K-Shell-Ewin Pass 80(15)A

NTS 82-G-15

"Ewin Pass Coal Property"
SHELL CANADA RESOURCES LTD

CL# 283,286-289, 1300

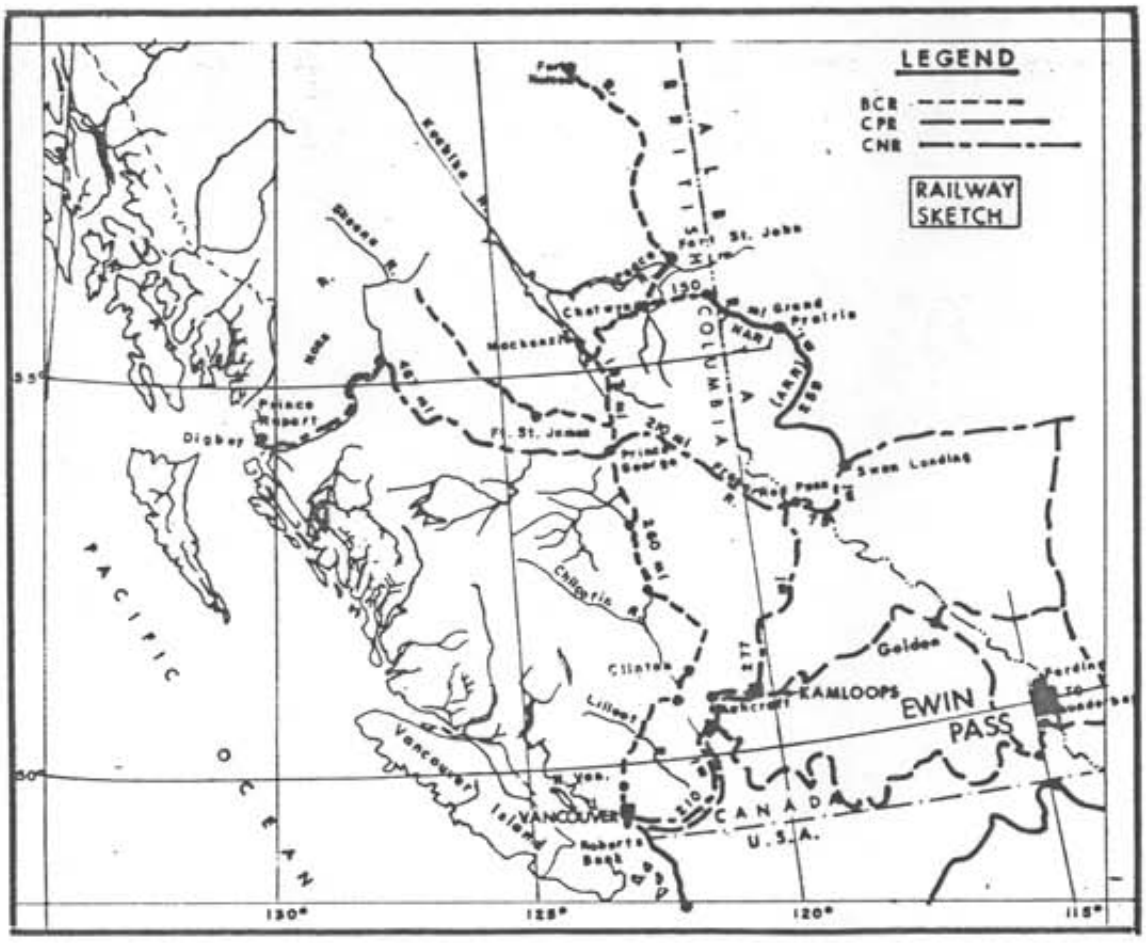
by CR Beavan

April 30 1981

397

K-Shell-Ewin Pass 80(1)A

EWIN PASS
COAL PROPERTY



87-89 1301-1302

Report on Coal Licences 282,283,286-289,291,292, 1300-1302 Group 264.
Kootenay Land District, British Columbia on work done
June – October 1980

Held by: SHELL CANADA RESOURCES LIMITED
Operated by: CROWS NEST RESOURCES LIMITED

Lat. 49° 57' To 50° 03', Long. 114° 42' - 114° 44' N.T.S. 82 G/15

April 30, 1981

Author
Catharine R. Beavan
Geologist
Crows Nest Resources Ltd.

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LIST OF ENCLOSURES

LIST OF APPENDICES

1.0 SUMMARY

The Ewin Pass Coal Property consists of eleven B.C. Coal Licences Nos. 282, 283, 286-289, 291, and 292 and 1300-1302, Group No. 264, covering approximately 1949 hectares of Crown coal land (see Enclosures 1 and 2). The property is held by Shell Canada Resources Limited and operated by Crows Nest Resources Limited, a wholly owned subsidiary of the former. Licences were transferred to Shell Canada Resources in 1979 upon its acquisition of the previous Licencee The Crows Nest Pass Oil and Gas Company Limited in 1978.

From June to October, 1980, an exploration program was conducted on the Ewin Pass property that consisted of:

1. drilling six diamond drill holes
2. backhoe and hand trenching 37 trenches
3. re-sampling the three 1979 adits
4. continued detailed geological mapping of Ewin Pass Ridge
5. location surveys
6. extensive reclamation work

50

660 000 m E 114 45

665 000 m

MT. BANNER EAST

CL278 CL277 CL1299

CL279 CL280 CL281 CL1302

MT BANNER

EWIN PASS

CL284 CL283 CL282 CL1301

GRP 64

CROWSNEST FREEHOLD BLOCK

EWIN PASS

CL285 CL286 CL287 CL1300

MT MICHAEL

CL304 CL289 CL288

MT. MICHAEL

CL290

GRP 266

CL291

MT LYNX

CL293 CL292 CL368

Service

NE CREEK EXTENSION

CL295 CL371

HORSESHOE CREEK

LINE CREEK MINE

HORSESHOE RIDGE

CL297 CL296 CL369

CL299 CL298

GRP 263

CL301 CL300

CL302

CL303

CL370 TEEPEE

TEEPEE MTN

MT SALTER

114 50

114 45

Scale 1:50 000

Kilometres 0.5 0 0.5 1.0 1.5 2.0 2.5 3.0 Kilometres

Miles 0.5 0 0.5 1.0 1.5 2.0 Miles

Transverse Mercator Projection
Universal Transverse Mercator Grid Zone 11

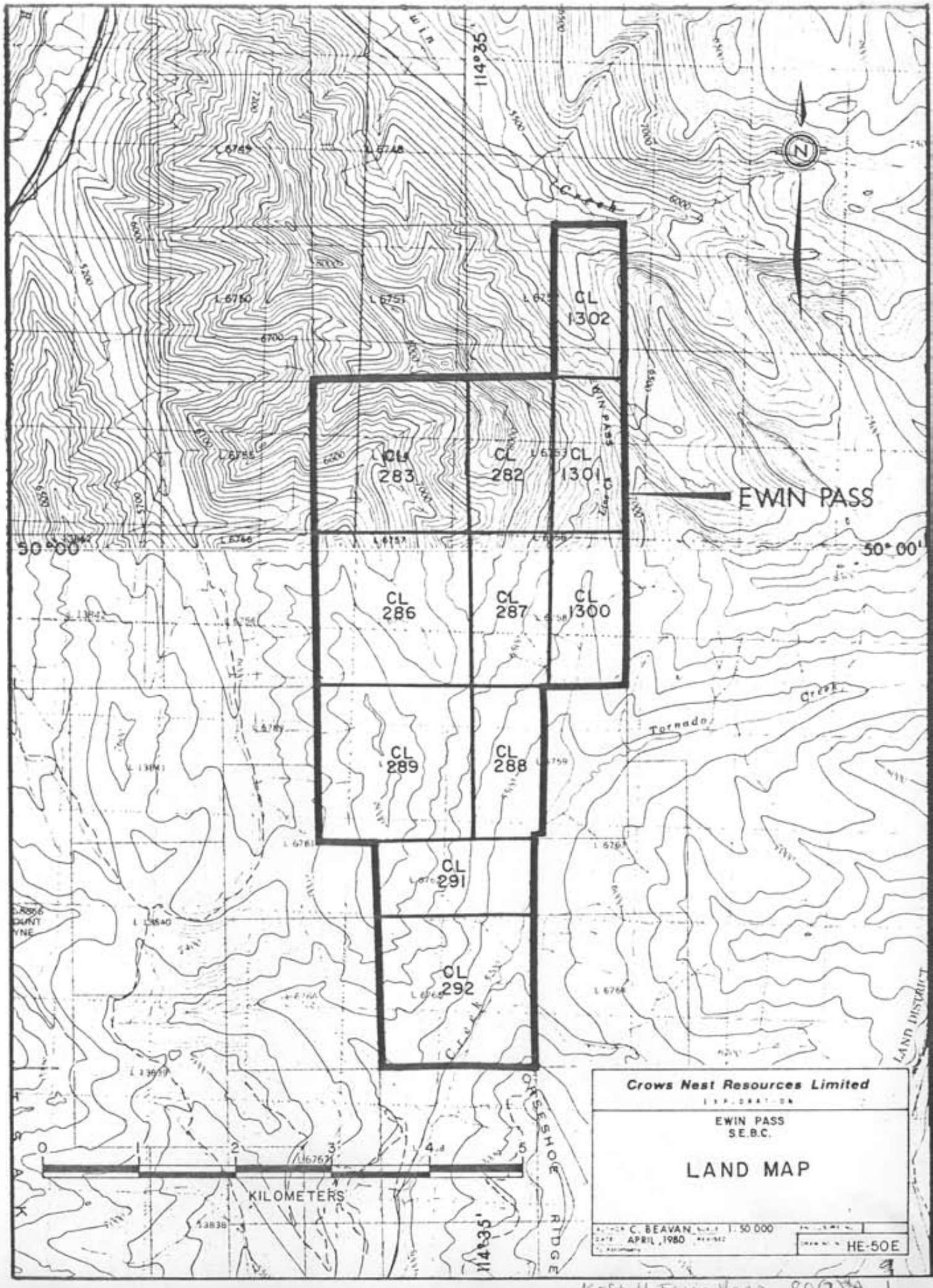
ECT PROSPECT
DARY
F BOUNDARY

Crows Nest Resource
EXPLORATION

CENTRAL B.C.
SE B.C.

PROJECT LOCATION MAP

R. PERRY
81/07/30



K-Shell-Ewin Pass 80(2)A 1

CROWS NEST RESOURCES LIMITED
EXPLORATION

B. C. COAL LICENCES
TENURE STANDING

BLOCK: CENTRAL BLOCK
GROUP: #264

PROJECT:
EVIN PASS
MT. MICHAEL
KOOTENAY LAND DISTRICT

YEAR:
DATE:

PROJECT			BLOCK			GROUP				LICENCE			ACQ/ADM		RENTALS		REQUIREMENT WORK						BUDGET		EXP	POT	COMMENTS, ETC.	
NAME	LICS. TOTAL NO.	AREA TOTAL AC/HA	NAME	LIC. TOTAL NO.	AREA TOTAL AC/HA	NO.	LICS. TOTAL NO.	AREA TOTAL AC/HA	YEAR	NO.	LEGAL DESCRIPTION	AREA TOTAL AC/HA	FEES YEAR	FEES $	ANNUAL $	TOTAL TO NEXT ANN. $10³	EXPIRED $10³	CURRENT YEAR LIC. USE	CURRENT YEAR $	PRE-PAYMENT YEAR	PRE-PAYMENT $	ANNIVERSARY DATE	CURRENT YEAR ACC	CURRENT YEAR $10³	TOTAL $10³	SHELL %		
EVIN PASS MT. MICHAEL	11	1949	CENTRAL BLOCK	36	7554	264	11	1949	80				74		9745	10.9	82.3				132,320				7,585.	Y		
													75	6,673.7			599.4	647	24,040	10	139,900	JAN. 31						
																	681.7				387,220							
										282	W½ 6751	130	75															
										283	LOT 6754	259	75															
										286	LOT 6757	259	75															
										287	W½ 6758	130	75															
										288	W½ 6759	130	75															
										289	LOT 6760	259	75															
										291	LOT 6762	133	75															
										292	LOT 6765	259	75															
										1300	E½ 6758	130	74															
										1301	E½ 6753	130	74															
										1302	E½ 6752	130	74															
										WORK DONE		PRIOR TO '78		1978	1979	1980	TOTAL											
											EVIN PASS	129.00		90,653	250,921	503,514	874,088											
											MT. MICHAEL	-		-		39,887	39,887											
						264	11	1949 Ha 4818 Ac		8	TOTAL	129,00		90,653	250,921	543,401	1,013,975											

GENERAL REMARKS: FILL NECESSARY LINES AND COLUMNS ONLY. COAL DEVELOPMENT POTENTIAL IS "Y" (PRIME) UNLESS OTHERWISE STATED. LICENCES HELD BY SHELL CANADA RESOURCES LTD. CNRL IS THE OPERATOR.

Enclosure 2

Structurally Ewin Pass Ridge is a dip-slope comparable to Line Creek Ridge with an average westward dip of 35° - 40°. Diamond drilling, trenching and continued geological mapping reconfirmed the general structural picture but revealed further complications due to faulting. Mapping in 1980 extended the reserve limits to the north by 0.7 kilometers bringing the reserves to approximately 30 million tonnes of metallurgical coal in place. The property holds good potential for open pit mining.

The Coal-Bearing Member of the Kootenay Formation on Ewin Pass Ridge has for some time been thought to contain excellent quality coking coal. Results of 1979 bulk sampling confirmed the good quality and excellent coking characteristics of two of the three thickest seams.They average 6.9% ash, 27.3% volatile matter, 65.4% fixed carbon and 8.5 F.S.I. In 1980 ten tonne bulk samples were taken from each of these two seams in order to do more carbonization tests.

2.0 INTRODUCTION

2.1 General Introduction

The Ewin Pass property lies within the Front Ranges of the Rocky Mountains in southeastern British Columbia. It is thirty-one kilometres north of Sparwood and twenty-two kilometres south-east of Elkford. The property is located in the middle part of Shell - CNRL's Central Block of licences. There are two other major projects in this block: Horseshoe Ridge to the southeast and the Line Creek open pit mine development immediately west of the latter. The CNRL proposed coal preparation plant is sixteen kilometres from the property.

Geographically the Ewin Pass property extends between:

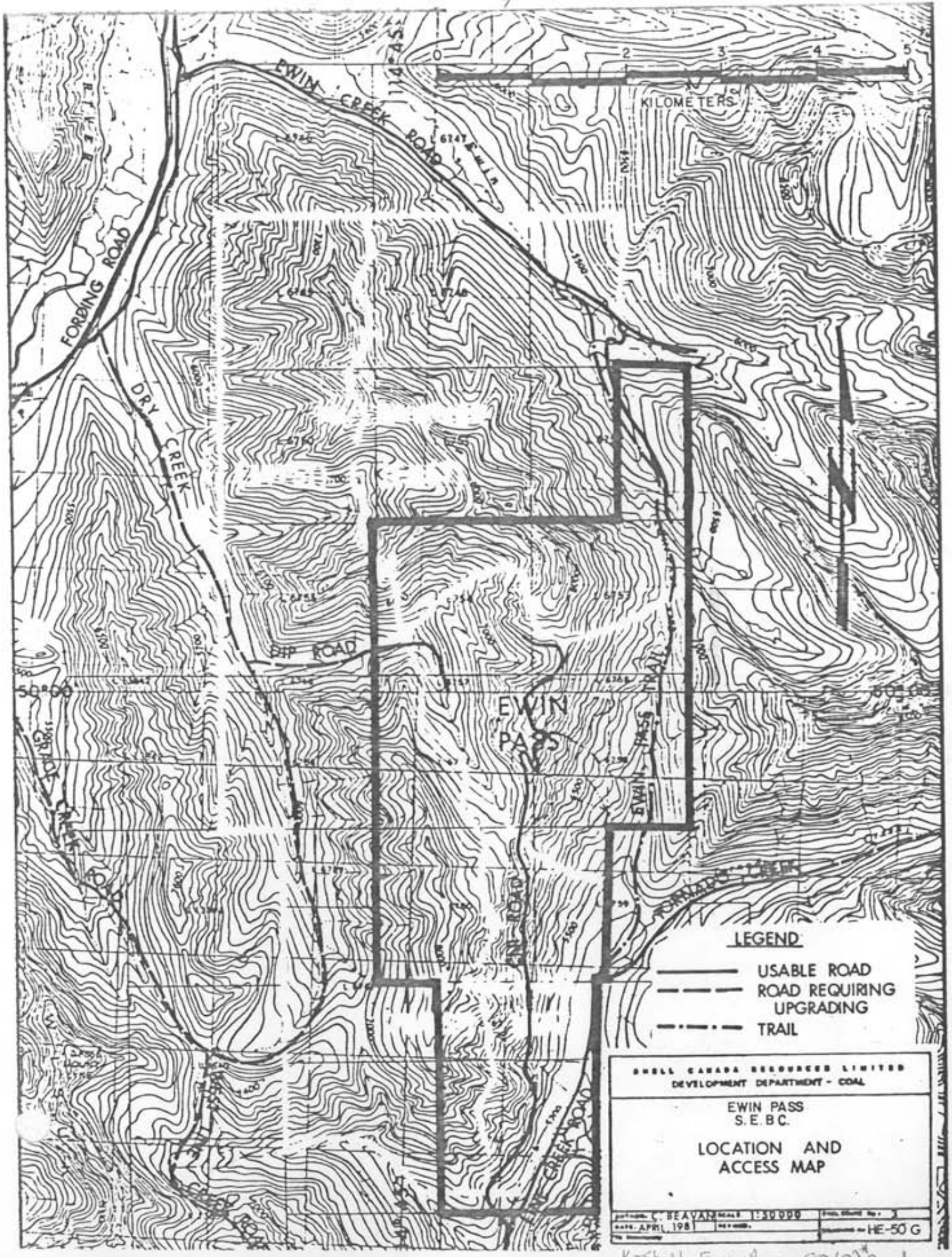
114° 42' and 114° 44' of Western Longitude and
49° 57' and 50° 03' of Northern Latitude
on NTS map sheets 82 G/15 and 82 J/2.

Main access to the property is from Highway 3 at Sparwood. It is fourteen kilometers along a main all-weather gravel road used by Crows Nest Industries logging operations in the area, then fourteen kilometres along the Line Creek Mine Road through Line Creek Canyon and three kilometres along a dirt road which goes up Ewin Pass Ridge. In addition, there is access to the north part

of the property via Ewin Creek Road and to the west via Dry Creek Road and Dip Road (see Enclosure 3).

Within the property is a network of old exploration roads throughout the area which is underlain by coal measures of the Kootenay Formation.

2/AAa.10



K-Shell-Ewin Pass 80(2)A 1

2.2 Summary of Work Done

2.2.1 Pre-1980 Exploration

Between 1968 and 1970 Crows Nest Industries Ltd. mapped the Ewin Pass property at a scale of 1:12,000 and drilled eight reverse-circulation rotary holes (EP74 - EP77, EP79 - EP81, EP83). All holes were drilled on coal licences 286 and 289 (see Enclosure 4 for locations of the drill holes). They were all vertical and all geophysically logged. In total 2132.6 metres were drilled.

In October, 1970 John T. Boyd Company of Pittsburg, Pennsylvania summarized the Ewin Pass exploration and presented a proposed mine area and reserve calculations for the property.

In 1978 the property was mapped by Shell Canada Resources Limited on scales of 1:24,000 and 1:12,000. Some coal seams were trenched and described. In addition, the following newly flown air photographs of the area were obtained from North West Survey Corp. (Yukon) Ltd:

High Level photographs	1:40,000	NW 55678 Line 6-S 092-095
Low Level photographs	1:20,000	NW 61778 Line 4-S 003-005

The following topographic maps were constructed from these photographs:

1:5000	82 G 15	Northwest	Zone J
	82 G 15	Northeast	Zone K
	82 J 2	Southwest	Zone B
	82 J 2	Southeast	Zone C
1:2000	82 G 15	Zone J	Units 69, 70, 79, 80
	82 G 15	Zone J	Units 89, 90, 99, 100
	82 G 15	Zone K	Units 61, 62, 71, 72
	82 G 15	Zone K	Units 81, 82, 91, 92
	82 J 2	Zone B	Units 9, 10, 19, 20
	82 J 2	Zone C	Units 1, 2, 11, 12

In 1979 the proposed pit area of the 1970 Boyd exploration program was mapped in detail at a scale of 1:2000; three adits were driven; 150 metres of trenching was done; and some reclamation work was carried out.

2.2.2 1980 Exploration Program - Objectives and Work Summary

Objectives of the 1980 Exploration Program were:

1. to gain as much structural and stratigraphic information as possible from detailed mapping and extensive trenching and 6 diamond drill holes on licences 286-289 inclusive.
2. to map and trench the area immediately north of the extent of the 1979 geological map on coal licences 286, 287, 282 and 283 to determine if there was coal in this region and if it would be structurally amenable to open pit mining.
3. to take ten tonne bulk samples from two of the thickest seams on coal licences 286 and 289 for further quality and carbonization testing.
4. to do further reclamation work on the property particularly on coal licences 286, 287 and 289.

2.2.2.1 Geological Mapping (Enclosure 4)

Detailed geological mapping was undertaken with a view to:

1. better define and extend to the north surface traces of coal seams and resistant sandstone units, and
2. gain as much structual information as possible.

Mapping was concentrated on Ewin Pass Ridge to the north of the 1979 geological map as well as further evaluating the geology within the 1979 map area - essentially the area within the cross section grid on the geological map (see Enclosure 4)

Mapping was done by chaining along roads and chain and compass traversing along tracable outcrops. Geology was plotted directly onto 1:2000 topographic maps from trenches and is plotted on the geological map (Enclosure 4).

2.2.2.2 Trenching

An extensive trenching program was carried out in 1980 on Ewin Pass. In all 29 backhoe trenches, totalling 5505 meters in length and averaging 1 meter in width, and 8 hand excavated trenches, totalling 405 meters in length and averaging 0.5 meters wide, were dug. Excavation of backhoe trenches was carried out with a 225 Backhoe. Labourers were hired to dig the hand trenches. All backhoe trenches were on existing roads while hand excavated trenches were all off road. The purpose of the trenching program was:

(1) to locate seams,

(2) to measure seam thicknesses,

(3) to describe seams,

(4) to gain structural information.

Trench locations are shown on the Geological Map in Enclosure 4. Backhoe trenches are labelled 80T0 to 80T32. The start or finish of a trench is marked with a + and coal lengths in the trenches and all structural information is recorded directly on the geological map. Hand excavated trenches are labelled 80HT1-80HT8 and any geological information gained from them is recorded on the map. The start or finish of almost all backhoe trenches was surveyed. (Backhoe trenches not surveyed are labelled as such on the map.) Mapping of the trenches was carried out by chaining from the survey nail along the trench. Hand excavated trenches

were located by chaining and compassing to them from known survey locations on roads. They were then mapped by chaining and compassing. Coal seams in most backhoe trenches were sampled and sent to the Crows Nest Resources lab in Fernie for proximate analysis. Enclosure 5 summarizes all trench information. Part A includes all backhoe trench information including trench length, which seams were encountered, whether or not they were sampled and if they were, what sample numbers they were given, what the trench length of the coal seams was and what true thickness was measured when such a measurement was possible. Part B on hand excavated trenches includes trench lengths and a description of what was found in the way of coal in these trenches. Unfortunately, in the hand excavated trenches where coal seams were expected to be uncovered either the overburden was too deep (>1.25 meters) or only minor coal bloom was encountered.

SUMMARY OF TRENCH DATA

A. BACKHOE TRENCHES

Enclosure 5

Trench Number	Trench Length	Seams Encountered	Sample Number	Thickness of Seam Measured in Trench	True thickness of Seam (where Measurable)
80 T-0	400	Upper 9	Not sampled	7.0	mostly bloom
		Middle 9	EPT-0 150.48-159.39	8.91	mostly bloom
		Lower 9	EPT-0 350.59-356.68	6.09	mostly bloom
80 T-1	180	?	EPT-1 212.80-223.93	11.13	faulted
		4	EPT-1 150.44-159.79	9.35	7.11
		5	Not sampled	7.38	2.46
		8	EPT-1 29.35-44.46	15.11	11.78
80 T-2	500	4	EPT-2 203.20-225.80	22.60	faulted
		8	EPT-2 20.00-31.31	11.31	faulted
80 T-3	100	4	EPT-3 40.79-46.94	6.15	faulted, only part of seam exposed
		4	EPT-3 54.00-77.43	23.43	
80 T-3A	30	4	Not sampled	30.0	tracing top part of seam
80 T-4	80	4	EPT-4 22.02-43.06	21.04	immeasurable
80 T-5	140	above 4	EPT-5 63.51-81.57	18.06	immeasurable
		above 4	EPT-5 134.22-143.30	9.08	5.13
80 T-6	80	above 4	EPT-6 38.65-43.30	14.76	2.15
		above 4	EPT-6 54.47-64.64	10.17	immeasurable
80 T-7	130	above 6	Not sampled	19.13	faulted and folded
80 T-8	80	above 4	EPT-8 26.19-33.85	7.66	immeasurable

2/AAa.18

SUMMARY OF TRENCH DATA

A. BACKHOE TRENCHES

Enclosure 5

Trench Number	Trench Length	Seams Encountered	Sample Number	Thickness of Seam Measured in Trench	True thickness of Seam (where Measurable)
80 T-9	70	above 4	EPT-9 30.35-63.69	33.34	immeasurable (mostly along strike)
80 T-10	170	several minor seams (2 m thick) above 4	Not sampled		
80 T-11	100	above 4	Not sampled	8.94	immeasurable
		above 4	Not sampled	4.38	approx. 1.90
		above 4	Not sampled	>10.50	>2.0 (base unexposed)
80 T-12	370	8	EPT-12 104.82-118.07	13.25	>7.60;top of seam unexposed
		8	EPT-12 122.10-191.15	69.05	follows bottom of seam
		8	EPT-12 219.06-233.85	14.79	>1.70;sheared; top of seam unexposed
	NOTE:	Seam 8 also expected from approximately 60 m to 100 m but overburden too deep.			
80 T-13	120	8	EPT-13 50.68-68.31	17.63	sheared,immeasur-able
		8	EPT-13 88.83-110.13	21.30	sheared,immeasur-able
80 T-14	90	above 8	EPT-14 56.29-59.91	3.62	2.04
		8	EPT-14 61.77-77.94	16.17	9.65
80 T-15-16	200	9	EPT-16 185.45-193.39	7.94	5.45
	NOTE:	Seam 8 expected from 0 to 40 m (approximately) but overburden too deep.			

SUMMARY OF TRENCH DATA

A. BACKHOE TRENCHES

Enclosure 5

Trench Number	Trench Length	Seams Encountered	Sample Number	Thickness of Seam Measured in Trench	True thickness of Seam (where Measurable)
80 T-17	80	4	EPT-17 13.65-21.98	8.33	>2.8; top of seam only exposed
80 T-18	180	5	EPT-18 11.61-16.91	5.30	approximately 4.75 (part of seam is crushed)
		4		12.42	6.60
	NOTE:	Seam 5 expected again from 160 m to 170 m (approximately) but overburden too deep.			
80 T-20	235	5	Not sampled	5.13	1.17
		4	Not sampled	13.20	immeasurable
80 T-21	85	8	Not sampled	13.52	>5.82
80 T-22	175	5	Not sampled	6.60	5.52
		4	Not sampled	10.10	8.90
		4 Rider	Not sampled	6.70	4.90
80 T-23	325	10B?	Not sampled	6.14	3.13
		9	Not sampled	3.81	1.90; top of seam faulted off
		9	Not sampled	1.95	faulted seam
		9	Not sampled	19.39	8.66 (faulted)
	NOTE:	Seam 8 expected from approximately 240 m to 280 m but overburden too deep.			
	NOTE:	from 300 m to 325 m the top 1.5 m of seam 8 is exposed in the road cut above 80 T-23. The trench is in overburden too deep to expose any more of the seam.			

SUMMARY OF TRENCH DATA

A. BACKHOE TRENCHES

Enclosure 5

Trench Number	Trench Length	Seams Encountered	Sample Number	Thickness of Seam Measured in Trench	True thickness of Seam (where Measurable)
80 T-24	370	5	Not sampled	10.2	3.69
	NOTE:	Seam 4 expected within the 140 m to 180 m interval but overburden too deep.			
80 T-25	210	None			
	NOTE:	Seam 5 expected within the 20 m to 60 m interval and Seam 4 expected within the 120 m to 160 m interval but overburden too deep.			
80 T-26	170	None			
	NOTE:	Seam 4 expected within the 40 m to 80 m interval but overburden too deep.			
80 T-29 (Branch 1)	125	5	EPT 29 36.86-40.95	4.09	3.02
		4	EPT 29 88.78-106.68	17.88	12.00(some sheared seams)
		4 Rider	EPT 29 120.04-123.28	3.24	1.25
80 T-29 (Branch 2)	150	5	EPT 29 58.20-64.75	6.97	approximately 3.00 (sheared)
		6?	EPT 29 139.82-143.95	4.13	2.35 (sheared)
80 T-31	20	8	Not sampled	20	only bloom exposed
80 T-32	540	4	Not sampled	14.2	7.0
		5	Not sampled	4.5	immeasurable
		8	Not sampled	22*	immeasurable; highly faulted

* (including some carbonaeous shale beds)

Total backhoe trenches: 29
Total length of backhoe trenches: 5505 meters

2/AAa.21

SUMMARY OF TRENCH DATA

B. HAND EXCAVATED TRENCHES

Trench Number	Trench Length	Seams Exposed
EP 80 HT-1	100	?; minor coal bloom; mostly overburden
EP 80 HT-2	40	?; minor coal bloom; mostly overburden
EP 80 HT-3	20	?; minor coal bloom; mostly overburden
EP 80 HT-4	25	overburden only
EP 80 HT-5	30	possibly some of Seam 4 ?; but mostly overburden
EP 80 - HT-6	50	mostly overburden
EP 80 HT-7	70	some of Seam 8 but mostly overburden
EP 80 HT-8	70	mostly overburden

Total hand trenches: 8

Total length of hand trenches: 405 meters.

2/AAa.22

2.2.2.3 Adits

Three adits were driven in 1979 into each of the three thickest seams (Seams 4, 8 and 9) on Ewin Pass and two tonne bulk samples were taken from each. In 1980 two of the three adits (adits 1 and 2) were again bulk sampled with 10 tonne bulk samples taken from each seam (Seam 4 and 8). Target Tunnelling Ltd. was contracted to take the bulk samples. Prior to sampling a channel sample was taken from the cross-cut in both adits and sent to the Crows Nest Resouces Lab in Fernie to confirm the 1979 FSI channel sample values. On completion of bulk sampling channel samples from the cross-cuts were taken, again to reconfirm the FSI values.

During the winter of 1979-1980 all 1979 channel and auger samples were tested at 1.5 specific gravity for ash content at the Crows Nest Resources Lab in Fernie.

The cross-cuts in all adits were channel sampled in 0.5 metre increments to gain information on quality variation across each seam. The cross-cuts in the adit into seam 9 was too wet to describe in detail in 1979 and in 1980 this cross-cut was dried out as much as possible so that a detailed description of Seam 9 could be obtained.

Enclosure 4 shows the locations of all adits. Enclosure 6 is an updated verison of the 1979 adit plan views, profiles and seam description showing ash values for channel and auger samples, proximate analyses of cross-cut increment samples and, for Seam 9, the detailed seam description. Enclosure 7 on page 21 gives the pre- and post- bulk sample channel FSI check values.

ENCLOSURE 7

1980 CROSS-CUT CHANNEL SAMPLES

	Adit 1 Seam 8	Adit 2 Seam 4
Proximate Analysis Before Bulk Sample (at 1.5 S.G.)		
Moisture	0.58	0.59
Ash %	5.36	2.25
Volatile Matter %	26.29	28.01
Fixed Carbon %	67.77	69.14
F.S.I.	8.5	8.5
Proximate Analysis After Bulk Sample (at 1.5 S.G.)		
Moisture	0.79	0.33
Ash %	5.15	3.93
Volatile Matter %	26.39	27.20
Fixed Carbon %	67.67	68.54
F.S.I.	8.5	8.5

2/AAa.25

2.2.2.4 Drilling and Downhole Geophysical Logging

Prior to 1980, nine rotary drill holes had been drilled and logged geophysically on Ewin Pass. The holes were EP74 - EP77, EP79 - EP81, EP83 and EP84 and are shown on Enclosure 4.

In 1980, six diamond holes were drilled and are plotted on Enclosure 4 as EP101 - EP106. All holes, with the exception of EP 101, were drilled on or beside existing roads. A 470 meter road was constructed to site EP 101. EP101 - EP105 were drilled by Tonto Drilling Ltd. and EP106 was drilled by Acadia Drilling Ltd. All holes were geophysically logged by Daves Logging Co. The suite of logs which were run on each hole were density, natural gamma, neutron, caliper and detailed density of coal seams thicker than 1 meter. Directional surveys of each hole were done with several directions taken on angle holes. Water for the drill rigs was trucked to the sites by Gallant Water Hauling from a creek one kilometer south down the Ewin Pass Property Road towards the Line Creek Road.

All holes were started with HQ drill rods. However, in holes EP101 and EP106 a switch to NQ rods was necessitated when 75.14 in EP106 and at 209.1 in EP101 the HQ rods became stuck in coal seams.

All drill core was logged descriptively from a base located adjacent to drill site EP75. Core recovery was close to 100% with the exception of coal seams where recovery varied from 60% to 100%. All coal semas were sampled for proximate analysis in 2 samples: 1 sample comprised the top 10% of the seam and the other sample comprised the remainder of the seam. See Enclosure 8 for a summary of drill hole data, Enclosure 9 for copies of geophysical logs with the natural gamma-neutron logs showing lithologies and Enclosure 10 for the drill core descriptions including coal seams proximate analysis.

Golder Associates, Consulting Geotechnical Engineers of Vancouver was hired todo a geotechnical evaluation of the Ewin Pass Property for input into a preliminary mine design. The written portion of their evaluation is in Appendix A.

2.2.2.5 Location Surveys

Location survey of trenches and drill holes was carried out by Sheltech Canada.

Conventional surveying methods were used to determine locations, elevations and UTM coordinates of 1980 drill locations and of one end of most backhoe trenches. In all, 33 points were surveyed. Appendix B shows a plot of these points and contains a report on location surveys.

2.2.2.6 Reclamation

The Ewin Pass reclamation program was carried out in July, August and September, 1980. A detailed report on Ewin Pass reclamation is included in Crows Nest Resources Limied Annual Reclamation Report for Coal Exploration to December 31, 1980 - B. C. Reclamation Permit # C54. This report was sent to J. D. McDonald, P. Eng., Senior Reclamation Inspector, in Victoria, B. C., in April, 1981. A brief summary of 1980 reclamation work on Ewin Pass is as follows:

(1) 1980 off-road drill sites were recontoured, seeded, fertilized and raked;

(2) 1980 on-road drill sites where the inside road bank had been excavated to accommodate the drill had the inside bank recontoured to conform with the general road bank configuration and were seeded, fertilized and raked;

(3) 1980 trenches were filled in;

(4) existing roads north of the proposed pit limit (essentially north of the cross-section grid in Enclosures 4) were recontoured, seeded, fertilized and raked;

(5) several roads within the proposed pit area i.e. within the Enclosure 4 cross-section grid were recontoured, seeded, fertilized and harrowed or raked;

(6) all other roads in the proposed pit area (other than the two main roads, one on either side of the ridge, that run almost the complete length of the area) were cross-trenched, seeded, fertilized and harrowed or raked;

(7) two old slide areas, one each below Adits 1 and 3, were hydroseeded and rolled with a sheep's foot packer.

(8) the main access road was blocked off from Line Creek Road above the Mines Services area, culverts were removed and the road was cross-trenched.

Recontouring and filling in trenches was accomplished with a 225 backhoe, and some help from a D-7 cat; cross-trenching was done with the D-7 cat; the bulk of the revegetation program was contracted to Interior Reforestation Company Limited of Cranbrook, B. C. who used a tractor for the seeding, fertilizing and harrowing. Steeper roads were seeded and fertilized by hand using a broadcaster and were hand raked.

2.3 List of Licences on Which Work Was Performed

The following list shows what work was carried out on which particular coal licences:

Type of Work	Coal Licence Number
Geological Mapping	282,283,286,287,288,289
Road Upgrading	286,287,288,289,291,292
Road Construction	286
Trenching	282,283,286,287,289
Adits	286,288,289
Drilling	286,287
Surveying	282,283,286,287,289
Reclamation	282,283,286,287,288,289

3.0 GEOLOGY

3.1 General Statement

Bedrock on the Ewin Pass property ranges from Jurassic Fernie Formation to the Lower Cretaceous-Jurassic Kootenay Formation. Nomenclature used in this report follows Gibson, 1977. See Enclosure 11 for the Table of Formations and their descriptions and Enclosure 12 for a Typical Stratigraphic Section from Ewin Pass Ridge.

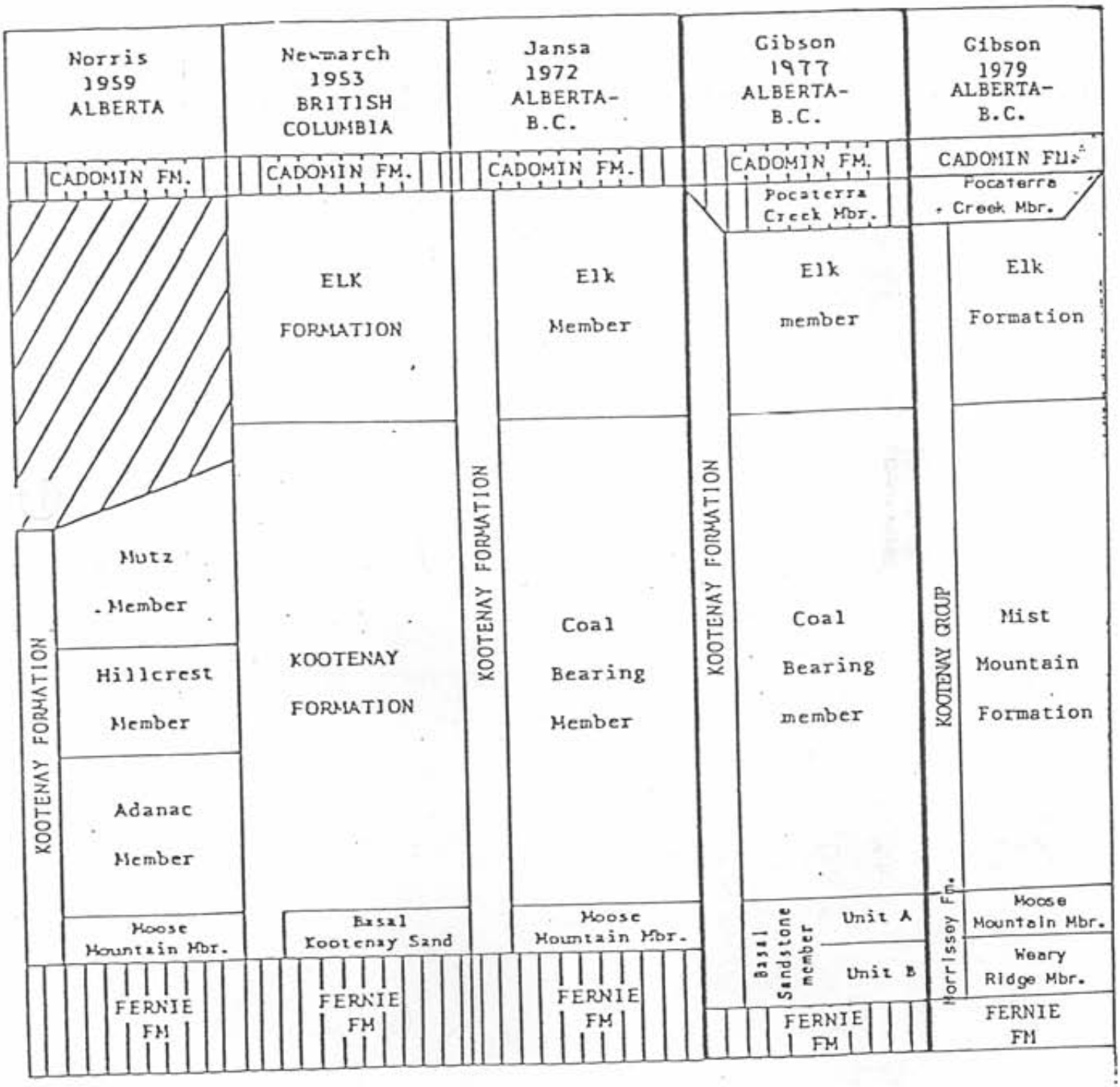
3.2 Stratigraphy

3.2.1 Fernie Formation

The Fernie is the oldest formation within the property. It makes up the bottom one half to two-thirds of the east side of Ewin Pass Ridge. It is a marine sequence of rocks dominated by dark-grey to black shales. In approximately 100 meters of the top, there is a transition to the "Passage Beds", a sequence of siltstones, shales and fine-grained sandstones interpreted to be a prograding beach complex.

Enclosure 11

TABLE OF FORMATIONS



3.2.2 Kootenay Formation

In southeastern British Columbia and southwestern Alberta the Kootenay Formation is part of an eastward thinning wedge of Jura-Cretaceous rocks. The Formation is divided into three rock-stratigraphic units: the Basal Sandstone Member, the Coal-Bearing Member and the Elk Member.

3.2.2.1 Basal Sandstone Member

A massive, cliff-forming sandstone marks the conformable transition from Fernie into the Kootenay Formation. This unit is a distinctive marker horizon in southeastern British Columbia and southwestern Alberta. It has been interpreted as both a delta-front sheet sand and a beach deposit.

At Ewin Pass, the Basal Sandstone can be distinctly seen approximately half way up the east side of the ridge at the south end angling its way up the ridge northerly. The Member is 65 meters thick and is conformably overlain by the Coal-Bearing Member.

3.2.2.2 Coal-Bearing Member

Interbedded dark grey, carbonaceous and argillaceous siltstone, silty shale, mudstone, fine-grained sandstone, minor conglomerate and thin to thick seams of coal characterize the Coal-Bearing Member. This member has been interpreted as representing either a deltaic or an interdeltaic coastal plan marsh environment.

The Coal-Bearing makes up the top one half to one-third of the east side of Ewin Pass Ridge and most of the west side.

3.2.2.3 Elk Member

Conformably overlying the Coal-Bearing Member in the Fernie-Sparwood area is the Elk Member. Thick, cliff-forming sequences of sandstone, coarsening upwards to conglomerate are interbedded with siltstone, mudstone, shale and sporadic, thin seams of coal. This Member has been interpreted as forming in an alluvial plain environment.

The Elk Member is present towards the bottom of the west side of Ewin Pass Ridge. In the centre part of the property the Elk is in the valley and does not outcrop. However, in the southwest part of the property the basal Elk can be distinquished as a persistant sandstone unit on airphotographs.

3.3 Structure

The Kootenay Formation in southeastern British Columbia is located in the Front Ranges of the Rocky Mountains within three separate, elongate areas, collectively called the Crowsnest Coalfields. The Ewin Pass property is located in the Elk Valley Coalfield which is the most northerly of the Kootenay Coalfields.

The Elk Valley Coalfield is 100 kilometers long and extends in a NNW direction from Crowsnest Pass to the Alberta-British Columbia boundary near Kananaskis Lakes. The Kootenay Formation is preserved in structural lows within the coalfield, namely the Fording River Syncline and the down-dropped block of the Erickson Normal Fault. The Ewin Pass property is towards the southern part of the Fording River Syncline on its eastern flank. The syncline is further complicated on this eastern limb by thrust faulting (Fording Thrust). Enclosure 13 shows the general geological setting of the Ewin Pass property.

Bedding on Ewin Pass Ridge strikes in a general 190-200 direction. Dips on the ridge are to the west varying between 20° and 60°, averaging 37°. In places, especially in the north part of the area bedding is overturned to the east. The cross-sections in Enclosures 14-38 show that the west side of the ridge approaches a dip-slope.

The 1980 mapping, drilling and trenching program upheld the conception of a relatively simple structural concept for Ewin Pass Ridge, particularly in the south half of the property. The two thrust faults on the property postulated in 1979 were confirmed by drilling in 1980: hole EP 102 showed the 9 seam repeated twice and hole EP 103 has a repeat of the 8 seam.

The following structural features were added to the 1980 geological map (Enclosure 4) and cross-sections (Enclosures 14 - 38) in addition to those put forth in the 1979 geological report.

(1) Several normal faults on the east side of Ewin Pass Ridge in the south half of the geological map area account for the discrepancy between the 30°-50° dips on the east side of the ridge and the apparent 20° dip when seams in outcrop are projected to the corresponding seams in drill hole. Normal faults have been interpreted in both holes EP 74 and EP 75. Mapping and air photograph interpretation in 1979 revealed 2 normal faults in the southern quarter of the map area and they help substantiate the presence of the 2 additional normal faults with a down throw to the east.

(2) EP 101, EP 81, air photograph interpretation and mapping show a thrust fault extending from the south east part of the map area in a northwesterly direction up the valley to the west of Ewin Pass Ridge. Exposed in the southwest part of the map area, this fault is unexposed through most of its length.

(3) EP 105, EP 79, EP 106 and surface mapping brought to light an additional thrust fault extending from approximately cross section 1400 N (Enclosure 28) to cross section 1900N (Enclosure 33) where it is cut off by a normal fault. This thrust fault comes to surface again in cross section 2100N (Enclosure 35) and is exposed in outcrop in the northern part of the map area as well as being present in EP 106.

(4) The normal fault that cuts off the thrust fault (described in (3)) extends from cross section 1400N (Enclosure 28) to cross section 2100N (Enclosure 35). The down throuwn side is to the west and this fault cuts off the surface outcropping of seam 4 from cross section 1700N (Enclosure 31) to cross section 1900N (Enclosure 33) and of seam 5 from cross section 1700N (Enclosure 31) to cross section 2100 (Enclosure 35).

(5) From cross section 2000N (Enclosure 34) north there is an additional thrust zone which is present in seam 4 in EP 106 and which complicates the surface geology on the top of the ridge from cross section 2000N (Enclosure 34) through the saddle at the north end of the cross section grid and onto the ridge north of Ewin Pass Ridge.

Mapping also revealed some very minor synclines and anticlines in the north half of the map area. Their axes appear to be short (100 meters), they trend east-west and their plunges are to the west.

3.4 Coal Geology

Enclosure 12 shows the coal seams present on Ewin Pass Ridge. The coal seams are correlatable to the seams on Line Creek Ridge; thus, seam numbers correspond to the seam numering system at Line Creek. Seams 4 through 10A are present on Ewin Pass Ridge with the exception of Seam 7 which is either not present or very thin and discontinuous. There are seams above Seam 4 up to the basal Elk Member but they have not been mapped in any detail and to date appear to be very thin (less than 1.5 meters thick). The main mineable seams are Seams 4, 5, 8 and 9.

The average thickness of Seam 4 from adit, trenching and drill hole information is 8.1 meters. From information to date this seam may be thickening towards the north part of the map area. However, this trend is masked by thrust faulting that occurs within the seam both in outcrop and at depth. Nonetheless, Seam 4 maintains its reputation of being very clean coal (see proximate analysis of Seam 4 - EP 106 and EP 105 in Enclosure 10).

Seam 5 averages 2.5 meters thick and it too appears to be thickening towards the north part of the map area. However, again it may be thrusting that is giving this impression of thickening.

Seam 6 appears from 1980 drill hole information to be a consistently present seam on the property. It surveys 0.6 meters thick.

Seam 8, from drillhole, trench and adit data, averages 13.3 meters thick. This seam thickens in the middle portion of the map area and, like seams 4 and 5, is affected by faulting in the north part of the property. Like seam 4, its quality is consistently good despite structural disturbance (see the proximate analysis for seam 8 in drill holes EP 105 and EP 106 in Enclosure 10).

Seam 9 averages 9.0 meters thick. Faulting has repeated this seam twice in the southern three quarters of the map area and three times in the northern quarter. Both outcrop and drill hole information show Seam 9 not to be of as good quality as Seams 4 and 8. However, seam 9 was redescribed and sampled incrementally during the 1980 adit program. The bottom 2.1 meters of the 8.3 meters exposed in the 1979 cross cut are very shaly coal. In part this bottom portion of the seam accounts for the only fair quality of the seam (see the proximate analysis and seam description of Seam 9 in Adit 3 - Enclosure 6).

Little additional information was learned about seams 10A and 10B during 1980. Both seams were intersected twice in EP 102 bringing their average thicknesses to: Seam 10B - 1.6 meters and Seam 10A - 1.6 meters. Both seams are highly shaly.

4.0 Coal Quality

One of the prime aims of the 1979 exploration program on Ewin Pass Ridge was to obtain bulk samples of unoxidized coal from Seams 4, 8 and 9 for coal and coke testing. Two tonne bulk samples were taken from each seam and sent first to Birtley Coal and Minerals Testing in Calgary for washing and then to Canmet in Ottawa for carbonization testing. The results of the Birtley tests were reported in the Ewin Pass Coal Property Geological Report for Work Done During 1979 and are reproduced below in Enclosure 39.

1979 Bulk Samples - Birtley Coal and Minerals Testing Centre

Seam #	Adit #	Washed	% ADM	% R.M.	% Ash	% V.M.	% F.C.	% S	FSI	Calcu. Basis
8	1	yes	4.8	0.4	6.3	27.0	66.3	0.51	8.5	ADB
4	2	no	2.3	0.5	7.5	27.5	64.5	0.40	8.5	ADB
9	3	yes	4.5	0.4	8.5	21.6	69.5	0.56	5.0	ADB

Enclosure 39

The results of the carbonization testing by Canmet in Ottawa are included in Appendix C.

Testing of seam quality was continued in 1980. Ten tonne bulk samples were taken from Adits 1 and 2 and again sent to Birtley Coal and Mineral Testing in Calgary for washing and then to Canmet in Ottawa for carbonization testing. Pre- and post- bulk sample cross-cut channel samples were taken to confirm the results of the bulk sample (see Enclosure 7). At the time of writing of this report results from neither Birtley nor Canmet had been received. In addition to the bulk samples from Adits 1 and 2 the following samples were taken for coal quality testing in 1980 and sent to the Crows Nest Resources lab in Fernie for proximate analysis:

(1) 0.5 meter increment samples (or increments to the closest natural break) from the cross-cuts in Adits 1, 2 and 3. See the adit plans in Enclosure 6 for the proximate analyses of these samples.

(2) Samples from major seams (thicker than 1 meter) in the drill holes. Two samples were taken from each seam: one including the top 10% of the seam and the other including the bottom 90% of the seam. The results of the proximate analysis on these samples are recorded in the drill core descriptions in Enclosure 10.

(3) Samples from seams exposed in trenches. Enclosure 5 shows which trenches were and which were not sampled. (Only seams which were exposed as actual coal and not mostly bloom were sampled). Appendix D is a list of the proximate analyses done on the trench samples.

5.0 MINEABILITY AND COAL RESERVES

Previous exploration on the Ewin Pass property indicated that there was open pit potential for a 1.2 kilometer by 0.7 kilometer area on Ewin Pass Ridge. A dip-slope situation exists in this area comparable to the Line Creek Ridge Mine area. There are approximately 400 meters of the Coal Bearing Member of the Kootenay Formation preserved on the ridge within which there is an aggregate thickness of 41.9 meters of coal in 5 mineable seams.

In 1970, John T. Boyd Co., on the basis of eight drill holes and geological mapping calculated the following reserves for Ewin Pass:

	Proven	Partially Proven	Total
Metallurgical coal tons (millions)	17.2	11.1	28.3
Oxidized coal tons (millions)	3.0	2.0	.0
Total tons (millions)	20.2	13.1	33.3
Stripping ratio	8.53	9.85	9.05

In 1980, the engineering department of Crows Nest Resources Limited calculated 22.3 million tonnes of metallurgical coal in place, 19.6 million tonnes of recoverable coal and 15.5 million tonnes of clean coal for Ewin Pass based on the 1979 Geological Report. These reserves can be placed into the Proven and Probable reserve categories.

In 1980 mapping was concentrated towards the north portions of Ewin Pass Ridge in an attempt to gain more information on the geology and to see if the potential pit area could be extended further north from its previous northern limit in the vicinity of cross-section 1600N in Enclosure 4. Reserve calculations on the 1980 geology will be completed in the spring of 1981 but the estimated additional reserves for the extended pit are 7.7 million tonnes in place. Total possible reserves for Ewin Pass are therefore 30 million tonnes of metallurgical coal in place.

2/AAa.44

6.0 COST STATEMENT

Costs for the 1980 exploration program on the Ewin Pass property are tabulated in Enclosure 40, the Application to Extend Term of Licence. The enclosure gives the nature of the expenditures referenced to the coal licences on which work was performed. Total cost of the 1980 Ewin Pass Program was $503,514.18.

2/AAa.45

7.0 BIBLIOGRAPHY

John T. Boyd Co. - Coal Reserve Development as of October 1970, Upper Elk River Coal Field, B. C. - 1970.

J. Fisher & G. Sloan - Geological Report on Work Done May 29, 1978 to August 23, 1978 for North Central Block Project, B. C. Coal Licences Nos. 277-293 Inclusive, 304 and 1299,1300, 1301, 1302 - 1979.

D. W. Gibson - Sedimentary Facies in the Jura - Cretaceous Kootenay Formation, Crows Nest Pass Area, Southwestern Alberta and Southeastern British Columbia - Bull, C.S.P.G. Vol. 25, No. 4, pp. 767 - 791.

A.P. Hamblin & R.G. Walker - Storm-dominated Shallow Marine Deposits: the Fernie - Kootenay (Jurrassic) Transition, Southern Rocky Mountains - Can. J. Earth Sci. Vo. 16, No. 9, pp. 1673 - 1690.

8.0 PROFESSIONAL VERIFICATION OF REPORT

Entitled: Ewin Pass Coal Property
Geological Report
for Work Done
During 1980

Catharine Beavan planned and carried out the 1980 geological field program on Ewin Pass B. C. Coal Licences held by Shell Canada Resources Limited. She also prepared this report. Mr. Frank Martonhegyi supervised the activity of this program under the general direction of the undersigned.

Catharine Beavan, B. Sc., graduated in Geology from McGill University, in 1970. She completed all course work towards a M.Sc. degree in Geology in 1979. Her experience with Western Canada coal exploration since 1977 includes positions with:

- B. P. Coal, Calgary, Alberta
- Crows Nest Industries Ltd., Calgary, Alberta
- Crows Nest Resources Limited, Calgary, Alberta

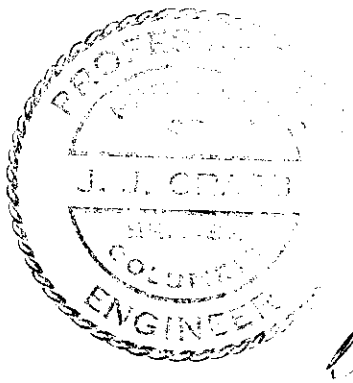
Frank Martonhegyi, M.E., graduated in Mining Geological Engineering from the University of the Heavy Industry, Hungary, in 1962; and received post-graduate training at the University of Saskatchewan, Saskatoon, in 1969-1971. His experience in Western Canadian coal exploration since 1971 includes positions with:

- CanPac Minerals Ltd., Calgary, Alberta
- Shell Canada Resources Ltd., Calgary, Alberta
- Crows Nest Resources Limited, Calgary, Alberta

His prior experience includes underground coal mining geology, geotechnical engineering and geochemistry in Hungary, Austria and Canada.

He currently holds the position of Senior Staff Geologist for Crows Nest Resources Limited supervising coal exploration in British Columbia.

I consider both the aforementioned geologists to be well qualified to undertake responsibilities they were assigned for this project. I am satisfied that the attached report dated April 30, 1981 has been competently prepared and justly represents the information obtained from this project.



J. J. Crabb, P. Eng.

April 30, 1981.

2/AAa.47

Enclosure 40

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

APPLICATION TO EXTEND TERM OF LICENCE

I, Bolton Agnew (Name) agent for Shell Canada Resources Limited (Name)

P.O. Box 100 (Address)

Calgary, Alberta, T2P 2H5. (Address)

Valid FMC No. 207568

hereby apply to the Minister to extend the term of Coal Licence(s) No(s). 282, 283, 286 to 289 Incl., 291, 292, 1300, 1301 & 1302; 11 Licences; 1949 Hectares

for a further period of one year.

2. Property name Ewin Pass and Mt. Michael, Group #264, Kootenay Land District

3. I am allowing the following Coal Licence(s) No(s). to forfeit N/A

4. I have performed, or caused to be performed, during the period January 30, 1980 to January 31, 1981, work to the value of at least $ 543,401.84 on the location of coal licence(s) as follows:

CATEGORY OF WORK	Licence(s) No(s).	Apportioned Cost
Geological mapping	282,283,286-289,291,292	$100,630.72
Surveys: Geophysical		
Geochemical		
Other: Location	282,283,286-289	5,950.00
Road construction	286-289, 291, 292	26,573.82
Surface work	282, 283, 286-289	16,974.25
Underground work	286, 288, 289	24,547.00
Drilling	282, 286	223,764.88
Logging, sampling, and testing	282, 286, 288, 289	39,780.27
Reclamation	282, 283, 286-289	73,995.20
Other work (specify)		
Off-property costs		31,185.70

5. I wish to apply $ 543,401.84 of this value of work on Coal Licence(s) No(s). 282, 283, 286-289 Incl., 291, 292, 1300, 1301, 1302

6. I wish to pay cash in lieu of work in the amount of $. N/A on Coal Licence(s) No(s).

7. The work performed on the location(s) is detailed in the attached report entitled Ewin Pass Geological Report '79 was submitted in April, 1980; Ewin Pass Geological Report '80 and Mt. Michael Geological Report '80 will be submitted in ninety days.

1981.01.28 (Date)

(Signature)

Land Supervisor (Position) Land Supervisor

(FORMS AND REPORT TO BE SUBMITTED IN DUPLICATE)

EWIN PASS PROJECT Part of Group #264

Application to extend term of licence for the entire group was submitted January 28th, 1981

CATEGORY OF WORK

GEOLOGICAL MAPPING Yes ☒ No ☐

		Area (Hectares)	Scale	Duration
Reconnaissance				
Detail:	Surface	390	1:2000	104 man-days
	Underground			
*Other (specify)				

Total Cost $ 66,937.72

GEOPHYSICAL/GEOCHEMICAL SURVEYS Yes ☒ No ☐

Method
Grid
Topographic Location Survey
*Other (specify)

Total Cost $ 5,950.00

ROAD CONSTRUCTION Yes ☒ No ☐

Length 15 km (upgrading & maintenance) Width 5 m
On Licence(s) No(s). 286-289, 291, 292
Access to

Total Cost $ 26,573.82

SURFACE WORK Yes ☒ No ☐

	Length	Width	Depth	Cost
Trenching	5.5	1m	up to 2m	
Seam Tracing				
Crosscutting				
*Other (specify)				

Total Cost $ 16,974.25

UNDERGROUND WORK Yes ☒ No ☐

	No. of Adits	Maximum Length	No. of Holes	Total Metres	Cost
Test Adits					
*Other workings	re-sampling three existing adits				

Total Cost $ 24,547.00

DRILLING Yes ☒ No ☐

		Hole Size	No. of Holes	Total Metres	Cost
Core:	Diamond	HQ	6	1369.2	
	Wireline				
Rotary:	Conventional				
	Reverse circulation				
*Other (specify)					

Contractor 5 holes - Tonto Drilling, 1 hole - Acadia Drilling
Where is the core stored? on site

Total Cost $ 223,764.88

LOGGING, SAMPLING AND TESTING Yes ☒ No ☐

Lithology:	Drill samples	☐	Core samples	☒	Bulk samples	●
Logs:	Gamma-neutron	☒	Density	☒		
*Other (specify)	caliper log					
Testing:	Proximate analysis	☒	FSI	☒	Washability	☒
	Carbonization	☒	Petrographic	☐	Plasticity	☐
*Other (specify)						

Total Cost: $39,780.27

OTHER WORK (specify details)

	Cost
Reclamation - seeding, fertilizing, harrowing existing roads old adit sites and new drill sites on CL 282, 283, 286-289	
Total Cost	$ 73,995.20
On-property costs	478,523.14
Off-property costs	24,991.70
Total Expenditures	$ 503,514.84

Original dated 1981.01.28
(Date)

ORIGINAL SIGNED
W. S. KOWALSKI
(Signature)

(Position)

*A full explanation of other work is to be included.

APPENDIX A

Golder Associates
CONSULTING GEOTECHNICAL ENGINEERS

REPORT TO
CROWS NEST RESOURCES LTD.
ON
GEOTECHNICAL STUDIES (PART A)
AT THE EWIN PASS PROSPECT

SPARWOOD, BRITISH COLUMBIA

DISTRIBUTION:

3 copies - Crows Nest Resources Ltd.
Calgary, Alberta

2 copies - Golder Associates
Vancouver, British Columbia

November 1980

802-1557

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APPENDIX I

1.0 INTRODUCTION

This report presents the geotechnical data collected during the 1980 exploration drilling program on the Crows Nest Resources Ltd. (CNRL) Ewin Pass property east of Elkford, B.C., see Figure 1.

The intent of the geotechnical phase of the field program was to gather field data which could act as a foundation for geotechnical input in any preliminary mine design, and be used to assess the requirements of any further geotechnical studies.

In accordance with the scope of the project, which was covered under CNRL Purchase Order No. CN20887, the field data has been essentially left in its raw form with the minimum of reduction to make it easily retrievable for later analyses and interpretation (Part B).

A Golder Associates geotechnical engineer was on site from July 22nd to September 2nd, 1980 and from September 17th to 28th, 1980, the latter period coincided with the completion of additional field work requested by Mr. Frank Martonhegyi.

The geotechnical work supplemented the work already being carried out by the Crows Nest Resources Geology Department, and concentrated on the following areas:

1.1 Geology

Since the stratigraphy and delineation of major structures were part of the geology department's investigation, the geotechnical program was aimed at determining the inter-relationships of jointing and bedding (structural fabric). This was accomplished through detailed structural logging of the 1980 drill core, and mapping of all rock cuts and exposures across the site. Section 2 covers this work in detail.

Figure 2 is a site plan showing the approximate locations of drill holes and mapping sites.

1.2 Hydrology

Hydrological work consisted of installation of piezometers for long term monitoring of pore pressures and falling head permeability tests to estimate the potential response of the groundwater regime to mining activity.

The location of piezometer installations is shown on Figure 2, with details presented on the summary geotechnical logs.

2.0 GEOTECHNICAL MAPPING AND LOGGING

Geotechnical mapping and logging of core were used to examine the structural fabric of the rock units in the sequence and the effect of major structures, as well as the overall rock condition.

2.1 Geotechnical Mapping

Rock cuts and exposures on site were mapped, recording the orientation and nature of bedding and joint fractures. Figure 2 shows the locations of the exposures mapped.

Since the data from the mapping will require detailed interpretation, they have been left unmodified and are not presented herein. The raw data could be made available upon request.

2.2 Geotechnical Logging

All core from the 1980 program was logged for geotechnical detail. In addition, the orientations of natural fractures in the core were refer-

enced to bedding wherever possible. These referenced orientations can be used to derive structural fabric orientations when the geological structure has been interpreted. However, at this stage the data is retained on file in the raw form.

The summary geotechnical logs presented in Appendix I contain the following data:

- core loss
- generalized lithology
- bedding dips
- core condition
- Rock Quality Designation (RQD)
- piezometer installation, with most recent water levels.

The presentation details for these features are described in detail in Appendix I.

3.0 GROUND WATER INVESTIGATIONS

The general aim of this aspect of the program was to evaluate piezometric pressures in the sequence, particularly the presence of any artesian pressures behind potential pit walls. The standpipe piezometers were also used for falling head tests to evaluate general rock permeabilities.

3.1 Piezometer Installations

Where possible, three piezometer installations were made in each exploration hole. Details of these installations are given in Table 3-1 and are shown diagrammetrically on the Summary Logs in Appendix I. As indicated, drill holes E.P. 101, E.P. 102 and E.P. 104 have double installations, the remainder have triple installations.

All piezometers were 2 cm I.D. PVC standpipes. The bottom 1 m of each standpipe was perforated with slots at 0.5 cm spacings, and the slotted sections were seated in filter zones composed of fine gravel. Seals composed of bentonite or grout were set between and above installations.

All the piezometers have removable caps with the exception of the two artesian installations in E.P. 101. It was requested by Mr. Adam Noel (CNRL) that these holes be left flowing. However, installation No. 1 is only just artesian and to ensure that this does not freeze, the water in the pipe was bailed out to a depth of 3.0 m, replaced with oil and sealed. To reduce erosion at the site of E.P. 101 and subsequent removal of seed, an elbow joint was placed on installation No. 2 and approximately 6 m of pipe added to take the higher flow volume away from the immediate drill hole site.

For future identification of individual piezometer locations, the deep piezometers have one notch, the intermediate piezometers have 2 notches and the shallowest have 3 notches.

3.2 Testing and Monitoring

3.2.1 Falling Head Tests

Falling head permeability tests were carried out in the following installations:

- E.P. 102 #1
- E.P. 103 #1
- E.P. 103 #2
- E.P. 104 #2
- E.P. 105 #1
- E.P. 105 #2

A typical set of test results is shown in Table 3-2 and represented in Figure 3. The remaining test data has been retained on file in the raw form.

3.2.2 Water Level Monitoring

All piezometers were monitored while Golder Associates personnel were still in the area. Figures 4 to 8 inclusive are the piezometer response curves to date. Water levels are given as down-hole depth below collar. No elevations have been given as drillhole collar survey data are not available at this time.

4.0 SAMPLING FOR ROCK STRENGTH TESTING

Although some qualitative idea of rock strengths can be derived from the logging, rock strength testing may eventually be required for design purposes. Considering this, core samples of typical rock types encountered in the drilling were collected and sealed in urethane foam for protection. A list of core samples taken is shown in Table 4-1.

5.0 FUTURE WORK (PART B)

All samples and data are presently stored at Golder Associates' Vancouver office where they are readily available for future testing and analysis, as required.

A program required to provide geotechnical input in any mine design using this data, could include:

- formulation of a geological "model" of the site, including:
  - (a) rock type distribution
  - (b) structure(s)
  - (c) structural fabric
- addition of hydrogeology to such a model.
- derivation of strength characteristics of the rock types and structural features in the model.

- analysis of proposed slopes against potential failure modes indicated by the model for proposed pit wall orientations.

Input required from Crows Nest Resources for such a program would consist of:

- the stratigraphy and major structures of the site as interpreted by CNR's Geology Department. Geotechnical mapping and logging data can be combined with these data to form the geological model.
- continued monitoring of the piezometers installed during the field program in order to evaluate the extent of seasonal fluctuations.
- initial concepts of pit geometry, mining method, and mining sequence. Knowing these, applicable slope orientations and geometries can be reviewed and recommendations made.

Recommendations from this study would be used as a basis for preliminary mine designs. Where particularly sensitive or critical conditions are indicated it may, however, be necessary to perform additional studies before the pit design can be finalized.

We trust this report fulfills your present requirements. Should you have any questions or require any further data, please do not hesitate to contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES

P.F. Stacey

I.T. Rozier

PFS/ITR/bn
802-1557

TABLE 3-1

PIEZOMETER INSTALLATIONS

Drill Hole	Installation Numbers	Depth to Tip (m)	Type	Stratigraphic Location	Depth to W.L. (m)	Date of Measurement
E.P. 101	#1	219.0	Sealed Standpipe	Below 8 Seam	Artesian (5 psi)	07/10/80
	#2	53.5	Sealed Standpipe	Below 4 Seam	Artesian (40 psi)	07/10/80
E.P. 102	#1	262.4	Sealed Standpipe	Below L-9 Seam	88.9	07/10/80
	#2	62.5	Sealed Standpipe	In 8 Seam	63.4 ?incorrect #?	07/10/80
E.P. 103	#1	108.8	Sealed Standpipe	In 8 Seam	58.1	07/10/80
	#2	67.0	Sealed Standpipe	Above 8 Seam	25.3	07/10/80
	#3	29.3	Open	Above 8 Seam	14.9	07/10/80
E.P. 104	#1	248.8	Sealed Standpipe	Below 8 Seam	23.2	25/09/80
	#2	119.2	Sealed Standpipe	Below 4 Seam	26.0	25/09/80
E.P. 105	#1	246.0	Sealed Standpipe	Below 8 Seam	88.7	07/10/80
	#2	213.0	Sealed Standpipe	Above 8 Seam	77.0	07/10/80
	#3	76.0	Open	Below 4 Seam	71.5	07/10/80
E.P. 106	#1	255.0	Sealed Standpipe	Below 8 Seam	34.4	07/10/80
	#2	87.8	Sealed Standpipe	Below 4 Seam	73.7	07/10/80
	#3	48.4	Open	Above 4 Seam	47.5	07/10/80

Note: The installation number is marked by notches cut into the piezometer pipe protruding at the surface.

TABLE 3-2

PERMEABILITY TESTING
(Typical Data for Falling Head Test)

Drillhole No. - E.P. 103
Piezometer - #2
Depth to Tip - 67.0 m
Depth to W.L. - 28.4 m
Hole Inclination - Vertical
Hole Diameter - 0.096 m (HQ)
Length of Test Zone - 4.5 m

Time	Depth to W.L. (m)	Progressive Fall in Head	H	Ho	H/Ho
0 secs.	19.85	0.00	8.55	8.55	1.000
10 secs.	19.92	0.07	8.48	8.55	0.992
15 secs.	20.00	0.15	8.40	8.55	0.982
30 secs.	20.08	0.23	8.32	8.55	0.973
45 secs.	20.20	0.35	8.20	8.55	0.959
60 secs.	20.30	0.45	8.10	8.55	0.947
90 secs.	20.51	0.66	7.89	8.55	0.922
2 mins.	20.72	0.87	7.68	8.55	0.898
4 mins.	20.86	1.01	7.54	8.55	0.882
8 mins.	21.99	2.14	6.41	8.55	0.750
15 mins.	24.51	4.66	3.89	8.55	0.455
30 mins.	26.60	6.75	1.80	8.55	0.210
45 mins.	27.51	7.66	0.89	8.55	0.104
60 mins.	28.09	8.24	0.31	8.55	0.036
100 mins.	28.25	8.40	0.15	8.55	0.018

TABLE 4-1

LIST OF CORE SAMPLES TAKEN

Sample No.	Drill Hole	Depth Top (m)	Depth Bottom (m)	Location in Sequence	Description
#1	E.P. 105	76.3	76.6	Below 4 Seam	Lam, SLT
#2	E.P. 105	232.6	232.9	Below 8 Seam	Lam, SLT
#3	E.P. 104	119.5	119.7	Below 4 Seam	Lam Silty, SST
#4	E.P. 104	234.5	234.7	Below 8 Seam	Lam Silty, SST
#5	E.P. 103	128.6	128.8	Below 8 Seam	Silty, MDS
#6	E.P. 102	66.0	66.2	Above 8 Seam	Lam, SLT
#7	E.P. 102	250.0	250.25	Below 9 Seam	Lam, SLT
#8	E.P. 101	39.3	39.5	Above 4 Seam	MDS
#9	E.P. 101	129.8	130.0	Below 4 Seam	SST
#10	E.P. 101	217.0	217.2	Below 8 Seam	Silty, MDS
#11	E.P. 106	250.0	250.3	Below 8 Seam	MDS

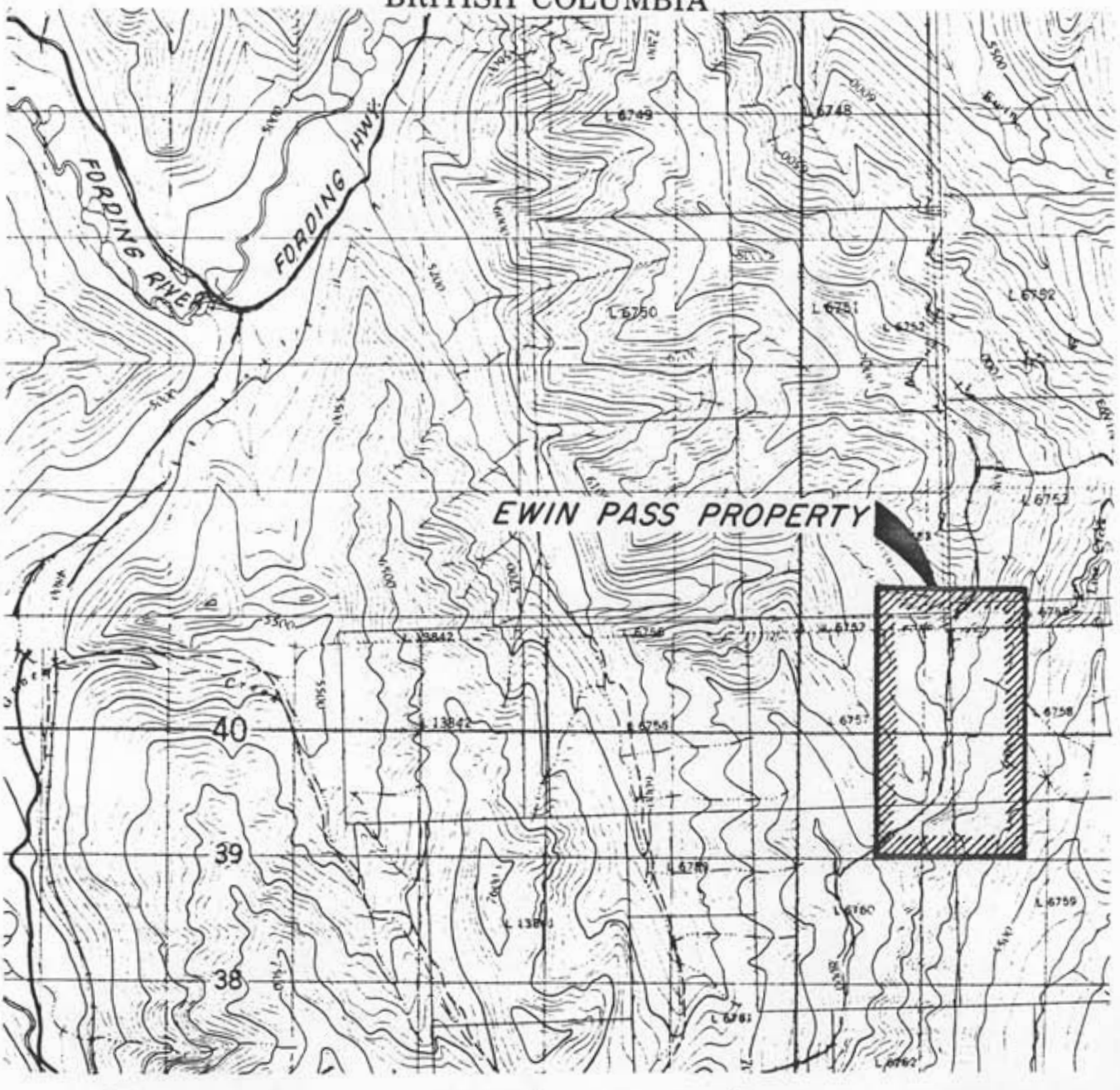
TABLE 4-1

LIST OF CORE SAMPLES TAKEN

Sample No.	Drill Hole	Depth Top (m)	Depth Bottom (m)	Location in Sequence	Description
#1	E.P. 105	76.3	76.6	Below 4 Seam	Lam, SLT
#2	E.P. 105	232.6	232.9	Below 8 Seam	Lam, SLT
#3	E.P. 104	119.5	119.7	Below 4 Seam	Lam Silty, SST
#4	E.P. 104	234.5	234.7	Below 8 Seam	Lam Silty, SST
#5	E.P. 103	128.6	128.8	Below 8 Seam	Silty, MDS
#6	E.P. 102	66.0	66.2	Above 8 Seam	Lam, SLT
#7	E.P. 102	250.0	250.25	Below 9 Seam	Lam, SLT
#8	E.P. 101	39.3	39.5	Above 4 Seam	MDS
#9	E.P. 101	129.8	130.0	Below 4 Seam	SST
#10	E.P. 101	217.0	217.2	Below 8 Seam	Silty, MDS
#11	E.P. 106	250.0	250.3	Below 8 Seam	MDS

SITE LOCATION PLAN

Figure 1



Project No. 802-1657 Drawn [illegible] Reviewed T.T.R Date NOV '80

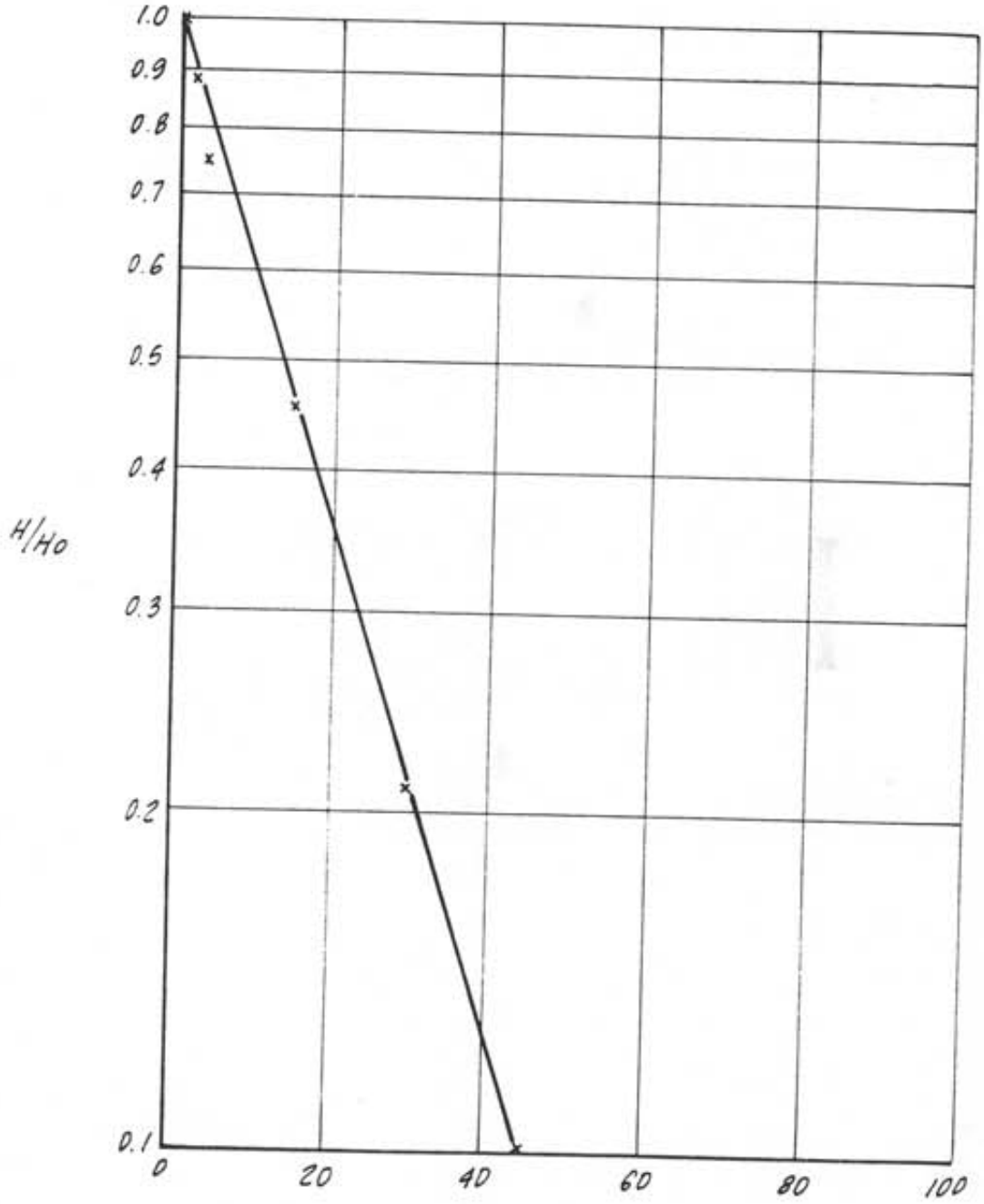
Golder Associates

K-Shell-Ewin Pass 80

FALLING HEAD PERMEABILITY TEST

Figure 3

D.H. # E.P. 103, Piezometer # 2

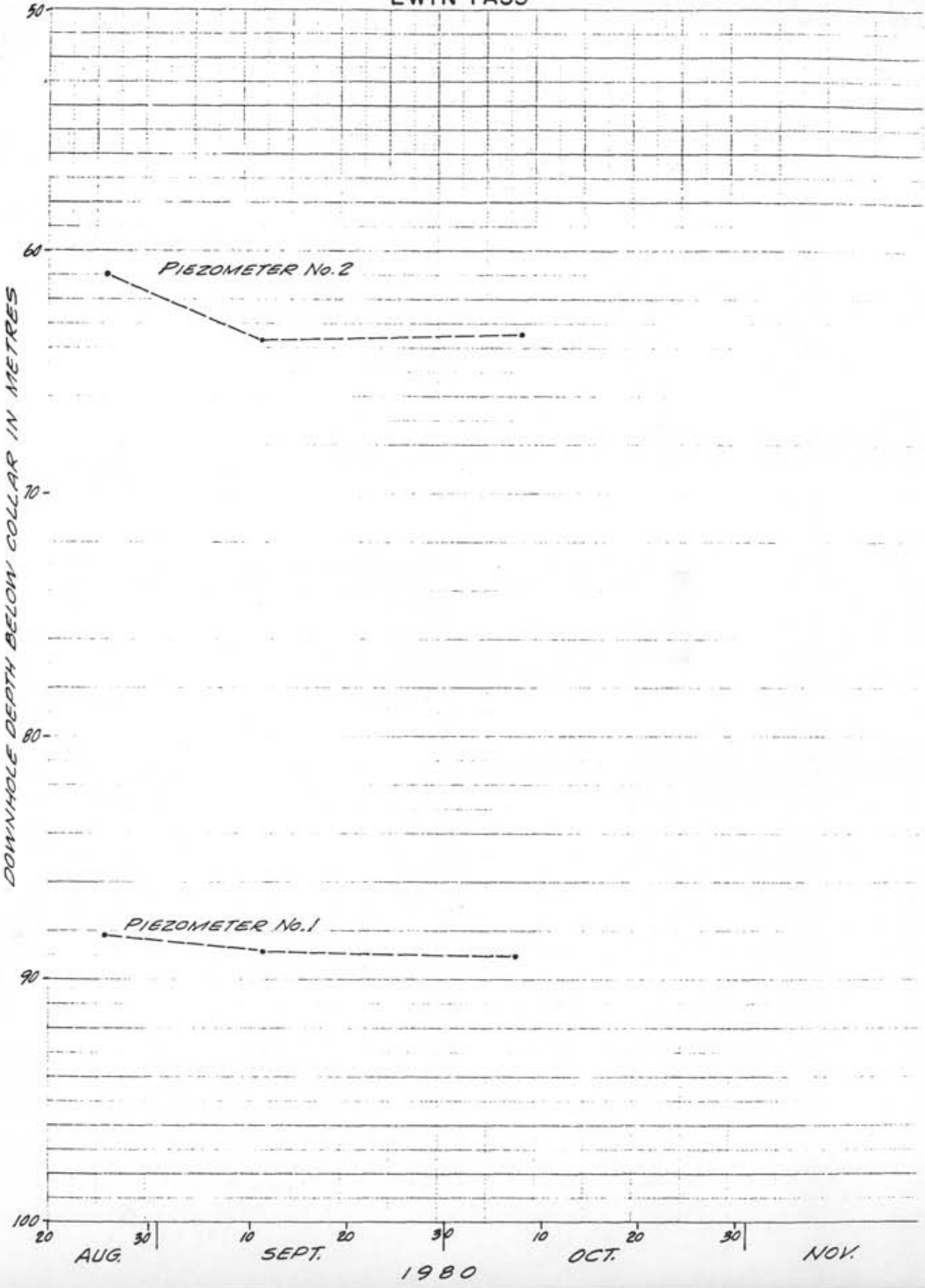


Depth to Tip - 67.0 m
Depth to W.L. - 28.4 m
Hole Inclination - Vertical
Hole Diameter - 0.096 m (HQ)
Length of Test Zone - 4.5 m

Project no. 802-1557 Drawn [illegible] Reviewed T.T.L. Date Nov. 180

PIEZOMETER RESPONSE E.P 102
EWIN PASS

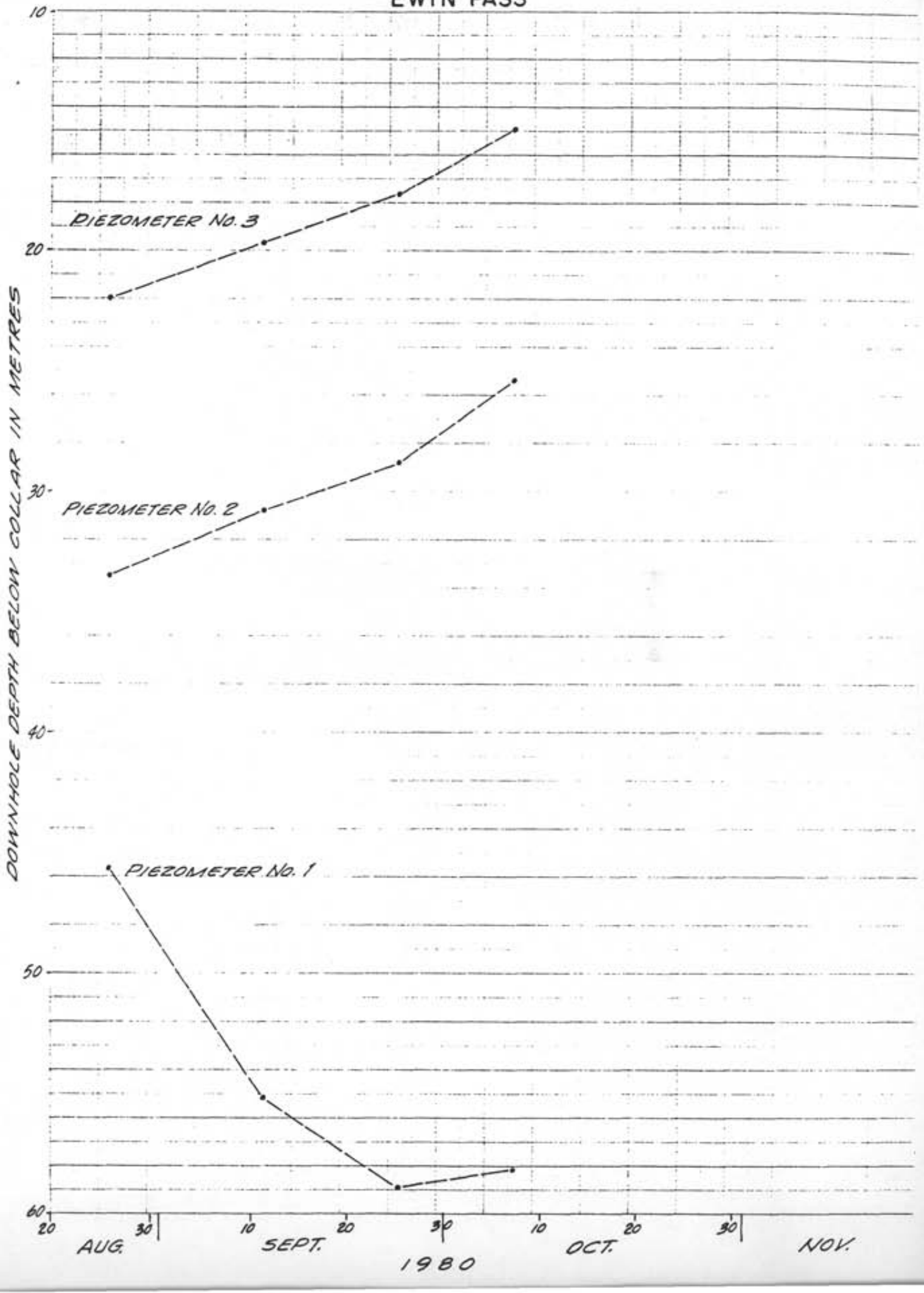
Figure 4



802-1557

PIEZOMETER RESPONSE E.P. 103
EWIN PASS

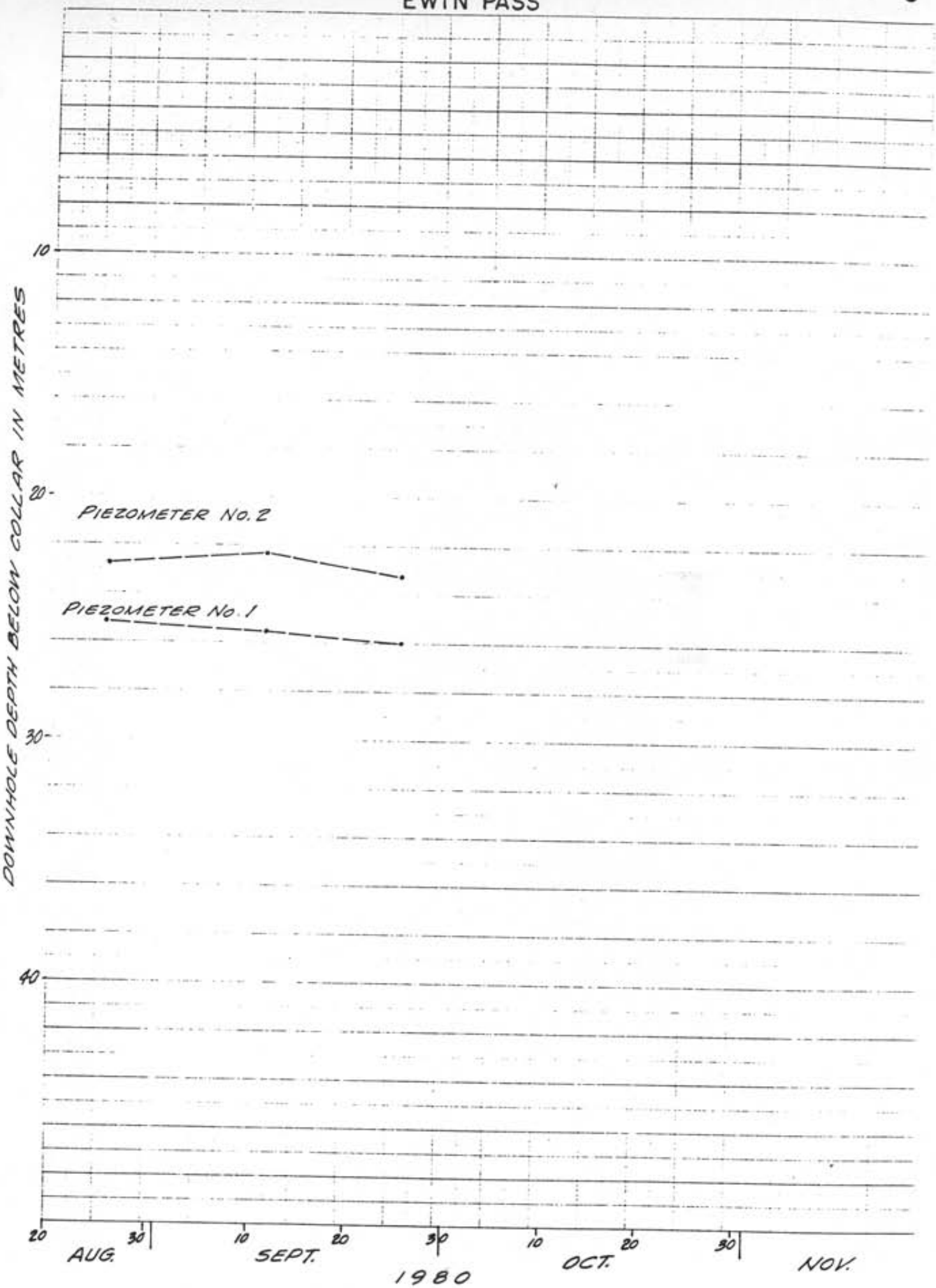
Figure 5



802-15.

PIEZOMETER RESPONSE E.P 104
EWIN PASS

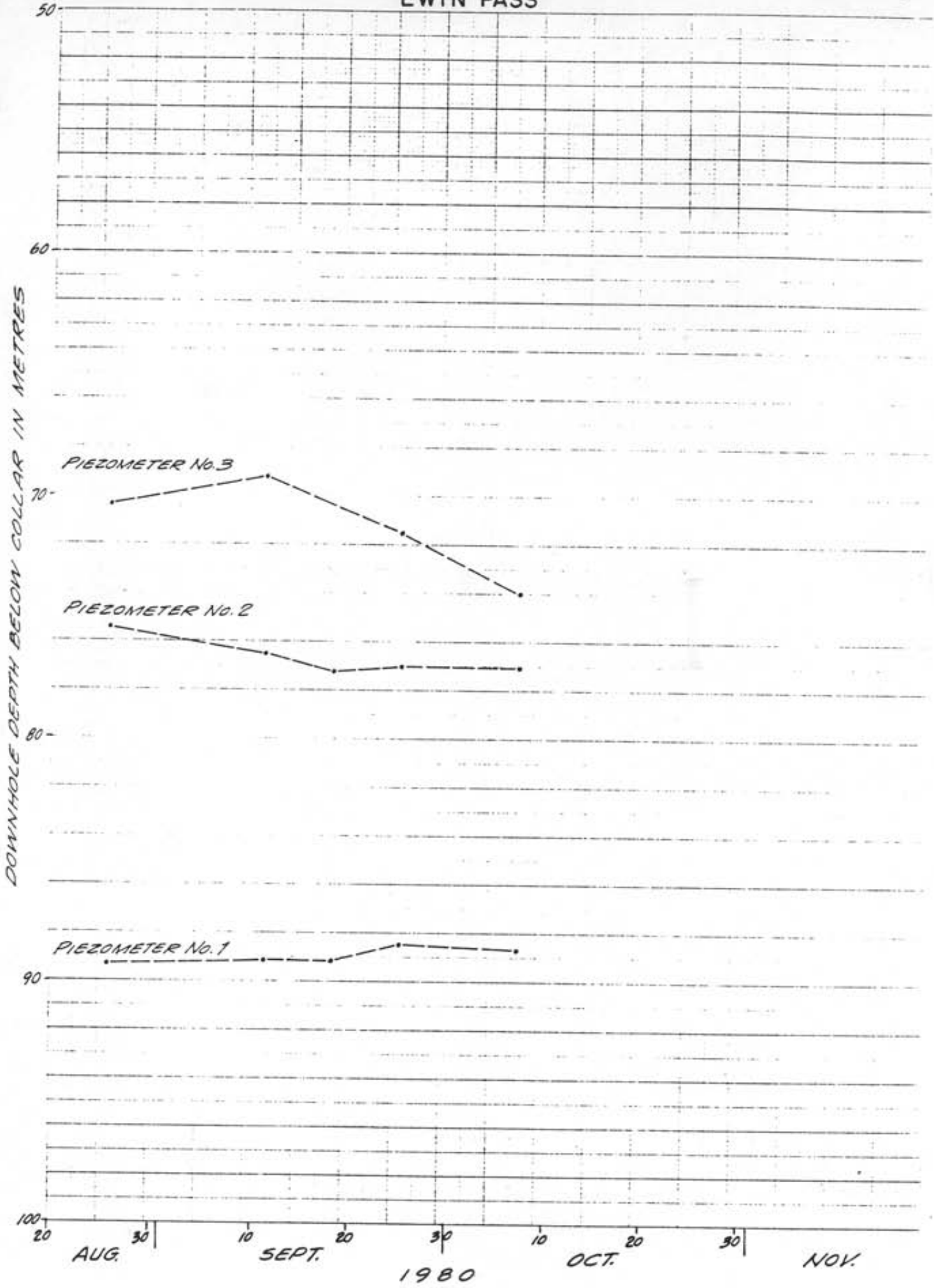
Figure 6



R82-1557

PIEZOMETER RESPONSE E.P. 105
EWIN PASS

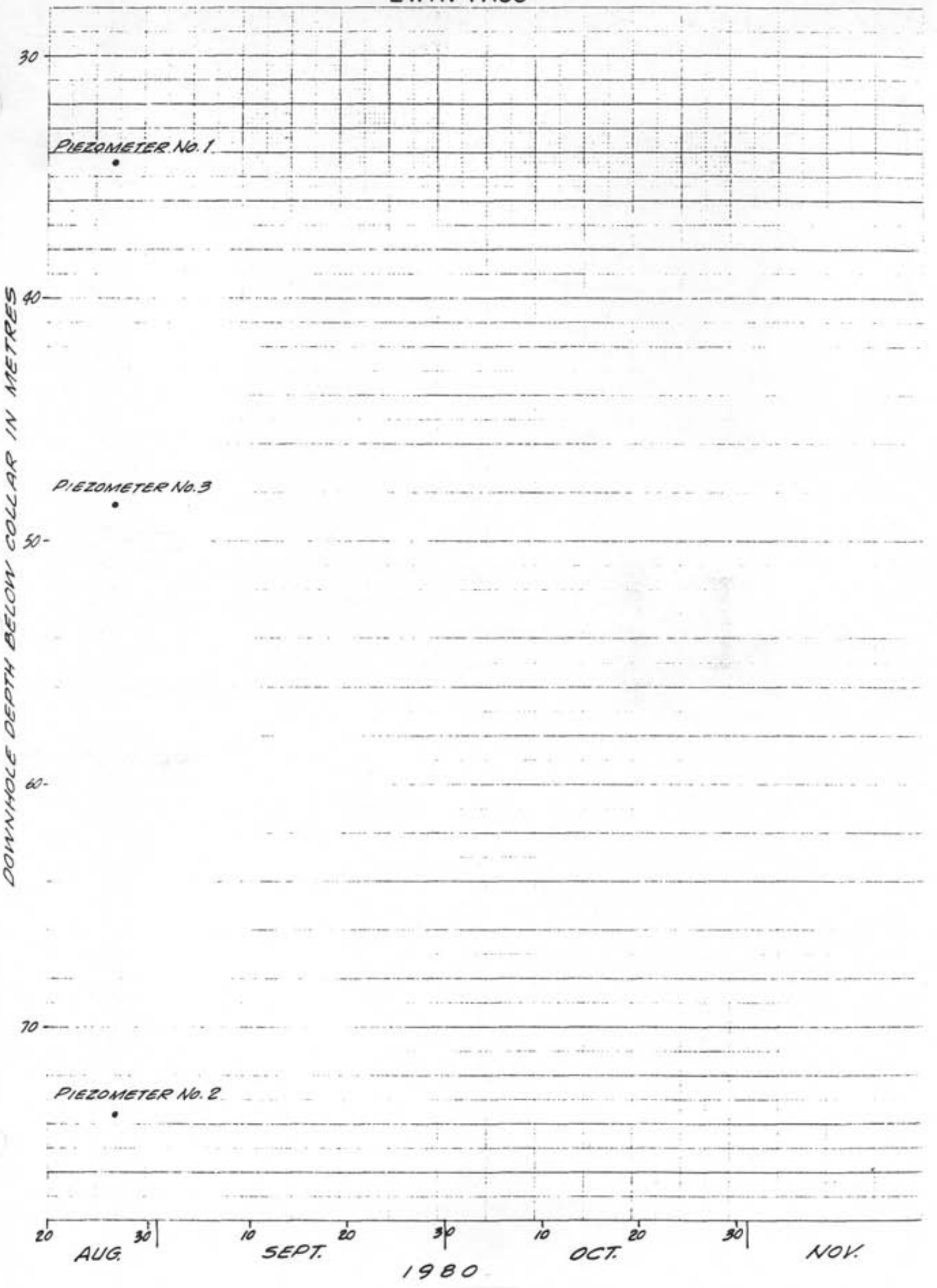
Figure 7



A02-1557

PIEZOMETER RESPONSE E.P 106
EWIN PASS

Figure 8



INTER-OFFICE CORRESPONDENCE

DATE: December 4, 1980

TO: CROWSNEST RESOURCES LIMITED (CNRL)

FROM: Sheltech Canada

SUBJECT: Location Surveys
EWIN PASS 4051 F
S.E. British Columbia

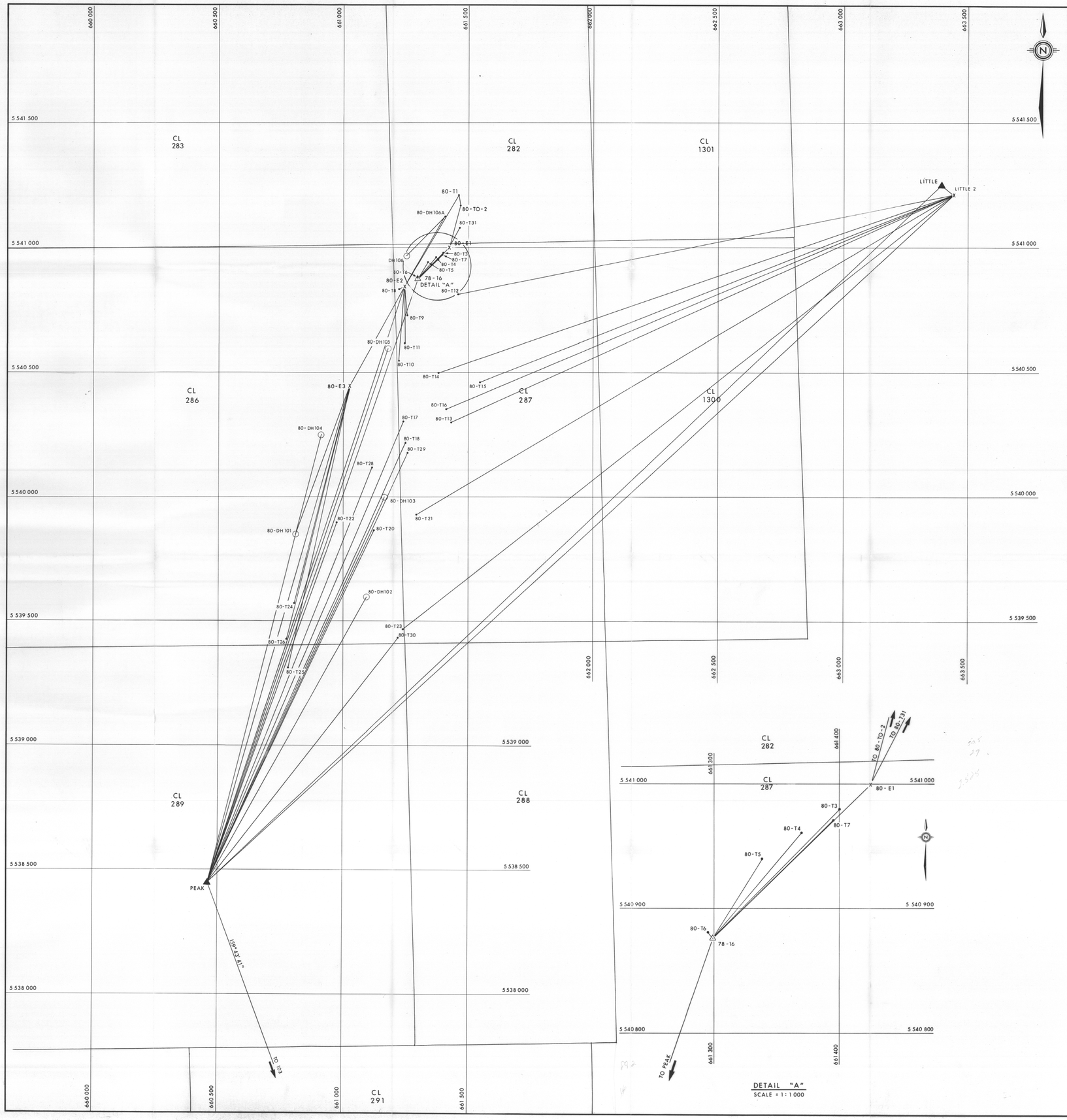
All surveying in the Ewin Pass area was done from the Crowsnest Control Network established in the summer of 1980 and using the July 14, 1980 results. Stations "Peak", "103", and "Little" were the three used from which four minor control points (80-E1, 80-E2, 80-E3, and Little #2) were established with excellent precision being obtained. From these various control stations, 29 trenches and 6 drill holes were surveyed.

Conventional survey methods using both 1" and 20" theodolite and electronic distance measuring equipment were used to obtain the survey data. Calculations were done in the UTM system with both distances and bearings reduced to plane and referred to 117° W. The results were given to CNRL personnel in both tabular and plan form.

The survey cost attributed to the Ewin Pass area was approximately $5,600.

Dave Poulsom

DP/eh



CONTROL	STATION	BEARING	DISTANCE	NORTHING	EASTING	ELEVATION	REMARKS
	103			5538446.10	660460.84	2481.1	
	Peak	339-43-41					
	78-16	19-01-26	2470.17	5540875.89	661298.67	2428.6	
	80-81	44-29-28	185.197	5540979.47	661400.16	2411.38	
	Peak						
	78-16	19-01-26		5540875.89	661298.67	2428.6	
	80-74	39-56-11	110.898	5540960.98	661395.35	2413.3	
	Peak						
	78-16	19-01-26		5540875.89	661298.67	2428.6	
	80-T7	45-37-06	135.344	5540975.56	661339.73	2417.6	
	Peak						
	78-16	19-01-26		5540875.89	661298.67	2428.6	
	80-T6	31-34-26	75.653	5540949.34	661339.73	2414.7	
	Peak						
	78-16	19-01-26		5540875.89	661298.67	2428.6	
	80-T6	324-10-51	6.157	5540880.88	661295.02	2428.6	
	Peak						
	80-E1	45-24-33		5540999.98	661474.89	2426.7	
	80-T11	27-13-01	80.011	5541039.76	661364.74	2379.7	
	Peak						
	80-E2	18-07-23		5540842.91	661245.22	2436.3	
	80-T10	108-28.00	298.041	5540845.27	661277.01	2397.6	
	Peak						
	80-E2	18-07-23		5540842.91	661245.22	2436.3	
	80-T11	179-52-41	325.703	5540617.71	661245.70	2406.0	
	Peak						
	80-E2	18-07-23		5540842.91	661245.22	2436.3	
	80-T9	174-50-51	115.627	5540727.76	661245.60	2417.3	
	Peak						
	80-E2	18-07-23		5540842.91	661245.22	2436.3	
	80-T8	294-56-25	14.685	5540830.54	661231.85	2430.1	

CONTROL	STATION	BEARING	DISTANCE	NORTHING	EASTING	ELEVATION	REMARKS
	103			5538446.10	660460.84	2481.1	
	PEAK	339-43-41					
	LITTLE 2	47-08-56	4070.71	5541214.57	663445.17	2287.8	
	LITTLE	305-10-14	63.00	5541250.86	663393.67	2274.5	
	PEEK	226-16-39					

TRENCHES	STATION	BEARING	DISTANCE	NORTHING	EASTING	ELEVATION	REMARKS
	103			5538446.10	660460.84	2481.1	
	Peak	339-43-41					
	80-E3	14-50-02	2077.59	5540444.86	661027.71	2353.7	
	80-E2	28-33-42	845.61	5540842.99	661245.29	2436.0	
	Peak	198-07-23					
	Peak						
	80-E3	14-50-02		5540444.86	661027.71	2353.7	
	80-T24	194-13-48	909.22	5539620.37	660805.93	2135.8	North End
	Peak						
	80-E3	14-50-02		5540444.86	661027.71	2353.7	
	80-T26	193-56-30	1049.95	5539826.81	660774.98	2159.6	
	Peak						
	80-E3	14-50-02		5540444.86	661027.71	2353.7	
	80-T25	197-14-00	1160.75	5539310.67	660701.86	2193.8	
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T17	250-31-18	2023.49	5540011.90	661467.14	2329.0	North End
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T14	248-38-36	2187.95	5540689.38	661380.90	2296.1	
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T15	248-16-46	2043.83	5540850.79	661546.71	2279.9	South End
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T16	247-00-08	2206.19	5540352.67	661414.33	2277.9	South end
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T23	231-33-24	2813.15	5539865.52	661241.84	2182.7	South End
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T21	239-09-43	2506.96	5539929.87	661290.66	2231.7	South End
	Peak						
	Little 2	47-08-56		5541214.57	663445.17	2287.8	
	80-T13	245-31-20	2209.88	5540298.94	661433.96	2272.9	South End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T18	76-02-49	1938.28	5540216.43	661250.78	2332.7	East End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T17	77-49-45	2012.96	5540301.38	661241.84	2358.9	East End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T29	78-45-40	1909.54	5540176.42	661249.09	2321.7	East End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T28	71-53-13	1796.20	5540118.61	661115.85	2259.1	East End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T25	35-00-32	1566.95	5539866.20	661173.14	2207.0	South End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T27	19-27-06	1539.15	5539696.86	660973.06	2135.4	South End
	103						
	Peak	339-43-41		5538446.10	660460.84	2481.1	
	80-T30	37-38-26	1484.57	5539431.48	661220.89	2180.1	South End

PIC

DRILL HOLES

NUMBER	BEARING	DISTANCE	NORTHING	EASTING	ELEVATION
103					
Peak	339-43-41				
DH-105	18-33-06	2760.38	5540589.03	661179.99	2388.7
103					
Peak	339-43-41				
DH-103	24-21-54	1704.70	5539998.11	661164.81	2249.0
103					
Peak	339-43-41				
DH-102	20-51-52	1310.68	5539593.93	661093.58	2175.3
103					
Peak	339-43-41				
DH-104	14-08-47	1856.82	5540247.15	660912.51	2214.2
Peak					
RD-E1	14-50-02				
DH-101	200-08-02	635.22	5539848.46	660809.06	2086.4
Peak					
RD-E2	18-07-23				
RDBH106A	30-11-32	376.902	5541175.47	661409.62	2376.8
RDBH106	225-40-21	218.28	5540927.65	661251.17	2388.1

LEGEND

- • — PLANT 6"NAIL
- X — PLANT 12"SPIKE
- ▲ — CONTROL POINT OF NETWORK
- ⊙ — DRILL HOLE
- △ — PHOTOGRAMETRIC POINT

ALL DISTANCES HAVE BEEN REDUCED TO U.T.M. PLANE AND ARE IN METRES AND DECIMALS THEREOF.
ALL BEARINGS ARE REFERRED TO 117° W
SURVEY PERFORMED BY Sheltech, 1980

397 K-Skihi-Ewin Pass 81(2)A

Sheltech Canada

Crows Nest Resources Limited
ENGINEERING

EWIN PASS
S.E.B.C.

TRAVERSE SURVEY MAP

100 0 100 200 300 400 metres
Scale 1:5000

appendix 25

AUTHOR: Sheltech	SCALE: 1:5000	ENCLOSURE No:
DATE: 81 02 26	REVISED:	DRAWING No: HI-62D
To Accompany		

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