SUSITNA
HYDROELECTRIC PROJECT

FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114

REFINEMENTS TO RESERVOIR AND RIVER TEMPERATURE AND ICE SIMULATIONS

FOR OCTOBER 1976 TO MAY 1977 METEOROLOGIC AND HYDROLOGIC DATA

VOLUME 7 - APPENDIX I

Final Report

HARZA-EBASCO
SUSITNA JOINT VENTURE

February 1985
Document No. 2606

ALASKA POWER AUTHORITY

Document No. 2606
Susitna File No. 6.18.7.5

SUSITNA HYDROELECTRIC PROJECT

REFINEMENTS TO RESERVOIR AND RIVER TEMPERATURE AND ICE SIMULATIONS

For October 1976 To May 1977 Meterologic And Hydrologic Data

VOLUME 7 - APPENDIX I

Report By
Harza-Ebasco Susitna Joint Venture

Prepared for
Alaska Power Authority

Final Report
February 1985

Appendix I

SUSITNA HYDROELECTRIC PROJECT

Refinements to Reservoir and River Temperature and Ice Simulations

For October 1976 to May 1977

Meteorologic and Hydrologic Data

APPENDIX I

This document contains refinements to reservoir and river temperature and ice simulations for 1996, 2001, 2002 and 2020 energy demands for hydrological and meteorological data from the period October 1976 to May 1977, as discussed in Section 3.4.3.1 of the main text.

APPENDIX - I

Ref. Report Section 3.4.3

The following table lists the affected reports and the required changes.

REPORT	CHANGE
Alaska Power Authority, 1984 Comments on FERC, DEIS Vol. 6, App. IV, Temperature Simulations, Watana and Devil Canyon Reservoirs	Replace Exhibits S, AB, AG, AL, and AQ with enclosed exhibits
Alaska Power Authority, 1984 Comments on FERC, DEIS, Vol. 7, App V, Temperature Simulations, Susitna River, Watana Dam to Sunshine Gaging Station, Open Water	Replace Exhibits Y, AH, and AM with enclosed exhibits
Alaska Power Authority, 1984 Comments on FERC DEIS Vol. 8, App VI, River Ice Simulations, Susitna River, Watana Dam to Confluence of Susitna and Chulitna Rivers	Change portions of text. Replace Exhibits I and O with enclosed exhibits
Harza-Ebasco Susitna Joint Venture, 1984, Susitna Hydroelectric Project, Instream Ice Simulation Study, for the Alaska Power Authority	Change portions of text, Replace Exhibits G and N with enclosed exhibits.

APPENDIX - I

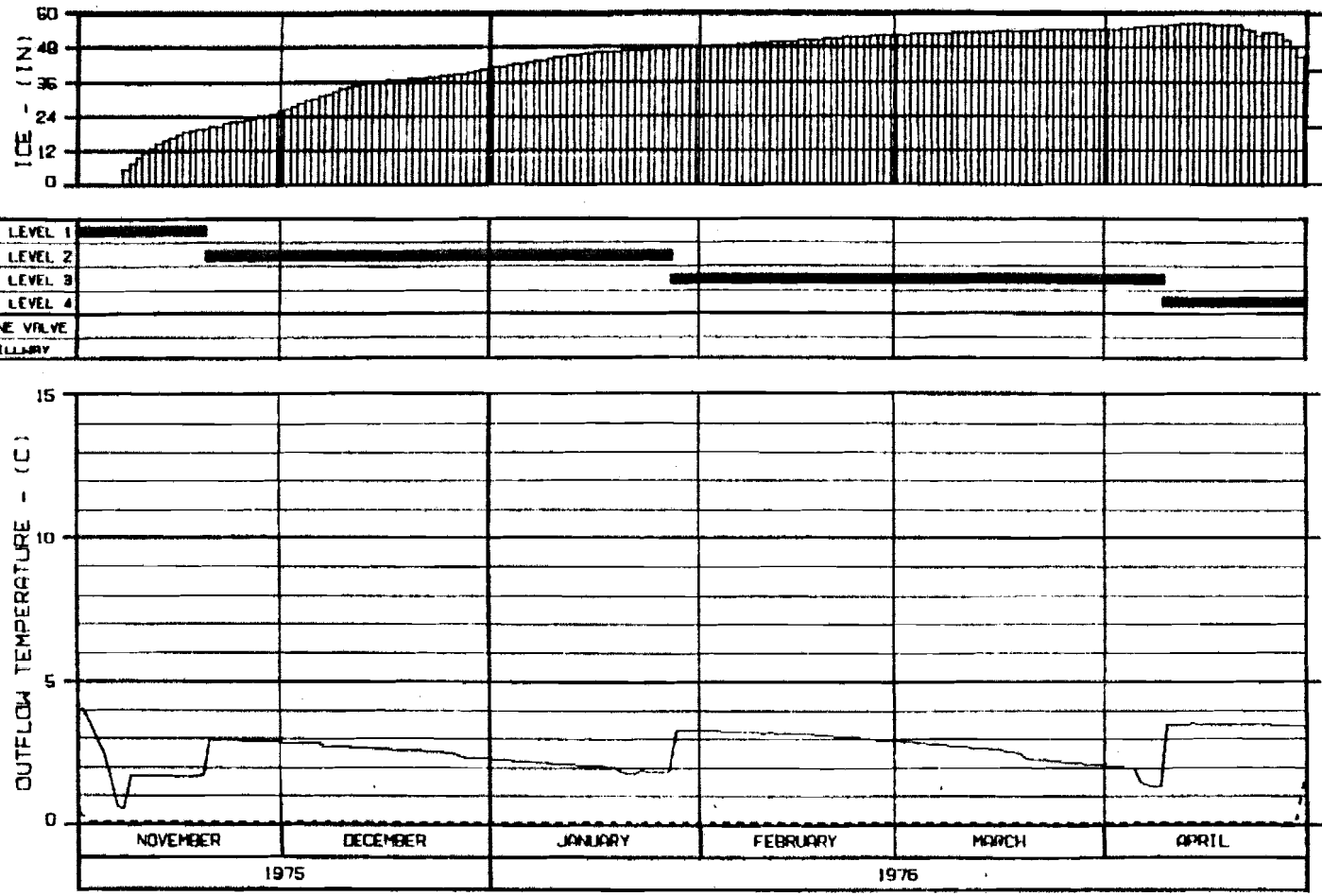
Refinement to Reservoir and River
Temperature and Ice Studies
For Simulation Period
October 1976 to May 1977

New Exhibits
S, AB, AG, AL, AQ

For

Alaska Power Authority Comments on the Federal Energy Regulatory Commission Draft Environmental Impact Statement of May 1984, Volume 6, Appendix IV, Temperature Simulations, Watana and Devil Canyon Reservoirs

EXHIBIT S



LEGEND: CASE: WA7696C - WATANA OPERATION ALONE IN 1996

——— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 2151 FT (655.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.9 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.8 M)
6. SPILLWAY CREST AT ELEVATION 2149 FT (654.7 M)

ALASKA POWER AUTHORITY

SUSITNA PROJECT	DYRESM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

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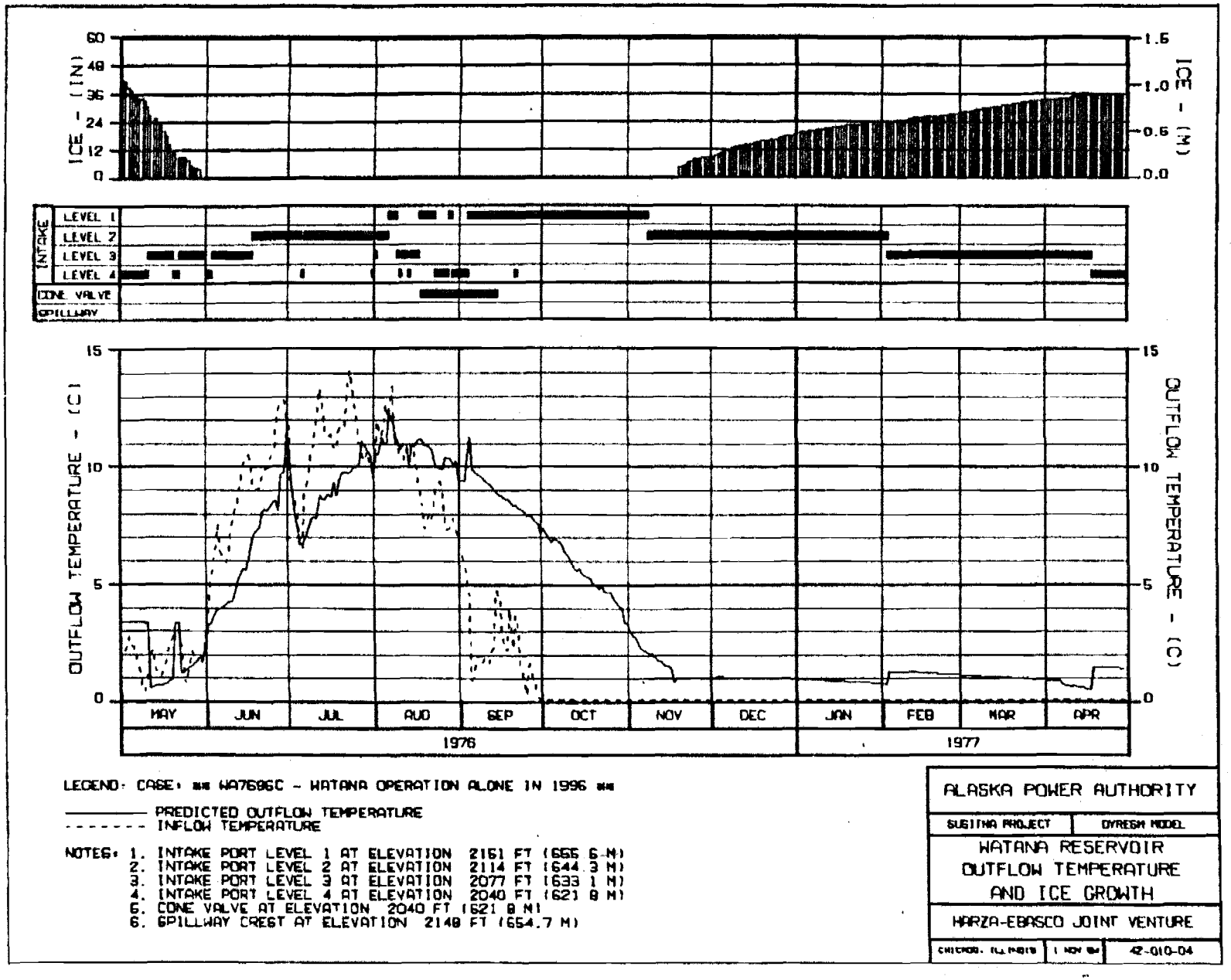


LEGEND: CASE: ## WA7696C - WATANA OPERATION ALONE IN 1996 ##

——— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 2161 FT (665.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.8 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.8 M)
6. SPILLWAY CREST AT ELEVATION 2148 FT (654.7 M)

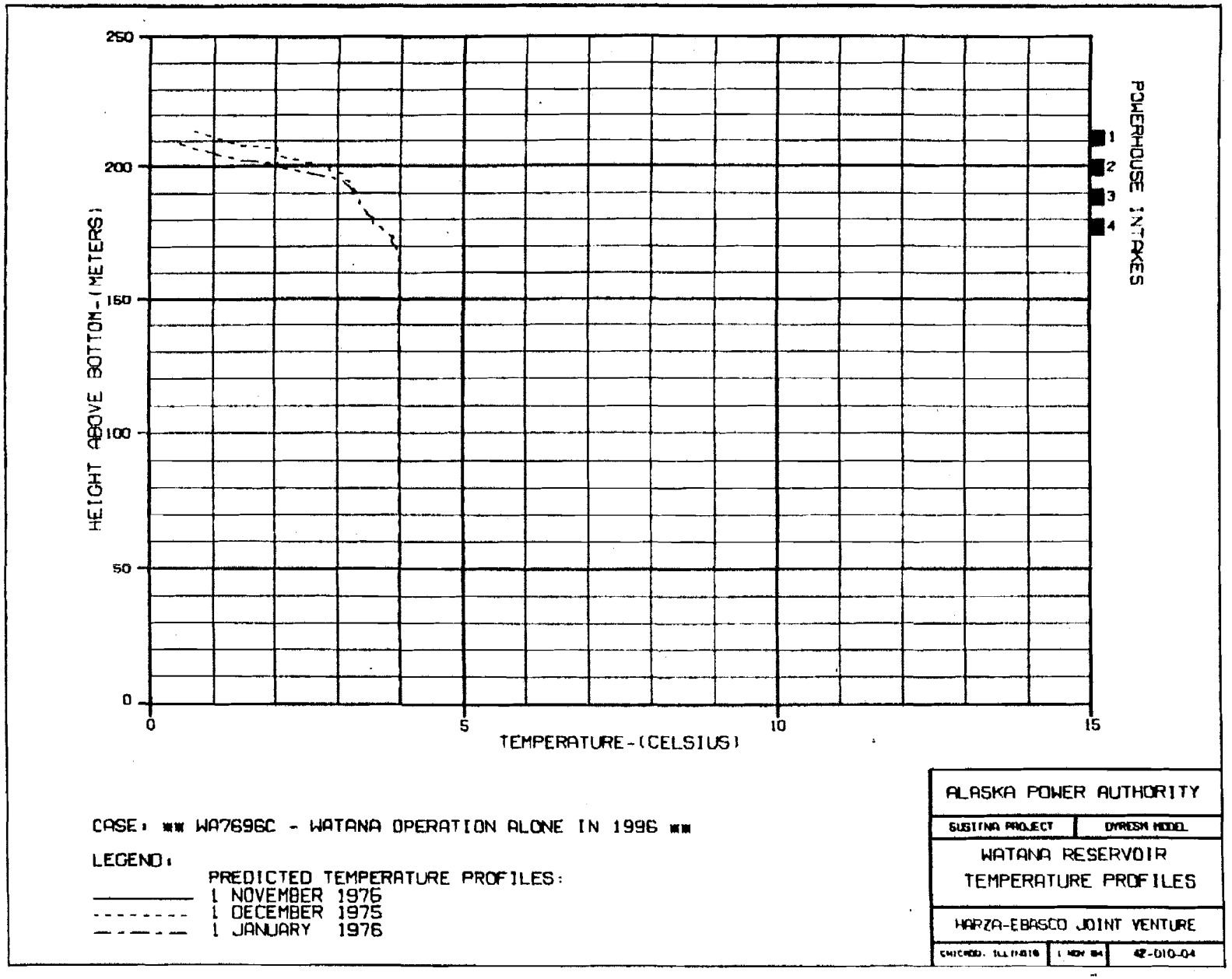
ALASKA POWER AUTHORITY

SUSITNA PROJECT	DYRESM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS	1 NOV 84	42-010-04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HEIGHT ABOVE BOTTOM-(METERS)
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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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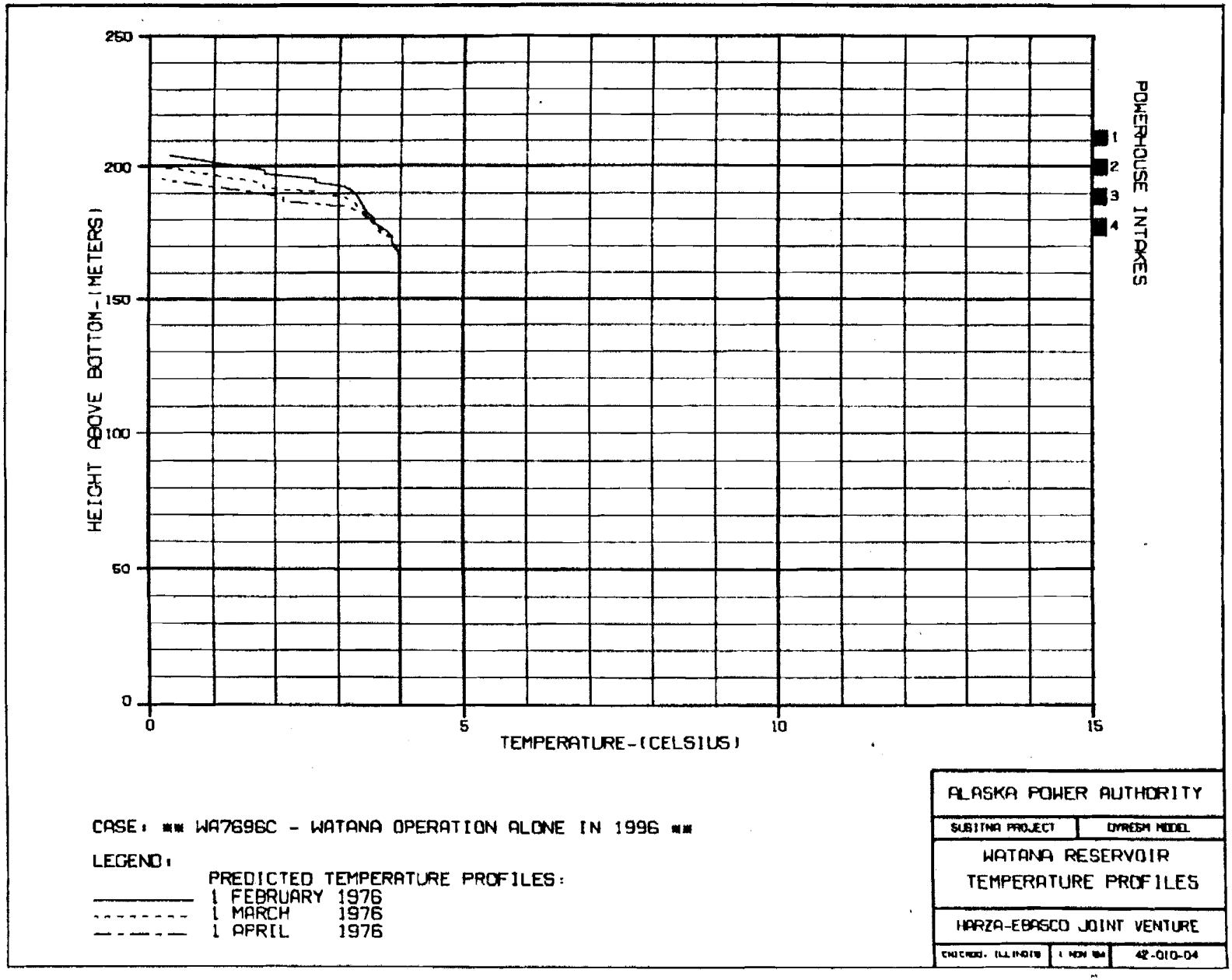
CASE: ** WA7696C - WATANA OPERATION ALONE IN 1996 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1975
1 JANUARY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
1 NOV 84
42-010-04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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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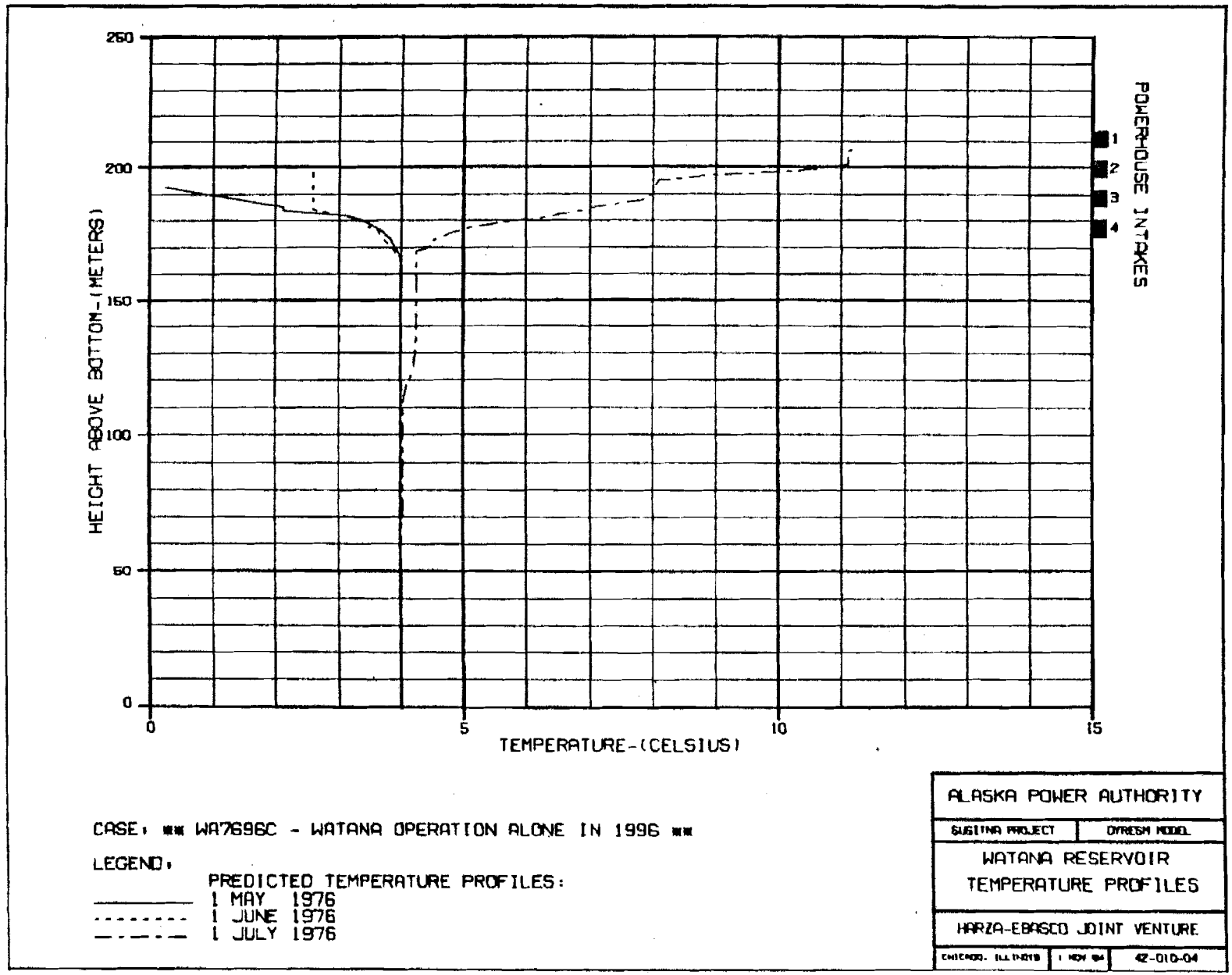
CASE: ** WA7696C - WATANA OPERATION ALONE IN 1996 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1976
1 MARCH 1976
1 APRIL 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
1 NOV 84
42-010-04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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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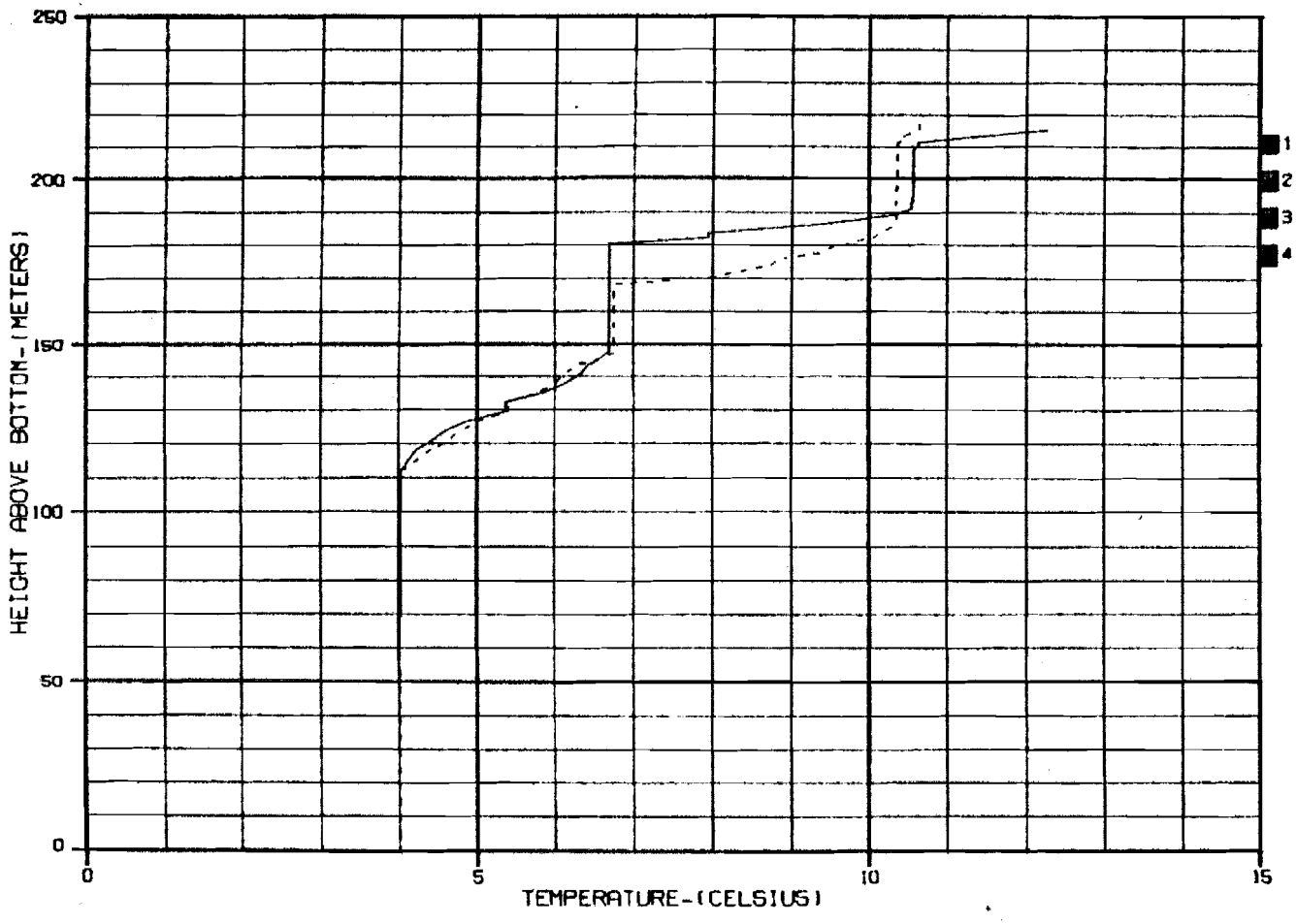
4
CASE: *** WA7696C - WATANA OPERATION ALONE IN 1996 ***
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 MAY 1976
1 JUNE 1976
1 JULY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
1 NOV 84
42-010-04



CASE: ** WA7696C - WATANA OPERATION ALONE IN 1996 **

LEGEND:

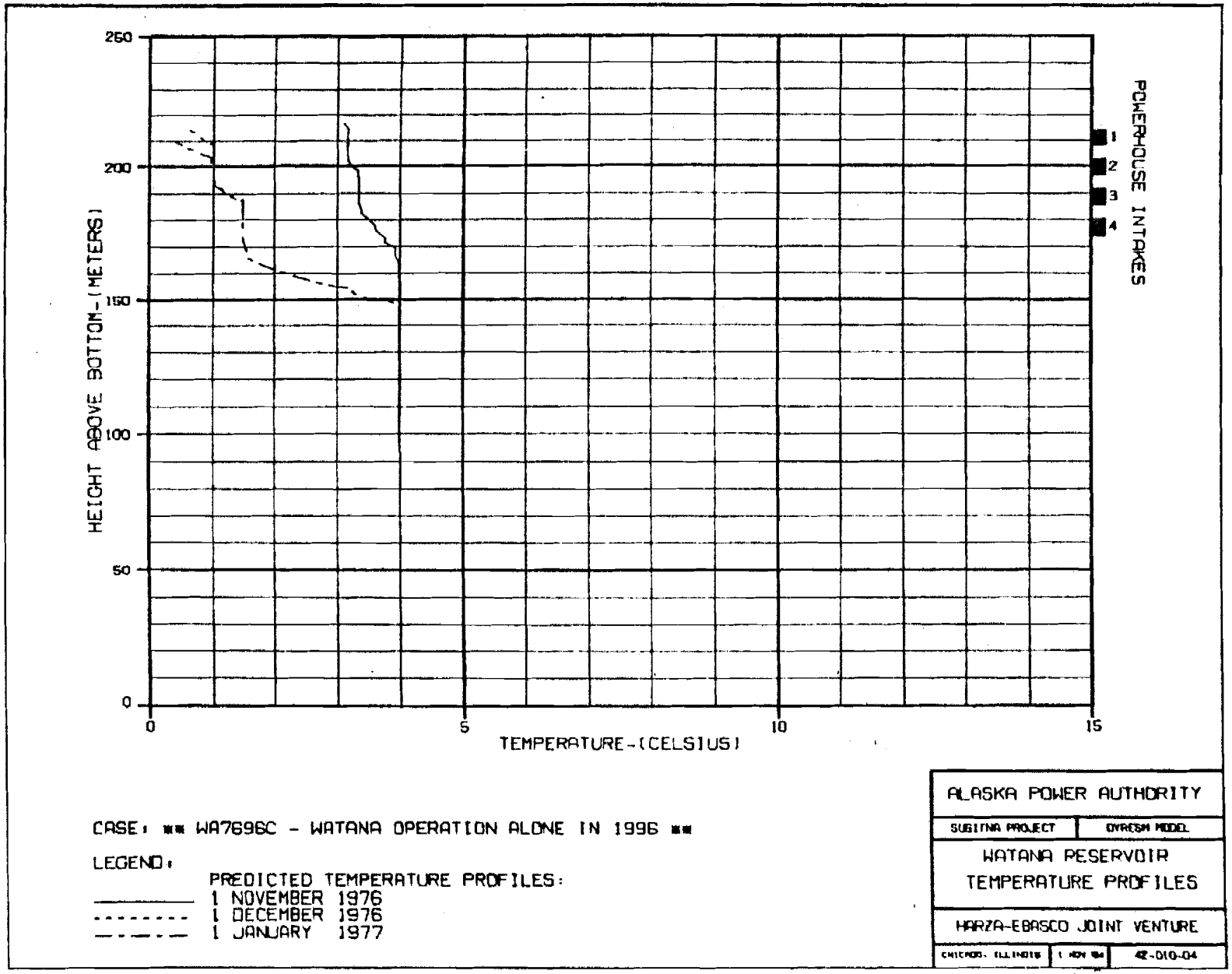
PREDICTED TEMPERATURE PROFILES:

———— 1 AUGUST 1976

- - - - - - - - 1 SEPTEMBER 1976

— — — — 1 OCTOBER 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
WATANA RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	42-010-04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HEIGHT ABOVE BOTTOM-(METERS)
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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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CASE: ** WA7696C - WATANA OPERATION ALONE IN 1996 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1976
1 JANUARY 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
1 NOV 84
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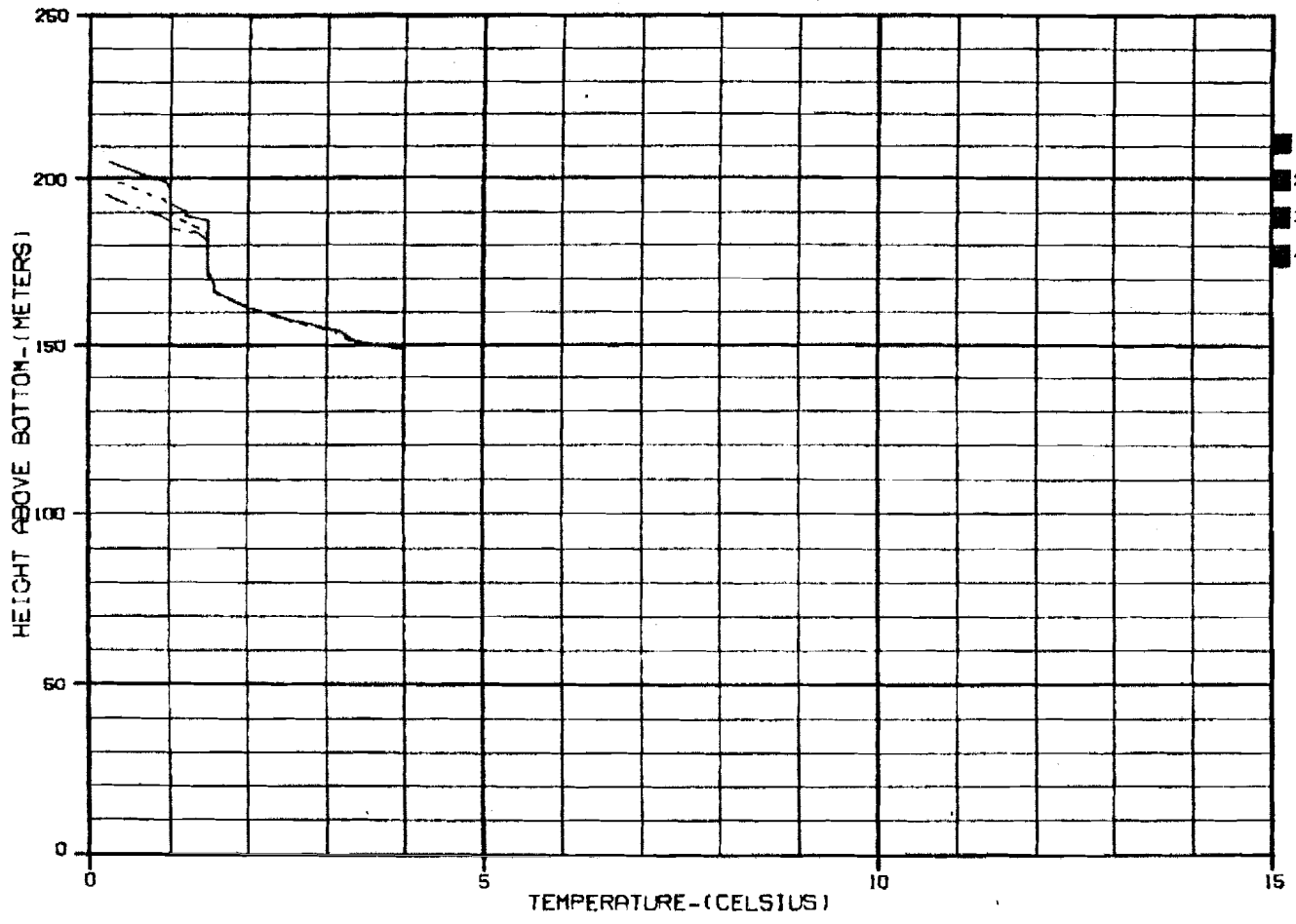


CASE: *** WA7696C - WATANA OPERATION ALONE IN 1996 ***

LEGEND:

PREDICTED TEMPERATURE PROFILES:

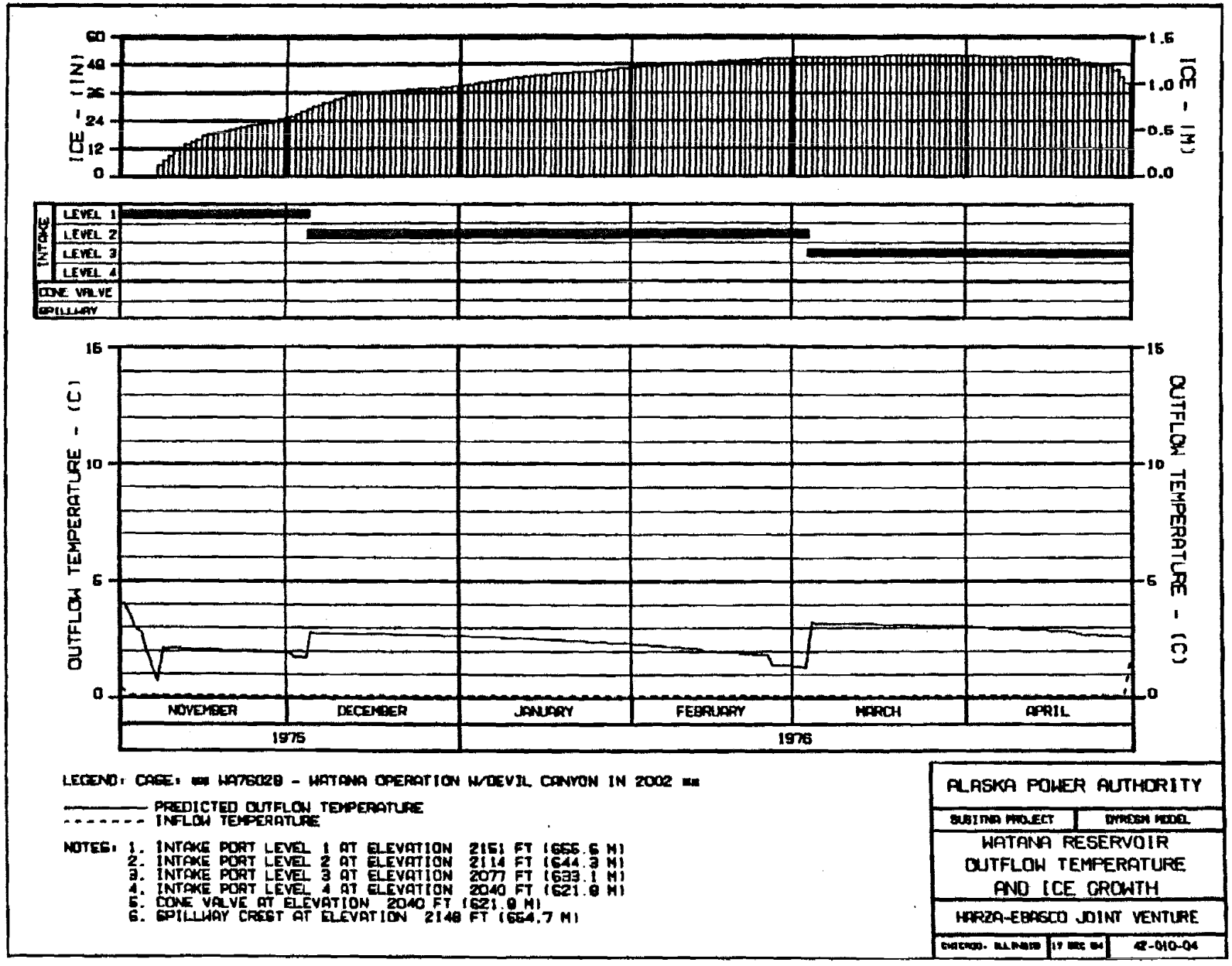
———— 1 FEBRUARY 1977

- - - - - - - - 1 MARCH 1977

— — — — — 1 APRIL 1977

ALASKA POWER AUTHORITY		
SUSITNA PROJECT	DYRESM MODEL	
WATANA RESERVOIR TEMPERATURE PROFILES		
HARZA-EBASCO JOINT VENTURE		
CHICAGO, ILLINOIS	1 NOV 84	42-010-04

EXHIBIT AB



LEGEND: CASE: WA76028 - WATANA OPERATION W/DEVIL CANYON IN 2002

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES:
1. INTAKE PORT LEVEL 1 AT ELEVATION 2151 FT (655.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.9 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.9 M)
6. SPILLWAY CREST AT ELEVATION 2148 FT (654.7 M)

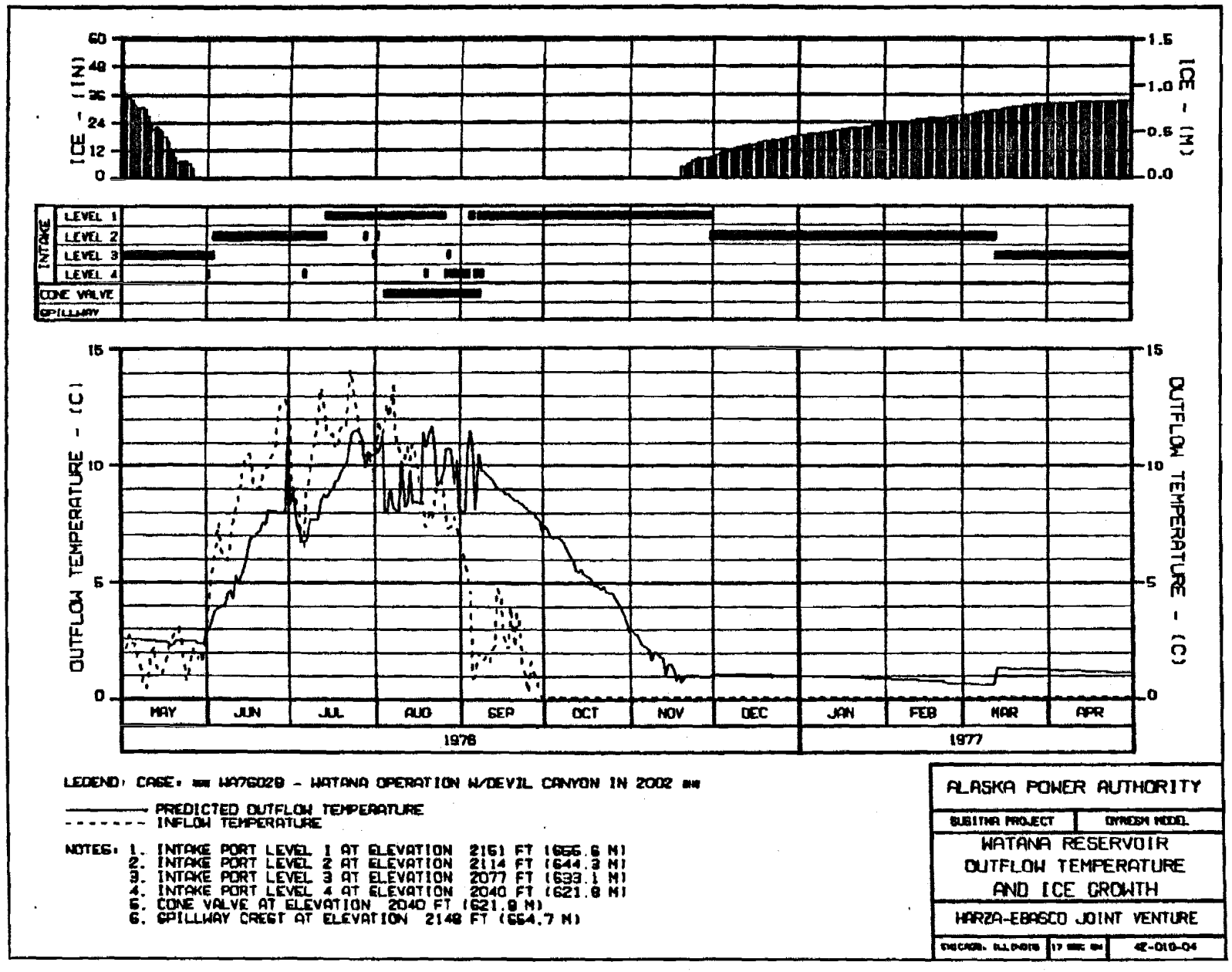
ALASKA POWER AUTHORITY

SUSITNA PROJECT | DYRESM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

42-010-04



LEGEND: CASE: WA7G029 - WATANA OPERATION W/DEVIL CANYON IN 2002

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES:
1. INTAKE PORT LEVEL 1 AT ELEVATION 2161 FT (658.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.9 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.9 M)
6. SPILLWAY CREST AT ELEVATION 2149 FT (654.7 M)

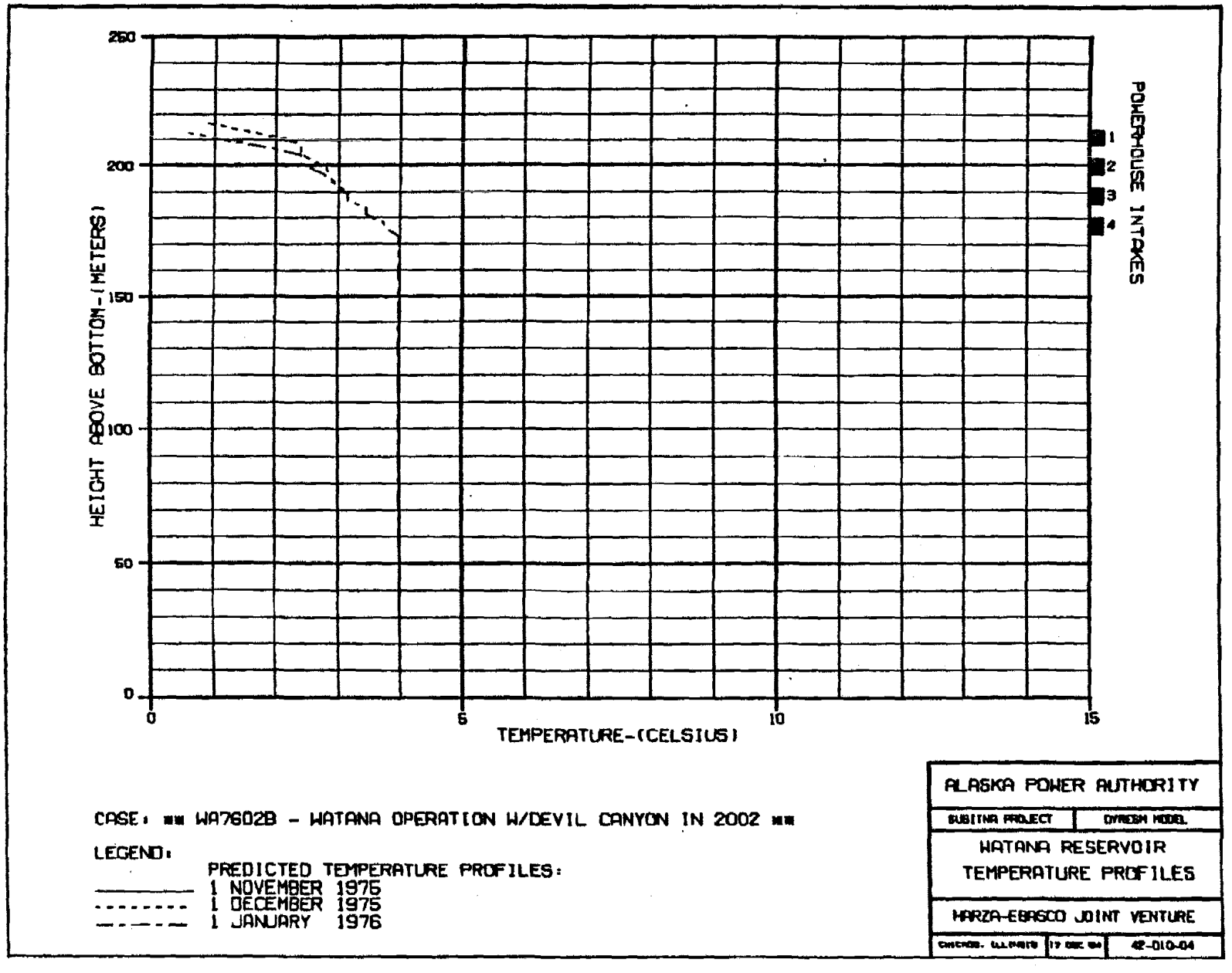
ALASKA POWER AUTHORITY

SUSITNA PROJECT	DYNOSIM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS	17 SEPT 84	42-010-04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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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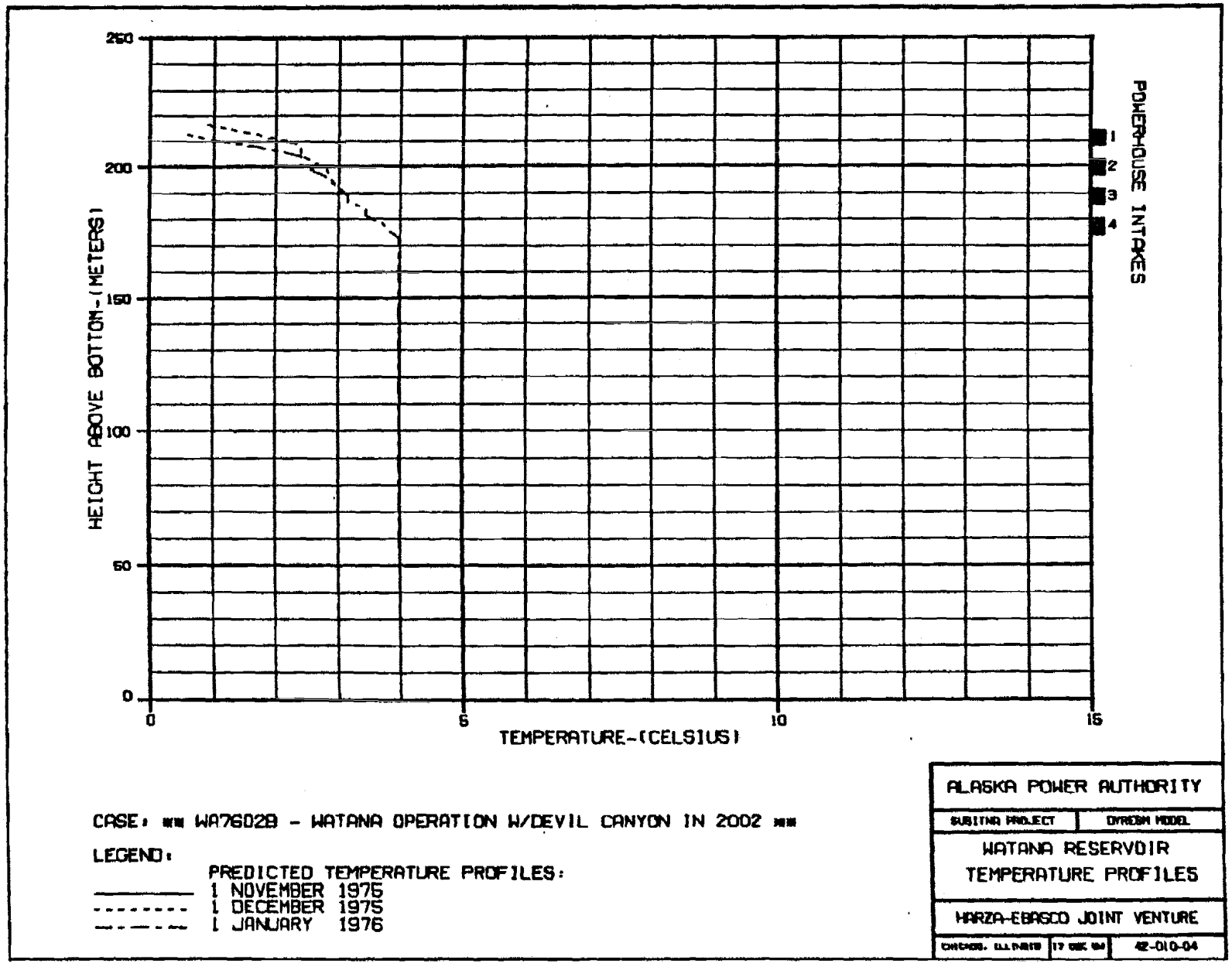
CASE: ** WA7602B - WATANA OPERATION W/DEVIL CANYON IN 2002 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1975
1 DECEMBER 1975
1 JANUARY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
17 DEC 84
42-010-04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HEIGHT ABOVE BOTTOM-(METERS)
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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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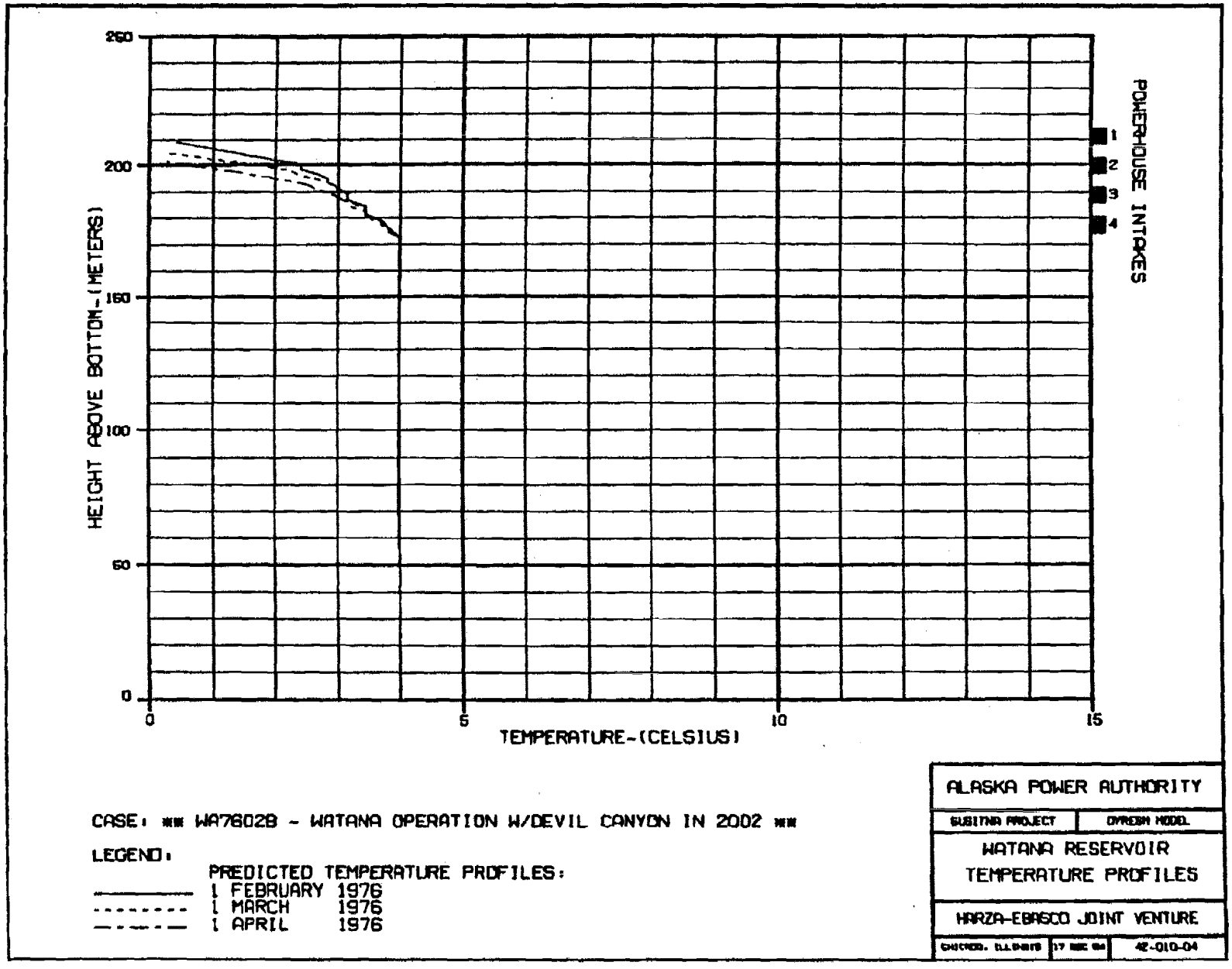
CASE: *** WA76028 - WATANA OPERATION W/DEVIL CANYON IN 2002 ***
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1975
1 DECEMBER 1975
1 JANUARY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04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HEIGHT ABOVE BOTTOM-(METERS)
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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
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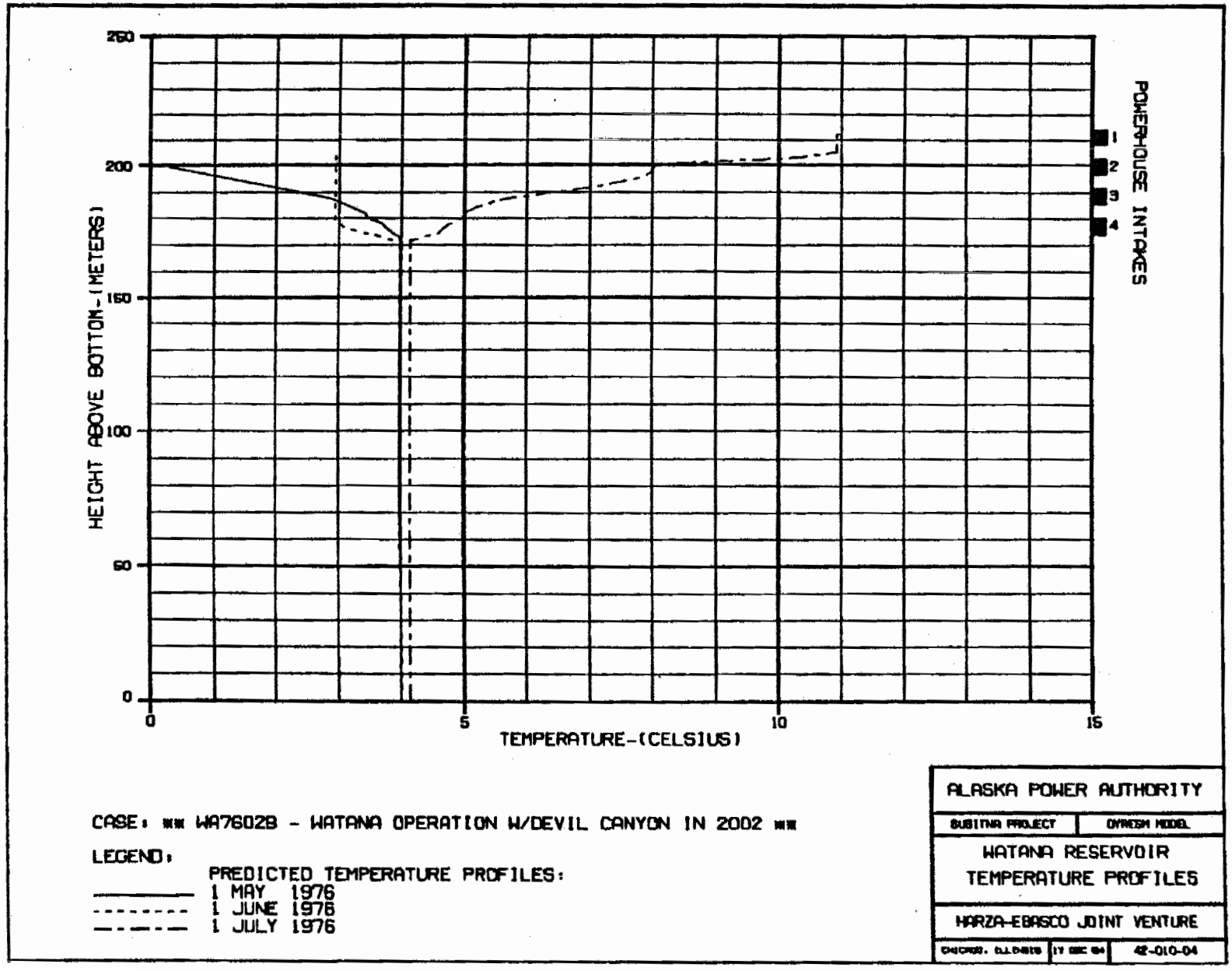
CASE: *** WA76028 - WATANA OPERATION W/DEVIL CANYON IN 2002 ***
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1976
1 MARCH 1976
1 APRIL 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04



CASE: ** WA76028 - WATANA OPERATION W/DEVIL CANYON IN 2002 **

LEGEND:

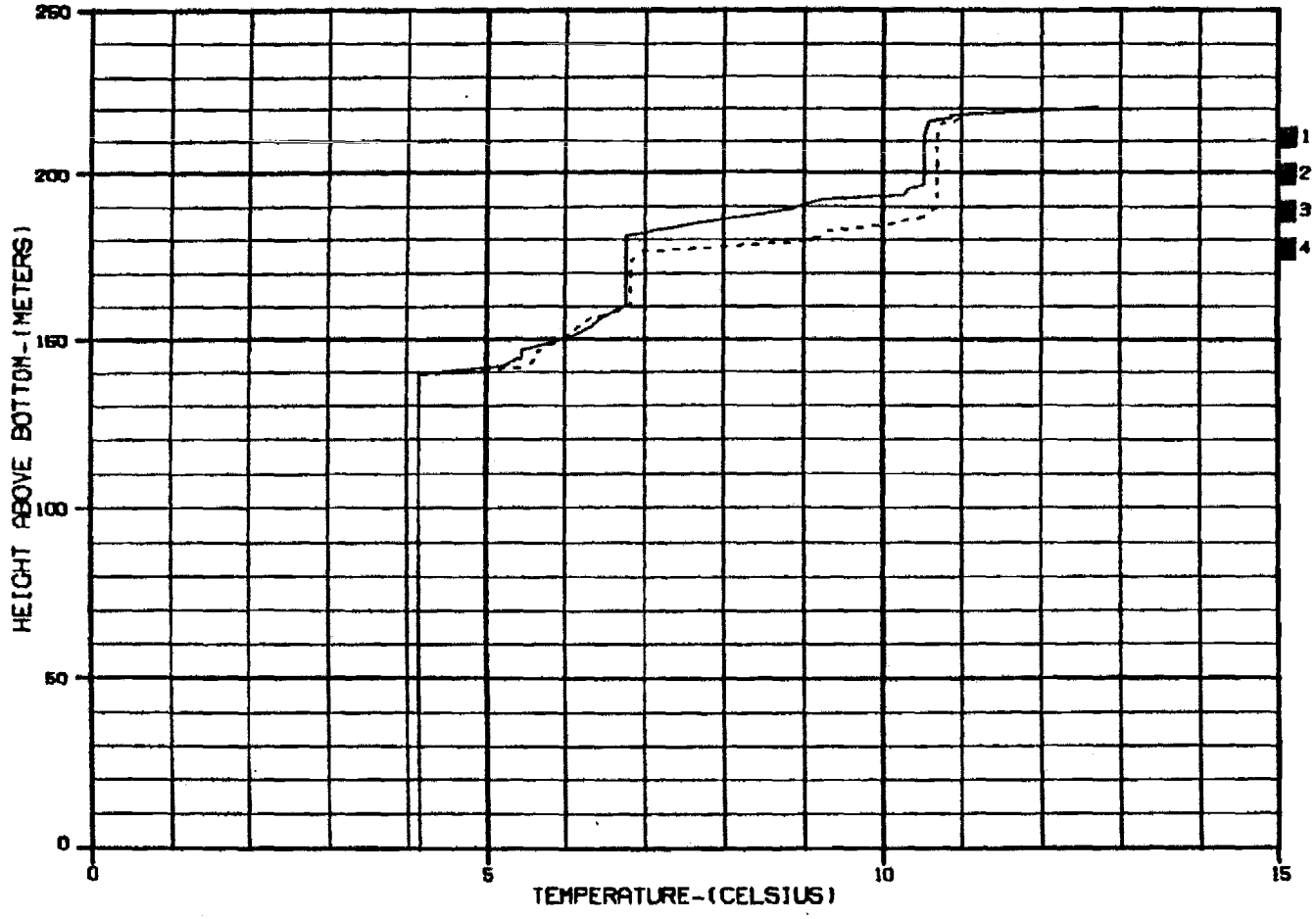
PREDICTED TEMPERATURE PROFILES:

———— 1 MAY 1976

- - - - - - - - 1 JUNE 1976

—·—·— 1 JULY 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
WATANA RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	42-010-04



CASE: ** WA7602B - WATANA OPERATION W/DEVIL CANYON IN 2002 **

LEGEND:

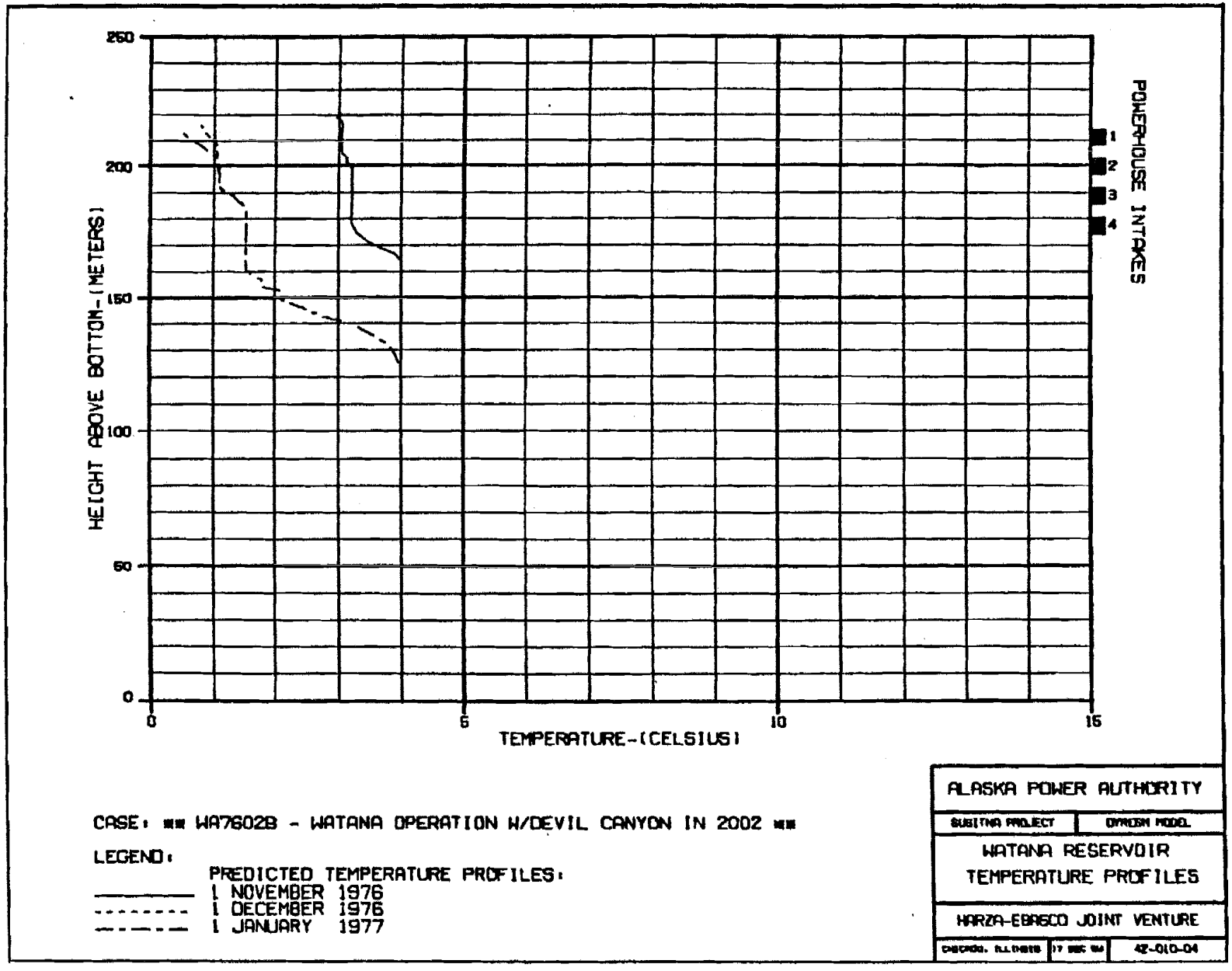
PREDICTED TEMPERATURE PROFILES:

———— 1 AUGUST 1976

- - - - - - - - 1 SEPTEMBER 1976

— — — — 1 OCTOBER 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
WATANA RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	17 DEC 84	42-010-04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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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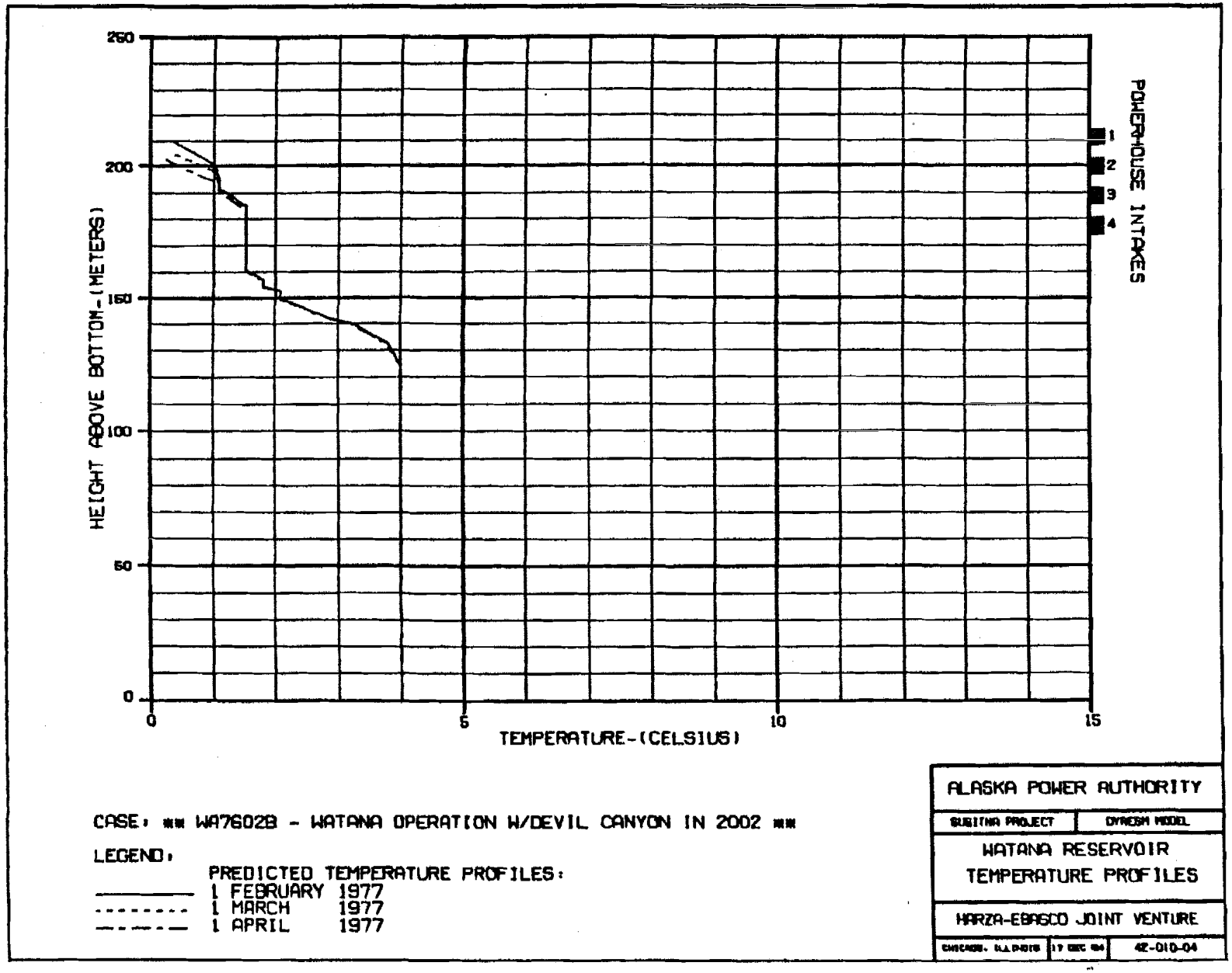
CASE: ** WA7602B - WATANA OPERATION W/DEVIL CANYON IN 2002 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1976
1 JANUARY 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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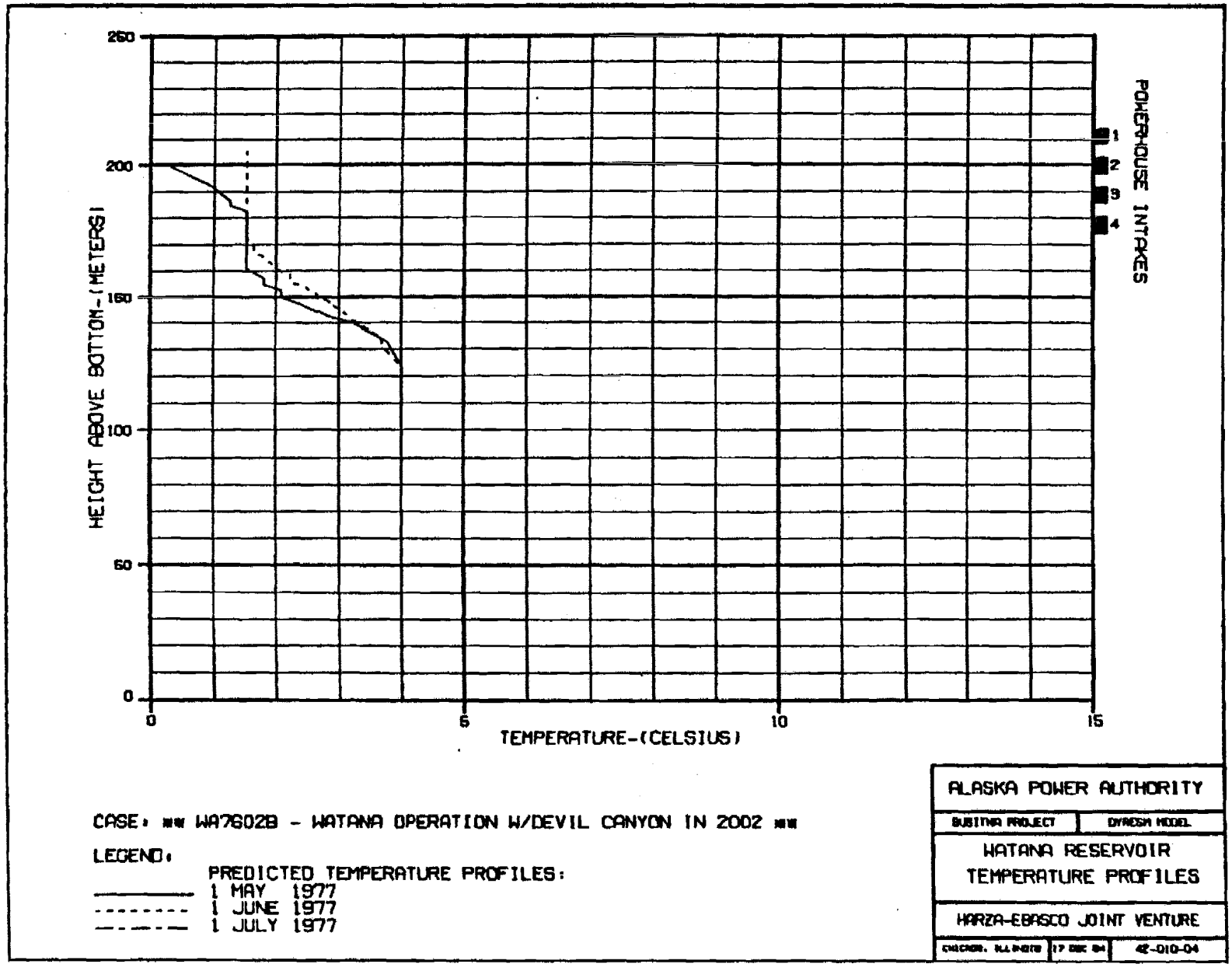
CASE: *** WA76028 - WATANA OPERATION W/DEVIL CANYON IN 2002 ***
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1977
1 MARCH 1977
1 APRIL 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYNESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04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TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
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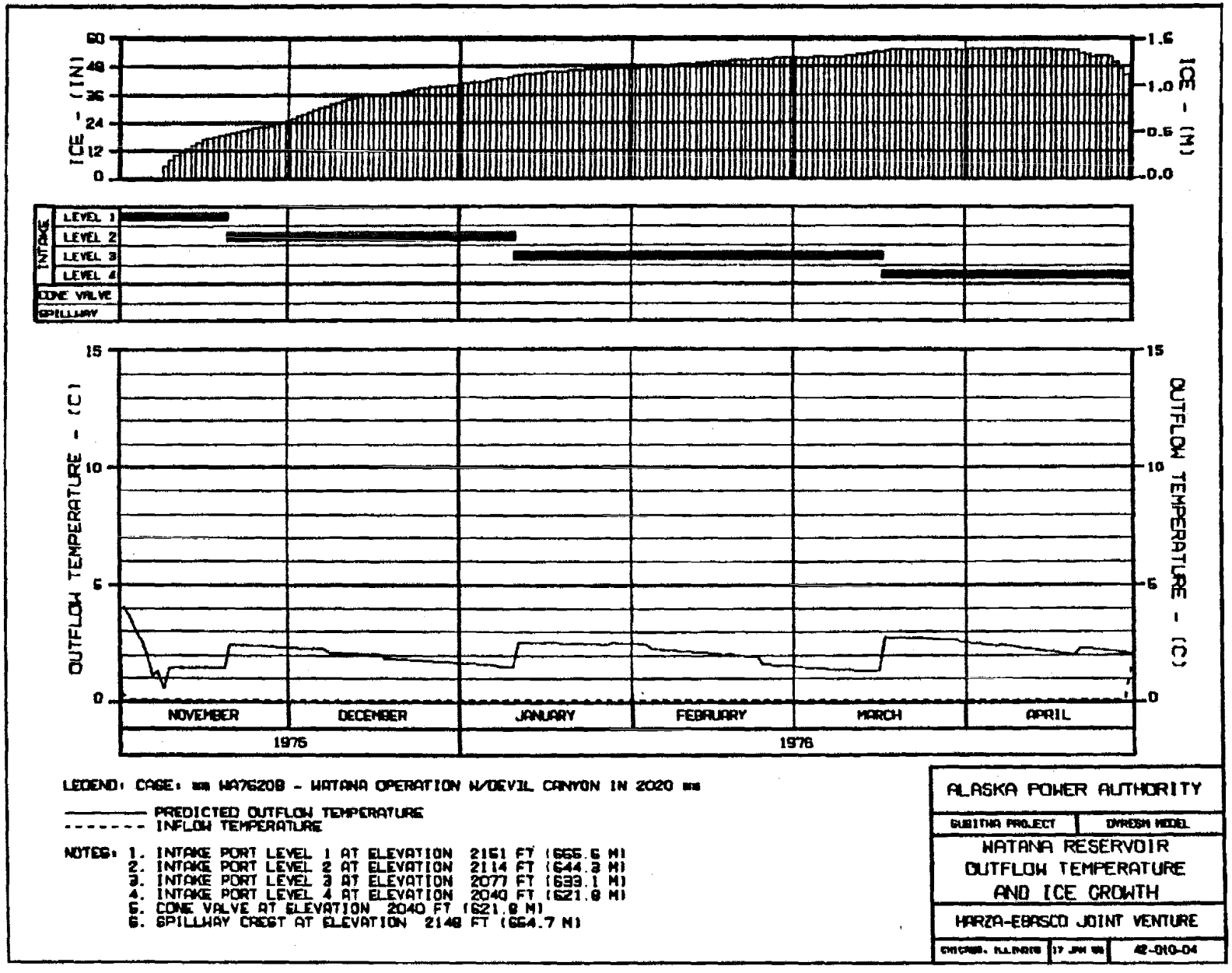
CASE: ** WA7602B - WATANA OPERATION W/DEVIL CANYON IN 2002 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 MAY 1977
1 JUNE 1977
1 JULY 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
17 DEC 84
42-010-04

EXHIBIT AG



LEGEND: CASE: WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES:
1. INTAKE PORT LEVEL 1 AT ELEVATION 2151 FT (655.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.8 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.8 M)
6. SPILLWAY CREST AT ELEVATION 2148 FT (654.7 M)

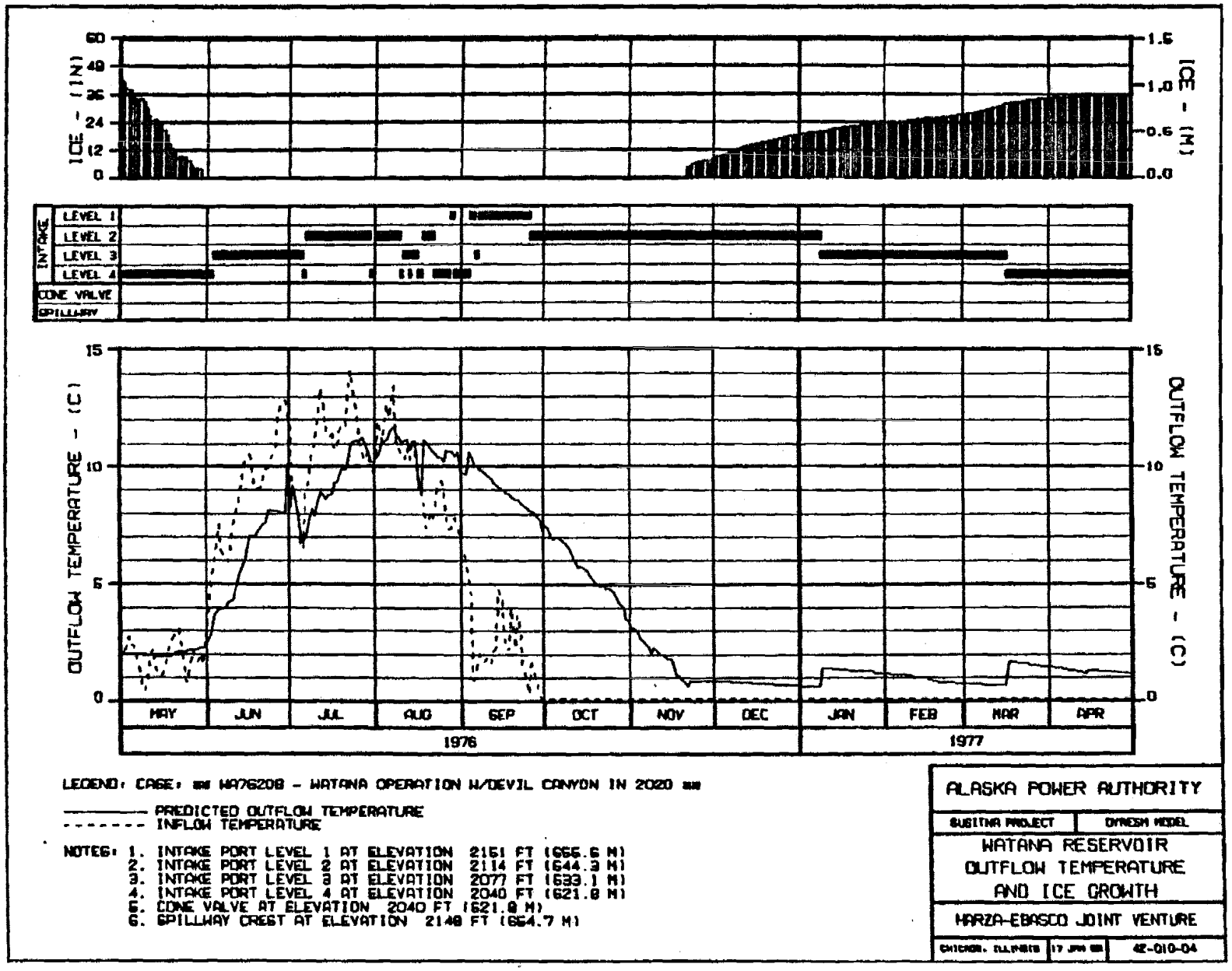
ALASKA POWER AUTHORITY

SUSITNA PROJECT	DAMSIM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS	17 JAN 86	42-010-04



LEGEND: CASE: ## WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020 ##

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES:
1. INTAKE PORT LEVEL 1 AT ELEVATION 2151 FT (655.6 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 2114 FT (644.3 M)
3. INTAKE PORT LEVEL 3 AT ELEVATION 2077 FT (633.1 M)
4. INTAKE PORT LEVEL 4 AT ELEVATION 2040 FT (621.8 M)
5. CONE VALVE AT ELEVATION 2040 FT (621.8 M)
6. SPILLWAY CREST AT ELEVATION 2148 FT (654.7 M)

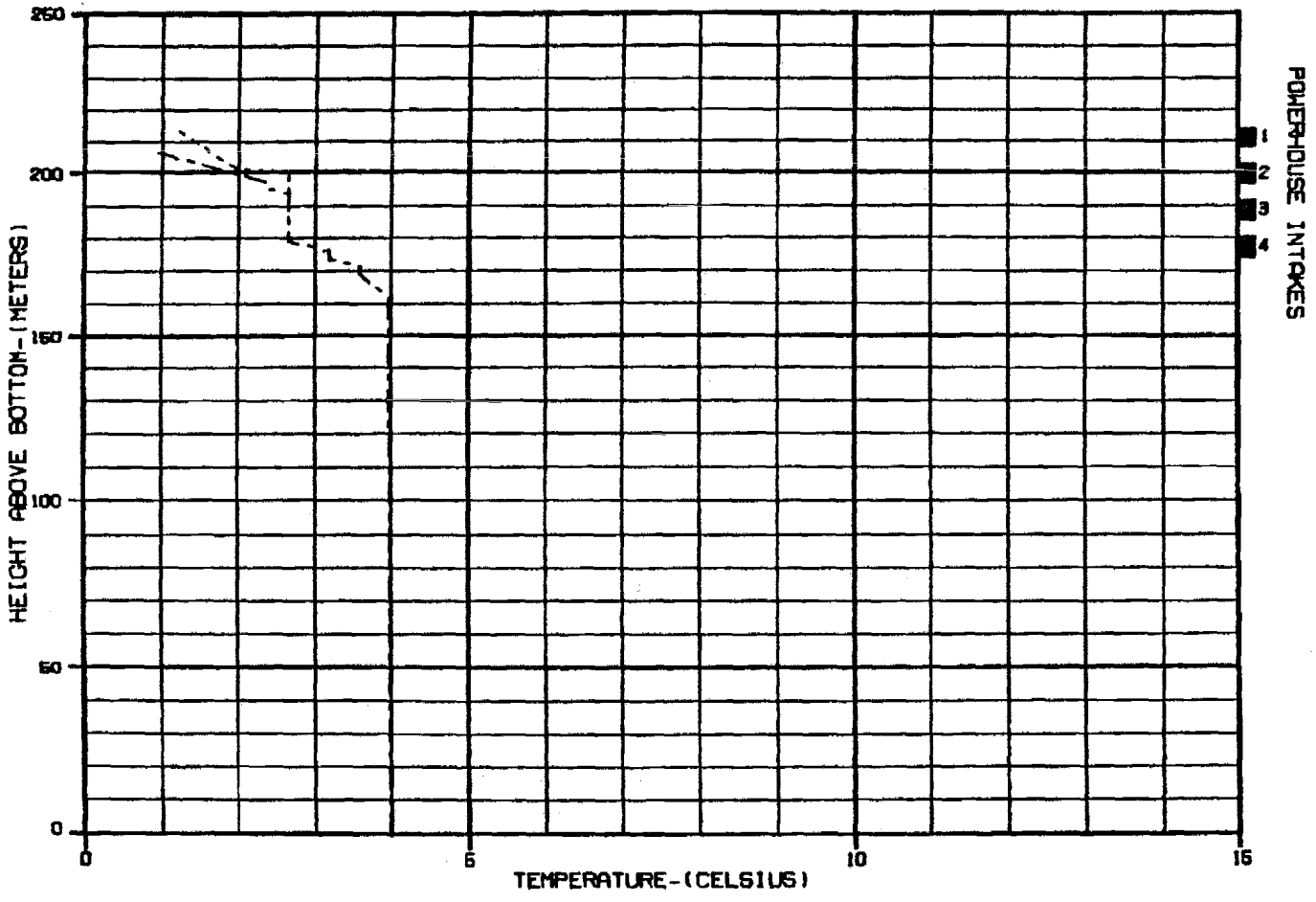
ALASKA POWER AUTHORITY

SUSITNA PROJECT	DYNESIM MODEL

WATANA RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS	17 JAN 85	42-010-04



CASE: *** WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020 ***

LEGEND:

PREDICTED TEMPERATURE PROFILES:

———— 1 NOVEMBER 1975

- - - - - - - - 1 DECEMBER 1975

———— 1 JANUARY 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
WATANA RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
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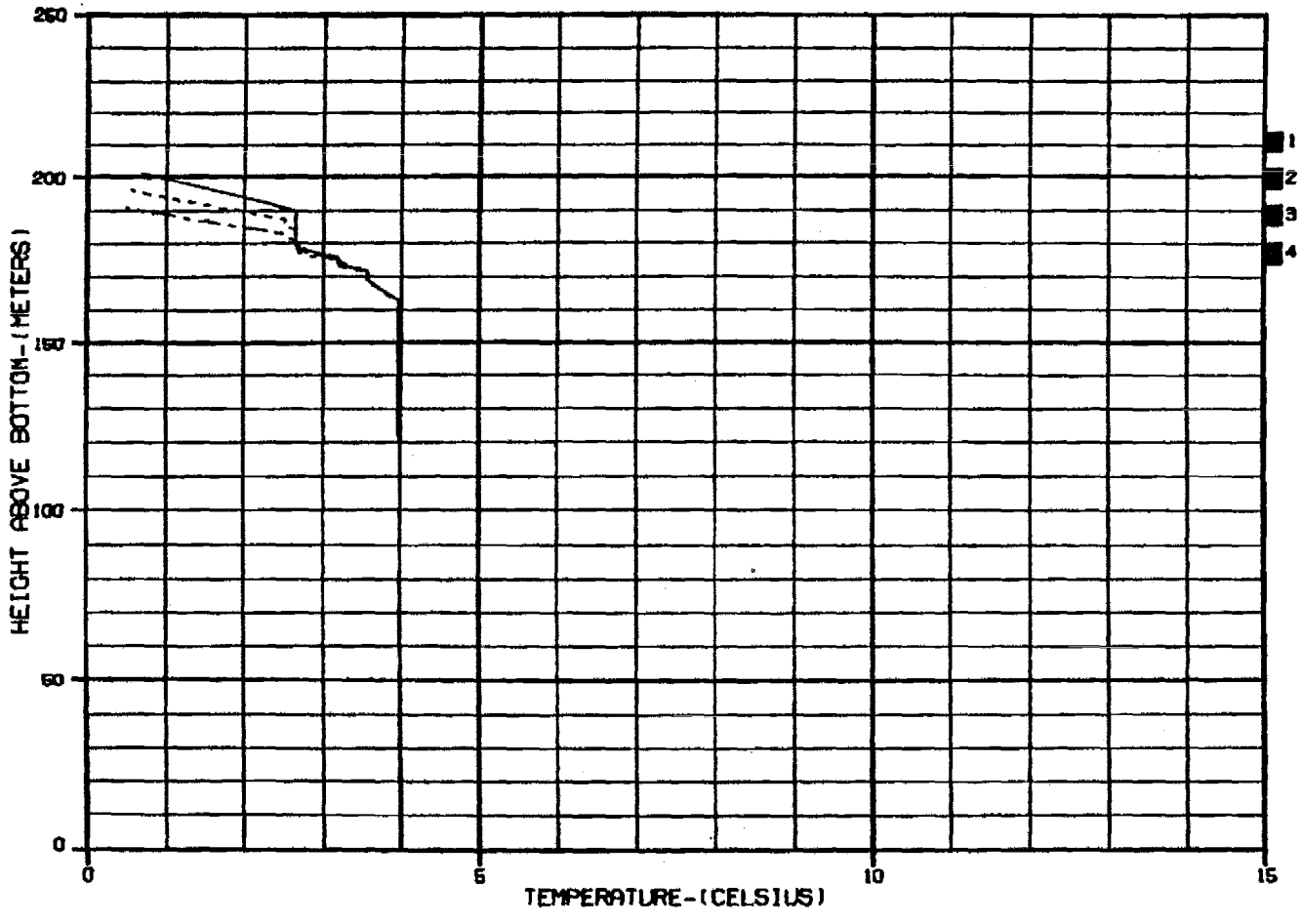


CASE: WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020

LEGEND:

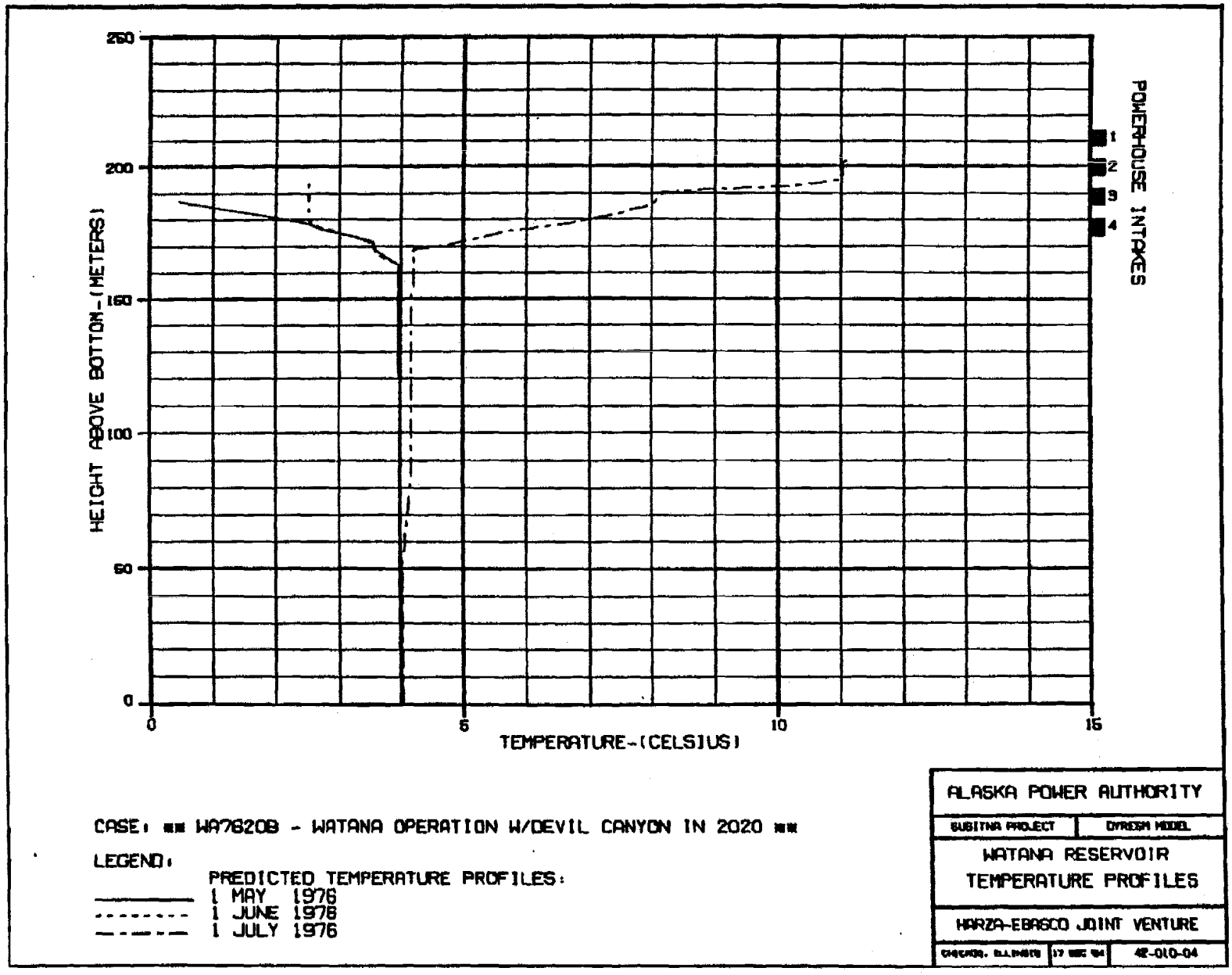
PREDICTED TEMPERATURE PROFILES:

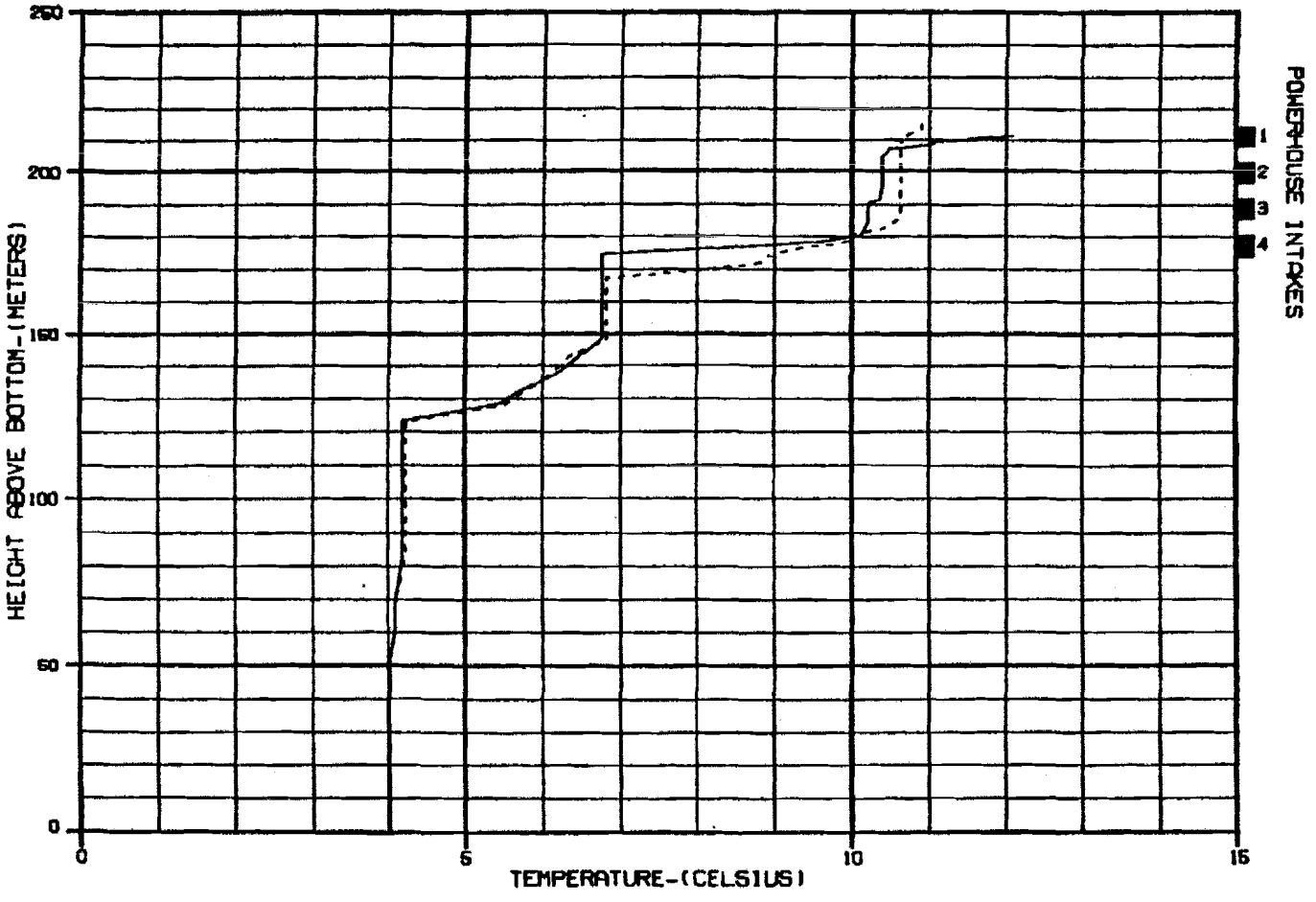
———— 1 FEBRUARY 1976

- - - - - - - - 1 MARCH 1976

—·—·—·— 1 APRIL 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	CHECK MODEL
WATANA RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHECKED:	42-010-04


HEIGHT ABOVE BOTTOM-(METERS)
250
200
150
100
50
0
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
3
4
CASE: ** WA7820B - WATANA OPERATION W/DEVIL CANYON IN 2020 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 MAY 1976
1 JUNE 1976
1 JULY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04



CASE: ** WA7620B - WATANA OPERATION W/DEVIL CANYON IN 2020 **

LEGEND:

PREDICTED TEMPERATURE PROFILES:

———— 1 AUGUST 1976

- - - - - - - - 1 SEPTEMBER 1976

— — — — — 1 OCTOBER 1976

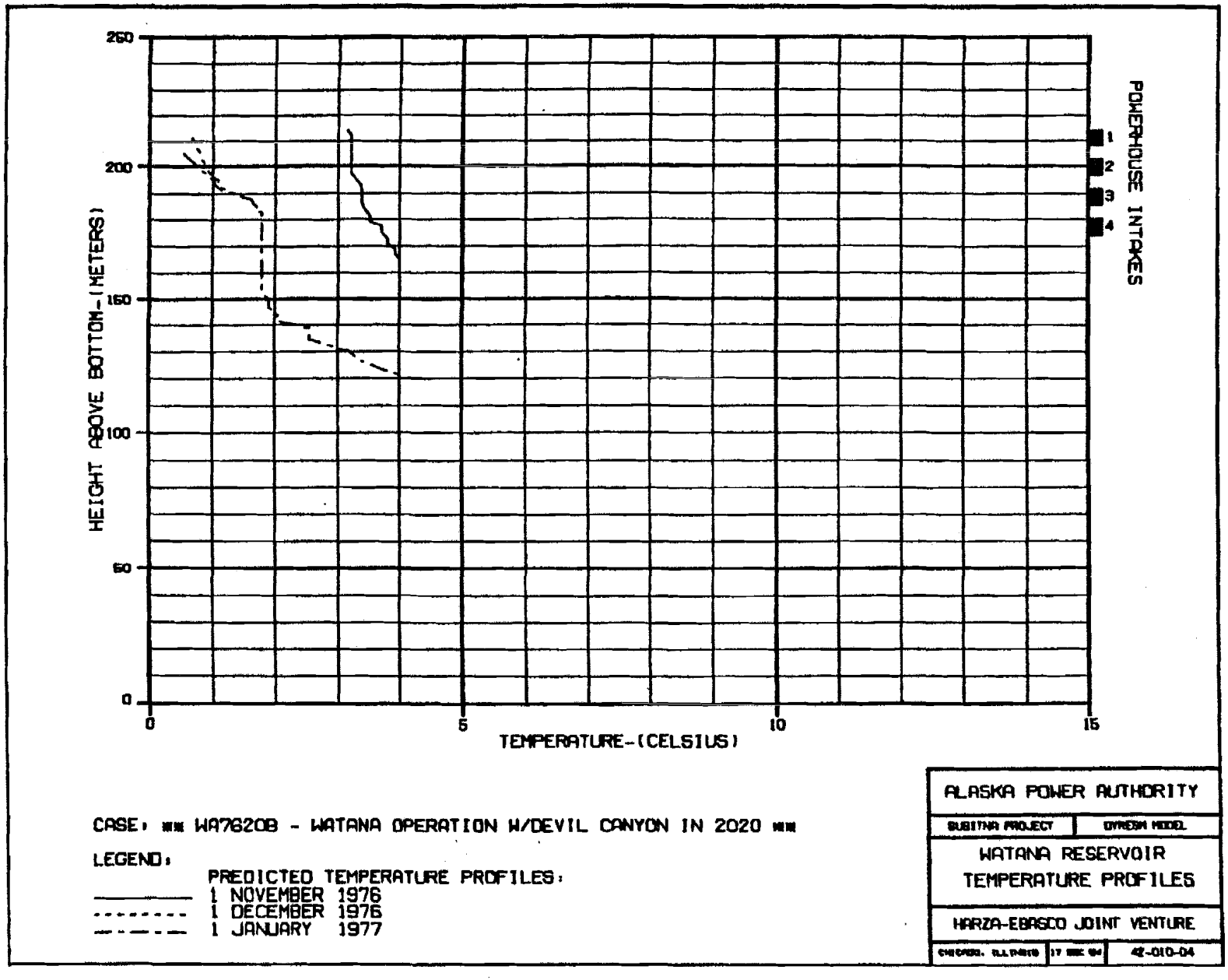
ALASKA POWER AUTHORITY

SUSITNA PROJECT | CYRIUM MODEL

WATANA RESERVOIR TEMPERATURE PROFILES

HARZA-EBASCO JOINT VENTURE

42-010-04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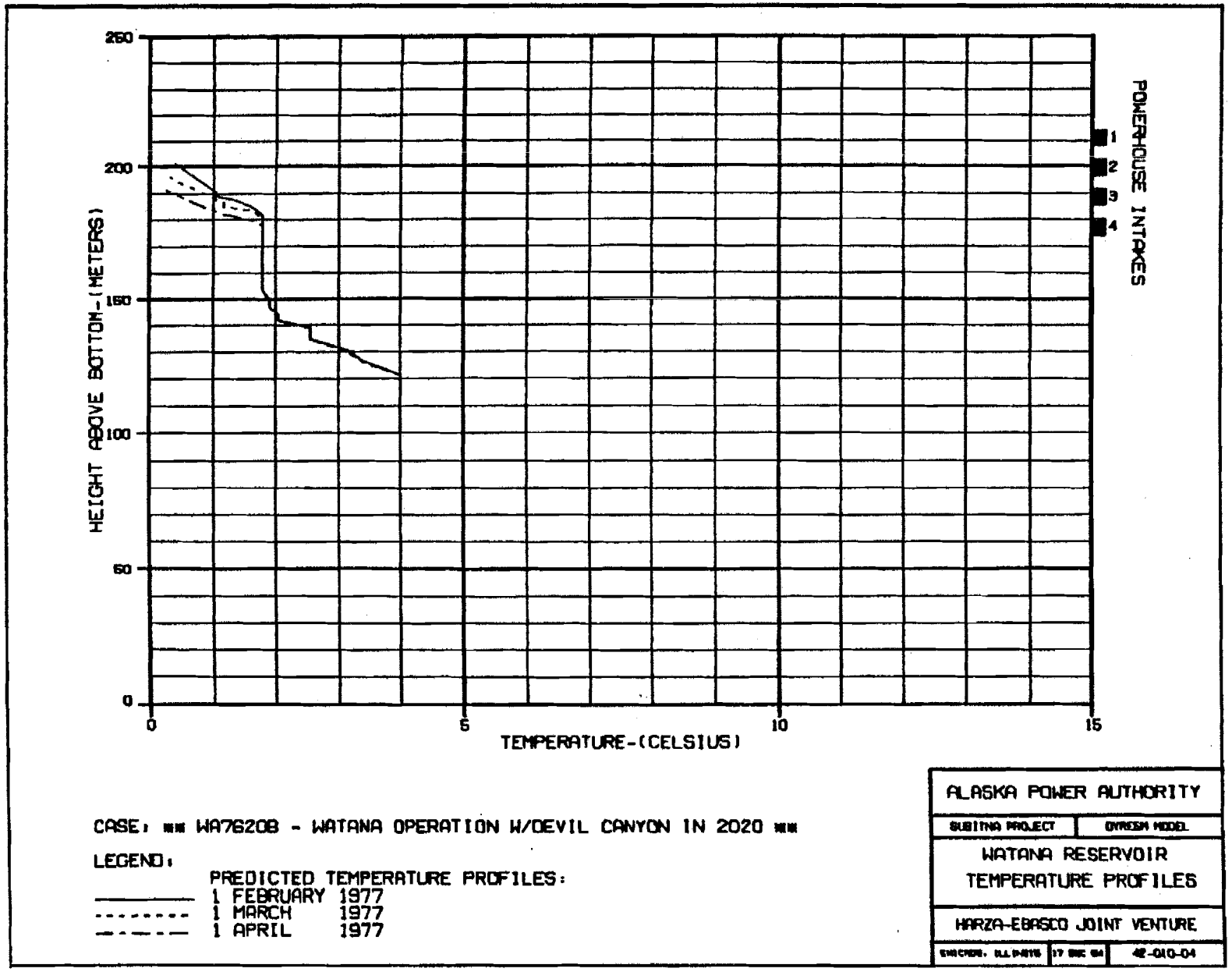
100
50
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
3
4
CASE: WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1976
1 JANUARY 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04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100
50
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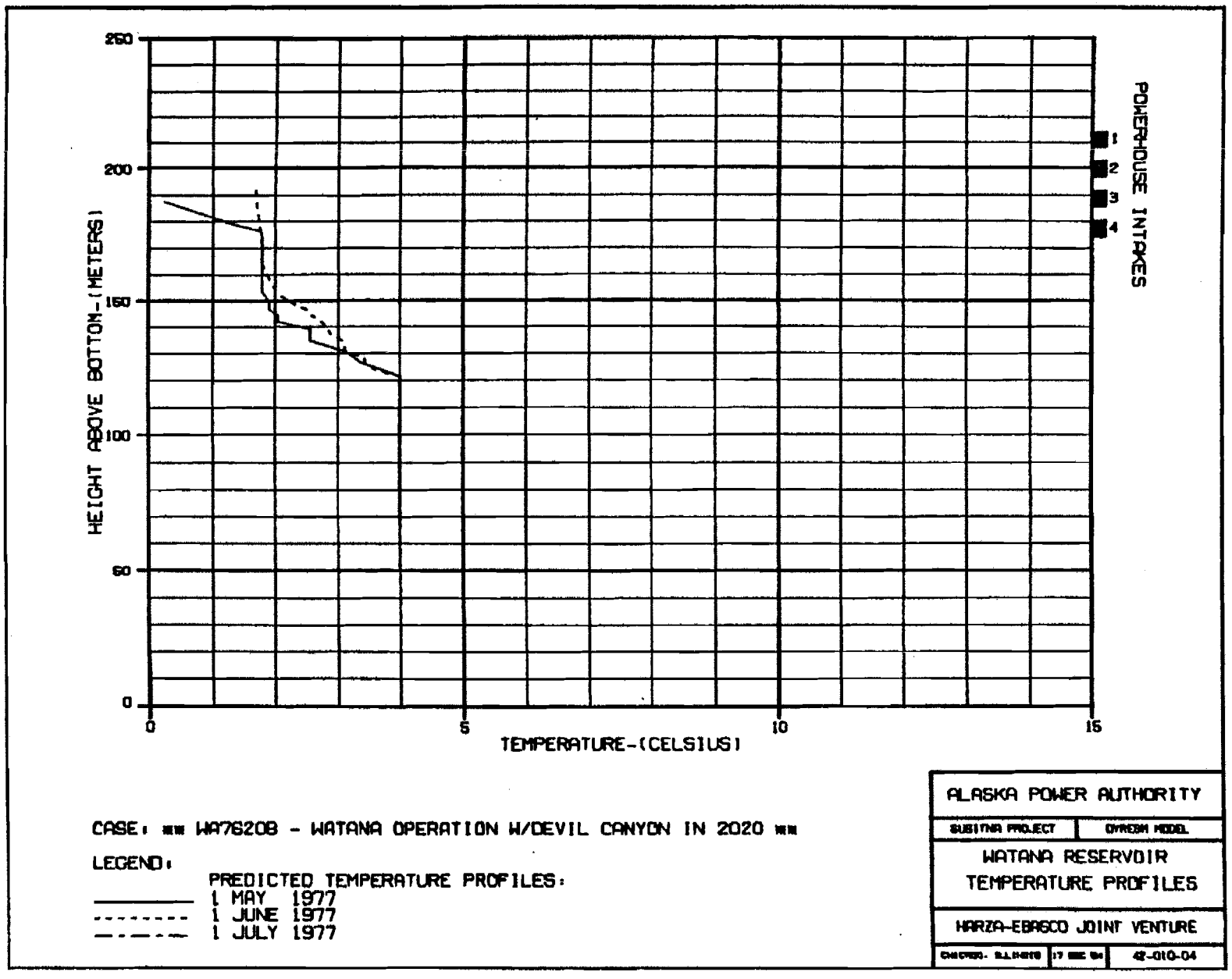
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
3
4
CASE: WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1977
1 MARCH 1977
1 APRIL 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04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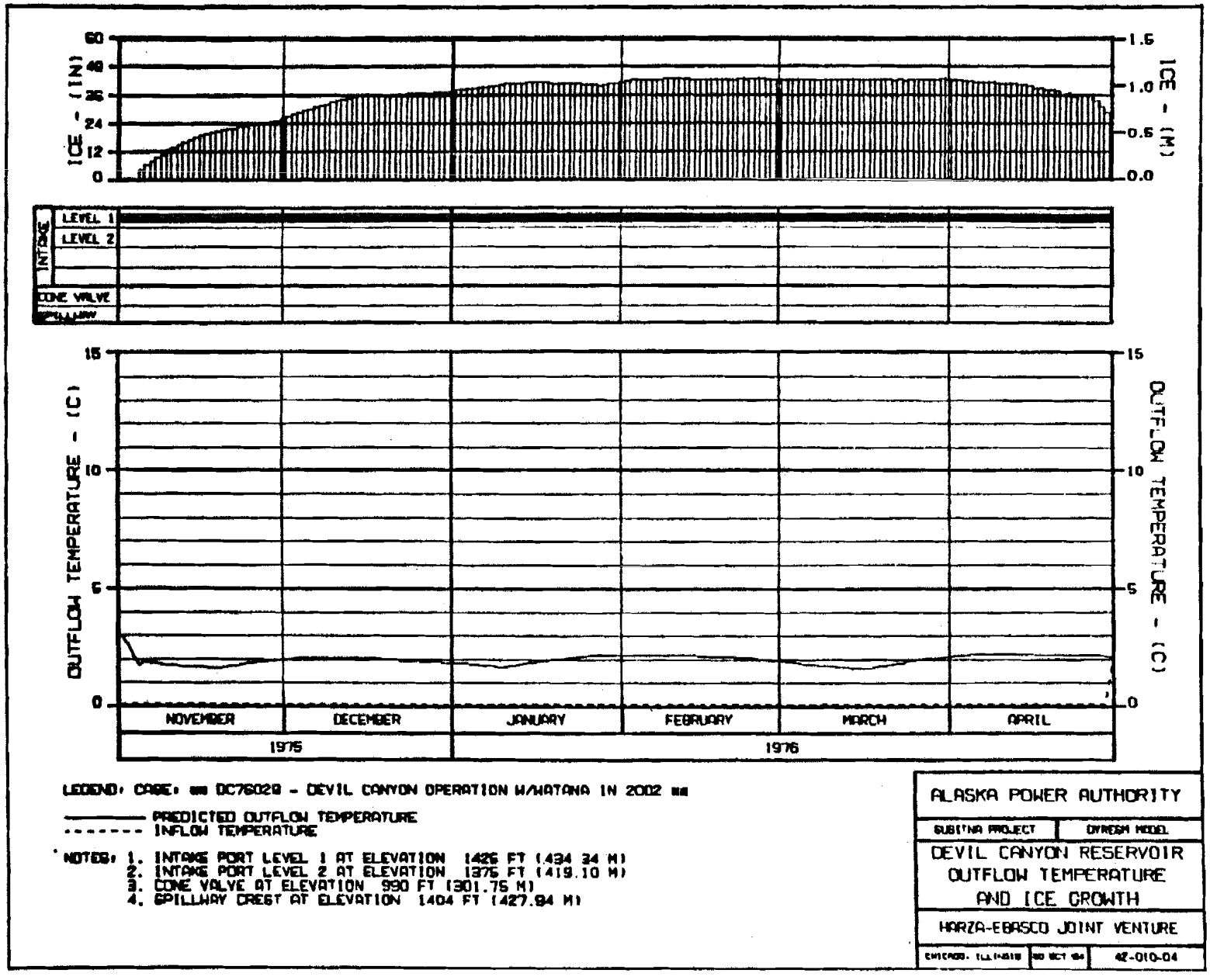
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
3
4
CASE: ** WA76208 - WATANA OPERATION W/DEVIL CANYON IN 2020 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 MAY 1977
1 JUNE 1977
1 JULY 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
WATANA RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04

EXHIBIT AL



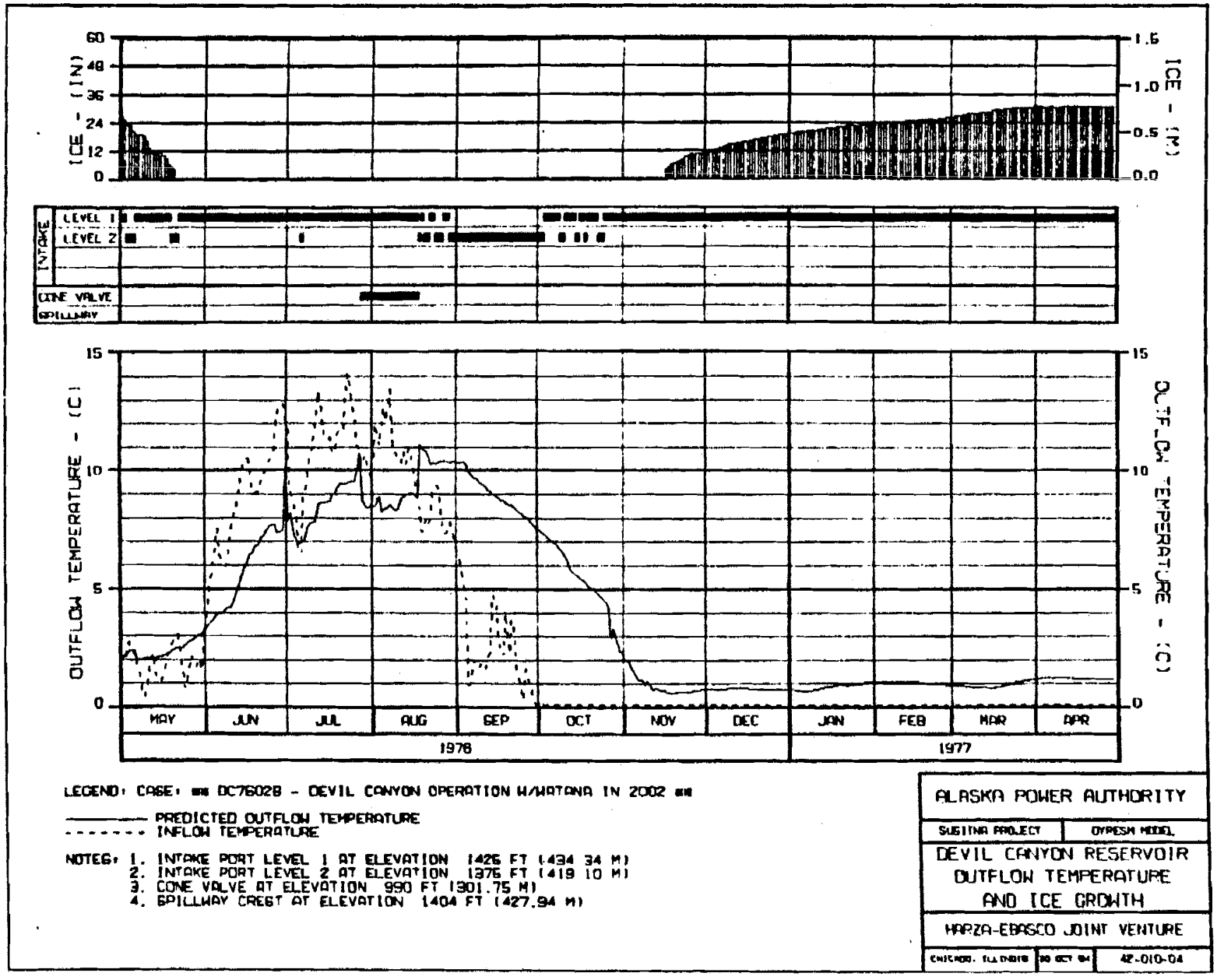
LEGEND: CASE: DC76028 - DEVIL CANYON OPERATION W/WATANA IN 2002

——— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 1426 FT (434.34 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 1375 FT (419.10 M)
3. CONE VALVE AT ELEVATION 990 FT (301.75 M)
4. SPILLWAY CREST AT ELEVATION 1404 FT (427.94 M)

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYNSIM MODEL
DEVIL CANYON RESERVOIR OUTFLOW TEMPERATURE AND ICE GROWTH	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	DEC 84
42-010-04	

Case -20 + 1
w/ modified wind.

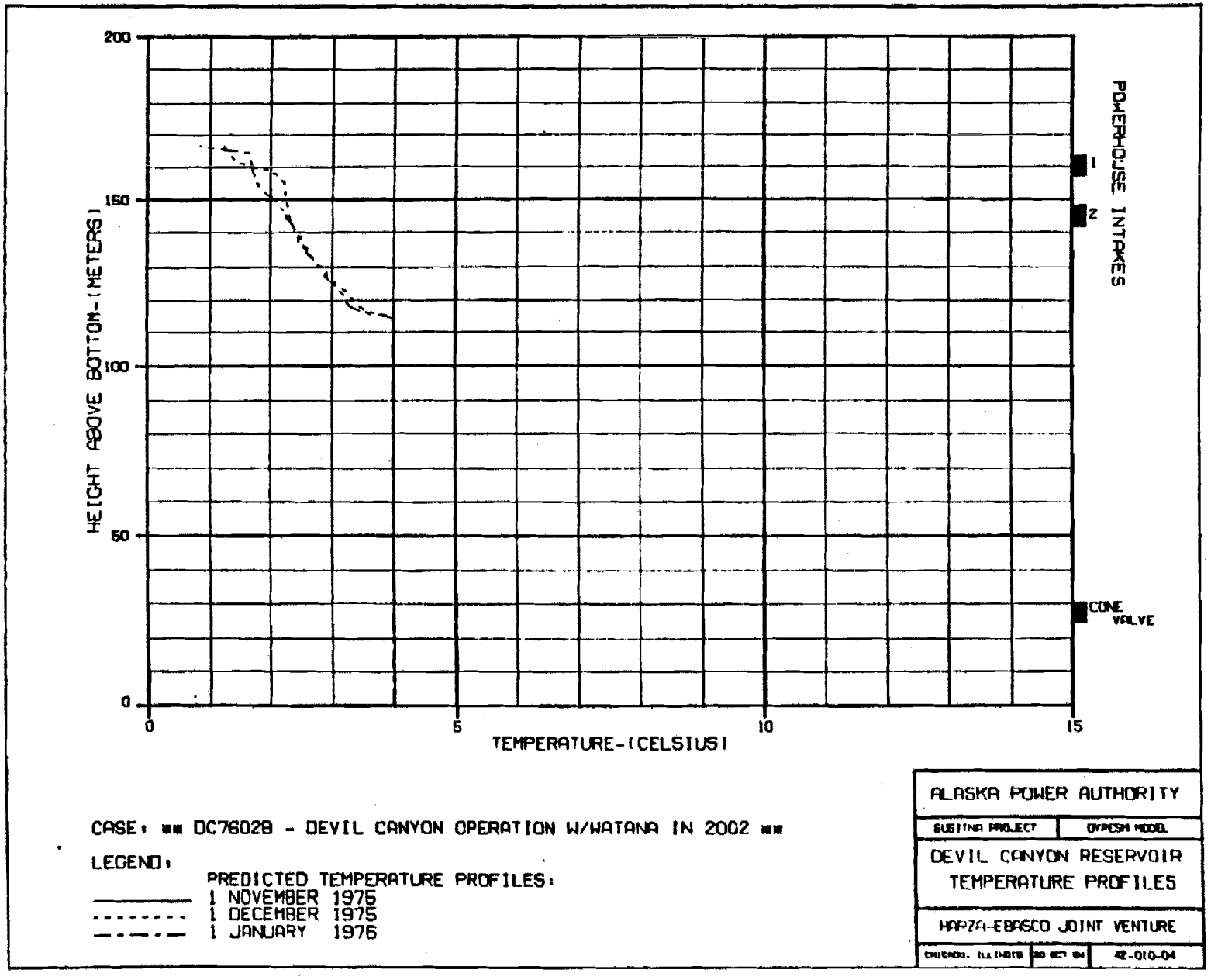


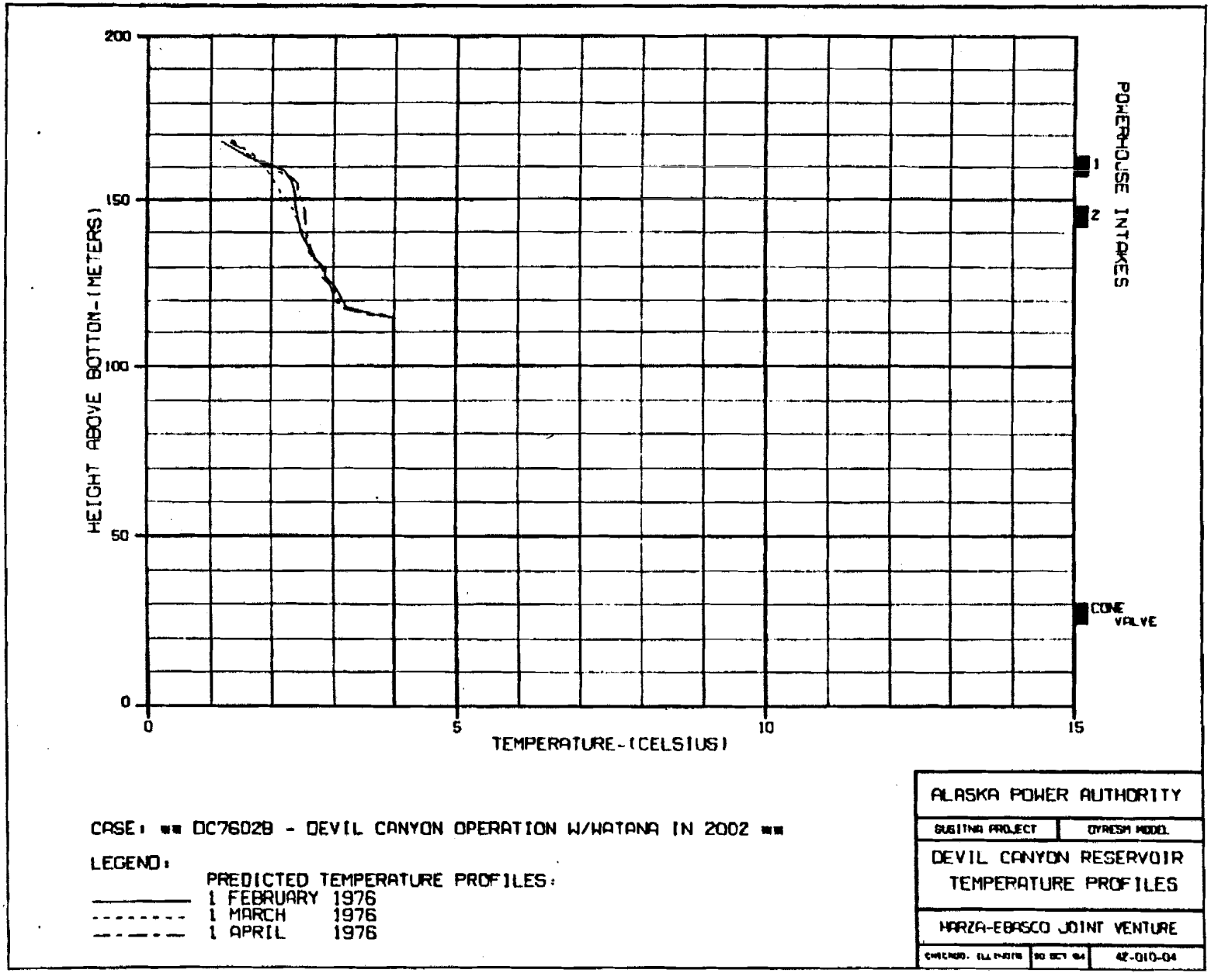
LEGEND: CASE: DC76028 - DEVIL CANYON OPERATION W/WATANA IN 2002

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 1426 FT (434.34 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 1376 FT (419.10 M)
3. CONE VALVE AT ELEVATION 990 FT (301.75 M)
4. SPILLWAY CREST AT ELEVATION 1404 FT (427.94 M)

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYPESM MODEL
DEVIL CANYON RESERVOIR OUTFLOW TEMPERATURE AND ICE GROWTH	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	42-010-04


200
150
100
50
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC76028 - DEVIL CANYON OPERATION W/WATANA IN 2002 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1975
1 JANUARY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYNSIM MODEL
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
42-010-04



CASE: ** DC76028 - DEVIL CANYON OPERATION W/WATANA IN 2002 **

LEGEND:

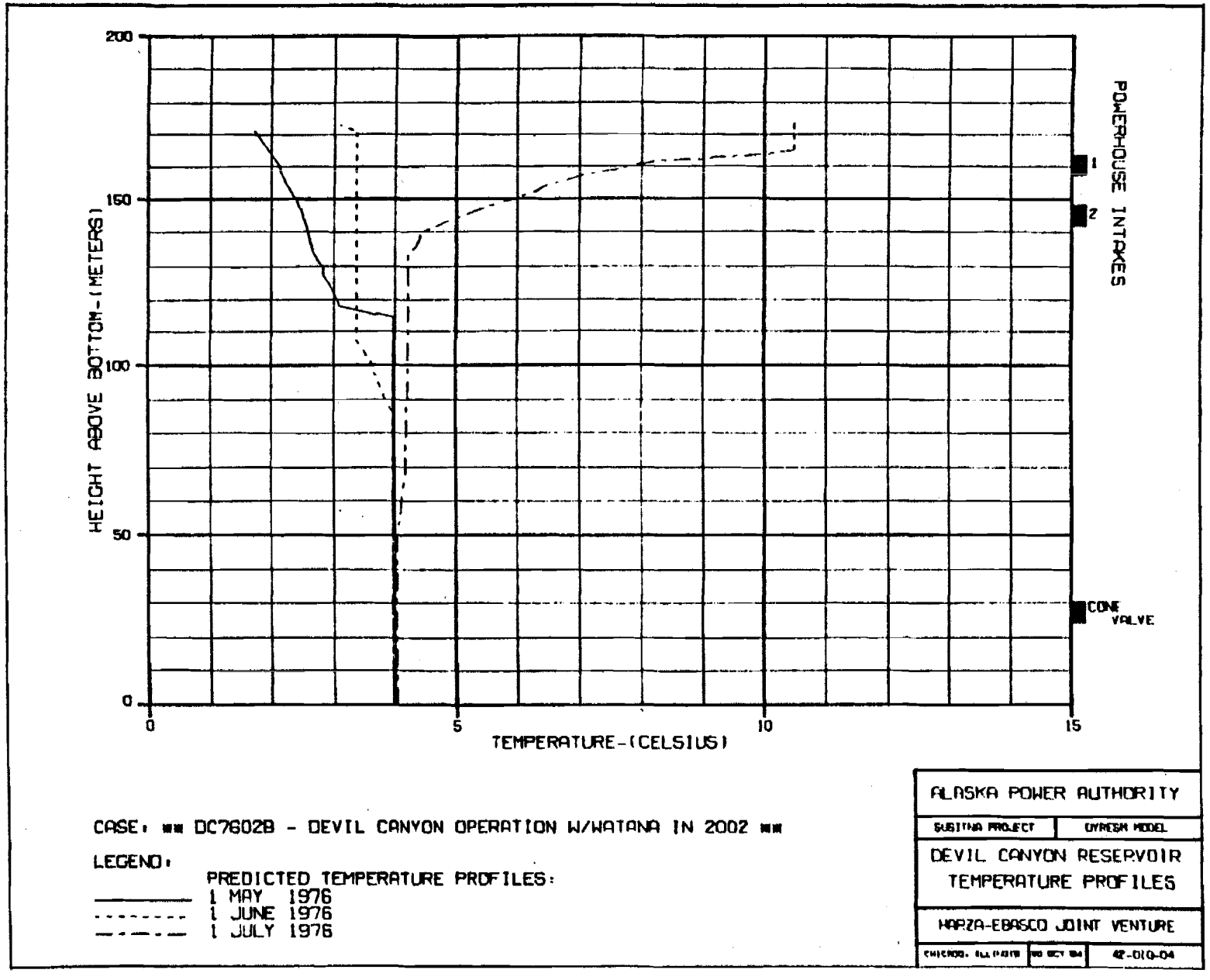
PREDICTED TEMPERATURE PROFILES:

——— 1 FEBRUARY 1976

- - - - - - - 1 MARCH 1976

—·—·— 1 APRIL 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	CYRESM MODEL
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	42-010-04


200
150
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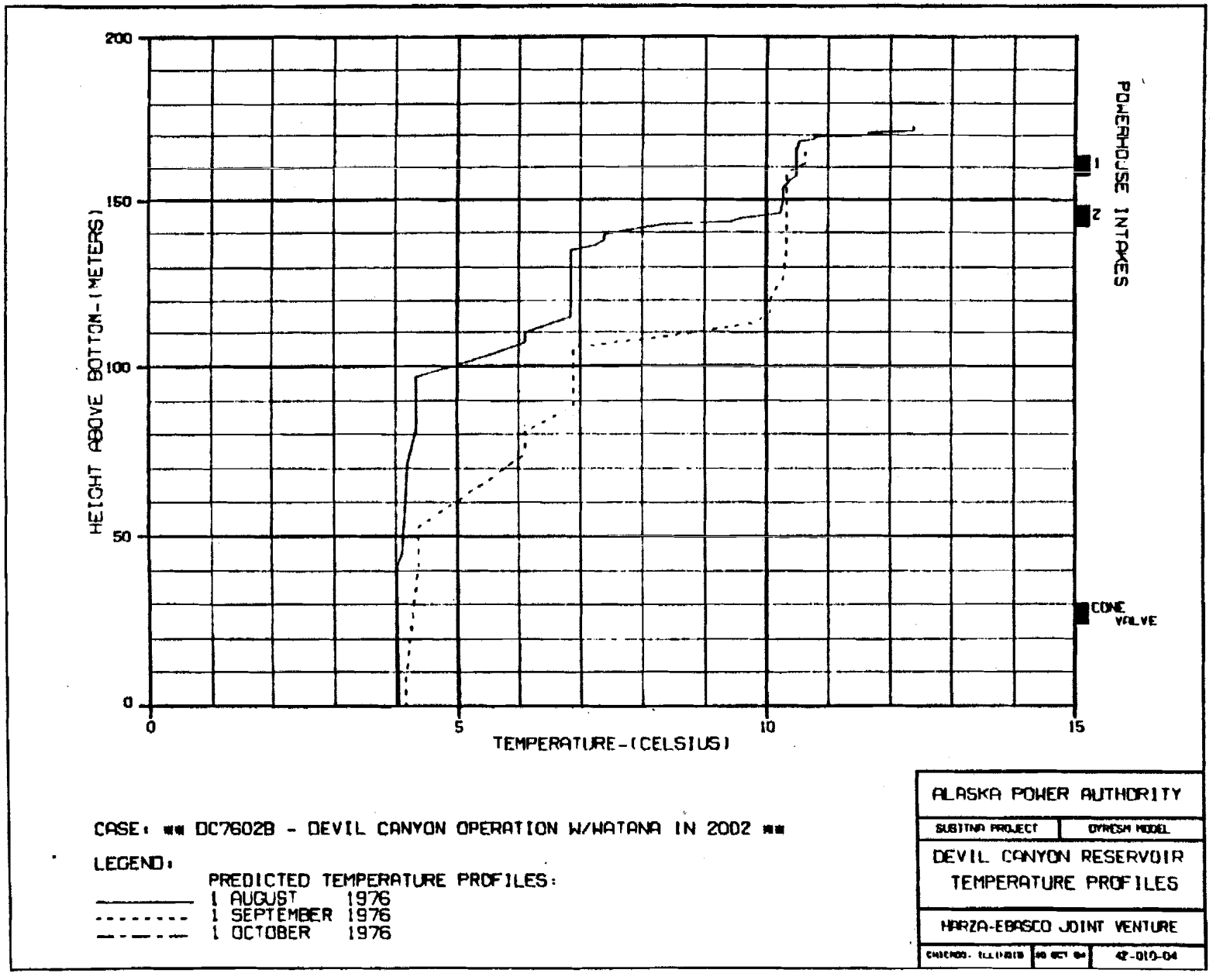
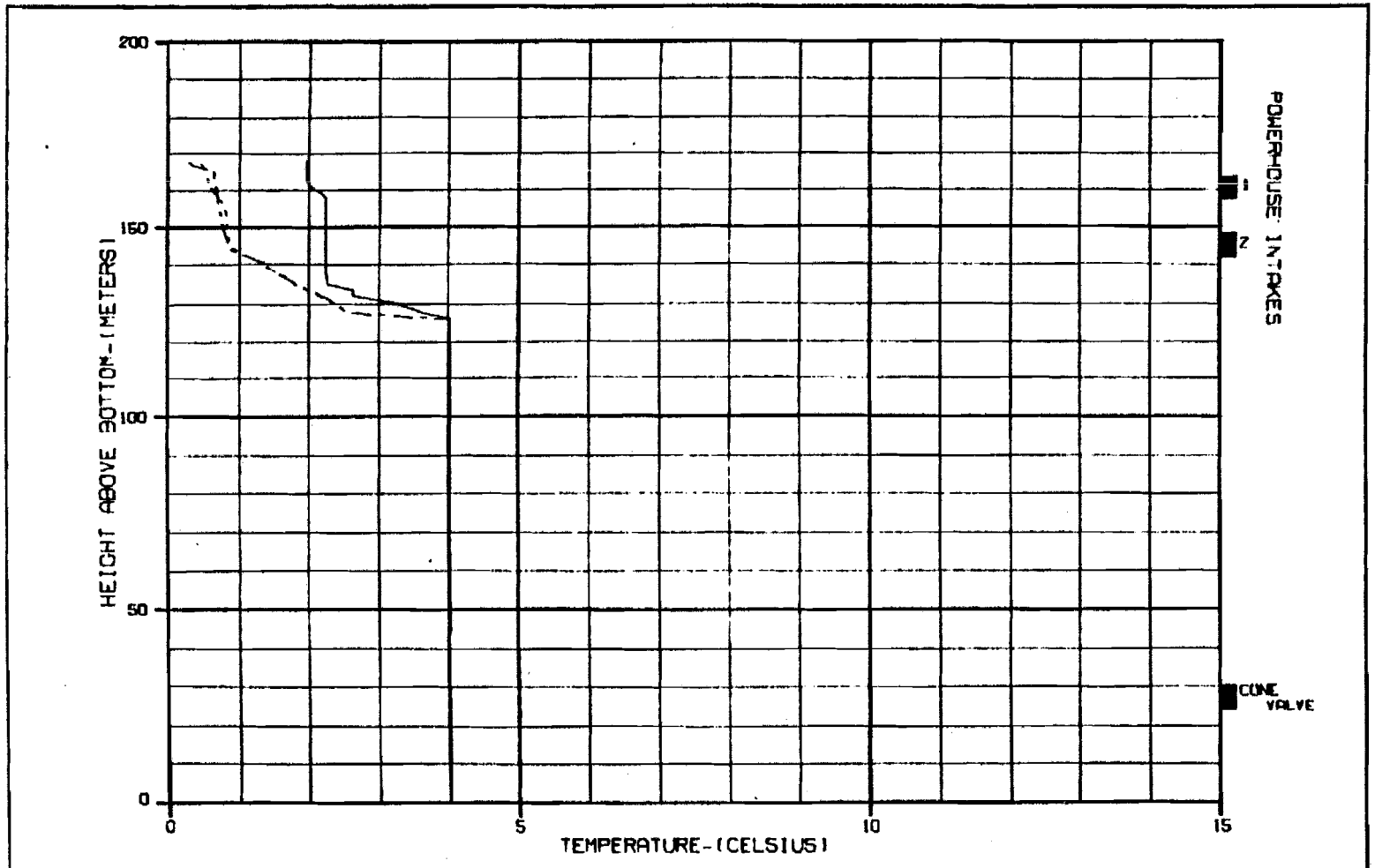
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC76028 - DEVIL CANYON OPERATION W/WATANA IN 2002 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 MAY 1976
1 JUNE 1976
1 JULY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
DEVIL CANYON RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04


200
150
100
50
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: *** DC7602B - DEVIL CANYON OPERATION W/WATANA IN 2002 ***
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 AUGUST 1976
1 SEPTEMBER 1976
1 OCTOBER 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
42-010-04



CASE: ** DC7602B - DEVIL CANYON OPERATION W/WATANA IN 2002 **

LEGEND:

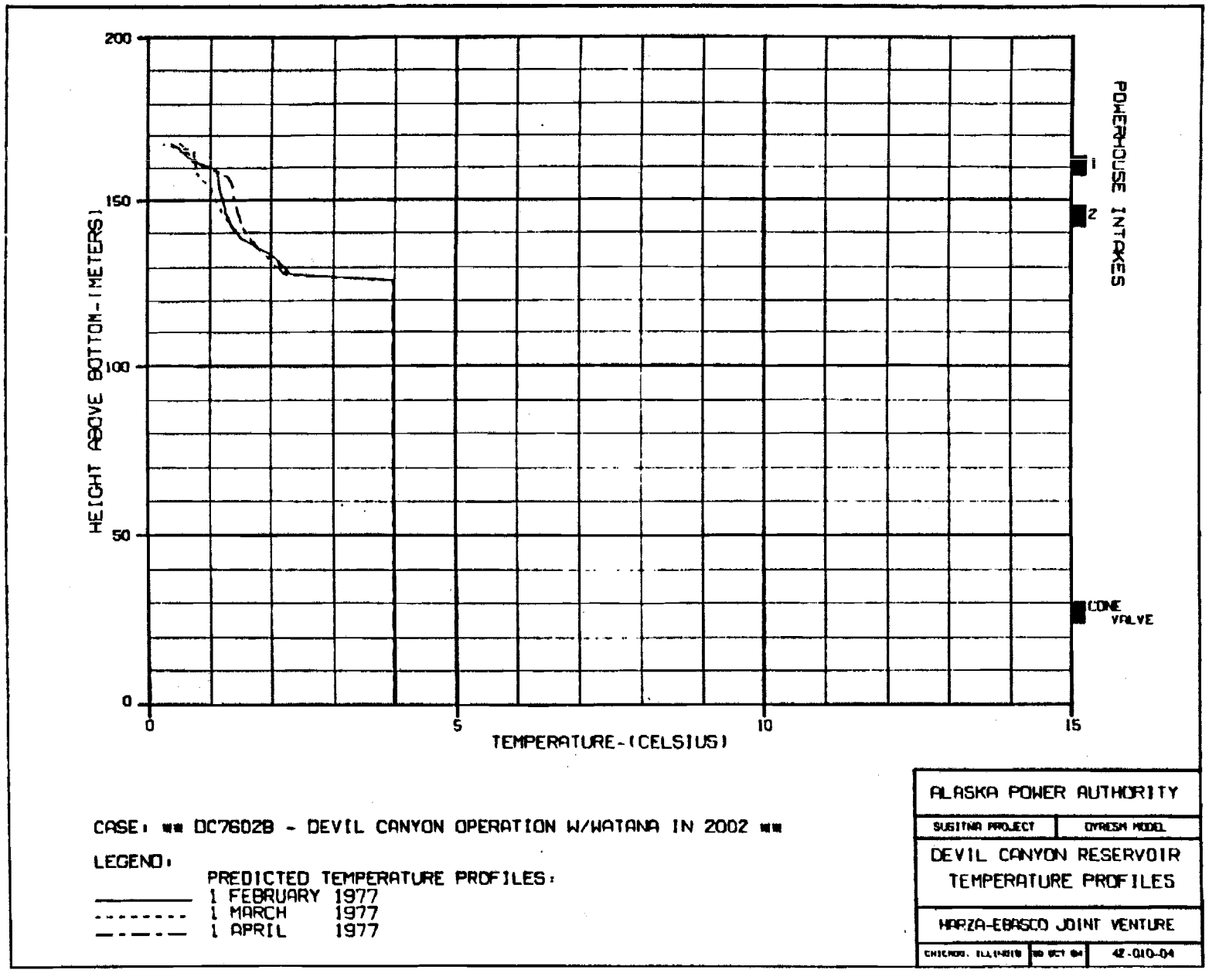
PREDICTED TEMPERATURE PROFILES:

———— 1 NOVEMBER 1976

- - - - - - - - 1 DECEMBER 1976

— — — — — 1 JANUARY 1977

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	42-010-04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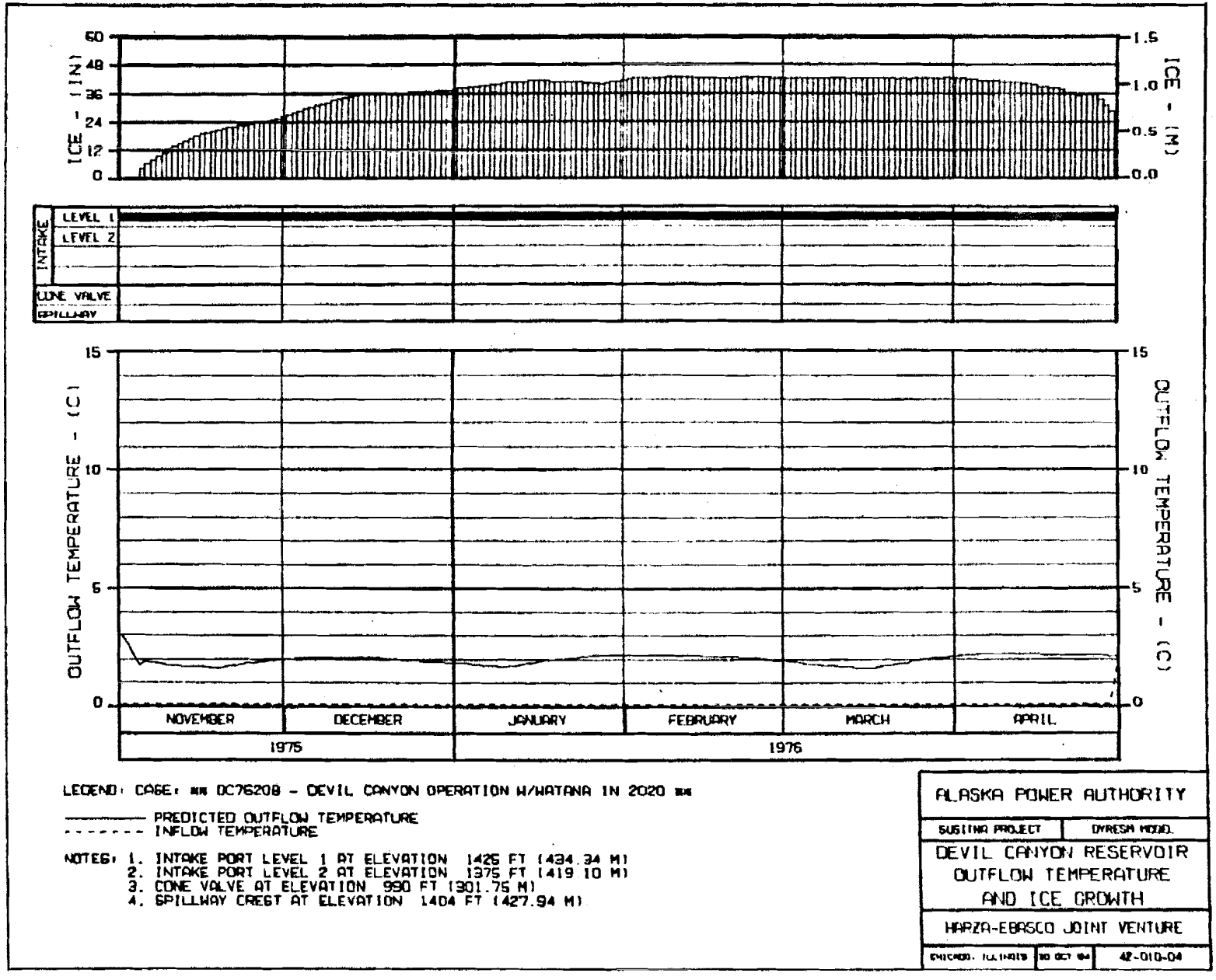
5
10
15
HEIGHT ABOVE BOTTOM-(METERS)
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC7602B - DEVIL CANYON OPERATION W/WATANA IN 2002 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1977
1 MARCH 1977
1 APRIL 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
CYRESM MODEL
DEVIL CANYON RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
42-010-04

EXHIBIT AQ

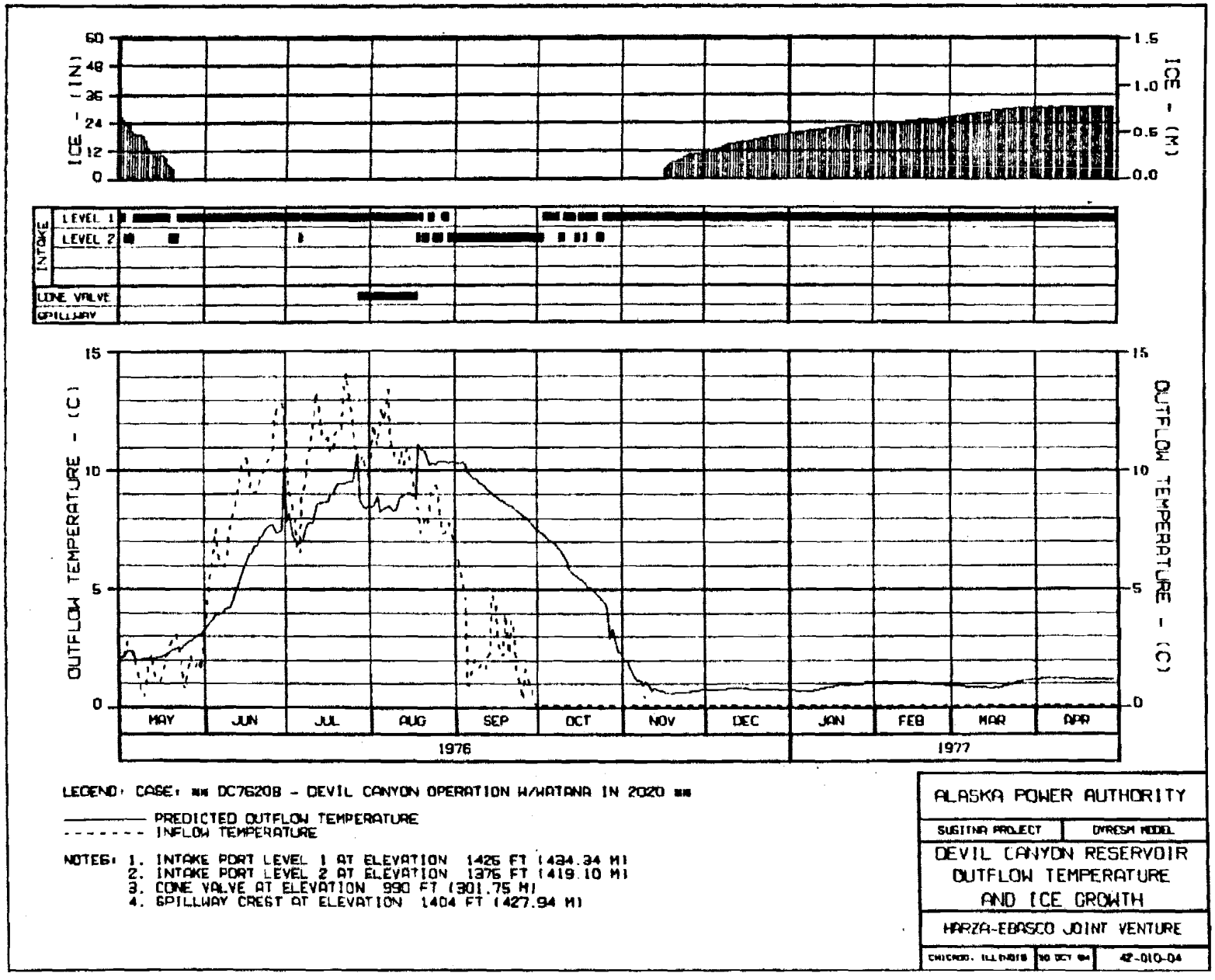


LEGEND: CASE: DC76208 - DEVIL CANYON OPERATION W/WATANA IN 2020

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 1426 FT (434.34 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 1375 FT (419.10 M)
3. CONE VALVE AT ELEVATION 990 FT (301.75 M)
4. SPILLWAY CREST AT ELEVATION 1404 FT (427.94 M)

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
DEVIL CANYON RESERVOIR OUTFLOW TEMPERATURE AND ICE GROWTH	
HARZA-EBASCO JOINT VENTURE	
ENCINO, ILLINOIS	30 OCT 84	42-010-04



LEGEND: CASE: DC7620B - DEVIL CANYON OPERATION W/WATANA IN 2020

———— PREDICTED OUTFLOW TEMPERATURE
- - - - - - - INFLOW TEMPERATURE

NOTES: 1. INTAKE PORT LEVEL 1 AT ELEVATION 1426 FT (434.34 M)
2. INTAKE PORT LEVEL 2 AT ELEVATION 1376 FT (419.10 M)
3. CONE VALVE AT ELEVATION 990 FT (301.75 M)
4. SPILLWAY CREST AT ELEVATION 1404 FT (427.94 M)

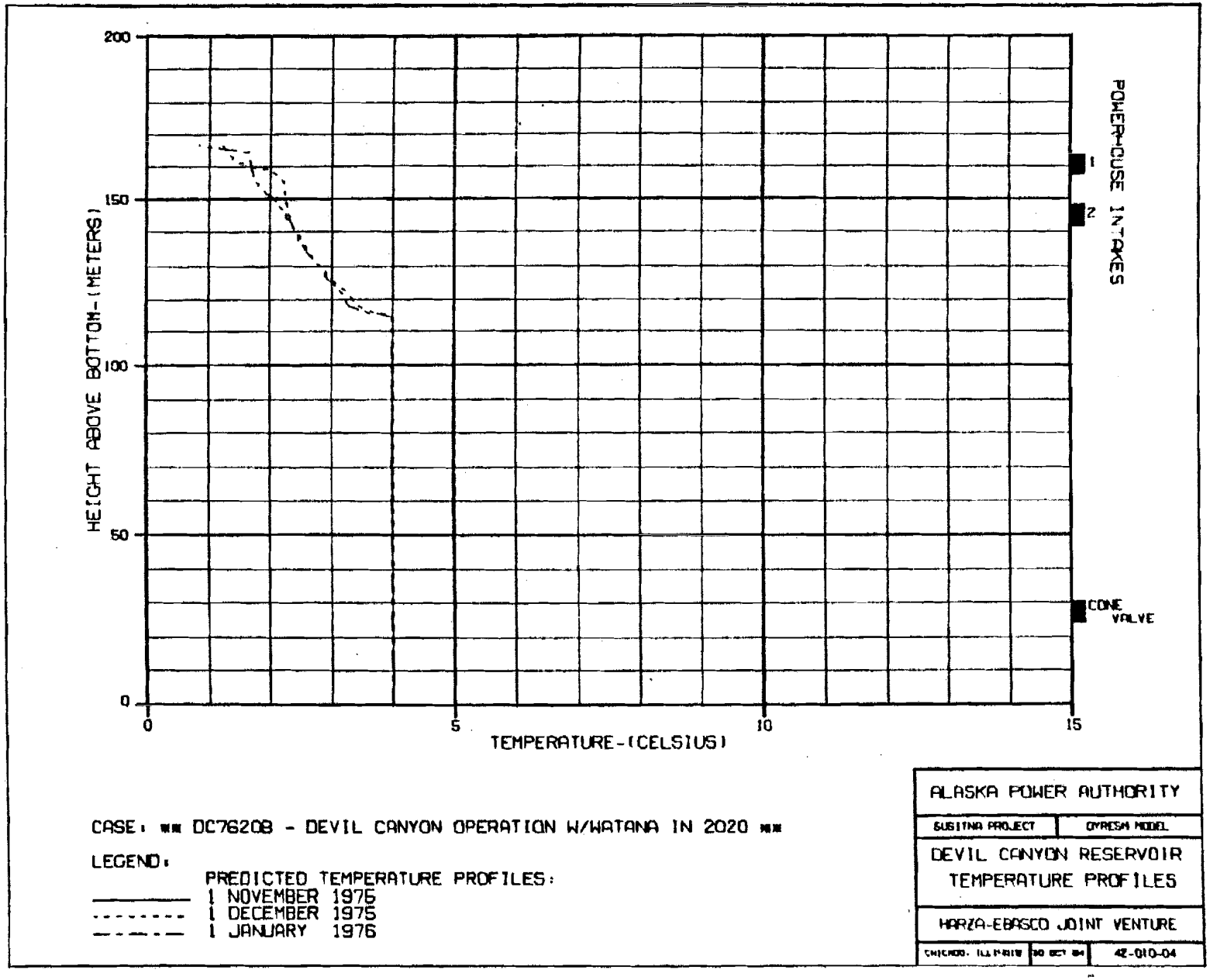
ALASKA POWER AUTHORITY

SUSITNA PROJECT	DYRESM MODEL

DEVIL CANYON RESERVOIR
OUTFLOW TEMPERATURE
AND ICE GROWTH

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS	30 OCT 84	42-010-04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150
100
50
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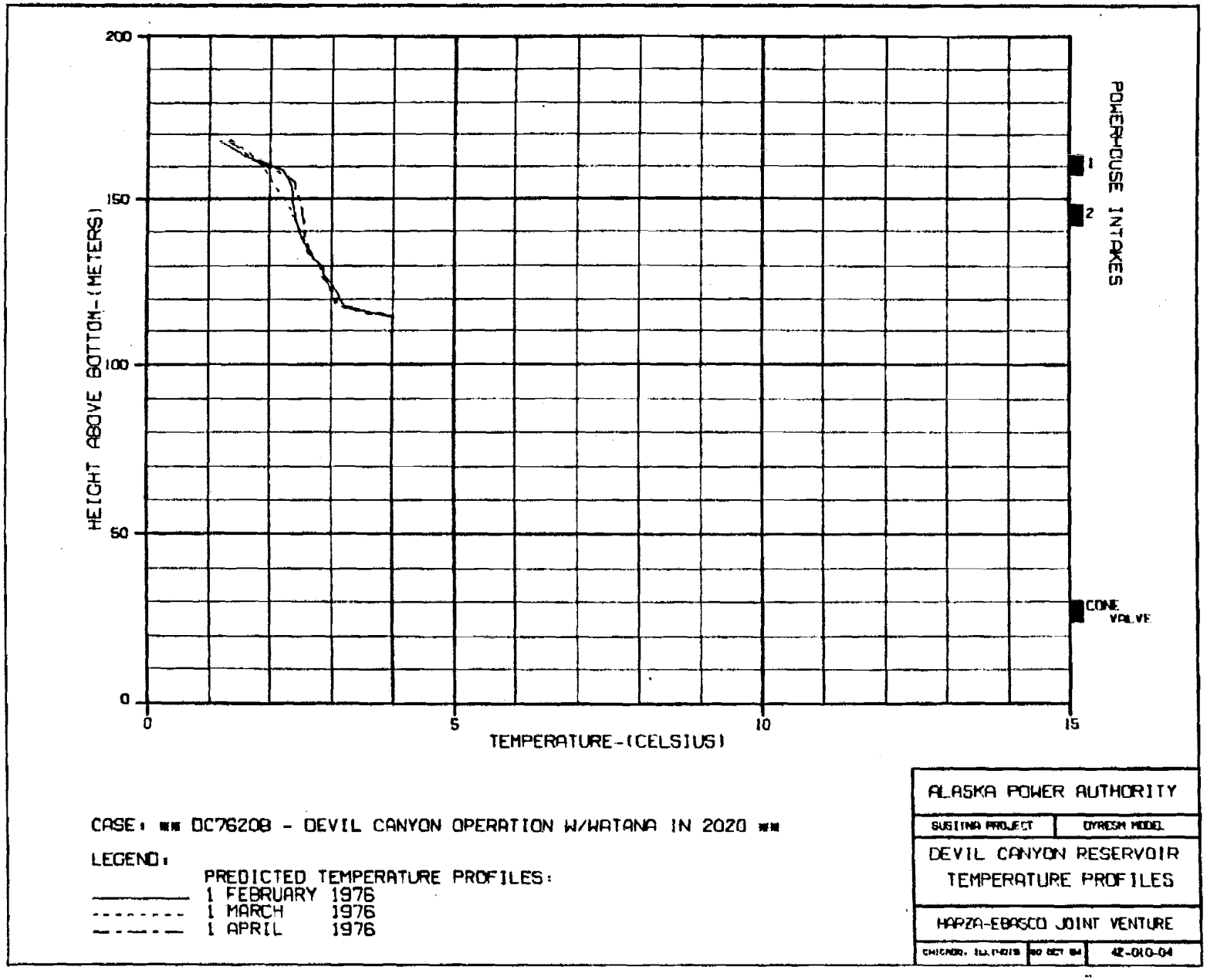
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC76208 - DEVIL CANYON OPERATION W/WATANA IN 2020 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1976
1 JANUARY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
CYRESA MODEL
DEVIL CANYON RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
DEC 84
42-010-04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50
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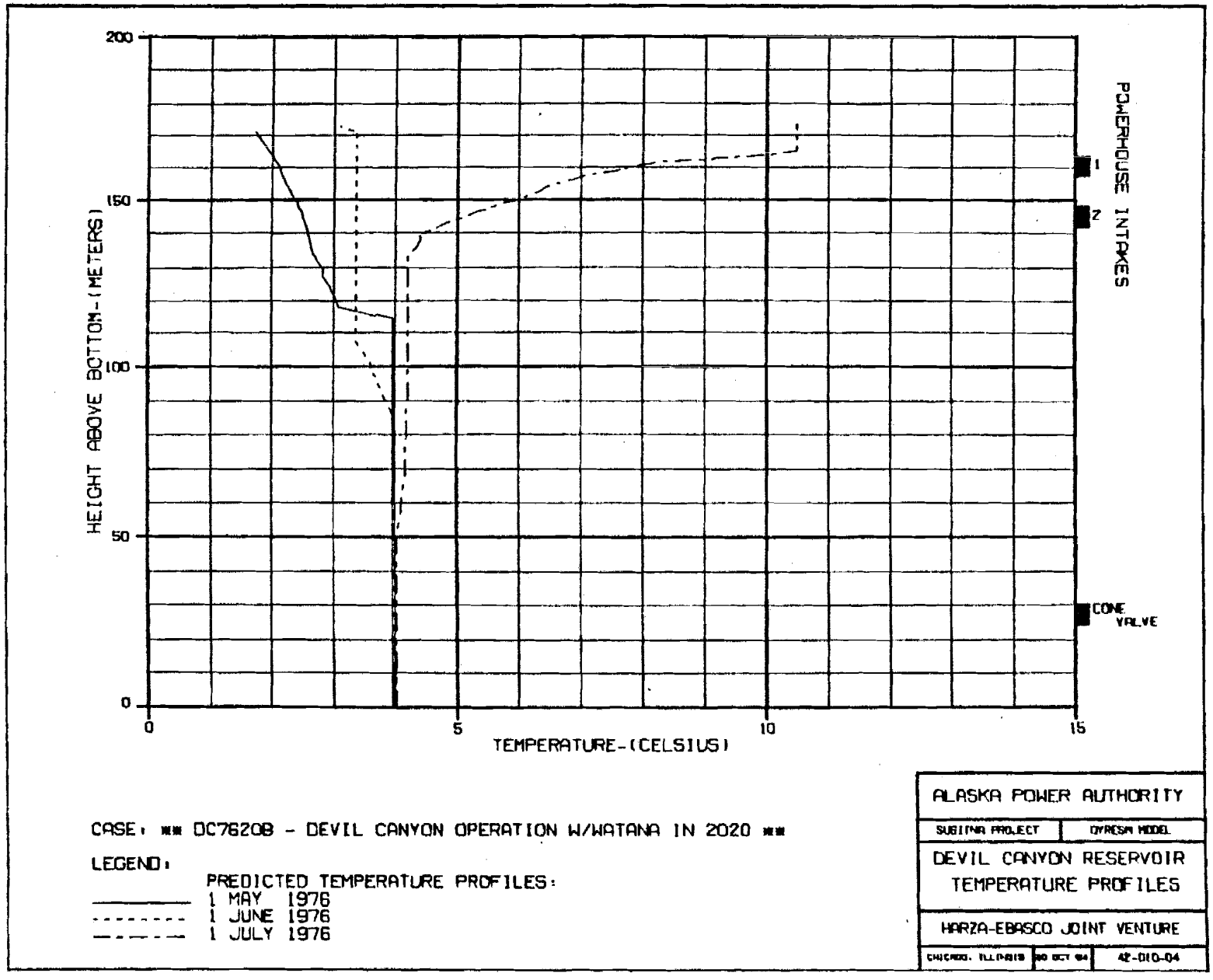
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC76208 - DEVIL CANYON OPERATION W/WATANA IN 2020 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1976
1 MARCH 1976
1 APRIL 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
DEVIL CANYON RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
OCT 84
42-010-04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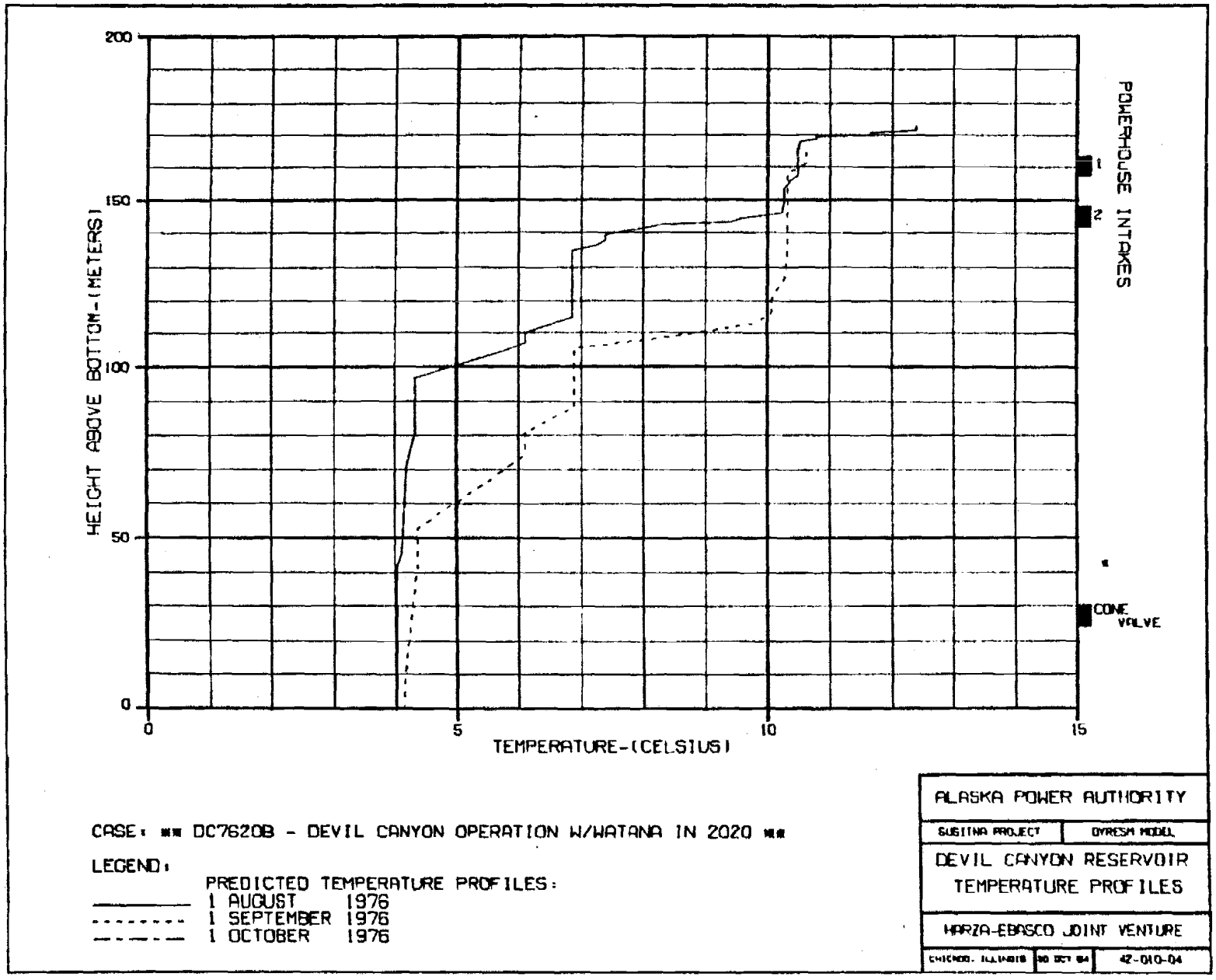
150
100
50
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC7620B - DEVIL CANYON OPERATION W/WATANA IN 2020 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 MAY 1976
1 JUNE 1976
1 JULY 1976
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
DEVIL CANYON RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
30 OCT 84
42-010-04



CASE: ** DC7620B - DEVIL CANYON OPERATION W/WATANA IN 2020 **

LEGEND:

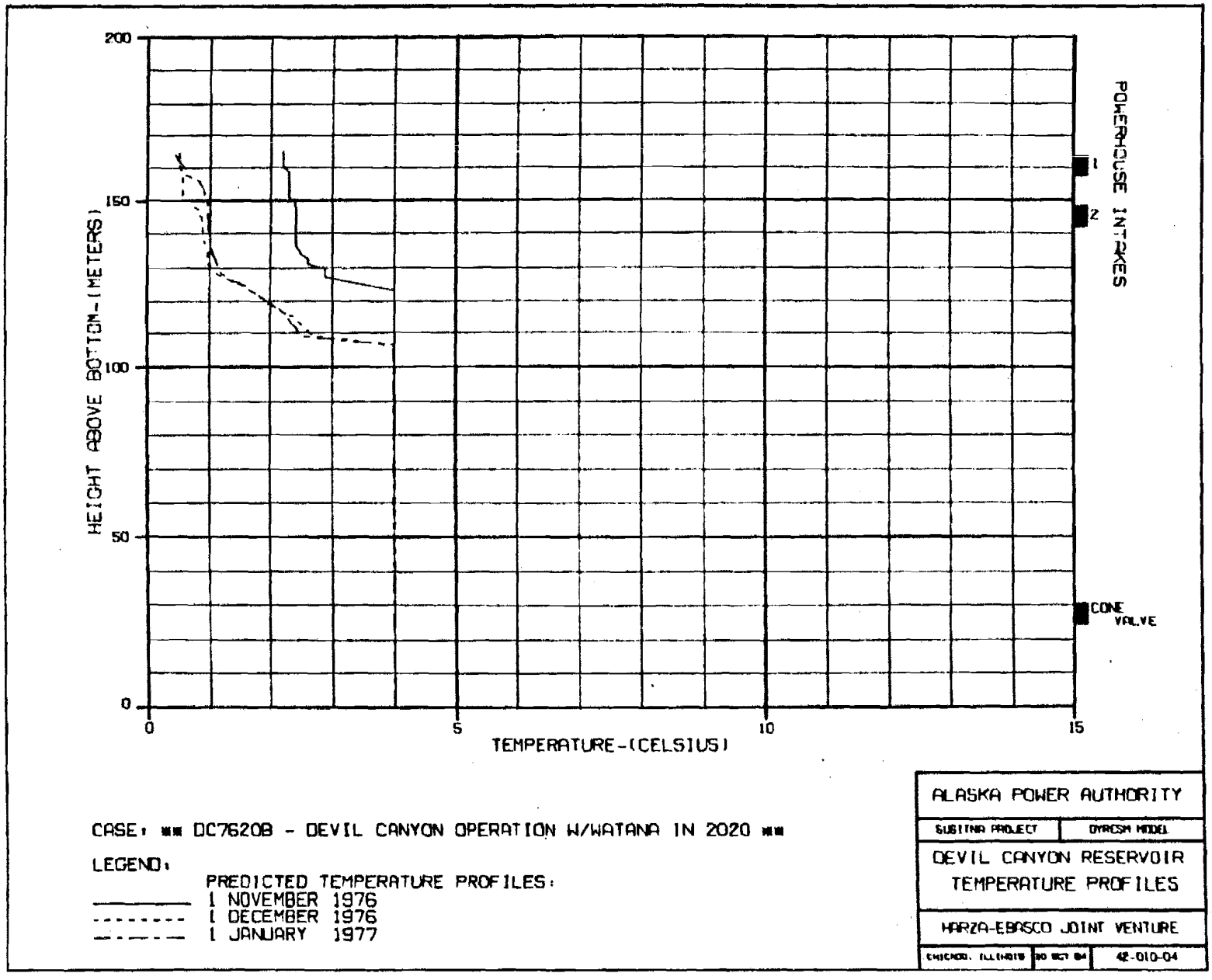
PREDICTED TEMPERATURE PROFILES:

———— 1 AUGUST 1976

- - - - - - - - 1 SEPTEMBER 1976

— — — — 1 OCTOBER 1976

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	DYRESM MODEL
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	30 OCT 84	42-010-04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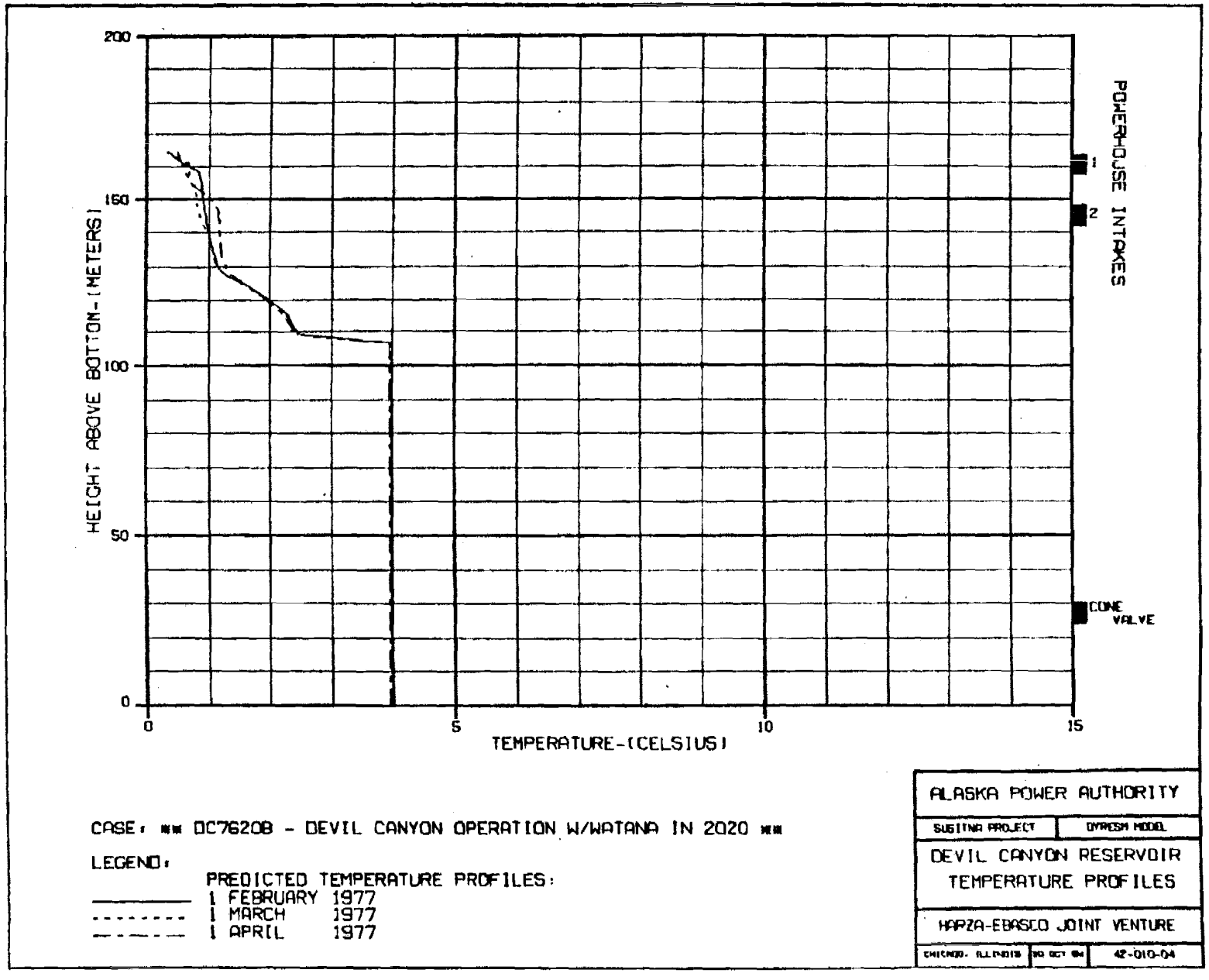
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: *** DC7620B - DEVIL CANYON OPERATION W/WATANA IN 2020 ***
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 NOVEMBER 1976
1 DECEMBER 1976
1 JANUARY 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
CYRESH MODEL
DEVIL CANYON RESERVOIR TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
42-010-04


200
150
100
50
0
HEIGHT ABOVE BOTTOM-(METERS)
0
5
10
15
TEMPERATURE-(CELSIUS)
POWERHOUSE INTAKES
1
2
CONE VALVE
CASE: ** DC76208 - DEVIL CANYON OPERATION W/WATANA IN 2020 **
LEGEND:
PREDICTED TEMPERATURE PROFILES:
1 FEBRUARY 1977
1 MARCH 1977
1 APRIL 1977
ALASKA POWER AUTHORITY
SUSITNA PROJECT
DYRESM MODEL
DEVIL CANYON RESERVOIR
TEMPERATURE PROFILES
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS
42-010-04

APPENDIX - I

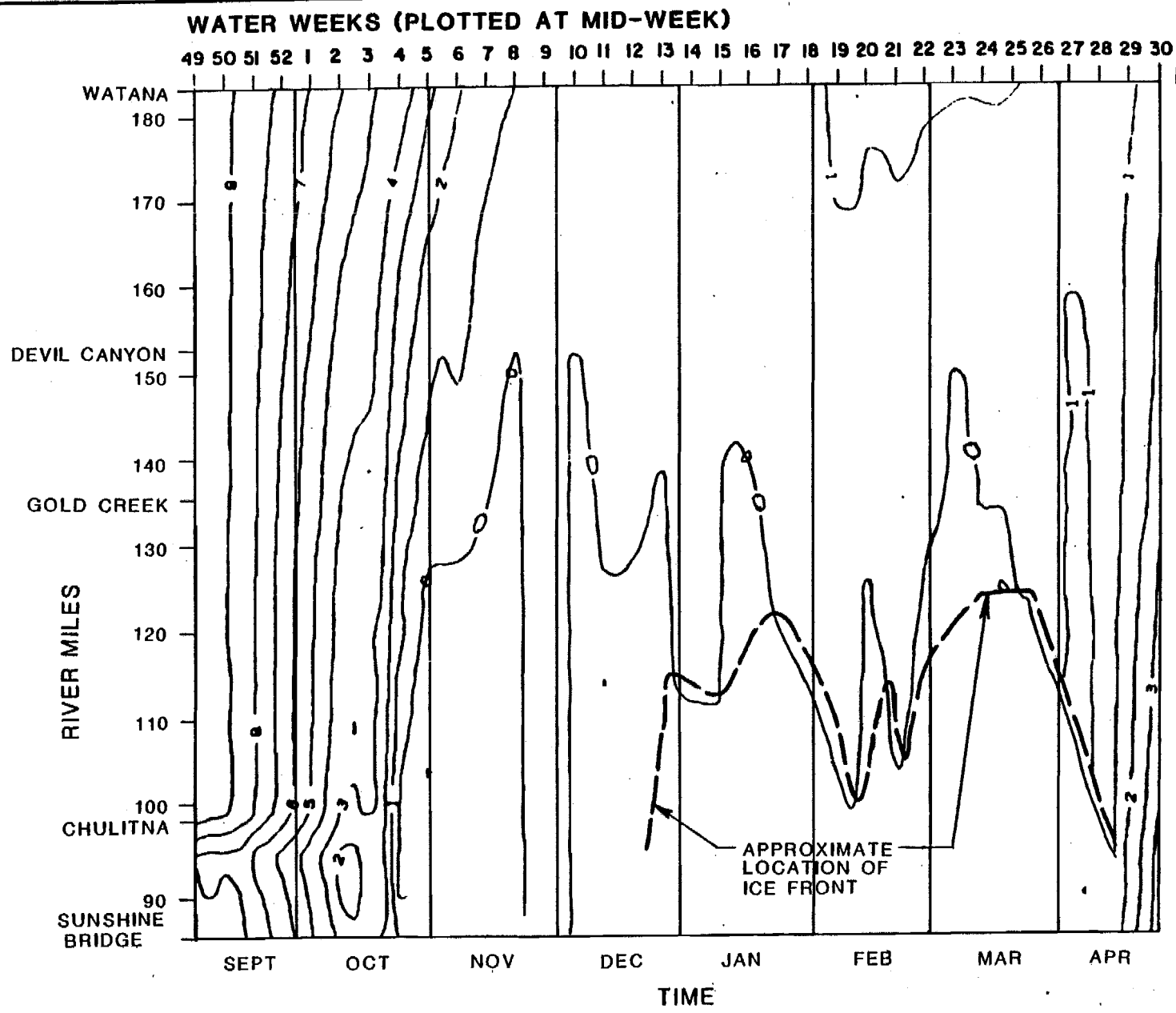
Refinement to Reservoir and River
Temperature and Ice Studies
For Simulation Period
October 1976 to May 1977

New Exhibits
Y, AH, AM

For

Alaska Power Authority Comments on the Federal Energy Regulatory Commission Draft Environmental Impact Statement of May 1984, Volume 7, Appendix V, Temperature Simulations, Susitna River, Watana Dam to Sunshine Stream Gaging Station, Open Water

EXHIBIT Y



NOTES :

1. TEMPERATURES IN °C.
2. APPROXIMATE LOCATION OF ICE FRONT FROM RIVER ICE SIMULATION PLOTS.

WATANA ONLY, 1996 ENERGY DEMAND

WINTER 1976-1977 CLIMATE DATA

CASE C FLOW REQUIREMENTS

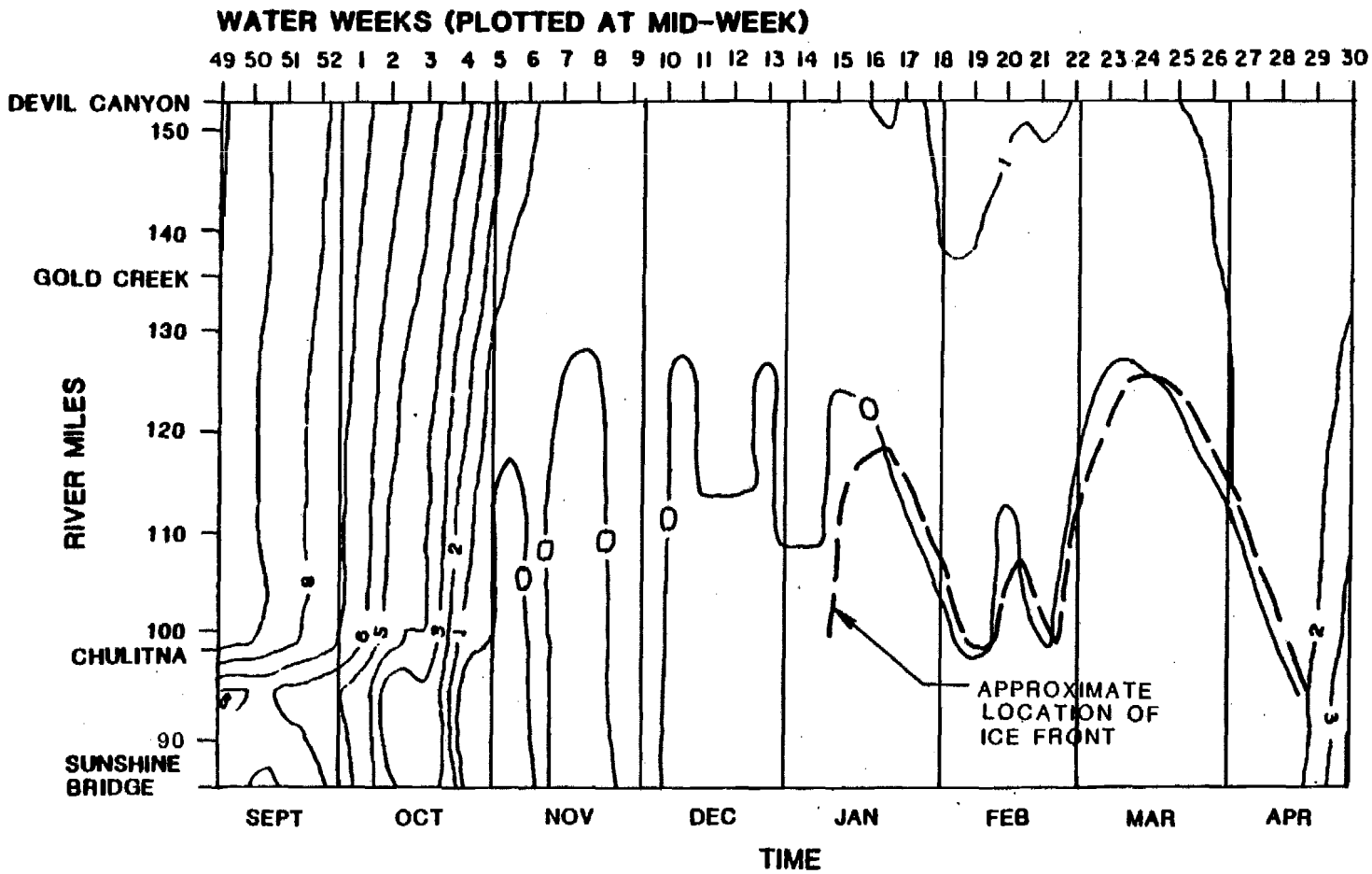
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

MIDDLE SUSITNA RIVER ISOTHERMS

ARCTIC ENVIRONMENTAL INFORMATION AND DATA CENTER

HARZA-EBASCO
SUSITNA JOINT VENTURE

EXHIBIT AH



NOTES :

1. TEMPERATURES IN °C.
2. APPROXIMATE LOCATION OF ICE FRONT FROM RIVER ICE SIMULATION PLOTS.

WATANA AND DEVIL CANYON OPERATING
2002 ENERGY DEMAND
WINTER 1976-1977 CLIMATE DATA
CASE C FLOW REQUIREMENTS

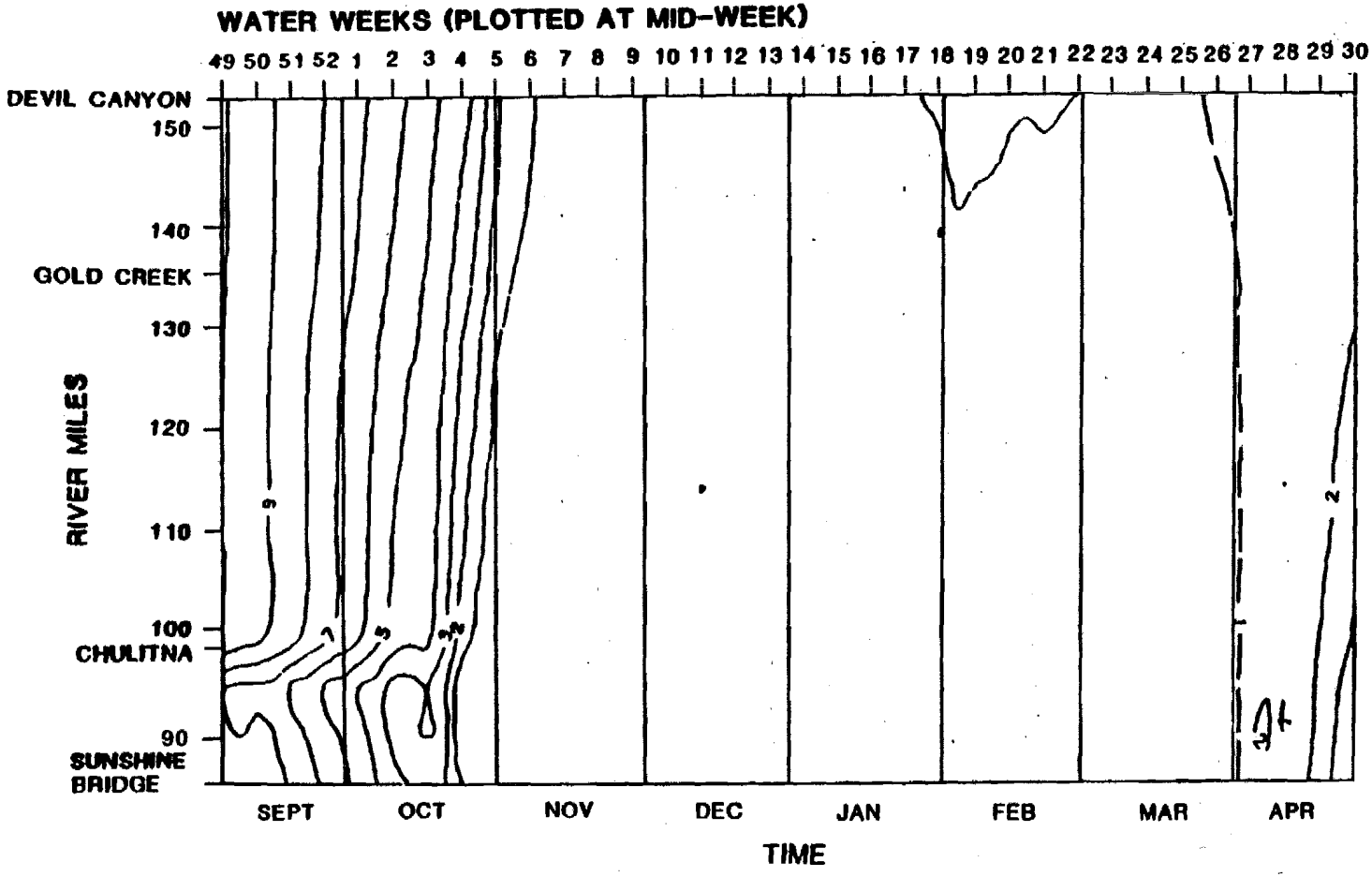
ALASKA POWER AUTHORITY
SUSITNA HYDROELECTRIC PROJECT

MIDDLE SUSITNA RIVER ISOTHERMS

ARCTIC ENVIRONMENTAL INFORMATION AND DATA CENTER

HARZA-EBASCO
SUSITNA JOINT VENTURE

EXHIBIT AM



NOTES :

1. TEMPERATURES IN °C.
2. ICE SIMULATION NOT MADE FOR THIS CASE. TEMPERATURES FROM NOVEMBER THROUGH APRIL SHOULD NOT BE USED.

WATANA AND DEVIL CANYON OPERATING
2020 ENERGY DEMAND
WINTER 1976-1977 CLIMATE DATA
CASE C FLOW REQUIREMENTS

ALASKA POWER AUTHORITY **SUSITNA HYDROELECTRIC PROJECT**	
MIDDLE SUSITNA RIVER ISOTHERMS	
ARCTIC ENVIRONMENTAL INFORMATION AND DATA CENTER	HARZA-EBASCO SUSITNA JOINT VENTURE

APPENDIX - I

Refinement to Reservoir and River
Temperature and Ice Studies
For Simulation Period
October 1976 to May 1977

Text Changes and
New Exhibits
I and O

For

Alaska Power Authority Comments on the Federal Energy Regulatory Commission Draft Environmental Impact Statement of May 1984, Volume 8, Appendix VI, River Ice Simulations, Susitna River, Watana Dam to Confluence of Susitna and Chulitna Rivers

SUSITNA HYDROELECTRIC PROJECT

ALASKA POWER AUTHORITY COMMENTS

ON THE

F.E.R.C. DRAFT ENVIRONMENTAL IMPACT STATEMENT

APPENDIX VI

RIVER ICE SIMULATIONS

ERRATA

TEXT

a) Table of Contents:

1.2.1	Replace	"Average" with "Warm"
1.2.2	Replace	"Average" with "Very Warm"
1.2.3	Replace	"Cold" with "Average"
4.2	Replace	"Average" with "Warm"
4.3	Replace	"Average" with "Warm"
4.4	Replace	"Cold" with "Average and Cold"
4.5	Replace	"Cold" with "Average and Cold"

b) Section 1.2, second paragraph, beginning with second sentence, should read, "The winters of 1976-77 and 1982-83 generally gave the lowest water levels and shortest ice cover. The 1981-82 winter resulted in somewhat more ice and higher water levels than the 1976-77 and 1982-83 winters. The winter of 1971-72 resulted in the greatest ice accumulation and furthest progression of the ice front. In the simulations discussed herein, the winter of 1981-82 represents an average winter, 1971-72 represents a cold winter, 1982-83 represents a warm winter and 1976-77 represents a very warm winter. Simulations have also been made for natural conditions for the winters of 1971-72, 1976-77, 1981-82 and 1982-83."

c) Section 1.2.1, title, replace "Average" with "Warm"

d) Section 1.2.2, title, replace "Average" with "Very Warm"

e) Section 1.2.2 first paragraph, eighth line, replace "127" with "124"

f) Section 1.2.3, title, replace "Cold" with "Average"

g) Chapter 3.0, eighth pagraph, twelfth line, replace "Cold" with "Colder"

h) Section 4.2, title, replace "Average" with "Warm"

i) Section 4.2, first paragraph, second line, replace "127" for "126"

j) Section 4.2, second paragraph, second line, replace "137" with "126," delete "upstream of the Gold Creek Bridge"

k) Section 4.2, second paragraph, fourth line, replace "4 to 6" with "2 to 5"

l) Section 4.2, second paragraph, sixth line, replace "approximately four feet higher than" with "equivalent to that"

m) Section 4.2, third paragraph, first line, replace "average" with "warm"

n) Section 4.2, third paragraph, third line, replace "137" with "126"

o) Section 4.3, title and first line, replace "average" with "warm"

p) Section 4.3, first paragraph, third line, replace "122" with "123"

q) Section 4.3, first paragraph, fourth line, replace "two to five" with "one to three"

r) Section 4.3, third paragraph should read, "Based on a simulation of 1976-77 winter conditions, the ice cover would reach approximately river mile 124. Maximum water levels attained would be 1 to 6 feet lower than with Watana only operation. Maximum water levels would be 0 to 1 foot lower than simulated natural conditions at the Slough 8A berms and 2 feet lower than natural conditions at the Slough 9 berm. The berms of Sloughs 8A and 9 would not be overtoped with the 2002

energy demand and would probably not be overtopped with the 2020 energy demand"

s) Sections 4.4 and 4.5, titles, replace "Cold" with "Average and Cold"

t) Section 4.4, thrid paragraph, first sentence, should read, "For the average and cold winters simulated, the leading edge of the ice progressed to river miles 137 and 142, respectively"

u) Section 4.5, first paragraph, first line, should read "The winters of 1981-82 and 1971-72, respectively, were used for simulating average and cold winter conditions..."

v) Section 4.5, first paragraph, fourth and seventh lines, replace "cold" with "average"

w) Section 4.5, first paragraph, fifth, seventh, eighth and tenth lines, replace "average" with "warm"

x) Section 4.5, first paragraph, ninth line, replace "126" with "124." Replace "4 miles" with "1 mile"

y) Section 4.5, second paragraph, first, fourth, seventh and ninth lines, replace "cold" with "average"

z) Section 4.5, second paragraph, third line, replace "5 to 9" with "3 to 7"

aa) Section 4.5, second paragraph, fifth line, replace "10" with "13"

bb) Section 4.5, second paragraph, ninth line, replace "average" with "warm"

cc) Section 4.5, third paragraph, fourteenth line, replace "an average" with "a warm"

dd) Section 4.5, third paragraph, sixteenth line, replace "117" with "120"

ee) Section 4.6, first paragraph, second line, replace " average and cold winter" with "warm and average winter"

ff) Section 4.6, second paragraph, sub heading one, replace "average" with "warm"

gg) Section 4.6, second paragraph, sub heading two, replace "cold" with "average"

hh) Section 4.6, third paragraph, third line, replace "average" with "warm."

TABLES

Replace Tables 1, 3, 4, 5, 10, 12 and 15 with the corresponding new tables attached.

EXHIBITS

Replace Exhibits I and O with the corresponding new exhibits attached.

Additionally, ice bridge formation at river mile 9 may be dependent on tides and the occurrence of extremely cold weather, factors which are not influenced by the project. Ice front progression past the Yentna River may be delayed somewhat with project, but in order to provide conservatism in the study, November 1 was accepted as the starting date for computations of filling the Lower Reach with ice.

Table 1 describes the ice simulations provided in this Appendix.

TABLE 1
RIVER ICE SIMULATIONS

Estimated Energy Demand for	Watana Operation		Watana/Devil Canyon Operations		Watana Filling	
	1996	2001	2002	2020	First Winter	Second Winter
Simulated Period						
Nov. '82-May '83 Avg. Year Warm Winter Temps	+	+	+	+	+	
Nov. '71-May '72 Wet Year Cold Winter Temps.	+	+	+	+		
Nov. '76-May '77 Dry Year Very Warm Winter Temps.	+		+			
Nov. '81-May '82 Wet Year Avg. Winter Temps.	+		+			+

TABLE 3

MAXIMUM ICE-AFFECTED WATER LEVELS FOR WINTER OF 1982-1983

Location	River Mile	Threshold Elev.1/	Simulated Natural Conditions	Energy Demand for Watana only		Devil Canyon	
				1996	2001	2002	2020
Whiskers slough head	101.5	367	366	370	370	369	370
Side channel at head of Gash Creek	112.0		456	459	461	457	457
Mouth of Slough 6A	112.34		459	462	463	460	459
Slough 8 head	114.1	476	474	476	478	475	475
Side channel MS II	115.5	482	484	488	489	487	488
Side channel MS II	115.9	487	486	491	492	490	491
River Mile 120	120.0		520	525	521	520	523
Moose slough head	123.5		548	550	550	545	550
Slough 8A head (west)	126.1	573	570	572	568	568	573
Slough 8A head (east)	127.1	582	582	582	582	581	583
Slougn 9 head	129.3	604	605	603	603	602	603
Side channel upstream of slough 9	130.6		621	617	617	616	617
Side channel upstream of 4th July Creek	131.8		630	628	628	627	628
Slough 9A head	133.7	651	651	650	650	650	650
Side channel upstream of slough 10	134.3	657	658	656	656	655	656
Side channel downstream of Slough 11	135.3		672	668	668	667	668
Slough 11 head	136.5	687	684	683	683	682	684
Slough 17 head	139.3		-	715	715	714	715
Slough 20 head	140.5	730	-	729	729	728	729
Slough 21 downstream end	141.8	747	-	746	746	746	747
Slough 21 head	142.2	755	-	753	753	752	753
Slough 22 head	144.8	788	-	786	786	785	787
Maximum upstream Extent of Ice Cover in Winter (river mile)			>137	126	124	123	126

TABLE 4

MAXIMUM ICE-AFFECTED WATER LEVELS FOR WINTER OF 1976-1977

Location	River Mile	Threshold Elev.[1]	Simulated Natural Conditions	Energy Demand for Watana only		Energy Demand for Devil Canyon	
				1996	2001[2]	2002	2020[3]
Whiskers Slough head	101.5	367	366	370		368	
Side channel at head of Gash Creek	112.0		454	457		456	
Mouth of Slough 6A	112.34		457	460		459	
Slough 8 head	114.1	476	472	475		474	
Side channel MS II	115.5	482	480	486		486	
Side channel MS II	115.9	487	483	489		489	
River Mile 120	120.0		520	525		520	
Moose slough head	123.5		546	552		547	
Slough 8A head (west)	126.1	573	569	574		568	
Slough 8A head (east)	127.1	582	581	583		581	
Slough 9 head	129.3	604	603	603		601	
Side channel upstream of slough 9	130.6		616	617		616	
Side channel upstream of 4th July Creek	131.8		626	628		627	
Slough 9A head	133.7	651	649	650		650	
Side channel upstream of slough 10	134.3	657	655	656		655	
Side channel downstream of Slough 11	135.3		668	667		667	
Slough 11 head	136.5	687	681	684		682	
Slough 17 head	139.3		-	715		714	
Slough 20 head	140.5	730	-	729		728	
Slough 21 downstream end	141.8	747	-	746		746	
Slough 21 head	142.2	755	-	753		752	
Slough 22 head	144.8	788	-	787		785	
Maximum upstream Extent of Ice Cover in Winter (river mile)			>137	126		124	

TABLE 5

MAXIMUM ICE-AFFECTED WATER LEVELS FOR WINTER OF 1981-1982

Location	River Mile	Threshold Elev.[1]	Simulated Natural Conditions	Energy Demand for Watana only		Devil Canyon	
				1996	2001[2]	2002	2020[3]
Whiskers slough head	101.5	367	368	371		369	
Side channel at head of Gash Creek	112.0		455	460		456	
Mouth of Slough 6A	112.34		457	462		458	
Slough 8 head	114.1	476	472	477		475	
Side channel MS II	115.5	482	484	488		485	
Side channel MS II	115.9	487	486	491		488	
River Mile 120	120.0		523	527		520	
Moose slough head	123.5		549	555		548	
Slough 8A head (west)	126.1	573	571	574		568	
Slough 8A head (east)	127.1	582	583	585		581	
Slough 9 head	129.3	604	606	607		601	
Side channel upstream of slough 9	130.6		620	620		616	
Side channel upstream of 4th July Creek	131.8		629	631		627	
Slough 9A head	133.7	651	651	653		650	
Side channel upstream of slough 10	134.3	657	657	659		655	
Side channel downstream of Slough 11	135.3		670	670		667	
Slough 11 head	136.5	687	683	687		682	
Slough 17 head	139.3		-	715		714	
Slough 20 head	140.5	730	-	729		728	
Slough 21 downstream end	141.8	747	-	746		745	
Slough 21 head	142.2	755	-	753		752	
Slough 22 head	144.8	788	-	787		785	
Maximum upstream Extent of Ice Cover in Winter (river mile)			>137	137		124	

TABLE 10

MAXIMUM ICE-AFFECTED WATER LEVELS FOR 1996 ENERGY DEMANDS-WATANA OPERATING

Location	River Mile	Threshold Elev.1/	Winter Weather Data Used			
			1971-1972	1976-1977	1981-1982	1982-1983
Whiskers slough head	101.5	367	372	370	371	370
Side channel at head of Gash Creek	112.0		459	457	460	459
Mouth of Slough 6A	112.34		462	460	462	462
Slough 8 head	114.1	476	478	475	477	476
Side channel MS II	115.5	482	490	486	488	488
Side channel MS II	115.9	487	492	489	491	491
River Mile 120	120.0		526	525	527	525
Moose slough head	123.5		556	552	555	550
Slough 8A head (west)	126.1	573	576	574	574	572
Slough 8A head (east)	127.1	582	587	583	585	582
Slough 9 head	129.3	604	609	603	607	603
Side channel upstream of slough 9	130.6		624	617	620	617
Side channel upstream of 4th July Creek	131.8		635	628	631	628
Slough 9A head	133.7	651	657	650	653	650
Side channel upstream of slough 10	134.3	657	663	656	659	656
Side channel downstream of Slough 11	135.3		675	667	670	668
Slough 11 head	136.5	687	688	684	687	683
Slough 17 head	139.3		717	715	715	715
Slough 20 head	140.5	730	732	729	729	729
Slough 21 downstream end	141.8	747	746	746	746	746
Slough 21 head	142.2	755	753	753	753	753
Slough 22 head	144.8	788	787	787	787	786
Maximum upstream Extent of Ice Cover in Winter (river mile)			141	126	137	126

TABLE 12

MAXIMUM ICE-AFFECTED WATER LEVELS FOR 2002 ENERGY DEMANDS

WATANA AND DEVIL CANYON OPERATING

LOCATION	River Mile	Threshold Elev.1/	Winter Weather Data Used			
			1971-1972	1976-1977	1981-1982	1982-1983
Whiskers slough head	101.5	367	371	368	369	369
Side channel at head of Gash Creek	112.0		458	456	456	457
Mouth of Slough 6A	112.34		460	459	458	460
Slough 8 head	114.1	476	475	474	475	475
Side channel MS II	115.5	482	487	486	485	487
Side channel MS II	115.9	487	489	489	488	490
River Mile 120	120.0		522	520	520	520
Moose slough head	123.5		553	547	548	545
Slough 8A head (west)	126.1	573	574	568	568	568
Slough 8A head (east)	127.1	582	585	581	581	581
Slough 9 head	129.3	604	606	601	601	602
Side channel upstream of slough 9	130.6		620	616	616	616
Side channel upstream of 4th July Creek	131.8		633	627	627	627
Slough 9A head	133.7	651	652	650	650	650
Side channel upstream of slough 10	134.3	657	659	655	655	655
Side channel downstream of Slough 11	135.3		670	667	667	667
Slough 11 head	136.5	687	685	682	682	682
Slough 17 head	139.3		714	714	714	714
Slough 20 head	140.5	730	728	728	728	728
Slough 21 downstream end	141.8	747	746	746	745	746
Slough 21 head	142.2	755	752	752	752	752
Slough 22 head	144.8	788	785	785	785	785
Maximum upstream Extent of Ice Cover in Winter (river mile)			137	124	124	123

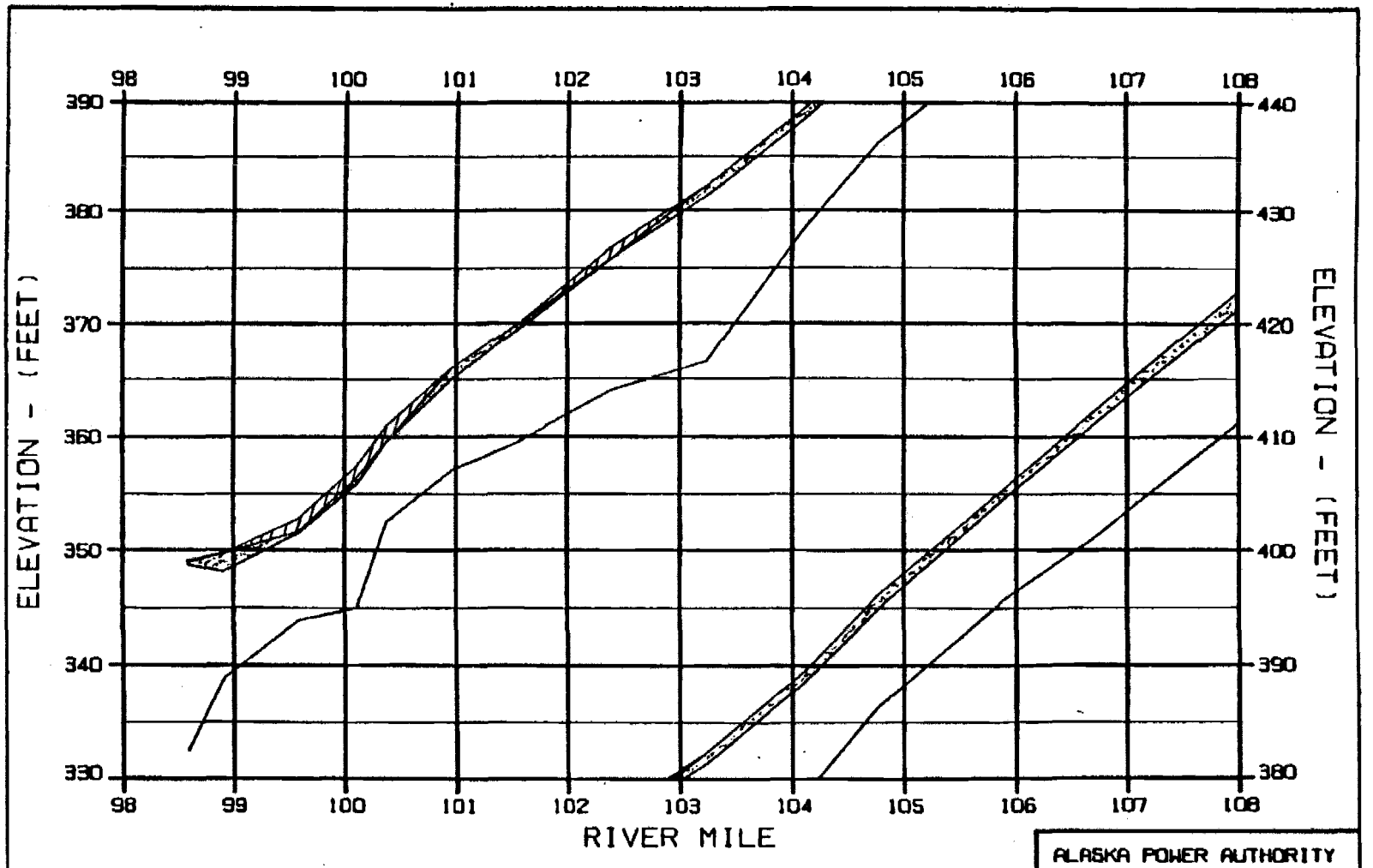
TABLE 15

RIVER ICE SIMULATIONS INCLUDED IN EXHIBITS

Exhibit	Project Status	Energy Demand Year	Meteorologic Hydrologic Data Year	Description Winter Temps	Description Summer Flows
B	Natural Conditions		1971-1972	Cold	Wet
C	Natural Conditions		1976-1977	Very Warm	Dry
D	Natural Conditions		1981-1982	Average	Wet
E	Natural Conditions	--	1982-1983	Warm	Average
F	Watana filling	first winter	1982-1983	Warm	Average
G	Watana filling	second winter	1981-1982	Average	Wet
H	Watana operating	1996	1971-1972	Cold	Wet
I	Watana operating	1996	1976-1977	Very Warm	Dry
J	Watana operating	1996	1981-1982	Average	Wet
K	Watana operating	1996	1982-1983	Warm	Average
L	Watana operating	2001	1971-1972	Cold	Wet
M	Watana operating	2001	1982-1983	Warm	Average
N	Watana & Devil Canyon operating	2002	1971-1972	Cold	Wet
O	Watana & Devil Canyon operating	2002	1976-1977	Very Warm	Dry
P	Watana & Devil Canyon operating	2002	1981-1982	Average	Wet
Q	Watana & Devil Canyon operating	2002	1982-1983	Warm	Average
R	Watana & Devil Canyon operating	2020	1971-1972	Cold	Wet
S	Watana & Devil Canyon operating	2020	1982-1983	Warm	Average

EXHIBIT I

C



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
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNB

OPTION?

ALASKA POWER AUTHORITY

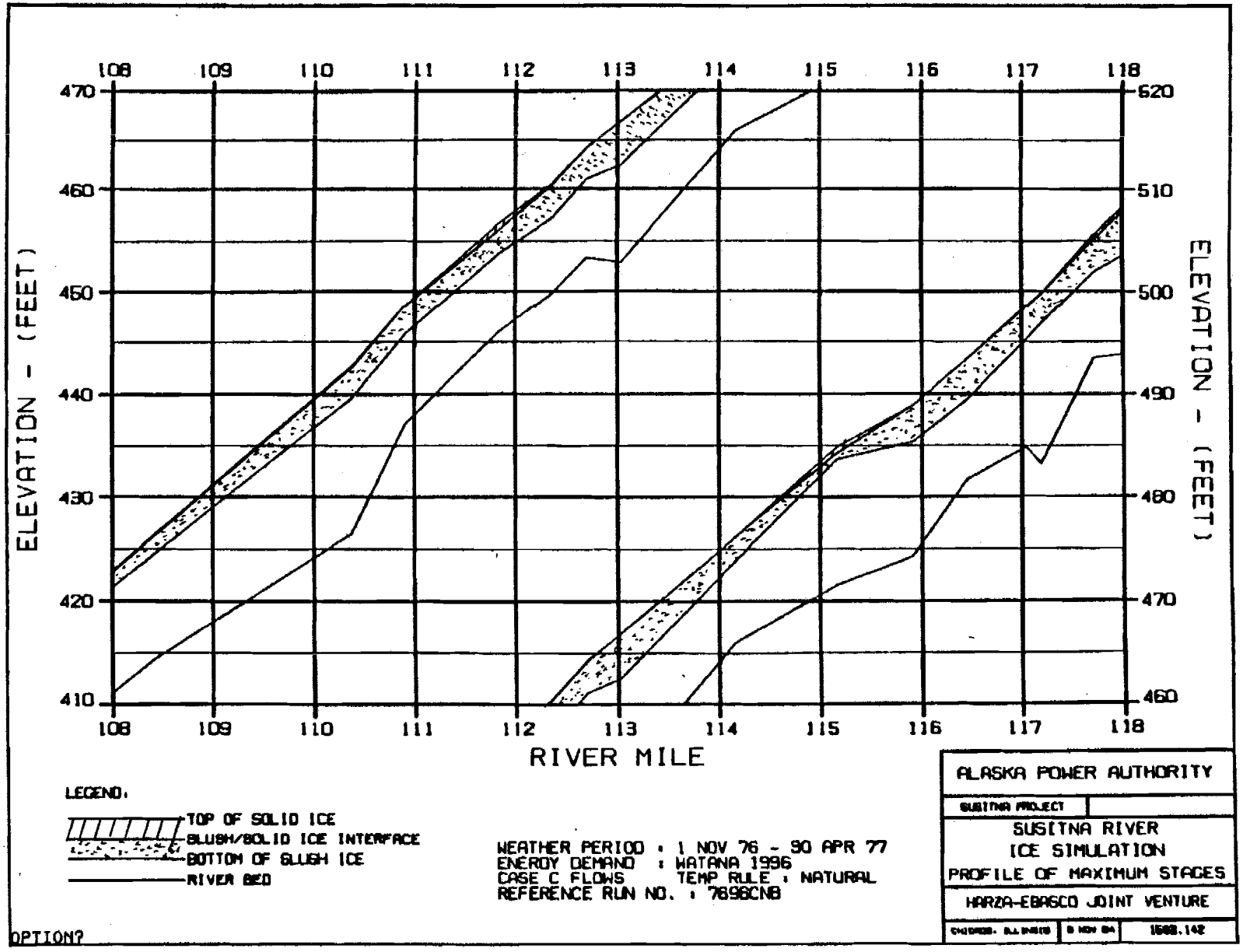
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 9 NOV 84 | 1988.142

C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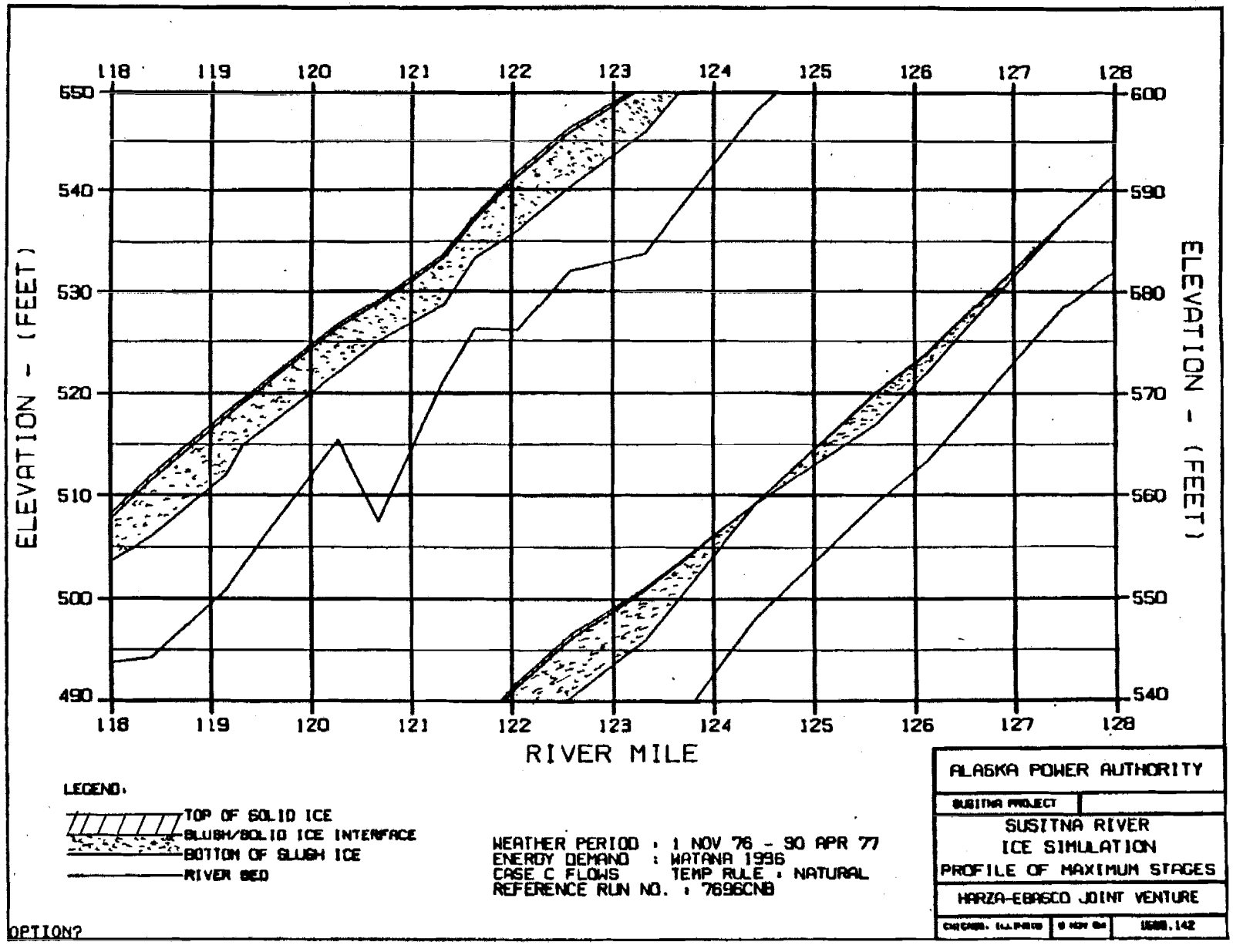
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1588.142

OPTION?

C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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
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1588.142

OPTION?

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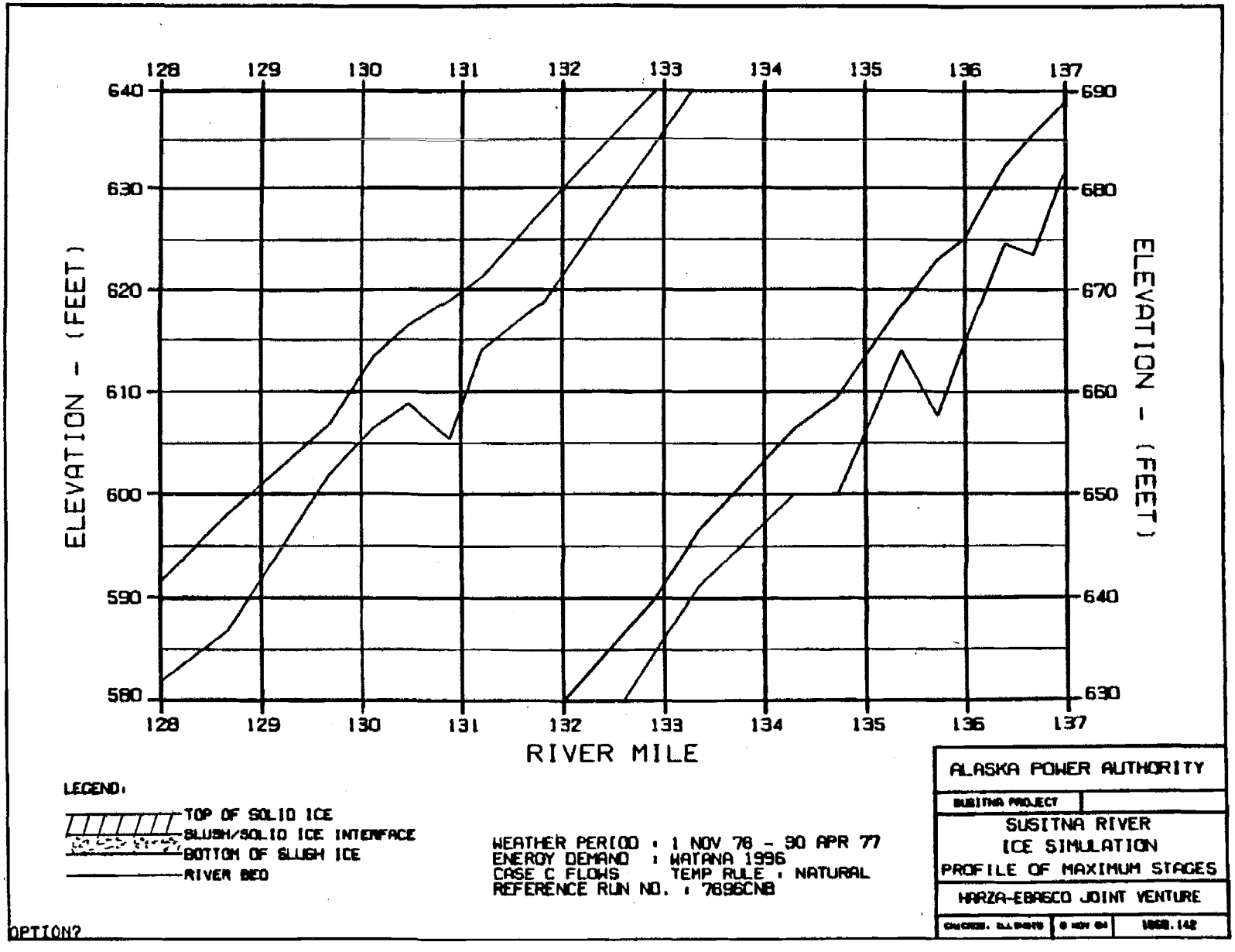
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ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE

OPTION?

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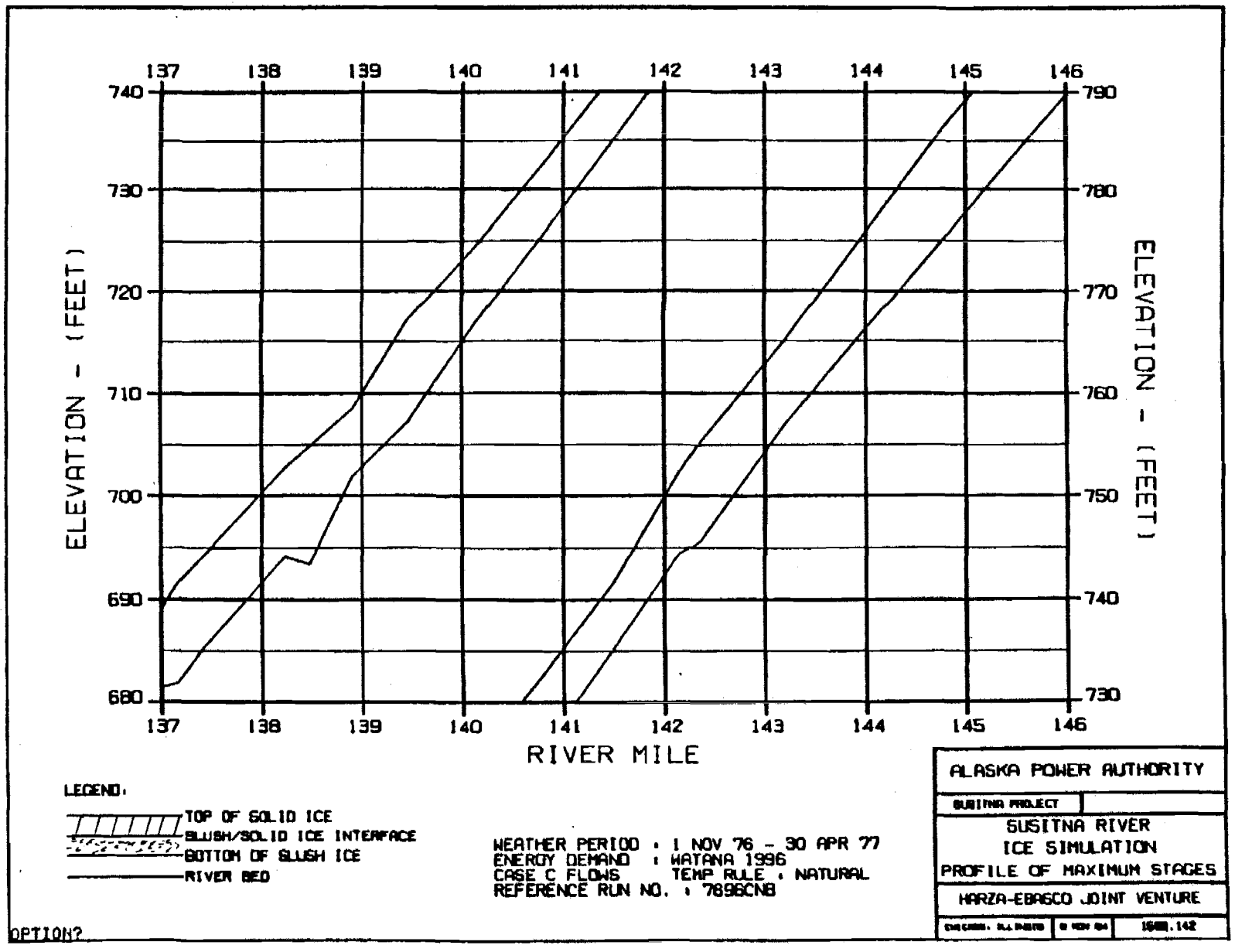
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ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. :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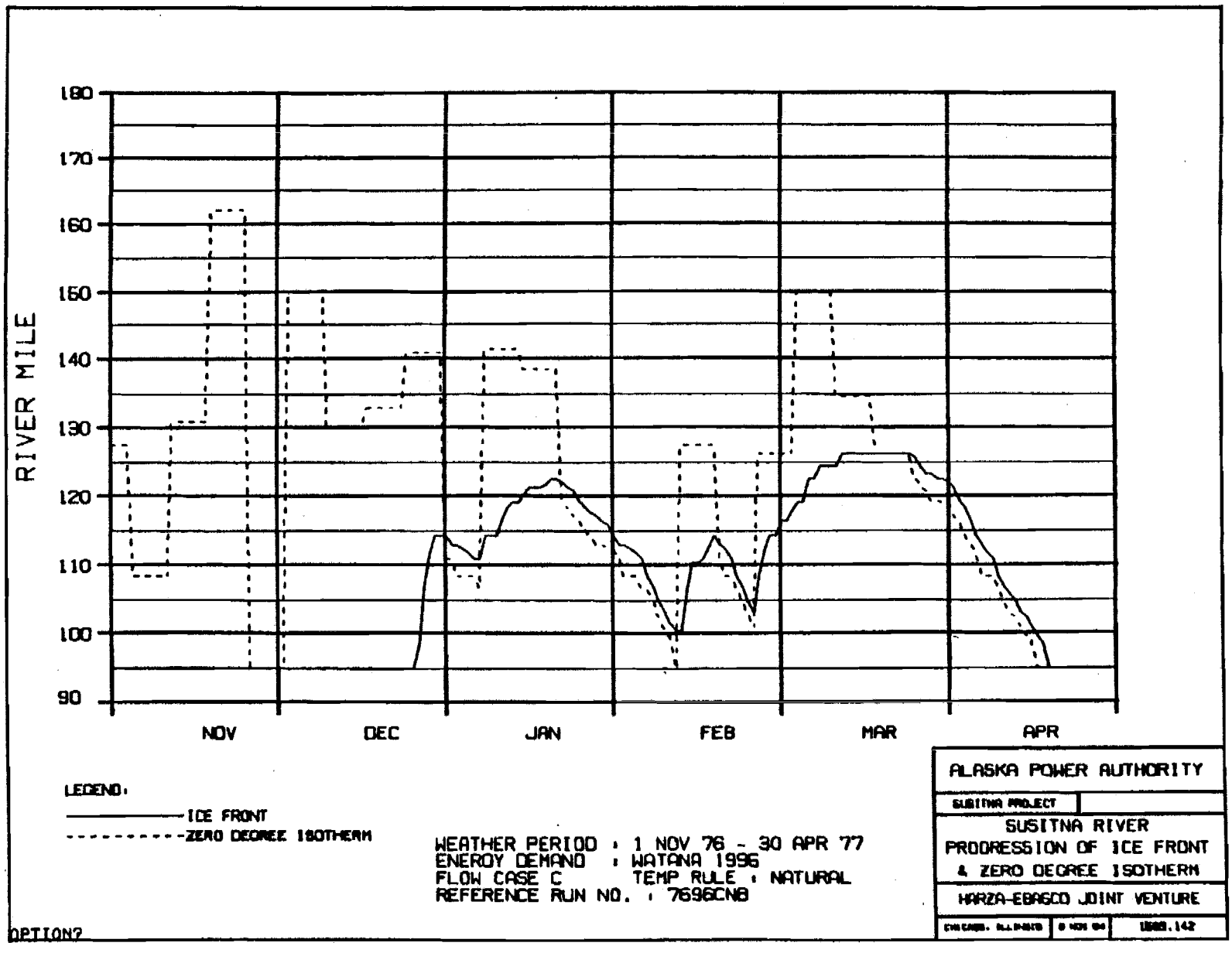
OPTION?


RIVER MILE
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JAN
FEB
MAR
APR
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. : 7696CN8
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
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& ZERO DEGREE ISOTHERM
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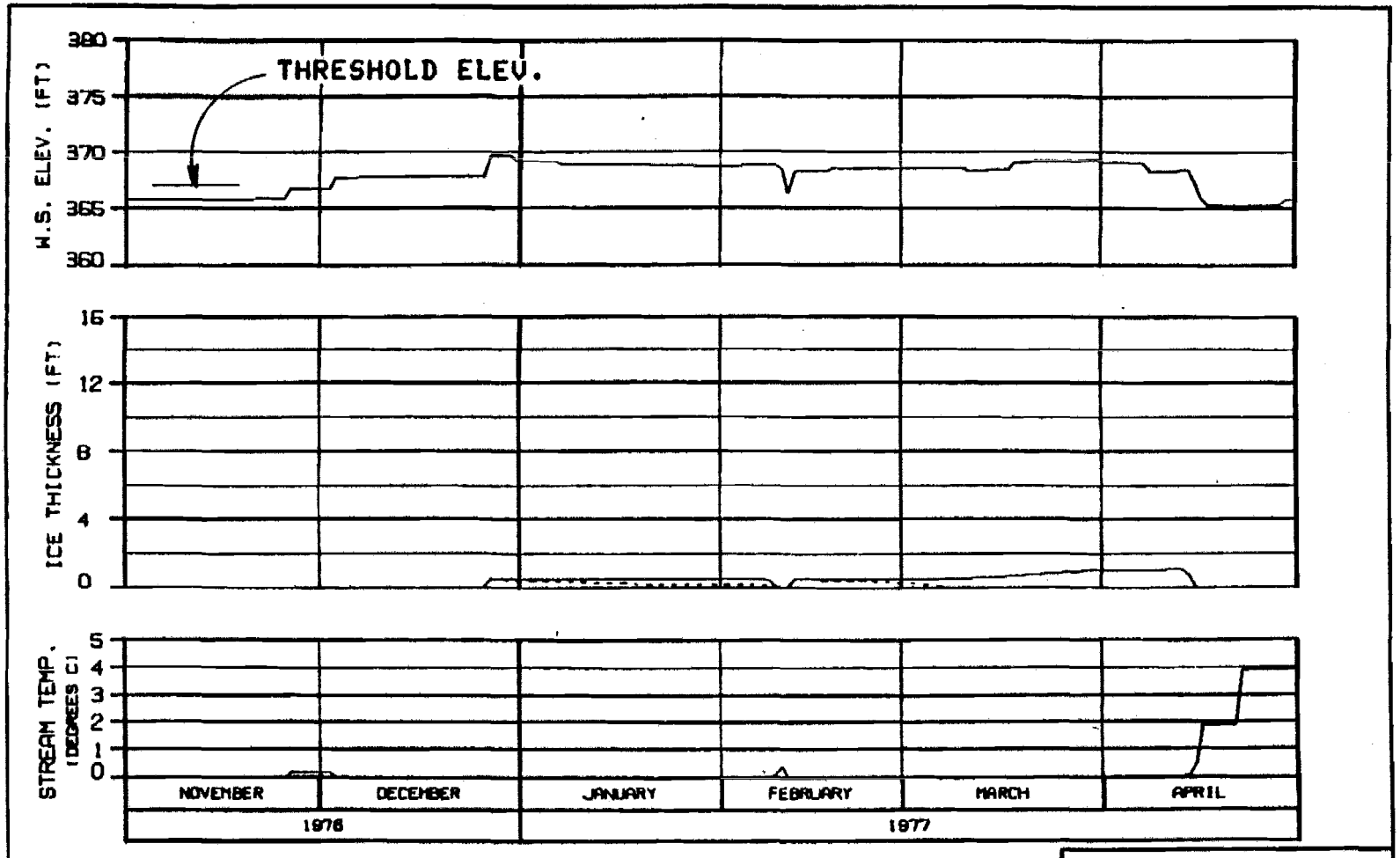


HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

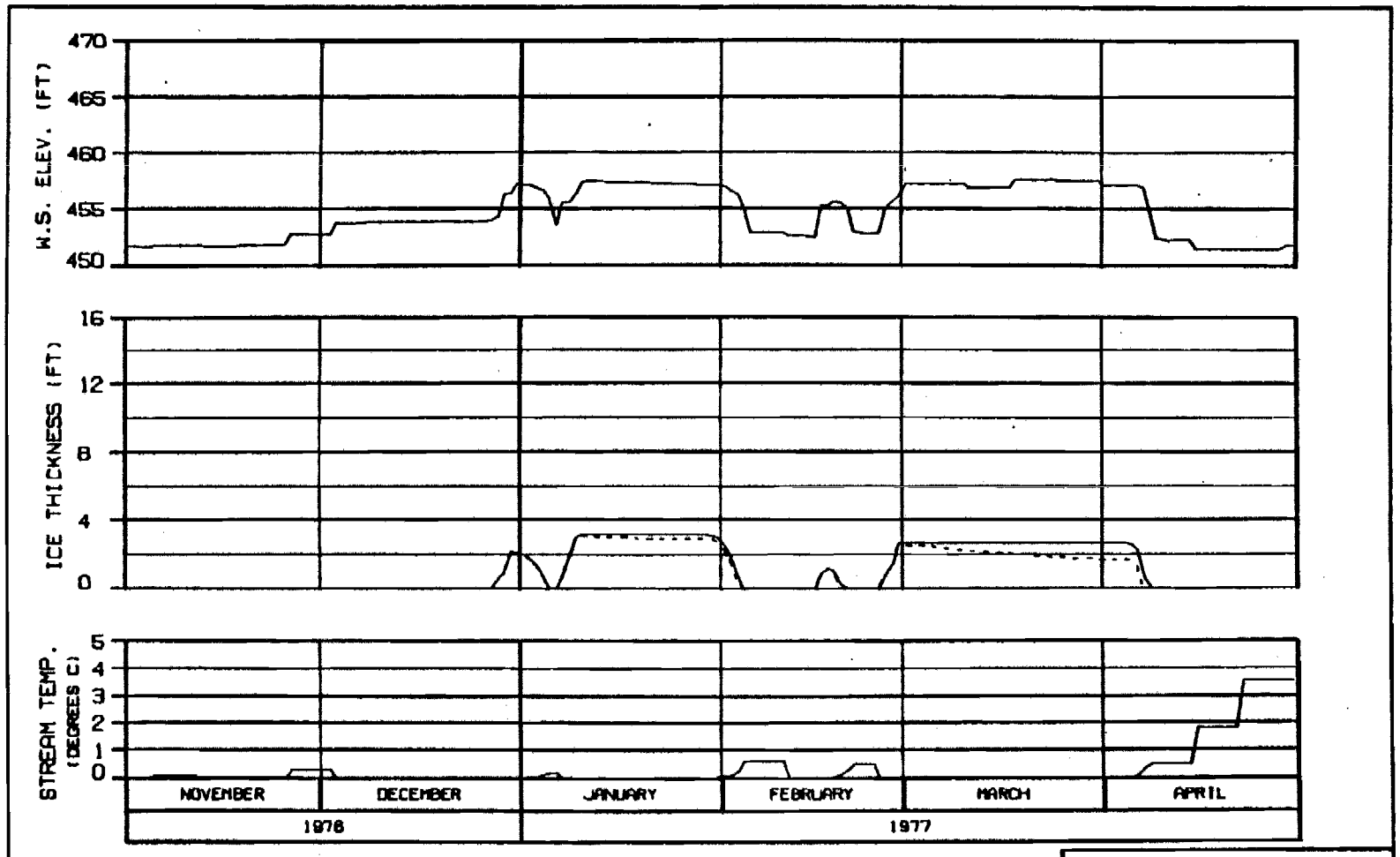
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 1568.142



SIDE CHANNEL AT HEAD OF GASH CREEK

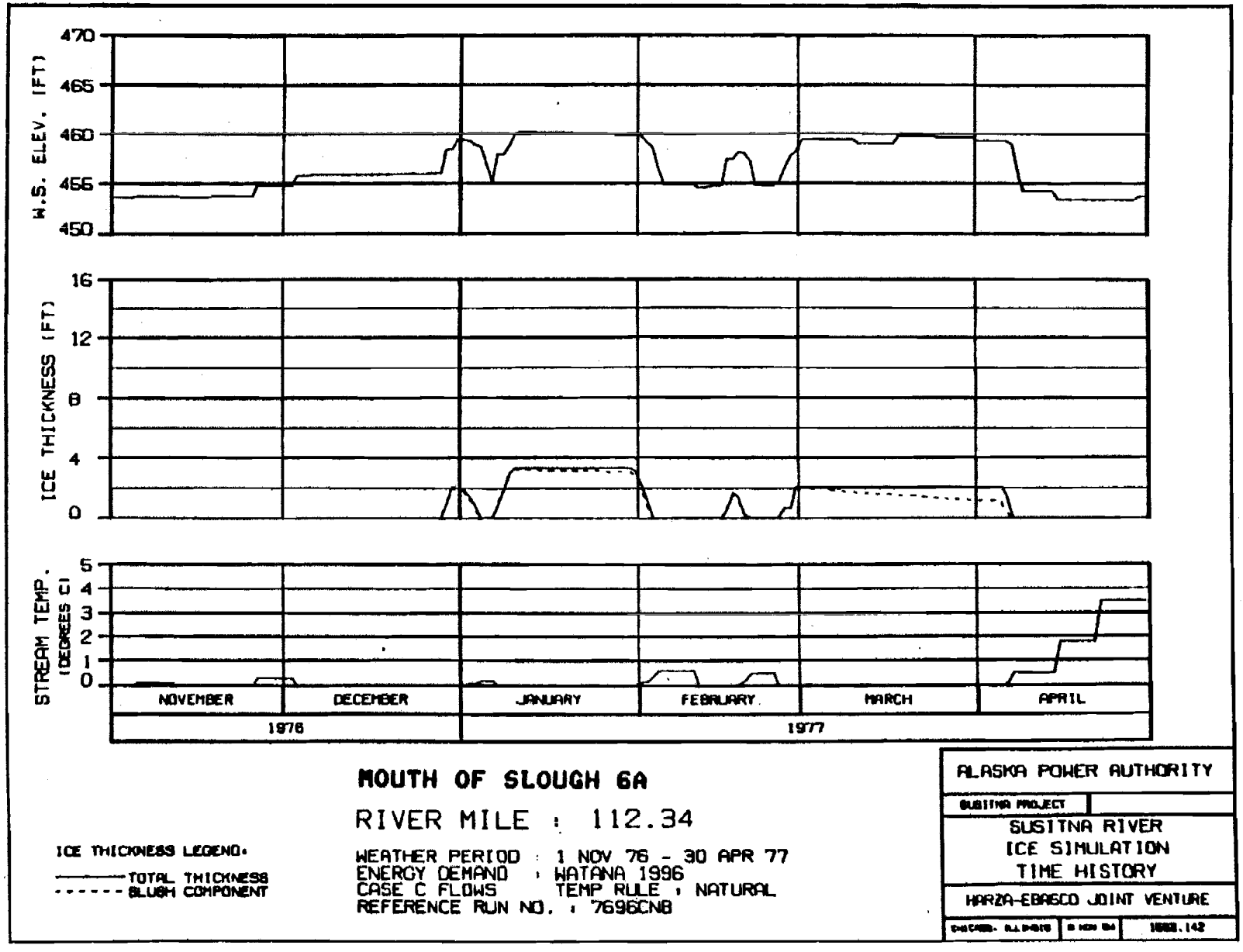
RIVER MILE : 112.00

ICE THICKNESS LEGEND:

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

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

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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB

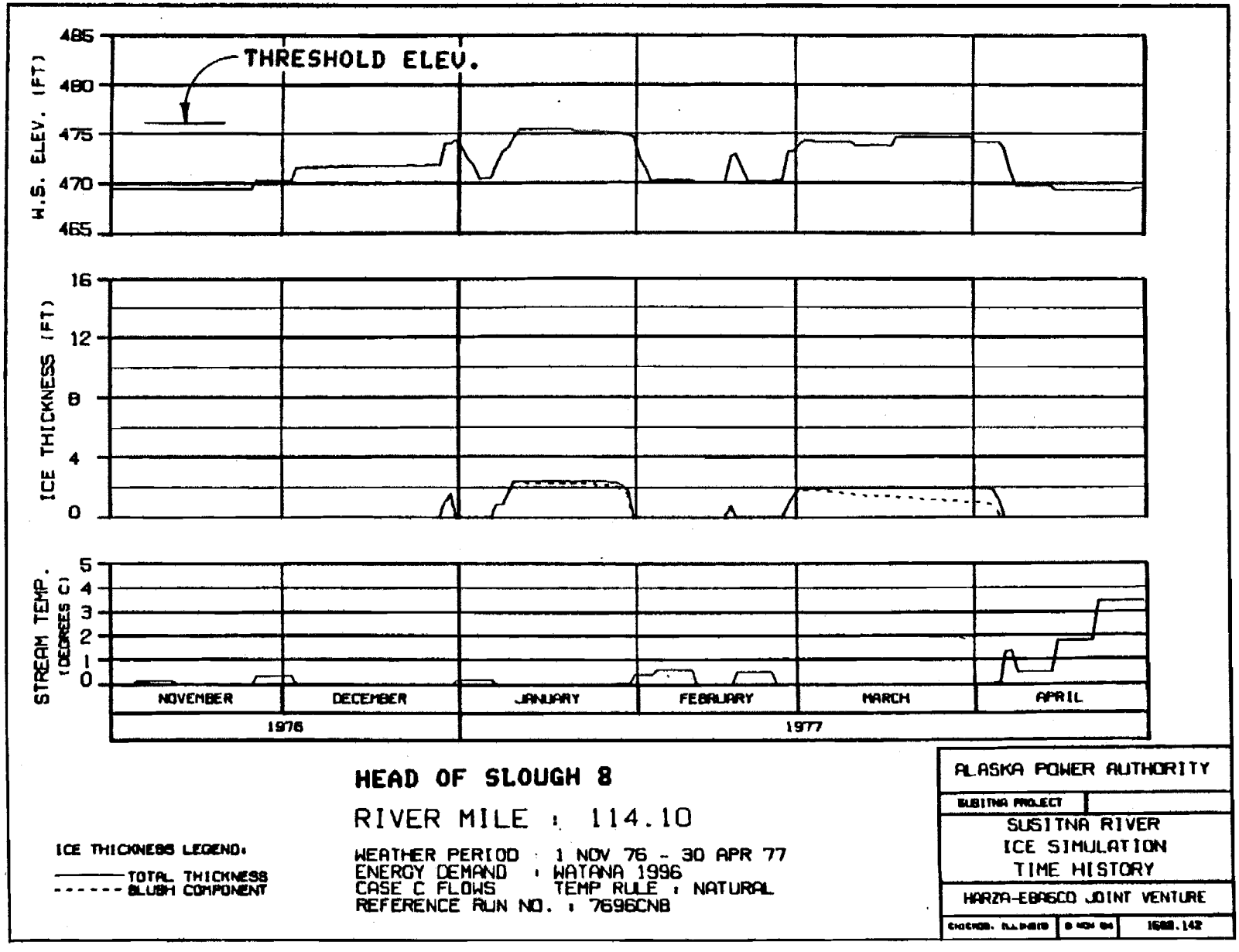
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1668.142



HEAD OF SLOUGH 8

RIVER MILE : 114.10

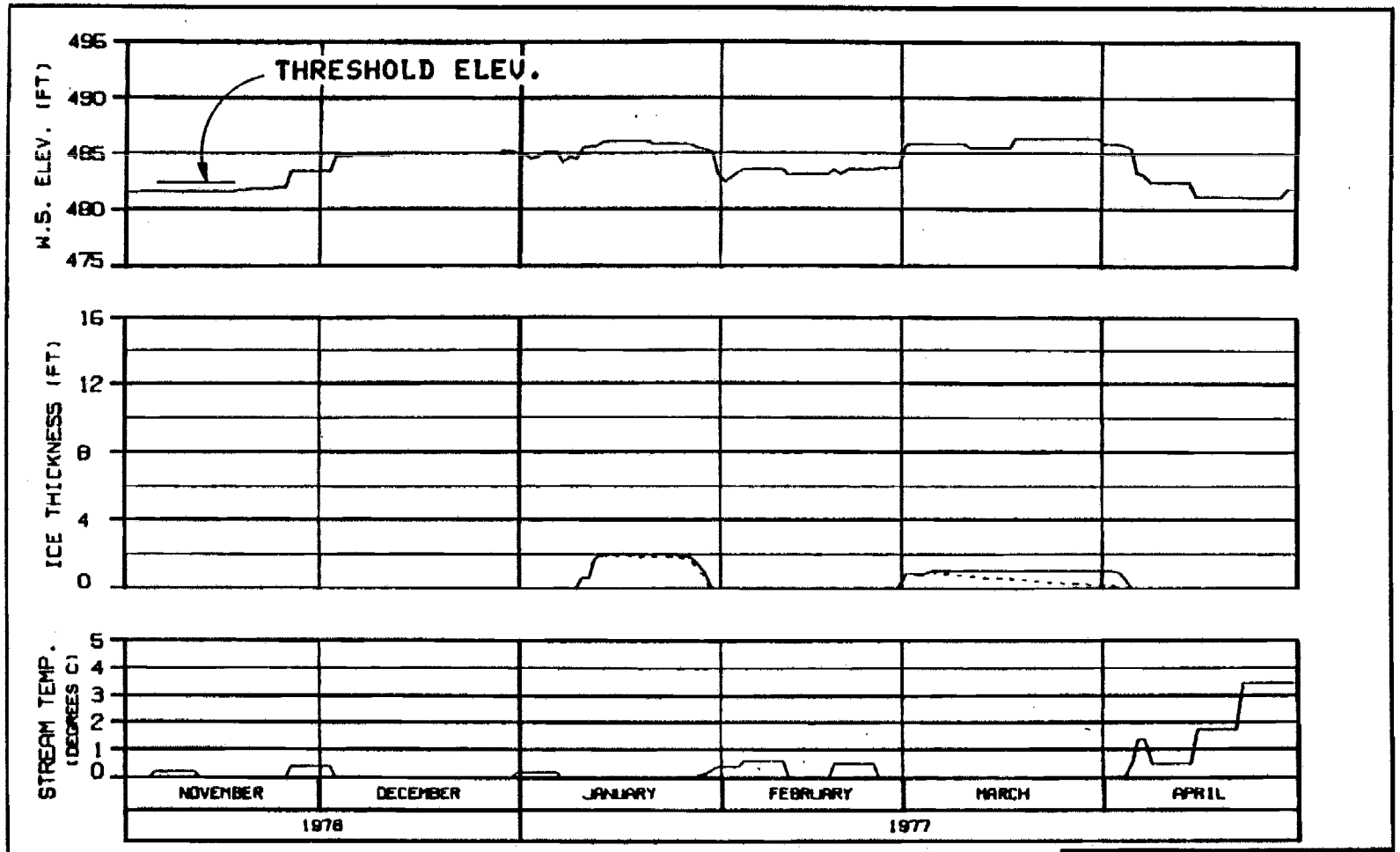
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHECKED: R.L.HEID	9 NOV 84	1688.142



SIDE CHANNEL MSII

RIVER MILE : 115.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

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

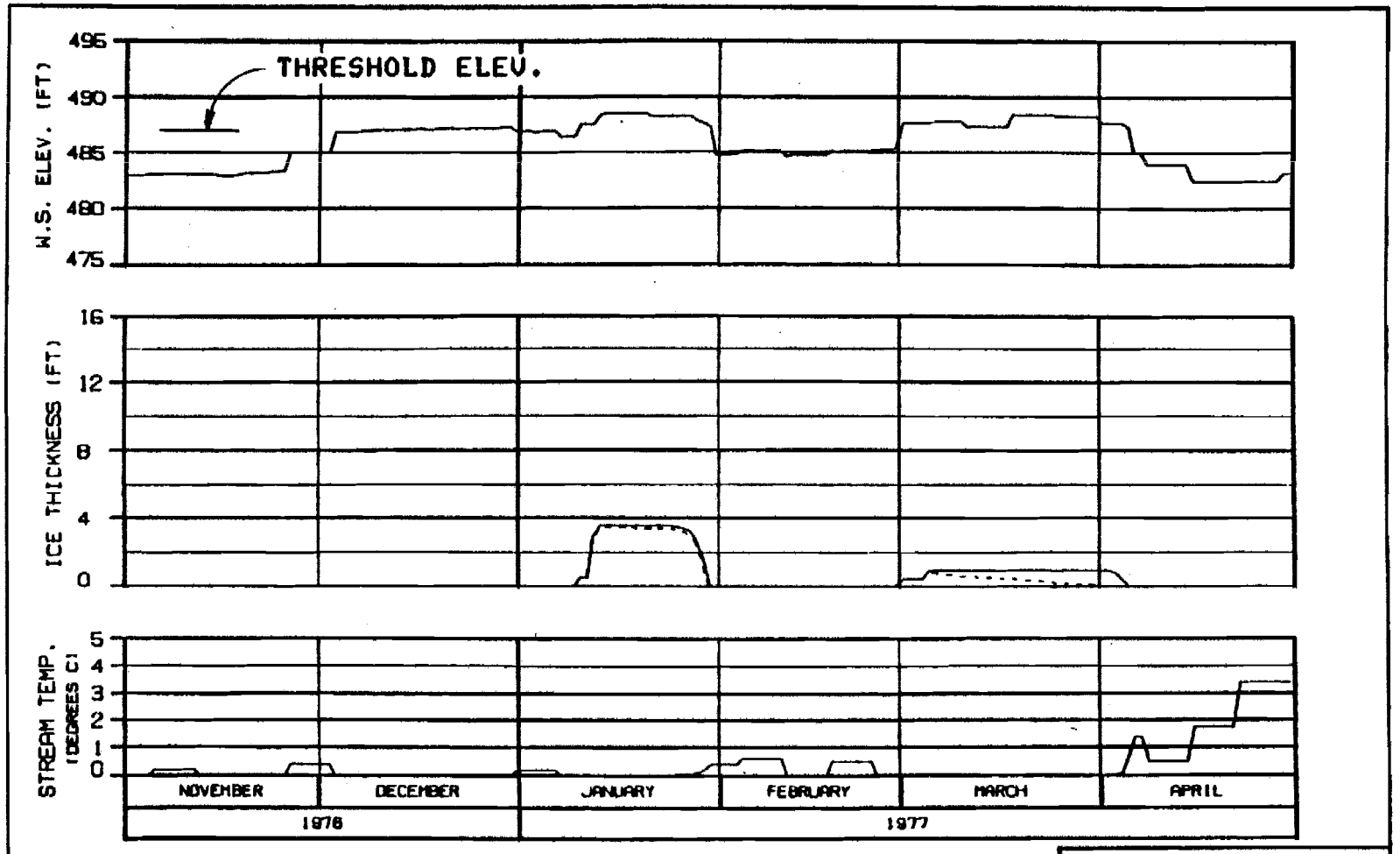
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 9 NOV 84 | 1868.142



HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

ICE THICKNESS LEGEND:

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

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

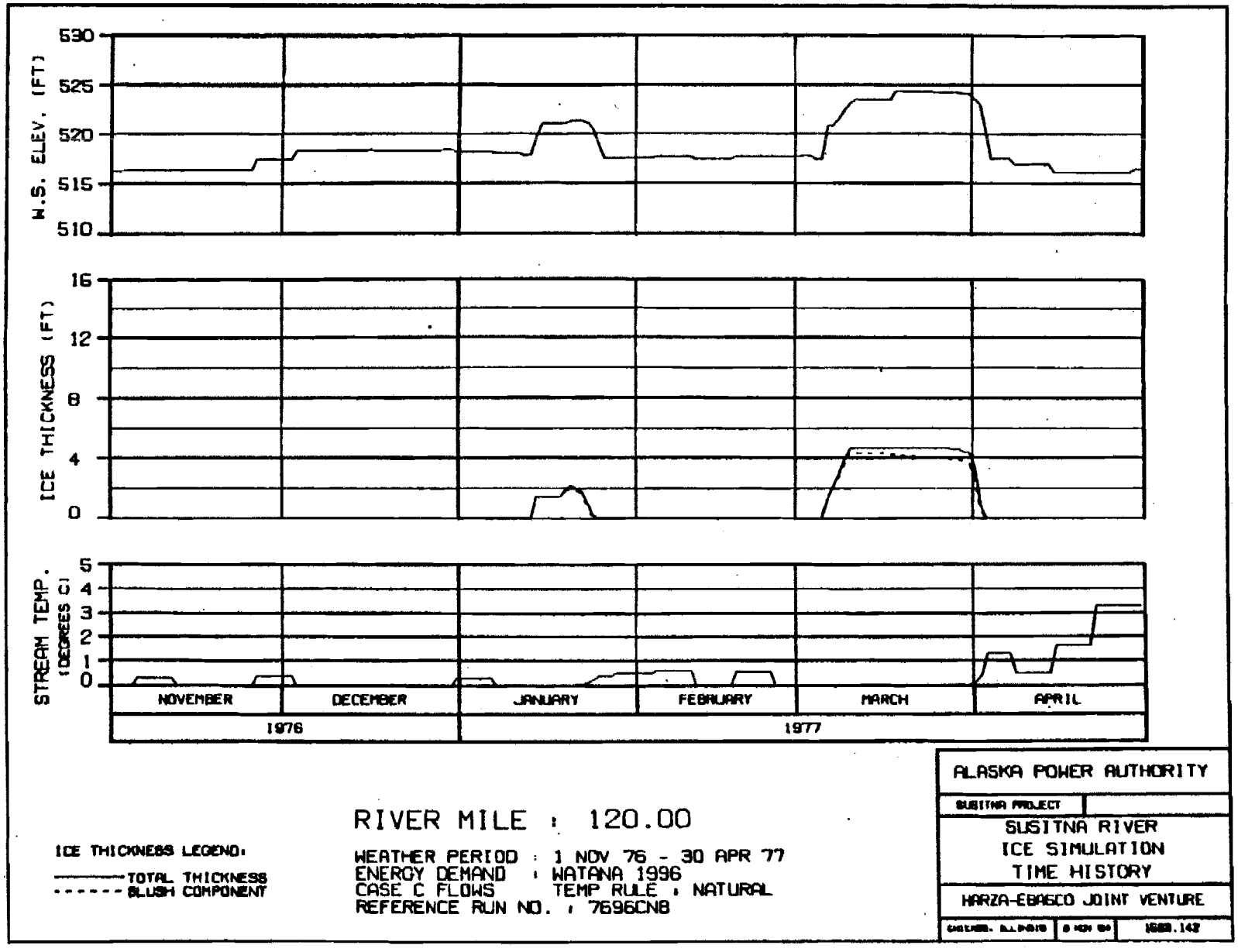
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 9 NOV 84 | 1888.142



ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

RIVER MILE : 120.00

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

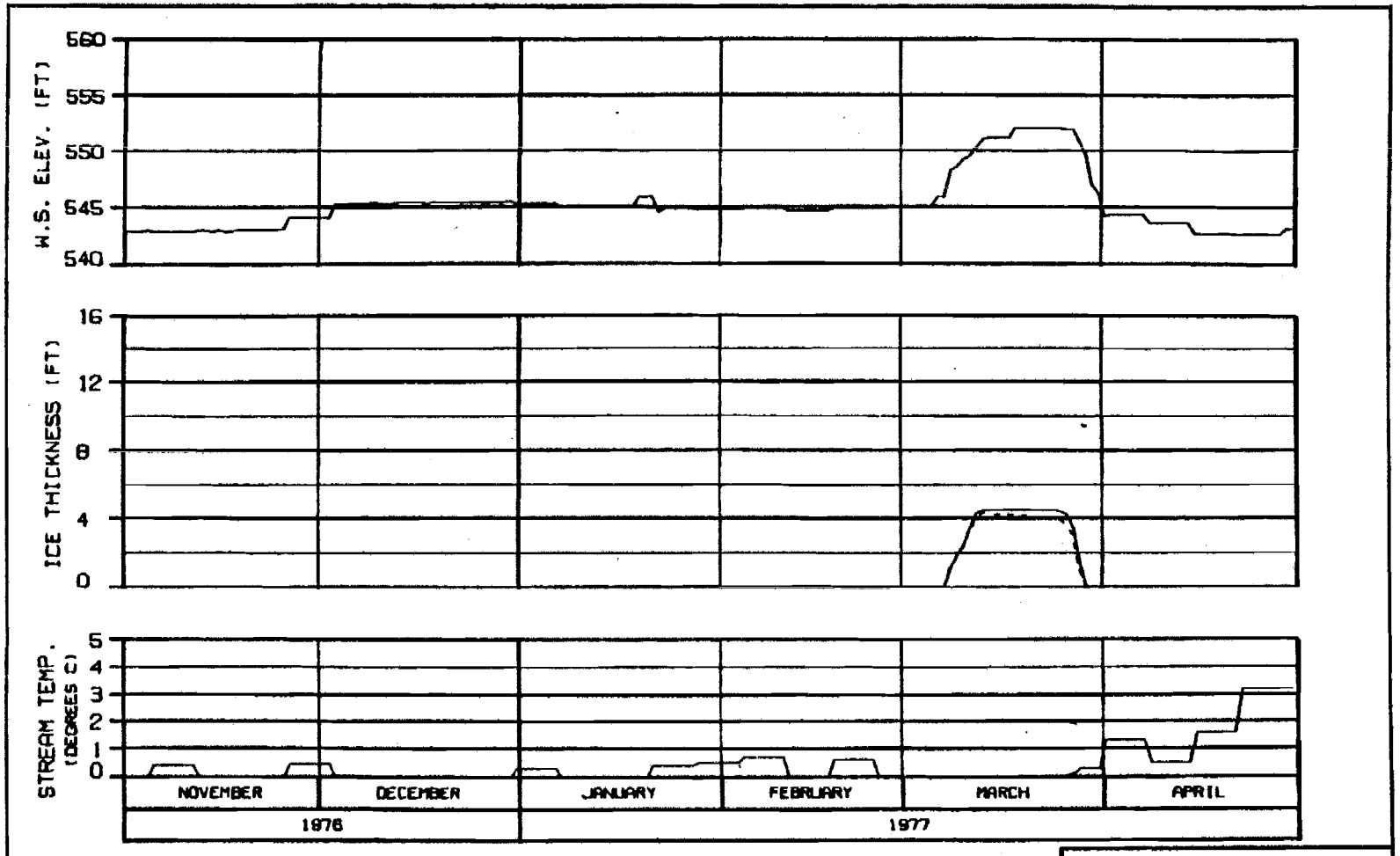
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1588.142



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

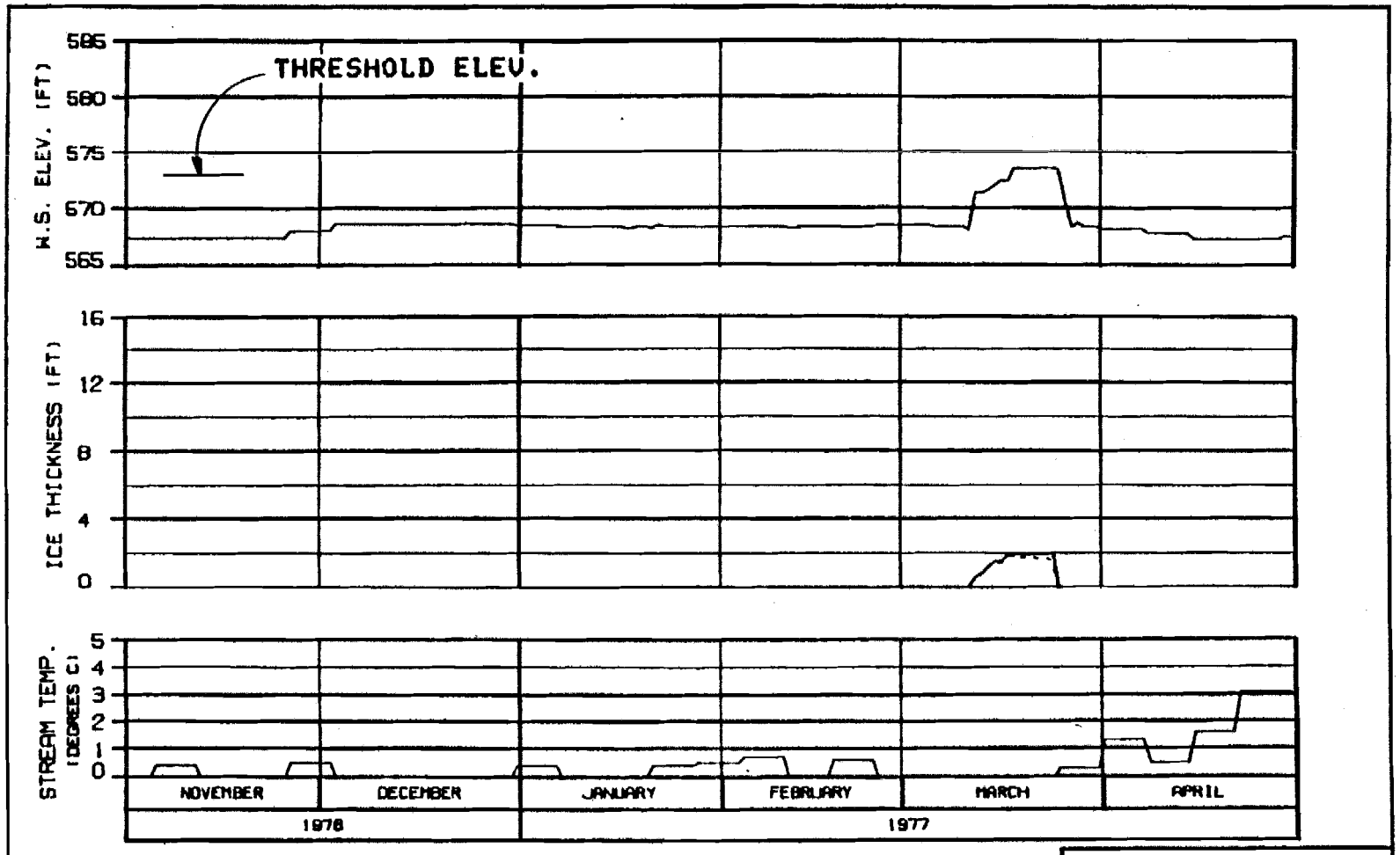
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	8 NOV 84	1588.142



HEAD OF SLOUGH 8A (WEST)

RIVER MILE : 126.10

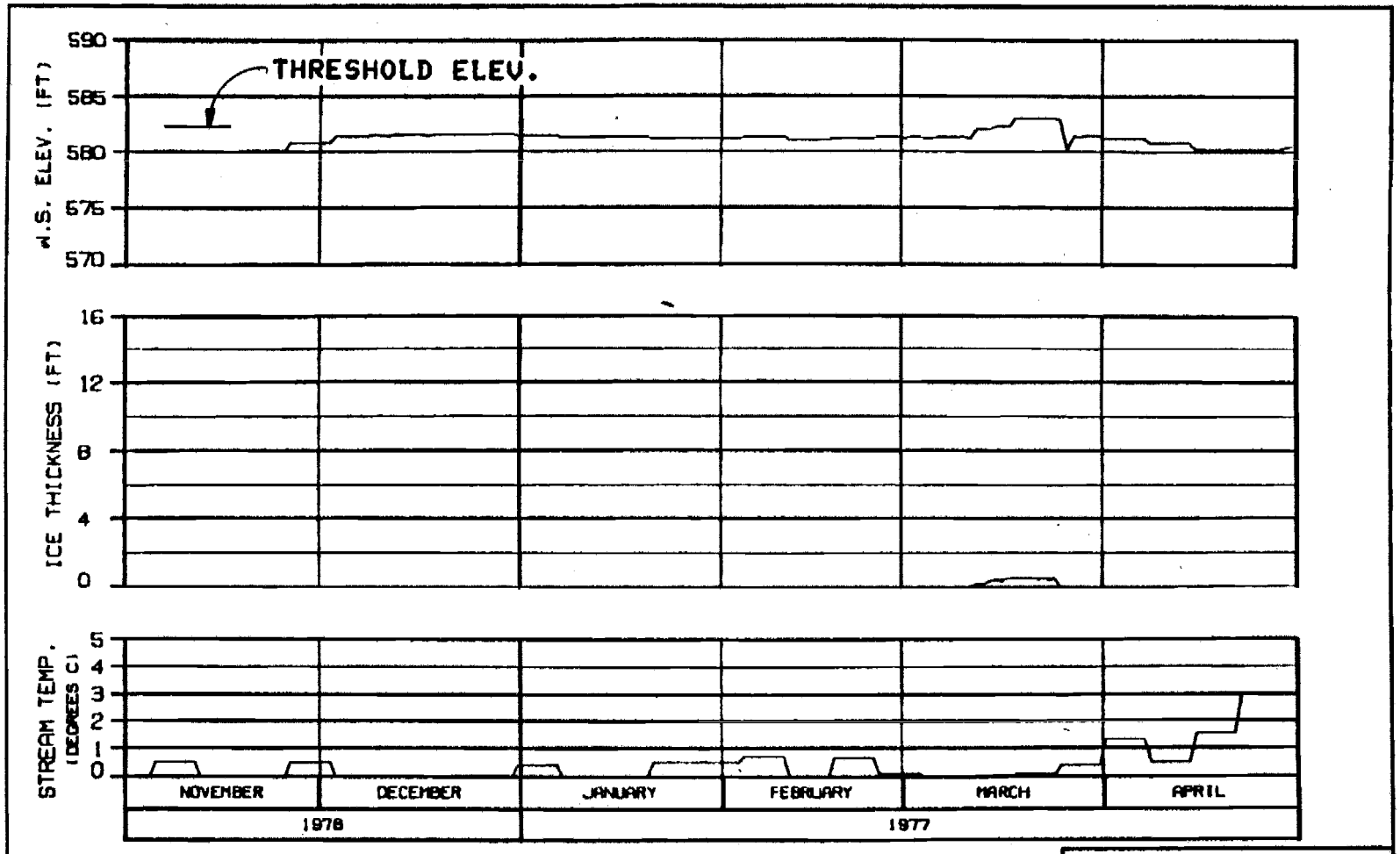
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1568.142



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:

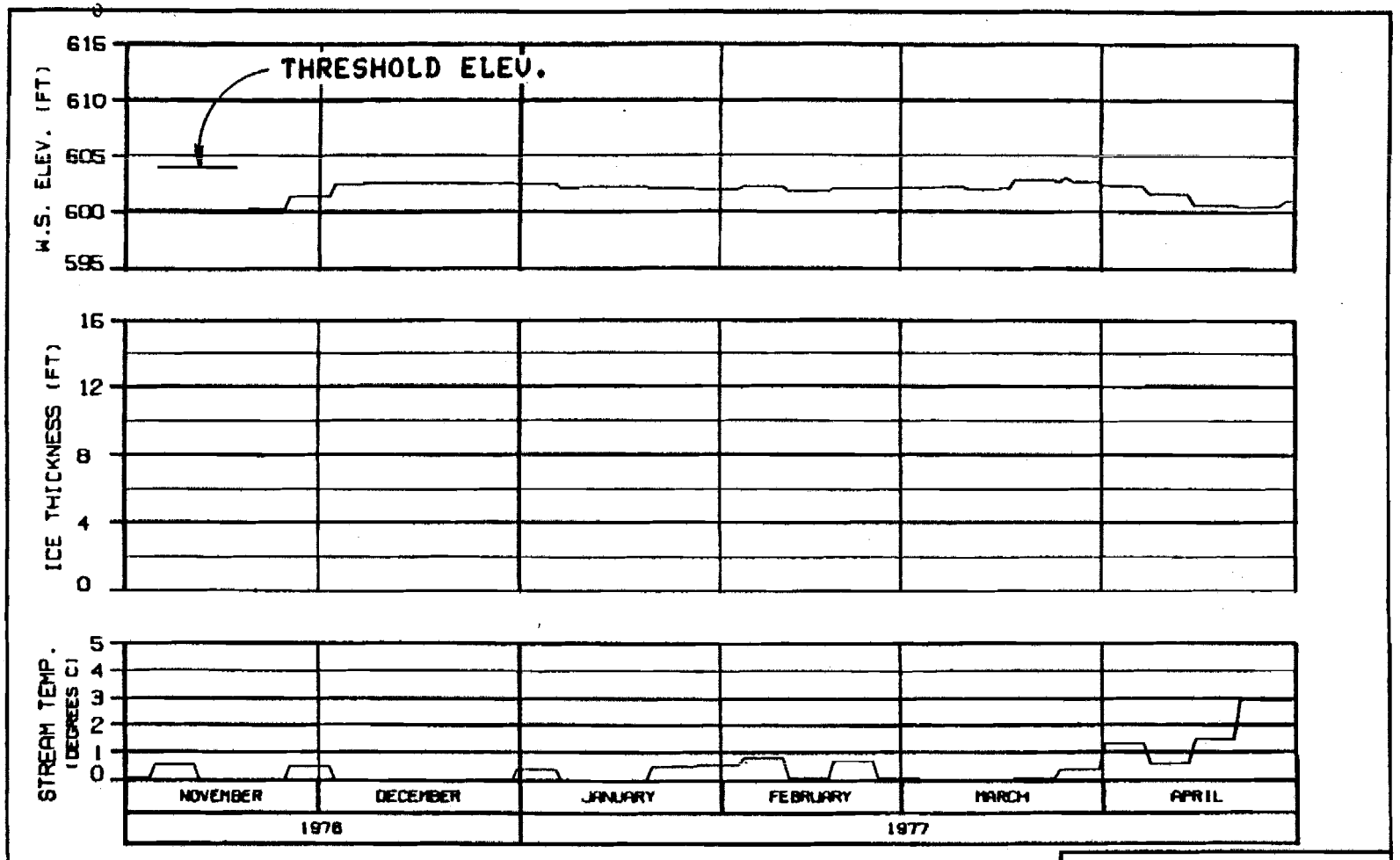
——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS · 9 NOV 84 · 1588.142

OPTION?



HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

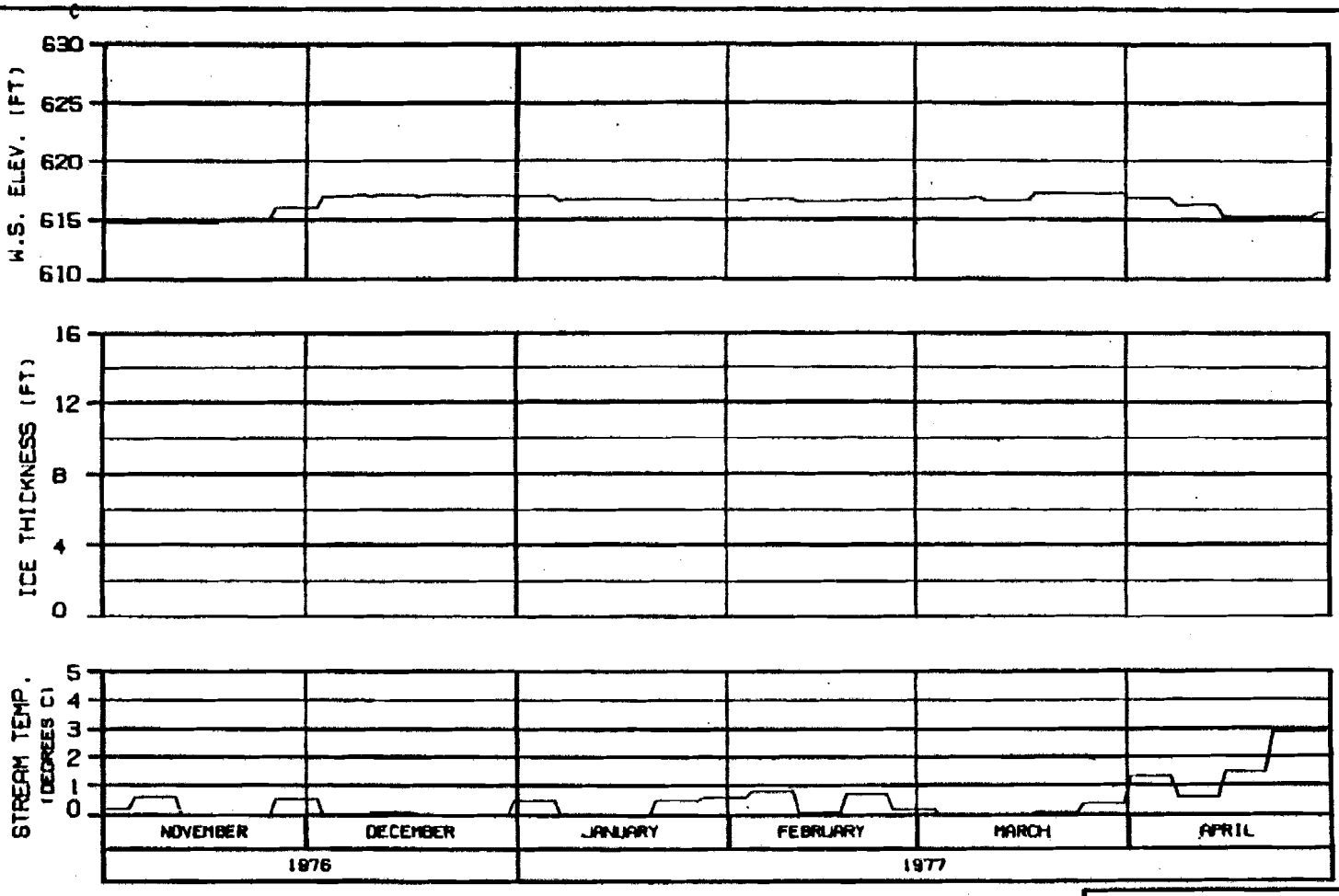
- - - - - - SLUSH COMPONENT

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

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

OPTION?

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

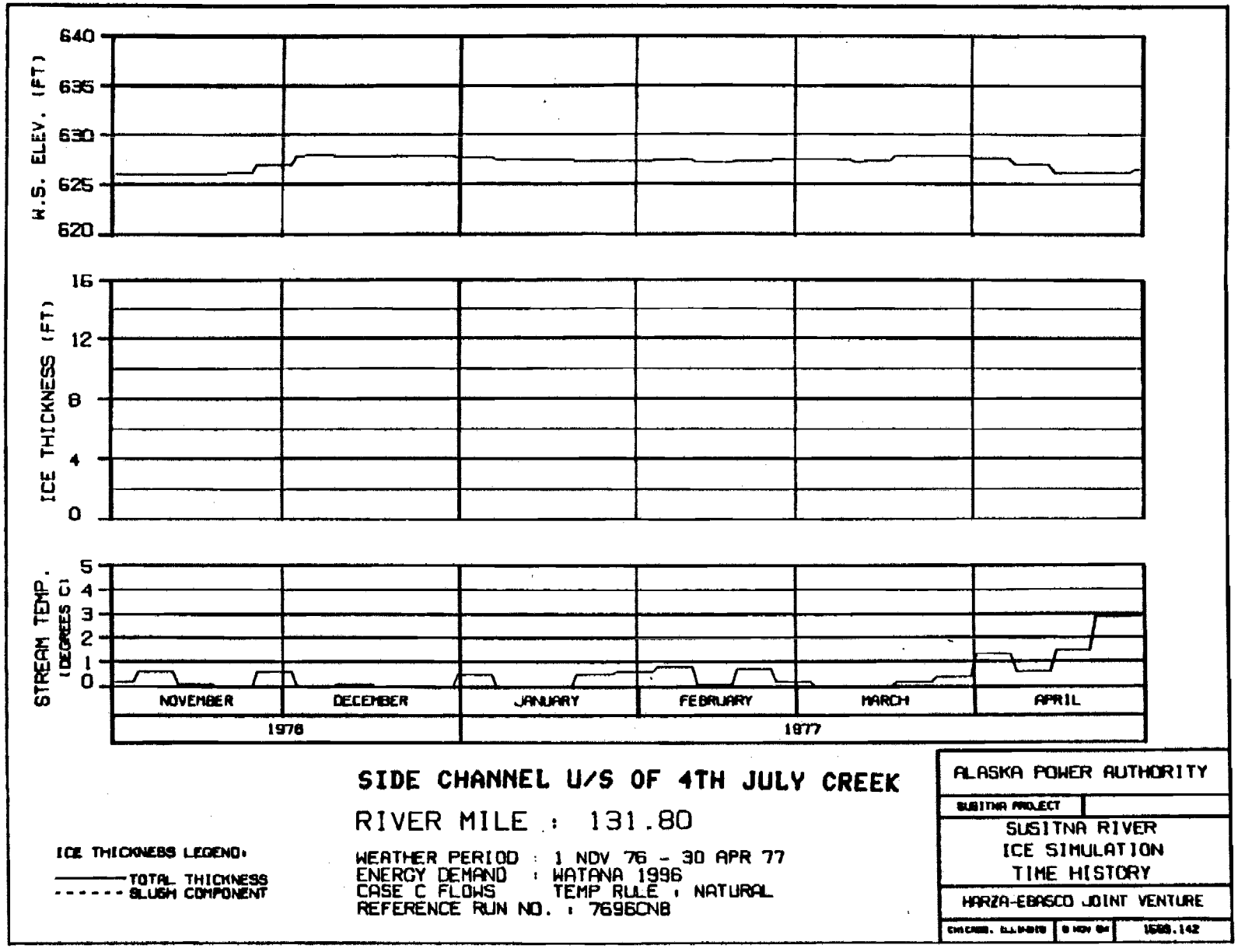
RIVER MILE : 130.60

ICE THICKNESS LEGEND:

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

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	1563.142



SIDE CHANNEL U/S OF 4TH JULY CREEK

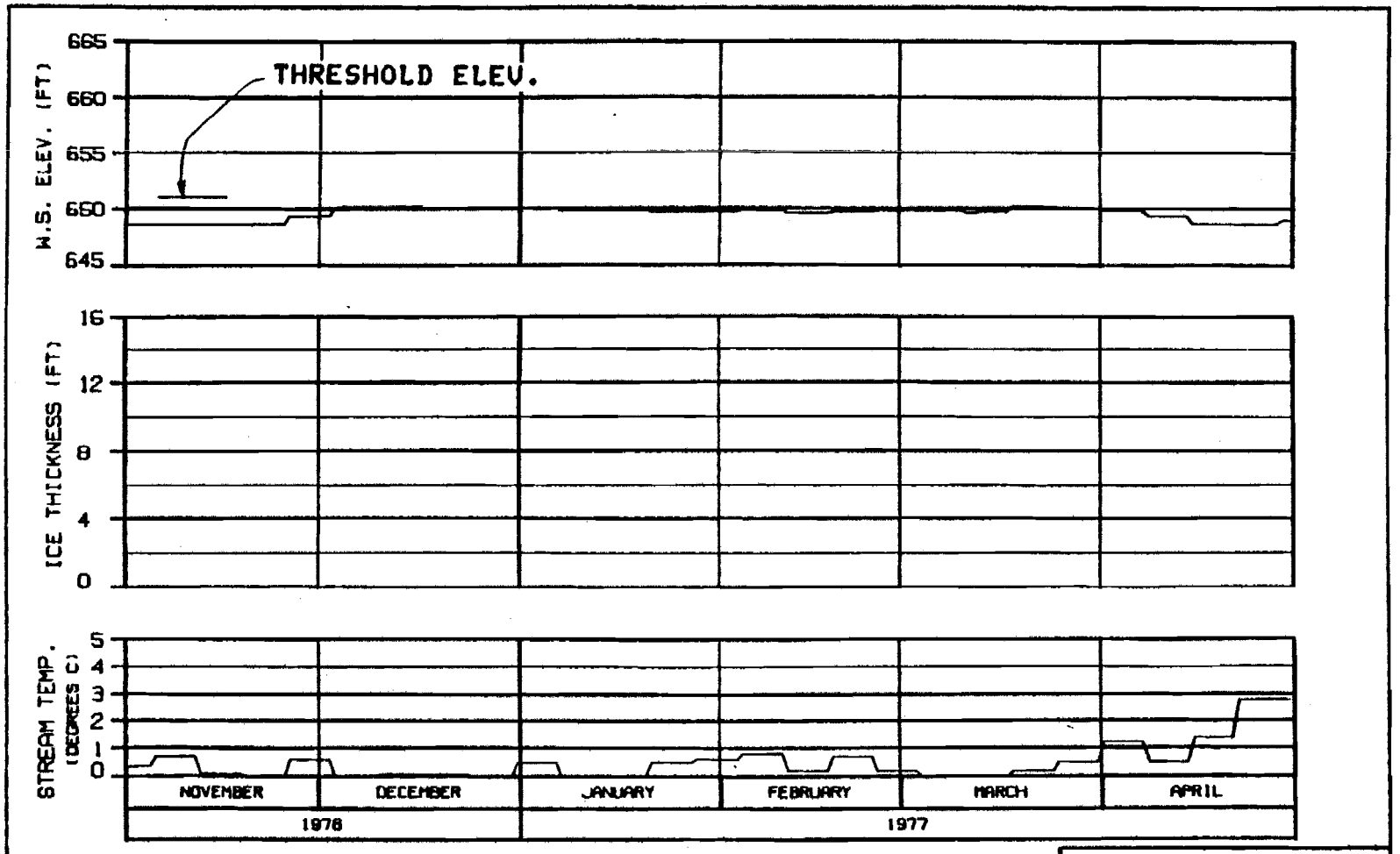
RIVER MILE : 131.80

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

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



HEAD OF SLOUGH 9A

RIVER MILE : 133.70

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

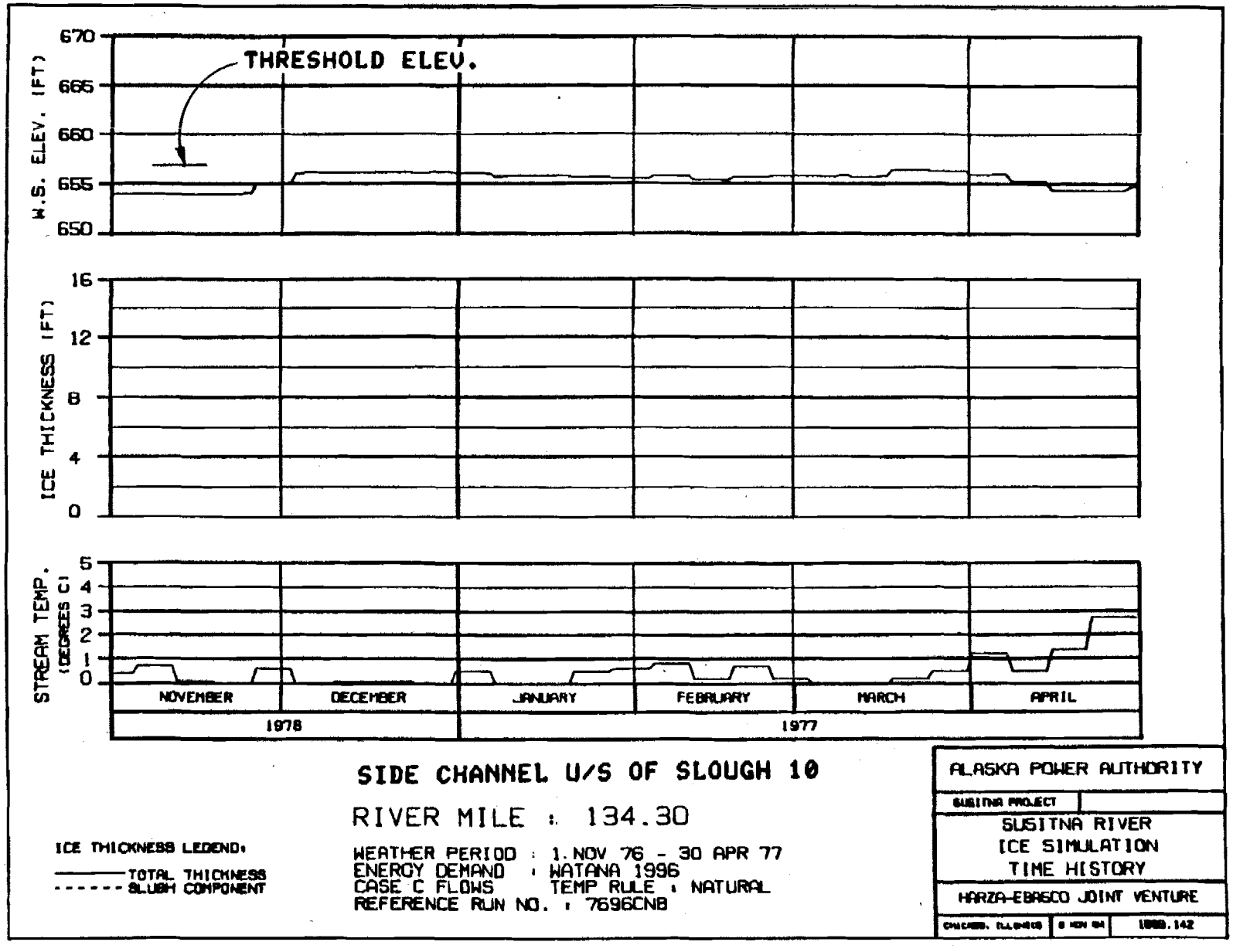
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 94 | 1588.142



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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB

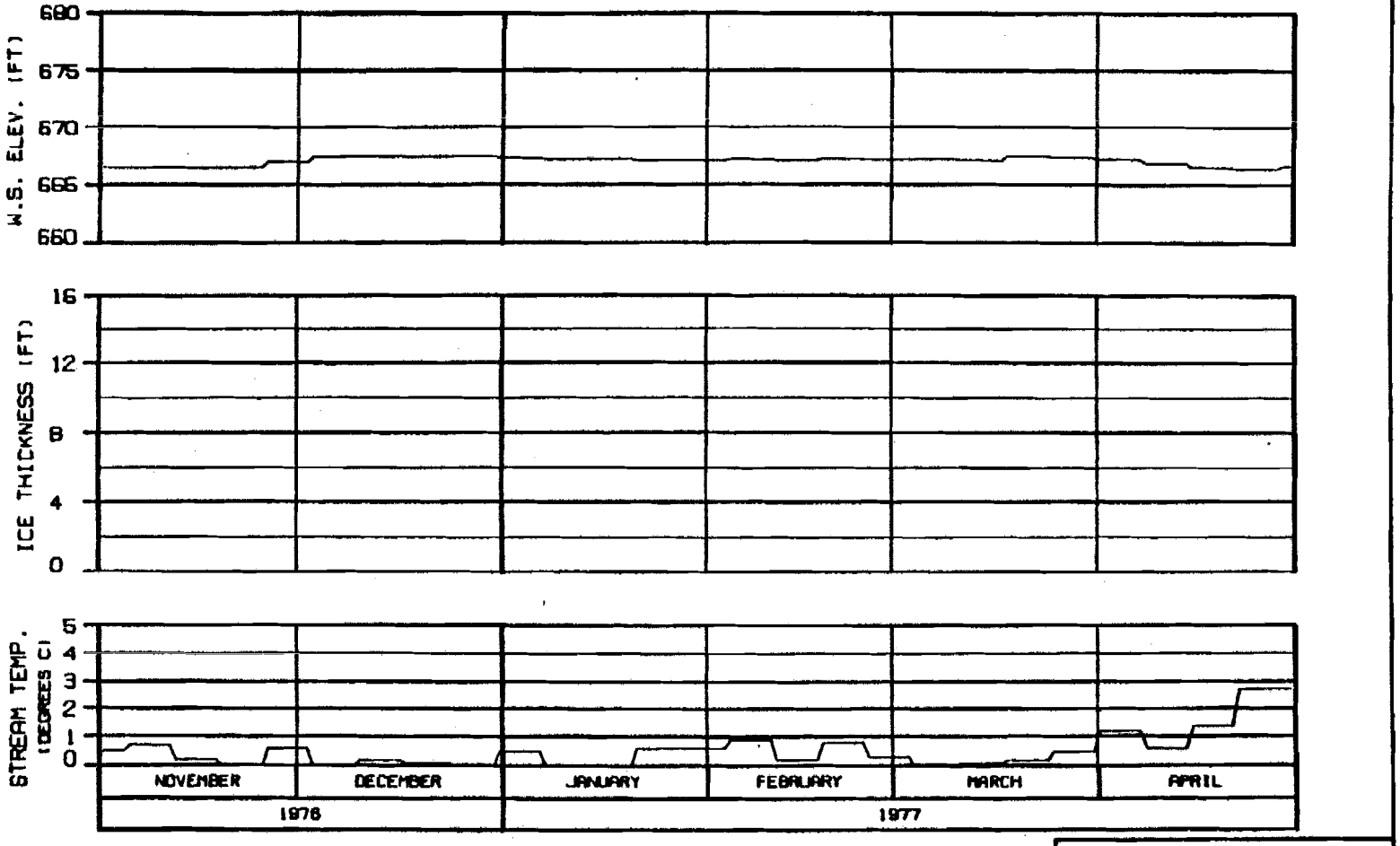
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1889.142



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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB

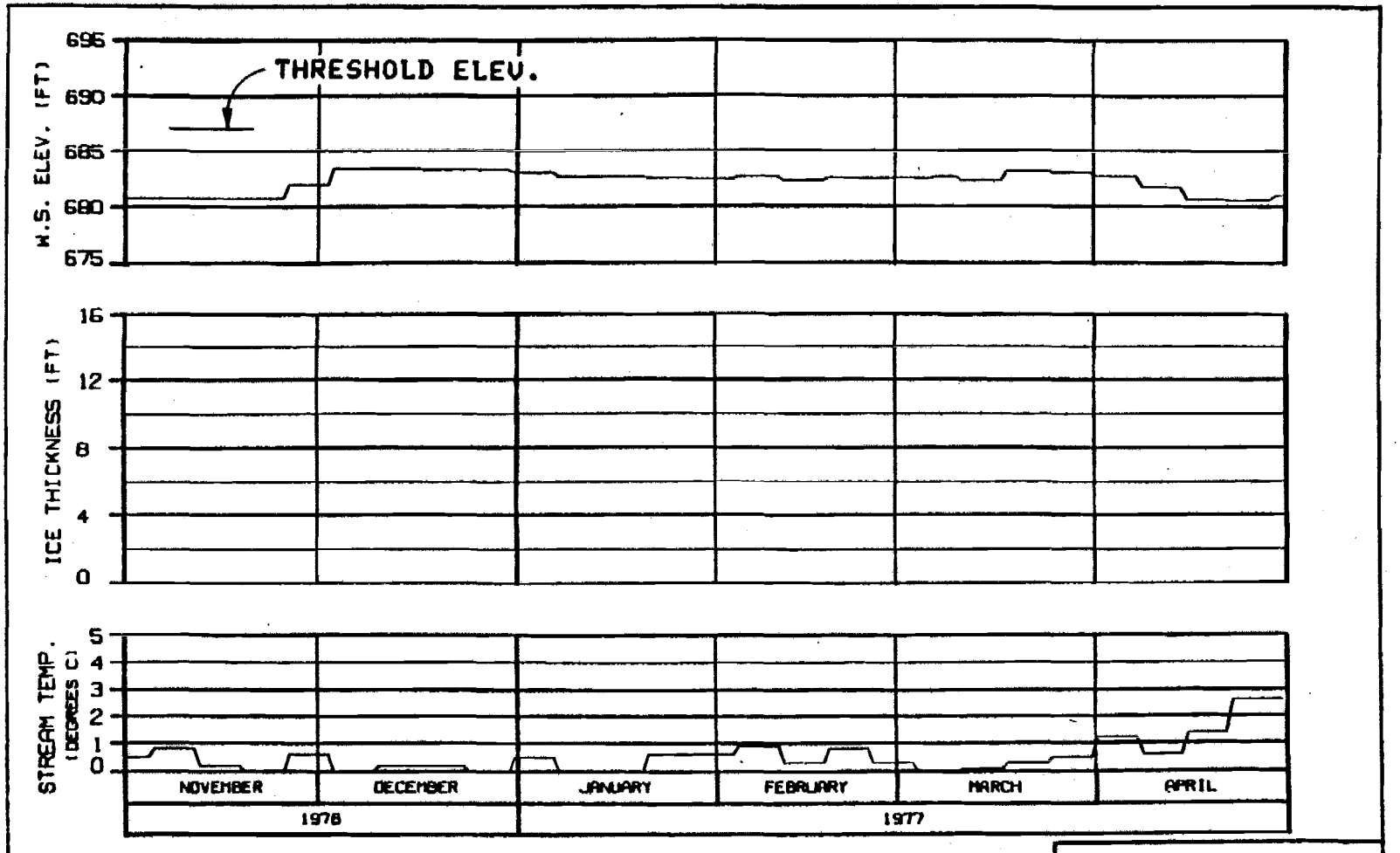
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1588.142



HEAD OF SLOUGH 11

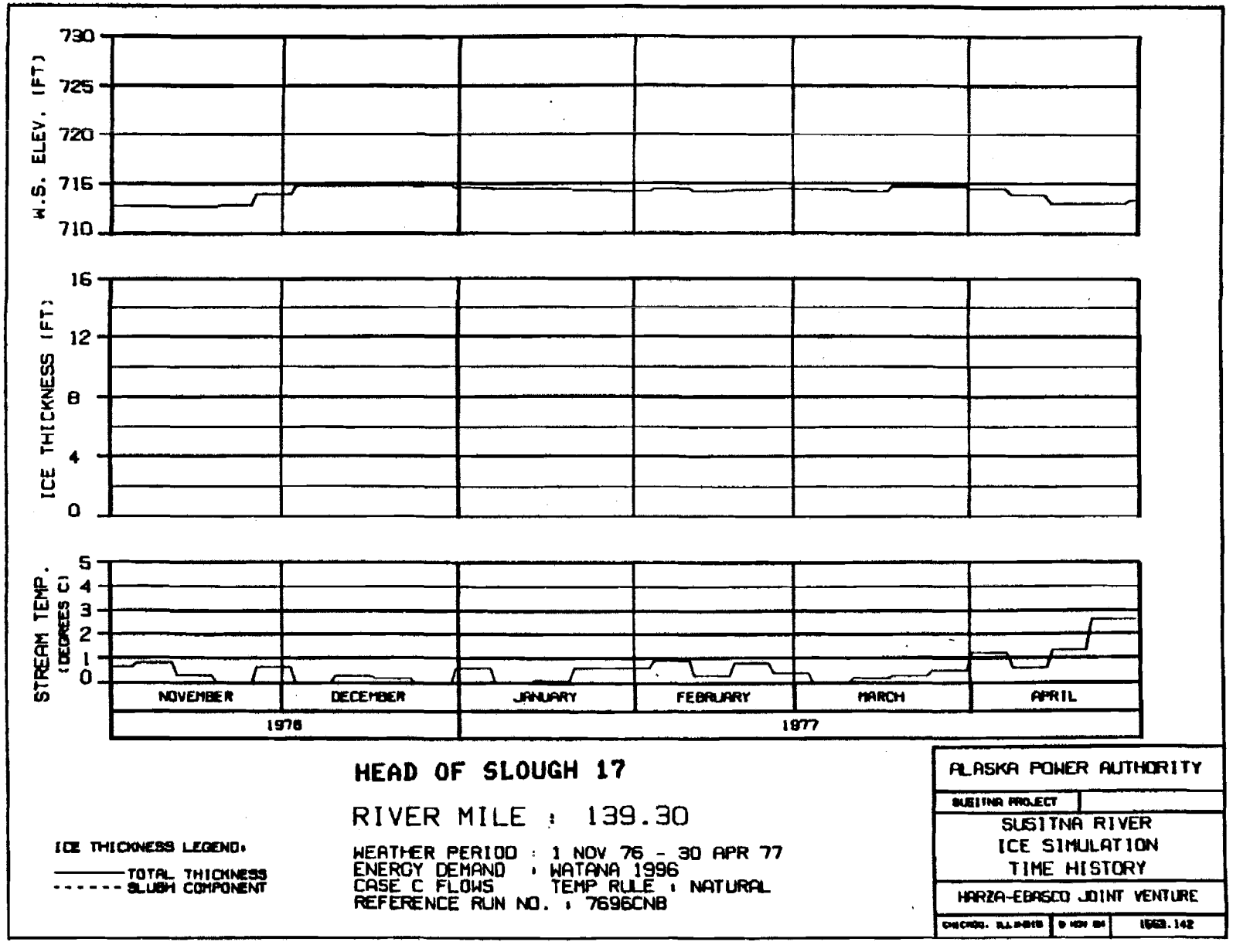
RIVER MILE : 136.50

ICE THICKNESS LEGEND:

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

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

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
1668.142



HEAD OF SLOUGH 17

RIVER MILE : 139.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

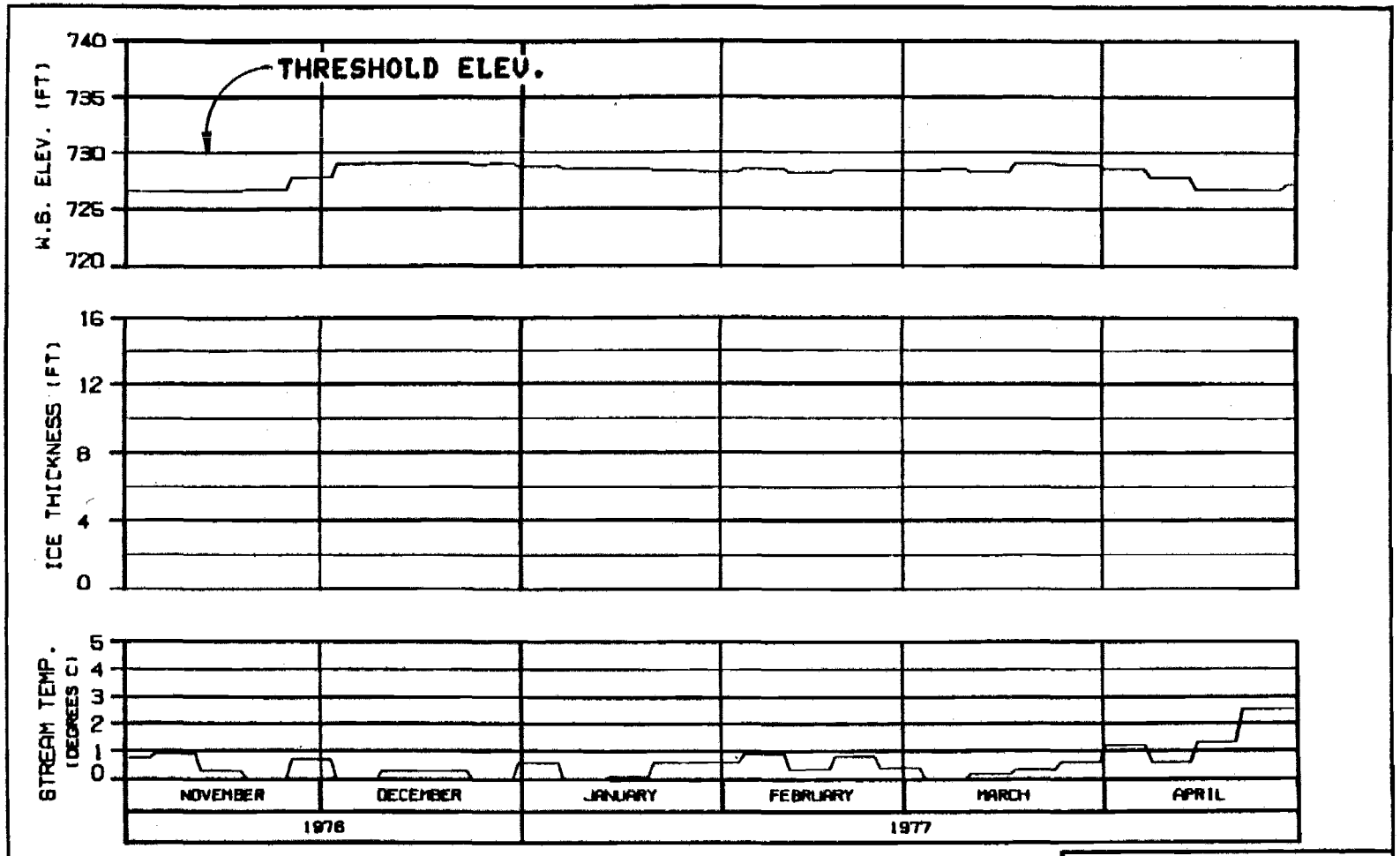
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1563.142



HEAD OF SLOUGH 20

RIVER MILE : 140.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

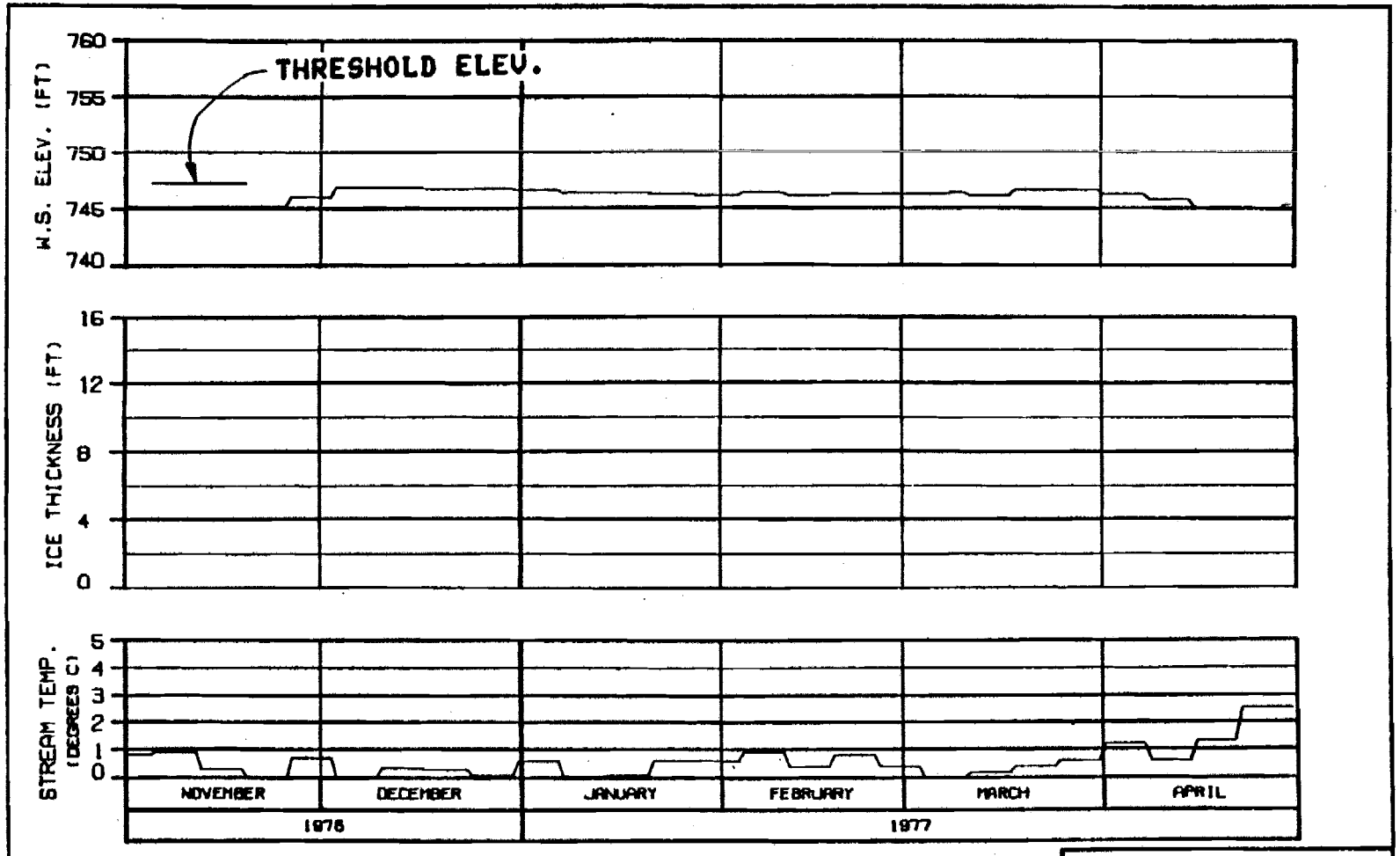
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1868.142



SLOUGH 21 (ENTRANCE A6)

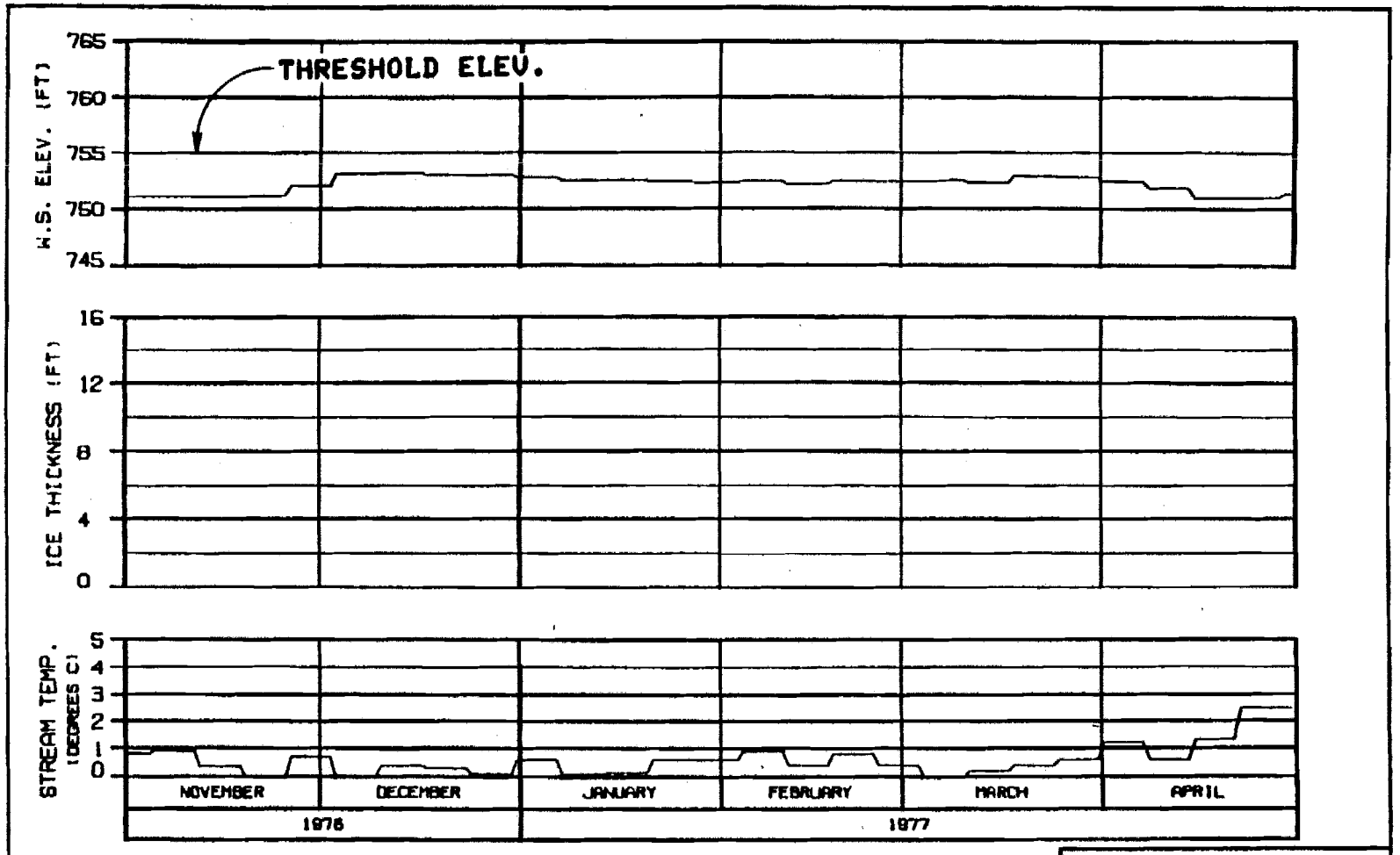
RIVER MILE : 141.80

ICE THICKNESS LEGEND:

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

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1868.142



HEAD OF SLOUGH 21

RIVER MILE : 142.20

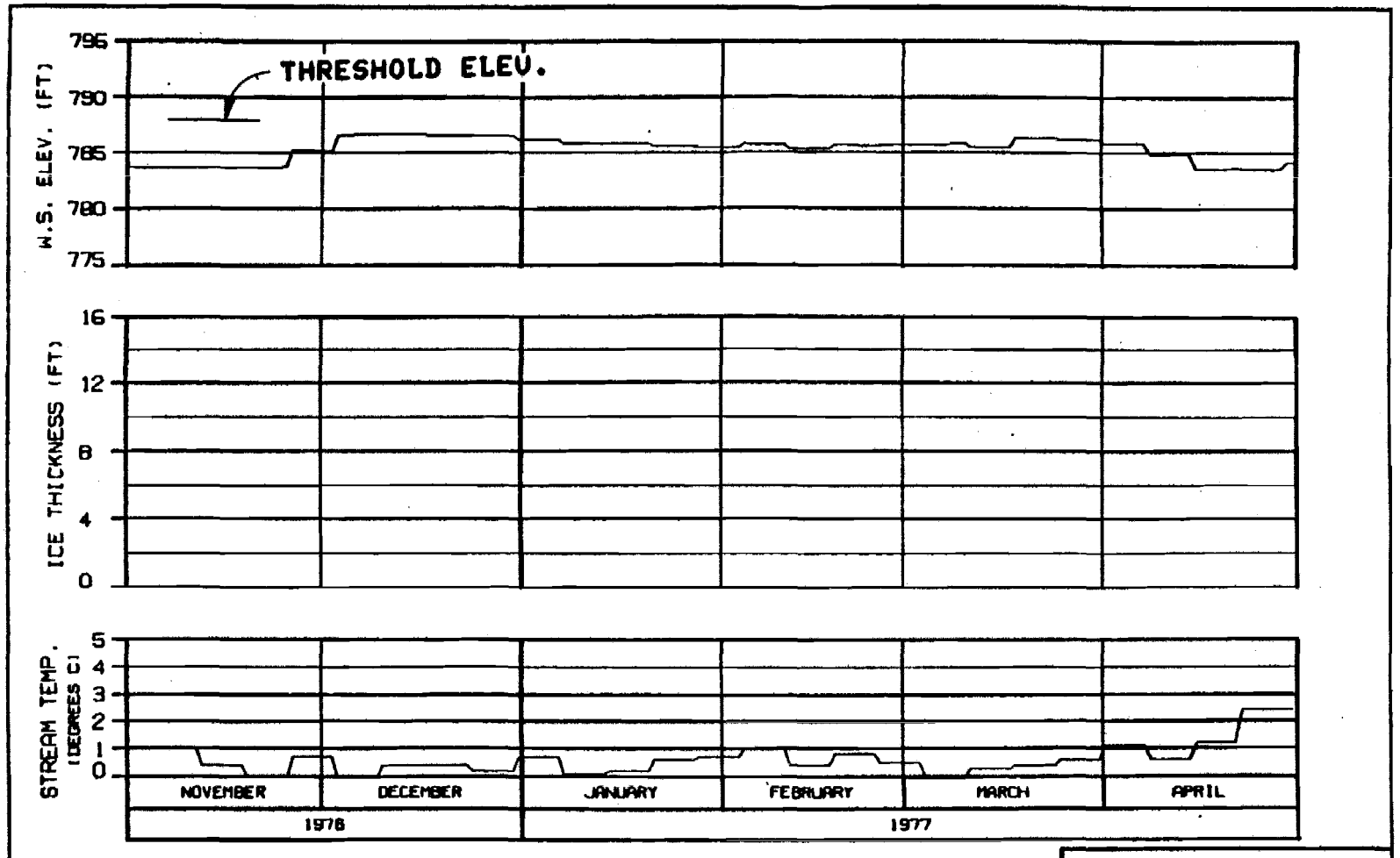
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1688.142



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY

SUSITNA PROJECT

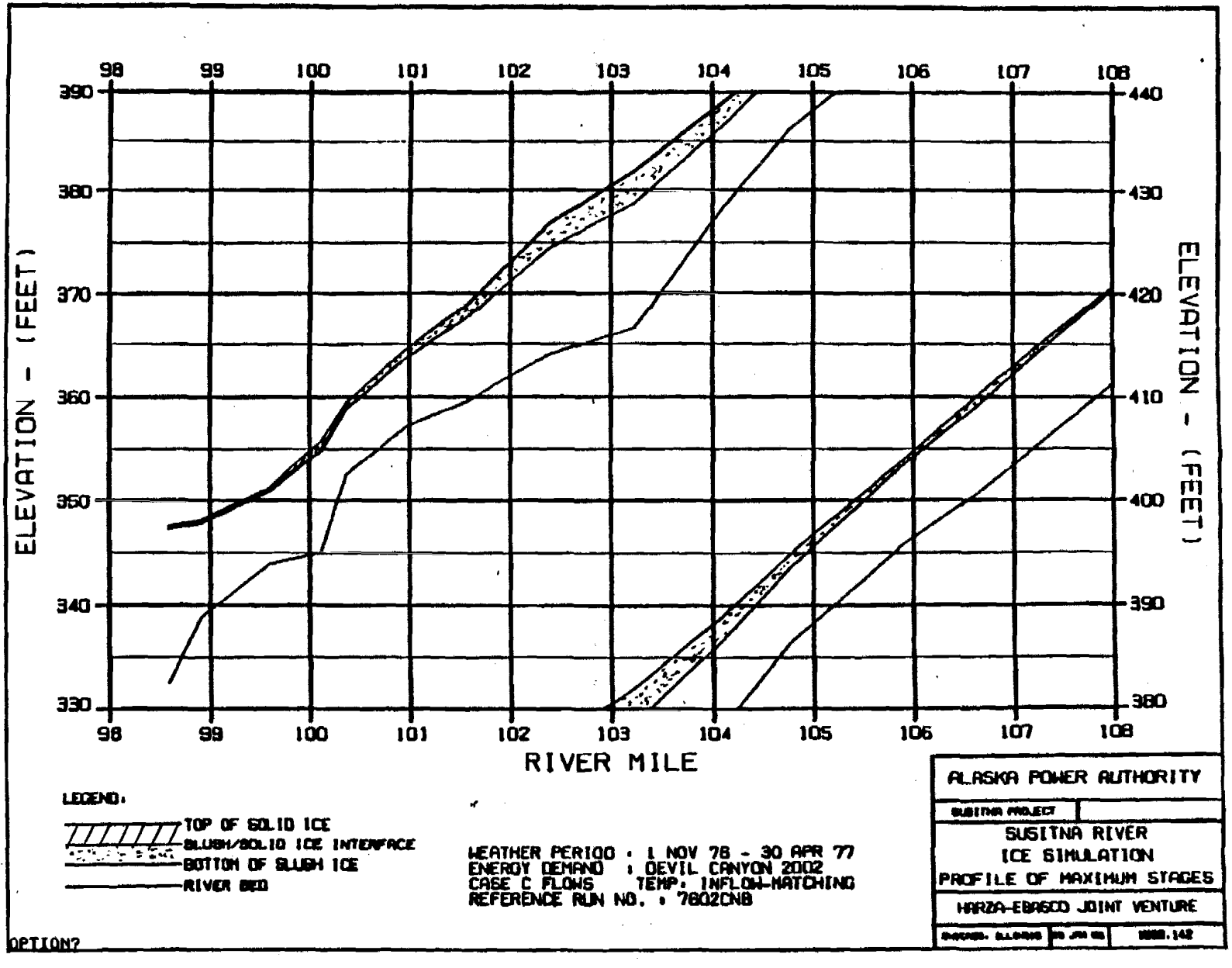
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

OPTION?

EXHIBIT O

C


98
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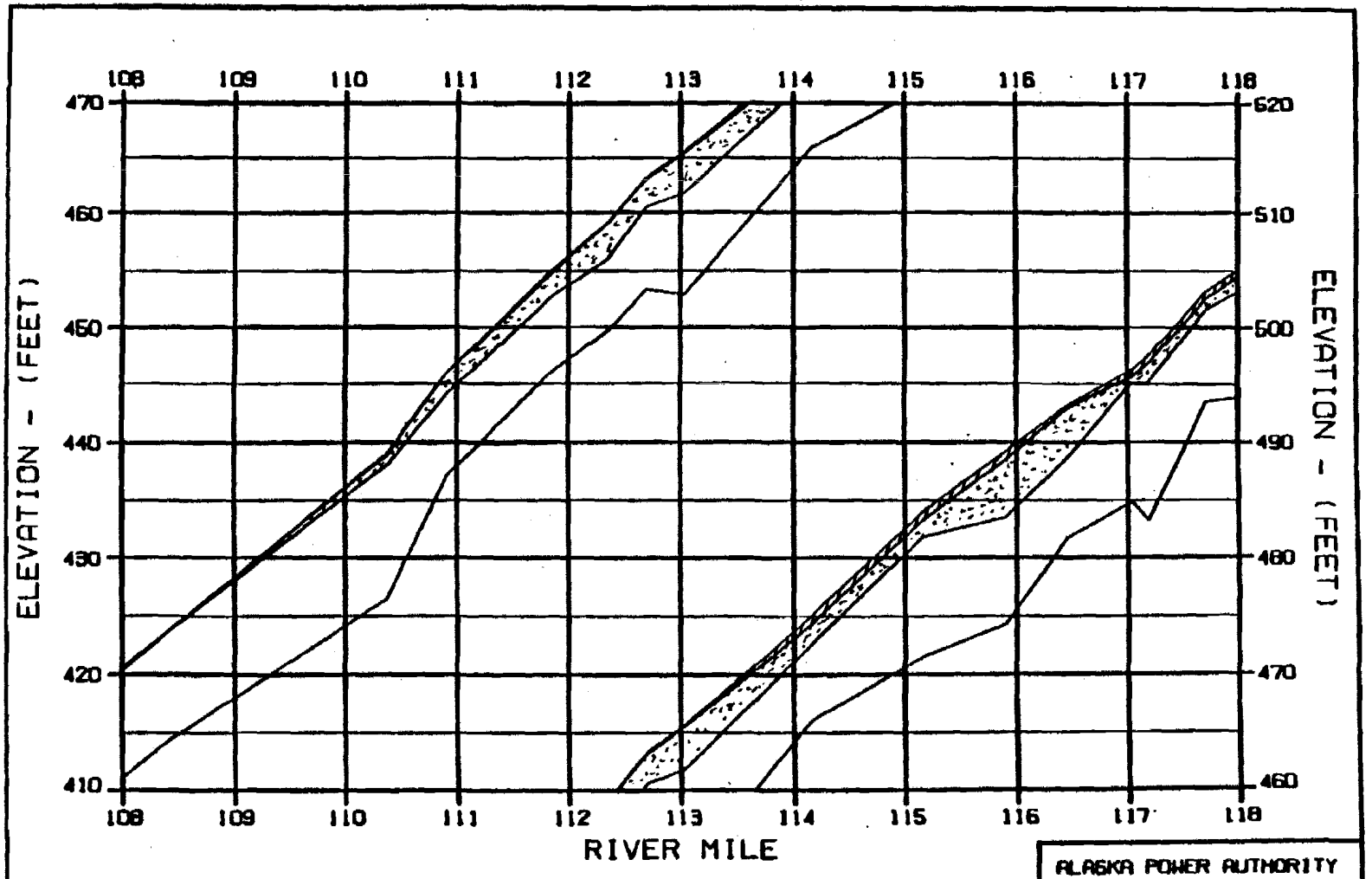
340
330
440
430
420
410
400
390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7802CNB

ALASKA POWER AUTHORITY

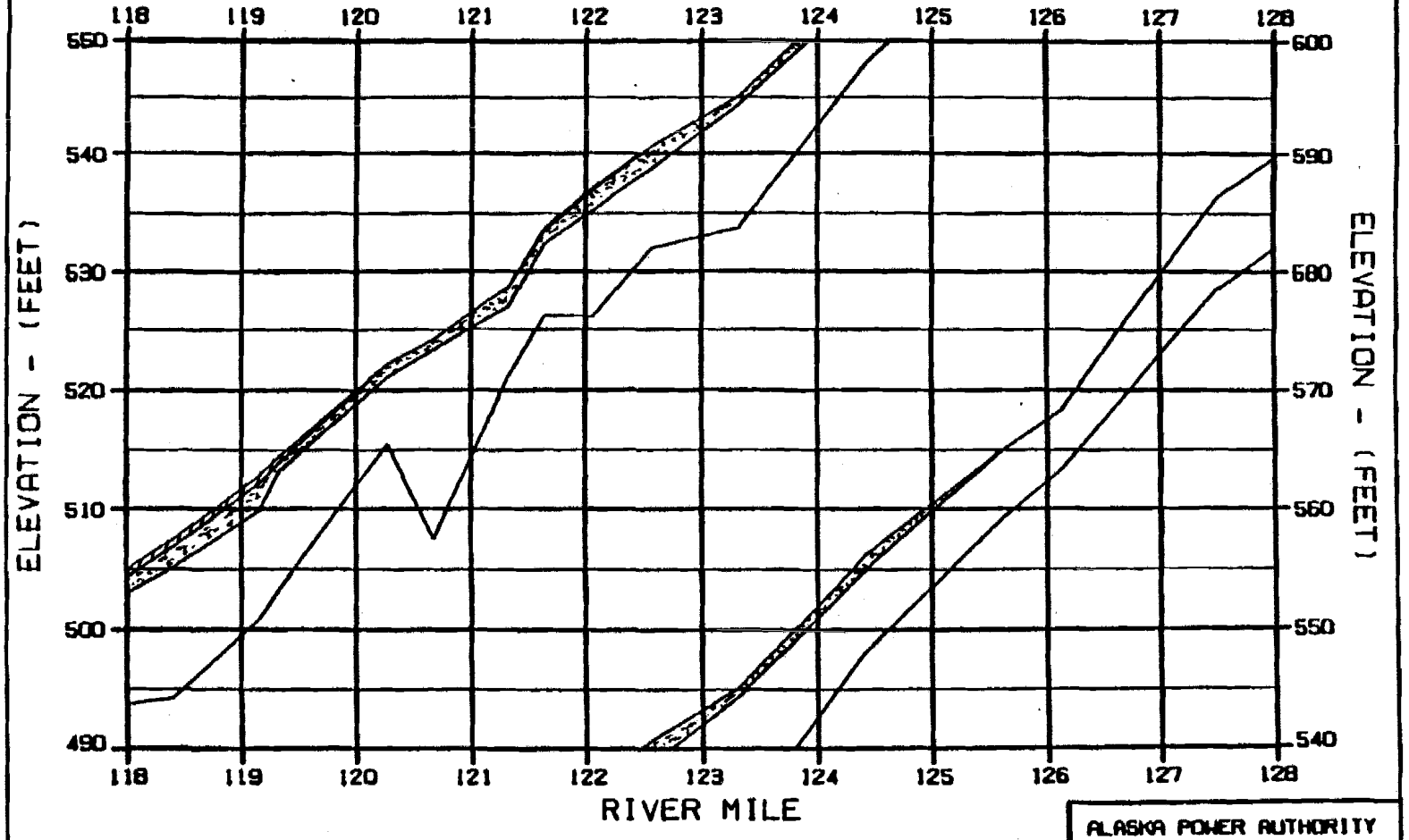
SUSITNA PROJECT

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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP. INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

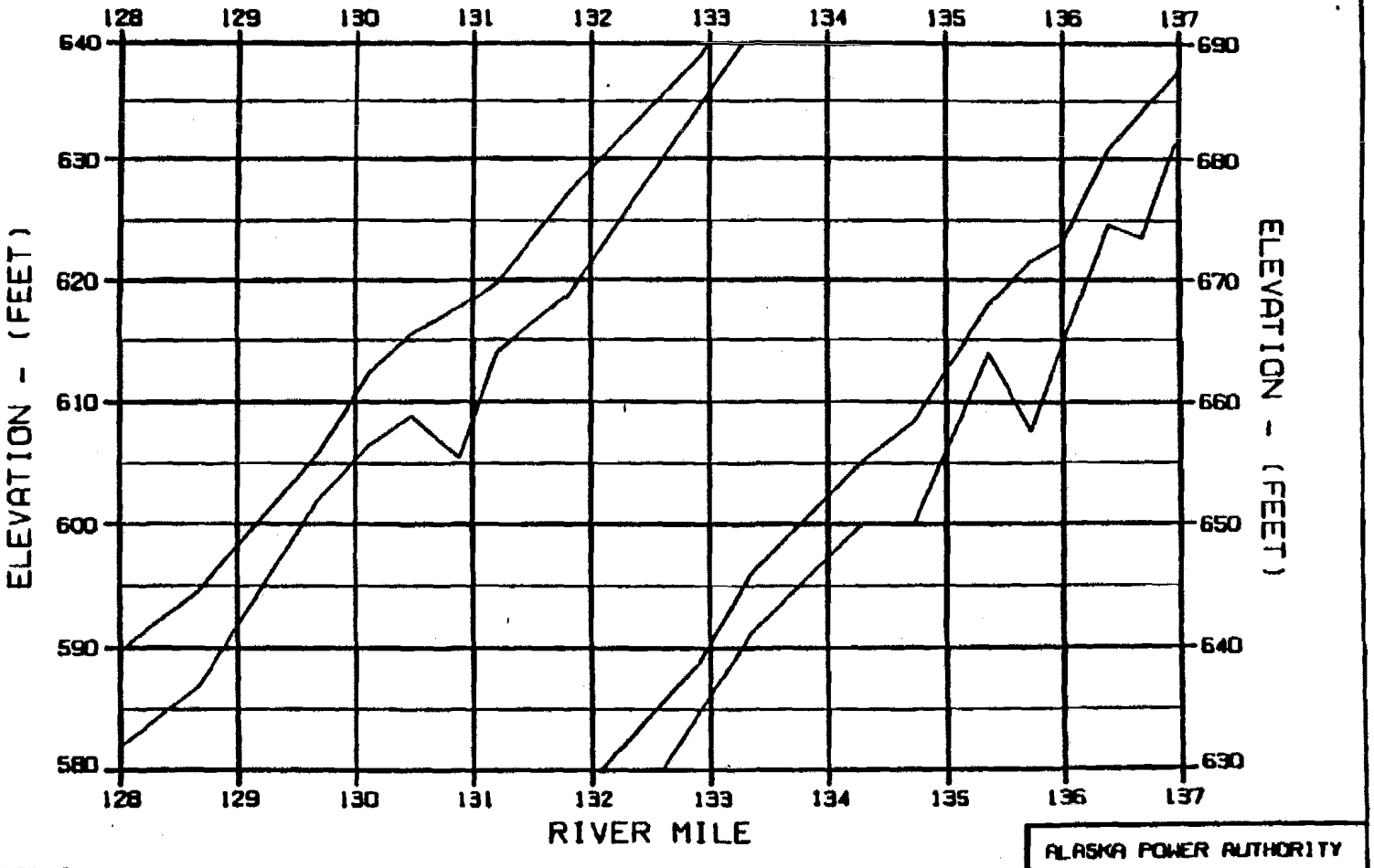
SUSITNA PROJECT

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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

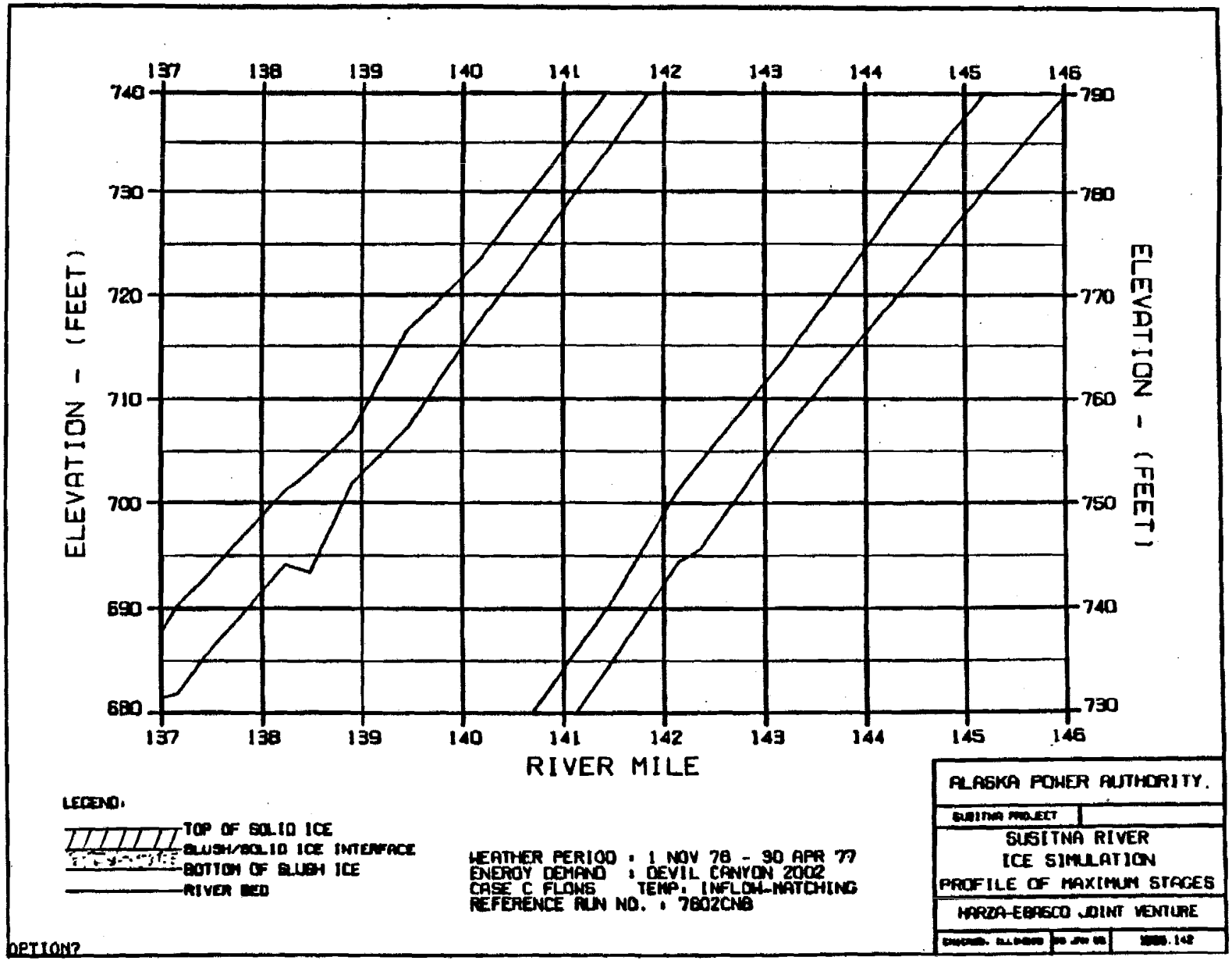
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

OPTION2

C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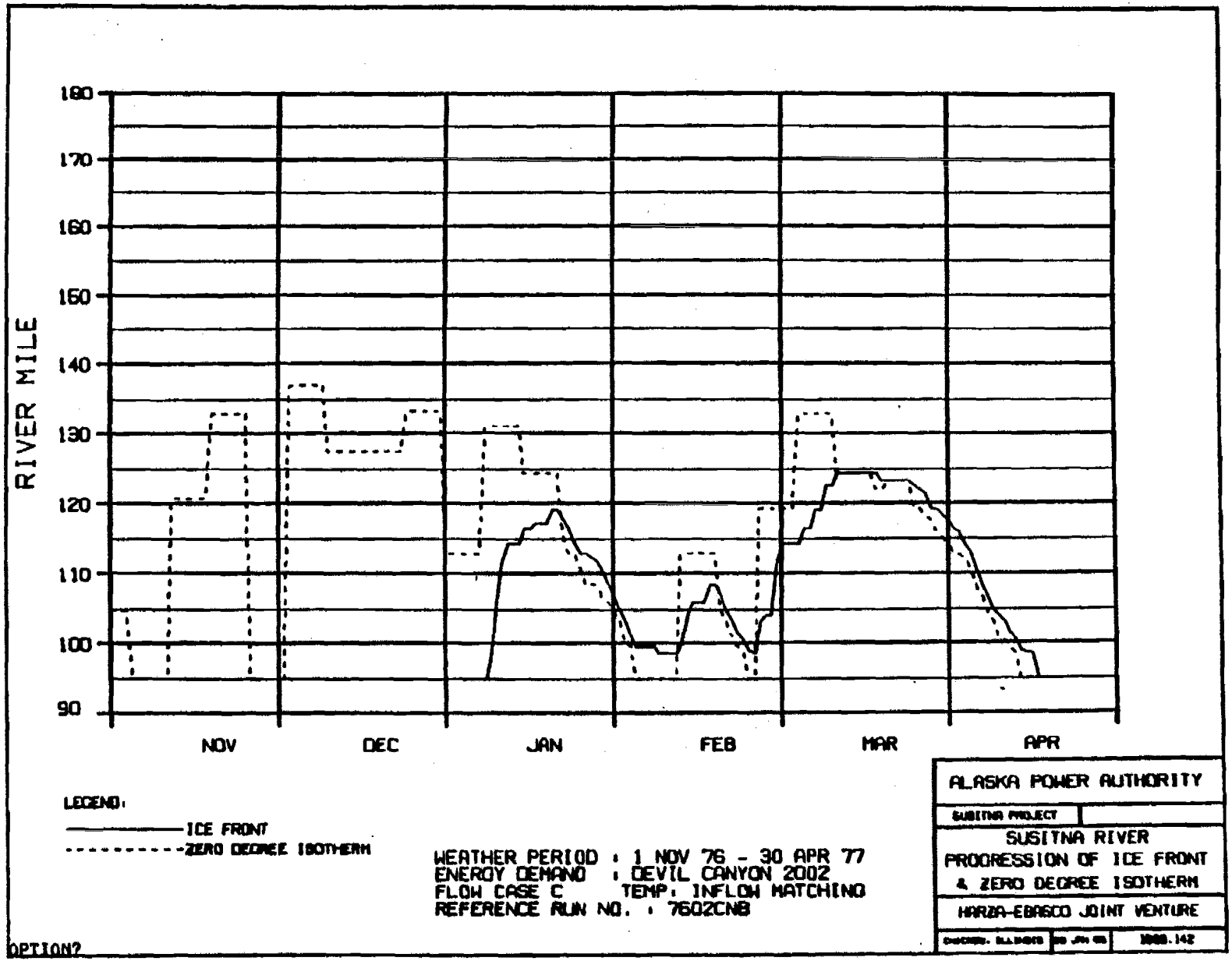
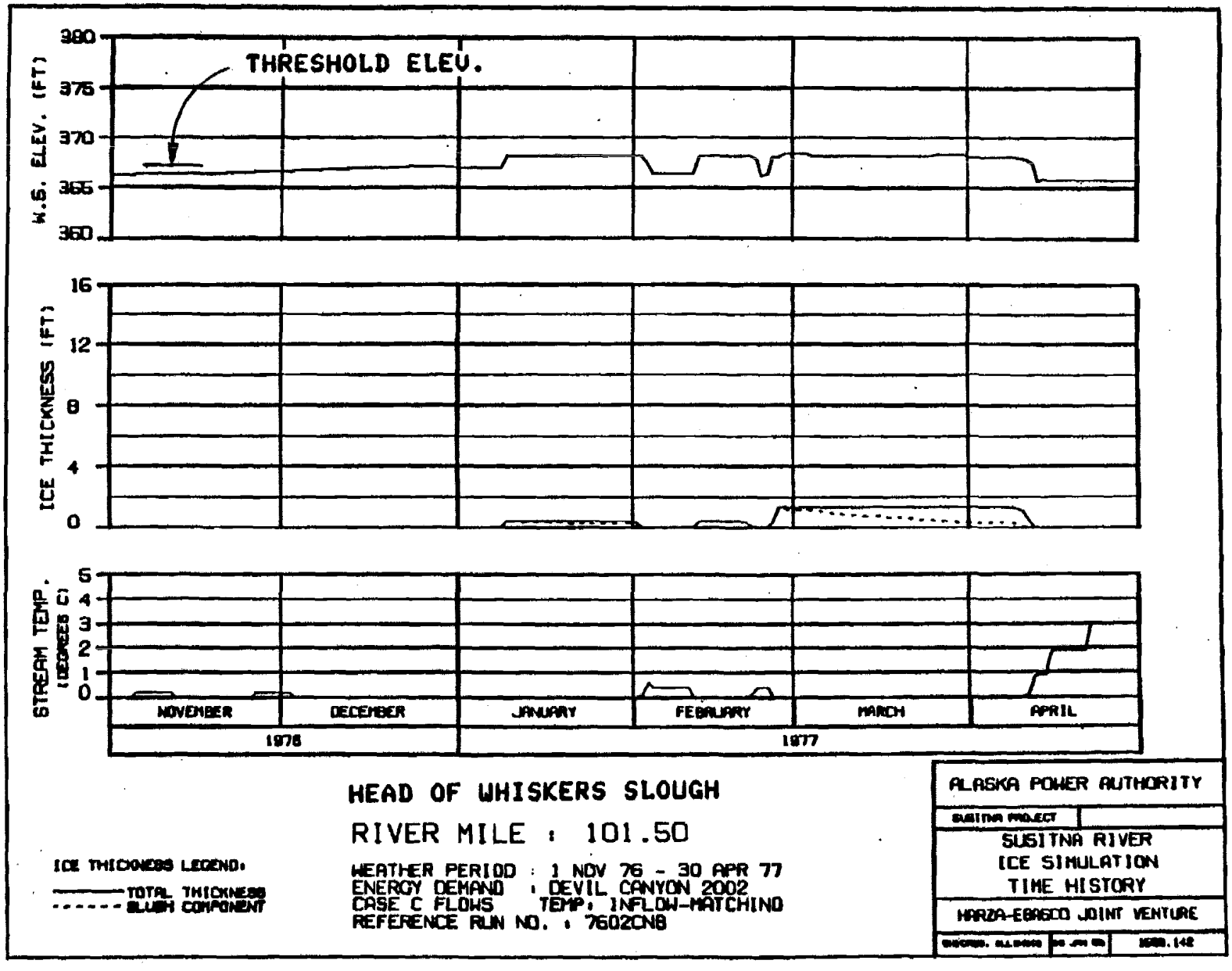
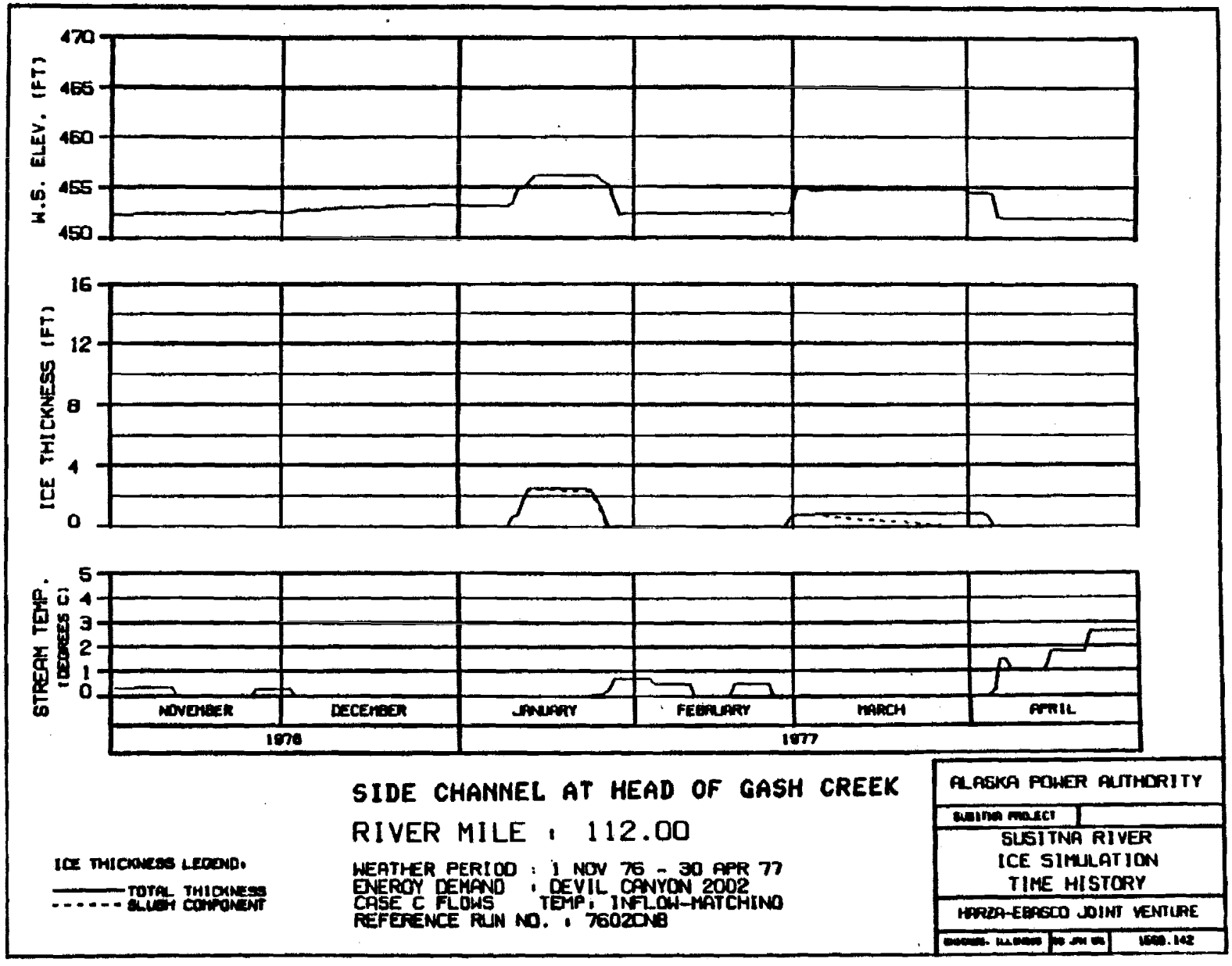
770
760
750
740
730
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7802CNB
ALASKA POWER AUTHORITY.
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

C


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 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
FLOW CASE C TEMP: INFLOW MATCHING
REFERENCE RUN NO. : 7602CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE
1988.142
OPTION?


W.S. ELEV. (FT)
380
375
370
365
360
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF WHISKERS SLOUGH
RIVER MILE : 101.50
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



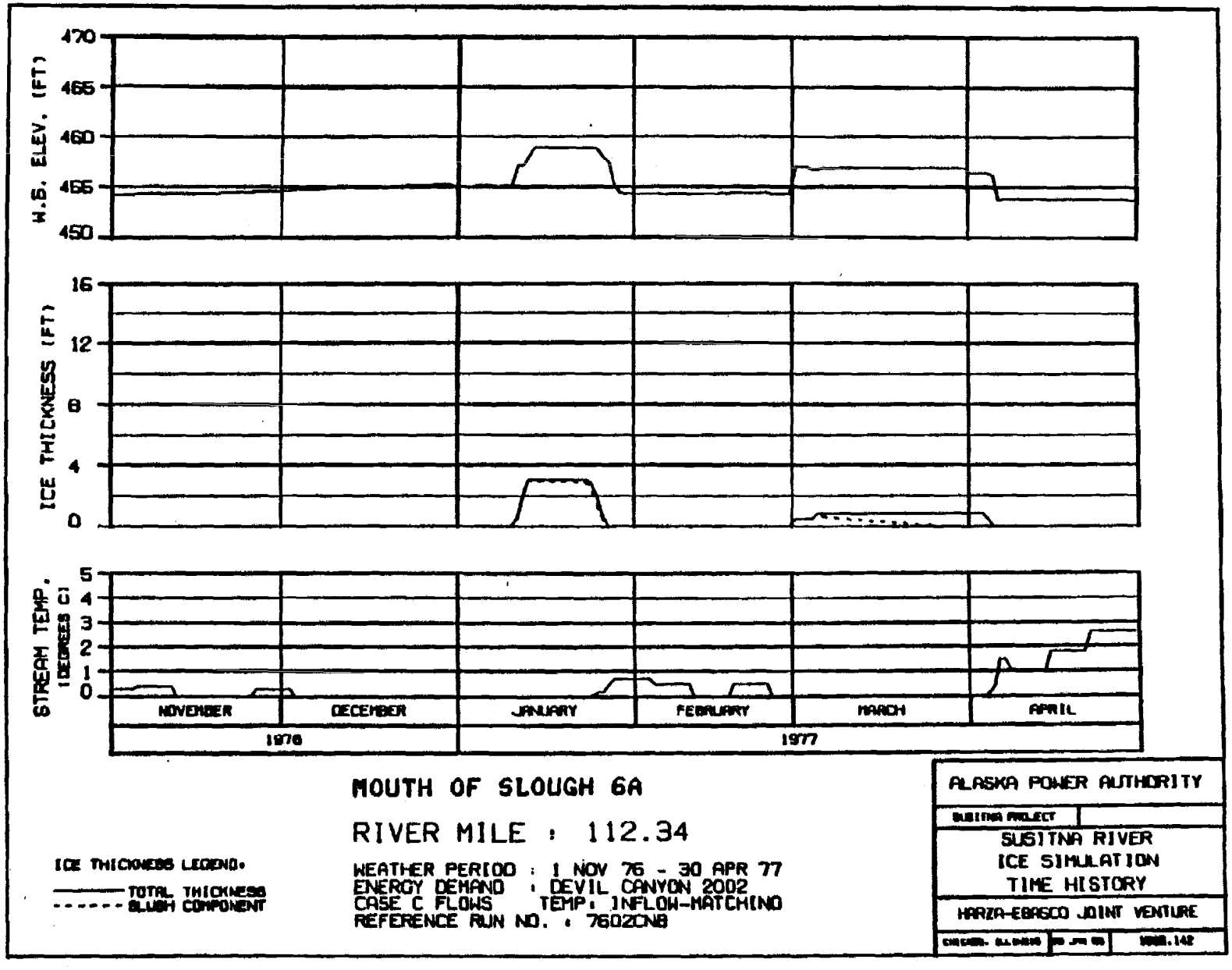
SIDE CHANNEL AT HEAD OF GASH CREEK

RIVER MILE : 112.00

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

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

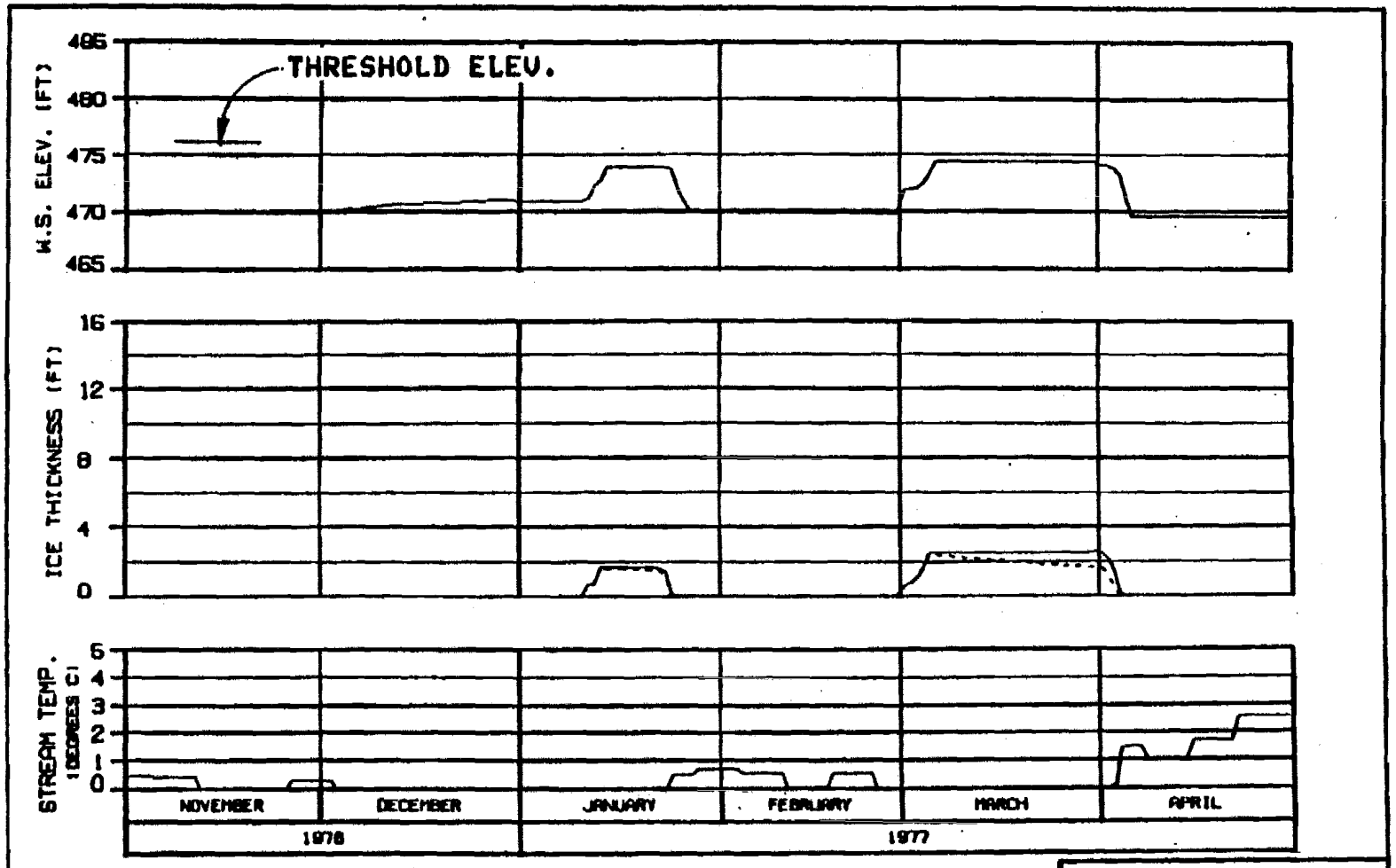
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

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:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

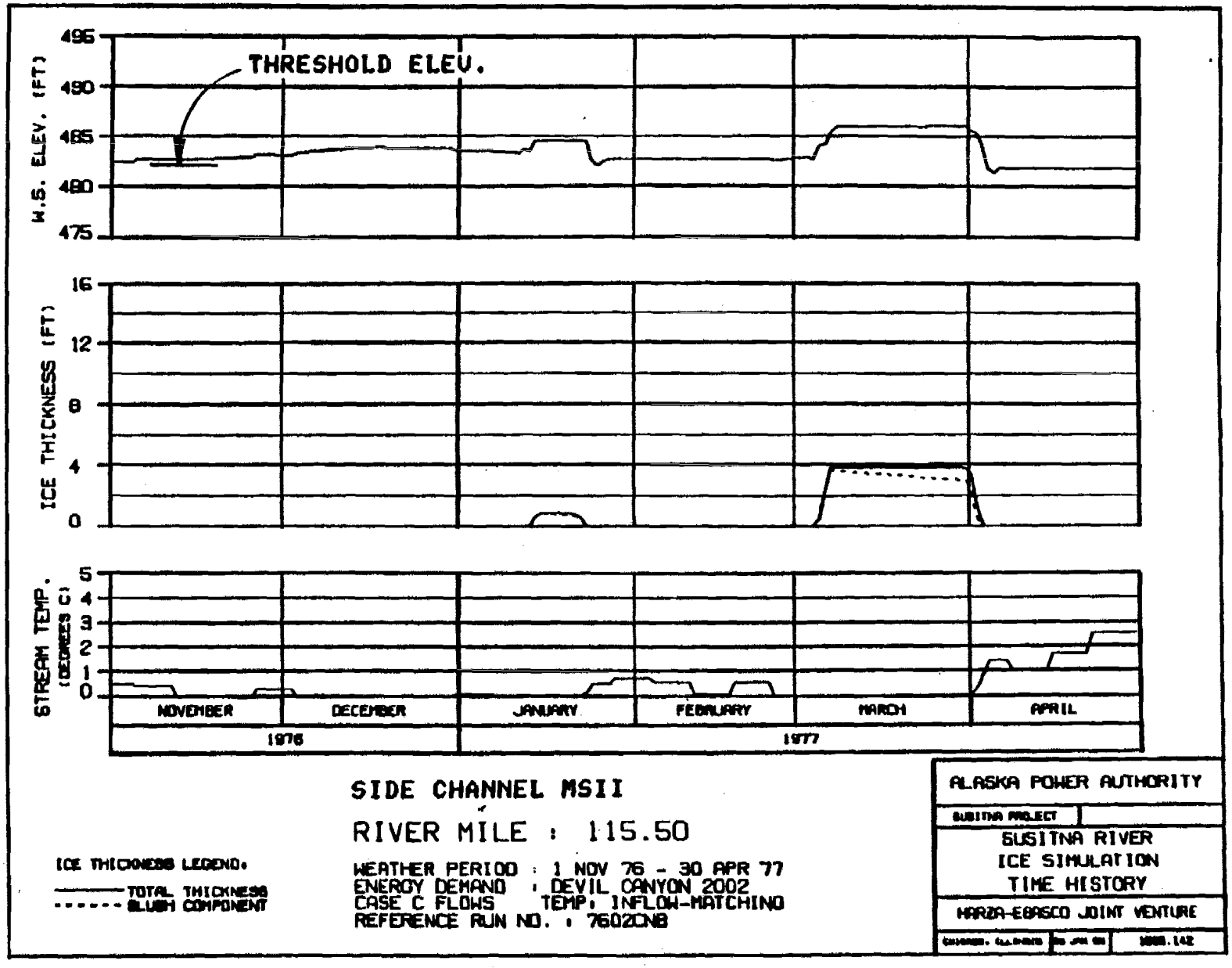
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 30 JAN 85 | 8688.142



SIDE CHANNEL MSII

RIVER MILE : 115.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

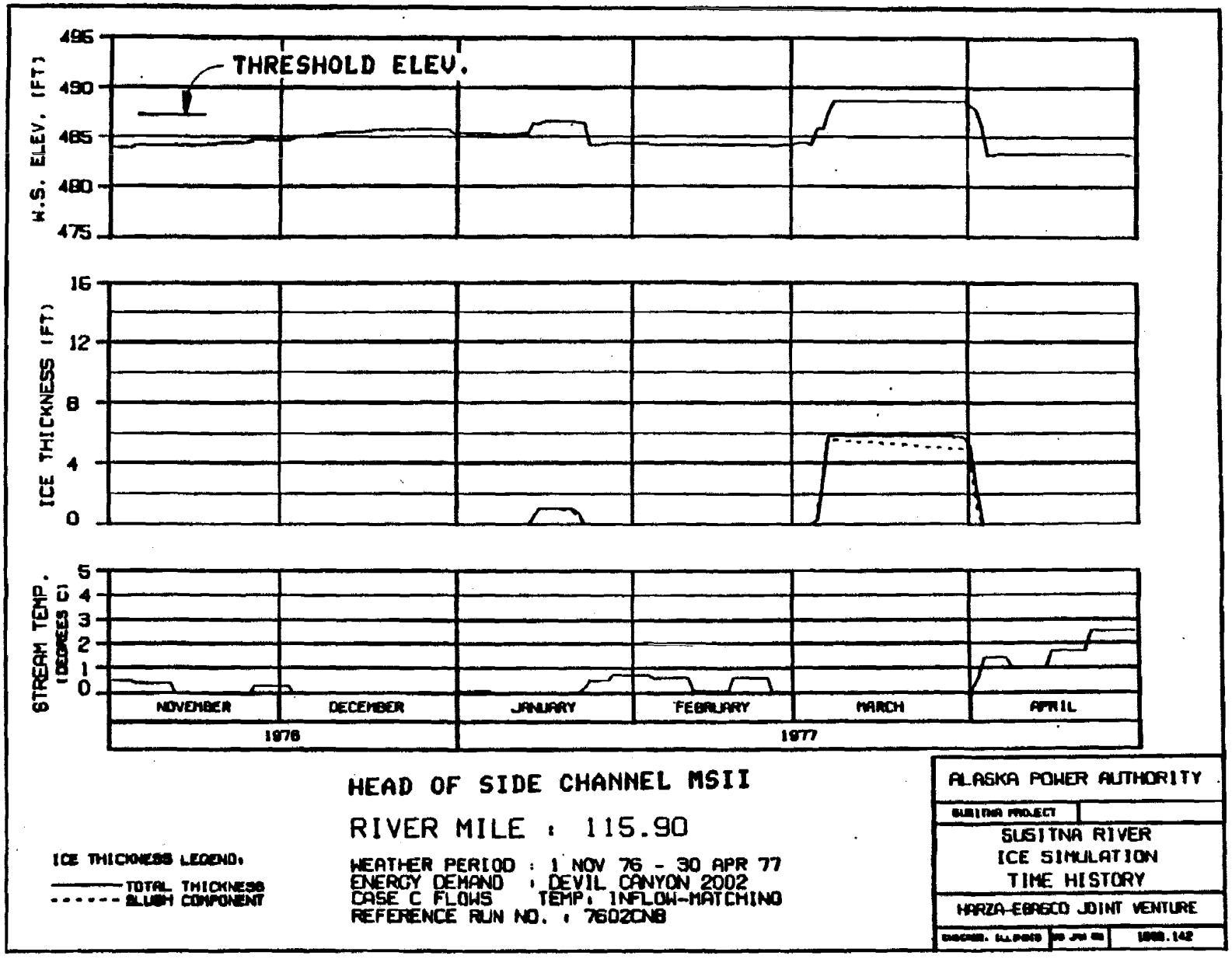
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



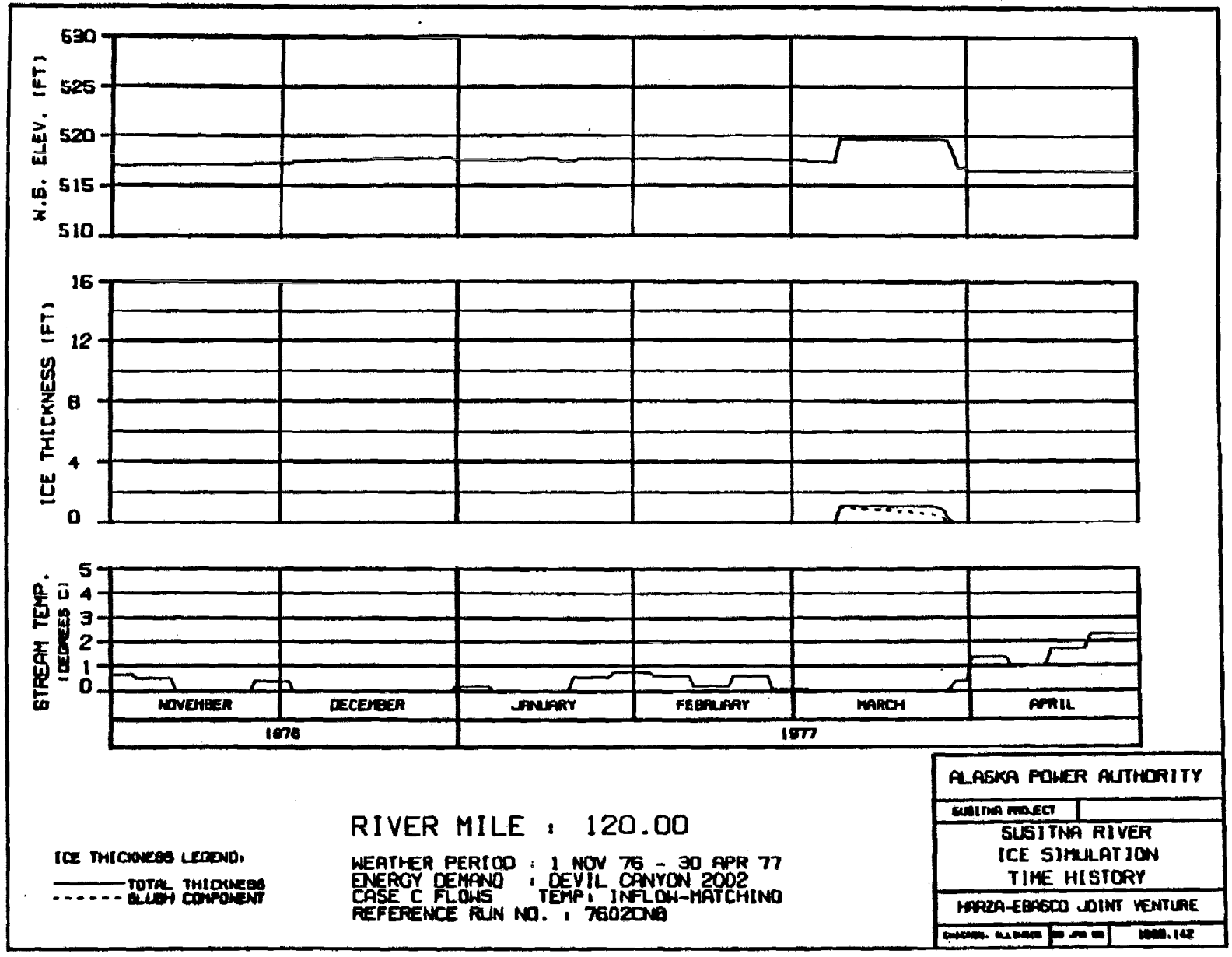
HEAD OF SIDE CHANNEL MSII

RIVER MILE : 115.90

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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



ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

RIVER MILE : 120.00

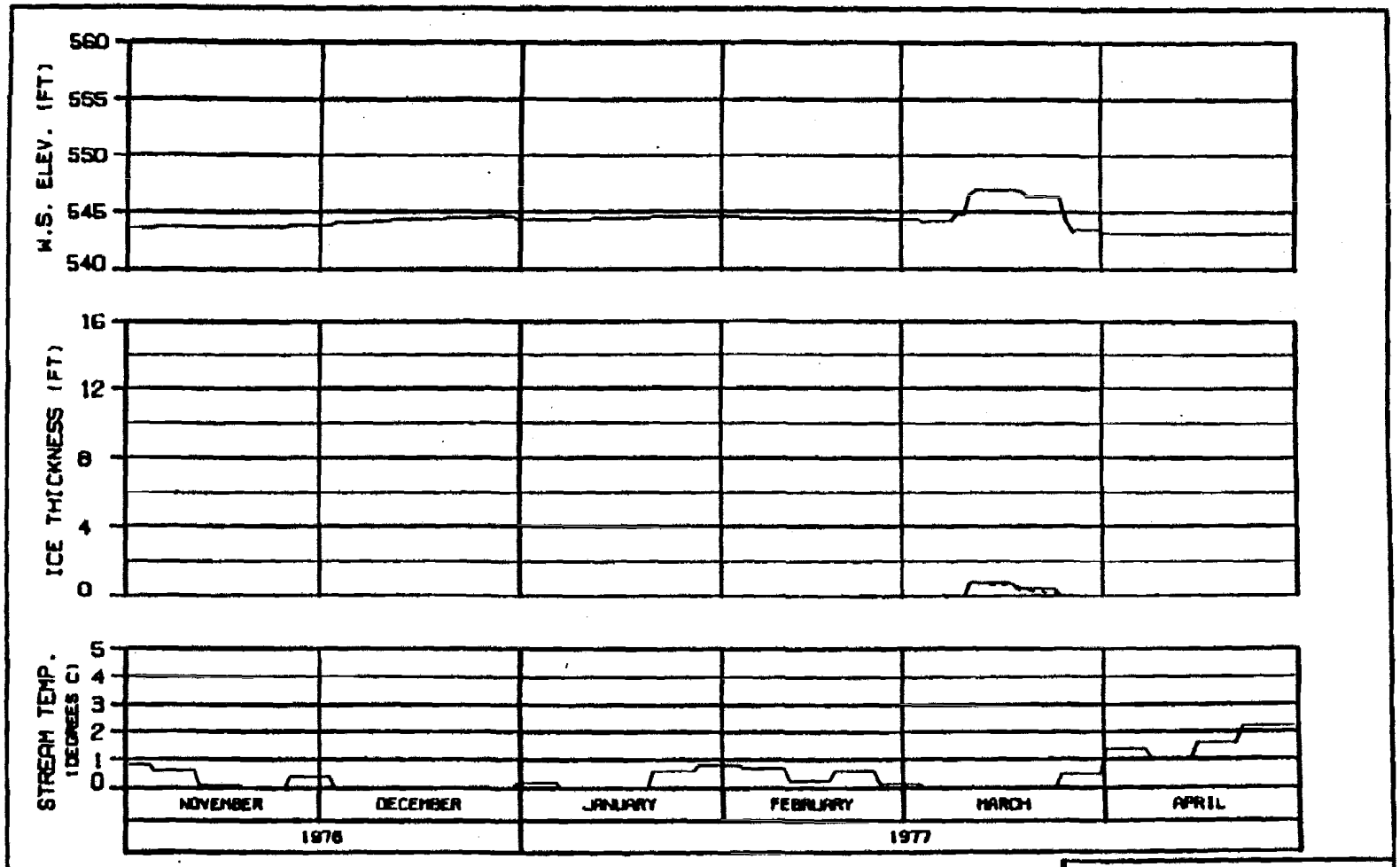
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

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

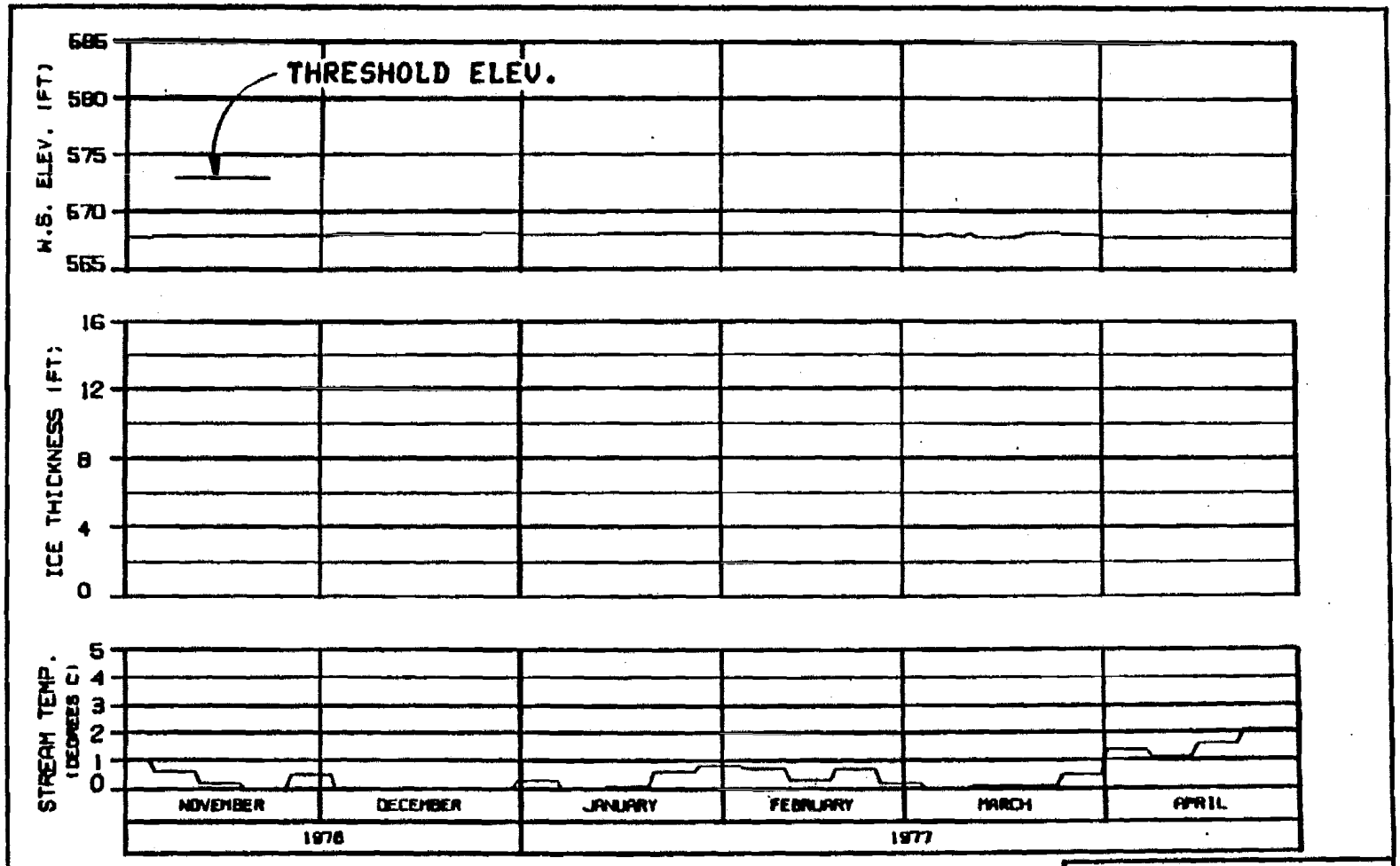
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

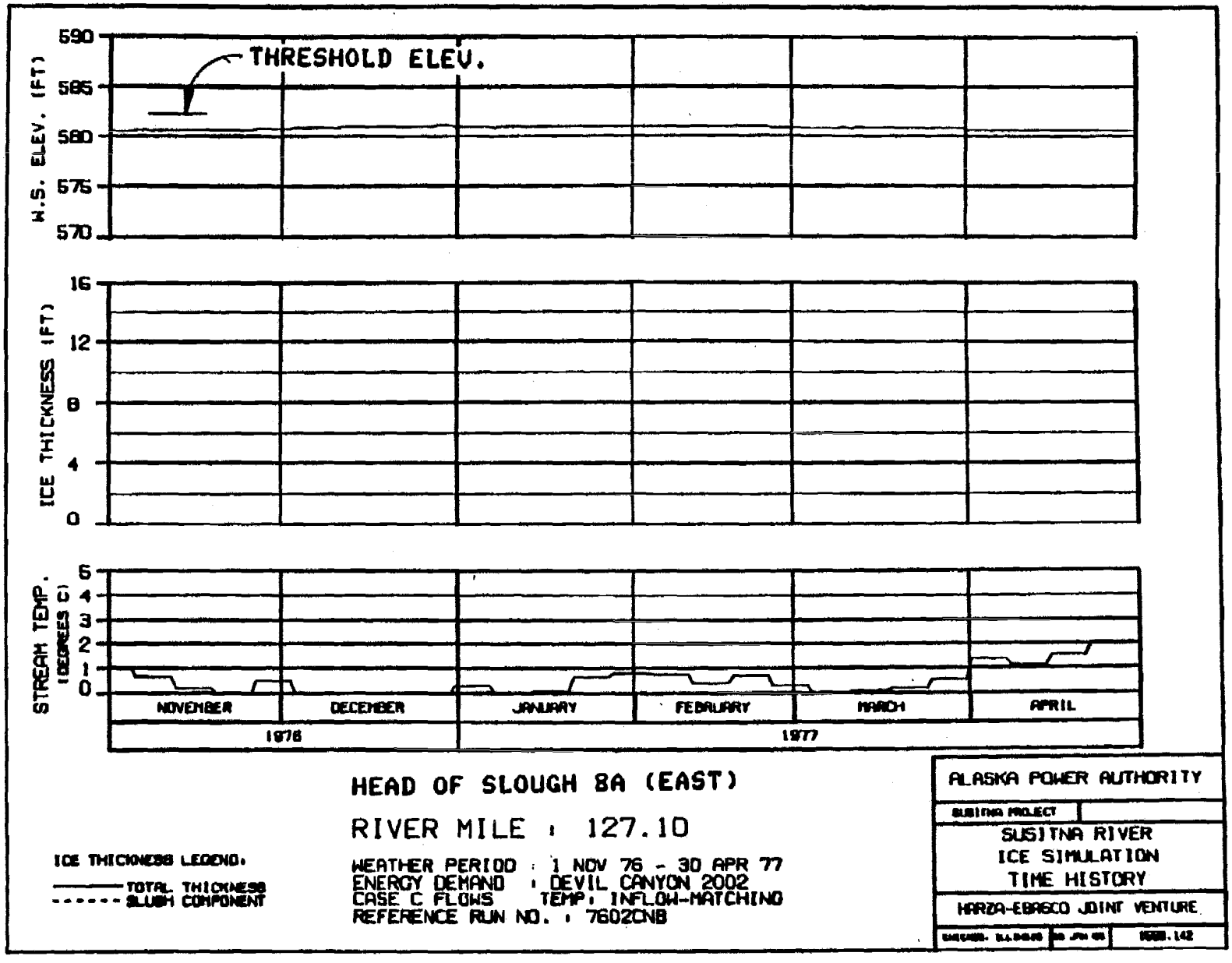
ALASKA POWER AUTHORITY

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:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

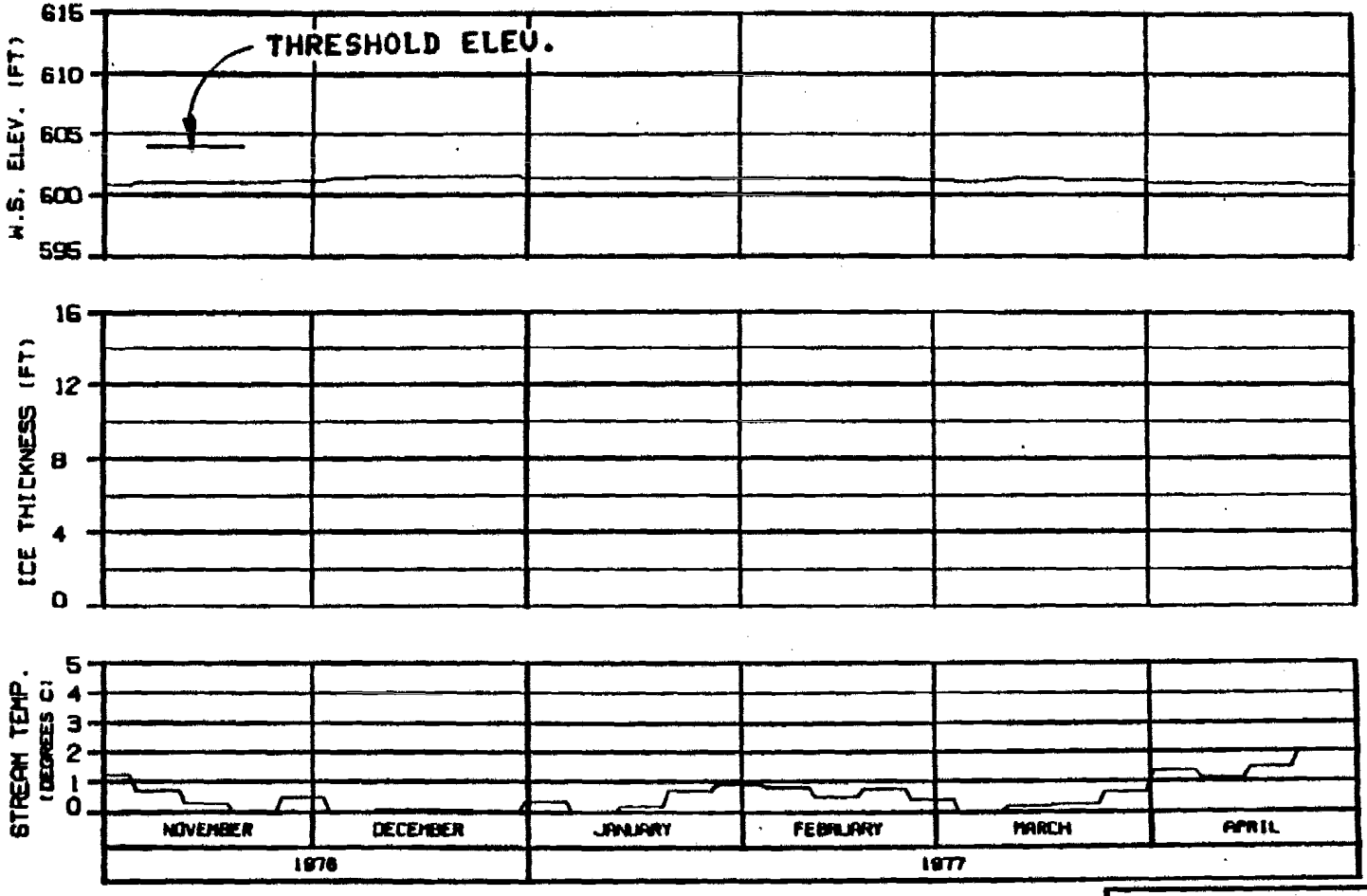
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

C

STOP



HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP. INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

OPTION?

ALASKA POWER AUTHORITY

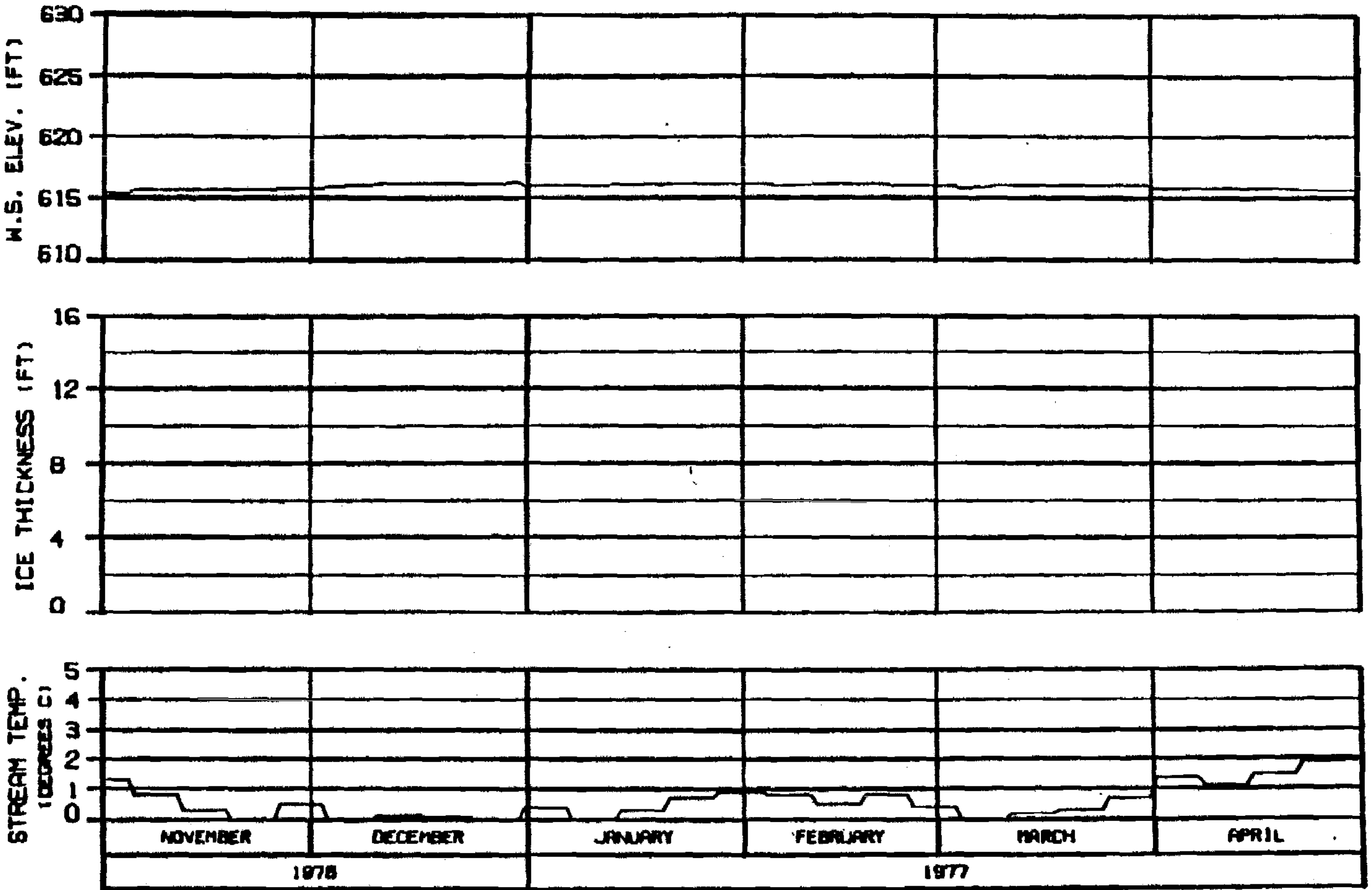
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

DRAWING ILLINOIS | 85 JAN 16 | 1983.142

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

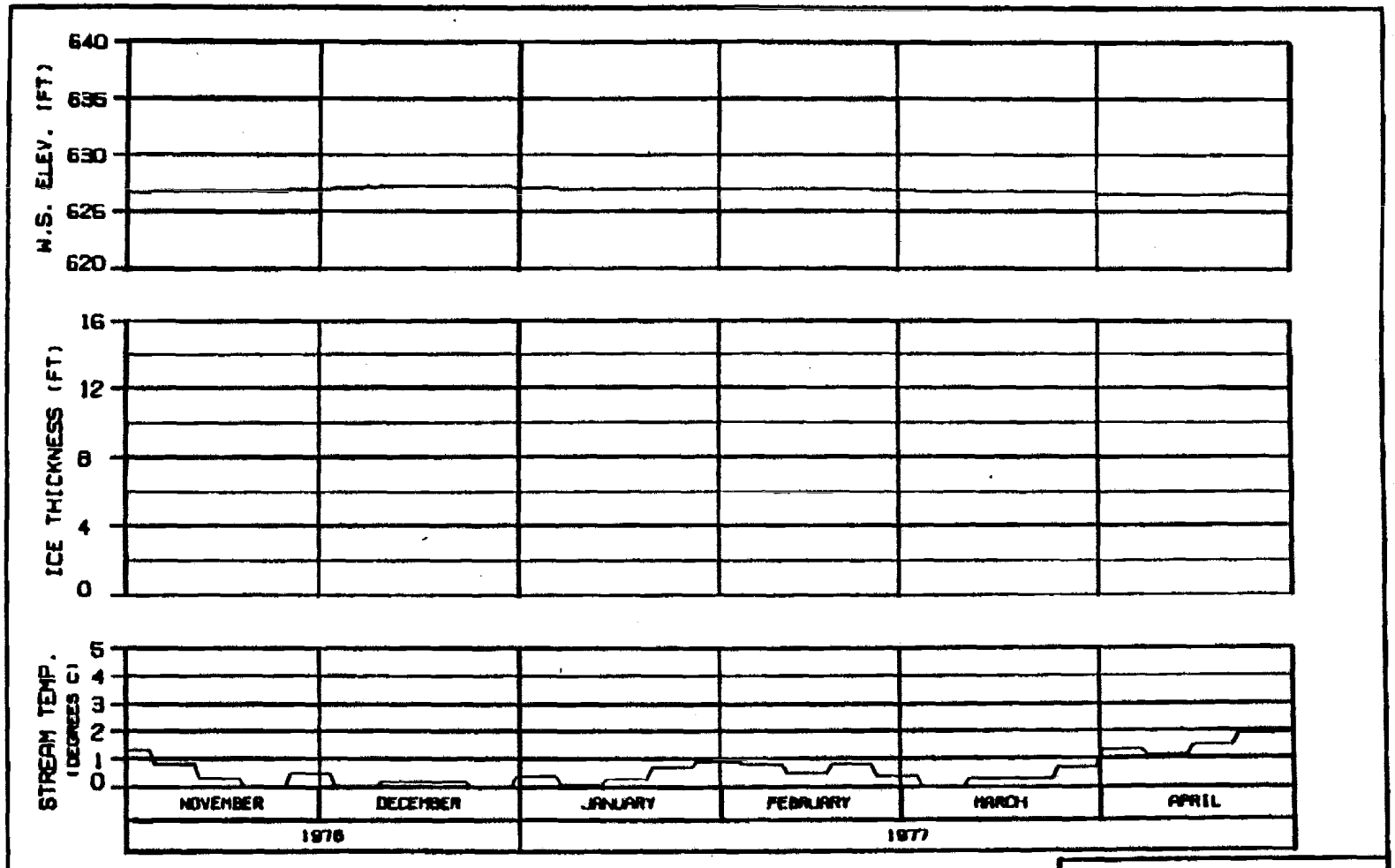
RIVER MILE : 130.60

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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

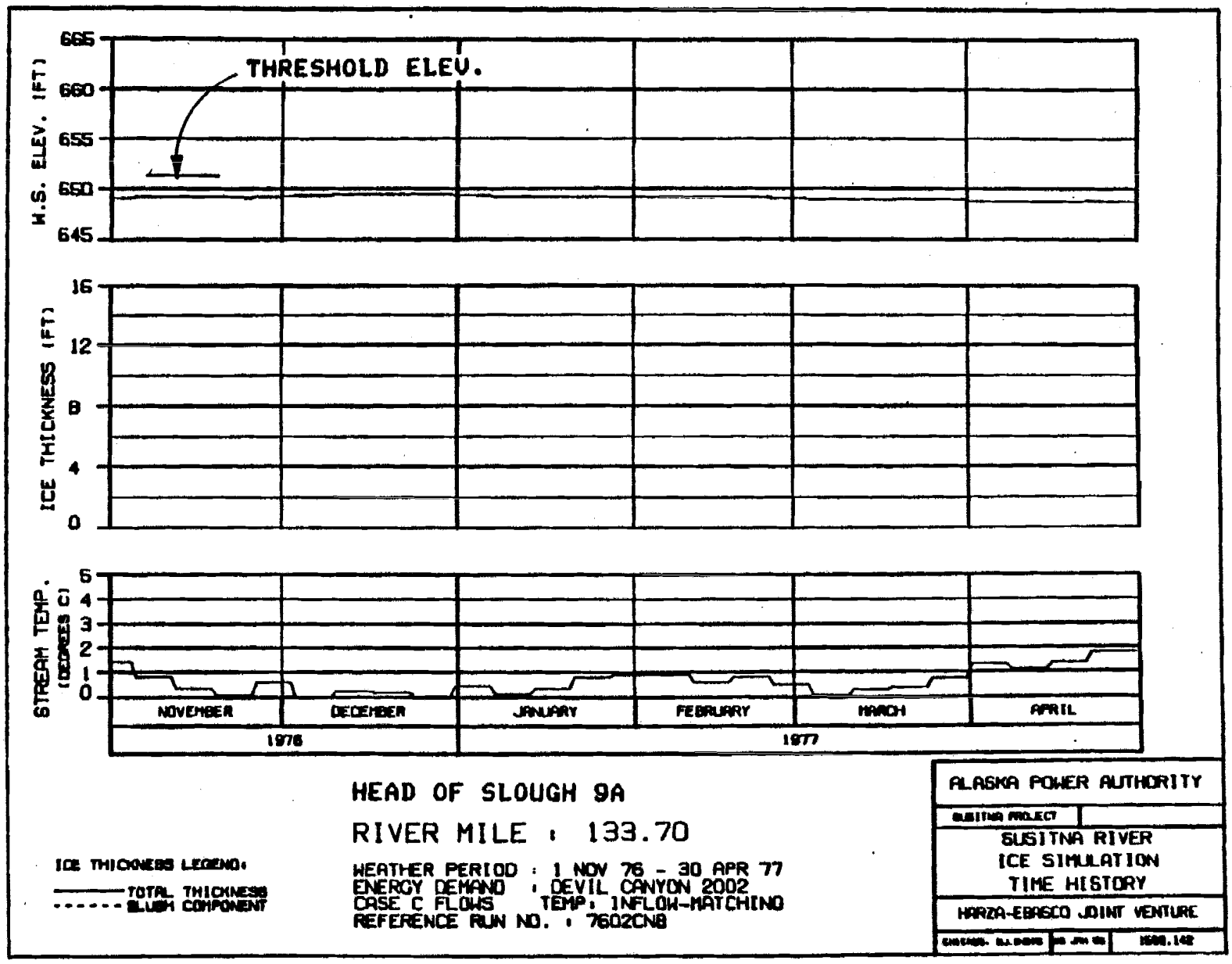
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 9A

RIVER MILE : 133.70

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

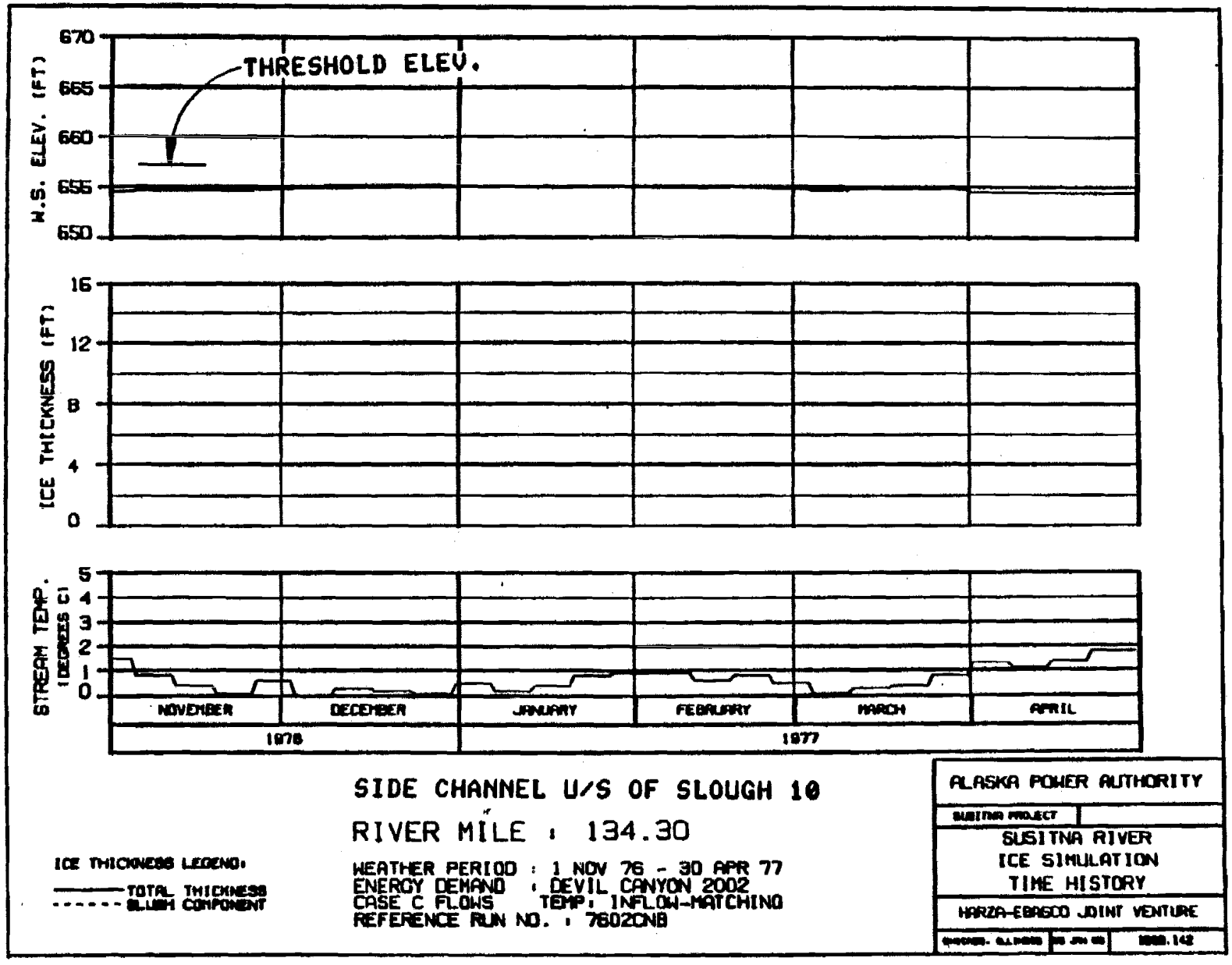
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | JOB NO. 1598.142



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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

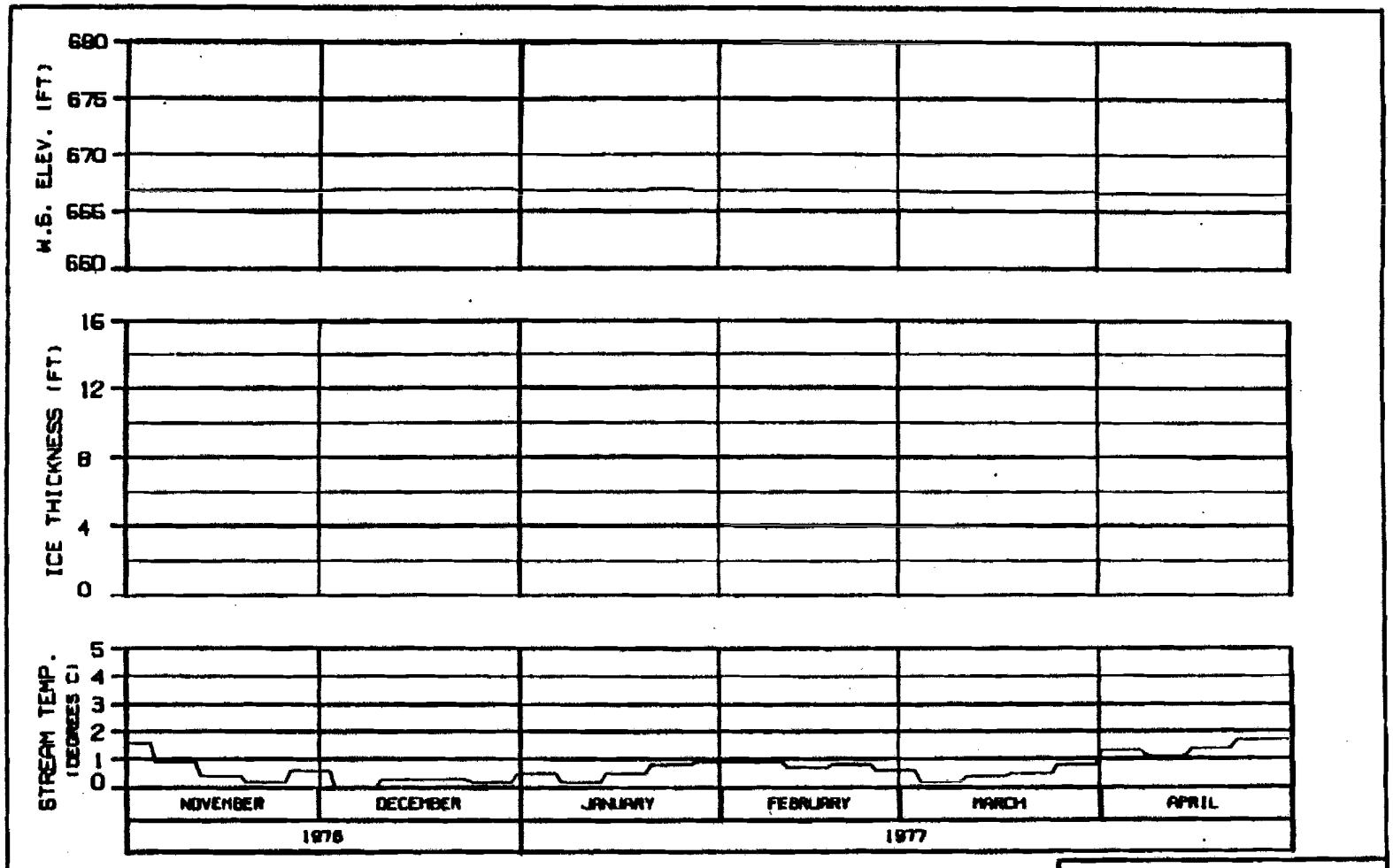
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1988.142



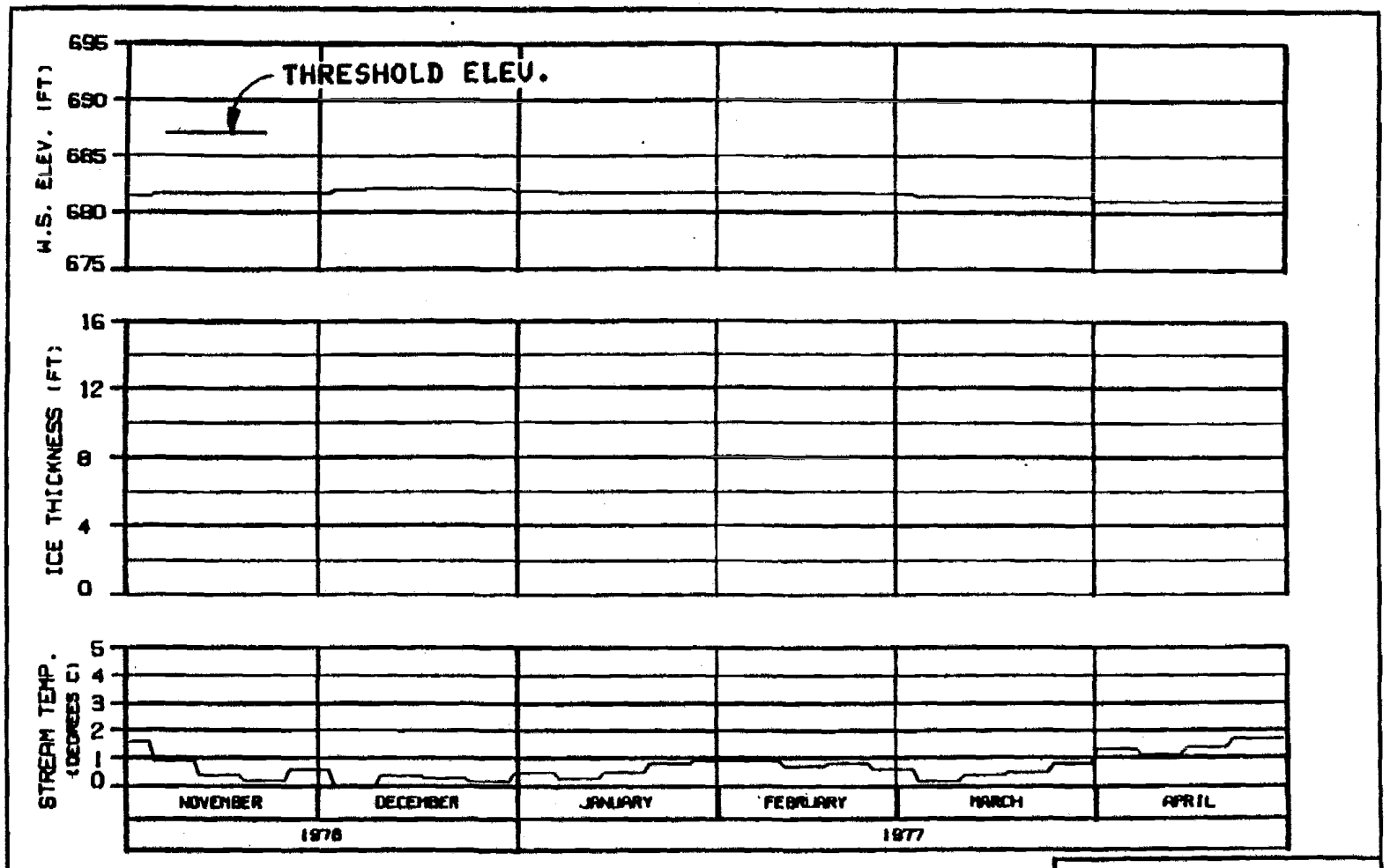
SIDE CHANNEL D/S OF SLOUGH 11

RIVER MILE : 135.30

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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



HEAD OF SLOUGH 11

RIVER MILE : 136.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

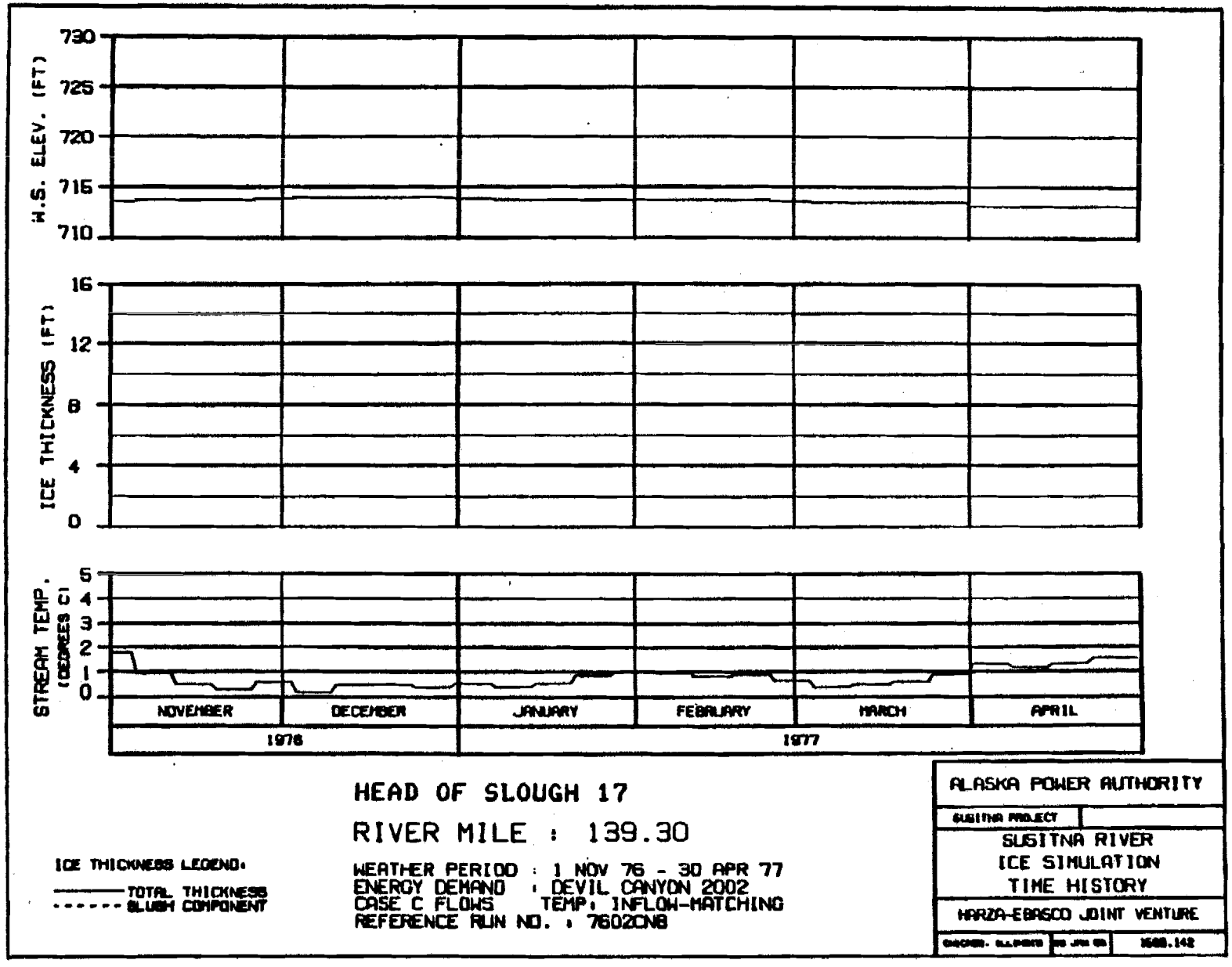
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE



HEAD OF SLOUGH 17

RIVER MILE : 139.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

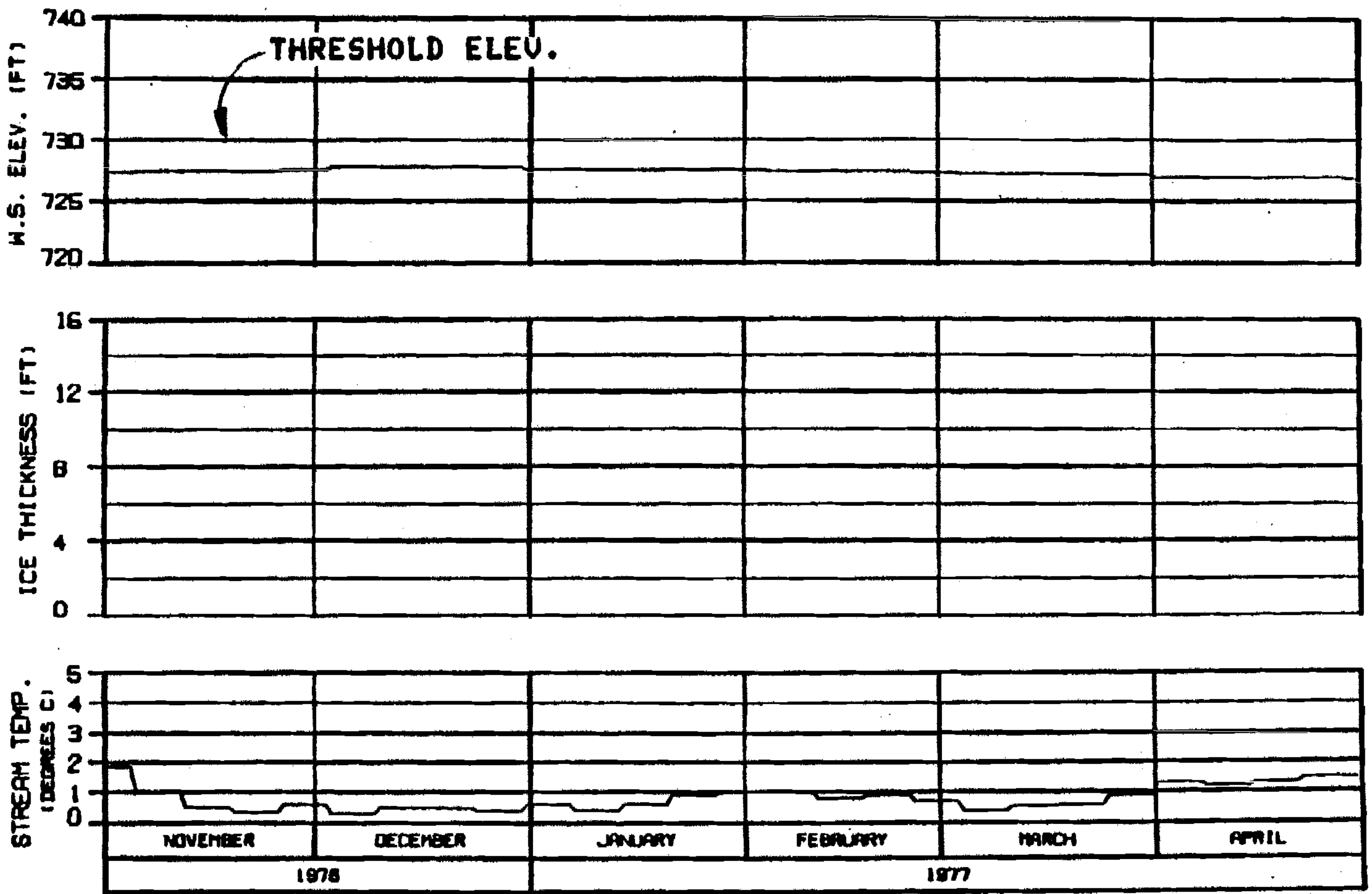
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1588.142



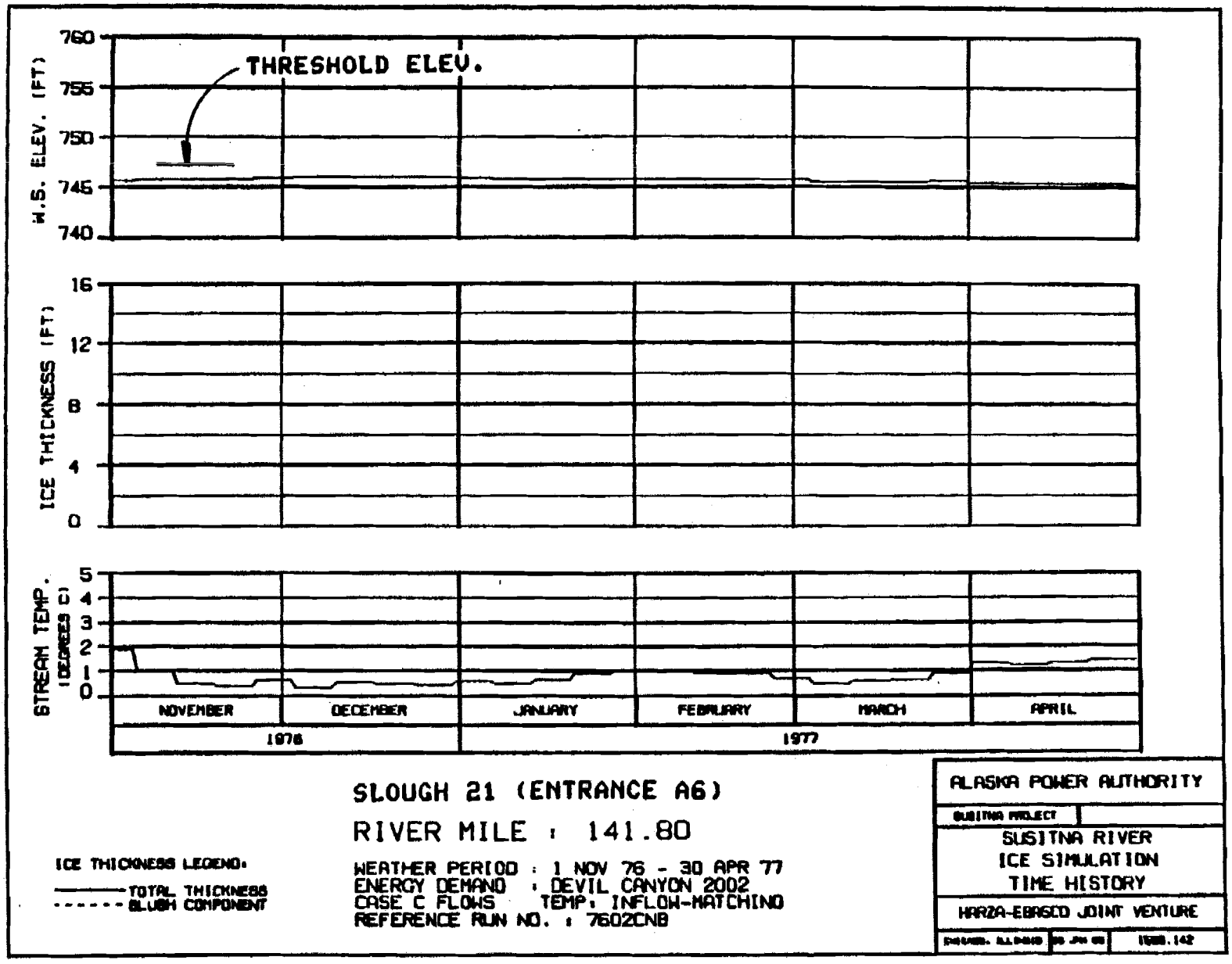
HEAD OF SLOUGH 20

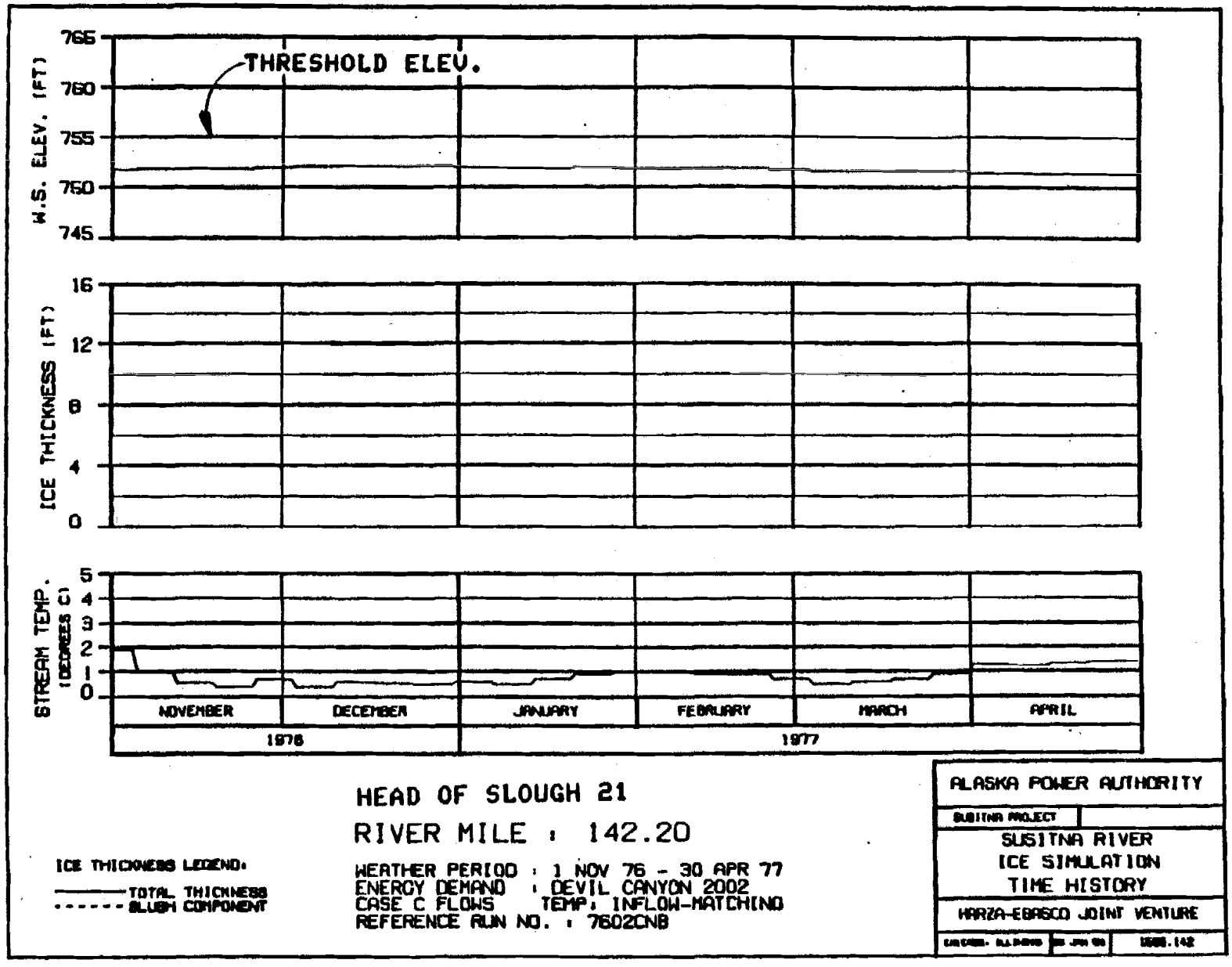
RIVER MILE : 140.50

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

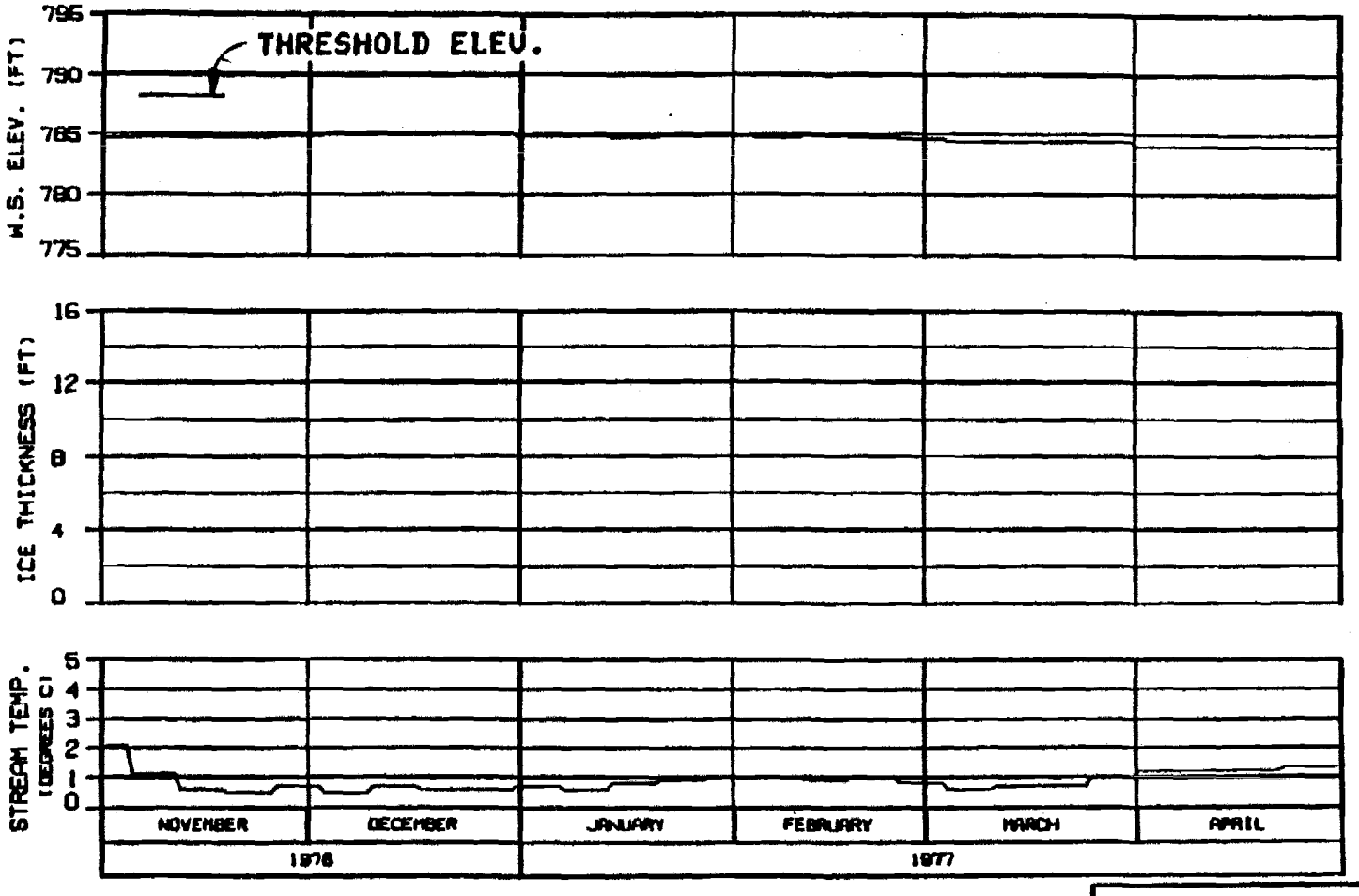
ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

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


W.S. ELEV. (FT)
760
755
750
745
740
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
SLOUGH 21 (ENTRANCE A6)
RIVER MILE : 141.80
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE


W.S. ELEV. (FT)
765
760
755
750
745
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF SLOUGH 21
RIVER MILE : 142.20
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
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:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

OPTION?

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] 06 JAN 86 [illegible]

APPENDIX - I

Refinement to Reservoir and River
Temperature and Ice Studies
For Simulation Period
October 1976 to May 1977

Text Changes and
New Exhibits
G and N

For

Instream Ice Simulation Study by Harza-Ebasco for the Alaska Power Authority. Transmitted to the Federal Energy Regulatory Commission on November 2, 1984.

42164312
850204

SUSITNA HYDROELECTRIC PROJECT
INSTREAM ICE SIMULATION STUDY
FINAL REPORT, OCTOBER 1984
DOCUMENT NO. 1986

ERRATA

TEXT

a) Section 3.3, first paragraph, 4th sentence should read, "The maximum upstream extent of the ice front ranges from River Mile 126 (1976-77 winter) to River Mile 140 (1971-72 winter)."

b) Section 3.3, third paragraph should read, "The mildest simulated river ice conditions for the 1996 energy demand occur for the winter of 1976-77 (Exhibit G). Maximum total ice thicknesses for this simulation range from 1 ft. to 6 ft., of which 1 ft. is solid ice. These thicknesses exist downstream of River Mile 126 and are generally similar to those of natural 1976-77 conditions in the same reach. However, the maximum with-project river stages in this reach are 2 ft. to 7 ft. higher than natural conditions due to the higher with-project winter flows. Maximum river stages for the 1976-77 with-project simulation are 1 ft. to 8 ft. lower than those of the 1971-72 simulation."

c) Section 3.3, fourth paragraph, fourth sentence should read, "Maximum extent of the ice cover with the warm releases is River Mile 126, versus River Mile 140 with inflow-matching release temperatures."

d) Section 3.5, first paragraph, second sentence should read, "Results show that the beginning of the ice front progression at the Chulitna confluence ranges from early December to early January, approximately 0-2 weeks later than the corresponding Watana-only simulations, and 4-7 weeks later than natural conditons for the same winters."

e) Section 3.5, first paragraph, third sentence should read, "Maximum upstream extent of the ice front ranges from River Mile 123 to 137, and is 2-13 miles downstream of that with Watana only and 1996 energy demand."

f) Section 3.5, third paragraph, fourth sentence should read, "Maximum river stages, where an ice cover exists, are 1 ft. to 6 ft. higher than corresponding natural conditions."

g) Section 4.0, item number one, first sentence should read, "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 6 weeks with Watana operating alone, and 4 to 7 weeks with Watana and Devil Canyon operating together."

TABLES

Replace Tables IV, V, VI, VII, VIII and IX with the corresponding new tables attached.

EXHIBITS

Replace Exhibits G and N with the corresponding new Exhibits attached. (Reference Run #7696CNB replaces #7696CNA, and Reference Run #7602CNB replaces #7602CNA).

SUSITNA HYDROELECTRIC PROJECT
MAXIMUM SIMULATED WINTER RIVER STAGES

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	1971-72[W]	1971-72	1982-83	1971-72	1976-77	1981-82	1982-83	1971-72	1982-83	1982-83	1981-82
Whiskers	101.5	367	[369]	366	[368]	[367]	[372]	[370]	[371]	[370]	[371]	[372]	[370]	[371]	[368]	[369]	[369]	[372]	[370]	367	367
Gash Creek	112.0	Unknown	456	455	455	456	459	457	460	459	460	459	461	458	456	456	457	459	457	455	455
6A	112.3	(Upland)	459	457	457	459	462	460	462	462	463	461	463	460	459	458	460	461	459	457	457
8	114.1	476	474	472	472	474	[478]	475	[477]	[476]	[477]	[476]	[478]	475	474	475	475	[476]	475	473	473
MS II	115.5	482	[484]	480	[484]	[484]	[490]	[486]	[488]	[488]	[488]	[489]	[489]	[487]	[486]	[485]	[487]	[490]	[488]	481	[483]
MS II	115.9	487	485	482	486	486	[492]	[489]	[491]	[491]	[490]	[491]	[492]	[489]	[489]	[488]	[490]	[492]	[490]	485	486
Curry	120.0	Unknown	522	520	523	520	526	525	527	525	523	525	521	522	520	520	520	525	523	520	521
Moose	123.5	Unknown	552	546	549	548	556	552	555	550	552	555	550	553	547	548	545	555	550	546	548
8A West	126.1	573	572	569	571	570	[576]	[574]	[574]	572	572	[575]	568	[574]	568	568	568	[575]	572	568	570
8A East	127.1	582	[584]	581	[583]	[582]	[587]	[583]	[585]	[582]	[582]	[586]	581	[584]	581	580	581	[585]	[582]	580	[582]
9	129.3	604	[605]	603	[606]	[605]	[609]	603	[607]	603	603	[610]	603	[606]	601	601	602	[608]	603	602	603
9 u/s	130.6	Unknown	622	616	620	621	624	617	620	617	617	625	617	620	616	616	616	621	617	616	618
4th July	131.8	Unknown	632	626	629	630	635	628	631	628	628	636	628	633	627	627	627	631	628	625	628
9A	133.7	651	[655]	649	[651]	[651]	[657]	650	[653]	650	650	[659]	650	[652]	650	650	650	[651]	650	650	650
10 u/s	134.3	657	[662]	654	[657]	[658]	[663]	658	[659]	656	656	[665]	656	[659]	655	655	655	[657]	656	[658]	655
11 d/s	135.3	Unknown	673	667	670	672	675	667	670	668	668	676	668	670	667	667	667	668	668	670	668
11	136.5	687	684	681	683	684	[688]	684	[687]	683	683	[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	–	–	–	–	[732]	729	729	729	729	[741]	729	728	728	728	728	729	729	727	729
21 (A6)	141.8	747	–	–	–	–	746	746	746	746	745	[751]	746	746	746	745	746	[747]	[747]	745	745
21	142.2	755	–	–	–	–	753	753	753	753	753	[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. [ ] Indicates locations where maximum river stage equals or exceeds a known slough threshold elevation. See Exhibits A-T for duration of overtoppings.
2. "Case C" operating guide is assumed for with-project simulations.
3. 1971-72[W] simulation assumes warm, 4° C reservoir releases. All other with-project simulations assume an "inflow-matching" temperature policy.
4. Upstream extent of simulated ice cover progression for Watana filling occurs upstream of River Mile 144.8.
5. All river stages in feet.
6. Winter air temperatures:
   1971-72 cold
   1976-77 very warm
   1981-82 average
   1982-83 warm

TABLE V

SUSITNA HYDROELECTRIC PROJECT
OCCURRENCES 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	6/6	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	2/6	0/2
Moose	123.5	6/6	4/6	0/2
8A West	126.1	5/6	3/6	0/2
8A East	127.1	4/6	1/6	0/2
9	129.3	3/6	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	2/6	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" operating guide and "inflow-matching" reservoir release temperatures are assumed for with-project simulations.

TABLE VI

SUSITNA HYDROELECTRIC PROJECT
EXPECTED PROJECT EFFECTS ON WINTER SLOUGH OVERTOPPING

Slough or Side Channel	River Mile	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[W]	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
9	114.1	X		X	X	X	X	X					X			
MS II	116.6		X							X					O	
MS II	116.9	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			O	O			O	
9	129.3				O	O		O			O	O		O	O	O
9A	133.7				O	O		O			O	O		O	O	O
10 u/s	134.3				O	O		O			O	O		O		O
11	136.5	X		X			X									

LEGEND:

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

NOTES:

1. "Case C" operating guide is 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. Winter air Temperatures:
   - 1971-72 cold
   - 1976-77 very warm
   - 1981-82 average
   - 1982-83 warm

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. 26	April 18	126
1981-82	Dec. 28	April 3	137
1982-83[W]	Dec. 12	Mar. 20	126
1971-72[W]	Dec. 17	Mar. 27	126
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. 8	April 14	124
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	126
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" operating guide is assumed for with-project simulations.
2. 1971-72[W] simulation assumes 4°C reservoir releases. All other with-project simulations assume an "inflow-matching" temperature policy.
3. Weather conditions:
   - 1971-72: Cold winter
   - 1976-77: Very warm winter
   - 1981-82: Average winter
   - 1982-83: Warm winter

TABLE VIII

SUSITNA HYDROELECTRIC PROJECT
TOTAL ICE THICKNESS
MAXIMUM SIMULATED VALUES

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	1971-72[W]	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	1	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	3	3	4	4	1	5	5
8	114.1	5	2	4	4	5	3	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	4	3	4	4	2	3	5
MSII	115.9	5	3	7	6	7	4	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	1	1	1	4	2	4	6
Moose	123.5	10	4	7	5	9	5	8	2	4	6	2	7	1	1		7	2	5	6
8A West	126.1	5	2	3	3	5	2	3	1	1	5		3				3	1	1	2
8A East	127.1	5	2	3	3	4		2			4		3				3		1	2
9	129.3	6	4	7	6	5		3			6		3				3		2	4
9 u/s	130.6	8	3	6	7	5		2			6		3				2		3	6
4th July	131.8	7	1	3	5	5		2			7		3				2		1	3
9A	133.7	7	1	3	3	6		2			8		3						3	2
10 u/s	134.3	11	1	3	4	7		2			9		4						6	2
11 d/s	135.3	6	1	3	5	6		2			8		3						3	3
11	136.5	5	1	3	4	3		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" operating guide is 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. Upstream extent of simulated ice cover progression for Watana filling occurs upstream of River Mile 144.8.
4. All ice thickness in feet.
5. Winter air temperatures:
   - 1971-72 cold
   - 1976-77 very warm
   - 1981-82 average
   - 1982-83 warm

TABLE IX

SUSITNA HYDROELECTRIC PROJECT
SOLID ICE THICKNESS
MAXIMUM SIMULATED VALUES

		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	1971-72[W]	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	1	3	2	3	5	2	5	1	2	2	4	1	2	3
Gash Creek	112.0	5	2	4	3	5	1	3	2	2	5	1	5	1	2	1	4	1	2	3
6A	112.3	5	2	4	3	5	1	3	2	2	5	1	5	1	2	1	4	1	2	3
8	114.1	5	2	4	3	5	1	3	2	2	5	1	5	1	2	1	4	1	2	3
MSII	115.5	5	2	4	3	5	1	3	2	1	5	1	4	1	1	1	4	1	2	3
MSII	115.9	5	2	4	3	5	1	3	1	1	5	0	4	1	1	1	4	1	2	3
Curry	120.0	5	2	4	3	5	1	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	0	1	0	0	4		3				1	0	1	2
8A East	127.1	5	2	3	3	3		1			4		3				1		1	2
9	129.3	5	2	3	3	3		1			4		3				1		1	2
9 u/s	130.6	5	2	3	3	3		1			4		2				0		1	2
4th July	131.8	5	1	3	3	2		1			4		2				0		1	2
9A	133.7	5	1	3	2	2		0			4		1						1	2
10 u/s	134.3	5	1	3	2	2		0			3		1						1	2
11 d/s	135.3	4	1	3	2	2		0			3		0						1	2
11	136.5	4	1	3	2	1		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

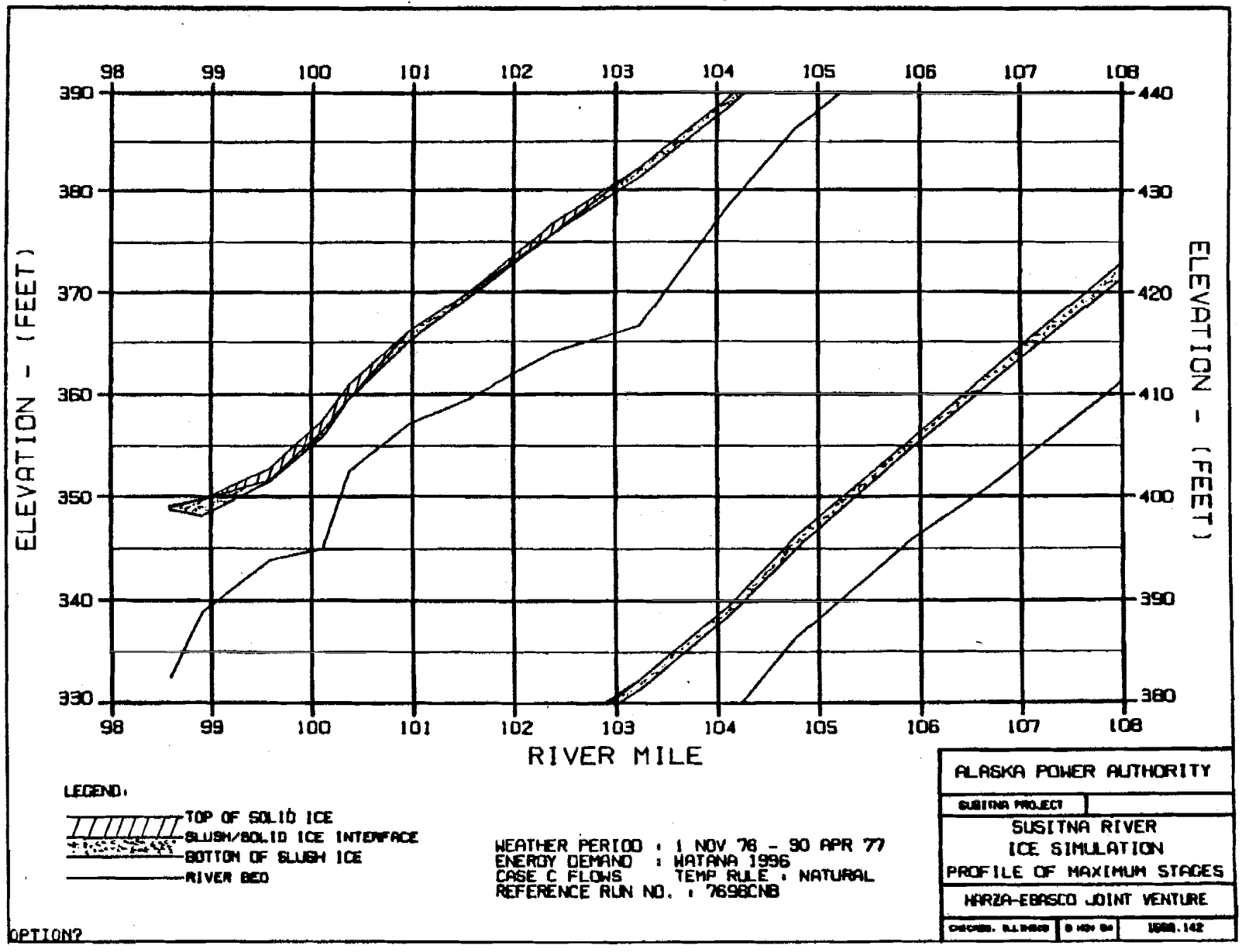
Upstream Extent of Ice Cover Progression

NOTES:

1. "Case C" operating guide is 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. Upstream extent of simulated ice cover progression for Watana filling occurs upstream of River Mile 144.8.
4. All ice thickness in feet.
5. Winter air temperatures:
   - 1971-72 cold
   - 1976-77 very warm
   - 1981-82 average
   - 1982-83 warm

EXHIBIT G

C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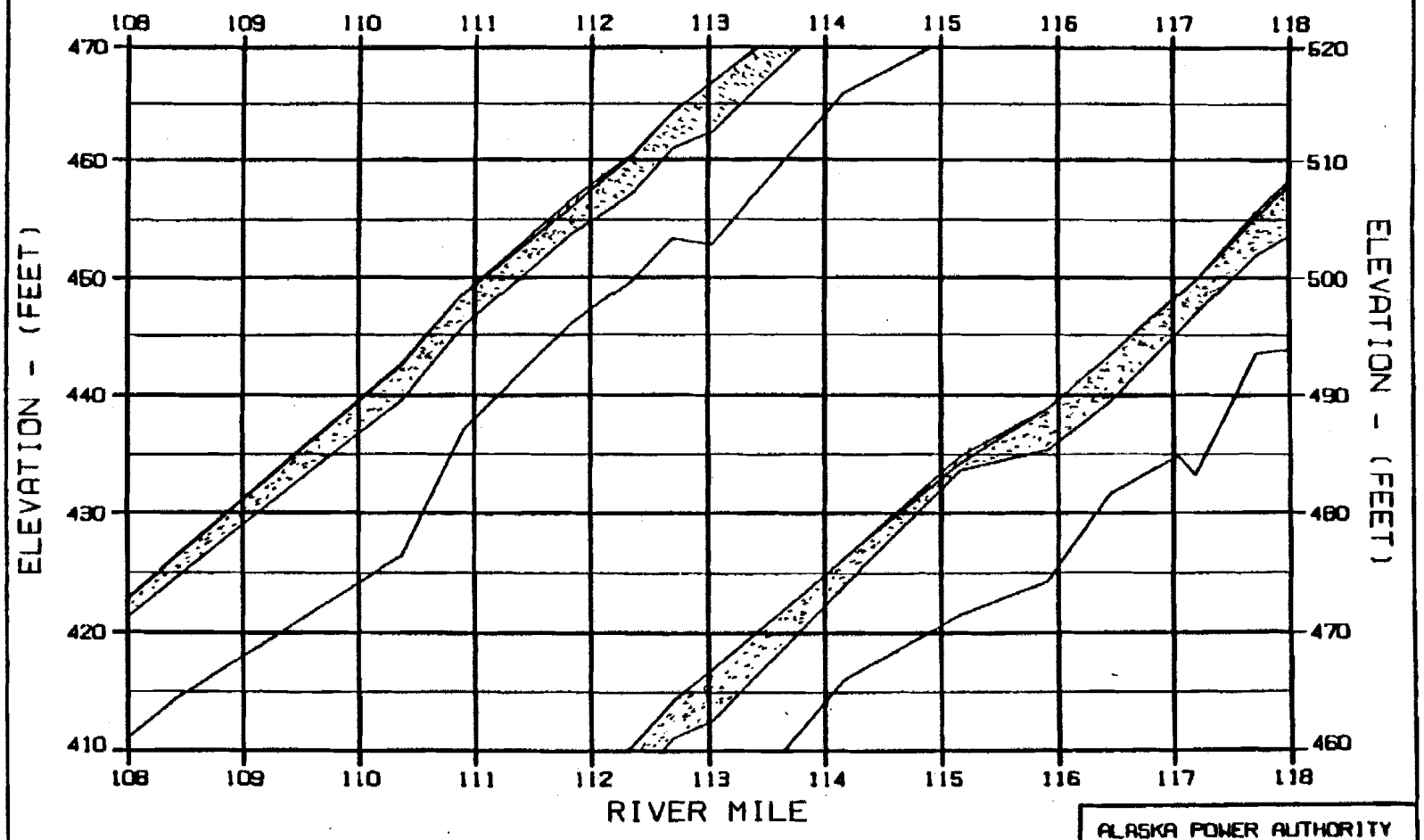
410
400
390
380
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1588.142

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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7698CNB

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

1588.142

OPTION?

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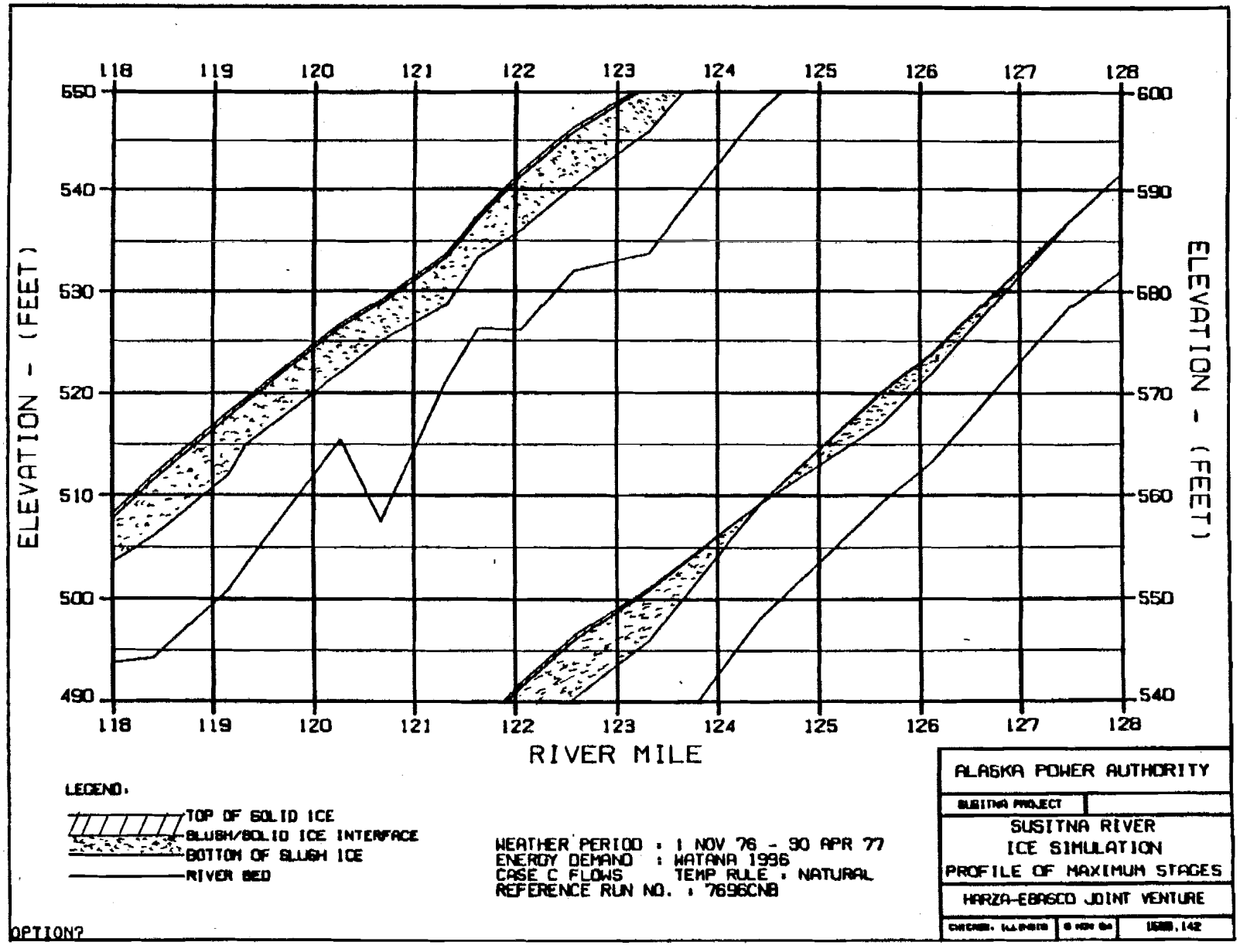
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540
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
OPTION?

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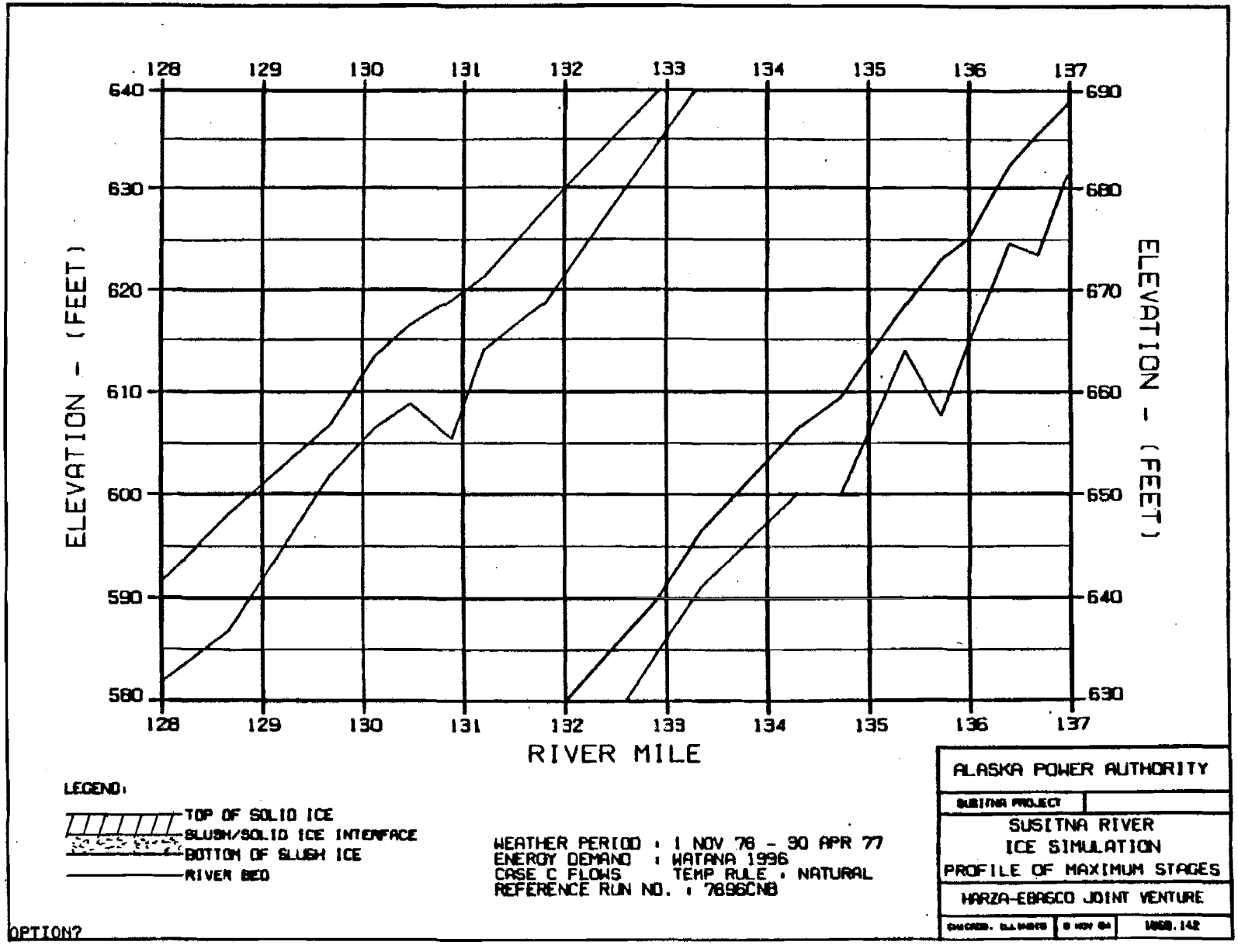
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650
640
630
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7896CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
8 NOV 84
1868.142
OPTION?

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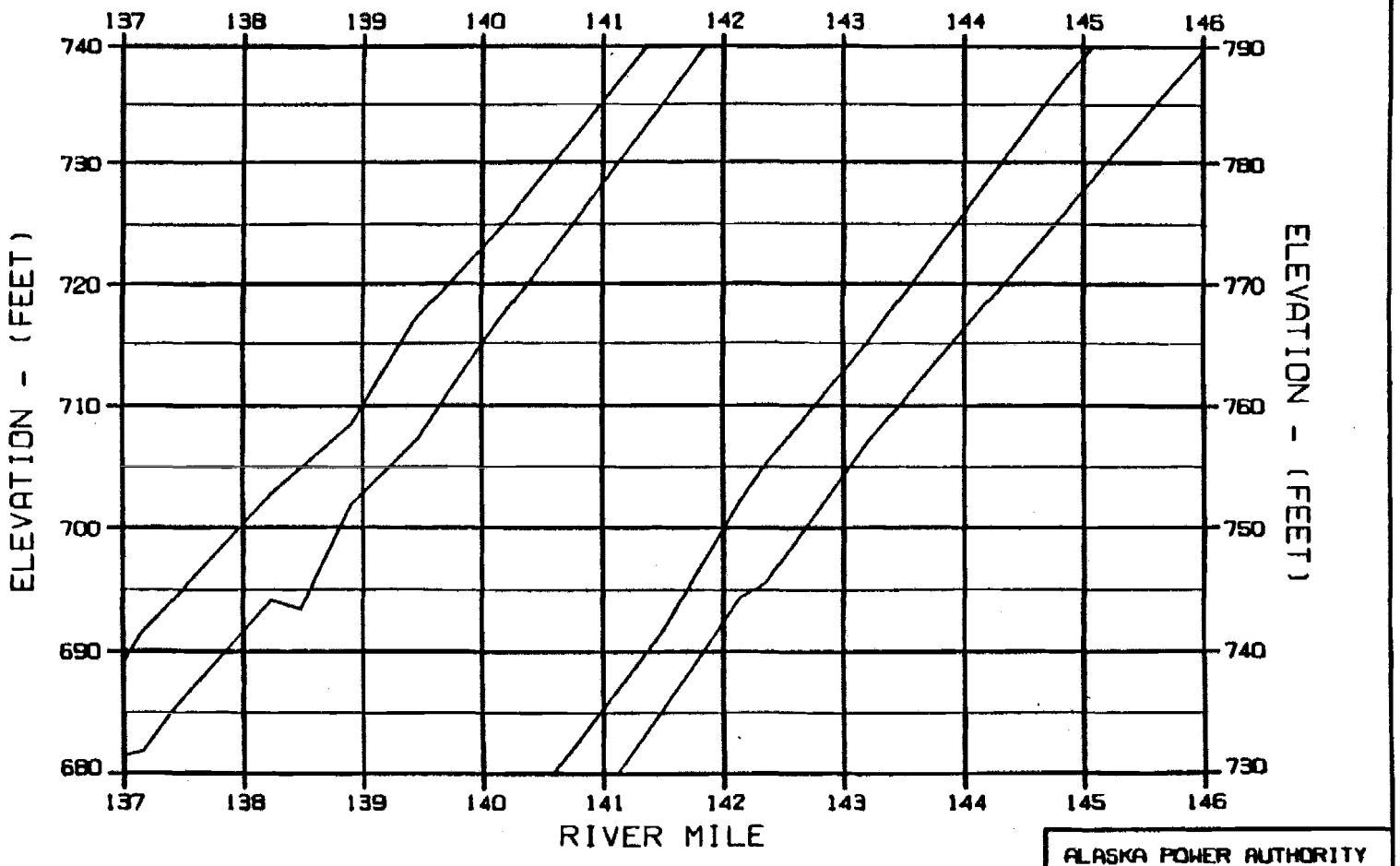


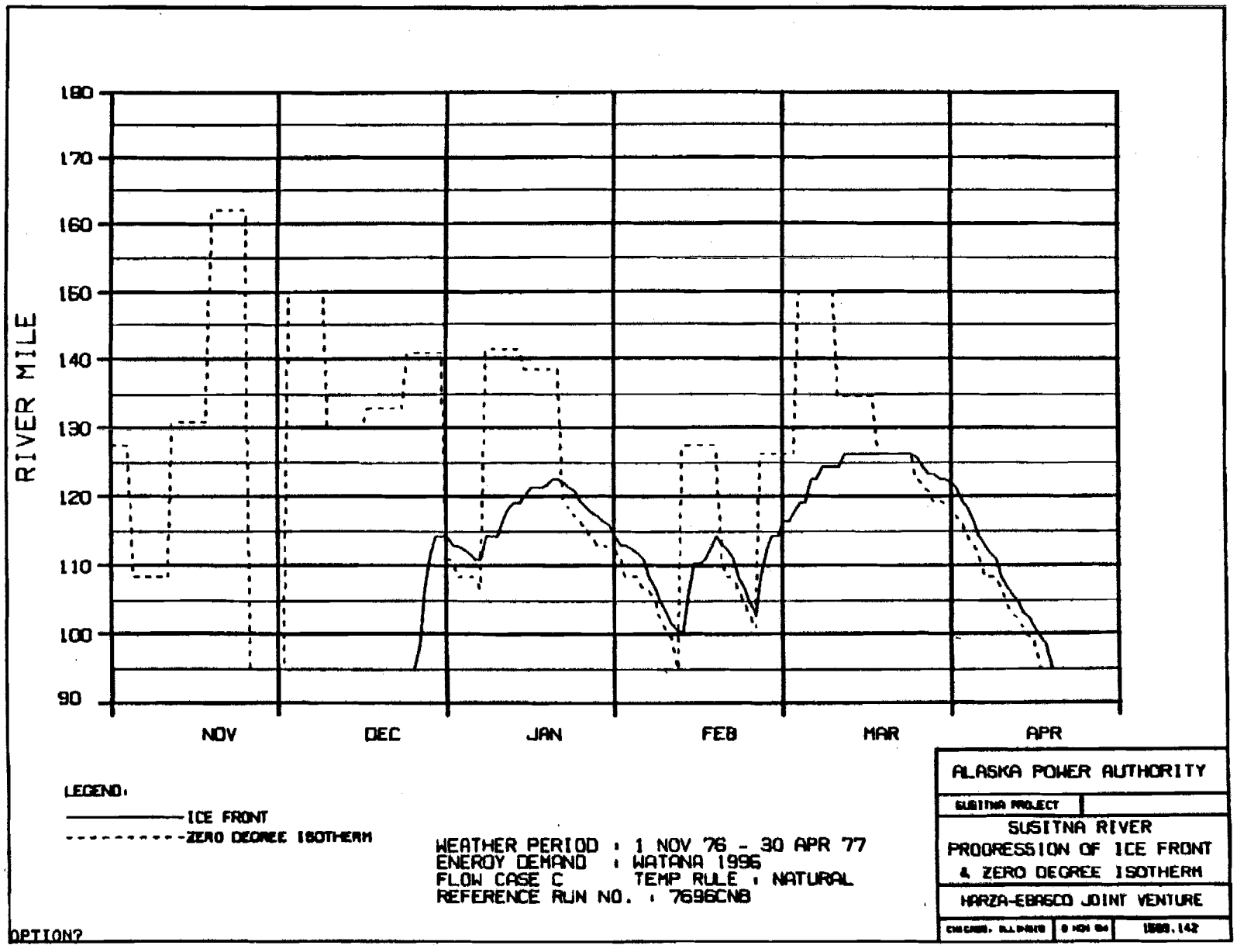
LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7896CNB

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1588.142

OPTION?


RIVER MILE
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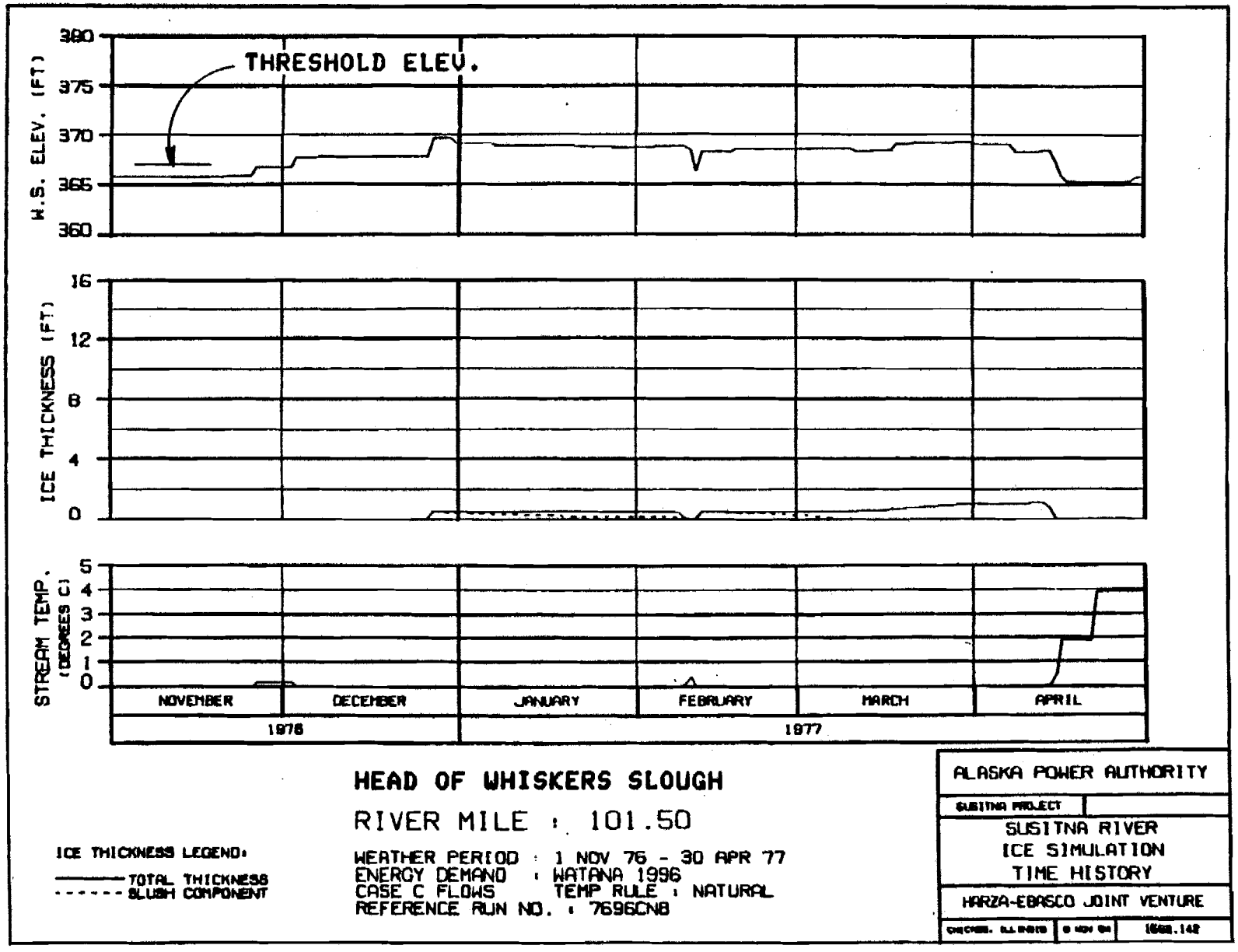
110
100
90
NOV
DEC
JAN
FEB
MAR
APR
LEGEND:
ICE FRONT
ZERO DEGREE ISOTHERM
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
FLOW CASE C TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE
1588.142
OPTION?



HEAD OF WHISKERS SLOUGH

RIVER MILE : 101.50

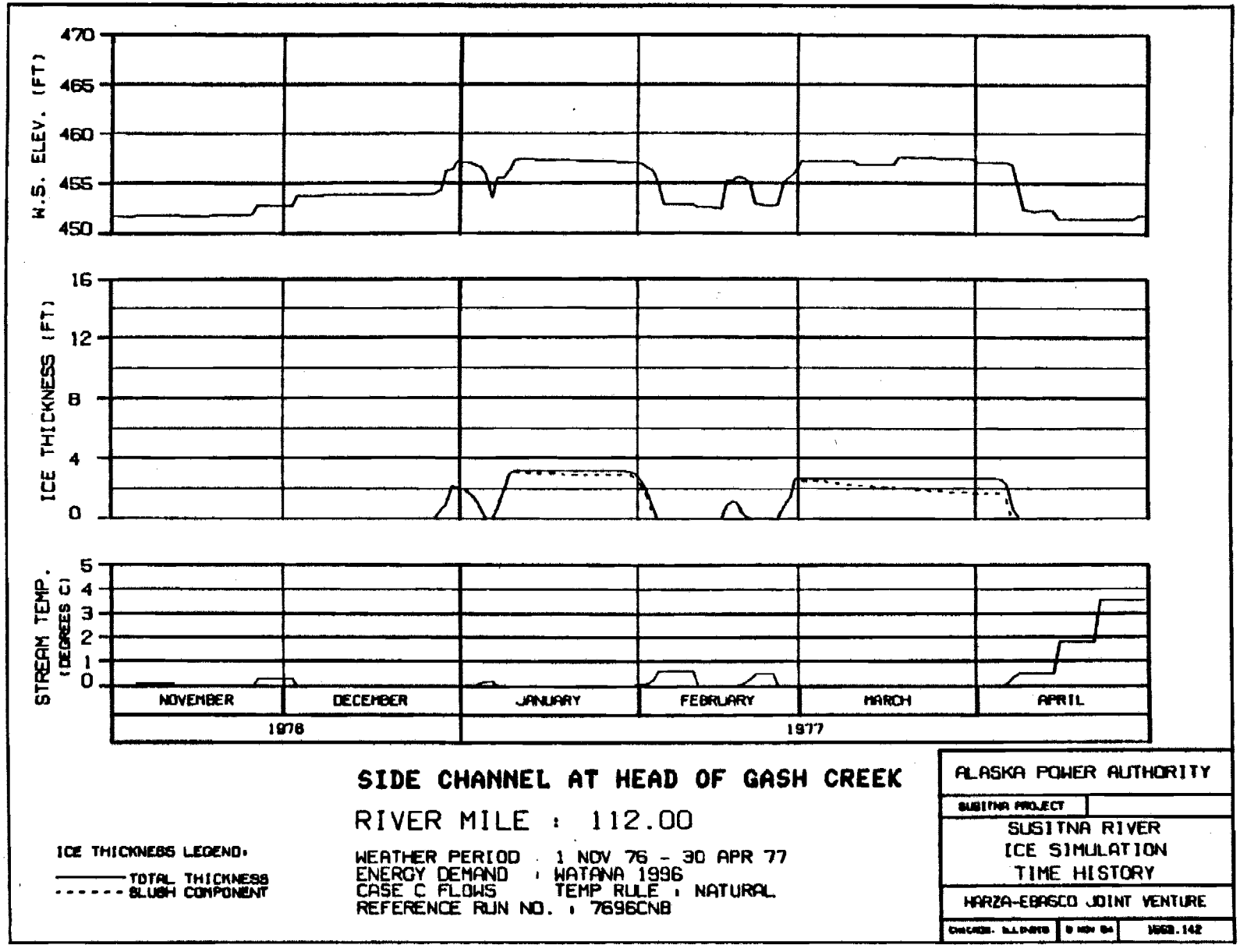
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER ICE SIMULATION TIME HISTORY
HARZA-EBASCO JOINT VENTURE
CHICAGO, ILLINOIS · NOV 84 · 1668.142



SIDE CHANNEL AT HEAD OF GASH CREEK

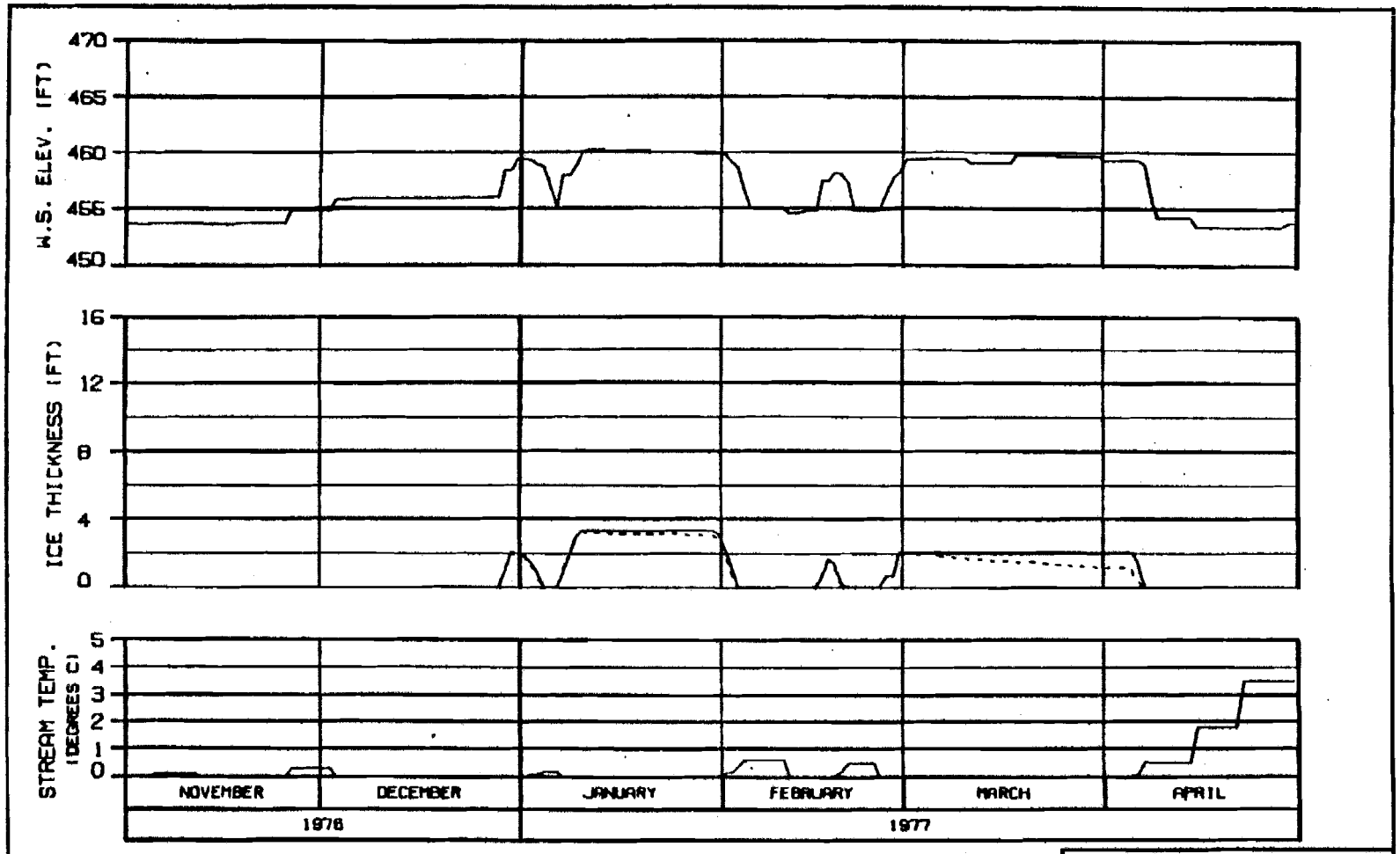
RIVER MILE : 112.00

ICE THICKNESS LEGEND:

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

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

ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
9 NOV 84
1668.142



MOUTH OF SLOUGH 6A

RIVER MILE : 112.34

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

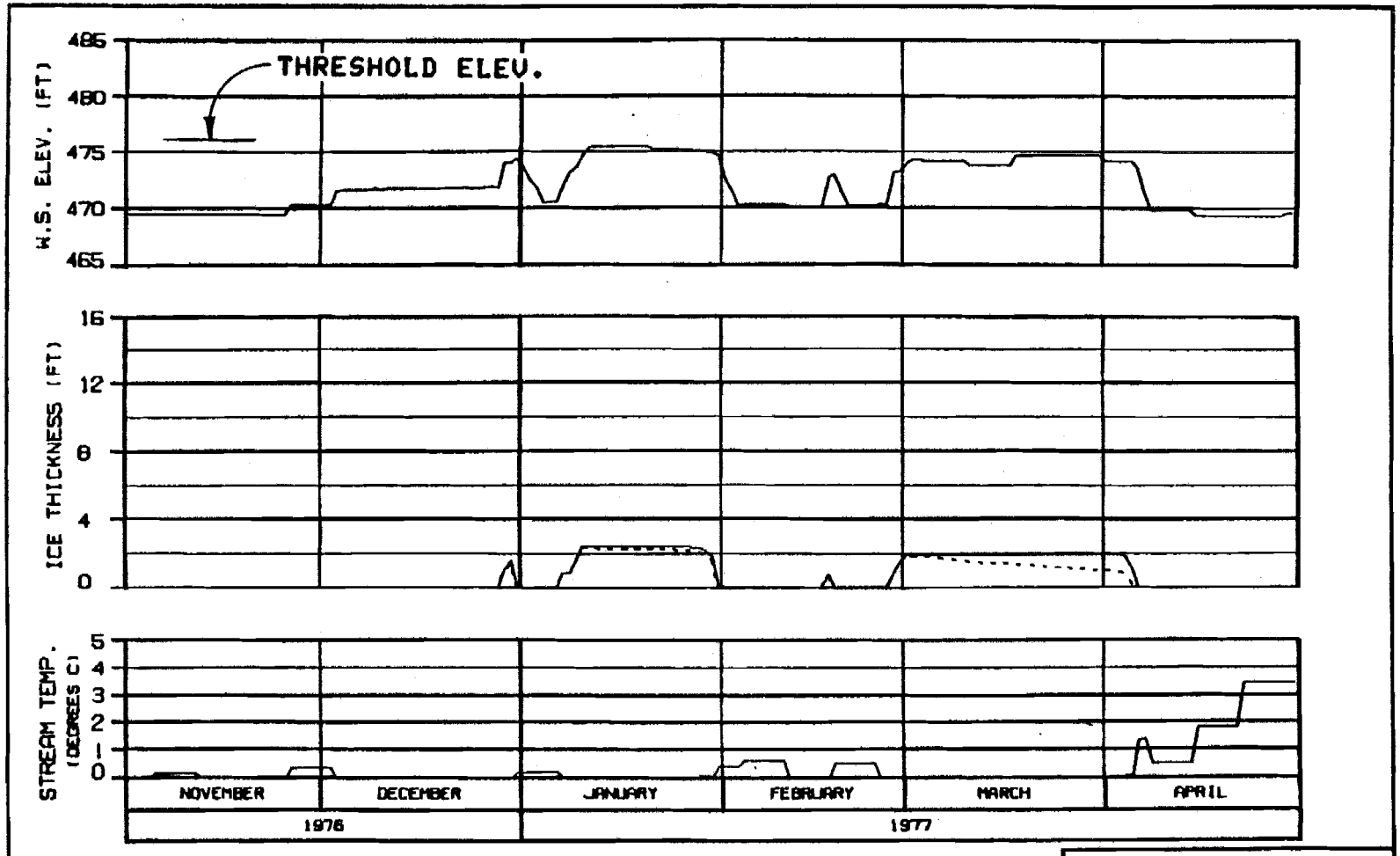
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 9 NOV 84 | 1883.142



HEAD OF SLOUGH 8

RIVER MILE : 114.10

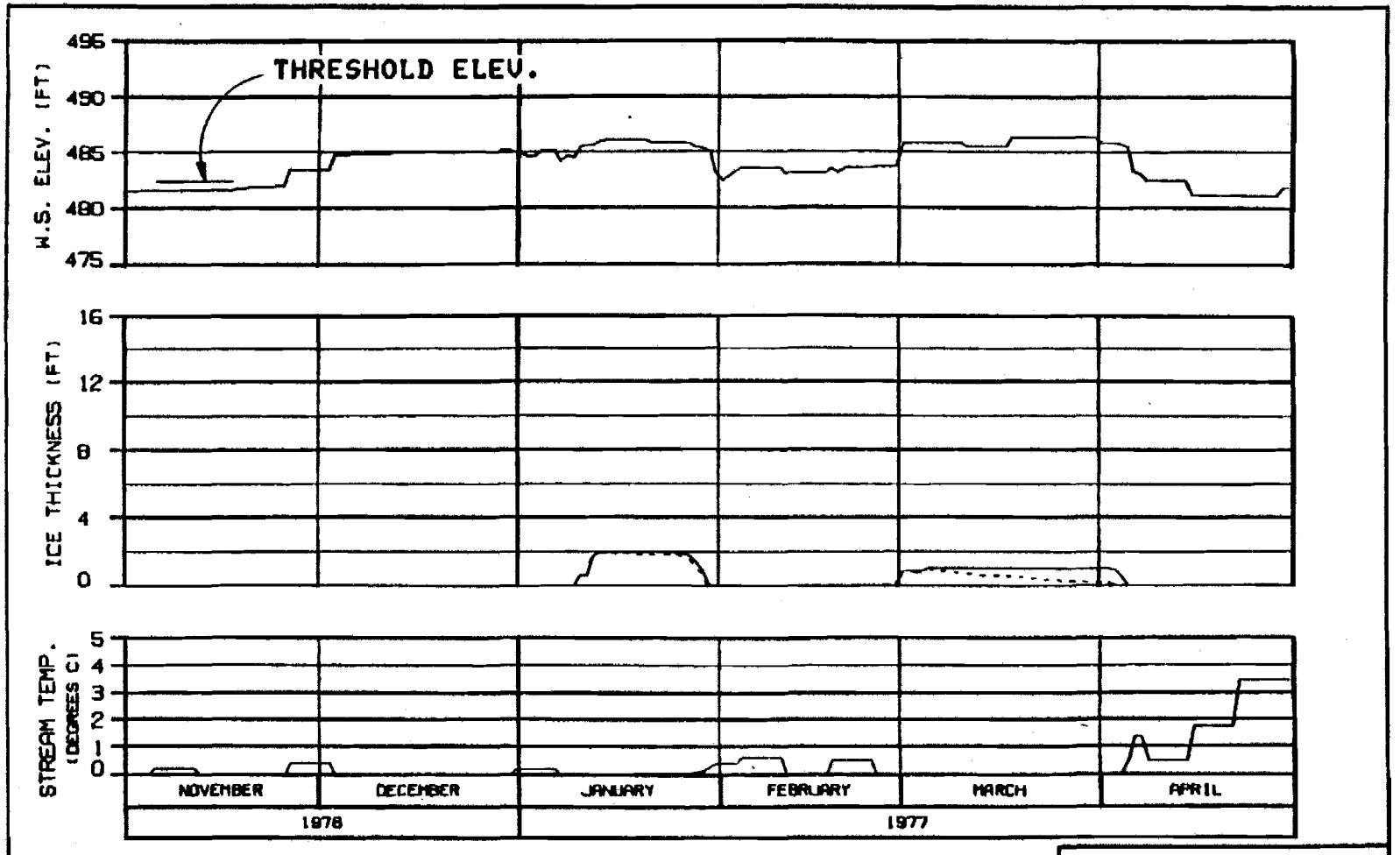
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

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



SIDE CHANNEL MSII

RIVER MILE : 115.50

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

ICE THICKNESS LEGEND:

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

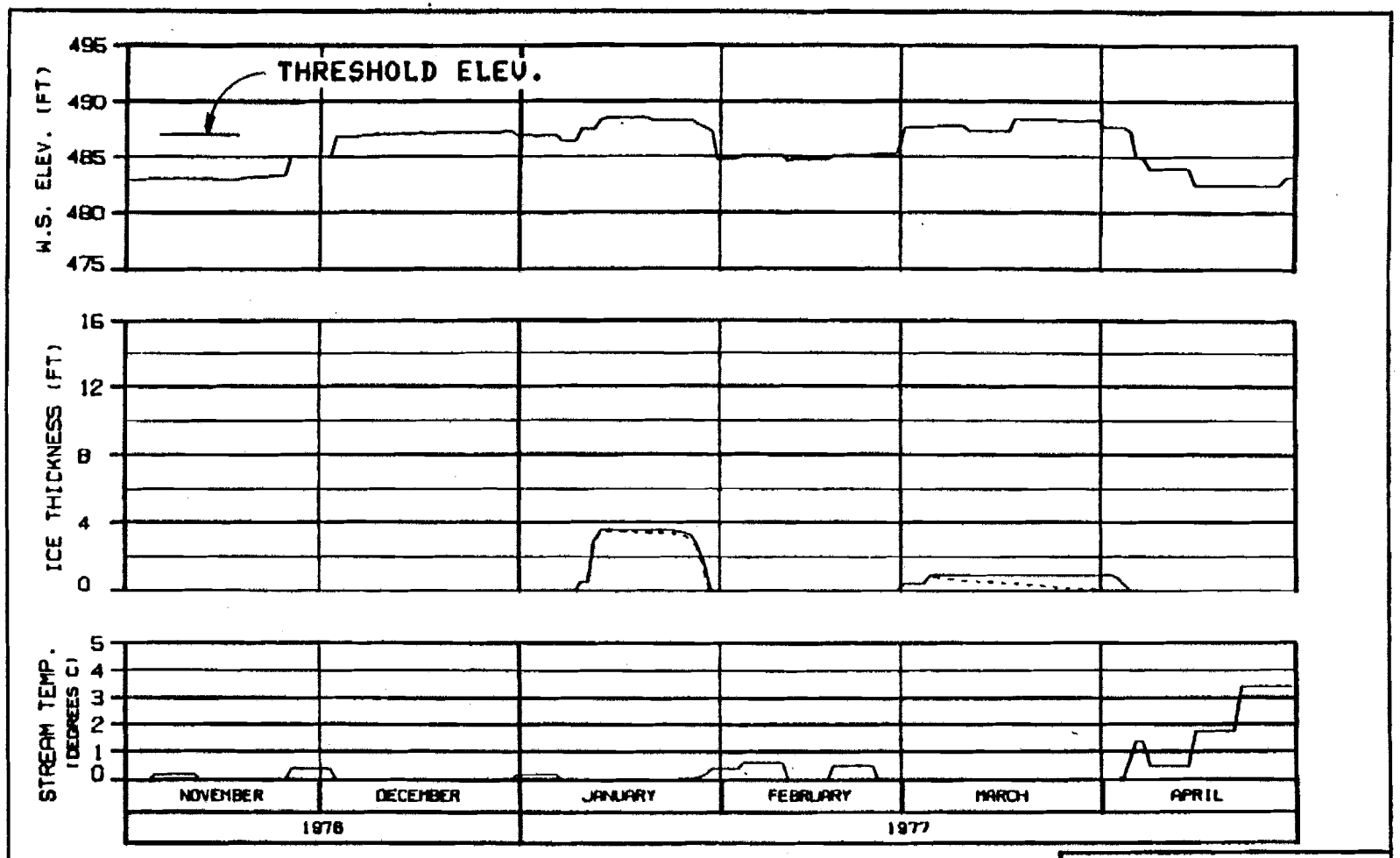
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHECKED: G.L.D. | 9 NOV 84 | 1988.142



HEAD OF SIDE CHANNEL MSII

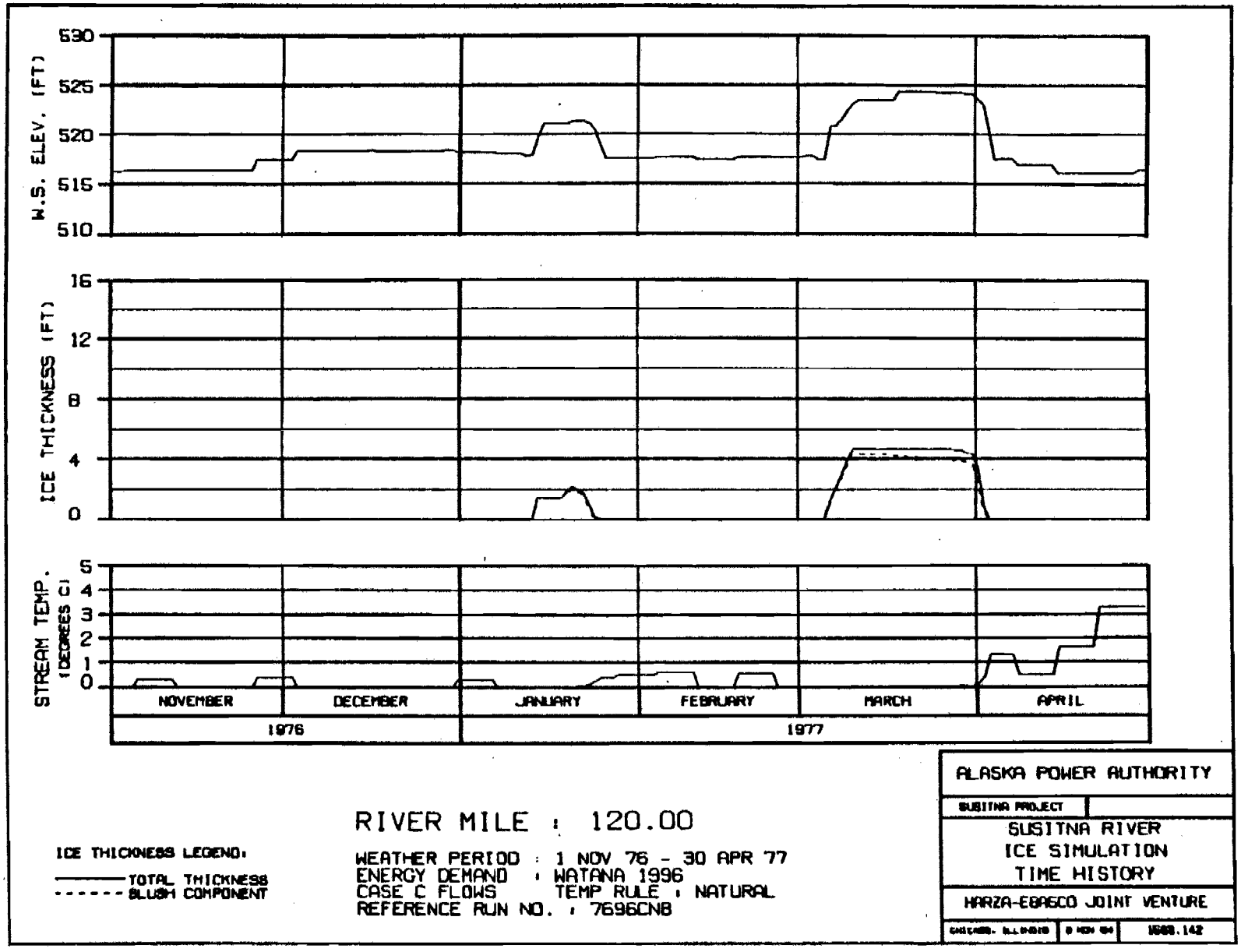
RIVER MILE : 115.90

ICE THICKNESS LEGEND:

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

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

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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

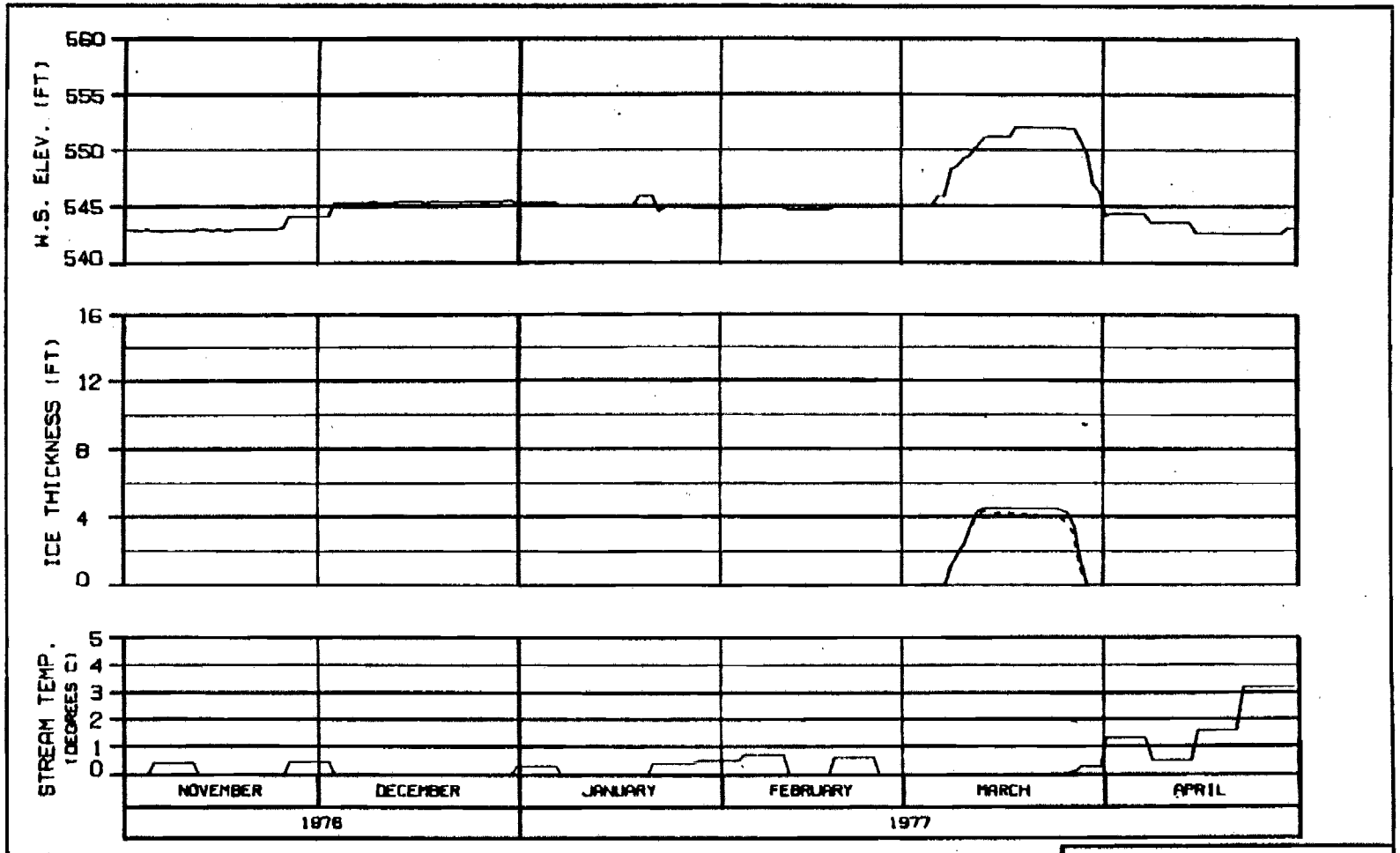
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1688.142



HEAD OF MOOSE SLOUGH

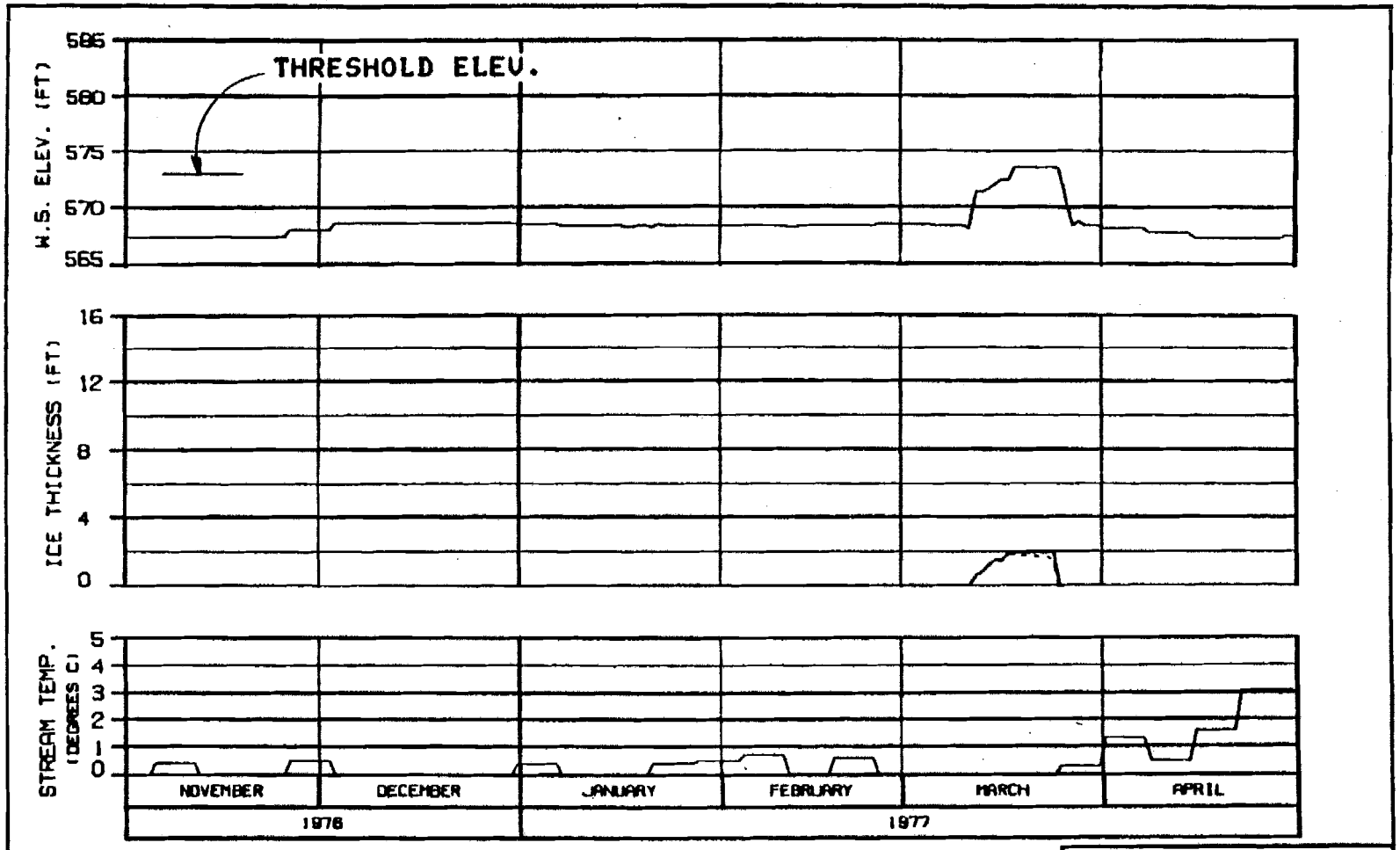
RIVER MILE : 123.50

ICE THICKNESS LEGEND:

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

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHECKED: ALL RIGHTS	1568.142



HEAD OF SLOUGH 8A (WEST)

RIVER MILE : 126.10

ICE THICKNESS LEGEND:

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

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

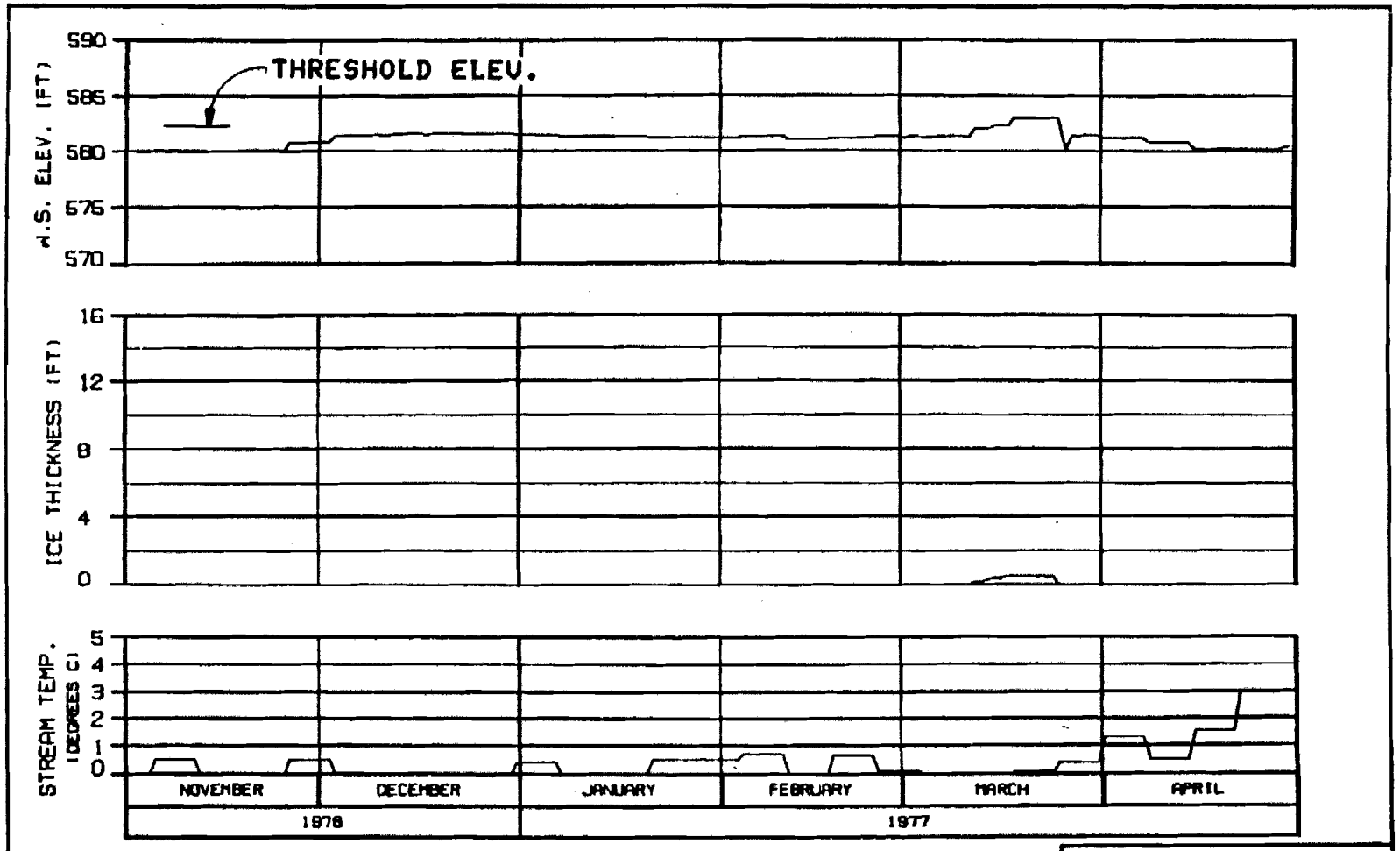
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 1668.142



HEAD OF SLOUGH 8A (EAST)

RIVER MILE : 127.10

ICE THICKNESS LEGEND:

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

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

ALASKA POWER AUTHORITY

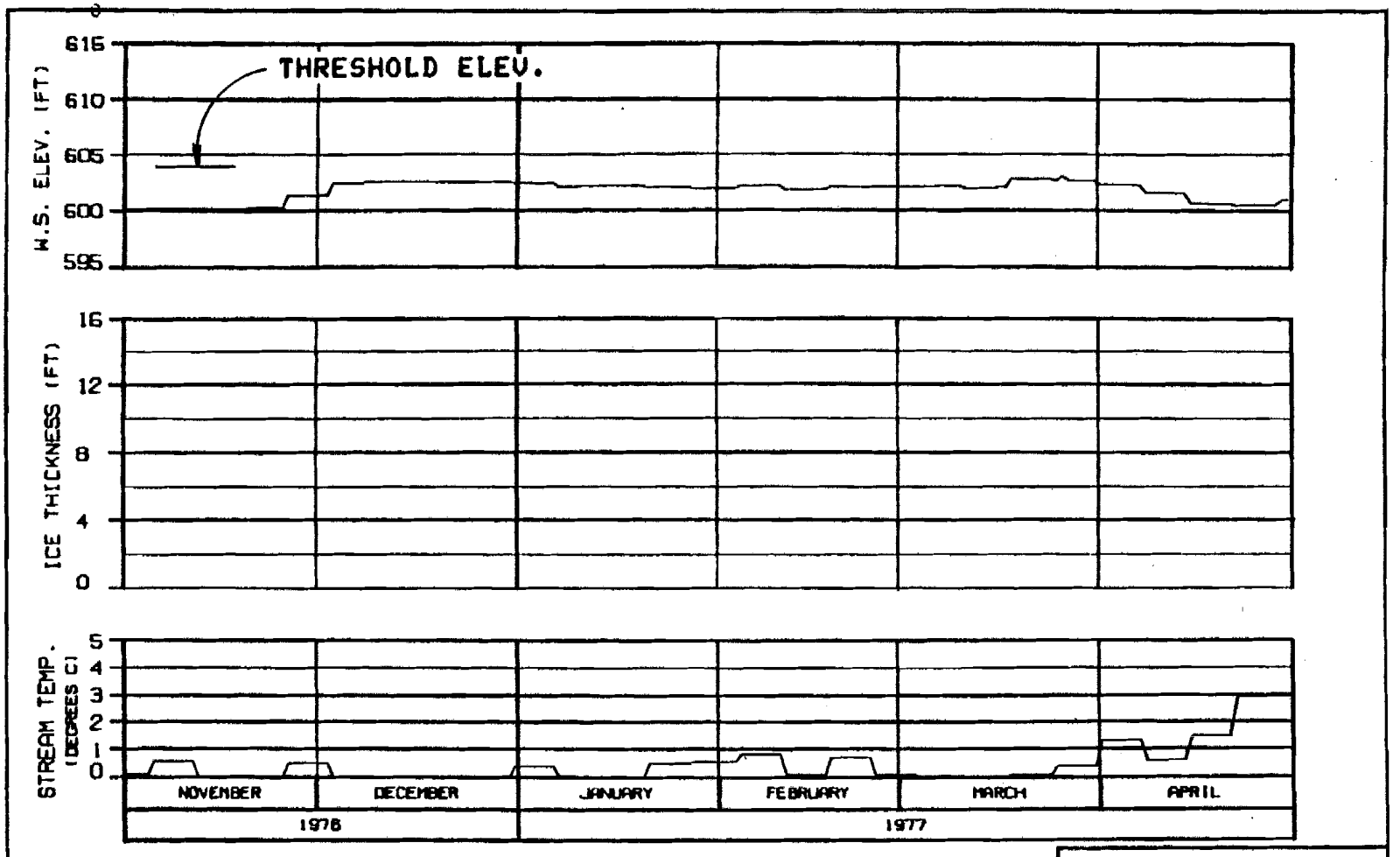
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 6 NOV 84 | 1688.142

OPTION?



HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

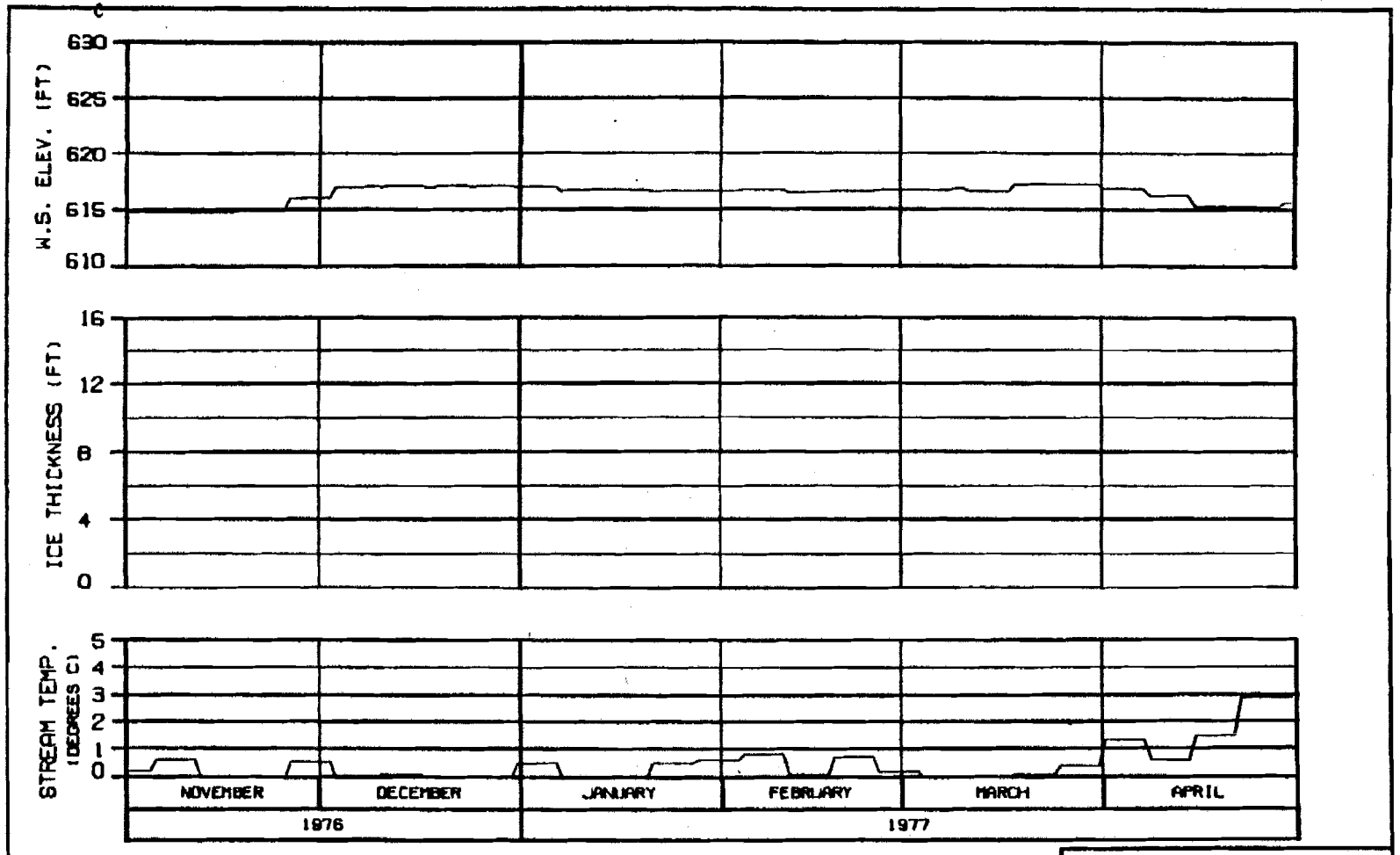
- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	1588.142

OPTION?

OPTION?



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

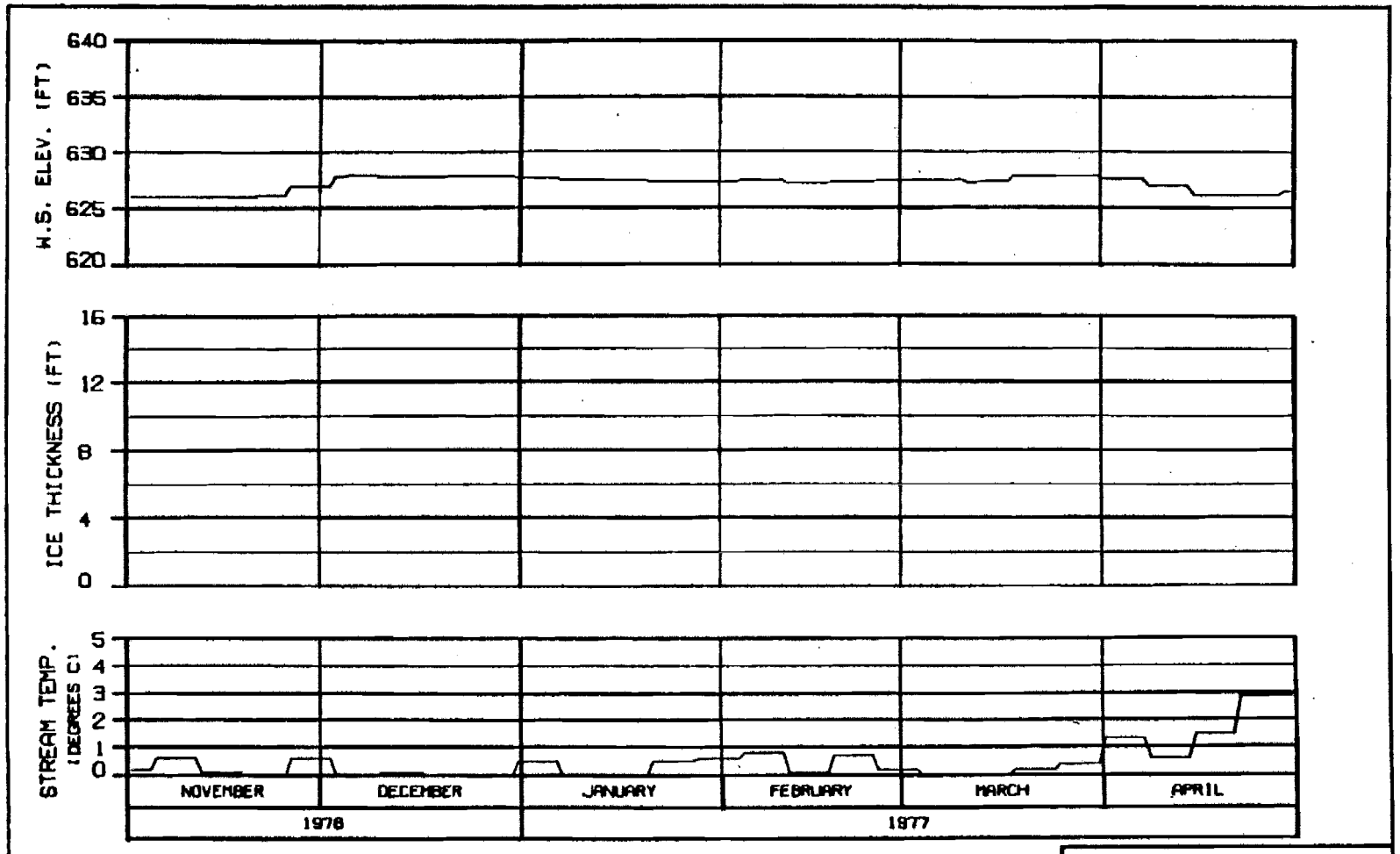
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHICAGO, ILLINOIS	1568.142



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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB

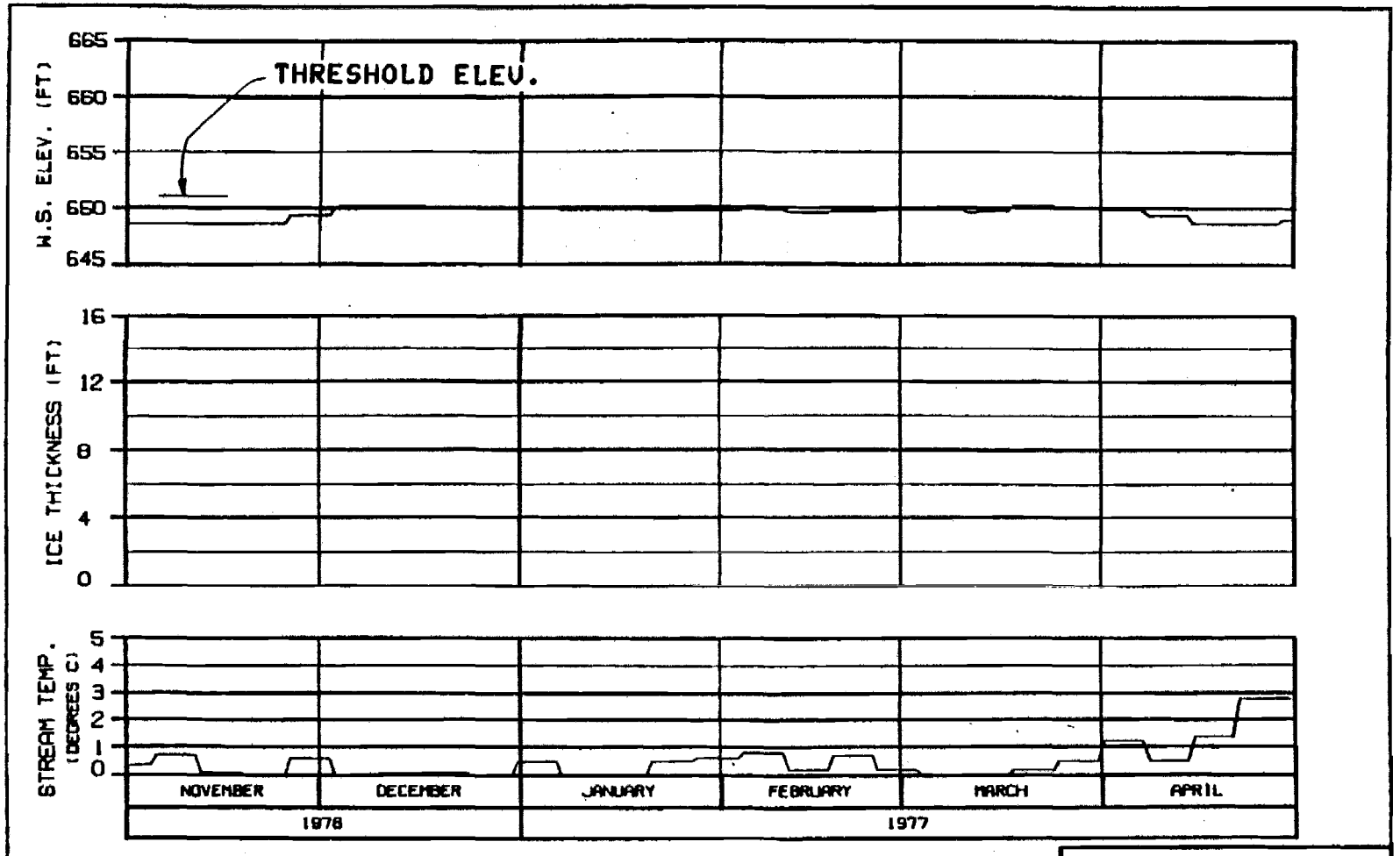
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 1688.142



HEAD OF SLOUGH 9A

RIVER MILE : 133.70

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

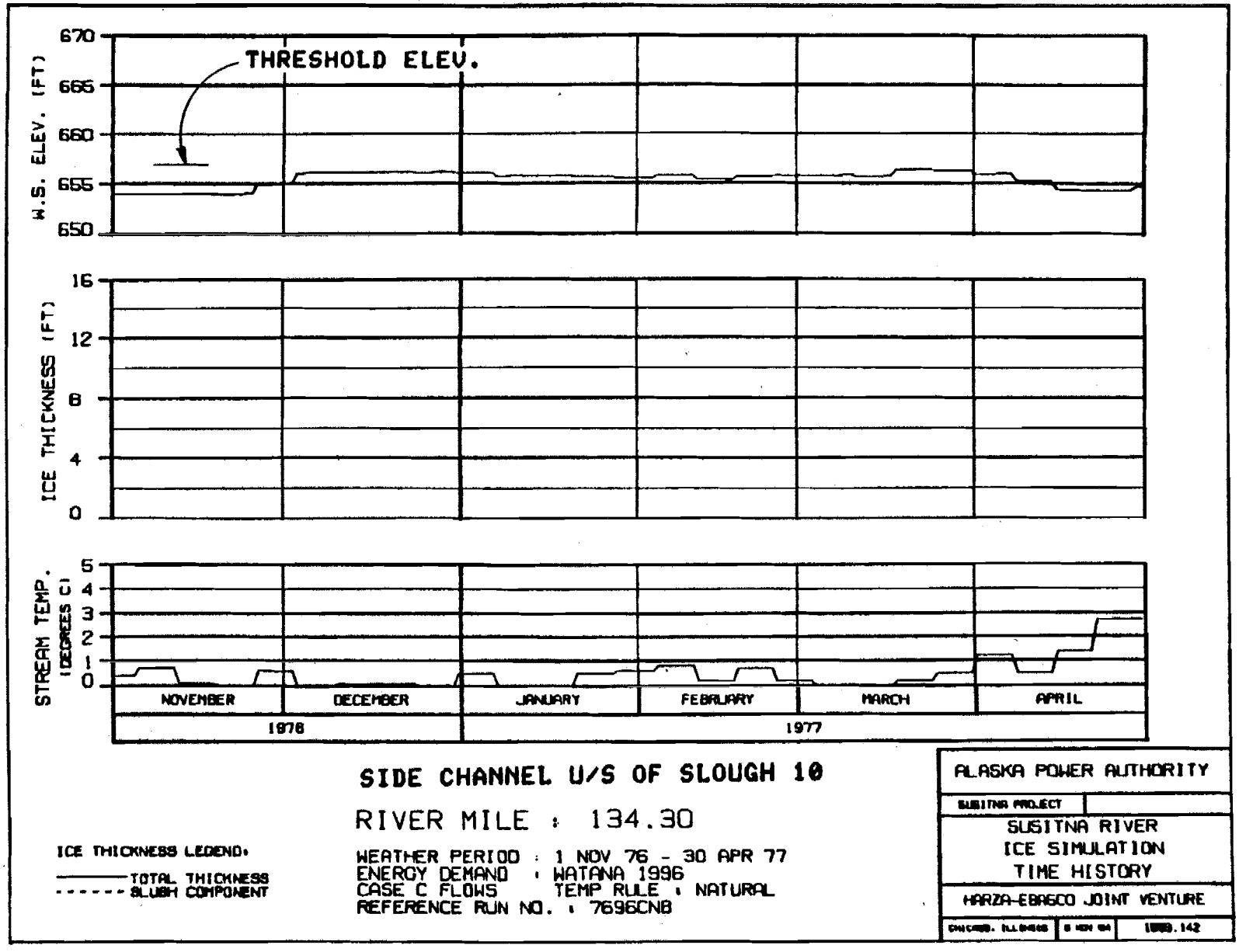
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1588.142



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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB

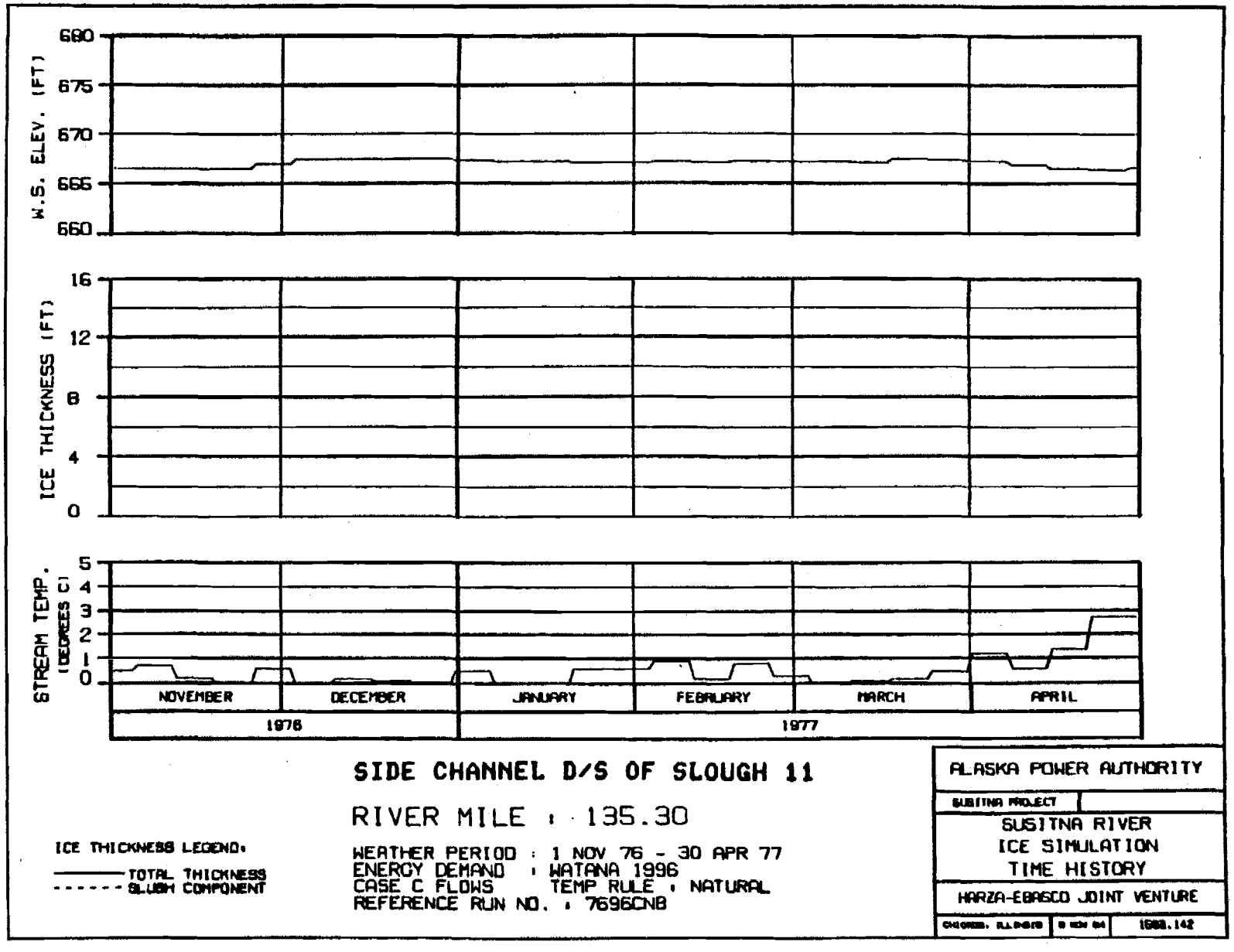
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1889.142



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
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CNB

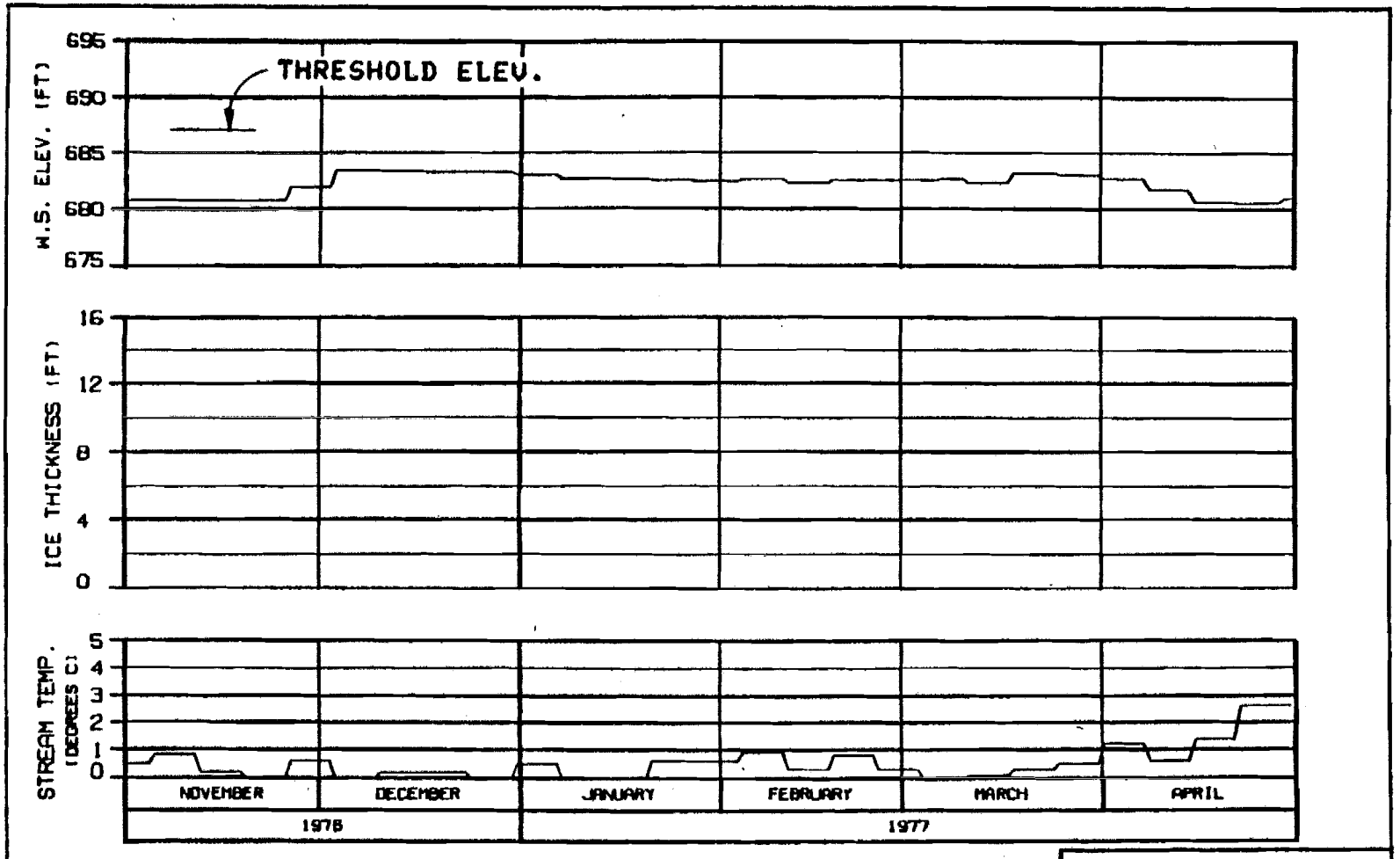
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 9 NOV 84 | 1988.142



HEAD OF SLOUGH 11

RIVER MILE : 136.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

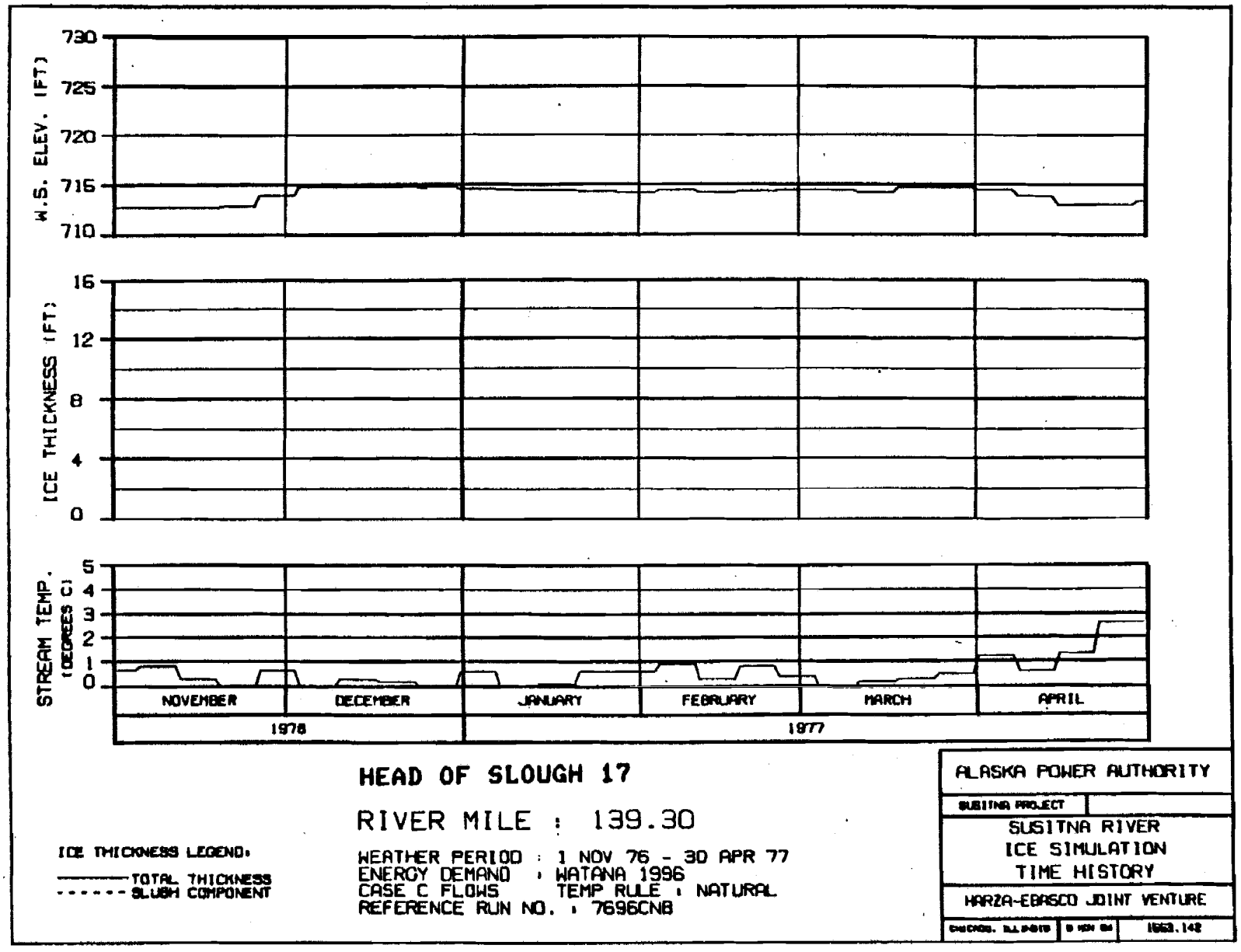
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1668.142



HEAD OF SLOUGH 17

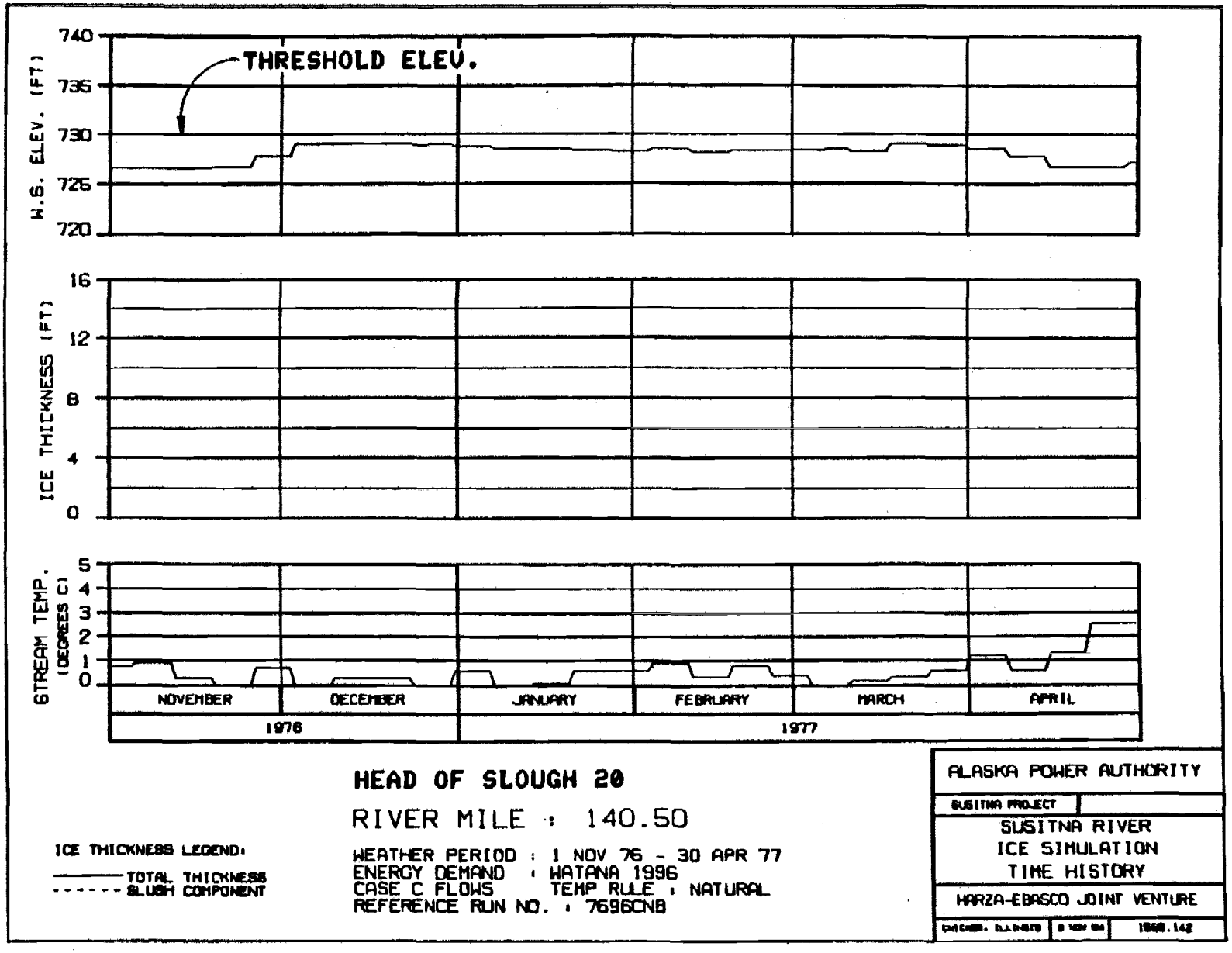
RIVER MILE : 139.30

ICE THICKNESS LEGEND:

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

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

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



HEAD OF SLOUGH 20

RIVER MILE : 140.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

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

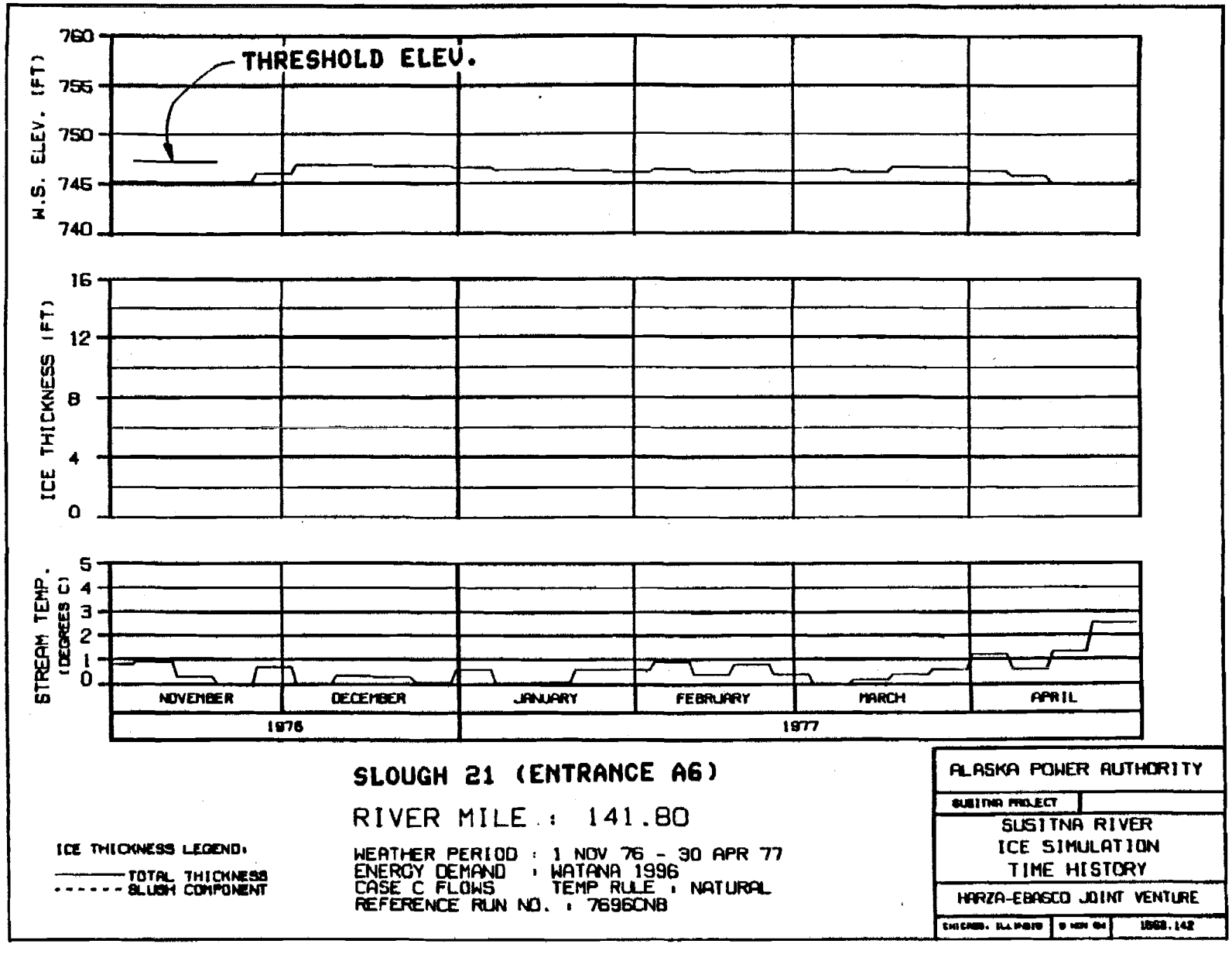
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

CHICAGO, ILLINOIS | 8 NOV 84 | 1868.142



SLOUGH 21 (ENTRANCE A6)

RIVER MILE : 141.80

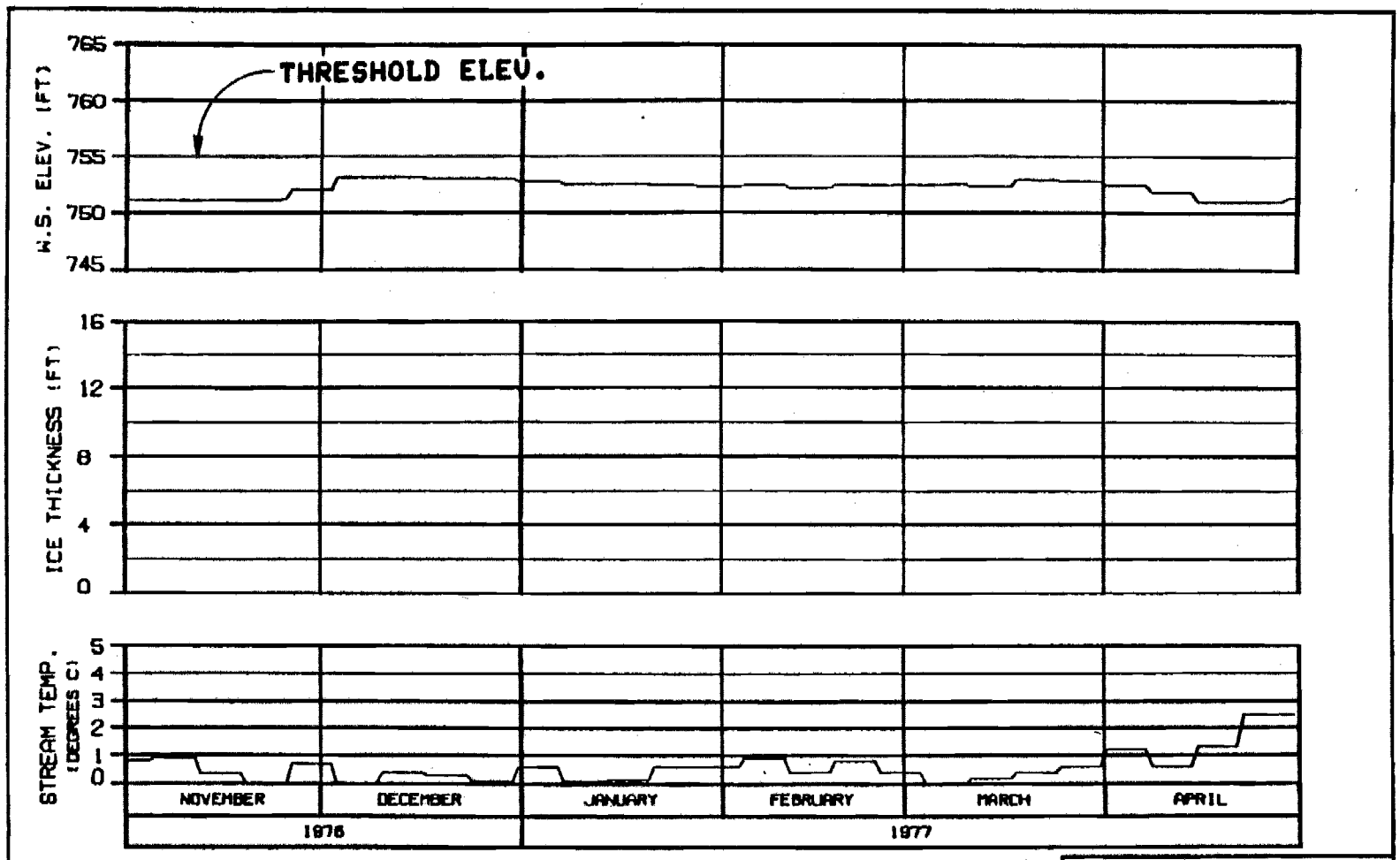
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

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

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
[illegible]	1868.142



HEAD OF SLOUGH 21

RIVER MILE : 142.20

ICE THICKNESS LEGEND:

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

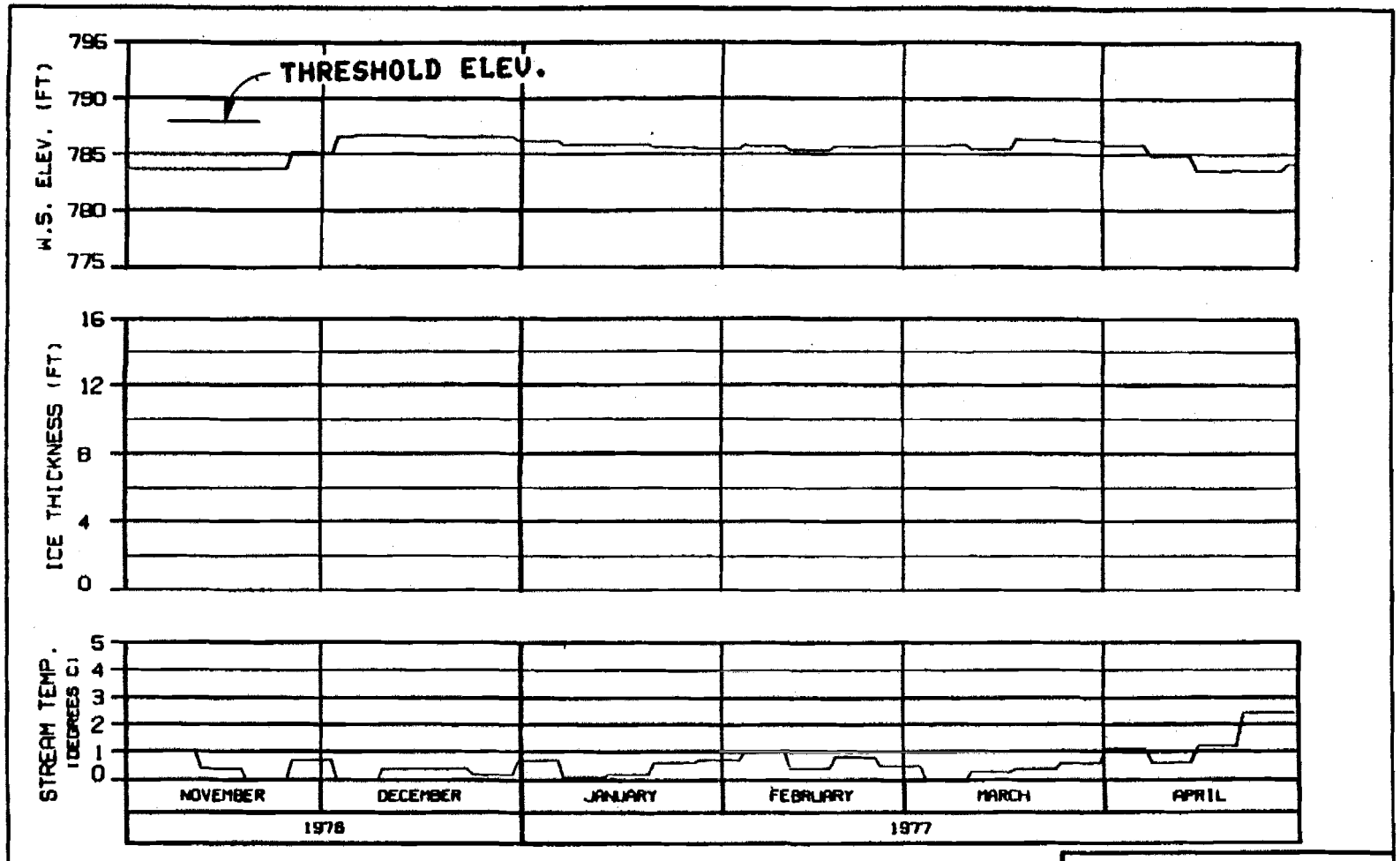
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1588.142



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : WATANA 1996
CASE C FLOWS TEMP RULE : NATURAL
REFERENCE RUN NO. : 7696CN8

OPTION?

ALASKA POWER AUTHORITY

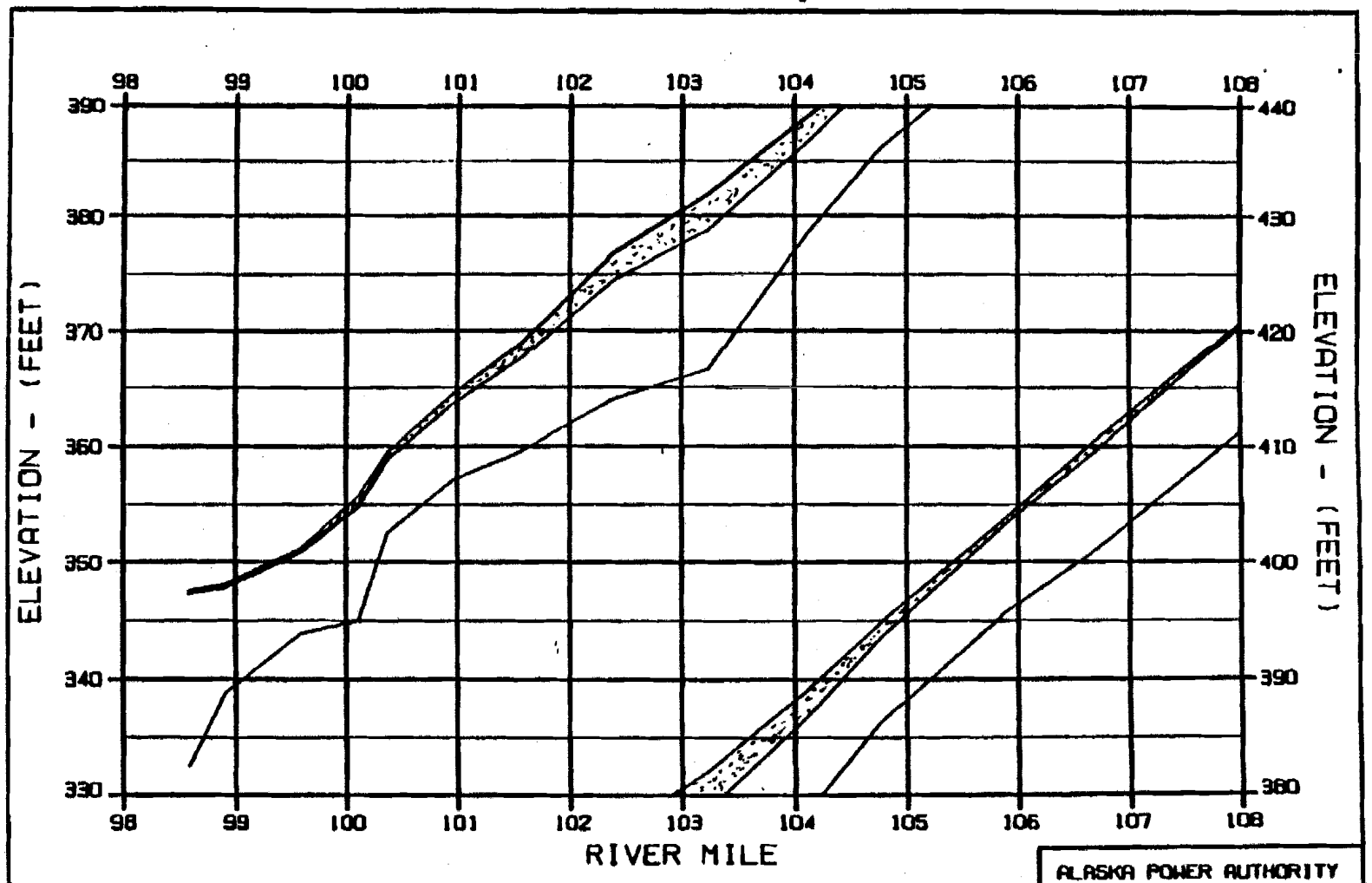
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

EXHIBIT N

C



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 : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7802CNB

ALASKA POWER AUTHORITY

SUSITNA PROJECT

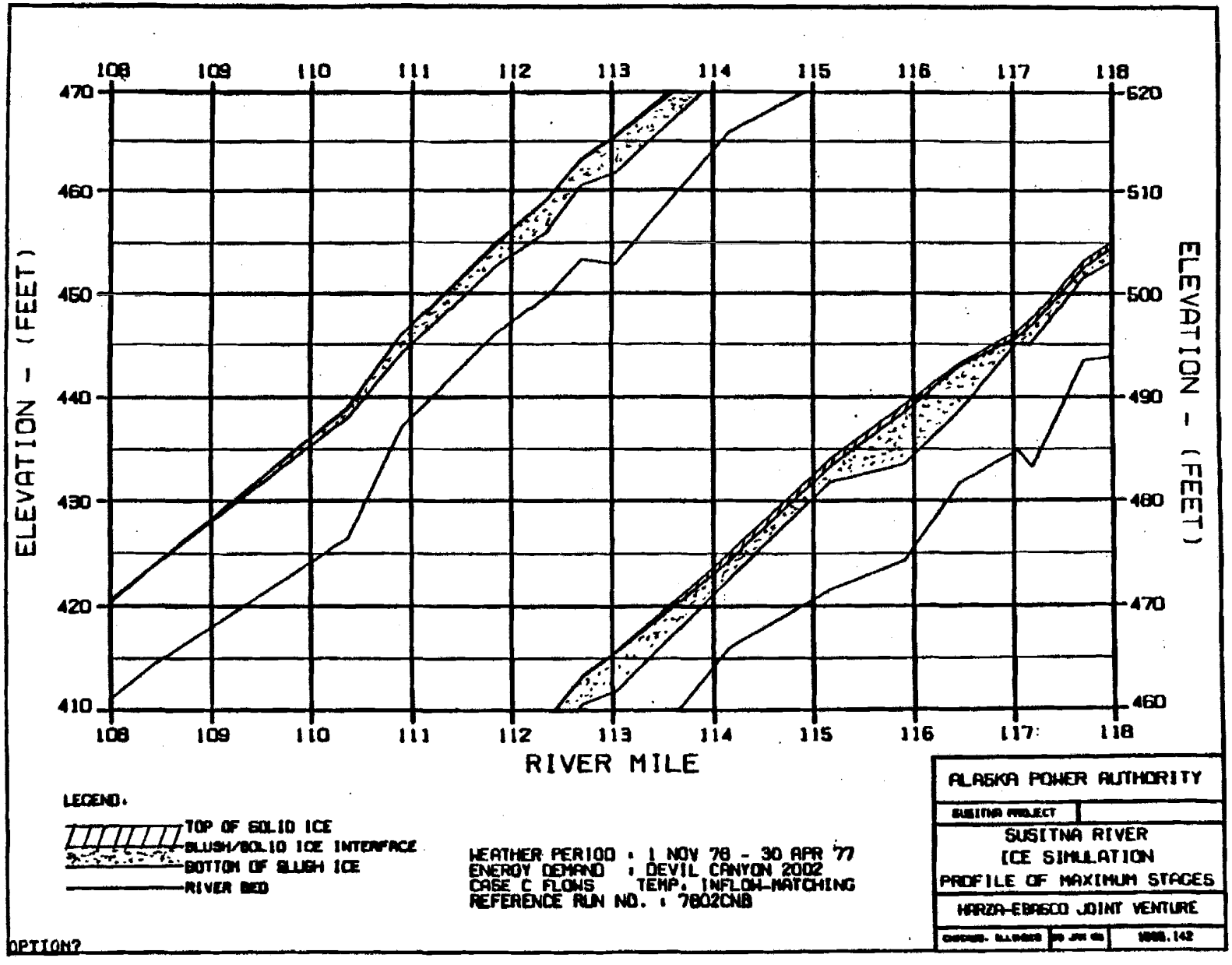
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

HARZA-EBASCO JOINT VENTURE

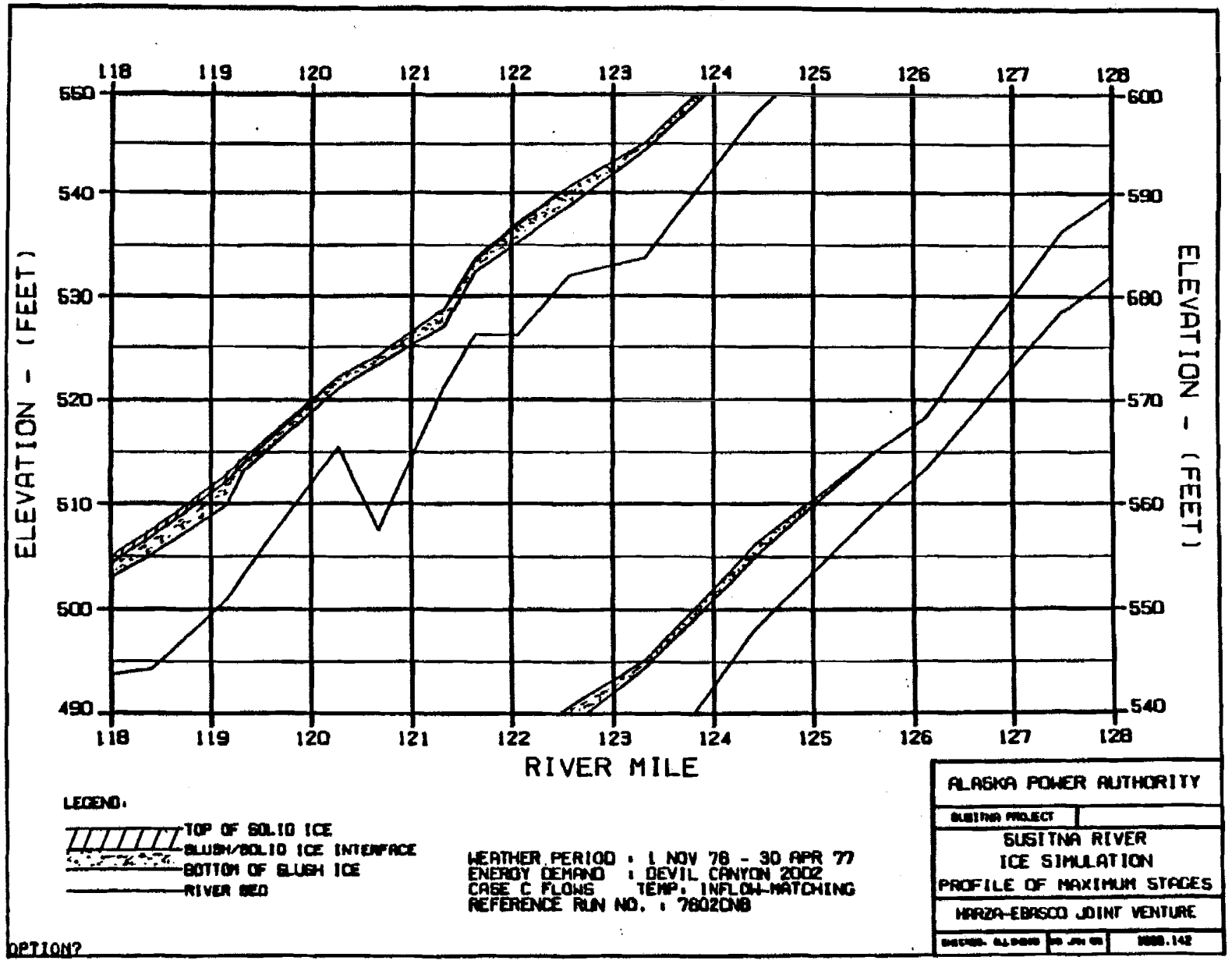
1988.142

OPTION?

C


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)
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 : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7802CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1986.142
OPTION?

C


118
119
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122
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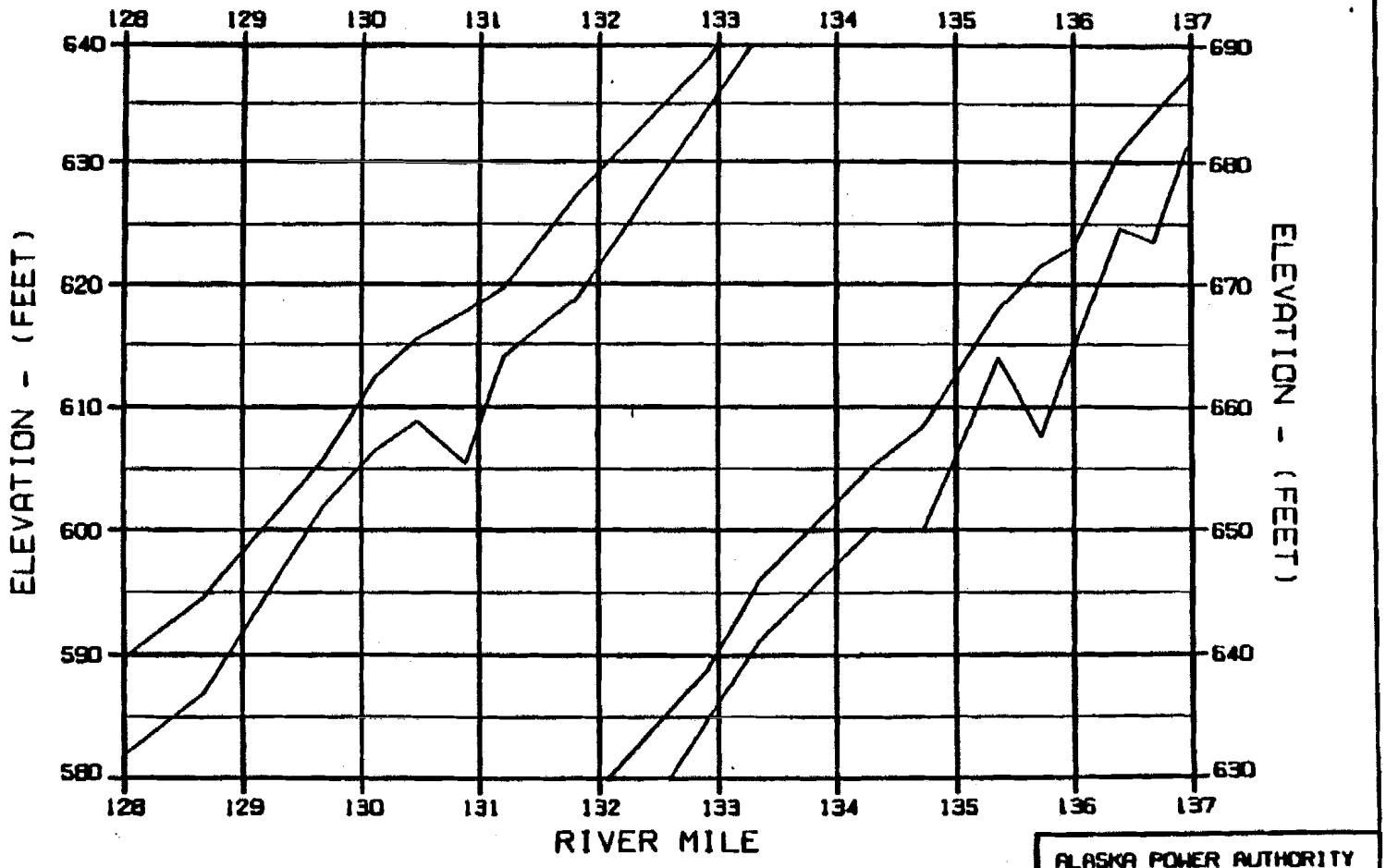
127
128
550
540
530
520
510
500
490
600
590
580
570
560
550
540
ELEVATION - (FEET)
ELEVATION - (FEET)
RIVER MILE
LEGEND:
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7802CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES
HARZA-EBASCO JOINT VENTURE
1988.142
OPTION?

C



LEGEND:

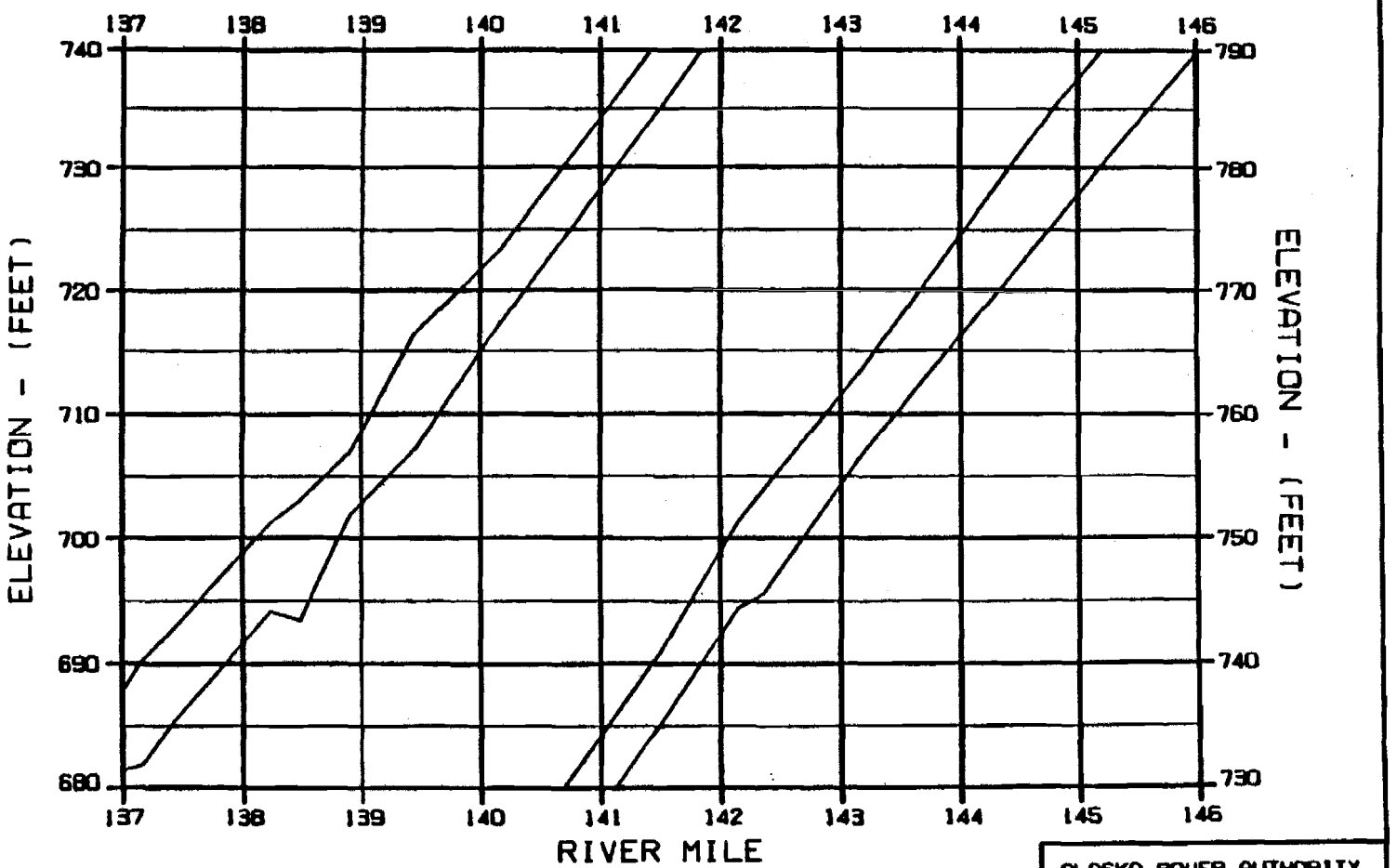
TOP OF SOLID ICE
SLUSH/SOLID ICE INTERFACE
BOTTOM OF SLUSH ICE
RIVER BED

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7802CNB

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

OPTION2

C



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 : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY.

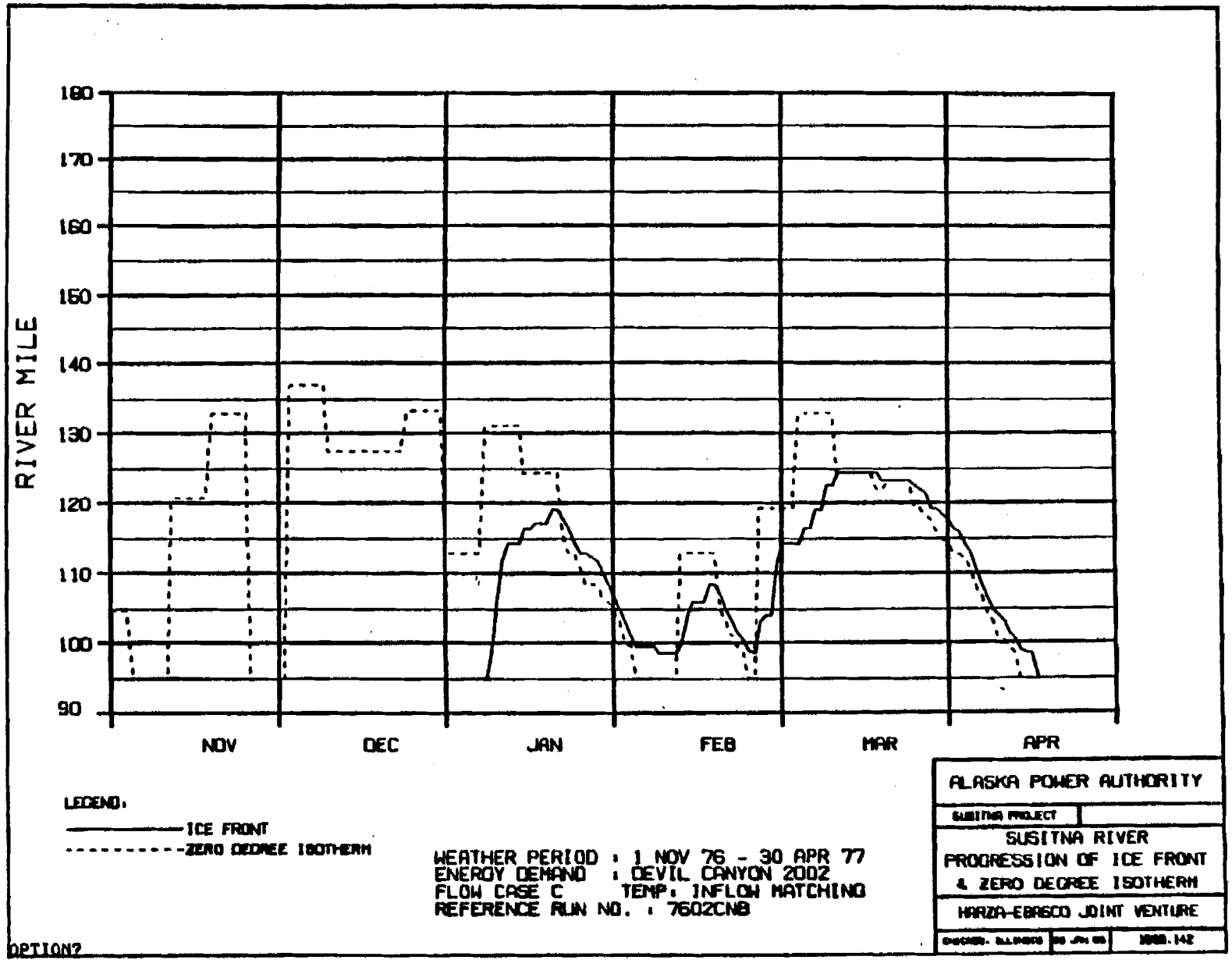
SUSITNA PROJECT

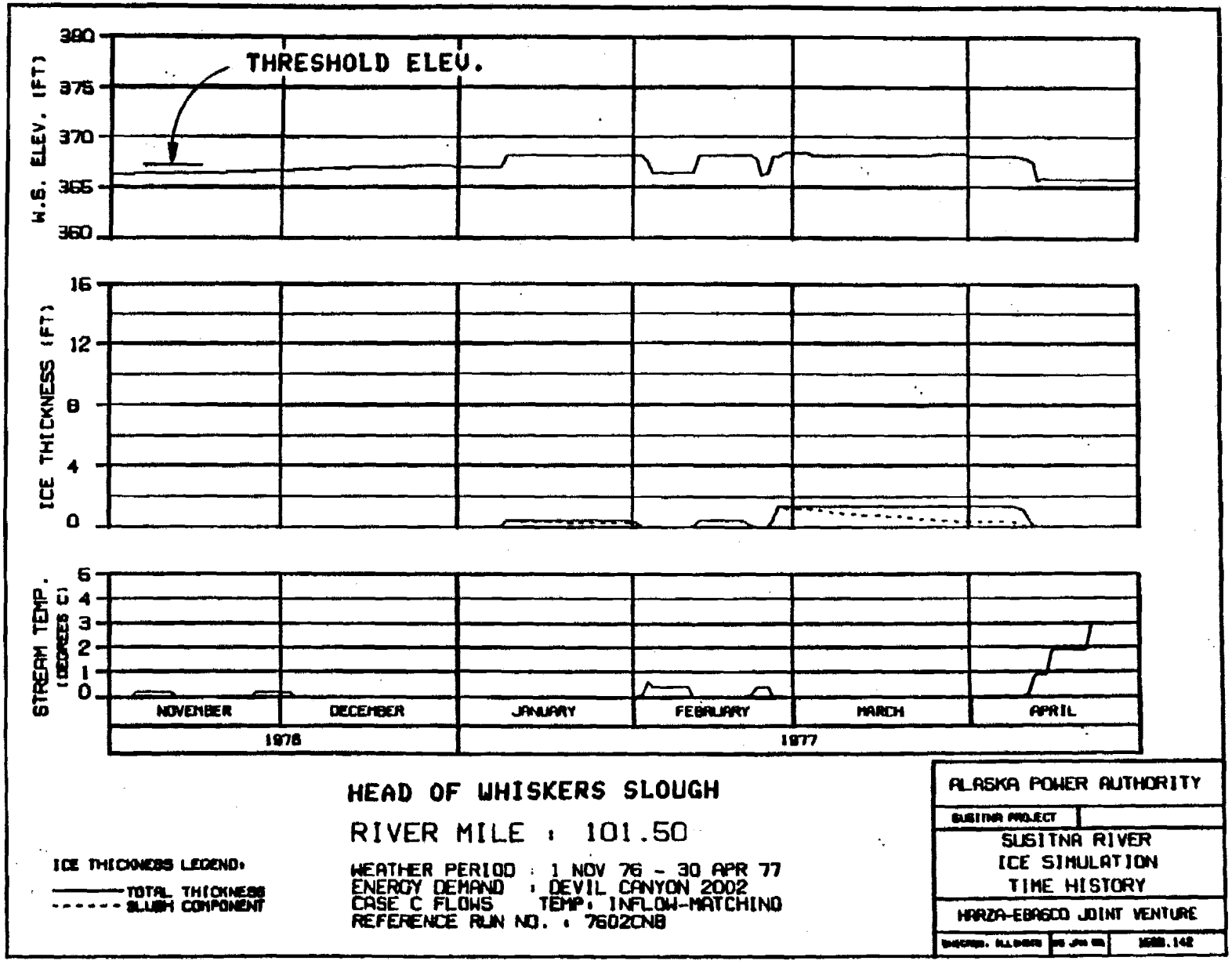
SUSITNA RIVER
ICE SIMULATION
PROFILE OF MAXIMUM STAGES

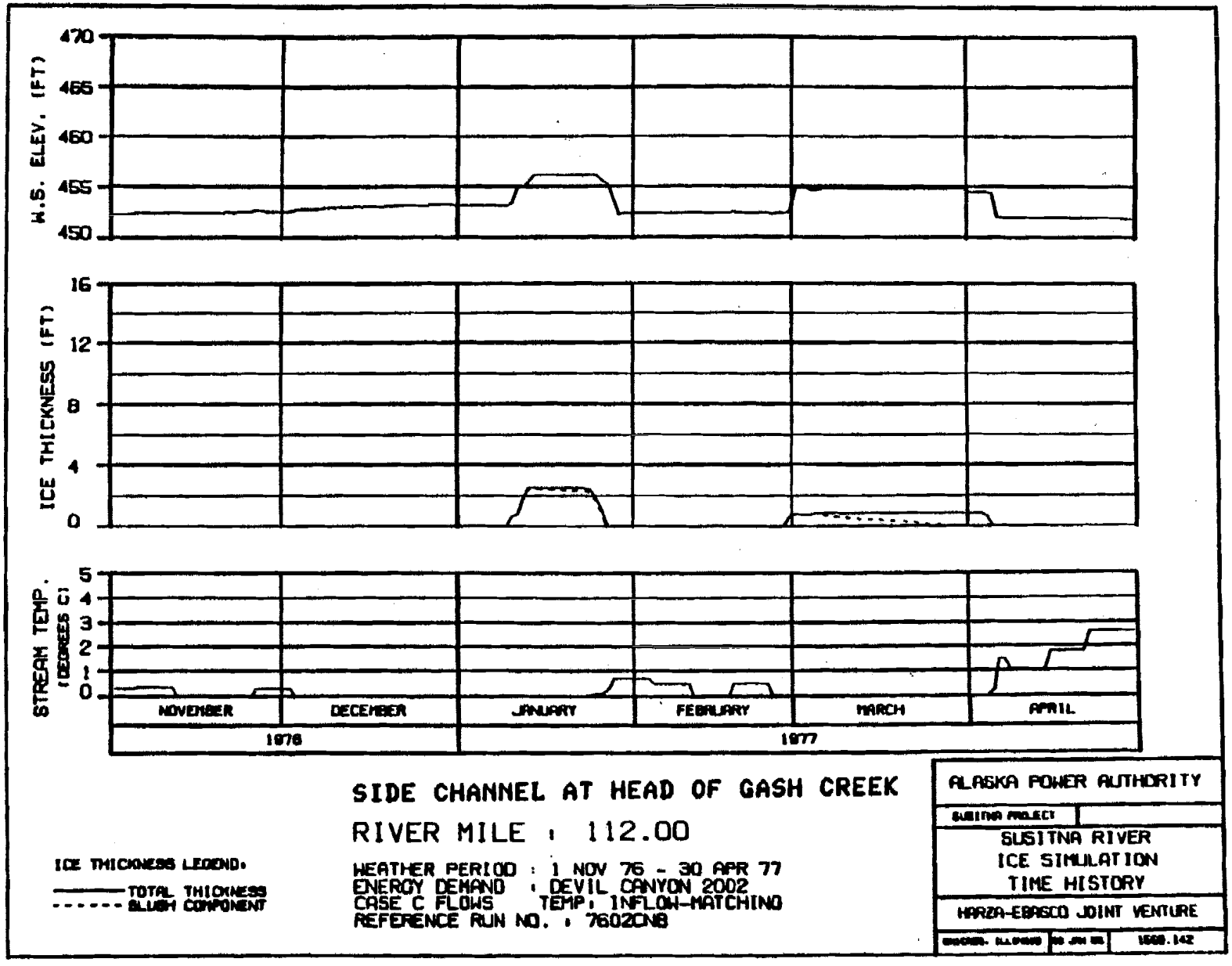
HARZA-EBASCO JOINT VENTURE

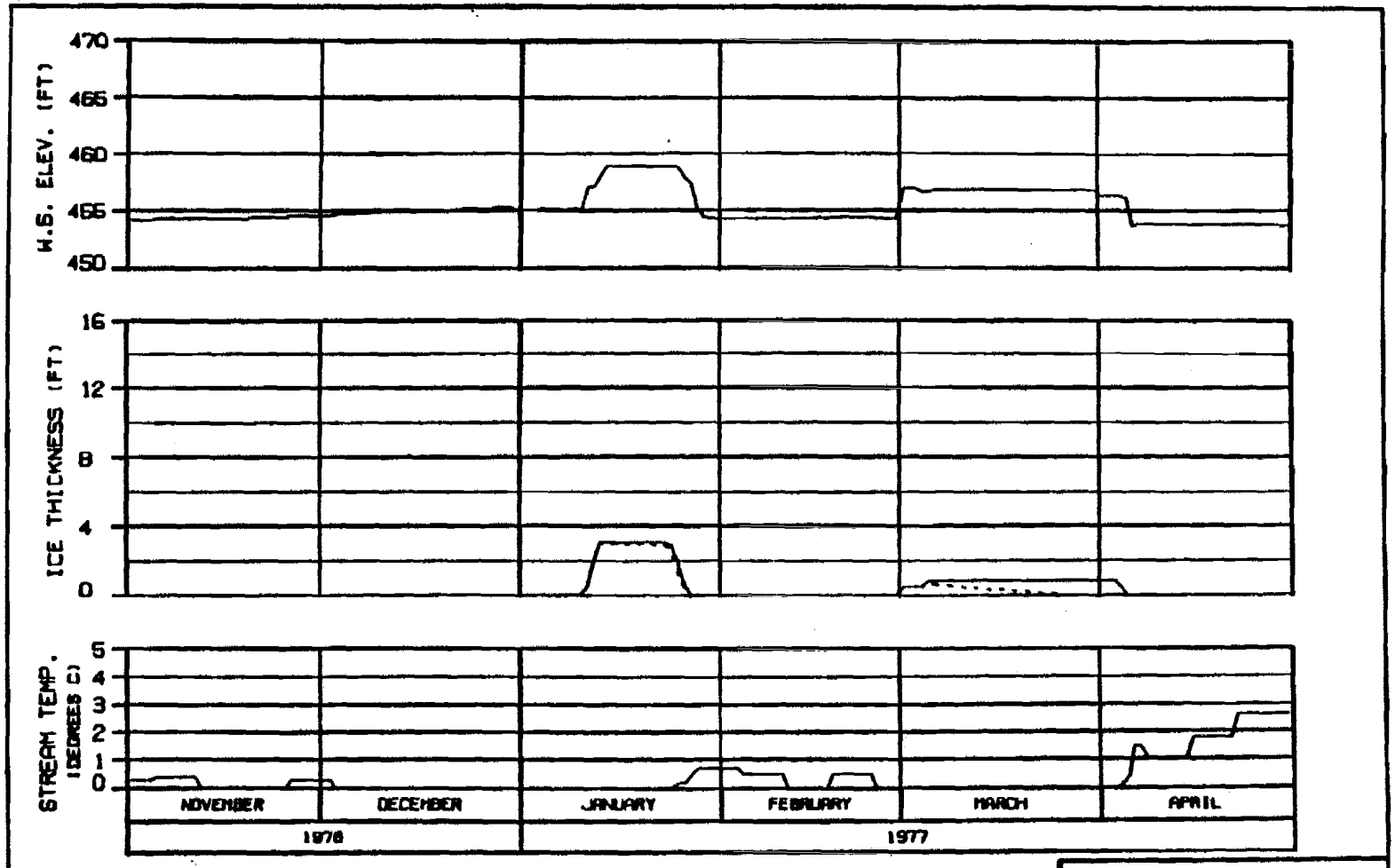
OPTION?

C


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 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
FLOW CASE C TEMP: INFLOW MATCHING
REFERENCE RUN NO. : 7602CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
PROGRESSION OF ICE FRONT
& ZERO DEGREE ISOTHERM
HARZA-EBASCO JOINT VENTURE
DECKER, ILLINOIS
30 JAN 85
1868.142
OPTION2


W.S. ELEV. (FT)
380
375
370
365
360
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
6
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF WHISKERS SLOUGH
RIVER MILE : 101.50
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE


W.S. ELEV. (FT)
470
465
460
455
450
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
SIDE CHANNEL AT HEAD OF GASH CREEK
RIVER MILE : 112.00
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE
1598.142



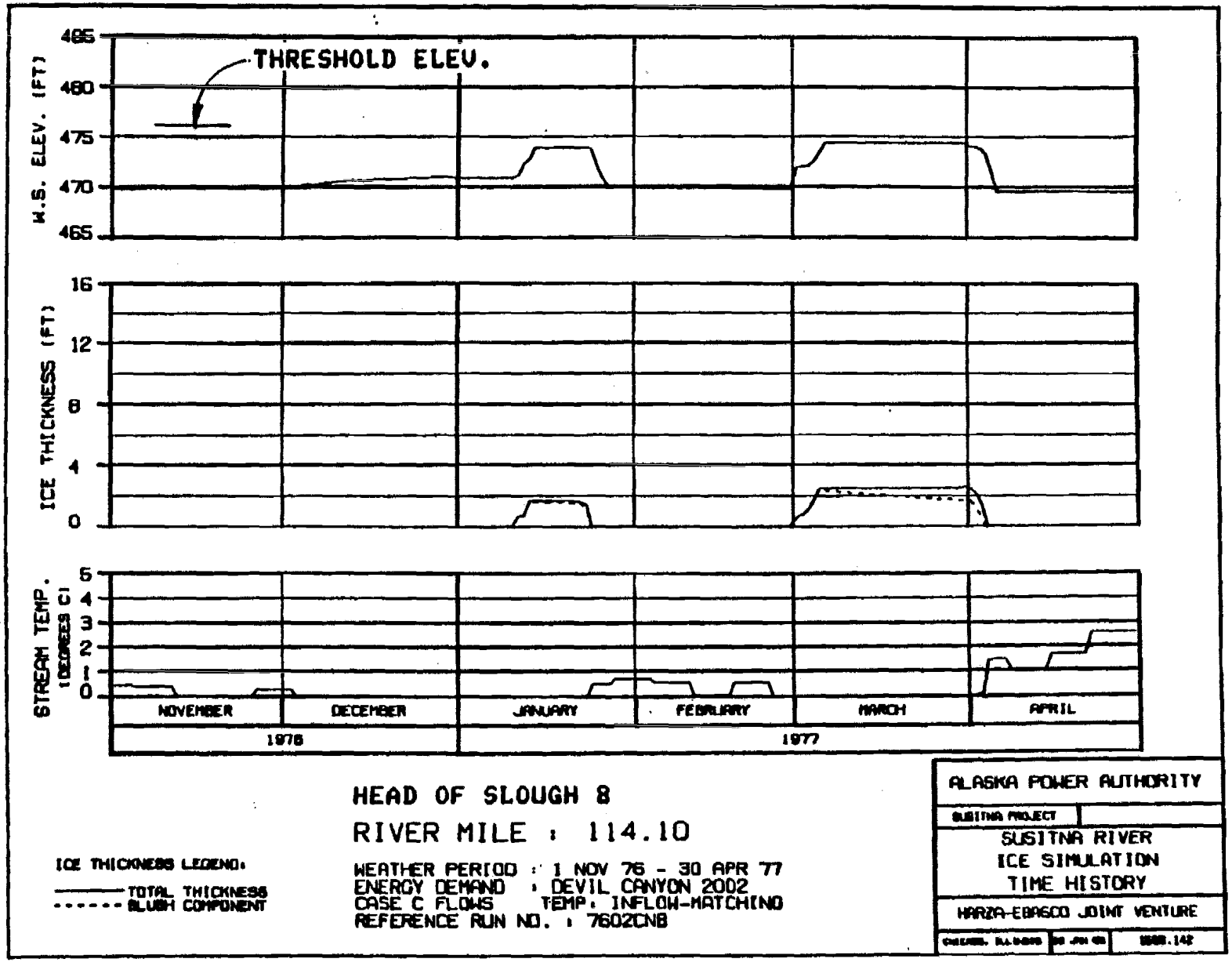
MOUTH OF SLOUGH 6A

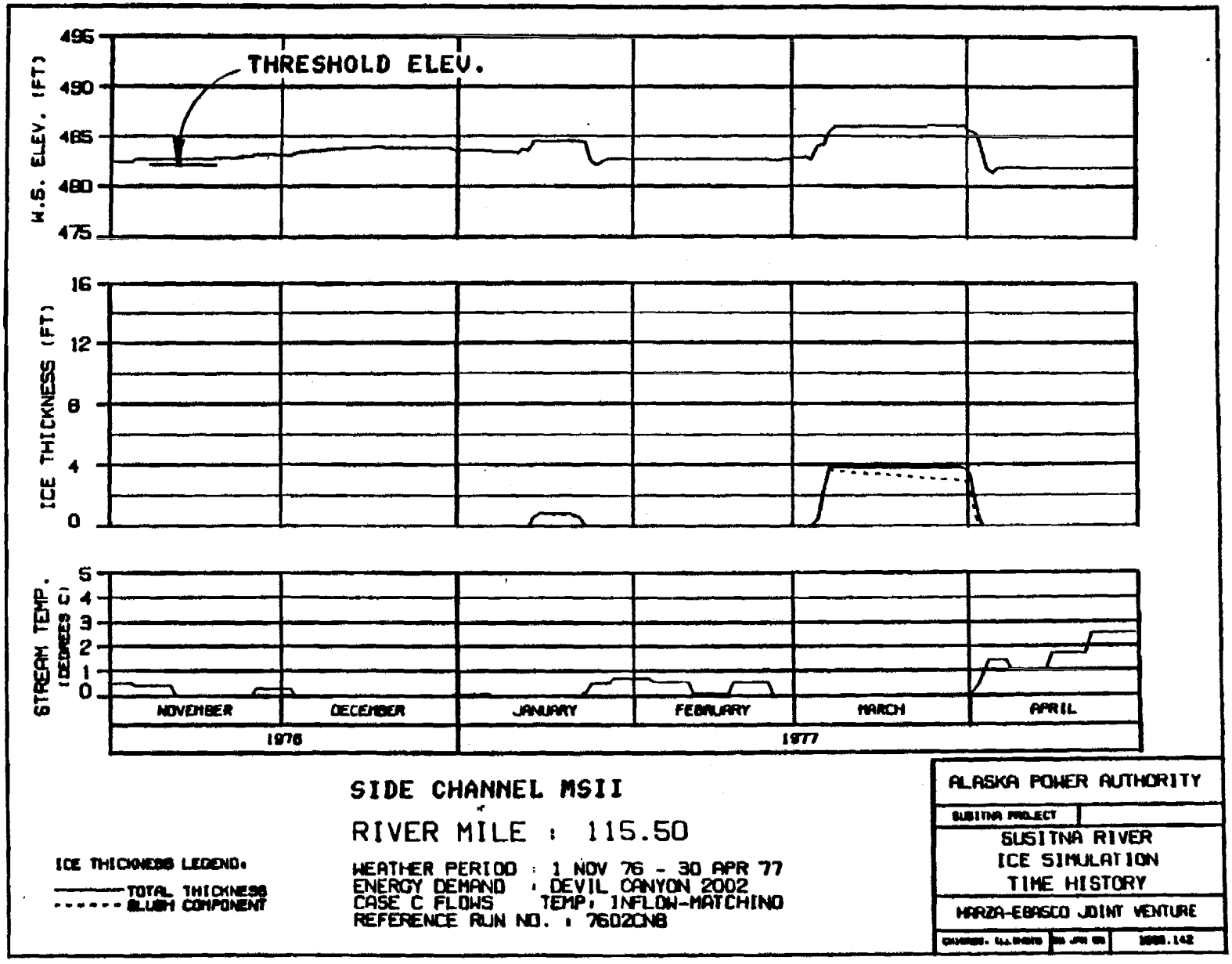
RIVER MILE : 112.34

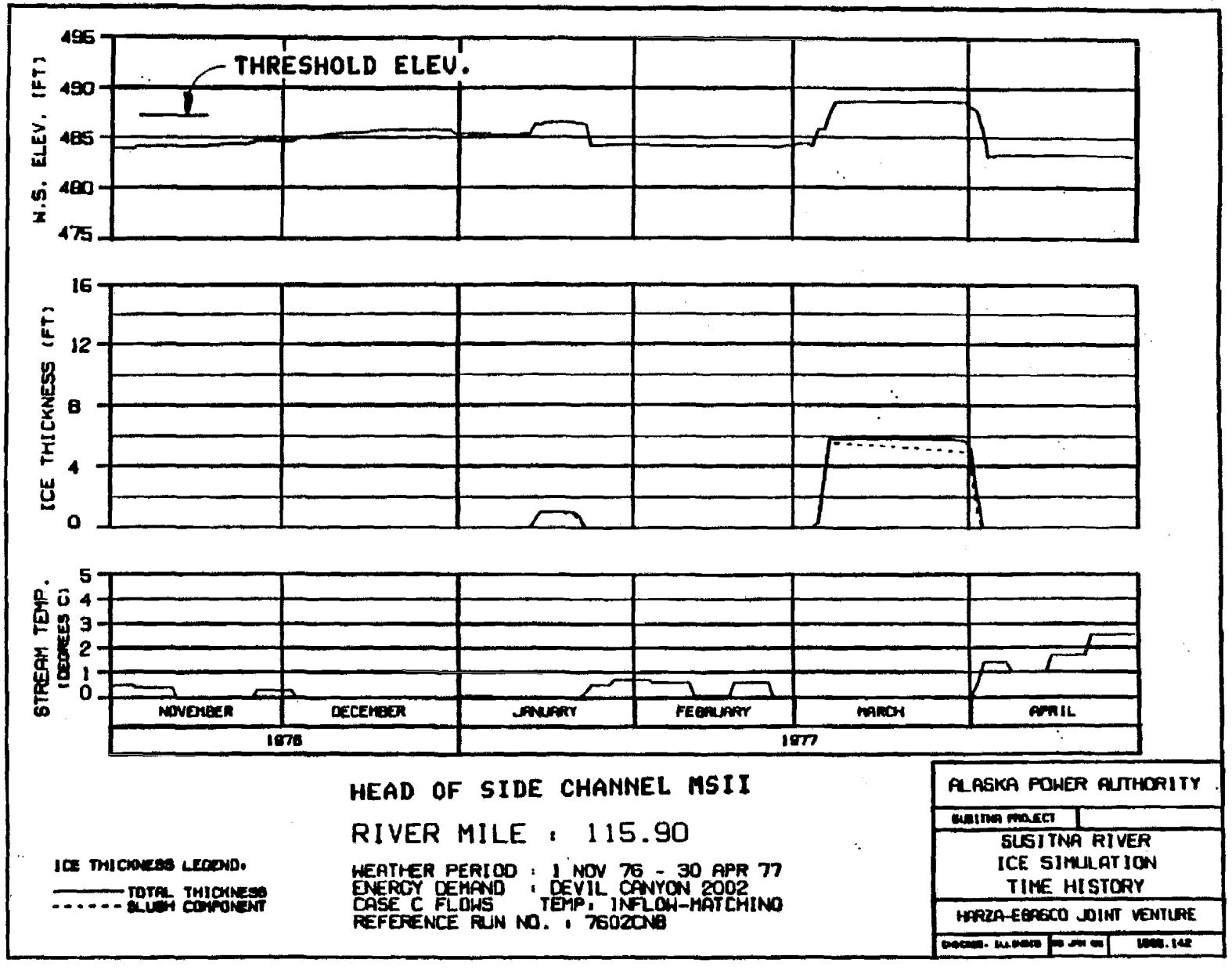
ICE THICKNESS LEGEND:
——— TOTAL THICKNESS
- - - - - - SLUSH COMPONENT

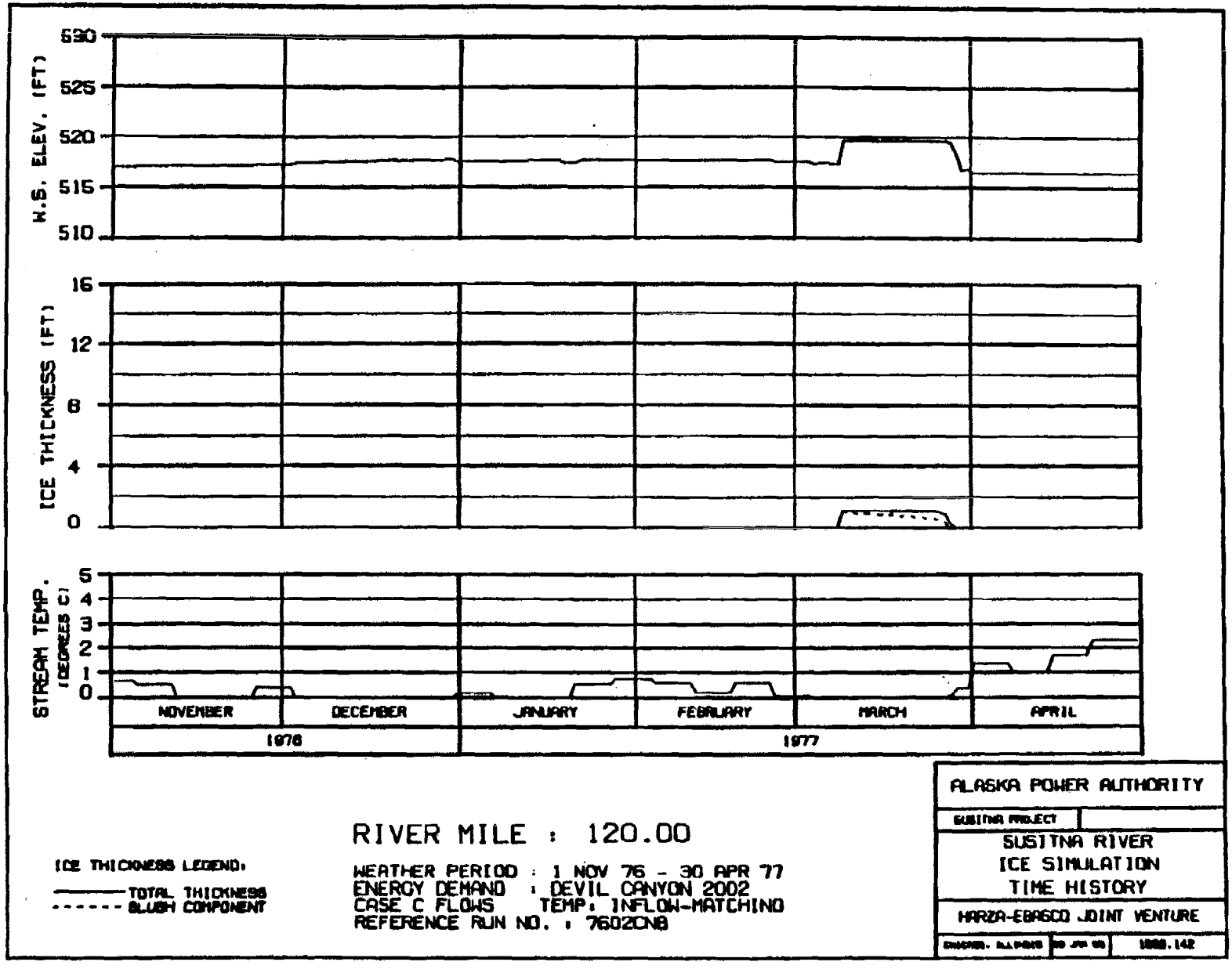
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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


W.S. ELEV. (FT)
485
480
475
470
465
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF SLOUGH 8
RIVER MILE : 114.10
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE


W.S. ELEV. (FT)
495
490
485
480
475
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
SIDE CHANNEL MSII
RIVER MILE : 115.50
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE


W.S. ELEV. (FT)
495
490
485
480
475
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF SIDE CHANNEL MSII
RIVER MILE : 115.90
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

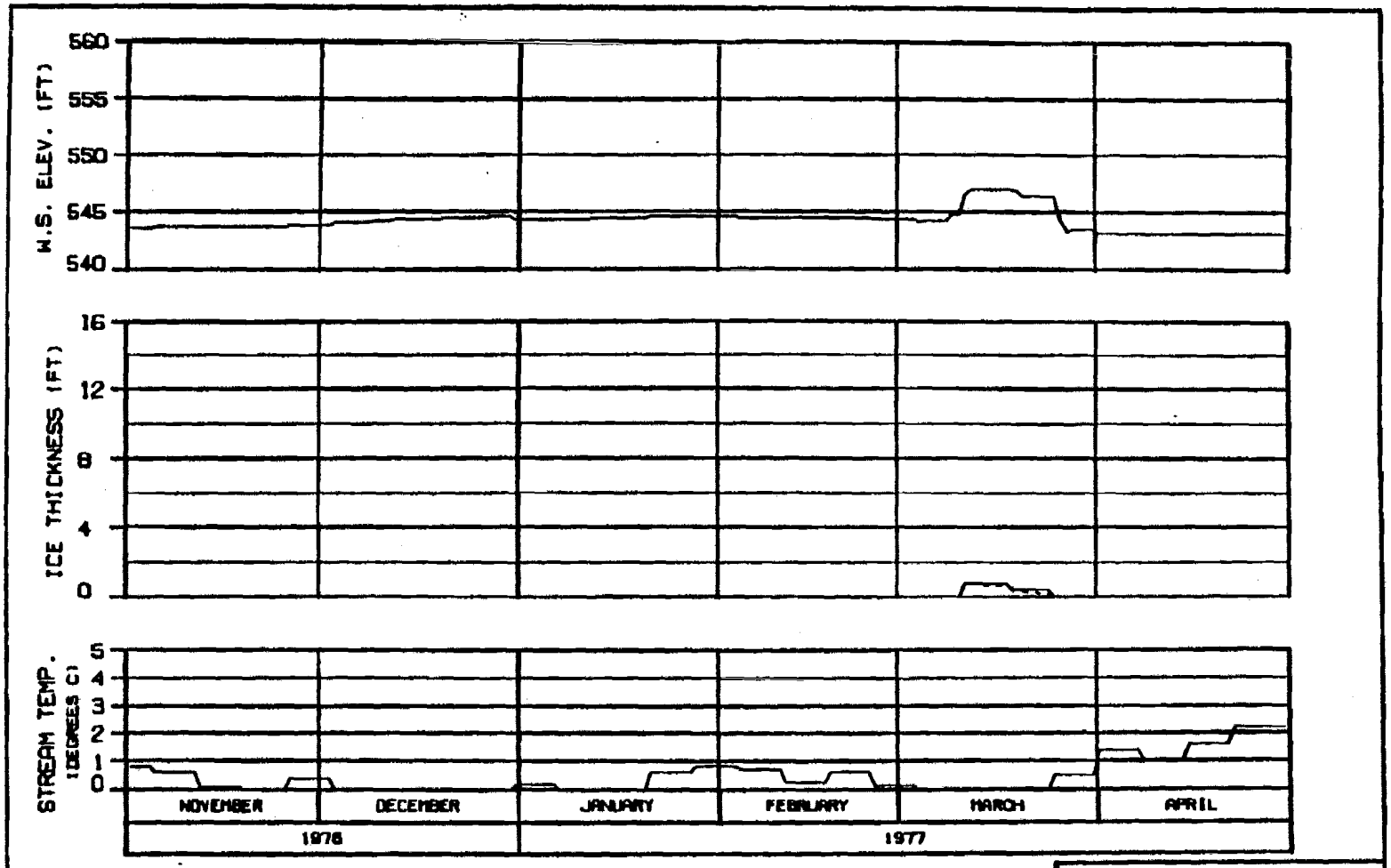
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] 1988.142



HEAD OF MOOSE SLOUGH

RIVER MILE : 123.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

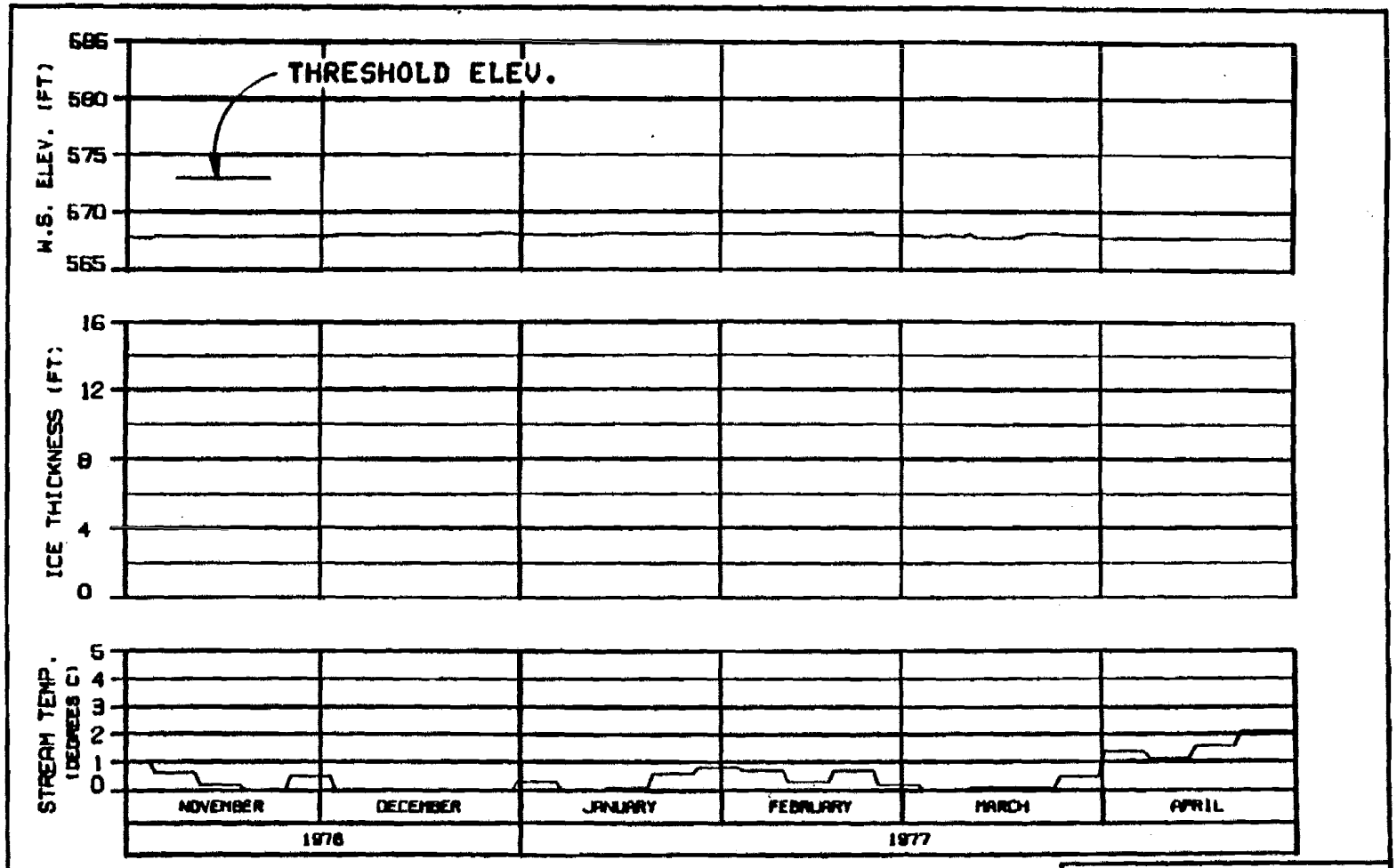
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

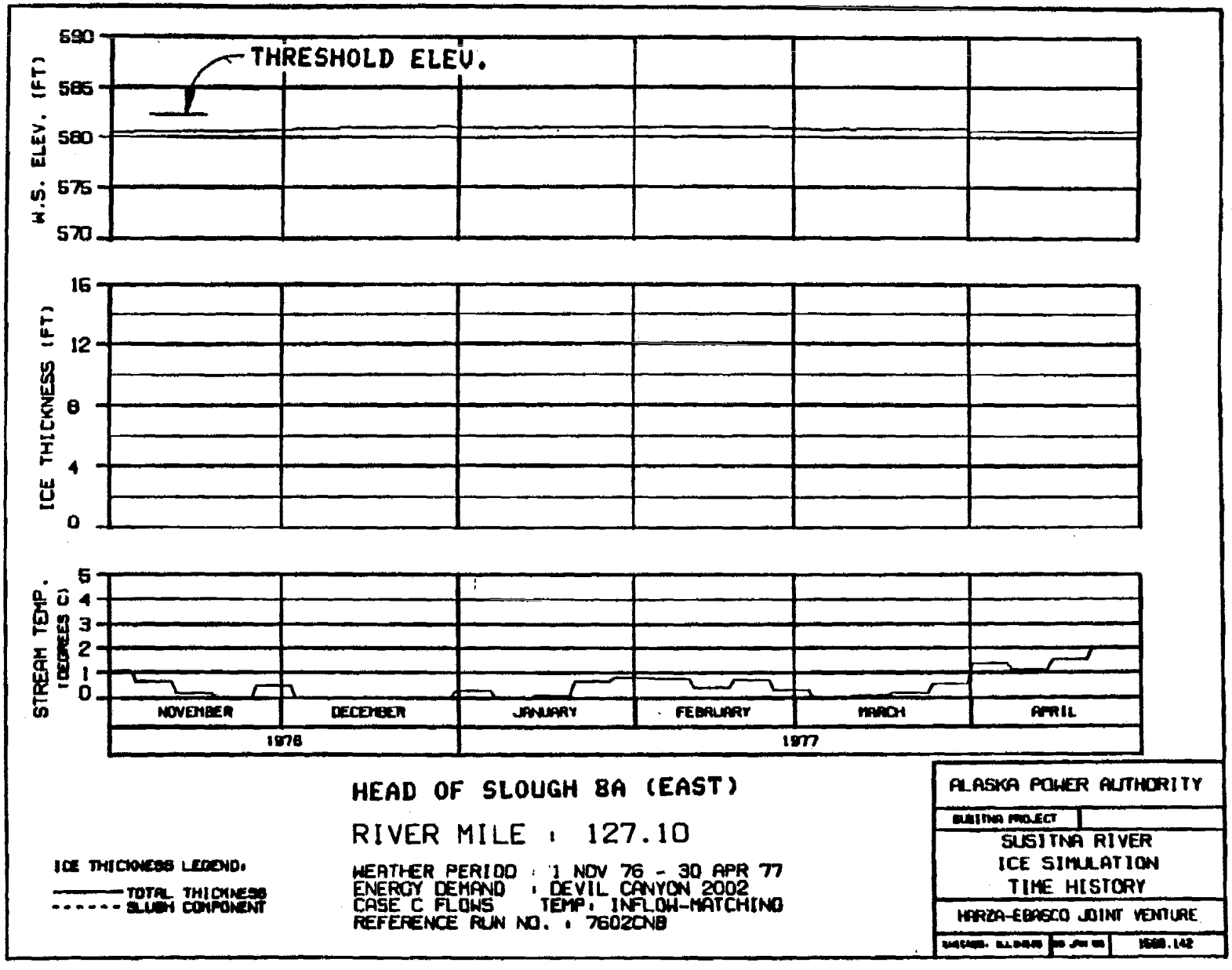
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

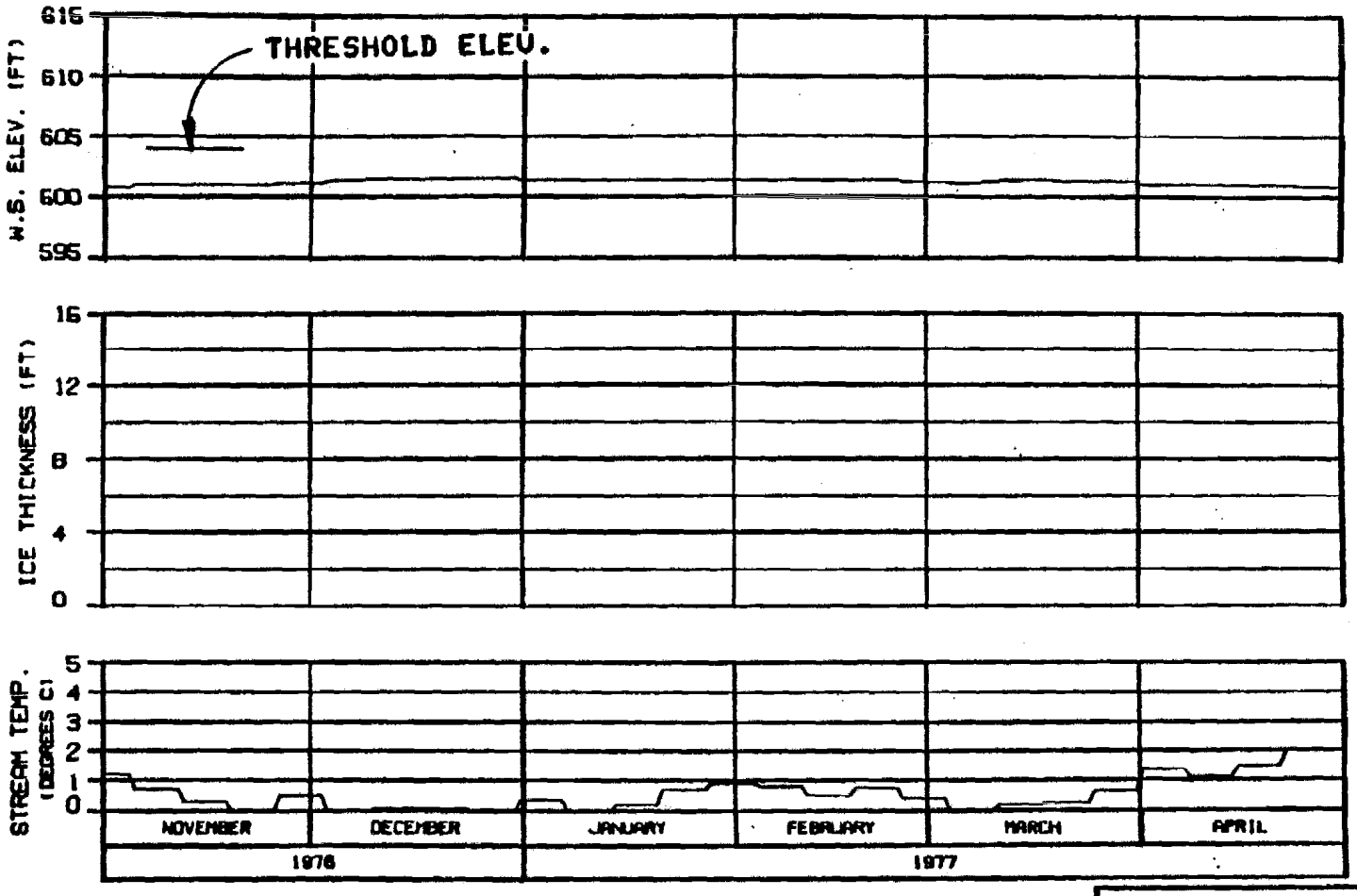
HARZA-EBASCO JOINT VENTURE

CHECKED: ILLEGIBLE | 30 JAN 85 | 2685.142


W.S. ELEV. (FT)
590
585
580
575
570
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF SLOUGH 8A (EAST)
RIVER MILE : 127.10
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE

C

STOP



HEAD OF SLOUGH 9

RIVER MILE : 129.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

SUSITNA PROJECT

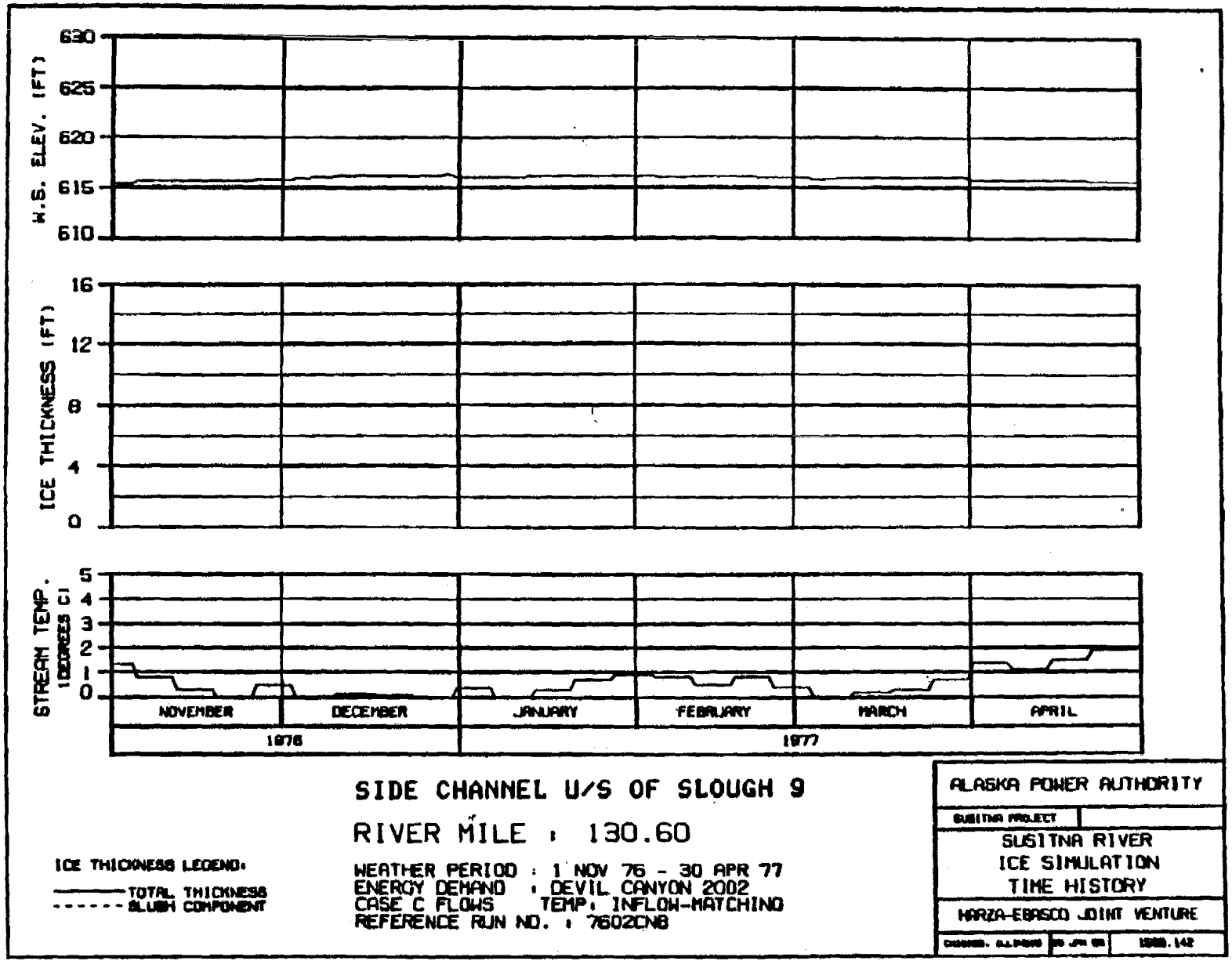
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

DRAWING NO. 1663.142

OPTION?

OPTION2



SIDE CHANNEL U/S OF SLOUGH 9

RIVER MILE : 130.60

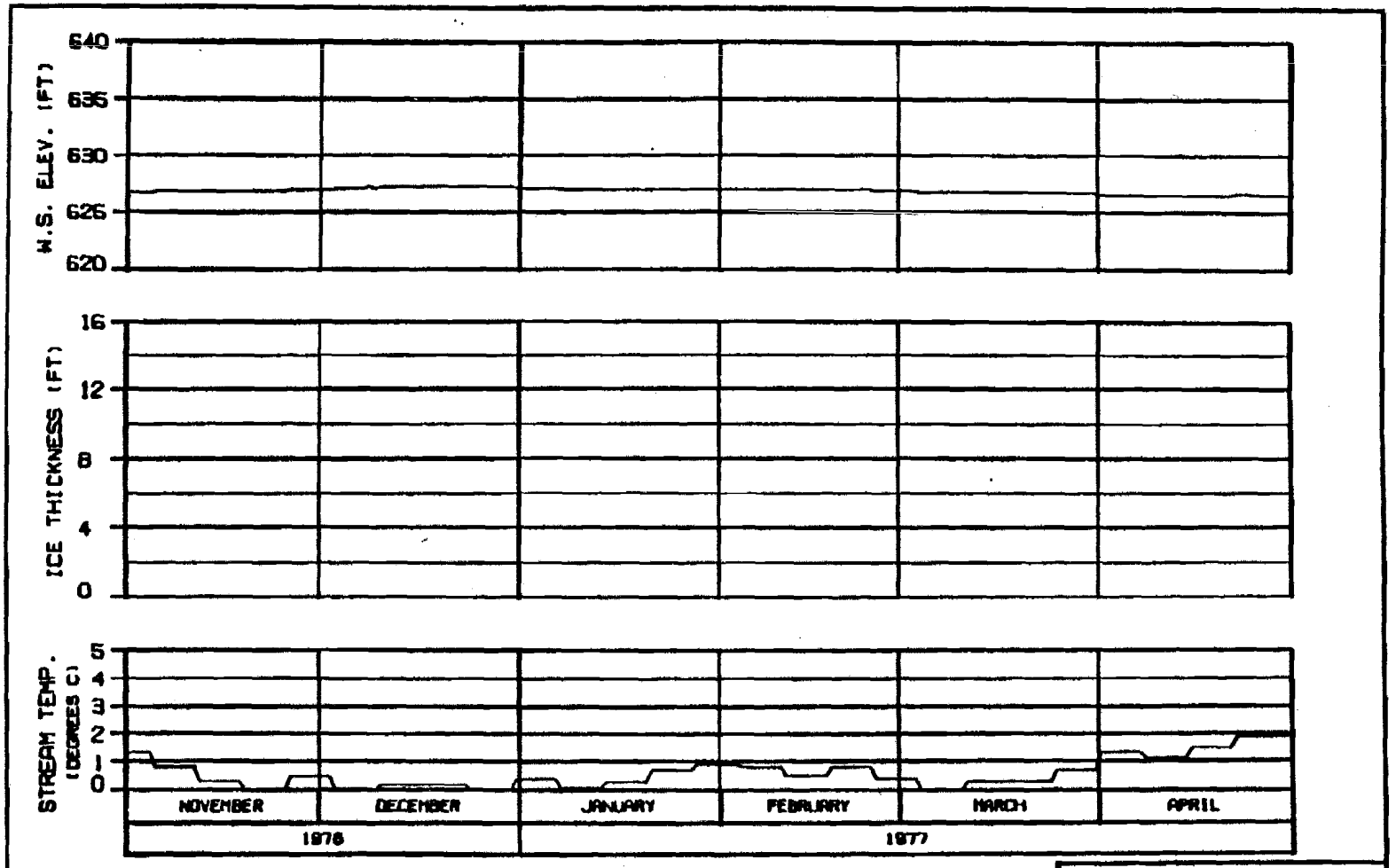
ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

ALASKA POWER AUTHORITY	
SUSITNA PROJECT	
SUSITNA RIVER ICE SIMULATION TIME HISTORY	
HARZA-EBASCO JOINT VENTURE	
CHKD. A.L.PEAK	1988.142



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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

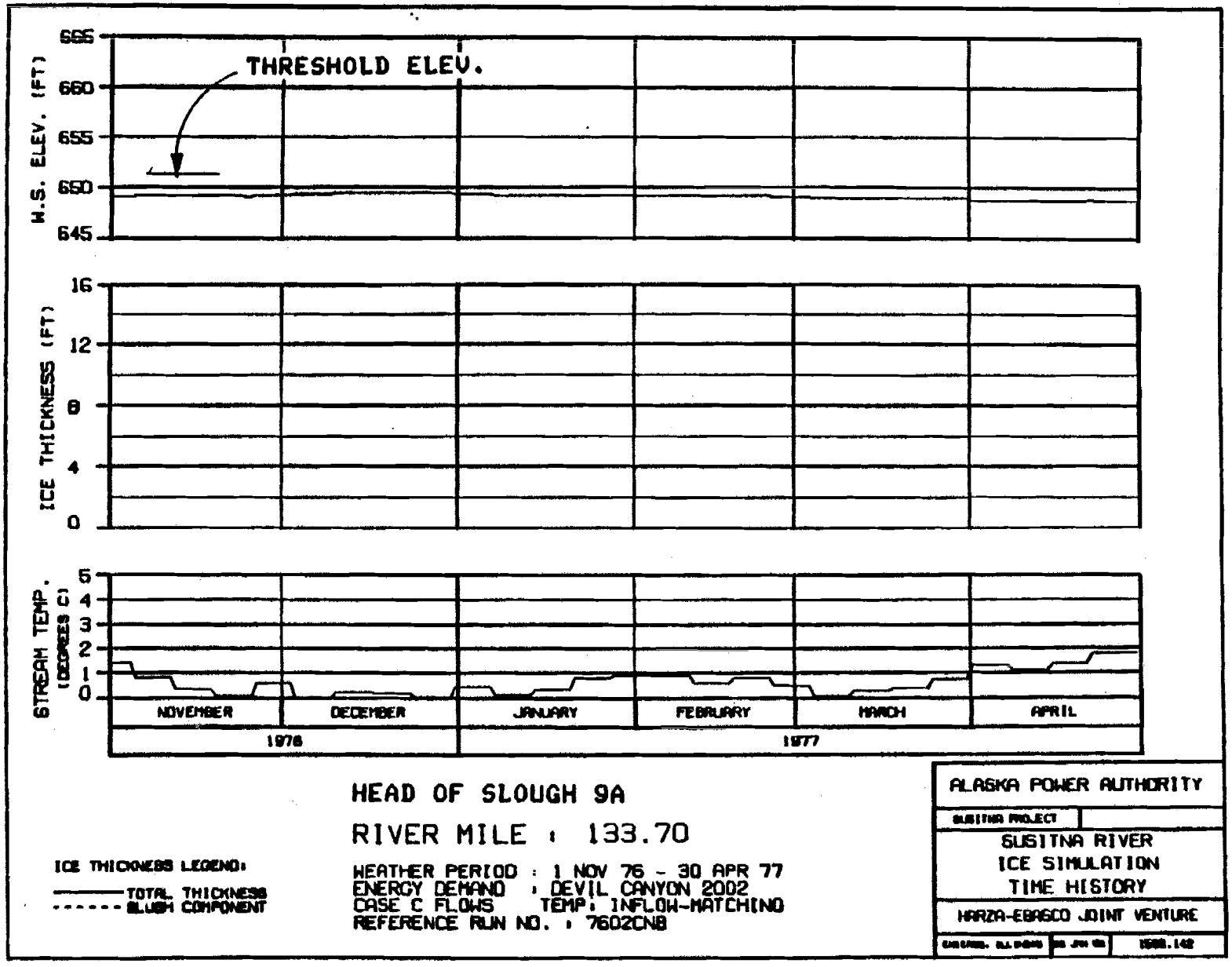
ALASKA POWER AUTHORITY

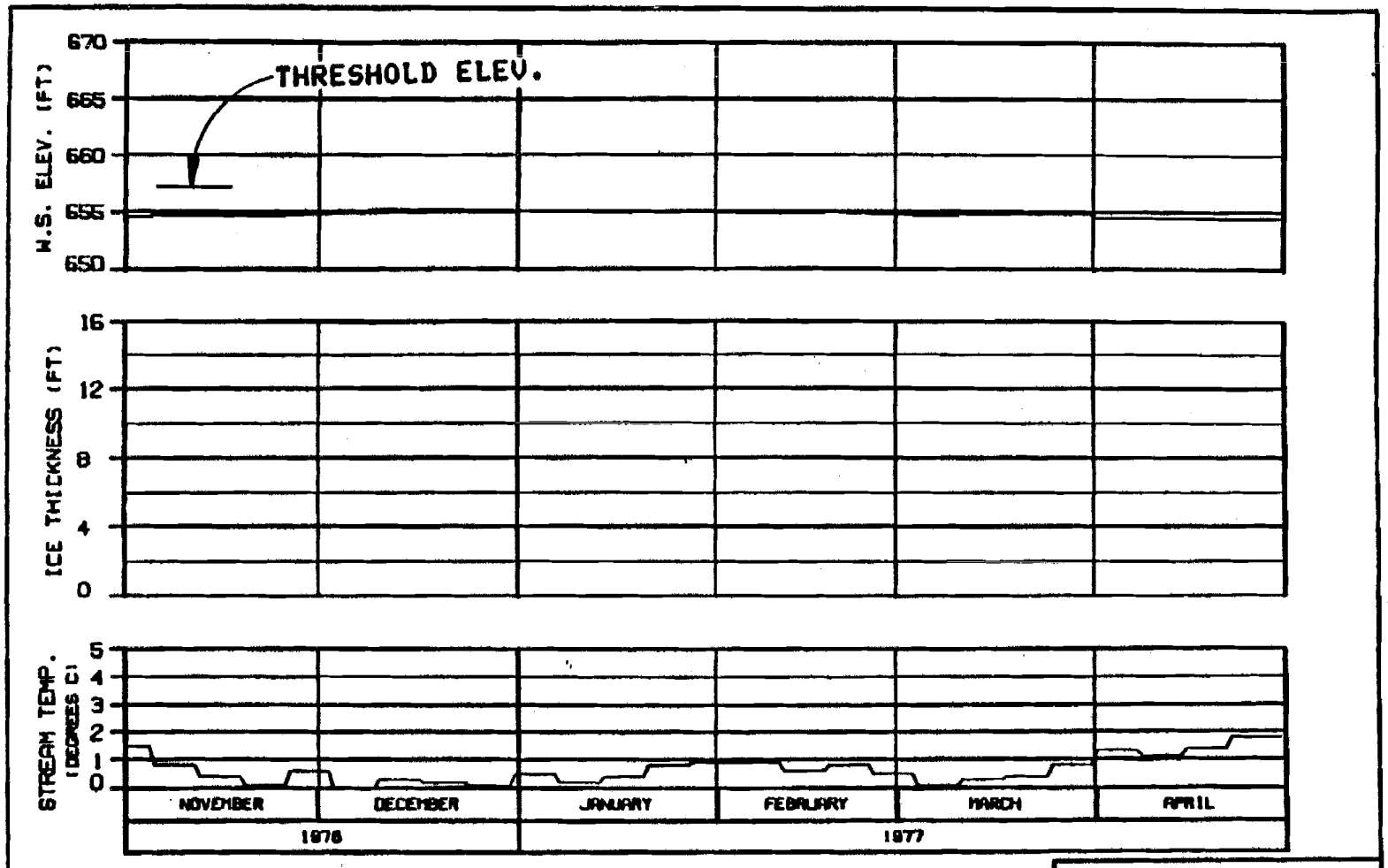
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1988.142


W.S. ELEV. (FT)
665
660
655
650
645
THRESHOLD ELEV.
ICE THICKNESS (FT)
16
12
8
4
0
STREAM TEMP. (DEGREES C)
5
4
3
2
1
0
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
1976
1977
HEAD OF SLOUGH 9A
RIVER MILE : 133.70
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB
ICE THICKNESS LEGEND:
TOTAL THICKNESS
SLUSH COMPONENT
ALASKA POWER AUTHORITY
SUSITNA PROJECT
SUSITNA RIVER
ICE SIMULATION
TIME HISTORY
HARZA-EBASCO JOINT VENTURE



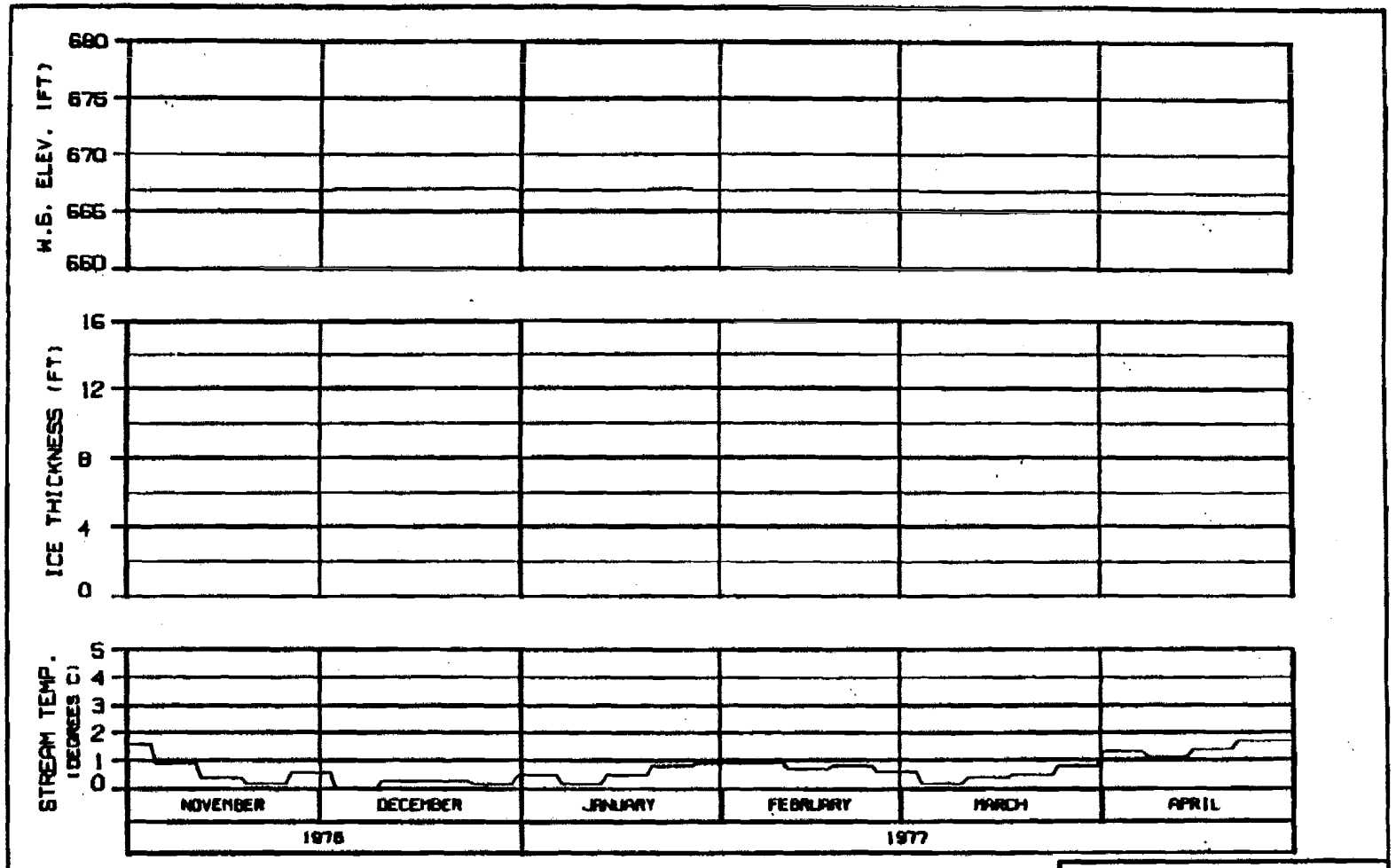
SIDE CHANNEL U/S OF SLOUGH 10

RIVER MILE : 134.30

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

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

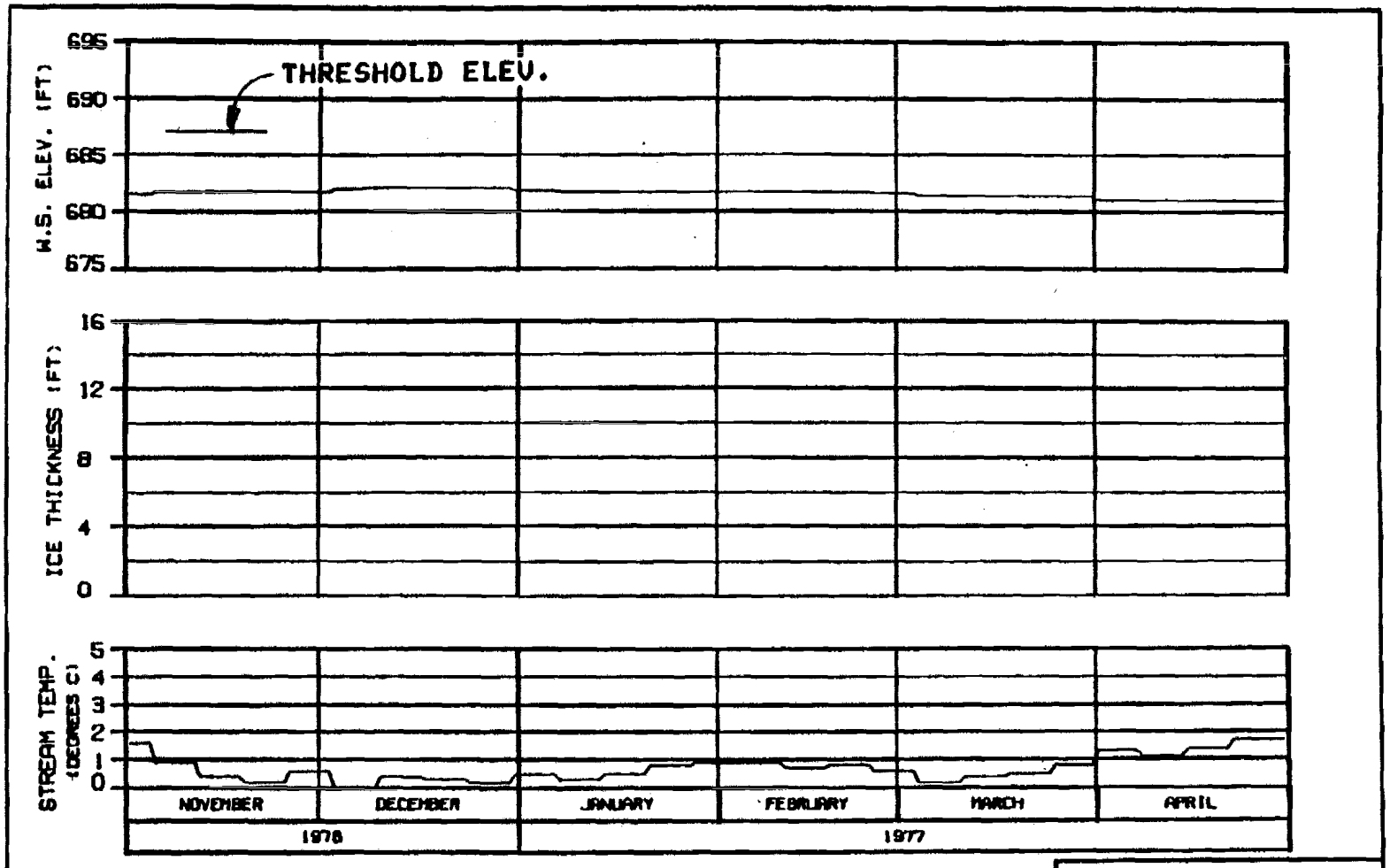
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1588.142



HEAD OF SLOUGH 11

RIVER MILE : 136.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

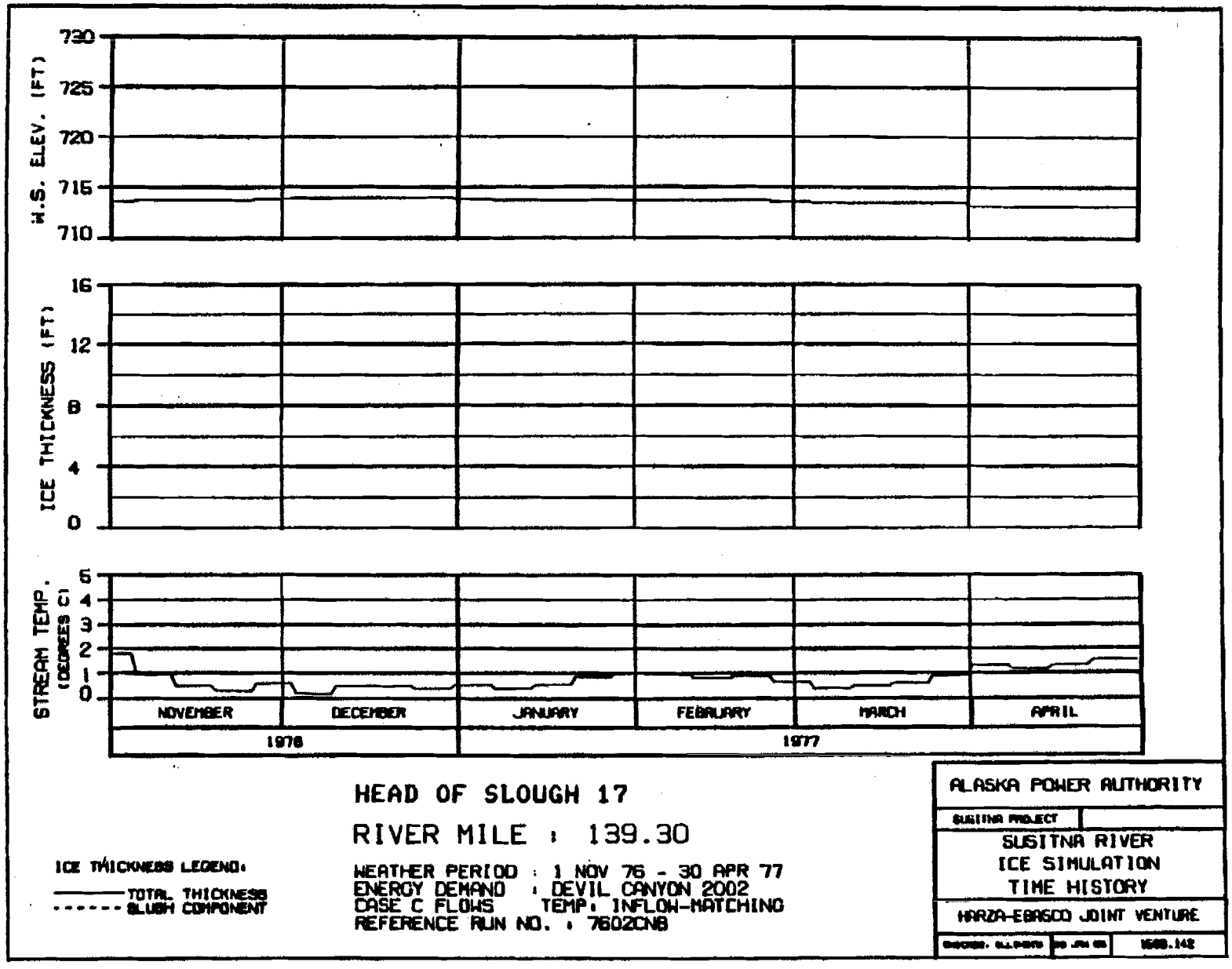
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1588.142



HEAD OF SLOUGH 17

RIVER MILE : 139.30

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

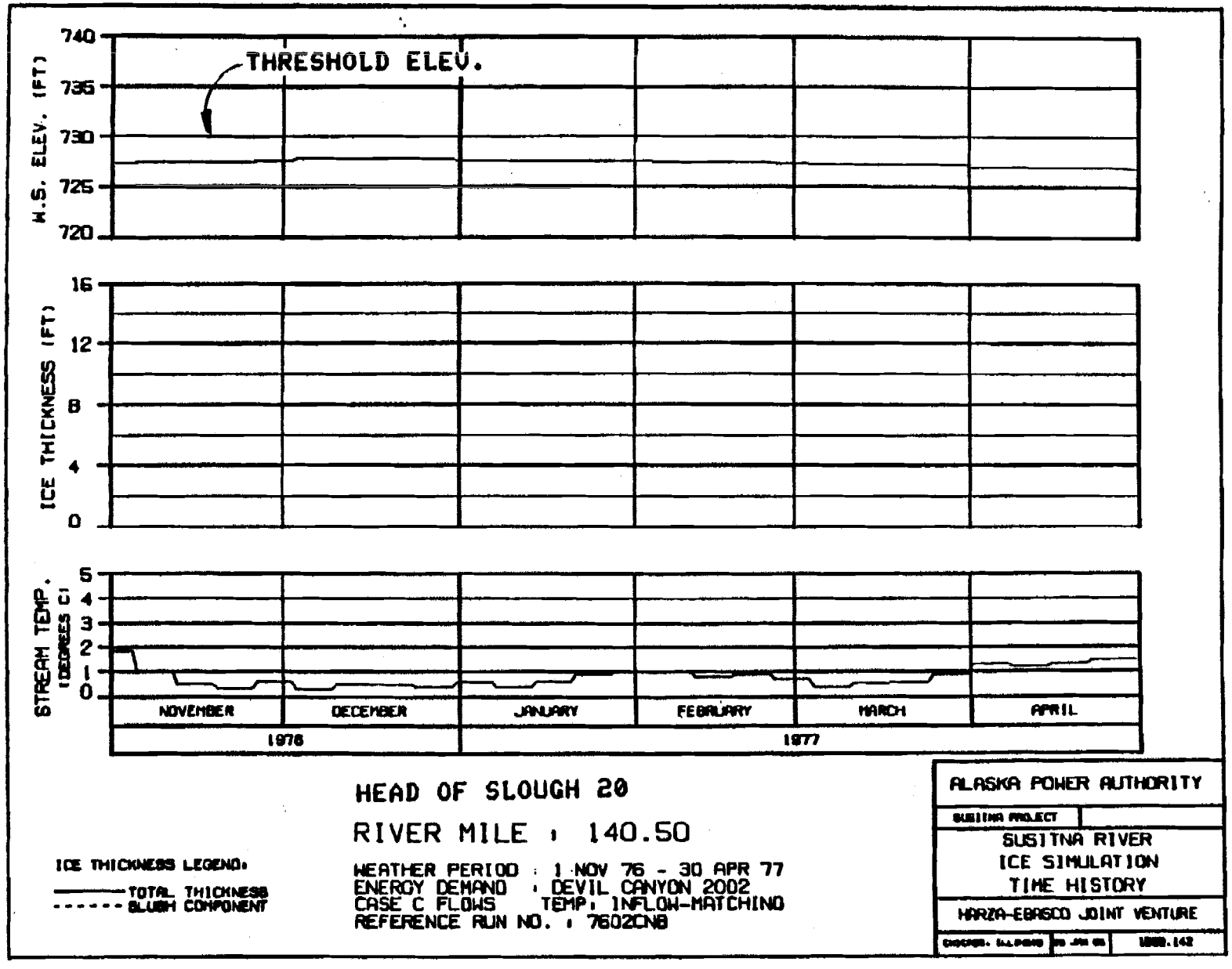
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1588.142



HEAD OF SLOUGH 20

RIVER MILE : 140.50

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

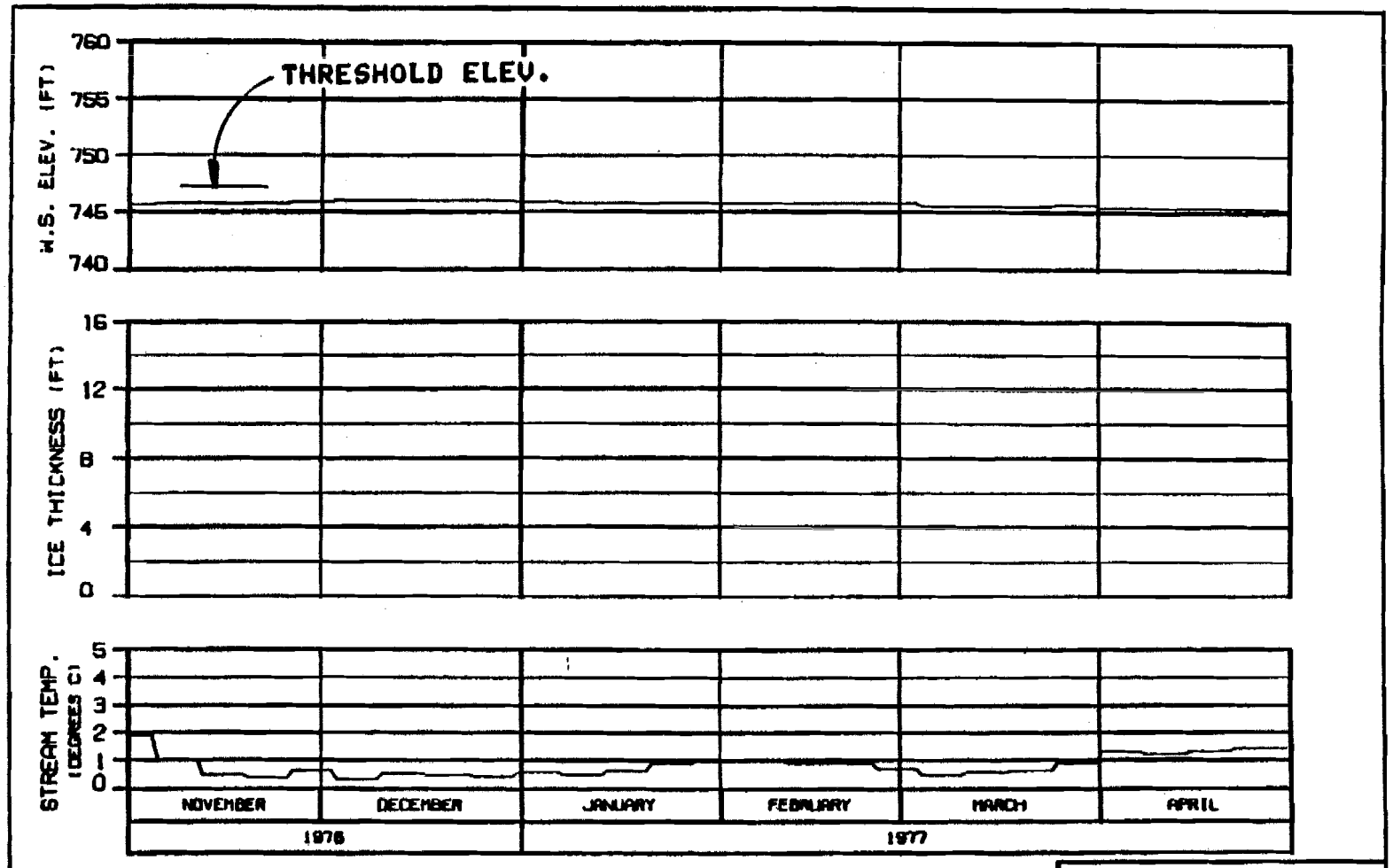
WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

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:

——— TOTAL THICKNESS

- - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

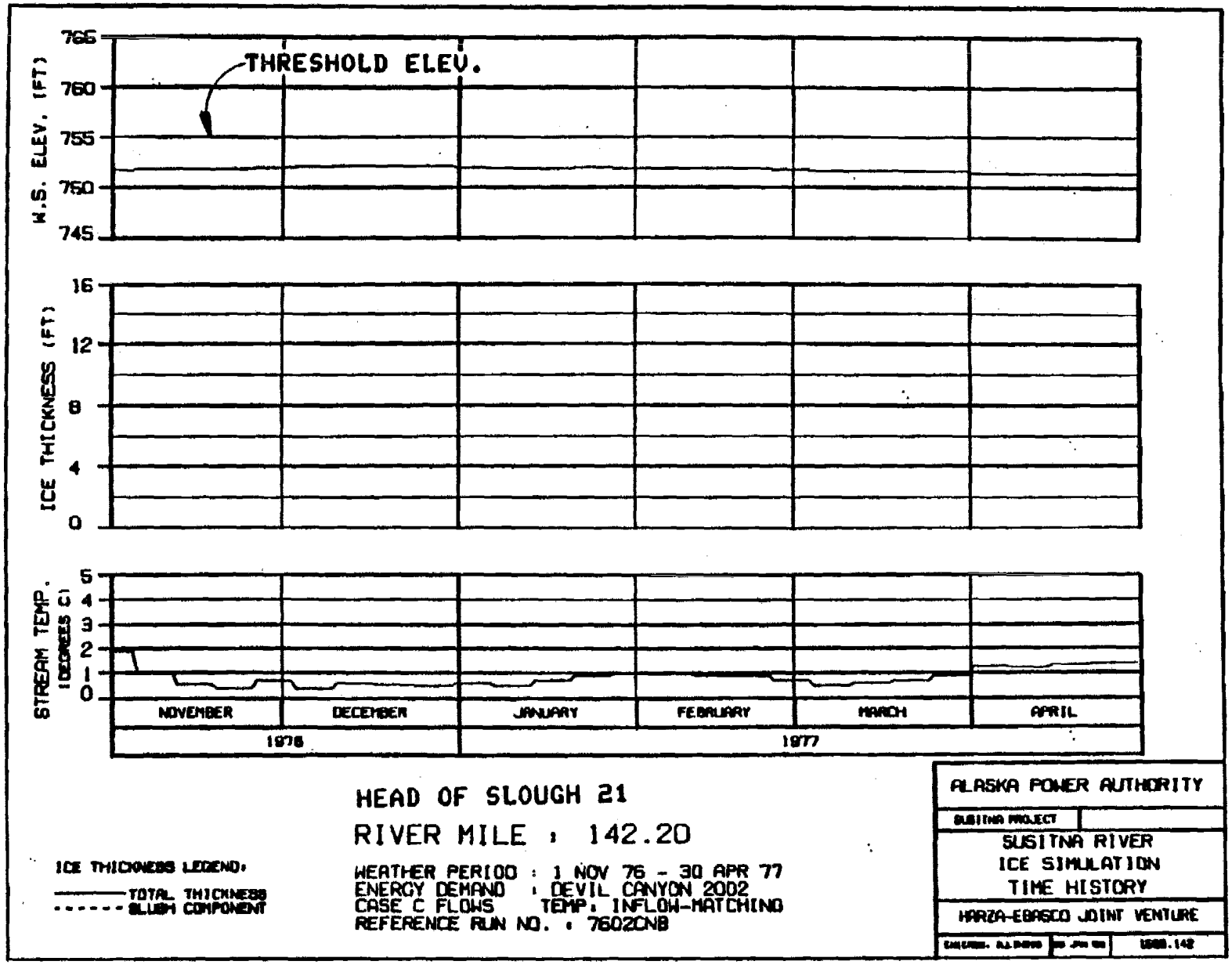
ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

[illegible] 1588.142



HEAD OF SLOUGH 21

RIVER MILE : 142.20

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CNB

ALASKA POWER AUTHORITY

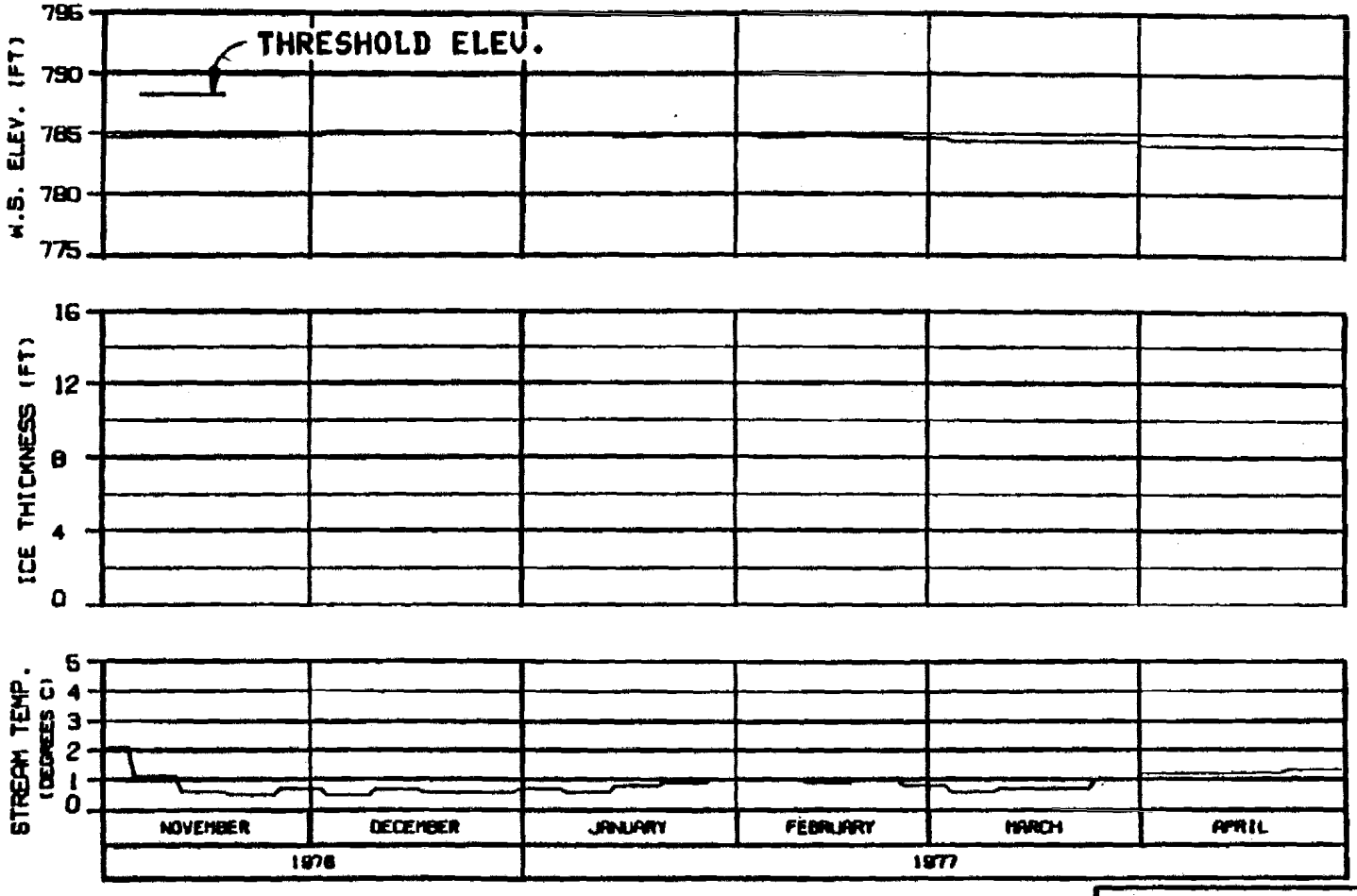
SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE

1588.142

C



HEAD OF SLOUGH 22

RIVER MILE : 144.80

ICE THICKNESS LEGEND:

——— TOTAL THICKNESS

- - - - - - SLUSH COMPONENT

WEATHER PERIOD : 1 NOV 76 - 30 APR 77
ENERGY DEMAND : DEVIL CANYON 2002
CASE C FLOWS TEMP: INFLOW-MATCHING
REFERENCE RUN NO. : 7602CN8

OPTION?

ALASKA POWER AUTHORITY

SUSITNA PROJECT

SUSITNA RIVER
ICE SIMULATION
TIME HISTORY

HARZA-EBASCO JOINT VENTURE