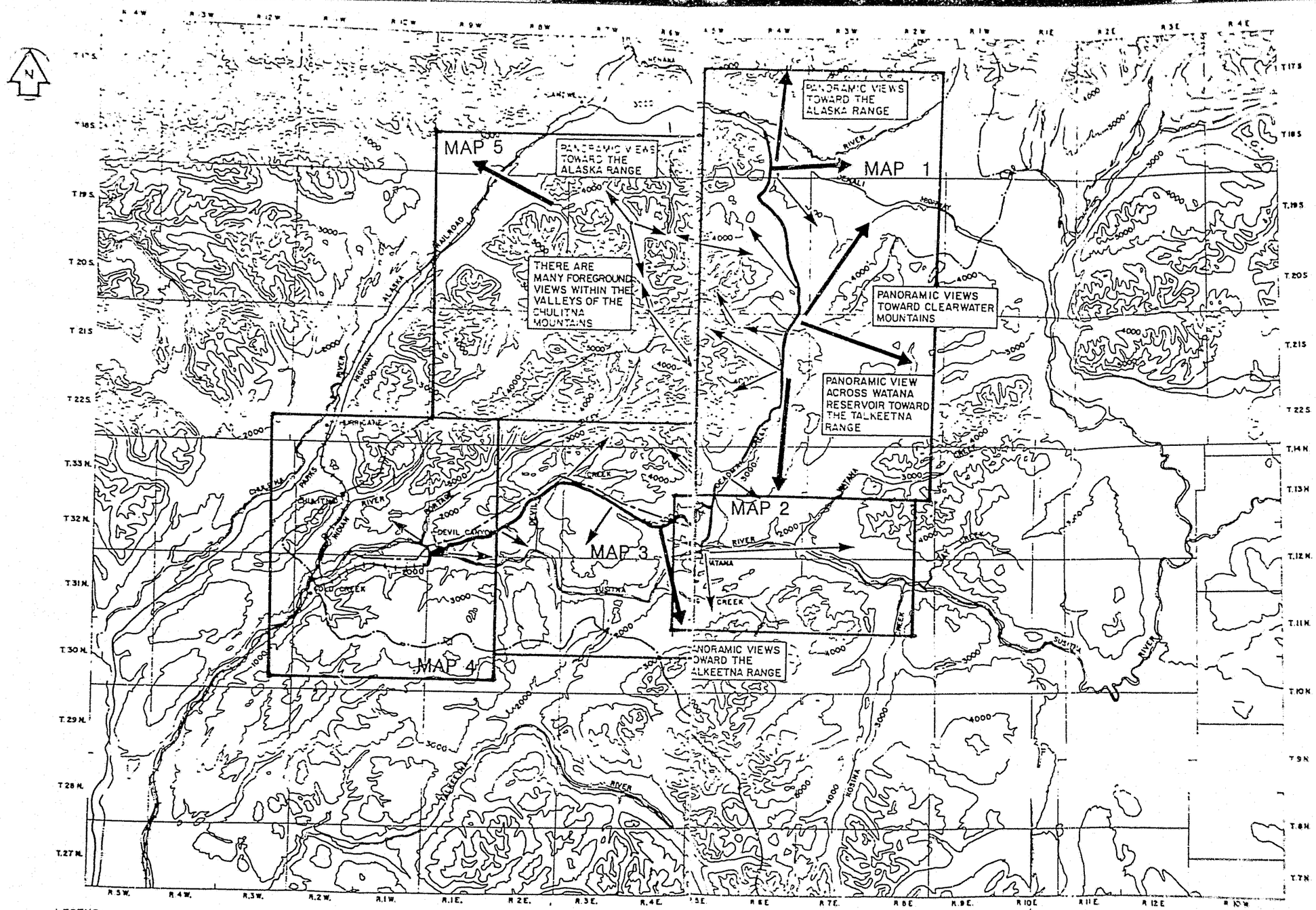
Observer Position:	Back country trails
View Duration:	Walking for indeterminate distance
Potential Viewers:	Hikers
Distance:	Panoramic
Facilities seen:	None

25 - Soul Creek, Deadman Creek and Tsusena Creek
29. Caribou Pass, etc.

Observer Position:	Back country trails
View Duration:	Walking pace at many positions
Potential Viewers:	Hikers and recreational users
Distance:	Panoramic, enclosed
Facilities seen:	None

30. Susitna River Views

Observer Position:	River surface or shore
View Duration:	Seen at floating speed for ±6 miles
Potential Viewers:	River recreationists
Distance:	Fore- to middle ground
Facilities seen:	Railroad



LEGEND:

PANORAMIC VIEWS

IMPORTANT FOREGROUND VIEWS

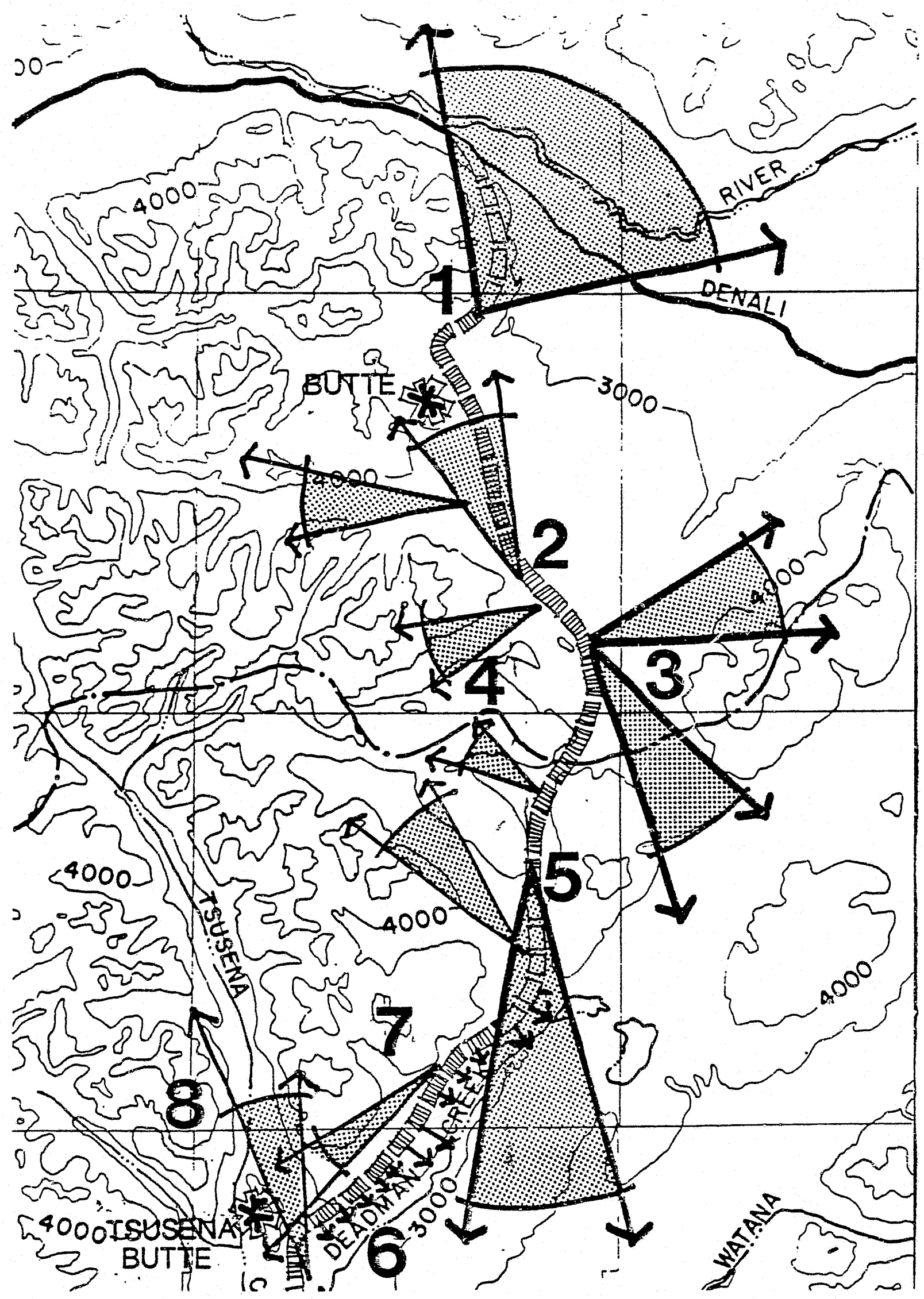
SIGNIFICANT VIEWS

SCALE 0 4 8 MILES

REVISED JUNE 1983

FIGURE E 8 8

8-2-13



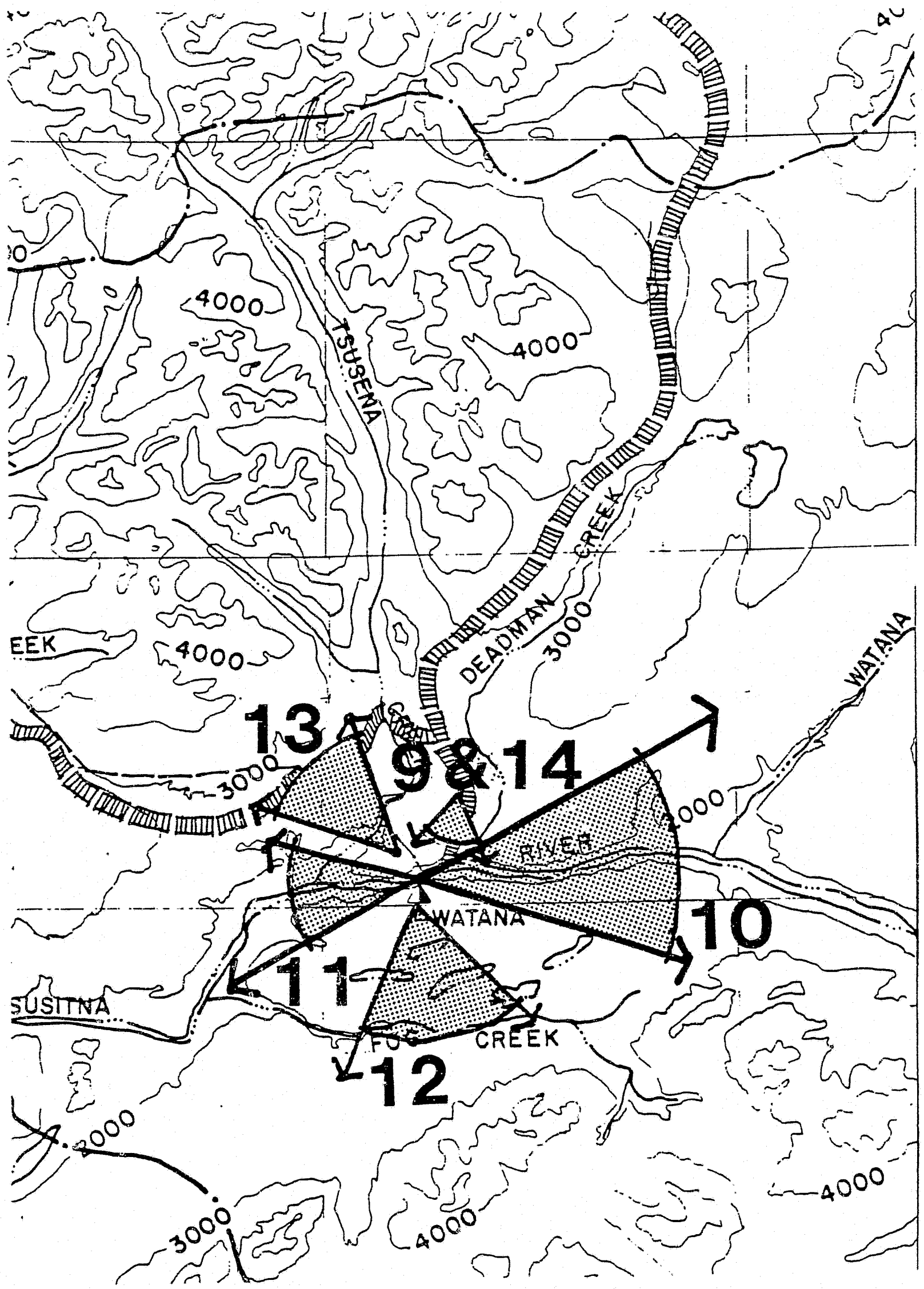
MAP 1

NORTH/SOUTH ACCESS ROAD
SIGNIFICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES

EDAW

8-2-14



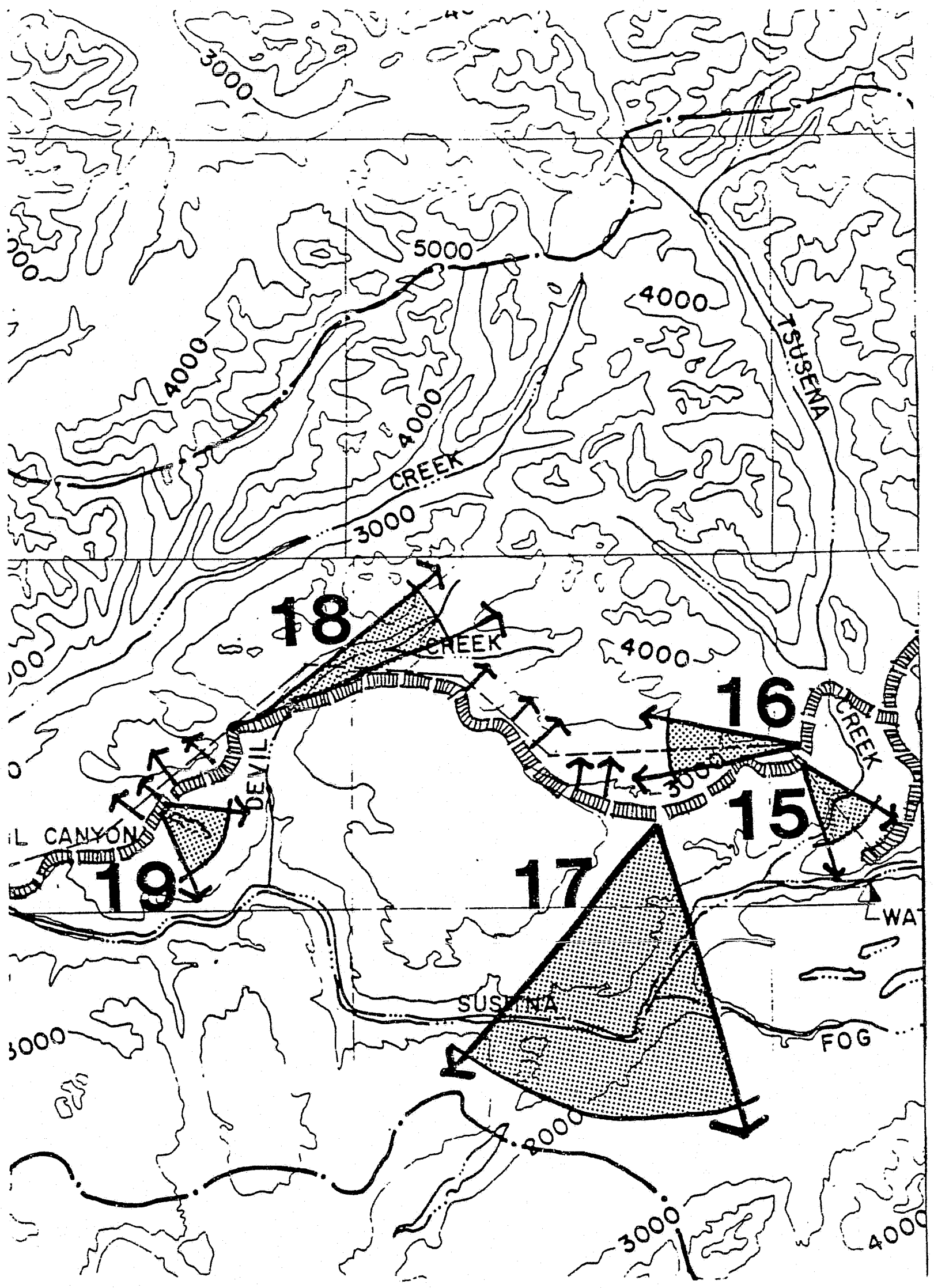
MAP 2

WATANA AREA
SIGNIFICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES

EDAW 1983

8-2-15



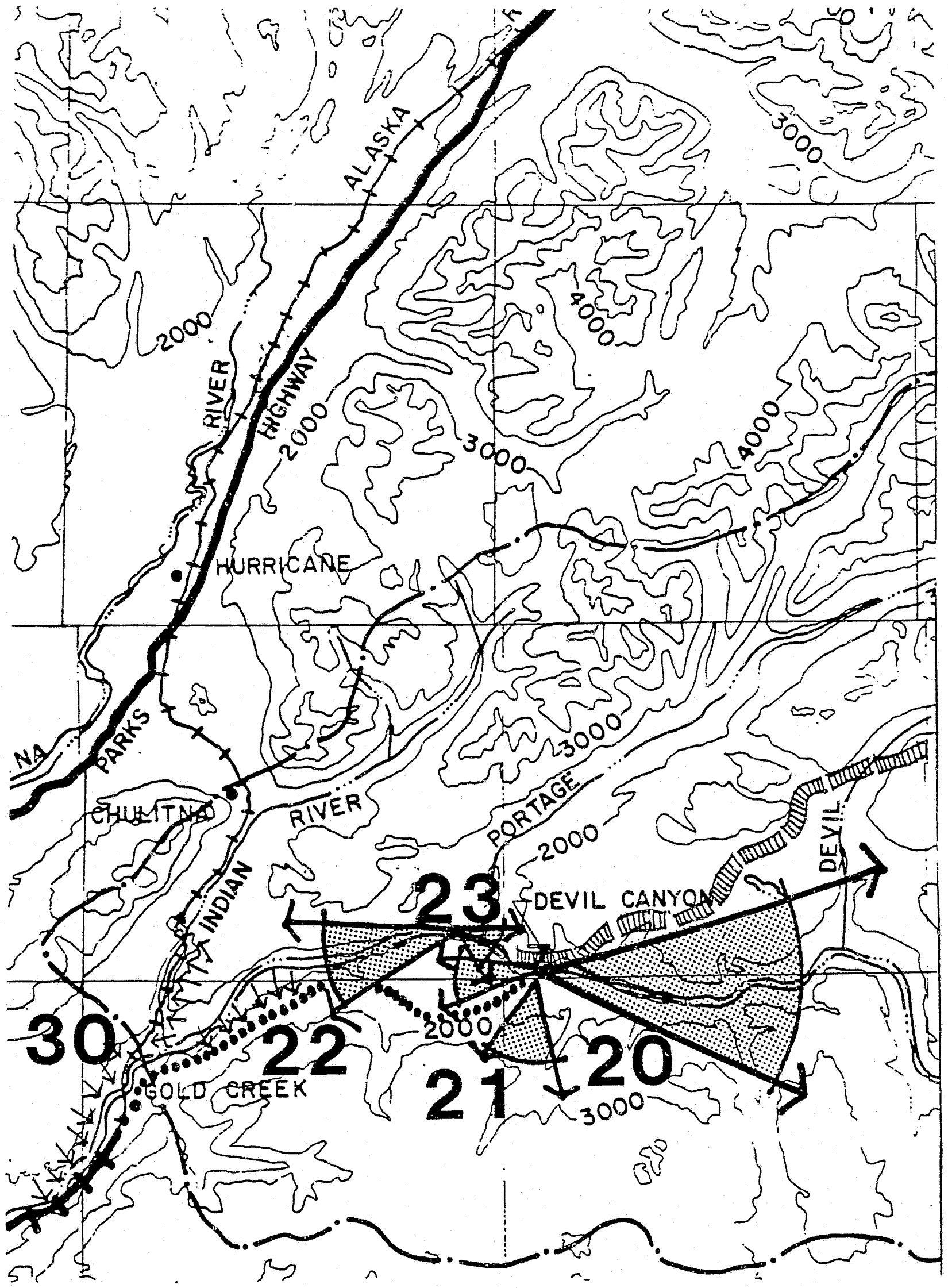
MAP 3

EAST/WEST ACCESS ROAD
SIGNICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES

EDAW 1983

8-2-16



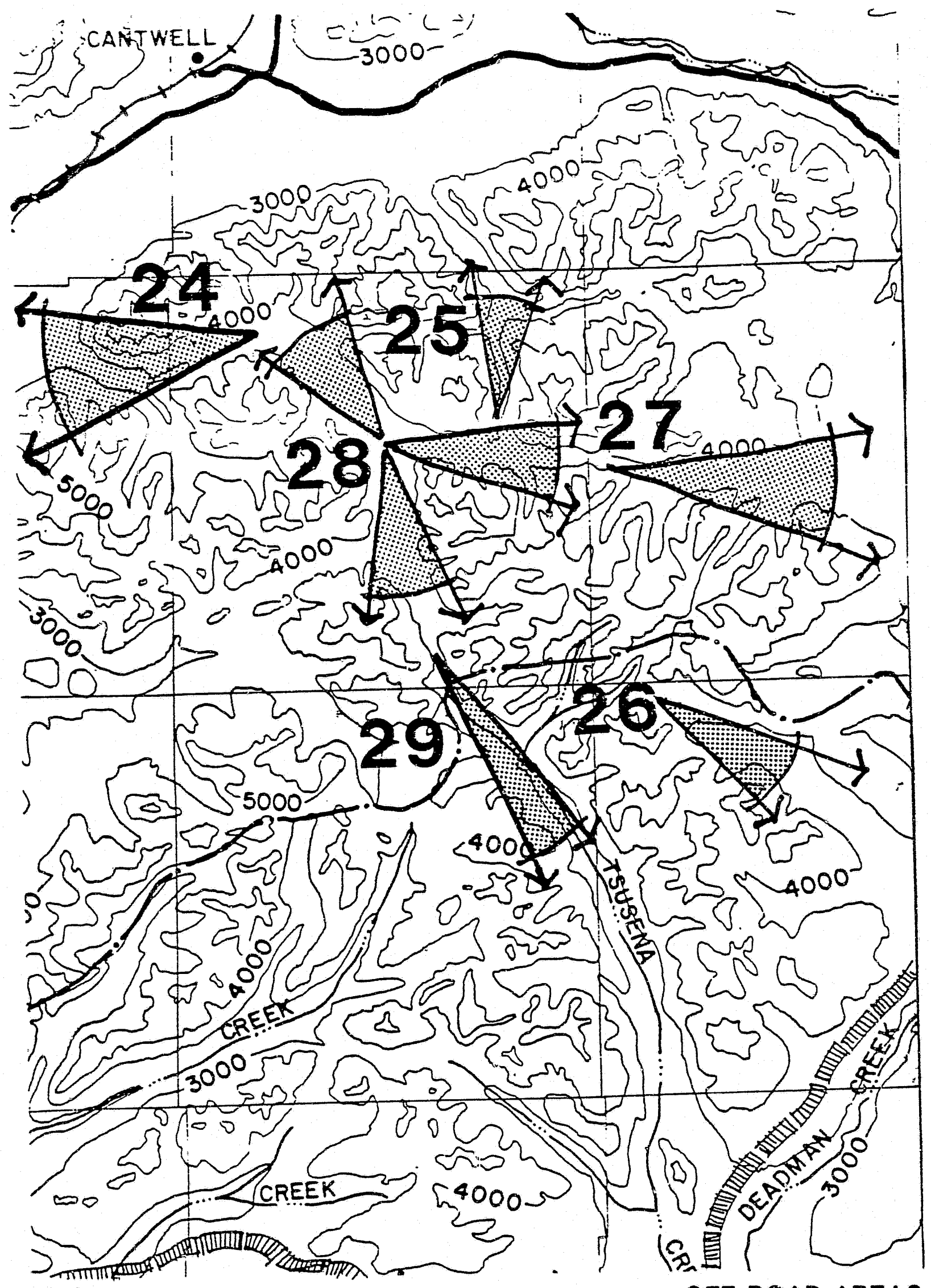
MAP 4

DEVIL CANYON AREA
SIGNIFICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES

8-2-17

EDAW 1983



MAP 5

OFF ROAD AREAS
SIGNIFICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES

EDAW 1983

8-2-18

EXHIBIT E

8. Aesthetic Resources

Comment 3 (p. E-8-36 to p. E-8-41)

Indicate if there is a distinction between use of the terms "medium" and "moderate", which are used interchangeably in the Aesthetic Value and Absorption Capability Rating Charts and on the Composite Rating Matrix.

Response

There is no distinction between the terms "medium" and moderate" as used in the Aesthetic Value and Absorption Capability Rating Charts and on the Composite Rating Matrix. The term "medium" should be replaced with "moderate" wherever it appears on pp. E-8-36 through E-8-41.

EXHIBIT E

8. Aesthetic Resources

Comment 4 (p. E-8-39 to p. E-8-40)

Indicate whether the absorption capability rating for the landscape character type of Tanana Ridge is "low" (p. E-8-39) or "moderate" (p. E-8-40).

Response

The absorption capability rating for the landscape character type of Tanana Ridge is "low". Therefore, the absorption capability rating should read as "low" on Line 1 of the Aesthetic Value and Absorption Capability Ratings chart on p. E-8-40 in Chapter 8, Exhibit E of the License Application.

EXHIBIT E

8. Aesthetic Resources

Comment 5 (p. E-8-41)

Indicate if the absorption capability rows have similar high, medium, and low designations as shown for the aesthetic value rating columns.

Response

The absorption capability rows should read "high", medium", and "low", from top to bottom on p. E-8-41 of Chapter 8, Exhibit E of the License Application. In addition, in accordance with the response to FERC Comment No. 3 under 8, Aesthetic Resources, the term "medium" should be replaced with the term "moderate" in the row and column headings on the chart.

EXHIBIT E

8. Aesthetic Resources

Comment 7 (p. E-8-61, para, 1; p. E-8-68, para. 3)

Provide a similar level of description and analysis to that used for the project area, access roads, and transmission line stubs (including photos, mapping, and descriptions of landforms, waterforms, vegetation, and views) for the Intertie transmission line corridor landscape types of Talkeetna Lowlands, Chulitna River, Broad Pass, Alaska Range, and Yanert River Valley (Step 3). Briefly describe and indicate on maps (Step 4) all significant viewpoints, viewsheds, distances, and potential numbers of viewers along the entire transmission line corridor (e.g., at road crossings, river crossings, skylined areas, etc.). Provide aesthetic value and absorption capability ratings for the Intertie landscape character types (Steps 5 & 6) and determine the project feature impacts (Steps 7 & 8). Finally, provide proposed mitigation measures for the Intertie project feature (Step 9).

Response

Additional study and further documentation of the transmission line corridors, addressing all aspects of route selection and evaluation, have been performed during the first six months of 1983. This effort will continue for several more months, with a full supplemental report on the project transmission system tentatively scheduled to be submitted in November, 1983. This report will include a visual resources analysis of all segments of the transmission corridor. In the interim, however, preliminary information concerning the Intertie corridor has been developed as requested. These findings are based on a literature review and limited field work. Final ground truthing will occur during the 1983 field season.

The remainder of this response separates Comment 7 into five parts. Each part corresponds exactly with the original comment.

PART 1

"Provide a similar level of description and analysis to that used for the project area, access road and transmission line stubs (including photos, mapping, and descriptions of landforms, waterforms, vegetation and views) for the Intertie transmission line corridor landscape types of Talkeetna Lowlands, Chulitna River, Broad Pass, Alaska Range and Yanert River Valley (Step 3)."

The subsequent discussion provides information on land forms, water forms, vegetation, views, and other characteristics for the following landscape character types of the Intertie portion of the Susitna transmission line:

- Susitna River Lowlands[1/]
- Mid-Susitna River Valley[1/]
- Talkeetna Mountains (lowlands and uplands)[1/]
- Chulitna River
- Broad Pass
- Alaska Range
- Yanert River Valley
- Nenana Uplands[1/]
- Curry Ridge[1/] (not directly impacted by the Intertie but existing in close association with the other units).

[1/] Because of several changes in the Intertie alignment subsequent to the publication of the Commonwealth Associates Intertie report (1982), these landscape character types were added to the five specified in Part 1 of Comment 7.

TALKEETNA MOUNTAIN (LOWLANDS AND UPLANDS)
(see EDAW Photo #3 on p. 8-7-56)

Landforms

- After rising steeply several thousand feet from the Susitna River valley, the landscape in the lower Talkeetna becomes a rolling terraced plateau.
- The average elevation is about 3000 feet (900 meters).
- A few knobs rise above 4000 feet (1200 meters).

Waterforms

- The tundra environment is very wet.
- The tundra contains hundreds of small lakes and muskey bogs.
- Gold, Cheechako, Chulitna and Disappointment Creeks are among the more scenic drainages.

Vegetation

- The dominant environment is tundra.
- Spruce trees scattered through the area are usually found at lower elevations within the drainages.

Views

- The flat and rolling character of these uplands affords panoramic views of the Alaska Range, and the Chulitna and Talkeetna mountains.

- Views of surrounding river valleys from high points and terrace edges are also very good.

Other

- Access into the area is predominantly by floatplane, snowmobile, and use of a few existing mining and/or settlement trails.

CURRY RIDGE
(see Commonwealth Photo #5 on p. 8-7-45)

Landforms

- The Curry Ridge landscape lies between the Susitna River lowlands and the Chulitna River landscape type.

- It is dominated by Curry Ridge and the Chulitna and Susitna Rivers.

- The two river valleys narrow to 5 to 8 miles wide along the base of Curry Ridge; the valley floors continue to slope gradually upward to 1400 feet in elevation at the north end of Curry Ridge.

- Curry Ridge reaches 4000 to 4500 feet in elevation.

Waterforms

- The Chulitna River varies in width from 1.5 miles in the middle of Denali National Park to approximately 100 yards near the park's southern boundary.

- The eastern portion of the landscape is dominated by the Susitna River and its tributary, the Indian River.

- Byers, Lucy, and Spinks lakes are the most visible.

Vegetation

- Landcover is upland spruce-deciduous and alpine tundra.
- Isolated areas of lowland spruce, deciduous forests, and low brush; muskeg-bog are present.
- The moist slopes are covered with brush.
- Willow and alder are typical deciduous cover.
- The plant system above timberline is alpine tundra where barren rocks are interspersed with herbaceous and shrubby low-growing plant mats.

Views

- South Curry Ridge commands an excellent view of Mt. Denali, rising above the flat Chulitna River valley, and Ruth Glacier.
- The Parks Highway and the Byers Lake area have excellent views of Curry Ridge.

CHULITNA RIVER
(see Commonwealth Photo #11 on p. 8-7-48)

Landforms

- Dividing the Alaska Range and Chulitna Mountains, this flat-to-rolling valley is predominantly an open landscape.
- The dominant Alaska Range rises gently from the valley in comparison to the steep rise of the Chulitna Mountains. Hurricane Creek and Hurricane Gulch form a dramatic descent from the Chulitnas.

- Landforms vary from level valleys to steep ridges in the Alaska Range to steeply incised valleys, exemplified by the Hurricane Gulch railroad bridge (which is 260 feet above the creek bottom).

Waterforms

- Water is abundant due to the presence of the meandering Chulitna River and its tributaries. The river divides into the East, Middle and West Forks within this landscape type.

- Waterfalls are present along Hurricane, Honolulu and Antimony Creeks and are visible from the Parks Highways.

- The lakes are small and elongated.

Vegetation

- Sparse-to-moderately-dense spruce-deciduous forested areas characterize the land cover in the bottomlands.

- Spruce-deciduous occupy the uplands, which merge into alpine tundra and rocky barren ground at the treeline.

- Large areas of deciduous vegetation occupy the floodplains and valley slopes.

- Treeless bogs with low-growing vegetation are also common.

- Visually, the thin, conical spruce stand out above the shrub vegetation, especially in the uplands.

Views

- Spectacular mountain, glacier, and valley views are offered in open areas and vantage points.

- There are prominent views of the Alaska Range to the west and steep river gulches and mountainous terrain along the Parks Highway.

Other

- The Alaska Railroad and Parks Highway parallel the river along the upper slopes and terraces on the Chulitna Mountains.

- These features cross the entire length of this landscape type from south to north.

- Several small road and railroad-related communities and a few designated recreational sites are located in the valley. Portions of the Parks Highway between Chulitna Pass and Broad Pass have been recommended for scenic highway designations by the Alaska Department of Natural Resources.

Broad Pass
(see Commonwealth Photos #13-15 on pp. 8-7-49 and 8-7-50, and EDAW Photo #7 on p. 8-7-58)

Landforms

- The area is characterized by a broad, gently-rolling, glacially-carved valley floor with little relief, and steep mountainous slopes separating the Alaska Range and the northwest Chulitna Mountains.

- The valley is over ten miles (16 km) wide near the town of Broad Pass, narrowing to four miles (6.4 km) wide near Cantwell).

- The highest elevation along the Parks Highway, approximately 2300 feet above sea level, occurs in Broad Pass.

- The area is characterized by contrasting topography.

- Valley floor morains and drumlins parallel the axis of this trough.

- This open, flat-to-rolling landscape is very scenic with long, linear lakes.

Waterforms

- Lakes are the most visible water feature in Broad Pass. Summit and Mirror Lakes are examples of the long, narrow lakes found in the pass.

- The Jack and East Fork Chulitna rivers are highly visible only at the northern and southern portions, respectively, of Broad Pass.

Vegetation

- The land cover is characterized by a variety of tundra and spruce cover patterns.

- Visually, white and black spruce are the most important vegetation in Broad Pass, since their spire-like shape and deep green color provide a contrast with the surrounding treeless lands.

Views

- Notable views from Broad Pass include Mt. Denali, Mt. Deborah, Mt. Pendleton, Panorama Mountain, and the Reindeer Hills. The Alaska Department of Natural Resources recommended in their 1981 Scenic Resources along the Parks Highway report that the road between the town of Broad Pass and Windy be considered for scenic designation.

Other

- The Parks Highway goes through the northern side of the pass near the Denali National Park boundary.

- The Alaska Railroad passes through the Summit Lake area and parallels the highway. Cantwell is the west junction of the Denali and Parks highways.

Alaska Range
(see Commonwealth Photo #18 on p. 8-7-51 and EDAW Photo #2 on p. 8-7-55)

- The Alaska Range landscape type lies north and west of many other landscape types, thus providing background views from them.

- The Intertie passes through this landscape character type in the Windy Pass area around Sugar Loaf Mountain.

Landforms

- The Alaska Range is a steep, crescent-shaped mountain range heavily sculptured by recent glacial activity. It is approximately 600 miles in length. The average width is 50 to 80 miles. Elevations range from approximately 2,000 feet in the valley to over 20,000 feet at Mt. Denali.

- The Nenana River valley is relatively narrow within the Windy Pass region of the range, thereby providing a contrast to the open Broad Pass landscape type to the south.

- The U-shaped valley, which is nearly flat, is almost 1 mile wide in places with broadly flaring walls rising 2,000 to 3,500 feet above the river. This topography provides direct views up the valley.

- Visually prominent landforms include Pyramid Mountain, Panorama Mountain, Reindeer Hills, Mt. Healy, Mt. Fellows, and Sugar Loaf Mountain.

Waterforms

- The most important water feature is the Nenana River, which is usually gentle with a few rapids.

- The Yanert Fork, Jack River, Moody Creek, Montana Creek, and Carlo Creek are other significant features.

- Glacial lakes are also present with the Deneki Lakes being the most visible.

- Streams occupying old glacial valleys have cut narrow gorges into the glacial drifts and underlying bedrock.

- Several major mountain peaks support glaciers that extend 20 or 30 miles from their sources and spread out in piedmont lobes at the mountain fronts.

Vegetation

- Land cover is primarily white spruce-dominated forests at the lower elevations (up to 3,000 feet) and bare rock surfaces at higher elevations.

- Snow is the most extensive land cover between mid-September and early May. During that time, the dark green spruce are visually distinctive.

- Treeline in the Alaska Range fluctuates with exposure and latitude. In general, tundra and forest separate between 2,500 and 3,200 feet. Shrub lands form a transition zone between the two zones.

- Wet tundra occurs on lower elevations.

- Alpine tundra in the higher areas may be primarily barren with low, clumping vegetation.

Views

- Within the Windy Pass area views are directed north and south, up and down the valley.

- Although present, glaciers are of minor visual significance in this part of the Alaska Range.

Other

- The primary evidence of human settlements includes the Alaska Railroad, Parks Highway, Cantwell, McKinley Village, and a few private residences.

YANERT RIVER VALLEY
(Yanert Fork)
(Photo not available - see Commonwealth photo #22 on p. 8-7-53 for similar landscape)

Landforms

- A 35-mile swath through the Alaska Range east from the Nenana River, the Yanert River Valley ranges from two miles in width at the Yanert Glacier to over five miles at the confluence with the Nenana River.

- The Alaska Range rises steeply from the valley near the glacier.

- Gently sloping terraces up to the mountains become progressively longer as the valley opens into the adjoining Nenana River Valley.

Waterforms

- The Yanert River is heavily braided for most of its length before turning into a broad fixed channel river for the last five miles.

Vegetation

- The valley is tundra dominated with scattered stands of spruce adjacent to the river bottom.

Views

- The Nenana Valley, Yanert Fork, and upper Nenana Valley near the Denali National Park entrance provide dramatic views.

EXISTING CONDITION/LANDSCAPE CHARACTER TYPE PHOTOGRAPHS

Individual landscape character types and existing conditions within the Intertie corridor were photographically documented by Commonwealth Associates, Inc., in their environmental studies of the Alaska Intertie (Commonwealth Associates, Inc., 1982). The list below indicates the landscape character types that are represented by the following Commonwealth photographs as well as several photos documented by EDAW Inc.

Landscape Character Types	Photograph Numbers (Commonwealth)	Photograph Numbers (EDAW Inc.)
Susitna River Lowlands	1,2,3	1
Curry Ridge	4,5,6,7	-
Chulitna River	8,9,10,11	-
Broad Pass	12,13,14,15	7
Alaska Range	14,15,16,17,18,19,20	2
Yanert River Valley	22	-

(Note: The Intertie route no longer passes through Nenana Gorge, so this landscape character type is not included in the supplemental response; see Plates G44 and G45).

PART 2

"Briefly describe and indicate on maps (Step 4) all significant viewpoints, viewsheds, distances and potential number of viewers along the entire transmission line corridor (e.g., at road crossings, river crossings, skylined areas, etc.)."

Significant views for the Willow to Healy segment of the Intertie have been mapped using aerial and limited ground reconnaissance, USGS topographic map analysis, and a literature review. Further view analysis, beyond what was presented in the License Application for the Willow to Anchorage and Healy to Fairbanks transmission stubs are currently in progress and are scheduled to be completed in November, 1983.

Criteria used in determining the significance of potential view points and view zones along the transmission corridor include:

Distance:	Foreground: 0 to 0.5 miles Middle ground: 0.5 to 2 miles Background: 2 miles and beyond
Potential:	Parks Highway tourists and local travelers
Viewers:	Denali Highway travelers Alaska Railroad travelers Local residents Back country recreationists Boaters/rafters
Context:	Landscape character type aesthetic value Landscape character type absorption capability in conjunction with exceptional natural features Other

The following views (listed by Intertie segment) have been identified as potentially significant.

Segment #1: Susitna River Lowlands (see Map 1 on p. 8-7-59)

A. ° Willow Creek Bridge Viewpoint

Distance: Middleground

Viewers: Parks Highway and Alaska Railroad travelers

Context: In general, this setting has a high absorption capability, but the transmission lines will be visible as they cross Willow Creek.

B. ° Willow Substation Vicinity View Zone (Fish Hook-Willow Road Viewpoint)

(see Commonwealth Photo #1 on p. 8-7-43)

Distance: Foreground/middle ground

Viewers: Local road travelers, local residents

Context: Both facilities will be somewhat visible at the substation site and just north, and as the transmission lines pass through the Willow area. This is particularly true along Fish Hook-Willow Road due to a lack of vegetation adjacent to the road.

C. ° Kashwitna River Crossing View Zone

Distance: Foreground

Viewers: Water recreationists

Context: High absorption capability because of the area's dense vegetation cover. This crossing would impact only a short segment of the river.

D. ° Caswell Residences View Zone

Distance: Middle ground

Viewers: Local residents

Context: Generally high absorption capability. The transmission line towers will be visible but not obtrusive.

E ° Larson Lake View Zone

Distance: Foreground/middle ground

Viewers: Future residents, lake recreationists

Context: Heavy vegetation will screen much of this conflict, except where the transmission lines pass close to the southern end of the lake, possibly making them visible from the water. Also as the transmission lines continue north, they rise along a ridge which places them in a silhouetted position between this property and Alaska Range views.

F. ° Talkeetna River Crossing View Zone

Distance: Foreground/middle ground

Viewers: Boaters, river recreationists (this river is heavily used)

Context: The wider, braided character of the river in this location may cause the crossing to be visible for some distance up and down the channel.

Segment #2: Talkeetna Lowlands/Uplands (see Maps 1 and 2 on pp. 8-7-59 and 8-7-60)

G. ° Chulitna Creek Crossing View Zone

Distance: Foreground/middle ground

Viewers: Creek recreationists

Context: Heavy vegetation cover may limit the views of this crossing.

H. ° Curry Ridge View Points

Distance: Background

Viewers: Back country recreationists in Denali State Park

Context: While the Talkeetna Landscape itself is not particularly sensitive, the state park within the adjacent Curry Ridge landscape is sensitive. Views across the valley of the transmission lines will potentially impact the wilderness experience of hikers along the ridge.

Segment #3: Mid-Susitna River Valley (see Map 2 on p. 8-7-60)

I ° Gold Creek Area View Zone
(see Commonwealth Photo #7 on p. 8-7-46)

Distance: Middle ground

Viewers: Local residents, Alaska Railroad travelers

Context: In the Gold Creek area, occasional glimpses of the transmission lines will be possible where vegetation provides inadequate screening.

J. ° Susitna River Crossing View Zone

Distance: Foreground/middle ground

Viewers: River boaters and recreationists (the river is fairly heavily used in this area for fishing, etc.)

Context: While the landscape generally has a moderate ability to absorb the transmission lines, the crossing will potentially intrude on the natural river experience here. However, the Gold Creek Substation south of this crossing will not be visible from the river.

K. ° Chuiltna Pass View Zone

Distance: Foreground

Viewers: Local Residents (Chulitna), Alaska Railroad travelers

Context: As a result of the higher elevations in Chulitna Pass, vegetation is more sparse and cannot provide screening for this 5000 foot section where the railroad and transmission lines pass. Some reduction of impact can be expected since views are generally oriented to the west away from the transmission lines.

Segment #4: Chulitna River Valley (see Map 2 on p. 8-7-60)

L. ° Hurricane Gulch Viewpoint

(See Commonwealth Photos #9 and #10 on p. 8-7-47)

Distance: Middle ground

Viewers: Parks Highway and Alaska Railroad travelers, visitors to the Hurricane Gulch pull-off

Context: This outstanding natural feature is very sensitive and contains little vegetation capable of screening the transmission line towers.

M. ° Honolulu Area View Zone

Distance: Foreground/Middle ground

Viewers: Alaska Railroad and Parks Highway users.

Context: This section has a high aesthetic rating. The highway has been proposed as a scenic highway. Due to the proximity and moderate ability of the scattered vegetation to screen the corridor, views could be obstrusive. This condition is partially mitigated by the fact that the best views along this area are away from the corridor to the west.

N. ° Forks Campground/rest area view point

Distance: Foreground

Viewers: Parks Highway travelers, campers, recreationists

Context: Because of the limited screening capability in the area and the proximity to the rest area, the transmission lines could seriously affect views from this area.

O. ° East Fork Chulitna River Crossing

Distance: Foreground

Viewers: Water recreationists

Context: This area has a high aesthetic quality.

Segment #5: Broad Pass (see Map 3 on p. 8-7-61)

P. ° Broad Pass Community View Zone

Distance: Foreground

Viewers: Parks Highways, Alaska Railroad travelers, local residents

Context: This area has a high aesthetic capability and low absorption capability

Q. ° Broad Pass Valley View Point

(see Commonwealth Photo #13 on p. 8-7-49)

Distance: Background

Viewers: Parks Highway and Alaska Railroad travelers

Context: This area provides a short opportunity to view the valley as the road and railroad cross the middle fork of the Chulitna River.

R. ° Summit Lake Area
(see commonwealth Photo #15 on p. 8-7-50)

Distance: Middle ground
Viewers: Alaska Railroad and Parks Highway travelers
Context: This area is a proposed scenic highway section of the Parks Highway. Views from tourist trains are directed toward the transmission lines. The area has high aesthetic quality and low absorption capability.

S. ° Cantwell Area
(see Commonwealth photo #16 on p. 8-7-50)

Distance: Foreground to middle ground
Viewers: Parks Highway, Alaska Railroad, Denali Highway, and Old Airport Road travelers; local residents
Context: The sparse vegetation cannot screen immediate views of the transmission lines in this area. There may also be little screening due to limited vegetation for the section leaving Cantwell and rising over the Reindeer Hills.

Segment #6: Alaska Range Windy Pass (see Map 3 on p. 8-7-61)

T. ° Windy Pass entrance/Nenana River crossing
(see Commonwealth Photo #17 on p. 8-7-51)

Distance: Foreground/middle ground
Viewers: Parks Highway and Alaska Railroad travelers, local residents of Windy, Nenana River boaters

Context: This view of the transmission lines is very apparent. However, the initial view beyond Windy Pass will take predominance for auto and train travelers. The proximity of the transmission lines to the Nenana River will make the lines highly visible to boaters. This part of Parks Highway is proposed for scenic highway designation.

U. ° Windy Pass Corridor

(see Commonwealth Photo #18 on p. 8-7-51)

Distance: Foreground to middle ground

Viewers: Parks Highway and Alaska Railroad travelers

Context: Although there is a fair amount of vegetation, the closeness of the transmission line alignment will cause it to be visible at certain angles. This is a proposed scenic highway area.

V. ° Carlo Creek

(see Commonwealth Photo #19 on p. 8-7-52)

Distance: Foreground to middle ground

Viewers: Local residents, Parks Highway and Alaska Railroad travelers

Context: This area exhibits high aesthetic character with limited absorption capability where the transmission lines cross Carlo Creek.

Segment #7: Yanert River Valley (see Map 3 on p. 8-7-61)

W. ° McKinley Village

Distance: Middle ground

Viewers: Local residents and tourists

Context: Views from McKinley Village across the valley will be somewhat affected since there is little vegetation to screen the transmission lines.

X. ° Yanert River Crossing

Distance: Foreground/middle ground

Viewers: Yanert and Nenana River recreationists/boaters

Context: This area is charactrized by high aesthetic value.

Segment #8: Alaska Range

No significant views identified.

Segment #9: Nenana Uplands (see Map 3 on p. 8-7-61)

Y. ° Healy

Distance: Foreground/middle ground

Viewers: Local residents

Context: Although this landscape character type is moderately capable of absorbing these facilities, the proximity to residences will cause visual disruption. Healy is already visually disrupted by an existing generation station and associated transmission facilities.

PART 3

"Provide aesthetic value and absorption capability ratings for the Intertie landscape character types (Steps 5 & 6)."

AESTHETIC VALUE AND ABSORPTION CAPABILITY RATINGS
FOR THE WILLOW TO HEALY INTERTIE

Landscape Character Type	Aesthetic Value	Absorption Capability	Comments
Susitna River Lowlands	Low	High	Low in aesthetic value due to lack of aesthetically attractive features. Scale is large and common. Flat terrain and diverse vegetation patterns should be able to effectively absorb most manmade features. Aesthetic impacts will not be significant.
Talkeetna Mountains (Lowlands)	Moderate	Moderate	Manmade features would be visible in most areas due to flat to rolling, open terrain. Scattered spruce trees are consistent with transmission line character.
Talkeetna Mountains (Uplands)	Moderate	Low	The overall aesthetic value of this area is good due primarily to variety of landforms, but is not as scenic (middle and foreground views) in comparison to many other character types. The bisecting forested river valleys create a distinct and interesting pattern.

AESTHETIC VALUE AND ABSORPTION CAPABILITY RATINGS
FOR THE WILLOW TO HEALY INTERTIE

Landscape Character Type	Aesthetic Value	Absorption Capability	Comments
Mid-Susitna River Valley	Moderate	Low	Common Alaskan landscape. Nothing makes it particularly distinctive. Existing manmade elements (i.e. railraod parallel to river, railroad bridge, cabins, and railroad-related structures) have not had significant negative aesthetic impacts.
Chulitna River	High	Moderate to High	Dense lowland forest vegetation and flat to rolling landforms allow for good absorption.
Broad Pass	High	Moderate to low	Spruce cover is arranged in long, narrow north/south stands which allow for good screening. Massive landforms also diminish impacts. DNR recommends this area be officially designated a scenic highway due to landscape's low-to-moderate absorption capability.
Alaska Range	High	Moderate to to high	The massiveness of the mountains will cause the facilities to be less significant because of the extreme difference in scale.

AESTHETIC VALUE AND ABSORPTION CAPABILITY RATINGS
FOR THE WILLOW TO HEALY INTERTIE

Landscape Character Type	Aesthetic Value	Absorption Capability	Comments
Alaska Range, cont.			Complex sharp topography allows effective concealment.
Yanert River Valley	Moderate	Moderate	Open forested lowlands and terraces allow for good absorption. Spruce stands offer similar form and texture compared to transmission lines.
Nenana Uplands	Moderate	Moderate	Landscape has good variety of landforms and vegetation patterns and large distinctive river. Aesthetic value is not high compared to many other Alaskan character types. The diverse patterns of the natural elements and generally open landscape will be able to absorb limited manmade features assuming proper planning and design.
Curry Ridge	High	Moderate to high	Sufficient vegetation, topography, and texture to absorb the transmission lines in lower areas. Upper elevations are less capable of absorption and include important recreational areas.

There are also impacts common to most alignments which were too numerous to locate and evaluate. These include: trails supporting activities such as hiking, hunting, dog sledding, and skiing; rafting, canoeing, and access waterways; aerial sightseeing tours, private aircraft, and railroad users; and visual impacts to residences where the alignment crosses jeep trails and other unimproved roads leading to their land. Finally, the analyses did not include cases where cleared rights-of-way will open up some wilderness areas to human trespass or access, primarily vehicular, which could lead to the destruction of natural values and consequential visual disruptions (Commonwealth, 1982).

PART 4

"Determine the project feature impacts (Steps 7 & 8)".

A preliminary examination of visual impacts along the Intertie portion of the Susitna transmission line corridor was conducted by EDAW, Inc. in the fall of 1982. These enclosed findings and evaluations are based on aerial and limited ground inspection of the preferred and alternative alignments as well as an examination of USGS topographic maps. Much of the inventory and analysis data is based on the March, 1982 Commonwealth Report: Anchorage-Fairbanks Transmission Intertie Environmental Assessment. While this document addressed only the construction phase of the Intertie, the inventory of existing conditions and analysis of the alignment are valid for the Susitna project phase. However, the prior construction of the Alaska Intertie creates one significant difference; namely, in many areas the Susitna transmission lines will be crossing otherwise pristine areas that have been previously affected by the construction of the Intertie.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #1 - Susitna River Lowlands
Landscape Character Type Composite Rating	1--low aesthetic value; high absorption capability
Feature Description	° Leaving the Willow Substation, Segment 1 parallels the Parks Highway and Alaska Railroad at a distance of 1 to 3 miles away for 20 miles. ° At P.I.10* the lines pull away from the road and run parallel to it, about five miles away. ° The segment passes within a quarter of a mile of Larson Lake at P.I.39 and P.I.40. ° The line leaves Talkeetna four miles to the west around P.I.40. ° After crossing the Talkeetna River, Segment 1 ends at P.I. 46.
Feature Impacts	° The line will generally be distant enough from the Parks Highway and screened by the thick foreground vegetation in this low landscape that it will be largely unseen by most viewers on the ground. Foreground vegetatio is defined as areas within one-half to one-quarter mile either side of the highway. This condition will largely conceal the alignment from motorists traveling the highway as well as persons residing along the highway.

*Points of inclination referenced in these charts are taken from Exhibit G, February 1983.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Feature Impacts, cont.	° Some impact will occur to motorists when the alignment is viewed from certain angles, i.e. for example, as one looks east over open bogs. But here, distance will lessen the impact as the alignment is 1.5 miles from the highway, causing the towers to resemble the thin, vertical black spruce in form and color. ° There are residences in Caswell with views to the towers but again, the one mile distance allows the towers to be integrated with the existing landscape, creating moderate visual impact. ° The open bog areas between the black spruce stands allow for a natural right-of-way, thus lessening the impact. ° Significant visual impact will be imposed upon residences along Fishhook-Willow Road due to the lack of vegetation immediately adjacent to the road. ° The lines will cross the southwest corner of the Mat-Su Borough's proposed Larson Lake development. Passing within one-quarter mile of the lake and rising along a north/south ridge, the Intertie would impact westward views from the property. ° The line will be highly visible as it crosses the Talkeetna River, an important recreational resource. Particularly when the Intertie is expanded, visual impacts will be significant at this point.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #2 - Talkeetna Mountains (Uplands/Lowlands)
Landscape Character Type Composite Rating	5--moderate aesthetic value; moderate absorption capability
Feature Description	° Beginning at P.I.46 just north of the Talkeetna River, segment #2 runs northward through rolling terrain. ° At P.I.52 about three miles away from Deadhorse, the line turns northeast to P.I.61 above the community of Gold Creek.
Feature Impacts	° There is little visual impact along the majority of Segment #2 because thick stands of spruce, birch and balsam poplar were retained as spatial separations between the alignment and residences. ° Impacts will occur where the alignment crosses trails and waterways leading to local residences, although maintenance of a vegetation buffer along major water courses will impair views along the right-of-way. ° There could be serious impact where the alignment crosses the southeast corner of the Chase II, Unit IV subdivision. ° The alignment bisects the West Talkeetna Bluffs Addition (1983) which is waiting for final approval of the Intertie project before starting disposals. The thick spruce and birch on-site vegetation should provide significant screening to the addition except to parcels nearest the right-of-way.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #3 - Mid-Susitna River Valley
Landscape Character Type Campsite Rating	5--moderate aesthetic value; moderate absorption capability
Feature Description	° Beginning at P.I.61, Segment #3 drops from 3000 ft in elevation to about 1300 feet. It passes within one mile of Gold Creek and the Alaska Railroad, which crosses the Susitna River at this point. ° The lines run parallel to the Susitna River for four miles. They are one-quarter to one-half mile from the river on the valley side. ° The Gold Creek Substation will be located at P.I.65 just above the Susitna River. ° From this point the Intertie turns northward and crosses the river. The Susitna Project stubs run east, following the Susitna River. ° Segment #3 also crosses the Indian River at P.I.70 and passes by Chulitna. ° Segment #3 runs through Chulitna Pass within one-half mile of the Alaska Railroad, ending at P.I.73.
Feature Impacts	° After the Talkeetna River crossing, the route will not be generally visible until it again nears the Susitna River, when it will be in full view from Curry Ridge in Denali State Park.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Feature Impacts, cont.	° The tower tops along Segment #3 will introduce a moderate degree of impact to residences along the Alaska Railroad and tourists traveling the railroad. This is due to the vegetation being generally shorter than the towers and the towers being located on slopes. ° The impact will increase if the towers are viewed through the scattered openings associated with the area, particularly in the Chulitna Pass where the railroad and transmission lines pass within one-half mile of each other.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #4 - Chulitna River
Landscape Character Type Composite Rating	8--high aesthetic value; moderate absorption capability
Feature Description	° Just north of Chulitna Pass Segment #4 begins at P.I.73. ° The power lines turn northward at this point, passing between Chulitna Butte and the Chulitna Mountains. ° The lines cross Hurricane Gulch around P.I.75 and the lines run alongside the Parks Highway (about one-half to one mile away) from P.I.74 until P.I.80 just north of where the lines cross the east fork of the Chulitna River.
Feature Impacts	° Impacts in the southern portion of the Chulitna River segment are generally low to moderate because of the visual absorption capability provided by the dense spruce and spruce-birch vegetation and the alignment which places Chulitna Butte between the towers and the Parks Highway. ° Segment #4 traverses a highly scenic and visibly sensitive landscape of Hurricane Gulch. Consequently, the alignment was kept at least one-half mile off the Parks Highway to allow using more of the foreground vegetation for screening. However, the tops of the towers will be visible occasionally from the Parks Highway and the cleared right-of-way will be visible as it crosses Hurricane Gulch.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Feature Impacts, cont.	° The foreground vegetation, the alignment's distance from the highway and the fact that the views along this portion of the highway are oriented to the west across the Chulitna River to the Alaska Range will moderate visual impact to motorists.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #5 - Broad Pass
Landscape Character Type Composite Rating	9--high aesthetic value; low to moderate absorption capability
Feature Description	° The segment begins just north of the East Chulitna River Valley P.I.80. ° It runs along the east side of the Middle Fork Chulitna River Valley, paralleling the Parks Highway and the Alaska Railroad (1/2 to 1 mile away). ° The line passes within one mile of Broad Pass community. ° Running along the valley edge, it crosses the Middle Fork of the Chulitna River at P.I.83. ° This segment passes within approximately four miles of the community of Cantwell where it crosses both the Jack River and the Denali Highway at P.I.90. ° Just north of Cantwell, Segment #5 rises out of the river valley and crosses Reindeer Hills, P.I.90 to 93 (mistakenly identified as P.I.99 in Exhibit G). ° After crossing the Nenana River, this segment ends south of Windy Pass (P.I.99).
Feature Impacts	° Impacts in the Broad Pass segment are low to moderate despite the low visual absorption capability of the landscape type because alignments are generally located in the background beyond the particular sensitive foreground and middle ground lands. Impacts became significant when alignments are placed in the foreground.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Feature Impacts, cont.	° The minimal impact can be attributed to four factors: the distance between the viewer and the alignment allows the towers to diminish in size relative to the viewers; the right-of-way will be less evident because the spruce in Broad Pass are arranged in long, narrow north to south stands allowing the openings between stands to be used as a natural cleared right-of-way; some of the alignment is located behind vertical topography and below the crest line to avoid complete silhouetting; and the massiveness of the mountains diminishes the presence of the towers because of the large scale differences. ° The alignment will introduce significant visual impacts into the Cantwell area because of its proximity to existing residential lands extending east out of Cantwell along the Denali Highway and Old Airport Road. ° The towers and cleared right-of-way will be apparent and adequate mitigation measures will be difficult because of the sparse, low vegetation. ° Significant visual impact by the towers will occur to nearby residences as the line crosses the Nenana River. The crossing will also potentially impact the wilderness experience of rafters on the Nenana River. ° The alignment over Reindeer Hills was chosen to minimize visibility from the Parks Highway. ° Where the alignment ranges from a few hundred feet to approximately two miles near Broad Pass community from the highway, visual impacts will be higher. ° The crossing of the Denali Highway, currently under study by the Bureau of Land Management for scenic highway designation, will also be in full view. This is the only major road crossing which occurs in the Intertie portion of the corridor.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #6 - Alaska Range (Windy Pass)
Landscape Character Type Composite Rating	8--high aesthetic value; moderate absorption capability
Feature Description	° The Intertie passes through the Alaska Range via Windy Pass. Beginning at P.I.99 the transmission lines follow the Nenana River. ° In this area, the alignment is located less than one-quarter mile from the Parks Highway and approximately one-half mile from the Alaska Railroad. ° Beginning at P.I.106 the widening valley allows the line to pull back to one-half mile away. ° Segment 6 ends at P.I.109.
Feature Impacts	° There will be some attention drawn to the alignment near the Parks Highway north of Cantwell. However, the massiveness of the surrounding landscape and the initial revealing of Windy Pass will get most of the attention, alleviating the negative exposure. ° The line will be highly visible to motorists as it parallels the Parks Highway and Panorama Mountain through Windy Pass. Only a few short, scattered spruce offer any screening on Panorama Mountain.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Feature Impacts, cont.	° Although there is generally a good distribution of foreground screening available between Slime and Carlo creeks, the alignment is so close to the highway and residences that it will be visible from certain angles. ° Impacts are generally low before Windy Pass. Impacts in the remainder of the Alaska Range landscape are low to moderate because the alignments were placed in the dense stands of spruce along the low river terraces. There is a general availability of foreground vegetation immediately adjacent to the highway. This and the increased distance, as the alignment moves away from the highway and residences, will lessen the impact. ° There are several residences behind McKinley Village which will have views to the line because of inadequate screening vegetation, but the impact will be lessened by the distance factor of one mile. ° The alignment will also introduce a potential visual impact to rafters on the Nenana River.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #7 - Yanert River Valley
Landscaping Character Type Composite Rating	8--high aesthetic value; moderate absorption capability
Feature Description	° P.I.109 begins the seventh Intertie segment. ° Dropping down from Windy Pass the Intertie traverses the Yanert River valley. ° The lines cross the river at P.I.110 where the Yanert joins the Nenana River. ° After following the east shore of the Nenana for about 2.5 miles, the Intertie turns northeast and ascends Montana Creek. ° Segment #7 ends at P.I.113.
Feature Impacts	° Crossing this valley, the alignment is approximately 2 miles east of the highway and will not have major impacts. ° Rafters will be potentially impacted at the Yanert River crossing.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #8 - Alaska Range (Sugar Loaf Mountain)
Landscape Character Type Composite Rating	8--high aesthetic value; moderate absorption capability
Feature Description	° Beginning at P.I.113, the Intertie corridor runs through the Alaska Range for about 12 miles. ° The lines run up the Montana Creek drainage in a northeasterly direction. ° At P.I.116 the lines turn back to the northwest and descend through the Moody Creek drainage to P.I.121.
Feature Impacts	° This route east of Suger Loaf Mountain was selected to eliminate visual impacts in the highly scenic Nenana Gorge area. ° There are bush pilots using the Moody and Montana Creek Basins as part of their tour as well as a hunting guide service. Both services feel the alignment will disrupt the views of hunters and airplane passengers.

RELATIONSHIP BETWEEN PROPOSED FEATURES AND LANDSCAPE RATINGS
STEPS 7, 8

Transmission Segment	Segment #9 - Nenana Uplands
Landscape Character Type Composite Rating	5--moderate aesthetic value; moderate absorption capability
Feature Description	° After crossing Sugar Loaf Mountain and descending along the Moody Creek drainage, the Nenana Uplands Segment begins at 2000 feet in elevation (P.I.121). ° Crossing the Healy Creek Basin, the Intertie terminates with a substation near the town of Healy (P.I.123).
Feature Impacts	° The location of the Healy Substation near the Alaska Railroad and Nenana Railroad will be highly visible. ° Healy residences will also be visually affected by Segment #8, although Healy is already visually disrupted by an existing generation station and its associated transmission facilities. ° No other residences will be affected.

PART 5

"Finally, provide proposed mitigation measures for the Intertie projects feature (Step 9)."

In addition to the mitigation program discussed on pp. E.8.47 through E.8.59 in Chapter 8, Exhibit E of the License Application, specific mitigation measures are currently being developed for the entire transmission line corridor, including the Intertie portion of the project. These are tentatively scheduled to be completed in November, 1983 and will be provided to the Federal Energy Regulatory Commission at that time.

Photo 1
Susitna River Lowland looking east near Willow.

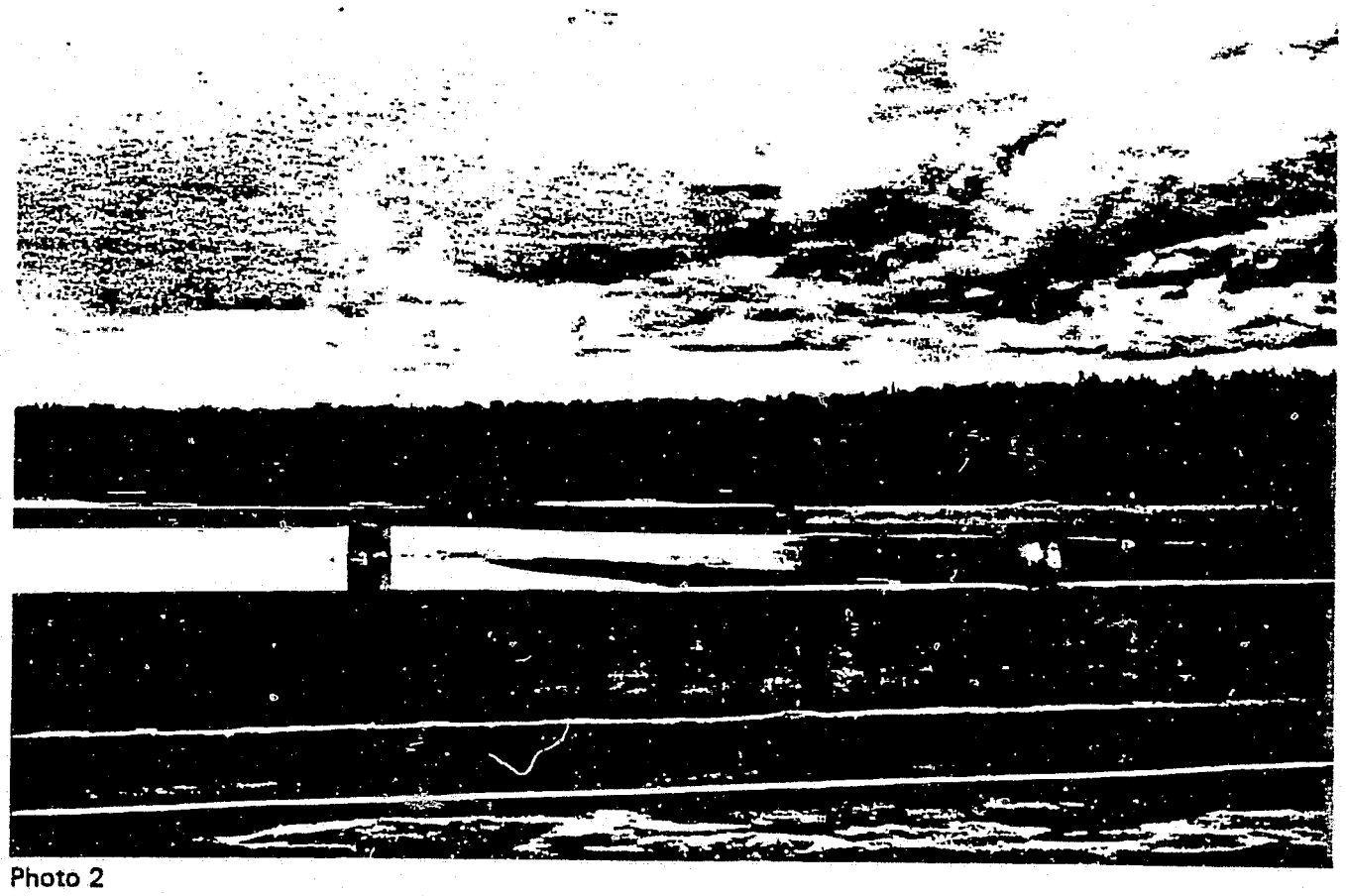


Photo 2
Susitna River Lowlands, Mile Post 104.3 south from the Susitna River Bridge.

FIGURE 21

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

8-7-43

Gilbert/Commonwealth

Photo 3
Susitna River Lowlands, Petersville Road.

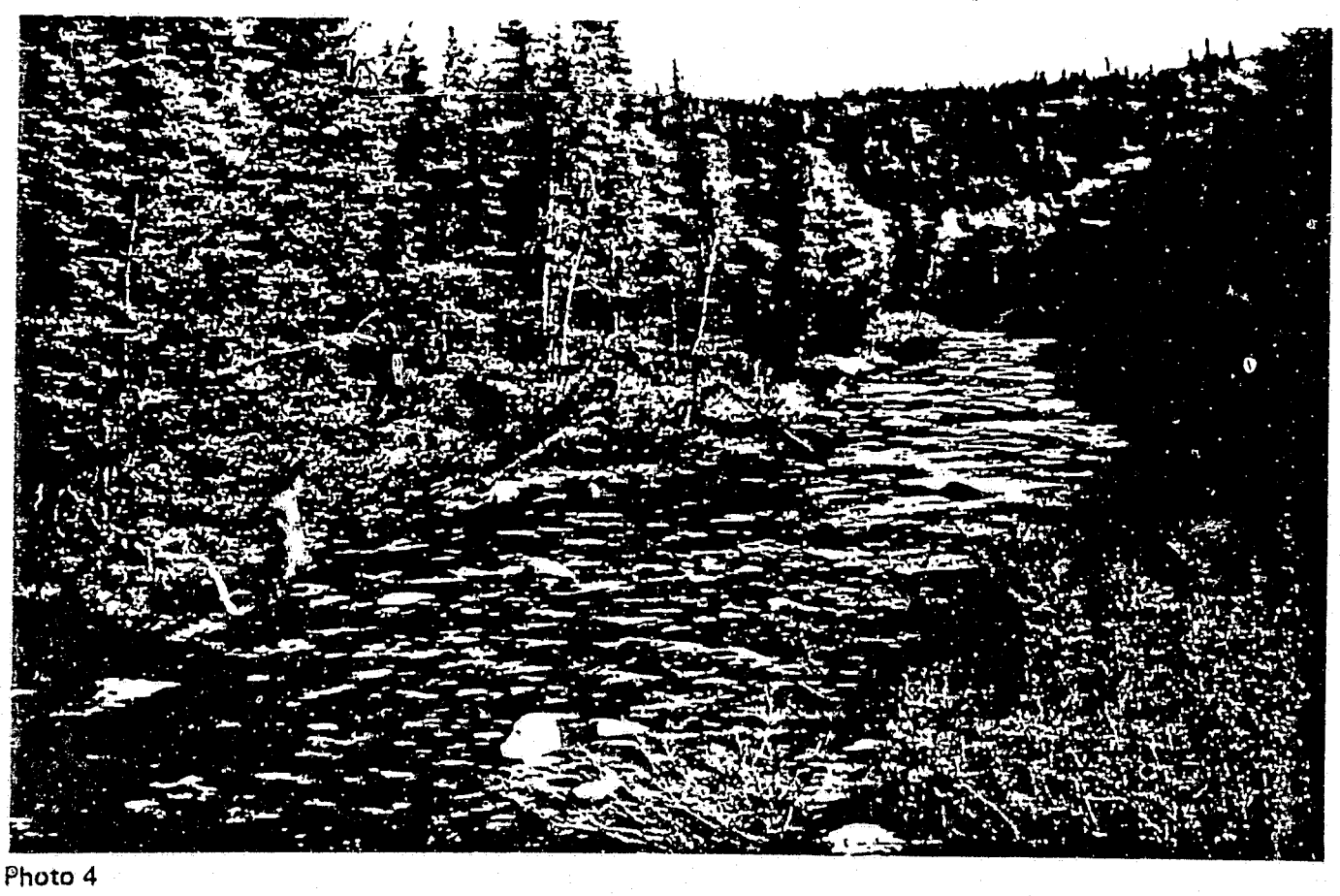


Photo 4
Mile Post 144.
Looking east up Byers Creek.

FIGURE 22
Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

8-7-44

Photo 5
Byers Lake, looking toward Curry Ridge.

Photo 6
Mile Post 168.
Looking at the north end of Curry Ridge, Pass Creek in foreground.

FIGURE 23
Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

8-7-45

Gilbert/Commonwealth

Photo 7
Railroad Mile Post 264.
Looking up the Susitna River north of Gold Greek.

Photo 8
Mile Post 170.
Looking west across the Chulitna River towards the Alaska Range.

FIGURE 24

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

8-7-46

Photo 9
Mile Post 174.
Looking east up Hurricane Gulch.

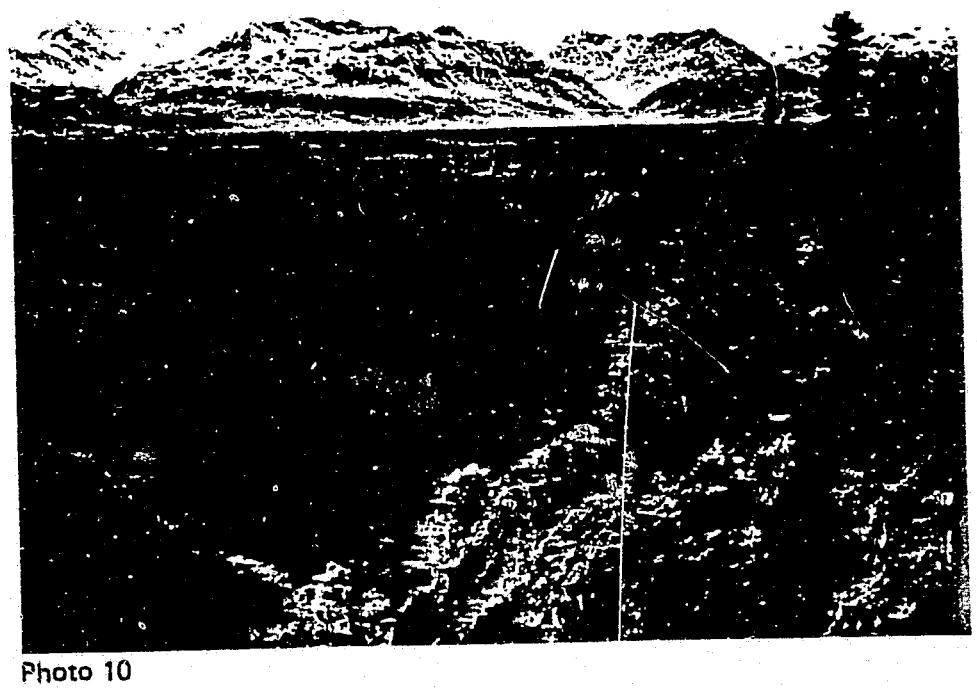


Photo 10
Mile Post 174.
Looking west down Hurricane Gulch.

8-7-47

FIGURE 25

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

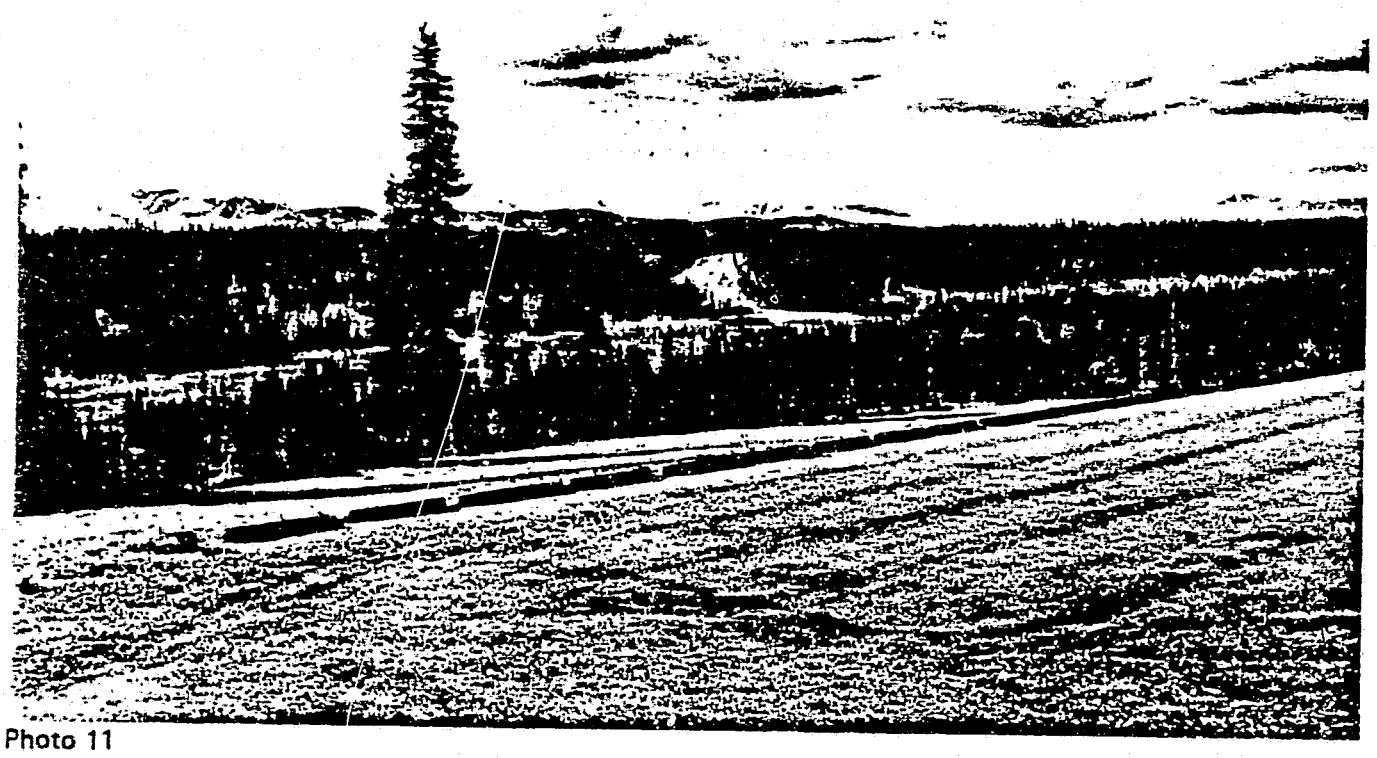


Photo 11
Mile Post 179.3.
Looking northwest across the Chulitna River.

Photo 12
Mile Post 194.3.
Looking east across the south end of Broad Pass.

FIGURE 26
Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

8-7-48

Photo 13
Mile Post 194.3.
Looking northeast toward the Alaska Range from the south end of Broad Pass.

Photo 14
Mile Post 198.
Looking southwest toward Mt. McKinley from Broad Pass.

FIGURE 27

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

8-7-49

Gilbert/Commonwealth

Photo 15
Mile Post 199.
Looking east across Summit Lake from Broad Pass.

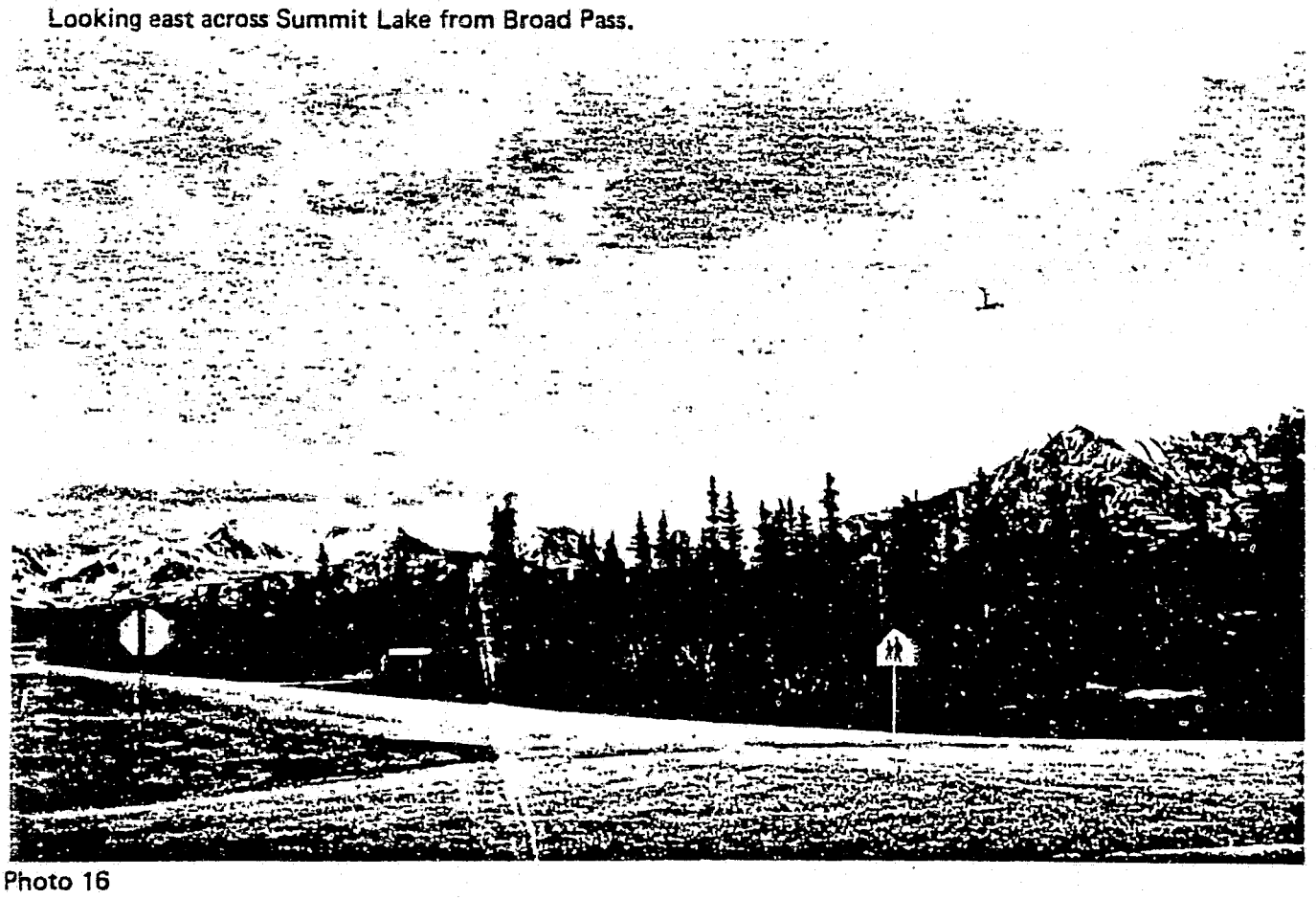


Photo 16
Mile Post 209.9.
Looking east toward the Denali Highway juncture with the Parks Highway.

8-7-50

FIGURE 28

Alaska Power Authority | ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

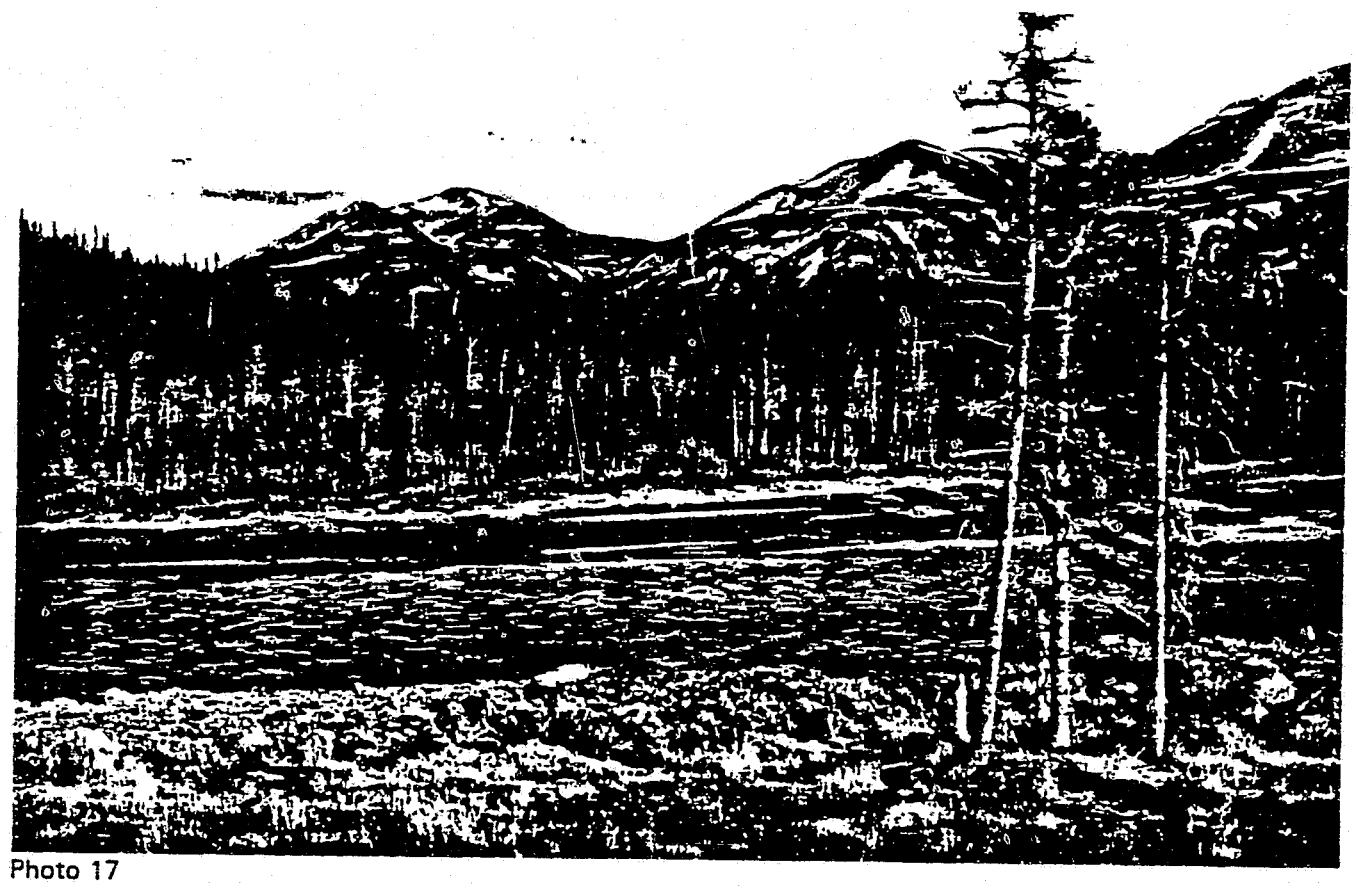


Photo 17
Mile Post 215.6.
Looking east across the Nenana River prior to entering Windy Pass from the south.

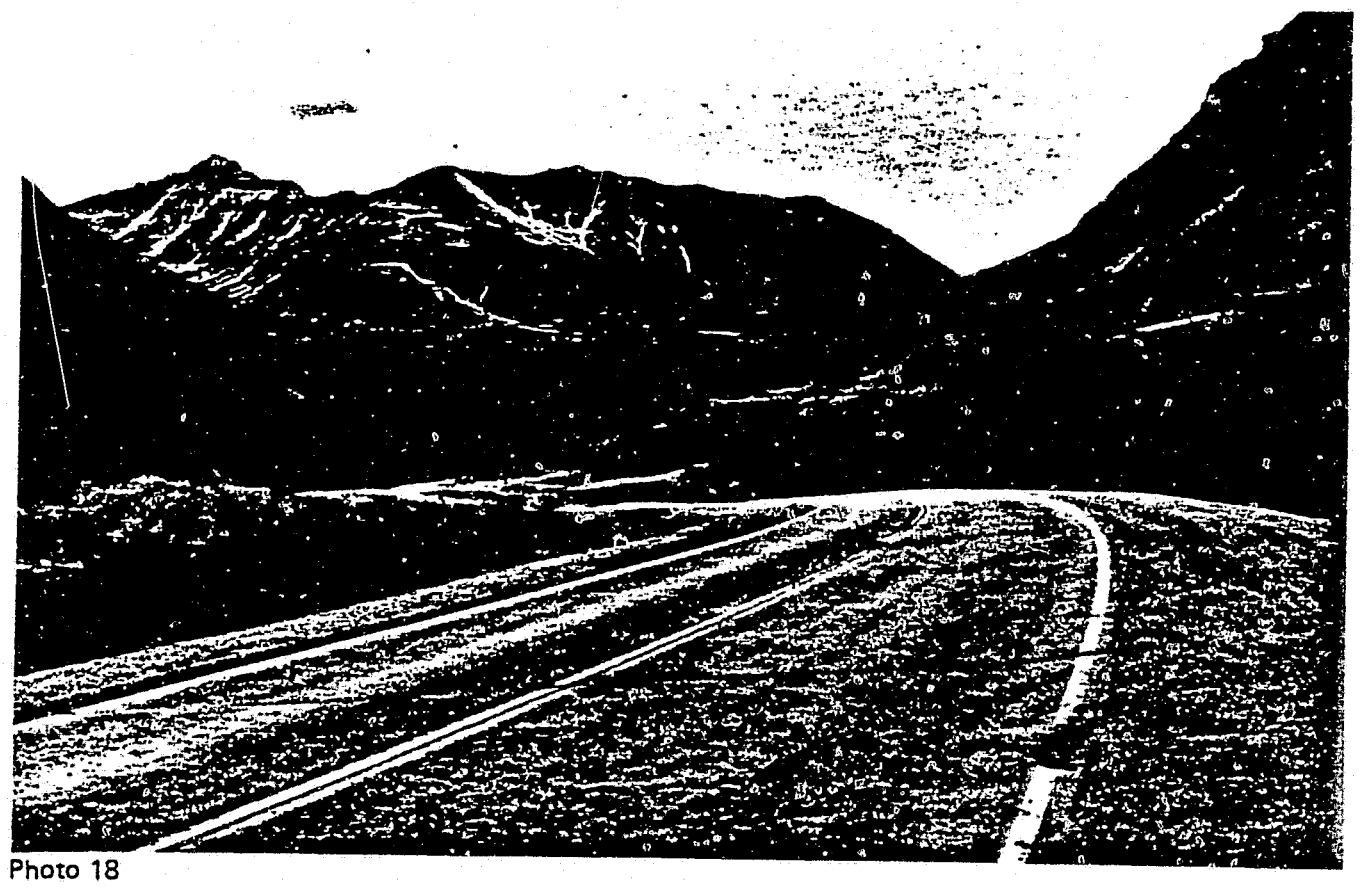


Photo 18
Mile Post 216.1.
Looking north up Windy Pass in the Alaska Range.

8-7-51

FIGURE 29

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

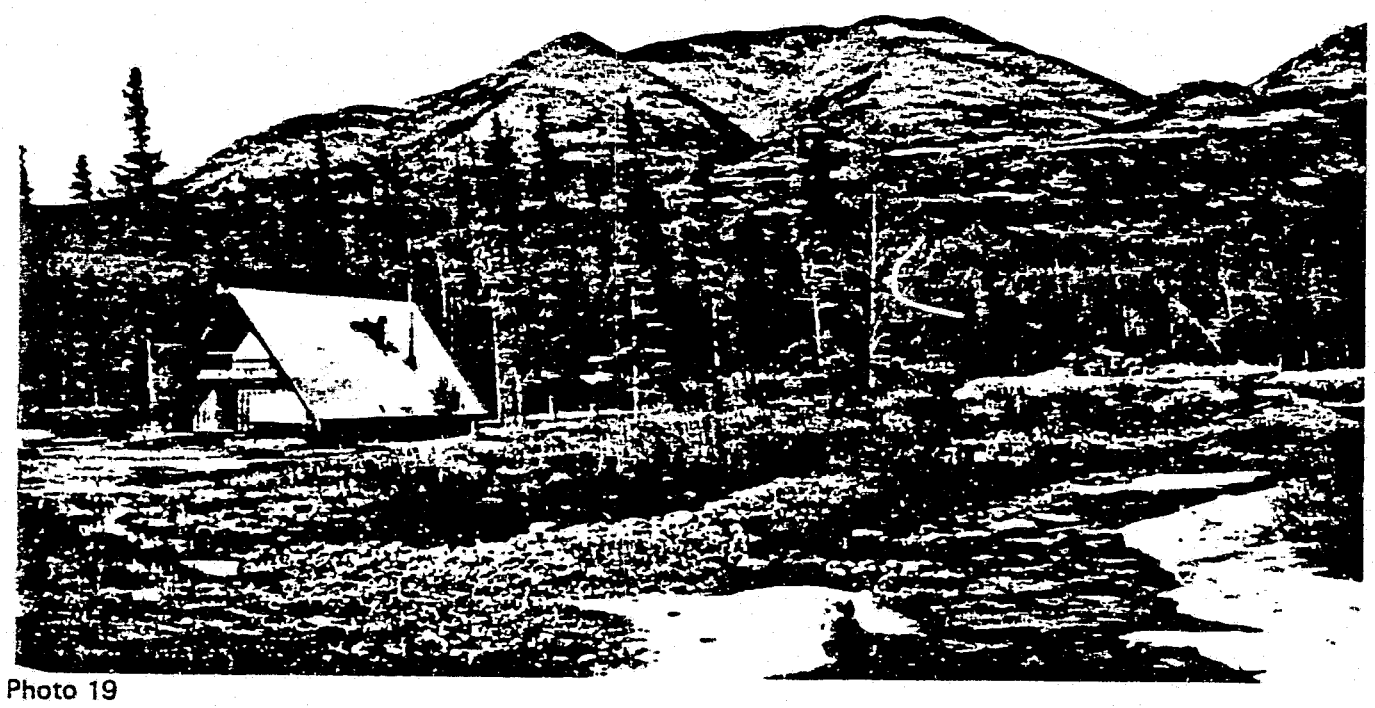


Photo 19
Mile Post 224.
Looking east up Carlo Creek in the Alaska Range.

Photo 20
Mile Post 237.
South of the Denali National Park entrance looking northeast.

8-7-52

FIGURE 30

Alaska Power Authority | ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

Existing Landscapes

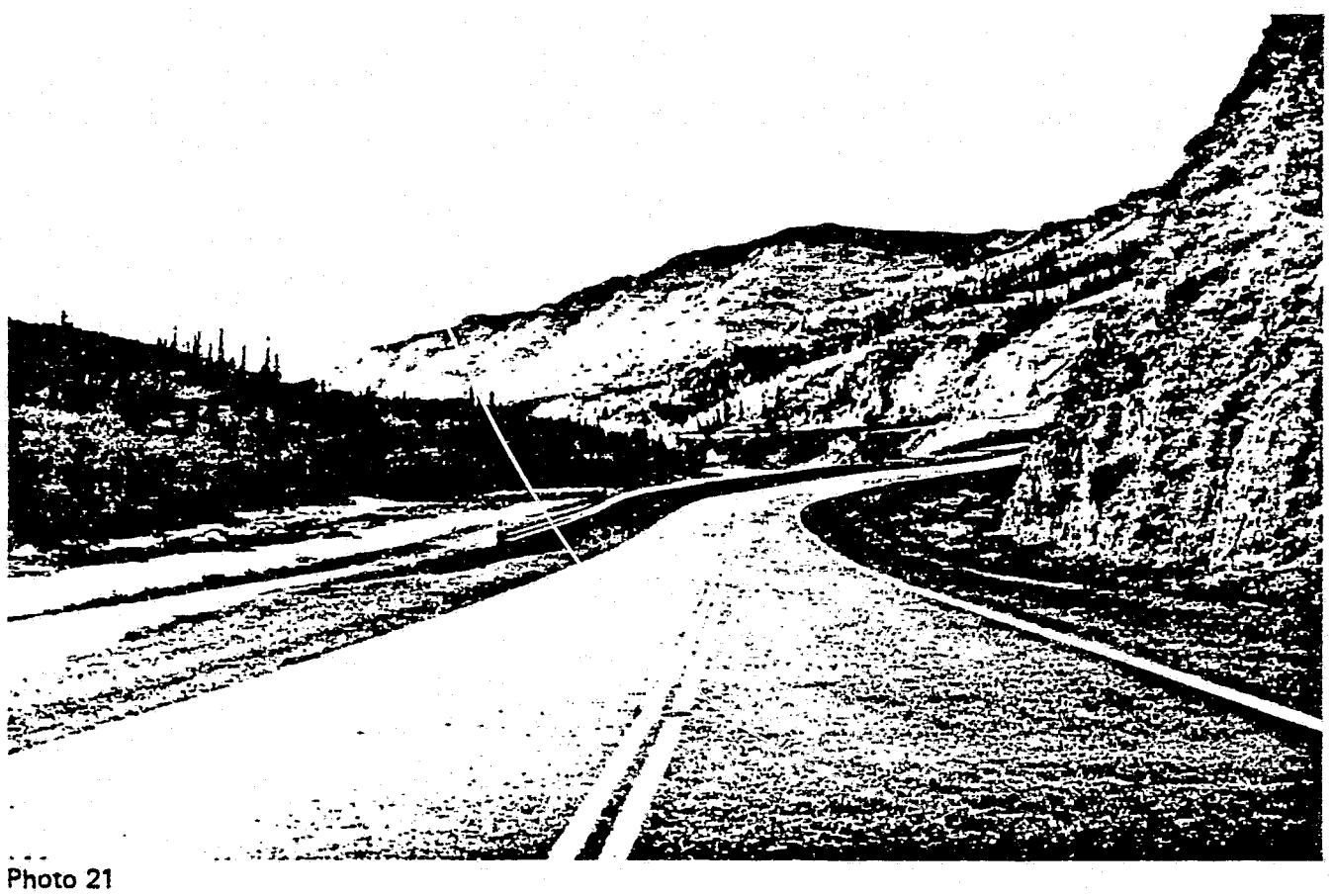


Photo 21
Mile Post 241.
Looking north up the Nenana Gorge.

Photo 22.
Mile Post 242.
Looking south down Nenana Gorge from the Dragonfly Creek area.

FIGURE 31

Alaska Power Authority ANCHORAGE FAIRBANKS TRANSMISSION INTERTIE

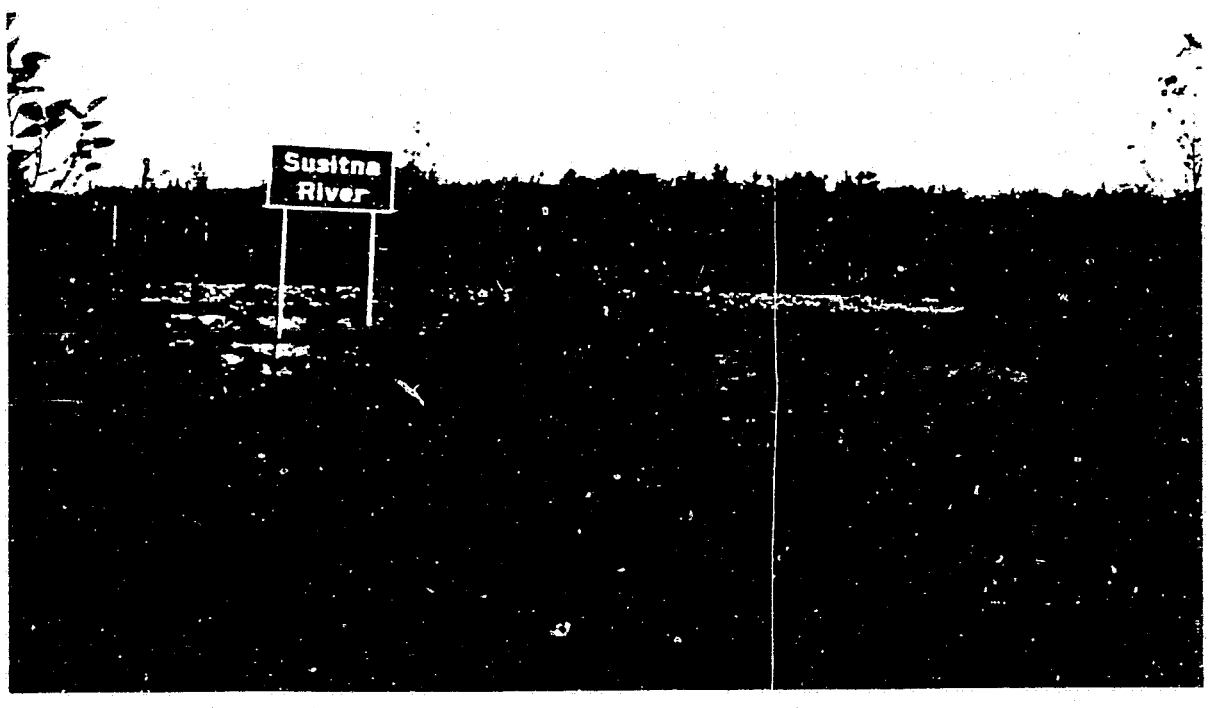
Existing Landscapes

8-7-53

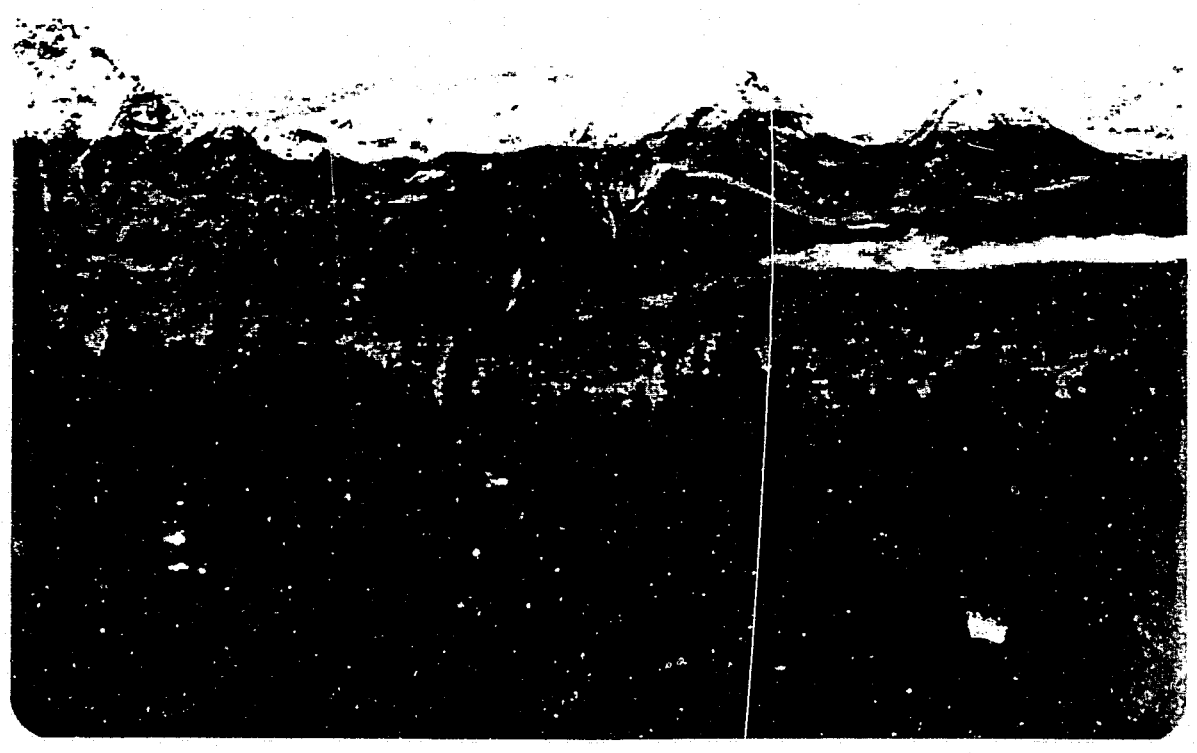
EXISTING CONDITIONS PHOTO DOCUMENTATION

EDAW INC 1983

8-7-54

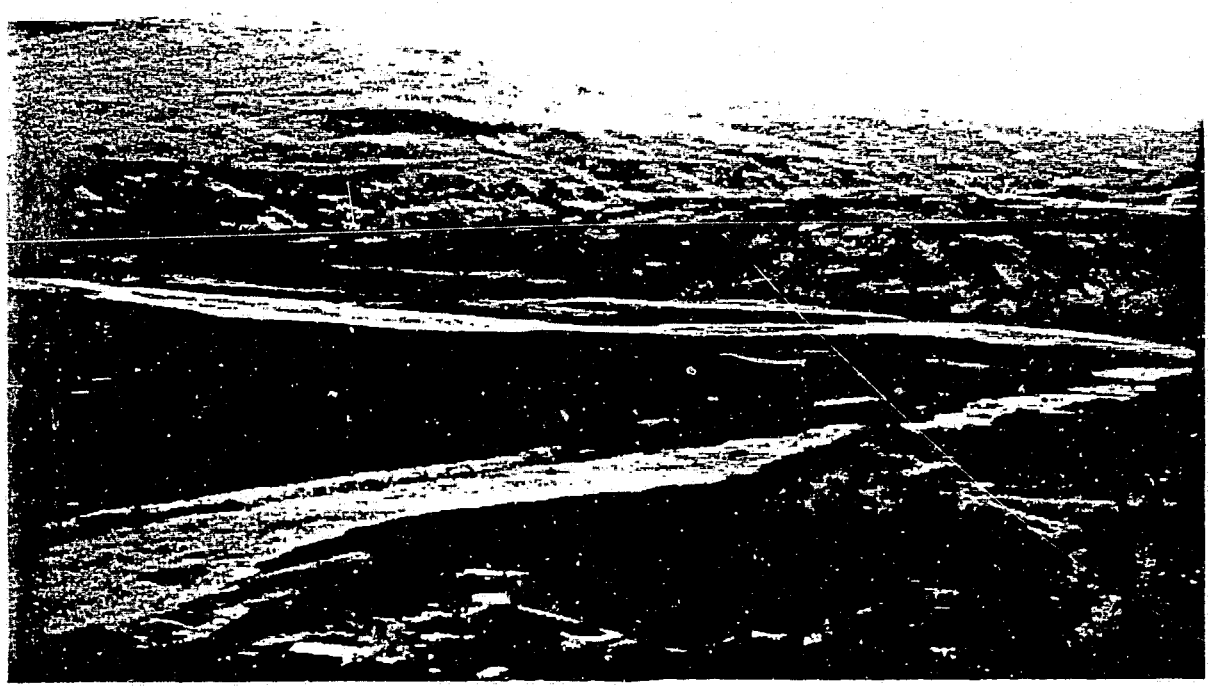


1 SUSITNA LOWLANDS



2 ALASKA RANGE

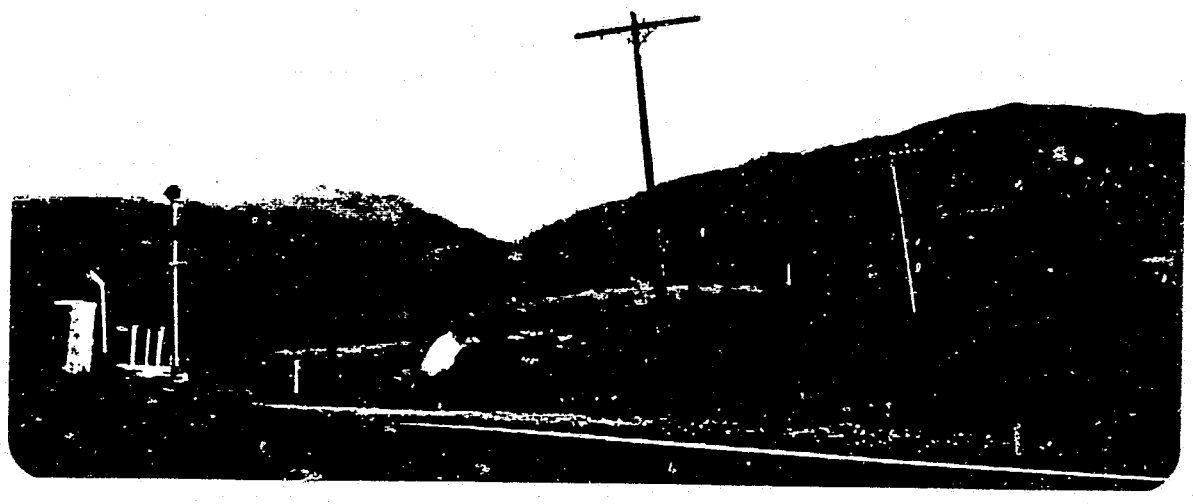
8-7-55



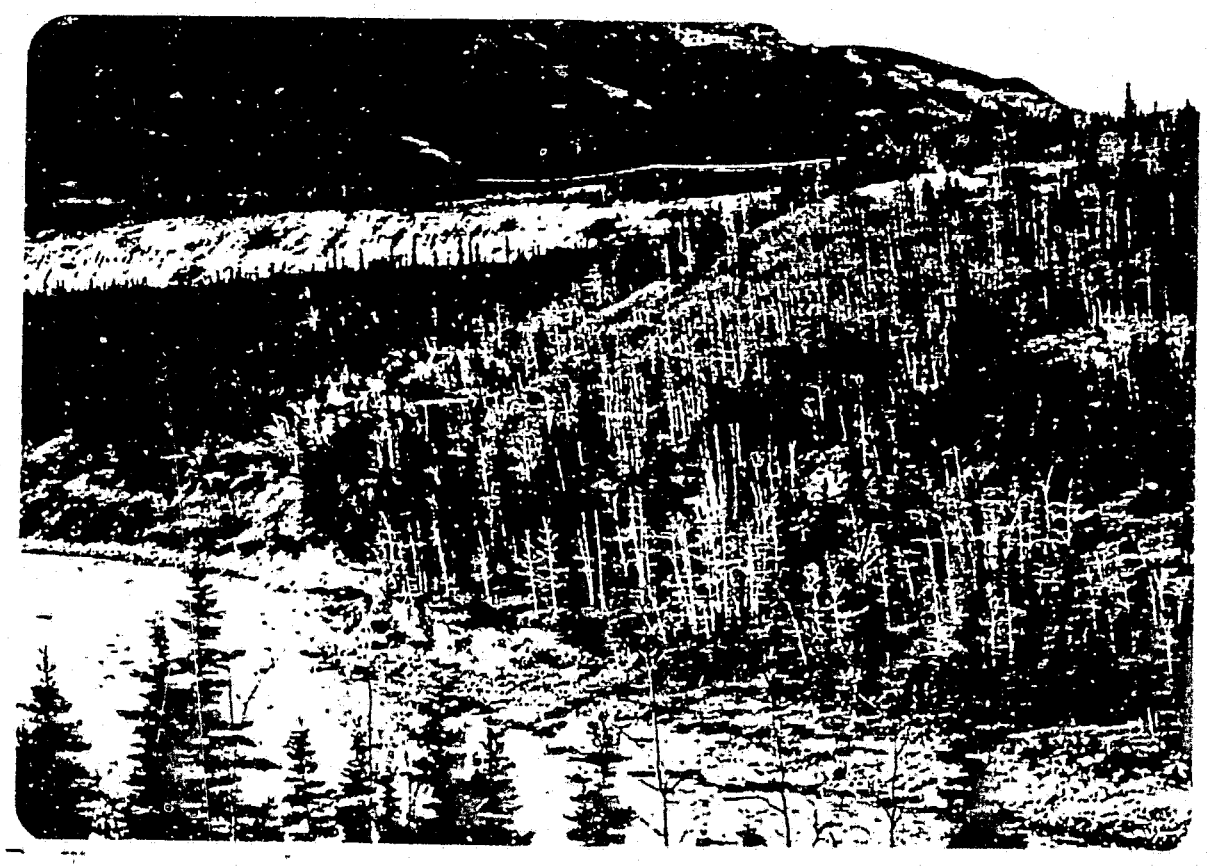
3 TALKEETNA LOWLANDS

4 TALKEETNA

8-7-56



5 ALASKA RAILROAD

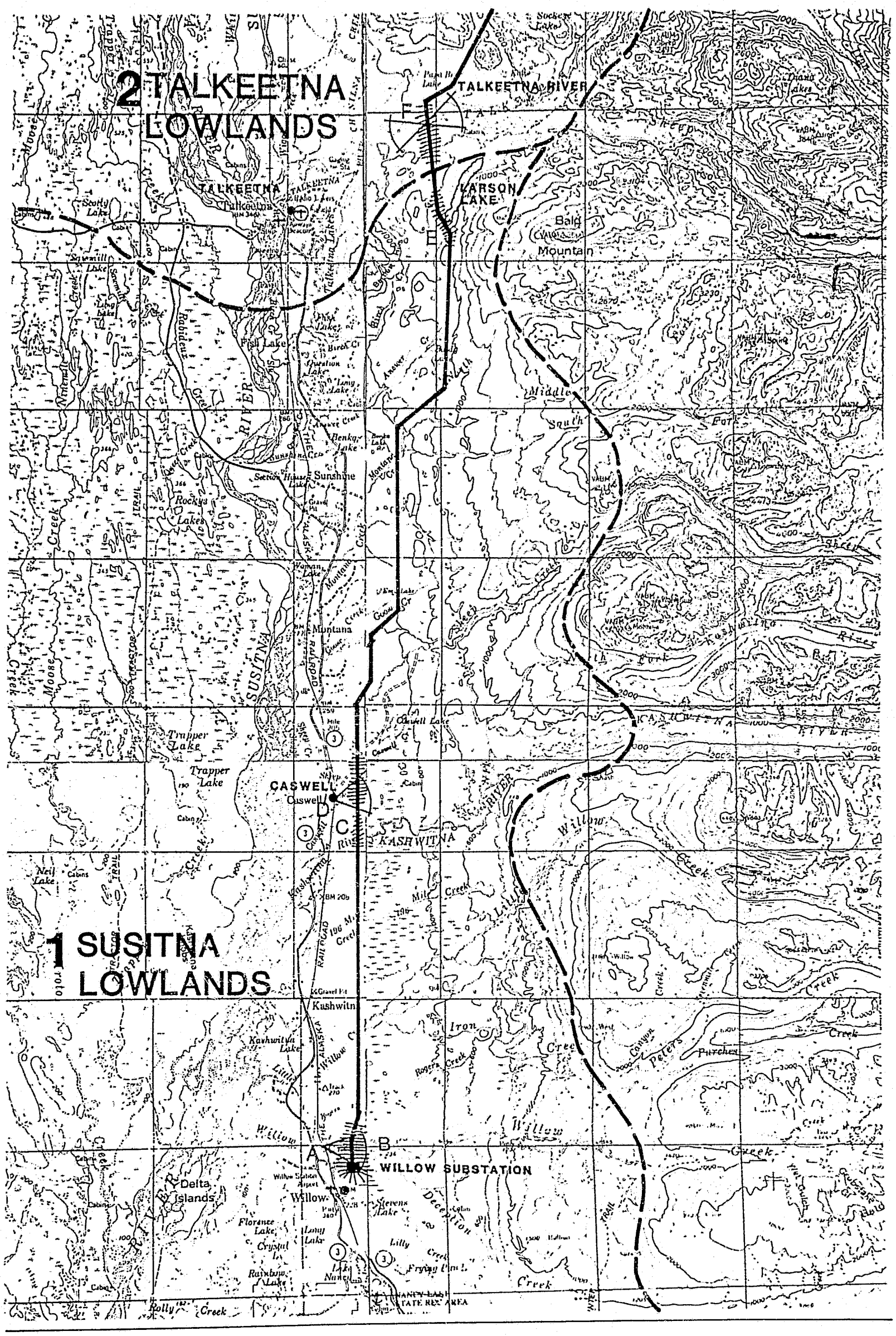


6 NENANA GORGE

8-7-57

7 BROAD PASS

8-7-58



MAP 1 OF 3

WILLOW HEALY TRANSMISSION INTERTIE
SIGNIFICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES

EDAW 1983

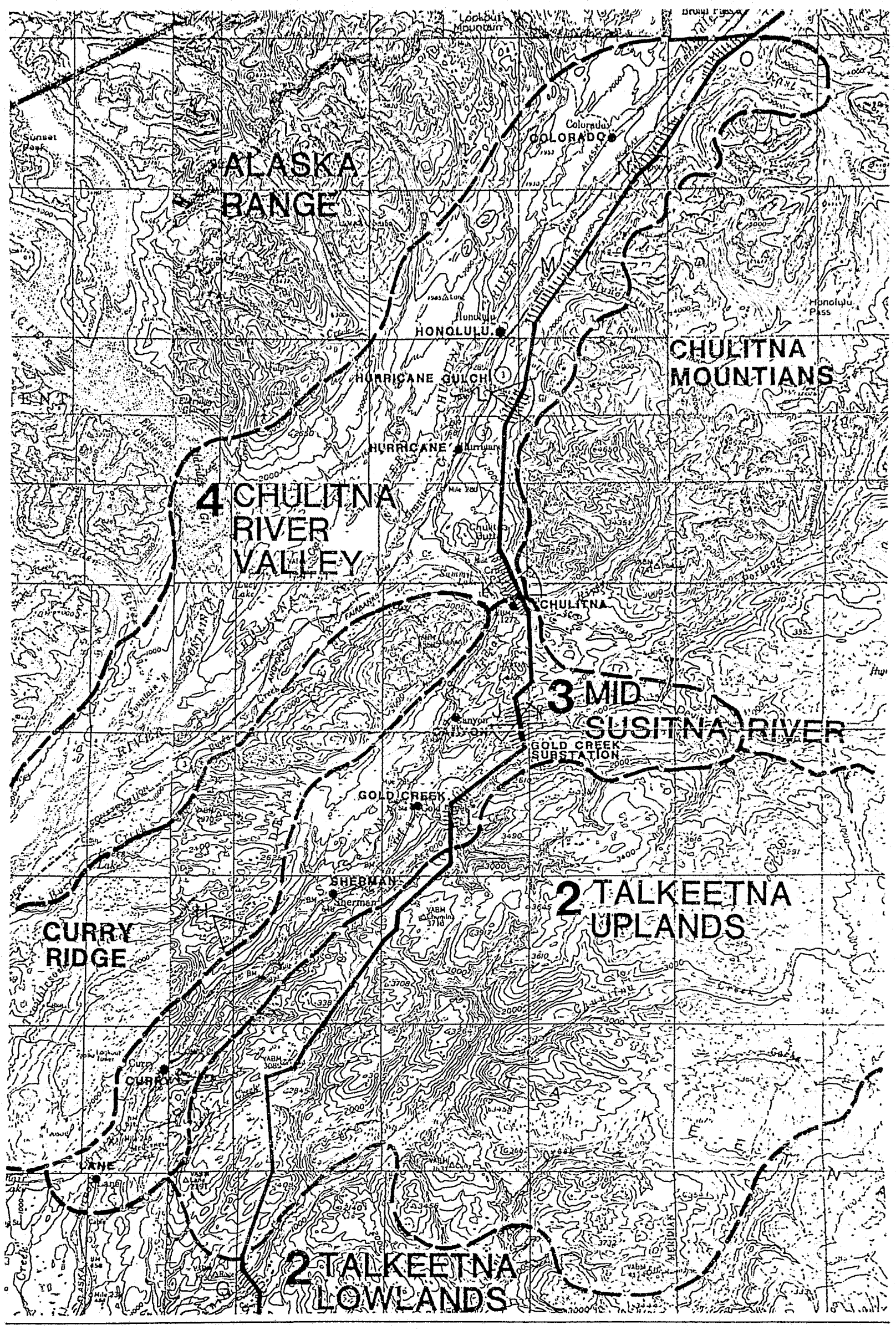
LEGEND

9 INTERTIE SEGMENT
INTERTIE CORRIDOR
A SIGNICANT VIEWS
VIEW ZONES
LANDSCAPE TYPES

8-7-59

12

FEED
MANUAL
AUTO
8
8.5
11
12
FOLD LENGTH



MAP 2 OF 3

WILLOW HEALY TRANSMISSION INTERTIE
SIGNIFICANT VIEWS

SUSITNA HYDRO ELECTRIC PROJECT AESTHETIC RESOURCES

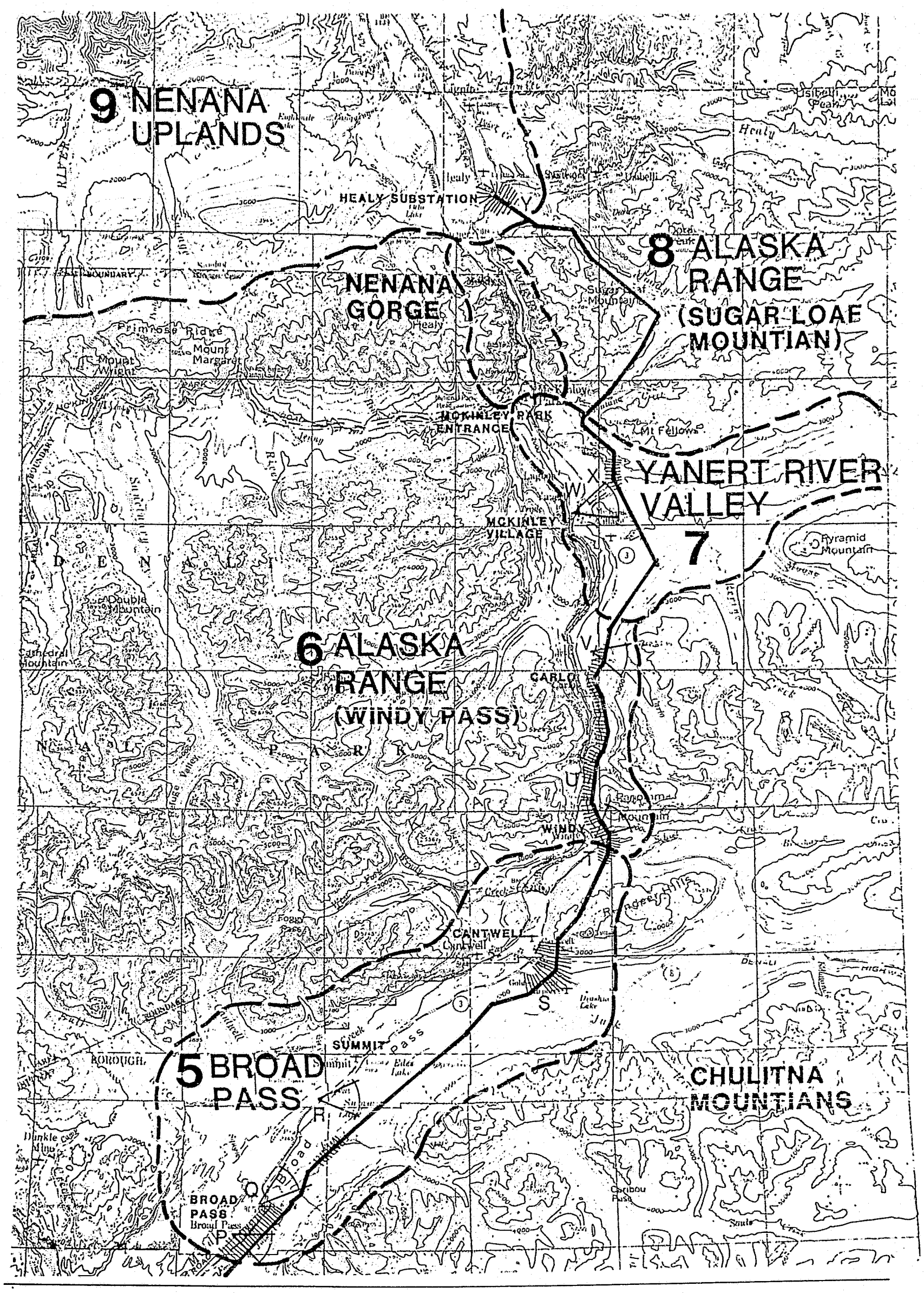
EDAW 1983

LEGEND

- 9 INTERTIE SEGMENT
- INTERTIE CORRIDOR
- A SIGNIFICANT VIEWS
- VIEW ZONES
- LANDSCAPE TYPES

8-7-60

12



MAP 3 OF 3
WILLOW HEALY TRANSMISSION INTERTIE
SIGNIFICANT VIEWS

SUSITNA HYDROELECTRIC PROJECT AESTHETIC RESOURCES
EDAW 1983

LEGEND

9	INTERTIE SEGMENT
	INTERTIE CORRIDOR
A	SIGNIFICANT VIEWS
	VIEW ZONES
	LANDSCAPE TYPES

8-7-61

EXHIBIT E

8. Aesthetic Resources

Comment 8 (p. E-8-61, para. 1 to p. E-8-68, para. 3)

Indicate the potential extent of visual impacts to the Denali National Park and Denali State Park due to the location of the proposed transmission line. Discuss the significance of these impacts in relation to viewpoints, distances, duration, and number of viewers. Indicate how any visual impacts to these areas will be mitigated.

Response

Denali National Park

Some adverse visual impacts will occur as a result of the proposed transmission line routing. In the area east of the Denali National Park boundary, no development has taken place. The landscape is dominated by extensive changes in elevation with Mt. Fellows, Sugarloaf Mountain, Mt. Healy, Pyramid Peak, and the Yanert Fork Valley as outstanding natural features.
An assessment of visual impacts due to the proposed transmission line distinguished views from two directions: (1) from the Parks Highway northeast towards the south-facing slopes of Mt. Fellows, and (2) from the Denali National Park entrance east towards the north facing slopes of Montana Creek. It is anticipated that changes in the scenic quality of the landscape will occur primarily as a result of the cleared transmission line right-of-way since the visibility of the proposed structures will be lessened with viewing distances exceeding 1.6 miles. Although the line of sight will be occasionally interrupted by topography or vegetation, the proposed transmission line will nevertheless be viewed periodically from the Parks Highway near Mile Posts 231 through 236. In addition, the northern

portion of the facility will be visible from various points within the park entrance area, particularly at the Denali Railroad Depot, where the proposed transmission line angles in a northeasterly direction across Montana Creek at a viewing distance of 3.3 miles. Other viewpoints in the park entrance area include Riley Creek Campground and the Mckinley Park Station Hotel. While viewing distances to the proposed transmission line vary from 2.7 miles at the campground to 3.4 miles at the hotel, views will be partially or totally obscured by existing vegetation or topography. In 1982, recreational visits at the park were approximately 322,000 with less than 7 percent of the visitors (21,194) having arrived via the Alaska Railroad (U.S. Department of Interior, National Park Service 1983.) The majority of these visits occurred between June and September.

The Intertie route selection process recognized the importance of reducing visual impacts in the vicinity of the Denali National Park entrance. Therefore, a transmission line route was selected to shorten the total number of miles of transmission line route in the area opposite the park entrance; to utilize a small promontory to partially conceal, break, and reduce the length of the transmission line visible from any one viewing point along the Parks Highway or Denali National Park entrance; and to keep the transmission line as distant as possible from these viewpoints. Placement of the Susitna transmisison line within the Intertie right-of-way would achieve these same objectives and minimize visual impacts in this area.

Mitigation of visual impacts associated with the Intertie will occur during the design and construction phases of the project. Since it was noted that right-of-way clearing represented the most significant visual effect, design changes were made to reduce clearing required during construction. Through revising tower placement (to take advantage of existing topography) and increasing tower height (to increase conductor-to-ground clearance), clearing in the right-of-way will be substantially avoided. As a result,

the principal clearing requirements in the vicinity of Mt. Fellows and north of the Yanert Fork will occur at each tower base (in an area approximately 20 by 20 feet for tangent structures and 25 by 70 feet for angle structures) and at selected puller and tensioner sites along the right-of-way (in an area approximately 75 by 500 feet at 10,000 foot intervals). Similar measures are possible for the proposed transmission line route for the Susitna project.

Denali State Park

Visual impacts of the proposed transmission line at Denali State Park will not be significant and will occur primarily from viewpoints in the northeastern portion of the park. Primary viewers will be hikers on the Curry Ridge and Indian Pass trails. Curry and Indian ridges eliminate views of the transmission line east from the Parks Highway or Byers Lake Campground. From the southern boundary of the park, the transmission line will be generally obscured from view for approximately 8.5 miles, where topography provides adequate screening. However, the transmission facilities will be visible to hikers east of Sherman and near Gold Creek, where the line drops from the Talkeetna Mountains to the Susitna River lowlands. Views of these areas will be distant (over 6.0 miles from Curry Ridge trail) and visibility will be primarily confined to the structures and conductors, since the right-of-way is situated above the treeline. Additionally, the extent of the impacts will be lessened somewhat due to the presence of higher background topography.

Views within Denali State Park are dominated by the presence of the Alaska Range and Mt. McKinley. Viewing distances to these features range from 35 to 40 miles along the Parks Highway, which bisects the park north to south. Views are predominantly northwest in their orientation. Principal viewers

are found along the Parks Highway. For example, over 6,900 visitors utilized the park in 1982 (Alaska Department of Natural Resources, Division of Parks, 1983). The Byers Lake Campground and highway rest area are the principal developed facilities and have been classified as a Class I Recreation Resource Zone, which is the only high density zone designated in the state park (Alaska Deparment of Natural Resources, Division of Parks 1975).

Little future development is anticipated by the Division of Parks in the eastern portion of Denali State Park except for a small campground proposed in the Park's Master Plan. The campground, located north of Gold Creek Station where the railroad crosses to the west side of the Susitna River, would be directly accessible to both park visitors and railroad passengers (Alaska Department of Natural Resources, Division of Parks 1975). The proposed transmission line would be situated approximately 1.1 miles to the east, with views partially interrupted by vegetation.

References

Alaska Department of Natural Resources, Division of Parks. Denali State Park, A Master Plan. 1975.

Alaska Department of Natural Resources, Division of Parks. Dave Stephens. June 3, 1983. Personal communication.

United States Department of the Interior, National Park Service. Ralph Pingley. June 1983. Personal communication.

EXHIBIT E

9. Land Use

Comment 1 (p. E-9-9, para. 2, to p. E-9-13, para. 2)

Describe the existing land status for the intertie portion of the proposed transmission line corridor. Indicate if Tables E.9.1 and E.9.2 include data for the intertie. If they do not, please include land status/ownership information for the intertie. Provide figures (similar to Figures E.9.4 - E.9.6 and E.9.10 - E.9.12) indicating land status and land use development maps for the intertie section of the proposed transmission line corridor. Land ownership should be provided for the intertie portion of the transmission line corridor in Exhibit G, plates 34-37 and 41-45.

Response

Tables E.9.1 and E.9.2 in Chapter 9, Exhibit E of the License Application include land status data for those portions of the Intertie corridor within the USGS Talkeetna Mountains Quads C-5, C-6, D-5, and D-6, and the USGS Healy Quad A-5. Although the Intertie route is not identified on the map, Figure E.9.3 in Chapter 9 depicts land status along more than 60 miles of the Intertie corridor, from south of Gold Creek to north of Cantwell.

The Anchorage-Fairbanks Intertie environmental assessement (Commonwealth Associates, Inc. 1982) describes land status and land use development between Willow and Healy along the selected route for the Susitna transmission lines. Current land use along the Intertie corridor is discussed on pp. 126-131 of the Commonwealth report; land use impacts are discussed on pp. 215-219. As shown in Figure 15 of the Commonwealth report, land use development in this corridor consists of numerous scattered parcels between Talkeetna and Willow, and isolated parcels and settlements along the highway

or railroad from Talkeetna to Healy. The Intertie route avoids almost all developed parcels south of Talkeetna (although many are within two miles), as well as Denali State Park and Denali National Park and Preserve. (Superlink 65 was subsequently relocated several miles to take the route further away from several homesteads along the Alaska Railroad near Sherman.) Steep terrain presented serious routing constraints, particularly in the northern portion of the corridor. Consequently, the selected route avoids, but passes close to, several small communities from Hurricane to Healy. Steep terrain between Hurricane and Gold Creek, combined with the location of Denali State Park, resulted in the selection of a route that passes through the Indian River land disposals.

Land status within the Intertie corridor is addressed on pp. 132-139 and 219-220 of the Commonwealth report. Federal lands, which are generally located north of Talkeetna, consist primarily of Denali National Park and Preserve, railroad withdrawals, and BLM land. Additionally, the state has extensive landholdings within the corridor (including selections), mostly south of Broad Pass. Moreover, the Matanuska-Susitna Borough has some lands in the southern portion of the route, generally near the Parks Highway and Petersville Road. Native lands and selections are concentrated in the Cantwell-Broad Pass area (Ahtna Region, Inc.) and near Talkeetna (Cook Inlet Region, Inc.). Private lands are generally confined to the southern one-third of the corridor south of Curry.

The attached table outlines the land ownership schedule for the Intertie portion of the Susitna transmission corridor. In addition, land ownership is provided for the Intertie portion of the transmission line corridor on revised Exhibit G plates 34-38 and 41-45, contained in the response to Supplemental Comment 16, Exhibit G.

June 29, 1983

Willow to Healy Intertie

Land Schedule

DESCRIPTION:	OSTENSIBLE OWNER:
T. 19N., R. 4W., S.M.	
Section 4: W½NW¼SW¼; ptn. of W½SW¼NW¼ Southerly of Road R/W	Private (Matanuska Electric Association)
Section 4: Hatcher Pass Road R/W	State of Alaska (DOT-PF)
Section 4: Lots 3 & 4; S½NW¼; SW¼ Northerly of Road R/W	Private (Ethel I. and William C. Jones)
T. 20N., R. 4W., S.M.	
Section 4 Section 9 Section 16 Section 21 Section 28 Section 33	State of Alaska (DNR)
T. 21N., R. 4W., S.M.	
Section 4: S½SE¼ Section 9 Section 16 Section 21 Section 28 Section 33	State of Alaska (DNR)
Section 4: N½SE¼; S½NE¼; Lot 1 & 2	Private (Cook Inlet Region, Inc.)
T. 22N., R. 4W., S.M.	
Section 4: E½ Section 9: E½ Section 16: N½SE¼; SE¼SE¼; N½SW¼SE¼ Section 28: E½	State of Alaska (DNR)
Section 16: N½; SW¼; S½SW¼SE¼ Section 21	Private (Cook Inlet Region, Inc.)
Section 33	Mat-Su Borough
T. 23N., R. 4W., S.M.	
Section 2: Lot 4; SW¼NW¼; W½SW¼	Private (Norman H. Read)
Section 10: S½SE¼; SE¼SW¼ Section 11: NW¼; W½W½SW¼ Section 15 Section 22: NW¼SW¼ Section 27: W½W½ Section 33	State of Alaska (DNR)
Section 22: N½; SE¼; E½SW¼; SW½SW¼	Private (Cook Inlet Region, Inc.)
Section 34: NW¼NW¼	Private (Alvera McClain)

9-1-3

DESCRIPTION:	OSTENSIBLE OWNER:
T. 24N., R. 4W., S.M.	
Section 1 Section 2: E½E½; S½NW¼NE¼; W½SE¼; SW¼NE¼; SE¼NW¼; NE¼SW¼; E½NW¼SW¼; SW¼NW¼SW¼; E½SW¼ excepting Tract 30 ASLS 79-109 Section 11: Excepting Tracts 30 & 31 of ASLA 79-109, USS 4063 & Yoder Road Section 14: N½NW¼ excepting Tract 31, ASLS 79-109	Private (Cook Inlet Region, Inc.)
Section 2: N½NW¼; SW¼NW¼; NW¼NW¼SW¼; N½NW¼NE¼	State of Alaska (DNR)
Section 2 & 11: Tract 30, ASLS 79-109	Private (Trude Hightower)
Section 11 & 14: Tract 31, ASLS 79-109	Private (G.G. Tomlinson)
Section 23 Section 26	Mat-Su Borough
Section 35: W½W½	Private (Harry J. Crimmins & Lawerence R. Schuffman)
T. 25N., R. 4W., S.M.	
Section 36	Private (CIRI)
T. 25N., R. 3W., S.M.	
Section 6 Section 7 Section 30: S½ Section 31	Private (CIRI)
Section 18 Section 19 Section 30: N½	State of Alaska (DNR)
T. 26N., R. 3W., S.M.	
Section 30: SW¼; W½W½NW¼	Mat-Su Borough
Section 31	Private (CIRI)
T. 26N., R. 4W., S.M.	
Section 1: E½	State of Alaska (DNR)
Section 12: E½ Section 13: E½ Section 24: E½ Section 25: NE¼	Mat-Su Borough

4-1-6

DESCRIPTION:	OSTENSIBLE OWNER:
T. 27N., R. 4W., S.M.	
Section 36: Excepting A.S.L.S. 74-77 & ASLA 74-78	State of Alaska (DNR)
T. 27N., R. 3W., S.M.	
Section 5 Section 8 Section 17 Section 19: SE¼SE¼ Section 20 Section 29: NW¼ Section 30 Section 31: Excepting A.S.L.S. 74-78	State of Alaska (DNR)
T. 28N., R. 3W., S.M.	
Section 5 Section 7: E½SE¼ Section 8 Section 17 Section 18: E½E½ Section 19 Section 20 Section 29 Section 32	State of Alaska (DNR)
Section 20 Section 29	Mining Claims located by Harold Parker
T. 29N., R. 3W., S.M.	
Section 3 Section 8: SE¼ Section 9 Section 10: N½NW¼; SW¼NW¼ Section 16: NW¼ Section 17 Section 20 Section 29 Section 32	State of Alaska (DNR)
T. 30N., R. 3W., S.M.	
Section 13: E½ Section 24 Section 25 Section 26 Section 34: SE¼ Section 35: NW¼; W½SW¼; NW¼NE¼SW¼; N½NE¼; N½NE¼	State of Alaska (DNR)
T. 30N., R. 2W., S.M.	
Section 5 Section 6 Section 7 Section 8 Section 18	U.S.A. (CIRI Selected)

9-1-5

Land Schedule

DESCRIPTION:	OSTENSIBLE OWNER:
T. 31N., R. 2W., S.M.	
Section 1 Section 2: SE¼SE¼ Section 10: SE¼ Southeasterly of Susitna River Section 11 Section 12 Section 15 Section 16: excepting USS 4851 Section 21: excepting USS 4851 USMS 2355 Section 28: W½ Section 32: SE¼ Section 33: W½; W½NE¼	State of Alaska (DNR)
Section 21: USMS 2355 & Gold Creek Assn. No. 2	Private Mining Claim (Clifford Driskell and Builders Millwork & Supply)
T. 32 N., R. 2W., S.M.	
Section 1: N½; N½S½ excepting USS 4602 & USS 4956; SE¼SE¼ Section 2: NE¼ Easterly of ARR excepting USS 4602 Section 12: E½E½ excepting Lot USS 4956 Section 13: E½E½ Section 24: E½E½ Section 25 Section 36: S½; NW¼	State of Alaska (DNR)
Section 1 & 2: Lot 4, USS 4956	Private (Buelah J. Colborn)
Section 1: Lot 2, USS 4602	Private (Estate of Oliver David Moore)
T. 33N., R. 2W., S.M.	
Section 14 Section 23 Section 26 Section 35: Easterly of ARR excluding USS 5515	State of Alaska (DNR)
T. 22S., R. 11W., F.M.	
Section 13: E½ Section 23: SE¼ Section 24 Section 26: E½ Section 35	State of Alaska (DNR)
T. 22S., R. 10W., F.M.	
Section 6 Section 7 Section 18	U.S.A. (BLM)

9-1-6

DESCRIPTION:	OSTENSIBLE OWNER:
T. 21S., R. 10W., F.M.	
Section 2 Section 3: E of Parks Highway Section 9: E of Parks Highway Section 10 Section 16 Section 20: E of Parks Highway Section 21: E½ Section 29 Section 30: E of Honolulu Creek and Parks Highway excepting AA6092 Section 31: E of Honolulu Creek excepting AA6078, AA7791, AA6092	State of Alaska (DNR)
T. 20S., R. 10W., F.M.	
Section 24: E of Chulitna River Section 25: E of Chulitna River Section 26: E of Chulitna River Section 35: E of Chulitna River	State of Alaska (DNR)
T. 20S., R. 9W., F.M.	
Section 4 Section 5: E of Parks Highway Section 7: E of Parks Highway	State of Alaska (DNR)
Section 8 Section 17 Section 18: Lots 2, 3, 4, E½W½, E½ Section 19	U.S.A. (BLM)
T. 19S., R. 9W., F.M.	
Section 12 Section 13 Section 14: E of Alaska Railroad Section 23 Section 26 Section 27: SE¼; E½NE¼; SW¼NE¼; S½SW¼; NE¼SW¼ Section 33: SE¼; S½NE¼; NE¼NE¼	Private (AHTNA, INC.)
Section 34	U.S.A. (AHTNA Selected)
Section 33: SW¼ Southerly of Parks Highway	State of Alaska
T. 19S., R. 8W., F.M.	
Section 4 Section 7 Section 8	Private (AHTNA, INC.)
Section 6: E½ Section 5	State of Alaska (DNR)

DESCRIPTION:	OSTENSIBLE OWNER:
T. 18S., R. 8W., F.M.	
Section 13 Section 23 Section 24 Section 25 Section 26 Section 27 Section 33 Section 34	U.S.A. (AHTNA Selected)
T. 18S., R. 7W., F.M.	
Section 3: NA F-14372	U.S.A. (David Nicklie, N/A)
Section 9: USS 5594	Private (Jake Tansy & Estate of Lilly Tansy)
Section 9 & 10: F-14360 NA	U.S.A. (Jack Tansy, N/A)
Section 17 Section 18	U.S.A. (AHTNA Selected)
Section 8: South of Parks Highway Section 9: excepting F-14360 & USS 5594 Section 10: NW¼ excepting F-14360, USS 5594 & F-14544 Section 3: excepting USS 5594, USS 5590 F-14372, F-14669, F-15557, USS 3229	Private (AHTNA Inc.)
T. 17S., R. 7W., F.M.	
Section 1: E of Parks Highway excepting USS 4434 Section 12: E of Parks Highway except USS 4322, USS 4434 & NA F-14665 Section 13: except F-14665 Section 23 Section 24 Section 26 Section 34: E½ except F-14372 Section 35	Private (AHTNA, INC.)
Section 12 & 13: m & b, F-14665	U.S.A. (Maggie Oliver, N/A)
Section 34: m & b, F-14372	U.S.A. (David Nicklie)
T. 16S., R. 7W., F.M.	
Section 1: E of Nenana River excepting USS 5576 Lot 2 Section 12: E of Nenana River Section 25: E of Nenana River excepting USS 5597 Section 36: E of Nenana River	Private (AHTNA, INC.)
Section 24: SE¼ excepting USS 5067	U.S.A. (AHTNA Selected)

DESCRIPTION:	OSTENSIBLE OWNER:
T. 16S., R. 6W., F.M.	
Section 6: excepting USS 5576 Section 7 Section 18: E of Nenana River excepting USS 3652 Section 19: E of Nenana River	Private (AHTNA, INC.)
T. 15S., R. 6W., F.M.	
Section 5: except F-17779 Section 8 Section 17: except USS 5604 Section 19: E of Parks Highway except USS 4040 & 5564 Section 30 Section 31: excepting Lot 2 USS 5576	Private (AHTNA, INC.)
Section 4 Section 9	U.S.A. (AHTNA Selected)
Section 20	U.S.A. (BLM)
T. 14S., R. 6W., F.M.	
Section 5 Section 6 Section 7 Section 18 Section 19: E of Nenana River Section 20 Section 29 Section 30: NE¼; E of Nenana River Section 32	State of Alaska (DNR)
T. 14S., R. 7W., F.M.	
Section 12 Section 13: E of Nenana River	State of Alaska (DNR)
T. 13S., R. 6W., F.M.	
Section 6 Section 7 Section 8 Section 16 Section 17 Section 18 Section 21 Section 28 Section 29 Section 32 Section 33	State of Alaska (DNR)
T. 13S., R. 7W., F.M.	
Section 1 Section 12	State of Alaska (DNR)

9-1-9

DESCRIPTION:	OSTENSIBLE OWNER:
T. 12S., R. 7W., F.M.	
Section 27 Section 28: E of Nenana River Section 34 Section 35 Section 36	State of Alaska (DNR)
Section 21: W½NW¼SW¼; W½E½NW¼SW¼; SW¼SW¼	Private (GVEA)

9-1-10

EXHIBIT E

9. Land Use

Comment 2 (p. E-9-13, para. 3)

Indicate the existing land values for the project area, transmission line corridor (including the Intertie), and adjacent lands to assist in substantiating statements in Section 3 of the Land Use chapter concerning changes in land values. Include a projection of future land values. If land values cannot be precisely determined for the project area or transmission line corridor, include some indication or examples of typical land values for the types of land in the project area.

Response

As indicated on p. E-9-13 in Chapter 9, Exhibit E of the License Application, land value data for the project area is generally unavailable due to land status and development characteristics. Market values apply only to state, borough, Native, or private lands that have been (or are to be) sold and developed, a status that is exhibited by only a small portion of the land in the project area and along the transmission corridor. Consequently, data for the areas of interest are sparse. Complete coverage is not maintained by public agencies or other sources. For example, the assessment program of the Matanuska-Susitna Borough principally covers only the Willow-Palmer area, with additional data for the few private parcels in the Parks Highway/Alaska Railroad corridor from Willow to Summit (e.g., the Cantwell-Broad Pass area). The sparse data coverage, combined with wide variations in land values based on location and other factors, makes it difficult to determine normal or typical values for lands adjacent to project facilities. The value of lands required for the project will not be established until the land-acquisition process occurs.

In the absence of a more comprehensive data series, information from the land disposal program of the Alaska Department of Natural Resources was assembled to provide a sample of land values near the project area and the transmission corridor. Data on subdivision and agricultural disposal parcels are useful as sample values because the purchase prices for these lands are established through a formal appraisal process prior to disposal. However, prices actually paid for these parcels are often much less than the appraisal price due to land discounts granted to qualified Alaska residents of up to 50 percent for non-veterans and 75 percent for veterans. Disposal parcels are often the only lands available for sale in remote areas of the state.

Data on unit prices, parcel size, type of access, and other factors are presented for eleven subdivisions and seven agricultural disposals in Table 1. As shown on the attached map, these disposals are located in the general vicinity of the project area or transmission corridor. In addition, all were active between 1981 and 1983. Nonetheless, this sample does not represent every disposal located near project facilities nor every disposal that was active during this period. For example, the sample does not cover the area around Anchorage where prices for individual lots may be $75,000 or more. As indicated on the map, the selected disposal areas are concentrated near the Parks Highway from Talkeetna to Anchorage and from Healy to Fairbanks. The Indian River Subdivision, the only parcel located within the general project area, is also along the Parks Highway. This location pattern is indicative of low-level development activity throughout this region of Alaska.

Unit prices for the subdivision sales listed in Table 1 range from $356 per acre in the Bald Mountain Subdivision, located approximately eight miles southeast of Talkeetna, to $5,268 per acre in the Parkridge Subdivision, located 14 miles west of Fairbanks. The wide disparity in the values of these two disposals may be explained by general location, site characteristics, and access. For example, the Parkridge Subdivision is view property

on a ridge adjacent to the Parks Highway and within easy commuting distance of Fairbanks. Therefore, this property would attract rather strong demand for suburban development. Conversely, the Bald Mountain area is more removed from large urban areas and the highway corridor. Currently, this land must be accessed via a cat trail by All-Terrain-Vehicle or snow-machine.

While land prices for the other nine subdivisions appear to reflect the pattern described above, the sample is too small and varied to identify definitive relationships. Sample values near the Healy-Fairbanks corridor are clearly highest for the two disposals close to Fairbanks, however per-acre values for disposal areas number 3 through 7 appear to be more dependent upon parcel size and site attributes than upon proximity to an urban area. The comparatively higher values for Puppy Haven, the only subdivision in the sample in the general vicinity of the southern transmission corridor, reflect its proximity to Anchorage and the greater level of development in the lower Susitna basin.

Agricultural land values are less variable, as indicated by the seven agricultural disposals in the sample. For example, appraisal prices range from $103 per acre at Moose Creek, located twelve miles southwest of Talkeetna, to $227 per acre for Delta Island, located four miles southwest of Willow. In general, land values are higher for the more southerly disposals due to climatic and marketing factors. Additionally, the proportion of Class II and III soils also appears to be a major price determinant.

A reliable projection of future land values in areas affected by the project cannot be provided. Land values have increased dramatically in Alaska during the past ten to fifteen years, as they have elsewhere in the United States. In addition to the broad-based economic forces underlying national real estate trends during this period, the recent Alaskan land value

escalation resulted from rapid population and economic growth and a restricted supply of land. As growth decelerates and state, borough, and Native corporation programs make more land available for development, land value appreciation is likely to taper off to an unpredictable level. This uncertainty would be prominent in developing land value projections for the undeveloped areas affected by the project, where a single event, such as the expansion or contraction of the state disposal program, could have a significant effect on the amount of available land and its price. Given these considerations, any land value projection would be merely speculation.

TABLE 1

SAMPLE LAND VALUE DATA

SUBDIVISIONS

Disposal Name	Map Number	Access Code	No. of Parcels	Ave. Parcel Size (acres)	Ave. Parcel Price ($)	Ave. Per Acre Price ($)
Northridge	1	1	18	11.6	26,450	2,277
Parkridge	2	1	13	5.3	27,796	5,268
Farmview	3	1	21	23.7	16,571	699
Nenana South	4	1	35	4.2	3,497	832
Anderson	5	3	53	36.9	22,245	603
June Creek	6	1	255	5.0	5,000	994
Panguingue Creek	7	3	165	6.0	5,684	953
Indian River	8	1	60	4.4	4,362	985
Bald Mountian	9	3	173	4.8	1,692	356
South Bald Mountain	10	3	84	11.6	5,955	511
Puppy Haven	11	3	13	38.8	41,530	1,069

AGRICULTURAL DISPOSALS

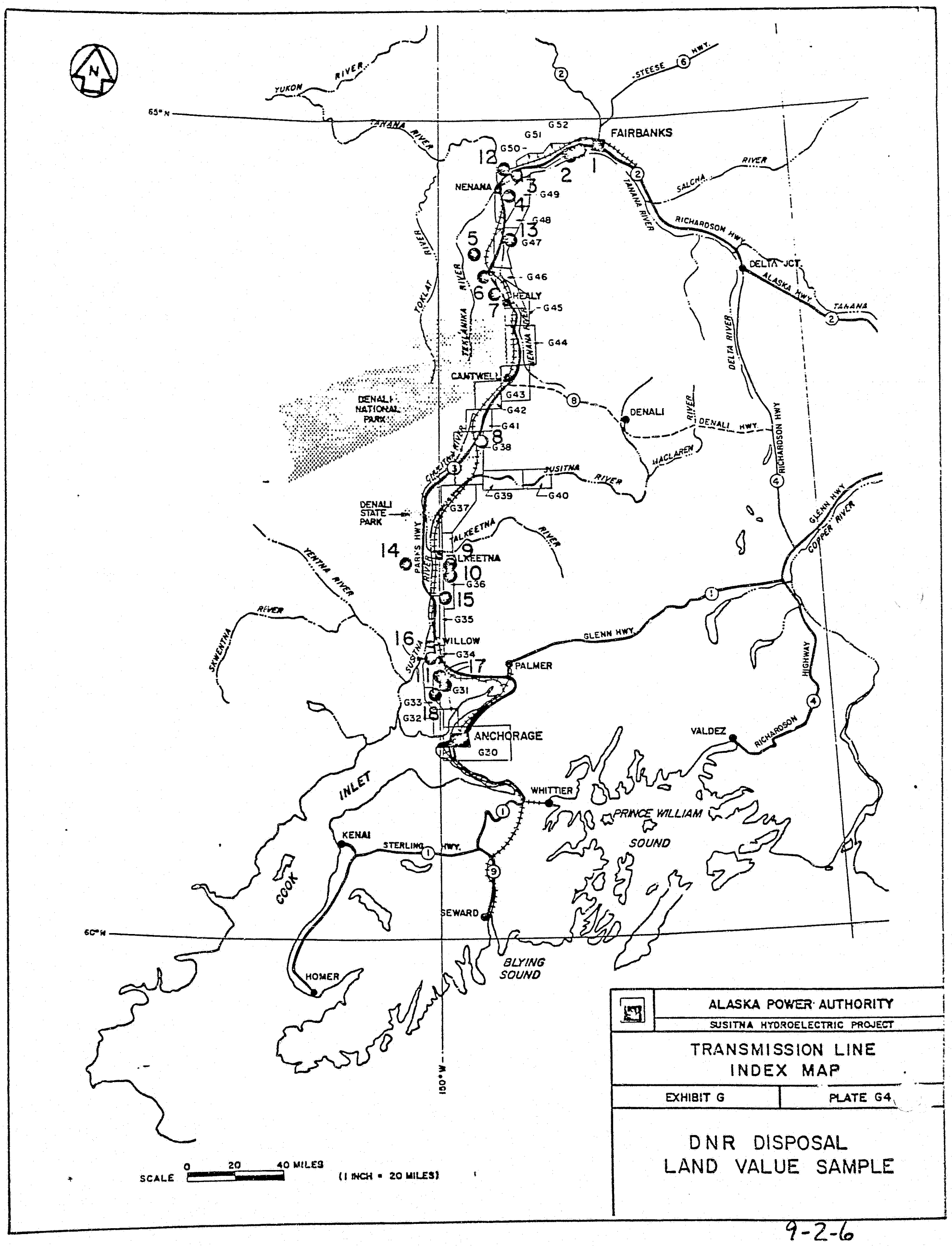
Disposal Name	Map Number	Access Code	No. of Parcels	Acres	Percent in Class II/III Soils	Ave. Per Acre Price ($)
Two Mile Lake	12	1	17	3,101	74	136
Brown's Court	13	1	9	1,775	96	134
Moose Creek	14	2	4	667	60	103
Goose Creek*	15	3	1	160	42	105
Delta Island	16	3	4	906	79	227
Nancy Lake	17	1	2	200	65	136
Little Susitna	18	2	3	560	73	152

*Crossed by project transmission line.

Access Code:

1 - Adjacent to (within one or two miles) the Parks Highway
2 - Served by major existing or planned secondary road
3 - Not accessed by main road

Source: Alaska Department of Natural Resources, Division of Land and Water Management. Materials prepared for State Land Disposal Brochures for 1981-1983 period.


N
YUKON RIVER
65° N
TANANA RIVER
STEESE HWY.
FAIRBANKS
G52
G51
G50
NENANA
G49
G48
G47
G46
HEALY
G45
G44
TOKLAT RIVER
TEKLANIKA RIVER
NENANA RIVER
CANTWELL
G43
G42
G41
G38
DENALI NATIONAL PARK
DENALI
DENALI HWY.
MACLAREN RIVER
SUSITNA RIVER
G39
G40
G37
DENALI STATE PARK
PARKS HWY
SUSITNA RIVER
TALKEETNA RIVER
TALKEETNA
G36
YENTNA RIVER
G35
SKWENTNA RIVER
WILLOW
G34
PALMER
G31
G33
G32
ANCHORAGE
G30
TANANA RIVER
SALCHA RIVER
RICHARDSON HWY
DELTA JCT.
ALASKA HWY
TANANA
DELTA RIVER
RICHARDSON HWY
GLENN HWY
COPPER RIVER
GLENN HWY
HIGHWAY
RICHARDSON
VALDEZ
WHITTIER
PRINCE WILLIAM SOUND
INLET
KENAI
STERLING HWY.
COOK
SEWARD
60° N
HOMER
BLYING SOUND
150° W
SCALE 0 20 40 MILES
(1 INCH = 20 MILES)
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
TRANSMISSION LINE
INDEX MAP
EXHIBIT G
PLATE G4
DNR DISPOSAL
LAND VALUE SAMPLE

9-2-6

EXHIBIT E

9. Land Use

Comment 3 (p. E-9-27, para. 3 to p. E-9-29, para. 6)

Describe existing land use management plans for the proposed transmission line corridor, including the intertie.

Response

Existing land use management plans for the transmission line corridor, including the Intertie portion, are generally described in Exhibit E, Chapter 9, Section 2.3 of the License Application. Land use jurisdiction is summarized below for the various segments of the Susitna transmission corridor.

Corridor Segment	Jurisdiction
Healy - Fairbanks	Fairbanks-North Star Borough; Alaska Department of Natural Resources; U.S. Department of Defense, National Park Service, and Bureau of Land Management; Ahtna Region, Inc.
Willow - Healy	Matanuska-Susitna Borough; Alaska Department of Natural Resources; U.S. National Park Service and Bureau of Land Management; Ahtna Region, Inc. and Cook Inlet Region, Inc.

Corridor Segment	Jurisdiction
Watana - Gold Creek	Matanuska-Susitna Borough; Alaska Department of Natural Resources; Cook Inlet Region, Inc.
Willow - Anchorage	Matanuska-Susitna Borough; Municipality of Anchorage; Alaska Department of Natural Resources; U.S. Department of Defense

The following discussion provides additional information on the planning activities in the jurisdictions outlined above.

In the Healy-Fairbanks corridor area, the Alaska Department of Natural Resources is developing a Tanana Area Plan. Currently only baseline information has been prepared; no policies or draft plans have been published. In addition, the Fairbanks-North Star Borough is preparing a comprehensive plan which covers approximately 25 miles of the northeastern portion of this segment. Furthermore, the Department of Natural Resources has an on-going and active disposal program in this region. Formal planning activities for Ahtna Region, Inc. lands have not begun. National Park Service and BLM activities are described in Chapter 9 of Exhibit E. Because the Healy-Fairbanks route avoids defense installations, the corridor would have no impact on plans for defense facilities in this area.

The planning activities of federal agencies and Native corporations within the Intertie corridor and the Watana-Gold Creek corridor are discussed in Chapter 9 of Exhibit E. While the planning efforts of the Mat-Su Borough were also described in Chapter 9, it should be noted that a draft of the Boroughs' new comprehensive plan was released in March, 1983. This plan, however, focuses on the more developed areas of the Borough and is directly

directly applicable to only about 30 miles of the Intertie corridor north of Willow. The creation and regulation of the Talkeetna Mountains Special Use District (see p. E-9-29 in Chapter 9) continues to represent the most significant Borough planning activity with reference to the transmission line in these areas. See pp. E-9-28, E-9-29, and E-9-54, in Chapter 9 for a discussion of the Alaska Department of Natural Resources planning activities.

Only a very small portion of the Willow-Anchorage transmission line corridor would be located within the Municipality of Anchorage. The municipality has both a current comprehensive plan and a draft utility corridor plan (Municipality of Anchorage 1982). The latter plan does not identify corridors within which future transmission lines would be located. Most of the transmission lines on the east side of Knik Arm would be located on federal military reservation lands under the jurisdiction of the U.S. Air Force (Elmendorf Air Force Base) and the U.S. Army (Fort Richardson). Master planning programs exist for both of these facilities.

The land use managment plans mentioned above and those listed in Chapter 9 of Exhibit E have been consulted with regard to the planning implications of the proposed transmission line. Additional and more detailed studies of planning activities and their relationships to the transmission line will occur during the continuing transmission studies. Identified planning concerns will be fully documented when these studies conclude in late 1983.

EXHIBIT E

9. Land Use

Comment 4 (p. E-9-31, para. 2, to p. E-9-52, para. 2)

Estimate impacts to land values within and adjacent to the project area and transmission line corridor.

Response

Impacts to land values within and adjacent to the project area and the transmission line corridor cannot be estimated with precision or certainty, due to the factors discussed in the response to Item 4. As stated on p. E-9-31 in Chapter 9, Exhibit E of the License Application, land values will tend to increase as a result of project-related activities, particularly for properties located along the Denali and Parks highways. However, given the small base of currently available land, the primary determinant of changes in land values will be in the supply responses of landowners. For example, if relatively little additional land is made available to accommodate project-induced development, land value increases could potentially be significant in areas where such development is concentrated. Conversely, much of the impetus for land value appreciation would be dissipated if public and private landowners responded to the project by greatly increasing the supply of developable land. Due to the transitional state of the land selection and management processes in the project area, it is not possible to accurately project these responses at this time.

EXHIBIT E

9. Land Use

Comment 5 (p. E-9-31, para. 2, to p. E-9-52, para. 2)

Indicate how proposed land uses within and adjacent to the project area and along the entire transmission line corridor will affect existing wetland and floodplain areas.

Response

Wetlands and project-related effects on wetlands are discussed in detail in Chapter 3, Exhibit E of the License Application. For example, existing wetland areas and wetland impacts are described on pp. E-3-220 through E-3-224 and on pp. E-3-245 and E-3-246, respectively. These discussions are supported by the quantification of vegetation impacts on pp. E-3-225 through E-3-244 and by Tables E.3.77 through E.3.86 and Figures E.3.38 through E.3.73. The responses to Comments 7 and 12 on the Botanical Resources Section of Chapter 3 should also be examined for corrections and additions to wetland impacts. These materials indicate the extent of wetland areas that would be occupied or disturbed by project facilities or inundated by the impoundments. In addition, they also describe the indirect effects on wetlands resulting from project development. The wetlands discussion on pp. E-9-21 through E-9-25 in Chapter 9 is keyed to the more extensive description and analyses in Chapter 3.

Project-related effects on floodplain areas were not described in detail in Exhibit E of the License Application, due to the lack of comprehensive data from which to identify floodplain areas. In general, floodplain effects will consist of direct effects resulting from project activities within floodplain areas, and indirect effects resulting from changed flow regimes or land use activity patterns. With the exception of the dams, project

facilities will be sited out of floodplains wherever possible. Nonetheless, some crossing of floodplains by the access road and transmission lines will be unavoidable. In general, the direct and indirect effects on floodplain resources (such as vegetation, wildlife, hydrology, and aesthetics) are described in Chapters 2 and 3 of Exhibit E, or can be inferred from the relevant resource discussions. For example, the effect of altered river flows on floodplain vegetation downstream from the project is identified on p. E-3-249 in Chapter 3. From a land use perspective, direct floodplain effects will be minor due to the generally low level of development and activity in the project area and along the transmission line corridor. However, the flow regulation and flood protection resulting from the project could indirectly contribute to land use development in floodplain areas downstream from Devil Canyon, such as in the Talkeetna area.

EXHIBIT E

9. Land Use

Comment 6 (p. E-9-49, para. 3, to p. E-9-51, para. 4)

Estimate induced land use changes (development and activity) for the intertie section of the transmission line corridor.

Response

Existing land use and land use impacts for the Anchorage-Fairbanks Intertie are described in the Intertie environmental assessement (Commonwealth Associates, Inc. 1982). The Intertie portion of the Susitna transmission line corridor will affect the same areas analyzed in the Commonwealth report. The incremental induced land use changes attributable to the Susitna transmission lines will be negligible. Any induced land use changes likely to result from increased access (such as possible effects on further residential development along the Fishhook-Willow Road and near Chase, Gold Creek, Cantwell, Indian River, and Healy) would result from the construction and maintenance of the Intertie and would occur with or without the Susitna project.

EXHIBIT E

9. Land Use

Comment 7 (p. E-9-50, para. 1)

Indicate if there are any other proposed agricultural sales along the entire transmission line corridor other than the Point MacKenzie agricultural sale.

Response

The following list identifies other proposed agricultural sales along the transmission line corridor in addition to the Point MacKenzie agricultural sale:

Willow to Anchorage Transmission Corridor

1) Fish Creek Management Unit -- located between the Point MacKenzie project and Red Shirt Lake. Agricultural sales will begin within the next two years. The proposed transmission corridor crosses approximately eleven miles of the Fish Creek unit. Planning for this unit is currently taking place. Therefore, the extent of agricultural sales is unknown.

2) Delta Islands agricultural disposal -- located approximately five miles southwest of Willow. The area is currently open for agricultural sales. The proposed transmission corridor is more than one mile from the Delta Islands disposal area.

Willow to Healy Transmission Corridor

1) Goose Creek Agricultural disposal -- 160-acre parcel (currently open for sale) located approximately seventeen miles southeast of Talkeetna, north of Goose Creek and east of Emil Lake. The Intertie easement occupies the western portion of the parcel, running one-half mile in length and 400 feet in width.

Healy to Fairbanks Transmission Corridor

1) Healy agricultural disposal -- begins approximately seven miles northwest of Healy and extends northward for six miles between the Parks Highway and the Nenana River. Agricultural sales will begin in Fiscal Year 1985. The proposed transmission corridor crosses six miles of the Healy disposal.

2) Windy agricultural disposal -- located south of the Clear Missile Early Warning Station. Agricultural sales will begin in Fiscal Year 1985. The proposed transmission corridor crosses approximately three miles of the Windy disposal.

3) Brown's Court agricultural disposal -- located ten miles south of Anderson and thirty miles north of Healy. Agricultural sales were offered in 1983. The transmission corridor passes approximately one-half mile from the southeastern corner of the parcel.

4) Goldstream agricultural disposal -- located west of the Bonanza Creek Experimental Forest. The agricultural sale is planned for Fiscal Year 1984. The prosposed transmission corridor either crosses or is adjacent to approximately 3.5 miles of the Goldstream disposal.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 1 (p. E-10-6, para. 5)

Provide the basis for determining the "cut-off points" for rating the 16 sites and and a description of how partial and total scores were integrated to yield selections.

Response

Cut-off points were established at 134 for total scores and 100 points for partial scores in order to select 10 of the 16 sites for more detailed development and cost estimates. The 10 sites were selected on the basis of total scores (which included eight criteria). Partial scores (which included 4 of the 8 criteria) were used only to validate the sites selected by using the total scores.[1]

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[1]Acres American, Inc. December 1981. Development Selection Report, Appendix C.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 2 (p. E-10-7)

Describe what, if any, geologic constraints were analyzed in assessing the alternative damsite impacts.

Response

No geologic constraints were analyzed in assessing the Snow and Keetna hydroelectric sites because little geologic information is available. At Snow River, a limited geologic reconnaissance was conducted of the site. The site is in a deep, narrow, incised gorge in bedrock composed of greywacke and slate (U.S. Department of Energy, 1980). Geologic conditions appear to be favorable based on the limited field reconnaissance.

At the Chakachamna hydroelectric site, an interim feasibility study has been completed which included an assessment of the geologic constraints which could impact the site (Bechtel, 1983). The potential constraints included the following:

(1) those associated with the physical layout of the civil structures (Lake Tapping, tunnel alignment/rock conditions, and the underground powerhouse site); and (2) those associated with the natural phenomena occurring within and adjacent to the project area (glacials, volcanic, and seismic activity).

The geologic constraints associated with the siting of the civil structures is a direct consequence of the level of investigations associated with an interim feasibility stage program. The sitings to date are based on no

subsurface exploration and very little geologic mapping. It was believed that suitable tunneling conditions would be encountered but there was a potential for high pressure groundwater conditions and high in-site rock stresses. Due to the proximity of the Lake Clark - Castle mountain fault to the underground powerhouse it was suggested that the structure be moved upstream away from the fault zone (see attached Figure 1). In one alternative, the construction of a major dam was proposed in Chakachatna Canyon. The foundation conditions on the north abutment consists of a complex sequence of lava flows, pyroclastics, volcaniclastics, outwash, and fill. It was suggested that construction of a dam across the canyon was likely to prove infeasible.

Glaciers

Barrier Glacier is the glacier that contains Chakachamna Lake and controls its water level. It was perceived that if hydroelectric development results in the lowering of the lake level the glacier may advance towards and block the Chakachatma River. A subsequent rise in the lake level could yield conditions conducive to an outburst flood from the lake. As a consequence, the lowering of the Chakachamna Lake level could cause the stream channels which drain adjacent lakes to incise their channels, thereby lowering the levels of the upstream lakes over time.

In the remote possibility Blockade Glacier advanced towards the McArthur River and caused the river bed to aggrade downstream, the tailwater level at the power plant site could rise. The extreme consequence would be blockage of the channel causing flooding of the powerhouse. The report states that no dramatic changes of these two glaciers is anticipated in the foreseeable future.

Volcanic Activity

The eruption of Mt. Spurr has occurred as recently as 1953. The probability of a major event occuring is small but it is a risk that would be associated

with development of the project. An eruption similar to the 1953 event would probably have little effect on the ability of the power facilities to continue in operation, but it could put the downstream fish passage facility out of service. The eruption could trigger a mud slide that could dam Chakachatna River thus flooding the facility. A catastrophic event similar to Mt. St. Helens, if directed towards the outlet and intake structures, could trigger a massive mudflow which could bury the upstream and downstream fish passage facility and the power intake. In addition, the heat generated by the pyroclastic ash flows could melt the lower parts of Barrier Glacier thus affecting the glacier's ability to contain Chakachamna Lake.

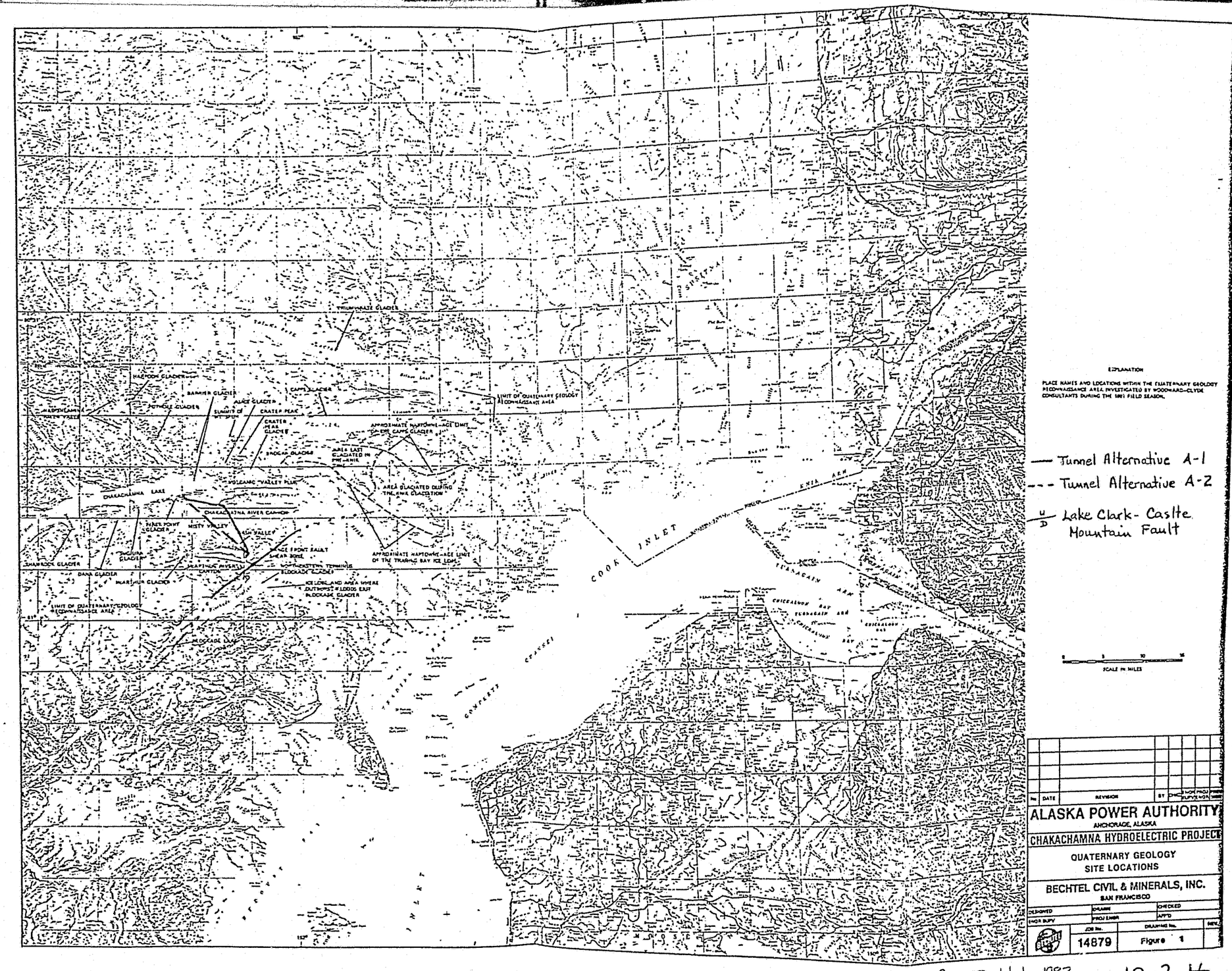
Seismic Activity

The potential seismic sources that may affect the site are the subduction zone and the Lake Clark-Castle Mountain fault. The Lake Clark-Castle Mountain fault crosses McArthur Canyon near the location of the proposed powerhouse (Figure 1). It is considered to be capable of causing a large earthquake with significant displacement during the life of the project. Therefore the proposed powerhouse location should be shifted some distance from the fault where the rock quality improves. The structure can be designed to withstand the ground motion but it is not possible to design against any significant displacement within the structure. Four faults or lineaments were identified in the Chakachatna Valley of which one trends toward the proposed power intake structure. Further investigation of these potential faults will be necessary.

REFERENCES

Bechtel, Civil and Minerals, Inc. 1983. Chakachamna Hydroelectric Project Interim Feasibility Assessment Report. Prepared for the Alaska Power Authority.

U.S. Department of Energy. 1980. Hydroelectric Alternatives for the Alaska Railbelt. Prepared for the Alaska Power Administration, Juneau.



from Bechtel, 1983

10-2-4

EXHIBIT E

10. Alternative Locations, Designs, and Energy Resources

Comment 4 (p. E-10-11, para. 5)

Provide a brief description of what is considered "typical scenic quality" for the Snow Site region.

Response

The Snow site is situated in an environmental setting that is typical of Alaska's Kenai Peninsula region. The site itself is located on the Snow River, one of the peninsula's major river drainage courses. The Snow River originates in the large glacial icefields in the Kenai Mountains immediately northeast of the Snow site. This mountain range is characterized by steep mountain peaks with sharply defined ridges, angular steep-sided crests, and conspicuous boulder outcrops. The Snow site region is visually dominated by these snow-capped peaks. Three prominent peaks (which rise to 4,000 feet or higher in elevation) surround the Snow site location. Snow and ice fields cover approximately 25 percent of this region, dominating the higher elevations year-round.[1/]

Steep slopes, elevation, and climatic conditions greatly influence the vegetation characterizing the Snow site region. Slopes above 4,000 feet in elevation are typically barren rock and talus surfaces with the timberline varying between 1,000 and 1,500 feet in elevation. Alpine vegetation and subalpine herbaceous meadows dominate slopes above the treeline, while mixed

1/ U.S. Department of Agriculture, Forest Service. May 1979. Visual Character Types. Juneau, Alaska.

conifer and deciduous species comprise much of the densely forested areas below. The glacially-carved valleys, rugged, snow-capped mountain ridges, and variety of vegetation characterizing the Snow site area create a potentially highly valued visual experience to the viewers.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 5 (p. E-10-11, para. 5, through p. E-10-12, para. 10)

Provide a brief description of the socioeconomic environment of the Snow and Keetna sites.

Response

A. Snow Site

As shown on the attached map, the Snow site is located in the Kenai Peninsula Borough approximately halfway between Seward and Moose Pass. Seward is the largest nearby population center, followed by Moose Pass and several smaller communities including Primrose, Lawing, and Lakeview.

Seward, a home rule city, had an estimated 1982 population of 1,828 (1982 Kenai Peninsula Borough Special Census). Commerical fishing and seafood processing contribute significantly to the income of area residents. Other major sources of employment include state and local government, service industries, and retail trade establishments. While timber harvesting and processing were large sources of employment historically, the lack of forested lands available for harvest and low demand for timber has significantly curtailed employment in this industry.

- About two-thirds of the housing units in Seward were single-family homes in 1982 (1982 Kenai Peninsula Borough Special Census) and a large number of housing units were rentals. In 1980, of the five principal communities in the Kenai Peninsula Borough, Seward had the highest proportion of rental units i.e., 45.4 percent (U.S. Bureau of the Census, 1980).

Law enforcement is provided by the Seward Police Department; while fire protection is the responsibility of a local fire department. Medical services are provided by Seward General Hospital, a two-doctor medical office, a chiropractor, a mental health clinic, and a nursing home. Water is provided by the city; waste water disposal is via the city sewer system.
Education facilities include one elementary school, one high school, and a branch of the Kenai Community College and a vocational training center. The 1982 enrollments at the elementary and high schools were 311 and 161, respectively.

Seward is the southern terminus of the Alaska Railroad. Additionally, it is connected to Anchorage by the Seward-Anchorage state highway, and is served by the Alaska ferry system.

The population of Moose Pass is 315 (1982 Kenai Peninsula Borough Special Census). The federal government is a major source of employment for residents of this area, since many residents work for the Alaska Railroad and the U.S. Forest Service. Additionally, some residents of the area commute to work in Seward and other nearby employment centers.

Housing consists primarily of owner-built, single-family structures. Police protection is provided by a resident state trooper, while fire protection is the responsibility of a volunteer fire department. The nearest medical services are at Seward. There is one elementary school (grades 1-8) in Moose Pass with a total enrollment of 30 children. Water is obtained from wells, and wastewater is disposed in individual septic tanks. Ground transportation to and from Moose Pass, which is principally via the Seward-Anchorage and Sterling highways, is variable, depending on the weather. There are no public airfields in close proximity to Moose Pass.

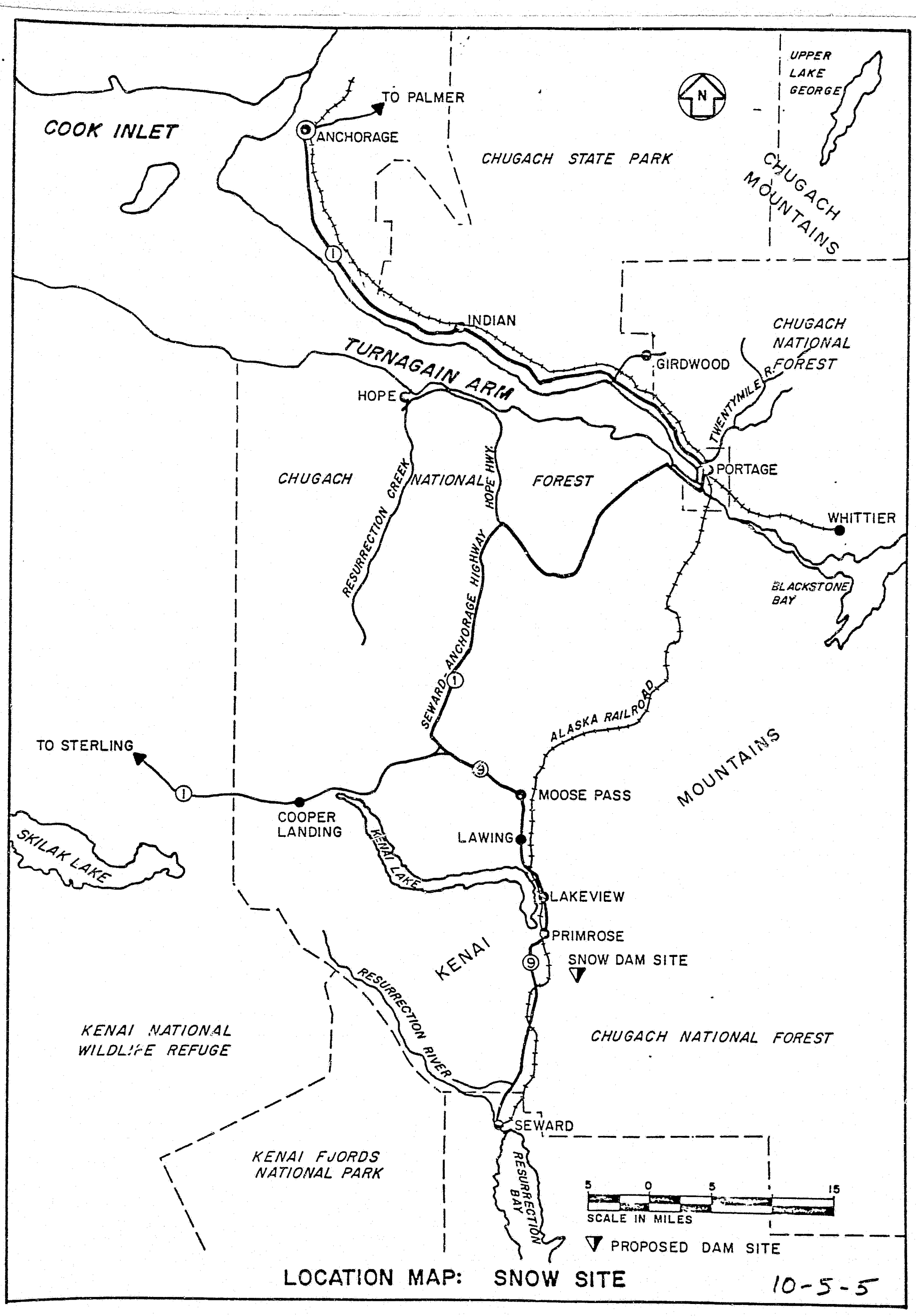
The Kenai Peninsula Borough and the City of Anchorage would contribute significantly to the work force for the project. The work force in the borough was estimated at 12,300, with a 9.8 percent unemployment rate in 1981. During the same year Anchorage had an estimated work force of 91,671 and a 6.9 percent unemployment rate (Bechtel 1981).

B. Keetna Site

The Keetna site (as shown in the attached map) is located on the Talkeetna River in a sparsely populated area of the Mat-Su Borough. The only community in the vicinity of the site is Talkeetna, with a 1981 population of approximately 640. The community of Trapper Creek, population 225, is located approximately sixty road miles west of Talkeetna and the Susitna River. North of Talkeetna, there are a number of small cabins that are not accessible by road. Major sources of income in the area are generally associated with tourism and recreation, including retail sales and guiding businesses. Other large employers include public schools, the Alaska Railroad, and the Federal Aviation Association (Alaska Power Authority 1983).

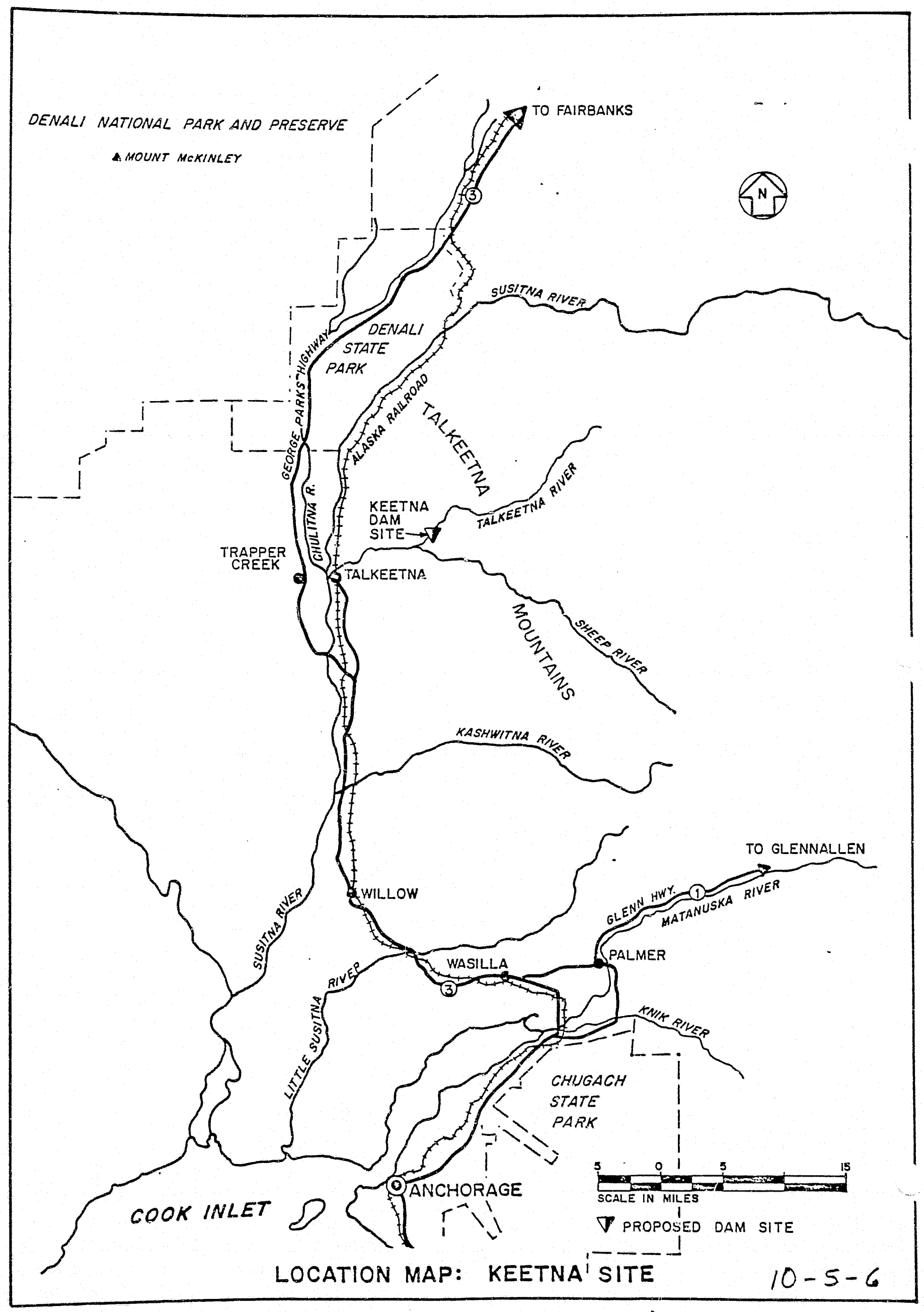
Almost all housing in the area consists of single family dwellings. There is one elementary school located in Talkeetna (1981 enrollment of 65) and one junior-senior high school (1981 enrollment of 122) approximately 30 miles south. Police protection is provided by the Alaska State Troopers at the Trapper Creek substation. (There are currently three officers assigned to the substation.) Talkeetna supports a fire service area and recently purchased new equipment for the Talkeetna firehouse. Medical care is provided by the Valley hospital in Palmer, private doctors in the southern part of the Mat-Su Borough, and facilities in Anchorage and Fairbanks. There is an ambulance located at the Talkeetna firehouse and volunteer Emergency Medical Trainees (EMTs) living in the vicinity. Water and sewage are provided by independent wells and septic tanks. The major transportation routes to the area include a spur of the Parks Highway, which ends at Talkeetna, and the Alaska Railroad. (Alaska Power Authority 1983.)

The southern portion of the Mat-Su Borough and the metropolitan areas of Anchorage and Fairbanks would contribute to the work force of the project. In 1981, the work force and unemployment rate in the Mat-Su Borough were 9,362 and 12.8 percent, respectively (Alaska Department of Labor 1983), compared to Anchorage which had a work force of 91,671 and 6.9 percent unemployment in the same year (Bechtel 1981), and Fairbanks which had a 1981 work force of 20,813 and an unemployment rate of 12.1 percent (Alaska Department of Labor 1983).



LOCATION MAP: SNOW SITE

10-5-5



LOCATION MAP: KEETNA SITE

10-5-6

EXHIBIT E

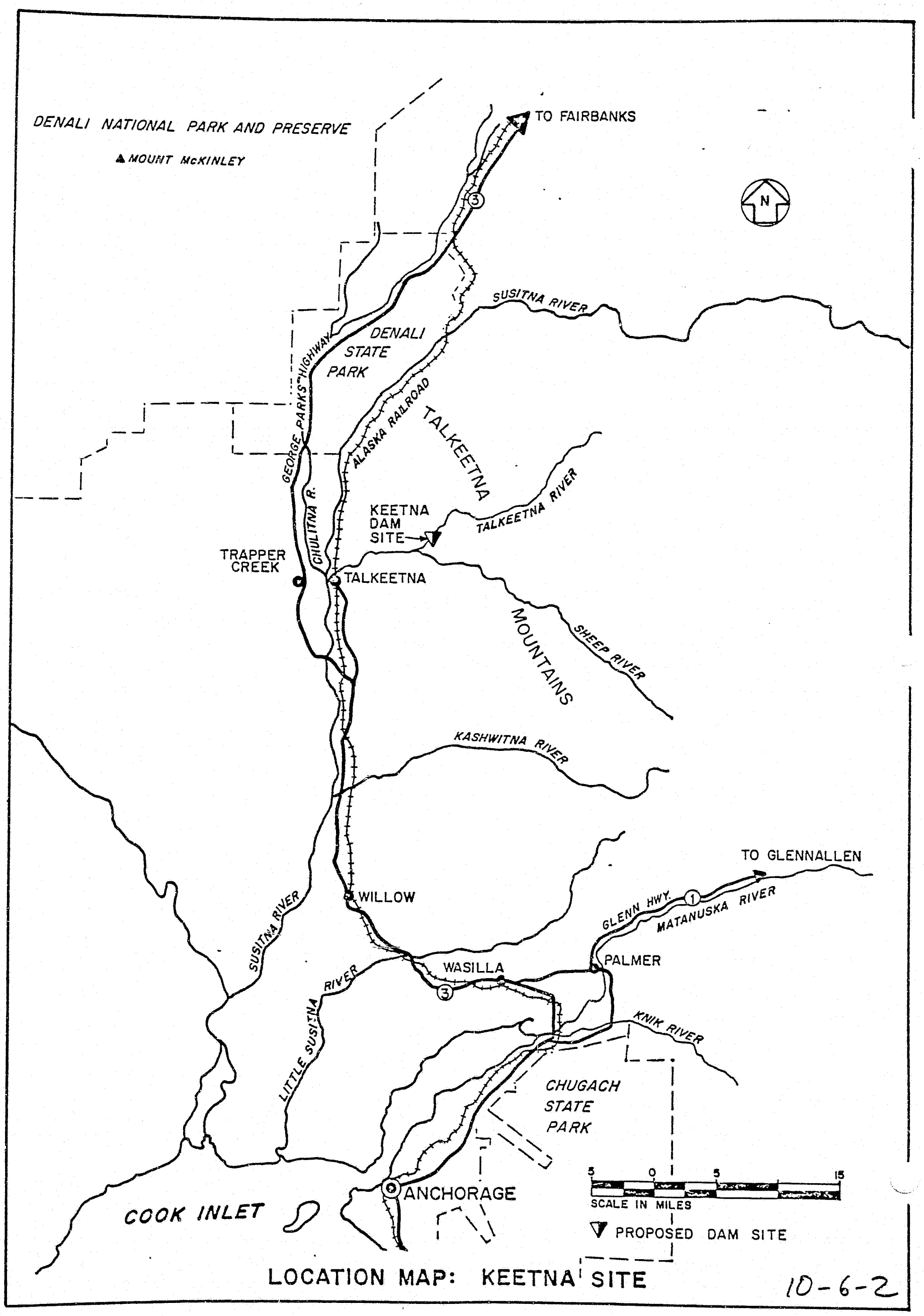
10. Alternative Locations, Designs, and Energy Resources

Comment 6 (p. E-10-12, para. 10)

Provide a brief description of the identified land uses for the Keetna site.

Response

Identified land uses in the area of the Keetna site (see attached map) are characterized by dispersed, low-intensity recreational and subsistence activities typical of remote areas in this region of Alaska. The closest land development consists of several homesteads at Larson Lake, approximately 13 miles southwest of the site (see p. E-9-20 in Chapter 9, Exhibit E of the License Application). Boating and off-road driving activities near the Keetna site are delineated in Figure E.7.4 in Chapter 7; fishing and boating are indicated activities further upstream. As described on p. E-7-22 in Chapter 7, approximately four to six boating parties are airlifted into Stephan Lake each year. In the site evaluation process (see Tables E.10.6 and E.10.7 in Chapter 10), the Keetna area was rated as having moderate recreational sensitivity (primarily due to existing and potential boating activity), and low agricultural, wilderness, and restricted land use sensitivities.



LOCATION MAP: KEETNA SITE

10-6-2

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 7 (p. E-10-13, para. 1)

Provide estimates of the acreage of vegetation that would be lost by construction of the Chakachamna, Snow, and Keetna sites.

Response

The Chakachamna project involves a lake tap rather than a reservoir and, thus, will affect relatively little vegetation. However, the operating range of the lake will be modified. The lake outlet will be raised by about 27 feet (8 m) and the operating maximum level will be the same as the historical maximum level, while the operating minimum level will be less than the natural minimum. More frequent indundation (than under natural conditions) and shoreline destabilization may effect small areas of shoreline vegetation, but the anticipated changes cannot be "refined" until site-specific, field verified, habitat maps have been prepared and the operating reservoir levels better defined. (Bechtel Civil & Minerals, Inc. 1983. Chakachamna Hydroelectric Project, Interim Feasibility Assessment Report. Volume I, Section 7. Prepared for Alaska Power Authority.)

The Snows and Keetna Projects have been studied only at a very preliminary reconnaissance level. Based on these data, the Snow Project would have a reservoir area of about 2,600 acres. About 2,000 acres of this area is presently vegetated. Similarly, the Keetna project would have a reservoir area of about 4,800 acres, including about 4,100 acres of vegetated area.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 8 (p. E-10-23, para. 6)

Provide a comparison of socioeconomic factors (e.g., housing, transportation, community attitudes) in the comparison of alternative plans.

Response

Because the alternative hydroelectric plans (discussed in Exhibit E, Chapter 10, Section 1.3 of the License Application) are all located within the Middle Susitna Basin and because a construction camp would be provided to accommodate project workers, communities in the project area are expected to be similarly affected by any one of the alternatives, assuming that work force requirements, project schedule, and local purchases are comparable for each alternative.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 9 (p. E-10-24, para. 3ff)

Indicate what weighting was assigned to economic, environmental, and social attributes.

Response

The comparison of alternative basin development plans described in Chapter 10, Section 1.3.5 of the license application considered economic, environmental, and social attributes. Specific weights were not assigned to the factors; rather, they were considered to be generally equal. A paired comparison technique was used which evaluated each pair of plans individually. The selected plan was then compared with the next alternative plan. When conflicts among the criteria were identified, a subjective tradeoff was conducted and the consequences documented.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 10 (p. E-10-26, para. 5 to p. E-10-28, para. 5)

Provide estimates of the acreage of vegetation that would be lost by construction of the High Devil Canyon-Vee damsites.

Response

Construction of the High Devil Canyon-Vee damsites would result in the following estimated vegetated and unvegetated area losses. The figures account for the impoundments, dams and spillways, camps and villages, and borrow areas. However, design of these projects has not proceeded far enough to allow more than crude estimates of area requirements for these latter project features.

	Vegetated Area		Unvegetated Area		Total	
	ha	acres	ha	acres	ha	acres
High Devil Canyon*	7,400	18,400	2,500	6,200	10,000	24,600
Vee Canyon**	3,500	8,700	600	1,400	4,100	10,100
Total	10,900	27,100	3,100	7,600	14,100	34,700

*Impoundment Area = 24,000 acres

**Impoundment Area = 9,400 acres

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 11 (p. E-10-27, para. 6)

Provide documentation for importance of Vee reservoir area to key furbearers.

Response

The Vee Canyon Reservoir area is outside the intensive furbearer study area of Gipson et al. (1982) and has never been systematically searched or surveyed for furbearers. No data are provided by Gipson et al. on use of areas upstream of Vee Canyon by aquatic furbeaers or marten, the furbearers identified as "key" species in the current report. Mention is made in Gipson et al. of the presence of lynx in the upper reaches of the proposed Watana impoundment near the mouth of the Oshetna River. Also, aerial transects for furbearer sign, which extended upstream almost to the Tyone River, demonstrated that the number of fox tracks increased markedly between Devil Canyon and the Tyone River. Foxes were most often found in vegetation types at elevations above the river valley in the study area with the exception of black spruce flats upstream from Vee Canyon. In addition, Gipson et al. states: "At the upper reaches of the proposed (Watana) impoundment fox density was observed to increase markedly. The south side of the river above Vee Canyon changes from mountainous terrain to open, marshy flats which are characteristic of good fox habitat." These "marshy flats" are also likely to be more attractive to most aquatic furbearers than "mountainous terrain".

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 12 (p. E-10-38, para. 5)

Describe the criteria used for evaluating responsiveness of access plans.

Response

Eighteen alternative access plans were evaluated according to the list of criteria on p. E-10-37 in Chapter 10, Exhibit E of the License Application. That evaluation produced seven access plans (all of which were located within three basic corridors). Those seven plans, in turn, were evaluated according to a subset of the criteria listed on p. E-10-37. That subset included the following:

1. No prelicense construction.

2. Minimize construction duration and maximize net project benefits.

3. Provide access between sites during project operation phase.

4. Provide access flexibility to ensure project is brought on-line within budget and schedule.

5. Accommodate preferences of Gold Creek and Indian River Communities.

As a result of this process, Plans 13, 16, and 18 were recommended as the most responsive plans.

10. Alternative Locations, Designs, and Energy Sources

Comment 13 (p. E-10-40, para. 2)

Explain how aesthetic resource issues were factored into the evaluation and comparison of alternative access plans.

Response

Aesthetic resource issues were assessed in relationship to all project facilities, including alternative access plans (as described in Exhibit E, Chapter 8, p. E-8-5 of the License Application). Aesthetic value ratings and absorption capabilities were assigned to all relevant areas and calculated into composite aesthetic ratings for each landscape character type, including access alternatives. Nonetheless, aesthetic resource issues were of less importance in the route selection process than were factors such as cost, access flexibility, schedule, environmental impacts, and land use (see list on p. E-10-37 in Chapter 10, Exhibit E of the License Application). While preferences of the local communities, Native organizations, and agencies were considered, the effort focused on the listed criteria at the route selection stage. Aesthetics issues will subsequently be used as decision factors in the detailed routing and design process, which will be completed in September 1983. (Access Plan Recommendation Report, August 1982, Acres American, Inc.)

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 14 (p. E-10-42, para. 1, to p. E-10-43, para. 2)

Indicate whether the alternative access route corridors will follow the alignments shown in Figures E.10.7 and E.10.8 or those in Figures E.3.42 through E.3.47. If the alignments shown in Figures E.10.7 and E.10.8 will be used, then provide vegetation and wetlands maps for these alternative routes. Also provide estimates of the number of hectares of vegetation types that would be cleared for the alternative access routes.

Response

For the southern route and a portion of the northern route none of the figures are correct. Vegetation Maps 1 and 2 with the correct routes are contained in Supplemental Attachments 10-14-1 and 10-14-2. Only segemnts requiring correction are depicted. The conversion from the vegetation types on the map to the Fish and Wildlife Service wetland categories (Cowardin et al. 1979) is in Table E.3.81. Areas of vegetation types for estimation of clearing and wetlands for the first six miles of road from Hurricane were calculated from the 1982 State of Alaska Department of Natural Resources Talkeetna Mountain Quad vegetation map. This map is not included, but detailed remapping of vegetation and wetlands in the project area is planned and new vegetation and wetland maps covering the entire area of the access routes will be submitted when available. Areas of vegetation types to be cleared for each access route are in Table 1.

Reference

Cowardin, L.M., V. Carter, F.C. Golet and E.T. LaRoe, 1979. Classification of Wetlands and Deepwater Habitats of the United States. Pub. FWS/BS-79-31. U.S. Fish and Wildlife Service.

TABLE 1

AREA OF VEGETATION TYPES TO BE CLEARED FOR ALTERNATIVE ACCESS ROUTES

	Route					
	Denali		North		South	
Vegetation Type	Hectares	Acres	Hectares	Acres	Hectares	Acres
Forest						
Woodland white spruce	5.7	14.2	41.3	102.1	24.7	60.7
Open white spruce	16.5	40.8	51.8	128.1	45.9	113.4
Woodland black spruce	1.8	4.4	--	--	4.1	10.2
Open black spruce	1.9	4.8	1.7	4.1	24.1	59.6
Open birch	0.6	1.5	1.2	2.9	1.8	4.3
Closed birch	0.9	2.2	-	-	-	-
Closed balsam poplar	0.3	0.7	-	-	0.6	1.4
Open mixed	18.5	45.7	11.2	27.6	28.8	71.0
Closed mixed	30.8	76.2	23.3	57.6	103.1	245.5
TOTAL	77.1	190.5	130.5	322.4	233.1	575.1
Shrubland						
Open tall	7.9	19.6	17.7	43.6	24.1	59.6
Closed tall	22.0	54.5	48.0	118.6	34.7	85.8
Low (birch)	123.5	305.1	64.6	159.7	28.3	69.8
Low (willow)	87.1	215.3	10.0	24.7	6.4	16.0
Low (mixed)	44.4	109.8	34.7	85.8	35.3	87.2
TOTAL	285.1	704.3	175.0	432.4	128.8	318.4
Tundra						
Wet sedge-grass	17.6	43.4	2.6	6.4	2.4	5.7
Sedge-grass	17.7	43.6	-	-	1.2	2.9
Sedge shrub	7.5	18.5	10.0	24.7	15.3	37.8
Mat and cushion	41.5	102.5	10.6	26.2	18.3	45.0
Grassland	-	-	0.9	2.3	-	-
TOTAL	84.2	208.0	24.1	59.6	37.2	91.4

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 15 (p. E-10-42, para. 1, to p. E-10-43, para. 2)

Estimate the acreage of wetlands to be impacted by each of the three alternative access routes, and provide a brief comparison among routes of the extent of access route effects on wetland drainage patterns.

Response

The area of wetlands impacted by each of the three alternative access routes is presented in Table 1. These estimates are based on the conversion of Viereck and Dryness vegetations types to Fish and Wildlife Service Wetland classes as described in Chapter 3 (Table E.3.81). These estimates of wetlands are very conservative. To refine the comparison among routes of the effects of access roads on wetland drainage patterns, information from engineering studies (particularly on soils) was also evaluated.

TABLE 1
AREA OF WETLANDS ON THREE ALTERNATIVE ACCESS ROUTES

	Route					
	Denali		North		South	
Wetland Type	Hectares	Acres	Hectares	Acres	Hectares	Acres
Palustrine Forested	20.5	50.7	53.5	132.2	74.7	184.6
Palustrine Shrub-scrub	225.0	630.2	109.3	270.2	70.0	173.0
Palustrine or Lacustrine emergent	17.6	43.4	2.6	6.4	2.4	5.7
TOTAL	263.1	724.3	165.4	408.8	147.1	363.3

The wetlands area from Hurricane to Indian River is part of both the southern and northern access routes and has a relatively high potential for drainage alteration. Soils in this area have a poor bearing capacity, and any excessive settlement of the road in such areas would make installation and maintenance of culverts difficult.

Estimated area of wetlands is similar for the two routes beyond Indian River and the potential for alteration of drainage patterns is also similar for the two routes.

The Denali route does not have any wetlands with as high a potential for drainage alteration as the Hurricane-Indian River segment on the North and South routes, but the total potential wetlands area is greater.

Drainage alterations can be avoided or minimized by careful analysis of surface drainage patterns during the detailed civil design phase. Proper placement of adequate numbers of culverts and other drainage structures, monitoring after construction, and installation of additional drainage structures if unanticipated drainage problems occur (see also response to Comment 18, Botanical Resources, Chapter 3, Exhibit E). A more detailed answer to this question will be possible when planned detailed wetlands mapping is available.

Reference

Cowardin, L.M., V. Carter, F.C. Golet and ET. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Published FWS/BS-79-31. U.S. Fish and Wildlife Service.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 17 (p. E-10-49, para. 5)

Describe weighting factors given to the criteria used in making the final choice.

Response

The choice of access routes was made with an emphasis on project objectives and general concerns of communities and resource agencies. While criteria were established and used in the selection process, specific weighting differentials were not developed for the criteria. Access flexibility and construction schedule compliance were emphasized in the final selection process, since cost considerations were not a key criterion. (Access Plan Recommendation Report, August 1982, Acres American, Inc.)

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 18 (p. E-10-54, para. 4)

Provide a description of the selection process for routing from Healy to Willow.

Response

The route-selection process used by Commonwealth Associates, Inc. to select a transmission line corridor from Healy to Willow is summarized on the attached flow chart. In general, the selection process first developed constraint maps and identified potential corridors. Objectives followed throughout the selection process included:

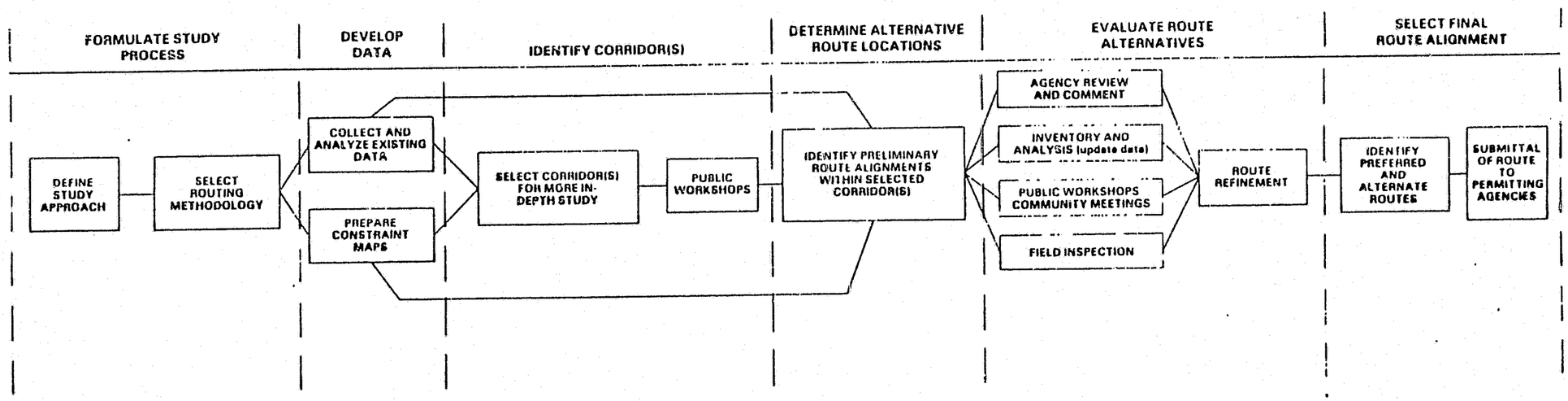
- Minimizing impact on land use,
- Minimizing conflict with existing lifestyles,
- Minimizing impact on natural systems,
- Minimizing visual impact,
- Minimizing impact on cultural resources,
- Maximizing sharing of existing rights-of-way, and
- Optimizing construction and operating costs.

The corridor-selection step produced potentially feasible corridors which were both technically acceptable (from an engineering, maintenance and system reliability point of view) and environmentally acceptable. Public workshops were held to review the corridor selection.

Within the corridors, preliminary route alignments were then identified based on data collected on terrain, topography, land ownership, stream crossings, property lines, scenic quality, and land use. Those alignments were reviewed with agencies and the public and revised in an iterative process according to engineering, environmental, and economic criteria. Detailed engineering and economic refinement analyses were performed on the preferred and alternative alignments as part of the final route selection process.

Route Selection Process

ANCHORAGE-FAIRBANKS TRANSMISSION INTERTIE



Source: Environmental Assessment Report: Anchorage-Fairbanks Transmission Intertie, Commonwealth Associates Inc., March 1982.

FIGURE 19

10-18-3

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 19 (p. E-10-61, para. 1)

Provide the criteria for assigning ratings to each alternative corridor.

Response

As stated on p. E-10-56 in Chapter 10, Exhibit E of the License Application, environmental criteria were carefully scrutinized in the screening process for the transmission line corridors. The primary environmental considerations were: aesthetic and visual (including impacts to recreation) and land use (including land ownership and the presence of existing rights-of-way). Additionally, the following environmental considerations were also considered to be significant in the evaluation process: Length of the transmission line, topography, soils, cultural resources, vegetation, fishery resources, and wildlife resources. In order to compare the alternative corridors environmentally, the environmental criteria were presented in a series of tables (see Tables E.10.21 through E.10.23 in Chapter 10), that illustrated combinations of environmental constraints for each corridor segment under study. An environmental rating was then assigned to each corridor that identified the relative rating of each corridor within the three study areas. The assignment of environmental ratings was a subjective technique intended as an aid to corridor screening.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 20 (p. E-10-61, para. 3, to p. E-10-77, para. 2)

Provide estimates of the number of hectares of wetlands within each of the alternative transmission corridors in the Northern and Southern Study Areas and each of the technically and economically acceptable alternatives in the Central Study Area. Provide similar estimates for vegetation types that will require extensive clearing.

Response

Estimates of the number of hectares of each vegetation type to be crossed by the alternative transmission corridors which are technically and economically acceptable are presented in Tables 1, 2, and 3 for the Northern, Central, and Southern Study Areas, respectively. Similar data are presented for wetlands in Tables 4, 5, and 6, respectively.

A variety of maps were used for the different study areas and an attempt was made to be consistent within study areas. Therefore, in the attached tables, data for the proposed routes are consistent with data for alternative corridors in the same study area. However, data for the proposed routes are not entirely consistent with the data presented for them in Chapter 3 of Exhibit E, which was derived from different maps.

U.S. Fish and Wildlife Service National Wetlands Inventory maps were not available except in the Southern Study Area. However, these data were not complete enough to allow for comparisons among routes.

TABLE 1

HECTARES OF EACH VEGETATION TYPE TO BE CROSSED BY THE TECHNICALLY AND ECONOMICALLY ACCEPTABLE ALTERNATIVE TRANSMISSION CORRIDORS IN THE NORTHERN STUDY AREA[1]

	Corridor[2]	
Vegetation Type	ABC	ABDC
Tall Conifer	21	0
Closed Tall Conifer	26	2
Open Intermediate Conifer	0	15
Dwarf Conifer	191	102
Closed Dwarf Conifer	158	268
Open Dwarf Conifer	146	110
Woodland Dwarf Conifer	50	96
Closed Deciduous	0	3
Closed Tall Deciduous	84	78
Closed Intermediate Deciduous	71	57
Open Mixed Forest	85	85
Closed Tall Mixed Forest	171	74
Tall Scrub	13	3
Closed Tall Scrub	35	106
Low Scrub	22	0
Closed Low Scrub	125	169
Open Low Scrub	100	100
Regrowth-Cutting area	6	0
Barren-strip mines/gravel pits	9	6
Water-rivers, streams	9	18
Total	1322	1292

[1] Based on 1:250,000-scale State of Alaska, Department of Natural Resources vegetation maps for the Fairbanks and Healy Quads. In many cases, individual map polygons were mapped as complexes (i.e., the polygon was labelled with two vegetation types consisting of a primary and a secondary type). In these cases only the primary components of the mapping complexes were tabulated.

[2] See Figure E.10.12 for corridor locations, corridor width equals 91 m (300 ft).

TABLE 2

HECTARES OF EACH VEGEATION TYPE TO BE CROSSED BY THE TECHNICALLY AND ECONOMICALLY ACCEPTABLE ALTERNATIVE TRANSMISSION CORRIDORS IN THE CENTRAL STUDY AREA[1/]

	Corridor[2/]						
Vegetation Type	ABCD	ABCF	ABECD	AJCD	ABECF	AJCF	CJAHI
Forest							
Open Spruce	88	88	97	6	97	6	6
Woodland Spruce	94	94	112	-	112	-	50
Closed Mixed	334	93	331	311	90	70	35
Open Mixed	38	123	56	74	141	159	84
Shrubland							
Open Tall	9	104	15	50	110	145	305
Birch	118	118	103	41	103	41	131
Willow	-	-	6	74	6	74	74
Mixed Low	-	-	7	-	7	-	208
Tundra							
Sedge-grass	-	-	3	-	3	-	-
Mat and cushion	-	-	10	-	10	-	163
Mat & cushion/ sedge-grass	-	-	26	50	26	50	50
Alpine Herbaceous	-	-	-	-	-	-	88
Snow and Ice	-	-	-	-	-	-	160
Barren	-	-	-	-	-	-	40
Water	10	-	16	16	6	6	6
Total	691	620	782	622	711	551	1400

1/ Based primarily on 1:250,000-scale mapping of McKendrick et al. (1982). The 1:63,000-scale mapping of McKendrick et al. (1982) and the 1:250,000-scale State of Alaska, Department of Natural Resources vegetation map of the Healy Quad were used for portions of some routes where the primary mapping did not have coverage.

2/ See Figure E.10.11 for corridor locations. Corridor width equals 91 m (300 ft) in areas with two circuits and 155 m (510 ft) in areas with four circuits.

TABLE 3

HECTARES OF EACH VEGETATION TYPE TO BE CROSSED BY THE TECHNICALLY AND ECONOMICALLY ACCEPTABLE ALTERNATIVE TRANSMISSION CORRIDORS IN THE SOUTHERN STUDY AREA[1/]

	Corridor[2/]		
Vegetation Type	ABC	ADFC	AEFC
Closed Conifer Forest	13	74	62
Open Coifier Forest	9	7	44
Closed Deciduous Forest	259	29	31
Mixed Forest	0	0	110
Closed Mixed Forest	512	110	0
Open Mixed Forest	53	54	34
Open Dwarf Tree Scrub	13	31	12
Open Tall Shrub-Scrub	49	0	0
Open Low Shrub-Scrub	0	38	0
Dry to Mesic Herbaceous	0	24	0
Wet Herbaceous	84	57	212
Sphagnum Bog	6	177	78
Water	16	0	0
Barren	6	0	0
Urban/Built-up	77	0	0
Total	1,097	601	583

1/ Based on 1:250,000-scale State of Alaska, Department of Natural Resources vegetation map for the Anchorage Quad. In many cases, individual map polygons were mapped as complexes (i.e., the polygon was labelled with two vegetation types consisting of a primary and a secondary type). In these cases only the primary components of the mapping complexes were tabulated.

2/ See Figure E.10.10 for corridor locations. Corridor width equals 91 m (300 ft).

TABLE 4

HECTARES OF POTENTIAL WETLANDS TO BE CROSSED BY THE TECHNICAL AND ECONOMICALLY ACCEPTABLE ALTERNATIVE TRANSMISSION CORRIDORS IN THE NORTHERN STUDY AREA[1/]

	Corridor[2/]	
Wetland Type	ABC	ABDC
Palustrine Forested	616	648
Palustrine Scrub-Shrub	295	378
Riverine	9	18
Total	920	1044

1/ Based on converting vegetation types given in Table 1 to the corresponding Cowardin et al. (1979) wetland types.

2/ See Figure E.10.12 for corridor locations.

TABLE 5

HECTARES OF POTENTIAL WETLANDS TO BE CROSSED BY TECHNICALLY AND ECONOMICALLY ACCEPTABLE ALTERNATIVE TRANSMISSION CORRIDORS IN THE CENTRAL STUDY AREA[1/]

	Corridor[2/]						
Wetland Type	ABCD	ABCF	ABECD	AJCD	ABECF	AJCF	CJAHI
Palustrine Forested	182	182	209	6	209	6	56
Palustrine Scrub-Shrub	118	118	116	115	116	115	413
Riverine/Lacustrine	10	0	16	16	6	6	6
Total	310	300	341	137	331	127	475

1/ Based on converting vegetation types given in Table 2 to the corresponding Cowardin et al. (1979) wetland types.

2/ See Figure E.10.11 for corridor locations.

TABLE 6

HECTARES OF POTENTIAL WETLANDS TO BE CROSSED BY THE TECHNICALLY AND ECONOMICALLY ACCEPTABLE ALTERNATIVE TRANSMISSION CORRIDORS IN THE SOUTHERN STUDY AREA[1/]

Wetland Type	Corridor[2/]		
	ABC	ADFC	AEFC
Palustrine Forested	22	81	106
Palustrine Scrub-Shrub	13	69	12
Palustrine/lacustrine emergent	90	234	290
Riverine	16	0	0
Total	141	384	408

1/ Based on converting vegetation types given in Table 3 to the corresponding Cowardin et al. (1979) wetland types.

2/ See Figure E.10.10 for corridor locations.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 21 (p. E-10-69 to p. E-10-79)

Indicate if any transmission line alternative is expected to require more (or less) construction of access roads.

Response

In all cases, the selected transmission line alternative for each major segment (Willow-Anchorage, Willow-Healy, Watana-Gold Creek, and Healy-Fairbanks) represents the alternative with the lowest requirements for new access construction. This results from attempting to minimize new access requirements in the corridor identification and evaluation process, and because of extensive opportunities to parallel existing access features or transmission lines.

Specific information about relative access requirements may be obtained from the discussion of transmission alternatives in Chapter 10, Exhibit E (pp. E-10-62 through E-10-82 and Figures E-10-10 through E-10-12) in the License Application.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 22 (p. E-10-80, para. 1, to p. E-10-83, para. 3)

Explain how aesthetic resource issues were factored into the evaluation process for the transmission line corridor to link the dam sites with the Intertie.

Response

Aesthetic resources were incorporated into the environmental evaluation process used for transmission corridor screening. Moreover, they were considered in identifying a preferred route within the selected corridor. This assessment focused on views and potential visual impacts from recreational areas, hiking trails, vistas, highways, and heavily utilized lakes or streams.

The environmental screening criteria listed on p. E-10-66 in Chapter 10, Exhibit E in the License Application were used to evaluate each alternate transmission line corridor from the dam site to the Intertie. As was done for the northern and southern study areas, those criteria were combined into environmental constraint tables and a relative environmental rating was assigned to each corridor. In addition to aesthetic resources, the screening criteria included: land use and land status, length of corridor, topography, soils, cultural resources, vegetation, and fish and wildlife resources. Following the selection of a preferred corridor, constraint mapping was used to select one route within the corridor. Aesthetic resources were one of three decision factors utilized in this process. The other two included biological constraints (primarily wetlands and habitat areas for important or sensitive species) and manmade constraints (land use, including recreation, and cultural resources). In general, the selected transmission line corrodor from the Intertie to the dam parallels closely the project access route.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 23 (p. E-10-83 to p. E-10-104)

Document whether the surface soils at the alternative borrow sites are expected to be similar to or different from those in the proposed project area.

Response

The surface soils have been investigated at alternative borrow sites through photointerpretation, reconnaissance and geologic mapping, seismic refraction surveys, soil borings, and test pits. Surface soils are defined as topsoil and the underlying parent soil deposit which affect erosion potential and vegetation development. While the depth of the surface soils may vary, the zone affecting surface erodability and vegetation is generally within 3 to 5 feet of the ground surface. Anticipated differences and similarities of surface soils for alternative borrow sites may be estimated from Table 1, which summarizes soil types, classifications, geologic origin, and other information indicating comparitive soil properties.

Borrow Sites E, D, G, I, and J are within the project boundaries, while Borrow Sites C, F, and H are outside the boundaries. The characteristics of the granular surface soils at Borrow Sites C, E, F, and G are generally expected to be similar with the possible exception of Borrow Site C, located in the upper portion of Tsusena Creek. The semi-pervious/impervious Borrow Sites D and H are different with respect to depth of organic material in the surface soils. Site H is expected to have relatively deep topsoil and high organic content with much deeper stripping than Site D. In comparison to

Site D, Site H has poor surface drainage and shallow permafrost. The pervious Borrow Sites I and J in the Susitna River are expected to be similar in surface soils, with Site I having more terrace deposits and associated topsoil area than Site J. Surface soil deposits at Sites I and J will have limited topsoil development due to their location in an active river flood plain.

TABLE 1

SURFACE SOILS AT ALTERNATIVE BORROW SITES

BORROW SITE	WATANA C	WATANA E	WATANA F	DEVILS CANYON G	WATANA & DEVILS CANYON D	WATANA H	WATANA I	WATANA J
Category of Material	Granular	Granular	Granular	Granular	Semi-pervious Impervious	Semi-pervious Impervious	Pervious	Pervious
Geologic Origin	Outwash Alluvium (reworked outwash) (Tsusena C)	Flood plain alluvium Terrace/Fan Alluvium Outwash (Susitna R/ Tsusena C)	Flood plain alluvium Terrace/Fan Alluvium (Tsusena Creek)	Flood plain alluvium Terrace/Fan Alluvium (Susitna R/ Cheechacko Creek)	Glacial ice disintergration Outwash Alluvium Basal Till	Glacial Lacustrine over Ablation Till	Flood plain Fan & terrace alluvium (Susitna R)	Flood plain Alluvium Terrace alluvium (Susitna R)
Topsoil Avg. Range Thickness Types of Topsoil	1' / 0-2' Estimate similar to F but less thickness	1' / 0 - 2' OL, ML, SM	1'/ 0.2 - 2.0' OL, ML, SM PT with boulders	0.5' / 0 - 1' OL, ML pockets of PT to 4.5'	1.5' / 0 - 6' OL, ML, SM with boulder fields	2.0/1.5'-7.5 OL, PT	None in active river channel 1'on Terraces OL, ML, SM	None in active river channel 1' on Terraces OL, ML, SM
Surface Soil Avg./Range Thickness Types	0.5 / 0 - 2' Estimate similar to F but less silty soils	3'/0-4.5' Silty Sands & Gravel	1.5' / 1-3' Silty Sands & Gravel	1.5-2.0/1-6.5' Silts & Silty Sand		-/1.5-4.5 Silts & Sands with some organics	Alluvial sands & gravels with surface silty soils on terraces	Alluvial sands & gravels with surface silty soils on terraces
Location	Outside required project boundaries	Inside required project boundaries	Outside required project boundaries	Inside required project boundaries	Inside required project boundaries	Outside required project boundaries	Inside required project boundaries	Inside required project boundaries

10-23-3

TABLE 1 (Continued)

SURFACE SOILS AT ALTERNATIVE BORROW SITES

BORROW SITE	WATANA C	WATANA E	WATANA F	DEVILS CANYON G	WATANA & DEVILS CANYON D	WATANA H	WATANA I	WATANA J
Estimated Average Stripping	1.5'	4'	2.5'	2.0'	1.5'	5.5'	None in Channel Up to 3'-4' on Terraces	None in Channel Up to 3'-4' on Terraces
Vegetation	Alpine tundra on walls. Heavy brush & trees at edge flood plain. Mixed grass & tundra near river	Dense spruce alder, tundra, isolated brush.	Mixed spruce & tundra. Areas of alders and undergrowth.	Scattered brush with descidous trees to dense trees & underbrush on hillside	Tundra & sedge grass with isolated spruce	Thick tundra muskeg, marshy, alder, underbrush	None in active channel	None in active channel
Drainage	Very good	Very Good	Good	Good	Poor to Good	Poor	Very Good	Very Good
Permafrost	Sporadic	None Encountered	Limited	None Encountered	Sporadic	Shallow Permafrost to 14'	None Encountered	None Encountered
Unified Soil System Class. of Borrow	GW SW GP GM SM SP	GW GP SW SM ML SP	GW GP SW SP SM GM ML	GW GP SW SP SM GM ML	Varies with Geologic origin See Reference 1	SM ML SC CL GW GM GC	GP SW SP GW SM GM	GW GP SW GM SM SP

10-23-4

TABLE 1 (Continued)

SURFACE SOILS AT ALTERNATIVE BORROW SITES

BORROW SITE	WATANA C	WATANA E	WATANA F	DEVILS CANYON G	WATANA & DEVILS CANYON D	WATANA H	WATANA I	WATANA J
Exploration Data Base	Photo interp. Visual Recon. 3 seismic 1 test pit	Photo interp. Geological 7 seismic 9 auger 28 test pits	Photo interp. Visual Recon. 6 test pits	Photo interp. Geological Mapping 14 auger borings 2 test pits	Photo interp. Geological Mapping 27 rotary, 38 auger, 8 hammer borings; and 45 test pits	Photo interp. Visual Recon. 8 auger borings	Photo interp. Geological Mapping 6 seismic lines	Photo interp. Visual Recon. 5 test pits
Reference	(3)p. D-35-36	(3)p. D-35-36 (2)p. 6-49-51 (1)p. 8-5	(3)p. D-35-36 (2)p 6-51-52	(2)p 7-27-30	(3)p. D-31-36 (2)p. 6-52-54 (1)p. 6-1-16 (1)p 8-1-6	(2)p. 6-54-56 (1)p. 8-6	(2)p. 6-54-56 (1)p. 8-5	(2)p. 6-54-56

Sources

Acres American Incorportated. 1982. Susitna Hydroelectric Project, 1982 Supplement to the 1980-81 Geotechnical Report. Prepared for the Alaska Power Authority.

Acres American Incorporated. 1982a. Susitna Hydroelectric Project, 1980-81 Geotechnical Report. Prepared for the Alaska Power Authority.

U.S. Army Corps of Engineers, Alaska District, 1979. Supplemental Feasibility Study, Upper Susitna River Basin, Watana Dam Site, Section D Foundations and Materials.

10-23-5

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 24 (p. E-10-83, para. 4, to p. E-10-104, para. 4)

Provide a brief discussion of how aesthetic resources were used in the evaluation process of determining borrow site alternatives.

Response

The primary emphasis in the general evaluation of borrow site alternatives was placed on water quality and environmental factors (especially the avoidance of streams and wetlands). While aesthetic resources were assessed for the selected borrow site areas, they were not specifically considered in the evaluation of the borrow site alternatives.

EXHIBIT E

10. Alternative Locations, Designs, and Energy Sources

Comment 26 (p. E-10-143, para. 4, through p. E-10-172, para. 2)

Provide a generic description of socioeconomic impacts of thermal alternatives other than coal, nuclear steam electric generation, biomass, geothermal, wind, and solar alternatives.

Response

This response assumes that Comment 26 was asking for a generic description of socioeconomic impacts of natural gas, nuclear, biomass, geothermal, wind, and solar electrical energy generating systems. This assumption was made because the text referred to in Comment 26 (p. E-10-143 through p. E-10-172) discusses these systems, but does not specifically address potential socioeconomic impacts.

Principal factors that will determine the extent and magnitude of socioeconomic impacts of electrical energy development include: the length of the construction and operation period, the size of the work force, the number and demographic characteristics of in-migrating workers, the ratio of project-related in-migrants to the existing population, the capacity of existing community infrastructure, and the location and amount of project-related expenditures. The following description provides a generic discussion of potential socioeconomic impacts resulting from the construction and operation of various electric energy generating technologies.

Natural Gas or Distillate-fired Steam Electric

In general, for a 200 MW natural gas or distillate-fired steam electric unit, the construction period could extend to 5 years with construction and

operation work forces peaking at approximately 600 and 70 workers, respectively. The majority of the project's capital expenditures would occur outside Alaska, while labor and fuel would come primarily from within the state.

Wind

The socioeconomic impacts of wind energy conversion systems would be minimal due to a short field assembly period for the wind turbines and small work force requirements. For example, it is expected that 10 to 15 persons would be required to work approximately 6 months to erect a 1-2.5 MW wind turbine. An on-site operating work force would not be required, and maintenance would be minimal. Expenditures for capital and labor would occur primarily outside Alaska.

Solar (Including Photovoltaic Systems and Thermal Electric Systems)

Construction of a 10 MW solar photovoltaic system would require about 100 construction/assembly workers (for 1 to 2 years) and approximately 10 operation and maintenance workers. In comparison, a similarly sized solar thermal electric system would require approximately 60 construction/assembly workers and 25 operation workers. Expenditures for capital and construction labor would occur primarily outside Alaska.

Biomass

Biomass-fired facilities typically would be sited in conjunction with sawmills, most of which are located in large- or medium-sized communities, such as Anchorage, Fairbanks, Nenana, and Soldotna. The construction period for 15 to 30 MW plants would range from 1.5 to 3 years. Work force requirements would be approximately 65 for construction and 25 for operation and maintenance. Expenditures for capital, labor, and fuel would be made primarily in Alaska.

Geothermal

The development and construction period for a 50 MW geothermal plant would be approximately 7 years. About 90 persons would be required for construction and 30 would be required for operation and maintenance. Project expenditures for capital and labor would be divided about equally inside and outside Alaska.

Nuclear

The socioeconomic impacts of a 1000 MW nuclear power plant would be potentially significant due to the long construction period (7 to 10 years) and large construction work force (averaging 1,300). An operation and maintenance work force of approximately 180 persons would be required. Project expenditures would be made primarily outside of Alaska since all equipment and most of the labor would be obtained from the lower 48 states.

References

Candidate Electric Energy Technologies for Future Application in the Rainbelt Region of Alaska, Volume IV. October 1982. Prepared by Battelle Pacific Northwest Laboratories for the Alaska Office of the Governor, Division of Policy Development, and Planning and the Governor's Policy Review Committee.

EXHIBIT E

11. List of Literature

Comment 1 (p. E-3-232, para. 4)

Wood et al. (1975).

Response

A search for the proper reference information is being conducted. This information will be provided to the Commission as soon as it is available.

EXHIBIT E

11. List of Literature

Comment 2 (p. E-5-129, para. 2)

Provide references for statement on commuting experiences of workers on similar projects.

Response

The following references were used to develop the statement on commuting experiences of workers on similar projects:

Denver Reserach Institute. February 1982. Socioeconomic Impacts of Power Plants. Prepared for Electric Power Research Institute.

Metz, W.C. September 11, 1980. The Mitigation of Socioeconomic Impacts by Electric Utilities. Public Utilities Fortnightly.

_____. 1981. Worker/Vehicle Ratios as Major Eastern Power Plant Construction Sites: A Time of Change. Traffic Quarterly. Volume 35, No. 3.

_____. September 1981. Construction Workforce Management: Worker Transportation and Temporary Housing Techniques. Prepared for the Western Rural Development Center.

_____. October 1981. Energy Industry Involvement in Worker Transportation. Submitted to Transportation Quarterly.

_____. August 25, 1982. Industry Initiatives in Impact Mitigation. Prepared for the Proceedings of the Alaska Symposium on Social, Economic, and Cultural Impact of Natural Resource Development. Anchorage, Alaska.

EXHIBIT E

11. List of Literature

Comment 3 (p. E-7-87, para. 1)

National Recreation & Park, Open Space Standards.

Response

The complete reference for "National Recreation & Park, Open Space Standards" is as follows:

The National Recreation and Parks Association. 1971. National Recreation & Park Open Space Standards. Washington, D.C.

EXHIBIT E

11. List of Literature

Comment 4 (Table E.7.9)

Frank Orth & Assoc., 4/82. Borough Planning Department, 10/21/82.

Response

The complete reference for "Frank Orth & Assoc. 4/82" is as follows:

Frank Orth & Associates, Inc. Peter Rogers. October 1982. Personal communication.

The complete reference for "Borough Planning Department, 10/21/82" is as follows:

Matanuska-Susitna Borough Planning Director. Claudio Arenas. October 1982. Personal communication.

11. List of Literature

Comment 5 (p. E-8-71 to p. E-8-72)

All references listed in the Aesthetic Resources References Section should be appropriately cited within the written text of the application. If these listings are not citations, please indicate that they constitute a bibliography.

Response

Except for documents cited within the text of Chapter 8, the references listed in the Aesthetics Resources References Section constitute a bibliography.

11. List of Literature

Comment 6 (p. E-10-120)

CIRI/Placer 1981.

Response

The complete reference for "CIRI/Placer 1981" is as follows:

Cook Inlet Region, Inc. and Placer Amex, Inc. 1981. Coal to Methanol Feasibility Study, Beluga Methanol Project. Volume IV, Environmental.

EXHIBIT E

11. List of Literature

Comment 7 (p. E-10-121)

Battelle 1978.

Response

The complete reference for "Battelle 1978" is as follows:

Battelle Pacific Northwest Laboratories, John B. Burnham. 1978. Natural Coal Utilization Assessment: The Impact of Increased Coal Consumption in the Pacific Northwest. Prepared for the U.S. Department of Energy. BNWL-RAP-21, VC-11.

EXHIBIT E

11. List of Literature

Comment 8 (Table E.7.13)

EDAW estimate.

Response

The reference for Note #4 on Table E.7.13 in Chapter 7, Exhibit E of the License Application should read as follows:

EDAW estimates based on Susitna River Cooperative Study Methodology (John O'Neill, November 1978).

EXHIBIT E

11. List of Literature

Comment 9 (Table E.7.16)

EDAW Inc.

Response

Table E.7.16 was compiled by EDAW, Inc. for the Susitna Recreation Plan. The data takes into consideration the following sources:

Acres American, Inc. March 1982. Susitna Hydroelectric Project, Feasibility Report. Volumes 1-7, Final Draft. Prepared for the Alaska Power Authority.

DeChiara, Joseph and John Callender. 1973. Time-Saver Standards for Building Types. McGraw-Hill, Inc. New York.

_____ and Lee Koppelman. 1975. Urban Planning and Design Criteria. Van Nostrand Reinhold Company. New York.

_____. 1978. Site Planning Standards. McGraw-Hill, Inc., New York.