SUSITNA HYDROELECTRIC PROJECT

INSTREAM ICE SIMULATION STUDY

Report by
Harza-Ebasco Susitna Joint Venture

Prepared for
Alaska Power Authoirty

Draft Report
September 1984

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EXHIBITS

ICECAL SIMULATION RESULTS:

LIST OF EXHIBITS (Cont'd)

INTERPRETIVE SKETCHES OF ICECAL RESULTS:

1.0 INTRODUCTION

1.1 Objective and Scope

Presented in this report are the results to date of the instream ice simulation studies for the Susitna Hydroelectric Project. The objective of these studies is to determine the effect of the proposed Watana and Devil Canyon Dams on river ice processes and the corresponding water surface elevations during the winter season in the Susitna River downstream of the dams. These studies are limited to the Middle Reach of the Susitna River (i.e., upstream of the confluence with the Chulitna River - See Figure 1), wherein the greatest impact of the project is expected.

The information presented in this report will be used in future environmental studies, particularly an assessment of possible project impacts on salmon migration and spawning. Of special interest in this regard are a number of slough and side channel areas, adjacent to the mainstem of the Susitna River, which are known to be the preferred habitat for salmon spawning. Results of the river ice studies are therefore focused on several of the more important slough and side channel locations along the Middle Susitna River. Results include continuous descriptions of ice thickness, water surface elevation and water temperature at these locations.

This report provides a comparison of pre-project (i.e., "natural") river ice conditions with that expected during operation of the proposed project (i.e., "with-project"). In order to provide a broad range of comparisons, various combinations of winter weather patterns, project energy demands, instream flow requirements and reservoir release temperature policies were considered. The river ice simulations cover the six month period from November 1 through April 30, during which the freeze-up and melt-out of the Middle Susitna River is generally expected to occur with-project.

The river ice simulation studies represent one component of a coordinated environmental study effort. Corresponding simulations of the reservoir operation, reservoir temperature distribution and stream temperature provided boundary conditions on which the river ice studies were based. The results of these related studies will be summarized in separate reports.

1.2 Project Background Information

The proposed Susitna Hydroelectric Project is to be located in south-central Alaska approximately 140 miles north-northeast of Anchorage and 110 miles south-southeast of Fairbanks. The proposed project, consisting of Watana and Devil Canyon dams, would generate electrical power for the Railbelt region of Alaska, i.e., the corridor surrounding the Alaska Railroad from Seward and Anchorage to Fairbanks. The Watana and Devil Canyon sites are 184 and 152 river miles, respectively, upstream from the mouth of the Susitna River at Cook Inlet.

Observation of natural ice processes on the Middle Susitna River have been documented by R&M Consultants, Inc. [1, 2, 3, 4] for the past four winters; 1980-81, 1981-82, 1982-83 and 1983-84. An additional study of natural hydraulic and ice conditions was also presented by R&M [5].

Preliminary river ice simulations with the ICESIM model were undertaken by Acres American, Inc. [6] in preparation of the FERC License Application. Harza-Ebasco [7] documented the river ice model ICECAL and its calibration to the Middle Susitna River for use in the present study. Stream temperature modeling with the SNTEMP model has been documented by the Arctic Environmental Information and Data Center [8]. The DYRESM model for reservoir temperature simulation has been documented by Harza-Ebasco [9].

2.0 METHODOLOGY

2.1 Model

The computer model ICECAL was used to generate the river ice simulations presented in this report. The model provides a daily summary of hydraulic, temperature and ice conditions throughout the study reach.

The particular hydraulic and ice operations performed by the ICECAL model include the following:

1. Hydraulic profiles are computed daily for the study reach. Computations are based upon the Bernoulli and Manning equations, and are equivalent to the "HEC-2" backwater program authored by the U.S. Army Corps of Engineers. The computations include the effect of existing ice covers and border ice in the river.

2. Water temperature profiles required for with-project simulations are provided by the SNTEMP stream temperature studies. For ice covered reaches of the river, the SNTEMP results are superseded by ICECAL temperature computations.

3. Frazil ice generation is computed for reaches of turbulent, open water in which the water temperature has dropped to 0°C. Frazil ice flow rates are tabulated as the ice is carried downstream with the flow.

4. Lateral or border ice growth proceeding from the river banks is computed. This lateral ice growth tends to restrict the open water surface area available for frazil ice generation.

5. Frazil ice particles tend to coalesce into pans or rafts of slush ice which can be accumulated downstream at a developing ice cover extending across the river width. Hydraulic conditions at the ice

cover are analyzed to determine if the incoming ice pans will accumulate at the upstream edge of the cover, thereby advancing the "ice front". Alternately, the incoming ice may be swept beneath the ice front and deposited downstream on the underside of the ice cover, thereby thickening the ice cover.

6. Slush and solid ice component thicknesses of the river ice cover are computed. Daily growth of solid ice is computed within the initial accumulations of slush ice.

7. Melting of the ice cover and retreat of its ice front are computed when warm water (i.e., above 0°C) reaches the ice cover. In this manner, a spring "melt-out" is simulated. Mechanical "break-up" of the ice cover is not considered, being beyond the state-of-the-art in river ice modeling. Although severe springtime break-up activity and resulting ice jams have been observed for certain years under natural conditions, it is expected that a more gradual spring melt-out, as considered in the model, will characterize the with-project condition. Severe springtime break-up activity is largely associated with rapid natural flow increases which lift and fracture the ice cover. The proposed project reservoirs will regulate such seasonal flow events, yielding a more steady flow regime in the Middle Susitna River and allowing an existing ice cover to melt in place.

Required input data for the ICECAL model includes the following:

1. River cross-sectional geometry and bed roughness for study reach

2. Weather conditions (daily air temperature and wind velocity) within the study reach

3. Water inflow hydrograph at upstream boundary of study reach

4. Daily frazil ice discharges at upstream boundary of study reach

5. Water temperature profiles between the upstream boundary and the location of the 0°C isotherm.

Further discussion of the input data used for natural and with-project simulations is presented in Sections 2.3 and 2.4, respectively.

A detailed documentation of the ICECAL model and its calibration to the Middle Susitna River for the winters of 1982-83 and 1983-84 is presented by Harza-Ebasco [7].

2.2 Range of Simulated Conditions

The particular river ice simulations included in this report are tabulated in Table I. As shown, the simulations include four winters of historical weather and flow data; 1971-72, 1976-77, 1981-82 and 1982-83. Air temperature data for these four winters is plotted in Figure 2. Figure 3 shows the corresponding natural river flow data. The winters of 1971-72 and 1981-82 are relatively cold whereas the winter of 1982-83 is average in temperature. The winter of 1976-77 is considered warmer than average.

is it or not?

The range of simulated conditions also includes various stages during development of the project; natural conditions, filling of Watana Reservoir (first and second winters), Watana operating alone (1996 and 2001 energy demands), and Watana and Devil Canyon operating together (2002 and 2020 energy demands). The year 1996 represents the expected first year of Watana power generation. Start-up of the Devil Canyon power generation is planned for the year 2002.

Reservoir releases for the with-project simulations satisfy the Case C minimum instream flow requirements. Case C is discussed in the FERC License Application [6] and is a compromise between power generation and environmental flow constraints (See Figure 4). Flow rates for the with-project simulations are adjusted on a weekly basis. Fluctuations of flow within a particular day or week are not considered.

is this true?
res. will be filled
by fall '93 ...

Temperature of the reservoir releases is controlled by operation of a multi-level intake structure. The policy of operation used in the simulations is based on an attempted match of the release temperature with that of the natural flow entering the reservoir. In effect, this "inflow matching" policy results in release of the coldest available water during the winter months. As a sensitivity investigation, one river ice simulation considers the effect of an assumed release of warm, 4°C water throughout the study period.

The range of simulated conditions in this study is intended to provide a broad base for comparisons between the natural and with-project river ice environments. Of necessity, all combinations of meteorology, hydrology, energy demands and reservoir operations could not be considered herein. However, the range of simulations included is believed adequate to allow significant conclusions regarding river ice behavior. Additional simulations and sensitivity analyses will be performed as needed.

2.3 Simulations of Natural Ice Conditions

As shown in Table I, this report includes natural ice simulations for the winters of 1971-72, 1976-77, 1981-82 and 1982-83. These simulations were based on the following conditions and assumptions:

1. Study Reach

Discuss limitations of study reach

The study reach extends from River Mile 98.6 (Chulitna confluence) to River Mile 139.4 (slightly upstream of Gold Creek). Progression of a defineable ice front has been observed in this reach under natural conditions. Upstream of Gold Creek, however, localized unsteady ice bridging processes have been observed to close the river prior to arrival of the ice front. Since the ICECAL model does not attempt to simulate such processes, and since observations of frazil ice quantities are available only at Gold Creek, the model does not extend upstream of this vicinity.

2. Period of Simulation

Simulations cover the 6 month period from November 1 through April 30. Ice front progression up the Middle Susitna River has not occurred prior to November 1 during the four years of ice observations. Simulation of spring break-up or melt-out is not attempted for natural conditions.

3. Starting Date for Ice Front Progression into the Middle Susitna River

When available, actual observations are used for the starting date of the ice front progression at the Susitna-Chulitna confluence. Observed starting dates have ranged from November 5 through December 8 and are shown in Table II. For years when observations are not available, an assumed date is selected within the observed range based on the severity of the particular winter.

4. Water Flow Rates

Historical flow data at Gold Creek (River Mile 137) was used as recorded by the USGS and/or R&M Consultants, Inc. (See Figure 3). Daily flow rates are interpolated for periods when data is not available. Flow rate adjustment factors were applied along the study reach to account for tributary inflows [5].

5. Weather Data

Daily air temperature and wind speed recorded at Talkeetna and Watana weather stations were interpolated linearly along the river length. Talkeetna data is available for all years simulated. Watana data, when not available, was estimated from a correlation with Talkeetna.

6. Frazil Ice Discharge at Upstream Boundary

This quantity was computed from actual ice observations at Gold Creek (River Mile 137), when available. These ice discharges were found to be well correlated with Talkeetna air temperature data. This correlation provided an estimate of frazil ice discharge at Gold Creek for years in which observations were not available.

7. Stream Temperatures

Stream temperatures were assumed at 0°C at the upstream boundary throughout the natural simulations. Possible stream temperature variations downstream of Gold Creek were computed within the ICECAL model.

2.4 Simulations of With-Project Ice Conditions

The various with-project ice simulations were based on the following conditions and assumptions:

1. Study Reach

The study reach extends from the Susitna-Chulitna confluence (River Mile 98.6) to the Watana (River Mile 184.4) or Devil Canyon (River Mile 152) damsite.

2. Period of Simulation

Simulations cover the 6 month period from November 1 through April 30. The freeze-up and melt-out of the Middle Susitna River are generally expected to occur during this period.

3. <u>Starting Date for Ice Front Progression into the Middle Susitna River</u>

Progression of the ice front upstream of the Susitna-Chulitna confluence begins when the Lower Susitna River (downstream of the Chulitna confluence) has frozen over. The Lower Susitna freeze-up is characterized by an initial ice bridge formation near River Mile 9 and the subsequent advance of an ice cover up to the Chulitna confluence.

The Lower Susitna ice cover is fed by frazil ice generated in the Yentna, Talkeetna, Chulitna, Lower Susitna and Middle Susitna Rivers. The ICECAL model considers the total volume of ice required to fill the Lower Susitna River from the Yentna confluence (River Mile 30) to the Chulitna confluence (River Mile 98.6) and computes the time needed to generate the necessary frazil ice. Frazil ice generation in the Middle Susitna River is computed directly by the model. The frazil ice contributions of the Talkeetna, Chulitna and Lower Susitna Rivers are computed by correlation with cumulative freezing degree days at the Talkeetna weather station.

Lower Susitna River ice observations suggest that the ice front typically reaches the Yentna confluence (River Mile 30) in late October or early November under natural conditions (See Table II). It is expected that this event will not be significantly delayed under with-project conditions. Although the frazil ice contribution from the Middle Susitna River is greatly reduced under with-project conditions, the Yentna River, which produces more than 50% of the total ice downstream of River Mile 30, remains unchanged. Also unchanged are the frazil ice contributions of the Chulitna and Talkeetna Rivers.

Based on the above, November 1 was selected as a representative date on which the Lower Susitna ice front reaches the Yentna confluence during with-project conditions. The ICECAL model and related computations of tributary frazil ice production therefore begin on November 1 for the with-project river ice simulations. Daily tabulations of cumulative ice production are performed until the ice storage capacity of the Lower Susitna is reached. At this point, the model begins progression of the ice cover at the Chulitna confluence (River Mile 98.6).

4. <u>Water Flow Rates</u>

Water flow rates at the upstream boundary of the ICECAL simulation are determined by releases from the Watana or Devil Canyon reservoirs. This information is read directly from the output of the corresponding Harza-Ebasco DYRESM simulation and is summarized in Figure 4. The flow rates are provided on a weekly basis and are adjusted along the study reach to account for tributary inflows. Fluctuations of flow within a particular day or week are not considered.

5. <u>Weather Data</u>

Daily air temperature and wind speed data is interpolated along the river length between Talkeetna, Devil Canyon and Watana weather stations. Watana and Devil Canyon data, when unavailable, is estimated from a correlation with Talkeetna data.

6. <u>Frazil Ice Discharge at Upstream Boundary</u>

Water released from the Watana and Devil Canyon reservoirs remains above 0°C throughout the year. Therefore, no frazil ice exists at the upstream boundary of the with-project simulations.

7. Stream Temperatures

Reservoir release temperatures are computed in daily time steps by the Harza-Ebasco DYRESM simulations. Corresponding SNTEMP simulations provide stream temperature profiles on a weekly basis throughout the study reach. This information is read directly into the ICECAL model. The SNTEMP stream temperature profiles are based upon open water conditions and are therefore not valid for that portion of the river which is ice covered. The SNTEMP results are therefore superseded by ICECAL temperature computations where an ice cover exists.

2.5 Slough and Side Channel Areas

Various slough and side channel areas adjacent to the mainstem Susitna River are of special importance as salmon spawning habitat. A typical slough, illustrated in Figure 5, is an overflow channel separated from the mainstem by a well-vegetated bar. Sloughs are often fed by an incoming creek and/or upwelling of groundwater. An alluvial berm generally extends across the upstream end of the slough, shielding it from the river. High natural river flows or ice activity will periodically overtop this upstream berm and flood the slough with water or ice. The water level at a given mainstem river mile which results in overtopping of a nearby slough berm is referred to in this study as the "threshold elevation." This is not necessarily the berm crest elevation, since the critical water level for overtopping that berm may be at a different river mile location.

The important sloughs and side channels have been identified and are tabulated in Table III. The most productive of these areas are indicated in Table III with a "*". For the purpose of the river ice simulations, it is assumed that these particular sloughs will be protected against possible overtopping by construction of artificial berms. That is, the model assumes that the cross-sectional area of these particular sloughs is not available to pass flow or store ice. This assumption has no influence on the model results for those simulations in which the river stages remain below the natural threshold elevations. For those simulations which show slough overtoppings, the slough protection assumption yields river stages which may be slightly higher than those expected without the articifial berms. The slough protection assumption therefore yields conservative results, reflecting the river stages for which the artificial berms would have to be designed.

2.6 Interpretations of Computer Simulations

River ice mechanics and modeling is a relatively primitive field of study. Ice processes are very complicated, unsteady and non-uniform, and many aspects are not yet fully understood. Although the ICECAL model is considered state-of-the-art, certain simplifications and limitations are necessarily involved. Three dimensional concepts are presented in a one-dimensional format, and the model therefore computes an average or characteristic velocity and ice thickness to represent a particular cross-section. The actual spatial distribution of velocity and ice thickness may be highly non-uniform and is beyond the scope of the model. Figure 6 contrasts actual and computed ice distribution at a hypothetical cross-section.

For these reasons, selected ICECAL computer simulations have been interpretted by R&M Consultants, Inc., based on their experience with Susitna River ice over the past four years. The particular interpretations included in this report are identified in Table I. The resulting interpretive sketches combine the quantitative ICECAL results with observed river ice distribution trends to yield the best estimate of the actual river appearance at selected cross-sections.

3.0 RESULTS

3.1 General

Results of the river ice simulations are presented in Exhibits A through S. Each exhibit includes the following information:

1. Profile of the maximum river stages which occurred during the simulation period and the corresponding ice cover thickness which existed on the date of maximum stage. (Since river stage is influenced by both flow rate and ice thickness, the ice thicknesses shown do not necessarily represent the maximum thickness.)

2. Location of the ice front and zero degree C water isotherm throughout the simulation.

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

Table IV is a summary of the maximum water surface elevations which occurred at selected slough and side channel areas for all the river ice simulations. Table V summarizes the number of occurrences where with-project simulations resulted in higher maximum stages than the corresponding natural conditions for the same weather period. Table VI shows those slough and side channel areas whose known threshold elevation was overtopped with-project but not under natural conditions, and vice versa. Table VII summarizes the starting date, maximum extent and melt-out date of the ice front for each simulation. Tables VIII and IX present the maximum total and solid ice thicknesses, respectively, which occurred during the simulations.

Interpretive sketches for selected ICECAL simulations are presented in Exhibits T-Z. Each sketch shows natural river conditions observed in 1983-84, a selected ICECAL simulation result and an interpreted version of the

ICECAL result for a particular river cross section. This interpreted version represents the best estimate of the actual appearance of the particular river cross section at the time of its maximum winter stage.

3.2 Simulations of Natural Conditions

Of the four years simulated, the relatively cold winter of 1971-72 (Exhibit A) typically results in the greatest ice thicknesses and highest river stages within the study reach. For this winter, maximum total ice thicknesses (solid + slush component) within the study reach range from 5' to 11', including up to 5' of solid ice. The winter of 1981-82 (Exhibit C), also considered cold, shows maximum total ice thicknesses of 4' to 10', of which 3' to 4' is typically solid ice. Maximum river stages for 1981-82 are often 1' to 3' lower than those for 1971-72.

The winter of 1982-83, average in temperature, was used for model calibration purposes [7]. Actual ice observations are shown along with simulated results in Exhibit D. Maximum total ice thicknesses for 1982-83 range from 3' to 8', of which 3' is typically solid ice. Maximum river stages are generally 0' to 4' lower than those of 1971-72.

The winter of 1976-77, warmer than average in temperature, results in the smallest ice thicknesses and lowest river stages of the four winters simulated. Maximum total ice thicknesses range from 1' to 7', of which 1' to 2' is solid ice. Maximum river stages for 1976-77 are generally 2' to 6' lower than those of 1971-72.

For the winters of 1971-72, 1981-82 and 1982-83, ice front progression at the Chulitna confluence (River Mile 98.6) begins in early or mid-November and reaches Gold Creek in late December or early January. The winter of 1976-77 however, shows the ice front beginning in early December and reaching Gold Creek in early March. All four simulations are characterized by a rapid initial ice front progression rate in the lower portion of the study reach with a gradual slowing as it approaches Gold Creek.

3.3 Watana Operating with 1996 Energy Demand

2(W,L,1M); 6(W,L,40)

Simulation results are presented in Exhibits E-I. As shown, the start of the ice front progression at the Chulitna confluence ranges from late November (1971-72 winter) to late December (1981-82 winter). This represents a delay of 2 to 5 weeks relative to natural conditions for the corresponding winters. The maximum upstream extent of the ice front is at River Mile 137-140 for the winters of 1971-72, 1976-77 and 1981-82, and at River Mile 127 for the winter of 1982-83. Completion of the spring melt-out in the Middle Susitna ranges from mid March (1982-83 winter) to mid May (1971-72 winter). This melt-out occurs 4 to 6 weeks earlier than natural river break-up based on observation of 1981-82 and 1982-83.

The most severe ice conditions for Watana operation and 1996 energy demand occur for the winter of 1971-72 (Exhibit E). For this simulation, maximum total ice thicknesses range from 2' to 11', including up to 5' of solid ice. These ice thicknesses are generally similar to those of natural conditions in the reach downstream of Gold Creek (River Mile 137). Maximum river stages, however, are 3' to 7' higher than natural conditions due to the significantly higher winter flow rates with the project.

The mildest simulated river ice conditions for the 1996 energy demand occur for the winter of 1982-83 (Exhibit H). Maximum total ice thicknesses for this simulation range from 2' to 8', including up to 2' of solid ice. These thicknesses are generally similar to natural 1982-83 conditions, but maximum with-project river stages are 2' to 5' higher than natural conditions due to the higher with-project winter flows. Maximum river stages for the 1982-83 with-project simulation are 0' to 7' lower than those of the 1971-72 severe conditions.

The effect of an assumed warm (4°C) water release from the Watana reservoir throughout the 1971-72 winter was considered as shown in Exhibit I. With these "warm" reservoir releases, the ice cover progression at the Chulitna confluence begins 3 weeks later and melt-out occurs approximately 7 weeks earlier than with the "inflow matching" temperature release policy of

Exhibit E (See Section 2.2). Maximum ice thicknesses with the warm releases range from 2' to 7', and maximum river stages are typically 1' to 7' lower than those with the "inflow-matching" releases. Maximum extent of the ice cover with the warm releases is River Mile 127, versus River Mile 140 under inflow matching release temperatures. It therefore appears that control of the reservoir release temperatures can potentially have a major impact on river ice development.

3.4 Watana Operating with 2001 Energy Demand

Simulations of Watana operating with the 2001 energy demand were performed for the winters of 1971-72 and 1982-83 (See Exhibits J and K). Results show that the ice front starting date, melt-out date and maximum upstream extent are similar to those of the 1996 energy demand for the corresponding winters. However, some redistribution of the frazil ice depositions along the river length is apparent. Such differences in ice distribution can be caused by different patterns of reservoir release temperatures occuring at different times within a given winter season. In particular, for the 1971-72 winter, the 2001 energy demand shows colder December reservoir releases than the 1996 demand, thereby causing a faster ice front progression. The subsequent heavy frazil production in January is therefore accumulated at a further upstream location for the 2001 demand. As a result, maximum river stages in the vicinity of river miles 137-142 for the 1971-72 winter with 2001 energy demand are 2' to 10' higher than those with the 1996 demand.

Maximum total ice thicknesses for the 1971-72 winter with 2001 energy demand range from 4' to 14' of which 4' to 5' is solid ice. Maximum river stages are 2' to 6' higher than for natural 1971-72 conditions.

Maximum total ice thicknesses for the 1982-83 winter with 2001 energy demand range from 2' to 7' including up to 2' of solid ice. Maximum river stages are 1' to 6' higher than natural conditions in the reach downstream of River Mile 124 where the with-project ice cover exists. Upstream of the with-project ice cover, however, maximum river stages are 1' to 4' lower than natural conditions. Although the with-project flow rates are higher, the displacement and frictional resistance of the natural ice cover in this reach result in higher river stages for natural conditions than with-project.

3.5 Watana and Devil Canyon Operating with 2002 Energy Demand

Simulation results for Watana and Devil Canyon operating with 2002 energy demand are presented in Exhibits L-O. Results show that the beginning of the ice front progression at the Chulitna confluence ranges from early December to mid-January, approximately 0-2 weeks later than the corresponding Watana-only simulations, and 4-6 weeks later than natural conditions for the same winters. Maximum upstream extent of the ice front ranges from River Mile 123 to 137, and is 3-13 miles below that with Watana only and 1996 energy demand. Simulated melt-out with both dams operating and 2002 energy demand ranges from mid-March to mid-May, being 0-3 weeks earlier than Watana-only simulations for the corresponding winters, and 7-8 weeks earlier than the natural break-up observed for the 1981-82 and 1982-83 winters.

For both dams operating with 2002 energy demand, the most severe ice conditions occur with the 1971-72 winter (Exhibit L). Maximum ice thicknesses for this case range from 3' to 7', of which 3' to 5' is solid ice. Maximum river stages are 1' to 5' lower than the corresponding Watana-only simulation with 1996 energy demand. Maximum river stages downstream of River Mile 130 are 0' to 4' higher than natural conditions. Upstream of this location, however, the ice cover is much thinner with-project and maximum river stages are 0' to 3' lower than natural conditions.

The winters of 1976-77, 1981-82 and 1982-83 (Exhibits M, N and O) all show relatively mild ice conditions for both dams operating with the 2002 energy demand. Maximum ice thicknesses for these cases range from 1' to 6', including 1' to 2' of solid ice. Maximum river stages are 0' to 7' lower than the corresponding Watana-only simulations with 1996 energy demand. Maximum river stages, where an ice cover exists, are 1' to 4' higher than corresponding natural conditions. Upstream of the with-project ice cover, maximum river stages are 0' to 5' lower than natural conditions. Again, the higher natural stages in this reach are due to the displacement and frictional resistance of the natural ice cover.

3.6 Watana and Devil Canyon Operating with 2020 Energy Demand

Simulations of Watana and Devil Canyon operating with the 2020 energy demand were performed for the winters of 1971-72 and 1982-83 (Exhibits P and Q). Results show that the ice front starting date and maximum upstream extent are generally similar to those of the 2002 energy demand for the corresponding winters. The spring melt-out with the 2020 energy demand, however, occurs 1 to 3 weeks earlier than with the 2002 energy demand. This is apparently caused by somewhat warmer reservoir release temperatures resulting from the 2020 reservoir simulation.

Simulation of the 1971-72 winter with 2020 energy demand shows maximum ice thicknesses which range from 2' to 7' including 1' to 4' of solid ice. Maximum river stages in the ice-covered reach (downstream of River Mile 130) are 1' to 7' higher than corresponding natural conditions. Upstream of the with-project ice cover, maximum river stages are 1' to 5' lower than those of natural conditions, due to the displacement and frictional resistance of the natural ice cover.

Simulation of the 1982-83 winter with 2020 energy demand shows maximum ice thicknesses ranging from 1' to 3', including up to 1' of solid ice. Maximum river stages in the ice-covered reach are 0' to 4' higher than natural conditions. Upstream of the with-project ice cover, maximum stages are 0' to 4' lower than corresponding ice-covered natural conditions.

3.7 Watana Filling

River ice simulations for the first and second years of filling the Watana reservoir are shown in Exhibits R and S. The first winter of filling, which involves relatively warm reservoir releases from the low level outlet works, was simulated with the average 1982-83 weather conditions. The second winter of filling includes release of colder water from the reservoir surface and was simulated with the cold 1981-82 weather conditions. The two simulations were selected to provide a likely range of ice conditions during the filling of the Watana reservoir.

Results for Watana filling show that the ice front progression at the Chulitna confluence begins in mid-December, 5-7 weeks later than corresponding natural conditions. The simulated melt-out for the first winter of filling occurs in early May, similar to the timing of break-up under natural conditions. The second winter of filling shows a melt-out in late May, 2 to 3 weeks later than the natural break-up. This earlier natural ice break-up is probably due to the spring flow increases which exist under natural conditions but not during filling conditions.

The Watana filling simulations show the ice front progressing up to River Mile 156-162. This ice progression is significantly further upstream than any of the other with-project simulations and is due to the lower river flows and velocities which exist under filling conditions. However, simulation of an ice front progression upstream of River Mile 140 is considered an approximation only, since intermittent bridging of lateral ice has been observed to be the dominant process in this reach for natural conditions.

Simulation of the first year of filling with the 1982-83 winter shows maximum ice thicknesses of 1' to 6', including up to 2' of solid ice. Maximum river stages are 0' to 5' lower than natural conditions for 1982-83.

Simulation of the second year of filling with the 1981-82 winter shows maximum ice thicknesses of 1' to 8', including up to 3' of solid ice. Maximum river stages are generally 0' to 3' lower than natural conditions for 1981-82.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The following preliminary conclusions are based upon the river ice simulation results to date and are subject to the various assumptions and conditions described in this report. In particular, the with-project ice results are based on a reservoir release temperature policy which attempts to match the natural stream temperatures incoming to the reservoir (i.e., coldest available water is released from the reservoir during winter season). Conclusions apply only to the Middle Susitna River (i.e, upstream of the confluence with the Chulitna River) wherein the most significant project impacts are expected.

1. Ice Front Progression and Melt-Out

   Relative to natural conditions, initial progression of the Middle Susitna ice front at the Chulitna confluence (River Mile 98.6) is expected to be delayed by 2 to 5 weeks with Watana operating alone, and 4 to 6 weeks with Watana and Devil Canyon operating together. A gradual spring melt-out with Watana operating alone is expected 4 to 6 weeks earlier than the natural, mechanical break-up. With both dams operating, the spring melt-out is expected 7 to 8 weeks earlier than the natural break-up.

   Maximum upstream extent of the river ice cover during the selected warm, average and cold winters is expected to range from River Mile 124 to 142 with Watana operating alone. With the addition of the Devil Canyon dam, this maximum upstream extent will be somewhat reduced, with an expected range of River Mile 123 to 137.

2. Ice Thicknesses

   In those reaches where an ice cover exists, the maximum total and solid ice thicknesses with Watana operating alone are expected to be generally similar to those of natural conditions. With both dams operating, the maximum total and solid ice thicknesses are expected to be typically 1' to 2' less than those of natural conditions.

3. River Stages and Slough Overtopping

In those reaches where an ice cover exists, the maximum river stages with Watana operating alone are expected to be generally higher than those of the natural conditions, typically by 2' to 7'. Corresponding maximum river stages in ice covered reaches with both dams operating are expected to be typically 1' to 6' higher than those of natural conditions.

Upstream of the with-project ice front, however, the maximum river stages with Watana operating alone are expected to be typically 1' to 3' lower than the corresponding natural conditions. With both dams operating, these maximum river stages are expected to be typically 1' to 5' lower than natural conditions. why

As a result of the above, overtopping of the natural threshold elevations in various slough and side channel areas in the lower reaches of the Middle Susitna is expected to be more frequent with the project than under natural conditions (See Table VI). Depending on the aquatic assessments, it may therefore be desirable to protect these particular areas with artificial berms. However, various slough and side channel areas in the upper reaches of the Middle Susitna are expected to be overtopped less frequently with the project than under natural conditions. Artificial berms, therefore, are not expected to be necessary for these locations.

4. Further Considerations

It is expected that the policy which governs reservoir release temperatures may have a major impact on the river ice development

5.0 REFERENCES

1. R&M Consultants, Inc., "Ice Observations, 1980-81", August 1981.

2. R&M Consultants, Inc., "Winter 1981-82, Ice Observations Report", December 1982.

3. R&M Consultants, Inc., "Susitna River Ice Study, 1982-83", August 1983.

4. R&M Consultants, Inc., "Susitna River Ice Study, 1983-1984", Draft Report, June 1984.

5. R&M Consultants, Inc., "Hydraulic and Ice Studies", March 1982.

6. Acres American, Inc. "Susitna Hydroelectric Project", Application for FERC License, February 1983, Volume 5A, Exhibit E, Chapter 2.

7. Harza-Ebasco, "Instream Ice, Calibration of Computer Model", Document No. 1122, April 1984.

8. Arctic Environmental Information and Data Center, "Stream Flow and Temperature Modeling in the Susitna Basin, Alaska", June 1983.

9. Harza-Ebasco, "Eklutna Lake Temperature and Ice Study", January 1984.

TABLE I

SUSITNA HYDROELECTRIC PROJECT
SCOPE OF RIVER ICE SIMULATIONS

Project Status	Natural Conditions	Watana Only Operating		Watana and Devil Canyon Operating		Watana Filling	
Flow Requirements	----	Case C		Case C		----	
Energy Demand	----	1996	2001	2002	2020	----	
Release Temperature	----	N W	N	N	N	----	
						1st Winter	2nd Winter
Historical Period:							
1971-72 (Cold winter)	X	2 X X 6	1 X	4 X	3 X		
1976-77 (Warm winter)	X	2 X		4 X			
1981-82 (Cold winter)	X	2 X		4 X			X
1982-83 (Average winter)	X	2 X	1 X	4 X	3 X	X	

Notes: 1. N represents natural "inflow matching" policy for reservoir release temperatures.

2. W represents assumed warm, 4°C temperature release.

Legend: X ICECAL simulation

X ICECAL simulation and interpretive sketch

TABLE II

SUSITNA HYDROELECTRIC PROJECT
OBSERVED ICE FRONT PROGRESSION
ON THE SUSITNA RIVER

Observed Location of Ice Front	River Mile	1980	1981	1982	1983
River Mile 9	9	Unknown	Early Nov.	Oct. 22	Oct. 26
Chulitna Confluence	98.6	Nov. 29	Nov. 18	Nov. 5	Dec. 8
Near Gold Creek	136	Dec. 12	Dec. 31	Dec. 27	Jan. 5

TABLE III

SUSITNA HYDROELECTRIC PROJECT
SLOUGH AND SIDE CHANNEL AREAS
IN MIDDLE SUSITNA RIVER

Area	River Mile Location	Threshold Elevation (feet)
*Whiskers Slough	101.5^H	367
Side Channel at Head of Gash Creek	112.0	Unknown
*Slough 6A	112.3^M	U
*Slough 8	114.1^H	476
Side Channel MSII	115.5	482
Side Channel MSII	115.9^H	487
Curry Slough	120.0^H	Unknown
*Moose Slough	123.5^H	Unknown
*Slough 8A - West Channel	126.1^H	573
*Slough 8A - East Channel	127.1^H	582
*Slough 9	129.3^H	604
Side Channel Upstream of Slough 9	130.6	Unknown
Side Channel Upstream of 4th July Creek	131.8	Unknown
Slough 9A	133.7^H	651
Side Channel Upstream of Slough 10	134.3	657
Side Channel Downstream of Slough 11	135.3	Unknown
*Slough 11	136.5^H	687
*Slough 17	139.3^H	Unknown
Slough 20	140.5^H	730
*Slough 21 - Entrance A6	141.8^H	747
*Slough 21	142.2^H	755
Slough 22	144.8^H	788

Legend:

- * - For purposes of simulation, these sloughs are assumed to be protected against overtopping.
- H - Indicated location represents the head of the slough or channel
- M - Indicated location represents the mouth of the slough or channel
- U - "Upland" slough with no upstream head or berm.

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED WINTER RIVER STAGES[4]

TABLE IV

Slough or Side Channel	River Mile	Threshold Elevation	NATURAL CONDITIONS				WATANA ONLY							WATANA AND DEVIL CANYON						WATANA FILLING	
							1996 DEMAND					2001 DEMAND		2002 DEMAND				2020 DEMAND		YR. 1	YR. 2
			1971-72	1976-77	1981-82	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72W	1971-72	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72	1982-83	1982-83	1981-82
Whiskers	101.5	367	$\boxed{369}$	366	$\boxed{368}$	$\boxed{367}$	$\boxed{372}$	$\boxed{370}$	$\boxed{371}$	$\boxed{370}$	$\boxed{371}$	$\boxed{372}$	$\boxed{370}$	$\boxed{371}$	$\boxed{368}$	$\boxed{369}$	$\boxed{369}$	$\boxed{372}$	$\boxed{370}$	367	367
Gash Creek	112.0	Unknown	456	455	455	456	459	457	460	459	460	459	461	458	455	456	457	459	457	455	455
6A	112.3	(Upland)	459	457	457	459	462	460	462	462	463	461	463	460	458	458	460	461	459	457	457
8	114.1	476	474	472	472	474	$\boxed{478}$	475	$\boxed{477}$	$\boxed{476}$	$\boxed{477}$	$\boxed{476}$	$\boxed{478}$	475	474	475	475	$\boxed{476}$	475	473	473
MS II	115.5	482	$\boxed{484}$	480	$\boxed{484}$	$\boxed{484}$	$\boxed{490}$	$\boxed{487}$	$\boxed{488}$	$\boxed{488}$	$\boxed{488}$	$\boxed{489}$	$\boxed{489}$	$\boxed{487}$	$\boxed{485}$	$\boxed{485}$	$\boxed{487}$	$\boxed{490}$	$\boxed{488}$	481	$\boxed{483}$
MS II	115.9	487	485	482	486	486	$\boxed{492}$	$\boxed{489}$	$\boxed{491}$	$\boxed{491}$	$\boxed{490}$	$\boxed{491}$	$\boxed{492}$	$\boxed{489}$	$\boxed{488}$	$\boxed{488}$	$\boxed{490}$	$\boxed{492}$	$\boxed{490}$	485	486
Curry	120.0	Unknown	522	520	523	520	526	525	527	525	523	525	521	522	521	520	520	525	523	520	521
Moose	123.5	Unknown	552	546	549	548	556	554	555	550	552	555	550	553	550	548	545	555	550	546	548
8A West	126.1	573	572	569	571	570	$\boxed{576}$	$\boxed{575}$	$\boxed{574}$	572	572	$\boxed{575}$	568	$\boxed{574}$	571	568	568	$\boxed{575}$	572	568	570
8A East	127.1	582	$\boxed{584}$	581	$\boxed{583}$	$\boxed{582}$	$\boxed{587}$	$\boxed{585}$	$\boxed{585}$	$\boxed{582}$	$\boxed{582}$	$\boxed{586}$	581	$\boxed{584}$	$\boxed{582}$	580	581	$\boxed{585}$	$\boxed{582}$	580	$\boxed{582}$
9	129.3	604	$\boxed{605}$	603	$\boxed{606}$	$\boxed{605}$	$\boxed{609}$	$\boxed{607}$	$\boxed{607}$	603	603	$\boxed{610}$	603	$\boxed{606}$	602	601	602	$\boxed{608}$	603	602	603
9 u/s	130.6	Unknown	622	616	620	621	624	622	620	617	617	625	617	620	616	616	616	621	617	616	618
4th July	131.8	Unknown	632	626	629	630	635	633	631	628	628	636	628	633	627	627	627	631	628	625	628
9A	133.7	651	$\boxed{655}$	649	$\boxed{651}$	$\boxed{651}$	$\boxed{657}$	$\boxed{655}$	$\boxed{653}$	650	650	$\boxed{659}$	650	$\boxed{652}$	650	650	650	$\boxed{651}$	650	650	650
10 u/s	134.3	657	$\boxed{662}$	654	$\boxed{657}$	$\boxed{658}$	$\boxed{663}$	$\boxed{661}$	$\boxed{659}$	656	656	$\boxed{665}$	656	$\boxed{659}$	655	655	655	$\boxed{657}$	656	$\boxed{658}$	655
11 d/s	135.3	Unknown	673	667	670	672	675	672	670	668	668	676	668	670	667	667	667	668	668	670	668
11	136.5	687	684	681	683	684	$\boxed{688}$	686	$\boxed{687}$	683	683	$\boxed{690}$	683	685	682	682	682	684	684	682	682
17	139.3	Unknown	–	–	–	–	717	715	715	715	715	727	715	714	714	714	714	715	715	712	713
20	140.5	730	–	–	–	–	$\boxed{732}$	$\boxed{730}$	729	729	729	$\boxed{741}$	729	728	728	728	728	729	729	727	729
21 (A6)	141.8	747	–	–	–	–	746	746	746	746	745	$\boxed{751}$	746	746	746	745	746	$\boxed{747}$	$\boxed{747}$	745	745
21	142.2	755	–	–	–	–	753	753	753	753	753	$\boxed{755}$	753	752	752	752	752	753	754	751	750
22	144.8	788	–	–	–	–	787	787	787	786	787	787	786	785	785	785	785	787	787	782	782

Upstream Boundary of Natural Simulations

Upstream Extent of Ice Cover Progression

NOTES:

1. $\boxed{}$ Indicates locations where maximum river stage equals or exceeds a known slough threshold elevation.
2. "Case C" instream flow requirements are assumed for with-project simulations.
3. 1971-72W simulation assumes warm, 4° C reservoir releases. All other with-project simulations assume an "inflow-matching" temperature policy.
4. All river stages in feet.

TABLE V

SUSITNA HYDROELECTRIC PROJECT
OCCURRENCES[1] WHERE WITH-PROJECT MAXIMUM RIVER STAGES ARE HIGHER THAN NATURAL CONDITIONS

Slough or Side Channel	River Mile	Watana Only Operating	Watana and Devil Canyon Operating	Watana Filling
Whiskers	101.5	6/6	6/6	0/2
Gash Creek	112.0	6/6	5/6	0/2
6A	112.3	6/6	5/6	0/2
8	114.1	6/6	6/6	1/2
MSII	115.5	6/6	6/6	0/2
MSII	115.9	6/6	6/6	0/2
Curry	120.0	6/6	3/6	0/2
Moose	123.5	6/6	4/6	0/2
8A West	126.1	5/6	4/6	0/2
8A East	127.1	4/6	2/6	0/2
9	129.3	4/6	2/6	0/2
9 u/s	130.6	3/6	0/6	0/2
4th July	131.8	3/6	2/6	0/2
9A	133.7	3/6	1/6	0/2
10 u/s	134.3	4/6	1/6	0/2
11 d/s	135.3	3/6	0/6	0/2
11	136.5	4/6	2/6	0/2

Notes:

1. For example, 4/6 means that 4 of the 6 with-project simulations resulted in a higher maximum river stage than the natural conditions for corresponding winters.

2. "Case C" instream flow requirements and "inflow-matching" reservoir release temperatures are assumed for with-project simulations.

TABLE VI

SUSITNA HYDROELECTRIC PROJECT
EXPECTED PROJECT EFFECTS ON WINTER SLOUGH OVERTOPPING

		WATANA ONLY							WATANA AND DEVIL CANYON						WATANA FILLING	
		1996 DEMAND					2001 DEMAND		2002 DEMAND				2020 DEMAND		YR.1	YR. 2
Slough or Side Channel	River Mile	1971-72	1976-77	1981-82	1982-83	1971-72W	1971-72	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72	1982-83	1982-83	1981-82
Whiskers	101.5		X							X					O	O
8	114.1	X		X	X	X	X	X					X			
MS II	115.5		X							X					O	
MS II	115.9	X	X	X	X	X	X	X	X	X	X	X	X	X		
8A West	126.1	X	X	X			X		X				X			
8A East	127.1		X					O		X	O	O			O	
9	129.3		X		O	O		O			O	O		O	O	O
9A	133.7		X		O	O		O			O	O		O	O	O
10 u/s	134.3		X		O	O		O			O	O		O		O
11	136.5	X		X			X									

LEGEND:

X Slough is overtopped with project, but not under natural conditions for the corresponding winter.

O Slough is overtopped with natural conditions, but not overtopped with project.

NOTES:

1. "Case C" instream flow requirements are assumed for with-project simulations.

2. 1971-72W simulation assumes warm, 4° C reservoir releases. All other with-project simulations assume an "inflow-matching" temperature policy.

TABLE VII

SUSITNA HYDROELECTRIC PROJECT
SIMULATED ICE FRONT PROGRESSION

	Starting Date at Chulitna Confluence	Melt-Out Date	Maximum Upstream Extent (River Mile)
Natural Conditions			
1971-72	Nov. 5	--	137[N]
1976-77	Dec. 8	--	137[N]
1981-82	Nov. 18	May 10-15[B]	137[N]
1982-83	Nov. 5	May 10[B]	137[N]
Watana Only - 1996 Demand			
1971-72	Nov. 28	May 15[E]	140
1976-77	Dec. 25	May 3[E]	137
1981-82	Dec. 28	April 3	137
1982-83	Dec. 12	Mar. 20	127
1971-72[W]	Dec. 17	Mar. 27	127
Watana Only - 2001 Demand			
1971-72	Nov. 28	May 15[E]	142
1982-83	Dec. 19	March 16	124
Both Dams - 2002 Demand			
1971-72	Dec. 2	May 3[E]	137
1976-77	Jan. 10	April 20	126
1981-82	Dec. 30	Mar. 12	124
1982-83	Dec. 22	Mar. 20	123
Both Dams - 2020 Demand			
1971-72	Dec. 3	April 15	133
1982-83	Dec. 14	Mar. 12	127
Watana Filling			
1982-83 (YR.1)	Dec. 23	May 2[E]	156[I]
1981-82 (YR.2)	Dec. 23	May 30[E]	162[I]

Legend:
- B - Observed natural break-up.
- E - Melt-out date is extrapolated from results when occurring beyond April 30.
- N - Ice cover for natural conditions extends upstream of Gold Creek (River Mile 137) by means of lateral ice bridging.
- I - Computed ice front progression upstream of Gold Creek (River Mile 137) is approximation only. Observations indicate closure of river by lateral ice in this reach for natural conditions.

Notes:
1. "Case C" instream flow requirements are assumed for with-project simulations.
2. 1971-72[W] simulation assumes warm, 4°C reservoir releases. All other with-project simulations assume an "inflow-matching" temperature policy.

SUSITNA HYDROELECTRIC PROJECT
TOTAL ICE THICKNESS
MAXIMUM SIMULATED VALUES^{3}

TABLE VIII

Slough or Side Channel	River Mile	NATURAL CONDITIONS				WATANA ONLY							WATANA AND DEVIL CANYON						WATANA FILLING	
						1996 DEMAND					2001 DEMAND		2002 DEMAND				2020 DEMAND		YR. 1	YR. 2
		1971-72	1976-77	1981-82	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72w	1971-72	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72	1982-83	1982-83	1981-82
Whiskers	101.5	5	2	4	3	5	2	3	2	3	5	2	5	1	2	2	4	1	2	3
Gash Creek	112.0	5	4	4	4	5	3	5	5	6	5	7	5	2	2	3	4	1	3	4
6A	112.3	6	5	4	5	5	3	5	4	6	5	7	5	2	3	4	4	1	5	5
8	114.1	5	2	4	4	5	2	4	3	4	5	5	4	2	3	3	4	1	3	3
MSII	115.5	5	2	5	5	6	2	5	5	4	5	6	4	3	3	4	4	2	3	5
MSII	115.9	5	3	7	6	7	3	7	6	6	5	8	4	6	4	6	5	3	5	8
Curry	120.0	6	5	7	4	7	5	8	5	3	5	1	4	3	1	1	4	2	4	6
Moose	123.5	10	4	7	5	9	6	8	2	4	6	2	7	4	1		7	2	5	6
8A West	126.1	5	2	3	3	5	3	3	1	1	5		3	1			3	1	1	2
8A East	127.1	5	2	3	3	4	3	2	0	0	4		3				3	0	1	2
9	129.3	6	4	7	6	5	3	3			6		3				3		2	4
9 u/s	130.6	8	3	6	7	5	4	2			6		3				2		3	6
4th July	131.8	7	1	3	5	5	3	2			7		3				2		1	3
9A	133.7	7	1	3	3	6	4	2			8		3						3	2
10 u/s	134.3	11	1	3	4	7	5	2			9		4						6	2
11 d/s	135.3	6	1	3	5	6	4	2			8		3						3	3
11	136.5	5	1	3	4	3	2	2			5		1						3	4
17	139.3					2					13								1	4
20	140.5					2					12								1	4
21 (A6)	141.8										3								1	2
21	142.2										1								1	1
22	144.8																		1	1

Upstream Boundary of Natural Simulations

Upstream Extent of Ice Cover Progression

NOTES:

1. "Case C" instream flow requirements are assumed for with-project simulations.
2. 1971-72^{W} simulation assumes warm, 4°C reservoir releases.
   All other with-project simulations assume an "inflow-matching" temperature policy.
3. All ice thickness in feet.

TABLE IX

SUSITNA HYDROELECTRIC PROJECT
SOLID ICE THICKNESS
MAXIMUM SIMULATED VALUES[3]

		NATURAL CONDITIONS				WATANA ONLY							WATANA AND DEVIL CANYON						WATANA FILLING	
						1996 DEMAND					2001 DEMAND		2002 DEMAND				2020 DEMAND		YR. 1	YR. 2
Slough or Side Channel	River Mile	1971-72	1976-77	1981-82	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72W	1971-72	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72	1982-83	1982-83	1981-82
Whiskers	101.5	5	2	4	3	5	2	3	2	3	5	2	5	1	2	2	4	1	2	3
Gash Creek	112.0	5	2	4	3	5	2	3	2	2	5	1	5	1	2	1	4	1	2	3
6A	112.3	5	2	4	3	5	2	3	2	2	5	1	5	1	2	1	4	1	2	3
8	114.1	5	2	4	3	5	2	3	2	2	5	1	5	1	2	1	4	1	2	3
MSII	115.5	5	2	4	3	5	2	3	2	1	5	1	4	1	1	1	4	1	2	3
MSII	115.9	5	2	4	3	5	2	3	1	1	5	0	4	1	1	1	4	1	2	3
Curry	120.0	5	2	4	3	5	2	2	0	1	5	0	4	1	1	0	3	0	2	3
Moose	123.5	5	2	4	3	4	1	2	0	0	4	0	4	0	0		2	0	2	2
8A West	126.1	5	2	3	3	4	1	1	0	0	4		3	0			1	0	1	2
8A East	127.1	5	2	3	3	3	1	1	0	0	4		3				1	0	1	2
9	129.3	5	2	3	3	3	1	1			4		3				1		1	2
9 u/s	130.6	5	2	3	3	3	1	1			4		2				0		1	2
4th July	131.8	5	1	3	3	2	1	1			4		2				0		1	2
9A	133.7	5	1	3	2	2	1	0			4		1						1	2
10 u/s	134.3	5	1	3	2	2	0	0			3		1						1	2
11 d/s	135.3	4	1	3	2	2	0	0			3		0						1	2
11	136.5	4	1	3	2	1	0	0			3		0						1	2
17	139.3					0					2								0	2
20	140.5					0					2								0	2
21 (A6)	141.8										1								0	2
21	142.2										0								0	1
22	144.8																		0	1

Upstream Boundary of Natural Simulations

Upstream Extent of Ice Cover Progression

NOTES:

1. "Case C" instream flow requirements are assumed for with-project simulations.
2. 1971-72W simulation assumes warm, 4°C reservoir releases.
   All other with-project simulations assume an "inflow-matching" temperature policy.
3. All ice thickness in feet.

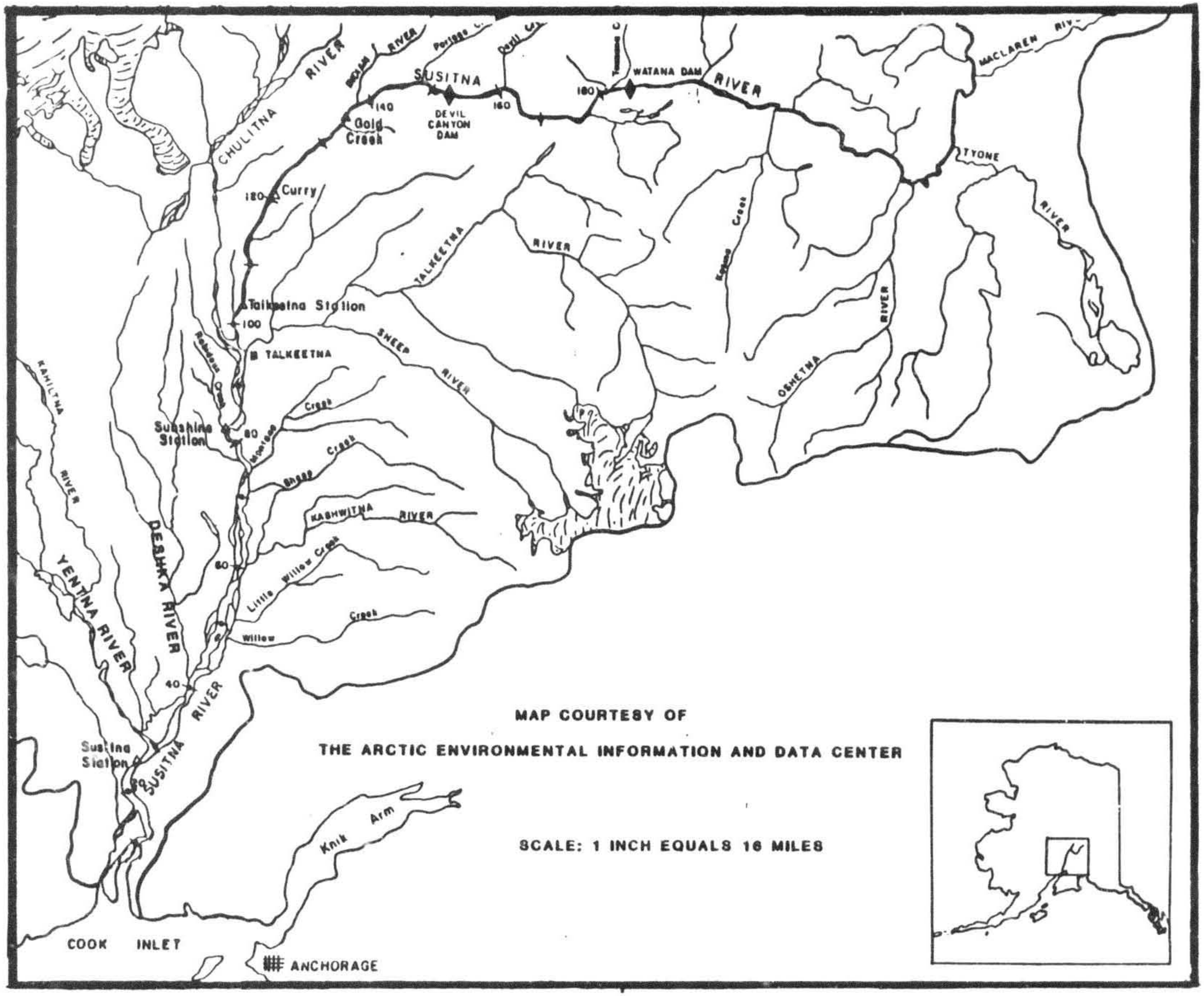


FIGURE 1 - SUSITNA RIVER

R&M CONSULTANTS, INC.
ENGINEERS GEOLOGISTS PLANNERS SURVEYORS

HARZA-EBASCO

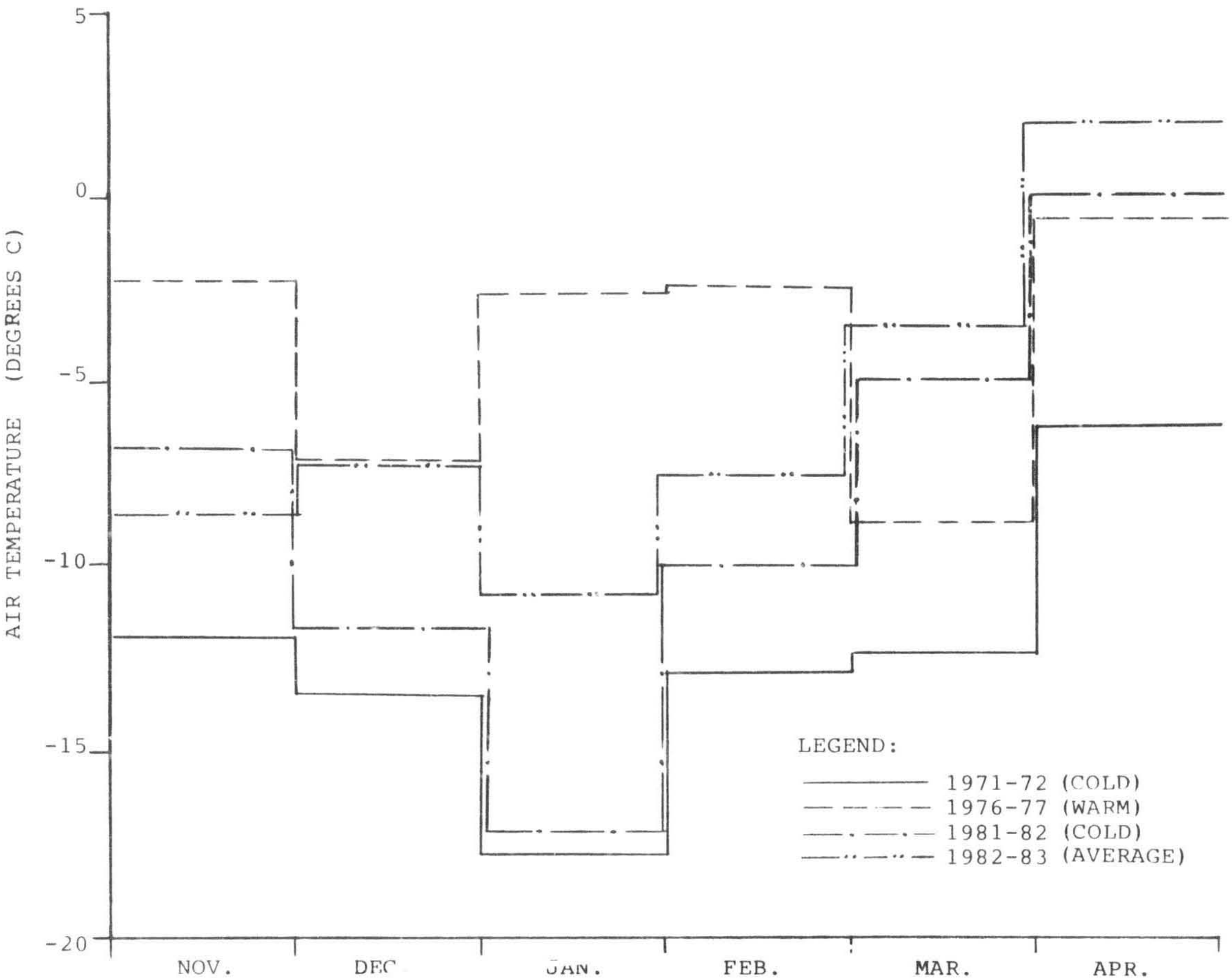


FIGURE 2 - AVERAGE MONTHLY AIR TEMPERATURES AT TALKEETNA

HARZA-EBASCO

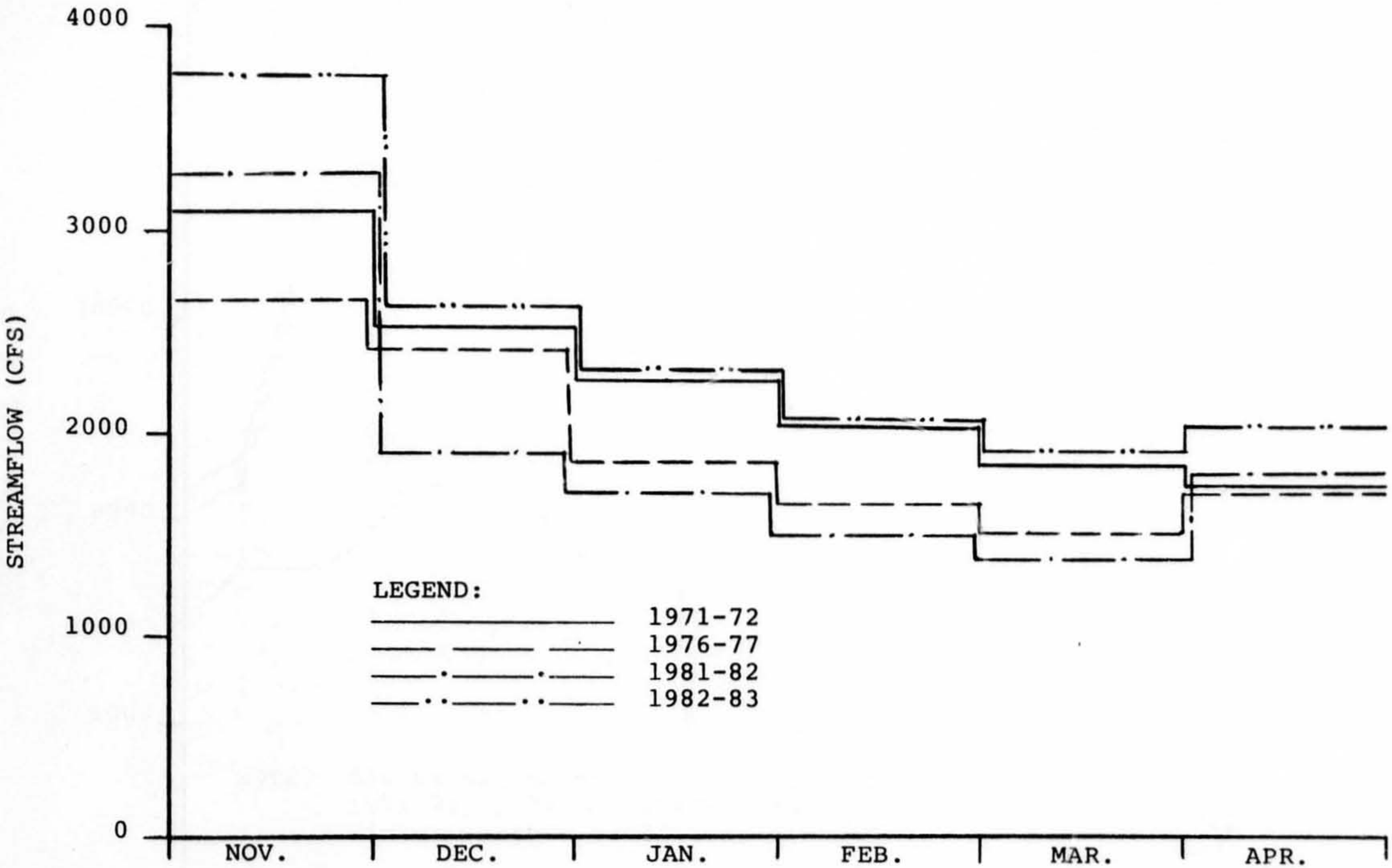


FIGURE 3 - SUSITNA RIVER NATURAL STREAMFLOWS AT GOLD CREEK — AVERAGE MONTHLY VALUES

HARZA-EBASCO

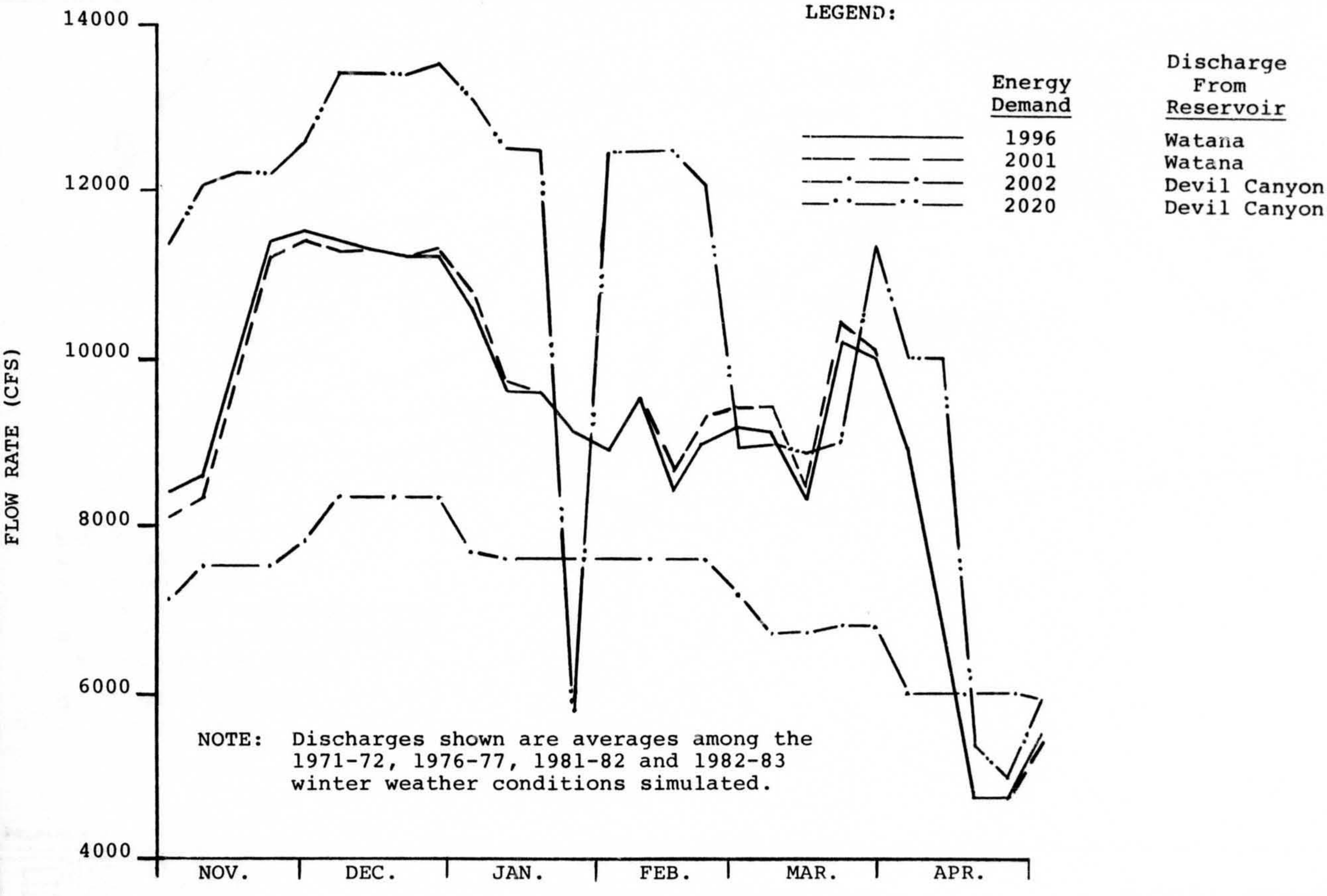
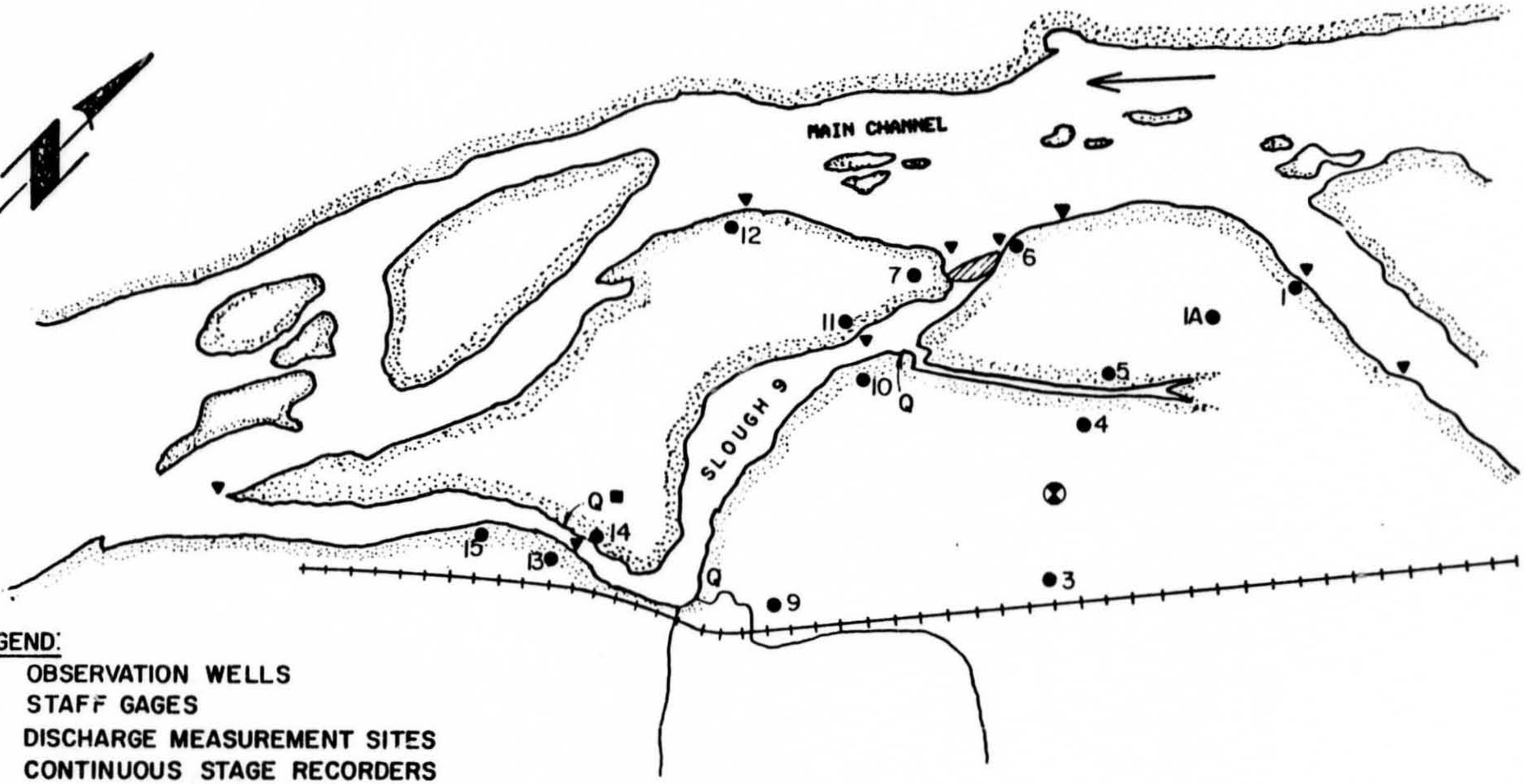


FIGURE 4 - DISCHARGE FROM PROJECT RESERVOIRS

HARZA-EBASCO



LEGEND:

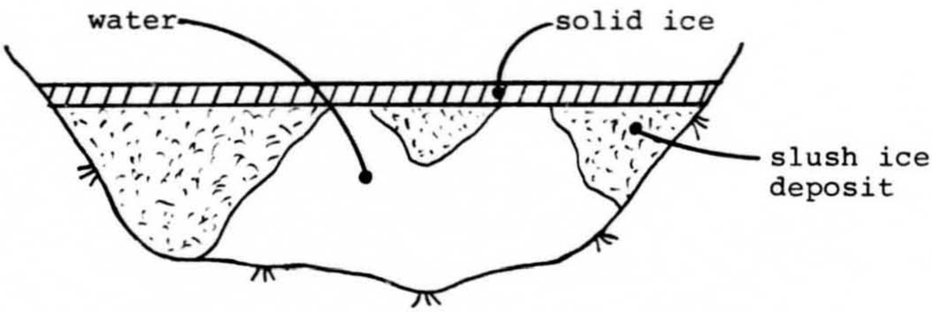
- ● OBSERVATION WELLS
- ▼ STAFF GAGES
- Q DISCHARGE MEASUREMENT SITES
- ■ CONTINUOUS STAGE RECORDERS
- CONTROLLING BERMS
- CLIMATE STATION
- ~ STREAMBED

PREPARED BY:

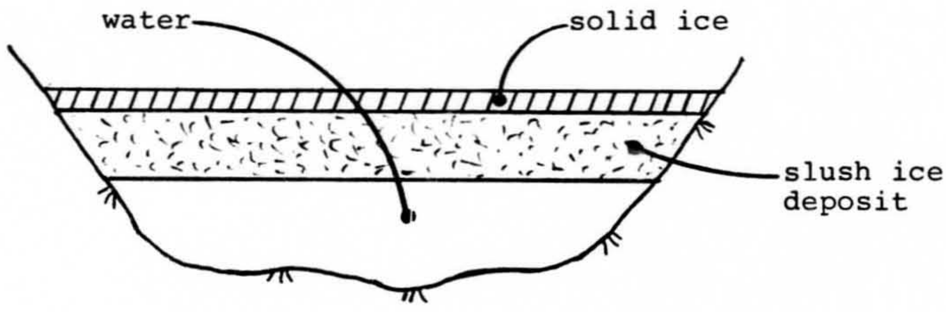
R&M CONSULTANTS, INC.

FIGURE 5 - TYPICAL SLOUGH

HARZA-EBASCO



a. Actual River Cross-Section



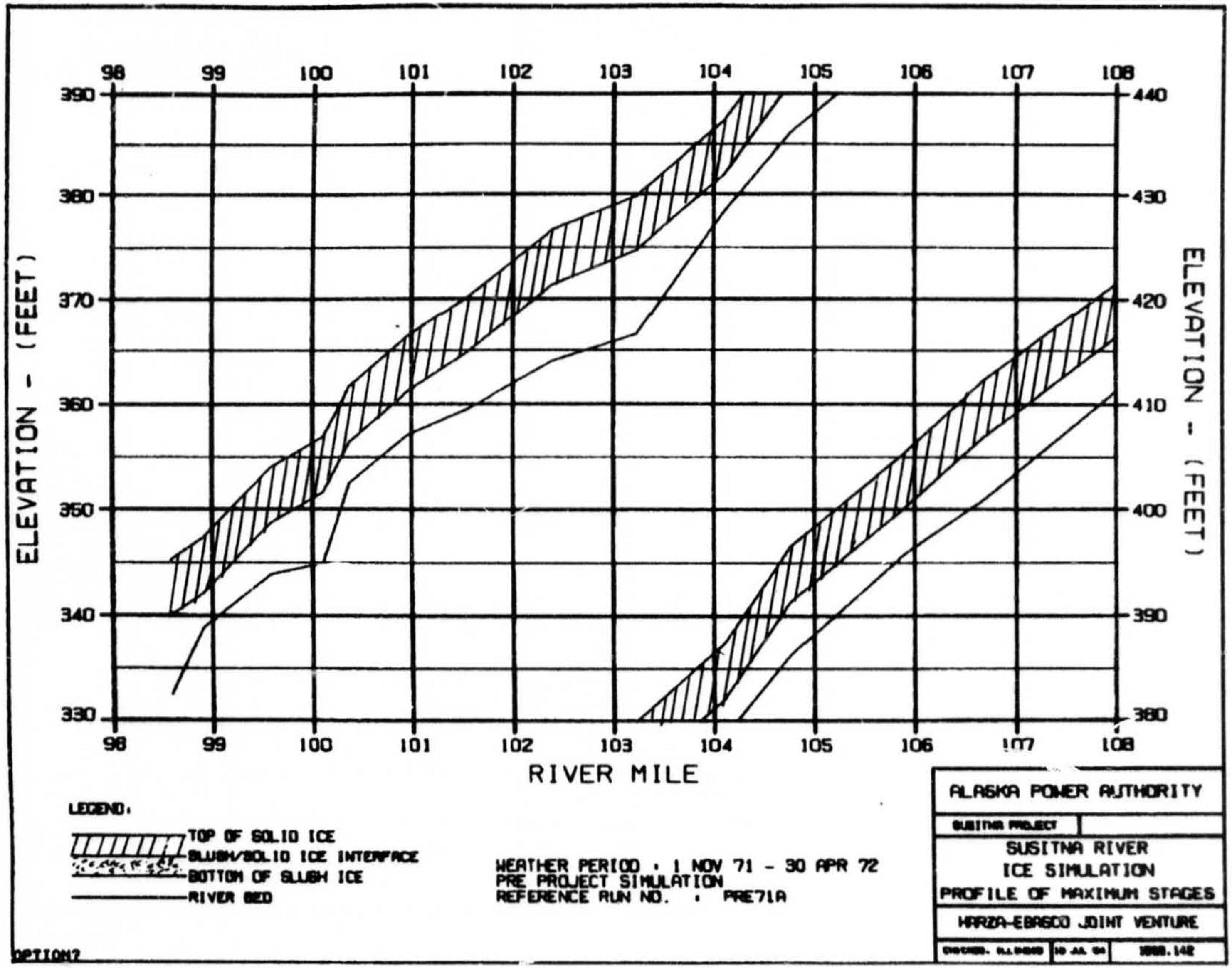
b. Simulated River Cross-Section

FIGURE 6 - ICE DISTRIBUTION - ACTUAL VS. SIMULATED

HARZA-EBASCO

EXHIBIT A

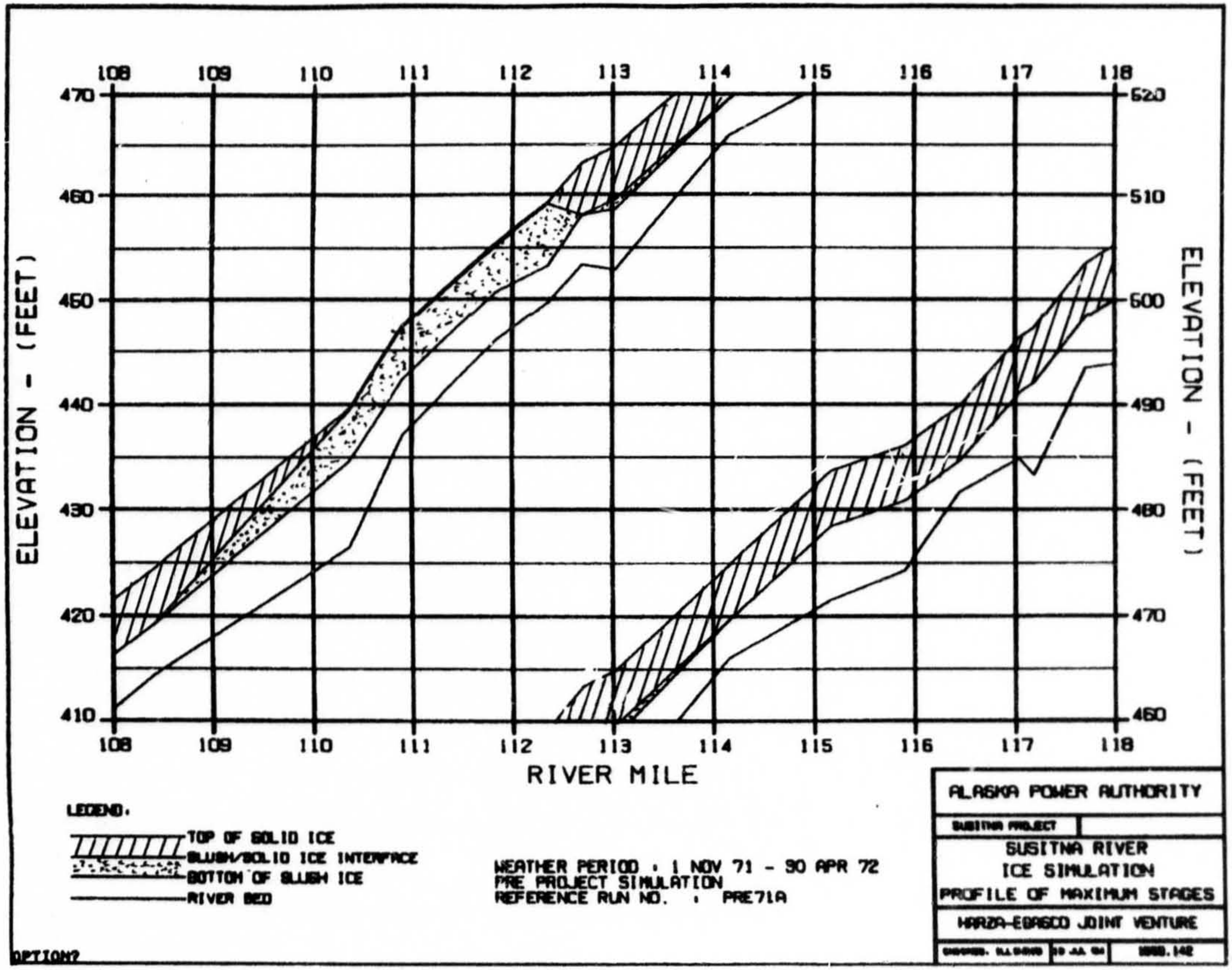
C



98 99 100 101 102 103 104 105 106 107 108
390
380
370
360
350
340
330
440
430
420
410
400
390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

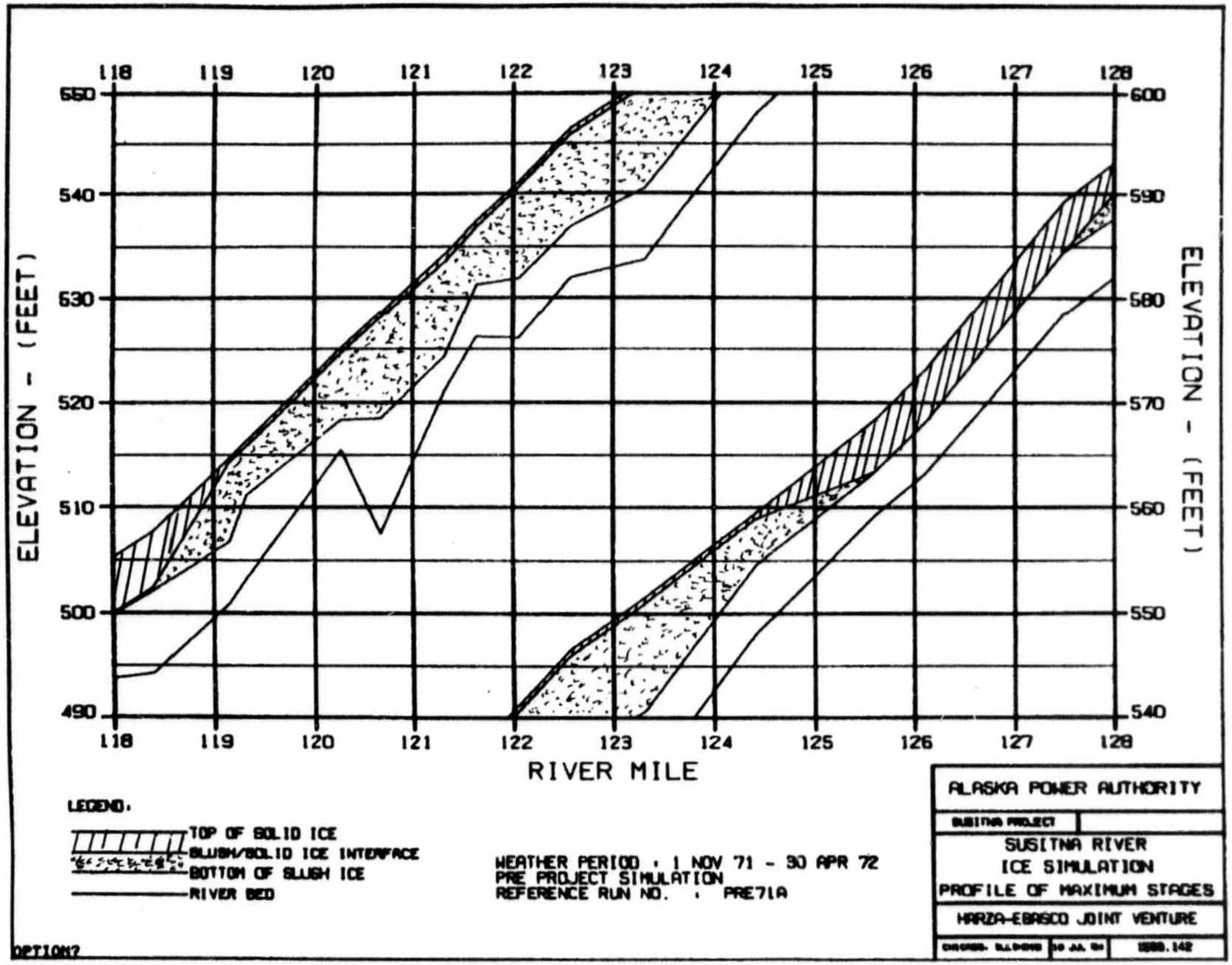
OPTION?

C



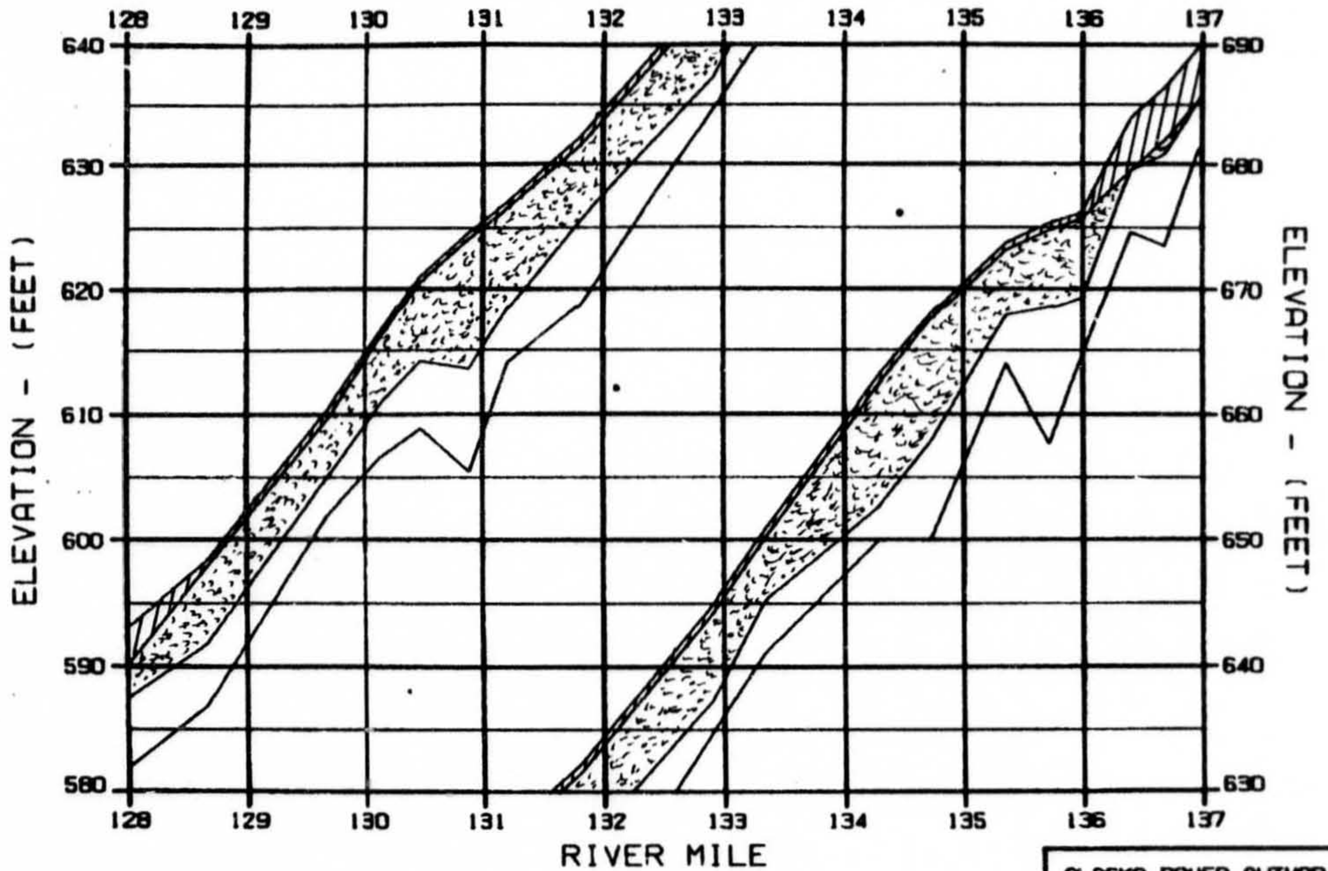
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
108
109
110
111
112
113
114
115
116
117
118
470
460
450
440
430
420
410
520
510
500
490
480
470
460
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

c



118 119 120 121 122 123 124 125 126 127 128
550
540
530
520
510
500
490
600
590
580
570
560
550
540
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C



LEGEND:

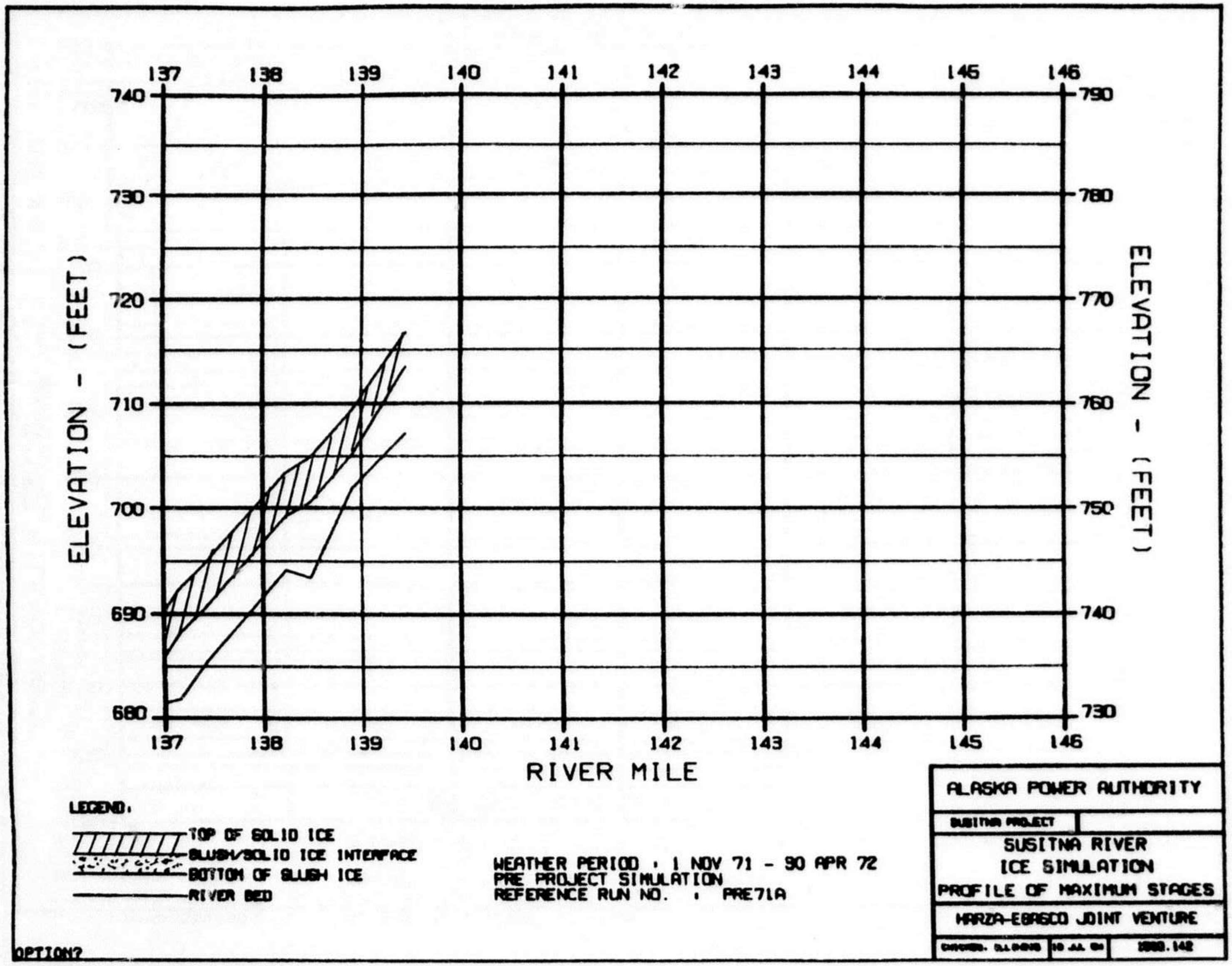
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

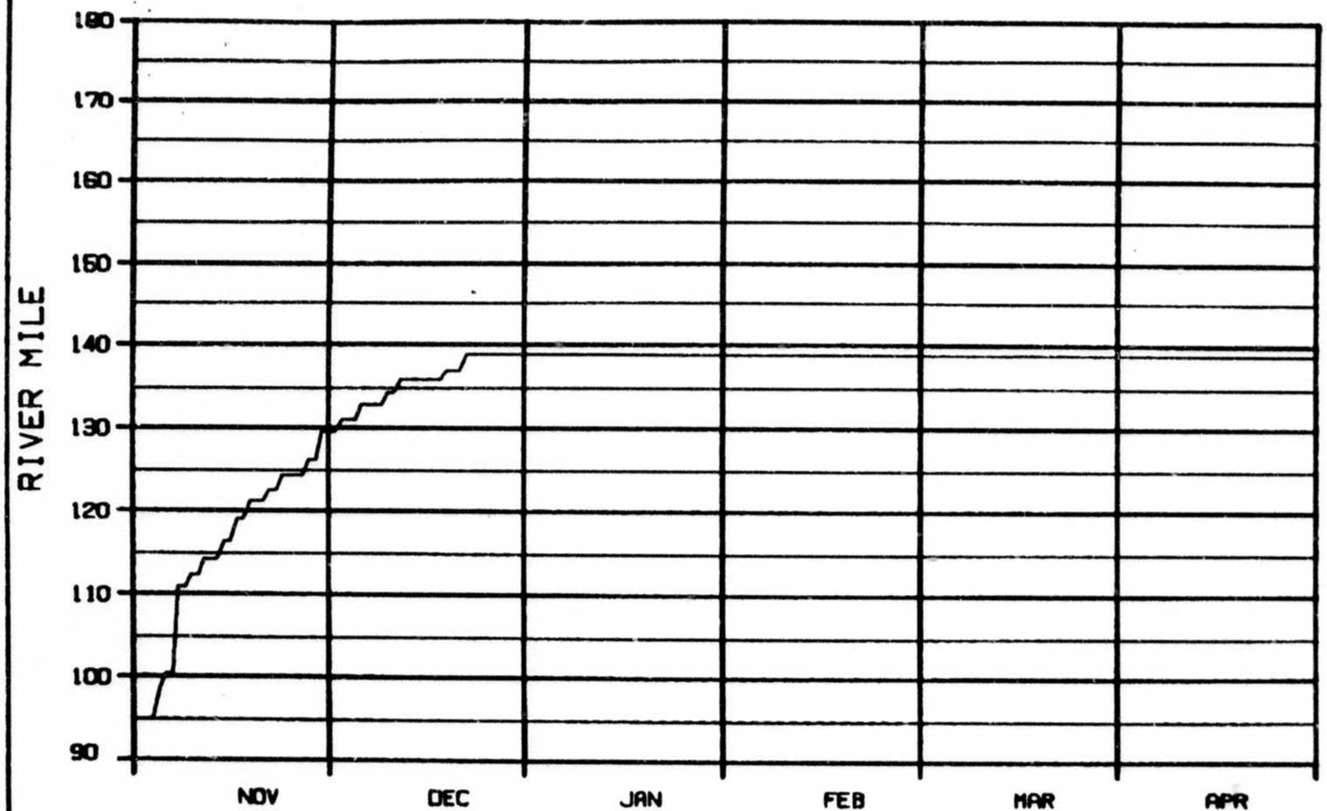
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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

OPTION?

c


137
138
139
140
141
142
143
144
145
146
740
730
720
710
700
690
680
790
780
770
760
750
740
730
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?



LEGEND:

—— ICE FRONT

- - - - ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

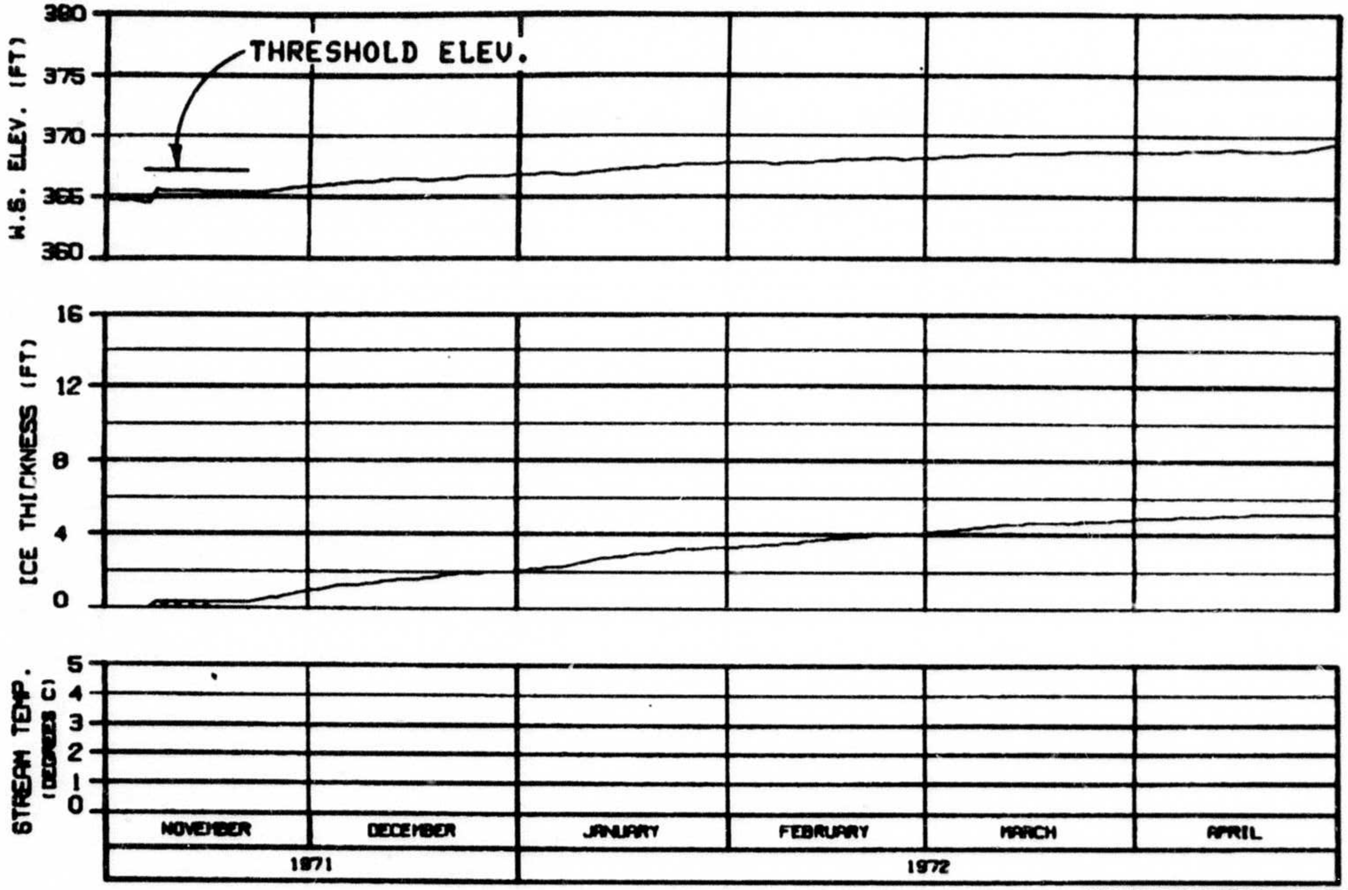
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM

HARZA-EBASCO JOINT VENTURE

OPTION2



HEAD OF WHISKERS SLOUGH

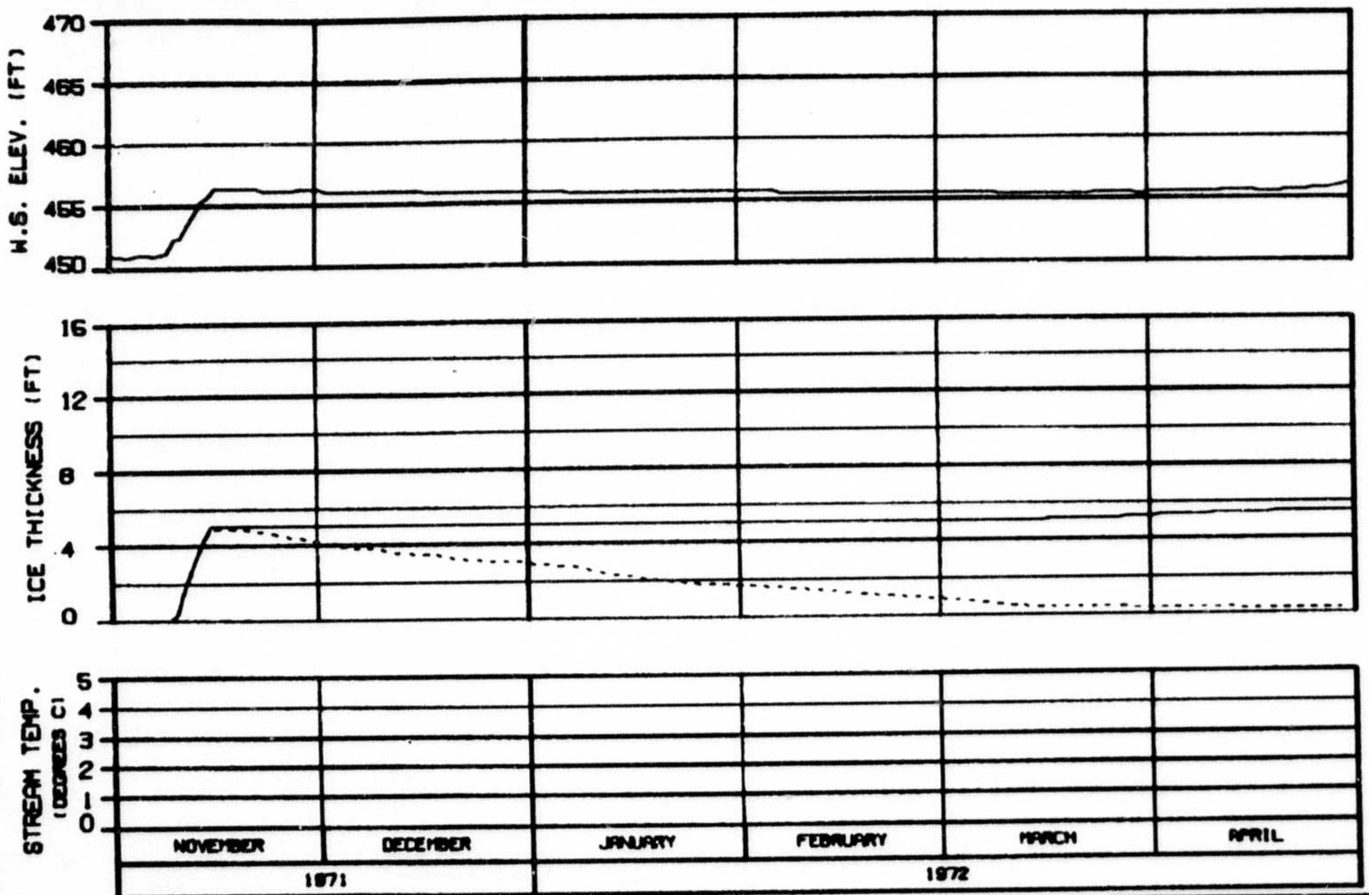
RIVER MILE : 101.50

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

ICE THICKNESS LEGEND:

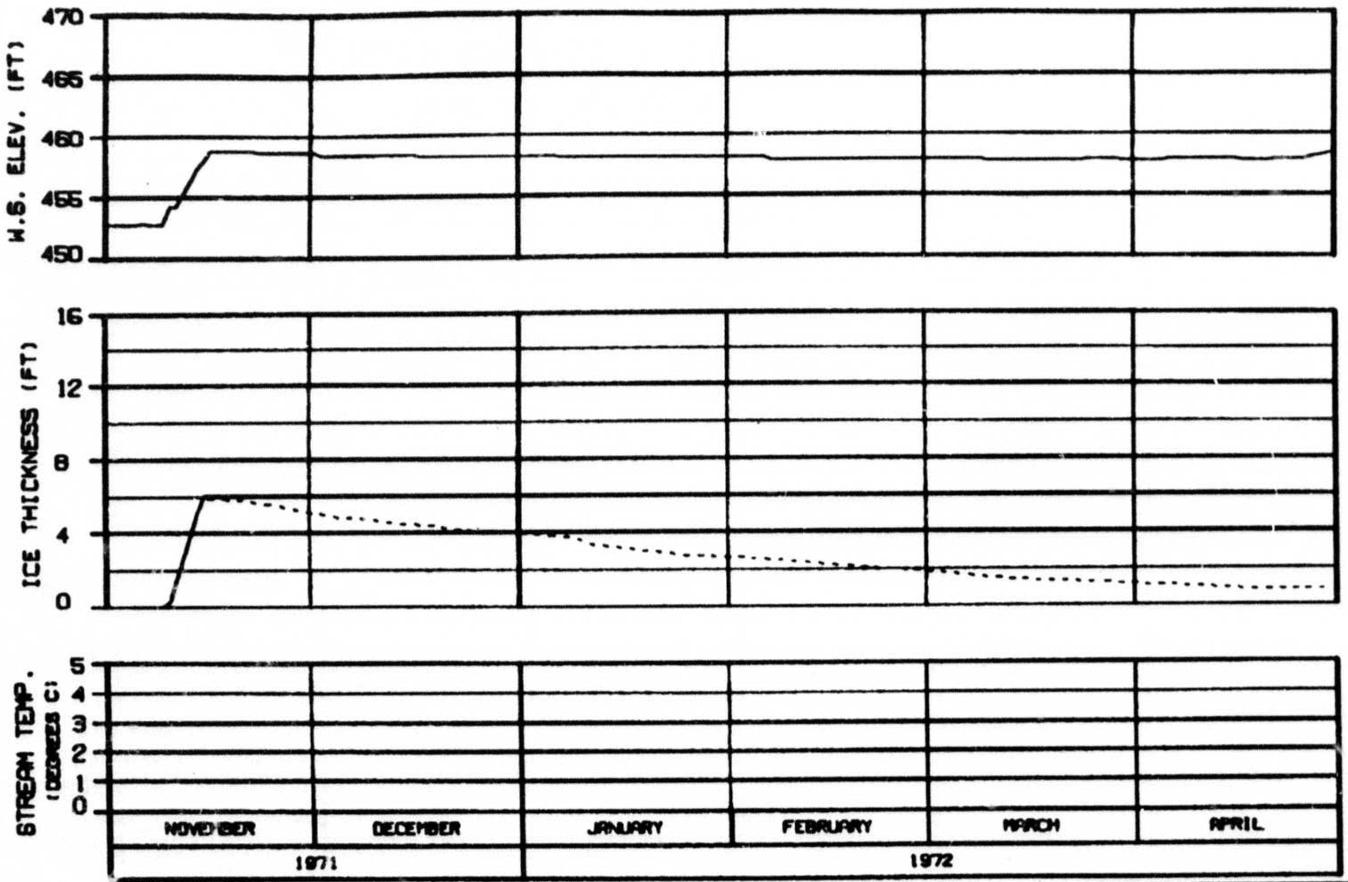
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



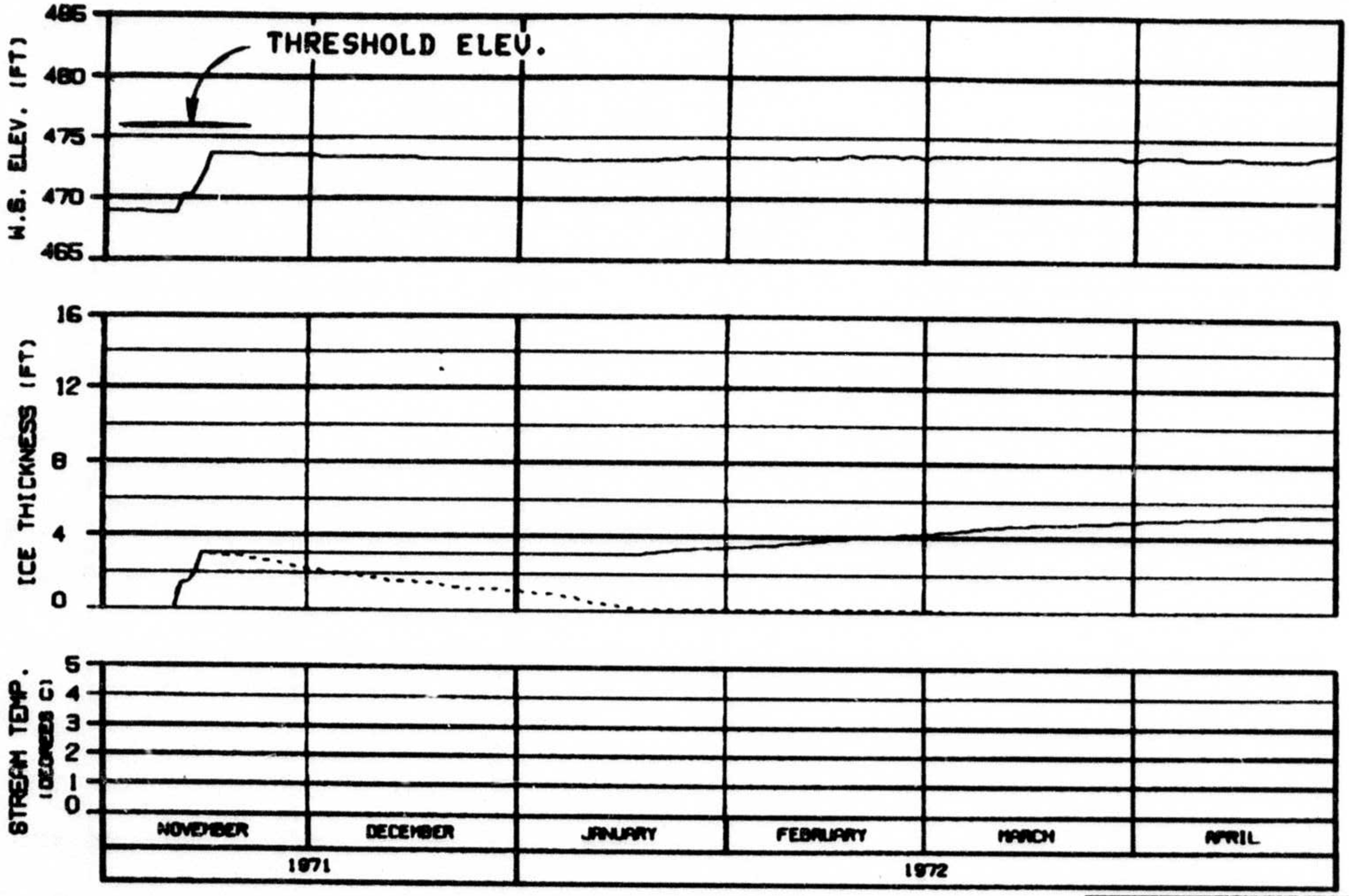
MOUTH OF SLOUGH 6A

RIVER MILE : 112.34

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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 8

RIVER MILE : 114.10

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

ICE THICKNESS LEGEND:

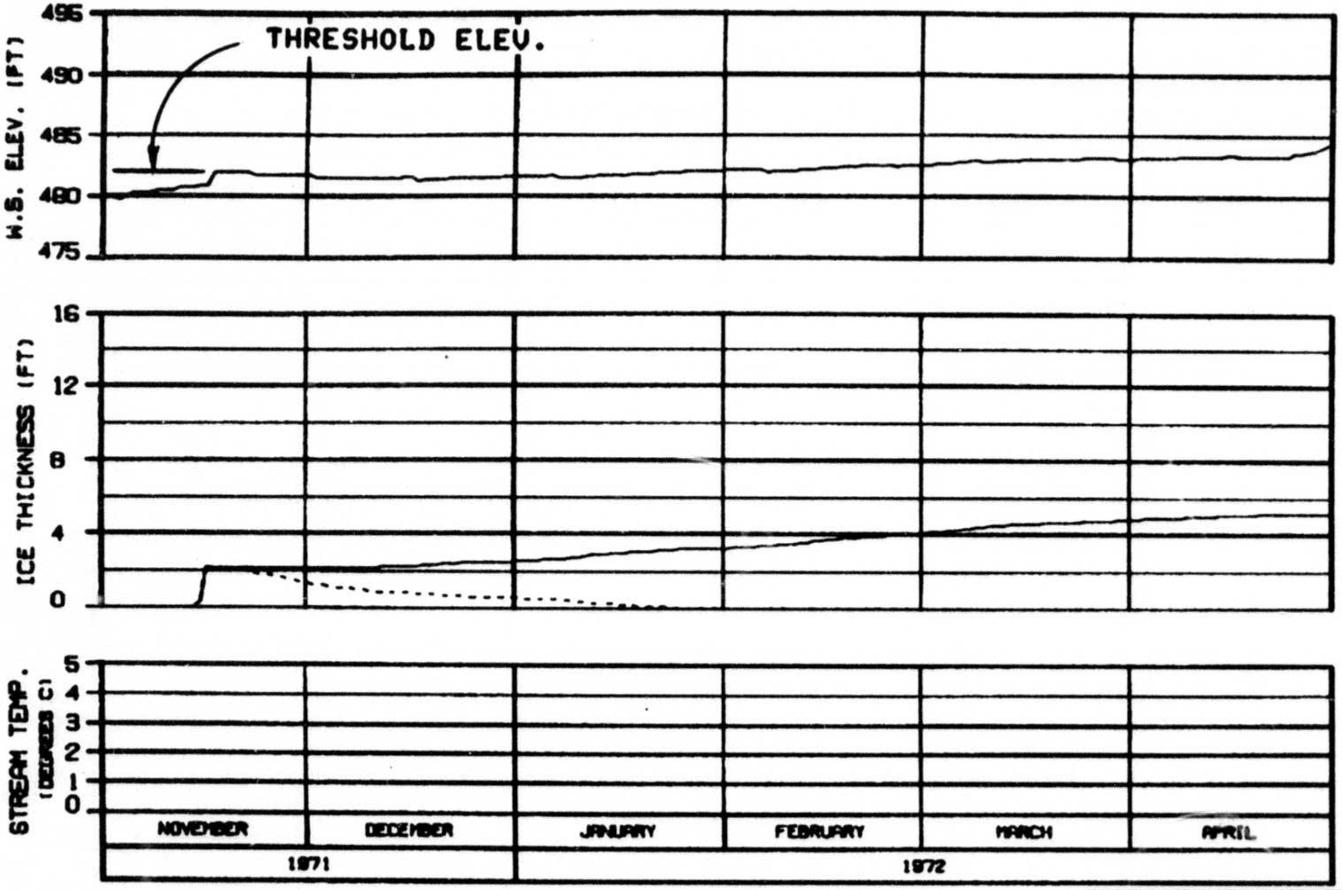
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL MSII

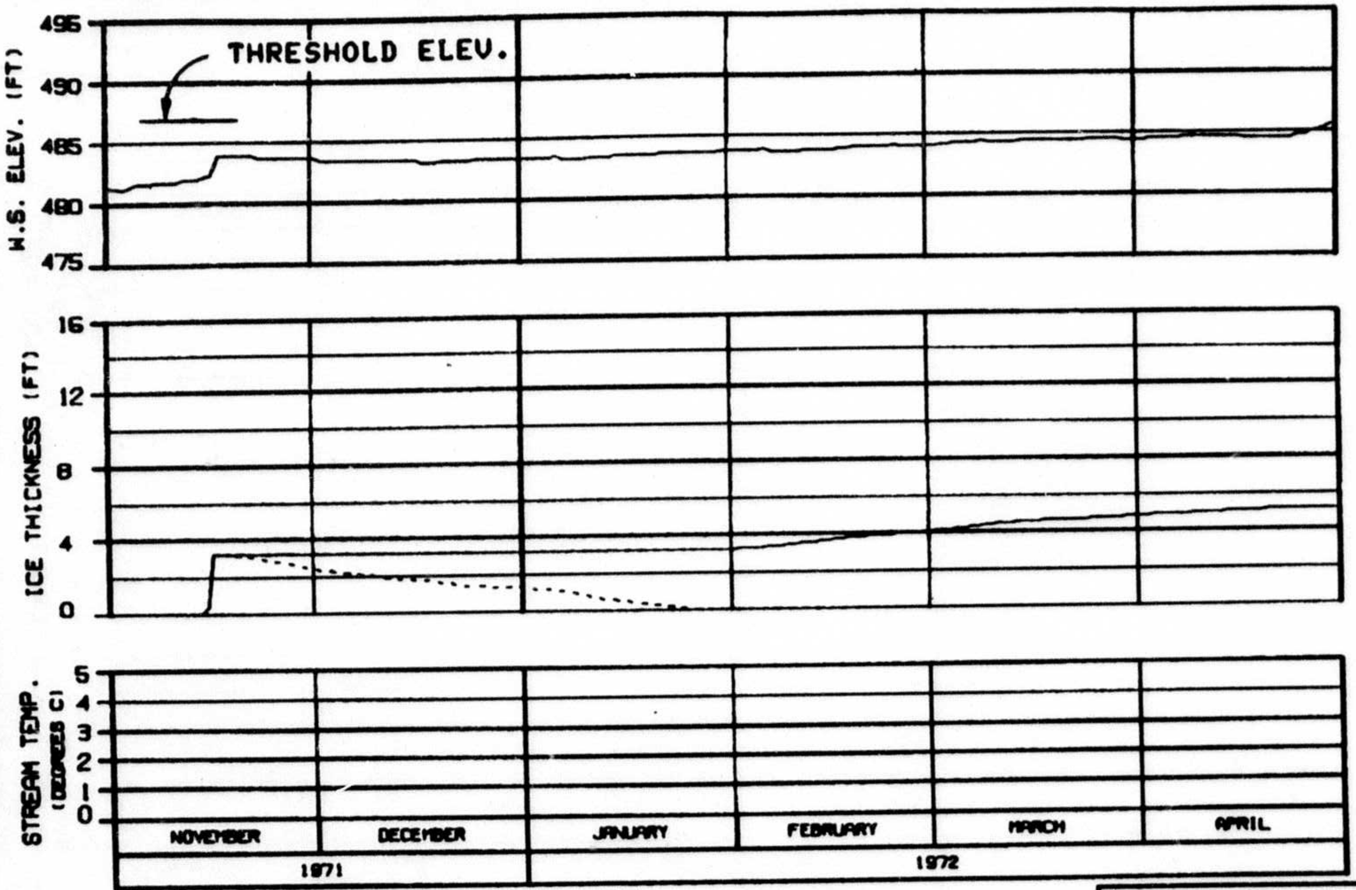
RIVER MILE : 115.50

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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



HEAD OF SIDE CHANNEL MSII

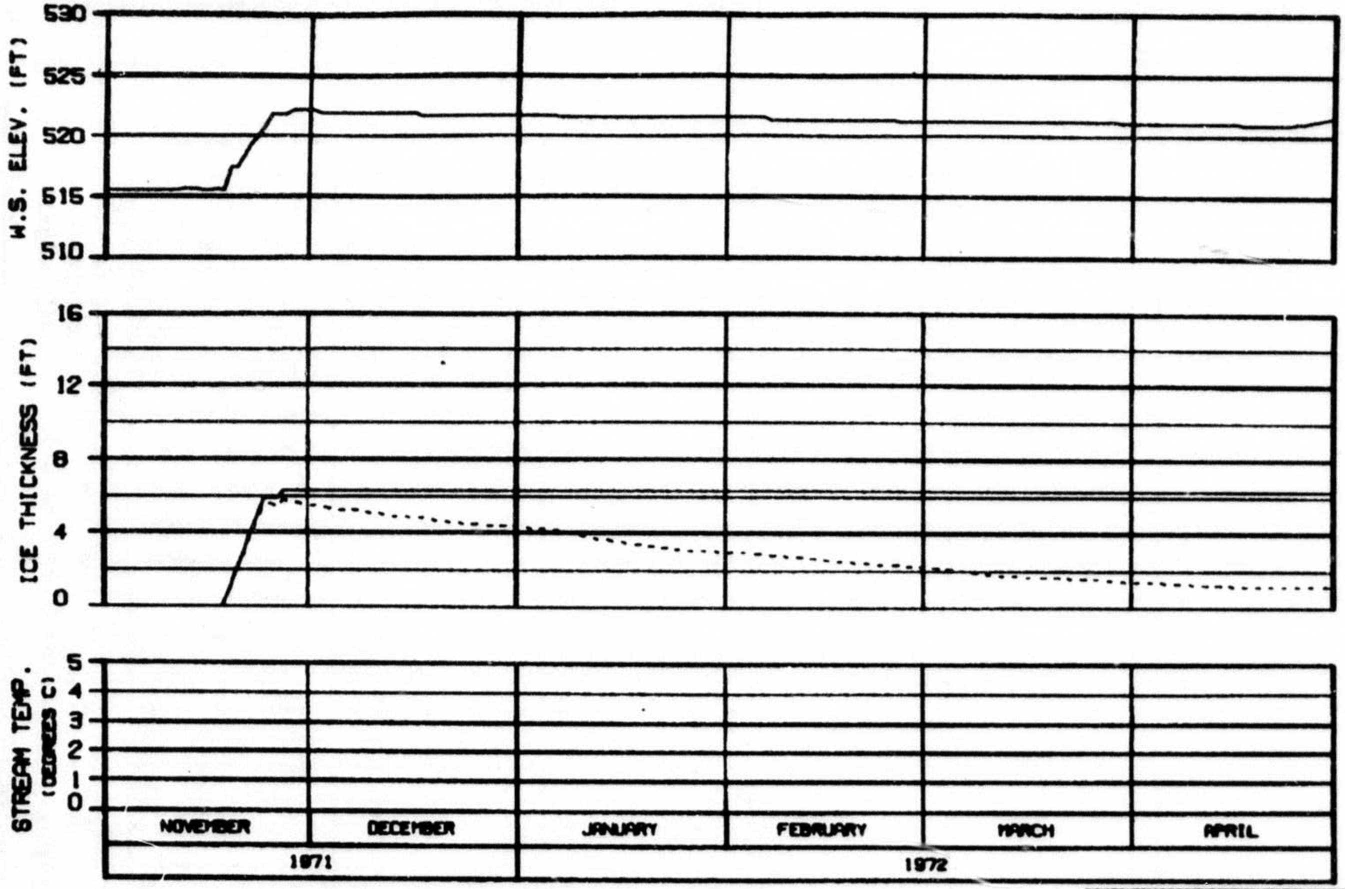
RIVER MILE : 115.90

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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



RIVER MILE : 120.00

ICE THICKNESS LEGEND:

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

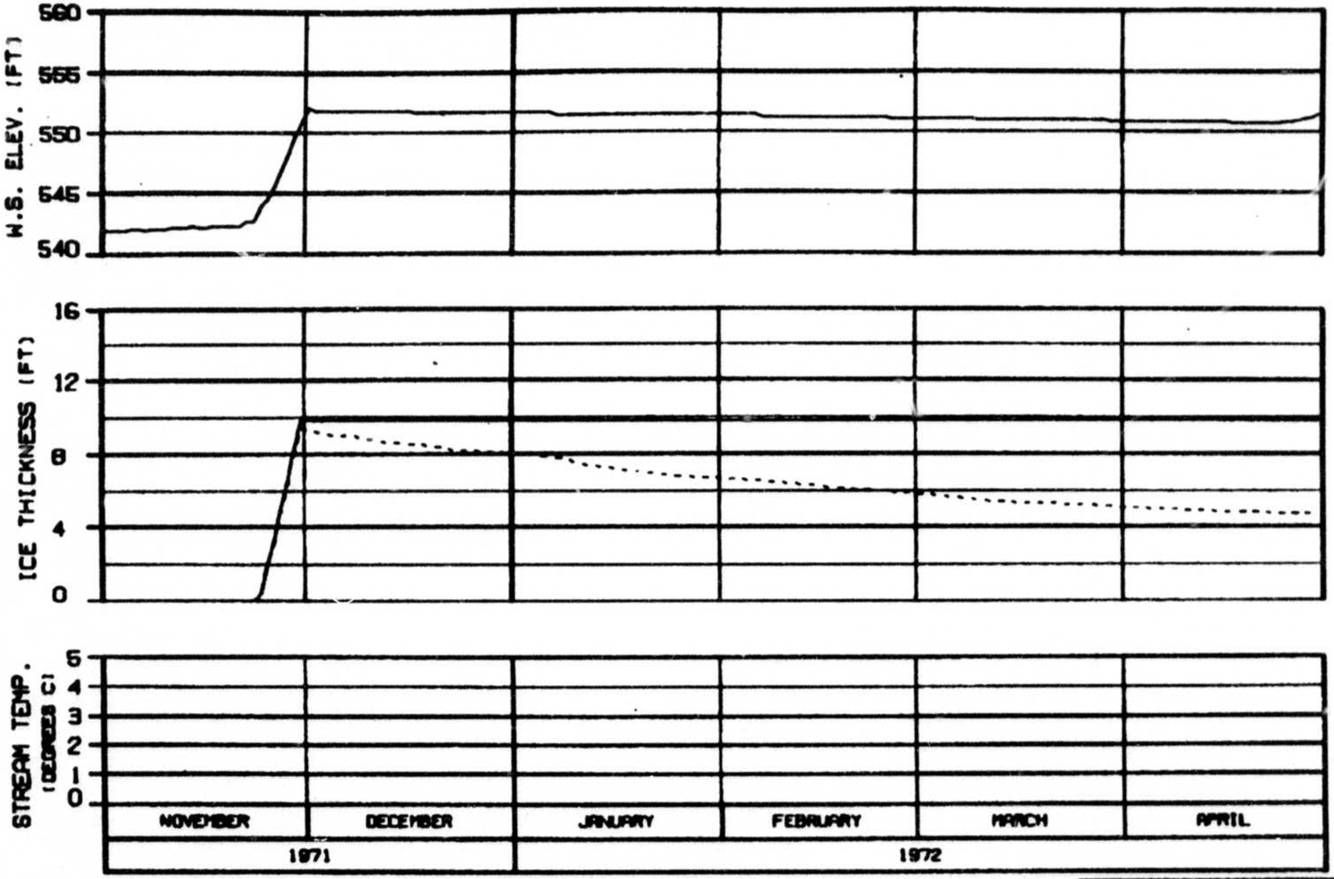
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF MOOSE SLOUGH

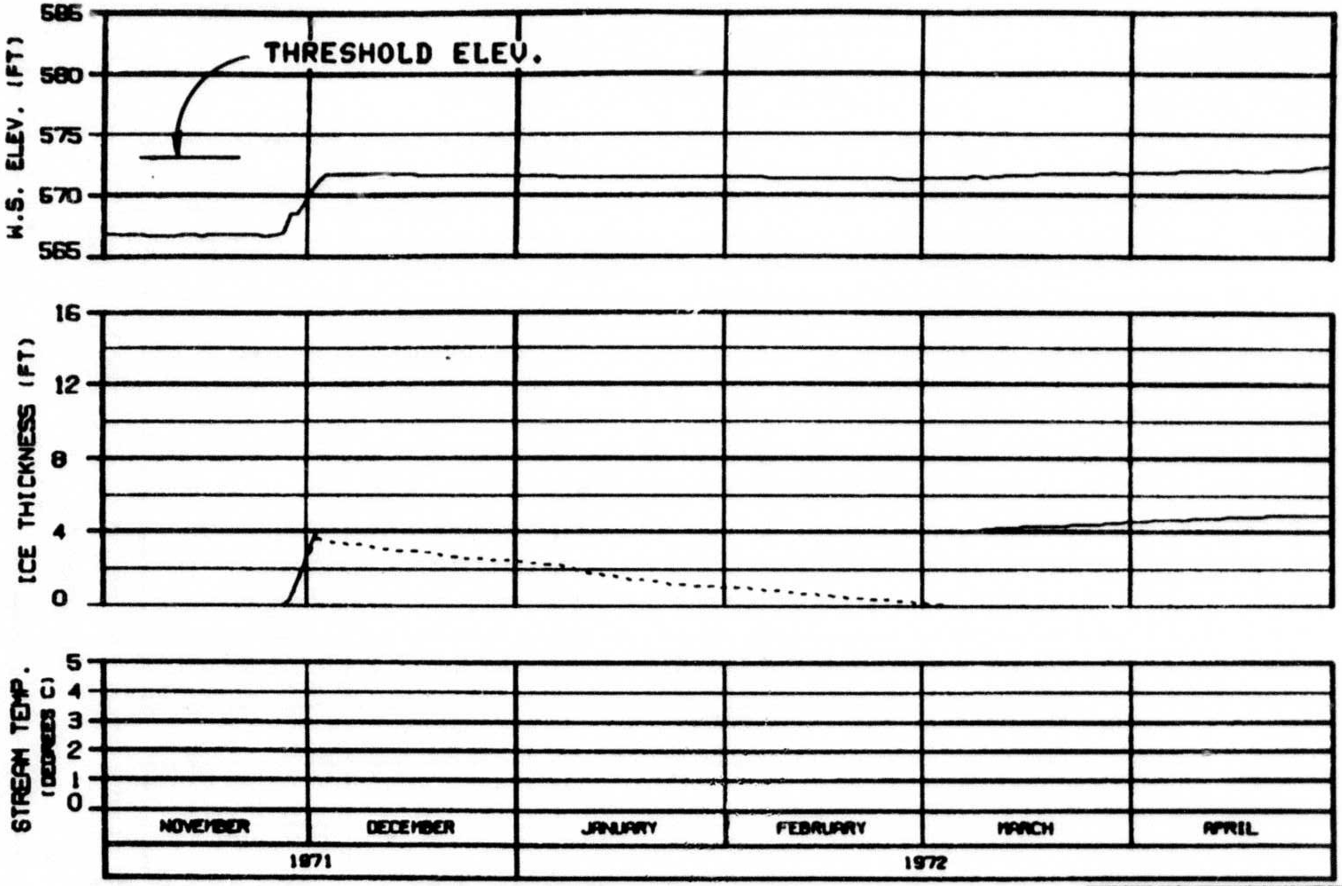
RIVER MILE : 123.50

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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



HEAD OF SLOUGH 8A (WEST)

RIVER MILE : 126.10

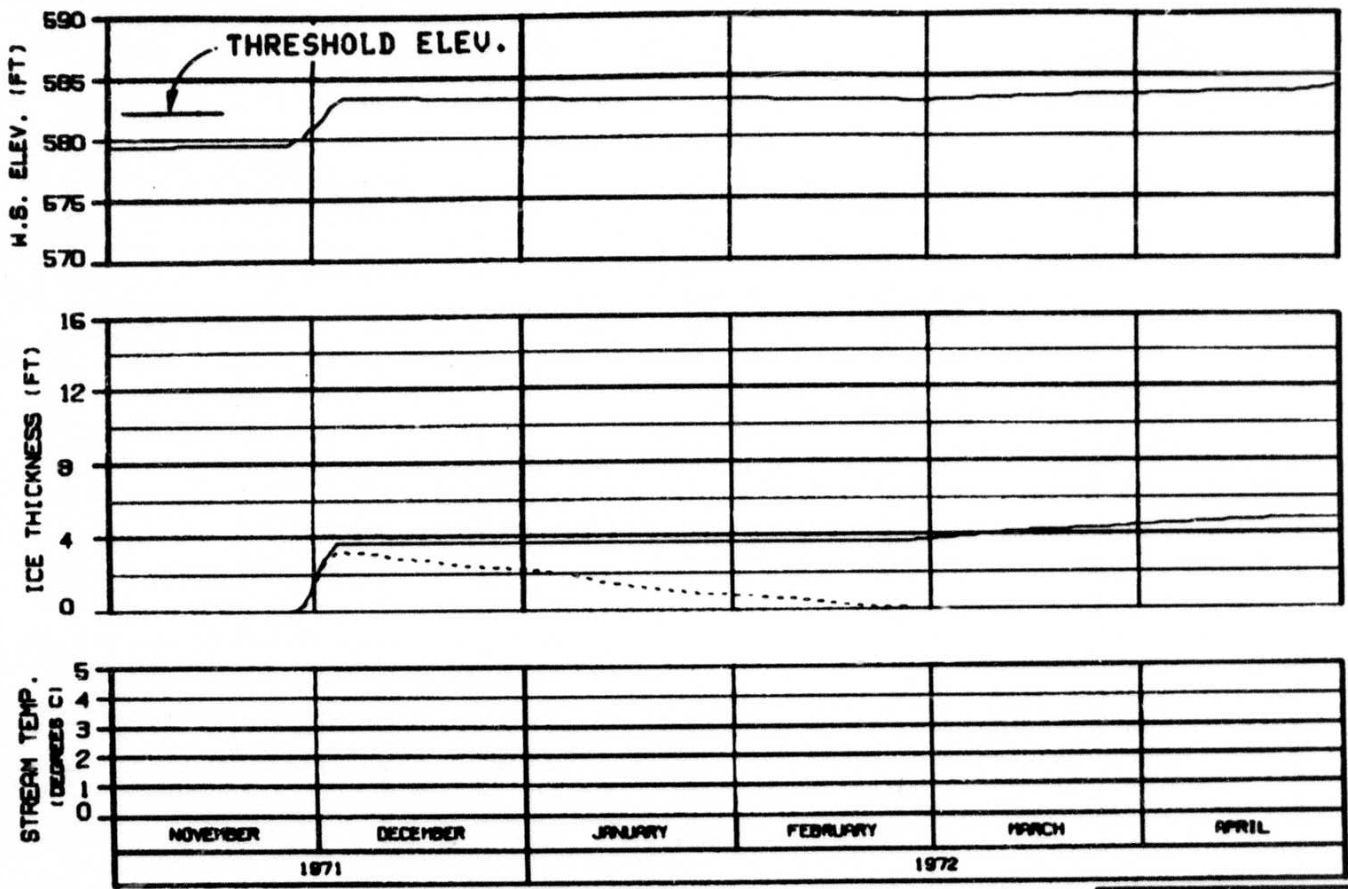
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

ICE THICKNESS LEGEND:

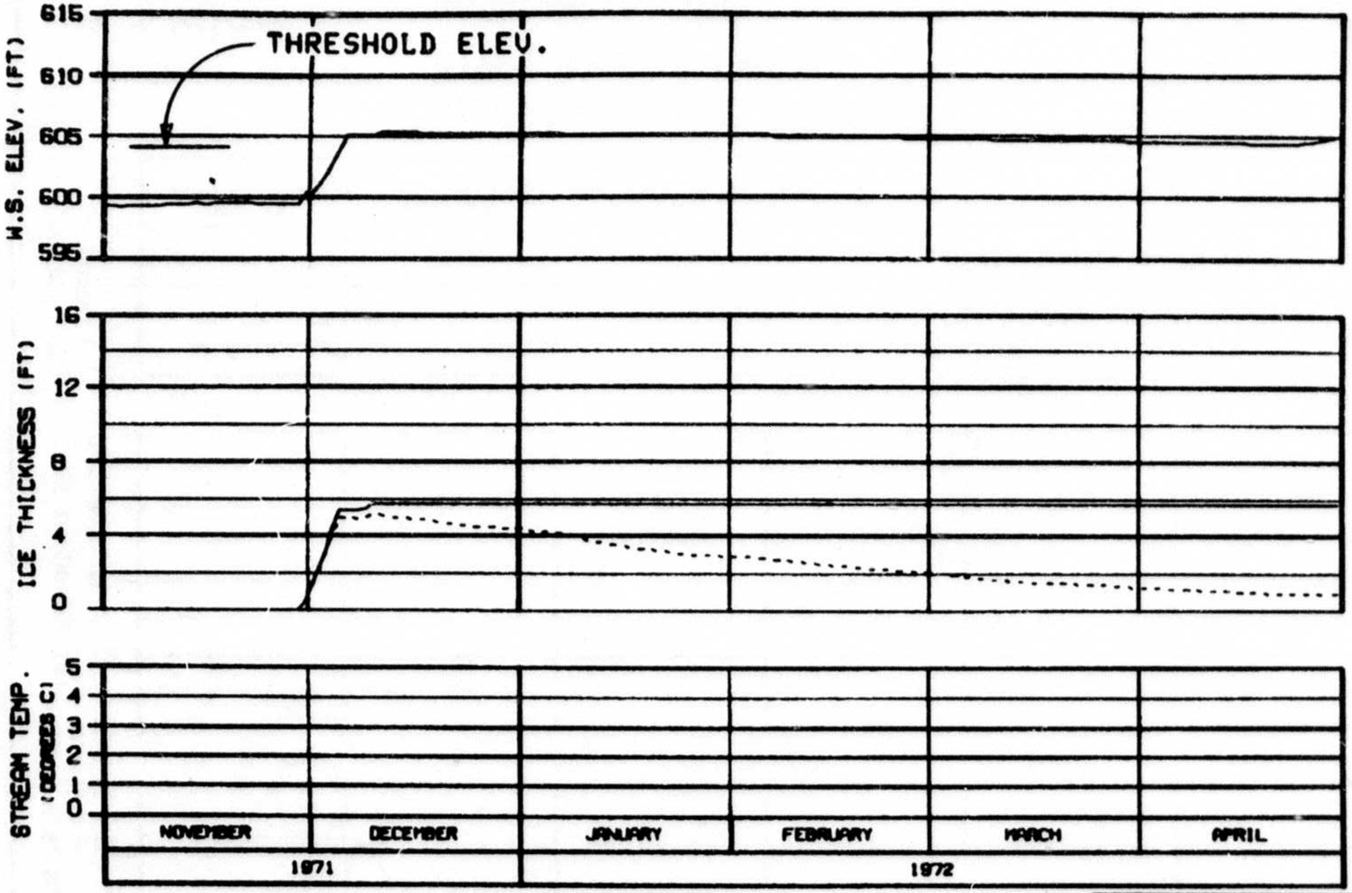
———— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9

RIVER MILE : 129.30

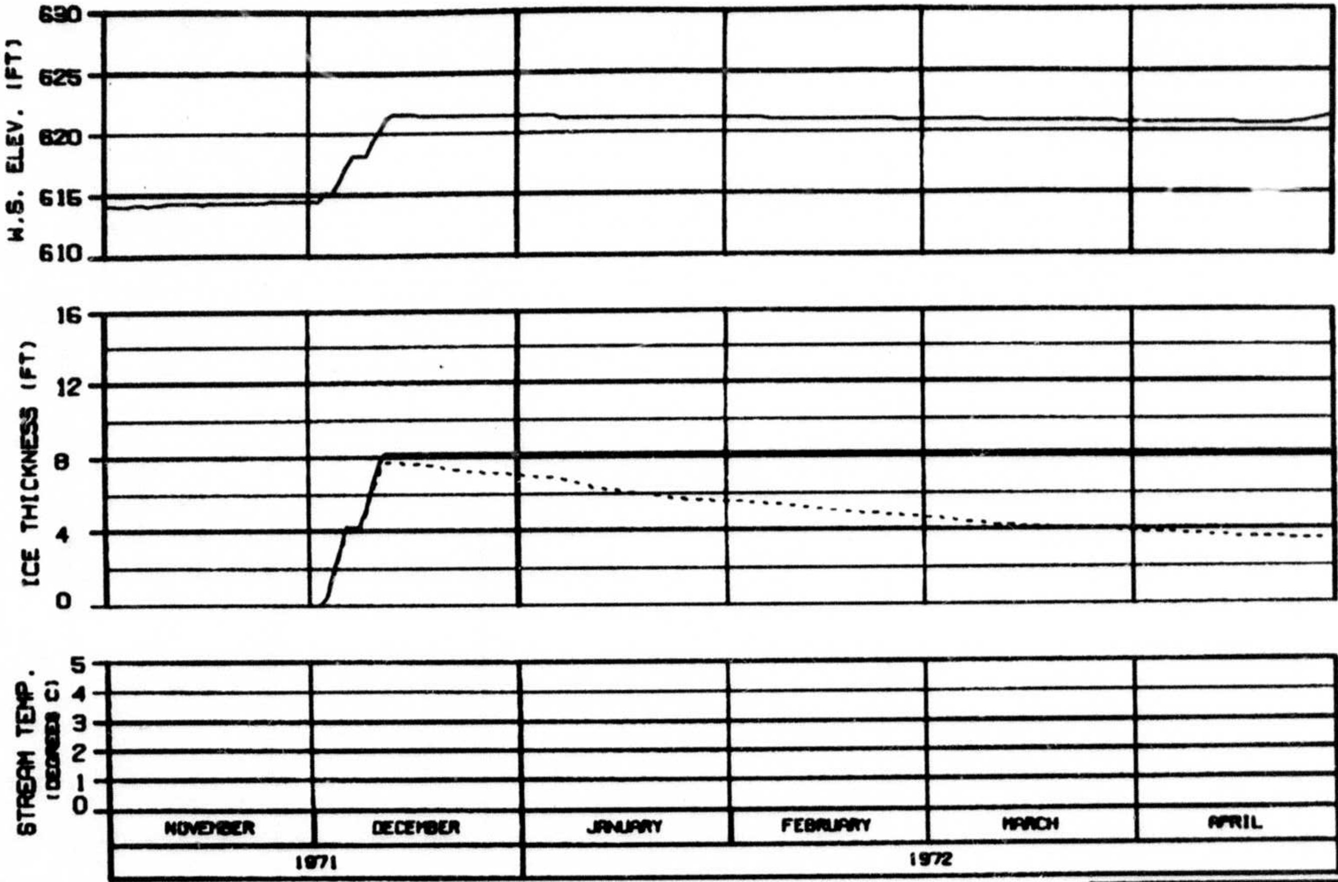
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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

OPTION?

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

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

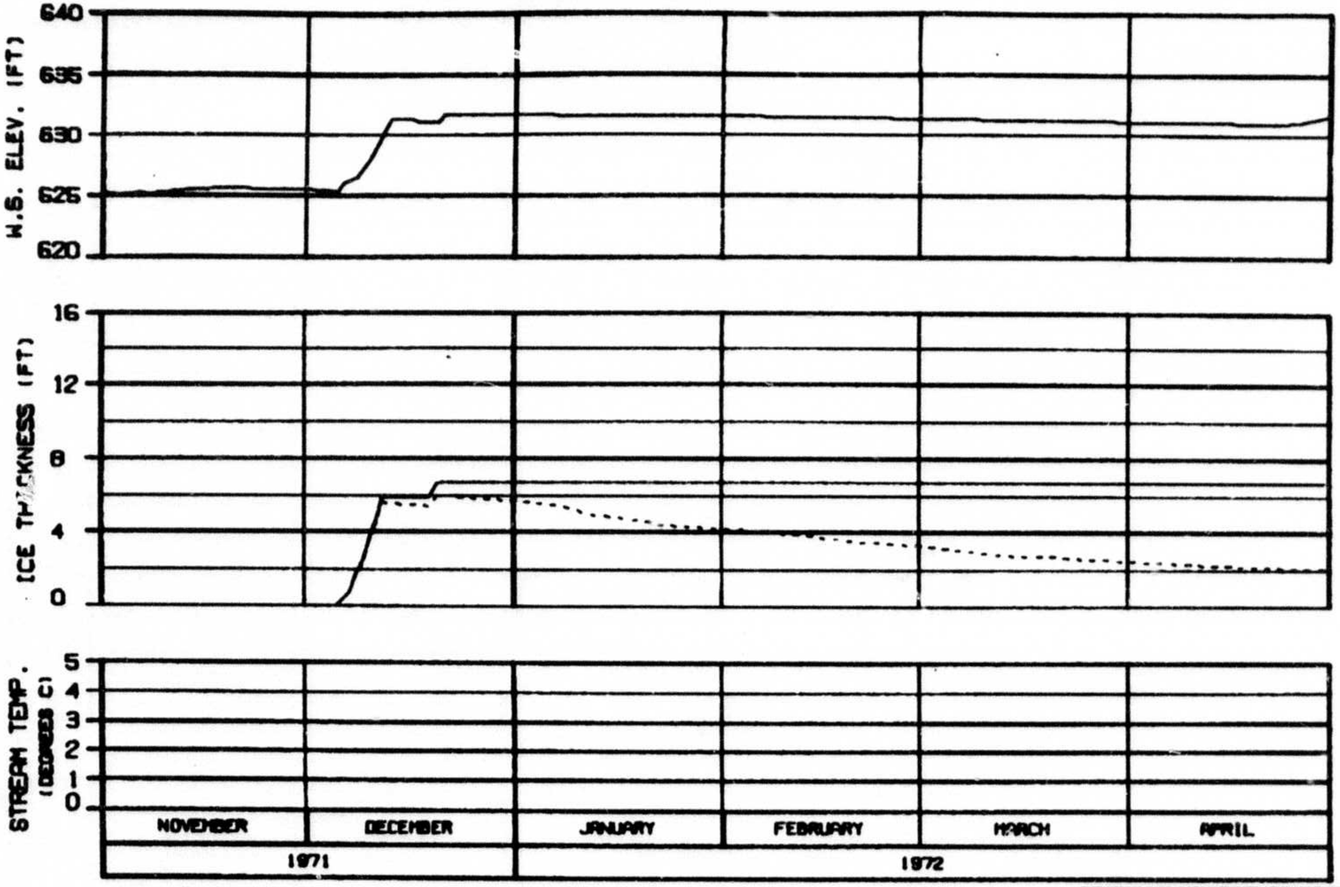
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

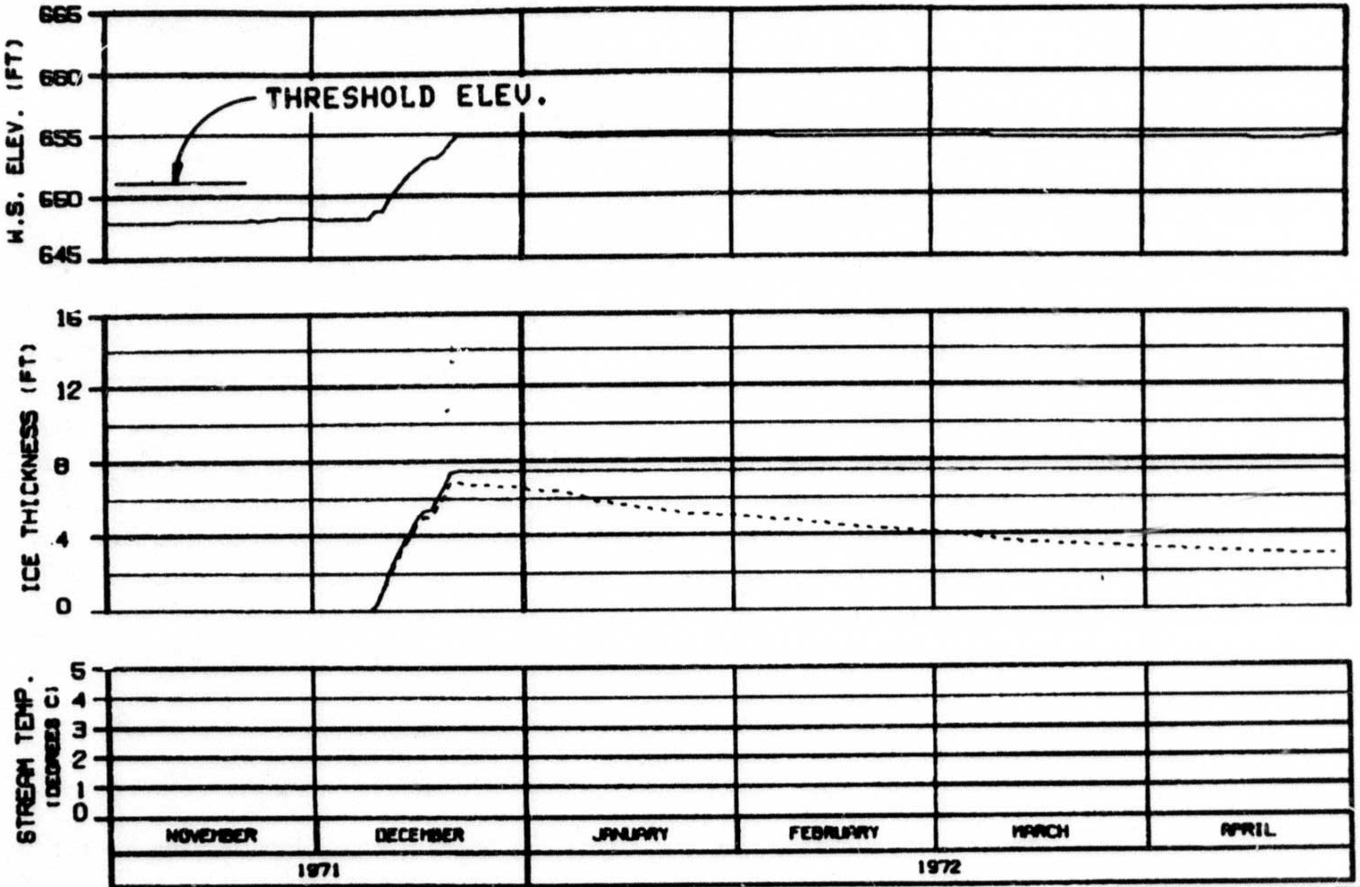
RIVER MILE : 131.80

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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



HEAD OF SLOUGH 9A

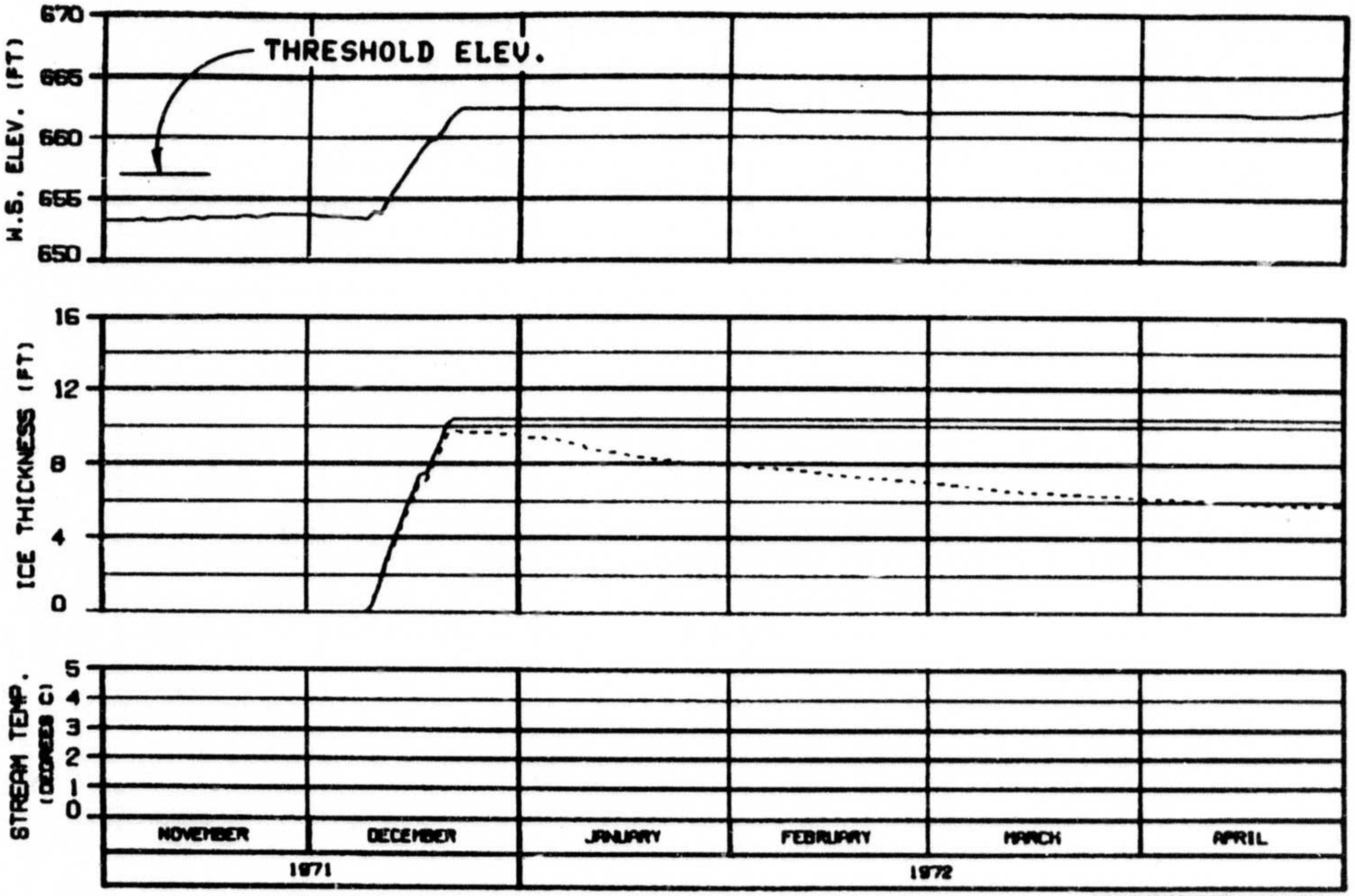
RIVER MILE : 133.70

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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



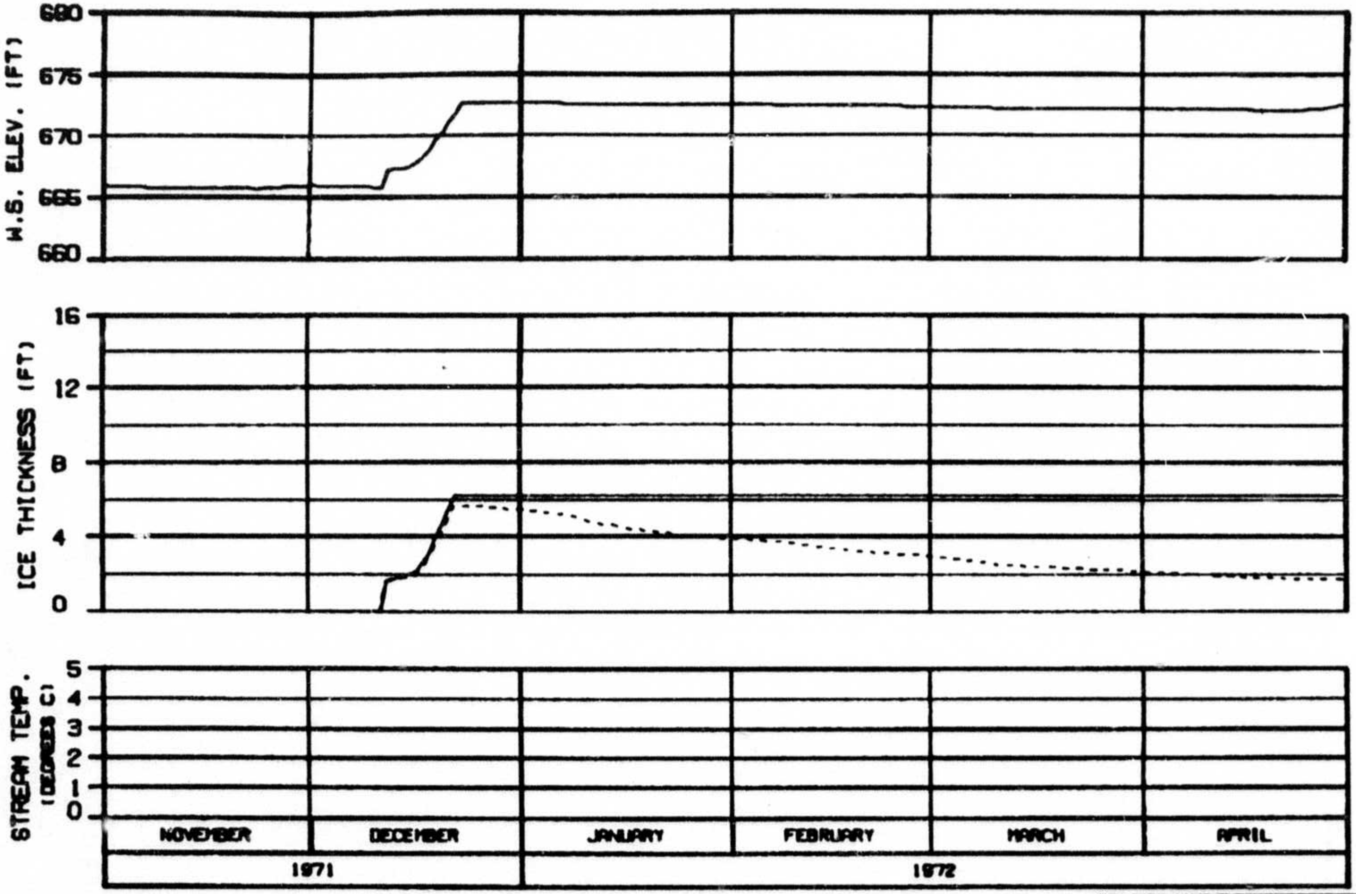
SIDE CHANNEL U/S OF SLOUGH 10

RIVER MILE : 134.30

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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

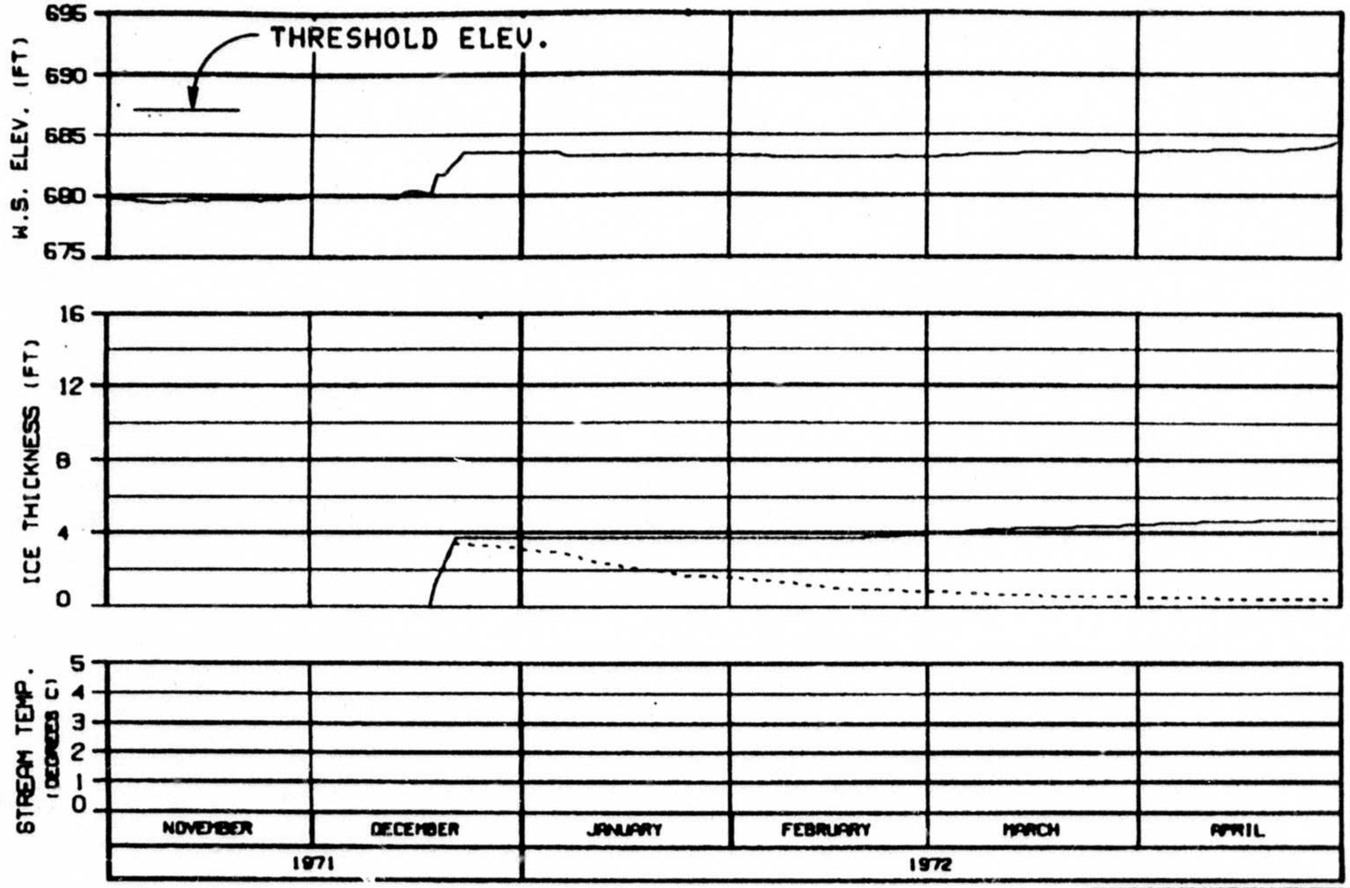
ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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

[illegible]	[illegible]	1800.142



HEAD OF SLOUGH 11

RIVER MILE : 136.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

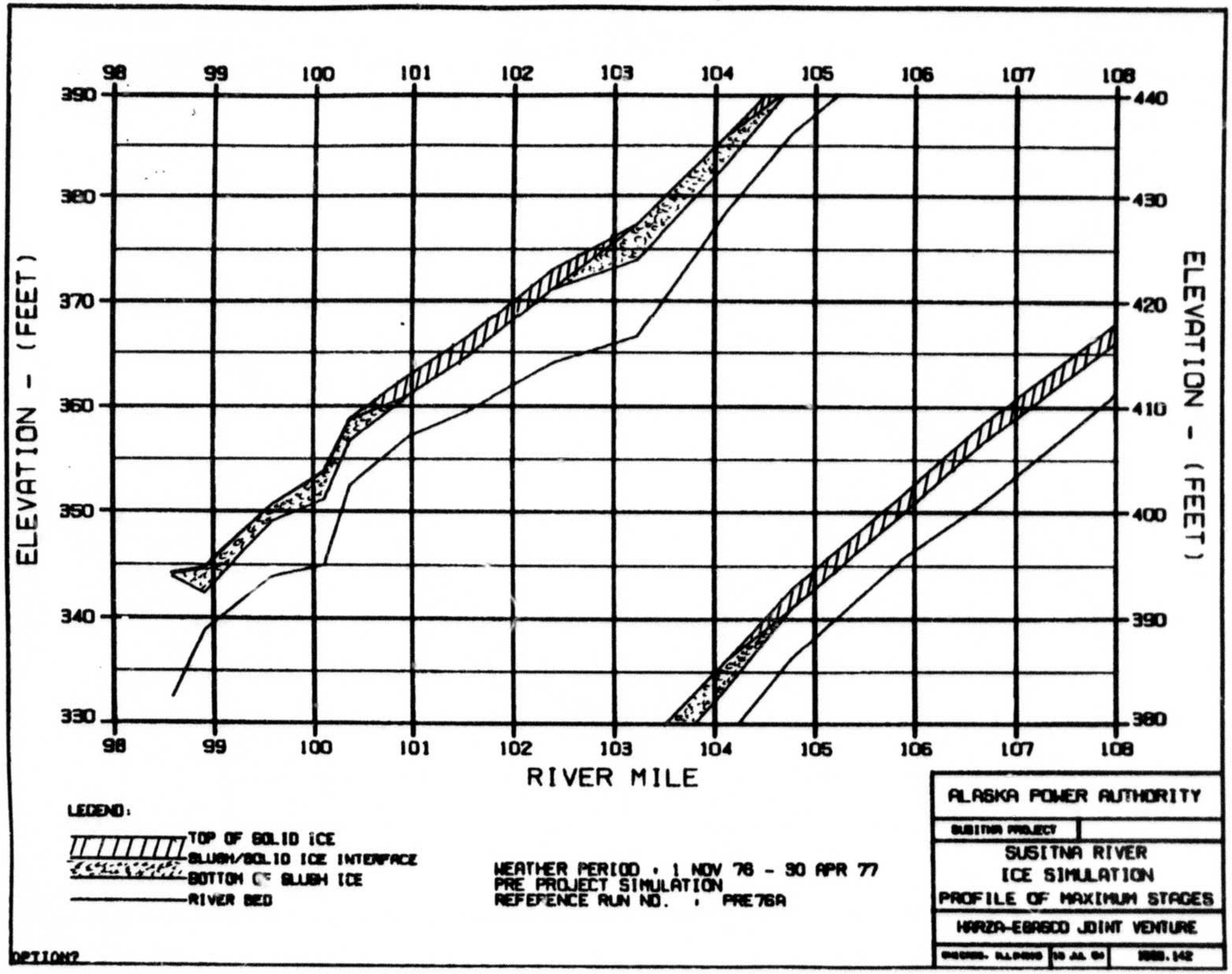
- - - - - SLUSH COMPONENT

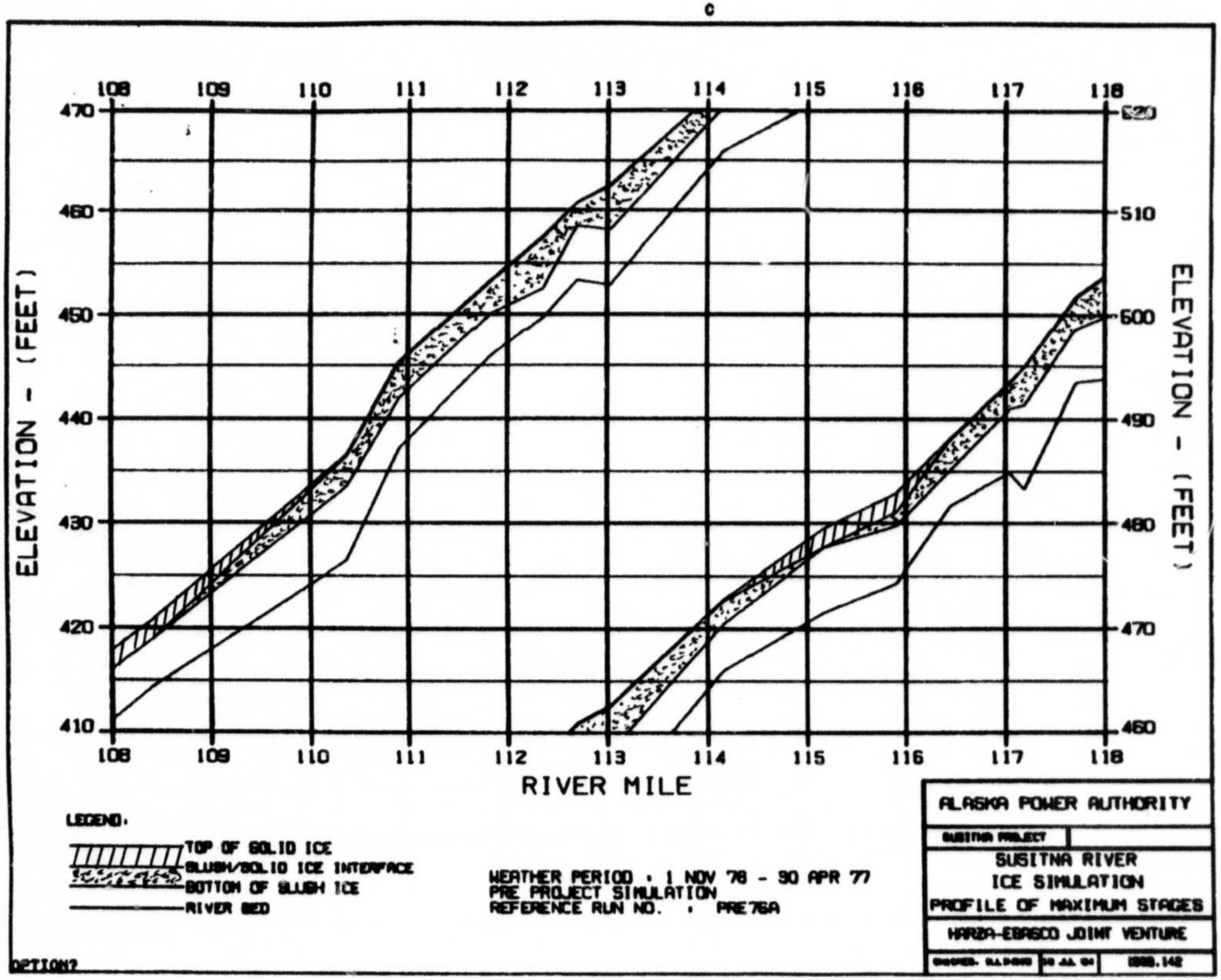
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE71A

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

EXHIBIT B

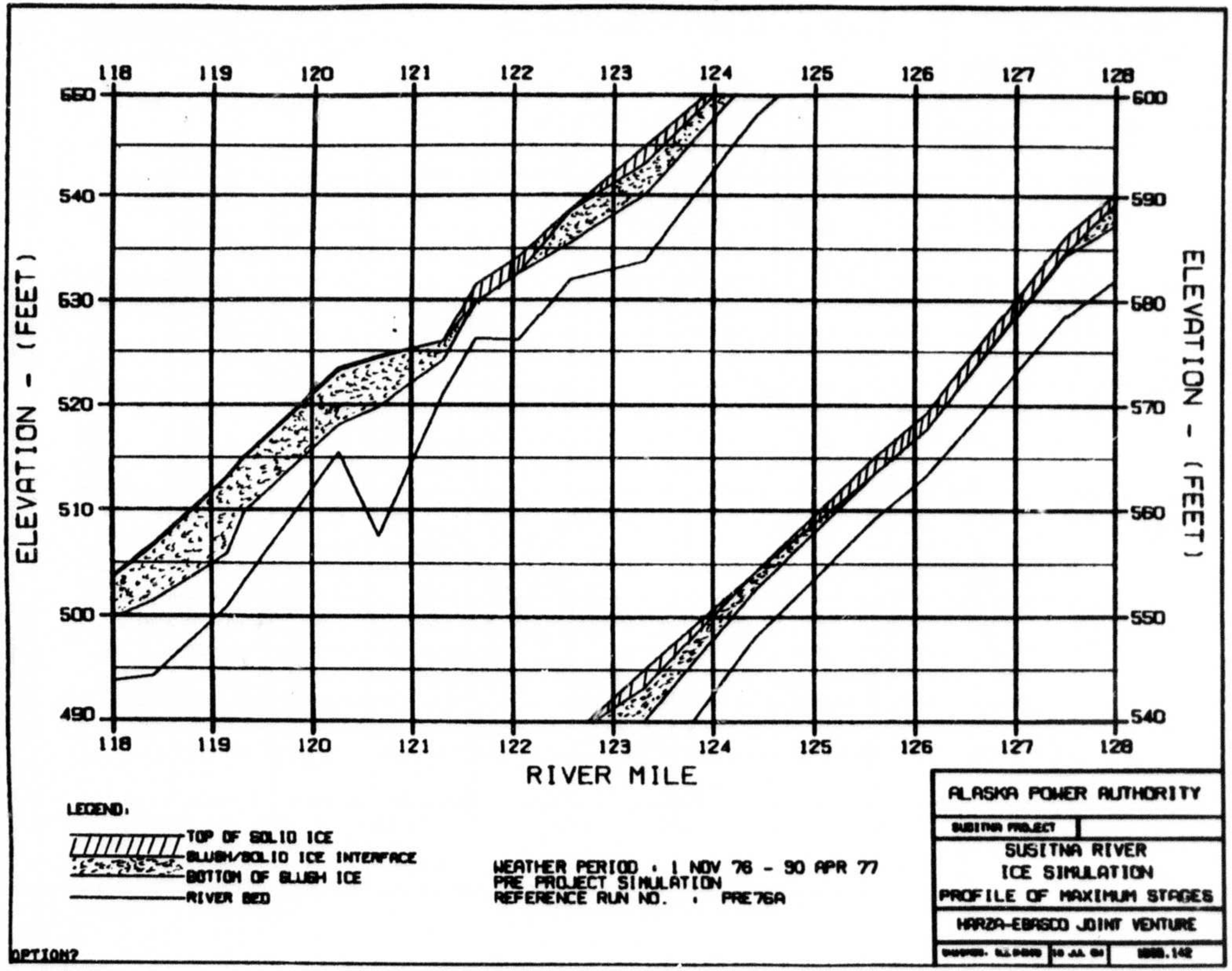
c


98
99
100
101
102
103
104
105
106
107
108
390
380
370
360
350
340
330
440
430
420
410
400
390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

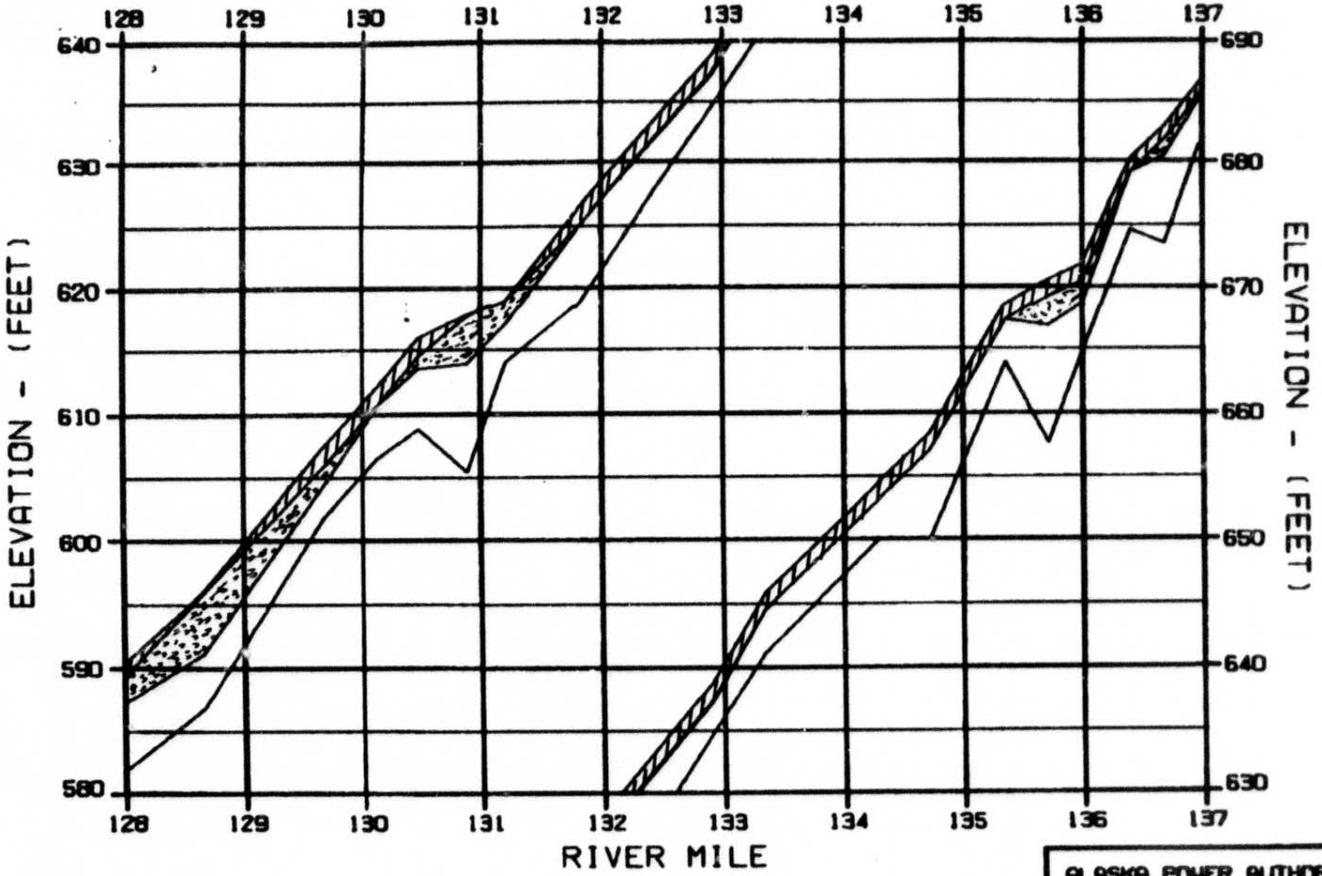


c
108 109 110 111 112 113 114 115 116 117 118
470
460
450
440
430
420
410
510
500
490
480
470
460
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

c


118
119
120
121
122
123
124
125
126
127
128
550
540
530
520
510
500
490
600
590
580
570
560
550
540
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

c



LEGEND:

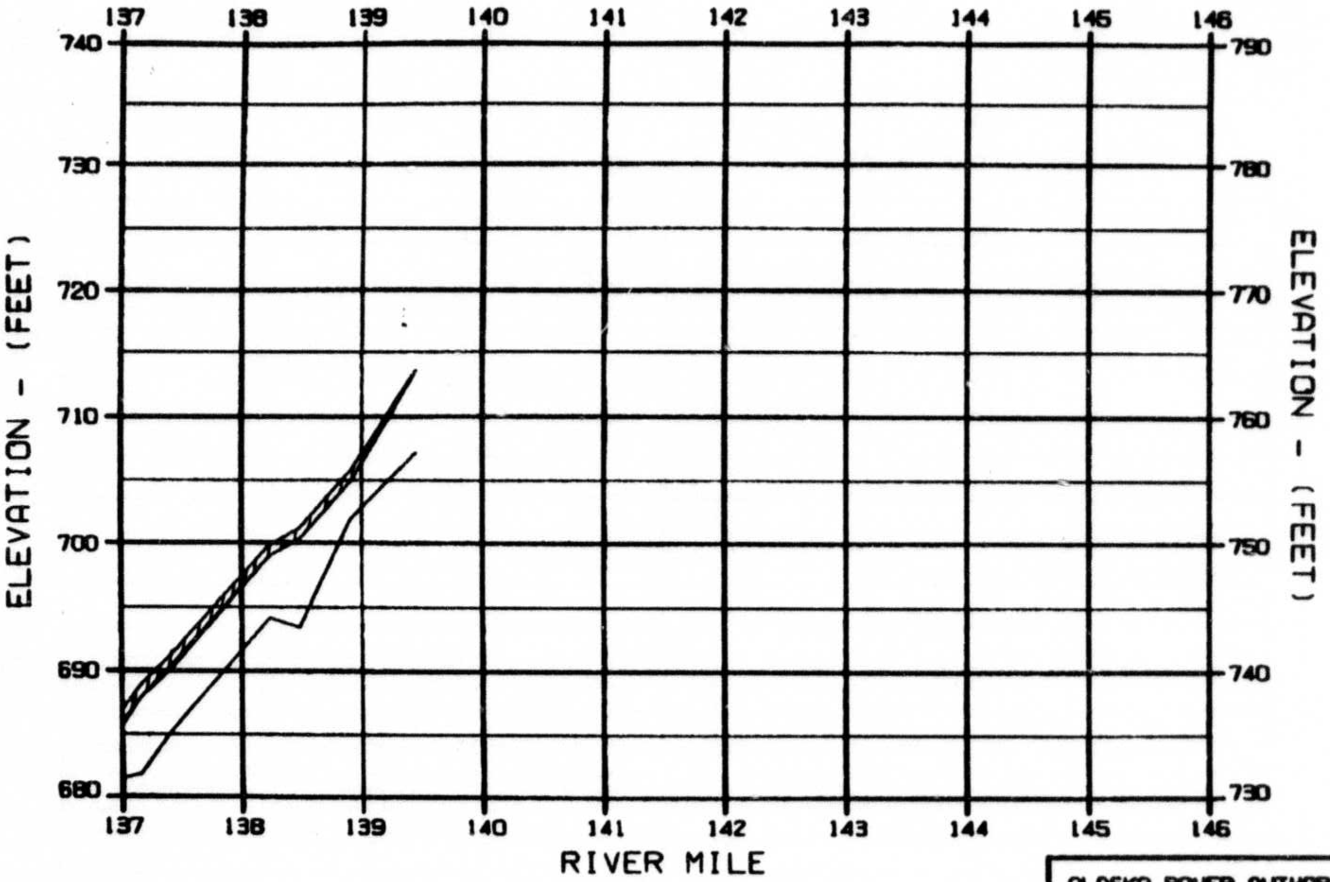
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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

OPTION?

C



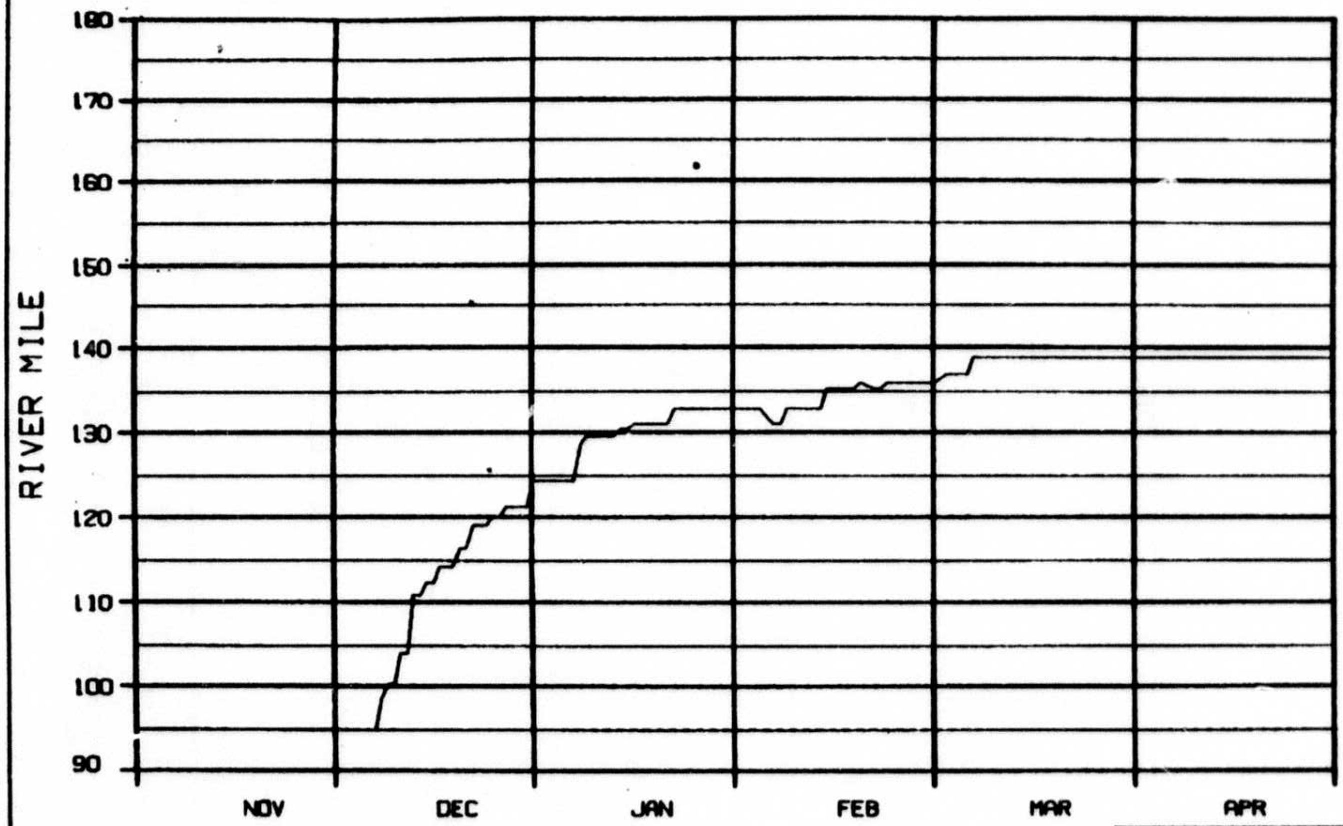
LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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

OPTION?



LEGEND:

——— ICE FRONT

- - - - ZERO DEGREE ISOTHERM

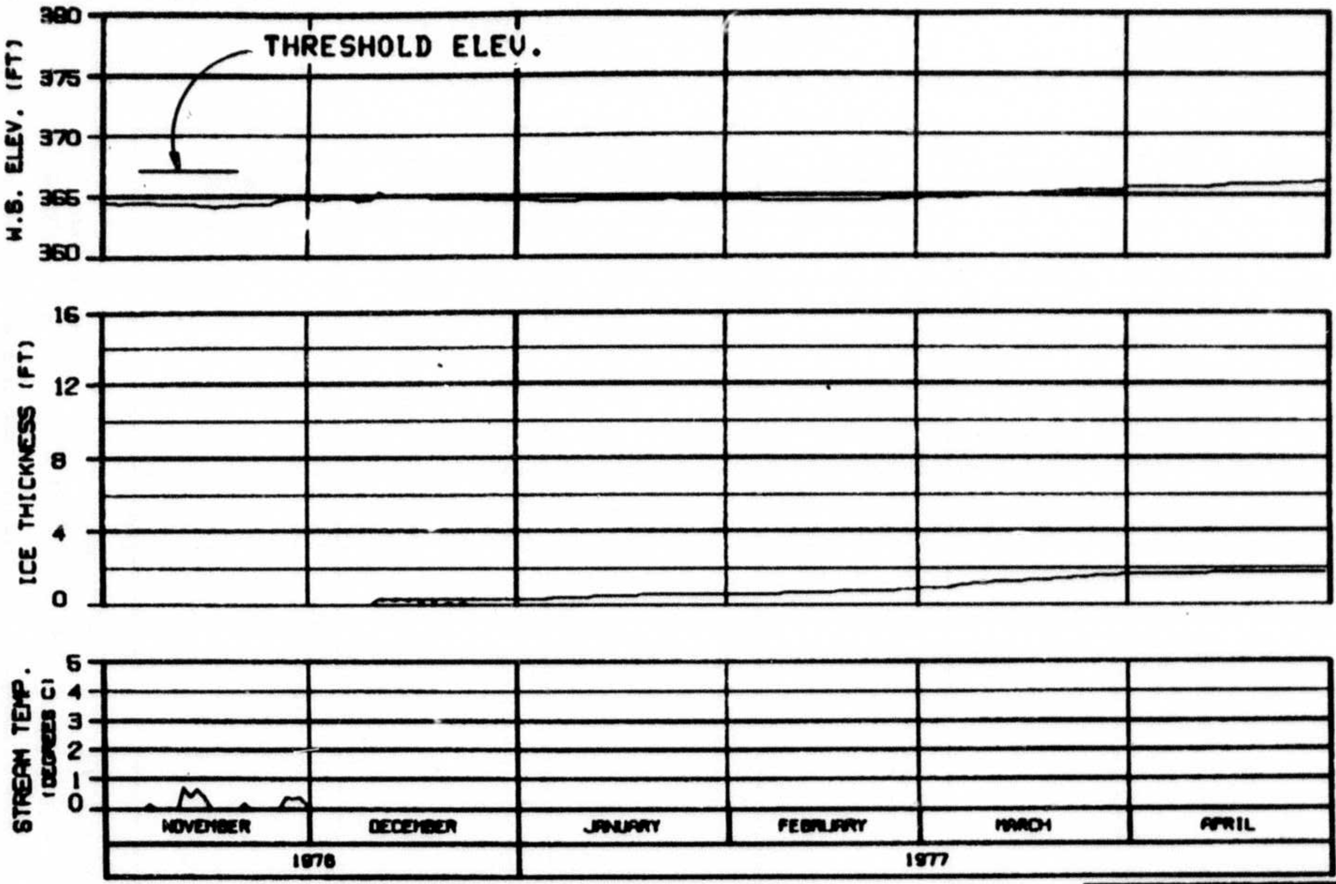
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM

HARZA-EBASCO JOINT VENTURE



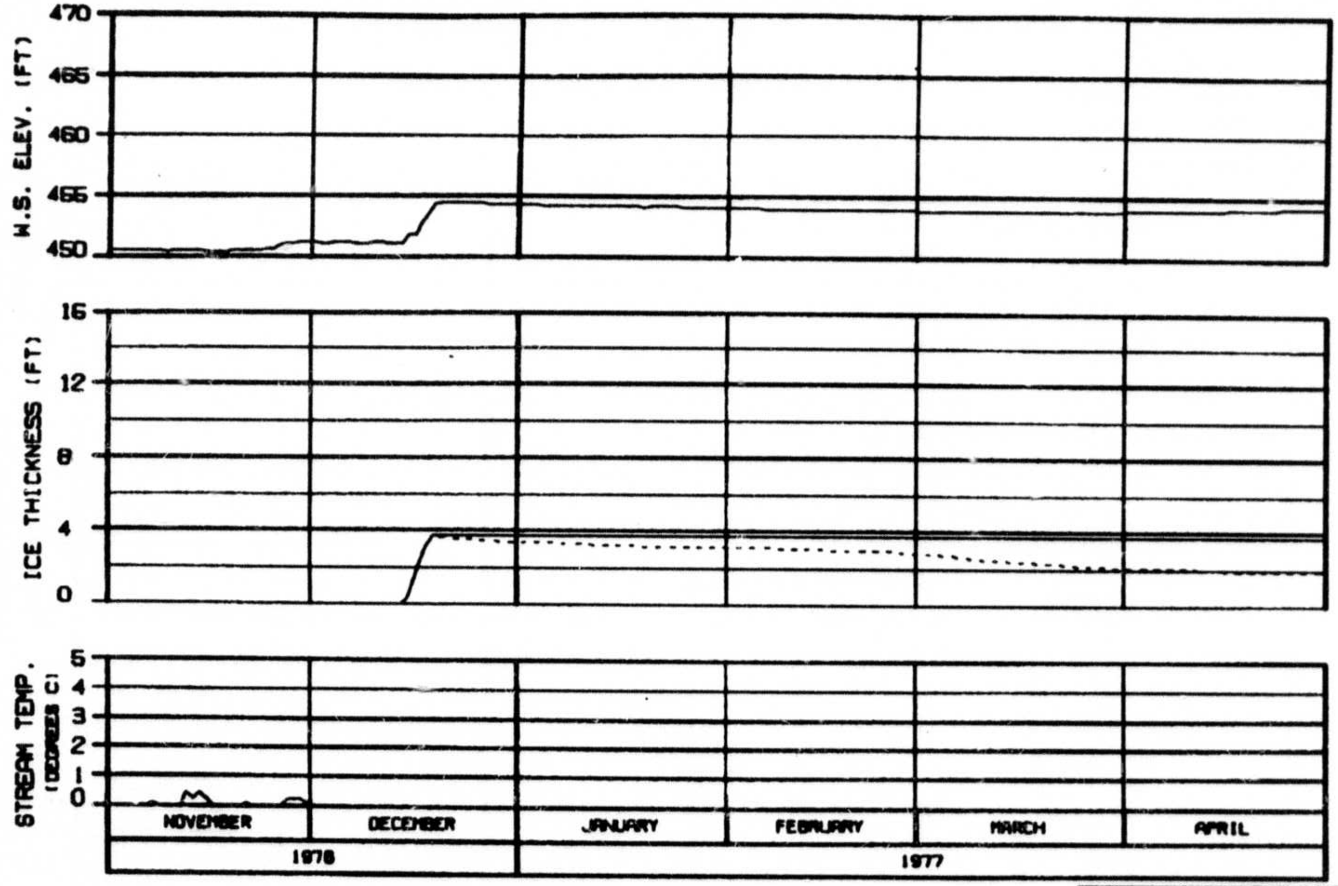
HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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

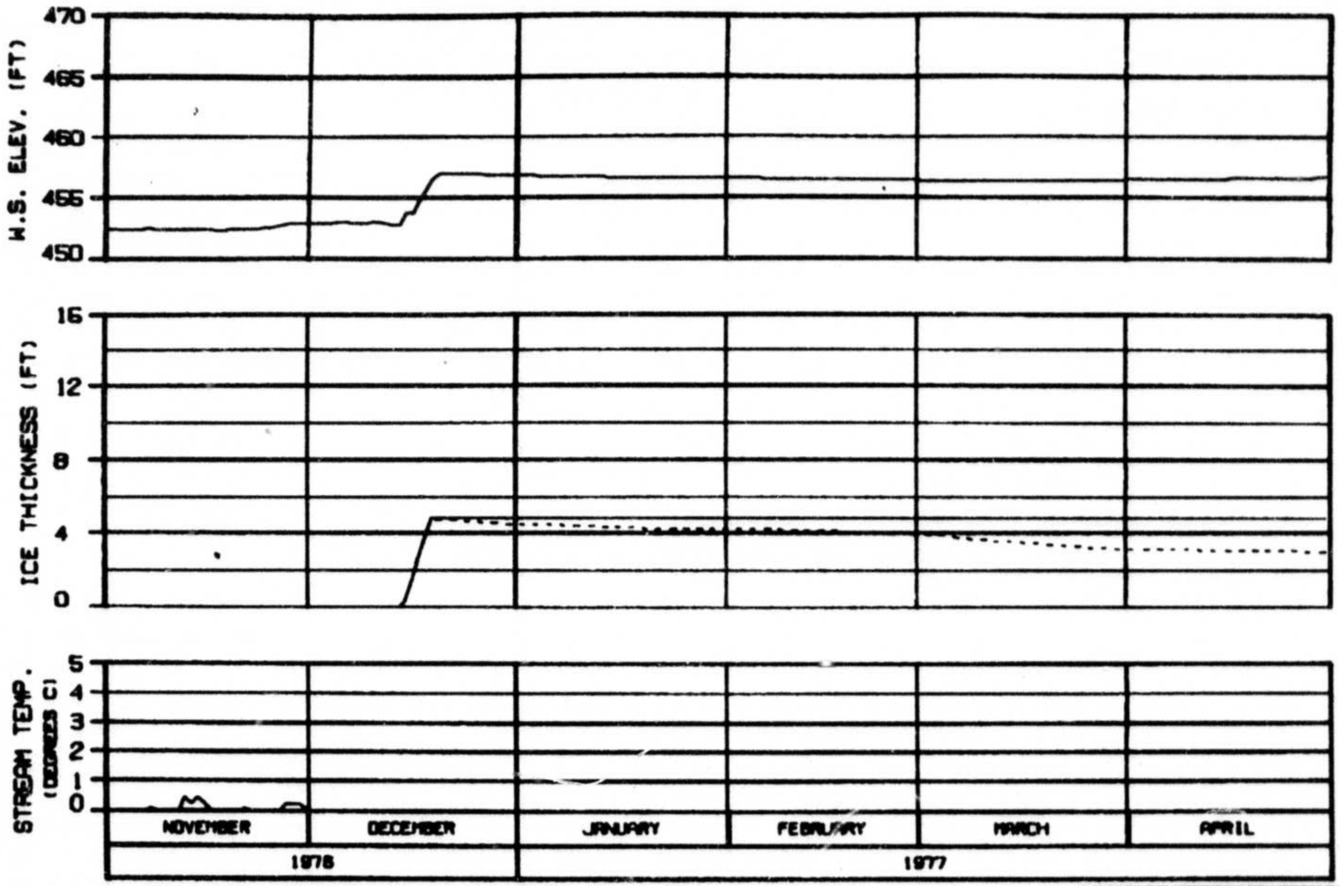
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



MOUTH OF SLOUGH 6A

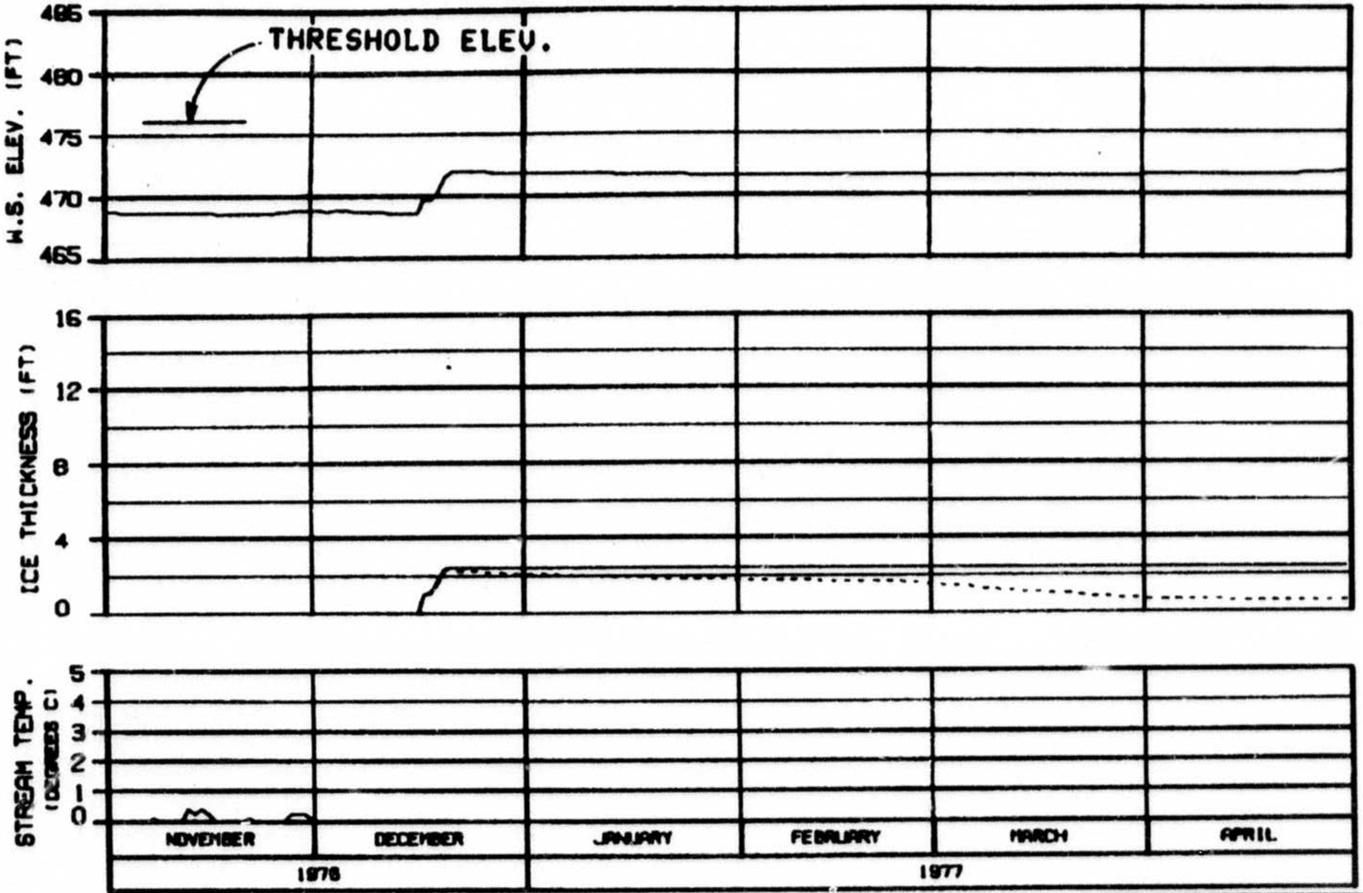
RIVER MILE : 112.34

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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



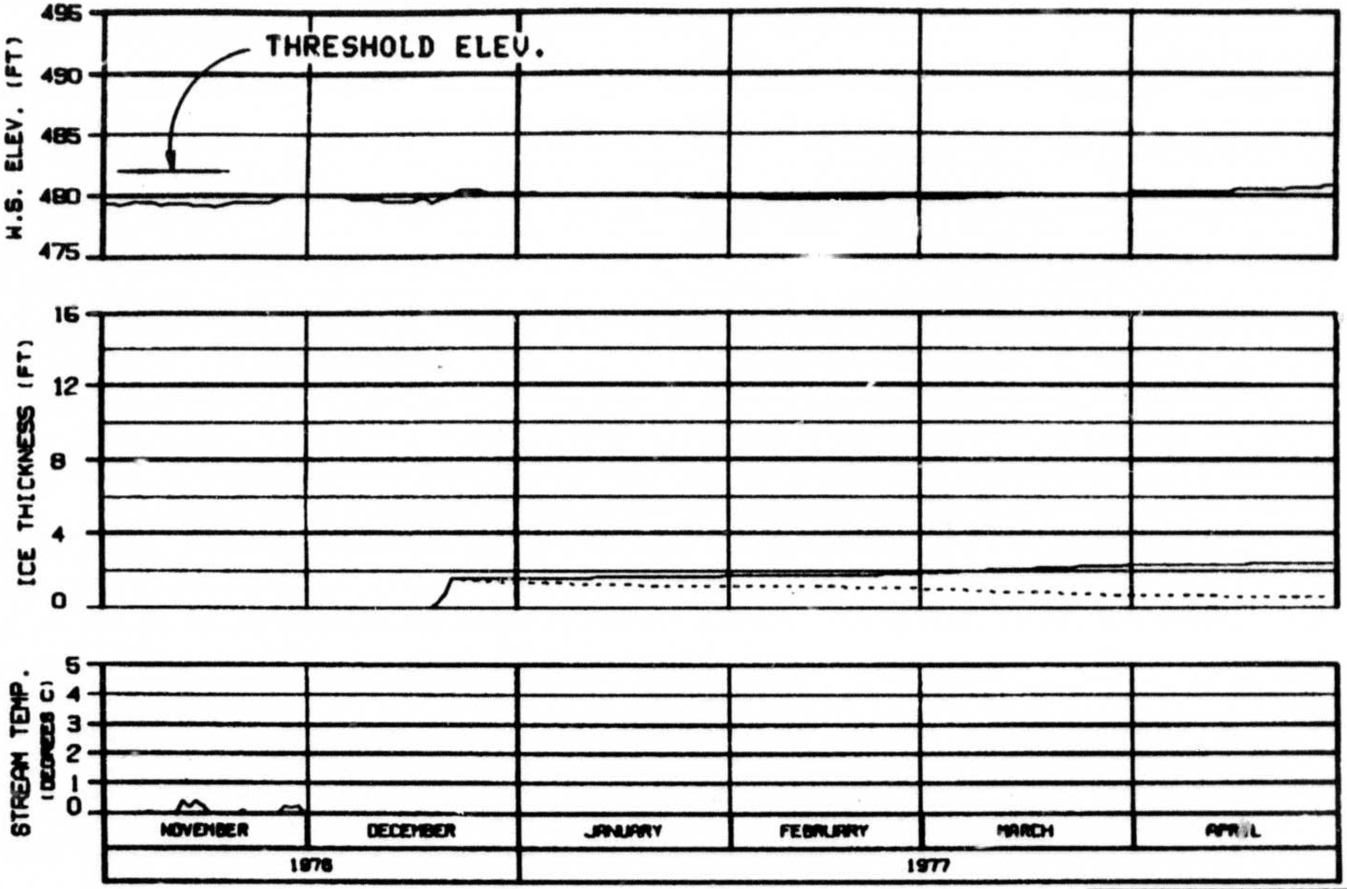
HEAD OF SLOUGH 8

RIVER MILE : 114.10

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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

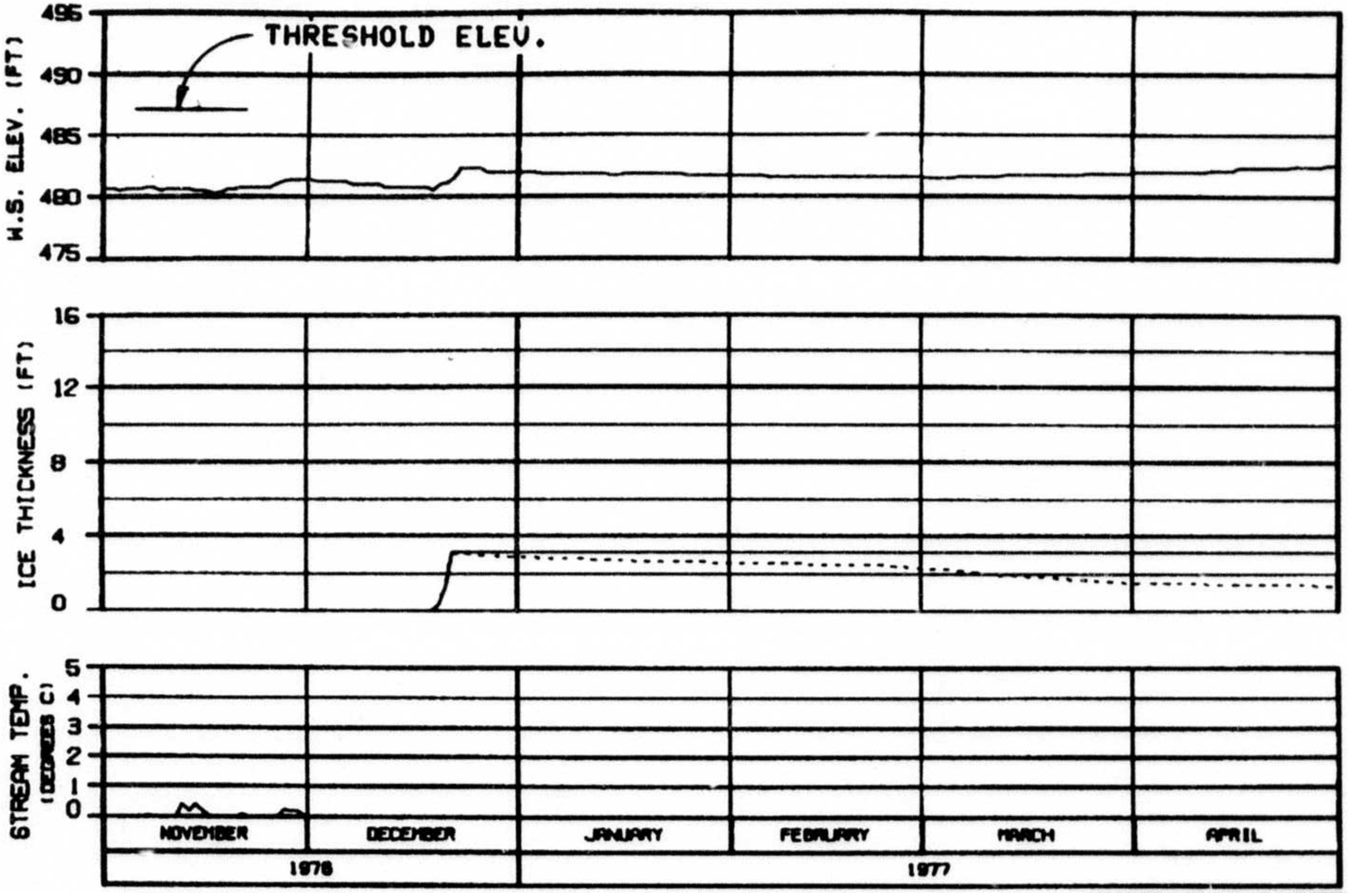
RIVER MILE : 115.50

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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



HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

ICE THICKNESS LEGEND:

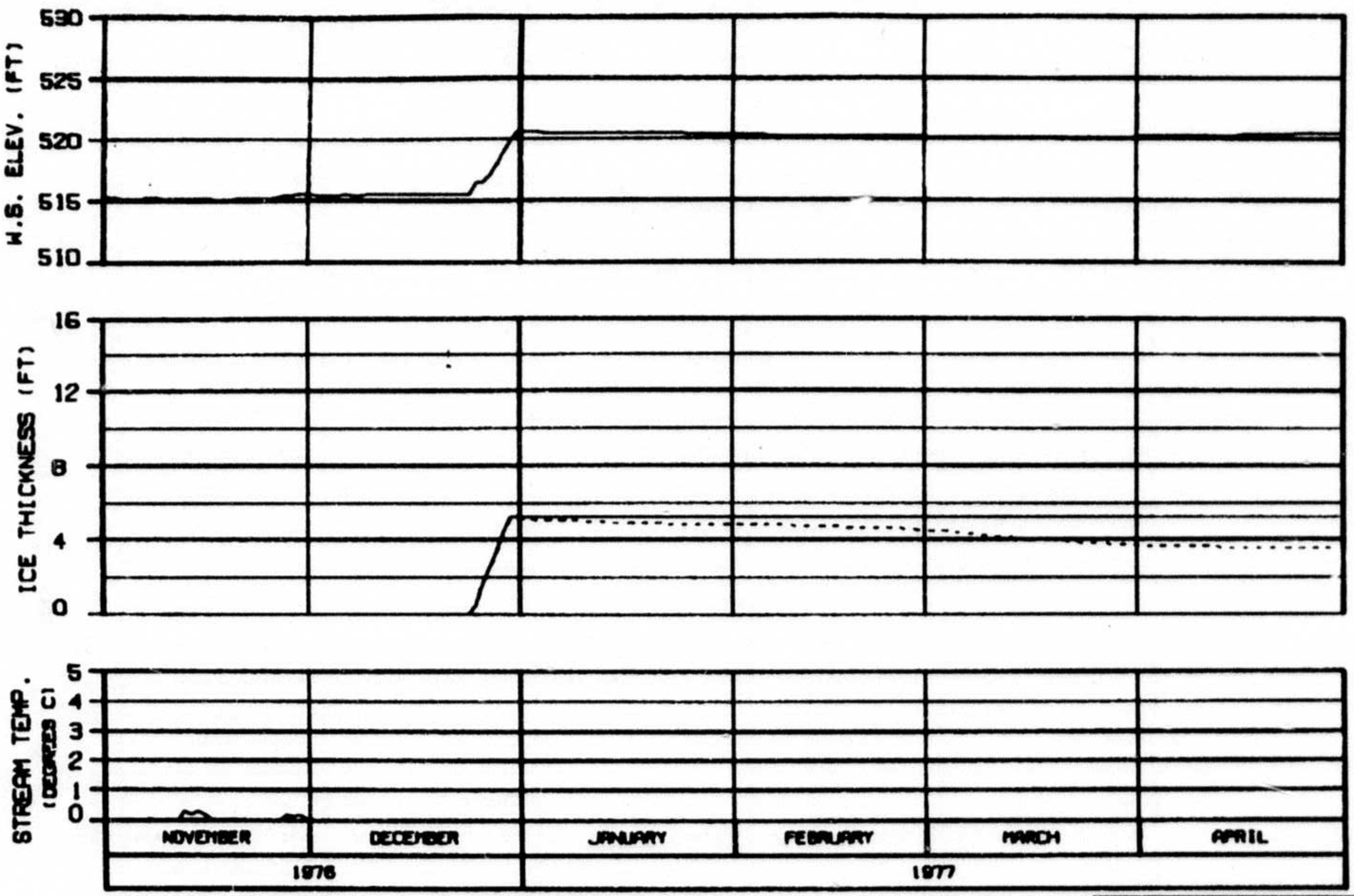
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



RIVER MILE : 120.00

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

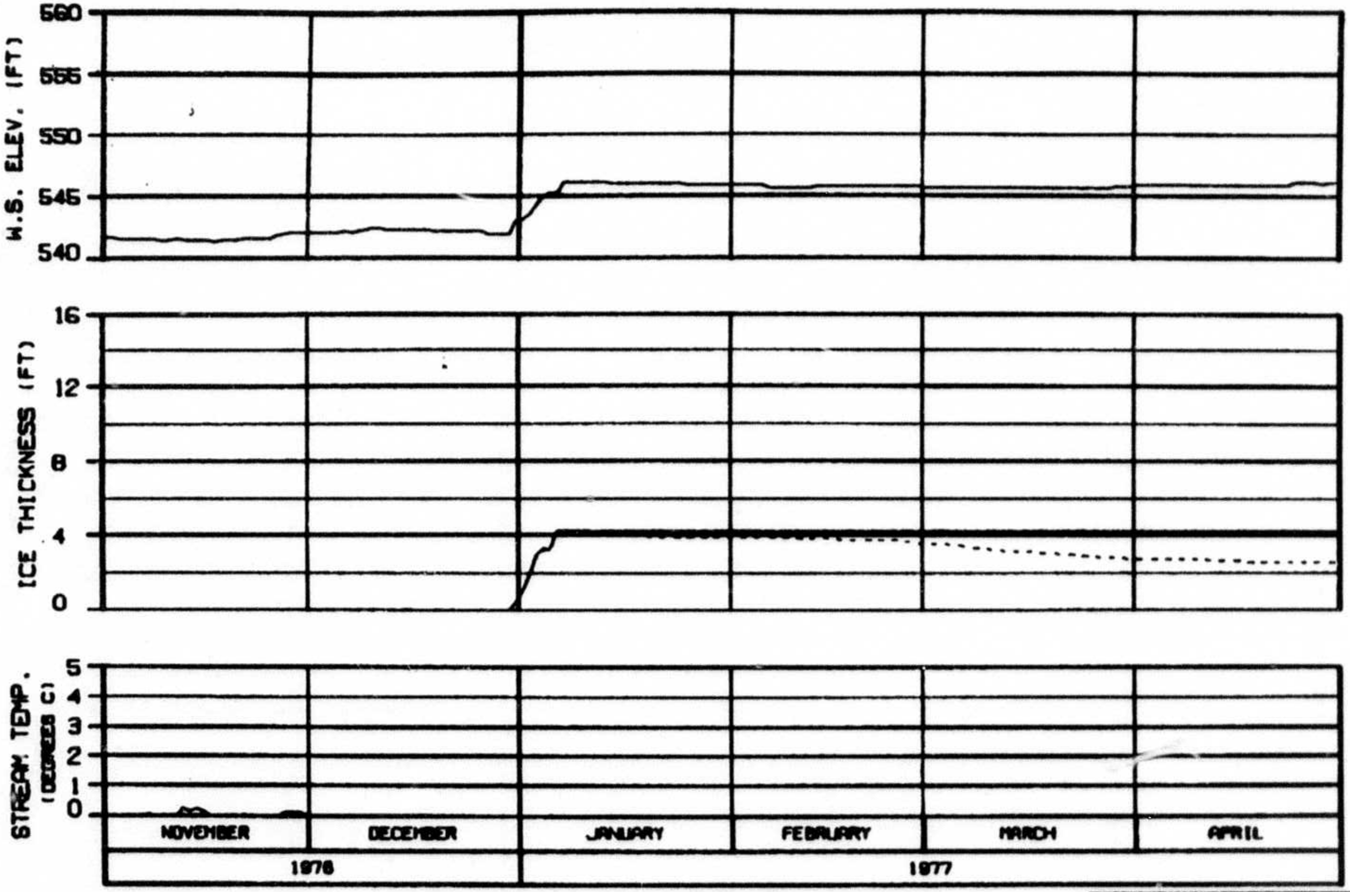
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] | [illegible] | [illegible]



HEAD OF MOOSE SLOUGH

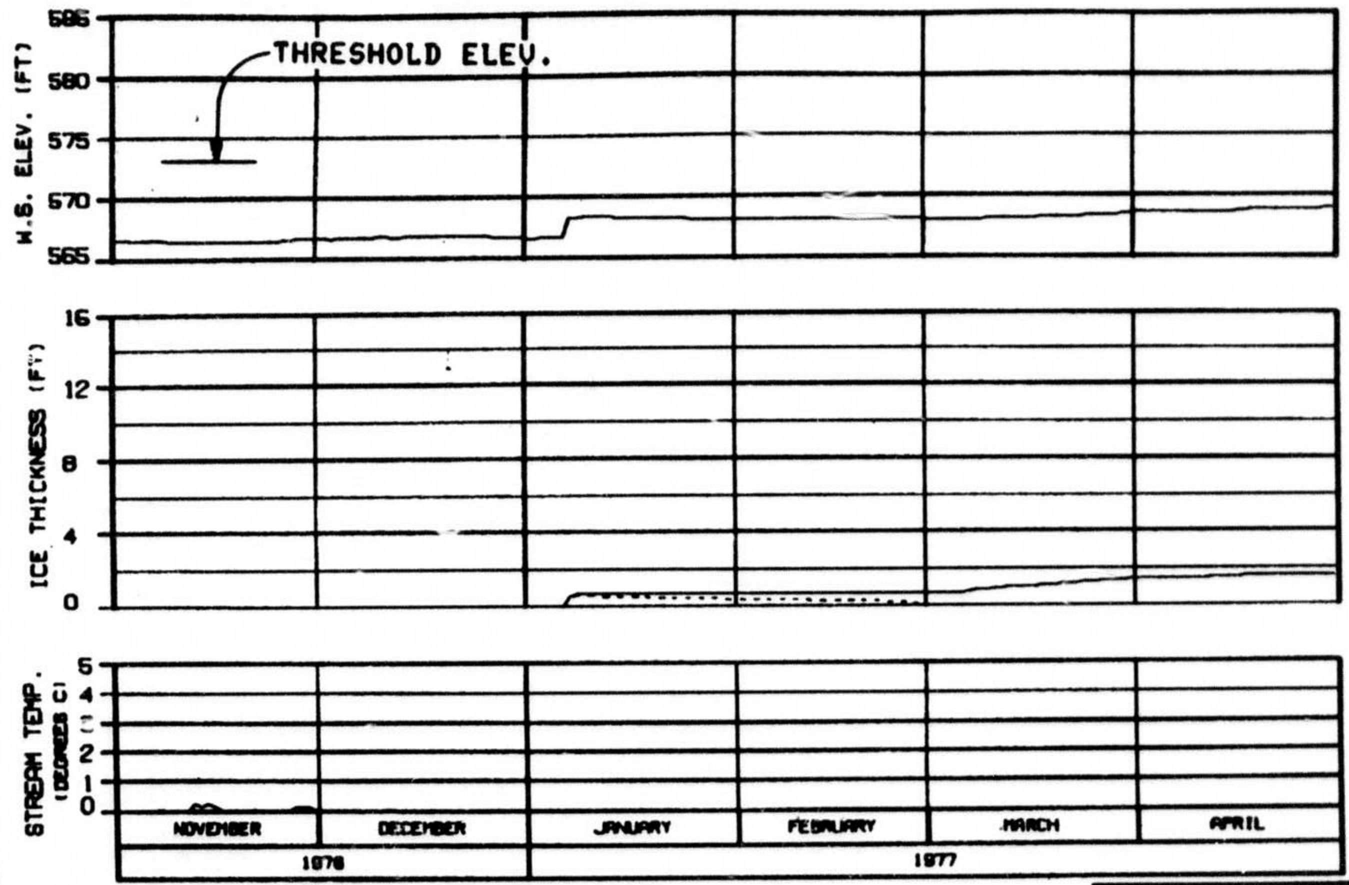
RIVER MILE : 123.50

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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 8A (WEST)

RIVER MILE : 126.10

ICE THICKNESS LEGEND:

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

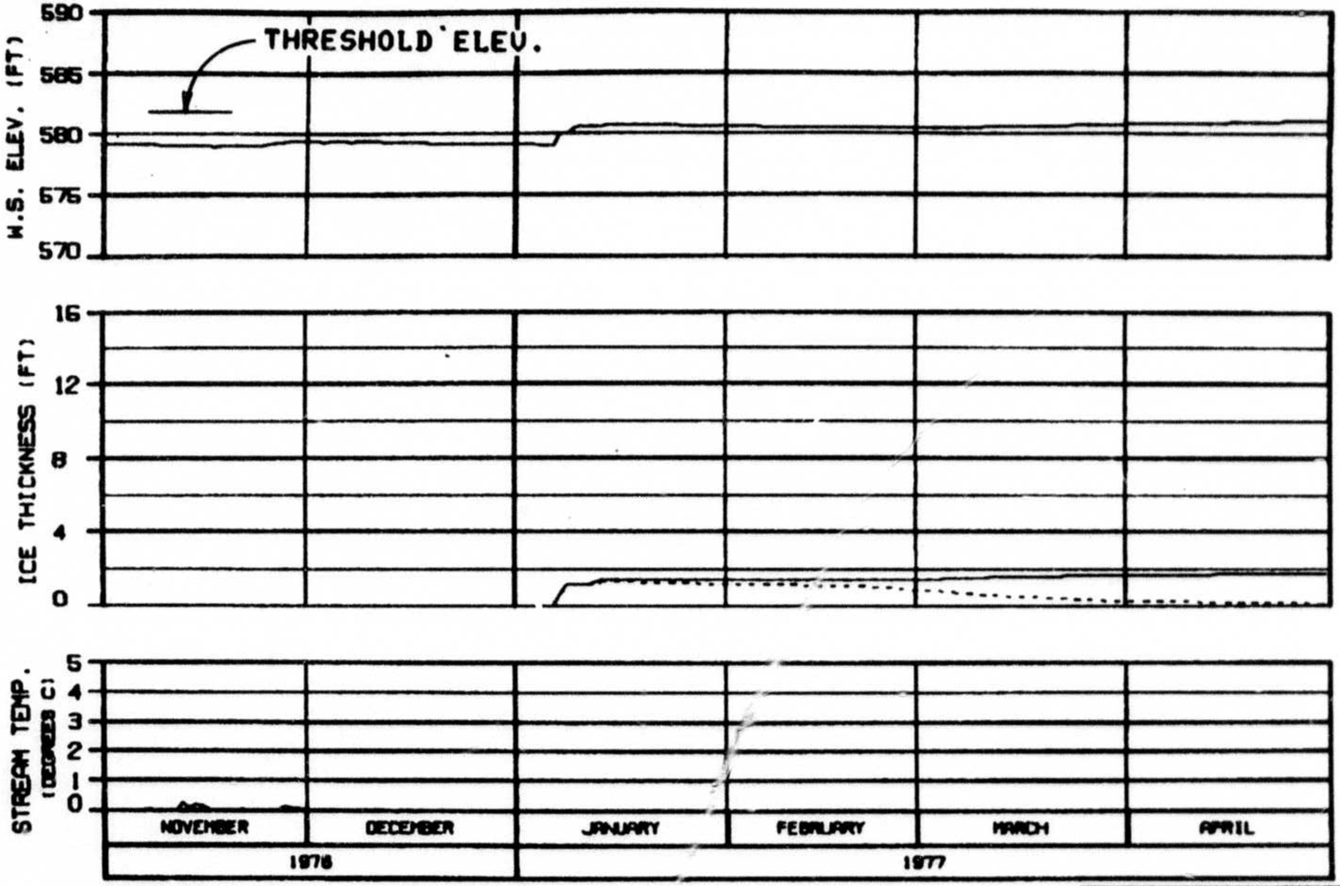
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:

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

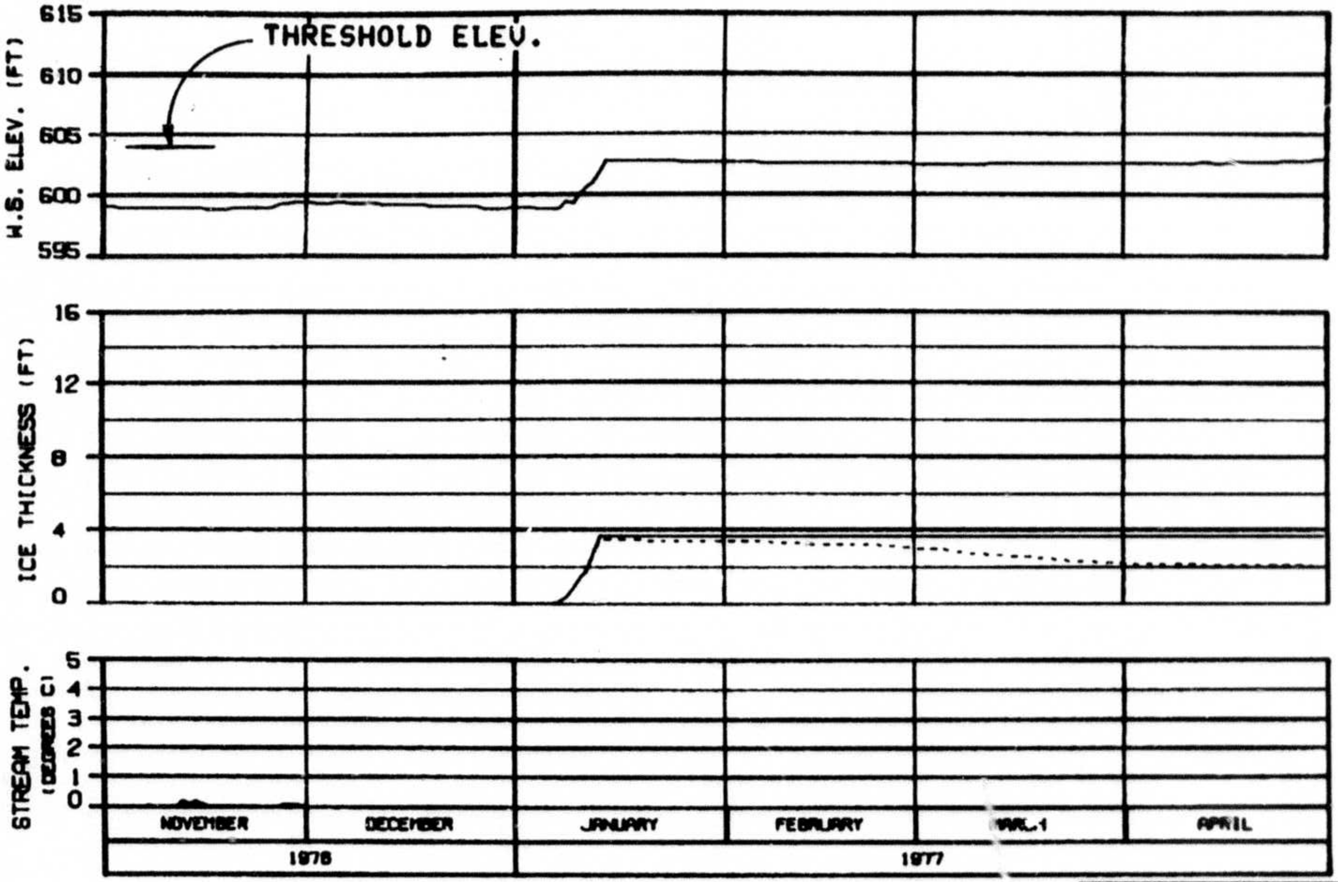
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

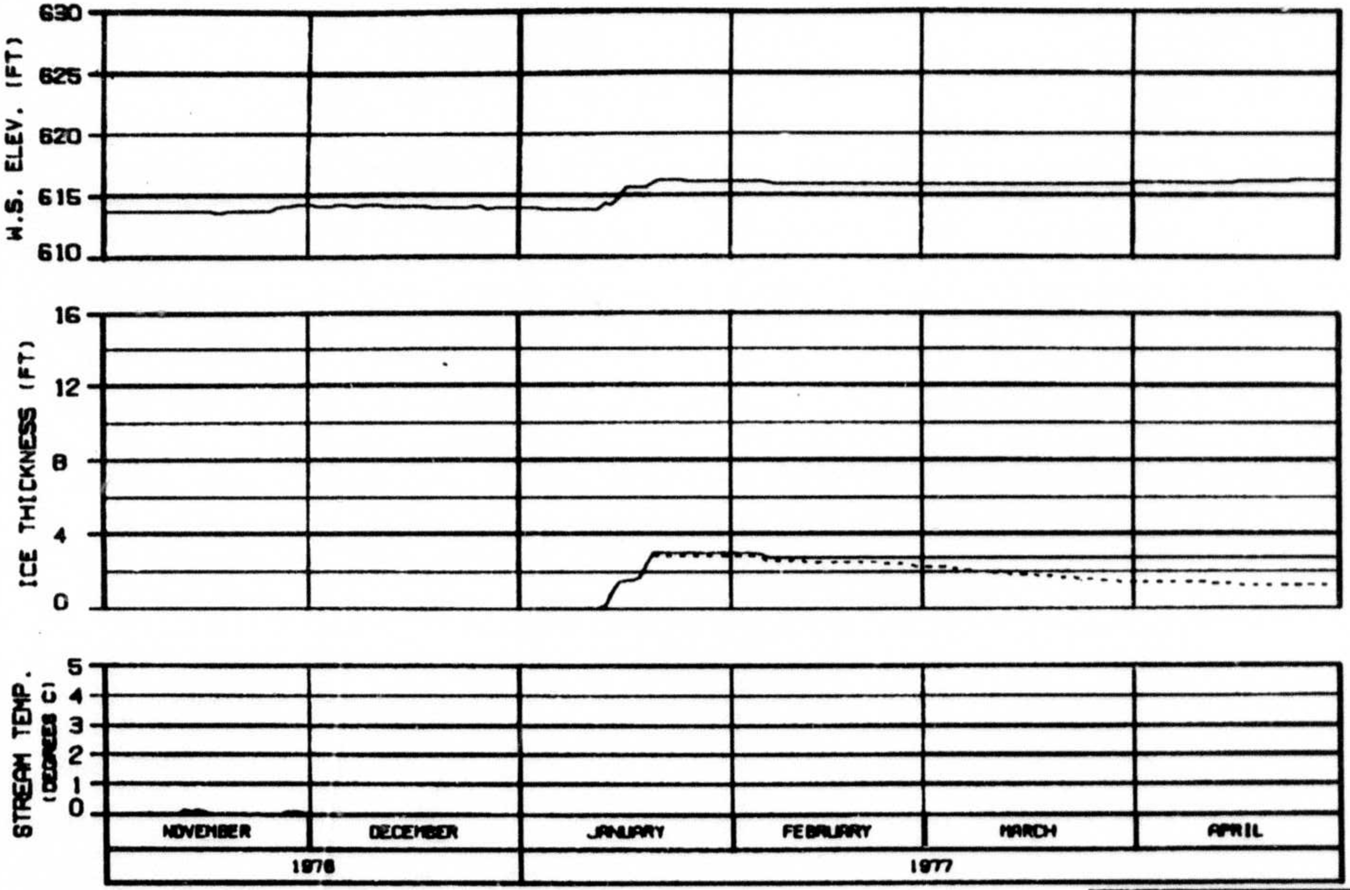
ICE THICKNESS LEGEND:

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

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

OPTION?

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

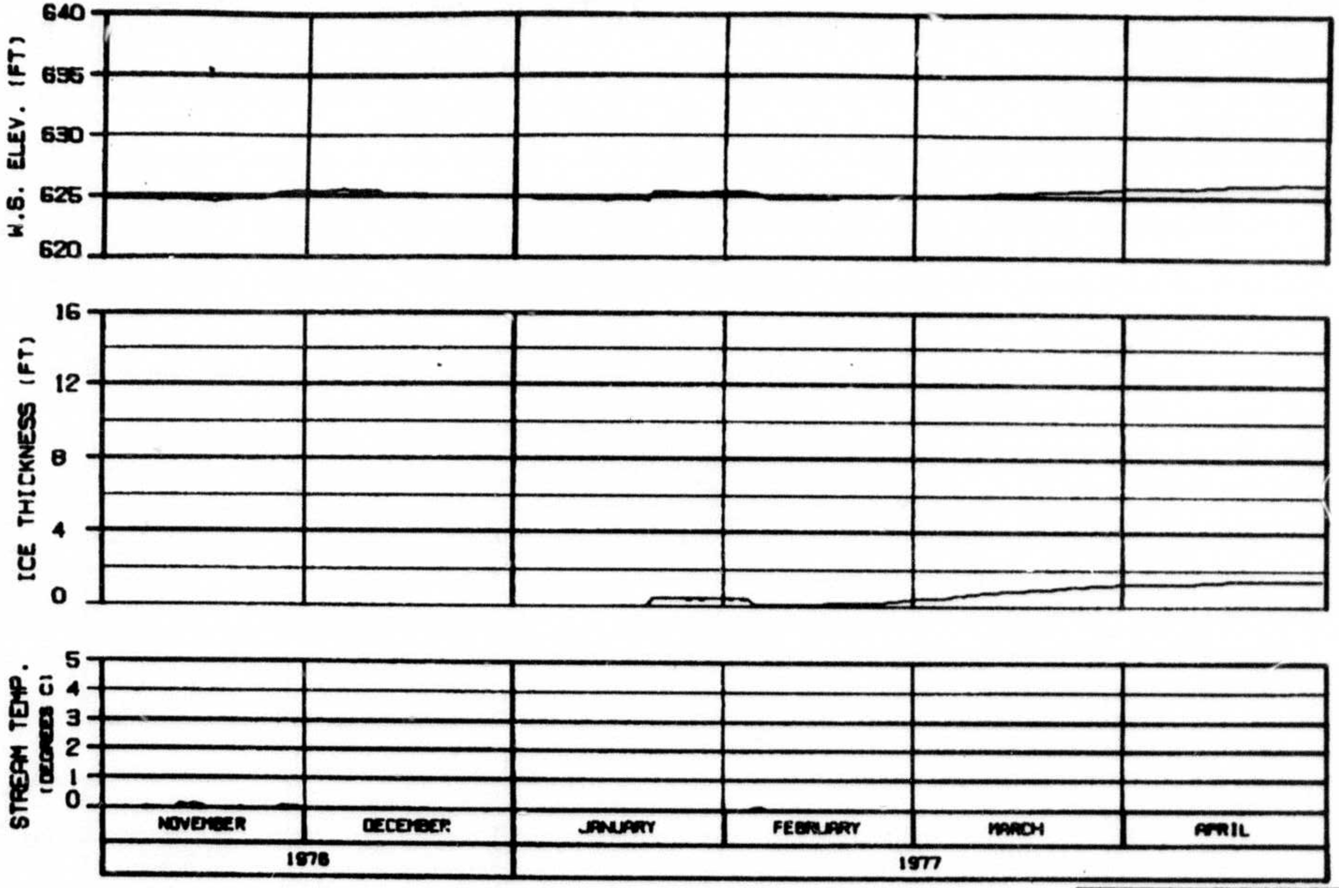
RIVER MILE : 130.60

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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



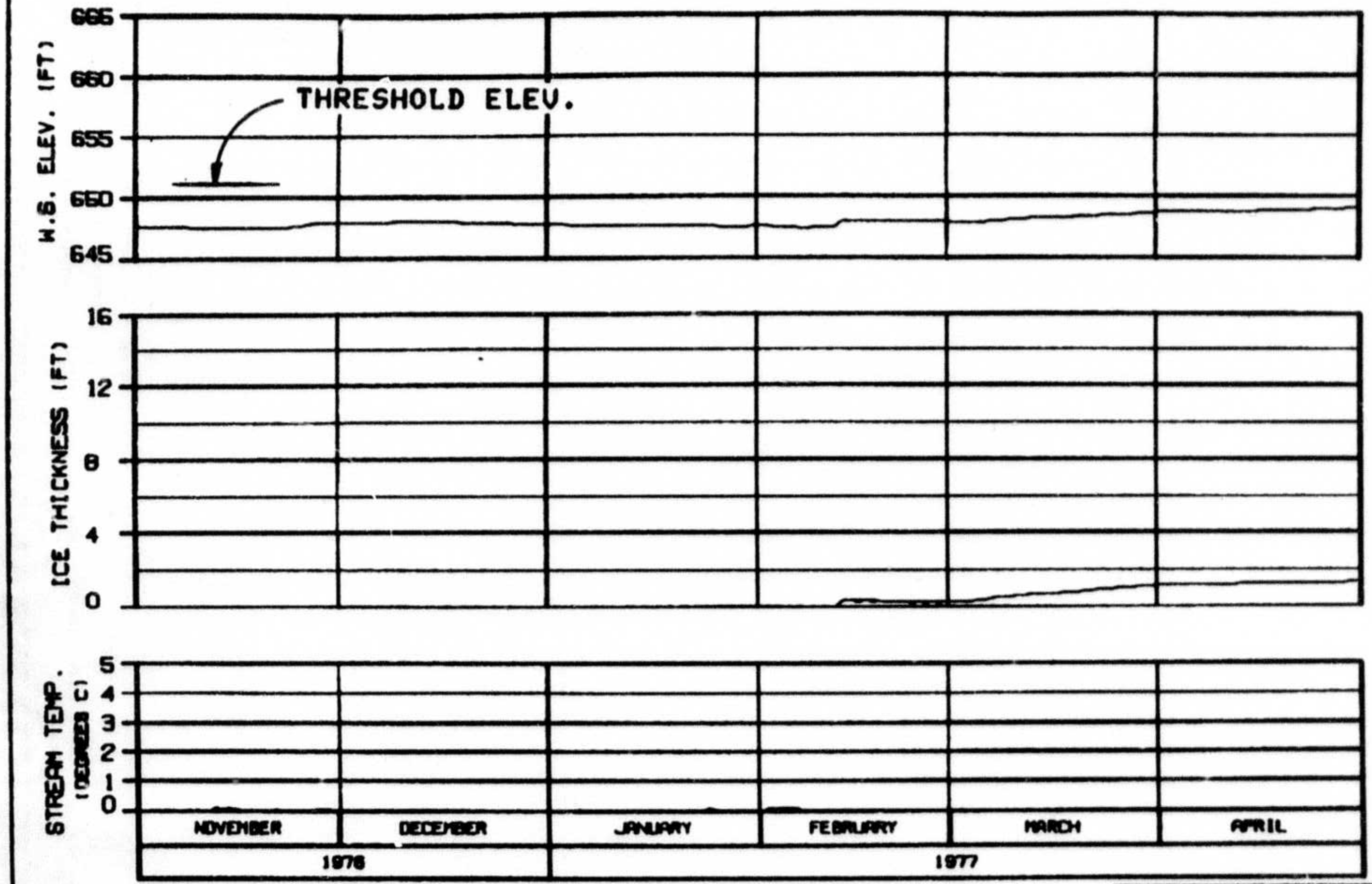
SIDE CHANNEL U/S OF 4TH JULY CREEK

RIVER MILE : 131.80

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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 LEDEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

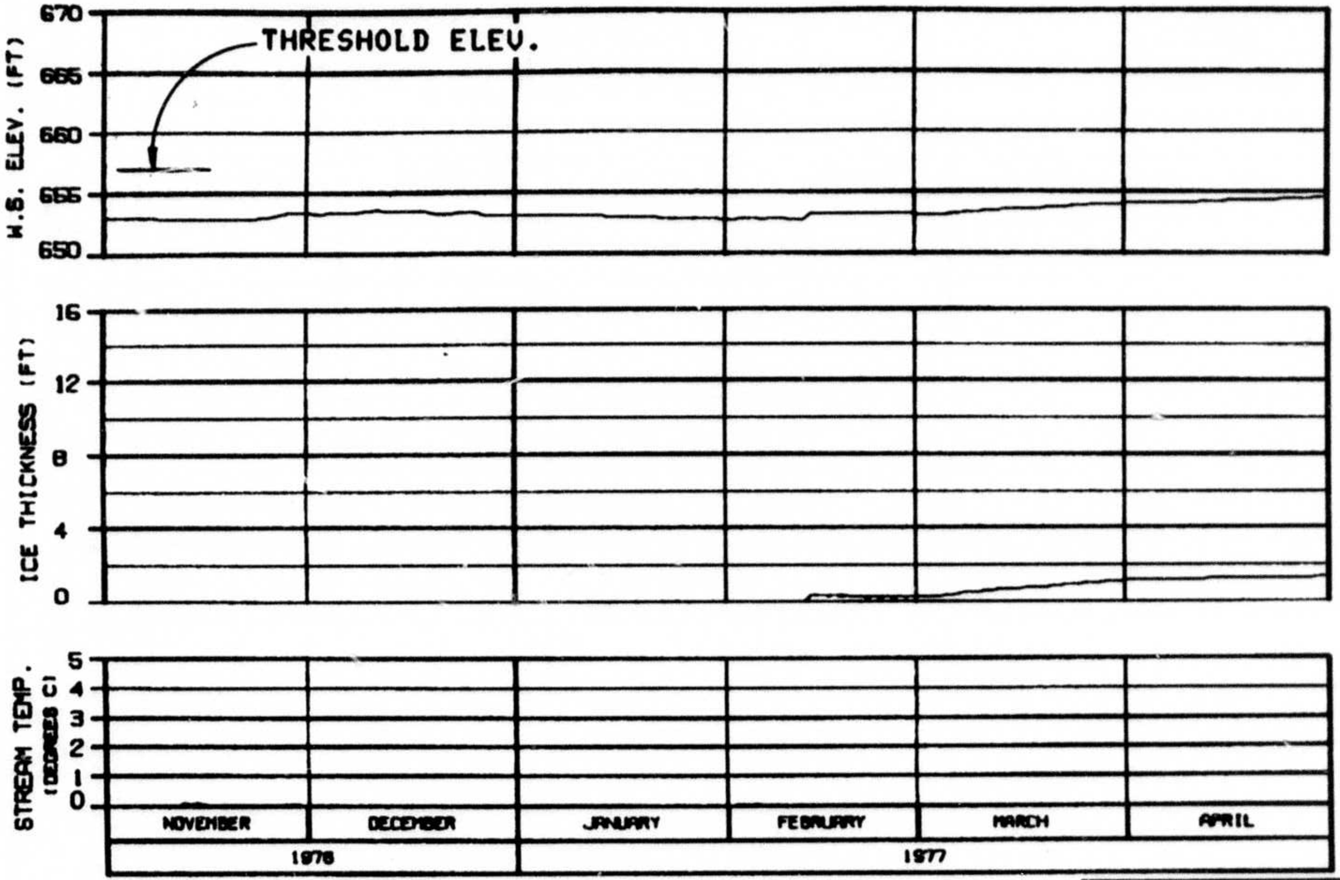
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] | [illegible] | [illegible].142



SIDE CHANNEL U/S OF SLOUGH 10

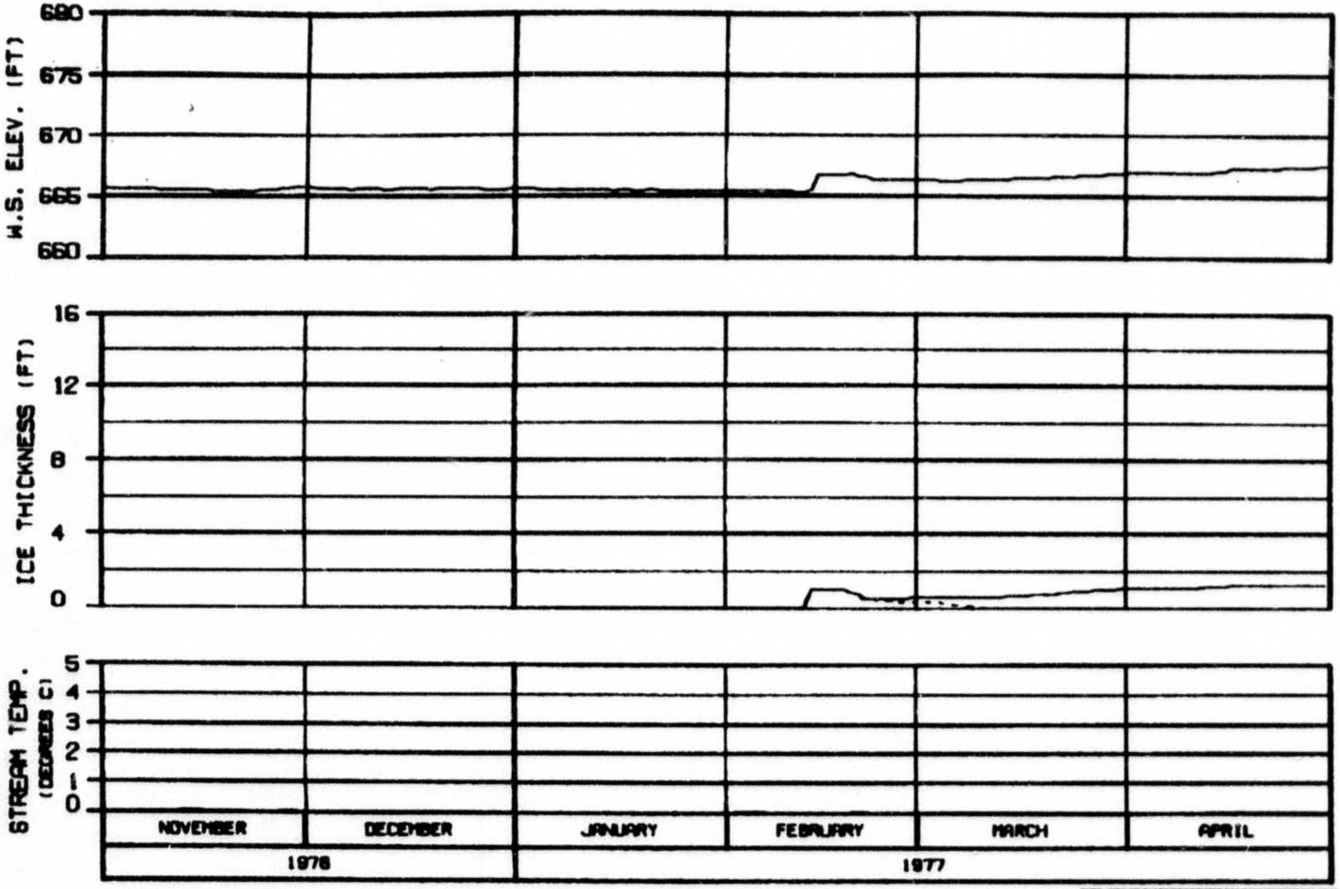
RIVER MILE : 134.30

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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



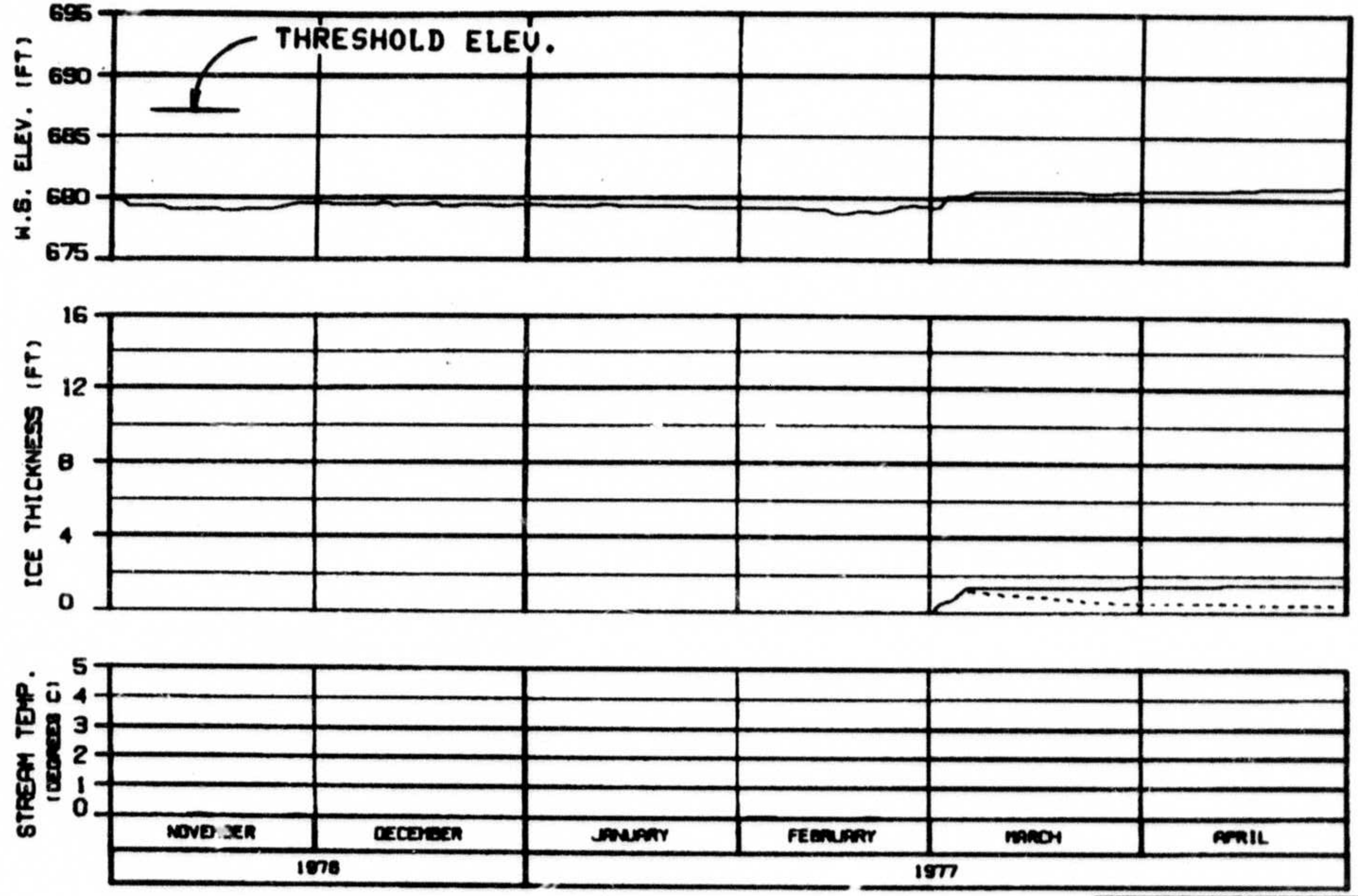
SIDE CHANNEL D/S OF SLOUGH 11

RIVER MILE : 135.30

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS | 10 JUL 84 | 1680.142



HEAD OF SLOUGH 11

RIVER MILE : 136.50

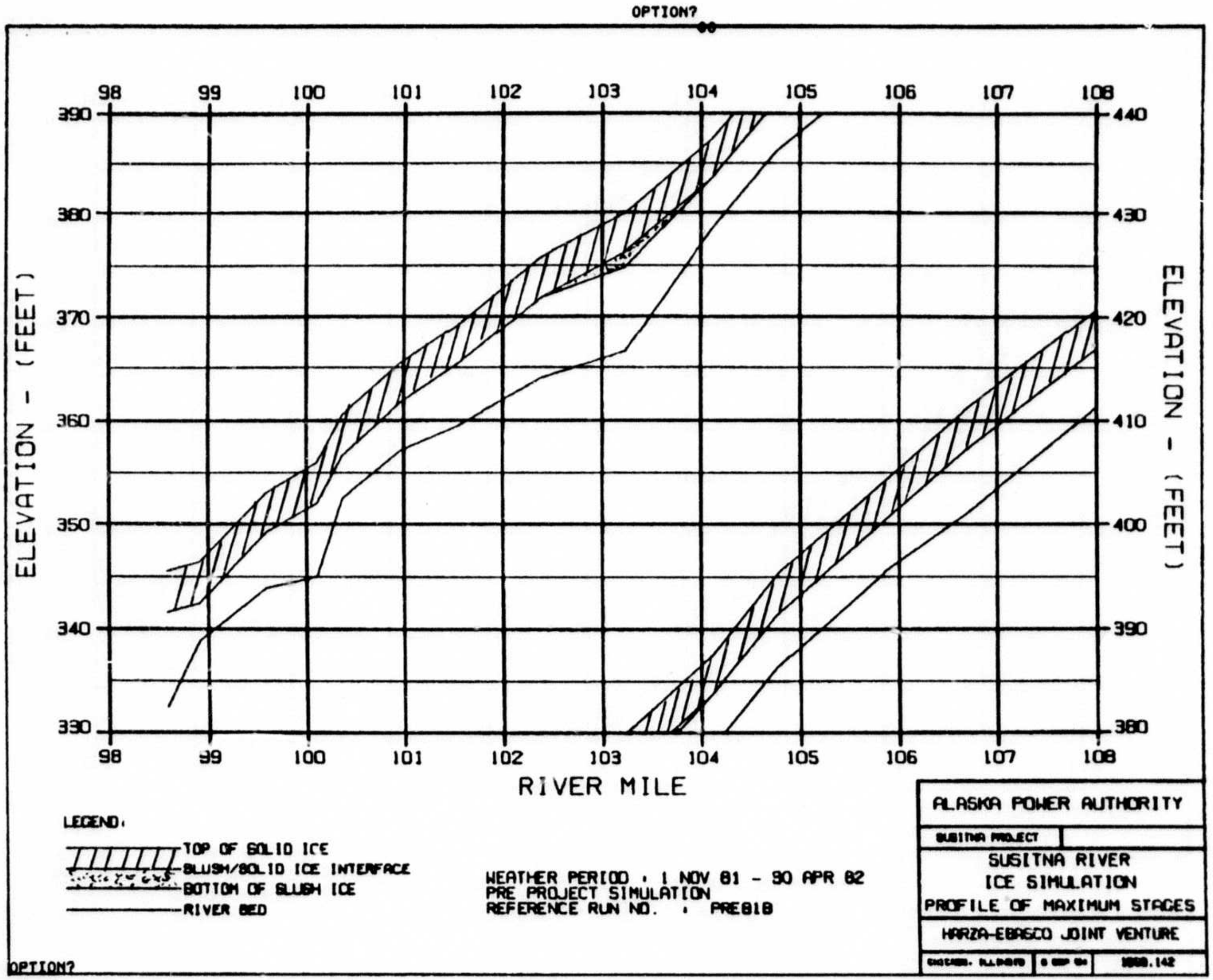
ICE THICKNESS LEGEND:

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

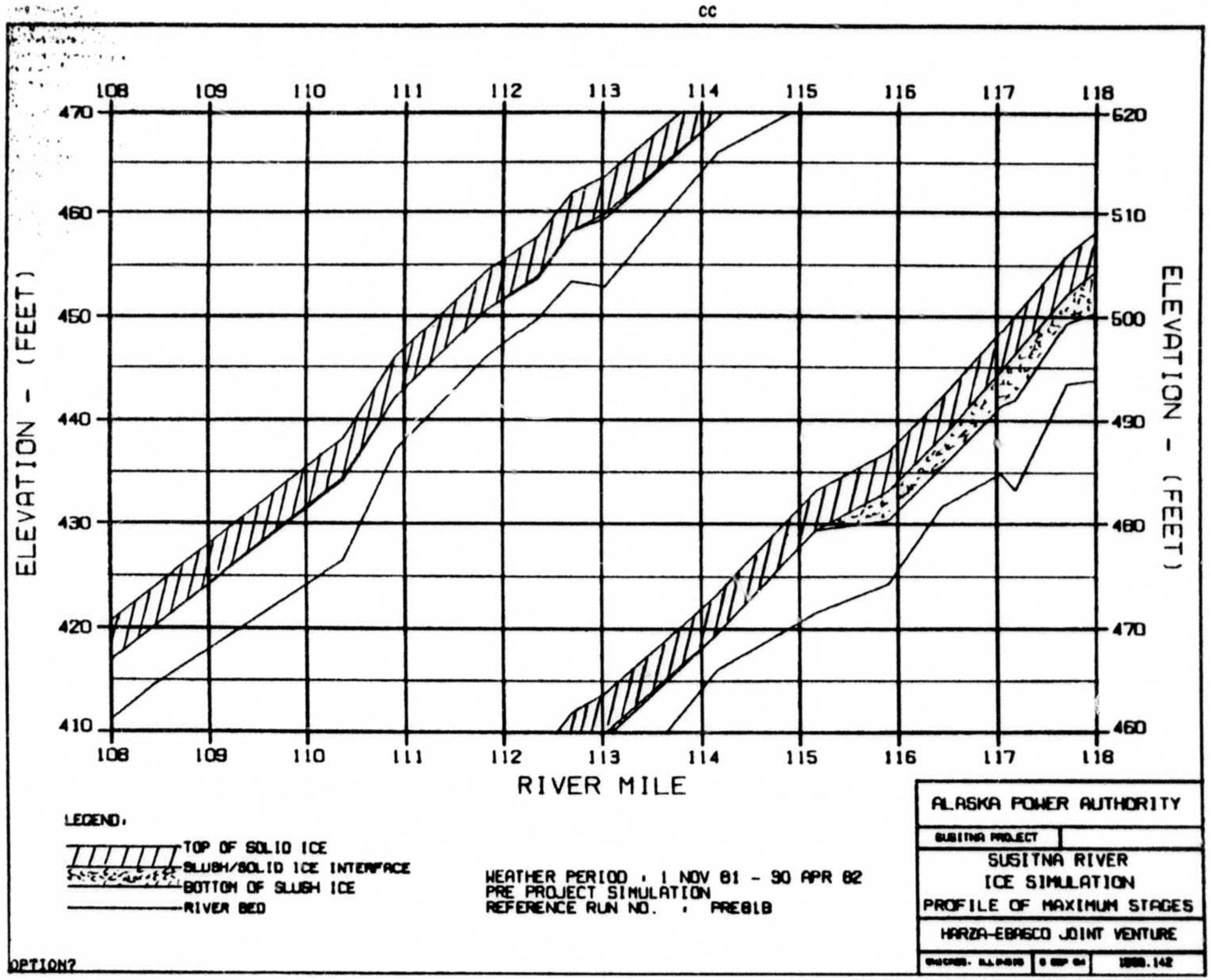
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE76A

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

EXHIBIT C

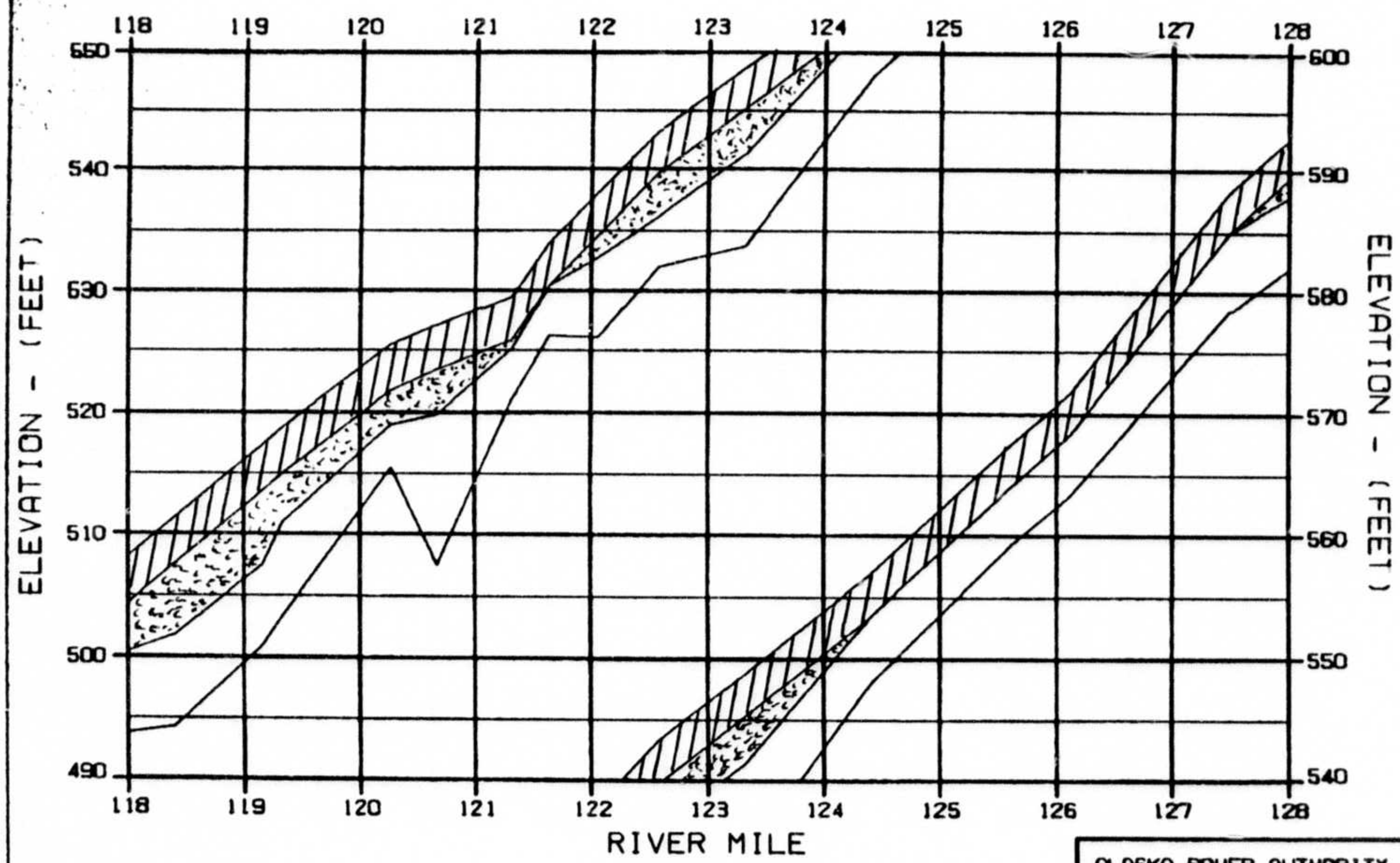


OPTION?
98
99
100
101
102
103
104
105
106
107
108
390
380
370
360
350
340
330
440
430
420
410
400
390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE818
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?



CC
108
109
110
111
112
113
114
115
116
117
118
470
460
450
440
430
420
410
620
510
500
490
480
470
460
ELEVATION - (FEET)
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
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

CC



LEGEND:

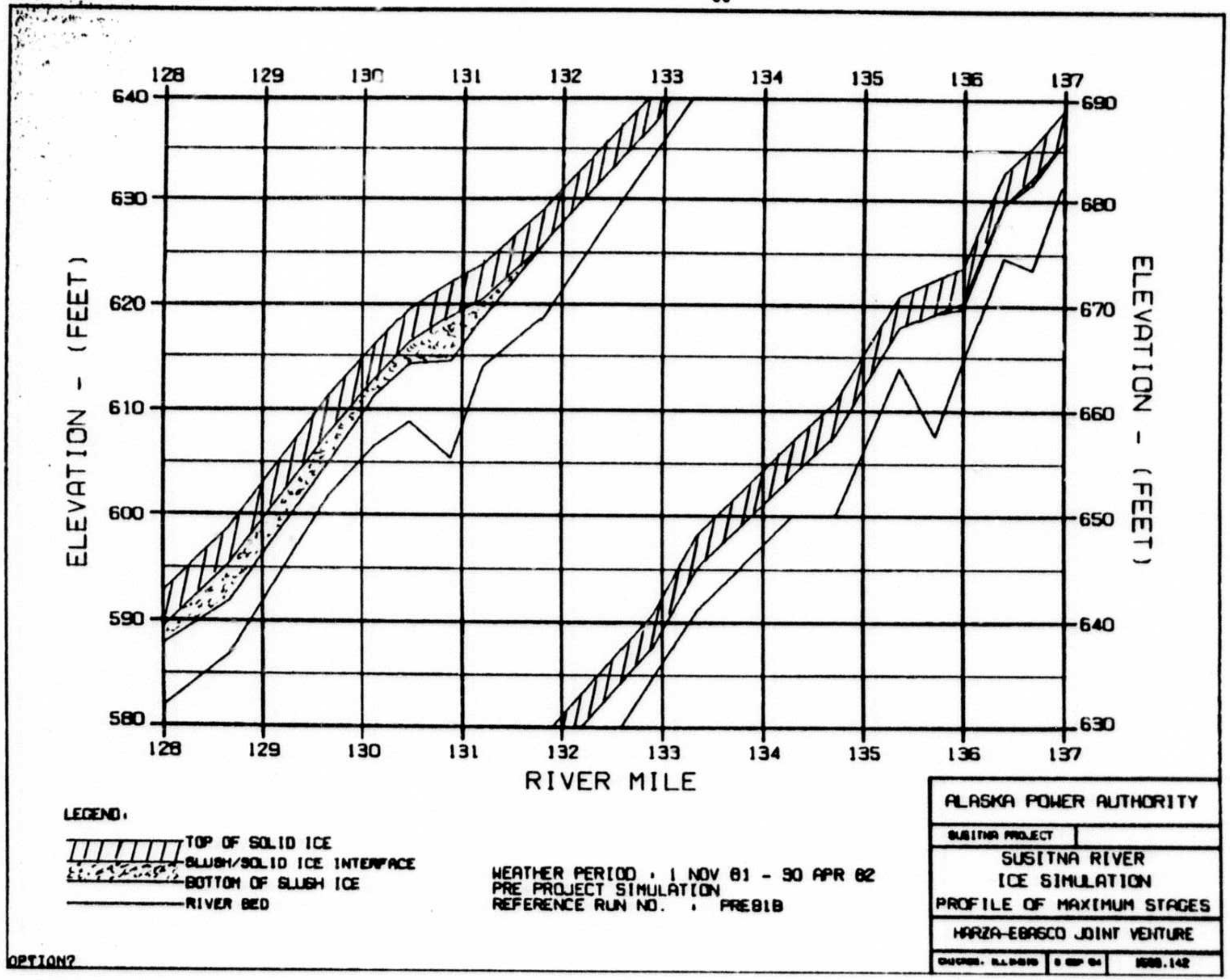
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

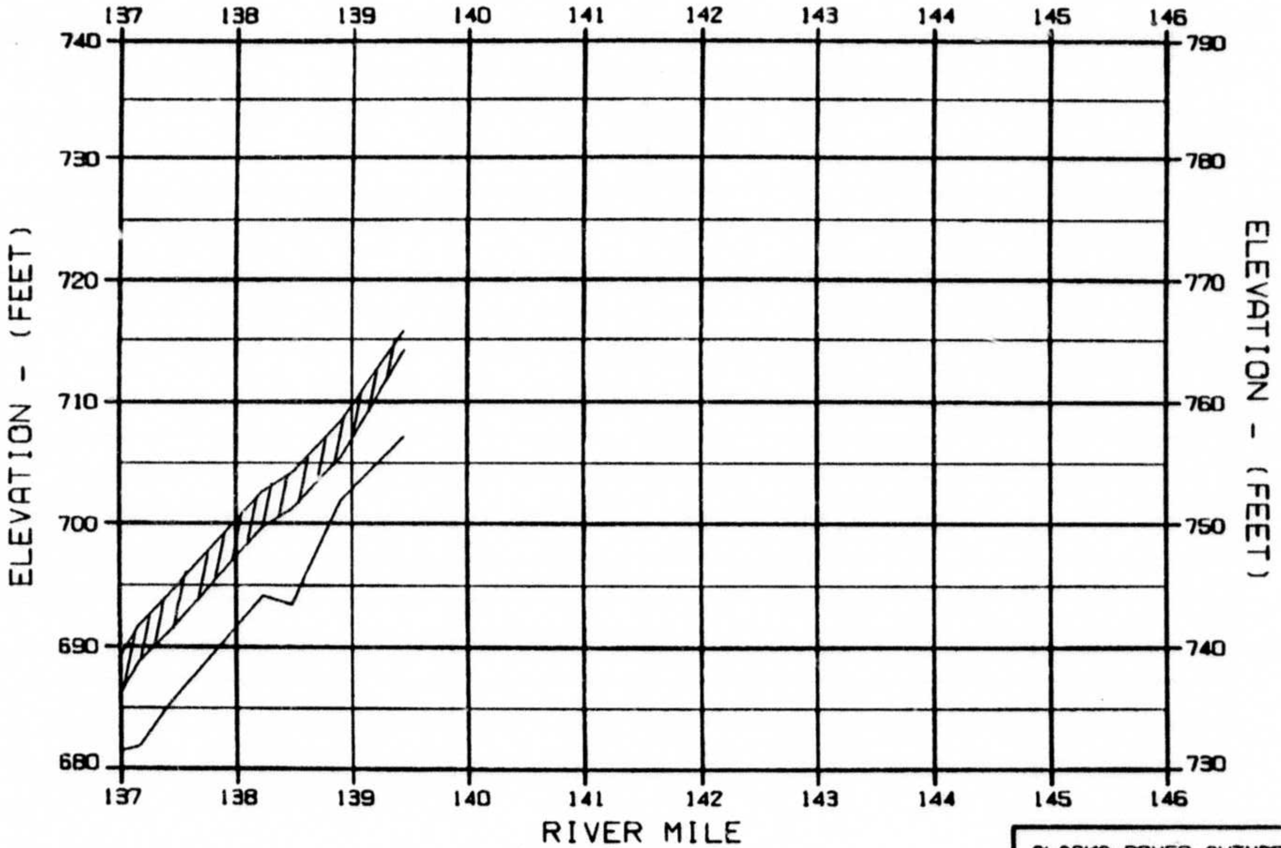
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

OPTION?

CC


128
129
130
131
132
133
134
135
136
137
640
630
620
610
600
590
580
690
680
670
660
650
640
630
ELEVATION - (FEET)
ELEVATION - (FEET)
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
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

CC



LEGEND:

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

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE818

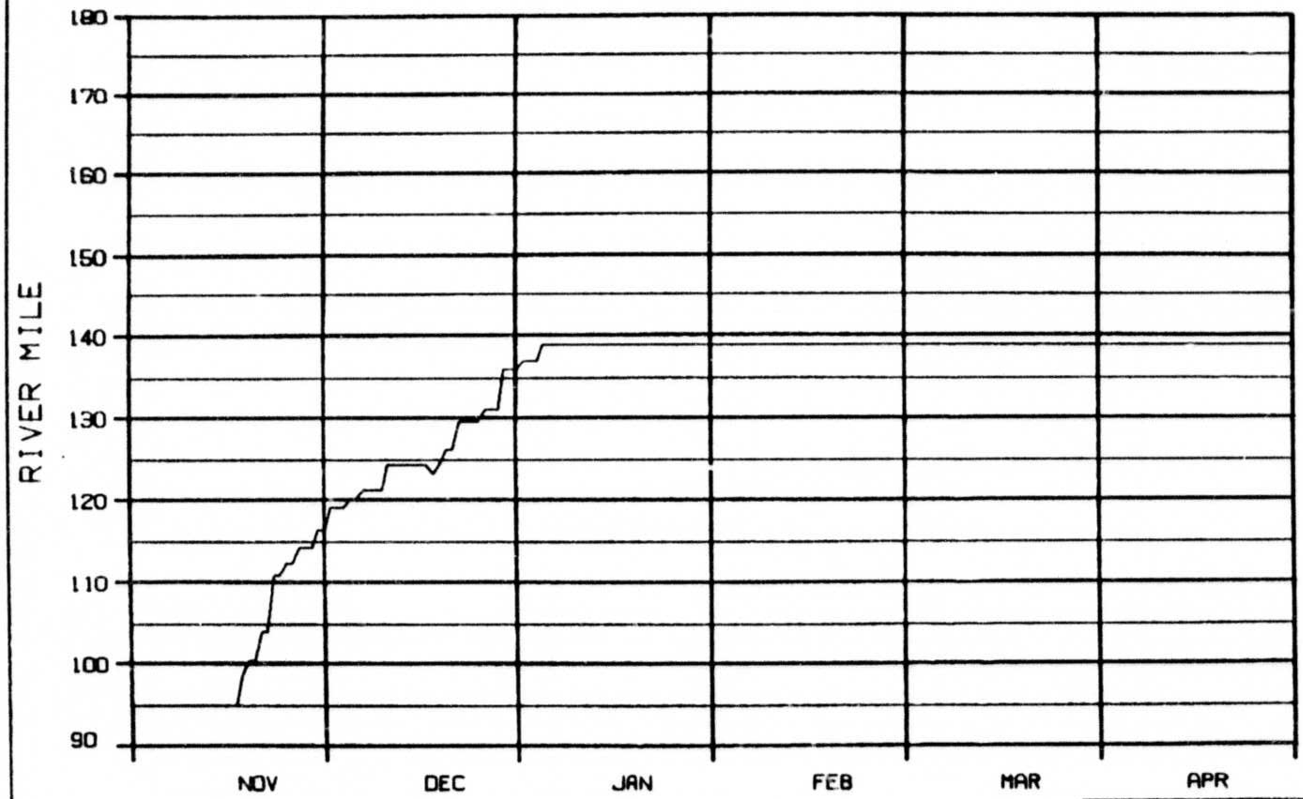
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

OPTION?



LEGEND:

ICE FRONT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

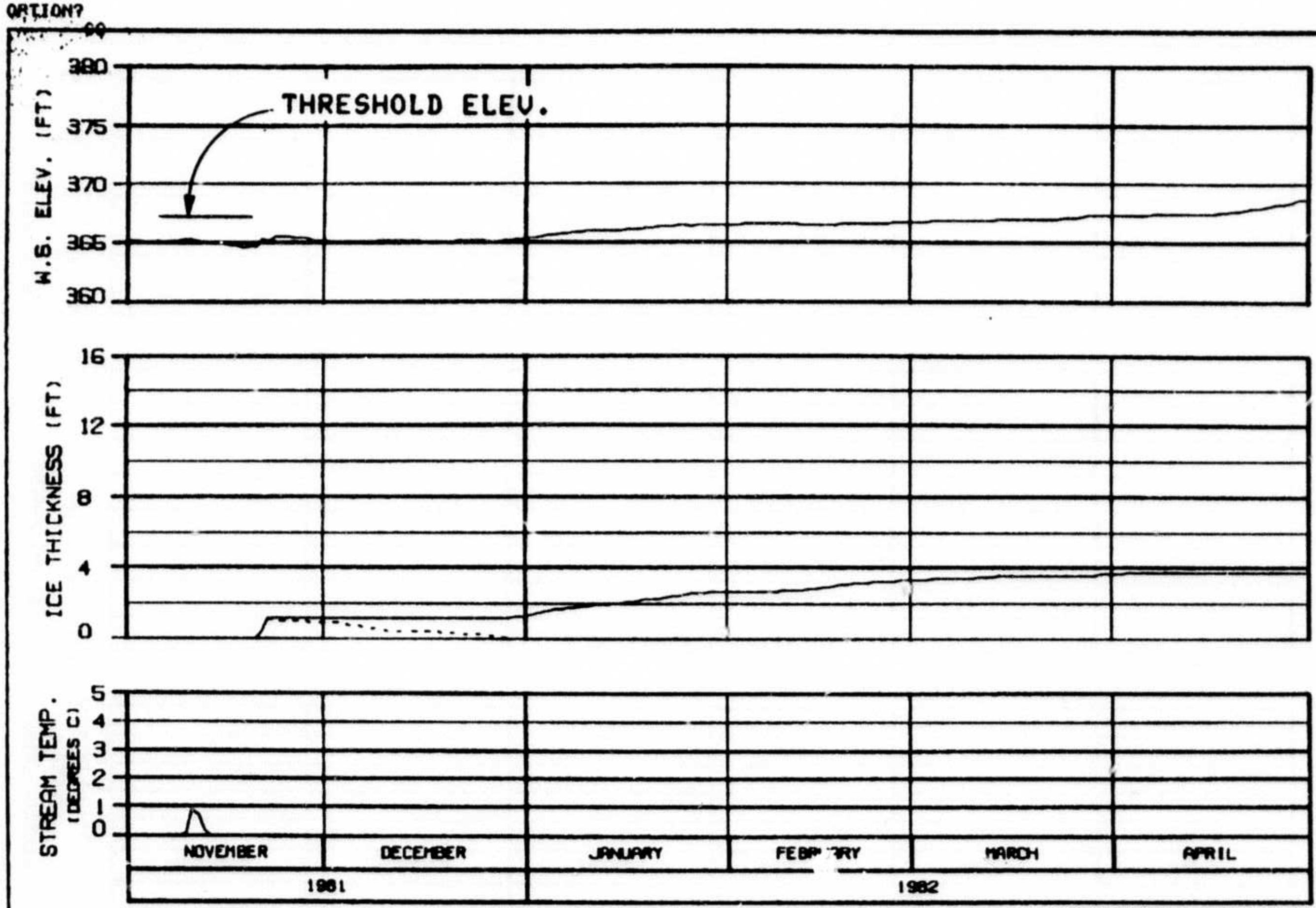
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM

HARZA-EBASCO JOINT VENTURE

OPTION?



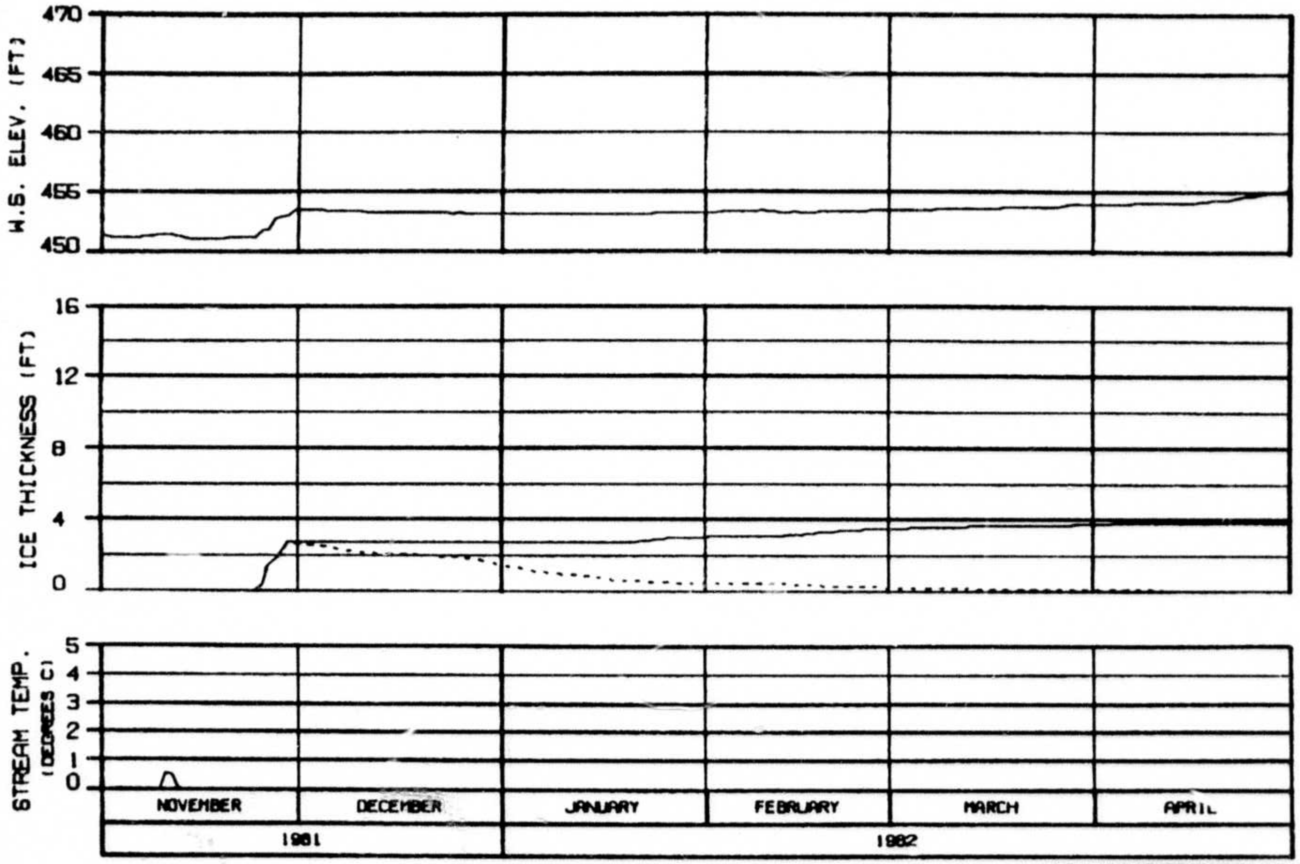
HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

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

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

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

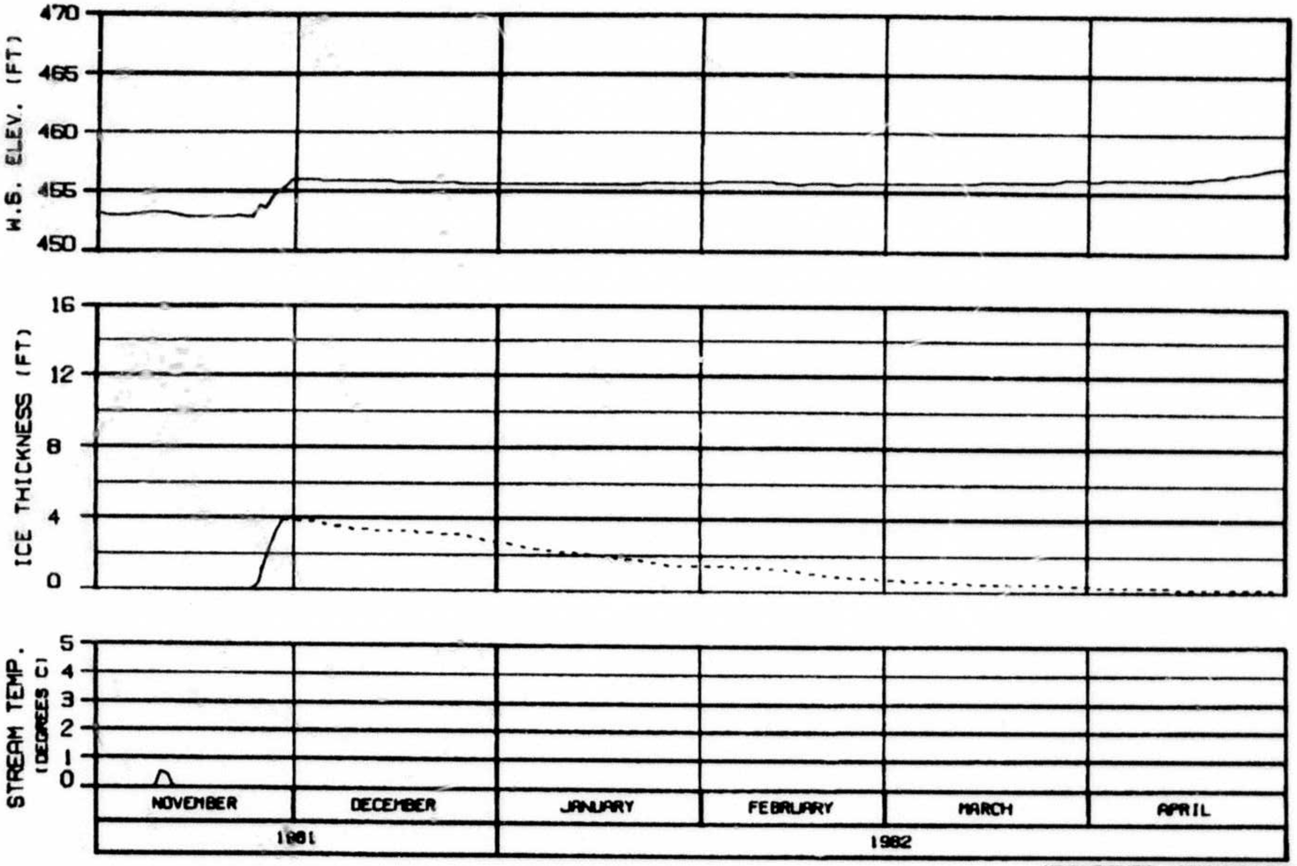
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



MOUTH OF SLOUGH 6A

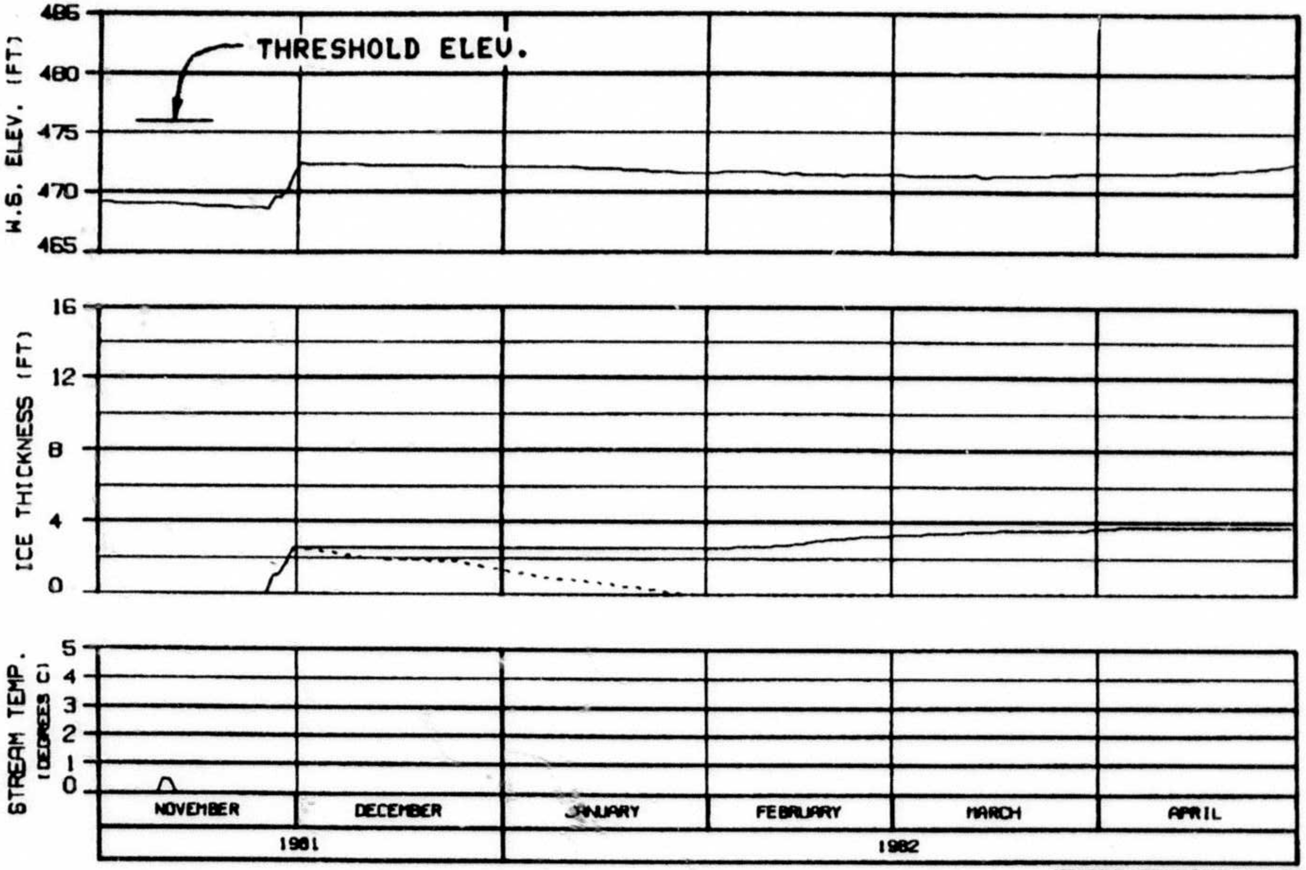
RIVER MILE : 112.34

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

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 8

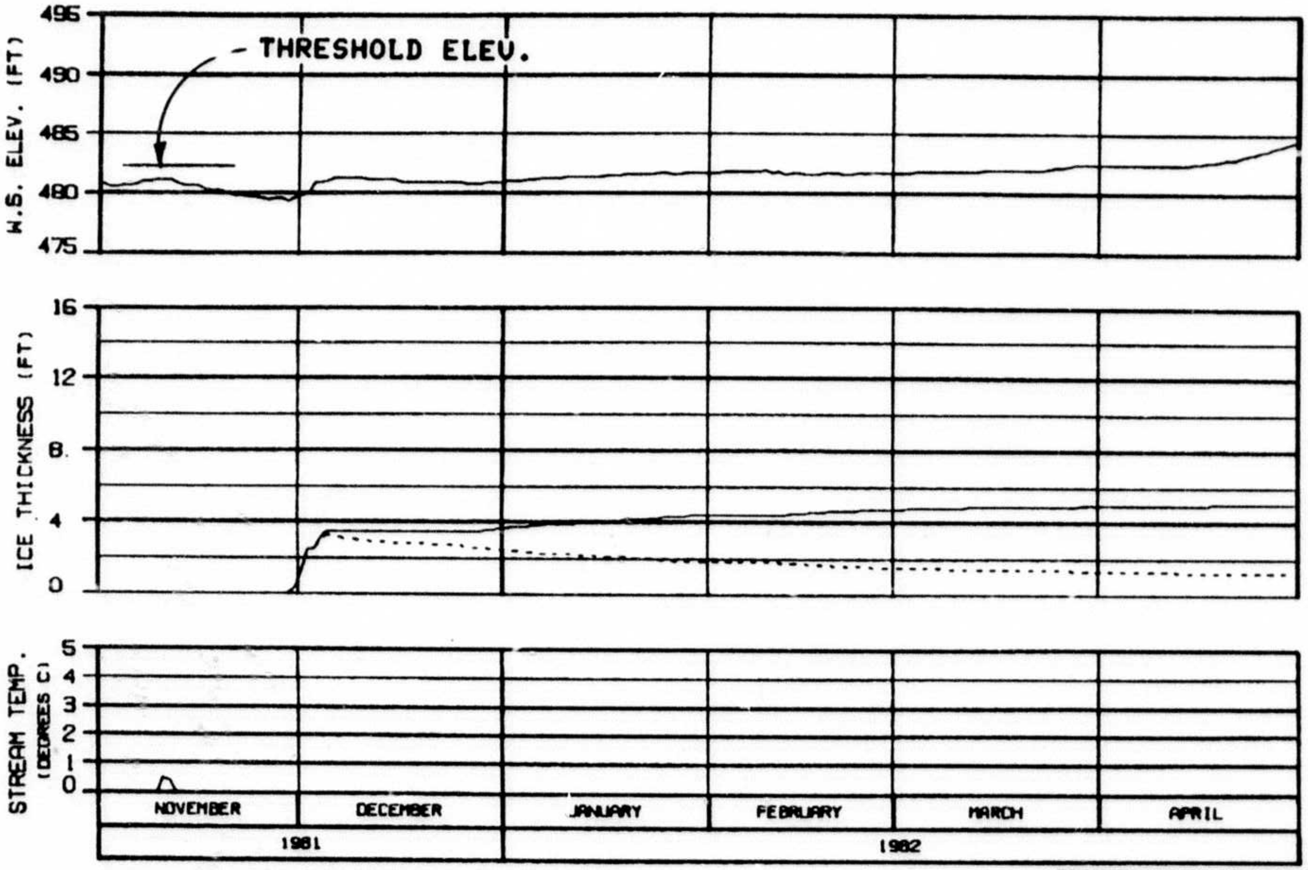
RIVER MILE : 114.10

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ICE THICKNESS LEGEND:

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

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



SIDE CHANNEL MSII

RIVER MILE : 115.50

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

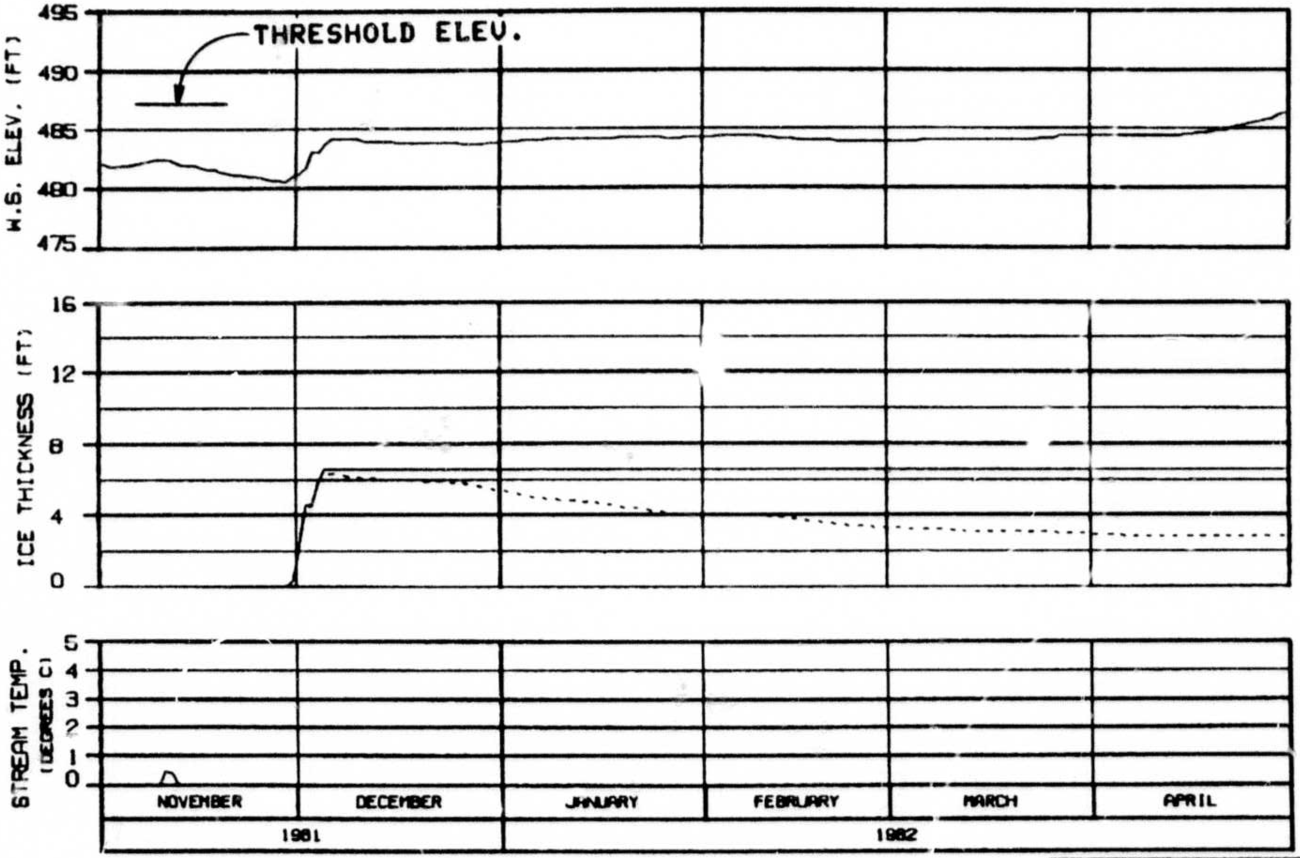
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SIDE CHANNEL MSII

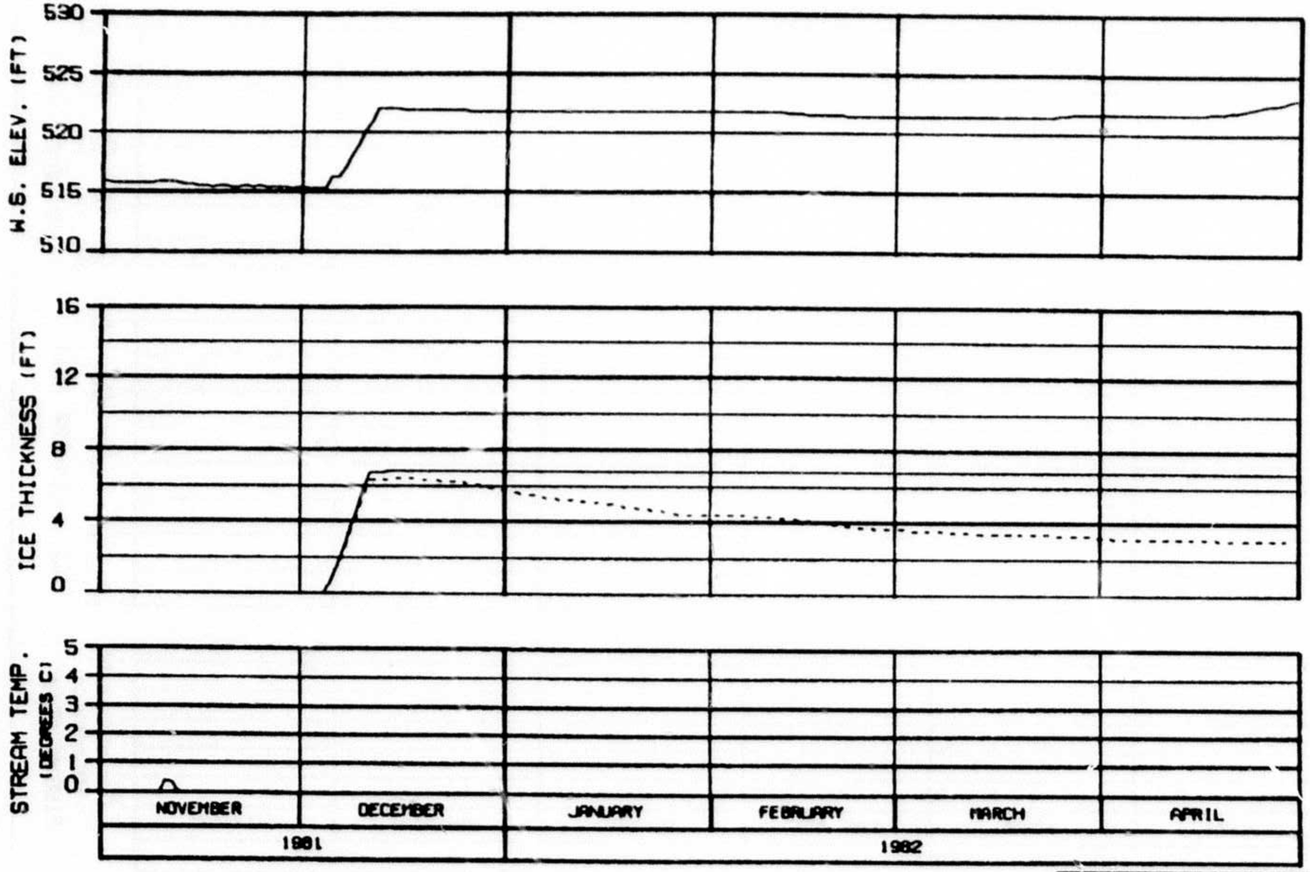
RIVER MILE : 115.90

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ICE THICKNESS LEGEND:

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	[illegible]	1000.142



RIVER MILE : 120.00

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

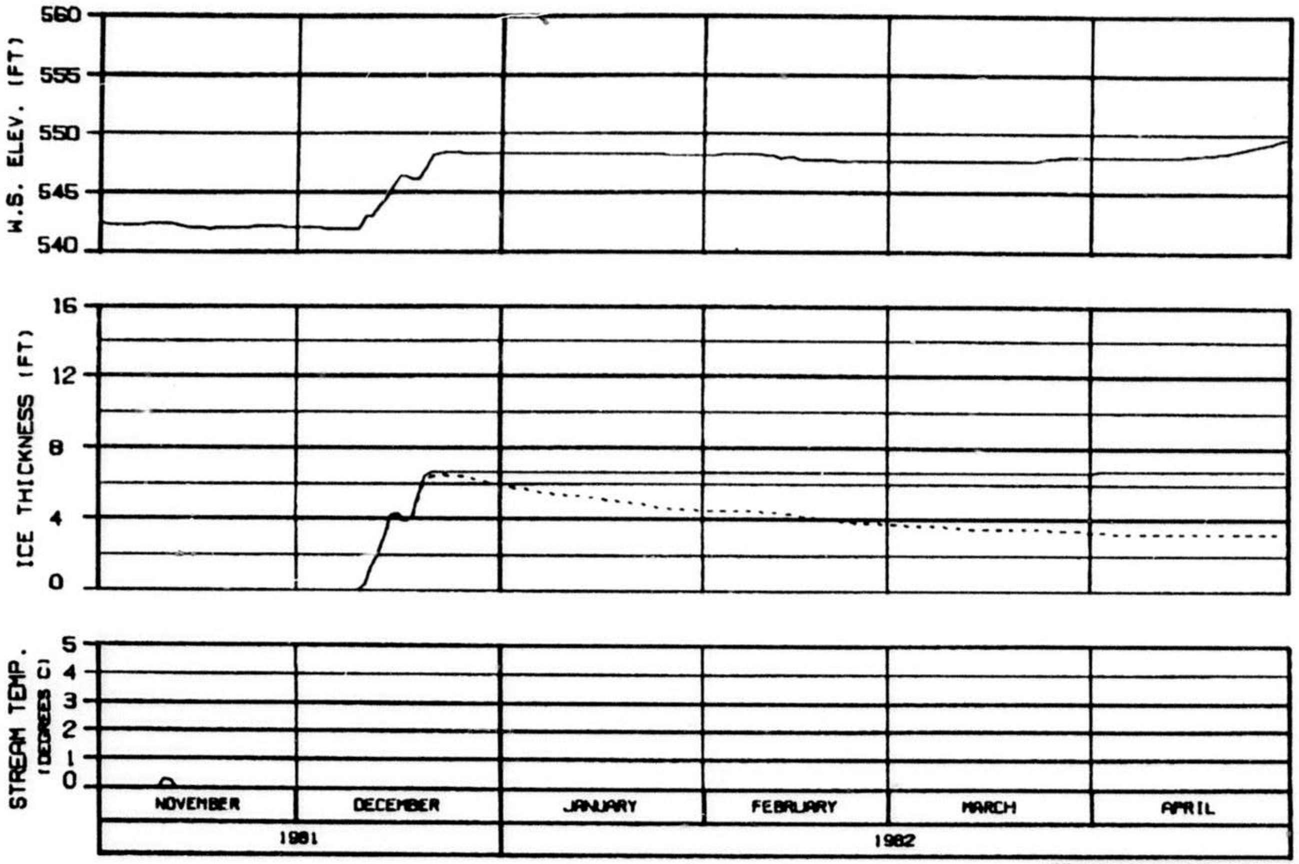
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible]



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

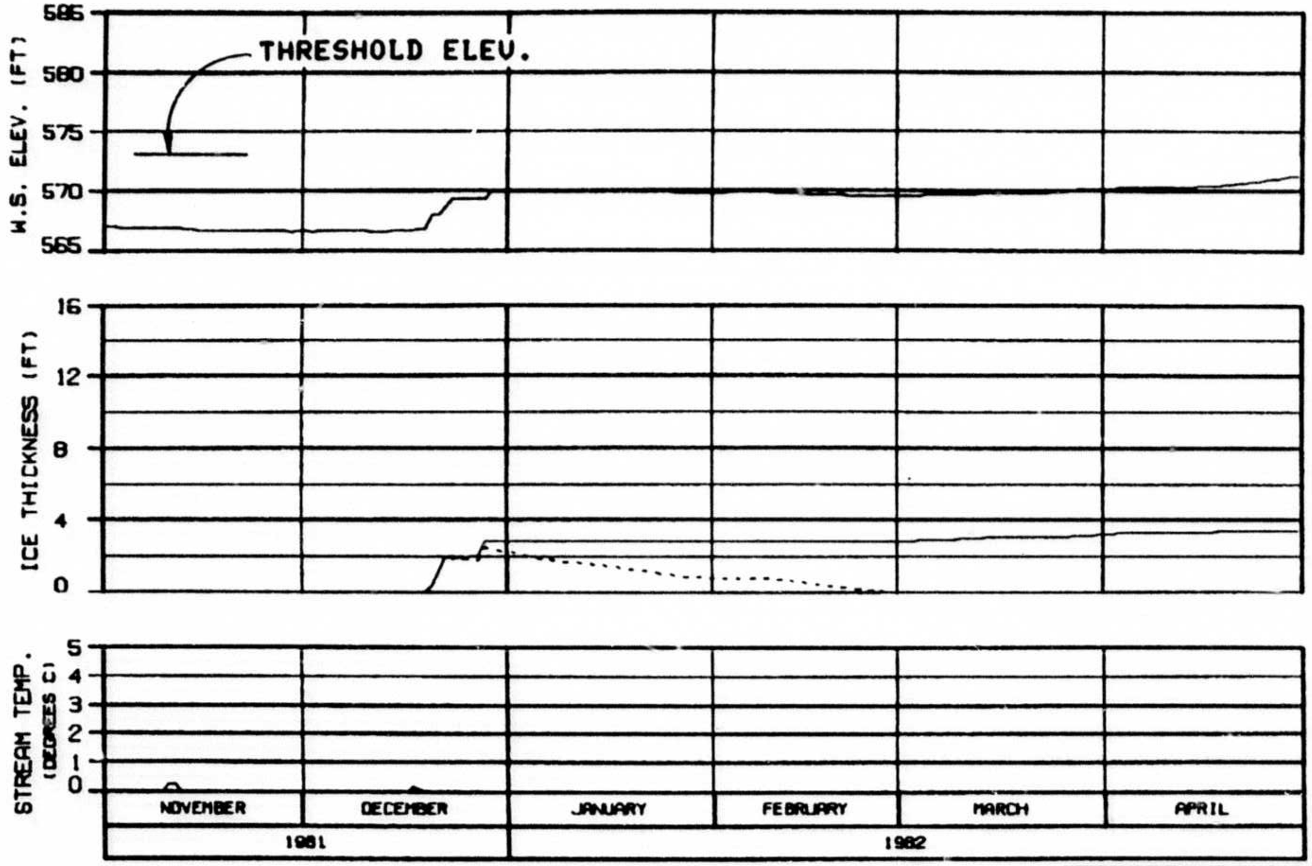
ICE THICKNESS LEGEND:
———— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8A (WEST)

RIVER MILE : 126.10

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ICE THICKNESS LEGEND:

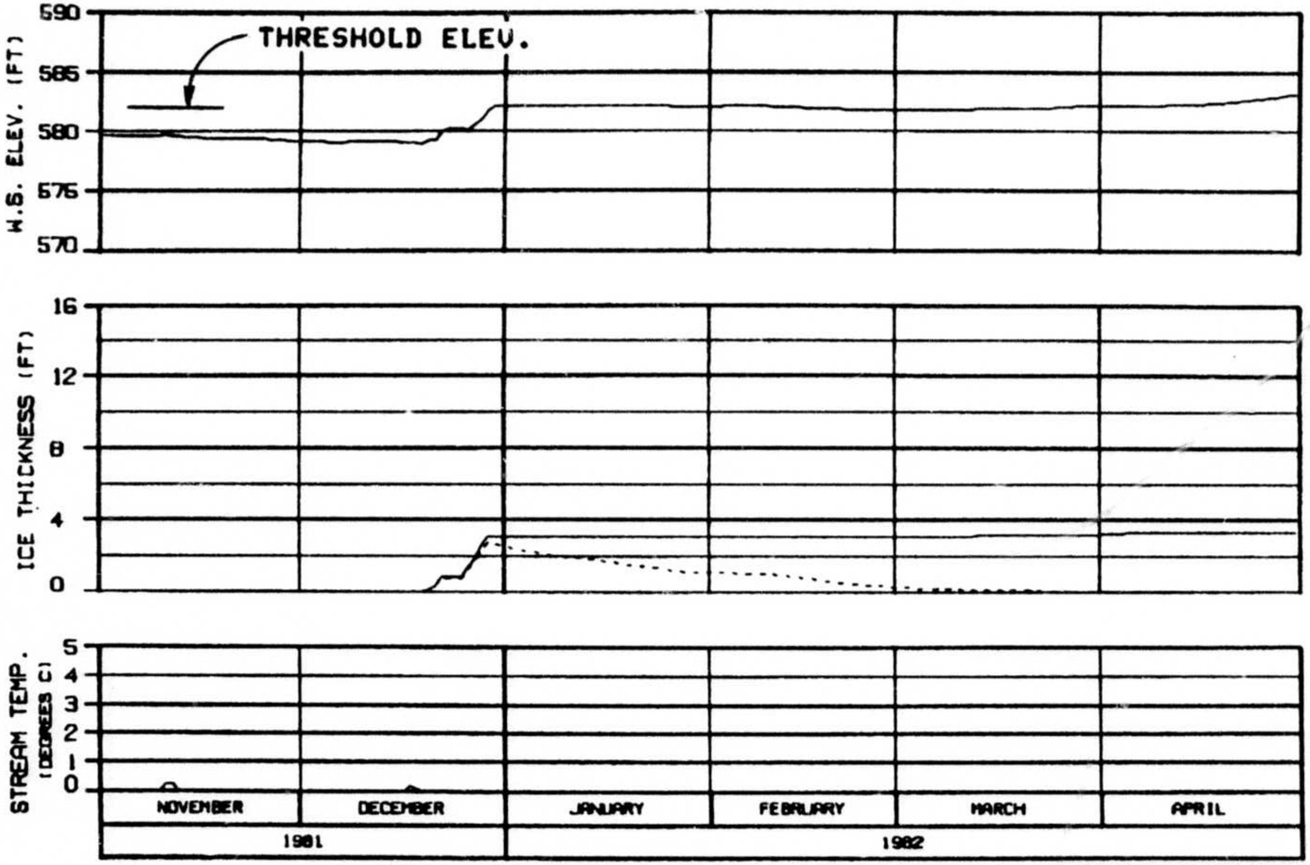
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8A (EAST)

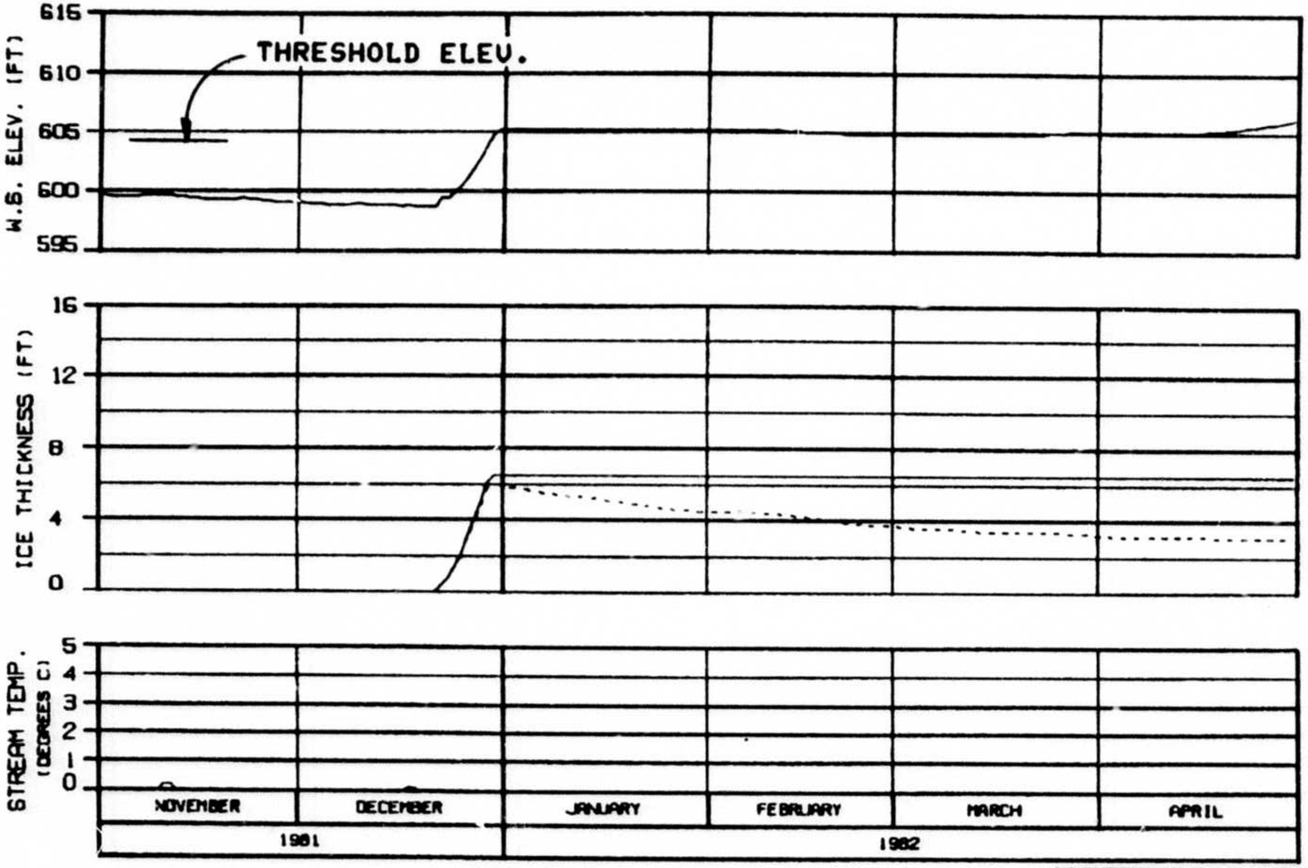
RIVER MILE : 127.10

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

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
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE818

ICE THICKNESS LEGEND:

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

OPTION?

ALASKA POWER AUTHORITY

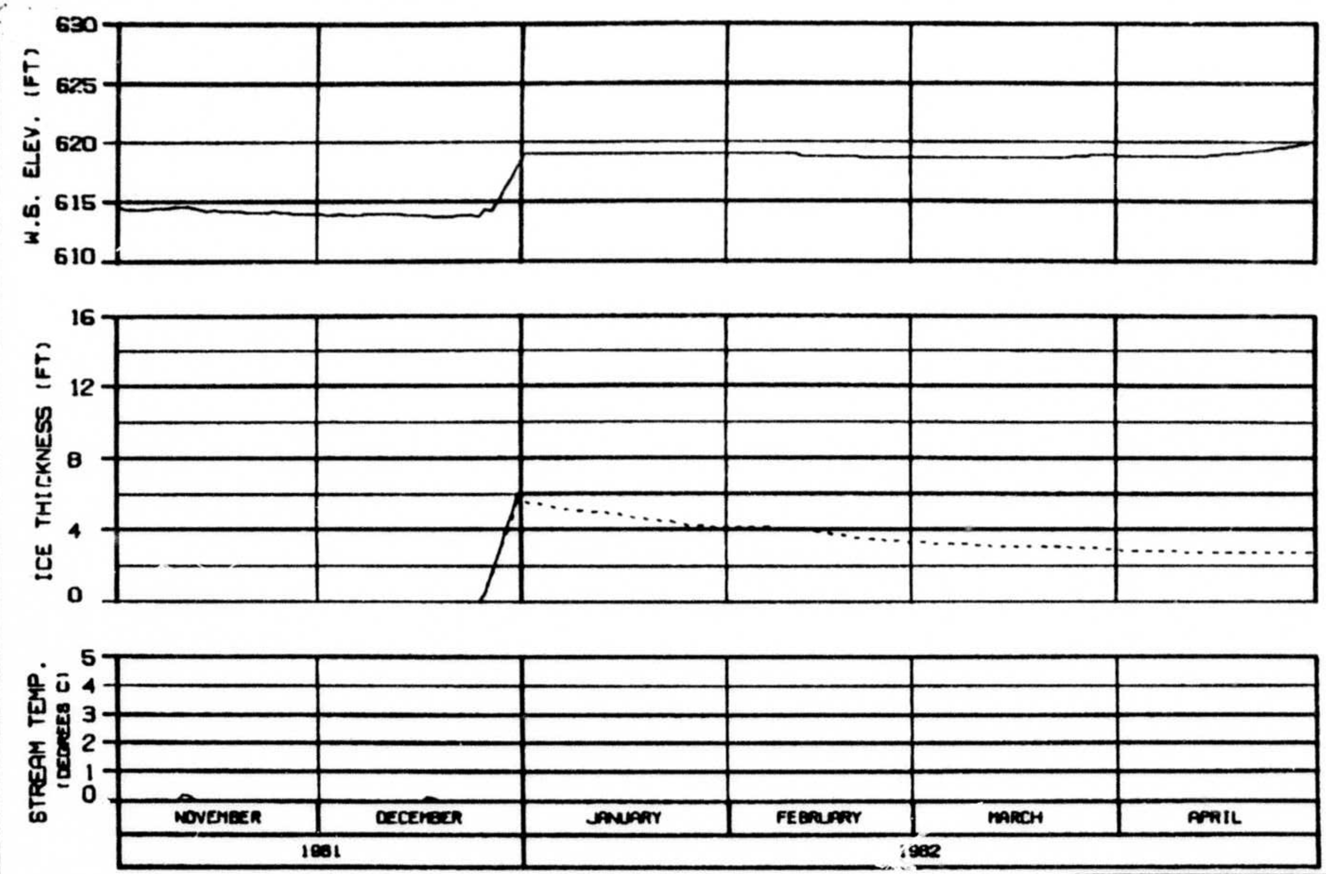
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | [illegible] SEP 84 | [illegible].142

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

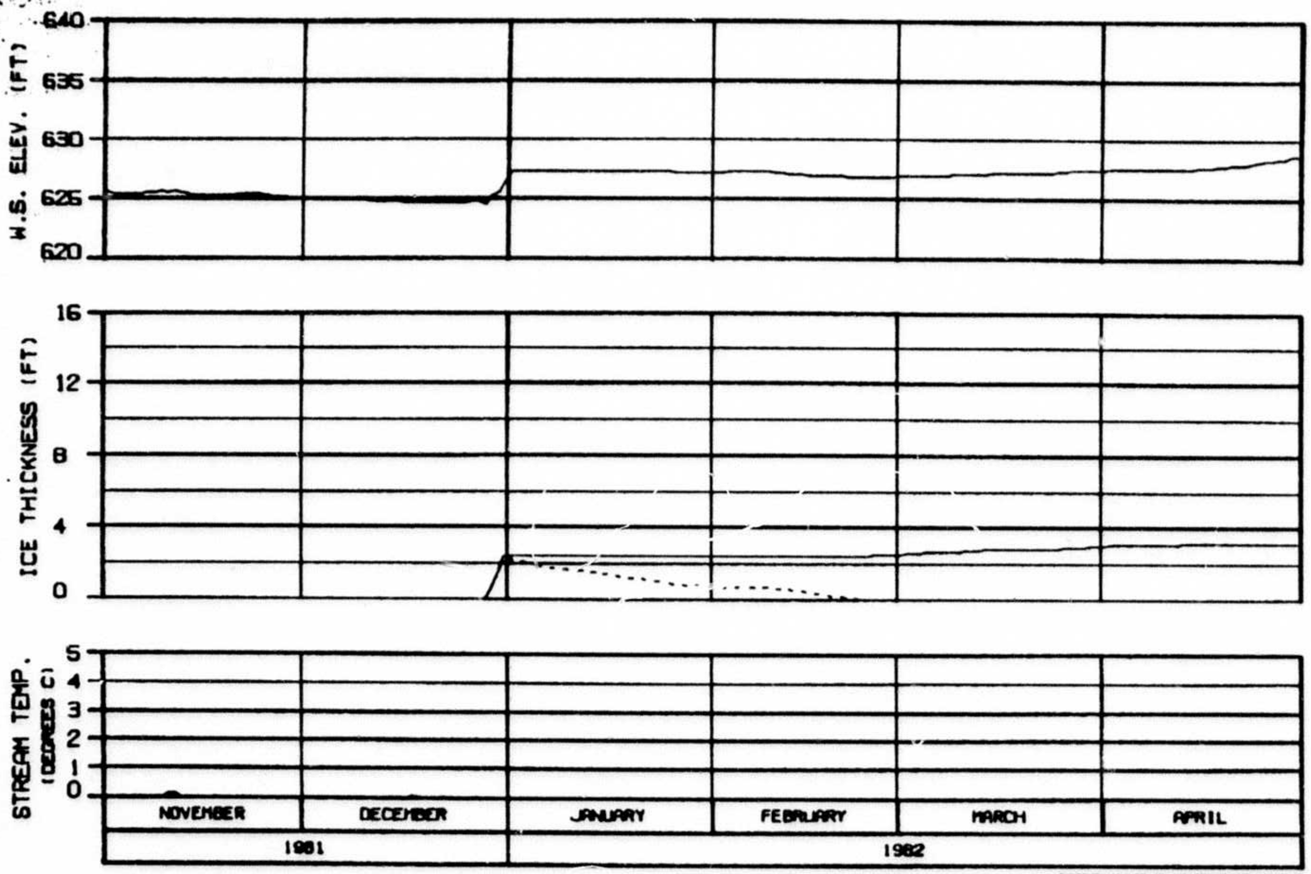
RIVER MILE : 130.60

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ICE THICKNESS LEGEND:

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS | 5 SEP 84 | 1530.142	



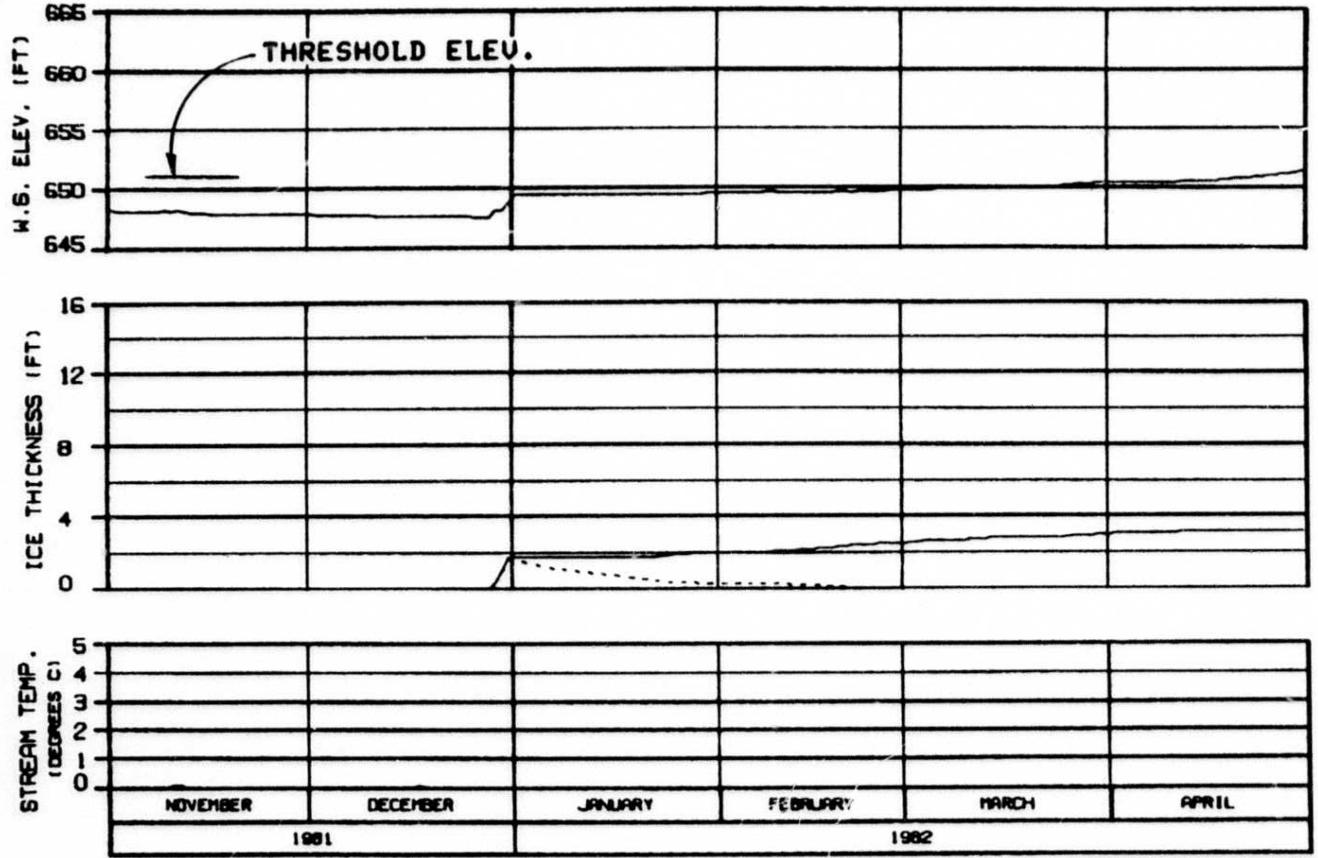
SIDE CHANNEL U/S OF 4TH JULY CREEK

RIVER MILE : 131.80

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

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	8 SEP 84	1808.142



ICE THICKNESS LEGEND:

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

HEAD OF SLOUGH 9A

RIVER MILE : 133.70

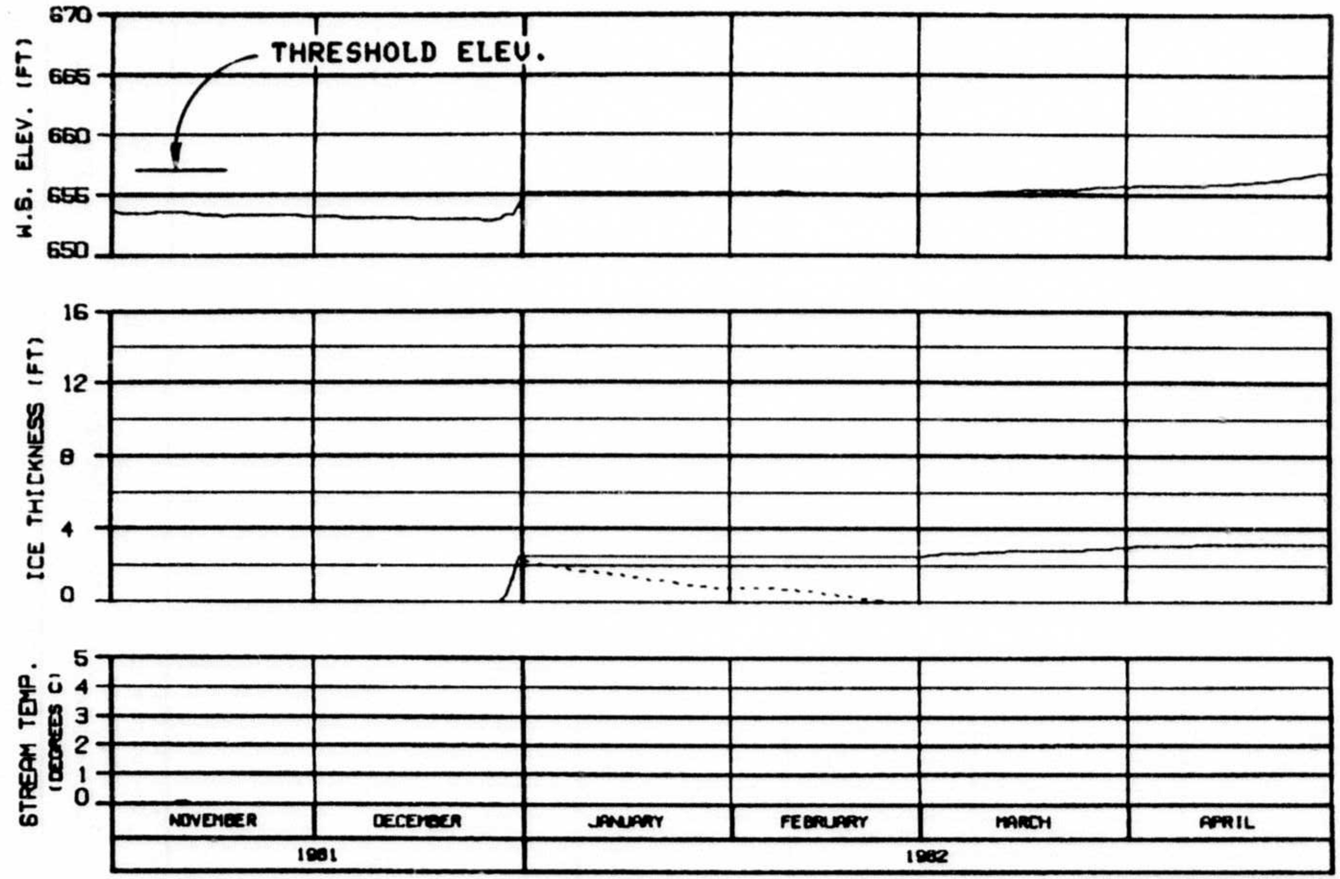
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

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
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

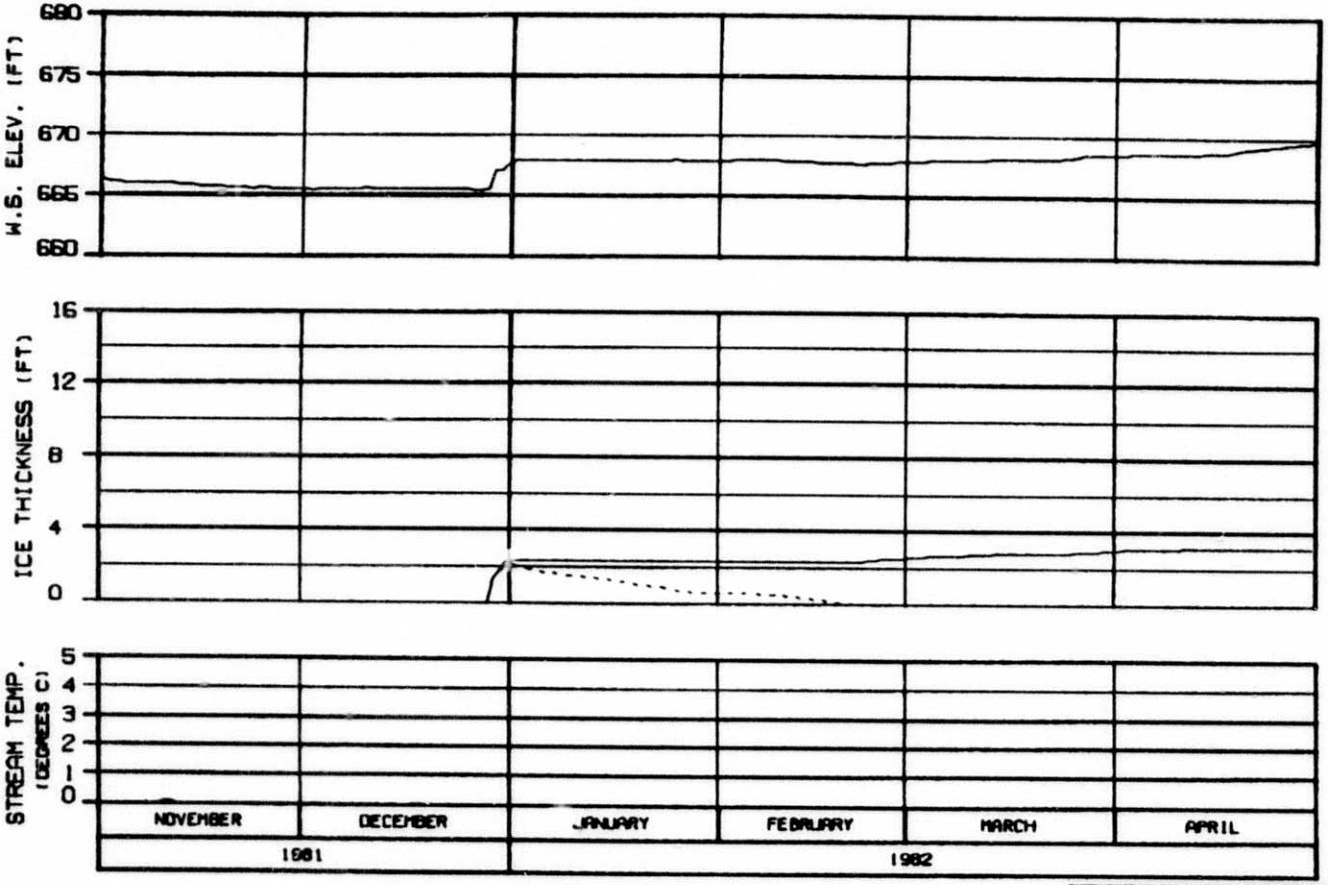
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

.142



SIDE CHANNEL D/S OF SLOUGH 11

RIVER MILE : 135.30

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ICE THICKNESS LEGEND:

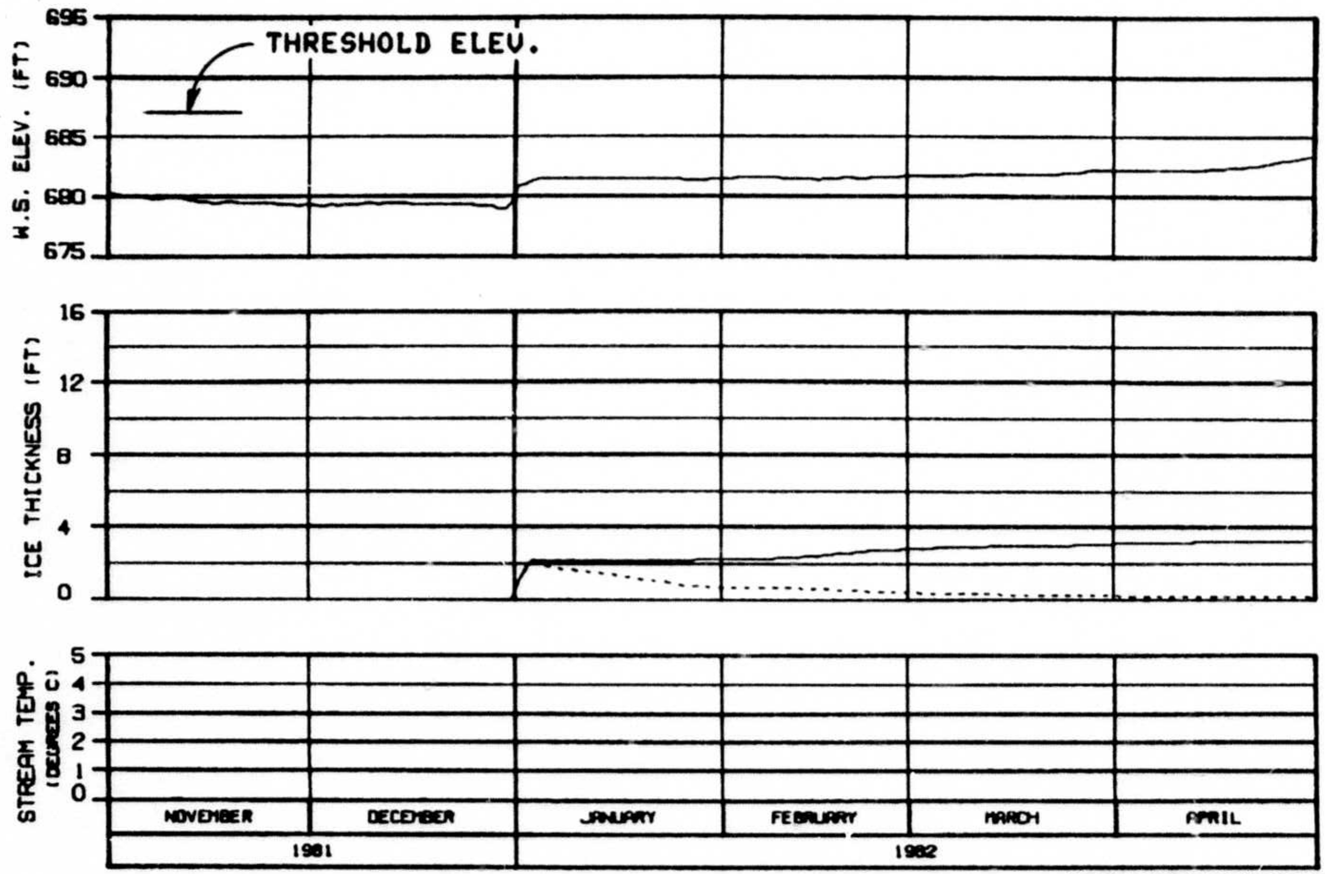
——— TOTAL THICKNESS
- - - - - SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 11

RIVER MILE : 136.50

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE81B

ICE THICKNESS LEGEND:

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

ALASKA POWER AUTHORITY

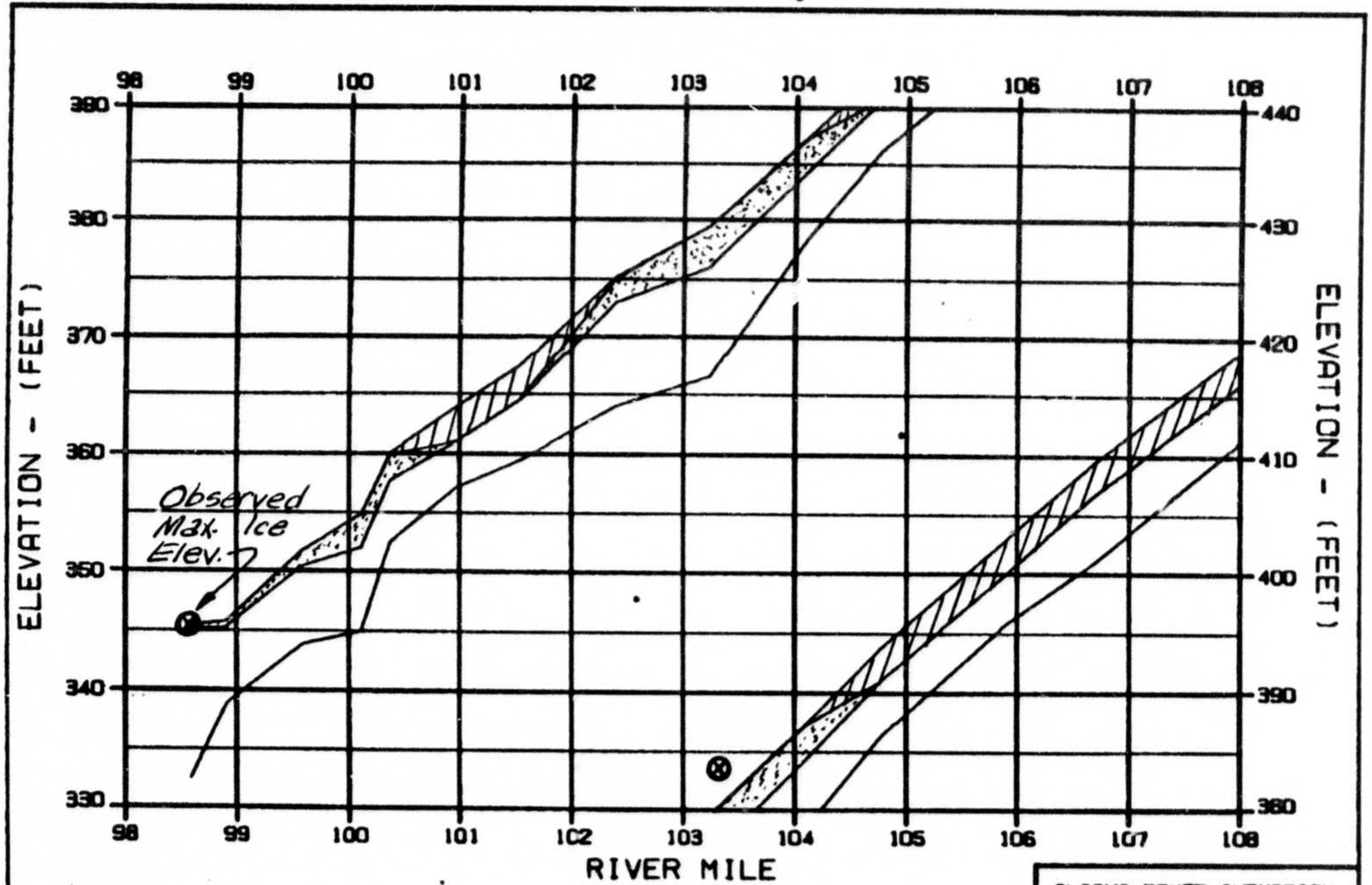
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

EXHIBIT D

c



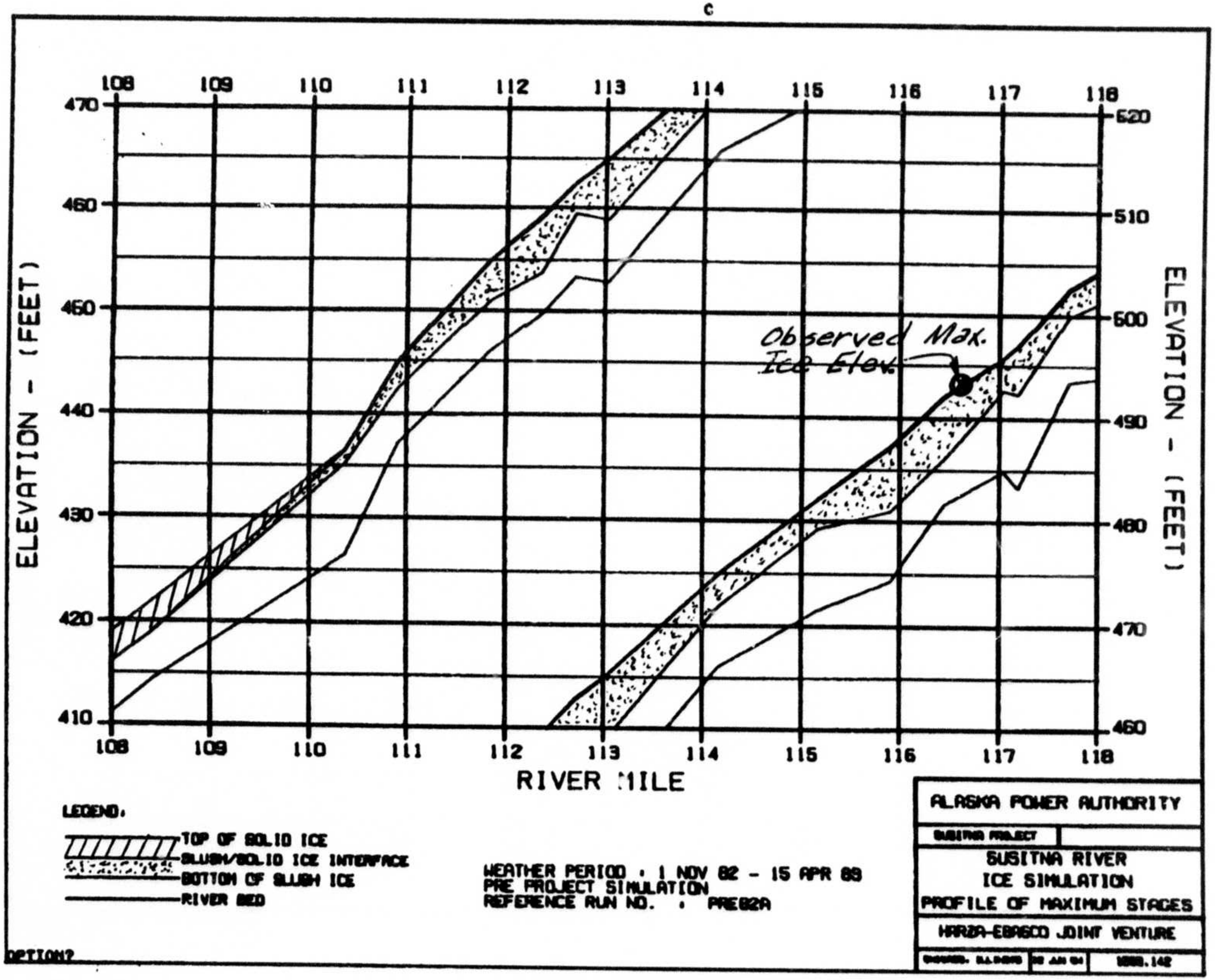
LEGEND:

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

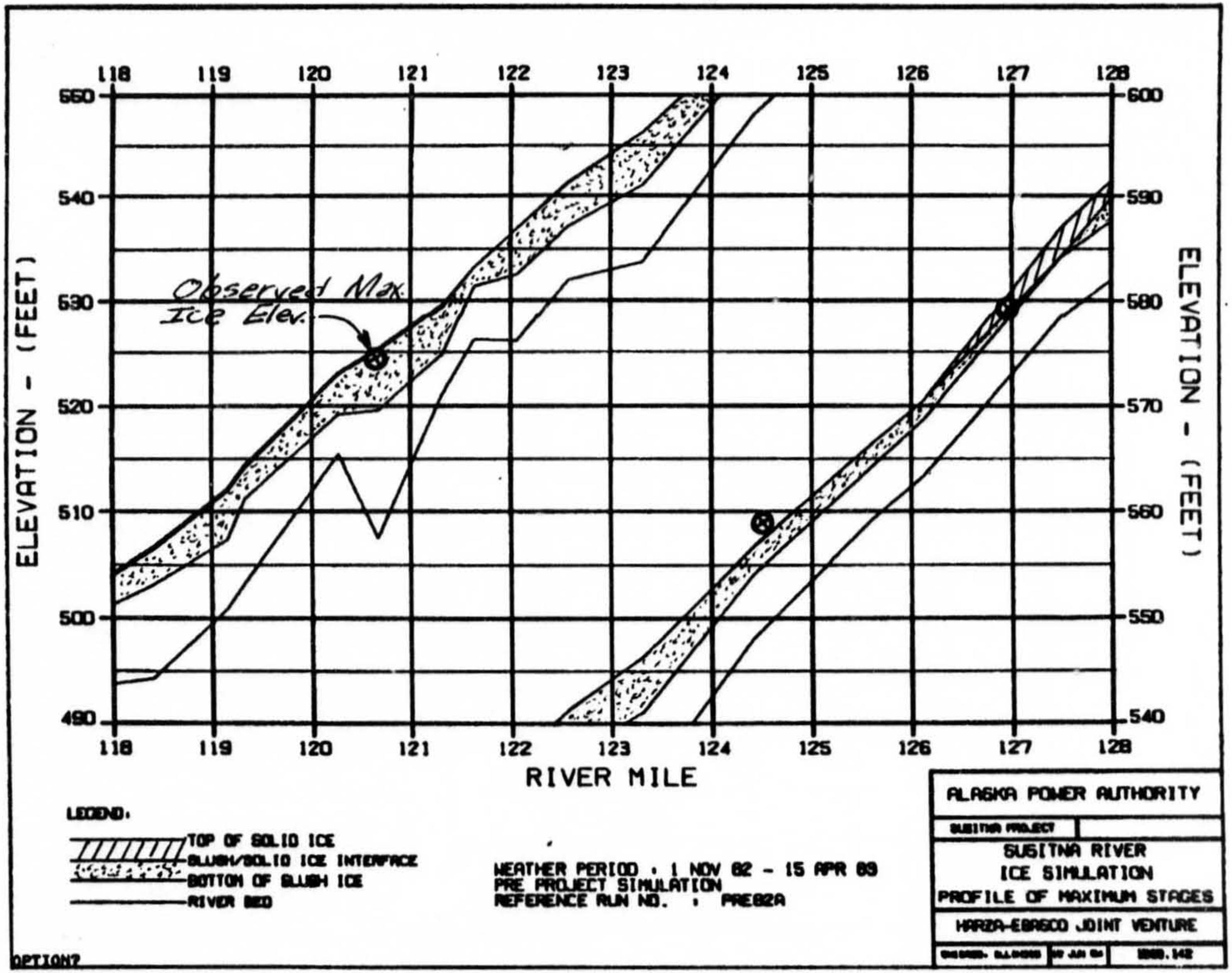
WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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

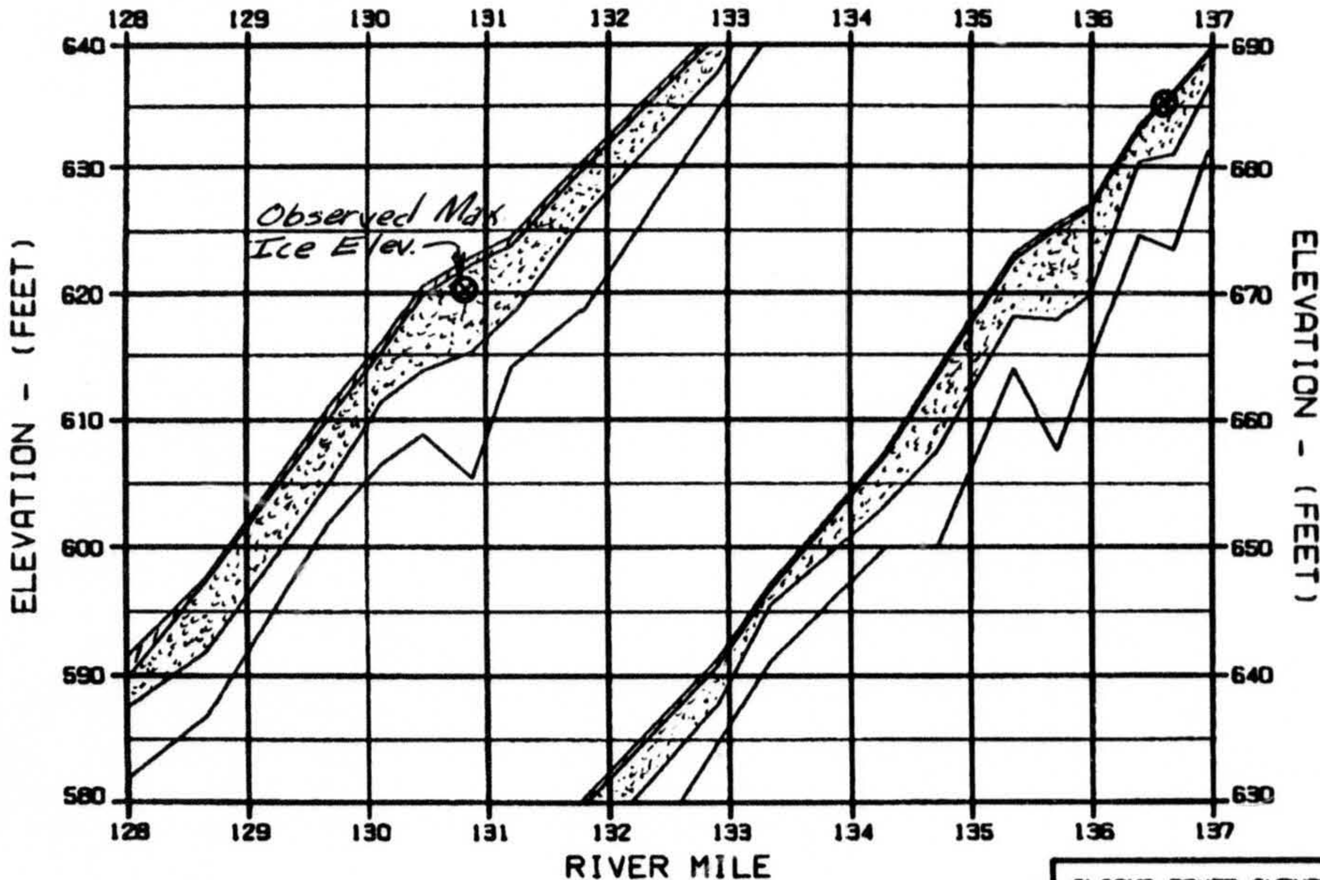
OPTION?



ELEVATION - (FEET)
470
460
450
440
430
420
410
108
109
110
111
112
113
114
115
116
117
118
620
510
500
490
480
470
460
RIVER MILE
Observed Max. Ice Elev.
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?


Observed Max Ice Elev.
ELEVATION - (FEET)
RIVER MILE
118 119 120 121 122 123 124 125 126 127 128
490 500 510 520 530 540 550
540 550 560 570 580 590 600
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

c



LEGEND:

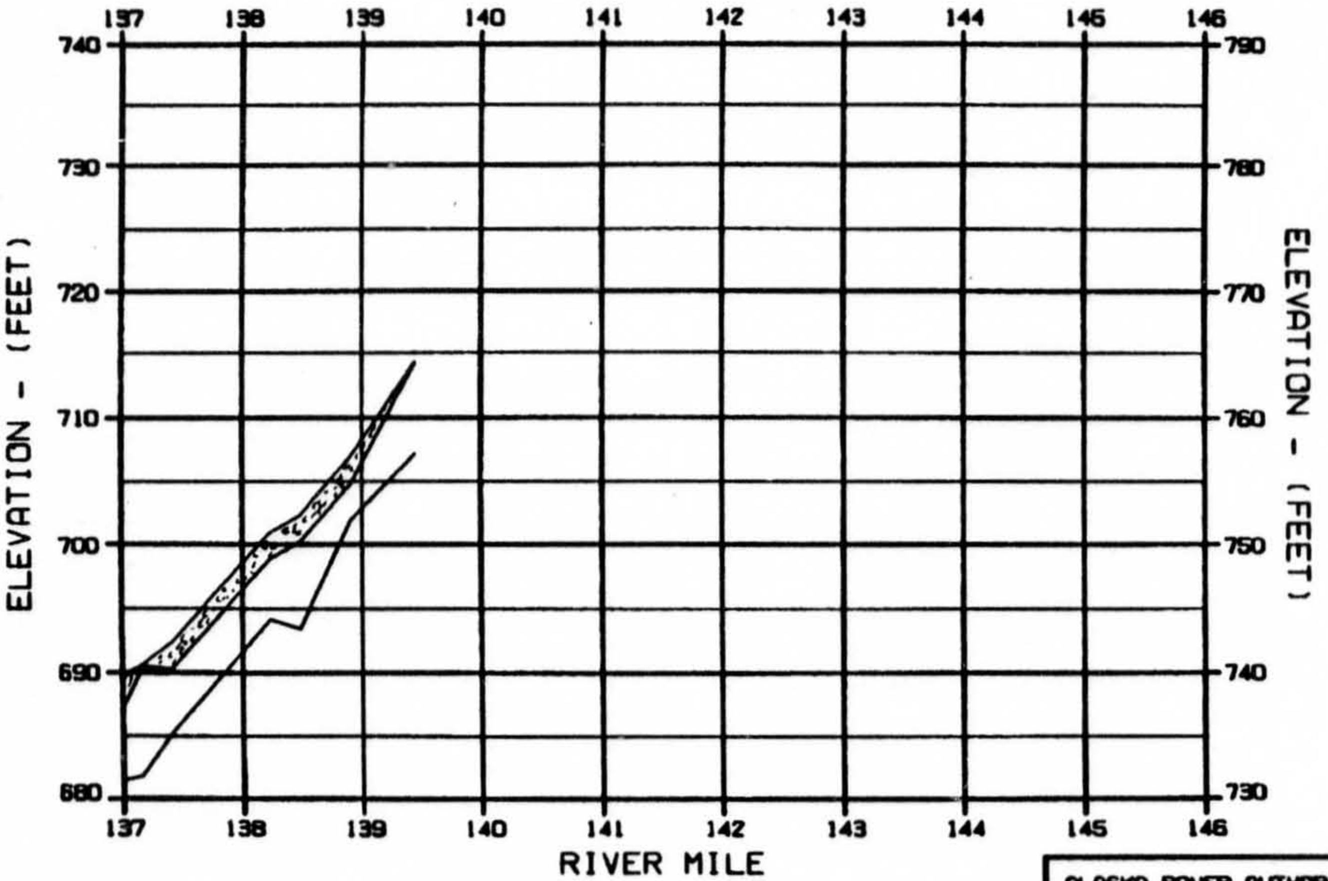
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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

OPTION?

c



LEGEND:

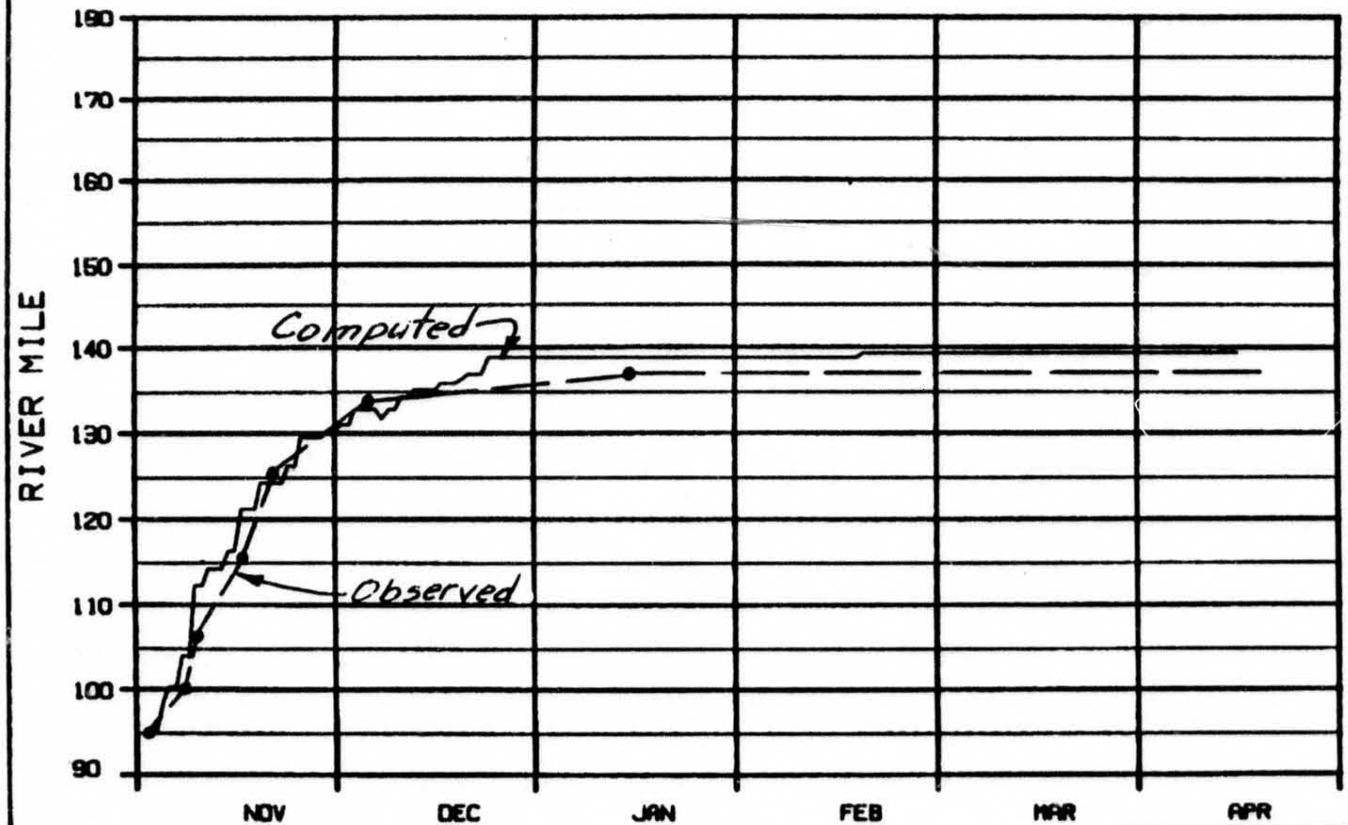
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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

OPTION?

c



LEGEND:

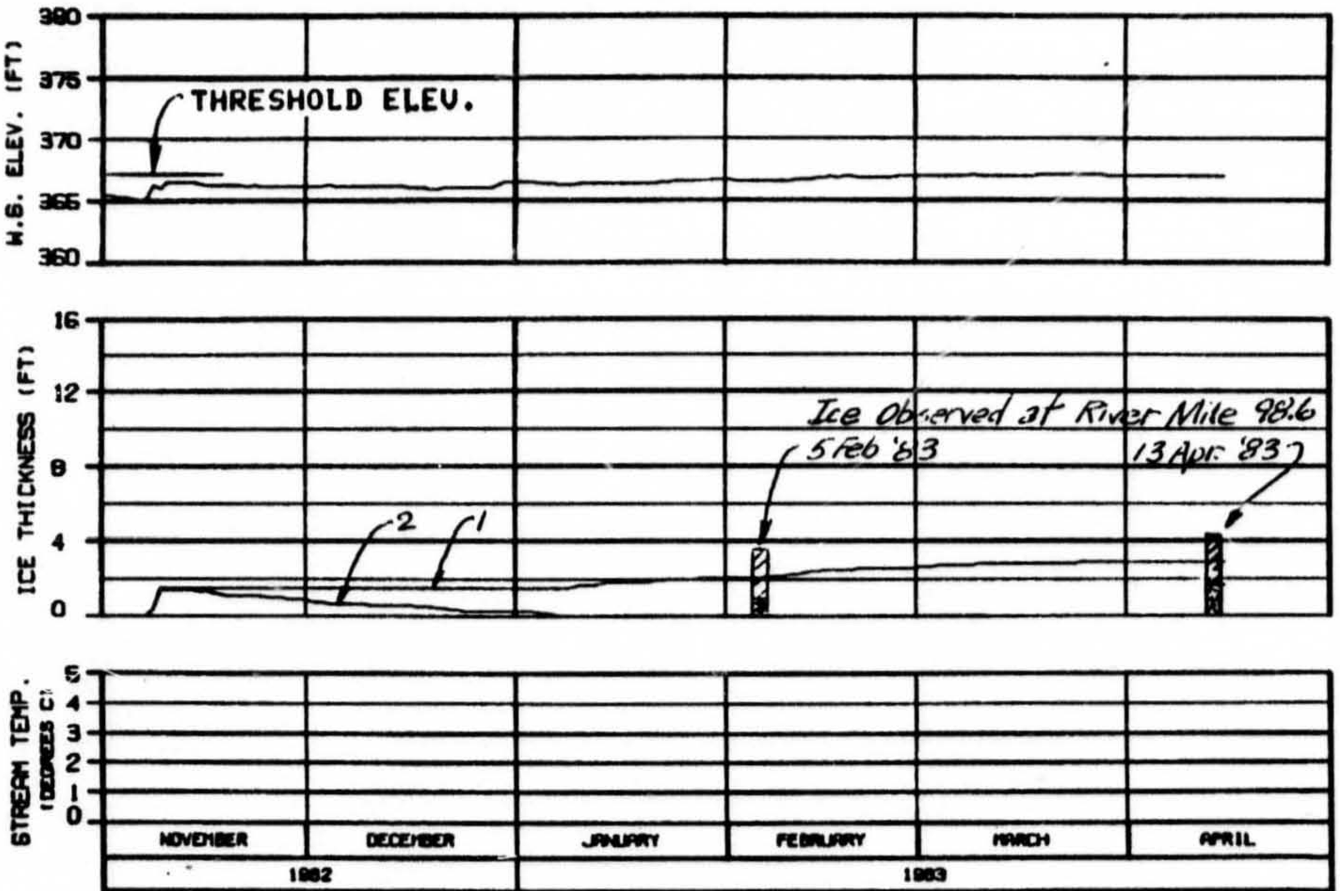
——— ICE FRONT

– – – – ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER PROGRESSION OF ICE FRONT & ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE

OPTION?



HEAD OF WHISKERS SLOUGH

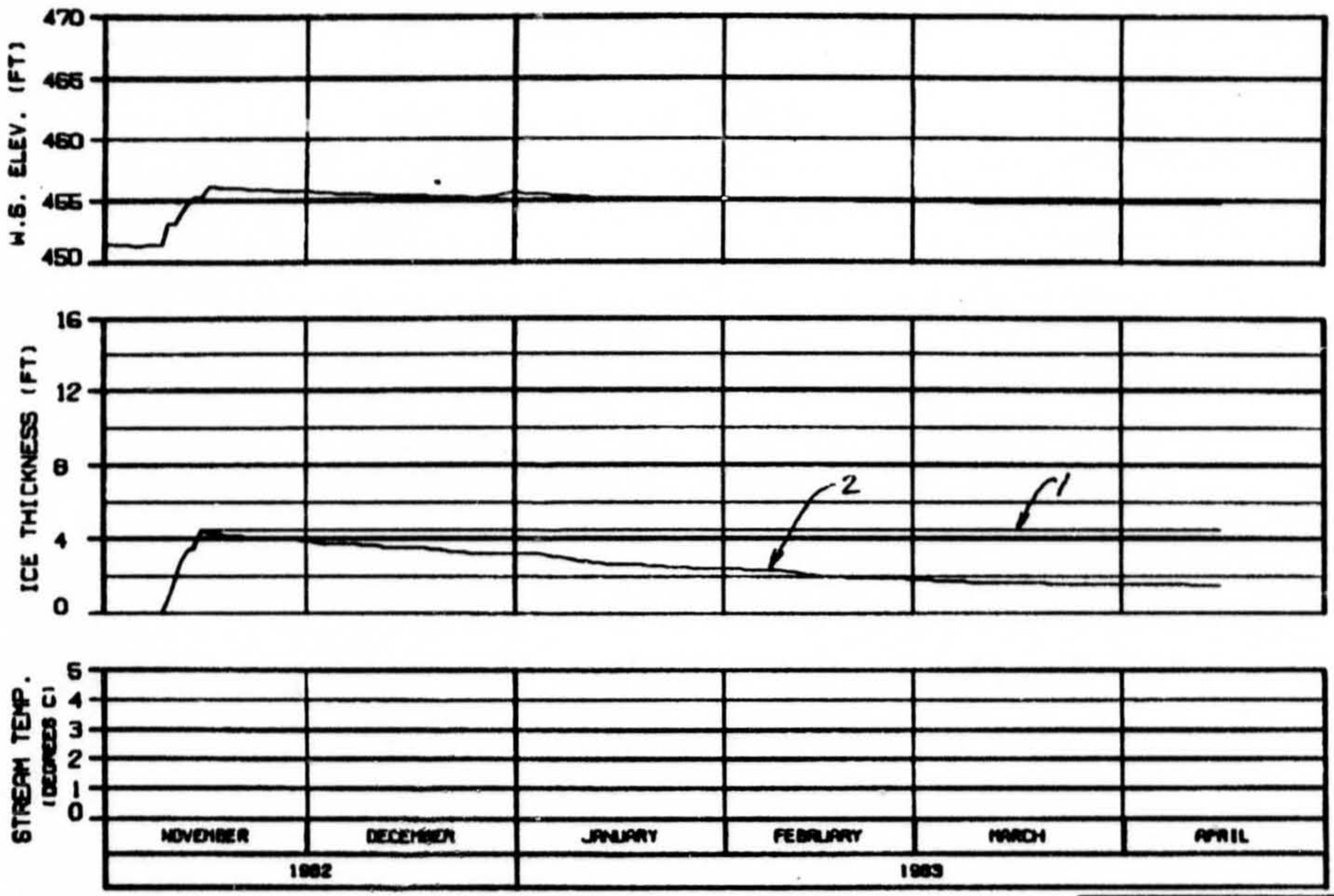
RIVER MILE : 101.50

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



SIDE CHANNEL AT HEAD OF GASH CREEK

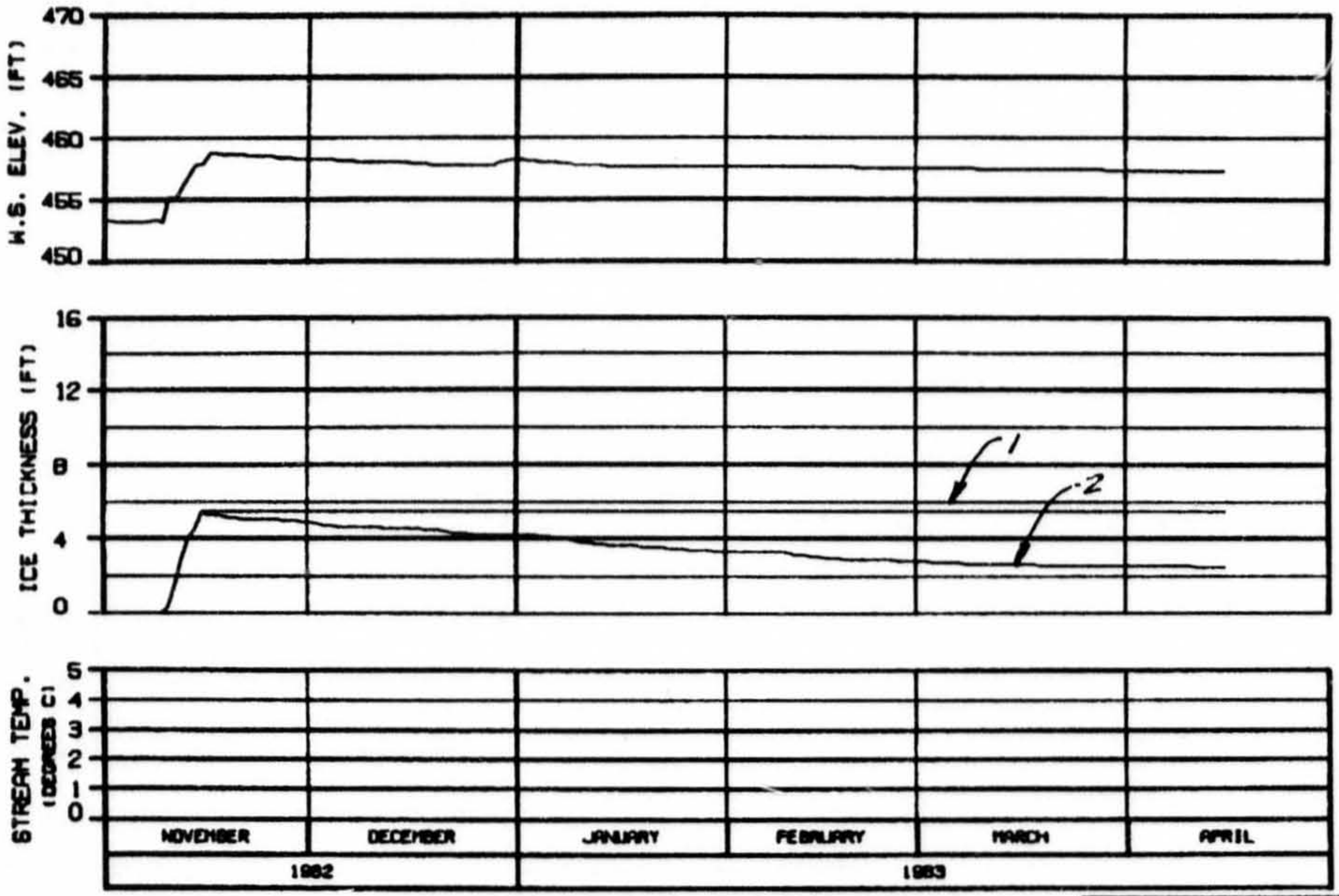
RIVER MILE : 112.00

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	14 JAN 84	[illegible].142



MOUTH OF SLOUGH 6A

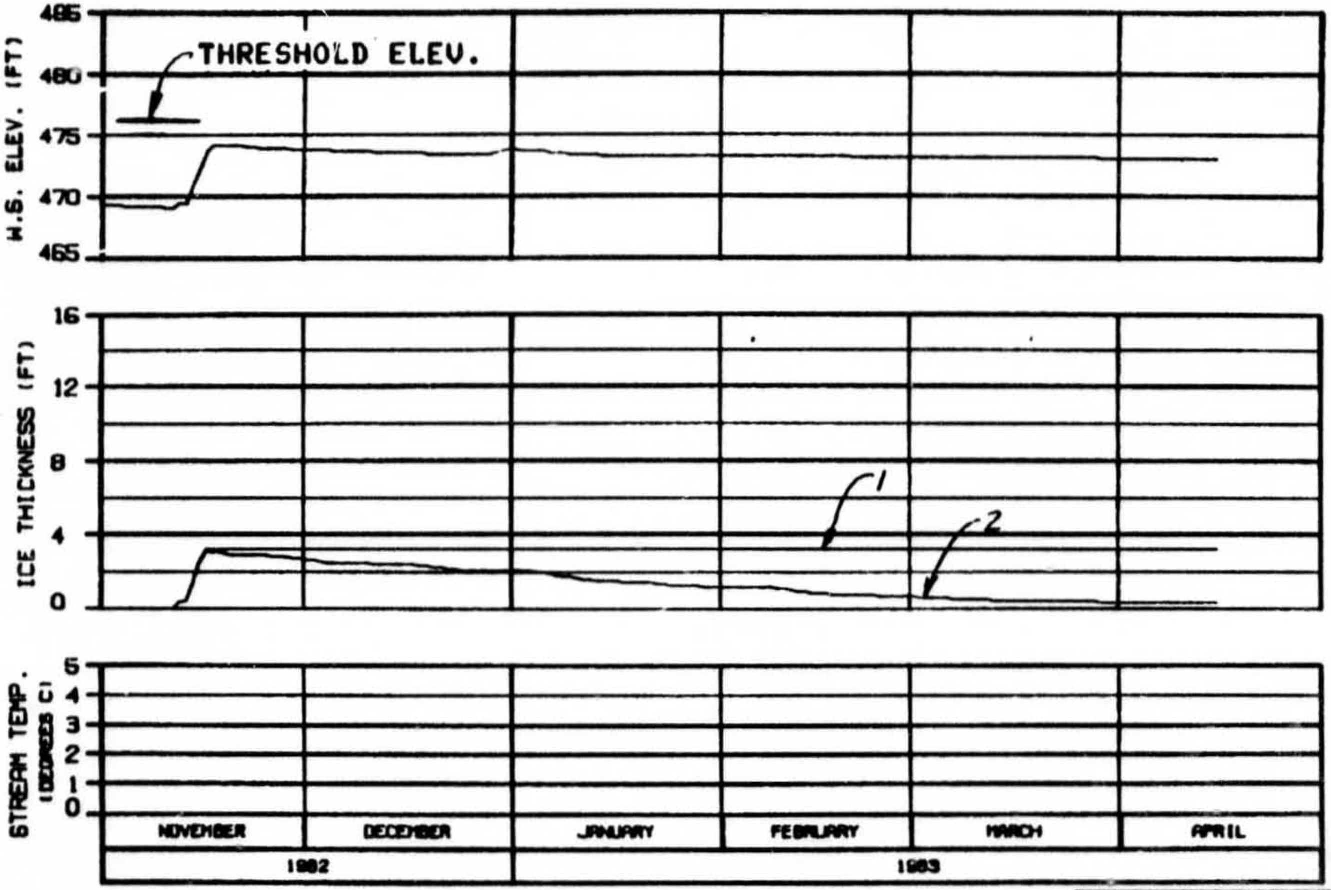
RIVER MILE : 112.34

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	14 JAN 84 · [illegible].142



HEAD OF SLOUGH 8

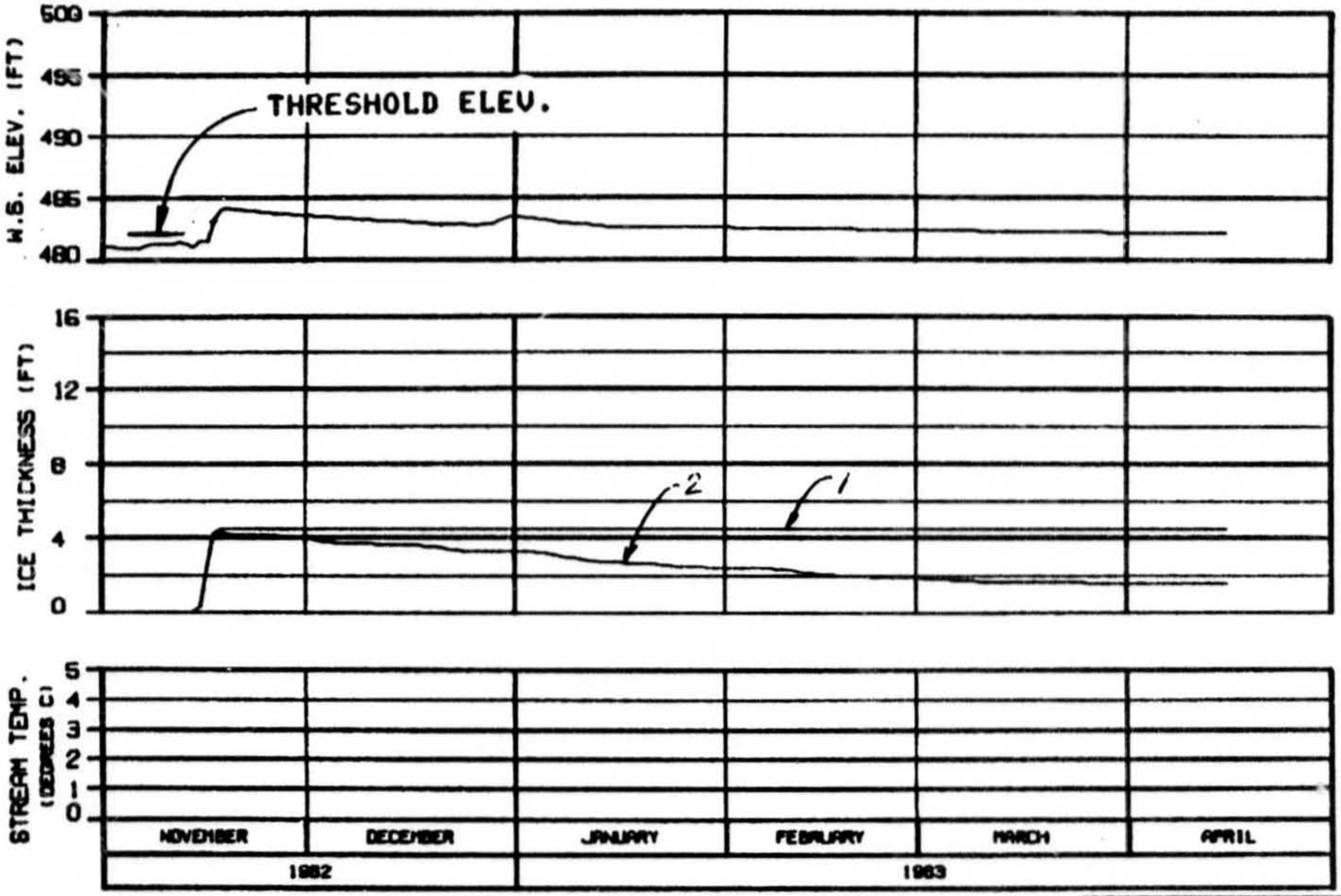
RIVER MILE : 114.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
[illegible]	14 JUN 84	[illegible].142



SIDE CHANNEL MSII

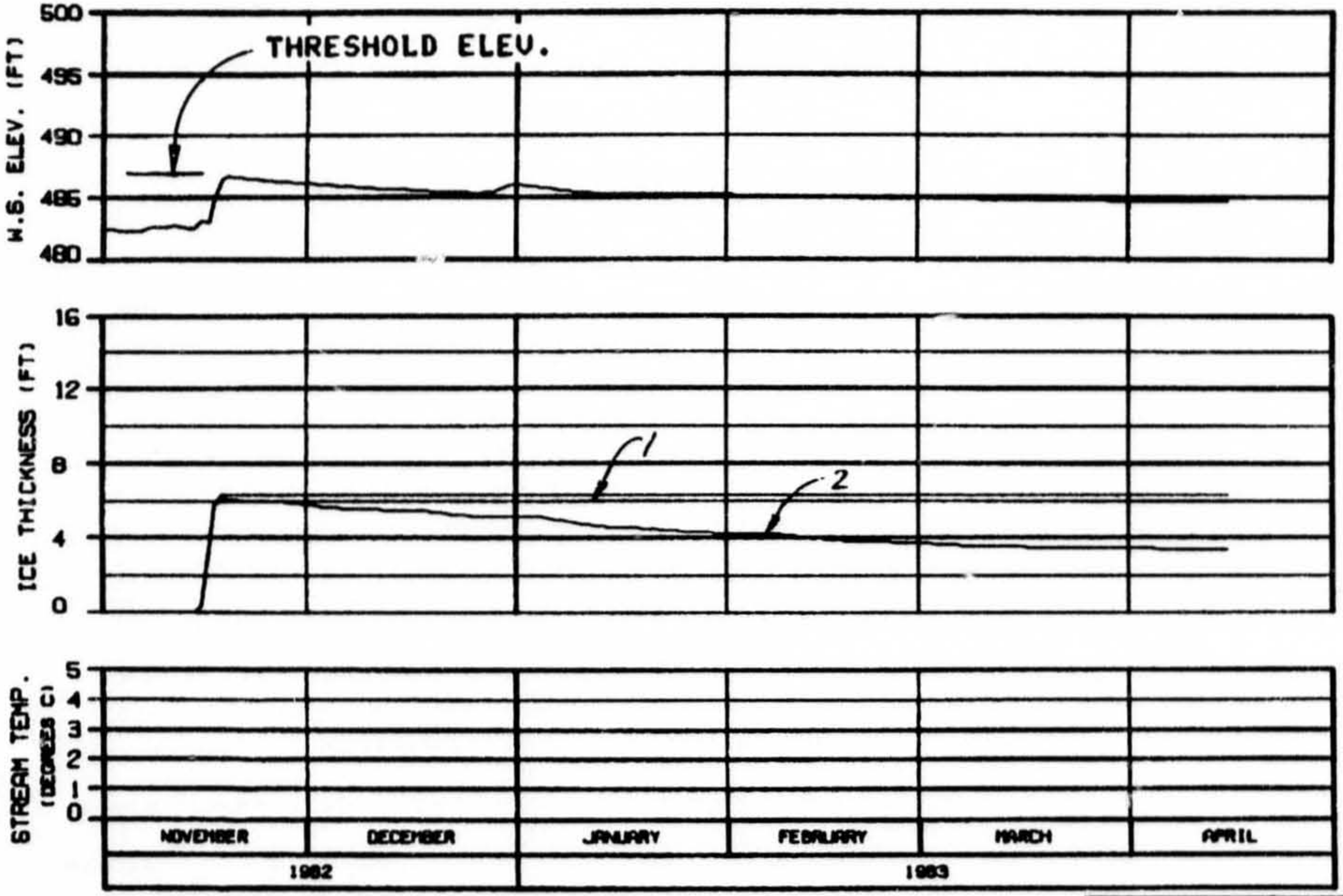
RIVER MILE : 115.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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



HEAD OF SIDE CHANNEL MSII

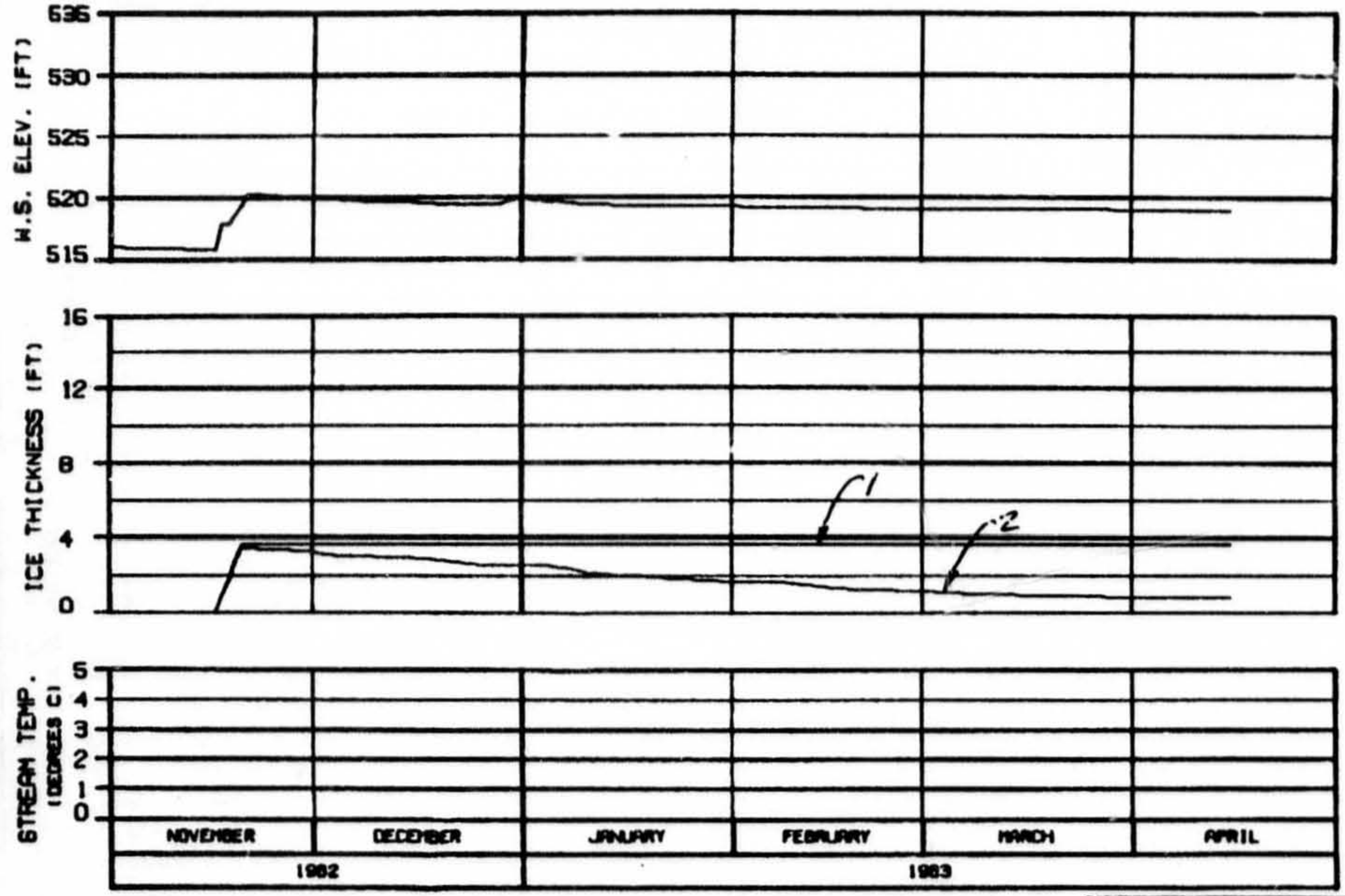
RIVER MILE : 115.90

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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



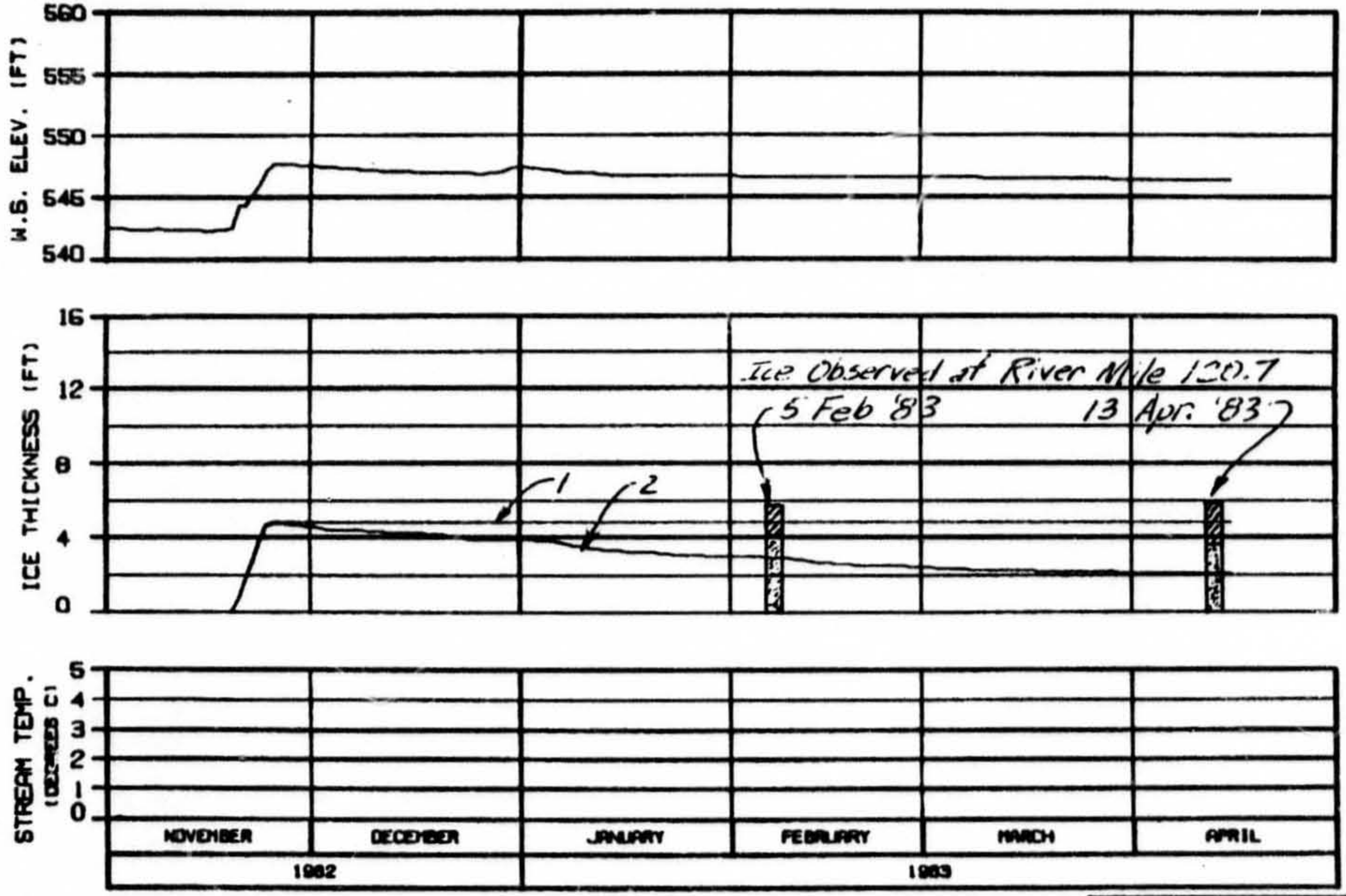
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

RIVER MILE : 120.00

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : [illegible]

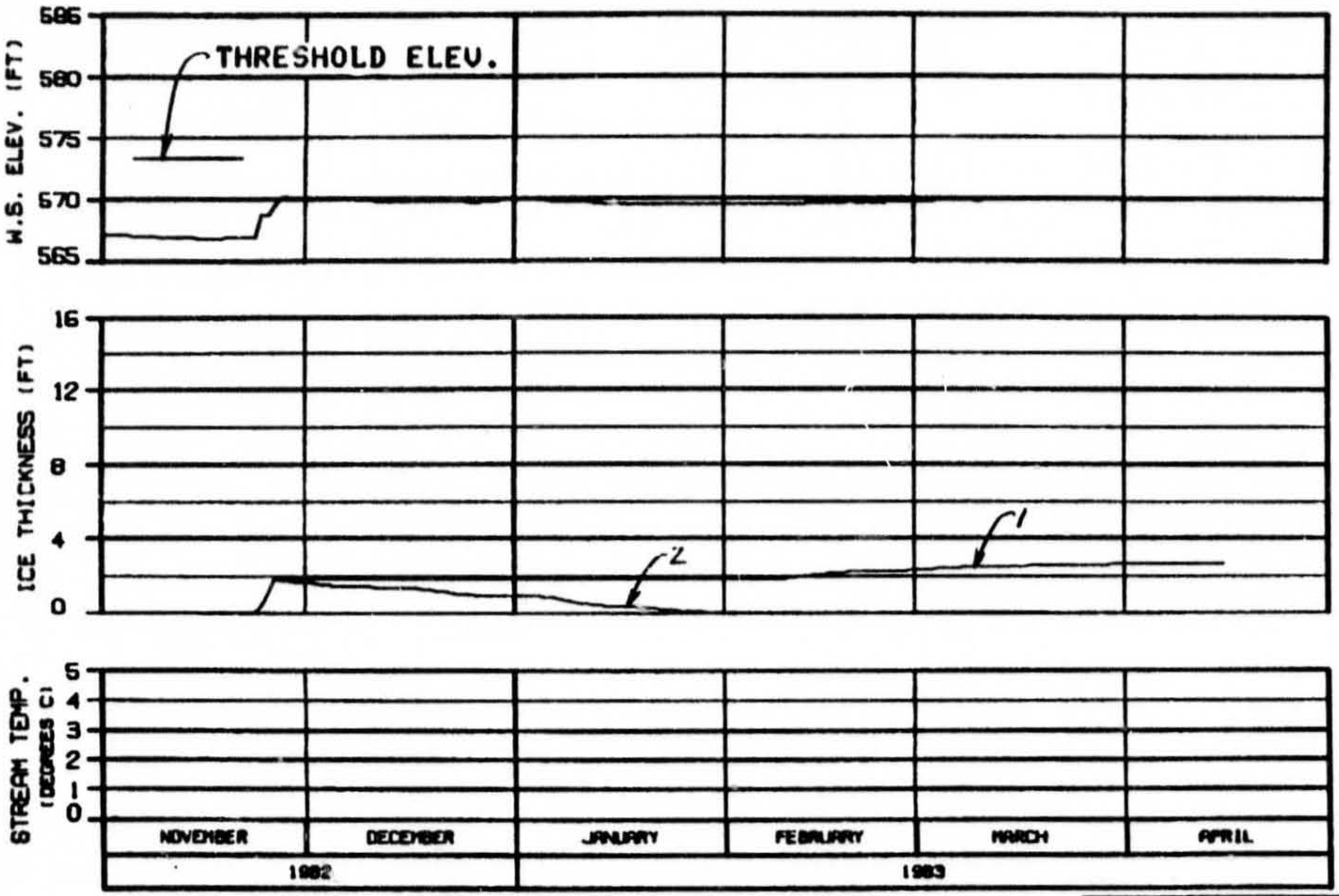
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] 1000.142



HEAD OF SLOUGH 8A (WEST)

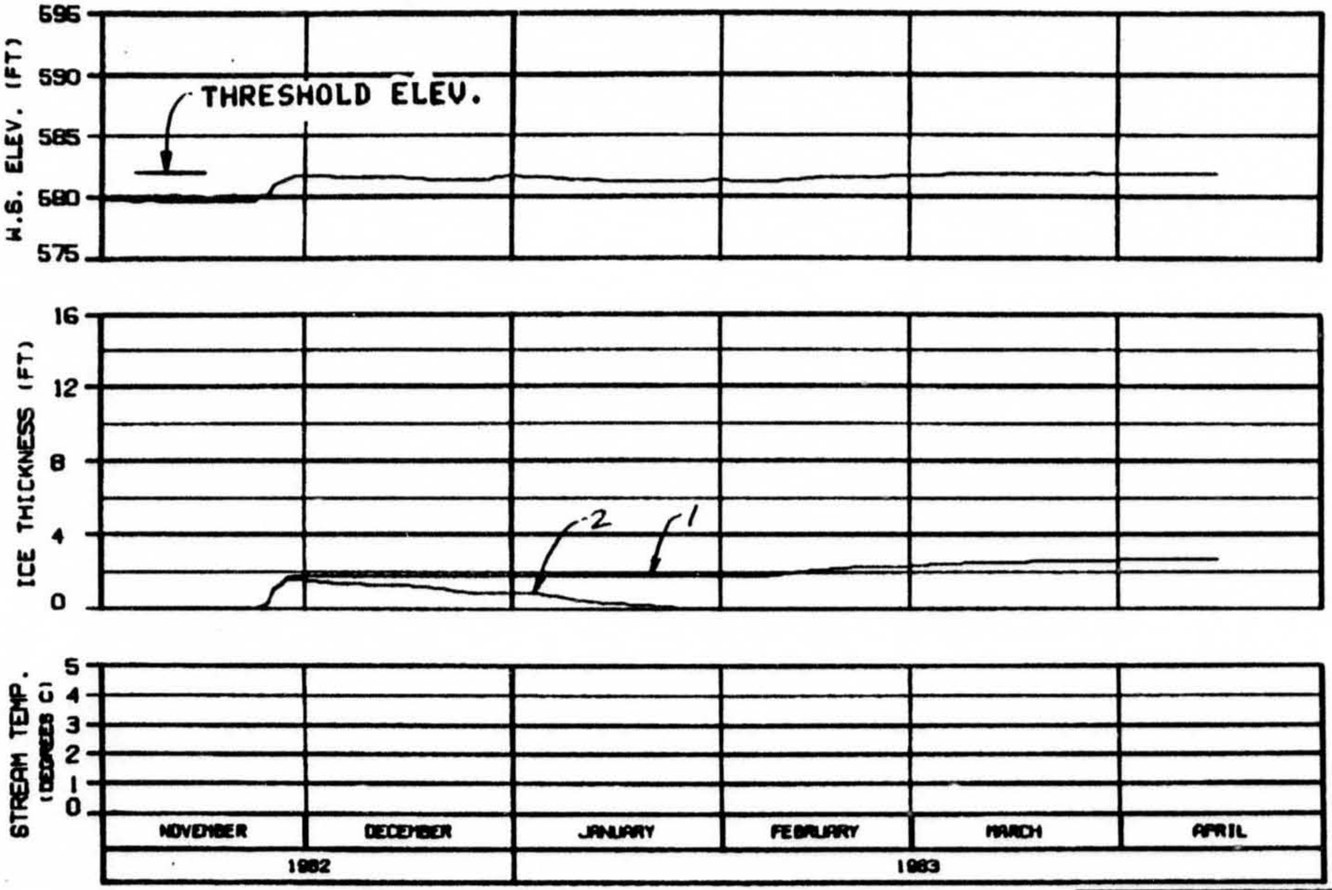
RIVER MILE : 126.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

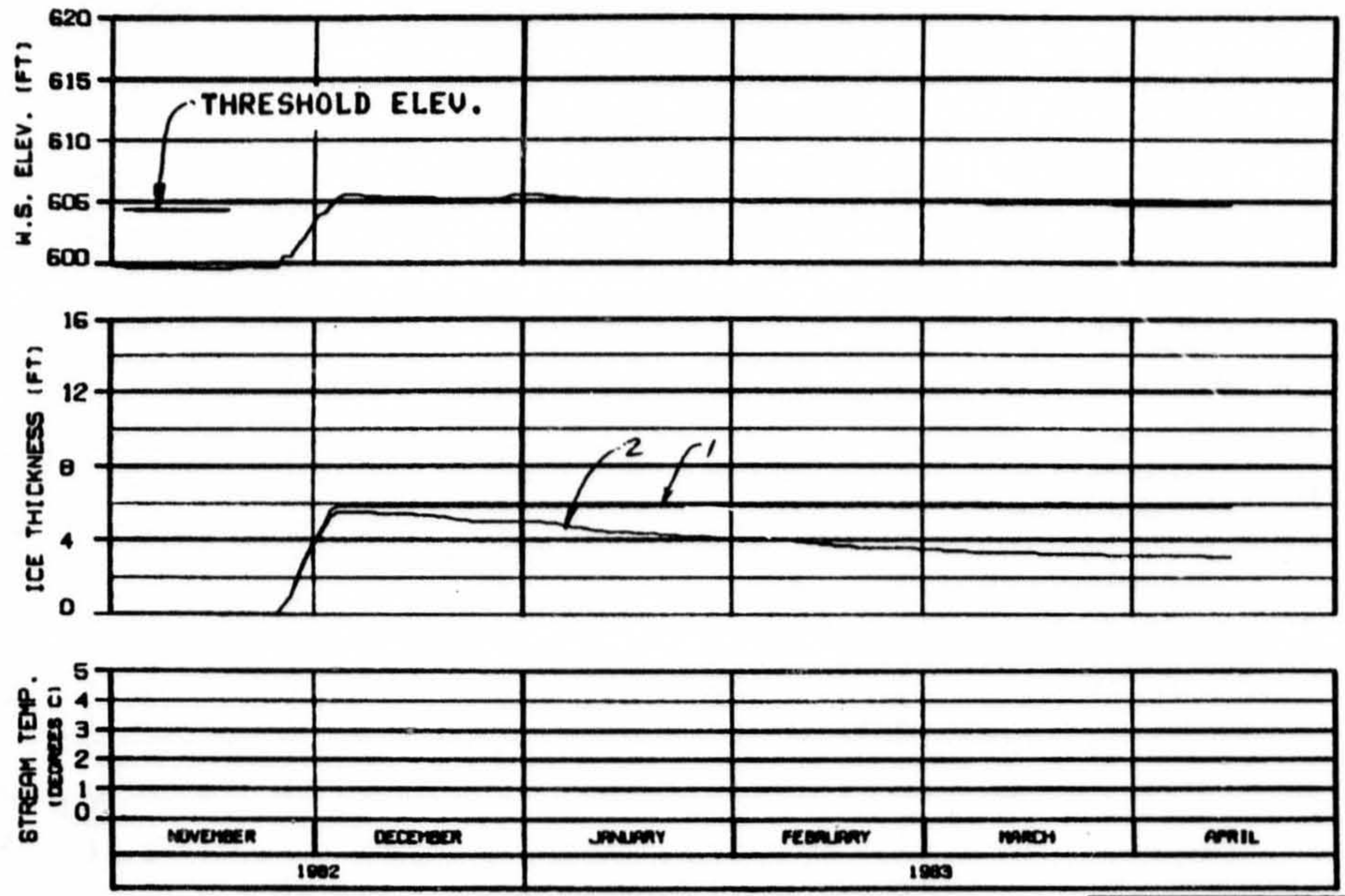
WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

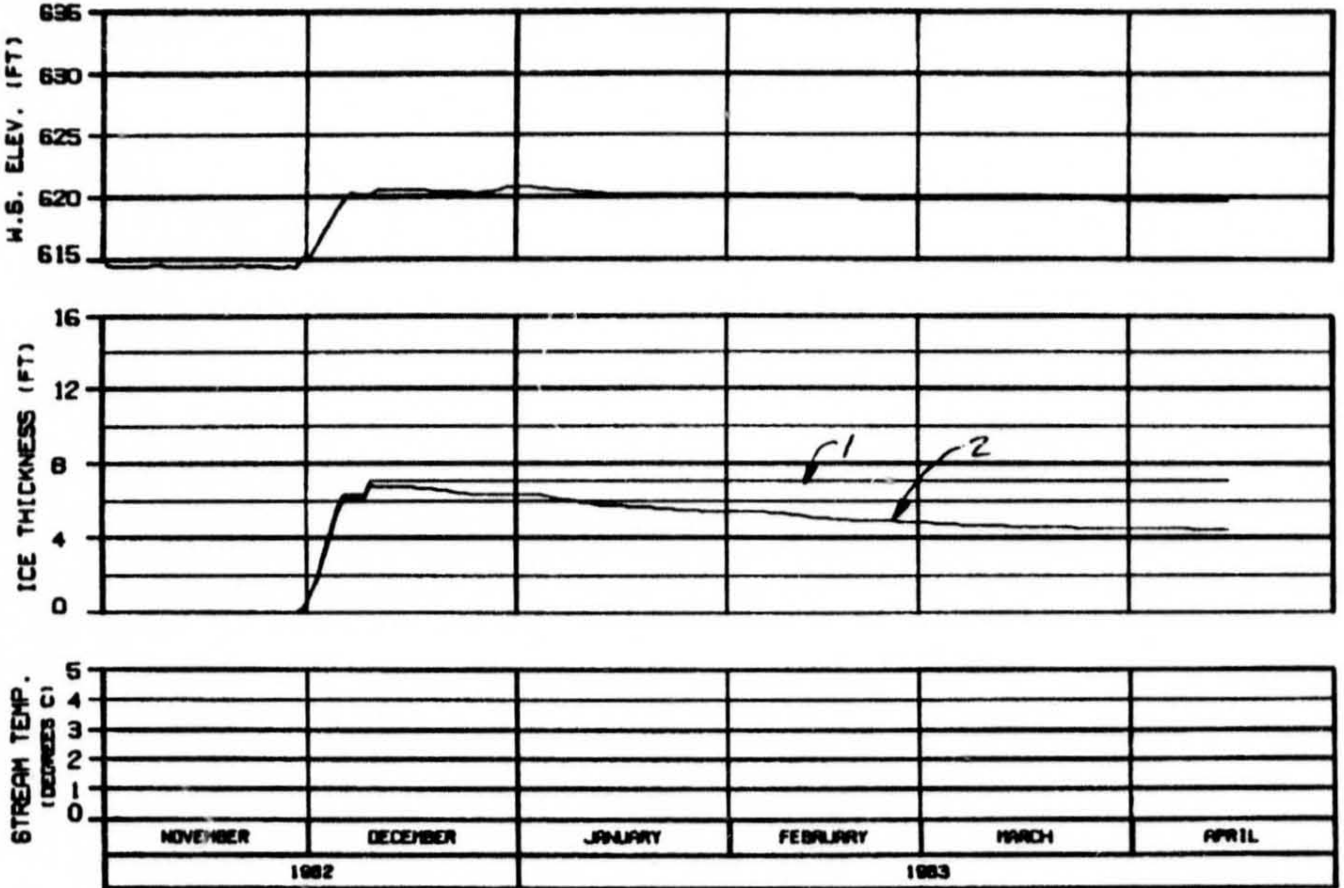
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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

OPTION?

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

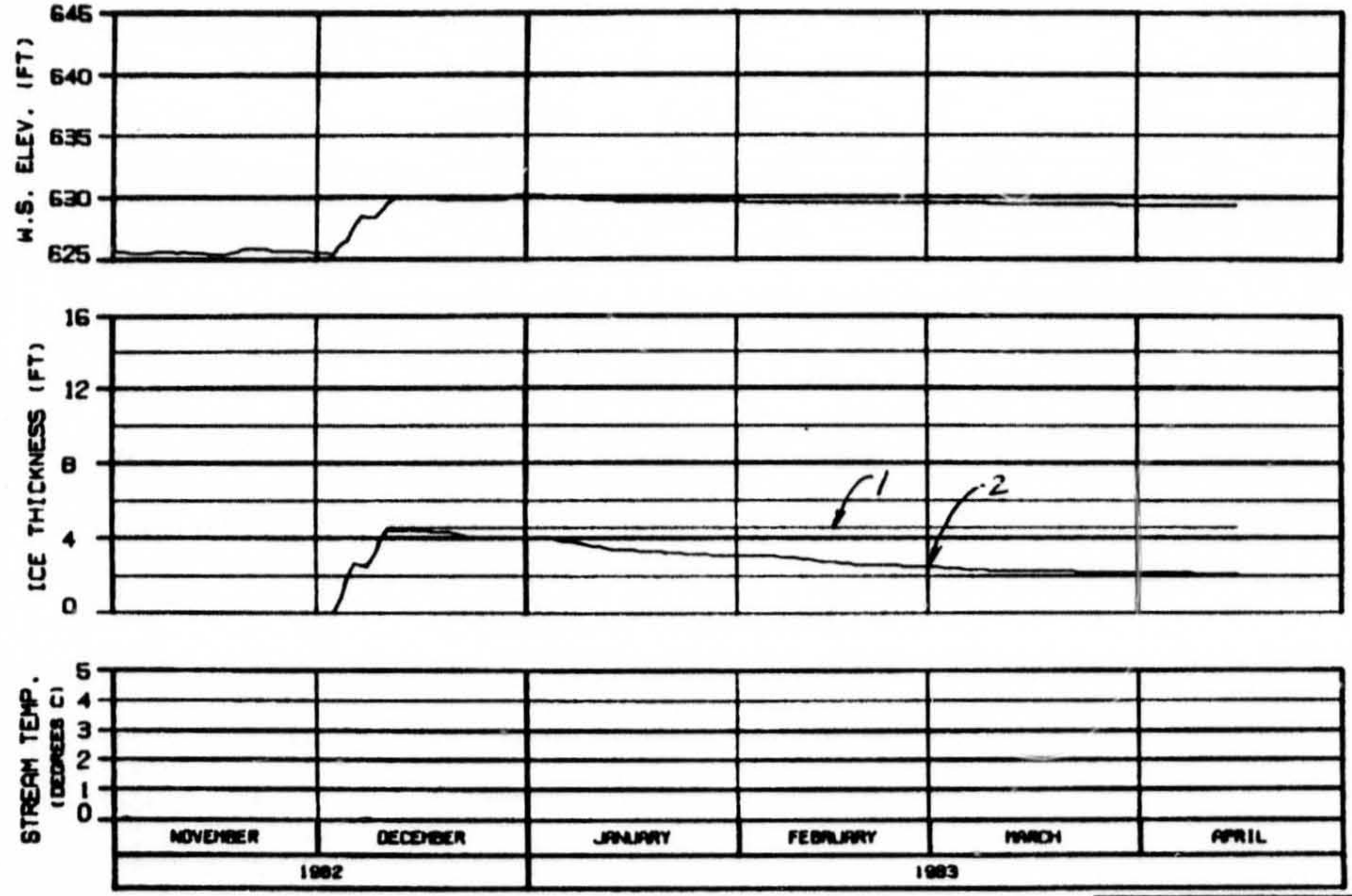
WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

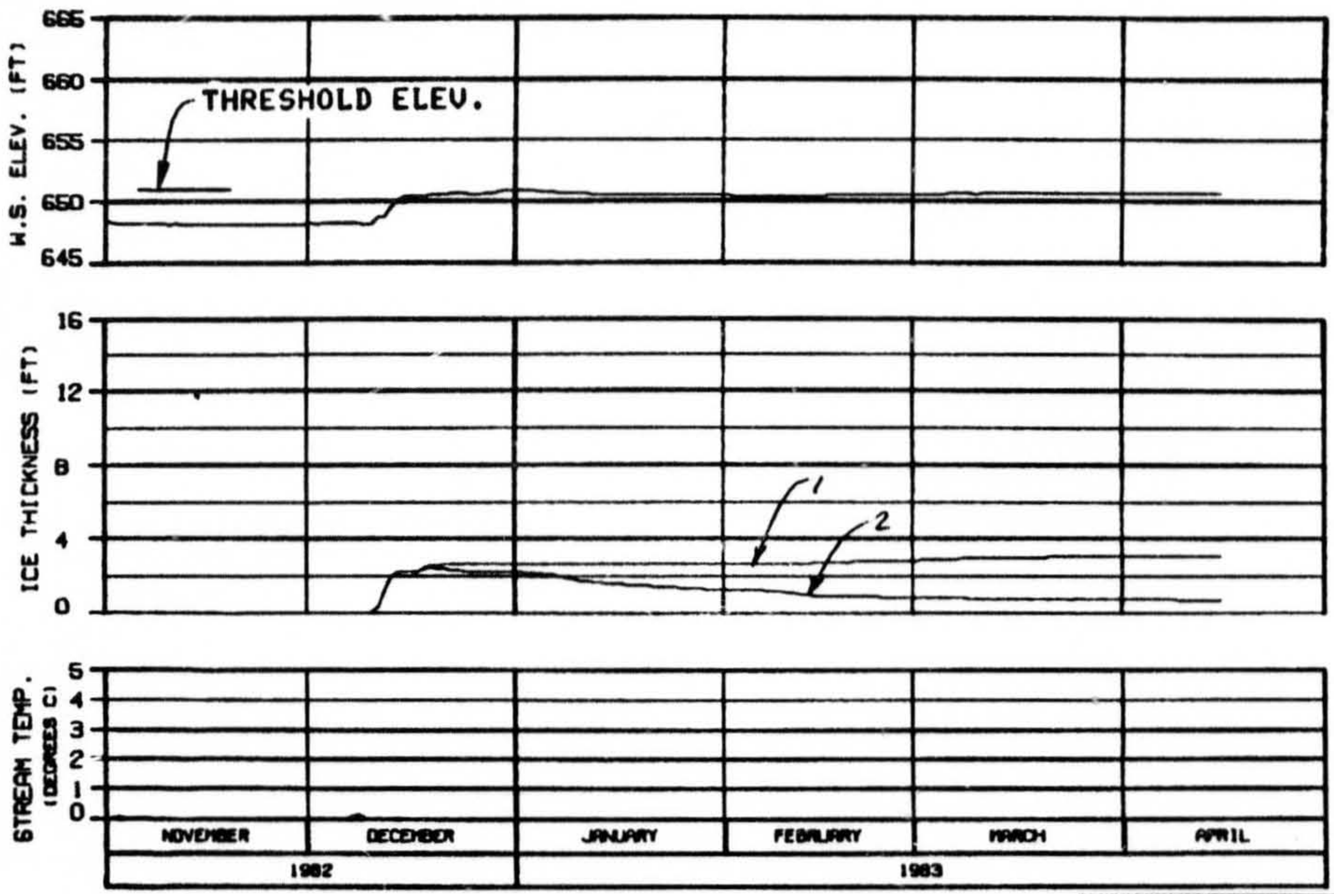
RIVER MILE : 131.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

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



HEAD OF SLOUGH 9A

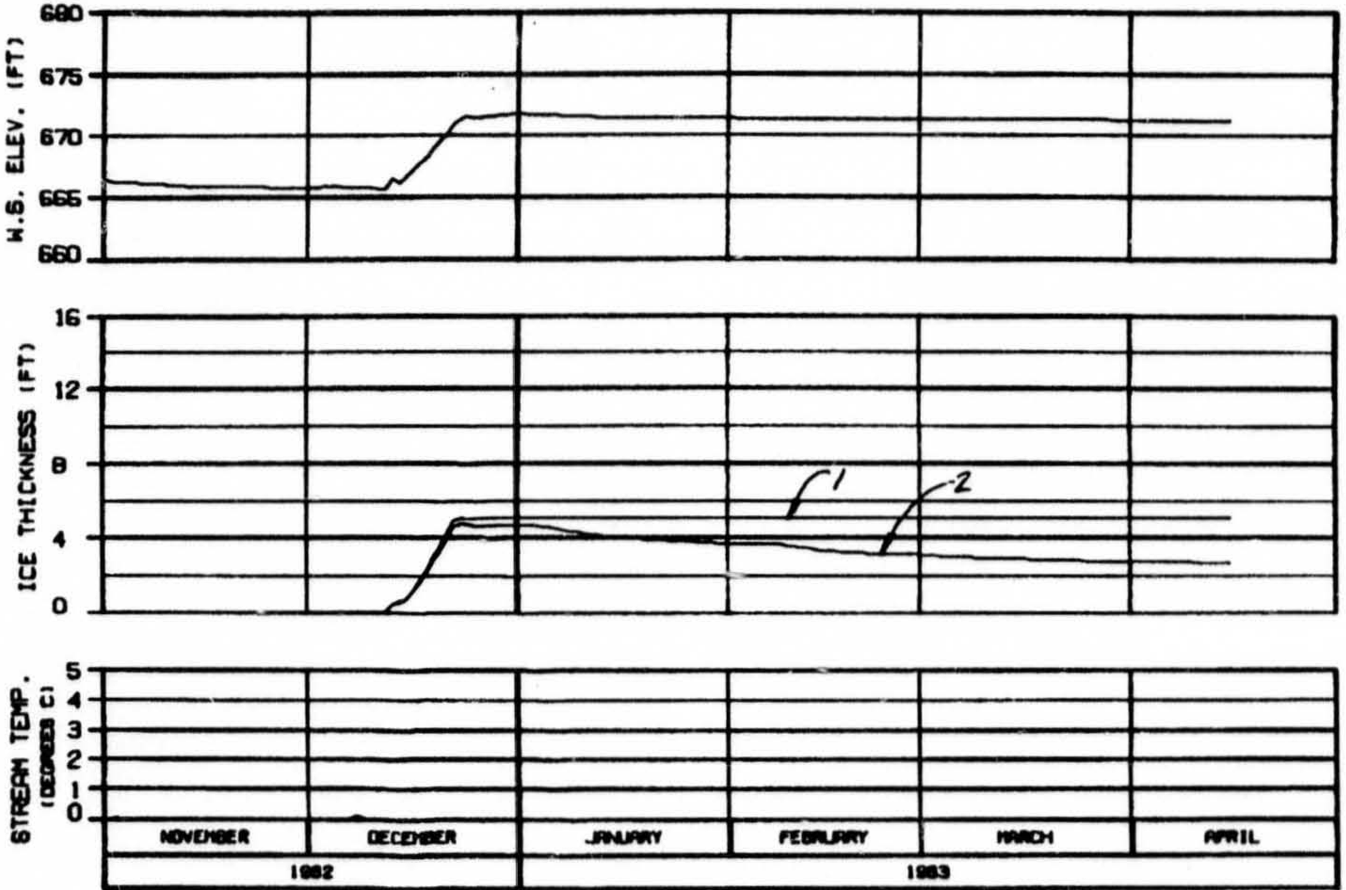
RIVER MILE : 133.70

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

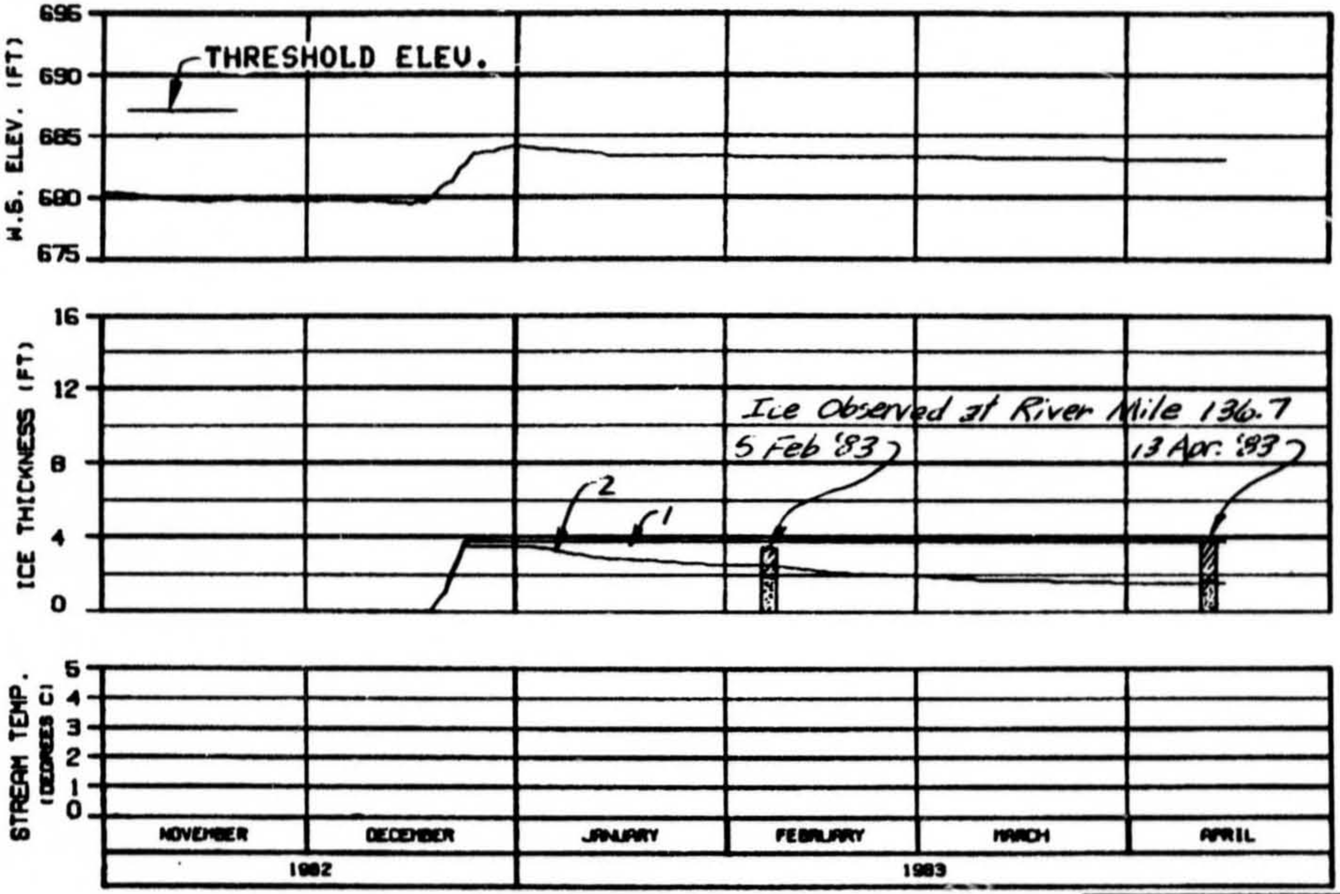
WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 11

RIVER MILE : 136.50

WEATHER PERIOD : 1 NOV 82 - 15 APR 83
PRE PROJECT SIMULATION
REFERENCE RUN NO. : PRE82A

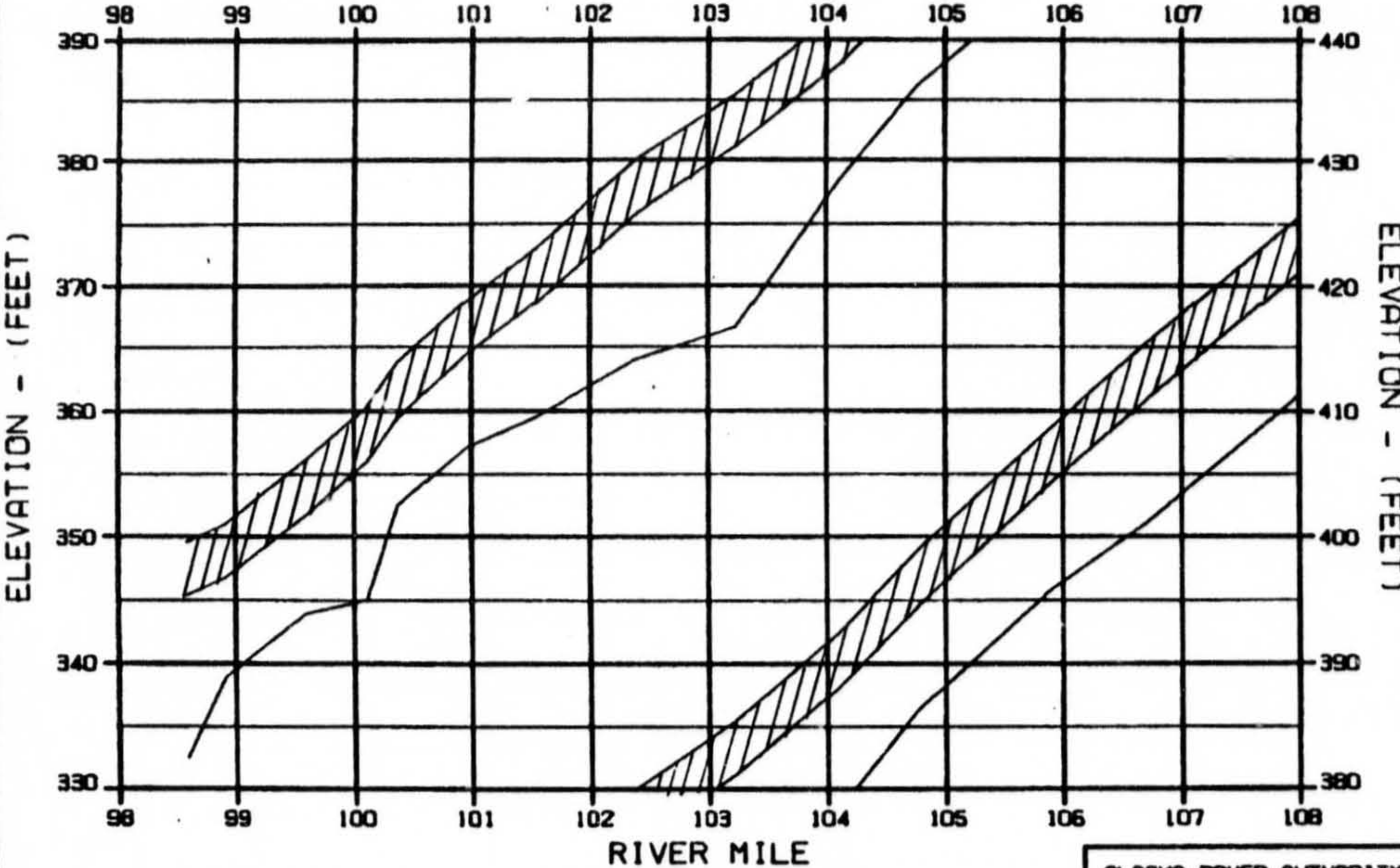
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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

EXHIBIT E

c



LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7198CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

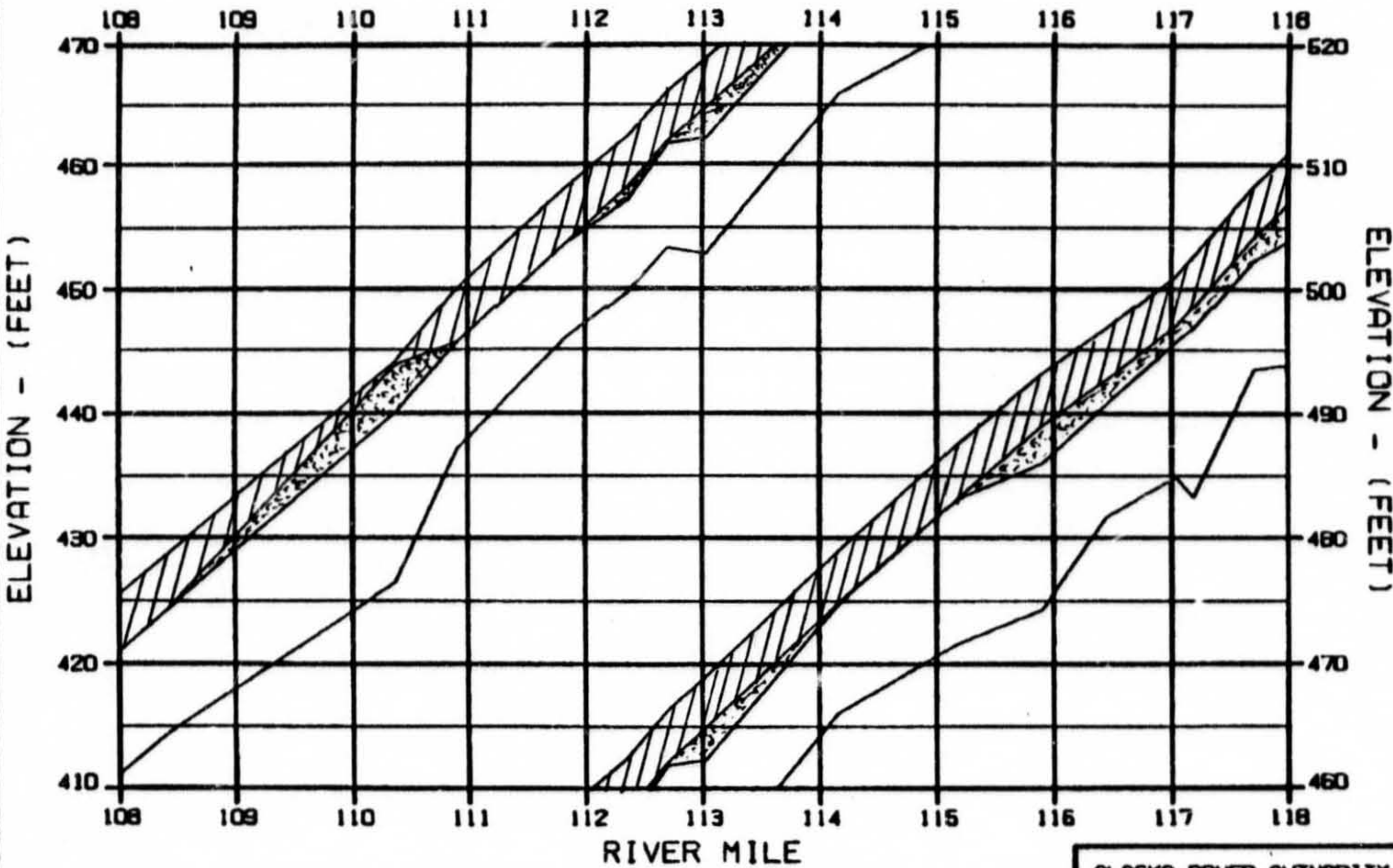
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 10 JAN 84 | [illegible].142

OPTION?

C



LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7198CNA

ALASKA POWER AUTHORITY

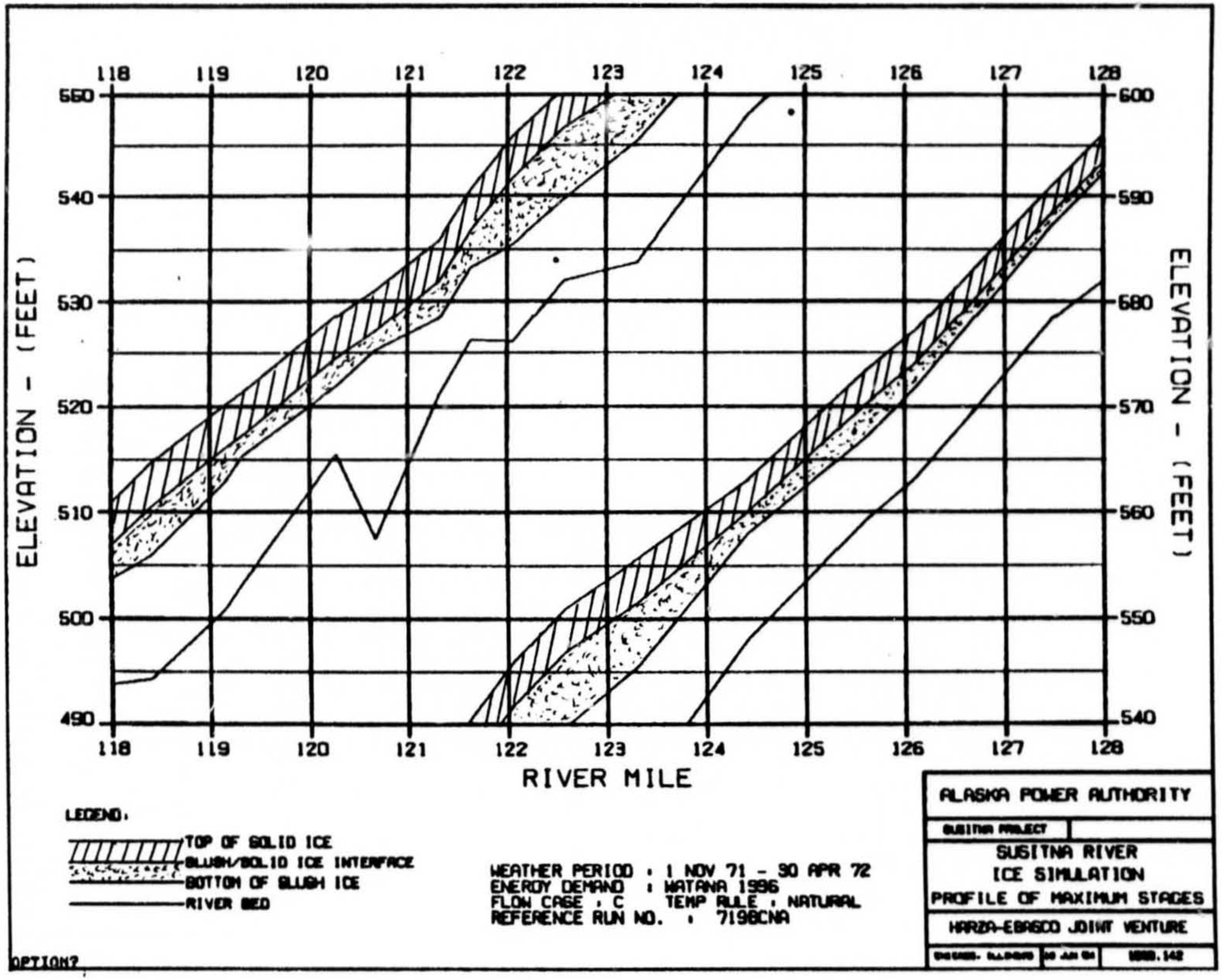
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

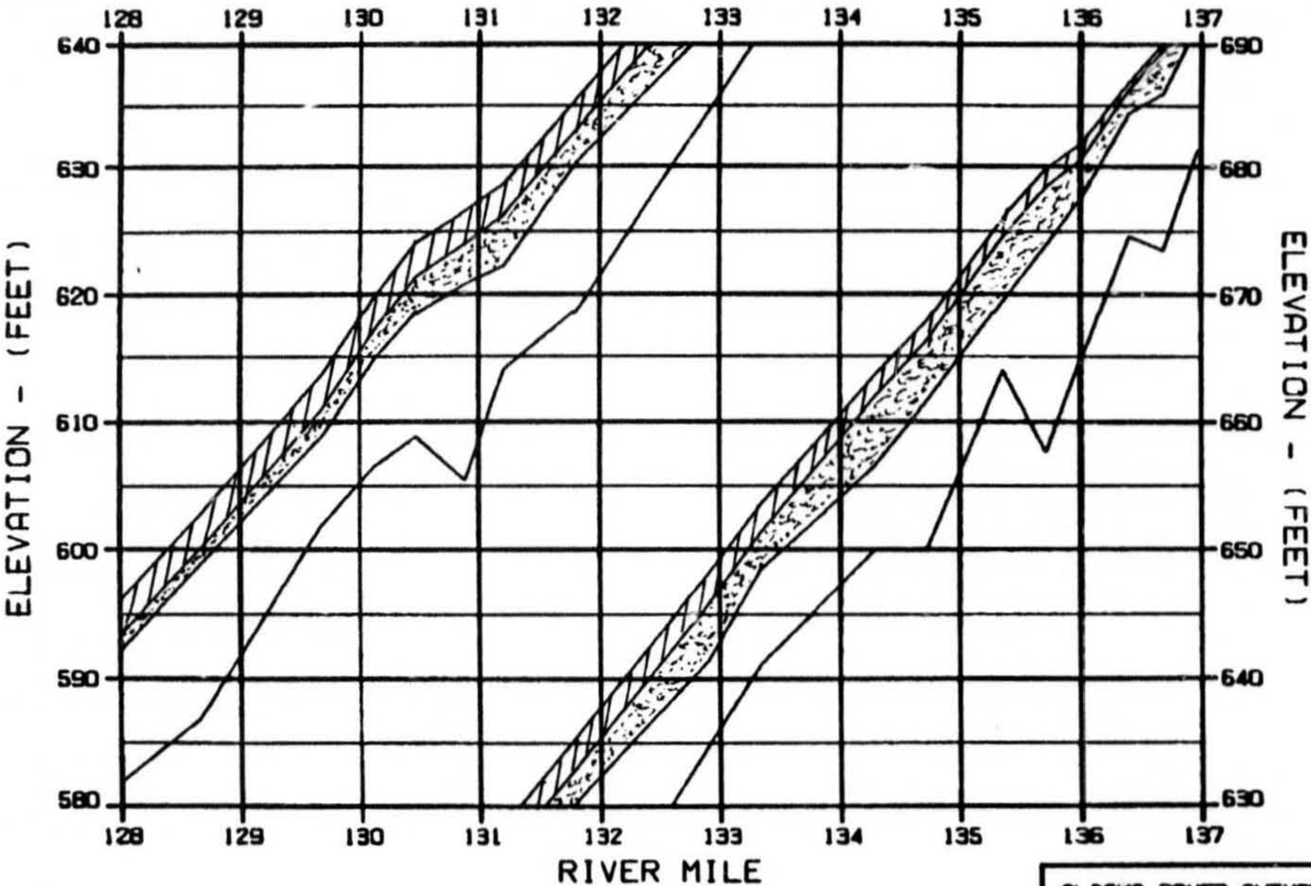
OPTION?

c



118 119 120 121 122 123 124 125 126 127 128
560
540
530
520
510
500
490
600
590
580
570
560
550
540
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7198CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C



LEGEND:

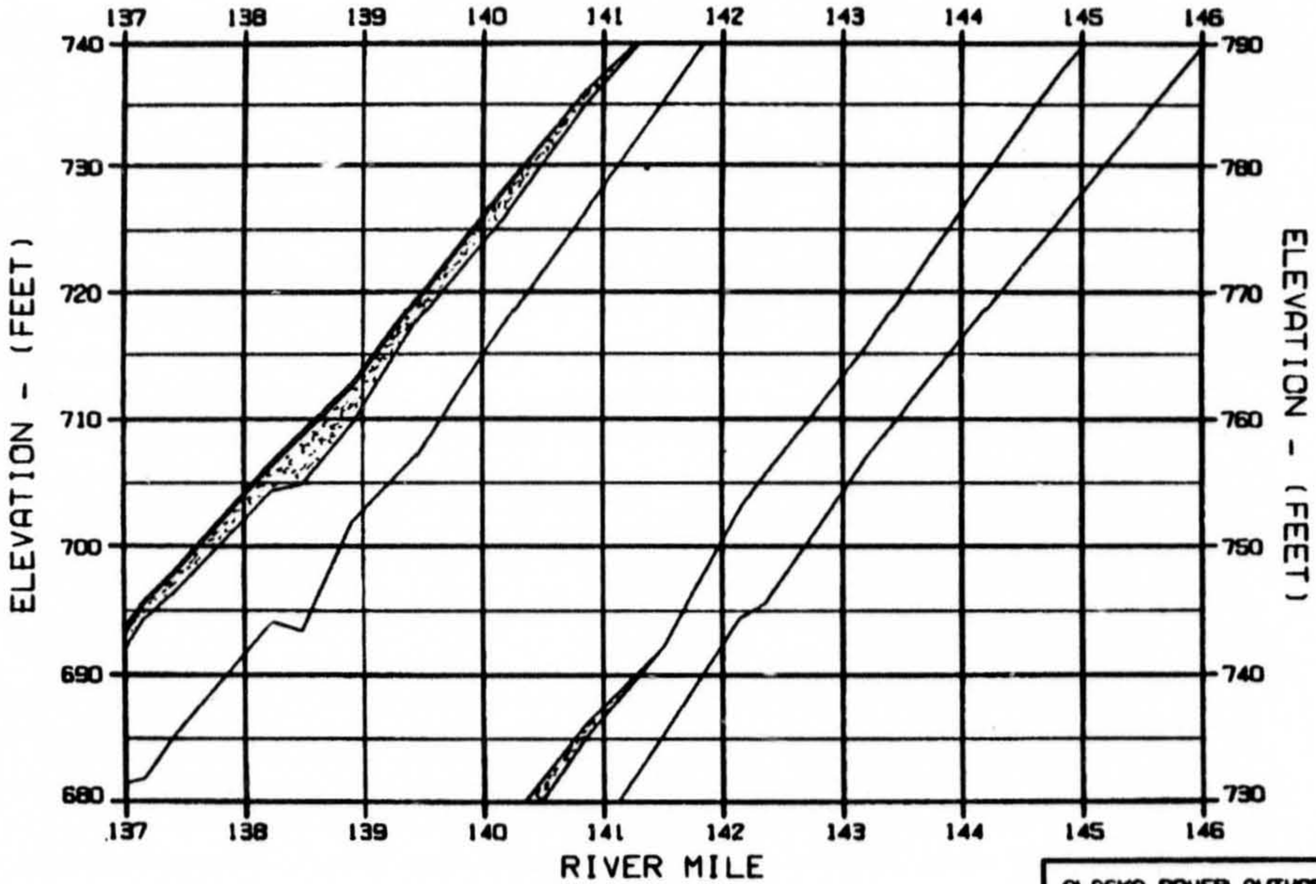
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1988.142

OPTION?

c



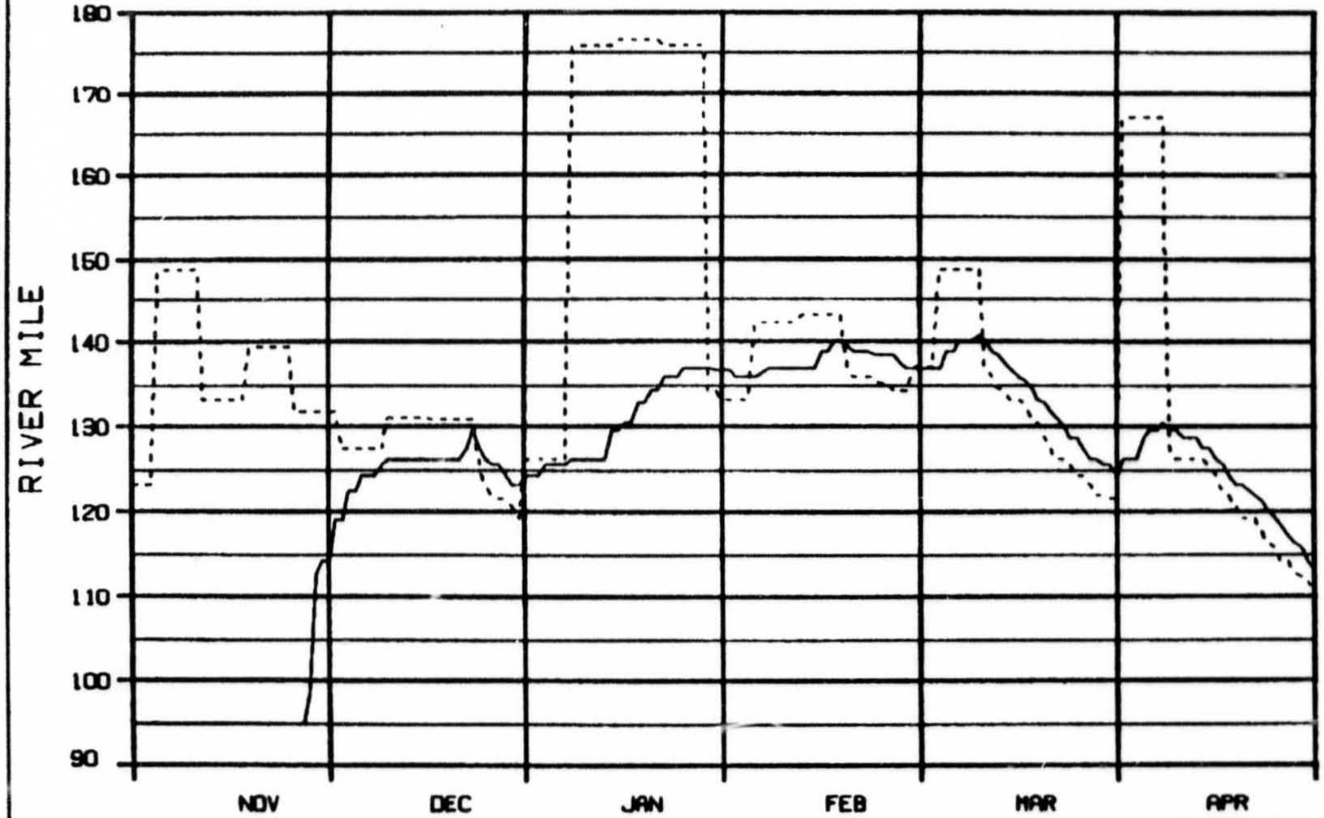
LEGEND:

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7198CNA

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

OPTION?



LEGEND:

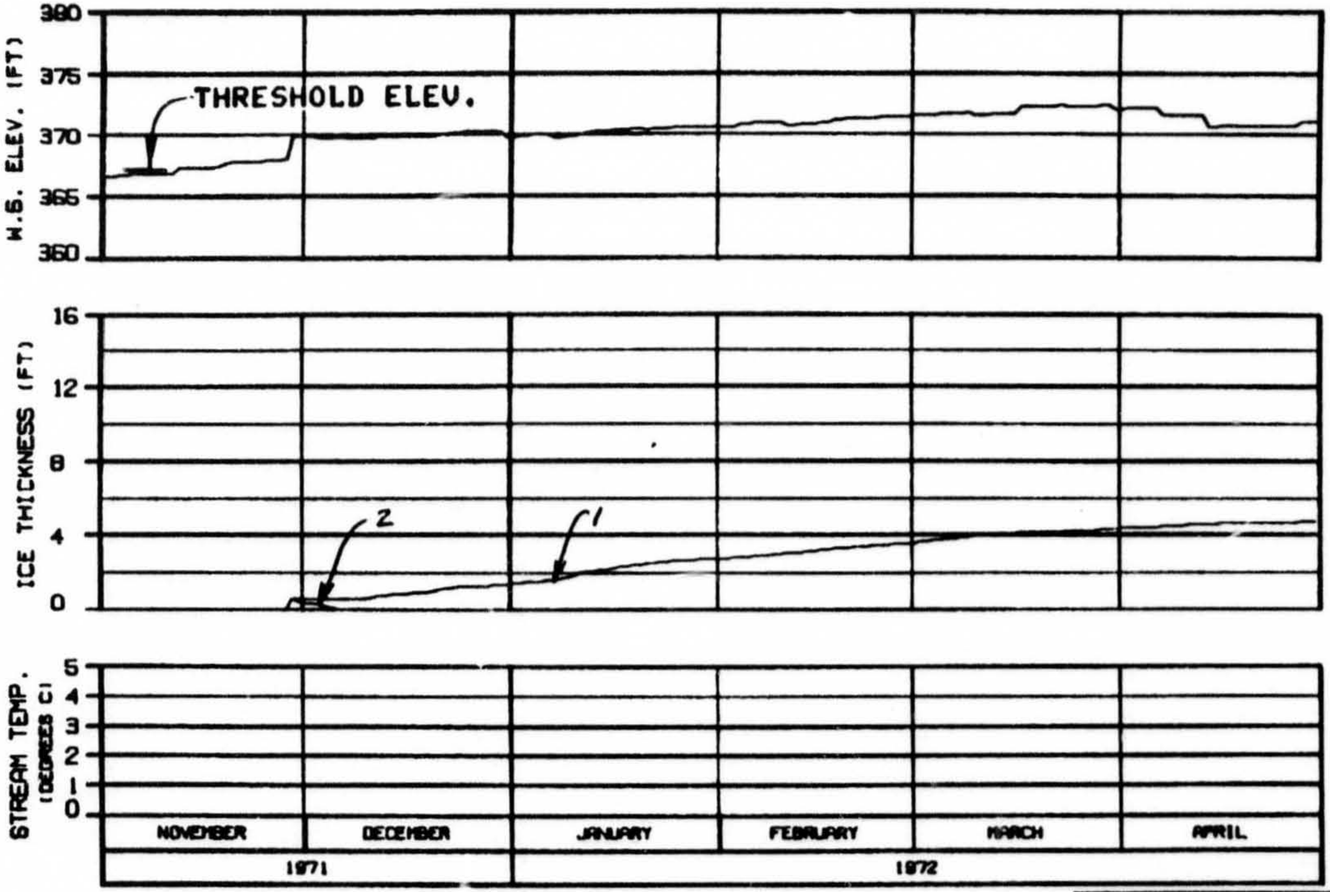
——— ICE FRONT

- - - - - ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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

OPTION?



HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

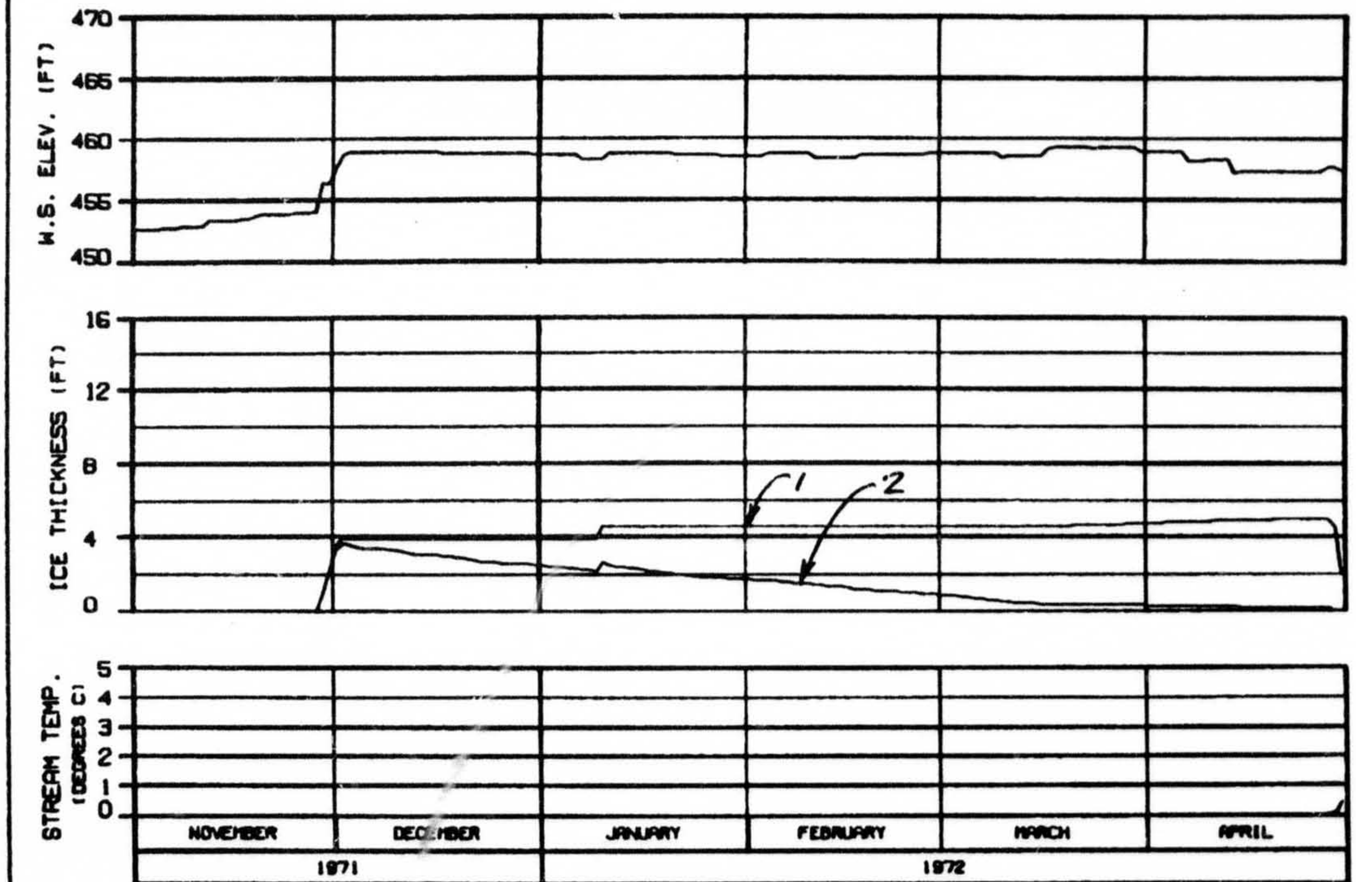
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

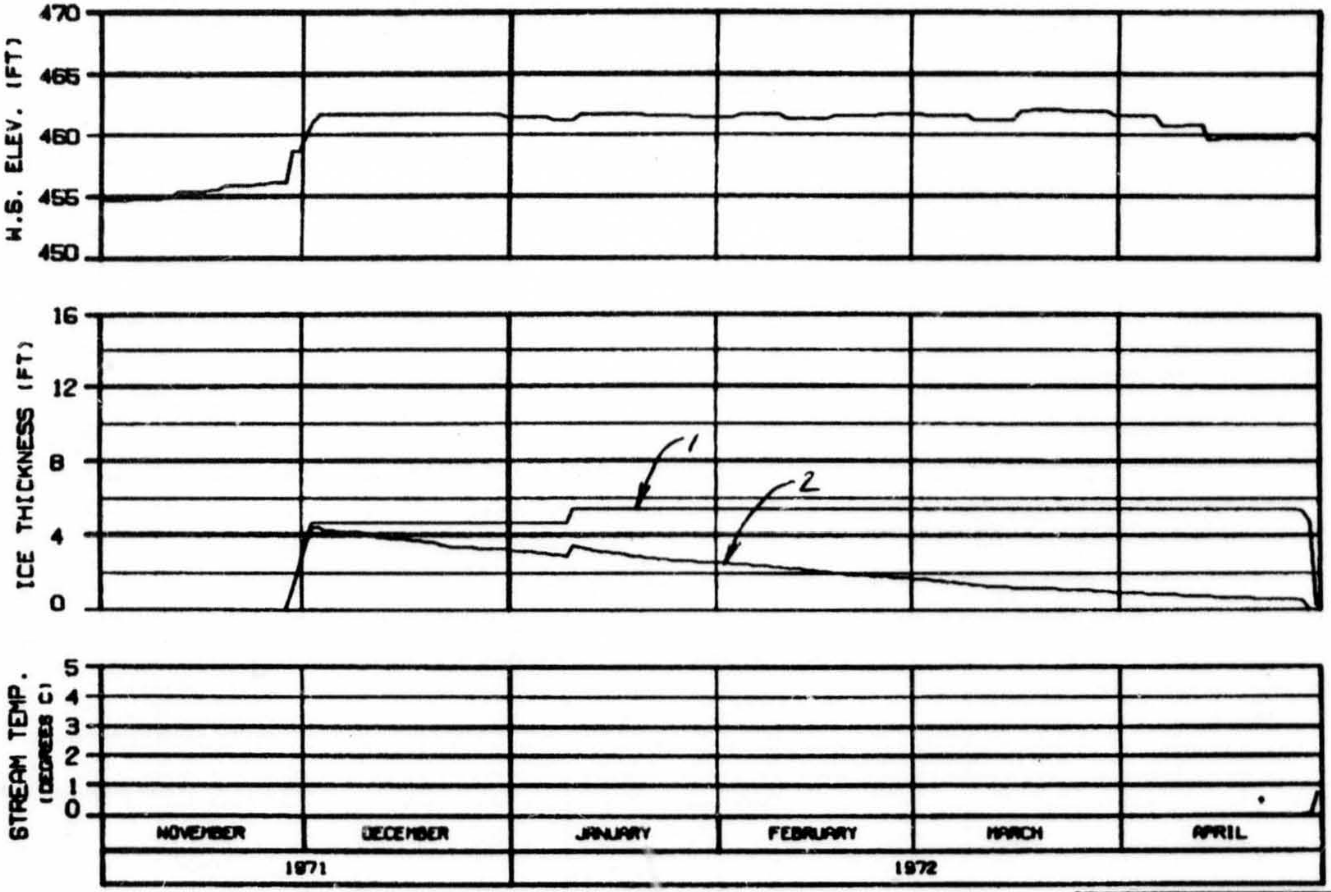
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

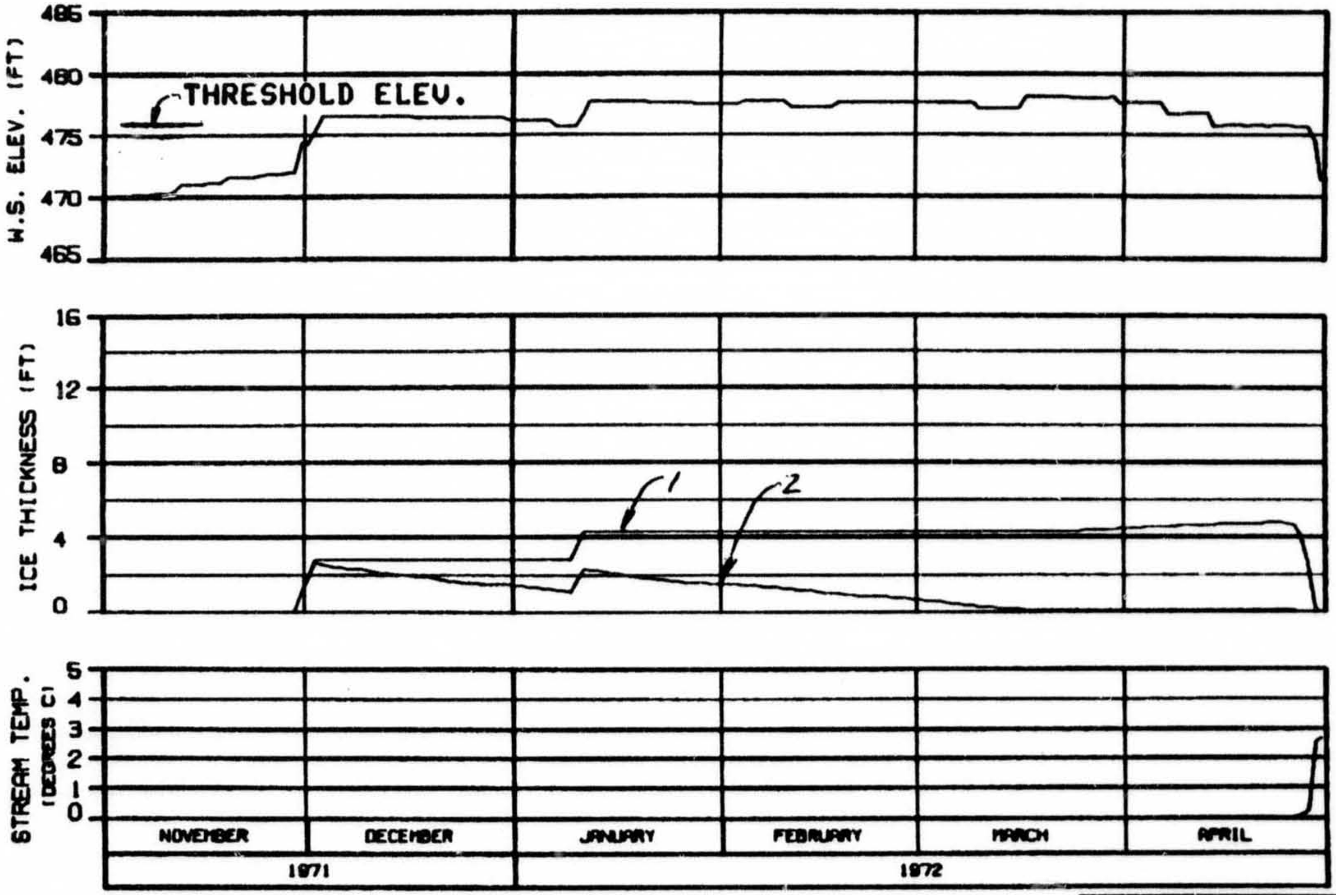
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8

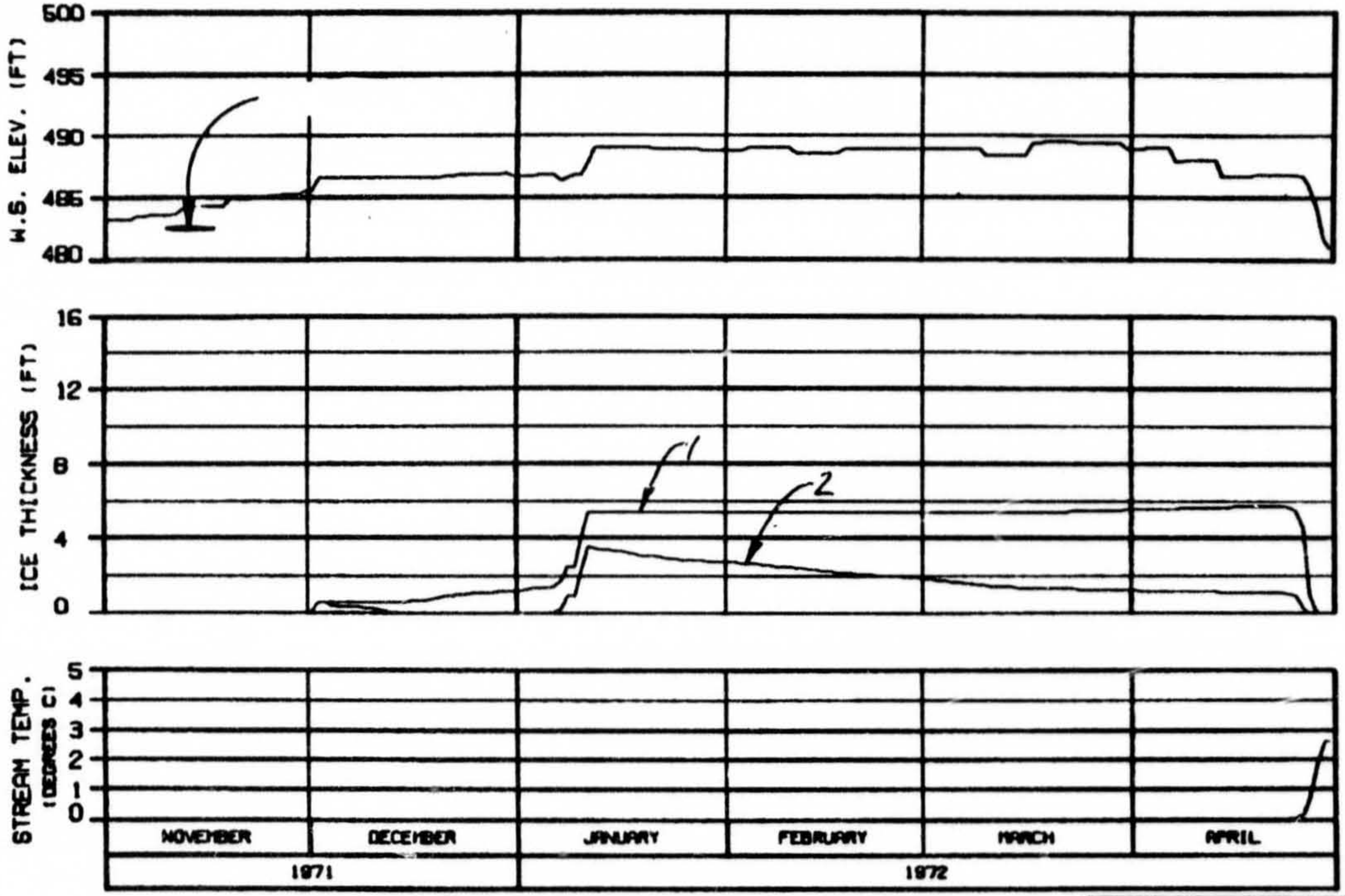
RIVER MILE : 114.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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



SIDE CHANNEL MSII

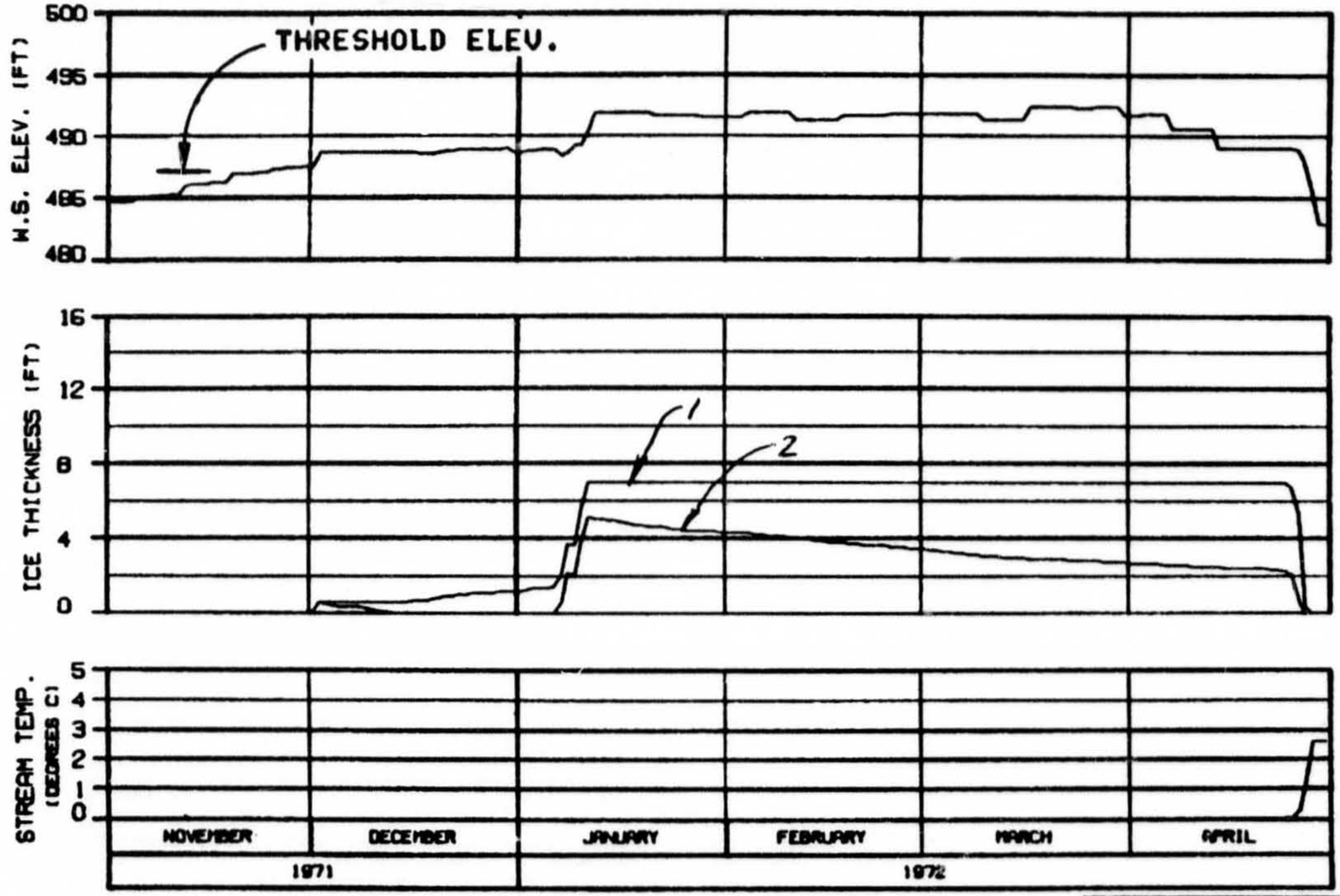
RIVER MILE : 115.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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



HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

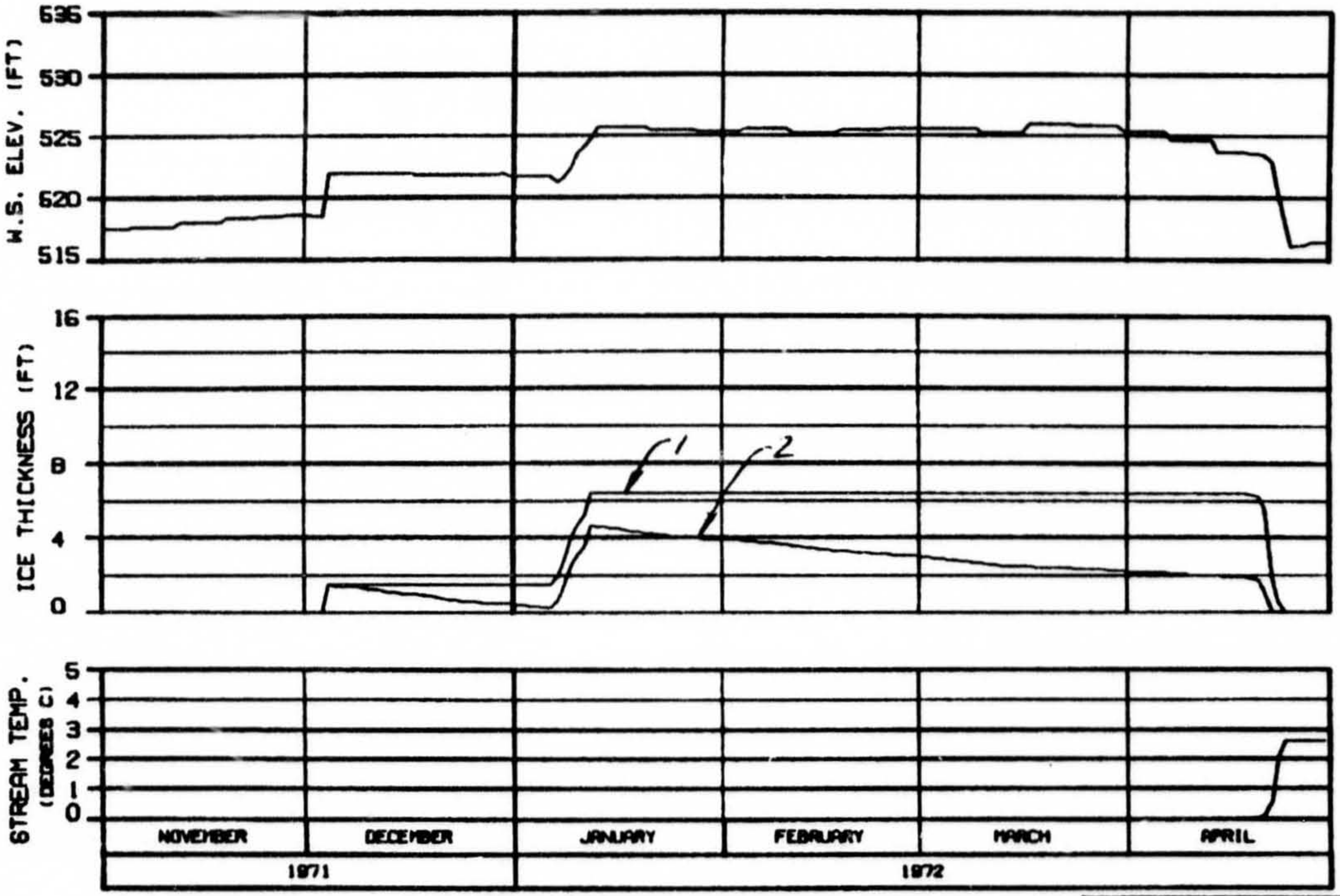
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1988.142



RIVER MILE : 120.00

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

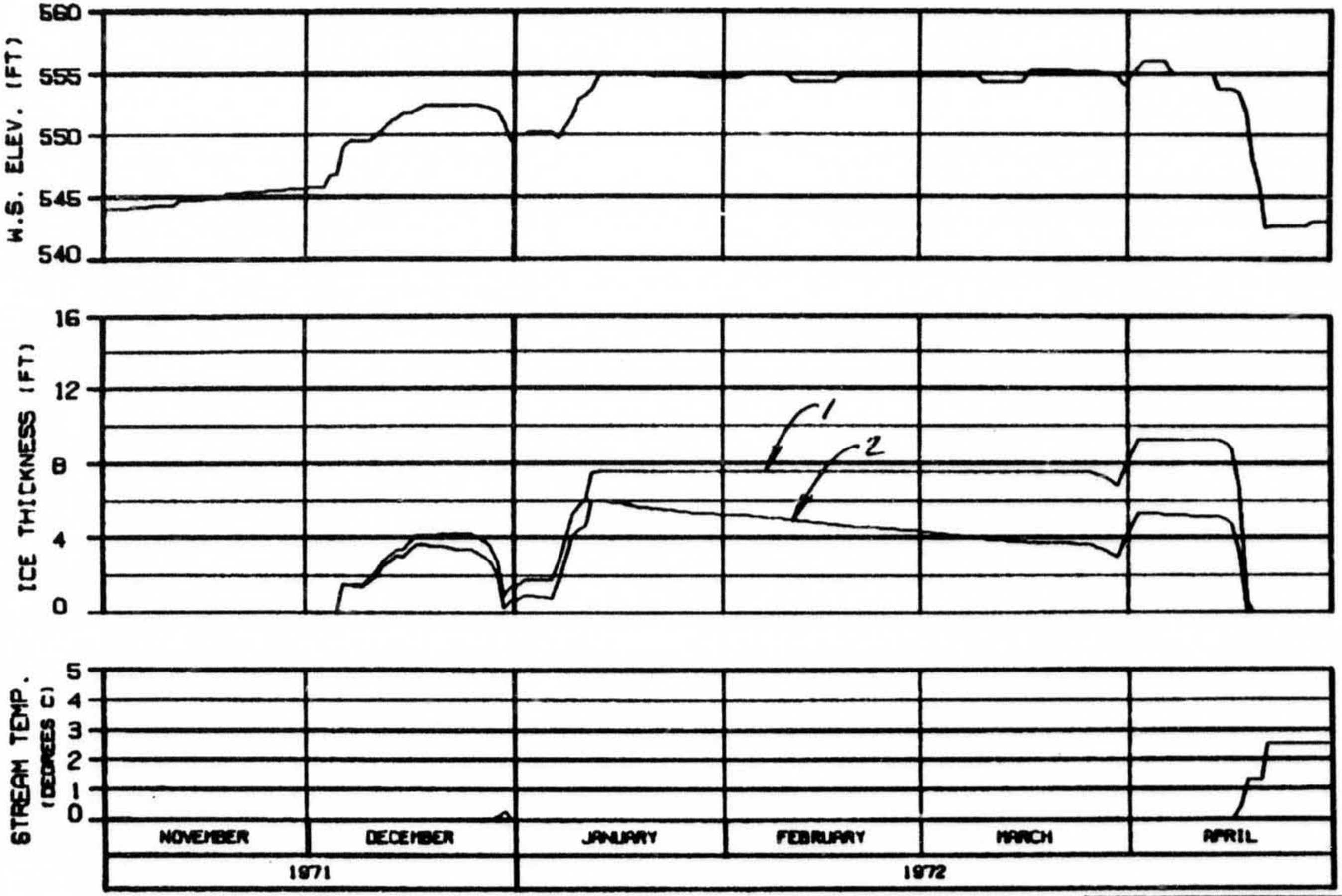
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C   TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

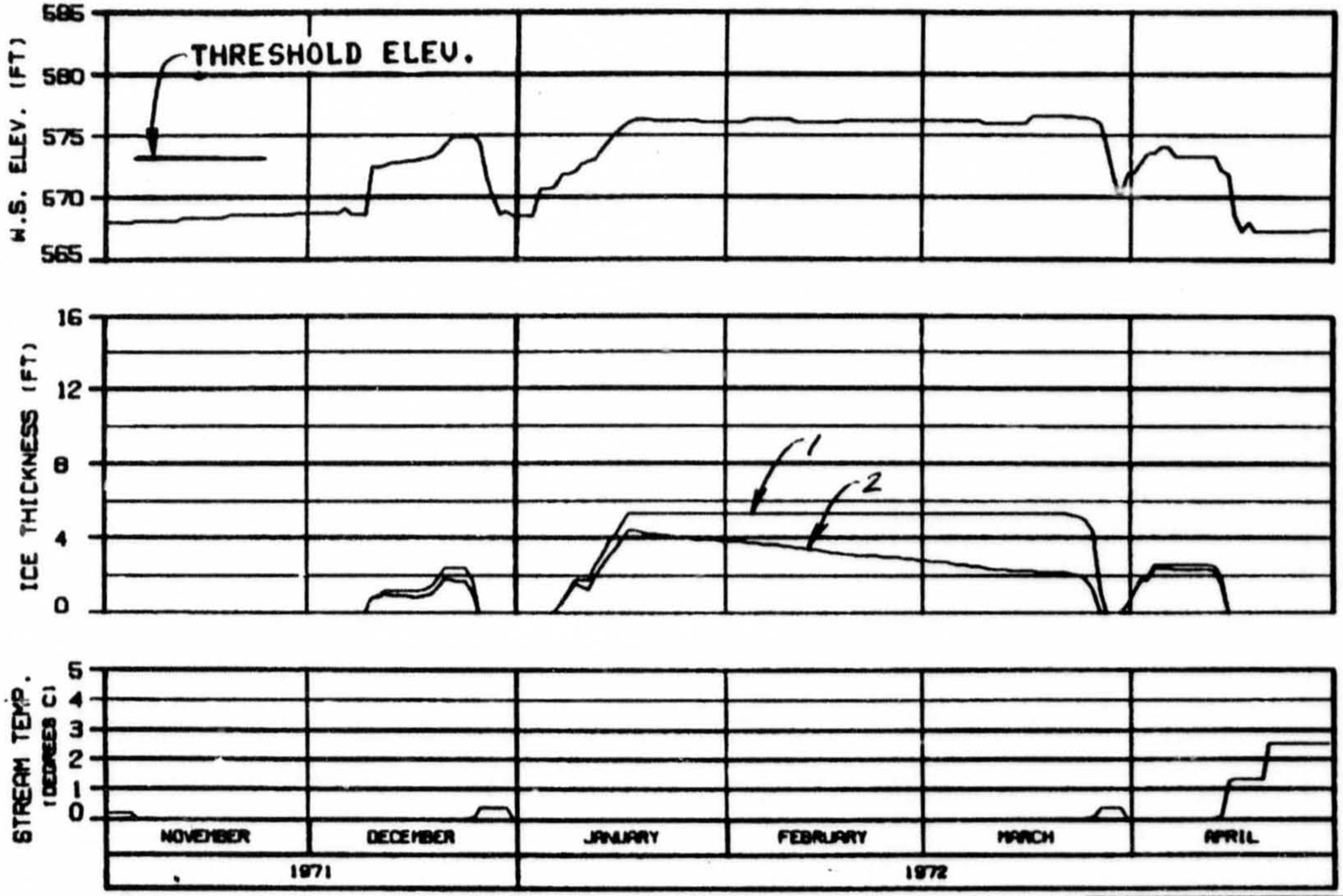
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1986.142



HEAD OF SLOUGH 8A (WEST)

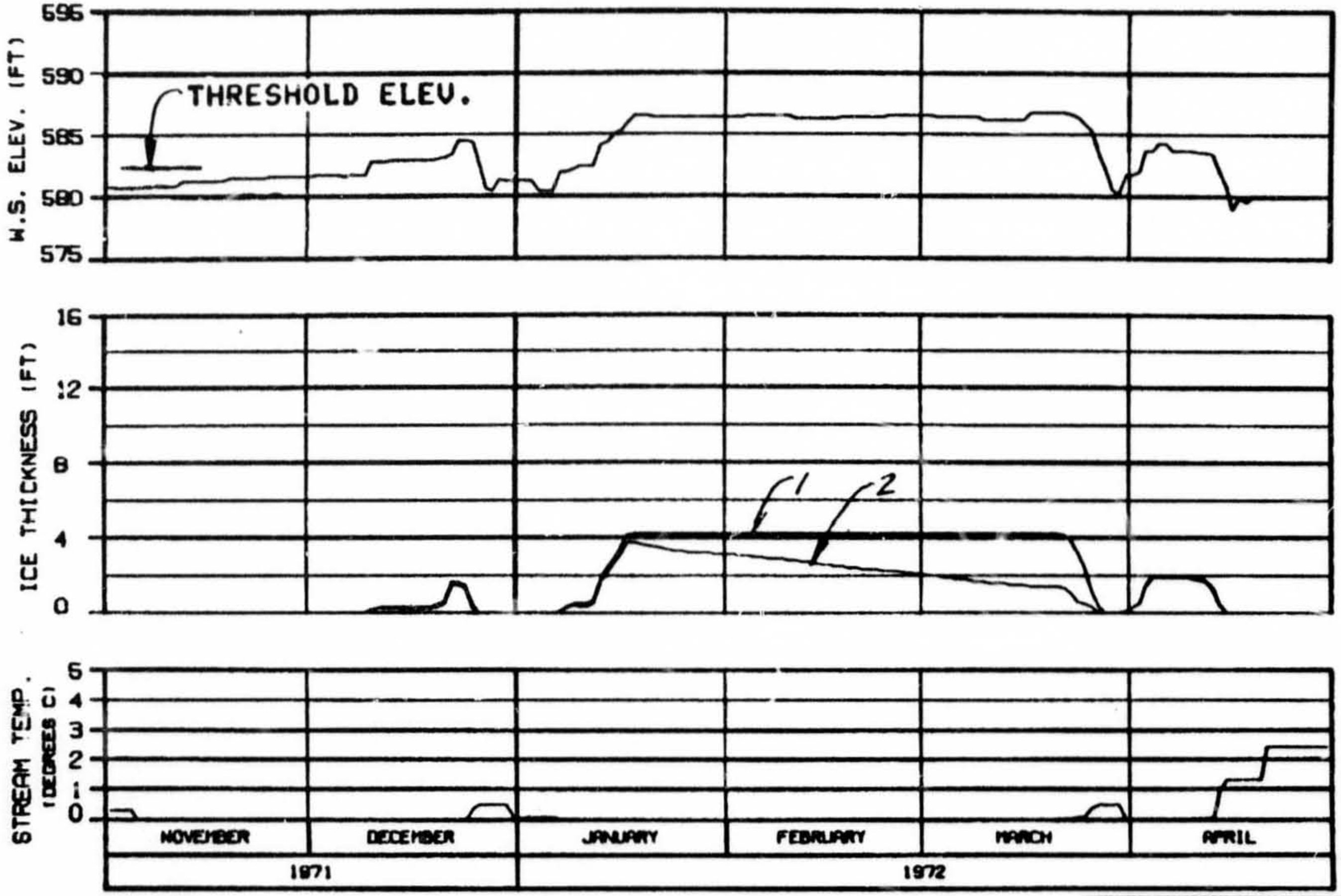
RIVER MILE : 126.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

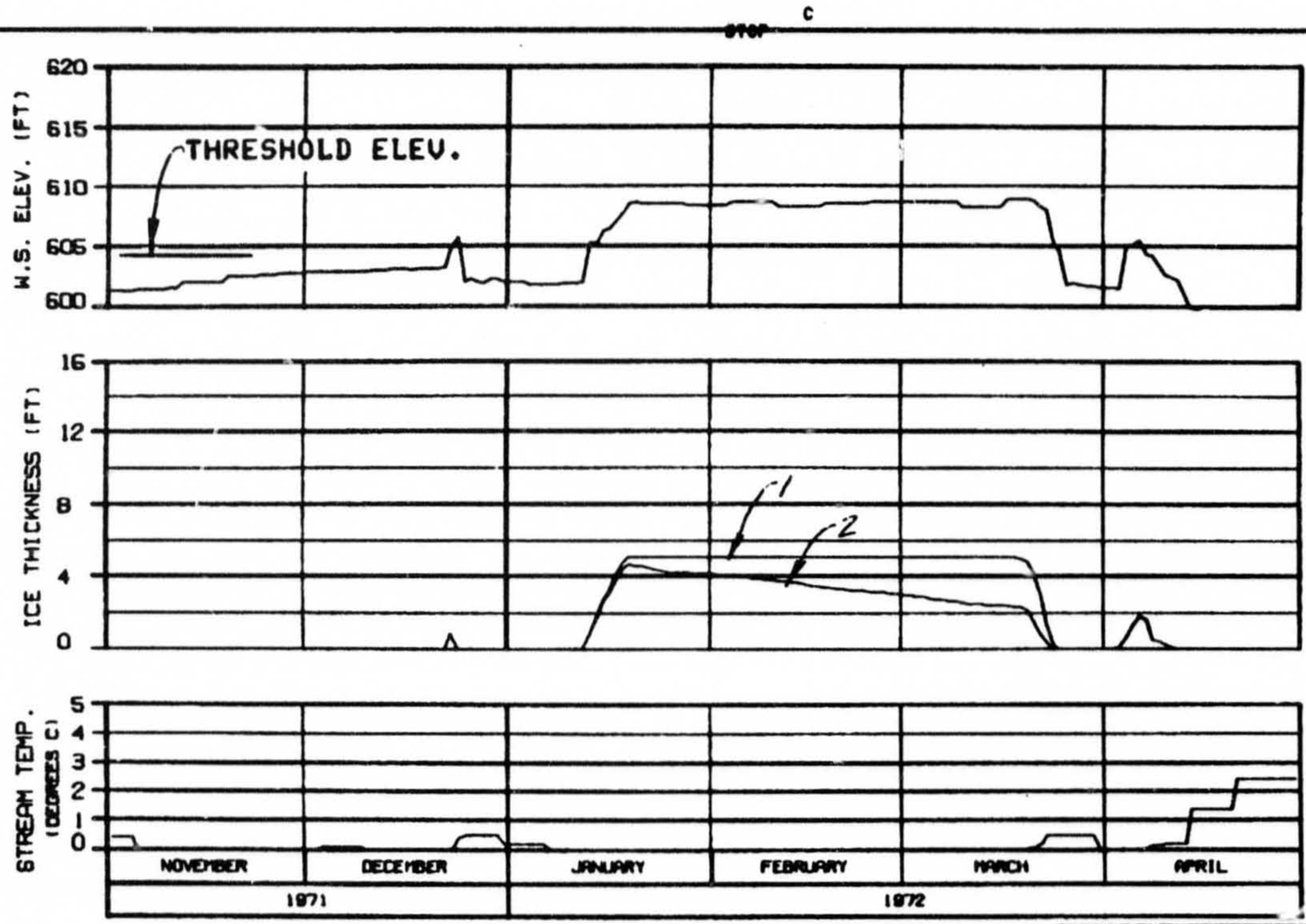
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

HEAD OF SLOUGH 9

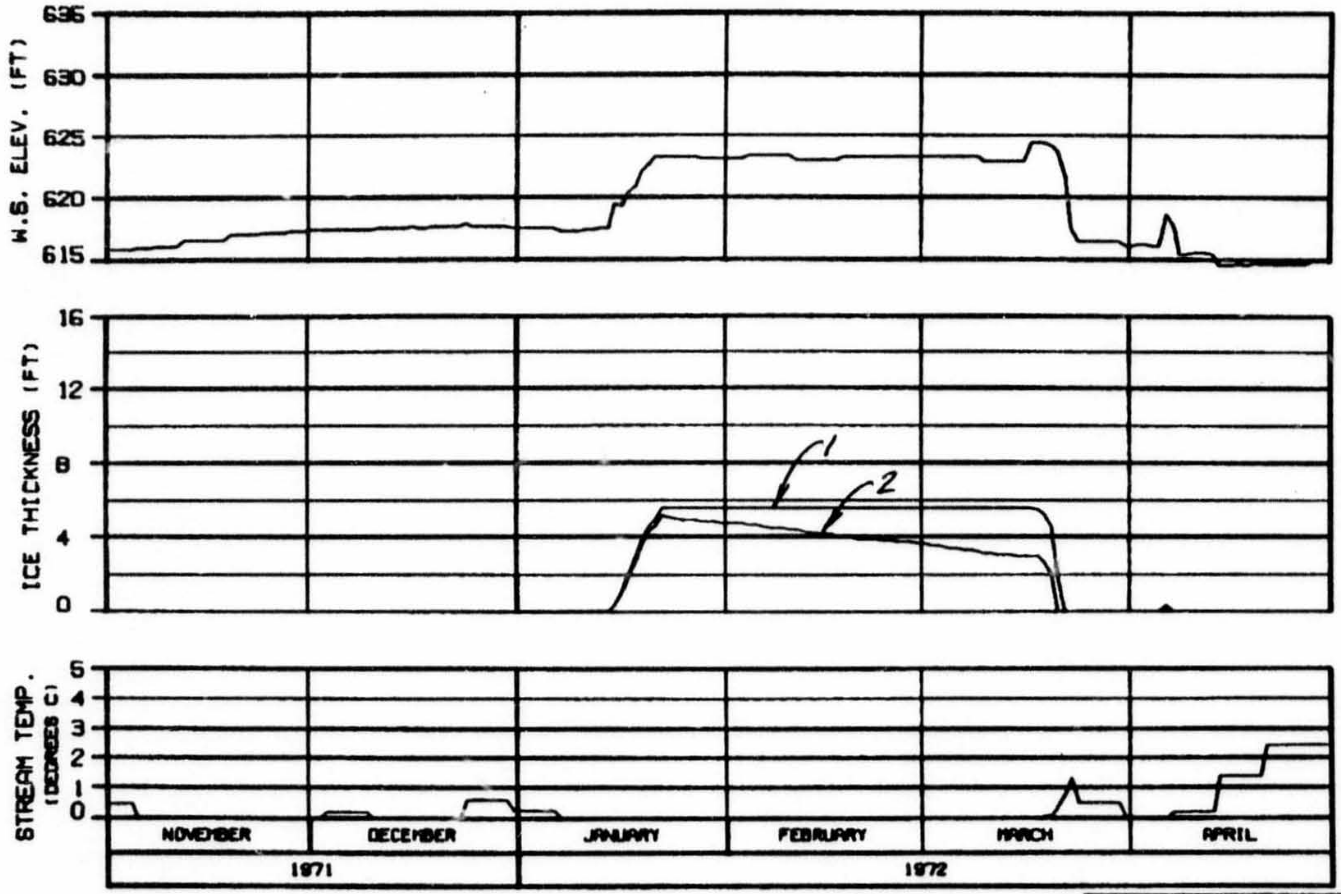
RIVER MILE : 129.30

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

OPTION?

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

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

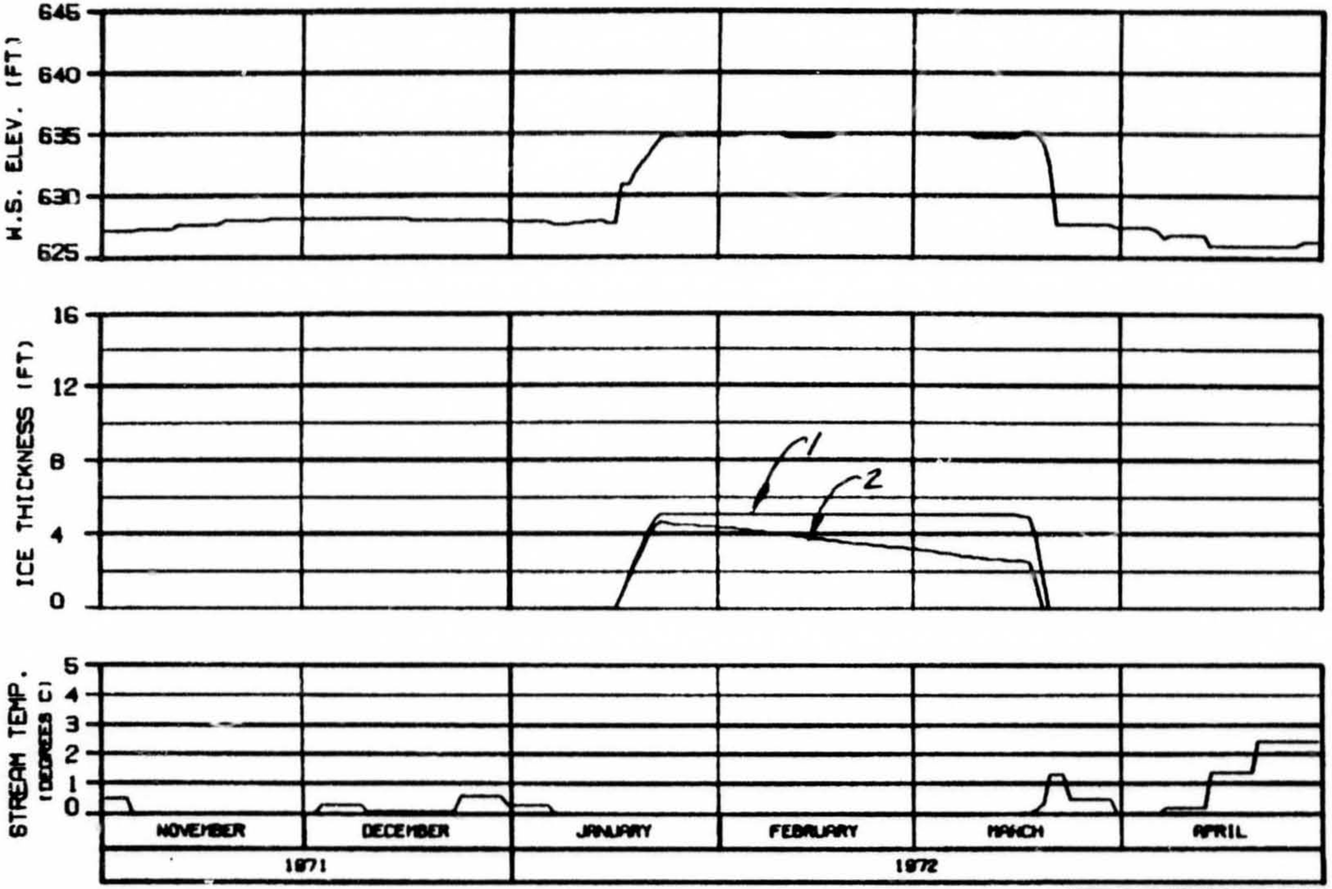
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C   TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

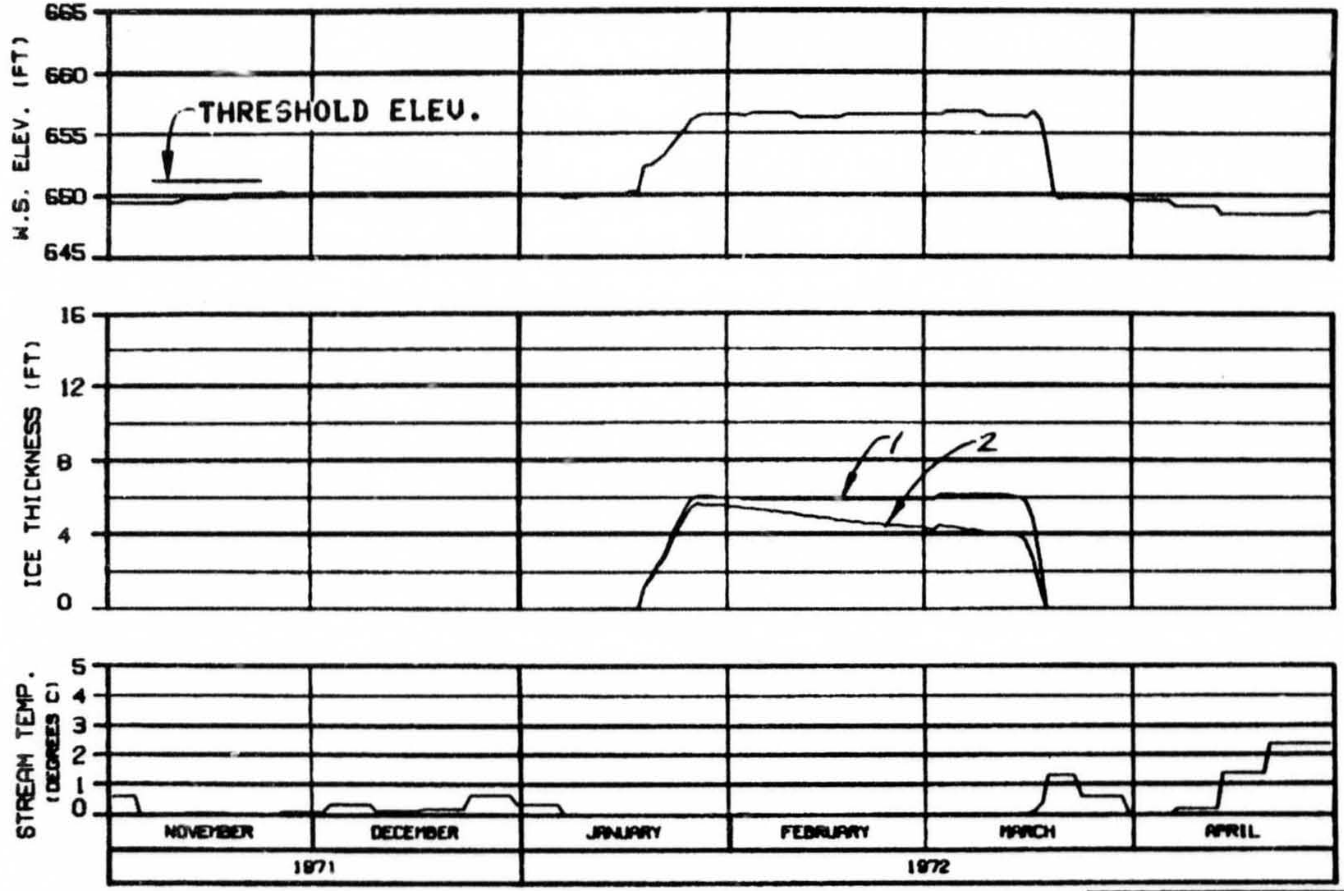
RIVER MILE : 131.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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



HEAD OF SLOUGH 9A

RIVER MILE : 133.70

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ICE THICKNESS LEGEND:

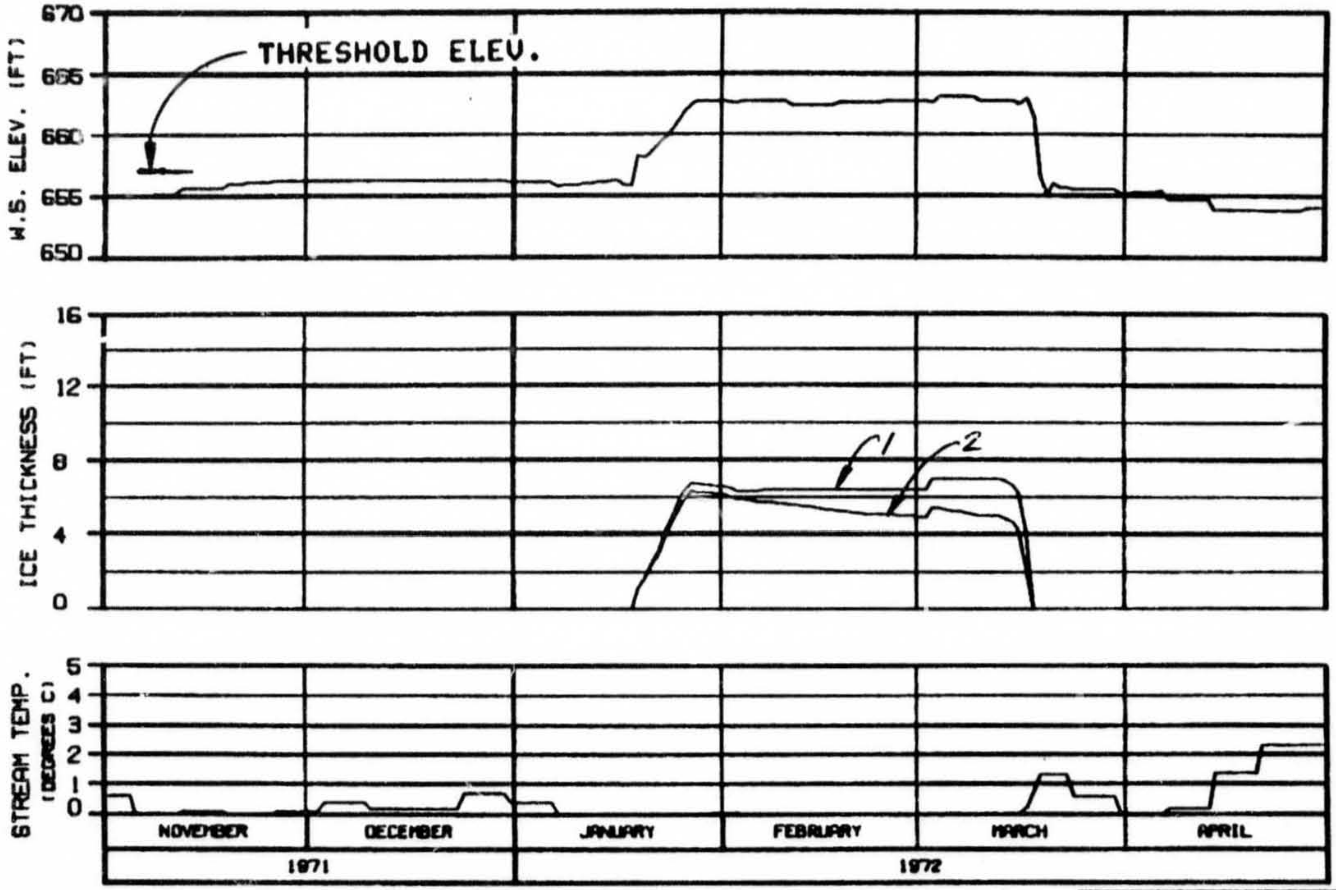
1. TOTAL THICKNESS
2. SLUSH COMPONENT

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

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ICE THICKNESS LEGEND:

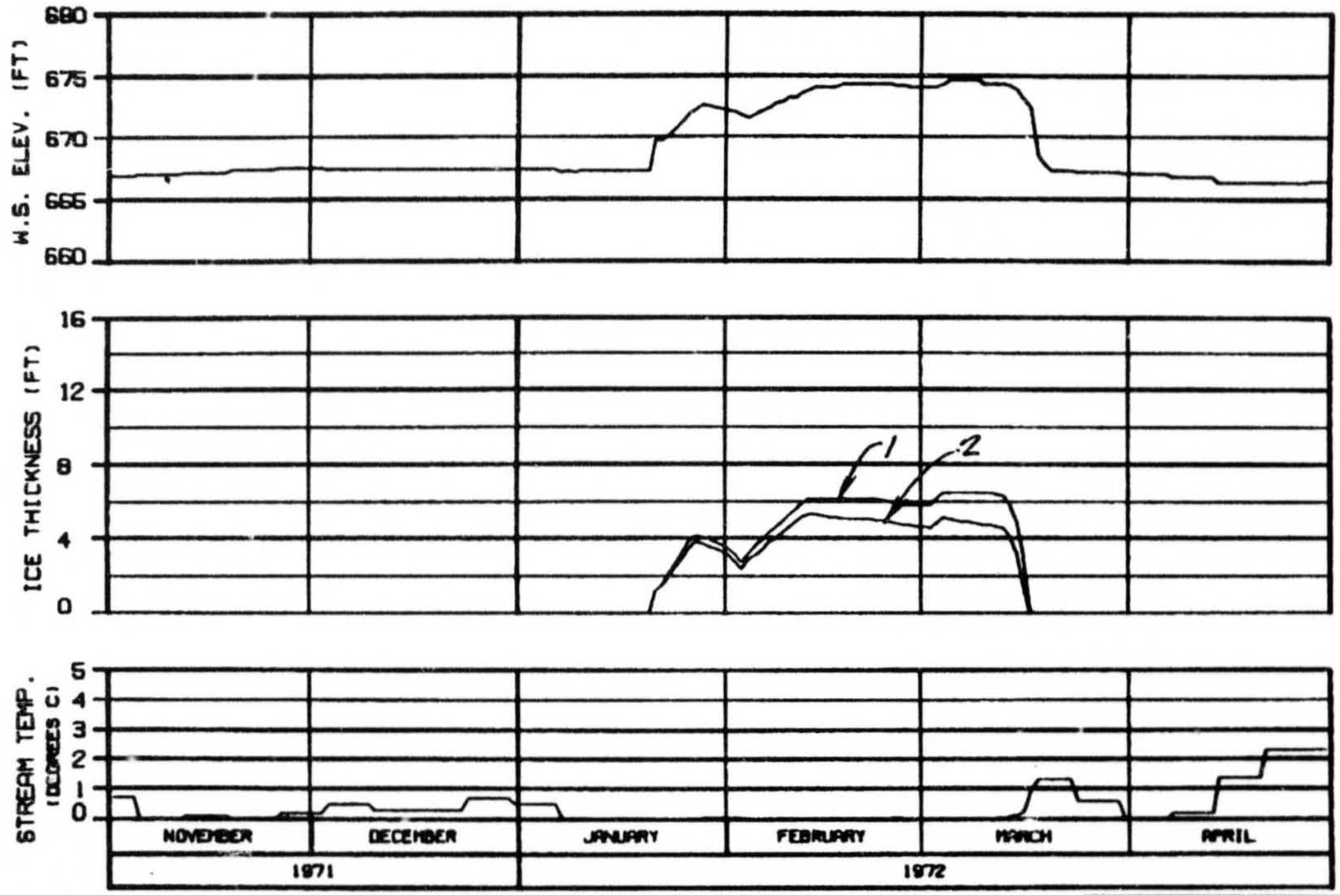
1. TOTAL THICKNESS
2. SLUSH COMPONENT

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

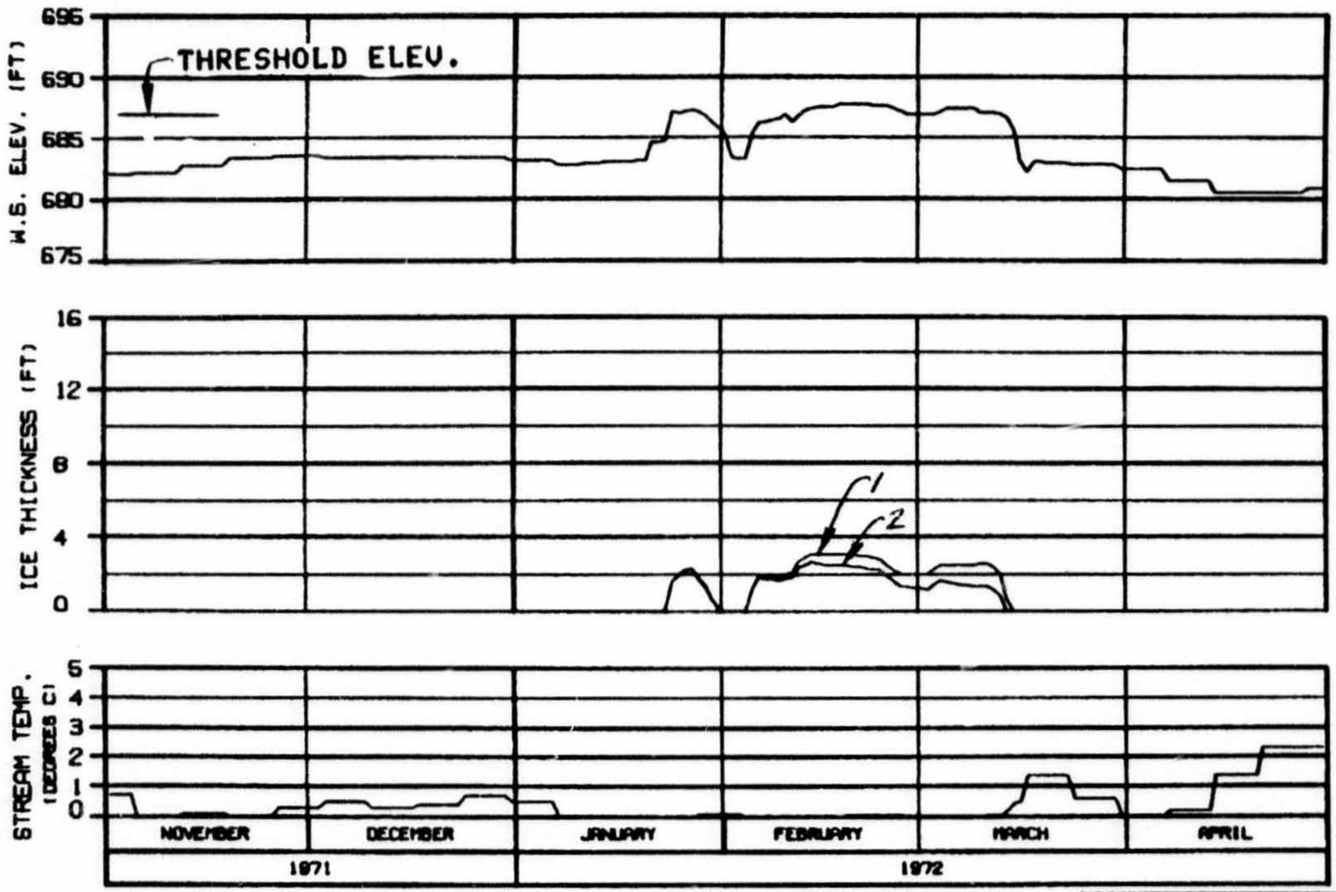
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 11

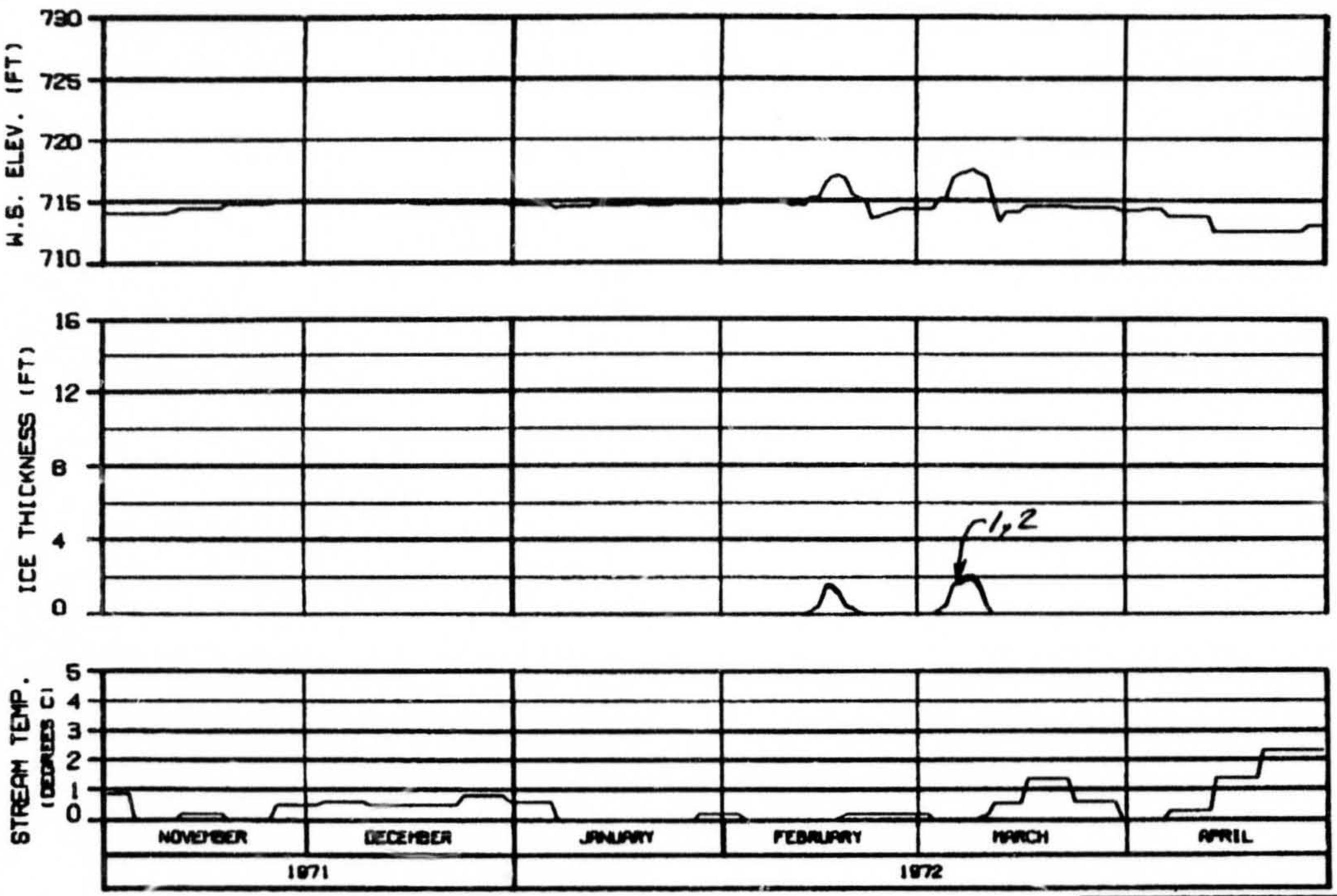
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

ICE THICKNESS LEGEND:

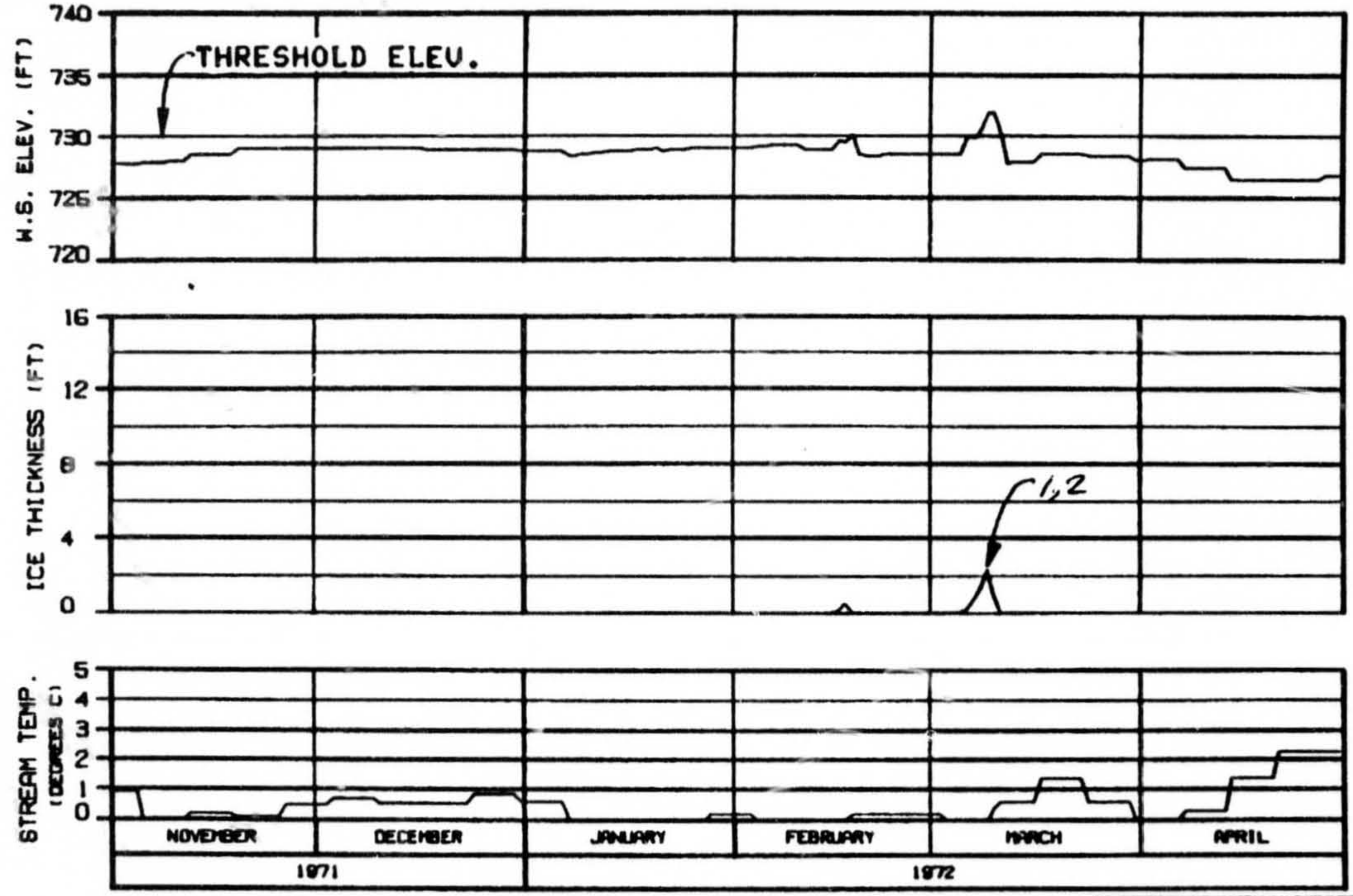
1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 20

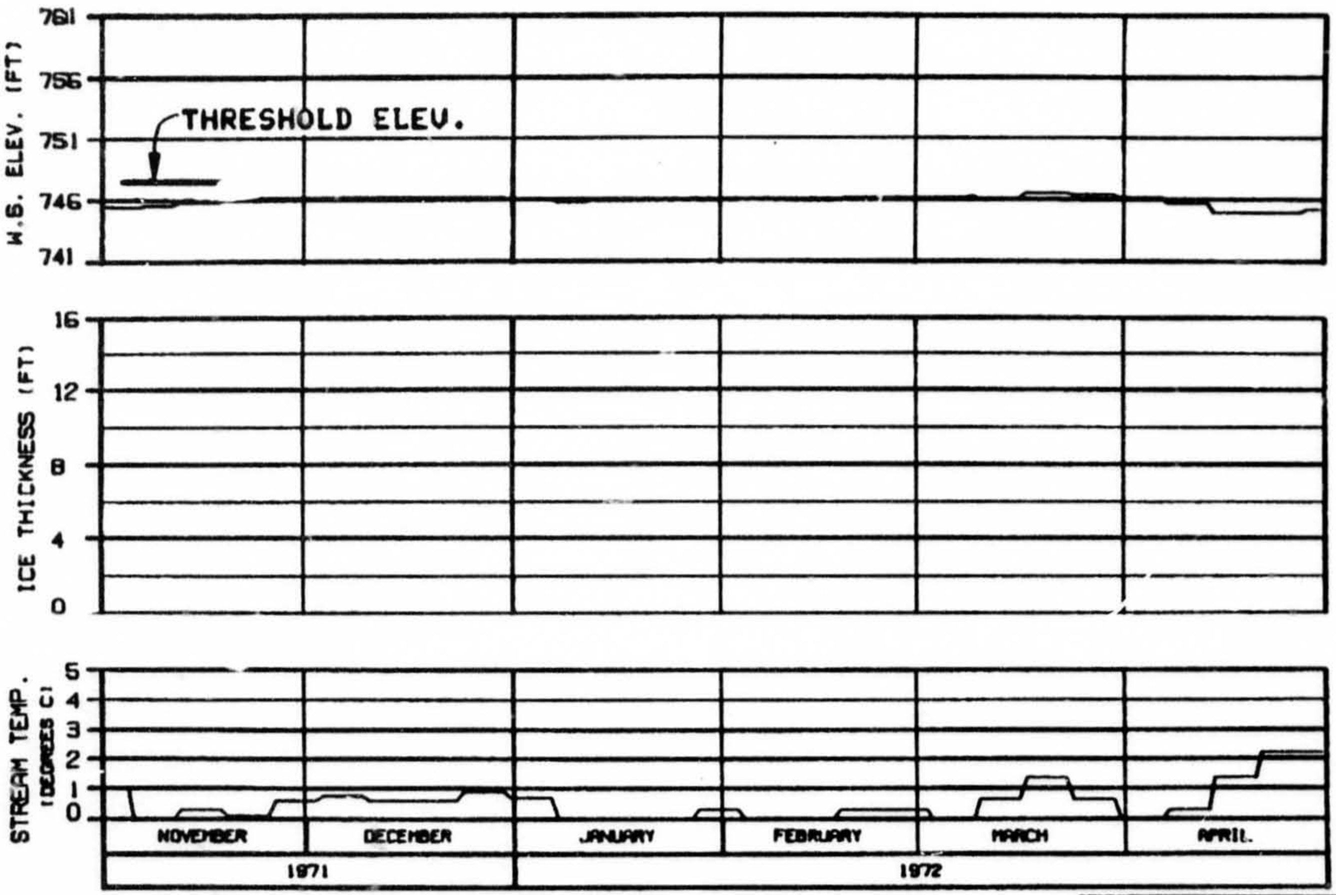
RIVER MILE : 140.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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



SLOUGH 21 (ENTRANCE A6)

RIVER MILE : 141.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

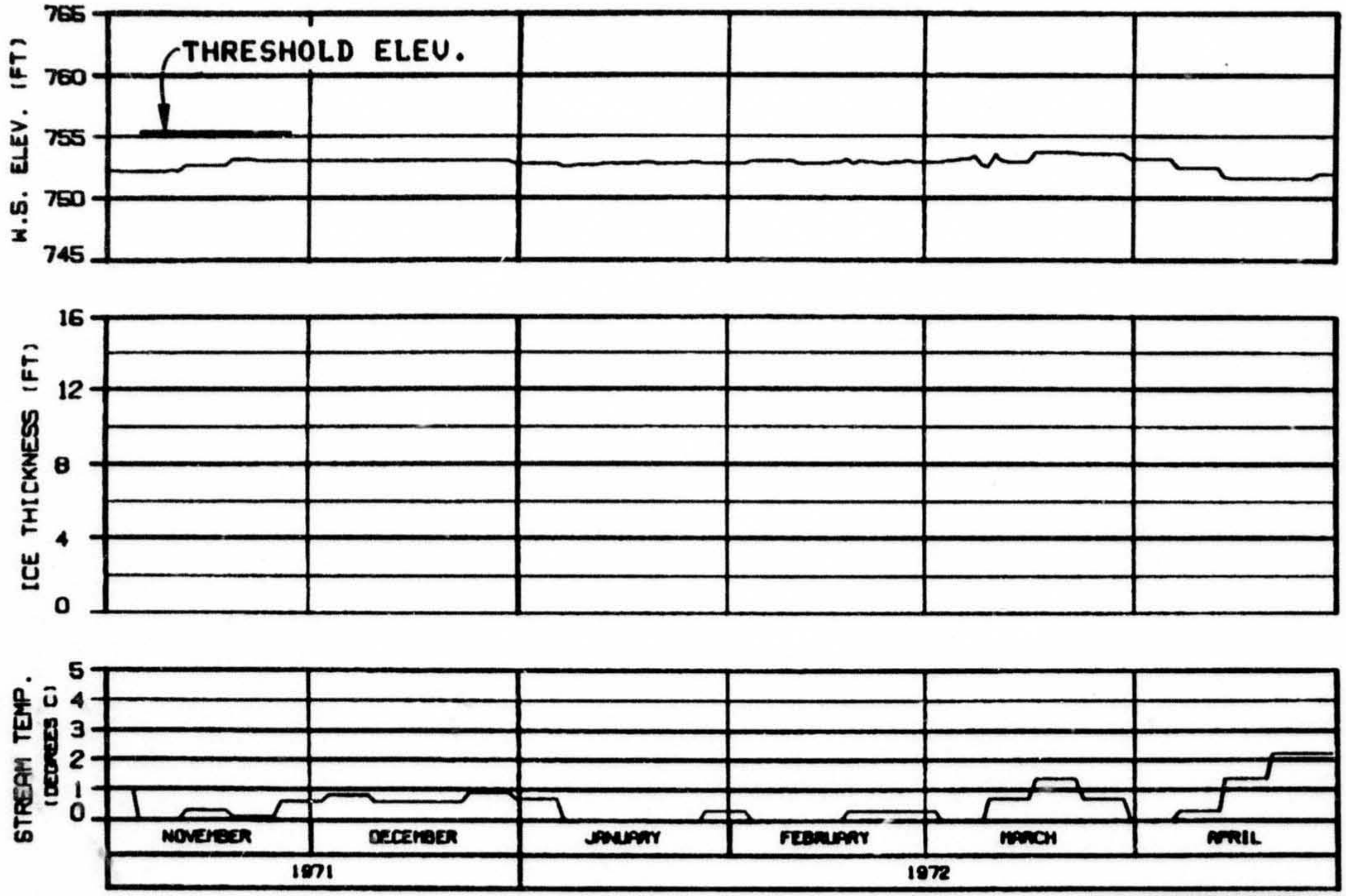
WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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:

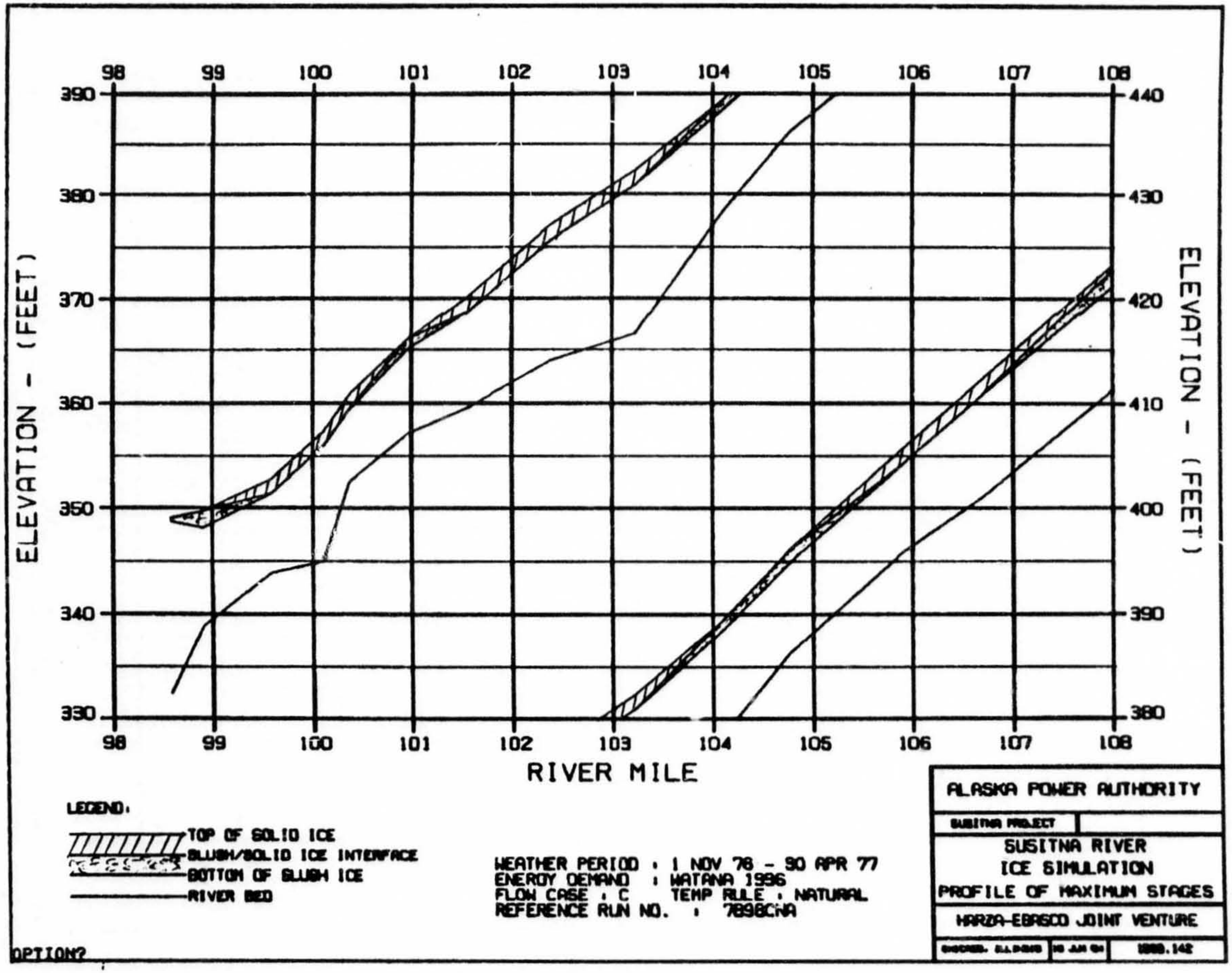
1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 71 - 30 APR 72
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7196CNA

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

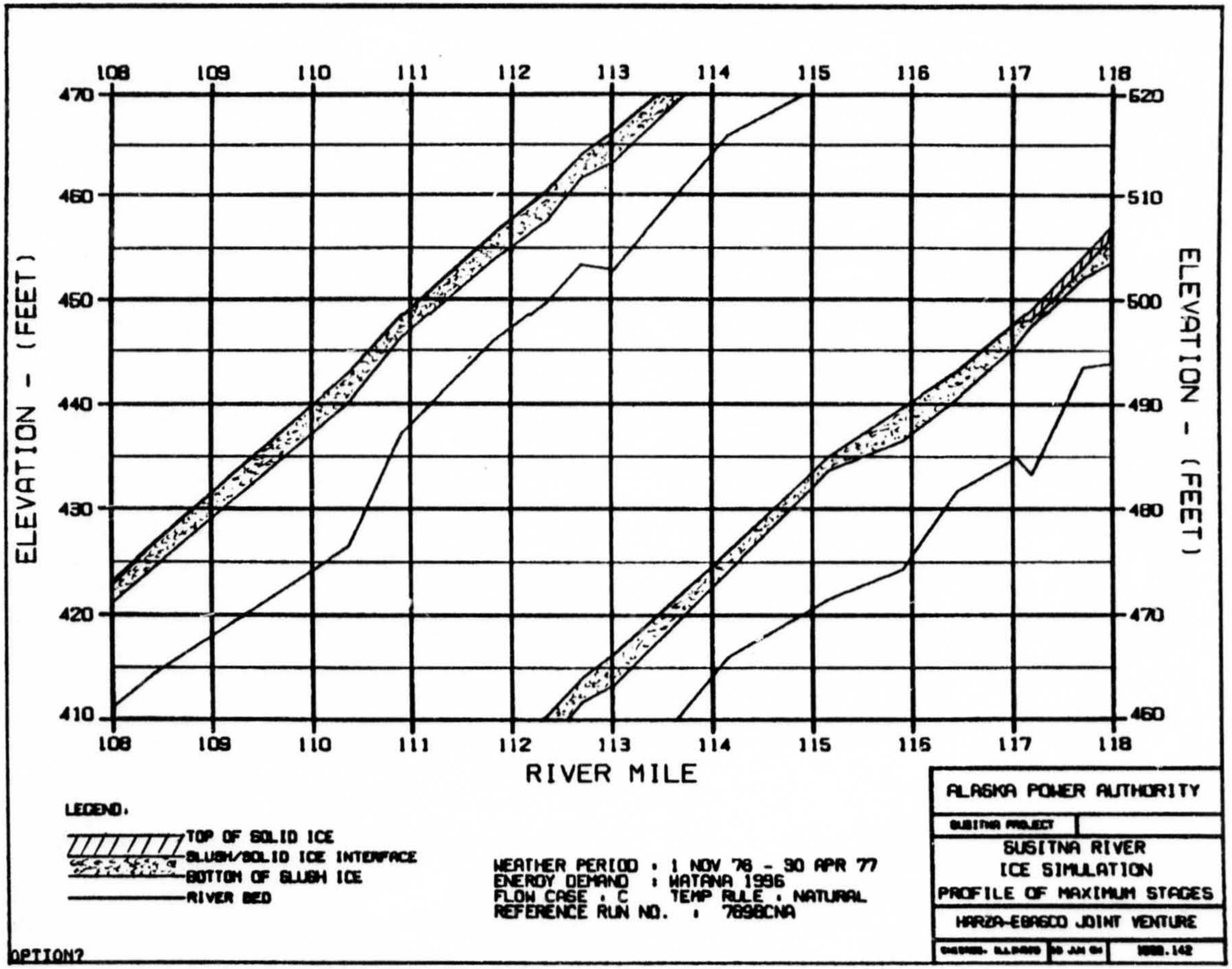
EXHIBIT F

C



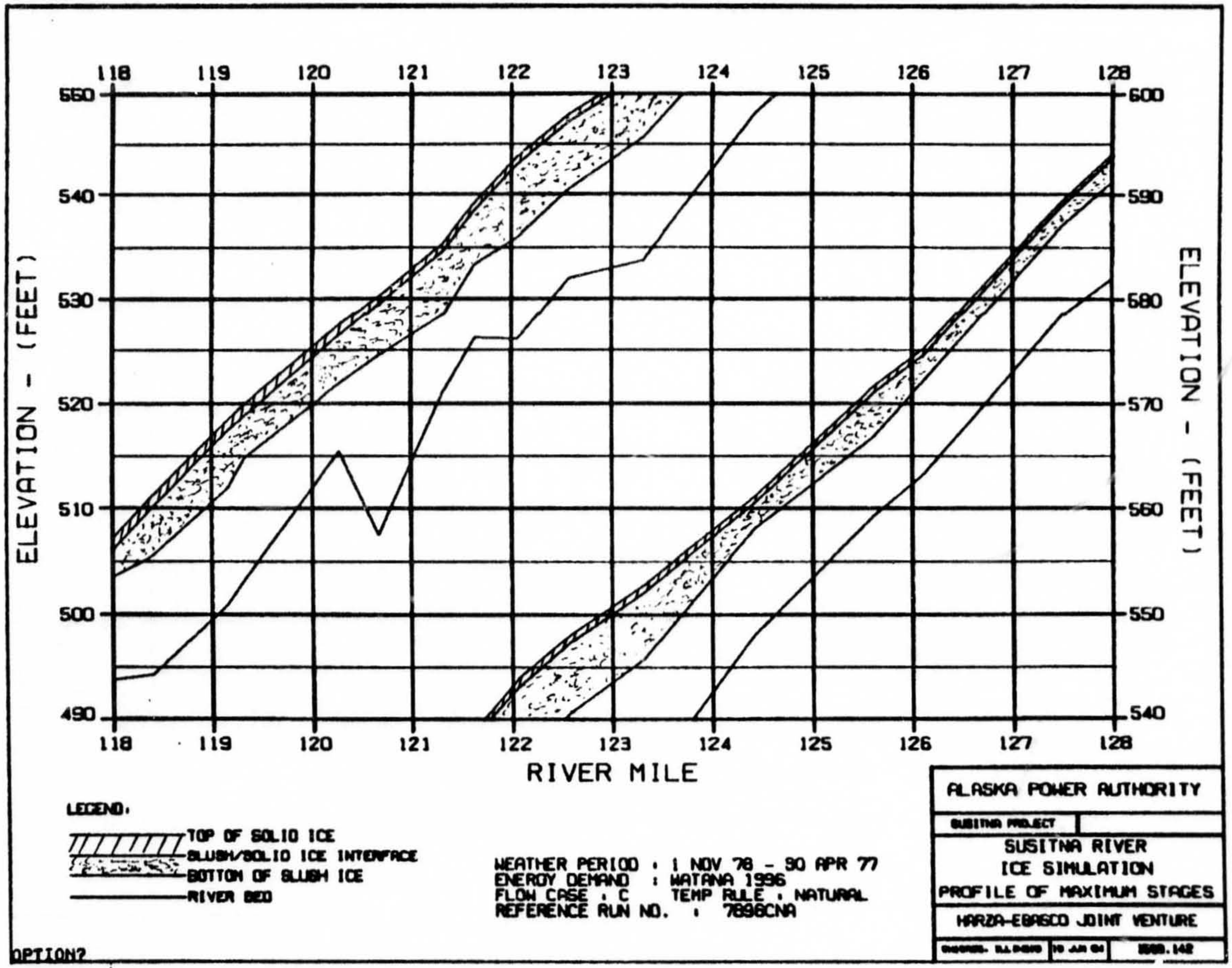
98
99
100
101
102
103
104
105
106
107
108
390
380
370
360
350
340
330
440
430
420
410
400
390
380
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C

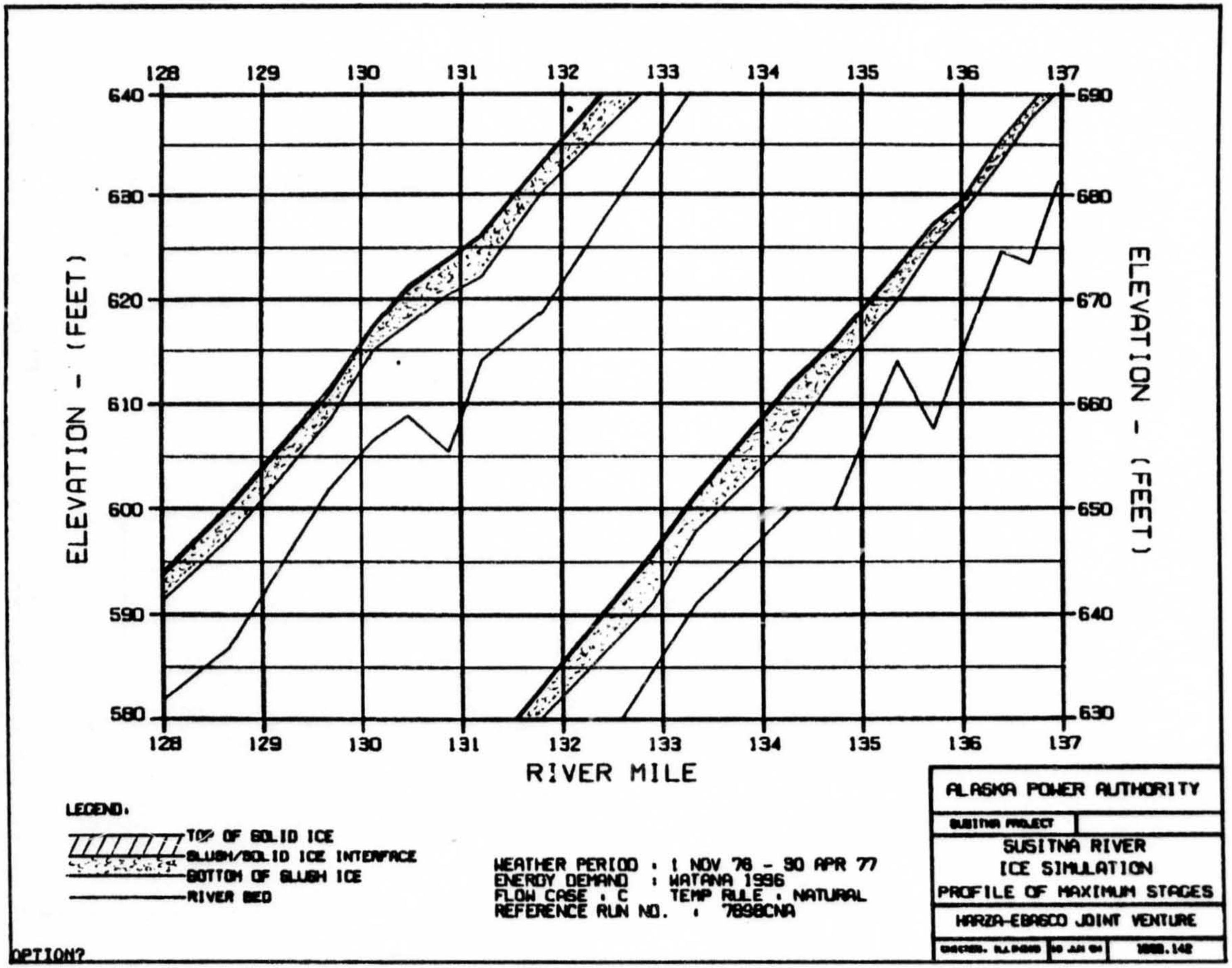


108 109 110 111 112 113 114 115 116 117 118
470 460 450 440 430 420 410
520 510 500 490 480 470 460
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1080.142
OPTION?

C

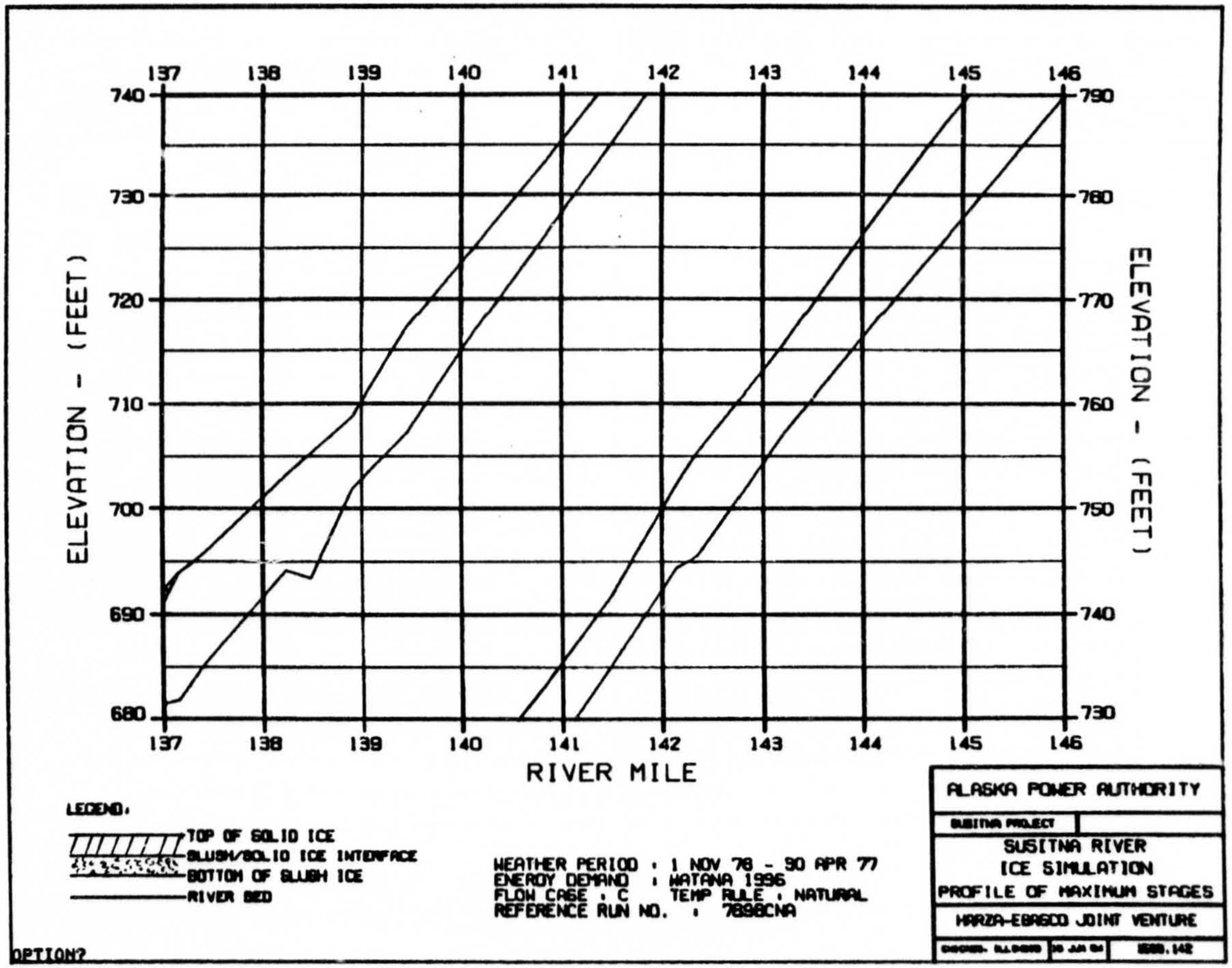

ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7896CNA
OPTION?
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

C



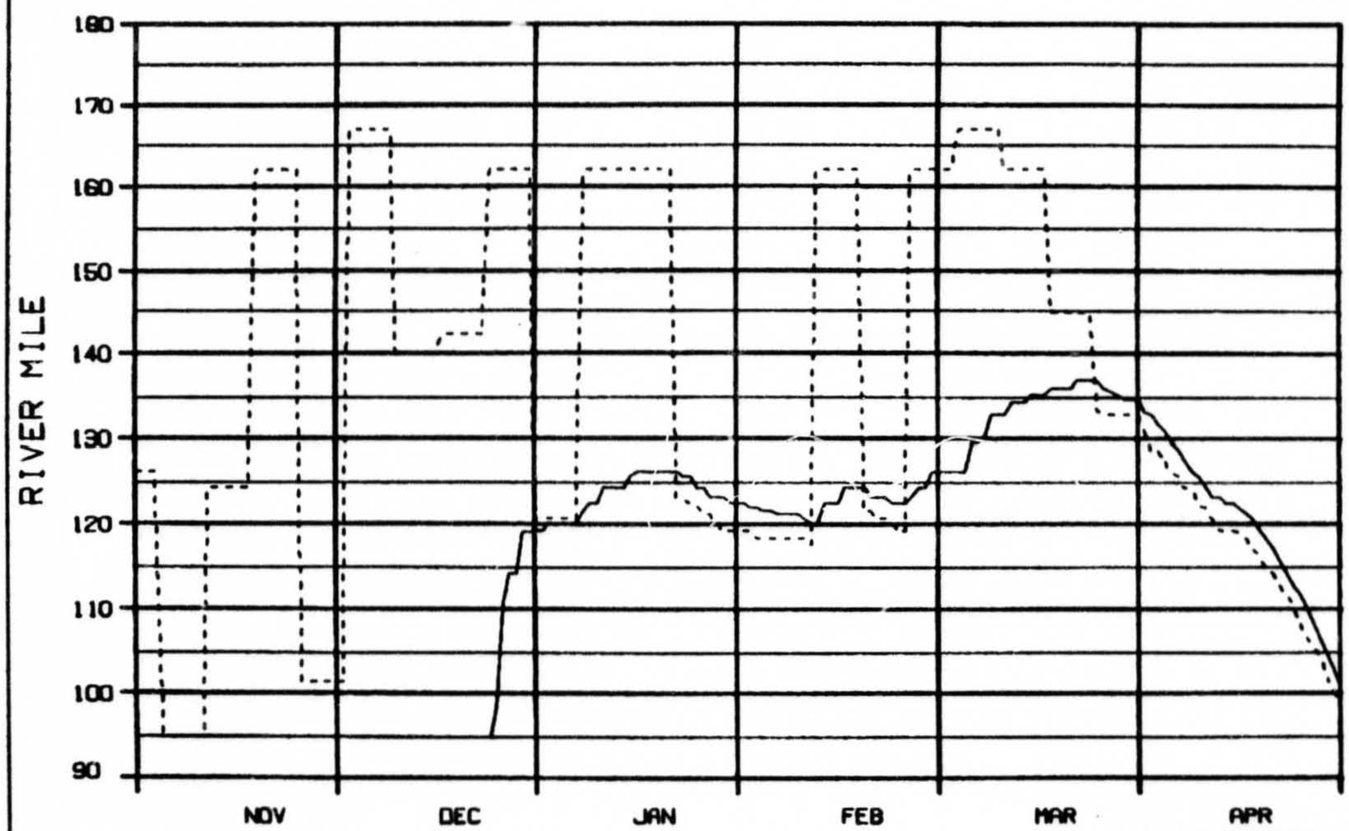
128 129 130 131 132 133 134 135 136 137
640 630 620 610 600 590 580
690 680 670 660 650 640 630
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C



137 138 139 140 141 142 143 144 145 146
740
730
720
710
700
690
680
790
780
770
760
750
740
730
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7898CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C

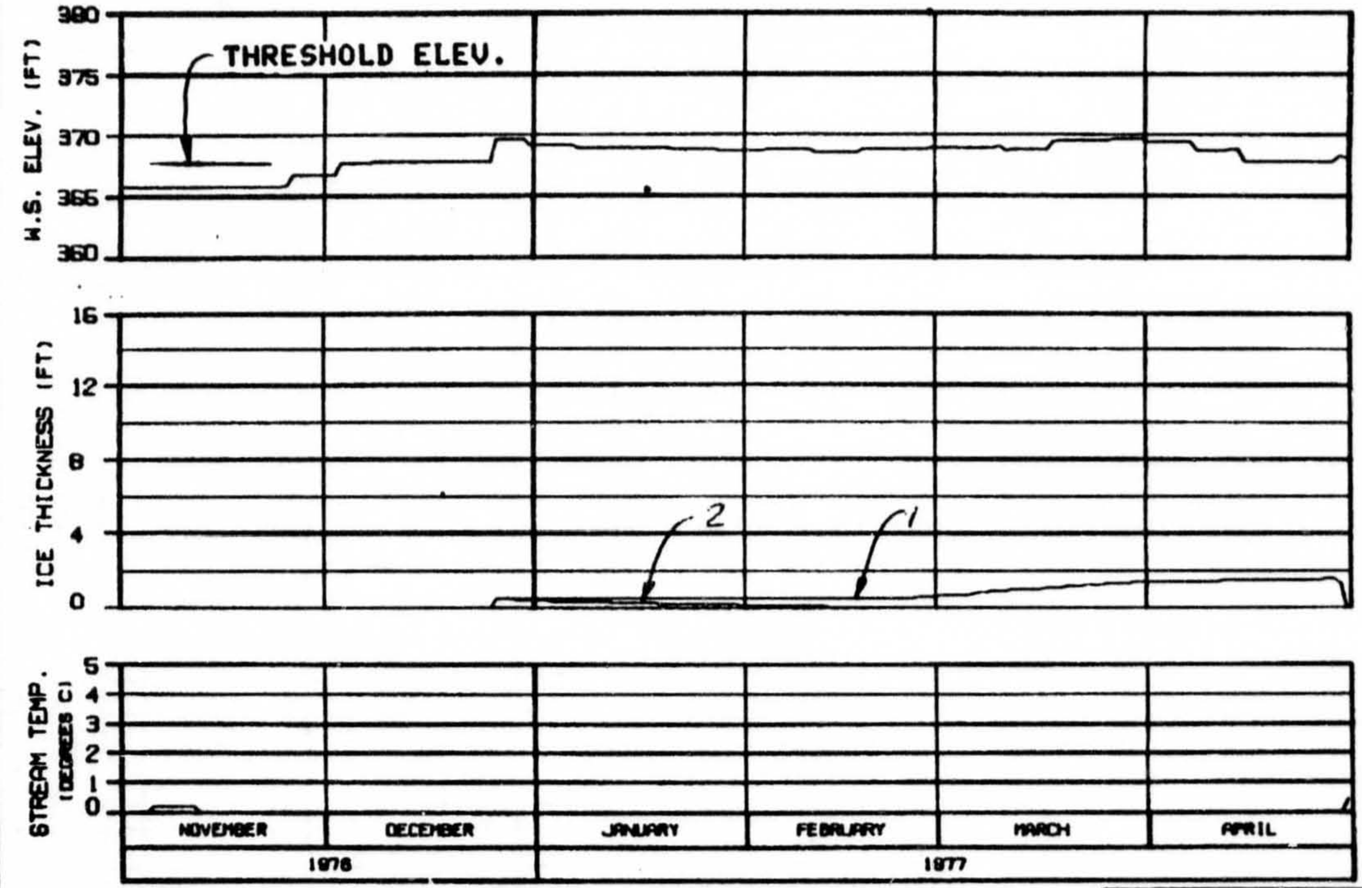


LEGEND:
ICE FRONT
ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE

OPTION?OPTION?



HEAD OF WHISKERS SLOUGH

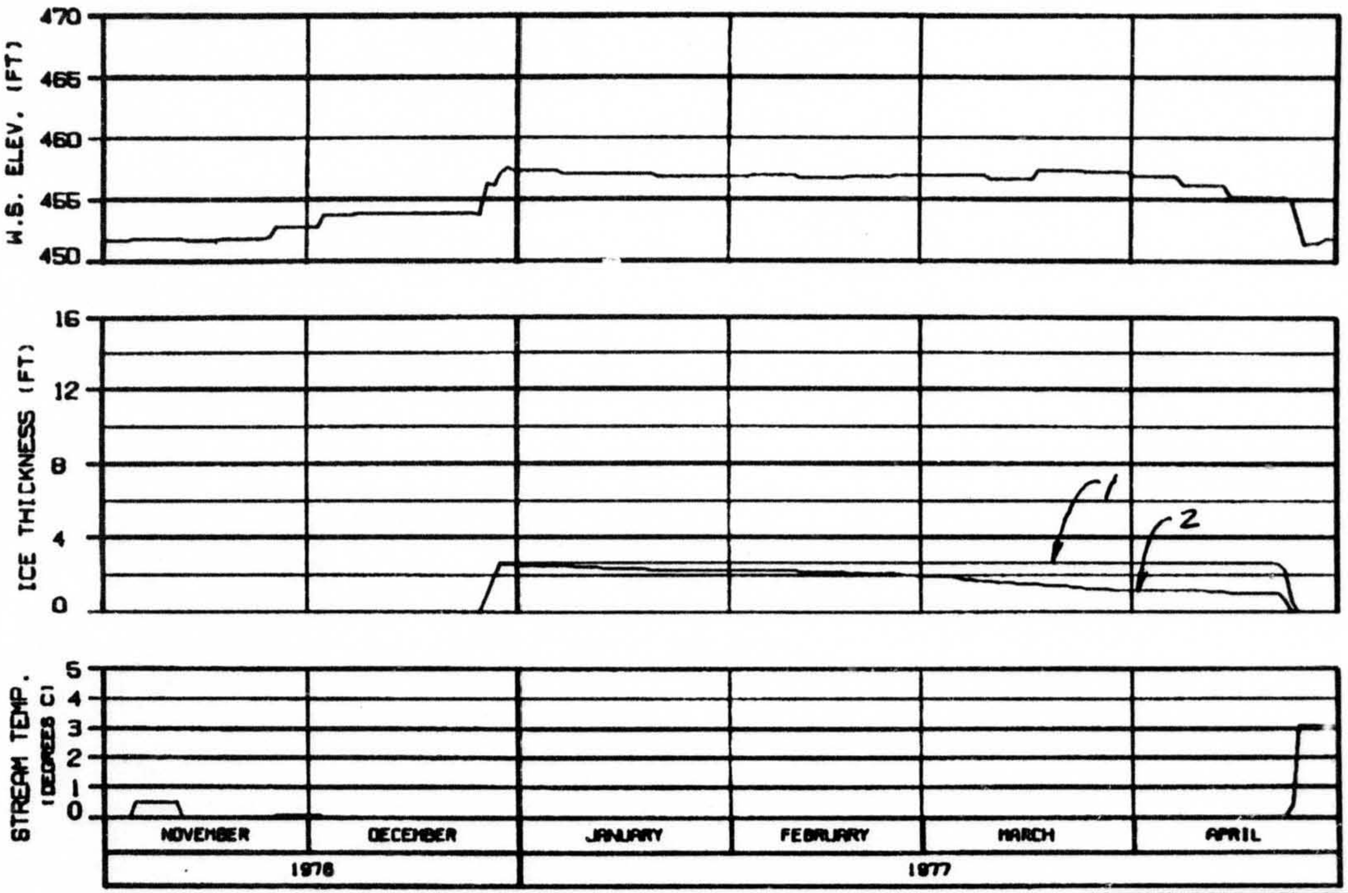
RIVER MILE : 101.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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



SIDE CHANNEL AT HEAD OF GASH CREEK

RIVER MILE : 112.00

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ICE THICKNESS LEGEND:

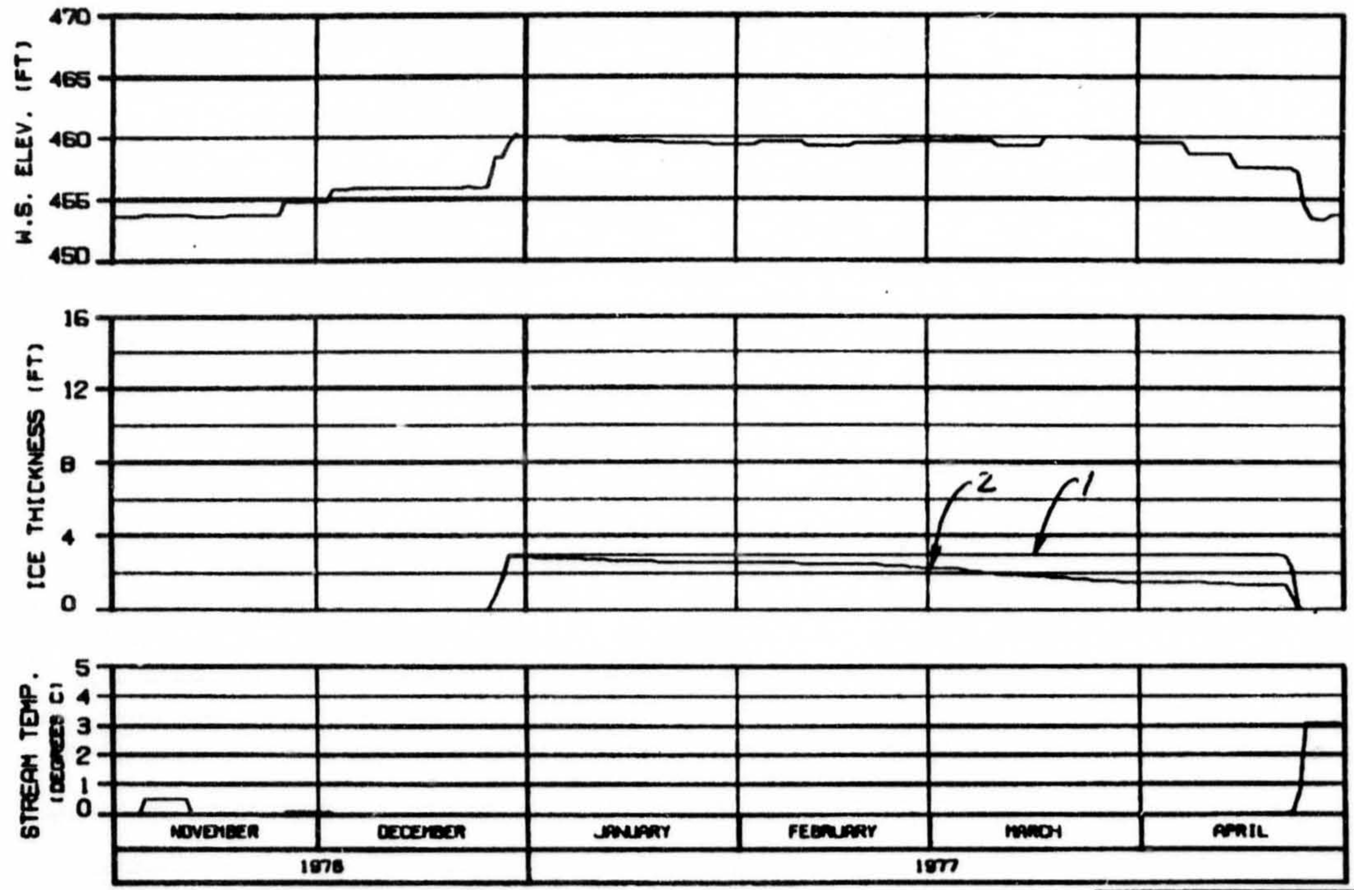
1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



MOUTH OF SLOUGH 6A

RIVER MILE : 112.34

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ICE THICKNESS LEGEND:

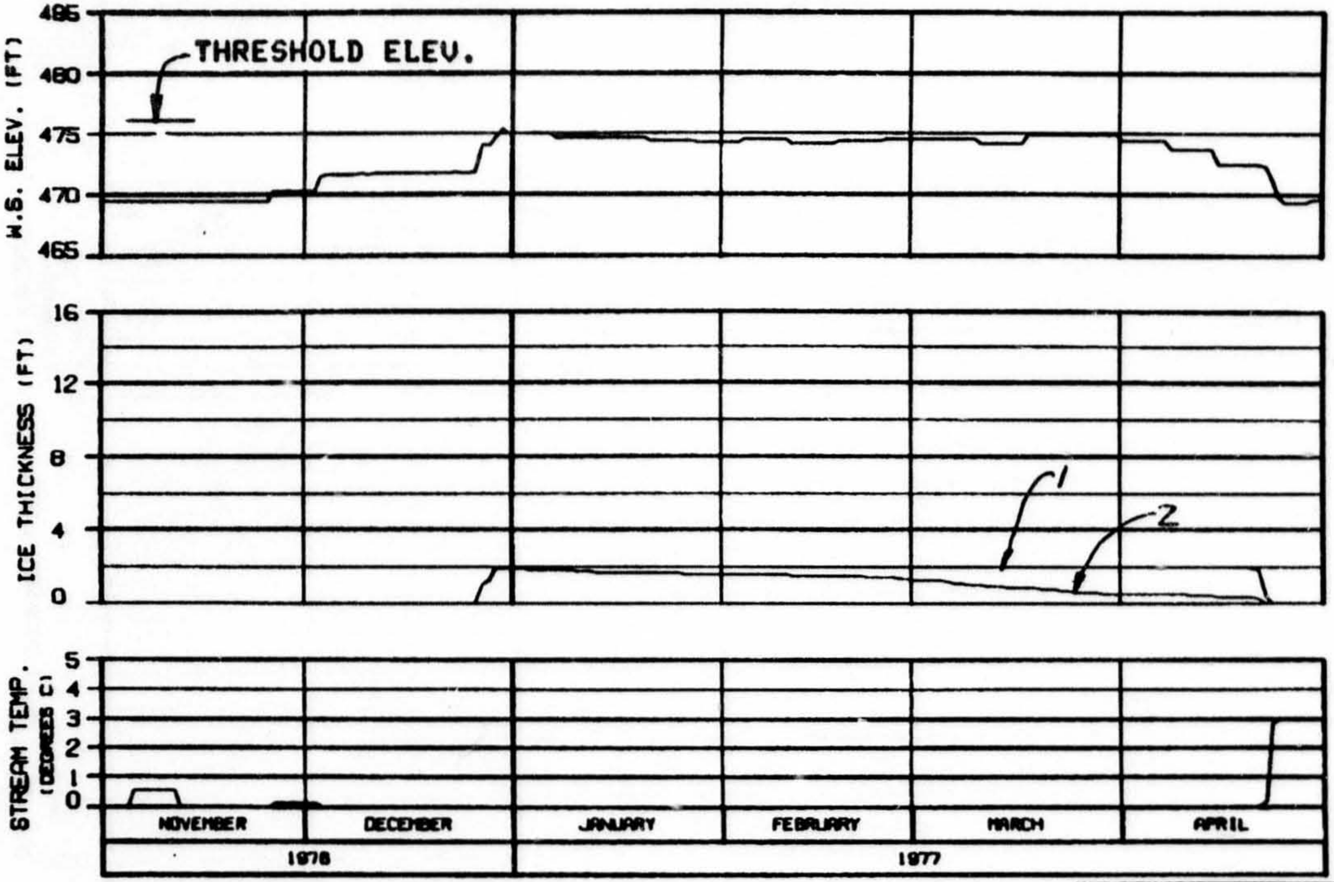
1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8

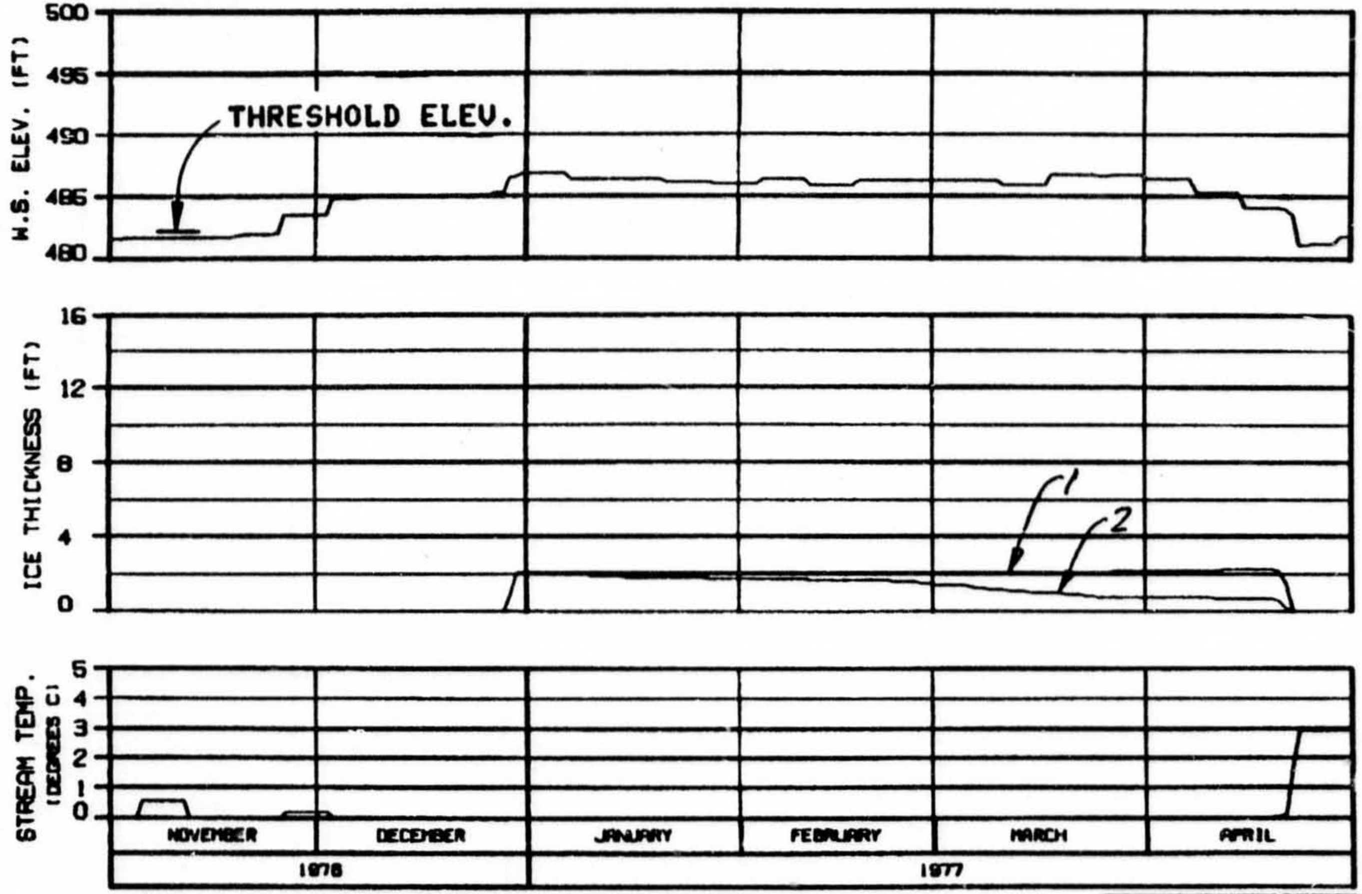
RIVER MILE : 114.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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



SIDE CHANNEL MSII

RIVER MILE : 115.50

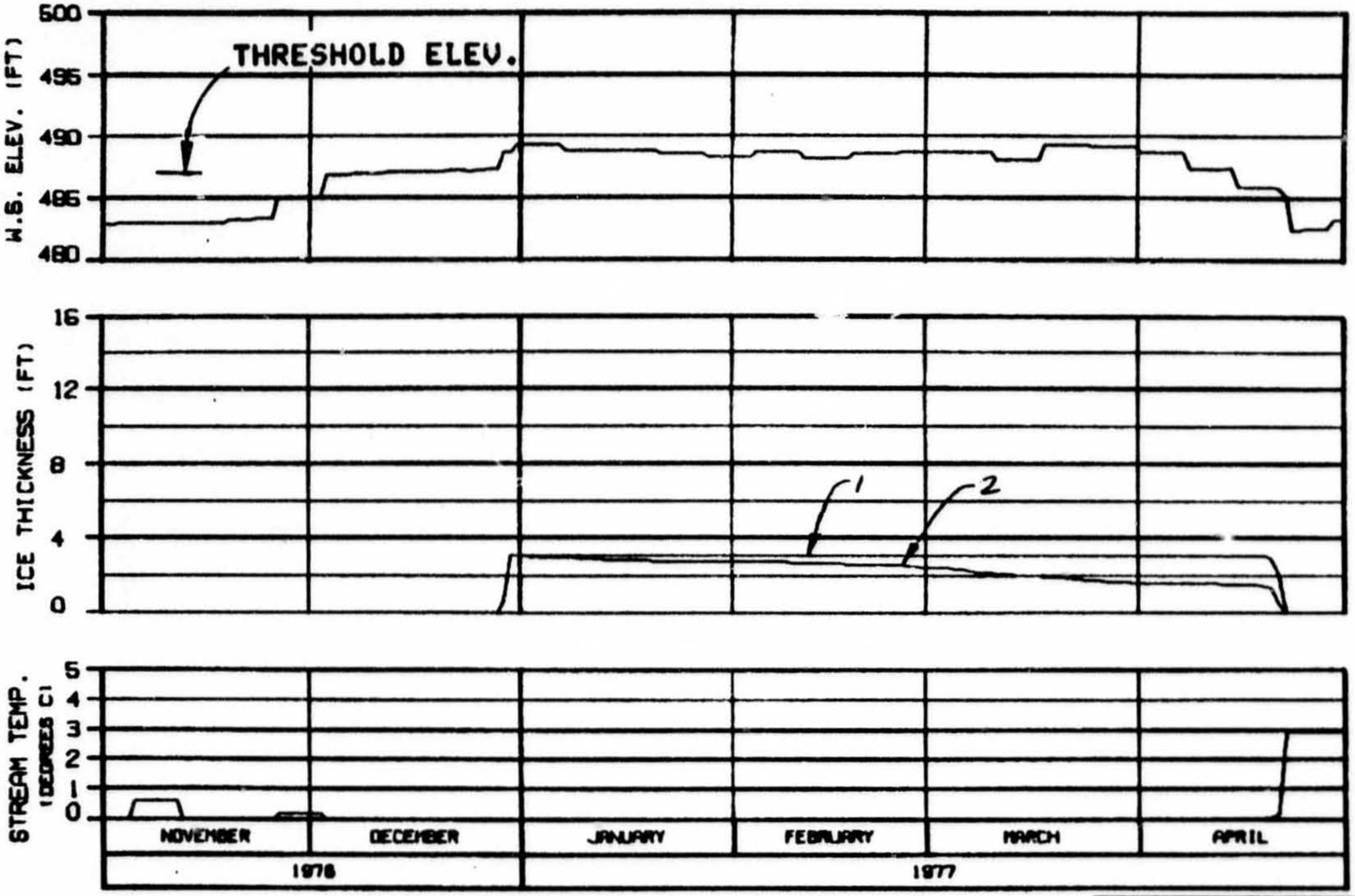
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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

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



HEAD OF SIDE CHANNEL MSII

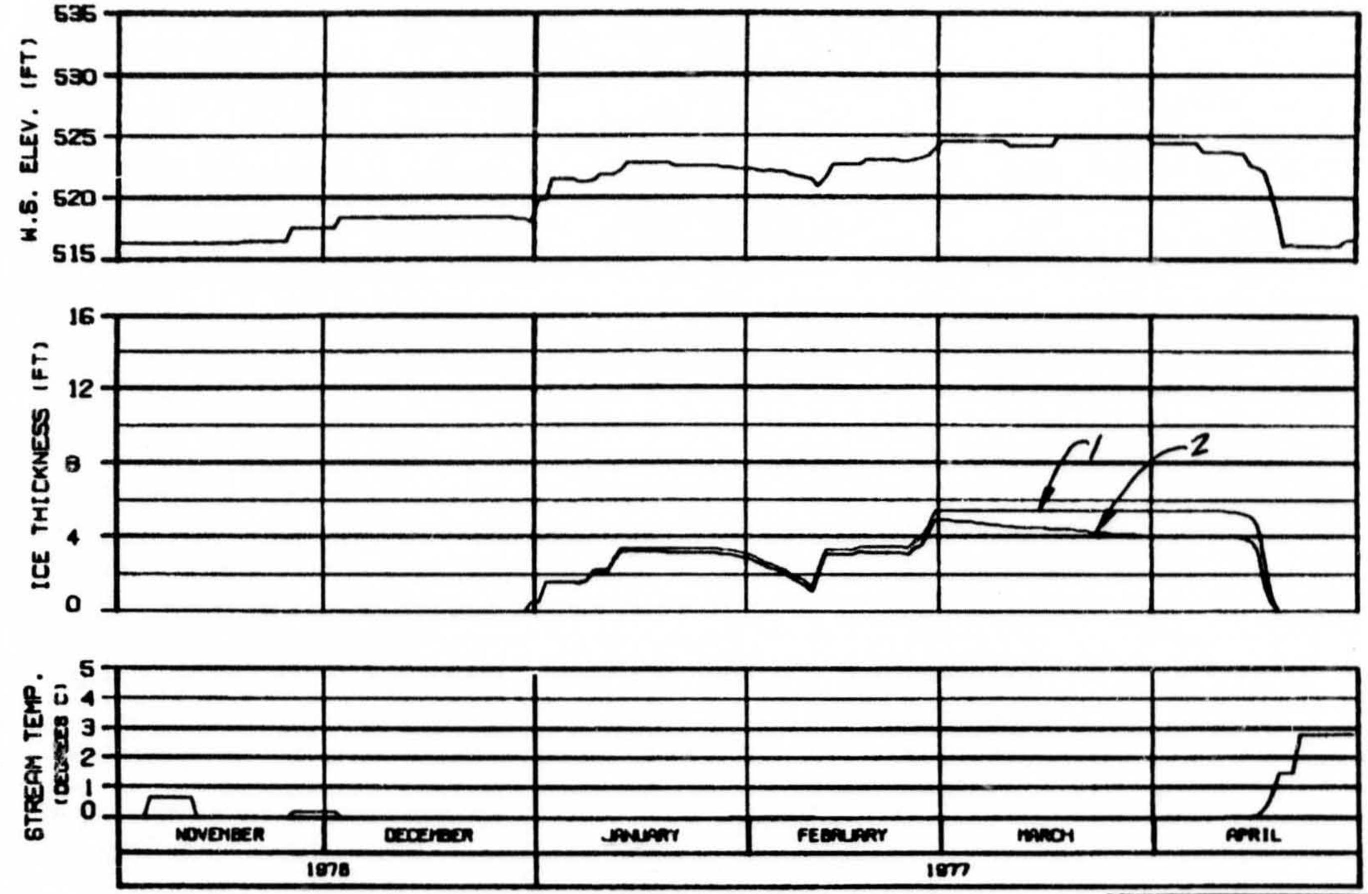
RIVER MILE : 115.90

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C   TEMP RULE : NATURAL
REFERENCE RUN NO. : [illegible]

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



ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

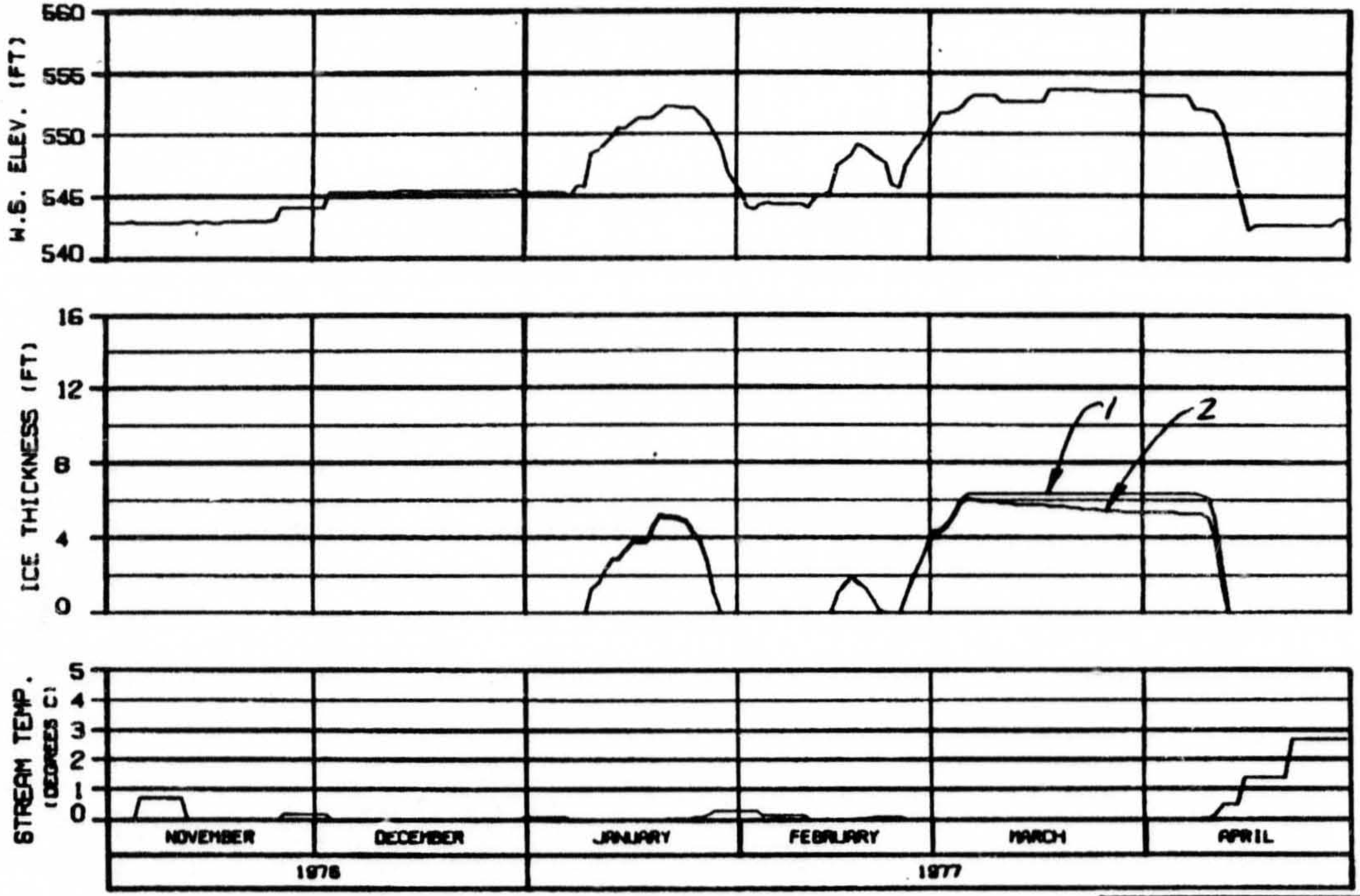
HARZA-EBASCO JOINT VENTURE

RIVER MILE : 120.00

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

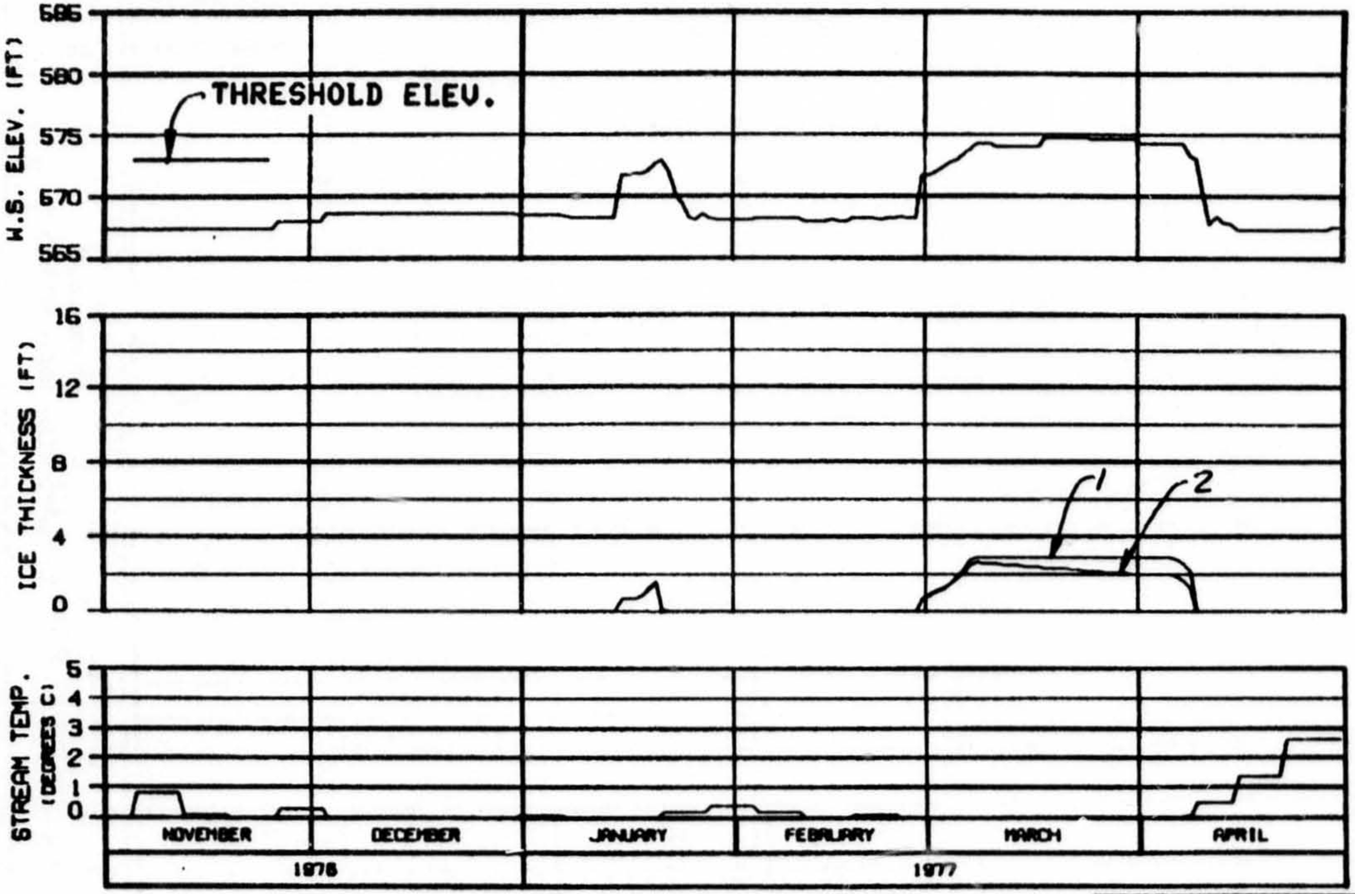
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8A (WEST)

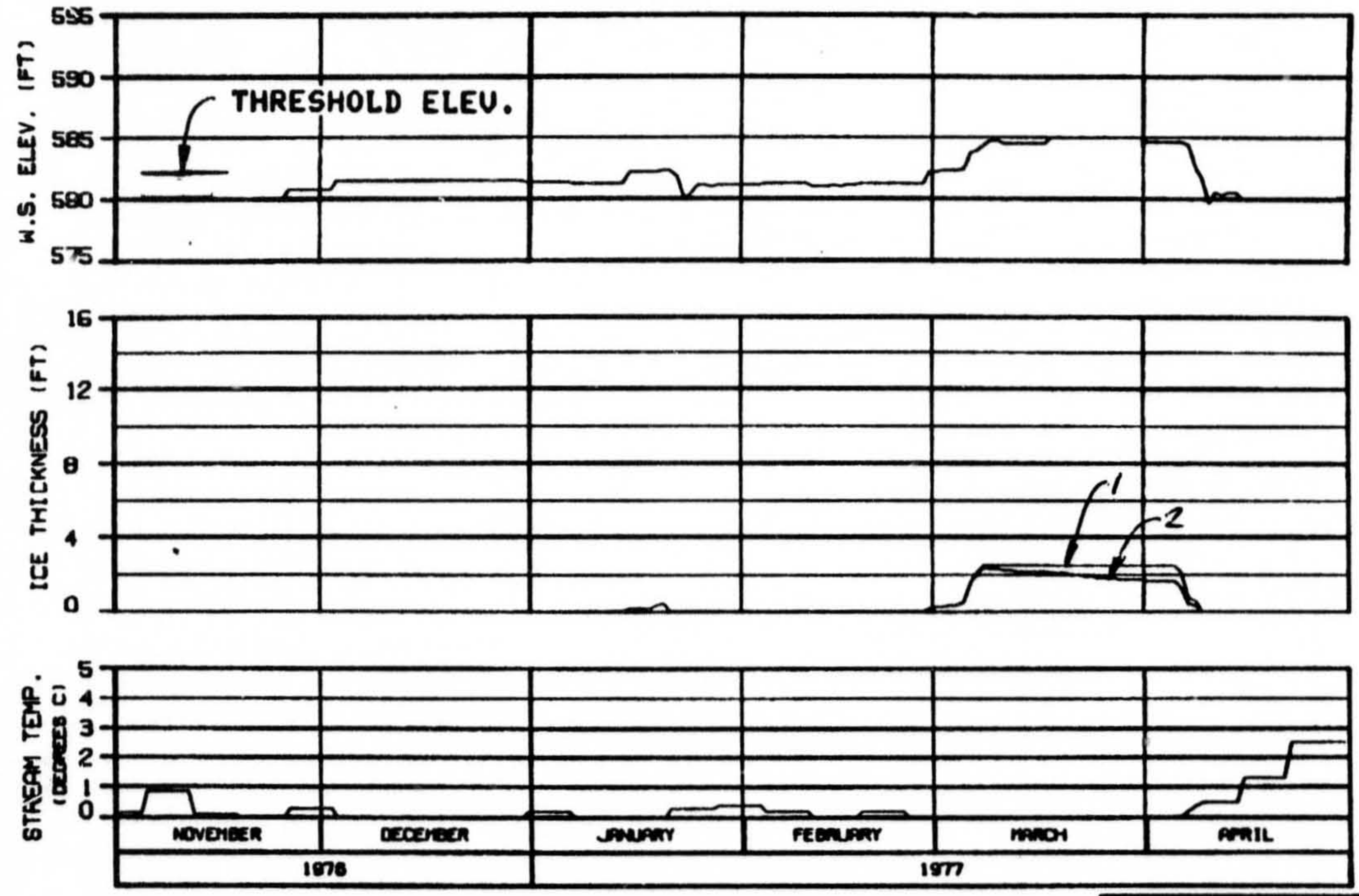
RIVER MILE : 126.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ICE THICKNESS LEGEND:

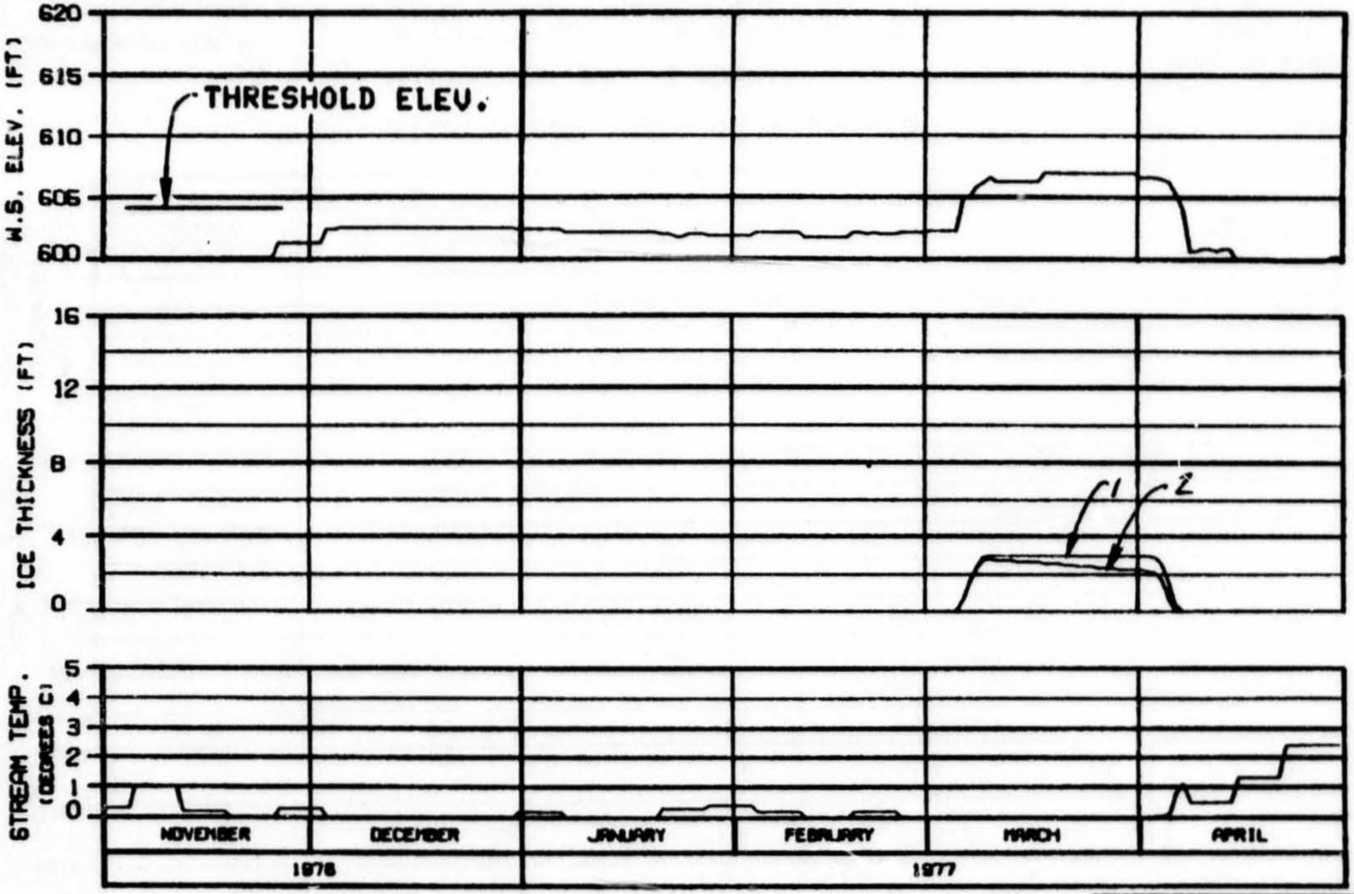
1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

OPTION?

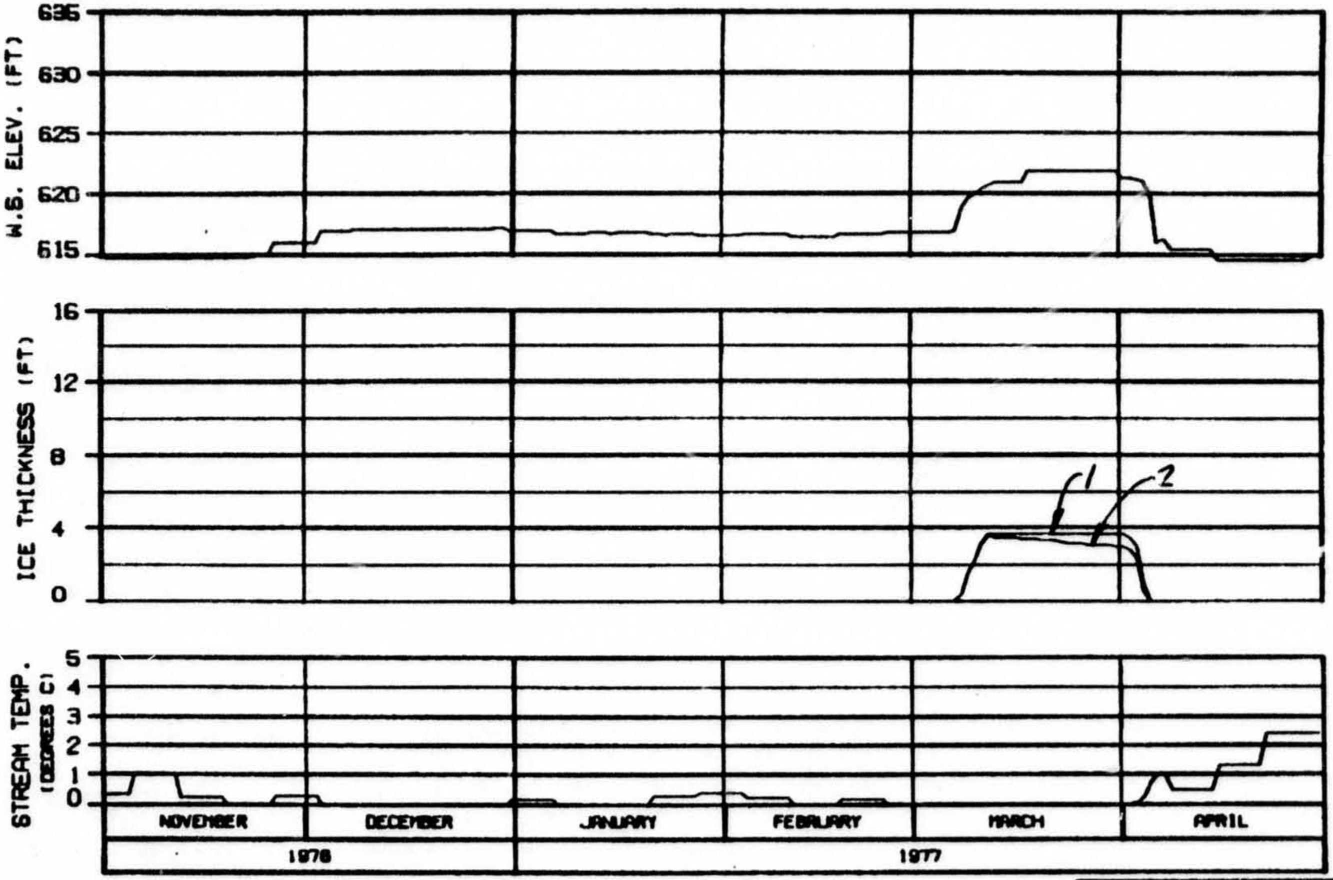
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

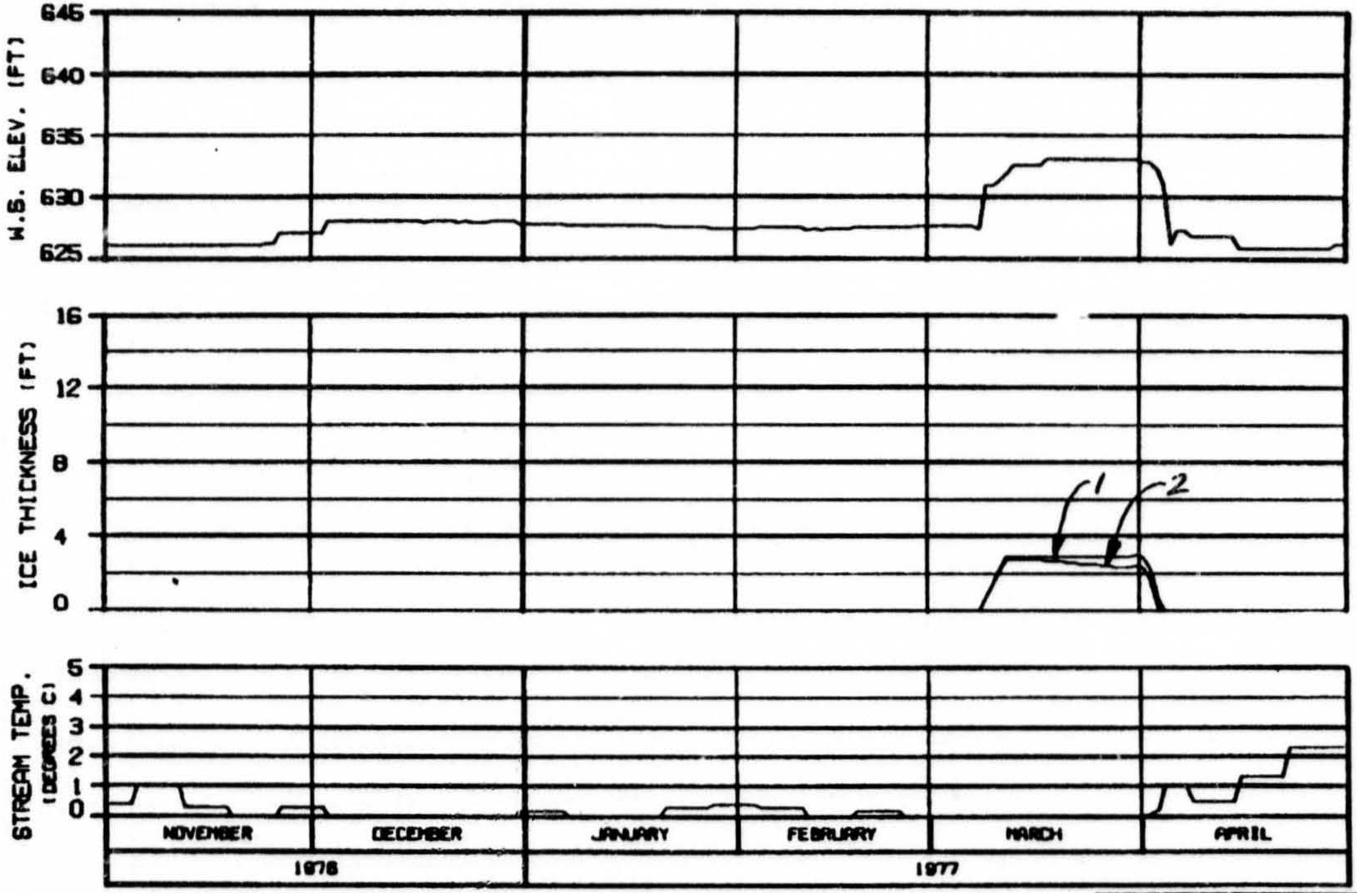
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

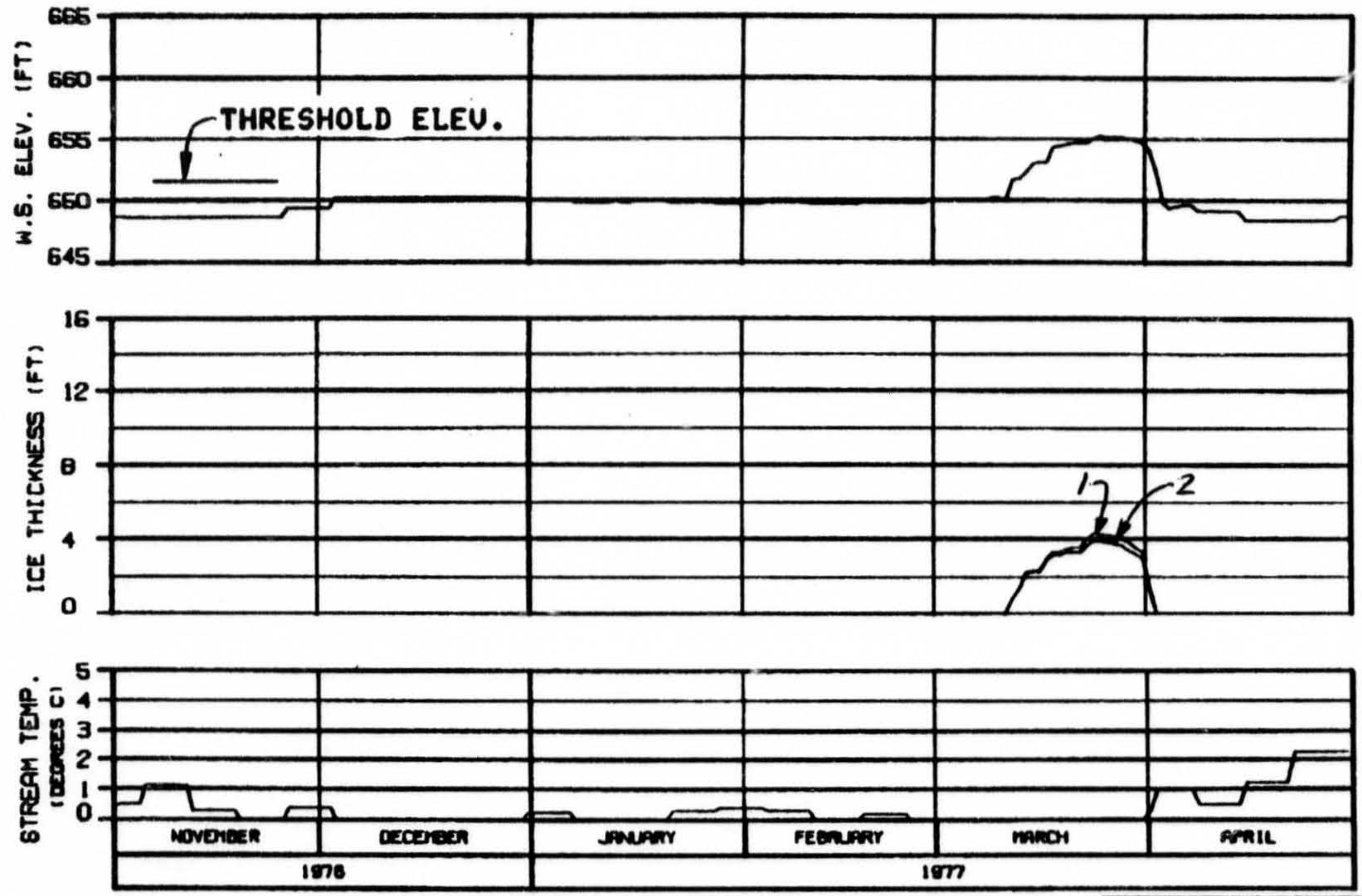
RIVER MILE : 131.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

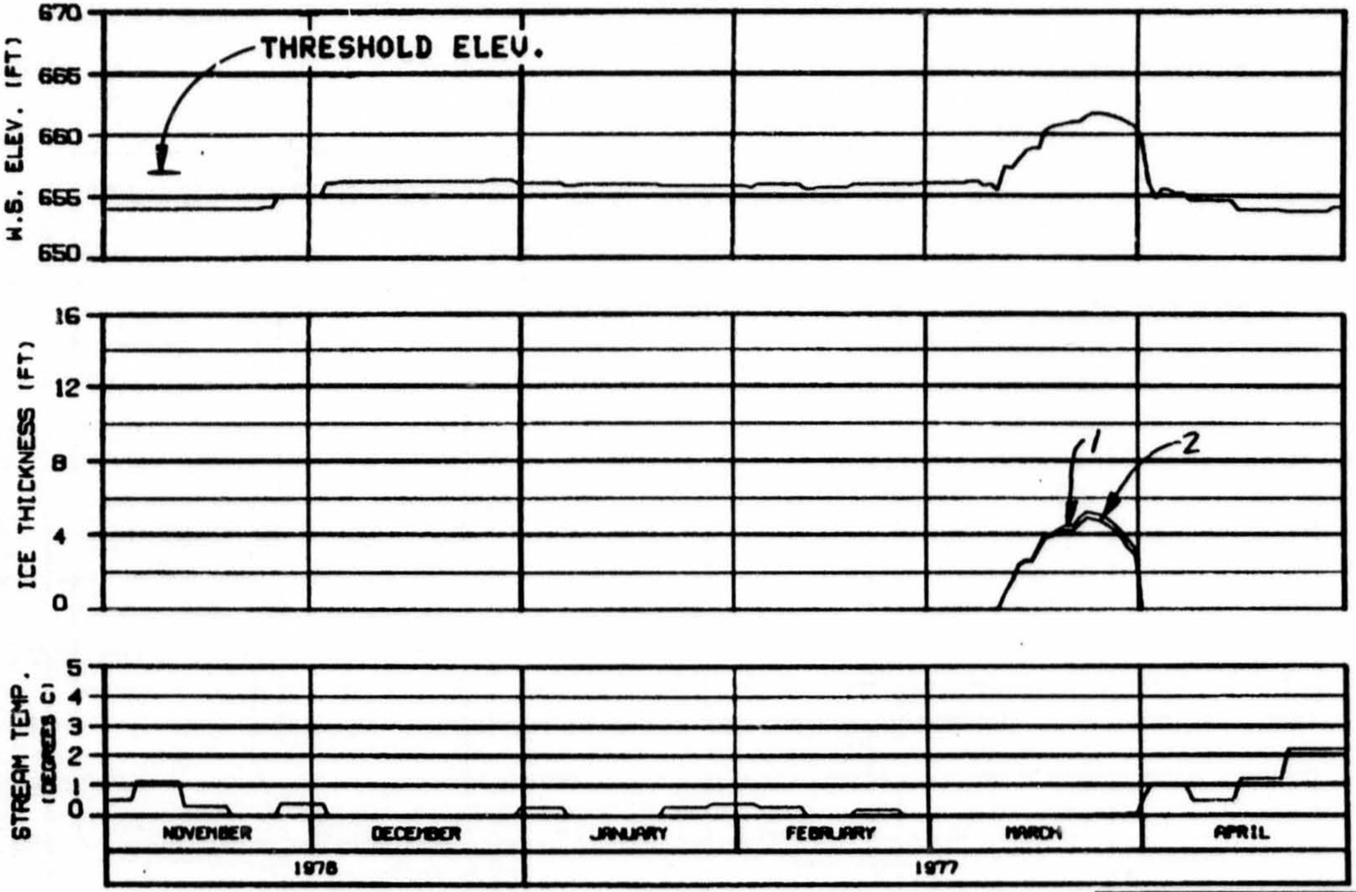
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF SLOUGH 10

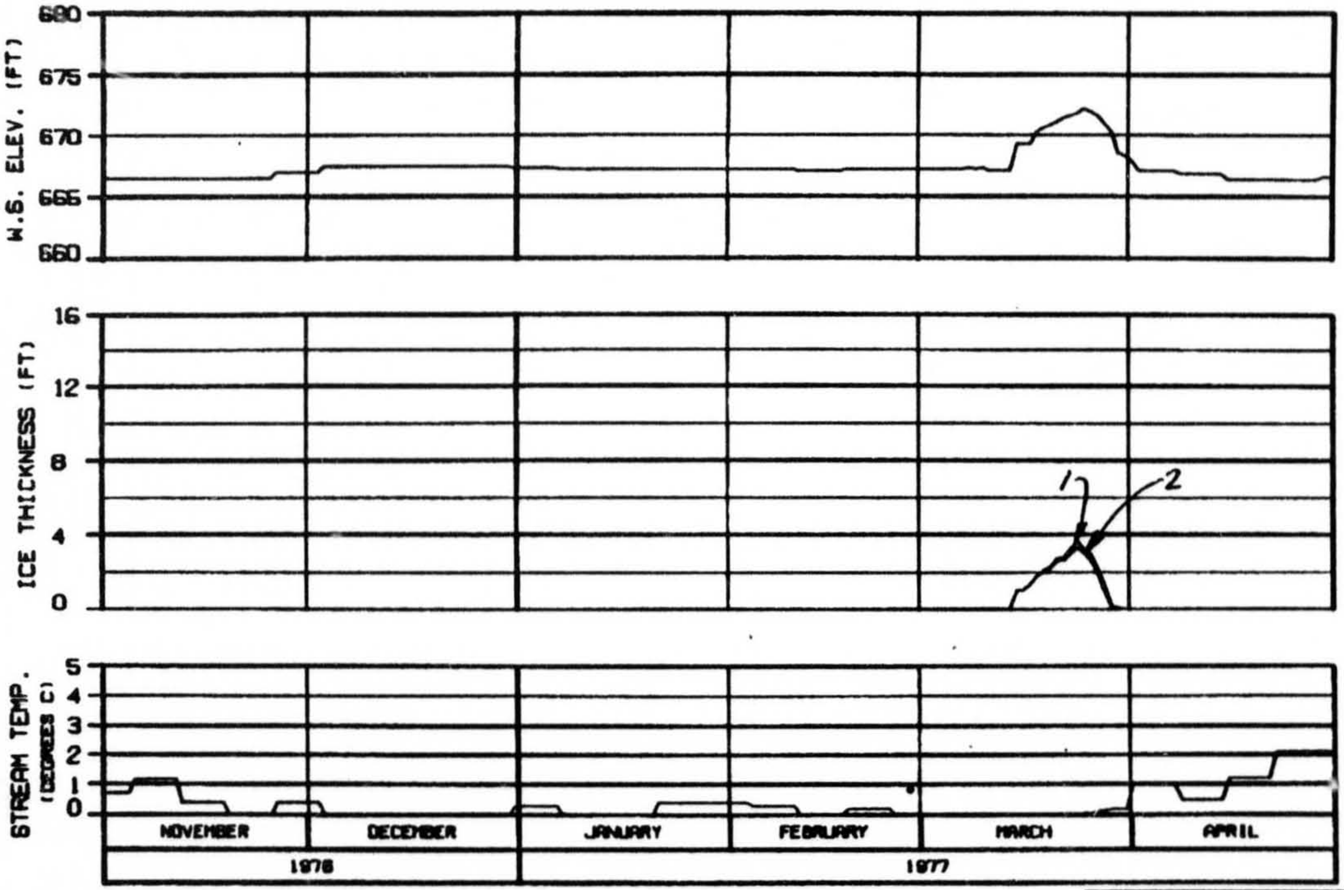
RIVER MILE : 134.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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



SIDE CHANNEL D/S OF SLOUGH 11

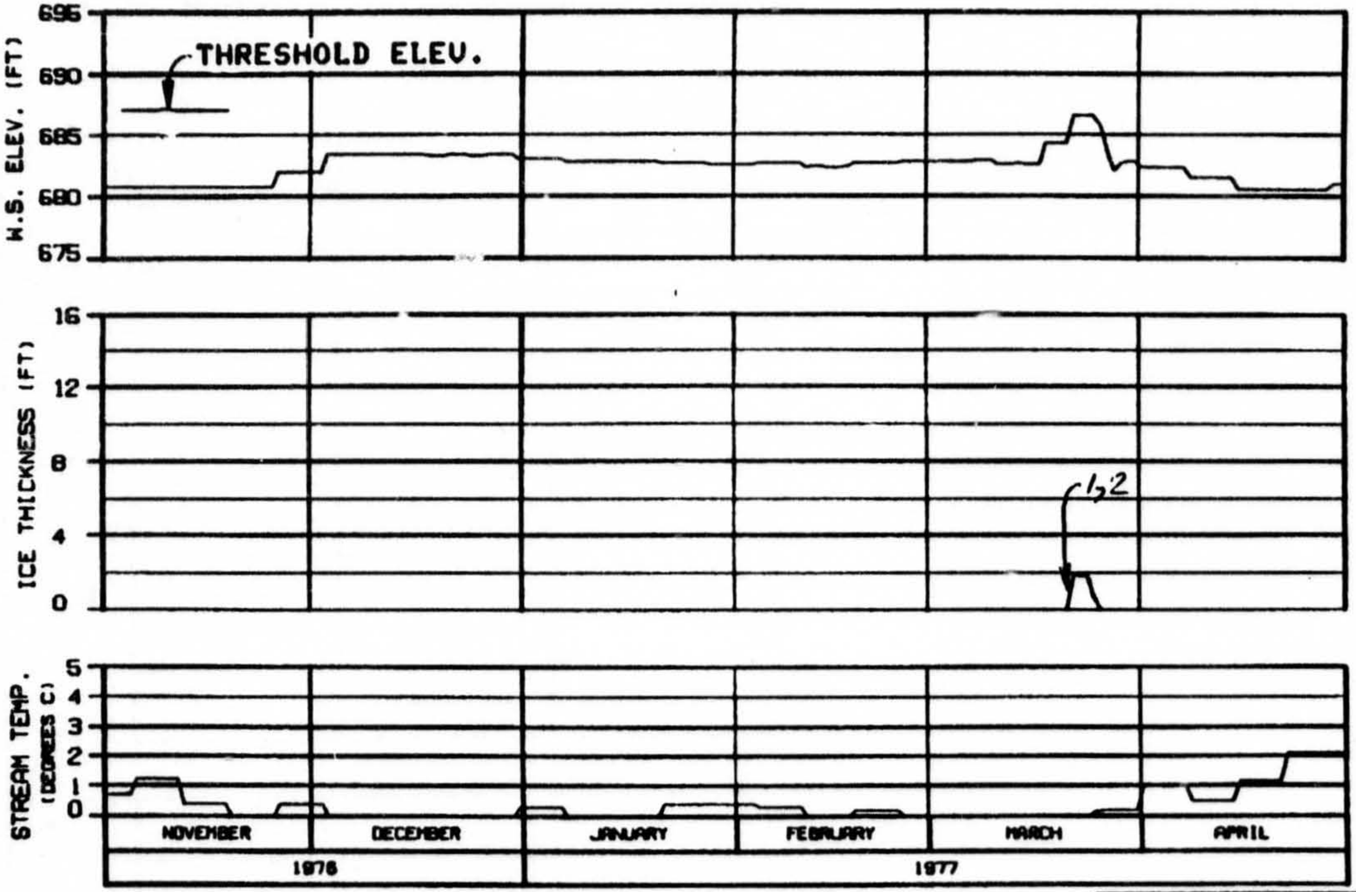
RIVER MILE : 135.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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



HEAD OF SLOUGH 11

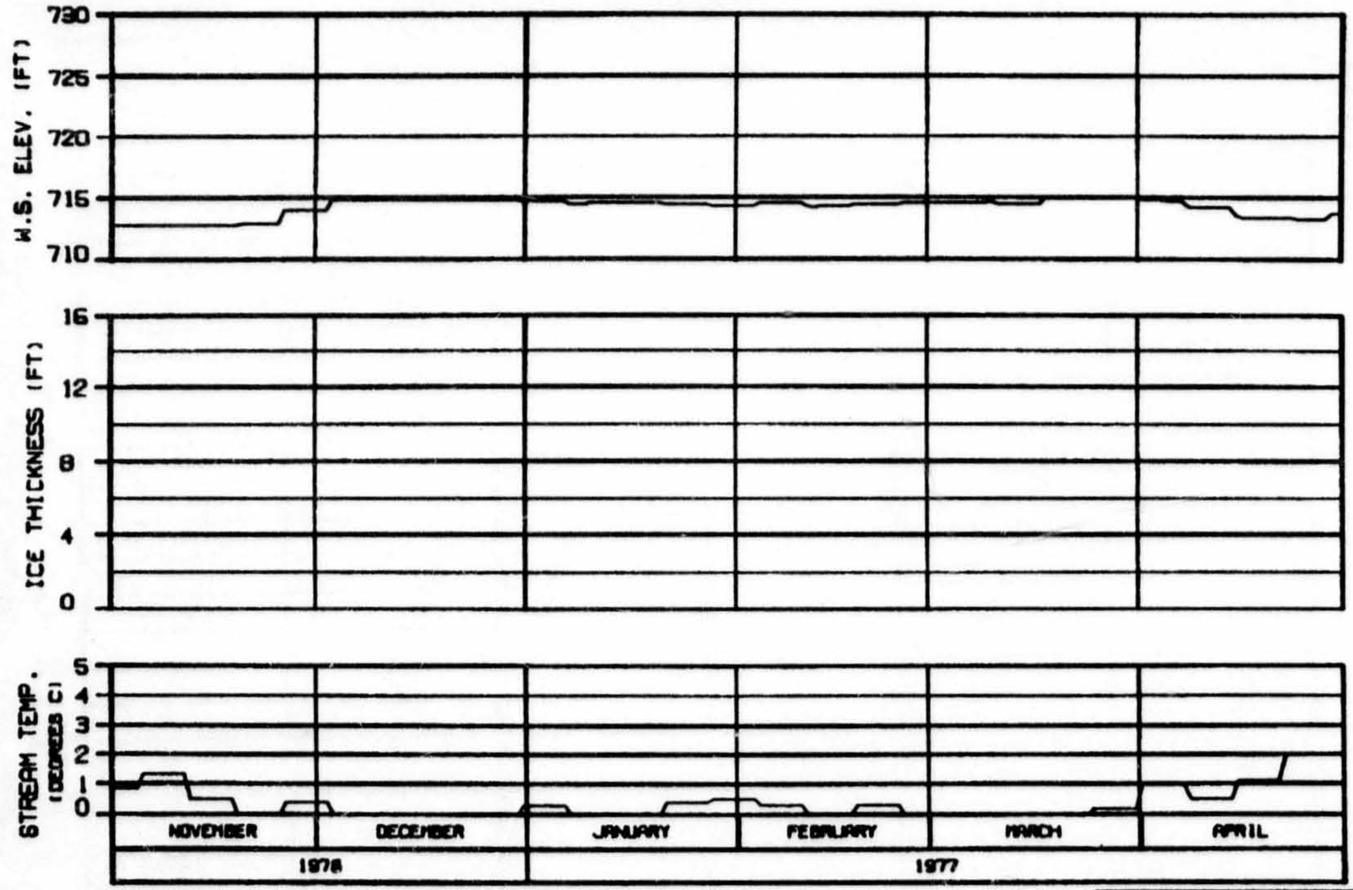
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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



HEAD OF SLOUGH 17

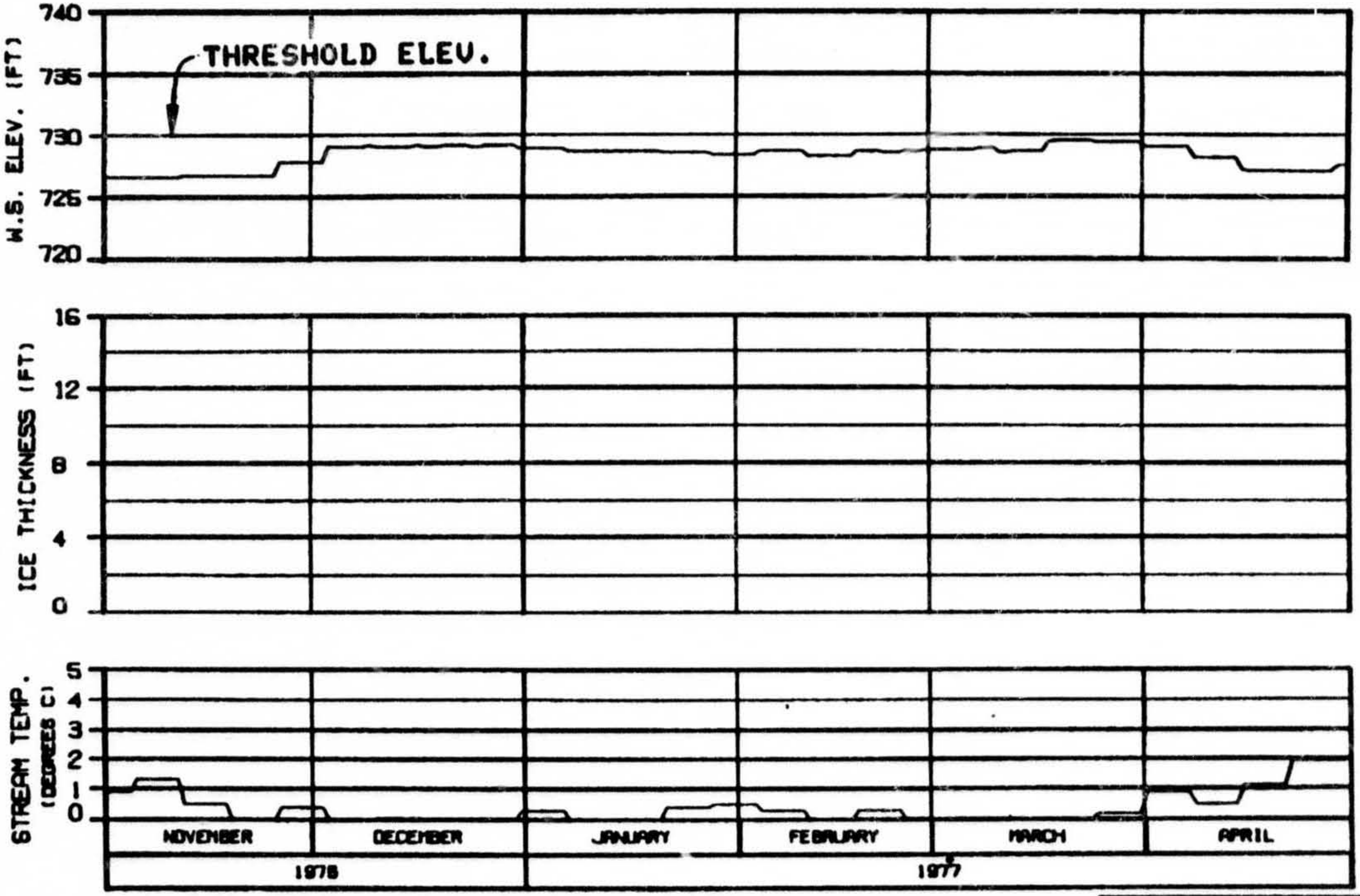
RIVER MILE : 139.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

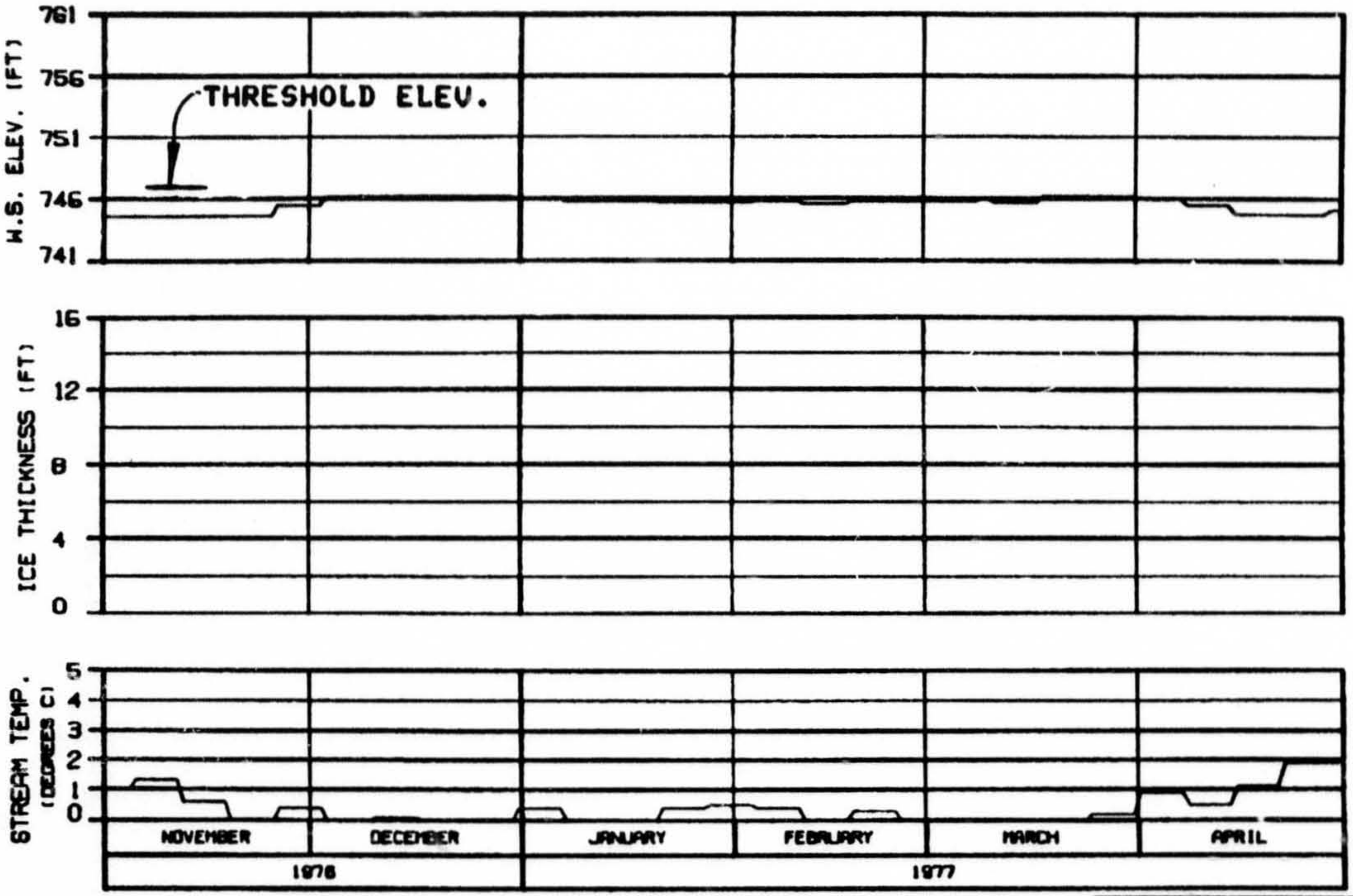
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP [illegible]
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

[illegible] JOINT VENTURE



SLOUGH 21 (ENTRANCE A6)

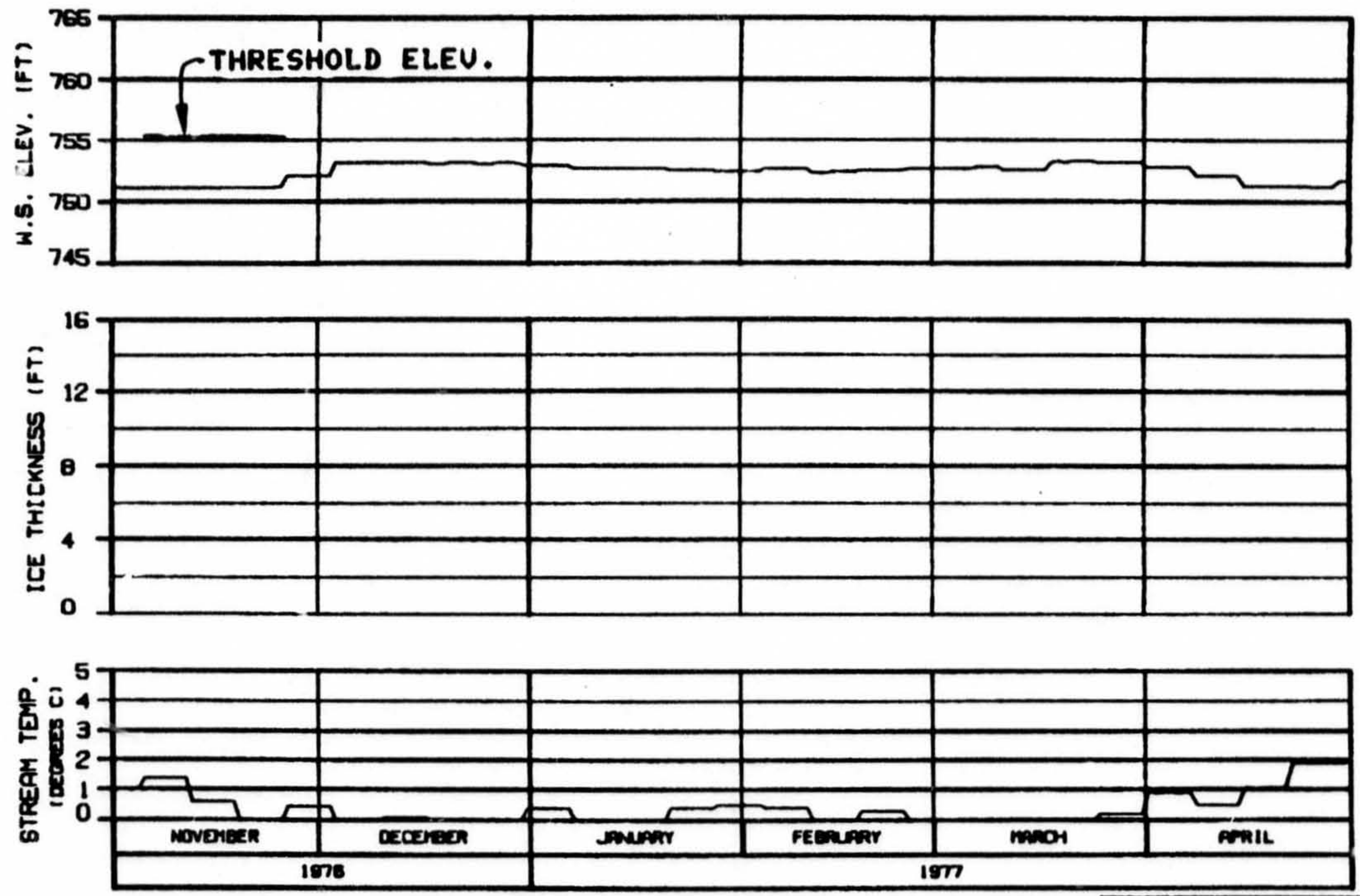
RIVER MILE : 141.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	30 JAN 84	[illegible].142



HEAD OF SLOUGH 21

RIVER MILE : 142.20

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

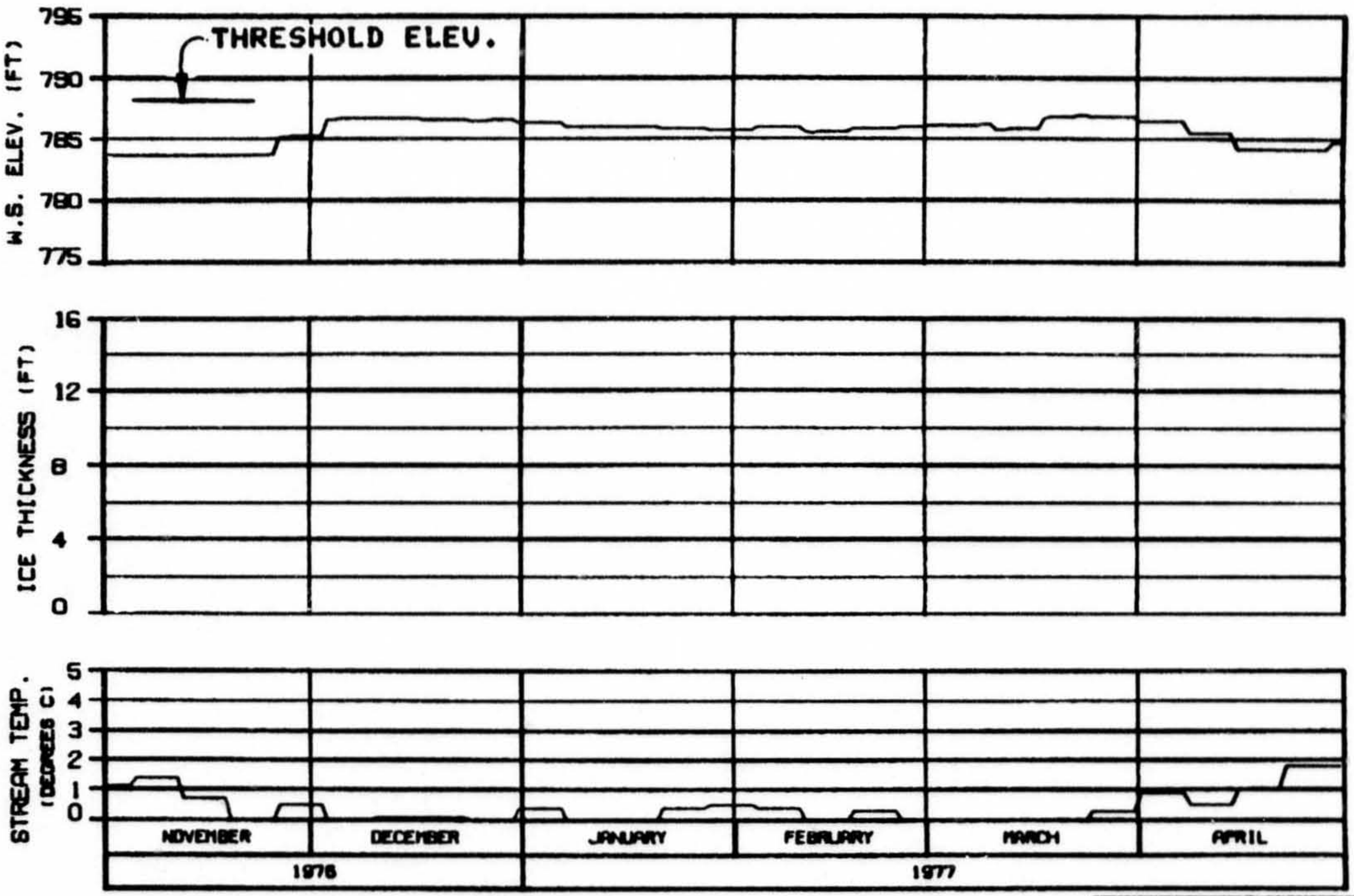
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE : C   TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

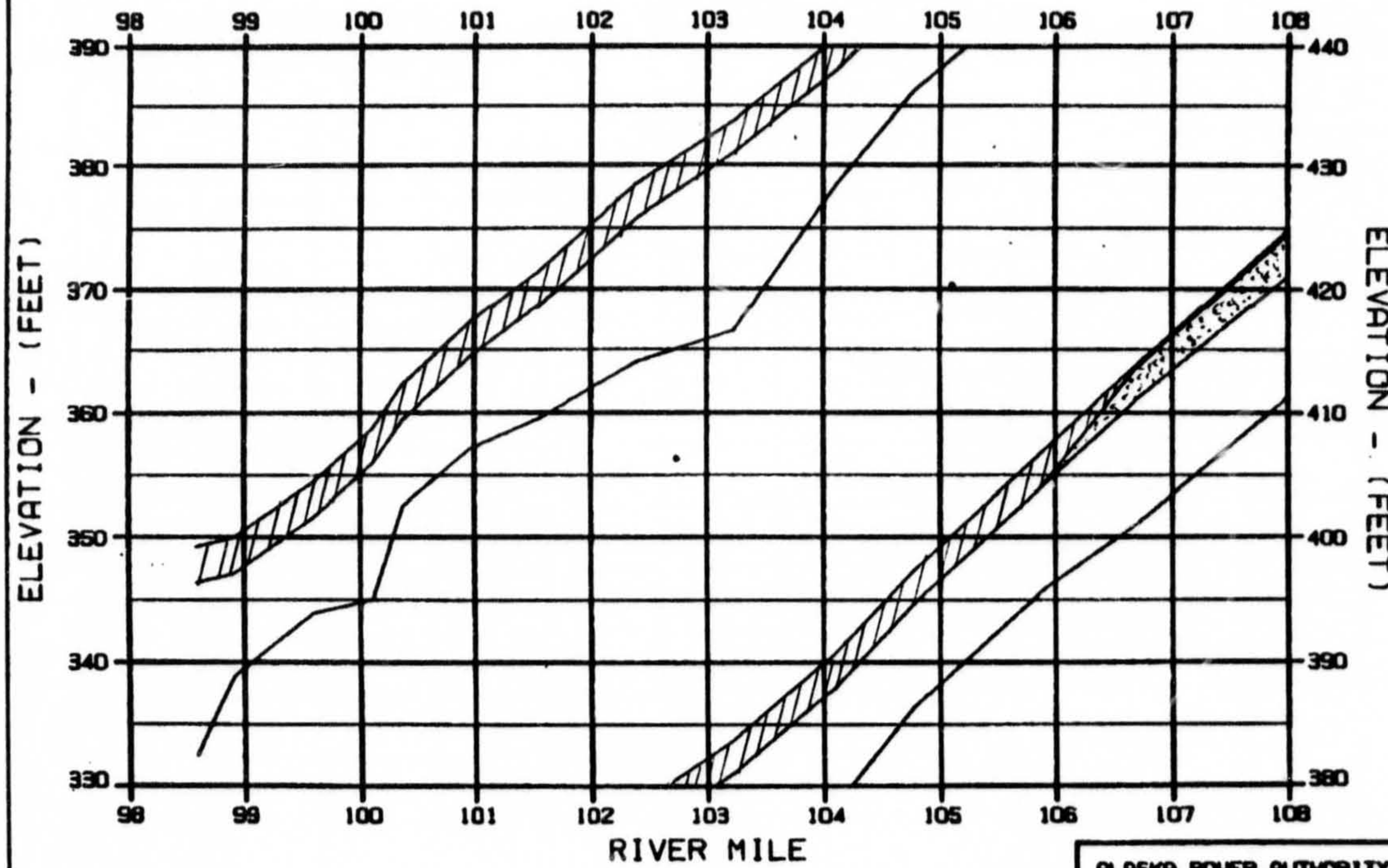
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

OPTION?

EXHIBIT G

C



LEGEND:

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

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8198CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

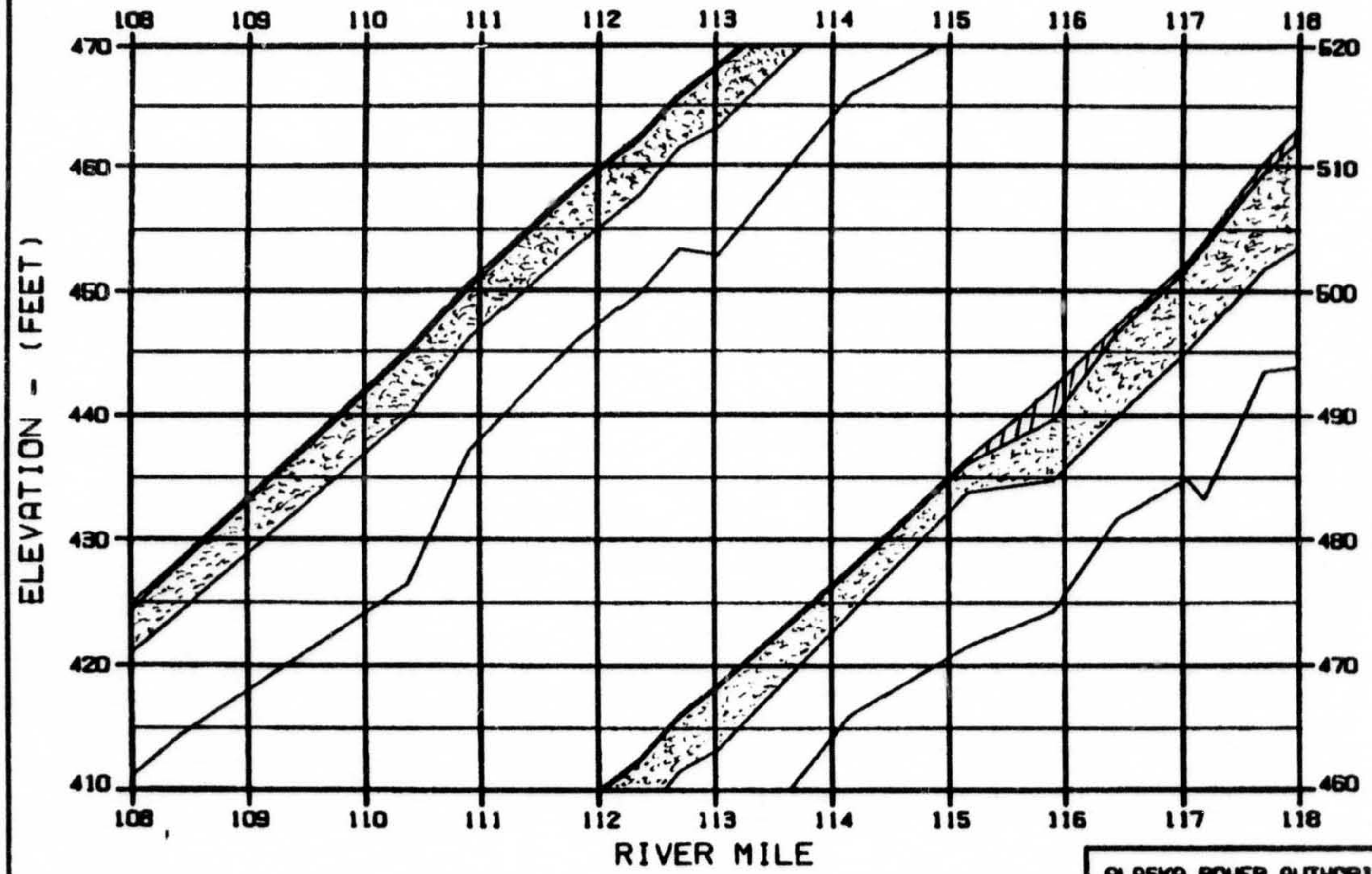
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

1000.142

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
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8198CNA

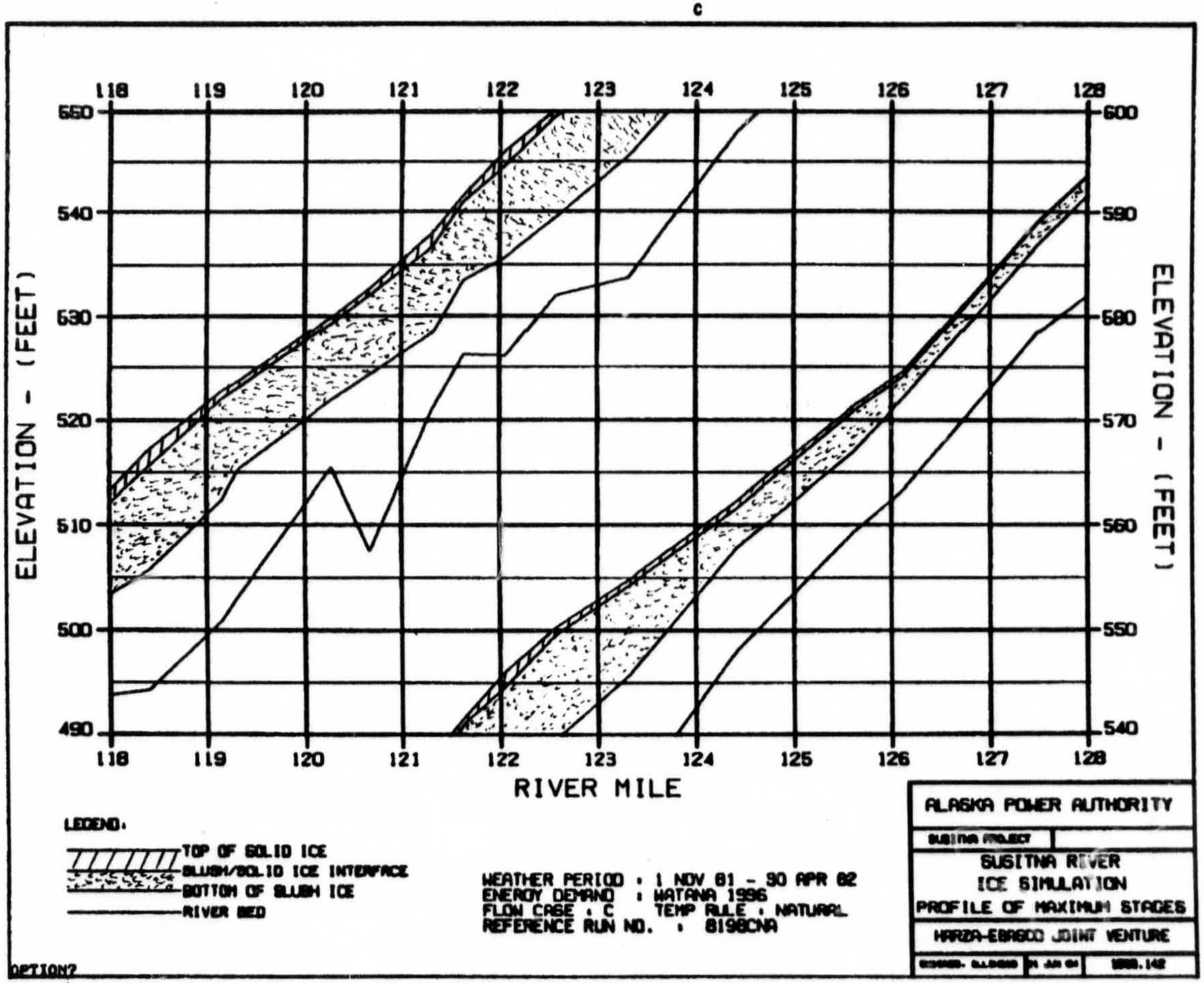
ALASKA POWER AUTHORITY

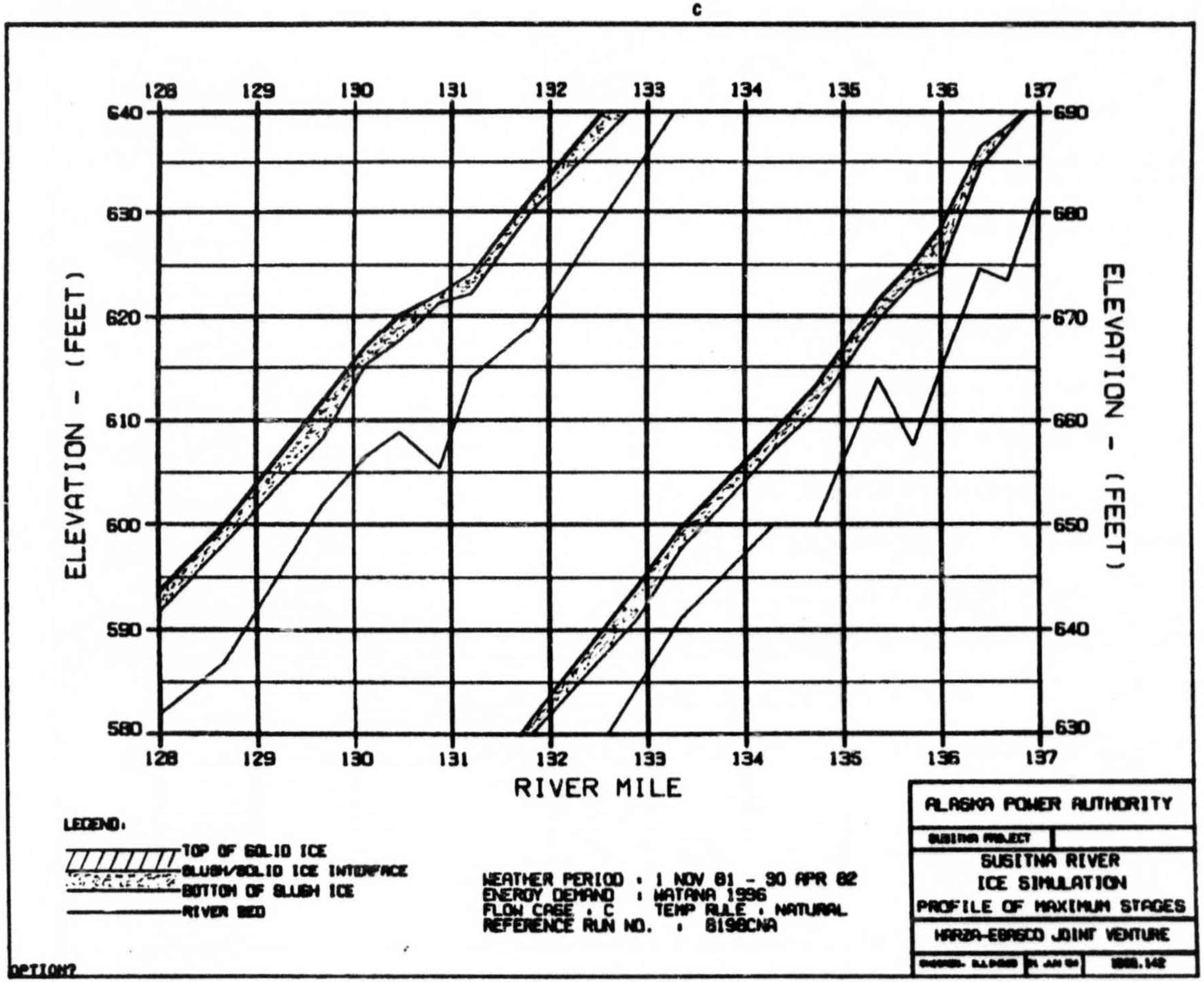
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

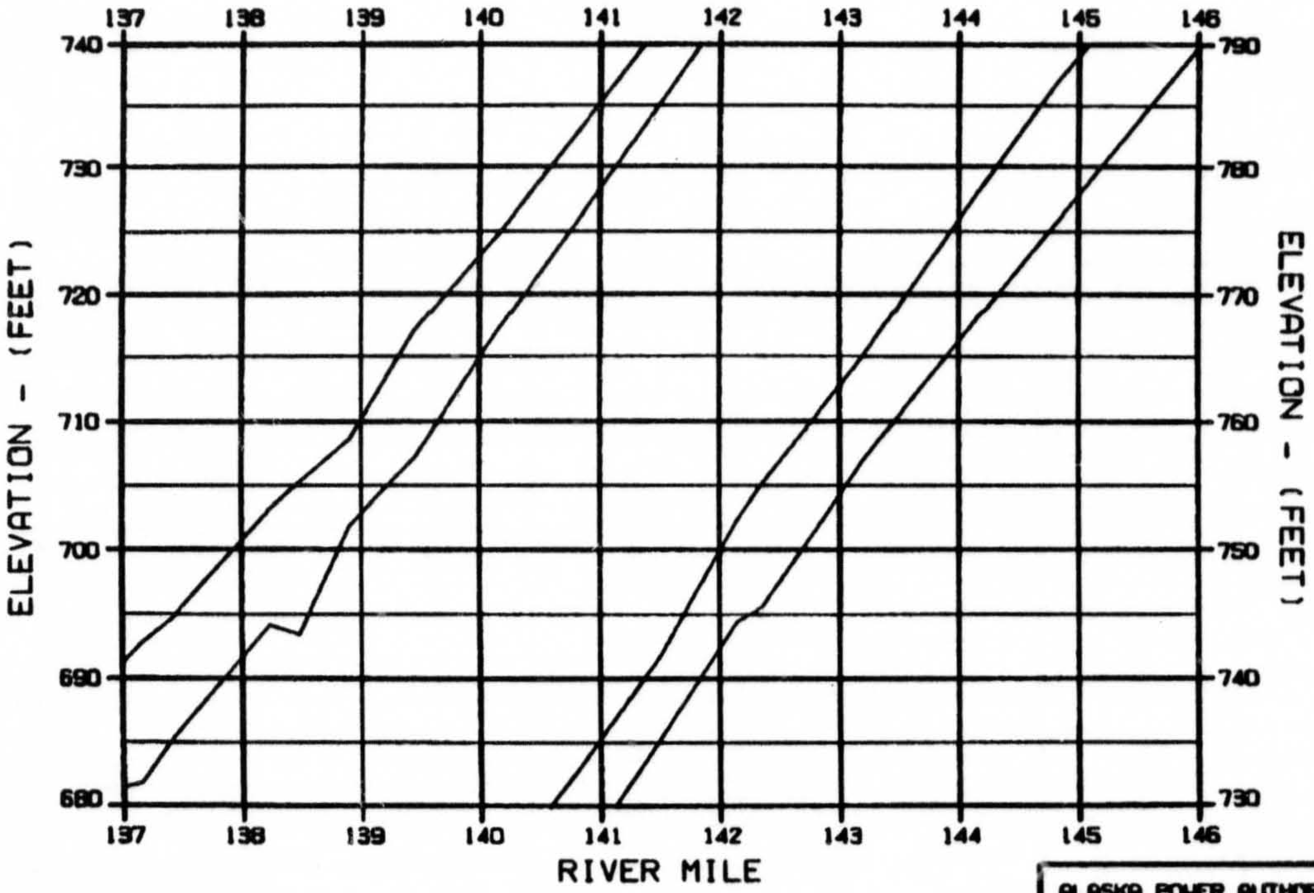
HARZA-EBASCO JOINT VENTURE

OPTION?


c
118
119
120
121
122
123
124
125
126
127
128
550
540
530
520
510
500
490
600
590
580
570
560
550
540
ELEVATION - (FEET)
ELEVATION - (FEET)
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
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8198CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?


C
128
129
130
131
132
133
134
135
136
137
640
630
620
610
600
590
580
690
680
670
660
650
640
630
ELEVATION - (FEET)
ELEVATION - (FEET)
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
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8198CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C



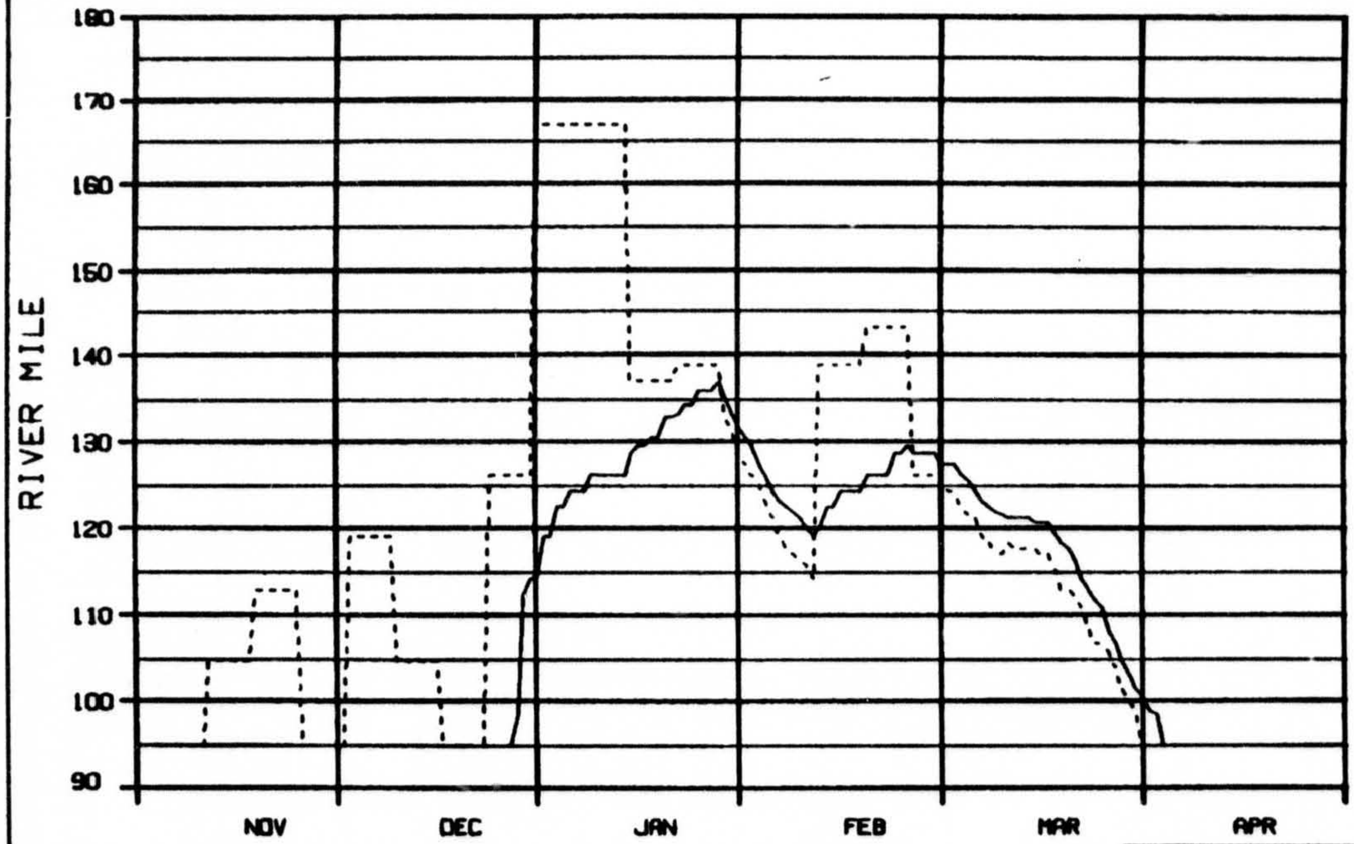
LEGEND:

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

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8198CNA

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES		
HARZA-EBASCO JOINT VENTURE		
[illegible]	[illegible]	[illegible].142

OPTION?



LEGEND:

ICE FRONT

ZERO DEGREE ISOTHERM

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

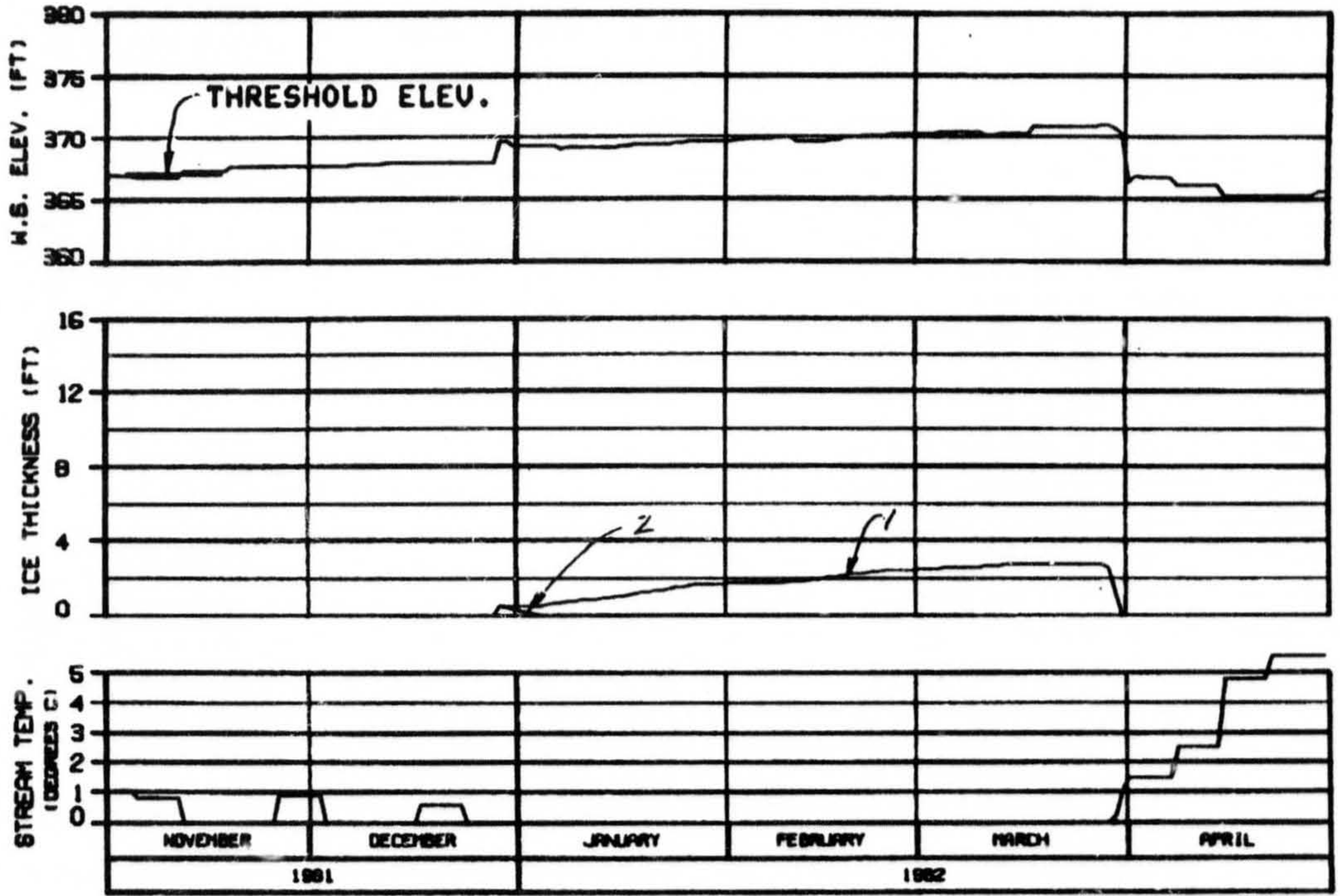
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM

HARZA-EBASCO JOINT VENTURE

OPTION?



HEAD OF WHISKERS SLOUGH

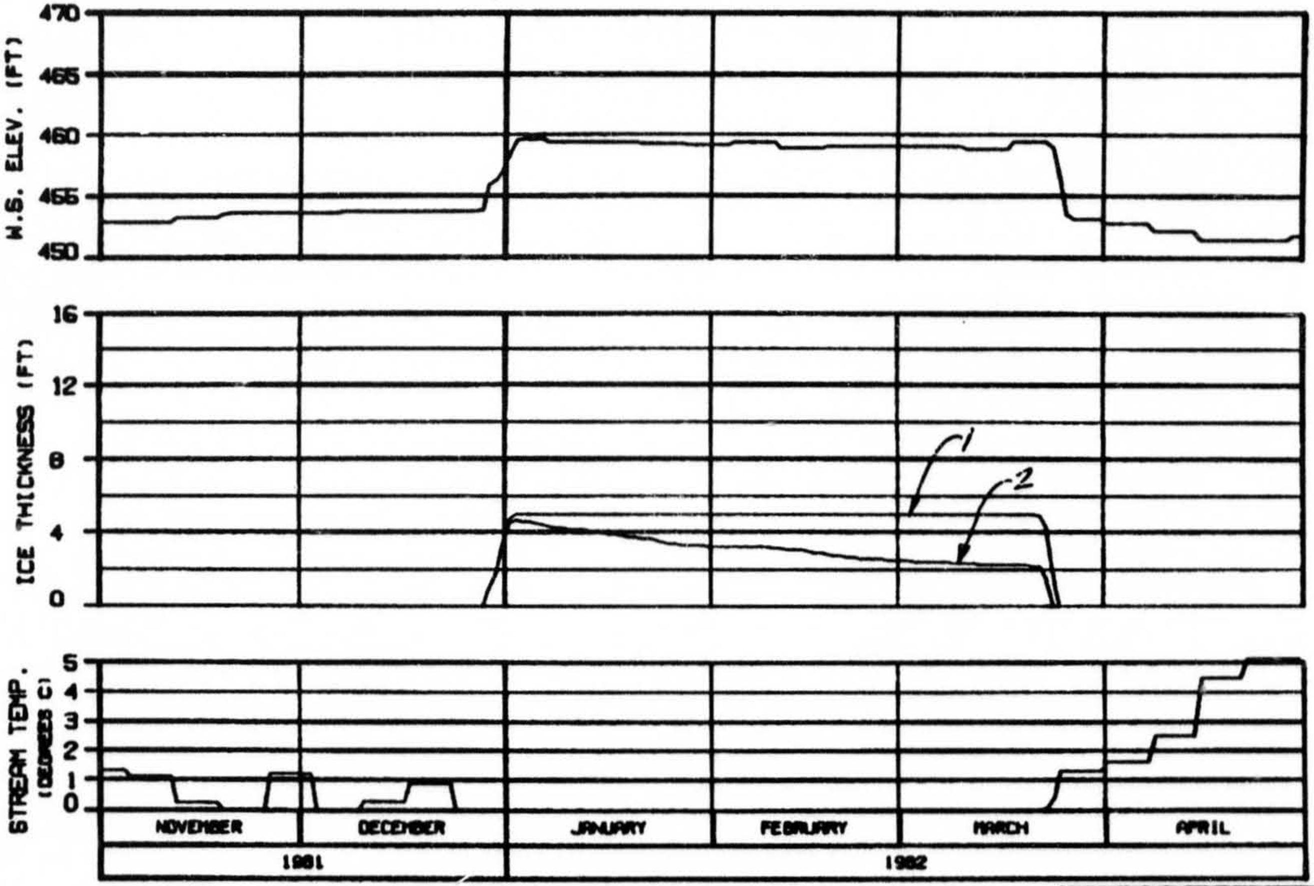
RIVER MILE : 101.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : B196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

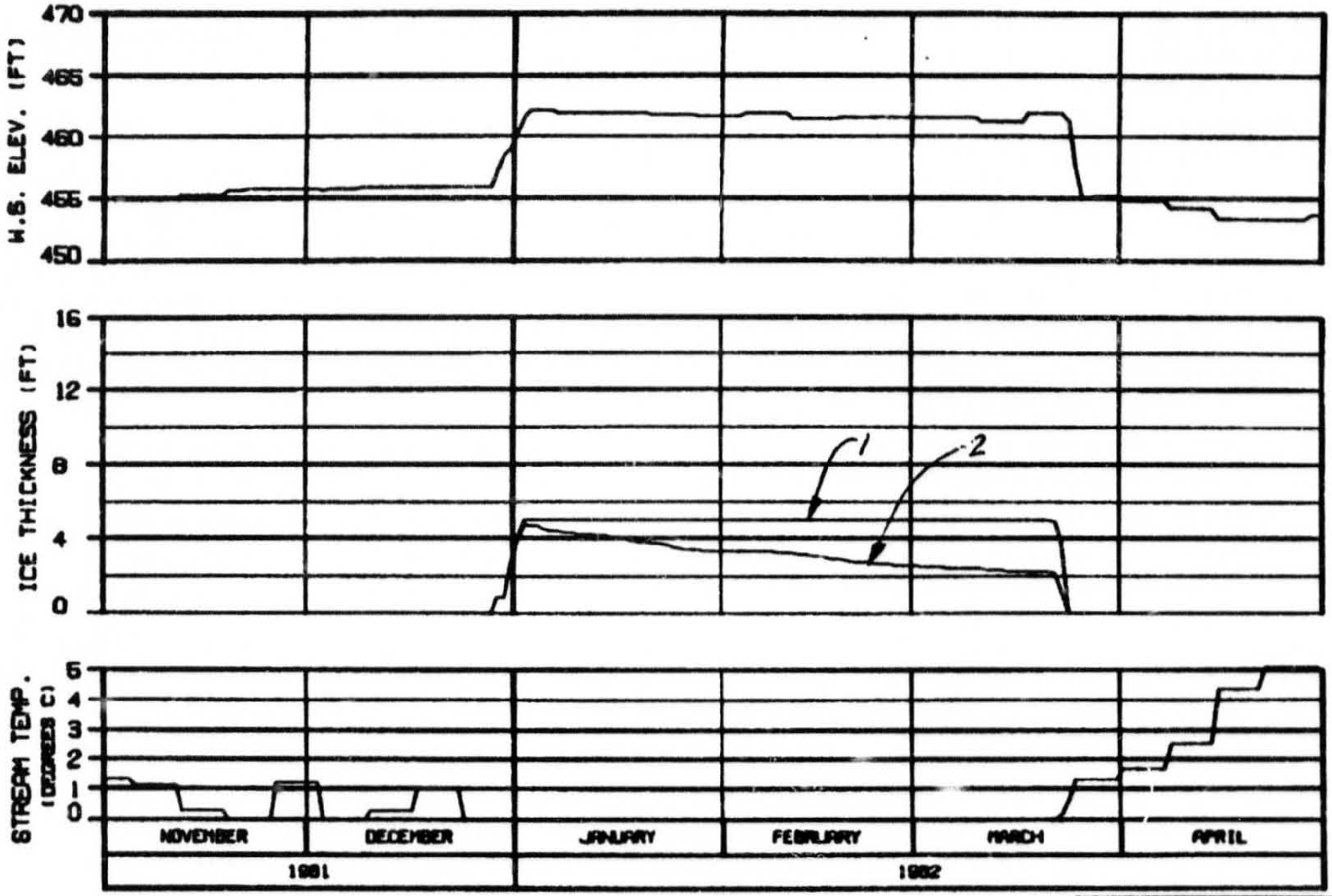
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



MOUTH OF SLOUGH 6A

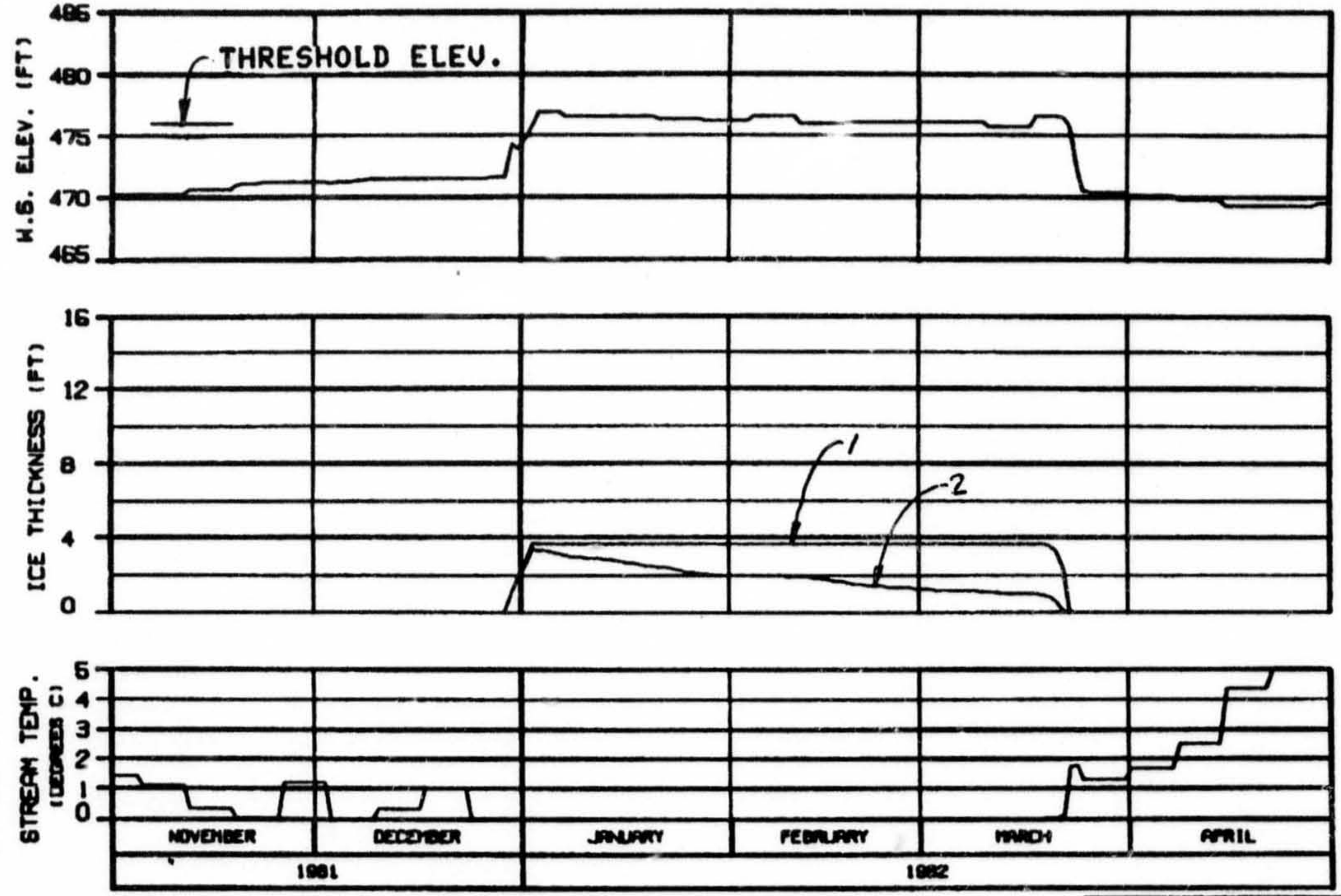
RIVER MILE : 112.34

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



HEAD OF SLOUGH 8

RIVER MILE : 114.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

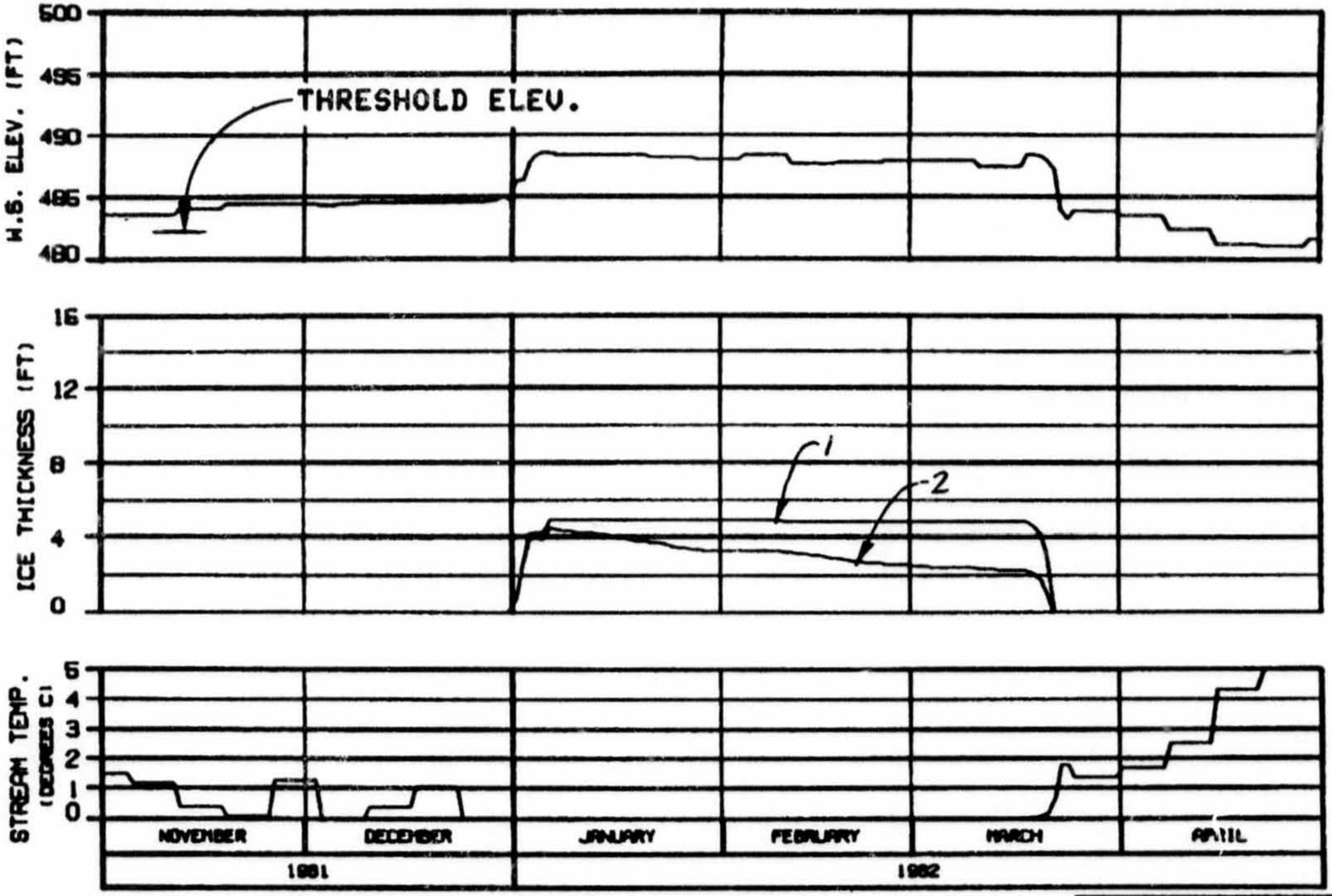
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL MSII

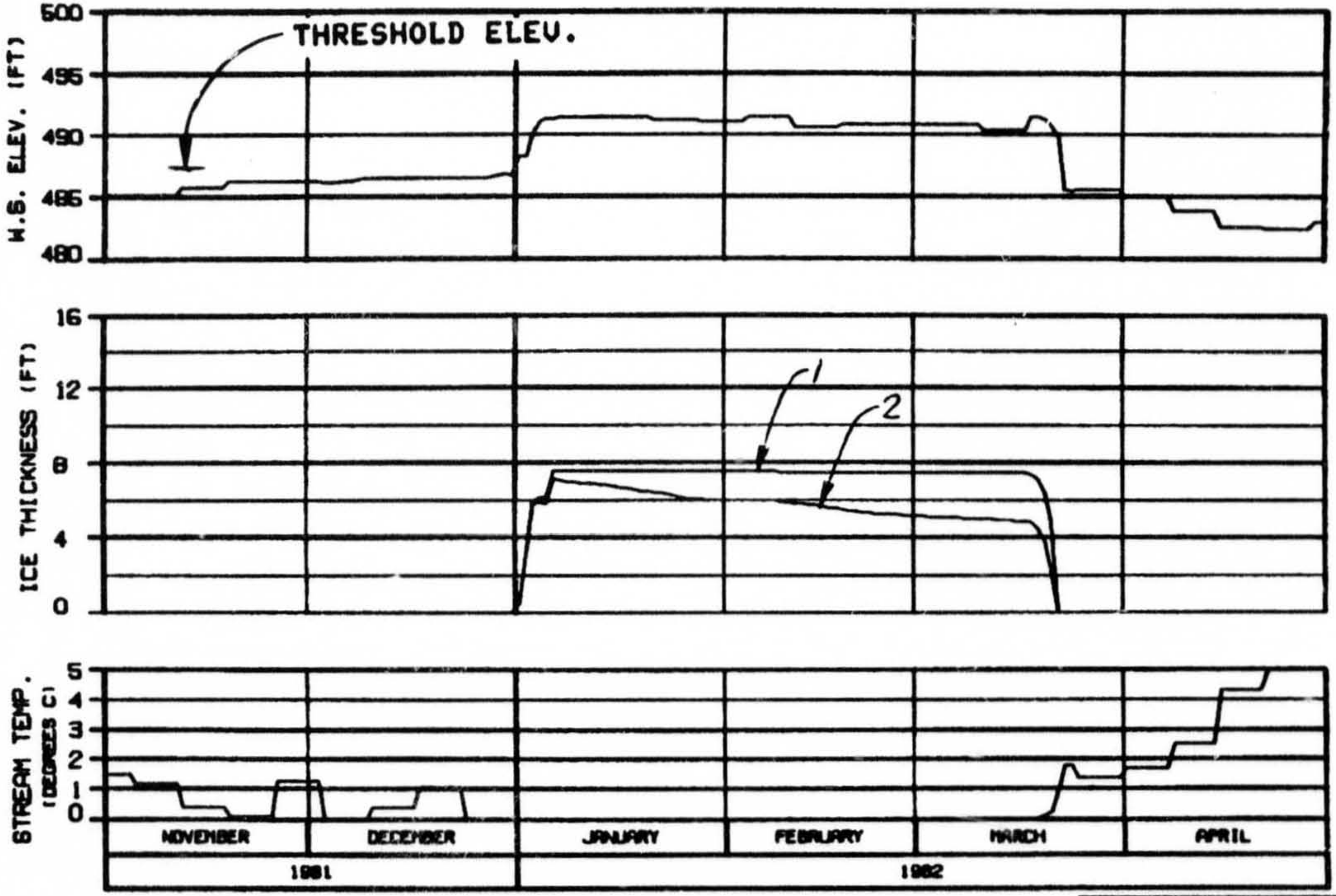
RIVER MILE : 115.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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



HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

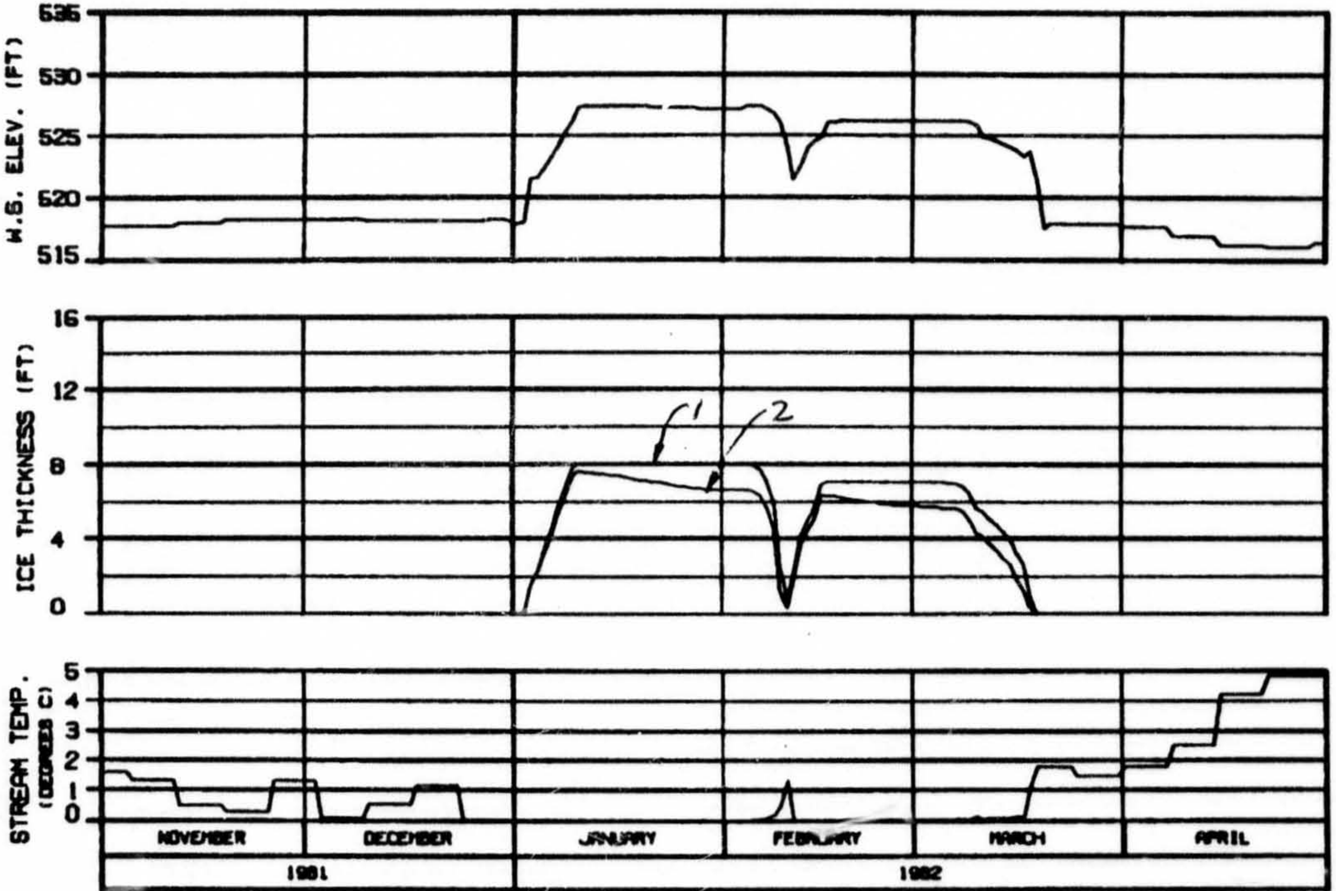
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



RIVER MILE : 120.00

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

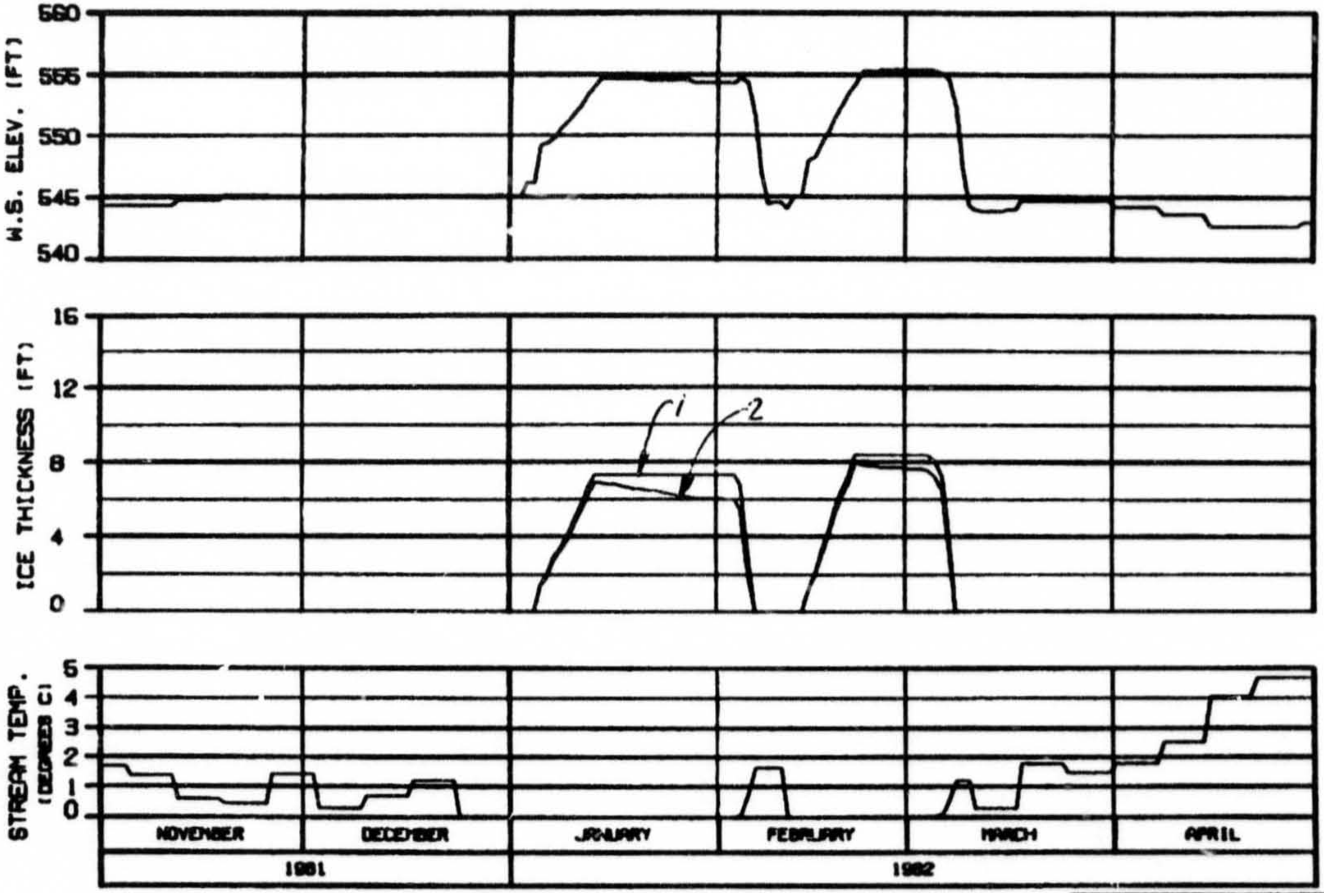
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

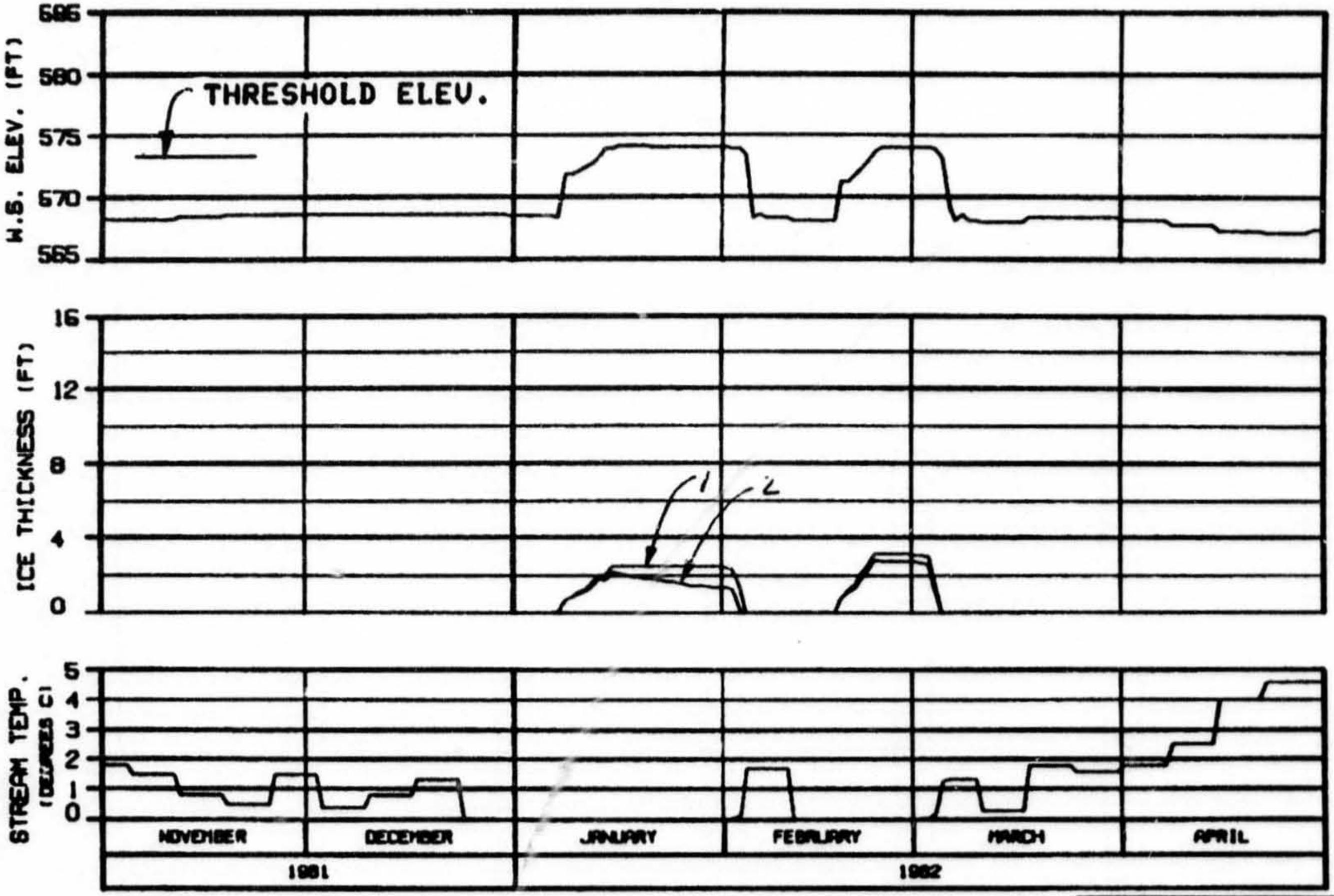
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] | [illegible] | [illegible].142



HEAD OF SLOUGH 8A (WEST)

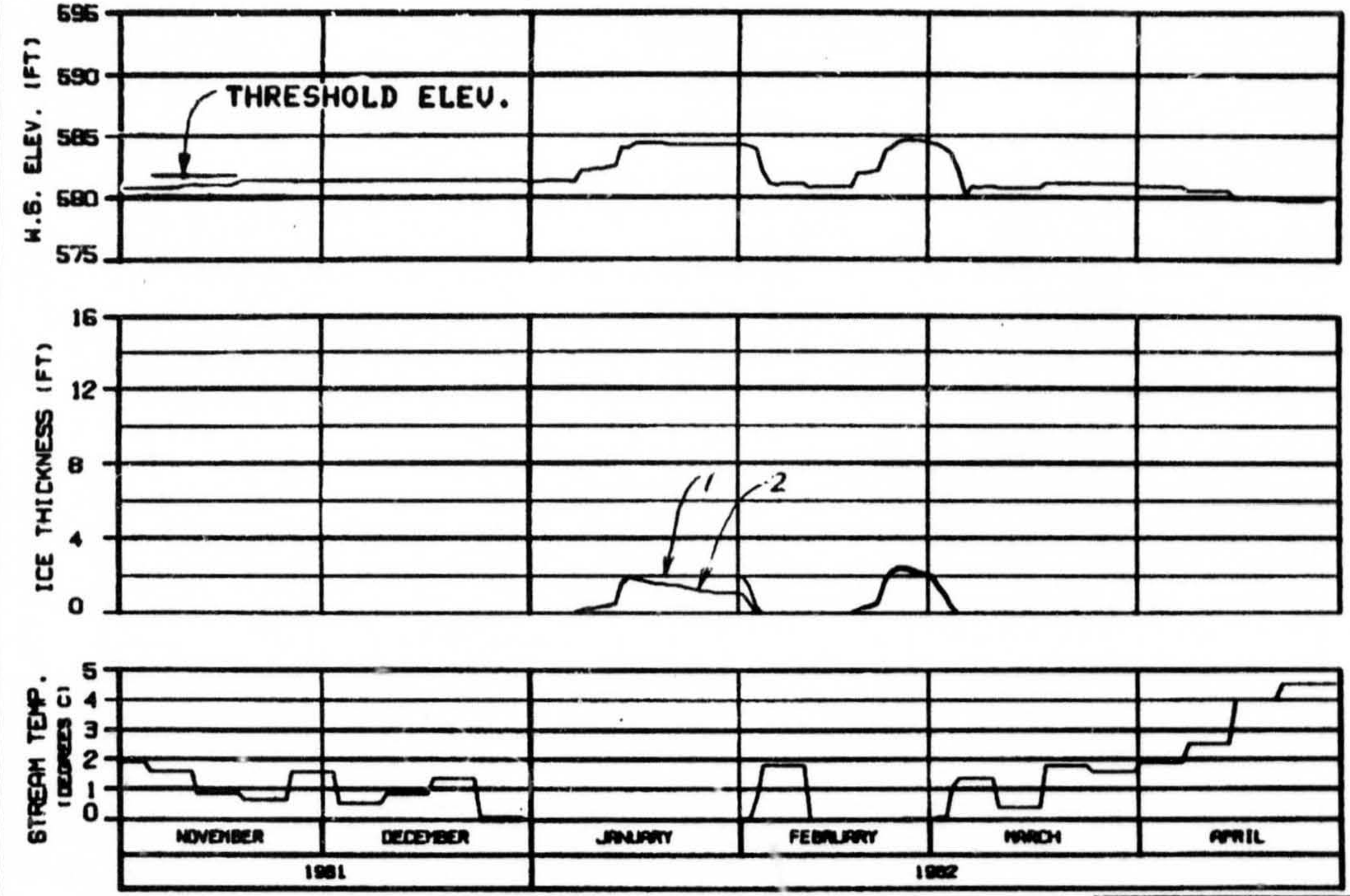
RIVER MILE : 126.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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



HEAD OF SLOUGH 8A (EAST)

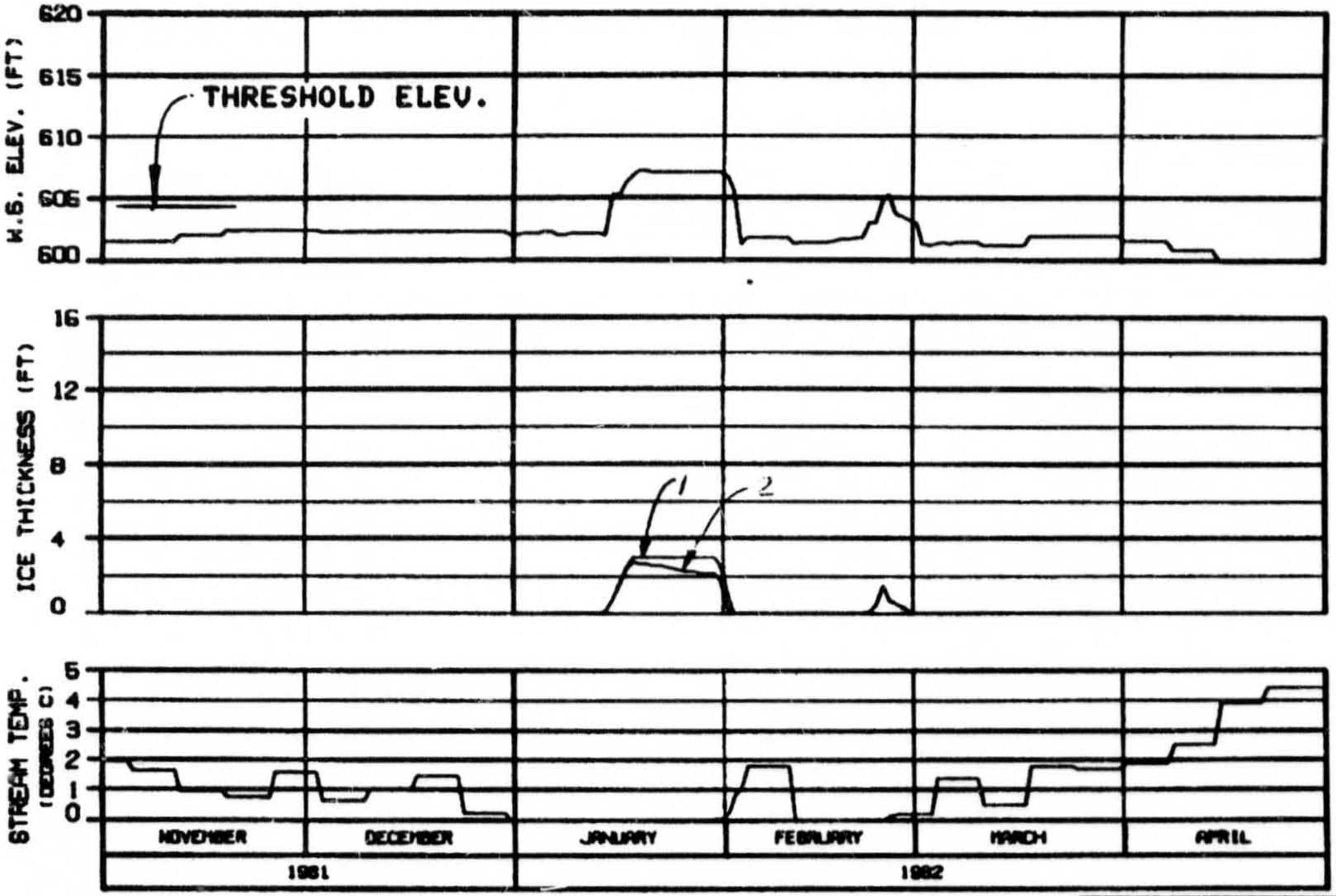
RIVER MILE : 127.10

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. 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

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

OPTION?

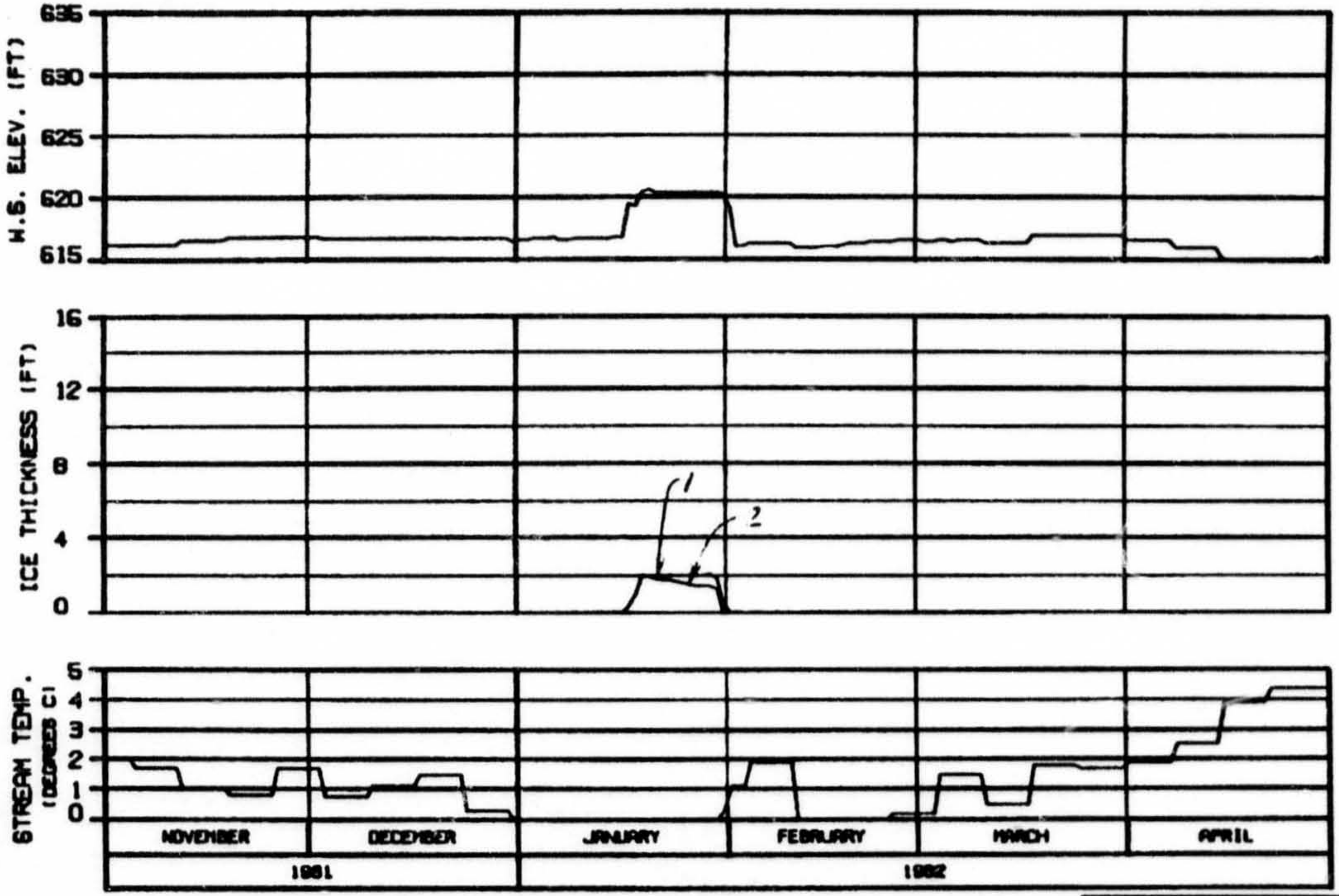
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

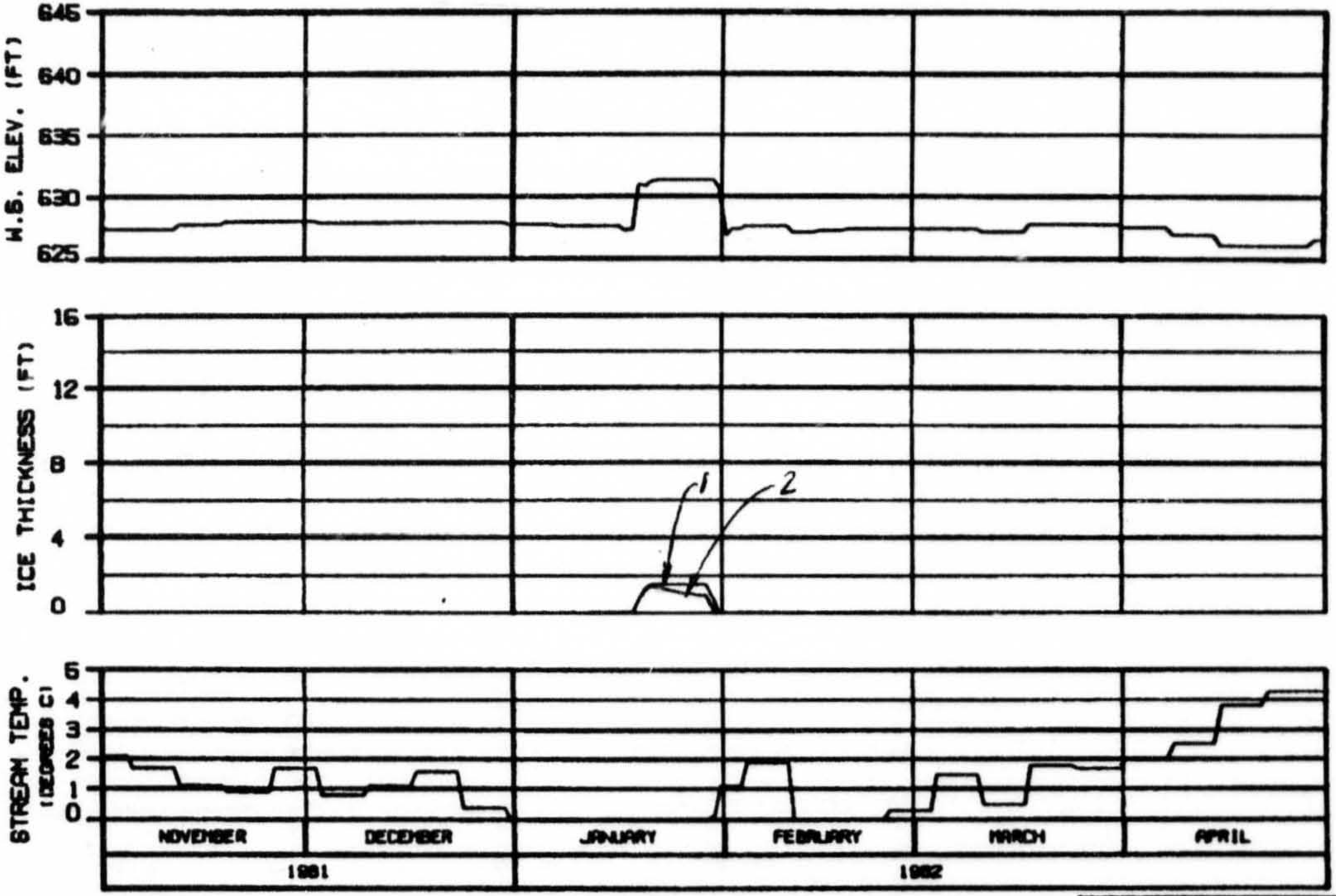
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SIDE CHANNEL U/S OF 4TH JULY CREEK

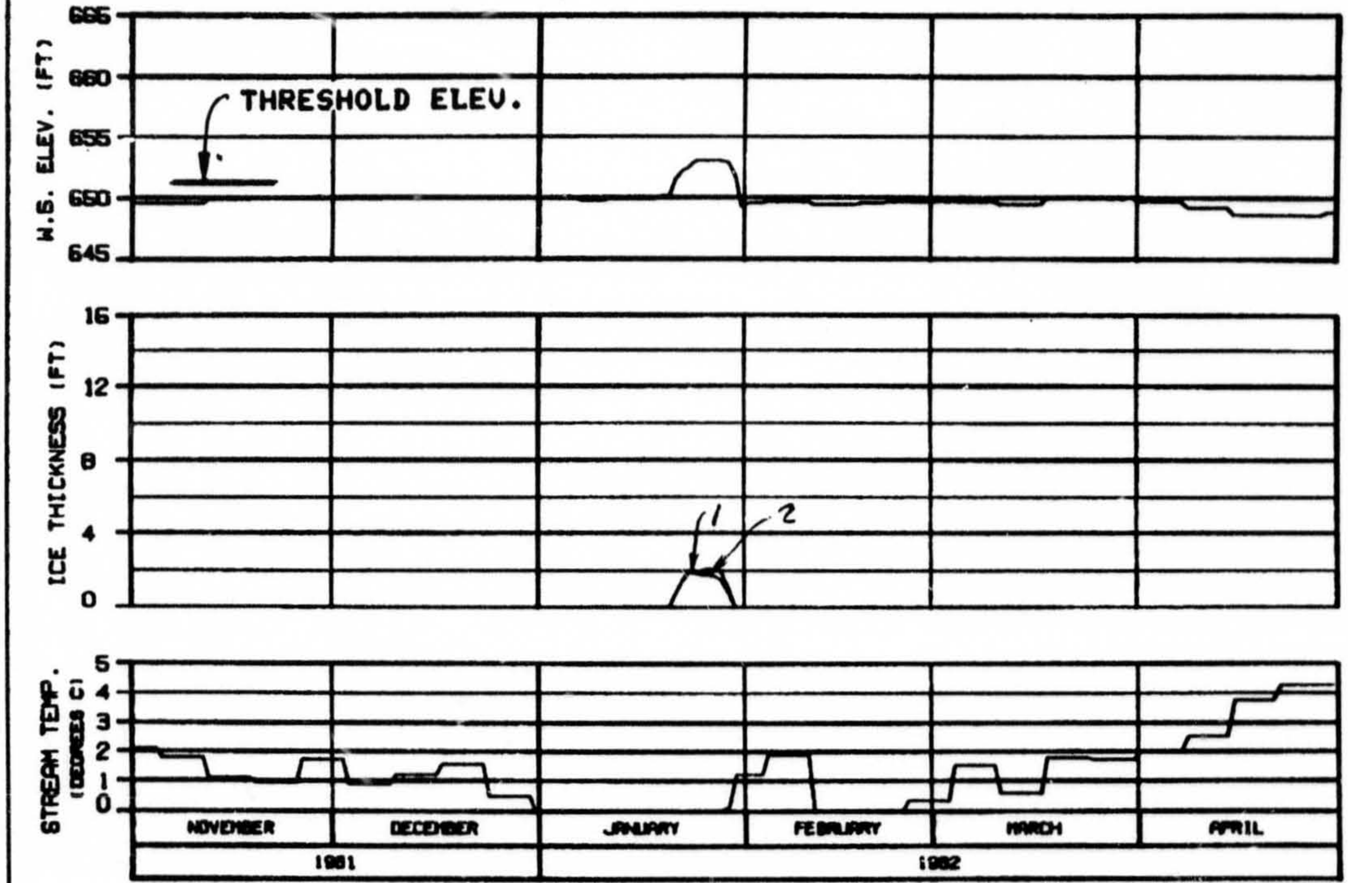
RIVER MILE : 131.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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



HEAD OF SLOUGH 9A

RIVER MILE : 133.70

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

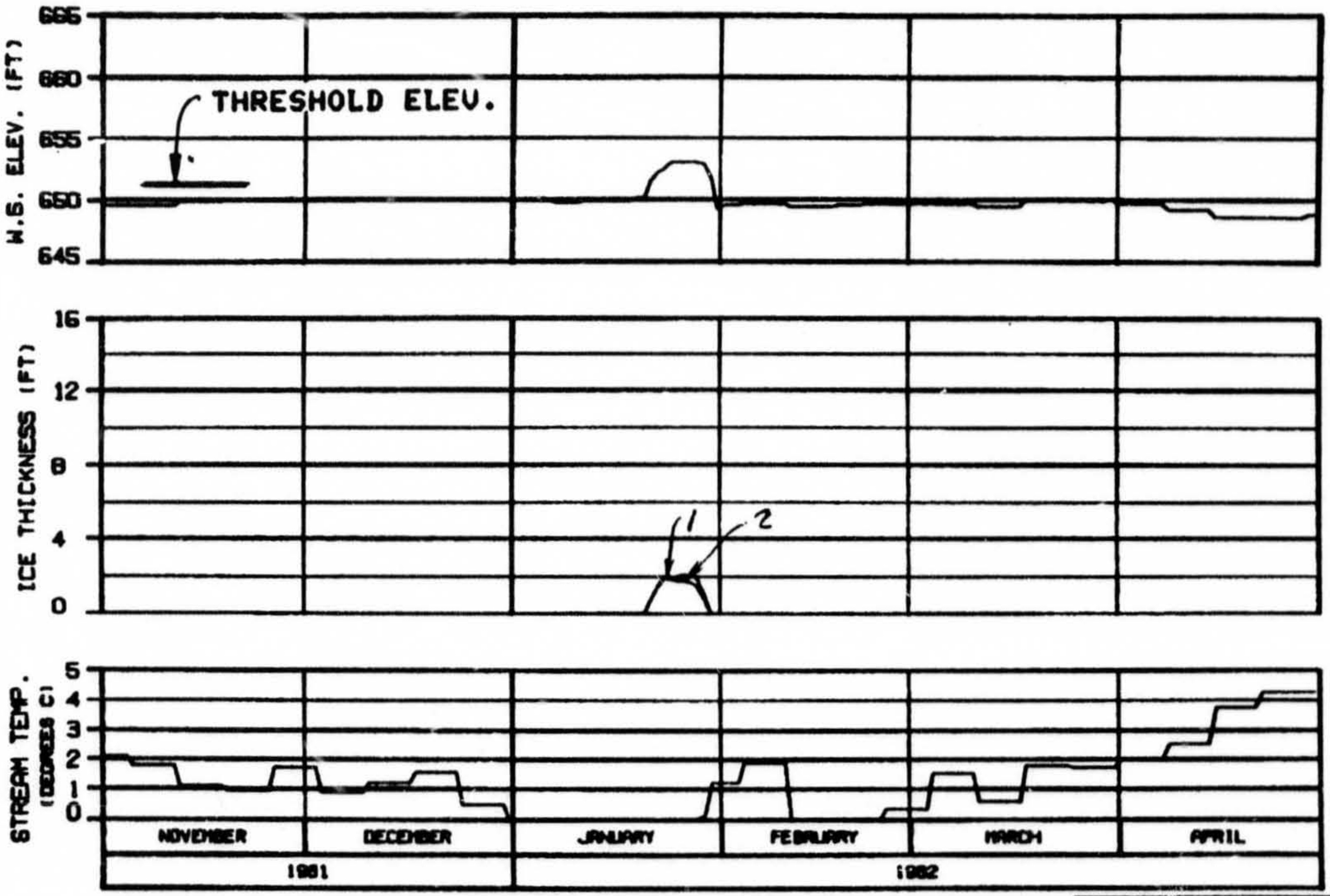
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9A

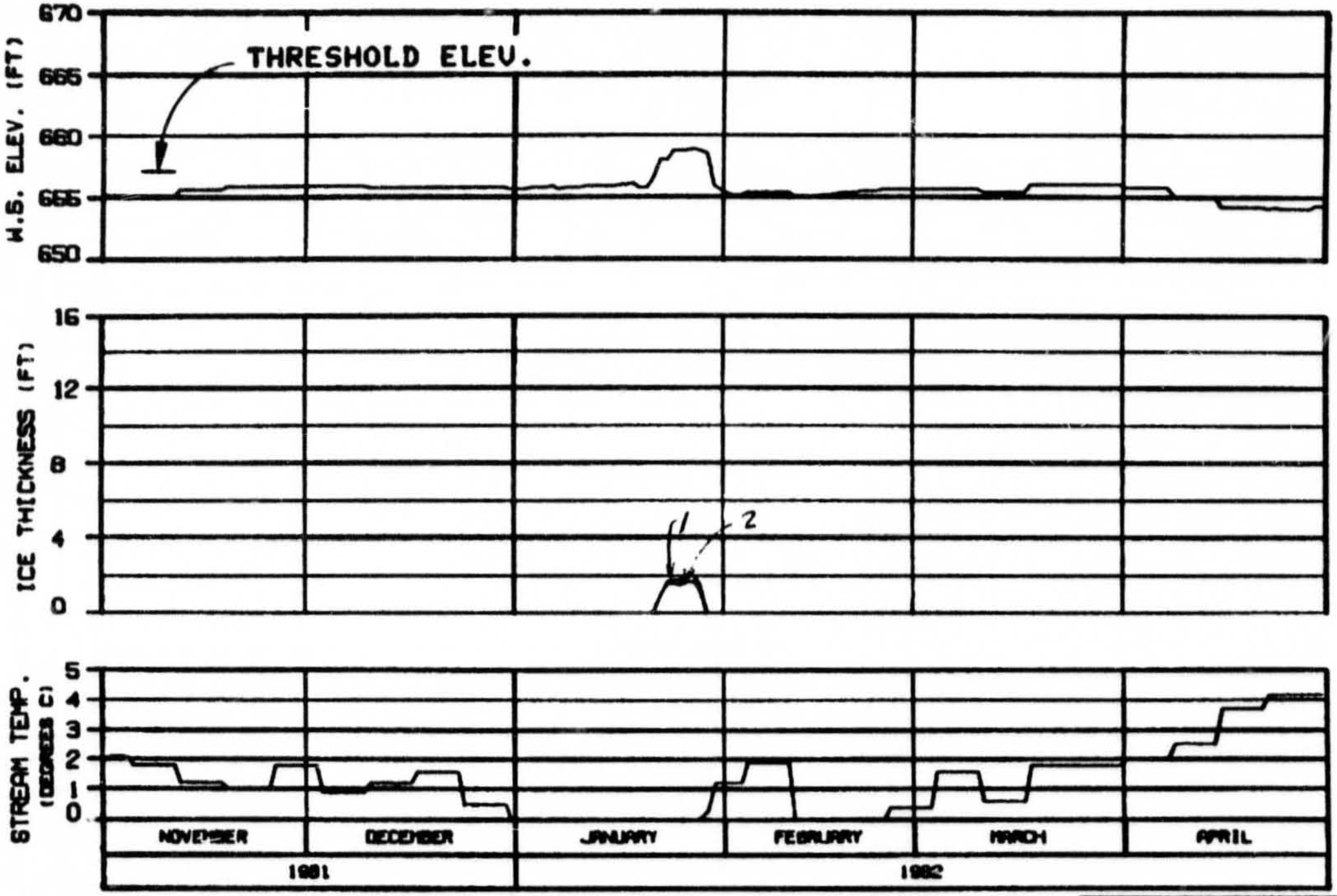
RIVER MILE : 133.70

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

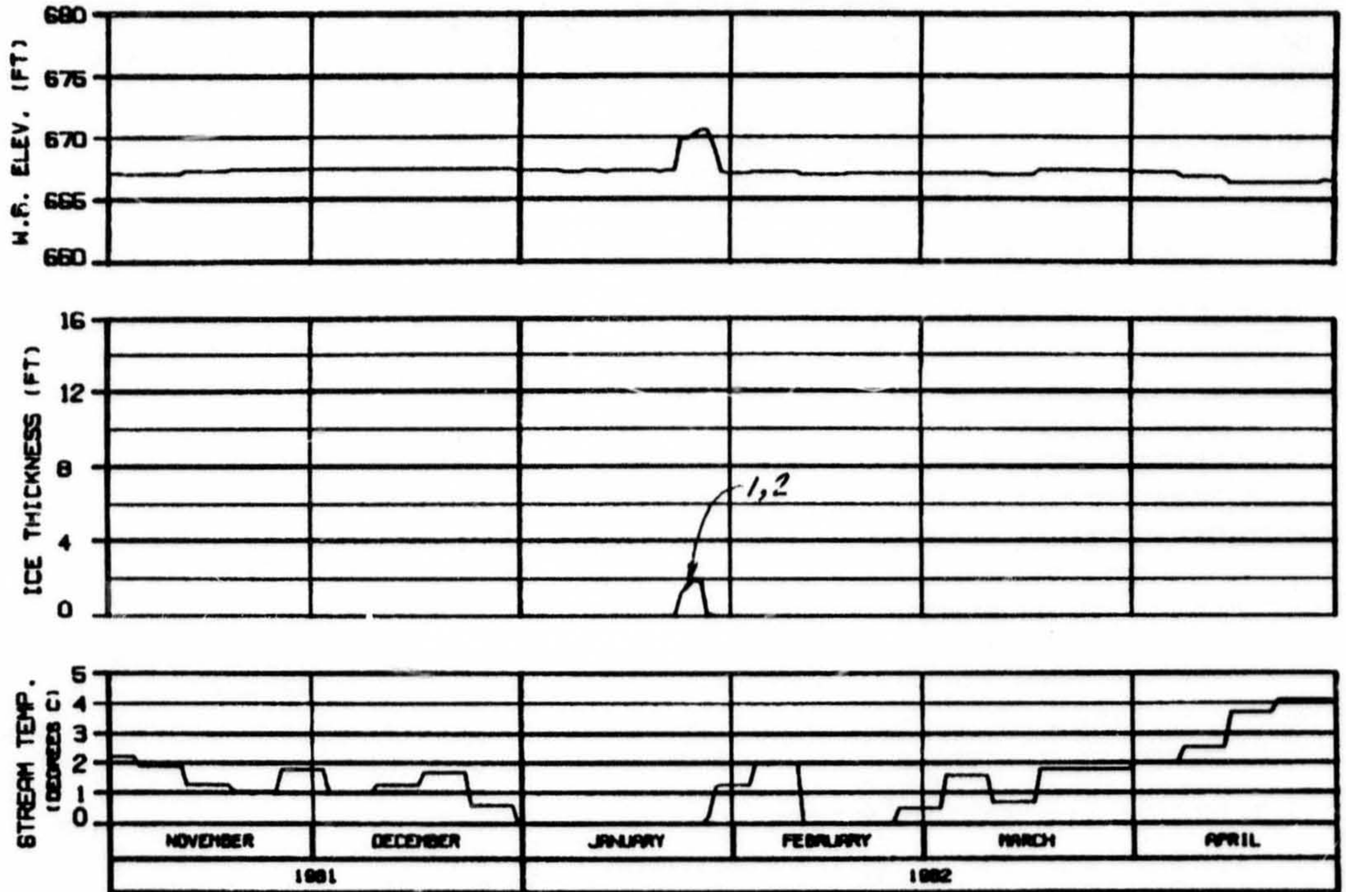
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

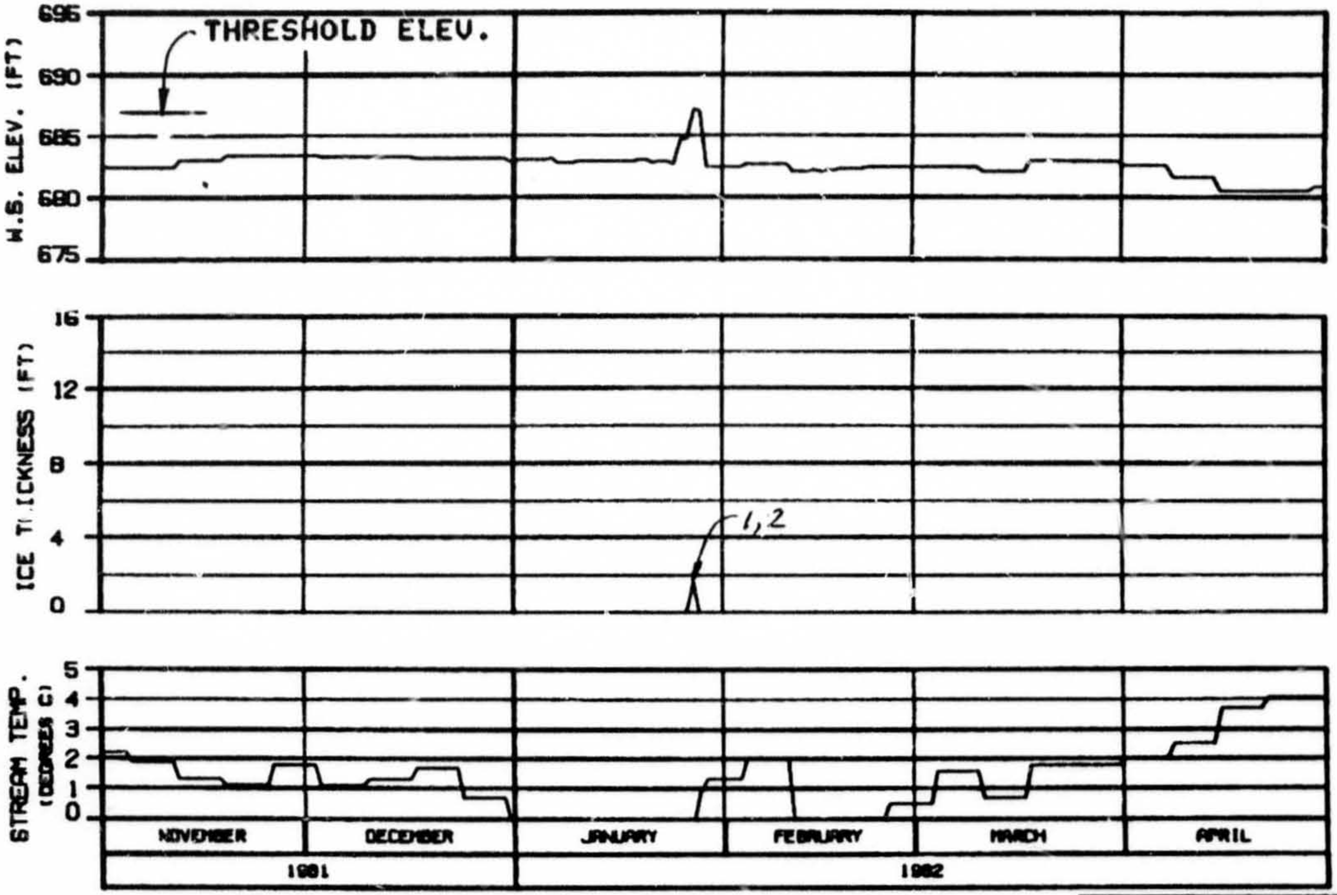
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP CASE : NATURAL
REFERENCE RUN NO. : 8196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

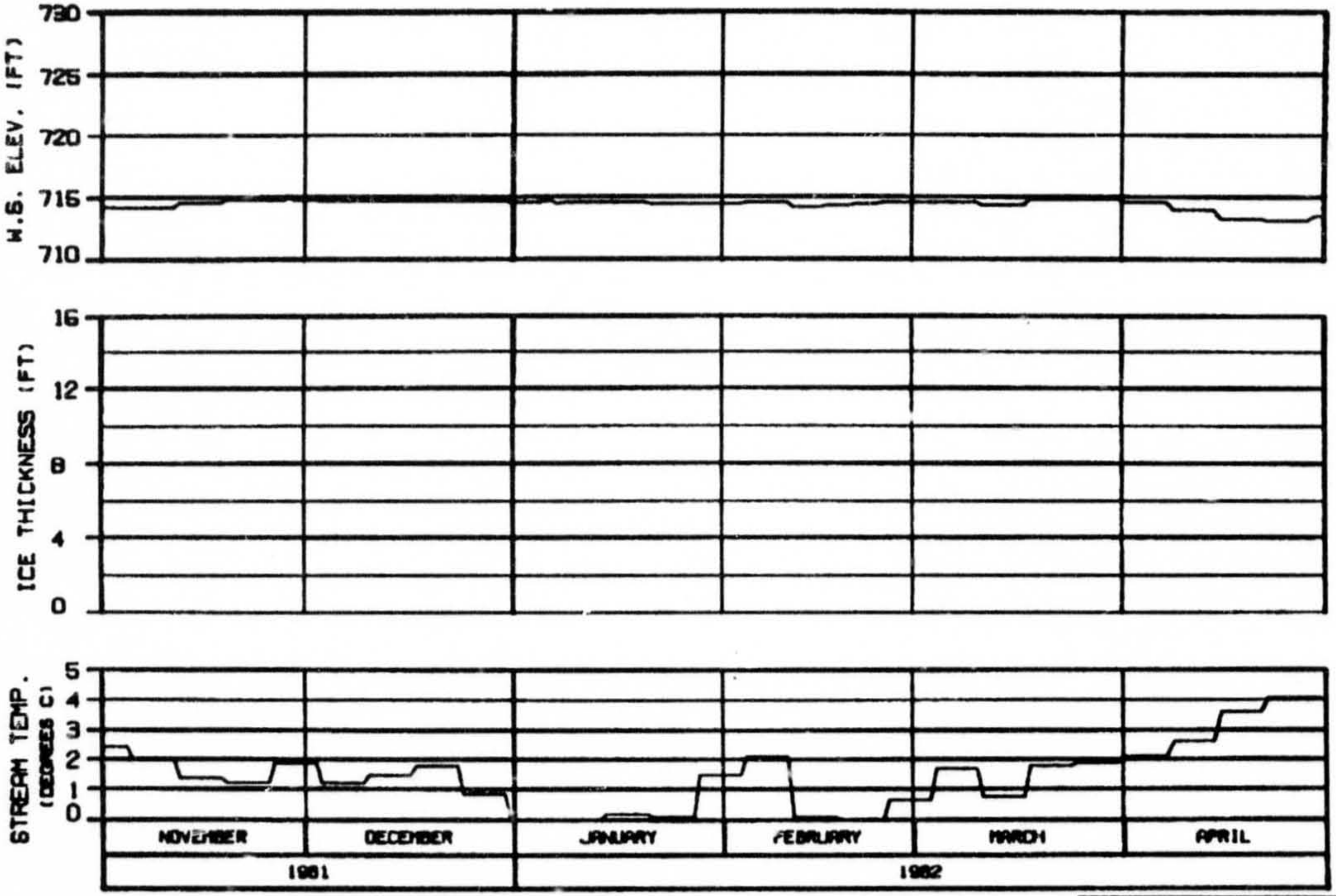
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible]



HEAD OF SLOUGH 17

RIVER MILE : 139.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

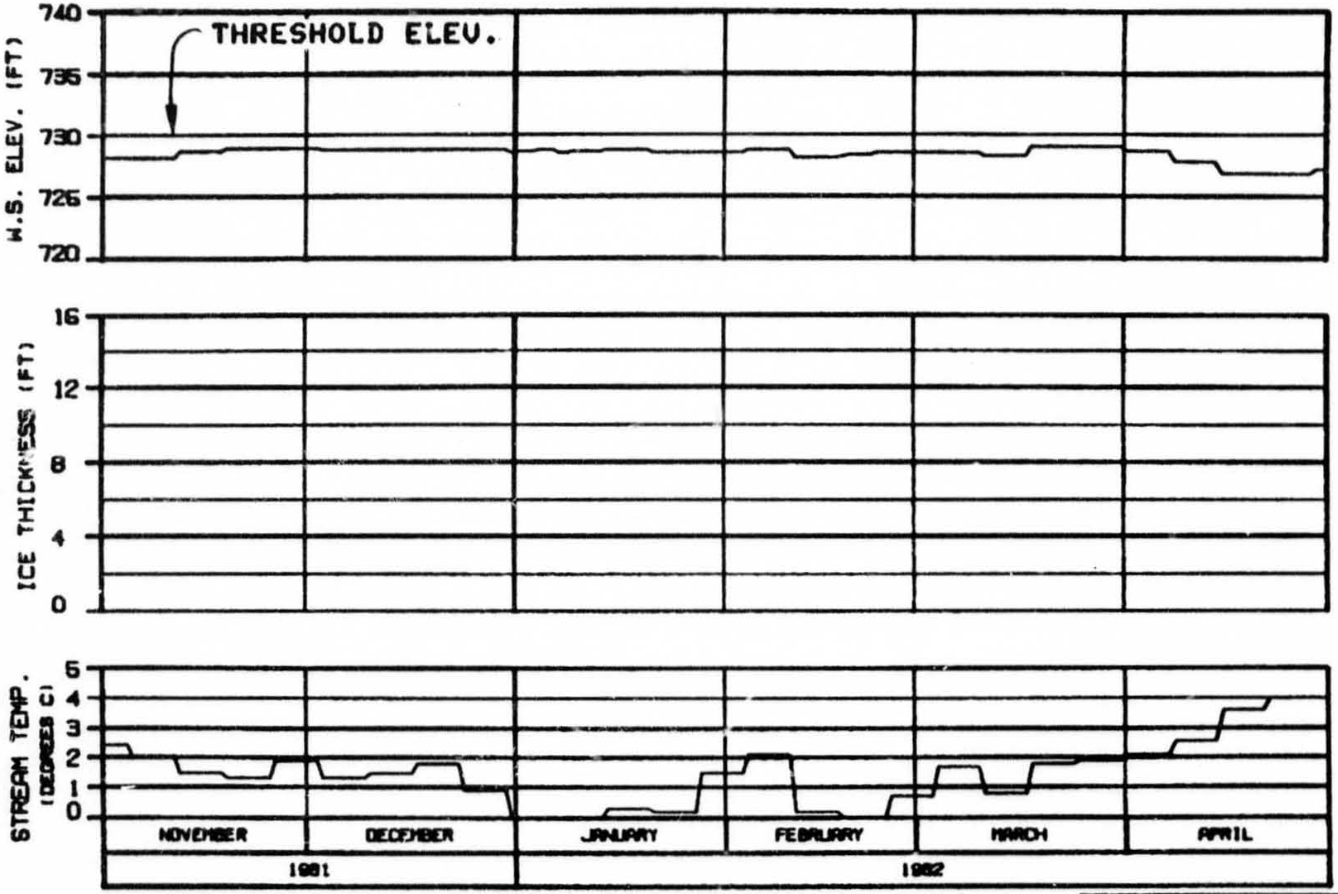
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

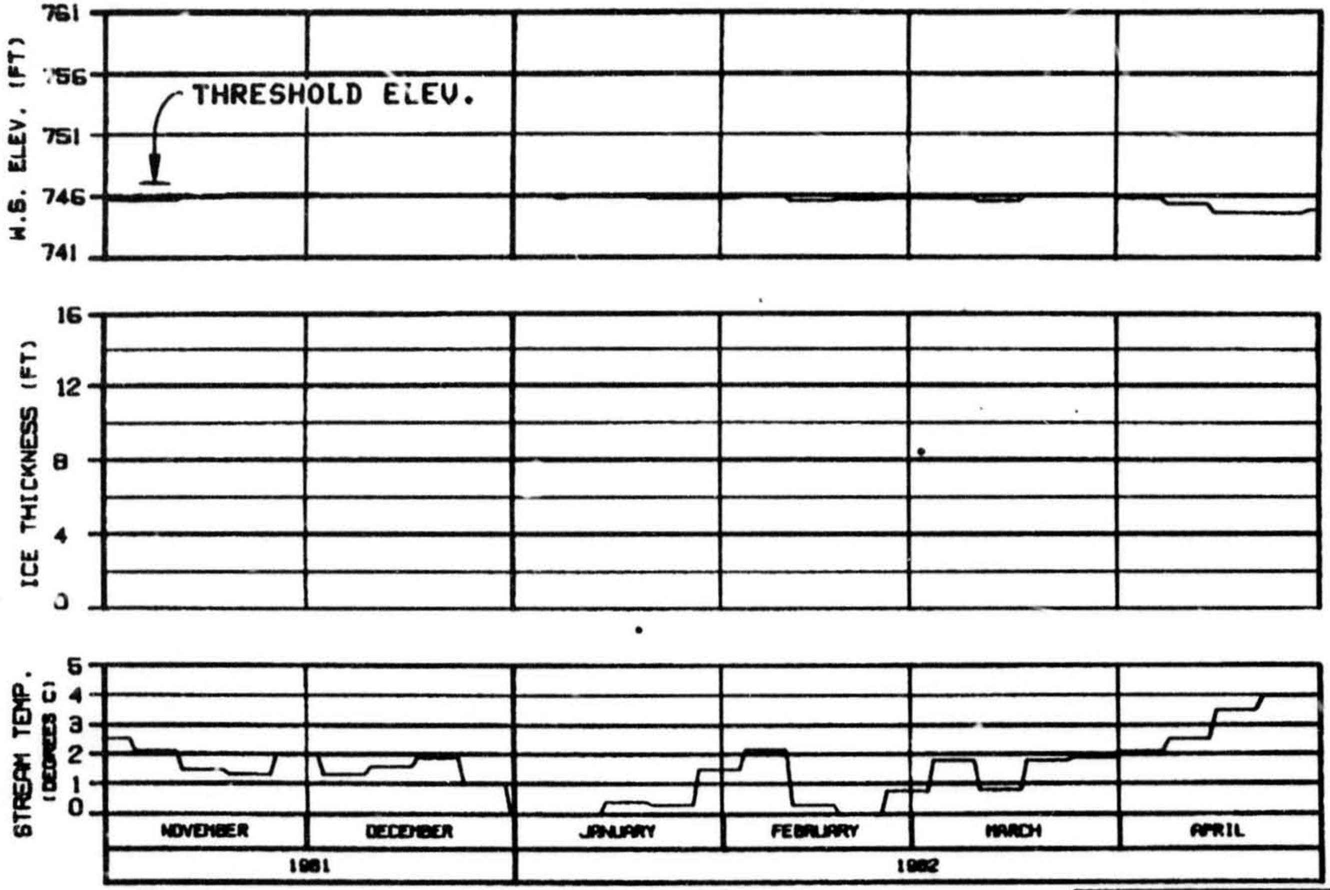
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



SLOUGH 21 (ENTRANCE A6)

RIVER MILE : 141.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

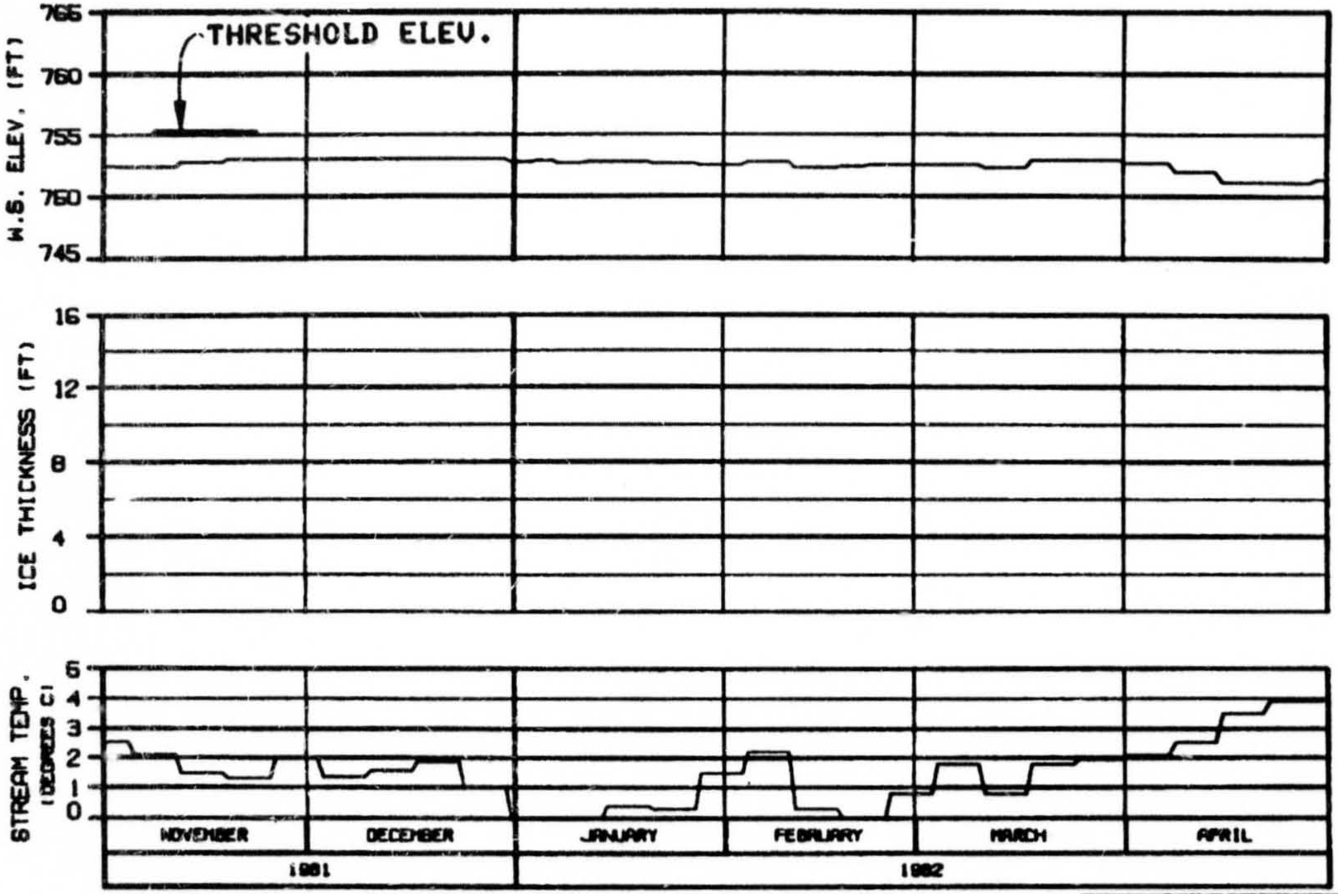
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 21

RIVER MILE : 142.20

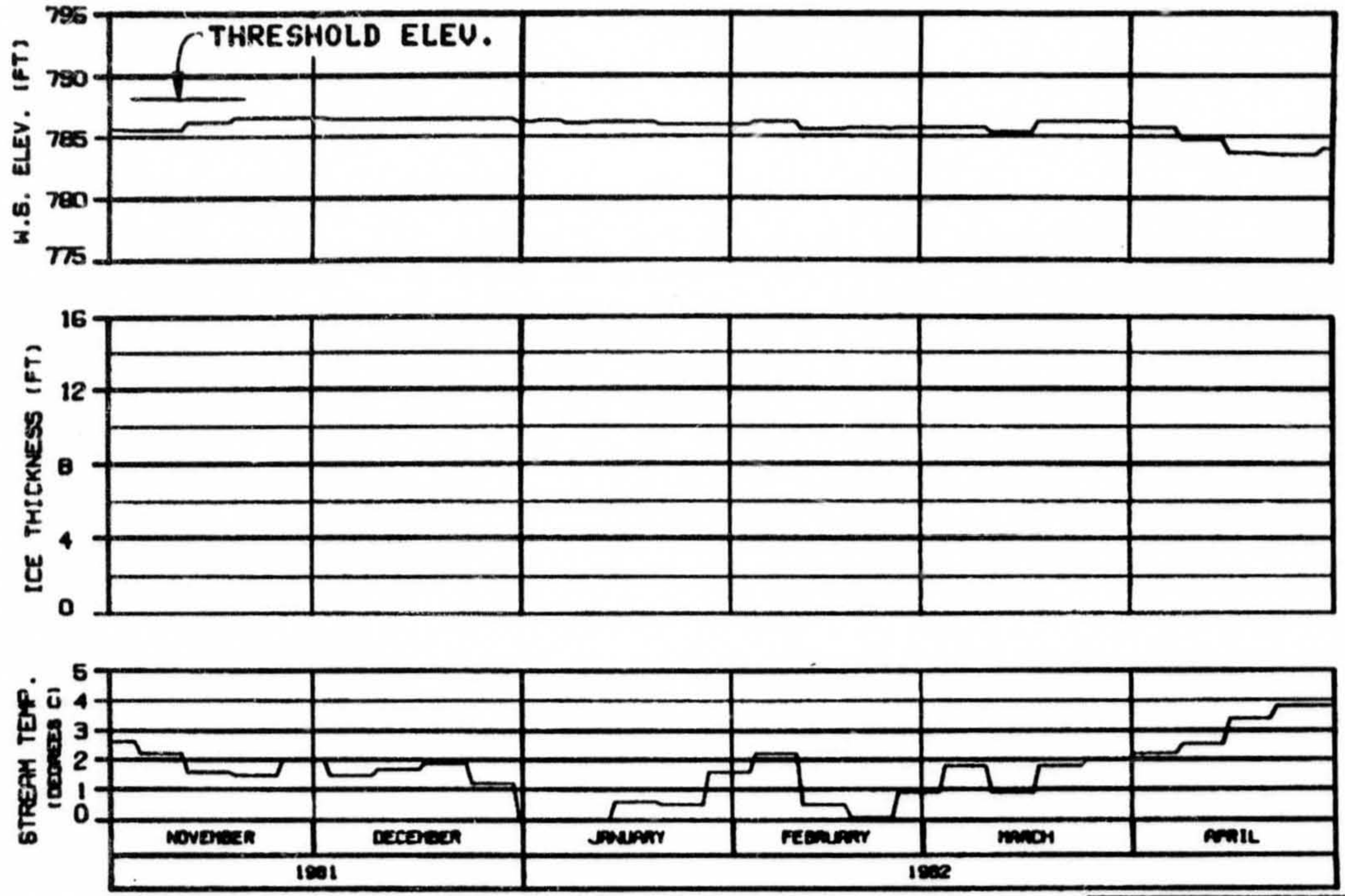
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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

C



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

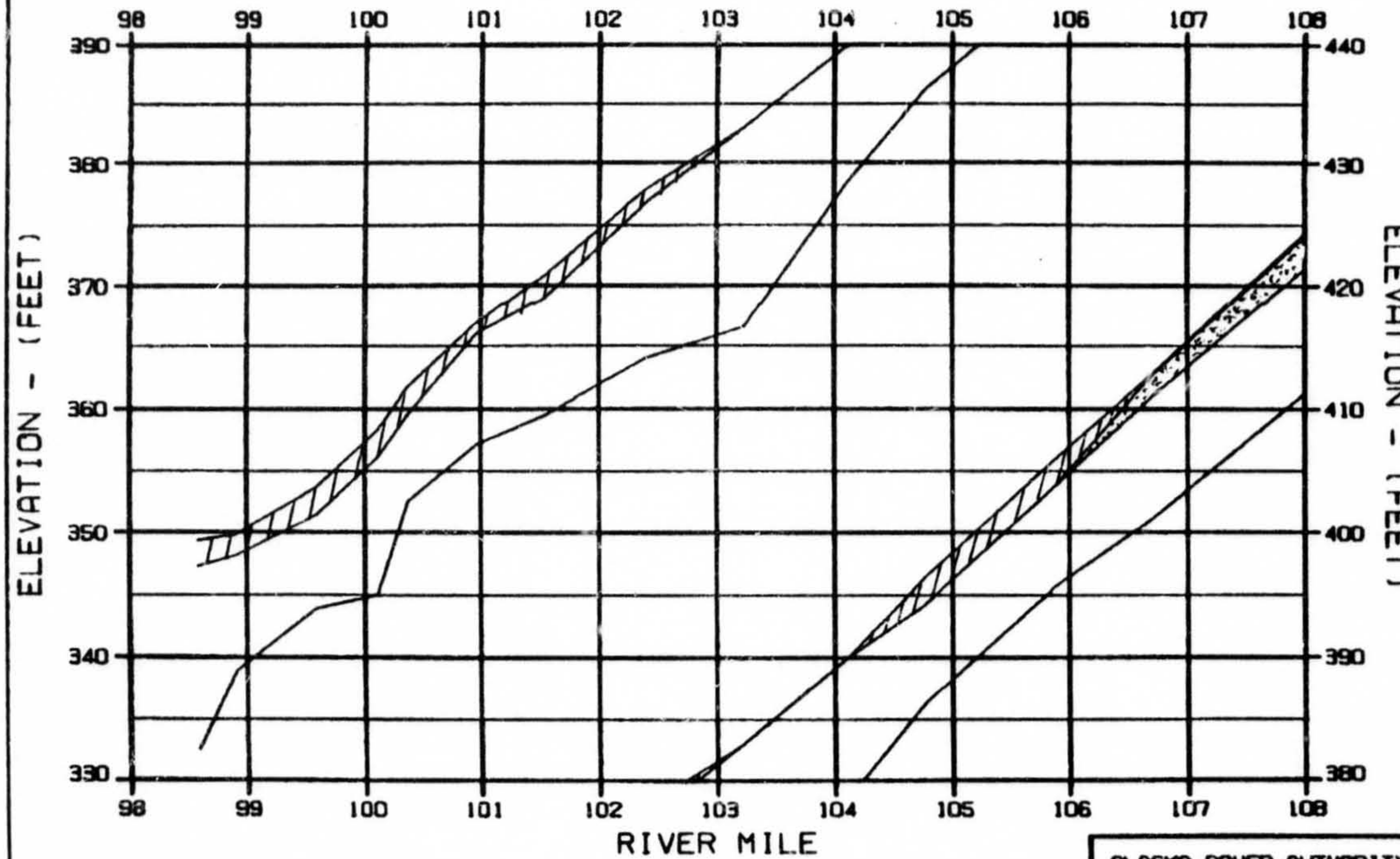
WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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

OPTION?

EXHIBIT H

C



LEGEND:

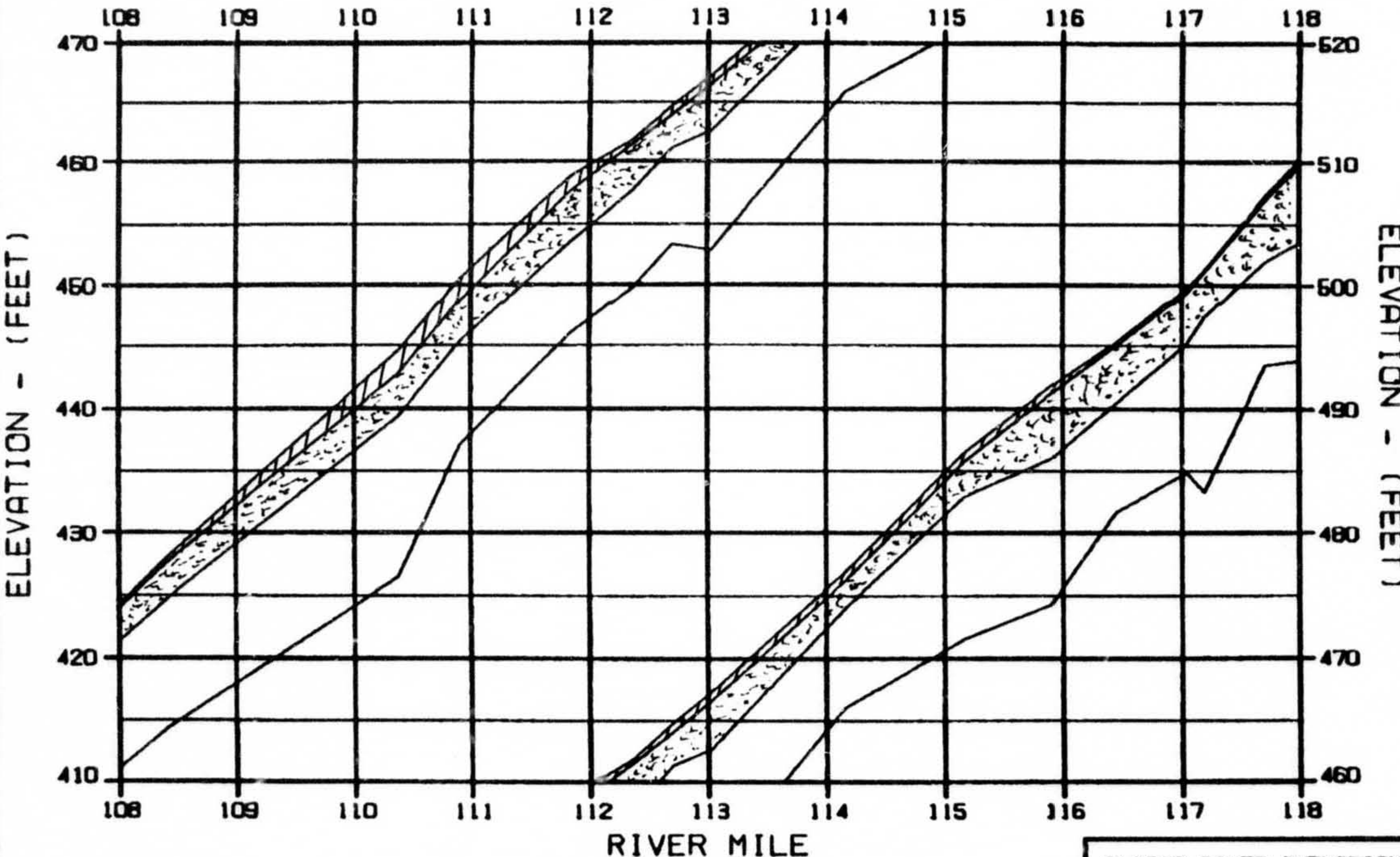
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8298CNA

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

OPTION?

C



LEGEND:

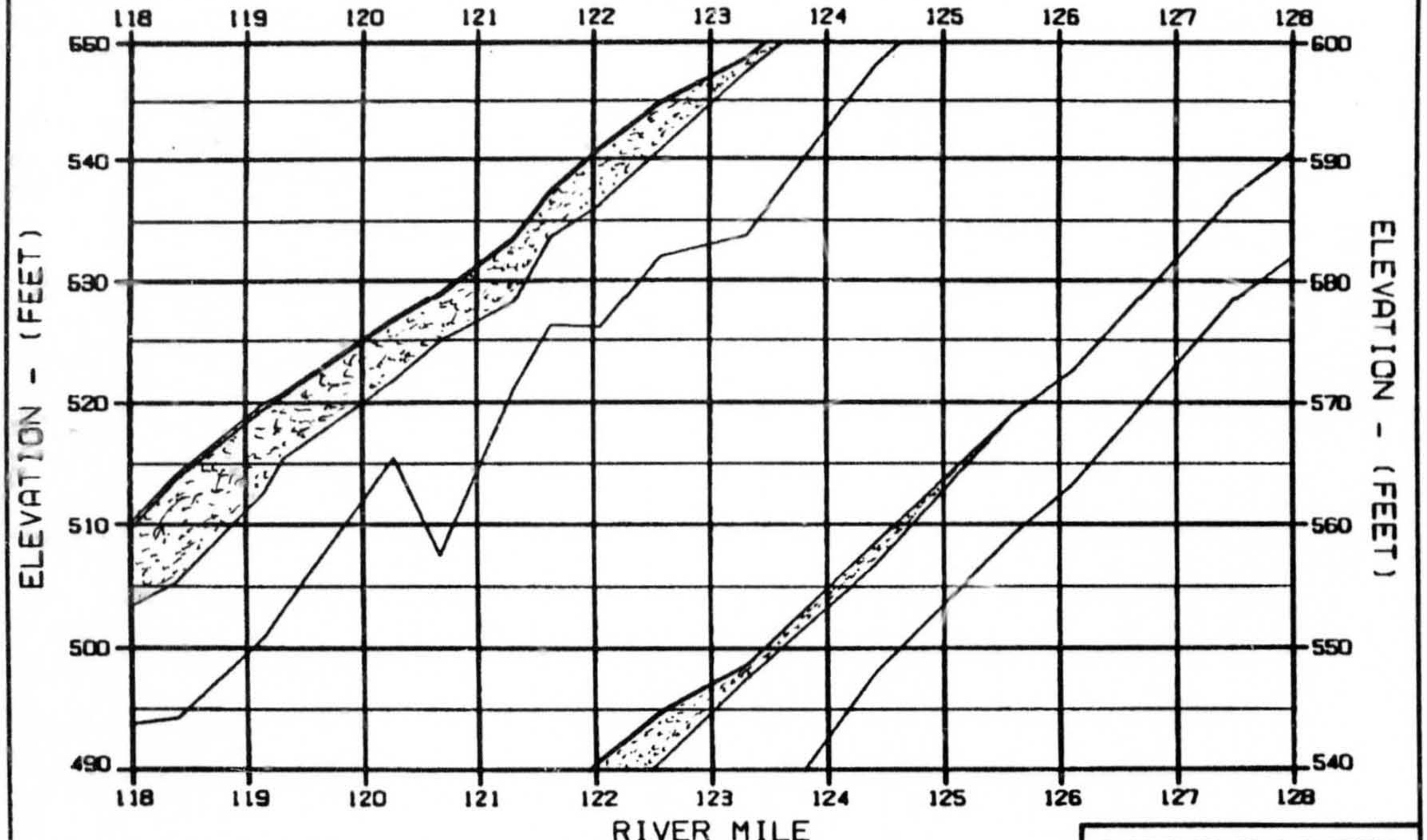
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8298CNA

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

OPTION?

c



LEGEND:

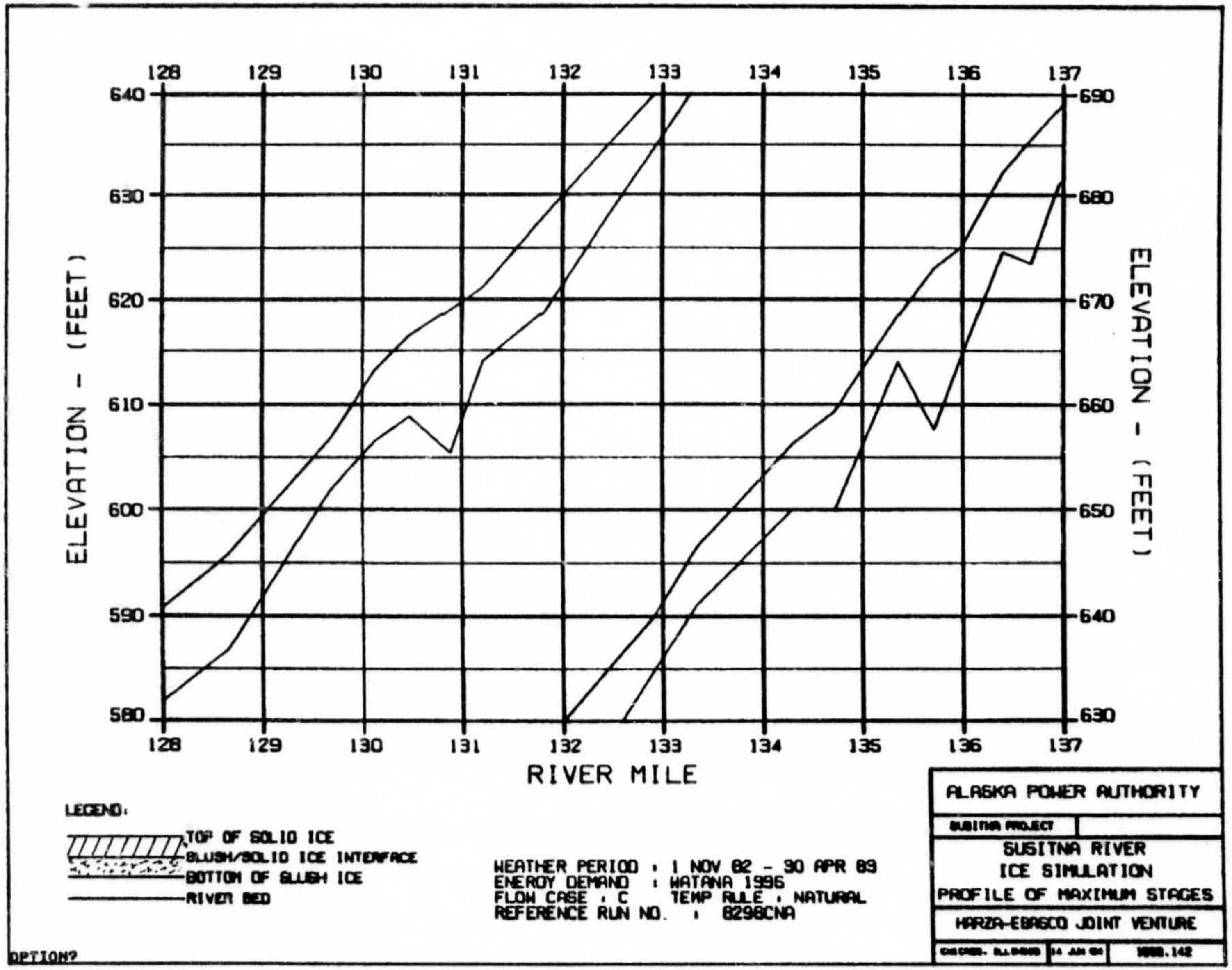
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

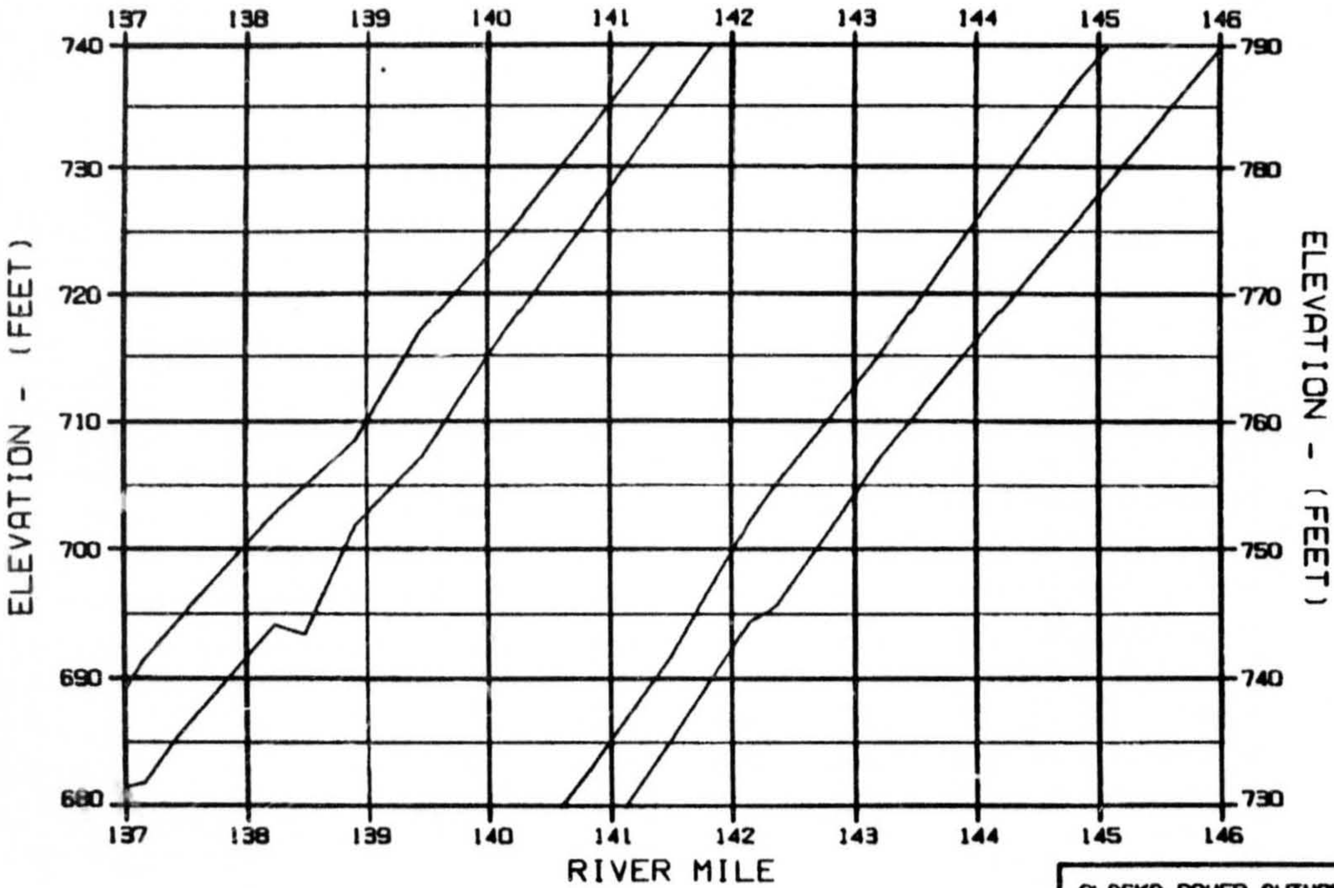
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

OPTION?

C


128
129
130
131
132
133
134
135
136
137
640
630
620
610
600
590
580
690
680
670
660
650
640
630
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8298CNA
ALASKA POWER AUTHORITY
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 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8298CNA

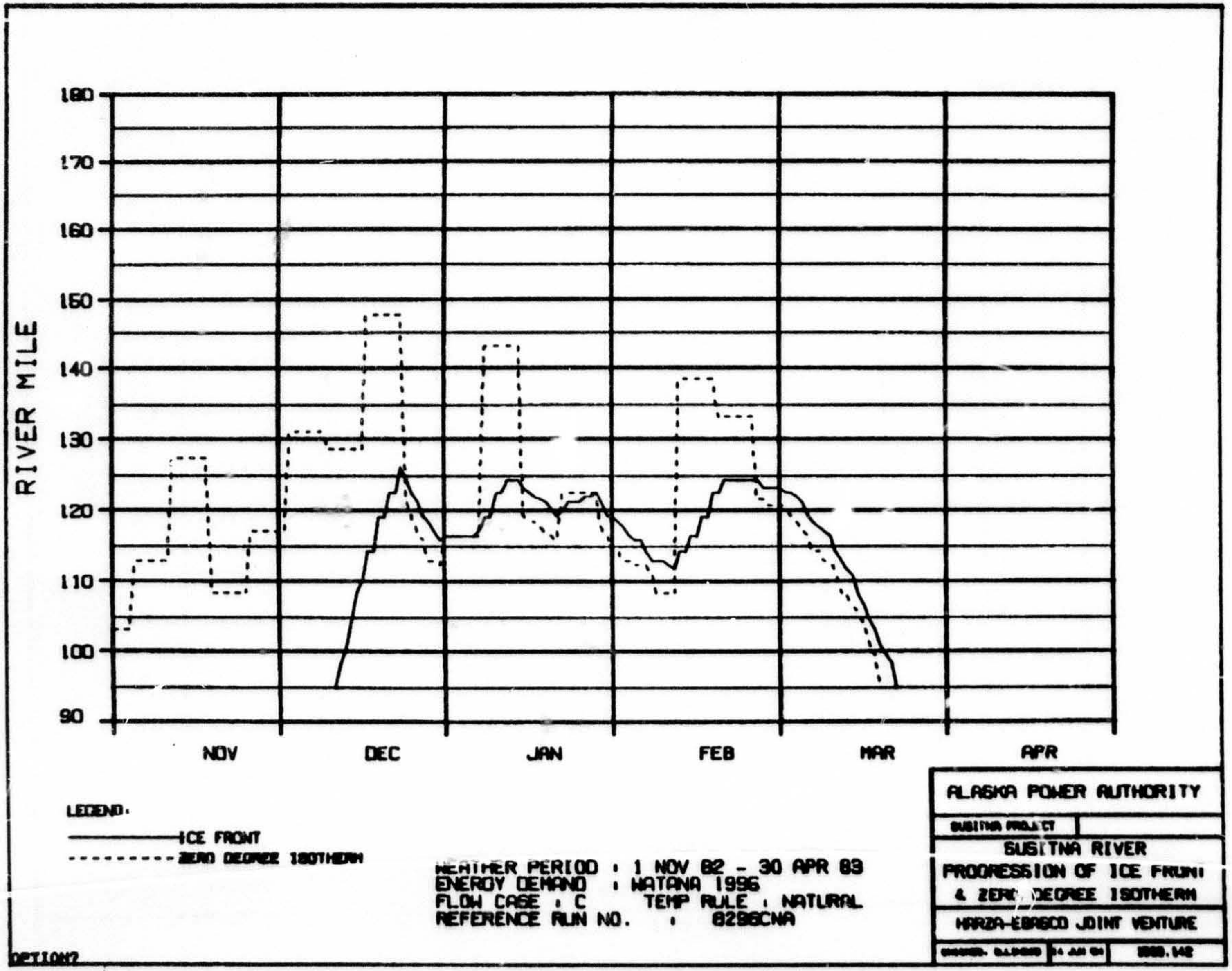
ALASKA POWER AUTHORITY

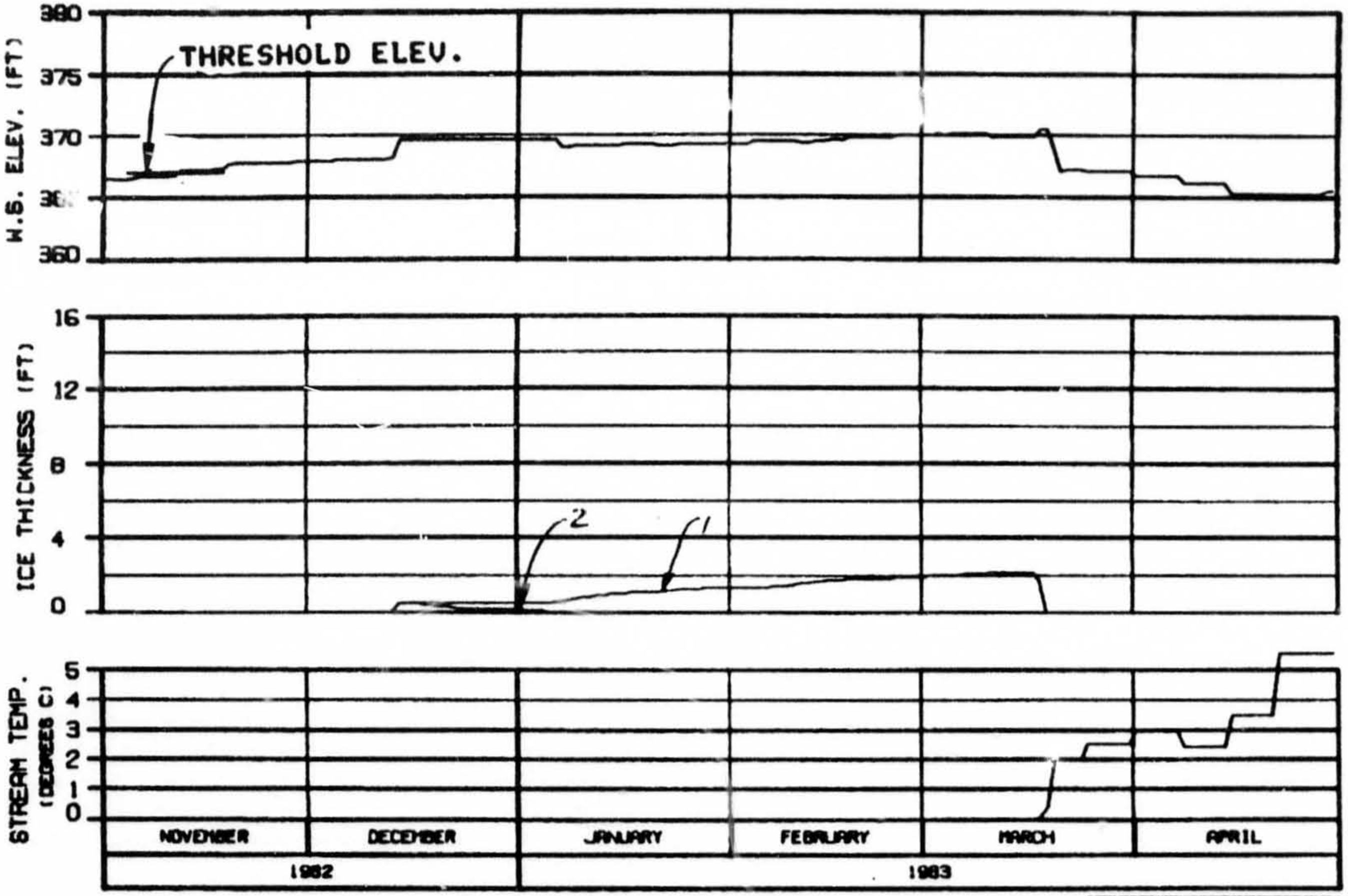
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

OPTION?


RIVER MILE
180
170
160
150
140
130
120
110
100
90
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
ICE FRONT
ZERO DEGREE ISOTHERM
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE
OPTION?



ICE THICKNESS LEGEND:

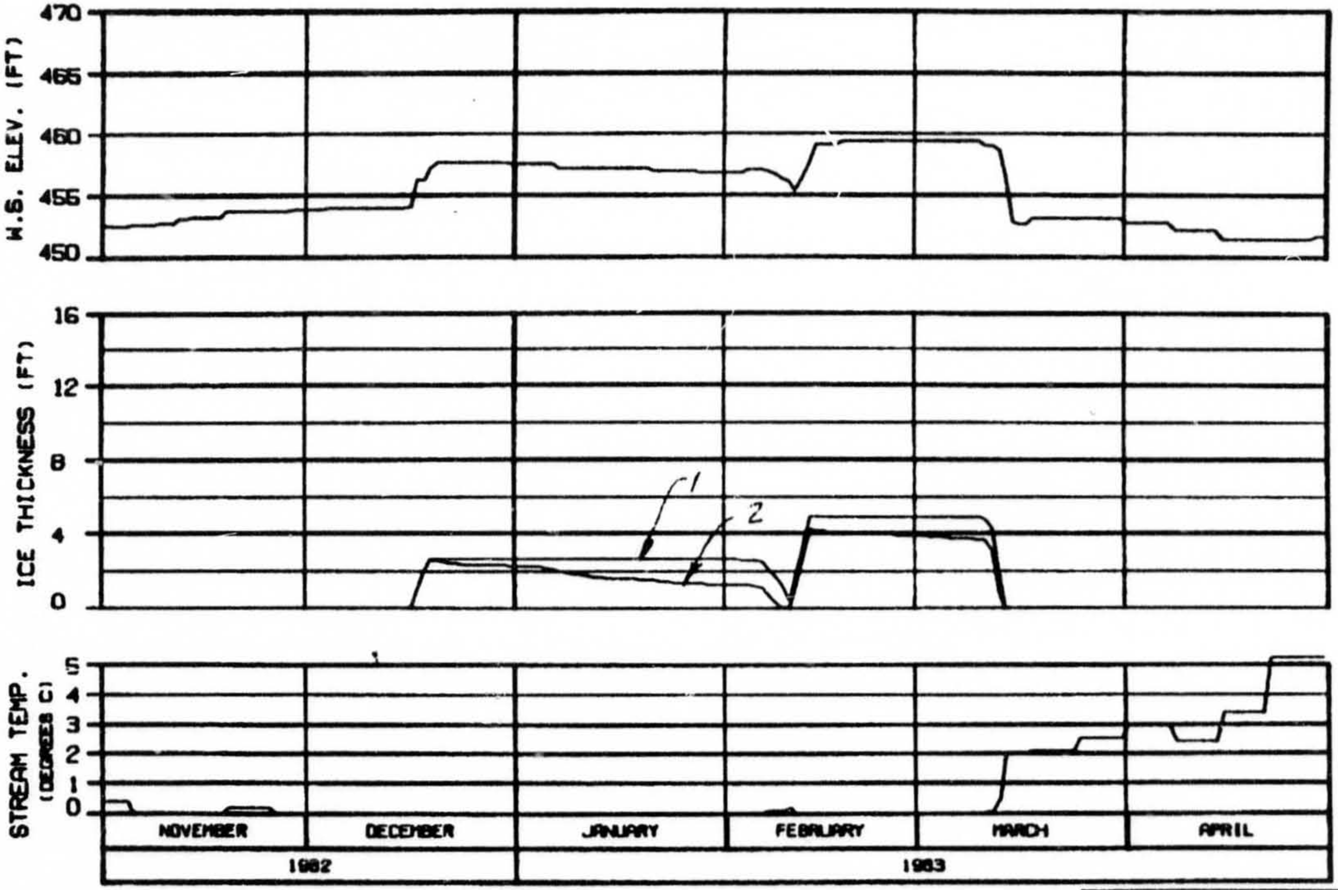
1. TOTAL THICKNESS
2. SLUSH COMPONENT

HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
[illegible]	[illegible]	1088.142



SIDE CHANNEL AT HEAD OF GASH CREEK

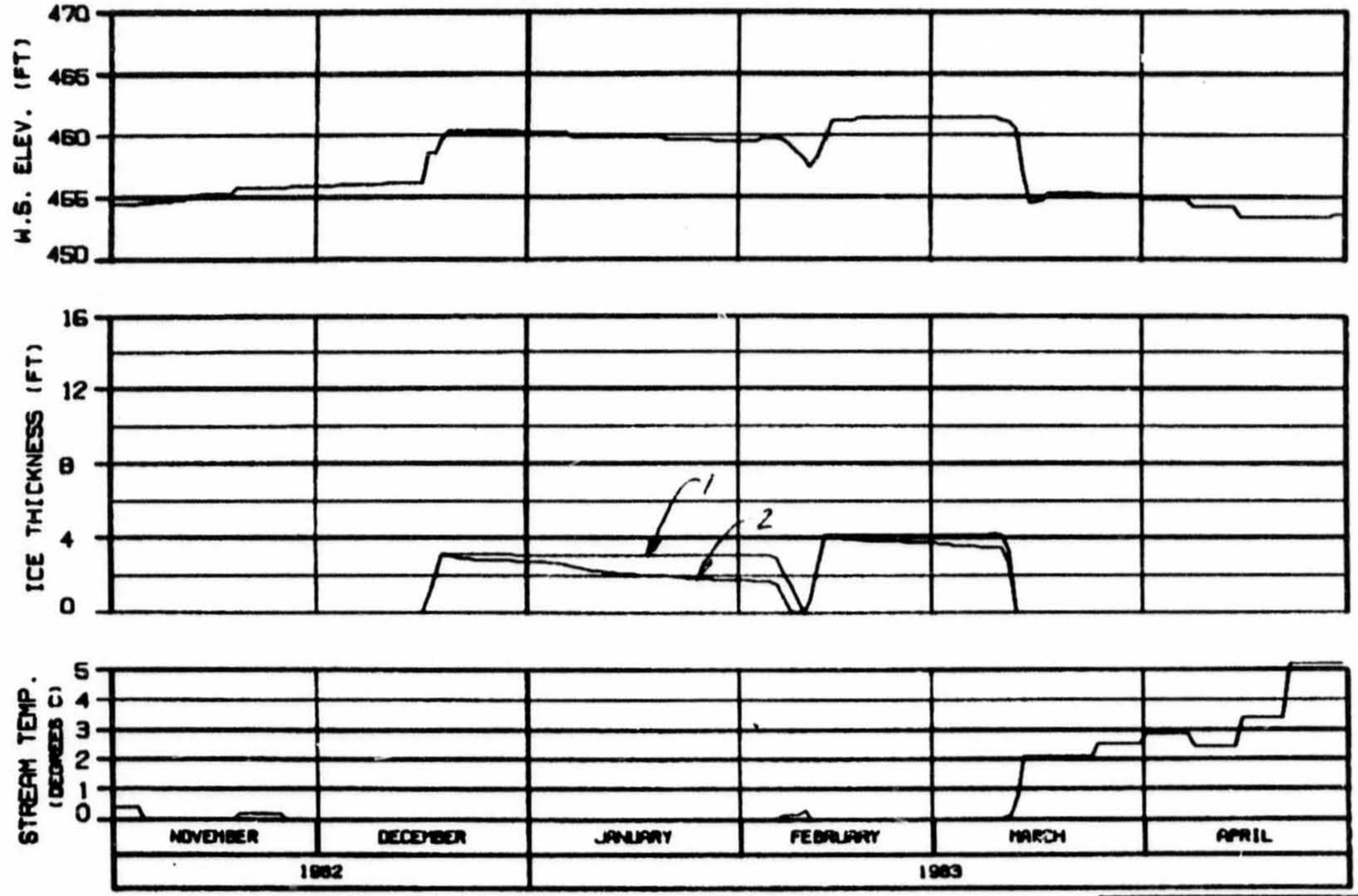
RIVER MILE : 112.00

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

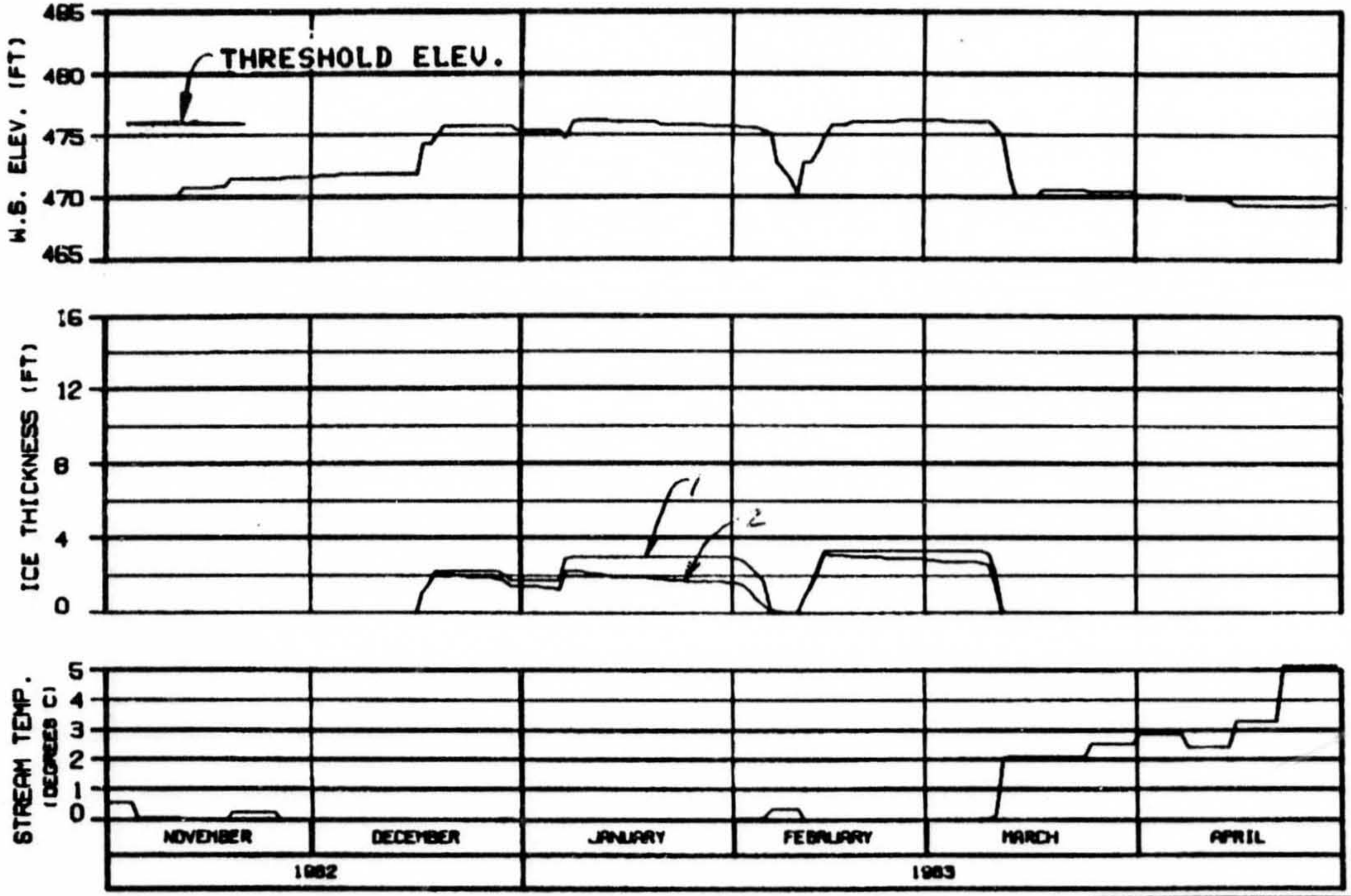
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 8

RIVER MILE : 114.10

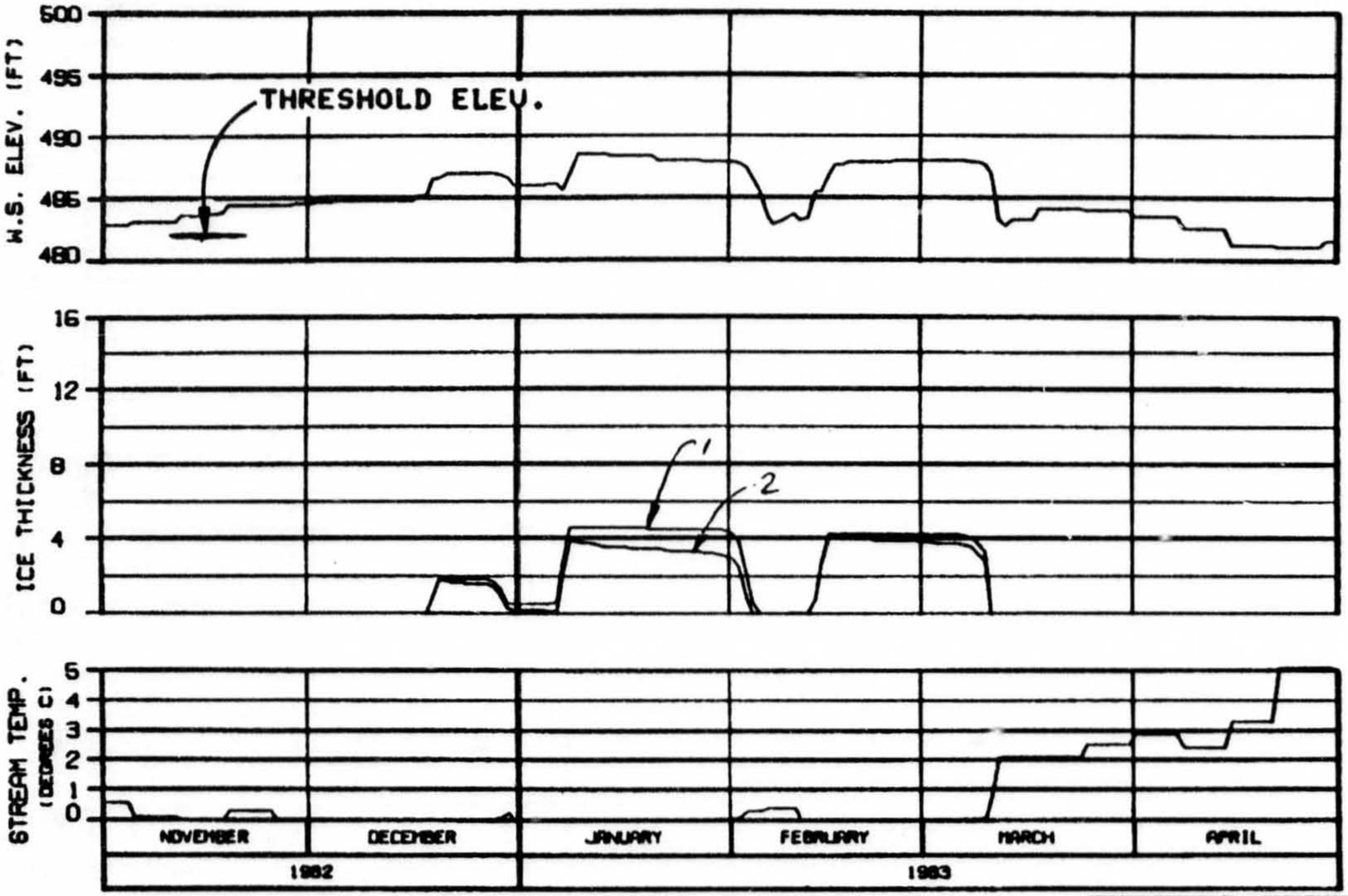
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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

[illegible]	[illegible] JAN [illegible]	[illegible].142



SIDE CHANNEL MSII

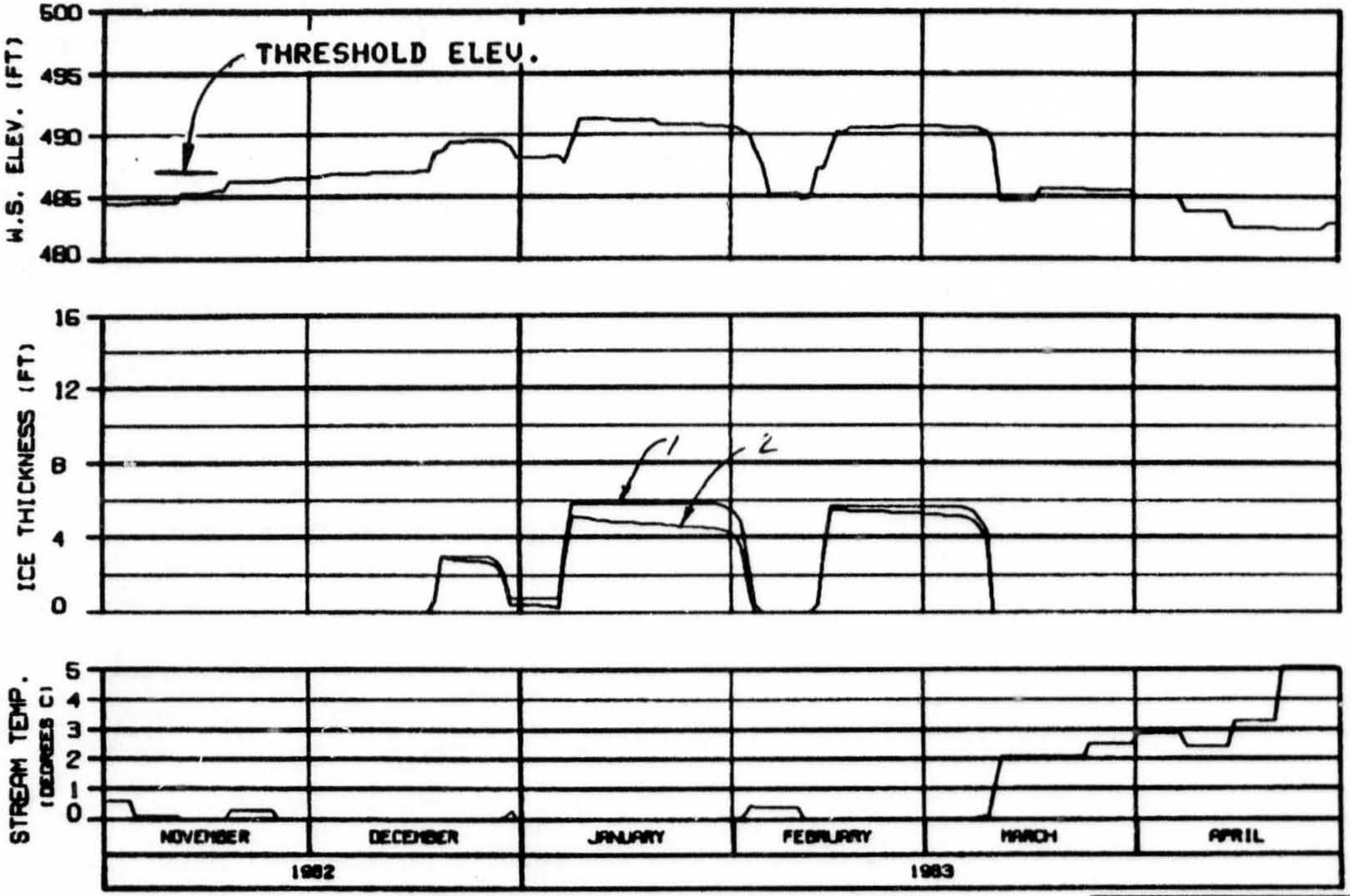
RIVER MILE : 115.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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



HEAD OF SIDE CHANNEL MSII

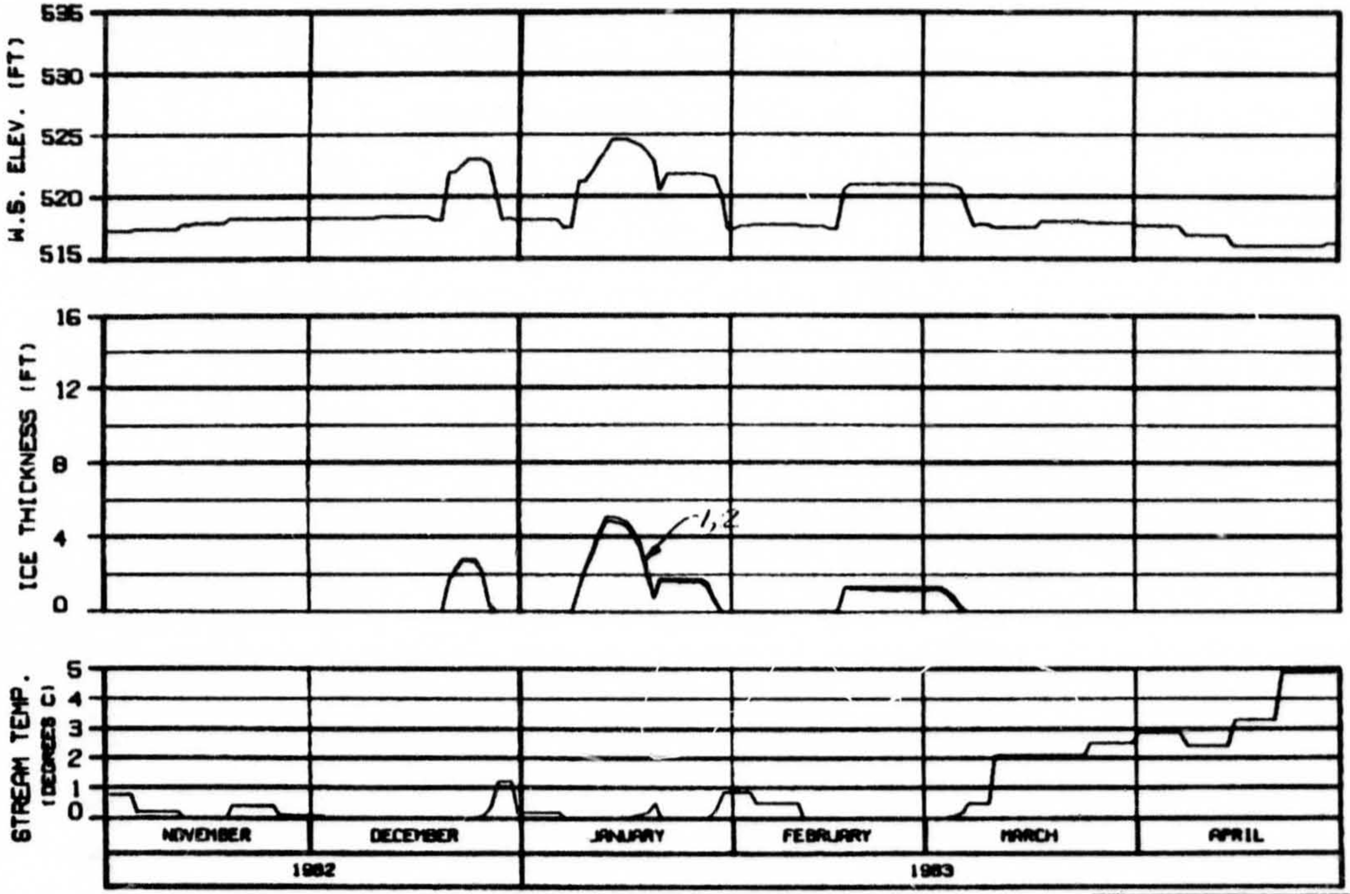
RIVER MILE : 115.90

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



RIVER MILE : 120.00

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

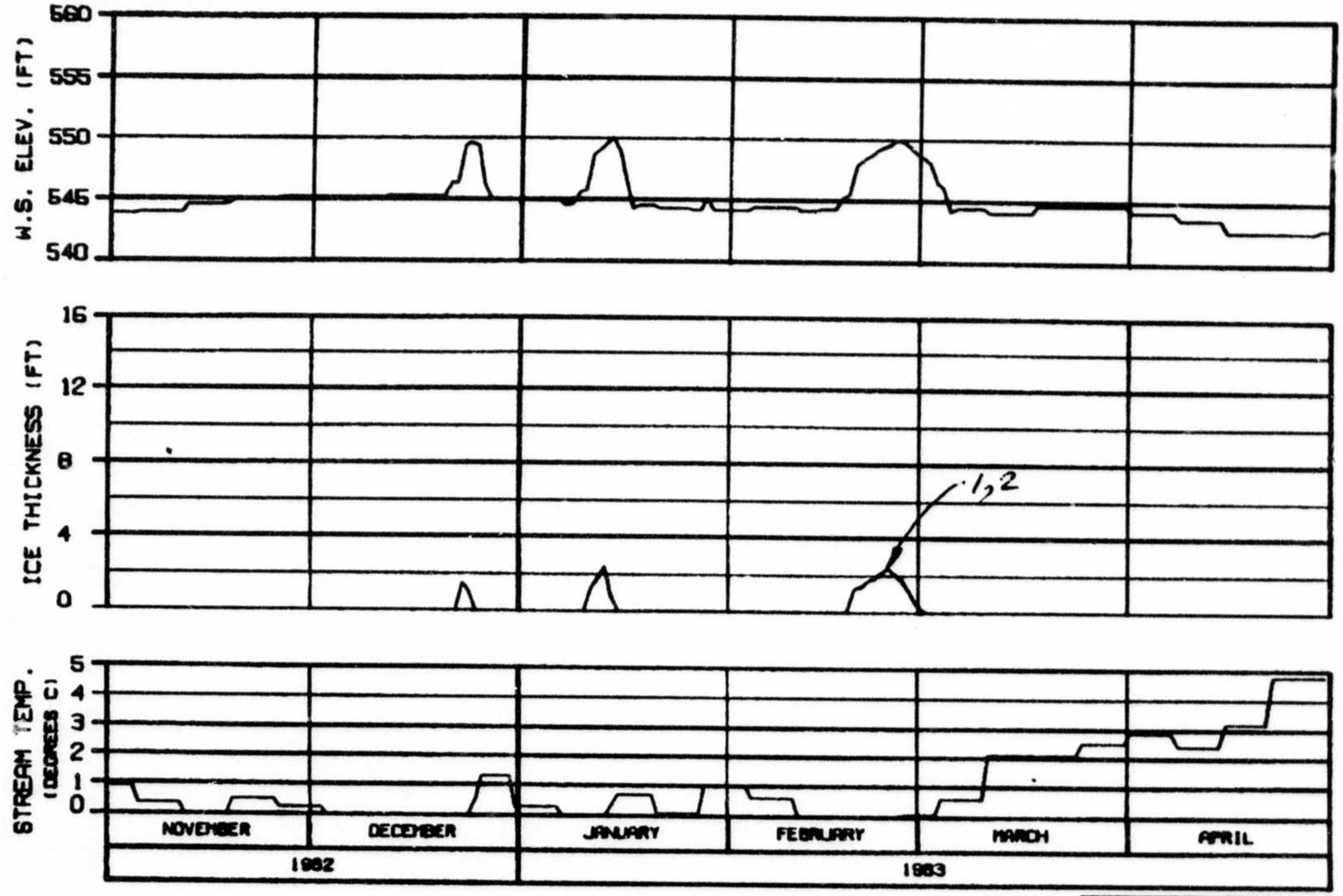
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF MOOSE SLOUGH

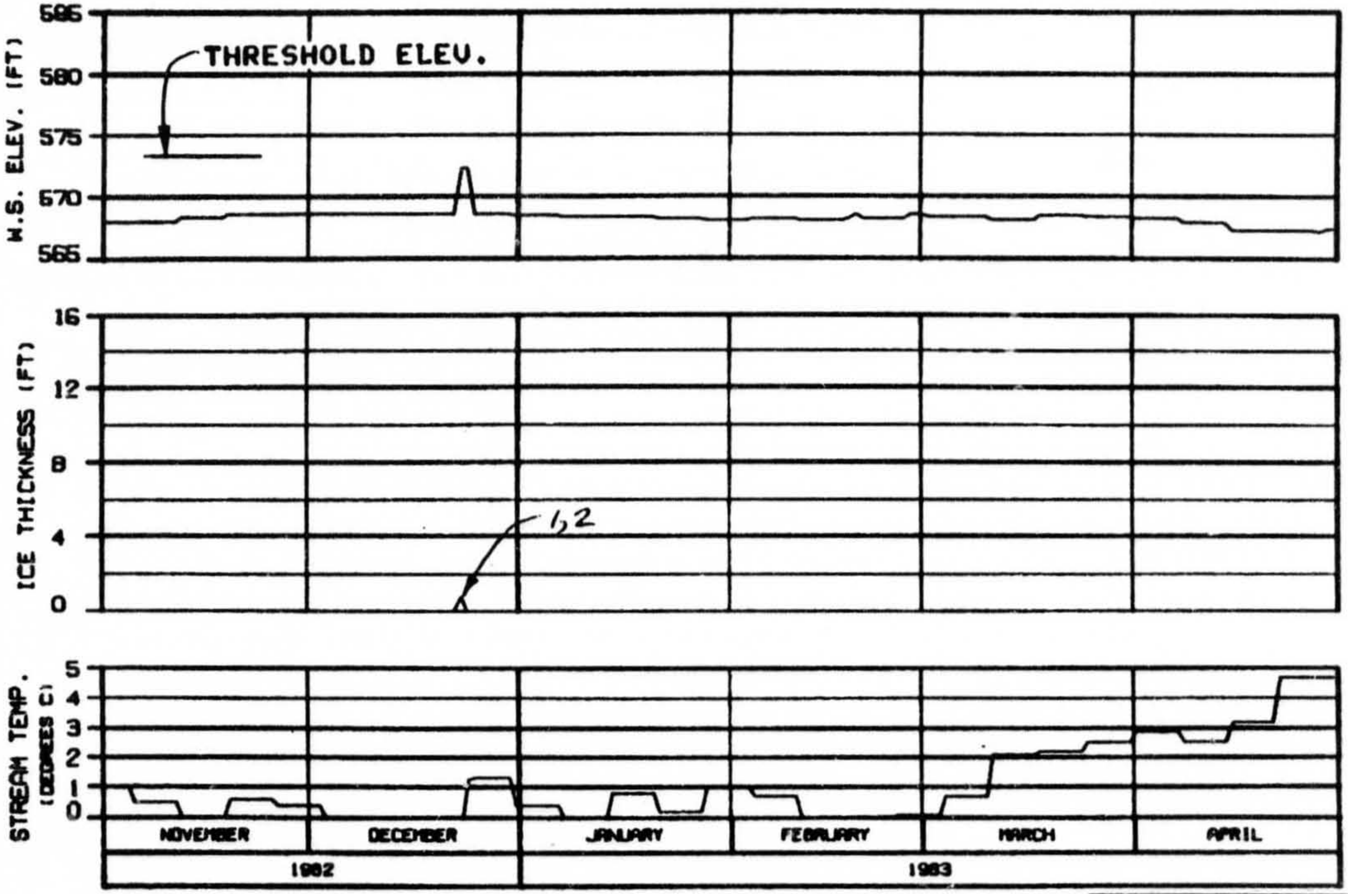
RIVER MILE : 123.50

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



HEAD OF SLOUGH 8A (WEST)

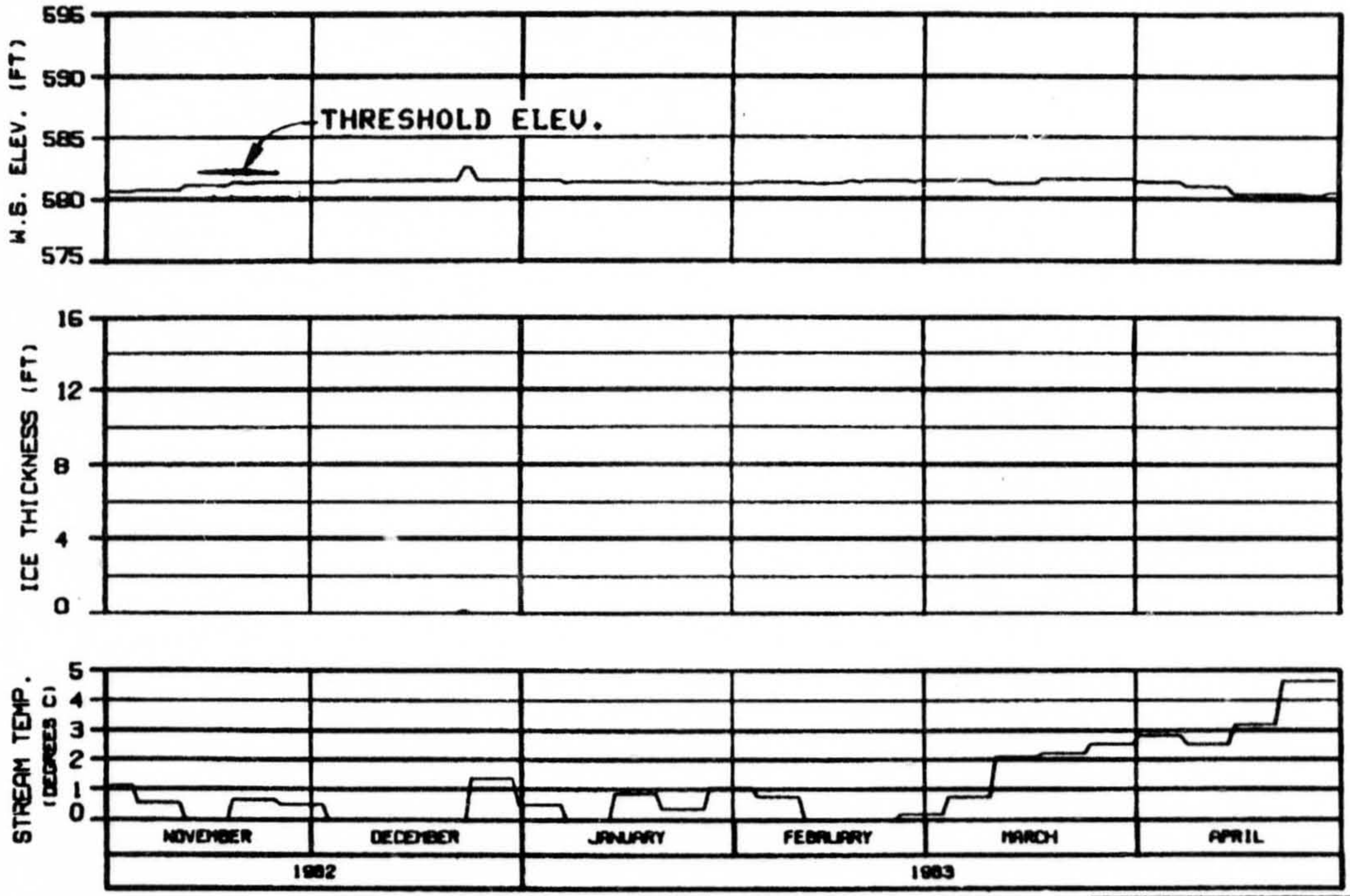
RIVER MILE : 126.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1000.142



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

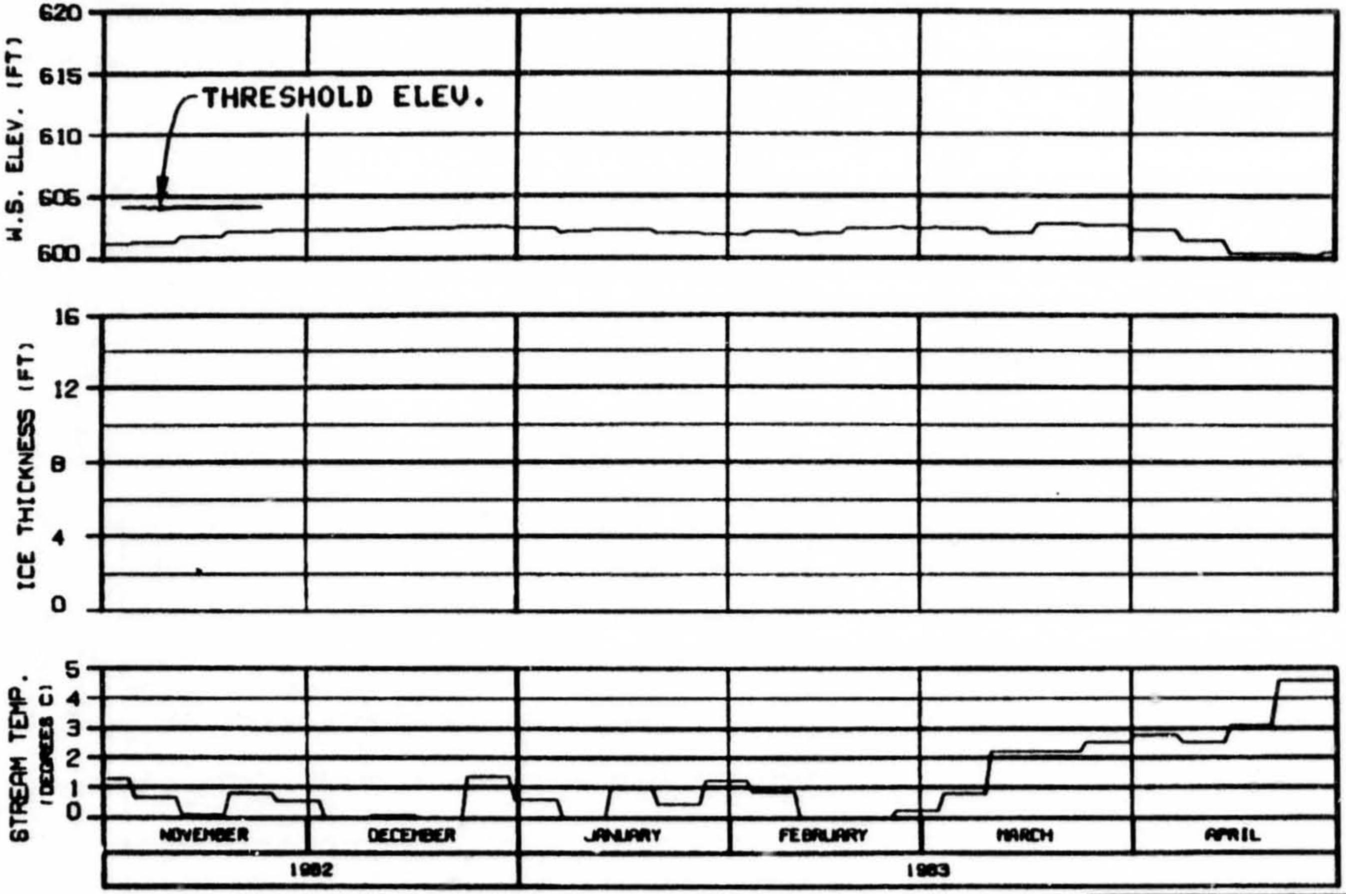
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

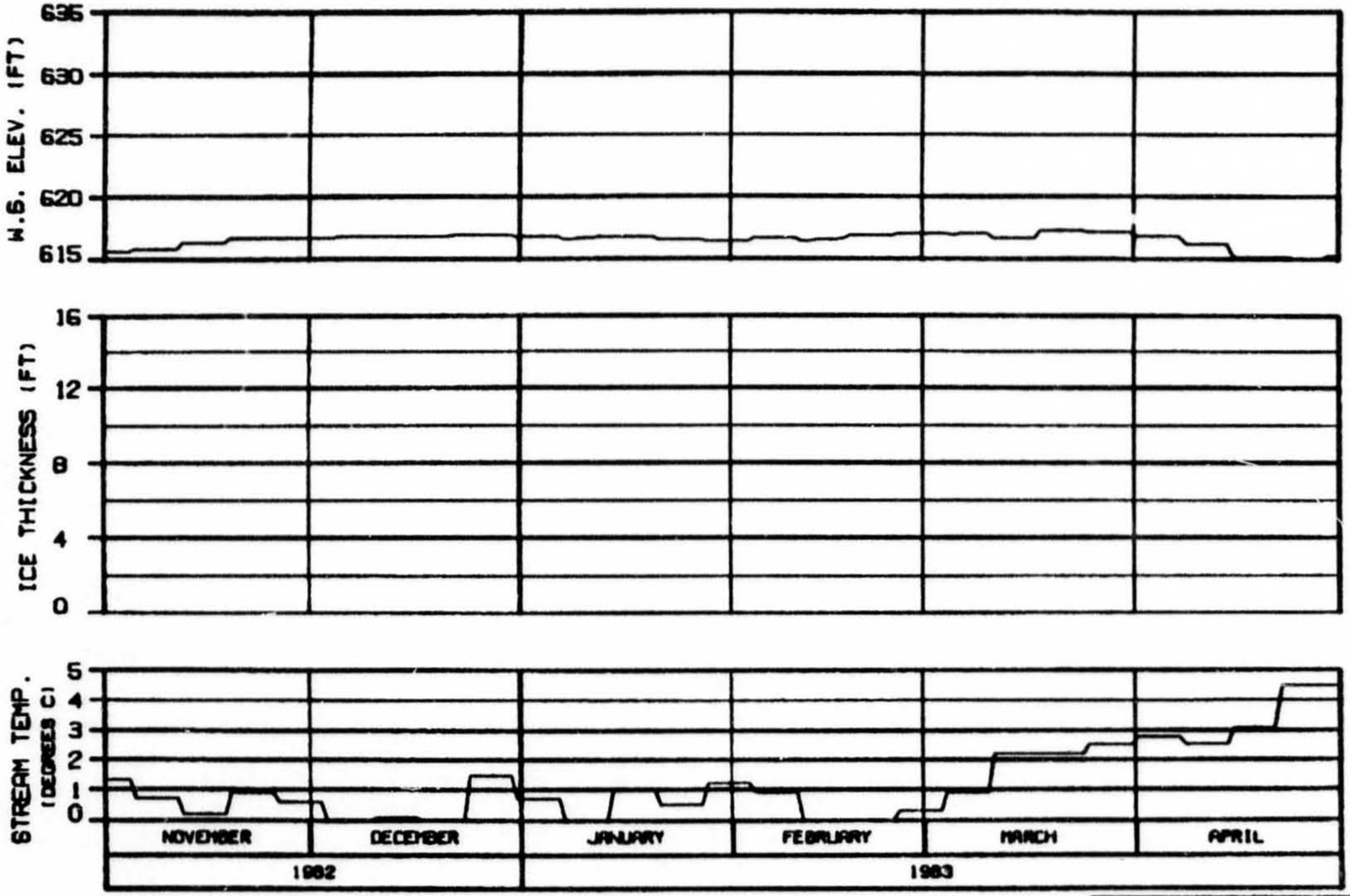
1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

OPTION?

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

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

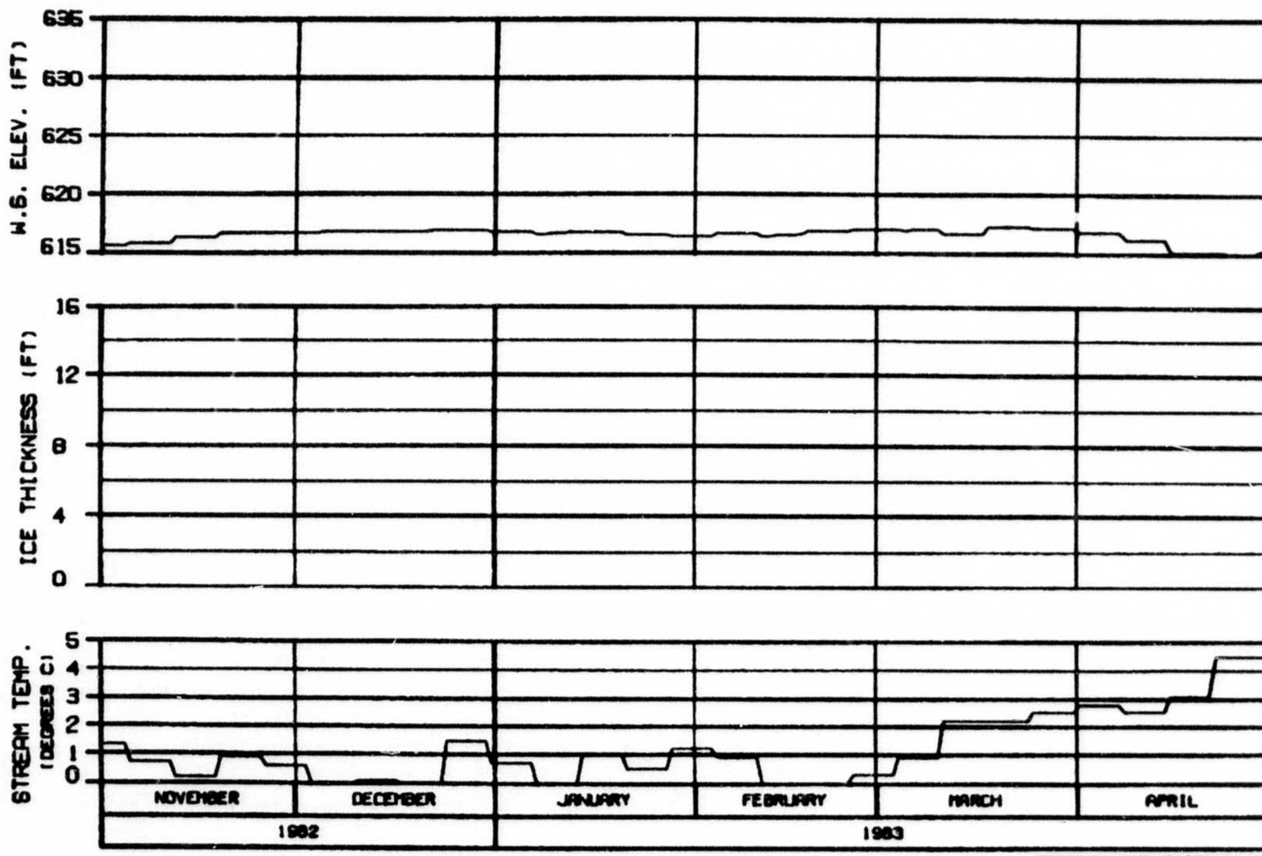
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

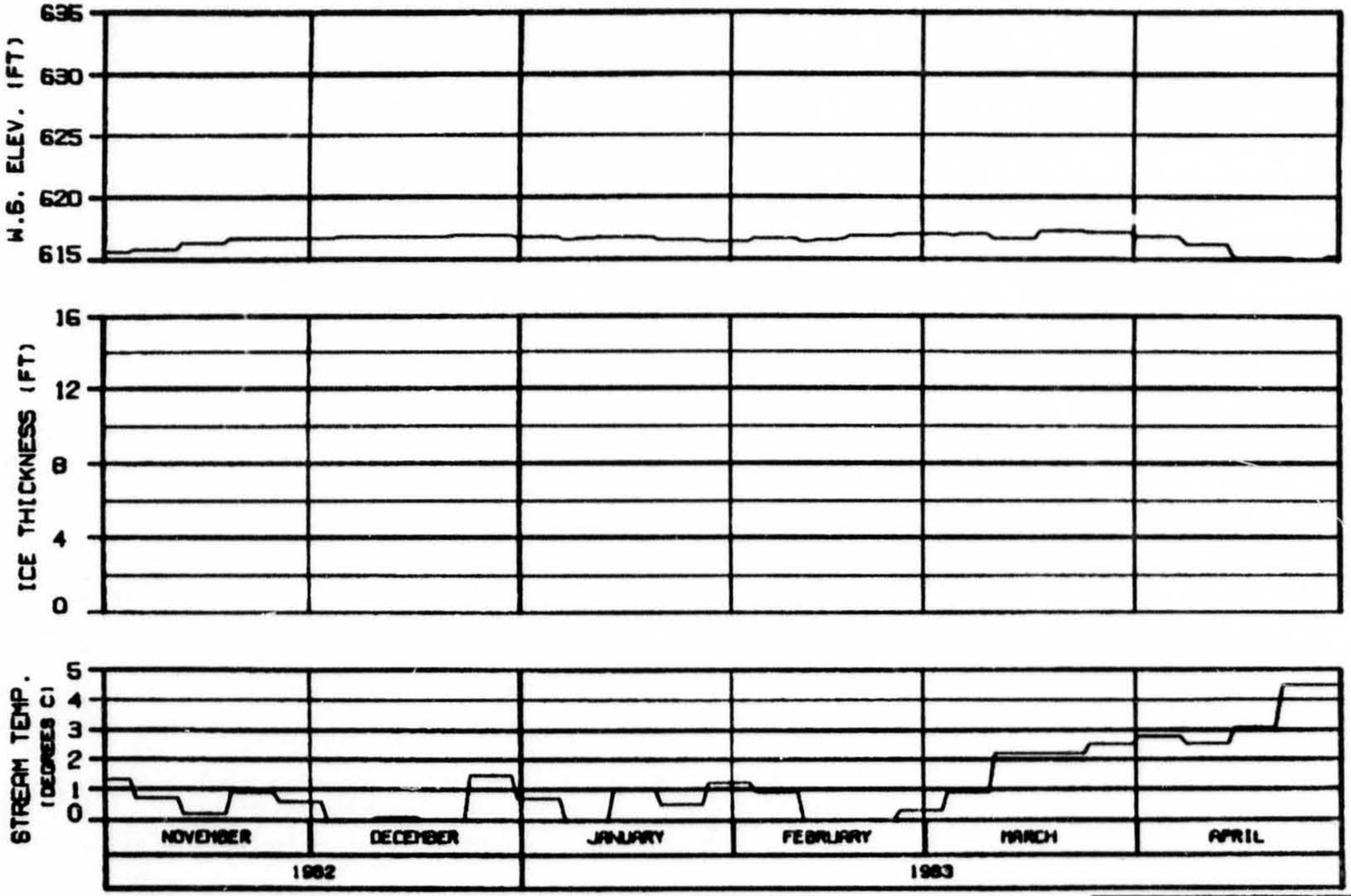
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

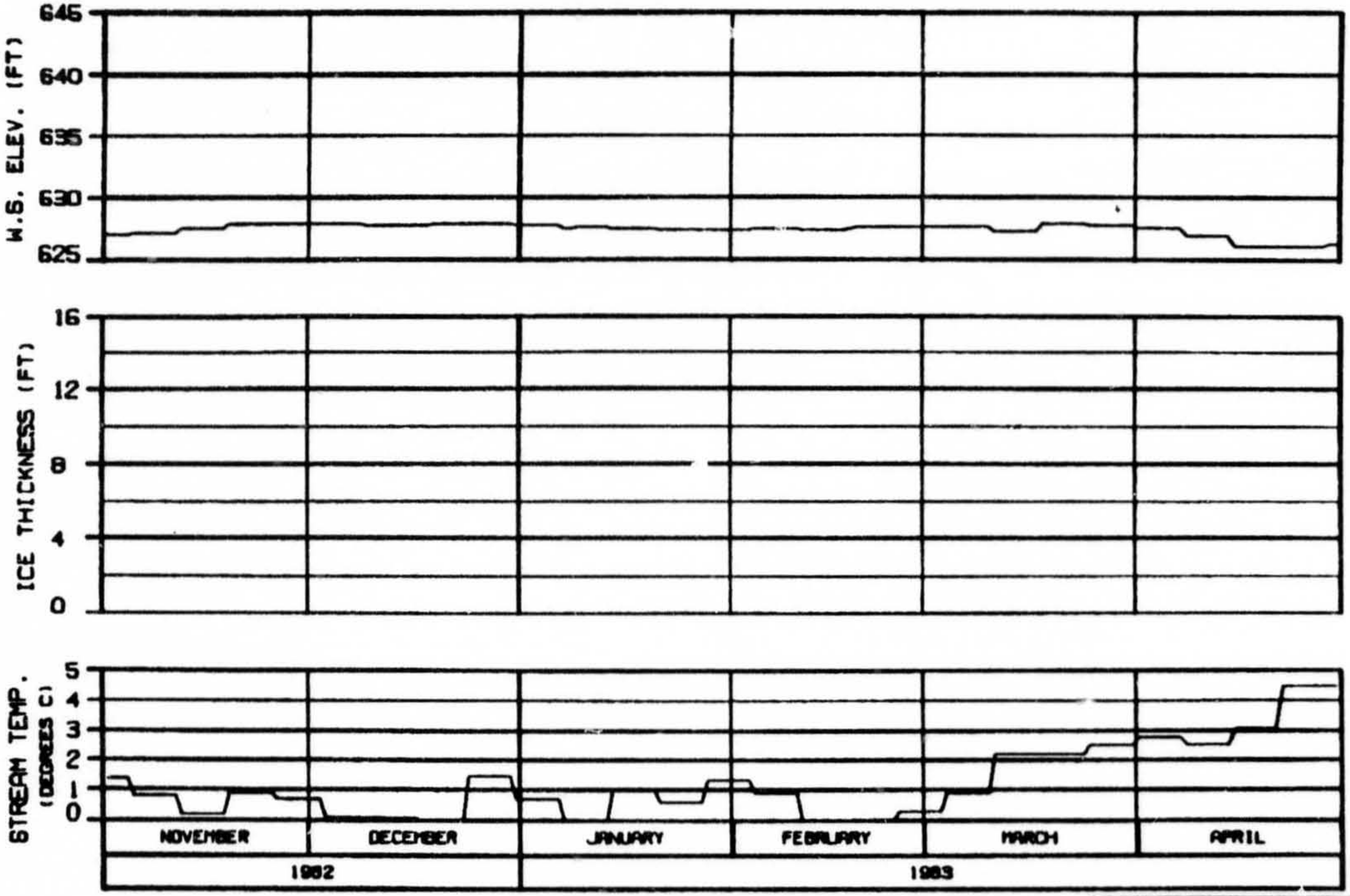
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] | [illegible] | [illegible]



SIDE CHANNEL U/S OF 4TH JULY CREEK

RIVER MILE : 131.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

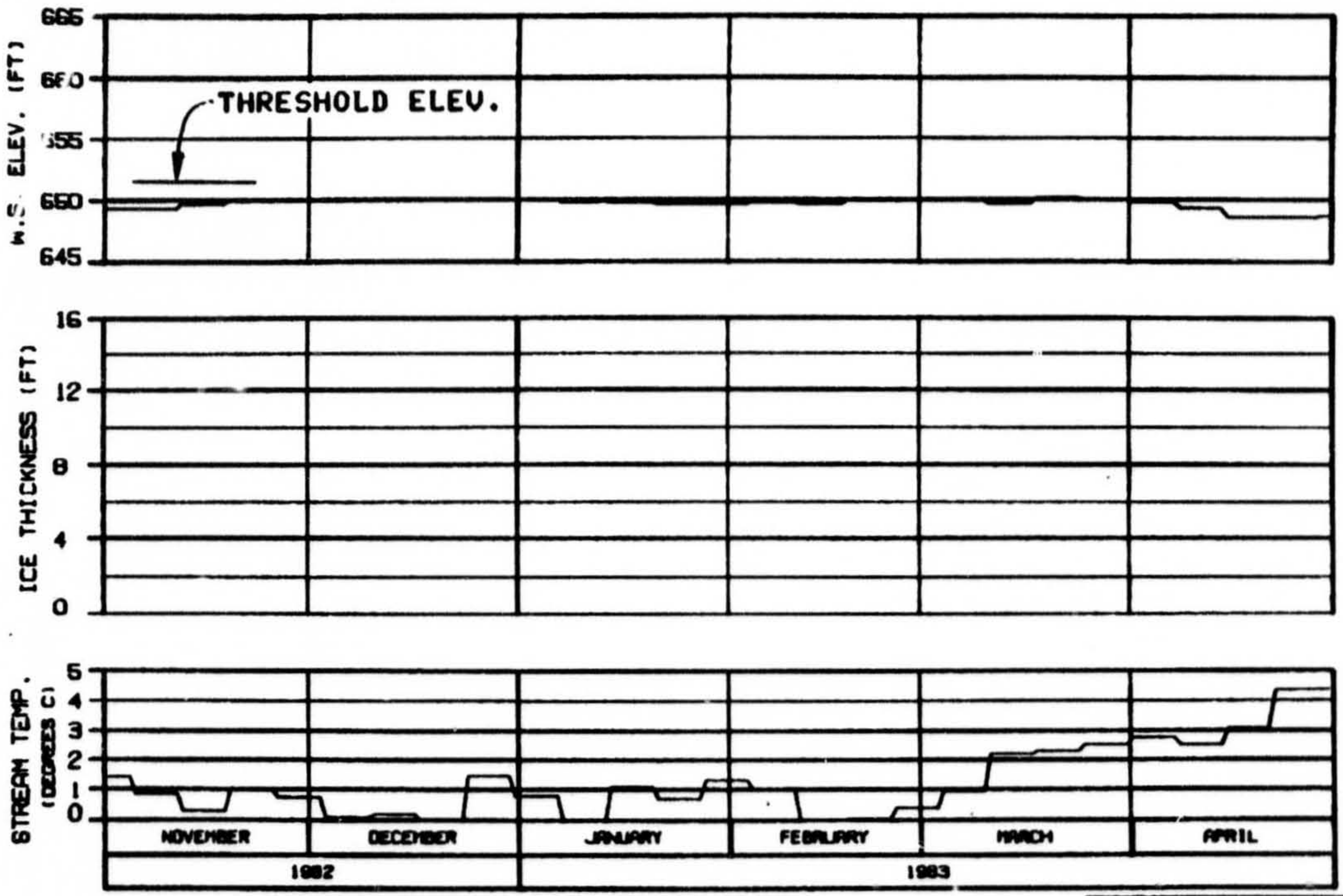
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9A

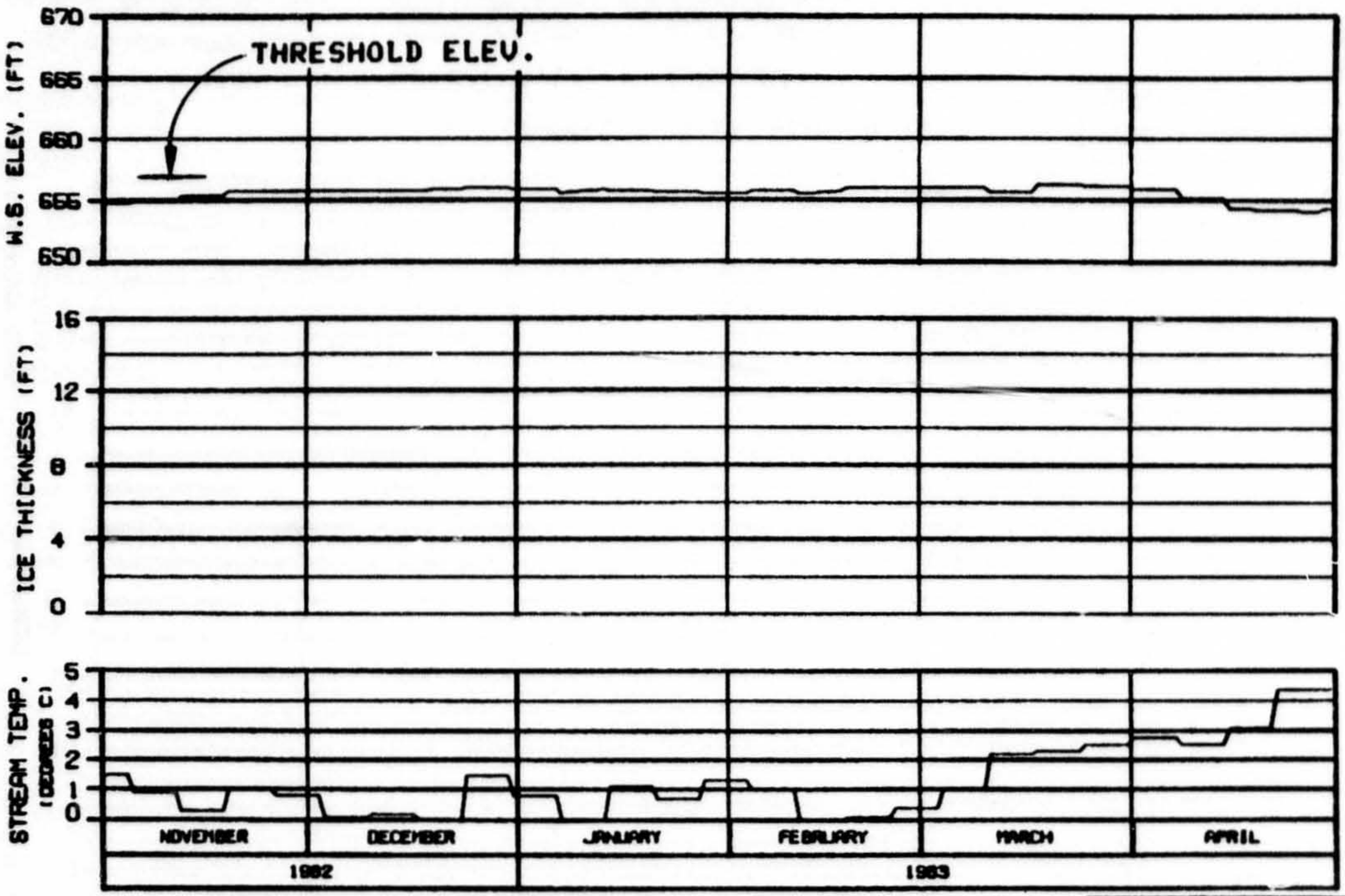
RIVER MILE : 133.70

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



SIDE CHANNEL U/S OF SLOUGH 10

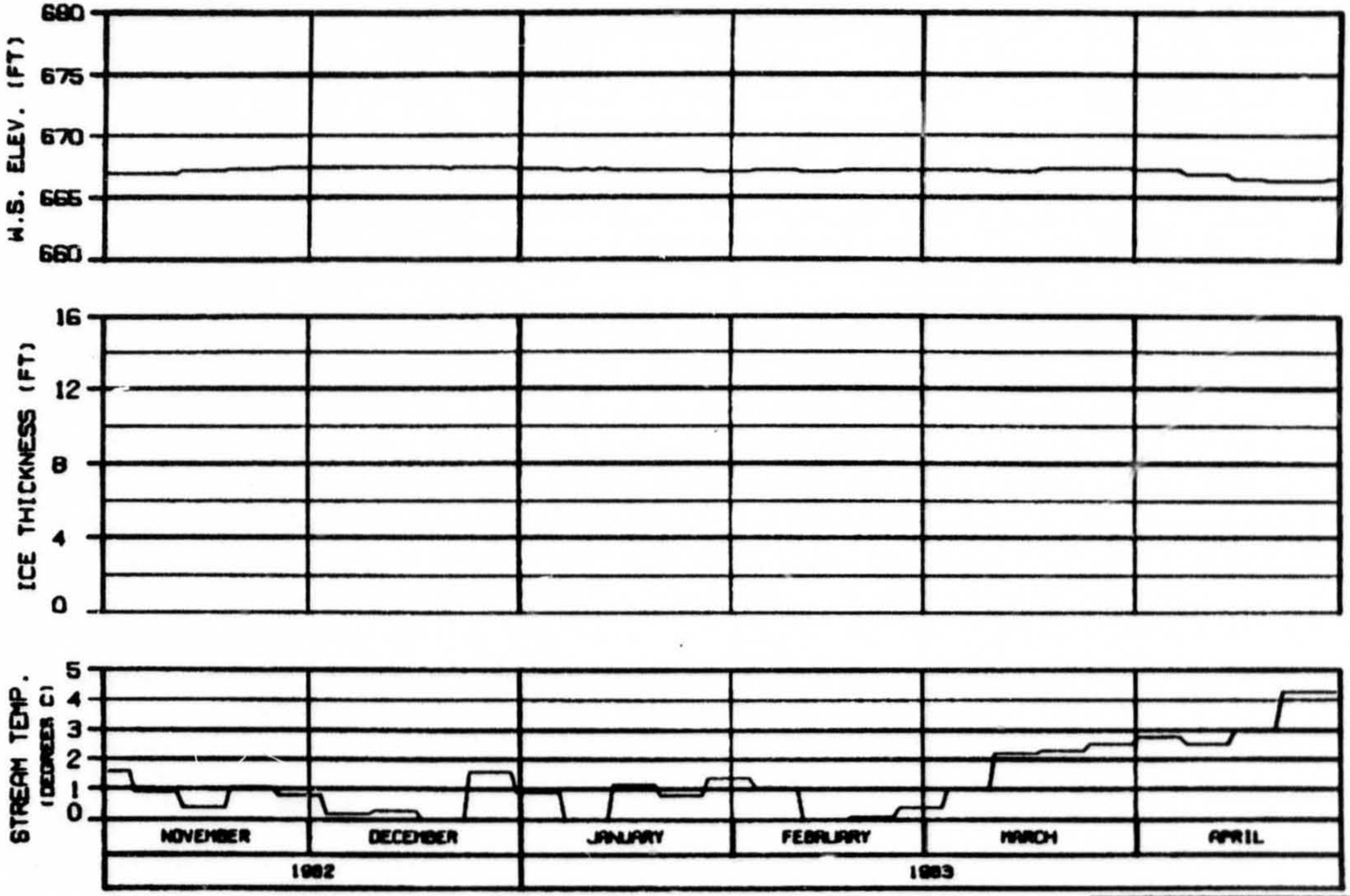
RIVER MILE : 134.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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



SIDE CHANNEL D/S OF SLOUGH 11

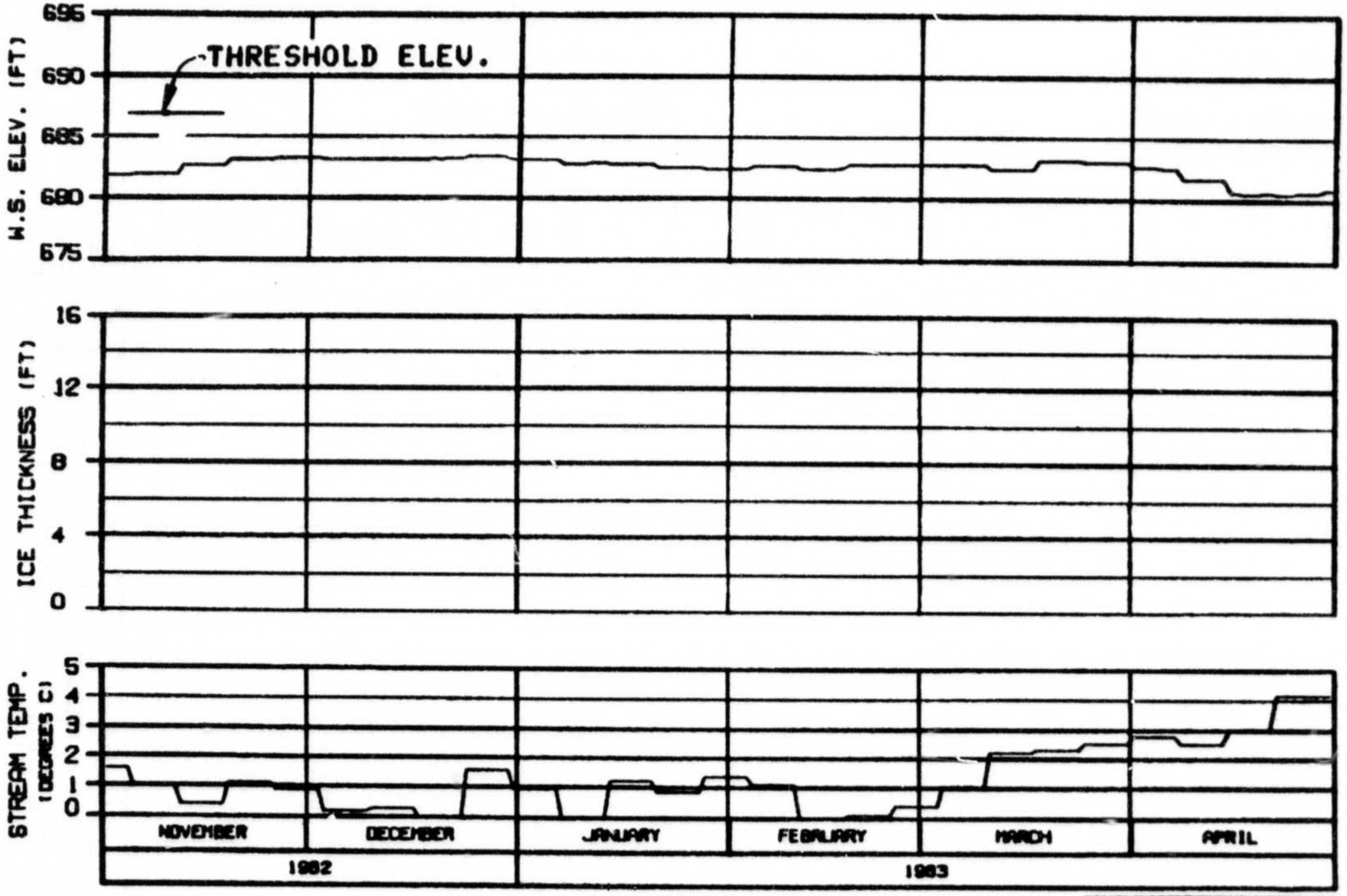
RIVER MILE : 135.30

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



HEAD OF SLOUGH 11

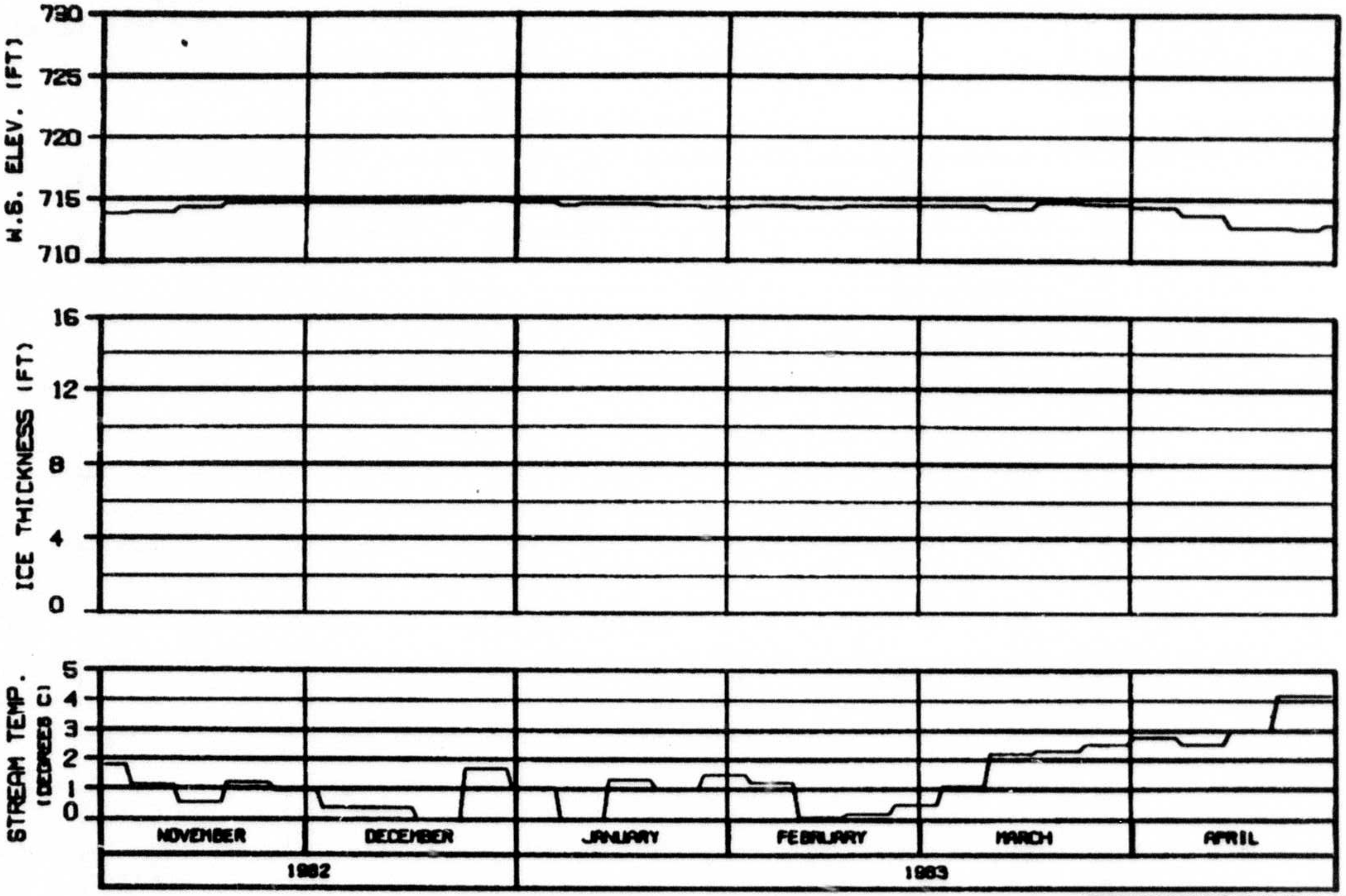
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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



HEAD OF SLOUGH 17

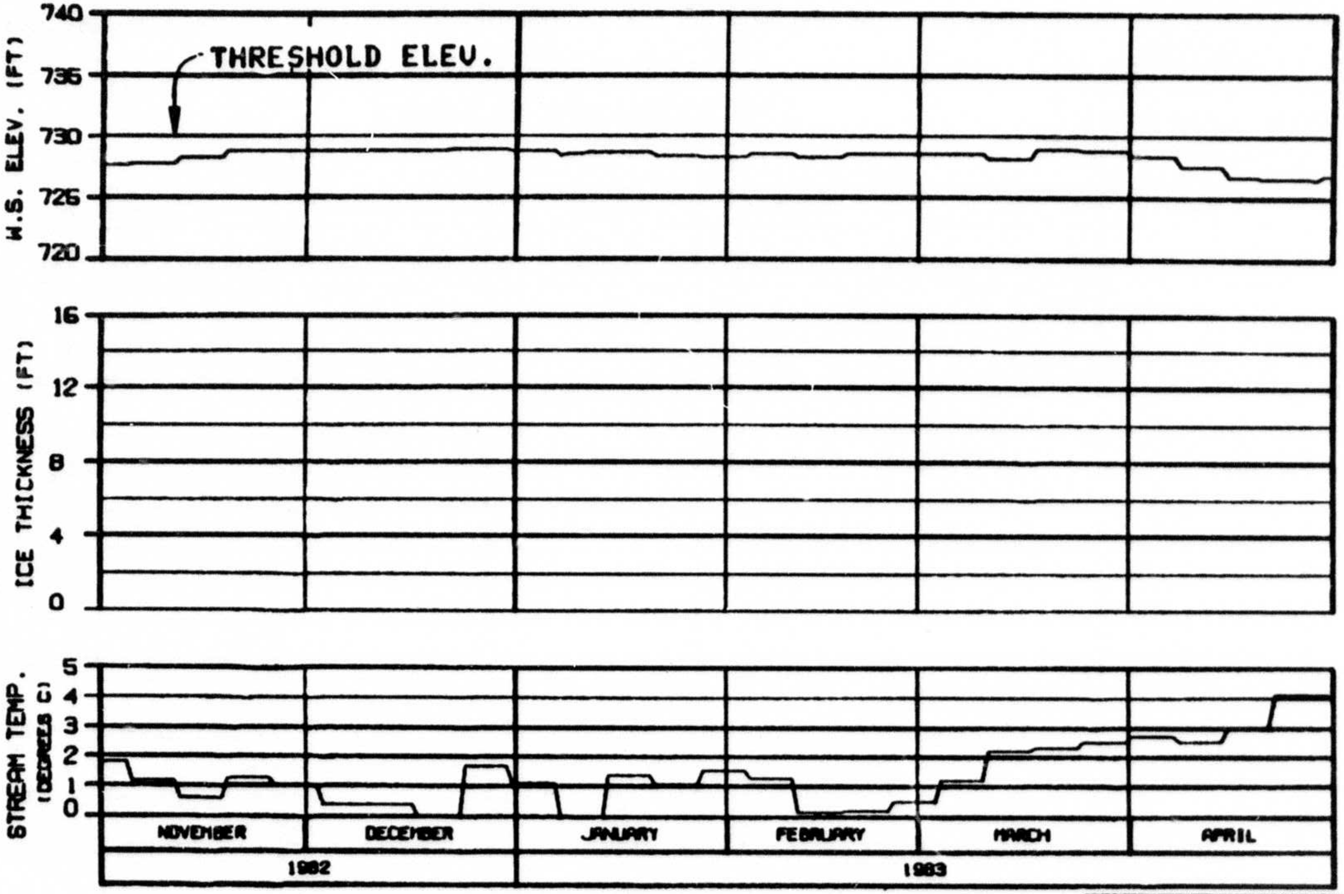
RIVER MILE : 139.30

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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



HEAD OF SLOUGH 20

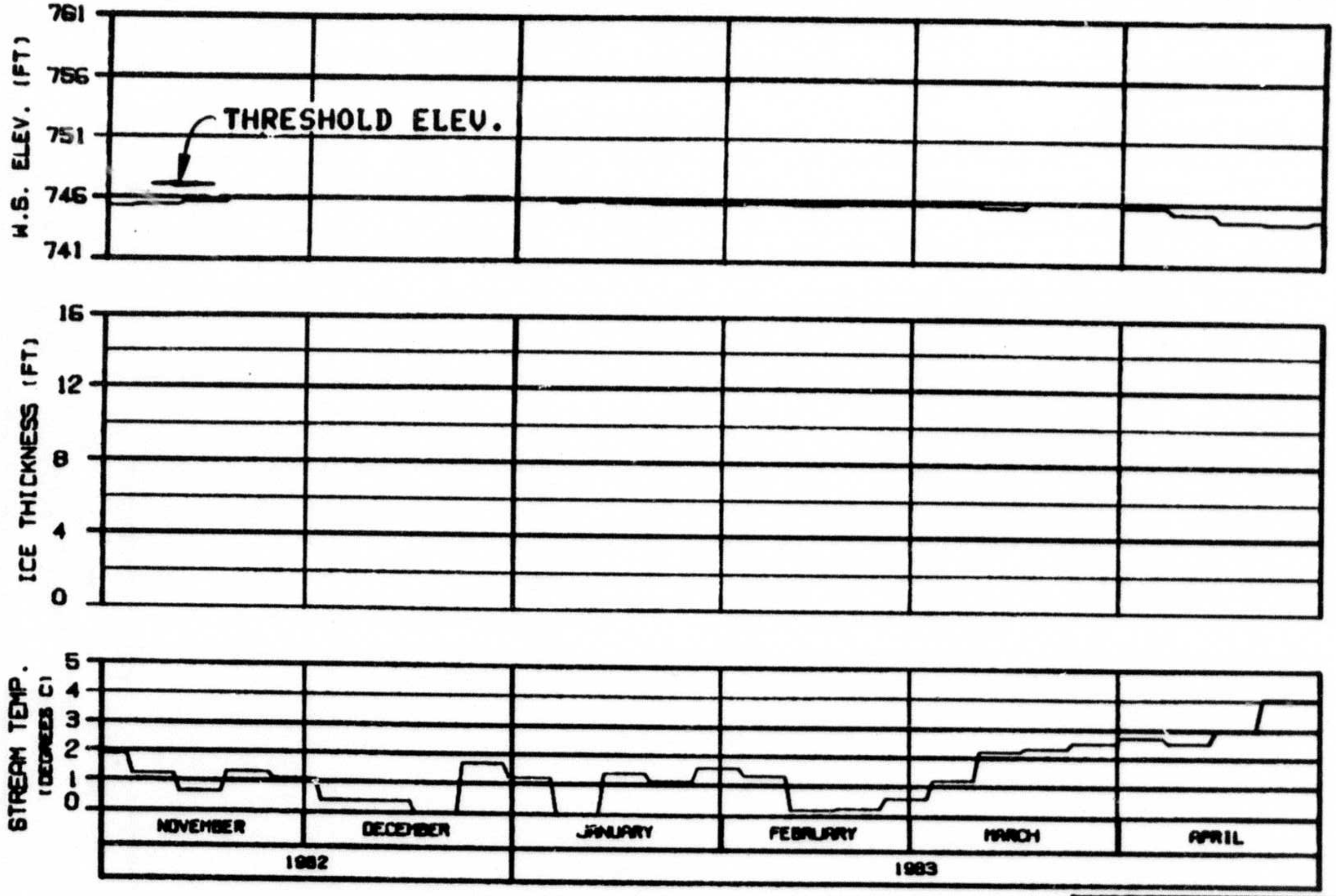
RIVER MILE : 140.50

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



SLOUGH 21 (ENTRANCE A6)

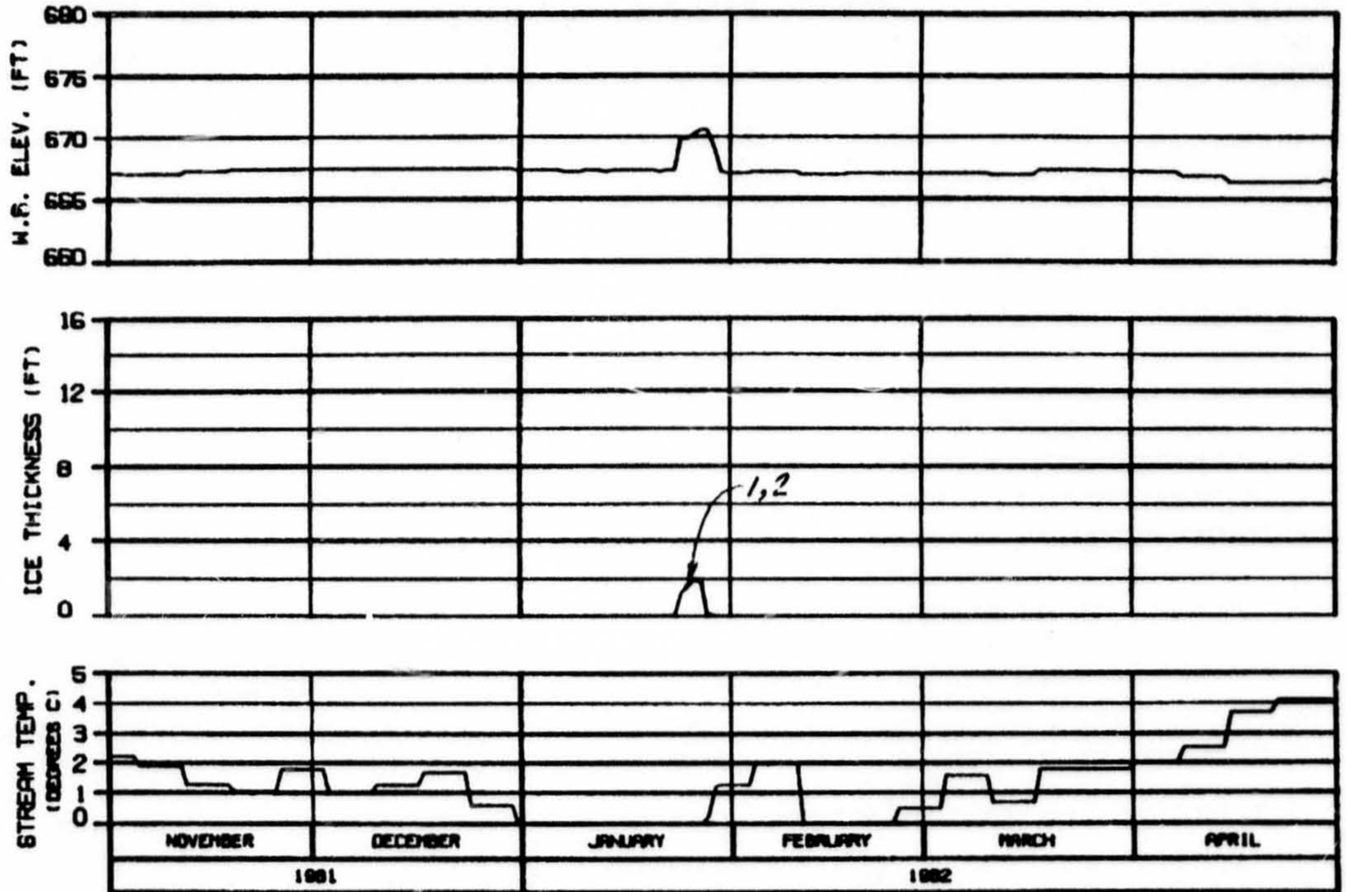
RIVER MILE : 141.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY		
SUSITNA PROJECT		
SUSITNA RIVER ICE SIMULATION TIME HISTORY		
HARZA-EBASCO JOINT VENTURE		
[illegible]	[illegible] JAN 84	[illegible].142



SIDE CHANNEL D/S OF SLOUGH 11

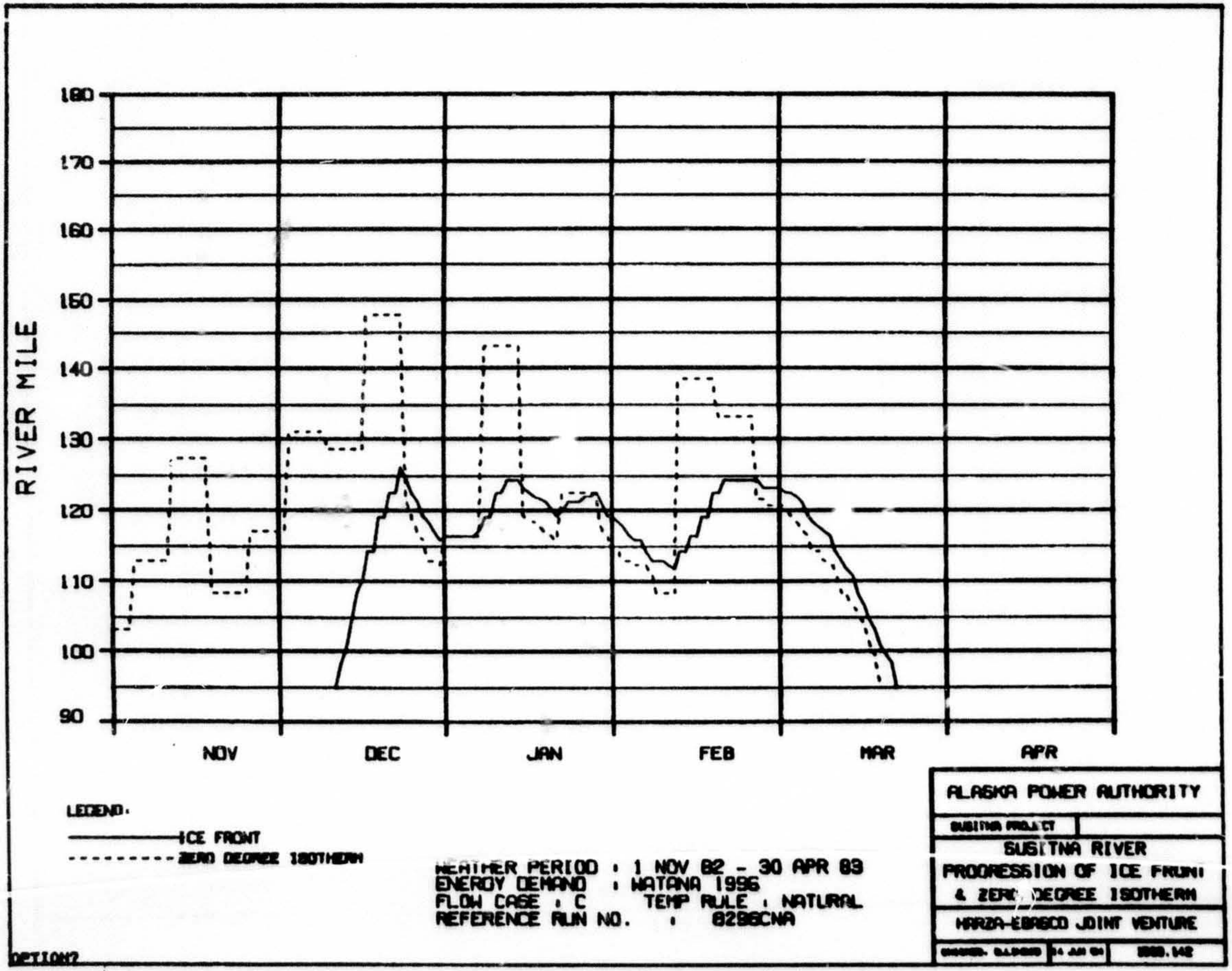
RIVER MILE : 135.30

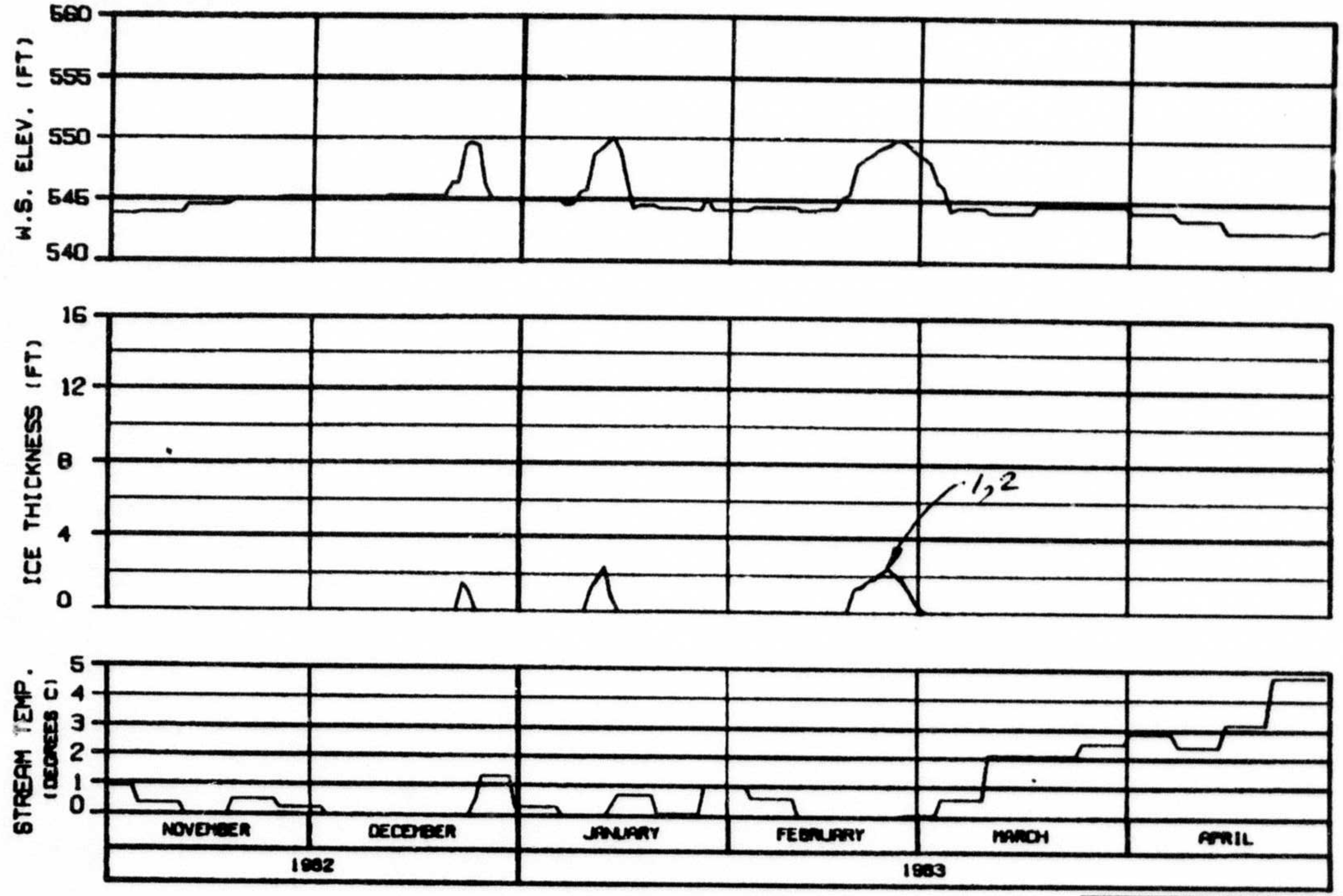
ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 81 - 30 APR 82
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8196CNA

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


RIVER MILE
180
170
160
150
140
130
120
110
100
90
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
ICE FRONT
ZERO DEGREE ISOTHERM
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE
OPTION7



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

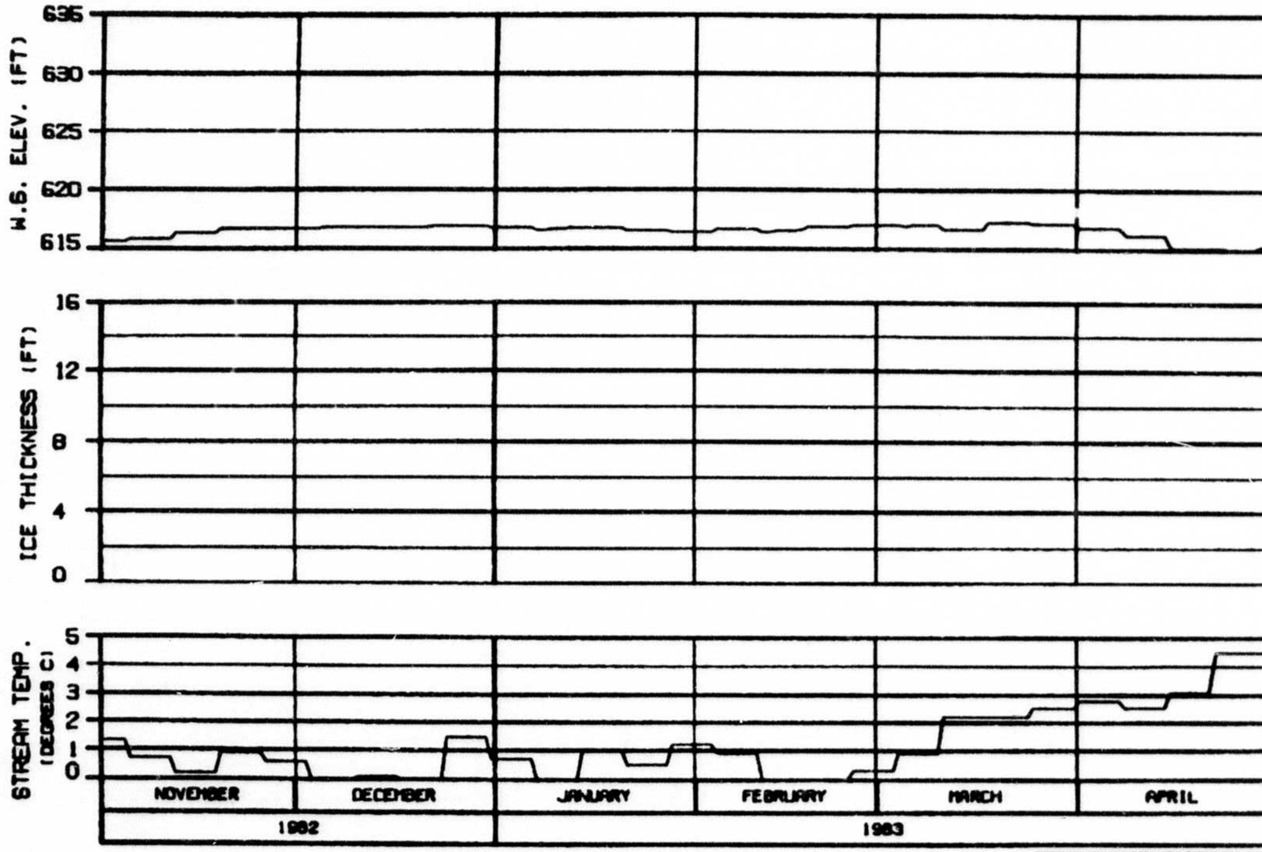
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHECKED. [illegible] | 18 JAN 84 | 1863.142

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

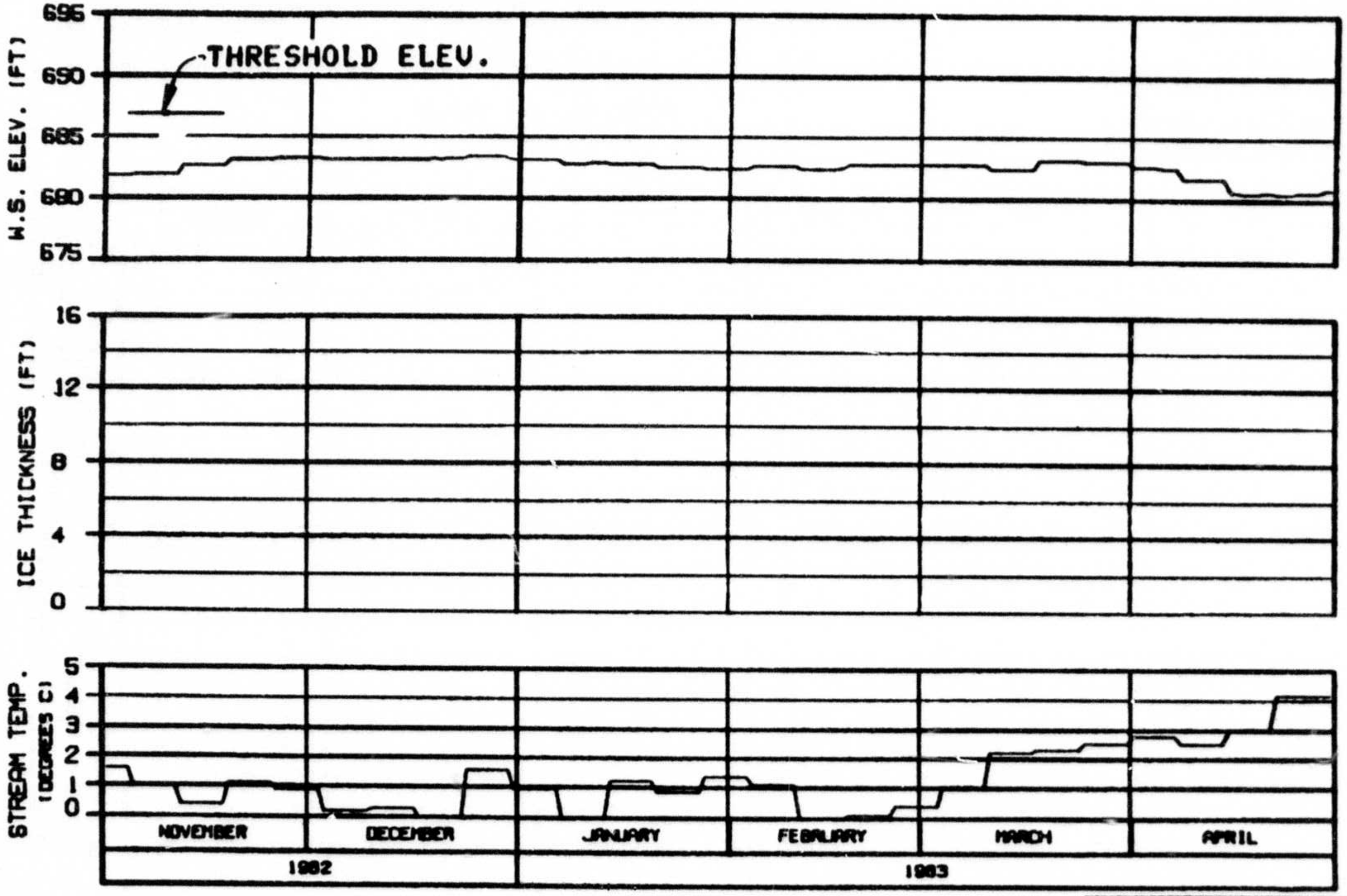
WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 11

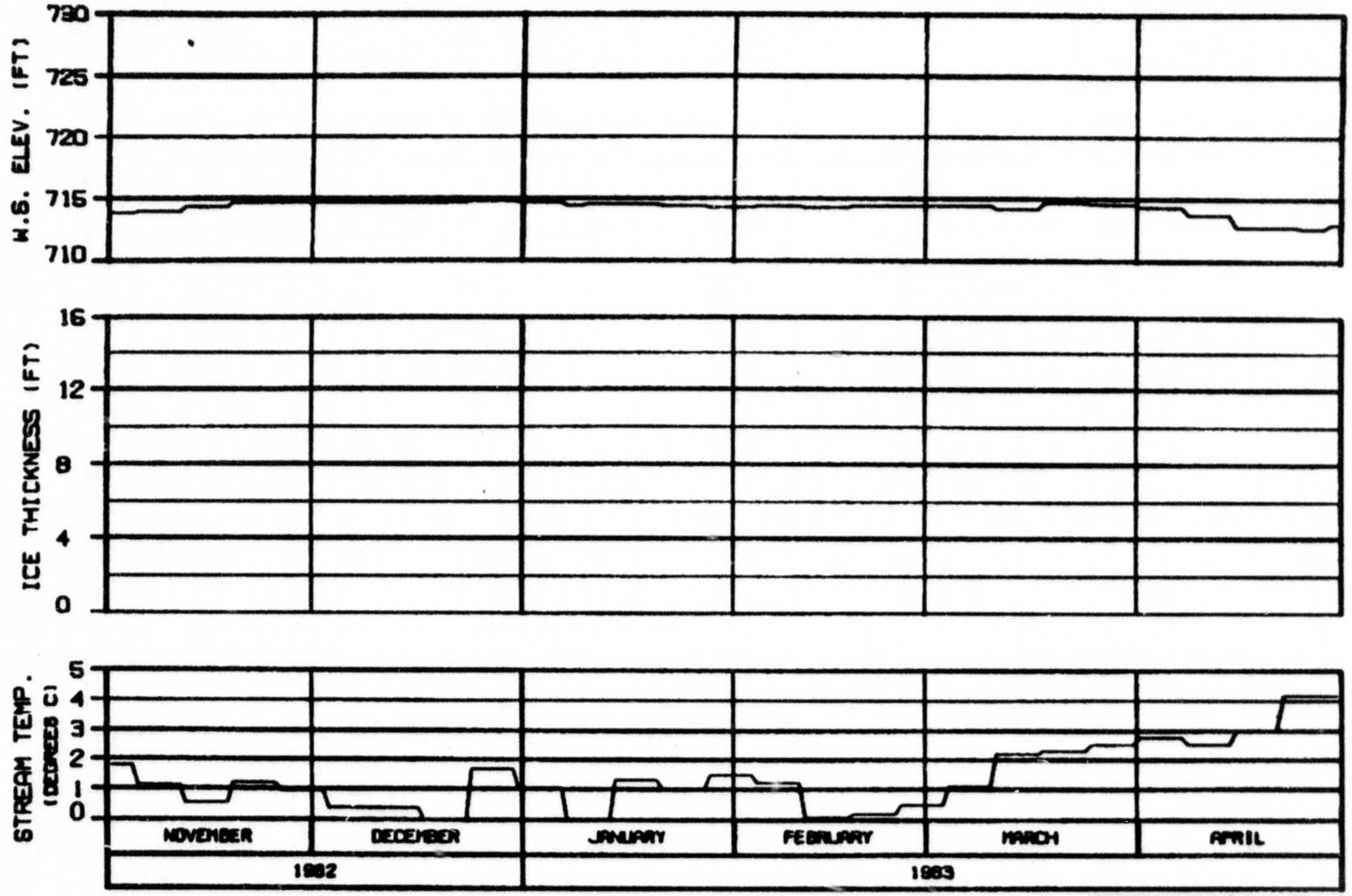
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

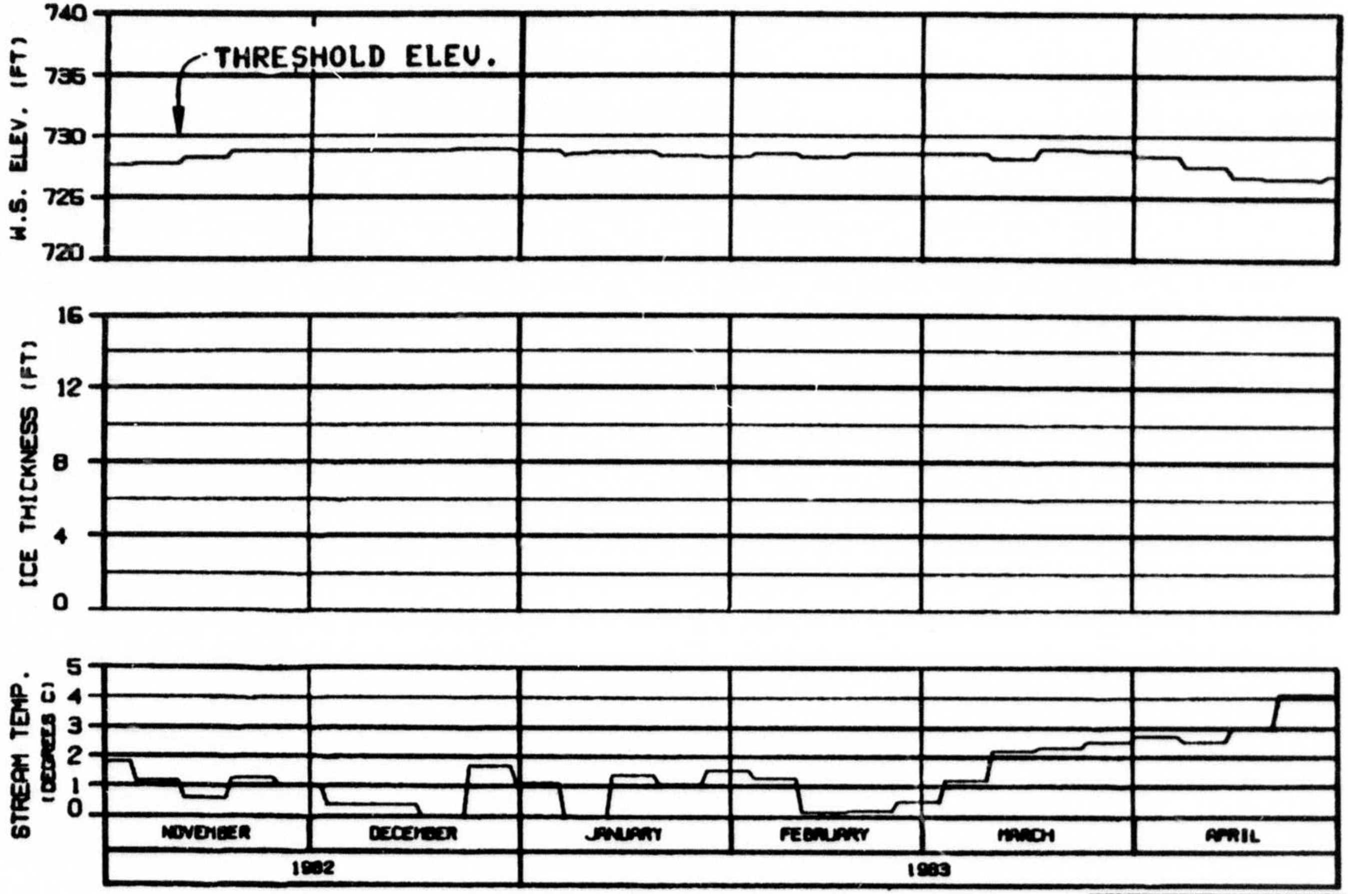
1. TOTAL THICKNESS
2. SLUSH COMPONENT

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 20

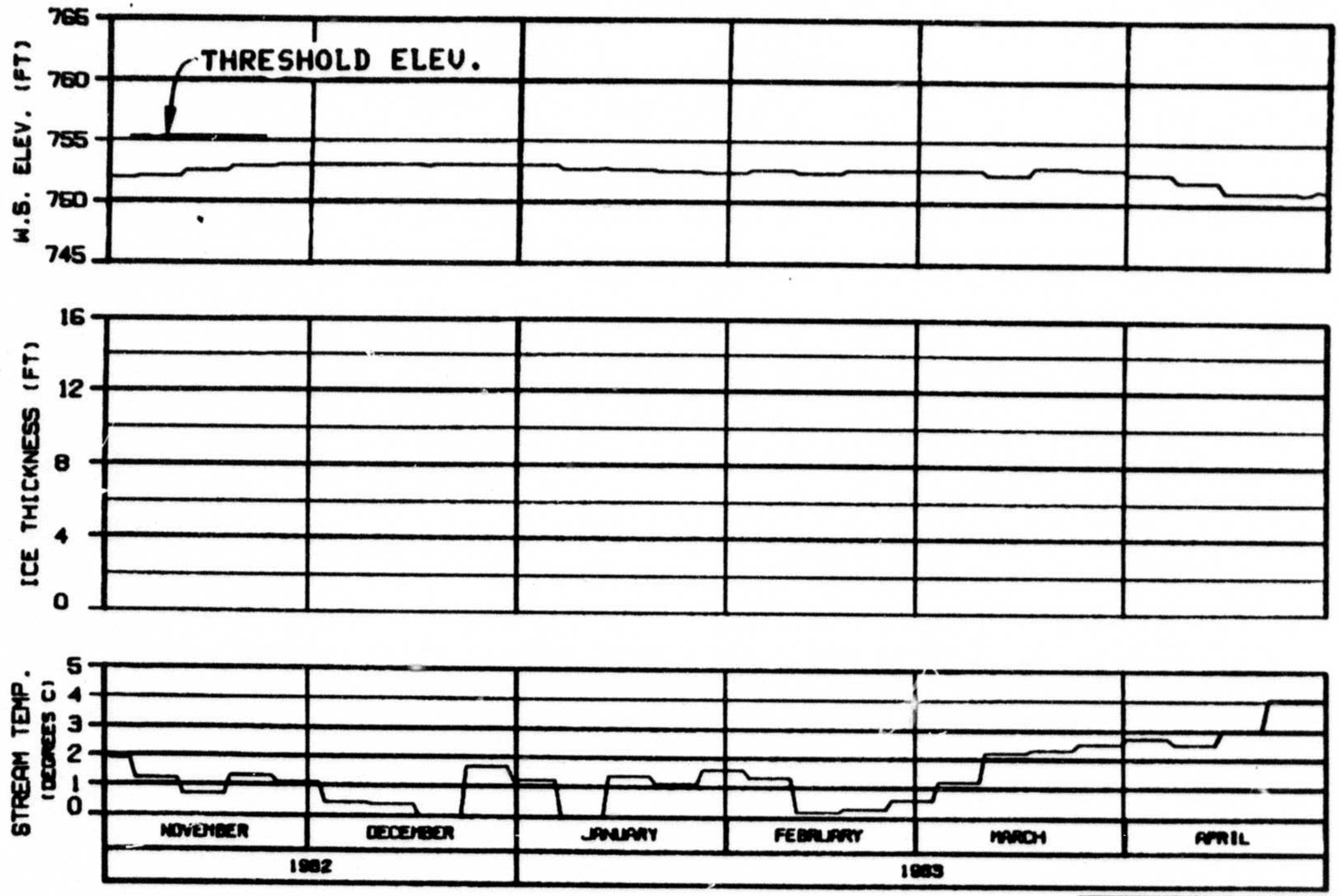
RIVER MILE : 140.50

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



HEAD OF SLOUGH 21

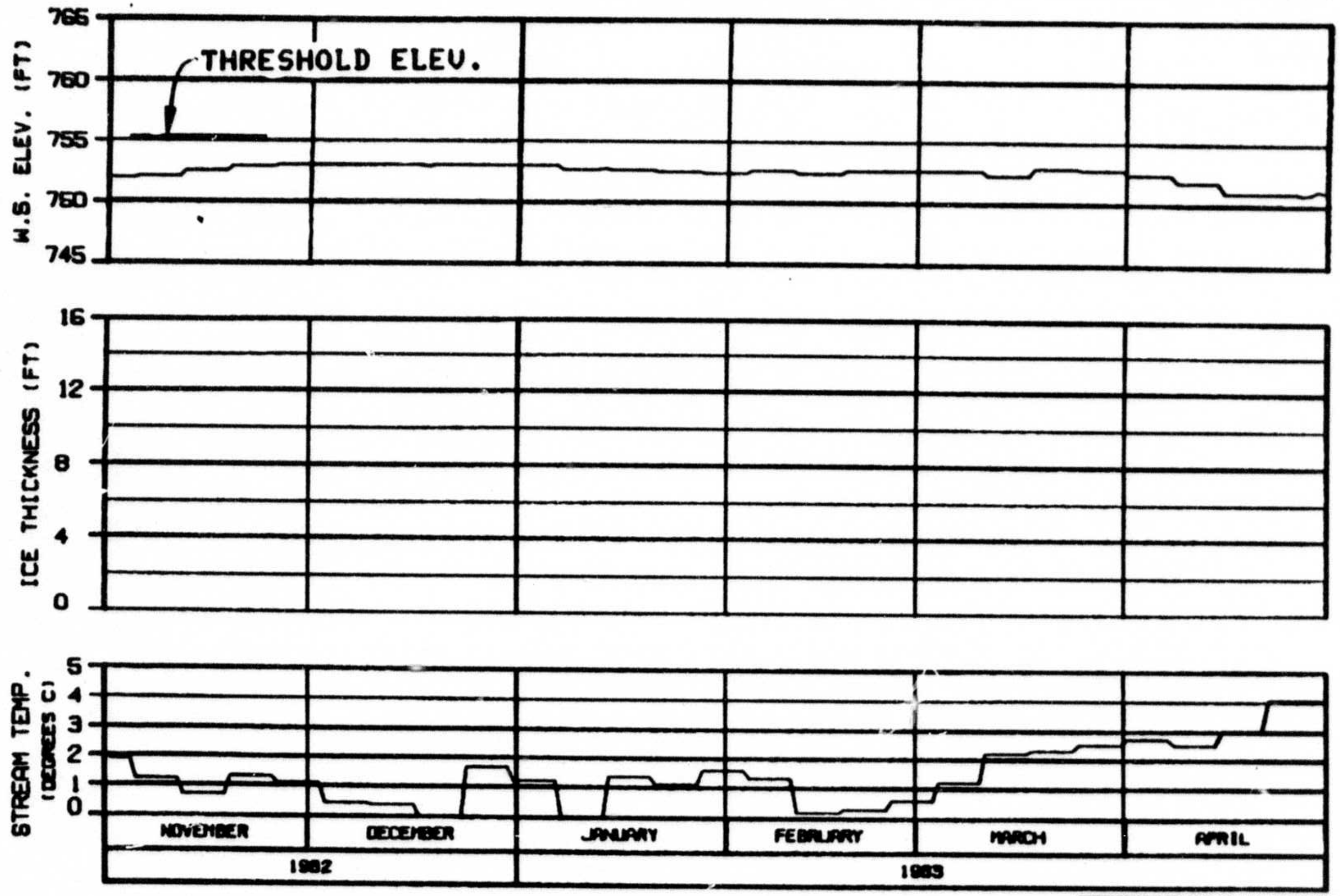
RIVER MILE : 142.20

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

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



HEAD OF SLOUGH 21

RIVER MILE : 142.20

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

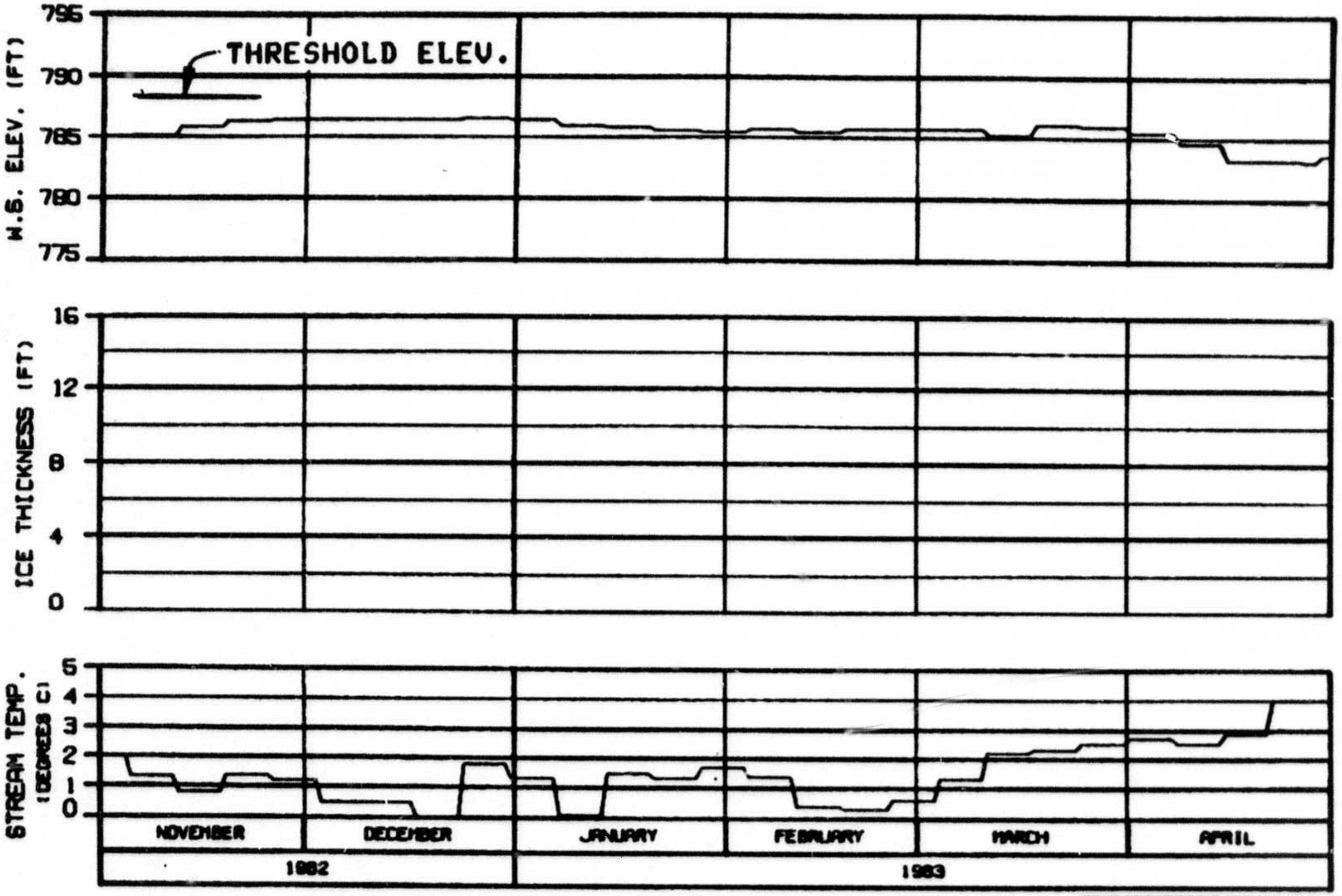
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

c



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

1. TOTAL THICKNESS
2. SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 82 - 30 APR 83
ENERGY DEMAND : WATANA 1996
FLOW CASE : C TEMP RULE : NATURAL
REFERENCE RUN NO. : 8296CNA

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

OPTION?