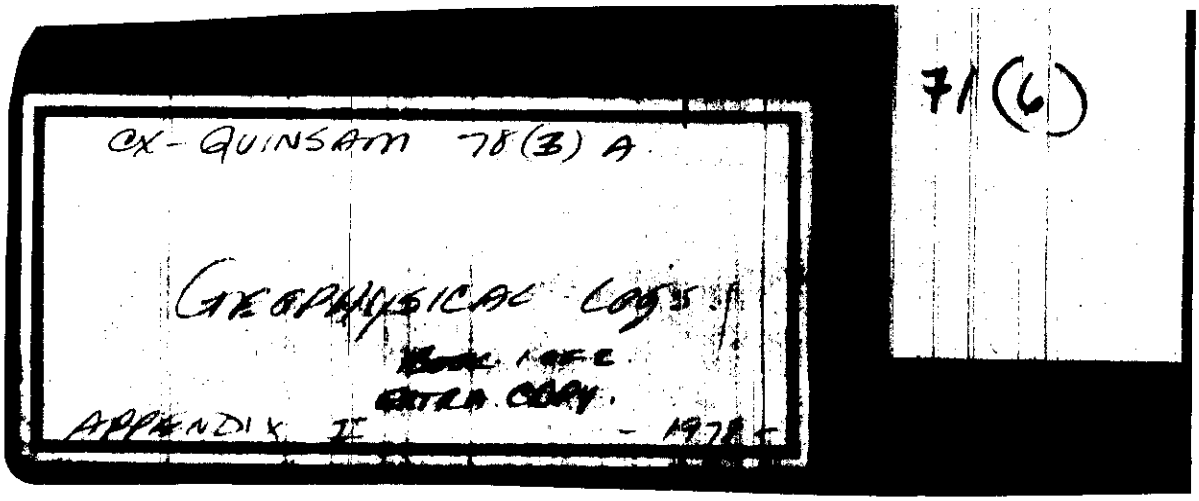


000 71 (6)

M QU-78-7

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE DRILLHOLE QU-78-7

LOCATION 92+50 2000 LT SEC. TP. RGE. W.

AREA QUINSAM

PROVINCE B.C.

71 (L1)

SURVEYED DATA

ELEV. 1123'

LOC. 92+78 1992' Lt.

RUN No.	1	2	3
DATE	13 FEB 78		
DEPTH-DRILLER	160		
DEPTH-LOGGER	156		
FLUID LEVEL	6		
LOGGING TIME	0.5HR		
DRILLED BY	H. Vincett		
RECORDED BY	U. Kranzberg		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 1/4	0	20	5	0	20
4	20	70			

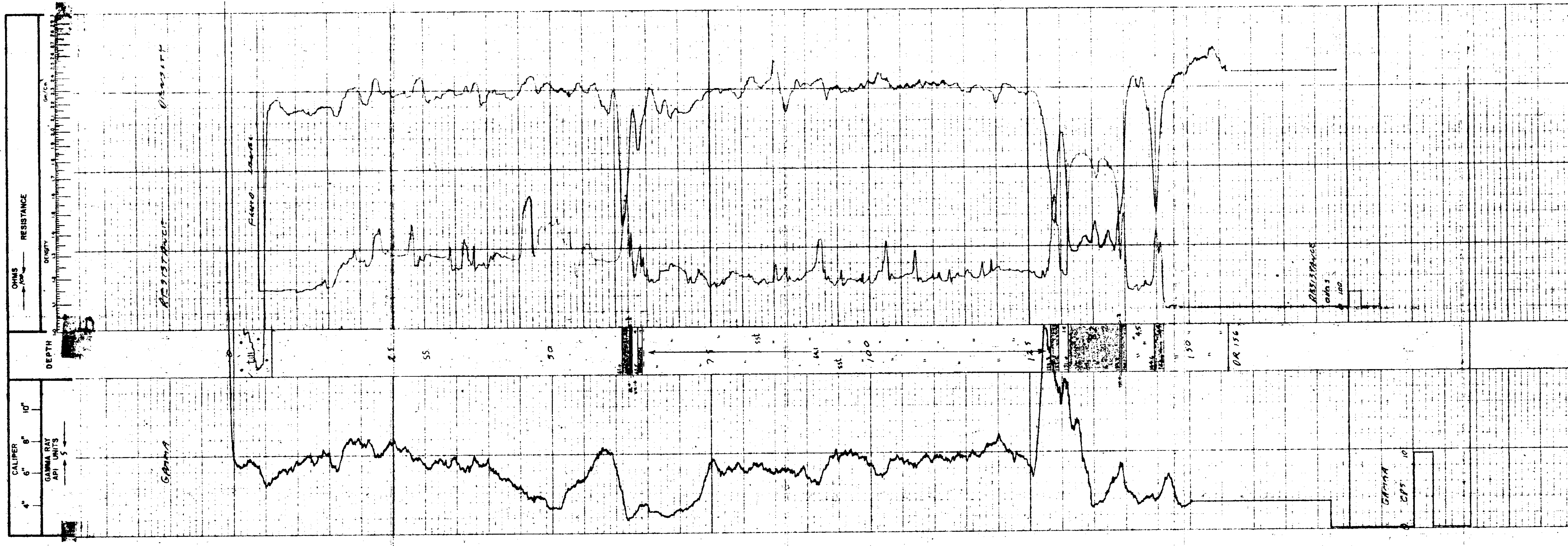
EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-105	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100 Ω /div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	156	0	12	4	100		5	1	1K	3R

REMARKS:



M QU-78-6-C

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE CORE HOLE QU-78-6-C

LOCATION 90+00 2250 FT SEC TP RGE W

AREA QUINSAM 71 (L2)

PROVINCE B.C.

SURVEYED DATA

ELEV. 1125'

LOC. 90+04 2251' Lt

RUN No.	1	2	3
DATE	14 FEB 78		
DEPTH-DRILLER	120		
DEPTH-LOGGER	119		
FLUID LEVEL	17		
LOGGING TIME	0.5 HR		
DRILLED BY	R. LOGAN		
RECORDED BY	V. KARAGEAS		
WITNESSED BY	S. GAMONDA		

BORE-HOLE RECORD

BIT	FROM	TO
8 1/4	0	18
6 7/8	18	TD

CASING RECORD SIZE	FROM	TO
7	0	18

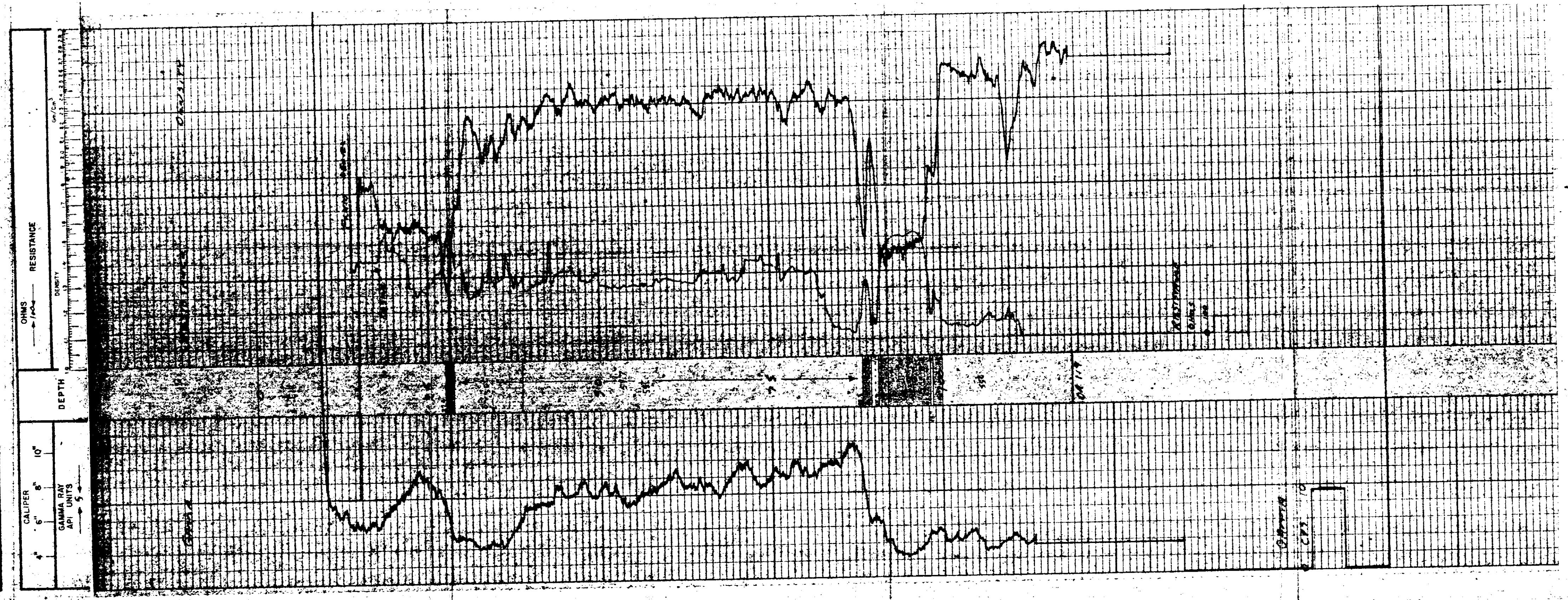
EQUIPMENT DATA

GAMMA RAY		RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-105	L-105	L-103	
DIAMETER	2 1/8"	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE ME	F	
TYPE	SCINT	SPACING	13"	
LENGTH	3"	LENGTH 1"		
GENERAL		HOR SCALE 100 ohm		
TRUCK No.	2	SOURCE MODEL	HOVP	
LOCATION	CAMPBELL RIVER	ISOTOPE	CS-137	
		STRENGTH	125 mC	

LOGGING DATA

RUN No.	GENERAL DEPTHS FROM	TO	SPEED Ft/min	GAMMA RAY T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV	DENSITY T C SEC.	SENS SETTINGS	ZERO
1	119	0	12	4	100		5	1	1K	

REMARKS



M

QU-78-5

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Drillhole QU-78-5

LOCATION 92+50 1500 LT SEC TP RGE W

AREA Quinsam

PROVINCE B.C.

71 (L3)

SURVEYED DATA

ELEV. 1117'

LOC. 92+502 1482 Lt.

RUN No.	1	2	3
DATE	13 FEB 78		
DEPTH-DRILLER	220		
DEPTH-LOGGER	217		
FLUID LEVEL	10		
LOGGING TIME	[illegible]		
DRILLED BY	H. Vaugatt		
RECORDED BY	V. Krebera		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4	0	13	5	0	13
4	13	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	1 ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		

GENERAL					
		HOR. SCALE	100 ohm		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	217	0	12	4	100		5	1	1K	4R

REMARKS

M QU-78-3

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE DRILL HOLE QU-78-3 92+50

LOCATION 2500 Lt SEC TP RGE W

AREA QUINSAM

PROVINCE B C

71 L4

SURVEYED DATA

ELEV. 1096'

LOC. 92+50 S1 2515' Lt.

RUN No.	1	2	3
DATE	13 FEB 78		
DEPTH - DRILLER	100		
DEPTH - LOGGER	88		
FLUID LEVEL	12.5		
LOGGING TIME	0.5 HR		
DRILLED BY	H. VINCENT		
RECORDED BY	V. MAURERA		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD

BIT	FROM	TO
6 3/4	0	32
4	32	TD

CASING RECORD

SIZE	FROM	TO
5	0	32

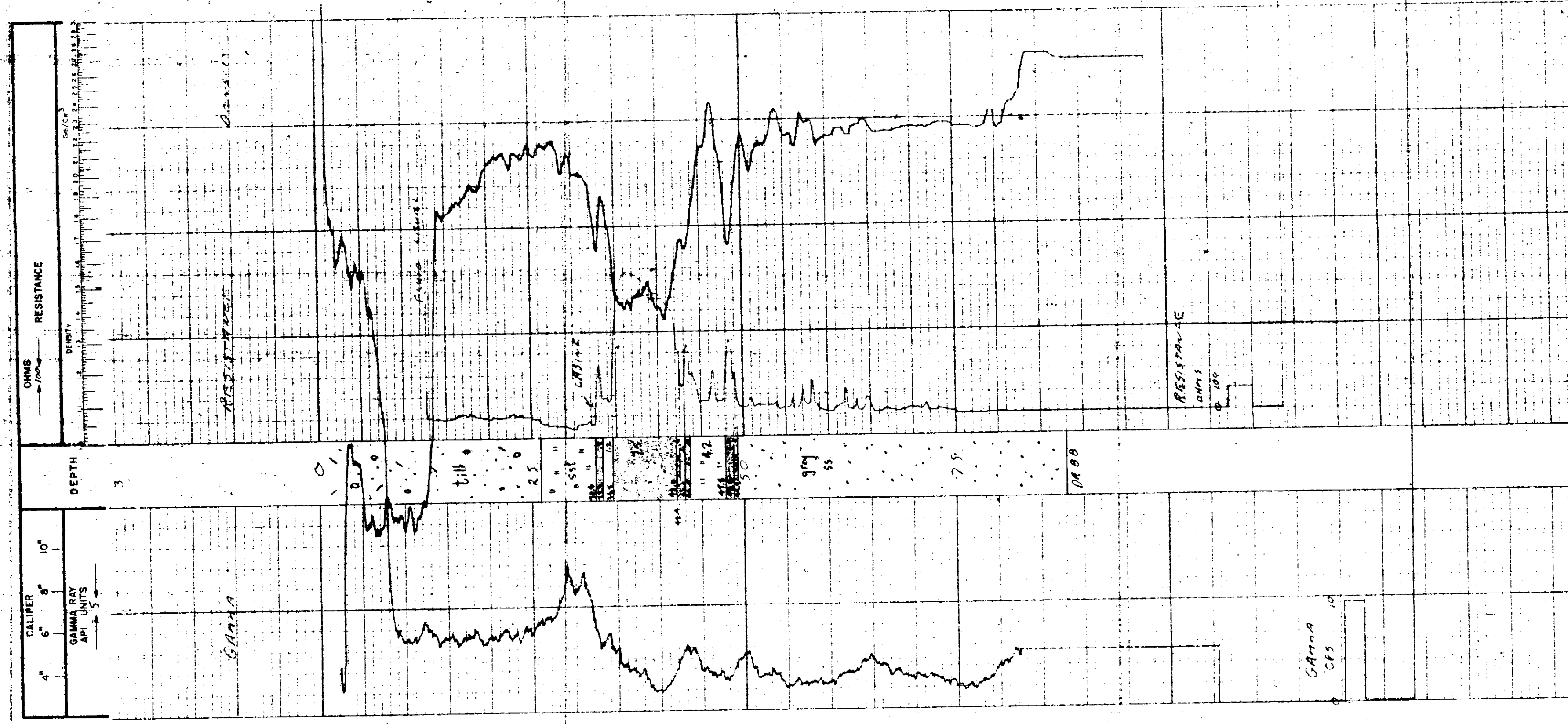
EQUIPMENT DATA

GAMMA RAY		RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	L-103	L-103	
DIAMETER	2 1/8"	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		15"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR SCALE	100'/in		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	CAMPBELL RIVER	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	GAMMA RAY T C SEC	GAMMA RAY SENS SETTING	GAMMA RAY ZERO	GAMMA RAY API UNITS PER DIV.	DENSITY T C SEC	DENSITY SENS SETTINGS	DENSITY ZERO
1	88	0	12	4	100		5	1	1M	1R

REMARKS



M QU-78-2

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE: Drillhole QU-78-2
LOCATION: 87+50 1500 Lt   SEC   TP   RGE   W
AREA: Quinsam
PROVINCE: B.C.

71 (L5)

SURVEYED DATA
ELEV. 1131'
LOC. Line 87+50
1486' Lt. of B/L

RUN No.	1	2	3
DATE	11 FEB 78		
DEPTH-DRILLER	240		
DEPTH-LOGGER	237		
FLUID LEVEL	3		
LOGGING TIME	3/4 HR		
DRILLED BY	H. Vincett		
RECORDED BY	V. Krueger		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4	0	10	5	0	10
4	10	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100Ω/div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	[illegible]	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	237	0	12	[illegible]	100		10	1	4R	4R

REMARKS:

M

QU-78-4-C

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Corehole QU-78-4-C

LOCATION 85+00 2250 LT SEC. TP. RGE W

AREA Quinsam

PROVINCE B.C.

71 (L6)

SURVEYED DATA

ELEV. 1102'

LOC. 84+86 2251' Lt

RUN No.	1	2	3
DATE	13 FEB 78		
DEPTH-DRILLER	93		
DEPTH-LOGGER	91		
FLUID LEVEL	Full		
LOGGING TIME	0.5 HR		
DRILLED BY	[illegible]		
RECORDED BY	[illegible]		
WITNESSED BY	[illegible]		

BORE-HOLE RECORD / CASING RECORD

BIT	FROM	TO	SIZE	FROM	TO
[illegible]	0	8	7	0	8
[illegible]	8	78			

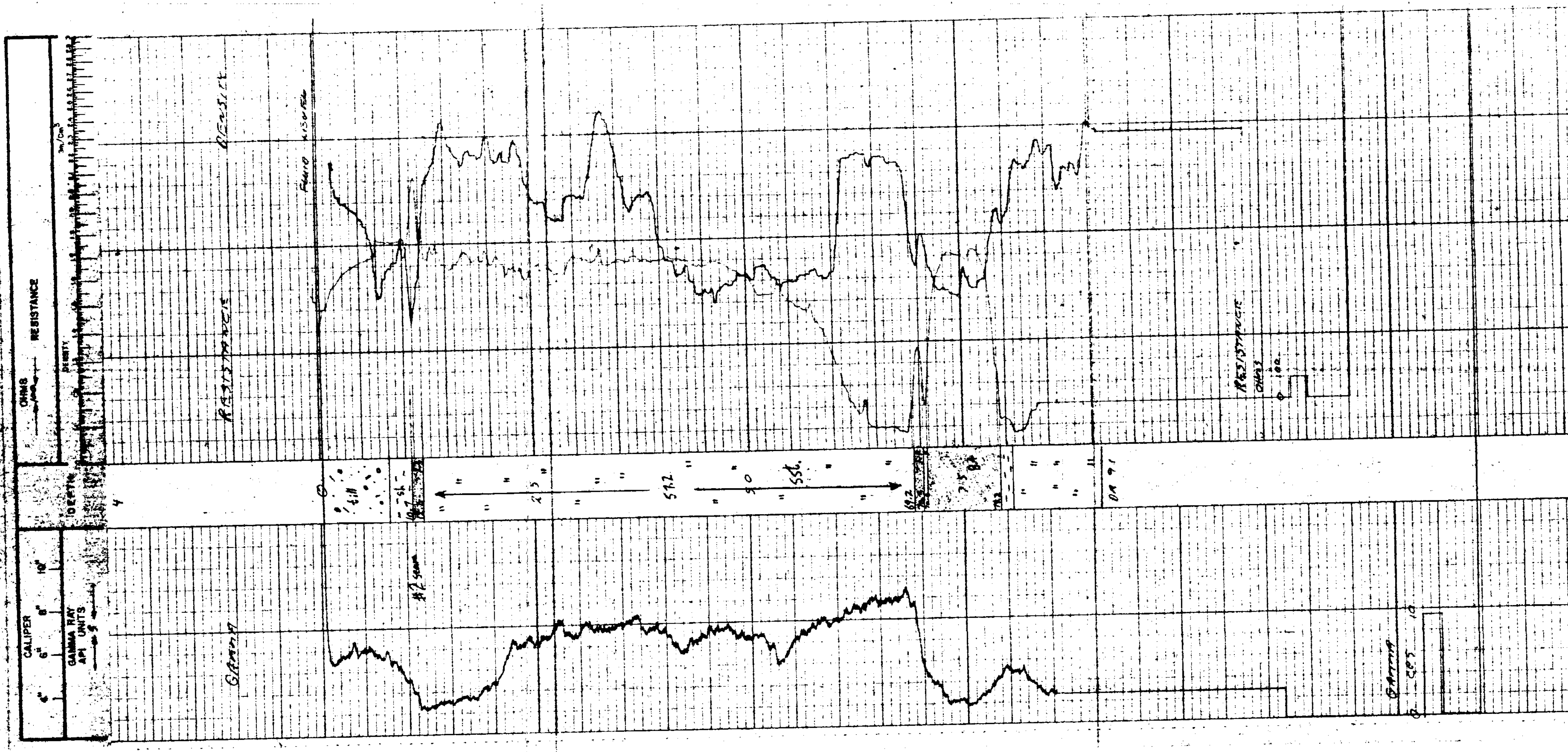
EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8	DIAMETER	2 1/8	2 1/8	
DETECTOR MODEL No.	GP-818	TYPE	NE	E	
TYPE	SCINT	SPACING		18"	
LENGTH	3"	LENGTH			
GENERAL		HOR. SCALE	[illegible]		
[illegible]		SOURCE MODEL		MOVP	
LOCATION	[illegible]	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	GAMMA RAY SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	DENSITY SENS SETTINGS	ZERO
1	91	0	12	4	100		5	1	1N	34

REMARKS:



M QU-78-1-C

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON ALBERTA

HOLE Coreholes QU-78-1-C

LOCATION 80+00 / 20+0 ... SEC TP RGE W

AREA Quinsam

PROVINCE B.C.

71 (L7)

SURVEYED DATA

ELEV. 1138'

LOC. Line 80+22

1982' Lt of BL

RUN No.	1	2	3
DATE	11 FEB 78		
DEPTH-DRILLER	171		
DEPTH-LOGGER	168		
FLUID LEVEL	1.5		
LOGGING TIME	3/4 HR		
DRILLED BY	A. Loomis		
RECORDED BY	V. Hanson		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
3 7/8	0	10		0	10
2 7/8	10	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-105	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	SE	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	33.3 ohm		
TRUCK No.	2	SOURCE MODEL		HOFF	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T.C. SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T.C. SEC.	SENS SETTINGS	ZERO
1	168	0	12		100		10	1	1K	4R

REMARKS: Resistance zero shift at 45 Ft.

QU-78-8

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE Drillhole QU-78-8	SURVEYED DATA
LOCATION 87+50 2000 Lt SEC. TP. RGE. W.	ELEV. 1132
AREA Quinsam **71** (L8)	LOC. 87+55 1955' Lt
PROVINCE B.C.	

RUN No.	1	2	3
DATE	17 Feb 78		
DEPTH-DRILLER	161		
DEPTH-LOGGER	161		
FLUID LEVEL	70.5		
LOGGING TIME	0.5 HR		
DRILLED BY	[illegible]		
RECORDED BY	[illegible]		
WITNESSED BY	[illegible]		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-105	TOOL MODEL No.	L-105	L-105	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CF-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100 ohm [illegible]		
TRUCK No.	2	SOURCE MODEL		ROVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T.C. SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T.C. SEC.	SENS SETTINGS	ZERO
1	161	0	12	4	100		5	1	1K	3K

REMARKS:

Driller did not fill hole with water

Qu-78-9-C

M

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Corehole Qu-78-9-C 90+00

LOCATION 1750 Lt SEC. TP. RGE. W.

AREA Quinsam 71 (L9)

PROVINCE B.C.

SURVEYED DATA

ELEV. 1125

LOC. 90+05 1735' Lt.

RUN No.	1	2	3
DATE	15 FEB 78		
DEPTH-DRILLER			
DEPTH-LOGGER	180		
FLUID LEVEL	5.5		
LOGGING TIME	0.5 HR		
DRILLED BY	A. Loomen		
RECORDED BY	V. Newmeer		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
8 1/8	0	8	7	0	8
6 3/8	8	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR SCALE	100 Ω/10 div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T C SEC	SENS SETTING	ZERO	API UNITS PER DIV	T C SEC	SENS SETTINGS	ZERO
1	180	0	12	4	.100		5	1	1K	5T

REMARKS:

QU-78-10

M

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE: DRILLHOLE QU-78-10	**SURVEYED DATA**
LOCATION: 107+50 1500 Lt SEC TP RGE W	ELEV. 1059'
AREA: Quinsam (71)	LOC. 108+15 1495' Lt.
PROVINCE: B.C. (L10)	

RUN No.	1	2	3
DATE	16 Feb 78		
DEPTH-DRILLER	120		
DEPTH-LOGGER	120		
FLUID LEVEL	2.5		
LOGGING TIME	0.5 HR		
DRILLED BY	J. Caswau		
RECORDED BY	V. Kanbear		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4	0	20	5	0	20
4	20	TD			

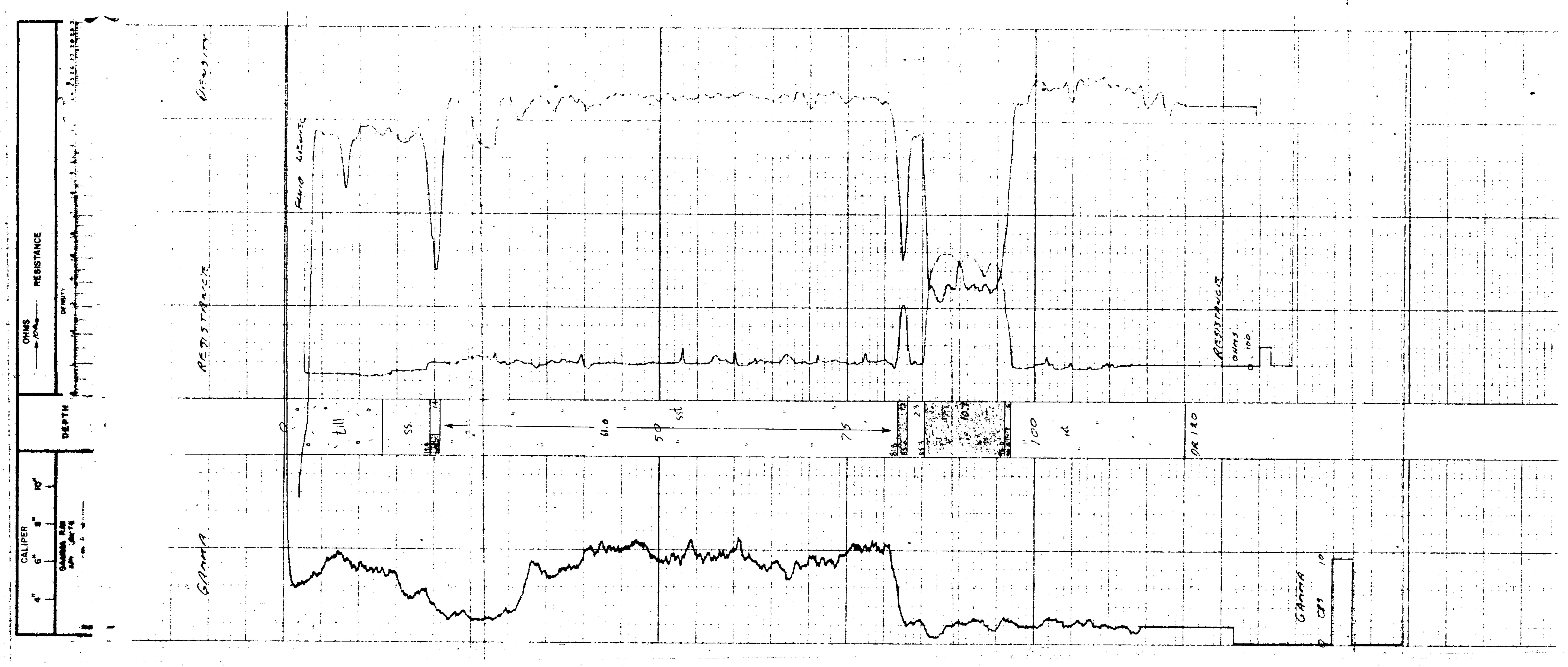
EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100 Ω/10 in		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	120	0	12	4	100		5	1	1K	3R

REMARKS:



QU-78-11

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE: DRILLHOLE QU-78-11
LOCATION: 97+30 1750 LT SEC. TP. RGE. W
AREA: QUINSAM
PROVINCE: B.C.

71 (L11)

SURVEYED DATA
ELEV. 110'
LOC. 97+45 1751' Lt.

RUN No.	1	2	3
DATE	16 FEB 78		
DEPTH-DRILLER	180		
DEPTH-LOGGER	175		
FLUID LEVEL	20.5		
LOGGING TIME	0.5 HR		
DRILLED BY	H. VINCENT		
RECORDED BY	V. MACGREGOR		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4	0	20	5	0	20
4	20	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	no scale		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	CAMPBELL RIVER	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	175	0	12	4	100		5	1	1N	3R

REMARKS:

QU-78-12

M

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE Drillhole QU-78-12

LOCATION 97+50 1250 LT SEC TP. RGE W.

AREA Quinsam

PROVINCE B.C.

71 (L12)

SURVEYED DATA

ELEV. 1105.3'

LOC. 97+44 1260' Lt

RUN No.	1	2	3
DATE	17 FEB 78		
DEPTH-DRILLER	220		
DEPTH-LOGGER	218		
FLUID LEVEL	59		
LOGGING TIME	0.5 HR		
DRILLED BY	[illegible]		
RECORDED BY	[illegible]		
WITNESSED BY	[illegible]		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4	0	20	5	0	20
3	20	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-105	TOOL MODEL No.	L-105	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-816	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	5"	LENGTH	5'		
GENERAL		HOR. SCALE	[illegible]		
TRUCK No.	6	SOURCE MODEL		NOVP	
LOCATION	[illegible]	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	218	0	12	4	100		5	1	1K	44

REMARKS:

QU-78-13-C

M

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE Coreholе QU-78-13-C

LOCATION 95+50 1250 Lt SEC TP RGE W

AREA Quinsam

PROVINCE B.C.

71 (L13)

SURVEYED DATA

ELEV. 1104

LOC. 95+02 1252' Lt.

RUN No.	1	2	3
DATE	17 Feb 78		
DEPTH-DRILLER	221		
DEPTH-LOGGER	218		
FLUID LEVEL	52		
LOGGING TIME	0.5 HR		
DRILLED BY	R. Lodoba		
RECORDED BY	V. Newbear		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
8 3/4	0	20	7	0	20
6	20	TD			

EQUIPMENT DATA

GAMMA RAY	
TOOL MODEL No.	L-103
DIAMETER	2 1/8"
DETECTOR MODEL No.	CP-516
TYPE	SCINT
LENGTH	3"

	RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	2 1/8"	
TYPE	ME	F	
SPACING		13"	
LENGTH	1"		
HOR. SCALE	100 Ω/DIV		
SOURCE MODEL		HOVP	
ISOTOPE		CS-137	
STRENGTH		125 mC	

GENERAL	
TRUCK No.	2
LOCATION	Campbell River

LOGGING DATA

RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	GAMMA RAY T C SEC.	GAMMA RAY SENS SETTING	GAMMA RAY ZERO	API UNITS PER DIV.	DENSITY T C SEC	DENSITY SENS SETTINGS	DENSITY ZERO
1	218	0	12	4	100		5	1	1K	4R

REMARKS:

M 9U-78-14.

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE DRILLHOLE 94-78-14

LOCATION 97+50 750' LT SEC. TP. RGE. W

AREA Quinsam

PROVINCE B.C.

SURVEYED DATA

ELEV. 10[illegible]' 1075'

LOC. 97+46 756' LL.

71 (L14)

RUN No.	1	2	3
DATE	18 FEB 78		
DEPTH-DRILLER	240		
DEPTH-LOGGER	239		
FLUID LEVEL	18		
LOGGING TIME	0.5 HR		
DRILLED BY	[illegible]		
RECORDED BY	V. [illegible]		
WITNESSED BY	S. [illegible]		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4	0	10	5	0	10
4	10	TD			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1		
GENERAL		HOR. SCALE	[illegible]		
TRUCK No.	8	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	239	0	12	4	100		5	1	1K	4R

REMARKS:

M QU-78-24

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE	DRILLHOLE QU-78-24
LOCATION	82+50 32+50 LT SEC TP RGE W
AREA	Quinsam 71 (45)
PROVINCE	B.C.
SURVEYED DATA	ELEV. 1121
LOC.	82+48 - 2256 LT

RUN No	1	2	3
DATE	MARCH 9/78		
DEPTH-DRILLER	140		
DEPTH-LOGGER	136		
FLUID LEVEL	26.6		
LOGGING TIME	[illegible]		
DRILLED BY	H. VINCER		
RECORDED BY	D. DUNBAR		
WITNESSED BY	S. GARDNER		

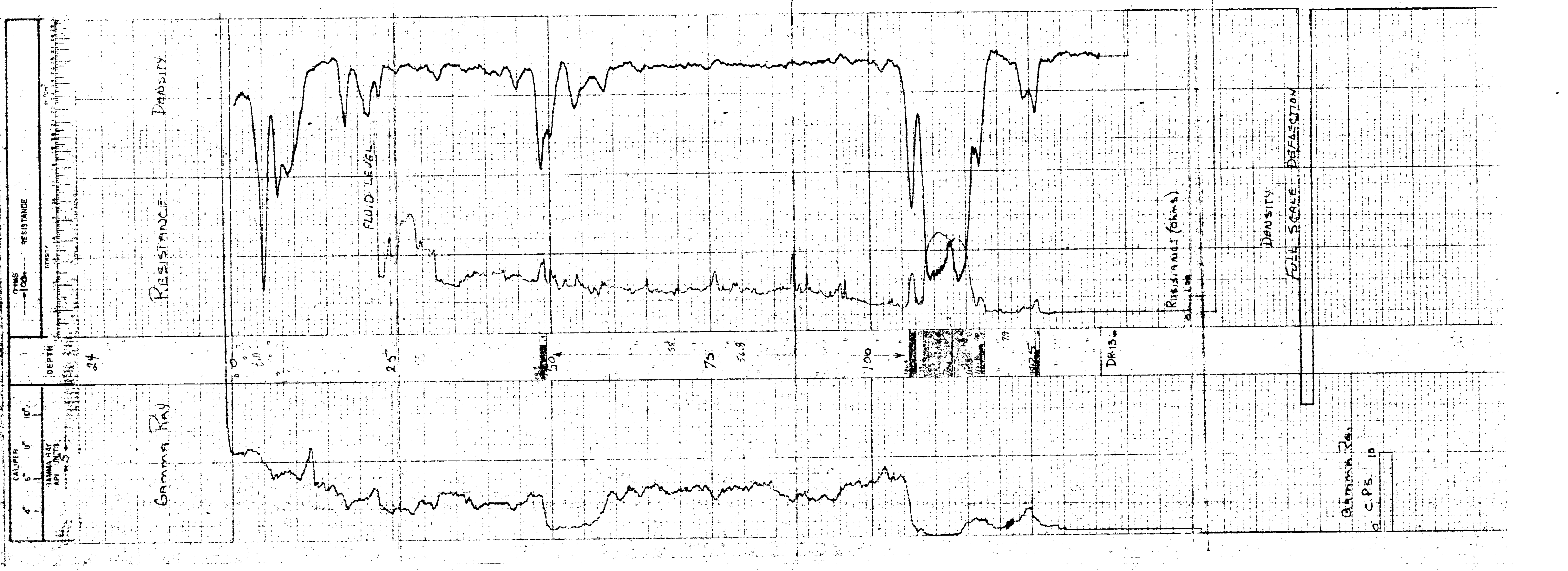
BORE-HOLE RECORD: BIT	FROM	TO	CASING RECORD: SIZE	FROM	TO
4 3/4"	SURF	21'	5½"	0	21 FEET
3 3/4"	21'	T.D.			

EQUIPMENT DATA: GAMMA RAY		RESISTANCE	DENSITY	CALIPER
TOOL MODEL No	L-103	L-103	L-103	
DIAMETER	2 7/8"	2 7/8"	2 7/8"	
DETECTOR MODEL No	CF-616			
TYPE	SCINT	NE	F	
LENGTH	3"			
SPACING			13"	
HOR. SCALE		100 ΩH		
SOURCE MODEL			NOVP	
ISOTOPE			CS-137	
STRENGTH			125 mC	
TRUCK No	2			
LOCATION	CAMPBELL RIVER			

LOGGING DATA

RUN No	DEPTHS FROM	DEPTHS TO	SPEED FT/MIN	GAMMA RAY T.C. SEC	SENS SETTING	ZERO	API UNITS PER DIV	DENSITY T.C. SEC	SENS SETTINGS	ZERO
1	136	0	12	4	100		5	1	1K	

REMARKS:



QU-78-15

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Drillhole QU-78-15   SURVEYED DATA

LOCATION 95+00 2500 LT SEC TP RGE W   ELEV. 1083'

AREA Quinsam   71 (L16)   LOC. 94+95 2520 LL

PROVINCE B.C.

RUN No.	1	2	3
DATE	18 Mar 78		
DEPTH-DRILLER	60		
DEPTH-LOGGER	56		
FLUID LEVEL	0 Full		
LOGGING TIME	9:3 PM		
DRILLED BY	H. Vincent		
RECORDED BY	V. Hencoff		
WITNESSED BY	S. Edmond		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
4 7/8	0	15	5	0	15
	15	56			

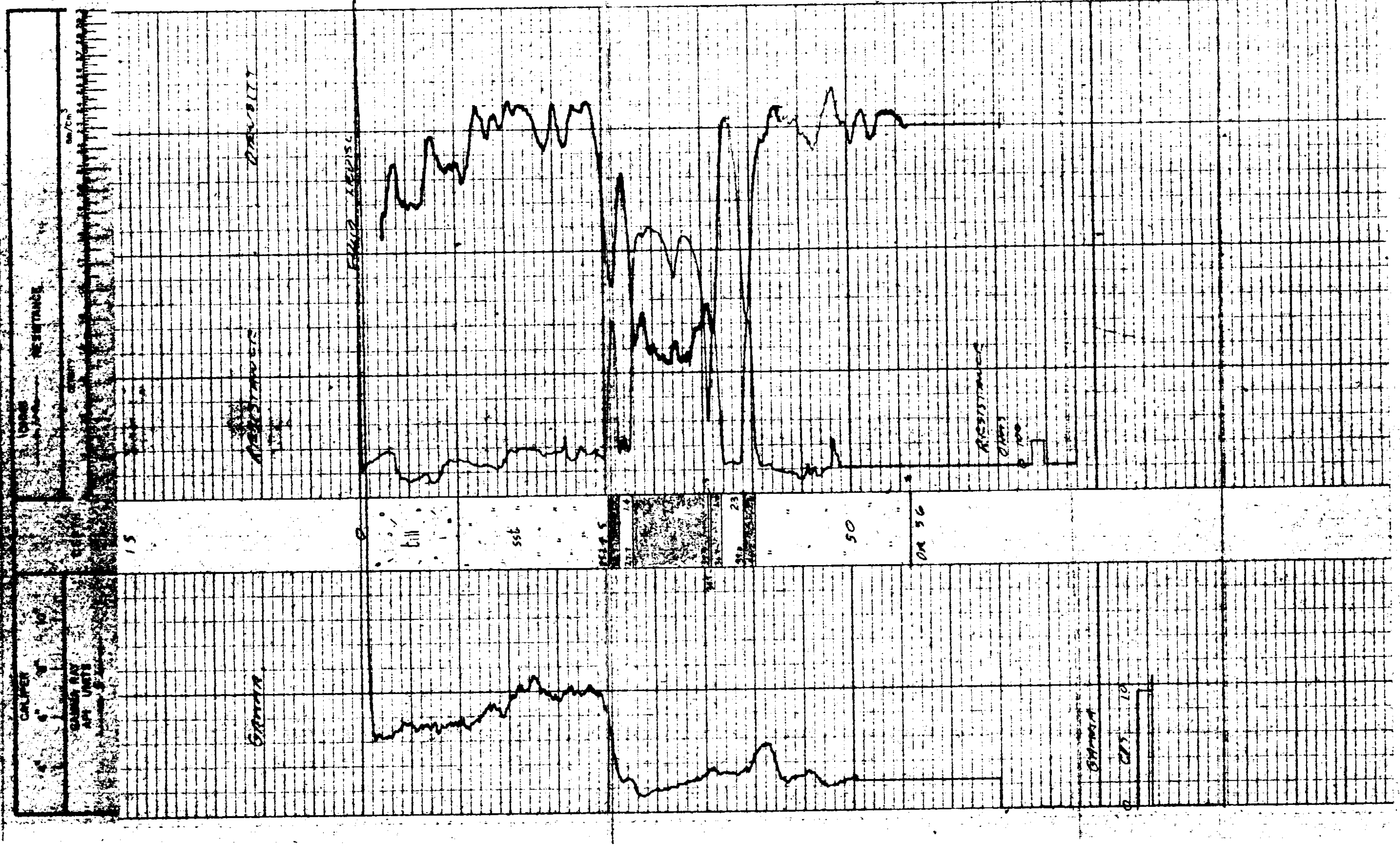
EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-105	TOOL MODEL No.	L-108	L-108	
DIAMETER	2 7/8	DIAMETER	2 3/4"	2 1/4"	
DETECTOR MODEL No.	OP-316	TYPE	SE		
TYPE	SCINT	SPACING		15"	
LENGTH	5	LENGTH	1		
GENERAL		HOR. SCALE	[illegible]		
TRUCK No.	4	SOURCE MODEL		NOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T.C. SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T.C. SEC.	SENS SETTINGS	ZERO
1	56	0	12	4	100		5	1	1K	44

REMARKS:



M

Qu-78-16-C

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Consmosr Qu-78-16-C

LOCATION 78-22 SEC TP RGE W

AREA Quinsam

PROVINCE B.C.

SURVEYED DATA

ELEV. 1475

CO. 95-25 -1047

71 (L17)

RUN No.	1	2	3
DATE	19 JAN 79		
DEPTH-DRILLER	222		
DEPTH-LOGGER	236		
FLUID LEVEL	9		
LOGGING TIME	0.5 HR		
DRILLED BY	[illegible]		
RECORDED BY	[illegible]		
WITNESSED BY	[illegible]		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
8 7/8	0	17	7	0	17
6	17	2?			

EQUIPMENT DATA

GAMMA RAY	
TOOL MODEL No.	L-103
DIAMETER	2 1/8
DETECTOR MODEL No.	ZP-516
TYPE	SCINT
LENGTH	3

	RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	C-103	
DIAMETER	2 1/8	2 1/8	
TYPE	ME	F	
SPACING		13	
LENGTH			
HOR. SCALE	[illegible]		
SOURCE MODEL		HOVP	
ISOTOPE		CS-137	
STRENGTH		125 mC	

GENERAL	
TRUCK No.	2
LOCATION	Campbell River

LOGGING DATA

GENERAL				GAMMA RAY					DENSITY		
RUN No	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T.C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T.C SEC	SENS SETTINGS	ZERO
1	236	0	12	4	108		5	1	112	42

REMARKS

GU-28-18

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE: [illegible] GU-28-18
LOCATION: 97+50 [illegible] SEC TP RGE W
AREA: [illegible]
PROVINCE: BC

71 (L18)

SURVEYED DATA
ELEV. 1091
LOC. 97+50 2259 [illegible]

RUN No.	1	2	3
DATE	19 FEB 78		
DEPTH-DRILLER	100		
DEPTH-LOGGER	97		
FLUID LEVEL	0.3		
LOGGING TIME	0.3 HR		
LOGGED BY	[illegible]		
RECORDED BY	[illegible]		
WITNESSED BY	[illegible]		

BORE HOLE RECORD / CASING RECORD

BIT SIZE	FROM	TO	SIZE	FROM	TO
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

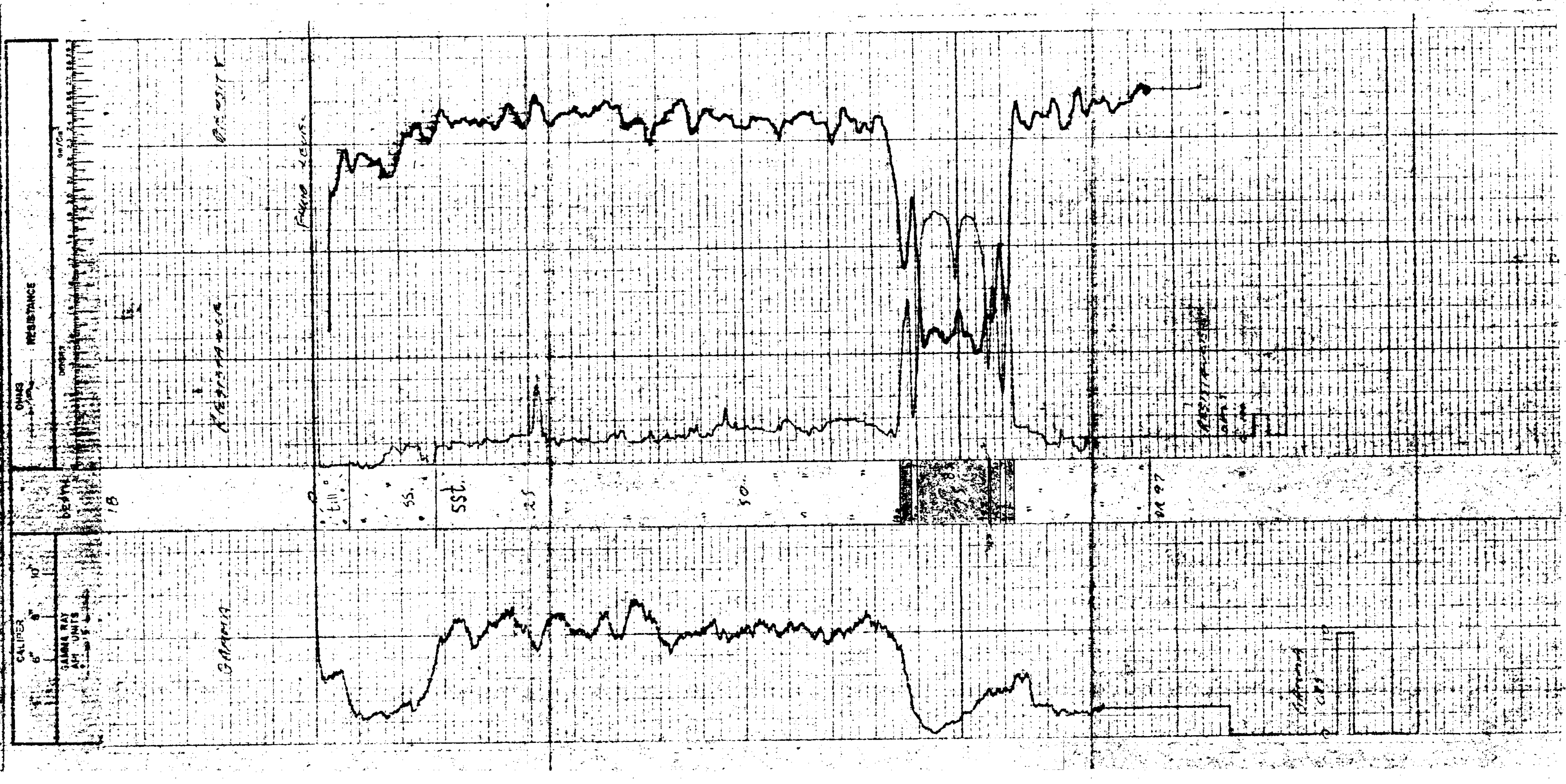
EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	[illegible]	TOOL MODEL No.	L-103	L-106	
DIAMETER	2 1/8	DIAMETER	2 1/2"	[illegible]	
DETECTOR MODEL No.	CP-516	TYPE	[illegible]	F	
TYPE	SCINT	SPACING		18	
LENGTH	[illegible]	LENGTH	1		
GENERAL		HOR. SCALE	[illegible]		
TRUCK No.	[illegible]	SOURCE MODEL		NCVP	
LOCATION	[illegible]	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	GAMMA RAY T.C. SEC.	GAMMA RAY SENS SETTING	GAMMA RAY ZERO	GAMMA RAY API UNITS PER DIV	DENSITY T.C. SEC.	DENSITY SENS SETTINGS	DENSITY ZERO
1	97	0	12	4	120		5	1	15	[illegible]

REMARKS:



M QU-78-19

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE DRILLHOLE - QU-78-19 — SURVEYED DATA

LOCATION 87+50 2500 LT SEC TP RGE W — ELEV. 1083'

AREA QUINSAM 71 (L19) — LOC. 87+56 749'LT

PROVINCE B.C.

RUN No.	1	2	3
DATE	Feb 28/78		
DEPTH-DRILLER	60		
DEPTH-LOGGER	59		
FLUID LEVEL	5'		
LOGGING TIME	5hr		
DRILLED BY	H. VINCENT		
RECORDED BY	D. DUNBAR		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD

BIT	FROM	TO
6¾"	0	10'
4½"	10'	T.D.

CASING RECORD

SIZE	FROM	TO
5"	0	10'

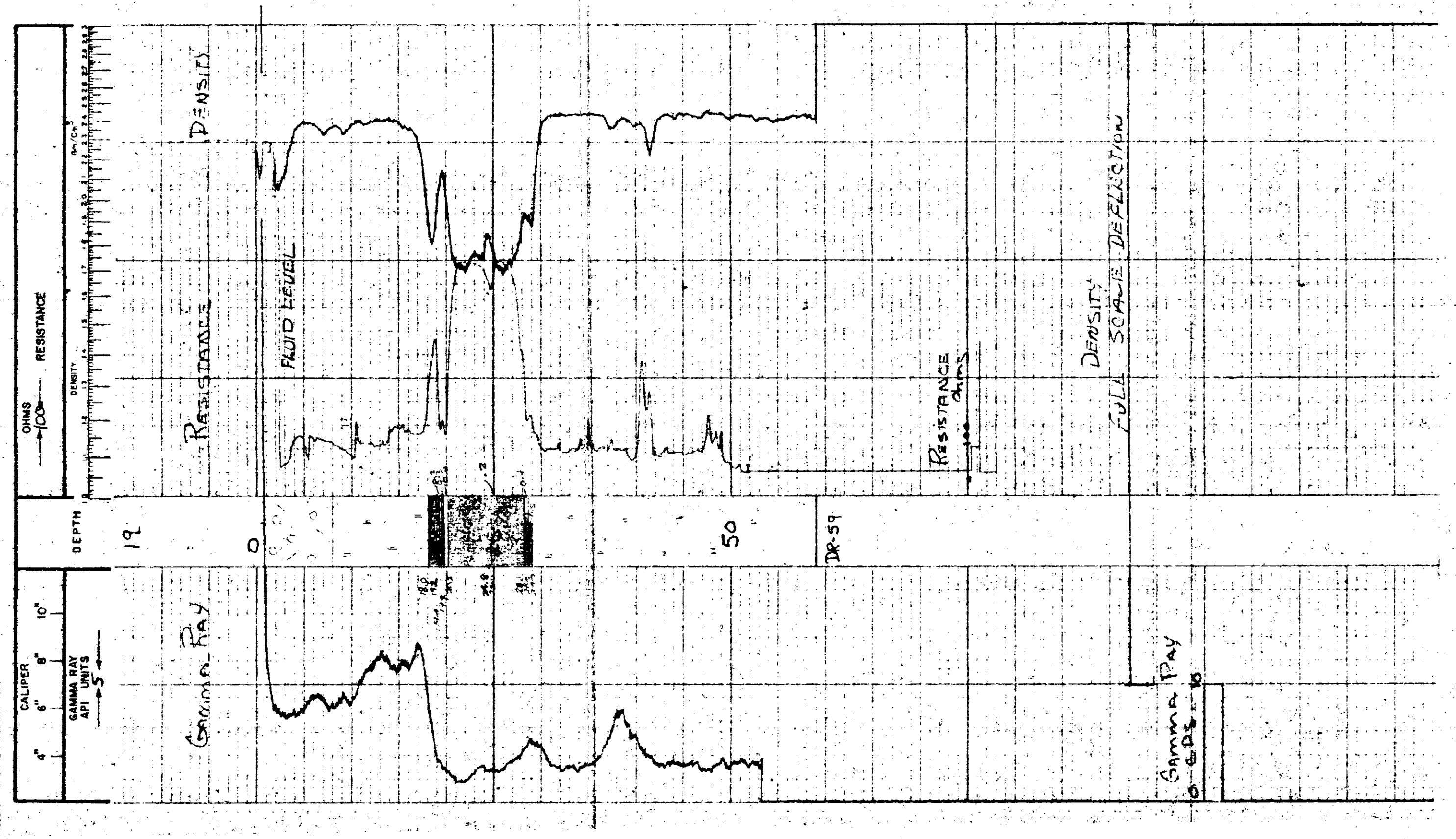
EQUIPMENT DATA

GAMMA RAY		RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	L-103	L-103	
DIAMETER	2 1/8"	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100'/div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	CAMPBELL RIVER	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	GAMMA RAY T C SEC.	GAMMA RAY SENS SETTING	GAMMA RAY ZERO	GAMMA RAY API UNITS PER DIV.	DENSITY T C SEC.	DENSITY SENS SETTINGS	DENSITY ZERO
1	59'	0	12	4	100		5	1	1K	56

REMARKS:



M QU-78-19

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE DRILLHOLE - QU-78-19

LOCATION 87+50 S 500 LT SEC TP RGE W

AREA QUINSAM

PROVINCE B.C.

71

SURVEYED DATA

ELEV. 1083'

LOC. 87+56 249½'LT

RUN No.	1	2	3
DATE	Feb. 28/78		
DEPTH-DRILLER	60		
DEPTH-LOGGER	59		
FLUID LEVEL	5		
LOGGING TIME	5hr		
DRILLED BY	H. VINCETI		
RECORDED BY	D. DUNBAR		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD

BIT	FROM	TO
6¾"	0	10'
4½"	10'	T.D.

CASING RECORD

SIZE	FROM	TO
5"	0	10'

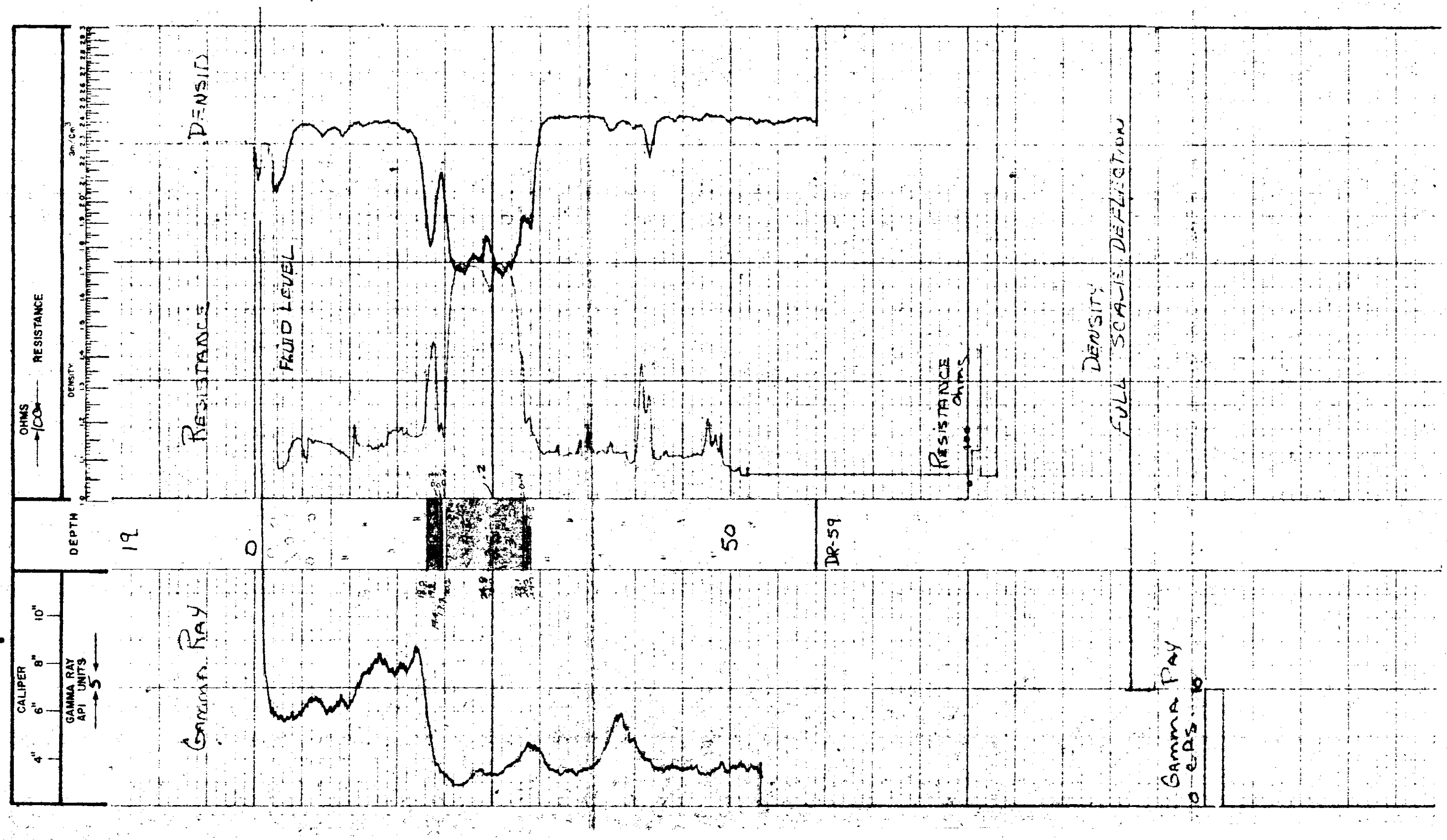
EQUIPMENT DATA

GAMMA RAY		RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 7/8"
DETECTOR MODEL No.	CP-516	TYPE	ME	F
TYPE	SCINT	SPACING		13"
LENGTH	3"	LENGTH	1"	
GENERAL		HOR. SCALE	400'/in	
TRUCK No	2	SOURCE MODEL		HOVP
LOCATION	CAMPBELL RIVER	ISOTOPE		CS-137
		STRENGTH		125 mC

LOGGING DATA

GENERAL RUN No	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	GAMMA RAY T C SEC.	GAMMA RAY SENS SETTING	GAMMA RAY ZERO	GAMMA RAY API UNITS PER DIV.	DENSITY T C SEC	DENSITY SENS SETTINGS	DENSITY ZERO
1	59'	0	12	4	100		5	1	1R	SL

REMARKS:



M

QU-78-20

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE: DRILLHOLE - QU-78-20
LOCATION: 77+50 1250 LT SEC TP RGE W
AREA: QUINSAM
PROVINCE: B.C.

(L21) 71

SURVEYED DATA
ELEV. 1104'
LOC. 77+47 1253 LT

RUN No.	1	2	3
DATE	March 1/78		
DEPTH-DRILLER	240'		
DEPTH-LOGGER	237'		
FLUID LEVEL	23'		
LOGGING TIME	.5 hr.		
DRILLED BY	H. Vincett		
RECORDED BY	D. Dunbar		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4"	0	20'	5"	0	20'
4 1/2"	20'	T.D			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100 Ω/div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	237	0	12	4	100		5	1	1K	5L

REMARKS:

M QU-78-21

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE CoreHole - QU-78-21
LOCATION 95+00 2250 LT SEC TP RGE W
AREA QUINSAM 71
PROVINCE B.C. L22

SURVEYED DATA
ELEV. 1109
LOC. 95+19 - 2250 LT

	1	2	3
RUN No.			
DATE	March 1 '78		
DEPTH-DRILLER	111		
DEPTH-LOGGER	109		
FLUID LEVEL	8'		
LOGGING TIME	7hr		
DRILLED BY	K. Logan		
RECORDED BY	D. DUNBAR		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD

BIT	FROM	TO
8¾	0	20'
6¼	20'	T.D.

CASING RECORD

SIZE	FROM	TO
7"	0	20'

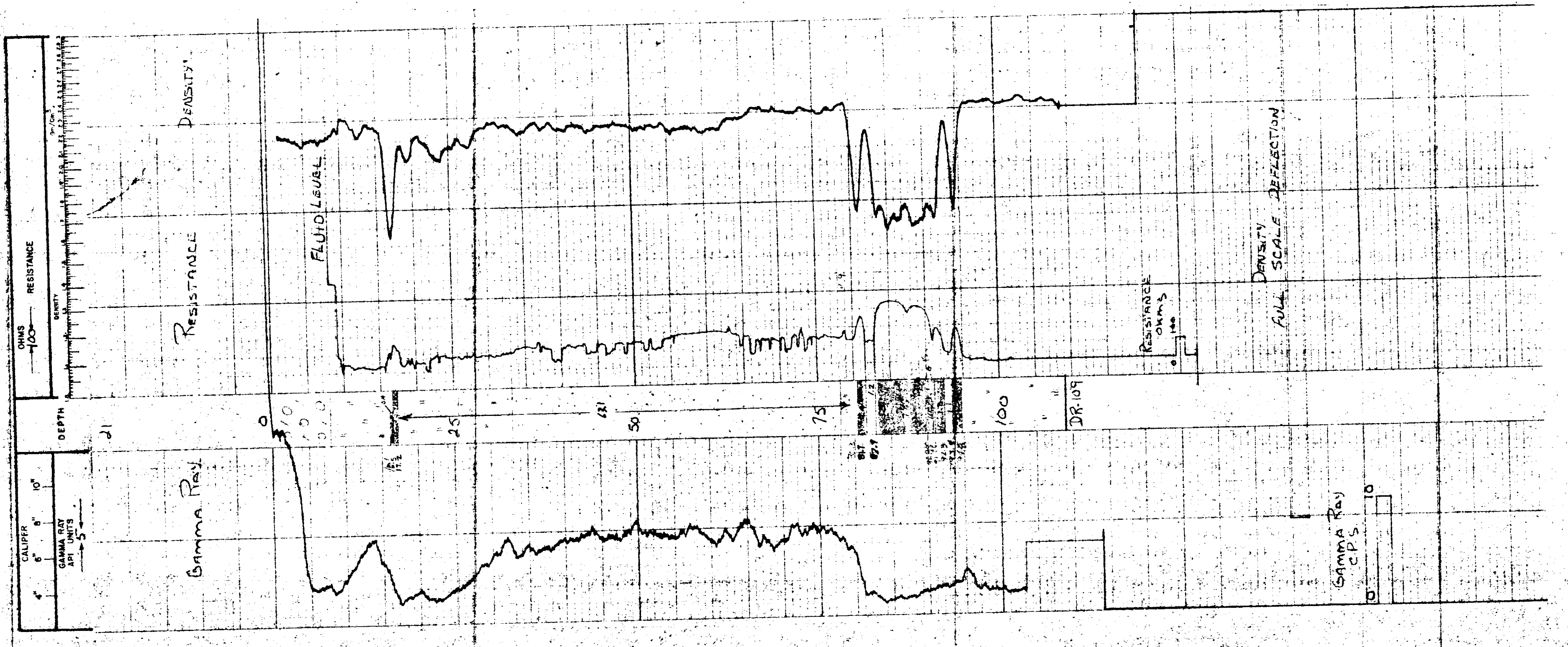
EQUIPMENT DATA

GAMMA RAY		RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	L-103	L-103	
DIAMETER	2 1/8"	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	MC	
TYPE	SCINT	SPACING	16"	
LENGTH	3'	LENGTH	1'	
GENERAL		HOR SCALE	100Ω/div	HOVP
TRUCK No.	2	SOURCE MODEL		CS-137
LOCATION	CAMPBELL RIVER	ISOTOPE		125 mC
		STRENGTH		

LOGGING DATA

RUN No.	GENERAL DEPTHS FROM	TO	SPEED Ft/min	GAMMA RAY T C SEC	SENS SETTING	ZERO	API UNITS PER DIV	DENSITY T C SEC	SENS SETTINGS	ZERO
1	109	0	12	+	100		5	1	1K	5½

REMARKS



M   QU-78-22

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE - DRILLHOLE QU 78 22.
LOCATION 77+30 1250 LT SEC TP RGE W
AREA QUINSAM
PROVINCE B.C. (L23) 71

SURVEYED DATA
ELEV. 1132'
LOC 77+58 1737 L.

RUN No.		2	3
DATE	MARCH 2/78		
DEPTH - DRILLER	225'		
DEPTH - LOGGER	217'		
FLUID LEVEL	3'		
LOGGING TIME	Shr TOTAL		
DRILLED BY	F. UNCKH		
RECORDED BY	L. DUNBAR		
WITNESSED BY	J. GARDNER		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4"	Surf.	20'			
4 1/2"	20'	T.D.			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	5	LENGTH	1"		
GENERAL		HOR. SCALE	100 Ω/div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T.C. SEC	SENS SETTING	ZERO	API UNITS PER DIV.	T.C. SEC	SENS SETTINGS	ZERO
1	217'	0	12	4	100		5	1	1K	

REMARKS:

M QU-78-23

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA.

HOLE: DRILLHOLE QU-78-23

LOCATION: 82+50 1750 LT SEC TP RGE W

AREA: QUINSAM 71

PROVINCE: B.C. (L24)

SURVEYED DATA

ELEV. 1140

LOC. 82+49 - 1749 LT

RUN No.	1	2	3
DATE	MARCH 3/78		
DEPTH-DRILLER	200'		
DEPTH-LOGGER	196'		
FLUID LEVEL	3.5'		
LOGGING TIME	.5 hr TOTAL		
DRILLED BY	H. VINCET		
RECORDED BY	D. DUNBAR		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6¼"	Surf	20'	5"	Surf	20'
4½"	20'	T.D.			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-105	TOOL MODEL No.	E-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	WE	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH			
GENERAL		HOR. SCALE	100 Ω/div.		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	CAMPBELL RIVER	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	196'	0	12	4	100		5	1	1K	

REMARKS: * RESISTANCE ELECTRODE Touched CASING.

M   Qu-78-26

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Drillhole Qu-78-26

LOCATION 92+50 1000 LT SEC TP RGE W

AREA Quinsam

PROVINCE B.C.

(L25) 71

SURVEYED DATA

ELEV. 1094

LOC. 92+50 - 952' LT

RUN No	1	2	3
DATE	March 5/78		
DEPTH-DRILLER	260'		
DEPTH-LOGGER	258'		
FLUID LEVEL	26.5'		
LOGGING TIME	5 hr. total		
DRILLED BY	H. Wincett		
RECORDED BY	D. Dunbar		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6 3/4"	Surf	9'	5 1/2"	Surf	9'
4 1/2"	9'	T.P.			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	MC	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100Ω/div.		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T.C. SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T.C. SEC	SENS SETTINGS	ZERO
1	258'	0	12	4	100		5	1	1K	

REMARKS -

M QU-78-27

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Corehole QU-78-27
LOCATION 90+00 1250 LT SEC. TP. RGE. W
AREA Quinsam
PROVINCE B.C. (L26) 71

SURVEYED DATA
ELEV. 1118'
LOC. 90+10 1729' LT

RUN No.	1	2	3
DATE	March 6/78		
DEPTH-DRILLER	237'		
DEPTH-LOGGER	237'		
FLUID LEVEL	8.5'		
LOGGING TIME	5hr Total		
DRILLED BY	R. Logan		
RECORDED BY	D. Dunbar		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
8¾"	Surf	7'	8½"	Surf	7'
6"	7'	205'			
5½"	205'	T.D.			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3'	LENGTH	1"		
GENERAL		HOR. SCALE	100Ω/div.		
TRUCK No.	2	SOURCE MODEL		HDVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	237'	0	12	4	100		.5	1	1K	

REMARKS:

M   QU-78-28.

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE DRILLHOLE QU-78-28

LOCATION 72+50 1250 LT SEC. TP RGE W.

AREA Quinsam 71

PROVINCE B.C. (L27)

SURVEYED DATA

ELEV. 1026

LOC. 7246 · 1272

RUN No	1	2	3
DATE	MARCH 7/78		
DEPTH-DRILLER	180'		
DEPTH-LOGGER	173'		
FLUID LEVEL	8'		
LOGGING TIME	.5hr total		
DRILLED BY	H. Vincett		
RECORDED BY	D. Dunbar		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6¾"	Surf	9'	5½"	Surf	9'
4½"	9'	T.D			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR SCALE	100 Ω/div		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV	T C SEC	SENS SETTINGS	ZERO
1	173'	0	12	4	100		5	1	1K	

REMARKS

M Qu-78-29

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE: DRILLHOLE QU-78-29
LOCATION: 72+50 750-T SEC TP RGE W
AREA: QUINSAM
PROVINCE: B.C. (L28) 71

SURVEYED DATA
ELEV. 973'
LOC. 72+53 - 799 LT

RUN No.	1	2	3
DATE	MARCH 7.78		
DEPTH-DRILLER	180'		
DEPTH-LOGGER	177'		
FLUID LEVEL	7'		
LOGGING TIME	.5 hr. total		
DRILLED BY	L. VINCETT		
RECORDED BY	D. DUNBAR		
WITNESSED BY	S. GARDNER		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
6¾"	Surf	13'	5½"	Surf	13'
4½"	13'	T.D.			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-100	TOOL MODEL No.	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No.	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100Ω/div.		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	CAMPBELL RIVER	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min.	T C SEC.	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	177'	0	12	4	100		5	1	1K	

REMARKS:

M QU-78-30C

LEXCO TESTING LTD.

GAMMA-DENSITY-RESISTANCE

700 ROYAL TRUST TOWER, EDMONTON CENTRE, EDMONTON, ALBERTA

HOLE Coreholq QU-78-30 c

LOCATION ~~1000 Lt~~ 75+00 SEC TP RGE W

AREA Quinsam

PROVINCE B.C (L29) 71

SURVEYED DATA

ELEV. 1077'

LOC. 74+92 1498' Lt.

RUN No.	1	2	3
DATE	MARCH 8/78		
DEPTH-DRILLER	200'		
DEPTH-LOGGER	199'		
FLUID LEVEL	58.8'		
LOGGING TIME	5 hr total		
DRILLED BY	R. Logan		
~~RECORDED BY~~	D. Dunbar		
WITNESSED BY	S. Gardner		

BORE-HOLE RECORD			CASING RECORD		
BIT	FROM	TO	SIZE	FROM	TO
8 3/4"	Surf	18'	8"	Surf	18'
6"	18'	160'			
5 1/8"	160'	T.D			

EQUIPMENT DATA

GAMMA RAY			RESISTANCE	DENSITY	CALIPER
TOOL MODEL No.	L-103	TOOL MODEL No	L-103	L-103	
DIAMETER	2 1/8"	DIAMETER	2 1/8"	2 1/8"	
DETECTOR MODEL No	CP-516	TYPE	ME	F	
TYPE	SCINT	SPACING		13"	
LENGTH	3"	LENGTH	1"		
GENERAL		HOR. SCALE	100Ω/div.		
TRUCK No.	2	SOURCE MODEL		HOVP	
LOCATION	Campbell River	ISOTOPE		CS-137	
		STRENGTH		125 mC	

LOGGING DATA

GENERAL				GAMMA RAY				DENSITY		
RUN No.	DEPTHS FROM	DEPTHS TO	SPEED Ft/min	T C SEC	SENS SETTING	ZERO	API UNITS PER DIV.	T C SEC	SENS SETTINGS	ZERO
1	199'	0	12	4	100		5	1	1K	

REMARKS: * Hole Blind at 58.8 Feet

WASHABILITY STUDY - PIT 3 NORTH

From the ash percent of the size analysis, washability curves for each size and also for the combined sizes (2" x 100 mesh). These curves indicate the following:

1. Core Hole #1 - Lab No. 1065
   - i -- The coal becomes progressively dirtier with a decrease in size; the dirtiest size is 100 x 0 mesh (34.5% ash)
   - ii -- By comparing washability curves of each size and the combined sizes:
     - a) There is no need to crush this coal to finer than 2" x 0.
     - b) The coal is easy to wash.
     - c) Theoretical recovery and ash % at cut point 1.8.

FRACTION	ASH %	RECOVERY
1" x 28 mesh	8.2	88.0
+ 1/4"	8.0	89.0
1/4" x 8 mesh	8.0	88.0
8 x 28 mesh	8.0	87.0

2. Core Hole # 2 - Lab No. 1069
   - i -- The coal becomes progressively dirtier with a decrease in size; the dirtiest is 100 x 0 Mesh (41.8% Ash)
   - ii -- By comparing washability curves of each size and the combined sizes:
     - a) There is no need to crush this coal to finer than 2" x 0.
     - b) The coal is easy to wash
     - c) Theoretical recovery and ash % at cut point 1.8.

FRACTION	ASH %	RECOVERY
1" x 100 mesh	10.5	84.0
+ 1/4"	12.5	82.5
1/4" x 8 mesh	10.0	83.5
8 x 28 mesh	9.0	80.5
28 x 100 mesh	9.0	74.0

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QUINSAM COAL PROJECT

1978

Stage I Submission

by

DRAFT COPY

Quinsam Coal Ltd.

FORWARD

This report represents the Stage I or Preliminary Assessment phase of the Four-Stage Assessment Procedure set forth by the Environment and Land Use Committee of British Columbia. Its purpose is to identify the major economic, environmental and social impacts of the Quinsam Project on the region in general.

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LIST OF TERMS

Tonne	- metric ton
lpm	- litres per minute
km	- kilometres
m	- metres
cu. m.	- cubic metres
R.O.M.	- run-of-mine
mm	- millimetres
igpm	- imperial gallons per minute
KV	- kilovolts
KWH	- kilowatt hours
KVA	- kilovolt-ampheres
CMC	- Canada Manpower Centre
MKwh	- million kilowatt hours
a.m.s.l.	- above mean sea level
m^3/sec.	- cubic metres per second
ha	- hectares

PART I - GENERAL DESCRIPTION OF THE QUINSAM COAL PROJECT

INTRODUCTION

Weldwood of Canada Limited and Luscar Ltd., as Joint-Venture participants, submitted a Prospectus of the Quinsam Coal Project to the British Columbia Government on December 8, 1977. The Prospectus provided an initial outline of the Quinsam Project and included preliminary information relating to geology, reserves, exploration, mining and off-site facilities.

Since submitting the Prospectus, Weldwood and Luscar have formed Quinsam Coal Ltd., the company which will be responsible for the development, construction and operation of the mine. Quinsam Coal Ltd., hereafter also referred to as the company, has initiated detailed environmental, socio-economic, engineering, financial and marketing studies to fully assess the feasibility and viability of developing the coal reserves on the Quinsam Property. Although many of these studies are still ongoing, much of the preliminary information received to date is summarized in this report. One item which has not been addressed, is the impact of the project on historical resources; however discussions have been initiated with Historical Sites Group and a reconnaissance survey is scheduled for the spring of 1979. Upon completion of all the studies, a more in-depth analysis of the project will be presented in the Stage II submission.

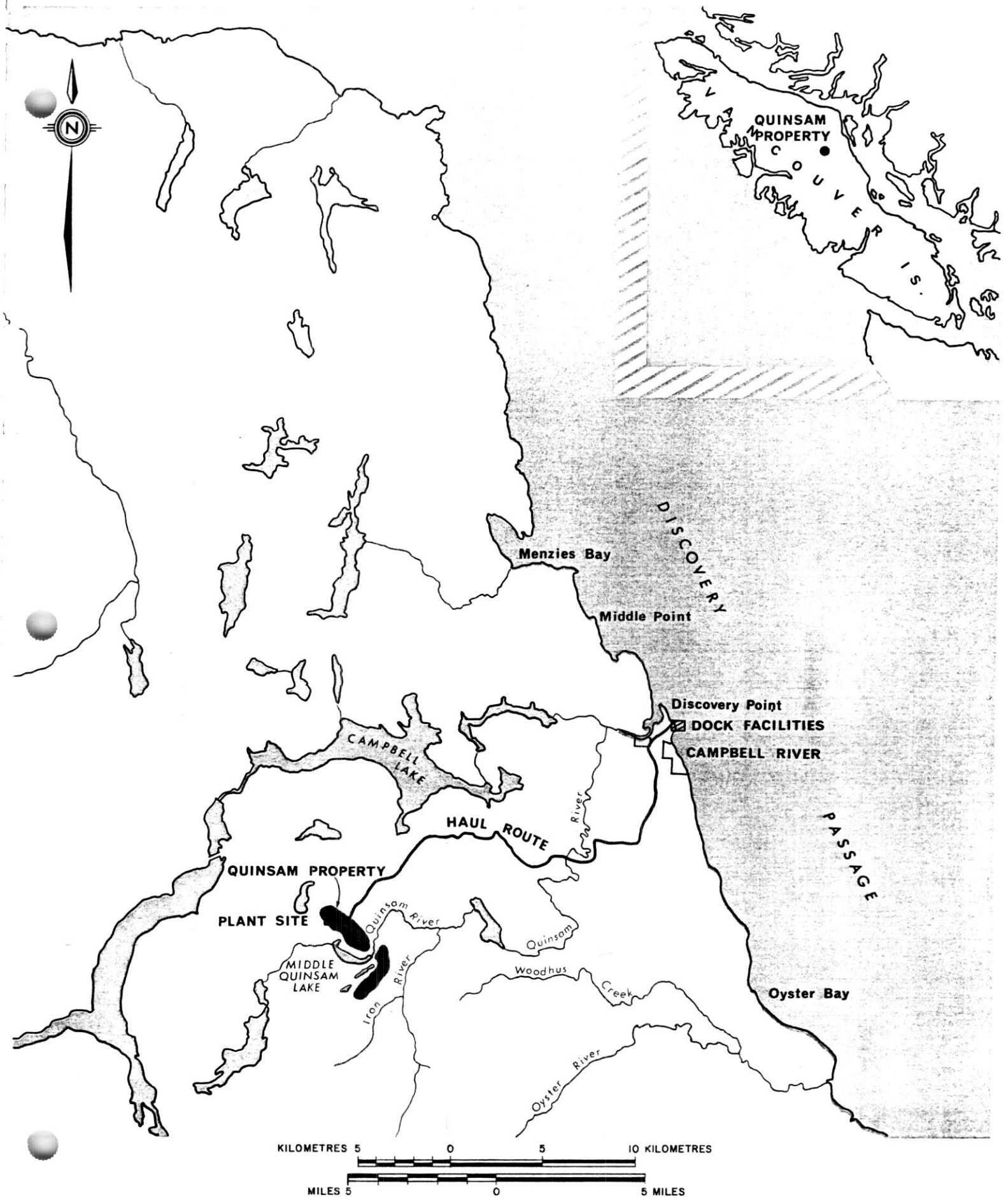
OBJECTIVES OF THE PROJECT

By employing standard surface mining techniques, the company proposes to produce approximately 0.91 million clean tonnes (1.0 million short tons) of coal annually from the Quinsam Property. In order to achieve this objective, mining zones will have to be developed; minesite facilities, including a preparation plant, will have to be constructed; major mining equipment assembled; and transportation routes and adequate docking facilities established. The project has been designed for an initial life of 11½ years, with provision to extend that term in the future by developing higher ratio, auger and underground reserves. Figure I shows the location of the Quinsam Property and proposed facilities.

RESERVES

In 1978, exploration has been geared towards confirming structure, quantity and quality of the proven reserve. Drill holes have been concentrated within designated mining limits on approximately 76 m (250 ft) centres. To date, drilling has not revealed any significant discrepancies between the reserve figures which were contained in the Prospectus. Reserves on the Quinsam Property can be summarized as follows:

Strip Reserves	18.72 million tonnes (20.80 million tons)
High Ratio Strip Reserves	3.60 million tonnes (4.00 million tons)
Auger Reserves	0.32 million tonnes (0.36 million tons)



GENERAL LOCATION MAP

FIGURE 1

Underground Reserves	7.43 million tonnes (8.26 million tons)
TOTAL	30.07 million tonnes (33.42 million tons)

In addition to the drilling program conducted by the company, four test pits were excavated, from which a total of approximately 72.5 tonnes (80 short tons) of coal were removed. The purpose of taking these bulk coal samples was to conduct washability studies and quality analyses necessary for plant design and product marketing. The location of the test pits and drill holes is shown in Figure II of the mining section in this report.

PRODUCTION

It is estimated that approximately 1.18 million tonnes (1.3 million short tons) must be mined in order to achieve the projected clean coal production of 0.91 million tonnes (1.0 million short tons).

The coal preparation plant envisioned for the Quinsam Project is a 272 tonne/hour (300 short ton/hour) Jig Plant. Basically, the plant employs a system of crushers, a Baum jig and screens to clean and size the coal. Due to the closed circuit design, water demand for the plant is expected to be less than 190 lpm (50 gpm). A more complete description of plant processing is contained in a following section of this report.

TRANSPORTATION

It is now proposed to employ three coal haulers (as opposed to seven stated in the Prospectus) to transport the clean coal from the plant to the dock facility. The haulers will be 100 ton bottom-dump, tractor-trailer units, operating on a three shift per day, seven days per week schedule. The proposed haul route will be along the existing Elk River Timber road and across the Island Highway to the Western Mines facility on Discovery Point.

DOCK FACILITY AND COAL TERMINAL

Quinsam Coal Ltd. engaged Swan Wooster Engineering Co. Ltd. to evaluate all possible dock sites within practical hauling distance from the Quinsam property. The study included the area from Elk Bay in the north to Oyster Bay in the south. Four sites were identified where it would be technically feasible to build a terminal, namely, Oyster Bay, Discovery Point (Western Mines), Middle Point and Menzies Bay.

Final site selection by the company was dependent upon a number of factors, namely:

1) environmental considerations;
2) haul distances;
3) road and bridge construction requirements;
4) land availability and acquisition costs;
5) ability to handle 49,863 tonne (55,000 D.W.T.) ships;

6) parameters of piloting, wind, waves, currents and tides.

Menzies Bay and Middle Point were considered the most difficult sites of the four identified at which to berth a ship. In addition, Menzies Bay and Middle Point are considered capable of only handling 31,731 tonne (35,000 D.W.T.) ships. For these reasons, the two sites were excluded from further consideration.

A capital cost comparison between Oyster Bay and Discovery Point concludes that Discovery Point could be developed to handle 49,863 tonne (55,000 D.W.T.) ships at a cost saving of $1.5 million over the Oyster Bay site. Comparison of access between the two sites reveals that Oyster Bay has an additional 13.2 km (8.2 miles) of haulage over adverse grades. This would substantially increase haul cycle times as well as increase road maintenance costs. Additional capital expense for haulage trucks would be required (approximately $500,000) along with increased annual operating costs (approximately $250,000). The Oyster Bay site would necessitate the establishment of the dock 600 meters (2000 feet) seaward from the Island Highway. This would, because of its prominence in the Bay, meet with opposition from local residences, cottage owners and tourist oriented businesses.

For economic and practical reasons, Discovery Point at the existing Western Mines facility, is the logical choice

for the coal terminal. Environmentally, International Environmental Consultants Ltd. of Richmond, B.C. have indicated there is no technical reason why a coal terminal could not be established on the Western Mines site at Discovery Point with no adverse effect on the estuary, providing appropriate safeguards are implemented. Therefore, the final conclusion as to which site would be best suited to the engineering requirements, economic restrictions and environmental and social concerns is the Western Mines site on Discovery Point.

MARKETING

Marketing surveys initiated in 1978 have revealed that although there is future potential to sell Quinsam coal to industries along the Canadian and U.S. Pacific Coast and the Gulf Coast, it appears that additional markets will have to be established offshore to sell the bulk of the production. Markets currently being investigated include the Pacific Rim and Europe.

PART II - MINING

OVERVIEW OF THE MINING PROPOSAL

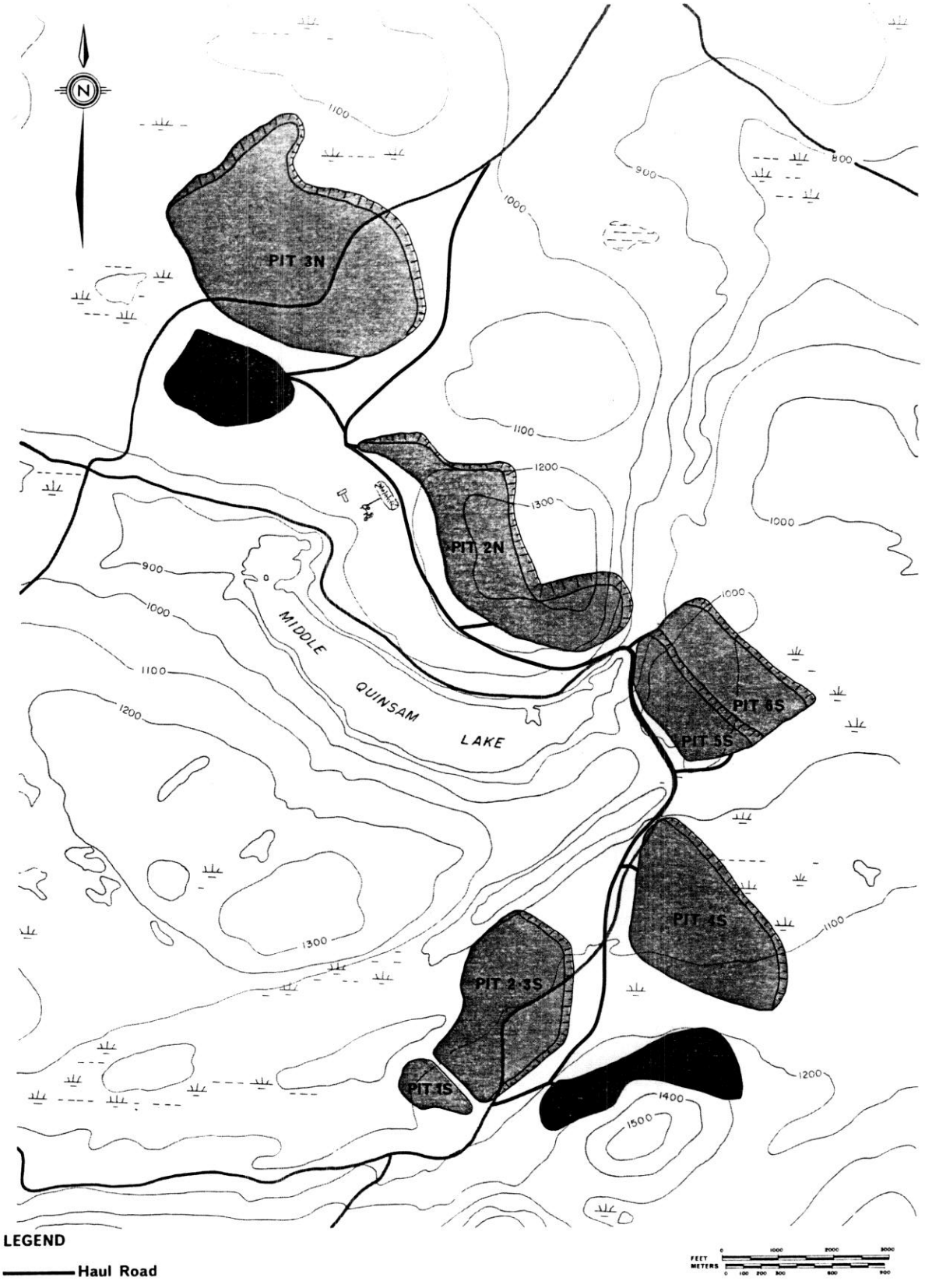
The mining scheme envisions utilizing a single large dragline and a truck shovel module for overburden removal. Wheeled front end loaders or large backhoes will be employed in coal extraction. Trucks will provide the means of conveyance for delivering raw coal to the plant and clean coal to the dock facility. Figure II shows the location of mine pits, dumps, roads and facilities.

Present surface mineable reserves will provide an initial mine life of 11.5 years. Additional surface mineable, auger and underground reserves could be developed in the future to extend the projected mine life.

Basis of Mine Planning

The following parameters are based on available information and have been used in preliminary mine planning:

1)	overall pit wall angle	45°
2)	dragline highwall angle	60°
3)	truck/shovel bench angle	60°
4)	truck/shovel bench height	10.7 m (35 ft)
5)	spoil dumps maximum height	33.5 m (110 ft)
	angle of repose	36°
	reclaim angle	26°
	swell factor	30%
6)	overall yield	76% of mineable reserves
7)	coal density	1.15 tonne per bank cu. m.



PIT LOCATION PLAN

FIGURE 2

Pit design has been centered around the concept of using a truck/shovel module to remove the uppermost material followed by a dragline to remove overburden to a combined maximum depth of 67 m (220 feet). The rehandle for the dragline becomes excessive when the overburden depth exceeds 30.5 m (100 feet) above the coal seam. Conventional open pit benches will be constructed by the shovel parallel to the strike of the coal. Due to the six degree dip of the coal, the overburden remaining for the dragline to remove will vary from 19.9 m (65 feet) on the up-dip edge of the bench to 30.5 m (100 feet) on the down-dip edge. It is planned to have the dragline strip along strike to the top of the coal, roughly parallel to the truck/shovel benches.

The overburden from the initial truck/shovel pits will be placed in out-of-pit dumps until such time as areas in the dragline stripped zones are available for backfilling. Over the projected mine life, 90% of the overburden removed will be returned as backfill into the mined-out pits. Approximately one year after final dump construction, slopes will be reduced to a maximum of 26° (2:1), the area capped with a suitable cover of regolith and then vegetated.

MINING OPERATIONS

Overburden Removal

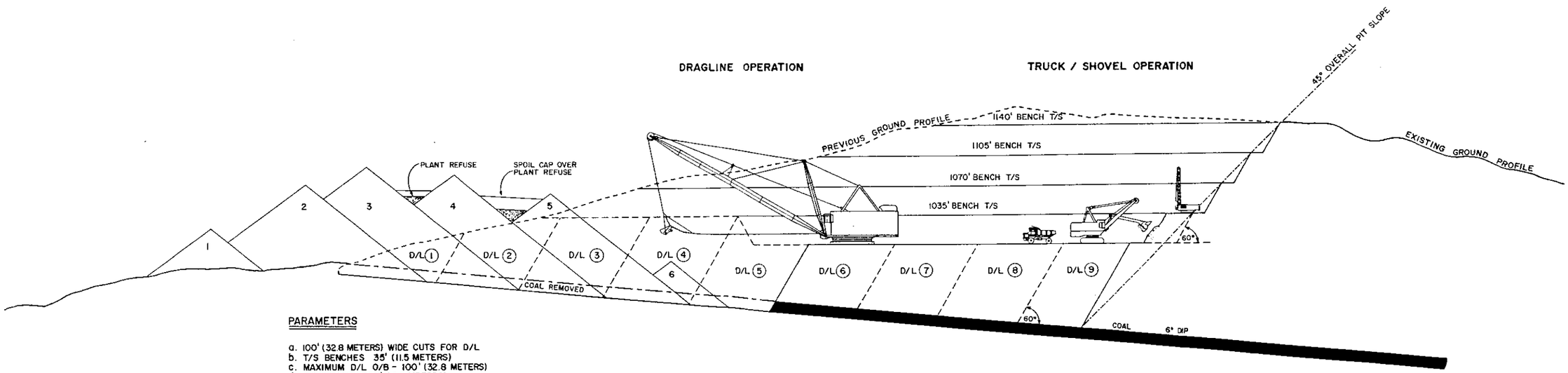
A 30.5 cubic meter (40 cubic yard) electric walking dragline will provide the primary stripping capacity coupled with a 17.6 cubic meter (23 cubic yard) shovel and 155 tonne (170 ton) rear-dump, electric-drive haul trucks.

The planned yardage to be moved will require the utilization of this equipment on a 24 hour, 7 days per week basis. Variations of coal quality will necessitate the operation of two to three pits at one time, in order that the various coals can be blended to produce a marketable product.

Each pit has an initial area that the dragline can work in that does not require pre-stripping by the truck/shovel. The relationship between the dragline overburden and the truck/shovel portion of the total overburden is such that the truck/shovel must begin pre-stripping 4 months prior to start-up of the dragline. This is to ensure that the dragline, which uncovers the vast majority of the coal during the mine life, always has the required prepared area available to excavate. Figure III is a typical cross-section through a mining zone.

The overburden to be removed consists of a covering of glacial till varying from a few inches to 30.5 m (100 feet) in depth and is underlain by a massive sandstone. Maximum expected pit depths will be approximately 67 m (220 feet). The out-of-pit dumps are expected to accomodate approximately 10% of the total overburden to be moved, or 12,233,000 BCM (16,000,000 BCY).

Truck/shovel excavation will be carried out using a 10.7 m (35 foot) bench height. The benches prepared will vary from 19.9 m (65 feet) to 30.5 m (100 feet) above the top of the main seam to be mined. In pits where the number



PARAMETERS

a. 100' (32.8 METERS) WIDE CUTS FOR D/L
b. T/S BENCHES 35' (11.5 METERS)
c. MAXIMUM D/L O/B - 100' (32.8 METERS)
d. D/L REACH = 256' (84 METERS)
e. ANGLE OF REPOSE - 36°
f. SWELL FACTOR - 30%

ILLUSTRATION OF PIT DEVELOPMENT

FIGURE 3

two seam is found, small amounts of coal may be removed by the truck/shovel module. Dozer work will be required in bench preparation and support for the dragline and shovel.

Drilling and Blasting

Drilling and blasting of the overburden is necessary to reduce the material to a size where it is capable of being handled by the dragline and shovel. Two overburden drills will precede the stripping sequence, coupled with a loading crew delivering ammonium nitrate explosives and primers to the hole. Blasting will be carried out in compliance with applicable B.C. regulations.

The competent nature of the coal will require that it be drilled and blasted to facilitate loading. A coal drill will be employed to drive small diameter holes, followed by light loading and blasting to "bump" the coal, breaking it and thereby producing a minimum amount of fines.

Coal Loading and Haulage

Loading of the coal into haulage trucks for transportation to the plant will be done by either a 5.3 cu.m. (7 cu.yd.) back-hoe or a 7.6 cu.m. (10 cu.yd.) front-end loader.

Transport to the plant will be via two 78.4 tonne (85 ton) mechanical drive, rear dump trucks. A total of 1.18 million tonnes (1.3 million tons) of raw coal will be required to produce the projected .91 million tonnes

(1.0 million tons) of clean coal annually.

Clean coal from the plant will be moved to the dock, a distance of approximately 29 km (18 miles), by 90.7 tonne (100 ton) bottom-dump, tractor-trailer, off-highway trucks. The clean coal haul will operate on a three shifts per day, 7 days per week schedule. This scheduling will result in the lowest possible haulage density of 1.2 loads per hour. The proposed route will follow the existing Elk River Timber haul road to the Island Highway and then to the Western Mines facility on Discovery Point. Upgrading and widening of the existing route will be required prior to mine start-up. Negotiations are underway with Elk River Timber regarding joint use of the road.

MINE SERVICES

During the dry summer months dust will be supressed by watering of the road surfaces. Icy conditions in winter will be controlled by sanding. Road maintenance will be provided by two large motor graders and a water/sand truck. A fuel/lube truck, welding truck and truck crane will provide field servicing of the mine equipment.

Pit dewatering and surface drainage will make use of a crawler backhoe, several pit pumps and a small farm tractor for pump moves and access to difficult areas.

Safety equipment on site will include a fire truck and an ambulance.

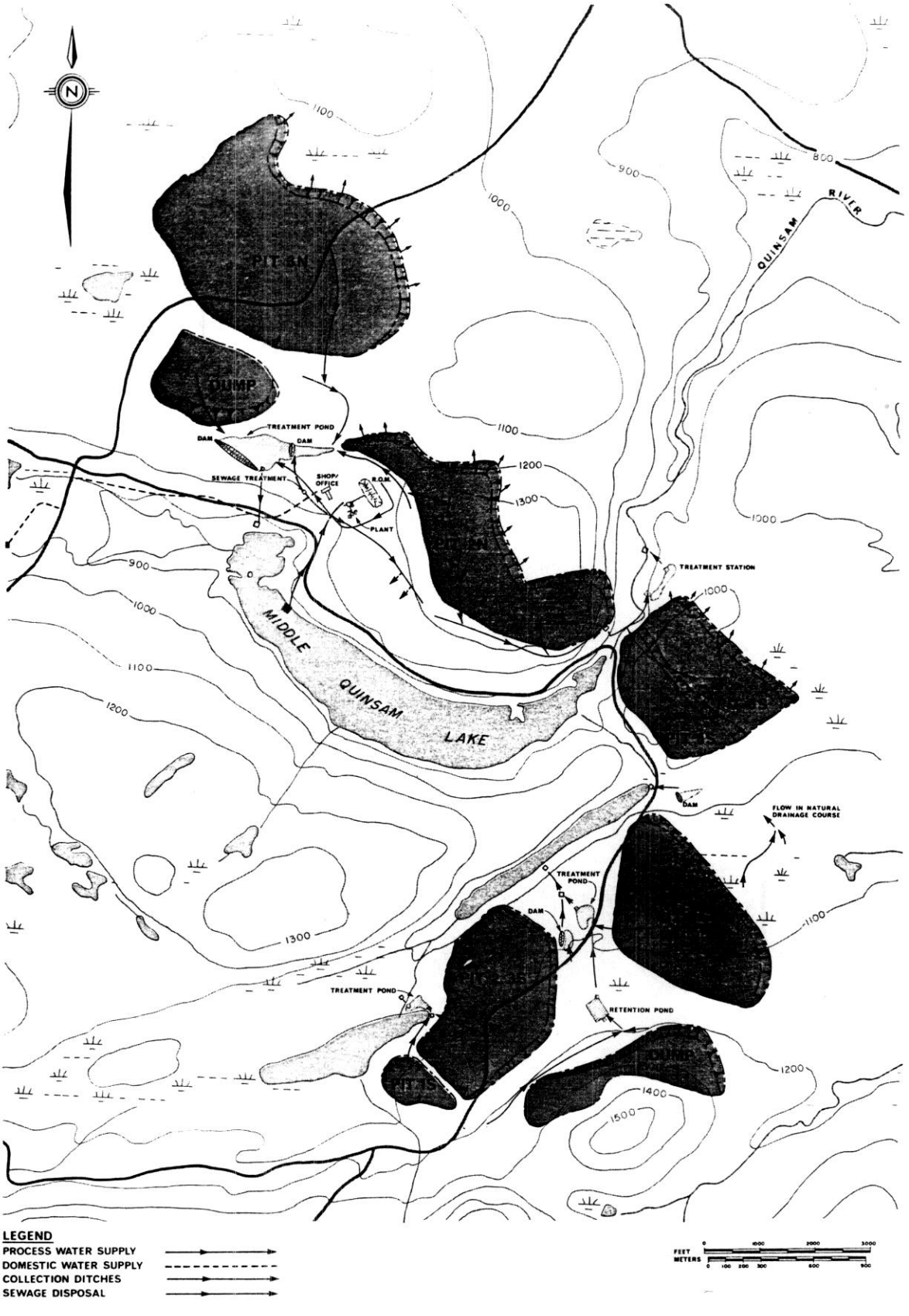
WATER MANAGEMENT

Surface water run-off from the pit and facilities area will be intercepted and directed by ditches to settling ponds for any required treatment before its ultimate return to the Quinsam water system.

Pit water will be pumped to a separate drainage ditch system which will direct it to treatment stations for required upgrading before release. Figure IV is a conceptual layout of the proposed surface water handling system.

Design of the preparation plant has included a closed water system with an emergency pond for handling those occasions when the thickener must be dumped. This water would then be decanted and treated before discharge.

The importance of maintaining acceptable water quality is recognized and the Joint-Venture participants are committed to ensuring all waters leaving the minesite meet the standards established.



WATER MANAGEMENT AND WATER SUPPLY

FIGURE 4

PART III - INDUSTRIAL COMPLEX

GENERAL

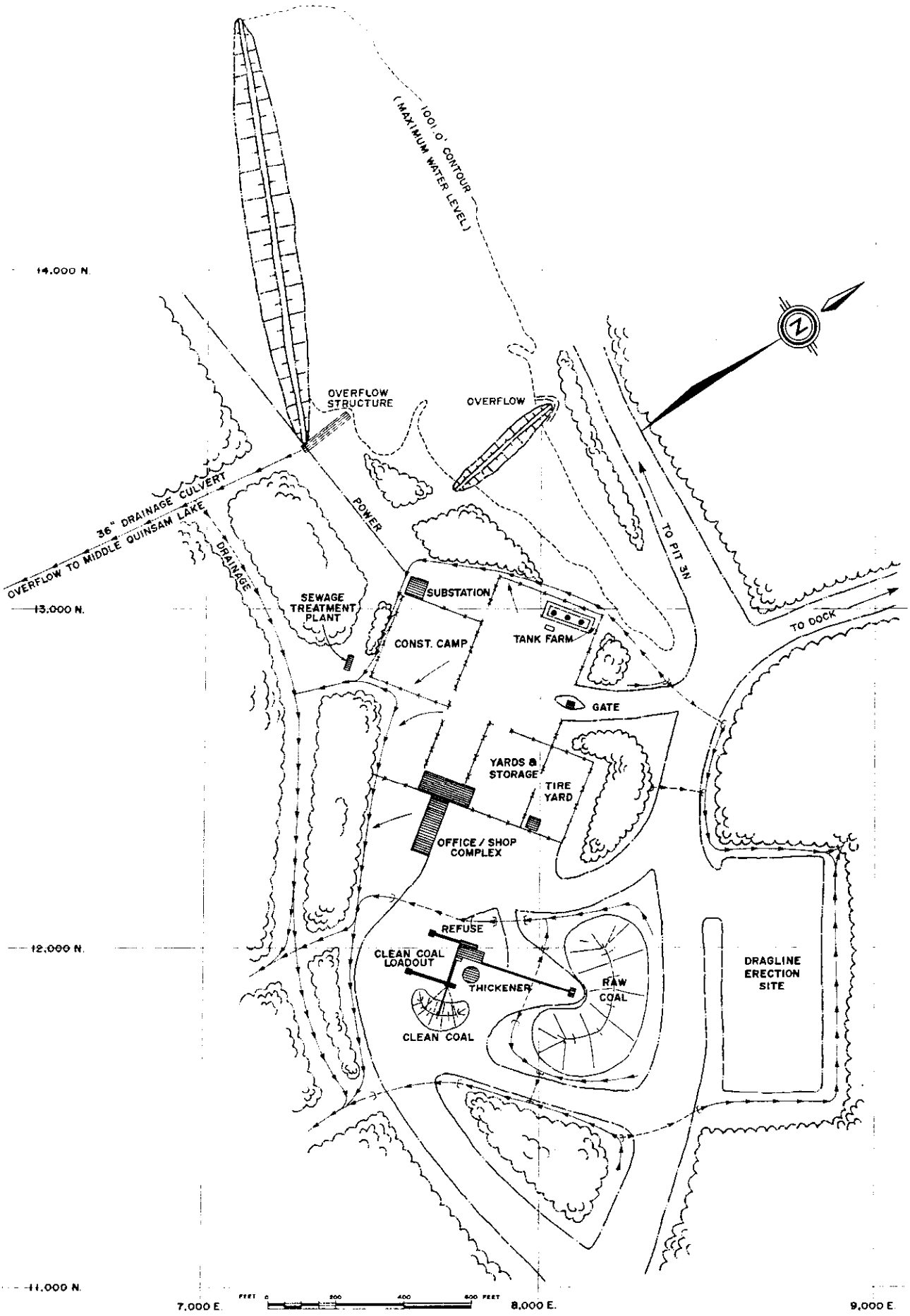
The Quinsam Industrial Complex will include the following facilities:

1) A coal preparation plant consisting of a dump hopper, crushing facility, screening and wash plant, scale and loadout, radial stacker and interconnecting conveyors and galleries.
2) A maintenance/office building including service bays, offices, warehousing and wash-dry facilities.
3) A tire shop for the repair and storage of tires for the mine equipment.
4) A tank farm for the storage and dispensing of fuels, lubricants and coolants.
5) A temporary modular camp for housing construction workers, if required.
6) Roads, water, sewer and electrical distribution systems.

The location of the facilities within the Industrial Complex is shown in Figure V.

PREPARATION PLANT

The raw coal will be delivered by 78.4 tonne (85 ton) rear dump trucks to the run-of-mine (R.O.M.) receiving hopper or the R.O.M. stockpiles, immediately adjacent to the hopper. Reclaiming from the stockpile will be by front-end loader or dozer to provide maximum flexibility in plant feed. Maximum plant feed is rated at 272 tonnes (300 tons) per hour.



INDUSTRIAL COMPLEX LAYOUT

FIGURE 5

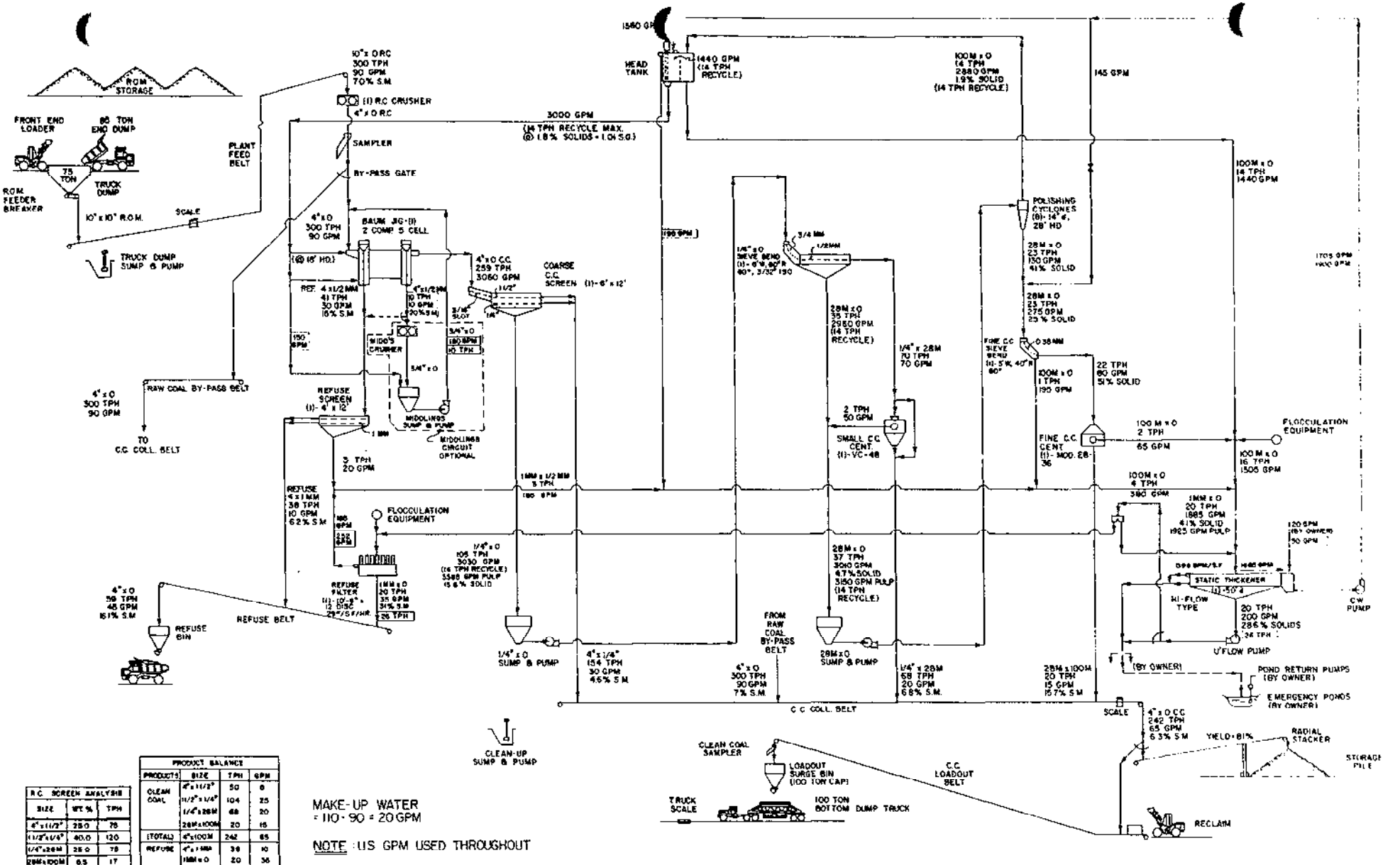
A breaker-feeder below the R.O.M. hopper will reduce the coal to a top-size of 254 mm (10 inches) and then feed it via conveyor to the plant. The coal will then be crushed to minus 102 mm (4 inches) and will be fed to the primary cleaning vessel, a 5 cell, two compartment, Baum jig. Refuse 102 mm x 0.5 mm (4" x 28 mesh), will be sent to a double deck refuse screen where the coarse refuse 102 mm x 1 mm will be removed and sent directly to the refuse bin by conveyor. The 1 mm x 0.5 mm refuse will report to the static thickener for the decanting of the entrained water.

Provision can be made for the installation of a crusher, sump and pump to improve coal recovery in the middlings fraction.

The 102 mm x 0 (4" x 0) clean coal product from the jig will then be fed to a double-deck coarse clean coal screen, where the 102 mm x 38 mm (4" x 1½") clean coal will be scalped off and sent directly to the clean coal belt.

A clean coal crusher may be installed to reduce the topsize to 38 mm (1½") depending on the market requirements.

The 64 mm x 0 (¼" x 0) portion will be directed to a sump and then be pumped to the classifying cyclones to begin the dewatering cycle. The underflow from the cyclones will be fed through a sieve bend and small clean coal screen for further dewatering and separation. The 6.4 mm x 0.5 mm



R.C. SCREEN ANALYSIS		
SIZE	WT %	TPH
4" x 1 1/2"	25.0	75
1 1/2" x 1/4"	40.0	120
1/4" x 28M	25.0	75
28M x 100M	6.5	17
100M x 0	4.5	13
TOTALS	100.0	300

PRODUCT BALANCE			
PRODUCTS	SIZE	TPH	GPM
CLEAN COAL	4" x 1 1/2"	50	8
	1 1/2" x 1/4"	104	25
	1/4" x 28M	68	20
	28M x 100M	20	15
(TOTAL)	4" x 100M	242	65
REFUSE	4" x 1MM	38	10
	1MM x 0	20	35
(TOTAL)	4" x 0	58	45
TOTAL	4" x 0	300	110

MAKE-UP WATER = 110 - 90 = 20 GPM

NOTE : US GPM USED THROUGHOUT

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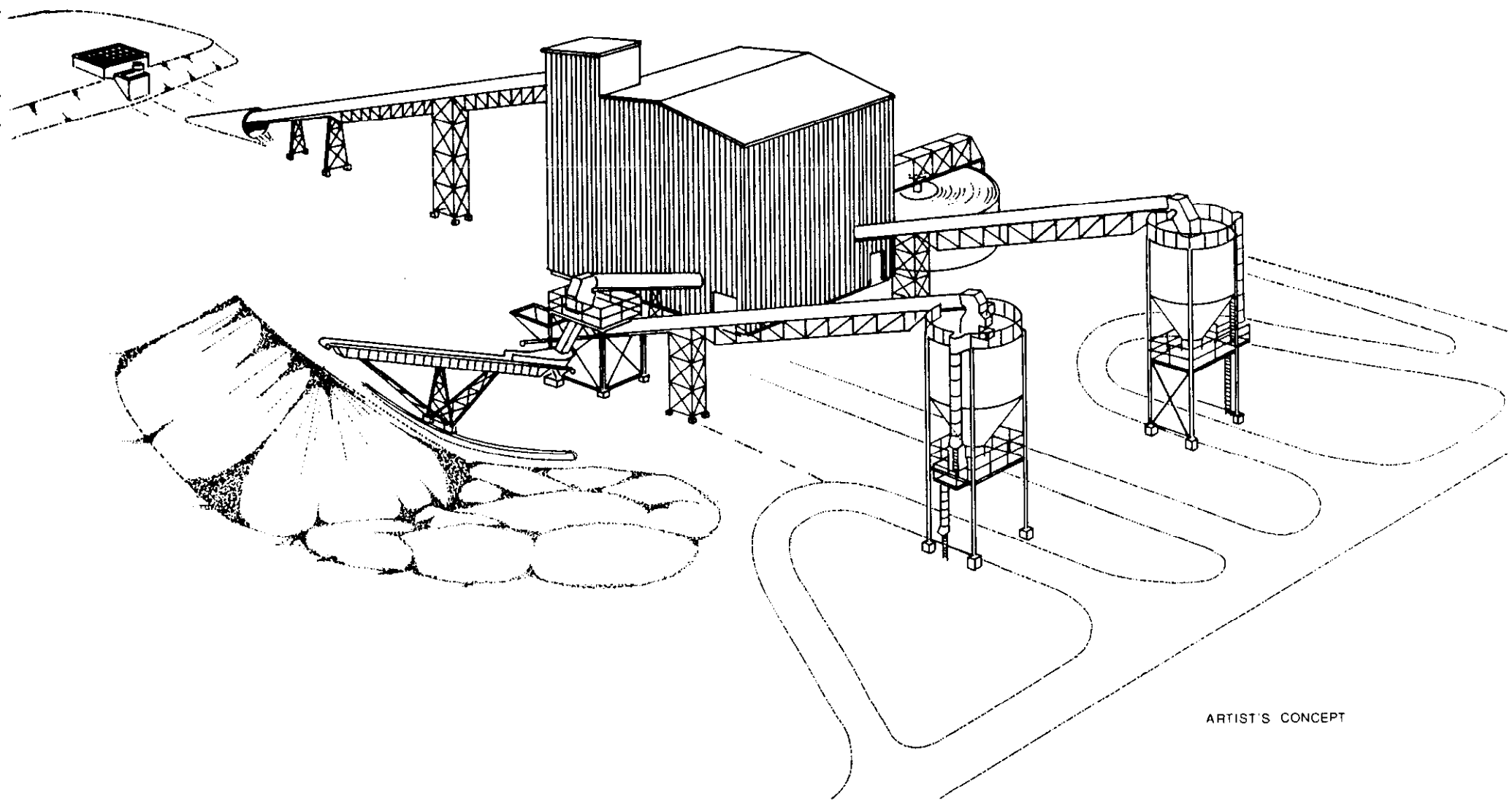
PLANT FLOWSHEET

FIGURE 6



PREPARATION PLANT

FIGURE 7

(¼" x 28 mesh) clean coal will be scalped off, dewatered in a centrifuge and sent to the clean coal conveyor belt.

The 0.5 mm x 0 (28 mesh x 0) material will go to a sump and then be pumped to polishing cyclones for further dewatering and then to a sieve bend for removing the 0.15 mm x 0 (minus 100 mesh) material. The 0.5 mm x 0.15 mm (28 mesh x 100 mesh) clean coal fraction will be dried mechanically by fine clean coal centrifuges and then be sent to the clean coal conveyor belt. The 0.15 mm x 0 (100 mesh x 0) material will report to the thickener in all cases, where it will be partially dewatered. Immediately before final discharge to the refuse bin, the 0.15 mm x 0 (100 mesh x 0) material is dewatered by a refuse filter where the surface moisture will be reduced to 30%. Figure VI illustrates the plant process system.

The final clean coal product is expected to have a surface moisture content of 6% to 7%. A radial stacker will deposit the clean coal in a stockpile, if the truck loadout surge bin is full. Reclaiming from the stockpile will be by front-end loader through a hopper and conveyor to the truck loadout surge bin.

Surface moisture of the refuse is projected to be from 15% to 16%. Return hauls with the coal trucks will deposit the refuse in the mined out pit areas where it will be buried beneath the spoil material. Figure VII is an artist's concept of the preparation plant proposed for Quinsam.

MAINTENANCE/OFFICE FACILITY

The proposed support facilities will consist of the following:

1) The combined welding and maintenance shop will have four service bays; two for maintenance, one for welding and one for equipment wash down.
2) The office layout provides for supervising staff offices, a first aid office, a general office and waiting room and a personnel training room.
3) The warehouse will contain a cardex inventory system and parts storage shelving. Larger parts not affected by the elements will be stored outside in a fenced enclosure.
4) The wash/dry complex has been oversized to allow for the accommodation of female employees in both the traditional and the non-traditional areas, and will include lockers, showers, wash basins and bathroom facilities.

TANK FARM

Storage and dispensing of fuels, lubes, coolant and greases will center around the tank farm facility. Surface storage tanks will be used for fuels while lubes and greases will be stored under cover. Dispensers for the petroleum products will be located at a service island. Dyking will be provided around the storage tank area to prevent migration of potential spills.

TIRE SHOP

The repair and storage of tires for the large mining equipment will be handled in a separate facility which will include a storage compound and a sheltered area for working on equipment.

CONSTRUCTION CAMP

Should the construction work force be of sufficient size, the project will provide accomodation for the construction work force. This would consist of a temporary mobile camp facility on the site. Originally it was intended to construct a camp to accomodate the expected peak work force of 450 - 500 persons; however, given the proximity of the site to Campbell River and the availability of hotel/motel accomodation, consideration is being given to accomodating the construction work force in town. This concept is dependent upon a number of factors, namely:

1) phasing of the construction;
2) reduction of the construction work force by utilizing modular construction techniques;
3) time duration of various construction projects;
4) the exact number of hotel/motel units available;
5) timing of construction with respect to tourist cycles;
6) construction projects by others.

WATER SYSTEM

It is proposed to use Middle Quinsam Lake for a water source; therefore, it will be necessary to establish a pumping station near the lake shore and to construct a water supply line to the industrial complex.

The system design will include provision for fire protection, plant process and domestic water supplies. Total expected water consumption is estimated at 91-227 litres/min. (20-50 igpm). Negotiations with B.C.Hydro, which holds the water rights in the area, are underway.

SEWAGE SYSTEM

Plans are to construct a mechanical treatment plant capable of handling either the effluent from the construction camp at peak capacity, or the operations work force, whichever is greater. The system established will be designed for combined connection to the mine operating facilities, and/or camp facility.

ELECTRICAL SUPPLY AND DISTRIBUTION SYSTEM

It has been assumed that B.C.Hydro will provide power from their Strathcona power station at the current industrial rates via an overhead 138 KV power supply line. The mines electrical system is expected to use a distribution voltage of 13.8 KV because of the length of transmission lines and trailing cable required to reach the extremes of the property. The primary transformers will be located near the middle of the property with secondary transformers at the

points of useage. The total power consumption expected will approximate 28,000,000 KWH per year with an average demand of 5400 KVA.

SECURITY

A full time security group will be operating at the mine site during construction and mine operation. A security gate controlling access to the site, combined with strategic fencing of the area will prevent unauthorized persons from entering the active areas.

PART IV - SOCIO - ECONOMIC IMPACT ASSESSMENT

* The following section is a summary of "Stage I - Socio-Economic Assessment of Quinsam Project", prepared by Currie, Coopers & Lybrand Ltd., June 1978, with which Quinsam Coal Ltd. concurs.

SCOPE AND PURPOSE

The socio-economic impact assessment was initiated to examine an early stage feasibility study. Since that time, some changes in the mine plan have occurred and are not reflected in this assessment. The effect of these changes will be incorporated in the Phase II submission. The two areas of change are in the total operating manpower and the construction camp requirements. Since these alterations are not yet finalized, the impact assessment remains unaltered.

This section of the report identifies the potential economic and social impacts of the development of the Quinsam Coal property on the Campbell River District area. The purpose of identifying these impacts is to indicate further work required to detail the more important effects of the mine development and to develop strategies for mitigating negative impacts and accentuating positive impacts.

EXISTING SOCIAL SETTING

EMPLOYMENT

The resident labour force in the Campbell River area is heavily oriented to occupations in primary and processing industries. Table I is a breakdown of the 1971 labour force by occupation in the Campbell River area compared to province-wide averages. The proportion of the total labour force engaged in primary occupations is nearly four times the provincial average. These primary occupations include forestry, fishing and mining, although employment in the mining industry is somewhat limited in the Campbell River area.

TABLE I - 1971 LABOUR FORCE BY OCCUPATION (PERCENT IN EACH CATEGORY)

	BRITISH COLUMBIA	CAMPBELL RIVER AREA
Managerial and Administrative	3.6	2.2
Teaching and Related	3.5	4.1
Medicine and Health	3.7	2.2
Technological, Social, Religious, Artistic and Related	4.6	2.7
Clerical and Related	15.6	12.3
Sales Occupations	10.6	8.0
Service Occupations	13.1	11.9
Farming, Horticulture, and Animal Husbandry	3.0	0.5
Other Primary Occupations	3.2	12.1
Processing Occupations	4.9	9.1
Machinery, Product Fabrication, Assembly and Watch Repair	7.9	9.2
Construction Trade Occupations	7.6	6.6
Transport Equipment Operating	9.0	4.8
Other Occupations and Not Stated	9.6	14.4
Total Experienced Labour Force (Number)	910,090	5,460

The percentage of total labour force in "white collar" occupations in the Campbell River area (43.4%) is significantly lower than the provincial average (54.7%), because of the predominance of primary industries as a source of employment.

The seasonally adjusted unemployment rate on Vancouver Island currently ranges between 8% and 9%. Canada Manpower and Immigration (CMC) statistics indicate that 40% to 45% (700 to 750) of the registered, unemployed, non-student, CMC clients in the North Island area are "blue collar" workers.

POPULATION

The Campbell River area has experienced a high rate of population growth over the past several years. Between 1971 and 1977, this rate was about 4.2% per annum, equal to the growth rate of the Regional District of Comox-Strathcona. This rate is substantially above the provincial rate of 2.5% per annum over the same period.

The population of the Campbell River area is expected to continue growing at a rate of about 4.2% per year to 2001. The following indicates the forecast population by five-year increments:

YEAR	POPULATION
1976	17,500
1981	21,600
1986	26,500
1991	32,500
1996	39,900
2001	48,700

The population (1971 & 1976) by age group profiles for Campbell River are tabulated below, along with similar profiles for Canada and British Columbia:

PERCENTAGE POPULATION BY AGE GROUP, 1971 & 1976

AGE GROUP	CANADA 1971	CANADA 1976	BRITISH COLUMBIA 1971	BRITISH COLUMBIA 1976	CAMPBELL RIVER AREA 1971	CAMPBELL RIVER AREA 1976
5 yrs.	8.4	7.5	27.9	7.0	9.8	8.8
5-14	21.1	18.1		17.1	23.2	19.8
15-24	18.6	19.5	17.7	18.6	18.2	19.6
25-34	13.4	15.8	13.4	16.1	14.8	17.5
35-44	11.8	11.3	11.7	11.4	12.6	12.0
45-54	10.6	10.7	11.1	10.9	10.5	10.3
55-64	8.0	8.3	8.8	9.2	6.6	7.0
65 +	8.0	8.7	9.4	9.8	3.9	5.0

The Campbell River area exhibits a better balance between male and female populations than do most smaller, resource-based towns. The ratio of males to females is 1.016 as compared to the Canadian average of 0.992. It has been found that an imbalance between male and female population can contribute to a lack of community stability. This suggests that the Campbell River area is not likely to experience community instability as a result of an imbalance of the sexes. The foregoing statistics indicate that the community is young and growing, yet well-balanced.

ECONOMIC BASE

Table II provides a comparison of the economic activities of the Campbell River and Comox Valley trade areas. Although the number of manufacturing and processing industries outlets is similar, the number of employees per outlet is almost nine times as high in the Campbell River area as in the Comox Valley area. This reflects the existence of the major industries in Campbell River, such as MacMillan-Bloedel and Crown Zellerbach.

Table III illustrates the differences which exist in average incomes throughout the Regional District of Comox-Strathcona.

TABLE II - SECLECTED INDICATORS OF ECONOMIC ACTIVITY (1977)

	Campbell River Trade Area* ('76 pop - 22,500)	Comox Valley Trade Area ('76 pop - 29,400)
No. of Manufacturing Operations	28	31
No. of Manufacturing Employees	2,087	265
Average Employees/Operation	74.5	8.5
No. of Wholesale Outlets	62	53
No. of Wholesale Employees	402	301
Average Employees/Outlet	6.5	5.7
No. of Retail Outlets	240	325
No. of Retail Employees	1,578	2,024
Average Employees/Outlet	6.6	6.2
No. of Accommodation & Restaurant Outlets	56	75
No. of Accommodation & Restaurant Employees	708	658
Average Employees/Outlet	12.6	8.8

* Based on boundaries used in above survey

TABLE III - AVERAGE INCOMES (1975)

Tahsis area	$ 11,008
Gold River	11,592
Campbell River	9,870
Comox	9,939
Courtenay	9,305
Cumberland	8,201
Regional District of Comox-Strathcona	9,600
Province of British Columbia	9,888

Housing

The following is a breakdown of the housing supply in the Campbell River area in 1976:

TOTAL DWELLINGS	5,025
OWNED DWELLINGS	3,390
RENTED DWELLINGS	1,655
SINGLE-FAMILY DETACHED	3,130
SINGLE-FAMILY ATTACHED	370
APARTMENT DWELLINGS	790
DUPLEX DWELLINGS	115

A breakdown of annual residential housing starts by housing type indicates that the current residential construction activity is moving towards the provision of more multiple-family housing. This trend is prevalent throughout Canada.

SERVICES

Education

Campbell River is located within School District 72. Most of the schools in this District are close to Campbell River. Total pupil enrollment at all schools is presently about 5,800. Although the enrollment of Kindergarten to Grade VII exceeds the "operating capacity" by some 21%, the School District is using portable classrooms to accommodate the extra demand. Portable classrooms are also being used to accommodate the total enrollment in the Grade VIII to Grade XII levels. Consideration is being given to

expanding four elementary schools and constructing a new elementary school and high school.

Commercial

The Campbell River area is relatively well served by retail and service facilities. Retail sales per capita in the Regional District of Comox-Strathcona are estimated at $2,640 in 1977, somewhat lower than the provincial average of $2,860. However, per capita disposable income is higher in Comox-Strathcona, $6,650 versus the provincial average of $6,370. These figures suggest that residents of the Comox-Strathcona area spend a smaller portion of their income on local goods and services. This is not too surprising, given the proximity of the larger urban centres of Nanaimo, Victoria and Vancouver, where a broader range of goods and services are available.

Medical and Health Facilities

The Campbell River area is served by the Campbell River and District General Hospital, which has a capacity of 136 beds, and provides all levels of hospital services. To the south, St. Joseph's General Hospital in Comox has 190 beds and provides acute, extended and psychiatric care.

There are 18 resident doctors, twelve dentists, three chiropractors and two optometrists, as well as a medical clinic located in the municipality. Ambulance services are also available in Campbell River.

Recreation Facilities

There are a large number and variety of publicly and privately provided recreation facilities in the Campbell River area, including an ice arena, with indoor pool under construction, a bowling alley, a nine-hole golf course, a curling rink, many parks, skiing areas nearby, marinas and tennis courts.

In addition, the natural amenities in the area provide many opportunities for outdoor recreation, including sport fishing, hunting, camping, hiking, oyster picking, clam digging, swimming, scuba diving and boating.

Cultural and Social

Located in the Campbell River area are a museum, a theatre, and a branch of the Vancouver Island Regional Library. There are also two drive-in theatres in the area.

There is an alcoholism and drug treatment centre located in Campbell River.

Communication Facilities

The Campbell River area is served by three weekly newspapers, CRTV cable TV (nine channels, ETV, and local programming) and a radio station, CFWB (1490). As part of the east coast area, it is also served by the Powell River radio station CHQB (1280).

Court and Judicial

Although currently sharing a building with the Campbell River RCMP detachment, the court offices are being considered for relocation to a new building.

Fire and Police Protection

The area within the municipal boundary of Campbell River District is served by the local fire department.

The RCMP detachment located in Campbell River provides police services to the central Vancouver Island area, parts of the mainland (around Bute Inlet), and the islands in the Johnstone and Georgia Straits. Police service is provided to the Campbell River District under contract with the municipality. In 1976, twenty-one RCMP personnel served the municipality, for a population:police ratio of 575:1. The British Columbia average is 560:1.

COMMUNITY INFRASTRUCTURE

The Sewage Disposal System

The Campbell River district has a sanitary sewer system with a secondary treatment plant constructed to serve a population of 15,000. The plant was designed to accommodate a doubling of capacity. This is anticipated to be necessary within the next two or three years, as a result of the municipality's normal growth.

The Storm Drainage System

Parts of Campbell River are served by storm sewers, including portions of the downtown area, Willow Point, and most of the newer subdivisions. Storm drainage is not generally considered a problem in most of the municipality.

Water Supply

There are five water districts in the Campbell River area, three of which are within the municipal boundaries. Water is supplied to the smaller water districts by the Greater Campbell River Water District. The source of the supply is Campbell Lake.

Subdivision Standards

The Campbell River area is well-planned and has a comprehensive array of zoning regulations and subdivision standards.

REGIONAL INFRASTRUCTURE

Transportation

Highway 28 is currently well under capacity, with an average daily traffic volume of 4,300 vehicles during the months of July and August (counted at a location one half mile west of Highway 19). Farther west, at the northern end of Buttle Lake, the traffic volume is only 850 vehicles per day.

EFFECT OF THE QUINSAM PROJECT

CAPITAL AND OPERATING COSTS

Annual capital costs associated with the Quinsam development will increase from about $0.5 million in 1978, to almost $11 million in Year 2, and $36 million in Year 3. After that time, annual capitat costs will vary due to the replacement schedule for major equipment.

Operating costs are estimated to total $12 million in Year 3 and $12.6 million annually from Year 4 to Year 14, expressed in 1977 dollars. About $5.2 million of the total annual operating cost will be in wages and salaries; the remainder will be in materials, supplies, royalties, licences and other expenses.

EMPLOYMENT

In this section, the mine-related employment requirements are outlined and estimates are made of the number of mine-related jobs which could be filled by the available local labour supply. Both direct and indirect employment will be required during the construction and operation phases of the project.

DIRECT EMPLOYMENT REQUIREMENTS - CONSTRUCTION

The construction phase of the project is expected to last about eighteen months and may require up to five hundred person-years of effort.

Forecasting, at this time, the number of construction workers who will be hired locally is difficult; however, there are some conditions which will influence this forecast:

- the level of construction work which will be contracted out by the company, and which contractors are successful in obtaining the contracts;
- the skills and experience of the available labour force at the time of construction, and
- the level of unemployment in the construction trades.

Given that about fifty percent of the currently unemployed construction workforce fall in the "labouring and elementary work" categories, and that unemployment in construction in the area is estimated to fall significantly below the March total of 240 during the summer months, it is forecasted that at least fifty of the construction workers will be hired locally.

Indirect Mine Employment Requirements - Construction

The construction phase will take place over a period of about eighteen months, and employment will peak in the summer of Year 2. The employment multiplier during this phase is expected to be quite low (in the order of 1.10) for the following reasons:

- The construction phase is of short duration; this suggests that a large number of the construction workers will be brought in from areas outside the Campbell River area.
- Many of these workers are likely to have specialized skills and will be working on individual tasks of short duration.
- Any increases in demand will probably be accommodated through modest improvements in business productivity, longer business hours, or the use of temporary or part-time labour, rather than an increase in capital investment.
- Given the fact that many of the construction workers will be in the Campbell River area temporarily, a substantial portion of the wages and salaries earned by these workers will not be spent locally.

A conservative multiplier of 1.10 leads to an estimate of indirect employment of fifty persons during the construction phase. Because of the relatively high unemployment in the Campbell River area and because these job opportunities will be of a temporary nature, it can be expected that virtually all of these jobs will be filled by local residents.

Direct Employment Requirements - Operations

The operations phase, expected to commence in the middle of Year 3, will employ about 235 persons. A few of these employees, mainly management, professional and technical personnel, will be on site during the construction phase. Based on previous experience at other Luscar mining developments, it is estimated that about 10% of the construction workers will assume positions as mine operating staff, due to similarities in required skills. It is also likely that the majority of these will be locally hired construction workers. About twenty-two of the operations phase salaried staff will be skilled personnel transferred from other operations.

Examination of the CMC statistics indicates that there are about 650 unemployed workers registered with CMC in the north Island area (with various forms and degrees of training) who may be suited for employment at the minesite. Since the total population of the area is about 50,000 and since perhaps 20,000 of these people live within commuting distance of the Quinsam site, it is estimated that, on the average, about 40% of the registered CMC clients live within this commuting distance.

However, certain other factors will influence the number of locally available employees who will join the mine work force. These factors are as follows:

1. Not all the unemployed persons looking for work are registered with CMC;
2. The current magnitude and characteristics of the resident unemployed labour force could change significantly by the time hiring for the operations phase commences;
3. The CMC statistics are for "primary occupations" only;
4. Currently unemployed workers with no experience or skills in mining operations may, on their own initiative and in anticipation of the mine project, upgrade their skills in specific areas;
5. Since the Campbell River area population has been growing at a rate of about 4.2% per year, it can be assumed that the total unemployed labour force will increase at roughly the same rate. Therefore, by early 1981, the absolute number of unemployed could be 10-12% higher.
6. In addition to CMC clients, there are also a number of "unemployed employables" registered with the Ministry of Human Resources. The majority of these people are suitable for occupation as labourers or clerical staff.

Therefore, for purposes of this perliminary assessment, it has been assumed that the maximum number of resident unemployed (including registered and not registered employables) available in each category is about 50% of the total registered unemployed in each category.

Table IV provides an estimate of the number of workers in each category who can be hired locally. Many of the workers will require varying degrees of training; however, on-the-job training has been done extensively at other Luscar coal mining operations as a result of labour shortages in certain skill areas.

In addition to on-the-job training given by the company, it may be desireable to administer special training courses in the Campbell River area. This is an area which should be more fully explored in the next stage of the assessment procedure. Preliminary discussions between the company's Industrial Relations staff and the Manager of the Campbell River Manpower Centre office have already been initiated.

In summary, it is estimated that about sixty-eight operations personnel will come from other Luscar mines or from other labour sources outside the vicinity of Campbell River. Table V shows a breakdown of the personnel.

Indirect Employment Requirements - Operations

Of the projected mine operations workforce of 235 persons, about 165 - 170 will be hired in the Campbell River area and about 65 - 70 will be brought in from outside the area.

With coal mining operations of this type, there is usually a substantial variation in estimates of the

EXHIBIT 10

Labour Force Required / Labour Force Available (partial only) (by primary occupation choice)	TOTAL AVAILABLE & EMPLOYABLE	Phys. sciences technologists & technicians	Clerical and related	Draftsmen	Surveyors	Accountants, Auditors	[illegible] mat'ls handling	Other motor transport operating	Truck Drivers	Other constr'n trades	Supervising: other constr'n trades	Pipefitting, plumbing	[illegible] workers	Carpenters & related	[illegible] exc'ng, grading, paving	[illegible] re above	Excavating, grading, paving	[illegible] Mechanics & Repair	Air, Farm, etc. Mechanics & Repair	Motor Vehicle Mechanics & Repair	Electrical [illegible] fab'n & assem'ly	Mechanical [illegible] fab'n & assem'ly	[illegible]	Mining & Quarrying	Forestry & logging	[illegible], sorting etc.	Timber Cutting & related	[illegible], etc. services	[illegible], etc.	[illegible], etc.	[illegible] and cooks	[illegible] & watchmen	No.
No.	656	1	368	4	8	7	1	3	63	5	144	4	2	34	5	2	33	10	36	41	1	2	4	26	25	107	18	25	9	64	24	8	
HOURLY PERSONNEL																																	
Dragline/Shovel Operator	4							2	2																								8
Dragline/Shovel Oiler	8																	2	4	2													8
Overburden Blaster	1																							1									1
O/B Blaster's Helper	1																							1									1
O/B Drill Operator	0																																6
O/B Drill Oiler	6																			6													6
Lectra Haul Operator	24								14															10									24
Dozer Operator	12																12																12
Coal Loader Operator	2								2																								2
Coal Driller/Blaster	1																							1									1
Coal Hauler Operator	8																									8							8
Dozer Operator	4																									4							4
Mechanic	8																	3	3	2													15
Welder	0																																8
Electrician	1																					1											8
Machinist	1																						1										1
Grader Operator	4								3						1																		4
Scraper Operator	2														2																		2
Dozer Operator	4																4																4
Pumpman	4										2									2													4
Servicemen	4																			4													4
Labourers	4										4																						4
Utility Eqpt. Operator	1										1																						1
Security	6																											2				4	6
Watchman	1																											1					1
Janitor	2																												2				2
Utility Truck Driver	1										1																						1
Control Room Operator	0																																3
Washery Operator	3						1																			2							8
Labourer	3										3																						3
R.O.M. Receiver	3																									3							3
Breaker Station Operator	3																									3							3
Clean Coal Loadout	3																									3							3
Front-end Loader Operator	2								1								1																2
Millwright	3													3																			3
Welder	0																																3
Electrician	0																																3
Truck Operator	12								6																	6							12
Mechanic	1																			1													1
Electrician	0																																1
Welder	0																																1
F.E.L. Operator	2								2																								2
Utility Operator	2										2																						2
Mtce Operator	4																			4													4
Sub-total	155						1	2	30	0	13	0	0	3	3	0	17	5	7	21	0	1	1	13	0	29	0	3	2	0	0	4	201
SALARIED PERSONNEL																																	
Mine Superintendent	0																																1
Asst. Mine Superintendent	0																																1
Mine Foreman	0																																4
Asst. Mine Foreman	0																																2
Plant Superintendent	0																																1
Plant Foreman	0																																4
Maintenance Superintendent	0																																1
Maintenance Foreman	0																																4
Office Manager/Accountant	1					1																											1
Personnel/Safety Manager	0																																1
Warehouse/Purchasing	0																																1
Warehouseman	4		4																														4
Bookkeeper	1					1																											1
Typist	2		2																														2
Mine Engineer	0																																1
Draftsmen/Technician	1			1																													1
Surveyor	1				1																												1
Rod Man	1				1																												1
Lab Technician	1	1																															1
Dock Foreman	0																																1
Sub-total	12	1	6	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34
GRAND TOTAL	167	1	6	1	2	2	1	2	30	0	13	0	0	3	3	0	17	5	7	21	0	1	1	13	0	29	0	3	2	0	0	4	235

TABLE V - BREAKDOWN OF OPERATIONS PERSONNEL

1) HOURLY PERSONNEL	
Dragline/shovel Operators	4
Overburden Drill Operators	6
Mechanics	7
Welders	12
Electricians	11
Control Room Operators	3
Washery Operators	3
2) SALARIED PERSONNEL	
Mine Superintendent	1
Assistant Mine Superintendent	1
Mine Foremen	4
Assistant Mine Foremen	2
Plant Superintendent	1
Plant Foremen	4
Maintenance Superintendent	1
Maintenance Foremen	4
Personnel/Safety Manager	1
Warehouse/Purchasing	1
Mine Engineer	1
Dock Foreman	1
TOTAL	68

employment "multiplier" effect, ranging from 1.2 to 2.5. Because the Campbell River area population is quite substantial and the proposed Quinsam Project is relatively small, the employment multiplier in this case is estimated between 1.5 and 2.0. This leads to an estimate of indirect employment during the operations phase of about 120 to 235 jobs.

It is estimated that a large proportion of these "indirect" jobs will be filled by Campbell River area residents, due to the following reasons:

1) The indirect jobs will be predominantly in the tertiary industries, such as retailing, community and personal services, and public administration. There appears to be a sustantial supply of available unemployed labour force in compatible white collar occupation categories in the Campbell River area.
2) Jobs in the tertiary industries generally pay less than would the average job and as a result are unlikely to attract labour force from areas outside Campbell River.
3) A large proportion of the indirect jobs are likely to be attractive to the female labour force, who are traditionally less mobile than the male labour force.

Accordingly, it is estimated that about 85% (100-200) of the indirect jobs created by the operations phase of the Quinsam Project will be filled by Campbell River residents.

INCOME LEVELS

Total mine-related employment (direct and indirect) during the operations phase is estimated to be between 355 and 470 jobs, about 88 to 103 of which would be hired as non-residents of the Campbell River area. Table VI presents a summary of direct and indirect employment effects of both the construction and operations phases of the Quinsam Project.

CONSTRUCTION PHASE

Since a breakdown of the construction workforce is not available at this time, the total income has been estimated on the basis of a proportion of the operations phase budget.

Based on figures generated during the Quinsam Project feasibility study, the following annual expenditures on wages and salaries were estimated:

YEAR	TOTAL ESTIMATED WAGES & SALARIES
1	$ 461,000
2	4,733,000
3	2,304,000

Income for indirect mine-related employment is especially difficult to estimate. However, for purposes of this analysis, it is assumed that the average annual income for such employees will be lower than the average income in the Courtenay area (which has predominantly white collar employment), and is estimated to be $9,000. The total income by year would be as follows:

TABLE VI - SUMMARY OF DIRECT AND INDIRECT EMPLOYMENT

	Construction Phase			Operations Phase		
	Hired Locally	Hired Outside Campbell River	Total	Hired Locally	Hired Outside Campbell River	Total
Direct Mine Employment	50	400	450	167	68	235
Indirect Mine Employment	50	0	50	100 - 200	20 - 35	100-235
Total Mine-Related Employment	100	400	500	267 - 367	88 - 103	355-470

YEAR	TOTAL INCOME IN SALARIES & WAGES
1	$ 45,000
2	450,000
3	225,000

OPERATIONS PHASE

Based on a breakdown of the direct, mine-related work force, annual individual incomes and total annual incomes, the following summary was prepared:

OPERATIONS STAFF	NO.	TOTAL ANNUAL AVERAGE INCOME	AVERAGE ANNUAL INCOME
Salaried Personnel	34	$ 895,000	$ 26,320
Hourly Personnel	201	4,286,000	21,320
All Personnel	235	5,181,000	22,050

The above figures, expressed in 1977/78 dollars, are expected to remain constant throughout the operations phase of the mine.

In addition to the expenditures made by the direct mine-related work force, there will also be expenditures made by the indirect work force, estimated to number between 120 and 235. Since it is not possible to provide a detailed breakdown of the income distribution of this group at this stage, it is assumed that their average income is equal to the Campbell River average income which, for 1977, is estimated at $11,400. This translates into a total annual

income for the "indirect" work force of about $1,370,000 to $2,680,000.

Estimated expenditures in the Campbell River area are based on the assumption that a substantial portion of the mine-related work force will be hired from the available local labour force. This labour force, even if unemployed, will have some income, a large proportion of which will be spent locally. A summary of personal income and expenditures is outlined below:

YEAR	TOTAL PERSONAL INCOME (DIRECT & INDIRECT EMPLOYMENT)	TOTAL ESTIMATED EXPENDITURES IN CAMPBELL RIVER AREA
1	$ 506,000	$ 96,000
2	5,183,000	977,600
3	5,804,500 - 6,459,500	2,538,300 - 2,970,600
4 - 14	6,551,000 - 7,861,000	4,116,200 - 4,981,000
	$84,181,500 - 99,246,500	48,890,100 - 58,835,200

Without the Quinsam Project, the total Campbell River average unemployment is estimated to be 8% in Year 3, or about eight hundred to a thousand unemployed persons. The operations phase is estimated to bring 267 to 367 jobs to the Campbell River area - jobs which are expected to be filled locally. With the workers brought in from outside the Campbell River area will come an additional forty-five persons without mine-related employment. The net increase in locally available jobs is, therefore, about 222 to 322. This demonstrates that the Quinsam Project has the potential to

reduce local unemployment by 20% to 40%.

POPULATION

Beginning with the construction phase, the Quinsam Project will bring a labour force of four hundred employees to the Campbell River area, with the majority of this work force residing in the construction camp. By the middle of Year 2, most of the seventy or so operations personnel hired or transferred from outside the area will take up residence in the community. In addition, mine-related "indirect" jobs will bring an additional thirty or so employees to the community.

Given that these new residents will be bringing their families with them, and that each additional employee represents an additional household, there will be one hundred new households, or about three hundred new residents.

It is estimated that by Year 3 the Campbell River labour force participation rate will be 0.48. Assuming that the participation rate for the mine-related population increases is similar to the Campbell River rate, the labour force would increase by about 145, one hundred of whom would be directly or indirectly employed in mine-related activities.

The size of the population increase in relation to the total population and the traditional rate of population growth will be relatively insignificant. Similarly, the effect of the population increase on the characteristics of

the Campbell River area population will also be insignificant.

ECONOMIC BASE

Because the Campbell River area has a relatively good supply and mix of equipment sales and service outlets, a portion of the materials and supplies requirements will be purchased locally including fuel, lubricants, small parts, small vehicles (cars & trucks), safety equipment, electrical parts, plumbing equipment, machine shop services, lumber and office supplies.

HOUSING

The average residential dwelling sold through Multiple Listing Service in 1976 in the North Vancouver Island area (north of the Oyster River) sold for $41,849. Since the average income for the direct, mine-related work force is about $22,050, it is estimated that the majority of these workers will be able to afford housing in the $40,000 to $55,000 range.

The indirect, mine-related work force is expected to have a lower average annual income, estimated to be equivalent to the 1977 estimated average income for Campbell River, i.e. $11,400. However, approximately 85% of this work force are already housed in Campbell River. Otherwise, these members of the work force will have to rent or purchase housing in the lower end of the housing price range.

The supply of housing in Campbell River can be increased by the required amount (i.e. about one hundred units) relatively easily by the local development/building industry. There are about 200 serviced and 125 unserviced lots in the planning approval process. There is sufficient land available within the municipal boundaries of Campbell River District to accomodate at least a tripling of the current population.

In addition, the current vacancy rate is about 2 - 4%, which translates into 100 to 200 dwellings. Therefore, the available existing housing stock can also accomodate some increase in population.

Although it is expected that the vast majority of the mine workers taking up residence in Campbell River will be purchasing single-family detached homes, there will be some demand for other types of dwellings. An approximate breakdown by tenure and type which may be expected is estimated as:

DWELLING		NUMBER
Tenure:	Owned	80
	Rented	20
Type:	Single-family Detached	65
	Single-family Attached	10
	Apartment	20
	Duplex	5

It is not expected that there will be a need for the company to assist in the provision or financing of the employee housing requirements.

EDUCATION

It is estimated that the operations phase would bring an additional 45 pupils in the Kindergarten to Grade VII level, and about 30 in the Grade VIII to Grade XII level. It is anticipated that no serious pressure will be created by the Quinsam Project, providing the building program proceeds according to plan.

COMMERCIAL

Since the available labour force already has some income and the increase in population brought on by the project is relatively small, it is not expected that the mine project will bring about significant expansion of current commercial facilities. Nor is it expected that the mix of commercial facilities and services will be significantly altered.

MEDICAL

Based on the relatively small number of additional residents brought by the mine development and the generally high level of medical and health services available locally, the mine's impact on most facilities and services of this type is expected to be insignificant. However, ways of mitigating possible problems with alcohol and drug abuse during the construction phase should be investigated as part

of the next stage in the assessment process.

RECREATION

Although an additional population of about 300 would result in increased use of the various regional and municipal facilities and services, local authorities opined that the additional demands could be met by the existing and planned facilities and services.

CULTURAL AND SOCIAL

Most of the social and counselling services available in the area will not be significantly affected, with the possible exception of the alcoholism and drug treatment centre located in Campbell River. It is felt that the construction phase is likely to have a greater impact on the need for alcoholism and drug treatment services than will the operations phase.

FIRE AND POLICE PROTECTION

At the minesite there will be a need for fire protection, which will be provided by the company in accordance with British Columbia regulations.

The construction phase of the Quinsam project, due to the temporary nature of the employment and the fact that many of the workers will be single or without their families, is likely to result in the need for some additional police protection. Potential problems include fighting, drunkeness, gambling, prostitution and drug trafficking.

The company's hiring and accommodation policies may serve to mitigate such problems, but additional police resources are likely to be required in any event. Details of the need for such resources should be worked out with the British Columbia Police Commission and the RCMP at the next stage of the Quinsam impact assessment process.

COMMUNITY INFRASTRUCTURE

Sewage disposal and storm drainage systems are not likely to be affected by the project. Water is supplied to the smaller water districts by the Greater Campbell River Water District. The source of supply is Campbell Lake. It is expected that the Quinsam Project related population increase can be readily accommodated in terms of the community's water supply.

The Campbell River area is well-planned and has a comprehensive array of zoning regulations and subdivision standards. Any new development associated with the Quinsam Project will be undertaken in accordance with all such local bylaws and standards which will ensure that new development is of good quality.

It is likely that the incremental needs will be spread out through the entire community, resulting in more intensive or, in some cases, productive use of existing facilities.

REGIONAL INFRASTRUCTURE

Some inconvenience may be caused by the movement of construction materials and major mining equipment. These can be mitigated in co-operation with the local RCMP detachment, who would be able to assist whenever extraordinarily slow-moving, heavily-loaded or oversized vehicles are required to use the public roadways in the area.

Coal will be trucked in one-hundred ton vehicles along private logging roads (Elk River Timber) and will be required to cross the public highway system at Highway 19, in order to access the private roadway to the dock facility of Western Mines Ltd. It is planned to complete a minor realignment of the private road in this location in order to eliminate the short jog currently necessary at the highway. The highway crossing will be constructed in consultation with the B.C. Department of Highways.

In order to minimize dust problems along the haulage route (especially near built-up areas), it may be necessary to apply an oil-treatment or to pave the roadway. It may also prove necessary to install dust covers on the haulage trucks to eliminate any potential problems with coal dust.

The Western Mines dock facility appears to be the best of several alternative dock facility locations studied by the company's engineering consultants. Some upgrading and repairs will have to be performed on the dock itself.

The District Municipality of Campbell River wishes to establish an industrial park north of Duncan Bay and believes that a deep-water docking facility in this location would be an asset to the community. However, the cost of building such a facility, constructing the bridge across the Campbell River and transporting the coal about another four miles would put the financial feasibility of the Quinsam project into serious question. Consequently, it is not judged to be feasible for the company to undertake the creation of an entirely new dock facility.

ENERGY

The mine's permanent electric power supply will come from the Strathcona Generating Station. A seven-mile supply line will be required, as well as about six miles of mine distribution lines. Annual power consumption is estimated at 27.55 MKwh, which based on appropriate British Columbia hydro rate schedule (April, 1977), results in an annual cost of about $365,000. No major problems are anticipated with respect to the construction of electric supply lines; however, there may be difficulties in obtaining sufficient power from B.C.Hydro to meet the proposed schedule.

SOCIAL AND ECONOMIC ADJUSTMENT CONSIDERATIONS

The Campbell River area, as discussed earlier, is a rapidly-growing, "boom town" type of community. There are apparently some local problems in terms of crime, alcoholism and drug abuse, typical of other such communities. The social problems which may arise as a result of the mine development are likely to be of the same genre and scale. However, experience has shown that as a community expands, diversifies and matures, its ability to deal with social problems improves, partly as a result of being able to afford better facilities and staff to avoid or treat these problems.

Based on the experience of mine developments, it is expected that the mine would be assessed at about 39% of the value of all structures and fixed machinery and equipment. Property tax levels would be based on a range between seventy and seventy-five mills, broken down as follows:

Schools	45 - 50 mills
Hospitals	3 - 6 mills
General Purpose	10 - 20 mills

Property taxes are therefore estimated at about $275,000 to $350,000 annually. The mine area is located in Electoral Area D of the Regional District of Comox-Strathcona. The additional capital and operating costs that will result from the mine development and the associated residential growth have not yet been determined.

CONCLUSION

The Quinsam project is expected to provide to the Campbell River area a number of socio-economic benefits as follows:

1) employment opportunities for local residents;
2) improved economic diversity;
3) continued employment possibilities for employees at Western Mines;
4) increased local tax revenues;
5) improved delivery of local government services;
6) continued population growth in the Campbell River area.

On the other hand, there remains the possibility of certain adverse impacts in the following areas:

1) alcohol and drug abuse;
2) crime rate.

Although this preliminary assessment of the Quinsam Project has identified the key areas of impact, further work is required in the next stage of the assessment process to investigate methods of enhancing positive impacts and mitigating negative impacts.

PART V - ENVIRONMENTAL IMPACT ASSESSMENT

* The following section is a summary of "Preliminary Environmental Impact Assessment of the Quinsam Coal Project", prepared by International Environmental Consultants Ltd., July 1978, with which Quinsam Coal Ltd. concurs.

SCOPE AND PURPOSE

International Environmental Consultants Ltd., of Richmond, B.C. prepared a Preliminary Environmental Impact Assessment of the Quinsam Coal Project, in July, 1978. The following information is an extraction and summarization of the I.E.C. report.

This section of the report identifies biophysical subject matter pertinent to the Quinsam River watershed region of Vancouver Island and subject matter pertinent to the areas of assessed environmental impact. The proposed industrial actions (for mining and shipping coal) were compared with the environmental baseline to identify areas of expected interactions. Those interactions considered to be most significant are identified, followed by a discussion of mitigative measures, essential data gaps that are to be filled by further study, resource management options and suggested monitoring programs.

No overriding biophysical environmental factors have been found at this stage that would preclude the mine development so long as appropriate planning and implementation takes into account the sensitivities that have been identified.

The most significant potential impacts perceived in the present conceptual mining plan fall into two broad categories. They are:

1) Preservation of the surface water quality and the fisheries resource in the Quinsam River.
2) Location and size of the area selected for the coal stockpile and loadout facilities on Discovery Point.

As a result of the study, and in view of eliminating unnecessary impacts and minimizing unavoidable impacts, a number of detailed studies have been initiated relative to the Stage II study. These studies are underway and are included as Terms of Reference in Appendix I.

ENVIRONMENTAL DATA BASE

PHYSICAL SETTING

The Quinsam Coal properties are situated about 29 km (18 miles) west of the municipality of Campbell River. The mine pits, waste dump and plant site will occupy a total area of less than 26 km^2 (4 mi^2). The elevation of Middle Quinsam Lake near the centre of the project area is about 260 m (910 ft) above sea level with the uplands in the vicinity of the lake reaching 365 - 395 m (1200 - 1300 ft) in elevation.

The proposed mine pits and facilities lie largely within the Quinsam River watershed with only a slight potential for drainage to the Campbell River system via Gooseneck Lake and Miller Creek in the north. The mine facilities flank Middle Quinsam Lake on the north, east and south sides. The Quinsam River drains Middle Quinsam Lake to the east. Two small unnamed lakes to the south of Middle Quinsam Lake, and one small lake to the north (Campbell drainage) are also adjacent to the project facilities.

PRESENT LAND USE

The entire Quinsam area is presently classified under the general category of woodland. The timber of the mine area is almost entirely second growth Douglas-fir that was planted some 15-20 years ago.

Land use patterns of the Campbell River area are typical for the east coast of Vancouver Island in that most urban, commercial, industrial and recreational land use is

concentrated near the Island Highway and the coast. Agricultural land parallels this to the west and the woodlands are in the interior.

The shoreline and Island Highway between Oyster River and Campbell River are flanked by homes and tourist resorts. Most of the development is within one-quarter to two miles of the highway.

Agriculture in the Campbell River area is concentrated in the lower Quinsam Valley and is largely devoted to hay production. Very little of the Agricultural Land Reserve acreage (about 30%) is presently used for agriculture, with poor irrigation cited as a major limiting factor.

AIR QUALITY

A climate summary of the Campbell River area is given in Table VII.

Prevailing winds on the east coast of Vancouver Island are from the southeast in late fall, winter and early spring, and from the northeast at other times. Calm periods are frequent and occur primarily overnight. Greatest wind speeds occur with the southeasterlies and are associated with the passage of Pacific storms.

The Pollution Control Branch currently maintains two air quality monitoring stations in the Campbell River area. The station locations and the parameters measured at

TABLE VII - CAMPBELL RIVER CLIMATE SUMMARY (CANADA DEPARTMENT OF THE ENVIRONMENT - ATMOSPHERIC ENVIRONMENT SERVICE 1975, FROM BELL AND THOMPSON 1977)

TEMPERATURE	
Mean Temperature - Annual	8.9°C
Mean Temperature - January	1.3°C
Mean Temperature - July	17.4°C
Extreme Maximum Temperature	37.2°C
Extreme Minimum Temperature	-17.8°C

PRECIPITATION	
Mean Annual Total Precipitation	1538 mm (60.6 in)
Mean Annual Rainfall	1436 mm (26.5 in)
Mean Annual Snowfall	104 cm (102 mm water equivalent - 40.9 in. snow)

ANNUAL NUMBER OF DAYS WITH:	
Frost	85 days
Measurable Precipitation	137 days

Average Annual Hours of Bright Sunshine 1751 hours

Frost Free Period

29 April - 27 October 180 days

each station are listed in Table VIII. Parameter statistics for the "Courthouse" station are given in Table IX.

SOILS

SURFICIAL GEOLOGY AND SOILS

The maritime climate of the Campbell River region has generally produced brightly coloured and strongly leached soils of strong acidity and low base saturation. Podzols and peats are the more common soil types found. The soil series relevant to the study area are described in Table X.

The soils of the Quinsam area have developed from unmodified glacial till. The till of this region is bouldery, compact and concrete-like. The resultant soils are stony or gravelly sand and of sandy loam to loam texture. Soils of the Dashwood series, which form a minor component in the study area, are formed from till that has been washed or covered by a few inches of glacio-fluvial or alluvial gravel. These soils are stony and sandy. The approximate location of the soil types near the mine site is shown in Figure VIII.

SOIL CAPABILITY FOR FORESTRY

The Middle Quinsam Lake is much more suited for forestry than for agriculture. Productive forest sites occur on all of the soil series present (except peat). The Quinsam and Dashwood series have medium to high site indices for forestry. The Dashwood series possesses an

TABLE VIII - CAMPBELL RIVER AIR QUALITY MONITORING STATIONS (P.C.B.)

SITE NO. AND LOCATION		PERIOD OF OPERATION	PARAMETERS MEASURED
110405	Dolphins Resort 4125 Discovery St.	1 June 1976 to present	Particulates (total, soluble, insoluble), ash (soluble, insoluble), sulfate, chloride, sulfation index
110406	Courthouse Bldg. 301 St. Ann's St.	8 August 1976 to present	As above, plus sulfur
110407	Senior Secondary School 305 Dogwood	1 June 1976 to 3 August 1977	Particulates (total, soluble, insoluble), ash (soluble, insoluble), sulfation index
110408	School Board 1415 Island Highway	1 June 1976 to August 1977	As above.
110409	School Bus Garage	25 August 1976 to 3 August 1977	As above.

TABLE IX - TEST RESULTS FOR CAMPBELL RIVER COURTHOUSE AIR QUALITY MONITORING STATION
(6 AUGUST 1976 - 15 MARCH 1978)

PARAMETER	SAMPLING METHOD*	NO. VALUES	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION
PARTICULATES:						
Total ($T/mi^2/mo$)	D	19	19.6	1.3	9.1	4.8
Total (mg/m^3)	S.P.	76	175.0	15.0	59.7	33.2
Total (mg)	S.P.	9	163.0	44.9	98.1	42.7
Soluble ($T/mi^2/mo$)	D	19	11.4	1.3	4.2	3.2
Insoluble ($T/mi^2/mo$)	D	19	8.9	<0.5	4.9	2.0
ASH:						
Soluble ($T/mi^2/mo$)	D	18	4.4	<0.5	1.8	1.1
Insoluble ($T/mi^2/mo$)	D	18	3.4	<0.5	3.7	1.8
SULFATE:						
Soluble ($T/mi^2/mo$)	D	2	1.1	0.96	1.03	0.07
SODIUM:						
Total (mg/m^3)	S.P.	9	3.5	0.5	1.4	0.9
Soluble ($T/mi^2/mo$)	D	2	0.54	0.21	0.38	0.17
SULFUR:						
Total (mg/m^3)	S.P.	9	2.1	0.9	1.5	0.4
CHLORIDE:						
Total (ug/m^3)	S.P.	9	5.3	<0.5	1.2	1.5
Soluble ($T/mi^2/mo$)	D	2	0.91	0.34	0.63	0.29
SULFATION INDEX ($mg/dm^2/D$)	Misc.	17	0.16	0.07	0.11	0.03

* D = Dustfall; S.P. = Suspended Particulate;

TABLE X - DESCRIPTION OF SOIL SERIES

SERIES	% COVER OF MINING LAND	TYPE	SOIL GROUP	DRAINAGE	DOMINANT TOPOGRAPHY	STONINESS	DESCRIPTION OF VIRGIN SOIL
Rough land	75%	Variety	-	Variable	Mountainous	Very stony	Thinly mantled bare rock.
Quinsam	25%	Gravelly sandy loam	Podzol	Well drained	Undulating to steeply sloping.	Moderately to very stony.	1-2 inches of grey platy sandy loam over 18-20 inches o reddish brown to yellowish brown permeable gravelly sandy loam, over pale brown to greyish compact and ver slowly permeable gravelly sandy loam till.
Dashwood		Loamy sand. Gravelly loamy sand.	Brown podzolic	Well to moderately well drained.	Sloping to gently sloping.	Frequently cobbly and stony.	25-30 inches of yellowish brown, loose, permeable gravelly loamy sand or loamy sand, over grey, often mottled very slowly permeable gravelly sandy loam till or marine clay

impermeable till which maintains a perched water table well into the summer months, creating favourable growth conditions.

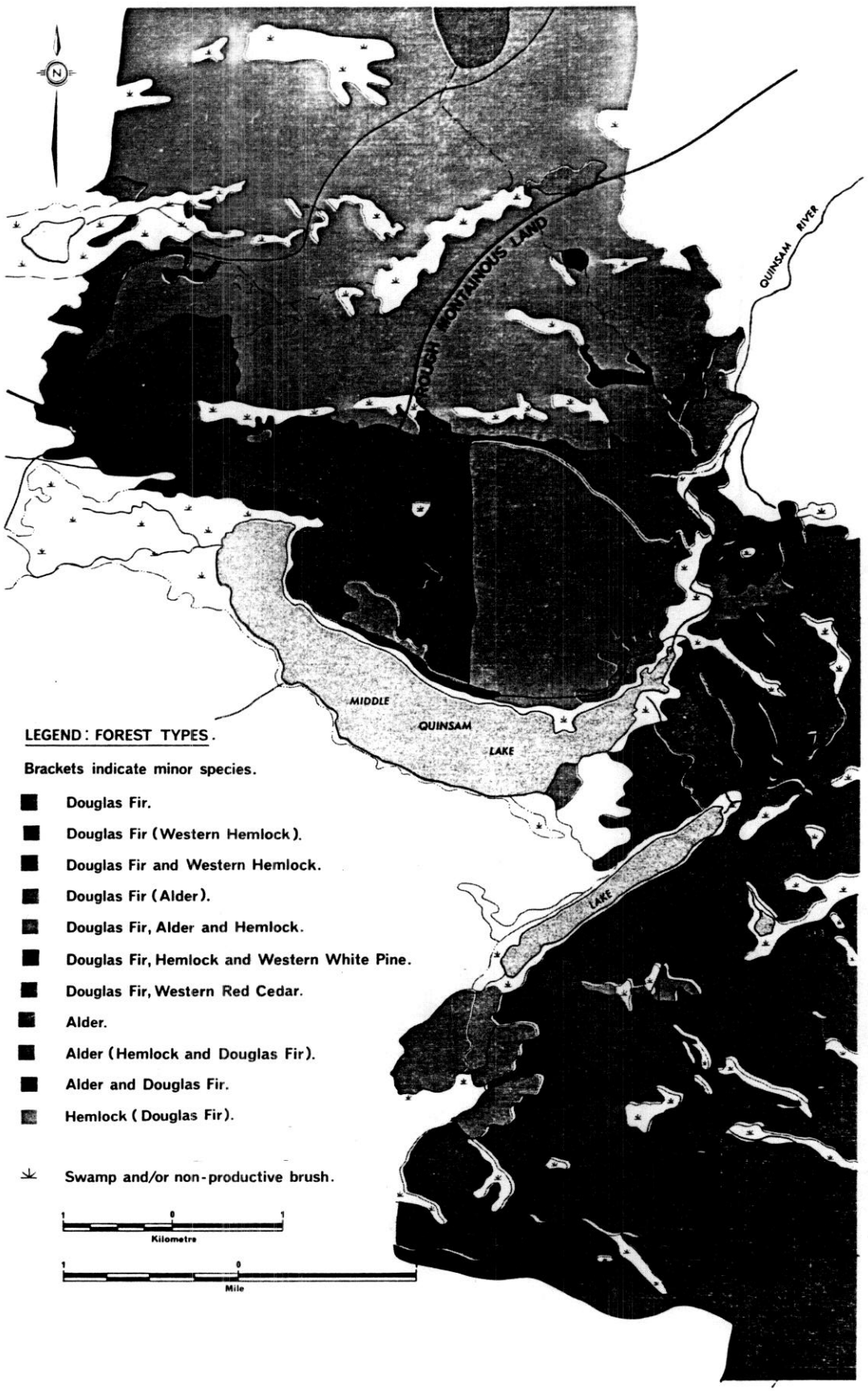
Good and medium forest sites predominate on the pit area.

VEGETATION

Douglas-fir is the characteristic dominant tree of the biogeoclimatic subzone; arbutus and grand fir commonly occur below 300 m a.m.s.l. Figure VIII shows the forest cover of the Quinsam Coal area as mapped by the B.C. Forest Service and Elk River Timber.

Sampling of vegetation plots found conifers present in the following order of dominance: western hemlock, western red-cedar and Douglas fir. Willow and alder were the most common deciduous trees. Herbs dominate the ground cover but have undoubtedly been altered from the natural state by logging and fires.

In an inventory report of the Quinsam River, the B.C. Fish and Wildlife Branch (1975) noted the composition of the streambank vegetation, which is included following Figure VIII.



FOREST COVER

with

GENERAL SOIL CLASSIFICATION

000 71 (9)

FIGURE 8

STREAM SECTION	% COVER	VEGETATION PRESENT
Lower Quinsam Lake to old Elk River Timber bridge	5-10%	Immature Douglas-fir association.
From bridge down to power transmission lines	20%	Mature alder association (with cow parsnip, devil's club and salmonberry)
From power lines down to Campbell River	20-30%	Mature hemlock, spruce and cedar (with salmonberry)

WILDLIFE

Birds

From 1973 to 1976, 140 species of birds were observed in the Campbell River estuary area. These species utilize its rich food supply, which includes vegetation, benthic and planktonic invertebrates and small fish.

Waterfowl

The east coast of Vancouver Island is an important wintering and staging area for waterfowl. Quinsam Lake and several ponds to the east of Quinsam Lake are considered important in this regard.

Upland Game Birds

The recent logging slashes of the area were prime breeding grounds for blue grouse. Rapid succession has made the area less suitable in recent years. Ruffed grouse is also an important game bird in the Campbell River area.

Birds of Prey

Site specific information is unavailable; however, the company has initiated a baseline inventory of birds in

the coal mining, haul road and proposed dock-site areas.

Mammals

Ungulates

The study area has very slight limitations to the production of ungulates and lies within an area mapped as moderately good winter range. Excessive snow depth is the major factor limiting ungulate production. A wildlife study on the development area has been initiated by the company.

FRESHWATER RESOURCES

PHYSICAL HABITAT

The Quinsam River is the major tributary to the Lower Campbell River, originating at elevation 360.9 m (1,100 ft.) above sea level in Upper Quinsam Lake, and flowing 51.5 km (32 mi) to the confluence with the Lower Campbell. B.C. Hydro controls a storage dam on Upper Quinsam Lake and a diversion dam upstream of Middle Quinsam Lake. The Quinsam River flows east from the diversion and then north to enter the Campbell River 3.5 km (2.2 mi) above its mouth. The Quinsam River drains a watershed area of 208.8 km^2 (108 mi^2).

SURFACE WATER QUALITY

Surface water samples have been collected and analyzed by the Water Resources Service for the period 1970 - 1978 at two locations on the Quinsam River:

1) above the confluence with the Campbell River;
2) at the end of the Quinsam Road.

The data is summarized in Table XI and illustrates seasonal variability.

Water from Lower Quinsam Lake was analyzed and rated unsuitable for domestic supply because of high temperatures and probable algal growth.

The Quinsam River hatchery operation requires water of continuous high quality. At present, the water supply for the hatchery is obtained from Cold Creek, which has a relatively constant temperature and low ammonia, coliform and metal concentrations. The Quinsam hatchery treats waste organic matter generated during the feeding and rearing of salmonoids prior to its discharge into the Quinsam River.

SURFACE WATER QUANTITY

The mean monthly discharge of the Quinsam River for the period 1957 - 1976 is summarized in Table XII. The mean flow in the Quinsam River during that period was 9.6 m^3/sec. (338 cfs).

Instantaneous flow in the upper Quinsam River is controlled by two dams, a storage dam on Upper Quinsam Lake and a diversion dam above Middle Quinsam Lake which diverts an average of 2.8 m^3/sec. (100 cfs) to Lower Campbell Lake. Maximum withdrawl from the Quinsam River is 8.5 m^3/sec. (330 cfs).

TABLE XI - QUINSAM RIVER WATER QUALITY SUMMARY*
(JANUARY 1970 - APRIL 1978)

		ABOVE CONFLUENCE WITH CAMPBELL RIVER			AT END OF QUINSAM ROAD		
	UNITS	MAX	MIN	MEAN	MAX	MIN	MEAN
Color	rel.unit.	15	<5	8.9	15	<5	8.9
pH	rel.unit.	8.2	6.8	7.5	8.2	7.0	7.6
Spec. Cond.	umho/cm	90	14	56.5	88	43	57.2
Solids Total	mg/l	64	36	47.8	56	36	45.3
Solids Diss.	mg/l	54	32	42.3	52	38	42
Solids Susp.	mg/l	10	<1	3.1	4.9	1.3	2.6
Temperature	°C	13.5	1.0	9.5	14.0	1.0	9.5
Diss. Oxygen	mg/l	13.7	7.8	10.7	13.9	7.8	11.1
Turbidity	J.T.U.	2.3	0.3	1.1	2.3	0.6	1.2
Alkalinity	mg/l	28.1	28.1	28.1	-	-	-
Hardness	mg/l	37.8	18.1	26.4	36.1	18.1	24.9
Ammonia	mg/l	.02	.01	.02	-	-	-
NO_2/NO_3	mg/l	.12	.01	.06	.05	.01	.03
Nitrate	mg/l	.22	<.02	.08	.18	<.02	.07
Nitrate	mg/l	<.005	<.005	.005	<.005	<.005	.005
Kjel. Nitrogen	mg/l	.14	.02	.08	.15	.15	.15
Total Nitrogen	mg/l	.19	.18	.19	.19	.19	.19
C.O.D.	mg/l	13.5	7.5	10.2	14.8	<10	10.5
Phosphate - Tot.	mg/l	.026	.004	.012	.022	.005	.010
Silica	mg/l	7.7	6.7	7.1	6.8	6.5	6.7
Sulphate	mg/l	5.0	1.7	4.5	<5.0	1.7	4.6
Tanin & Lignin	mg/l	.6	.2	.3	.5	.1	.3

TABLE XI - CONT'D...

		ABOVE CONFLUENCE WITH CAMPBELL RIVER			AT END OF QUINSAM ROAD		
	UNITS	MAX	MIN	MEAN	MAX	MIN	MEAN
Calcium - Diss.	mg/l	11.0	5.1	7.7	10.5	5.3	7.5
Calcium - Total	mg/l	5.6	5.6	5.6	5.6	5.6	5.6
Copper - Diss.	mg/l	.010	<.001	.007	-	-	-
Copper - Total	mg/l	<.01	<.001	.003	<.01	<.001	.003
Iron - Diss.	mg/l	.4	0	.17	-	-	-
Iron - Total	mg/l	1.7	0	.32	.36	.01	.23
Lead - Diss.	mg/l	.003	<.001	.002	-	-	-
Lead - Total	mg/l	.011	<.001	.003	.010	<.001	.003
Magnesium - Diss.	mg/l	2.5	1.0	1.5	2.4	1.0	1.5
Magnesium - Total	mg/l	1.0	1.0	1.0	1.0	1.0	1.0
Mercury - Total	mg/l	.13	.02	.06	.08	<.02	.05
Sodium - Diss.	mg/l	1.7	1.7	1.7	1.6	1.6	1.6
Zinc - Diss.	mg/l	.010	<.005	.007	-	-	-
Zinc - Total	mg/l	<.005	<.005	.005	.005	<.005	.005
Fecal Coliform	MPN	240	<2	50	1600	<2	214
Total Coliform	MPN	2400	2	352	2400	33	606

TABLE XII- QUINSAM RIVER MEAN MONTHLY DISCHARGE (cubic feet per second)/ by 35.314 equals m^3/sec.

YEAR	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1976	432	343	253	234	197	165	87	74	127	133	186	306
1975	302	220	449	393	376	182	106	87	159	305	1500	460
1974	611	532	648	397	257	279	170	83	116	137	326	541
1973	792	209	344	148	154	103	62	42	87	189	325	1090
1972	177	427	1290	615	300	241	76	94	156	99	321	566
1971	660	700	410	460	312	191	84	88	136	205	703	229
1970	306	336	227	179	151	102	57	66	114	119	180	726
1969	204	434	491	528	260	130	80	78	148	176	543	811
1968	1710	438	475	174	193	119	87	80	141	592	890	787
1967	606	407	566	254	208	154	67	61	99	347	322	767
1966	572	437	508	265	180	145	101	82	109	158	557	1380
1965	296	548	285	247	151	101	84	77	74	268	515	780
1964	636	504	294	184	147	285	160	112	108	152	211	302
1963	435	477	393	337	247	96	112	118	106	491	703	695
1962	484	451	270	231	202	144	92	134	108	393	743	1150
1961	1070	980	786	443	436	210	114	72	84	122	249	364
1960	312	641	202	346	251	244	91	65	64	188	344	588
1959	737	281	375	273	336	247	136	61	84	163	315	513
1958	744	816	310	305	191	112	67	58	72	315	250	765
1957	266	226	536	421	223	101	101	139	98	88	153	513
AVERAGE	818	480	456	441	239	168	97	84	110	232	717	667

AQUATIC INVERTEBRATES

Extensive studies of invertebrate communities and salmonoid stomach analysis have been summarized in a series of reports for the Campbell River and its estuary. Site-specific information for the Quinsam River consists of an aquatic habitat evaluation and mapping survey in 1975 between the fish hatchery and the hydro diversion. The results were not available for inclusion in this report.

FISH

Extensive use has been made of the many comprehensive reports available on both anadromous and resident fish populations of the area. Anadromous fish stocks are represented by chum, pink, coho and a few sockeye salmon with steelhead and cutthroat trout in moderate numbers. Resident fish populations in the Quinsam River drainage system above the major migration barrier include the inland subspecies of cutthroat trout, Dolly Varden char, rainbow trout and Kokanee salmon.

Additional information is available from Environment Canada fisheries officers and the Quinsam River hatchery. The hatchery staff are presently considering transplanting salmon fry to the upper watershed to allow utilization of additional natural rearing habitats and increase the productive capacity of the river system.

GROUNDWATER RESOURCES

Small wells in the area of the Oyster River delta are the closest wells identifiable and they report a high iron content and poor quality. Extensive drilling has been done during mining exploration on the Quinsam property; however, no groundwater hydrology or water quality measurements have been made to date.

The Quinsam hatchery receives water from Cold Creek. Water quality data can be made available by the hatchery.

MARINE RESOURCES

Campbell River Estuary

The Campbell River and its main tributary, the Quinsam River, with a combined total average annual flow of 108.0 m^3/sec. (3,816 cfs), provide the main fresh water discharge to the estuary. Three features of the estuary are significant when considering the location of new industrial plants in the vicinity. These are:

1) the migration of salmon upstream to spawn and the return of fingerlings to the estuary;
2) the already highly industrialized nature of the estuary; and
3) the relatively small size of the estuary considering its economic importance for commercial and recreational fish production.

Migration and Spawning

Data on spawning escapements from the sea to the river for the five species of salmon in the Campbell River system are available from the Fisheries Officers' annual spawning reports. The spawning success and the number of fry returning to the estuary on their route to the sea are not known.

Physical Size

The estuarine zone is normally inundated and exposed by daily tide ranges and is the center of transition between marine and freshwater environments where fingerling fish will congregate during their acclimation period. It also represents the zone of highest biological energy where a significant part of the food for acclimating young fish will be found.

Industrialization

The estuary has been used for a variety of industrial purposes and although present industrial uses do not entirely eliminate useful habitat for acclimation and feeding, there is general agreement that they have considerably reduced this very important area of the estuary.

In the nearshore waters that have been measured in previous studies, the ocean water is vertically mixed and highly oxygenated due to the rapid tidal ebb and flow. Biological activity is high. The approaches to Campbell River in the vicinity of the Western Mines wharf, are known to

be used by adult salmonoids in their passage towards the nearby river mouths and by juvenile fish that will eventually move out to sea.

It is the unique flushing action of high velocity tidal currents that has maintained a high standard of water quality in Discovery Passage. The effect of the tidal flushing is clearly shown by the marine flora and fauna that have maintained populations as diverse and abundant as any found in the coastal waters of B.C.

The Federal Environmental Protection Service has carried out surveys of the sanitary condition of the marine waters in Discovery Passage in the vicinity of Campbell River since 1973. In the immediate foreshore area at Campbell River, the sewage system appears to function normally and the sanitary condition of these waters is considered adequate from a public health point of view.

It is generally agreed that the presence of pronounced daily current fluctuation in Discovery Passage continues to maintain the high quality of the waters immediately adjacent to Campbell River and the Campbell River estuary.

IMPACT ASSESSMENT

In this section of the report the preliminary expectations of potential and probable environmental impacts are identified and briefly discussed. The listing is intentionally extensive for the sake of completeness at this stage, but it does not imply that all of the impacts identified are inevitable, nor that they have equal probabilities of occurance. Many of the impacts may not occur at all, and this preliminary listing should be regarded as representing worst case situations.

AIR QUALITY

During infrequent dry periods, slight to moderate air quality problems may be locally created during the construction and operational phases of the project by windblown fugitive dust and coal fines from several sources. Fugitive dust will originate from road and facility construction, topsoil, till and overburden stripping and stockpiling and from hauling. Coal dust will originate from the mining operation, during the transfer from pits to and through the processing operation, during truck loading and hauling to the dock stockpile, from the stockpile itself and during final transfer to ships.

SOILS

The major impact on soils will result from breaking up the existing soil profile by stripping and removal from areas such as the mine pits, plant site and roads. Suitable surface materials will be reused during mining reclamation as a surface growth medium spread over the recontoured landscape to promote rapid and productive revegetation. Thus, the negative impacts from stripping and removal will be eliminated by positive impacts of implementing an effective reclamation and revegetation program.

VEGETATION

The major negative impact on vegetation will result from clearing prior to mining in areas that will be utilized in the mining operation. These areas will be established and revegetated with plants adapted to the area. Reclamation and revegetation will proceed simultaneously with mining, thus minimizing the duration that any area remains disturbed. Only 80 to 120 ha (200 - 300 ac) are expected to be disturbed at any one time.

WILDLIFE

Many of the adverse impacts to wildlife that would result from the mining project are unavoidable. These are the impacts expected to result from temporary habitat destruction necessary for mining to proceed. The removal of existing vegetative cover and stripping of soils and surface material will result in the temporary displacement of local populations to surrounding similar habitats.

Because the habitats to be disturbed are small in relation to the large surrounding area of similar habitats, these impacts are not considered to be of major importance.

Large mammals, particularly deer, using the area and the vicinity of haul roads will encounter an increased risk of collision with vehicles. The noise of mine and plant construction and operation as well as vehicular noise and harassment, may contribute somewhat to displacement of animals from the immediate site. These impacts are not considered to be of major importance but they will persist during the entire operation with varying degrees of intensity.

SURFACE WATER

A potential exists that surface water quality could be negatively affected by mining activities. Changes could occur in levels of both suspended solids and dissolved solids, either of which could be deleterious to the fish populations, their food chains or their critical habitats, especially in the spawning and rearing grounds.

The potential sources of these materials is runoff from disturbed surfaces, water collecting in the pits from subsurface aquifers and precipitation, emergency discharges from the coal processing plants, and leachates from coal stockpiles, disposal of used oils and greases and domestic sewage disposal.

It appears that with proper design to handle extreme circumstances, all of the potential impacts are avoidable.

FISH

Changes in water quality affecting fish will have the greatest significance as an environmental impact. The anadromous fish populations of the Quinsam River and lower reaches of the Campbell River are sources of great recreational attraction to residents and visitors alike. The high water quality of the rivers contributes significantly to the income of the town. Consequently, private industry as well as municipal, provincial and federal agencies have a commitment to preserve the condition prevailing at present.

To avoid the risk of affecting water quality through mining activities, the company proposes a unique water collection system designed to intercept all surface water and groundwater flows that may be interrupted by mining. Using a system of gradient tenches and conduits, the intercepted water will be channeled to one of four treatment stations, thus ensuring that only treated waters will be discharged to the river from the mining operation or from any part of the mining property. The proposed water collection and treatment system is intended to preserve water quality in the river.

GROUNDWATER

There is no information available regarding the location and characteristics of goundwater acquifers on the property, therefore, the nature and extent of any interactions with mining activity can not be ascertained at this time.

Potential impacts on groundwater quality might be expected to occur as a result of surface runoff collection and pit seepage disposal, emergency discharges from the coal processing plant, and the disposal of used oils and greases. These would likely be very localized interactions of only minor significance.

If the coal should prove to have a capability of producing acidic or otherwise contaminated leachates from the percolation of rainwater through stockpiles or otherwise exposed surfaces, a potential exists for further adverse interactions with groundwater quality.

The most significant aspect of potential groundwater contamination would be the possibility that water of imparied quality may flow into surface water in the Quinsam River or the estuary, where deleterious effects on fish might occur. Insufficient information exists to know how remote such a possibility may be.

It is possible that mining may interfere with the flow of groundwater aquifers that contribute to the

Quinsam River discharge. It is also possible that mining activities could result in a drawdown of smaller surface water bodies. Groundwater investigations are scheduled to be conducted in conjunction with geotechnical studies in mid-1979. The results of these studies and an identification of the impacts will be incorporated into the Stage II Submission.

MARINE RESOURCES

Even though it may have no direct effect on the estuary, further industrialization in the vicinity of the estuary will be viewed as a continuing erosion of estuarine values and a potential threat to the local livelihoods dependent upon the fisheries resource.

However, from the evidence of earlier work on the effects of industrial pollutants on Discovery Passage, the possibility that the marine resources adjacent to the stockpile and loadout area would be significantly affected by such pollutants, is remote. The extensive water exchange in the Passage caused by tidal currents, has been shown to maintain good water quality at nearby locations that regularly receive large quantities of industrial effluent. No significant ecological effects of leachate seepage or blown dust from the stockpile are envisaged in Discovery Passage.

RECLAMATION

The impacts expected to occur as a result of reclamation and reforestation are largely beneficial and corrective of some of the temporary negative interactions that result from mining and surface disturbance.

Recontouring of surface disturbances and rapid revegetation will enhance erosion control, reduce the risks of degrading the water quality, re-establish vegetative communitites and wildlife habitats and return the land to a self-sustaining production. Assuming appropriate water quality in the small lakes left in part of the reclaimed pits, minor positive impacts will result from habitat diversification for waterfowl and perhaps resident fish.

RESOURCE MANAGEMENT OPTIONS

The following is a discussion of steps designed to help achieve a simultaneous orderly development sequence for the mining project and a high degree of environmental protection. The discussion includes recommendations for additional studies to fill essential data gaps that have been identified in this initial study phase.

A number of the biophysical impacts identified and discussed previously, were properly anticipated by the company in the conceptual planning. The appropriateness of the measures proposed to eliminate and mitigate these impacts are further discussed below with some additional options for consideration.

Recommendations are also made for the establishment of certain monitoring programs to quantify baseline conditions, establish certain parameters for the detailed design phase as well as to document the long-term effectiveness of the planning and implementation of resource management programs.

METEOROLOGY

A meterological station is in the process of being established at the mine site to obtain records for the following parameters: temperature, humidity, wind speed and direction and precipitation. These data will be analyzed for at least a full year. In subsequent years, less frequent observations but representative of season, will be collected and analyzed during the operational phase for completion of the record and for future assistance in reclamation planning. Precipitation data, however, will be obtained continuously during the subsequent period, as a monitor on the effectiveness of the engineering design of runoff and seepage control.

AIR QUALITY

High volume samplers will be run for a full year, and analyzed weekly, to obtain adequate baseline data on airborne particulate matter at the process plant site and at the stockpile and dock area. Such a monitoring program would assess changes in particulate concentrations during the operational period. Air quality parameters do not need additional measurement at this time.

During dry periods fugitive dust can be controlled by regular spraying with water. Coal dust sources may be reduced by spraying with water, but may also require covers at certain points, such as trucks and conveyors.

The design and location of stockpiles should be such that blown dust is minimized. Limited stockpile height and a longitudinal shape conforming with prevailing winds may also help to alleviate coal dust problems at the loadout area.

Because of the exposure to severe winds occasionally experienced in Campbell River, some form of shielding or enclosure of the stockpile may be required. This shielding may be possible with dense rows of trees.

Emissions from the processing plant will be required to meet government standards. Depending on the details of the process design, particulate emissions will require closer scrutiny in later phases of the design.

SURFICIAL GEOLOGY AND SOILS

In additional work planned for this property, the company will determine the surficial deposits and thickness at a scale of 1:1000 conforming to the terrain analyses of the Resource Analyses Branch of the Ministry of the Environment of British Columbia. Questions related to soil usability, groundwater, slope stability, optimum transportation routing, aggregate location, overburden stripping and

stockpiling, and the risk of toxic leachate formation will be addressed in a study of the engineering characteristics of soils and rock on the property.

The capacity of soil and rock in the overburden to support plant growth will be investigated. A soil sampling program for nitrogen, potassium, phosphorous and pH will be initiated. Trace elements such as copper, lead and zinc will be measured in selected sub-samples. This information will form the basis of detailed reclamation planning, including the selection of a suitable growth medium for revegetation; the identification of possible soil amendments, and the selection of suitable plant species for both short and long-term vegetative cover.

VEGETATION

Since it is intended that the final reclamation plan will be aimed at returning the disturbed land to a self-sustaining cover or commercial forest production, substantial use will be made in the reclamation planning process of existing locally derived experience with forest management, plant communitites, revegetation and tree growth that is presumably resident in the timber companies. The coal property is located in the coast forest region, a zone that is favourable for natural regrowth on disturbed ground.

A reforestation prescription is being formulated by the company using data on the present condition of the vegetation and soils. The predominant plant associations

will be classified. Within each type the succession to climax will be described giving special attention to the dynamics of invasion by pioneer species and their soil/water/temperature/light requirements, to the serial growth of communitites supporting wildlife, and to the physical characteristics of the climax vegetation.

Edaphic and physiographic features of the property will be studied to provide a correlation of the area's features with plant growth thus providing reclamation planners a better understanding of the succession dynamics to climax forest.

WILDLIFE

Wildlife habitats lost due to vegetation removal, mining and other surface disturbances, will largely be replaced or even enhanced by revegetation during the reclamation period. The company has already initiated programs to document the quality of these wildlife habitats and their current usage prior to mining. The manner in which reclamation proceeds and the species selected for revegetation of disturbed areas, will provide browse and cover for some years after mining before the forest matures.

The revegetation program will be augmented by natural regeneration and colonization from the surrounding forest. Recolonization by wildlife species from surrounding habitats will also occur naturally. When the detailed reclamation plan is prepared it will take into account

methods of restoring and benefiting wildlife habitats.

The company has initiated further year-round studies of wildlife. These will provide the basic site specific data that is needed to measure and manage the changes caused by future mining and reclamation activity.

Included in this work is a habitat analysis and classification which will give special attention to utilization by terrestrial and aquatic mammals, a deer and elk census will be attempted over winter. Ungulate pellet plot surveying and browse utilization surveys will be conducted on the property and in the transportation corridor to the shoreline loadout facility. Permanent transects representative of the property will be established and recorded for use in future monitoring of the mining operation. These data will be interpreted for the impact of mining on wildlife resources on the property following the E.L.U.C. "Coal Guidelines" published in March 1976.

An avian resource management program and impact assessment study is in progress. A series of transects will be walked each season by ornithologists who will record the sight and sound of all birds they encounter on the property and along the proposed haul route. Special emphasis will be placed on recording flocks of birds. The utilization by birds of lakes and adjacent wetlands habitats will be mapped and documented. The estuary and marine habitats in the vicinity of Discovery Point will be included in the study

area. A series of representative transects will be established and recorded for use in future monitoring of the mining operation.

GROUNDWATER

A preliminary groundwater survey is being conducted by the company. These data are required to meet a major deficiency in the present information base needed for mine planning and environmental impact evaluation.

The objectives of the studies are to classify groundwater circulation, to measure the discharge and recharge areas, the quality and quantity of flow and seasonal effects. These data are for use in many aspects of the mine planning process. Included are the engineering of pit slopes and general pit configuration. Design criteria for waste water treatment and discharge; the effects of mixing ground and surface water flows; monitoring the effects of mining on the groundwater conditions in the district and maintenance of high quality discharge. During reclamation, the relationship of groundwater quality and discharge to the abandoned pits will in part determine the end use objective of the pits and the necessity for management of overflow waters from the pits to the surrounding surface drainage.

A detailed environmental impact assessment of the proposed mine on the groundwater resource will be made.

The potential for leaching dissolved noxious materials into rainwater percolating through the stored coal pile and subsequently entering the estuary, requires further investigation. The potential for production of noxious leachates to the groundwater or directly to surface waters is being studied, as well as the feasibility of sheltering the storage piles.

SURFACE WATER

Because the Quinsam River is of high significance to both commercial and sport fishing, special precautions are required to ensure that water quality is not degraded at the risk of the fishery resource. Cognizant of this, the company has already initiated steps to provide that protection. Weekly, monthly and quarterly sets of samples are being taken in a detailed surface water quality monitoring program now in effect on the property. Regular analyses of these samples for a comprehensive range of water chemistry parameters will be conducted for the coming tweleve months. The following data will form a detailed baseline for monitoring future mining operations: the baseline water quality and discharge characteristics as well as aquatic ecological conditions and population characteristics and habitats of both resident and anadromous fish species.

In addition, an extensive surface drainage collection system is planned around the entire mine and plant area to collect and treat runoff waters and pit

seepage before it is allowed to enter the Quinsam River. Furthermore, the proposed processing plant is expected to be a closed-circuit system with no liquid effluent, except in emergency upset circumstances. In such emergencies, containment and treatment of the ffluent would be accommodated before any discharge is made to surface water courses.

Prior to final designing of these collection systems, more information will be required about the expected quality and quantity of these several potential discharges. Pending results of these analyses, differing treatment strategies may be required. For example, pit water or emergency process water releases may contain dissolved solids, while surface runoff may only have suspended solids loads, thus making separation and treatment of streams more economical than a combined treatment.

In addition, more detailed site-specific information such as precipitation and soil percolation data are required to be able to design the systems with sufficient capacity to handle extreme conditions without failures.

As more of this information becomes available, it may also be desireable to consider locating the discharges at slightly different locations to enhance the margin of assurance for maintaining downstream water quality.

It is clear that a great many of the necessary activities at the mining site have potential for impacting

surface water quality. It is also clear, however, that most, if not all, of these potential impacts can be reduced to negligible levels or eliminated completely by the judicious collection of additional data and incorporation of that information into final design and operating procedures.

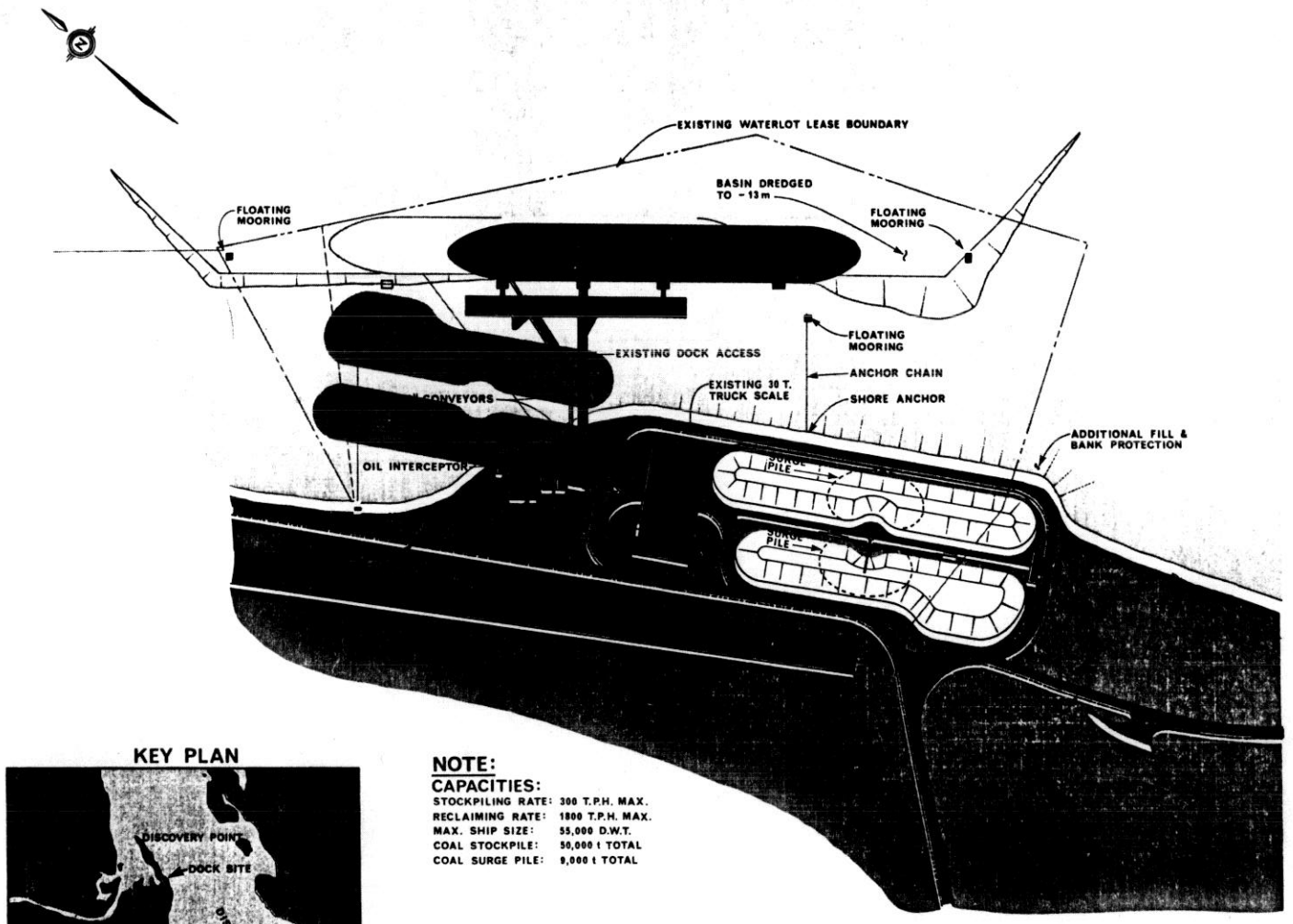
At the stockpile and dock site, methods of preventing contamination of the estuary by particulates or noxious dissolved materials leaching from the coal, requires additional consideration.

Determinations of the coal quality, regarding its ability to generate leachates and to spontaneously combust, as well as the selection of final dust suppression measures, will dictate the degree of precaution required to collect and treat surface water before its' release.

ESTUARY

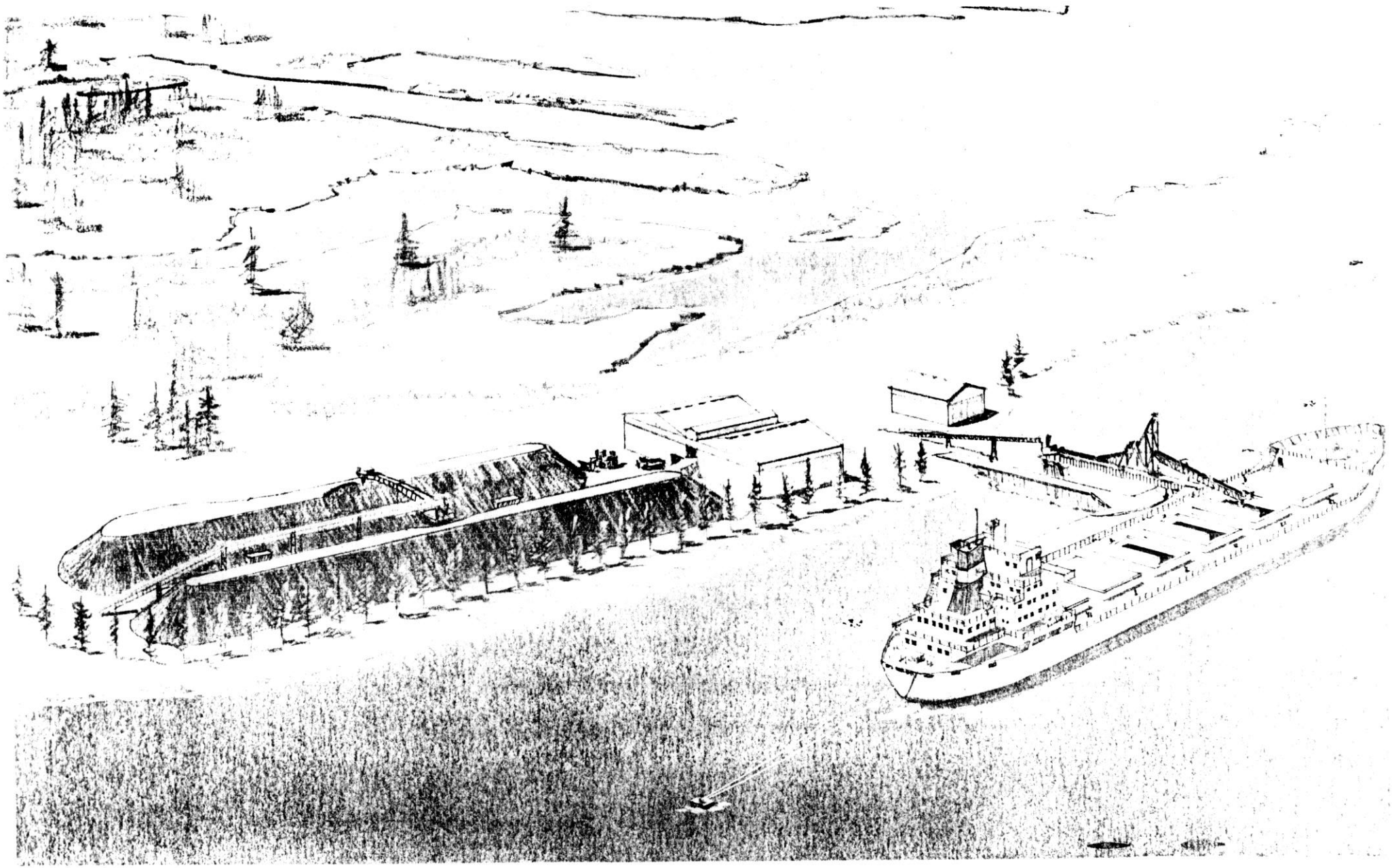
It is recognized that the Campbell River estuary, including the surge zones, is of great significance to the maintenance of healthy stocks of anadromous fishes of great economic importance. Information gaps have been identified earlier concerning coal quality, dusting precipitation, soils and water quality, all of which are relevant to the protection of the estuary. The incorporation of new information on these topics into the final design of a stockpile and loadout facility should make it possible to mitigate against any deterioration in estuary water quality.

The proposed Quinsam loadout facility will be located on the dock presently used by Western Mines Ltd. for shipping copper concentrate from their Buttle Lake mine. Some modification of the wharf will be required to accommodate the coal vessels. The wharf has a depth alongside of approximately 11.8 m (39 ft). Vessels of 178.8 m (587 ft) in length with a draught of 11.6 m (38 ft) have used this facility in previous years. The alternative coal terminal site evaluation study by Swan Wooster has shown that vessels from 10 - 35,000 deat weight DWT could use the present facility with no further modification to the dock. The general arrangement of the proposed terminal is shown in Figure IX. Figure X is an artist's concept of the terminal. The terminal arrangement shown is for 55,000 DWT ships, requiring minor modification to the existing dock and limited dredging of the approaches to the berth. The stockpile area shown has a capacity of 45,359 tonnes (50,000 short tons) and will be required to handle a throughput of 0.91 million tonnes (1 million tons) per year with the minor landfill on the foreshore shown in Figure X. This site is thought to be of sufficient size to handle this magnitude of material. The stockpile would be approximately 9 m (30 ft) high. Other stockpile areas adjacent to Discovery Point are also under study.



LAYOUT OF COAL TERMINAL

FIGURE 9



Proposed Discovery Point Terminal, Campbell River, B.C.

QUINSAM COAL LTD.

SWAN WOOSTER ENGINEERING CO LTD
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FIGURE 10

FISH

Resident Fish and Monitoring Study

The company is presently conducting an inventory of resident fish populations and a monitoring program to collect baseline biological data. The study area extends from the confluence of the Quinsam and Iron Rivers to the hydro diversion and includes Middle Quinsam and Long Lakes. The inventory will include mapping of spawning and rearing habitats and a population census using electro-shock and gillnet techniques. The species, weight, length, sex, age and feeding habits of specimens taken from Middle Quinsam and Long Lakes will be determined.

Five monitoring stations have been established to sample and determine invertebrates, water quality, periphyton, and substrate composition.

Invertebrate samples are being taken to assess the population and seasonal variability of organisms. They will also provide a measure of baseline productivity. Water quality measurements will include dissolved oxygen, pH, conductivity and temperature. The periphyton samples will be analysed for species composition, relative abundance and biomass. Frozen bottom substrate samples will be used to determine the composition of coal fines, organic debris, rocks, gravel, sand and silt, pore space, and other physical features of the spawning grounds.

Anadromous Fish Study

Present and potential utilization of the Quinsam River by anadromous fish populations is currently being documented by the company. Spawning and rearing habitats are being mapped from the river mouth upstream to the limit of fish migration: the large waterfall below Middle Quinsam Lake, about 25.5 km (16 miles) from the mouth of the Quinsam River. The numbers and location of each species (pink, chum, coho, spring salmon, and steelhead trout) will be established; the utilization of the redds and spawning success will be used in future years as a monitoring tool.

RECLAMATION

A detailed reclamation plan will be required as part of the permit acquisition procedure. Preparation of a suitable plan must take into consideration not only established general principles but also details of site-specific features and characteristics including topography, climate, soils, drainage, local vegetative communities and land use objectives.

Reclamation goals should first be established by the mining company, and then extensive use should be made of existing local experience and information to define the steps to achieve those goals. Several of the programs recommended earlier in this report will provide site-specific information essential to the final reclamation plan. This includes the monitoring of precipitation, the characterization and mapping of tills and soils, identification of erosion potentials,

definition of groundwater characteristics, monitoring of surface water quality and discharges, definition of vegetative communities and characterization of wildlife habitats and current usage patterns.

Depending particularly upon the surveys of till characteristics and soil quality and availability, it may become desireable to establish on-site field plots to test alternative revegetation strategies. Among the field trials that may be desireable are the use of buried tills as a growth medium, the possible need for amendment applications and seeding of selected species for initial soil stabilization and enrichment prior to tree planting.

With the judicious application of information obtained from these various sources, a detailed reclamation plan can be constructed. The plan will identify the orderly and most economical means of such things as materials handling, recontouring, spreading, stabilizing and revegetating disturbed lands. It should, in addition, detail drainage patterns, equipment requirements, monitoring programs, corporate commitments and land use objectives.

HAUL ROAD

Most of the proposed haul route from the mine to the dock facilities will be over existing forest haul roads. It is possible that a certain amount of rerouting will be required in the general vicinity of Highway 28 near Echo and Mirror Lakes. Site-specific environmental evaluations

will be made of that part of the proposed route to ensure that final siting and design is compatible with environmental values.

POWER SUPPLY

It is assumed that electric power supply will be provided to the mine site by way of a B.C. Hydro powerline. No details were made available in this regard and it is assumed that environmental studies of such a right-of-way would be the responsibility of the power company. It is recommended that the corridor selection studies should aim to achieve compatibility of the route with existing environmental features.

APPENDIX I

STAGE II STUDIES

Seven studies have been initiated based on the evaluation of the Environmental Impact Assessment as summarized in this report. The impact assessment identified two broad areas of potential impact:

1) Surface water quality and the fisheries resource;
2) Stockpile and loadout at Discovery Point.

Rather than use a cost benefit analysis to determine a level of protection, the Company has engineered protective systems to eliminate impacts as a result of normal conditions. The Company has also included contingency protection for any abnormal situations which may arise. For this reason, the objective of the following studies is to achieve a solid background to monitor against during the operation of the mine.

A) PROJECT: SURFACE WATER QUALITY

Baseline studies are being conducted on a one year cycle to include seasonal variations.

OBJECTIVES: To conduct routine sampling and chemical analyses of surface waters on the Quinsam Project site, in order to provide a baseline for monitoring purposes.

B) PROJECT: RESIDENT FISH

Baseline studies are being conducted on a one year cycle to include seasonal variations.

OBJECTIVES: To conduct a detailed environmental impact assessment of the proposed Quinsam Coal Mine, relative to the ecology of fish populations resident in the fresh waters of the project site.

To prepare resource management recommendations relative to the identified impacts such that unnecessary impacts can be eliminated and unavoidable impacts minimized and controlled.

To establish field survey stations and document baseline conditions relative to the fresh water ecology, such that change and recovery during the coal mining operation, can be monitored.

C) PROJECT: ANADROMOUS FISH MONITORING

Baseline studies are being conducted over a nine month cycle to include seasonal variations.

OBJECTIVES: To develop a monitoring program for Quinsam River anadromous fish populations.

To quantify baseline conditions relative to the above monitoring program, such that any deviation from that baseline, during the coal mining operation, can be readily detected.

D) PROJECT: AVIANS

Baseline studies are being conducted over a fifteen month cycle to include seasonal variations.

OBJECTIVES: To conduct a detailed environmental impact assessment of the proposed Quinsam Coal Project, relative to the ecology of avian populations.

To prepare resource management recommendations relative to the identified impacts such that unnecessary impacts can be eliminated and unavoidable impacts minimized and controlled.

To establish field survey transects and document baseline conditions in the avian population such that change and recovery, during the coal mining operation, can be monitored.

E) PROJECT: WILDLIFE

Baseline studies are being conducted over a fifteen month cycle to include seasonal variations.

OBJECTIVES: To conduct a detailed environmental impact assessment of the proposed Quinsam Coal Project, relative to the ecology of wildlife populations (includes ungulates, furbearers, carnivores).

To prepare resource management recommendations relative to the identified impacts such that unnecessary impacts can be eliminated and unavoidable impacts can be minimized and controlled.

To establish field survey transects and document baseline conditions in the wildlife populations such that change and recovery, during the coal mining

LITERATURE REVIEW

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CX-QUINSAM 78 (6)(SEC 5) A

GEOLOGY OF THE COAL RESERVE

IN THE AREA OF QUINSAM EAST

QUINSAM, CAMPBELL RIVER

BRITISH COLUMBIA

Submitted by:
R.J. Ronaghan

February 22nd, 1979

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1 Drillhole Location and Information

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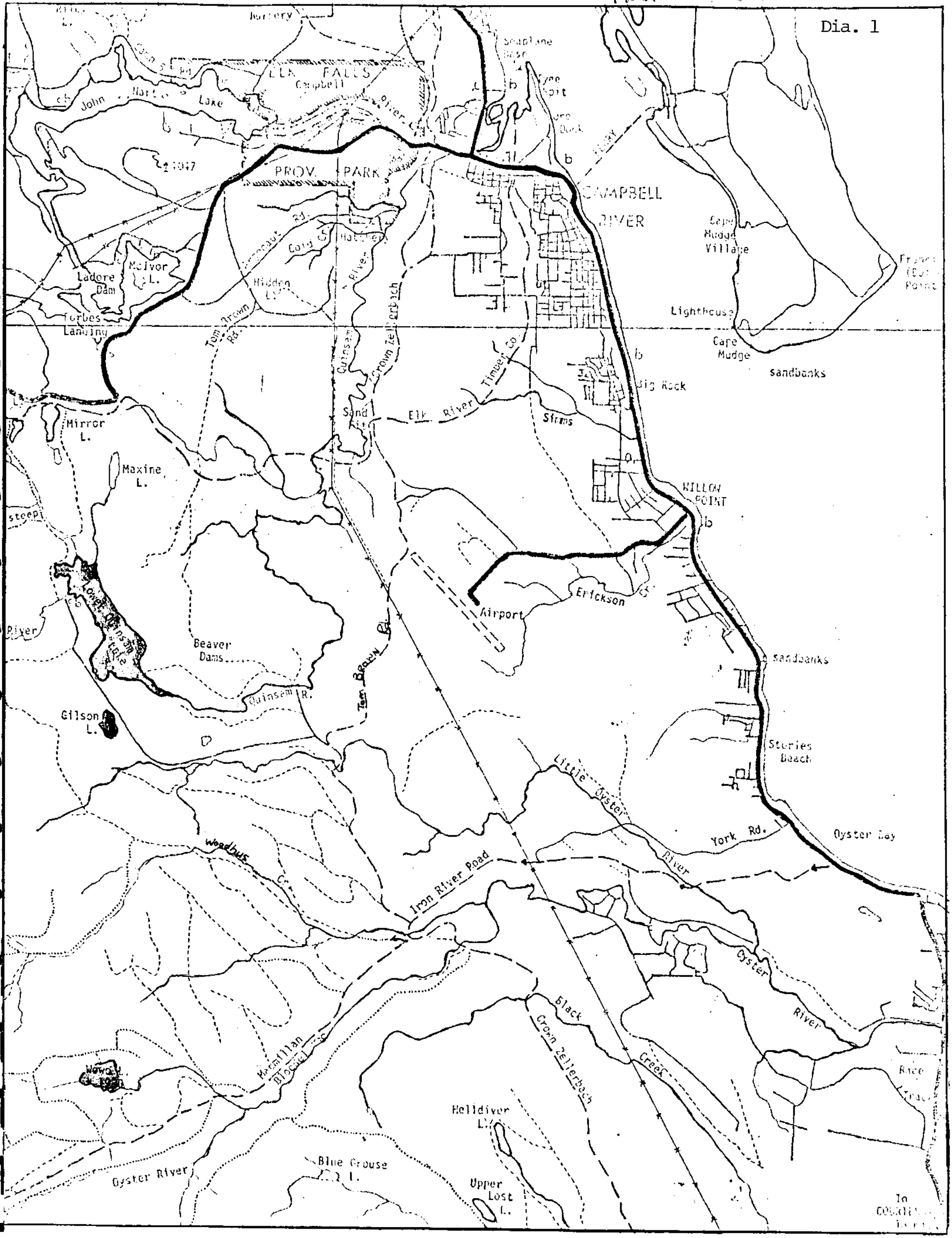
1.0 INTRODUCTION

This report is a summary of the drilling program undertaken in November, 1978, in the Quinsam East Block. Within this 650 acre area, a coal reserve in the order of 5.531 million tons was outlined.

Quinsam East is situated approximately 10 miles south of Campbell River, to Oyster Bay, then 8 miles due west. The nearest settlement is that of Oyster River, which is not really a town but a village or cluster of homes along the Island highway. The main industry of the area is logging.

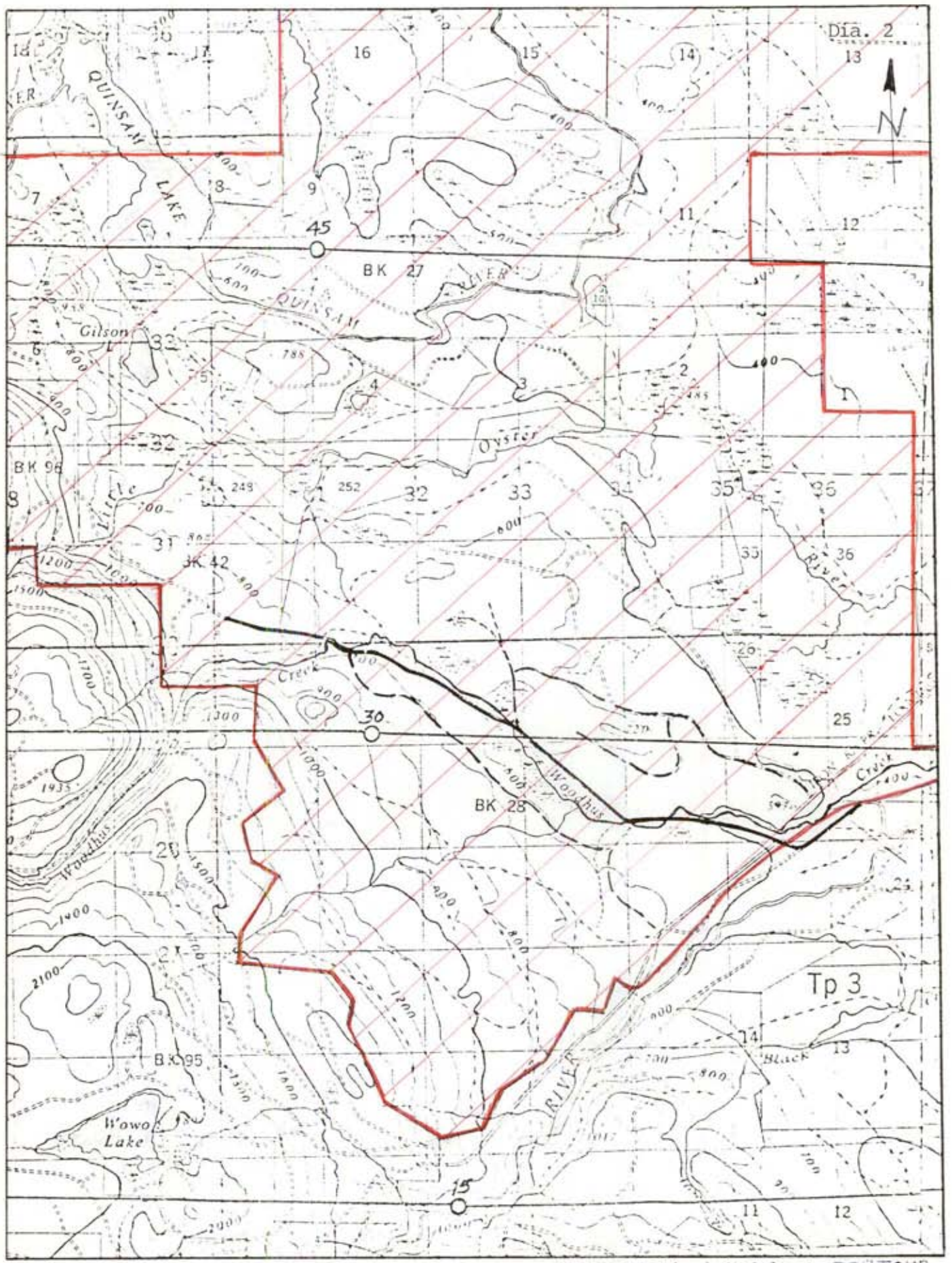
Access to the East block is off the Tom Brown Road (Crown Zellerbach main haul road to Campbell River) on two existing logging roads, Dia. 1. The main road crosses the Woodhus Creek twice, with no bridge at either crossing. The other road is the Forestry Department fire access road, which crosses a small creek and has a narrow bridge capable of taking a 3/4 ton truck quite easily.

Because of the very wet lowlands, access off these roads is limited. If drilling is resumed in this area, it is recommended that it commence in mid summer during the dry season. During the rainy season, excess water routes itself down and across the roads making any movement, on or off the road, very difficult and damaging to the environment. Drainage is through the Woodhus Creek stream system to the Oyster River; from there, an easterly flow takes it to the Straites of Georgia. The Oyster River is a major spawning course for salmon.


Dia. 1
Nursery
ELK FALLS
Campbell
River
John Hart Lake
Seaplane Base
Tyee Spit
PROV. PARK
CAMPBELL RIVER
Cape Mudge Village
Ladore Dam
McIvor L.
Hidden L.
Hatchery
Forbes Landing
Tom Brown Rd.
Quinsam River
Crown Zellerbach
Lighthouse
Cape Mudge
sandbanks
Big Rock
Elk River Timber Co.
Sand Pit
Mirror L.
Maxine L.
WILLOW POINT
steep
Airport
Erickson
River
Beaver Dams
Tom Brown Rd.
Quinsam R.
sandbanks
Gilson L.
Stories Beach
Little Oyster River
York Rd.
Oyster Bay
Woodhus Cr.
Iron River Road
Oyster River
Black Creek
Crown Zellerbach
MacMillan Bloedel
Helldiver L.
Race Track
Blue Grouse L.
Oyster River
Upper Lost L.

Vegetation over the area is typical of the northwest Pacific Coast. On the well-drained slopes, Douglas fir have been replanted, with minor Hemlock and Cedar second growth occurring. In the wet lowlands, alders prevail with minor cedar and hemlock. The undergrowth consists of a variety of ferns, bushes and low shrubs.

As the East block is inland from the ocean, the maritime influence is not as strong as in coastal areas. The elevation is around 800', limiting freezings but large snowfalls are experienced in the winter months. Total precipitation, mostly in the form of rainfall, varies from 40 to 58 inches annually, with about 75% of this occurring during the winter months. The average mean temperature throughout the region is 9^{o} Celsius.

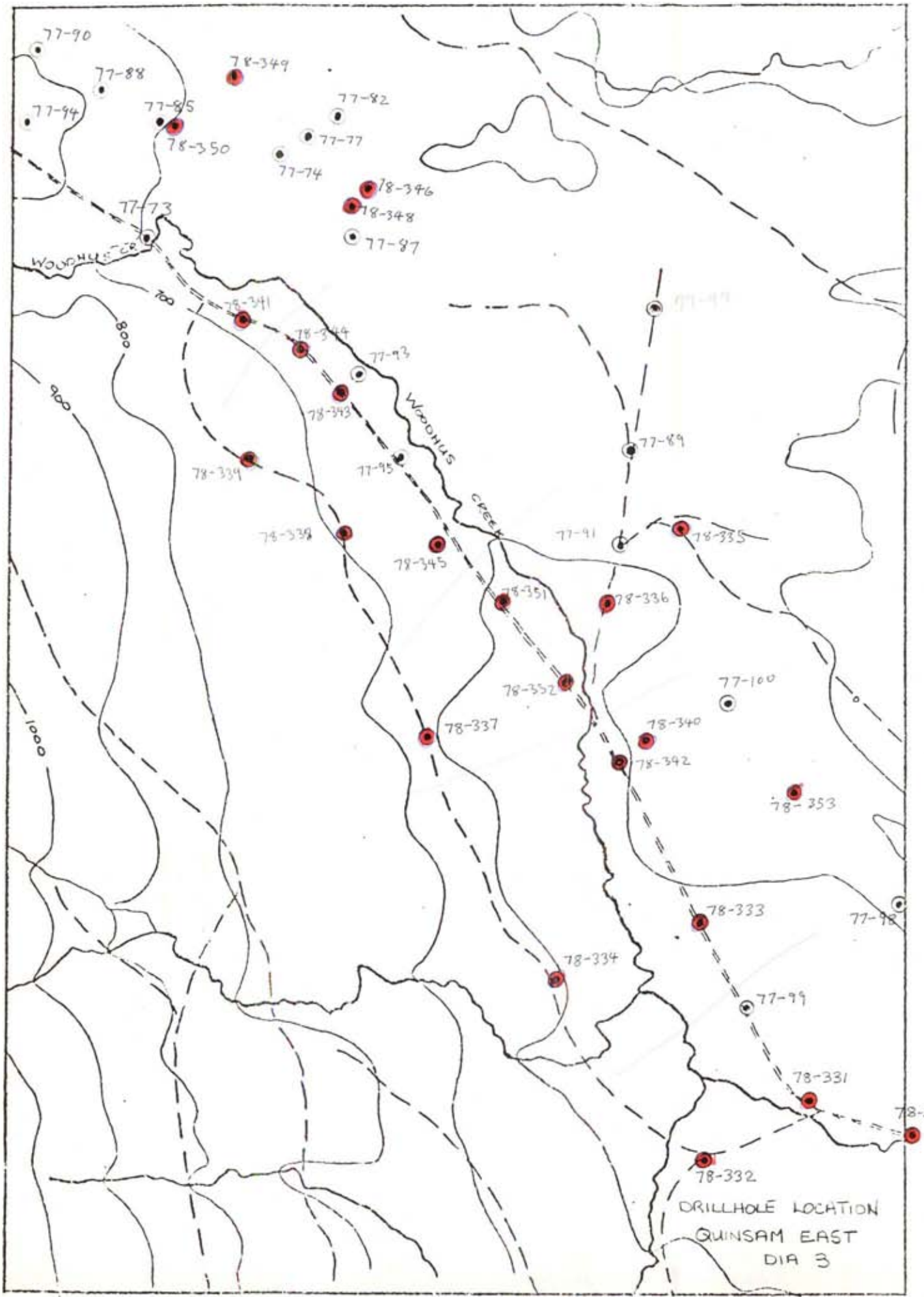


PROPERTY LOCATION CONTOUR MAP

2.0 TECHNICAL INVESTIGATIONS

During the period commencing October 31, 1978 through to November 24, 1978, 23 (twenty-three) drillholes were completed for a total logged footage of 5,148 feet, Dia. 3. Where possible, the holes were drilled on cut lines, but due to wet conditions, most holes were drilled on existing roads. For this reason some holes in the initial program were dropped.

All drilling was performed with Lexco Testing Ltd.'s Rigs 06 and 07, using air-water combined with the Mission hammers. Where the ground was broken or heavy overburden was encountered, the rigs were forced to use drilling mud and rotary bit for hole stability.

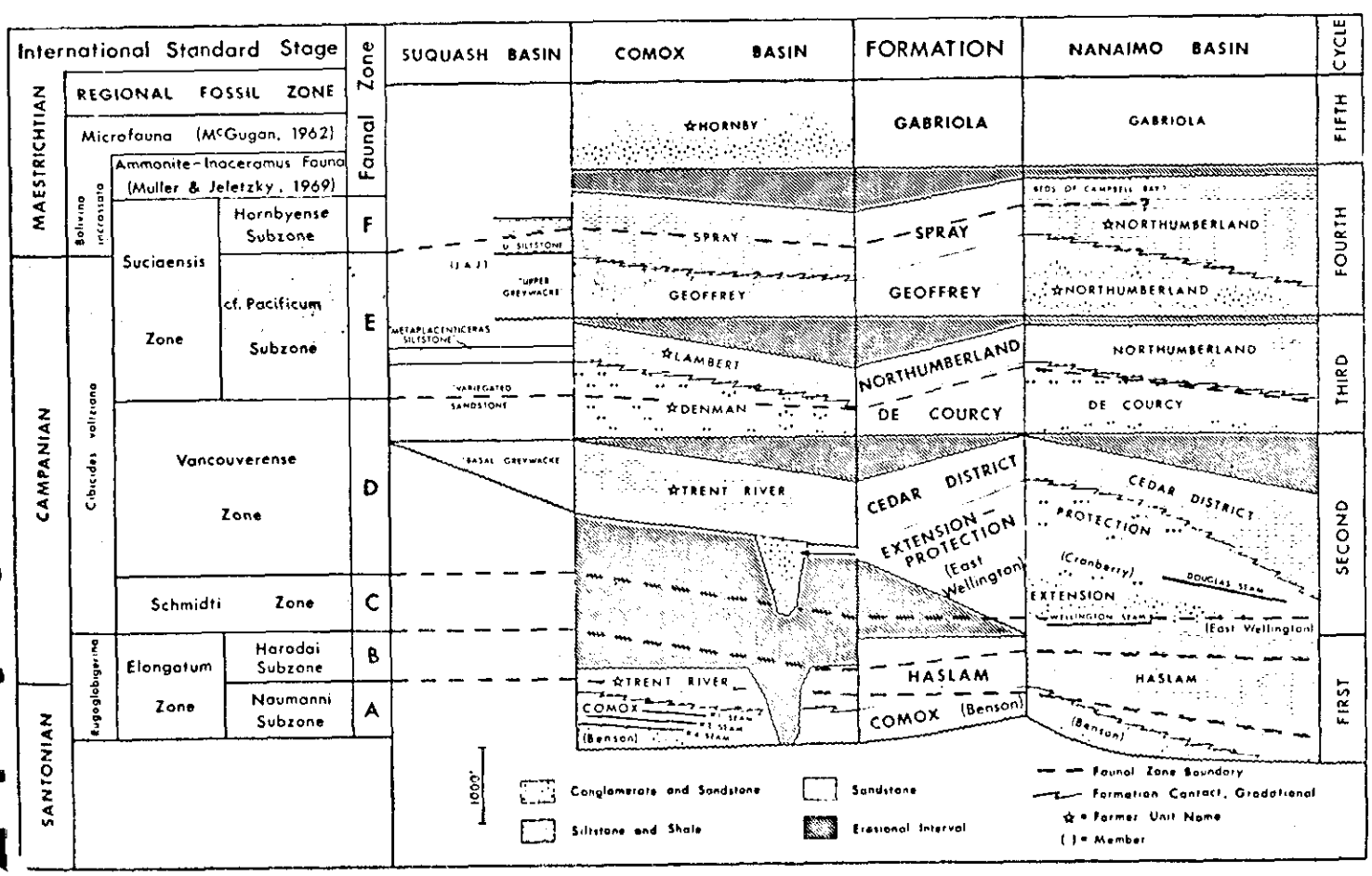

77-90
77-88
77-94
77-85
78-350
78-349
77-82
77-77
77-74
78-346
78-348
77-87
77-73
WOODHUS CR
100
800
900
1000
78-341
78-344
77-93
78-343
78-339
77-95
WOODHUS CREEK
78-338
78-345
78-351
78-336
78-352
78-337
77-89
77-91
78-335
77-100
78-340
78-342
78-353
78-333
77-98
78-334
77-99
78-331
78-347
78-332
DRILLHOLE LOCATION
QUINSAM EAST
DIA 3

3.0 GEOLOGY

Upper Cretaceous strata on Vancouver Islands' east coast contains numerous coal deposits that accumulated in coastal plain and alluvial environments. This succession of strata ranges from Late Santonian through Early Maestrichtian and is referred to as the Nanaimo Group. The Nanaimo Group forms an alluvial prograded coast with direction of sedimentation towards what is now Georgia Strait. A ridge of Pre-Cretaceous rocks divide the coastal belt at Nanoose Bay, and the northern area of deposition is referred to as the Comox basin. Within this basin, economic coal is limited to the lower part of the formation.

Table 1

Biochronological & Lithological Divisions of Nanaimo Group

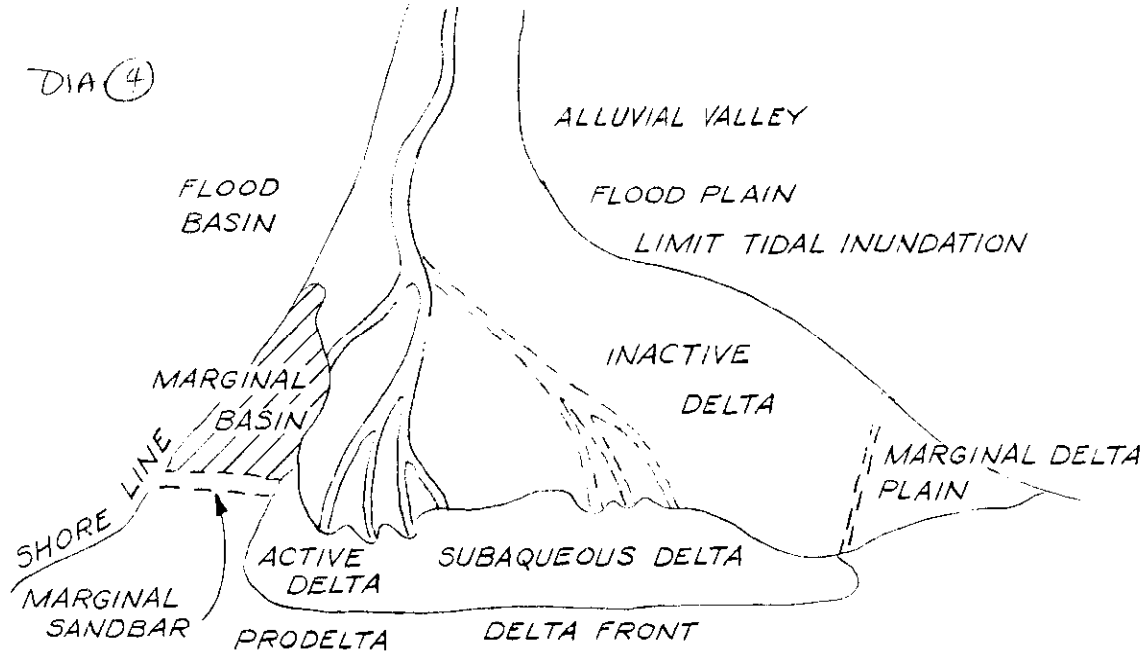


3.1 Deposition

The Upper Cretaceous Comox Group was deposited in subsiding alluvial prograding delta. The alluvial basin was bounded on the west side by the uplifting Island Intrusives, supplying the majority of the detrital material, with subsequent erosion of the Karmutsen and Island Intrusive formations.

Coal seams of the Quinsam East Block were probably deposited in marginal basins, with depositional environment favorable for that of peat swamps, Dia. 4.

Major Physiographic Components of an Alluvial-Delta System



The recurrance of localized swamp conditions is attributed to repeated build-up and destruction of marginal sandbars, together with the effects of differential compaction (Atchison 1968). Atchison proposed that periodic spreading of these marginal sand accumulations over the swamps, followed by greater compaction of the swamp sediments, would lead to the re-establishment of sandbars on the margins of subsidence. Therefore, new swamps would tend to develop above older swamp deposits.

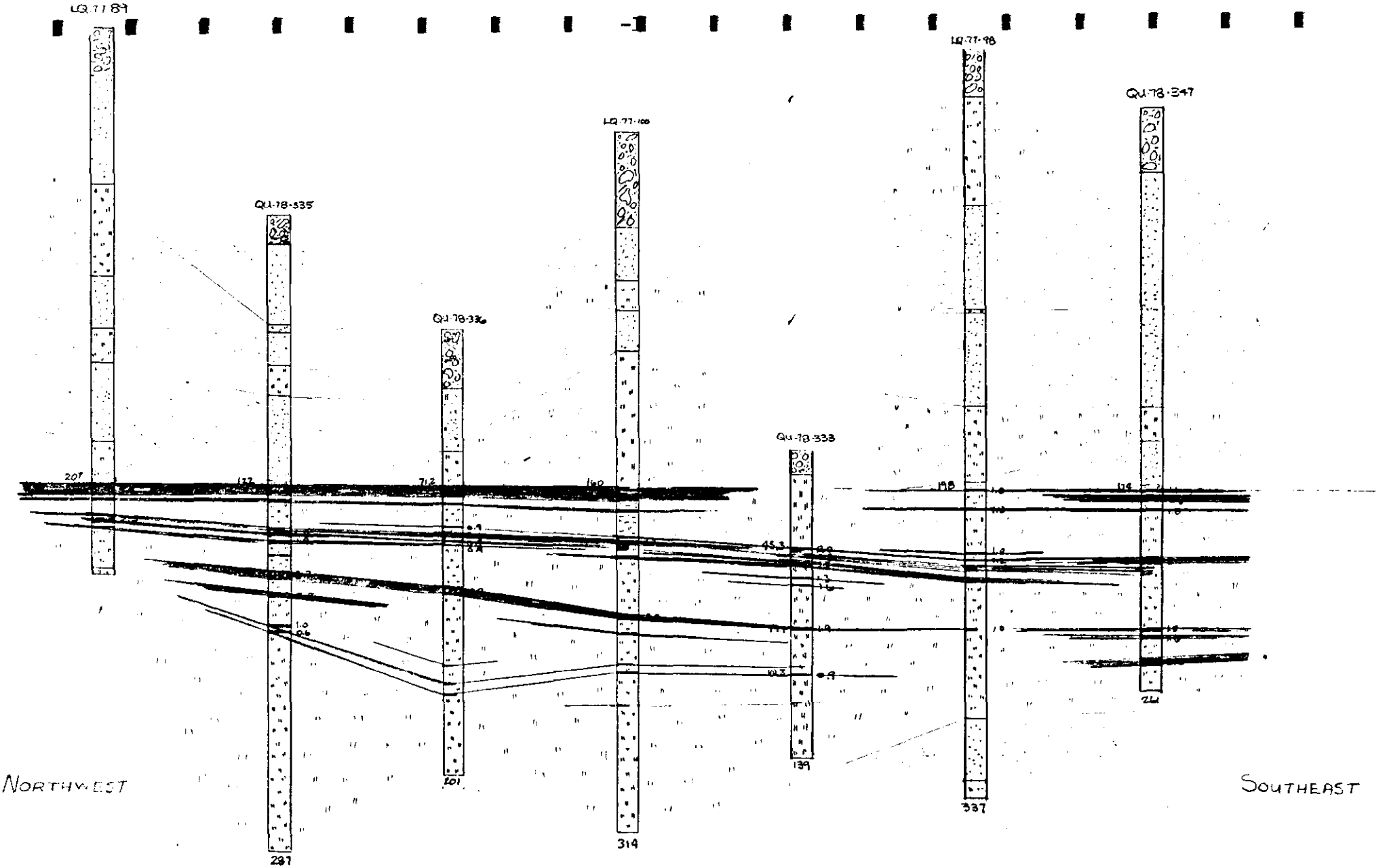
In the Quinsam East area, there are four main cycles of coal deposition. The three upper-most cycles are good examples of the repeated build-up and destruction of marginal bars. The coal seams are confined to a stratigraphic sequence of shales and interbedded coals, ranging in thickness from 40 feet to over 80 feet. Though direction of sedimentation between the coal seams will differ slightly, the overall direction appears to be to the south east. This is indicated by individual seams splaying and thinning in the direction of sedimentation. eg. The upper-most seam thins from 5 feet to less than 1 foot in a section running from north east to south east, Dia. 5.

The other seams of this group also thin and shale in the same direction.

The fourth or lower-most seam is confined to a stratigraphic sequence of about 20 feet. As in the upper seams, the lower seam splays and shales to the south east, however, the accumulation of plant matter in the fourth seam was abruptly cut off by the deposition of a coarse-grained arkosic sandstone with abundent pebbly layers. In areas where erosion has not occurred, this sandstone sequence is over one hundred feet thick, Dia. 6.

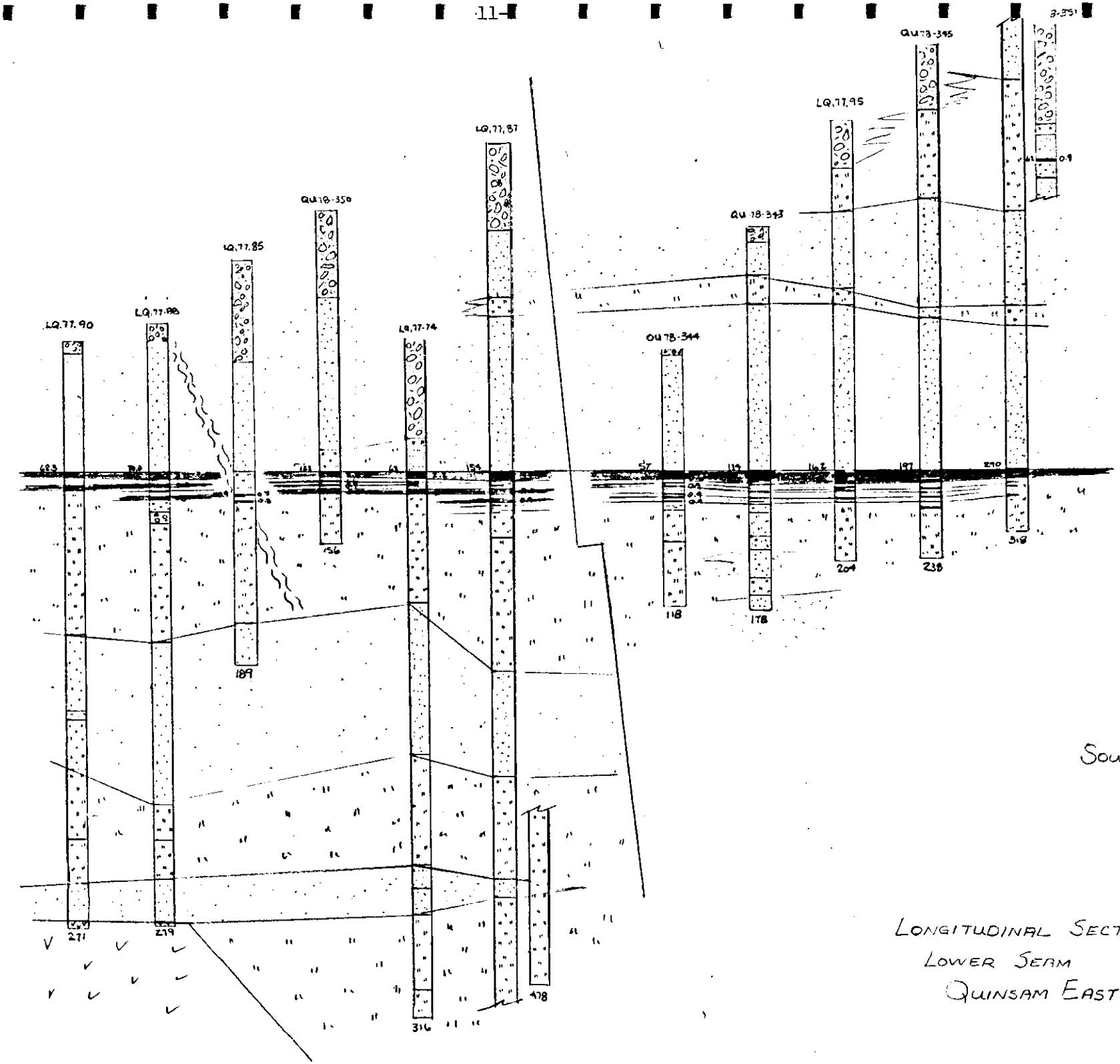
3.2 Stratigraphy

The sedimentary strata of the Comox basin is an alternating succession of shales, sandstones and conglomerates with minor coal appearing in the lower formations. The group is divided into eight formations, of which no economic coal is found above the Lower Comox formation.



LONGITUDINAL SECTION
UPPER SEAMS
QUINSAN EAST

Dia. 5



NORTHWEST

SOUTHEAST

LONGITUDINAL SECTION
LOWER SEAM
QUINSAM EAST

Dia. 6

The Comox formation is a white to brownish-grey sandstone, with interbeds of shale, siltstones, conglomerate lenses and coal seams.

The most abundant rock in the Comox formation is a homogeneous, chalk-white to brownish-grey to greyish-green, fine to medium-grained sandstone. There are occasional lenses of pebble conglomerate and thicker bands of cobble and boulder conglomerate in this unit. These conglomerate bands and lenses are of restricted distribution and are of no value as horizon markers.

Siltstone and shale interbeds in the Comox formation are mostly thin-bedded, fine-grained and brownish-grey, containing minor lenses of very soft brown mud rock. Associated with these siltstones are coal seams of economic importance.

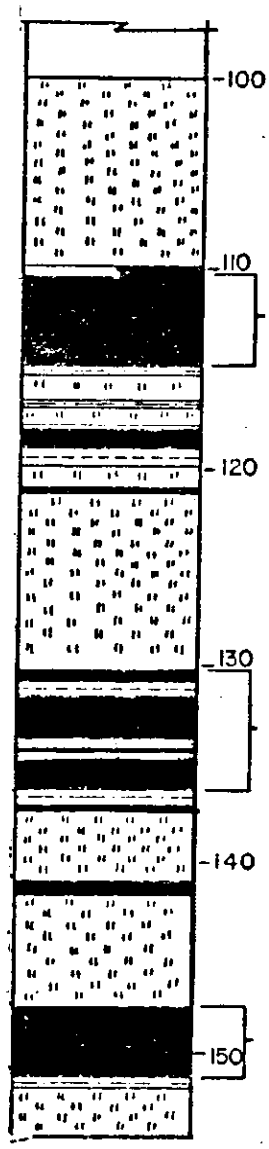
In the Quinsam East Block, the Comox formation lies unconformably above the Triassic Karmutsen formation, which in turn is intruded by the Lower Cretaceous Island Intrusives. Above this is a succession of detrital sediments that have great laterial variation. The coal seams of the East Block are in the lower-most portion of this succession.

The lower-most coal seam is seated on a medium-hard, fine-grained, grey-brown siltstone, below which a lense of cobble conglomerate is indicated in some holes. The coal horizon itself is made up of coal seams ranging in size from 3.0 feet to less than 1 foot, interbedded with hard to medium-hard shales, and occasional carbonaceous sandstone. This 20 foot horizon is capped by a succession of sandstones with minor lenses of siltstone, Dia. 7 and 8.

TITLE

LITHOLOGY AND QUALITY OF SEAMS 1 - 4

LQ -77-91C

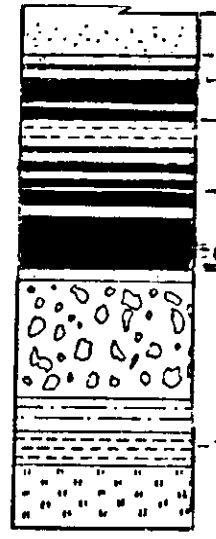


M.: 1.89
A.: 15.88
S.: 0.46
B.t.u./lb.: 11635

M.: 1.51
A.: 32.37
S.: 1.48
B.t.u.: 9101

M.: 1.47
A.: 17.16
S.: 3.30
B.t.u./lb.: 11701

LQ-77-74C



M.: 1.49
A.: 26.19
S.: 0.75
B.t.u./lb.: 9757

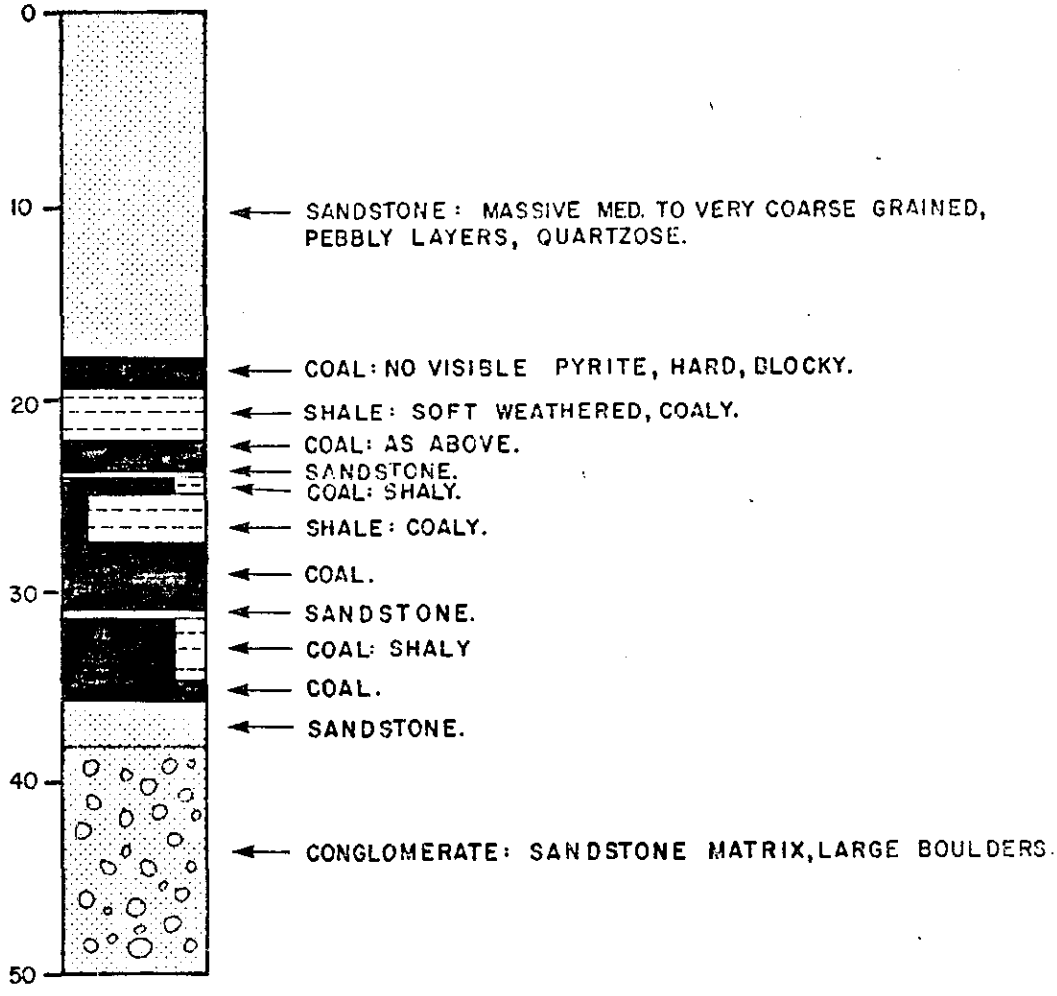
M.: 1.25
A.: 34.89
S.: 0.92
B.t.u./lb.: 8547

LITHOLOGY

- COAL
- COALY SHALE
- SHALY COAL
- SANDSTONE
- SILTSTONE
- SHALE
- MUDSTONE
- CONGLOMERATE

Dia. 7

NOTE: RESULTS ON AIR DRY BASIS.



LITHOLOGY LOWER SEAM
WOODHUS CREEK OUTCROP

Dia. 8

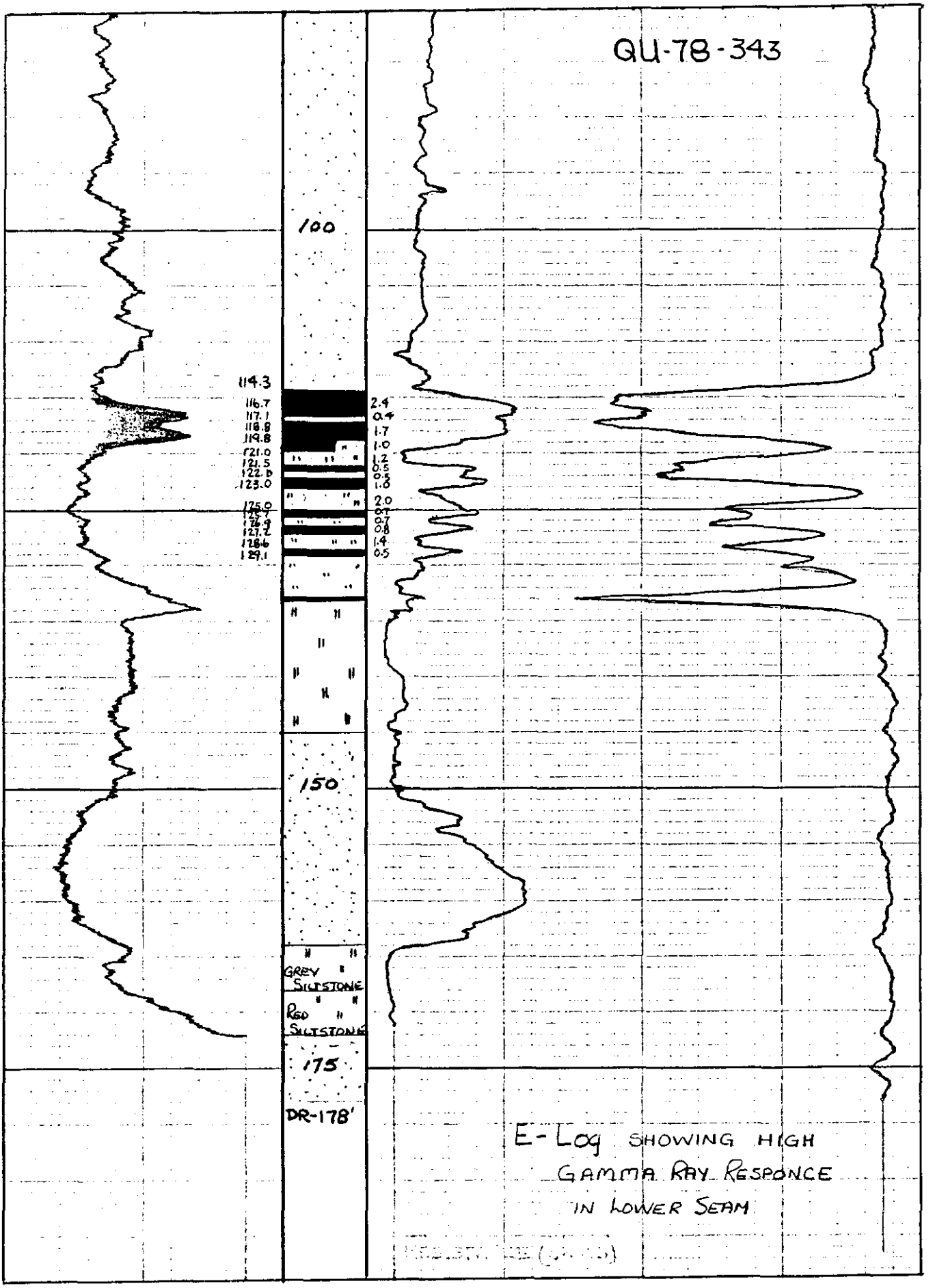
The upper-most coal horizon, Dia. 7, is a thick succession of siltstones interbedded with coal. Within this horizon there are three continuous coal zones, separated by siltstone partings varying in thickness from north east to south east. The coal seams themselves have great laterial variation and also thin away from the basin edge. The coal succession is immediately capped by a very compondent, fine-grained, medium-grey siltstone, overlaid by the normal succession of sandstone interbedded with siltstone.

The E-log signature of the lower-most seam is very unusual, with the upper-most coal band having a very high gamma response, Dia. 9.

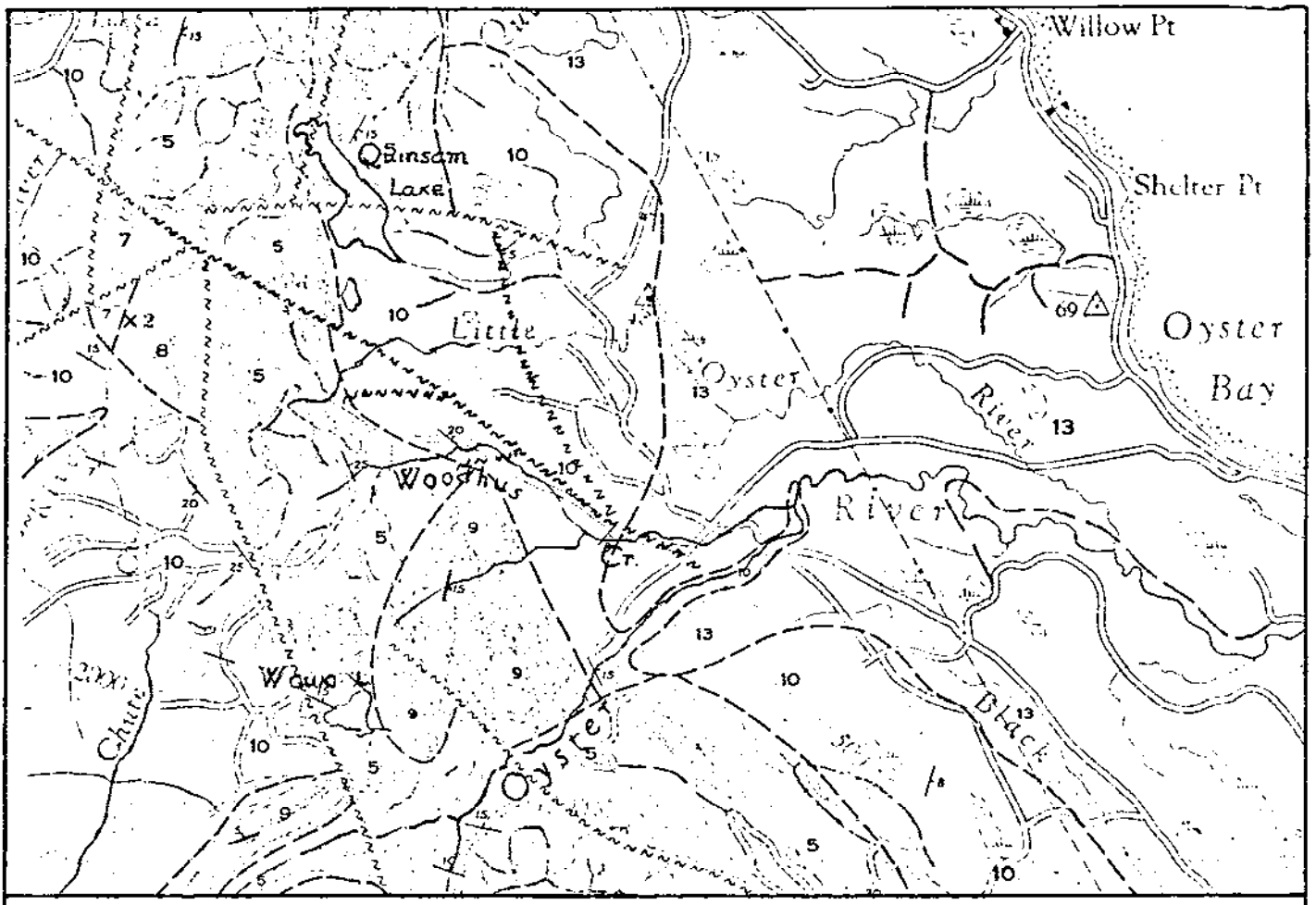
This signature is apparent in all holes drilled in 1977 and 1978, that encountered this particular seam. One possible explanation for this gamma response is that part of the ash content of the upper-most seam could be volcanic ash or bentonite, deposited with the coal forming vegetation. This is the only occurrance of this nature in the overall Quinsam Project.

3.3 Structural Geology

In the area of the East Block, the introduction of the Late Cretaceous Island Intrusives created regional uplift, which has produced a series of down faulted blocks. The major fault is a north west trending, normal fault, cutting the area into two separate blocks. The reconstruction of the sedimentary basin indicates a horizontal movement of over two miles, with the vertical displacement being over 150 feet. A series of secondary traverse faults branch off this main fault further displacing these blocks. These faults have a much smaller horizontal and vertical displacement.


QU-78-343
100
150
175
114.3
116.7
117.1
118.8
119.8
121.0
121.5
122.b
123.0
125.0
126.9
127.2
128.6
129.1
2.4
0.4
1.7
1.0
1.2
0.5
0.5
1.0
2.0
0.7
0.7
0.8
1.4
0.5
GREY SILTSTONE
RED SILTSTONE
DR-178'
E-Log SHOWING HIGH GAMMA RAY RESPONCE IN LOWER SEAM

Dia. 9



LEGEND

CENOZOIC

QUATERNARY
PLEISTOCENE AND RECENT

13 Glacial and alluvial deposits

CRETACEOUS OR TERTIARY

12 Porphyritic hornblende dacite, fine-grained quartz diorite, related breccias

CRETACEOUS
UPPER CRETACEOUS
NANAIMO GROUP (9 - 11)

11 TRENT RIVER FORMATION: shale, silty shale, minor shaly sandstone

10 COMOX FORMATION: sandstone, pebbly sandstone, minor conglomerate, shale, coal

9 Boulder conglomerate, minor lithic sandstone

MESOZOIC

JURASSIC AND (?) CRETACEOUS
COAST INTRUSIONS

8 Granodiorite, minor quartz diorite

TRIASSIC AND (?) JURASSIC
VANCOUVER GROUP (5 - 7)

7 Tuff, and lithic volcanic breccia and lava; argillite, siltstone; includes some rocks of unit 6

TRIASSIC
UPPER TRIASSIC

6 Limestone, calcareous shale; skarn near intrusive contacts

5 Massive, partly amygdaloidal, basalt, pillow basalt, pillow breccia; minor tuff, volcanic breccia
5A: Limestone, calcareous siltstone, shale, interbedded in 5

4 Diabase

PALAEOZOIC

PERMIAN AND (?) EARLIER
SICKER GROUP (1 - 3)

3 Limestone, in part with chert nodules

2 Greywacke, argillite, conglomerate

1 Propylitic banded tuff and volcanic breccia, chlorite schist

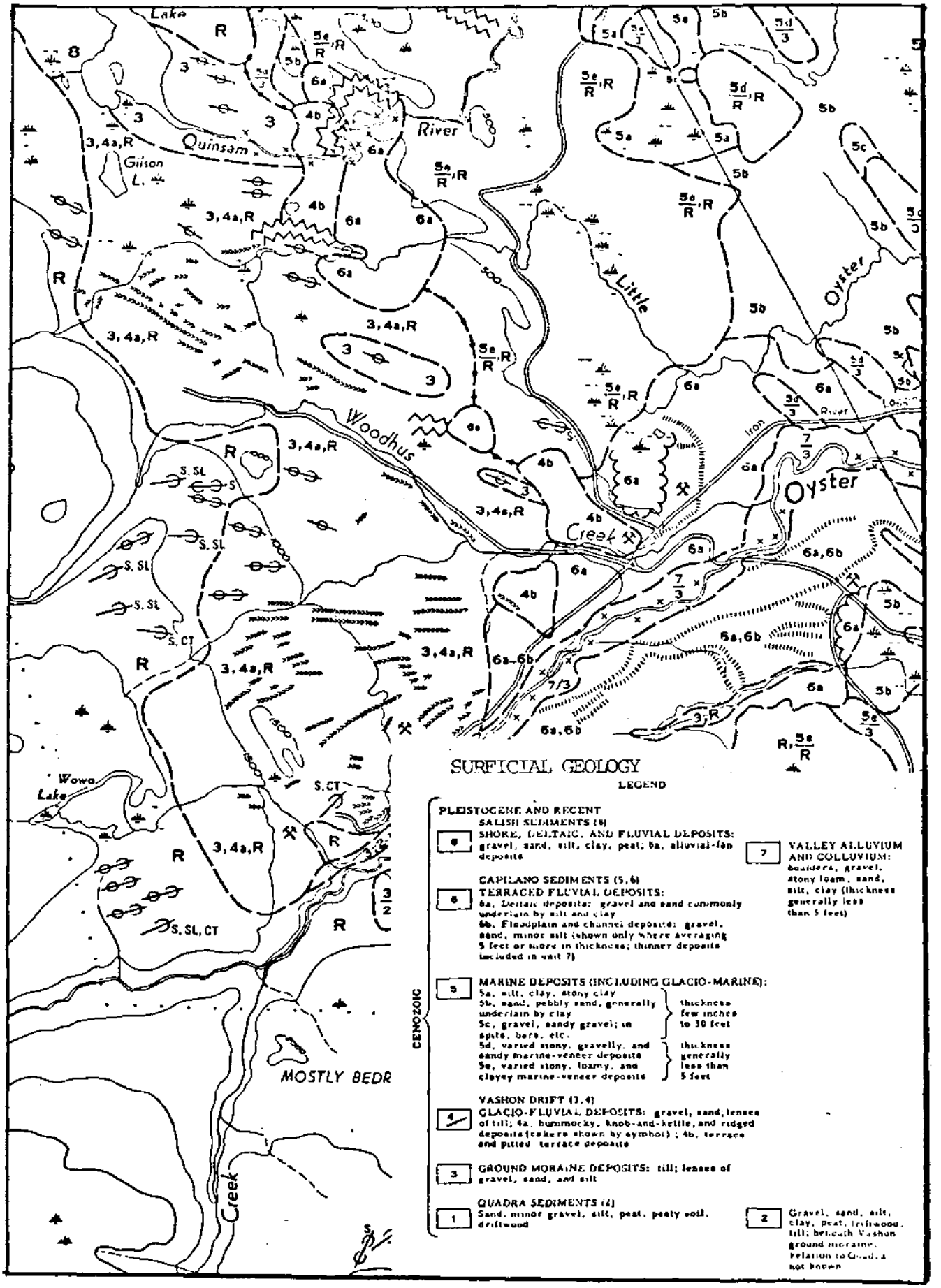
Geological boundary, approximate
Bedding (horizontal, inclined, overturned) + / /
Bedding (observed from distance or from air photos) /
Schistosity /
Fault, assumed
Coal mine (shaft, slope, with local number) ⊠4 ⊱5
Mineral occurrence (developed, undeveloped) ⊠6 ×7

Geology of East Block Area

Over the area, the predominant style of faulting is high angle normal displacement of gently tilted blocks, with very little evidence of folding, although minor rolls were in evidence in underground workings in the Comox area to the south, Dia. 10.

3.4 Surficial Geology

Glaciation during the Pleistocene time has left a Glacio-Fluvil Deposit covering the Comox formation. In the East Block, the general direction of ice advance was to the south east. Due to the linear character of the structure, there is an accumulation of till on the downthrow side of the fault blocks, leaving the upthrow side with practically no covering at all. There are several small heights of land to the north east which are esker and morain deposits of till, with lenses of gravel, sand and silt, Dia. 11.


Lake
Quinsam River
Gilson L.
Little Oyster River
Woodhus Creek
Iron Oyster Creek
Wowo Lake
MOSTLY BEDR
Creek
SURFICIAL GEOLOGY
LEGEND
CENOZOIC
PLEISTOCENE AND RECENT
SALISH SEDIMENTS (8)
8 SHORE, DELTAIC, AND FLUVIAL DEPOSITS: gravel, sand, silt, clay, peat; 8a, alluvial-fan deposits
CAPILANO SEDIMENTS (5,6)
6 TERRACED FLUVIAL DEPOSITS:
6a, Deltaic deposits: gravel and sand commonly underlain by silt and clay
6b, Floodplain and channel deposits: gravel, sand, minor silt (shown only where averaging 5 feet or more in thickness; thinner deposits included in unit 7)
5 MARINE DEPOSITS (INCLUDING GLACIO-MARINE):
5a, silt, clay, stony clay
5b, sand, pebbly sand, generally underlain by clay
5c, gravel, sandy gravel; in spits, bars, etc.
thickness few inches to 30 feet
5d, varied stony, gravelly, and sandy marine-veneer deposits
5e, varied stony, loamy, and clayey marine-veneer deposits
thickness generally less than 5 feet
VASHON DRIFT (3,4)
4 GLACIO-FLUVIAL DEPOSITS: gravel, sand; lenses of till; 4a, hummocky, knob-and-kettle, and ridged deposits (esker shown by symbol); 4b, terrace and pitted terrace deposits
3 GROUND MORAINE DEPOSITS: till; lenses of gravel, sand, and silt
QUADRA SEDIMENTS (2)
1 Sand, minor gravel, silt, peat, peaty soil, driftwood
7 VALLEY ALLUVIUM AND COLLUVIUM: boulders, gravel, stony loam, sand, silt, clay (thickness generally less than 5 feet)
2 Gravel, sand, silt, clay, peat, driftwood, till; beneath Vashon ground moraine; relation to Quadra not known

Dia. 11

4.0 COAL QUALITY

Coal quality information is based on 1977 results. Coreholes were drilled in each of the blocks, giving quality for all the four seams.

Hole No.	Seam No.	Thickness	Moisture %	Ash %	Sulphur %	Btu/lb.
LQ-77-74C	4	2.3	1.49	26.19	0.75	9,757
	4	6.0	1.25	34.89	0.92	8,547
LQ-77-91C	1	4.5	1.89	15.88	0.46	11,645
	2	7.25	1.51	32.37	1.48	9,101
	3	4.45	1.70	17.16	3.30	11,701

All samples on an air dried basis.

Coring in the 1978 program was suspended due to the rapid deterioration of roads and line, making drilling alone difficult and at times impossible.

5.0 RESERVES

The inplace recoverable coal reserves were calculated within a 0-200' highwall using three categories:

0'-120' of overburden
120'-160' of overburden
160'-200' of overburden

Reserves were calculated by plan metering individual seams to the three categories and converting this figure to sq. ft. This figure was then multiplied by the average raw coal thickness in that category, then divided by 27 sq. ft. to obtain a volume in cubic yards. The volume was then multiplied by 1.2 tons/cu. yd. to arrive at a tonnage.

TABLE 2

QUINSAM RESERVES EAST BLOCK

Seam No.	Categories	Area Msq'	Average Seam Thickness	Seam Volume M Tons	Overburden Volume Mcuyd.	Parting Volume Mcuyd.
Seam 5	0-120'	3.278	4.37'	0.64	10.32	
	120-160'	1.963	4.00'	0.35	10.18	
	160-200'	2.703	3.45'	0.45	10.02	
Seam 6	0-120'	2.585	5.72'	0.66		1.561
	120-160'	2.304	4.70'	0.48		1.391
	160-200'	2.770	4.00'	0.49		1.672
Seam 7	0-120'	2.472	3.30'	0.36		0.814
	120'160'	1.559	3.30'	0.229		0.523
	160-200'	1.865	2.80'	0.232		0.626
Seam 8						
Block A	0-120'	1.534	4.20'	0.287	4.829	
	120-160'	0.394	5.10'	0.089	2.043	
	160-200'	0.349	5.10'	0.079	2.327	
Block B	0-120'	1.176	6.40'	0.335	3.702	
	120-160'	0.480	6.40'	0.137	2.489	
	160-200'	0.435	6.40'	0.124	2.819	
Block C	0-120'	1.646	6.08'	0.445	6.218	
	120-160'	0.460	6.08'	0.124	2.385	
	160-200'	0.075	6.08'	0.020	0.472	
TOTALS				5.531	57.804	6.587
					64.391	

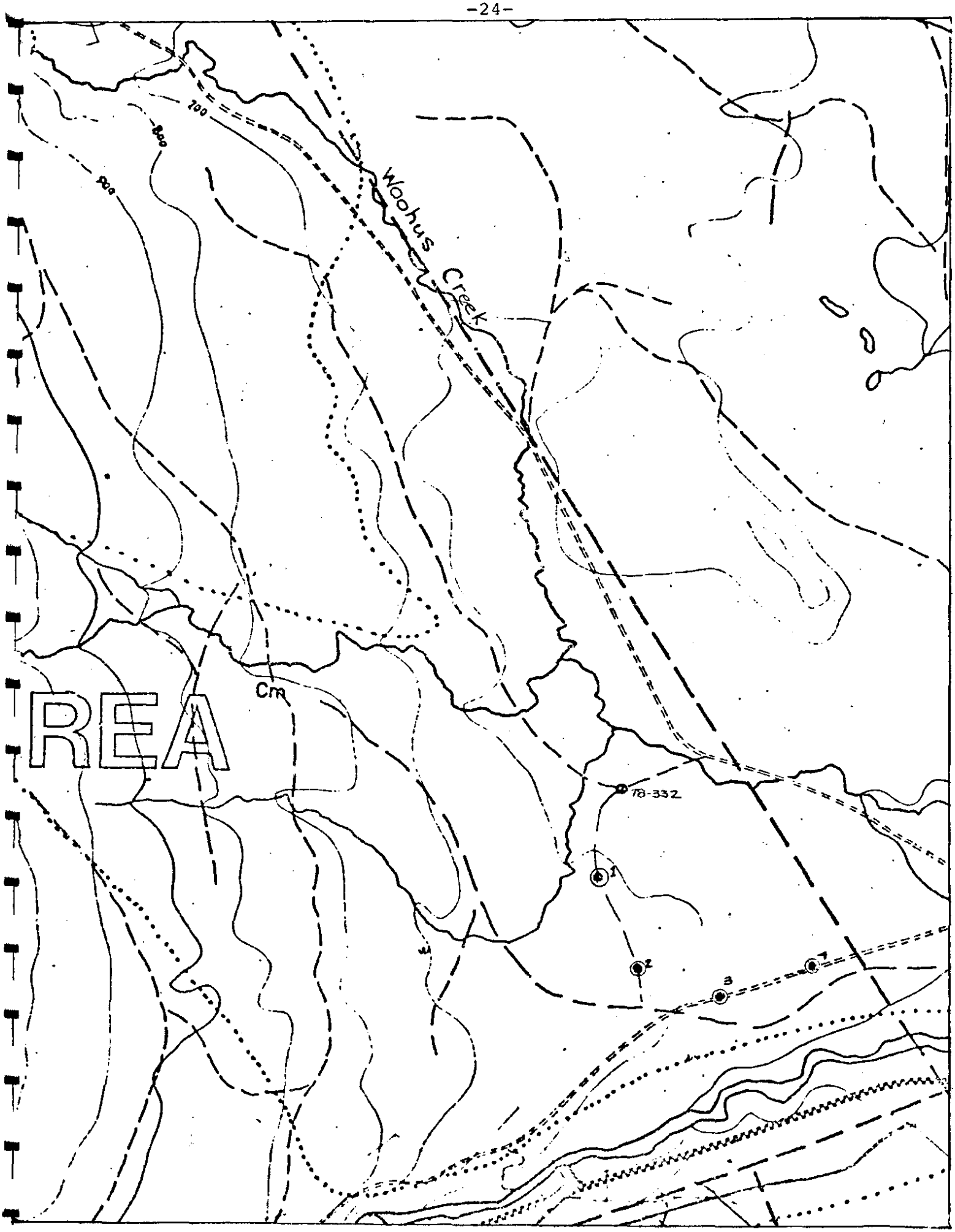
RECOMMENDATIONS

Drilling in November of 1978 has deliniated four individual coal seams in two separate sedimentary horizons. The new interpretation of this area leads to two areas of further interest. One would be an extension of previous drilling, down strike, to the north west. It is felt that this drilling will deliniate basin edge for the lower seam.

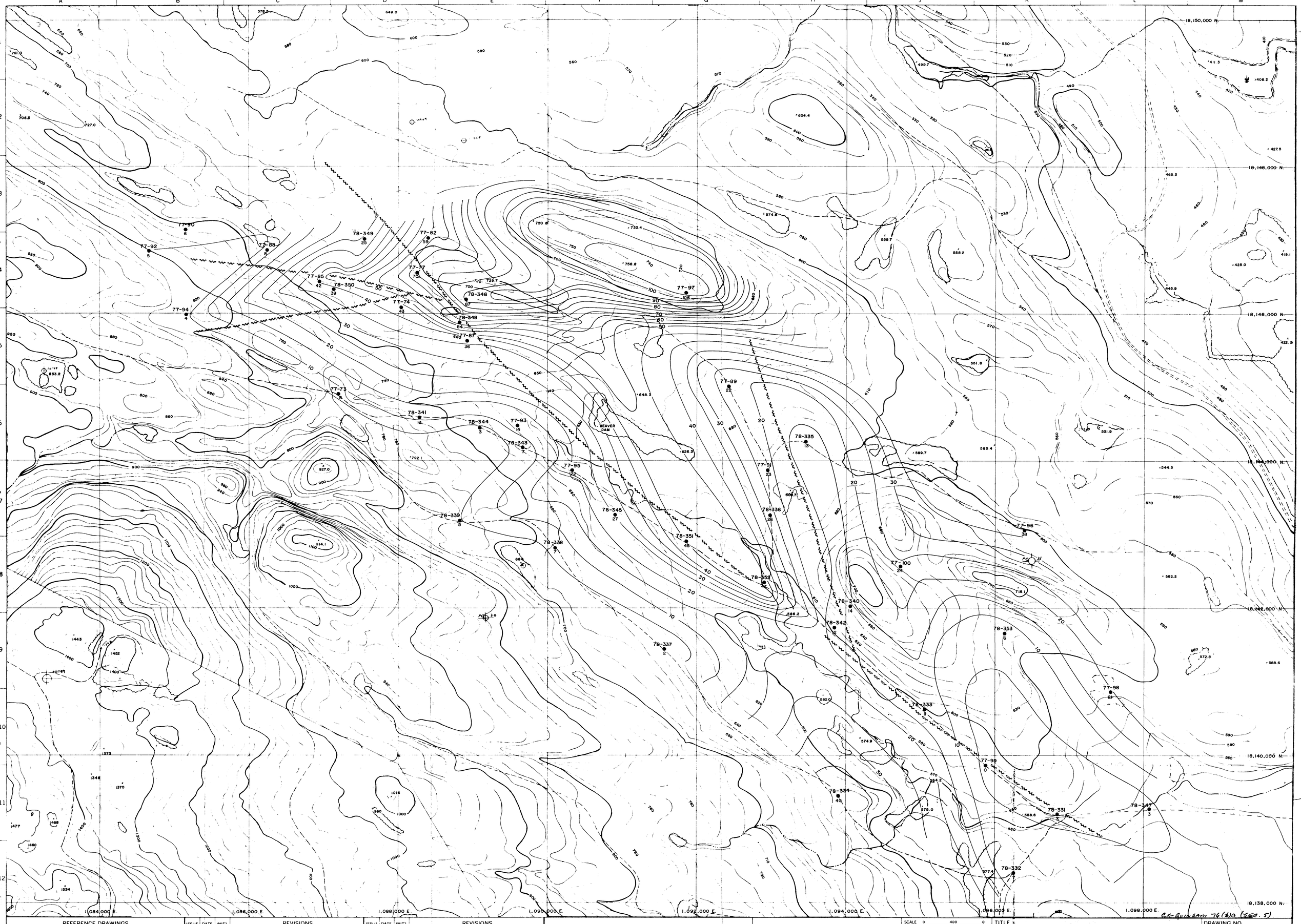
The major north west running fault split the basin and moved it horizontally over two miles. The west side of this basin should be drilled for any further uplifting.

In the north, although of the lower priority, no roads or lines exist for supplementary drilling. In the southern area three to four holes could be drilled on existing roads, Dia. 12.

If infill drilling is to take place in the East Block, it should be undertaken in the summer months to permit access to these areas.



Dia. 12



REFERENCE DRAWINGS	
QS.G. 202 GF. 13	THIS BASE MAP.

ISSUE	DATE	INIT'L	REVISIONS

ISSUE	DATE	INIT'L	REVISIONS

LUSCAR LTD.

QUINSAM PROJECT

SCALE 0 400 0 feet

	BY	DATE
DRAWN	T. CHRUSCIEL	FEB. 23, 1979.
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TITLE

QUINSAM EAST

GLACIAL TILL ISOPACH

DRAWING NO.

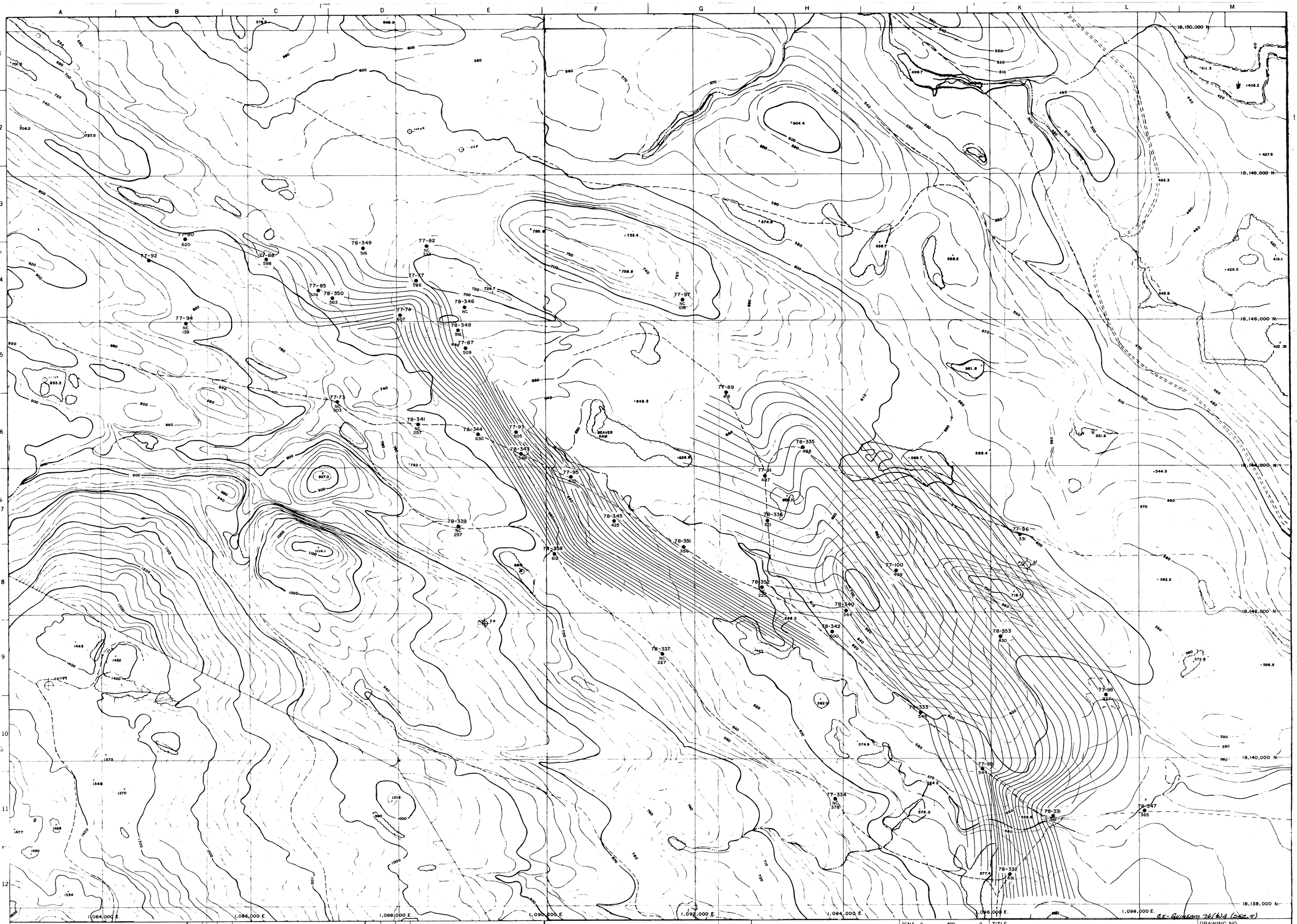
QS. G. 218 GF. 13

ISSUE

71 (VII)

OK-Quinsam 76(6)A (Sec. 5)

APPENDIX # 4.



REFERENCE DRAWINGS	
QS.G. 202 GF. 13	THIS BASE MAP

ISSUE	DATE	INIT'L	REVISIONS

ISSUE	DATE	INIT'L	REVISIONS

LUSCAR LTD.

QUINSAM PROJECT

SCALE 0 400 0 1000

	BY	DATE
DRAWN	T. CHRUSCIEL	FEB. 28, 1979.
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1st ISSUED		

TITLE

QUINSAM EAST

STRUCTURE CONTOURS

71 (m2)

DRAWING NO.

QS.G. 219 GF. 13

ISSUE

APPENDIX # 2

18,150,000 N.
18,148,000 N.
18,146,000 N.
18,144,000 N.
18,142,000 N.
18,140,000 N.
18,138,000 N.

1,084,000 E. 1,086,000 E. 1,088,000 E. 1,090,000 E. 1,092,000 E. 1,094,000 E. 1,096,000 E. 1,098,000 E.

77-90
Till 6.0'
1.7 62.3
1.7 68.0
To 271

77-92

77-88
Till 8.0'
6.3 70.0
To 279

78-349
Till 25.0'
4.0 129
2.0 135
To 220

77-82
Till 63.0'
To 323

77-77
Till 70.0'
6.7 168.4
Split
To 249

77-85
Till 47.0'
1.3 109
To 189

78-350
Till 39.0'
6.3 122.4
Split
To 156

77-74
Till 47.0'
8.1 Split 6.2
To 316

78-346
Till 87.0'
NC
To 378

78-348
Till 64.0'
U 213
To 300

77-87
Till 40.0'
7.1 153.9
Split
To 478

77-94
Till 4.0'
NC
To 139

77-73
Till 8.0'
NC
To 303

78-341
Till 13.0'
NC
To 257

78-344
Till 3.0'
5.1 572
To 118

77-93
Till 12.0'
6.7 Hi.7 Split
To 478

78-343
Till 70'
7.1 14.3
To 178

77-95
Till 22.0'
5.3 182.0 Split
To 204

78-345
Till 27.0'
7.0 197.1
To 238

78-339
Till 5.0'
NC
To 257

78-338
Till 70'
3.5 71.0
2.1 77.3
0.9 82.6
0.7 84.3
To 158

78-351
Till 44.0'
0.9 62.3
5.3 290.5
To 318

78-337
Till 2.0'
NC
To 277

77-97
Till 106.0'
No Eq
T 106

77-89
Till 22.0'
5.0 206.9
3.5 221.0
To 243

BEAVER DAM

78-335
Till 19.0'
12.2.5 5.2
14.18 5.0
16.6 3.2
17.0 2.0
To 282

77-91
Till 26.0'
3.7 112.1
3 131.2
3.8 145.2
To 159

78-336
Till 26.0'
3.9 71.2
5.6 89.3
3.9 116.3
1.9 164.3
To 201

78-352
Till 47.0'
NC 225
To 226

78-340
Till 14.0'
38.7 46
70.3 64
85.5 5.5
93.4 2.6
To 182

78-342
Till 12.0'
7.8 24
3.0 42.3
To 181

77-100
Till 42.0'
4.2 169.3
Split
3.7 182.3
Split
To 314

77-96
Till 38.0'
4.4 242.2
1.8 251.3
6.1 269.8
2.0 302.2
To 334

78-353
Till 4.0'
2.6 187.3
1.1 194.6
4.7 213.0
2.5 227.7
To 255

78-333
Till 11.0'
6.4 48.3
Body Split
To 139

77-98
Till 21.0'
4.1 Split
226.4
To 337

77-99
Till 10.0'
2.0 34.3
1.2 41.8
5.7 59.8 Split
To 144

78-334
Till 42.0'
NC
To 378

78-331
Till 3.0'
28 202.6
2.0 207.8
To 242

78-347
Till 58.0'
3.9 173.8
2.5 204.5
2.7 206.6 Dirty
2.9 233.5
2.2 247.5
To 261

78-332
Till 7.0'
3.6 79.0
4.0 97.0
1.4 101.0
1.5 113.5
1.0 116.5
To 309

EX-Quinsam 78(6)A (Sec. 5)

REFERENCE DRAWINGS		ISSUE	DATE	INIT'L	REVISIONS	ISSUE	DATE	INIT'L	REVISIONS
QS.G.202 GF.13	THIS BASE MAP								

LUSCAR LTD.

QUINSAM PROJECT

SCALE 0 400 0 Feet

	BY	DATE
DRAWN	T. CHRUSCIEL	FEB. 15, 1979
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APPROVED		
1st ISSUED		

TITLE

QUINSAM EAST

DRILLHOLE LOCATION

71

DRAWING NO.

QS.G.214 GF.13

ISSUE

CX QUINSAM 78(4)A

SUMMARY

QUINSAM COAL QUALITY

December 2, 1980

Province of
British Columbia

Ministry of
Energy, Mines and
Petroleum Resources

December 30, 1980

Alex Matheson
Geology
BUILDINGS

Dear Alex:

Re: Wellington Colliery Company Limited
Quinsam Project

As you may recall, Wellington Colliery Company Limited recently submitted an Application to Extend Term of Licence for their Quinsam Coal Licences. At the time of submission, the company advised me that they were claiming $14,694.60 for work done after the anniversary date in 1979 but reported this in the report of work entitled Geology of the Coal Reserve in the Area of Pit 2 North and Pit 2 North Extension. After you and I discussed their submission, you asked that I request the analyses mentioned on page 25 of their report of work. In this regard, I am enclosing the report of coal analyses which Wellington has now submitted.

As all available information is now in, may I apply the $14,694.60 requested by Wellington?

Yours very truly,

Paul Hagen
Coal Administrator

*ns

Enclosure

SUMMARY OF SEAM #1 RIDER

CORE ANALYSIS

Lab No.	Corehole No.	Mois-ture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
311	QU-78- 6(C)	1.74	22.41	36.63	39.23	8.32	10,375	
314	QU-78- 9(C)	1.88	19.85	37.86	40.31	3.02	10,635	
316	QU-78-13(C)	1.71	21.80	37.75	38.74	3.02	10,421	
318	QU-78-16(C)	1.80	20.37	36.78	41.05	6.22	10,827	
320	QU-78-21(C)	1.89	22.20	35.92	39.99	5.68	10,522	
323	QU-78-27(C)	1.96	18.47	36.75	42.82	4.70	11,310	
327	QU-78-30(C)	2.93	13.69	39.65	43.73	2.88	11,347	
329	QU-78-31(C)	1.71	21.70	37.92	38.67	8.62	10,845	
379	QU-78-39(C)	2.75	14.86	36.80	45.59	3.12	11,741	
381	QU-78-44(C)	2.34	29.17	33.98	34.51	6.13	9,341	
383	QU-78-45(C)	2.32	24.35	35.07	38.26	5.22	10,356	
385	QU-78-46(C)	2.12	17.18	37.96	42.74	6.62	10,354	
389	QU-78-49(C)	2.22	10.37	39.85	47.56	2.52	12,476	
392	QU-78-50(C)	2.38	10.83	38.53	48.26	2.72	12,316	
394	QU-78-52(C)	2.15	19.35	37.04	41.46	3.18	11,007	
396	QU-78-55(C)	2.12	23.10	38.22	36.56	2.86	10,469	
418	QU-78-36(C)	2.28	16.71	37.19	43.82	2.38	11,351	

SUMMARY OF SEAM #1N

CORE ANALYSIS

Lab No.	Corehole No.	Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
210	QU-78- 4(C)	2.40	11.87	37.32	48.41	1.19	12,077	1
211	QU-78- 1(C)	2.47	10.61	36.85	50.07	0.95	12,228	1
312	QU-78- 6(C)	2.67	14.98	35.80	46.55	0.90	11,388	1
315	QU-78- 9(C)	2.71	11.48	36.98	48.83	0.56	11,966	1½
317	QU-78- 13(C)	2.75	11.41	35.97	49.87	0.46	12,000	1½
319	QU-78- 16(C)	2.76	8.31	38.10	50.83	0.84	12,481	1½
321	QU-78- 21(C)	2.79	12.23	36.64	48.34	0.44	11,677	1½
324	QU-78- 27(C)	2.79	10.53	37.00	49.68	0.50	12,093	1½
328	QU-78- 30(C)	2.65	9.17	38.07	50.11	1.10	12,424	1½
330	QU-78- 31(C)	3.30	8.53	37.74	50.43	0.56	12,452	1
380	QU-78- 39(C)	3.30	8.25	36.80	51.65	0.79	12,465	1½
382	QU-78- 44(C)	2.68	10.68	36.74	49.90	0.82	11,999	1
384	QU-78- 45(C)	3.05	10.35	37.27	49.33	1.34	12,035	1
386	QU-78- 46(C)	3.06	9.83	37.73	49.38	0.40	12,104	1½
415	QU-78- 58(C)	3.15	11.83	36.53	48.49	0.46	11,789	1
416	QU-78- 79(C)	3.41	13.27	38.77	47.91	0.31	11,271	1½
408	QU-78- 67(C)	2.72	12.77	36.95	47.56	0.38	11,901	1
417	QU-78- 92(C)	3.10	10.83	36.09	49.98	0.61	11,880	1½
419	QU-78- 36(C)	3.09	9.45	38.28	49.18	0.33	12,207	1
421	QU-78- 96(C)	3.11	13.19	35.07	48.62	0.73	11,489	1½
430	QU-78-104(C)	2.83	12.49	36.26	48.41	0.86	11,636	1½
431	QU-78-112(C)	2.86	12.15	36.46	48.53	0.62	11,665	1
498	QU-78-109(C)	3.49	10.37	35.70	50.68	0.45	12,114	1
508	QU-78-114(C)	3.19	20.22	34.03	42.56	1.18	10,569	½
503	QU-78-134(C)	3.53	9.26	36.05	51.16	0.48	12,275	1
507	QU-78-137(C)	3.68	16.67	31.22	48.43	1.08	11,069	½
511	QU-78- 71(C)	2.80	9.76	36.56	50.88	0.51	12,130	1
512	QU-78- 71(C)	2.69	11.58	35.06	50.66	0.32	11,775	1
596	QU-78-141(C)	3.85	13.01	35.29	47.85	1.74	11,632	1

SUMMARY OF SEAM #1S

CORE ANALYSIS

Lab No.	Corehole No.	Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
533	QU-78-148(C)	3.20	10.37	37.48	48.95	0.92	12,204	1
539	QU-78-153(C)	3.02	13.27	36.33	47.80	1.08	11,854	1
552	QU-78-163(C)	3.22	10.90	36.65	49.23	1.32	12,152	1½
590	QU-78-179(C)	2.80	18.62	33.07	45.51	0.88	10,942	1
591	QU-78-192(C)	2.54	26.71	31.34	39.42	1.51	9,677	1½
592	QU-78-198(C)	2.72	25.75	30.49	41.04	0.56	9,750	1
589	QU-78-202(C)	2.93	16.29	34.07	46.71	0.54	11,243	1½
602	QU-78-208(C)	2.47	22.76	35.85	38.92	0.73	10,000	1
616	QU-78-213(C)	2.78	16.01	35.25	45.95	1.50	11,542	1½
618	QU-78-215(C)	2.55	19.69	34.11	43.65	0.75	10,807	1
	QU-79- 7(C)	1.63	20.88	34.33	43.16	1.07	10,766	
	QU-79- 9(C)	1.60	16.12	35.81	46.47	1.14	11,525	
	QU-79- 12(C)	1.51	21.31	32.84	44.34	1.03	10,673	
	QU-79- 28(C)	1.92	15.99	36.83	45.26	1.73	12,338	
	QU-79- 30(C)	1.10	16.73	35.25	46.92	0.81	11,784	

SUMMARY OF SEAM #2

CORE ANALYSIS

Lab No.	Corehole No.	Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
313	QU-78- 9(C)	1.74	31.65	34.57	32.04	4.42	8,950	
402	QU-78- 58(C)	2.70	14.47	38.56	44.27	2.11	11,685	
406	QU-78- 67(C)	2.78	13.54	37.74	45.94	2.22	11,805	
409	QU-78- 79(C)	2.90	9.49	39.18	48.43	1.32	12,345	
412	QU-78- 92(C)	2.87	14.52	37.26	45.34	1.51	11,566	
420	QU-78- 96(C)	3.22	14.22	37.22	45.34	2.08	11,660	
422	QU-78-104(C)	3.03	11.26	36.93	48.78	1.98	12,045	
426	QU-78-112(C)	2.62	16.44	38.71	42.23	1.85	11,380	
496	QU-78-109(C)	1.99	12.65	38.28	47.08	1.94	11,717	
504	QU-78-137(C)	3.34	11.49	37.02	48.15	1.70	12,153	
509	QU-78- 71(C)	3.32	14.38	36.52	45.78	2.06	11,545	
582	QU-78-192(C)	2.83	11.23	38.73	47.21	3.20	12,490	
585	QU-78-198(C)	3.10	10.09	37.25	49.56	2.18	12,456	
588	QU-78-202(C)	3.12	10.05	36.30	50.53	2.69	12,437	
593	QU-78-141(C)	3.94	14.81	34.85	46.40	0.65	11,110	
603	QU-78-213(C)	2.54	23.60	35.07	38.79	3.28	10,188	1½
617	QU-78-215(C)	2.86	13.63	35.49	48.02	1.94	11,978	1
615	QU-78-228(C)	4.39	12.59	38.47	44.55	1.46	11,465	
593	QU-78-141(C)	3.71	14.54	36.71	45.04	1.64	11,358	
	QU-79- 6(C)	1.58	21.47	33.31	43.64	0.56	10,725	
	QU-79- 12(C)	1.35	19.68	36.01	42.96	3.63	11,166	
	QU-79- 28(C)	1.41	24.99	33.97	39.63	4.75	10,110	
	QU-79- 30(C)	0.98	24.22	35.54	39.26	3.12	10,355	
	QU-79-33(C)	1.41	20.72	35.82	42.32	2.52	10,720	

SUMMARY OF SEAM #3

CORE ANALYSIS

Lab No.	Corehole No.	Mois-ture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
554	QU-78-148(C)	3.04	10.93	38.00	48.03	2.26	12,147	1
555	QU-78-153(C)	2.75	15.07	36.52	45.66	3.26	11,644	1½
556	QU-78-157(C)	3.09	21.42	43.74	40.75	2.07	10,359	1
546	QU-78-158(C)	2.34	16.68	35.33	45.65	3.92	11,332	1
557	QU-78-163(C)	2.76	13.47	37.00	46.77	3.82	11,665	1½
553	QU-78-165(C)	3.03	10.60	38.74	47.63	3.04	12,183	1
619	QU-78-217(C)	2.35	33.34	31.24	33.07	2.61	8,990	1
620	QU-78-228(C)	1.63	31.25	33.03	34.09	2.62	9,343	1
651	QU-78-243(C)	1.49	15.97	37.01	45.53	5.50	11,813	1½
645	QU-78-254(C)	1.29	16.02	37.75	44.94	5.50	11,800	3
648	QU-78-258(C)	1.41	13.11	37.75	47.73	3.13	12,290	2
649	QU-78-267(C)	1.65	18.78	36.60	42.97	3.40	11,322	1
650	QU-78-267(C)	1.74	29.89	34.00	34.37	2.42	9,400	1
678	QU-78-324(C)	1.76	22.57	35.36	40.31	3.84	10,679	1½
673	QU-78-324(C)	1.72	20.24	35.61	42.43	0.88	10,490	1½
675	QU-78-324(C)	1.65	20.68	35.91	41.76	0.89	10,393	1½
	QU-78- 10(C)	1.59	10.00	39.04	49.37	2.96	12,595	
	QU-78- 14(C)	1.86	22.50	32.85	42.79	1.09	10,295	
	QU-78- 16(C)	1.71	26.56	33.02	38.71	1.49	9,939	
	QU-78- 18(C)	0.97	23.21	34.26	41.56	0.95	10,413	
	QU-79- 19(C)	0.99	18.80	35.17	45.04	1.17	11,120	
	QU-79- 20(C)	0.99	24.94	33.46	40.61	1.56	10,057	
	QU-79- 22(C)	0.82	31.80	30.78	36.60	1.73	8,960	
	QU-79- 26(C)	0.97	28.44	36.01	34.58	1.66	9,497	
	QU-79- 32(C)	0.89	32.29	29.41	37.41	3.18	9,224	
	QU-79- 34(C)	0.88	33.99	28.69	36.44	3.80	8,900	
	QU-79- 36(C)	1.06	23.13	34.83	40.98	2.60	10,731	
	QU-79- 37(C)	1.01	19.00	37.52	42.47	2.82	11,406	
	QU-79- 39(C)	0.91	26.31	31.25	41.53	3.14	10,364	
	QU-79- 11(C)	1.43	18.46	35.32	44.79	3.76	11,317	
	QU_79- 17(C)	1.75	25.29	31.90	41.06	1.01	10,052	
	QU-79-13(C)	1.82	18.31	33.05	46.82	1.02	11,009	
	QU-79-15(C)	1.81	16.11	33.35	48.73	1.58	11,293	

CORE ANALYSIS

Lab No.	Corehole No.	Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
387	QU-78- 47(C)	2.69	14.75	37.67	44.89	0.78	11,361	
388	QU-78- 49(C)	3.05	11.23	36.81	48.91	0.45	11,891	
391	QU-78- 50(C)	3.19	8.12	37.77	50.92	0.46	12,470	
393	QU-78- 52(C)	3.08	10.80	37.53	48.59	0.36	11,965	
395	QU-78- 55(C)	3.14	10.87	36.63	49.36	0.64	11,965	
	QU-78- 1(C)	1.82	16.25	34.47	47.46	0.39	11,375	
	QU-79- 2(C)	1.68	12.51	35.39	50.42	0.66	12,043	
	QU-79- 3(C)	1.78	20.21	33.30	44.71	0.41	10,786	
	QU-79- 4(C)	1.80	17.30	35.37	45.53	2.81	11,500	
	QU-79- 5(C)	1.63	26.64	32.53	39.20	1.28	9,646	
	QU-79- 6(C)	1.58	19.82	30.44	48.16	2.20	10,768	
	QU-79- 8(C)	1.77	13.18	35.75	49.30	0.58	11,920	

SUMMARY OF SEAM #4

CORE ANALYSIS

Lab No.	Corehole No.	Moisture	Ash	Volatile Matter	Fixed Carbon	Sulphur	BTU/lb.	F.S.I.
	QU-79- 16(C)	1.45	27.36	32.98	38.21	3.74	9,850	
	QU-79- 18(C)	1.68	23.65	34.85	39.82	4.42	10,410	
	QU-79- 26(C)	0.86	34.71	30.59	33.84	2.86	8,690	
	QU-79-324(C)	1.76	22.57	35.36	40.31	3.84	10,679	

071
(MI)
CX - QUINSAM 78 (2*)A (*4)

REFERENCE DRAWINGS	ISSUE	DATE	INIT'L	REVISIONS	ISSUE	DATE	INIT'L	REVISIONS

LUSCAR LTD.

QUINSAM COAL LTD.

SCALE 1 : 8,000
200 100 0 200 METERS

	BY	DATE
DRAWN		
CHECKED		
APPROVED		
1st ISSUED		

TITLE

QUINSAM DRILLHOLE LOCATION MAP

DRAWING NO. QSG 366/GF 37

ISSUE