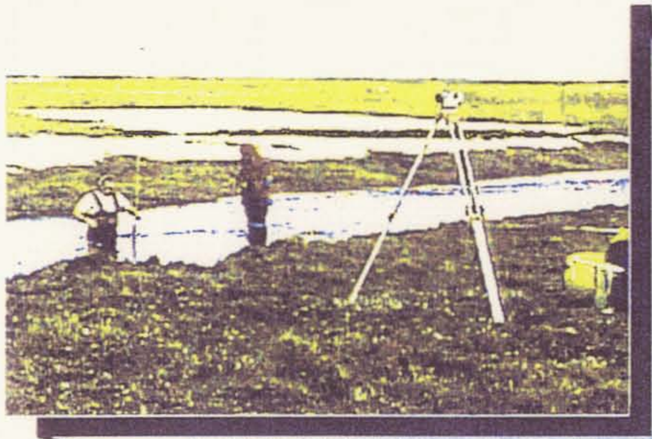
1998 SPRING BREAKUP AND HYDROLOGIC ASSESSMENT

SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA



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1.0 INTRODUCTION

This data report summarizes the observations and measurements made during the 1998 spring breakup at streams along the proposed pipeline route (Figure B-1, Appendix B). The purpose of the project was to collect baseline hydrologic and hydraulic data that could be used for pipeline design and environmental assessment. The field work was conducted between 21 May and 12 June 1998.

As shown on the Location Map (Figure B-1, Appendix B), the project is located east of Deadhorse, between the Staines River and Badami Camp, on the North Slope of Alaska. At the beginning of the field effort, the project was still in the conceptual stages of design. At that time, the project was expected to consist of an export pipeline between approximately the Point Thompson West site and Badami Camp. Infield pipelines and a road were expected to connect the Sourdough #3 site, the North Staines River #1 site and the Point Thompson Unit #3 site with the Point Thompson West site.

Prior to the field work, a review was made of the available maps and aerial photographs in order to identify streams crossing the proposed pipelines. Once the field crew arrived on site, the streams were assessed as to their significance with regard to pipeline design, and placed into one of two categories. Category I streams are minor streams having poorly defined channels and drainage areas, while Category II streams have definable channels and drainage areas. The information collected differed between the two categories of streams. At Category I streams the information collected generally included visual estimates of the:

(1) width of the flow at the 1998 peak water surface elevation,
(2) maximum depth of water at the 1998 peak water surface elevation, and
(3) mid channel velocity at the 1998 peak water surface elevation.

At Category II streams the information collected generally included the information for Category I streams plus:

(1) the peak water surface elevation during the 1998 spring breakup at the proposed pipeline crossing and at one other cross section located either upstream or downstream from the proposed pipeline crossing;
(2) a discharge measurement made as close to the flood peak as possible, including water surface elevation measurements at both cross sections at the time of the discharge measurement;
(3) a survey of the two cross sections described in item 1 above, and the length of the thalweg between the two cross sections, based on (a) a three dimensional coordinate system and (b) a primary temporary bench mark (TBM) having an assumed elevation of 100.00 feet, an assumed Northing of 5,000 feet and an assumed Easting of 5,000 feet; and
(4) notes regarding the width of gravel in the stream bed at each cross section.

At selected Category II streams, bed material samples were collected and the gradation measured.

Proposed pipeline crossings of Category I streams include: PLX 05, PLX 13, PLX 14, PLX 18, PLX 19, PLX 20, PLX 20A, PLX 20B, PLX 21, and PLX 25. Proposed pipeline crossings of Category II streams include: PLX 01 (West Badami Creek), PLX 02 (Middle Badami Creek), PLX 03 (East Badami Creek), PLX 04, PLX 06, PLX 07, PLX 08, PLX 09, PLX 10, PLX 11, PLX 12, PLX 15, PLX 16, PLX 22, PLX 23, PLX 24, PLX 26, PLX 27, PLX 28, and PLX 29. The stream associated with proposed pipeline crossing PLX 17 was not identifiable in the field and was dropped from further consideration.

It should be noted that a survey of the proposed pipeline route had not been undertaken prior to the field work. Thus, the proposed pipeline crossings were located based on a hand held global positioning system (GPS) and coordinates taken from the mapping available at the start of the project.

2.0 HYDROLOGIC OBSERVATIONS

2.1 General Hydrologic Observations

Watersheds within the project area range in size from approximately 1 to 90 square miles (Table 1). Several of the watersheds are without clearly defined boundaries or drainage channels, while other watersheds contain well-established stream channels. Typically, the watersheds over 10 square miles in size are long and narrow.

Stream channel characteristics range from shallow grass lined swales to incised channels with gravel beds. The maximum size of the gravel was generally less than 3 inches. Many of the streambeds are composed of a combination of grass and gravel.

2.2 1998 Spring Breakup

The 1998 spring snowmelt progressed from south to north during the early stages (Photo C-1), and then combined with a general melt 5 to 10 miles from the coast. The narrowness of many of the watersheds resulted in a short time of concentration and a rapid rise and recession in the water surface elevation.

The first observed indication of runoff occurred on the afternoon of 25 May 1998. Approximately 25 miles southeast of Badami, water was flowing over snow-filled channels in East Badami Creek (PLX 03), and the ponds were beginning to collect water. North of this area the ground was more than 90 percent snow covered with little evidence of saturation.

By mid-afternoon on 26 May 1998, the leading edge of the flow had moved 3 to 4 miles downstream. Within the next 24 hours most of the streams between Badami Camp and 12 miles east were flowing. From about 12 miles east at PLX 12 to 23 miles east of Badami Camp no flow was observed.

Streams west of PLX 12 were flowing mostly out of banks with channels 50 to 80 percent snow filled on the afternoon of 28 May 1998. East of PLX 12 similar conditions did not develop until 29 May.

Throughout the project area, the peak water surface elevation occurred between 29 and 31 May 1998. In general the streams with the larger watersheds crested earlier than those draining smaller areas. Dense snowdrifts located within the channels affected most of the crest elevations. Snow blockage was estimated to range from 10 to 80 percent.

As snowmelt progressed, and the rate of flow increased, the snow within the channels was rapidly cleared. In most cases the peak discharge probably occurred at a slightly lower stage (0 to 1 foot, about 0.4 feet on average) and shortly after the peak water surface elevation (usually within hours).

Snowmelt in the general vicinity of the project occurred rapidly. On 28 May it was estimated that the ground was 60 to 80 percent snow covered. On 29 May only an estimated 20 percent of the snow cover existed. By 1 June all of the streams were in recession. However, areas of indefinite channels and ponded or sheet flow had not started to recede by 1 June.

Although slush and snow floes were observed in the streams, no solid ice floes were observed.

1998 EVENT WAS PROBABLY ABOUT 2 YR EVENT.

Based on the 3 streams monitored by the USGS in the vicinity of Deadhorse and Pump Station 3, it appears that the 1998 spring breakup flood peak generally had a reoccurrence interval of 2 to 5 years. It is likely that the streams monitored for this project experienced floods with similar recurrence intervals.

EAST CR (DA = 43 sm) 1998 Q_p = 530 cfs R.P. = 1.6 yrs
KUPARUK R (DA 3130 sm) 1998 Q_p = 3130 cfs R.P. = 2.3 yr.
NUNAVAIK CR (DA 2.8) 1998 Q_p = 25 cfs R.P. = 1.3 yrs
SAG R. TRIB (DA 12) 1998 Q_p = 85 cfs R.P. = 2.4 yrs

2.3 Pipeline Crossing Data

A summary of the data collected at each stream is presented in Table A-1 (Appendix A), and includes:

(1) the spring peak water surface elevation, velocity, width, depth, water surface slope, and date of occurrence;
(2) a preliminary estimate of the bankfull elevation, width, and depth;
(3) the width of the gravel bottom; a summary of the discharge measurement, where one was made; and
(4) a summary of other miscellaneous measurements, where such were made.

A summary of the locations and elevations of the temporary bench marks used in the survey is presented in Table A-2 (Appendix A).

A photograph showing the typical size of the gravel exposed in many of the channel bottoms is presented in Photo C-2 (Appendix C). Photographs of the typical vegetal conditions within the channels and along the floodplain are presented in Photos C-3 through C-5 (Appendix C).

Additional information concerning specific pipeline crossings is presented in the appendices. For Category I streams, photographs of the streams are presented. For Category II streams, plan and profiles of the survey data, bed material gradations where available, photographs, discharge measurements where available, and a summary of the survey data are presented. Discharge measurements were made on all Category II streams except PLX 01, PLX 02, PLX 23, PLX 26 and PLX 29. Bed material gradations are provided for streams PLX 03, PLX 06, PLX 09, PLX 15, PLX 16, PLX 24, and PLX 28. A description of the water surface elevations measured at times other than the peak water surface elevation or the discharge measurement, and the portion of the channel covered with gravel, are presented on the cross section plots.

The requirement for valve locations for the crude oil transmission pipeline is governed by the Code of Federal Regulations Part 195 (CFR 195), "Transportation of Hazardous Liquids by Pipeline". The regulations would cover the crossings labeled PLX01 through PLX22, based on the preliminary alignment used for this study. CFR 195.260 states :

195.260 Valves:location.
"A valve must be installed at each of the following locations: …
(e) On each side of a water crossing that is more than 100 feet wide from high-water mark to high-water mark unless the Administrator finds in a particular case that valves are not justified."

The "high water mark" referenced in the above regulations is interpreted as being the "Bankfull" condition reported in this initial study. From Table A-1, it is clear that East Badami Creek is well over 100 feet at the preliminary crossing location and would require consideration of valving.

Four other crossings exceed a bankfull width of 100 feet directly at the proposed crossings – PLX07, PLX09, PLX16 and PLX22. However, all of these streams show a width of less than 100 feet at the "Other" cross sections reported in Table A-1. The data show that the bankfull width is variable for these streams, and pipeline reroutes can reduce the estimates of bankfull width to less than 100 feet at all of these crossings if required to show agreement with the stipulated language. In addition PLX22 is located close to the facility and the valve at facility discharge should suffice for this crossing in any case.

On the other hand, intermediate valves and/or other leak control measures along the alignment are prudent in any case. For planning purposes, valves or other leak control measures (e.g. vertical loops) are recommended to be included for design consideration at PLX09 and PLX16, which are roughly the one-third points of the 22 mile pipeline from the planned CPF to the Badami facilities. These crossings are in addition to the East Badami Creek crossing. From photo PLX 07-1 as well as from the data in Table A-1, a minor reroute upstream will satisfy the stipulations at this location and should be included in further preliminary route descriptions.

2.4 Staines/Canning River Reconnaissance

A very brief reconnaissance of the Staines/Canning Rivers was made on 2 June 1998. The purpose of the reconnaissance was to look for signs that the west bank had been overtopped by floodwaters.

Between 19 and 16 miles upstream from the Sourdough #3 site, visual estimates of the bank height suggest that it ranges from approximately 50 to 8 feet. Within this reach the Canning River is confined to nearly a single channel with high banks.

Between 11 and 6 miles upstream from the Sourdough # 3 site, visual estimates suggest that the bank height ranges from approximately 12 to 3 feet. Within this reach, flood debris was estimated to lie 6 to 4 feet below the top of the bank.

Approximately 1 mile upstream from the Sourdough #3 site, visual estimates of the bank height suggest that it is about 5 feet high. Visual estimates also suggest that the ground rises approximately 5 feet between the top of the bank and the Sourdough # 3 site.

Throughout the reach of the Staines/Canning Rivers investigated, no flood debris was observed at the top of the west bank. However, it is rare to find evidence of a flood that is more than about 25 years old on the North Slope. Another complicating factor is the large areas of aufeis that form in the Staines/Canning Rivers. Therefore, in order to estimate the likelihood of a large flood (on the order of a 100- to 200-year flood) overtopping the west bank and contributing to flooding within the project area, it will probably be necessary to perform at least preliminary hydraulic computations. Ideally, data describing the extent and thickness of the icings would also be available at the time of the computations.

3.0 PIPELINE ALIGNMENT CONSIDERATIONS

The proposed pipeline crossings discussed in this report were selected prior to the field program, based on an office reconnaissance of the available maps and aerial photographs. While in the field, a brief assessment of the desirability of the proposed crossing locations was made. In considering the desirability of the proposed crossing locations, it was assumed that shifts of less than 100 feet would be better addressed during the pipeline route survey. Additionally, it was assumed that the pipeline would generally not be moved a great distance from the original location due to other alignment considerations. Based on these criteria, two of the proposed pipeline crossings were identified as candidates for a possible shift in location.

3.1 Pipeline Crossing PLX 01

The proposed crossing at PLX 01 is located about 1200 feet upstream from the road that connects the Badami airstrip with the Badami Camp. At the peak water surface elevation of the 1998 spring breakup flood, the water surface was 460 feet wide at the proposed crossing. The right bank is relatively low. It was about 2 feet under water at the peak of the 1998 spring breakup flood. The right floodplain also contains a pond that is 240 feet wide, in the direction of the crossing.

Approximately 400 feet upstream from the proposed pipeline crossing the channel has higher banks and the flow area is more uniformly distributed. Thus, consideration should probably be given to moving the pipeline crossing upstream.

3.2 Pipeline Crossing PLX 28

At the proposed PLX 28 crossing, the channel is wide and shallow. At the peak of the 1998 spring breakup flood the water surface width was 284 feet. A 66-foot wide flat bench forms part of the left floodplain, while the main channel has a width of 115 feet.

Upstream from the proposed pipeline crossing, approximately 200 to 500 feet, the banks are higher and the water surface width at the peak of the 1998 spring breakup flood was narrower. Thus, consideration should probably be given to moving the pipeline crossing to this reach of the river.

Another possibility is to eliminate the PLX 28 crossing. If the pipeline coming into the PLX 28 crossing were routed to the PLX 29 crossing and joined to the pipeline at PLX 29, approximately 2200 feet of pipeline would be eliminated. Alternatively, the pipeline coming into PLX 29 could be routed to a location 200 to 500 feet upstream from the present PLX 28 pipeline and joined to the PLX 28 pipeline at that location. This option would also eliminate approximately 2200 feet of pipeline.

APPENDIX A: SUMMARY TABLES

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Table A-1: Summary Of Selected Hydrologic Parameters

Stream Crossing Designation	II West Badami Cr. PLX 01	II Middle Badami Cr. PLX 02	II East Badami Cr. PLX 03	II PLX 04	I PLX 05	II PLX 06
Drainage Area (sm)	40.3	31.5	88.7	7.49		23.8
1998 Spring Peak Stage						
At Proposed Crossing						
Date	5/29/98	5/29/98	5/29/98	5/29/98	5/29/98	5/29/98
Water Surface Elev. (ft) (25)	97.78	101.87	99.59	99.35		98.61
Velocity (fps)	< 2.0	< 2.0	≥ 5.0	< 2.5	< 2.0	
Surface Width (ft)	459	358	276	200	12	335
Max Depth (ft)	8.6	10.9	6.0	4.0	2.5	5.8
Water Surface Slope (ft/ft)	0.0009	0.0005	0.0009	0.0017		0.0023
See Notes	1, 7, 23	2, 23, 31	3	5		4
Approximate Bankfull Conditions						
At Proposed Crossing						
Elevation (ft) (25)	94.0	94.5	98.8	97.2		96.5
Surface Width (ft)	58	45	220	58	12	56
Max Depth (ft)	4.8	3.6	5.2	1.8	2.5	3.7
Gravel Bed Width (ft)	30	4	143	36	0	12
See Notes						
At Other X-Sec						
Location	2002 u/s	1132 d/s	1387 u/s	337 u/s		897 u/s
Elevation (ft) (25)	97.4	82.2	99.0	98.2		98.0
Surface Width (ft)	91	56	330	41		66
Max Depth (ft)	3.6	4.2	3.0	3.4		3.2
Gravel Bed Width (ft)	56	13	301	14		24
See Notes		31				
Discharge Measurement						
Date			6/1/98	5/30/98		6/1/98
Water Surface Elev. (ft) (25)			96.71	98.28		96.50
Discharge (cfs)			596	225		207
Average Velocity (fps)			1.94	1.63		2.47
Max Mean Velocity In Any Vertical			2.87	3.31		3.31
Surface Width (ft)			143	132		56.0
Max Depth (ft)			3.2	2.7		3.4
Water Surface Slope (ft/ft)			0.0007	0.0028		0.0023
See Notes			19			19
Miscellaneous Observations At Proposed Crossing						
Date	5/30/98	5/30/98	6/1/98			
Water Surface Elev. (ft) (25)	97.16	100.14	96.71			
Water Surface Slope (ft/ft)	0.0007	0.0009	0.0011			
Water Depth (ft) max			3.2			
Velocity (fps)			1.94			
See Notes	19	19	19			

Table A-1: Summary Of Selected Hydrologic Parameters (continued)

	II	II	II	II	II	II
Stream Crossing Designation	PLX 07	PLX 08	PLX 09	PLX 10	PLX 11	PLX 12
Drainage Area (sm)	3.46	1.35	41.4	11.3	4.87	13.2
1998 Spring Peak Stage						
At Proposed Crossing						
Date	5/29/98	5/29/98	5/29/98	5/29/98	5/29/98	5/29/98
Water Surface Elev. (ft) (25)	99.04	99.06	99.34	98.84	98.59	99.13
Velocity (fps)			>5	> 3	> 1	> 3
Surface Width (ft)	168	80	290	~440	~304	202
Max Depth (ft)	5.2	1.6	5.3	5.2	4.2	5.9
Water Surface Slope (ft/ft)	0.0004	0.0033	0.0003	0.0021	0.0022	0.0018
See Notes	5	5	4	6	5, 22, 23	4
Approximate Bankfull Conditions						
At Proposed Crossing						
Elevation (ft) (25)	98.2	98.7	98.0	97.0	97.1	96.3
Surface Width (ft)	107	74	145	89	57	66
Max Depth (ft)	4.3	1.4	4.0	3.4	2.7	3.1
Gravel Bed Width (ft)	5 & 28	0	16	5	13	53
See Notes	21					
At Other X-Sec						
Location	747 u/s	391 u/s	1027 u/s	800 u/s	507 u/s	560 d/s
Elevation (ft) (25)	98.1	99.8	99.0	98.8	98.2	95.2
Surface Width (ft)	93	40	85	54	35	66
Max Depth (ft)	3.6	1.5	4.7	2.2	4.5	2.8
Gravel Bed Width (ft)	4	0	18	10	11	45
See Notes						
Discharge Measurement						
Date	6/1/98	6/1/98	5/30/98	6/1/98	6/1/98	6/1/98
Water Surface Elev. (ft) (25)	95.62	98.24	96.85	97.03	97.56	97.00
Discharge (cfs)	82.3	13.0	~600	176	65.2	245
Average Velocity (fps)	2.00	0.93	~3.9	2.30	0.98	1.73
Max Mean Velocity In Any Vertical	3.28	1.06	~5.5	4.28	2.22	2.25
Surface Width (ft)	52.0	23	~97	73	64.0	93.0
Max Depth (ft)	1.3	0.90	2.3	2.2	3.0	3.0
Water Surface Slope (ft/ft)	0.0026	0.0047	0.0018	0.0023	0.0027	0.0015
See Notes		29	20,22,26	19	19	19
Miscellaneous Observations At Proposed Crossing						
Date	6/1/98					
Water Surface Elev. (ft) (25)	95.59					
Water Surface Slope (ft/ft)	0.0027					
Water Depth (ft) max						
Velocity (fps)						
See Notes	19					

Table A-1: Summary Of Selected Hydrologic Parameters (continued)

	I	I	II	II		I
Stream Crossing Designation	PLX 13	PLX 14	PLX 15	PLX 16	PLX 17	PLX 18
Drainage Area (sm)	6.82		5.41	32.1		1.75
1998 Spring Peak Stage						
At Proposed Crossing						
Date	5/30,31	5/30,31	5/29/98	5/29/98		5/30,31
Water Surface Elev. (ft) (25)			98.96	97.53		
Velocity (fps)	≤1.5	≤ 1.0	> 3.5	> 5.0		
Surface Width (ft)	≤ 800	≤30	243	101		≤ 90
Max Depth (ft)	≤1.5	≤1.5	6.6	3.2		≤ 1.1
Water Surface Slope (ft/ft)			0.0022	0.0014		≤ 1.0
See Notes		13	4, 22	9	14	15
Approximate Bankfull Conditions						
At Proposed Crossing						
Elevation (ft) (25)			97.6	98.4		
Surface Width (ft)			51	111		
Max Depth (ft)			5.2	4.1		
Gravel Bed Width (ft)			13	18		
See Notes						
At Other X-Sec						
Location			403 d/s	1211 u/s		
Elevation (ft) (25)			98.0	97.1		
Surface Width (ft)			56.0	93		
Max Depth (ft)			2.4	4.1		
Gravel Bed Width (ft)			16	19		
See Notes						
Discharge Measurement						
Date			6/3/98	5/30/98		
Water Surface Elev. (ft) (25)			95.92	96.64		
Discharge (cfs)			48.8	~254		
Average Velocity (fps)			1.07	~4.1		
Max Mean Velocity In Any Vertical			1.34	~5		
Surface Width (ft)			27.0	38.0		
Max Depth (ft)			3.5	~2.6		
Water Surface Slope (ft/ft)			0.0016	0.0019		
See Notes				3, 20		
Miscellaneous Observations At Proposed Crossing						
Date			6/1/98			6/3/98
Water Surface Elev. (ft) (25)			96.69			
Water Surface Slope (ft/ft)			0.0021			
Water Depth (ft) max						1.1
Velocity (fps)						0.7 (s)
See Notes						24

Table A-1: Summary Of Selected Hydrologic Parameters (continued)

	I	I	I	I	I	II
Stream Crossing Designation	PLX 19	PLX 20	PLX 20A	PLX 20B	PLX 21	PLX 22
Drainage Area (sm)		3.29			8.24	3.00
1998 Spring Peak Stage						
At Proposed Crossing						
Date		5/30,31	5/30,31	5/30,31	5/30,31	5/29/98
Water Surface Elev. (ft) (25)						97.87
Velocity (fps)	≤ 2.5	≤ 2.0	≤ 1.5	< 1.0	≤ 1.5	< 2.5
Surface Width (ft)	≤ 200	~200	~800	≤ 30	≤ 30	~204
Max Depth (ft)	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.5	5.5
Water Surface Slope (ft/ft)						0.0017
See Notes	16	17	17	18	18	10, 22
Approximate Bankfull Conditions						
At Proposed Crossing						
Elevation (ft) (25)						96.0
Surface Width (ft)				6	≤ 30	104
Max Depth (ft)				0.5	≤ 1.0	3.6
Gravel Bed Width (ft)				0	0	13
See Notes						
At Other X-Sec						
Location						736 d/s
Elevation (ft) (25)						96.0
Surface Width (ft)						46
Max Depth (ft)						2.5
Gravel Bed Width (ft)						11
See Notes						
Discharge Measurement						
Date						5/31/98
Water Surface Elev. (ft) (25)						96.64
Discharge (cfs)						117
Average Velocity (fps)						1.36
Max Mean Velocity In Any Vertical						2.2
Surface Width (ft)						78.0
Max Depth (ft)						2.7
Water Surface Slope (ft/ft)						0.0016
See Notes						19
Miscellaneous Observations At Proposed Crossing						
Date	6/3/98	6/3/98	6/3/98	6/3/98		
Water Surface Elev. (ft) (25)						
Water Surface Slope (ft/ft)						
Water Depth (ft) max	0.7	0.5	0.7	0.5	0.8	
Velocity (fps)	2.2 (s)	1.38 (s)	1.3 (s)	0.35 (s)	1.03 (s)	
See Notes	24	24	24	24	24	

Table A-1: Summary Of Selected Hydrologic Parameters (continued)

Stream Crossing Designation	II PLX 23	II PLX 24	I PLX 25	II PLX 26	II PLX 27	II PLX 28
Drainage Area (sm)		12.9			1.61	18.0
1998 Spring Peak Stage						
At Proposed Crossing						
Date	5/29,30	5/29/98	5/29/,5/30	5/29/98	5/30/98	5/29/98
Water Surface Elev. (ft) (25)	96.07	95.96		97.36	93.08	97.00
Velocity (fps)	< 2.5	< 3.0	≤ 1.5	< 2	< 3	3.5
Surface Width (ft)	60	202	~250	260	101	284
Max Depth (ft)	2.0	7.8	≤ 1.5	3.9	2.8	5.5
Water Surface Slope (ft/ft)	0.0025	0.0009		0.0027	0.0043	0.0008
See Notes	10	6, 23	13,14,22	6	7	12, 23
Approximate Bankfull Conditions						
At Proposed Crossing						
Elevation (ft) (25)	96.1	94.7		96.4	92.3	94.6
Surface Width (ft)	60	101		68	79	125
Max Depth (ft)	2.0	6.5		2.9	2.0	3.1
Gravel Bed Width (ft)	6	60		0	64	114
See Notes				18		
At Other X-Sec						
Location	583 u/s	334 u/s		717 u/s	984 u/s	512 u/s
Elevation (ft) (25)	97.6	94.8		98.2	92.3	96.0
Surface Width (ft)	39	109		46	41	70
Max Depth (ft)	2.0	5.7		4.4	3.2	5.6
Gravel Bed Width (ft)	0	18		26	18	27
See Notes						
Discharge Measurement						
Date		5/31/98			5/31/98	5/31/98
Water Surface Elev. (ft) (25)		91.35			92.88	96.31
Discharge (cfs)		271			80.6	391
Average Velocity (fps)		2.86			1.71	3.31
Max Mean Velocity In Any Vertical		3.89			2.44	5.08
Surface Width (ft)		74.0			37	74.4
Max Depth (ft)		2.7			2.4	2.4
Water Surface Slope (ft/ft)		0.0021			0.0011	0.0015
See Notes		8			19,30	27, 32
Miscellaneous Observations At Proposed Crossing						
Date	5/31/98		6/4/98	5/31/98		
Water Surface Elev. (ft) (25)	95.78			95.06		
Water Surface Slope (ft/ft)	0.0024			0.0020		
Water Depth (ft) max			0.5			
Velocity (fps)	< 2.5			< 2.0		
See Notes				19		

Table A-1: Summary Of Selected Hydrologic Parameters (continued)

Stream Crossing Designation	II PLX 29
Drainage Area (sm)	17.7
1998 Spring Peak Stage	
At Proposed Crossing	
Date	5/29/98
Water Surface Elev. (ft) (25)	96.93
Velocity (fps)	
Surface Width (ft)	210
Max Depth (ft)	9.5
Water Surface Slope (ft/ft)	0.0014
See Notes	11, 23
Approximate Bankfull Conditions	
At Proposed Crossing	
Elevation (ft) (25)	93.6
Surface Width (ft)	49
Max Depth (ft)	6.2
Gravel Bed Width (ft)	25
See Notes	
At Other X-Sec	
Location	
Elevation (ft) (25)	
Surface Width (ft)	
Max Depth (ft)	
Gravel Bed Width (ft)	
See Notes	
Discharge Measurement	
Date	
Water Surface Elev. (ft) (25)	
Discharge (cfs)	
Average Velocity (fps)	
Max Mean Velocity In Any Vertical	
Surface Width (ft)	
Max Depth (ft)	
Water Surface Slope (ft/ft)	
See Notes	
Miscellaneous Observations At Proposed Crossing	
Date	6/3/98
Water Surface Elev. (ft) (25)	90.00
Water Surface Slope (ft/ft)	0.0020
Water Depth (ft) max	
Velocity (fps)	
See Notes	

Table A-1: Summary Of Selected Hydrologic Parameters (continued)

Notes:

1. The downstream culvert was 80 percent plugged by snow.
2. Channel was approximately 30 percent blocked by snow at the time of the event.
3. Channel was approximately 10 percent blocked by snow at the time of the event.
4. Channel was approximately 10 - 20 percent blocked by snow at the time of the event.
5. Channel was approximately 20 - 30 percent blocked by snow at the time of the event.
6. Channel was approximately 10 - 30 percent blocked by snow at the time of the event.
7. Channel was approximately 30 - 50 percent blocked by snow at the time of the event.
8. Channel was less than 10 percent blocked by snow at the time of the event.
9. Channel was approximately 20 percent blocked by snow at the time of the event.
10. Channel was less than 20 percent blocked by snow at the time of the event.
11. Channel was approximately 30 percent blocked by snow at the time of the event.
12. Channel was approximately 50 percent blocked by snow at the time of the event.
13. There were numerous small channels at this location.
14. There was no definable drainage at this location.
15. There was a broad area of sheet flow at this location.
16. The water at this site was flowing in numerous small polygon troughs.
17. This stream channel was broad and flat.
18. This channel was grass lined.
19. The channel was clear of snow at the time of this event.
20. Discharge was partially measured and partially estimated.
21. There are two gravel channels at this location.
22. Width was partially measured and partially estimated.
23. The water was flowing on the top of the snow, and the water depth represents the depth of the water and the depth of the snow to the bottom of the channel.
24. An "(s)" next to the velocity means the velocity is a surface velocity.
25. Elevation is based on an arbitrary elevation at a single temporary bench mark established at each crossing.
26. Velocity was partially measured and partially estimated.
27. There was snow in the channel at the time the discharge measurement was made.
28. The values presented in this table are preliminary and subject to revision at the time the 1998 spring breakup report is prepared.
29. This discharge made 60 feet upstream from pipeline crossing.
30. This discharge measurement made at upstream cross section.
31. Water surface elevations, widths and depths are provisional and subject to verification of the survey data.
32. This discharge measurement was made 500 feet upstream from the upstream cross section.

file: table1a.xls

Table A-2: TEMPORARY BENCH MARK LOCATIONS

Stream	Latitude	Longitude	Elevation (ft)	Description	Survey Point Number
PLX 01	N 70° 08' 02.4"	W 147° 03' 29.7"	100.00	Primary Temporary Bench Mark for PLX 01 and PLX 02 (TBM1A)	1
			100.36	Temporary Bench Mark (TBM1B)	2
			97.30	Temporary Bench Mark (TBM 1C)	178
PLX 02	N 70° 08' 02.4"	W 147° 03' 29.7"	100.00	Primary Temporary Bench Mark for PLX 01 and PLX 02 (TBM1A)	1
	N 70° 07' 57.7"	W 147° 02' 29.8"	98.76	Temporary Bench Mark (TBM2A)	53
			95.61	Temporary Bench Mark (TBM2B)	222
PLX 03	N 70° 08' 22.2"	W 146° 59' 58.9"	100.00	Primary Temporary Bench Mark (TBM3A)	1
	N 70° 08' 10.6"	W 146° 59' 59.5"	105.59	Temporary Bench Mark (TBM3B)	2
PLX 04	N 70° 08' 24.7"	W 146° 56' 39.4"	100.00	Primary Temporary Bench Mark (TBM4A)	1
	N 70° 08' 23.0"	W 146 ° 56' 26.8"	99.26	Temporary Bench Mark (TBM4B)	18
	N 70° 08' 25.9"	W 146 ° 56' 38.7"	99.53	Temporary Bench Mark (TBM4C)	2
PLX 06	N 70° 08' 53.7"	W 146° 52' 05.1"	100.00	Primary Temporary Bench Mark (TBM6A)	1
	N 70° 08' 47.9"	W 146° 51' 56.1"	101.45	Temporary Bench Mark (TBM6B)	2
PLX 07	N 70° 08' 57.2"	W 146° 50' 13.0"	100.00	Primary Temporary Bench Mark (TBM7A)	1
	N 70° 08' 55.0"	W 146° 50' 11.4"	99.10	Temporary Bench Mark (TBM7B)	2
	N 70° 09' 01.7"	W 146° 50' 08.4"	98.52	Temporary Bench Mark (TBM7C)	17
PLX 08	N 70° 09' 15.4"	W 146° 47' 48.6"	100.00	Primary Temporary Bench Mark (TBM8A)	1
	N 70° 09' 14.7"	W 146° 47' 45.5"	99.86	Temporary Bench Mark (TBM8B)	2
	N 70° 09' 15.4"	W 146° 47' 54.9"	99.85	Temporary Bench Mark (TBM8C)	13
PLX 09	N 70° 09' 17.5"	W 146° 45' 45.1"	100.00	Primary Temporary Bench Mark (TBM9A)	1
	N 70° 09' 16.2"	W 146° 45' 47.6"	98.10	Temporary Bench Mark (TBM9B)	80
	N 70° 09' 10.7"	W 146° 45' 23.7"	102.09	Temporary Bench Mark (TBM9C)	2
PLX 10	N 70° 09' 35.5"	W 146°41' 12.5"	100.00	Primary Temporary Bench Mark (TBM10A)	1
	N 70° 09' 32.9"	W 146° 41' 11.6"	99.54	Temporary Bench Mark (TBM10B)	18
	N 70° 09' 39.4"	W 146° 41' 13.8"	98.92	Temporary Bench Mark (TBM10C)	2

Table A-2: TEMPORARY BENCH MARK LOCATIONS (continued)

Stream	Latitude	Longitude	Elevation (ft)	Description	Survey Point Number
PLX 11	N 70° 09' 46.8"	W 146° 37' 51.0"	100.00	Primary Temporary Bench Mark (TBM11A)	1
	N 70° 09' 48.6"	W 146° 37' 47.1"	99.15	Temporary Bench Mark (TBM11B)	2
	N 70° 09' 44.4"	W 146° 37' 42.5"	99.20	Temporary Bench Mark (TBM11C)	76
PLX 12	N 70° 10' 10.1"	W 146° 35' 10.1"	100.00	Primary Temporary Bench Mark (TBM12A)	1
	N 70° 10' 09.3"	W 146° 35' 14.0"	94.64	Temporary Bench Mark (TBM12B)	2
	N 70° 10' 13.6"	W 146° 35' 09.0"	97.59	Temporary Bench Mark (TBM12C)	90
PLX 15	N 70° 10' 35.1"	W 146° 29' 54.8"	100.00	Primary Temporary Bench Mark (TBM15A)	1
	N 70° 10' 31.7"	W 146° 30" 00.0"	98.35	Temporary Bench Mark (TBM15B)	29
	N 70° 10' 36.1"	W 146° 29' 58.4"	98.58	Temporary Bench Mark (TBM15C)	2
PLX 16	N 70° 10' 25.7"	W 146° 26' 52.7"	100.00	Primary Temporary Bench Mark (TBM16A)	1
	N 70° 10' 20.4"	W 146° 26' 48.8"	101.08	Temporary Bench Mark (TBM16B)	2
PLX 22	N 70° 10' 06.2"	W 146° 17' 19.3"	100.00	Primary Temporary Bench Mark (TBM22A)	1
	N 70° 10' 09.9"	W 146° 17" 15.6"	98.25	Temporary Bench Mark (TBM22B)	2
	N 70° 10' 04.3'	W 146° 17' 19.0"	96.91	Temporary Bench Mark (TBM22C)	162
PLX 23	N 70° 09' 41.4"	W 146° 14' 50.4"	100.00	Primary Temporary Bench Mark for PLX 23 and PLX 24 (TBM24A)	1
	N 70° 09' 45.1"	W 146° 15' 20.5"	96.92	Temporary Bench Mark (TBM23A)	101
	N 70° 09' 46.9"	W 146° 15' 04.3"	95.53	Temporary Bench Mark (TBM23B)	175
PLX 24	N 70° 09' 41.4"	W 146° 14' 50.4"	100.00	Primary Temporary Bench Mark for PLX 23 and PLX 24 (TBM24A)	1
	N 70° 09' 40.2"	W 146° 14' 47.8"	95.56	Temporary Bench Mark (TBM24B)	78
	N 70° 09' 42.9"	W 146° 14' 43.2"	96.21	Temporary Bench Mark (TBM24C)	2
PLX 26	N 70° 09' 25.2"	W 146° 12' 26.1"	100.00	Primary Temporary Bench Mark (TBM26A)	1
	N 70° 09' 21.8"	W 146° 12' 21.5"	98.68	Temporary Bench Mark (TBM26B)	40
	N 70° 09' 27.8"	W 146° 12' 23.9"	97.82	Temporary Bench Mark (TBM26C)	2

(continued on next page)

Table A-2: TEMPORARY BENCH MARK LOCATIONS (continued)

Stream	Latitude	Longitude	Elevation (ft)	Description	Survey Point Number
PLX 27	N 70° 09' 02.9"	W 146° 09' 25.8"	100.00	Primary Temporary Bench Mark (TBM27A)	1
	N 70° 09' 06.2"	W 146° 09' 24.4"	100.23	Temporary Bench Mark (TBM27B)	36
	N 70° 08' 58.6"	W 146° 09' 38.9"	93.38	Temporary Bench Mark (TBM27C)	2
PLX 28	N 70° 08' 37.8"	W 146° 06' 46.3"	100.00	Primary Temporary Bench Mark (TBM28A)	1
	N 70° 08' 38.8"	W 146° 06' 39.4"	95.70	Temporary Bench Mark (TBM28B)	2
PLX 29	N 70° 08' 15.5"	W 146° 06' 57.3"	100.00	Primary Temporary Bench Mark (TBM29A)	1
	N 70° 08' 06.3"	W 146° 07' 10.7"	100.33	Temporary Bench Mark (TBM29B)	2

Note:

1. The primary temporary bench mark was assumed to have (1) an elevation of 100.00 feet, (2) a Northing of 5,000 feet, and (3) an Easting of 5,000 feet. The primary temporary bench mark at each stream provided the vertical and horizontal control for that stream.
2. The latitude and longitude are based on North American Datum 1927.
3. Temporary bench marks consist of a 0.5 inch diameter rebar driven into the ground.
4. The latitude and longitude were estimated with a Garmin II Plus hand held Global Positioning System.

file: tableA2.xls

APPENDIX B: LOCATION MAP

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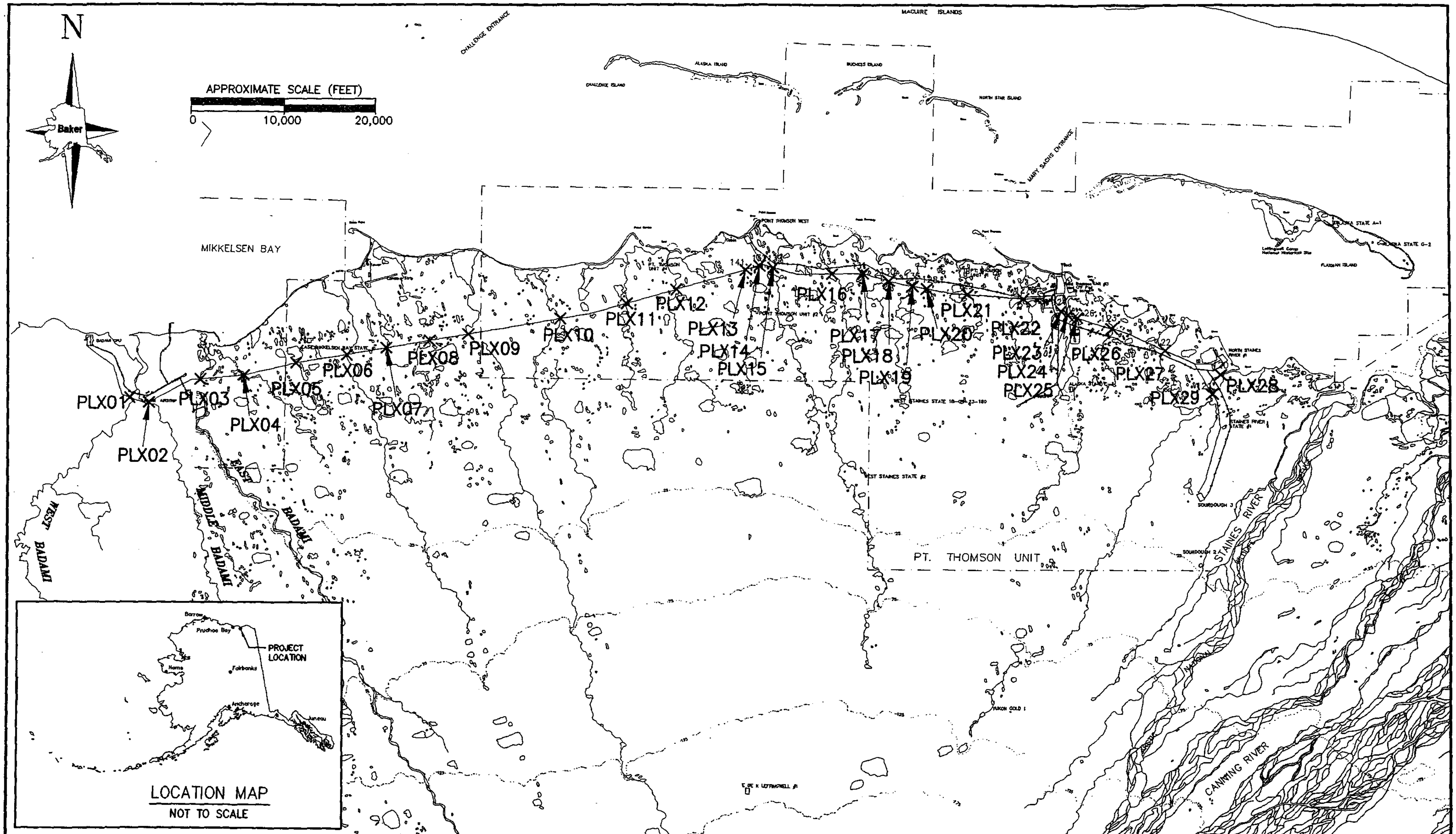

NO.:	DATE:	REVISION	BY:

PLAN VIEW

SOURDOUGH DEVELOPMENT PROJECT AREA
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	7/29/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADPloc.dwg
CHECKED:	JWA	SCALE:	1" = 10,000'

FIGURE: B-1

APPENDIX C: GENERAL PHOTOGRAPHS

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Photo C-1: The leading edge of the snowmelt run-off.

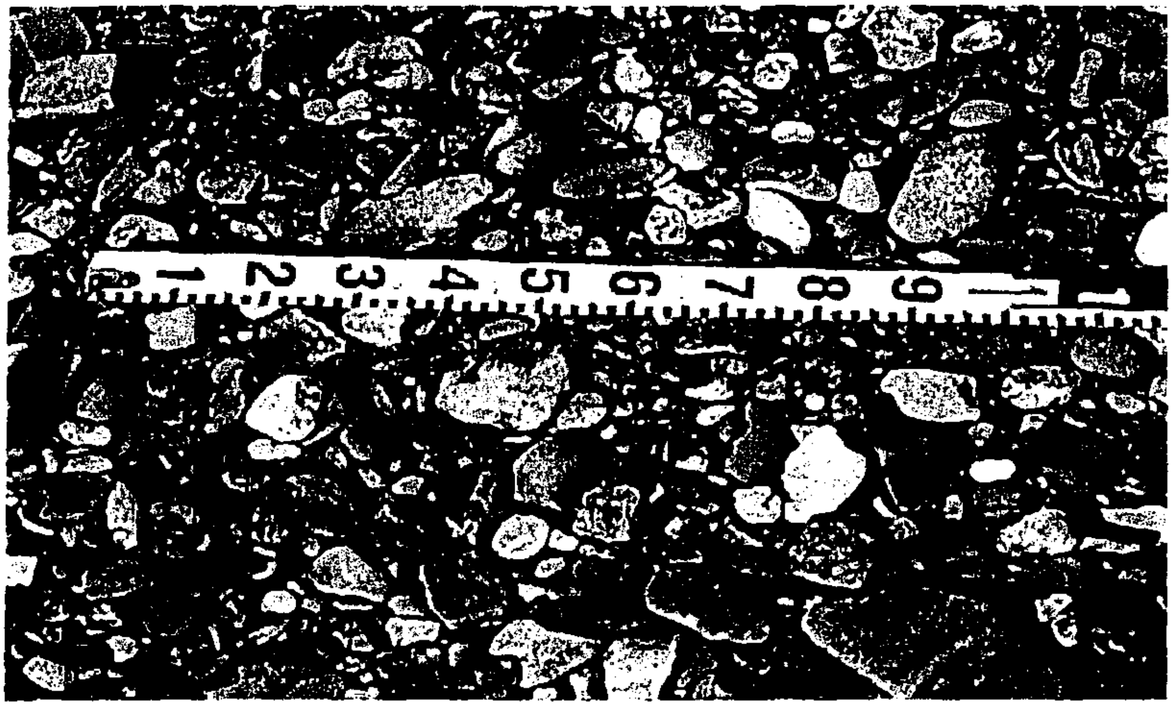

Photo C-2: Typical bed material within the gravel bed streams of this area.

APPENDIX C - TYPICAL PHOTOGRAPHS	Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98 — Project: 23247	C-1
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	Checked: JWA — Scale:	

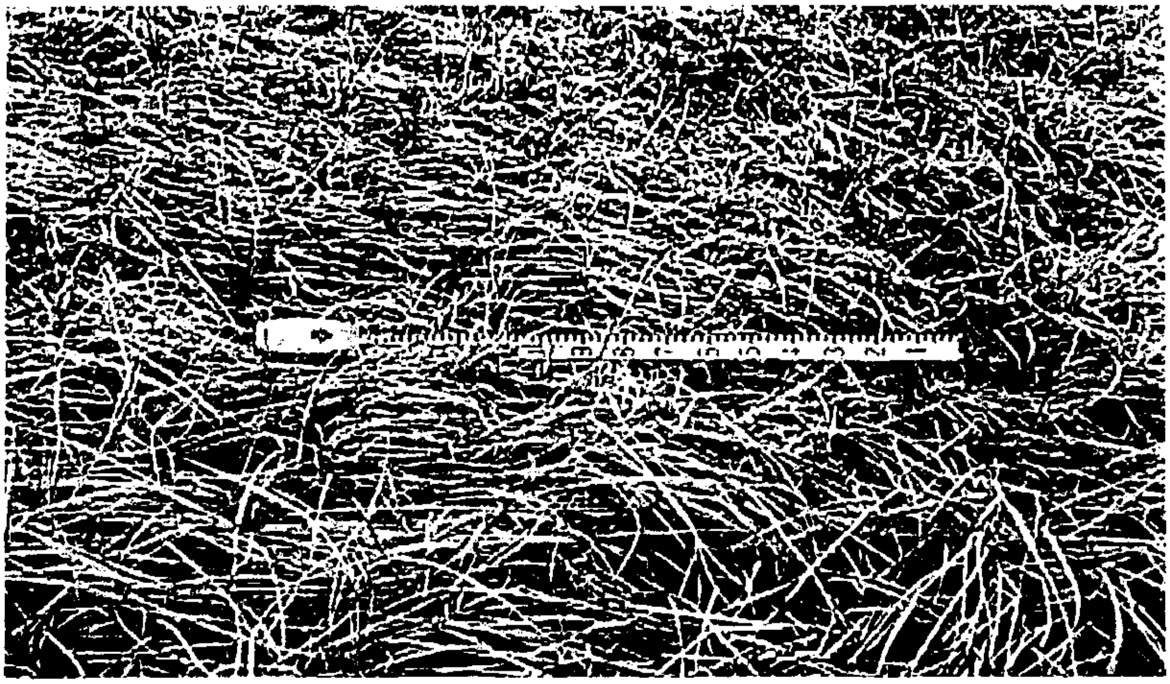

Photo C-3: Typical tundra vegetation.

Photo C-4: Typical vegetation in grass covered channel with low flow. Note that the grass is not laid down by the flow.

APPENDIX C - TYPICAL PHOTOGRAPHS	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	C-2
	Drawn: JDA	File: Appendix C	
	Checked: JWA	Scale:	

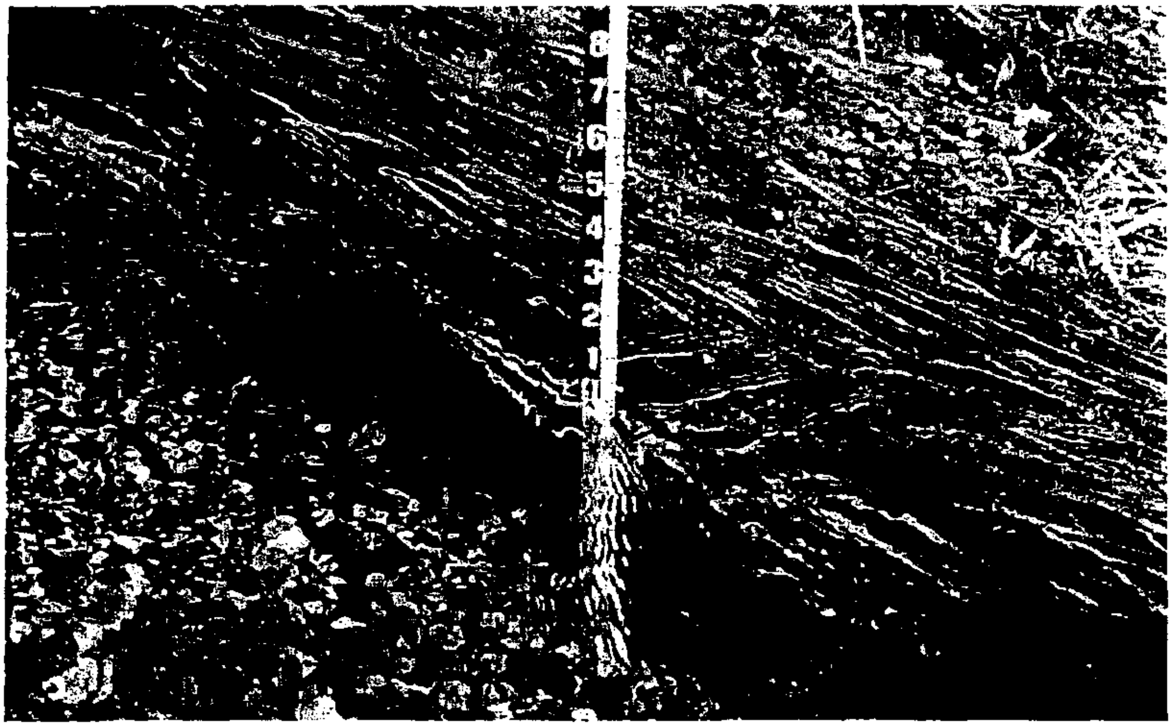

Photo C-5: Typical grass and gravel channel with medium flow. Note how the grass is laid down by the higher flow.

APPENDIX D: PLX 01

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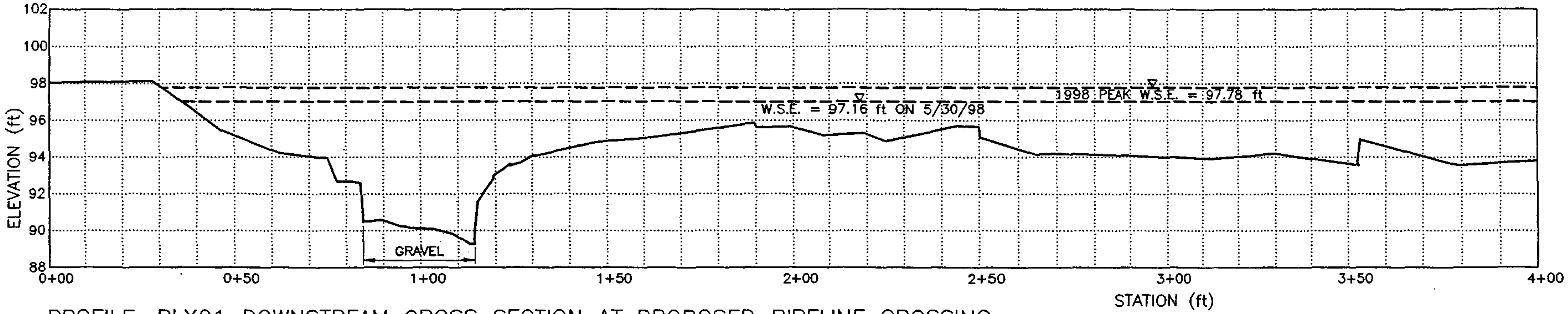
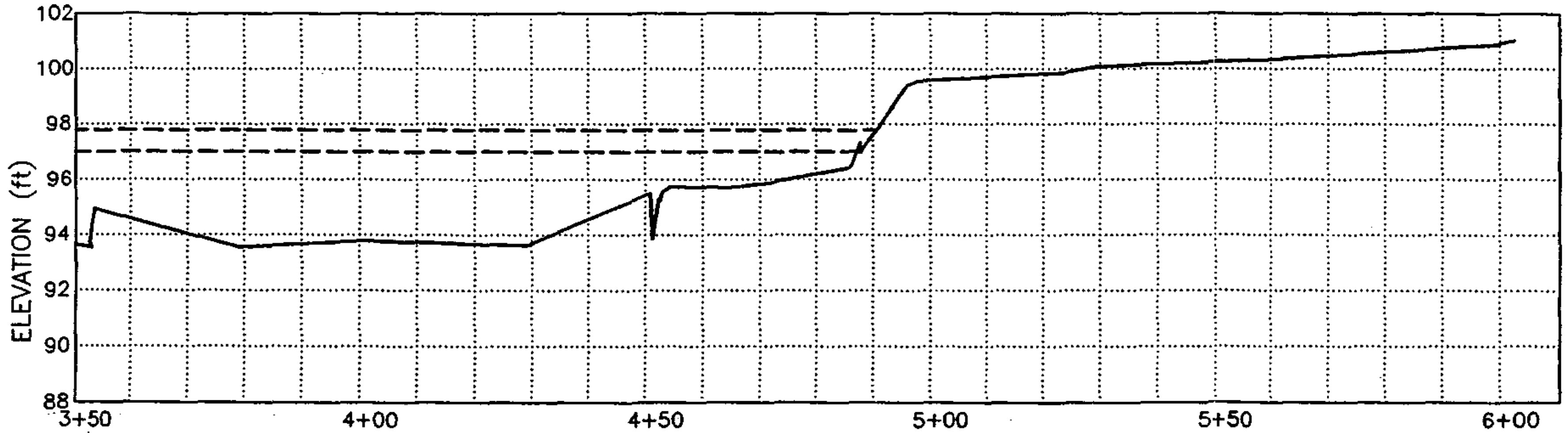
Notes:

1. THE SURVEY DATA FOR PLX 02 CONTAINED IN TABLES PLX 01-1 AND PLX 01-3 ARE PROVISIONAL, SUBJECT TO VERIFICATION.



PROFILE: PLX01 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING
STATION 0+00 TO STATION 4+00

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX01 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING
STATION 3+50 TO STATION 6+10

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM1A.
2. W.S.E.= WATER SURFACE ELEVATION

REVISION			
NO.:	DATE:		BY:

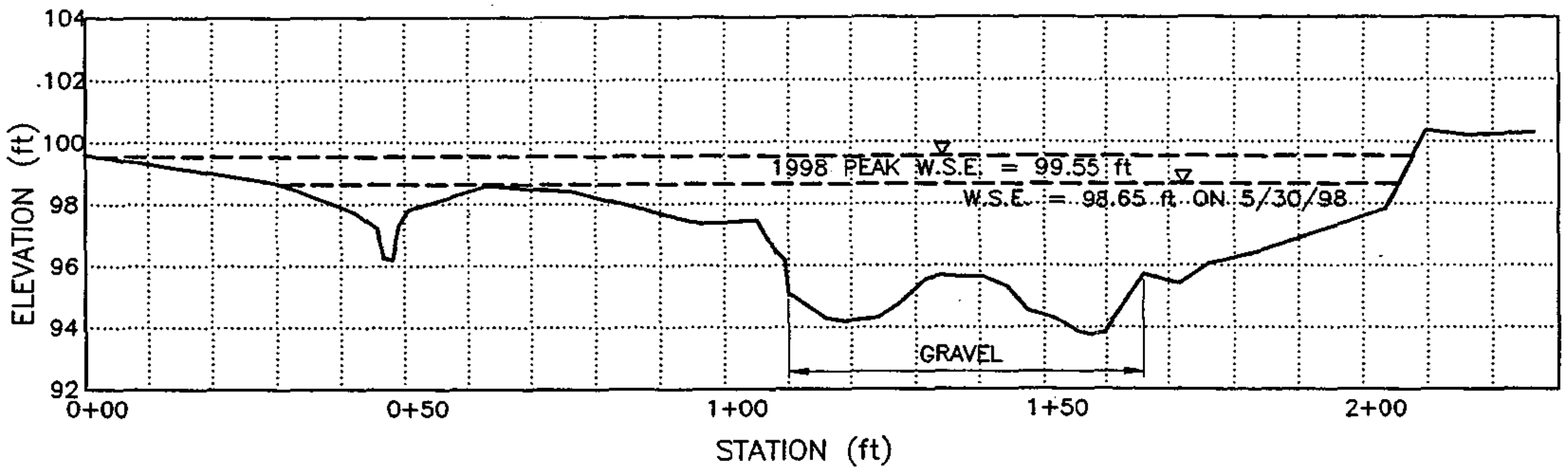
STREAM PLX01 – WEST BADAMI CREEK
PROFILE

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X1
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX
01-3



PROFILE: PLX01 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM1A.
2. W.S.E.= WATER SURFACE ELEVATION

REVISION			
NO.:	DATE:		BY:

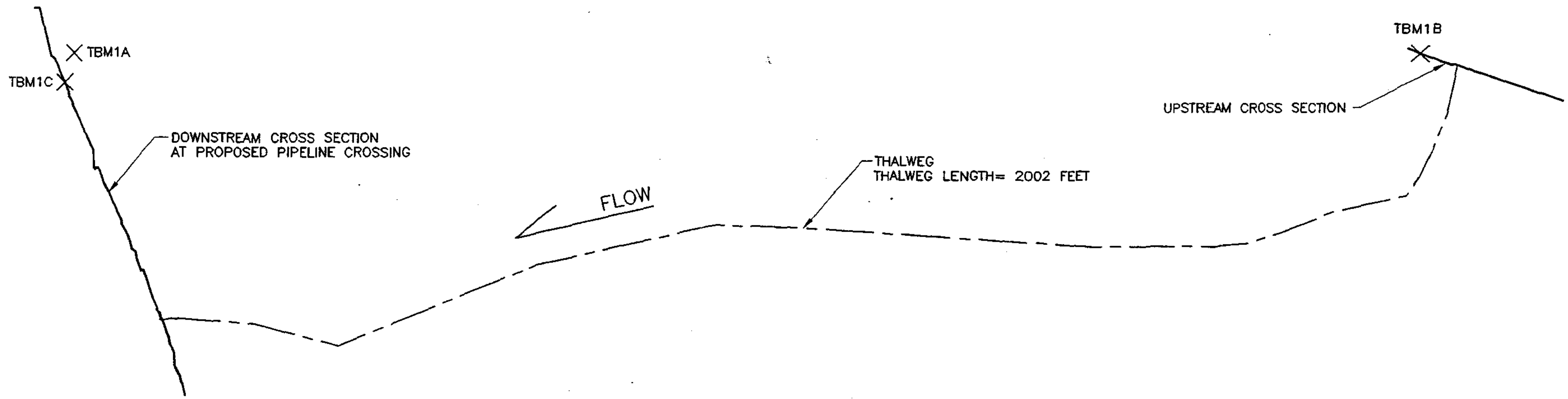
STREAM PLX01 – WEST BADAMI CREEK
PROFILE

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X1
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 01-2



NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM1A.

REVISION			
NO.:	DATE:		BY:

STREAM PLX01 – WEST BADAMI CREEK
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA.

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X1
CHECKED:	JWA	SCALE:	1"= 160'

FIGURE:
PLX 01-1

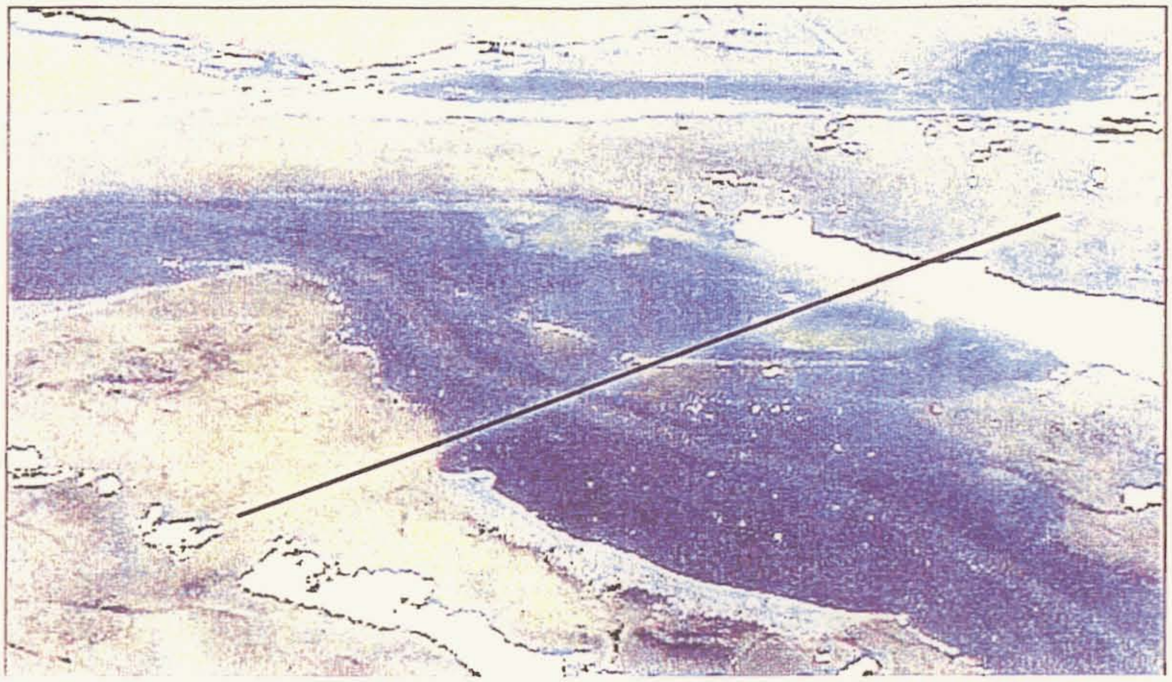


Photo PLX 01-1: Looking northeast at the proposed pipeline crossing (5/30/98).

Photo PLX 01-2: Looking downstream at the main channel of the proposed pipeline crossing (6/6/98).

STREAM PLX 01 PHOTOGRAPHS	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 01-1
	Drawn: JDA	File: photo01	
	Checked: JWA	Scale:	

Table PLX 01-1: Survey Data For PLX 01 And PLX 02

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	TBMP-01 (TBM1A)
2	5000	3095.01	100.36	CG-UPSTR (TBM1B)
50	5300.232984	5195.474763	99.38	P01-P02-TRAV
51	3899.835966	5299.795892	99.38	PK-CULVERT
52	4890.640407	5661.193955	98.76	PK-LITTLE-CULV.
53	6263.448502	5711.026862	98.76	CG-PO2-UPSTR (TBM2A)
100	5006.713798	3110.113077	100.283	T
101	5002.983794	3101.108912	100.201	T/SH
102	4997.473998	3089.423831	97.85	GB
103	4989.575679	3070.32216	96.405	REW
104	4986.855769	3064.094153	96.07	G
105	4985.733331	3059.97293	95.428	G
106	4983.662495	3054.143215	95.719	G/C
107	4984.122043	3047.540494	93.828	C
108	4982.435737	3043.234365	93.873	C
109	4981.020191	3039.90599	94.3	C
110	4980.093594	3036.072063	94.548	C
111	4978.400333	3033.321445	95.323	C
112	4977.10004	3029.607813	95.634	C
113	4976.020588	3026.236406	95.643	C
114	4974.921322	3023.268337	95.688	C
115	4973.7132	3021.233367	95.543	C
116	4972.675683	3017.286121	94.721	C
117	4971.690997	3014.485188	94.327	C
118	4970.991873	3011.975816	94.248	C
119	4970.178109	3009.266131	94.207	C
120	4969.166908	3006.358727	94.302	C
121	4968.310022	3003.895007	94.657	C
122	4967.322372	3000.834643	95.102	C/G
123	4967.238817	3000.118748	96.184	G
124	4966.836964	2998.954801	96.434	LEW
125	4965.829707	2996.24692	97.463	T
126	4962.944427	2987.907535	97.361	T
127	4956.243421	2969.181468	98.407	T
128	4951.753336	2956.269562	98.59	T
129	4947.779865	2944.843258	97.83	REW
130	4947.235933	2943.279101	97.287	G
131	4946.73462	2942.398183	96.213	G
132	4946.243338	2940.9906	96.256	G
133	4945.989042	2940.262011	97.202	G
134	4944.766729	2936.759935	97.745	LEW
135	4940.929881	2925.184924	98.688	T
136	4936.166431	2911.490125	99.145	T/HW
137	4931.099406	2896.92256	99.604	T
138	5025.951276	3035.235038	93.764	TH
139	4982.877492	3045.466065	93.925	TH

Table PLX 01-1: Survey Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
140	4953.929527	3050.932792	93.874	TH
141	4912.853444	3059.463398	93.837	TH
142	4858.830204	3080.314296	93.759	TH
143	4819.538686	3096.466742	94.172	TH
144	4791.832923	3113.588417	92.76	TH
145	4768.723912	3211.77967	92.829	TH
146	4737.889491	3289.483202	93.423	TH
147	4723.379248	3335.355051	92.619	TH
148	4718.046541	3388.401301	92.397	TH
149	4717.729952	3570.459449	91.287	TH
150	4732.717025	3742.284341	92.069	SB
151	4744.931049	3968.850216	89.148	TH
152	4748.405933	4098.707201	90.5	TH
153	4690.540218	4347.626322	90.359	TH
154	4573.74379	4629.406704	89.929	TH
155	4605.327681	4748.740818	88.489	TH
156	4613.248371	4864.89821	89.264	TH
157	4593.089585	4954.267791	89.426	TH
158	4611.260889	4879.138302	89.245	C/G
159	4616.204285	4880.113853	92.756	G
160	4620.566126	4881.779147	93.589	G
161	4623.456302	4882.519405	93.691	G
162	4626.479624	4884.038695	94.087	REW
163	4642.403111	4889.799028	94.817	T
164	4683.152032	4901.851833	95.85	TWET
165	4710.455651	4913.698365	95.286	TWET
166	4733.338758	4923.543115	95.701	TWET
167	4738.496784	4926.063664	95.658	LEW
168	4738.890486	4926.174978	95.045	G
169	4756.599283	4933.102251	94.19	M
170	4811.639333	4958.188748	94.196	M
171	4831.348939	4970.818379	93.74	M
172	4831.863525	4971.515726	94.939	ICE
173	4924.110369	5003.064626	95.51	ICE
174	4925.937548	5003.035797	95.243	M/G
175	4926.308443	5003.185228	95.545	G
176	4936.773334	5008.185217	95.707	REW
177	4957.42392	5014.202161	96.417	T/TOE
178	4959.1925	5014.791132	97.305	CREST.GA. (TBM1C)
179	4968.416994	5019.052087	99.567	SH
180	4992.521746	5028.237528	99.864	T
181	5065.562887	5057.255753	101.032	T
200	6245.658959	5664.886223	99.438	T
201	6261.131706	5705.026038	97.304	T
202	6275.141597	5738.291372	95.413	T

Table PLX 01-1: Survey Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
203	6279.073329	5751.40701	94.602	LEW
204	6280.617912	5755.398766	94.209	G
205	6282.585511	5760.182562	94.2	G
206	6283.602469	5762.794743	93.713	G
207	6284.605445	5765.371005	93.367	G
208	6285.575892	5767.729506	93.122	G
209	6286.519205	5770.346266	92.967	G
210	6287.298707	5773.043713	92.436	G
211	6288.435238	5774.093273	92.255	G
212	6289.381801	5776.468495	91.046	TH
213	6087.357761	5827.496541	90.123	TH
214	6022.326142	5816.967	90.508	TH
215	5847.733274	5627.650619	87.59	TH
216	5769.302631	5518.651647	90.212	TH
217	5688.440937	5484.067956	89.279	TH
218	5631.228723	5490.548408	88.878	TH
219	5508.792711	5551.376814	89.895	TH
220	5325.01729	5562.43127	88.362	TH/CS
221	5257.279931	5574.157918	87.616	TH
222	5319.443741	5527.283934	95.611	CGDS (TBM2B)
223	6322.375358	5864.585523	97.847	T
224	6308.639173	5828.790128	97.787	T
225	6298.225281	5801.737811	96.359	SH
226	6296.770449	5797.943062	95.451	T
227	6295.504677	5795.037232	94.648	REW
228	6294.862937	5793.355409	94.123	G
229	6293.680492	5790.256548	93.965	G
230	6292.114511	5786.152544	94.262	G
231	6290.508844	5781.944535	94.076	G
232	6289.614034	5779.599485	93.513	G
233	6289.163409	5778.418523	92.774	G
234	6288.660659	5777.502194	90.927	C
235	6288.78954	5777.598548	92.446	G/C
236	6346.210713	6237.443113	86.895	T
237	6340.681613	6211.442143	86.285	T
238	6334.786682	6180.262066	86.474	T/GB
239	6332.24634	6169.837834	84.85	T
240	6326.390834	6144.462389	83.99	T
241	6320.894826	6119.200192	83.546	T
242	6318.304234	6108.611855	82.561	T
243	6317.243315	6103.239523	82.333	T
244	6316.580207	6099.734617	82.197	REW
245	6315.971448	6096.814153	81.703	REW
246	6315.298771	6093.398708	81.144	G
247	6314.473663	6090.560863	80.538	G
248	6314.157597	6088.071484	79.148	G/C
249	6314.339761	6087.285385	78.406	TH/C

Table PLX 01-1: Survey Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
250	6311.714234	6075.452902	77.99	C/G
251	6310.774409	6073.485857	80.037	G
252	6310.394155	6072.004832	80.268	G
253	6310.27856	6070.70693	81.89	G
254	6309.940649	6068.043993	78.469	LEW
255	6308.726925	6062.582934	79.289	T
256	6307.758754	6059.330011	79.625	T
257	6307.239142	6057.121802	80.304	T
258	6305.731338	6049.086738	79.661	T
259	6304.240423	6041.063758	80.847	T/CG
260	6304.23058	6040.984121	84.542	T/CG
261	6302.432558	6031.346915	86.008	T
262	6298.219479	6011.030394	87.368	T
263	6291.859552	5985.885988	88.307	T

Legend:

G = grass	TH = thalweg	US = upstream
T = tundra	CG = crest gage	TWET = wet tundra
C = cobbles	GB = ground break	M = mud
LEW = left edge of water	SH = shoulder	SB = sand bags
REW = right edge of water	DS = downstream	PK = "pk" nail
CL = center line		

file:plx1&2.xls

Table PLX 01-2: Additional Survey Data For PLX 01

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P01TBMCL
2	5000	3095	99.64	PO1TBMUS
11	4501.89656	4844.977258	98.042	T
12	4529.211699	4852.062736	98.128	T
13	4533.217381	4853.445769	97.564	T/HWM
14	4546.152667	4859.124905	95.455	T
15	4562.689989	4859.805568	94.208	T
16	4574.490327	4864.827362	93.934	T
17	4576.209056	4865.531673	92.994	LEW/G
18	4577.13166	4865.564867	92.672	G
19	4580.753102	4866.469948	92.67	G
20	4583.404379	4866.702355	92.589	G
21	4584.042791	4866.906627	90.46	C
22	4588.930951	4868.294908	90.577	C
23	4593.320508	4870.483522	90.244	C
24	4597.544911	4871.828881	90.118	C
25	4601.794321	4872.990804	90.086	C
26	4606.757875	4874.563446	89.824	C
27	4610.790202	4876.514611	89.246	C/TH
28	4611.873879	4877.158674	89.363	C
29	4612.732651	4877.430474	91.542	G
30	4616.950891	4878.724678	93.003	REW
31	4621.153094	4880.33797	93.539	T
32	4627.238641	4882.816402	94.052	T
33	4657.146903	4894.761106	95.072	T
34	4682.437171	4905.254965	95.617	T
35	4690.532254	4908.274355	95.667	T/POND/LEW
36	4699.304711	4911.761877	95.172	M
37	4714.930837	4918.96025	94.856	M
38	4751.463419	4932.752212	94.137	M
39	4770.103328	4939.36002	94.11	M
40	4797.553637	4950.31603	93.913	M
41	4833.887397	4965.192195	93.548	M
42	4858.93131	4973.018821	93.546	M
43	4878.230118	4981.713846	93.792	M
44	4904.765446	4993.192065	93.626	M
45	4924.77534	5002.674373	93.873	M
46	4925.716808	5002.907774	95.302	G
47	4927.672905	5003.407345	95.736	REW
48	4944.103424	5008.807318	95.859	T
49	4957.982766	5014.15964	96.52	T

Table PLX 01-2: Additional Survey Data For PLX 01 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
50	4959.299999	5014.789013	96.975	CG.C/L. See note 1.
51	4966.649531	5018.523473	99.407	T.C/L. See note 1.
52	4996.776056	5033.825687	100.08	T.C/L. See note 1.
53	5027.493948	5041.257927	100.338	T.C/L. See note 1.
54	5065.143074	5050.151828	100.893	T

Legend:

G = grass	TH = thalweg	US = upstream
T = tundra	CG = crest gage	TWET = wet tundra
C = cobbles	GB = ground break	M = mud
LEW = left edge of water	SH = shoulder	SB = sand bags
REW = right edge of water	DS = downstream	PK = "pk" nail
CL = center line		

Notes:

1. These point numbers were also used as control in Table PLX 01-1 (P-01.txt) and are not the same points. Point No. 50 in this table is the same point as No. 178 in Table PLX 01 (P-01.txt).

file:plx01-2.xls

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	4890.64	5661.19	105.4	PK/L.CULV.
2	3899.84	5299.8	104.63	PK/B.CULV.
101	4827.733907	5648.36582	104.818	GSH
102	4844.302932	5657.304352	105.047	GSH
103	4867.384937	5669.520818	105.249	GSH
104	4878.887623	5675.544168	105.237	GSH
105	4888.54205	5680.242788	105.161	GSH
106	4906.053357	5689.904426	104.745	GSH
107	4926.664201	5700.294125	104.464	GSH
108	4947.974525	5710.324977	104.364	GSH
109	4967.61046	5719.838279	104.279	GSH
110	4985.438666	5685.873976	104.605	GSH
111	4965.663366	5675.758419	104.689	GSH
112	4944.301039	5665.256504	104.777	GSH
113	4925.852841	5655.314272	104.733	GSH
114	4915.486644	5650.160915	104.713	GSH
115	4905.241428	5644.587603	104.776	GSH
116	4894.325655	5638.233995	104.897	GSH
117	4874.456423	5628.641427	104.811	GSH
118	4856.586081	5618.992294	104.693	GSH
119	4833.823798	5608.371976	104.643	GSH
120	4840.429744	5599.212413	98.805	GTO
121	4867.323976	5608.115731	97.724	GTO
122	4907.372003	5614.20194	92.507	SB
123	4897.799864	5616.849096	94.385	SB
124	4877.953879	5608.290662	97.014	SB
125	4877.821448	5622.38851	100.977	SB
126	4934.702227	5653.928726	101.913	SB
127	4957.410851	5645.225183	93.316	SB
128	4936.431703	5631.991306	91.817	SB
129	4928.463425	5640.310634	98.077	SB
130	4923.152696	5640.464096	100	SB
131	4920.536197	5636.187037	97.414	SB
132	4925.896507	5628.902602	91.51	SB
133	4920.451823	5632.227713	95.284	SB
134	4915.871946	5631.42031	97.525	SB
135	4913.222248	5627.568649	95.483	SB
136	4917.225592	5623.198793	92.284	SB
137	4914.850575	5621.486121	92.372	SB
138	4910.068834	5626.432604	95.409	SB
139	4903.332621	5628.158676	99.225	SB
140	4903.767467	5621.994787	95.031	SB
141	4909.067642	5615.846789	92.154	SB
142	4911.823072	5618.868499	91.813	CI

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
143	4911.410803	5619.123021	99.661	CT
144	4850.215699	5691.068697	99.122	CT
145	4849.935297	5691.517706	91.529	CI
146	4856.964706	5700.552501	89.671	CI
147	4857.398291	5699.958093	98.474	CT
148	4924.73674	5621.305528	98.517	CT
149	4925.436204	5620.453358	89.657	CI
150	4932.089514	5629.466388	91.757	CI
151	4931.8194	5630.045071	100.529	CT
152	4870.794958	5701.596478	100.319	CT
153	4870.258173	5702.131141	91.755	CI
154	4895.892077	5691.988913	101.484	SB
155	4845.22525	5666.268208	101.63	SB
156	4831.773502	5683.955135	91.52	SB
157	4847.091802	5688.869133	90.871	SB
158	4852.600136	5681.760176	96.389	SB
159	4858.333946	5680.500064	98.759	SB
160	4859.531255	5686.329915	95.178	SB
161	4862.283508	5689.121807	95.799	SB
162	4866.486511	5689.251423	97.373	SB
163	4867.72134	5695.446607	93.395	SB
164	4864.298989	5698.703788	91.915	SB
165	4866.983764	5699.211273	92.258	SB
166	4879.895316	5691.394139	100.147	SB
167	4880.397788	5697.539061	96.211	SB
168	4873.737326	5705.107618	91.467	SB
169	4896.188448	5704.604611	96.714	SB
170	4884.155969	5742.141242	96.961	T
171	4869.557921	5733.950875	94.821	T
172	4865.10601	5731.194919	92.99	REW
173	4863.668709	5730.237981	92.332	G
174	4858.230689	5727.768983	92.123	G
175	4856.352135	5726.332765	88.556	C
176	4828.481045	5709.615155	88.976	M
177	4823.416403	5705.288797	90.413	M
178	4818.963658	5702.006159	91.709	M/G
179	4817.581523	5701.236148	92.997	LEW
180	4814.804652	5699.545105	93.718	T
181	4790.731484	5684.755622	96.015	T
182	4933.463616	5566.823805	98.243	T
183	4951.607411	5587.092533	96.921	T
184	4960.217507	5600.268294	93.597	LEW
185	4961.131798	5601.371112	92.757	C
186	4966.097131	5606.788728	92.469	C

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
187	4971.682232	5614.665054	91.72	C/G
188	4971.607175	5614.898446	91.718	C/G
189	4975.407088	5618.069491	90.655	C
190	4981.954088	5621.580851	90.416	C
191	4982.157177	5623.155551	90.64	C
192	4982.242786	5623.707155	91.889	G
193	4984.338328	5628.1406	92.728	G
194	4991.276513	5639.733358	93.631	REW
195	4997.92915	5649.156225	93.857	T
196	4999.590867	5650.950368	94.918	T
197	5016.965314	5666.749171	97.206	T
201	3792.533545	5328.312382	104.302	GSH
202	3836.713353	5325.226107	104.28	GSH
203	3857.079319	5323.272477	104.365	GSH
204	3873.447275	5322.959112	104.508	GSH
205	3884.366741	5321.942354	104.453	GSH
206	3894.880123	5321.134322	104.405	GSH
207	3905.853412	5320.504369	104.17	GSH
208	3917.693206	5319.478067	104.09	GSH
209	3930.67259	5318.85317	103.962	GSH
210	3946.812453	5318.191544	103.936	GSH
211	3988.978773	5318.055321	103.68	GSH
212	4031.539713	5320.028824	103.671	GSH
213	4026.278368	5279.611475	104.065	GSH
214	3984.272416	5278.226649	104.223	GSH
215	3947.948558	5277.740656	104.217	GSH
216	3938.480352	5277.953473	103.777	GSH
217	3930.892371	5277.873806	103.766	GSH
218	3918.030931	5277.582982	103.917	GSH
219	3906.463333	5278.790345	104.346	GSH
220	3895.247747	5279.495468	104.461	GSH
221	3883.776061	5280.737306	104.392	GSH
222	3872.788145	5281.923762	104.264	GSH
223	3856.304159	5283.64971	104.041	GSH
224	3816.549511	5288.196719	104.295	GSH
225	3773.519186	5292.389681	104.845	GSH
226	3769.282352	5278.932717	97.619	GTO
227	3794.16473	5275.53447	97.071	GTO
228	3832.213777	5267.56962	95.806	GTO
229	3869.085417	5257.378673	93.801	SB
230	3864.455965	5258.006307	93.728	SB
231	3853.602832	5260.256896	95.459	SB
232	3859.563934	5268.931927	97.544	SB

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
233	3865.826435	5276.776809	101.783	SB
234	3884.79429	5275.678604	102.514	SB
235	3938.0707	5271.592777	101.378	SB
236	3947.199148	5253.39604	93.89	SB
237	3951.261643	5247.910644	93.549	SB
238	3941.733699	5245.014233	90.561	SB
239	3940.40995	5238.006297	89.735	SB
240	3934.086122	5239.424766	90.826	SB
241	3929.611108	5243.516878	95.912	SB
242	3923.400841	5240.965013	89.923	SB
243	3917.298876	5244.60597	95.983	SB
244	3911.244114	5244.087452	90.238	SB
245	3909.275251	5259.463717	94.927	SB
246	3905.588961	5262.831381	97.65	SB
247	3901.040847	5258.537822	93.956	SB
248	3899.53684	5250.125488	90.723	SB
249	3899.151042	5259.70357	93.569	SB
250	3894.891387	5265.088111	98.611	SB
251	3890.735518	5261.872082	95.196	SB
252	3889.055917	5253.523014	92.404	SB
253	3888.127467	5261.857976	95.061	SB
254	3884.111009	5269.399375	100.124	SB
255	3879.484252	5265.9219	96.963	SB
256	3878.379997	5257.960462	93.674	SB
257	3877.26056	5264.695881	95.937	SB
258	3873.50651	5271.100835	100.518	SB
259	3869.41114	5265.917492	96.994	SB
260	3870.813837	5257.151061	93.189	SB
261	4070.219915	5269.617893	97.645	GTO
262	4024.099217	5264.521817	96.838	GTO
263	3973.210656	5259.682134	95.808	GTO
264	4104.887355	5340.515357	97.977	GTO
265	4058.452657	5335.477198	97.34	GTO
266	3957.458142	5334.676158	95.318	GTO
267	3849.292339	5346.158448	95.084	GTO
268	3822.23501	5346.788352	95.896	GTO
269	3782.794244	5346.029354	97.049	GTO
270	3729.653644	5348.201976	98.59	GTO
271	3854.413581	5346.691802	94.621	SB
272	3870.053927	5346.815309	93.47	SB
273	3870.213551	5338.58633	96.689	SB
274	3874.01493	5331.843108	100.628	SB
275	3878.042832	5339.67932	95.729	SB
276	3878.181138	5346.961276	93.407	SB

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
277	3880.834338	5347.423848	92.839	SB
278	3880.768434	5339.664337	95.69	SB
279	3884.671702	5331.979103	100.337	SB
280	3889.290629	5338.442079	95.447	SB
281	3889.013367	5347.117734	92.463	SB
282	3890.985828	5347.186559	92.375	SB
283	3891.72968	5340.613455	94.621	SB
284	3895.512841	5333.720716	98.687	SB
285	3900.443006	5340.129982	93.652	SB
286	3900.290258	5346.851092	90.944	SB
287	3902.09559	5348.183998	90.645	SB
288	3902.016905	5341.284709	93.566	SB
289	3906.397272	5335.037984	97.409	SB
290	3911.28951	5339.832596	93.352	SB
291	3911.117898	5346.676896	90.141	SB
292	3912.869156	5345.815279	90.571	SB
293	3913.0896	5343.13839	91.656	SB
294	3917.902773	5337.462982	95.014	SB
295	3922.509975	5341.411445	92.144	SB
296	3922.706418	5343.581392	90.817	SB
297	3924.793137	5344.208539	90.411	SB
298	3924.68601	5342.253243	92.219	SB
299	3930.179131	5338.431638	95.282	SB
300	3934.611154	5342.546162	91.859	SB
301	3934.494849	5348.80835	89.063	SB
302	3937.351573	5346.224643	90.325	SB
303	3946.239017	5334.845776	95.508	SB
304	3943.290436	5331.085019	97.02	SB
305	3928.810539	5332.259126	96.782	SB
306	3917.540854	5332.247394	97.058	SB
307	3906.211361	5332.234476	98.119	SB
308	3895.445503	5331.305389	99.313	SB
309	3881.244174	5329.713835	100.828	SB
310	3873.421052	5329.751424	101.175	SB
311	3863.023962	5330.839768	100.557	SB
312	3857.58153	5340.784612	96.348	SB
313	3874.304279	5354.031225	93.515	CI
314	3874.237366	5353.69461	101.051	CT
315	3884.925728	5345.474362	92.548	CI
316	3884.626543	5345.219782	100.494	CT
317	3895.979107	5347.364639	91.046	CI
318	3896.109672	5347.004622	99.117	CT
319	3906.698553	5348.63756	89.869	CI
320	3906.544283	5348.108626	97.943	CT

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
322	3918.066383	5354.234498	96.139	CT
323	3929.698372	5353.678987	88.03	CI
324	3929.635481	5353.375424	96.115	CT
325	3929.477388	5238.768876	87.329	CI
326	3929.664802	5239.370184	96.069	CT
327	3917.325206	5239.995786	87.601	CI
328	3918.053926	5240.585717	96.222	CT
329	3905.308274	5248.327904	89.86	CI
330	3905.248959	5248.909712	97.888	CT
331	3895.301354	5252.311572	90.887	CI
332	3895.279906	5252.690119	99.056	CT
333	3883.667794	5255.609893	92.53	CI
334	3883.900041	5255.808869	100.477	CT
335	3873.356509	5258.820862	93.267	CI
336	3873.334261	5259.454752	100.857	CT
337	3836.926243	5194.410875	95.59	T
338	3861.985242	5194.939661	94.436	T
339	3885.988453	5194.503436	93.417	T
340	3900.350887	5195.071891	92.228	LEW
341	3907.159485	5195.208086	91.352	G
342	3912.047337	5195.100718	91.164	G
343	3912.593925	5195.283389	89.286	C
344	3923.534719	5189.901171	89.492	C
345	3930.295773	5190.599499	89.486	C
346	3935.669539	5190.432969	90.035	C
347	3941.012313	5190.490097	90.302	C
348	3946.273343	5191.746865	90.876	C
349	3947.623494	5191.611213	92.232	REW
350	3948.736925	5191.52099	92.996	T
351	3957.994186	5191.533541	94.593	T
352	3999.951581	5194.592029	96.345	T
353	4049.619507	5204.656556	97.664	T
354	4067.192938	5391.693413	97.19	T
355	4052.021236	5394.254652	94.788	T
356	4009.696643	5398.533436	95.132	T
357	3964.577456	5403.419692	95.247	T
358	3947.597955	5404.866738	93.921	T
359	3939.280715	5405.20516	92.105	REW
360	3936.117775	5405.551547	91.339	G
361	3934.268609	5405.361788	88.485	C
362	3900.21331	5410.783199	88.719	C
363	3898.022905	5410.63918	90.818	G
364	3892.216249	5410.43404	92.151	LEW
365	3883.68042	5410.980423	93.87	T

Table PLX 01-3: Culvert Data For PLX 01 And PLX 02 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
366	3831.7445	5409.133585	95.238	T
367	3797.431222	5404.888647	97.228	T

Legend:

G = grass	CL = center line	DS = downstream
T = tundra	TH = thalweg	US = upstream
C = cobbles	CG = crest gage	M = mud
LEW = left edge of water	GB = ground break	SB = sand bags
REW = right edge of water	SH = shoulder	PK = "pk" nail
CI = Culvert Invert	CT = Culvert Top	

file:culverts.xls

APPENDIX E: PLX 02

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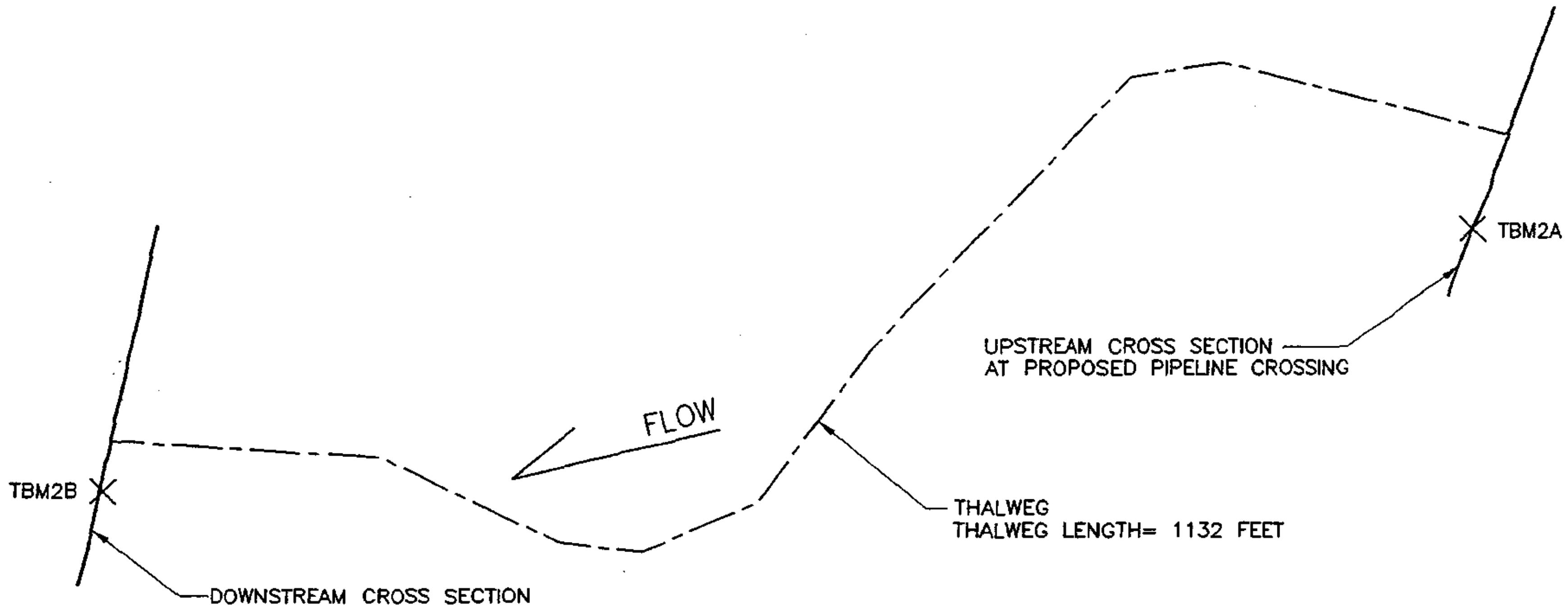
Notes:

1. THE PLAN AND PROFILE FOR PLX 02, AND THE DATA CONTAINED THEREIN, ARE PROVISIONAL, SUBJECT TO VERIFICATION OF THE SURVEY DATA CONTAINED IN TABLES PLX 01-1 AND PLX 01-3.

2. The survey and culvert data associated with PLX 02 were collected in combination with the data collected for PLX 01 and are presented in Tables PLX 01-1 and PLX 01-3.



TBM1A

NOTES:

1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM1A. THIS IS THE SAME TBM USED FOR THE PLX01 SURVEY.

PROVISIONAL
SUBJECT TO CHANGE UPON FURTHER REVIEW OF SURVEY DATA

REVISION			
NO.:	DATE:		BY:

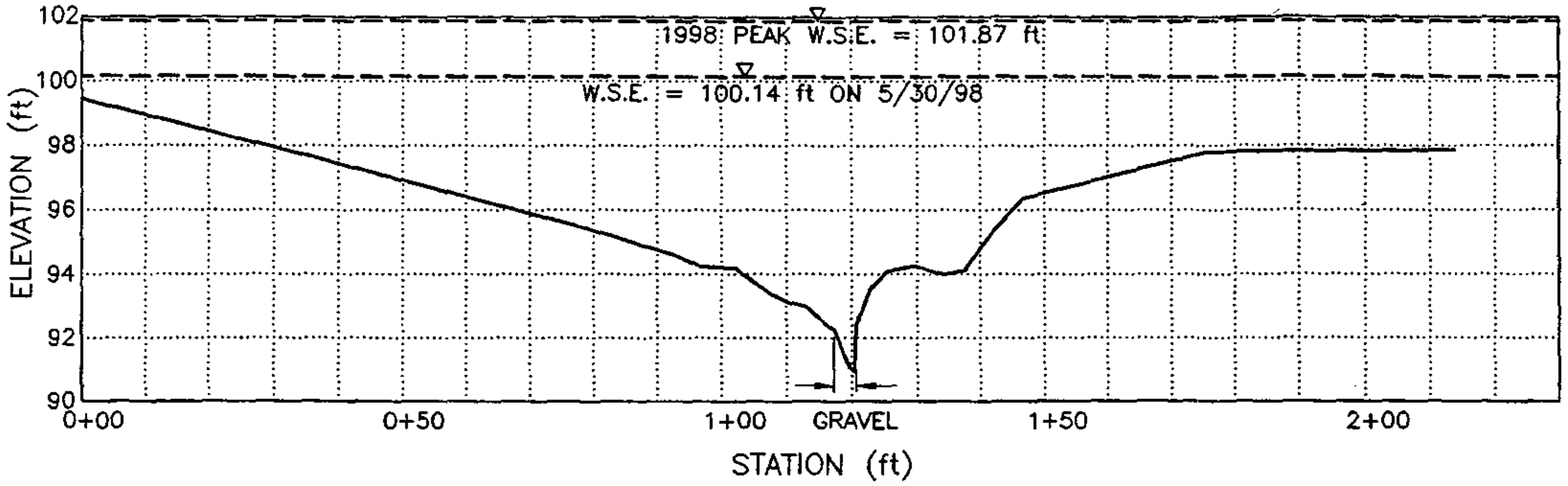
STREAM PLX02 – MIDDLE BADIMI CREEK
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

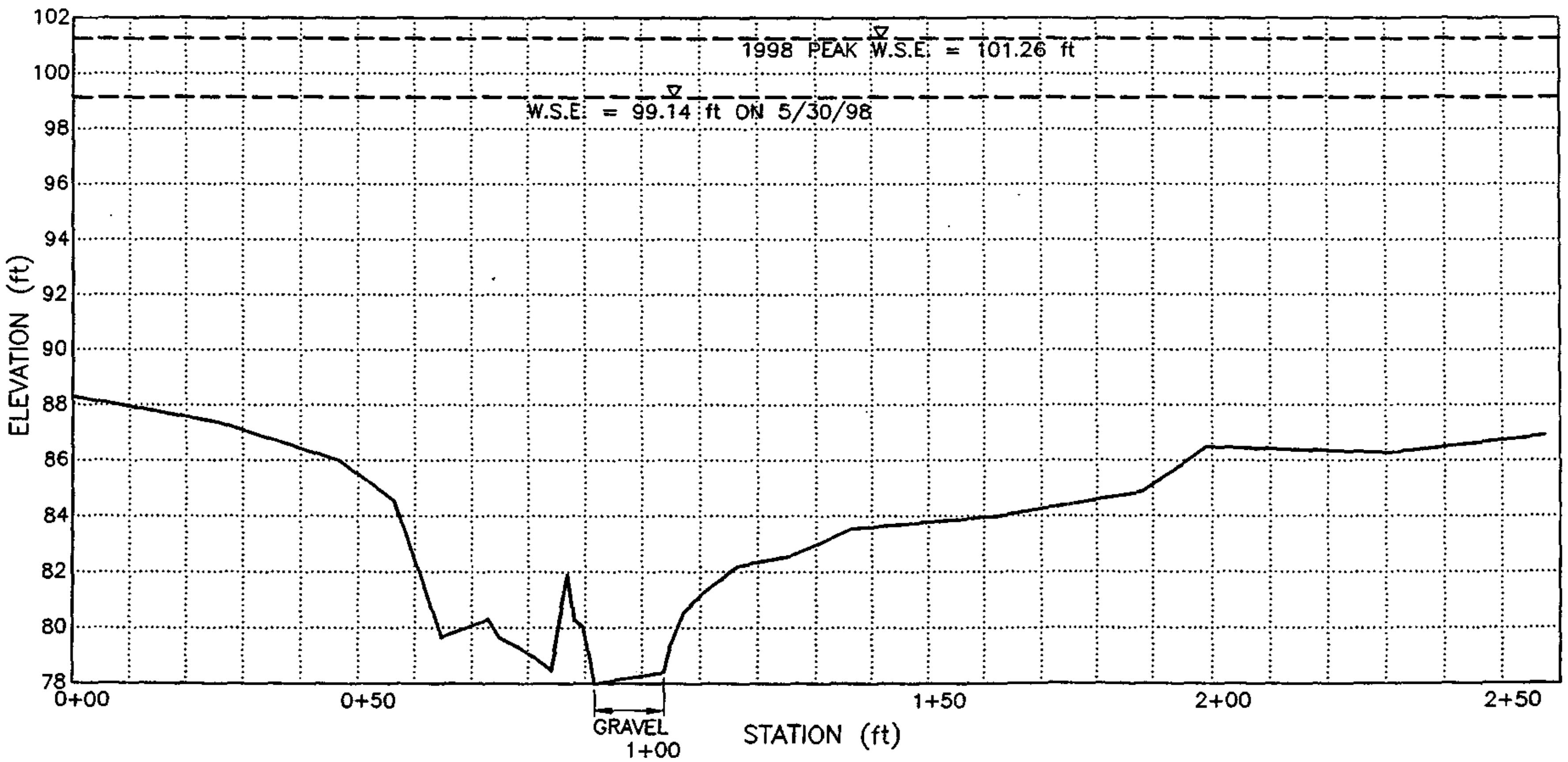
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X2
CHECKED:	JWA	SCALE:	1"= 120'

FIGURE:
PLX 02-1



PROFILE: PLX02 UPSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX02 DOWNSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'

PROVISIONAL
SUBJECT TO CHANGE UPON FURTHER REVIEW OF SURVEY DATA

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM1A.
2. W.S.E.= WATER SURFACE ELEVATION

REVISION			
NO.:	DATE:		BY:

STREAM PLX02 – MIDDLE BADIMI CREEK
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X2
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 02-2

Photo PLX 02-1: Looking east at stream (5/30/98).

Photo PLX 02-2: Looking north, the proposed pipeline crossing is at the upper portion of the riffle in the straight reach before the bend to the left (6/2/98).

STREAM PLX 02 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 02-1
	Drawn: JDA	File: photo02	
	Checked: JWA	Scale:	

Photo PLX 02-3: Looking north, the person in the photo is indicating the peak water surface elevation at the crossing (6/6/98).

STREAM PLX 02 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98 — Project: 23247 Drawn: JDA — File: photo02 Checked: JWA — Scale:	PLX 02-2

APPENDIX F: PLX 03

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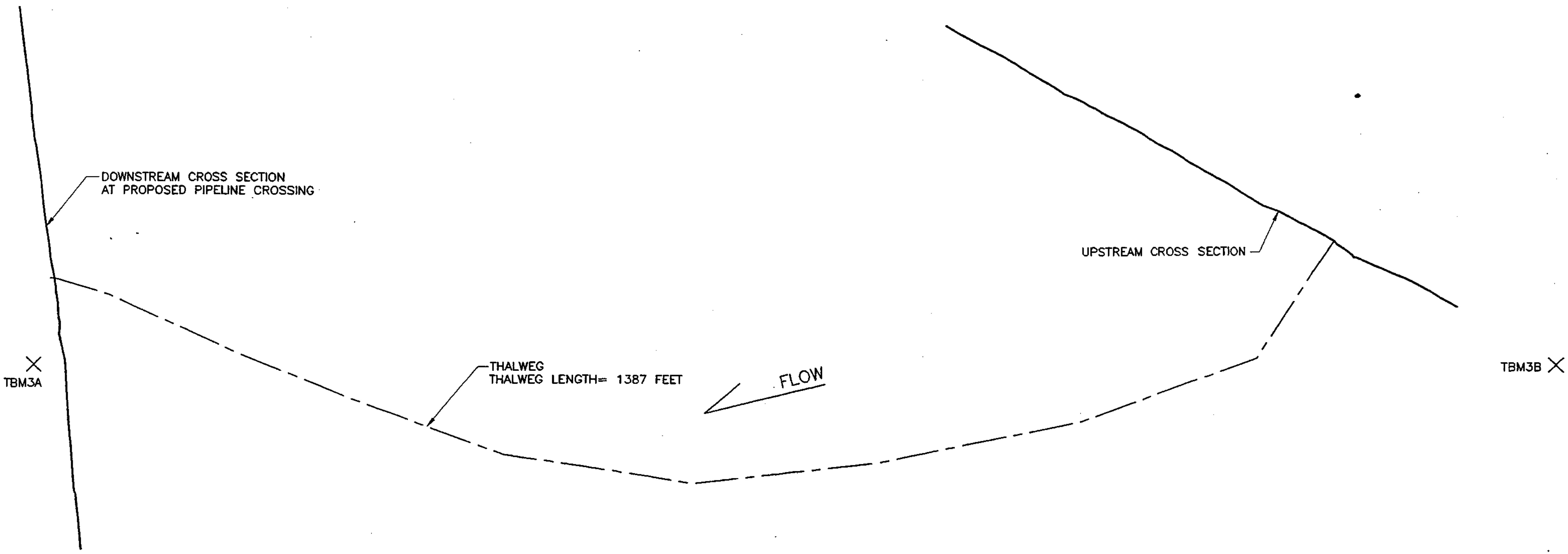


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM3A.

NO.:	DATE:	REVISION	BY:

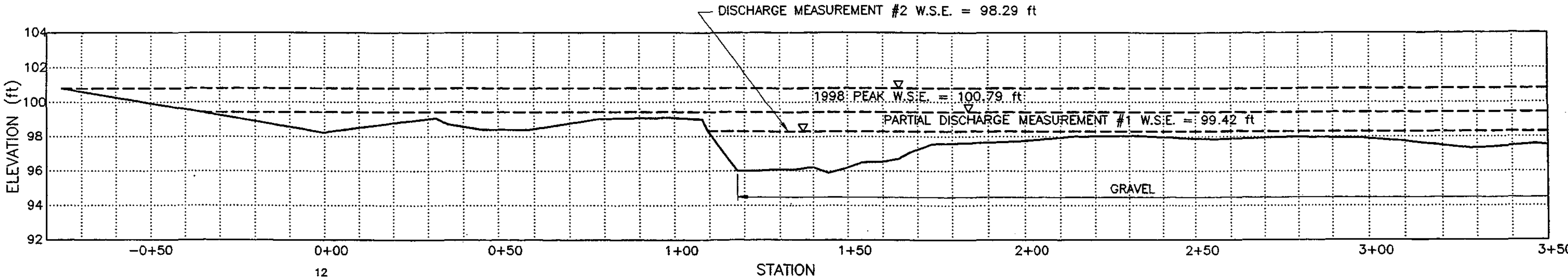
STREAM PLX03 – EAST BADAMI CREEK
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X3
CHECKED:	JWA	SCALE:	1"= 100'

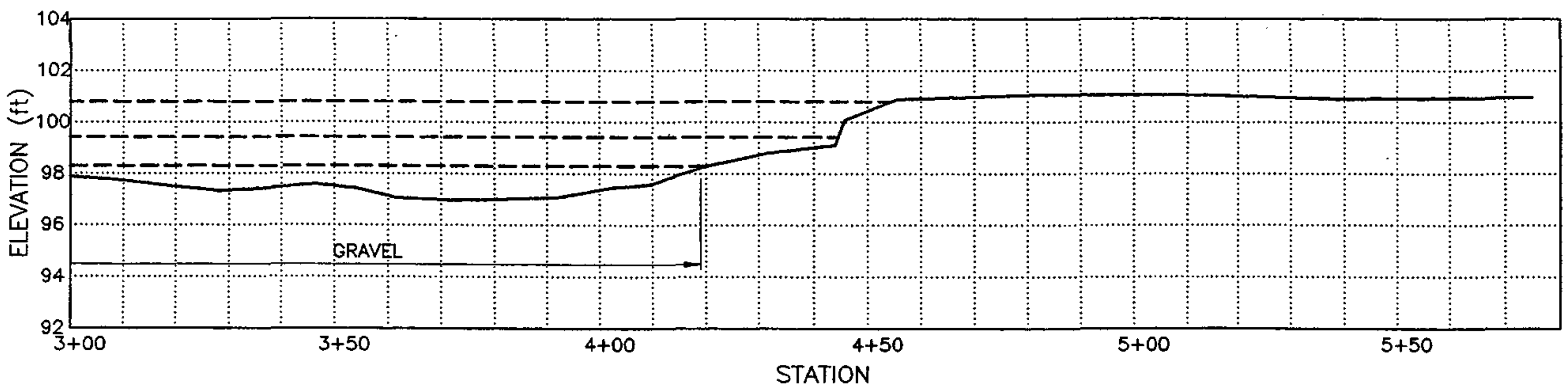
FIGURE:
PLX
03-1



12

PROFILE: PLX03 UPSTREAM CROSS SECTION – STATION -0+80 TO STATION 3+50

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX03 UPSTREAM CROSS SECTION – STATION 3+00 TO STATION 5+80

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM3A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

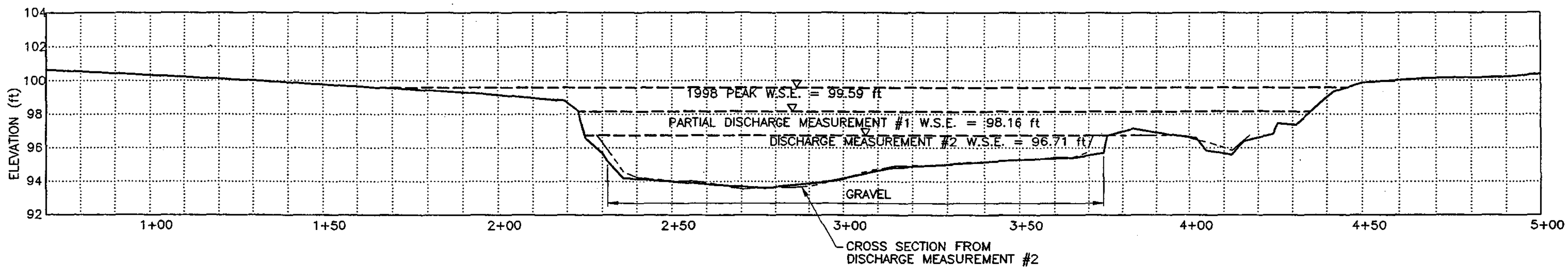
STREAM PLX03 – EAST BADAMI CREEK
PROFILE

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X3
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 03-2



PROFILE: PLX03 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM3A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

NO.:	DATE:	REVISION	BY:

STREAM PLX03 – EAST BADAMI CREEK
PROFILE

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X3
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 03-3

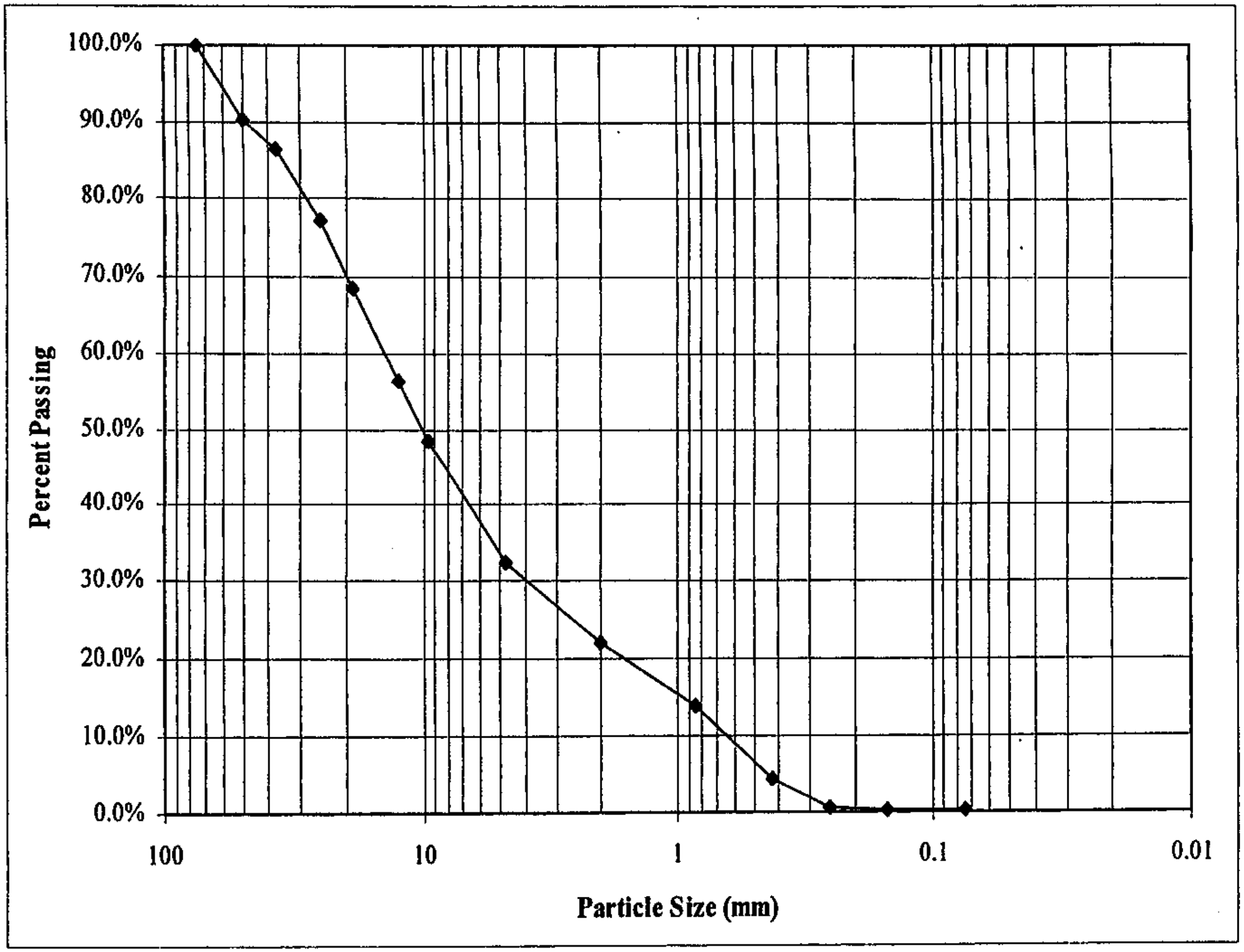


Figure Number: PLX 03-4

Baker Michael Baker Jr., Inc.

Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 03
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

REVISION:

NO:	DATE:		BY:

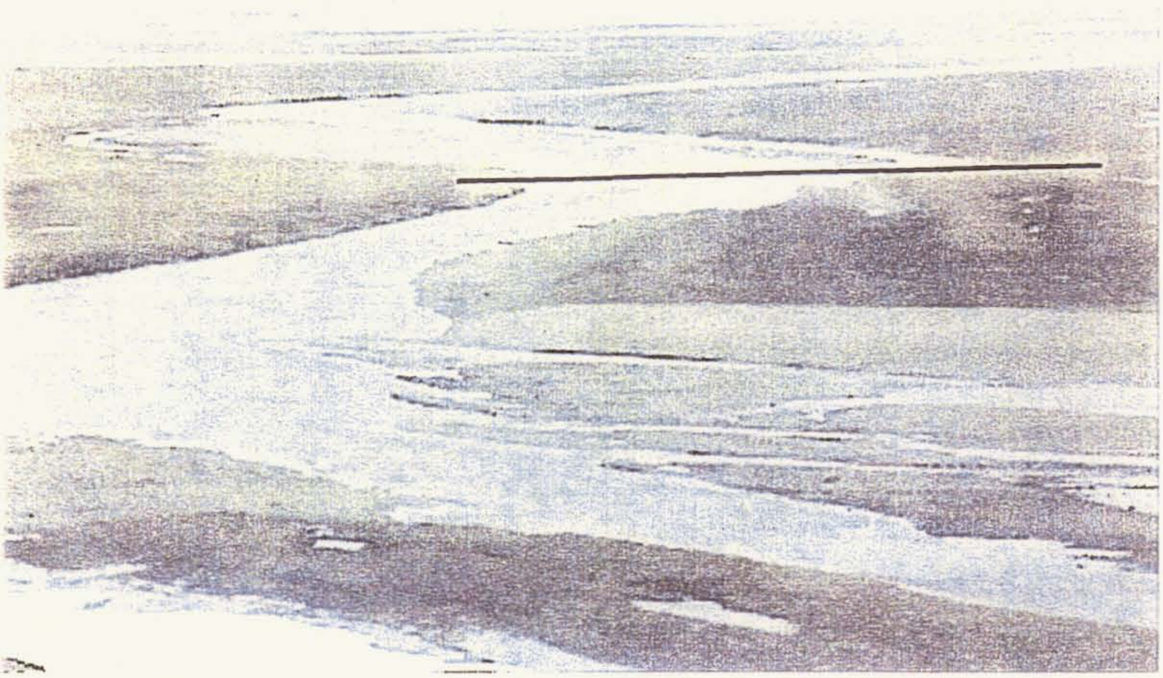


Photo PLX 03-1: Looking north at the proposed pipeline crossing (6/8/98).

Photo PLX 03-2: Looking north at the proposed pipeline crossing (6/11/98).

STREAM PLX 03 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247		PLX 03-1
	Drawn: JDA	File: photo03		
	Checked: JWA	Scale:		

Photo PLX 03-3: Looking west at the proposed pipeline crossing (6/2/98).

STREAM PLX 03 PHOTOGRAPHS	Baker — Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 03-2
	Drawn: JDA	File: photo03	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 03 East Badami Creek - Discharge Measurement Number 1 (Partial Measurement)

Date:	5/30 ,1998	**Party:**	J. Meckel, P. McGranahan				
Width:	197	**Area:**		**Vel:**	**G.H.:**	**Disch.:**	cfs
No Secs.		**G.H. change:**		**in.:**	**hrs.:**	**Susp.:**	Rod
Method coef.:	1	**Hor. Angle coef.**	1	**Sus. Coef.:**	1	**Meter No.**	std 1

Gage Readings						
Time	**Recorder**	**Inside**	**Outside**			
				Type of meter:	Price A	
				Date rated:	Std No 1	
				Meter:	ft. above bottom of weight.	
	upstream x-sec	WSE=	99.41	**Spin before meas.**	ok	**after** ok
				Method:	Wading at proposed pipeline crossing.	
	downstream x-sec	WSE=	98.16			
Weighted M.G.H.				**Levels obtained**	this time	
G.H. corrections						
Correct M.G.H.						

Measurement rated: Incomplete

Cross section: Fairly uniform - ice on bottom 20%.

Flow: **Weather:** clear -wind **Air °F@:**

Gage: Upstream ok, downstream bent, w.s. refered for levels. **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Channel

Section was free of ice in the area of the most discharge.

Remarks Estimed that the maximum velocity was about 130 percent of that at sta 52.

Estimated that maximum depth was 4-5 feet.

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 03 Measurement 1 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	242.0	8.5	0.0						0.0	0.0	Right Edge Water (1030 hr)
	225.0	21.0	1.6	0.6	30	43	1.54	1.54	33.6	51.7	
	200.0	25.0	0.9					0.00	22.5	0.0	Snow/slush
	175.0	17.5	2.0	0.6	40	41		3.21	35.0	112	Bottom ice
	52.0	5.0	2.3	0.6	100	42	5.20	5.20	11.5	59.8	
				s	100	41	5.32		0.0	0.0	
	50.0	3.5	1.2	0.6	80	42		4.16	4.2	17.5	
	45.0	2.5									Left Edge Water (1110 hr)
	197.0										

file: disch_P03c.xls

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 03 East Badami Creek - Discharge Measurement Number 2

Date: 6/1 ,1998 **Party:** J. Meckel, P. McGranahan

Width: 143 **Area:** 307 **Vel:** 1.94 **G.H.:** **Disch.:** 596 cfs

No Secs. 32 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
	upstream x-sec	WSE=	98.29
	downstream x-sec	WSE=	96.71
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: **ft. above bottom of weight.**

Spin before meas. ok **after** ok

Method: Wading at proposed pipeline crossing, downstream cross section.

Levels obtained this time

Measurement rated: good (5%) **based on following conditions:**

Cross section: Very uniform, smooth cobble

Flow: evenly distributed **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Broad riffle 300-500 ft. downstream clear - streambed smooth cobble $\leq$ 3".

Remarks Sand, gravel, mostly firm - light short grass on right side.

Note that there was no flow between station 3 and 49, therefore width of section is 189 ft, width of flow is 143 ft.

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 03 Discharge Measurement 2 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo- lutions	Time In seconds	VELOCITY At Point (fps)	Mean in- vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	3.0	2.5	0.0								Right Edge Water (1630)
	8.0	6.0	1.1		0		grass bar				Dead water
	15.0	7.5	0.4		0						" "
	23.0	17.0	0.0								Left Edge Water
	49.0	14.0	0.0								Right Edge Water
	51.0	3.0	1.0	0.6	10	45		0.50	3.0	1.5	Edge grass
	55.0	4.5	1.3	0.6	15	53		0.64	5.9	3.7	Small cobble
	60.0	5.0	1.3	0.6	15	42		0.80	6.5	5.2	" "
	65.0	7.5	1.4	0.6	15	48		0.70	10.5	7.4	" "
	75.0	10.0	1.5	0.6	15	46		0.73	15.0	11.0	" "
	85.0	10.0	1.6	0.6	20	44		1.01	16.0	16.2	" "
	95.0	7.5	1.8	0.6	25	48		1.16	13.5	15.7	" "
	100.0	5.0	1.8	0.6	25	44		1.26	9.0	11.3	" "
	105.0	5.0	1.8	0.6	25	40		1.38	9.0	12.4	" "
	110.0	5.0	2.0	0.6	30	40		1.65	10.0	16.5	" "
	115.0	5.0	2.2	0.6	40	42		2.10	11.0	23.1	" "
	120.0	5.0	2.6	0.8	40	45	1.96	2.18	13.0	28.3	" "
				0.2	50	46	2.39				" "
	125.0	5.0	2.8	0.2	50	43	2.55	2.35	14.0	32.9	" "
				0.8	40	41	2.15				" "
	130.0	5.0	3.0	0.8	40	42	2.15	2.44	15.0	36.6	" "
				0.2	50	40	2.74				" "
	135.0	5.0	3.1	0.2	60	45	2.92	2.51	15.5	38.9	" "
				0.8	40	42	2.10				" "
	140.0	5.0	3.1	0.8	50	43	2.55	2.77	15.5	42.9	" "
				0.2	60	44	2.99				" "
	145.0	5.0	3.1	0.2	60	42	3.13	2.87	15.5	44.5	" "
				0.8	50	42	2.61				" "
	150.0	5.0	3.2	0.8	50	41	2.68	2.80	16.0	44.8	" "
				0.2	60	45	2.92				" "

DISCHARGE MEASUREMENT NOTES (PLX 03 Discharge Measurement 2 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	155.0	5.0	3.0	0.2	60	43	3.06	2.78	15.0	41.7	Small cobble
				0.8	50	44	2.50				" "
	160.0	5.0	2.8	0.8	50	43	2.55	2.80	14.0	39.2	" "
				0.2	60	43	3.06				" "
	165.0	5.0	2.7	0.2	60	42	3.13	2.78	13.5	37.5	" "
				0.8	50	45	2.44				" "
	170.0	5.0	2.7	0.8	40	41	2.15	2.44	13.5	32.9	" "
				0.2	60	48	2.74				" "
	175.0	5.0	2.6	0.2	50	48	2.29	2.02	13.0	26.3	" "
				0.8	40	50	1.76				" "
	180.0	4.5	2.5	0.6	30	45		1.47	11.3	16.5	" "
	184.0	4.5	2.2	0.6	15	41		0.82	9.9	8.1	" "
	189.0	4.0	0.8	0.6	5	43		0.27	3.2	0.9	Edge grass
	192.0	1.5	0.0					0.73			Left Edge Water (1730)
	189	189.0							307.2	596.0	

file: disch_P3a.xls

Table PLX 03-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P03TBMCL (TBM3A)
2	5000	3501.836227	105.593	P03TBMUS (TBM3B)
11	5110.531359	3695.474296	98.239	SGUS
12	5059.781144	3598.034043	98.212	T
13	5060.130409	3599.415217	98.28	T
14	5069.165774	3614.710612	98.754	T
15	5076.542073	3625.564726	99.054	THW
16	5077.704449	3628.644704	98.72	T
17	5082.587656	3637.235257	98.388	T
18	5088.809647	3649.040967	98.39	T
19	5097.596794	3667.003108	99.009	T
20	5106.396374	3685.589229	99.068	T
21	5110.246724	3693.563509	98.97	T
22	5113.13038	3697.092813	97.447	T
23	5113.937505	3698.051851	97.131	LEW
24	5116.499594	3701.402866	95.997	C
25	5120.218806	3706.467086	96.006	C
26	5123.614733	3711.629113	96.079	C
27	5127.065571	3714.672978	96.084	CTH
28	5129.777072	3719.280696	96.217	C
29	5132.071602	3723.180354	95.882	C
30	5134.684192	3727.173377	96.138	C
31	5136.9869	3731.280771	96.486	C
32	5140.004486	3736.348873	96.524	C
33	5142.209647	3740.715786	96.715	C
34	5143.817629	3743.685958	97.087	REW
35	5146.301928	3749.358687	97.552	C
36	5157.591257	3769.334392	97.688	C
37	5163.5235	3785.231935	97.996	C
38	5172.568926	3800.601116	98.033	C
39	5185.039393	3820.607782	97.839	C
40	5196.277801	3841.073652	97.965	C
41	5206.640463	3857.263269	97.916	LEW
42	5213.279822	3866.882836	97.726	C
43	5217.875763	3874.61197	97.509	C
44	5222.208229	3883.166778	97.323	C
45	5226.324934	3891.703497	97.414	C
46	5230.800253	3899.354011	97.584	C
47	5235.210597	3905.688238	97.426	C
48	5238.77963	3912.081947	97.054	C
49	5243.681408	3921.625956	96.958	C
50	5248.189158	3929.474583	96.995	C
51	5252.711107	3939.001637	97.06	C
52	5257.542357	3948.063515	97.439	C
53	5261.691622	3954.73099	97.575	C
54	5263.618871	3958.825165	97.917	REW
55	5266.409586	3963.654777	98.283	CT
56	5271.893501	3974.046703	98.8	T
57	5276.3385	3985.626994	99.104	T
58	5277.265221	3987.067905	100.071	T

Table PLX 03-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
59	5282.795799	3995.230981	100.872	T
60	5296.365444	4017.529634	101.058	T
61	5312.920042	4043.719032	101.059	T
62	5324.963782	4066.83113	100.896	T
63	5343.402008	4097.898675	100.96	T
64	5276.459277	3706.148663	96.022	THFL
65	5007.585728	3791.777563	94.022	TH
66	4943.406482	3968.459955	95.865	TH
67	4900.406238	4170.086527	95.196	TH
68	4880.422044	4350.422204	95.45	TH
69	4909.597908	4535.762746	93.372	TH
70	4966.513059	4686.654802	94.347	TH
71	5010.83169	4793.987905	93.745	TH
72	5071.728858	4925.751413	93.636	TH
73	5089.558839	5075.000928	93.684	THFL
74	5361.431877	5013.639139	100.68	T
75	5341.965775	5011.352472	100.619	T
76	5320.274198	5008.946068	100.562	T
77	5298.411333	5006.438987	100.205	T
78	5277.898662	5004.23082	100.136	T
79	5260.252574	5002.208098	99.882	TRB
80	5251.781641	5001.916492	99.352	T
81	5241.110317	5000.824103	97.363	T
82	5235.787113	5000.045725	97.454	T
83	5234.323077	5000.045441	96.819	T
84	5225.890354	4998.69676	96.402	T
85	5222.353201	4997.779249	95.585	T
86	5215.254033	4996.853379	95.838	T
87	5212.375994	4996.468051	96.596	T
88	5203.67438	4995.155687	96.812	T
89	5193.69788	4993.729493	97.14	T
90	5186.007765	4992.840756	96.738	T
91	5184.920788	4992.774848	95.695	REW
92	5176.001071	4991.614481	95.408	C
93	5160.927436	4990.192496	95.309	C
94	5141.556049	4987.41488	95.019	C
95	5124.855536	4984.841683	94.811	C
96	5107.528694	4982.562752	94.031	C
97	5088.473624	4979.217019	93.607	CTH
98	5073.971345	4977.284656	93.808	C
99	5062.587053	4975.821773	93.982	C
100	5047.831168	4975.000375	94.213	C
101	5043.298382	4973.932254	95.207	C
102	5041.812143	4973.884147	95.69	LEW
103	5037.015703	4974.177488	96.554	T
104	5034.787023	4974.439899	98.18	T
105	5030.70673	4974.617237	98.814	P3CLCG
106	5003.91943	4968.625952	99.289	NWS
107	4943.83383	4965.414428	99.998	T
108	4912.512938	4962.640986	100.32	T

Table PLX 03-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
109	4873.686066	4959.630719	100.742	T
110	4812.758036	4952.088895	102.055	T
111	4866.931111	4957.638902	101.799	TBM

Legend:

G = grass	TH = thalweg	US = upstream
T = tundra	CG = crest gage	TWET = wet tundra
C = cobbles	GB = ground break	M = mud
LEW = left edge of water	SH = shoulder	SB = sand bags
REW = right edge of water	DS = downstream	PK = "pk" nail
CL = center line		

file:plx3.xls

APPENDIX G: PLX 04

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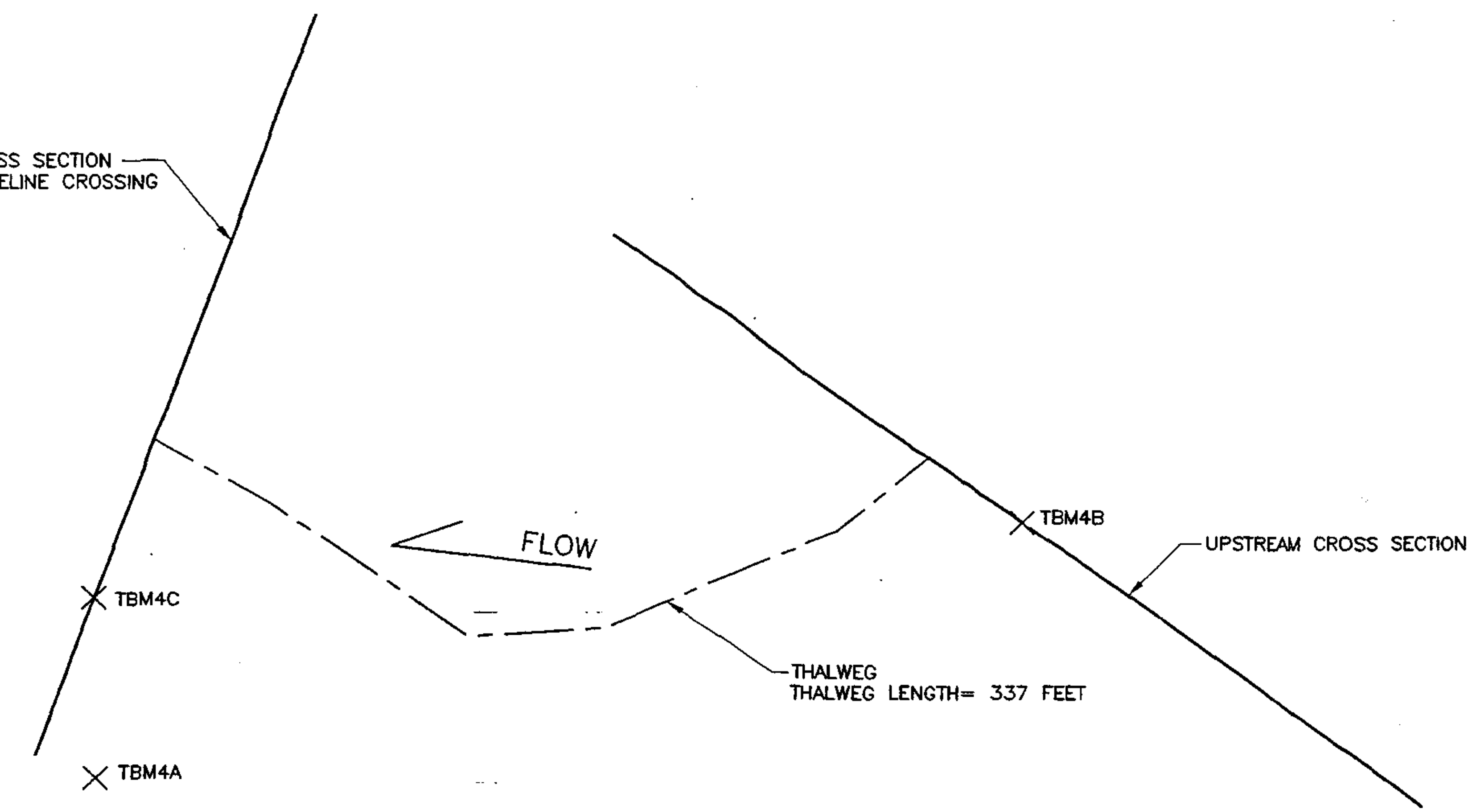


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM4A.

REVISION			
NO.:	DATE:		BY:

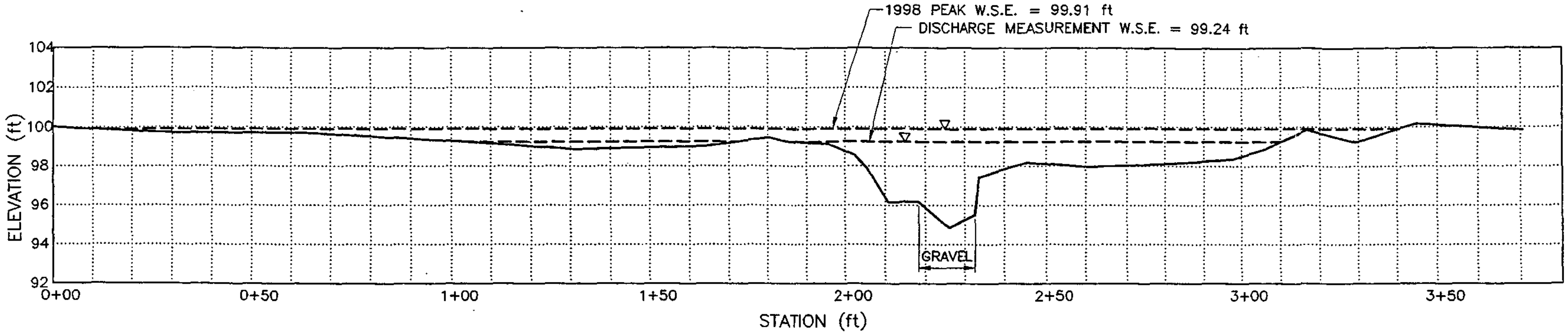
STREAM PLX04
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

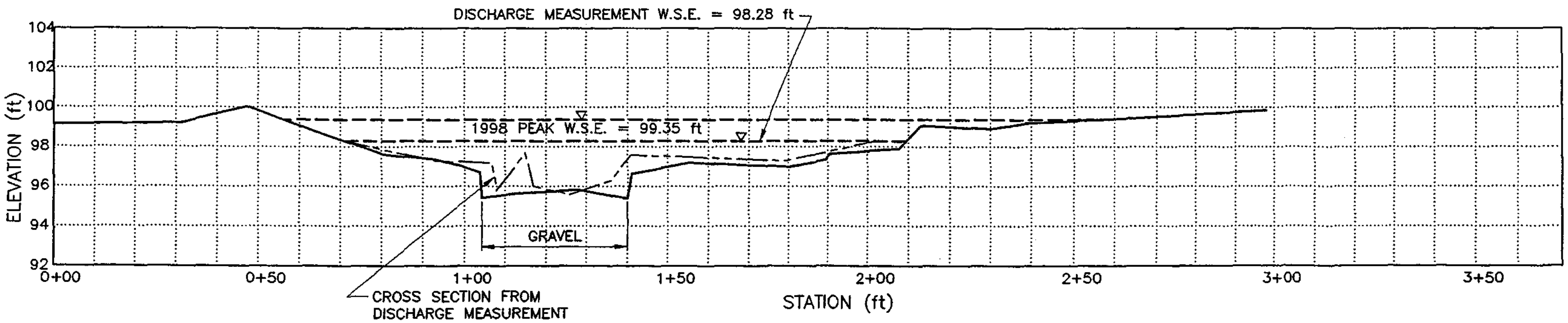
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X4
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX
04-1



PROFILE: PLX04 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX04 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM4A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

STREAM PLX04
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X4
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX
04-2

Photo PLX 04-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 04-2: Looking north at the proposed pipeline crossing (6/6/98).

STREAM PLX 04 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT	Date: 6/7/98	Project: 23247	PLX
	Drawn: JDA	File: photo04	

Photo PLX 04-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 04-2: Looking north at the proposed pipeline crossing (6/6/98).

STREAM PLX 04 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247		PLX 04-1
	Drawn: JDA	File: photo04		
	Checked: JWA	Scale:		

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 04 at downstream cross section

Date: 5/30 ,1998 **Party:** J. Meckel, P.McGranahan

Width: 132 **Area:** 138 **Vel:** 1.63 **G.H.:** **Disch.:** 225 cfs

No Secs. 11 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.**

Gage Readings

Time	Recorder	Inside	Outside
	upstream x-sec	WSE=	99.24
	downstream x-sec	WSE=	98.28
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: ft. above bottom of weight.

Spin before meas. ok **after** ok

Method: Wading at downstream cross section

Levels obtained this date

Measurement rated: fair 8% **based on following conditions:**

Cross section: Non-uniform, grass, cobbles, ice & snow.

Flow: **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Riffle 100' downstream - ice snow.

Remarks

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 04 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	0.0	11.2	0.0				4	18	0	0.0	Left Edge Water (18:00 crest)
	22.4	18.0	1.0	5	25	41	1.35	1.22	18	21.9	
	36.0	7.3	1.1	0.6	40	46		1.92	8.03	15.4	
	37.0	4.0	2.5	0.6	20	46		0.97	10	9.7	
	44.0	4.5	0.6	0.6	60	41		3.21	2.7	8.7	
	46.0	5.5	2.3	0.6	80	53		3.31	12.6	41.7	
	55.0	9.5	2.7	0.2	50	41	2.68	2.44	25.6	62.5	
				0.8	40	40	2.20		0.0	0.0	
	65.0	7.5	2.0	0.6	25	43		1.29	15.0	19.4	
	70.0	21.5	0.7	0.6	15	42		0.82	15.1	12.3	
	108.0	30.8	1.0	0.6	20	42		1.08	30.8	33.3	E of ice on bottom REW
	131.5	11.8	0.0								Right EdgeWater (1830 crest)
	131.5	131.5							137.7	224.8	

file: disch_P4.xls

Table PLX 04-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P04PCL (TBM4A)
2	5000	5068.715984	99.533	P04.P.C/L (TBM4C)
11	5491.703607	4989.139814	99.994	T/HWM
12	5467.021879	5007.925412	99.696	T
13	5440.696358	5026.192908	99.7	T
14	5410.312059	5048.382101	99.281	T
15	5385.544595	5066.248678	98.866	T
16	5358.884218	5085.636193	98.996	T
17	5345.529066	5094.994359	99.468	T
18	5342.512488	5097.20829	99.265	CG/US (TBM4B)
19	5333.344149	5104.197563	99.12	T
20	5327.782505	5107.963139	98.564	LEW
21	5325.28577	5110.147103	97.816	G
22	5323.687665	5111.56871	97.122	G
23	5321.180911	5113.061899	96.165	C
24	5315.192246	5117.610479	96.188	C
25	5308.817049	5121.957688	94.846	C/TH
26	5302.958829	5125.49826	95.507	C
27	5302.337089	5126.117428	97.416	G
28	5292.778449	5132.65619	98.19	G
29	5280.075572	5141.817382	97.961	G
30	5263.242178	5153.732162	98.118	G
31	5250.281959	5163.684627	98.37	REW
32	5243.688268	5169.18385	98.883	T
33	5235.436139	5175.479812	99.843	T
34	5224.996377	5182.505718	99.211	T
35	5212.700503	5191.665823	100.15	T
36	5191.236284	5205.884809	99.853	T
37	5329.922813	5166.686121	96.765	TH/FL
38	5275.2387	5094.056408	96.484	TH
39	5247.756655	5099.402253	96.311	TH
40	5236.092823	5077.839047	95.927	TH
41	5187.537658	5057.132268	94.935	TH
42	5136.892241	5053.800661	95.359	TH
43	5063.539277	5105.001963	95.466	TH
44	5012.133165	5142.624031	94.976	TH/FL
45	5080.99992	5288.300523	99.843	T
46	5069.630272	5258.909505	99.472	T
47	5060.393167	5232.917361	99.181	T
48	5057.430681	5225.104342	98.897	T
49	5051.697624	5208.748504	99.056	T
50	5049.802824	5203.826929	97.9	T
51	5043.795433	5187.74605	97.622	T
52	5043.506721	5186.876912	97.334	REW
53	5040.152497	5178.352102	96.977	G

Table PLX 04-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
54	5031.474844	5154.646236	97.176	G
55	5026.72545	5141.196541	96.616	G
56	5026.369344	5140.282618	95.388	C
57	5021.976498	5129.114255	95.815	C/TH
58	5017.334034	5115.620434	95.641	C
59	5013.982942	5106.851411	95.424	C
60	5013.824244	5106.339866	96.702	G
61	5011.702055	5100.945013	97.105	G
62	5009.937342	5096.252943	97.368	LEW
63	5005.812935	5084.692355	97.596	T
64	4999.668889	5068.639201	98.798	CG.C/L
65	4994.005713	5053.405215	100.036	T
66	4988.788459	5038.337029	99.21	T
67	4978.002697	5008.908583	99.116	T

Legend:

G = grass	TH = thalweg	US = upstream
T = tundra	CG = crest gage	TWET = wet tundra
C = cobbles	GB = ground break	M = mud
LEW = left edge of water	SH = shoulder	SB = sand bags
REW = right edge of water	DS = downstream	PK = "pk" nail
CL = center line		

file:plx4.xls

APPENDIX H: PLX 05

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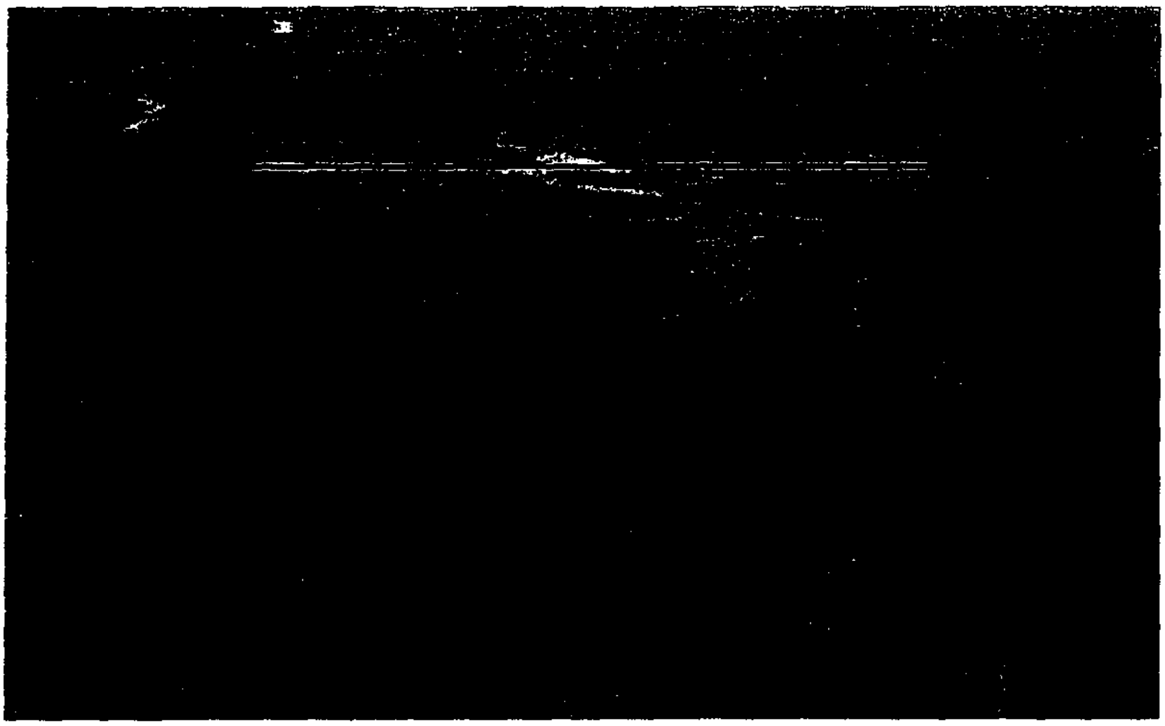


Photo PLX 05-1: Looking north at the proposed pipeline crossing (6/8/98).

STREAM PLX 05
PHOTOGRAPHS

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

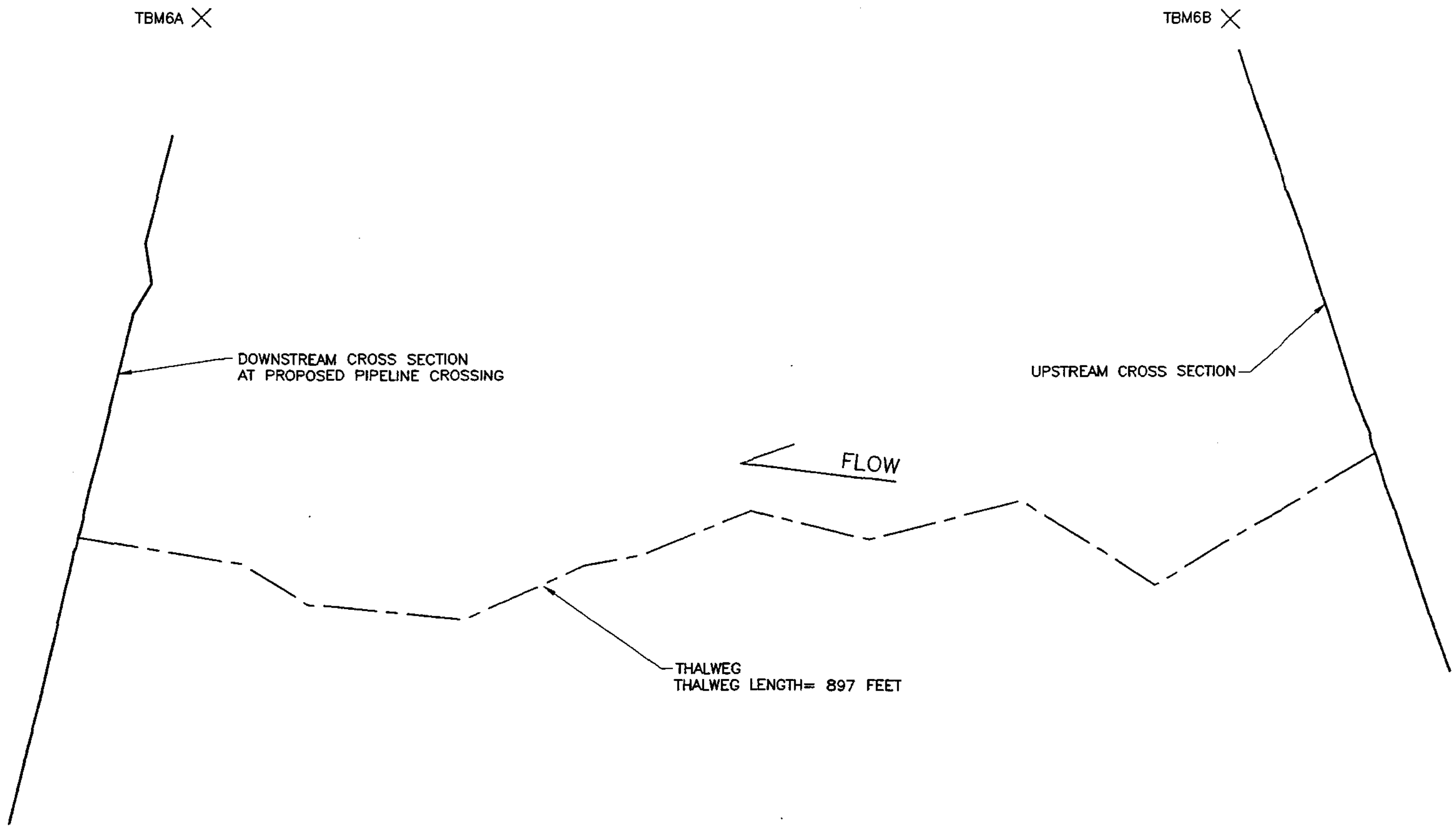
Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo05
Checked: JWA	Scale:

Photo Number:

PLX
05-1

APPENDIX I: PLX 06

TABLE OF CONTENTS



NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM6A.

REVISION			
NO.:	DATE:		BY:

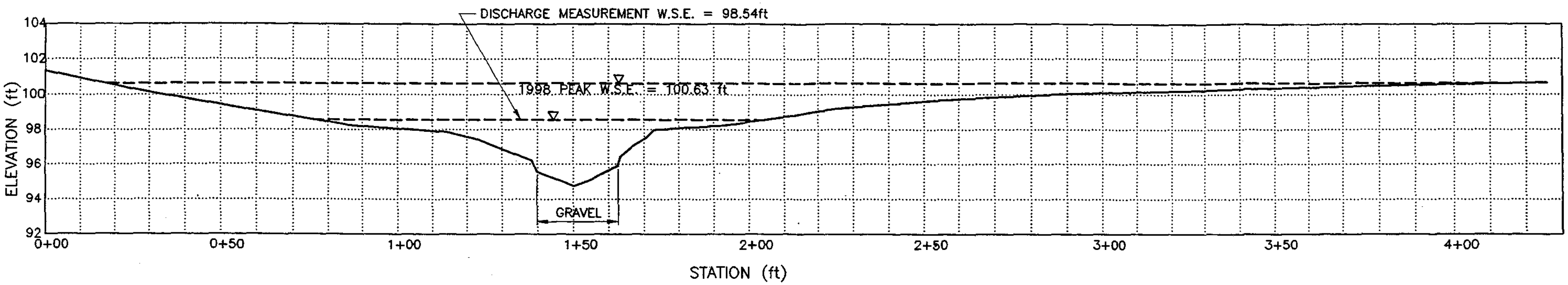
STREAM PLX06
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

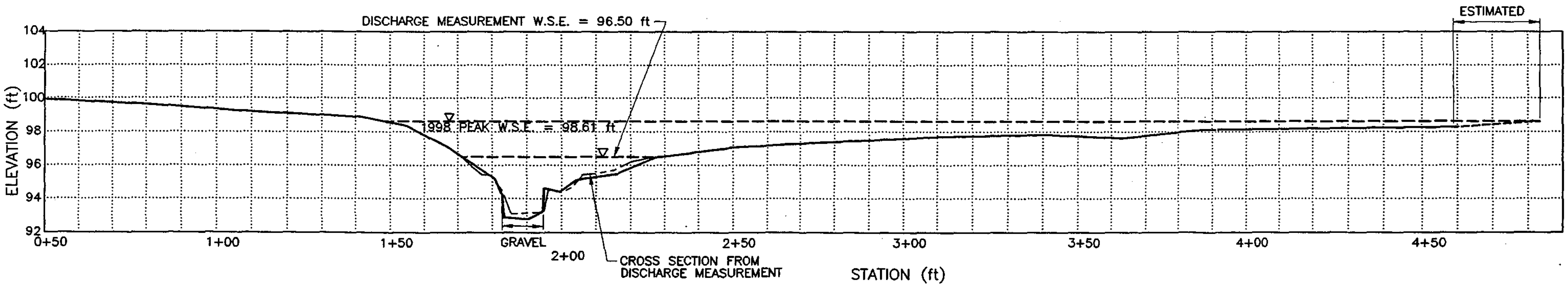
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X6
CHECKED:	JWA	SCALE:	1"= 80'

FIGURE:
PLX
06-1



PROFILE: PLX06 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX06 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM6A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

NO.:	DATE:	REVISION	BY:

STREAM PLX06
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X6
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX
06-2

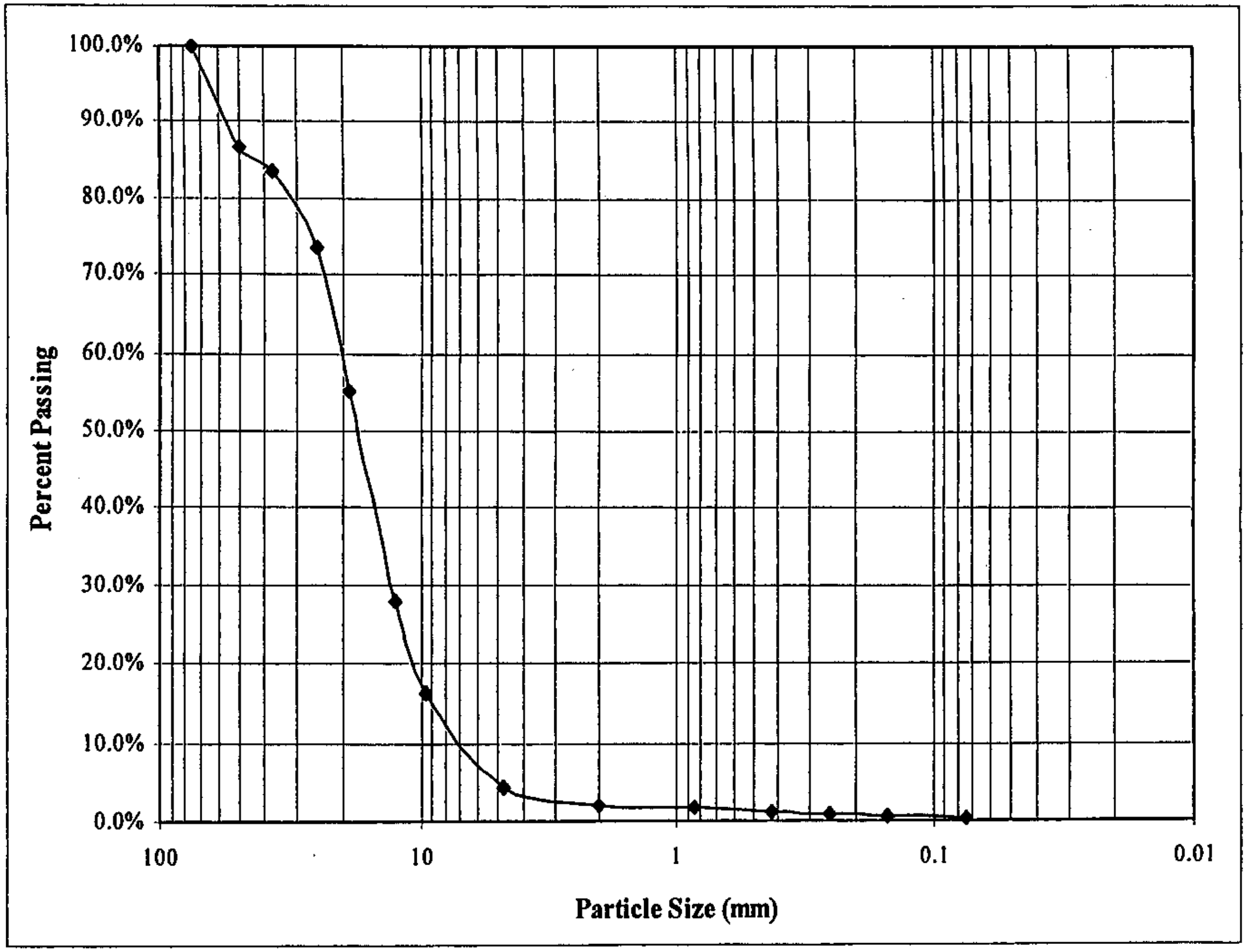


Figure Number
PLX 06-3

Baker Michael Baker Jr., Inc.

Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 06
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

REVISION:

NO:	DATE:		BY:

Photo PLX 06-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 06-2: Looking north at the upstream cross section (6/11/98).

STREAM PLX 06 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number: PLX 06-1
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	
	Drawn: JDA	File: photo06	
	Checked: JWA	Scale:	

Photo PLX 06-3: Looking north at the upstream cross section (6/8/98).

Photo PLX 06-4: Looking north at the proposed pipeline crossing (6/1/98).

STREAM PLX 06 PHOTOGRAPHS	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 06-2
	Drawn: JDA	File: photo06	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 06 at proposed pipeline crossing

Date: 6/1 ,1998 **Party:** J. Meckel, P McGranahan

Width: 56 **Area:** 83.7 **Vel:** 2.47 **G.H.:** **Disch.:** 207 cfs

No Secs. 16 **G.H. change:** **in.:** **hrs.:** **Susp.:**

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
	upstream x-sec	WSE=	9854
	downstream x-sec	WSE=	96.5
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: ft. above bottom of weight.

Spin before meas. ok **after** ok

Method: Wading at proposed pipeline crossing, downstream cross section.

Levels obtained

Measurement rated: Poor over 8% **based on following conditions:**

Cross section: Partly uniform - grass, cobble smooth, no snow or ice.

Flow: **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Riffles throughout - channel at high stage.

Remarks Channel has grass up to 8-10". Short section smooth cobbles < 3" - sand.

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 06 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	21.0	1.5	0.0						0	0.0	Left edge water (0900)
	24.0	3.0	0.6	s	20	46	0.968	0.87	1.8	1.6	
	27.0	3.0	1.1	0.6	40	52		1.7	3.3	5.6	
	30.0	3.0	1.1	0.6	40	44		2	3.3	6.6	
	33.0	2.8	2.1	0.6	50	47		2.34	5.8	13.5	Edge grass
	35.5	5.5	3.4	0.8	40	41	2.15	2.94	18.7	55.0	Small cobble
				0.2	80	47	3.72				
	44.0	4.8	3.3	0.2	80	45	4.07	3.31	15.7	51.9	Small cobble
	45.0	1.0	3.2	0.6	30	46	1.44	2.64	3.2	8.4	Edge grass
				s	80	41	4.26				
	46.0	2.5	2.0	0.6	60	40		3.28	5.0	16.4	
	50.0	3.5	2.1	0.6	60	46		2.86	7.4	21.0	
	53.0	3.0	1.8	0.6	30	41		1.62	5.4	8.7	
	56.0	3.5	1.1	0.6	40	49		1.8	3.9	6.9	
	60.0	4.5	1.0	0.6	20	46		0.97	4.5	4.4	
	65.0	5.0	0.8	0.6	25	40		1.38	4.0	5.5	
	70.0	6.0	0.3	s	15	44	0.763	0.69	1.8	1.2	
	77.0	3.5	0.0					0	0.0	0.0	Right edge water (0945)
	56.0	56.0							83.7	206.8	

Table PLX 06-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P06.TBM.C/L (TBM6A)
2	5000	4344.343096	101.448	P16.TBM.US (TBM6B)
11	4979.746546	4338.674674	100.66	T
12	4927.982426	4321.444807	100.456	T
13	4854.035847	4295.509772	100.056	SG/US
14	4816.355942	4283.816739	99.678	T
15	4789.591238	4274.849823	99.178	T
16	4759.127951	4265.102675	98.227	T
17	4739.995608	4258.408545	97.961	T
18	4737.936055	4257.49552	97.503	REW
19	4734.053898	4255.478932	96.963	G
20	4731.25489	4254.439164	96.442	G
21	4730.37703	4254.949058	95.904	C
22	4723.371355	4253.177224	95.159	C
23	4718.507601	4251.156727	94.757	C/TH
24	4708.654497	4247.78499	95.57	C
25	4707.426631	4247.540837	96.213	G
26	4697.643153	4244.69122	97.007	G
27	4692.022526	4242.386036	97.476	LEW
28	4684.348747	4239.619287	97.851	T
29	4658.056028	4231.429788	98.231	T
30	4630.131132	4222.614837	99.15	T
31	4602.224976	4213.818284	100.219	T
32	4575.803864	4204.391173	101.337	T
33	4748.382504	4172.045777	96.638	TH/FL
34	4632.176826	4394.409007	92.711	TH
35	4687.662896	4480.01247	94.19	TH
36	4661.796202	4575.390284	92.479	TH
37	4680.524956	4650.963681	94.531	TH
38	4652.468766	4718.058278	94.447	TH
39	4644.282661	4757.901634	92.818	TH
40	4609.455917	4832.657415	92.443	TH
41	4619.048048	4933.065908	93.577	TH
42	4645.396847	4975.531949	94.545	TH
43	4701.989746	5145.698229	92.424	TH/FL
44	4476.138306	5120.555172	100.666	T
45	4503.039882	5114.529282	100.057	T
46	4527.887209	5109.176656	99.893	T
47	4556.162824	5102.071331	99.581	T
48	4584.136111	5096.14779	99.163	T
49	4614.660876	5089.336499	98.871	T
50	4627.041946	5086.466088	98.357	T/HWM
51	4639.151275	5083.631026	97.041	T
52	4652.479224	5080.808458	95.171	LEW

Table PLX 06-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
53	4654.550242	5080.115075	94.244	G
54	4655.048582	5079.72639	92.86	C
55	4661.885138	5078.146301	92.797	TH
56	4665.896065	5076.920736	93.245	C
57	4666.045204	5076.8864	94.61	G
58	4670.595933	5075.737794	94.413	G
59	4675.178639	5074.791901	95.111	REW
60	4686.664587	5072.29918	95.462	T
61	4697.511117	5070.120885	96.429	NAIL
62	4719.874956	5064.200081	97.041	T
63	4748.014404	5057.750979	97.369	T
64	4779.023142	5050.232877	97.696	T
65	4808.467212	5043.56401	97.804	T
66	4828.3698	5031.732323	97.602	SG.C/L
67	4854.567397	5035.949779	98.103	T
68	4923.675936	5018.588161	98.264	T

Legend:

G = grass	TH = thalweg	US = upstream
T = tundra	CG = crest gage	TWET = wet tundra
C = cobbles	GB = ground break	M = mud
LEW = left edge of water	SH = shoulder	SB = sand bags
REW = right edge of water	DS = downstream	PK = "pk" nail
CL = center line		

file:plx6.xls

APPENDIX J: PLX 07

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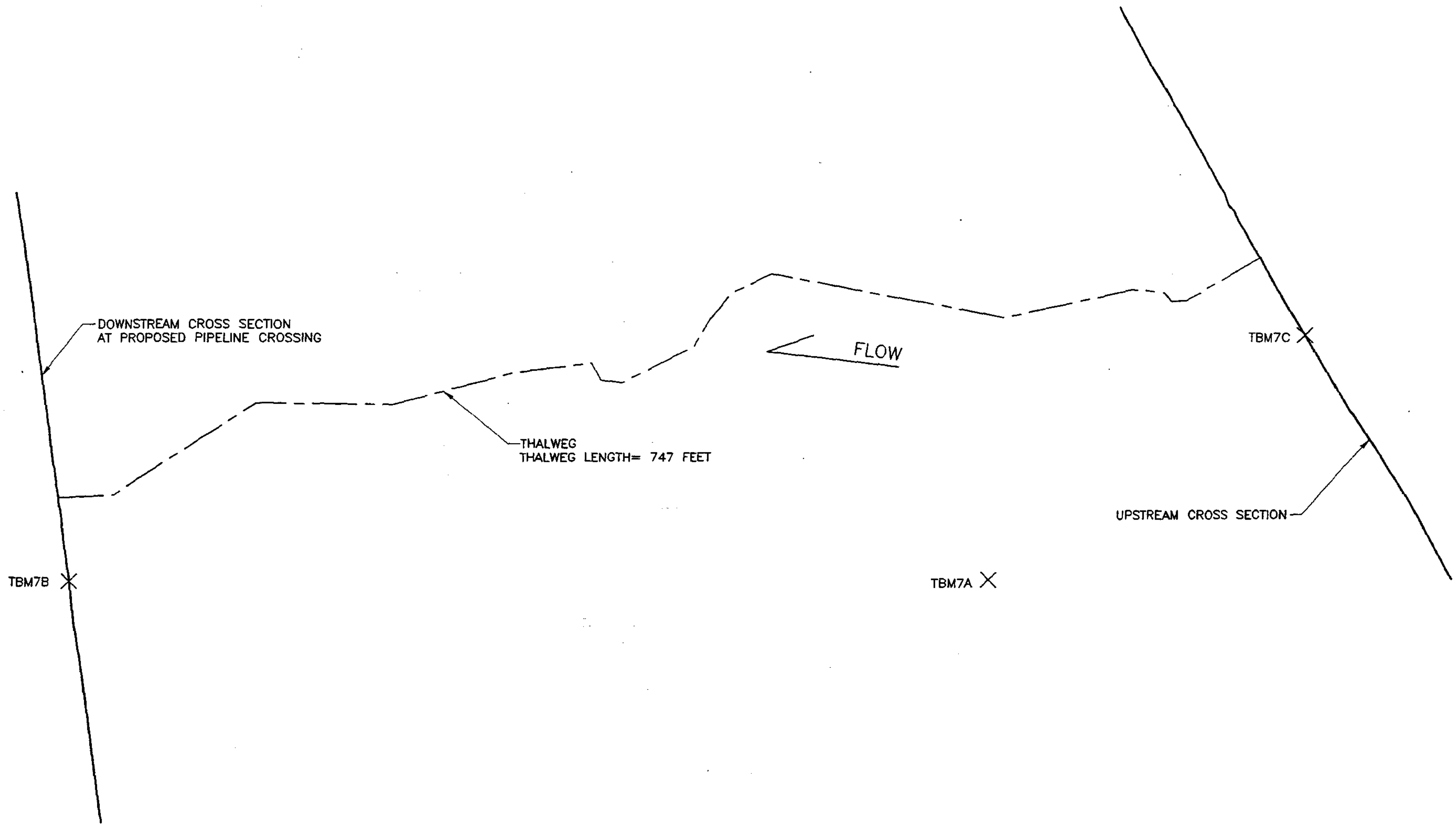


NOTES:

1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM7A.

REVISION			
NO.:	DATE:		BY:

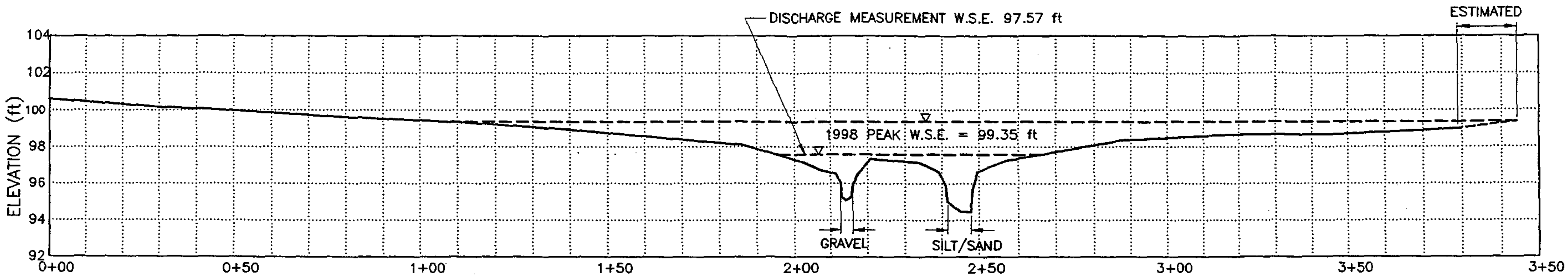
STREAM PLX07
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

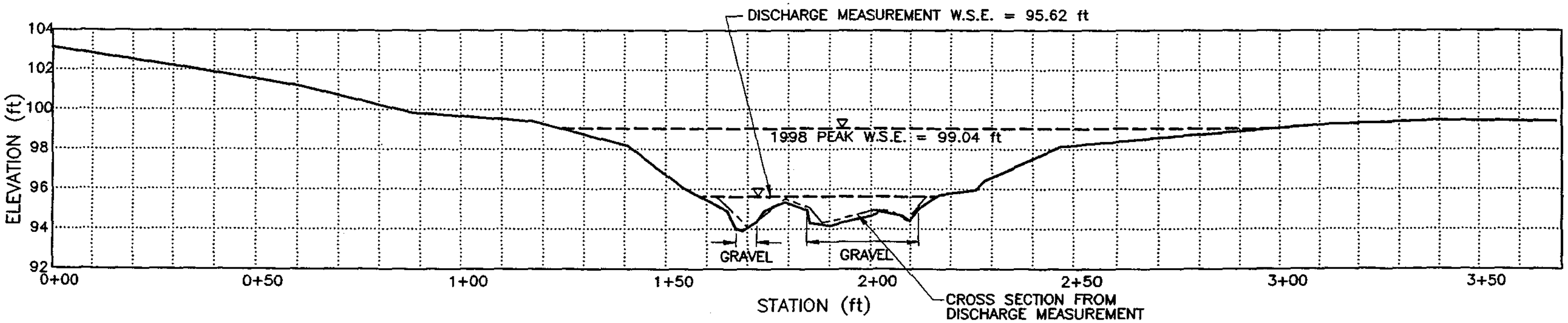
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X7
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX
07-1



PROFILE: PLX07 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX07 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM7A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

STREAM PLX07
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X7
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX
07-2

Photo: PLX 07-1: Looking north at the proposed pipeline crossing (6/11/98).

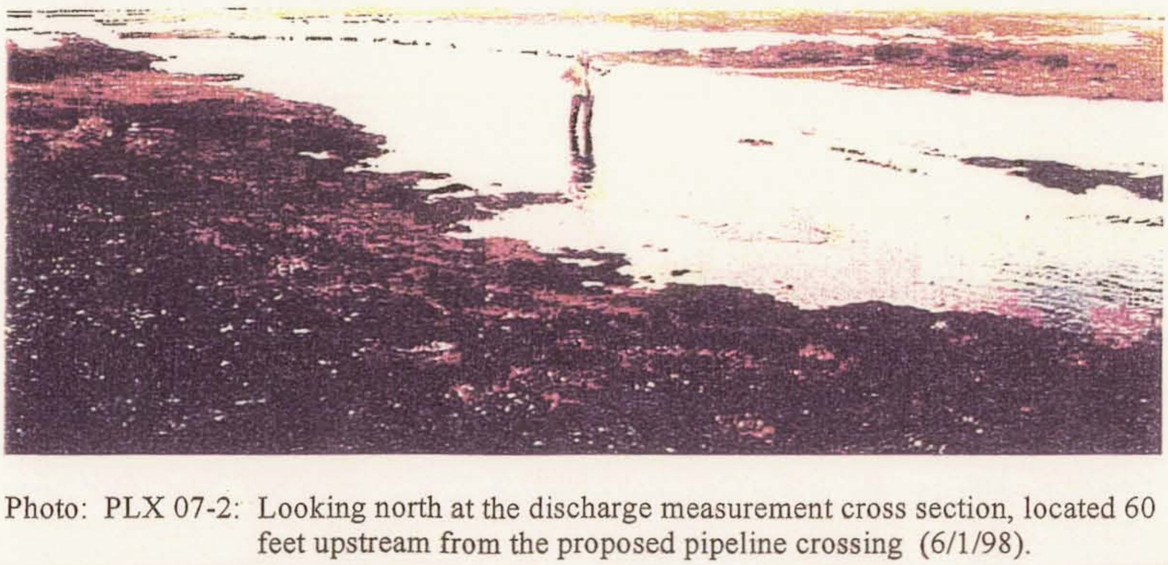


Photo: PLX 07-2: Looking north at the discharge measurement cross section, located 60 feet upstream from the proposed pipeline crossing (6/1/98).

STREAM PLX 07 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 07-1
	Drawn: JDA	File: photo07	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 07 at proposed pipeline crossing

Date: 6/1 ,1998 **Party:** J. Meckel, P. McGranahan

Width: 52 **Area:** 41.2 **Vel:** 2.00 **G.H.:** **Disch.:** 82.3 cfs

No Secs. 11 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** Noted **Sus. Coef.:** 1 **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
	upstream x-sec	WSE=	97.57
	downstream x-sec	WSE=	95.62
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: ft. above bottom of weight.

Spin before meas. ok **after** ok

Method: Wading at proposed pipeline crossing, downstream cross section.

Levels obtained

Measurement rated: **based on following conditions:**

Cross section: Irregular - grass, cobbles.

Flow: Not evenly distributed. **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Riffle 100-150 downstream clear.

Remarks Channel composed of firm grass < 8", cobbles = < 3", sand.

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 07 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	71.0	2.0	0.0								Left edge water (1030)
0.9	67.0	4.0	0.7	0.6	30	45	1.47	1.32	2.8	3.7	
0.94	63.0	6.5	1.6	0.6	30	46	1.44	1.35	10.4	14.0	
	54.0	7.5	0.1				0.20	0.20	0.8	0.2	
	48.0	4.5	0.6	0.6	60	40		3.28	2.7	8.9	
	45.0	4.0	1.3	0.6	60	42		3.13	5.2	16.3	Edge grass/cobble
	40.0	6.0	1.1	0.6	60	41		3.21	6.6	21.2	small cobble
0.98	33.0	6.0	0.7	0.6	50	45	2.44	2.39	4.2	10.0	" " "
0.97	28.0	4.5	0.7	0.6	20	45	0.99	0.96	3.2	3.0	" " "
	24.0	4.5	1.2	0.6	20	48		0.93	5.4	5.0	Edge grass/cobble
	19.0	2.5	0.0						0.0	0.0	Right edge water (1100)
	52.0	52.0							41.2	82.3	

file: disch_P7.xls

Table PLX 07-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P07.TBM (TBM7A)
2	5000	5519.894587	99.095	P07.P.C/L (TBM7B)
3	4999.924379	5519.934927	98.175	CG.C/L
11	4998.991317	4738.29578	100.591	T
12	5024.951223	4751.907536	100.169	T
13	5042.252794	4760.711702	99.983	T/HWM
14	5068.254338	4775.953955	99.615	T
15	5093.825312	4790.332706	99.348	T
16	5120.072867	4805.057362	98.956	T
17	5142.016449	4817.014268	98.524	CG/US (TBM7C)
18	5162.401449	4828.481951	98.079	T/HWM
19	5176.442808	4835.887721	97.161	T
20	5180.623785	4837.888121	96.728	T
21	5184.644539	4839.969685	96.539	LEW
22	5185.794509	4840.567255	96.036	G
23	5185.942442	4840.737481	95.288	C
24	5186.998854	4841.140483	95.073	TH
25	5187.940652	4842.423244	95.253	C
26	5188.24877	4842.63836	95.96	G
27	5189.558884	4843.337987	96.556	REW
28	5192.36185	4844.922087	97.332	G
29	5204.01914	4851.006886	97.142	G
30	5208.475423	4854.099237	96.596	LEW
31	5210.078886	4854.707701	95.87	G
32	5210.522445	4854.935932	95.044	M
33	5213.503043	4856.306426	94.485	M
34	5215.884766	4858.310044	94.446	M
35	5216.236536	4858.626009	95.678	G
36	5217.329368	4859.4108	96.608	REW
37	5224.157863	4862.074691	97.228	T
38	5250.623614	4876.828783	98.338	T
39	5277.137585	4891.8015	98.649	T
40	5302.026119	4906.138119	98.655	T
41	5330.653591	4921.845266	98.984	T
42	5211.392215	4790.037739	94.93	TH/FL
43	5162.274703	4884.807569	95.512	TH
44	5161.680933	4893.913256	95.219	TH
45	5166.963107	4897.434186	94.739	TH
46	5168.880116	4915.523284	94.81	TH
47	5153.255932	4990.768157	93.6	TH
48	5161.955667	5033.044297	94.268	TH
49	5178.683198	5120.290305	94.069	TH
50	5167.578118	5143.603635	93.78	TH
51	5152.51232	5156.201832	95.101	TH

Table PLX 07-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	5136.941383	5165.150234	94.06	TH
53	5115.856607	5206.794541	94.509	TH
54	5117.53841	5218.49549	93.405	TH
55	5127.347023	5223.867948	93.851	TH
56	5121.955773	5267.178323	94.702	TH
57	5103.379254	5336.329591	94.175	TH
58	5104.54735	5412.620289	94.22	TH
59	5050.389306	5494.285771	93.719	TH
60	5055.116251	5560.300872	94.359	TH/FL
61	5226.039613	5549.88817	99.42	T
62	5197.1792	5545.527739	99.466	T
63	5166.978521	5541.650708	99.209	T
64	5135.68495	5537.756247	98.695	T
65	5105.476213	5533.712243	98.137	T
66	5086.847418	5531.152886	96.405	T
67	5084.779843	5530.781146	95.964	T
68	5076.088444	5530.019301	95.701	T
69	5070.878708	5529.253799	94.984	REW
70	5068.572612	5528.983796	94.419	G
71	5066.380255	5528.544686	94.682	G
72	5060.918669	5527.849449	94.885	G
73	5060.256642	5527.501469	94.708	C
74	5054.244811	5526.914818	94.408	C
75	5049.009672	5526.089678	94.149	C/TH
76	5044.1978	5525.573612	94.297	C
77	5043.413949	5525.402693	94.926	LEW
78	5038.270091	5524.446326	95.33	G
79	5033.268432	5524.123374	94.914	REW
80	5031.388971	5524.044888	94.355	G/C
81	5027.989759	5523.632608	93.877	C/G
82	5026.379373	5523.246718	94.008	G
83	5024.128179	5523.226818	94.872	LEW
84	5013.355394	5521.618578	96.049	T
85	4976.909216	5517.354055	99.407	T
86	4947.867363	5512.865274	99.84	T

(continued on next page)

Table PLX 07-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
87	4920.366054	5509.016092	101.188	T
88	4893.196829	5505.420631	102.109	T
89	4860.572455	5501.155183	103.118	T

Legend:

G = grass	TH = thalweg	US = upstream	CL = center line
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	PK = "pk" nail	

file:plx7.xls

APPENDIX K: PLX 08

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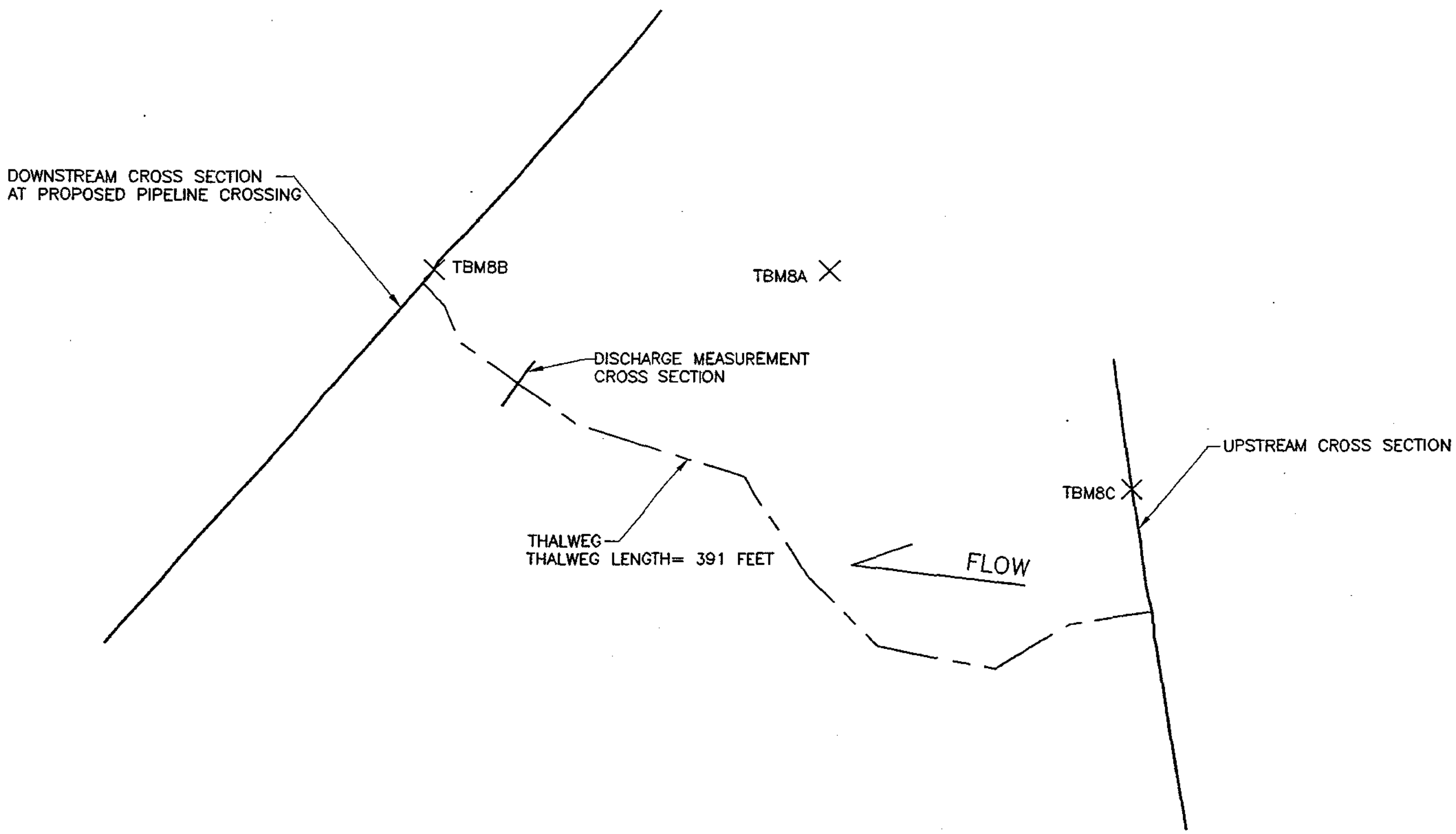


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM8A.

REVISION			
NO.:	DATE:		BY:

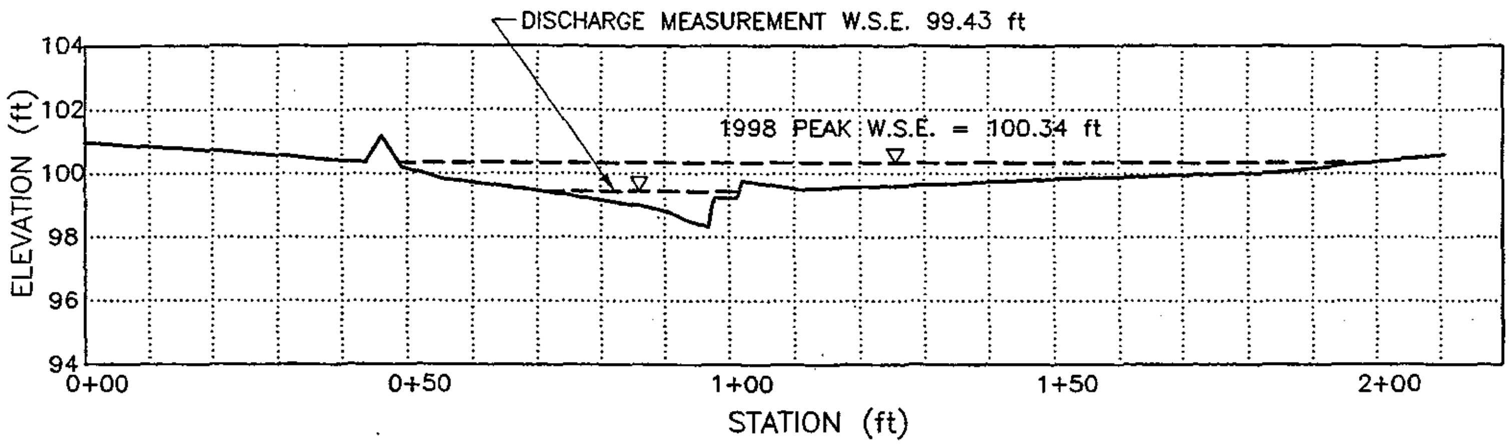
STREAM PLX08
PLAN

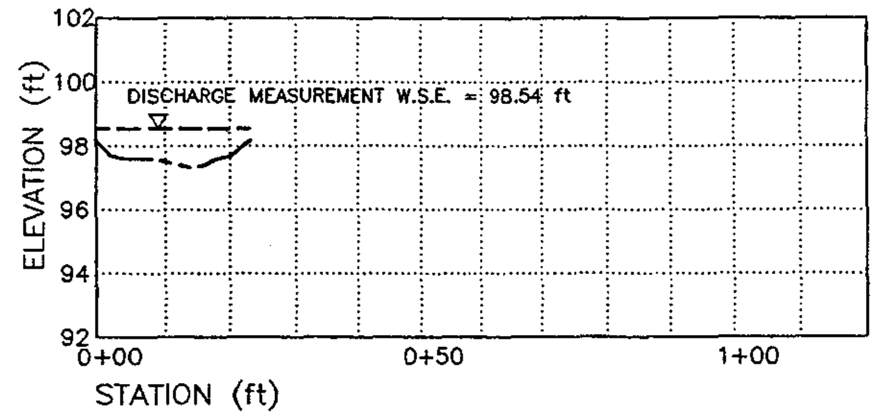
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X8
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE: PLX 08-1



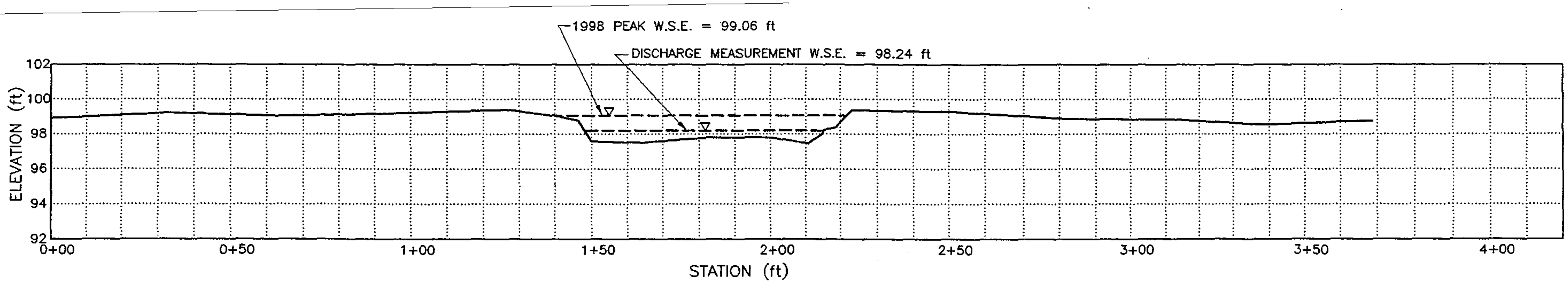


PROFILE: PLX08 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'

PROFILE: PLX08 DISCHARGE MEASUREMENT CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX08 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM3A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DISCHARGE MEASUREMENT CROSS SECTION IS LOCATED 60 FEET UPSTREAM FROM THE DOWNSTREAM CROSS SECTION.

REVISION			
NO.:	DATE:		BY:

STREAM PLX08
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X8
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 08-2

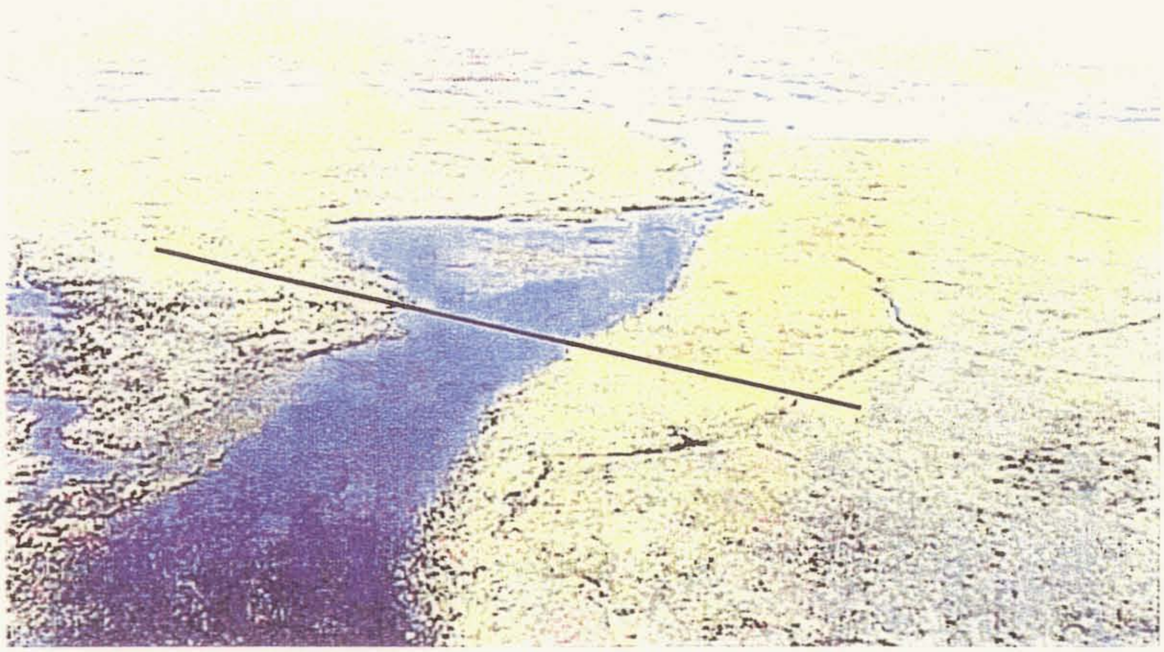


Photo: PLX 08-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 08-2: Looking north at the proposed pipeline crossing (6/6/98).

STREAM PLX 08 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number
	Date: 6/7/98	Project: 23247	PLX 08-1
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Drawn: JDA	File: photo08	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION:	PLX 08, 60 feet upstream from the proposed pipeline crossing						
Date: 6/1 ,1998	**Party:**	J. Meckel, P. McGranahan					
Width: 23	**Area:** 14.0	**Vel:** 0.921	**G.H.:**		**Disch.:**	12.9 **cfs**	
No Secs. 12	**G.H. change:**		**in.:**	**hrs.:**		**Susp.:**	Rod
Method coef.: 1	**Hor. Angle coef.** 1		**Sus. Coef.:** 1	**Meter No.**			

Gage Readings					
Time	**Recorder**	**Inside**	**Outside**	**Type of meter:**	Price AA
				Date rated:	Std No 1
				Meter:	**ft. above bottom of weight.**
	upstream x-sec	WSE=	99.43	**Spin before meas.**	ok **after** ok
				Method:	Wading 60' upstream from pipeline crossing.
					Proposed pipeline crossing is at the
	downstream x-sec	WSE=	98.24		downstream cross section.
Weighted M.G.H.				**Levels obtained**	
G.H. corrections					
Correct M.G.H.					

Measurement rated:	Fair	**based on following conditions:**	
Cross section:	Uniform grass.		
Flow:	Evenly distributed.	**Weather:**	**Air °F@:**
Gage:			**Water °F@:**
Other:			
Record Removed:		**Intake flushed:**	
Observer			
Control	Narrow channel & riffle 180' downstream clear.		
Remarks	slope = 1.23/260 ft. = .00473 in reach of 260 ft at measurement		
G.H. of zero flow:		**ft.**	

DISCHARGE MEASUREMENT NOTES (PLX 08 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	32.0	1.5	0.0						0.0	0.0	Right edge water (1115)
	29.0	2.5	0.6	S	15	52	0.80	0.72	1.4	1.0	
	27.0	2.0	0.7	S	20	42	1.06	0.95	1.3	1.2	
	25.0	2.0	0.8	S	25	48	1.16	1.04	1.6	1.7	
	23.0	2.0	0.9	S	25	48	1.16	1.04	1.8	1.9	
	21.0	2.0	0.8	S	25	47	1.18	1.06	1.6	1.7	
	19.0	2.0	0.7	S	20	46	0.97	0.87	1.4	1.2	
	17.0	2.0	0.7	S	20	46	0.97	0.87	1.3	1.1	
	15.0	2.0	0.7	S	20	41	1.08	0.97	1.3	1.3	
	13.0	2.0	0.7	S	20	50	0.89	0.80	1.3	1.0	
	11.0	2.0	0.5	S	20	49	0.91	0.82	1.0	0.8	
	9.0	1.0	0.0								Left edge water (1200)
	23.0	23.0							14.0	12.9	

file: disch_P8.xls

Table PLX 08-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P08.TBM. (TBM8A)
2	5000	5172.17623	99.859	P08.PC/L (TBM8B)
3	5000.283708	5172.114383	98.357	CG.C/L
11	4960.544301	4878.667929	100.601	T
12	4934.306032	4874.974541	100.014	T
13	4902.933202	4870.536246	99.846	CGUS (TBM8C)
14	4878.361672	4866.516362	99.609	T
15	4861.688785	4864.529377	99.504	T
16	4853.22665	4862.691964	99.753	T
17	4852.092483	4862.402101	99.215	T
18	4848.991317	4861.774116	99.231	T
19	4848.494388	4861.716966	99.063	REW
20	4847.951853	4861.377095	98.306	G/TH
21	4844.975753	4861.135157	98.488	G
22	4841.856093	4860.951673	98.781	G
23	4837.481966	4860.951026	98.974	G
24	4832.664494	4859.878909	99.112	LEW
25	4820.14139	4857.772078	99.487	T
26	4806.851929	4855.827829	99.842	T
27	4800.822782	4854.883162	100.207	T
28	4797.686301	4854.496401	101.167	T
29	4795.380336	4853.986334	100.365	T
30	4774.3744	4850.559402	100.695	T
31	4752.188895	4846.907246	100.965	T
32	4856.301352	4801.579255	98.803	TH/FL
33	4842.733656	4898.63257	97.273	TH
34	4823.025695	4929.364573	98.535	TH
35	4832.926501	4979.559948	98.198	TH
36	4864.322205	5009.675919	96.53	TH
37	4908.166516	5036.839271	97.957	TH
38	4916.16756	5062.575334	97.855	TH
39	4932.536614	5102.931411	97.592	TH
40	4967.250989	5160.846782	97.701	TH
41	4984.387414	5167.812052	97.674	TH
42	5013.728359	5206.690374	97.399	TH/FL
43	4834.595189	5314.586377	98.91	T
44	4859.135107	5293.168336	99.193	T
45	4883.380928	5272.896179	99.037	T
46	4906.319156	5252.330716	99.183	T
47	4930.085393	5231.690131	99.406	T
48	4940.399085	5223.473411	99.062	T
49	4945.677819	5219.209496	98.775	T
50	4946.930208	5218.022565	97.926	LEW
51	4948.355495	5216.68774	97.586	G
52	4959.140096	5207.598658	97.504	G

Table PLX 08-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
53	4973.115992	5195.447566	97.802	G
54	4986.196228	5184.241338	97.802	G
55	4992.035466	5178.933997	97.548	G
56	4994.404923	5177.217257	97.465	G/TH
57	4997.201233	5174.655896	97.954	REW
58	4997.879765	5174.226434	98.238	T
59	5004.523525	5169.758559	99.354	T
60	5025.319535	5150.742332	99.287	T
61	5048.94387	5129.611704	98.864	T
62	5070.786564	5111.059173	98.832	T
63	5090.897828	5093.245898	98.531	T
64	5113.712237	5073.59503	98.753	T

Legend:

G = grass	TH = thalweg	US = upstream	CL = center line
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	PK = "pk" nail	

file:plx8.xls

APPENDIX L: PLX 09

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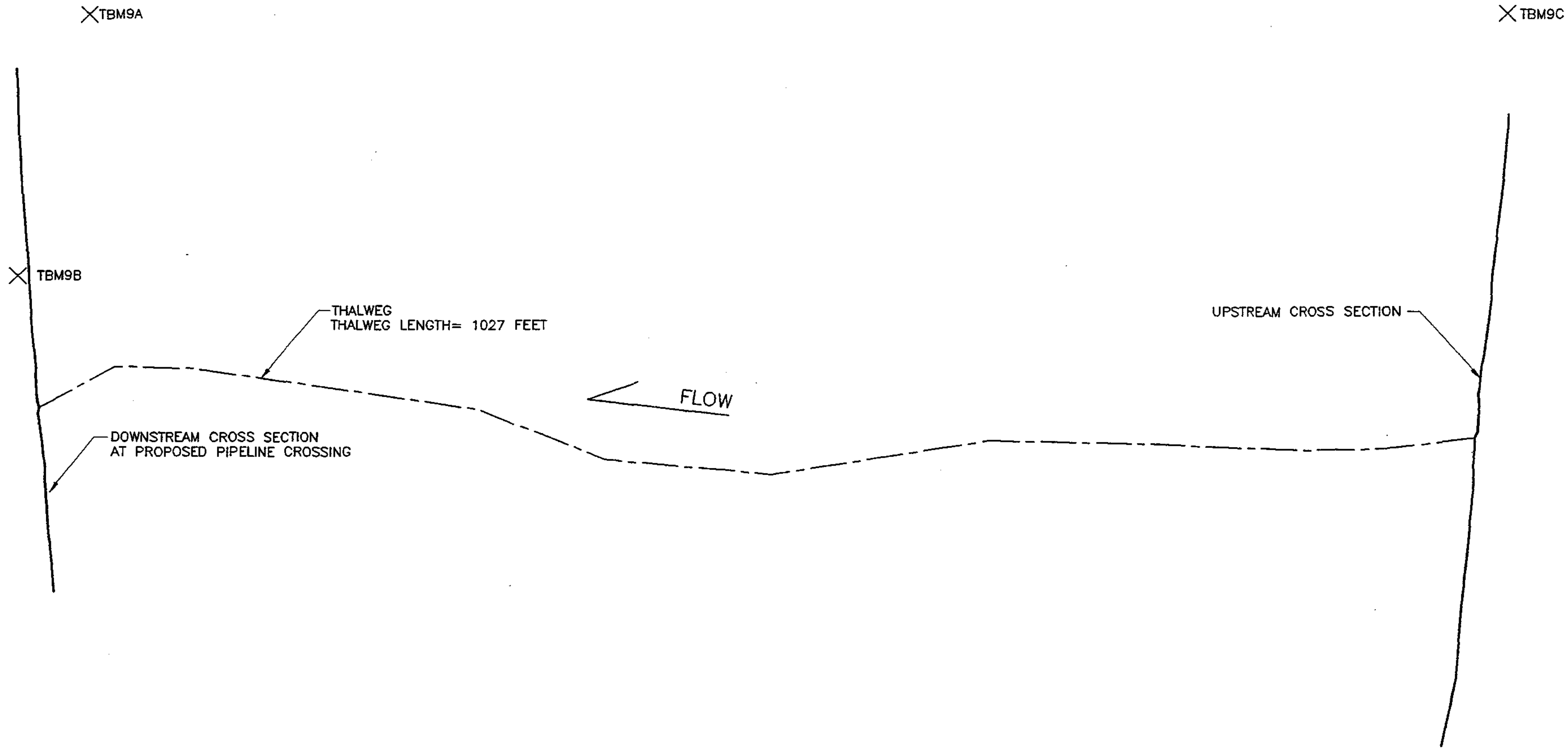


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM9A.

REVISION			
NO.:	DATE:		BY:

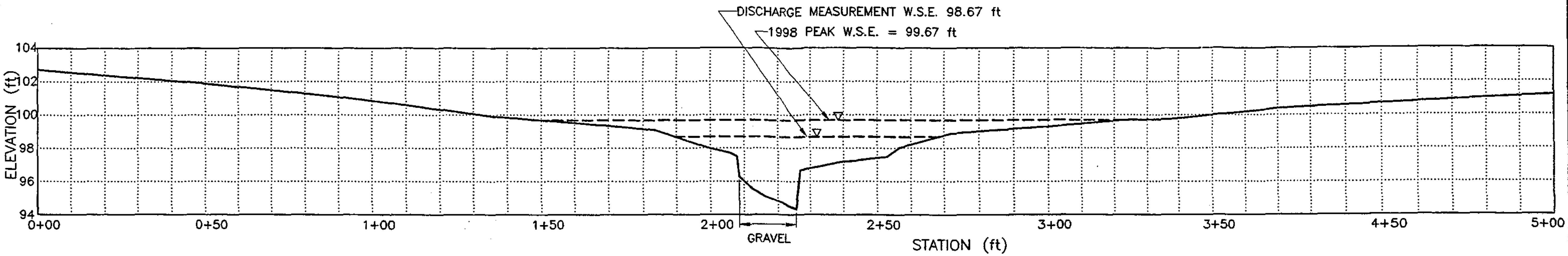
STREAM PLX09
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

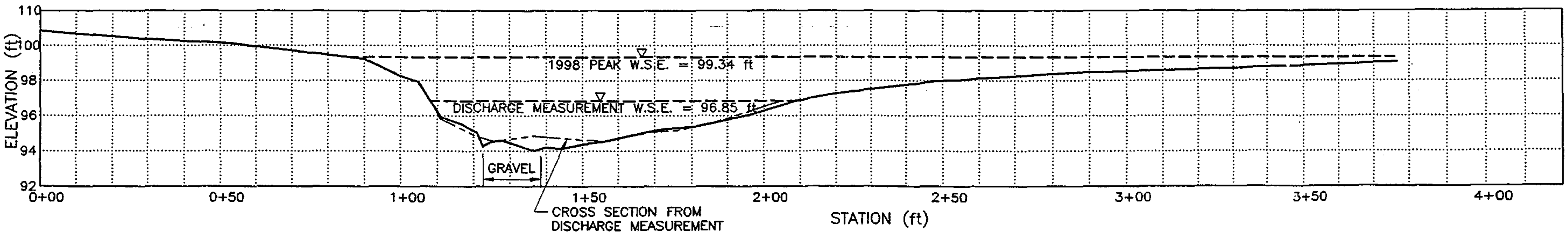
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X9
CHECKED:	JWA	SCALE:	1"= 80'

FIGURE:
PLX
09-1



PROFILE: PLX09 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX09 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM9A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

STREAM PLX09
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker — Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP–X9
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 09-2

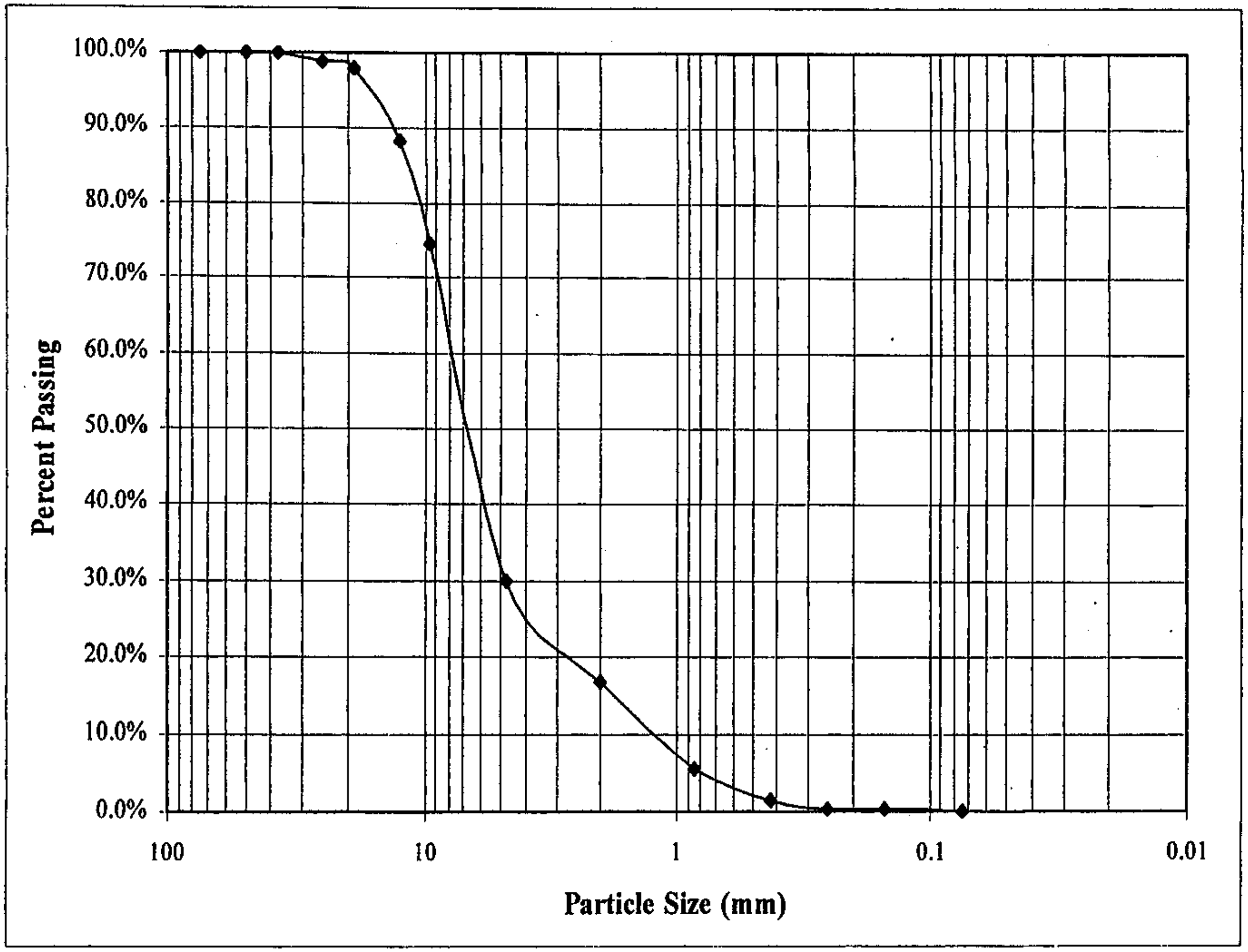


Figure Number: PLX 09-3

Baker Michael Baker Jr., Inc.

Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 09
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

REVISION:

NO:	DATE:		BY:

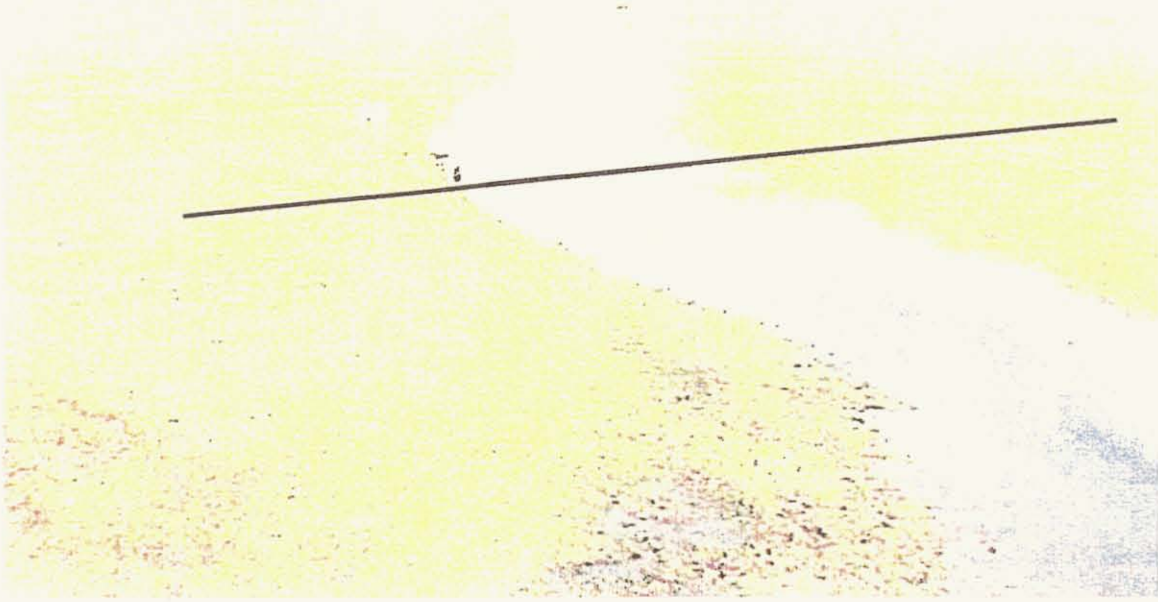


Photo PLX 09-1: Looking northwest at the proposed pipeline crossing (6/11/98).

Photo PLX 09-2: Looking northwest at the proposed pipeline crossing (6/11/98).

STREAM PLX 09 PHOTOGRAPHS SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Baker Michael Baker Jr., Inc. Date: 6/7/98 Drawn: JDA Checked: JWA	Project: 23247 File: photo09 Scale:	Photo Number: PLX 09-1

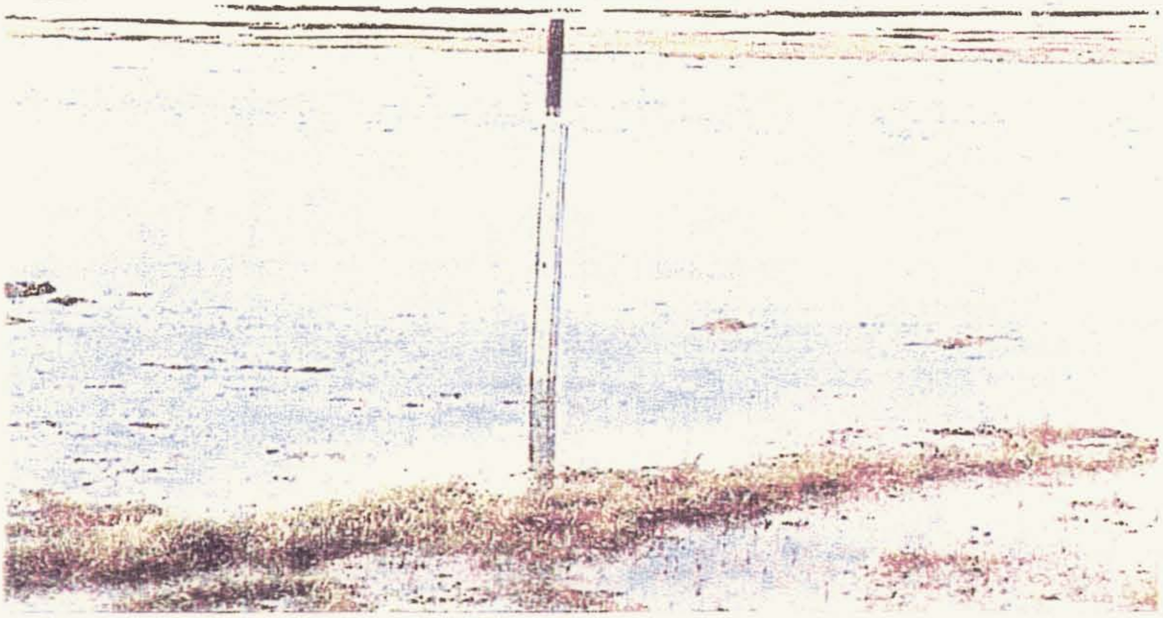


Photo PLX 09-3: Looking west at the proposed pipeline crossing and staff gage (5/28/98).

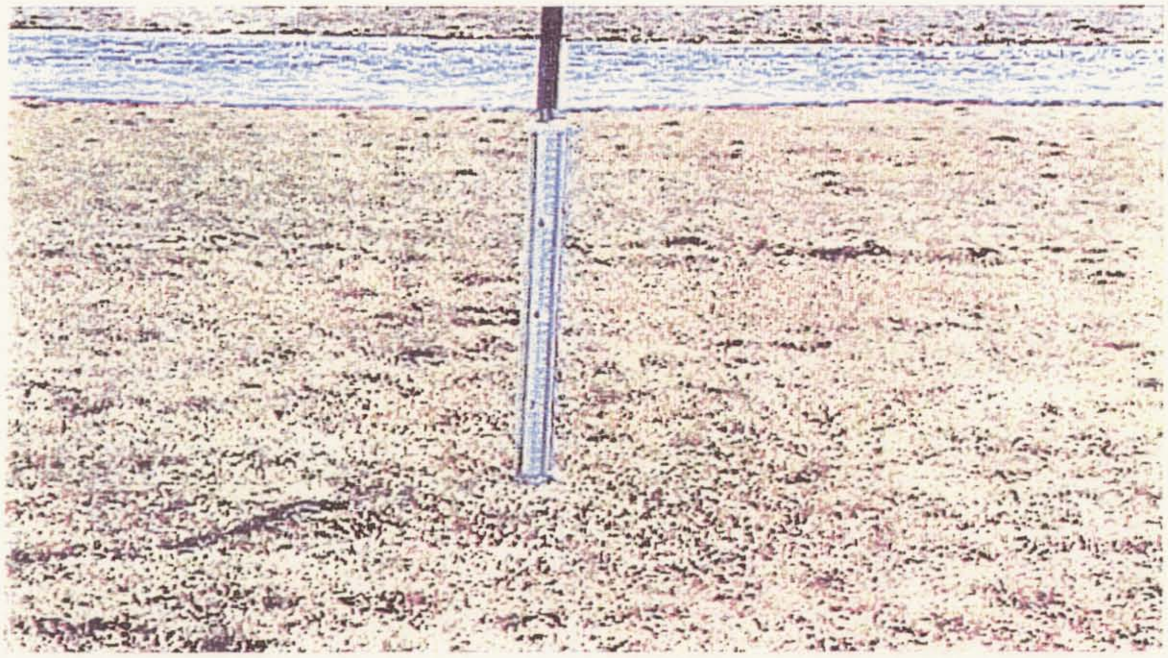


Photo PLX 09-4: Looking southwest at the proposed pipeline crossing and staff gage (5/29/98), note change in water surface elevation between this picture and previous picture.

STREAM PLX 09
PHOTOGRAPHS

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo09
Checked: JWA	Scale:

Photo Number:
PLX
09-2

DISCHARGE MEASUREMENT NOTES

LOCATION:	PLX 09 at proposed pipeline crossing (Partially Estimated)						
Date:	5/30 ,1998	**Party:**	J. Meckel, P. McGranahan				
Width:	96.7	**Area:**	156[E]	**Vel:**	3.9[E]	**G.H.:**	**Disch.:** 603[E] cfs
No Secs.	10	**G.H. change:**		**in.:**	**hrs.:**		**Susp.:** Rod
Method coef.:	1	**Hor. Angle coef.**	1	**Sus. Coef.:**	1	**Meter No.**	

Gage Readings

Time	**Recorder**	**Inside**	**Outside**
	downstream x-sec	WSE=	96.85
	upstream x-sec	WSE=	98.67
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA
Date rated: Std No 1
Meter: ft. above bottom of weight.
Spin before meas. ok **after** ok
Method: Wading at proposed pipeline crossing, downstream cross section.

Levels obtained

Measurement rated: Poor (over 8%), Partially Estimated **based on following conditions:**
Cross section: Uniform grass and cobbles. Some ice on left side.
Flow: **Weather:** **Air °F@:**
Gage: **Water °F@:**
Other:
Record Removed: **Intake flushed:**
Observer

Control Channel clear.

Remarks Discharge was partially measured and partially estimated.
For stations 91.5 to 116.5 the depth was taken from survey notes, and the velocity was estimated at time of the measurement.
G.H. of zero flow: ft.

E = Estimated

DISCHARGE MEASUREMENT NOTES (PLX 09 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	22.3	9.1	0.0						0.0	0.0	Right Edge water (1515 hr)
	40.5	14.7	1.2	0.6	40	48		1.84	17.6	32.5	
	51.7	10.1	1.7	0.6	50	48		2.29	17.2	39.3	
	60.7	9.9	1.8	0.6	60	43		3.06	17.8	54.5	
	71.5	15.4	2.3	0.6	100	45		4.85	35.4	171.8	
	91.5	15.0	2.0					5.50	30.0	165.0	Estimated
	101.5	7.5	2.3					5.20	17.2	89.4	Estimated
	106.5	7.5	2.0					3.00	15.0	45.0	Estimated
	116.5	6.3	1.0					1.00	6.3	6.3	Estimated
	119.0	1.3	0.0					0.00	0.0	0.0	Left edge water (1545 hr)
	96.7	96.7							156.5	603.8	

file: disch_P9.xls

Table PLX 09-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P09TBMPCL (TBM9A)
2	5000	4005.439138	102.089	P09TBMUS (TBM9C)
4	4966.979931	4005.350208	101.343	SGUS
11	4928.236174	4004.931448	101.227	T
12	4885.482897	4008.784505	100.792	T
13	4843.988115	4013.586954	100.382	T
14	4811.322247	4017.131184	99.729	T
15	4796.287198	4017.747062	99.682	T
16	4779.019556	4019.764824	99.366	T
17	4760.476088	4021.968112	99.098	T
18	4746.579982	4024.877109	98.878	T
19	4730.729322	4026.292155	97.996	REW
20	4727.395523	4026.738118	97.48	G
21	4718.593643	4026.196673	97.254	G
22	4713.610557	4026.670823	97.154	G
23	4706.873314	4027.243014	96.88	G
24	4701.302502	4027.475054	96.655	G
25	4699.986544	4027.64328	94.311	C
26	4695.534834	4029.439937	94.732	CTH
27	4690.772048	4029.517784	95.097	C
28	4687.29782	4029.442785	95.488	C
29	4683.143047	4029.778566	96.276	C
30	4683.200479	4029.954424	96.276	C
31	4682.409903	4030.083777	97.488	G
32	4680.114456	4029.995624	97.71	LEW
33	4673.866672	4030.758984	98.005	T
34	4658.21487	4030.873424	99.071	T
35	4638.200571	4032.895248	99.445	T
36	4610.934758	4035.279614	99.901	T
37	4571.638613	4039.639362	100.928	T
38	4522.407532	4043.08543	101.942	T
39	4475.799226	4052.963716	102.71	T
40	4686.014027	3986.11025	96.004	THFL
41	4687.426131	4093.005293	95.964	TH
42	4686.690925	4145.127159	95.645	TH
43	4691.269818	4251.633895	93.804	TH
44	4693.864268	4369.965949	94.296	TH
45	4669.163668	4521.270054	94.847	TH
46	4679.863648	4638.893161	94.026	TH
47	4716.051408	4727.650234	93.812	TH
48	4732.035479	4832.385527	92.063	TH
49	4745.826977	4927.98311	92.084	TH
50	4747.37612	4982.986996	92.51	TH
51	4704.995812	5068.966311	93.366	THFL

Table PLX 09-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	4585.454563	5025.78843	100.851	T
53	4615.594209	5028.734945	100.369	T
54	4637.745698	5030.534308	100.119	T
55	4661.431946	5032.136596	99.566	T
56	4675.103448	5032.16652	99.244	T
57	4684.526117	5033.273622	98.328	T
58	4690.114624	5033.930366	97.95	T
59	4696.100555	5034.639893	95.928	T
60	4701.465409	5035.539379	95.547	T
61	4705.969953	5036.080646	95.04	LEW
62	4707.613871	5036.238691	94.263	G
63	4710.034277	5036.366997	94.53	C
64	4712.941033	5036.957007	94.603	C
65	4717.512436	5036.159652	94.297	CTH
66	4721.805983	5037.098416	94.015	C
67	4724.917464	5037.742762	94.205	G
68	4729.090495	5037.899748	94.133	G
69	4735.099577	5038.310393	94.386	G
70	4741.845966	5038.5302	94.569	G
71	4748.67499	5038.109046	94.875	G
72	4757.03574	5038.862205	95.229	REW
73	4766.870626	5040.489624	95.411	T
74	4782.791083	5041.636757	96.142	T
75	4804.253371	5042.490822	97.249	T
76	4832.681164	5044.207543	97.957	T
77	4869.949568	5047.352338	98.455	T
78	4916.600058	5049.949538	98.72	T
79	4961.090563	5051.165933	99.074	T
80	4812.810866	5050.941005	98.105	P09TBM2 (TBM9B)
81	4793.65213	5041.737179	96.842	N
82	4958.670228	4992.387638	99.27	SG
83	5263.394308	5324.829951	98.794	HV54, Photo Panel - set by others

Legend:

G = grass	TH = thalweg	US = upstream	CL = center line
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	PK = "pk" nail	

file:plx9.xls

APPENDIX M: PLX 10

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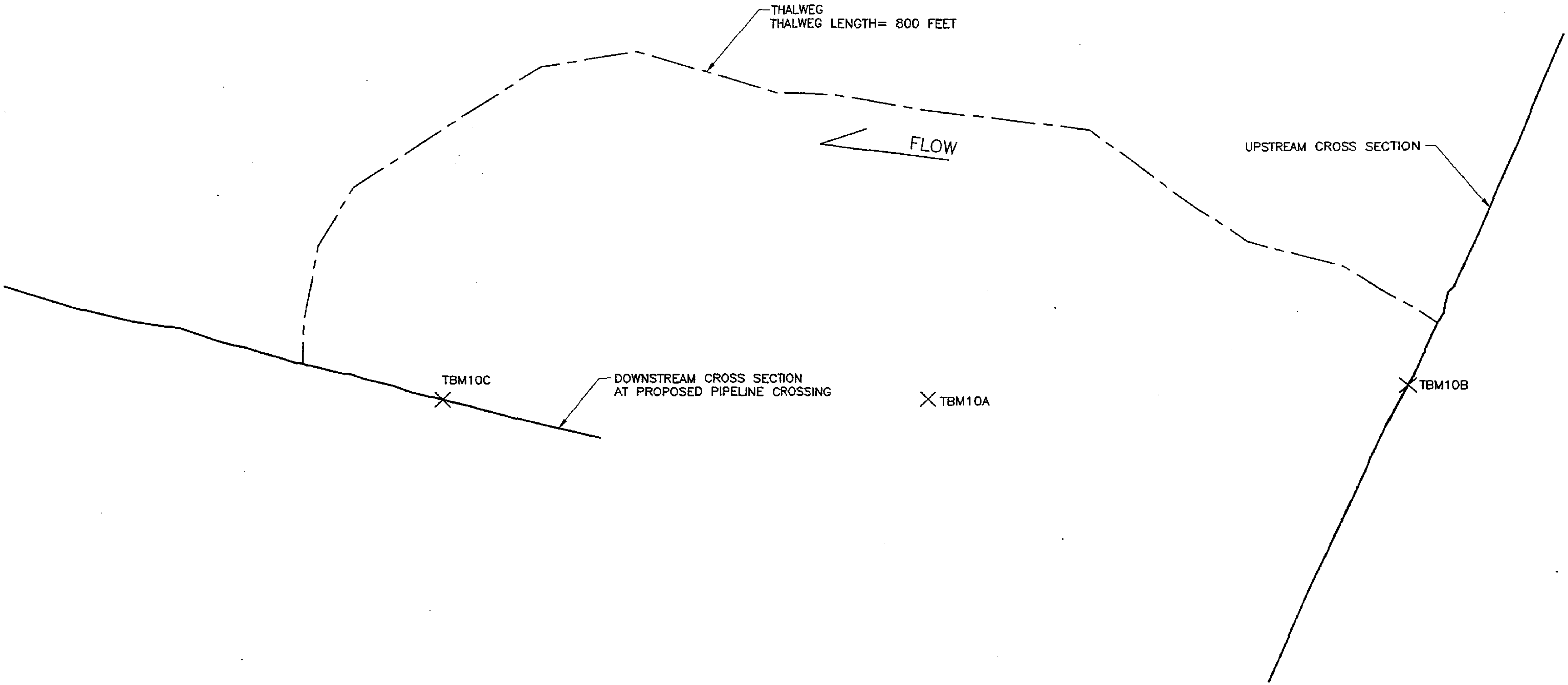


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM10A.

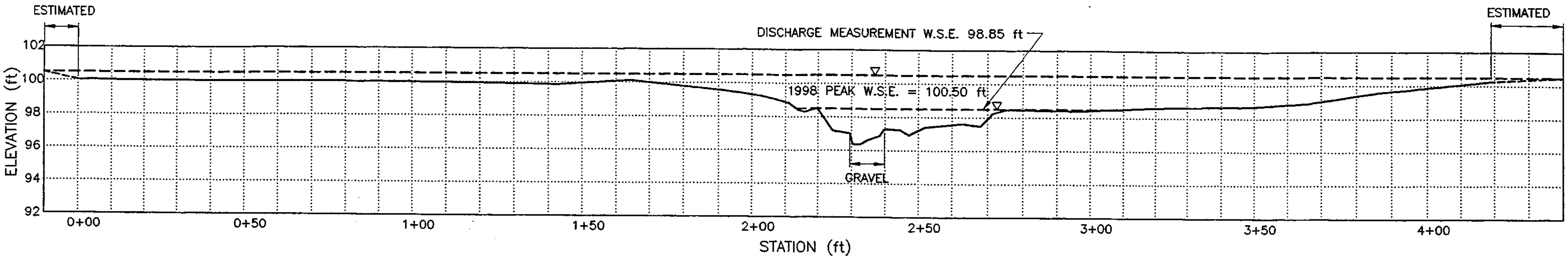
REVISION			
NO.:	DATE:		BY:

STREAM PLX10
PLAN
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

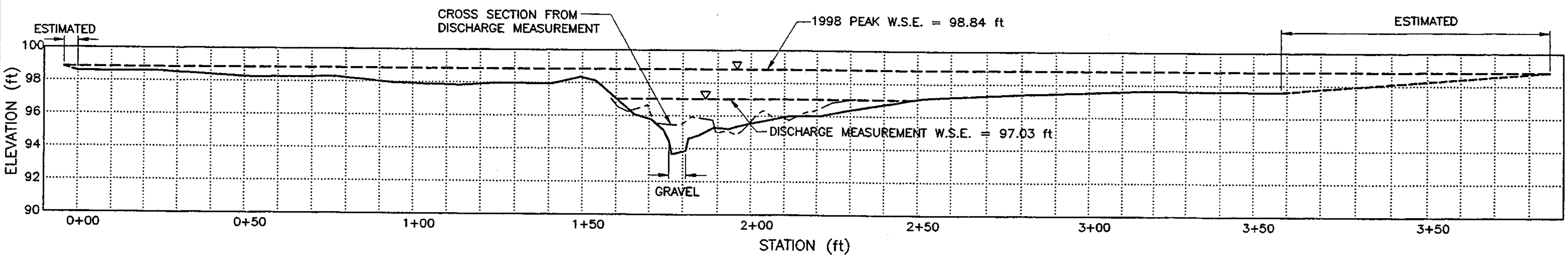
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X10
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX
10-1



PROFILE: PLX10 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX10 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM10A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

NO.:	DATE:	REVISION	BY:

STREAM PLX10
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X10
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX
10-2

Photo PLX 10-1: Looking north at the proposed pipeline crossing (6/1/98).

Photo PLX 10-2: Looking northwest at the proposed pipeline crossing (6/11/98).

STREAM PLX 10 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
	Date: 6/7/98	Project: 23247	PLX 10-1
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Drawn: JDA	File: photo10	
	Checked: JWA	Scale:	

Photo PLX 10-3: Looking east at the proposed pipeline crossing (6/1/98); note crest mark on lath.

STREAM PLX 10 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 10-2
	Drawn: JDA	File: photo10	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION:	PLX 10 at proposed pipeline crossing						
Date:	6/1 ,1998	**Party:**	J. Meckel, P. McGranahan				
Width:	73	**Area:**	76.5	**Vel:**	2.30	**G.H.:**	**Disch.:** 176 cfs
No Secs.	26	**G.H. change:**		**in.:**		**hrs.:**	**Susp.:** Rod
Method coef.:	1	**Hor. Angle coef.**	1	**Sus. Coef.:**	Noted	**Meter No.**	

Gage Readings					
Time	**Recorder**	**Inside**	**Outside**	**Type of meter:**	Price AA
				Date rated:	Std 1
				Meter:	**ft. above bottom of weight.**
	upstream x-sec	WSE=	98.85	**Spin before meas.** ok	**after** ok
				Method:	Wading at proposed pipeline crossing,
	downstream x-sec	WSE=	97.03		downstream cross section.
Weighted M.G.H.				**Levels obtained**	this time
G.H. corrections					
Correct M.G.H.					

Measurement rated: Good — **based on following conditions:**

Cross section: Irregular - mostly grass 8-10".

Flow: Uneven distribution — **Weather:** **Air °F@:**

Gage: — **Water °F@:**

Other:

Record Removed: — **Intake flushed:**

Observer

Control Riffle 100-150 downstream clear.

Remarks Grass - rough, small amount of cobble < 2".

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 10 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	137.0	3.5	0.0						0.0	0.0	Right edge water (1315 hr)
	130.0	6.0	0.2	s	10	48	0.47	0.43	1.2	0.5	
	125.0	4.0	0.7	0.6	40	52		1.70	2.8	4.8	
	122.0	4.0	0.8	0.6	40	45		1.96	3.2	6.3	
	117.0	3.5	1.3	0.6	50	40		2.74	4.6	12.5	
	115.0	2.0	1.1	0.6	60	43		3.06	2.2	6.7	
	113.0	2.0	1.2	0.6	80	50		3.50	2.4	8.4	
	111.0	2.0	1.0	0.6	80	48		3.65	2.0	7.3	
	109.0	2.0	0.7	0.6	80	41		4.26	1.4	6.0	
	107.0	2.0	1.0	0.6	80	48		3.65	2.0	7.3	
	105.0	2.0	1.5	0.6	80	50		3.50	3.0	10.5	
0.98	103.0	2.0	1.9	0.6	80	40	4.37	4.28	3.8	16.3	
0.96	101.0	2.0	2.2	0.6	80	43	4.07	3.91	4.4	17.2	Edge grass
0.96	99.0	2.0	2.0	0.6	80	44	3.98	3.82	4.0	15.3	Small cobble
0.97	97.0	2.0	2.0	0.6	60	40	3.28	3.18	4.0	12.7	" "
0.97	95.0	1.5	2.1	0.6	40	50	1.76	1.71	3.2	5.4	" "
0.98	94.0	2.0	1.3	0.6	50	48	2.29	2.24	2.6	5.8	Edge grass
0.98	91.0	3.0	1.2	0.6	30	45	1.47	1.44	3.6	5.2	
0.99	88.0	3.0	1.1	0.6	40	48	1.84	1.82	3.3	6.0	
1	85.0	3.0	1.6	0.6	10	45		0.50	4.8	2.4	
1	82.0	4.0	1.6	0.6	30	44		1.51	6.4	9.7	
1	77.0	3.5	1.5	0.6	25	48		1.16	5.3	6.1	
1	75.0	4.0	0.4	S	7	50	0.33	0.29	1.6	0.5	
1	69.0	4.5	0.8	0.6	15	41		0.82	3.6	3.0	
1	66.0	2.5	0.5	S	10	52	0.44	0.40	1.3	0.5	
1	64.0	1.0	0.0						0.0	0.0	Left edge water (1400 hr)
	73.0	73.0							76.5	176.1	

file: disch_P10.xls

Table PLX 10-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P10.TBM (TBM10A)
2	5000	5282.459824	98.915	P10PCL (TBM10C)
3	4999.630039	5282.628993	97.942	CG.C/L
6	4999.993153	5282.445536	98.914	CK
11	4832.375265	4799.621793	100.044	T
12	4873.210025	4781.715073	99.995	T
13	4893.069439	4773.27477	100.01	T
14	4917.810792	4761.905342	99.986	T
15	4939.572039	4751.983904	99.943	T
16	4963.309403	4742.019108	99.863	T
17	4982.941818	4733.304273	100.116	T
18	5007.893632	4721.753526	99.538	CGUS (TBM10B)
19	5017.639271	4717.115119	99.232	T
20	5025.30885	4713.992707	98.837	T
21	5027.975702	4712.673772	98.432	T
22	5029.900108	4712.163986	98.298	G
23	5033.211422	4710.503816	98.515	LEW
24	5034.392979	4709.957324	98.182	G
25	5037.594419	4708.603561	97.176	G
26	5042.120247	4706.395055	97.025	G
27	5042.844109	4706.114823	96.39	C
28	5045.176276	4705.154136	96.38	CTH
29	5046.910049	4703.914514	96.631	C
30	5050.030566	4702.314825	96.88	C
31	5051.236367	4701.518459	97.286	G
32	5056.0289	4701.053106	97.266	G
33	5058.764655	4700.204788	96.912	G
34	5063.620921	4699.181457	97.393	G
35	5067.241664	4695.364747	97.503	G
36	5073.052136	4693.029173	97.629	G
37	5077.542607	4690.941176	97.488	G
38	5080.667967	4689.725132	98.235	REW
39	5084.564611	4688.033314	98.482	T
40	5102.551618	4679.896104	98.404	T
41	5125.535647	4670.439875	98.626	T
42	5151.987861	4658.718737	98.718	T
43	5167.962721	4652.165182	98.937	T
44	5186.229076	4645.076864	99.581	T
45	5216.340143	4631.911638	100.256	T
46	5021.970496	4639.062569	96.794	THFL
47	5079.339729	4756.360124	96.662	TH
48	5094.456478	4812.906544	96.116	TH
49	5117.601601	4847.841309	96.46	TH
50	5160.41197	4907.188984	95.976	TH
51	5172.809054	5006.005266	95.565	TH

Table PLX 10-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	5181.094028	5053.379972	95.373	TH
53	5182.439741	5088.680906	94.626	TH
54	5206.421929	5169.272159	94.368	TH
55	5197.565103	5224.214115	94.203	TH
56	5164.018387	5277.385983	95.483	TH
57	5126.128272	5334.033646	95.112	TH
58	5091.529594	5354.841122	93.243	TH
59	5047.287817	5363.13111	94.508	TH
60	4986.90034	5390.315761	94.7	THFL
61	4976.767717	5191.0879	98.577	T
62	4982.365857	5215.319108	98.579	T
63	4988.792005	5241.775098	98.248	T
64	4995.455736	5265.880974	98.278	T
65	4999.540918	5282.663878	97.949	CGCL
66	5004.464171	5301.385926	97.818	T
67	5008.14725	5311.997996	97.964	T
68	5011.946616	5327.536522	97.933	T
69	5014.725836	5335.596973	98.339	T
70	5015.421345	5340.150254	98.113	T
71	5018.154025	5351.28717	96.076	LEW
72	5019.422142	5356.379804	95.754	G
73	5020.202345	5359.93646	95.096	G
74	5020.360078	5361.493793	94.492	G
75	5020.826289	5362.263174	93.656	C
76	5021.253056	5363.837283	93.732	CTH
77	5021.821619	5366.24987	93.859	C
78	5021.691473	5367.062852	94.598	G
79	5022.566745	5370.28876	94.823	G
80	5023.692477	5374.120874	95.283	G
81	5024.971118	5378.176226	95.201	G
82	5026.324048	5383.123978	95.472	G
83	5028.086161	5388.520431	95.711	G
84	5030.740771	5395.749362	96.002	REWX
85	5032.644273	5404.993298	96.019	T
86	5035.014061	5413.127868	96.369	T
87	5042.368694	5434.386157	97.129	T
88	5046.653898	5462.084196	97.384	T
89	5055.658283	5497.94815	97.653	T
90	5068.182379	5537.622815	97.602	T

(continued on next page)

Table PLX 10-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
88	5046.653898	5462.084196	97.384	T
89	5055.658283	5497.94815	97.653	T
90	5068.182379	5537.622815	97.602	T

Legend:

G = grass	TH = thalweg	US = upstream	PK = "pk" nail
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	CL = center line	

file:plx10.xls

APPENDIX N: PLX 11

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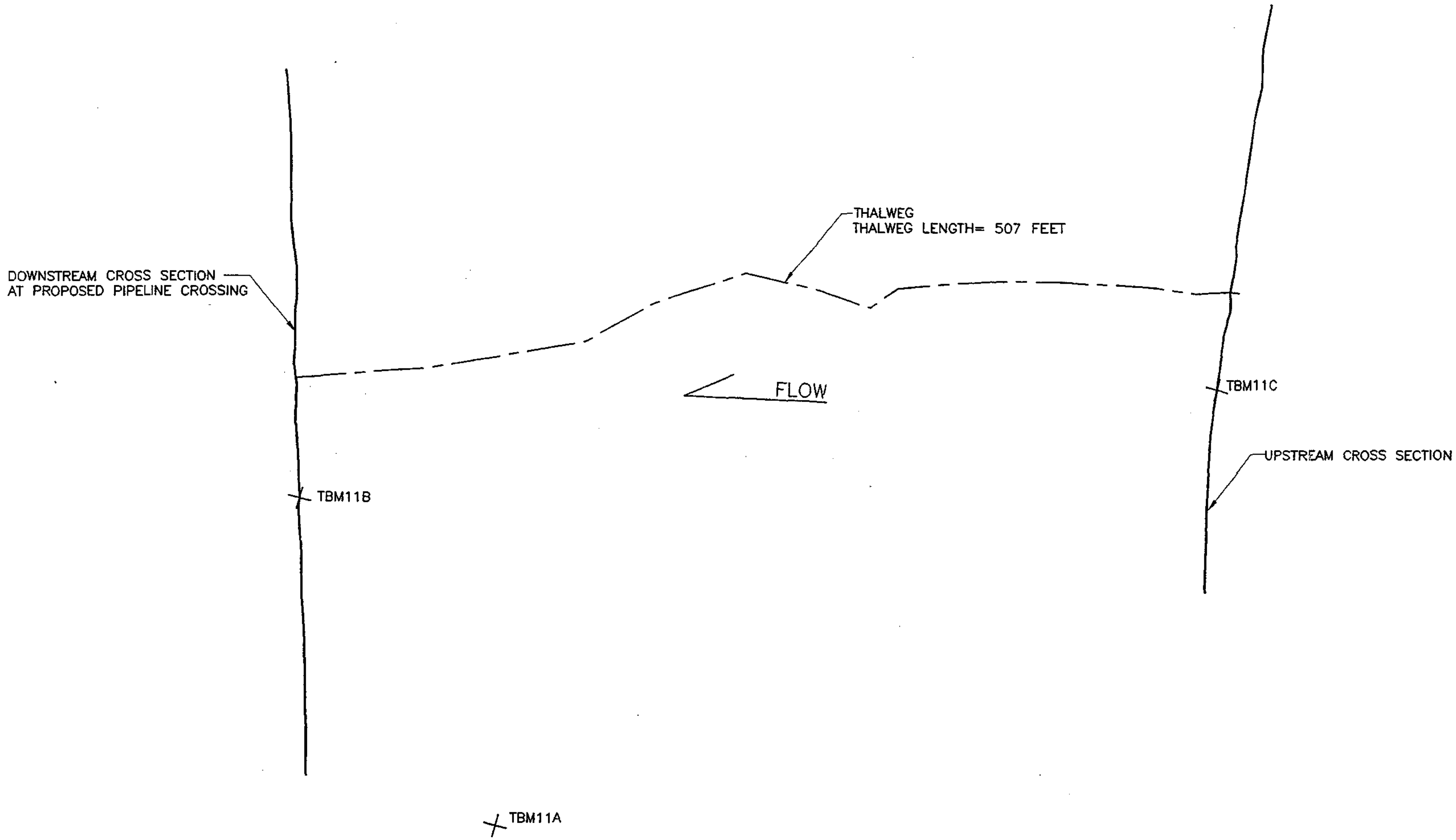


NOTES:

1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM11A.

REVISION			
NO.:	DATE:		BY:

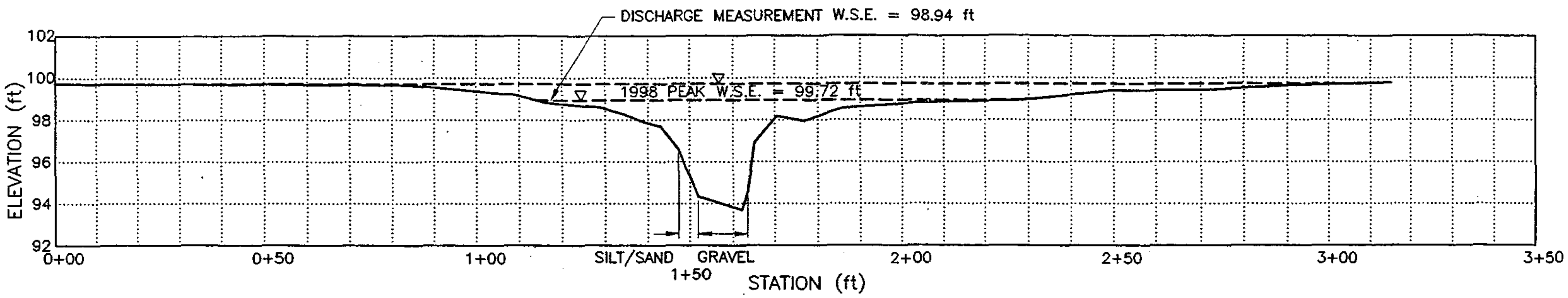
STREAM PLX11
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

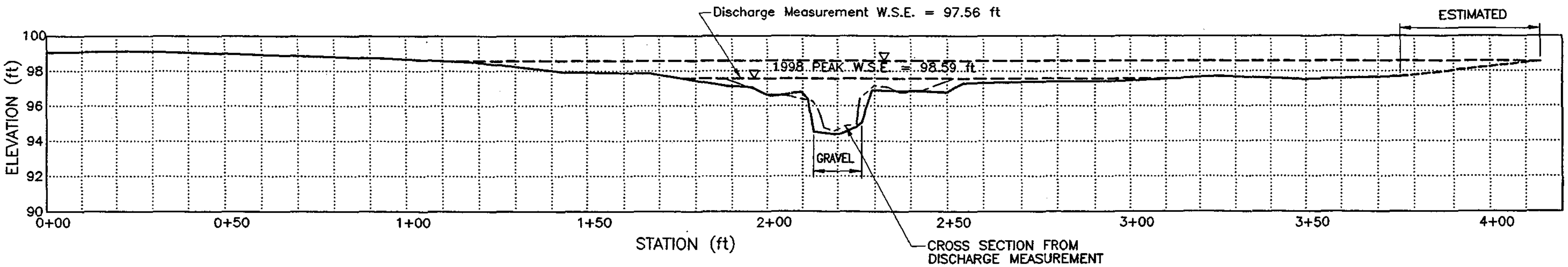
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X11
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX
11-1



PROFILE: PLX11 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX11 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM11A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

STREAM PLX11
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X11
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX
11-2

Photo PLX 11-1: Looking north at the proposed pipeline crossing, water depth is 1 foot (6/1/98).

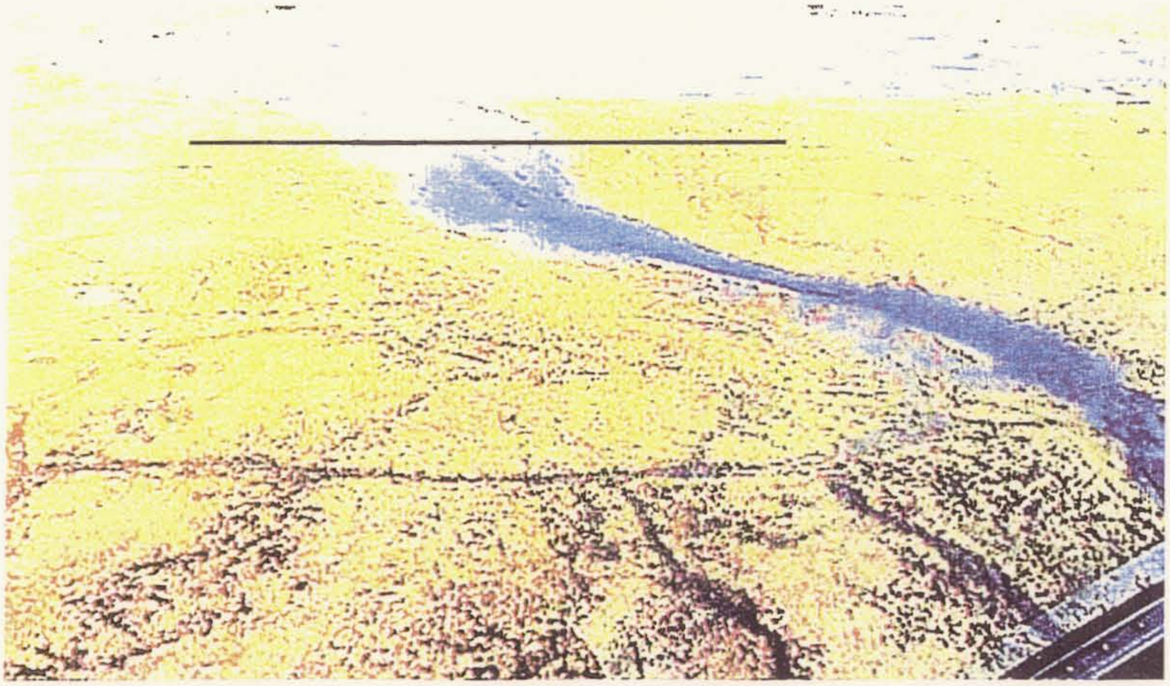


Photo PLX 11-2: Looking north at the proposed pipeline crossing (6/11/98).

STREAM PLX 11 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.	Photo Number
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 11-1
	Drawn: JDA	File: photo11	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 11 at proposed pipeline crossing

Date: 6/1 ,1998 Party: J. Meckel, P. McGranahan

Width: 64 Area: 66.2 Vel: 0.985 G.H.: Disch.: 65.2 cfs

No Secs. 17 G.H. change: in.: hrs.: Susp.: Rod

Method coef.: 1 Hor. Angle coef. 1 Sus. Coef.: 1 Meter No.

Gage Readings			
Time	Recorder	Inside	Outside
	upstream x-sec	WSE=	98.94
	downstream x-sec	WSE=	97.56
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: ft. above bottom of weight.

Spin before meas. ok after ok

Method: Wading at proposed pipeline crossing, downstream cross section.

Levels obtained this day

Measurement rated: Fair based on following conditions:

Cross section: Trapazoid with over banks.

Flow: Weather: Air °F@:

Gage: Water °F@:

Other:

Record Removed: Intake flushed:

Observer

Control Lake 200 ft downstream. Channel overbanks of grass. Streambed smooth cobble < 3", sand.

Remarks No snow or ice.

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 11 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	110.0	3.5	0.0						0.0	0.0	Left edge water (1400 hr)
	103.0	6.0	0.5	s	7	54	0.30	0.27	3.0	0.8	
	98.0	5.5	0.9	s	10	53	0.43	0.39	5.0	1.9	
	92.0	6.5	1.0	s	10	42	0.54	0.49	6.5	3.2	
	85.0	4.0	1.3	0.6	20	53		0.84	5.2	4.4	
	84.0	1.0	1.6	0.6	20	49		0.91	1.6	1.5	
	83.0	1.0	2.1	0.6	20	42		1.06	2.1	2.2	
	82.0	2.0	2.8	0.8	15	43	0.78	1.44	5.6	8.1	Edge grass
	79.0	3.0	3.0	0.2	40	42	2.10	2.22	9.0	20.0	smooth cobbles
				0.8	40	42	2.10				" "
	76.0	3.0	2.7	0.8	30	41	1.62	1.77	8.1	14.3	" "
				0.2	40	46	1.92		0.0	0.0	" "
	73.0	2.0	2.6	0.2	20	50	0.89	0.86	5.2	4.4	Edge grass
				0.8	15	41	0.82		0.0	0.0	
	72.0	2.5	1.1	s	7	50	0.33	0.29	2.8	0.8	
	68.0	4.0	0.4	s		0		0.00	1.6	0.0	
	64.0	3.5	0.5	s	0	0		0.00	1.8	0.0	
	61.0	4.5	0.8	s	15	45	0.75	0.67	3.6	3.6	
	55.0	7.5	0.7	s	0		0.00	0.00	5.3	0.0	
	46.0	4.5	0.0				0.00		0.0	0.0	Right edge water (1500 hr)
	64.0	64.0							66.2	65.2	

Table PLX 11-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	START (TBM11A)
2	5000	5201.772255	99.148	P11PCL (TBM11B)
3	5000	5201.856814	97.931	CG
11	4928.624257	5071.847914	99.071	T
12	4940.683611	5092.785136	99.137	T
13	4952.569471	5114.656762	99.015	T
14	4963.843584	5134.572159	98.873	T
15	4974.220581	5155.253685	98.727	T
16	4985.9893	5176.112397	98.508	T
17	4997.353719	5198.473567	97.923	T
18	5009.339877	5218.661854	97.866	T
19	5018.721504	5237.805568	97.12	LEW
20	5022.083869	5243.642345	97.068	G
21	5024.207054	5246.452025	96.713	G
22	5025.207964	5248.767562	96.55	G
23	5027.86642	5252.97308	96.707	G
24	5029.505543	5255.551509	96.793	G
25	5030.159792	5257.384183	96.38	G
26	5030.894089	5258.872114	94.53	CTH
27	5032.916032	5263.484547	94.406	CTH
28	5034.161371	5266.210393	94.42	C
29	5036.17729	5269.194636	94.771	C
30	5037.014992	5270.508635	95.06	M
31	5038.733381	5272.961241	96.884	G
32	5043.020741	5280.323705	96.847	G
33	5045.619021	5284.764862	96.843	G
34	5049.044595	5290.869455	96.755	G
35	5052.165079	5294.423682	97.287	REW
36	5060.762234	5309.588522	97.376	T
37	5071.38831	5333.469959	97.431	T
38	5085.385459	5356.951813	97.709	T
39	5097.20209	5378.272589	97.531	T
40	5108.437722	5402.159375	97.676	T
41	4990.420522	5296.135	94.927	THFL
42	5094.70199	5228.427199	94.438	TH
43	5171.293783	5200.313312	95.233	TH
44	5211.592942	5200.093498	96.714	TH
45	5261.310303	5189.669227	95.964	TH
46	5291.340877	5161.206805	95.251	TH
47	5309.51977	5140.54917	94.008	TH
48	5326.960567	5142.053425	95.028	TH
49	5350.064236	5131.687038	95.687	TH
50	5374.538154	5119.210331	96.654	TH
51	5401.54819	5103.079301	95.351	TH

Table PLX 11-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	5440.926553	5076.832855	95.57	TH
53	5459.705211	5062.143236	95.608	TH
54	5497.628706	5007.612258	97.401	THFL
55	5570.701126	5174.163221	99.772	T
56	5555.148652	5156.292124	99.639	T
57	5544.428849	5139.068362	99.409	T
58	5529.848847	5123.272611	99.401	T
59	5515.913025	5105.602009	98.907	T
60	5501.629745	5088.77688	98.841	T
61	5489.396293	5074.002096	98.55	T
62	5487.514594	5069.99862	98.29	REW
63	5484.617922	5065.977535	97.941	G
64	5480.627353	5061.04881	98.175	G
65	5476.916023	5057.079857	96.891	G
66	5475.842091	5055.676426	94.586	C
67	5474.826617	5054.717706	93.704	CTH
68	5469.772118	5046.015571	94.333	C
69	5468.195333	5044.623942	95.046	M
70	5466.365773	5042.773192	96.618	M
71	5463.521098	5039.63591	97.673	G
72	5460.522935	5036.704511	97.907	G
73	5457.725024	5033.22281	98.26	LEW
74	5454.313769	5028.704623	98.609	T
75	5446.623673	5018.697387	98.814	T
76	5442.262194	5012.889975	99.204	CGUS (TBM11C)
77	5426.998319	4993.7063	99.657	T
78	5405.135095	4959.800174	99.693	T
79	5381.846693	4921.936405	99.736	T

Legend:

G = grass	TH = thalweg	US = upstream	PK = "pk" nail
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	CL = center line	

file:plx11.xls

APPENDIX O: PLX 12

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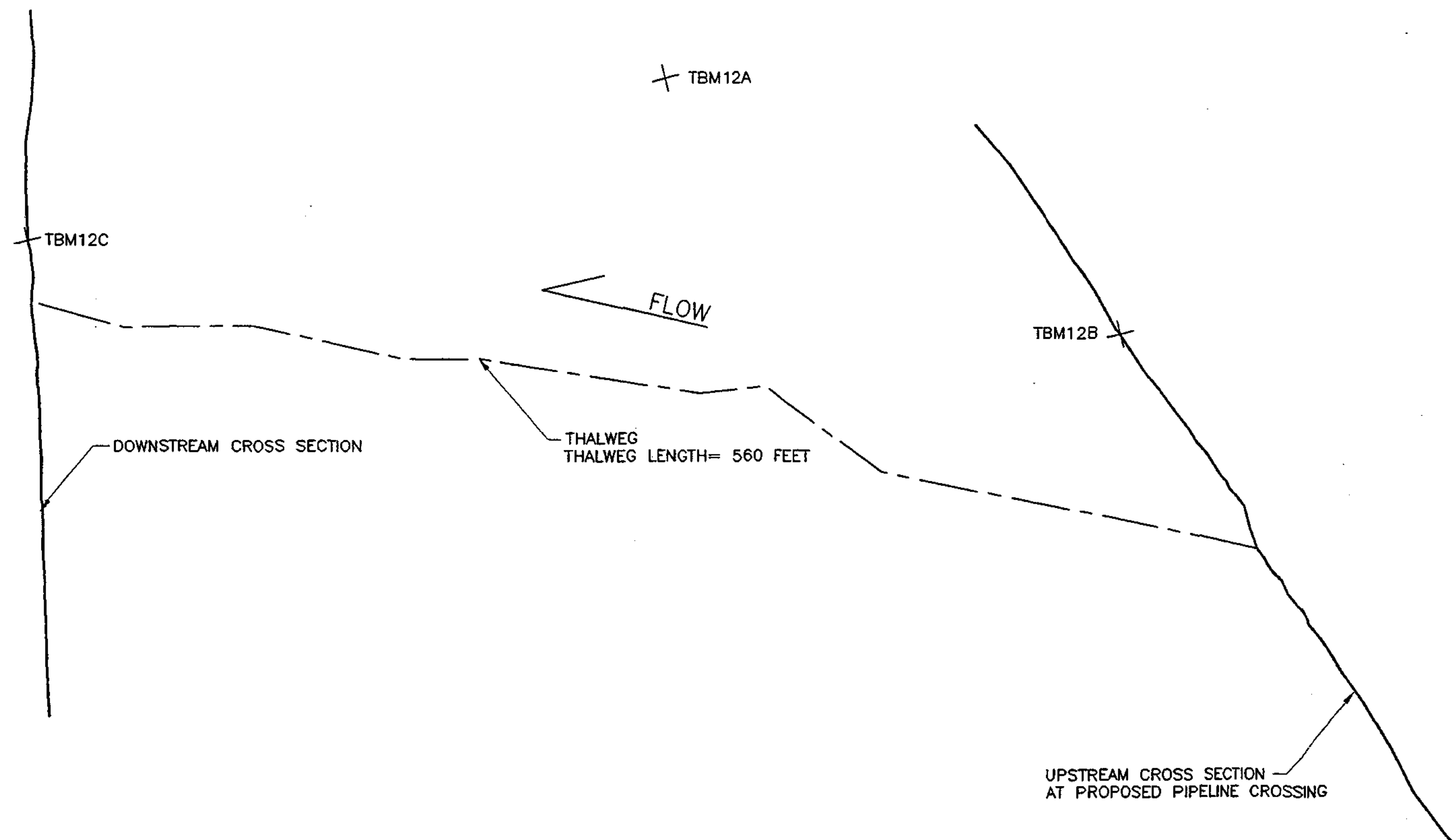


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM12A.

REVISION			
NO.:	DATE:		BY:

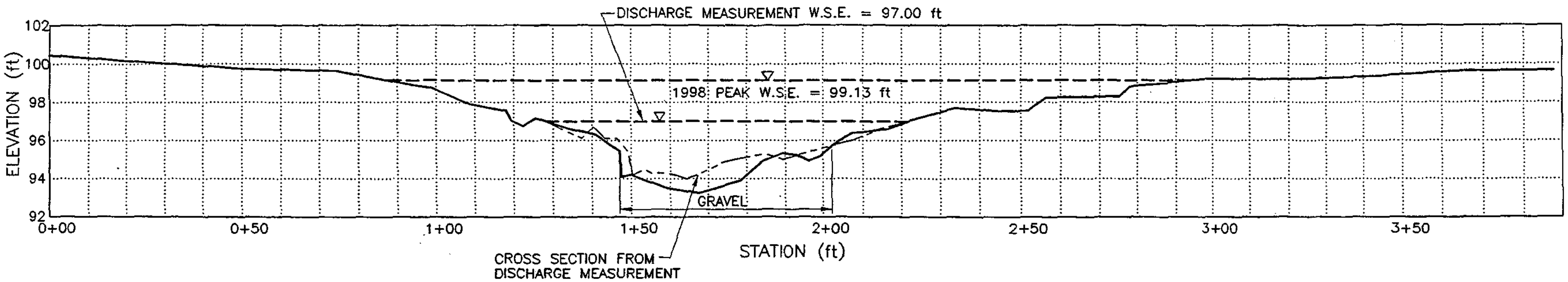
STREAM PLX12
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

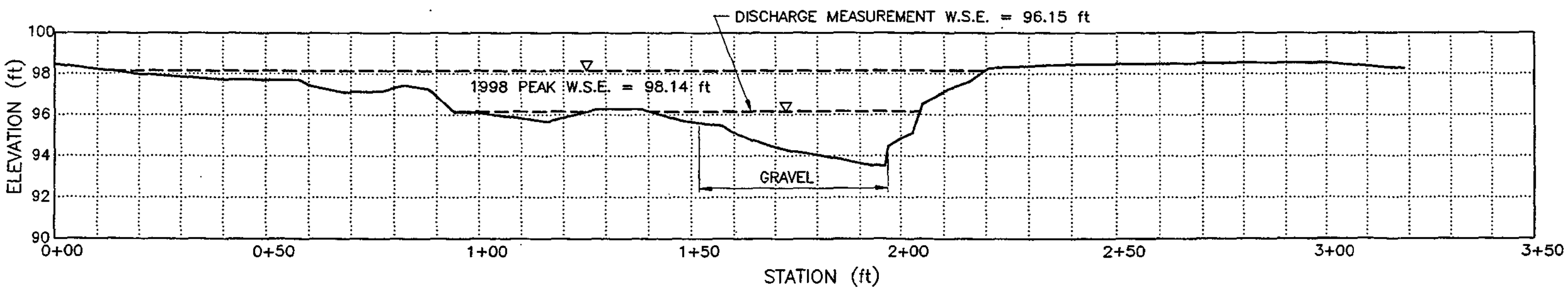
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X12
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE: PLX 12-1



PROFILE: PLX12 UPSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX12 DOWNSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM12A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

NO.:	DATE:	REVISION	BY:

STREAM PLX12
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X12
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 12-2

Photo PLX 12-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 12-2: Looking southeast at the proposed pipeline crossing (6/5/98).

STREAM PLX 12 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 12-1
	Drawn: JDA	File: photo12	
	Checked: JWA	Scale.	

DISCHARGE MEASUREMENT NOTES

LOCATION:	PLX 12 at proposed pipeline crossing						
Date:	6/1 ,1998	Party:	J. Meckel, P. McGanahan				
Width:	93	Area: 142	Vel: 1.73	G.H.:		Disch.: 245	cfs
No Secs.	23	G.H. change:	in.:	hrs.:		Susp.:	Rod
Method coef.:	1	Hor. Angle coef.	1	Sus. Coef.: Noted		Meter No.	

Gage Readings					
Time	Recorder	Inside	Outside	Type of meter:	Price AA
				Date rated:	Std No 1
				Meter:	ft. above bottom of weight.
	Upstream x-sec	WSE=	97.00	Spin before meas.	ok after ok
				Method:	Wading at proposed pipeline crossing, upstream cross section.
	downstream x-sec	WSE=	96.15		
Weighted M.G.H.				Levels obtained	this time
G.H. corrections					
Correct M.G.H.					

Measurement rated: Good — based on following conditions:

Cross section: Fairly uniform smooth cobbles < 3", short grass.

Flow: — Weather: — Air °F@:

Gage: — Water °F@:

Other:

Record Removed: — Intake flushed:

Observer

Control Broad riffle 100-150 ft. downstream clear.

Remarks

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 12 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	22.0	2.5	0.0						0.0	0.0	Left edge water (1515 hr)
	27.0	4.5	0.5	s	15	40	0.84	0.75	2.3	1.7	
0.98	31.0	3.5	0.9	s	25	46	1.20	1.08	3.2	3.4	
0.98	34.0	3.0	0.3	s	20	48	0.93	0.84	0.9	0.8	
0.98	37.0	3.0	0.9	s	25	43	1.29	1.16	2.7	3.1	
0.98	40.0	3.0	0.9	s	30	47	1.41	1.27	2.7	3.4	
0.99	43.0	2.0	1.6	0.6	30	43		1.54	3.2	4.9	Edge grass
0.98	44.0	2.0	2.8	0.8	25	45	1.23	1.56	5.6	8.7	Small cobble
0.98				0.2	40	47	1.88		0.0	0.0	" "
0.99	47.0	2.5	2.5	s	30	44		1.90	6.3	11.9	" "
				0.6	40	46		1.92	0.0	0.0	" "
0.99	49.0	2.5	2.7	0.6	40	41		2.15	6.8	14.5	" "
0.98	52.0	3.0	2.7	0.6	40	39		2.25	8.1	18.2	" "
0.98	55.0	3.0	2.8	0.6	40	43		2.05	8.4	17.2	" "
0.98	58.0	3.0	3.0	0.6	40	40		2.20	9.0	19.8	" "
1	61.0	3.0	2.8	0.6	40	41		2.15	8.4	18.1	" "
1	64.0	3.0	2.5	0.6	40	46		1.92	7.5	14.4	" "
1	67.0	4.5	2.2	0.6	40	48		1.84	9.9	18.2	" "
1	73.0	5.5	1.9	0.6	40	44		2.00	10.5	20.9	" "
1	78.0	5.0	1.7	0.6	40	48		1.84	8.5	15.6	" "
1	83.0	6.0	2.0	0.6	30	42		1.58	12.0	19.0	" "
1	90.0	9.0	1.6	0.6	25	41		1.35	14.4	19.4	" "
1	101.0	9.0	1.0	0.6	20	42		1.06	9.0	9.5	" "
	108.0	7.0	0.4	s	20	49		0.91	2.8	2.5	Edge grass
	115.0	3.5	0.0						0.0	0.0	Right edge water (1600 hr)
	93.0	93.0							142.0	245.4	

file: disch_P12.xls

Table PLX 12-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P15.TOPO (TBM12A)
2	5000	4770.255932	94.638	P12PCL (TBM12B)
11	4999.99443	4770.235809	98.293	P12PCL
12	5050.515507	4870.896995	99.641	T
13	5042.035566	4849.937183	99.648	T
14	5031.887428	4829.725179	99.336	T
15	5021.292696	4809.295023	99.2	T
16	5011.129685	4789.874564	99.217	T
17	5000.682686	4772.881283	98.789	T
18	4991.494138	4753.338246	98.233	T
19	4989.68005	4749.122271	97.529	T
20	4986.992202	4742.728591	97.531	T
21	4982.41879	4732.656279	97.701	T
22	4977.767167	4722.070656	97.042	T/C
23	4974.953742	4716.882019	96.594	C
24	4971.779946	4708.405388	96.367	REW
25	4969.4499	4704.021952	95.725	G
26	4968.231719	4701.159956	95.167	C
27	4966.90772	4698.444481	94.923	C
28	4965.942418	4694.833987	95.259	C
29	4963.977973	4691.876636	95.34	C
30	4962.448341	4686.761614	94.87	C
31	4960.295339	4681.735153	93.874	C
32	4952.13647	4673.734764	93.238	C
33	4946.700938	4666.777343	93.518	CTH
34	4944.641182	4661.841048	93.913	C
35	4942.518858	4658.894071	94.224	C
36	4941.540992	4656.64777	94.072	C
37	4941.281127	4656.32996	95.42	G
38	4939.320472	4650.11904	96.307	LEW
39	4935.744951	4644.910713	96.593	T
40	4932.356847	4636.897156	97.169	T
41	4931.203473	4633.910703	96.755	T
42	4929.694348	4631.299197	97.019	T
43	4928.475861	4630.221981	97.569	T
44	4925.185017	4621.530807	97.877	T
45	4920.540461	4612.569562	98.766	T
46	4916.519093	4605.419316	99.022	T
47	4909.974694	4590.494094	99.648	T
48	4898.488395	4569.830528	99.73	T
49	4886.387535	4550.68733	100.062	T
50	4875.302238	4524.821189	100.464	T
51	5036.639672	4697.901497	92.649	TH/FL
52	4894.089744	4828.591041	94.976	TH
53	4901.885772	4892.51982	92.625	TH

Table PLX 12-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
54	4884.695774	4916.124042	93.304	TH
55	4849.356348	5008.535849	93.718	TH
56	4832.802433	5037.283729	92.756	TH
57	4812.985019	5101.97564	92.977	TH
58	4783.860873	5151.217349	93.895	TH
59	4745.822034	5253.108129	93.787	TH/FL
60	4614.279931	5091.565478	98.448	T
61	4630.035692	5102.040242	97.995	T
62	4647.41725	5112.702465	97.721	T
63	4663.198121	5122.234633	97.688	T
64	4665.640955	5123.637098	97.393	T
65	4672.180431	5128.031268	97.108	T
66	4679.720869	5132.864112	97.138	T
67	4684.061604	5135.338852	97.43	T
68	4689.03562	5138.233545	97.249	T
69	4694.169023	5141.565728	96.124	T
70	4699.034601	5144.521526	96.095	T
71	4713.277571	5152.747351	95.665	T/C
72	4722.942004	5159.074211	96.28	C
73	4731.676005	5164.312869	96.277	C
74	4739.590573	5169.668833	95.724	C
75	4747.780978	5174.708056	95.463	C
76	4749.594534	5175.381029	95.187	LEW
77	4753.777131	5178.117409	94.783	C
78	4757.341144	5181.110357	94.469	C
79	4761.355698	5184.029803	94.242	C
80	4766.261336	5187.567166	94.044	C
81	4769.477452	5190.215904	93.891	C
82	4773.355193	5192.520683	93.694	CTH
83	4777.629014	5194.852065	93.546	C
84	4780.405889	5196.04306	93.506	C
85	4781.184298	5196.150261	94.442	G
86	4783.90437	5197.8514	94.861	G
87	4786.451092	5199.234381	95.108	REW
88	4788.162883	5200.596939	96.506	TU
89	4792.904075	5204.14512	97.234	T
90	4796.53809	5207.728165	97.593	P12CGDS (TBM12C)
91	4800.476092	5210.009501	98.28	T
92	4816.479969	5220.213304	98.456	T

(continued on next page)

Table PLX 12-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
93	4834.17202	5230.255411	98.477	T
94	4851.879603	5237.182894	98.533	T
95	4870.215271	5246.607653	98.542	T
96	4886.330964	5257.637627	98.256	T

Legend:

G = grass	TH = thalweg	DS = downstream	CL = center line
T = tundra	CG = crest gage	US = upstream	PK = "pk" nail
C = cobbles	GB = ground break	TWET = wet tundra	
LEW = left edge of water	SH = shoulder	M = mud	
REW = right edge of water		SB = sand bags	

file:plx12.xls

APPENDIX P: PLX 13

TABLE OF CONTENTS

Photo PLX 13-1: Flow is in small indistinct channels (6/5/98).

Photo PLX 13-2: Looking northwest at the proposed pipeline crossing (6/11/98).

STREAM PLX 13 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 13-1
	Drawn: JDA	File: photo13	
	Checked: JWA	Scale:	

APPENDIX Q: PLX 14

TABLE OF CONTENTS

Photo PLX 14-1: During the 1998 break-up there was no flowing water at this location, only standing water in lakes (6/5/98).

STREAM PLX 14
PHOTOGRAPHS

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker	Michael Baker Jr., Inc.
Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo14
Checked: JWA	Scale:

Photo Number:
PLX
14-1

APPENDIX R: PLX 15

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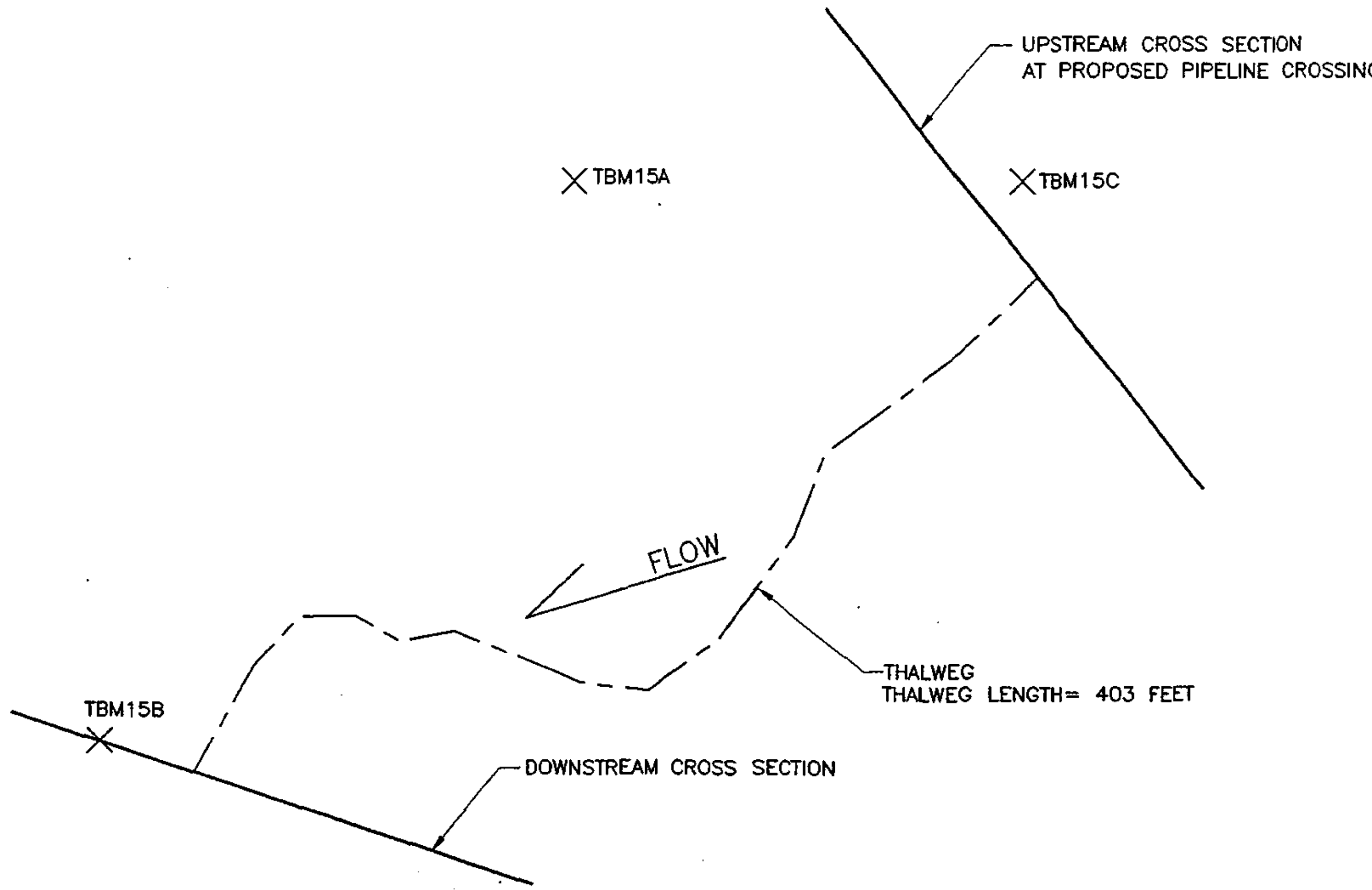


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM15A.

REVISION			
NO.:	DATE:		BY:

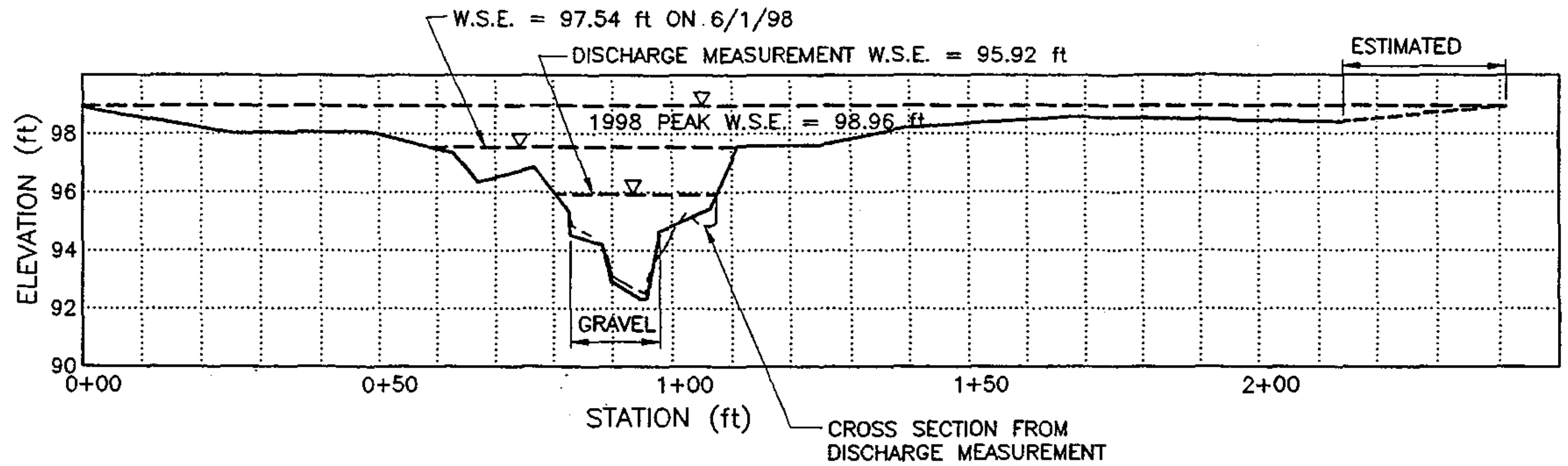
STREAM PLX15
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

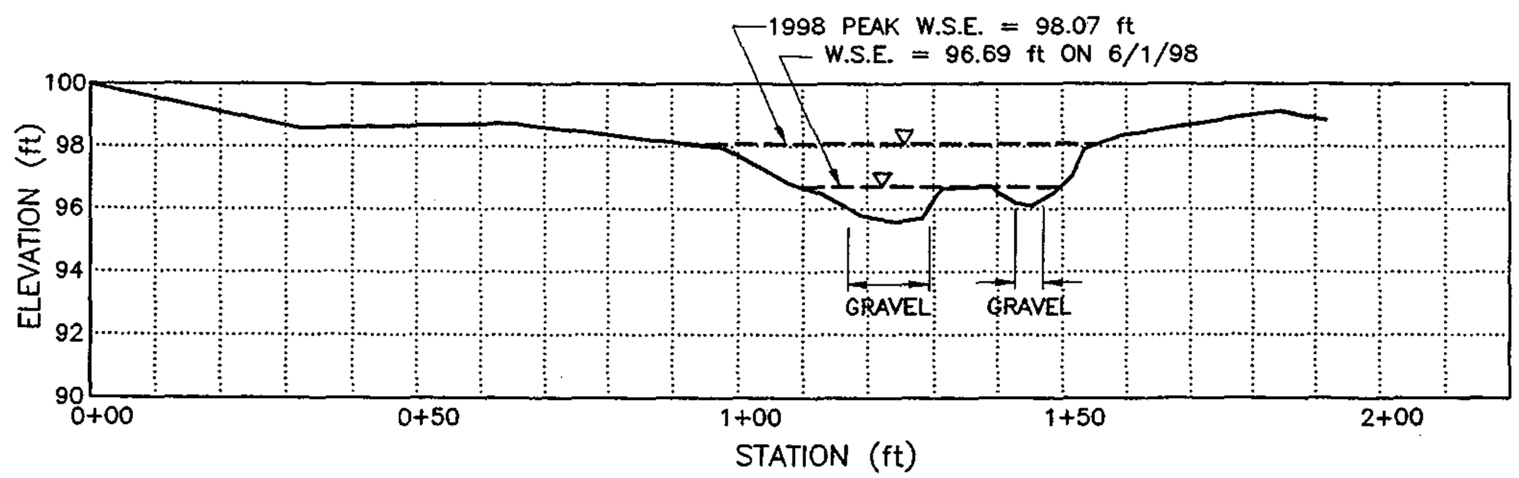
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X15
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX
15-1



PROFILE: PLX15 UPSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX15 DOWNSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM15A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

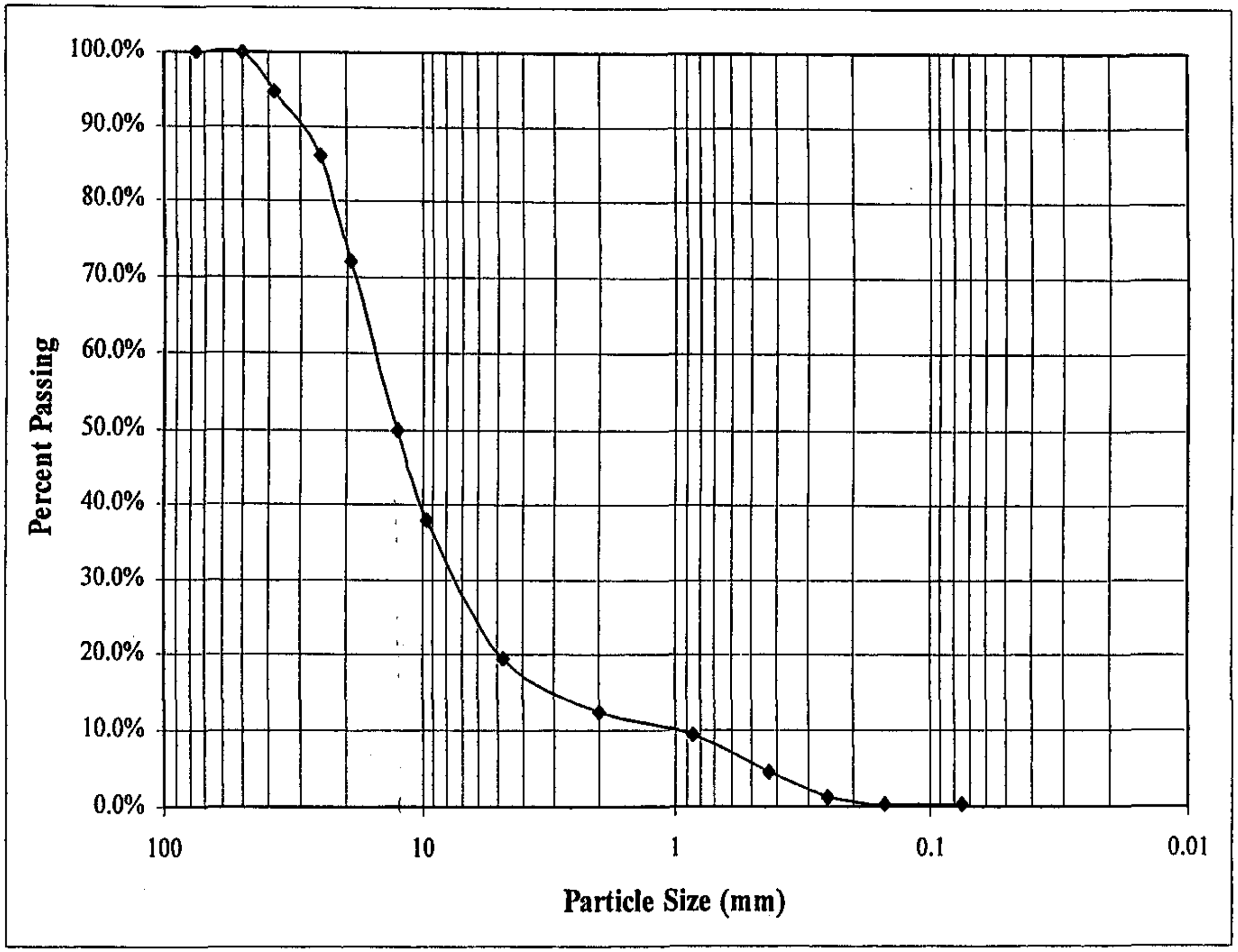
STREAM PLX15
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X15
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 15-2



Baker	Michael Baker Jr., Inc.
Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 15
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Figure Number:
PLX
15-3

REVISION:

NO:	DATE:		BY:

Photo PLX 15-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 15-2: Looking north at the upstream cross section (6/11/98).

STREAM PLX 15 PHOTOGRAPHS	
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	

Baker Michael Baker Jr., Inc.	
Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo15
Checked: JWA	Scale:

Photo Number:
PLX
15-1

Photo PLX 15-3: Looking north at the proposed pipeline crossing (6/3/98).

STREAM PLX 15 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247		PLX 15-2
	Drawn. JDA	File: photo15		
	Checked: JWA	Scale:		

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 15 at proposed pipeline crossing

Date: 6/3 ,1998 **Party:** T. Riopelle, J. Meckel

Width: 27.0 **Area:** 45.8 **Vel:** 1.07 **G.H.:** **Disch.:** 48.8 cfs

No Secs. 15 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** Noted **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
	upstream x-sec	WSE=	95.92
	100 feet downstream	WSE=	95.76
	of the upstream x-sec		
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: **ft. above bottom of weight.**

Spin before meas. ok **after** ok

Method: Wading at proposed pipeline crossing, upstream cross section.

Levels obtained

Measurement rated: Fair (8%) **based on following conditions:**

Cross section: Non-uniform long grass/cobbles.

Flow: Fairly well distributed. **Weather:** **Air °F@:**

Gage: **Water °F@:** 38.3

Other:

Record Removed: **Intake flushed:**

Observer

Control Riffle 100-140 ft downstream, clear no snow or ice. Grass and cobbles.

Remarks Grass in channel $\leq$ 8" long - cobbles round & smooth < 2 1/2".

G.H. of zero flow: **ft,**

DISCHARGE MEASUREMENT NOTES (PLX 15 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	90.0	1.0	0.0					0.00	0.0	0.0	Left edge water (0950 hr)
	92.0	1.5	0.5	s	15	58	584.00	0.53	0.8	0.4	
	93.0	2.0	1.1	0.6	15	50		0.67	2.2	1.5	
	96.0	2.8	1.5	0.6	27	49		1.22	4.0	4.9	
	98.5	1.8	1.9	0.6	25	42		1.32	3.3	4.4	
	99.5	2.3	2.8	0.2	30	44	1.51	1.28	6.3	8.1	
				0.8	25	53	1.05		0.0	0.0	
	103.0	2.8	3.2	0.2	30	44	1.51	1.34	8.8	11.8	
				0.8	2.5	48	1.16		0.0	0.0	
1	105.0	1.5	3.5	0.2	25	40	1.38	1.08	5.2	5.6	
				0.8	15	43	0.78		0.0	0.0	
0.96	106.0	1.5	2.5	0.6	25	51	1.09	1.05	3.8	4.1	
0.95	108.0	2.0	1.9	0.6	25	55	1.01	0.96	3.8	3.8	
0.88	110.0	2.0	1.2		15	48	0.70	0.62	2.4	1.7	
0.80	112.0	2.0	0.6		15	51	0.66	0.53	1.2	0.8	
0.96	114.0	2.0	1.0		15	54	0.63	0.60	2.0	1.3	
0.99	116.0	1.5	1.1		10	69	0.34	0.33	1.7	0.6	
	117.0	0.5	1.0		0				0.5	0.0	
											Right edge water (1020 hr)
	27.0	27.0							45.8	48.8	

Table PLX 15-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P15 TBM (TBM15A)
2	5156.394842	5000	98.581921	P15 P C/L (TBM15C)
3	5156.394842	5000	97.601921	GRN P C/L
11	4984.522847	4747.95347	99.971182	T
12	4954.324231	4759.386967	98.576253	T
13	4923.322943	4769.388282	98.723713	T
14	4891.841599	4778.814242	97.931538	T/GR
15	4882.800259	4782.992215	96.830313	GR
16	4878.080852	4785.007475	96.485044	LEW
17	4872.320071	4787.411542	95.774567	C
18	4867.216298	4789.109049	95.585362	C/TH
19	4863.365056	4789.957516	95.702541	C
20	4860.944111	4790.858081	96.487388	REW
21	4860.28092	4791.32296	96.658009	G
22	4853.005756	4794.00618	96.686026	G
23	4852.011794	4794.178986	96.473766	LEW
24	4849.757772	4795.126701	96.198092	C
25	4847.322499	4795.705356	96.083679	C
26	4843.809281	4796.530004	96.510742	REW
27	4841.135097	4797.321261	97.051849	T
28	4839.348969	4797.732223	97.917498	T
29	4833.739419	4799.372299	98.347349	CG US (TBM15B)
30	4809.723899	4806.879949	99.132323	T
31	4803.030723	4809.558163	98.82581	T
32	4855.065575	4749.331198	94.283021	TH/FL
33	4887.636857	4826.257622	94.812763	TH
34	4903.328682	4843.899307	94.330874	TH
35	4922.902586	4844.318889	93.692613	TH
36	4938.659735	4835.060999	93.321654	TH
37	4957.817992	4838.765975	94.539031	TH
38	5001.905038	4820.170407	94.562483	TH
39	5025.768386	4817.130898	94.332979	TH
40	5051.532175	4835.588563	92.976264	TH
41	5077.50297	4872.905085	94.618863	TH
42	5088.134474	4902.507164	93.736201	TH
43	5132.257147	4936.289694	90.981344	TH
44	5200.727565	4987.097707	94.196436	TH/FL
45	5219.459419	4890.322399	98.921149	T
46	5206.346767	4912.776762	98.035227	T
47	5194.85776	4932.709542	98.08029	T
48	5187.606579	4945.864923	97.340936	T
49	5185.623442	4949.475411	96.338174	T
50	5181.048258	4958.197093	96.8343	T
51	5178.497217	4963.188401	95.49388	LEW

Table PLX 15-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	5178.095967	4963.68953	95.286335	G
53	5178.012185	4963.756048	94.530328	C
54	5175.876184	4968.720063	94.212563	C
55	5175.025078	4970.139179	92.916738	C
56	5173.087492	4974.800684	92.317873	C/TH
57	5172.824818	4975.933168	92.332948	C
58	5171.905908	4977.94446	94.650119	G
59	5169.238062	4982.556555	95.131084	G
60	5167.454514	4985.169639	95.421043	REW
61	5164.904896	4989.219664	97.586484	T
62	5148.105063	5012.049956	98.196572	T
63	5126.451177	5031.456201	98.584207	T
64	5089.165936	5060.919942	98.408904	T

Legend:

G = grass	TH = thalweg	US = upstream	PK = "pk" nail
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	CL = center line	

file:plx15.xls

APPENDIX S: PLX 16

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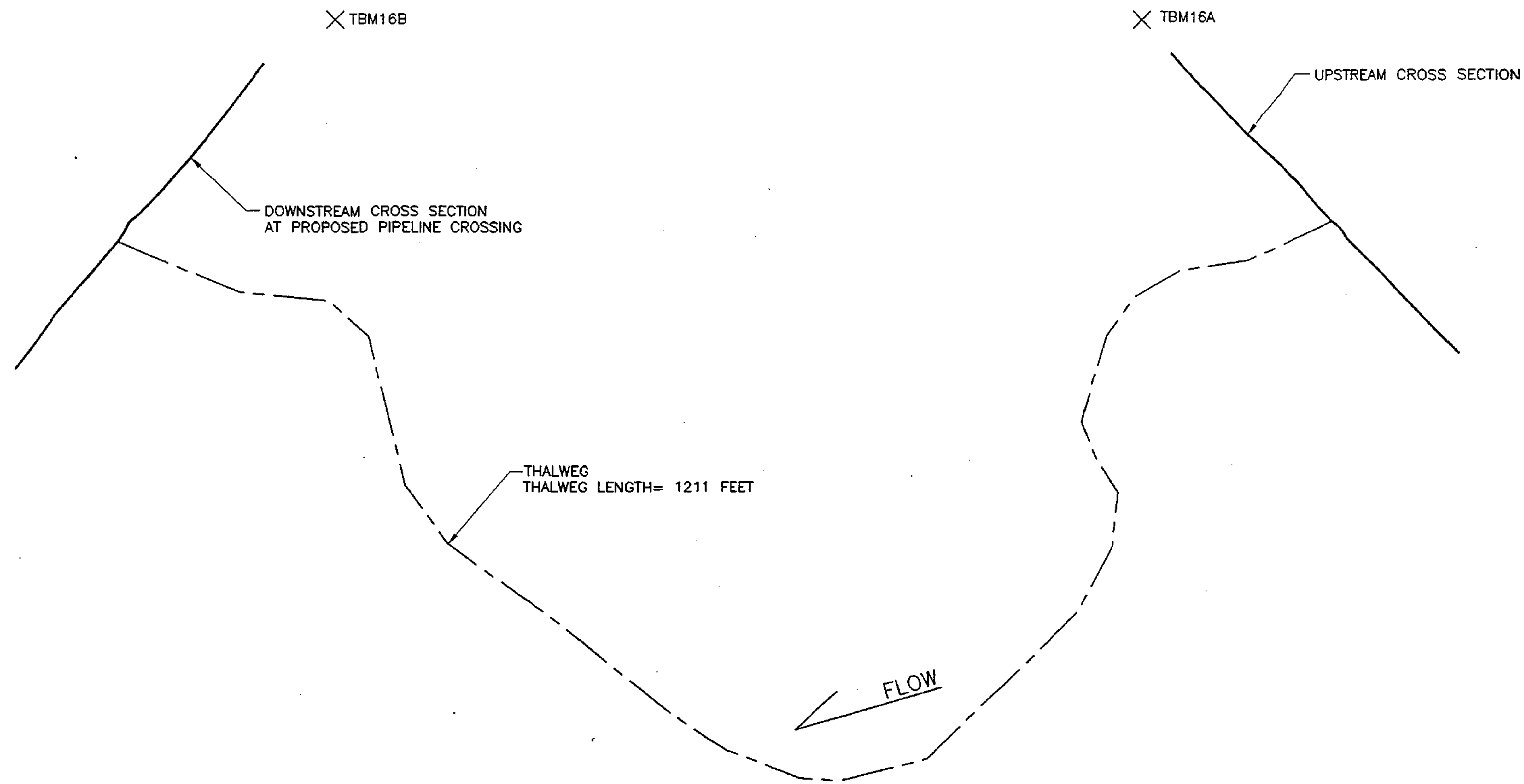


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM16A.

NO.:	DATE:	REVISION	BY:

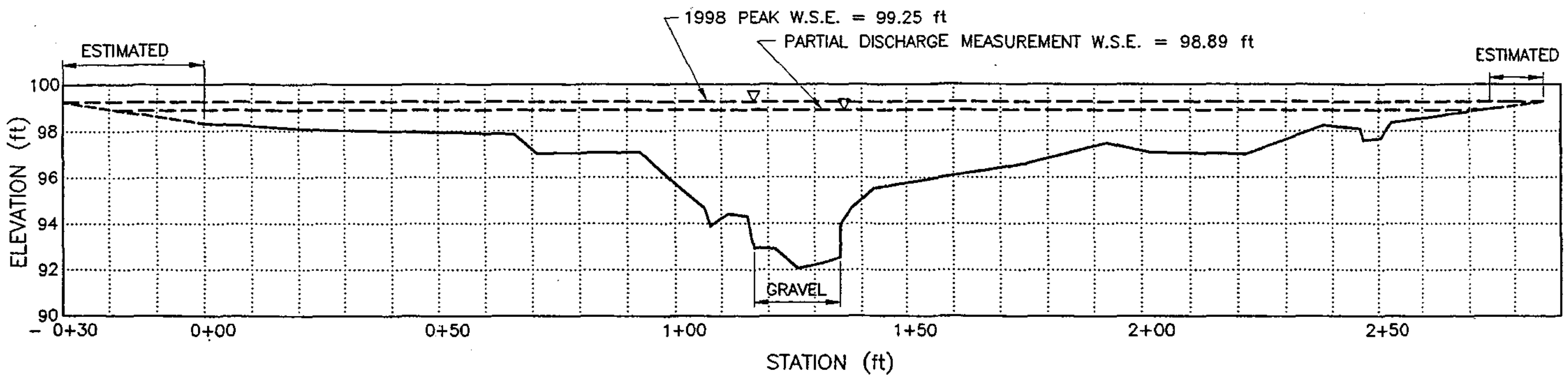
STREAM PLX16
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

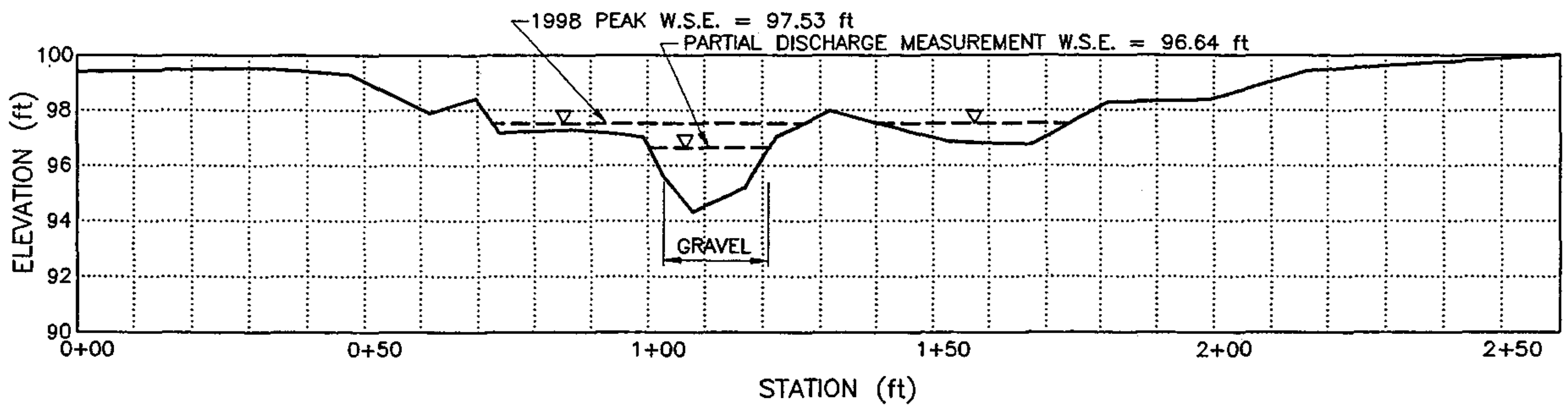
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X16
CHECKED:	JWA	SCALE:	1"= 80'

FIGURE:
PLX
16-1



PROFILE: PLX16 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX16 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM16A.
2. W.S.E.= WATER SURFACE ELEVATION

NO.:	DATE:	REVISION	BY:

STREAM PLX16
PROFILES
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP–X16
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 16-2

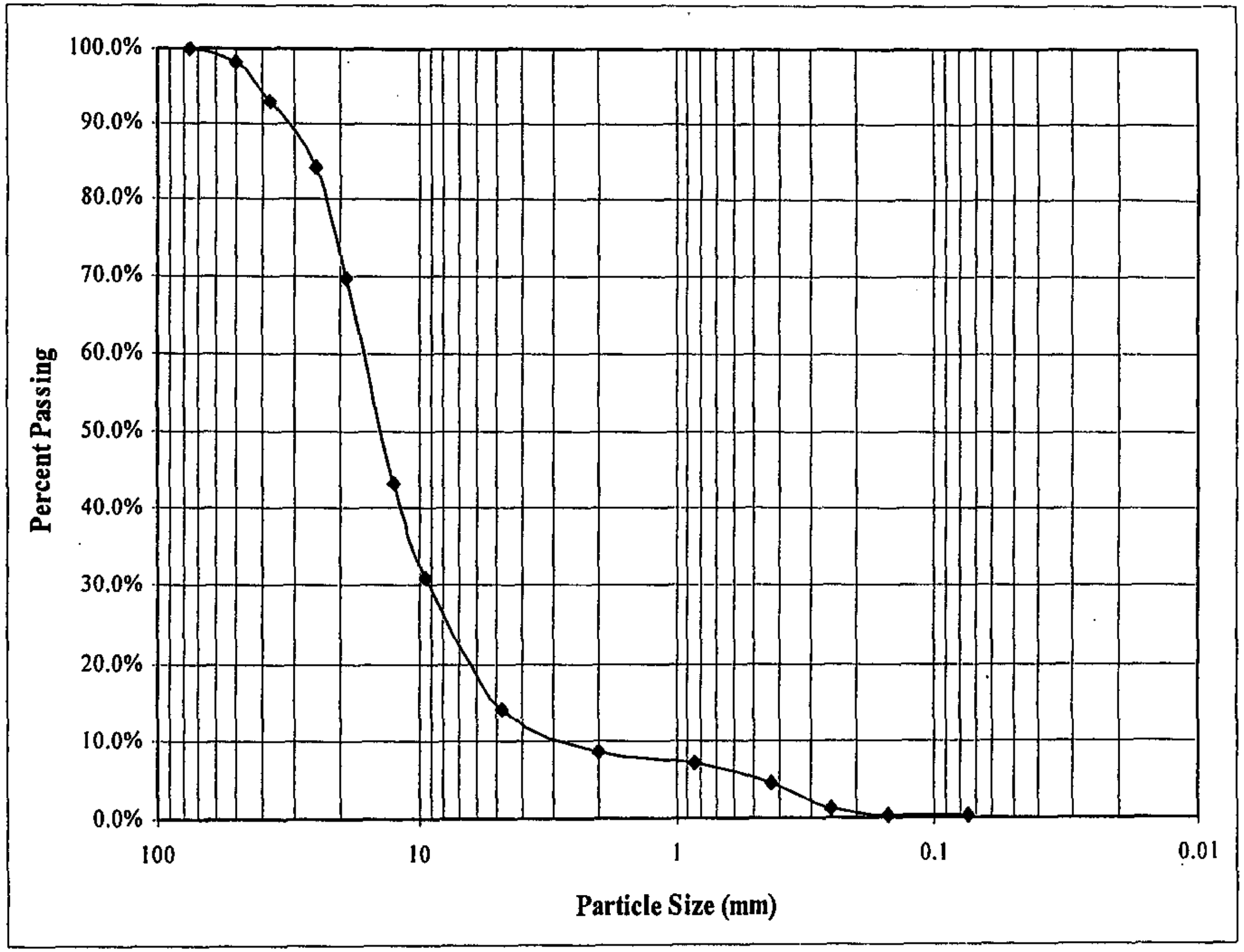


Figure Number: PLX 16-3

Baker Michael Baker Jr., Inc.

Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 16
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

REVISION:

NO:	DATE:		BY:

Photo PLX 16-1: Looking north at the proposed pipeline crossing (6/2/98).

Photo PLX 16-2: Looking north at the proposed pipeline crossing (6/5/98).

STREAM PLX 16 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 16-1
	Drawn: JDA	File: photo16	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 16 at proposed pipeline crossing (Partially Estimated)

Date: 5/30 ,1998 **Party:** J. Meckel, P. McGranahan

Width: 38 **Area:** 61.7 E **Vel:** 4.1 E **G.H.:** **Disch.:** 254 E cfs

No Secs. 7 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** **Meter No.**

Type of meter: Price A

Date rated: Std

Meter: ft. above bottom of weight.

Spin before meas. ok **after** ok

Method: Wading at proposed pipeline crossing, downstream cross section.

Gage Readings

Time	Recorder	Inside	Outside
	upstream x-sec	WSE=	98.89
	downstream x-sec	WSE=	96.64
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Levels obtained this date

Measurement rated: poor (over 8%), Partially Estimated **based on following conditions:**

Cross section: Fairly uniform - grass and small cobble.

Flow: 10%± snow affect. **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Channel - overbank flow, some ice on bottom.

Remarks Discharge was partially measured and partially estimated.
At stations 75 to 80 the depth was taken from survey notes, and the velocity was estimated at the time of measurement.

G.H. of zero flow: ft.

E = Estimated

DISCHARGE MEASUREMENT NOTES (PLX 16 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	42.0	5.5	0.0						0.0	0.0	Right edge water (1630 hr)
	53.0	8.5	1.4	0.6	50	41		2.68	11.9	31.9	
	59.0	7.5	1.8	0.6	80	40		4.37	13.5	59.0	
	68.0	8.0	2.6	0.6	100	48		4.55	20.8	94.6	
	75.0	5.0	2.6	E				5.00	13.0	65.0	Estimated
	78.0	2.5	1.0	E				1.50	2.5	3.8	Estimated
	80.0	1.0	0.0	E				0.00	0.0	0.0	Left edge water (1700 hr)
	38.0	38.0							61.7	254.3	

file: disch_P16.xls

Table PLX 16-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P16 TBM C/L (TBM16A)
2	4472.531131	5000	101.083249	P16 US TBM (TBM16B)
3	4472.536131	5000	100.853281	GROUND P16US
11	4262.768967	4768.062684	99.40077	T
12	4281.31956	4793.752006	99.544981	T
13	4290.324665	4806.889881	99.301371	HWM
14	4299.650097	4817.572515	97.890196	T
15	4304.692407	4823.844908	98.420094	T
16	4307.428774	4827.055095	97.176124	T
17	4316.353612	4837.307573	97.303895	T
18	4323.678531	4846.429734	97.037942	LEW
19	4326.163688	4849.139616	95.572685	G/C
20	4329.664924	4852.923873	94.311606	C/TH
21	4331.910191	4856.807833	94.72895	C
22	4334.572493	4860.463002	95.17761	C
23	4336.317855	4863.564417	96.438432	C
24	4337.089834	4865.397134	97.016292	REW
25	4344.382452	4871.537987	97.977869	T
26	4358.954421	4886.838184	96.847539	T
27	4368.337066	4898.211411	96.757233	T
28	4377.535968	4908.729967	98.28624	T
29	4388.734551	4922.372725	98.386841	T/C.G.U.S.
30	4399.145536	4936.081796	99.449834	T
31	4425.547073	4970.717976	100.019118	T
32	4278.086866	4875.862552	95.73035	TH/FL
33	4408.899045	4819.078598	96.092742	TH
34	4467.697894	4813.228232	95.155153	TH
35	4493.576836	4789.541975	95.217298	TH
36	4517.429229	4689.335381	94.340157	TH
37	4545.952425	4649.195207	93.437131	TH
38	4616.633383	4596.819153	94.666145	TH
39	4690.957266	4535.65958	93.113944	TH
40	4728.129837	4511.071694	93.232675	TH
41	4777.686488	4492.486409	92.574306	TH
42	4805.799211	4490.920068	92.96869	TH
43	4861.020324	4505.518042	92.967765	TH
44	4906.518803	4550.626452	93.056261	TH
45	4957.292102	4602.832461	93.697352	TH
46	4979.991588	4647.791526	93.269593	TH
47	4983.968243	4684.436805	93.802715	TH
48	4969.215019	4707.713891	92.307227	TH
49	4960.276023	4732.157967	91.90693	TH
50	4967.528876	4760.144923	92.147203	TH
51	4976.272548	4789.936115	93.176615	TH

Table PLX 16-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	4994.555712	4815.81	93.40463	TH
53	5025.757499	4834.148563	92.59634	TH
54	5071.380949	4840.92273	91.914413	TH
55	5138.791138	4880.081232	91.956211	TH/FL
56	5210.417885	4778.545512	98.316457	T
57	5193.144941	4797.158141	98.032411	T
58	5165.466084	4827.177035	97.851411	T
59	5162.213756	4830.902505	97.007996	T
60	5146.818751	4845.832606	97.065334	T
61	5141.96017	4850.934372	95.785929	T
62	5137.039196	4855.660909	94.655712	LEW
63	5136.471697	4856.899126	93.876943	G
64	5134.468709	4860.171391	94.394124	G
65	5131.84267	4863.221002	94.301491	G
66	5130.803225	4864.174221	92.948898	C
67	5127.390102	4867.036298	92.908054	C
68	5123.767002	4870.535504	92.048102	C/TH
69	5120.020859	4874.36267	92.280097	C
70	5117.600442	4877.164898	92.534873	C
71	5117.452949	4877.318956	93.964673	G
72	5115.919874	4879.108142	94.649492	REW
73	5112.747043	4882.531115	95.515988	T
74	5102.64849	4894.372544	96.020492	T
75	5090.491233	4906.810327	96.599902	T
76	5078.059339	4918.825291	97.479549	T
77	5071.209783	4924.759899	97.051935	T/S.G.C/L
78	5057.389668	4938.832749	96.985774	T
79	5045.580647	4950.407296	98.238712	T
80	5039.855599	4955.759602	98.098251	T
81	5039.152457	4956.195403	97.567956	T
82	5036.52819	4959.105559	97.675401	T
83	5034.856474	4960.676895	98.348683	T
84	5019.773114	4977.846097	98.966844	T

Legend:

G = grass	REW = right edge of water	DS = downstream	CL = center line
T = tundra	TH = thalweg	US = upstream	PK = "pk" nail
C = cobbles	CG = crest gage	TWET = wet tundra	
LEW = left edge of water	GB = ground break	M = mud	
	SH = shoulder	SB = sand bags	

file:plx16.xls

APPENDIX T: PLX 18

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Photo PLX 18-1: Looking east at the proposed pipeline crossing (6/3/98).

Photo PLX 18-2: Looking north at the proposed pipeline crossing (6/3/98).

STREAM PLX 18 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 18-1
	Drawn: JDA	File: photo18	
	Checked: JWA	Scale:	

APPENDIX U: PLX 19

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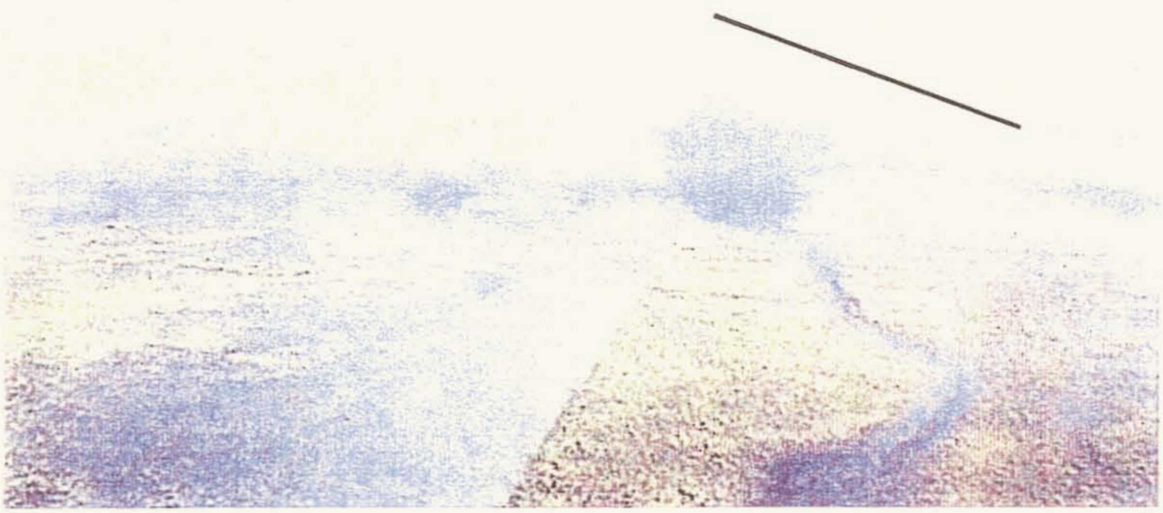

Photo PLX 19-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 19-2: Looking north at the proposed pipeline crossing (6/11/98).

STREAM PLX 19 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 19-1
	Drawn: JDA	File. photo19	
	Checked: JWA	Scale:	

APPENDIX V: PLX 20, 20A And 20B

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Photo PLX 20-1: Looking north at the proposed pipeline crossing of PLX 20 (6/3/98).

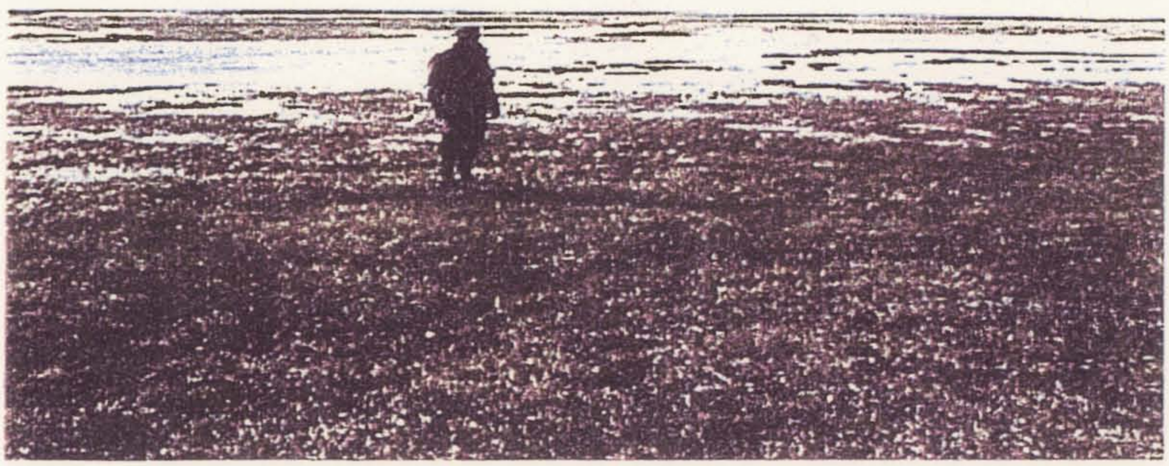

Photo PLX 20-2: Looking west at the proposed pipeline crossing of PLX 20A (6/3/98).

STREAM PLX 20 PHOTOGRAPHS SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Baker — Michael Baker Jr., Inc.		Photo Number: PLX 20-1
	Date: 6/7/98	Project: 23247	
	Drawn: JDA	File: photo20	
	Checked: JWA	Scale:	

Photo PLX 20-3: Looking northwest at the proposed pipeline crossing of PLX 20B and PLX 21 (6/11/98).

STREAM PLX 20 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.	Photo Number:
	Date: 6/7/98	Project: 23247	PLX 20-2
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Drawn: JDA	File: photo20	
	Checked: JWA	Scale:	

APPENDIX W: PLX 21

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Photo PLX 21-1: Looking north at the proposed pipeline crossing (6/11/98).

STREAM PLX 21 PHOTOGRAPHS SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Baker Michael Baker Jr., Inc.		Photo Number: PLX 21-1
	Date: 6/7/98	Project: 23247	
	Drawn: JDA	File: photo21	
	Checked: JWA	Scale.	

APPENDIX X: PLX 22

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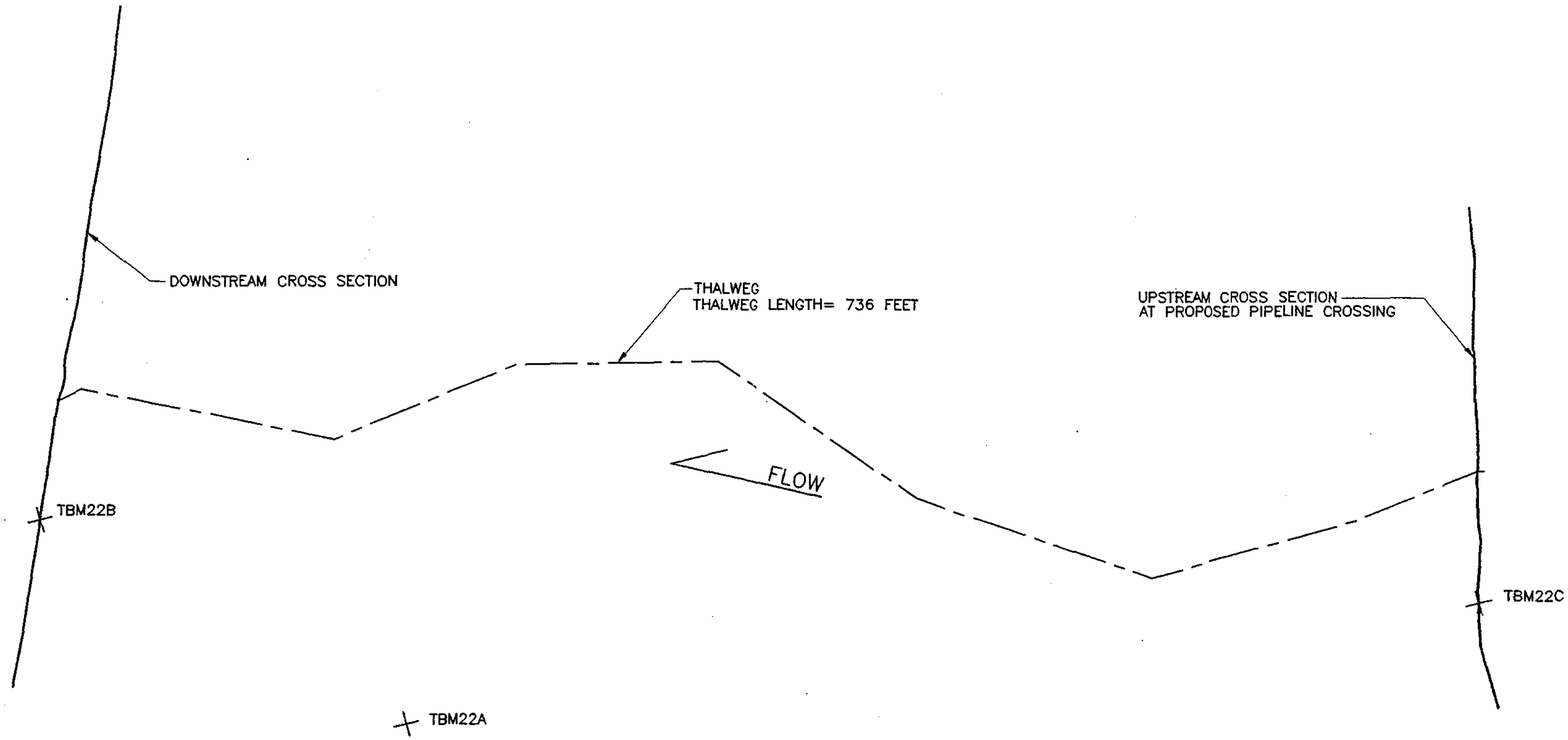


NOTES:

1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM22A.

REVISION			
NO.:	DATE:		BY:

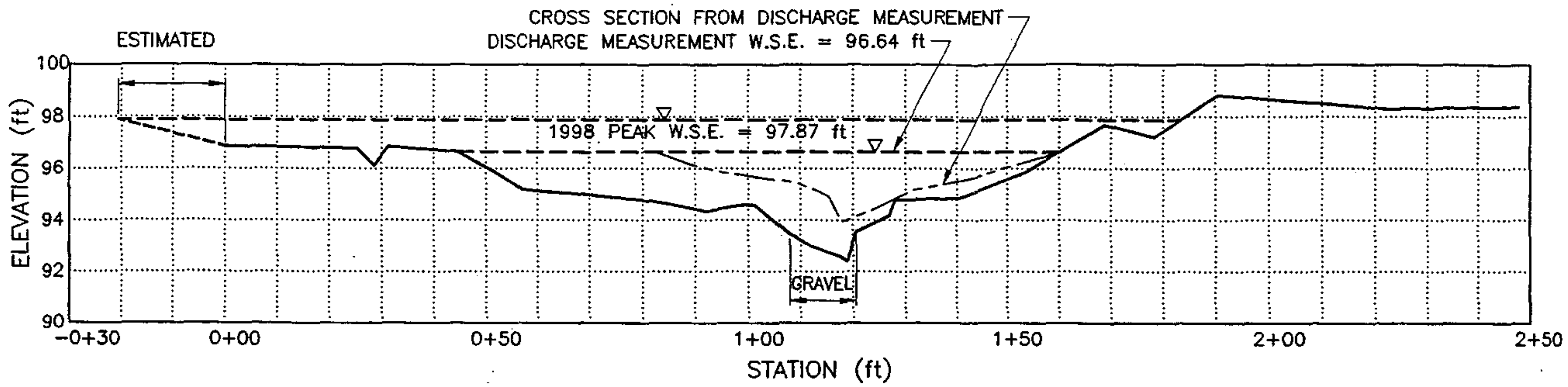
STREAM PLX22
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

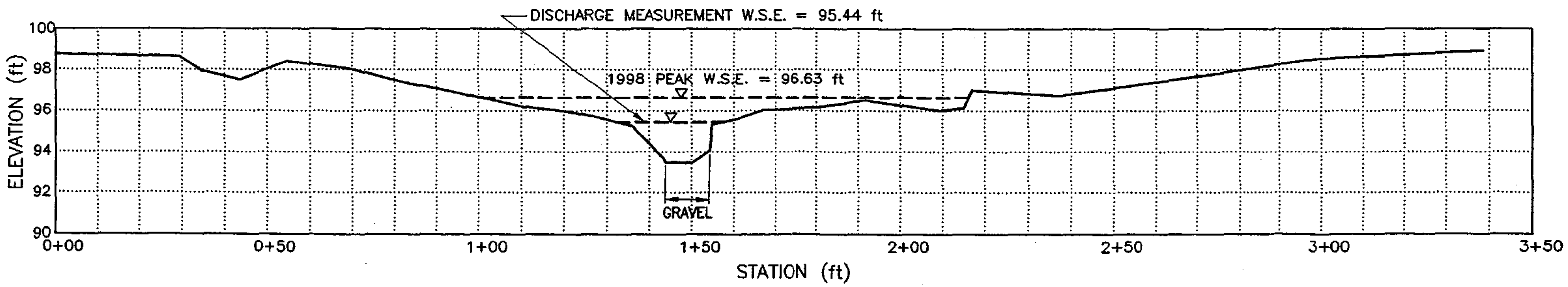
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X22
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX 22-1



PROFILE: PLX22 UPSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX22 DOWNSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM22A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION			
NO.:	DATE:		BY:

STREAM PLX22
PROFILES
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X22
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 22-2

Photo PLX 22-1: Looking north at the proposed pipeline crossing (6/11/98).

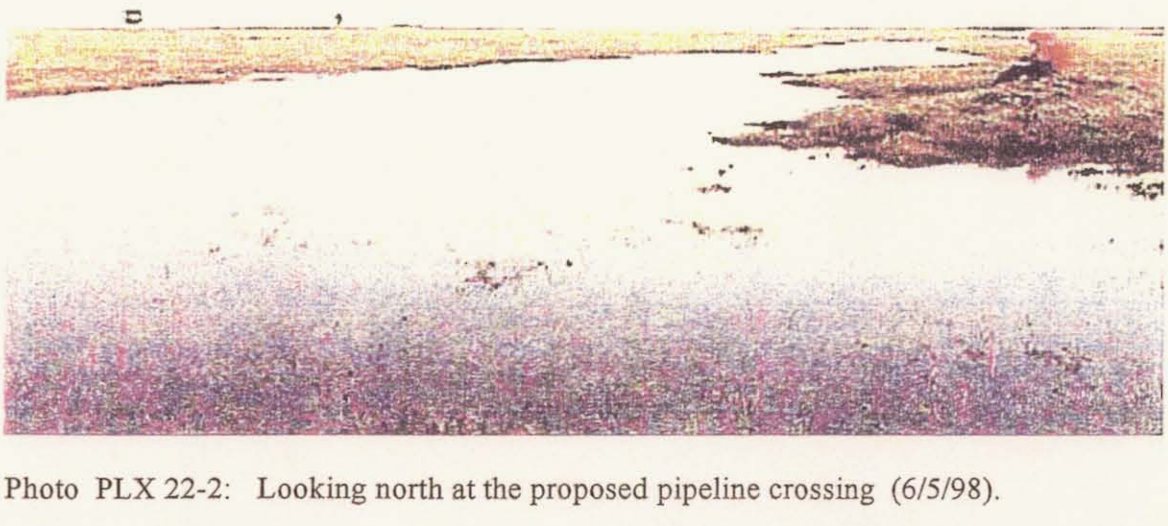


Photo PLX 22-2: Looking north at the proposed pipeline crossing (6/5/98).

STREAM PLX 22 PHOTOGRAPHS SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Baker Michael Baker Jr., Inc.		Photo Number: PLX 22-1
	Date: 6/7/98	Project: 23247	
	Drawn: JDA	File: photo22	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 22 at proposed pipeline crossing

Date: 5/31 ,1998 **Party:** J. Meckel, P. McGranahan

Width: 78 **Area:** 86.3 **Vel:** 1.36 **G.H.:** **Disch.:** 117 cfs

No Secs. 11 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.**

Gage Readings

Time	Recorder	Inside	Outside
	upstream x-sec	WSE=	96.64
	downstream x-sec	WSE=	95.44
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: ft. above bottom of weight.

Spin before meas. ok **after** ok

Method: Wading at pipeline crossing, upstream cross section.

Levels obtained this date

Measurement rated: Fair **based on following conditions:**

Cross section: Uniform, grass 4" - 8", cobbles 3".

Flow: **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Diagonal riffle 100-200' downstream clear. Flow just within banks.

Remarks

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 22 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	109.0	3.5	0.0						0.0	0.0	Left Edge Water (1730 hr)
	102.0	6.5	0.5	S	5	52	0.23	0.21	3.3	0.7	
	96.0	6.5	0.8	S	20	49	0.91	0.82	5.2	4.3	
	89.0	7.0	1.0	S	20	42	1.06	0.95	7.0	6.7	
	82.0	6.5	1.2	0.6	30	42		1.58	7.8	12.3	
	76.0	4.3	1.7	0.6	40	43		2.05	7.2	14.8	
	73.5	4.0	2.7	0.8	20	47	0.95	1.78	10.8	19.2	Edge grass
				0.2	50	42	2.61				Cobbles
	68.0	6.8	2.3	0.6	50	50		2.20	15.5	34.2	Edge grass
	60.0	10.0	1.5	0.6	30	44		1.51	15.0	22.7	
	48.0	14.5	1.0	0.6	3	42		0.18	14.5	2.6	Right edge water (1800 hr)
	31.0	8.5	0.0								
	78.0	78.0							86.3	117.3	

file: disch_P22.xls

Table PLX 22-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	P22 TBM (TBM22A)
2	4797.801083	5000	98.248303	P22 CG PC/L (TBM22B)
3	4797.701163	4999.995096	97.330924	GR
101	4827.099717	4921.988025	98.758263	T
102	4817.323665	4949.606319	98.620603	T
103	4815.292564	4954.674228	97.923393	T
104	4811.874844	4962.996586	97.501733	T
105	4808.101546	4973.210666	98.407435	T
106	4802.800458	4987.377279	98.047788	T
107	4794.216581	5007.93038	97.002989	T
108	4787.904106	5025.28569	96.201888	T
109	4783.910342	5035.025766	95.943471	LEW
110	4781.739136	5040.173225	95.730399	G
111	4779.205848	5046.014597	95.421651	G
112	4778.791891	5048.933778	95.274071	G
113	4776.178777	5055.983581	94.977933	G
114	4775.792991	5056.397805	93.489708	C/TH
115	4774.52745	5062.770463	93.479525	C
116	4773.237103	5066.542886	94.034208	C
117	4773.017583	5067.205331	95.306059	G
118	4769.910901	5072.736951	95.604782	G
119	4767.604429	5078.147041	96.015429	REW
120	4763.537011	5090.598686	96.147635	T
121	4760.28692	5101.711021	96.486029	T
122	4753.852906	5117.919255	96.018646	T
123	4751.709495	5123.357521	96.107402	T
124	4750.810376	5125.132605	96.990313	T
125	4743.068354	5144.068683	96.724966	T
126	4722.205214	5201.449298	98.510727	T
127	4705.848365	5238.187491	98.91	T
128	4704.354619	5009.463203	94.155671	TH/FL
129	4782.590197	5066.301763	93.680294	TH
130	4900.086799	5105.455365	94.253045	TH
131	4957.147269	5180.790358	93.445181	TH
132	5040.625484	5230.496588	94.041421	TH
133	5157.661739	5219.611673	93.719108	TH
134	5275.253003	5241.414014	93.26503	TH
135	5348.4305	5316.091424	93.093722	TH
136	5405.742717	5380.037988	93.438536	TH/FL
137	5318.074698	5477.5596	98.381456	T
138	5332.766348	5456.824866	98.29349	T
139	5348.210841	5429.068041	98.816235	T
140	5354.319789	5418.539438	97.221778	T
141	5359.624716	5410.534896	97.679615	T

Table PLX 22-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
142	5367.265844	5397.537883	95.853106	T
143	5374.698865	5386.15319	94.840489	T
144	5381.265158	5375.905602	94.76968	REW
145	5381.779941	5374.883147	94.149769	G
146	5384.701777	5369.309769	93.51925	G
147	5385.558562	5367.875989	92.411928	C
148	5386.137945	5366.377863	92.587167	C/TH
149	5388.835383	5361.415969	92.990264	C
150	5390.953228	5358.347251	93.446122	C/G
151	5394.474218	5352.580229	94.574987	G
152	5395.685194	5350.346373	94.579739	G
153	5399.123029	5344.817776	94.345415	G
154	5405.058247	5336.91661	94.720851	LEW
155	5411.874963	5323.241528	95.013574	T
156	5416.616517	5314.24401	95.165596	T
157	5423.292315	5303.373575	96.650278	T
158	5430.503223	5292.554433	96.828135	T
159	5432.263383	5290.560207	96.107095	T
160	5434.588804	5288.163433	96.786435	T
161	5452.863064	5269.752307	96.852788	T
162	5419.375752	5310.038643	96.912492	TOP REBAR (TBM22C)
163	5419.471945	5310.109757	95.811867	GROUND AT CGDS

Legend:

G = grass	REW = right edge of water	DS = downstream	CL = center line
T = tundra	TH = thalweg	US = upstream	PK = "pk" nail
C = cobbles	CG = crest gage	TWET = wet tundra	
LEW = left edge of water	GB = ground break	M = mud	
	SH = shoulder	SB = sand bags	

file:plx22.xls

APPENDIX Y: PLX 23

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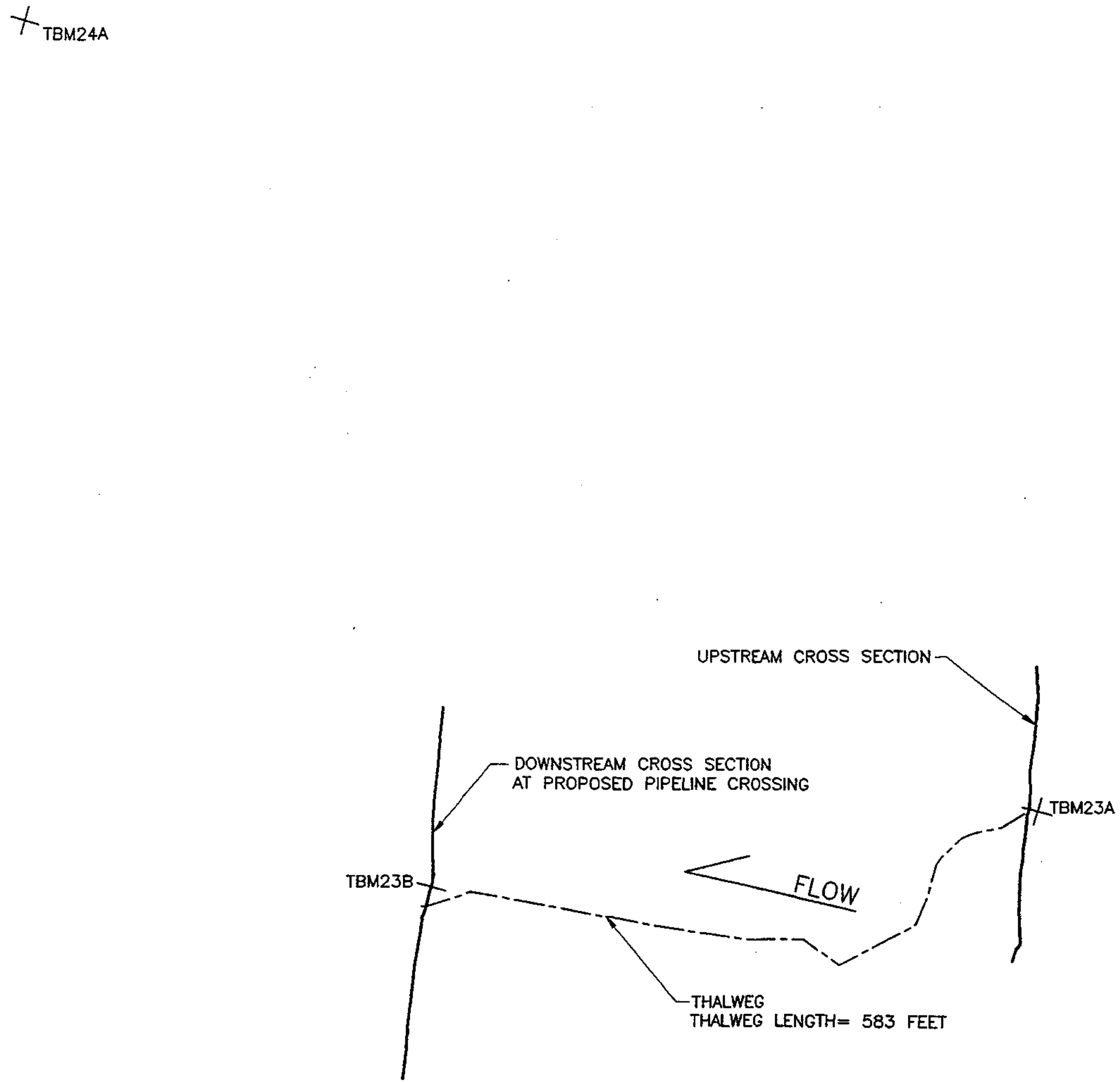


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM24A. THIS IS THE SAME TBM USED FOR THE PLX24 SURVEY.

REVISION			
NO.:	DATE:		BY:

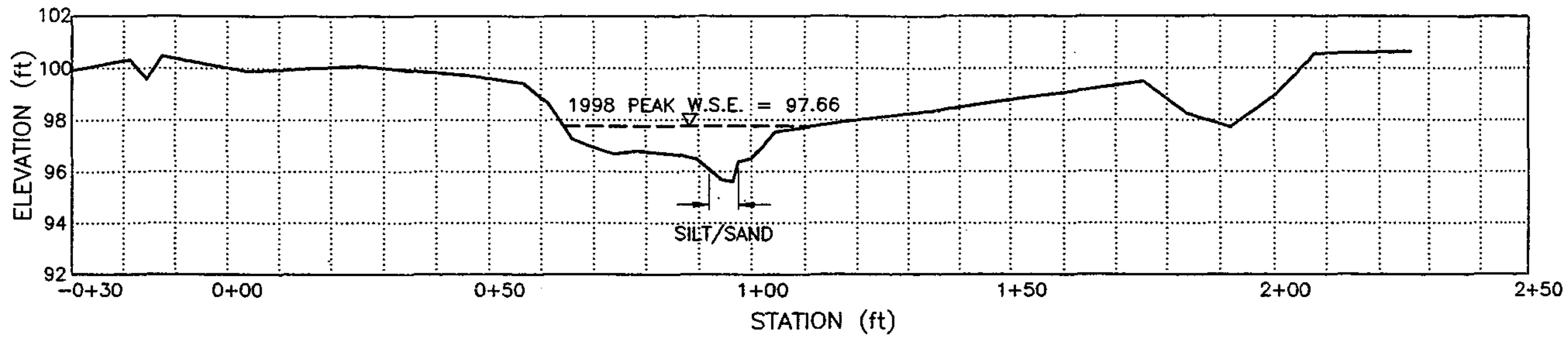
STREAM PLX23
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

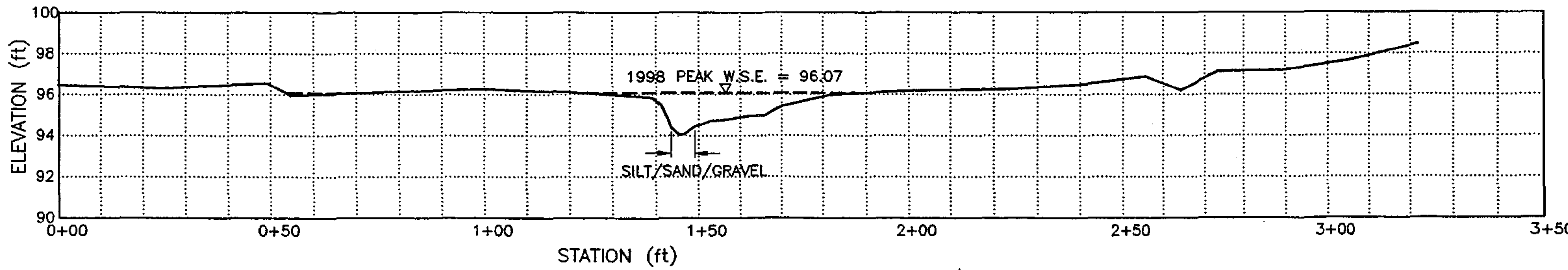
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X23
CHECKED:	JWA	SCALE:	1"= 120'

FIGURE:
PLX
23-1



PROFILE: PLX23 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX23 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM24A.
2. W.S.E.= WATER SURFACE ELEVATION

REVISION			
NO.:	DATE:		BY:

STREAM PLX23
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X23
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 23-2

Photo PLX 23-1: Looking west (upstream) at the proposed pipeline crossing (6/11/98).

Photo PLX 23-2: Looking upstream at the proposed pipeline crossing (6/4/98).

STREAM PLX 23 PHOTOGRAPHS	Baker	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247		PLX 23-1
	Drawn: JDA	File: phtot23		
	Checked: JWA	Scale:		

Table PLX 23-1: Survey Data For PLX 23 And PLX 24

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	TBM/P24 (TBM24A)
2	5000.005002	5206.363351	96.209	P24P/CL (TBM24C)
3	4050.7243	4824.871277	98.713	P23
11	5000.215148	5206.406944	95.142	CG/CL
12	4938.627226	5255.745242	96.675	316/T
13	4923.794945	5164.859872	97.544	T
14	4957.909632	5183.021714	96.818	T
15	4984.761965	5198.161539	96.122	T
16	5019.278108	5217.136397	94.184	T
17	5036.61483	5226.066791	94.699	T
18	5045.247891	5229.71656	91.347	T
19	5051.045674	5231.393314	90.17	T
20	5056.588642	5233.835005	90.189	G
21	5057.50804	5234.498853	89.701	LEW
22	5059.194618	5234.868313	88.814	M
23	5060.443593	5236.029727	88.985	M/C
24	5062.532873	5238.125947	89.408	C
25	5064.00008	5238.689535	89.685	REW
26	5065.275459	5239.519126	89.902	C
27	5072.722401	5244.288474	89.886	C
28	5080.307986	5248.65892	90.143	C
29	5087.103978	5253.687277	89.841	C
30	5091.572613	5255.869645	89.722	LEW
31	5095.064931	5258.127873	89.504	C
32	5096.933689	5259.81758	89.287	C
33	5100.164731	5260.86244	88.713	C
34	5103.021362	5262.523553	88.455	C
35	5105.804149	5263.78717	88.167	C/TH
36	5107.447332	5264.316731	88.181	C
37	5108.631268	5264.778984	88.732	G
38	5111.037464	5266.695708	89.751	REW
39	5115.796365	5269.884026	91.439	T
40	5126.410527	5275.099641	94.793	T
41	5164.87155	5300.797749	96.061	T
42	5208.157726	5318.89071	97.113	T
43	5372.733806	5076.417107	97.225	T
44	5338.565892	5047.607441	96.443	T
45	5313.498374	5024.504641	95.72	T
46	5304.010356	5015.356171	94.771	T
47	5287.916759	5004.020338	91.234	T
48	5284.085037	4999.924249	91.68	T
49	5281.293449	4996.965541	91.511	T
50	5280.412611	4996.193226	91.099	REW
51	5277.447257	4993.676925	90.991	C

Table PLX 23-1: Survey Data For PLX 23 And PLX 24 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
52	5274.343349	4991.005614	90.57	C
53	5270.832271	4988.49092	90.653	C
54	5267.467734	4985.208823	90.529	C
55	5263.987159	4982.253875	90.47	C
56	5260.407635	4978.851134	90.588	C
57	5257.160477	4976.118794	91.021	LEW
58	5255.20985	4974.339214	90.875	C
59	5252.628184	4972.258344	90.757	C
60	5251.73591	4971.398672	90.272	C
61	5251.159638	4970.594276	89.699	C
62	5249.60374	4968.732006	89.569	C
63	5247.686102	4966.38924	89.112	C/TH
64	5245.426157	4964.220499	89.525	C
65	5243.505295	4961.735033	89.905	C
66	5241.398681	4959.266768	90.293	C
67	5240.62349	4958.334982	90.682	LEW
68	5240.49451	4958.002959	91.3	T
69	5238.570407	4956.214137	91.872	T
70	5232.897673	4952.051753	91.836	T
71	5230.472945	4950.111503	93.765	T
72	5225.811709	4946.117288	94.08	T
73	5218.063232	4940.253735	95.465	T
74	5206.119201	4932.353238	95.28	T
75	5187.459468	4919.197158	95.811	T
76	5149.598463	4890.983119	96.586	T
77	5119.627707	4863.410509	96.876	T
78	5202.516647	4935.946994	95.555	US/CG (TBM24B)
79	5281.665286	4930.794651	87.343	TH/FL
80	5200.398305	5002.487317	88.892	TH
81	5168.991746	5103.761237	88.182	TH
82	5136.855395	5173.730134	87.89	TH
83	5120.370355	5232.507568	88.549	TH
84	5089.599264	5282.571494	86.571	TH/FL
101	3985.059053	4603.445377	96.922	CG/US (TBM23A)
102	4094.165768	4540.795795	100.643	T
103	4077.712784	4549.552705	100.558	T
104	4070.91889	4552.941867	98.981	T
105	4064.084528	4557.805393	97.724	T
106	4057.297151	4562.438693	98.251	T
107	4050.37409	4566.885773	99.485	T
108	4018.735465	4590.883075	98.381	T
109	4003.13007	4599.588898	97.942	T
110	3991.889838	4607.114916	97.511	T
112	3988.211942	4609.838527	96.505	G

Table PLX 23-1: Survey Data For PLX 23 And PLX 24 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
113	3986.616352	4611.714108	96.352	G
114	3985.985886	4612.716873	95.599	M/TH
115	3984.176064	4613.932051	95.676	M
116	3980.013076	4616.296991	96.471	G
117	3977.613674	4618.254078	96.643	G
118	3974.190576	4620.489764	96.712	G
119	3971.041237	4622.856938	96.797	G
120	3967.477727	4625.334279	96.677	G
121	3963.922521	4628.104055	96.971	LEW
122	3961.217796	4630.220465	97.25	T
123	3957.219472	4632.531185	98.615	T
124	3953.14919	4635.248141	99.414	T
125	3944.892692	4642.016238	99.719	T
126	3927.076215	4653.095689	100.066	T
127	3908.79276	4664.007363	99.875	T
128	3894.432901	4671.797165	100.453	T
129	3892.059627	4673.630202	99.581	T
130	3890.417528	4677.375559	100.321	T
131	3882.817601	4685.870768	99.916	T
132	3952.389045	4596.600299	96.545	TH/FL
133	3987.141565	4633.300493	95.292	TH
134	3994.877345	4657.841228	96.039	TH
135	3996.483505	4669.125087	95.5	TH
136	3990.315917	4691.821775	95.091	TH
137	3987.685392	4698.69532	93.314	TH
138	3967.924608	4718.345339	93.675	TH
139	3951.058505	4739.464121	94.935	TH
140	3952.096513	4812.960261	95.344	TH
141	3987.132719	4827.701803	95.116	TH
142	4012.817632	4872.134857	92.976	TH
143	4062.270426	4933.835945	94.219	TH
144	4117.228001	4997.095331	94.315	TH
145	4163.869623	5052.191943	94.254	TH
146	4193.253419	5136.660986	94.089	TH/FL
147	4313.871472	4991.65488	98.449	T
148	4300.423352	5001.205014	97.662	T
149	4287.58123	5010.683567	97.178	T
150	4273.998465	5019.664809	97.12	T
151	4267.012329	5025.039354	96.196	T
152	4260.047993	5030.015284	96.873	T
153	4246.914606	5039.256959	96.481	T
154	4233.283479	5048.722024	96.245	T
155	4214.898794	5059.360948	96.199	T
156	4196.979517	5069.380424	95.979	T

Table PLX 23-1: Survey Data For PLX 23 And PLX 24 (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
157	4187.39375	5075.338496	95.444	REW
158	4184.179616	5078.140601	94.977	G
159	4181.38563	5081.277844	94.961	G
160	4178.123827	5084.082603	94.796	G
161	4174.67899	5087.52778	94.701	G
162	4171.984897	5090.220062	94.439	M
163	4170.347476	5091.719341	94.097	M/TH
164	4169.375462	5092.95612	94.037	C
165	4168.005522	5094.403059	94.376	C
166	4167.524933	5095.141035	94.884	G
167	4166.3626	5096.054337	95.48	LEW
168	4165.264583	5098.204622	95.862	T
169	4150.855481	5109.363248	96.095	T
170	4133.44518	5123.293583	96.246	T
171	4097.848065	5149.10334	95.962	T
172	4093.680391	5152.443656	96.569	T
173	4073.008108	5165.869725	96.305	T
174	4053.067942	5180.315167	96.452	T
175	4188.414476	5076.599262	95.527	P23/CG/PCL (TBM 23B)
176	4938.382957	5255.841982	96.616	CK361
177	4999.98999	5206.58056	95.151	CKP24PCL
178	5202.859192	4936.316645	95.534	CKP24US

Legend:

G = grass	TH = thalweg	US = upstream	PK = "pk" nail
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	CL = center line	

file:plx23&24.xls

APPENDIX Z: PLX 24

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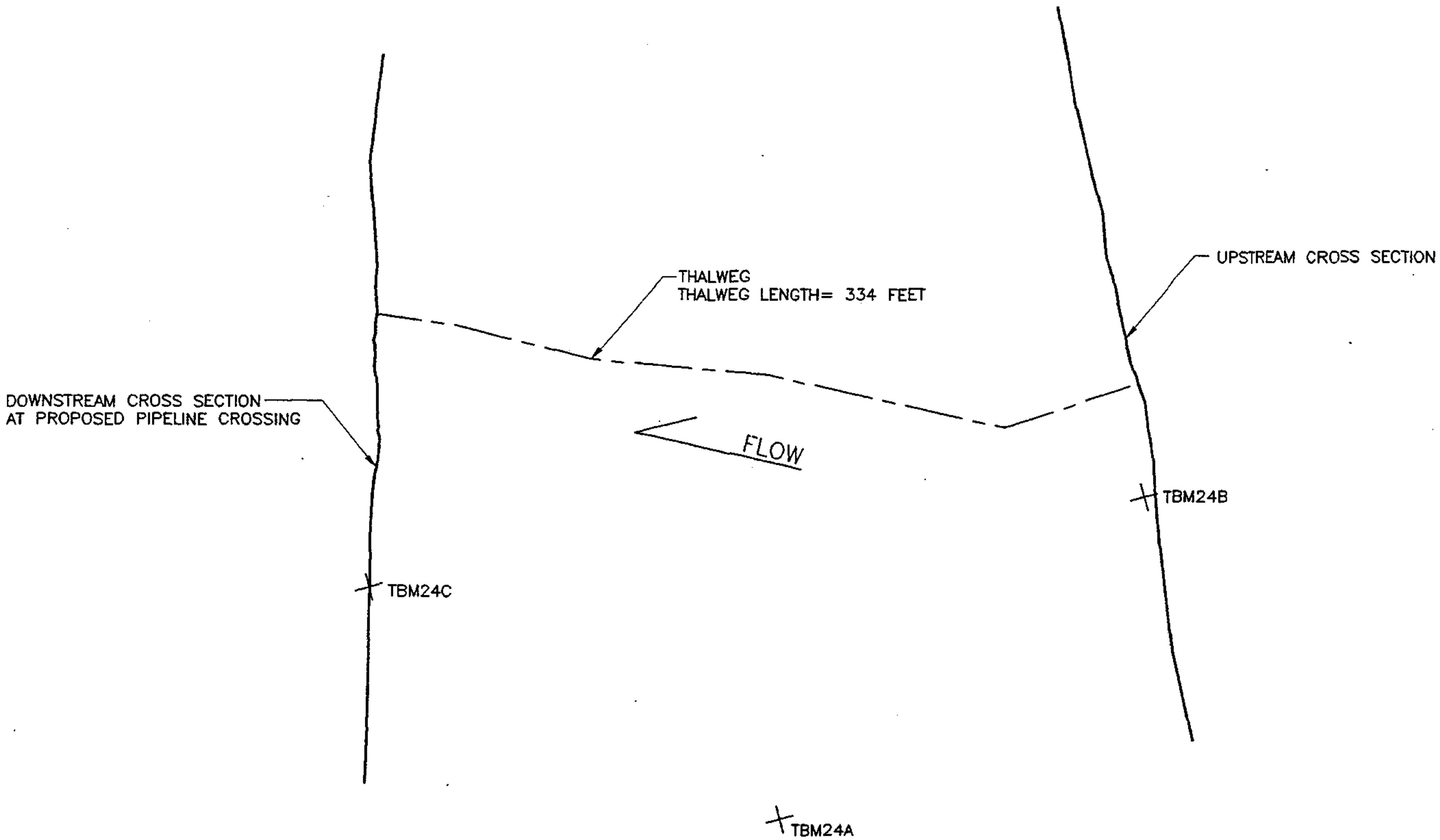
Notes:

1. The survey data associated with PLX 024 were collected in combination with the data collected for PLX 23 and are presented in Table PLX 23-1.



NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM24A.

REVISION			
NO.:	DATE:		BY:

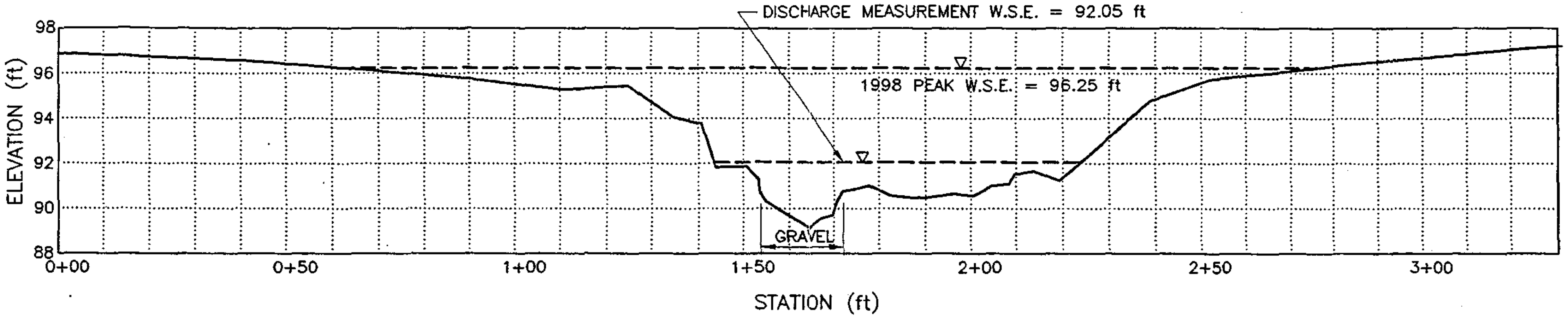
STREAM PLX24
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

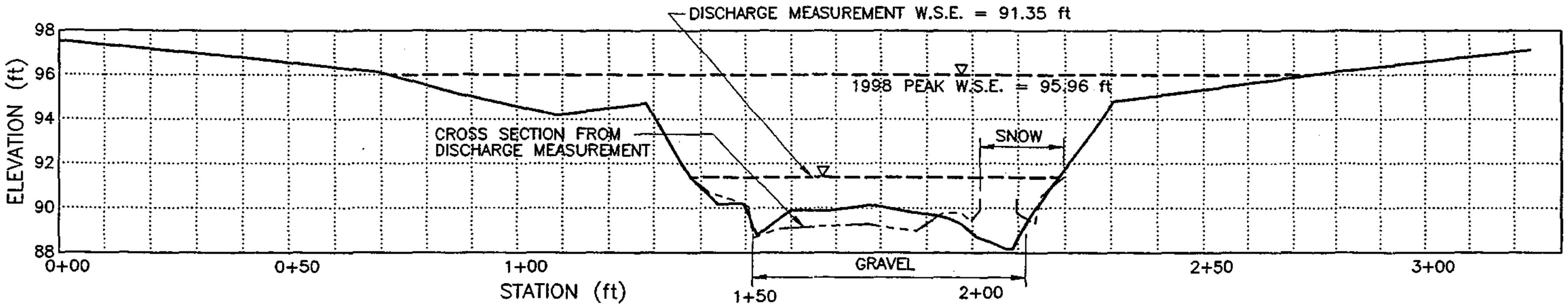
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X24
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE: PLX 24-1



PROFILE: PLX24 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX24 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM24A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

REVISION

NO.:	DATE:		BY:

STREAM PLX24
PROFILES

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X24
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 24-2

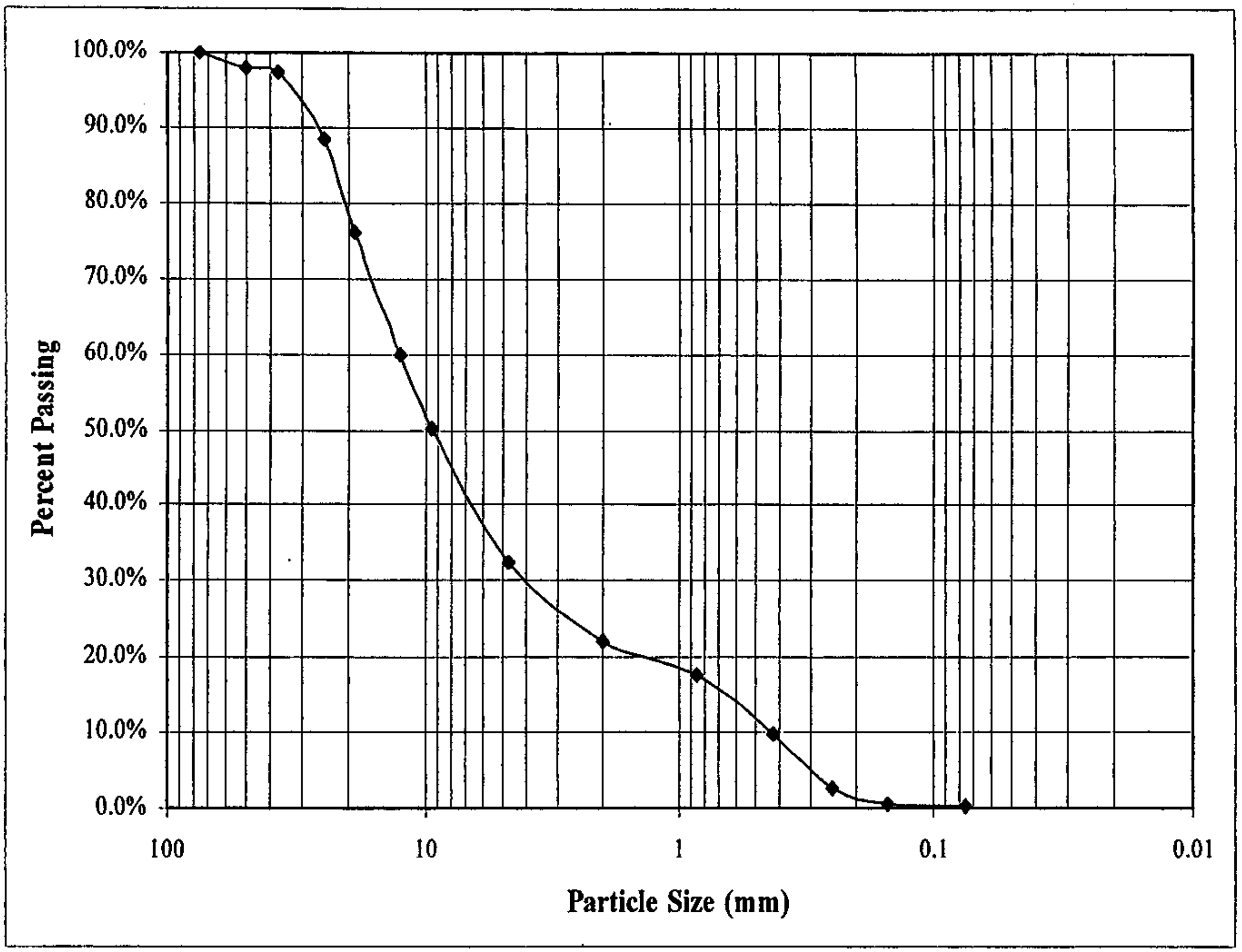


Figure Number: PLX 24-3

Baker Michael Baker Jr., Inc.

Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 24
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

REVISION:			
NO:	DATE:		BY:

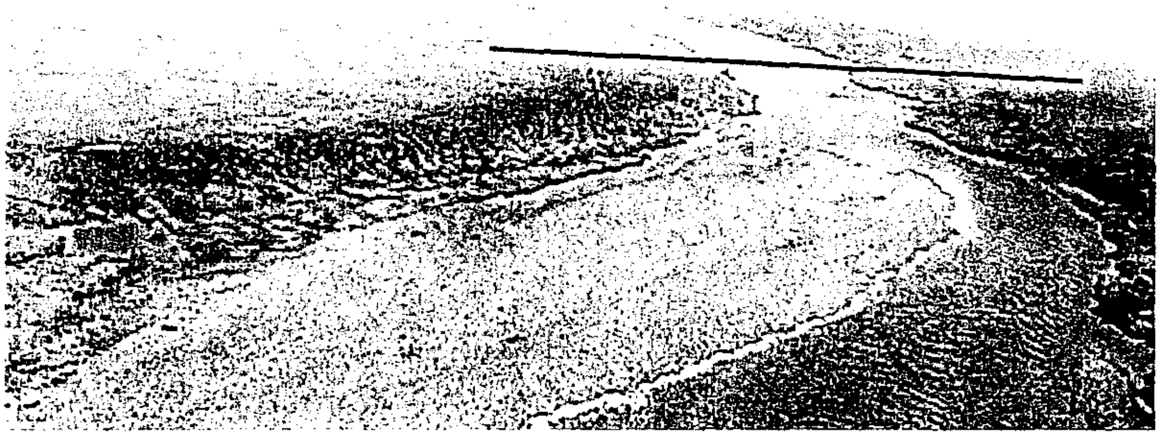


Photo PLX 24-1: Looking northwest at the proposed pipeline crossing (6/11/98).

Photo PLX 24-2: Looking north at the upstream cross section (6/11/98).

STREAM PLX 24
PHOTOGRAPHS

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Michael Baker Jr., Inc.

Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo24
Checked: JWA	Scale:

Photo Number:

PLX
24-1

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 24 at proposed pipeline crossing

Date: 5/31 ,1998 **Party:** J. Meckel, P. McLanahan

Width: 74 **Area** 94.7 **Vel:** 2.86 **G.H.:** **Disch.:** 271 cfs

No Secs. 18 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.**

Gage Readings			
Time	**Recorder**	**Inside**	**Outside**
	upstream x-sec	WSE=	92.05
	downstream x-sec	WSE=	91.35
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Type of meter: Price AA

Date rated: Std No 1

Meter: **ft. above bottom of weight.**

Spin before meas. ok **after** ok

Method: Wading at proposed pipeline crossing, downstream cross section.

Levels obtained this date

Measurement rated: **based on following conditions:**

Cross section: Uniform except for ice and snow along right portion.

Flow: **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Narrow channel 150' downstream uniform clear of snow and ice.

Remarks Cross section is uniform. Bed material smooth, cobbles 2" and sand. Grass 4-8" laid down by flow.
Snow and ice extend above the water surface between stations 28 and 36.

G.H. of zero flow: **ft.**

DISCHARGE MEASUREMENT NOTES (PLX 24 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	18.0	2.5	0.0						0.0	0.0	Right Edge Water (16:30)
	23.0	3.0	0.9	0.6	20	48		0.93	2.7	2.5	
	24.0	2.5	2.1	0.6	25	48		1.16	5.3	6.1	bottom ice
	28.0	2.0	1.6	0.6	40	46		1.92	3.2	6.1	Left Edge Water (edge snow)
	36.0	1.0	1.5	0.6	60	49		2.69	1.5	4.0	Right Edge Water (edge snow)
	38.0	2.0	2.0	0.6	80	50		3.50	4.0	14.0	cobbles
	40.0	3.0	1.6	0.6	80	50		3.50	4.8	16.8	"
	44.0	5.0	1.6	0.6	80	49		3.57	8.0	28.6	"
	50.0	5.5	1.4	0.6	80	46		3.80	7.7	29.3	"
	55.0	5.0	1.3	0.6	80	45		3.89	6.5	25.3	"
	60.0	7.5	1.1	0.6	80	45		3.89	8.3	32.1	"
	70.0	10.0	1.2	0.6	60	41		3.21	12.0	38.5	"
	80.0	8.0	1.3	0.6	50	50		2.20	10.4	22.9	"
	86.0	3.5	2.7	0.6	50	42		2.61	9.5	24.7	"
	87.0	2.5	1.3	0.6	60	45		2.92	3.3	9.5	grass
	91.0	4.5	1.0	0.6	30	42		1.58	4.5	7.1	grass
	96.0	4.5	0.7	s	25	42	1.32	1.19	3.2	3.7	grass
	100.0	2.0	0.0						0.0	0.0	Left Edge Water (17:15)
Total	74.0	74.0							94.7	271.2	

file: disch_P24.xls

APPENDIX AA: PLX 25

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Photo PLX 25-1: Looking north at the proposed pipeline crossing (6/11/98).

STREAM PLX 25 PHOTOGRAPHS	
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	

Baker	Michael Baker Jr., Inc.
Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo25
Checked: JWA	Scale:

Photo Number:
PLX
25-1

APPENDIX BB: PLX 26

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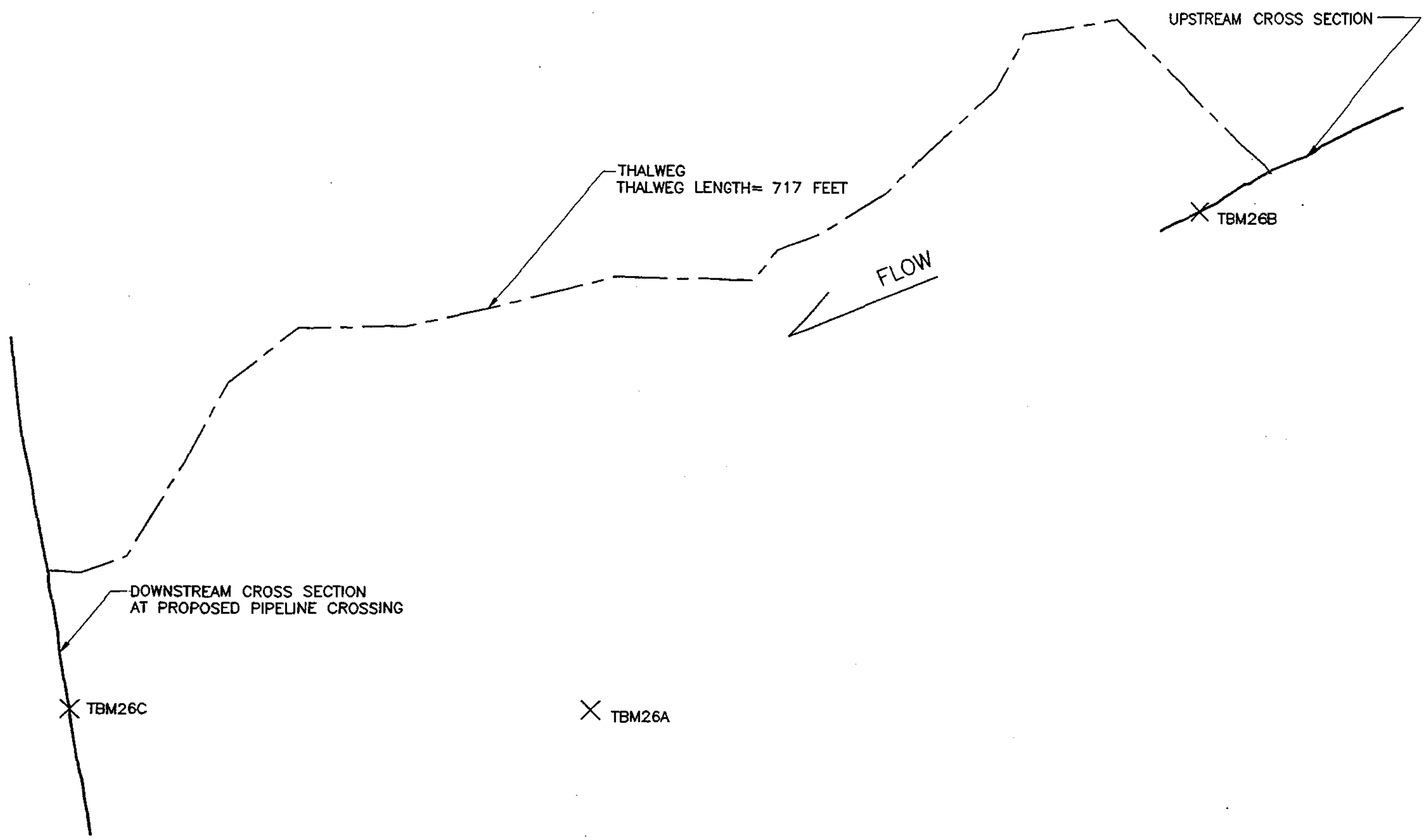


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM26A.

NO.:	DATE:	REVISION	BY:

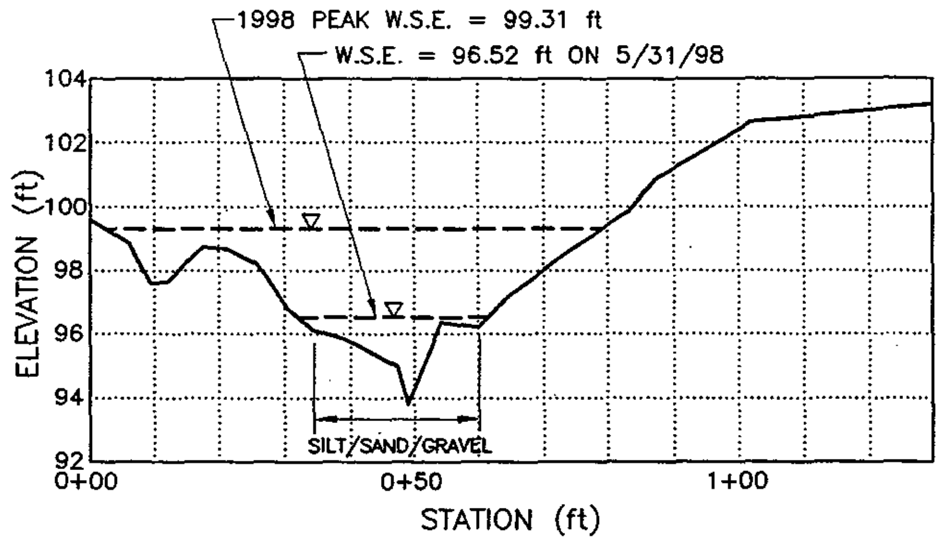
STREAM PLX26
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

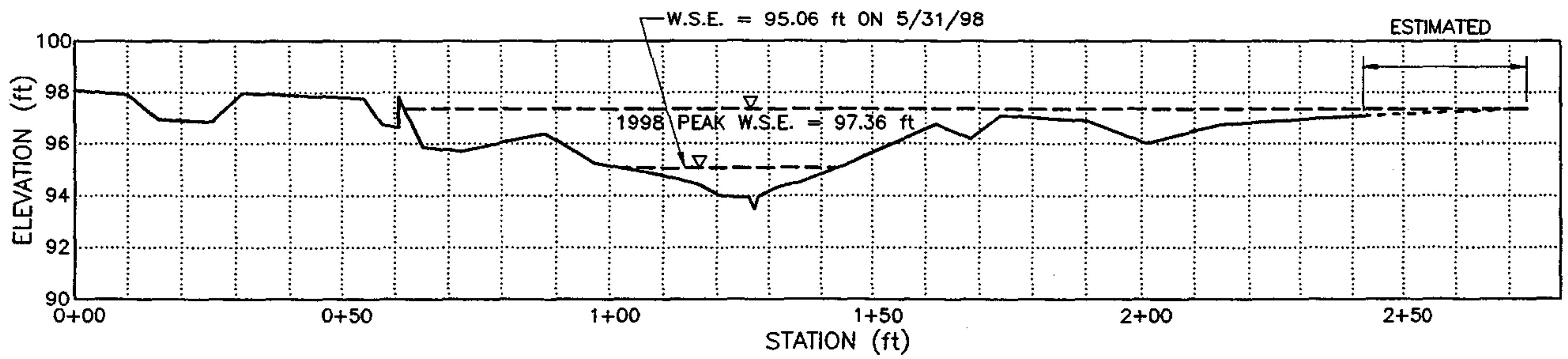
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X26
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX
26-1



PROFILE: PLX26 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX26 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM26A.
2. W.S.E.= WATER SURFACE ELEVATION

NO.:	DATE:	REVISION	BY:

STREAM PLX26
PROFILES
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X26
CHECKED:	JWA	SCALE:	VARIES

FIGURE:
PLX 26-2

Photo PLX 26-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 26-2: Looking north from upstream of the proposed pipeline crossing (6/11/98).

STREAM PLX 26 PHOTOGRAPHS	Baker — Michael Baker Jr., Inc.	Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98 — Project: 23247 Drawn: JDA — File: photo26 Checked: JWA — Scale:	PLX 26-1

Table PLX 26-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	TBM.P26 (TBM26A)
2	5000	5242.618129	97.817	P26.P.C/L.REB. (TBM26C)
11	4999.929467	5242.475498	96.625	T.CG.C/L
12	4940.098773	5232.480848	98.06	T
13	4949.974609	5233.873088	97.912	T
14	4955.762017	5235.12247	96.932	T
15	4965.416674	5236.618367	96.851	T
16	4970.864563	5238.052349	97.974	T
17	4993.539686	5242.001632	97.749	T
18	4996.94938	5242.467182	96.724	T
19	5004.423763	5243.622509	95.864	T
20	5011.469703	5244.727352	95.717	T
21	5026.754101	5247.280559	96.394	T
22	5035.742016	5248.245538	95.256	T
23	5048.297517	5250.184834	94.798	T
24	5054.955614	5251.463419	94.433	LEW/G
25	5058.733578	5252.25401	94.017	G
26	5062.145602	5252.535841	93.934	G
27	5064.560293	5252.538261	93.923	G
28	5065.791871	5252.779835	93.482	G/TH
29	5066.292797	5252.967904	93.92	G
30	5070.294115	5253.663402	94.361	G
31	5073.784108	5254.542235	94.491	REW/G
32	5084.633008	5256.42775	95.34	T
33	5099.932677	5259.243504	96.743	T
34	5106.210424	5260.044445	96.189	T
35	5111.762929	5261.024532	97.084	T
36	5127.604293	5264.469158	96.891	T
37	5138.199228	5265.903013	96.002	T
38	5152.116679	5267.501943	96.756	T
39	5178.981388	5270.197866	97.089	T
40	5240.162648	4713.122164	98.679	CG/US (TBM26B)
41	5231.266465	4732.455688	99.576	T
42	5234.255247	4726.997904	98.857	T
43	5235.623836	4724.03867	97.591	T
44	5236.413014	4721.518849	97.663	T
45	5238.773628	4716.55878	98.734	T
46	5242.382406	4709.126616	98.192	T
47	5244.224902	4704.768235	96.773	T
48	5246.730685	4701.739115	96.133	LEW/G
49	5248.999947	4697.909072	95.866	G
50	5253.390568	4690.692674	94.999	G/M
51	5253.642319	4688.803619	93.806	M
52	5256.792471	4684.548497	92.674	M/C

Table PLX 26-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
53	5259.4215	4679.355162	92.52	TH/C
54	5261.196898	4675.410579	93.454	M
55	5264.648892	4667.621633	94.751	M/G
56	5266.703708	4661.907155	95.571	G
57	5268.610194	4658.2484	96.124	REW/G
58	5271.450486	4655.047963	97.124	T
59	5278.313158	4640.895369	98.947	T
60	5289.56592	4616.352585	99.486	T
61	5190.025616	4651.045823	94.502	TH/FL
62	5331.394415	4753.310969	91.745	TH
63	5324.430331	4796.649586	93.604	TH
64	5298.299723	4810.084084	93.227	TH
65	5248.544624	4861.18797	92.793	TH
66	5230.469871	4889.797073	92.073	TH
67	5221.898745	4911.090809	93.227	TH
68	5207.336041	4924.125784	92.33	TH
69	5208.848796	4988.800855	92.91	TH
70	5193.492271	5048.297847	93.528	TH
71	5184.950392	5086.292913	93.784	TH
72	5184.103454	5135.967126	93.45	TH
73	5157.501742	5169.187499	93.137	TH
74	5118.664429	5189.606057	92.722	TH
75	5073.560956	5216.324504	92.018	TH
76	5065.322931	5237.738555	93.438	TH
77	5059.025761	5294.355159	92.61	TH/FL

Legend:

G = grass	TH = thalweg	US = upstream	PK = "pk" nail
T = tundra	CG = crest gage	TWET = wet tundra	
C = cobbles	GB = ground break	M = mud	
LEW = left edge of water	SH = shoulder	SB = sand bags	
REW = right edge of water	DS = downstream	CL = center line	

file:plx26.xls

APPENDIX CC: PLX 27

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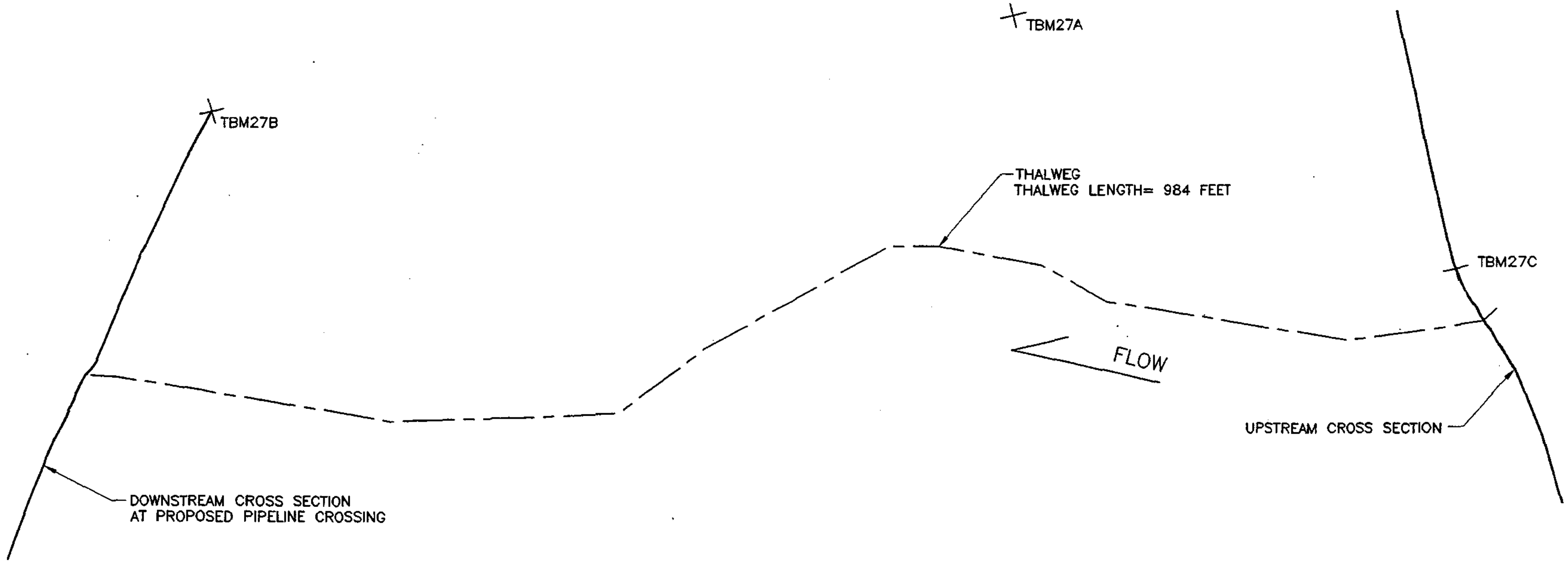


NOTES:

1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM27A.

REVISION			
NO.:	DATE:		BY:

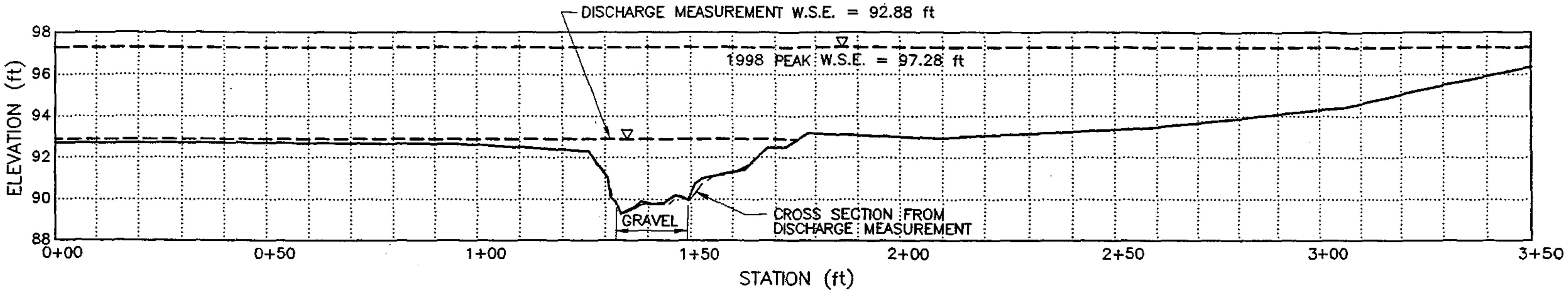
STREAM PLX27
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

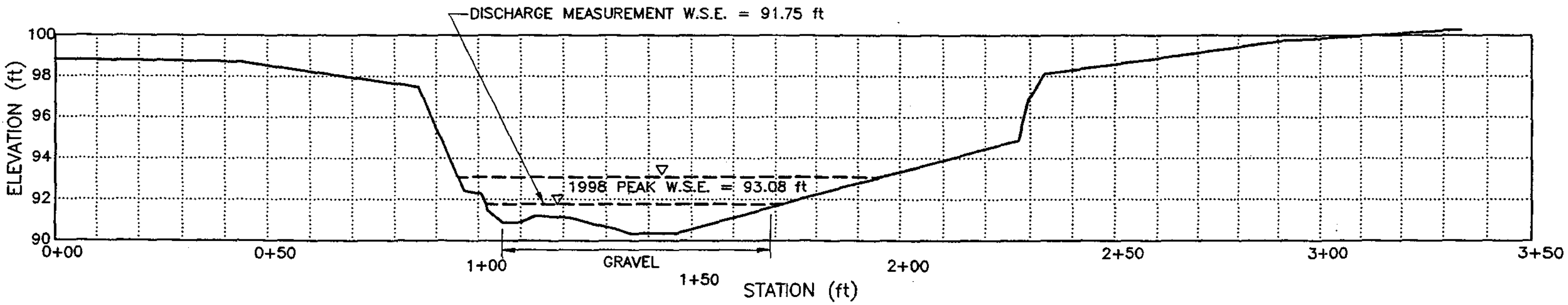
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X27
CHECKED:	JWA	SCALE:	1"= 80'

FIGURE: PLX 27-1



PROFILE: PLX27 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX27 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM27A.
2. W.S.E.= WATER SURFACE ELEVATION
3. THE DIFFERENCE IN THE SURVEY AND DISCHARGE MEASUREMENT CROSS SECTIONS IS DUE TO A SLIGHT DIFFERENCE IN WHERE THE MEASUREMENTS WERE MADE.

NO.:	DATE:	REVISION	BY:

STREAM PLX27
PROFILES
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X27
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 27-2

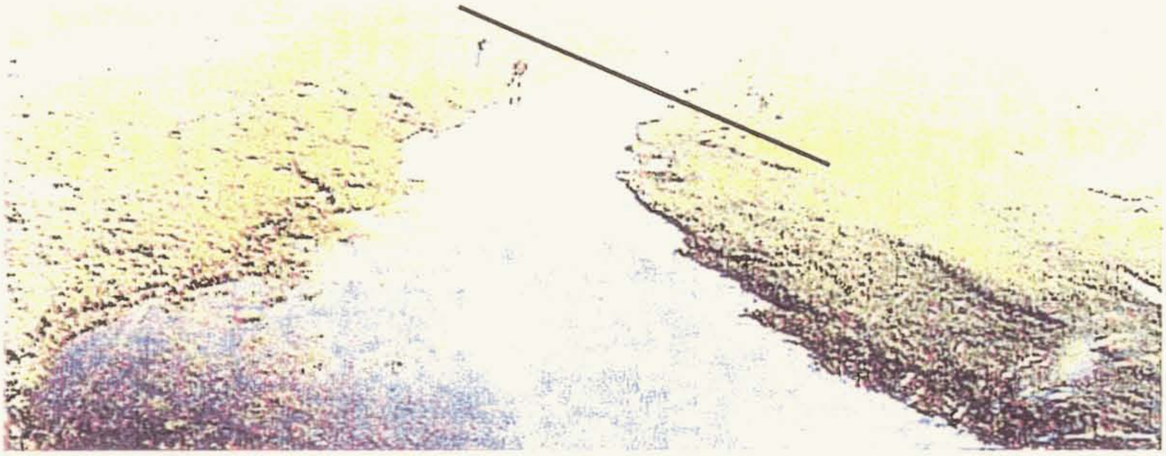


Photo PLX 27-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 27-2: Looking north at the proposed pipeline crossing (6/4/98).

STREAM PLX 27 PHOTOGRAPHS	Baker Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 27-1
	Drawn: JDA	File: photo27	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 27 at upstream cross section

Date: 5/31 ,1998 **Party:** J. Meckel, P. McGranahan

Width: 37 **Area:** 46.9 **Vel:** 1.71 **G.H.:** **Disch.:** 80.6 cfs

No Secs. 17 **G.H. change:** **in.:** **hrs.:** **Susp.:** Rod

Method coef.: 1 **Hor. Angle coef.** 1 **Sus. Coef.:** 1 **Meter No.**

Type of meter: Price AA

Date rated: Std No 1

Meter: **ft. above bottom of weight.**

Spin before meas. **after**

Method: Wading at upstream cross section. Proposed pipeline crossing is at the downstream cross section.

Gage Readings

Time	Recorder	Inside	Outside
	upstream x-sec	WSE=	92.88
	downstream x-sec	WSE=	91.75
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Levels obtained

Measurement rated: **based on following conditions:**

Cross section: Uniform - cross small cobbles. Grass 4" - 8"

Flow: **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Riffle 100' downstream. Clear - no snow or ice. Flow well within established channel. STA 28 edge of grass. Cobbles to STA 17 edge of grass.

Remarks

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 27 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	48.0	3.0	0.0						0.0	0.0	Right Edge Water (15:40)
	42.0	4.5	0.5	s	10	50	0.46	0.41	2.3	0.9	
	39.0	3.0	0.6	s	10	42	0.54	0.49	1.8	0.9	
	36.0	3.0	0.9	0.6	7	47		0.35	2.7	0.9	
	33.0	2.5	1.8	0.6	30	49		1.35	4.5	6.1	
	31.0	2.0	1.6	0.6	40	51		1.73	3.2	5.5	
	29.0	1.5	1.8	0.6	30	41		1.62	2.7	4.4	
	28.0	1.5	1.9	0.6	40	47		1.88	2.9	5.4	
	26.0	2.0	2.0	0.6	50	47		2.35	4.0	9.4	
	24.0	2.0	2.0	0.6	50	45		2.44	4.0	9.8	
	22.0	2.0	1.9	0.6	40	42		2.10	3.8	8.0	
	20.0	2.0	2.2	0.6	40	41		2.15	4.4	9.5	
	18.0	1.5	2.4	0.6	50	48		2.29	3.6	8.2	
	17.0	1.5	2.3	0.6	50	49		2.24	3.5	7.7	
	15.0	1.5	1.5	0.6	25	44		1.26	2.3	2.8	
	14.0	2.0	0.7	s	20	50	0.89	0.80	1.4	1.1	
	11.0	1.5	0.0						0.0	0.0	Left Edge Water (16:10)
Total	37.0	37.0							46.9	80.6	

file: disch_P27.xls

Table PLX 27-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	TBMP27 (TBM27A)
2	5341.98989	5000	93.375165	P27/CG/CL (TBM27C)
11	5342.119772	5000.033173	92.510296	CG/CL
12	5222.835646	5132.215164	96.361012	T
13	5252.550643	5099.234909	94.41074	T
14	5284.600868	5062.428926	93.399048	T
15	5317.239567	5025.942488	92.934134	T
16	5338.107444	5003.532585	93.167371	T
17	5346.008374	4997.257237	92.445516	T
18	5349.943529	4993.76443	91.403339	T
19	5357.901634	4987.718954	91.003056	REW
20	5359.717734	4986.748628	90.735135	G
21	5361.105164	4985.943642	89.95785	G
22	5363.793564	4984.690693	90.207839	G
23	5365.019799	4984.40862	90.071867	G
24	5366.824392	4983.699003	89.795845	G/C
25	5369.012934	4982.104684	89.775465	C
26	5370.736422	4980.669653	89.893107	C
27	5372.444232	4979.412596	89.578525	C
28	5375.231506	4978.163507	89.288175	C/TH
29	5376.335073	4977.778896	89.844564	G
30	5377.476244	4976.986039	90.109485	G
31	5378.152455	4976.806798	91.049078	LEW
32	5382.650327	4974.975665	92.301634	T
33	5408.329934	4959.063304	92.642489	T
34	5446.54685	4927.886239	92.712542	T
35	5480.4737	4895.081172	92.706664	T
36	4572.360492	4679.113653	100.226015	CG/US (TBM27B)
37	4572.397523	4678.91456	100.26512	T
38	4574.190129	4635.466299	99.718089	T
39	4579.978029	4578.672755	98.122402	T
40	4579.990335	4574.889185	96.829483	CG/US
41	4579.931933	4572.763567	94.86323	T/S
42	4591.41904	4492.558669	90.365824	C
43	4590.882916	4487.202015	90.363918	C
44	4589.607198	4481.516397	90.341042	C/TH
45	4589.729371	4477.336749	90.591162	C
46	4590.101517	4472.381229	90.824641	C
47	4590.53246	4467.975494	91.080068	C
48	4591.472286	4463.514928	91.159786	C
49	4591.884788	4459.449525	91.190994	C
50	4591.959849	4455.910022	90.877638	C
51	4592.499597	4451.439158	90.873341	C
52	4592.914641	4448.010953	91.472525	C

Table PLX 27-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
53	4593.09967	4447.729535	91.804468	LEW
54	4593.135391	4446.514738	92.282602	T
55	4593.620232	4442.515557	92.420496	T
56	4593.699032	4431.55374	97.465756	T
57	4599.774655	4389.651705	98.715443	T
58	4607.311924	4346.851852	98.813979	T
59	4534.269729	4480.833868	90.10718	TH/FL
60	4607.498164	4490.811282	90.570143	TH
61	4655.871122	4509.141071	90.637918	TH
62	4779.823796	4555.26751	90.297763	TH
63	4869.745817	4610.114609	90.088016	TH
64	4908.074483	4635.301592	90.124138	TH
65	4935.127473	4701.11043	90.202868	TH
66	4945.873704	4720.059214	89.160668	TH
67	5006.334566	4823.746853	88.124961	TH
68	5035.47533	4840.821317	89.629978	TH
69	5099.127097	4862.739315	89.781784	TH
70	5155.968545	4862.562411	88.712151	TH
71	5305.619189	4922.319521	89.175223	TH
72	5355.292481	4961.106576	88.956632	TH
73	5388.084825	5027.440061	89.561611	TH/FL
74	4986.967257	4566.900024	99.97136	HV40, photo control set by others

Legend:

G = grass	REW = right edge of water	DS = downstream	CL = center line
T = tundra	TH = thalweg	US = upstream	PK = "pk" nail
C = cobbles	CG = crest gage	TWET = wet tundra	
LEW = left edge of water	GB = ground break	M = mud	
	SH = shoulder	SB = sand bags	

file:plx27.xls

APPENDIX DD: PLX 28

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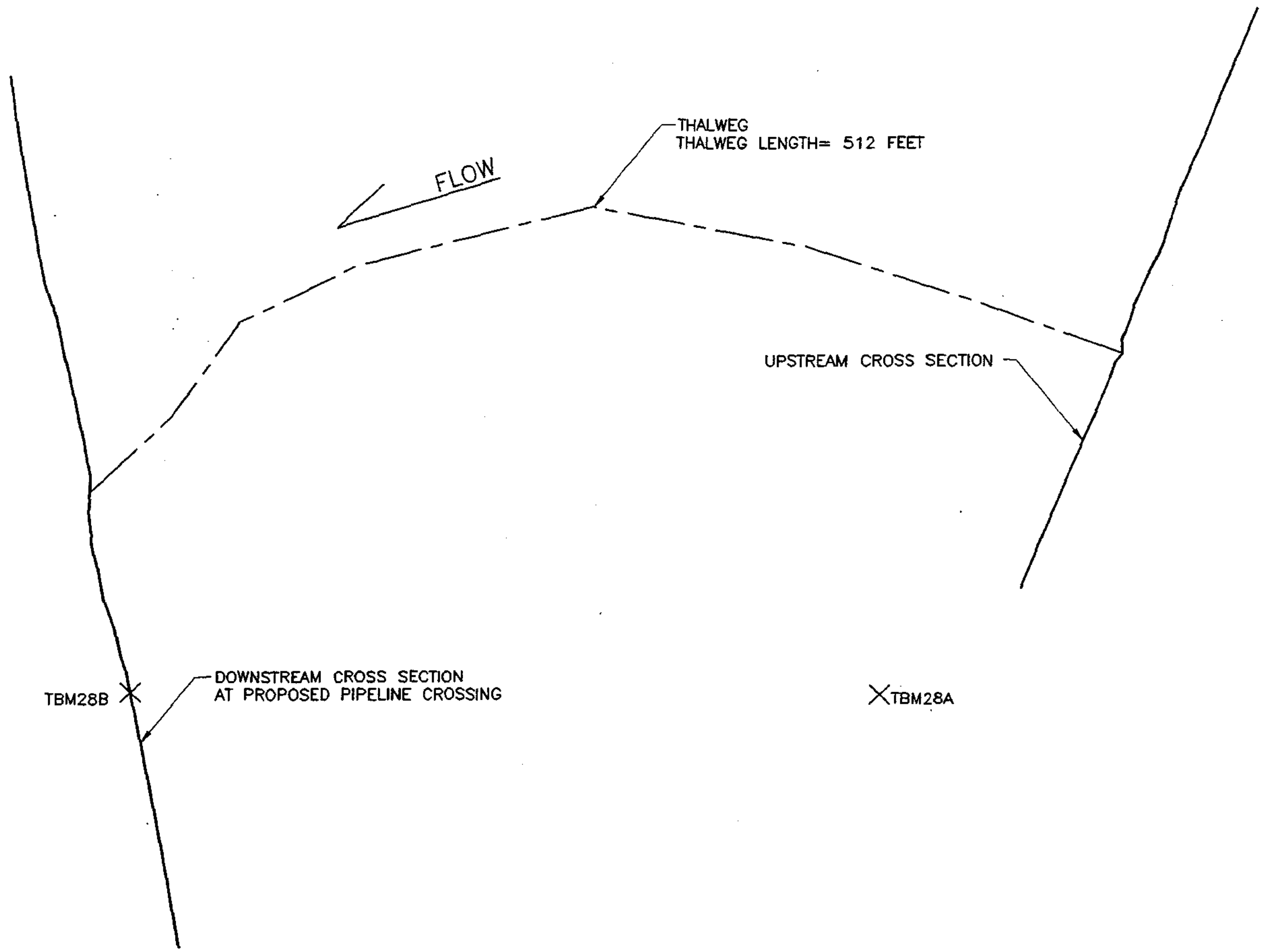


NOTES:

1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM28A.

REVISION			
NO.:	DATE:		BY:

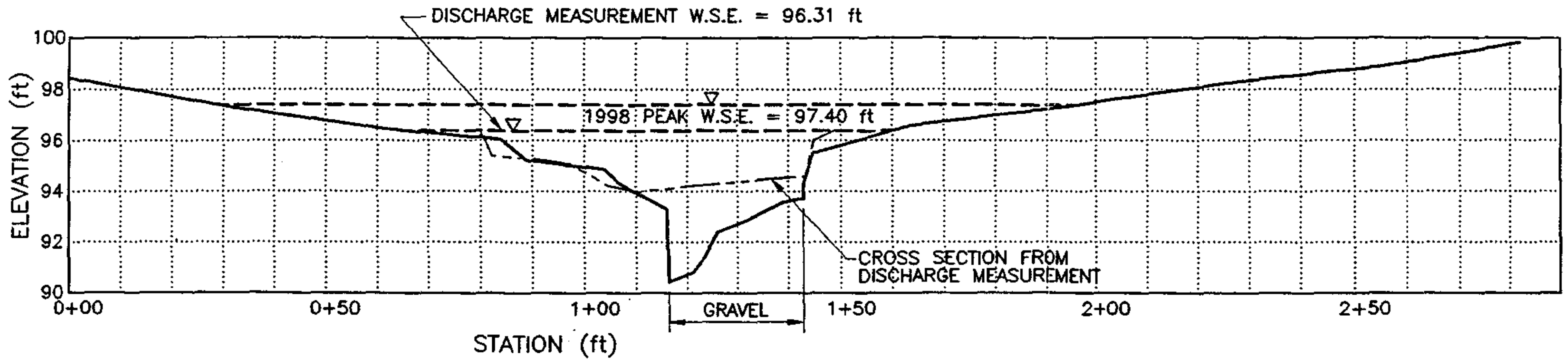
STREAM PLX28
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

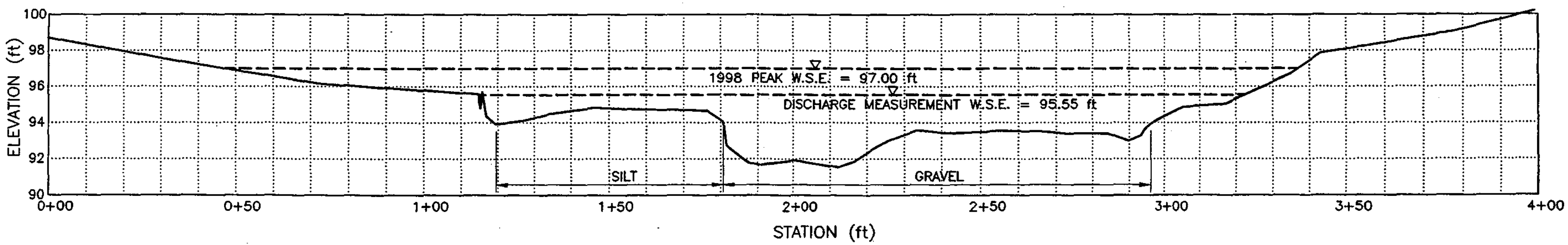
DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X28
CHECKED:	JWA	SCALE:	1"= 60'

FIGURE:
PLX 28-1



PROFILE: PLX28 UPSTREAM CROSS SECTION

SCALE: H 1"= 30'
V 1"= 6'



PROFILE: PLX28 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM28A.
2. W.S.E.= WATER SURFACE ELEVATION
3. DISCHARGE MEASUREMENT CROSS SECTION AFFECTED BY ICE IN CHANNEL.

REVISION			
NO.:	DATE:		BY:

STREAM PLX28
PROFILES
SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X28
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 28-2

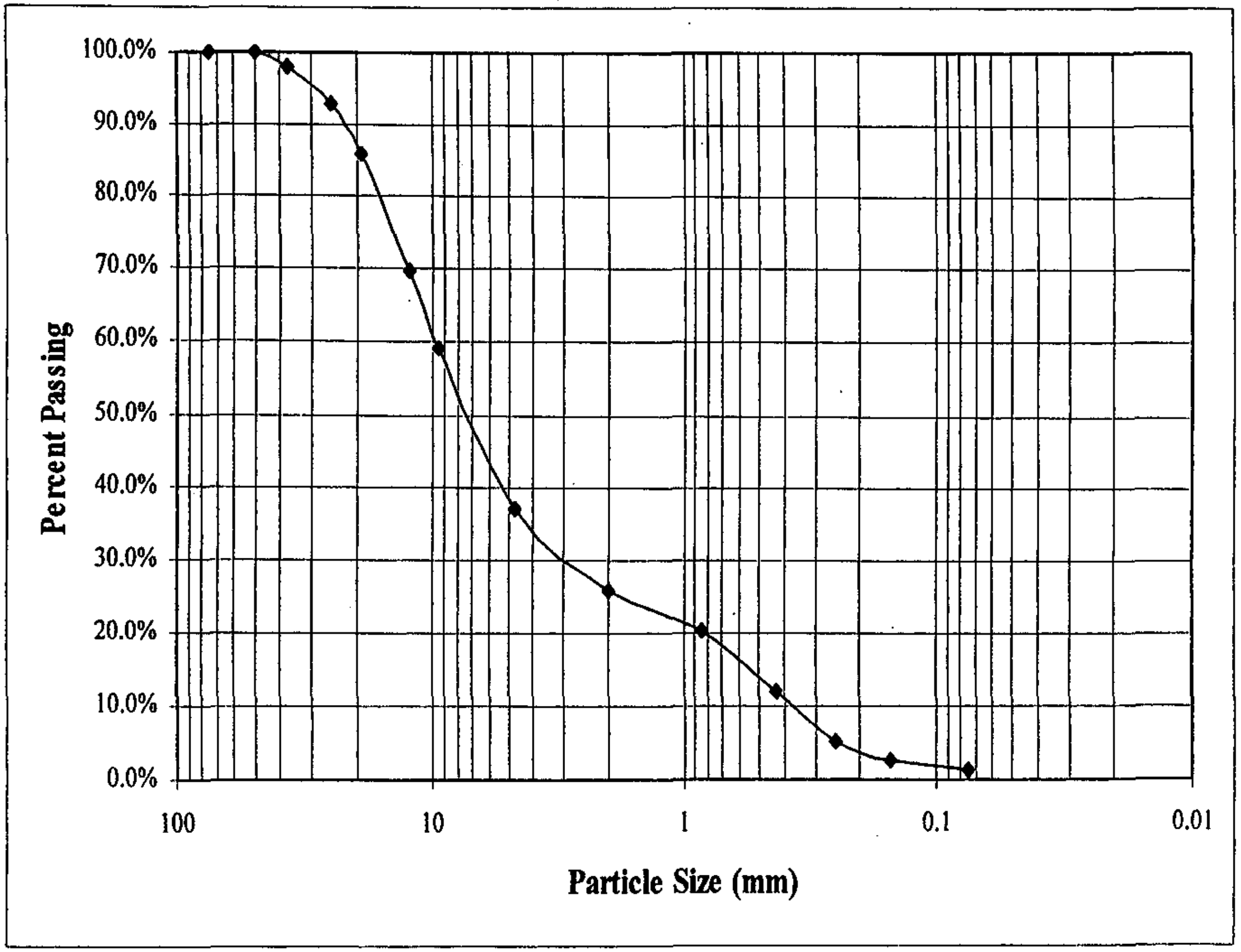


Figure Number: PLX 28-3

Baker Michael Baker Jr., Inc.

Date: 8/6/98	Project: 23247
Drawn: JDA	File: gradations.ppt
Checked: JWA	Scale: N/A

STREAM PLX 28
BED MATERIAL GRADATION

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

REVISION:

NO:	DATE:		BY:

Photo PLX 28-1: Looking north at the proposed pipeline crossing (6/11/98).

Photo PLX 28-2: Looking north at the proposed pipeline crossing (6/2/98).

STREAM PLX 28 PHOTOGRAPHS	Michael Baker Jr., Inc.		Photo Number:
SOURDOUGH AREA DEVELOPMENT PROJECT NORTH SLOPE, ALASKA	Date: 6/7/98	Project: 23247	PLX 28-1
	Drawn: JDA	File: photo28	
	Checked: JWA	Scale:	

DISCHARGE MEASUREMENT NOTES

LOCATION: PLX 28, 500 feet upstream from the upstream cross section

Date: 5/31 ,1998 **Party:** J. Meckel, P. McGranahan

Width: 74.4 **Area:** 118 **Vel:** 3.31 **G.H.:** **Disch.:** 391 cfs

No Secs. 10 **G.H. change:** in.: hrs.: **Susp.:**

Method coef.: **Hor. Angle coef.** **Sus. Coef.:** **Meter No.**

Type of meter: Price AA

Date rated: Std No 1

Meter: ft. above bottom of weight.

Spin before meas. ok **after** ok

Method: Wading 500 feet above the upstream cross section.
Proposed pipeline crossing is at the downstream cross section.

Gage Readings

Time	Recorder	Inside	Outside
	upstream x-sec	WSE=	96.31
	downstream x-sec	WSE=	95.55
Weighted M.G.H.			
G.H. corrections			
Correct M.G.H.			

Levels obtained

Measurement rated: Poor (over 8%). Uniform short grass - some ice. **based on following conditions:**

Cross section:

Flow: **Weather:** **Air °F@:**

Gage: **Water °F@:**

Other:

Record Removed: **Intake flushed:**

Observer

Control Channel expanding - mostly clear of snow and ice. Grass 4-8" high, cobbles 2-4", and sand.

Remarks s= .76/512=.0015 ft/ft.

G.H. of zero flow: ft.

DISCHARGE MEASUREMENT NOTES (PLX 28 Continued)

Angle coef.	Dist. From Initial point (ft)	Width (ft)	Depth (ft)	Observ. depth	Revo-lutions	Time In seconds	VELOCITY At Point (fps)	VELOCITY Mean in-vertical (fps)	Area (s.f.)	Discharge (cfs)	Description
	44.6	3.9							0.0	0.0	Left Edge Water (14:30)
	52.4	7.7	1.0	0.6	10	48		0.47	7.7	3.6	
	60.0	7.6	1.1	0.6	40	46		1.92	8.3	15.9	
	67.5	7.5	1.3	0.6	80	50		3.50	9.8	34.1	
	75.0	6.8	2.2	0.6	80	42		4.16	14.9	61.8	
	81.0	16.0	2.4	0.6	100	43		5.08	38.4	195.1	Grounded ice
	107.0	16.3	1.9	0.6	50	43		2.55	30.9	78.7	Grounded ice
	113.5	4.0	1.8	0.7	5	47		0.25	7.2	1.8	Grounded ice
	115.0	2.8	0.4	5.0	3	70	0.11	0.10	1.1	0.1	
	119.0	2.0							0.0	0.0	Right Edge Water (15:00)
Total	74.4	74.4							118.2	391.2	

file: disch_P28.xls

Table PLX 28-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	TBM-P28 (TBM28A)
2	5000	5330.1548	95.701	P28/CL/CG (TBM28B)
3	4886.240296	5309.004891	98.71	T
4	4918.212999	5314.579028	97.483	T
5	4957.363927	5321.983234	96.177	T
6	4999.032089	5329.992282	95.59	T
7	4999.552019	5330.009673	94.806	LEW
8	5001.065161	5330.382622	94.369	G
9	5003.764304	5331.091684	93.925	MUD
10	5010.794669	5332.205554	94.108	MUD
11	5018.135136	5334.705444	94.49	M/G
12	5029.68953	5337.000554	94.827	REW
13	5043.345402	5341.847908	94.718	T
14	5058.902276	5344.693128	94.657	T
15	5063.22772	5345.727833	94.048	T-C/B
16	5064.056329	5346.225891	92.741	C
17	5069.849718	5347.197801	91.795	C
18	5073.375418	5347.065364	91.672	C/POSS.TH
19	5082.921059	5348.21594	91.936	C
20	5094.896117	5347.444261	91.544	C
21	5099.623745	5347.52467	91.867	C
22	5104.797132	5348.416968	92.616	C
23	5108.762111	5349.045925	93.038	C
24	5115.843075	5350.362566	93.574	C
25	5125.409781	5352.299674	93.431	C
26	5136.809807	5354.730108	93.552	C
27	5147.675056	5356.984076	93.532	C
28	5154.372257	5358.687683	93.398	C
29	5165.778297	5361.096303	93.399	C
30	5171.208539	5361.808492	93.009	C
31	5174.457765	5363.194659	93.312	C
32	5175.737009	5363.372096	93.704	C/G
33	5176.987731	5363.975252	93.974	REW
34	5186.318905	5367.144329	94.868	T
35	5197.557331	5369.216171	95.043	T
36	5215.129313	5372.073144	96.703	T
37	5223.237999	5373.517018	97.868	T
38	5235.973278	5375.546433	98.279	T
39	5257.885894	5378.973346	99.081	T
40	5278.686639	5381.863581	100.211	T
41	5309.293216	4829.016334	99.829	T
42	5285.000269	4839.747208	98.894	T
43	5257.980409	4850.896474	98.263	T
44	5229.014727	4863.915864	97.346	T

Table PLX 28-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
45	5199.949395	4874.308411	96.586	T
46	5182.525471	4882.107177	95.472	T/TB
47	5181.091548	4883.070669	94.281	REW
48	5180.969665	4883.043671	93.719	M
49	5177.826834	4884.573053	93.586	M/C
50	5171.239418	4886.700883	92.896	C
51	5165.307495	4888.941238	92.394	C
52	5162.874015	4890.111365	91.389	C
53	5160.77338	4890.681542	90.825	C
54	5155.423544	4890.467921	90.449	C/TH
55	5155.08353	4890.538661	93.282	G
56	5150.980891	4893.565936	93.795	G
57	5146.893094	4894.861801	94.302	LEW/G
58	5144.239005	4896.099059	94.858	T
59	5130.470109	4902.045217	95.211	T
60	5126.011113	4904.212664	96.034	T
61	5105.349386	4913.512073	96.451	T
62	5078.60395	4925.095587	97.278	T/IPP28/HWM
63	5048.880233	4937.367335	98.452	T
64	5203.249738	5030.557231	92.585	TH
65	5220.79868	5125.332013	91.23	TH
66	5194.510369	5230.115359	91.901	TH
67	5169.156343	5281.987735	92.732	TH
68	5126.413197	5312.186207	92.746	TH
69	5095.168215	5344.169602	92.057	TH

Legend:

G = grass	REW = right edge of water	DS = downstream	CL = center line
T = tundra	TH = thalweg	US = upstream	PK = "pk" nail
C = cobbles	CG = crest gage	TWET = wet tundra	
LEW = left edge of water	GB = ground break	M = mud	
	SH = shoulder	SB = sand bags	

file:plx28.xls

APPENDIX EE: PLX 29

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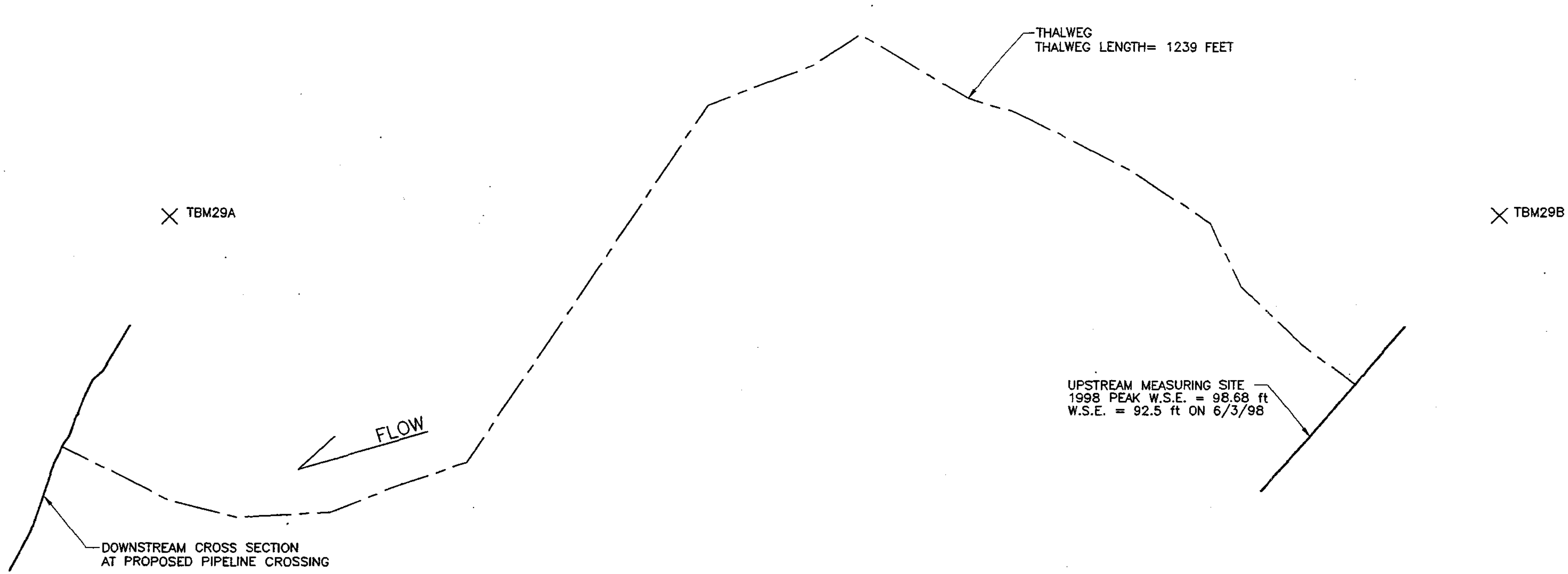


NOTES:
1. THE PRIMARY TEMPORARY BENCH MARK WAS ASSUMED TO HAVE: (1) AN ELEVATION OF 100.00 FEET, (2) A NORTHING OF 5000 FEET, AND (3) AN EASTING OF 5000 FEET. THE PRIMARY TEMPORARY BENCH MARK AT EACH STREAM PROVIDED THE VERTICAL AND HORIZONTAL CONTROL.
2. THE PRIMARY TEMPORARY BENCH MARK ON THIS STREAM IS TBM29A.

NO.:	DATE:	REVISION	BY:

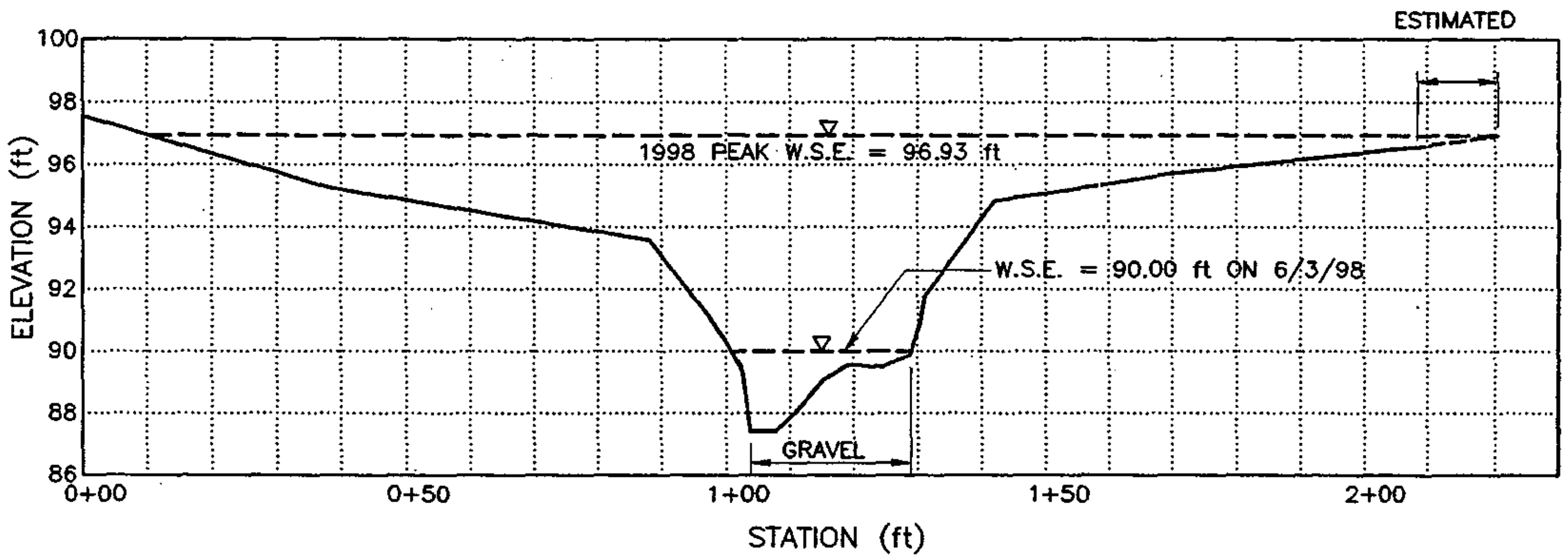
STREAM PLX29
PLAN

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X29
CHECKED:	JWA	SCALE:	1"= 80'

FIGURE:
PLX
29-1



PROFILE: PLX29 DOWNSTREAM CROSS SECTION AT PROPOSED PIPELINE CROSSING

SCALE: H 1"= 30'
V 1"= 6'

NOTES:
1. THE ELEVATIONS SHOWN ARE BASED ON AN ASSUMED ELEVATION OF 100.00 AT TBM29A.
2. W.S.E.= WATER SURFACE ELEVATION

REVISION			
NO.:	DATE:		BY:

STREAM PLX29
PROFILE

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

DATE:	8/3/98	PROJECT:	SADP
DRAWN:	BC	FILE:	SADP-X29
CHECKED:	JWA	SCALE:	VARIES

FIGURE: PLX 29-2

Photo PLX 29-1: Looking northeast at the proposed pipeline crossing (6/2/98).

Photo PLX 29-2: Looking northeast at the proposed pipeline crossing (6/11/98).

STREAM PLX 29
PHOTOGRAPHS

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Baker Michael Baker Jr., Inc.

Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo29
Checked: JWA	Scale:

Photo Number:
PLX
29-1

Photo PLX 29-3: Looking north at the proposed pipeline crossing (6/3/98).

STREAM PLX 29
PHOTOGRAPHS

SOURDOUGH AREA DEVELOPMENT PROJECT
NORTH SLOPE, ALASKA

Michael Baker Jr., Inc.

Date: 6/7/98	Project: 23247
Drawn: JDA	File: photo29
Checked: JWA	Scale:

Photo Number:
PLX
29-2

Table PLX 29-1: Survey Data

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
1	5000	5000	100	TBM/CL/P29 (TBM29A)
2	4008.94	5000	100.33	TBM/UPS/P29 (TBM29B)
101	4097.470492	5109.573261	96.562	SG
102	4076.634779	5084.506776	97.816	T
103	4103.692388	5117.183395	96.16	T
104	4107.055037	5121.480383	92.468	REW
105	4107.903538	5121.783456	91.227	C
106	4111.713693	5126.575648	90.915	C
107	4113.744168	5128.610657	87.852	TH
108	4154.537493	5098.155668	89.677	TH
109	4199.886019	5053.474696	90.256	TH
110	4222.738848	5005.558291	89.225	TH
111	4284.724441	4965.277888	88.542	TH
112	4371.642871	4920.712882	89.665	TH
113	4405.20552	4910.665113	90.533	TH
114	4485.420652	4863.401537	90.297	TH
115	4518.821434	4885.132875	88.974	TH
116	4598.861575	4916.319589	89.509	TH
117	4664.306012	5014.110506	89.856	TH
118	4779.536391	5187.896635	90.583	TH
119	4829.133696	5205.282398	89.826	TH
120	4881.193047	5226.413903	89.428	TH
121	4948.297513	5230.359172	88.632	TH
122	4998.041966	5218.304124	87.452	TH
123	5114.226815	5151.324452	88.083	TH/FL
124	5057.399231	5124.484746	95.354	SG
125	5029.455533	5083.083838	96.572	T
126	5050.056649	5117.77523	95.688	T
127	5064.49989	5139.911077	94.831	T
128	5068.63488	5150.296435	91.676	T
129	5068.151327	5151.143555	90.945	REW
130	5069.227427	5152.228312	89.884	C
131	5071.493922	5156.086288	89.503	C
132	5073.032468	5160.936959	89.583	C
133	5074.423144	5165.052964	89.066	C
134	5075.939922	5169.017819	88.035	C
135	5078.257975	5171.380051	87.415	C
136	5080.224302	5174.76596	87.414	C
137	5080.867497	5176.00957	89.547	G
138	5082.671129	5180.754594	91.129	LEW

(continued on next page)

Table PLX 29-1: Survey Data (continued)

Survey Point Number	Easting (ft)	Northing (ft)	Elevation (ft)	Description
139	5086.684095	5189.019646	93.575	T
140	5102.263454	5236.962766	95.263	T
141	5119.678209	5270.990923	97.565	T

Legend:

G = grass	REW = right edge of water	DS = downstream	CL = center line
T = tundra	TH = thalweg	US = upstream	PK = "pk" nail
C = cobbles	CG = crest gage	TWET = wet tundra	
LEW = left edge of water	GB = ground break	M = mud	
	SH = shoulder	SB = sand bags	

file:plx29.xls

PROJECT REPORT

TEXT AND FINAL ADJUSTED VALUES

SOURDOUGH PHOTO CONTROL PROJECT

JULY 1997

FOR

AeroMap U.S., Inc.
2014 MERRILL FIELD DRIVE
ANCHORAGE, ALASKA 99501-4116

BY

C.A. HERSCHBACH, R.L.S.
SURVEYING CONSULTANT
P.O. BOX 521084
BIG LAKE, ALASKA 99652
PHONE: (907) 892-7839

I. INTRODUCTION

AeroMap U.S. had a requirement for horizontal and vertical control for photogrammetric mapping of the Sourdough Project area situated between Bullen Point and the Staines River and extending seven to thirteen miles inland from the Beaufort Sea coastline on the North Slope, Alaska. After preliminary discussions and the submission of several written and verbal proposals by the survey consultant, a contract was executed 26 June, 1997.

The contract required the determination of X, Y, and Z coordinates and postmarking of a total of 93 HV points, 48 being entirely new locations in the southerly portions of the project area and 41 to coincide, where possible, with HV points set under the consultant's direction some fourteen years ago in the northerly portions of the project area. Also, four were to be set on existing NGS monumentation, also in the northerly portions of the project area. The survey was to be accomplished by a combination of conventional spirit differential leveling and utilization of GPS technology, as the consultant had proposed.

The vertical datum was to be Mean Sea Level, East Dock, Prudhoe Bay, to be established by extending vertical control from the Badami mapping project immediately to the west and adjoining this project. The consultant emphasized he could not vouch for the accuracy of the vertical tie from the Badami project to East Dock itself, as this had been done previously by others.

Horizontal control was to be based on NGS monumentation within or adjacent to the project area, taking care to assure consistency of the horizontal datum between the Badami and Sourdough projects. Final submission of the horizontal data to AeroMap would be in Alaska State Plane Coordinates, NAD 1927, Zone 3.

BPX would provide helicopter support with a ERA Bell 206 Long Ranger helicopter based in Deadhorse. The helicopter would be available for night time use by the consultant's team from the night of 10 July, 1997 to the night of 6 August, 1997, if the project so required.

A project control map with numbered photo control points, a listing of coordinates of new points digitized from USGS 1" = 1 mile maps and the approximate coordinates of the old points was furnished the consultant by AeroMap. AeroMap also provided a 70mm camera with sufficient film to accomplish the postmarking requirement.

It was expected all field work would be completed by 6 August, 1997 and all required elevations, coordinates and postmark data furnished AeroMap during August 1997.

The consultant provided all personnel, equipment, software, vehicle, room and board for field personnel and miscellaneous supplies as required on this project. This report details that logistical support and describes in detail the techniques utilized to accomplish the project. A primary control diagram, project point plot, final elevations and coordinate values are included in the attached appendices. Also included are photographs of recovered NGS monumentation in the project area and photographs of primary equipment utilized.

II. QUALIFICATIONS OF CONSULTANT

The lead consultant and project manager was Clarence A. "Bud" Herschbach, registered land surveyor and certified inshore and offshore hydrographic surveyor. Mr. Herschbach is a 43 year Alaska resident and registered as a professional surveyor in Alaska and 12 other States. His experience as a surveyor on the North Slope, Alaska began during Dewline construction in the 1950s, extended through nearly all phases of oil exploration and production and, though now retired, continues on occasional specific projects.

The primary assistant consultant was Thomas C. Herschbach. Thomas Herschbach is also registered as a professional land surveyor in Alaska. He was born and raised in Alaska and has been involved on major survey projects throughout the State for the past 17 years. He is especially well experienced in GPS surveys and survey related computer operations. Thomas was in charge of those aspects of the Sourdough project.

III. PREMOBILIZATION AND PLANNING PRIOR TO FIELD ACTIVITIES

This activity was completed between June 26 and July 9, 1997. The consultant and AeroMap professionals met in detailed planning sessions to determine a project plan that would meet the analytical triangulation requirements, while at the same time be feasible from a survey and site access point of view. A project planning map indicating the old and new point positions was developed.

The planning map was carefully studied to determine the suitability of various survey approaches to accomplish the desired result. Control recovery requirements were determined and field logistics were planned. Several additional copies of USGS 1" = 1 mile maps of the project area were acquired and the proposed photo control layout plotted thereon. Latitude and longitudes were digitized by AeroMap of all new postmark positions. State Plane coordinate values of the old points were converted to Latitudes and Longitudes and all Latitudes and Longitudes converted to NAD 83 datum as this is the datum the ERA helicopter GPS utilizes. All available NGS control data was acquired, thoroughly reviewed so the data could be coordinated in the field, and control that was deemed desirable to recover was highlighted.

Supplies such as mosquito repellent, field books, computer paper, computer disks, and monumentation material were purchased. All equipment was packaged to protect it during shipment to the field. Lease of four Trimble 4000 SSI Geodetic GPS receivers was arranged from Accupoint Incorporated in Anchorage. Airline reservations were made and tickets purchased. Availability of room and board, vehicles and other supplies at Deadhorse was determined by telephone communications, and reservations made where required.

A portable postmarking panel of highly reflective 10" wide material was fabricated. Each leg was six foot in length except one which was eight foot in length, this to always be aligned to the North. A grommet was placed in the center to fit over the rebar planned to be used to mark each postmark location. The ends of each panel leg had weights sewn within to facilitate placement and positioning in windy conditions, natural or helicopter induced.

A Hasselblad 70mm camera was acquired from AeroMap and tested to assure it was working properly. A bull's eye leveling bubble was glued on the film magazine to facilitate the perpendicular positioning of the camera, since it was to be hand held during postmarking photography due to the model helicopter to be utilized.

Planning was completed and mobilization to the field was possible on the preplanned date. The survey crew and all equipment was in place ready to begin field work on the night of July 10. Room and board and field office space was obtained from The Arctic Caribou Inn as The Prudhoe Bay Hotel, the consultant's first choice, was filled to capacity by other oil field contractors. A four wheel drive crew cab vehicle was leased for the length of field activity from Nana Oil Field Services. The living arrangements, field office arrangements and vehicle proved to be entirely satisfactory.

IV. CHRONOLOGY OF FIELD OPERATIONS

Mobilization:

Two consultant personnel with basic equipment as baggage traveled to Deadhorse on the afternoon of 10 July, 1997 via Alaska Airlines Flight 55. The remaining equipment and supplies had been airfreighted to Deadhorse on the 8th and was already at the air cargo terminal in Deadhorse upon personnel arrival. A lease truck, as had been arranged by telephone, was picked up at Nana Oil Field Services and the equipment and supplies picked up. Rooms were secured at The Arctic Caribou Inn and a field office was set up. Field work began on the night of July 10th. A third crew man, who would serve as rodman and survey helper, arrived on Alaska Airlines Flight 55 on July 14th, the flight having been delayed by one day due to fog at the Deadhorse Airport.

Personnel:

C. A. "Bud" Herschbach, R.L.S., Project Manager and Principal Consultant
Thomas C. Herschbach, R.L.S., GPS Manager and Data Reduction Manager
Douglas Herschbach, Rodman and Survey Helper

Equipment:

The consultant supplied all equipment, except the camera. This included:

4	Trimble 4000 SSI Geodetic GPS receivers with antennas, tripods and software.
1	Hasselblad Model 500 EL/M camera with Distagon 40mm F4 lense with yellow filter. Battery powered and equipped with detachable handle and bull's eye leveling bubble.
1	Sokkisha automatic level with tripod and 16 foot rod.
1	Topcon DL-102 electronic digital level with 3 meter rod, tripod and software.
4	FM Hand-held radios.

1	Four-wheel drive crew cab pickup truck.
2	Magellan hand-held GPS navigation receivers.
1	Trimble hand-held GPS navigation receiver.
1	Pentium based computer with printer.
	Miscellaneous small survey tools and equipment.
	A variety of appropriate surveying software packages.

Supplies:

Various supplies were carried with the survey team, which included:

1	Collapsible postmarking panel.
8	70-exposure rolls of 70 millimeter Kodak Tri-X film.
	Monumentation, lath and flagging materials.
	Miscellaneous maps, computer disks, printer paper, field books, etc.

Field Operations:

With the availability of the helicopter, field operations began on the night of July 10, 1997. The scheduled work day was from 7:00 p.m. in the evening until 7:00 a.m. in the morning. This varied significantly in practice due to the non-availability of the helicopter and prevailing dense fog in the early morning hours. The earliest the crew ever departed Deadhorse was 7:30 p.m. and the latest 12:30 a.m. in the morning. The average was 8:00 to 8:30 p.m. The crew sometimes returned early due to dense fog which not only hampered helicopter flight but prevented leveling by curtailing visibility directly and coating the instrument lenses with water droplets. One night was not worked as fog totally prevented the helicopter from flying. In addition, two nights were not worked due to non-availability of the helicopter because of required maintenance. The survey team took advantage of these shutdowns by catching up on data reduction and computations. A flight log is attached detailing helicopter usage. Although the extensive amount of helicopter non-availability was frustrating, the pilot, Ron Adair, was exceptional in both capability and interest. Without his expertise and cooperation this project would have taken considerably longer to complete and many more hours of flight time expended. GPS observations were completed on the night of July 27/28 and all remaining field work completed on the night of July 29/30. The GPS receivers were shipped via Alaska Airlines on July 28th and the personnel and remaining equipment departed by Alaska Airlines late afternoon on July 30th, 6 days ahead of the original estimated completion date.

Unpacking of equipment and final computations were begun the following day. Final elevations, coordinates and this project report were delivered to AeroMap on August 29, 1997.

V. FIELD PROCEDURES

Field procedures on the Sourdough Project consisted of four primary functions: recovery of NGS control and existing photo control points in northern project area and setting of rebar and lath on new photo control points in southern project area, collapsible panel emplacement and low level photography, GPS procedures, and differential leveling procedures. All, of course, required various levels of logistical support and other sub-functions fell within these four primary functions. Following, this report details how each of the primary functions was accomplished.

A. Recovery:

Eight NGS control monuments were to be searched for in the project area. Only five were located and all were in poor condition. A summary of the results of this investigation is as follows:

Station	Comments
SAVAK	Recovered. Monument 2.38 feet above ground and leaning slightly. Curiously, the NGS CD-ROM based data files does not list this station but a phone call to NGS secured positional data.
GORDON	Destroyed or covered by beach gravel.
HOBSON	Recovered. Monument 4.09 feet above ground and leaning.
NORA	Destroyed or covered by beach gravel.
TUNDRA	Recovered. Monument 4.35 feet above ground and leaning. Rebar found at base set by F. Robert Bell and Associates in 1993.
RODA	Recovered. Monument 4.05 feet above ground and leaning.
NYGREN	Recovered. Monument has been hit by vehicle and bent dramatically. Cap missing. Found rebar at base of monument.
LILY	Monument destroyed. Has relatively recently fallen over eroding bluff.

Note: Photographs of all recovered monuments in the project area are provided in Appendices to this project report.

Due to the weakness of the control stations directly within the project area the search and recovery was extended to stations immediately outside the project area. These consisted of "TIGVARIAK EAST BASE", "IOVIK" and "ELIZA" in the Badami area as these had been previously recovered during the survey of photo control for that mapping project. These stations were again recovered. The helicopter was also landed west of the Staines River and a foot search made for "FINISH" in ANWR. It was recovered in good condition. Also recovered were photo control points 537 and 538 of the Badami Survey Project. These were later to be utilized as beginning bench marks for the differential leveling for the Sourdough Project. Also points 304, 311, 313, 314, and 315, recently set by Mike Schoder of AeroMap and included in his GPS static survey were recovered for inclusion in the Sourdough mapping control net. To prevent duplicate and/or confusion these were given new numerical identification numbers as follows: 304=1304, 311=1311, 313=634, 314=637 and 315=636.

Of the 41 old photo control points in the northerly project area 38 were found, generally in good condition although all of the mechanically driven aluminum rods were jacked one to three feet due to frost action. New points were set in the general area of the three missing points.

In addition, two control rebar set by F. Robert Bell and Associates in 1993 in the Yukon Gold area were recovered in good condition.

B. Monumentation:

Following recovery work all new postmark locations were marked with 30" x 1/2" rebar, lath and hi-vis flagging. These were set by navigating to the previously digitized latitudes and longitudes by use of the helicopter GPS unit and the points set at the desired locations as indicated by this instrument. In all cases a flat area was selected of a relatively dark color so as to attain high contrast with the white panel to be later utilized. By chance, this procedure was accomplished in dense fog conditions and no visual reference to surrounding land marks was possible. The later accurate survey, however, indicated all were very close to preselected desired locations.

Postmark locations were similarly monumented at the three northerly locations where the old panel points were not found and also near the locations of unrecovered NGS stations "LILY" and "GORDON". These last two were given identification names "LILY OFFSET" and "GORDON OFFSET".

C. Postmarking and low level photography:

The low level postmarking photography was accomplished during four separate sessions when weather and light conditions permitted. The postmarking was accomplished utilizing a 10" x 12' (6 foot legs) retrievable panel which was placed at each panel location, photographed, and then removed. One leg was two foot longer (8') than the other three, and, using a hand compass, this leg was always aligned in a northerly direction to assist the photogrammetrist in later alignment of the low level photography with the high level photograph. The panel was made of impregnated canvas material of a high white gloss color. A weight of approximately one pound was sewn into each end so as to hold it down in windy conditions. A grommet was placed in the center as an aid to centering the panel on the rebar that was emplaced in the ground.

The postmarking was accomplished by a two man survey team, plus pilot. The helicopter normally landed slightly to one side of the premarked panel location. After one individual with the panel, hand held radio and compass embarked, the helicopter would ascend to the predetermined height over the panel. During this time the individual on the ground would lay out the panel, properly orienting the long leg in a northerly direction. After the photo runs were achieved, the pilot notified the individual on the ground by use of the VHF radio that suitable photography had been attained. At this signal the individual on the ground refolded the panel and put it in an accompanying laundry-type bag to prevent it from being blown around by the rotor blast during the subsequent helicopter reboarding operation. The helicopter would then land, pick up the individual on the ground and proceed to the next postmark point. Approximately ten points per flight hour could be postmarked in this fashion.

The right rear door was removed from the helicopter prior to all postmarking photo missions. All loose items were removed from the back seat area of the helicopter to avoid their being blown about. Photography was accomplished using a Hasselblad, Model 500 EL/M, 70mm camera hand-held outside the rear doorway from which the door had been removed. A bull's eye bubble was glued to the back of the camera to facilitate pointing the camera perpendicularly downward. By holding the camera at door sill level and just outside the door, the skid was outside the photo image and an unobscured view was attained.

70 millimeter Kodak Tri-X film was used in oversized magazines which allowed approximately 70 exposures per roll of film. Three or more photographs were taken of each panel as the helicopter made runs at approximately 60 miles per hour across the panel location. One photograph was normally taken when the panel was approximately one-third into the frame from the direction of flight, one was taken when directly over the panel and one was taken approximately one-third of a frame past the panel point. Where possible, all runs were made from south to north, toward the long leg of the panel.

Where the photographer or pilot felt the run was not suitably aligned over the target, or that a camera tilt exceeding 5 degrees existed at the time the exposures were made, the helicopter would make a 180 degree teardrop turn and make a return run in a North-South direction to attain more photos while holding flight time to a minimum.

The pre-planned photo height was ideally 1,000 feet above ground level. The height above ground was determined by the helicopter pilot utilizing his radar altimeter. All photos were taken at, or very near, the pre-determined height.

The first photos were taken the night of July 14 and some trial and error was required to properly coordinate the actions of the pilot, photographer and ground crewman. The field party had concern some photo runs were sufficiently to one side or the other that the panel was not suitably in the frame. AeroMap did not have a problem in this respect, however, and no reflights were required. In all cases exposed film was shipped to Anchorage by Alaska Airlines counter to counter service the day after exposure so its suitability could be determined and adjustments made in the photo process if the developed film indicated this was desirable. This proved very successful as a quality control procedure. No reflights were required, however, on this project.

In all case, except as mentioned in the following paragraph, a shutter speed of 1:250 or 1:500 of a second was utilized with the lens openings varied to meet the existing light conditions. Light availability was determined intermittedly with a hand held light meter. Camera lenses were taped in position so as to prevent them inadvertently rotating due to vibrations in the helicopter. The photographer had a light meter available at all times to check the light conditions as he felt necessary. Kodak Tri-X film proved to be versatile under poor light conditions at high shutter speeds and would be highly recommended for any future photography of the type taken.

On the final postmark panel photographed a series of frames were exposed at 1:125 of a second shutter speed as it was near midnight and light conditions very poor. This shutter speed was thought to be undesirable due to the speed of the helicopter over the panel target and the unavoidable vibrations in the Bell Long Ranger type helicopter. Later analysis by AeroMap, however, indicated this photography was suitable for its desired purpose if light conditions did not allow a faster shutter speed. If this relatively slow shutter speed is used in the future, however, care must be taken by the photographer not to rest his camera or arms on the doorsill so as to isolate the camera from the rotor induced vibrations.

The only difficulty in the postmarking photography occurred on the second photo mission on the night of 20 July. On the third panel the camera lens suddenly jammed and all efforts by the photographer failed to remedy the problem so photography was suspended and leveling undertaken instead. Consultation by phone with AeroMap the following day could not identify the problem so the camera was sent by one day air service to AeroMap in Anchorage. They were able to identify and remedy the problem and returned the camera to Deadhorse one day later. The camera performed satisfactory during the rest of the project. On any future project the photographer should discuss the potential and solution for camera lens jamming with Steve Sparks of AeroMap in Anchorage.

D. GPS Survey:

A total of 107 points were surveyed on this project utilizing GPS, 14 by static GPS methods for inclusion in the primary control network and 93 by rapid static methods to fill in the intermediate points. One NGS station "LEFFINGWELL" was not actually occupied during this project survey but the long static GPS observations taken by Mike Schoder of AeroMap utilizing Trimble 4000 SSI Geodetic GPS receivers the first week of July, 1997, were utilized.

Equipment:

GPS equipment was leased by the consultant from Accupoint, Incorporated of Anchorage, Alaska. This equipment included four Trimble 4000 SSI, nine channel, dual frequency geodetic receivers and associated L1/L2 geodetic antennas, cables, tribrachs, tripods, batteries and chargers. Trimble's GPSurvey post-processing software package, Version 2.20, was used for GPS data computations.

The Trimble 4000 SSI dual frequency geodetic receivers utilized are small in size, packaged in compact units well-suited to helicopter operations, and are supplemented by flexible, comprehensive software. The Geodetic Surveyor SSI offers the highest productivity and accuracy available in a dual frequency GPS receiver for post-processed land surveying and mapping applications. Utilizing Trimble's Super-Trak technology for robust satellite tracking, even in difficult locations, these receivers maintain a firm lock on signals once acquired, and are capable of very short occupation times in fast static mode with a published accuracy of 5 mm horizontally, 1 cm vertically, and 1 arc second of azimuth.

All primary control stations on this project were observed for a minimum of 60 minutes, and in most cases several hours, with the receiver operating in static mode. Many of these control vectors were observed multiple times on different occasions, thus giving many redundant baselines for verification purposes. All panel points were observed a length of time wherein the receivers indicated an accurate position had been attained. Generally three base stations were operated in static mode and one rover unit operated in fast static mode. A network of multiple, interconnecting vectors was thus established. By utilizing the 7 recovered horizontal control stations and 37 vertical bench marks surveyed by differential levels (33 surveyed on this project and four from the Badami Survey Project), the network was subsequently rotated and scaled to the existing control and tipped and tilted to agree with the local geoid (leveling datum).

Field Computations:

Field computations were done on a daily basis and included the routine downloading and backup of the GPS data, running satellite predictions for the following day, as well as baseline computations. A Pentium based computer was available in the field for the duration of the project for these tasks. The GPS data would be downloaded from the receiver into a subdirectory of the hard drive. Station ID's, session number and HI's were then verified. All discrepancies were resolved before archiving the data to 3-1/2" floppy disks.

After data backup, satellite predictions for the following night were performed to ascertain the ideal times for observing and to avoid any windows of poor satellite availability and/or high PDOP. Once these predictions were done and plots made for the next nights use, baseline computations were performed. This processing consisted of using the Trimble WAVE baseline processor, version 2.20, to compute the delta X, delta Y, and delta Z vector components for each baseline. Each baseline consisted of four separate solutions:

- L1 code
- Iono free triple
- P/C1 Lw Ln float
- L1 fixed (or Iono free fixed)

After the vectors were processed, the various statistical indicators were examined and in most cases the high ratios and low reference variances obtained indicated acceptable results. These statistics also gave confidence to which solution should be used. The vector components were then loaded into a database and various combinations of Cartesian loop closures were computed. These loop closures gave an additional indication of the quality of the data.

After loop closures were computed, the vectors were further analyzed through least squares methods. This was done through Trimble's Network Adjustment Module. The approximate coordinates, observed vectors and estimated weights were input into the adjustment program. The preliminary adjustment was executed and the statistics in the form of the standard error of unit weight and the normalized residuals were analyzed. These "daily" adjustments are of a minimally constrained type, i.e., one arbitrary station is held fixed.

Once all the field observations were completed, the daily adjustments were combined into one large adjustment for the entire project area. This adjustment insured the internal integrity of the observed network and any weak vectors were located through this process and reobserved prior to project demobilization. The final minimally constrained adjustment for the project area produced a standard error of unit weight of 0.98 and includes 336 vectors. All vectors used in the adjustment were based on the double difference solution. The average coordinate precisions were in the 5 mm range, with the majority of vector accuracies meeting or exceeded the 1.0 ppm (1:1,000,000) range. Based on this minimally constrained adjustment, a decision was made to demobilize the GPS field operation for this project.

E. Differential Leveling:

Care must be taken when acquiring elevations by GPS methods, as GPS heights are referenced to a surface called the ellipsoid, whereas real world elevations as normally utilized are referenced to a surface called the geoid. The ellipsoid and geoid are of differing heights and are tilted a small amount about both North-South and East-West axis. The latest available geoidal separation computer program (Geoid 96) provides only an approximate correction for any given local area. Bench marks determined by differential levels are thus mandatory every five to ten miles if elevations determined by GPS are to be properly correlated to the local datum. In this case, 33 new bench marks were determined by differential levels throughout the project area, a considerable over kill.

Top of rebar of Point 537 of the Badami Project was utilized as the origin bench mark for this project. It's elevation was first verified by leveling to existing Badami Point 538. The two points agreed with record values by 0.01 of a foot.

Over 43 miles of levels (actual distance traveled was actually much more due to water bodies to be detoured) were carried out on this project. All runs were double-rodded so as to provide a check closure without returning in the opposite direction. The level was pegged to verify it was in adjustment, foresights and backsights were balanced and all shots were held to 200 foot or less in length. The night work minimized heat waves and the resulting refraction. Third order standards were attained or the segment in question was rerun. Three segments, totaling approximately three miles, had to be rerun to meet this requirement. Approximately five miles forward progress per shift was attained, although fog terminated most shifts early. A two man leveling crew remained on site all one day to make up for the numerous shortened night shifts. Bench marks were established at all geographical limits of the project. In addition, elevations were set by differential levels on a considerable number of interior points. All GPS derived elevations were computer-adjusted to match the spirit level derived datum.

The hand-held Magellan GPS units proved themselves of great value during the leveling process. Few visible landmarks exist at ground eye level in the project area and guidance from point to point was entirely by these units, especially in foggy conditions.

The water surface of the Beaufort Sea was shot from 14 HV points near the shoreline. The night was windy and water quite rough making accurate readings difficult. These shots, however, serve as an excellent quality control procedure, especially on the East-West vertical component of the project. These readings indicate a possible maximum 0.20 foot vertical deviation from the westerly to easterly limits of the project area, a distance of approximately 20 miles. These readings do indicate, however, the entire project datum to be from 0.60 foot to 1.20 foot low, relative to mean sea level. The exact amount is uncertain due to the scarcity of tidal information in this area and the impact environmental conditions can have on coastal water levels at any particular point in time.

Visual observations indicated a low tide stage at the time the water readings were taken. Assuming a tide range of 0.65 to 0.70 foot in this area a datum error of approximately 0.60 foot is indicated. GPS observations taken by Mike Schoder of AeroMap from this project's point 637 (Mike's 314) to NGS station "Leffingwell" on Flaxman Island, when reduced by this consultant, however, would indicate a datum error of nearer 1.20 foot. Station "Leffingwell" has an elevation leveled from a bench mark established by three days of tidal observations in 1981. See conclusions for more thoughts on this issue.

VI. POST FIELD COMPUTATIONS

Following return from the field, a meeting was held with AeroMap to review preliminary data. An intense period of computations followed. All field notes were double checked and variously weighted adjustments were run by computer and the results analyzed. Various plots were made to facilitate use of the data by the client.

Post field GPS computations consisted of completing a constrained adjustment, in NAD 1927, for the entire project area. This adjustment, performed with the Trimble Network Adjustment Module software, is where known horizontal and vertical stations were held fixed to their published values. The adjustment output consists of the final adjusted coordinates and the associated statistics. Many iterations were attempted with this final adjustment to ascertain which horizontal control stations to hold fixed. The final constrained adjustment held the following stations fixed:

Horizontal: "TIGVARIAK EAST BASE", "IOVIK", "SAVAK", "FINISH", "YUKON GOLD GPS CONTROL POINT E", "LEFFINGWELL", "YUKON GOLD GPS CONTROL POINT YG-1"

Vertical: H.V. control points 306, 325, 395 (Nora Offset), 418, 423, 603, 607, 611, 612, 613, 614, 615, 616, 618, 619, 628, 635, 637, 638, 640, 641, 642, 643, 644, 645, 646, 647, 648, TUNDRA_REBAR, 1311(AeroMap's 311), 1304 (AeroMap's 304), and Badami H.V. Points 383, 537, 538, and "ELIZA".

Note: Elevations determined by differential leveling procedures based upon given height for rebars at panel points 537 and 538, Badami Mapping Project.

There are 108 stations and 336 vectors in the final adjustment. The final adjustment for this project produced the following statistics:

Standard Error:	1.02
Deflection in Latitude:	0.6801"
Deflection in Longitude:	-0.4888"
Azimuth Rotation:	-14.0481"
Network Scale:	1.000021487118

Due to distortions in the network control (incorrect shapes of geometric figures defined by the fixed network) the highly accurate GPS network was artificially degraded to conform to the existing NGS control stations. The majority of horizontal control stations used in the final adjustment are second order (1:20,000) stations and the final positions derived in this GPS survey can therefore not be said to exceed that accuracy.

Final adjusted X, Y, and Z values were delivered to AeroMap on August 29, 1997.

VII. SUMMARY AND CONCLUSIONS

The techniques and procedures utilized followed the pre-work plan very closely and proved to be an efficient time and cost-effective method to accomplish the goals of the field program. Only minor modifications were necessary in the field work plan to meet localized conditions.

A close review and analysis of the data herein leads the consultant to believe all goals of the contract were achieved. Stations TIGVARIAK EAST BASE, IOVIK, ELIZA, LEFFINGWELL and FINISH were incorporated outside the scope of the contract to offset the poor conditions of the control stations within the project area. Bell's rebars, "Yukon Gold GPS Control Point E" and "Yukon Gold GPS Control Point YG-1" were also incorporated into the survey in order to bring all survey points in the project area into a single, consistent net.

The consultant believes all desired accuracy specifications were achieved and, in fact, exceeded. The horizontal accuracy achieved by GPS far exceeded that of the existing control net, and was artificially degraded to conform to existing NGS control monuments, whose published values will undoubtedly be used by others in the future in the project area. The vertical values, within this and the Badami Project area, within themselves, appear to be excellent and to meet all specifications required for accurate mapping of the area. The mapping tie to the Badami area mapping should be seamless. As noted previously, however, the entire vertical datum may vary from true mean sea level by up to 1.20 foot. Many questions remain on this issue. The most obvious include:

1. Is the East Dock bench mark truly representative of mean sea level for the area as it originally involved only a very short period of tidal observations?

2. Is the vertical tie from East Dock to Badami accurate?

3. Are single water surface shots in this area meaningful considering potential environmental impact on coastal water levels and minimal tidal data in this project area?

4. Is the "Leffingwell" vertical data meaningful considering the short duration observations and 16 year potential movement of bench marks?

Several steps could be taken to shed further light on this issue.

1. A long static GPS observation from the Badami or Sourdough project datum could be made back to East Dock to confirm their relationship.

2. A long static GPS observation could then be made from East Dock to the NGS tidal bench mark on West Dock to determine East Dock's relationship to true mean sea level. The West Dock NGS bench mark was established by long and on going observations.

3. A long term tide gauge could be established in the Sourdough or Badami Project area and an accurate tidal bench mark established. NGS may be agreeable to establish a tidal bench mark on the newly constructed Badami dock.

4. As long as the Badami and Sourdough vertical datums are good within themselves their accurate relationship to mean sea level may not be meaningful and nothing further may need to be done.

Senior project managers should further consider this issue.

Weather conditions were very difficult during the field operations, especially for night operations, but about what one must expect and be prepared for on the North Slope of Alaska. An earlier start of each night's operation would be very beneficial as the nightly fog usually does not envelope the area until after midnight. Time of use of the helicopter needs to be more clearly defined in future such operations as much survey crew time was wasted awaiting transportation in the ERA hanger. Use of a helicopter totally dedicated to the survey effort possibly would be cost effective even if a helicopter need be mobilized specifically for this effort. A Bell 206 (not Long Ranger) with range extender would be satisfactory for this type survey program and an ASTAR ideal due to its unique suitability for aerial photography (i.e. low rotor vibrations and port suitable for hard mounting of camera).

The helicopter operation, after ERA became familiar with the unique requirements of this project, proceeded reasonably well but only through outstanding cooperation and effort by the assigned pilot. As always, pilot technique and attitude is an all important factor in a helicopter supported survey operation. The helicopter was equipped with a GPS receiver which was extremely useful in navigating to specific operational areas and in recovery of existing points and locating ground crews. The ongoing fog would have proven much more of a hampering factor without the GPS unit.

Likewise, the consultant-supplied, hand-held GPS navigation receiver were of great value in finding one's way around in poor visibility conditions on the ground and should be a required item on any survey program on the North Slope occurring away from the immediate Deadhorse area.

Few changes would be made in any similar survey effort in the future. The procedures and techniques utilized were deemed to be time and cost-effective and to meet all desired accuracy parameters.

Helicopter Flight Log
Sourdough Survey Project (AeroMap Photo Control)

DATE	FLIGHT HOURS	COMMENTS
7/10/97	2.8	Terminated work at 1:30 AM due to fog.
7/11/97	4.0	Terminated work at 4:45 AM due to fog.
7/12/97	4.7	
7/13/97	0.0	No field work or flight due to bad weather.
7/14/97	8.0	
7/15/97	0.0	No flight due to helicopter maintenance.
7/16/97	6.6	
7/17/97	7.7	
7/18/97	4.0	Terminated work at 3:30 AM due to fog.
7/19/97	7.0	Work & flight hampered by fog.
7/20/97	2.1	Terminated work at 3:36 AM due to fog.
7/21/97	1.8	Flew to project area but no work due to fog.
7/22/97	3.7	Terminated work at 3:00 AM due to fog.
7/23/97	6.5	Two men ran levels during the day to avoid fog, in addition to night work.
7/24/97	3.4	Helicopter was not available until 12:30 AM due to maintenance.
7/25/97	4.6	Light rain but relatively good weather.
7/26/97	7.1	
7/27/97	0.0	No field work or flight due to helicopter maintenance.
7/28/97	2.4	
7/29/97	2.2	

78.6 Hours total helicopter flight hours on project.

Note: Total days 2nd pilot required for survey support - 20.

FINAL ADJUSTED VALUES - SOURDOUGH PHOTO CONTROL PROJECT - 8/29/97

Ellipsoid: NAD27
Output: State Plane Zone 3, Pt #, Northing, Easting, Elevations(Feet)
Notes: * = Indicates elevation derived by differential levels.
Elevations based off rebar height for pt 537, 1994 Badami Survey
Points labeled with 1994 are from the 1994 Badami Survey

PT#	Northing	Easting	Elevation (Top Rebar, Alum. Rod or Monument)	Elev. (Panel)	Comments
302	5893997.739	468910.167	50.76	50.42	
304	5895695.816	484664.517	24.55	24.28	
305	5895200.442	490287.912	21.70	21.21	
306	5894906.800	491937.148	18.61	18.29	*
310	5897360.242	469503.333	40.23	39.93	
316	5899457.050	491550.672	13.96	13.60	
317	5900794.416	484617.929	13.08	12.71	
322	5901547.619	458320.178	38.41	37.81	
324	5901442.161	448174.795	42.37	42.17	
325	5901633.952	443140.149	42.13	41.99	*
326	5901402.695	437167.633	41.94	41.72	
328	5901299.913	426592.097	36.88	36.53	
329	5901290.634	420913.566	41.19	40.87	
336	5903854.279	469384.863	20.48	20.09	
337	5903782.513	487029.035	8.80	8.48	
342	5906183.562	468918.117	12.94	12.51	
344	5906288.415	458278.703	24.83	24.58	
346	5905487.637	448114.520	29.55	29.31	
348	5906336.263	437075.459	29.21	28.99	
350	5906832.312	427143.792	21.40	21.08	
351	5906926.737	421765.039	22.85	22.74	
359	5910216.807	426408.487	14.66	14.55	
361	5908904.007	469352.579	7.58	6.86	
362	5908856.218	479288.910	9.42	9.02	
364	5910420.987	474530.688	4.94	4.54	
367	5912970.377	458138.970	3.62	3.32	
371	5911640.937	437447.989	14.67	14.45	
375	5911432.446	417800.597	14.86	14.65	
377	5912353.017	406700.308	10.91	10.58	
383	5915131.723	398233.694	5.19	4.40	* 1994 Survey
385	5915477.987	405989.327	7.11	6.66	
387	5914390.349	426703.422	2.86	2.60	
391	5914773.941	458431.438	3.20	3.05	
395	5917277.973	446793.025	2.73	2.56	* NORA_OFFSET
398	5917438.548	433195.869	3.56	3.32	
413	5904664.798	407512.047	22.30	22.05	
414	5910257.220	407725.889	10.97	10.74	
418	5909624.234	446567.560	18.56	18.31	*
419	5910081.447	458280.426	12.67	12.43	
22	5913319.051	467967.561	3.24	2.65	

23	5914464.888	447288.230	7.27	6.89	*	
9	5919126.073	435937.547	4.76	4.13		
37	5891346.116	395679.154	51.175	49.995	*	1994 Survey
38	5896953.082	393018.176	38.875	37.775	*	1994 Survey
39	5901966.098	395595.499	34.050	32.540	*	1994 Survey
01	5900438.012	410747.644	39.99	39.87		
02	5897340.581	406924.415	43.79	43.71		
03	5892160.449	410710.078	57.89	57.76	*	
04	5887485.535	409066.917	71.68	71.46		
05	5883279.225	409787.570	85.58	85.45		
06	5897669.104	423336.213	42.83	42.62		
07	5892336.620	426374.810	65.15	65.03	*	
08	5886894.476	424878.122	80.91	80.74		
09	5882812.788	426679.876	94.57	94.39		
10	5896931.800	439770.211	55.81	55.69		
11	5892109.642	442729.824	69.05	68.90	*	
12	5886956.676	440835.037	85.01	84.90	*	
13	5882589.131	443968.495	98.02	97.92	*	
14	5877693.002	446806.816	114.65	114.49	*	
15	5873153.556	444461.926	130.93	130.80	*	
16	5891872.730	451449.423	68.64	68.54	*	
17	5896403.660	461951.473	48.94	48.68		
18	5892128.591	458616.329	63.22	63.07	*	
19	5886907.746	463204.652	73.63	73.49	*	
20	5882223.329	458500.002	92.83	92.69		
21	5877287.453	459417.463	107.51	107.37		
22	5872043.880	458487.383	125.70	125.57		
23	5868172.839	457182.172	140.82	140.64		
524	5863540.637	458606.183	151.59	151.44		
525	5859652.103	460412.780	161.00	160.84		
526	5854369.419	458364.295	182.62	182.47		
527	5891731.913	474732.975	49.08	49.00		
528	5886271.528	478860.044	55.98	55.82	*	
529	5882277.371	475522.641	71.09	70.96		
530	5877475.728	474324.962	86.57	86.46		
531	5872090.284	475003.291	99.61	99.50		
532	5868549.222	469652.997	119.56	119.49		
533	5863154.805	469602.799	133.88	133.73		
534	5858207.934	468517.657	153.04	152.25		AeroMap's 313
535	5854378.978	471312.786	151.91	151.86	*	
536	5903827.366	493522.550	2.63	2.20		AeroMap's 315
537	5900795.145	498669.298	1.81	1.33	*	AeroMap's 314
538	5899030.551	495628.990	5.65	5.51	*	
539	5890864.829	485960.166	38.15	38.04		
540	5891090.927	491866.222	20.89	20.72	*	
541	5886876.950	489954.118	35.46	35.26	*	
542	5881733.259	486365.010	53.99	53.85	*	
543	5876747.172	486993.330	61.68	61.59	*	
544	5872516.026	485408.482	74.33	74.24	*	
545	5870540.494	483036.095	82.04	81.84	*	
546	5868747.301	480313.616	92.02	91.91	*	
547	5863941.656	477322.394	109.28	109.20	*	
18	5859923.885	475893.008	123.98	123.87	*	
002	5914299.163	417021.631	16.56	16.40		GORDON_OFFSET

1003	5914194.916	434704.362	16.90	12.81		HOBSON
006	5907663.907	481832.158	8.77	8.49		LILY_OFFSET
1012	5910503.721	455113.967	15.29	14.69	*	TUNDRA_REBAR
1304	5880245.283	485736.172	55.32	54.73	*	AeroMap's 304
1311	5851169.293	468716.748	173.54	173.05	*	AeroMap's 311
1359	5909770.816	398210.375	14.07	13.57	*	Badami359(1994)

FINAL ADJUSTED VALUES - SOURDOUGH PHOTO CONTROL PROJECT - 8/29/97

Ellipsoid: NAD27
Output: Point #, Latitude, Longitude, Elevations (Feet)
Notes: * = Indicates elevation derived by differential levels.
Elevations based off rebar height for pt 537, 1994 Badami Survey
Points labeled with 1994 are from the 1994 Badami Survey

PT#	Latitude	Longitude	Elevation (Top Rebar, Alum. Rod or Monument)	Comments
302	70 07 17.182416	146 14 58.643084	50.76	
304	70 07 34.358913	146 07 23.369146	24.55	
305	70 07 29.577671	146 04 40.771240	21.70	
306	70 07 26.708380	146 03 53.083733	18.61	*
310	70 07 50.279783	146 14 41.888772	40.23	
316	70 08 11.461004	146 04 04.402702	13.96	
317	70 08 24.508274	146 07 25.015170	13.08	
322	70 08 30.943176	146 20 05.937989	38.41	
324	70 08 29.290396	146 24 59.448517	42.37	
325	70 08 30.821778	146 27 25.151034	42.13	*
326	70 08 28.083369	146 30 17.892952	41.94	
328	70 08 26.137635	146 35 23.821179	36.88	
329	70 08 25.484547	146 38 08.096133	41.19	
336	70 08 54.150534	146 14 46.073334	20.48	
337	70 08 53.943801	146 06 15.408159	8.80	
342	70 09 17.042676	146 14 59.858519	12.94	
344	70 09 17.571062	146 20 07.893484	24.83	
346	70 09 09.076981	146 25 01.994043	29.55	
348	70 09 16.601006	146 30 21.745388	29.21	
350	70 09 20.604347	146 35 09.400298	21.40	
351	70 09 21.005371	146 37 45.147772	22.85	
359	70 09 53.822828	146 35 31.640645	14.66	
361	70 09 43.818364	146 14 47.599251	7.58	
362	70 09 43.679790	146 09 59.825033	9.42	
364	70 09 58.928156	146 12 17.781941	4.94	
367	70 10 23.286650	146 20 13.009041	3.62	
371	70 10 08.806553	146 30 12.229918	14.67	
375	70 10 04.907943	146 39 41.338109	14.86	
377	70 10 12.696179	146 45 03.212510	10.91	
383	70 10 38.951690	146 49 09.572140	5.19	* (1994 Survey)
385	70 10 43.344373	146 45 24.934978	7.11	
387	70 10 34.900056	146 35 24.269338	2.86	
391	70 10 41.042182	146 20 04.821521	3.20	
395	70 11 04.954193	146 25 42.648915	2.73	* NORA_OFFSET
398	70 11 05.472293	146 32 16.897634	3.56	
413	70 08 57.178595	146 44 36.976901	22.30	
414	70 09 52.207170	146 44 32.760918	10.97	
418	70 09 49.657991	146 25 47.619391	18.56	*
419	70 09 54.879094	146 20 08.448794	12.67	
422	70 10 27.188238	146 15 28.252456	3.24	

423	70	10	37.319394	146	25	27.723467	7.27	*	
429	70	11	22.303554	146	30	57.825053	4.76		
537	70	06	44.676890	146	50	14.127890	51.175	*	(1994 Survey)
538	70	07	39.457290	146	51	33.284990	38.875	*	(1994 Survey)
539	70	08	29.113810	146	50	20.770450	34.050	*	(1994 Survey)
601	70	08	15.988449	146	43	01.894701	39.99		
602	70	07	45.072173	146	44	51.382068	43.79		
603	70	06	54.571368	146	43	00.164489	57.89	*	
604	70	06	08.400114	146	43	46.024104	71.68		
605	70	05	27.114018	146	43	23.772971	85.58		
606	70	07	50.109645	146	36	56.951176	42.83		
607	70	06	57.957584	146	35	27.591725	65.15	*	
608	70	06	04.286598	146	36	09.284214	80.91		
609	70	05	24.313748	146	35	16.121746	94.57		
610	70	07	44.316517	146	29	01.570329	55.81		
611	70	06	57.112169	146	27	34.943318	69.05	*	
612	70	06	06.285667	146	28	28.535095	85.01	*	
613	70	05	23.560835	146	26	57.122583	98.02	*	
614	70	04	35.603594	146	25	34.220675	114.65	*	
615	70	03	50.789274	146	26	40.895200	130.93	*	
616	70	06	55.379782	146	23	22.936185	68.64	*	
617	70	07	40.535199	146	18	20.127769	48.94		
618	70	06	58.314033	146	19	55.883584	63.22	*	
619	70	06	07.194172	146	17	42.564144	73.63	*	
620	70	05	20.879808	146	19	57.682257	92.83		
621	70	04	32.379193	146	19	30.445074	107.51		
622	70	03	40.753935	146	19	56.444377	125.70		
623	70	03	02.607174	146	20	33.434188	140.82		
624	70	02	17.122038	146	19	51.689580	151.59		
625	70	01	38.968512	146	18	59.099286	161.00		
626	70	00	46.900351	146	19	57.212864	182.62		
627	70	06	55.108285	146	12	10.119886	49.08		
628	70	06	01.523483	146	10	10.425079	55.98	*	
629	70	05	22.138004	146	11	46.421941	71.09		
630	70	04	34.869666	146	12	20.519194	86.57		
631	70	03	41.919990	146	12	00.444966	99.61		
632	70	03	06.898421	146	14	34.240735	119.56		
633	70	02	13.836296	146	14	35.067144	133.88		
634	70	01	25.134885	146	15	05.717825	153.04		AeroMap's 313
635	70	00	47.581077	146	13	44.891415	151.91	*	
636	70	08	54.466956	146	03	07.472861	2.63		AeroMap's 315
637	70	08	24.667807	146	00	38.498281	1.81	*	AeroMap's 314
638	70	08	07.299821	146	02	06.427449	5.65	*	
639	70	06	46.865466	146	06	45.652008	38.15		
640	70	06	49.174235	146	03	55.015899	20.89	*	
641	70	06	07.702482	146	04	50.102795	35.46	*	
642	70	05	17.053402	146	06	33.481637	53.99	*	
643	70	04	28.020298	146	06	15.103450	61.68	*	
644	70	03	46.373776	146	07	00.575378	74.33	*	
645	70	03	26.893738	146	08	08.828242	82.04	*	
646	70	03	09.191161	146	09	27.144738	92.02	*	
647	70	02	21.840229	146	10	52.906354	109.28	*	
648	70	01	42.277604	146	11	33.693603	123.98	*	
1000	70	09	20.984905	147	08	14.389498	21.15	*	ELIZA (1994)

C. A. "Bud" Herschbach
Surveying Consultant
Registered Land Surveyor Certified Hydrographer

August 29, 1997

AeroMap U.S.
2014 Merrill Field Drive
Anchorage, Alaska 99501-4116

RECEIVED
AUG 29 1997
AEROMAP U.S.

ATTN: Steve St. Peter

RE: Sourdough Survey - Letter of Transmittal

Dear Steve:

Transmitted herewith are final vertical and horizontal values for the photo control points established during the recently completed field work. Also included are three copies of the final project report and an invoice for the final 25% of the project contract amount.

We appreciate the opportunity to work with you on this project. Give me a call if any questions arise.

Very truly yours,

C. A. Herschbach

C. A. "Bud" Herschbach, R.L.S.

P.O. Box 521084 • Big Lake, AK 99652 • Tel. (907) 892-7839

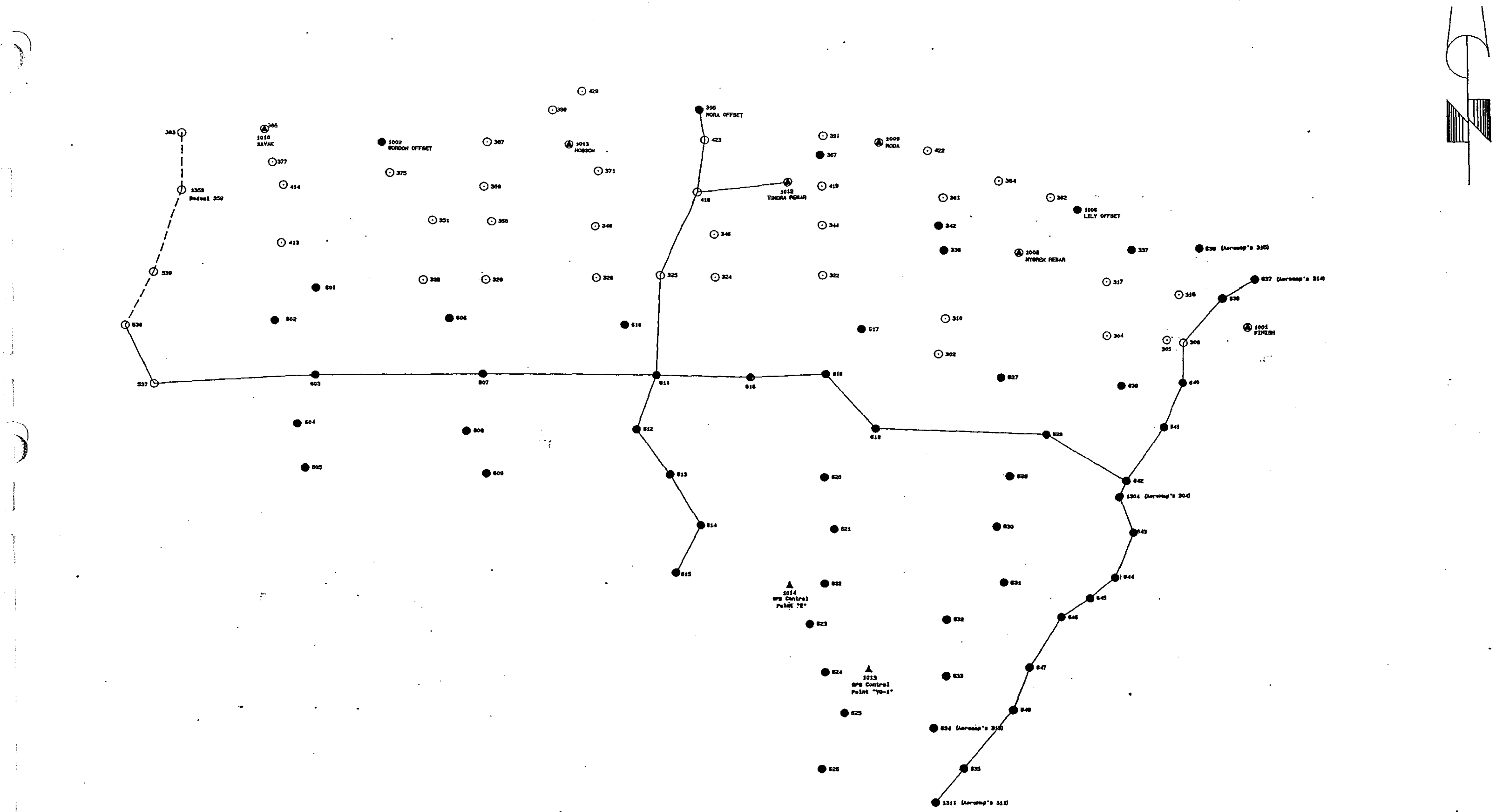
INAL ADJUSTED VALUES - SOURDOUGH PHOTO CONTROL PROJECT - 8/29/97

llipsoid: NAD27
utput: State Plane Zone 3, Pt #, Northing, Easting, Elevations (Feet)
otes: * = Indicates elevation derived by differential levels.
Elevations based off rebar height for pt 537, 1994 Badami Survey
Points labeled with 1994 are from the 1994 Badami Survey

T#	Northing	Easting	Elevation (Top Rebar, Alum. Rod or Monument)	Elev. (Panel)	Comments
02	5893997.739	468910.167	50.76	50.42	
04	5895695.816	484664.517	24.55	24.28	
05	5895200.442	490287.912	21.70	21.21	
06	5894906.800	491937.148	18.61	18.29	*
10	5897360.242	469503.333	40.23	39.93	
16	5899457.050	491550.672	13.96	13.60	
17	5900794.416	484617.929	13.08	12.71	
22	5901547.619	458320.178	38.41	37.81	
24	5901442.161	448174.795	42.37	42.17	
25	5901633.952	443140.149	42.13	41.99	*
26	5901402.695	437167.633	41.94	41.72	
28	5901299.913	426592.097	36.88	36.53	
29	5901290.634	420913.566	41.19	40.87	
36	5903854.279	469384.863	20.48	20.09	
37	5903782.513	487029.035	8.80	8.48	
342	5906183.562	468918.117	12.94	12.51	
344	5906288.415	458278.703	24.83	24.58	
346	5905487.637	448114.520	29.55	29.31	
348	5906336.263	437075.459	29.21	28.99	
350	5906832.312	427143.792	21.40	21.08	
351	5906926.737	421765.039	22.85	22.74	
359	5910216.807	426408.487	14.66	14.55	
361	5908904.007	469352.579	7.58	6.86	
362	5908856.218	479288.910	9.42	9.02	
364	5910420.987	474530.688	4.94	4.54	
367	5912970.377	458138.970	3.62	3.32	
371	5911640.937	437447.989	14.67	14.45	
375	5911432.446	417800.597	14.86	14.65	
377	5912353.017	406700.308	10.91	10.58	
383	5915131.723	398233.694	5.19	4.40	* 1994 Survey
385	5915477.987	405989.327	7.11	6.66	
387	5914390.349	426703.422	2.86	2.60	
391	5914773.941	458431.438	3.20	3.05	
395	5917277.973	446793.025	2.73	2.56	* NORA_OFFSET
398	5917438.548	433195.869	3.56	3.32	
413	5904664.798	407512.047	22.30	22.05	
414	5910257.220	407725.889	10.97	10.74	
418	5909624.234	446567.560	18.56	18.31	*
19	5910081.447	458280.426	12.67	12.43	
22	5913319.051	467967.561	3.24	2.65	

3	5914464.888	447288.230	7.27	6.89	*	
9	5919126.073	435937.547	4.76	4.13		
37	5891346.116	395679.154	51.175	49.995	*	1994 Survey
38	5896953.082	393018.176	38.875	37.775	*	1994 Survey
39	5901966.098	395595.499	34.050	32.540	*	1994 Survey
01	5900438.012	410747.644	39.99	39.87		
02	5897340.581	406924.415	43.79	43.71		
03	5892160.449	410710.078	57.89	57.76	*	
04	5887485.535	409066.917	71.68	71.46		
05	5883279.225	409787.570	85.58	85.45		
06	5897669.104	423336.213	42.83	42.62		
07	5892336.620	426374.810	65.15	65.03	*	
08	5886894.476	424878.122	80.91	80.74		
09	5882812.788	426679.876	94.57	94.39		
10	5896931.800	439770.211	55.81	55.69		
11	5892109.642	442729.824	69.05	68.90	*	
12	5886956.676	440835.037	85.01	84.90	*	
13	5882589.131	443968.495	98.02	97.92	*	
14	5877693.002	446806.816	114.65	114.49	*	
15	5873153.556	444461.926	130.93	130.80	*	
16	5891872.730	451449.423	68.64	68.54	*	
17	5896403.660	461951.473	48.94	48.68		
18	5892128.591	458616.329	63.22	63.07	*	
19	5886907.746	463204.652	73.63	73.49	*	
20	5882223.329	458500.002	92.83	92.69		
21	5877287.453	459417.463	107.51	107.37		
2	5872043.880	458487.383	125.70	125.57		
23	5868172.839	457182.172	140.82	140.64		
24	5863540.637	458606.183	151.59	151.44		
25	5859652.103	460412.780	161.00	160.84		
26	5854369.419	458364.295	182.62	182.47		
27	5891731.913	474732.975	49.08	49.00		
28	5886271.528	478860.044	55.98	55.82	*	
29	5882277.371	475522.641	71.09	70.96		
30	5877475.728	474324.962	86.57	86.46		
31	5872090.284	475003.291	99.61	99.50		
32	5868549.222	469652.997	119.56	119.49		
33	5863154.805	469602.799	133.88	133.73		
34	5858207.934	468517.657	153.04	152.25		AeroMap's 313
35	5854378.978	471312.786	151.91	151.86	*	
36	5903827.366	493522.550	2.63	2.20		AeroMap's 315
37	5900795.145	498669.298	1.81	1.33	*	AeroMap's 314
38	5899030.551	495628.990	5.65	5.51	*	
39	5890864.829	485960.166	38.15	38.04		
40	5891090.927	491866.222	20.89	20.72	*	
41	5886876.950	489954.118	35.46	35.26	*	
42	5881733.259	486365.010	53.99	53.85	*	
43	5876747.172	486993.330	61.68	61.59	*	
44	5872516.026	485408.482	74.33	74.24	*	
45	5870540.494	483036.095	82.04	81.84	*	
46	5868747.301	480313.616	92.02	91.91	*	
47	5863941.656	477322.394	109.28	109.20	*	
8	5859923.885	475893.008	123.98	123.87	*	

?02	5914299.163	417021.631	16.56	16.40		GORDON_OFFSET
03	5914194.916	434704.362	16.90	12.81		HOBSON
?06	5907663.907	481832.158	8.77	8.49		LILY_OFFSET
?12	5910503.721	455113.967	15.29	14.69	*	TUNDRA_REBAR
?04	5880245.283	485736.172	55.32	54.73	*	AeroMap's 304
?11	5851169.293	468716.748	173.54	173.05	*	AeroMap's 311
?59	5909770.816	398210.375	14.07	13.57	*	Badami359(1994)

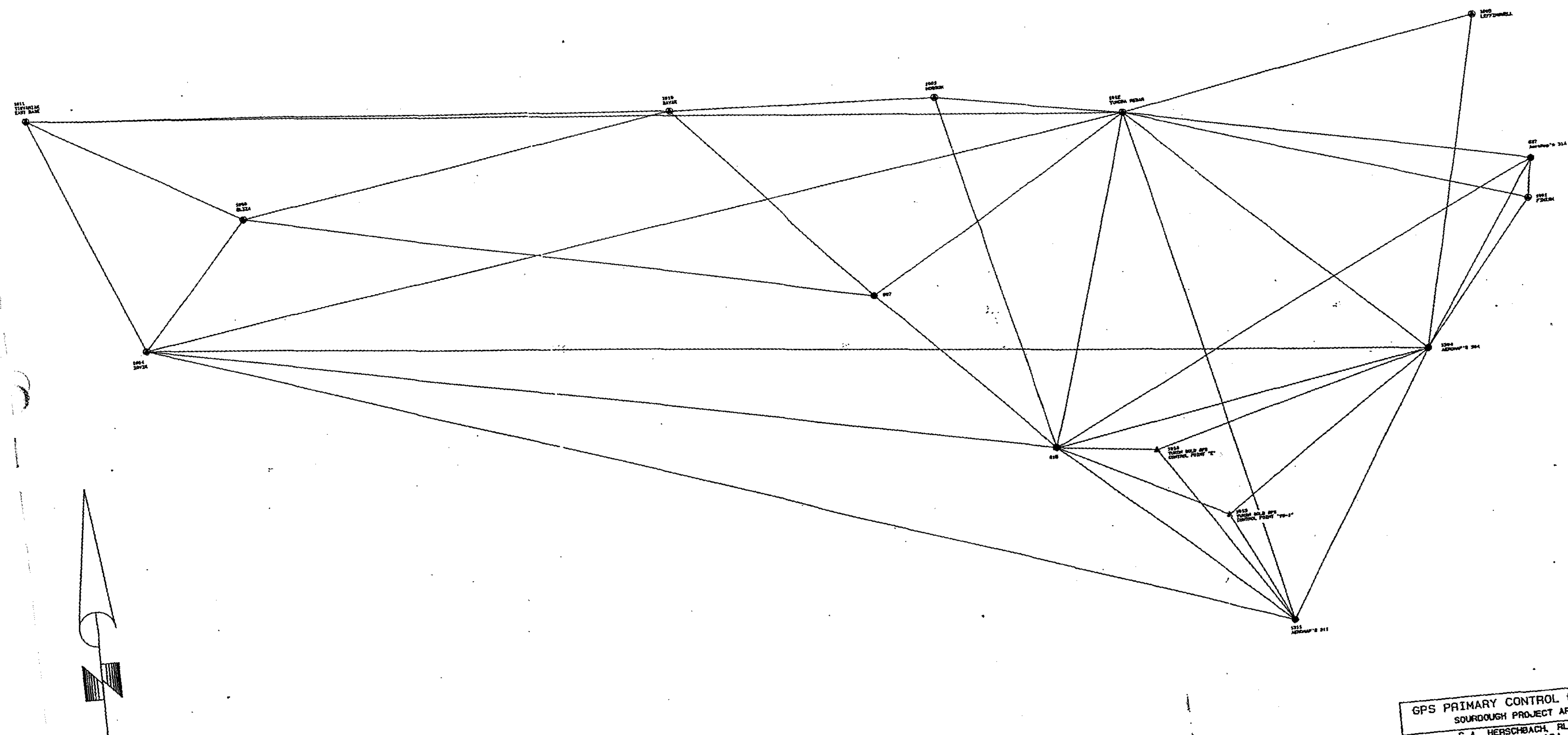


LEGEND

OL POINT, BRASS CAP MONUMENT
N GOLD GPS CONTROL POINT
PHOTO CONTROL POINT
TING PHOTO CONTROL POINT FROM
IOUS MAPPING PROJECTS
L RUNS BADAMI PROJECT
ERENTIAL LEVEL RUNS

PHOTO CONTROL POINT PLOT
SOURDOUGH PROJECT AREA

C.A. HERSCHBACH, RLS
P.O. BOX 521084
BIG LAKE, ALASKA, 99652
Phone: 907-892-7839



GPS PRIMARY CONTROL DIAGRAM

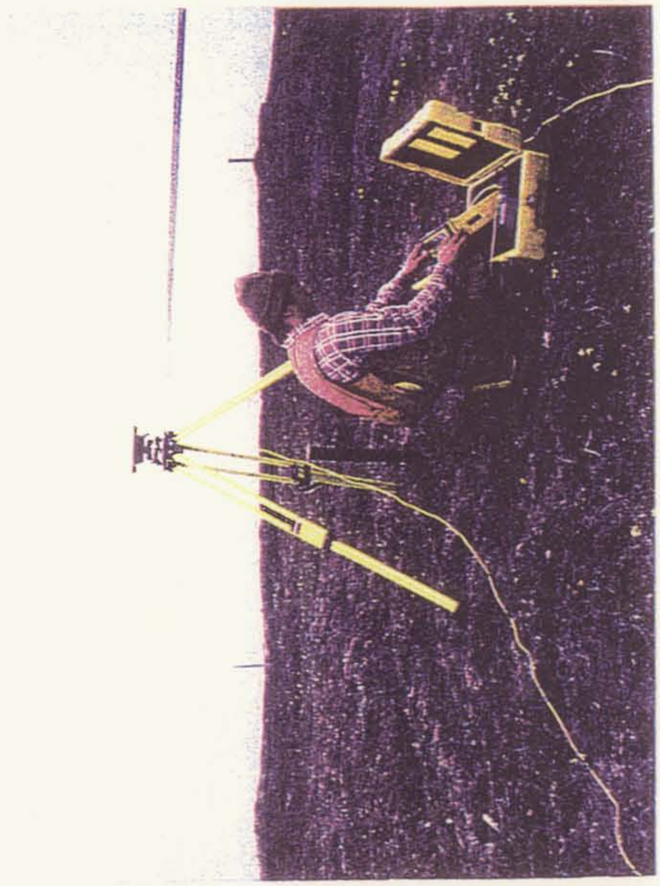
SOURDOUGH PROJECT AREA

C.A. HERSCHBACH, RLS
P.O. BOX 521084

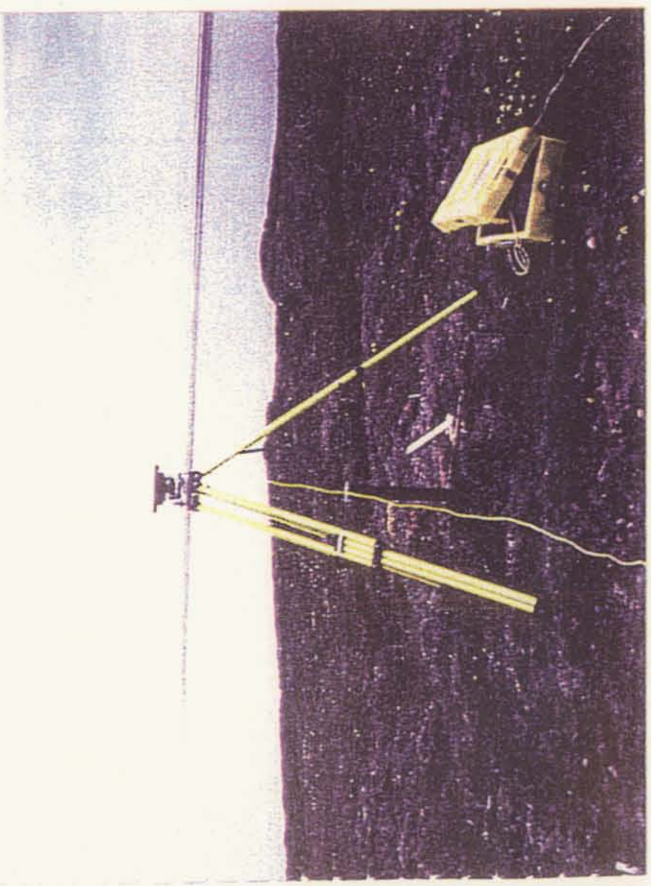
LEGEND

- EXISTING NGS CONTROL MONUMENT
- NEW PHOTO CONTROL POINT
- ▲ YUKON GOLD CONTROL POINT

Trimble 4000SSi GPS



GPS operation



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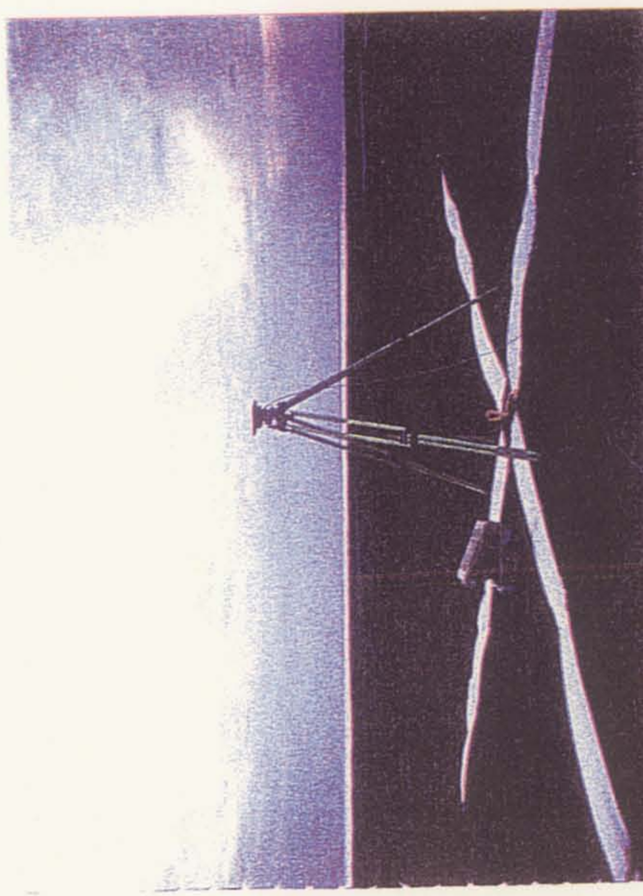

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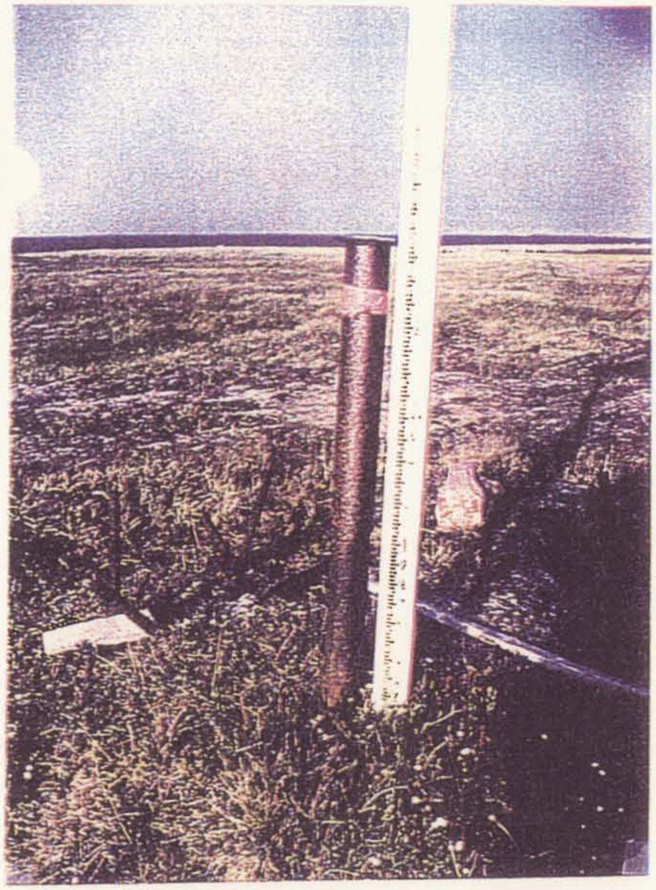
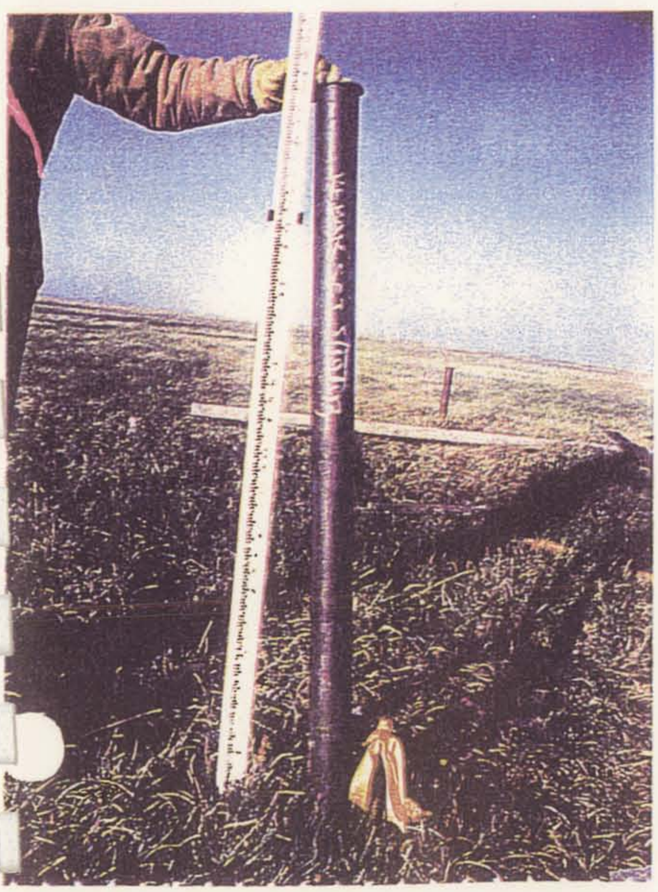


NGS Station "SAVAK"

NGS Station "Hopson"

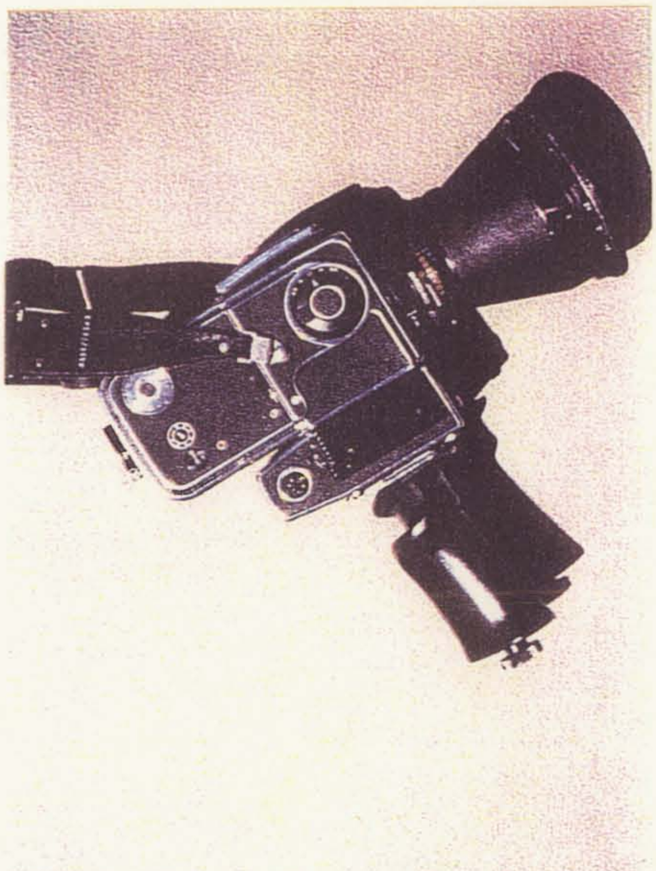


NGS Station "TUNDRA"

NGS Station "RODA"

NGS station "NYGREN"

Bell 206 Long Ranger



Hasselblad model 500 EL/M

Diffential Leveling

Sourdough Area Development Project Economic Screening Study February 1998

TABLE OF CONTENTS

APPENDICES

Executive Summary

BPXA is evaluating the opportunity to develop the Sourdough Area prospects, which include both the condensate from the Point Thomson gas field as well as neighboring oil reservoirs. The development prospects are linked in that the condensate by itself does not offer favorable economics, and the oil fields are difficult to produce. The BPXA concept is to tap the gas reserves, and produce the condensate from that gas, resulting in a rich and favorable export product. In addition, a portion of the gas stream would then be processed into miscible injectant (MI) to be injected into the oil reservoirs to improve the well yields for those Brookian deposits. The separate products would then be mixed into a single export stream for transmission back to Pump Station #1 of the Trans Alaska Pipeline System (TAPS) for delivery to Valdez and final export destination.

This document reports the outcome of an economic evaluation of a number of possible development options. An estimating strategy was developed for the Sourdough Area Development Project, and applied uniformly to the various development options using cost indices benchmarked to existing and developing North Slope projects. Although drilling costs are not included, the project drilling group supplied their initial estimates of optimal pad locations and processing requirements to aid the evaluation.

The recommended option based on this screening study is a scenario which co-locates the processing facility to an onshore single drill pad used to develop both the Point Thomson gas field and near shore Flaxman reserves. A significant processing component is involved to handle the gas and production of MI, and is included in a main facility located close to this drill pad. The transmission pipeline would also originate at this point, travel in an aboveground mode to the Badami unit, and then follow the Badami and Endicott pipelines to PS#1 of TAPS. The current economics are based on a new pipeline, although concurrent studies are underway which focus on the use of existing horsepower and pipeline segments along this route to improve the project economics.

Additionally, two scenarios which are expansions of this first option are introduced which allow further development of Point Thomson prospects as well as the Flaxman reserves

further offshore. These scenarios can be viewed as incremental to the base option, thus improving the project cash flow during startup of the development project. In addition, the base option is seen to be compatible with further developments of neighboring prospects, if and when those reservoirs are further proved.

The options #7, #8 and #9 are the recommended options, with option #7 as a base option and #8 and/or #9 viewed as expansions to that base option. More detailed design definition and cost estimating will focus on this development scenario.

1.0 INTRODUCTION

British Petroleum Exploration (Alaska), Inc. (BPXA) is evaluating the opportunity to develop the Point Thomson condensate reserves and neighboring Sourdough Area prospects. The project development area is located approximately 25 miles east of the Badami Development Project or approximately 60 miles east of the Prudhoe Bay Unit (Figure 1).

The development prospects of the Point Thomson gas field and neighboring Brookian oil fields are linked in that the condensate by itself does not offer favorable economics, and the oil fields are difficult to produce. The BPXA concept is to tap the gas reserves, and produce the condensate from that gas, resulting in a rich and favorable export product. In addition, a portion of the gas stream would then be processed into miscible injectant (MI) to be injected into the oil reservoirs to improve the well yields for those Brookian deposits. The separate products would then be mixed into a single export stream for transmission back to Pump Station #1 of the Trans Alaska Pipeline System (TAPS) for delivery to Valdez and final export destination.

The proposed Sourdough Area Development Project (SADP) involves a central processing facility, an approximately 63.5 mile pipeline transmission to PS#1, both well and injection lines to well pads, an airfield, an infield road system, a gravel source, and associated drilling pads.

As part of the conceptual engineering effort numerous infrastructure layout scenarios were investigated. A large part of this investigation was cost estimates for various scenarios to facilitate finding the most cost effective, "fit for purpose" layout. The infrastructure layouts evaluated took into account drilling considerations, environmental issues, and commercial viability. The next section, Chapter 2, explains the approach to the estimation process, while Chapter 3 defines the cost items included in the estimate. Chapter 4 defines the options evaluated in the screening process, and presents the results of the cost estimation.

2.0 COST ESTIMATION ACCURACY

2.1 General

The principal difference between project estimates is the design and plan information available and the accuracy required of the estimate. The accuracy of the estimate will change depending on the level of design definition. The terminology used for this estimate process is contained in Appendix A.

In the conceptual stage of design, the project is typically defined in terms of major components, e.g. linepipe, stations, major facilities. At this level, estimates can only be made using broad industry and experience based guidelines, such as the concept of "dollars per in-diameter mile" used in pipeline estimating. Broad factors are then applied to express perceived variations such as geographical factors. As design progresses, more definition of the components of the major elements are better known and can thus be separately costed using specific vendor and contractor quotes or recent analogous project experience. Thus, accuracy of the cost estimation increases with design.

Contingency is the additional amount that is added to the estimate to account for the uncertainties in the estimated amounts. Uncertainty in estimation for hardware items can be attributed to a large number of factors such as lack of detail in the item being estimated, lack of basic information about unit costs, uncertainty in supply/demand factors at the time of bid, etc. In most cases, the uncertainty is greatest for those items that require an estimation of labor. Labor estimation has all of the uncertainty factors associated with hardware estimation, but in addition can include productivity, weather, contracting, permitting and a number of other unknowns. Note, in particular, that contingency is not intended to address cost changes associated with scope change, but is rather intended to address the uncertainty range in the estimate for the project as described to the estimator.

The level of contingency should take the increase in accuracy into account. In the early stages of a project, a 90% level would not be expected to be close to the mean estimate (the "P50" estimate value). As the project progresses, the confidence in the design and estimation should increase, i.e. the 90% level is "closer" to the mean value. Thus, for the same level of uncertainty, say 90%, the estimate value should be closer to P50.

For example, say that at the original phase of design the P50 estimate is $1000, and that through a risk analysis it is ascertained that the actual bid would come in at $2000 90% of the time. Later in design, the estimate indicates that the P50 value is still $1000, but that increased information allows us to say that the actual bid would come in at $1500 90% of the time. The estimate P50 value has not changed, but the accuracy increase allows us to decrease the money for contingency and retain the same confidence in the estimate. It follows that it is not necessary to change the project view of the acceptable level of risk of a project as the project progresses, but that increased design definition and estimating unit costs would lead to a lowered required funding of the project for the same desired confidence level. Again, note that this process is distinct from savings due to changes in the design scope and/or improved technology to accomplish the scope.

2.2 Project Specific

For this project, estimates are to be made using the best available information referenced, and all assumptions listed. The estimate values are to be the "P50" values, i.e. if the item went for bid a large number of times and/or to a large number of contractors, the estimated value would equal the average of all the bids. In other words, the estimated values are expected to be the "mean" actual cost for the service or equipment being estimated.

The contingency level that is acceptable to the project can only be decided by the project management, and is an expression of the risk that they are willing to undertake. To aid in this decision process, it is worthwhile to show how the estimate would vary depending on the full range of contingency. This is done through a formal estimate risk analysis which assigns the range of uncertainty for each element in the estimate, and then combines the individual range estimates through a numerical process to find the range of uncertainty of the combined total of all estimated elements.

At this conceptual stage of the project, the estimates are considered Level 0. This is considered adequate for economic screening of alternative options. With the scant information available during this early stage of conceptual design, a formal risk analysis provides little additional information. The screening evaluation benchmarked, to the degree possible, major cost items against similar experience on developed or developing North

Slope projects. Based on these benchmarks and experience, it is our judgement that an additional amount of 40% of the mean estimates provided for the screening options should provide about a 90% confidence level that the actual costs will be at or below the mean estimates contained in this report, e.g. if the mean estimate quoted is $100 million, then 90% of the time the actual costs would be $140 million or below.

3.0 COST ESTIMATION PROCEDURE

3.1 Methodology

The initial screening studies were done using the FAST-EST computer software developed by OPC Engineering, Inc. of Houston, Texas. FAST-EST is a system of computer programs designed for performing field development planning, feasibility studies and cost estimates for onshore oil and gas field developments. The software used in this study was licensed to BP Exploration (Alaska), Inc. (BPXA) and was used with their permission. Basic cost indices input into the FAST-EST model are presented in Appendix B.

The software was used to model the BPXA Liberty Project and the results were compared to a detailed estimate to determine accuracy and to validate the cost indices used by the program. This comparison was done by BPXA "in-house" and was not part of the conceptual engineering effort. The results of this comparison indicate that, while on a line by line basis that results are not always comparable to other project estimates, the overall results are comparable. This is considered reasonable since estimation techniques and individual estimators will often allocate individual cost factors to different cost items at this level of analysis. An adjustment of a few of the default values increased the accuracy of the line by line comparison, but did not affect the overall accuracy. For example, increasing the erection productivity and the erection cost per hour to more reasonable values resulted in a more reasonable number of manhours while not significantly altering the cost.

A number of minor problems with the software were identified during the screening efforts, none of which seriously impaired the screening process.

3.2 Project Cost Items

A checklist of the major items used for cost estimating at this level of project development is shown in Table 3-1.

Table 3-1

Project Cost Item Checklist

Project Cost Item	Included in this Cost Analysis?
Central Processing Facility – Civil (Pad, Buildings…)	Yes
Major Drivers (Pumps, Compressors)	Yes
Well Pads	Yes
Well Pad equipment (manifolds…)	Yes
Infield Gathering Lines	Yes
Infield Injection Lines	Yes
Infield Pipeline Support System	Yes
Infield Roads	Yes
Transmission Pipeline	Yes
Transmission Support System	Yes
Dock	Yes
Airstrip	Yes
Construction Indirects (Camps, Catering,…)	Yes
Drilling – Labor and Material	**No**
Freight	Yes
Finance Costs	**No**
Engineering Costs	Yes
Contingency	**No**
Operating and Maintenance	**No**
Permitting Costs	**No**

From the above list, the most significant item that is not included in this cost analysis is an estimate of the drilling costs. However, the estimation group worked as closely as possible with the drilling group to select pad locations and scenarios that reflect the current reservoir and drilling scenarios of interest.

The specifics of the individual major cost items used in this study are explained in the following sections.

3.2.1 Central Processing Facility

The CPF estimate includes costs for gravel pad, permanent camp, communication system, and all process facilities (equipment and structures). The size of the gravel pad is assumed to be 1750-feet long by 850-feet wide by 5-feet thick.

3.2.2 Export Pipeline

The export pipeline is a 16-inch diameter elevated line extending about 63.5 miles from the CPF to Pump Station 1. The actual length is dependant on the location of the facilities for each option. Crossings of East Badami Creek, No Name River, Shaviovik River, Kadleroshilik River and the Sagavinirktok River are all to be accomplished using conventional open-ditching techniques. Additional costs associated with these river crossings were not included in the economic screening studies since they are the same for all options. These costs will be included in the detailed estimate.

3.2.3 Dock

The gravel dock will extend approximately 1500-feet offshore and will have a 15-foot freeboard. The maximum water depth is 10-feet. A 50-foot wide drive lane will extend from shore 1100-feet to a 400-foot by 400-foot lay-down area. The seaward end will have a vertical sheet-pile face, while all other sides will be dressed to a 7 horizontal to 1 vertical (7:1) slope. A 50-foot wide module road from the dock to the CPF is included in this estimate. The gravel road will be 5 feet thick and have 2:1 sideslopes.

3.2.4 Airstrip

The gravel airstrip is 5500-feet long by 150-feet wide by 5-feet thick. The last 300-feet at each end will be widened an additional 50-feet, for a total width of 200-feet and the sideslopes will be 2:1. Runway lights will be installed as well as fueling facilities and minimal maintenance/emergency/passenger facilities. An access road from the airstrip to the CPF is included in this estimate. The gravel access road will be 32-feet wide and will be 5-feet thick with 2:1 sideslopes.

3.2.5 Construction Camp

The estimate for the temporary construction camp includes housing and catering costs to handle up to 500 workers, depending on the option.

3.2.6 Drill Pads

The estimate for the main drill pads includes costs for the gravel pad, well houses, manifolds, gathering lines and re-injection lines. There will be two manifolds on some pads, one for the Point Thomson gas and the other for the Brookian oil. The length of all lines is estimated based upon the mapping for that option. All line sizes are estimated using the piping requirements of API 5LX grade X65. The size of drill pads, for civil quantity estimates, are 800-feet long by 500-feet wide by a uniform 5-feet thick.

4.0 INITIAL SCREENING STUDIES

A number of possible alternatives were considered as viable options for further consideration and economic evaluation. An economic evaluation was undertaken for each option using the FAST-EST program, after review of the unit cost indices used by the program to estimate cost for the major equipment and labor items. The same program and unit cost indices were used for the evaluation of all alternatives. This is considered a Level 0 estimate study, suitable for evaluating the relative cost indices of project development alternatives.

4.1 Description of Options

Following are the descriptions of the alternatives investigated in this screening study :

Case 1 was the initial scenario considered and consisted of a centrally located process facility, with a nearby airstrip, and six drill pads: Callaway, Chilkoot, Flaxman, Point Thomson East, Point Thomson West, and Sourdough. Callaway was co-located with Point Thomson West, while Flaxman was co-located with Point Thomson East. This scenario also had a dock located approximately 1-mile east of the existing Point Thomson Unit #3 pad. Case 1 is presented on Figure 2.

Case 2 differed from Case 1 only in the location of the CPF and airstrip. The CPF was located nearer the shore, very close to the Point Thomson West pad. The airstrip was also located nearer the shore. While this scenario actually required a longer export pipeline, it reduced the length of the high-pressure injection lines considerably. Case 2 is presented on Figure 3.

Case 3 is the same as Case 1 with the addition of a drill pad at Lynx. Case 3 is presented on Figure 4.

Case 4 is the same as Case 2 with a Lynx Pad. Case 4 is presented on Figure 5.

Case 5 differed from the others in CPF location, airstrip location, dock location, and the addition of another drill pad located at Point Hopson, significantly further west than the remainder of the drill pads. A cursory analysis showed that the added cost was not warranted due to the significant distance from the actual penetrated hydrocarbon reserves central to this development.

Case 6 was aimed at identifying possible cost savings through consolidation of the Sourdough and Chilkoot Pads. After cursory evaluation; Cases 7, 8 and 9 were found to be superior.

Cases 5 and 6 were dropped from further evaluation.

Case 7 evaluated the scenario that Point Thomson and Flaxman would be developed, if possible, from a single drill pad located adjacent to the existing North Staines River #1 pad. The Central Process Facility would be located nearby with an airstrip approximately 1 mile to the southwest. A dock would be located on the point immediately west of the CPF. Case 7 is presented in Figure 6.

Case 8 is the same as Case 7 with an additional drill pad located at the existing Point Thomson Unit #3 pad. This would allow development of additional Point Thomson reserves as well as the potential Callaway reserves and, to a lesser extent, Lynx. Case 8 is presented in Figure 7.

Case 9 further builds on Case 8 with an additional drill pad being located on Flaxman Island to allow further development of the Flaxman formation. In addition to the drill pad, a small landing pier, and minimal maintenance/camp facilities would be required. Case 9 is presented in Figure 8.

4.2 Results

Cost breakdowns for Cases 1, 2, 3, 4, 7, 8 and 9 are presented in Table 4-1. Summary output for these cases from the FAST-EST models is presented in Appendix C. (The FAST-EST output report contains a known error in computing the freight costs on the gathering/support lines, this error has been hand corrected on the copies contained in this report.)

The results indicate a preference for the last three options investigated, Options #7, 8 and 9. Although the co-location of the main drill pad and facilities further east involves higher export pipeline costs, the cost of the associated development infrastructure (well lines, injection lines, etc) more than make up for this loss in these options. In addition, there are other savings not immediately evident in this cost analysis due to expected lower operational and maintenance costs that should be realized with the operating personnel closely located to the main facilities and drilling location. Further examination of these favorable options prompted renewed interest in the co-location of a dock near the central facilities location. Using the available bathymetry data, a dock location near the facilities is possible and will be further examined in planned field studies.

The favorable cost outcome coincides with the project preference to focus initially on only those areas containing known hydrocarbon deposits, i.e., Point Thomson, Flaxman and Sourdough.

Table 4-1

Initial Cost Estimate Comparison (in $1000's)

	CPF	Export Pipeline	Well Lines	Injection Lines	Civil Infrastructure	Drill Sites	Total
Case 1	$372,365	$140,258	$17,446	$25,173	$28,353	$39,145	***$622,740***
Case 2	$372,365	$141,436	$17,542	$21,231	$26,333	$39,145	***$618,052***
Case 3	$376,242	$140,258	$19,437	$26,404	$30,299	$45,856	***$638,496***
Case 4	$376,242	$141,436	$19,793	$22,101	$28,533	$45,856	***$633,961***
Case 7	$368,259	$149,687	$3,793	$2,859	$20,621	$21,733	***$566,952***
Case 8	$370,457	$149,687	$7,926	$15,703	$23,980	$27,532	***$595,285***
Case 9	$372,655	$149,687	$22,746	$26,883	$24,330	$33,038	***$629,339***

5.0 CONCLUSIONS

The outcome of the economic screening study shows favorable economics for the development of a single well pad that would develop the reserves and condensates from Flaxman and Point Thomson. In addition, a pad would be located at the Sourdough prospect with a direct connecting road to the central processing facilities located near the main drill pad. This is Case #7 in the screening options described. The economics coincide with the project preference to focus on only those areas containing known hydrocarbon deposits, i.e. Point Thomson, Flaxman and Sourdough. A dock location near this facility appears feasible, based on the available bathymetry data. In addition, this option utilizes an existing abandoned pad at the main facility location which serves to minimize the new footprint required for the project.

The Cases #8 and #9 build on this case to develop additional Point Thomson reserves to the west of the main facilities, and additional Flaxman reserves further offshore. The economics of these options are also favorable when considered on a cost per barrel basis. Moreover, the three alternatives are not mutually exclusive, i.e. either Case #8 and/or Case #9 can be treated as expansions of the base case (Case #7). This leads to additional favorable economics by treating the three options as phased development scenarios, wherein Case #7 is developed first and then expanded to include additional Point Thomson and Flaxman reserves. A suboption of Case #7 would be to develop only the main drill pad first, and then phase in the Sourdough field thereafter, but still within the same construction plan. (The development of only the Point Thomson/Flaxman main site without Sourdough leads to a reduced, and probably unfavorable, return when measured in Capex cost/barrel/day.)

As reservoirs are proved, additional prospects from currently unproved reservoirs, e.g. Lynx, Callaway, can be further included in the total project development scenario.

Further project definition and detailed cost estimating is planned to explore further the Case #7 Development Scenario, with and without phasing, for inclusion of the Point Thomson Unit #3 drill pad, and the Flaxman Island pad.

FIGURES

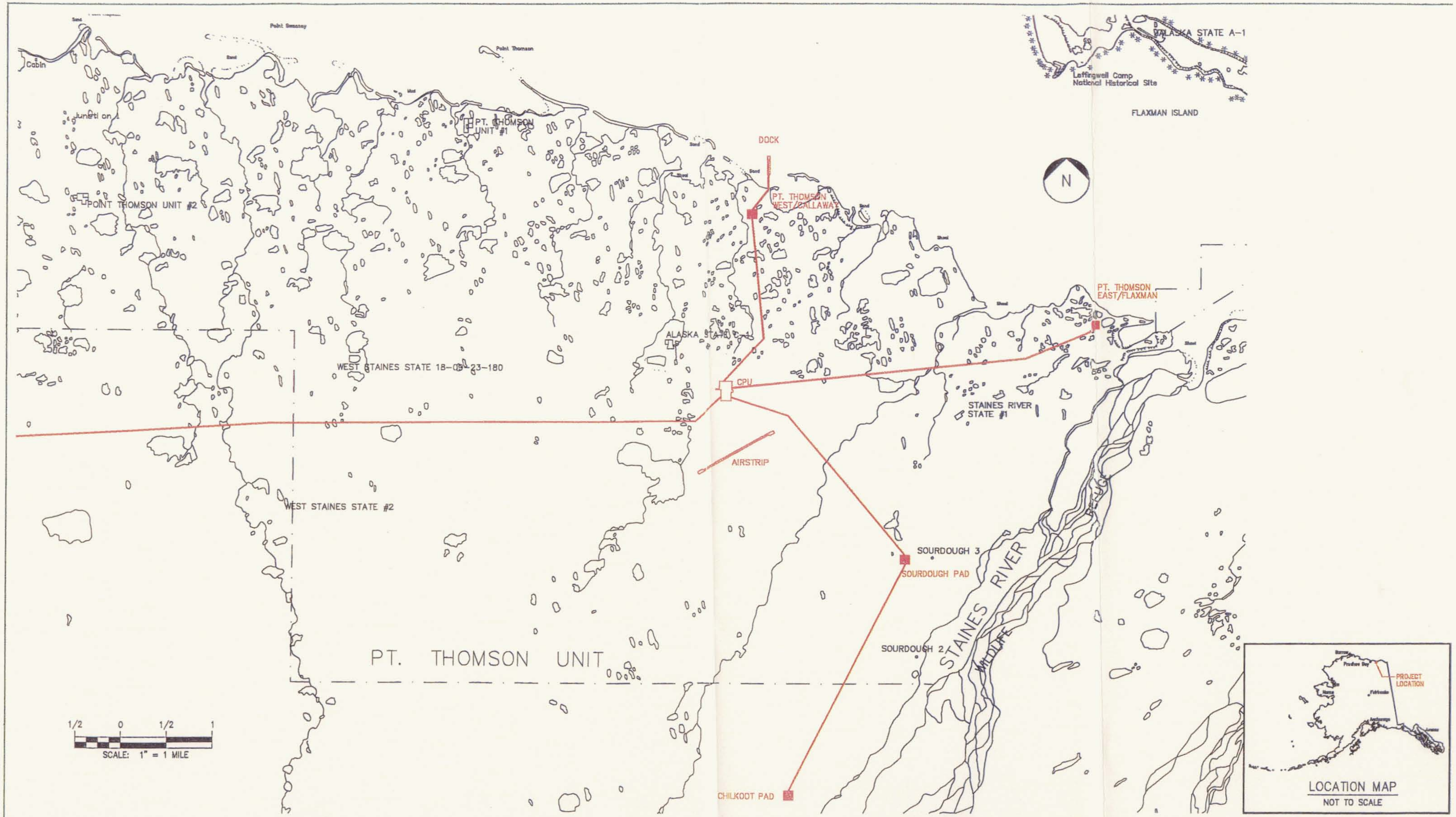


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FIGURE 2

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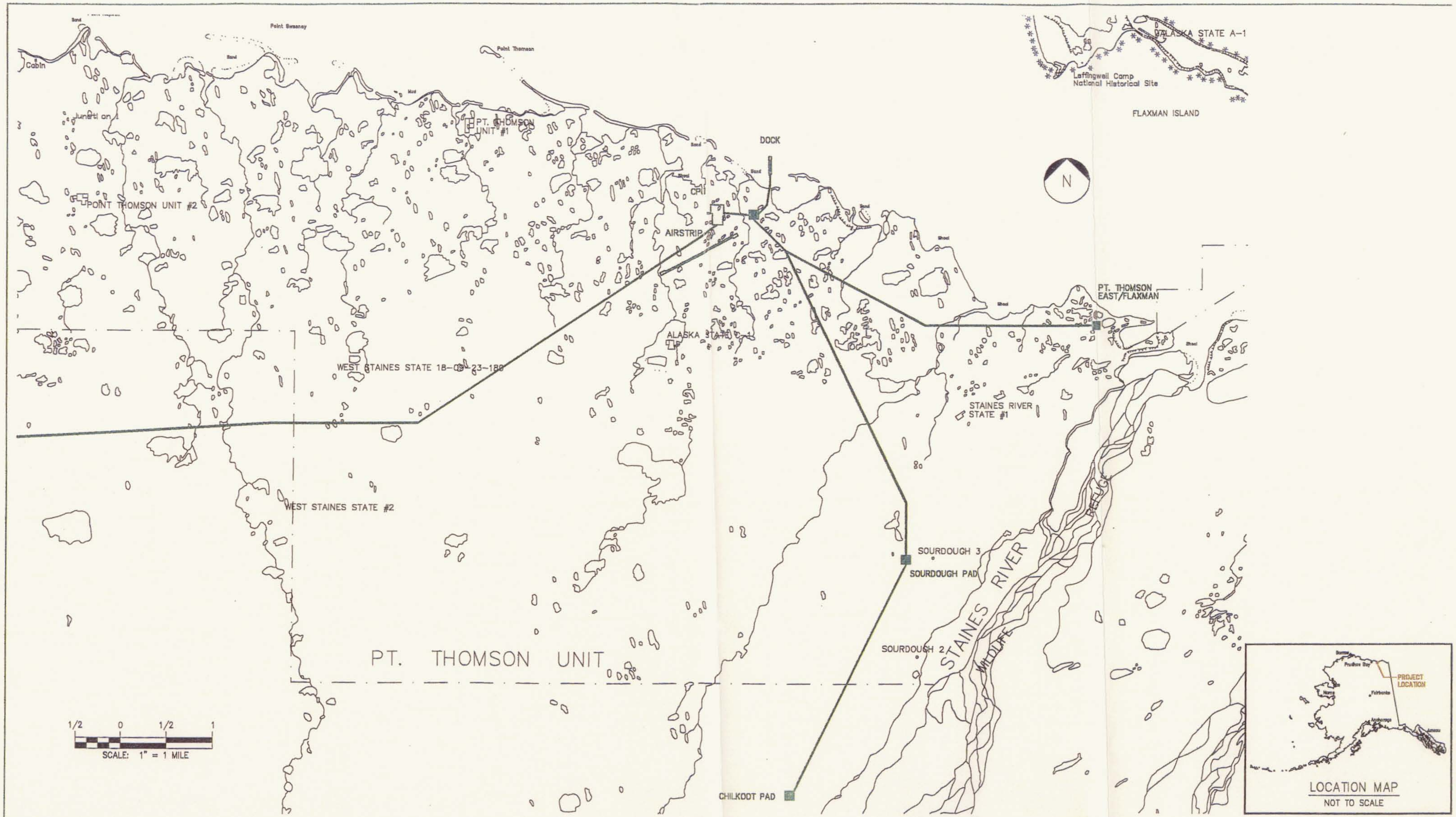

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FIGURE 3

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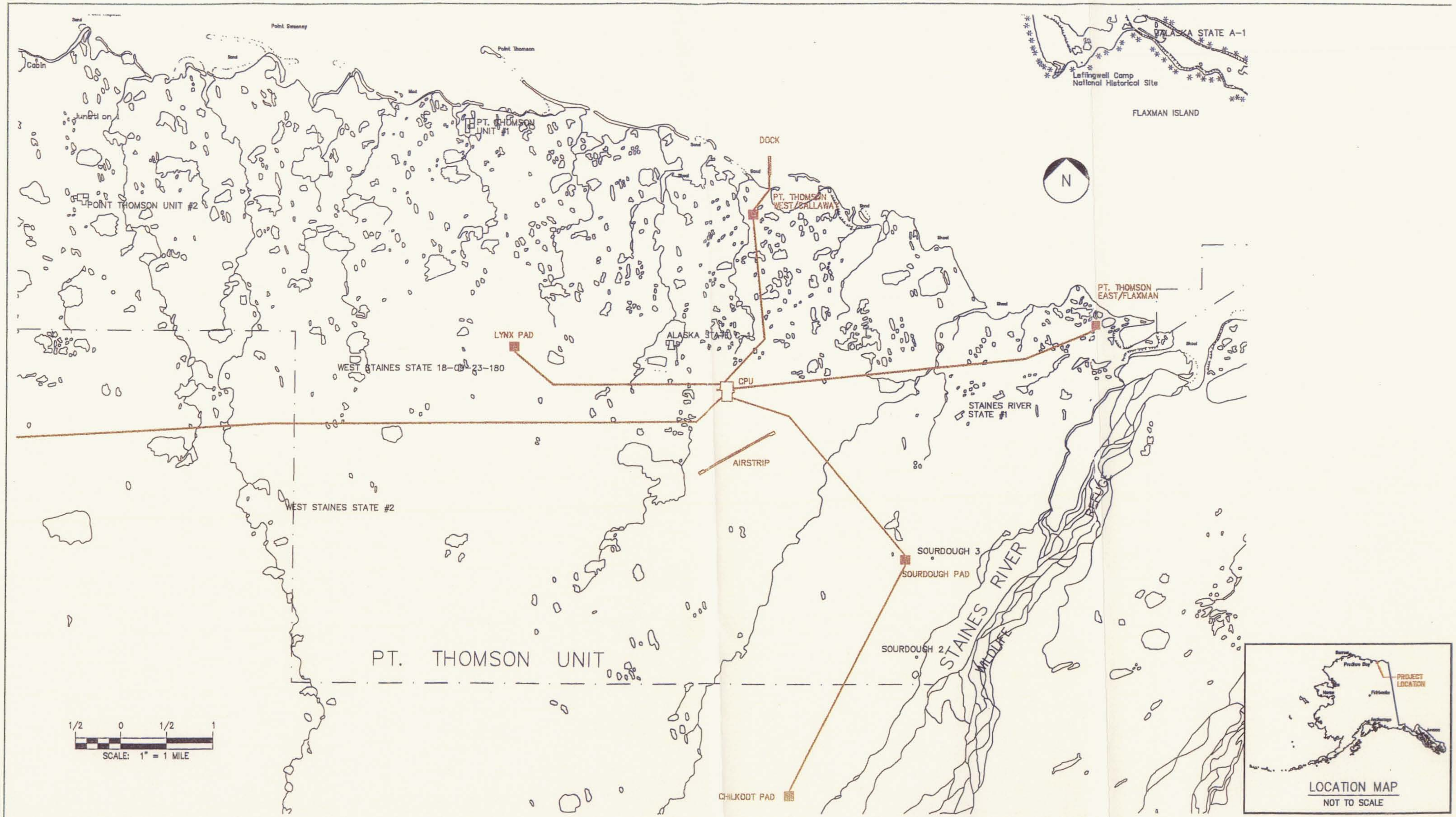

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FIGURE 4

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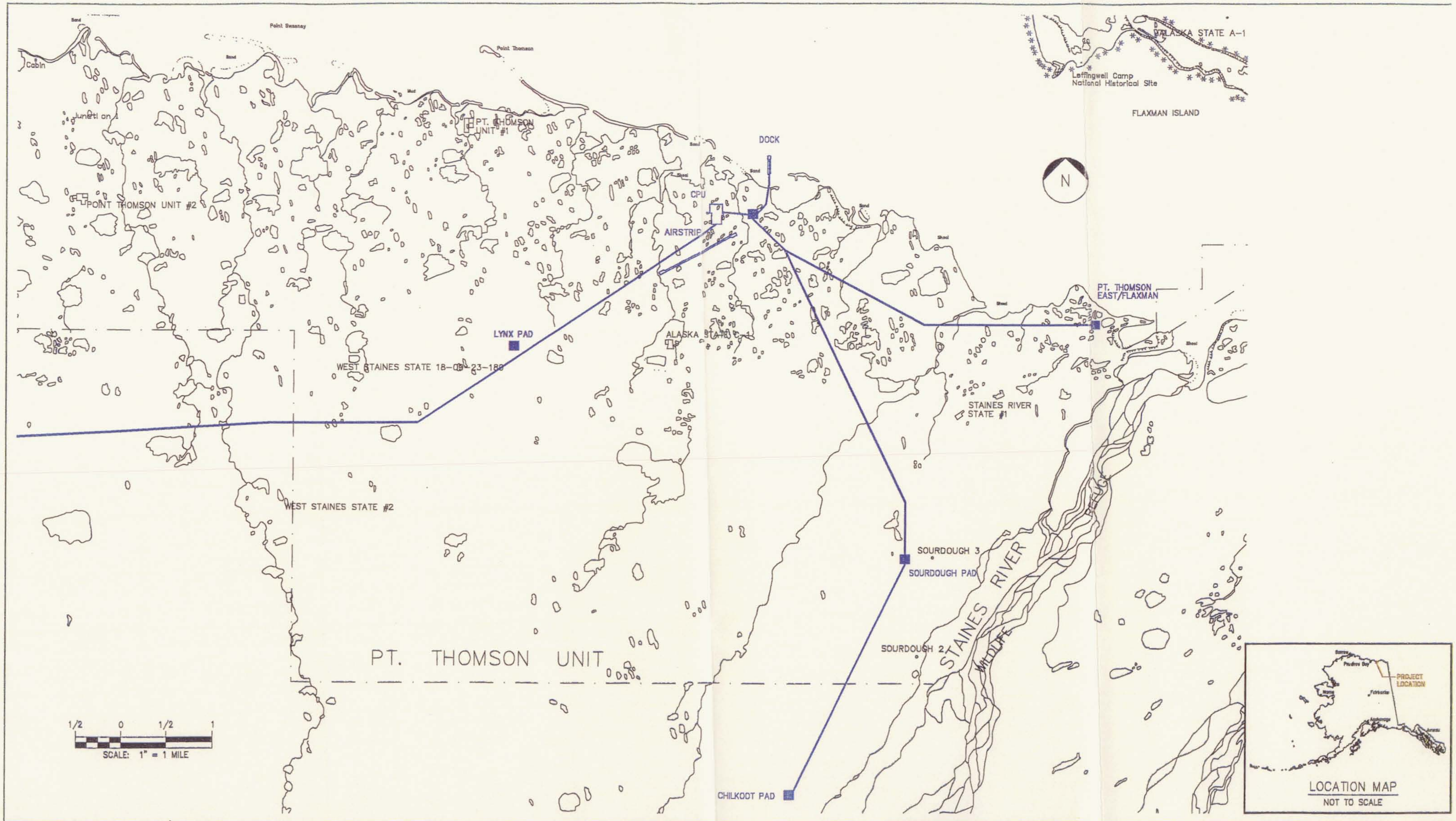

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FIGURE 5

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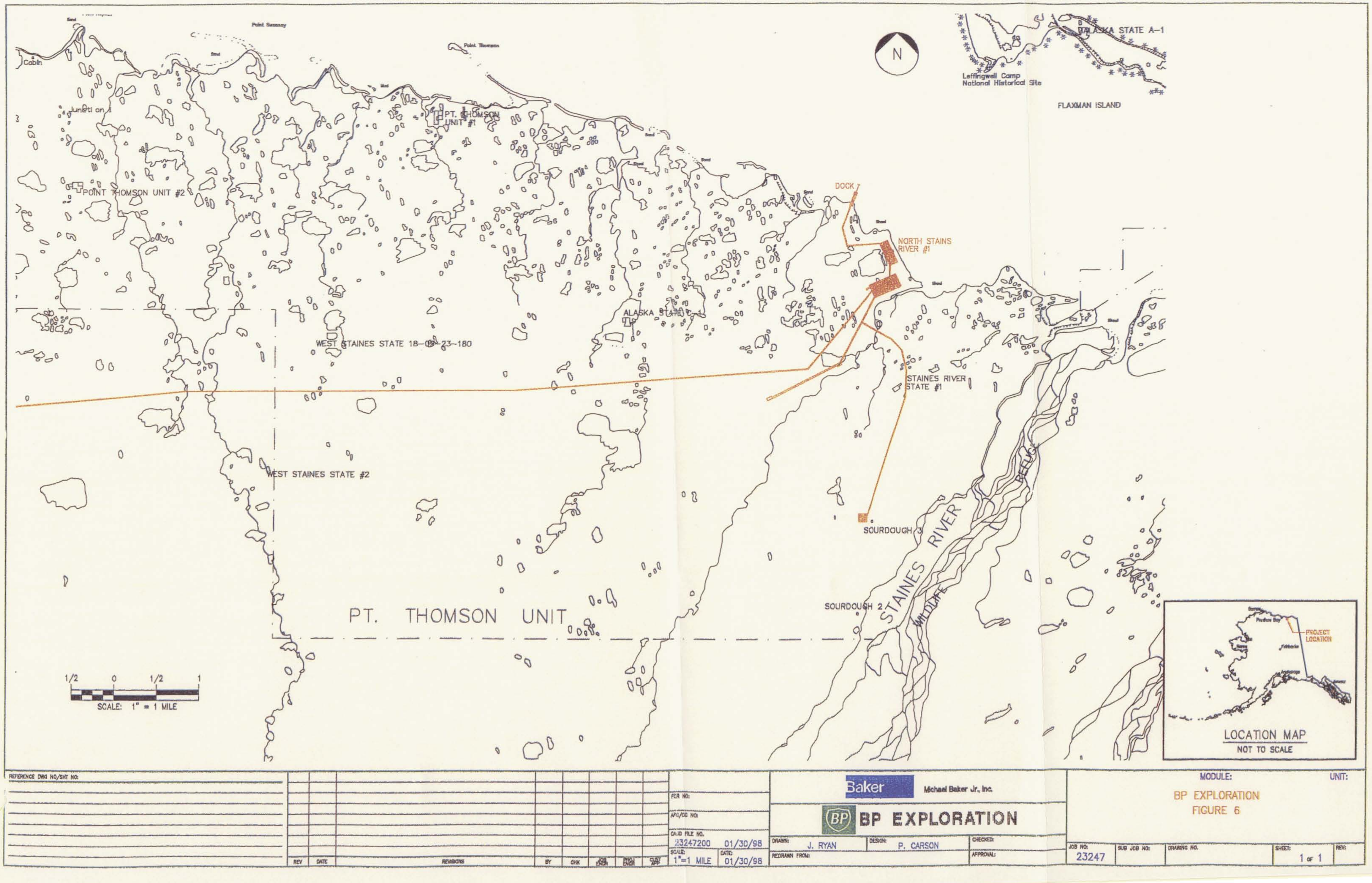

Point Sweeney
Point Thomson
Cabin
Junction
PT. THOMSON UNIT #1
POINT THOMSON UNIT #2
ALASKA STATE A-1
Leffingwell Camp National Historical Site
FLAXMAN ISLAND
N
DOCK
NORTH STAINS RIVER #1
ALASKA STATE C-1
WEST STAINES STATE 18-09-23-180
STAINES RIVER STATE #1
WEST STAINES STATE #2
SOURDOUGH 3
SOURDOUGH 2
STAINES RIVER
WILDLIFE
REFUGE
PT. THOMSON UNIT
1/2 0 1/2 1
SCALE: 1" = 1 MILE
PROJECT LOCATION
LOCATION MAP
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FIGURE 6
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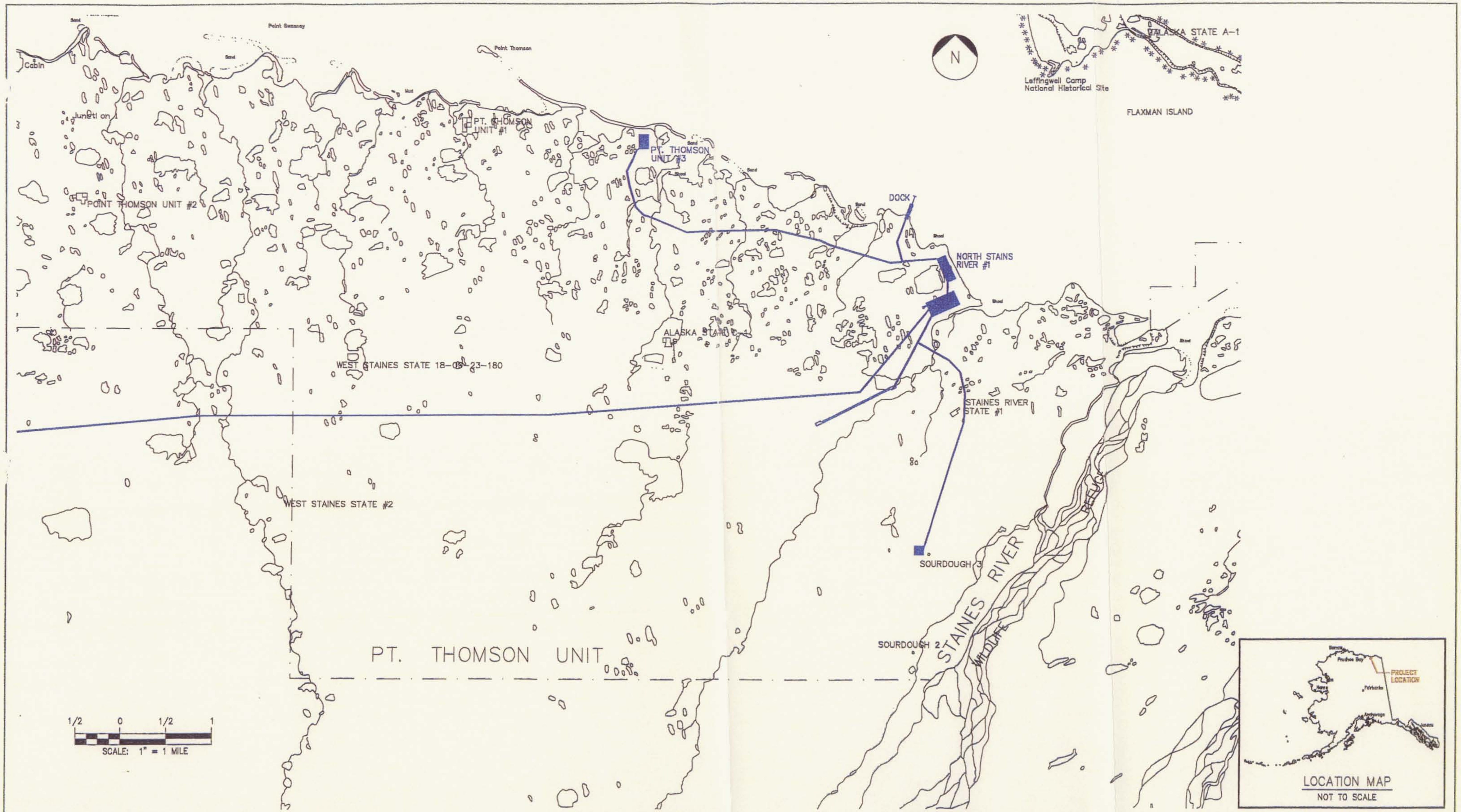

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FIGURE 7

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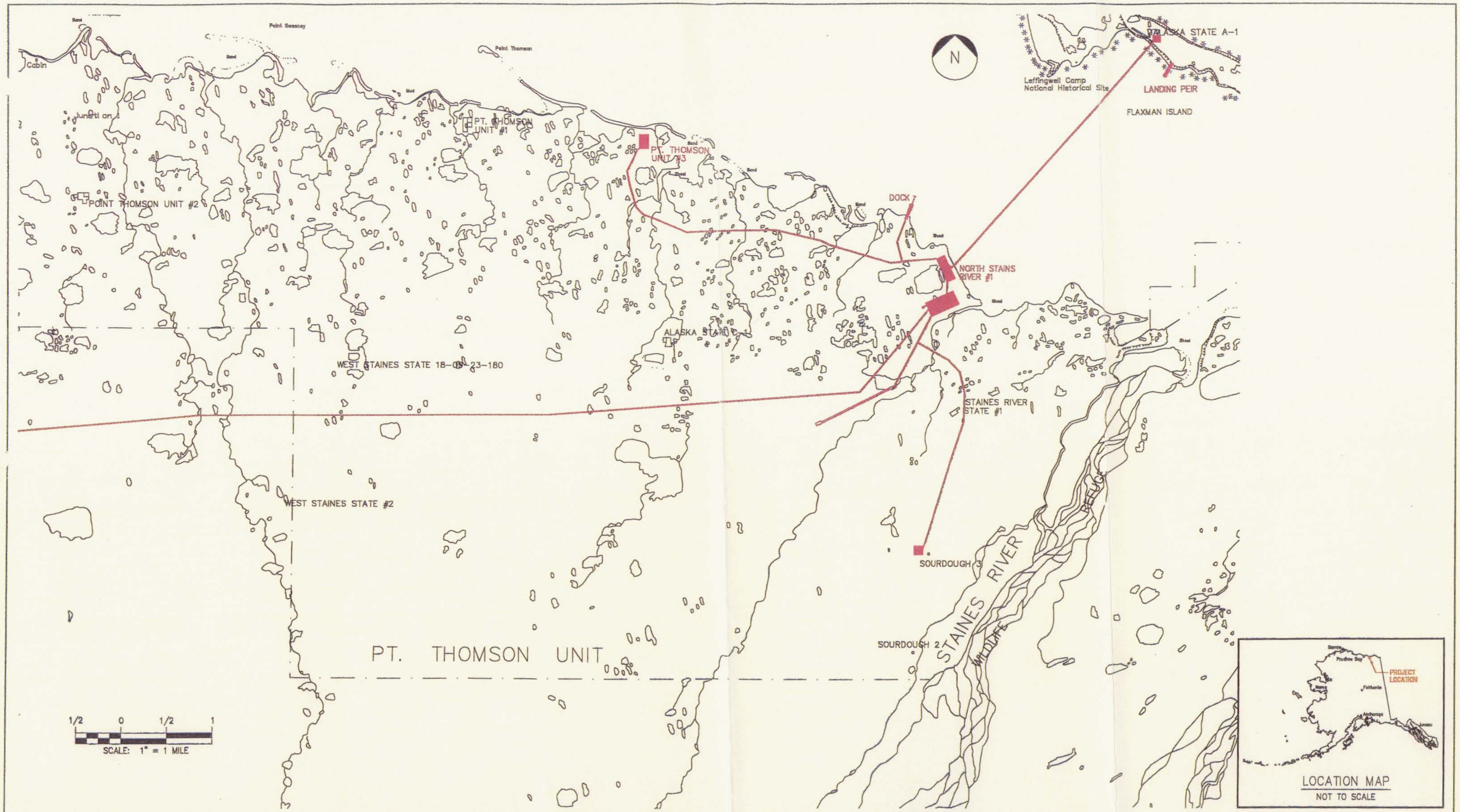

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		CADD FILE NO. 23247200 01/30/98	DRAWN: J. RYAN — DESIGN: P. CARSON — CHECKED:
		SCALE: 1"=1 MILE — DATE: 01/30/98	REDRAWN FROM: — APPROVAL:

MODULE: BP EXPLORATION FIGURE 8 — UNIT:

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Appendix A
Estimate Accuracy Definition

Budget Estimate (Level 0)

The budget estimate evaluates the approximate cost of a project early in the proposal stage. If the cost is greater than the expected benefits or if the job will not bring an adequate return on investment required, the project is dropped as impractical. Normally the budget estimate is made from known costs of similar projects already completed. Contingency and escalation factors are usually projected and included. Budget estimates are identified as "Level 0 in the "Detailed Cost Estimate Procedures."

Conceptual Estimates (Level 1)

Conceptual estimates can be made at several stages during the conceptual design stage. The accuracy of the estimates can range from 20 to 30 percent of the actual costs depending upon the plan information available. The conceptual estimate will be utilized in comparing and evaluating various designs and construction techniques. Constructability will be defined and evaluated at this level. Conceptual estimates are identified as "Level 1" in the "Detailed Cost Estimate Procedures".

Preliminary Design Estimates (Level 2)

The preliminary design estimate, or order of magnitude estimates, is made by the construction estimator and the design engineers. The estimate is based on the conceptual drawings, the equipment requirements and the flow sheets when the final design is between 30 and 60 percent complete. This estimate serves as a check against the final conceptual estimate and should be within 15 to 25 percent of the final construction costs. The preliminary design estimate is identified as "Level 2" in the "Detailed Estimate Procedures" There may be several estimates in the "Level 2" category.

Final Design Estimate (Level 3)

The final design estimate is the construction estimator and design engineers' last estimate and will be compared with the contractor's bid estimate. This estimate shall be a detailed estimate made from completed drawings and specification. It does not include any allowances for later change orders. This estimate will also become a model of information in preparation for the "Bid Proposal Documents" of (RFP). The estimator will assist in the preparation and critique the final "Bid Proposal Documents." The final design estimate is identified as "Level 3" in the "Detailed Estimate Procedures." This estimated should be within 5 to 10 percent of the average cost of bids received from the bidders.

Contractor's Bid Estimate

This should be the most complete, detailed estimate of all costs of labor, equipment and material to construct the project shown on the drawings and described in the specifications. The drawings, specifications, site conditions, weather data, instruction to bidders, etc. should be as detailed and complete as possible. All work should be identified and quantified. If not quantifiable, unit prices should be identified and made as complete as possible. The more complete the RFP, the more accurate the Contractor's cost estimate will be and the less likely that change-orders will be required.

Change Order Estimates (Level 4)

The change order estimate is a bid estimate made on a change required after the contract is awarded. It is made in a manner similar to the contractors bid estimate. Note, contractors bid documents are usually specific about what is a change order or a changed condition. Usually labor rates, equipment rates, payroll burdens, small tools, material markup, subcontractor markup, etc., overhead and profit is fixed by the contract documents. In some cases, items such as small tools may be excluded from a change order. The final change order estimate is identified as "Level 4" in the "Detailed Estimate Procedures."

Appendix B
Base Cost Indices

Description	FAST-EST Variable	Unit	Cost
COSTS:			
Infield roads, 32' x 5', 2:1 sideslope	Gravel road	mile	$ 761,500
Module road, 50' x 5', 2;1 sideslope	Paved Road	mile	$1,087,500
Well pads, 500' x 800' x 5', 2:1 sideslope	Well site preparation	each	$1,412,000
Airstrip, 5000' x 150' x 5', 2:1 sideslope	Airstrip	each	$3,609,000
Dock, 1500' x 50' plus 400' x 400'	Added to site prep.	each	$7,600,000
Fabrication labor rate	Fabrication labor rate	hour	$ 78
Erection labor rate	Erection labor rate	hour	$ 90
Erection management labor rate	Erection management labor rate	hour	$ 95
CPF pad, 1300' x 650' x 5', 2:1 sideslope	CPF site preparation	each	$4,000,000
Infield pipeline material	Well line & support line material	kip	$ 405
Infield pipeline installation	Well line & support line installation	dia.-in. mile	$ 34,000
Infield pipeline coating and insulation	Well line & support line coating/insulation	dia.-in. mile	$ 12,000
Mainline pipeline material	Export pipeline material	kip	$ 390
Mainline pipeline installation	Base export pipeline installation	dia.-in. mile	$ 32,900
Mainline pipeline coating and insulation	Export pipeline material insulation	dia.-in. mile	$ 11,000
Marine freight	Marine freight	kip	$ 225
Engineering labor rate	Engineering labor rate	hour	$ 75
Construction camp	Construction camp	person	$ 26,700
Communications	Communications	each	$3,000,000
Aerial powerline	Powerline	mile	$ 84,700
OTHER FACTORS:			
Aboveground pipeline factor	Pipeline installation factors, stilts	1.5	
Design maximum ambient air temp.	Design maximum ambient air temp.	40	degrees F

Appendix C
Estimate Model Output
Screening Study

Case 1 - CPU Option .

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Chilkoot											
MANIFOLD	192.2	131.0	402.3	1642.5	10.1	236.8	355.2	0.0	2970.1	0.0	2970.1
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	214.4	582.0	2074.9	1916.1	50.8	478.7	718.1	0.0	6035.1	0.0	6035.1
WELLSITE: Sourdoug											
MANIFOLD	559.9	267.5	844.7	1732.1	22.6	340.4	510.6	0.0	4278.0	0.0	4278.0
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	582.1	718.4	2517.4	2005.7	63.3	582.4	873.6	0.0	7342.9	0.0	7342.9
WELLSITE: PTWest											
MANIFOLD	310.8	340.5	964.8	9378.1	25.5	1099.4	1649.1	0.0	13768.3	0.0	13768.3
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	355.3	941.0	3154.4	9751.4	74.9	1420.2	2130.3	0.0	17827.6	0.0	17827.6
WELLSITE: PTEast											
MANIFOLD	229.8	243.9	691.4	920.5	17.1	208.6	312.9	0.0	2624.2	0.0	2624.2
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	274.3	844.4	2881.1	1293.8	66.4	529.4	794.0	0.0	6683.5	0.0	6683.5
WELLSITE: Flaxman											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8

Case 1 - CPU Option 1

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Callaway											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8
CENTRAL PROCESSING FACILITY: PTAC CPF											
MANIFOLD	404.1	298.3	936.9	142.8	38.9	267.3	356.4	0.0	2444.8	0.0	2444.8
SEPARATION	2245.4	2653.3	8493.5	1445.6	452.7	2225.7	2967.6	0.0	20483.8	0.0	20483.8
CRUDE METERING	462.4	166.3	505.1	74.8	25.4	181.3	241.7	0.0	1656.9	0.0	1656.9
LOW PRES. GAS COMPR.	2685.4	1514.9	5065.1	842.1	238.9	1516.1	2021.5	0.0	13884.0	0.0	13884.0
REINJ. GAS COMPR.	57336.5	21821.1	67414.7	12007.0	3120.4	23786.9	31715.9	0.0	217202.4	0.0	217202.4
REINJ. GAS DEHYD.	2751.4	2028.9	6401.0	1162.7	338.1	1851.6	2468.8	0.0	17002.5	0.0	17002.5
PIG/SPHERE LAUNCHER	47.1	291.3	836.7	164.1	18.6	200.9	267.8	0.0	1826.5	0.0	1826.5
PRODUCED WATER	299.9	122.4	405.2	57.4	20.9	132.7	177.0	0.0	1215.4	0.0	1215.4
RELIEF	20.1	127.6	396.6	76.0	10.1	93.1	124.1	0.0	847.7	0.0	847.7
POWER GENERATION	8854.7	983.7	1801.9	225.1	183.7	1779.8	2373.1	0.0	16202.0	0.0	16202.0
POWER DISTRIBUTION	4127.0	4090.2	14568.7	2488.5	397.2	3791.2	5054.9	0.0	34517.6	0.0	34517.6
FIRED HEATERS	3147.9	1569.4	6815.6	443.6	488.3	1796.5	2395.3	0.0	16656.6	0.0	16656.6
HEATING MEDIUM	31.4	88.9	313.9	44.8	10.5	71.9	95.8	0.0	657.2	0.0	657.2
EFFLUENT WATER	51.2	569.8	1824.8	317.1	48.6	414.4	552.6	0.0	3778.6	0.0	3778.6
INSTRUMENT AIR	123.9	130.3	597.8	38.6	38.1	133.6	178.1	0.0	1240.4	0.0	1240.4
UTILITY AIR	0.0	45.2	136.3	27.6	2.5	31.4	41.8	0.0	284.7	0.0	284.7
FUEL GAS	53.0	68.2	207.1	41.3	5.8	55.4	73.9	0.0	504.7	0.0	504.7
DIESEL FUEL	806.2	181.5	832.5	140.5	100.0	294.1	392.1	0.0	2746.9	0.0	2746.9
INERT GAS	118.3	39.6	111.7	21.8	4.5	43.7	58.3	0.0	398.0	0.0	398.0
CHEMICAL INJECTION	20.1	30.5	41.5	8.3	1.2	15.0	20.1	0.0	136.6	0.0	136.6
FIRE PROTECTION	284.8	187.4	596.4	93.6	21.5	174.3	232.4	0.0	1590.4	0.0	1590.4
CONTROL CENTER	468.0	50.3	103.4	20.0	4.2	96.2	128.3	0.0	870.5	0.0	870.5
BUILDINGS	1256.8	0.0	716.4	145.1	127.6	317.7	423.6	0.0	2987.2	0.0	2987.2
TANKAGE	158.2	620.6	1994.5	403.9	118.6	476.6	635.4	0.0	4407.8	0.0	4407.8
FLARE	1191.4	225.6	951.3	104.8	84.1	371.0	494.6	0.0	3422.7	0.0	3422.7
SITE PREPARATION	0.0	0.0	0.0	4000.0	0.0	600.0	800.0	0.0	5400.0	0.0	5400.0
TOTAL	86945.4	37905.1	122068.4	24537.1	5900.2	40718.4	54291.2	0.0	372365.8	0.0	372365.8

Case 1 - CPU Option .

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELL LINES	0.0	1877.2	0.0	8489.0	1042.9	1336.2	1704.7	2996.1	17446.0	0.0	17446.1
GATHERING LINES	0.0	7700.2	0.0	7224.4	4418 ~~35336.1~~	1747.4	1673.2	2549.8	25173 ~~56251.0~~	0.0	25173 ~~56251.0~~
EXPORT LINES	0.0	5891.0	0.0	93962.4	3398.7	11032.5	15501.6	10472.0	140258.3	0.0	140258.3
INFRASTRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20753.5	20753.5	0.0	20753.5
DRILLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	89107.0	57406.2	135885.4	151341.2	~~46002.0~~ 14943	58548.6	78741.6	36771.4	~~[illegible]~~ 622745	0.0	~~[illegible]~~ 622745

Case 2 - CPF Option .

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Chilkoot											
MANIFOLD	192.2	131.0	402.3	1642.5	10.1	236.8	355.2	0.0	2970.1	0.0	2970.1
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	214.4	582.0	2074.9	1916.1	50.8	478.7	718.1	0.0	6035.1	0.0	6035.1
WELLSITE: Sourdoug											
MANIFOLD	559.9	267.5	844.7	1732.1	22.6	340.4	510.6	0.0	4278.0	0.0	4278.0
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	582.1	718.4	2517.4	2005.7	63.3	582.4	873.6	0.0	7342.9	0.0	7342.9
WELLSITE: PTWest											
MANIFOLD	310.8	340.5	964.8	9378.1	25.5	1099.4	1649.1	0.0	13768.3	0.0	13768.3
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	355.3	941.0	3154.4	9751.4	74.9	1420.2	2130.3	0.0	17827.6	0.0	17827.6
WELLSITE: PTEast											
MANIFOLD	229.8	243.9	691.4	920.5	17.1	208.6	312.9	0.0	2624.2	0.0	2624.2
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	274.3	844.4	2881.1	1293.8	66.4	529.4	794.0	0.0	6683.5	0.0	6683.5
WELLSITE: Flaxman											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8

Case 2 - CPF Option

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Callaway											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8
CENTRAL PROCESSING FACILITY: PTAC CPF											
MANIFOLD	404.1	298.3	936.9	142.8	38.9	267.3	356.4	0.0	2444.8	0.0	2444.8
SEPARATION	2245.4	2653.3	8493.5	1445.6	452.7	2225.7	2967.6	0.0	20483.8	0.0	20483.8
CRUDE METERING	462.4	166.3	505.1	74.8	25.4	181.3	241.7	0.0	1656.9	0.0	1656.9
LOW PRES. GAS COMPR.	2685.4	1514.9	5065.1	842.1	238.9	1516.1	2021.5	0.0	13884.1	0.0	13884.1
REINJ. GAS COMPR.	57336.5	21821.1	67414.6	12007.0	3120.4	23786.9	31715.9	0.0	217202.4	0.0	217202.4
REINJ. GAS DEHYD.	2751.4	2028.9	6401.0	1162.7	338.1	1851.6	2468.8	0.0	17002.5	0.0	17002.5
PIG/SPHERE LAUNCHER	47.1	291.3	836.7	164.1	18.6	200.9	267.8	0.0	1826.5	0.0	1826.5
PRODUCED WATER	299.9	122.4	405.2	57.4	20.9	132.7	177.0	0.0	1215.4	0.0	1215.4
RELIEF	20.1	127.6	396.6	76.0	10.1	93.1	124.1	0.0	847.7	0.0	847.7
POWER GENERATION	8854.7	983.7	1801.9	225.1	183.7	1779.8	2373.1	0.0	16202.0	0.0	16202.0
POWER DISTRIBUTION	4127.0	4090.2	14568.6	2488.5	397.2	3791.1	5054.9	0.0	34517.5	0.0	34517.5
FIRED HEATERS	3147.9	1569.4	6815.6	443.6	488.3	1796.5	2395.3	0.0	16656.6	0.0	16656.6
HEATING MEDIUM	31.4	88.9	313.9	44.8	10.5	71.9	95.8	0.0	657.2	0.0	657.2
EFFLUENT WATER	51.2	569.8	1824.8	317.1	48.6	414.4	552.6	0.0	3778.6	0.0	3778.6
INSTRUMENT AIR	123.9	130.3	597.8	38.6	38.1	133.6	178.1	0.0	1240.4	0.0	1240.4
UTILITY AIR	0.0	45.2	136.3	27.6	2.5	31.4	41.8	0.0	284.7	0.0	284.7
FUEL GAS	53.0	68.2	207.1	41.3	5.8	55.4	73.9	0.0	504.7	0.0	504.7
DIESEL FUEL	806.2	181.5	832.5	140.5	100.0	294.1	392.1	0.0	2746.9	0.0	2746.9
INERT GAS	118.3	39.6	111.7	21.8	4.5	43.7	58.3	0.0	398.0	0.0	398.0
CHEMICAL INJECTION	20.1	30.5	41.5	8.3	1.2	15.0	20.1	0.0	136.6	0.0	136.6
FIRE PROTECTION	284.8	187.4	596.4	93.6	21.5	174.3	232.4	0.0	1590.4	0.0	1590.4
CONTROL CENTER	468.0	50.3	103.4	20.0	4.2	96.2	128.3	0.0	870.5	0.0	870.5
BUILDINGS	1256.8	0.0	716.4	145.1	127.6	317.7	423.6	0.0	2987.2	0.0	2987.2
TANKAGE	158.2	620.6	1994.5	403.9	118.6	476.6	635.4	0.0	4407.8	0.0	4407.8
FLARE	1191.4	225.6	951.3	104.8	84.1	371.0	494.6	0.0	3422.7	0.0	3422.7
SITE PREPARATION	0.0	0.0	0.0	4000.0	0.0	600.0	800.0	0.0	5400.0	0.0	5400.0
TOTAL	86945.4	37905.1	122068.3	24537.1	5900.2	40718.4	54291.2	0.0	372365.7	0.0	372365.7

Case 2 - CPF Option 1

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELL LINES	0.0	1753.0	0.0	8682.8	973.9	1350.0	1718.6	3064.5	17542.7	0.0	17542.7
GATHERING LINES	0.0	6183.0	0.0	6415.8	3435 ~~[illegible]~~	1486.3	1446.6	2264.4	21231 ~~30150.9~~	0.0	21231 ~~30150.9~~
EXPORT LINES	0.0	5940.5	0.0	94752.0	3427.2	11125.3	15631.9	10560.0	141436.9	0.0	141436.9
INFRASTRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18733.3	18733.3	0.0	18733.3
DRILLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	89107.0	55814.3	135885.4	151516.0	~~43980.2~~ 14061	58394.0	78659.2	34622.2	~~646978.3~~ 618059	0.0	~~646978.2~~ 618059

Case 3 - CPU Option 1 with x

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Chilkoot											
MANIFOLD	192.2	131.0	402.3	1642.5	10.1	236.8	355.2	0.0	2970.1	0.0	2970.1
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	214.4	582.0	2074.9	1916.1	50.8	478.7	718.1	0.0	6035.1	0.0	6035.1
WELLSITE: Sourdoug											
MANIFOLD	559.9	267.5	844.7	1732.1	22.6	340.4	510.6	0.0	4278.0	0.0	4278.0
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	582.1	718.4	2517.4	2005.7	63.3	582.4	873.6	0.0	7342.9	0.0	7342.9
WELLSITE: PTWest											
MANIFOLD	310.8	340.5	964.8	9378.1	25.5	1099.4	1649.1	0.0	13768.3	0.0	13768.3
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	355.3	941.0	3154.4	9751.4	74.9	1420.2	2130.3	0.0	17827.6	0.0	17827.6
WELLSITE: PTEast											
MANIFOLD	229.8	243.9	691.4	920.5	17.1	208.6	312.9	0.0	2624.2	0.0	2624.2
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	274.3	844.4	2881.1	1293.8	66.4	529.4	794.0	0.0	6683.5	0.0	6683.5
WELLSITE: Flaxman											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8

Case 3 - CPU Option 1 witl x

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Callaway											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8
WELLSITE: Lynx											
MANIFOLD	367.7	205.5	640.0	1690.6	16.4	290.4	435.6	0.0	3646.2	0.0	3646.2
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	390.0	656.4	2312.6	1964.2	57.1	532.3	798.5	0.0	6711.1	0.0	6711.1
CENTRAL PROCESSING FACILITY: PTAC CPF											
MANIFOLD	449.2	307.6	983.3	145.3	43.0	282.8	377.1	0.0	2588.3	0.0	2588.3
SEPARATION	2272.4	2687.1	8606.5	1463.0	458.8	2254.4	3005.8	0.0	20748.0	0.0	20748.0
CRUDE METERING	462.4	166.3	505.1	74.8	25.4	181.3	241.7	0.0	1656.9	0.0	1656.9
LOW PRES. GAS COMPR.	2727.4	1528.0	5104.6	849.0	240.7	1531.3	2041.8	0.0	14022.7	0.0	14022.7
REINJ. GAS COMPR.	57364.0	21842.2	67483.3	12020.3	3123.5	23806.5	31742.0	0.0	217381.8	0.0	217381.8
REINJ. GAS DEHYD.	2751.8	2029.3	6402.1	1162.9	338.2	1851.9	2469.2	0.0	17005.2	0.0	17005.2
PIG/SPHERE LAUNCHER	47.1	291.3	836.7	164.1	18.6	200.9	267.8	0.0	1826.5	0.0	1826.5
PRODUCED WATER	302.3	125.4	416.9	58.6	21.5	135.5	180.7	0.0	1240.9	0.0	1240.9
RELIEF	20.1	128.5	399.2	76.6	10.2	93.7	124.9	0.0	853.2	0.0	853.2
POWER GENERATION	8854.7	983.7	1801.9	225.1	183.7	1779.8	2373.1	0.0	16202.0	0.0	16202.0
POWER DISTRIBUTION	4573.9	4391.4	15632.2	2665.9	428.7	4089.5	5452.7	0.0	37234.3	0.0	37234.3
FIRED HEATERS	3164.1	1578.1	6855.0	445.7	491.0	1806.4	2408.6	0.0	16749.0	0.0	16749.0
HEATING MEDIUM	31.4	89.4	315.4	45.1	10.5	72.2	96.3	0.0	660.4	0.0	660.4
EFFLUENT WATER	51.2	577.4	1847.2	321.7	49.0	419.6	559.5	0.0	3825.6	0.0	3825.6
INSTRUMENT AIR	123.9	130.8	599.0	38.9	38.1	133.9	178.5	0.0	1243.0	0.0	1243.0
UTILITY AIR	0.0	45.5	137.3	27.8	2.5	31.6	42.1	0.0	286.8	0.0	286.8
FUEL GAS	53.0	68.6	208.5	41.5	5.9	55.7	74.3	0.0	507.6	0.0	507.6
DIESEL FUEL	806.2	181.8	833.5	140.8	100.0	294.3	392.4	0.0	2749.0	0.0	2749.0
INERT GAS	118.3	39.8	112.4	22.0	4.5	43.9	58.5	0.0	399.4	0.0	399.4
CHEMICAL INJECTION	20.1	30.7	41.8	8.3	1.2	15.1	20.2	0.0	137.3	0.0	137.3
FIRE PROTECTION	285.9	188.9	601.7	94.3	21.7	175.6	234.2	0.0	1602.3	0.0	1602.3
CONTROL CENTER	468.0	50.3	103.4	20.0	4.2	96.2	128.3	0.0	870.5	0.0	870.5
BUILDINGS	1351.9	0.0	770.6	156.0	137.2	341.8	455.7	0.0	3213.3	0.0	3213.3
TANKAGE	158.2	620.6	1994.5	403.9	118.6	476.6	635.4	0.0	4407.8	0.0	4407.8
FLARE	1193.6	226.3	953.6	105.2	84.2	371.8	495.8	0.0	3430.5	0.0	3430.5
SITE PREPARATION	0.0	0.0	0.0	4000.0	0.0	600.0	800.0	0.0	5400.0	0.0	5400.0
TOTAL	87651.3	38308.9	123545.6	24776.7	5960.9	41142.4	54856.5	0.0	376242.3	0.0	376242.3

Case 3 - CPU Option 1 with … x

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELL LINES	0.0	2065.6	0.0	9486.0	1147.6	1490.0	1900.1	3348.0	19437.3	0.0	19437.3
GATHERING LINES	0.0	7917.8	0.0	7742.4	4399 ~~43133.5~~	1839.3	1773.1	2732.6	26404 ~~65138.8~~	0.0	26404 ~~65138.8~~
EXPORT LINES	0.0	5891.0	0.0	93962.4	3398.7	11032.5	15501.6	10472.0	140258.3	0.0	140258.3
INFRASTRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22699.7	22699.7	0.0	22699.7
DRILLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	90202.8	58872.5	139675.3	155060.2	~~54021.6~~ 15287	59750.5	80400.8	39252.4	~~627216.1~~ 638502	0.0	~~627216.1~~ 638502

Case 4 - CPF Option 2 witl ix

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Chilkoot											
MANIFOLD	192.2	131.0	402.3	1642.5	10.1	236.8	355.2	0.0	2970.1	0.0	2970.1
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	214.4	582.0	2074.9	1916.1	50.8	478.7	718.1	0.0	6035.1	0.0	6035.1
WELLSITE: Sourdoug											
MANIFOLD	559.9	267.5	844.7	1732.1	22.6	340.4	510.6	0.0	4278.0	0.0	4278.0
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	582.1	718.4	2517.4	2005.7	63.3	582.4	873.6	0.0	7342.9	0.0	7342.9
WELLSITE: PTWest											
MANIFOLD	310.8	340.5	964.8	9378.1	25.5	1099.4	1649.1	0.0	13768.3	0.0	13768.3
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	355.3	941.0	3154.4	9751.4	74.9	1420.2	2130.3	0.0	17827.6	0.0	17827.6
WELLSITE: PTEast											
MANIFOLD	229.8	243.9	691.4	920.5	17.1	208.6	312.9	0.0	2624.2	0.0	2624.2
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	274.3	844.4	2881.1	1293.8	66.4	529.4	794.0	0.0	6683.5	0.0	6683.5
WELLSITE: Flaxman											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8

Case 4 - CPF Option 2 with x

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Callaway											
MANIFOLD	367.7	205.5	640.0	910.1	16.4	212.3	318.5	0.0	2670.5	0.0	2670.5
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1080.7	34.3	351.6	527.5	0.0	4429.8	0.0	4429.8
WELLSITE: Lynx											
MANIFOLD	367.7	205.5	640.0	1690.6	16.4	290.4	435.6	0.0	3646.2	0.0	3646.2
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	390.0	656.4	2312.6	1964.2	57.1	532.3	798.5	0.0	6711.1	0.0	6711.1
CENTRAL PROCESSING FACILITY: PTAC CPF											
MANIFOLD	449.2	307.6	983.3	145.3	43.0	282.8	377.1	0.0	2588.3	0.0	2588.3
SEPARATION	2272.4	2687.1	8606.5	1463.0	458.8	2254.4	3005.8	0.0	20748.0	0.0	20748.0
CRUDE METERING	462.4	166.3	505.1	74.8	25.4	181.3	241.7	0.0	1656.9	0.0	1656.9
LOW PRES. GAS COMPR.	2727.4	1528.0	5104.6	849.0	240.7	1531.3	2041.8	0.0	14022.8	0.0	14022.8
REINJ. GAS COMPR.	57364.0	21842.2	67483.4	12020.3	3123.5	23806.5	31742.0	0.0	217381.8	0.0	217381.8
REINJ. GAS DEHYD.	2751.8	2029.3	6402.1	1162.9	338.2	1851.9	2469.2	0.0	17005.2	0.0	17005.2
PIG/SPHERE LAUNCHER	47.1	291.3	836.7	164.1	18.6	200.9	267.8	0.0	1826.5	0.0	1826.5
PRODUCED WATER	302.3	125.4	416.9	58.6	21.5	135.5	180.7	0.0	1240.9	0.0	1240.9
RELIEF	20.1	128.5	399.2	76.6	10.2	93.7	124.9	0.0	853.2	0.0	853.2
POWER GENERATION	8854.7	983.7	1801.9	225.1	183.7	1779.8	2373.1	0.0	16202.0	0.0	16202.0
POWER DISTRIBUTION	4573.9	4391.4	15632.2	2665.9	428.7	4089.5	5452.7	0.0	37234.3	0.0	37234.3
FIRED HEATERS	3164.1	1578.1	6855.0	445.7	491.0	1806.4	2408.6	0.0	16749.0	0.0	16749.0
HEATING MEDIUM	31.4	89.4	315.4	45.1	10.5	72.2	96.3	0.0	660.4	0.0	660.4
EFFLUENT WATER	51.2	577.4	1847.2	321.7	49.0	419.6	559.5	0.0	3825.6	0.0	3825.6
INSTRUMENT AIR	123.9	130.8	599.0	38.9	38.1	133.9	178.5	0.0	1243.0	0.0	1243.0
UTILITY AIR	0.0	45.5	137.3	27.8	2.5	31.6	42.1	0.0	286.8	0.0	286.8
FUEL GAS	53.0	68.6	208.5	41.5	5.9	55.7	74.3	0.0	507.6	0.0	507.6
DIESEL FUEL	806.2	181.8	833.5	140.8	100.0	294.3	392.4	0.0	2749.0	0.0	2749.0
INERT GAS	118.3	39.8	112.4	22.0	4.5	43.9	58.5	0.0	399.4	0.0	399.4
CHEMICAL INJECTION	20.1	30.7	41.8	8.3	1.2	15.1	20.2	0.0	137.3	0.0	137.3
FIRE PROTECTION	285.9	188.9	601.7	94.3	21.7	175.6	234.2	0.0	1602.3	0.0	1602.3
CONTROL CENTER	468.0	50.3	103.4	20.0	4.2	96.2	128.3	0.0	870.5	0.0	870.5
BUILDINGS	1351.9	0.0	770.6	156.0	137.2	341.8	455.7	0.0	3213.3	0.0	3213.3
TANKAGE	158.2	620.6	1994.5	403.9	118.6	476.6	635.4	0.0	4407.8	0.0	4407.8
FLARE	1193.6	226.3	953.6	105.2	84.2	371.8	495.8	0.0	3430.5	0.0	3430.5
SITE PREPARATION	0.0	0.0	0.0	4000.0	0.0	600.0	800.0	0.0	5400.0	0.0	5400.0
TOTAL	87651.3	38309.0	123545.6	24776.7	5960.9	41142.4	54856.5	0.0	376242.3	0.0	376242.3

Case 4 - CPF Option 2 wit[illegible] [illegible]x

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELL LINES	0.0	1966.0	0.0	9809.9	1092.2	1523.8	1939.5	3462.3	19793.7	0.0	19793.7
GATHERING LINES	0.0	6308.3	0.0	6813.6	3504 ~~10286.7~~	1552.7	1520.8	2404.8	22401 ~~57886.0~~	0.0	22101 ~~57886.0~~
EXPORT LINES	0.0	5940.5	0.0	94752.0	3427.2	11125.3	15631.9	10560.0	141436.9	0.0	141436.9
INFRASTRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20933.4	20933.4	0.0	20933.4
DRILLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	90202.8	57212.9	139675.3	155244.8	~~50148.2~~ 14364	59590.4	80318.1	37360.5	~~660753.0~~ 633965	0.0	~~660752.9~~ 633965

Alternate 1 - Minimal Faci. .s (CASE 7)

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Sourdoug											
MANIFOLD	559.9	267.5	844.7	1732.1	22.6	340.4	510.6	0.0	4278.0	0.0	4278.0
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	582.1	718.4	2517.4	2005.7	63.3	582.4	873.6	0.0	7342.9	0.0	7342.9
WELLSITE: PtThom											
MANIFOLD	569.2	393.0	1156.9	1795.3	34.2	391.4	587.2	0.0	4927.1	0.0	4927.1
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	613.6	993.5	3346.5	2168.6	83.5	712.2	1068.3	0.0	8986.4	0.0	8986.4
WELLSITE: Flaxman											
MANIFOLD	367.7	205.5	640.0	1690.6	16.4	290.4	435.6	0.0	3646.2	0.0	3646.2
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1861.2	34.3	429.7	644.5	0.0	5405.5	0.0	5405.5
CENTRAL PROCESSING FACILITY: PTAC CPF											
MANIFOLD	269.0	270.3	797.7	135.4	26.6	220.9	294.5	0.0	2014.3	0.0	2014.3
SEPARATION	2245.4	2653.3	8493.5	1445.6	452.7	2225.7	2967.6	0.0	20483.8	0.0	20483.8
CRUDE METERING	462.4	166.3	505.1	74.8	25.4	181.3	241.7	0.0	1656.9	0.0	1656.9
LOW PRES. GAS COMPR.	2685.5	1514.9	5065.2	842.1	238.9	1516.2	2021.5	0.0	13884.3	0.0	13884.3
REINJ. GAS COMPR.	57338.5	21822.6	67419.6	12008.0	3120.6	23788.3	31717.7	0.0	217215.2	0.0	217215.2
REINJ. GAS DEHYD.	2751.4	2028.9	6401.0	1162.7	338.1	1851.6	2468.8	0.0	17002.5	0.0	17002.5
PIG/SPHERE LAUNCHER	47.1	291.3	836.7	164.1	18.6	200.9	267.8	0.0	1826.5	0.0	1826.5
PRODUCED WATER	299.9	122.4	405.2	57.4	20.9	132.7	177.0	0.0	1215.4	0.0	1215.4
RELIEF	20.1	126.0	391.8	75.1	10.1	91.9	122.6	0.0	837.5	0.0	837.5
POWER GENERATION	8854.7	983.7	1801.9	225.1	183.7	1779.8	2373.1	0.0	16202.0	0.0	16202.0
POWER DISTRIBUTION	3091.4	3480.5	12408.3	2137.5	328.9	3167.7	4223.5	0.0	28837.8	0.0	28837.8
FIRED HEATERS	3147.9	1569.4	6815.6	443.6	488.3	1796.5	2395.3	0.0	16656.6	0.0	16656.6
HEATING MEDIUM	31.4	88.0	311.0	44.2	10.4	71.2	94.9	0.0	651.2	0.0	651.2
EFFLUENT WATER	51.2	556.0	1783.4	308.8	47.8	404.9	539.9	0.0	3691.9	0.0	3691.9
INSTRUMENT AIR	123.9	129.4	595.6	38.2	38.0	133.1	177.4	0.0	1235.5	0.0	1235.5
UTILITY AIR	0.0	44.6	134.4	27.2	2.4	30.9	41.2	0.0	280.9	0.0	280.9
FUEL GAS	50.9	67.0	202.9	40.5	5.6	54.2	72.2	0.0	493.1	0.0	493.1
DIESEL FUEL	806.2	180.8	830.6	140.2	99.9	293.7	391.6	0.0	2742.9	0.0	2742.9
INERT GAS	118.3	39.2	110.5	21.6	4.4	43.4	57.9	0.0	395.4	0.0	395.4
CHEMICAL INJECTION	20.1	30.1	41.0	8.2	1.2	14.9	19.9	0.0	135.2	0.0	135.2

Alternate 1 - Minimal Faci... (CASE 7)

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
FIRE PROTECTION	283.6	185.1	588.4	92.4	21.2	172.4	229.9	0.0	1573.0	0.0	1573.0
CONTROL CENTER	468.0	50.3	103.4	20.0	4.2	96.2	128.3	0.0	870.5	0.0	870.5
BUILDINGS	1040.3	0.0	593.0	120.1	105.6	263.0	350.7	0.0	2472.7	0.0	2472.7
TANKAGE	158.2	620.6	1994.5	403.9	118.6	476.6	635.4	0.0	4407.8	0.0	4407.8
FLARE	1191.4	224.6	948.4	104.2	84.0	370.3	493.7	0.0	3416.7	0.0	3416.7
SITE PREPARATION	0.0	0.0	0.0	11600.0	0.0	1740.0	2320.0	0.0	15660.0	0.0	15660.0
TOTAL	85557.0	37245.0	119578.3	31740.6	5796.1	41118.1	54824.2	0.0	375859.4	0.0	375859.4
WELL LINES	0.0	387.4	0.0	1868.3	215.2	291.5	371.3	659.4	3793.1	0.0	3793.1
GATHERING LINES	0.0	656.1	0.0	1047.2	364 ~~11066.0~~	207.3	214.9	369.6	2859 ~~14361.8~~	0.0	2859 ~~14361.8~~
EXPORT LINES	0.0	6287.1	0.0	100279.2	3627.2	11774.2	16543.7	11176.0	149687.4	0.0	149687.4
INFRASTRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13021.4	13021.4	0.0	13021.4
DRILLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	87120.6	46760.8	127036.9	140970.8	~~31686.5~~ 10184	55115.5	74540.6	25226.4	~~578458.0~~ 566756	0.0	~~578458.0~~ 566756

Alternate 2 - Minimal Facilities w 1 PT Pads (CASE B)

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
WELLSITE: Sourdoug											
MANIFOLD	559.9	267.5	844.7	1732.1	22.6	340.4	510.6	0.0	4278.0	0.0	4278.0
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	582.1	718.4	2517.4	2005.7	63.3	582.4	873.6	0.0	7342.9	0.0	7342.9
WELLSITE: PtThom											
MANIFOLD	363.3	349.7	1004.9	1764.5	28.4	348.2	522.4	0.0	4381.5	0.0	4381.5
POWER DISTRIBUTION	44.4	600.5	2189.7	373.3	49.4	320.8	481.2	0.0	4059.3	0.0	4059.3
TOTAL	407.8	950.2	3194.6	2137.8	77.8	669.0	1003.6	0.0	8440.8	0.0	8440.8
WELLSITE: Flaxman											
MANIFOLD	367.7	205.5	640.0	1690.6	16.4	290.4	435.6	0.0	3646.2	0.0	3646.2
POWER DISTRIBUTION	0.0	267.9	954.6	170.6	18.0	139.3	209.0	0.0	1759.3	0.0	1759.3
TOTAL	367.7	473.4	1594.6	1861.2	34.3	429.7	644.5	0.0	5405.5	0.0	5405.5
WELLSITE: PT#3											
MANIFOLD	183.9	201.6	555.3	1673.5	12.5	261.4	392.1	0.0	3280.4	0.0	3280.4
POWER DISTRIBUTION	22.2	451.0	1672.6	273.6	40.7	241.9	362.9	0.0	3065.0	0.0	3065.0
TOTAL	206.2	652.5	2227.9	1947.1	53.2	503.4	755.1	0.0	6345.4	0.0	6345.4
CENTRAL PROCESSING FACILITY: PTAC CPF											
MANIFOLD	314.0	279.6	844.1	137.9	30.7	236.3	315.1	0.0	2157.8	0.0	2157.8
SEPARATION	2245.4	2653.3	8493.5	1445.6	452.7	2225.7	2967.6	0.0	20483.8	0.0	20483.8
CRUDE METERING	462.4	166.3	505.1	74.8	25.4	181.3	241.7	0.0	1656.9	0.0	1656.9
LOW PRES. GAS COMPR.	2685.4	1514.9	5065.2	842.1	238.9	1516.1	2021.5	0.0	13884.2	0.0	13884.2
REINJ. GAS COMPR.	57337.8	21822.1	67417.9	12007.7	3120.5	23787.8	31717.1	0.0	217210.9	0.0	217210.9
REINJ. GAS DEHYD.	2751.4	2028.9	6401.0	1162.7	338.1	1851.6	2468.8	0.0	17002.5	0.0	17002.5
PIG/SPHERE LAUNCHER	47.1	291.3	836.7	164.1	18.6	200.9	267.8	0.0	1826.5	0.0	1826.5
PRODUCED WATER	299.9	122.4	405.2	57.4	20.9	132.7	177.0	0.0	1215.4	0.0	1215.4
RELIEF	20.1	126.5	393.3	75.4	10.1	92.3	123.1	0.0	840.8	0.0	840.8
POWER GENERATION	8854.7	983.7	1801.9	225.1	183.7	1779.8	2373.1	0.0	16202.0	0.0	16202.0
POWER DISTRIBUTION	3417.5	3681.4	13119.4	2254.1	350.9	3370.9	4494.5	0.0	30688.7	0.0	30688.7
FIRED HEATERS	3147.9	1569.4	6815.6	443.6	488.3	1796.5	2395.3	0.0	16656.6	0.0	16656.6
HEATING MEDIUM	31.4	88.3	311.9	44.4	10.4	71.4	95.2	0.0	653.1	0.0	653.1
EFFLUENT WATER	51.2	560.4	1796.7	311.4	48.0	408.0	543.9	0.0	3719.7	0.0	3719.7

Alternate 2 - Minimal Facilities w 2 PT Pads (CASE 8)

SYSTEM COST SUMMARY

SYSTEM	EQUIPMENT MATERIAL USD(000)	BULK MATERIAL USD(000)	FABRICATION COST USD(000)	ERECTION COST USD(000)	FREIGHT COST USD(000)	ENGINEERING COST USD(000)	PROJECT MANAGEMENT USD(000)	OTHER COST USD(000)	SUBTOTAL COST USD(000)	CONTINGENCY USD(000)	TOTAL COST USD(000)
INSTRUMENT AIR	123.9	129.7	596.3	38.3	38.1	133.2	177.6	0.0	1237.1	0.0	1237.1
UTILITY AIR	0.0	44.8	135.0	27.3	2.4	31.1	41.4	0.0	282.1	0.0	282.1
FUEL GAS	50.9	67.2	203.7	40.6	5.6	54.4	72.5	0.0	494.8	0.0	494.8
DIESEL FUEL	806.2	181.0	831.2	140.3	99.9	293.8	391.7	0.0	2744.2	0.0	2744.2
INERT GAS	118.3	39.3	110.9	21.7	4.5	43.5	58.0	0.0	396.2	0.0	396.2
CHEMICAL INJECTION	20.1	30.2	41.1	8.2	1.2	14.9	19.9	0.0	135.7	0.0	135.7
FIRE PROTECTION	283.6	185.7	590.3	92.8	21.2	172.8	230.5	0.0	1576.8	0.0	1576.8
CONTROL CENTER	468.0	50.3	103.4	20.0	4.2	96.2	128.3	0.0	870.5	0.0	870.5
BUILDINGS	1108.8	0.0	632.0	128.0	112.5	280.3	373.8	0.0	2635.4	0.0	2635.4
TANKAGE	158.2	620.6	1994.5	403.9	118.6	476.6	635.4	0.0	4407.8	0.0	4407.8
FLARE	1191.4	224.9	949.4	104.4	84.0	370.5	494.0	0.0	3418.6	0.0	3418.6
SITE PREPARATION	0.0	0.0	0.0	11600.0	0.0	1740.0	2320.0	0.0	15660.0	0.0	15660.0
TOTAL	85995.9	37462.1	120395.1	31871.7	5829.6	41358.7	55144.9	0.0	378058.0	0.0	378058.0
WELL LINES	0.0	848.0	0.0	3862.4	471.1	607.4	774.7	1363.2	7926.8	0.0	7926.8
GATHERING LINES	0.0	5122.9	0.0	4175.2	2844 ~~[illegible]~~	1077.2	1007.3	1473.6	15703 ~~31196.9~~	0.0	15703 ~~31196.8~~
EXPORT LINES	0.0	6287.1	0.0	100279.2	3627.2	11774.2	16543.7	11176.0	149687.4	0.0	149687.4
INFRASTRUCTURE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16380.9	16380.9	0.0	16380.9
DRILLING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GRAND TOTAL	87559.7	52514.6	129929.6	148140.3	~~20496.5~~ 13003	57001.9	76747.5	30393.7	~~610783.8~~ 595290	0.0	~~610783.7~~ 595290