SUSITNA
HYDROELECTRIC PROJECT

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INSTREAM ICE SIMULATIONS: SUPPLEMENTARY STUDIES FOR MIDDLE SUSITNA RIVER

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Report by
Harza-Ebasco Susitna Joint Venture

Prepared for
Alaska Power Authority

Final Report
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NOTICE

ANY QUESTIONS OR COMMENTS CONCERNING
THIS REPORT SHOULD BE DIRECTED TO
THE ALASKA POWER AUTHORITY
SUSITNA PROJECT OFFICE

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Exhibit	Project Status[1]	Weather Period	Flow Requirement	Intake Operating Policy
A	Stage I	1981-82	Case E-VI	Inflow-Matching
B	Stage II	1981-82	Case E-VI	Inflow-Matching
C	Stage III	1981-82	Case E-VI	Inflow-Matching
D	Stage I	1981-82	Case E-I	Inflow-Matching
E	Stage II	1981-82	Case E-I	Inflow-Matching
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EXHIBITS G-X: TWO-STAGE PROJECT

Exhibit	Project Status	Energy Demand[1]	Weather Period	Flow Requirement	Intake Operating Policy	Watana Intake Design	Devil Canyon Cone Valve Intake
G	Watana Only	2001	1981-82	Case C	Inflow-Matching	Original	Present
H	Watana Only	2001	1981-82	Case C	Warmest Water	Original	Present
I	Watana Only	2001	1981-82	Case C	Lowest Port	Original	Present

1) See note on page ix

LIST OF EXHIBITS (continued)

ICECAL SIMULATION RESULTS

Exhibit	Project Status	Energy Demand[1]	Weather Period	Flow Requirement	Intake Operating Policy	Watana Intake Design	Devil Canyon Cone Valve Intake
J	Watana Only	2001	1981-82	Case E-VI	Inflow-Matching	Original	Present
K	Watana Only	2001	1981-82	Case E-VI	Warmest Water	Original	Present
L	Watana Only	2001	1971-72	Case C	Warmest Water	Original	Present
M	Watana & Devil Canyon	2002	1981-82	Case C	Warmest Water	Original	Present
N	Watana & Devil Canyon	2002	1981-82	Case E-VI	Inflow Matching	Original	Present
O	Watana & Devil Canyon	2002	1981-82	Case E-VI	Warmest Water	Original	Present
P	Watana Only	2001	1981-82	Case C	Warmest Water	1880/1850	Present
Q	Watana Only	2001	1981-82	Case C	Warmest Water	1800/1770	Present
R	Watana Only	2001	1971-72	Case C	Warmest Water	1880/1850	Present
S	Watana Only	2001	1971-72	Case C	Warmest Water	1800/1770	Present
T	Watana Only	2001	1971-72	Case C	Warmest Water	1800/1500	Present
U	Watana Only	2001	1971-72	Case C	Warmest Water	1636/1470	Present

1) See note on page ix

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ICECAL SIMULATION RESULTS

Exhibit	Project Status	Energy Demand[1]	Weather Period	Flow Requirement	Intake Operating Policy	Watana Intake Design	Devil Canyon Cone Valve Intake
V	Watana & Devil Canyon	2002	1981-82	Case C	Warmest Water	1800/1770	Present
W	Watana & Devil Canyon	2002	1981-82	Case C	Warmest Water	Original	High
X	Watana & Devil Canyon	2002	1981-82	Case C	Warmest Water	1800/1770	High

1) The projected energy demands in the Amendment to the License Application (Alaska Power Authority 1985) have been revised from the original License Application (Alaska Power Authority 1983). The exhibits in this report show the energy demand years based on the original License Application. The following table is provided to facilitate conversion of energy demand years shown on the exhibits in this report to energy demand years for the amended License Application.

	ENERGY DEMAND YEAR	
	Shown on Exhibit	Amended License Application
Three Stage Project		
Watana (Elev. 2000)	2001	mid-Stage I
Watana (Elev. 2000) and Devil Canyon	2002	mid-Stage II
Watana (Elev. 2185) and Devil Canyon	2020	late-Stage III
Two Stage Project		
Watana (Elev. 2185)	2001	mid-Stage I
Watana (Elev. 2185) and Devil Canyon	2002	early-Stage III

SUMMARY

River ice simulation results are presented herein as a supplement to those included in the "Instream Ice Simulation Study" (Harza-Ebasco 1984b). The supplementary simulations are intended to include recent refinements in the proposed Susitna Hydroelectric Project and to evaluate the sensitivity of Susitna River ice processes to various parameters. The following were considered:

a) Revised "three-stage" construction of the project

b) Alternative instream flow requirements

c) Alternative operating policies for multi-level power intakes

d) Alternative low levels for Watana power intake

e) Alternative levels for Devil Canyon outlet works.

Results of the river ice simulations support the following conclusions:

1. Expected river ice conditions with the proposed Case E-VI flow requirements are not significantly different from those with Case C or Case E-I requirements.

2. It is expected that the "warmest water" and the "lowest port" alternative operating policies may tend to reduce somewhat the ice cover development relative to the proposed "inflow-matching" policy. However, this trend did not hold for all of the sensitivity simulations and should not be counted on as a general rule. In particular, with Devil Canyon Dam in operation the alternative operating policies have no significant effect on river ice.

3. It is expected that provision of lower ports at the Watana power intake would generally tend to reduce somewhat the extent of the ice front progression and the maximum river stages near the upstream extent of the cover. However, substantial reductions in the ice conditions are not expected to occur consistently unless a very low intake port at Elevation 1636 is provided.

4. An alternative high intake (elevation 1425) for the Devil Canyon outlet works has no significant effect on expected river ice conditions relative to the present design, although it increases release temperatures during brief periods of summer operation.

1.0 INTRODUCTION

This report presents the results of river ice simulations for the middle reach of the Susitna River (i.e., downstream of the proposed Susitna Hydroelectric Project and upstream of the Chulitna River confluence - see Figure 1). These river ice simulations are provided as a supplement to the previously published "Instream Ice Simulation Study' (Harza-Ebasco 1984b). One purpose of the present study is to provide updated river ice results based on recent refinements to the proposed Susitna Hydroelectric Project. In particular, these updated results are based on the revised "Case E-VI" instream flow requirements and the "Three-Stage" construction sequence (Alaska Power Authority 1985), which has replaced the "Two-Stage" project proposed in the original License Application (Alaska Power Authority 1983). This report is also intended to evaluate the sensitivity of Susitna River ice processes to several parameters beyond the scope of the earlier report. These include alternative power intake operating policies, alternative designs for the Watana multi-level power intakes, alternative instream flow requirements and alternative intake elevations for the Devil Canyon outlet works. The scope of these alternatives is discussed in Chapter 2.

Many of the sensitivity simulations described in this report were carried out with the Case C flow requirements and the "two-stage" project prior to the adoption of the "Case E-VI" flow requirements and the "three-stage" project by the Alaska Power Authority. The general trends of the sensitivity results are not expected to be affected by these changes in flow requirements and construction staging. Conclusions regarding sensitivity of river ice processes are therefore considered valid.

The methodology for the supplementary river ice simulations herein is identical to that employed for the Instream Ice Simulation Study (Harza-Ebasco 1984b). The calibrated river ice model ICECAL (Harza-Ebasco 1984a) is used to generate the simulations. Each ICECAL simulation is based on the results of a corresponding reservoir temperature simulation (via the DYRESM model, Alaska Power Authority 1984, Harza-Ebasco 1984d) and a stream temperature simulation (via the SNTEMP model, Arctic Environmental Information and Data Center 1984, Alaska Power Authority 1984). Results of the ICECAL model are presented in terms of representative ice thicknesses and water surface elevations as a function of time and location along the river. Results continue to be focused at the river mile locations of those slough and side channels believed to be most important in terms of salmon production.

A more complete description of the background, methodology, capabilities and limitations of the river ice modeling process is included in the previously published reports (Harza-Ebasco 1984a, Harza-Ebasco 1984b).

2.0 SCOPE OF RIVER ICE SIMULATIONS

2.1 General

Initial ICECAL simulations included in the "Instream Ice Simulation Study" (Harza-Ebasco 1984b) were based on conditions presented in the original License Application (Alaska Power Authority 1983). These conditions included a "two-stage" construction sequence (i.e., Watana completed in 1996, Devil Canyon completed in 2002), the Case C flow requirements (Figure 2), multi-level Watana power intake geometry shown in Figure 3, and the "inflow-matching" operating policy for the power intakes (i.e., an attempt to match the reservoir release water temperatures with the natural flow temperatures). These initial simulations were performed for a variety of weather conditions and project energy demands.

Several refinements to the proposed Susitna Hydroelectric Project have recently been adopted by the Alaska Power Authority, and are fully discussed in the License Application Amendment currently under preparation (Alaska Power Authority 1985). In particular, these refinements include the "Case E-VI" flow-requirements (Figure 2) and the "three-stage" construction sequence for the project as outlined below:

1. Stage I - A lower Watana Dam (normal maximum pool elevation 2000 ft. MSL) would be constructed.

2. Stage II - The full Devil Canyon Dam (normal maximum pool elevation 1455 ft. MSL) would be added.

3. Stage III - Watana Dam would be raised to its ultimate height (normal maximum pool elevation 2185 ft. MSL).

This report includes ICECAL simulations which are based upon these project refinements as currently adopted. These ICECAL simulations were performed for operation of Stage I, Stage II and Stage III based on the 1981-82 weather conditions (an average winter in terms of mean air temperatures). The "inflow-matching" power intake operating policy and the Case E-VI flow requirements, adopted by the Alaska Power Authority, were assumed for these simulations. The effects of the alternative Case E-I flow requirements (Figure 4), relative to the adopted Case E-VI requirement, were also simulated. Case E-I was selected for these sensitivity studies since it has the highest minimum summer flow requirements of the suggested alternative flow constraints (Harza-Ebasco 1984c). The summer minimum flow requirement for Case E-I is 14,000 cfs as compared to 9,000 cfs for Case E-VI. Ice conditions for summer minimum flow requirements between these two extremes are expected to be within the simulated range of conditions for E-VI and E-I.

As detailed in the following sections, this report also includes a number of sensitivity simulations. These simulations were performed to investigate the effects on river ice due to alternative flow requirements, additional low power intakes at Watana Dam, alternative intake operating policies which attempt the release of warmer water, and alternative intake elevations for the Devil Canyon outlet works. The scope of these sensitivity simulations is shown in Table I. Although these sensitivity simulations, as well as those presented in the "Instream Ice Simulation Study" (Harza-Ebasco 1984b), were based upon the original "two-stage" project, the general trends of the results are believed applicable to the "three-stage" project also. Conclusions regarding the sensitivity of river ice to weather conditions, flow requirements, power intake designs, operating policies and outlet works designs, based on the simulations of the "two-stage" project, are therefore also believed valid for the "three-stage" project.

2.2 Alternative Operating Policies for Watana and Devil Canyon Multi-Level Power Intakes

Water temperatures within the proposed Watana and Devil Canyon reservoirs will vary with time and depth. The multi-level power intake structures proposed for the Watana and Devil Canyon reservoirs are therefore intended to provide some degree of control over the reservoir release temperatures discharged to the river through the powerhouse. Alternative policies considered herein for operating the multi-level power intakes include "inflow-matching", "warmest water" and "lowest port". The "inflow-matching" policy, which was assumed for the "Instream Ice Simulation Study" (Harza-Ebasco 1984b) and has been adopted by the Alaska Power Authority for the License Application studies (Alaska Power Authority 1983, 1985), represents a year-round attempt to match the reservoir release temperatures with the natural temperature of the flow entering the reservoir. In effect, "inflow-matching" results in winter release of the coldest water available to the power intakes. The "inflow-matching" policy also is expected to result in the lowest possible suspended sediment concentration in the reservoir outflow during the winter, thereby minimizing the project effects in this regard (Alaska Power Authority 1985). The "warmest water" policy represents a year-round policy of releasing the warmest water available to the power intakes. For both "inflow-matching" and "warmest water" policies, the particular intake port selected for operation will vary with the changing reservoir levels and temperature profiles. The "lowest port" operating policy means that the lowest port of the multi-level power intake will be operated year-round regardless of water temperatures.

Comparisons of river ice simulations for these three alternative operating policies are based on the "two-stage" project, Case C and Case E-VI alternative flow requirements (see Section 2.3) and the weather conditions of 1981-82 and 1971-72 (average and cold winters, respectively, in terms of mean air temperature).

2.3 Alternative Instream Flow Requirements

River ice simulations based on the "Case C" and "Case E-VI" alternative instream flow requirements are compared in this report. The "Case C" instream flow requirement (Figure 2) was proposed in the original Susitna Hydroelectric Project License Application (Alaska Power Authority 1983) and was assumed for the "Instream Ice Simulation Study" (Harza-Ebasco 1984b). The "Case E-VI" flow requirement (Figure 2) represents a recommended refinement of "Case C" as described in the report "Evaluation of Alternative Flow Requirements" (Harza-Ebasco 1984c)and the License Application Amendment

(Alaska Power Authority 1985). Comparisons of river ice simulations for "Case C" and "Case E-VI" are based on both "inflow-matching" and "warmest water" operating policies (Section 2.2), Watana and Watana + Devil Canyon operating ("two-stage" project), and the 1981-82 weather conditions (an average winter in terms of mean air temperatures). Figure 5 shows a comparison of the simulated Case C and Case E-VI flow rates released from Watana reservoir for Watana operating alone with 2001 energy demand and the 1981-82 weather conditions. Figure 6 shows corresponding flows released from Devil Canyon reservoir with the 2002 energy demand.

2.4 Alternative Designs for Watana Multi-Level Power Intake

River ice simulations are provided for several alternative designs of the Watana multi-level power intake structure as detailed in Table 2. The "original design" shown in Figure 3 corresponds to that proposed in the original License Application (Alaska Power Authority 1983) and is also applicable to Stage III of the "three-stage" project. This design includes intake ports at elevations 2151, 2114, 2077 and 2040 ft. MSL with an approach channel at elevation 2025 ft. MSL. This "original design" was assumed for the "Instream Ice Simulation Study" (Harza-Ebasco 1984b). The alternative Watana power intake designs considered herein are similar to the "original design" but with one additional low level port at elevation 1880, 1800 or 1636 ft. MSL (Table 2). These alternative power intake designs are considered in order to determine if an additional low level port can effectively provide warmer winter reservoir releases and subsequently reduced river ice cover development downstream relative to that with the "original design". Comparisons of river ice simulations for the alternative power intake designs are based on the "warmest water" operating policy (Section 2.2), "Case C" flow requirements (Section 2.3), Watana and Watana + Devil Canyon operating ("two-stage" project) and the 1971-72 and 1981-82 weather conditions.

2.5 Alternative Designs for Devil Canyon Outlet Works

River ice simulations are included for two alternative designs for the intake to the Devil Canyon outlet works. The "present design" provides the outlet works intakes at elevation 930 and 1050 ft. MSL and was used for the "Instream Ice Simulation Study" (Harza-Ebasco 1984b). As discussed in the License Application Amendment (Alaska Power Authority 1985), an alternative "high level" intake at elevation 1425 ft. MSL was considered for the purpose of warming the reservoir release temperatures by 1°C to 2°C during summer operation of the outlet works. River ice simulations were performed to determine if such a change in summer release temperatures would have any effect on winter conditions. River ice results for the "present design" and "high level" outlet works are compared on the basis of the "warmest water" power intake operating policy (Section 2.2), "Case C" flow requirements (Section 2.3), the "original" and Elev. 1800 Watana power intake designs (Section 2.4) and the average 1981-82 winter weather conditions.

3.0 RESULTS

3.1 General

The supplementary river ice simulation results are presented in Exhibits A through X. These exhibits are presented in the same format as those of the "Instream Ice Simulation Study" (Harza-Ebasco 1984b) and include the following information:

1. Profile of maximum river stages which occurred during the simulation period and the corresponding ice cover thickness which existed on the date of maximum stage.

2. Location of the ice front and 0°C water isotherm throughout the simulation.

3. Time history of water surface elevation, ice thickness and water temperature at selected slough and side channel locations.

Tables 3, 6 and 9 present a summary of the maximum simulated river stages and simulated ice front progression for the various alternatives considered in this study (see Chapter 2). With a similar format, Tables 4, 7 and 10 summarize the maximum simulated total ice cover thicknesses (i.e., solid + slush ice components - Harza-Ebasco 1984b) and Tables 5, 8 and 11 show the maximum solid ice component thicknesses for the various alternatives.

For comparative purposes, Tables 3 through 11 include summary results of certain river ice simulations already presented in the Instream Ice Simulation Study (Harza-Ebasco 1984b) with simulations prepared for this supplementary study.

3.2 Three-Stage Project

River ice simulations for the current "three-stage" Susitna Hydroelectric Project are presented in Exhibits A, B and C. These results are summarized in Tables 3, 4 and 5 and Figures 7 through 10. These results are based on the "inflow-matching" operating policy and Case E-VI flow requirements. (Additional simulations based on the Case E-I flow requirements are shown in Exhibits D, E and F and are also summarized in Tables 3, 4 and 5.) The results are shown for operation of Stage I, Stage II and Stage III and are based on the average winter weather conditions of 1981-82. Results of the corresponding reservoir temperature simulations are shown in Figures 14, 15 and 16. Simulated flow rates released from the reservoirs are shown in Figures 11, 12 and 13. Simulations of Stage I and Stage II are believed to be representative of typical ice conditions throughout the duration of those particular stages. The Stage III simulation represents conditions when the project's annual energy output is nearing its ultimate capacity.

The river ice simulation results for Stage I, Stage II and Stage III indicate the following:

3.2.1. Stage I Operation

a) Ice cover progression upstream of Talkeetna in an average winter is expected to begin in mid-December, approximately 3 weeks later than for natural conditions. The ice cover would reach a maximum extent near RM 139 in late January and would melt-out by late April, about 2 weeks earlier than the spring breakup of natural conditions.

b) Maximum total ice cover thicknesses in an average winter would range from 3 feet to 9 feet along the river, and are generally similar to those of natural conditions. Maximum solid ice thicknesses of 3 feet are expected.

c) Maximum river stages within the ice-covered reach (downstream of RM 139) in an average winter would generally be 2 to 6 feet higher than those of natural conditions and additional sloughs, including Slough 11, would be overtopped. Those sloughs overtopped under natural conditions would be overtopped by greater amounts with Stage I operating.

d) Upstream of the ice cover, the river would remain open with some border ice and anchor ice expected within approximately 10 to 25 miles upstream of the cover.

e) River ice results with Case E-I flow-requirements are similar to those with Case E-VI.

3.2.2. Stage II Operation

a) Ice cover progression upstream of Talkeetna in an average winter is expected to be further delayed from Stage I operation, beginning in late December (approximately 6 weeks later than under natural conditions). Ice front progression is expected to reach a maximum extent near RM 133 in late January and would melt-out by late March, about 6 weeks earlier than the natural spring breakup.

b) Maximum total ice cover thicknesses in an average winter would range from 2 to 6 feet and would be less than or equal to those of natural conditions. Solid ice thicknesses of up to 3 feet are expected.

c) Maximum river stages within the ice-covered reach (downstream of RM 133) in an average winter would typically be 1 to 4 feet higher than those of natural conditions and would cause an additional overtopping event at Slough 8.

d) Upstream of the ice cover, maximum river stages would be less than or equal to those of natural conditions, and Slough 9A would no longer be overtopped. Water temperatures in this reach (i.e., upstream of RM 133) would remain above 0°C for Stage II operation in an average winter and no border or anchor ice is expected.

e) River ice results with Case E-I flow requirements are similar to those with Case E-VI.

3.2.3. <u>Stage III Operation</u>

a) Ice cover progression upstream of Talkeetna in an average winter is expected to start at the beginning of January, similar to that of Stage II operation and about 6 weeks later than under natural conditions. The ice cover is expected to reach a maximum extent near RM 114 in late January and would melt out by early March, about 9 weeks earlier than the natural spring breakup.

b) Maximum total ice cover thicknesses in an average winter would range from 1 to 3 feet and would be several feet less than under natural conditions. Solid ice thicknesses are not expected to exceed 1.5 feet.

c) Maximum river stages within the ice-covered reach (downstream of RM 114) in an average winter would be about 2 feet higher than those of natural conditions.

d) Upstream of the ice cover, maximum river stages would be typically less than those of natural conditions. Slough overtoppings in this reach would be less frequent and less severe than under natural conditions.

e) River ice results with Case E-I show somewhat greater ice development than with Case E-VI. Slough overtoppings and the timing of the ice front progression, however, remain similar for Case E-I and Case E-VI.

f) The Stage III simulation described above is based on the projected energy demand when the project is operating near its ultimate capacity. Earlier in the Stage III operation, it is expected that river ice conditions would be generally similar to those described above, except that the ice cover may progress to a point between RM 120 and RM 126. This conclusion is based on simulation of the final stage of the two-stage project (equivalent to Stage III) for an energy demand which is slightly less than the demand during the early years of Stage III operation (Exhibit N).

3.3 Alternative Operating Policies for Watana and Devil Canyon Multi-Level Power Intakes - "Two-Stage" Project

3.3.1 Watana Operating Alone with 2001 Energy Demand

River ice simulation results for the alternative power intake operating policies for Watana operating alone ("two-stage" Project) are presented in Exhibits G through L. A summary of these results is shown in Tables 6, 7 and 8. (Note that these exhibits and tables also consider the effects of the alternative instream flow requirements - see Section 3.4.)

Review of Tables 6, 7 and 8 suggests that the relative effects on river ice of the alternative Watana power intake operating policies (i.e. "inflow-matching", "warmest water" and "lowest port" - see Section 2.2) do not follow a simple general trend. These river ice results, however, are consistent with the corresponding results of the reservoir temperature simulations (DYRESM model) and can best be discussed in conjunction with the DYRESM results. Figures 17, 18 and 19 show these corresponding reservoir temperature simulation results for the alternative power intake operating policies based on Watana operating alone with 2001 energy demand.

Figure 17 shows that, based on Case C flows and 1981-82 weather conditions, the "lowest port" operating policy provides significantly warmer releases (often by 1°C or more) during the winter months than either the "inflow-matching" or "warmest water" policies. This is reflected in the river ice results (Tables 6, 7 and 8) which show a significantly reduced ice front extent, reduced ice thickness and river stages and fewer slough overtoppings for the "lowest port" policy relative to "inflow-matching" or "warmest water." Figure 17 also shows that the "lowest port" policy provides summer releases in the range of 6 to 8°C. These temperatures are often 4°C colder than those obtained using the "inflow-matching" or "warmest water" policies. Further downstream, however, this temperature difference is only about 2°C (Alaska Power Authority 1985). To some extent, these cold summer releases of the "lowest port" policy may allow the reservoir to store a relatively large amount of thermal energy (compared to the alternative policies) which can subsequently be released in the form of warmer water the following winter. Based on Case C flows and the 1981-82 weather conditions, it therefore appears that the "lowest port" policy is more effective than the other policies in reducing the extent of river ice development.

Based on the Case C flows and 1981-82 weather conditions, Tables 6, 7 and 8 show that the "warmest water" operating policy is not effective in reducing river ice development relative to "inflow-matching". In fact, simulated results of the "warmest water" policy at some locations show greater ice thicknesses and river stages than the "inflow-matching" policy. These river ice results are consistent with the corresponding reservoir temperature simulation results (see Figure 17) which show that, for Case C flows and 1981-82 weather, the "warmest water" policy provides winter releases which are often cooler than those of the "inflow-matching" policy. Although this result may appear unusual, it should be emphasized that these alternative power intake operating policies are year-round policies. As shown in Figure 17, the summer releases of the "warmest water" policy are often warmer than those with "inflow-matching". The "warmest water" policy may therefore cause faster depletion of thermal energy storage in the reservoir and subsequently colder water available for release the following winter.

A comparison of the "warmest water" and "inflow-matching" policies is also made for the Case E-VI flows with 2001 energy demand and 1981-82 weather conditions. The simulated river ice results for Case E-VI are again consistent with the corresponding reservoir temperature simulation results shown in Figure 18. With Case E-VI (see Figure 18), the "warmest water" policy again shows summer releases which are often warmer than those of "inflow-matching", but also shows warmer winter releases. In this case, the reservoir ice cover formed earlier with the "warmest water" policy than with the "inflow-matching" policy and subsequently tended to insulate the reservoir from the further cooling effects of wind and air temperature. The earlier ice cover formation with "warmest water" policy appears to be caused by removal of greater amounts of warm water from near the reservoir surface, resulting in cooler surface temperatures. As shown in Tables 6, 7 and 8, simulated river ice results for Case E-VI with the "warmest water" policy show reduced ice thicknesses, river stages and ice front extent and fewer slough overtoppings relative to "inflow-matching".

Alternative operating policies for Watana operating alone with 2001 energy demand and Case C flows are also simulated for 1971-72 weather conditions (cold winter). For these conditions, Figure 19 shows that reservoir releases with the "warmest water" policy are warmer during the winter months than those with the "inflow-matching" policy. These release temperatures are again reflected in the simulated river ice results. As shown in Tables 6, 7 and 8, the "warmest water" policy (with Case C flows, 2001 energy demand, 1971-72 weather) results in reduced ice thicknesses and river stages and fewer slough overtoppings in the reach upstream of River Mile 126 relative to the "inflow-matching" policy.

3.3.2 Watana and Devil Canyon Operating with 2002 Energy Demand

River ice simulation results for the "inflow-matching" and "warmest water" power intake operating policies for Watana and Devil Canyon operating ("Two-Stage" Project) with 2002 energy demand are presented in Exhibits M, N and O. These results are based on Case C and Case E-VI flows and the 1981-82 (average) weather conditions. As shown in Tables 6, 7 and 8, the river ice results for the "warmest water" policy are nearly identical to those with with "inflow-matching" policy. The corresponding reservoir temperature simulation results (Figures 20 and 21) show that the "warmest water" policy provides slightly warmer winter releases than "inflow-matching", but this difference is not great enough to significantly affect the river ice development.

3.4 Alternative Instream Flow Requirements - "Two-Stage" Project

3.4.1 Watana Operating Alone with 2001 Energy Demand

River ice simulation results for Watana operating alone with the Case C and Case E-VI alternative flow requirements are presented in Exhibits G, H, J and K. These comparisons are based on the "Two-Stage" Project, the 1981-82 weather conditions and 2001 energy demand and consider both "inflow-matching" and "warmest water" intake operating policies. Results are summarized in Tables 6, 7 and 8. As discussed in Section 3.3.1, trends in river ice simulation results reflect the corresponding trends in the reservoir temperature simulation results. Simulated Watana reservoir release temperatures for the alternative instream flow requirements are compared in Figures 22 and 23.

Based on the "inflow-matching" policy, simulated reservoir release temperatures during the winter for Case C and Case E-VI show significant time-variation (Figure 22) but the average winter release temperatures for the two flow cases appear quite similar. The corresponding river ice simulations for "inflow-matching" show that Case E-VI causes slightly greater ice thicknesses and river stages upstream of River Mile 126 and slightly reduced ice thicknesses and river stages downstream of River Mile 126 relative to Case C. The extent of the ice cover progression and the occurrences of slough overtoppings, however, remains nearly the same for Case C and Case E-VI.

Based on the "warmest water" policy, Figure 23 shows that Case E-VI results in warmer winter reservoir releases (often by 1°C) than those of Case C. This is reflected in reduced river ice extent, reduced river stages and fewer slough overtoppings for the Case E-VI river ice simulations relative to Case C (Tables 6, 7 and 8) based on the "warmest water" policy.

3.4.2 Watana and Devil Canyon Operating with 2002 Energy Demand

River ice simulation results for the alternative flow requirements with both dams operating are presented in Exhibits M, N and O. Comparisons of Case C and Case E-VI are based on the "Two-Stage" Project, the 1981-82 weather conditions and 2002 energy demand and include "inflow-matching" and "warmest water" operating policies. Corresponding results of the Devil Canyon reservoir release temperature simulations are shown in Figures 24 and 25.

Figures 24 and 25 show that the simulated winter releases from Devil Canyon reservoir for Case E-VI are generally quite similar or only slightly colder than those of Case C. This trend is reflected in the river ice simulations which show generally similar river stages, ice thicknesses and slough overtoppings for Case C and Case E-VI flow requirements.

3.5 Alternative Designs for Watana Multi-Level Power Intake - "Two-Stage" Project

3.5.1 Watana Operating Alone with 2001 Energy Demand

River ice simulation results for alternative Watana power intake designs (see Section 2.4) are presented in Exhibits H, L and P through U based on Watana operating alone ("Two-Stage" Project), 2001 energy demand, Case C flows and the "warmest water" operating policy. These results are summarized for comparison in Tables 9, 10 and 11. Figures 26 and 27 show simulated reservoir release temperatures for several of these alternatives and are consistent with the trends in river ice simulation results.

Tables 9, 10 and 11 show that the addition of a lower level intake port may tend to reduce somewhat the extent of the simulated river ice cover and corresponding river stages near the upstream extent of the cover. Based on the 1971-72 weather conditions, the largest reduction in ice extent, relative to the original intake design, is simulated for the addition of an intake port at elevation 1636 ft. For this alternative, the ice cover extent is reduced by 9 miles and simulated overtopping at sloughs 9A, 11, 20 and 21 is prevented, relative to the original intake design.

Provision of a lower level intake port at elevation 1880 or 1800 ft., however, does not necessarily result in significantly reduced river ice development. Based on the 1971-72 weather conditions, for example, an additional intake at elevation 1880 ft. provides no reduction in river ice extent or slough overtoppings relative to the original intake design. A lower level intake at elevation 1800 ft. shows only a very slight reduction in river ice extent and prevents at most only one additional slough (Slough 21-A6) from overtopping relative to the original design.

It therefore appears that the addition of lower level Watana power intake ports at elevation 1636 would substantially reduce the extent of river ice development relative to the "original design". Intake ports at elevations 1880 or 1800 ft, however, may not be very effective.

3.5.2 Watana and Devil Canyon Operating with 2002 Energy Demand

River ice simulation results for alternative Watana intake designs are presented in Exhibits M, V, W and X based on Watana and Devil Canyon operating ("Two-Stage" Project), 2002 energy demand, 1981-82 weather conditions, Case C flows and the "warmest water" intake operating policy. These results are summarized for comparison in Tables 9, 10 and 11. Note that comparisons are based on both "present" and "high" alternative designs for the Devil Canyon outlet works (see Section 2.5). Figures 28 and 29 show the corresponding reservoir release temperature simulation results.

Tables 9, 10 and 11 show that an additional Watana intake port at elevation 1800 results in a very slight reduction in river ice development relative to the original Watana intake designs. For the most part, river stages and slough overtoppings with the lower (Elevation 1800) intake are the same as those with the original design. This trend occurs based on both the "present design" and the "high level" Devil Canyon outlet works. It therefore again appears that lower level Watana power intakes at elevations 1880 or 1800 ft may not be very effective in reducing river ice development.

3.6 Alternative Designs for Devil Canyon Outlet Works - "Two-Stage" Project

River ice simulation results for the "present" and "high level" designs for the Devil Canyon outlet works (see Section 2.5) are presented in Exhibits M, V, W and X. These alternatives are based on 1981-82 weather conditions, the "Two-Stage" Project, 2002 energy demand, Case C flows and "warmest water" operating policy. The results are summarized for comparison in Tables 9, 10 and 11. Corresponding results of the reservoir release temperature simulations are shown in Figures 30 and 31.

As shown in Tables 9, 10 and 11, there is no significant difference in river ice results between the alternative Devil Canyon outlet works designs. This is true based on both the "original design" and the alternative "El. 1800" design for the Watana power intakes. The similarity of winter reservoir release temperatures for the alternative Devil Canyon outlet works is apparent from Figures 30 and 31.

4.0 CONCLUSIONS

The following conclusions are based on the river ice simulations presented in this study and the "Instream Ice Simulation Study" (Harza-Ebasco 1984b).

4.1 "Three-Stage" Project as Currently Adopted - Average Winter Weather

Expected river ice conditions during an average winter with operation of Stage I, Stage II and Stage III are as shown in Figure 10 and described in Section 3.2 of this report. Ice front progression at Talkeetna, with Stage I operating, would be delayed about 3 weeks (relative to natural conditions) until mid-December, and would be further delayed until late December or early January with the operation of Stages II and III respectively. Spring meltout in the Middle Susitna River with Stage I operating would be completed by late April about 2 weeks earlier than the natural breakup. With addition of Stages II and III, the meltout would be further advanced, occurring in late to early March, respectively.

The maximum upstream extent of the ice cover during an average winter would be in the vicinity of RM 139 with Stage I operating. This ice cover extent would be reduced to near RM 133 with Stage II operating and further reduced to the vicinity of RM 114 with Stage III operating. The total thickness of the river ice cover with Stage I operating would be generally similar to that of natural conditions. Ice cover thickness would be progressively reduced with the addition of Stages II and III.

Maximum river stages within the ice-covered reaches during operation of Stages I, II and III would generally be several feet higher than those of natural conditions. The frequency and magnitude of slough overtoppings within the ice-covered reaches during project operation would therefore be greater than under natural conditions (Table 3). Mitigation measures such as construction of berms will therefore be undertaken with the project to prevent these sloughs from overtopping. Upstream of the ice-cover, however, maximum river stages with the project operating would be generally less than or equal to those of natural conditions. Frequency and magnitude of slough overtoppings upstream of the ice cover with the project in operation would therefore be less than or equal to natural conditions.

4.2 Weather Conditions

The conclusions of Section 4.1 above are based on the average winter weather conditions of 1981-82. In a cold winter, such as that of 1971-72, the ice front progression upstream of Talkeetna would be expected to begin several weeks earlier and would extend a few miles further upstream than with the average winter conditions. The maximum with-project ice front progression would occur with Stage I operating during a cold winter and would be expected to reach the vicinity of RM 142 (versus RM 139 in an average winter). Maximum ice cover thicknesses and river stages in a cold winter are likely to be about 2 feet greater than those in an average winter. Further slough overtopping would therefore be expected in a cold winter.

In a very warm winter, such as that of 1976-77, the extent of the ice cover is expected to be a few miles downstream of that in an average winter. Maximum ice cover thicknesses and river stages in a very warm winter are expected to be about 2 feet less than those in an average winter. Fewer and less severe slough overtoppings are therefore expected in a very warm winter.

4.3 Alternative Power Intake Operating Policies

The conclusions of Section 4.1 above were based on the recommended "inflow-matching" operating policy for the multi-level power intakes. It is expected that the "warmest water" and the "lowest port" alternative operating policies may tend to reduce somewhat the ice cover extent and maximum ice thicknesses and may result in fewer slough overtoppings, relative to the "inflow-matching" policy. However, this trend did not hold for all of the sensitivity simulations and should not be counted on as a general rule. In particular, with Devil Canyon Dam in operation (Stages II or III) the alternative operating policies are expected to have no significant effect on river ice.

4.4 Alternative Instream Flow Requirements

The expected river ice conditions with the Case E-I or Case C flow requirement are not significantly different from those with the recommended Case E-VI requirements.

4.5 Alternative Designs for Watana Power Intake

The conclusions of Section 4.1 above are based on the Stage I and Stage III multi-level power intake elevations shown in Table II. It is expected that provision and use of alternative lower intake ports would generally tend to reduce somewhat the extent of the ice front progression and the maximum river stages near the upstream extent of the cover. However, substantial reductions in the ice conditions are not expected to occur consistently unless a very low intake port at Elevation 1636 is provided.

4.6 Alternative Elevations for Devil Canyon Outlet Works

It is expected that an alternative high level intake at elevation 1425 ft. MSL would have no significant effect on river ice relative to the present design for the Devil Canyon outlet works.

5.0 REFERENCES

Alaska Power Authority 1983, Before the Federal Energy Regulatory Commission, Project No. 7114, Application for Major License, The Susitna Hydroelectric Project prepared by Acres American, Inc.

Alaska Power Authority 1984, Before the Federal Energy Regulatory Commission, Project No. 7114, Application for Major License, The Susitna Hydroelectric Project, Alaska Power Authority Comments on the Federal Energy Regulatory Commission Draft Environmental Impact Statement of May 1984, Appendices IV and V. Prepared by The Harza-Ebasco Susitna Joint Venture.

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Arctic Environmental Information and Data Center 1984, Susitna Hydroelectric Project, Assessment of the Effects of the Proposed Susitna Hydroelectric Project on Instream Temperature and Fishery Resources in the Watana to Talkeetna Reach, Draft Report for Harza-Ebasco for Alaska Power Authority.

Harza-Ebasco 1984a, Susitna Hydroelectric Project, Instream Ice, Calibration of Computer Model, for Alaska Power Authority.

Harza-Ebasco 1984b, Susitna Hydroelectric Project, Instream Ice Simulation Study, Final Report, for Alaska Power Authority.

Harza-Ebasco 1984c, Susitna Hydroelectric Project, Evaluation of Alternative Flow Requirements, for Alaska Power Authority.

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TABLES

SUSITNA HYDROELECTRIC PROJECT
SCOPE OF SUPPLEMENTARY RIVER ICE SIMULATIONS
TWO-STAGE PROJECT

PROJECT STATUS		WATANA ONLY 2001 DEMAND							WATANA + DEVIL CANYON 2002 DEMAND			
WEATHER CONDITIONS		1981-82					1971-72		1981-82			
FLOW REQUIREMENTS		CASE C			CASE E-VI		CASE C		CASE C		CASE E-VI	
OPERATING POLICIES		I	W	L	I	W	I	W	I	W	I	W
DEVIL CANYON OUTLET WORKS	WATANA POWER INTAKE DESIGN											
PRESENT DESIGN El. 930, 1050	ORIGINAL	G	H	I	J	K	△	L	△	M	N	O
	1880/1850		P					R				
	1800/1770		Q					S		V		
	1800/1500							T				
	1636/1470							U				
HIGH LEVEL El. 1425	ORIGINAL									W		
	1800/1770									X		

LEGEND: G,H,I ..etc ICECAL EXHIBIT PRESENTED HEREIN

△ ICECAL SIMULATION PRESENTED PREVIOUSLY (HARZA-EBASCO 1984b)

POWER INTAKE OPERATING POLICIES:

- I INFLOW-MATCHING
- W WARMEST WATER
- L LOWEST PORT

TABLE 2

SUSITNA HYDROELECTRIC PROJECT
ALTERNATIVE WATANA POWER INTAKE DESIGNS
PORT ELEVATIONS IN FEET M.S.L.

	Original Design*	Alt. 1880/1850	Alt. 1800/1770	Alt. 1800/1500	Alt. 1636/1470	Stage I
Level 1	2151	2151	2151	2151	2151	1964.5
Level 2	2114	2114	2114	2114	2114	1926.5
Level 3	2077	2077	2077	2077	2077	1888.5
Level 4	2040	2040	2040	2040	2040	1850.5
Level 5	—	1880	1800	1800	1636	1812.5
Approach Channel	2025	1850	1770	1500	1470	1800

* Stage III design is same as "original design", except approach channel is at El. 1800.

TABLE 3

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED WINTER RIVER STAGES
1981-82 WEATHER CONDITIONS (AVERAGE WINTER)
THREE-STAGE PROJECT vs NATURAL CONDITIONS

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	NATURAL CONDITIONS	WATANA ONLY		WATANA AND DEVIL CANYON			
				STAGE I		STAGE II		STAGE III	
				CASE E-VI	CASE E-I	CASE E-VI	CASE E-I	CASE E-VI	CASE E-I
Whiskers	101.5	367	[368]	[370]	[370]	[370]	[370]	[370]	[370]
Gash Creek	112.0	Unknown	455	457	458	459	458	457	457
6A	112.3	(Upland)	457	459	461	461	461	459	460
8	114.1	476	472	475	[478]	[476]	[476]	474	475
MS II	115.5	482	[484]	[487]	[490]	[487]	[487]	[485]	[486]
MS II	115.9	487	486	[489]	[493]	[490]	[490]	[487]	[488]
Curry	120.0	Unknown	523	526	526	521	520	518	522
Moose	123.5	Unknown	549	555	555	551	551	545	545
8A West	126.1	573	571	[575]	[574]	[573]	[573]	569	569
8A East	127.1	582	[583]	[585]	[585]	[584]	[584]	581	582
9	129.3	604	[606]	[607]	[607]	[605]	[605]	603	603
9 u/s	130.6	Unknown	620	620	621	619	619	617	617
4th July	131.8	Unknown	629	633	632	630	630	628	628
9A	133.7	651	[651]	[656]	[656]	649	649	650	650
10 u/s	134.3	657	[657]	[664]	[663]	655	655	656	656
11 d/s	135.3	Unknown	670	675	674	667	667	668	668
11	136.5	687	683	[688]	[687]	682	682	684	684
17	139.3	Unknown	UPSTREAM BOUNDARY OF NATURAL SIMULATIONS	715	715	714	714	715	715
20	140.5	730		729	729	728	728	729	729
21 (A6)	141.8	747		747	747	746	746	747	747
21	142.2	755		753	753	752	752	753	753
22	144.8	780		787	786	785	785	787	787
LRX-3 Ice Front Starting Date			11-18	12-10	12-10	12-29	12-29	1-2	1-1
Max. Ice Front Extent (River Mile)			137 [4]	139	139	133	133	114	120
Melt-Out/Breakup Date			5-10	4-28	4-20	3-26	3-28	3-5	3-6

UPSTREAM EXTENT OF ICE COVER PROGRESSION

NOTES:

1. ☐ LOCATIONS WHERE MAXIMUM RIVER STAGE OVERTOPS A KNOWN SLOUGH THRESHOLD ELEVATION.
2. ALL RIVER STAGES IN FEET MSL.
3. "INFLOW-MATCHING" POWER INTAKE OPERATING POLICY IS ASSUMED FOR PROJECT SIMULATIONS.
4. ICE COVER FOR NATURAL CONDITIONS EXTENDS UPSTREAM OF GOLD CREEK (RIVER MILE 137) BY MEANS OF BORDER ICE BRIDGING.

TABLE 3

TABLE 4

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED TOTAL ICE THICKNESS
1981-82 WEATHER CONDITIONS (AVERAGE WINTER)
THREE-STAGE PROJECT vs NATURAL CONDITIONS

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	NATURAL CONDITIONS	WATANA ONLY		WATANA AND DEVIL CANYON			
				STAGE I		STAGE II		STAGE III	
				CASE E-VI	CASE E-I	CASE E-VI	CASE E-I	CASE E-VI	CASE E-I
Whiskers	101.5	367	4	3	3	3	3	2	2
Gash Creek	112.0	Unknown	4	3	4	5	5	1	3
6A	112.3	(Upland)	4	3	4	5	5	1	3
8	114.1	476	4	3	5	4	3	1	2
MS II	115.5	482	5	3	7	4	4		1
MS II	115.9	487	7	3	8	6	7		1
Curry	120.0	Unknown	7	7	7	2	2		1
Moose	123.5	Unknown	7	9	9	5	4		
8A West	126.1	573	3	4	3	3	3		
8A East	127.1	582	3	3	3	2	2		
9	129.3	604	7	3	4	2	2		
9 u/s	130.6	Unknown	6	3	4	2	2		
4th July	131.8	Unknown	3	3	4	1	1		
9A	133.7	651	3	6	6				
10 u/s	134.3	657	3	9	7				
11 d/s	135.3	Unknown	3	7	6				
11	136.5	687	3	4	3				
17	139.3	Unknown							
20	140.5	730							
21 (A6)	141.8	747							
21	142.2	755							
22	144.8	780							

UPSTREAM BOUNDARY OF NATURAL SIMULATIONS (dashed line below Slough 11 in Natural Conditions column)

NOTES:

1. ALL ICE THICKNESS IN FEET.
2. "INFLOW-MATCHING" POWER INTAKE OPERATING POLICY IS ASSUMED FOR PROJECT SIMULATIONS.

TABLE 4

TABLE 5

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED SOLID ICE THICKNESS
1981-82 WEATHER CONDITIONS (AVERAGE WINTER)
THREE-STAGE PROJECT vs NATURAL CONDITIONS

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	NATURAL CONDITIONS	WATANA ONLY		WATANA AND DEVIL CANYON			
				STAGE I		STAGE II		STAGE III	
				CASE E-VI	CASE E-I	CASE E-VI	CASE E-I	CASE E-VI	CASE E-I
Whiskers	101.5	367	4	3	3	3	3	2	2
Gash Creek	112.0	Unknown	4	3	3	3	3	0	1
6A	112.3	(Upland)	4	3	3	3	3	0	1
8	114.1	476	4	3	3	3	3	0	1
MS II	115.6	482	4	3	3	2	2		0
MS II	115.9	487	4	3	3	2	2		0
Curry	120.0	Unknown	4	3	3	2	1		0
Moose	123.5	Unknown	4	3	3	1	1		
8A West	126.1	573	3	3	3	1	1		
8A East	127.1	592	3	2	2	1	1		
9	129.3	604	3	2	2	1	1		
9 u/s	130.6	Unknown	3	2	1	0	0		
4th July	131.8	Unknown	3	2	1	0	0		
9A	133.7	651	3	1	1				
10 u/s	134.3	657	3	1	1				
11 d/s	135.3	Unknown	3	1	1				
11	136.5	607	3	1	1				
17	139.3	Unknown							
20	140.5	730							
21 (A6)	141.8	747							
21	142.2	755							
22	144.8	780							

UPSTREAM BOUNDARY OF NATURAL SIMULATIONS

NOTES:

1. ALL ICE THICKNESS IN FEET.
2. "INFLOW MATCHING" POWER INTAKE OPERATING POLICY IS ASSUMED FOR PROJECT SIMULATIONS.
3. '0' REPRESENTS SOLID ICE FORMATION < 0.5' THICK

TABLE 5

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED WINTER RIVER STAGES, TWO-STAGE PROJECT: SENSITIVITY STUDIES
ALTERNATIVE POWER INTAKE OPERATING POLICIES AND INSTREAM FLOW REQUIREMENTS

TABLE 6

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	WATANA ONLY: 2001 ENERGY DEMAND							WATANA + DEVIL CANYON: 2002 DEMAND			
			WINTER 1981-82					WINTER 1971-72		WINTER 1981-82			
			CASE C FLOWS			CASE E–VI		CASE C		CASE C		CASE E–VI	
			I	W	L	I	W	I	W	I	W	I	W
Whiskers	101.5	367	[371]	[371]	[370]	[371]	[370]	[372]	[372]	[369]	[369]	[369]	[369]
Gash Creek	112.0	Unknown	461	458	458	458	457	459	459	456	455	456	455
6A	112.3	(Upland)	464	461	460	460	460	461	461	458	458	459	458
8	114.1	476	[477]	[476]	475	475	475	[476]	[477]	475	475	476	476
MSII	115.5	482	[489]	[487]	[487]	[488]	[487]	[489]	[489]	[485]	[485]	[485]	[485]
MS II	115.9	487	[491]	[490]	[490]	[490]	[489]	[491]	[492]	[488]	[488]	[488]	487
Curry	120.0	Unknown	525	525	522	524	522	525	527	520	520	520	520
Moose	123.5	Unknown	553	556	552	552	546	555	556	548	548	548	548
8A West	126.1	573	[574]	[574]	[573]	[575]	569	[575]	575	568	568	571	571
8A East	127.1	582	[584]	[585]	[582]	[585]	582	[586]	585	580	581	581	581
9	129.3	604	[606]	[606]	602	[607]	603	[610]	607	601	601	601	601
9 u/s	130.6	Unknown	620	620	617	621	617	625	622	616	616	616	616
4th July	131.8	Unknown	632	633	628	633	628	636	633	627	627	627	627
9A	133.7	651	[652]	[654]	650	[654]	650	[659]	[655]	650	649	649	649
10 u/s	134.3	657	[658]	[660]	656	[660]	656	[665]	[663]	655	655	655	655
11 d/s	135.3	Unknown	667	670	668	668	668	676	674	667	667	667	667
11	136.5	687	683	684	684	684	684	[690]	[687]	682	682	682	682
17	139.3	Unknown	715	715	715	715	715	727	718	714	714	714	714
20	140.5	730	729	729	729	729	729	[741]	[735]	728	728	728	728
21 (A6)	141.8	747	747	747	747	747	747	[751]	[749]	745	746	746	746
21	142.2	755	753	753	753	754	754	[755]	754	752	752	752	752
22	144.8	788	787	787	787	787	787	787	787	785	785	785	785
SIMULATED ICE FRONT PROGRESSION:													
Ice Front Start at River Mile 98.6			12 30	12 28	1 2	12 28	1 3	11 28	12 1	12 30	1 1	12 30	12 31
Maximum Ice Front Extent (River Mile)			134	136	126	134	123	142	142	124	124	126	126
Melt-Out Date			4 3	3 29	3 19	3 23	3 9	5 15	5 3	3 12	3 13	3 19	3 18

UPSTREAM EXTENT OF ICE COVER PROGRESSION

NOTES:

1. [ ] LOCATIONS WHERE MAXIMUM RIVER STAGE OVERTOPS A KNOWN SLOUGH THRESHOLD ELEVATION.
2. OPERATING POLICIES FOR WATANA AND DEVIL CANYON POWER INTAKES:
   - I INFLOW-MATCHING
   - W WARMEST WATER
   - L LOWEST PORT
3. ALL RIVER STAGES IN FEET MSL.
4. "ORIGINAL DESIGN" FOR WATANA POWER INTAKE IS ASSUMED THROUGHOUT.
5. WINTER AIR TEMPERATURES: 1981-82 AVERAGE 1971-72 COLD
6. TWO-STAGE PROJECT.

TABLE 6

SUSITNA HYDROELECTRIC PROJECT

TABLE 7

MAXIMUM SIMULATED TOTAL ICE THICKNESSES, TWO-STAGE PROJECT: SENSITIVITY STUDIES
ALTERNATIVE POWER INTAKE OPERATING POLICIES AND INSTREAM FLOW REQUIREMENTS

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	WATANA ONLY: 2001 ENERGY DEMAND							WATANA+DEVIL CANYON: 2002 DEMAND			
			WINTER 1981-82					WINTER 1971-72		WINTER 1981-82			
			CASE C FLOWS			CASE E-VI		CASE C		CASE C		CASE – E-VI	
			I	W	L	I	W	I	W	I	W	I	W
Whiskers	101.5	367	3	3	2	3	2	5	5	2	2	3	2
Gash Creek	112.0	Unknown	7	3	3	2	2	5	5	2	2	3	2
6A	112.3	(Upland	7	4	3	2	2	5	5	3	2	4	3
8	114.1	476	4	3	3	2	1	5	5	3	3	4	3
MS II	115.5	482	5	4	4	3	1	5	5	3	2	3	1
MS II	115.9	487	6	6	6	3	1	5	6	4	3	4	3
Curry	120.0	Unknown	6	7	3	4	2	5	7	1	1	1	1
Moose	123.5	Unknown	5	9	5	4		6	8	1	1	3	3
8A West	126.1	573	2	3	2	2		5	4			1	1
8A East	127.1	582	2	2		2		4	3				
9	129.3	604	1	2		2		6	2				
9 u/s	130.6	Unknown	1	2		2		6	3				
4th July	131.8	Unknown	2	3		3		7	3				
9A	133.7	651	1	3		2		8	5				
10 u/s	134.3	657	1	3		2		9	7				
11 d/s	135.3	Unknown		2				8	5				
11	136.5	687						5	3				
17	139.3	Unknown						13	3				
20	140.5	730						12	5				
21 (A6)	141.8	747						3	1				
21	142.2	755						1					
22	144.8	788											

NOTES:

1. OPERATING POLICIES FOR WATANA AND DEVIL CANYON POWER INTAKES:
   - I INFLOW-MATCHING
   - W WARMEST WATER
   - L LOWEST PORT
2. ALL ICE THICKNESSES IN FEET
3. "ORIGINAL DESIGN" FOR WATANA POWER INTAKE IS ASSUMED THROUGHOUT
4. WINTER AIR TEMPERATURE: 1981-82 AVERAGE; 1971-72 COLD
5. TWO-STAGE PROJECT.

TABLE 7

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED SOLID ICE THICKNESSES, TWO-STAGE PROJECT: SENSITIVITY STUDIES ALTERNATIVE POWER INTAKE OPERATING POLICIES AND INSTREAM FLOW REQUIREMENTS

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	WATANA ONLY: 2001 ENERGY DEMAND							WATANA+DEVIL CANYON: 2002 DEMAND			
			WINTER 1981-82					WINTER 1971-72		WINTER 1981-82			
			CASE C FLOWS			CASE E-VI		CASE C		CASE C		CASE E-VI	
			I	W	L	I	W	I	W	I	W	I	W
Whiskers	101.5	367	3	3	2	3	2	5	5	2	2	3	2
Gash Creek	112.0	Unknown	3	3	2	2	1	5	5	2	2	2	2
6A	112.3	(Upland)	3	3	2	2	1	5	5	2	2	2	2
8	114.1	476	2	3	2	2	1	5	5	2	2	2	2
MS II	115.5	482	2	2	1	2	1	5	4	1	1	1	1
MS II	115.9	487	2	2	1	2	1	5	5	1	1	1	1
Curry	120.0	Unknown	1	2	1	2	0	5	4	1	1	1	1
Moose	123.5	Unknown	1	1	1	1		4	3	0	0	1	1
8A West	126.1	573	1	1	0	1		4	3			1	0
8A East	127.1	582	1	1		1		4	3				
9	129.3	604	1	1		1		4	2				
9 u/s	130.6	Unknown	1	1		0		4	2				
4th July	131.8	Unknown	0	1		0		4	2				
9A	133.7	651	0	0		0		4	2				
10 u/s	134.3	657	0	0		0		3	2				
11 d/s	135.3	Unknown		0				3	2				
11	136.5	687						3	1				
17	139.3	Unknown						2	1				
20	140.5	730						2	1				
21 (A6)	141.8	747						1	0				
21	142.2	755						0					
22	144.8	788											

NOTES:

1. OPERATING POLICIES FOR WATANA AND DEVIL CANYON POWER INTAKES.
   - I INFLOW-MATCHING
   - W WARMEST WATER
   - L LOWEST PORT
2. ALL ICE THICKNESSES IN FEET.
3. "ORIGINAL DESIGN" FOR WATANA POWER INTAKE IS ASSUMED THROUGHOUT.
4. WINTER AIR TEMPERATURE.
   1981-82 AVERAGE
   1971-72 COLD
5. TWO STAGE PROJECT.
6. "0" REPRESENTS SOLID ICE FORMATION < 0.5' THICK

TABLE 9

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED WINTER RIVER STAGES, TWO-STAGE PROJECT: SENSITIVITY STUDIES
ALTERNATIVE DESIGNS FOR WATANA POWER INTAKE AND DEVIL CANYON OUTLET WORKS INTAKE

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	WATANA ONLY : 2001 ENERGY DEMAND								WATANA+DEVIL CANYON: 2002 DEMAND			
			WINTER 1981-82			WINTER 1971-72					WINTER 1981-82			
			ORIGINAL	1880/1850	1800/1770	ORIGINAL	1880/1850	1800/1770	1800/1500	1636/1470	ORIGINAL	1800/1770	ORIGINAL	1800/1770
											PRESENT (EL. 1050)		HIGH (EL. 1425)	
Whiskers	101.5	367	371	370	370	372	372	372	372	372	369	369	369	369
Gash Creek	112.0	Unknown	458	458	458	459	461	459	461	460	455	455	455	455
6A	112.3	(Upland)	461	461	460	461	464	461	464	462	458	458	458	458
8	114.1	476	476	476	476	477	480	477	478	478	475	474	475	474
MS II	115.5	482	487	487	488	489	490	491	490	489	485	485	485	485
MS II	115.9	487	490	489	491	492	493	494	493	492	488	487	488	486
Curry	120.0	Unknown	525	522	524	527	526	528	527	525	520	520	520	520
Moose	123.5	Unknown	556	551	552	556	555	557	556	555	548	545	548	544
8A West	126.1	573	574	572	574	575	574	574	575	574	568	568	568	568
8A East	127.1	582	585	582	584	585	585	585	585	584	581	581	581	581
9	129.3	604	606	602	604	607	608	607	608	605	601	601	601	601
9 u/s	130.6	Unknown	620	617	617	622	624	621	621	620	616	616	616	616
4th July	131.8	Unknown	633	628	628	633	635	633	633	631	627	627	627	627
9A	133.7	651	654	650	650	655	654	656	656	650	649	649	649	649
10 u/s	134.3	657	660	656	656	663	660	663	662	657	655	655	655	655
11 d/s	135.3	Unknown	670	668	667	674	672	673	673	668	667	667	667	667
11	136.5	687	684	683	683	687	687	688	687	683	682	682	682	682
17	139.3	Unknown	715	715	715	718	719	717	716	715	714	714	714	714
20	140.5	730	729	729	729	735	735	730	730	729	728	728	728	728
21 (A6)	141.8	747	747	747	747	749	749	747	747	747	746	746	746	746
21	142.2	755	753	753	753	754	754	753	753	753	752	752	752	752
22	144.8	788	787	787	787	787	787	787	787	787	785	785	785	785
SIMULATED ICE FRONT PROGRESSION:														
Ice Front Start at River Mile 98.6			12-28	1-2	1-1	12-1	12-2	12-2	12-3	12-6	1-1	1-1	1-1	1-1
Maximum Ice Front Extent (River Mile)			136	126	129	142	142	140	139	133	124	122	124	122
Melt-out Date			3-29	3-15	3-20	5-3	4-30	4-26	4-25	4-5	3-13	3-9	3-14	3-10

WATANA POWER INTAKE DESIGN

DEVIL CANYON OUTLET WORKS

UPSTREAM EXTENT OF ICE COVER PROGRESSION

NOTES:

1. [box] LOCATIONS WHERE MAXIMUM RIVER STAGE OVERTOPS A KNOWN SLOUGH THRESHOLD ELEVATION.
2. ALL RIVER STAGES IN FEET MSL.
3. CASE C INSTREAM FLOW REQUIREMENTS AND "WARMEST WATER" POWER INTAKE OPERATING POLICY IS ASSUMED THROUGHOUT.
4. WINTER AIR TEMPERATURE. 1981-82 AVERAGE, 1971-72 COLD
5. TWO STAGE PROJECT.

TABLE 9

TABLE 10

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED TOTAL ICE THICKNESSES, TWO-STAGE PROJECT: SENSITIVITY STUDIES
ALTERNATIVE DESIGNS FOR WATANA POWER INTAKE AND DEVIL CANYON OUTLET WORKS INTAKE

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	WATANA ONLY: 2001 ENERGY DEMAND								WATANA+DEVIL CANYON: 2002 DEMAND			
			WINTER 1981-82			WINTER 1971-72					WINTER 1981-82			
			ORIGINAL	1880/1850	1800/1770	ORIGINAL	1880/1850	1800/1770	1800/1500	1636/1470	ORIGINAL	1800/1770	ORIGINAL	1800/1770
											PRESENT (EL. 1050)		HIGH (EL. 1425)	
Whiskers	101.5	387	3	2	2	5	5	5	4	3	2	2	2	2
Gash Creek	112.0	Unknown	3	4	4	5	7	4	7	5	2	1	2	1
6A	112.3	(Upland)	4	5	3	5	7	4	7	5	2	2	3	1
8	114.1	476	3	3	3	5	6	4	5	4	3	2	3	2
MS II	115.5	482	4	3	5	5	6	7	7	5	2	1	2	1
MS II	115.9	487	6	5	6	6	7	11	8	6	3	2	3	1
Curry	120.0	Unknown	7	2	5	7	7	9	7	5	1	1	1	1
Moose	123.5	Unknown	9	4	5	8	8	9	8	8	1		1	
8A West	126.1	573	3	1	3	4	2	3	3	3				
8A East	127.1	582	2		2	3	2	2	2	2				
9	129.3	604	2			2	3	3	3	1				
9 u/s	130.6	Unknown	2			3	5	2	3	1				
4th July	131.8	Unknown	3			3	4	3	3	1				
9A	133.7	651	3			5	3	5	5					
10 u/s	134.3	657	3			7	4	6	6					
11 d/s	135.3	Unknown	2			5	3	4	4					
11	136.5	687				3	3	3	3					
17	139.3	Unknown				3	4	2						
20	140.5	730				5	5							
21 (A6)	141.8	747				1	1							
21	142.2	755												
22	144.8	788												

WATANA POWER INTAKE DESIGN

DEVIL CANYON OUTLET WORKS

NOTES:

1. ALL RIVER STAGES IN FEET MSL.
2. CASE C INSTREAM FLOW REQUIREMENTS AND "WARMEST WATER" POWER INTAKE OPERATING POLICY IS ASSUMED THROUGH.
3. WINTER AIR TEMPERATURE
   1981-82 AVERAGE
   1971-72 COLD
4. TWO STAGE PROJECT.

TABLE 10

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED SOLID ICE THICKNESSES,TWO-STAGE PROJECT: SENSITIVITY STUDIES
ALTERNATIVE DESIGNS FOR WATANA POWER INTAKE AND DEVIL CANYON OUTLET WORKS INTAKE

SLOUGH OR SIDE CHANNEL	RIVER MILE	THRESHOLD ELEVATION	WATANA ONLY: 2001 ENERGY DEMAND								WATANA+DEVIL CANYON:2002 DEMAND				
			WINTER 1981-82			WINTER 1971-72					WINTER 1981-82				
			ORIGINAL	1880/1850	1800/1770	ORIGINAL	1880/1850	1800/1770	1800/1500	1636/1470	ORIGINAL	1800/1770	ORIGINAL	1800/1770	WATANA POWER INTAKE DESIGN
											PRESENT (EL. 1050)		HIGH (EL. 1425)		DEVIL CANYON OUTLET WORKS
Whiskers	101.5	367	3	2	2	5	5	5	4	3	2	2	2	2	
Gash	112.0	Unknown	3	2	2	5	4	4	4	3	2	1	2	1	
6A	112.3	(Upland)	3	2	1	5	4	4	4	3	2	1	2	1	
8	114.1	476	3	2	1	5	4	4	3	3	2	1	2	1	
MS II	115.5	482	2	1	1	4	4	4	3	3	1	1	1	1	
MS II	115.9	487	2	1	1	5	3	4	3	3	1	1	1	1	
Curry	120.0	Unknown	2	1	1	4	3	3	3	3	1	0	1	0	
Moose	123.5	Unknown	1	1	1	3	3	3	2	2	0		0		
8A West	126.1	573	1	0	1	3	2	2	2	1					
8A East	127.1	582	1		0	3	2	2	2	1					
9	129.3	604	1			2	2	2	2	0					
9 u/s	130.6	Unknown	1			2	2	2	2	0					
4th July	131.8	Unknown	1			2	2	2	2	0					
9A	133.7	651	0			2	2	1	1						
10 u/s	134.3	657	0			2	2	1	1						
11 d/s	135.3	Unknown	0			2	1	1	1						
11	136.5	687				1	1	1	1						
17	139.3	Unknown				1	1	0							
20	140.5	730				1	1								
21 (A6)	141.8	747				0	0								
21	142.2	755													
22	144.8	788													

NOTES:

1. ALL RIVER STAGES IN FEET MSL.
2. CASE C INSTREAM FLOW REQUIREMENTS AND "WARMEST WATER" POWER INTAKE OPERATING POLICY IS ASSUMED THROUGH
3. WINTER AIR TEMPERATURE
   1981-82 AVERAGE
   1971-72 COLD
4. TWO STAGE PROJECT.
5. "0" REPRESENTS SOLID ICE FORMATION < 0.5' THICK

FIGURES

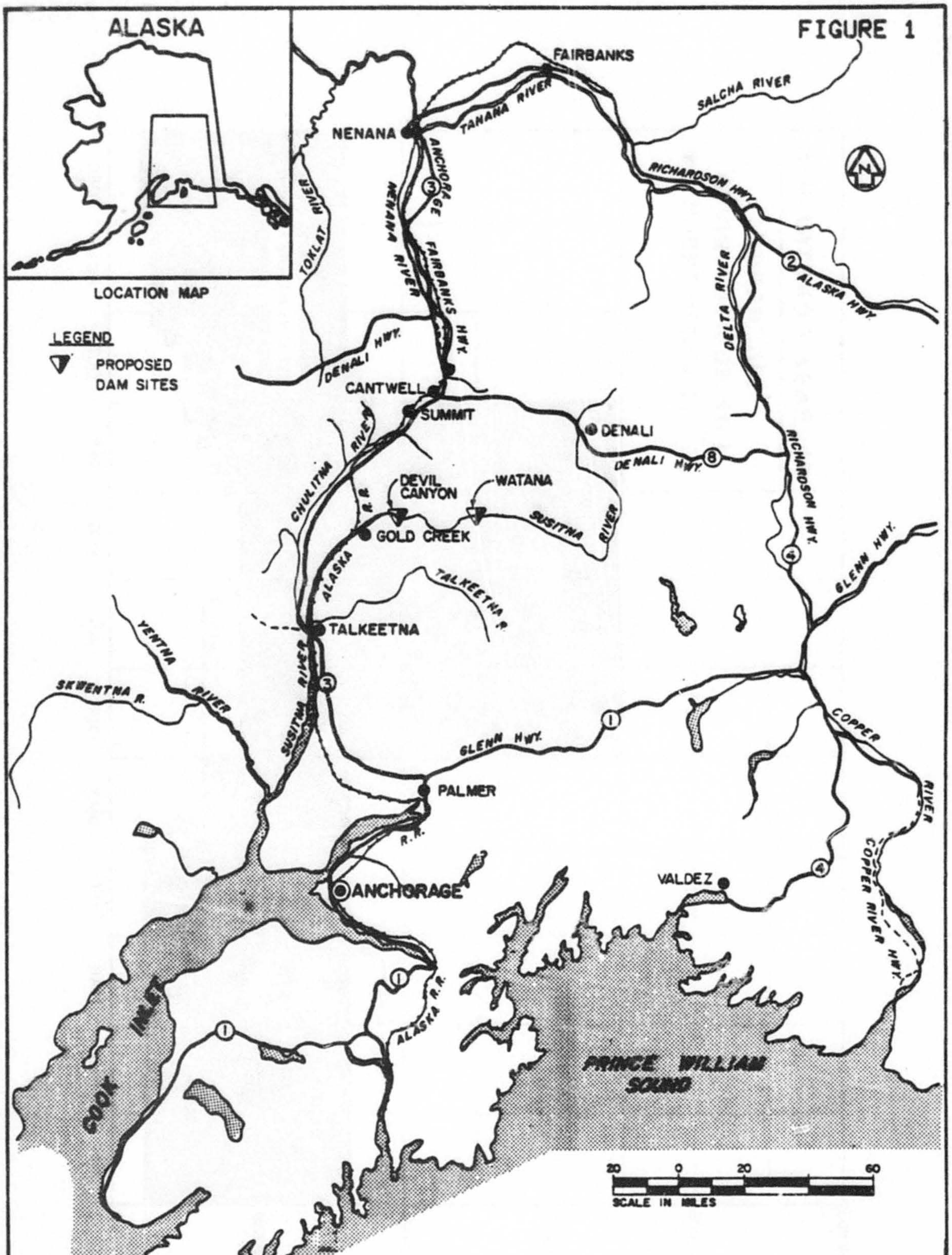


FIGURE 1

LOCATION MAP

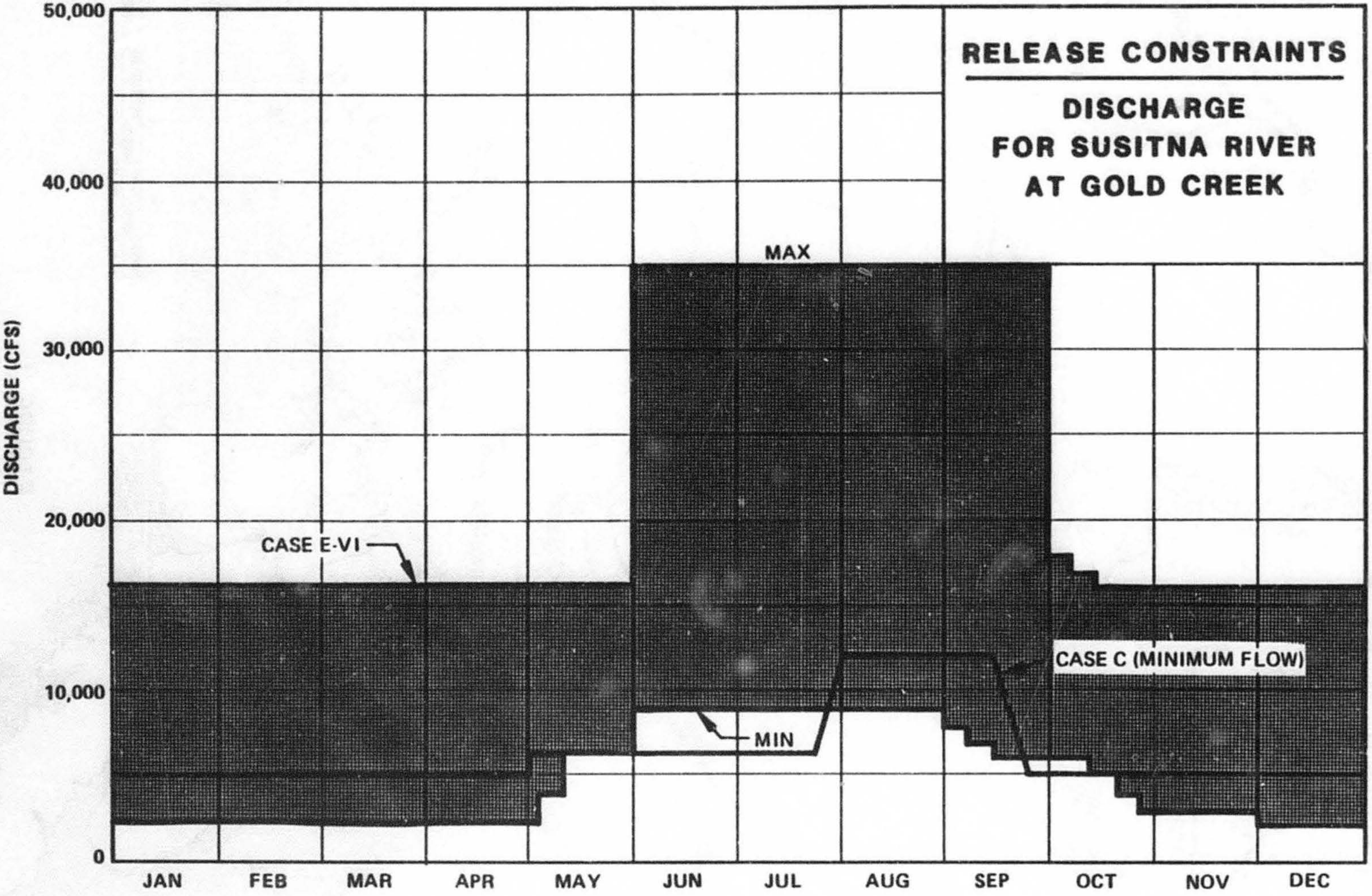

RELEASE CONSTRAINTS
DISCHARGE
FOR SUSITNA RIVER
AT GOLD CREEK
DISCHARGE (CFS)
50,000
40,000
30,000
20,000
10,000
0
MAX
CASE E-VI
MIN
CASE C (MINIMUM FLOW)
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE 2

FIGURE 3

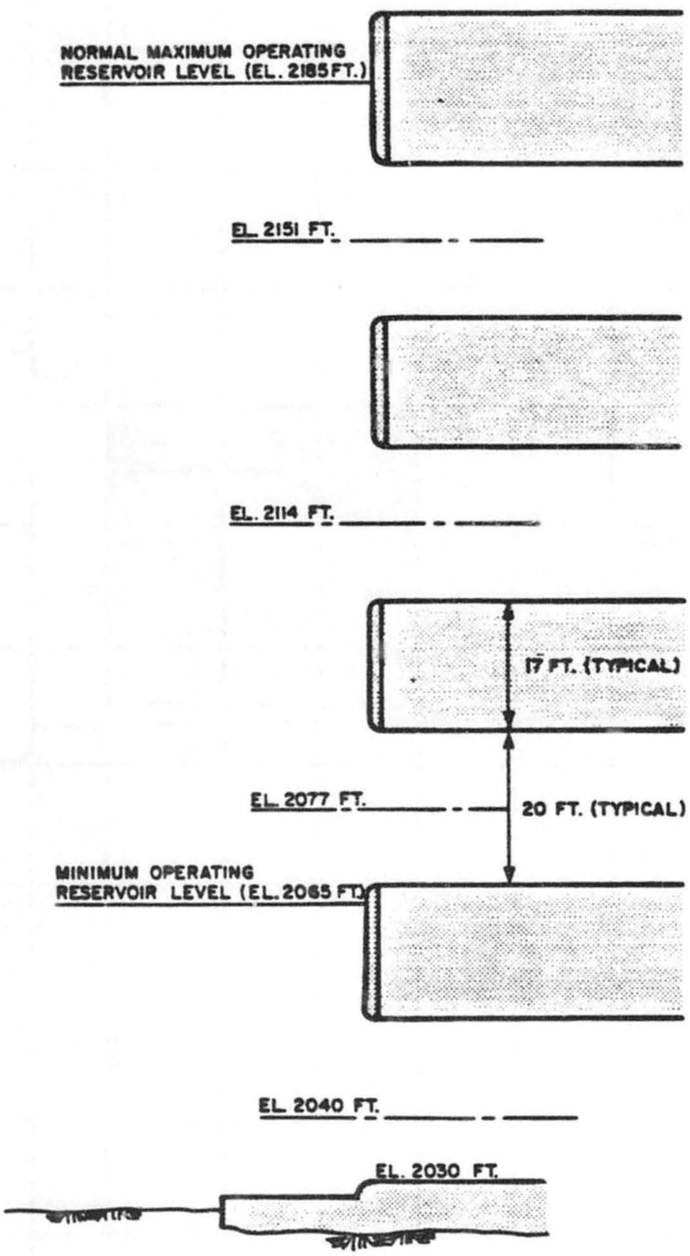


FIGURE 3

WATANA MULTILEVEL INTAKE
ORIGINAL DESIGN

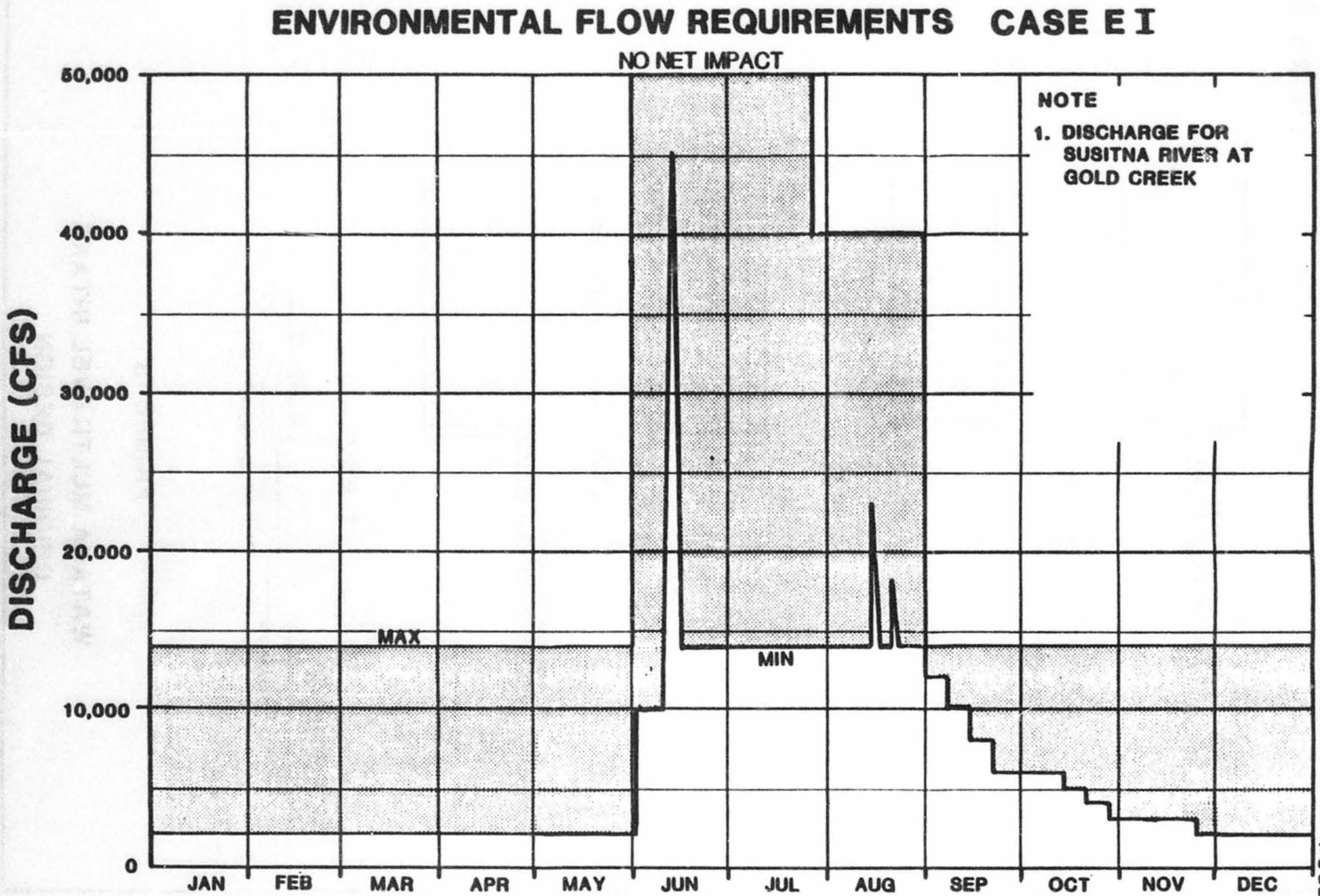

ENVIRONMENTAL FLOW REQUIREMENTS CASE E I
NO NET IMPACT
DISCHARGE (CFS)
50,000
40,000
30,000
20,000
10,000
0
NOTE
1. DISCHARGE FOR SUSITNA RIVER AT GOLD CREEK
MAX
MIN
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE 4

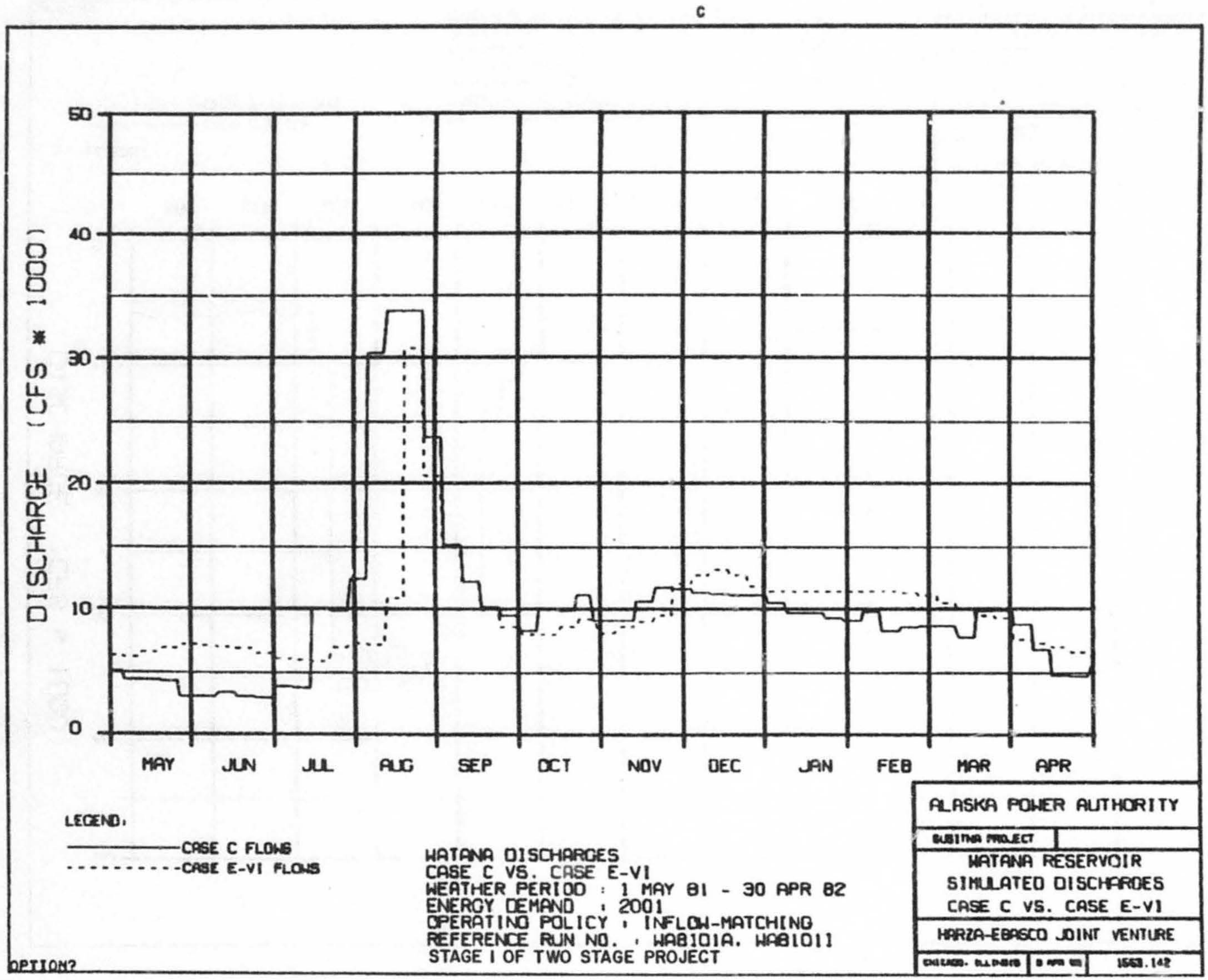
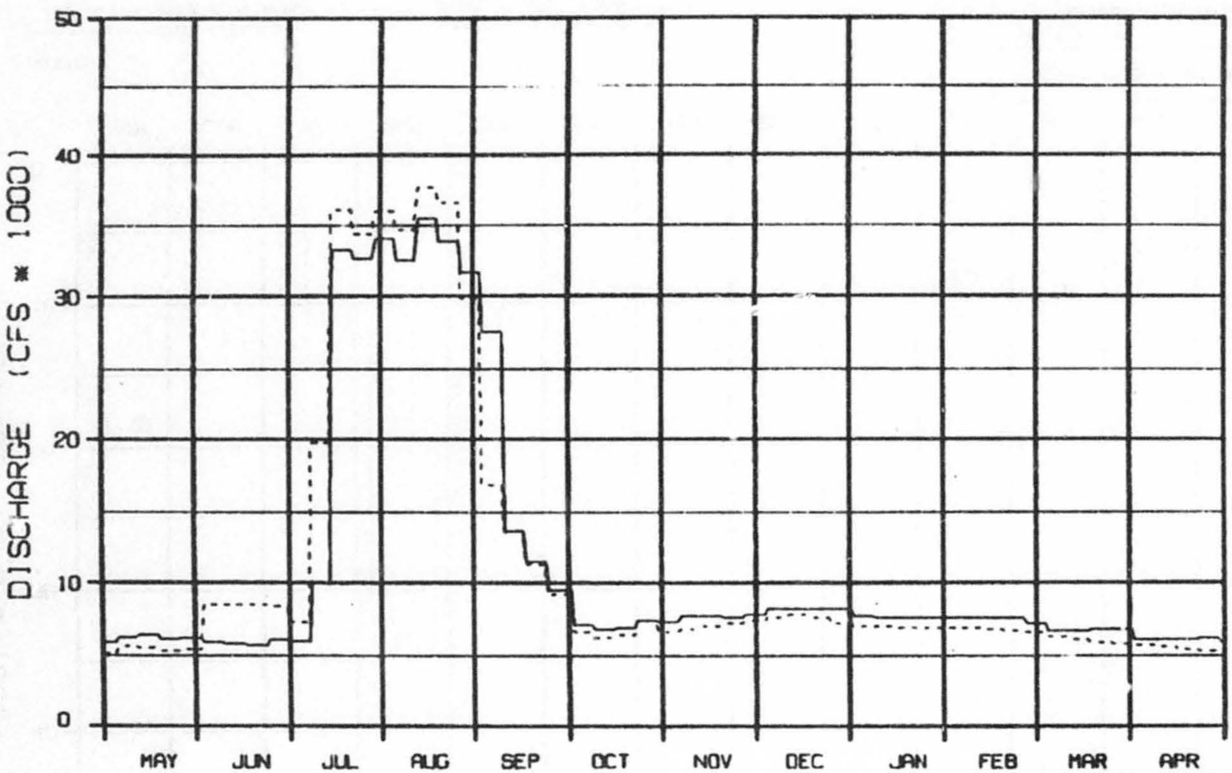

C
DISCHARGE (CFS * 1000)
50
40
30
20
10
0
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
CASE C FLOWS
CASE E-VI FLOWS
WATANA DISCHARGES
CASE C VS. CASE E-VI
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : WA8101A, WA81011
STAGE I OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
SIMULATED DISCHARGES
CASE C VS. CASE E-VI
HARZA-EBASCO JOINT VENTURE
1563.142

FIGURE 5

C



LEGEND.

————— CASE C FLOWS

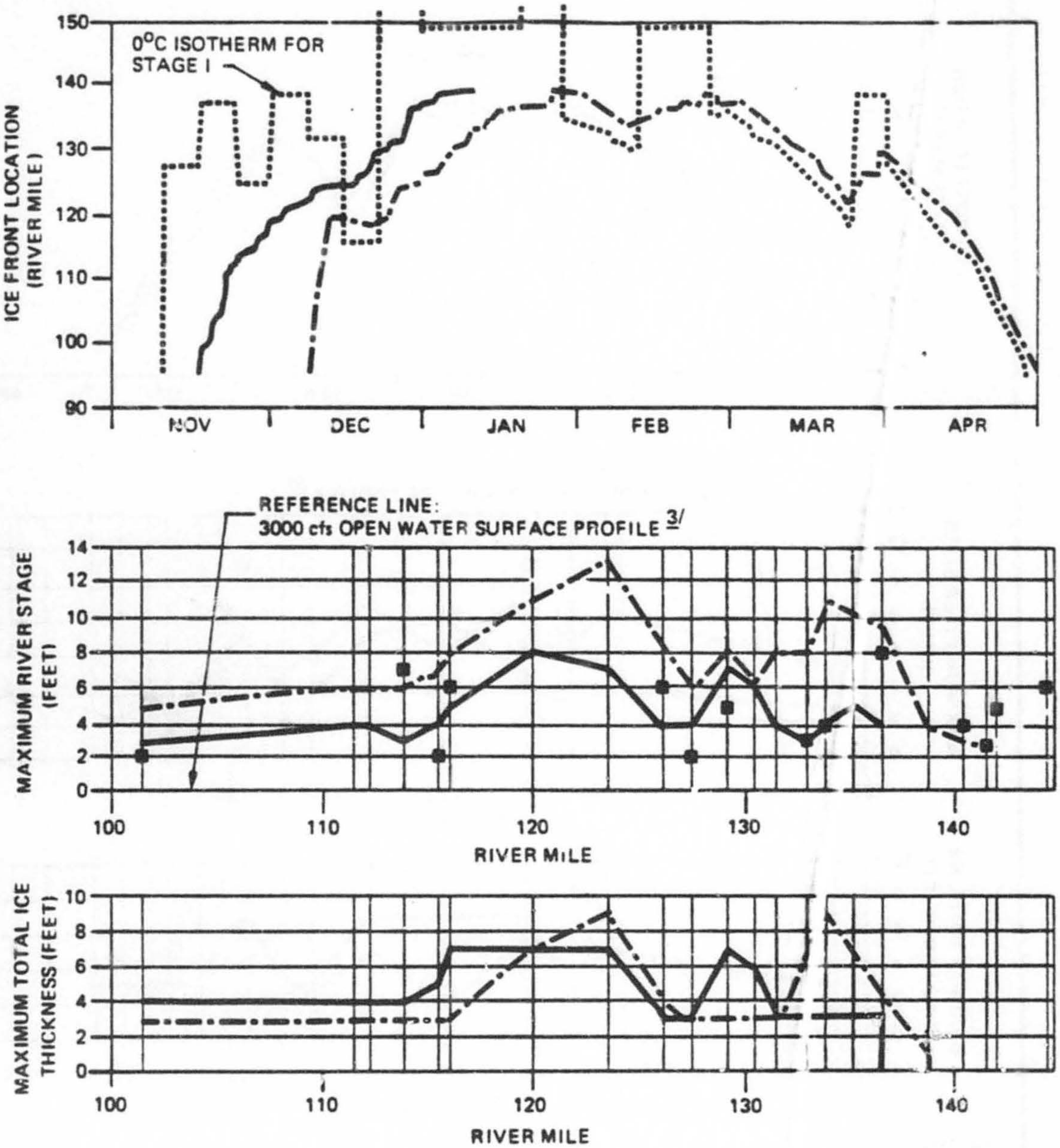
- - - - - - CASE E-VI FLOWS

DEVIL CANYON DISCHARGES
CASE C VS. CASE E-VI
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : DC8102D. DC8102L
STAGE II OF TWO STAGE PROJECT

OPTION?

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
DEVIL CANYON RESERVOIR SIMULATED DISCHARGES CASE C VS. CASE E-VI		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	8 APR 85	1563.142

FIGURE 6



NOTES:

1. STAGE I SIMULATION BASED ON CASE E–VI FLOWS. STAGE I ENERGY DEMAND, INFLOW MATCHING TEMPERATURE POLICY.
2. NATURAL CONDITIONS NOT SIMULATED UPSTREAM OF RM 140.
3. 3000 cfs REPRESENTS TYPICAL WINTER FLOW UNDER NATURAL CONDITIONS AT FREEZE UP.

LEGEND:

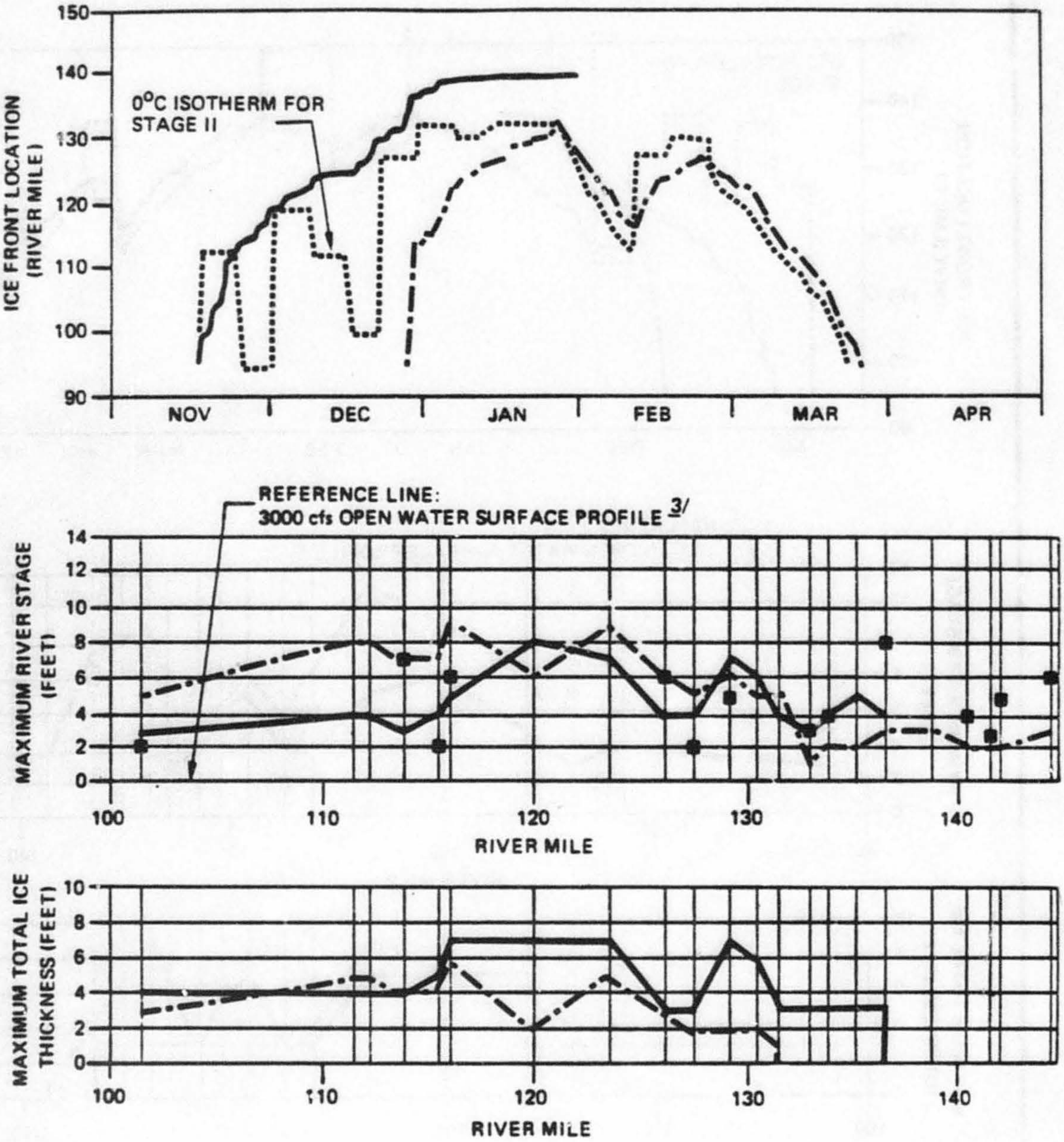
- NATURAL CONDITIONS
- STAGE I OPERATING
- NATURAL SLOUGH BERM ELEVATION

FIGURE 7

SIMULATED RIVER ICE CONDITIONS
STAGE I vs. NATURAL
1981-82 WEATHER CONDITIONS
CASE E-VI FLOWS

HARZA-EBASCO SUSITNA JOINT VENTURE
ALASKA POWER AUTHORITY

FIGURE 8



NOTES:

1. STAGE II SIMULATION BASED ON CASE E-VI FLOWS, MID STAGE II ENERGY DEMAND, INFLOW MATCHING TEMPERATURE POLICY
2. NATURAL CONDITIONS NOT SIMULATED UPSTREAM OF RM 140.
3. 3000 cfs REPRESENTS TYPICAL WINTER FLOW UNDER NATURAL CONDITIONS AT FREEZE UP'

LEGEND:

NATURAL CONDITIONS

STAGE II OPERATING

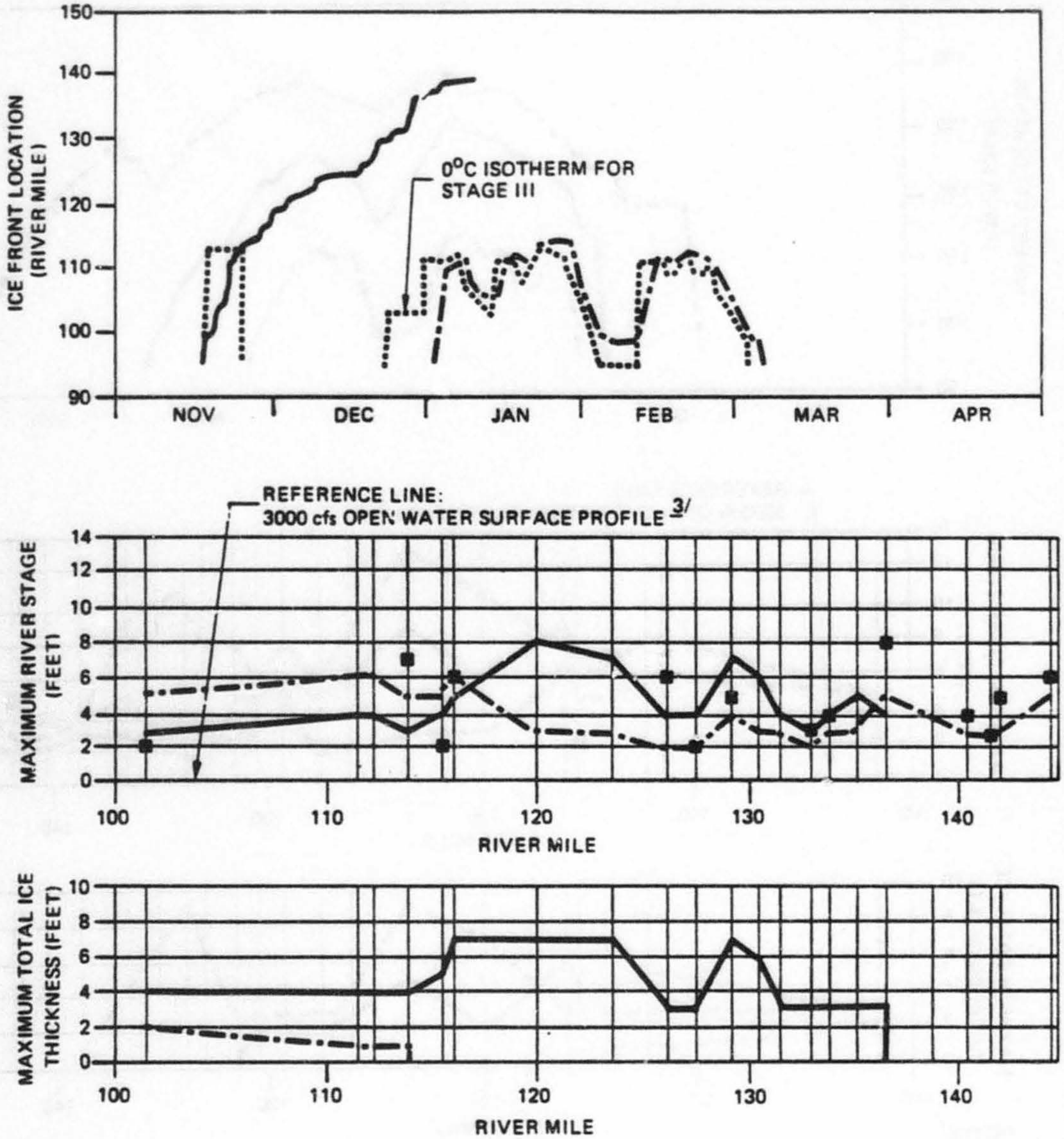
■ NATURAL SLOUGH BERM ELEVATION

FIGURE 8

SIMULATED RIVER ICE CONDITIONS
STAGE II vs. NATURAL
1981-82 WEATHER CONDITIONS
CASE E-VI FLOWS

HARZA-EBASCO SUSITNA JOINT VENTURE
ALASKA POWER AUTHORITY

FIGURE 9



NOTES:

1. STAGE III SIMULATION BASED ON CASE E–VI FLOWS, LATE STAGE III ENERGY DEMAND, INFLOW MATCHING TEMPERATURE POLICY
2. NATURAL CONDITIONS NOT SIMULATED UPSTREAM OF RM 140.
3. 3000 cfs REPRESENTS TYPICAL WINTER FLOW UNDER NATURAL CONDITIONS AT FREEZE UP.

LEGEND:

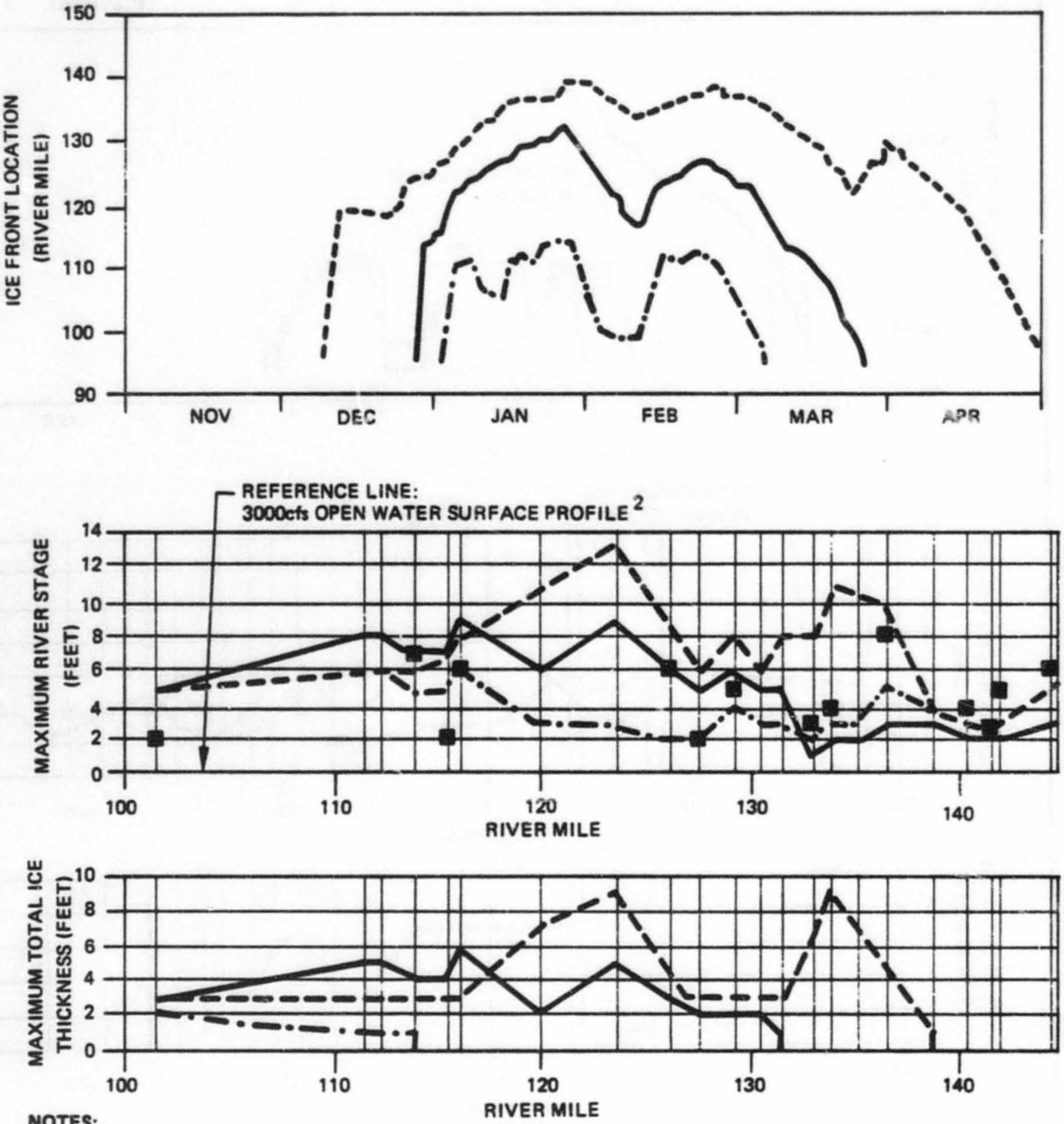
- NATURAL CONDITIONS (solid line)
- STAGE III OPERATING (dash-dot line)
- ■ NATURAL SLOUGH BERM ELEVATION

FIGURE 9

SIMULATED RIVER ICE CONDITIONS
STAGE III vs. NATURAL
1981-82 WEATHER CONDITIONS
CASE E-VI FLOWS

HARZA-EBASCO SUSITNA JOINT VENTURE
ALASKA POWER AUTHORITY

FIGURE 10



NOTES:

1. SIMULATION BASED ON CASE E-VI FLOWS "INFLOW-MATCHING" POWER INTAKE OPERATION, THREE-STAGE PROJECT.
2. 3000cfs REPRESENTS TYPICAL WINTER FLOW UNDER NATURAL CONDITIONS AT FREEZE UP.

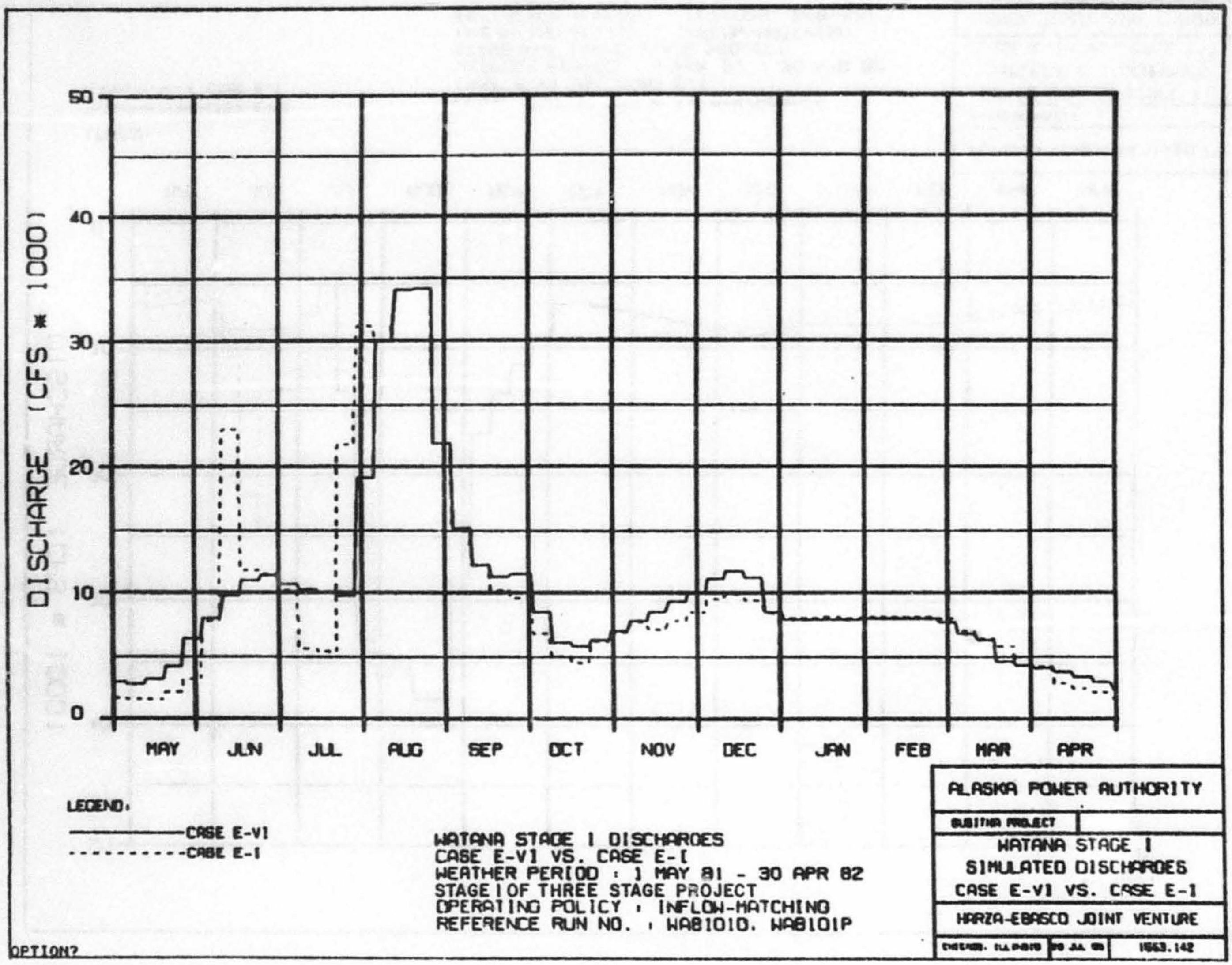
LEGEND:

- – – – STAGE I OPERATING
- ——— STAGE II OPERATING
- — · — STAGE III OPERATING
- ■ NATURAL SLOUGH BERM ELEVATION

FIGURE 10

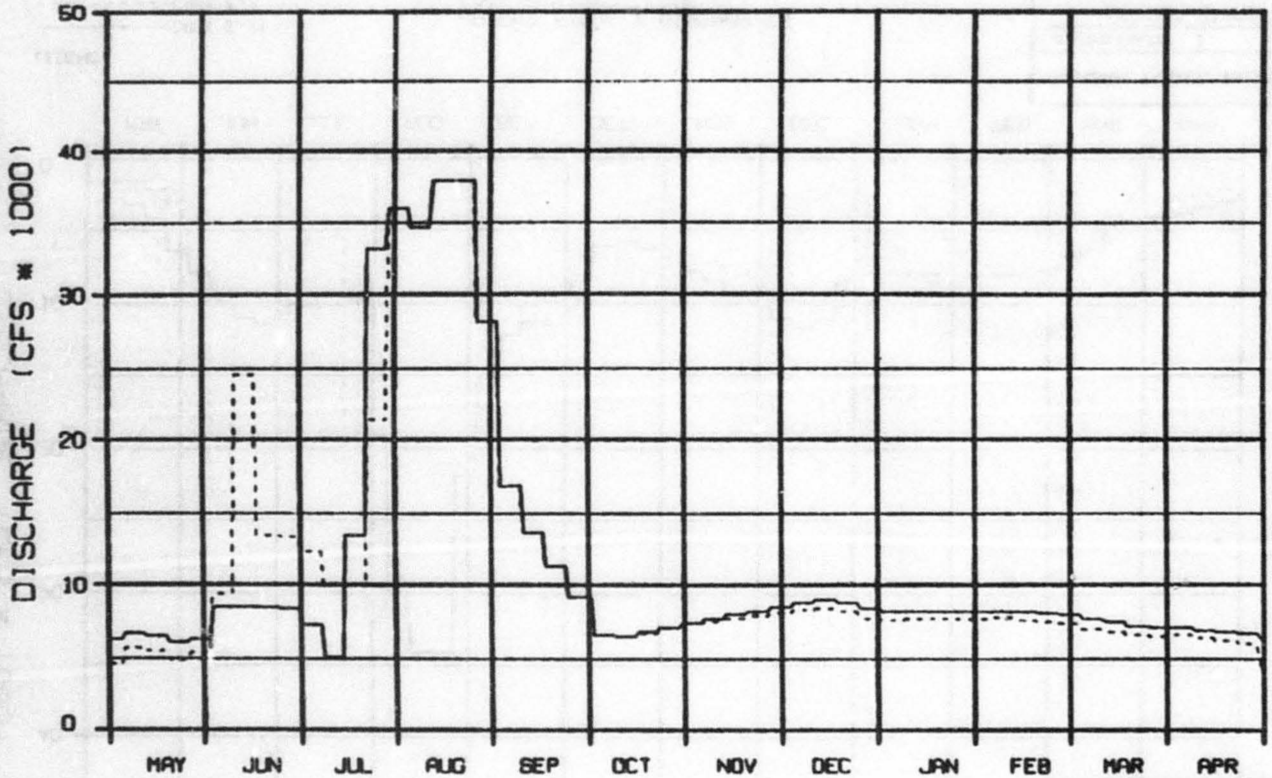
SIMULATED RIVER ICE CONDITIONS
STAGES I, II AND III
1981-82 WEATHER CONDITIONS
(AVERAGE WINTER)

HARZA-EBASCO SUSITNA JOINT VENTURE
ALASKA POWER AUTHORITY



DISCHARGE (CFS * 1000)
50
40
30
20
10
0
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
CASE E-VI
CASE E-I
WATANA STAGE I DISCHARGES
CASE E-VI VS. CASE E-I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
STAGE I OF THREE STAGE PROJECT
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : WA8101D, WA8101P
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA STAGE I
SIMULATED DISCHARGES
CASE E-VI VS. CASE E-1
HARZA-EBASCO JOINT VENTURE
1663.142
OPTION?

FIGURE 11



LEGEND:

——— CASE E-VI

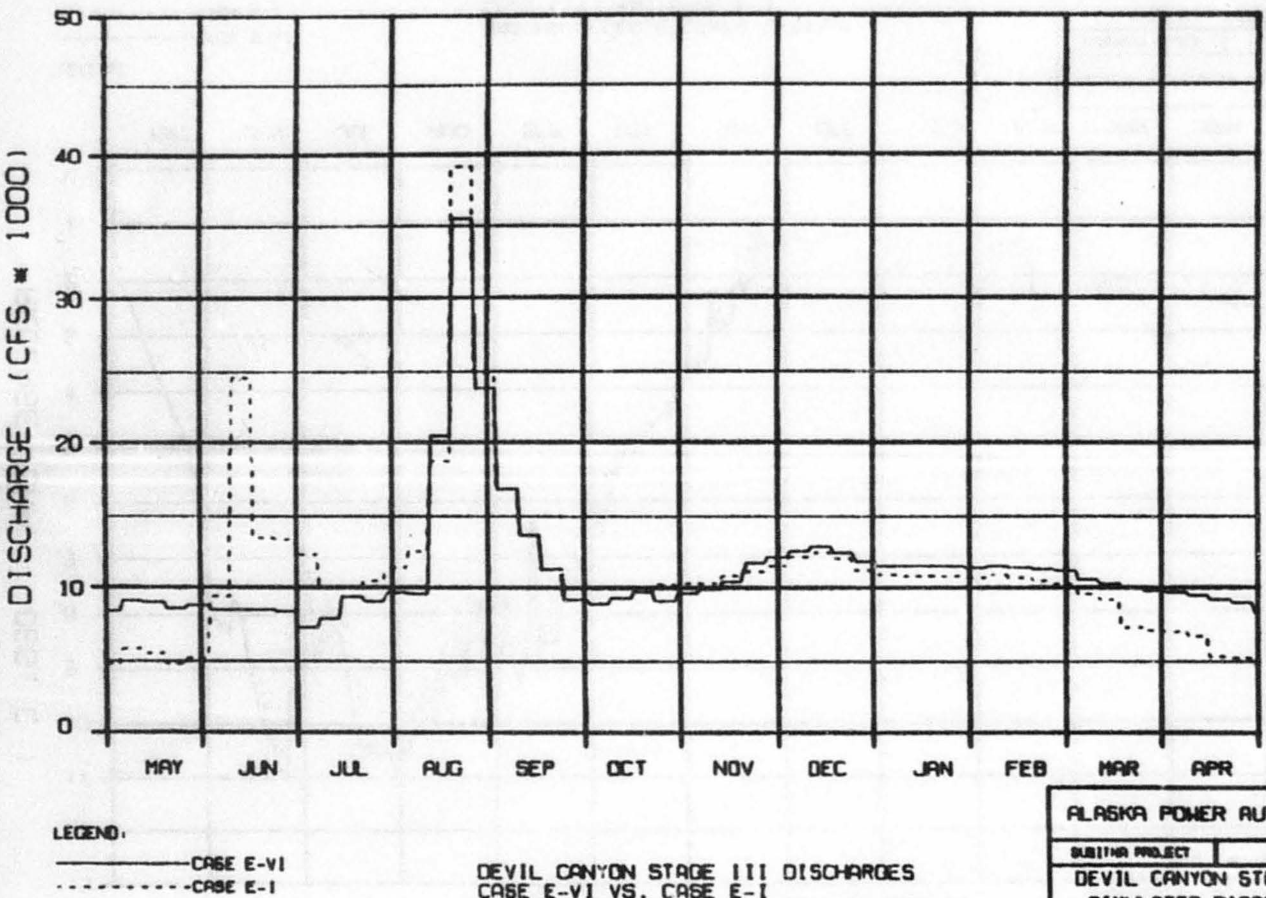
- - - - - CASE E-I

DEVIL CANYON STAGE II DISCHARGES
CASE E-VI VS. CASE E-I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
STAGE II OF THREE STAGE PROJECT
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : DC8102S. DC8102U

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
DEVIL CANYON STAGE II SIMULATED DISCHARGES CASE E-VI VS. CASE E-I		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	20 JUL 85	1983.142

OPTION?

FIGURE 12



DEVIL CANYON STAGE III DISCHARGES
CASE E-VI VS. CASE E-I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
STAGE III OF THREE STAGE PROJECT
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : DC8120E. DC8120D

PTION?

ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON STAGE III
SIMULATED DISCHARGES
CASE E-VI VS. CASE E-I
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 20 JUL 84 | 1668.142

FIGURE 13

LEGEND:

————— CASE E-VI

- - - - - - - CASE E-I

WATANA RELEASE TEMPS - STAGE I
CASE E-VI VS. CASE E-I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
STAGE I OF THREE STAGE PROJECT
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : WA81C1D.WA81D1P

OPTION?

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
WATANA STAGE I SIMULATED RELEASE TEMPS CASE E-VI VS. CASE E-I	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS · 29 JUL 83	1583.142

FIGURE 14

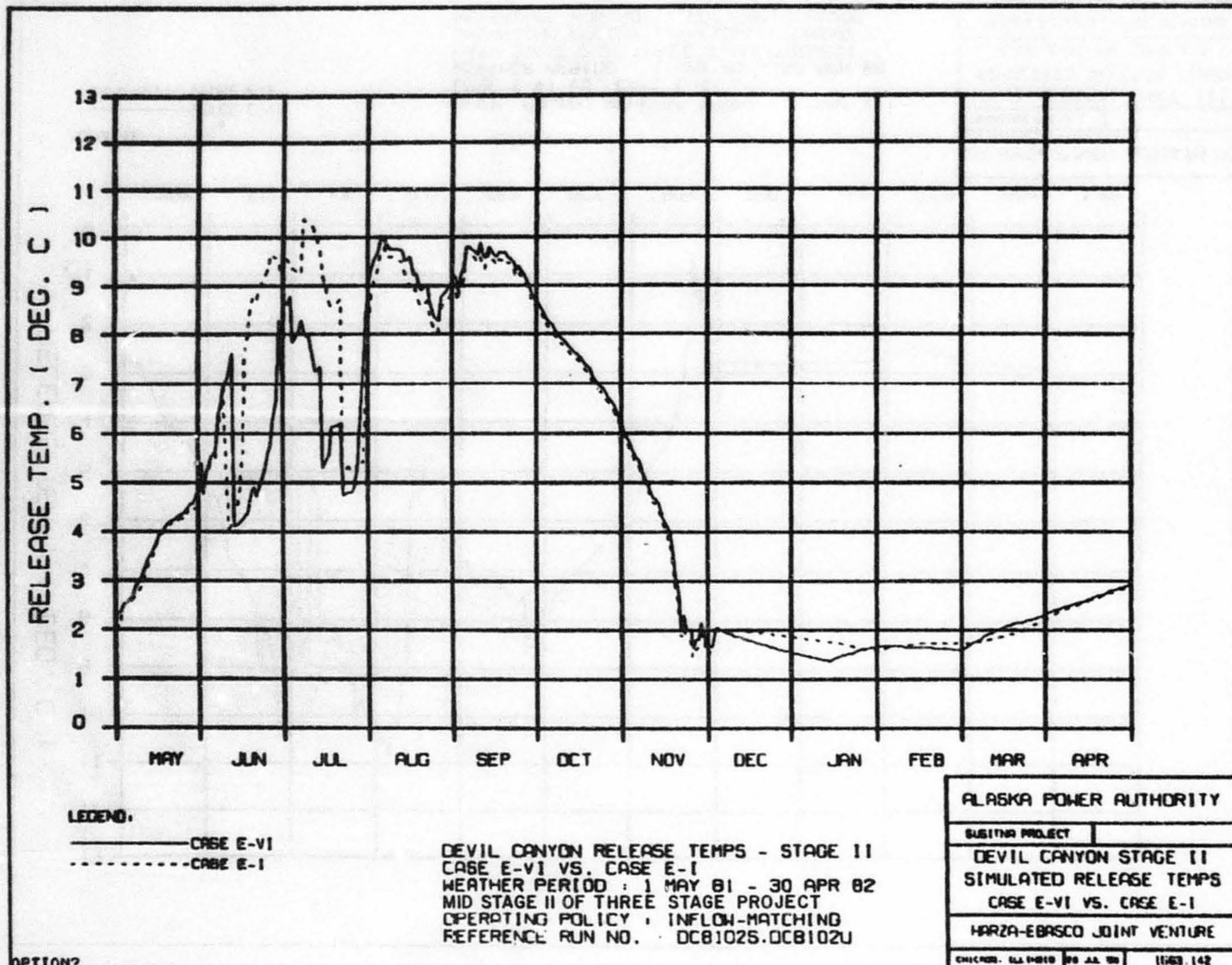
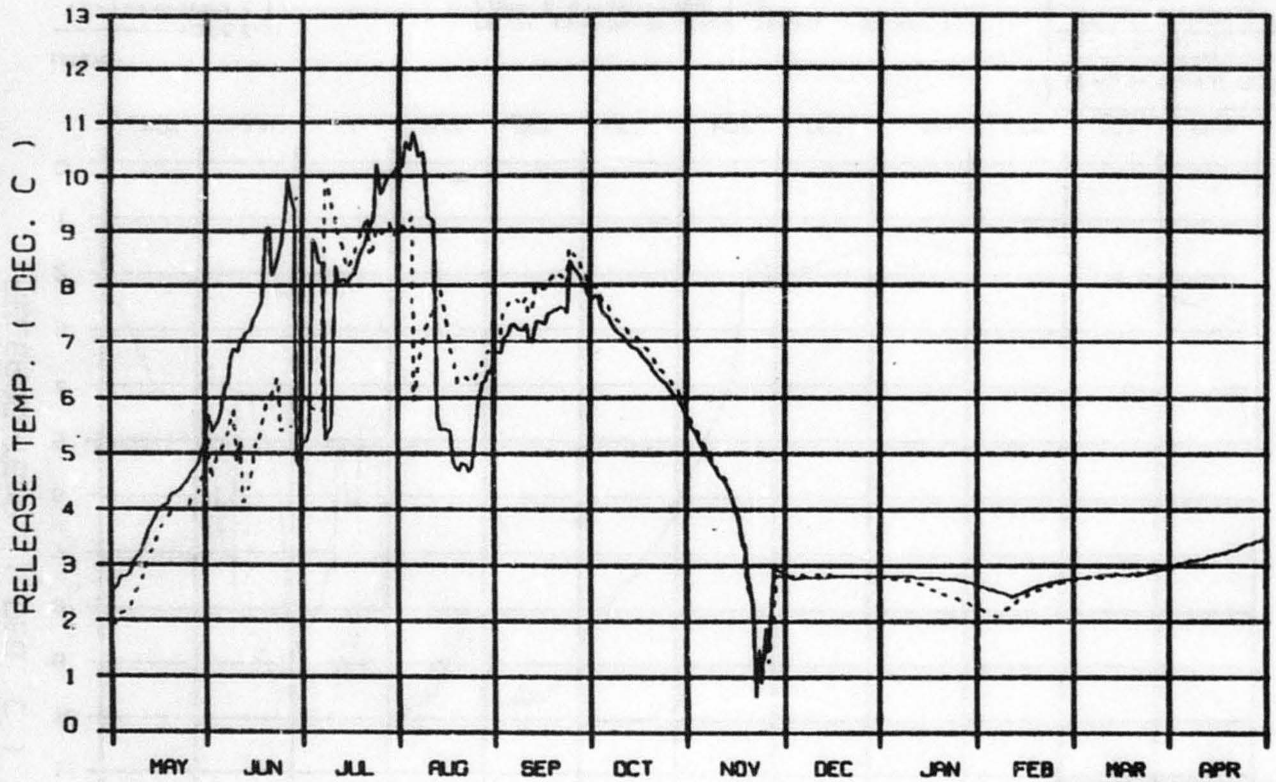

RELEASE TEMP. (DEG. C)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
CASE E-VI
CASE E-I
DEVIL CANYON RELEASE TEMPS - STAGE II
CASE E-VI VS. CASE E-I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
MID STAGE II OF THREE STAGE PROJECT
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. DC81025.DC8102U
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON STAGE II
SIMULATED RELEASE TEMPS
CASE E-VI VS. CASE E-I
HARZA-EBASCO JOINT VENTURE
OPTION?

FIGURE 15



DEVIL CANYON RELEASE TEMPS - STAGE III
CASE E-VI VS. CASE E-I
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
LATE STAGE III OF THREE STAGE PROJECT
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : DC8120E.DC8120D

ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON STAGE III SIMULATED RELEASE TEMPS CASE E-VI VS. CASE E-I
HARZA-EBASCO JOINT VENTURE
1583.142

FIGURE 16

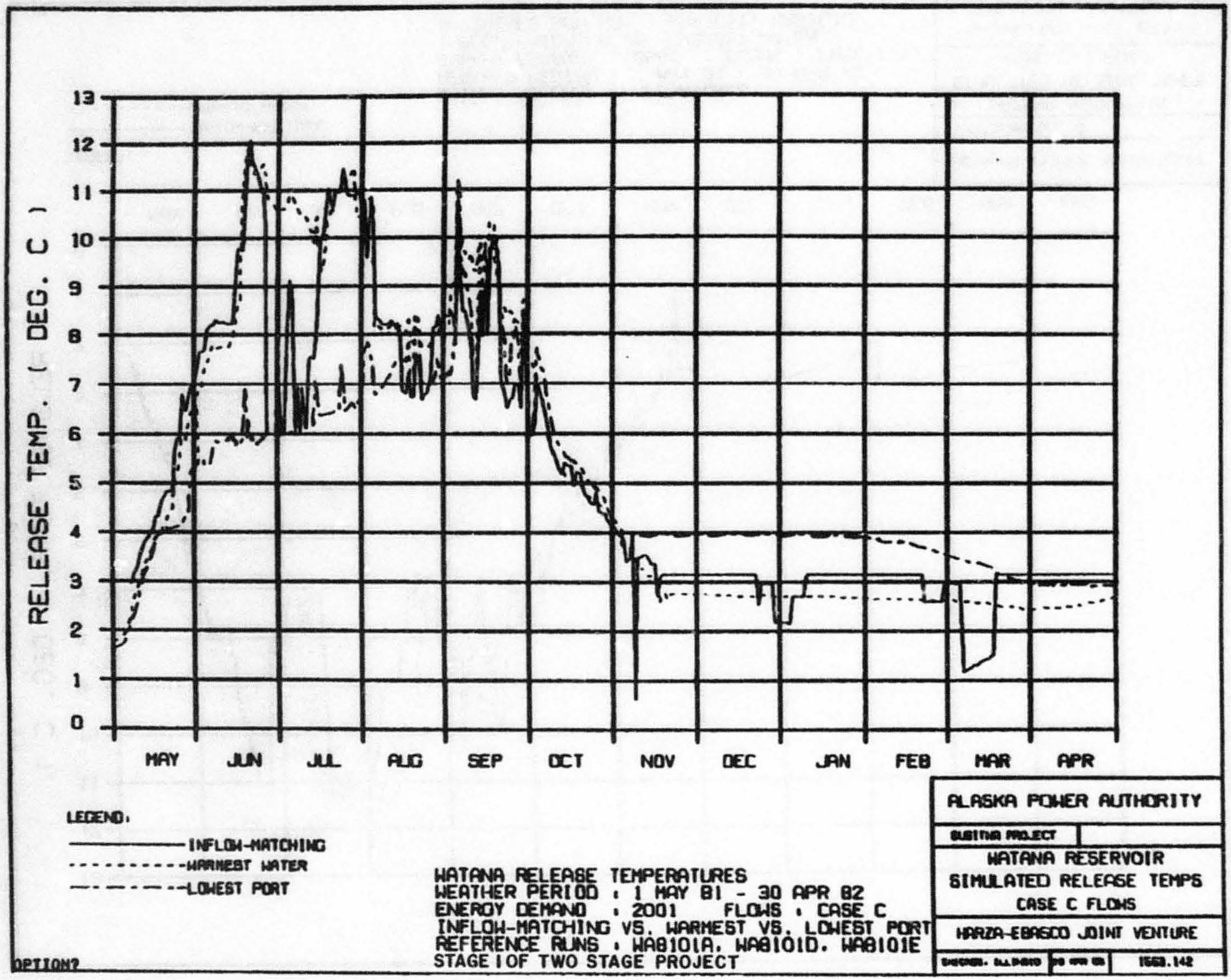
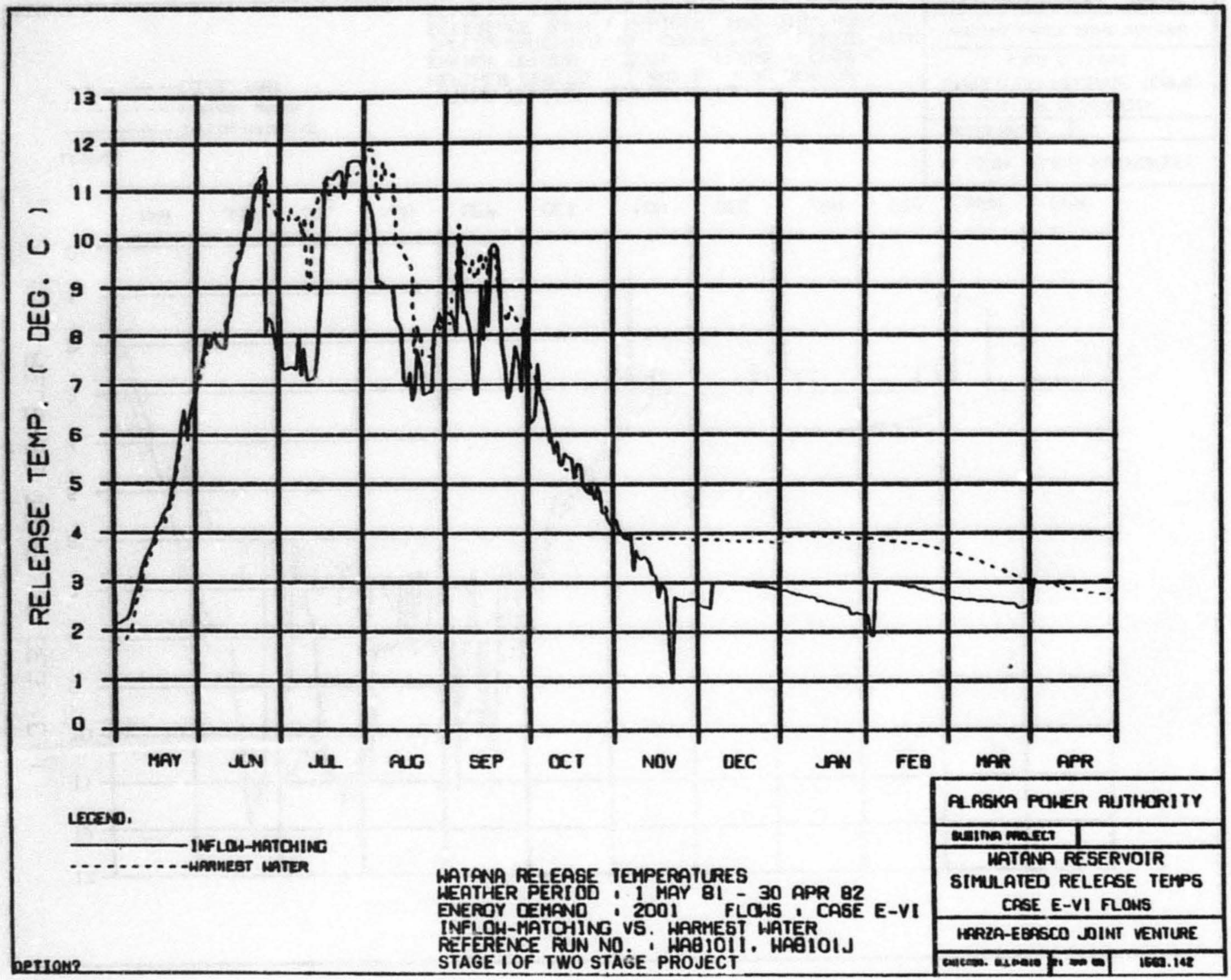

RELEASE TEMP. (DEG. C)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
INFLOW-MATCHING
WARMEST WATER
LOWEST PORT
WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001 FLOWS : CASE C
INFLOW-MATCHING VS. WARMEST VS. LOWEST PORT
REFERENCE RUNS : WA8101A, WA8101D, WA8101E
STAGE I OF TWO STAGE PROJECT
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
SIMULATED RELEASE TEMPS
CASE C FLOWS
HARZA-EBASCO JOINT VENTURE
1563.142
OPTION?

FIGURE 17



RELEASE TEMP. (DEG. C)
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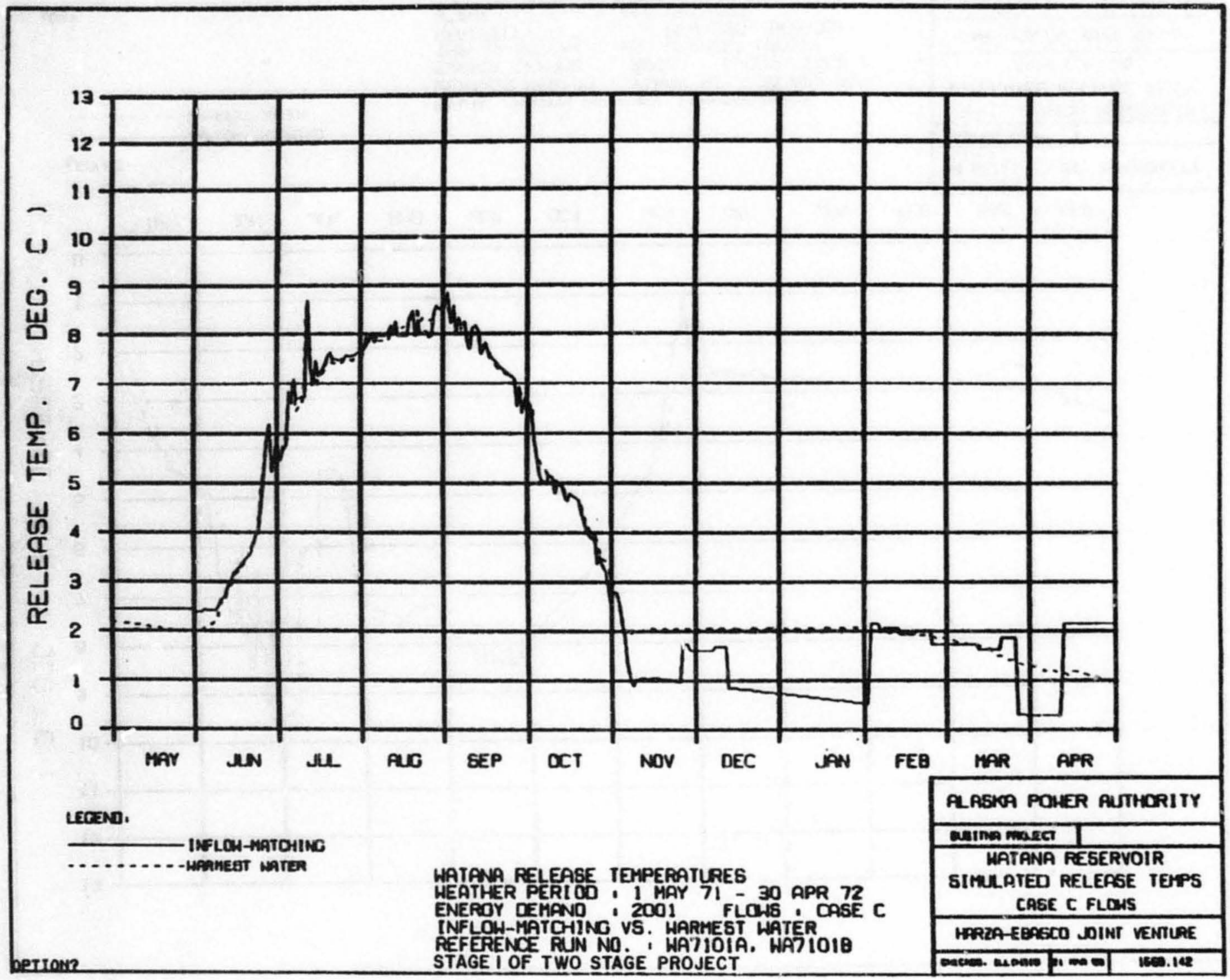
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
INFLOW-MATCHING
WARMEST WATER
WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001 FLOWS : CASE E-VI
INFLOW-MATCHING VS. WARMEST WATER
REFERENCE RUN NO. : WA8101I, WA8101J
STAGE I OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
SIMULATED RELEASE TEMPS
CASE E-VI FLOWS
HARZA-EBASCO JOINT VENTURE
1583.142

FIGURE 18


RELEASE TEMP. (DEG. C)
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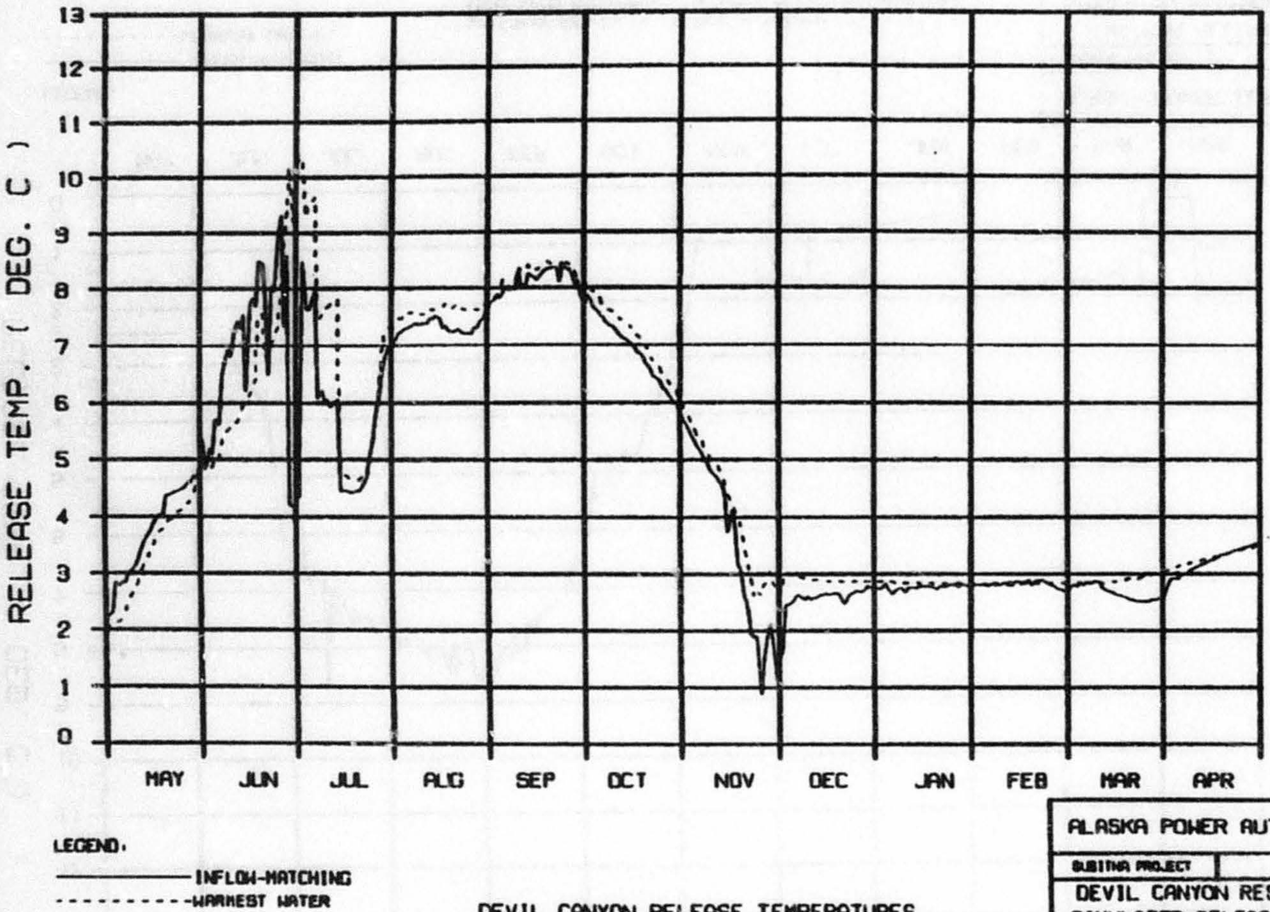
APR
LEGEND:
INFLOW-MATCHING
WARMEST WATER
WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 71 - 30 APR 72
ENERGY DEMAND : 2001 FLOWS : CASE C
INFLOW-MATCHING VS. WARMEST WATER
REFERENCE RUN NO. : WA7101A, WA7101B
STAGE I OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
SIMULATED RELEASE TEMPS
CASE C FLOWS
HARZA-EBASCO JOINT VENTURE

FIGURE 19

C

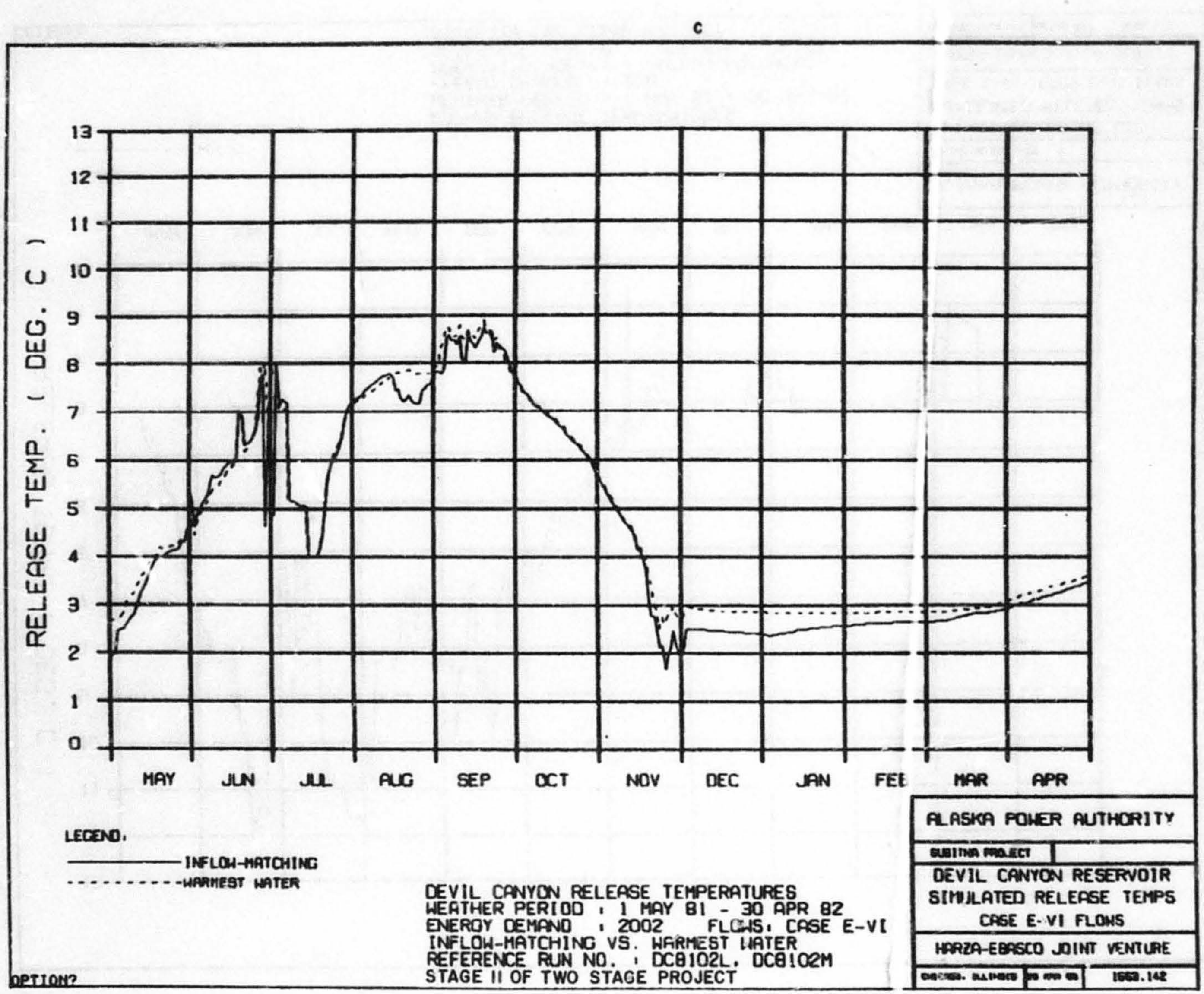


DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS: CASE C
INFLOW-MATCHING VS. WARMEST WATER
REFERENCE RUN NO. : DC8102D, DC8102F
STAGE II OF TWO STAGE PROJECT

OPTION?

ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR SIMULATED RELEASE TEMPS CASE C FLOWS
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS · 20 APR 83 · 1663.142

FIGURE 20


C
RELEASE TEMP. (DEG. C)
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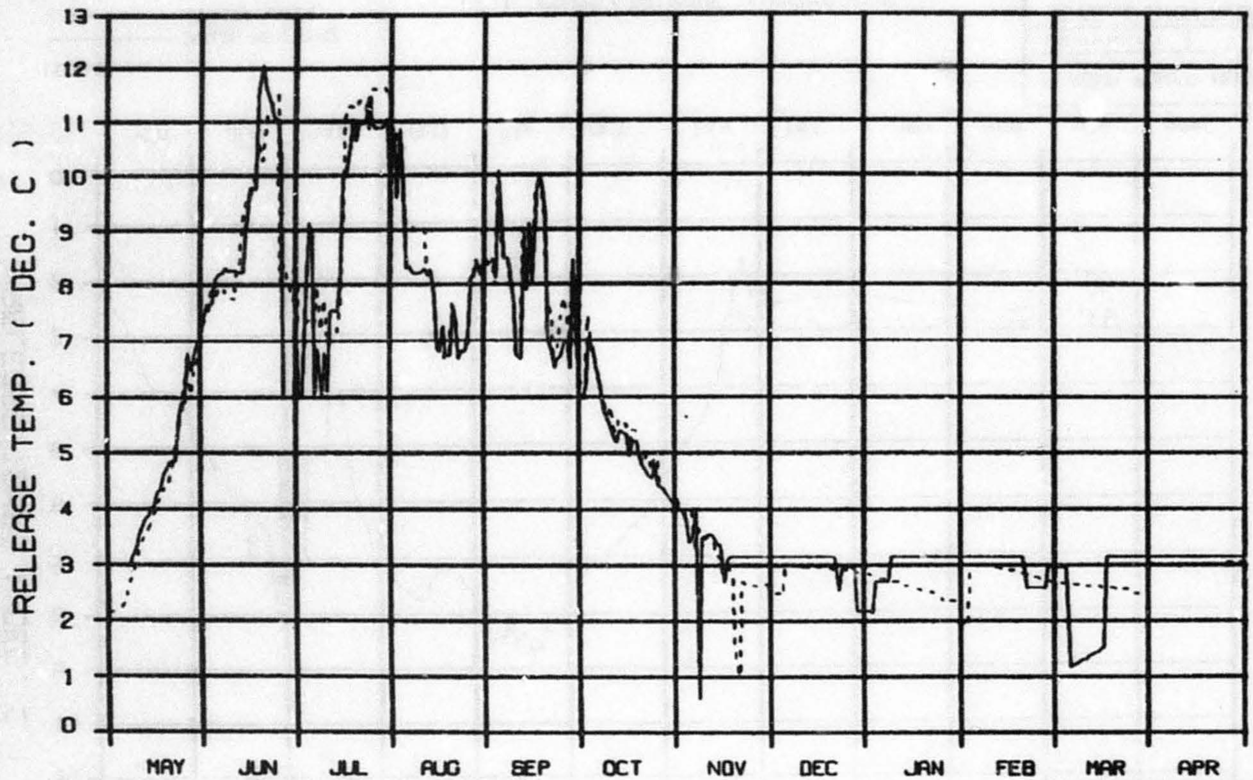
JAN
FEB
MAR
APR
LEGEND:
INFLOW-MATCHING
WARMEST WATER
DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS: CASE E-VI
INFLOW-MATCHING VS. WARMEST WATER
REFERENCE RUN NO. : DC8102L, DC8102M
STAGE II OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR
SIMULATED RELEASE TEMPS
CASE E-VI FLOWS
HARZA-EBASCO JOINT VENTURE

FIGURE 21

C



LEGEND:

———— CASE C

- - - - - - CASE E-VI

WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : WA8101A, WA8101I
STAGE I OF TWO STAGE PROJECT

OPTION?

ALASKA POWER AUTHORITY

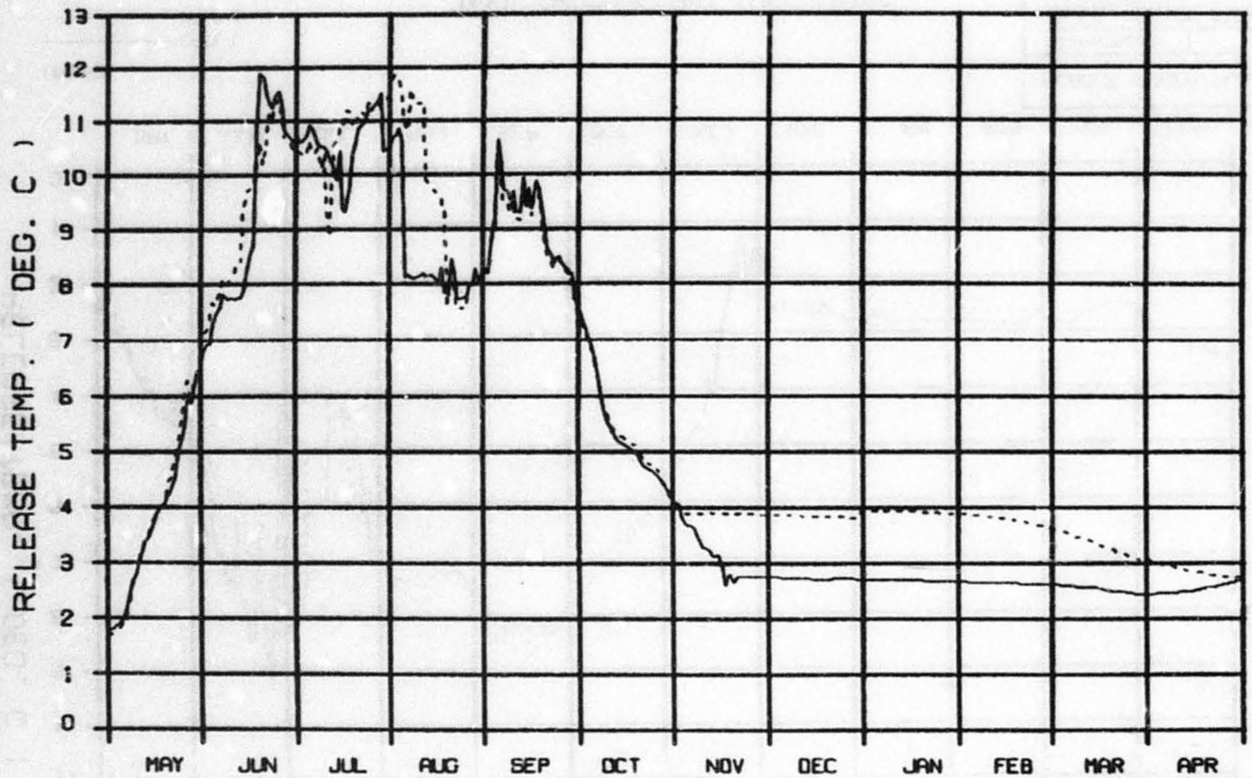
SUSITNA PROJECT

WATANA RESERVOIR
SIMULATED RELEASE TEMPS
CASE C VS. CASE E-VI FLOWS

HARZA-EBASCO JOINT VENTURE

FIGURE 22

c



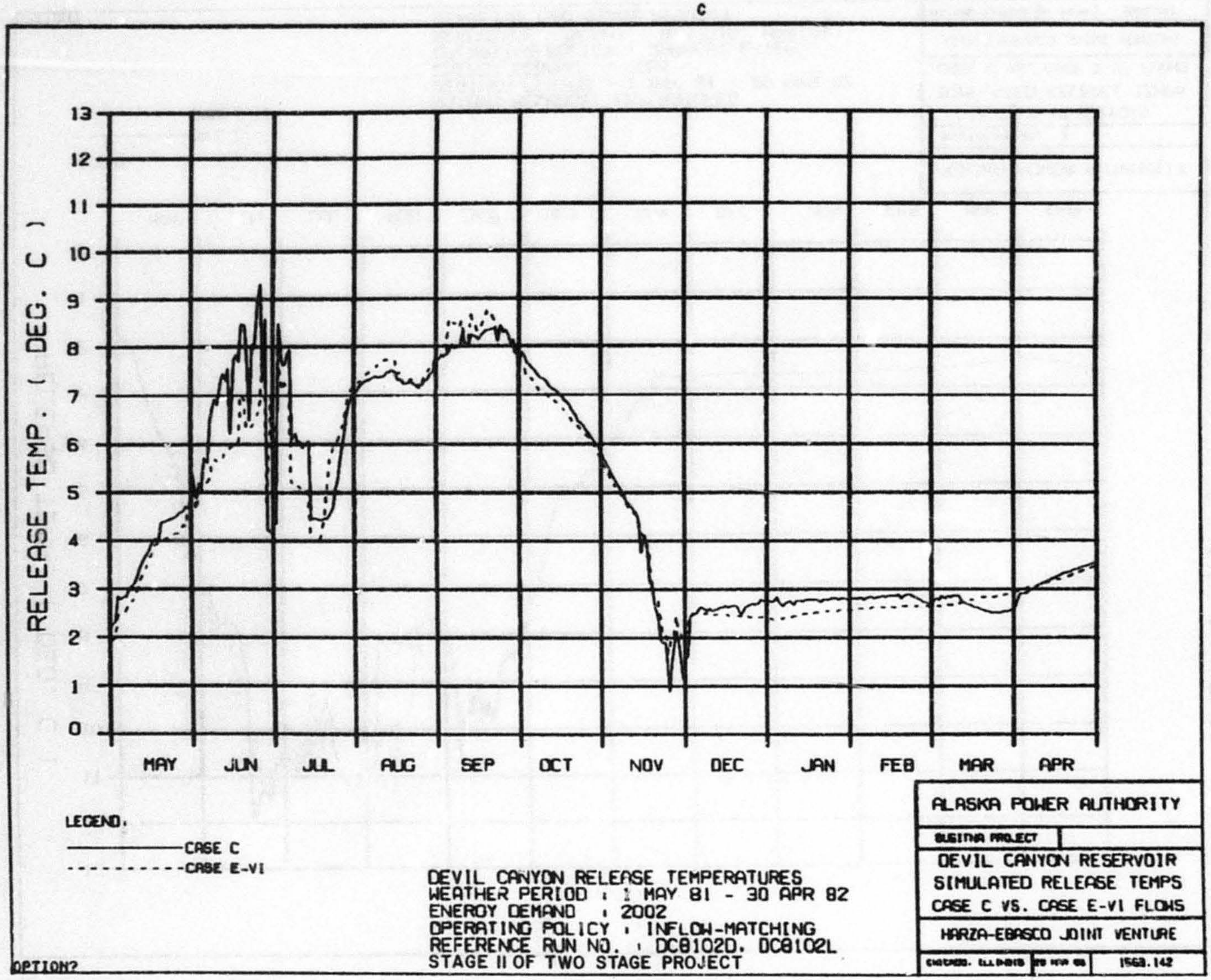
LEGEND:
———— CASE C
- - - - - CASE E-VI

WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001
OPERATING POLICY : WARMEST WATER
REFERENCE RUN NO. : WA8101D, WA8101J
STAGE I OF TWO STAGE PROJECT

OPTION?

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
WATANA RESERVOIR SIMULATED RELEASE TEMPS CASE C VS. CASE E-VI FLOWS		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	[illegible]	1563.142

FIGURE 23


C
RELEASE TEMP. (DEG. C)
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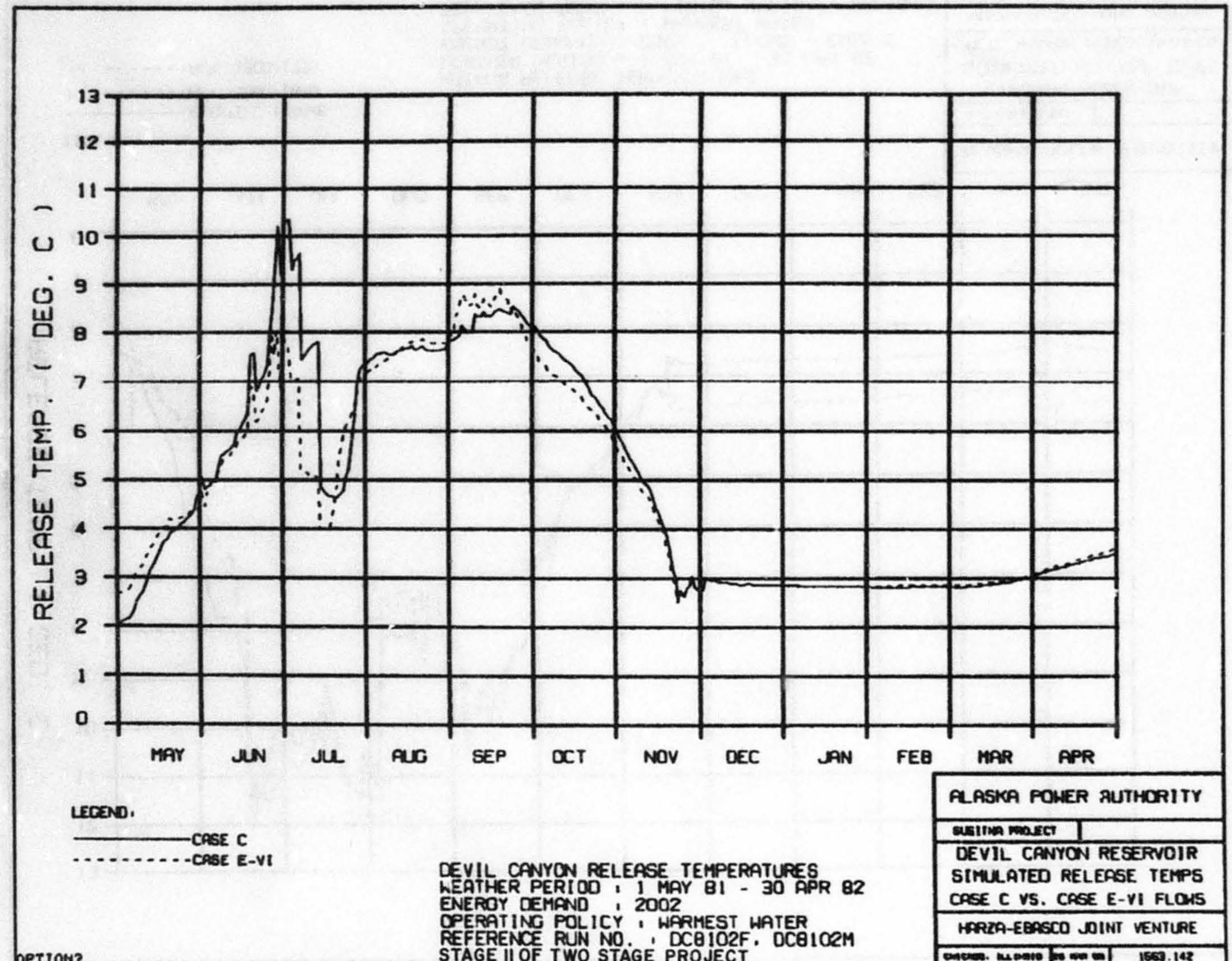
MAR
APR
LEGEND.
CASE C
CASE E-VI
DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002
OPERATING POLICY : INFLOW-MATCHING
REFERENCE RUN NO. : DC8102D, DC8102L
STAGE II OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR
SIMULATED RELEASE TEMPS
CASE C VS. CASE E-VI FLOWS
HARZA-EBASCO JOINT VENTURE
1568.142

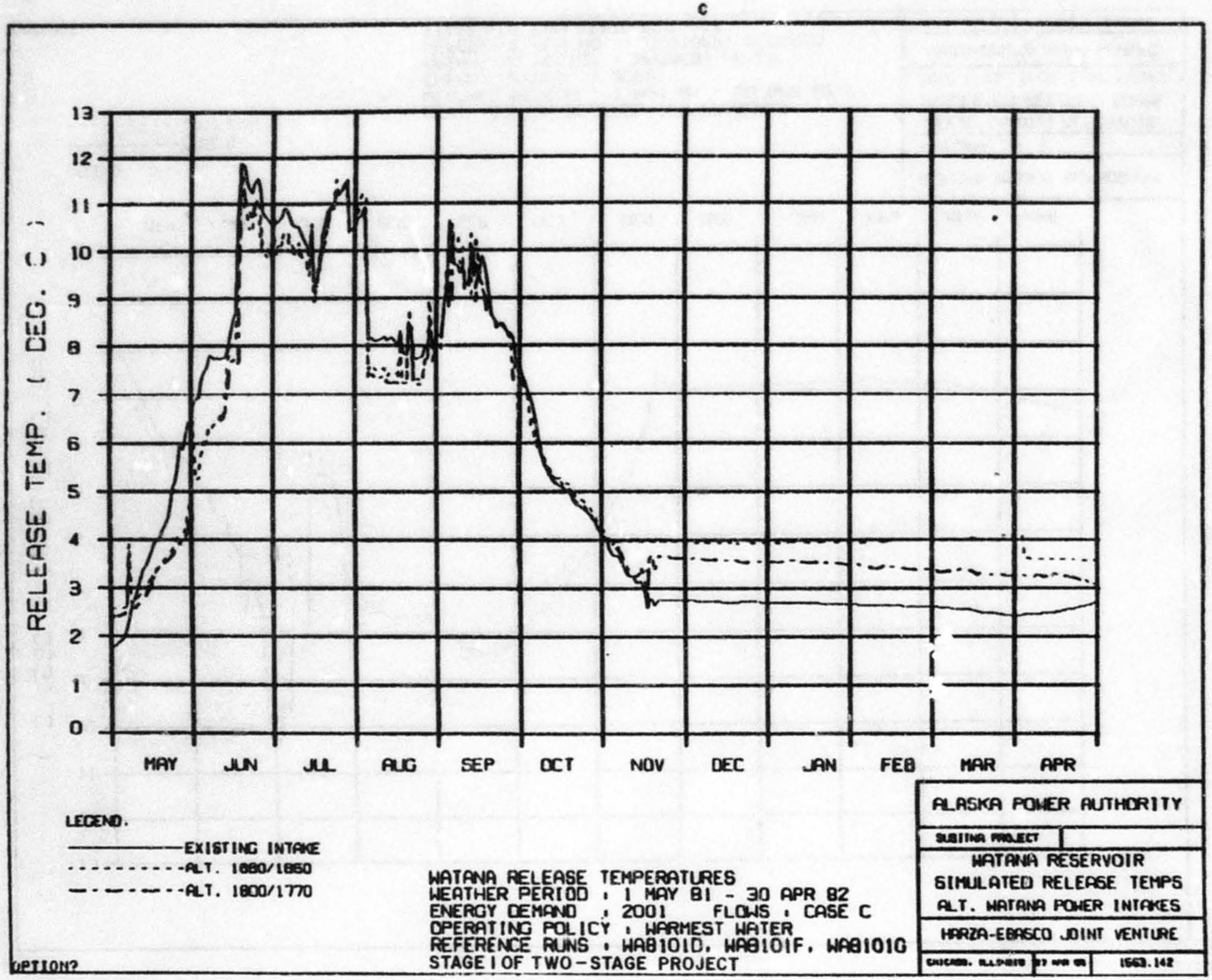
FIGURE 24



DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002
OPERATING POLICY : WARMEST WATER
REFERENCE RUN NO. : DC8102F, DC8102M
STAGE II OF TWO STAGE PROJECT

ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR SIMULATED RELEASE TEMPS CASE C VS. CASE E-VI FLOWS
HARZA-EBASCO JOINT VENTURE
1563.142

FIGURE 25


C
RELEASE TEMP. (DEG. C)
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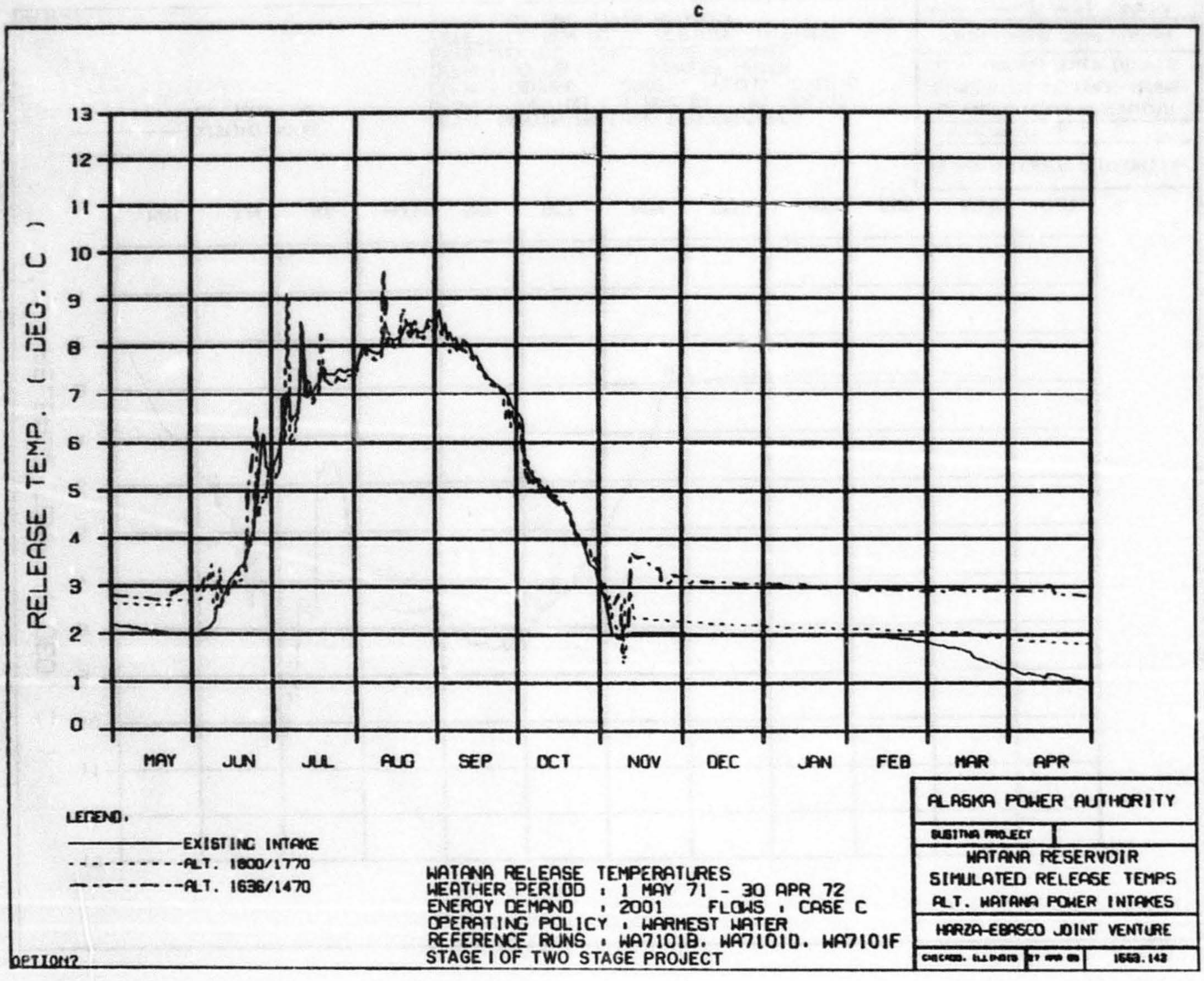
APR
LEGEND.
EXISTING INTAKE
ALT. 1880/1850
ALT. 1800/1770
WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2001 FLOWS : CASE C
OPERATING POLICY : WARMEST WATER
REFERENCE RUNS : WA8101D, WA8101F, WA8101G
STAGE I OF TWO-STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
SIMULATED RELEASE TEMPS
ALT. WATANA POWER INTAKES
HARZA-EBASCO JOINT VENTURE
1563.142

FIGURE 26



C
RELEASE TEMP. (DEG. C)
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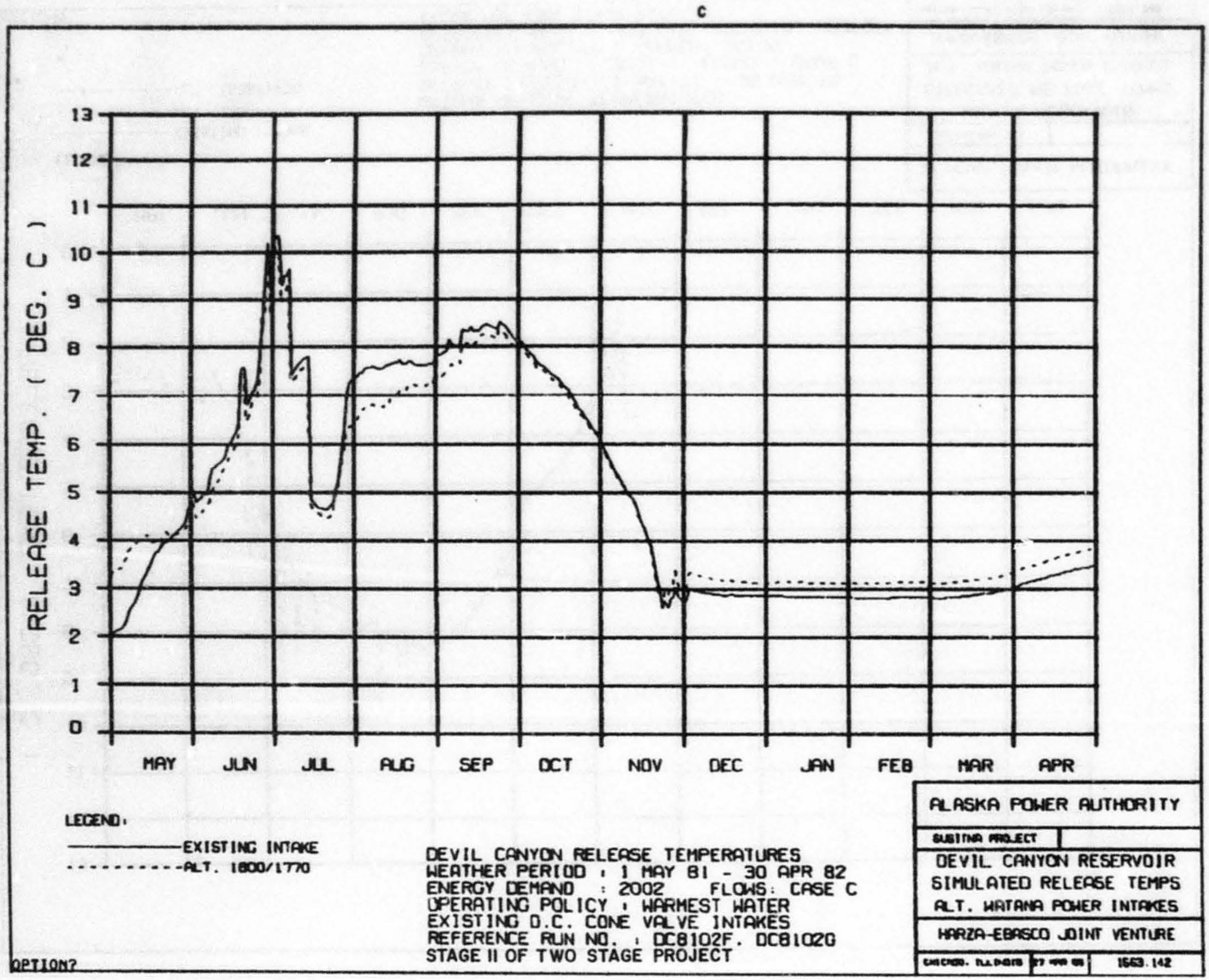
FEB
MAR
APR
LEGEND:
EXISTING INTAKE
ALT. 1800/1770
ALT. 1636/1470
WATANA RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 71 - 30 APR 72
ENERGY DEMAND : 2001 FLOWS : CASE C
OPERATING POLICY : WARMEST WATER
REFERENCE RUNS : WA7101B, WA7101D, WA7101F
STAGE I OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
WATANA RESERVOIR
SIMULATED RELEASE TEMPS
ALT. WATANA POWER INTAKES
HARZA-EBASCO JOINT VENTURE

FIGURE 27


C
RELEASE TEMP. (DEG. C)
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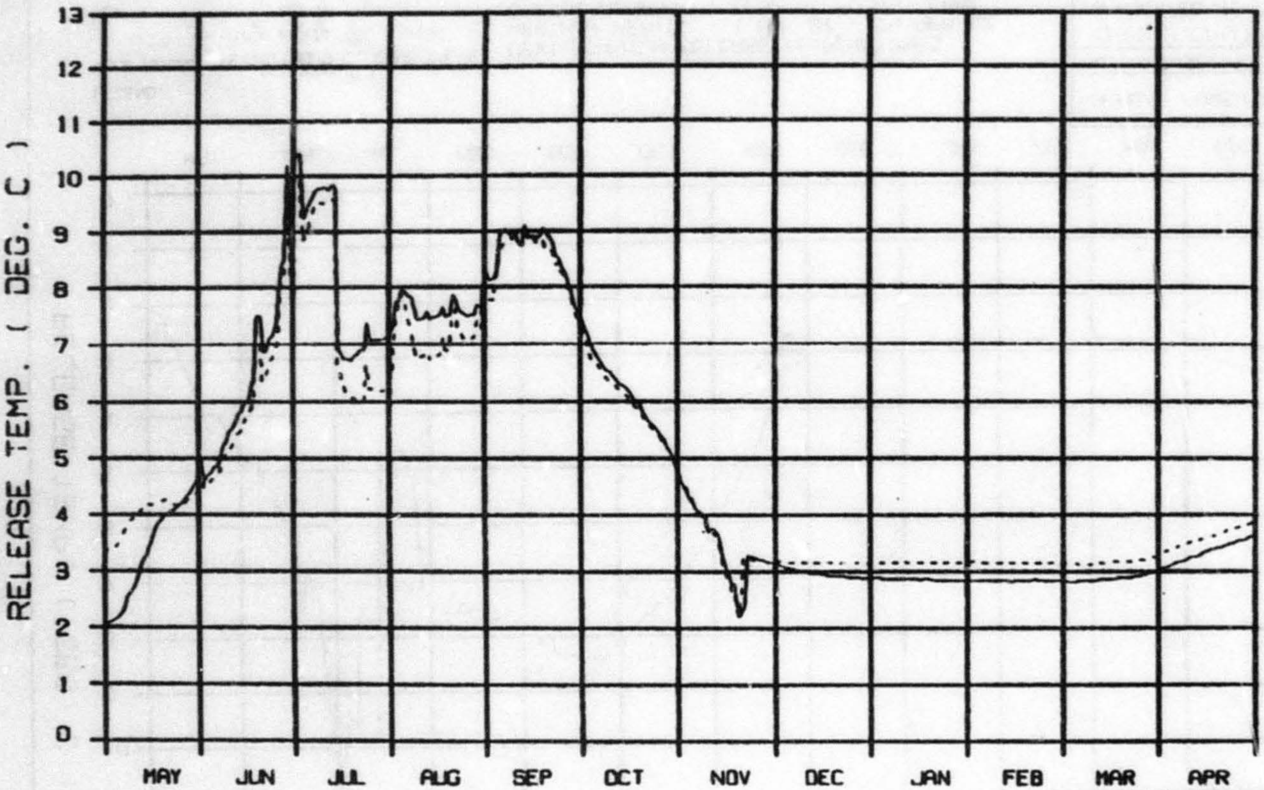
APR
LEGEND:
EXISTING INTAKE
ALT. 1800/1770
DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS: CASE C
OPERATING POLICY : WARMEST WATER
EXISTING D.C. CONE VALVE INTAKES
REFERENCE RUN NO. : DC8102F. DC8102G
STAGE II OF TWO STAGE PROJECT
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR
SIMULATED RELEASE TEMPS
ALT. WATANA POWER INTAKES
HARZA-EBASCO JOINT VENTURE
1563.142
OPTION?

FIGURE 28



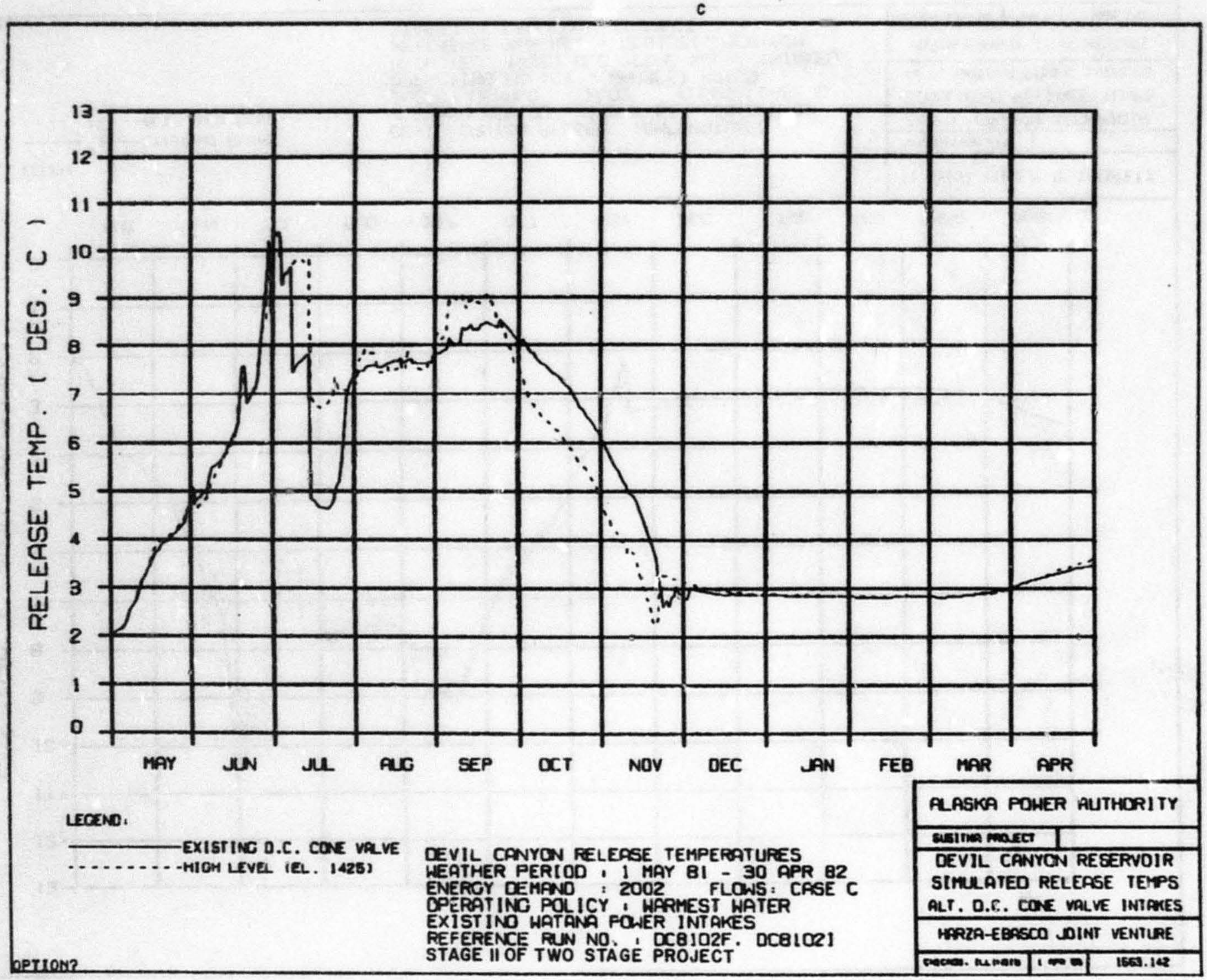
LEGEND:
——— EXISTING INTAKE
- - - - ALT. 1800/1770

DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS: CASE C
OPERATING POLICY : WARMEST WATER
HIGH (EL. 1425) D.C. CONE VALVE INTAKES
REFERENCE RUN NO. : DC81021. DC8102H
STAGE II OF TWO STAGE PROJECT

OPTION?

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
DEVIL CANYON RESERVOIR SIMULATED RELEASE TEMPS ALT. WATANA POWER INTAKES		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	27 APR 83	1563.142

FIGURE 29


C
RELEASE TEMP. (DEG. C)
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JAN
FEB
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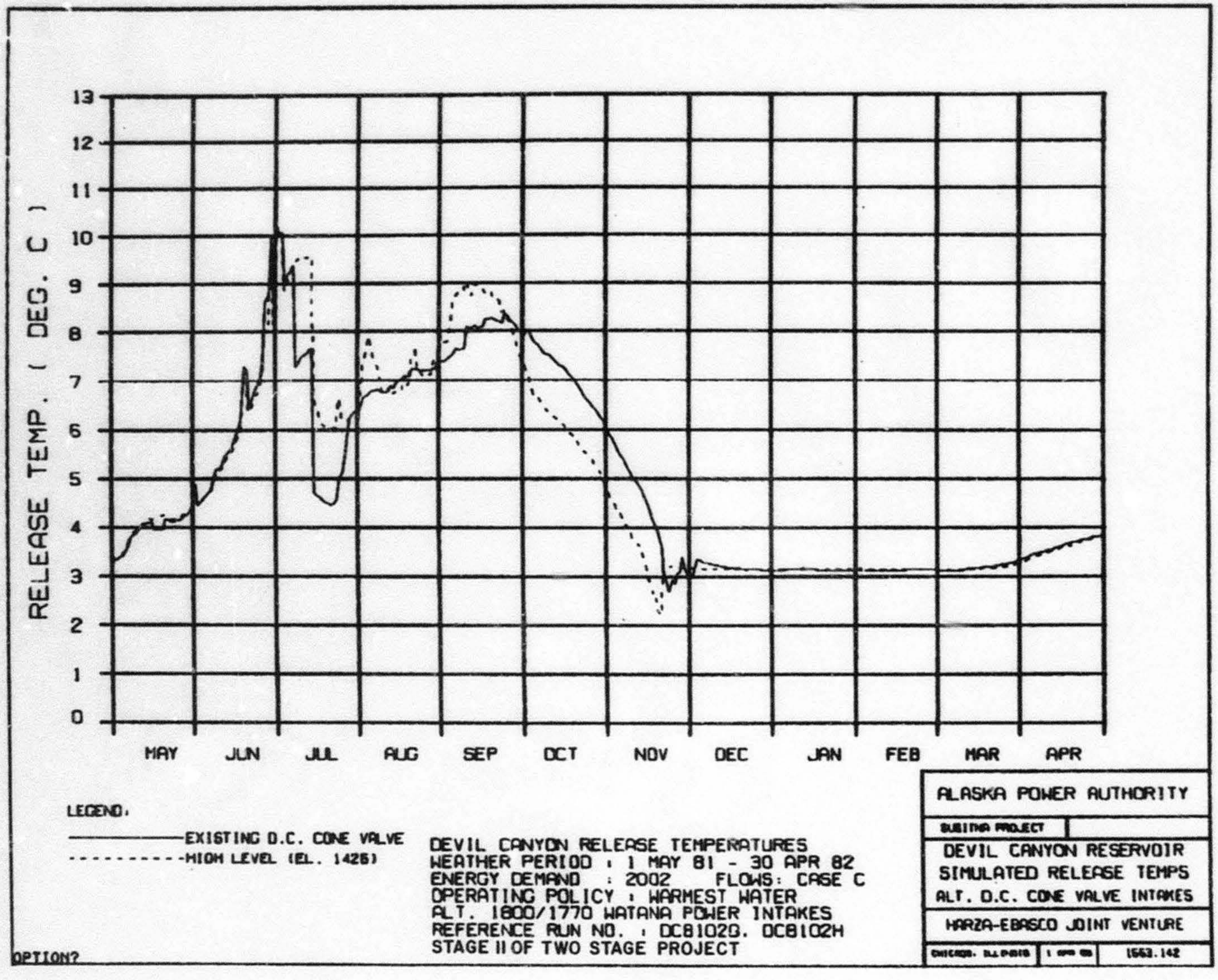
APR
LEGEND:
EXISTING D.C. CONE VALVE
HIGH LEVEL (EL. 1425)
DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS: CASE C
OPERATING POLICY : WARMEST WATER
EXISTING WATANA POWER INTAKES
REFERENCE RUN NO. : DC8102F. DC8102I
STAGE II OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DEVIL CANYON RESERVOIR
SIMULATED RELEASE TEMPS
ALT. D.C. CONE VALVE INTAKES
HARZA-EBASCO JOINT VENTURE
1563.142

FIGURE 30

C



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RELEASE TEMP. (DEG. C)
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FEB
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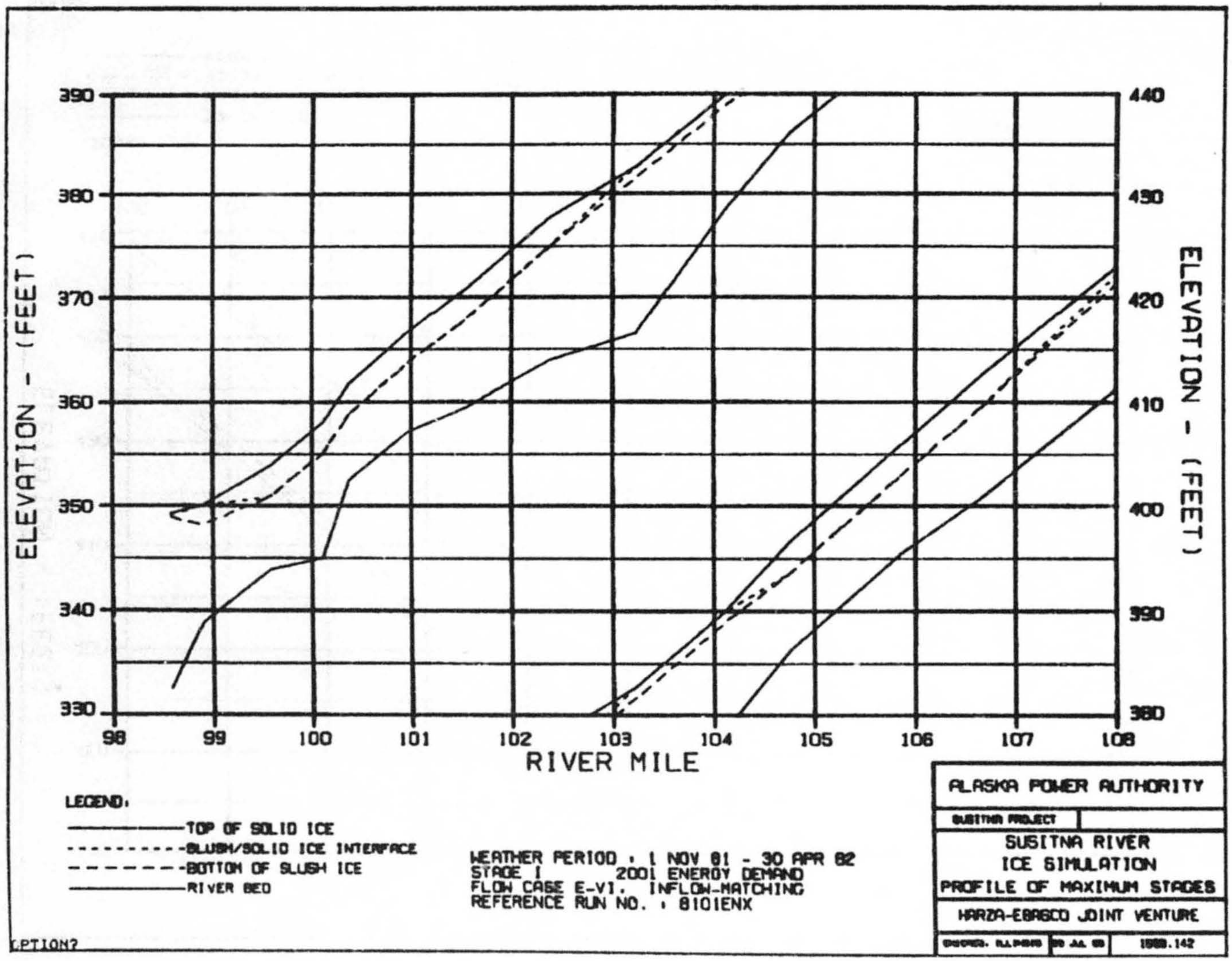
APR
LEGEND:
EXISTING D.C. CONE VALVE
HIGH LEVEL (EL. 1426)
DEVIL CANYON RELEASE TEMPERATURES
WEATHER PERIOD : 1 MAY 81 - 30 APR 82
ENERGY DEMAND : 2002 FLOWS: CASE C
OPERATING POLICY : WARMEST WATER
ALT. 1800/1770 WATANA POWER INTAKES
REFERENCE RUN NO. : DC8102G. DC8102H
STAGE II OF TWO STAGE PROJECT
OPTION?
ALASKA POWER AUTHORITY
DEVIL CANYON RESERVOIR
SIMULATED RELEASE TEMPS
ALT. D.C. CONE VALVE INTAKES
HARZA-EBASCO JOINT VENTURE
1563.142

FIGURE 31

EXHIBITS

EXHIBIT A



390
380
370
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410
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390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
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102
103
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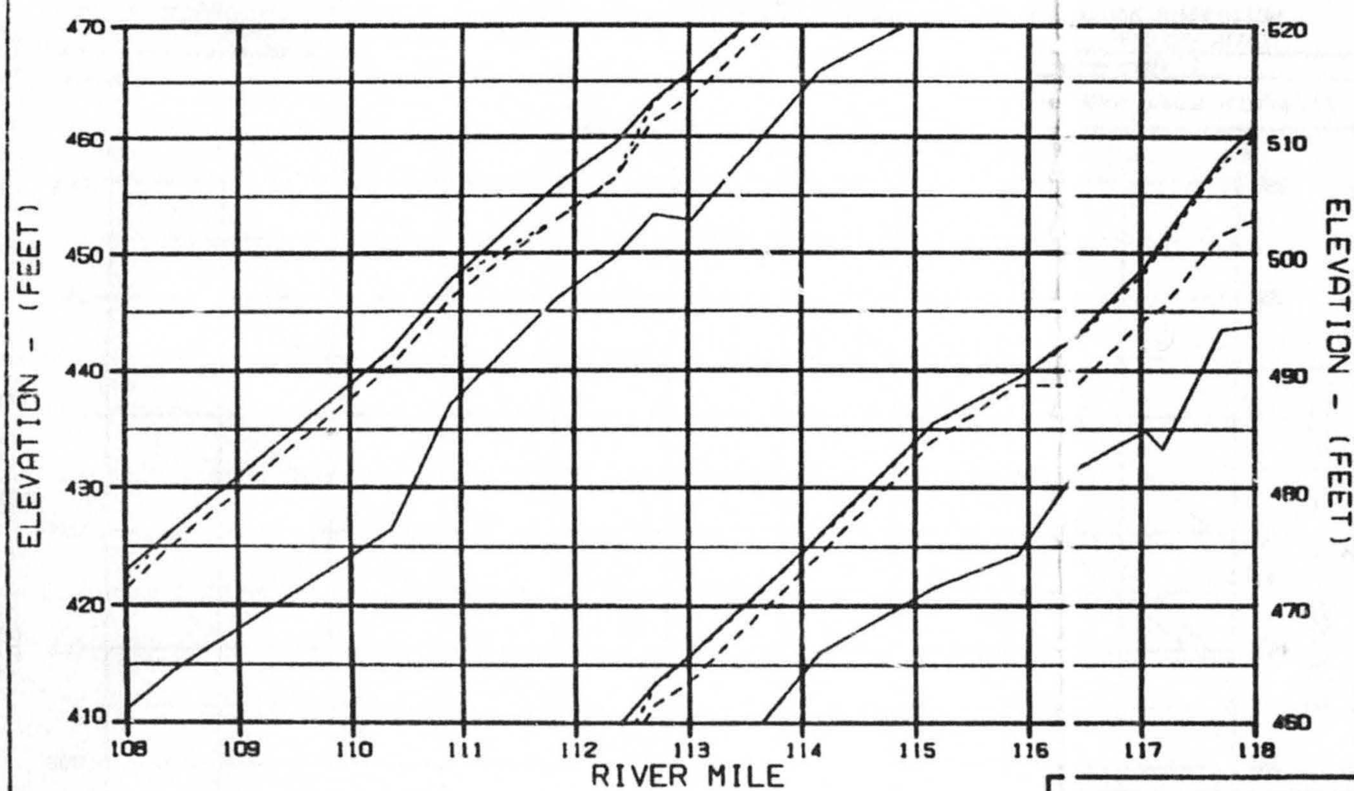
105
106
107
108
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

c



LEGEND:

- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

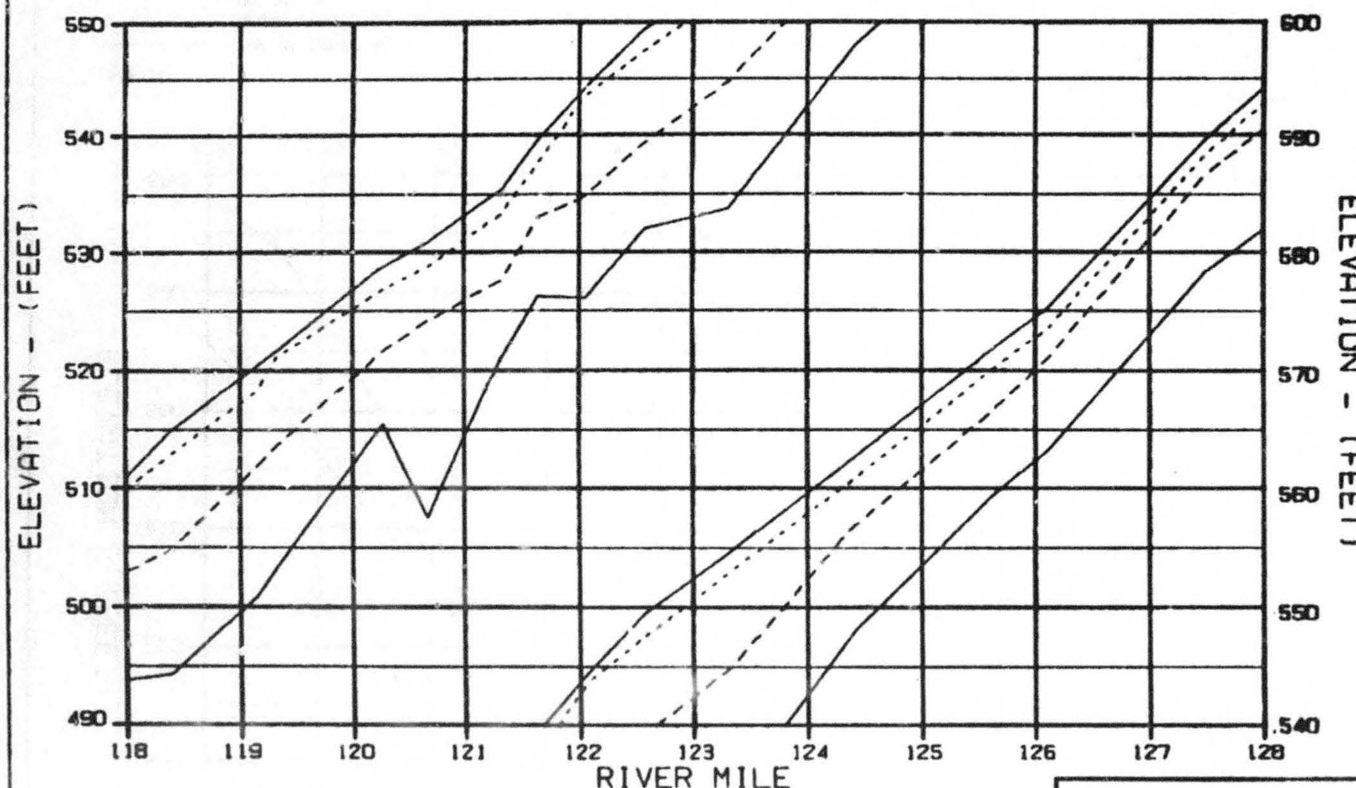
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

1668.142

OPTION?

c



LEGEND:

- ———— TOP OF SOLID ICE
- - - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	[illegible]	1060.142

OPTION?

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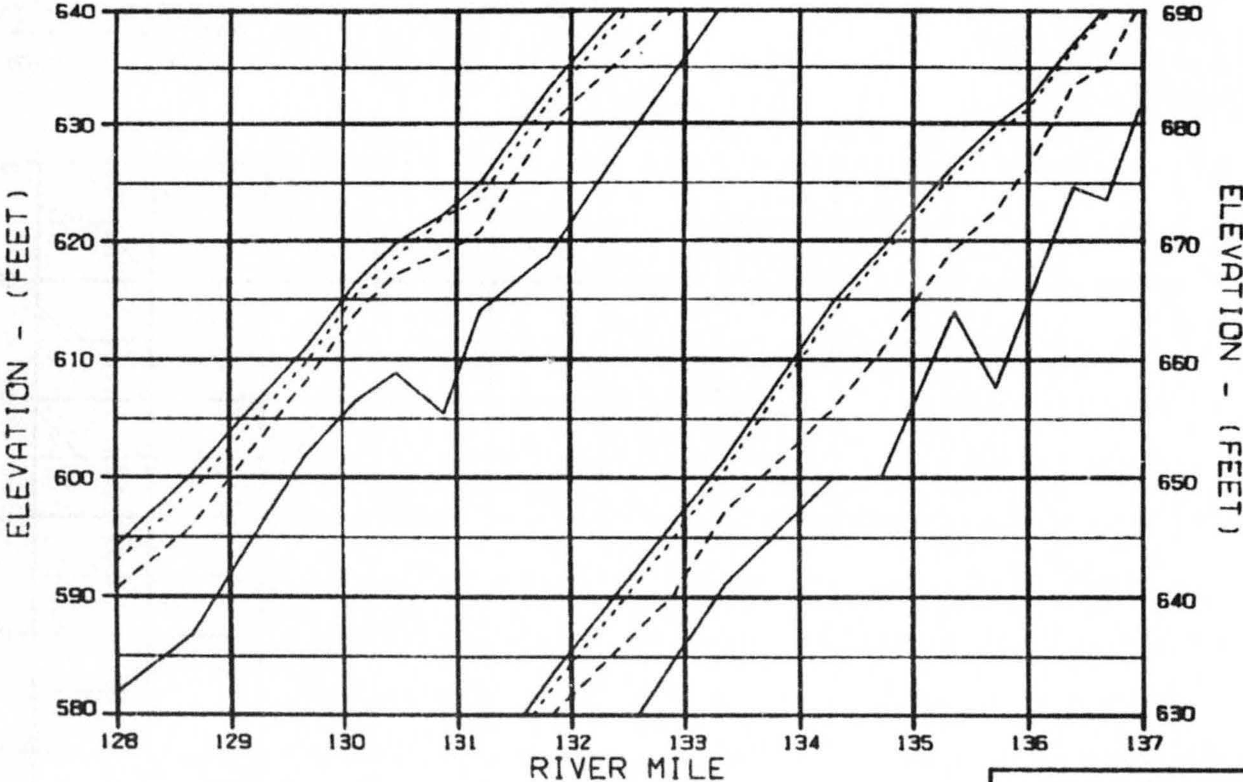


LEGEND:

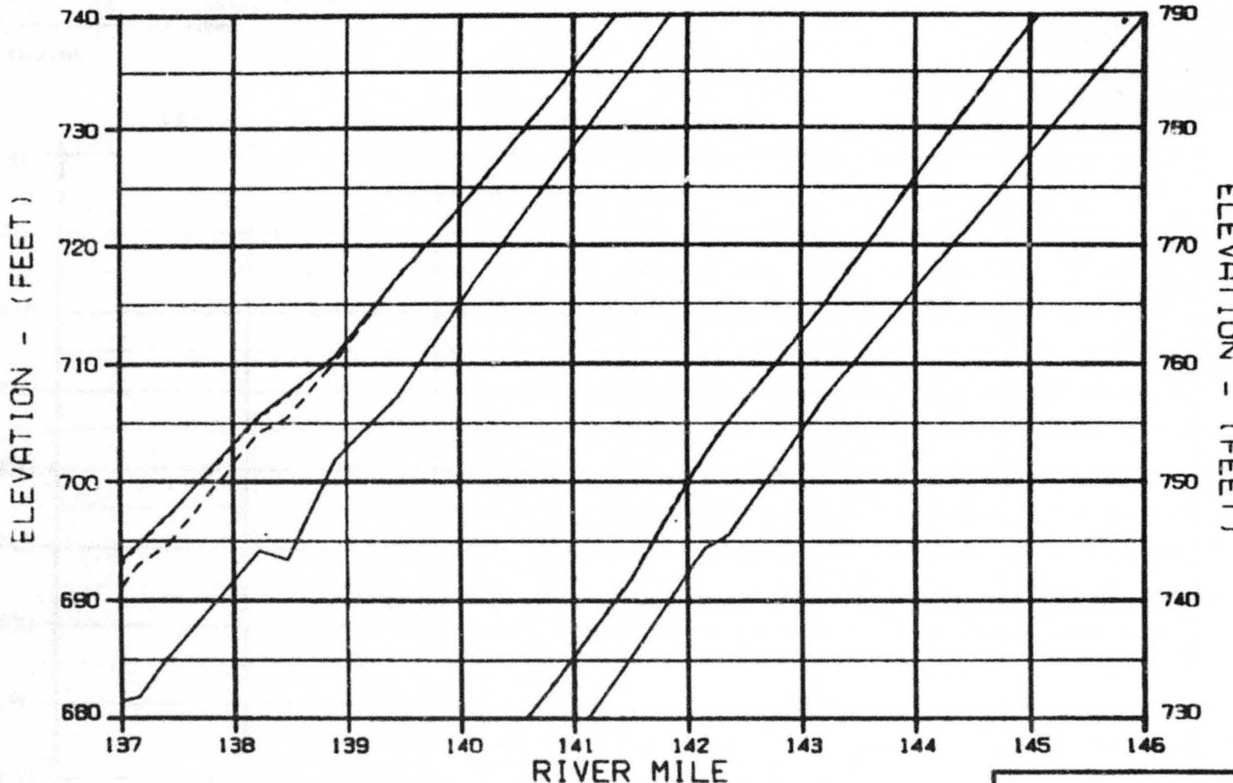
- TOP OF SOLID ICE
- SLUSH/SOLID ICE INTERFACE
- BOTTOM OF SLUSH ICE
- RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES	
HARZA-EBASCO JOINT VENTURE	
1503.142	

OPTI.117

c

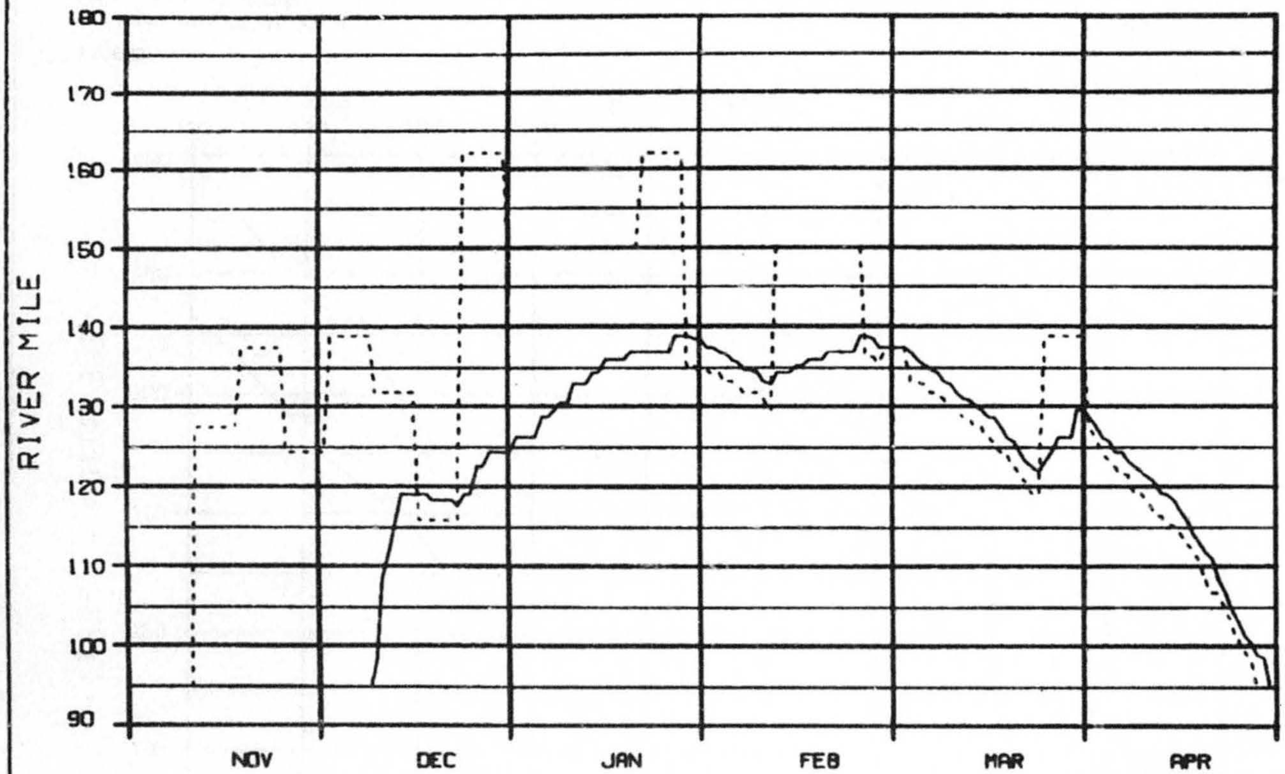


LEGEND:

- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES	
HARZA-EBASCO JOINT VENTURE	
1888.142	



LEGEND:

——— ICE FRONT

- - - - - ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-VI . INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY

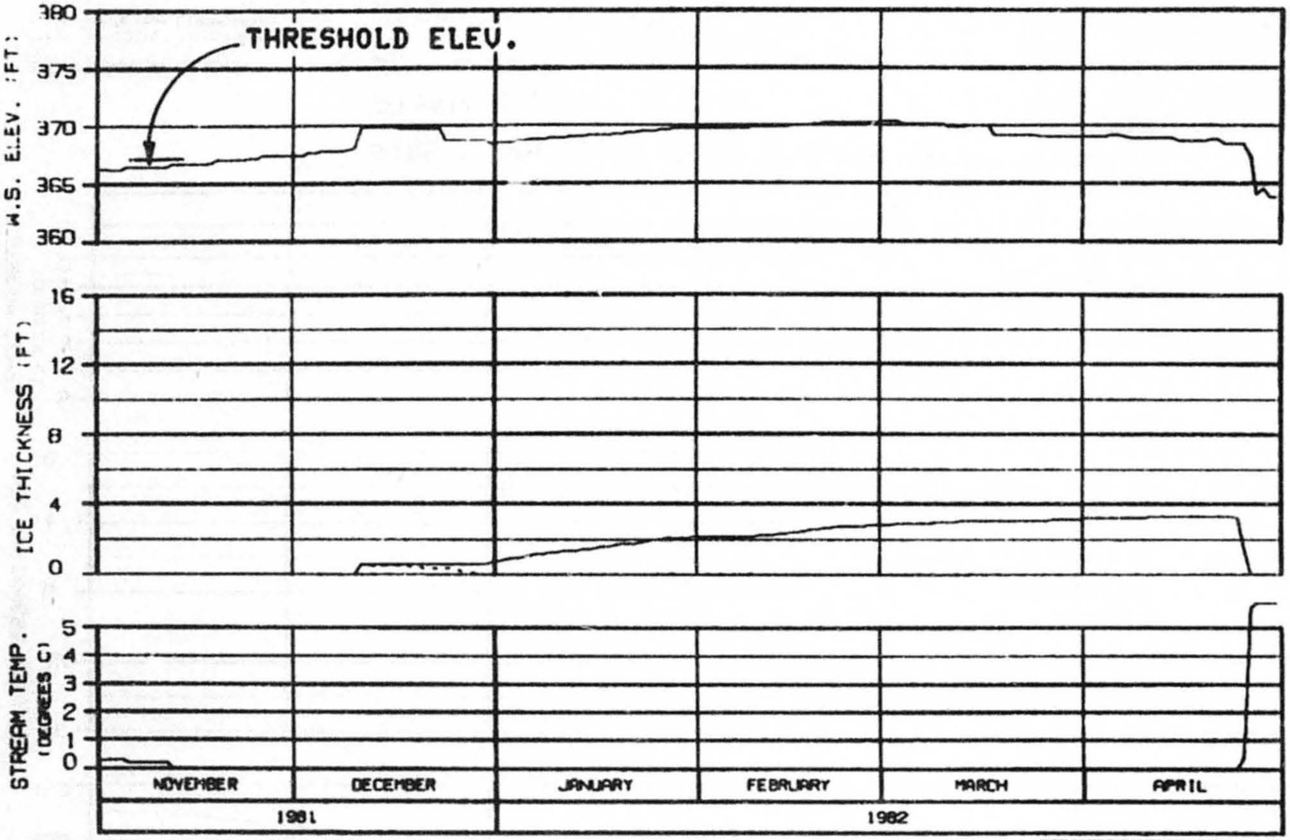
SUSITNA PROJECT

SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM

HARZA-EBASCO JOINT VENTURE

1588.142

OPTION?



HEAD OF WHISKERS SLOUGH

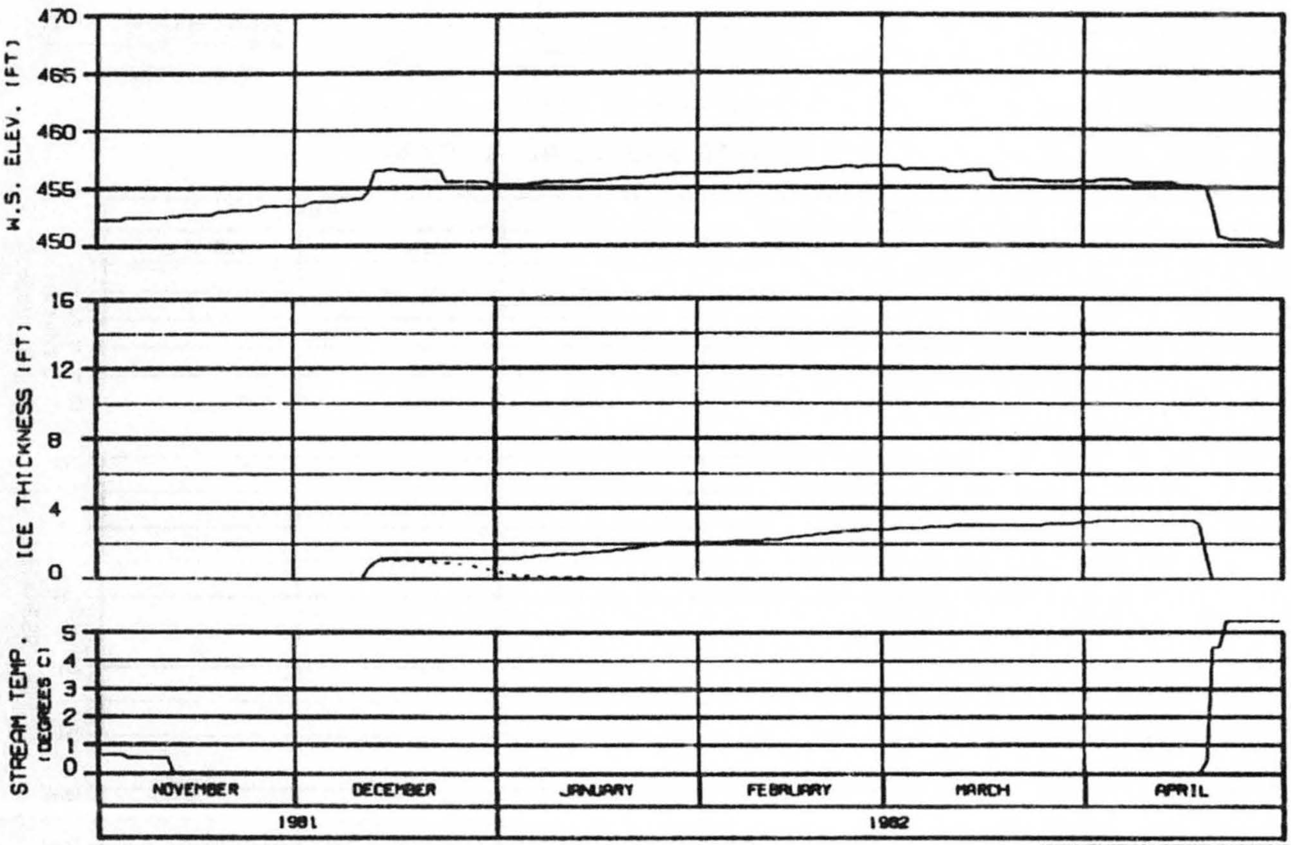
RIVER MILE : 101.50

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | JUL 85 | 1563.142



SIDE CHANNEL AT HEAD OF GASH CREEK

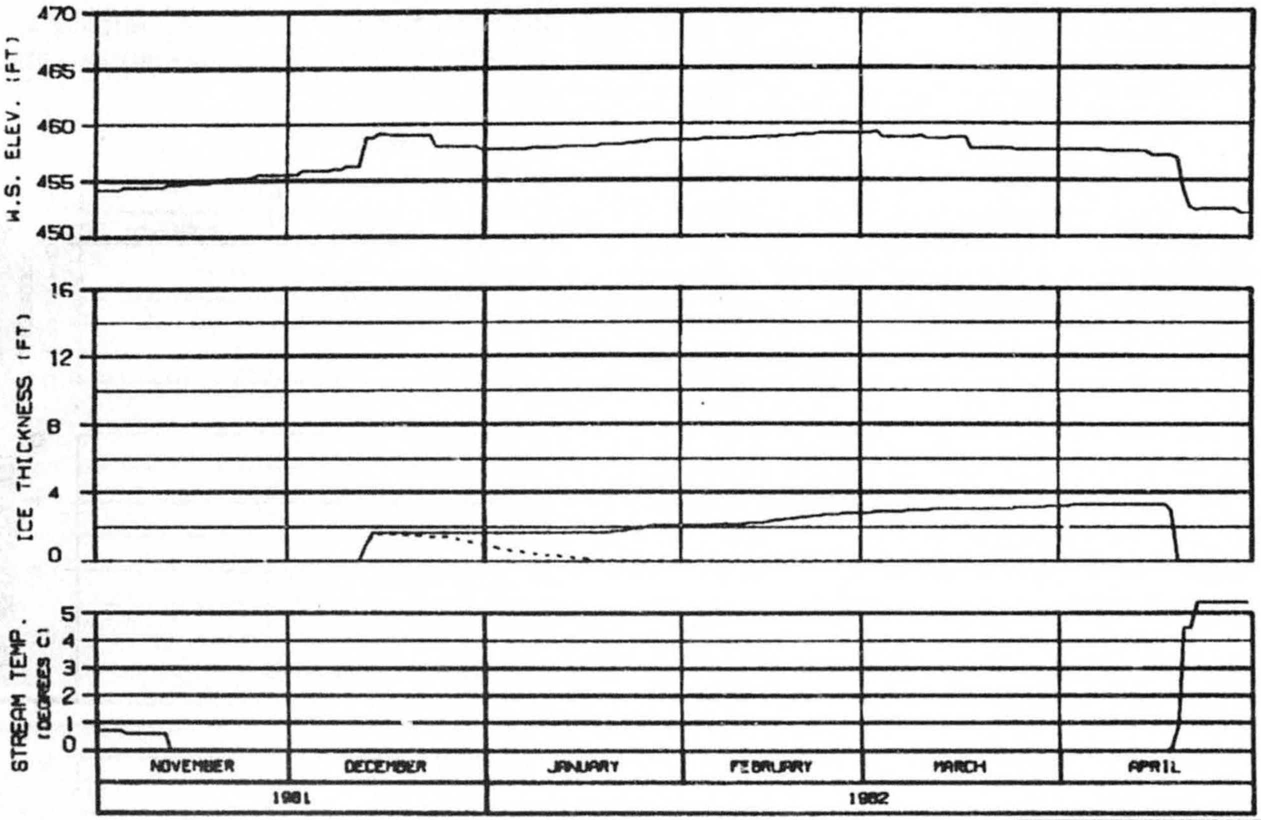
RIVER MILE : 112.00

WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ICE THICKNESS LEGEND:

———— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS · 29 JUL 85	1603.142



MOUTH OF SLOUGH 6A

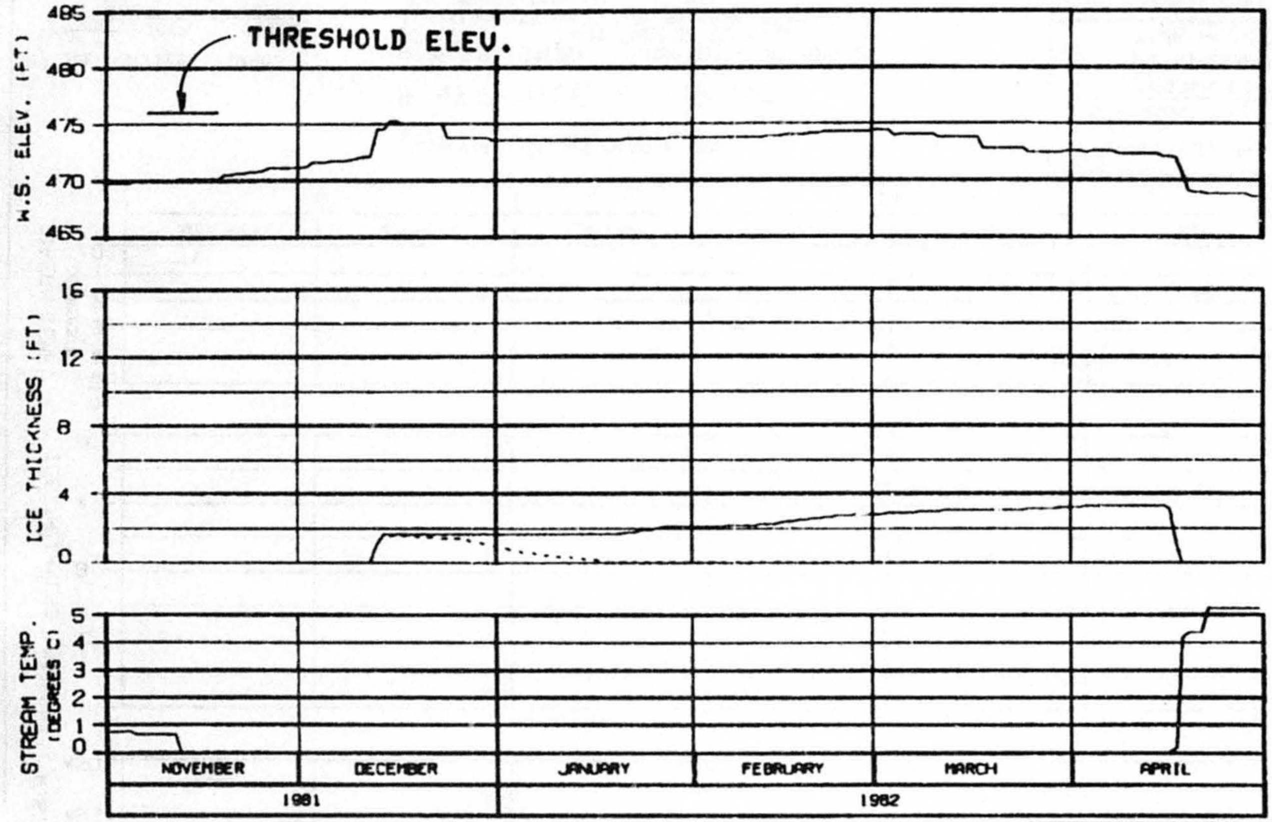
RIVER MILE : 112.34

ICE THICKNESS LEGEND:

- ——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING , FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	[illegible]	[illegible]



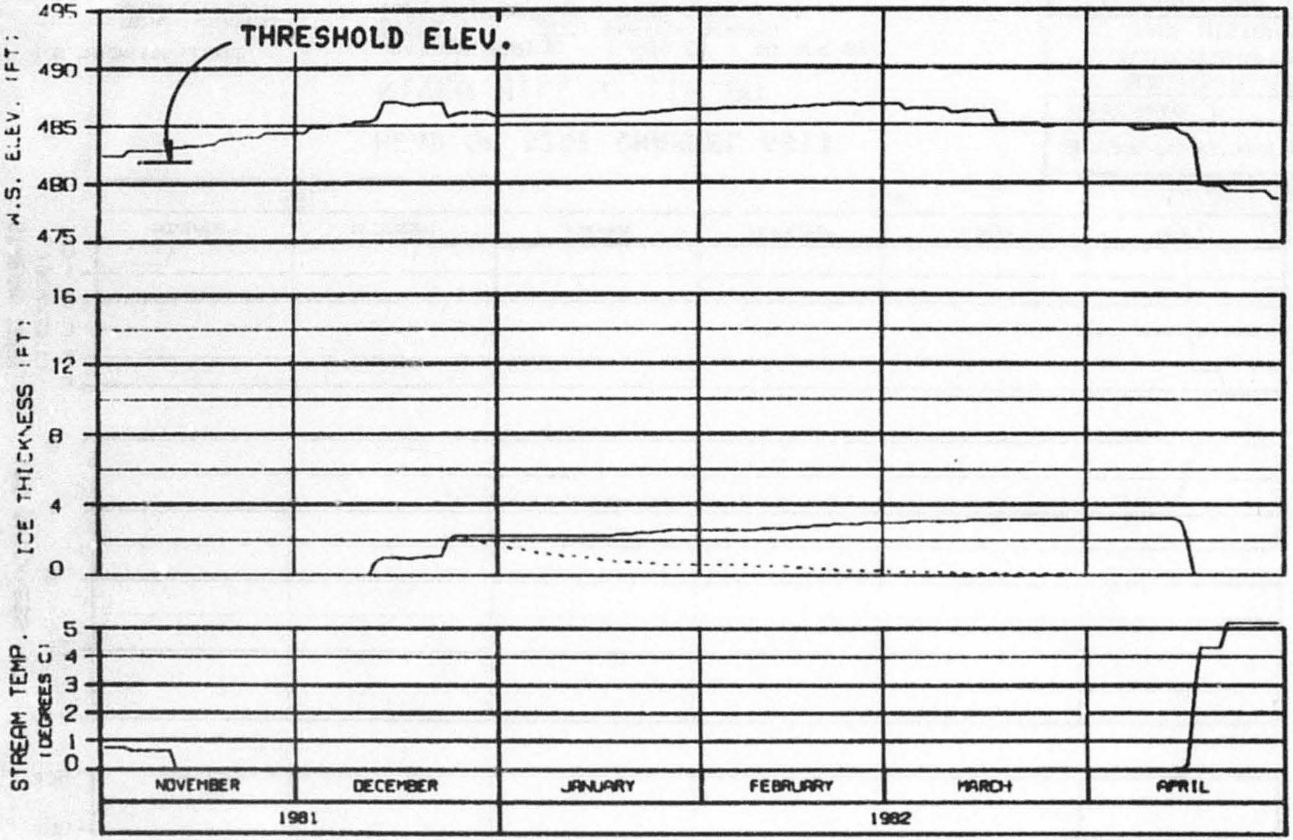
HEAD OF SLOUGH 8

RIVER MILE : 114.10

ICE THICKNESS LEGEND:
- TOTAL THICKNESS
- SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 1563.142



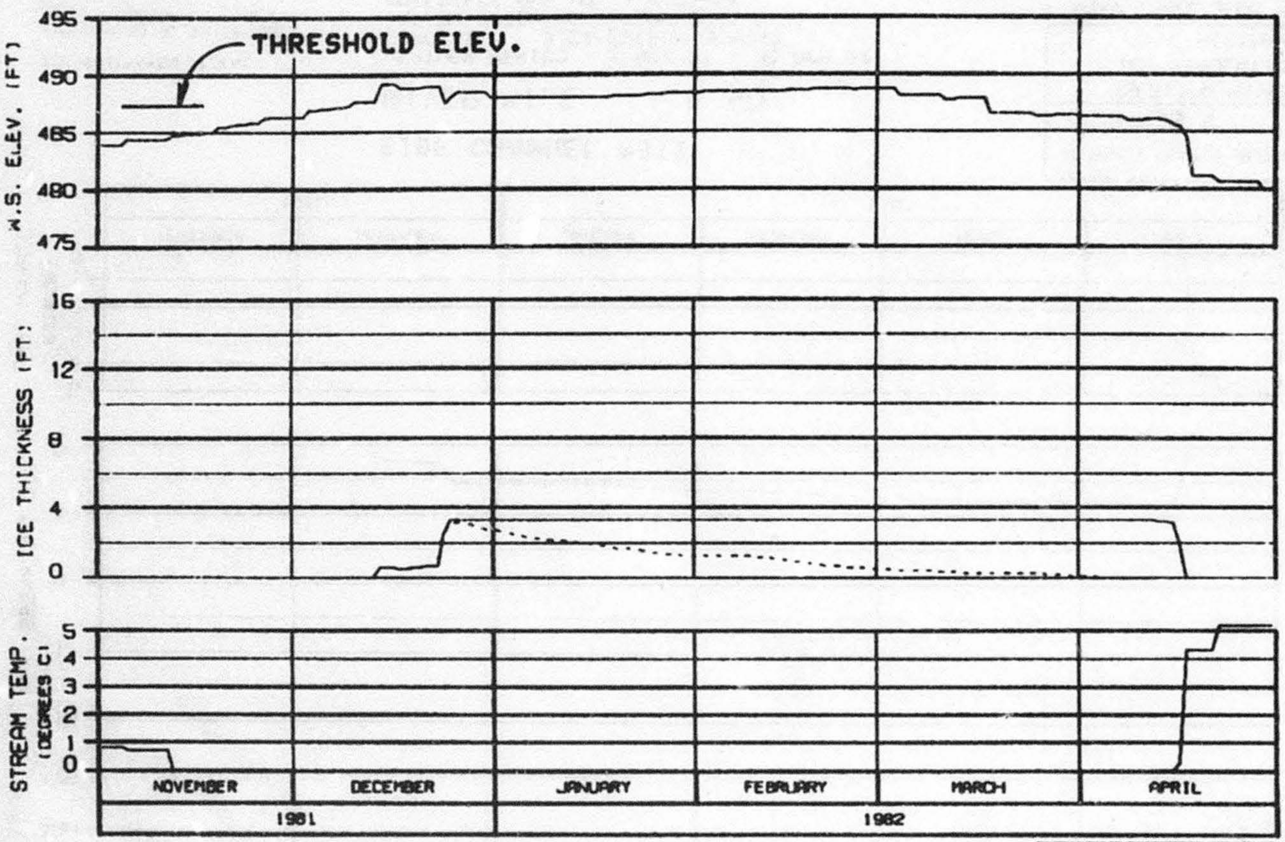
SIDE CHANNEL MSII

RIVER MILE : 115.50

ICE THICKNESS LEGEND:
—— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 1983.142



HEAD OF SIDE CHANNEL MSII

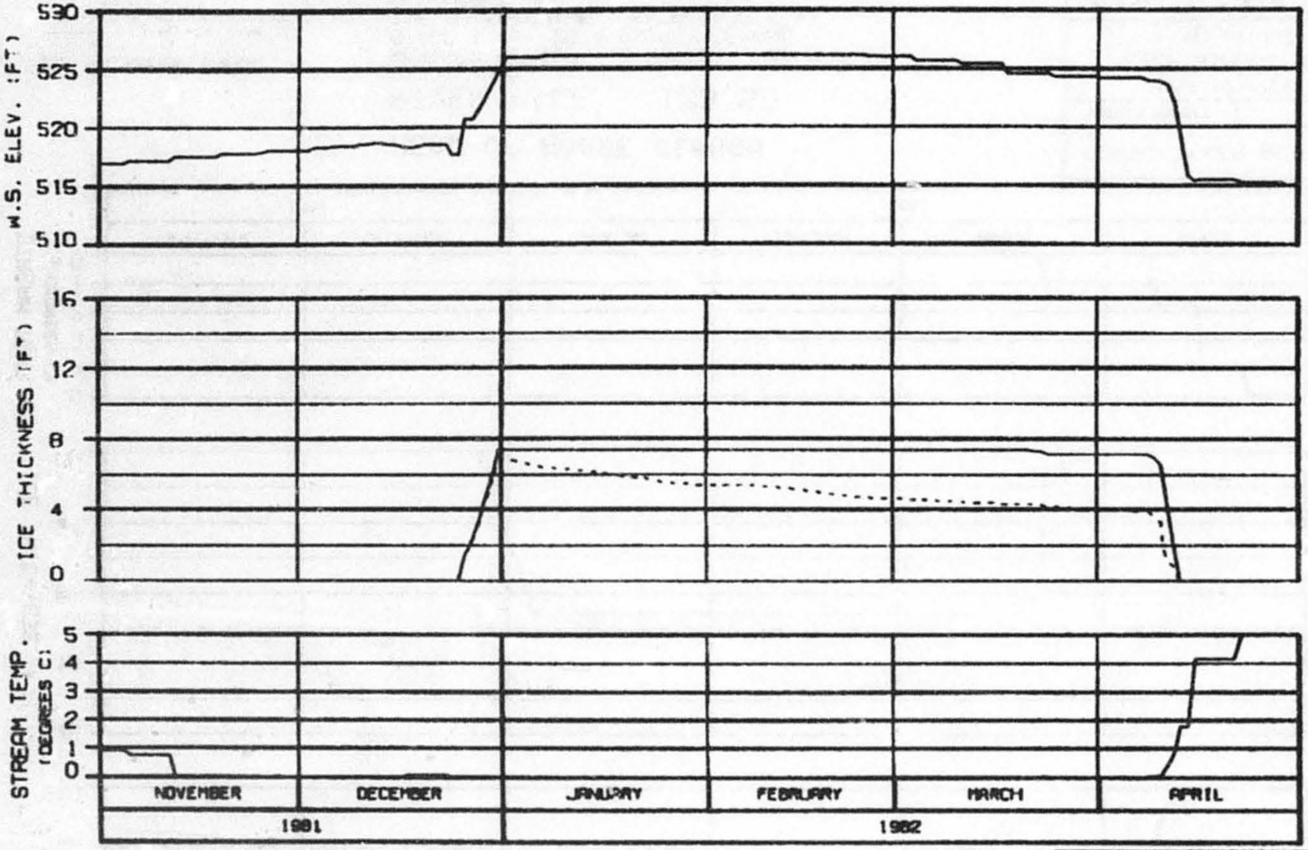
RIVER MILE : 115.90

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : BIDIENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1563.142

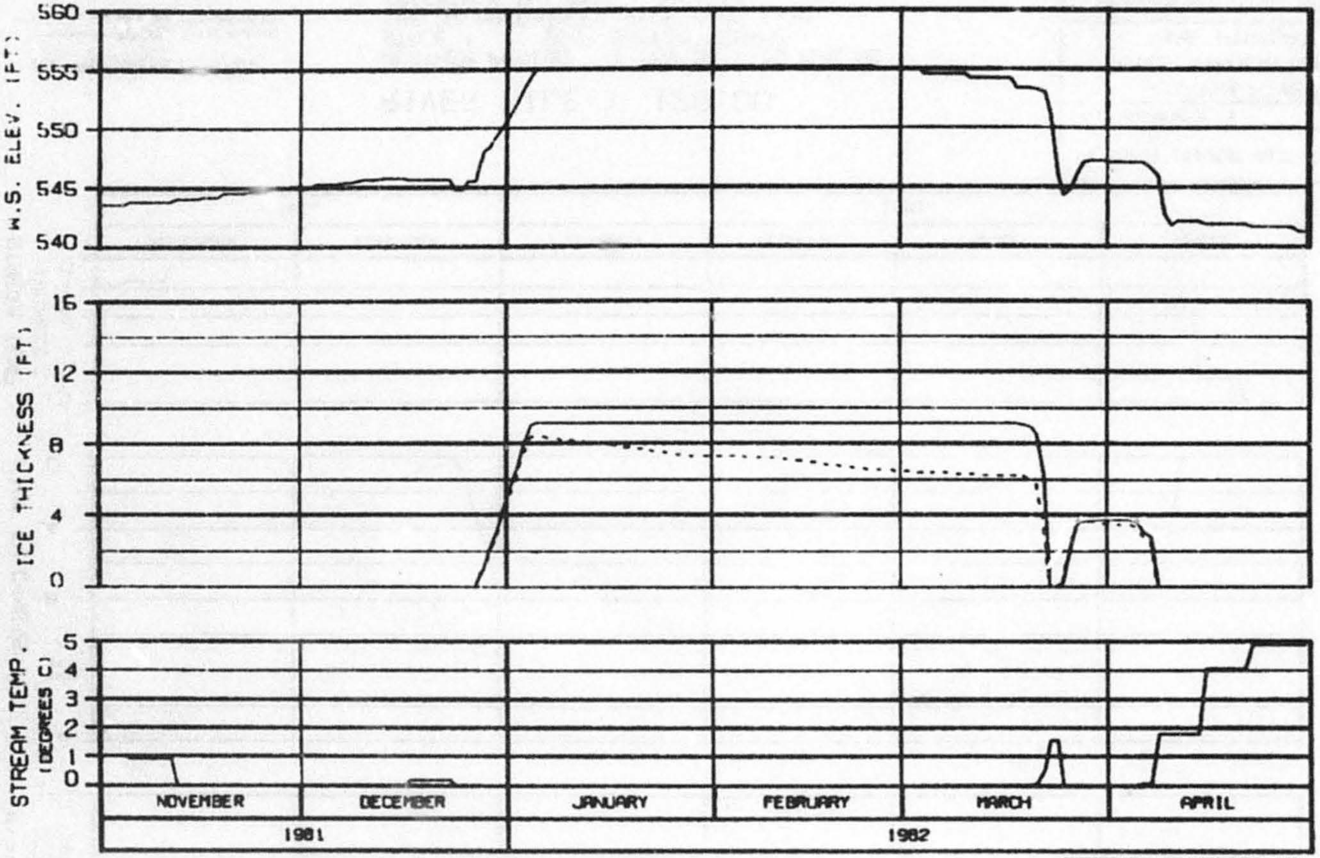


RIVER MILE : 120.00

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - SLUSH COMPONENT

WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I : 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

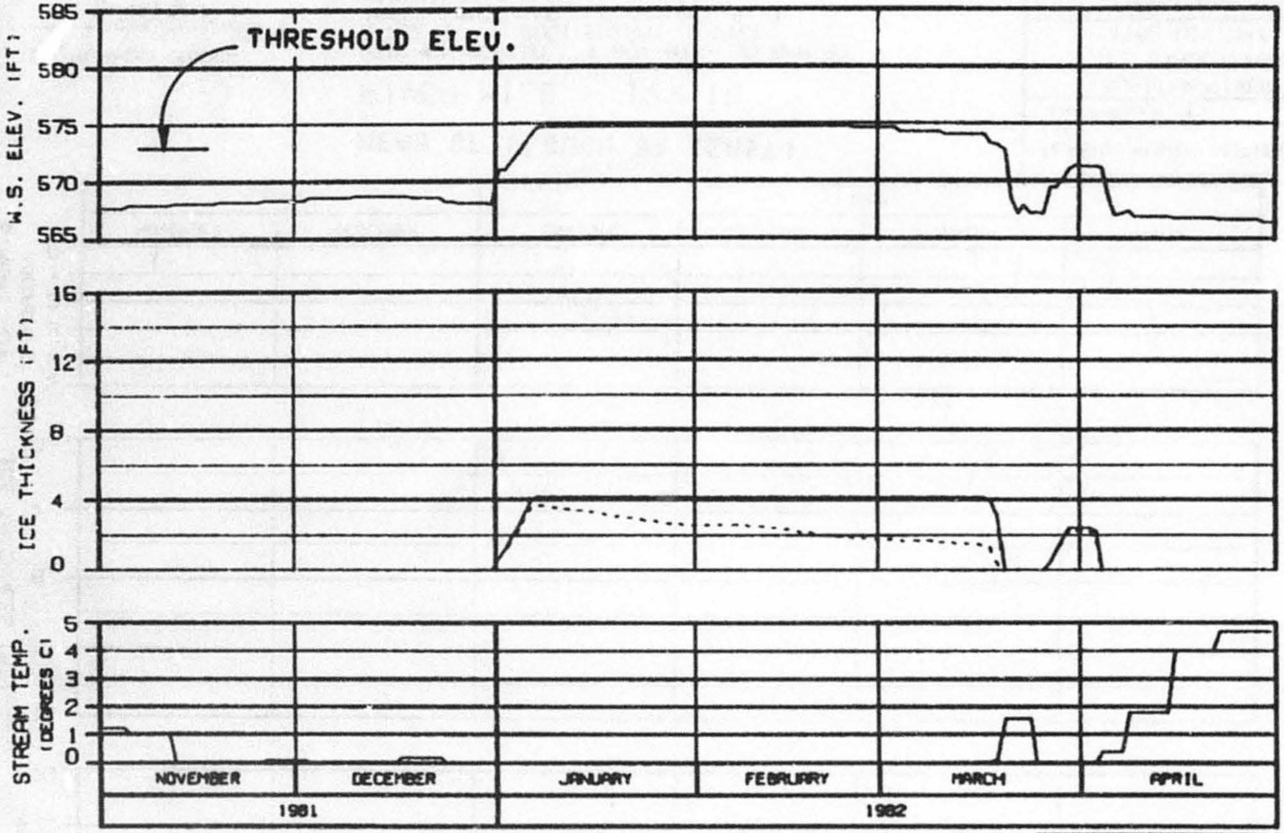
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 29 JUL 85 | 1988.142



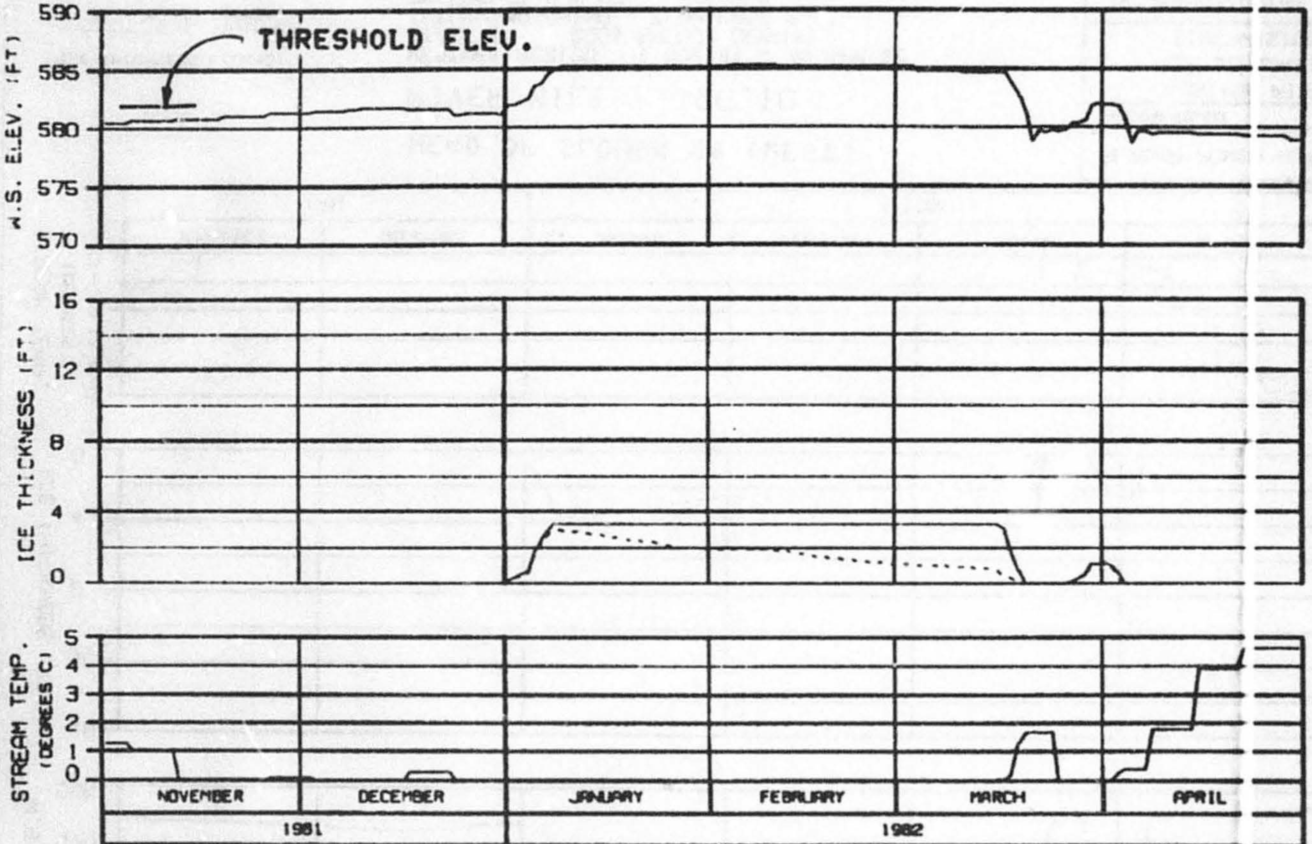
HEAD OF SLOUGH 8A (WEST)

RIVER MILE : 126.10

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ICE THICKNESS LEGEND:

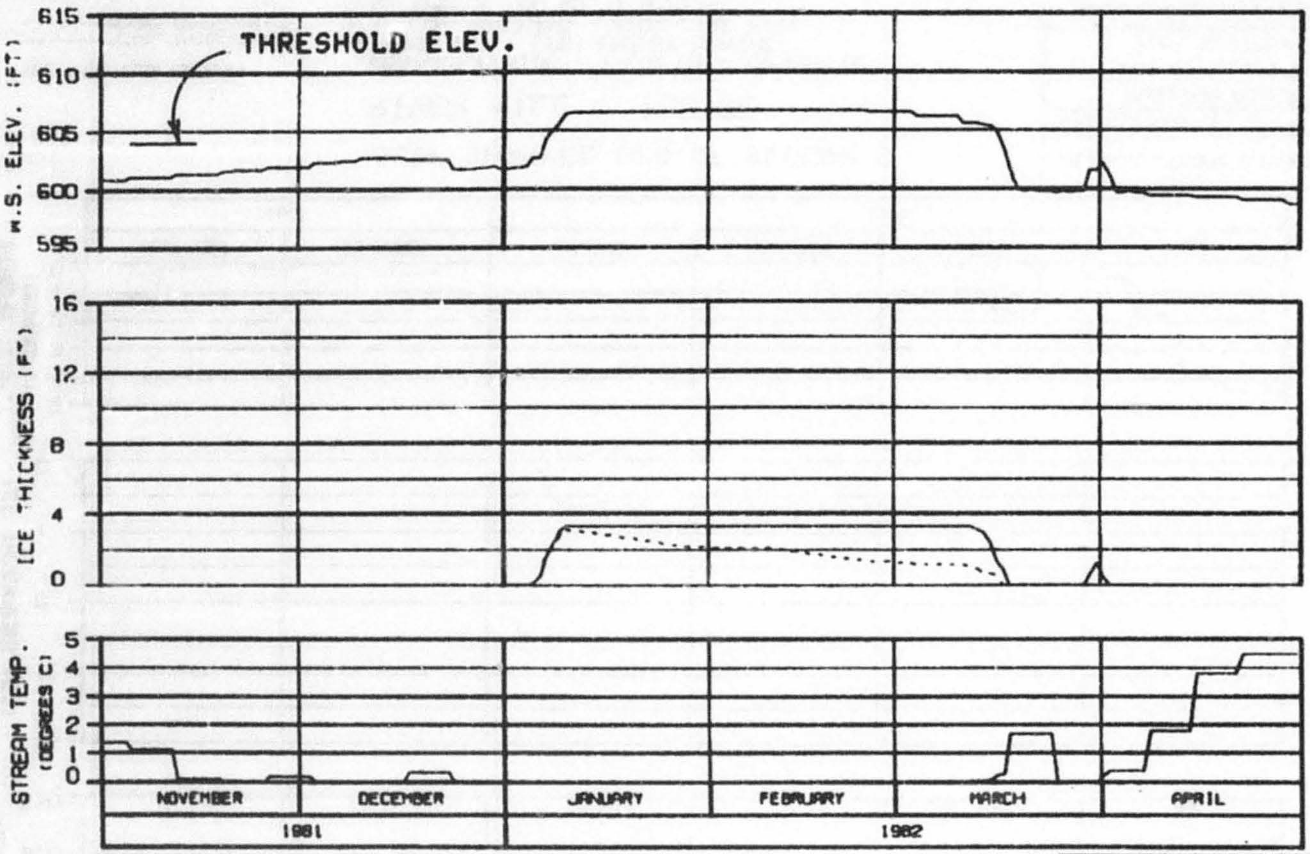
——— TOTAL THICKNESS
- - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9

RIVER MILE : 129.30

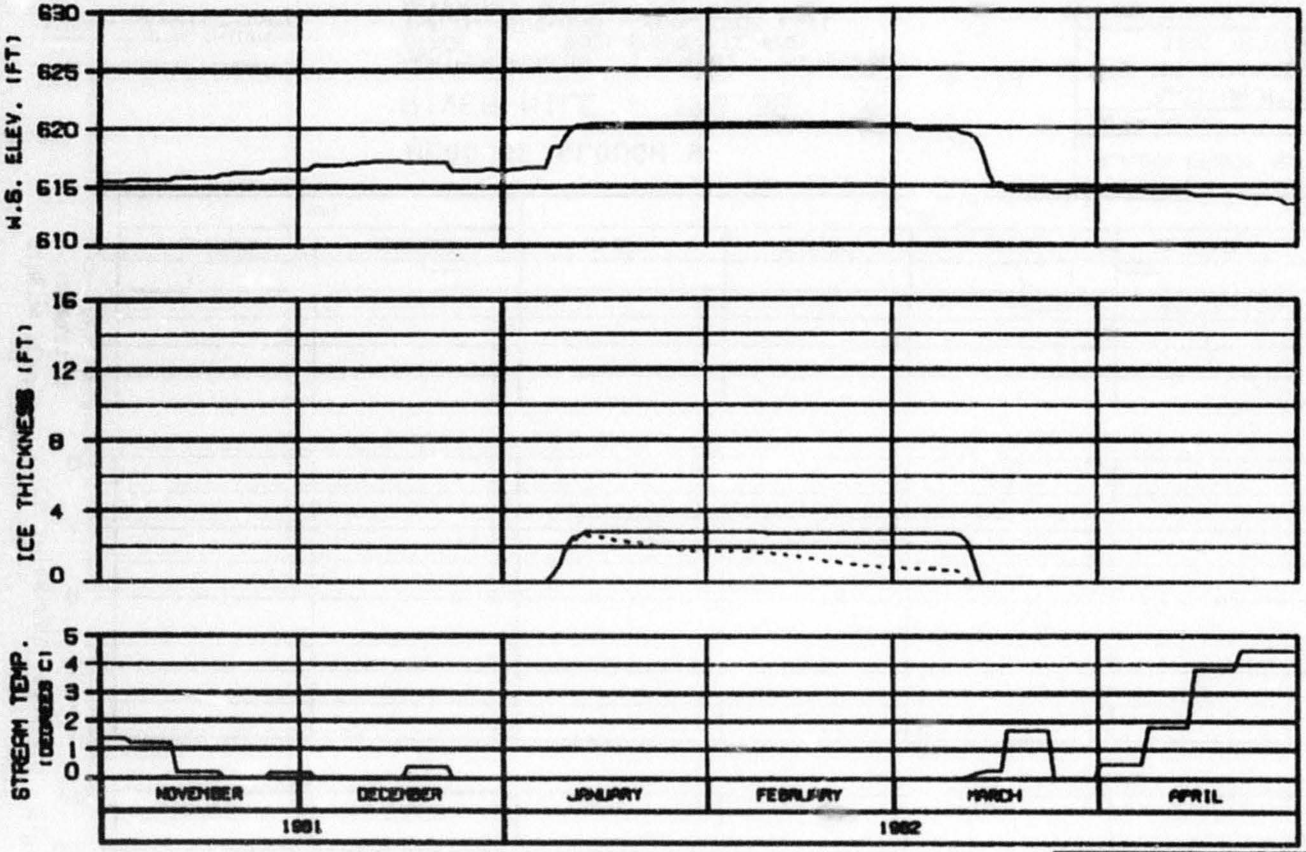
WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 1569.142

OPTION?

OPTION7



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:
- ——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I   2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

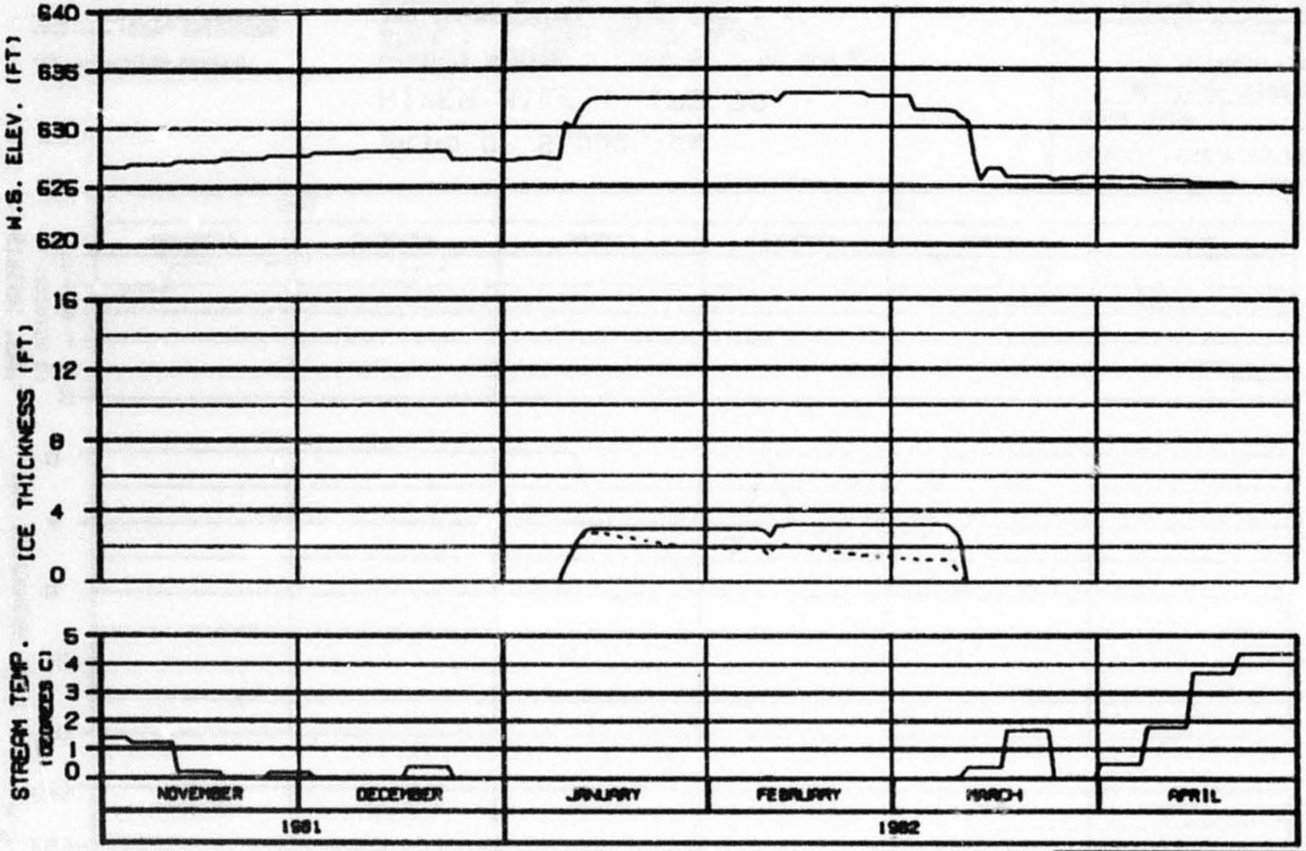
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1989.142



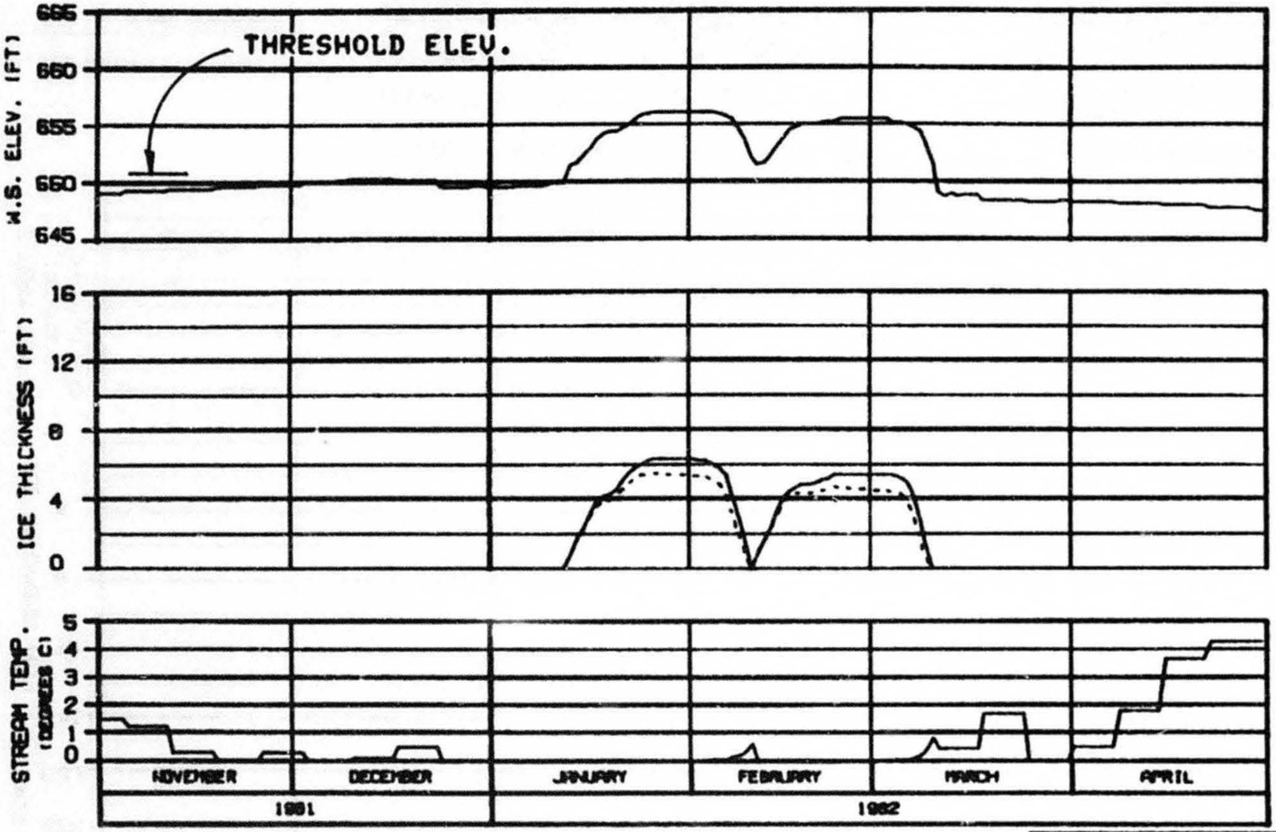
SIDE CHANNEL U/S OF 4TH JULY CREEK

RIVER MILE : 131.80

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
[illegible] 1985.142



HEAD OF SLOUGH 9A

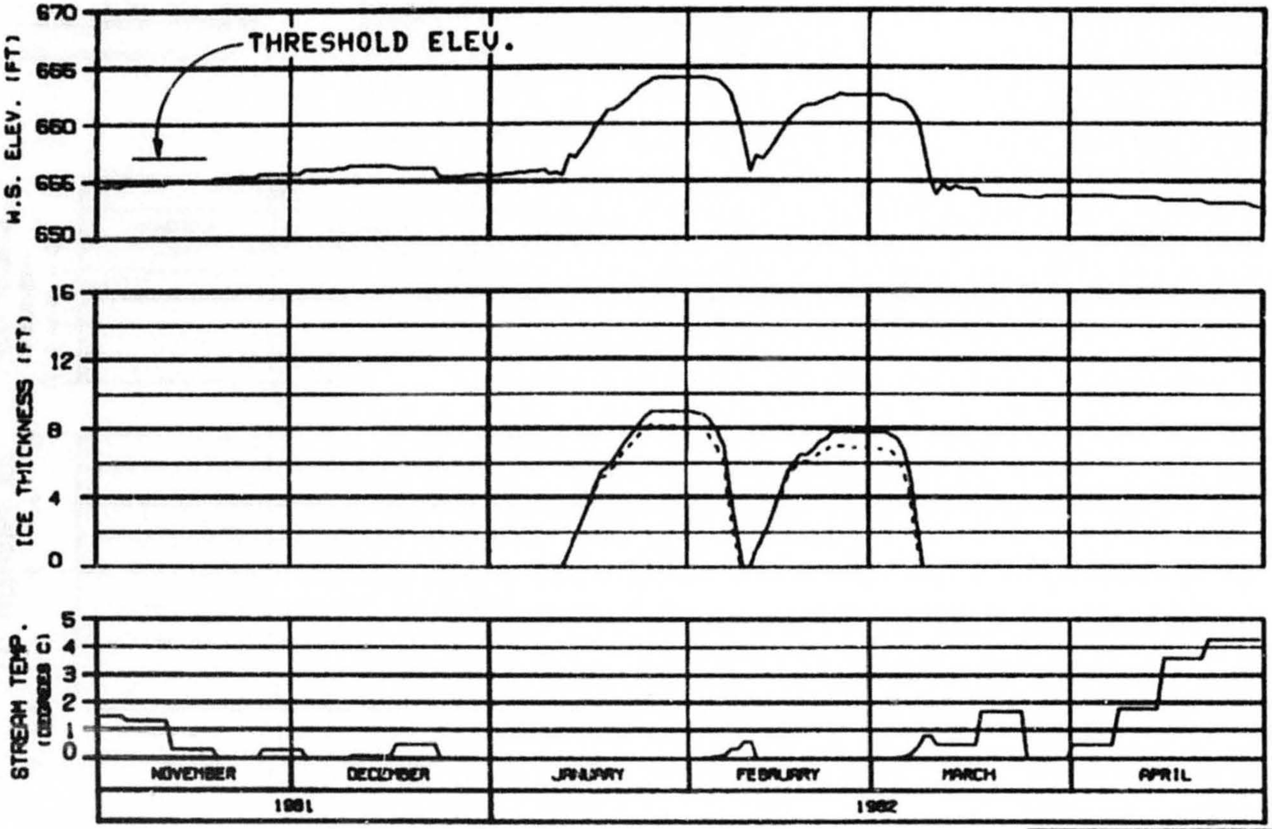
RIVER MILE : 133.70

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	



SIDE CHANNEL U/S OF SLOUGH 10

RIVER MILE : 134.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

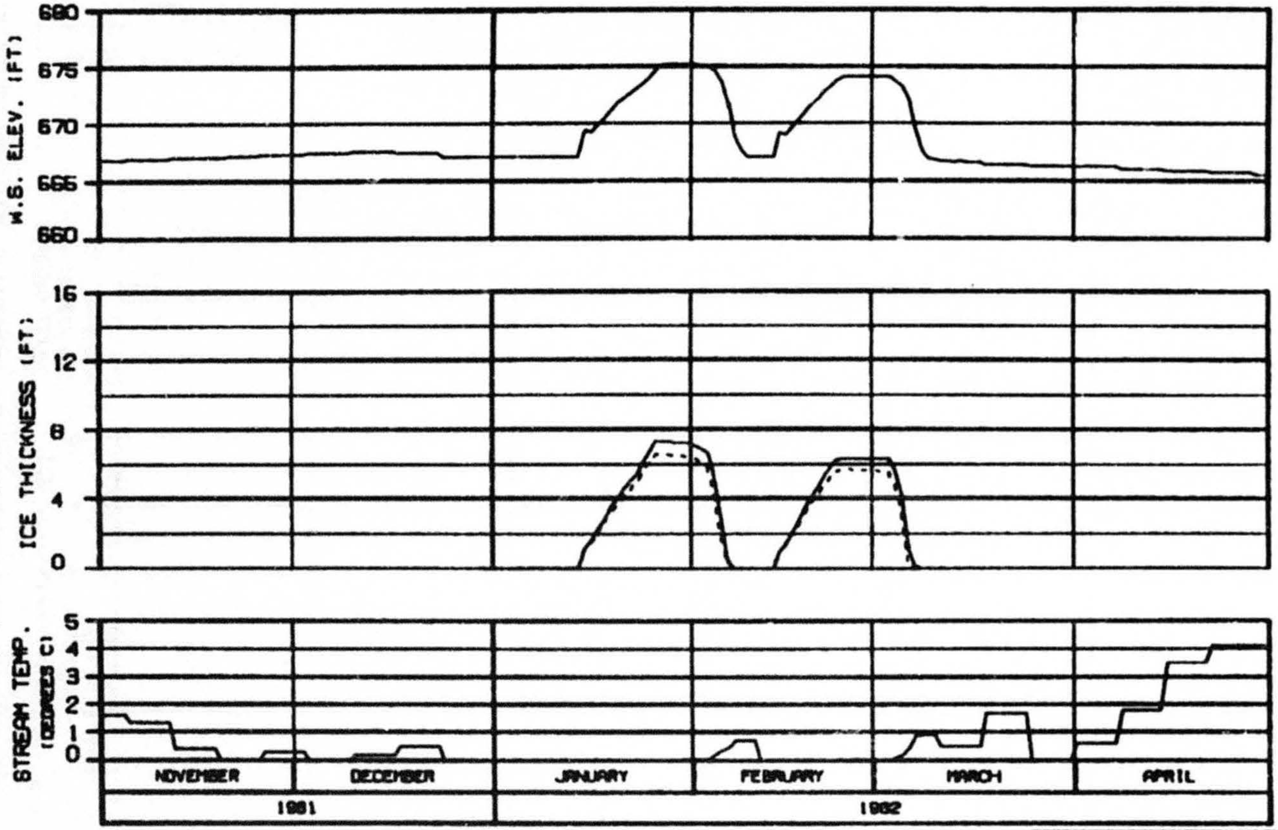
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING , FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL D/S OF SLOUGH 11

RIVER MILE : 135.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

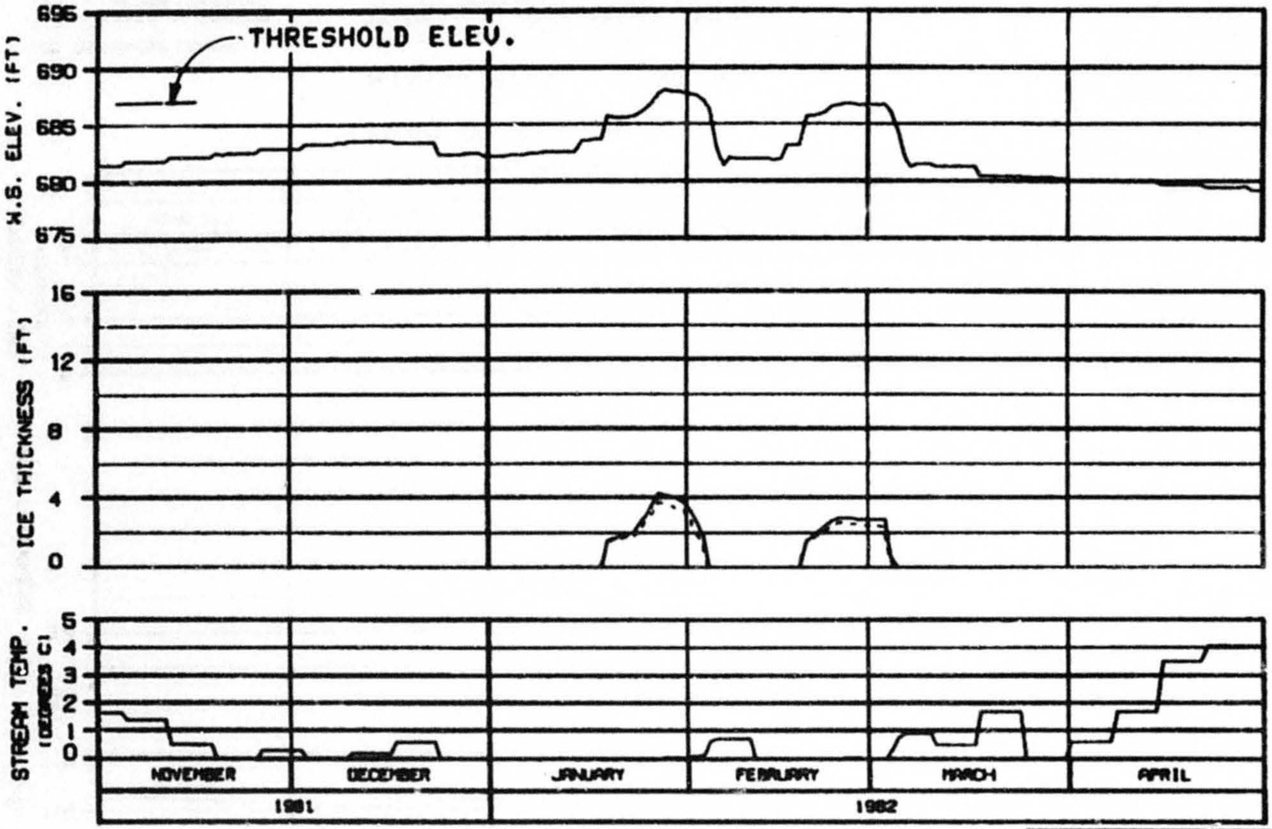
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 11

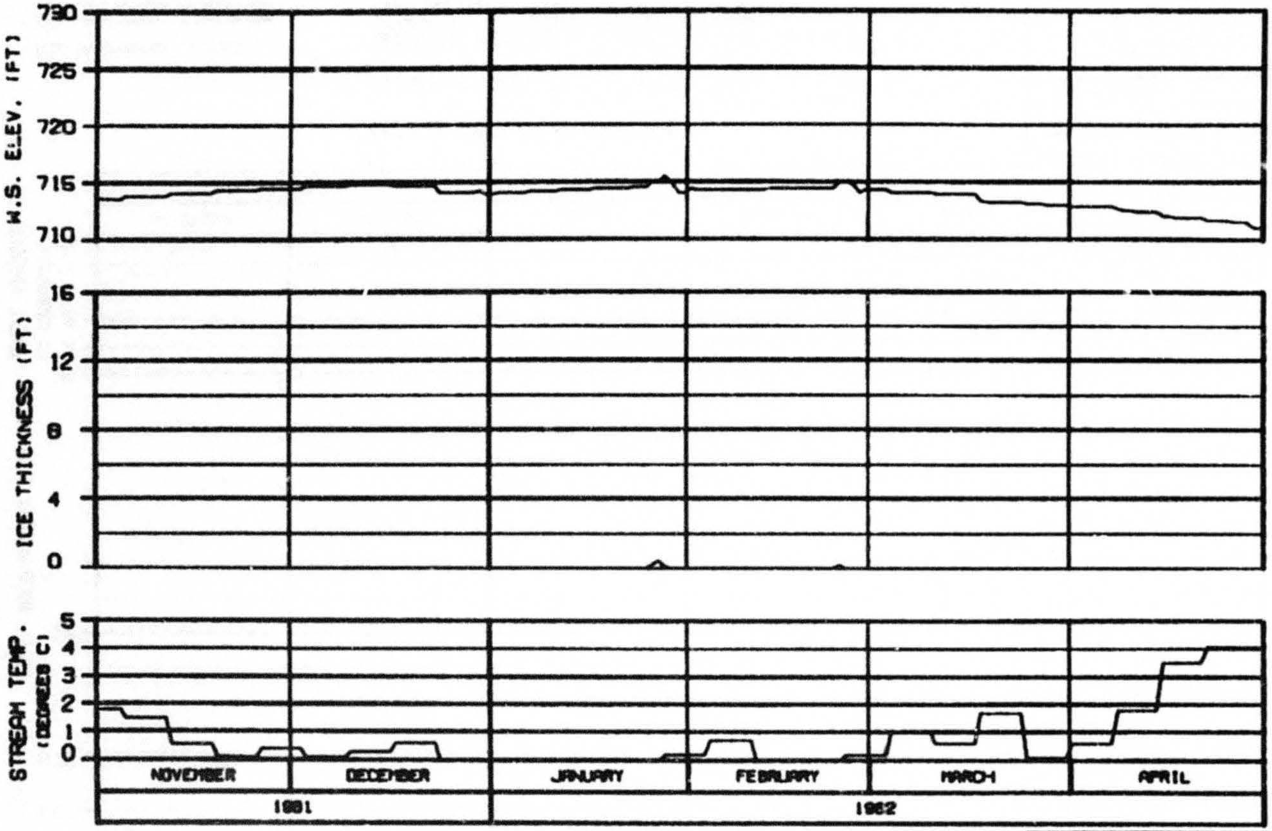
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE



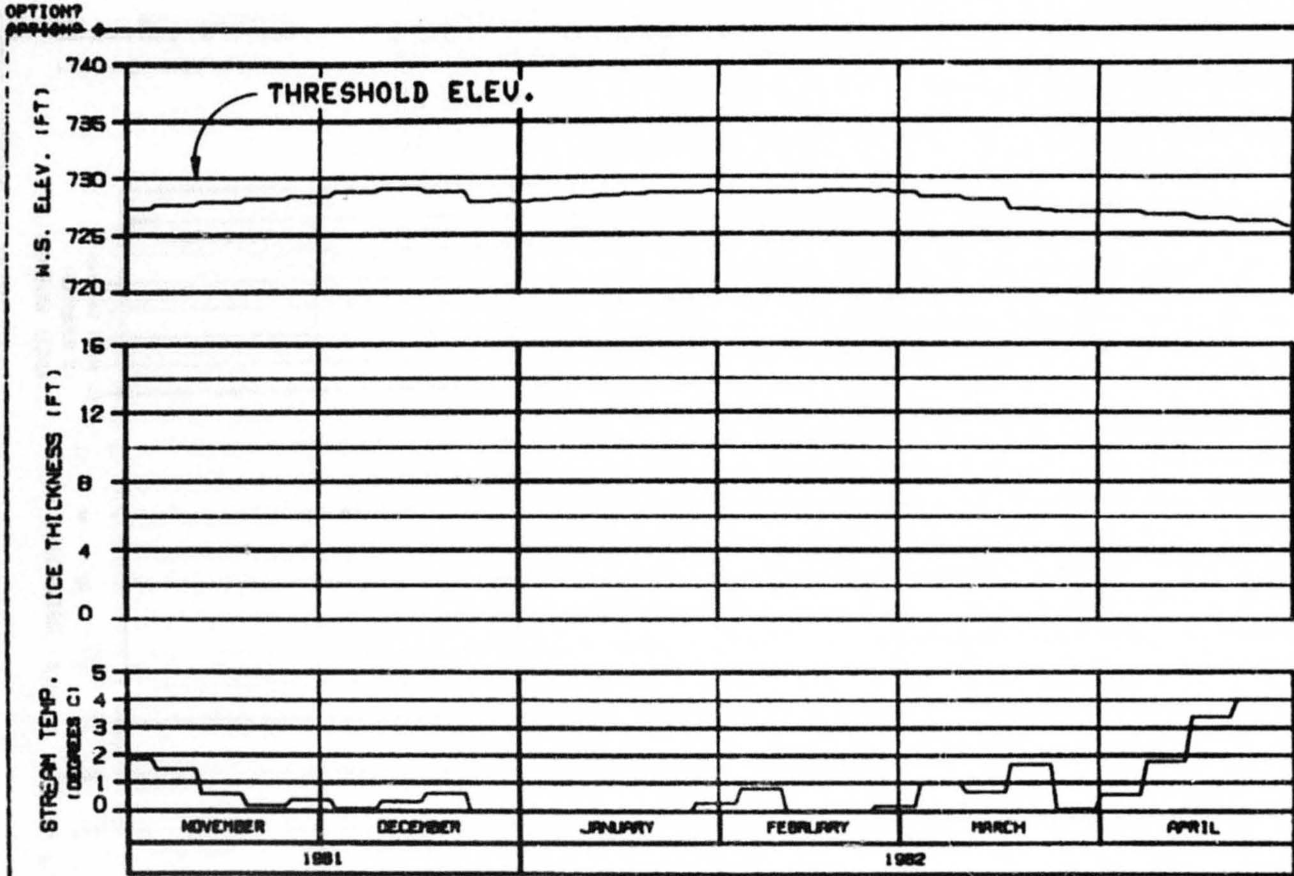
HEAD OF SLOUGH 17

RIVER MILE : 139.30

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



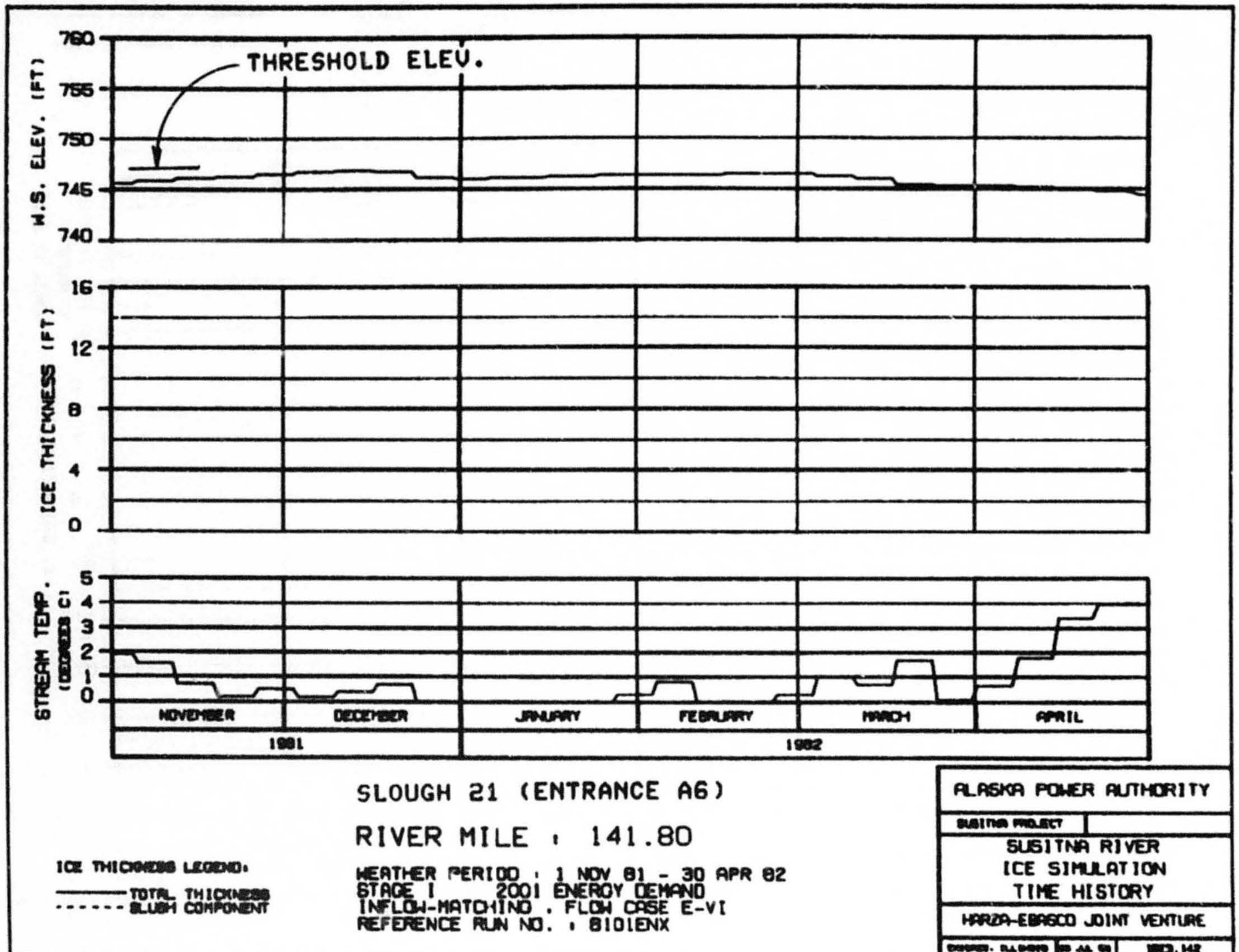
HEAD OF SLOUGH 20

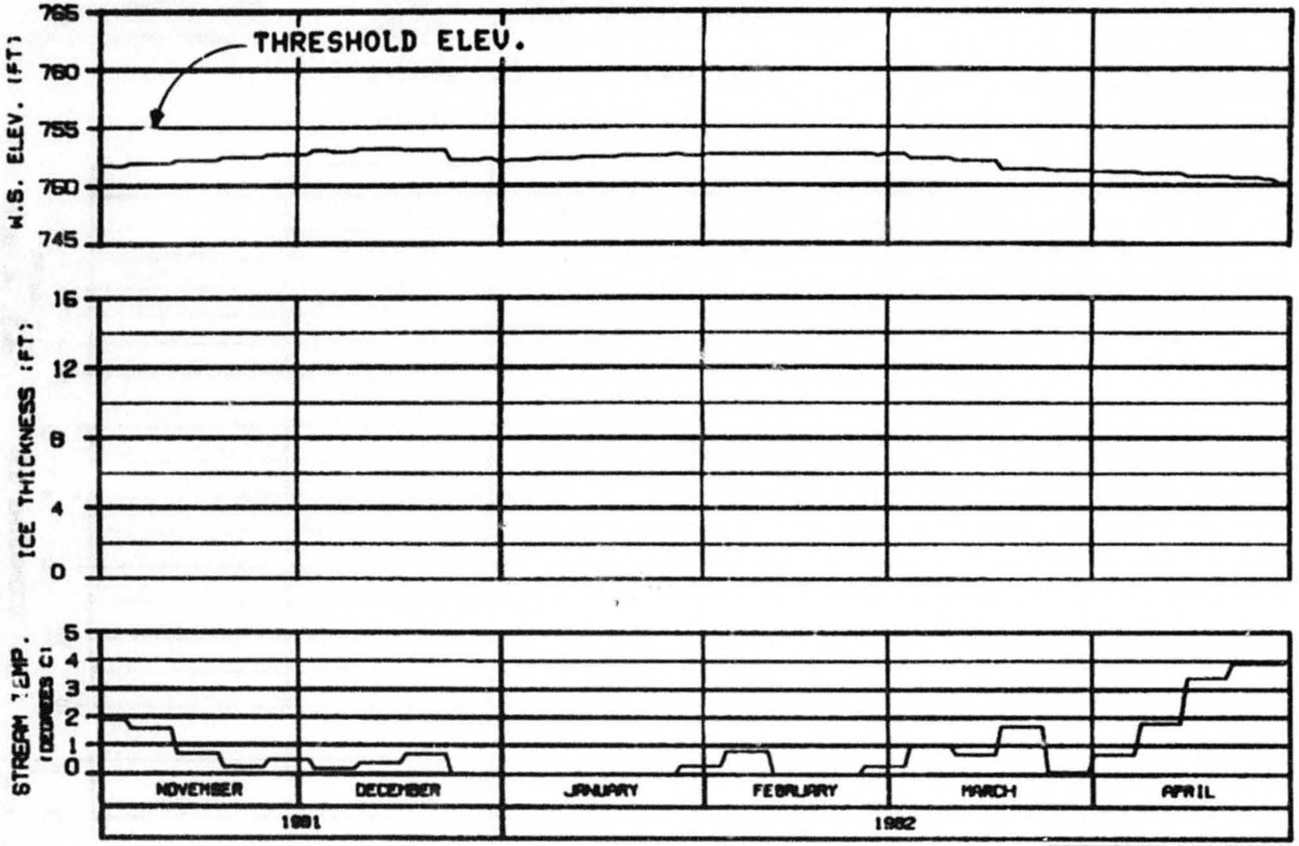
RIVER MILE : 140.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE


THRESHOLD ELEV.
W.S. ELEV. (FT)
760
755
750
745
740
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1981
1982
SLOUGH 21 (ENTRANCE A6)
RIVER MILE : 141.80
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 21

RIVER MILE : 142.20

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I   2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY

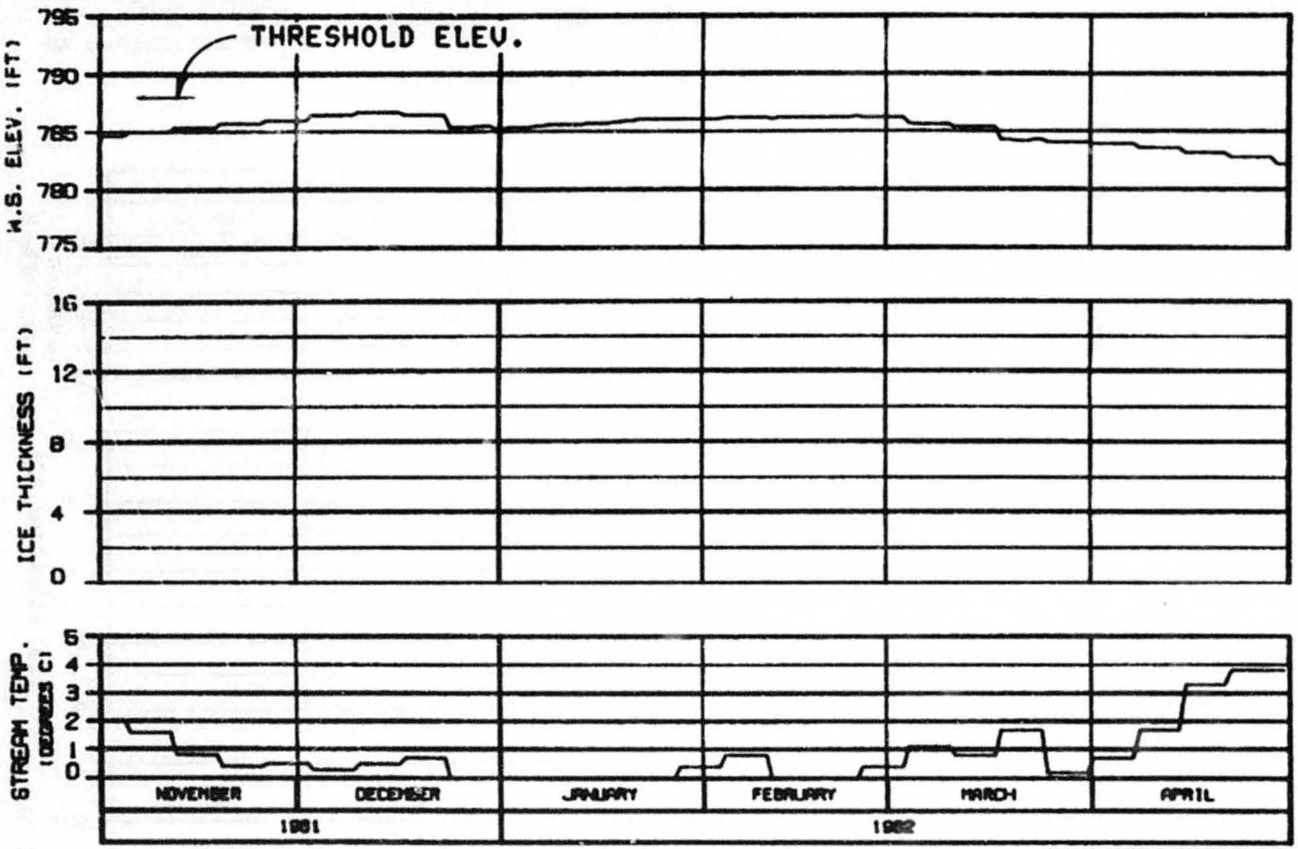
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

OPTION?

C



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

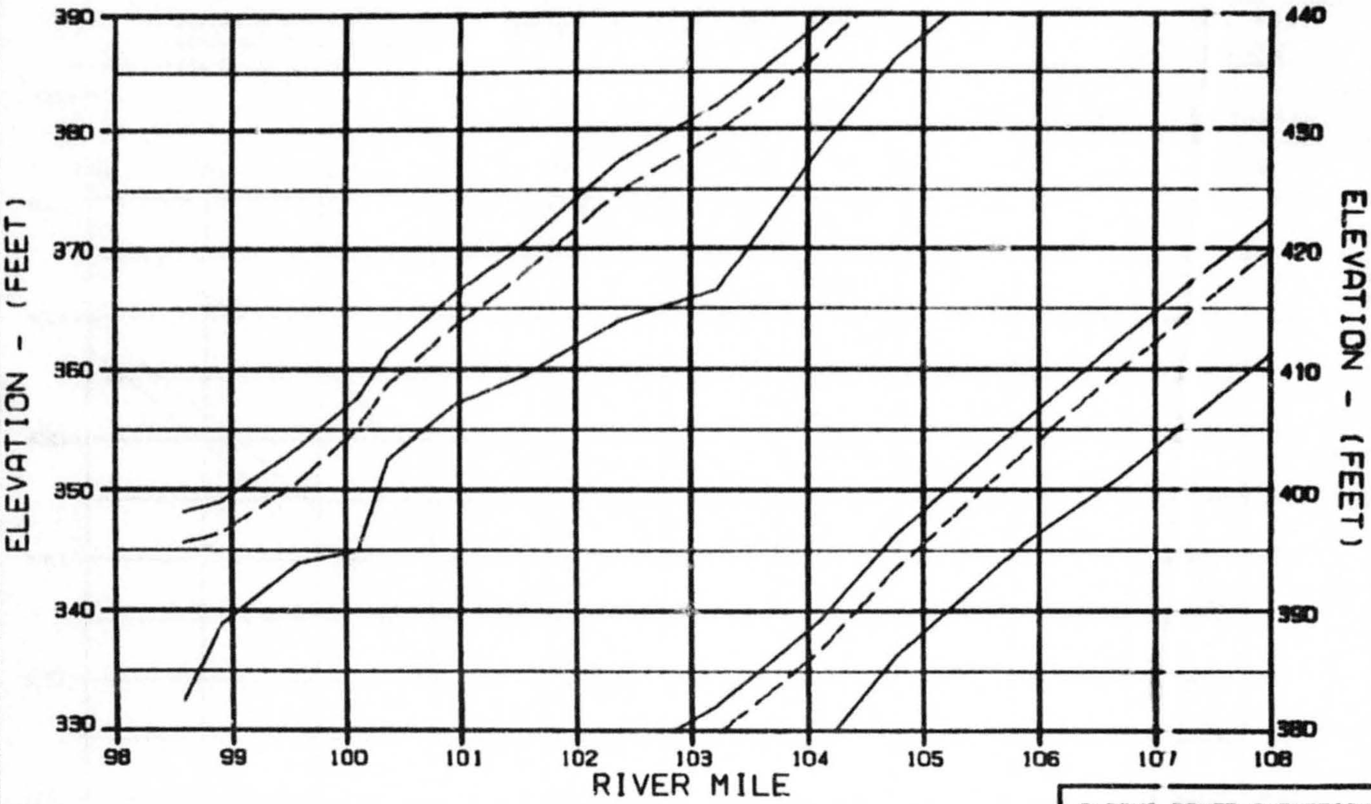
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
REFERENCE RUN NO. : 8101ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE

OPTION?

EXHIBIT B

C



LEGEND:

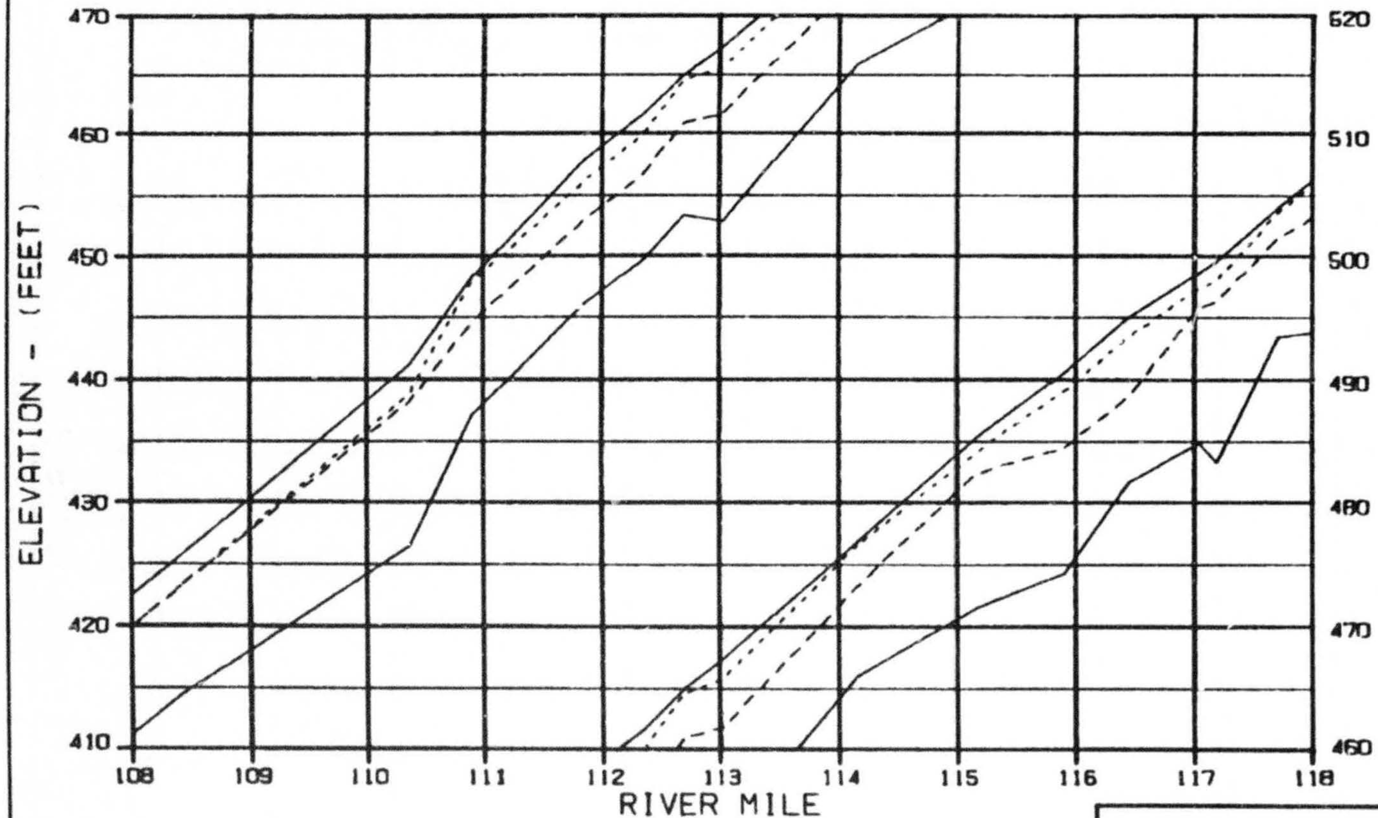
———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
— — — — BOTTOM OF SLUSH ICE
———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES	
HARZA-EBASCO JOINT VENTURE	
1568.142	

OPTION?

C



LEGEND:

- TOP OF SOLID ICE
- SLUSH/SOLID ICE INTERFACE
- BOTTOM OF SLUSH ICE
- RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

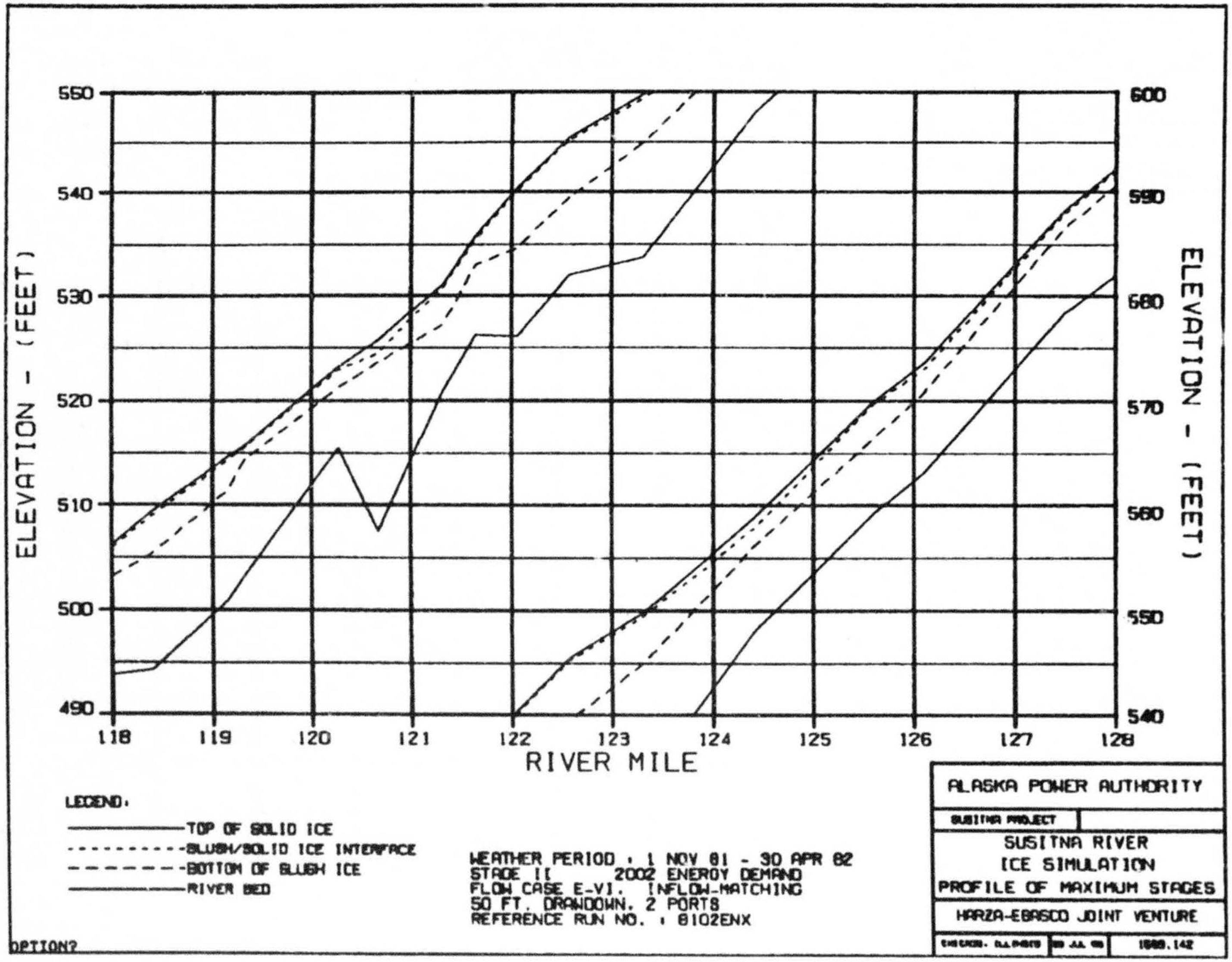
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

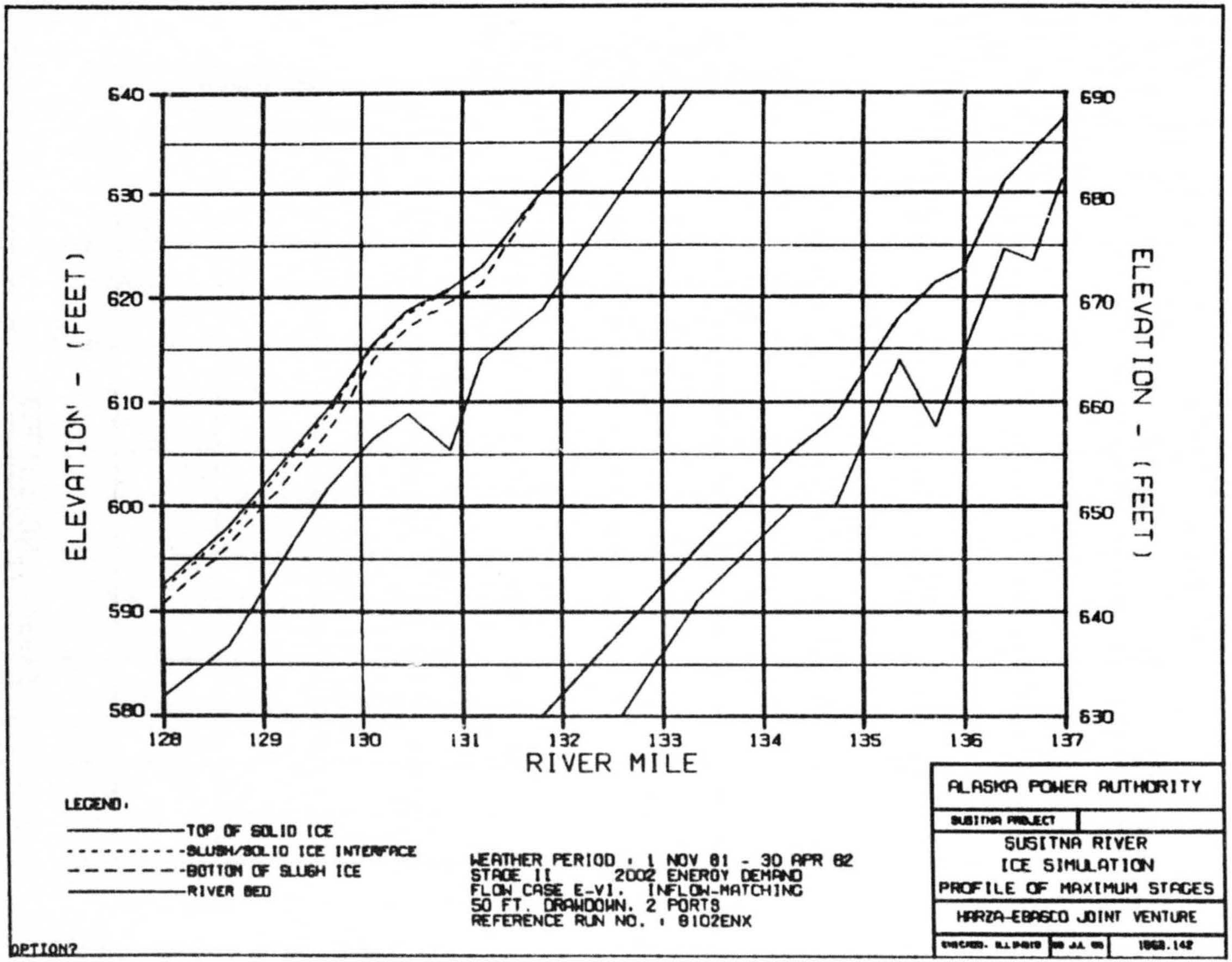
1683.142

OPTION?

C

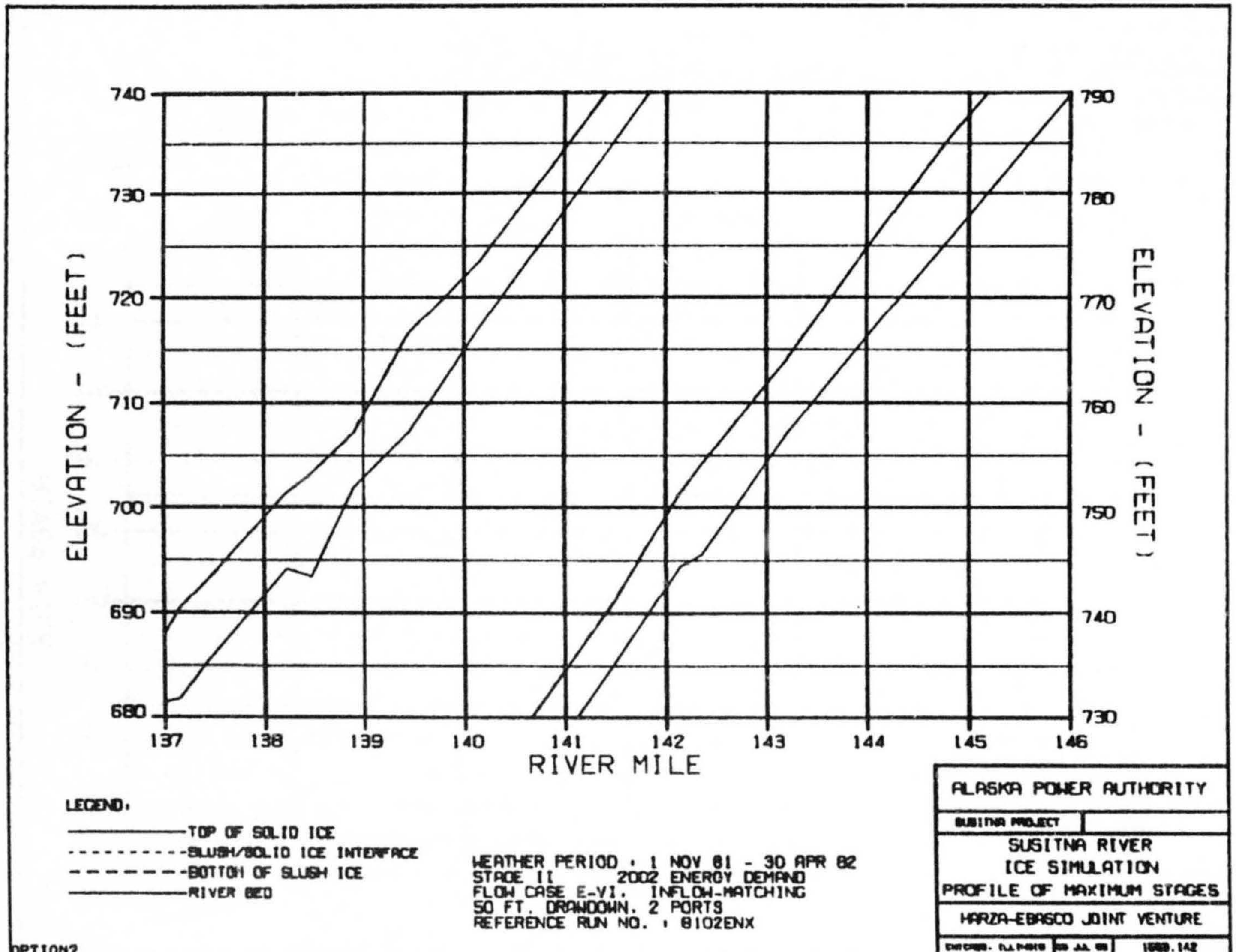

550
540
530
520
510
500
490
600
590
580
570
560
550
540
ELEVATION - (FEET)
ELEVATION - (FEET)
118
119
120
121
122
123
124
125
126
127
128
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN, 2 PORTS
REFERENCE RUN NO. : 8102ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

c



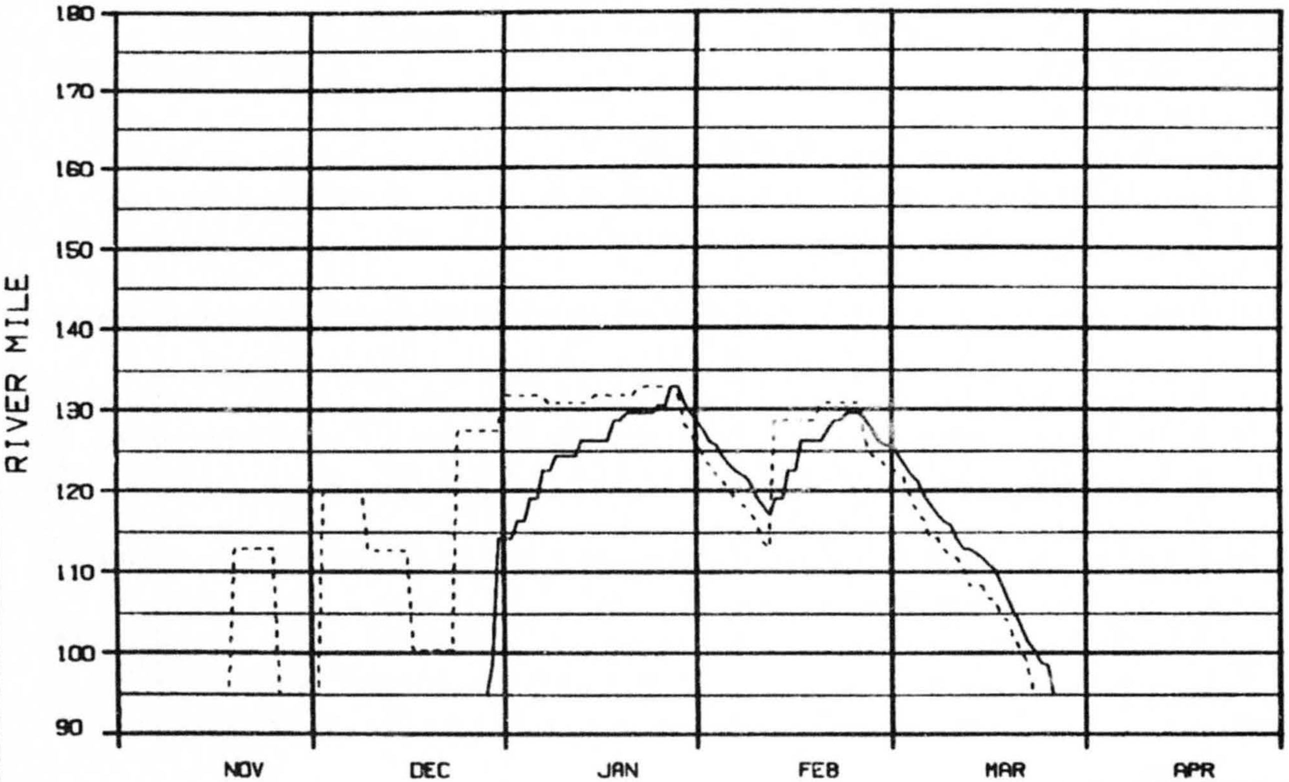
ELEVATION - (FEET)
640
630
620
610
600
590
580
ELEVATION - (FEET)
690
680
670
660
650
640
630
128
129
130
131
132
133
134
135
136
137
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN, 2 PORTS
REFERENCE RUN NO. : 8102ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1868.142
OPTION?

C



ELEVATION - (FEET)
RIVER MILE
740
730
720
710
700
690
680
790
780
770
760
750
740
730
137
138
139
140
141
142
143
144
145
146
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C



LEGEND:

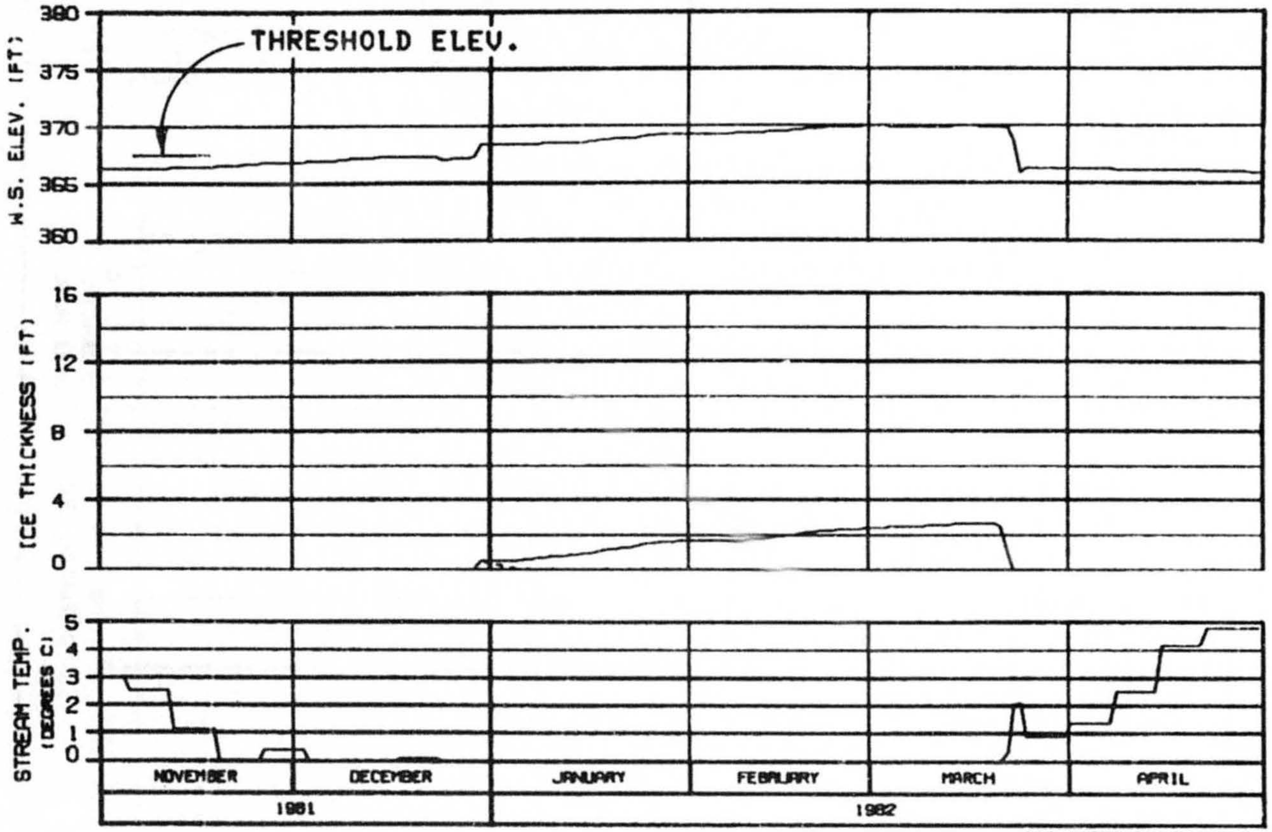
——————— ICE FRONT

- - - - - - - - - ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENEROY DEMAND
FLOW CASE E-VI . INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER PRODRESSION OF ICE FRONT & ZERO DEORAE ISOTHERM
HARZA-EBASCO JOINT VENTURE
1988.142

OPTION?



HEAD OF WHISKERS SLOUGH

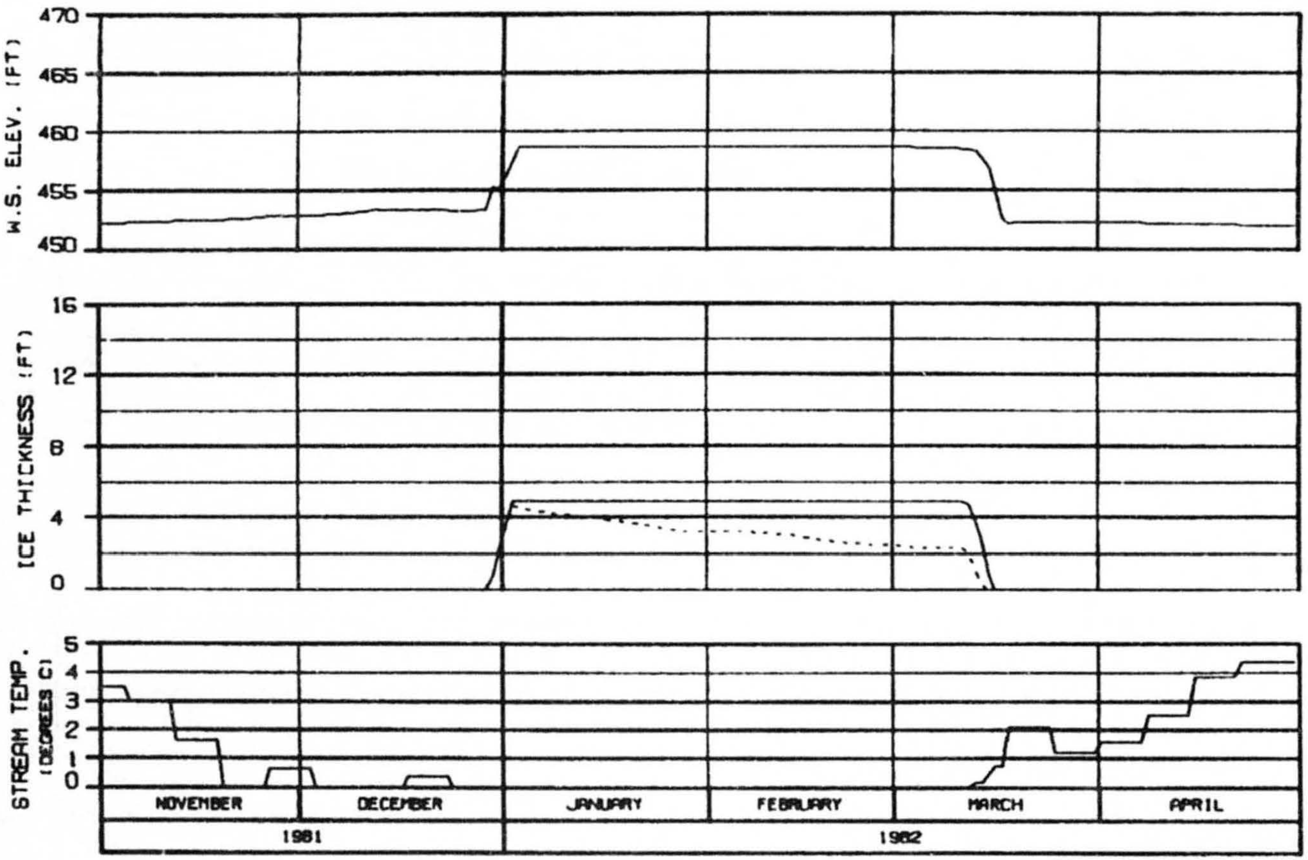
RIVER MILE : 101.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS · JUL 85	1563.142



SIDE CHANNEL AT HEAD OF GASH CREEK

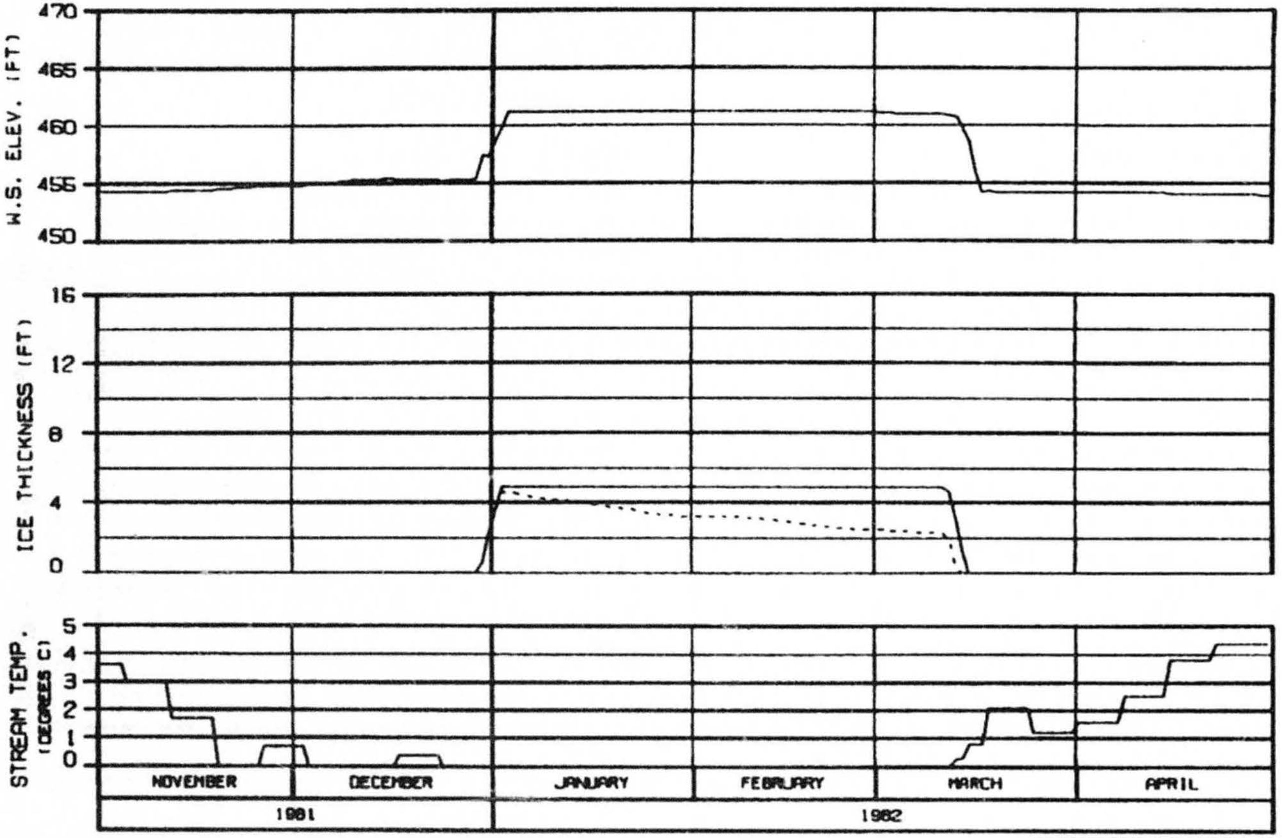
RIVER MILE : 112.00

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	



MOUTH OF SLOUGH 6A

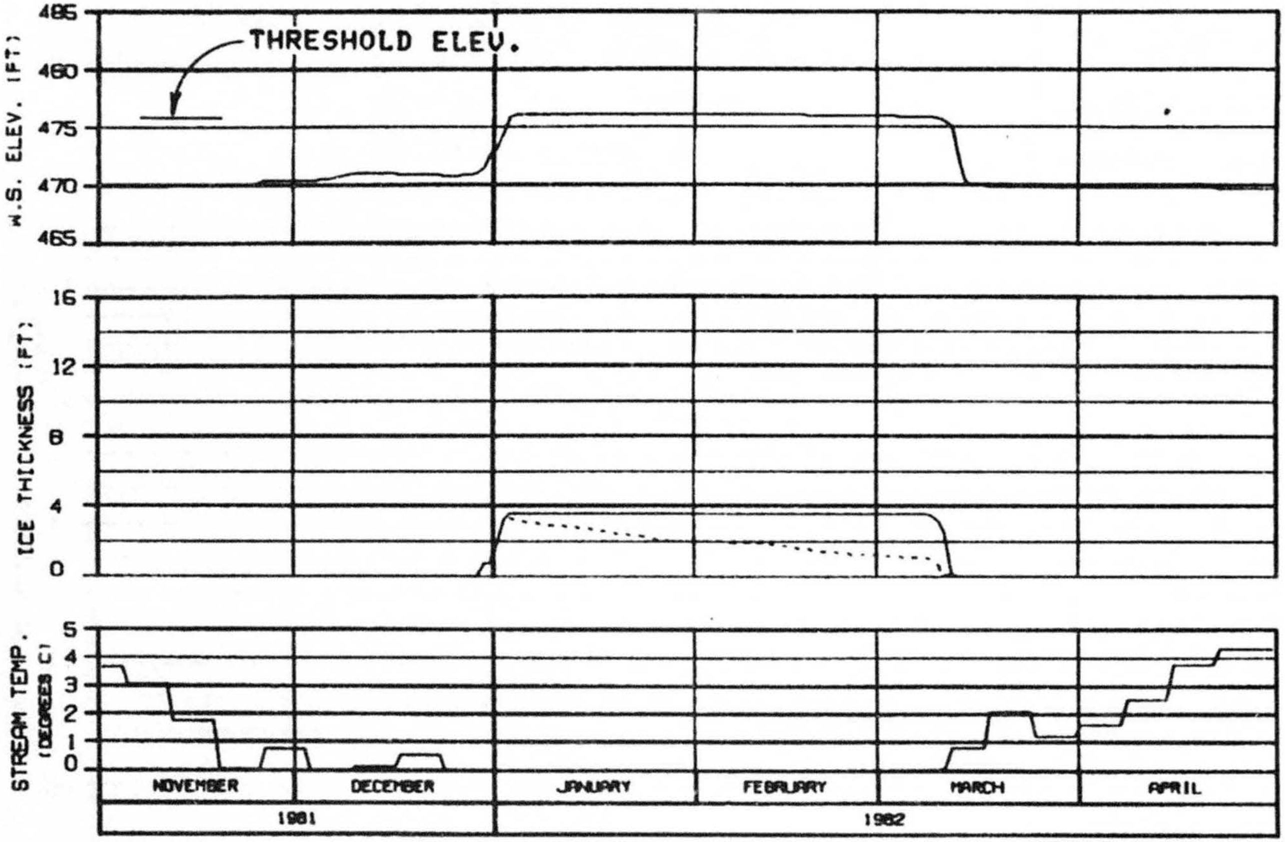
RIVER MILE : 112.34

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
[illegible]	[illegible]	1983.142



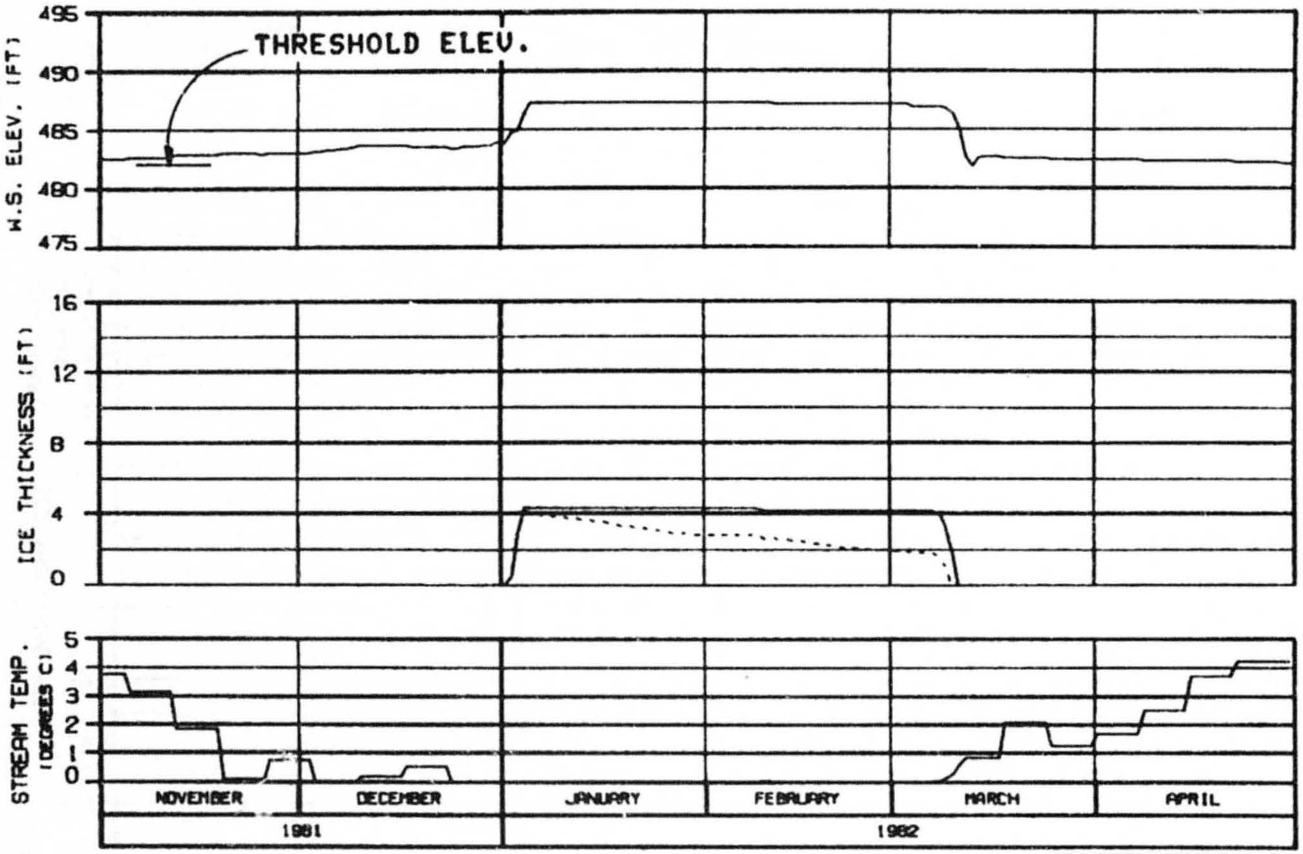
HEAD OF SLOUGH 8

RIVER MILE : 114.10

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS



SIDE CHANNEL MSII

RIVER MILE : 115.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
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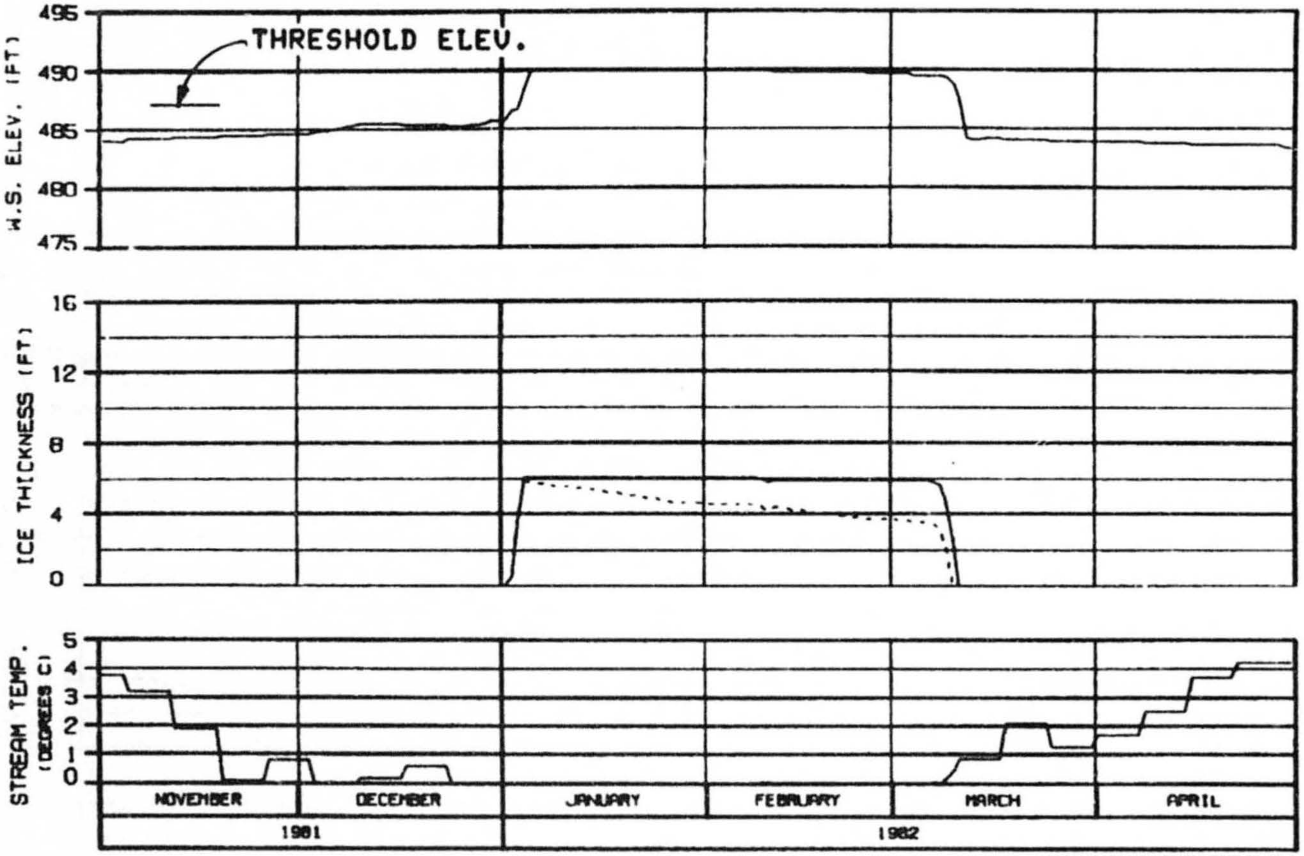


HEAD OF SIDE CHANNEL MSII

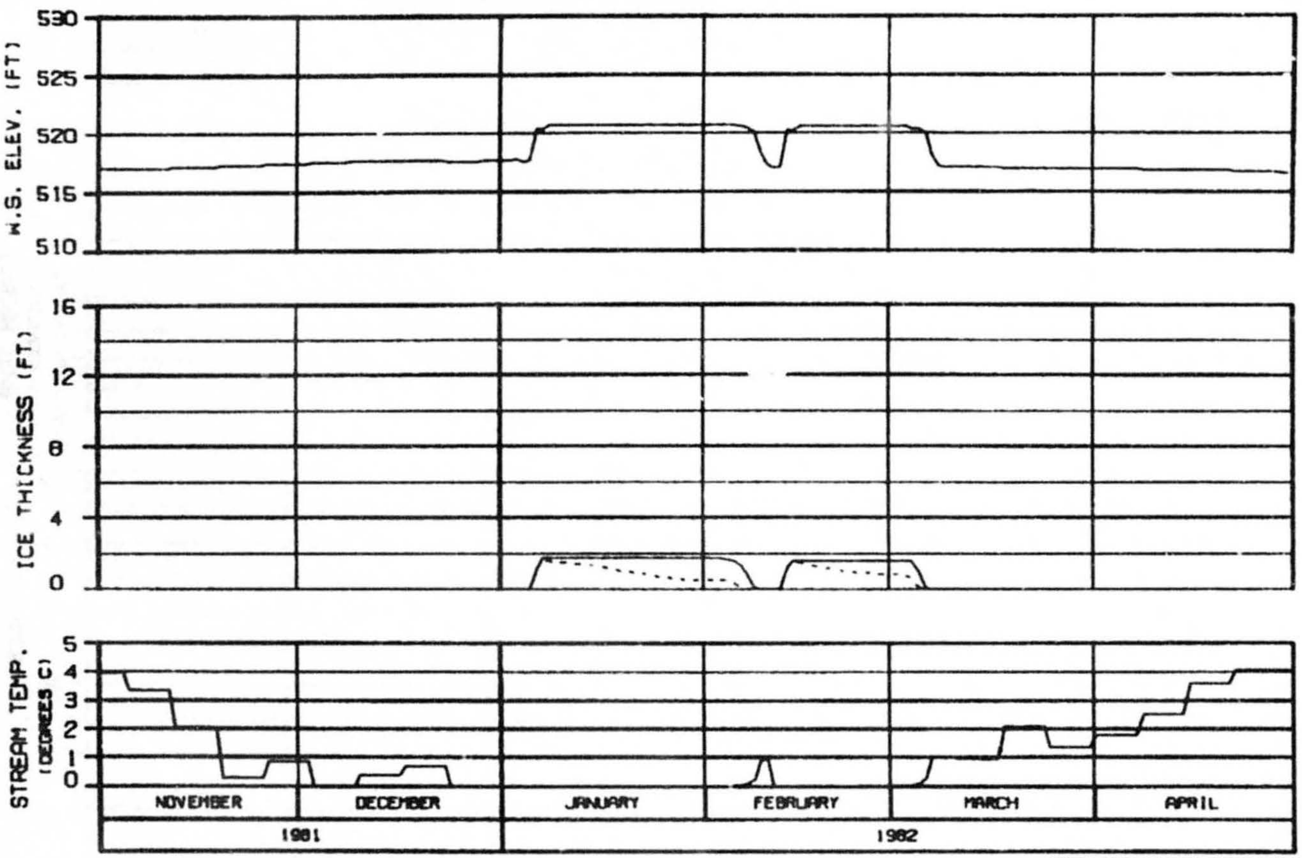
RIVER MILE : 115.90

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN, 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 30 JUL 85 | 1863.142

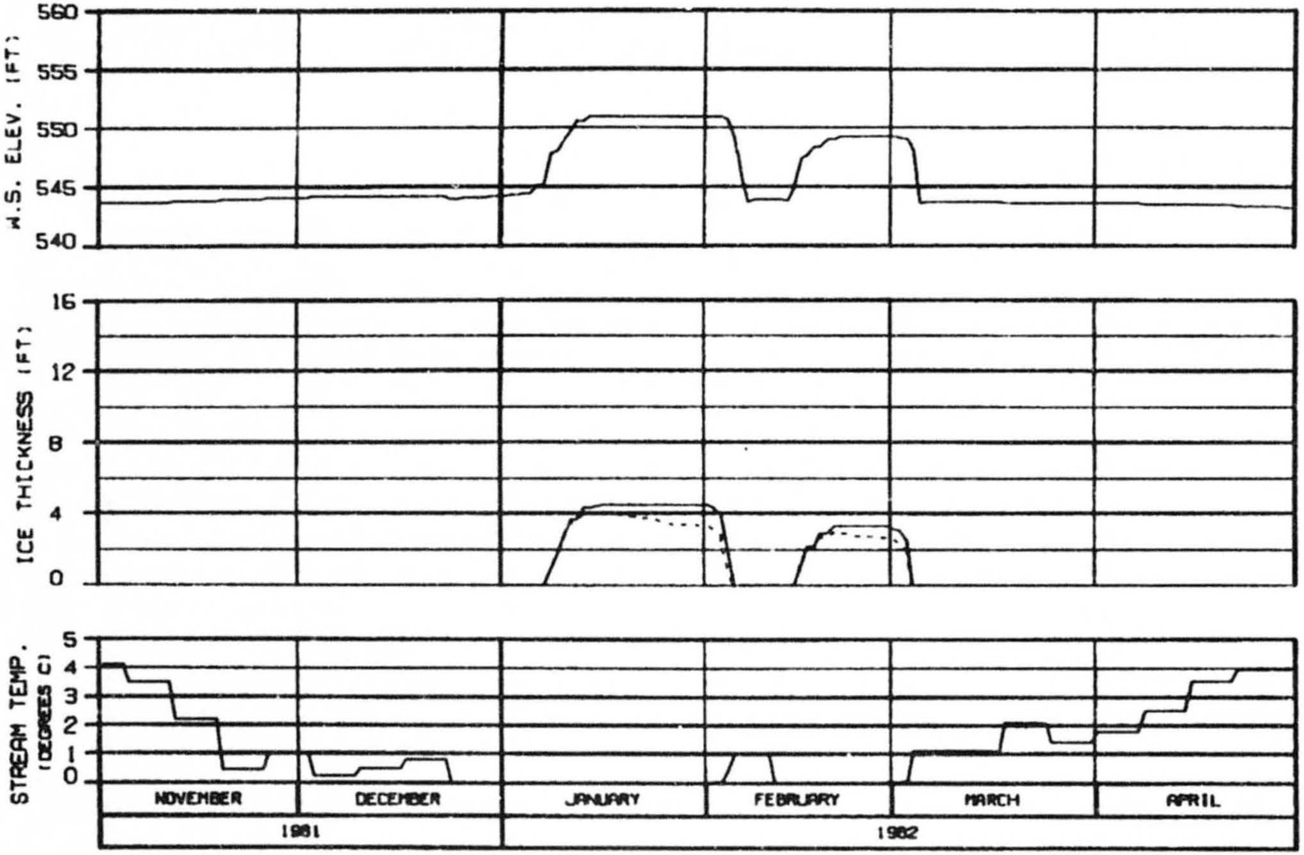


RIVER MILE : 120.00

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | [illegible] | 1[illegible].142



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

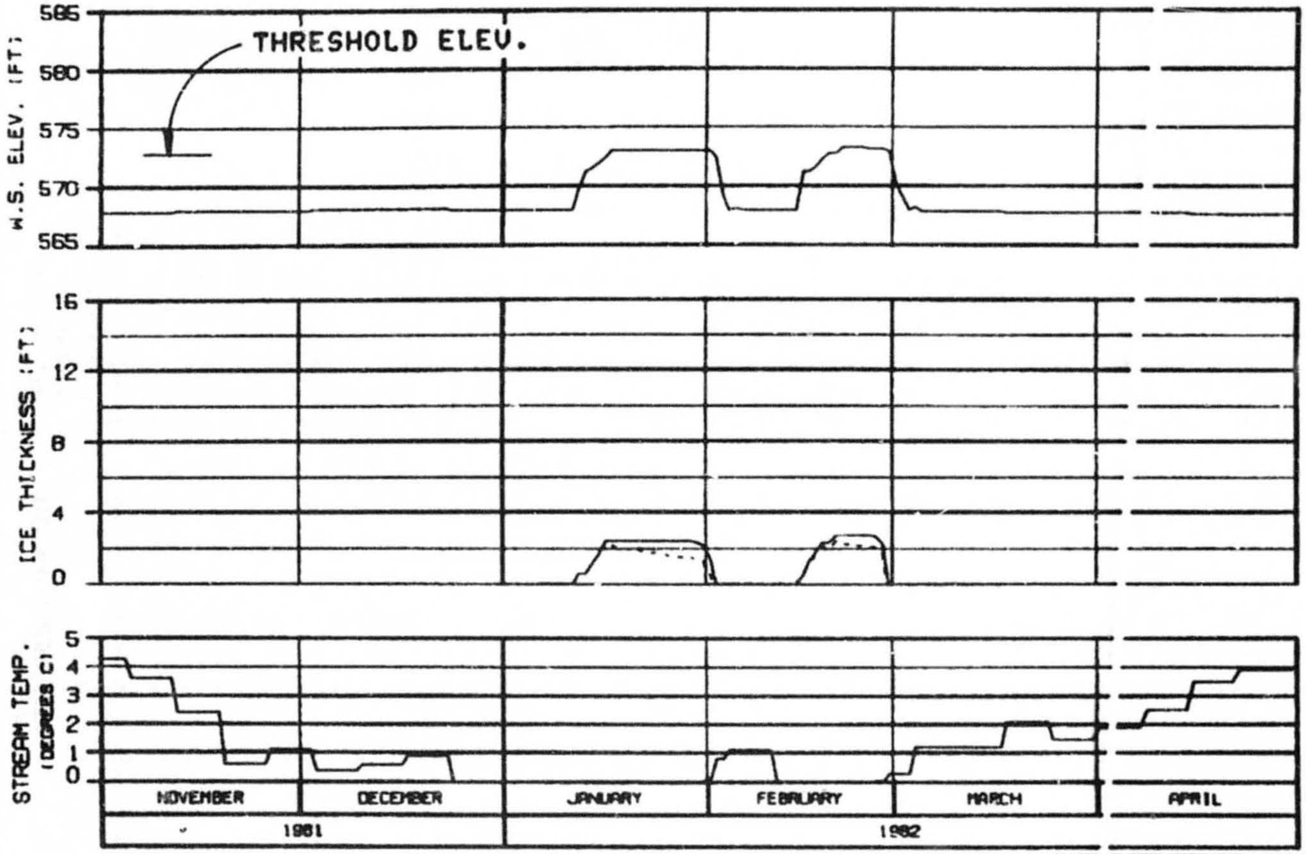
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | [illegible] | [illegible].142



HEAD OF SLOUGH 8A (WEST)

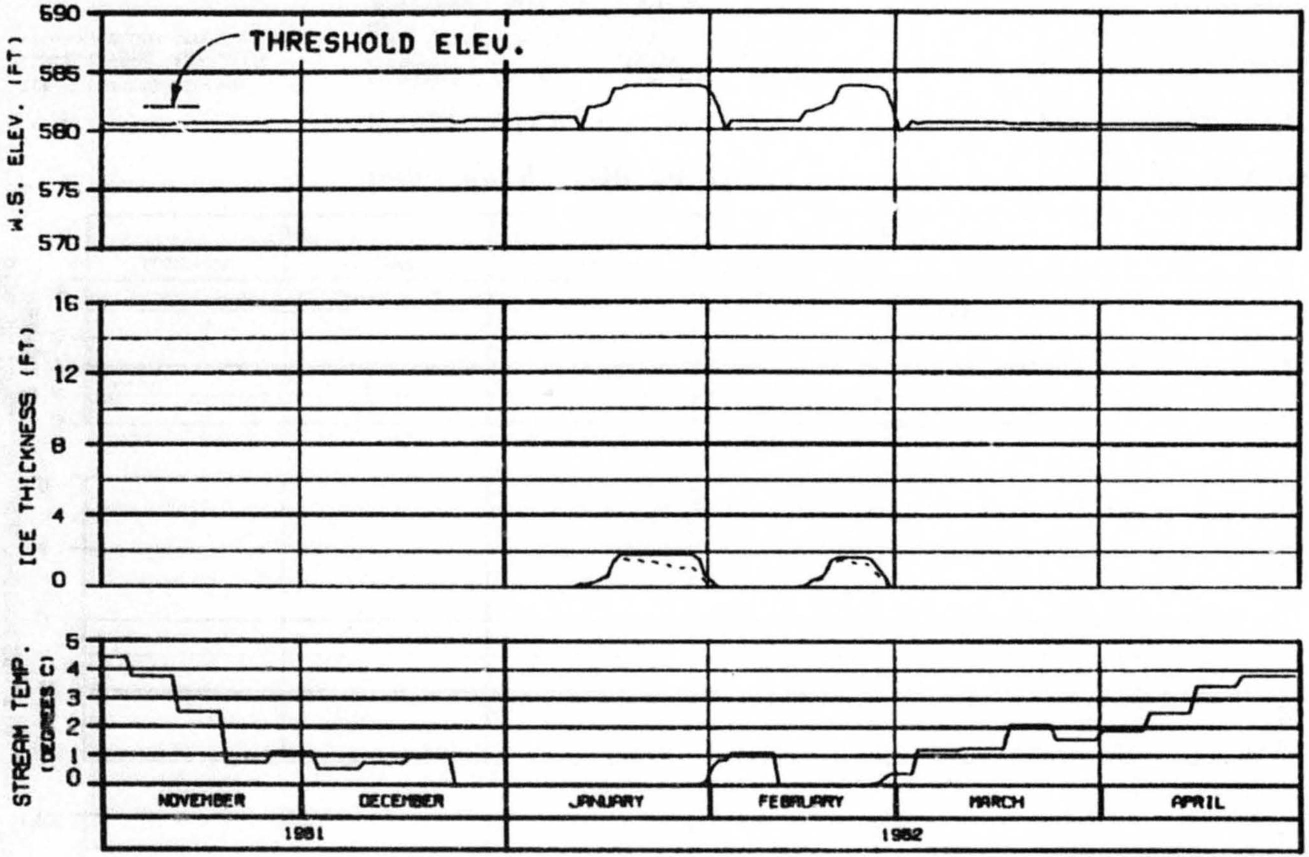
RIVER MILE : 126.10

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
1583.142	



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS · 1588.142

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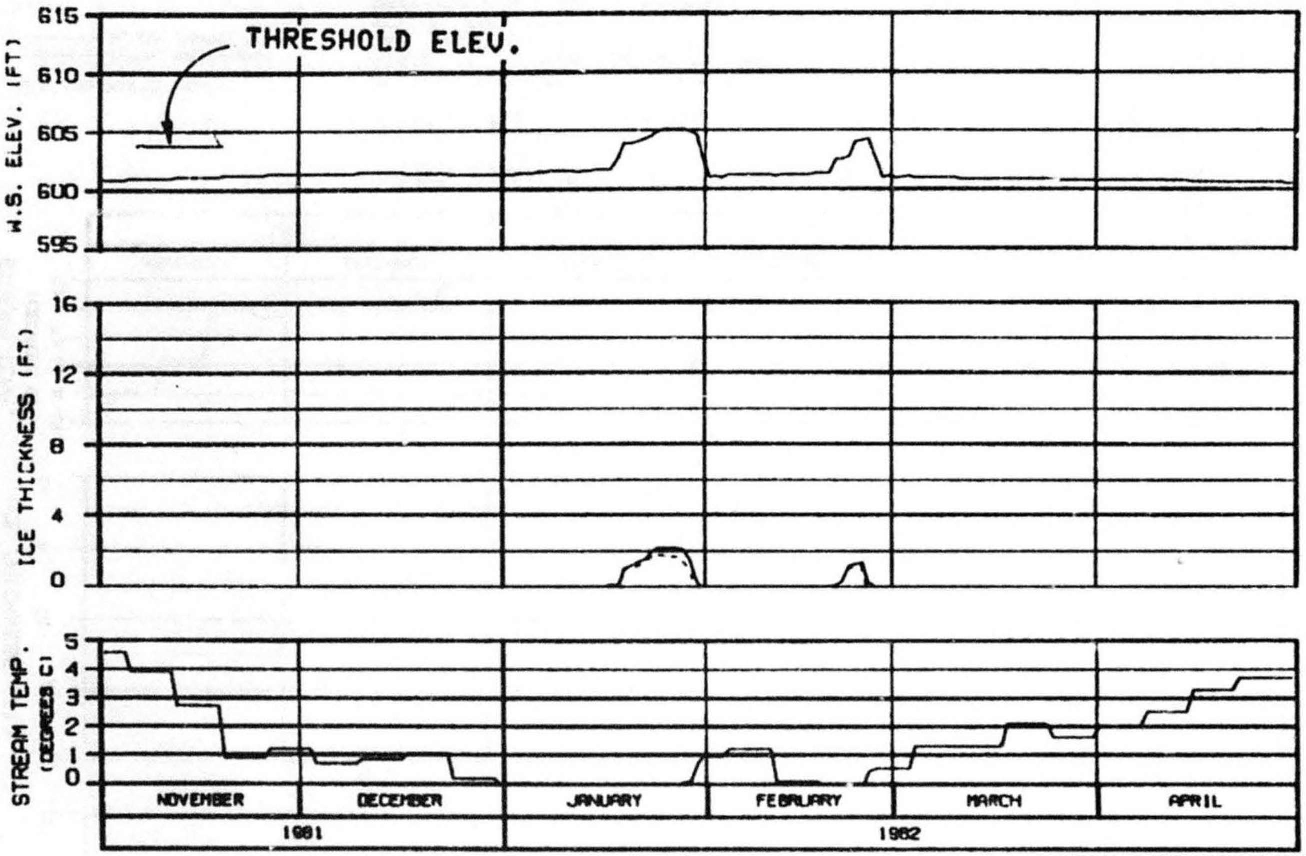


HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

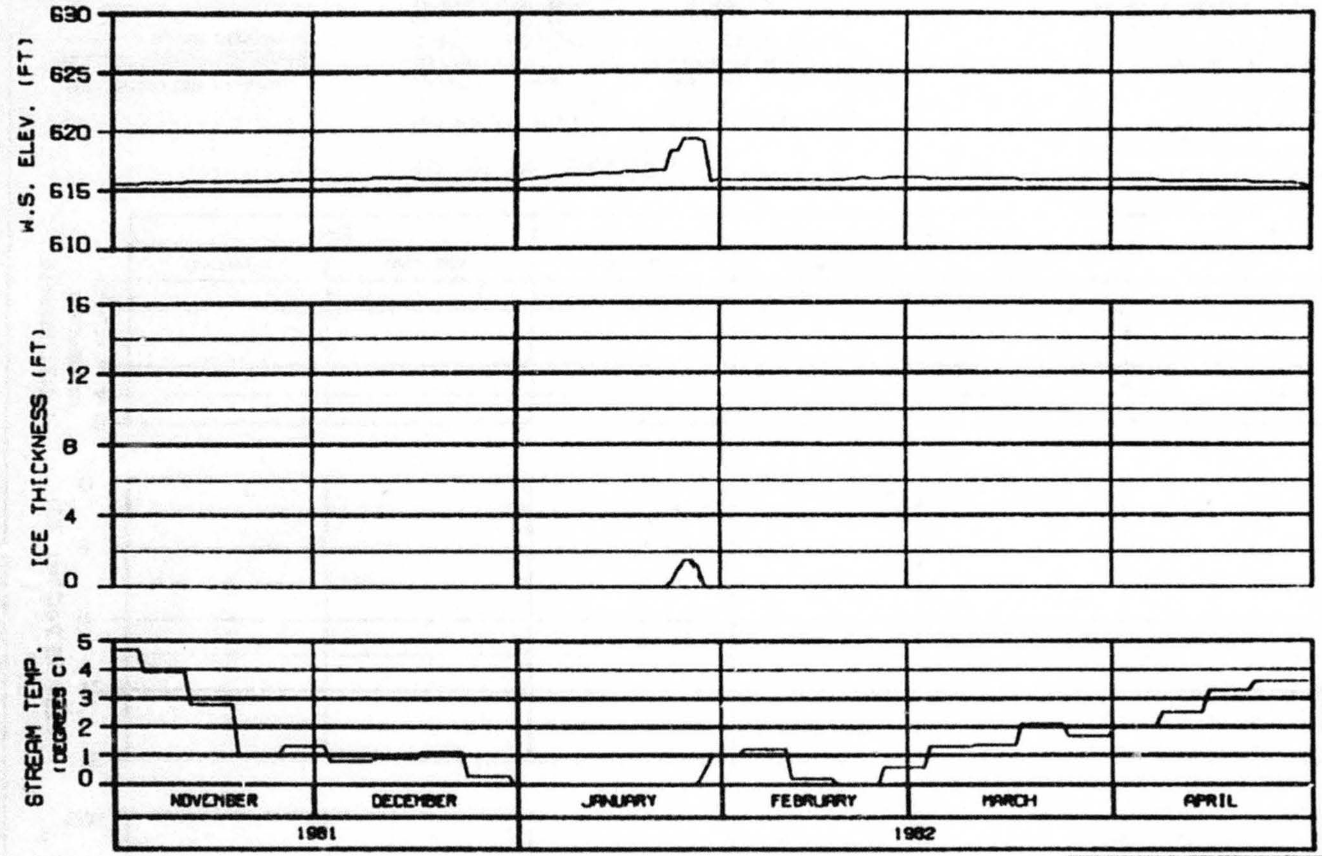
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	20 JUL 83	1663.142

OPTION?

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

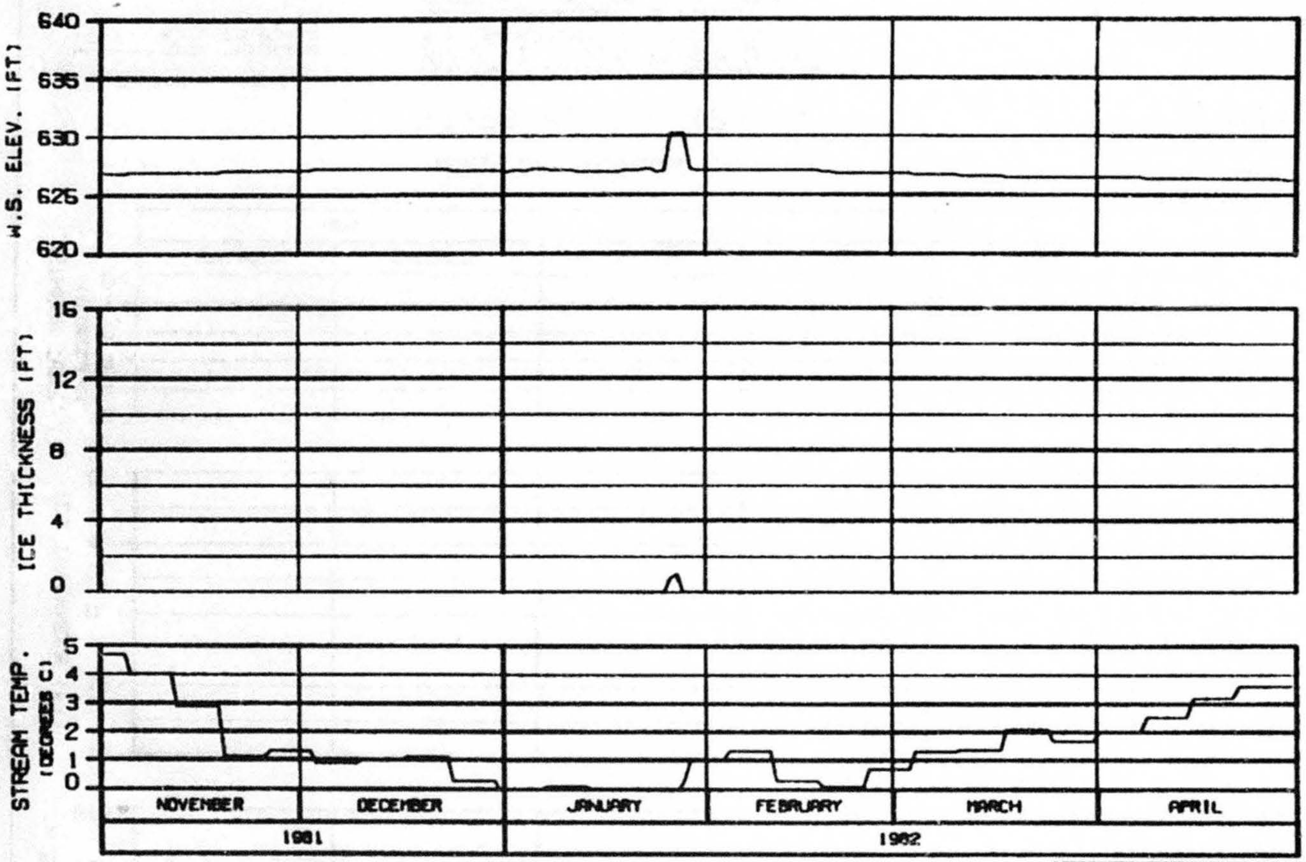
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

RIVER MILE : 131.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

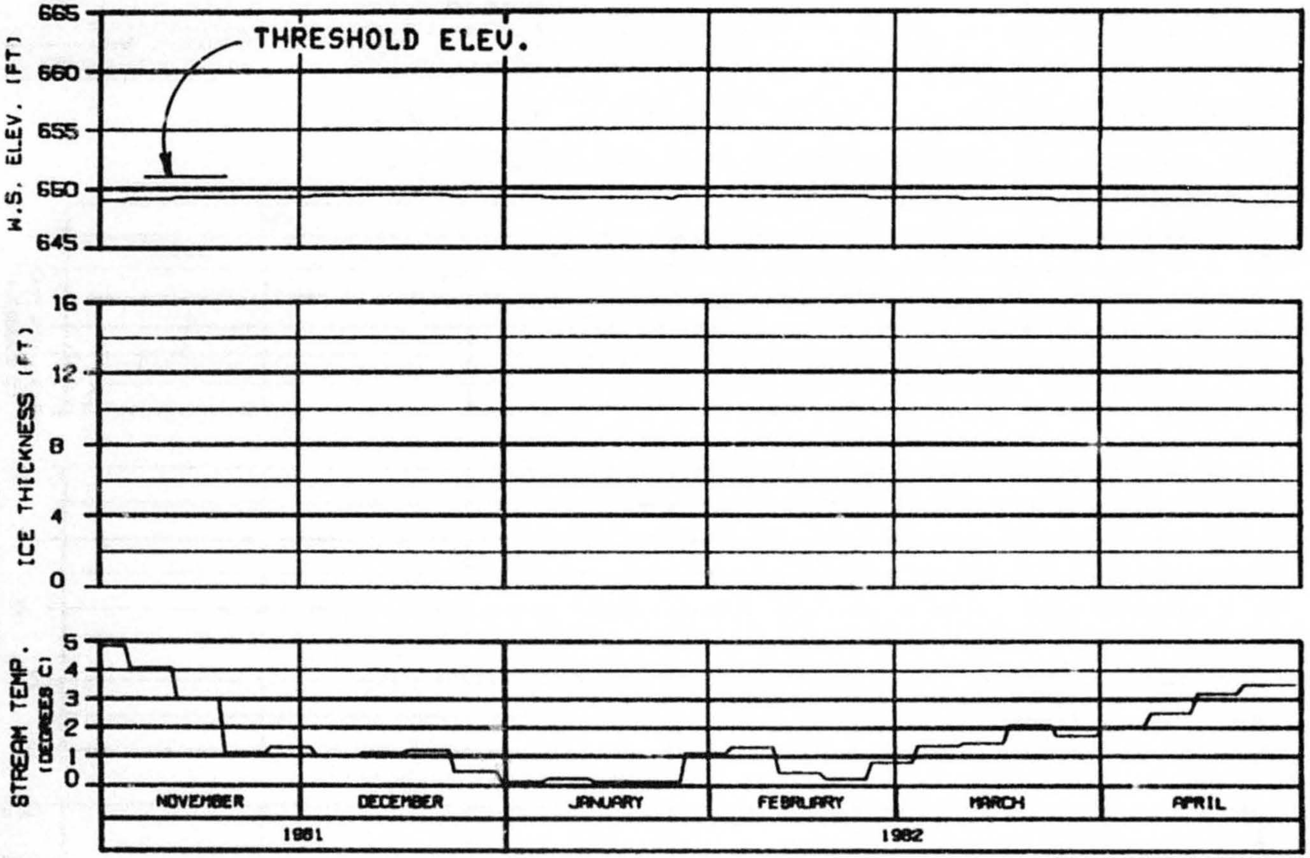
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



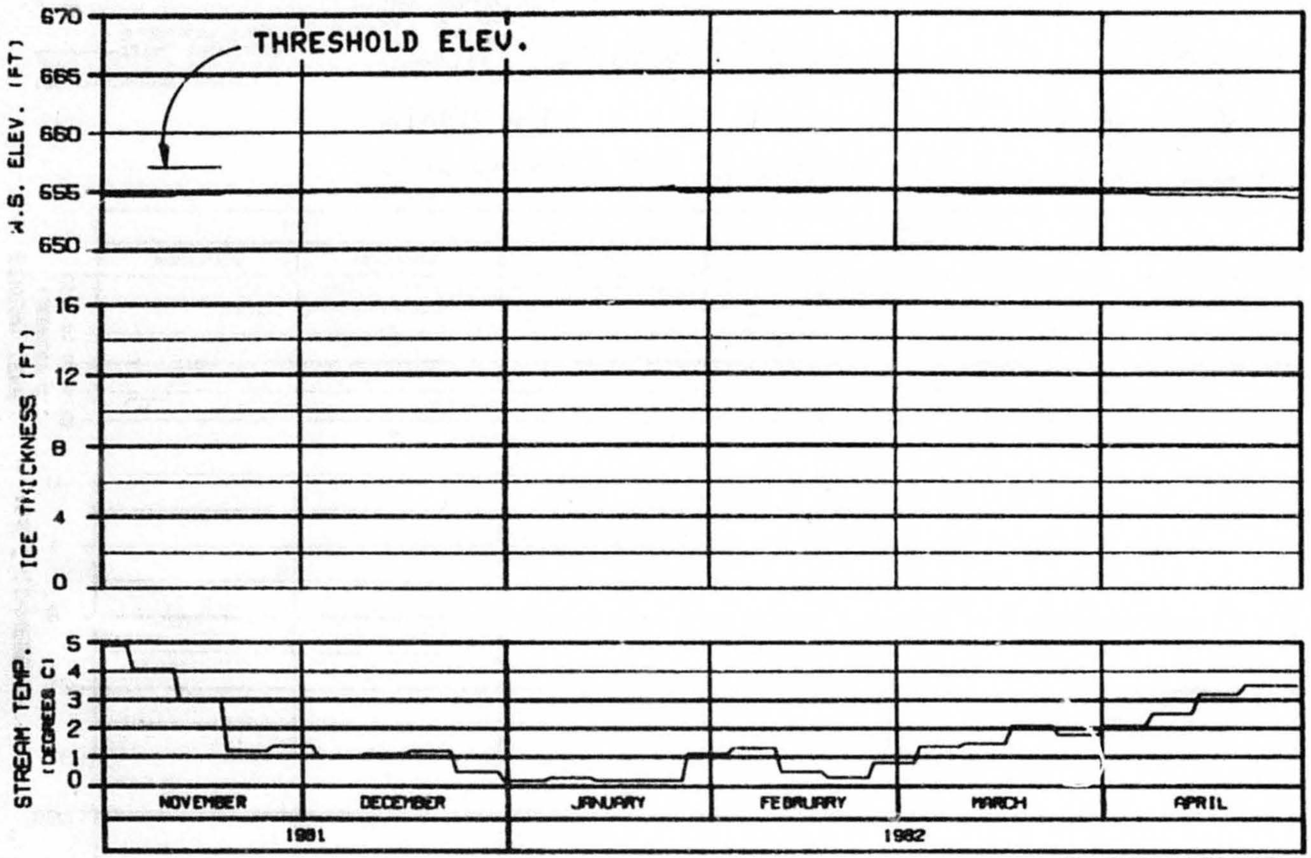
HEAD OF SLOUGH 9A

RIVER MILE : 133.70

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	1988.142



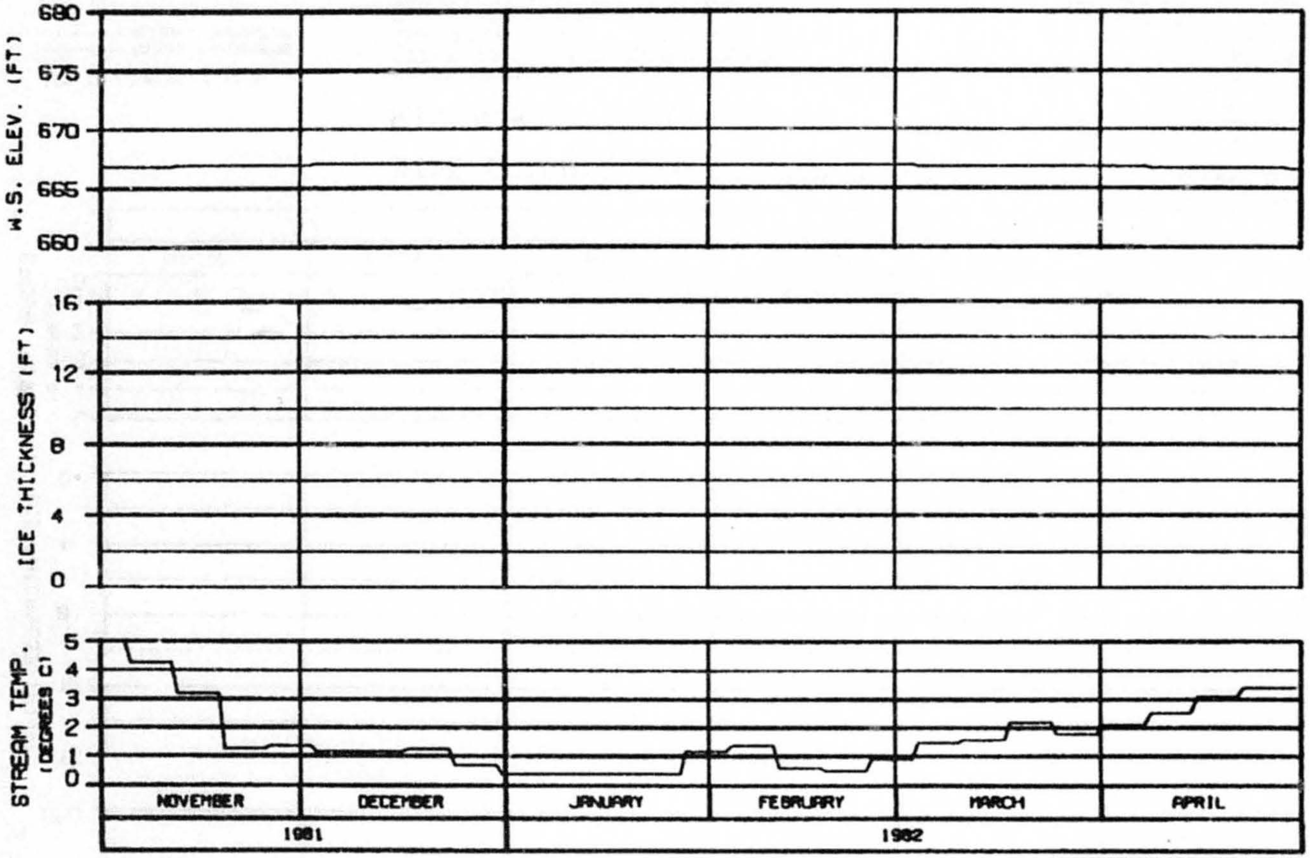
SIDE CHANNEL U/S OF SLOUGH 10

RIVER MILE : 134.30

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1983.142



SIDE CHANNEL D/S OF SLOUGH 11

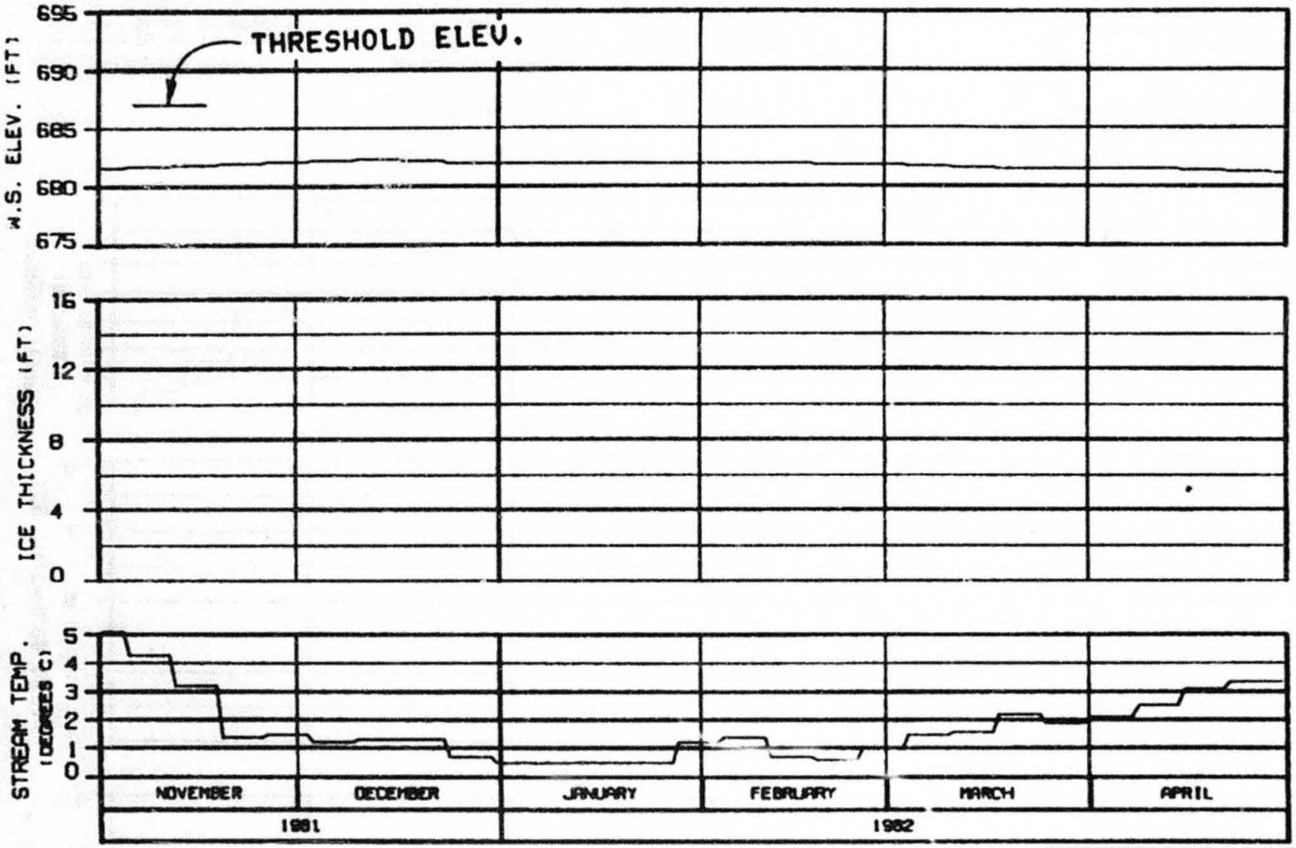
RIVER MILE : 135.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1983.142



HEAD OF SLOUGH 11

RIVER MILE : 136.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

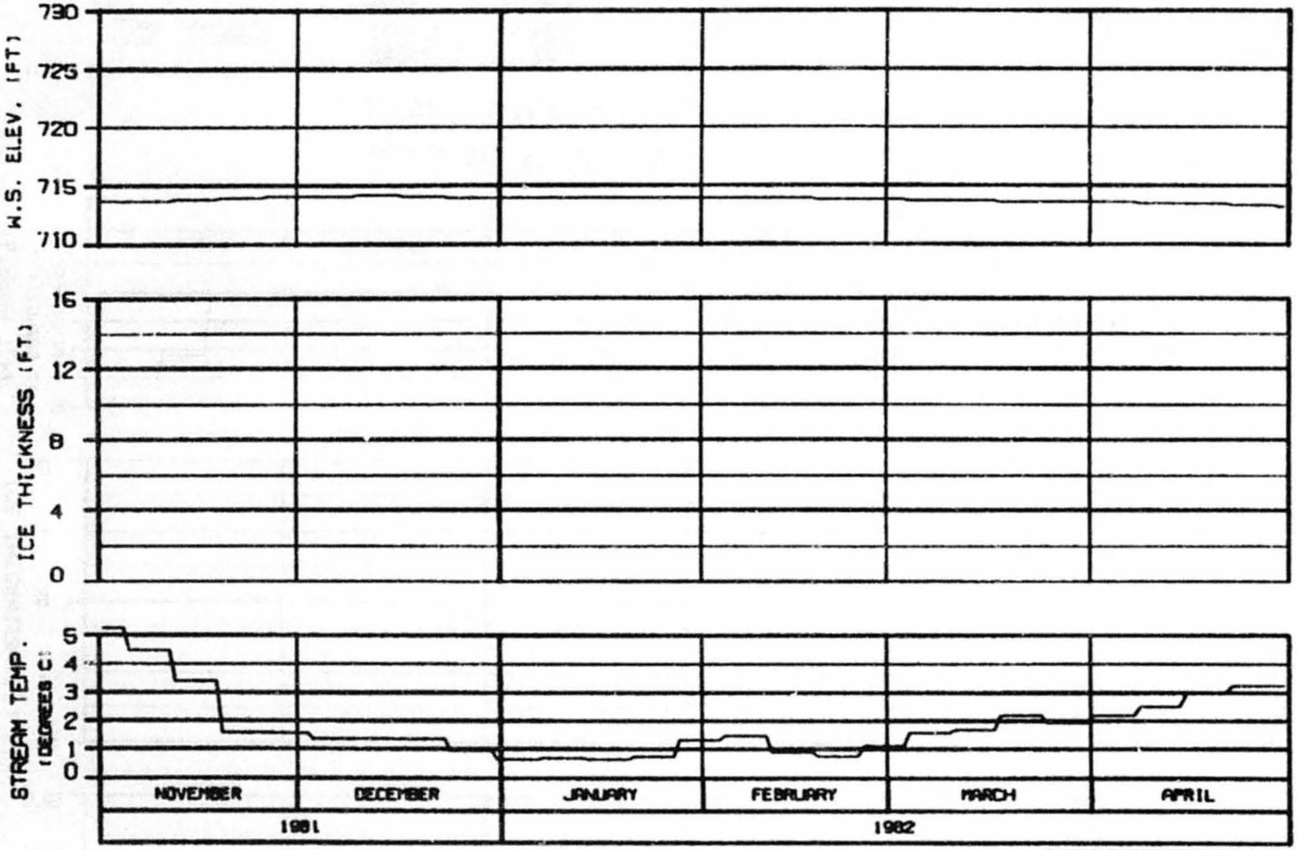
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 17

RIVER MILE : 139.30

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ICE THICKNESS LEGEND:

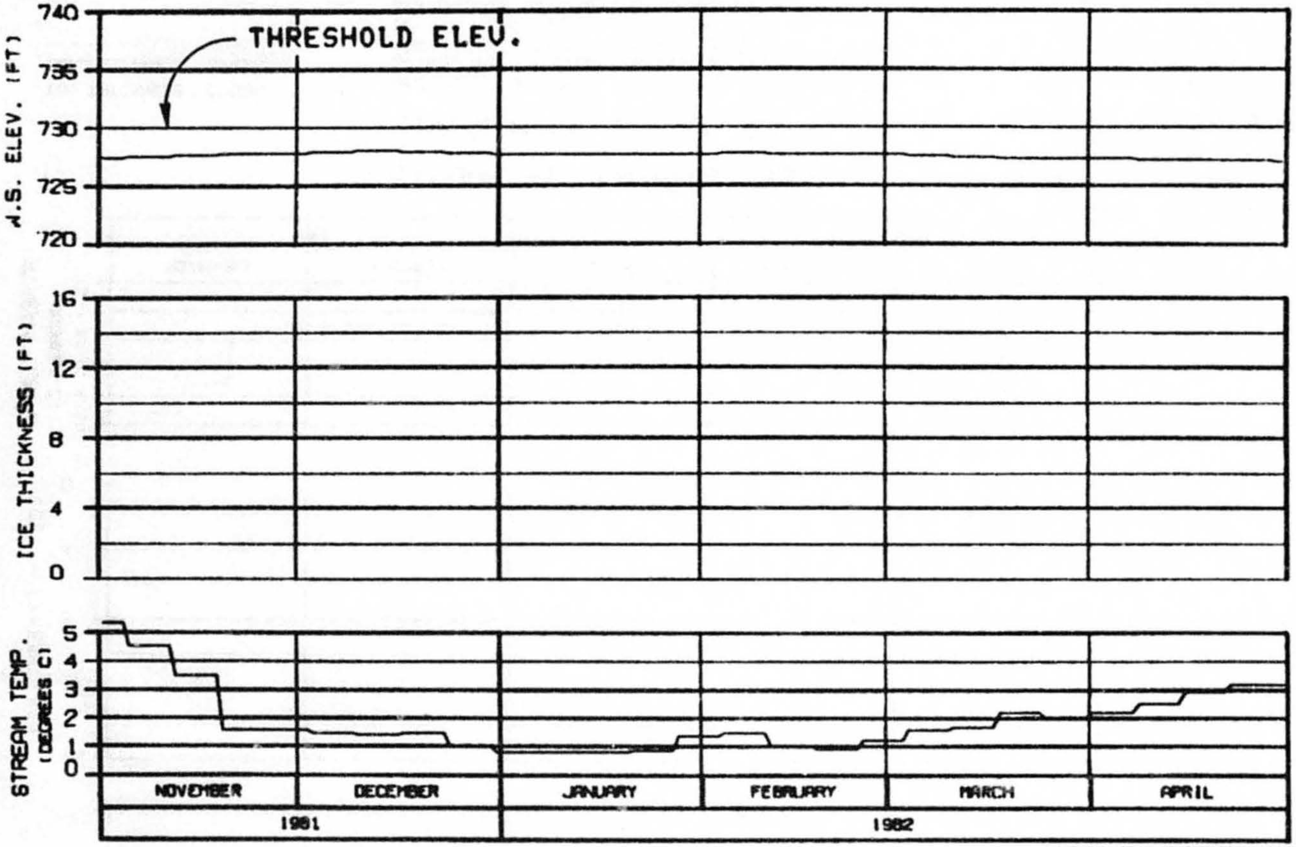
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



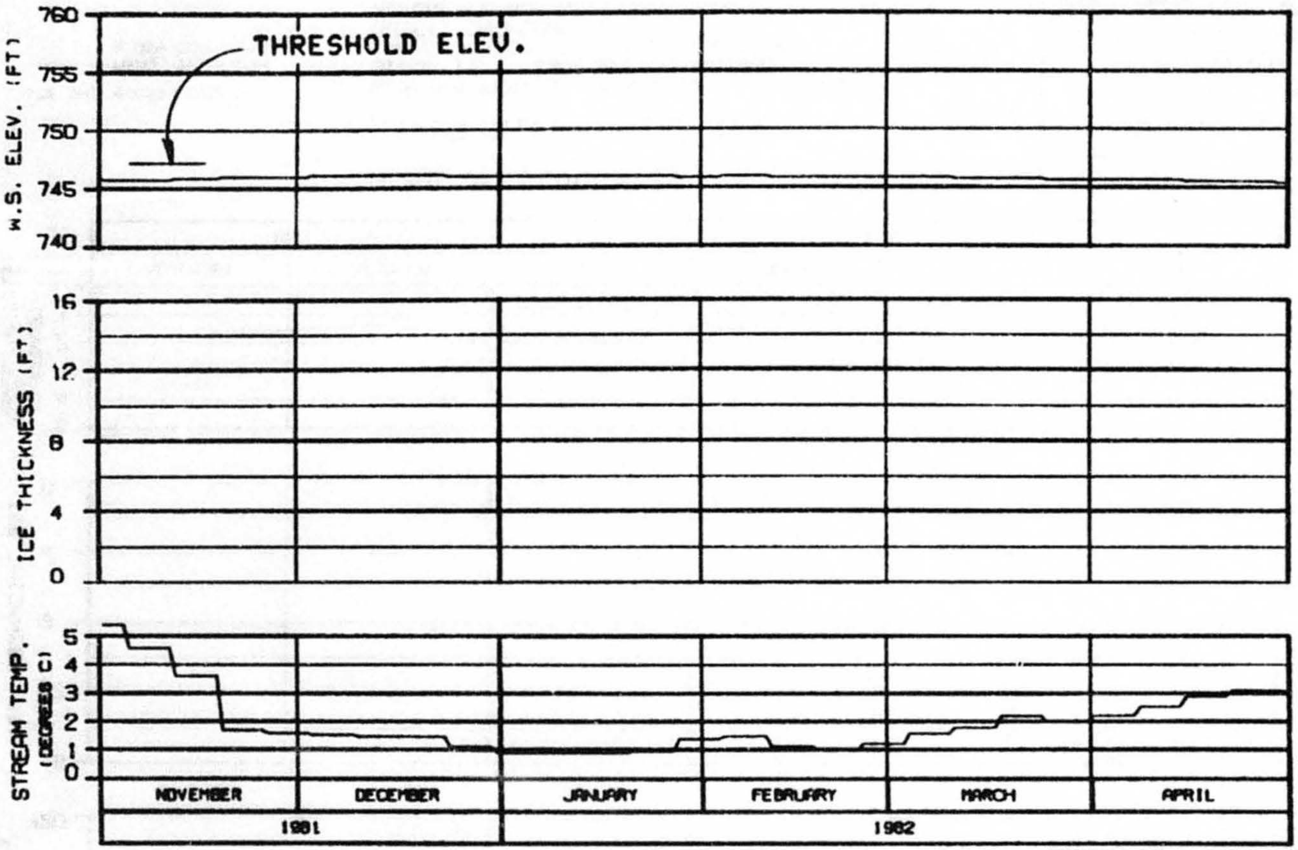
HEAD OF SLOUGH 20

RIVER MILE : 140.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	30 JUL 85	1983.142



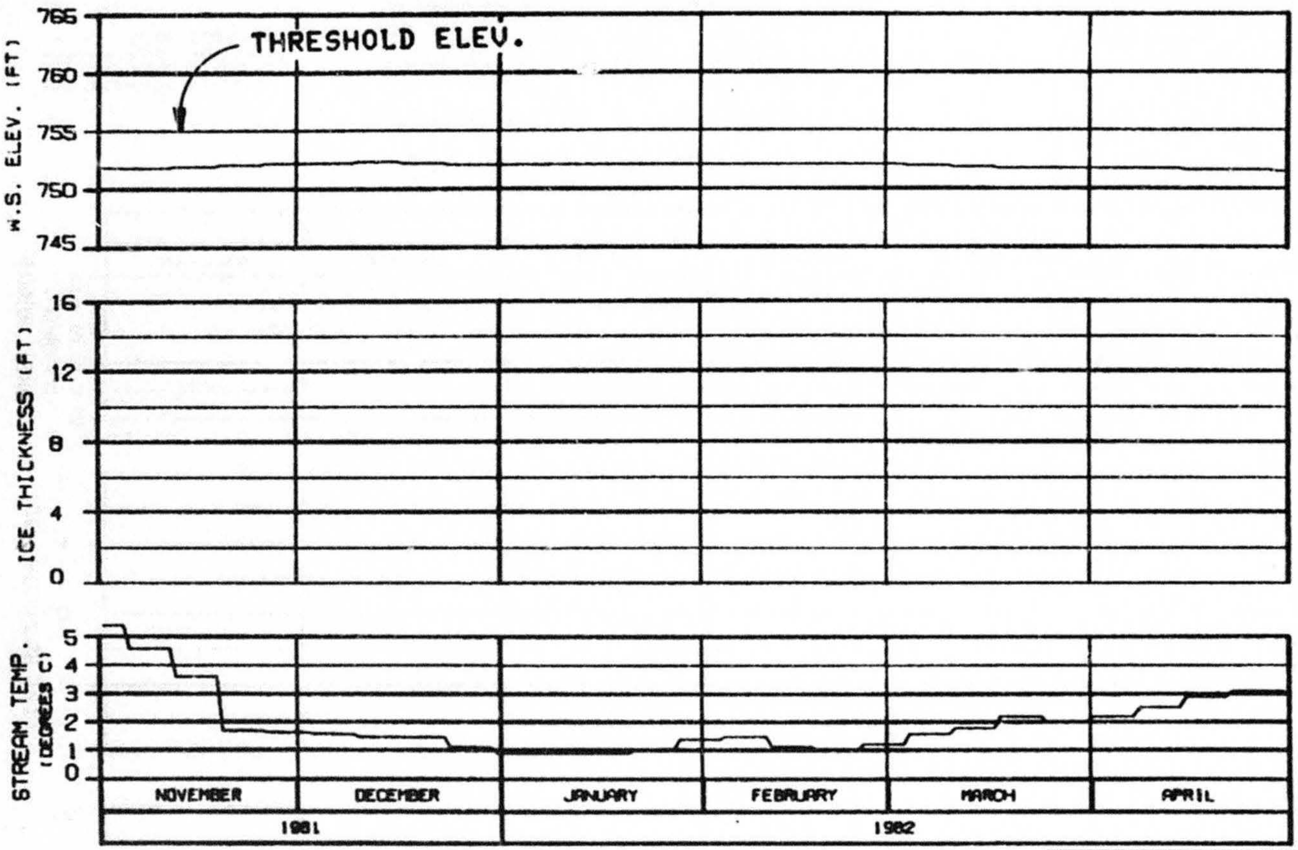
SLOUGH 21 (ENTRANCE A6)

RIVER MILE : 141.80

ICE THICKNESS LEGEND:
—— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 21

RIVER MILE : 142.20

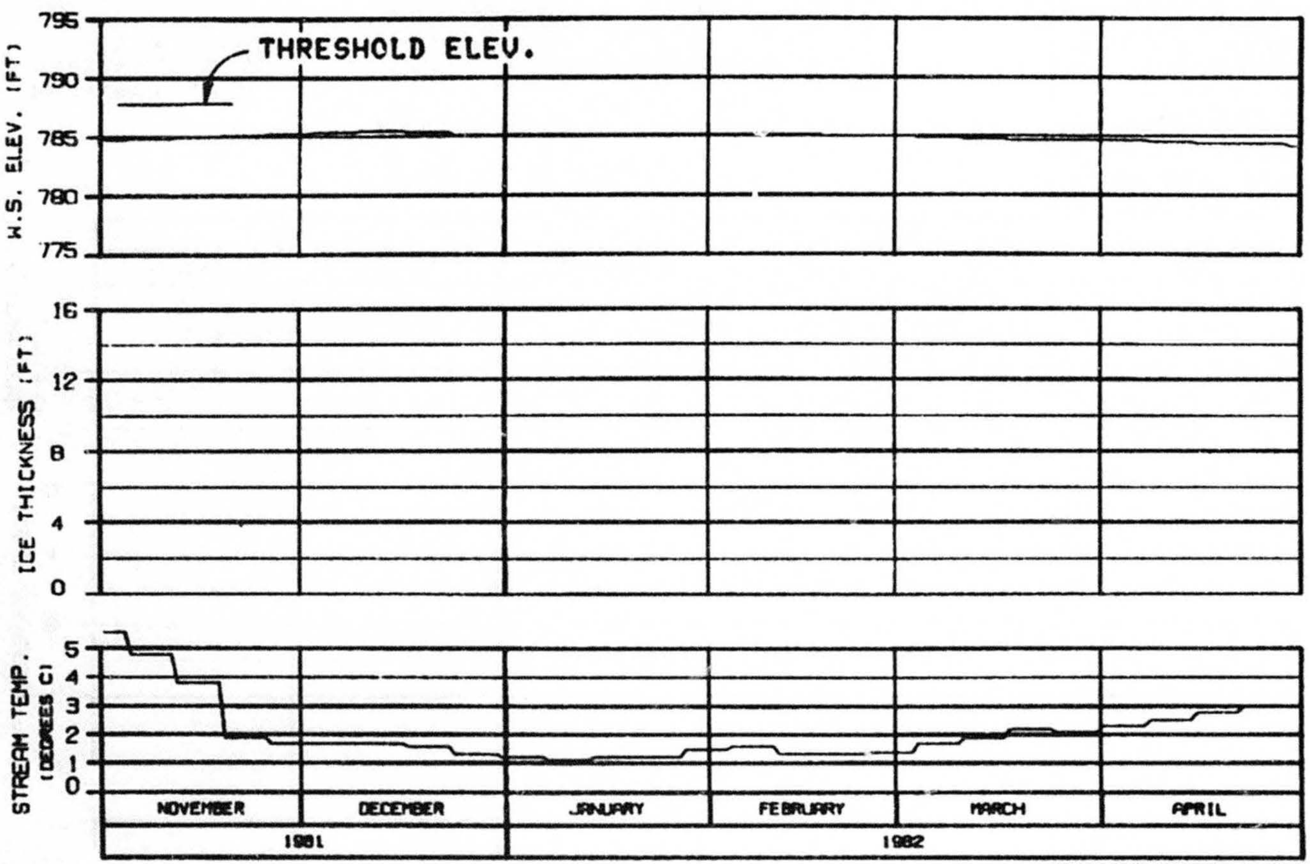
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN, 2 PORTS
REFERENCE RUN NO. : 8102ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
1983.142

c



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:
—————— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD . 1 NOV 81 - 30 APR 82
STAGE II 2002 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8102ENX

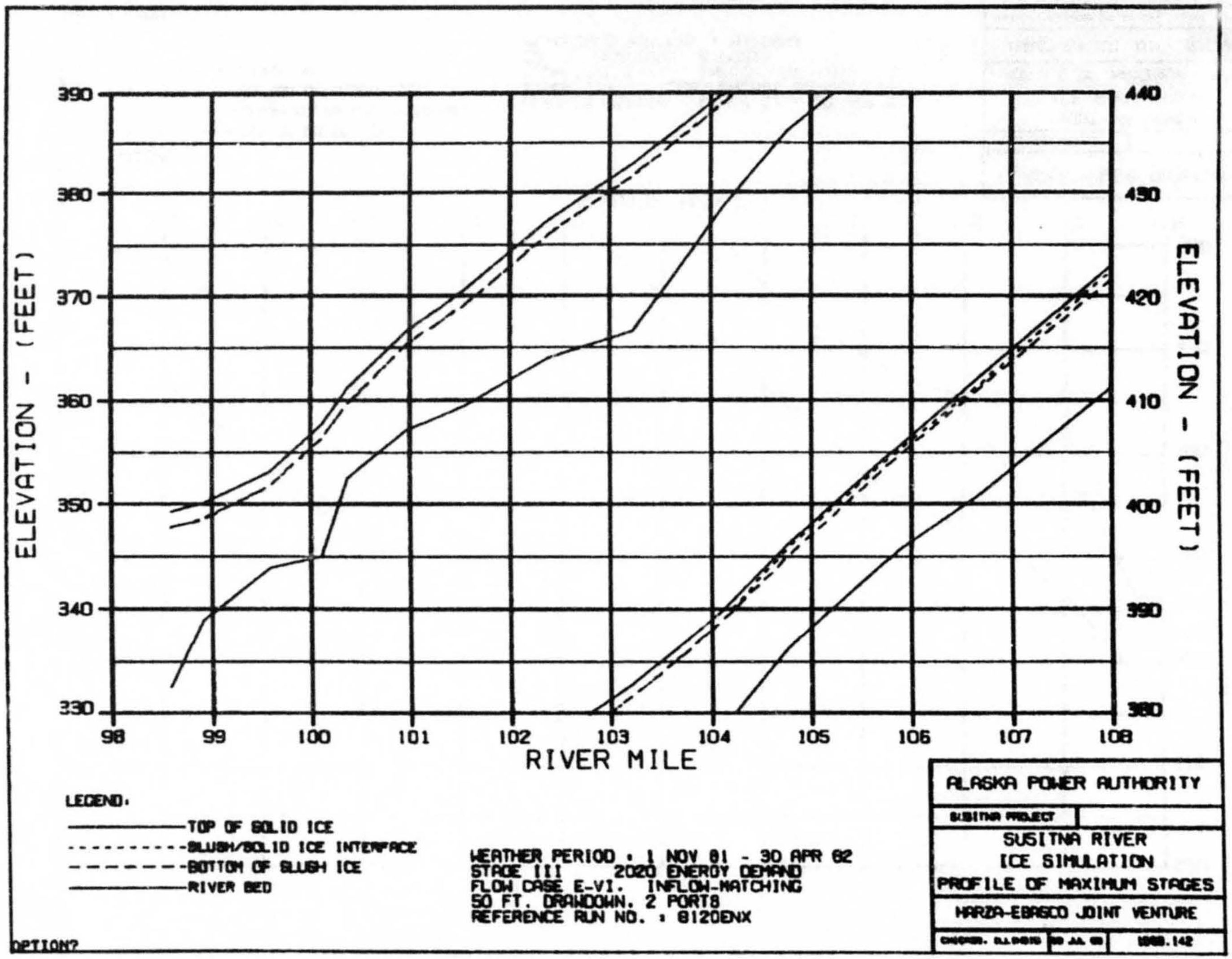
ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS 89 JUL 86	1989.142

OPTION?

EXHIBIT C

EXHIBIT C

c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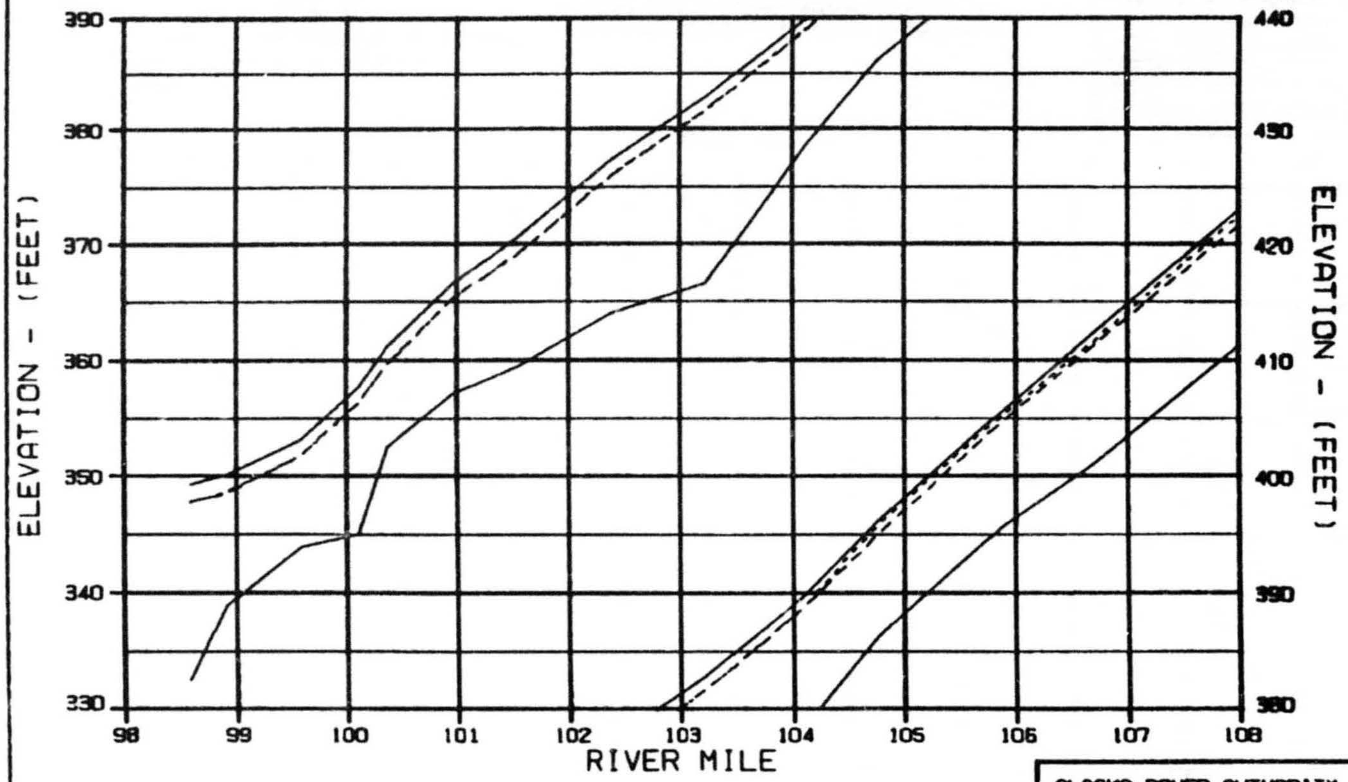
410
400
390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
98
99
100
101
102
103
104
105
106
107
108
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN, 2 PORTS
REFERENCE RUN NO. : 8120ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

EXHIBIT C

C



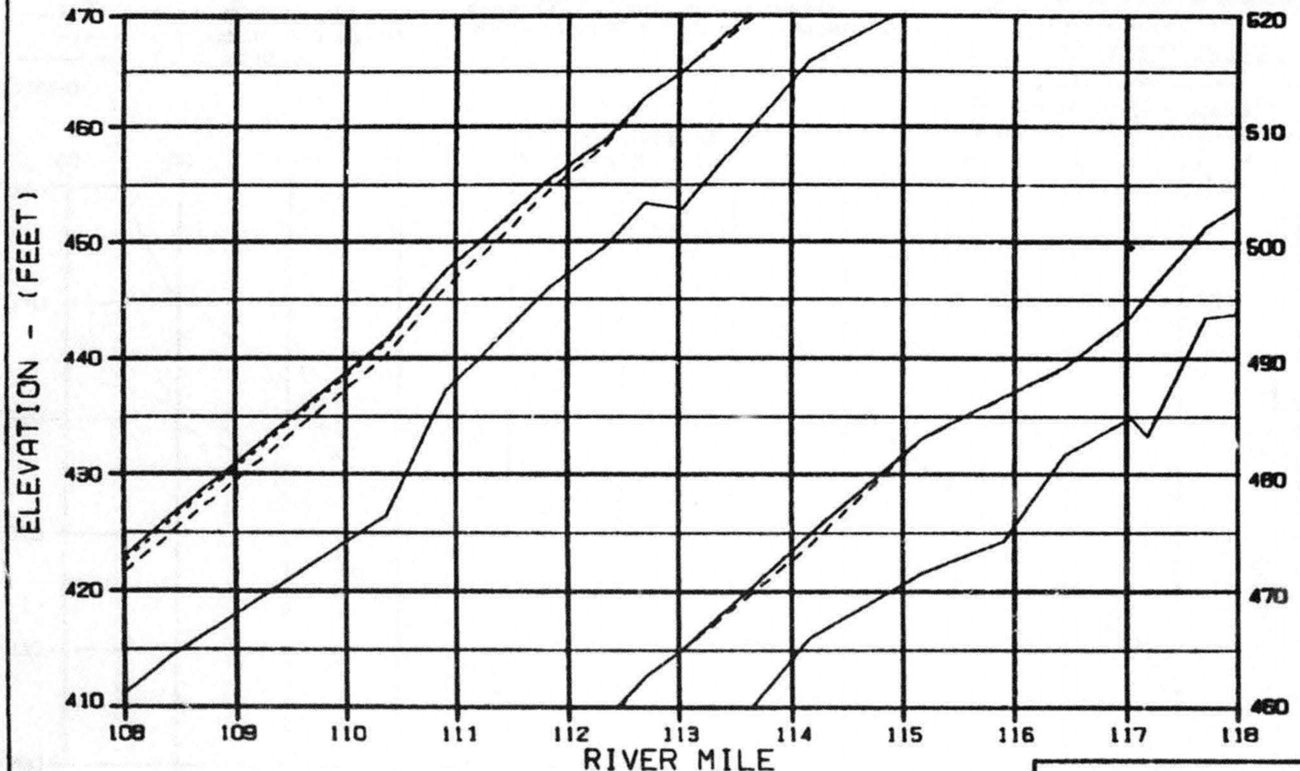
LEGEND:

- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	[illegible]	[illegible]

OPTION?



LEGEND:

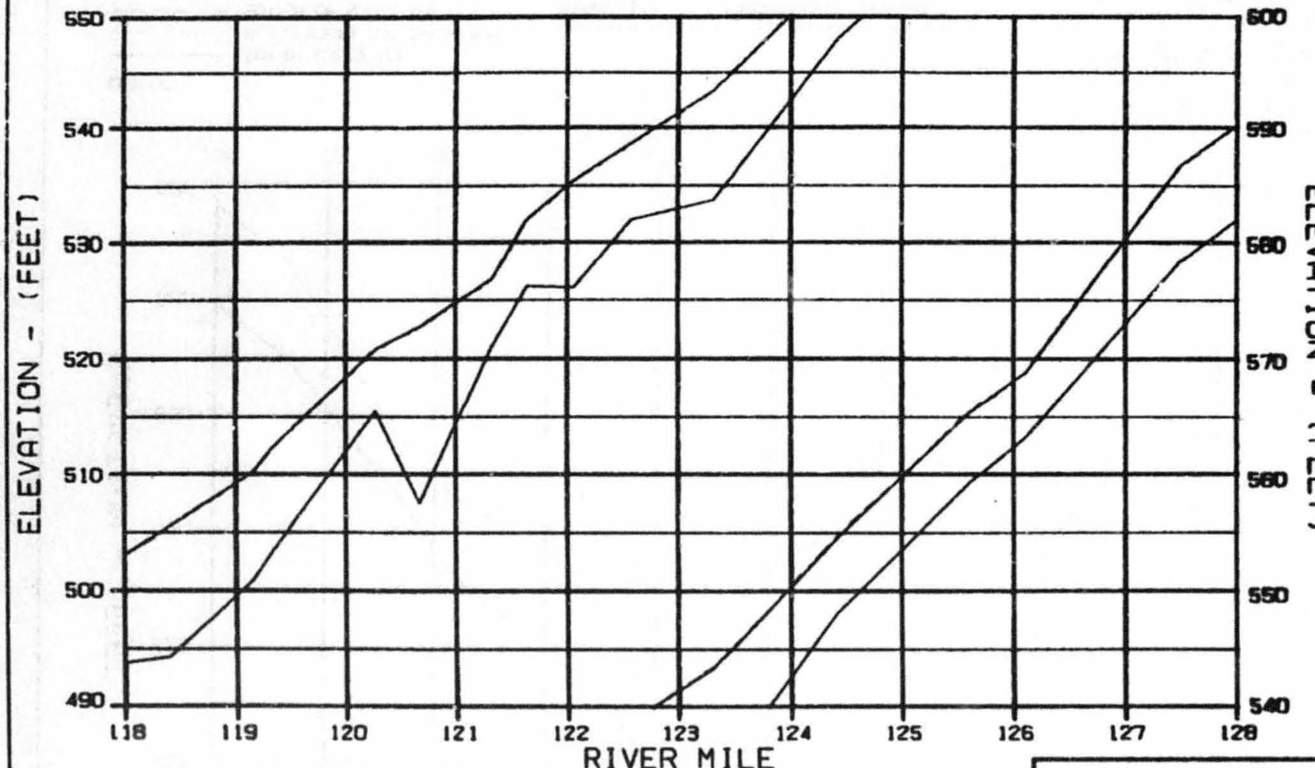
- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES		
HARZA-EBASCO JOINT VENTURE		
CHECKED: [illegible]	[illegible]	1988.142

OPTION?OPTION?

C



LEGEND:

- TOP OF SOLID ICE
- SLUSH/SOLID ICE INTERFACE
- BOTTOM OF SLUSH ICE
- RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY

SUSITNA PROJECT

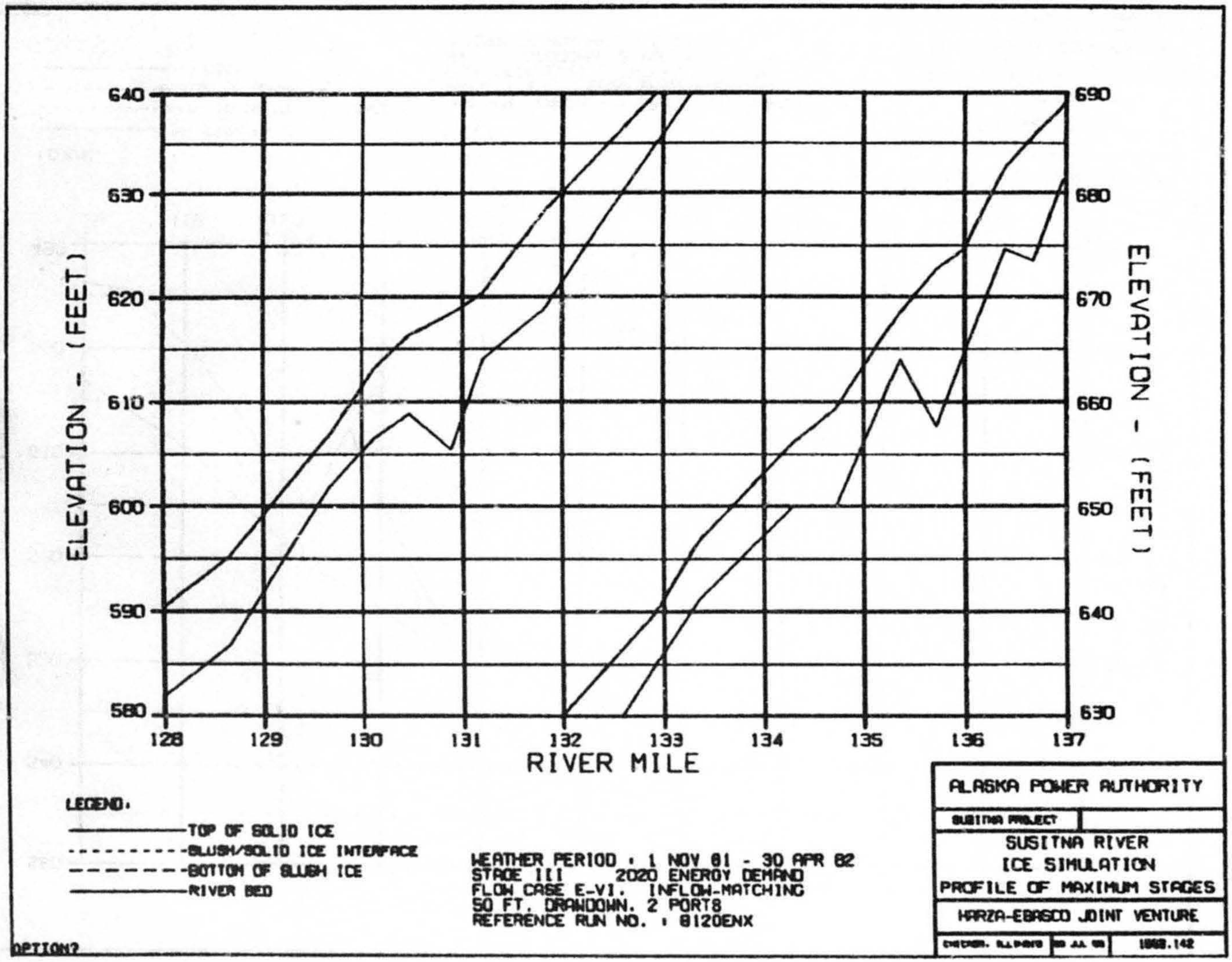
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

1063.142

OPTION?

c



640
630
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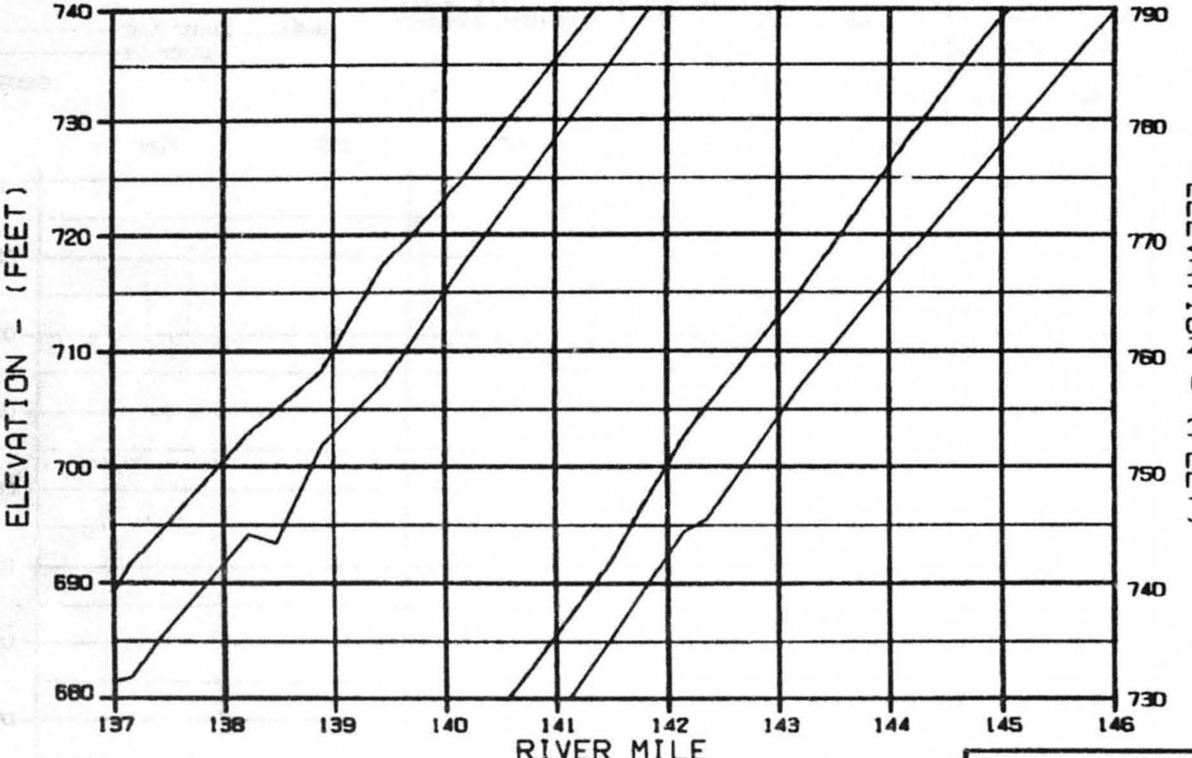
640
630
ELEVATION - (FEET)
ELEVATION - (FEET)
128
129
130
131
132
133
134
135
136
137
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

OPTION?

c



LEGEND:

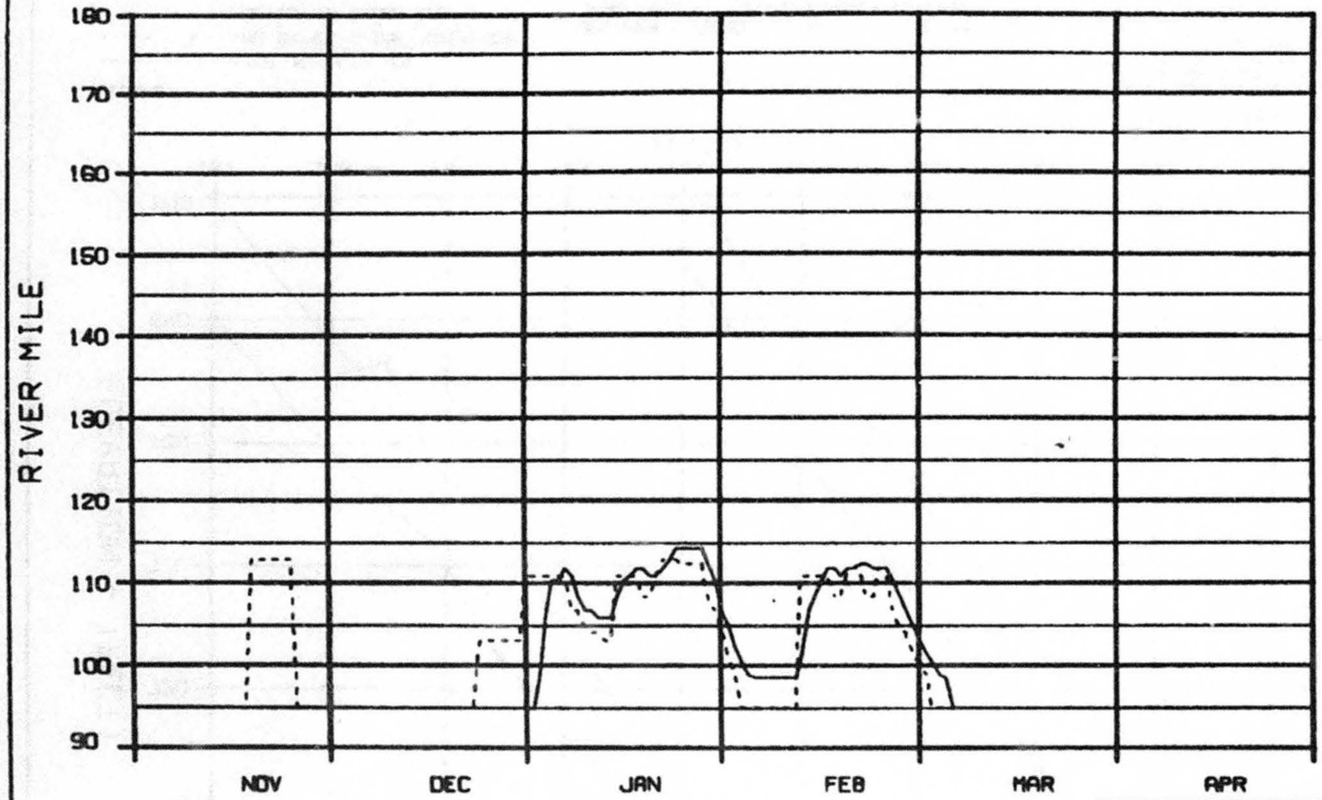
- ————— TOP OF SOLID ICE
- - - - - - - SLUSH/SOLID ICE INTERFACE
- — — — — BOTTOM OF SLUSH ICE
- ————— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI. INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	[illegible]	1988.142

OPTION?

c



LEGEND:

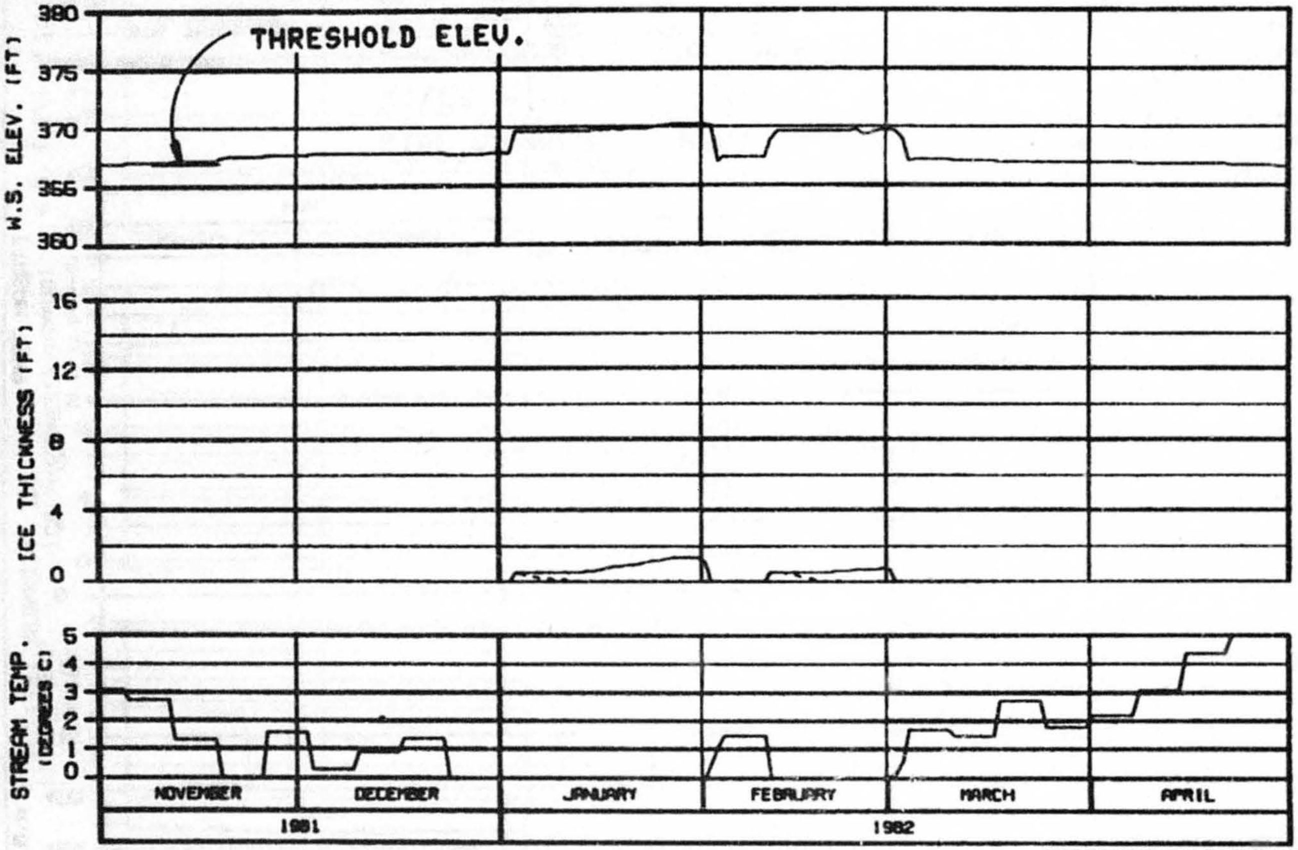
——————— ICE FRONT

- - - - - - - - - ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
FLOW CASE E-VI . INFLOW-MATCHING
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

OPTION?

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER PROGRESSION OF ICE FRONT & ZERO DEGREE ISOTHERM		
HARZA-EBASCO JOINT VENTURE		
[illegible]	[illegible]	[illegible].142



HEAD OF WHISKERS SLOUGH

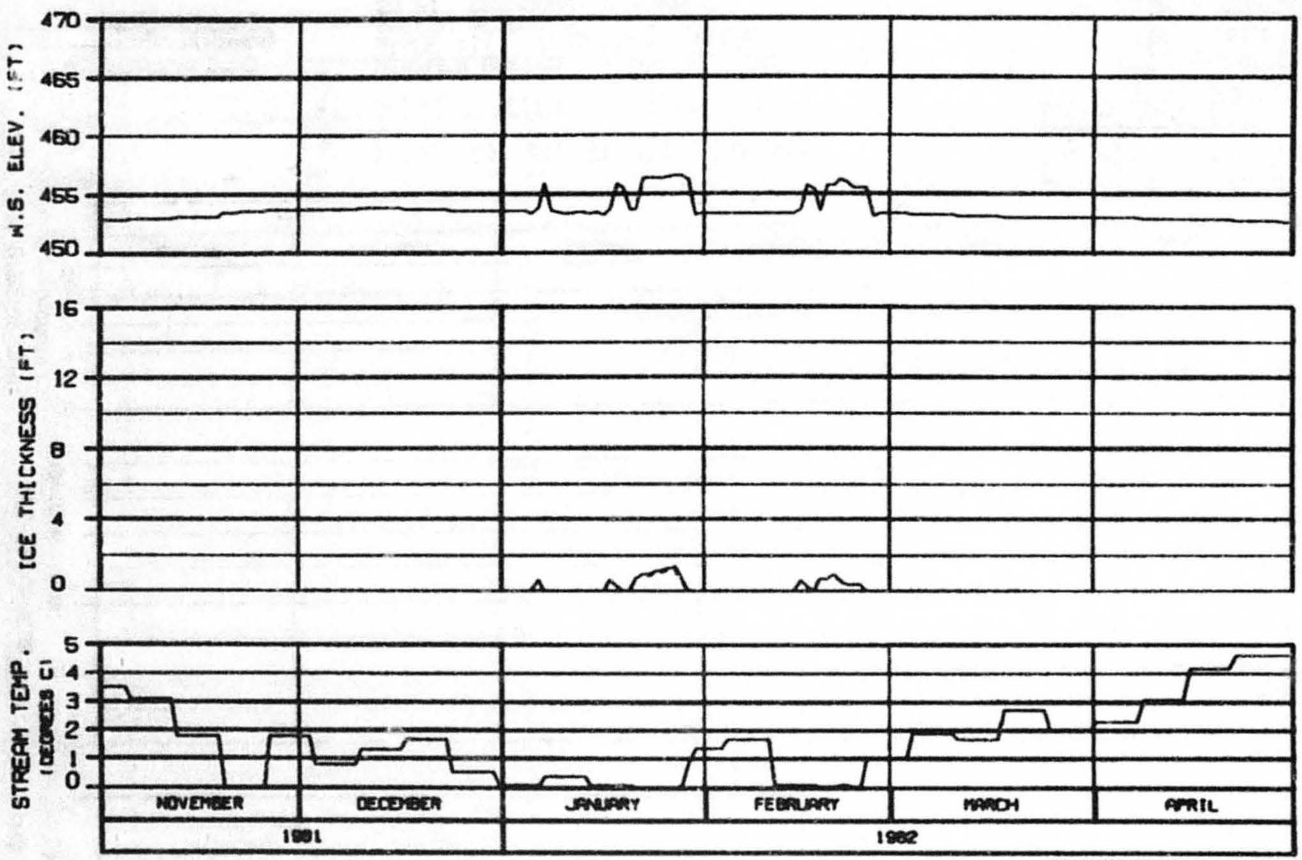
RIVER MILE : 101.50

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE



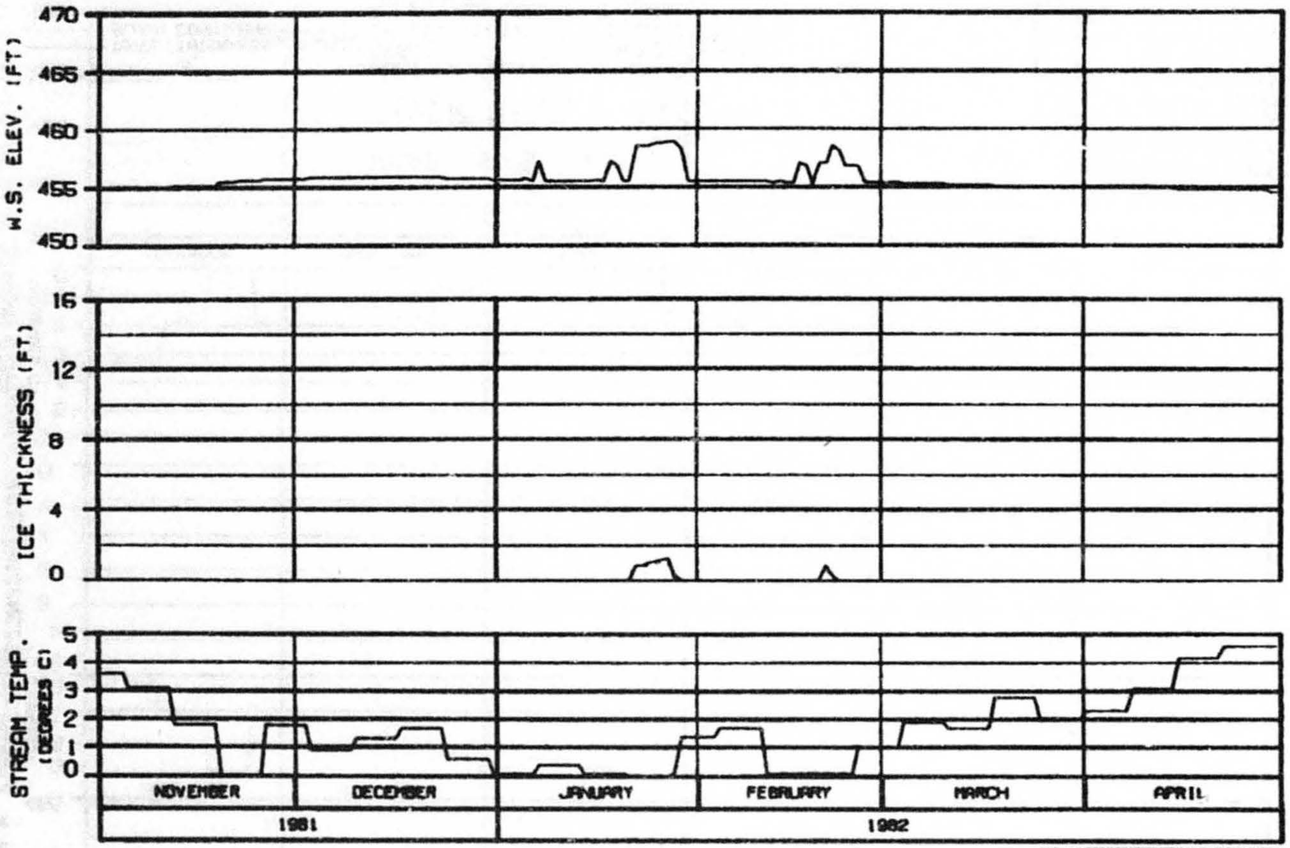
SIDE CHANNEL AT HEAD OF GASH CREEK

RIVER MILE : 112.00

ICE THICKNESS LEGEND:
———— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
1669.142



MOUTH OF SLOUGH 6A

RIVER MILE : 112.34

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

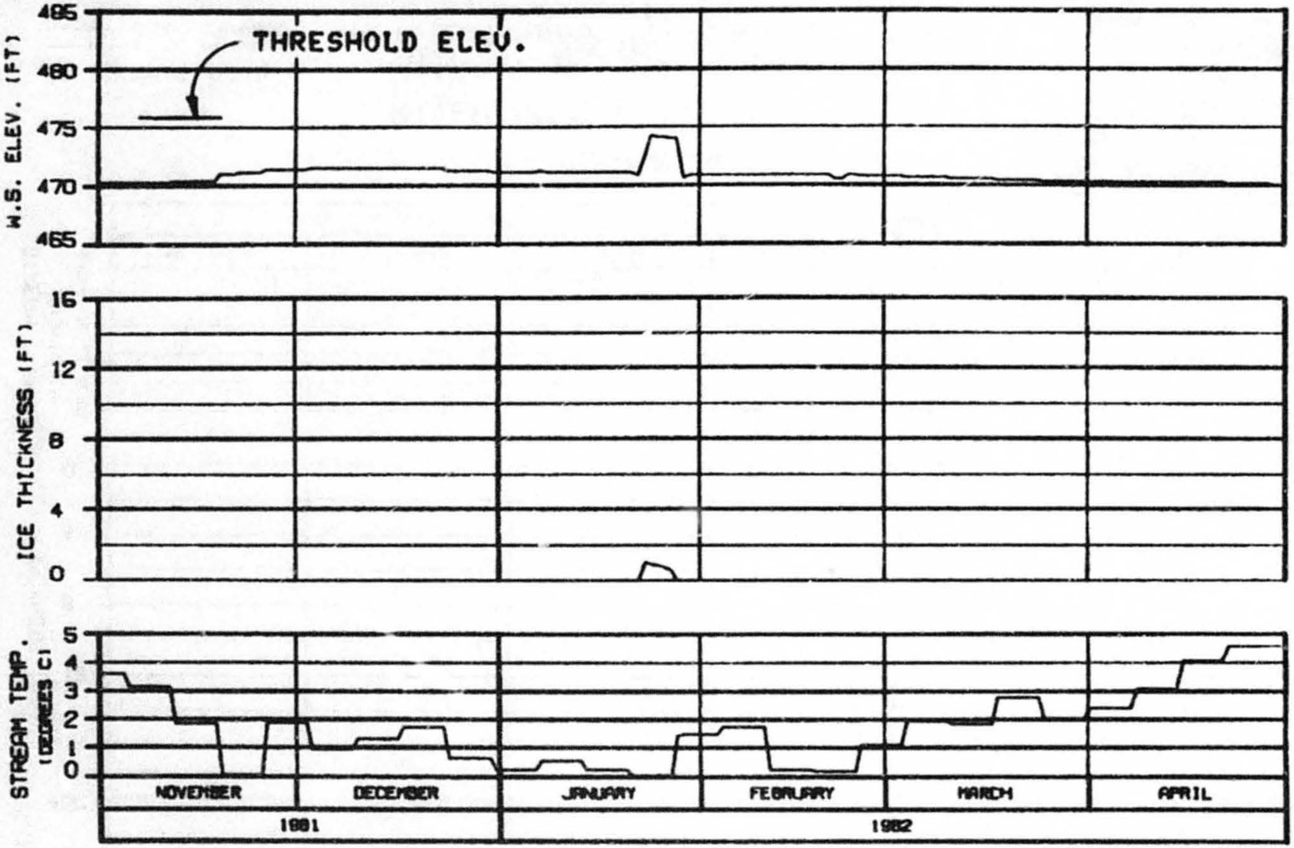
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1889.142

OPTION?



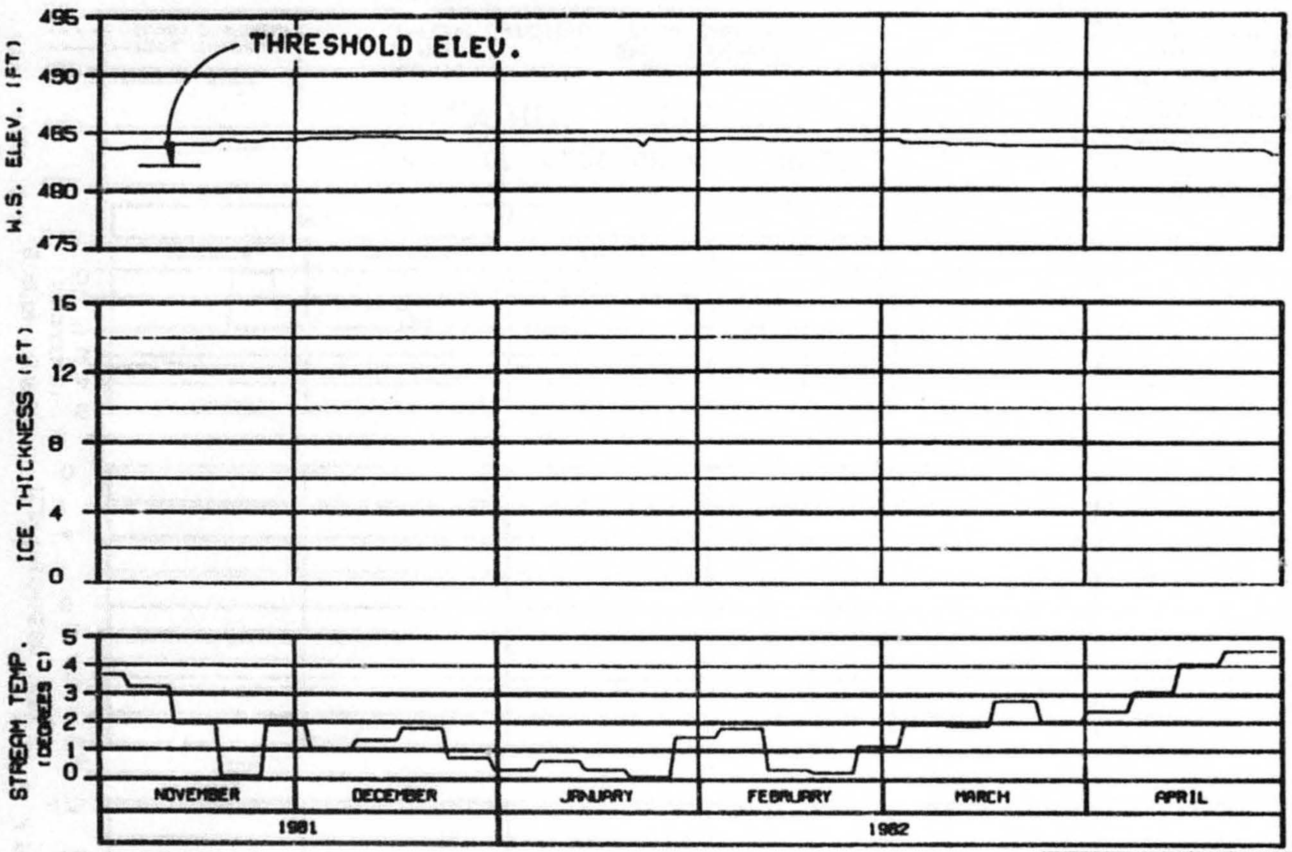
HEAD OF SLOUGH 8

RIVER MILE : 114.10

ICE THICKNESS LEGEND:
—— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS · [illegible] · 1983.142



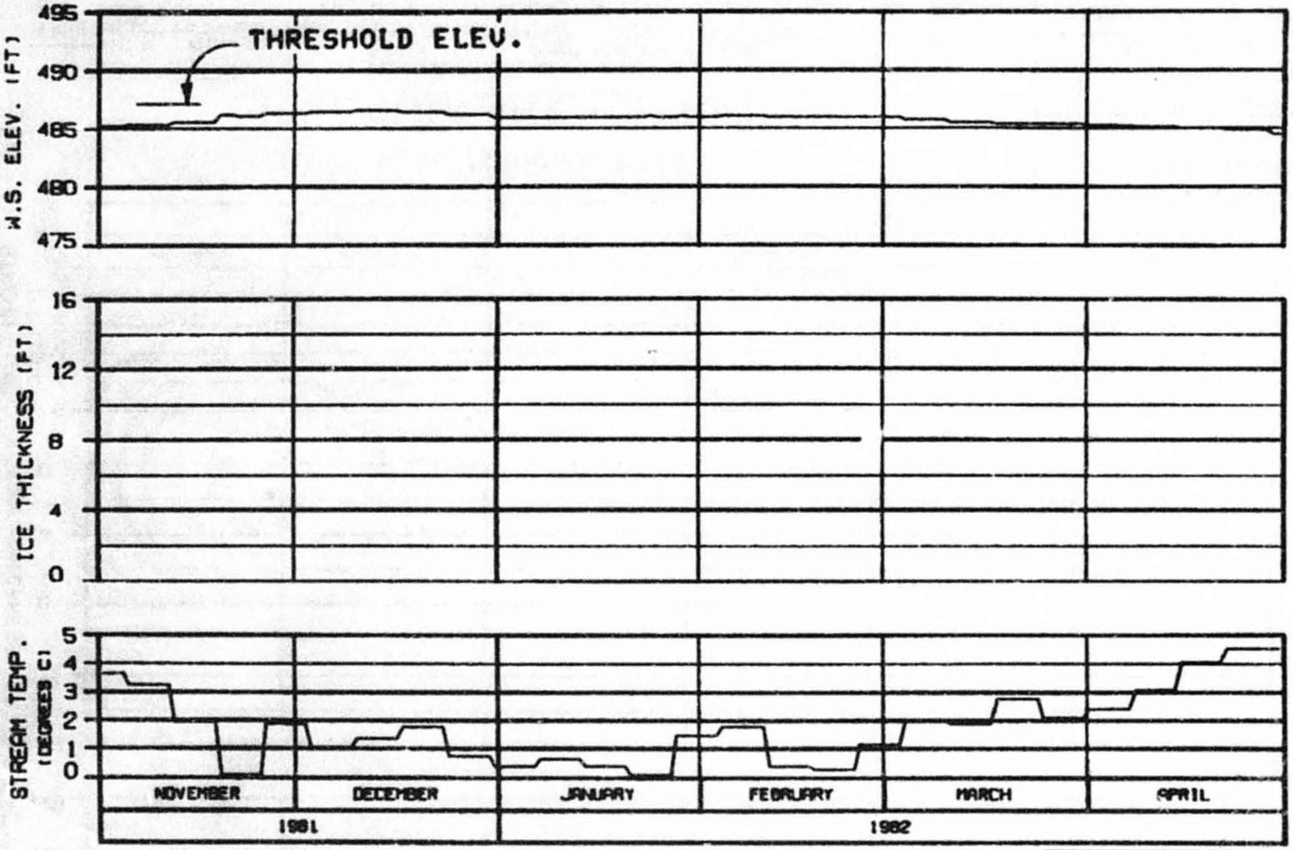
SIDE CHANNEL MSII

RIVER MILE : 115.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1988.142



HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

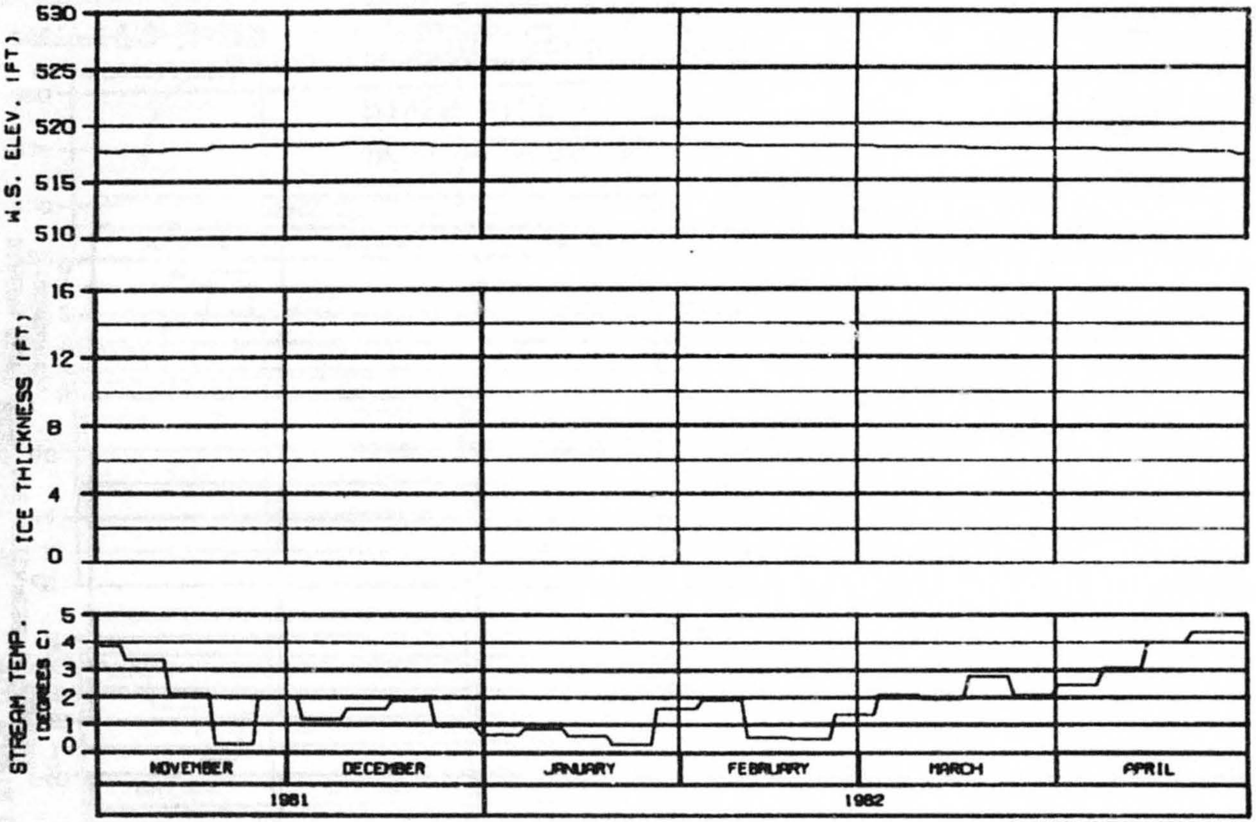
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible]



ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

RIVER MILE : 120.00

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

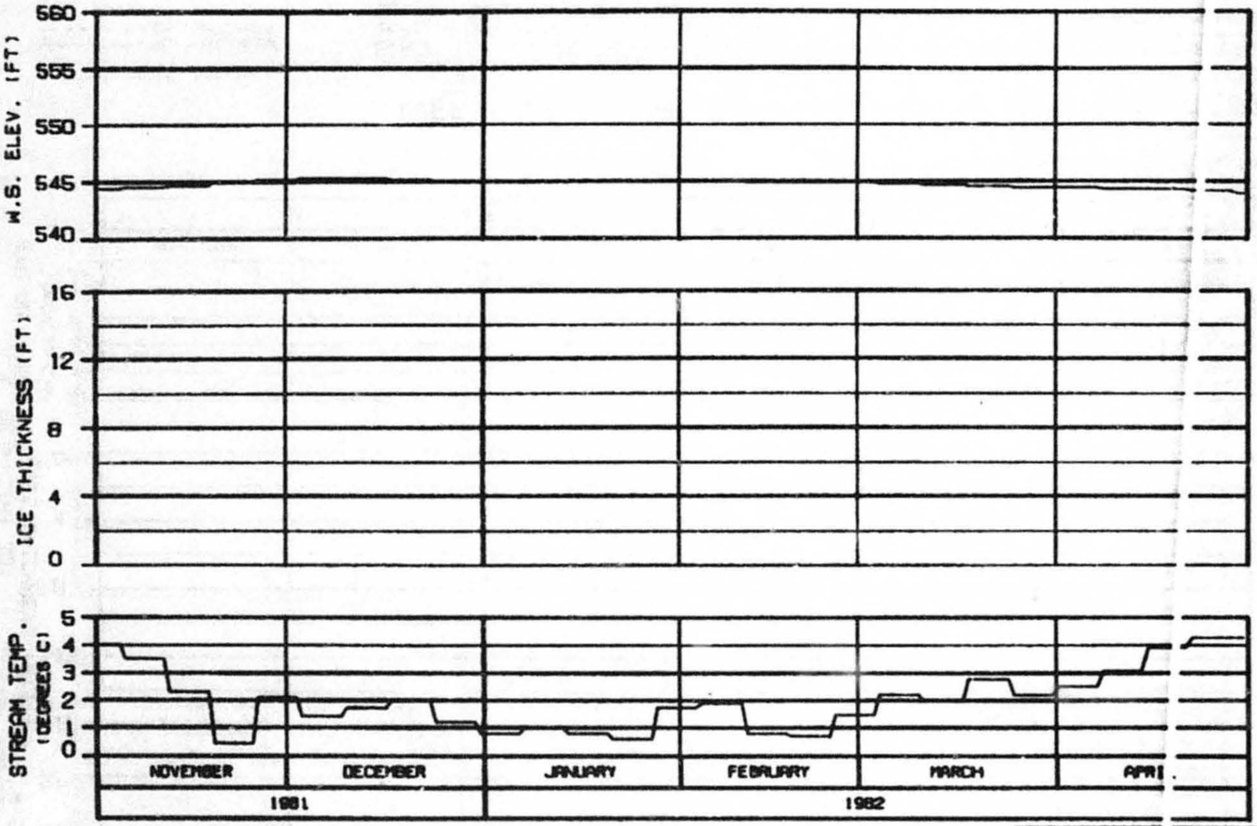
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 1088.142



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

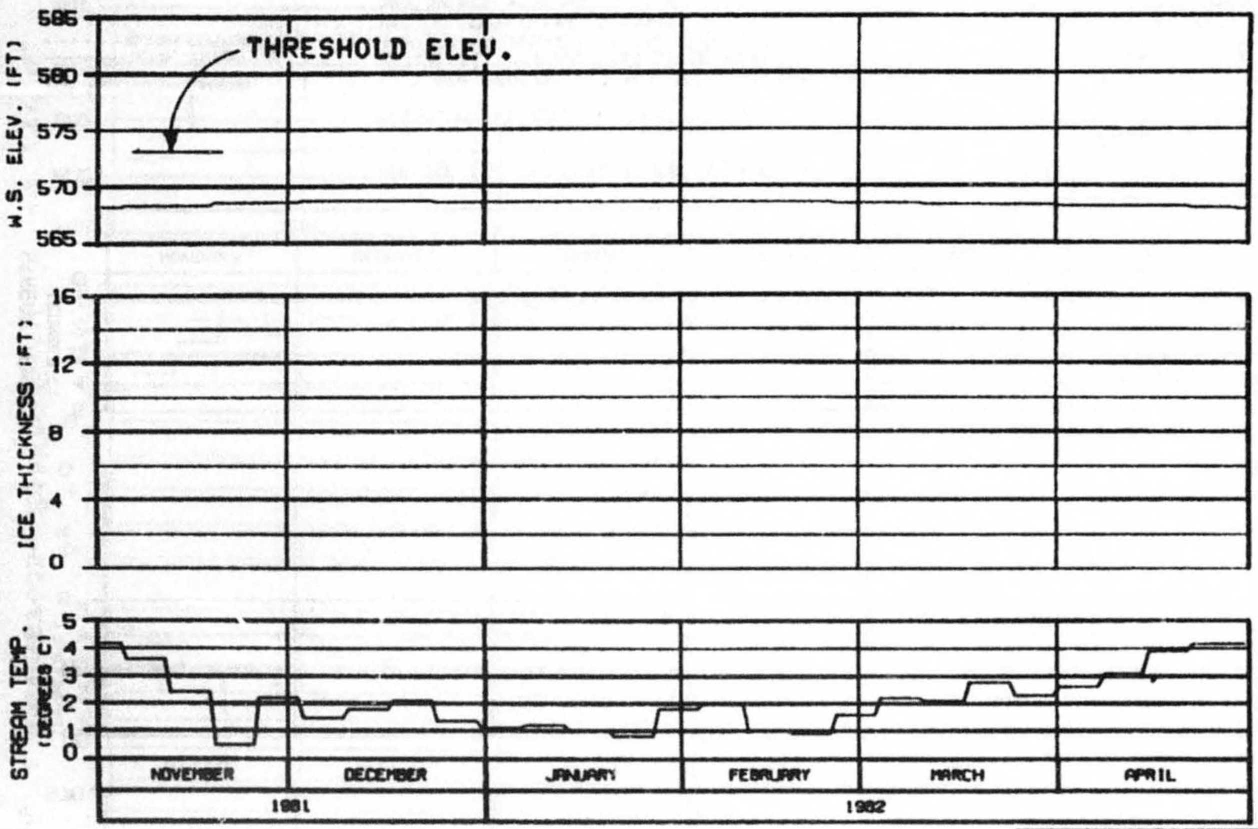
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POW ER AUTHORITY

SUSITNA PROJECT

SUSIT A RIVER
ICE SI MULATION
TIME HISTORY

HARZA-EBASC J JOINT VENTURE



HEAD OF SLOUGH 8A (WEST)

RIVER MILE : 126.10

ICE THICKNESS LEGEND:
—— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

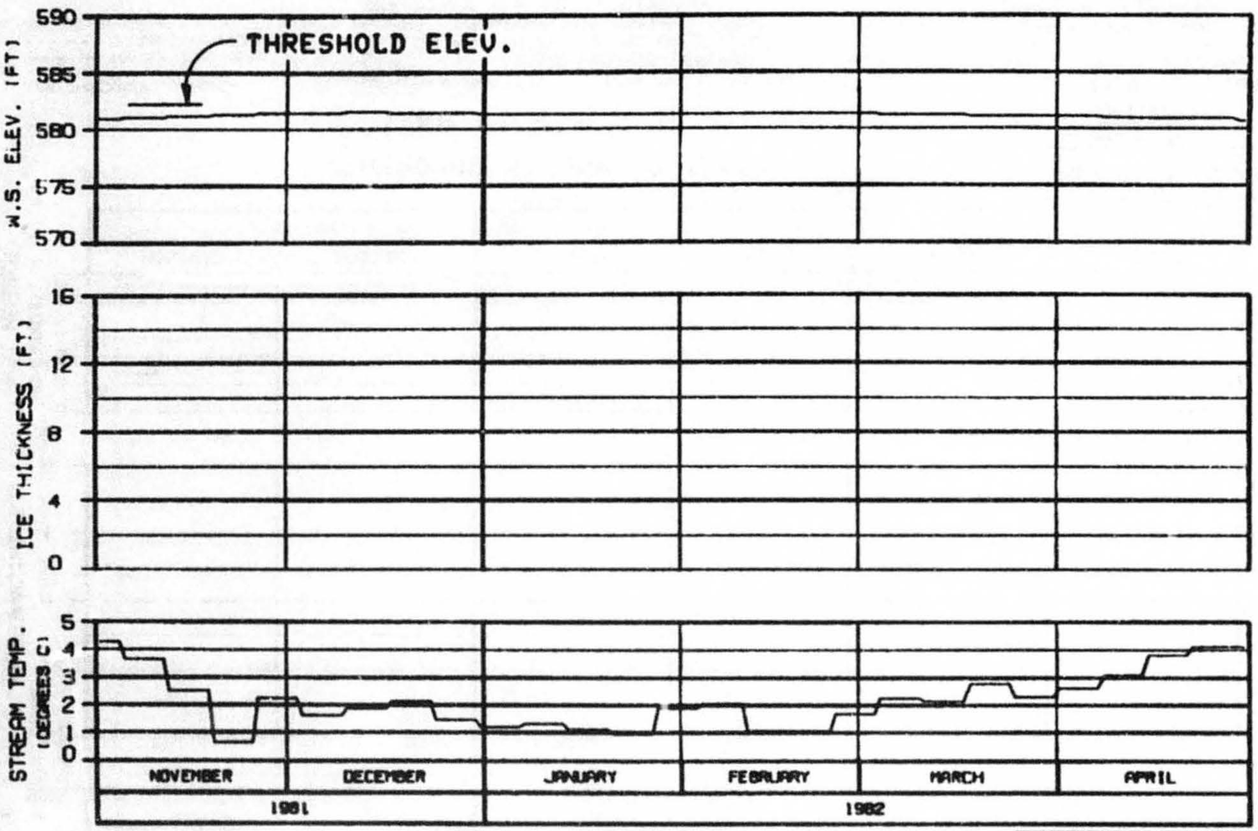
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS	[illegible]	1648.142



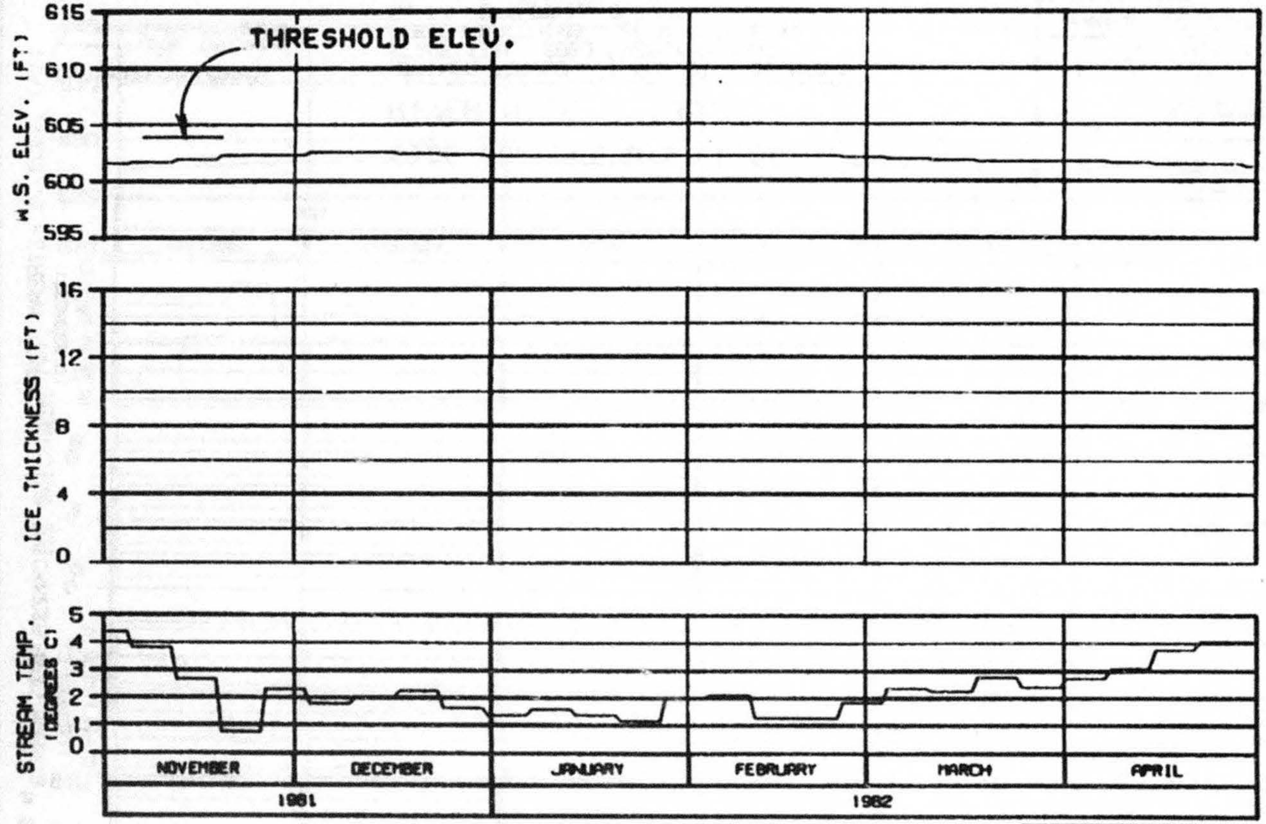
HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
[illegible]	[illegible]	1988.142



ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

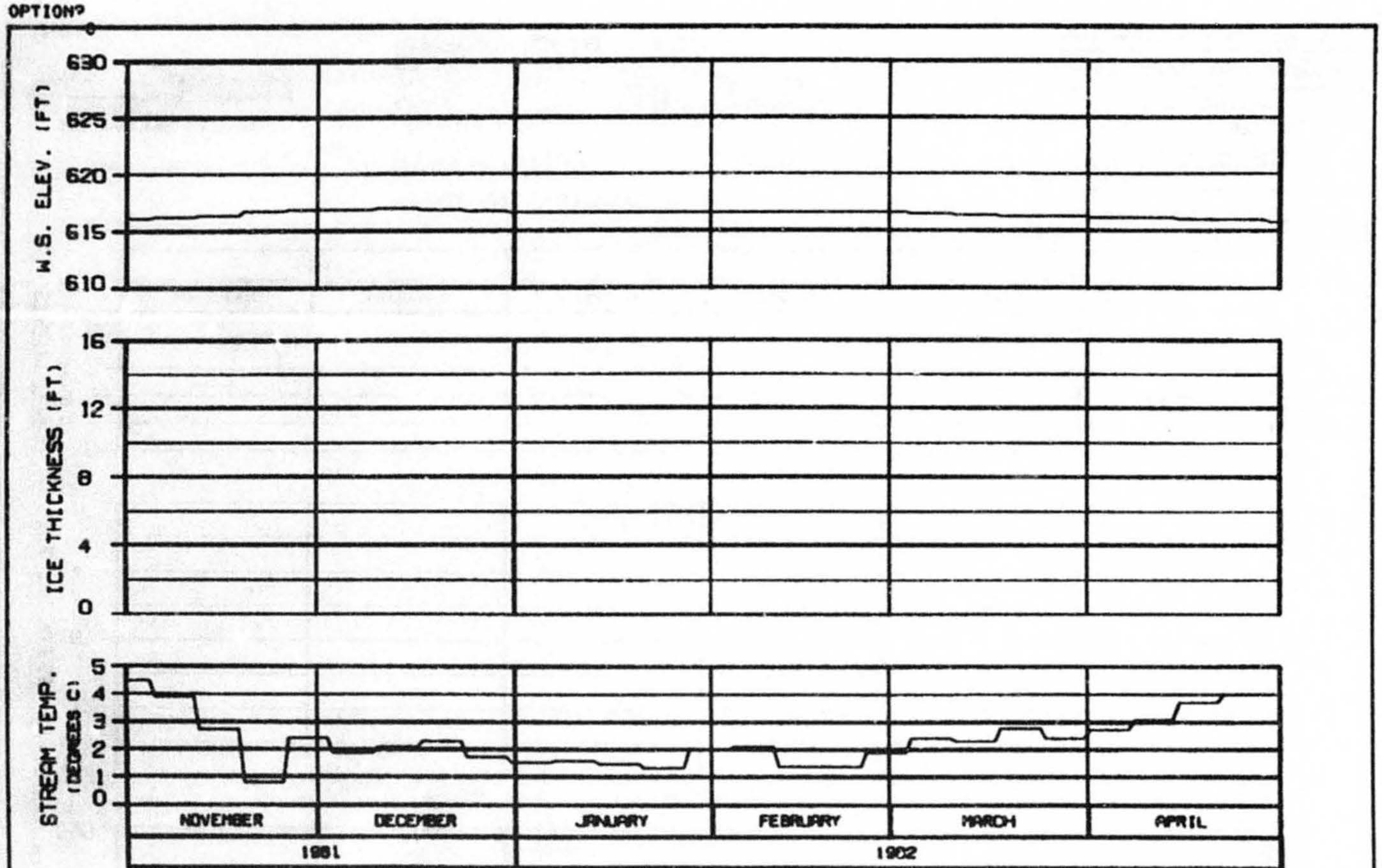
HEAD OF SLOUGH 9

RIVER MILE : 129.30

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN, 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE

OPTION7



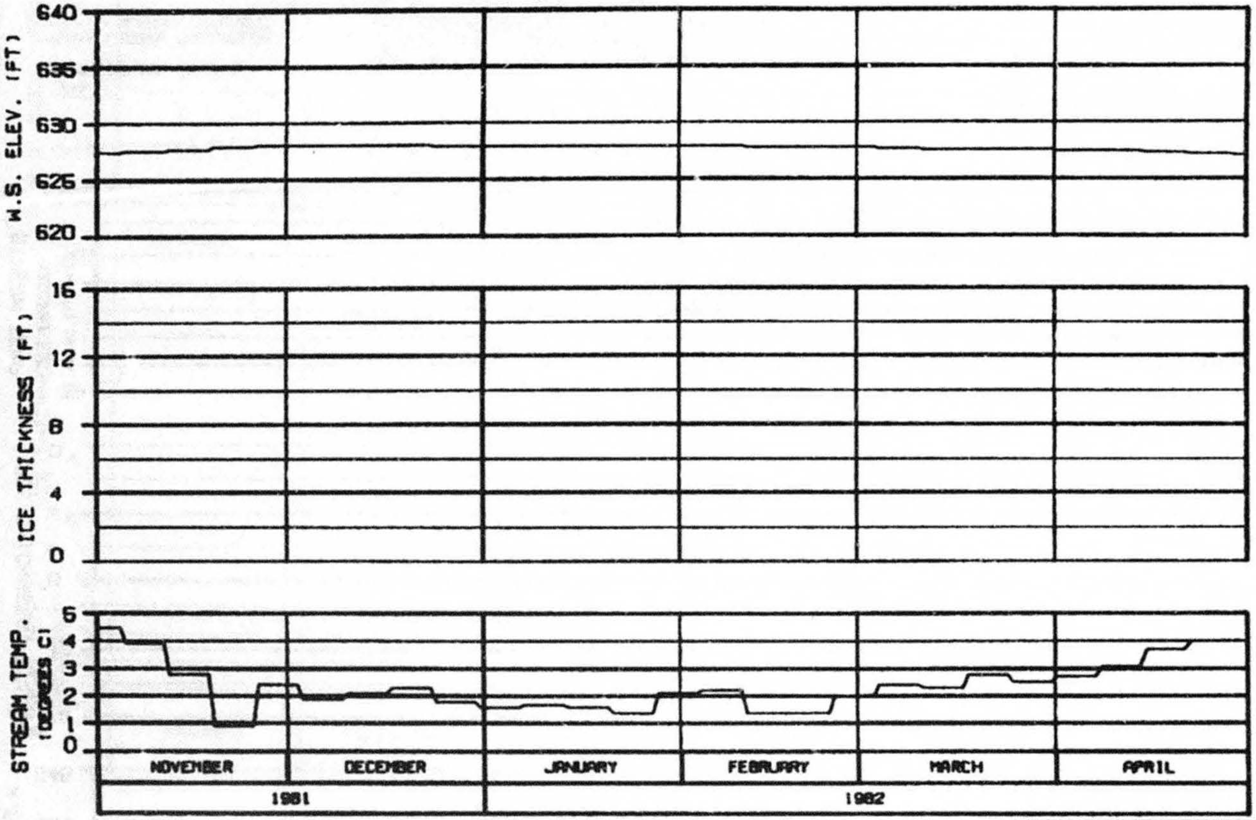
SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

RIVER MILE : 131.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

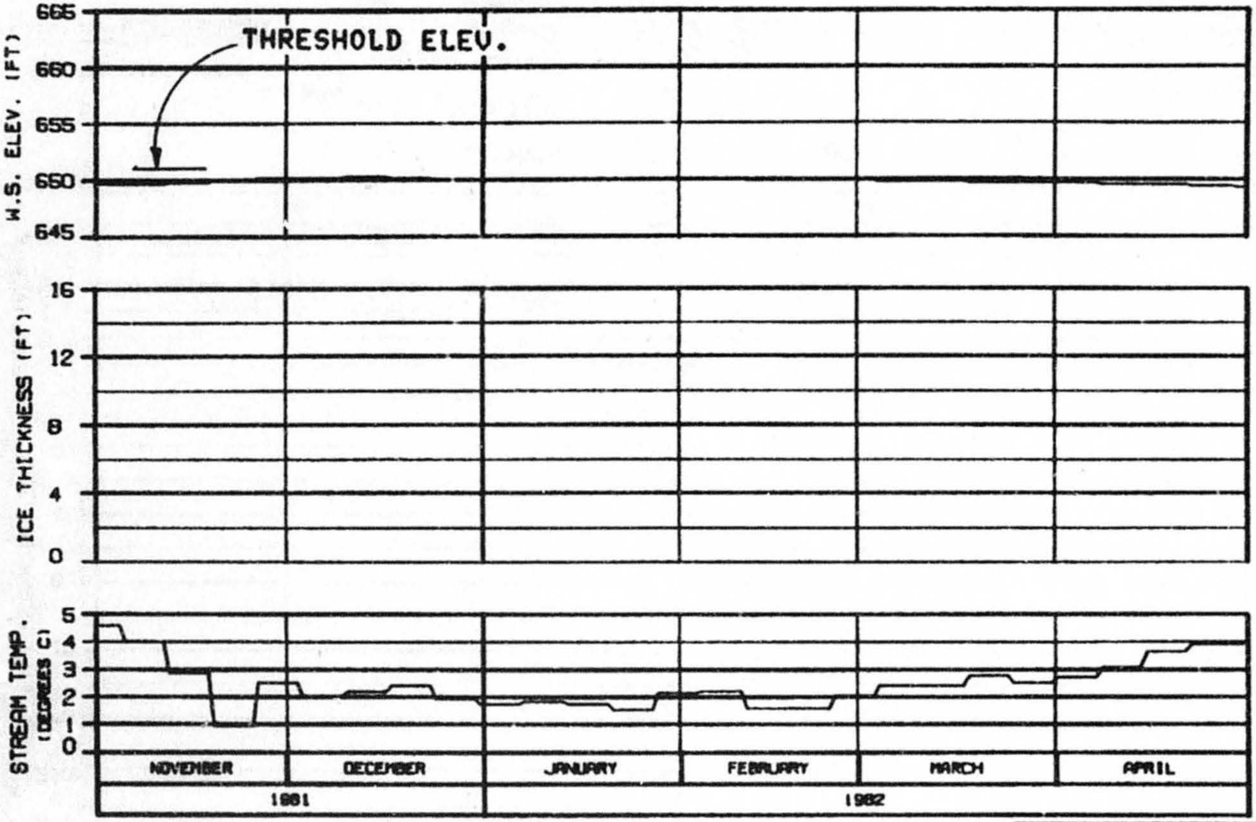
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 20 JUL 85 | 1683.142



HEAD OF SLOUGH 9A

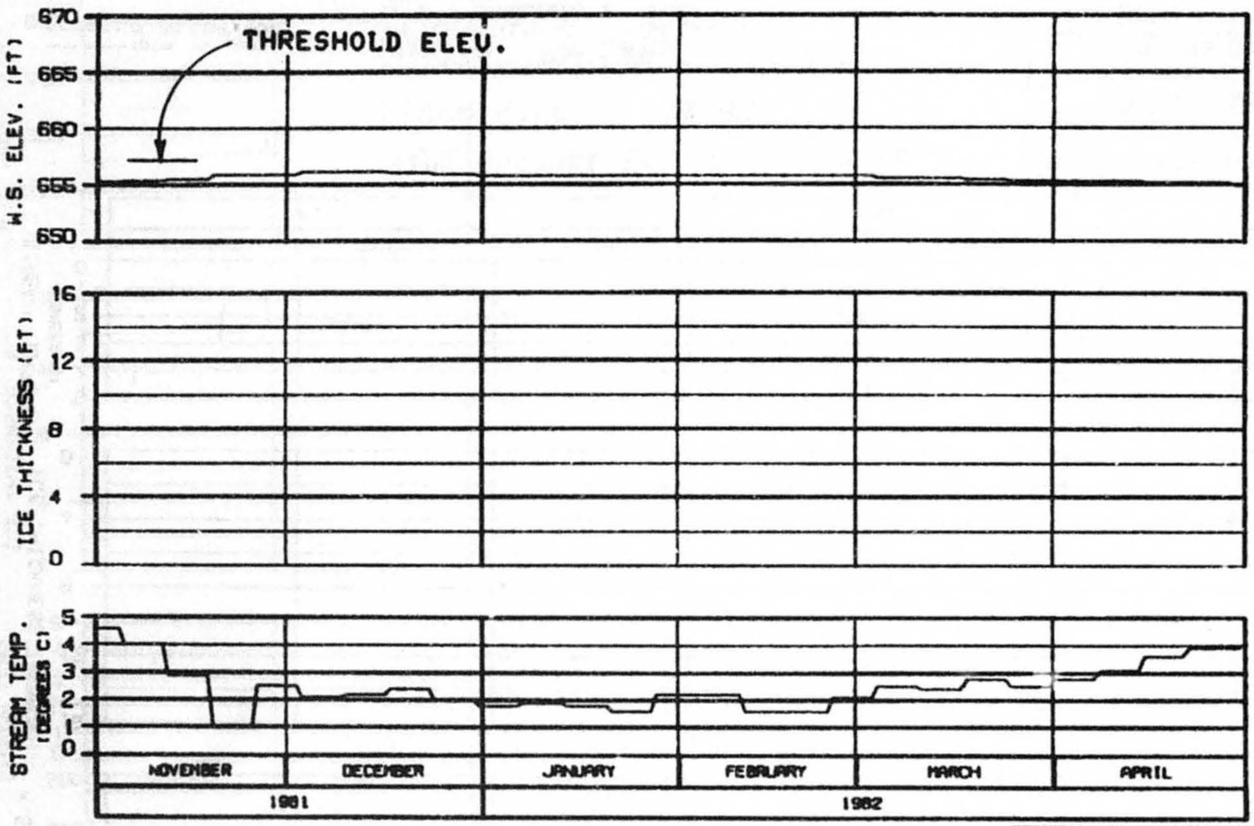
RIVER MILE : 133.70

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING , FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	



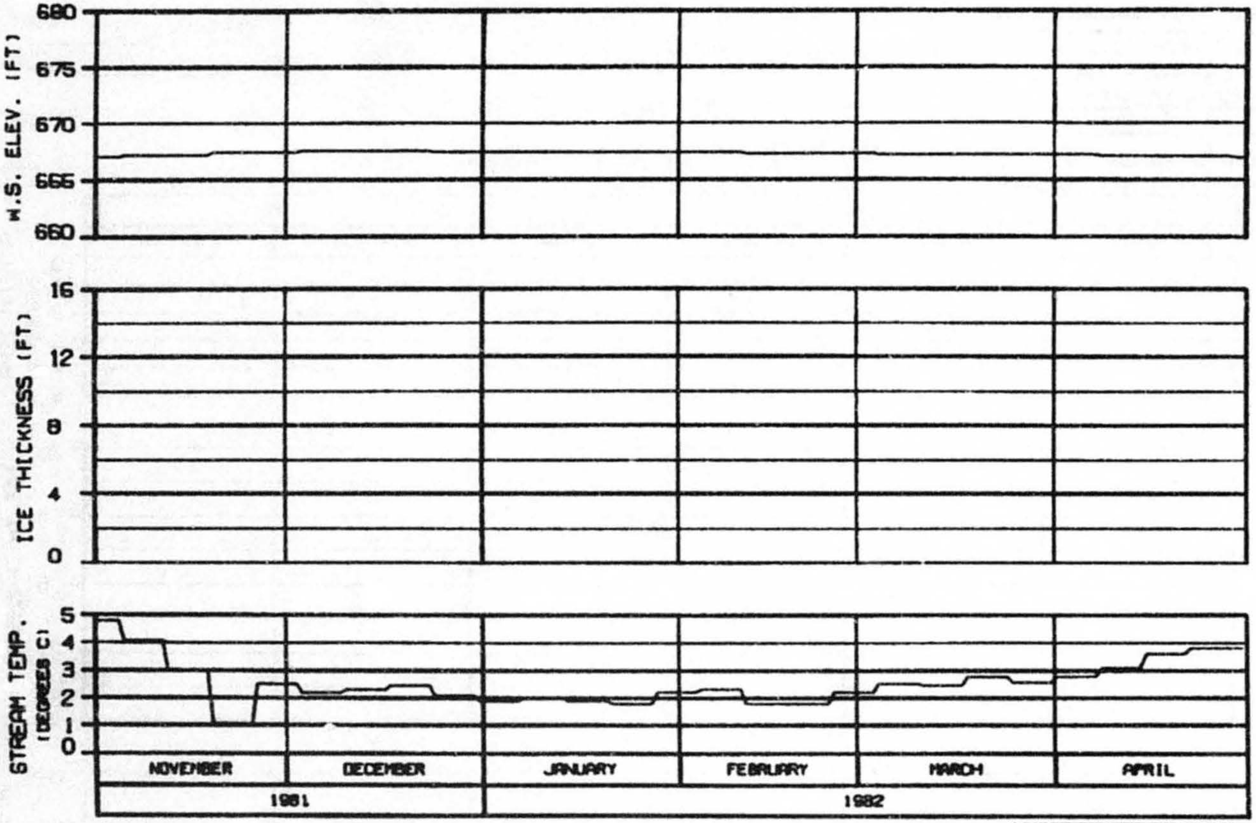
SIDE CHANNEL U/S OF SLOUGH 10

RIVER MILE : 134.30

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : B120ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 1660.142



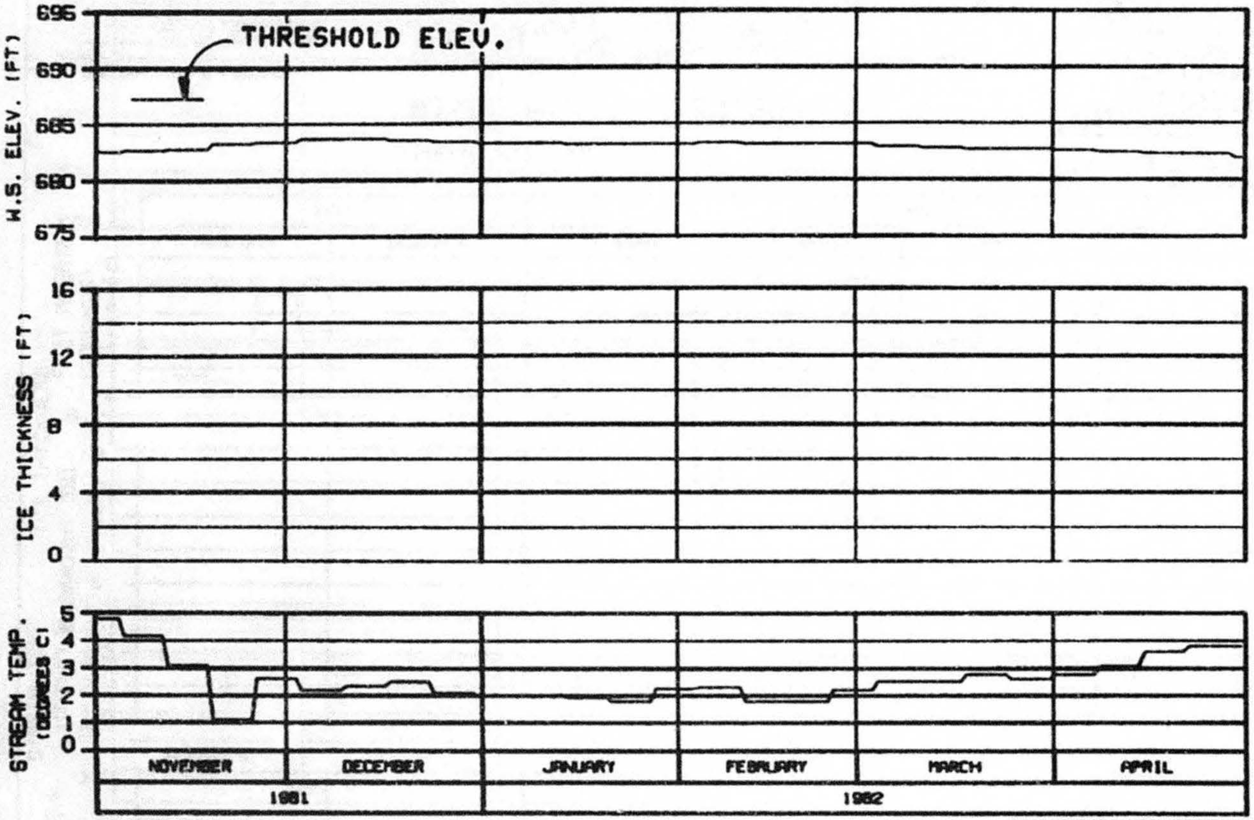
SIDE CHANNEL D/S OF SLOUGH 11

RIVER MILE : 135.30

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	[illegible]	[illegible].142



HEAD OF SLOUGH 11

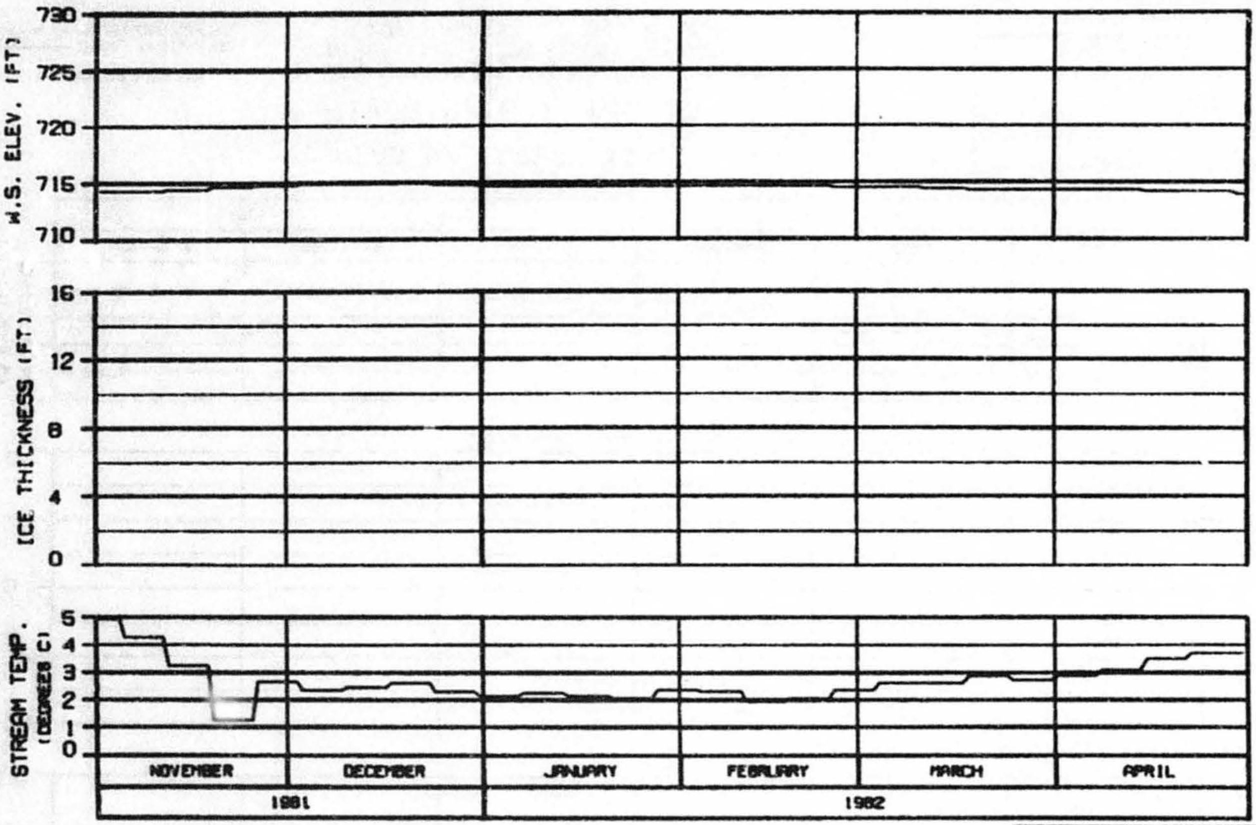
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

—————— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	[illegible]	[illegible]



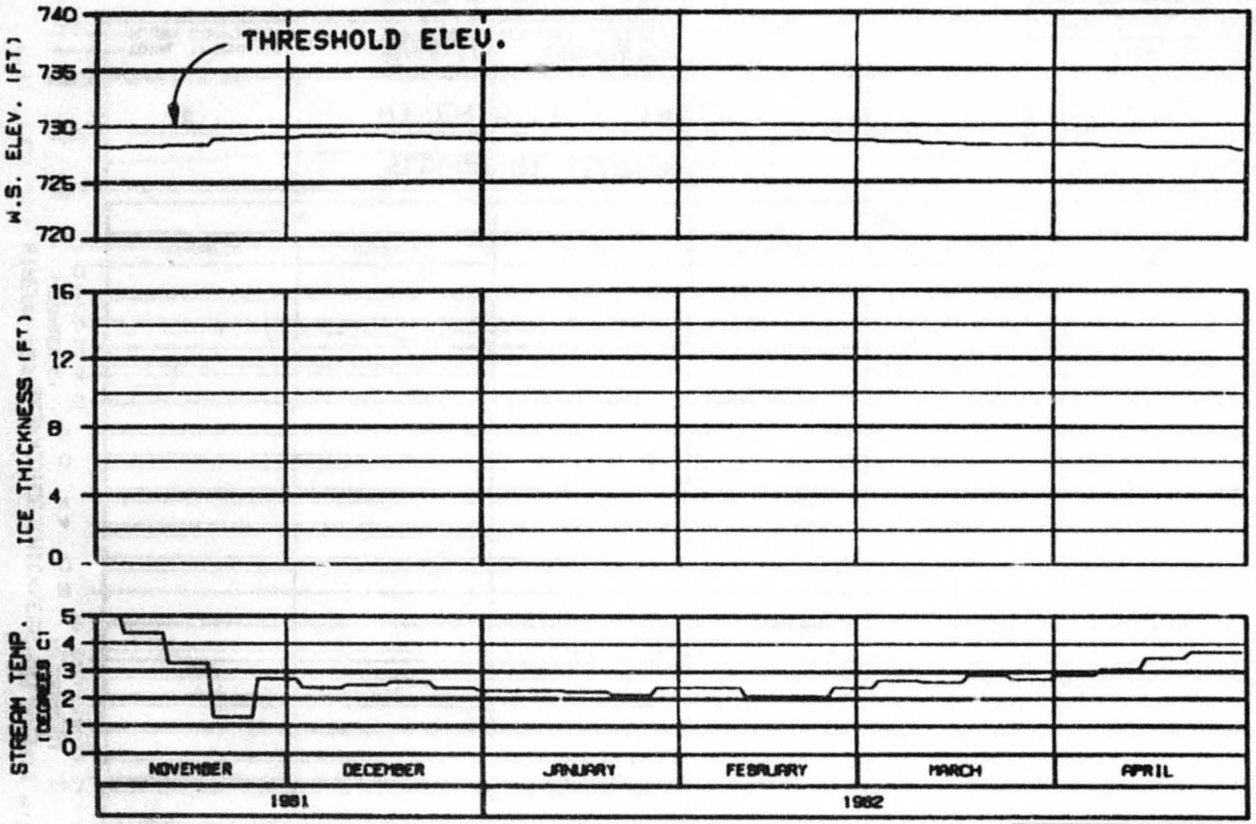
HEAD OF SLOUGH 17

RIVER MILE : 139.30

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	30 JUL 85	1888.142



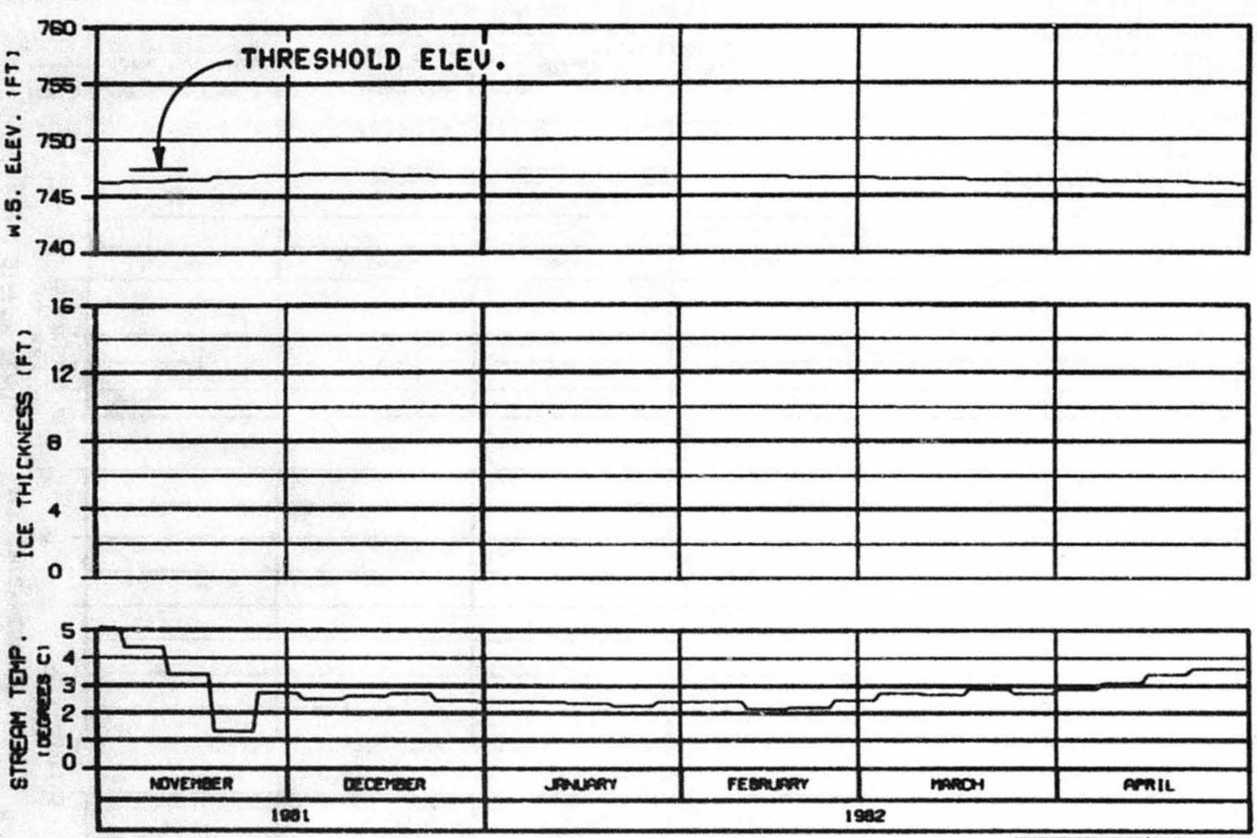
HEAD OF SLOUGH 20

RIVER MILE : 140.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1988.142



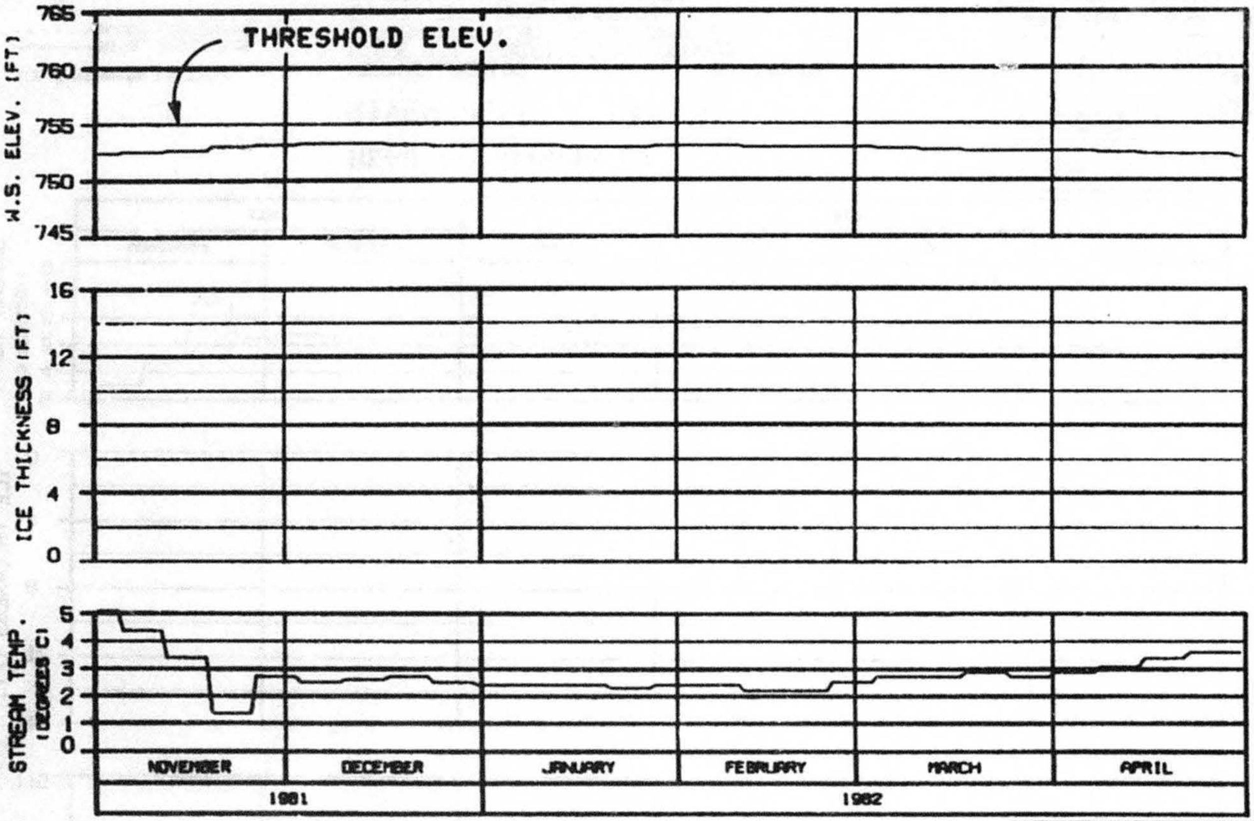
SLOUGH 21 (ENTRANCE A6)

RIVER MILE : 141.80

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
------ SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
1983.142



HEAD OF SLOUGH 21

RIVER MILE : 142.20

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY

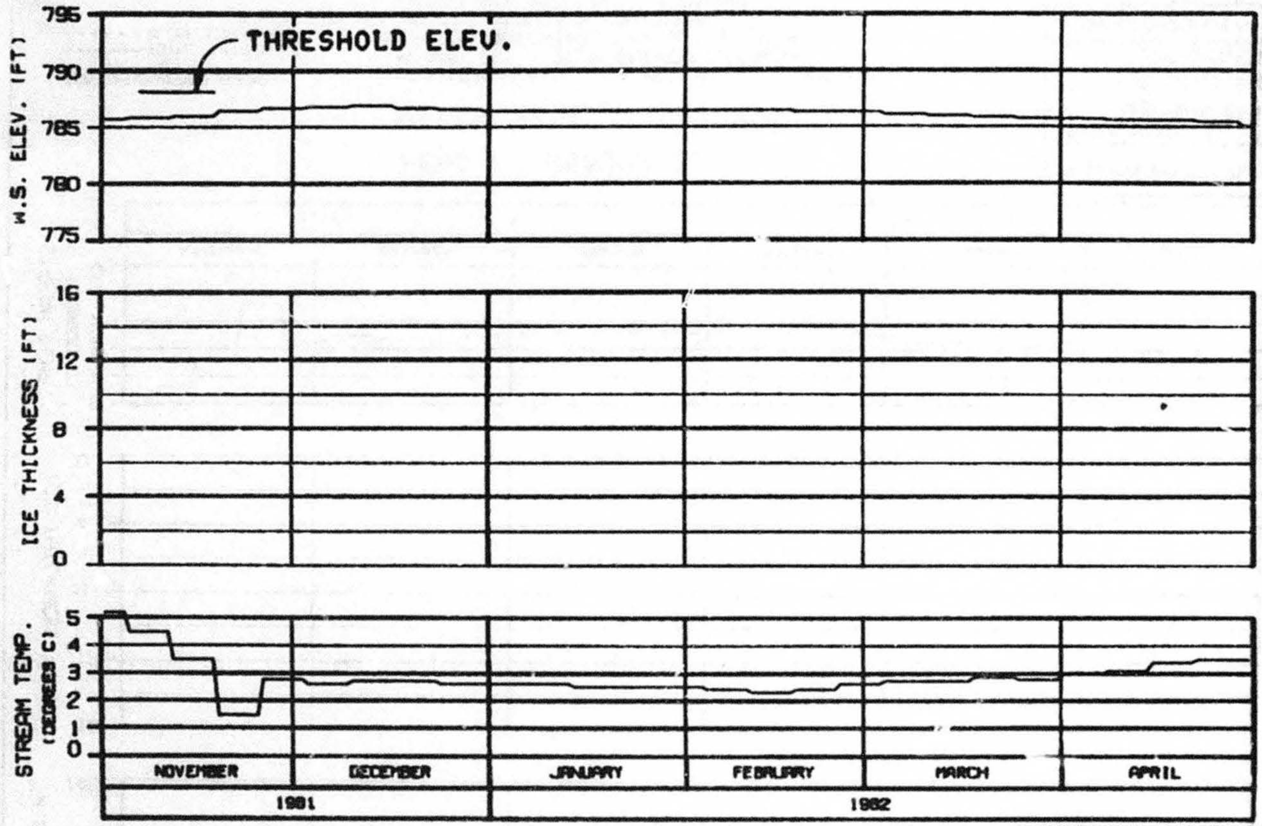
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 1588.142

C



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

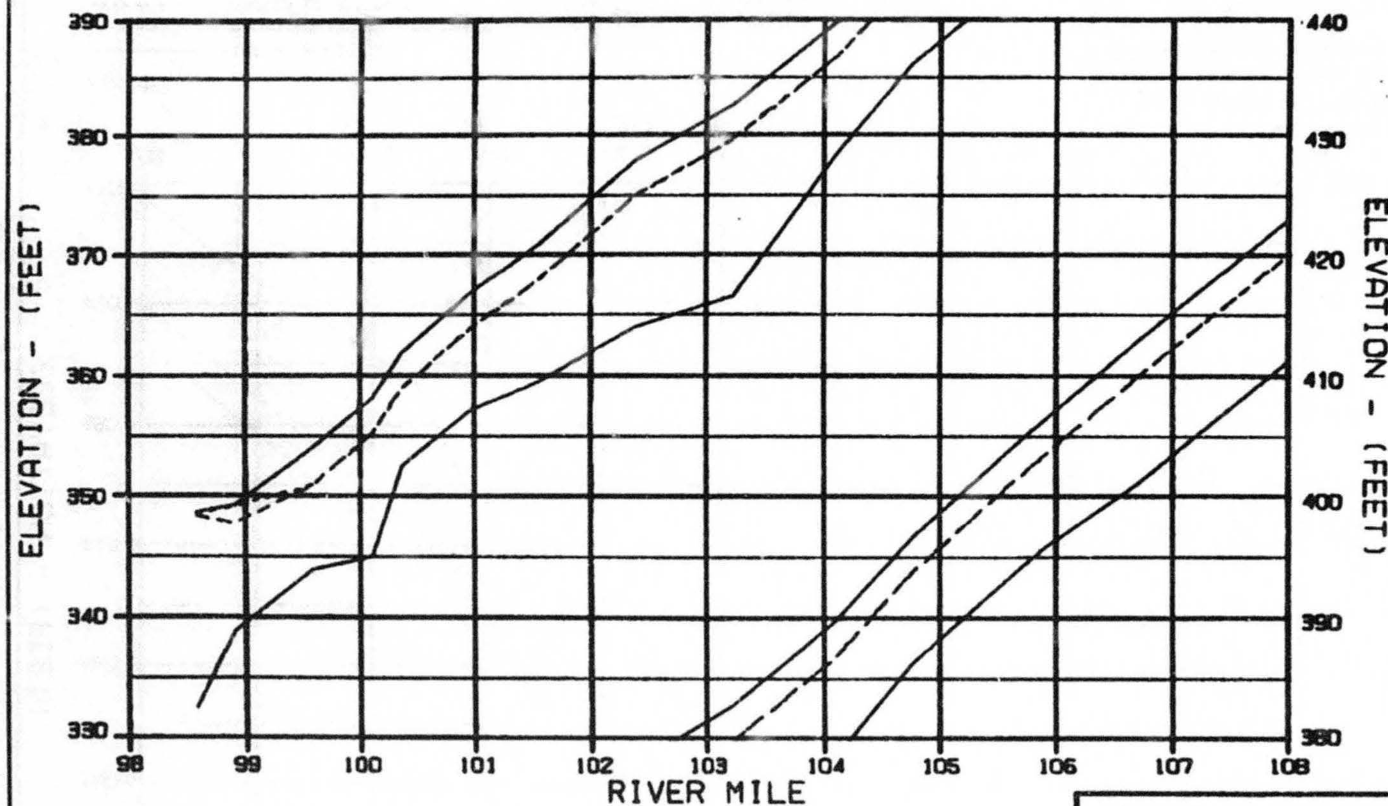
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE III 2020 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-VI
50 FT. DRAWDOWN. 2 PORTS
REFERENCE RUN NO. : 8120ENX

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE

OPTION?

EXHIBIT D

C



LEGEND:

- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-I. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY

SUSITNA PROJECT

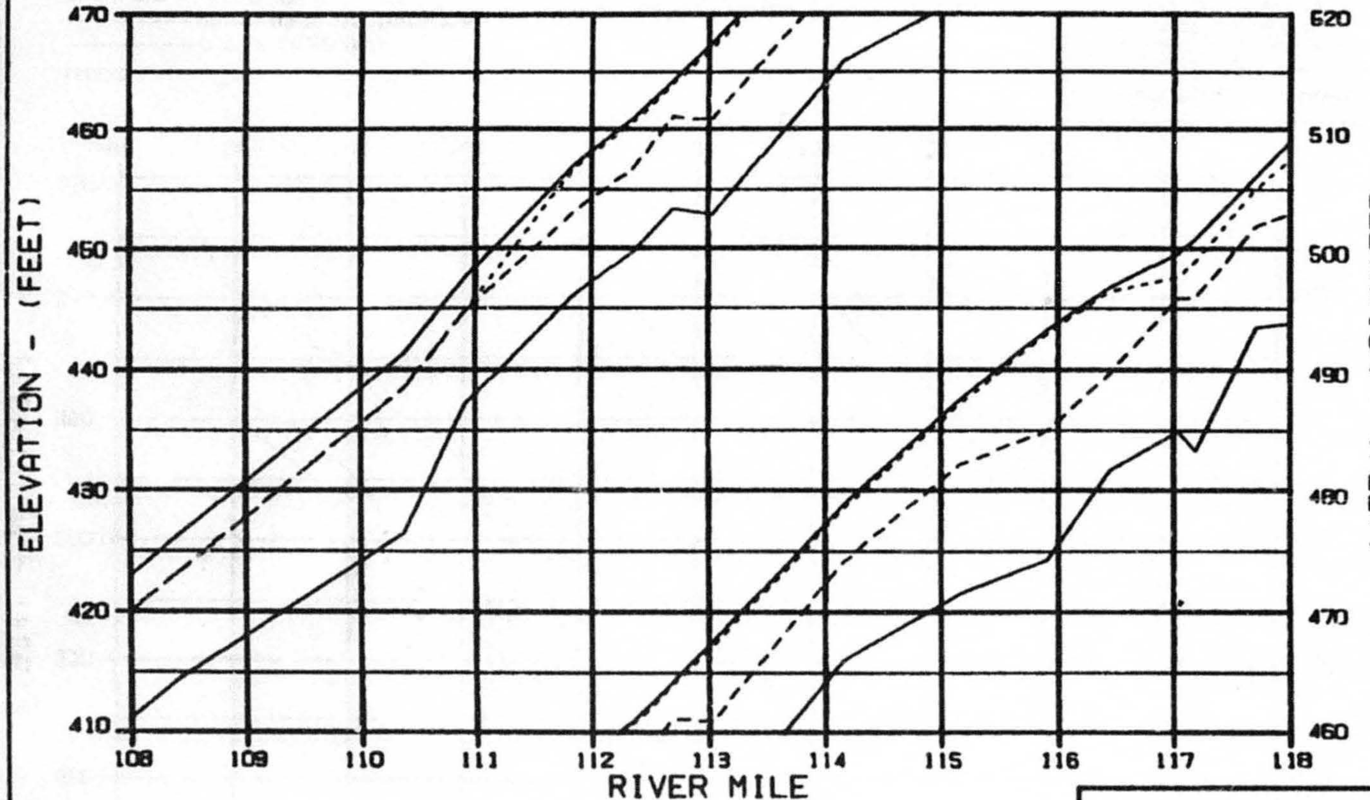
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

1989.142

OPTION?

c



LEGEND:

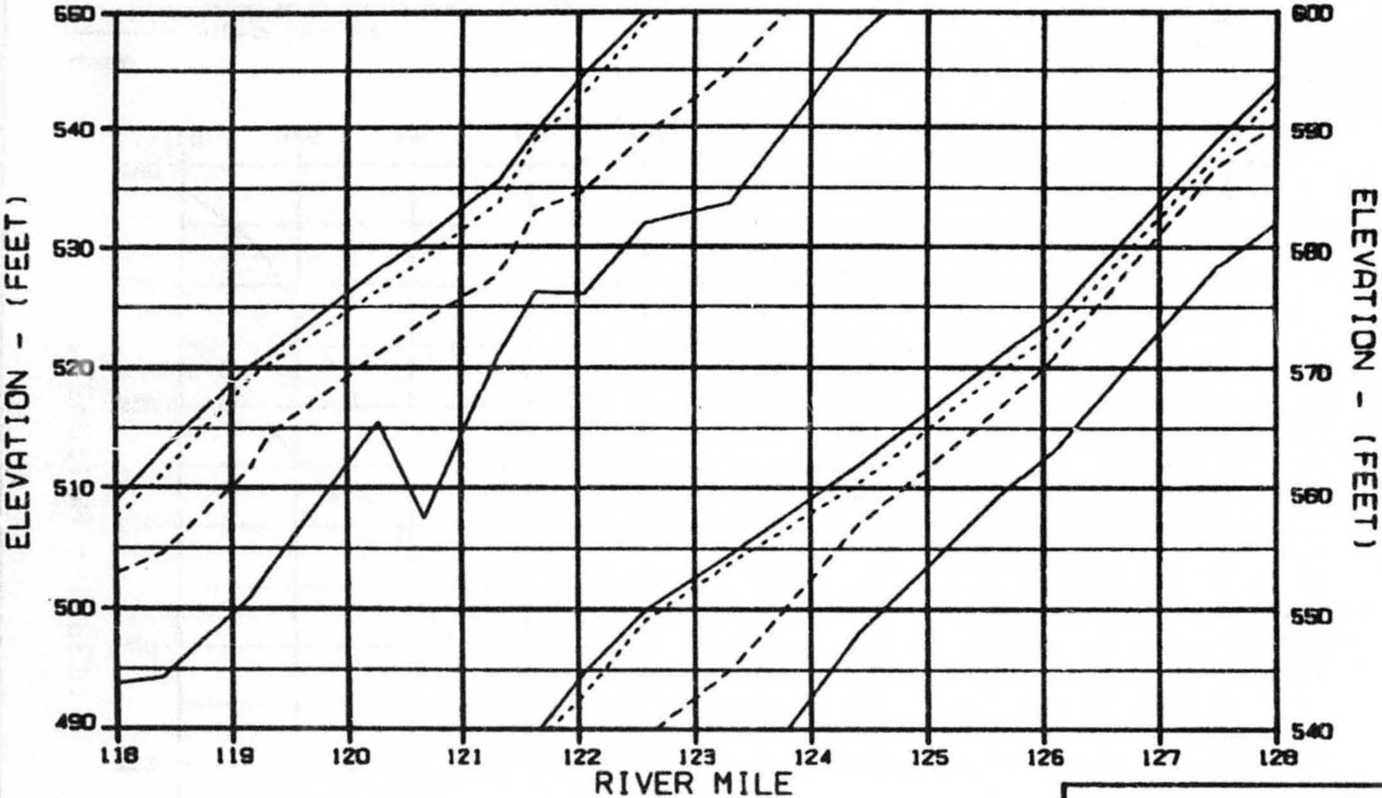
- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-I. INFLOW-MATCHING
REFERENCE RUN NO. : 6101ENY

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES	
HARZA-EBASCO JOINT VENTURE	

OPTION?

c



LEGEND:

- ———— TOP OF SOLID ICE
- - - - - - SLUSH/SOLID ICE INTERFACE
- — — — BOTTOM OF SLUSH ICE
- ———— RIVER BED

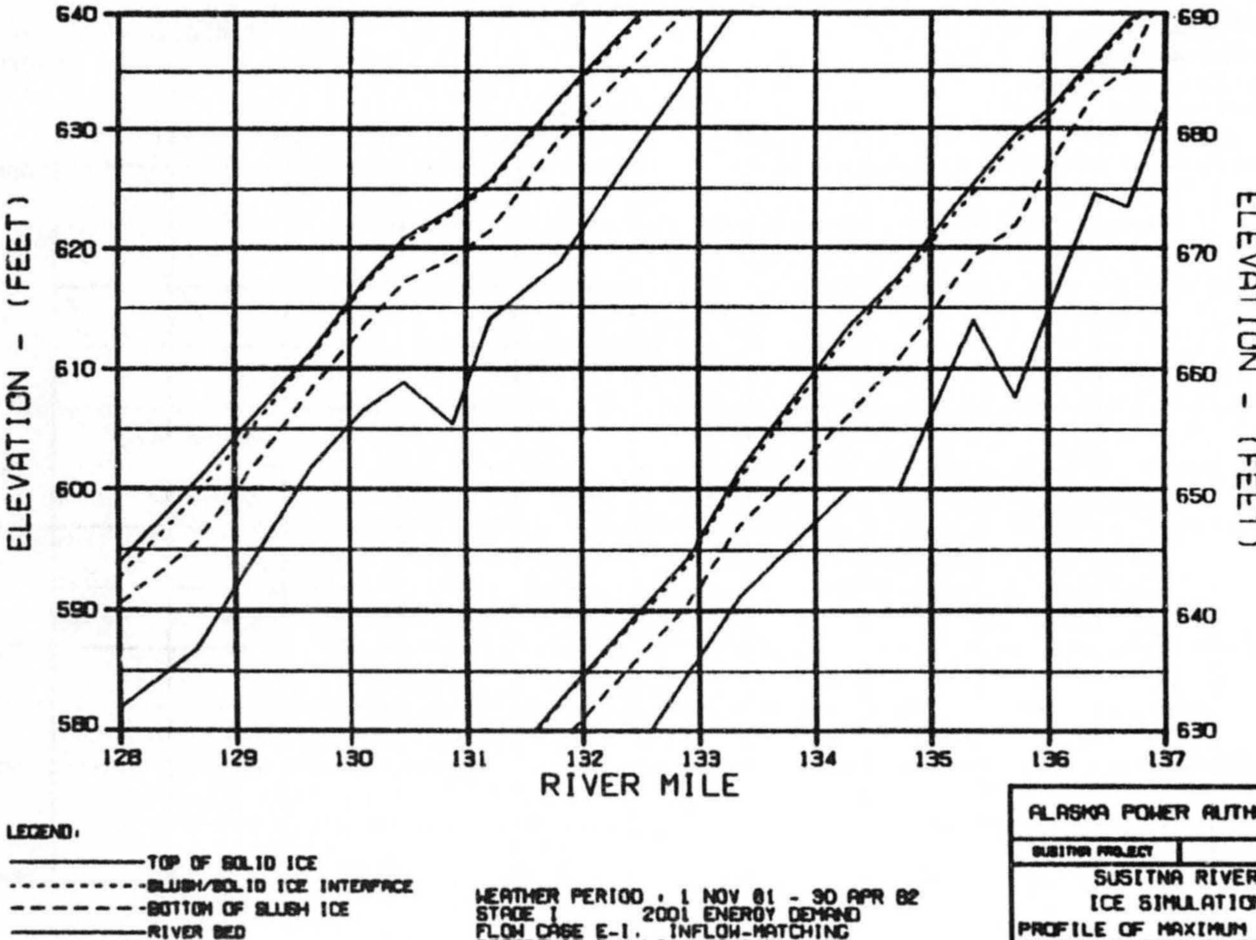
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-I. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

OPTION?

OPTION?

C



WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
FLOW CASE E-I. INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY

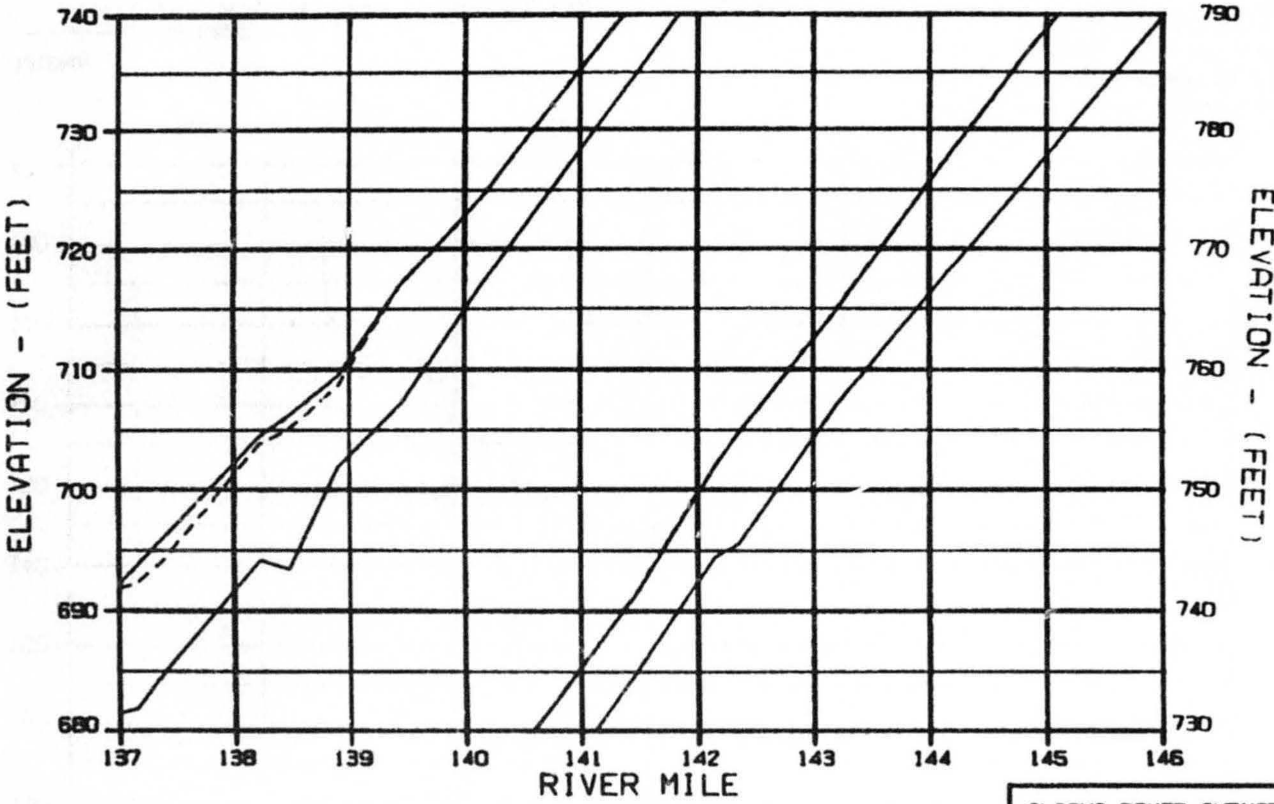
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

OPTION?

C



LEGEND:

- TOP OF SOLID ICE
- SLUSH/SOLID ICE INTERFACE
- BOTTOM OF SLUSH ICE
- RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I   2001 ENERGY DEMAND
FLOW CASE E-I.   INFLOW-MATCHING
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY

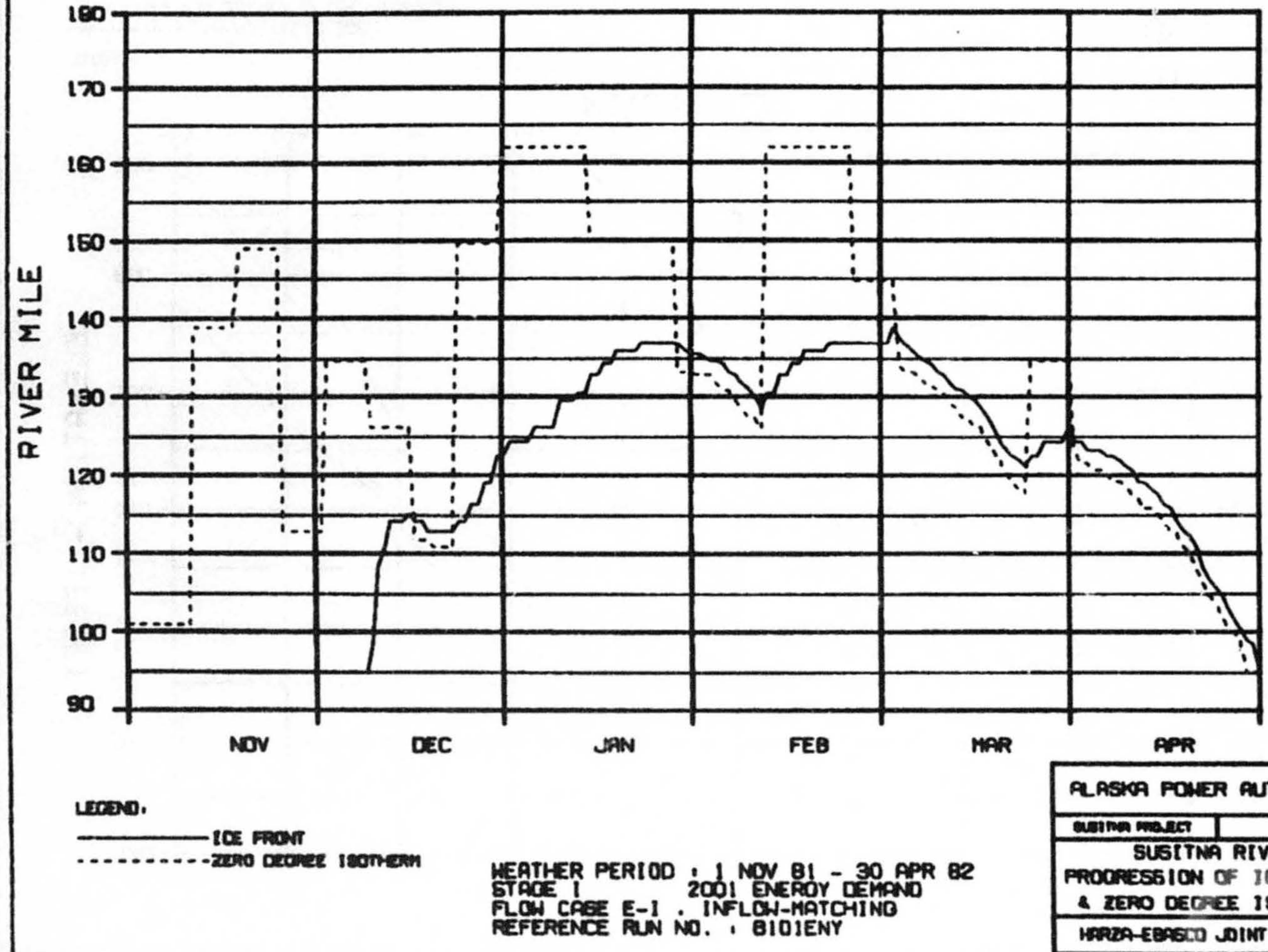
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

OPTION?

c



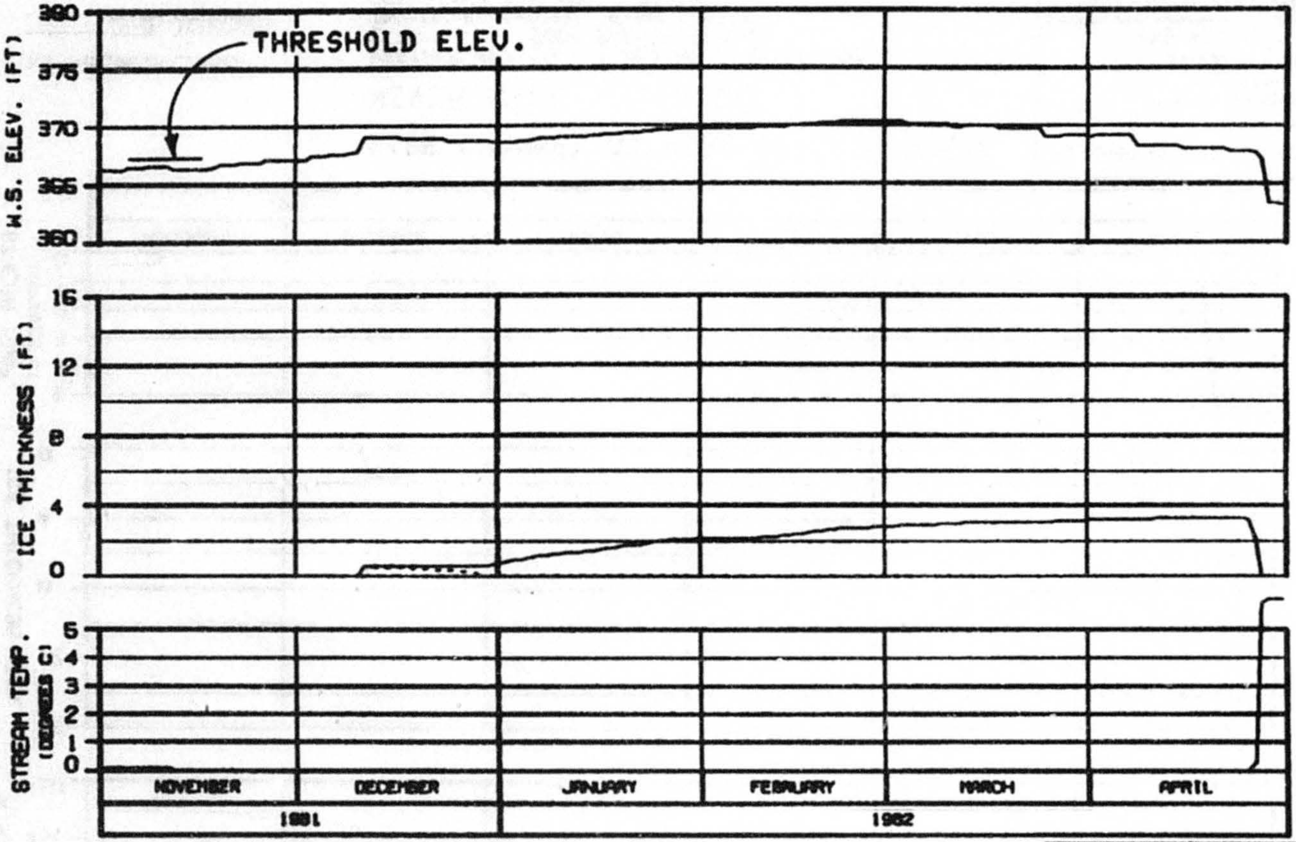
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM

HARZA-EBASCO JOINT VENTURE

OPTION?



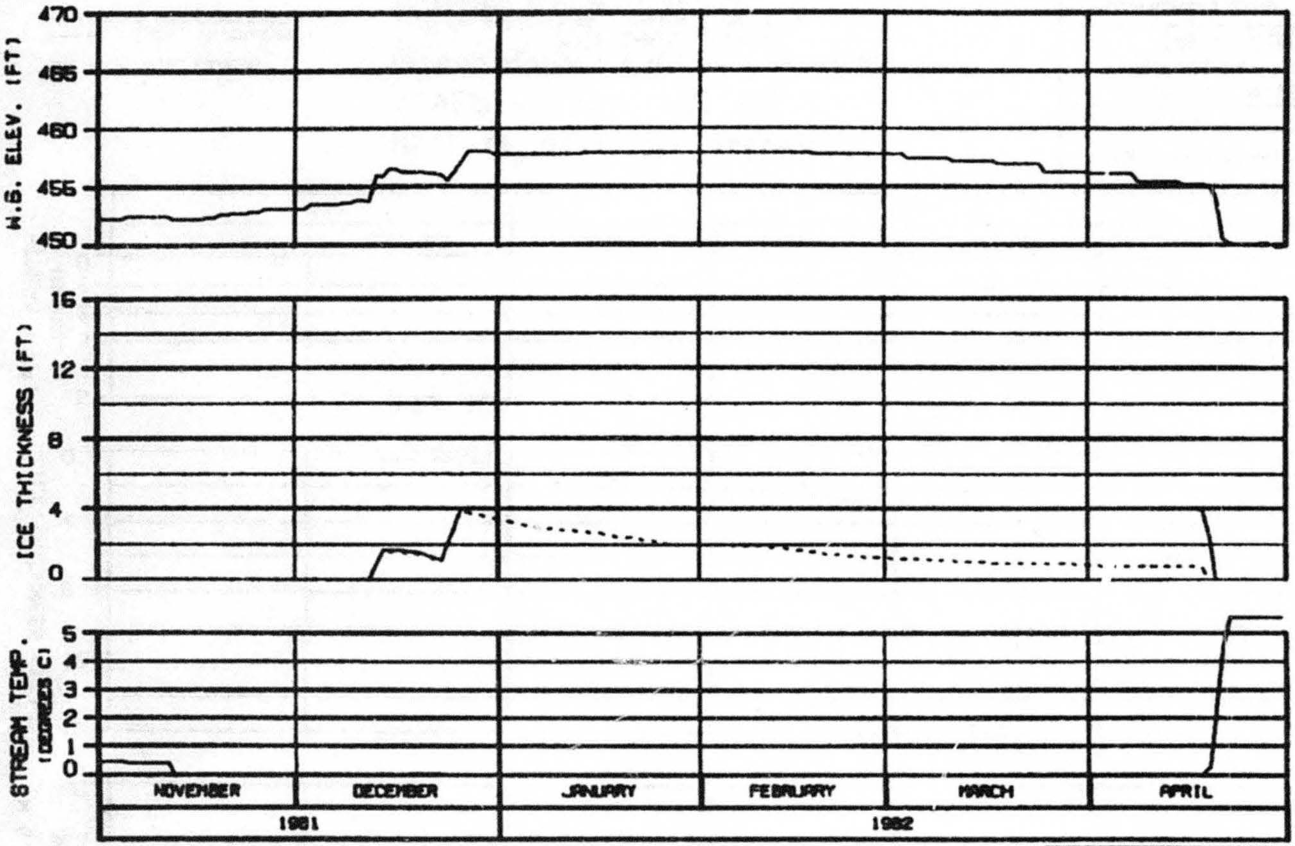
HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-1
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
1983.142	



SIDE CHANNEL AT HEAD OF GASH CREEK

RIVER MILE : 112.00

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

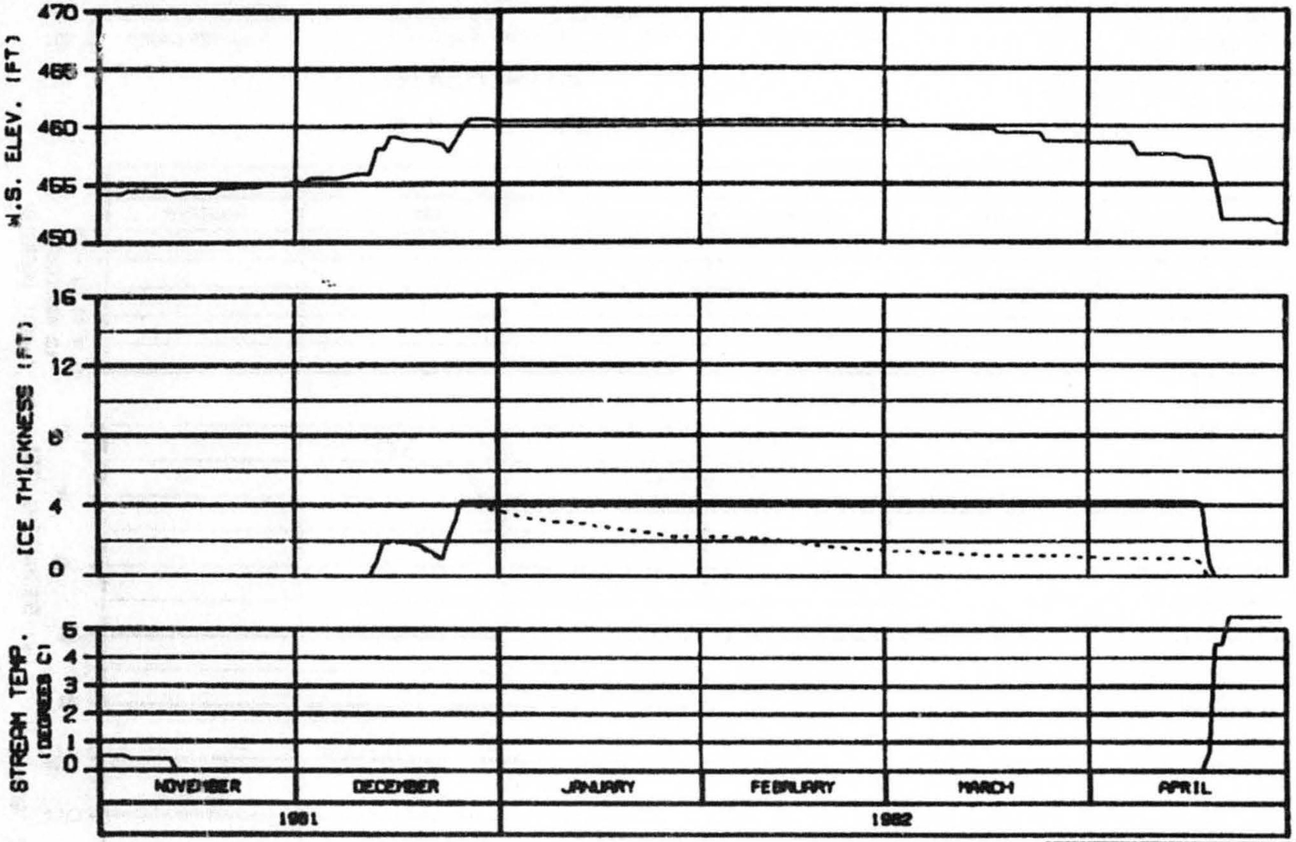
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-1
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



MOUTH OF SLOUGH 6A

RIVER MILE : 112.34

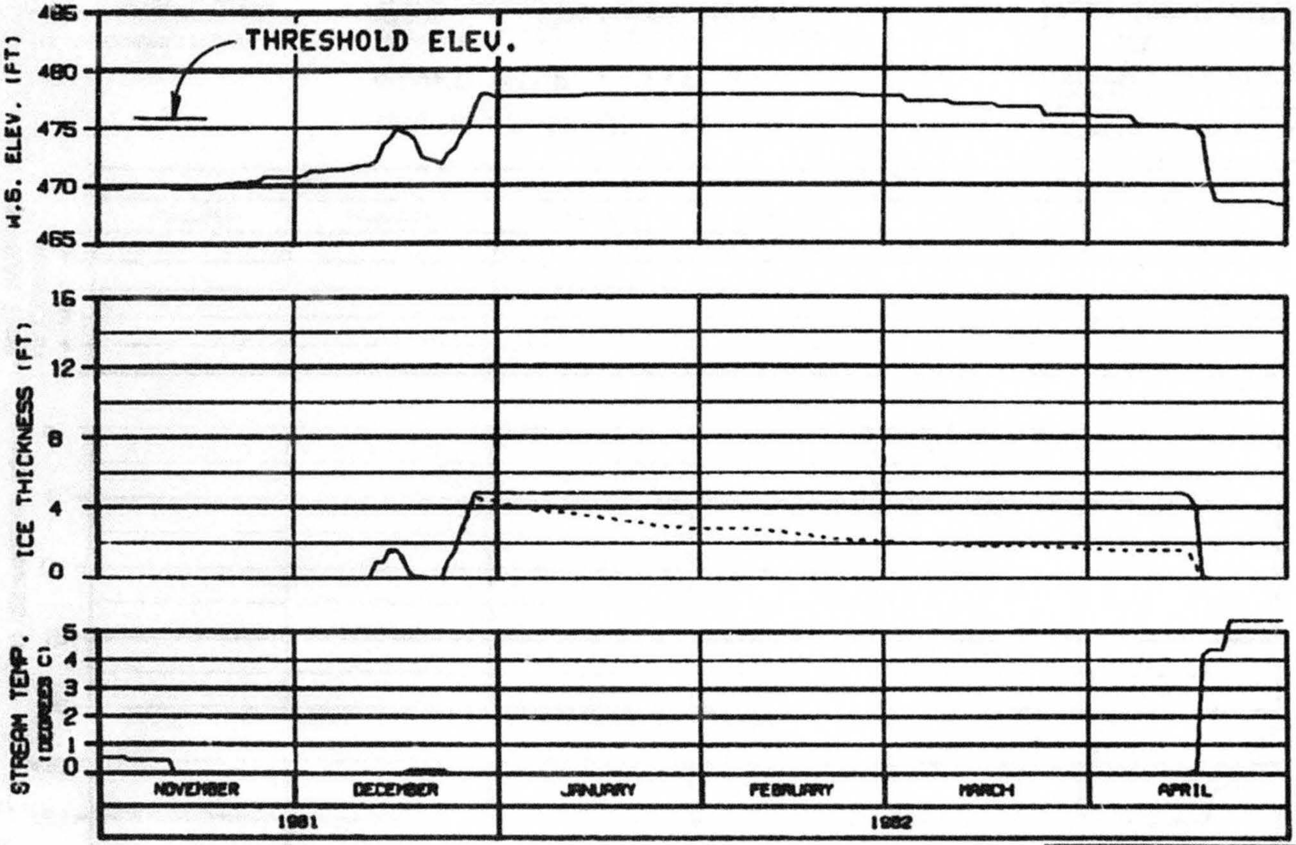
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-I
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
1080.142

OPTION?



HEAD OF SLOUGH 8

RIVER MILE : 114.10

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-I
REFERENCE RUN NO. : 8101ENY

ICE THICKNESS LEGEND:

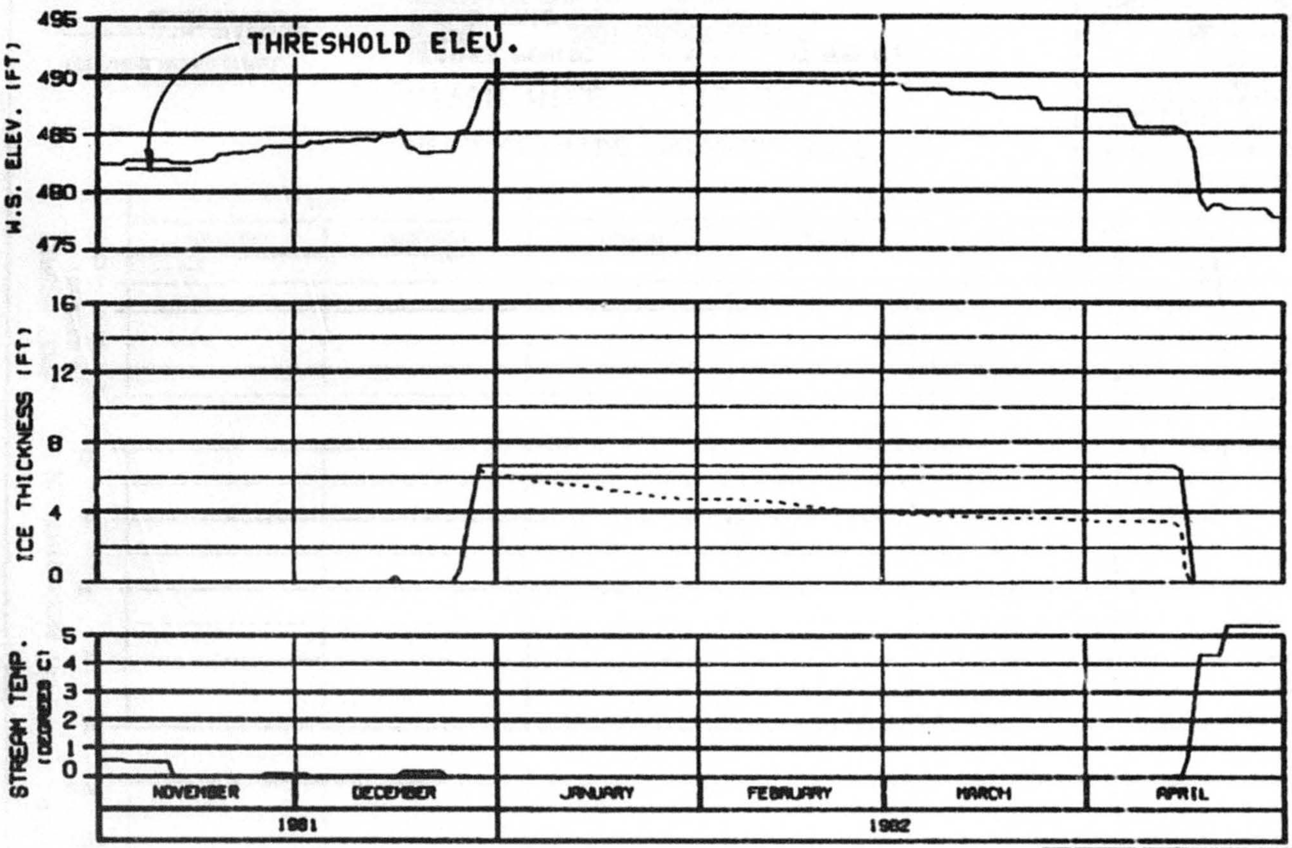
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL MSII

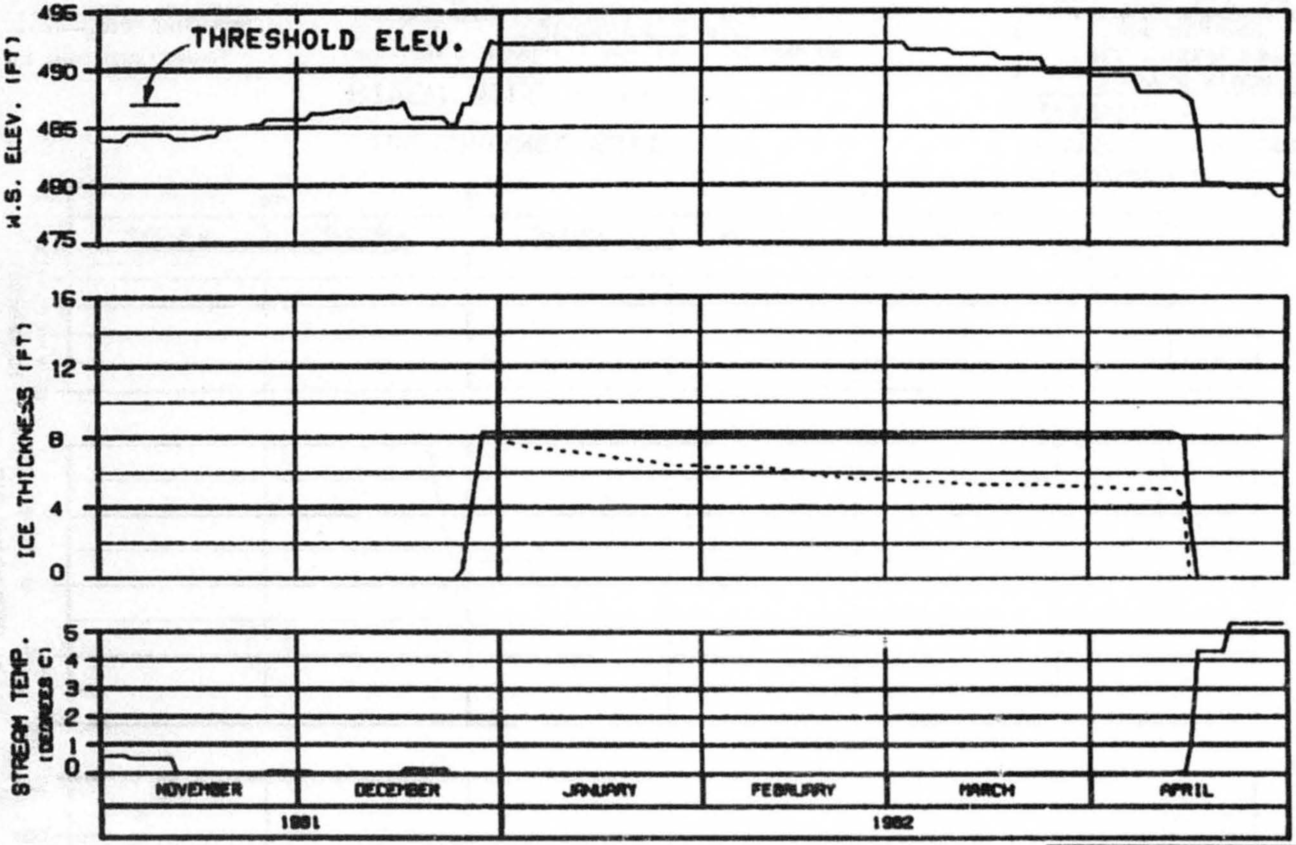
RIVER MILE : 115.50

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING , FLOW CASE E-I
REFERENCE RUN NO. : BIOIENY

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	

OPTION?



HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-I
REFERENCE RUN NO. : 8101ENY

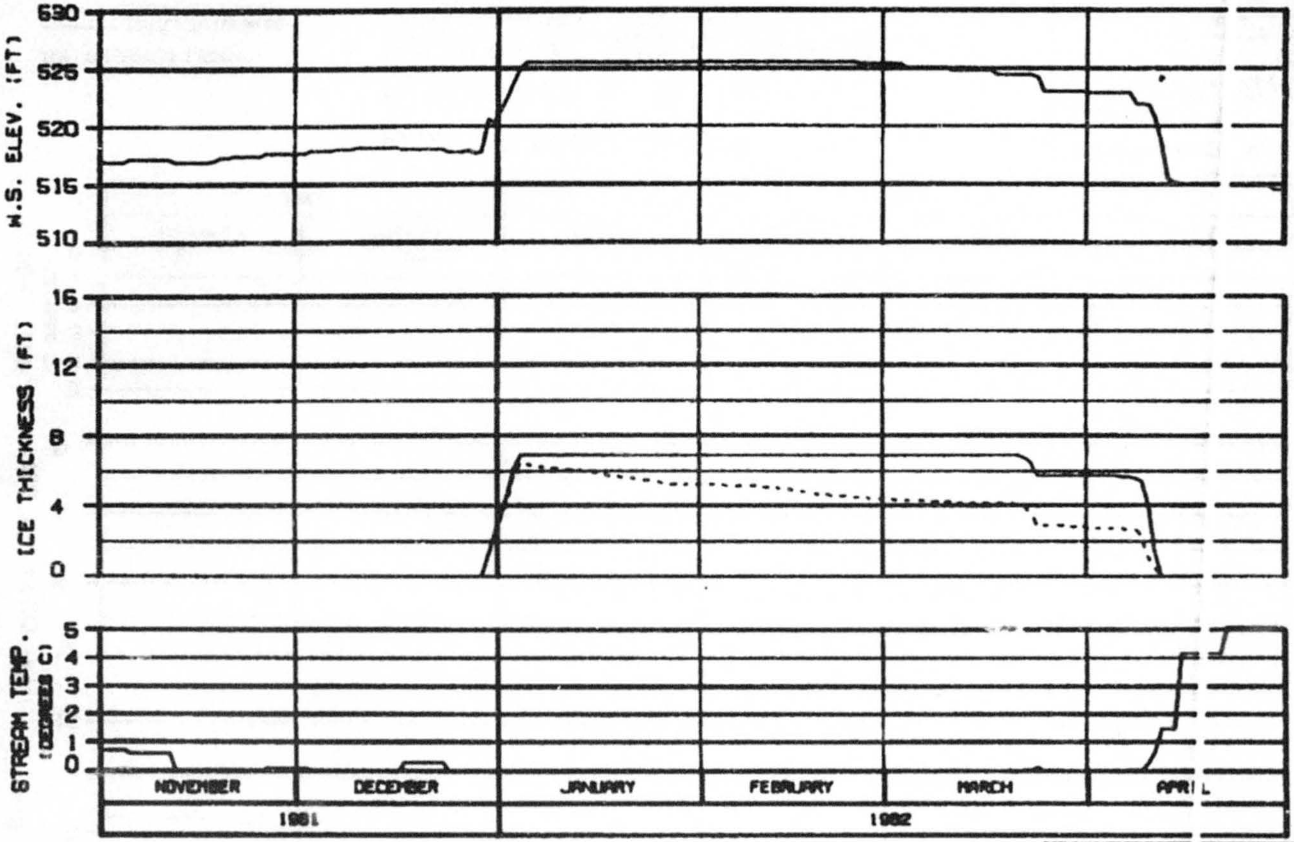
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible]



RIVER MILE : 120.00

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS
------ SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
STAGE I 2001 ENERGY DEMAND
INFLOW-MATCHING . FLOW CASE E-I
REFERENCE RUN NO. : 8101ENY

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE