ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

INTERNAL REVIEW BOARD MEETING #2
STATUS OF TASKS 4, 5 AND 6

OCTOBER 14, 1980

APA REVIEW MEETING
STATUS OF GENERATION PLANNING STUDIES

OCTOBER 15, 1980

NOTES ON MEETINGS

ACRES

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NOTES ON MEETINGS

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ATTACHMENTS

1. AGENDA

September 30, 1980

OCTOBER 14 MEETING

Location: Board Room - Niagara Falls office.

To Attend:	APA -	R. Mohn
	Project Managers -	J. Lawrence, J. Hayden
	Task Supervisors -	I. Hutchison, V. Singh, P. Tucker
	Project Team -	G. Krishnan, R. Curtis
	Internal Review Board -	H. Eichenbaum, D. MacDonald, L. Wolofski
	Working Group -	S. Thompson, A. Tawil, A. Burgess, M. Vanderburgh, J. Sinclair

Agenda:

Time	Topic	Speaker(s)
8:30	Introduction (to meetings on 14th & 15th)	J. Lawrence/J. Hayden
9:00	Seismic Studies and Geotechnical Investigations (Tasks 4 & 5)	V. Singh/S. Thompson
10:30	Break	---
10:45	Geotechnical & Seismic Design Criteria	V. Singh
12:00	Lunch	---
1:00	Engineering Design Studies (Subtasks 6.01-6.06)	I. Hutchison
3:00	Break	---
3:15	Design Studies Continuation & Wrap Up	I. Hutchison/ J. Lawrence/J. Hayden

October 15th Meeting

Time and Location

Wednesday, October 15, 1980, 8:30 (all day)
Conference Room, Buffalo Office
Buffalo, New York

Attendance

Acres American: J. Lawrence
J. Hayden
C. Debelius
I. Hutchison
P. Tucker (morning)
G. Krishnan (morning)
S. Diener
A. Simon
P. Hoover
K. Young
P. Yee (afternoon)

APA: R. Mohn

Agenda

Time	Topic	Speaker
8:30	Generation Planning Parameters	P. Tucker
9:30	Thermal Alternatives (6.32)	P. Tucker
10:15	Break	
10:30	Hydro Alternatives (6.33)	P. Tucker
11:30	Environmental Screening	K. Young
12:30	Lunch	
1:15	Load Forecast Review (6.34)	P. Yee
3:00	Conservation and Load Management (6.35)	P. Hoover
4:00	Work Plan-Generation Planning	P. Hoover

Moderator: John D. Lawrence

2. NOTES ON MEETINS - OCTOBER 14, 1980

(Figures 1 through 14 attached to these notes are copies of viewgraphs presented to illustrate points discussed in the notes. Copies of other viewgraphs used during presentations are attached in Section 3. A selection of 35mm slides was also used as background during the presentation).

Susitna Hydroelectric Project
Internal Review Board Meeting #2
October 14, 1980

November 5, 1980
P5700.13.10
P5700.13

Acres Consulting Services Office, Canada

Summary

PRESENT:

R. Mohn	)	APA
J.D. Lawrence	)	
C. Debelius	)	
J. Hayden	)	
I. Hutchison	)	
V. Singh	)	AAI
P. Tucker	)	
S. Thompson	)	
G. Krishnan	)	
R. Curtis	)	
H. Eichenbaum	)	
D. MacDonald	)	
L. Wolofsky	)	ACS
A. Tawil	)	
A. Burgess	)	

INTRODUCTION

The key topics for discussion were outlined by John Lawrence. These included:

a) Review of Geotechnical studies, including preliminary results of the Summer 1980 and discussion of future investigation.

b) Review of seismic studies. In particular, the 1980 preliminary work, work proposed for 1981 and the determination of levels of acceptable risk as requested by Woodward-Clyde.

c) Arch dam concepts and factors affecting the selection of the dam type at Devil Canyon.

d) Review of alternative hydroelectric developments to the Devil Canyon-Watana concept within the Susitna Basin.

e) Key topics that should be discussed with the Acres review panel the week of October 20, 1980.

REVIEW OF GEOTECHNICAL STUDIES

Previous geotechnical studies have included boreholes, trenches, and/or seismic lines at Denali, Vee, Watana, and Devil Canyon sites. Current studies by Acres have been limited to the Devil Canyon and Watana sites. For each of these two sites a brief review of previous studies was given and available results of the summer 1980 program were presented with discussion of the winter 1980 program.

WATANA SITE

The extent of the Corps of Engineers 1978 drilling program is shown in Figure 1. Areas of concern identified by the Corps of Engineers included:

a) a buried valley approximately in the location northeast of the proposed spillway;

b) shear zones at approximately the upstream and downstream toes of the rockfill dam.

It was noted that the final Corps report stated that the spillway probably should be moved due to the buried valley. The bedrock at the Watana site is an Andesite and Granodiorite. It is generally a good quality rock.

The locations of the suggested borrow sources were shown and material availability was discussed. The gradation curve for the impervious material (Borrow Area D) was discussed and it was agreed that it would most likely prove satisfactory.

The summer 1980 drilling program at Watana is shown in Figure 2. The purpose of this program was to confirm locations of features identified from previous studies and to assist in locating the dam and spillway structures in future design work. As a result, boreholes did not necessarily line up with structures proposed by the Corps.

Seismic lines were used to determine the location (and shape) of the buried valleys. At present, information from the seismic lines is not available.

Three boreholes have been completed this summer. These were:

BH-2 located in fingerbuster shear zone on right abutment;
BH-6 located in right abutment near downstream of toe of slope;
BH-8 located above proposed location of powerhouse in left abutment.

Borehole 2 showed a sheared zone to be located between hole depths 90 and 160 feet. The hole intersected the shear zone contact at an angle of 30° to 40°. Difficulty in drilling was encountered due to hole collapse, however the feature was groutable. The drilling program did not uncover anything that would seriously affect the feasibility of the dam site.

Four areas have been identified which will require further investigations in this winter's and next summer's program. These are:

a) upstream shear zone approximately perpendicular to river;
b) downstream shear zone approximately perpendicular to river;
c) buried channel in right abutment;
d) depth of overburden in channel.

The winter program will be finalized after review with the review panel next week.

DEVIL CANYON

Previous field investigations at Devil Canyon were performed by the USBR in 1957. A shear zone has been speculated under the saddle dam in the left abutment. A series of joint sets and shear zones were identified perpendicular to the river. It has also been suggested by Acres geologists that a series of open joints may be found parallel with the river in the left abutment.

As with the Watana site, the 1980 investigation program at Devil Canyon was confirmatory in nature. Three boreholes have been completed to date (see Figure 3):

BH-1 located in right abutment near proposed powerhouse;

BH-2 located in right abutment to show jointing pattern;

BH-4 located in auxiliary dam region and angled to intersect the suspected shear zone.

Boreholes 1 and 2 showed excellent quality rock. Borehole 4 failed to identify the suspected shear zone. The dam site bedrock consists of a Argulite rock. Although strength testing has not been completed, it is not believed that the rock will show directional strength properties.

The possible location of open joints in the left abutment was identified as a major concern. These joints could lead to large block failures. Mapping of the canyon walls will be very difficult with a large amount of rigging or technical climbers required. It was suggested that an estimate of the potential for such occurrences could be obtained by observations of block failures upstream and downstream of the site. This would also lead to indications regarding the seismicity. This exercise will be part of the air photo interpretation performed by R&M Consultants.

The winter drilling program as proposed by the Alaska office consisted of 5 drillholes along the base of the canyon. It has been proposed by Stu Thompson that three of these holes would be extremely costly due to access problems and could be replaced by two boreholes slightly upstream and angled under the river. These would determine the existance or nonexistance of a shear zone or fault under the river.

It was discussed whether adits would be required prior to submission of the FERC application. These adits would be used to determine the physical condition, distribution and character of the geologic features, and deformation properties of the abutments. It was pointed out that for any dam, adits would be necessary before actual construction and therefore the investment would be a matter of timing and associated risks. It was decided that:

a) Planning would commence immediately for construction of adits in the 1981 season if the decision for adits is finalized. This matter is to be reviewed by the panel next week.

b) Design studies would continue with determination of the economics associated with an arch dam as opposed to other dam types.

c) A final go-ahead decision would be made prior to award of any adit contract based on (b) above.

It was pointed out that slightly upstream of the dam site at the horseshoe bend in the river there is an abrupt change in geology that could be associated with a fault. This was discussed further when the seismic material was presented. It is near this bend that an aggregate source has been identified.

SEISMIC STUDIES

The status of the 1980 program for Task 4 was presented as follows:

4.01	Review of Available Data	Completed in June.
4.02	Short Term Seismologic Monitoring Program	Completed in field in Sept. Review in progress to be completed by Dec., 1980.
4.03	Preliminary RIS	Historical record assembled and compared with Watana. Devil Canyon task to be completed by Dec., 1980.
4.04	Remote Sensing Image Analysis	All work (except low sun angle photo) completed in June. 3-4 weeks effort and photo next year (inclement weather factor).
4.05	Seismic Geology Reconnaissance	Completed in Aug., culminating in a site review meeting.
4.06	Evaluation and Reporting	Has begun. To be completed by Dec., 1980. (acceptable risk under review by AAI).
4.07	Preliminary Ground Motion Studies	Has begun. To be completed by Dec., 1980.

The Devil Canyon and Watana sites are located between the Denali Fault and the Castle Mountain Fault. Both of these are major faults and are considered active. Several smaller fault like features are located much closer to the two sites. Woodward-Clyde have identified all lineaments within the region and have ranked them in order of activity and priority for further evaluation where questions exist as to their activity.

Three lineasments are located near the two dam sites. The first crosses the river just upstream of Devil Canyon Dam at the horseshoe bend in the river. The second is known as the Susitna Fault which runs in a ENE direction and crosses the Susitna River approximately 3 miles downstream of the Watana site. The third lineament has been called the Talkeetna Fault and intersects the Susitna Fault.

A letter tabled from Woodward-Clyde requesting guidance on the level of acceptable risk that they should assume in their studies generated intensive discussion. It was agreed that Woodward-Clyde would be approached as to why they need this information and further discussion be held during the external review board meeting. Consultants should be made aware of the question prior to the meeting to allow meaningful discussions.

ARCH DAM AT DEVIL CANYON

The evaluation of an arch dam at Devil Canyon (Subtask 6.04) has to date consisted of a historical review in which several of the world's highest arch dams have been tabulated (Table 1) and shown graphically in terms of height and width (Figure 4). It can be seen that from a precedent experience point of view an arch dam at Devil Canyon would not be unusual.

Results of a preliminary finite element dynamic analysis (Figures 5 and 6) showed that a thin arch dam as proposed by the USBR would have stress problems not only for the thermal loadings, but also due to earthquake loadings.

It was suggested that an attempt should be made to obtain and check the analysis performed by the USBR and the Corps of Engineers. Acres developed a gravity arch design which was tabled. Preliminary analysis indicated that structurally, this is feasible even when abutment displacements of 2 cm are allowed to occur. Stresses (Figures 7 and 8) are within or near allowable limits with the exception of the thermal loading. Stresses due to the thermal loading would generally be less than shown. Analysis was based on a -40°F downstream face and a 32°F upstream face with a linear gradient between.

Results of arch dam studies to date show nothing has yet emerged that would make an arch dam technically infeasible. The question of whether to proceed with arch dam design and the requisite geotechnical exploratory work (adits) is therefore an economic choice with consideration of the associated risks.

The proposed gravity arch dam layout was tabled. A layout for a impervious core rockfill dam is currently being developed. Cost estimates will be prepared to aid in the decision of whether or not to proceed with geotechnical investigations and design of an arch dam. It was pointed out that definite problems exist with either a rockfill or arch dam, but none were identified that would preclude the feasibility of either type dam.

TUNNEL SCHEMES

As an alternative to a high dam at Devil Canyon, the possibility of a tunnel from an upstream point has been considered. Four tunnel schemes have been considered as shown in Figure 9 and Figure 10. Three of these schemes involve a 29 mile long tunnel from the Watana site to Devil Canyon with the fourth involving a shorter 15 mile tunnel from a re-regulation dam approximately midway between Watana and Devil Canyon.

The energy available from these schemes depends to a large part on tunnel size and whether the scheme will be used for peaking or base load (see Table 2). A discrepancy was pointed our in that the peaking scheme had a lower installed capacity than the base load scheme. This needs verification.

PLANNING STUDIES

Previous Studies

Studies have been performed on the development of the hydroelectric potential of the Upper Susitna River since approximately 1950. These studies have collectively identified a total of 12 sites above Gold Creek, 11 of which are on the main branch of the Susitna and one on the Tyone River which is a tributary. The location of these sites are shown in Figure 11 with a profile shown in Figure 12.

Current Studies

The general approach for current studies is shown in Figure 13. A preliminary screening deleted sites below Portage Creek (Gold Creek and Olson) from further study due to environmental concerns in particular the effect a dam in this region would have on salmon fisheries. Devils Creek was assumed for planning purposes to be represented by High Devil Canyon and therefore eliminated from the planning model studies. Similarly Butte Creek was considered to be the same as Denali. Tyone was eliminated due to its small potential.

The environmental aspects of the various sites were presented (see Table 3). It was suggested that these be reviewed by the Susitna Steering Committee in Alaska.

Hydroelectric development arrangements with cost estimates have been prepared for the following sites and crest elevations:

Site	Crest Elevation	Dam Type	Arrangement Prepared By
Devil Canyon	1,310	Concrete gravity	Acres
Devil Canyon	1,455	Concrete gravity	Corps
High Devil Canyon	1,755	Concrete faced rockfill	Acres
Watana	2,060	Rockfill	Acres
Watana	2,195	Rockfill	Corps
Susitna III	2,215	Rockfill	Acres
Susitna III	2,375	Rockfill	Acres
Vee	2,310	Rockfill	USBR
Vee	2,360	Rockfill	USBR
Maclaren	2,410	Rockfill	Acres
Denali	2,552	Earthfill	Corps

The hydropower potential at the various sites is shown in Table 4 with preliminary estimates of unit costs for energy. To give an indication of relative costs, the average annual energy was plotted against the cost of a project (see Figure 14). Preliminary indications are that High Devil Canyon may be the cheapest, single development, but when full basin development is considered, Devil Canyon and Watana would be cheaper.

The computer models are summarized in Table 5. These will be used to select the optimum development plans for capacity requirements of approximately 400 MW, 800 MW and 1600 MW.

CONCLUSIONS

The conclusions of the discussions were outlined by John Lawrence. These were as follows:

a) Geotechnical Exploration - The results of the summer work must be brought in-house and finalized. For the winter program we have a good idea of what will be done at Watana and preliminary ideas about Devil Canyon. Next year's program still needs development.

b) Seismic Studies - Acres should question Woodward-Clyde's reason for asking about the level of risk that was acceptable for the project. The external panel should be made aware of the question prior to next week and be prepared for discussions.

c) Arch Dam - Planning should be initiated now for adits. Concurrently, costs should be compared for thin arch, gravity arch, gravity and rockfill dams to give an indication of potential savings associated with an arch dam.

d) Tunnel Alternative - The work to date should be firmed up with further development of Scheme 3.

e) Alternative Hydroelectric Development Sites - Further work is required in refinement of the alternative arrangements and to come up with the optimum development.

TABLES 1-5

FIGURES 1-13

(Meeting of October 14, 1980)

TABLE 1

DAM	LOCATION	HEIGHT	CREST LENGTH	BASE THICK.	MINIMUM THICK.	VOLUME	SEISMIC PARAMETERS	FOUNDATION	ABUTMENTS	REMARKS	CENT. ANGLE
Contra (1965)	Ticino, Switzerland	722 (220)	1246 (380)			861,000 (658,000)					
Mratinje (1976)	Montenegro, Yugoslavia	722 (220)	879 (268)			971,000 (742,000)					
Glen Canyon (1964)	Arizona, USA	710 (216)	1560 (475)			4,901,000 (3,747,000)					
Luzzone (1963)	Ticino, Switzerland	682 (208)	1738 (530)			1,739,000 (1,330,000)					
Mohamed Reza Shah Pahlavi (1963)	Khouzestan, Iran	666 (203)	696 (212)			647,000 (497,000)					
Almendra (1970)	Salmanca, Spain	662 (202)	1860 (567)			2,188,000 (1,673,000)					
Inguri (1985)	Georgia, USSR	892 (272)	2513 (766)	282	33 (10 m)	4,967,000 (3,800,000)				ENR Dec. 14, 1978 + Dave Shandalov Info Thin Arch	
Vaiont (1961)	Veneto, Italy	858 (262)	624 (190)			460,000 (352,000)				Overtopped by 400 ft high wave on Oct. 9, 1963. Minor chipping of the top 3 ft due to boulders was the only damage.	
Sayan-Shusen (1980)	Krasnoyarsk, USSR	794 (242)	3504 (1068)			11,916,000 (9,117,000)					
Chirkei (1975)	North Caucusas, USSR	764 (233)	1109 (338)	98 (30 m)	21 (6.5 m)	1,602,000 (1,226,000)					
Mauvoisin (1957)	Valais, Switzerland	777 (237)	1706 (520)			2,655 (2,030)					
El Cajon (1984)	Yoro/Cortes, Honduras	741 (226)	1253 (382)			1,924,000 (1,472,000)					

TABLE 1 (Con't)

DAM	LOCATION	HEIGHT	CREST LENGTH	BASE THICK.	MINIMUM THICK.	VOLUME	SEISMIC PARAMETERS	FOUNDATION	ABUTMENTS	REMARKS	CENT. ANGLE
El Cajon (1984)	Yoro/Cortes Honduras	741 (226)	1253 (383)			1,924,000 (1,472,000)					
Hoover (1936)	Nevada, Arizona, U.S.A.	726 (221)	1244 (379)	660	45	4,400,00 (3,364,000)	Spaced between two faults about 900 ft apart			Gravity Arch	
Vidraru-Arges	Romania	548 (167)	588 (292)	82 (25.0)	20 (6.0)		Earthquake in 1977 with an intensity of 7-8 on the MSk scale at the site. 7 = 2-1/2 %g. 8 = 5% g. 9 = 10% g.			Measurements after the earthquake showed no odifications to normal behavior.	
Morrow Point	Colorado	465	720	51.65'	12.0	360,000	In design it is mood up a point				
Crystal Dam	Neatren Colorado	340	620			145,000					
Green Lake Dam	Sitka, Alaska	210	460	16 ft.		26,000	Miximum Credible earthquake Magnitude = 8 Richter @ 16 mi. Acceleration = 0.40 g. Duration = 45 sec. Design Earthquake Magnitude = 8 Richter @ 33 mi. Acceleration = 0.23 g. Duration = 40 sec.e	Competent massive graywacke		Unsymmetrical with	

TABLE 1 (Con't)

DAM	LOCATION	HEIGHT	CREST LENGTH	BASE THICK.	MINIMUM THICK.	VOLUME	SEISMIC PARAMETERS	FOUNDATION	ABUTMENTS	REMARKS	CENT. ANGLE
Gokcekaya	Turkey	521 (159)	1620 (494)	74 (22.5)	20 (6)	933,000 (714,000)				Designed by EBASCO	107.4
Idikki	India	555	1200	80	25	613,000					
Auburn	California	685	4150	200	40	6,300,000				3 circular arcs Left 4000 ft rod 980' arc Center 1400 ft rod 1810' arc Right 4000 ft rod 1275' arc	
Pacoima	California	372 (113)	589 (180)	99 (30.2)	10.4 (3.2)	220,000 (168,000)	Seven significant faults within 3.8 miles (6 kM) radius of the site. 1952 - Earthquake of 5.0 Rickter @ 15 mi. 1971 - San Fernando earthquake 6.6 Rickter @ 4 mi. measured (Horizontal (Acc. 1.25 g (in each (direction (Vertical Acc. (0.70 g base rock estimated at 0.6 to 0.8 g	Gneissic Quartz Joint sets divide rock into angular blocks of approximately 4' 0"		- Built around 1930 - Constant angle arch - Earthquake loads not considered in design	

TABLE 2 - ECONOMICS OF TUNNEL ALTERNATIVES

	INST. CAP. U/S MW	INST. CAP. D/S MW	AV. AN. ENER. GWH		CAP COST 10^6 $	ENERGY COST $/1000 KWH
US CORPS DAMS	790	780	6855		2150	35
TUNNEL SCHEMES						
1	790	500	5700	A	2250	45
				B	2300	50
				C	2750	55
2	35 (790)	1150	4900	A	2100	50
				B	2200	50
				C	2650	65
3	790	~~600~~ 375	~~6100~~ 6029	A	~~1950~~ 1900	35
				B	1950	40
				C	2100	40
4	35 (790)	~~1300~~ 800	~~5840~~ 5660	A	~~2100~~ 2050	40
				B	~~2150~~ 2100	45
				C	~~2450~~ 2400	50

NOTE: CORRECTIONS MADE SUBSEQUENT TO MEETING.

B: 15 MILE HAUL

C: SENSITIVITY, 2X TUNNEL COST

No	Site	Environmental Implications					
		Biological		Social		Institution	Overall
		Fish	Wild	Local	Reg.		
1	Gold Creek	M	M	M	L	X	H
2	Olson (Susitna II)	M	M	M	L	X	H
3	Devil Canyon	L	L	M-H	M-H	M	L
4	Hi Devil Canyon (Susitna I)	L	M	M-H	M-H	M	M
5	Devil Creek	L	M	M-H	M	M	M
6	Watana	L	M-H	L-M	L-M	M	M
7	Susitna III	L-M	M-H	M-H	M-H	M-H	M
8	Vee	L-M	M-H	H-H	M-H	M-H	H
9	Mc Laren	L-M	M-H	L-M	L-M	M-H	M
10	Denali	L	L-M	L-M	L-M	M-H	L
11	Butte Creek	L	M-H	L-M	L-M	M	L
12	Tyone	L	M-H	M	H	M-H	M

TABLE 3

TABLE 4

No	SITE		CAPACITY INST. (MW)	CAPACITY DEP. (MW)	ENERGY AV. 10^9 Kwh	ENERGY FIRM 10^9 Kwh	ENERGY SEC. 10^9 Kwh	COST (1980) TOTAL $ x10^6	COST (1980) ENERGY mills/kwh
1	GOLD CREEK	a							
		b	260			1,140		900	90
2	OLSON (SUSITNA II)	a							
		b		187	.915	.820		850	70
3	DEVIL CANYON	a	265	230	1.125	1.010		750	80
		b		594	3.325			800	30
4	H DEVIL CANYON (SUSITNA I)	a	630	550	3.360	2,320		1000	35
		b							
5	DEVIL CREEK	a							
		b							
6	WATANA	a	660	560	3.500	2,440		1,350	45
		b							
7	SUSITNA III	a	330	290	1.730			1350	90
		b							
8	VEE	a	330	200	0.970	.880		550	65
		b		300	1450	1310			45
9	Mc LAREN	a	11	9	.045	.040		800	1,600
		b							
10	DENALI	a	70	60	.370	.260		500	107
11	BUTTE CREEK	a	AV. FLOW 2700 cfs						
12	TYONE	a	MAX STORAGE 1200 cfs/month AV. FLOW 300 cfs						

TABLE 5

COMPUTER MODELING

SCREENING MODEL (L.P.)

INPUT: STORAGE/YEILD/COST INFORMATION
SIMPLIFIED HYDROLOGY
POWER DEMAND

OUTPUT: OPTIMUM SITES/HEIGHTS
APPROX. RULE CURVES
APPROX. FIRM POWER/ENERGY
APPROX. INPUT TO GENERATION PLANNING MODEL

SIMULATION MODEL

INPUT: PHYSICAL DATA
RULE CURVES
MONTHLY HYDROLOGY
MONTHLY DEMAND

OUTPUT: MONTHLY ENERGY/POWER OUTPUT
DEGREE OF FAILURE TO MEET DEMAND
INPUT TO GEN. PLANNING MODEL

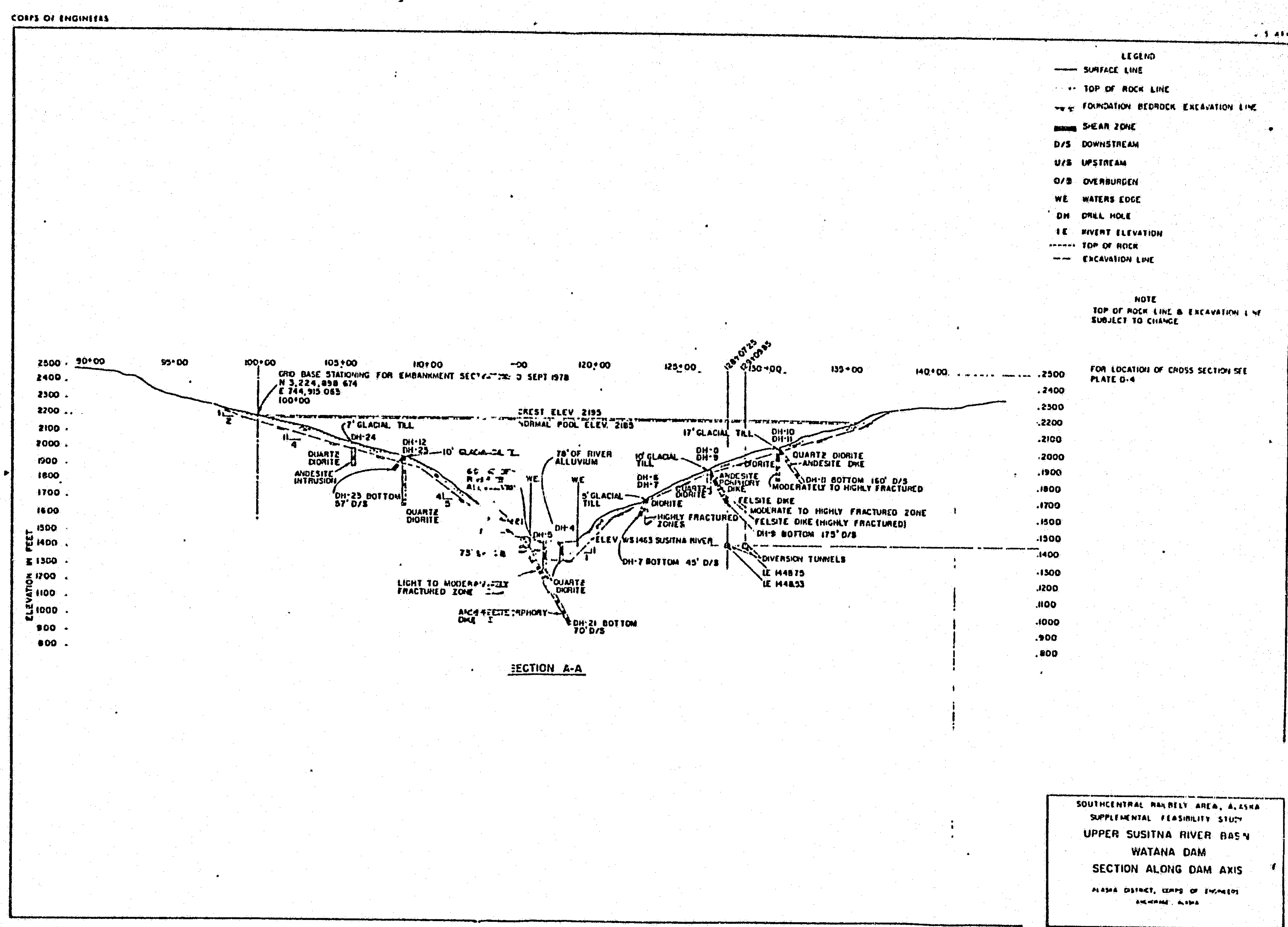

CORPS OF ENGINEERS
LEGEND
SURFACE LINE
TOP OF ROCK LINE
FOUNDATION BEDROCK EXCAVATION LINE
SHEAR ZONE
D/S DOWNSTREAM
U/S UPSTREAM
O/B OVERBURDEN
WE WATERS EDGE
DH DRILL HOLE
IE INVERT ELEVATION
TOP OF ROCK
EXCAVATION LINE
NOTE
TOP OF ROCK LINE & EXCAVATION LINE SUBJECT TO CHANGE
FOR LOCATION OF CROSS SECTION SEE PLATE D-4
CREST ELEV 2195
NORMAL POOL ELEV. 2185
7' GLACIAL TILL
10' GLACIAL TILL
17' GLACIAL TILL
78' OF RIVER ALLUVIUM
5' GLACIAL TILL
QUARTZ DIORITE
ANDESITE INTRUSION
DH-23 BOTTOM 57' D/S
ANDESITE DIKE
DH-8 BOTTOM 160' D/S
MODERATELY TO HIGHLY FRACTURED
FELSITE DIKE
MODERATE TO HIGHLY FRACTURED ZONE
FELSITE DIKE (HIGHLY FRACTURED)
DH-9 BOTTOM 175' D/S
HIGHLY FRACTURED ZONES
WS 1463 SUSITNA RIVER
DH-7 BOTTOM 45' D/S
DIVERSION TUNNELS
IE 1448.75
IE 1448.53
LIGHT TO MODERATELY FRACTURED ZONE
DH-21 BOTTOM 70' D/S
ELEVATION IN FEET
SECTION A-A
SOUTHCENTRAL RAILBELT AREA, ALASKA
SUPPLEMENTAL FEASIBILITY STUDY
UPPER SUSITNA RIVER BASIN
WATANA DAM
SECTION ALONG DAM AXIS
ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA

FIGURE 1

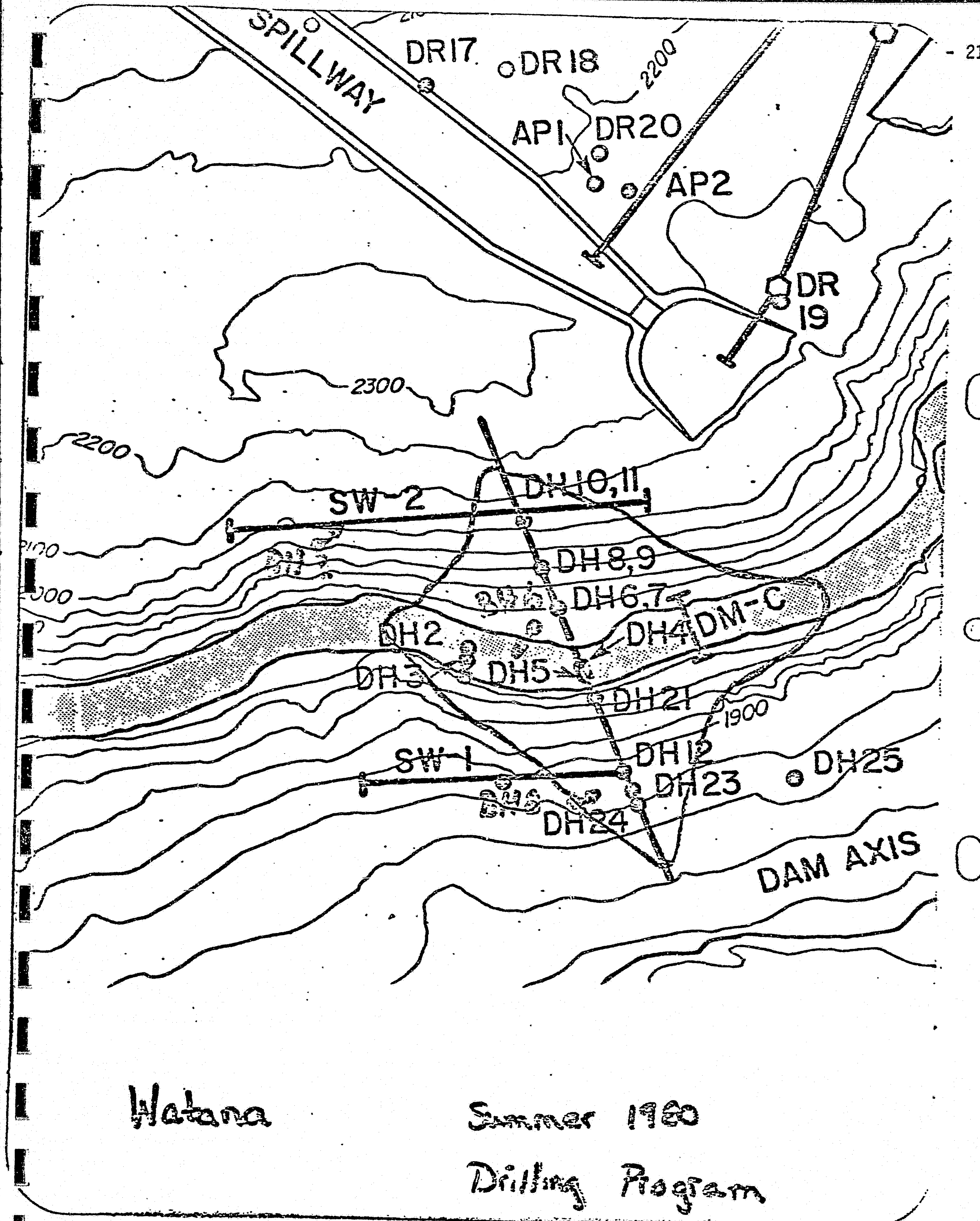
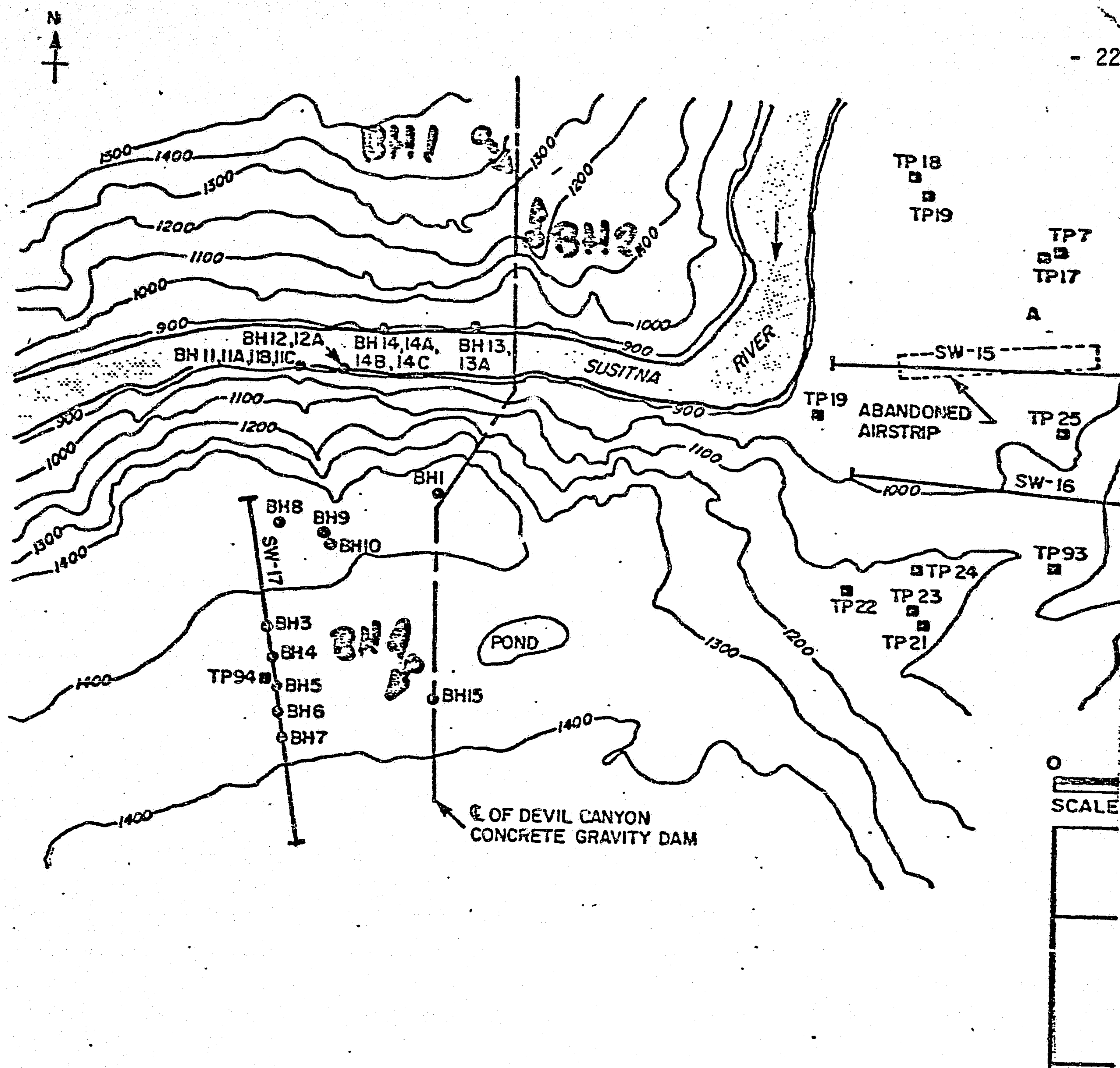

SPILLWAY
DR17
DR18
2200
AP1
DR20
AP2
DR 19
2300
2200
SW-2
DH10,11
DH8,9
DH6,7
DM-C
DH4
DH2
DH3
DH5
DH21
1900
DH12
DH23
DH25
SW-1
DH24
DAM AXIS
Watana
Summer 1980
Drilling Program

FIGURE 2



REF. U.S. ARMY CORPS OF ENGINEERS DEVIL CANYON
SITE PLAN AND LOCATION

Devils Canyon

Drilling Program
Summer 1980

FIGURE 3

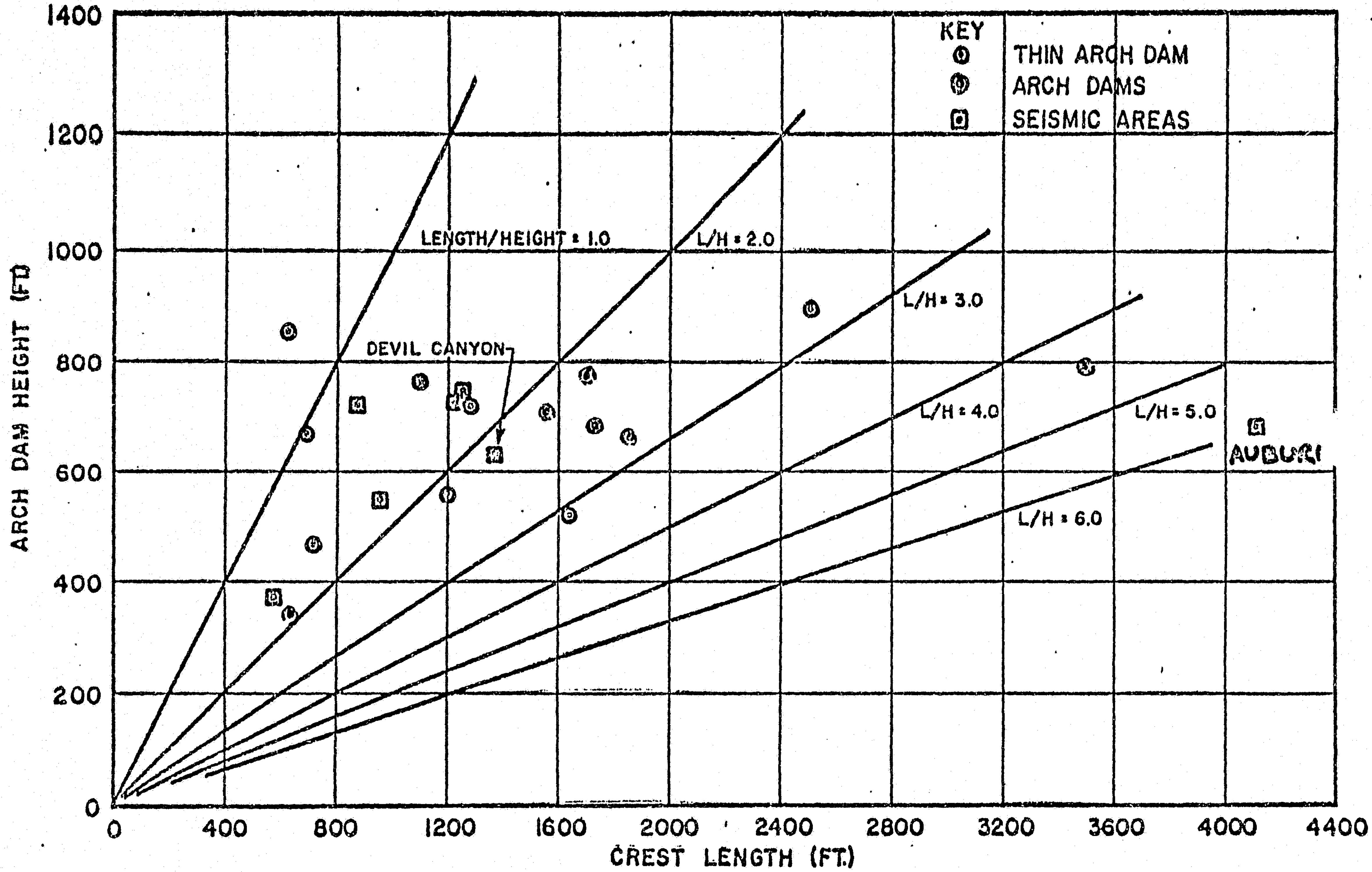


FIGURE 4

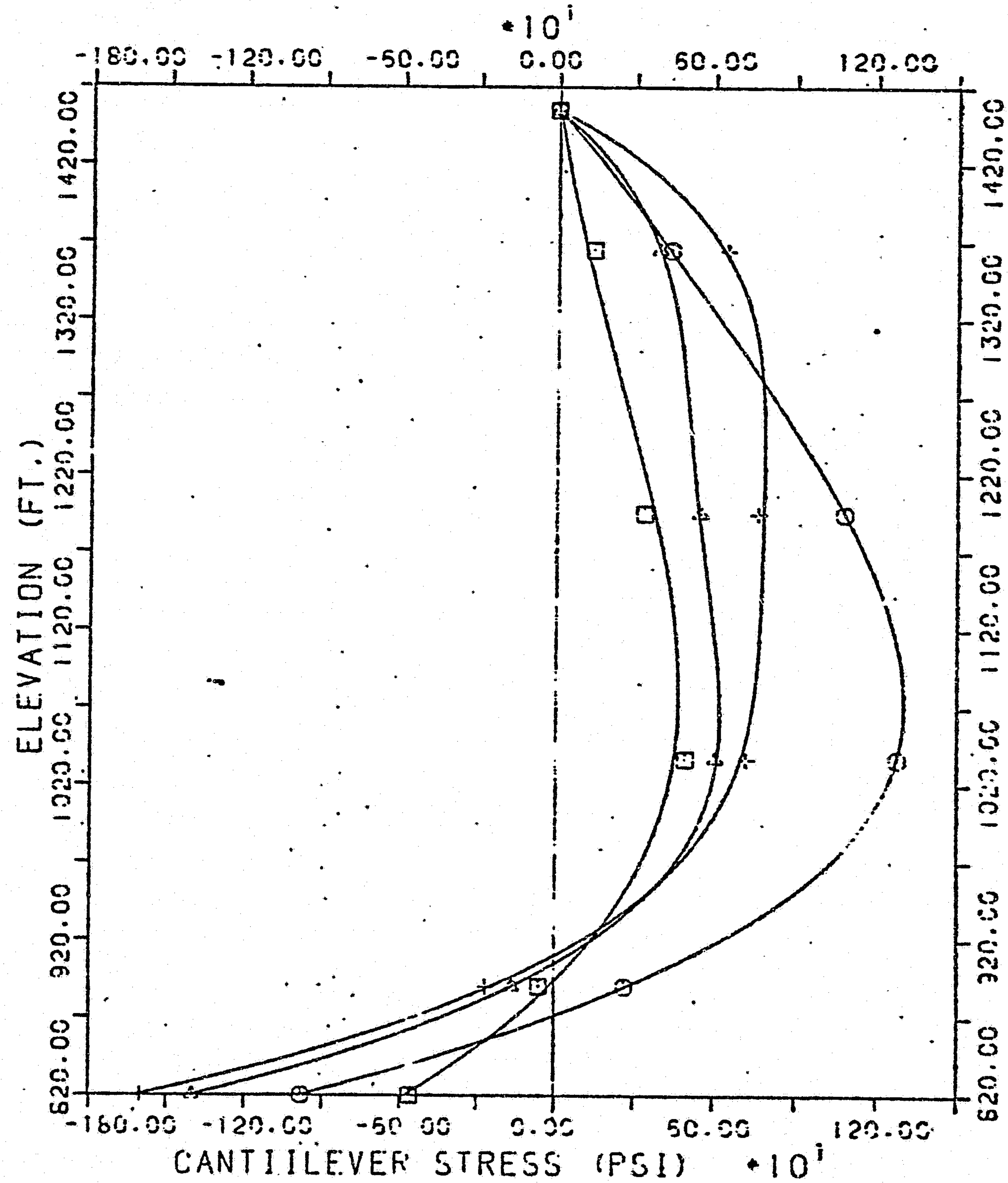
ARCH DAM HEIGHT VS. CREST LENGTH

FIGURE 5

ADAP RESULTS: SUSITNA THIN ARCH DAM

CROWN CANTILEVER STRESSES

EXTRADOS



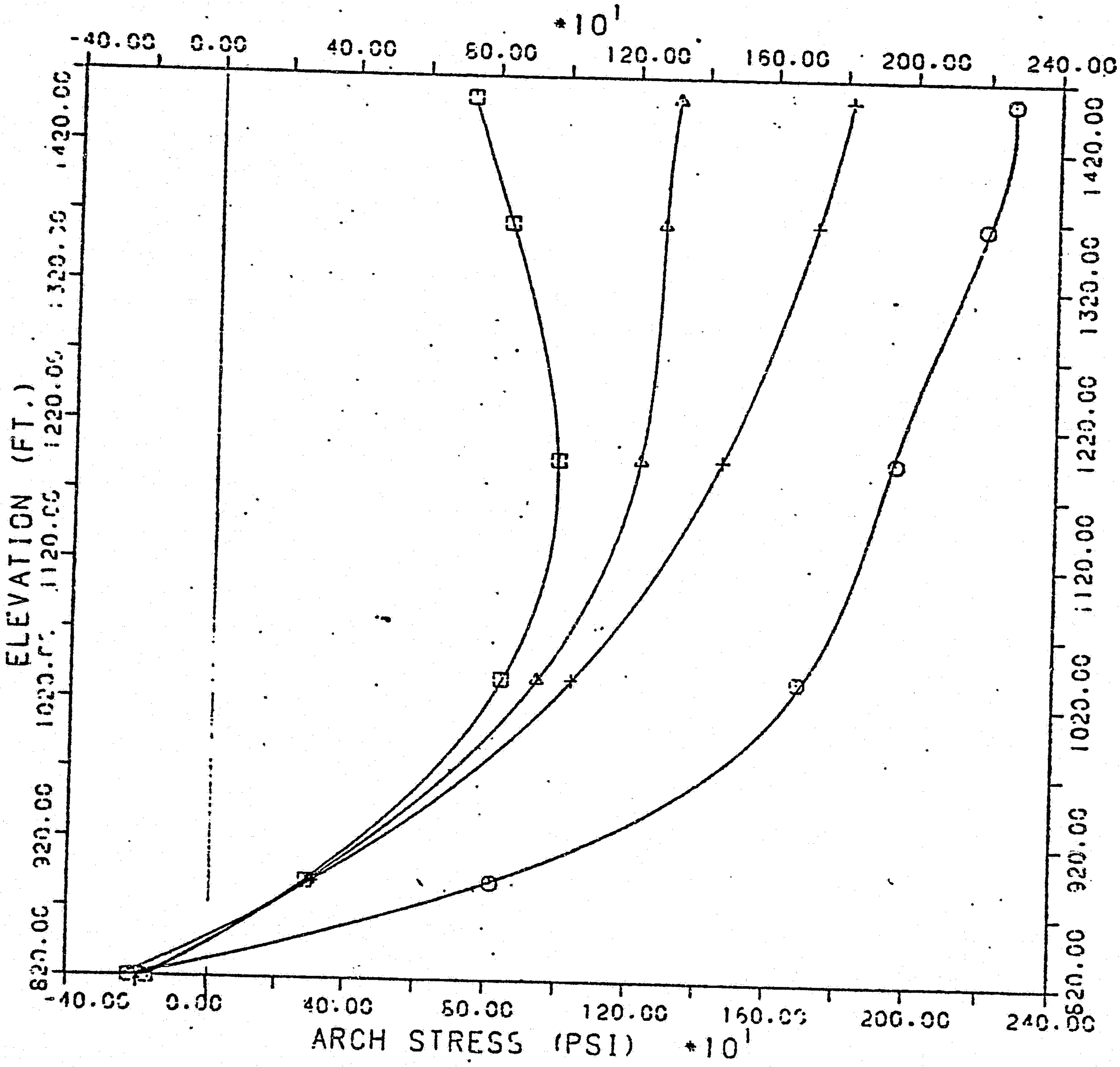
LEGEND:
- ⊡ HYDRO.+GRAV.
- ⊙ HYDRO.+GRAV.+TEMP.
- △ HYD.+GRV.+EQ (0.25G)
- \+ HYD.+GRV.+EQ (0.50G)

FIGURE 6

ADAP RESULTS: SUSITNA THIN ARCH DAM

CROWN ARCH STRESSES

EXTRADOS



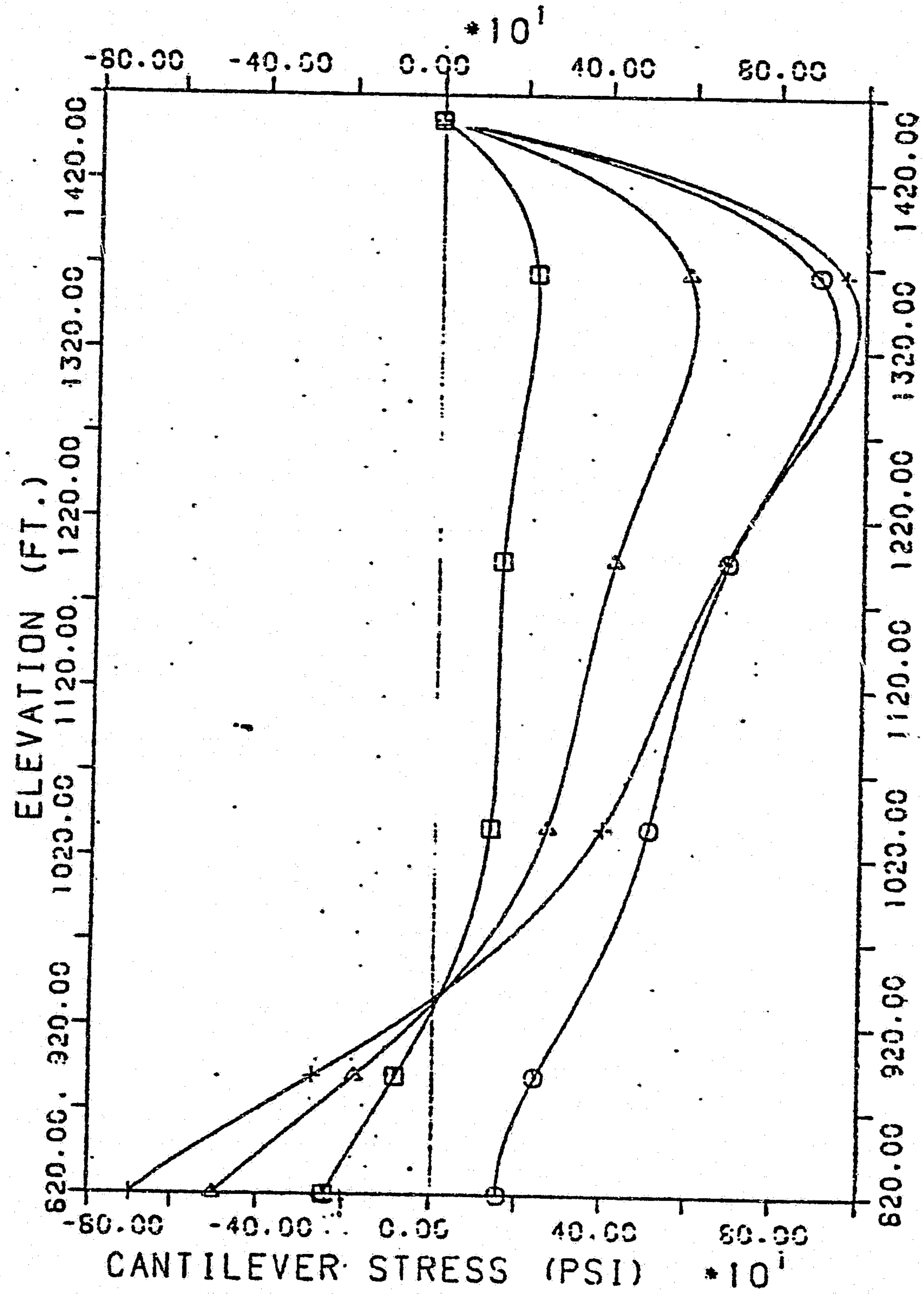
LEGEND:
- □ HYDRO.+GRAVITY
- ○ HYD.+GRV.+TEMP.
- △ HYD.+GRV.+EQ(0.25G)
- \+ HYD.+GRV.+EQ(0.50G)

FIGURE 7

ADAP RESULTS: SUSITNA ARCH-GRAVITY DAM

CROWN CANTILEVER STRESSES

EXTRADOS



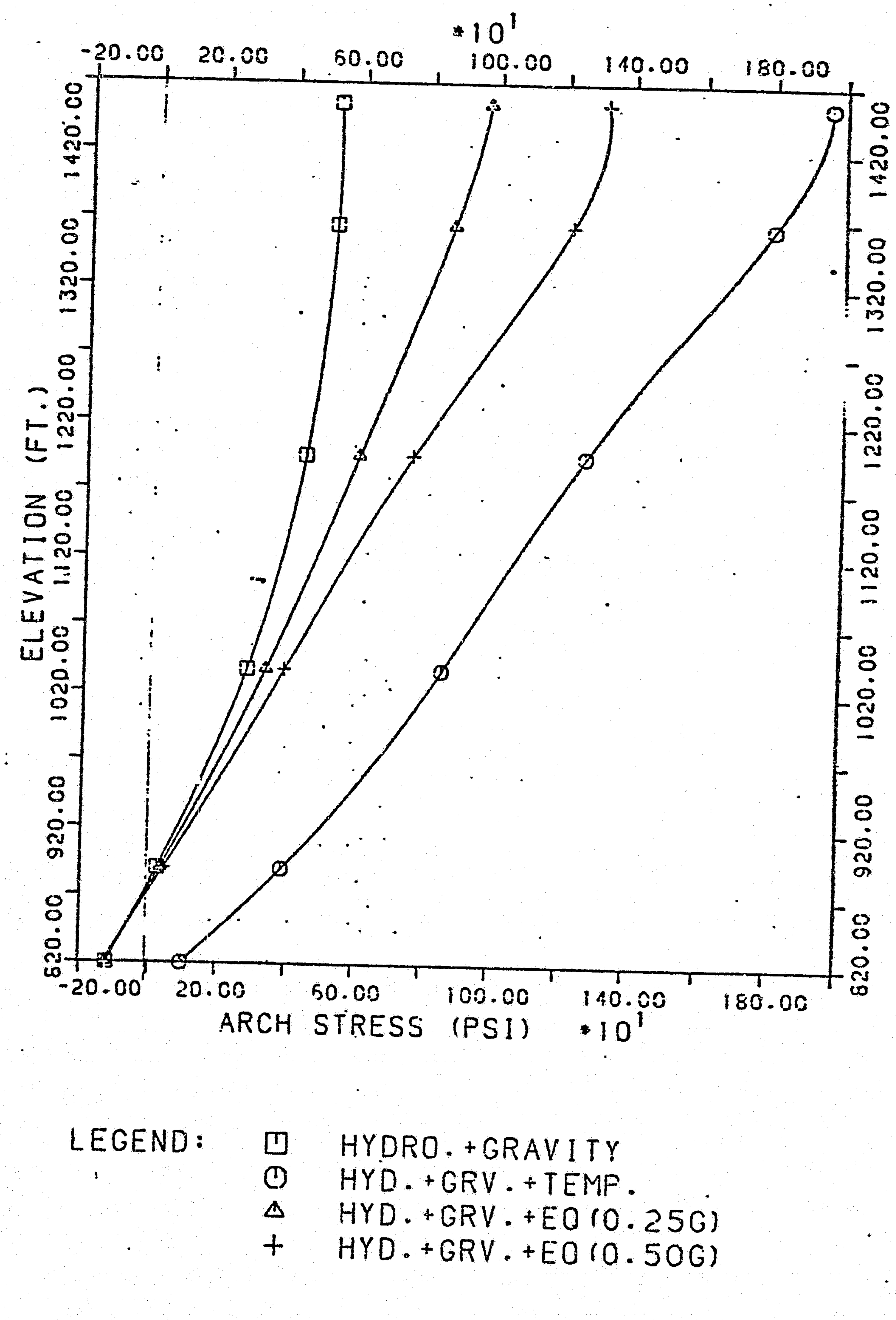
LEGEND:
□ HYDRO.+GRAVITY
○ HYD.+GRV.+TEMP.
△ HYD.+GRV.+EQ(0.25G)
+ HYD.+GRV.+EQ(0.50G)

FIGURE 8

ADAP RESULTS: SUSITNA ARCH-GRAVITY DAM

CROWN ARCH STRESSES

EXTRADOS



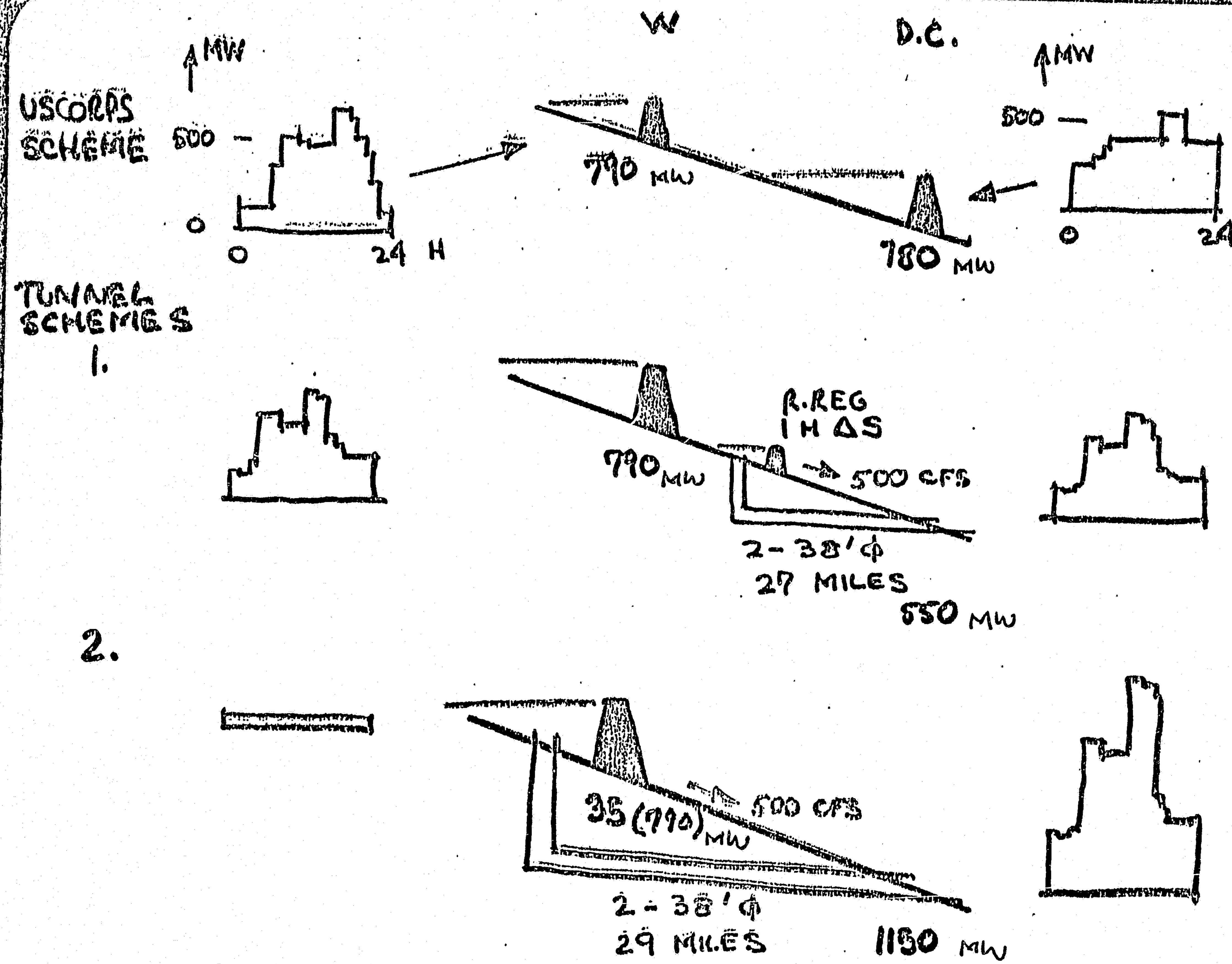
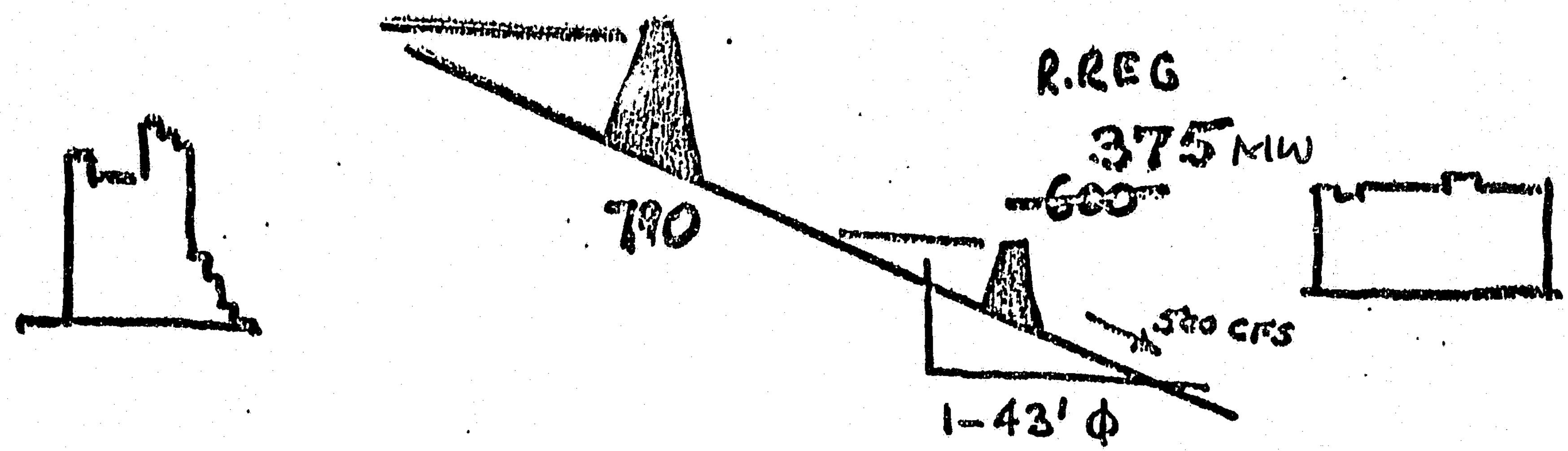


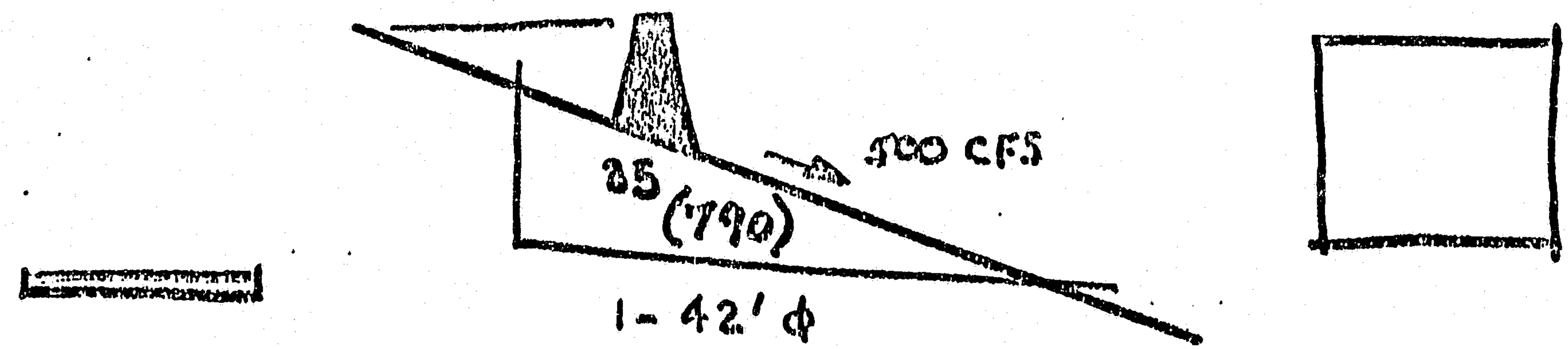
FIGURE 9

TUNNEL ALTERNATIVES - "PEAKING"

3



4



NOTE: CORRECTIONS TO INSTALLED CAPACITY MADE SUBSEQUENT TO THE MEETING.

FIGURE 10

TUNNEL ALTERNATIVES - "BASE LOAD"

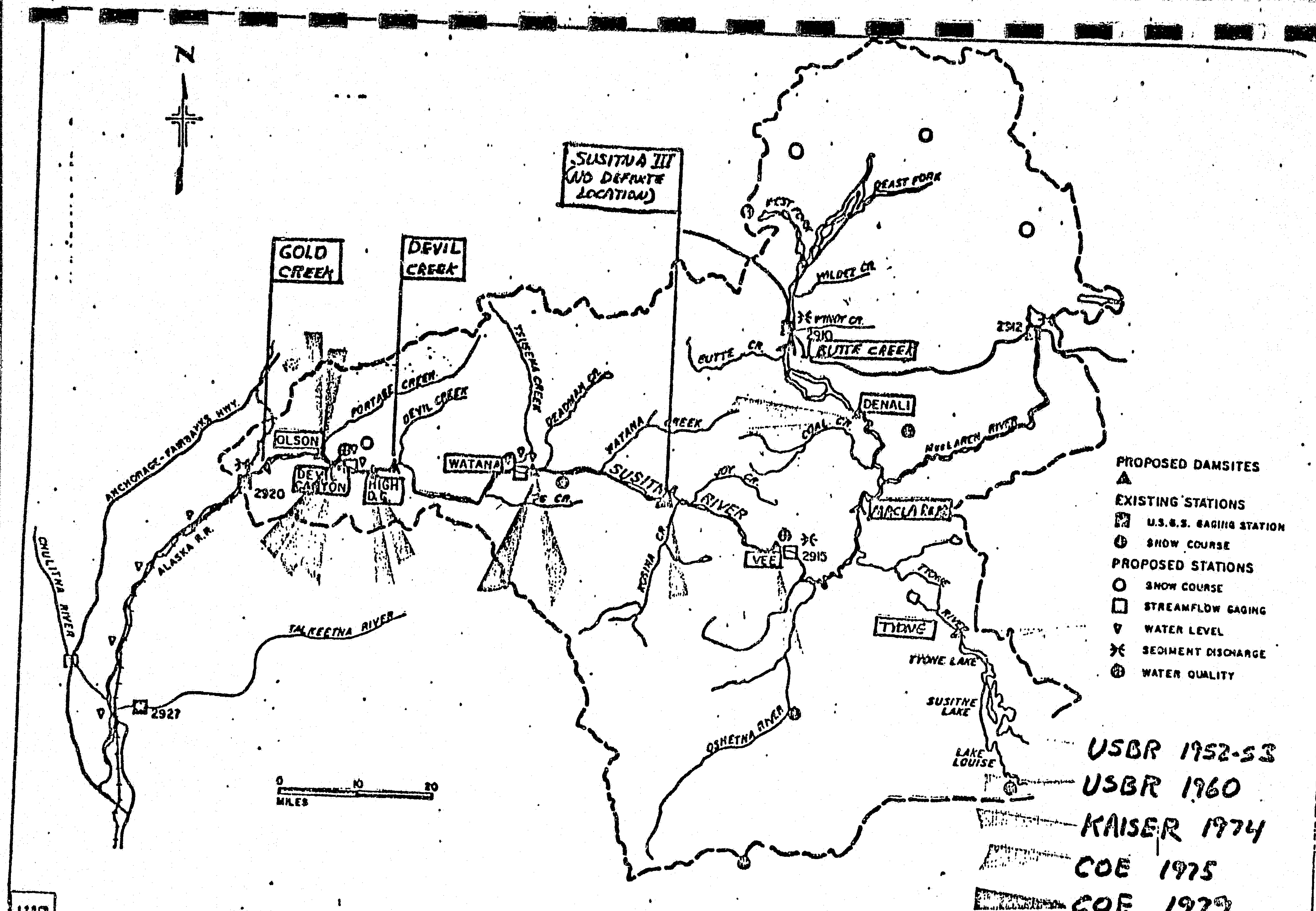


FIGURE 11 LOCATION OF PROPOSED DAMSITES

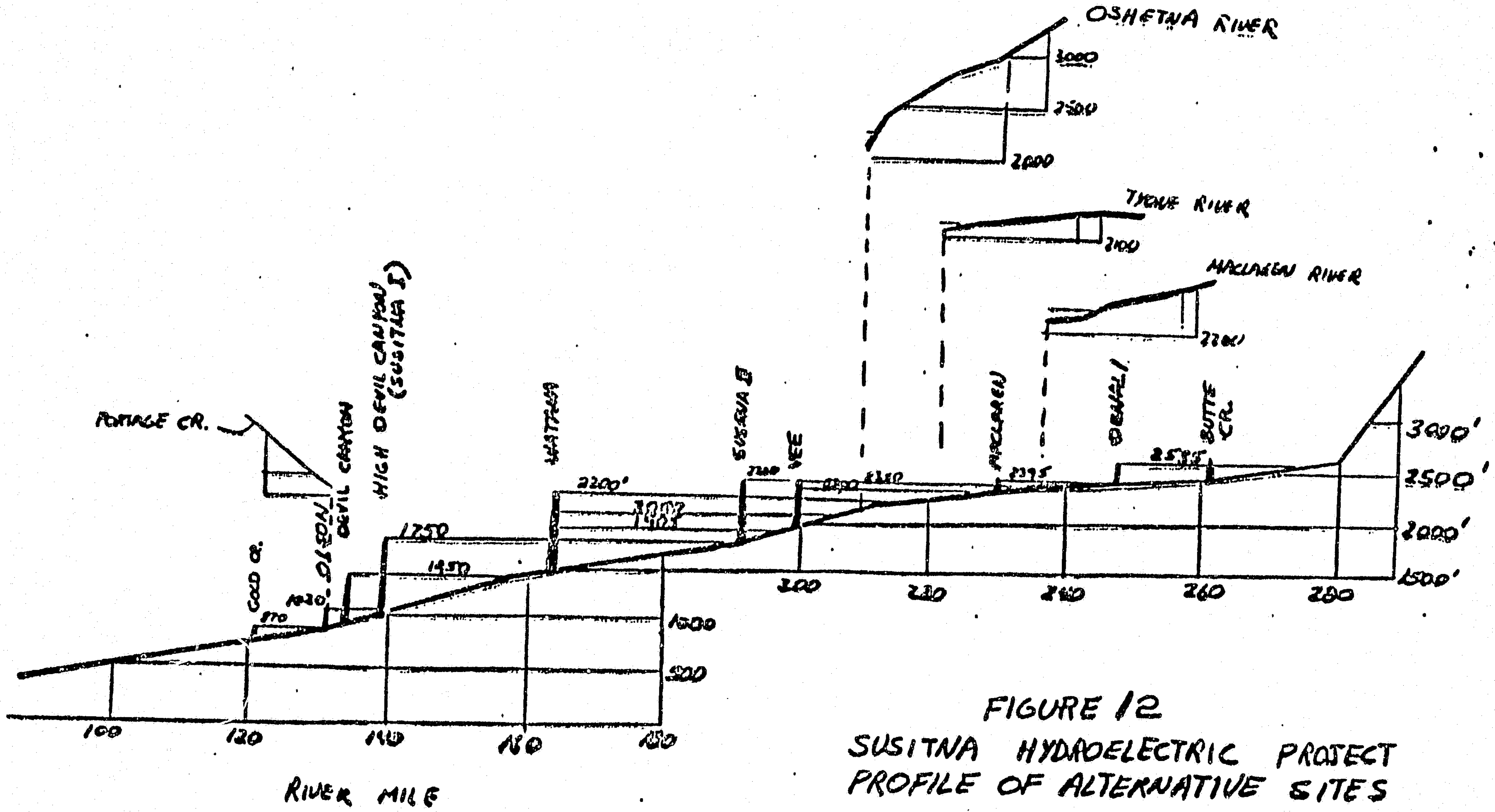


FIGURE 12
SUSITNA HYDROELECTRIC PROJECT
PROFILE OF ALTERNATIVE SITES

GENERAL APPROACH
ALTERNATIVE DAM SITES (6.03/6.06)

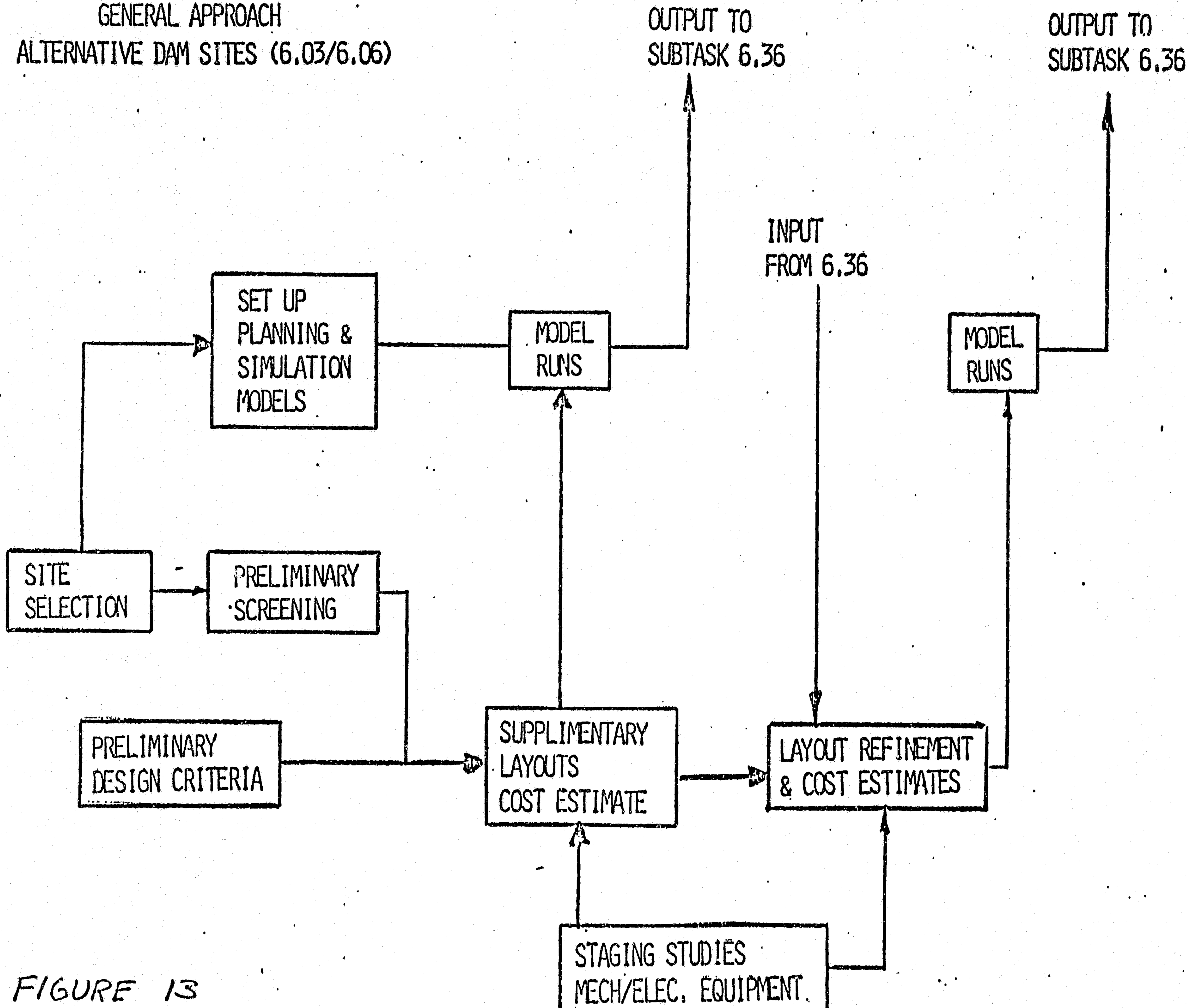
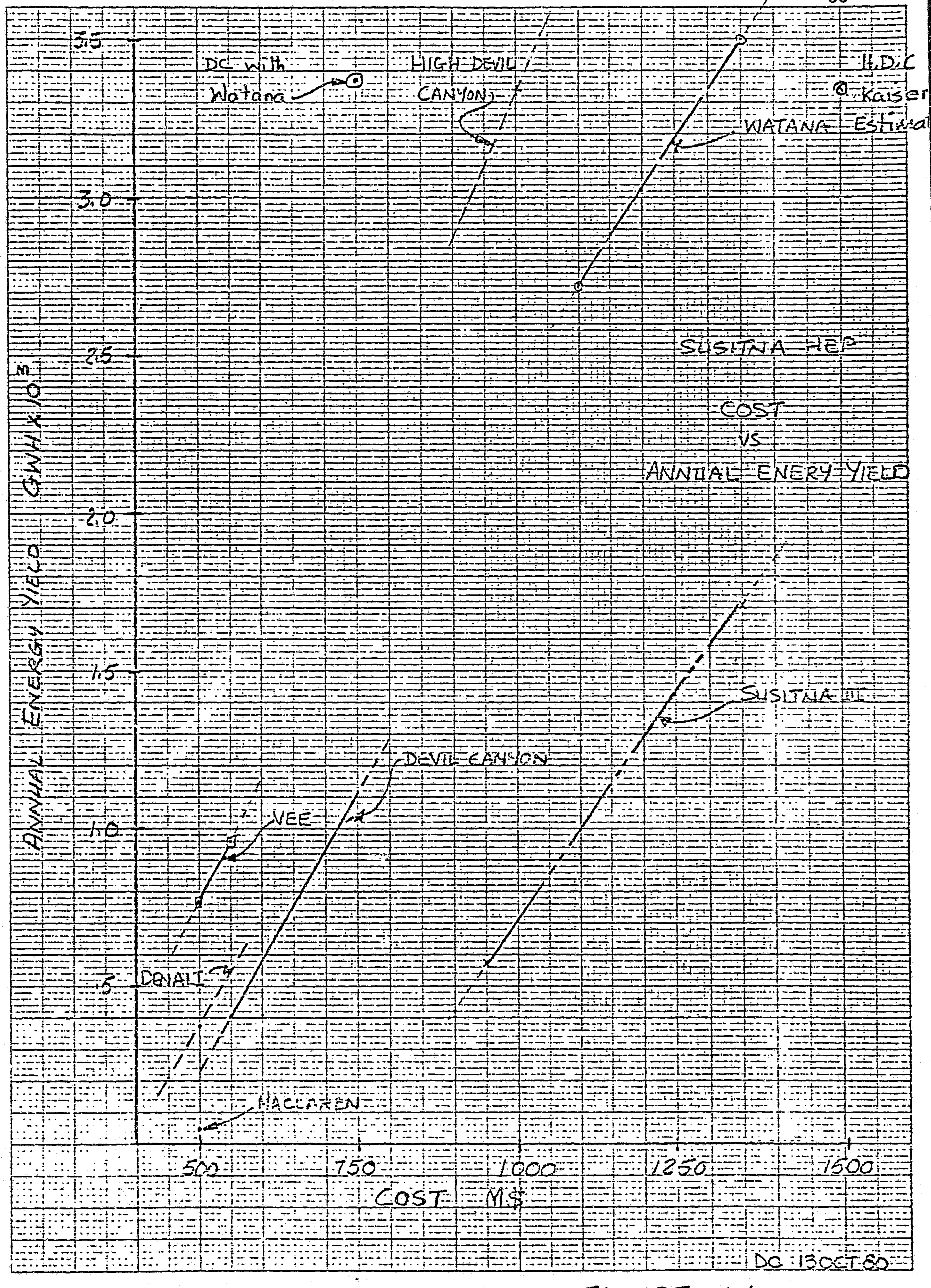


FIGURE 13


3.5
3.0
2.5
2.0
1.5
1.0
.5
DC with Watana
HIGH DEVIL CANYON
H.D.C @ Kaiser
WATANA Estimat
SUSITNA HEP
COST
VS
ANNUAL ENERY YIELD
ANNUAL ENERGY YIELD GWH x 10³
SUSITNA II
DEVIL CANYON
VEE
DENALI
MACLAREN
500
750
1000
1250
1500
COST M$
DC 13OCT80

3. COPIES OF PRESENTATION VIEWGRAPHS

(Meeting of October 14, 1980)

OBJECTIVES (6.03/.06)

6.03: IDENTIFY APPROPRIATE SCHEME.

ADD: STUDIES OF SMALLER FACILITIES

6.06: REVIEW POTENTIAL FOR STAGED DEVELOPMENT AT WATANA AND DEVILS CANYON

ADD: STAGING OF ALTERNATIVE SITES
STUDY OF MECHANICAL/ELECTRICAL EQUIPMENT

FORM NO. 152 REV. 1

HYDRAULIC DESIGN CONSIDERATIONS:

CONSIDERATION / SITES	DENALI	MACLAREN	VEE	SUSITNA III	WATANA	HIGH DEVIL CANYON	DEVIL CANYON	REMARKS
DRAINAGE AREA. mi^2	1260	2320	4140	4225	5180	5760	5810	
AVERAGE DISCHARGE. cfs	3290	4360	6190	6350	8140	9140	9230	
SPILLWAY DESIGN FLOOD. cfs ASSUMED AS 75% of PMF	89,800	106,000	133,000	137,000	175,000	198,000	200,000	Assume for initial spillway sizing without routing.
DIVERSION SCHEME								
DIVERSION FLOOD cfs	42,500	50,000	63,000	64,600	82,600	93,500	94,400	1150 YR Flood
DIVERSION TUNNEL - MAX. VELOCITY ft/s	50	50	50	50	50	50	50	
COFFERDAM HEIGHT ft	—	—	—	—	—	—	—	COFFERDAMS sized to ALLOW CONSTRUCTION IN ONE YEAR
MAX. PENSTOCK VELOCITY ft/s	20	20	20	20	20	20	20	
OPEN POWER CANAL VELOCITY ft/s	3	3	3	3	3	3	3	Max. Velocity allowed to maintain stable ice cover
MAX. TAILRACE Velocity ft/s	8	8	8	8	8	8	8	
RESERVOIR FREEBOARD. ft								
ROCK STRUCTURE	20	20	20	20	20	20	20	FREEBOARD ABOVE DESIGN FLOOD LEVEL.
EARTH STRUCTURE	15	15	15	15	15	15	15	SLIDE INDUCED SURGES
CONCRETE STRUCTURE	8	8	8	8	8	8	8	ASSUMED LESS THAN FLOOD SURCHARGE PLUS WIND EFFECTS
50yr SEDIMENT ACCUMULATION Ac-ft	290,000	243,000	162,000	165,000	204,000	248,000	252,000	Without u/s development. CORPS FIGURES & INTERPOLATION
AVERAGE TAILWATER LEVEL (ft)	2405	2320	1925	1810	1480	1030	880	USCORPS FIGURES & ESTIMATE BY AAI.
heigth								

Calculations

SUBJECT:

JOB NUMBER 13-[illegible] 06

FILE NUMBER

SHEET OF

BY De/ISK DATE 10/2

APP DATE

Table 6

CIVIL DESIGN PARAMETERS

Site (Pool El.)	Dam Type	Height (ft)	Length (ft)	Length / Height	Reservoir Area (acres)	Gross Storage x 10^6 Ac-ft	Spillway Type	Low Level Outlet
Gold Creek	Earthfill	135	4,900	36	--	--	--	--
Olson (920)	Concrete Gravity	50	400	7	--	.01	Overflow Section of Dam	--
Olson (1020)	Concrete Gravity	145	--	--	--	--	--	--
Devil Canyon (1450)	Thin Arch) 74	635	1,370	2	7,550	1.1	Chute w/Flip Bucket	Yes
	Thrust Block) Alternative	110	155	1.4	--	--		
	Earthfill	200	950	4.2	--	--	--	--
	Gravity &) 79	650	1,590	2.4	7,550	1.1	Center Section of Dam	Yes
	Earthfill) Alternative	200	720	3.6	--	--		
High Devil Canyon (1750)	Concrete-faced Rockfill	810	3,050	3.8	24,200	4.7	Channel Cut Into South Abutment	--
Devil Creek	Concrete	350 Max	--	--	--	--	--	--
Low Watana (1905)	Earthfill	515	1,650	3.2	--	2.5	Channel Cut In Saddle Into Tsusena Creek	--
Mid Watana (2050)	Earthfill	660	2,600	3.9	--	5.2	" " "	--
High Watana (2200)	Earthfill	810	3,450	4.3	43,000	9.4	" " "	--
Susitna III	--	--	--	--	--	--	--	--
Vee (2300)	Earthfill	455	--	--	--	3.4	--	--
Vee (2350)	Earthfill	--	--	--	--	--	--	--
Maclaren (2395)	Earth & Concrete	100	2,300	23	--	0.2	--	--
Denali (2535)	Earthfill	260	--	--	--	3.9	19' Dia. Glory Hole w/Conduit Through Embankment	--
Denali (2552)	Earthfill	219*	2,050	9.4	51,000	5.4	--	--
Denali (2590)	Earthfill	205*	1,900	9.3	--	5.7	--	--
Butte Creek	--	100	500	5	--	--	--	--
Tyone	Earthfill & Concrete	35	500	14		--	--	--

*Discrepancy must be due to better information in the 1961 study - Denali (2552)

Table 10

HYDROPOWER PARAMETERS

Site (Pool El.)	Head (ft)	Mean Annual Flow (cfs)	Installed Capacity (MW)	Dependable Capacity (MW)	Average Annual Energy ($x10^9$ kWh)	Firm Energy ($x10^9$ kWh)	Secondary Energy ($x10^9$ kWh)	% of River Potential (1)	Remarks
Gold Creek	190	9,616	260			1.139		≈17%	With U/S Regulation
Olson (920)	45	9,413							
Olson (1020)	145	9,413		187	0.915	0.821		13%	With U/S Regulation
Devil Canyon(1450)	570	9,280	776	206	1.489	0.900	0.750	21%	
High D.C. (1750)	720	9,170	700	600	3.350	2,628	0.600	47%	Data from Corps - 1975
Devil Creek		9,170							
Low Watana (1905)	425	8,160	≈420	252	1.550	1.104	0.750	22%	
Mid Watana (2050)	570	8,160	≈500	457	2.601	1.997	0.550	36%	
High Watana (2200)	720	8,160	792	686	3.346	3.004	0.350	47%	
Susitna III	600	6,194	445			1.840		≈28%	
Vee (2300)	375	6,194		300	1.450	1.310		20%	With U/S Regulation
Vee (2350)	425	6,194							
Maclaren									
Denali	------	------	------	------	------ NO POWER GENERATION ------	------	------	------	------
Butte Creek									
Tyone									
Devil Canyon Denali	N/A	N/A		571	3.300	2.500	0.700	46%	
Devil Canyon Low Watana	N/A	N/A		731	4.485	3.200	1.270	62%	
Devil Canyon Mid Watana	N/A	N/A		1,062	5.730	4.650	1.000	78%	
Devil Canyon High Watana	N/A	N/A		1,427	6.850	6.250	0.550	95%	

Table 10 (Cont'd)

HYDROPOWER PARAMETERS

Site (Pool El.)	Head	Mean Annual Flow	Installed Capacity	Dependable Capacity	Average Annual Energy	Firm Energy	Secondary Energy	% of River Potential (1)	Remarks
	(ft)	(cfs)	(MW)	(MW)	($x10^9$ kWh)	($x10^9$ kWh)	($x10^9$ kWh)		
Devil Canyon High Watana Denali	N/A	N/A		1,552	6.911	6.800	0.111	96%	
Susitna I Susitna II Susitna III	N/A	N/A	1,308		6.309			88%	
Devil Canyon Watana Vee Denali	N/A	N/A		1,427	6.881	6.252	0.629	96%	
Olson High Devil Canyon Vee Denali	N/A	N/A		1,347	6.511	5.900	0.611	91%	
Devil Canyon Watana Vee Denali Olson					7.181+	6.552		100%	

(1) Percent of Maximum Average Annual Energy with Devil Canyon, Watana, Vee, Denali; Olson assumed to be 100%

00138

Table 11

COST COMPARISON

Site (Pool El.)	Estimated Cost (1)	Year of Estimate	Escalation Factor (Whitman Index)	1980 Cost	Dependable Capacity	Cost/kW	Avg. Annual Energy	Cost/kW-hr 15% Annual Charge	Notes
	$ x 10^6			x10^6$	MW		10^6 kW-hr	Mills	
Gold Creek	338	1968	550/210	885	260 (4)	3,404	1,139 (5)	117	(3)(6)
Olson (920)									
Olson (1020)	380	1975	550/377	554	187	2,964	915	91	*(3)(6)
Devil Canyon Arch (1450)	714	1975	550/377	1,042	206	5,056	1,489	105	*(2)
	432	1975	550/377	630	594	1,062	3,235	29	*(3)(6) with H. Watana
	463	1975	550/377	675	206	3,277	1,489	68	*(8)
Devil Canyon Gravity (1450)	535	1975	550/377	780	206	3,286	1,489	79	*(7)(3)
	535	1975	550/377	780	594	1,313	3,235	36	*(7)(6)(3)
	823	1978	550/495	914	594	1,539	3,235	42	(3)(6) with H. Watana
High Devil Canyon (1750)	1,266	1975	550/377	1,846	600	3,078	3,350	83	*(2)
	1,015	1975	550/377	1,481	600	2,470	3,350	67	*(8)
Devil Creek									
Low Watana (1905)	668	1975	550/377	975	252	3,868	1,550	94	*(2)
	420	1975	550/377	613	252	2,431	1,550	59	*(3)
Mid Watana (2050)	877	1975	550/377	1,279	457	2,800	2,601	74	*(2)
	628	1975	550/377	916	457	2,004	2,601	53	*(3)
High Watana (2200)	1,088	1975	550/377	1,587	686	2,313	3,346	71	*(2)
	837	1975	550/377	1,221	686	1,780	3,346	55	*(3)
	1,765	1978	550/495	1,961	686	2,859	3,346	88	*(2) Revised Estimate
Vee (2300)	477	1975	550/377	696	300	2,320	1,450	72	*(3)
Vee (2350)	527	1975	550/377	769					*(3)
Maclaren									
Denali (2335)	340	1975	550/377	496	None		None		*(3)
Denali (2552)	134	1960	550/170	433	None		None		
Denali (2590)	80	1953	550/122	331	None		None		
Butte Creek									
Tyone									

* Estimated in same base year therefore best for comparison
(1) Generally includes contingencies but not IDC
(2) Constructed first (i.e. includes main access road and transmission line)
(3) Later development
(4) Installed capacity
(5) Firm energy
(6) With U/S Regulation
(7) 1978 cost adjusted back to 1975 using relative costs of Arch Dam and Gravity Dam, Page B-9, Corps 1979 Report and escalated to 1980 costs
(8) Constructed first but excludes common costs of transmission lines and roads ($251,000,000, 1975)

Table 11

COST COMPARISON

Site (Pool El.)	Estimated Cost (1)	Year of Estimate	Escalation Factor (Whitman Index)	1980 Cost	Dependable Capacity	Cost/kW	Avg. Annual Energy	Cost/kW-hr 15% Annual Charge	Notes
	$ x 10[6]			$x10[6]	MW		10[6] kW-hr	Mills	
Gold Creek	338	1968	550/210	885	260 (4)	3,404	1,139 (5)	117	(3)(6)
Olson (920)									
Olson (1020)	380	1975	550/377	554	187	2,964	915	91	*(3)(6)
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	432	1975	550/377	630	594	1,062	3,235	29	*(3)(6) with H. Watana
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	535	1975	550/377	780	594	1,313	3,235	36	*(7)(6)(3)
	823	1978	550/495	914	594	1,539	3,235	42	(3)(6) with H. Watana
High Devil Canyon (1750)	1,266	1975	550/377	1,846	600	3,078	3,350	83	*(2)
	1,015	1975	550/377	1,481	600	2,470	3,350	67	*(8)
Devil Creek									
Low Watana (1905)	668	1975	550/377	975	252	3,868	1,550	94	*(2)
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Mid Watana (2050)	877	1975	550/377	1,279	457	2,800	2,601	74	*(2)
	628	1975	550/377	916	457	2,004	2,601	53	*(3)
High Watana (2200)	1,088	1975	550/377	1,587	686	2,313	3,346	71	*(2)
	837	1975	550/377	1,221	686	1,780	3,346	55	*(3)
	1,765	1978	550/495	1,961	686	2,859	3,346	88	*(2) Revised Estimate
Vee (2300)	477	1975	550/377	696	300	2,320	1,450	72	*(3)
Vee (2350)	527	1975	550/377	769					*(3)
Maclaren									
Denali (2335)	340	1975	550/377	496	None		None		*(3)
Denali (2552)	134	1960	550/170	433	None		None		
Denali (2590)	80	1953	550/122	331	None		None		
Butte Creek									
Tyone									

* Estimated in same base year therefore best for comparison
(1) Generally includes contingencies but not IDC
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(3) Later development
(4) Installed capacity
(5) Firm energy
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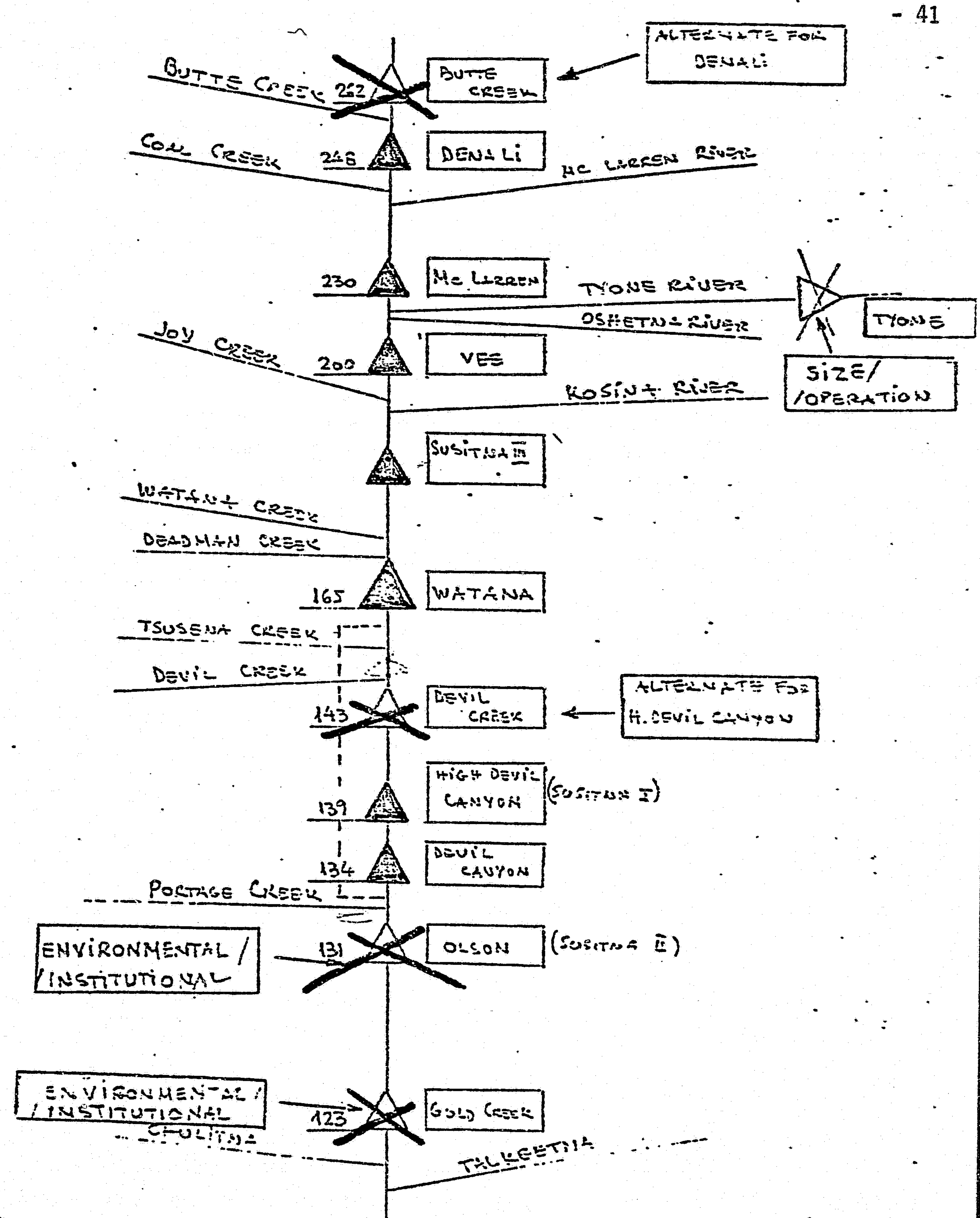
(8) Constructed first but excludes common costs of transmission lines and roads ($251,000,000, 1975)

Calculations

SUBJECT:

JOB NUMBER ______
FILE NUMBER ______
SHEET ______ OF ______
BY AJS DATE ______
APP ______ DATE ______



LEGEND

△ DAM

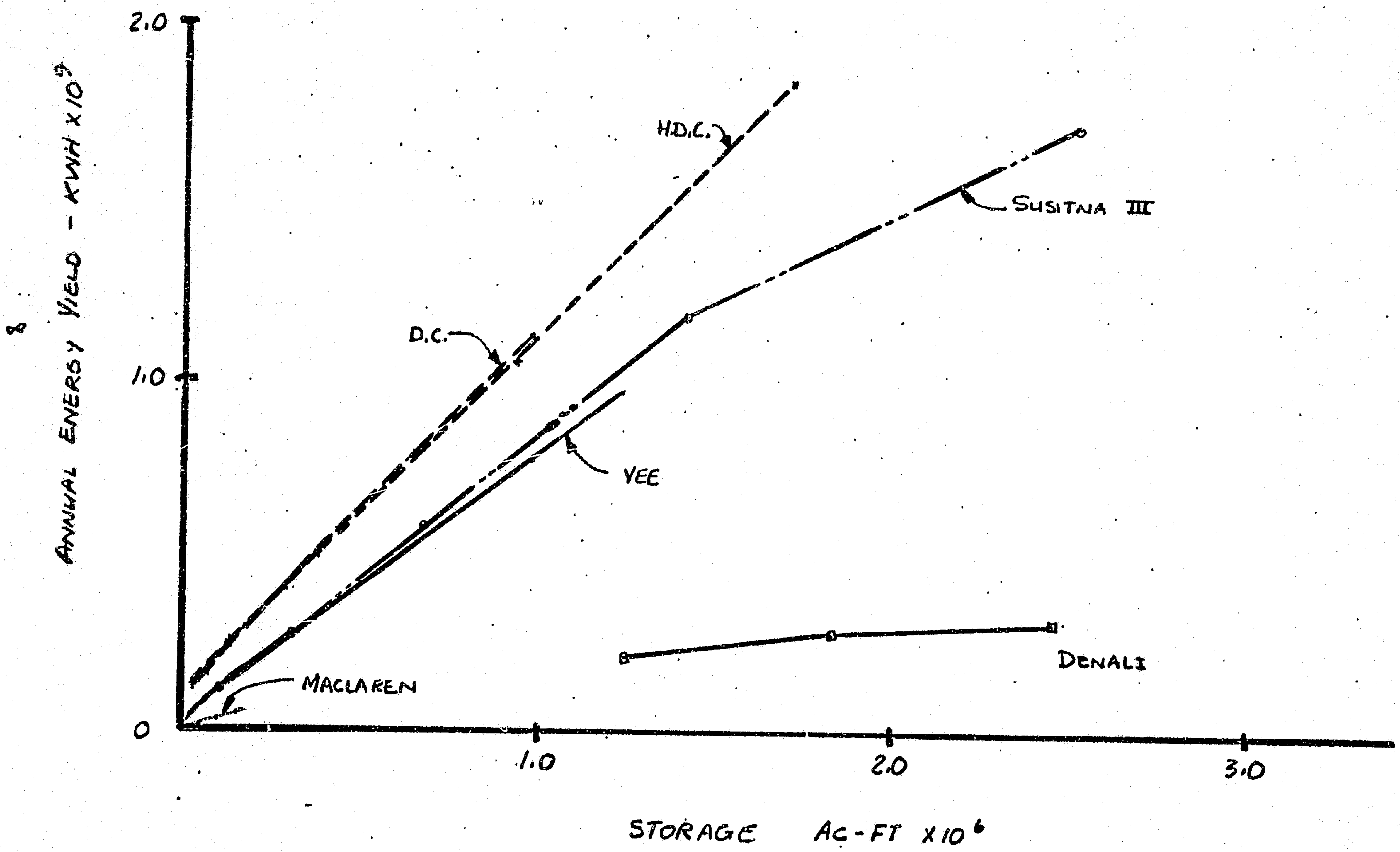
123 RIVER MILE

---- TUNNEL ALTERNATIVE

FIG. SUSITNA HYDROELECTRIC SYSTEM SITES SCREENING

FORM NO. 152 REV. 1

(3)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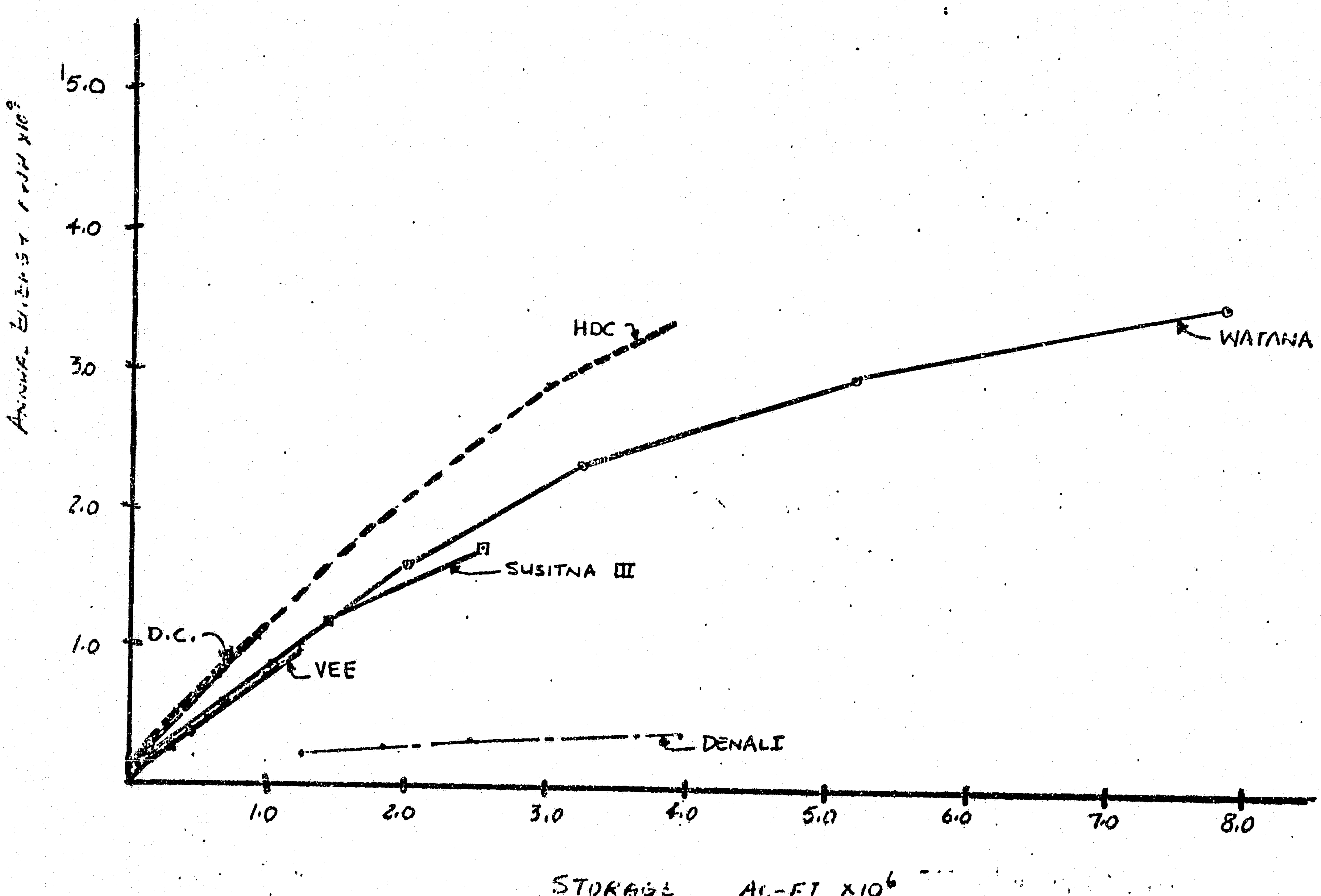
ANNUAL ENERGY YIELD - KWH X 10⁹
H.D.C.
D.C.
SUSITNA III
YEE
MACLAREN
DENALI
1.0
2.0
3.0
STORAGE AC-FT X 10⁶

0 0 1 3 8

(1)



5.0
4.0
3.0
2.0
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HDC
WATANA
SUSITNA III
D.C.
VEE
DENALI
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7.0
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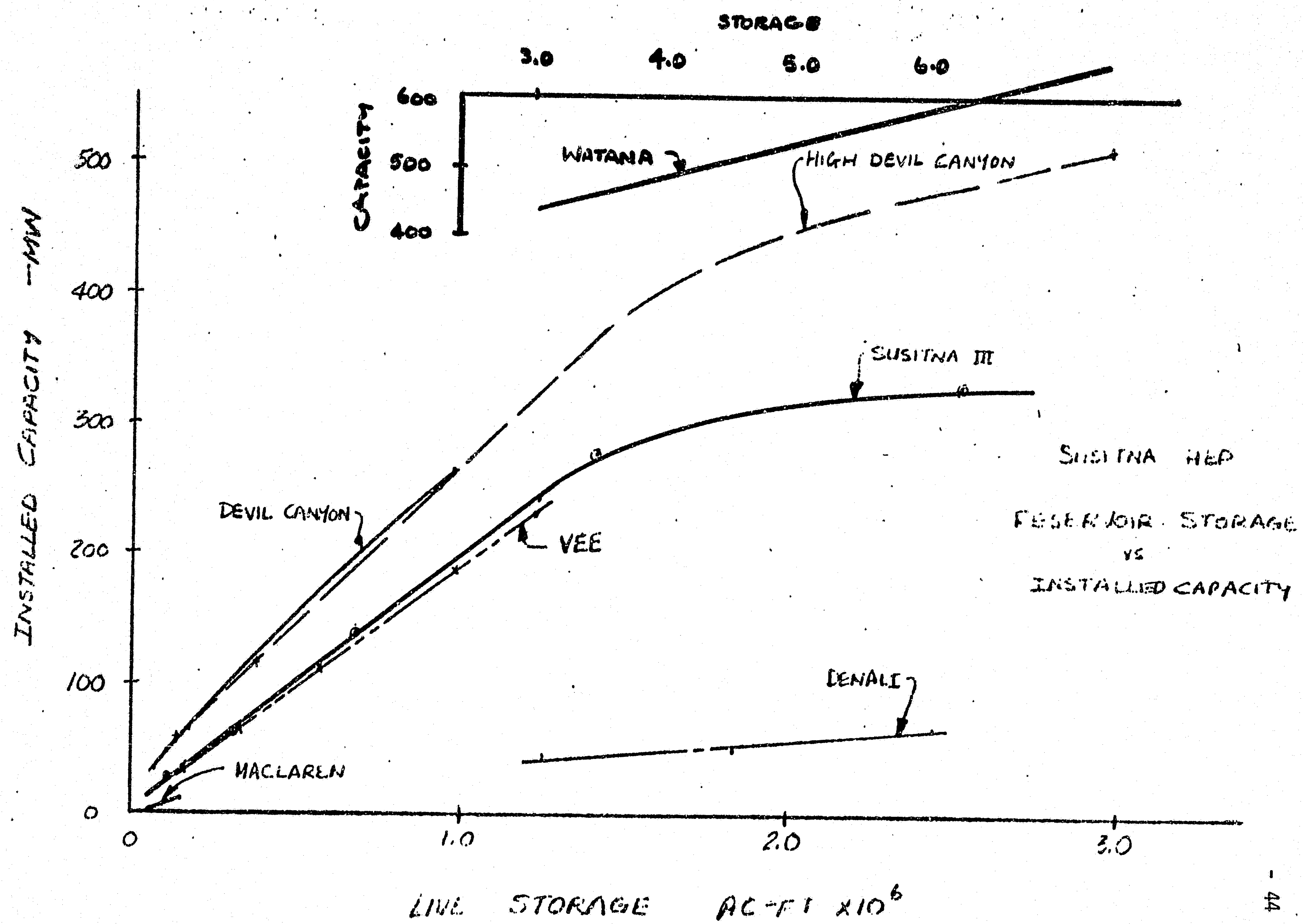
STORAGE AC-FT x10⁶



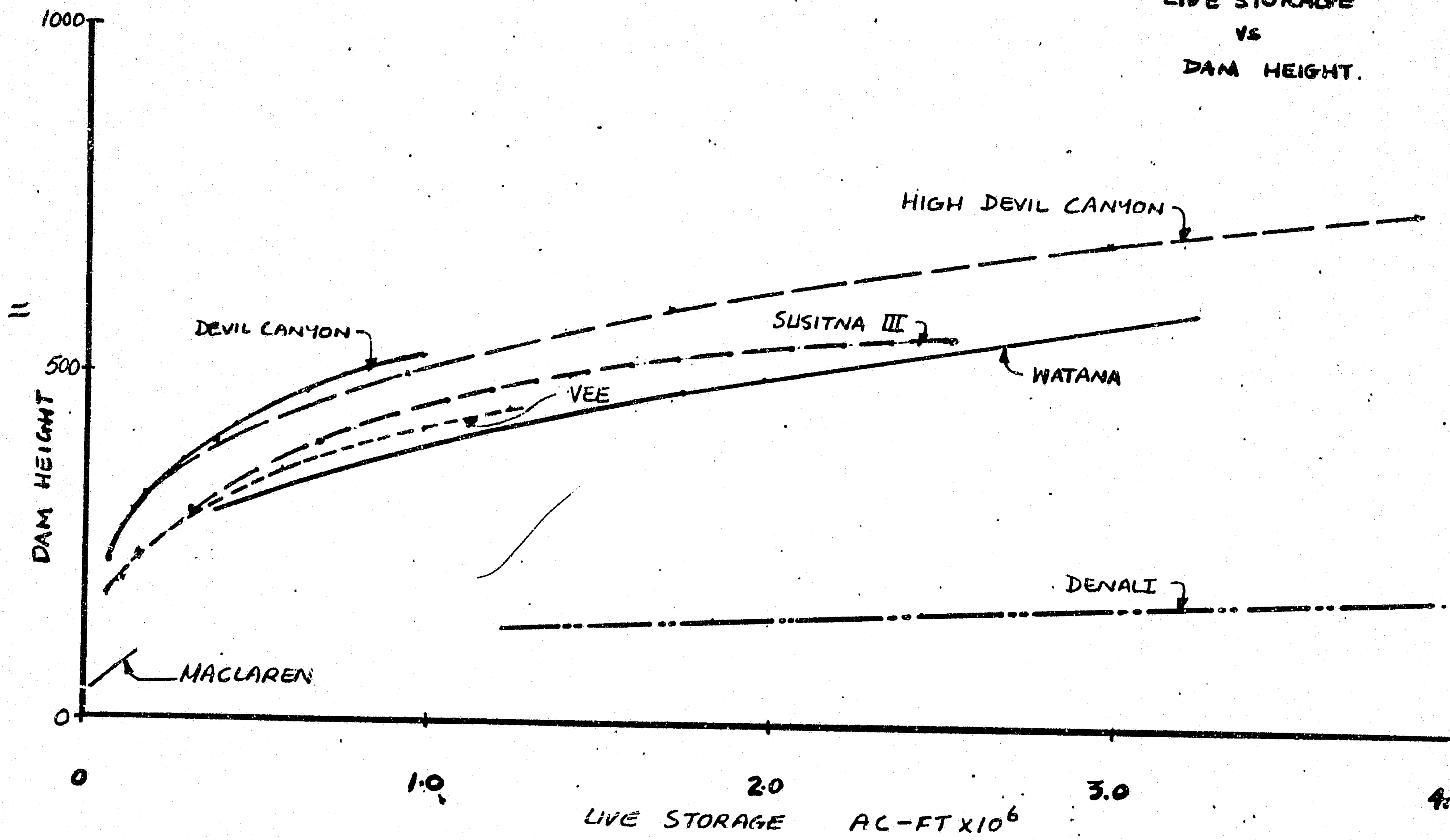
SUSITNA HEP

RESERVOIR STORAGE
VS
INSTALLED CAPACITY

DC 13 OCT 80

SUSITNA HEP

LIVE STORAGE
VS
DAM HEIGHT.



DC 13OCT 80

SUSITNA HYDROELECTRIC DEVELOPMENT
POTENTIAL DAMSITES - LEVELS OF DEVELOPMENT

SITE		MAX. LEVEL OF DEV.	LAYOUTS DEVELOPED IN PREVIOUS STUDIES: DAM CREST	PREVIOUS STUDIES: DAM HT. □	CURRENT STUDIES: DAM CREST	CURRENT STUDIES: DAM HT. □
BUTTE CREEK		2700	-	-	-	-
DENALI		2650	2552	200	2552	200
MACLAREN		2410	—	-	2410	135
VEE	i	2375	—	-	2360	460
SUSITNA III	i	2375	-	-	2375	600
	ii		-	-	2215	640
WATANA	i	2360	2215	775	2215 *	775
	ii		2060	620	2060 *	620
	iii		1915	470		
HIGH DC	i	2000	1755	720	1755	720
DC	i	1600	1455	550	1455	550
	ii				1310	405
	iii				1455 ✱	550
OLSON		1400	-	-	-	-
GOLD CREEK		1000	-	-	-	-

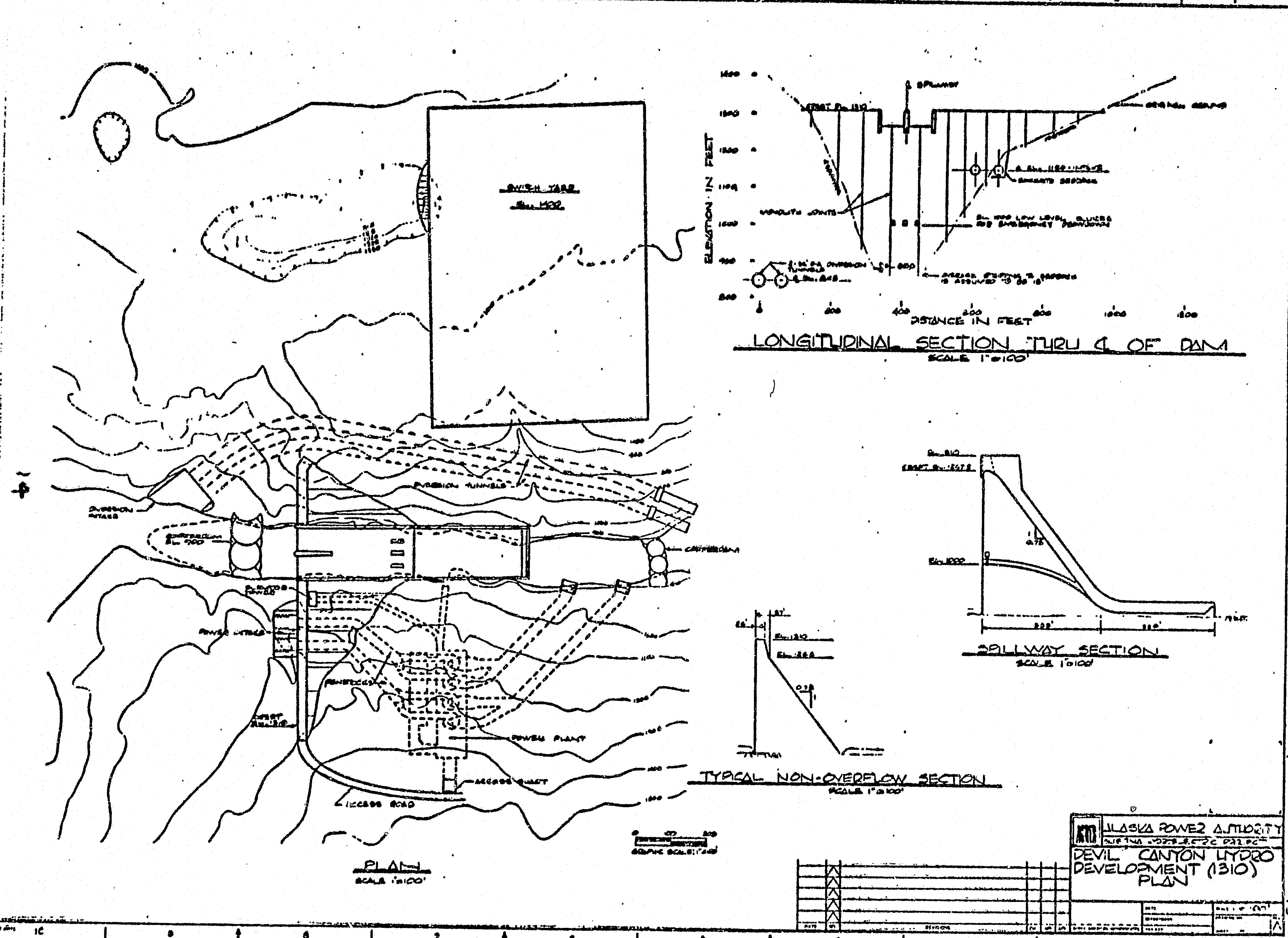
* ALTERNATIVE SPILLWAY ARRANGEMENT

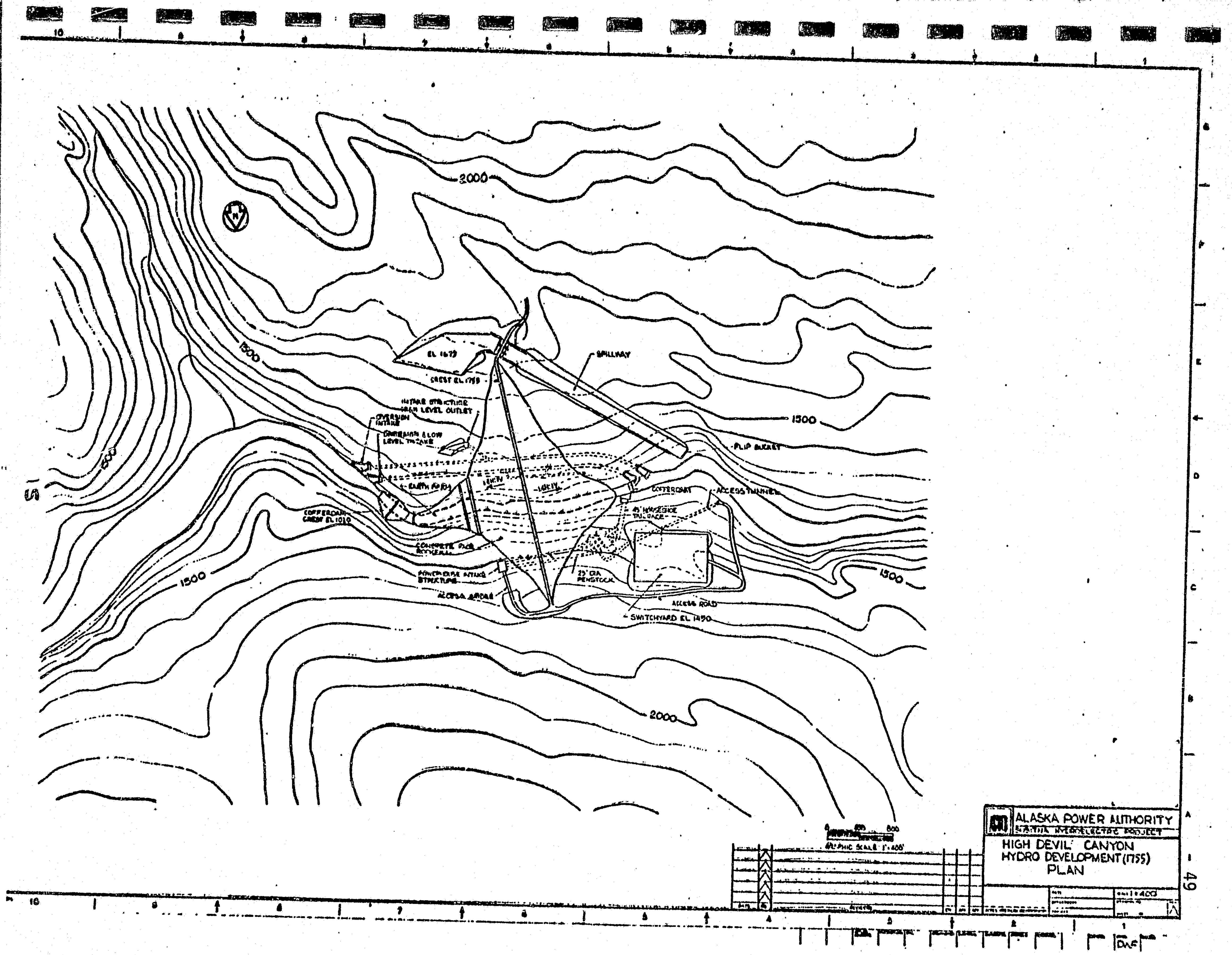
✱ ROCKFILL DAM ALTERNATIVE

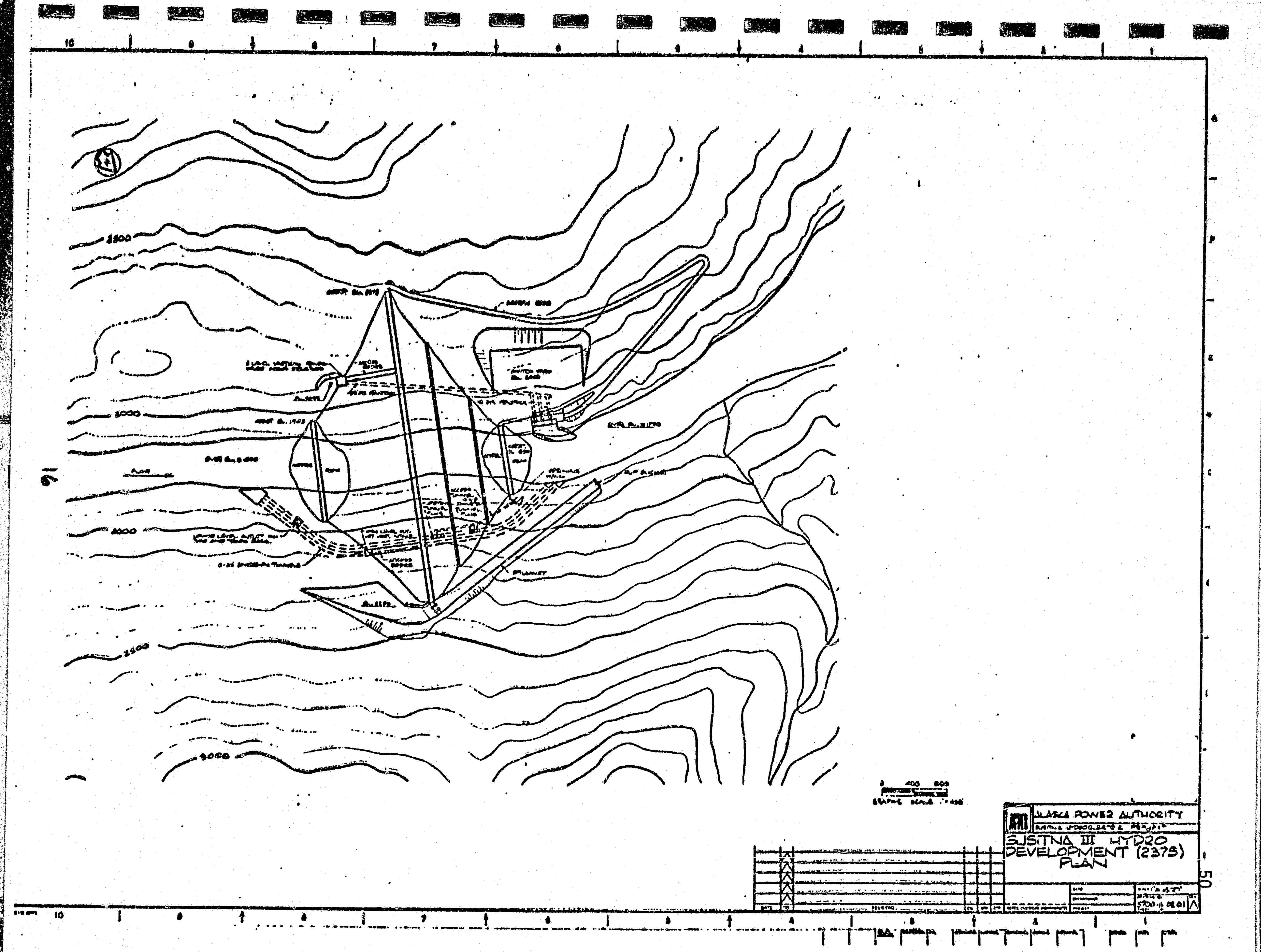
□ DAM HTS. FROM APPROX. STREAM BED ELEVATION.

No	Site	Environmental Implications					
		Biological		Social		Institution	Overall
		Fish	Wild	Local	Reg.		
1	Gold Creek	M	M	M	L	X	H
2	Olson (Susitna I)	M	M	M	L	X	H
3	Devil Canyon	L	L	M-H	M-H	M	L
4	H Devil Canyon (Susitna II)	L	M	M-H	M-H	M	M
5	Devil Creek	L	M	M-H	M	M	M
6	Watana	L	M-H	L-M	L-M	M	M
7	Susitna III	L-M	M-H	M-H	M-H	M-H	M
8	Vee	L-M	M-H	M-H	M-H	M-H	H
9	McLaren	L-M	M-H	L-M	L-M	M-H	M
10	Denali	L	L-M	L-M	L-M	M-H	L
11	Butte Creek	L	M-H	L-M	L-M	M	L
12	Tyone	L	M-H	M	H	M-H	M

0 0 1 3 8

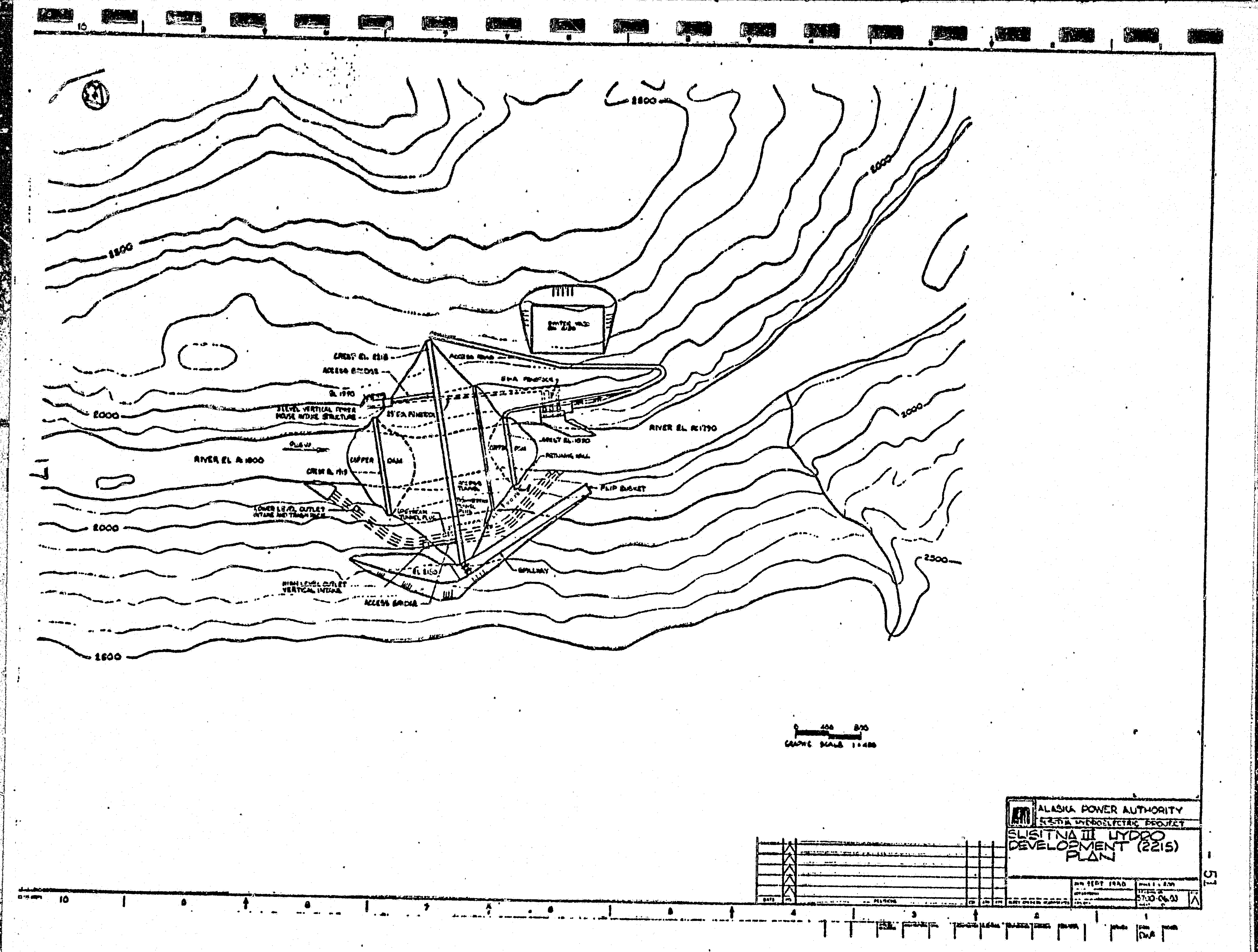

SWITCH YARD
DIVERSION TUNNELS
DIVERSION INTAKES
COFFERDAM
POWER INTAKES
PENSTOCKS
POWER PLANT
ACCESS SHAFT
ACCESS ROAD
PLAN
ELEVATION IN FEET
DISTANCE IN FEET
LONGITUDINAL SECTION THRU ℄ OF DAM
SPILLWAY SECTION
TYPICAL NON-OVERFLOW SECTION
ALASKA POWER AUTHORITY
DEVIL CANYON HYDRO
DEVELOPMENT (1310)
PLAN

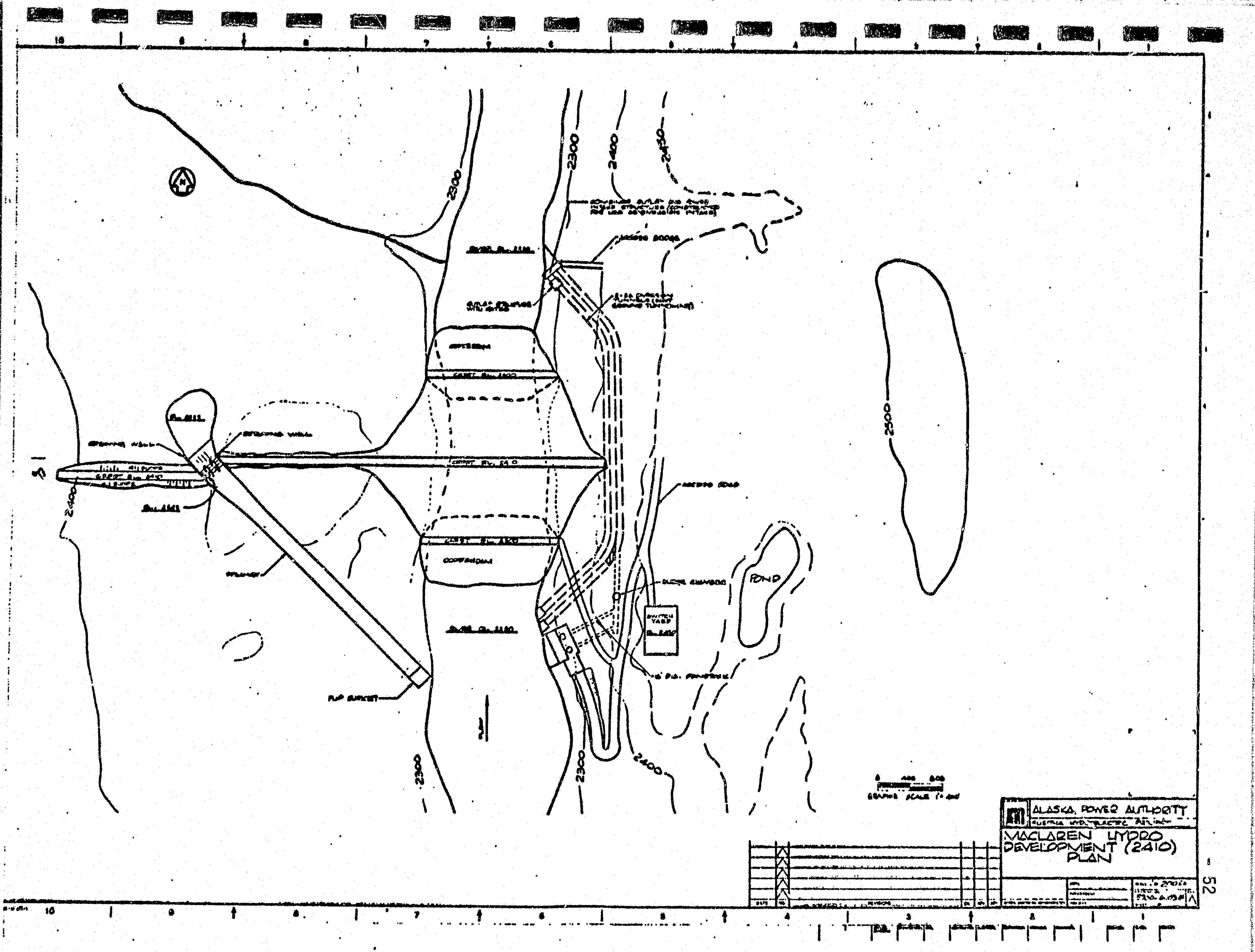

2000
1500
EL 1673
CREST EL 1755
SPILLWAY
INTAKE STRUCTURE
HIGH LEVEL OUTLET
DIVERSION INTAKE
DIVERSION & LOW LEVEL INTAKE
FLIP BUCKET
COFFERDAM
ACCESS TUNNEL
COFFERDAM CREST EL 1010
CONCRETE FACE ROCKFILL
POWERHOUSE INTAKE STRUCTURE
25' DIA PENSTOCK
ACCESS ROAD
SWITCHYARD EL 1490
GRAPHIC SCALE 1"=400'
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
HIGH DEVIL CANYON
HYDRO DEVELOPMENT (1755)
PLAN



2500
2000
3000
2500
3000
0 400 800
ALASKA POWER AUTHORITY
SUSITNA III HYDRO DEVELOPMENT (2375) PLAN

50


2000
2500
1800
RIVER EL. ±1790
ACCESS ROAD
ACCESS BRIDGE
COFFER DAM
RETAINING WALL
FLIP BUCKET
SPILLWAY
HIGH LEVEL OUTLET
VERTICAL INTAKE
LOWER LEVEL OUTLET
GRAPHIC SCALE
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT
SUSITNA III HYDRO
DEVELOPMENT (2215)
PLAN
SEPT 1980


2300
2400
2450
2500
POND
ALASKA POWER AUTHORITY
MACLAREN HYDRO
DEVELOPMENT (2410)
PLAN

INTERFACE WITH GENERATION
PLANNING STUDIES

INFO TRANSFER.

1. OPTIMUM 400 MW SCHEME
   800 MW
   1600 MW

2. CURVES FOR INTERMEDIATE SCHEMES

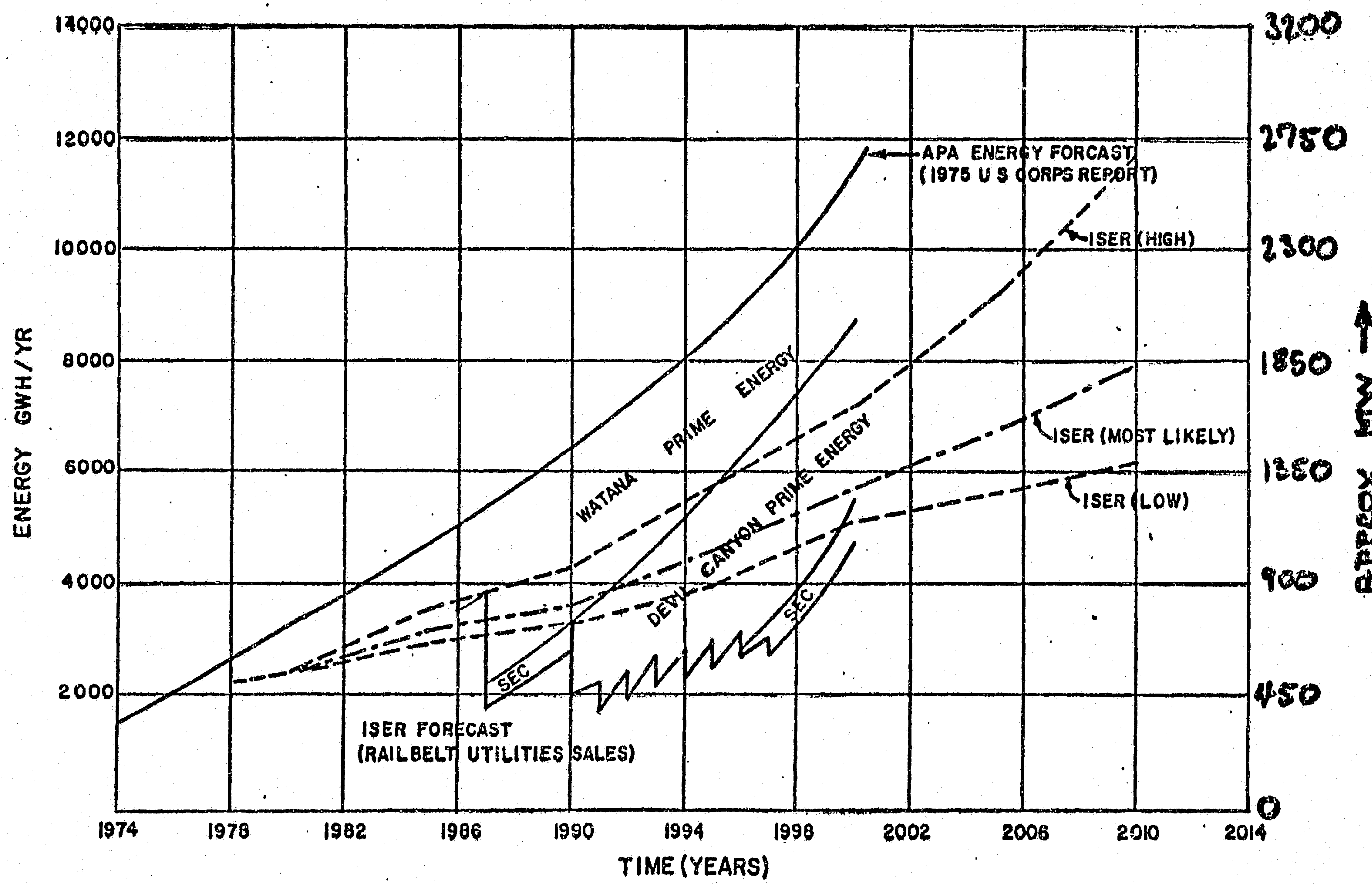
3. DATA FOR GENERATION PLANNING MODEL.

FEEDBACK

OPTIMUM SIZE OF DEVELOPMENT (OR RANGE).

STAGING SCHEDULES

FIGURE 1



14000
12000
10000
8000
6000
4000
2000
ENERGY GWH/YR
3200
2750
2300
1850
1380
900
450
0
APPROX MW
1974
1978
1982
1986
1990
1994
1998
2002
2006
2010
2014
TIME (YEARS)
APA ENERGY FORCAST (1975 U S CORPS REPORT)
ISER (HIGH)
ISER (MOST LIKELY)
ISER (LOW)
WATANA PRIME ENERGY
DEVIL CANYON PRIME ENERGY
SEC
SEC
ISER FORECAST (RAILBELT UTILITIES SALES)

4. NOTES ON MEETING

October 15, 1980

Susitna Hydroelectric Project
APA Review Meeting
October 15, 1980

Acres American Incorporated Offices, Buffalo, NY

Primary Objectives

1. Familiarization with work program.

2. Review of:

   - Progress of thermal generating alternatives study
   - Progress of hydropower generating alternatives study
   - Environmental screening
   - Analysis of ISER forecasts
   - Generation planning work plan

Introduction

The meeting began with John Hayden briefly introducing all participates. The focus of the meeting was identified as a discussion of portions of the generation planning efforts which is being conducted, primarily, in the Columbia Office. Peter Tucker, as the lead person on these studies, initiated the discussion by referencing the design transmittal of the generation planning parameters which have been under review internal for approximately one month. These parameters were previously the topic of discussion as of the September Technical Review Meeting. The parameters written in the design transmittal are intended for extensive internal review and review by the APA prior to their use in generation planning modeling.

Robert Mohn indicated that the APA has been legislatively charged to adopt planning regulations which are currently in draft form. It is not necessary that they are directly used in the Susitna Study, but, if consistency is possible, it would also be desirable. A copy of the APA draft document was provided (Attachment F).

The topic for discussion of the generation planning study was the intertie assumption. It was noted that the interconnected systems as recommended by IECO would likely not become a reality unless Susitna is developed. Therefore, the intertie assumption should be carefully scrutinized for its impact on generation planning studies conclusions. The conclusion of the meeting was that the interconnection cost assumption may be made for screening purposes, but should be identified in generation planning studies so that no alternatives are overburdened or underburdened with cost of generation. It was recognized that the assumption of the full intertie is beneficial economically to a decentralized system compared to a centralized system. Thus, it will be necessary for all conclusions to be evaluated in light of the intertie assumption. (Subsequent to the meeting, it has been decided that the 138 kV line from Healy to Willow may be assumed to be in place. Other necessary lines must be charged to an alternative, as necessary).

Analyses of Thermal Alternatives

Pete Tucker's presentation centered around review of the table of the different alternatives cost and sizes, which is included in Attachment A. Cost for the different alternatives came from an EPRI manual dated 1978. The Handy-Whitman Index was used for updating cost to current levels. The factor was used to change the lower 48 prices into Alaska prices based on Battelle's work. This work was reviewed by R. Lang in the Buffalo Office. It is noted that the Corps estimating factor was as low as 1.5 which is the lowest of all studies reviewed.

Coal-fired steam plant production costs were found to be approximately 90 mills/kWh. This total includes capital costs, O&M and fuel costs. A factor was included in these estimates to reflect increased costs to remote regions. The estimated costs of the thermal alternatives are shown on the handout used in Appendix A. Alternatives studied include coal-fired steam, combined cycle, gas turbine and diesel. Gas turbine peaking capacity was found to be about 110 mills/kWh. It was noted that baseload gas turbines should also be included. as an alternative in generation planning as a sensitivity test.

With unrestricted use the plants could operate at about a 60 percent capacity factor. In the base plan existing gasified plants will be allowed to dispatch at whatever rate is economic. In accordance with the Fuel Use Act, however, new plants will be limited to peaking status.

Relative to fuel escalation, it was stated that Acres would be using the Department of Energy figures which were recently published on October 7 in the Federal Register. In their feasibility planning criteria, APA has recently adopted a 3-1/2 percent value for the 20 years as their planning standard. This figure will be used in fuel escalation sensitivity studies in Subtask 6.36. It was also decided that sensitivity analyses for interest rates and escalation should include the APA economic values of zero percent inflation, 3 percent discount rate, and 3.5 percent fuel escalation.

Hydro Alternatives Analyses

The center of the hydro alternatives analyses presentation was a list of the best alternative sites which passed through the first screenings. Initially, 65 sites were identified as having production costs less than 120 mills/kWh of these sites, 16 were eliminated by environ ental criteria screening. Sixteen sites were removed at this stage. Of the 49 sites remaining, the ten best sites relative to production costs were presented on a handout (Attachment C).

The first-stage screening utilized existing information from the Alaska Power Administration and the Corps of Engineers. The comment was made that the APA data is probably a lot more responsible that the Corps data from a reliability standpoint. Concerning the phase-two screening, it was conclude [illegible]t initial individual plan layouts should be done for 10 to ~~12~~ 15 best sites i[illegible]ad of diluting the effort on more sites. It was suggested that conclusions could be drawn from the latest estimates and work done on Bradley Lake, which can be acquired from the Corps of Engineers, Anchorage District. A check would be made on the amount of manhours and time requirements for detailed layouts and cost estimates for 10 to ~~12~~ 15 preferred hydro alternatives.

Environmental Screening

Kevin Young described the initial screening process and the second-stage more detailed screening process. Sixty-five sites were initially identified by the screening process of which 16 were eliminated. The primary criteria for initial screening included those sites which were in national parks or wilderness areas or high-quality anadromous fish stream. These criteria are listed in a handout in Appendix C. Those sites which were eliminated in the prescreening were also listed in the handout.

TES is involved in the steering committee which would be reviewing the Susitna alternatives. They are prepared to comment on the alternatives screening process but not to actively participate due to budget and scope limitations.

The Chakachamna site was discussed. It was questioned whether the site should have been screened out due to its fluctuation of a lake which is included in the Clark National Monument. The site was not screened initially since no construction would take place in the monument. Robert Mohn suggested that in the environmental screening process of some of the more difficult sites, such as Chakachamna, review materials should be sent to park managers or local fish and wildlife personnel and allow them to make a compatibility judgment. Additionally, they could be asked for possible mitigative effects prior to screening out the alternatives. One reference which can be included in the second-stage screening will be a CH2M Hill report which was done for the Corps of Engineers on a broad environmental screening of hydro sites in the Fairbanks and Anchorage areas.

This report may be available from either Robert Mohn or from the Corps of Engineers, Anchorage District. Also discussed as an issue was the allowance of economic projects to carry through the first screening which would override environmental criteria. There are several advantages and disadvantages to this criteria with the primary disadvantage being the criticism which could be leveled by allowing an otherwise environmentally unacceptable alternative to continue in the screening process.

Review of the ISER Forecast

John Hayden initiated this discussion noting that the workshop review of June 10th and 11th provided a mixed reaction to the ISER forecast. In general, local utilities believed that the forecast should be higher, whereas individuals at the public meeting said that the forecast should be lower.

Since the meetings, Peter Yee has conducted a detailed review of the eocnomic and social parameters which went into the ISER forecast. Mr. Yee's presentation followed a handout in Attachment D. Discussion focused on three areas, the ISER methodology and model, the model runs and results and model deficiencies and implications.

One key limitation of the ISER forecasting is that only the mid-range government expenditure future was pursued, not the high and low. This results in a limited range of forecasts by the ISER end-use model. It was suggested to have ISER operate their model for the high government spending and high economic activity scenario to get a higher bracket on the forecast range. In addition, they should review the low economic, low government expenditures scenario to get a lower bracket. Battelle will be doing this in their alternatives study but it will not be completed in time for the generation planning studies Subtask 6.36.

Subsequently, a telephone call to ISER found that it would be impossible to have this work done prior to December. Therefore, the decision was made to use the numbers in the interim, which Peter Yee has developed.

The ISER mid-level forecast will be used in the base planning forecast, with the sensitivity analysis performed using the high and low forecast range identified by Peter Yee.

Other limitation of the ISER model includes a narrow range of projected industrial growth and the impact of relative price and suitability shifts of alternative fuels.

Conservation and Load Management

Phil Hoover discussed the work plan for Subtask 6.35 using overhead visual display (Attachment E) which outlines the report to be produced by Subtask 6.35. It was noted that the future modifications to load shapes and patterns will be made on the low economic growth, low government expenditure forecasts used from Peter Yee's ISER review. The plan for additional load management conservation measures will be a conceptual plan based on results from experimentation and application in the lower 48 states with the suggestive judgment as to the possible affect on the future power demands in Alaska. Robert Mohn noted that the energy probe study done for the Alaska legislature has already done a study similar in nature and should be reviewed. Of particular use from the report would be the methodology of applying end-use changes or conservation at the end-use sector to the ISER model.

Generation Planning Studies

A review has been completed of alternative models available for the Subtask 6.36 alternative planning. The results were presented by Phil Hoover. The review has found that although there are a number of existing system planning models available with diversified features. The review has concluded that considering the study objectives, the most appropriate and cost-effective model to use would be the General Electric OGP-5 model as originally anticipated in the scope of work.

The proposed work plan for the generation planning studies was prescribed in a handout. The work will be divided into four phases with specific objectives to each phase.

The initial phase will be to develop a base plan for the railbelt, with and without Susitna project. This phase will use the mid-range ISER forecast and mid-level escalation interest parameters to identify the best Susitna alternative.

The second phase of the process will deal with the impact of variable levels of load forecast on the plans identified in Phase 1. The high and low forecasts developed by Peter Yee, based on the ISER projections will be used to the high and low ranged. Additionally, the conservation and load management forecast done in Subtask 6.35 will be analyzed. A great deal of discussion centered on the method of assessing the results of overplanning and underplanning capacity additions to the system. It was generally agreed that the analysis should identify the plan that balances the penalties of being high or low on capacity addition to the system.

The impact of variable planning parameters will be reviewed in the third phase. This will include reviewing the impact of using the high and low range escalation scenarios and the alternative fuel escalation price shifts for the mid-range escalation forecast. In addition, in this phase the impact of variable capital costs for the projects shall be reviewed.

In the final sensitivity phase, the Phase 2 analyses of the alternative load forecasts will be assessed with variable planning parameters. The key areas of sensitivity relative to these parameters will be identified by the results of Phases 2 and 3.

Conclusions

Some of the key points and conclusions which came out of the meeting were:

(1) Specific layouts and cost estimates are necessary for the 10 - 12 best hydroelectric site alternatives. This is preferable to using previously developed estimates or more generalized data for a greater number of sites. The Bradley Lake data currently being developed by the Corps can be used as input to cost estimates.

(2) The assumption of a fully intertied system for generation planning is not justified in the absence of a Susitna project. Only a 138 kV line can be assumed to exist. For initial screening of alternatives, the costing of transmission to an intertie and the cost of an intertie, if greater than 138 kV, must be included.

(3) Although current federal law may prohibit its uses, one scenario should include the availability of natural gas-fired generation plants at high capacity factors (60 percent). The natural gas prices shall be at market prices.

(4) APA is preparing economic evaluation criteria for use in feasibility studies. Although it is not mandatory that they be used for the Susitna study, the incorporation as possible would be appropriate.

(5) The environmental basis used for screening Susitna alternatives and other alternatives should be consistent. The methodology will be presented to the Susitna steering committee at the meetings the first week of November.

(6) The mid-range ISER forecast will be used as the basic forecast for generation planning in Subtask 6.36. In order to widen the band width between the high and low scenarios, a forecast with ISER's high economic sector activity and high government expenditure will be used. The low activity combination as well will be used. These forecasts cannot be run by ISER until December at the earliest. The estimated forecasts by Peter Yee will be used as close approximations of the model results.

(7) The consideration of balancing the penalties for having an excess or deficiency of capacity will be of great interest. More consideration will be given to supplying detailed methodology for this aspect of the sensitivity studies.

PMH/kh

Attachments

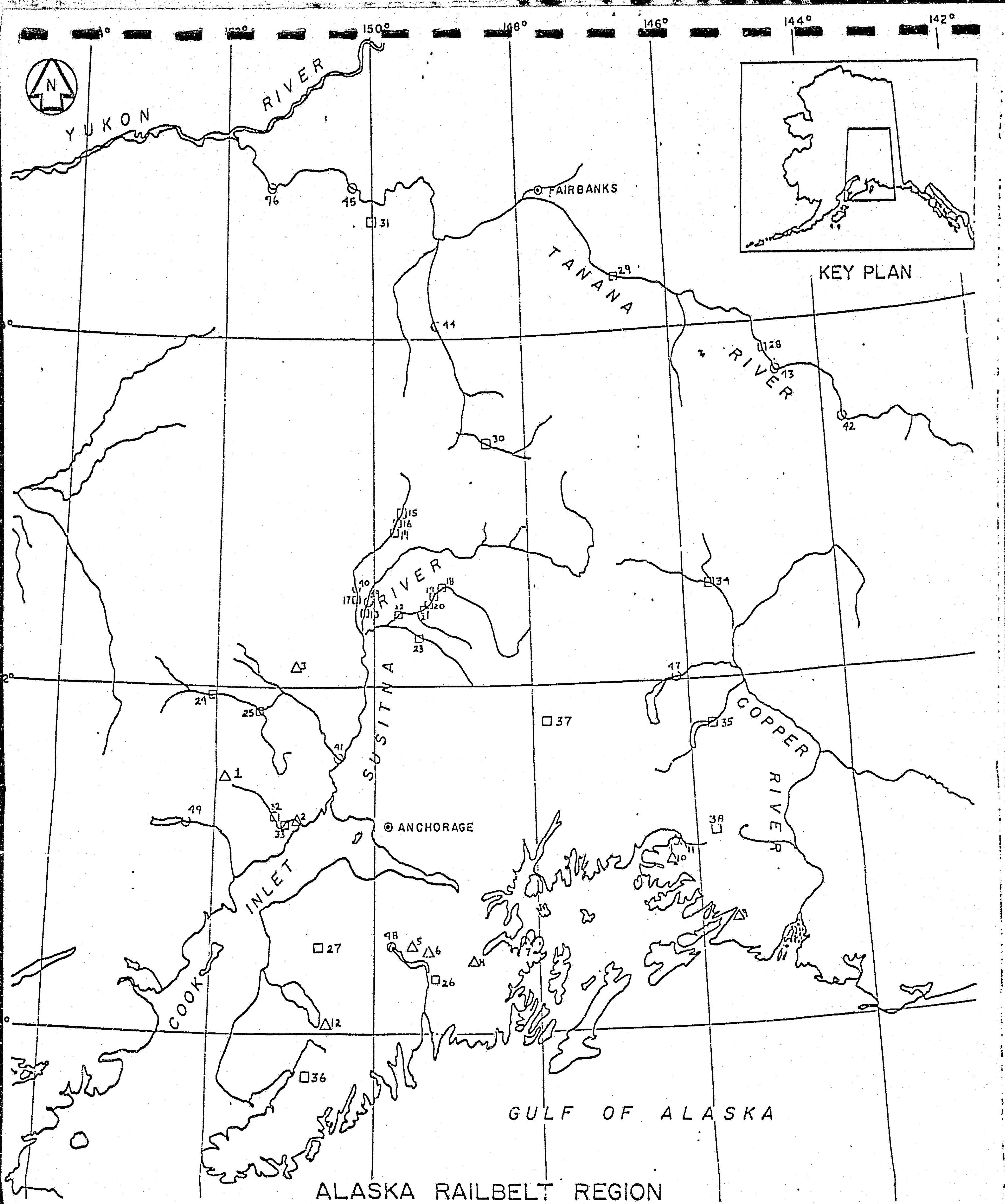
ATTACHMENT A

Potential Hydroelectric Sites Passing Rough Screening

(Short List)

Site	Stream	Regulation (1)	Trans. (miles) (2)	Trans. Cost (\$/kW) (3)	Capacity (MW) COE	Capacity (MW) APA	Cap. Fac. (%) COE	Cap. Fac. (%) APA	Cost (4) (\$/kW) COE	Cost (4) (\$/kW) APA	Cost (4) (mill/kWh) COE	Cost (4) (mill/kWh) APA
Upper Nellie Juan	Nellie Juan R.	Good	80	1333	12	12	54	55	3450	3855	100.3	91.8
Tustumena	Tustumena R.	Good	90	857	21	21	55	55	1733	4120	49.5	114.7
Lower Chulitna	Chulitna R.	Good	36	80	90	90	50	50	2747	2215	80.7	66.7
Keetna	Talkeetna R.	Good	16	43	74	74	50	50	1820	3028	53.5	89.3
Skwentna	Skwentna R.	Good	88	198	98	89	57	55	2080	3507	53.6	79.7
Bradley Lake	Bradley R.	Good	112	238	94	94	50	50	1103	1675	32.4	49.2
Lowe	Lowe R.	Fair	16	58	55	55	53	50	2333	3403	64.7	84.1
Tokichitna	Chulitna R.	Good	36	42	184	170	50	55	1671	2483	47.6	64.3
Yentna	Yentna R.	Good	28	42	219	132	50	55	2307	2945	65.8	75.7
Chakachamna	Chakachatna R.	Good	84	51	366	332	50	55	743	1824	21.2	47.3

(1) Good = 70 - 100%; Fair = 40 - 70%; Poor = <40%.
(2) Measured from site to intertie system.
(3) Based on \$200,000/mile.
(4) Does not include transmission cost.



ALASKA RAILBELT REGION

0-25 MW | 25-100 MW | >100 MW

1. Strandline L.
2. Lower Beluga
3. Lower Lake Cr.
4. Allison Cr.
5. Crescent Lake 2
6. Grant Lake
7. McClure Bay
8. Upper Nellie Juan
9. Power Creek
10. Silver Lake
11. Solomon Gulch
12. Tustumena
13. Whiskers
14. Coal
15. Chulitna
16. Ohio
17. Lower Chulitna
18. Cache
19. Greenstone
20. Talkeetna 2
21. Granite Gorge
22. Keetna
23. Sheep Creek
24. Skwentna
25. Talachulitna
26. Snow
27. Kenai Lower
28. Gerstle
29. Tanana R.
30. Bruskasna
31. Kantishna R.
32. Upper Beluga
33. Coffee
34. Gulkana R.
35. Klutina
36. Bradley Lake
37. Hick's Site
38. Lowe
39. Lane
40. Tokichitna
41. Yentna
42. Cathedral Bluffs
43. Johnson
44. Browne
45. Junction Is.
46. Vachon Is.
47. Taziina
48. Kenai Lake
49. Chakachamna

ACRES

Hydroelectric Sites
Passing Rough Screening

Figure 1

ATTACHMENT B

TABLE 3-1

ESTIMATED THERMAL PLANT CAPITAL COSTS IN RAILBELT

Plant Type	Capacity (MW)	Heat Rate Btu/kWh	Capital Cost ($/kW) 1	2	3	O & M Cost (mills/$kWh) (not including fuel) 1	2	3
Coal-Fired Steam	500	10,500	2061	2248	2748	5.89	6.42	7.85
Coal-Fired Steam	250	10,500	2286	2495	3049	6.18	6.75	8.25
Coal-Fired Steam	100	10,500	2612	2849	3482	9.1	9.9	12.1
Combined Cycle	250	8,300	780	850	1039	21.02	22.93	20.03
Gas Turbine	75	12,000	660	721	881	23.36	25.48	31.15
Diesel	10	11,500	1056	---	---	9.0	9.5	10.0

1 - ANCHORAGE - 1.65 FACTOR
2 - BELUGA - 1.80 FACTOR
3 - HEALY/NENANA/FAIRBANKS - 2.20 FACTOR

All costs are January 1, 1980 dollars.

TABLE 3-2

COMPARISON OF CAPITAL COSTS

Plant Type	Capacity (MW)	Heat Rate Btu/kWh	Capital Cost ($/kW)		O & M Cost Mills/kWh (not including fuel)	
			Lower 48	Alaska Factor = 1.5	Lower 48	Alaska Factor = 1.5
Coal-Fired Steam	500	10,500	1249	1874	3.5	5.25
Coal-Fired Steam	250	10,500	1385	2078	3.7	5.55
Coal-Fired Steam	100	10,500	1583	2374	5.5	8.25
Combined Cycle	250	8,300	472	708	12.7	19.1
Gas Turbine	75	12,000	400	600	14.2	21.2
Diesel	10	11,500	704	1056	9.5	14.3

All costs are January 1, 1980 dollars.

TABLE 4-2

POTENTIAL ALASKAN FUEL PRICES

FUEL	LOCATION	FUEL COST RANGE C/MMBTU*	REMARKS
COAL	Beluga M/M	(133 - 140)	Ref (2)
	Beluga Exp.	(215 - 229)	Ref (2)
	Healy M/M	106	Ref (1) & Ref (14)
	Nenana	(106 - 128)	Ref (1)
	Fairbanks	(140 - 141)	Ref (1) & Ref (14)
	Anchorage (Healy)	(150 - 153)	Ref (3)
NATURAL GAS	Anchorage	(24.0 - 104.0)	Ave. 3.4 Ref (9)
	Cook Inlet Export	(190 - 200)	Nikiski Data Ref (27)
	Prudhoe Bay Export	(318 - 464)	Ref (6) & Ref (7) & (8)
OIL	Prudhoe Bay	\$13.42/bbl \$24.52/bbl	Controlled (1977) Decontrolled (1983) Ref (11)

* 1980 \$
Healy Coal = 8350 Btu/lb
Beluga Coal = 8000 Btu/lb
Natural Gas = 1000 Btu/cf
Ave U.S. Coal = 133.3/MMBTU
NG = 210.3/MMBTU
Ref (9) May, 1980

ATTACHMENT C

Environmental Criteria for Preliminary Screening of Hydro Sites

1. Existing National Parks

Parks within study area: Mt. McKinley National Park

Description of exclusion criteria: Land is not available for hydropower development.

2. National Monument Proclamations

Lands within study area: Wrangell-St. Elias National Park
Denali National Park
Lake Clark National Park

Description of exclusion criteria:

These lands were withdrawn on December 1, 1978 from hydropower development and will remain withdrawn for twenty years or until Congress passes legislation settling the issue. To date, all the versions of the Alaska Lands Bill have included these lands under some type of protected status that would make hydropower development highly unlikely. It should be noted that if the lands bill is passed, a few of the sites located in these areas could again be available for consideration.

Boundary Reference: Map - "Administration National Monument Proclamations and FLPMA Withdrawals."
Feb. 12, 1980

3. Non Mitigatable Impacts to Major Anadromous Fishery

Description of exclusion criteria:

A site was excluded if it was identified by both of the following criteria.

a. The proposed development is on the mainstem of a major anadromous fish river with three or more species present.

b. An anadromous fish run exceeding 50,000 is identified at the mouth of the river and the proposed development is located downstream of the confluence any with major tributaries, or a major fishing area is impacted.

Criteria Reference:

a. Alaska's Fisheries Atlas, Vol. I, State of Alaska Dept. of Fish & Game, 1978.

b. Map prepared by:
Resource Planning Team
Joint Rederal State Land Use Planning Commission "Fisheries"
(File No. FW-9, Alaska Resources Library)

Sites excluded in environmental preliminary screening:

Site	Criteria
Healy Carlo Yanert - 2	National Park (Mt. McKinley)
Cleave Wood Canyon	National Monument (Wrangell-St. Elias Nat'l Park) and Major Fishery
Tebay Lake Hanagita Gakona Sanford	National Monument (Wrangell-St. Elias Nat'l Park)
Lake Creek Upper McKinley River Teklanika	National Monument (Denali Nat'l Park)
Crescent Lake	National Monument (Lake Clark Nat'l Park)
Kasilof River	Major Fishery
Million Dollar Rampart	Major Fishery

ENVIRONMENTAL EVALUATION MATRIX FOR SYSTEM PLANNING STUDY

Evaluation Criteria		Alternatives A	B	C	D ⟶
Ecological	Fish	#	#	#	
	Big Game	#	#	#	
	Protected Species	#	#	#	
Social	Recreation				
	Socio Cultural				
Land Use & Designation	National Monuments				
	Parks				
	Subsistance				
	Cultivatable Lands				
	Population Centers				

3 - major significance
2 - moderate significance
1 - minimal significance
? - unknown

[#] refers to data base upon which assessment was made

FACT SHEETS

Name -

Location -

Energy -

Capacity -

Cost -

Site Conditions -

Environmental Evaluation -

- information on criteria used in the "environmental evaluation matrix"

ATTACHMENT D

DISCUSSION OF ISER FORECASTS

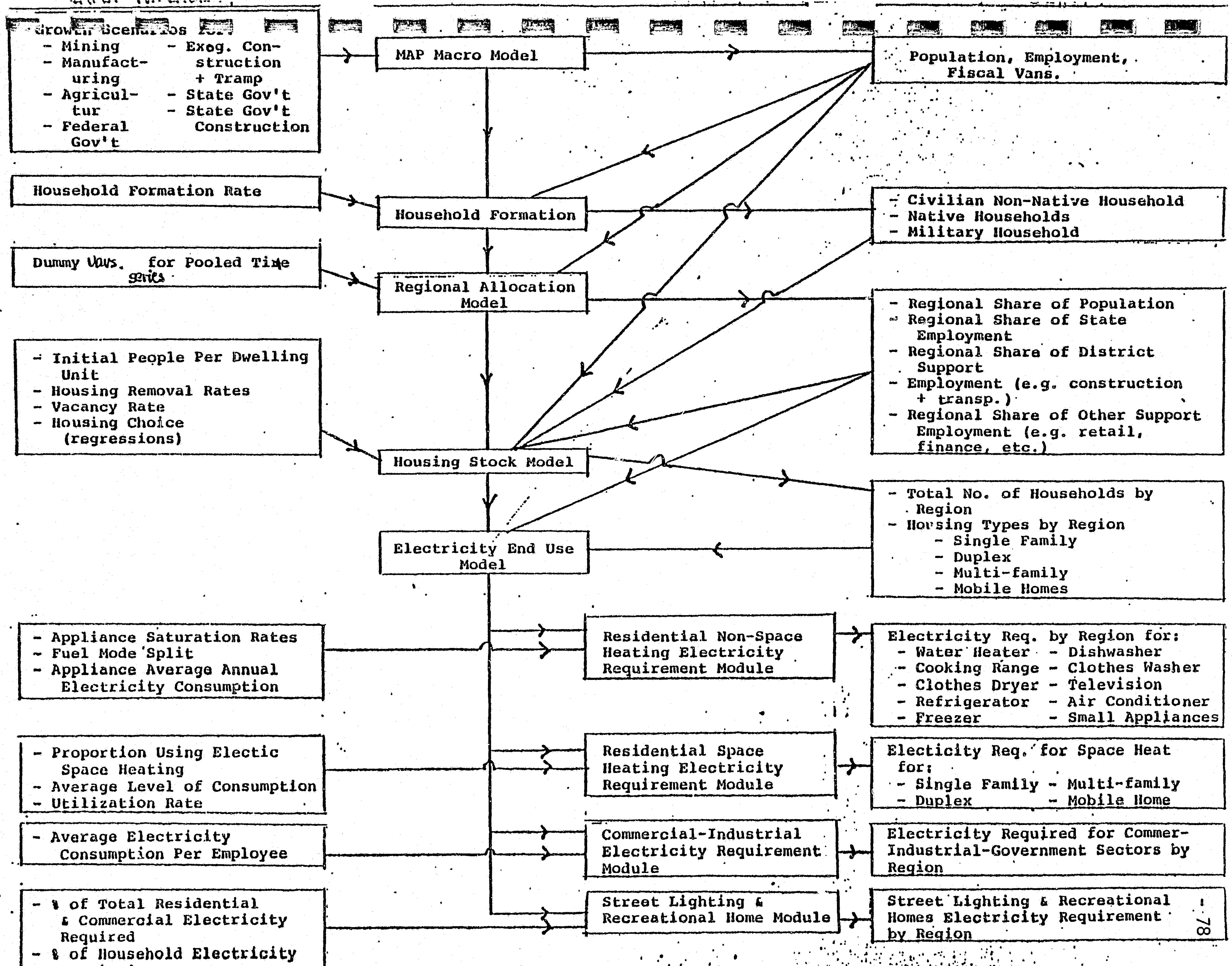
October 14, 1980

TOPICS

I GENERAL STRUCTURE

OF

ISER MODEL

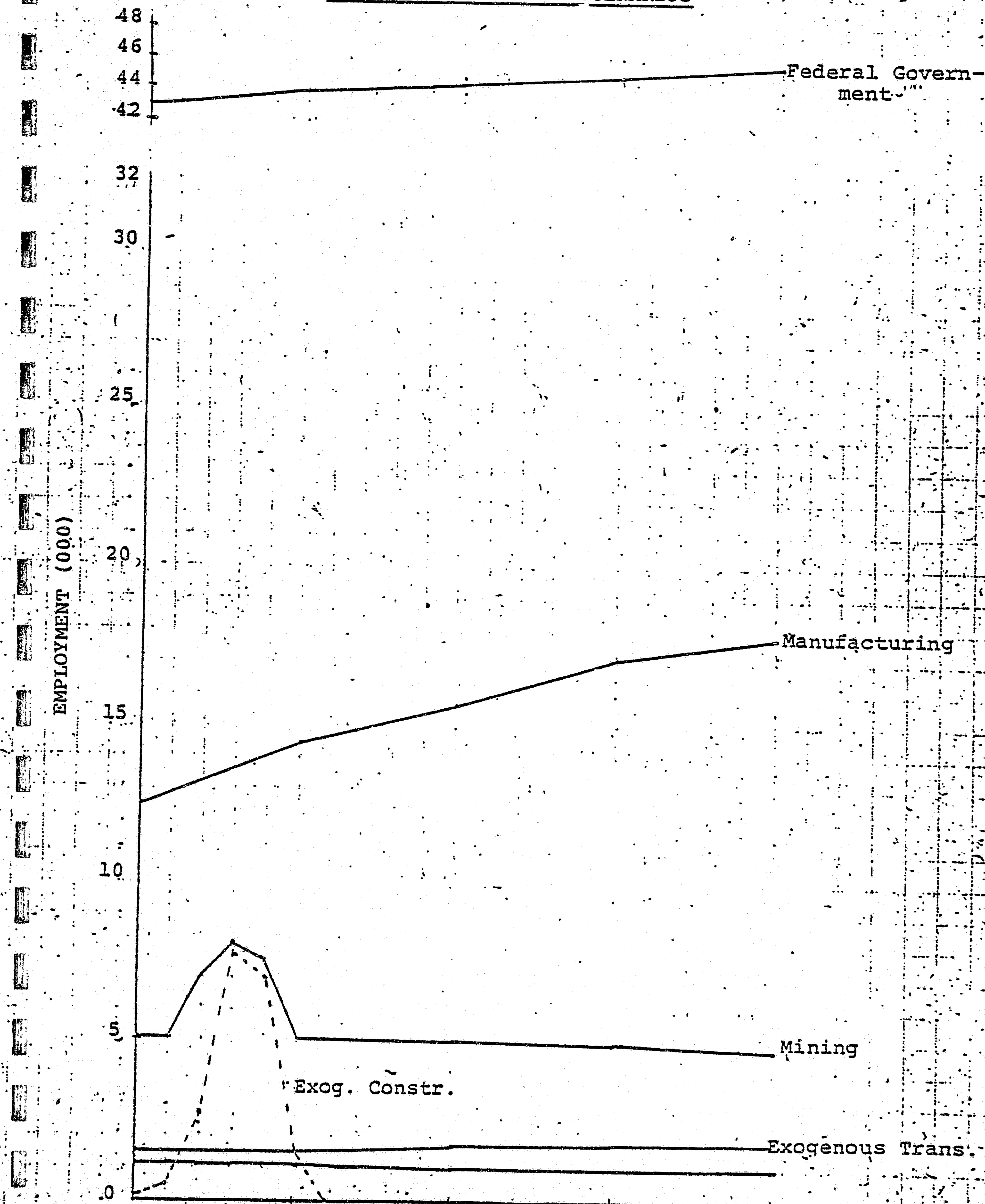


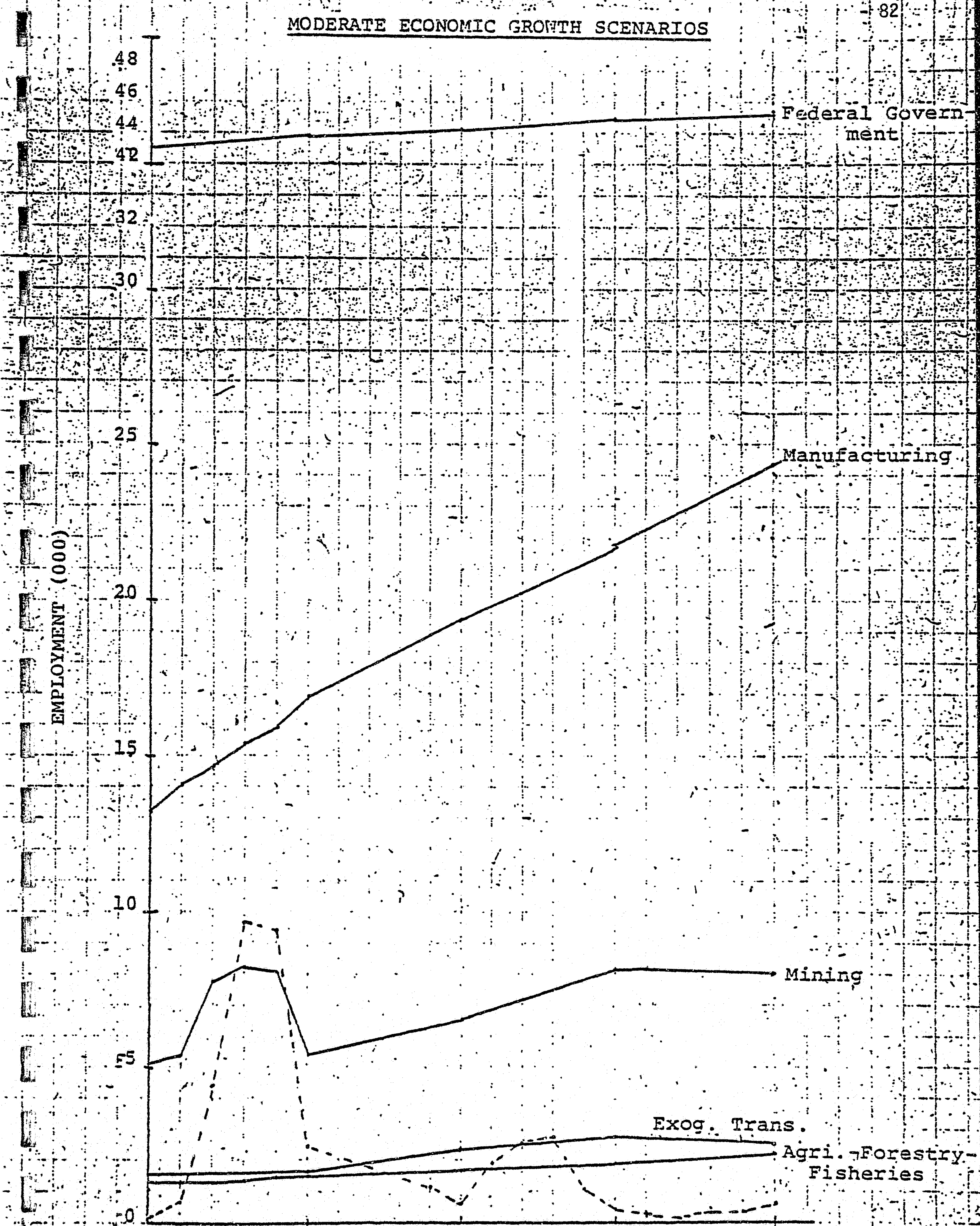
- Mining
- Manufacturing
- Agricultur
- Federal Gov't
- Exog. Construction + Tramp
- State Gov't
- State Gov't Construction
MAP Macro Model
Population, Employment, Fiscal Vans.
Household Formation Rate
Household Formation
- Civilian Non-Native Household
- Native Households
- Military Household
Dummy Vars. for Pooled Time series
Regional Allocation Model
- Regional Share of Population
- Regional Share of State Employment
- Regional Share of District Support
- Employment (e.g. construction + transp.)
- Regional Share of Other Support Employment (e.g. retail, finance, etc.)
- Initial People Per Dwelling Unit
- Housing Removal Rates
- Vacancy Rate
- Housing Choice (regressions)
Housing Stock Model
- Total No. of Households by Region
- Housing Types by Region
- Single Family
- Duplex
- Multi-family
- Mobile Homes
Electricity End Use Model
- Appliance Saturation Rates
- Fuel Mode Split
- Appliance Average Annual Electricity Consumption
Residential Non-Space Heating Electricity Requirement Module
Electricity Req. by Region for:
- Water Heater
- Cooking Range
- Clothes Dryer
- Refrigerator
- Freezer
- Dishwasher
- Clothes Washer
- Television
- Air Conditioner
- Small Appliances
- Proportion Using Electic Space Heating
- Average Level of Consumption
- Utilization Rate
Residential Space Heating Electricity Requirement Module
Electicity Req. for Space Heat for:
- Single Family
- Duplex
- Multi-family
- Mobile Home
- Average Electricity Consumption Per Employee
Commercial-Industrial Electricity Requirement Module
Electricity Required for Commer-Industrial-Government Sectors by Region
- % of Total Residential & Commercial Electricity Required
- % of Household Electricity
Street Lighting & Recreational Home Module
Street Lighting & Recreational Homes Electricity Requirement by Region

II MODEL RUNS AND RESULTS

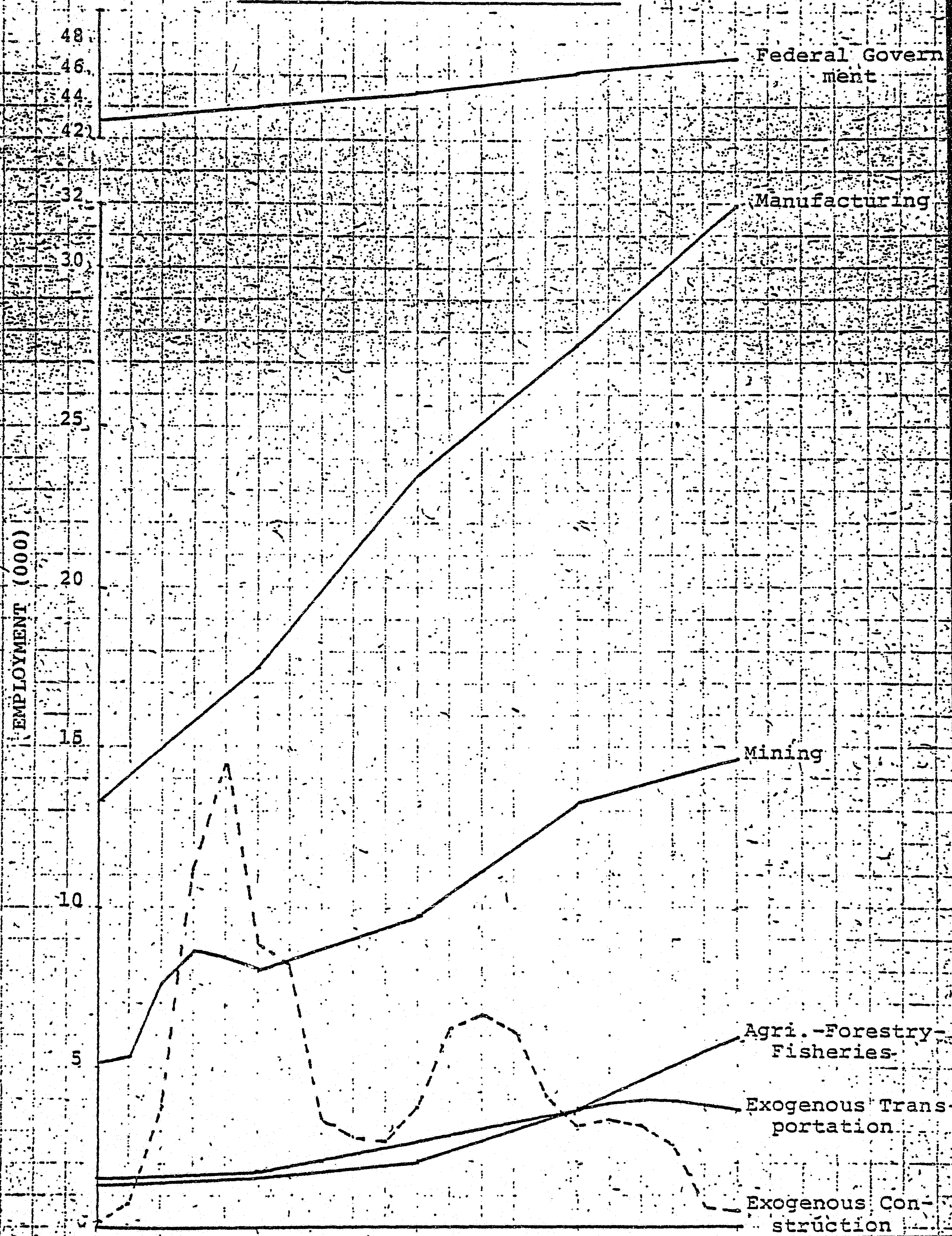
II.1 - Economic Scenarios

- Low, Moderate and High Basic Employment Scenarios are defined.
- Low, Moderate and High State Government Expenditure Scenarios are defined.
- Basic employment and State Government expenditure Scenarios are combined to yield a total of 9 economic Scenarios.
- All scenarios result in positive fund balance with lowest level of $49 billion with high government expenditure scenario in year 2000.
- Exhibits are attached to illustrate basic employment scenarios.

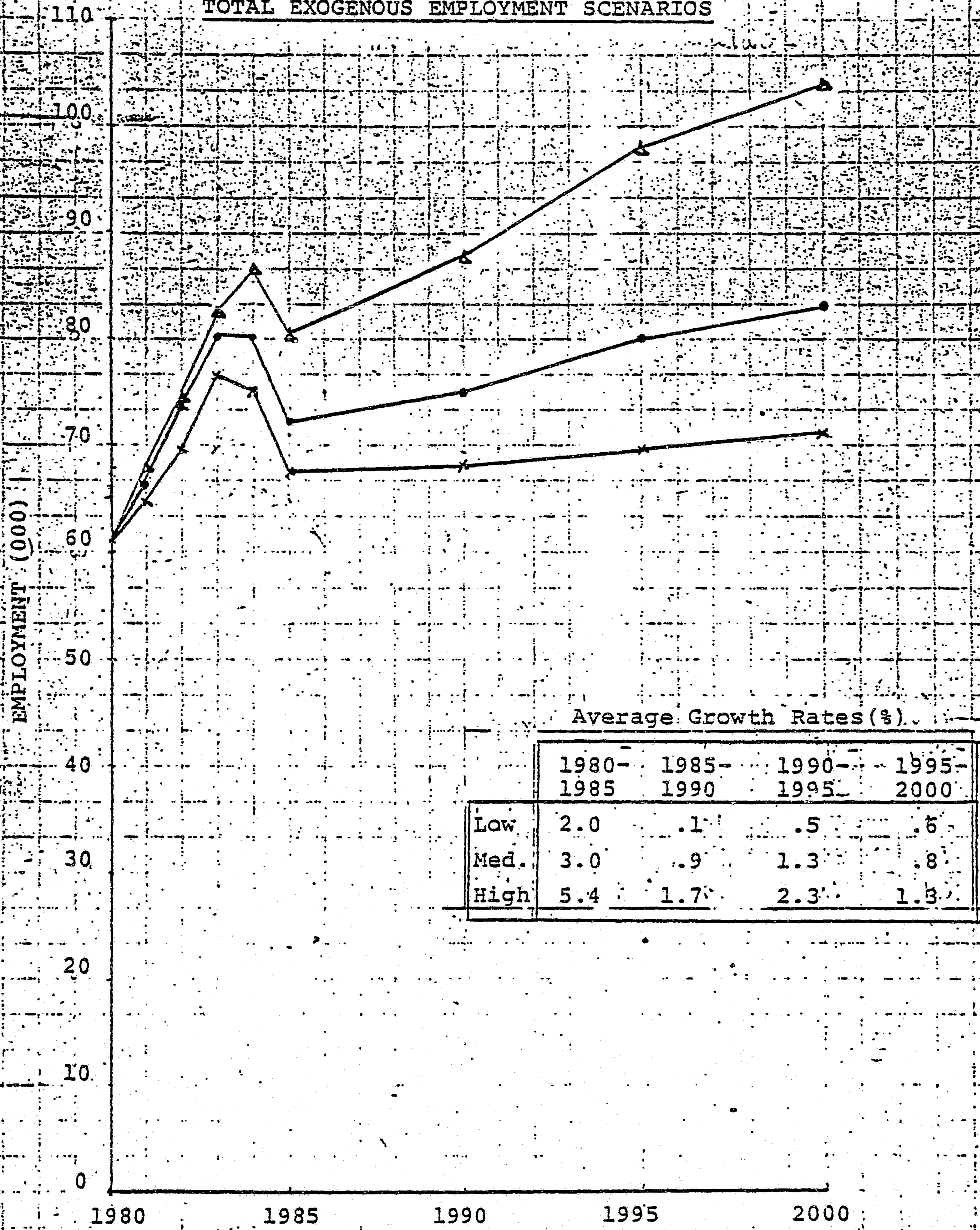

48
46
44
42
32
30
25
20
15
10
5
0
EMPLOYMENT (000)
Federal Government
Manufacturing
Mining
Exog. Constr.
Exogenous Trans.


MODERATE ECONOMIC GROWTH SCENARIOS
EMPLOYMENT (000)
48
46
44
42
32
30
25
20
15
10
5
0
Federal Government
Manufacturing
Mining
Exog. Trans.
Agri.-Forestry-Fisheries

HIGH ECONOMIC GROWTH SCENARIOS



TOTAL EXOGENOUS EMPLOYMENT SCENARIOS

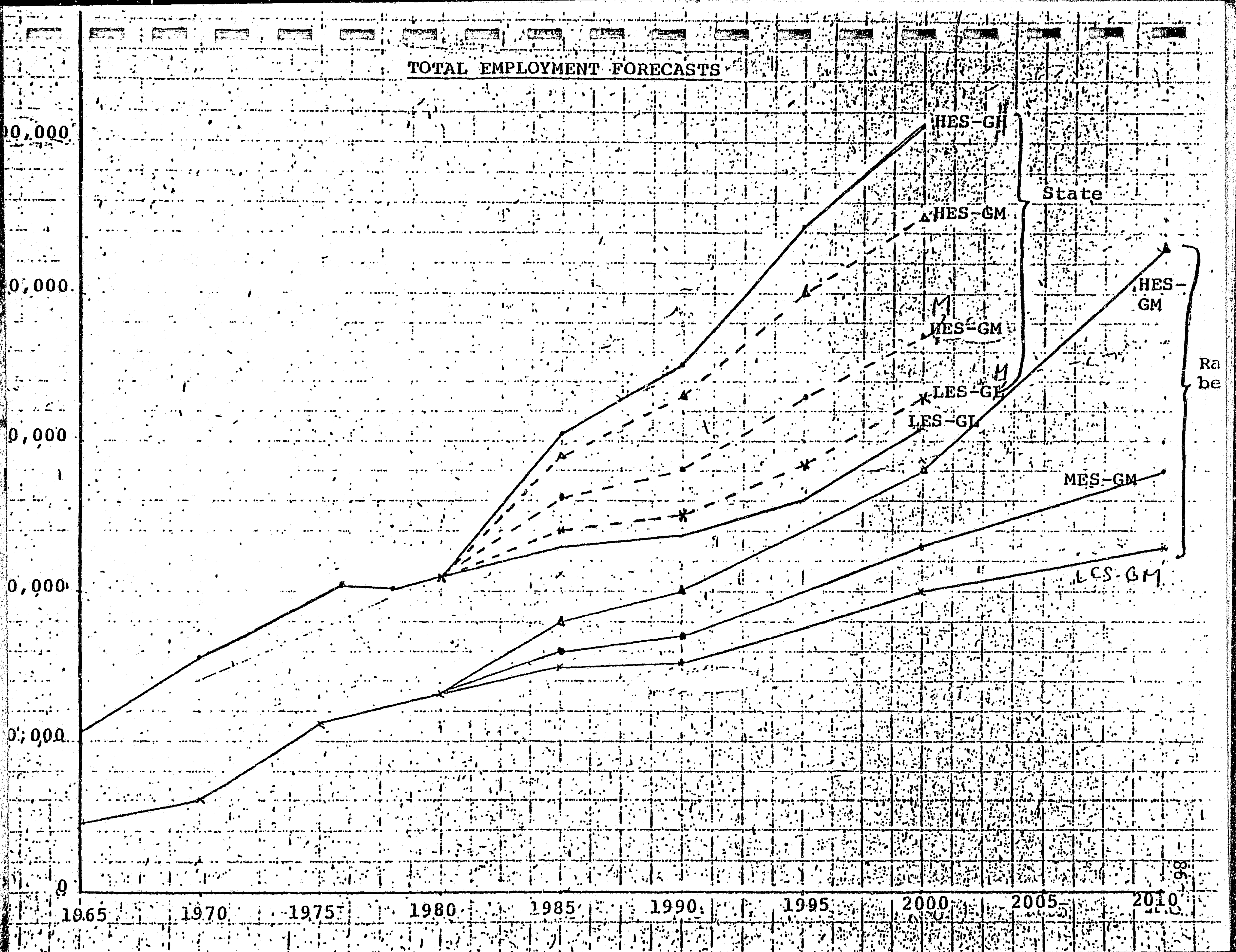


Average Growth Rates (%)

	1980-1985	1985-1990	1990-1995	1995-2000
Low	2.0	.1	.5	.6
Med.	3.0	.9	1.3	.8
High	5.4	1.7	2.3	1.3

II.2 - Economic Projections

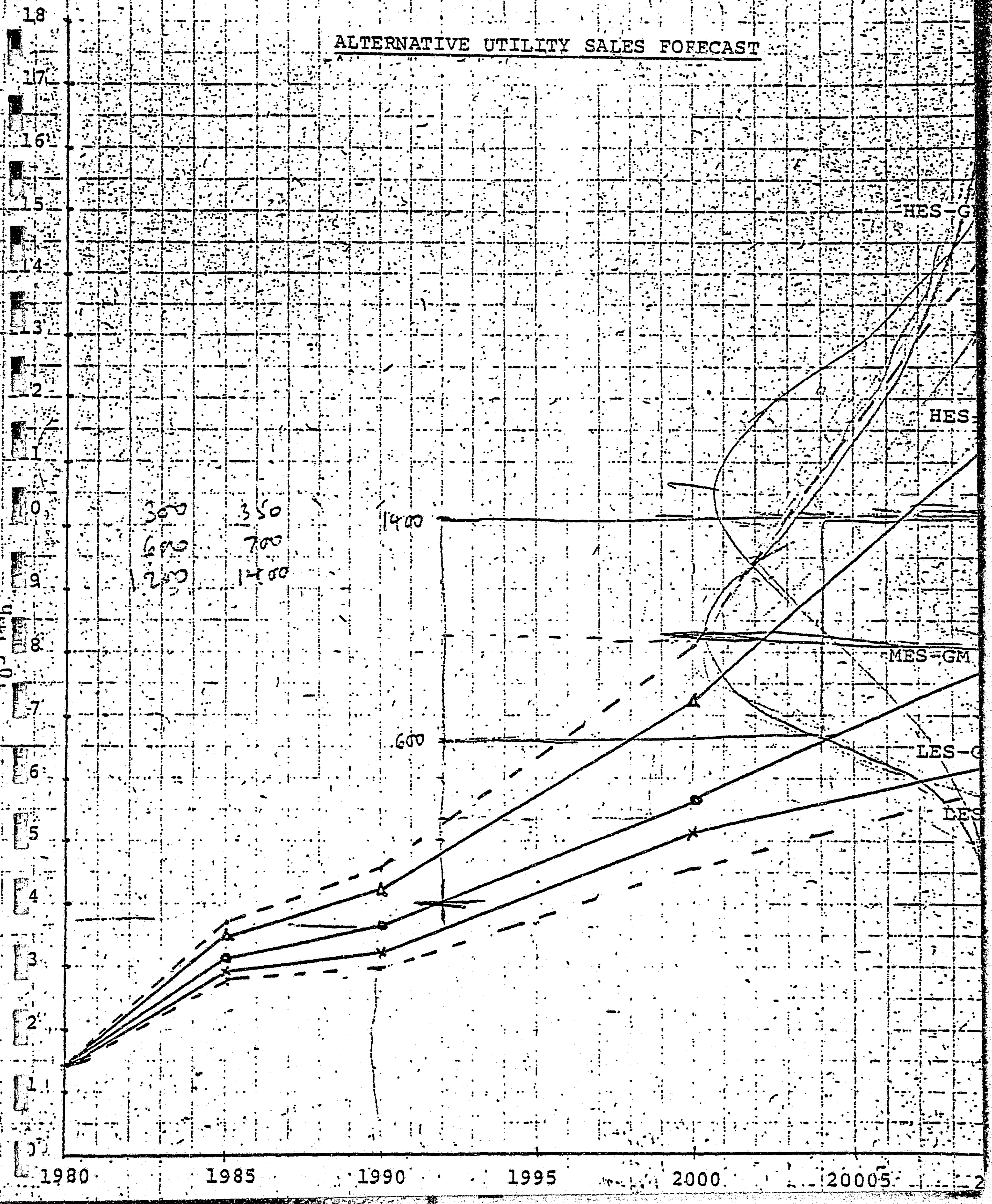
- 9 economic scenarios are defined and 9 sets of projections are for Alaska.
- Railbelt economic projections are made for only 3 scenarios.
- Economic projections for employment, population, households, and housing stock are shown in attached graphs. Also, annual growth rates for projections are attached.

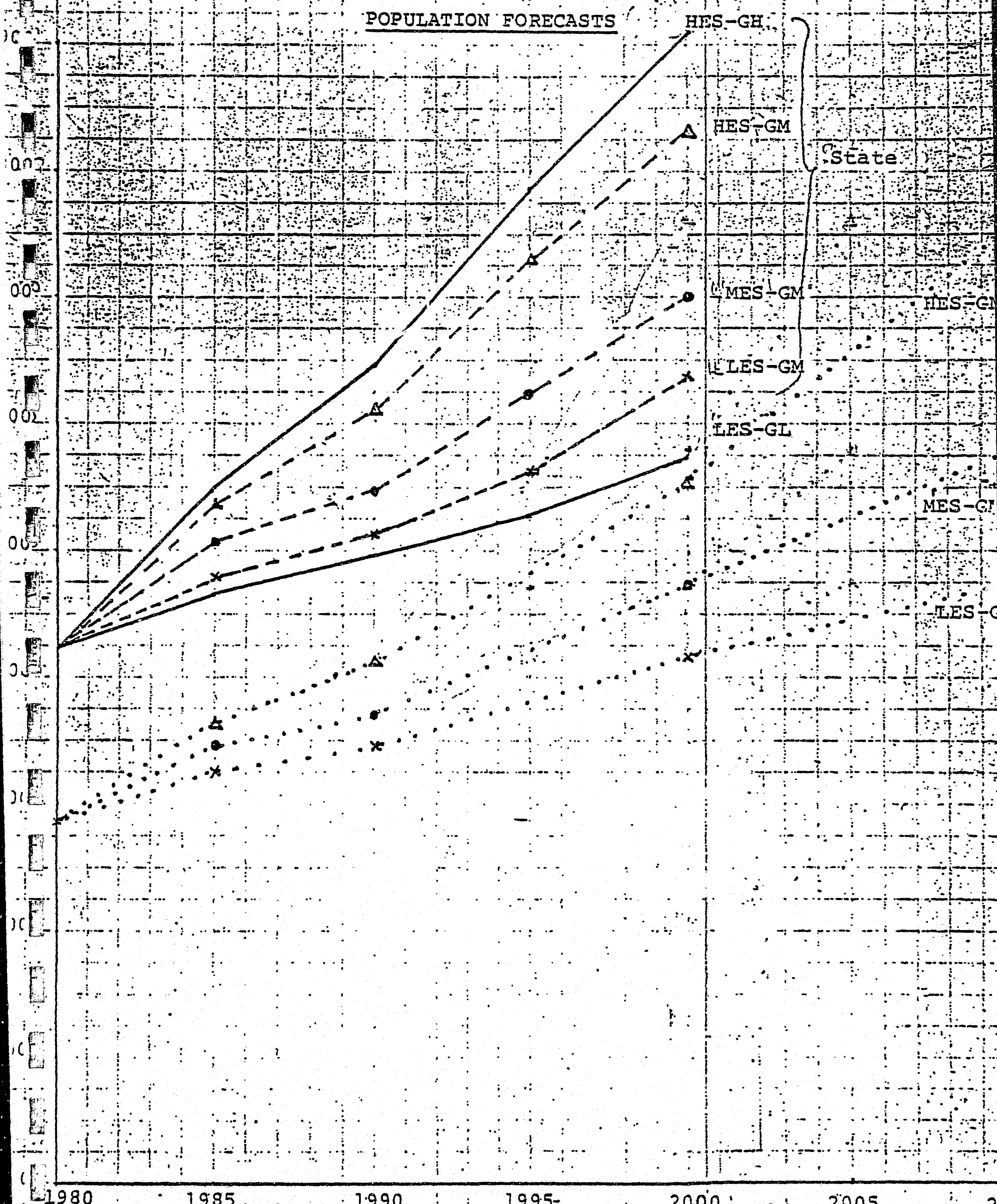

TOTAL EMPLOYMENT FORECASTS
HES-GH
HES-GM
HES-GM
LES-GL
LES-GL
State
HES-GM
MES-GM
LES-GM
Ra
be
0,000
0,000
0,000
0,000
0,000
0
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

FUTURE EMPLOYMENT ANNUAL GROWTH RATES (%)

	1980-1985	1985-1990	1990-2000	2000-2010	1980-2000
STATE:					
LES-GL	1.9	.6	1.9	-	1.6
LES-GM	3.0	.9	2.7	1.0	2.3
MES-GM	4.5	1.3	2.8	2.0	2.9
HES-GM	6.7	2.5	3.2	3.3	3.9
HES-GH	7.7	3.1	3.7	-	4.5
RAILBELT:					
LES-GM	2.3	.9	2.9	1.0	2.3
MES-GM	3.9	1.3	3.0	2.0	2.8
HES-GM	6.5	2.1	3.5	3.3	3.9

ALTERNATIVE UTILITY SALES FORECAST

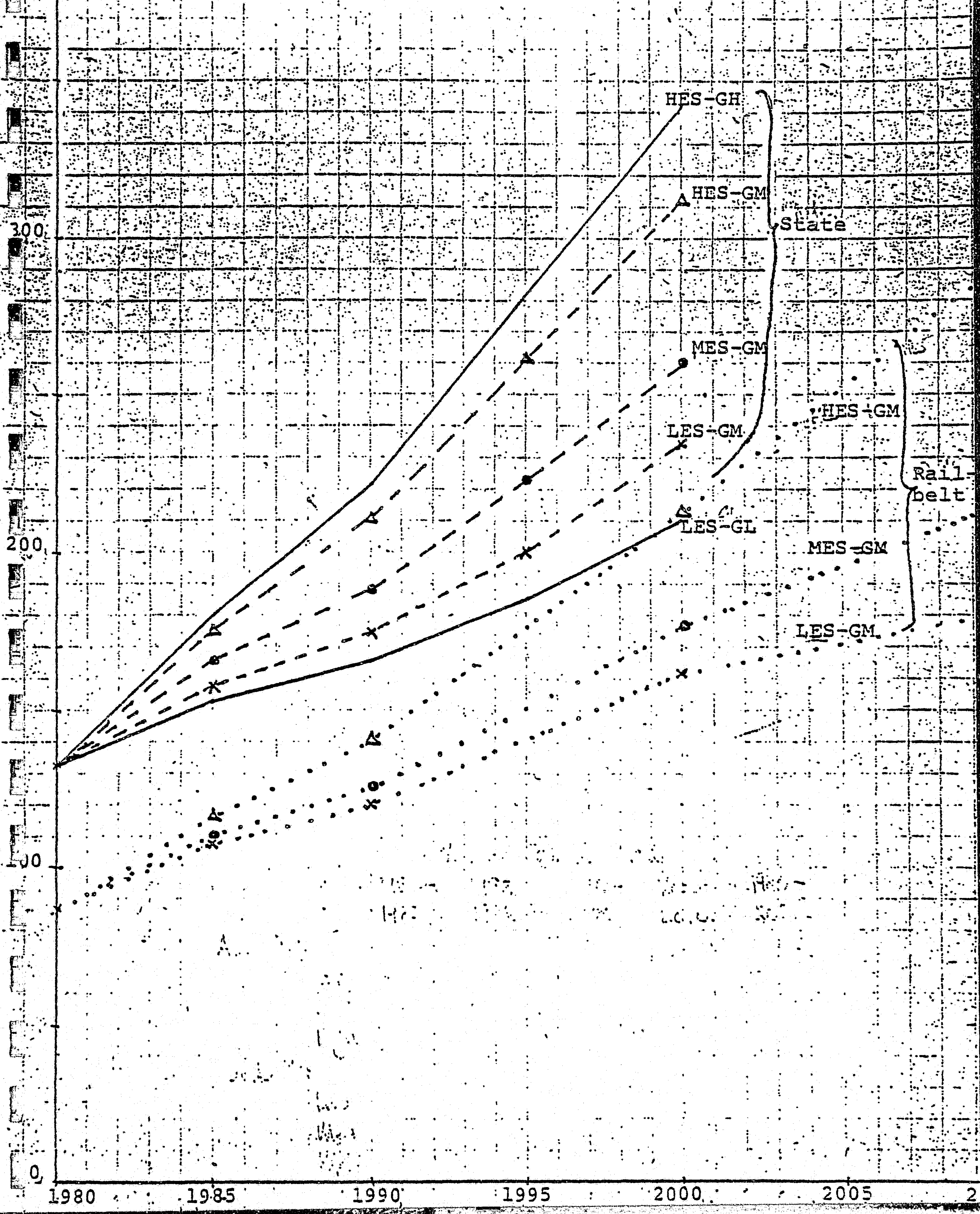



POPULATION FORECASTS
HES-GH
HES-GM
State
MES-GM
LES-GM
LES-GL
HES-GM
MES-GM
LES-G
1980
1985
1990
1995
2000
2005

FUTURE POPULATION ANNUAL GROWTH RATES (%)

	1980-1985	1985-1990	1990-2000	2000-2010	1980-2000
STATE:					
LES-GL	2.1	1.0	1.6	-	1.6
LES-GM	2.7	1.2	2.2	1.0	2.1
MES-GM	3.7	1.6	2.5	2.0	2.6
HES-GM	4.9	2.8	3.1	3.3	3.5
HES-GH	5.5	3.2	3.5	-	3.9
RAILBELT:					
LES-GM	2.7	1.3	2.2	1.0	2.1
MES-GM	3.7	1.6	2.5	2.0	2.6
HES-GM	5.0	2.6	3.1	3.3	3.4

HOUSEHOLD FORECASTS



FUTURE HOUSEHOLD ANNUAL GROWTH RATES (%)

	1980-1985	1985-1990	1990-2000	2000-2010	1980-2000
STATE:					
LES-GL	2.8	1.6	2.4	–	2.3
LES-GM	3.4	2.1	3.0	1.0	2.9
MES-GM	4.3	2.7	3.3	2.0	3.4
HES-GM	5.6	3.7	4.0	3.3	4.4
HES-GH	6.1	4.3	4.5	–	4.8
RAILBELT:					
LES-GM	4.4	2.1	3.0	1.0	3.2
MES-GM	4.8	2.6	3.5	2.0	3.6
HES-GM	5.9	3.8	4.2	3.3	4.5

FUTURE RAILBELT HOUSING STOCK GROWTH RATES (%)

	1980-1990	1990-2000	2000-2010	1980-2010
LES-GM:				
Single Family	2.8	2.8	.9	2.2
Multi-Family	2.9	3.9	1.0	2.6
Mobile Home	2.9	2.8	1.3	2.3
Duplex	0	4.6	.8	1.8
MES-GM:				
Single Family	3.3	3.4	2.0	2.9
Multi-Family	3.8	4.0	2.2	3.4
Mobile Home	2.9	4.1	1.9	3.0
Duplex	1.3	4.1	1.6	2.3
HES-GM:				
Single Family	4.5	3.9	3.4	3.9
Multi-Family	5.5	4.6	3.2	4.4
Mobile Home	4.7	4.0	3.1	3.9
Duplex	1.3	5.8	3.6	3.6

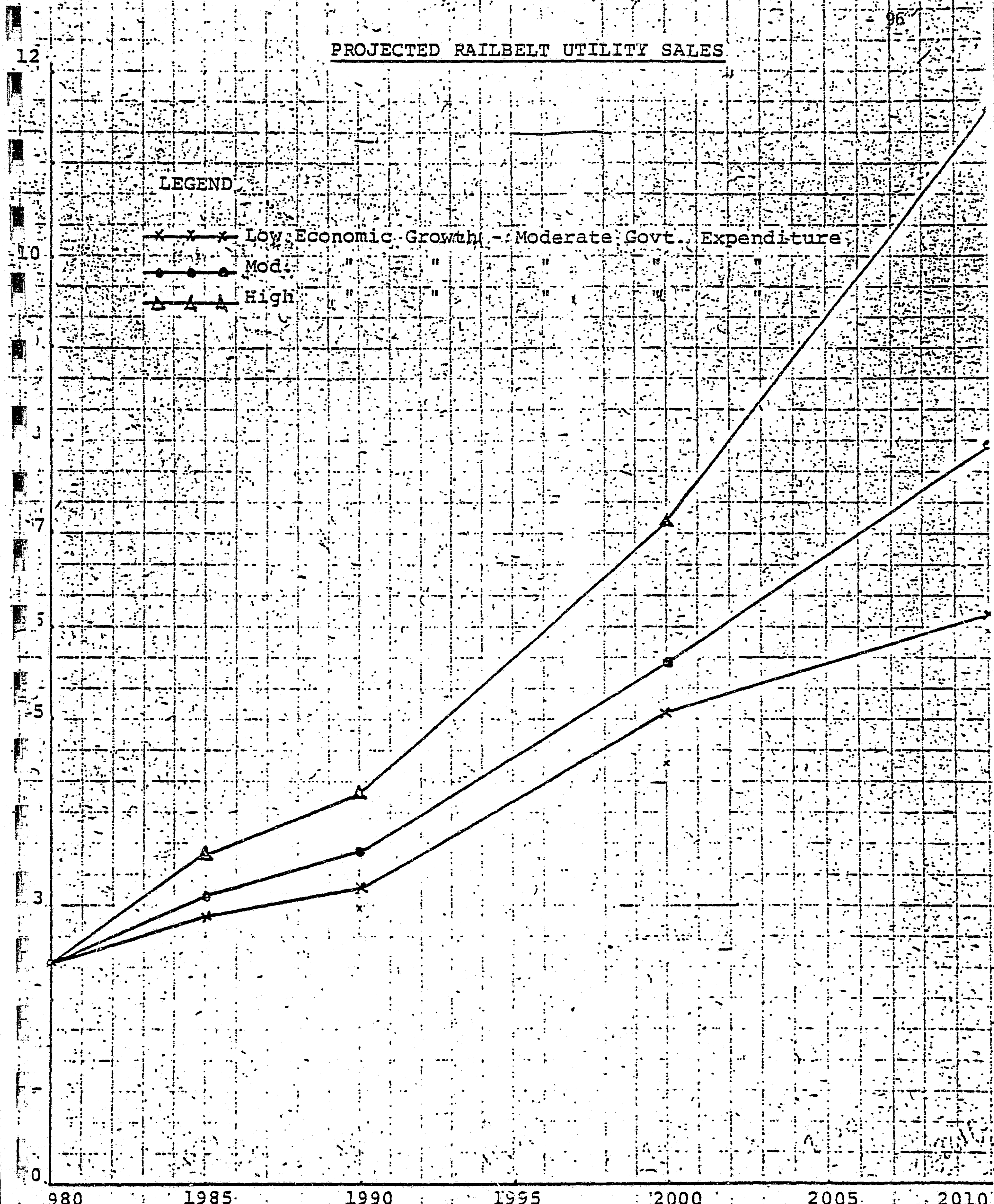
II.3 - Utility Sales Forecasts

- Forecasts present ed for only 3 scenarios, i.e. Low, Medium, High economic growth with moderate government expenditure.

- Forecasts by End-Use Sectors are attached.

RAILBELT UTILITY SALES PROJECTIONS BY END USE SECTORS (10^3 MWh)

	LOW GROWTH				MODERATE GROWTH				HIGH GROWTH			
	Residential	Commercial Industrial	Misc.	Total	Residential	Commercial Industrial	Misc.	Total	Residential	Commercial Industrial	Misc.	Total
1980	1117	1248	25%	2390	1117	1248	25	2390	1117	1248	25	2390
1985	1350	1541	30%	2921	1533	1718	33	3171	1482	2042	37	3561
1990	1533	1670	34%	3237	1638	1923	38	3599	1815	2423	44	4282
2000	2244	2803	53%	5100	2487	3184	59	5730	2955	4163	74	7166
2010	2706	3410	63%	6179	3310	4561	81	7952	4481	7136	119	11736
Annual Growth Rate	3.0%	3.4%	3.1%	3.2%	3.7%	4.4%	4.0	41%	4.7%	6.0%	5.3%	5.4%


PROJECTED RAILBELT UTILITY SALES
LEGEND
Low Economic Growth - Moderate Govt. Expenditure
Mod. " " " "
High " " " "
12
10
7
5
3
0
980
1985
1990
1995
2000
2005
2010
YEAR

III MODEL LIMITATIONS AND IMPLICATIONS

III.1 - Limitations

- Economic growth Scenario
- State/Government expenditure Scenario
- Commercial/Industrial End-use Forecasting Module
- Energy Mode Split re relative price and substitutability of energy
- Upper and lower bounds of Scenario set

III.2 - Implications

- Utility Sales forecast for upper and lower bound of existing scenario set
- Scenario depicting stable industrial growth with high and moderate government expenditure
- Improved commercial/Indistrial End-use Forecasting Module
- Relative Price and Substitutability of Fuel
- Net Impact of above.

ATTACHMENT E

Subtask 6.35

Report Outline

Load Management and Conservation

1. Load Management and Conservation Measures Included in ISER's Forecast
   - ISER's Forecasting Methodology
   - Measures Included in ISER's Forecast
   - Future Modification to Load Shapes and Patterns

2. Potential Additional Load Management and Conservation Measures
   - Measures Experimented and Applied in the Lower 48 States
   - Possible Effect on Future Power Demand (Social and Economic Costs)
   - Conceptual Plans for Additional Load Management and Conservation in Alaska

3. Impacts of the Conceptual Plan
   - On the Total Capacity and Energy
   - On the Shape of the Forecast Duration Curve

4. Revised Load Forecast Data

PHASE 4 Objective - Final Sensitivity

A. After reviewing the results of Phase 2 and 3, analyses of the alternative load growth will be assessed with variable parameters. For example, the development of a Susitna plan under high growth and low escalation; base level fuel escalation. (8)

ATTACHMENT F

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ATTACHMENT F

DRAFT:
RECEIVED FROM R. MOHN 10.15.80

(FOR CONSIDERATION BY ACRES AND IF APPROPRIATE USE IN SUSITNA GENERATION PLANNING STUDIES)

SECTION

Purpose

Techniques

Standard Criteria

Purpose. The purpose of a feasibility study is to assess the technical, economic and environmental aspects of a particular project or program previously identified in a reconnaissance study in sufficient detail to permit a decision regarding licensing, permitting and investment in detailed engineering and design. A feasibility study shall include information about the project, a statement of all assumptions which affect the economic feasibility of the project and a comparative analysis of all reasonable alternatives to the project under study.

Techniques. (a) Included in the information about the proposed project shall be total project construction costs, total project operating costs, the timing and amount of anticipated power output from the completed project, a benefit-to-cost ratio, the estimated cost of power based on a hypothetical set of market conditions, the potential effect of the project on the environment of the area which will be served by the project, the availability of alternative financing, and estimates of major indirect costs and benefits.

(b) The statement of all assumptions which affect the economic feasibility of the project shall include the discount rate, relative price trends, the electric load growth assumptions, and the planning period. The statement of assumptions shall also address the hypothetical market conditions upon which the cost of power estimate is based, to include debt-equity ratio, term of financing, interest rates, and inflation rate.

(c) The comparative analysis of alternatives shall address, at a minimum, three plans: the preferred plan, the "base case" plan, and the second most preferred plan as identified in the reconnaissance study. In the event that a feasibility study is undertaken in the absence of a previous reconnaissance study completed in accordance with ______________ (recon regs), the alternative plans to be addressed shall be determined by the Alaska Power Authority based on available information.

(d) Draft feasibility reports shall be distributed for comment to the affected local governments and utilities, to affected public land managers and to affected federal and state agencies. Reviewers shall have 30 days in which to comment.

(e) The completed feasibility report shall be transmitted to the Division of Budget and Management with a statement of findings and recommendations.

(f) Copies of the completed report shall be distributed to the affected local governments and utilities, libraries, affected public land managers, and affected federal and state agencies.

Standard Criteria. (a) A "base case" plan will be developed that would meet the forecasted requirements of the community or region and that would result from a continuation of present practices in the community and/or a reliance on liquid fossil fuel generation modes. This "base case" plan will serve as a basis for comparing alternative plans.

(b) Other alternatives, either singly or in combination, shall be incorporated into a number of plans that satisfy the forecasted requirements. All plans should be formulated to provide a common level of reliability.

(c) A reference date and planning period shall be established for economic evaluation. The planning period shall be twenty years unless the set of alternatives under consideration warrant a shorter or longer period.

(d) The costs to engineer, design, construct, maintain and operate shall be estimated for each plan in terms of reference year dollars, but taking into account relative price trends, if any. These relative price trends shall be established annually by the Power Authority not later than July 1.

(e) Using a discount rate representing the estimated long-term real cost of money, the present worth of plan costs over the planning period shall be calculated as of the reference date, with adjustment for varying economic lives. This discount rate will be established annually by the Power Authority not later

(f) Various combinations of alternatives and timing shall be evaluated to formulate least cost plans.

(g) The following indicators, at a minimum, shall be used to evaluate plans:

(1) Economic

- present worth of plan cost
- cost of power (base case plan and two most preferred plans, only)

(2) Environmental

- community preferences
- impact on community infrastructure
- timing in relation to other capital projects
- air quality
- water quality
- fish and wildlife impacts
- land use and ownership status
- terrestrial impacts

(3) Technical

- safety
- reliability
- availability

(h) The hypothetical market conditions upon which the cost of power estimate is based shall be established annually by the Power Authority not later than July 1.

ALASKA POWER AUTHORITY

Attachment #2

SUMMARY OF RECOMMENDATIONS

ANALYSIS PARAMETERS FOR FY-81

ECONOMIC ANAYLSIS

Inflation Rate - 0%
Discount Rate - 3%
Petroleum Fuel Escalation - 3.5%

COST OF POWER ANALYSIS (HYPOTHETICAL MARKET CONDITIONS)

Inflation Rate - 7%
Debt:Equity Ratio - 1:0
Cost of Debt - 8.5%
Term - 20 years for diesel and gas turbine generaion
- 30 years for coal combustion steam generation
- 35 years for hydroelectric facilities

DISCOUNT RATE

A discount rate is required in an economic analysis to place plan benefits and costs occurring in different years on an equivalent basis. The choice of discount rate is a much debated topic. Some argue that the appropriate rate is the "opportunity cost" rate, that is, one which equals the rate of return on the next best investment. Others argue that a relatively lower "social time preference" rate should be used. A second issue is whether a "real" or "nominal" discount rate is most appropriate. In other words, should inflation be included as part of the analysis?

Mr. David Reaume, then Chief of Research for the Division of Economic Enterprise of the Department of Commerce and Economic Development, responded to our request for guidance with a recommendation to use the market yield on corporate bonds in a risk class that roughly parallels the risks inherent in our projects. According to Reaume, these rates are usually 2.5 to 3.5 percent above the anticipated long-term average rate of inflation.

Reaume, on the issue of real versus nominal rates, states: "If the dollar amounts to be discounted are in nominal terms (current dollars), then the discount rate should be a nominal rate. If the dollar amounts to be discounted are in real terms (constant dollars), then the discount rate should be a real (inflation adjusted) rate. It does not matter which of the two choices you adopt. What you do not want to do is discount nominal dollar amounts with a real interest rate or vice versa."

Reaume recommended that the APA use a 2.5 percent real discount rate.

The Electric Power Research Institute, in a 1977 publication entitled "Technical Assessment Guide", recommends that, for electric utilities, "(if) a study is being made where inflation is being neglected in future costs, inflation must also be neglected in the cost of money, resulting in a weighted cost of capital at 3.8 percent..." This is based on a 50% debt-equity ratio and conditions in 1977.

A third useful reference is a report entitled Treatment of Inflation in the Development of Discount Rates and Levelized Costs in NEPA Analyses for the Electric Utility Industry. It was prepared in 1979 by the Nuclear Regulatory Commission. The reports abstract states: "A relation is established between inflation and the cost of money (i.e., discount rate) thus providing a means of maintaining consistency between discount rates and various assumed inflation rates and assurance that cost-benefit analysis results are not biased because of inconsistent assumptions concerning inflation and discount rates. The historical cost of money to the utility industry with and without inflation is examined and the rationale for a 3% discount rate to be used in cost-benefit analyses relating to the production of electricity is presented."

Page Two
Discount Rate

Recommendation: For the purpose of economic analysis in reconnaissance and feasibility studies conducted during FY 81, costs and benefits shall be calculated in constant dollars and discounted using a "real" discount rate of 3.0 percent.

ESCALATION RATES

The relative price trends affecting project costs are important in an economic analysis regardless of the assumptions made about the overall inflation rate. These relative price changes are called escalation rates.

The cost item of primary concern in terms of escalation is petroleum fuels, and in particular diesel oil and fuel oil. Data Resources Inc. projects "that the average world export price of oil will rise between 1980 and 1990 at an average annual rate of abort 3.5 percentage points higher than overall U.S. inflation." This is from DRI's U.S. Long Term Review, Spring 1980.

Nonfuel cost items may also have price trends that depart somewhat from the overall inflation rate. The magnitude of such departures are relatively minor, however, and the impact of ignoring them on the outcome of economic analyses is nil.

Recommendation: The cost of diesel oil, fuel oil and other petroleum fuels shall be assumed to escalate over the next twenty years at a rate of 3.5 percent above inflation. The escalation rates for other fuels shall be zero unless specific cost studies indicate otherwise. The escalation rates for non-fuel cost items shall be assumed to be zero.

ALASKA POWER AUTHORITY

INFLATION RATE

Whereas for an economic analysis the inflation rate is best assumed to be 0%, the cost of power analysis must assume a rate of inflation to determine the nominal cost of energy in current dollars. The long term 20-30 year rate of inflation has averaged 4%/year while the 1970's experienced a 7%/year rate of inflation. Even though the current rate of inflation is in excess of 10%, the long term rate of inflation is forecast to be between 6.5% and 8% dependent upon the perspective of the forecasting source.

RECOMMENDATION: For the purpose of cost of power analysis during FY81, the long term general inflation rate shall be assumed to be 7%.

DEBT:EQUITY RATIO

The debt: equity ratio for capital project financing depends upon the cost of the project and the alternatives available to finance the project. REA cooperatives have access to REA loan funds at 2% and 5%, and FFB and CFC long term financing currently at approximately 11%. The Power Authority and utilities have access to tax exempt financing secured by the revenue of the projects or in some cases guaranteed by CFC at rates varying between 8% and 11%, depending upon market conditions. All of these alternatives represent debt financing. In general, the utilities and the Power Authority are not capable of equity investment in new generation capacity, and debt financing is the most common source of capital.

RECOMMENDATION: The debt to equity ratio for power project financing shall be assumed to be 1:0.

COST OF DEBT

Due to the numerous sources and diversity of interest rates for debt financing of power projects, one interest rate should be adopted for consistentency in analysis of costs of power from alternative power projects, and to serve as the basis for determining the level of State or federal assistance which may be necessary to finance a power project. The interest rate identified by statute for loans from the power project fund is a rate equal to the percentage of the average weekly yield of municipal bonds for a 12 month period preceding the date of a loan which is determined from municipal bond yield rates reported in the 30 year revenue index of the Weekly Bond Buyer. This interest rate was approximately 8.4% for FY80 and is approximately 8.6% for the 12 months preceding this meeting.

RECOMMENDATION: The cost of debt for cost of power analysis shall be assumed to be 8½%/year.

TERM

The term of debt financing associated with power projects is dependent upon the source of financing, the type of project, and market conditions. Long term REA and CFC financing is generally for a 35 year term. The revenue bond market has been price sensitive to long term 40-year issues, and 30-35 year terms appear most probable for revenue bond financing in the next year. The term of financing seldom exceeds the aniticipated useful life of a project, which is 15-20 years for diesel and gas turbine generation, 25-30 years for coal generation capacity, and 50 years for hydroelectric projects.

RECOMMENDTION: The term for debt financing shall be assumed to be 20 years for diesel and gas turbine generation, 30 years for coal combustion steam generation capacity, and 35 years for hydroelectric facilities.