B.C. HYDRO

HAT CREEK PROJECT

MINING FIELD PROGRAM 1982

TRENCH D

MINING DEPARTMENT

Prepared by: Mining Department

CR36

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MINING FIELD PROGRAM 1982

TRENCH D

CONTENTS

CONTENTS - (Cont'd)

TABLES

FIGURES

CONTENTS - (Cont'd)

PHOTOS

APPENDICES

SUMMARY

This report outlines the field activities associated with the Trench D portion of the 1982 Mining Field Program at Hat Creek.

Contracts for overburden removal for Trench D were awarded in early May 1982 and work commenced on site on 26 May 1982. The entire trench site ground cover was grubbed and cleared and topsoil was scraped and stockpiled for future reclamation. A total of 120 448 bank cubic metres was excavated during the 5 weeks of overburden removal. This included 72 269 bank cubic metres of overburden and 48 179 bank cubic metres of waste coal.

The exposed coal measures were geophysically logged, channel sampled and mapped by Mining Department geologists. The individual beds were identified in terms of zones and subzones and detailed plans were formulated for excavating the bulk sample.

Coal mining commenced at the east end of the pit and progressed westward to the Medicine Creek clay at the top of the A-zone coal. A P&H 418 backhoe was used to cut a slot trench 11 m wide at the top, 2.5 m high and 10 m wide at the bottom. A 2 m x 2 m cut on the south side was excavated and sent to the crusher to form the bulk sample. Partings <2 m thick were deliberately left in the sample to comply with existing mine design criteria. The coal and parting material which was not used in the bulk sample was stored in separate piles, according to the subzone groupings developed in the mining plan. These stockpiles were compacted with a tractor-dozer to prevent spontaneous combustion.

The bulk sample material was crushed to -15 cm topsize in a portable jaw crusher. Each subzone grouping from the mine was crushed and sampled separately. A total of 772.6 t of crushed material was placed in one

common windrow pile. Comparison of analytical results from the channel samples and the bulk samples indicated that the overall bulk sample was representative of A-zone ROM coal. The composite sample pile was subsampled to produce the various bulk samples required for coal quality and coal preparation pilot scale tests.

Bulk samples were shipped offsite in late August to the following test facilities:

1. EPRI Coal Cleaning Test Facility in Homer City, Pa.

   - 10 t (50)drums (A-zone coal)
   - 150 t - 2 bottom hopper rail cars (A-zone coal)

2. KHD - Batac Jig Test Facility in Bochum, West Germany

   - 10 t (51) drums (A-zone coal)

3. Hazemag, Union Town, Pa.

   - 1 t (5) drums (Medicine Creek clay)

4. H. Colijn, Monroevill, Pa. (material handling consultant)

   - 1 - (5) gallon pail of -1/4 inch - "A"-zone coal

At the time of this writing, only the Homer City tests had been performed. Laboratory tests were still in progress, but preliminary indications are that Hat Creek A-zone coal can be successfully washed without undue process problems in either the preparation plant circuitry or in the tailing dewatering equipment.

Environmental protection planning was conducted concurrently with the development of the study program. Topsoil was scraped from both the trench proper and the waste disposal area and stockpiled for use in reclamation. Care was taken to provide suitable drainage control works in all disturbed areas. A dust study was undertaken to determine airborne dust concentrations at various distances from the excavation activities and to evaluate methods of control. Two leachate piles were established using a mixture of tills and silty clays in one and Medicine Creek claystone in the other.

Miscellaneous areas were scarified by rake and other areas were recontoured to lessen slopes prior to reseeding. Numerous test plots were created in order to demonstrate the ability to reclaim different types of waste materials under a variety of conditions.

SECTION 1.0 - INTRODUCTION

The Trench D program was planned by B.C. Hydro's Mining Department and consultants in January and February 1982. The program was designed to provide practical design information for selective mining and material handling and to confirm the stratigraphy, coal quality and coal preparation characteristics of the A-zone coal.

Previous exploration and studies indicated that the A-zone coal could be selectively mined, but no bulk sample test work had been conducted. It was first planned to dig 6.5 m high benches in the coal using a 3 to 5 m^3 shovel, but financial constraints caused the program to be reduced to a single 2.5 m high bench excavated with less expensive 2 m^3 backhoe. These changes eliminated the opportunity to collect quantitative data on dilution, mining loss, face slope stability and minimum mining thickness.

The remainder of the program objectives were all attained. Detailed stratigraphic information was obtained using geophysical logs, channel samples and detailed geological mapping. Representative samples were taken for coal quality and coal preparation studies, material handling characteristics were observed and tested, and various geotechnical and environmental studies were undertaken.

SECTION 2.0 - DESCRIPTION OF FIELD ACTIVITIES

The field activities associated with the Trench D program began in mid May 1982 and were completed by the end of August 1982. The program was planned and executed by a team made up of B.C. Hydro staff, consultants and contractors.

2.1 MANPOWER

Supervision and technical control of the field program was carried out by the following personnel:

W.C. Fothergill	B.C. Hydro	Site Manager
H. Kim	B.C. Hydro	Geologist
A.W. Penner	B.C. Hydro	Geologist
F.G. Hathorn	B.C. Hydro	Environmental Engineer
B. Payne	Consultant	Coal Preparation Specialist
T. Beckett	P.L. Contracting	Surveyor
I. Fothergill	P.L. Contracting	Surveyor

The excavation, coal crushing, handling and sampling and reclamation work was carried out by personnel from various contractors as follows:

(a) Overburden Excavation

(Bid Contract)
36 days @ 10 hr/day

Dozer Operator	1
Motorscraper Operators	4
Shift Boss	1

(b) Coal Slot Bench Excavation (ERA)

18 days @ 8 hr/day

Shift Boss	1
Hydraulic Excavator Operator	1
Diesel Dump Truck Operator	2
Front End Loader/Dozer Operator	1

(c) Coal Preparation and Sampling

Crusher Foreman	1
Crusher Helpers	2
Sampling Helpers	1
Electrician and Mechanical (Part-time)	1
Assay Lab - Coal Analysis Technician	2

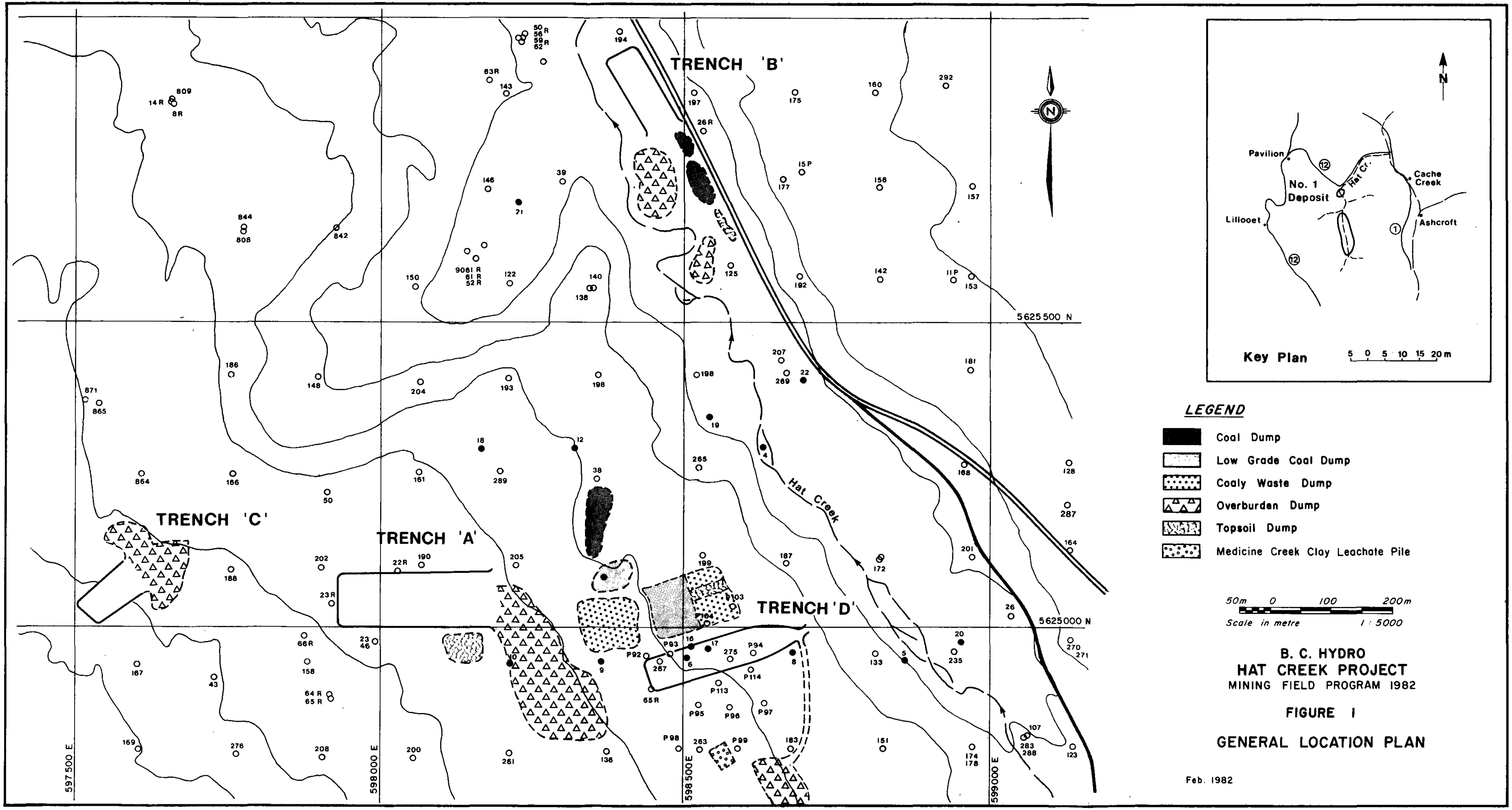
(d) Reclamation and Environmental

Dozer - Water Truck Operator	1

During the peak activity period, when coal slot excavation and coal sampling were proceeding simultaneously, an average of 20 people were required to manage and execute the trench program.

2.2 SITE PREPARATION

The Trench D site and waste dumps were stadia surveyed from existing bench marks (see Fig. 1). Pickets were placed on each side of the trench at 20 m intervals and at the corners of the areas designated for waste dumps. The trench and waste dump sites were then grubbed and cleared with a tractor-dozer. The trees were bucked and stacked and the topsoil was stockpiled.



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MINING FIELD PROGRAM 1982

FIGURE 1

GENERAL LOCATION PLAN

Feb. 1982

The surveying was done by B.C. Hydro surveyors and the grubbing and clearing by H.E. Sanders Ltd.

2.3 OVERBURDEN REMOVAL

The overburden removal contract was awarded to H.E. Sanders Ltd., and work began on 26 May. The clearing and grubbing was completed on 2 June. The overburden was removed using a bulldozer and from two to four motorscrapers. The overburden was placed on two adjacent waste dumps, one for clay and the other for sand and gravel. The overburden removal contract included removing the coal from the upper bench. This coal was stockpiled as waste coal because the motorscrapers were not able to separate the coal from the interbedded waste partings. The motorscrapers did not encounter difficulty digging any of the materials in Trench D with the exception of the dense basal till which reduced their productivity only slightly. Approximately 50 to 100 boulders of 1 to 2 m in diameter were excavated and stockpiled. Dust was generally not a problem but a water truck was used when required. The overburden removal contract was completed on 11 July.

A total of 120 448 bank cubic metres was excavated from Trench D during the overburden removal. This included 72 269 bank cubic metres of overburden and 48 179 bank cubic metres of waste coal.

2.4 PRE-MINING TESTING AND SAMPLING

The sampling procedures used in Trench D were first tested in Trench A. Since the coal in Trench A had been exposed for 5 years and some areas of the trench floor had been backfilled, a tractor-dozer was employed to expose fresh coal. Once this was completed, a trencher was used to dig a small steep sided ditch in which to winch a geophysical probe. It proved to be impossible to cut a clean, straight ditch of uniform depth with the trencher because of the difference in digging characteristics between coal, clay and carbonate. The trencher was abandoned in favour of a grader. An acceptable path for the geophysical probe was prepared by operating a motor-grader with the blade at maximum tilt and gouging out about 30 cm of material. This left a relatively straight, uniform "vee" shaped ditch. A small amount of cleanup with a spade was required to finally prepare the coal surface.

The basic objectives of the geophysical logging trials were to establish a method of correlating the beds exposed in the trench within the stratigraphic sequence and to provide a guideline for channel sampling. To this end both the natural gamma and gamma resistivity (density) logs were attempted. Extraneous "air peaks" on the density log rendered this trace unuseable and after several unsuccessful attempts to flood the ditch, this log was abandoned. The natural gamma tool produced "normal" looking traces which could be readily compared to the established downhole gamma logs.

Once the overburden removal had been completed, the geophysical logging methods established in Trench A were carried out in Trench D. Three separate lines were prepared and logged with the natural gamma probe. The south line was chosen for detailed work because it offered the most complete exposure of A-zone coal.

The geophysical traces were carefully examined by the geologists and all exposed beds were identified in accordance with the zone and subzone system previously established. It was decided to channel sample each subzone separately in order to further relate the geophysics to the coal quality. It should be noted, however, that some very small subzones were identified on the geophysical traces but were too small to be sampled separately.

Channel samples were taken with the aid of a rented hydraulic percussion hammer. The hammer was fitted with an 8 cm wide shovel bit and was used to cut an 8 cm wide x 8 cm deep sample from the bottom of the "vee" shaped geophysical trench (Photo Nos. 1 and 2). Fig. 2 shows the natural gamma log trace, the channel sample identification numbers and the geologists descriptive logs. This information was used to formulate the detailed plans for excavating the bulk sample.

2.5 MINING

(a) Objectives

The objectives of the Trench D excavation were as follows:

1. To obtain detailed confirmation of previous geological and coal quality interpretations by exposing the entire A-zone coal sequence in a slot-type trench.

2. To provide representative ROM coal samples for pilot plant coal preparation tests, material handling tests and various coal characteristic studies.

3. To test methods of selective mining in an area with numerous wastebeds of varying widths.

The original trench design included as an objective the gathering of geotechnical information on material strengths at bench height exposures of 6.5 m. This objective was abandoned due to financial constraints and ultimately only 2.5 m high benches were excavated.

(b) Excavation Sequence (Fig. 3 shows the Trench Layout Plan)

The coal slot was excavated starting from the east and working upgrade to the west toward the Medicine Creek claystone at the top of the A-zone coal. The trench was planned this way because the

ROKE OIL ENTERPRISES LTD. CALGARY, ALBERTA

GAMMA RAY

FILE NO.	
COMPANY	B. C. HYDRO
WELL	TRENCH D (A ZONE COAL)
LOCATION	SOUTH LINE
FIELD	HAT CREEK
PROVINCE	BRITISH COLUMBIA
Permanent Datum	GROUND LEVEL
Run No.	ONE
Date	14 JULY 1982
First Reading	S1 + 80
Last Reading	S0 + 20
Footage Logged	200
Operating Time	2 HOURS
Truck No.	37
Recorded By	SIM
Witnessed By	KIM, FERNER

Remarks

GR # 278

GAMMA RAY API

INTERVAL (m)	SAMPLE	ZONE IDENTIFICATION	DESCRIPTION
10·1	TD-19	A1C1	Mainly coal, lower section becomes weakly clayey.
		A1W1	
3·6	TD-20	A1C2	
1·9	TD-21	A1W2	Shaly coal or carb. clst.
1·7	TD-22	A1C3	
3·6	TD-23	A1W3	Mainly clst. some carb.
3·7	TD-24	A1C4	Coal, lustrous platy
6·9	TD-25	A1W4	Clst. Weakly carb. Lenticular marl at the base 0·3 m excl. sampling.
3·1	TD-26	A2C1	Coal, lustrous massive.
1·6	TD-27	A2W1	Shaly coal.
6·4	TD-28	A2C2	
·9	TD-29	A2W2	Carb. clst.
5·6	TD-30	A2C3	
1·0	TD-31	A2W3	Ash. carb. marl.
4·0	TD-32	A2C4	Coal
3·7	TD-33	A2C5	Coal
1·4	TD-34	A3W1	
2·7	TD-35	A3W2	Clst.
1·4	TD-36	A3C2	Shaly coal
·5	TD-37	A3W3	Clst
2·6	TD-38	A3C3	Mixed coal & shaly coal.
1·2	TD-39	A3W4	Silty clst.
3·5	TD-40	A3C4	Mixed coal shaly coal some carb.
2·3	TD-41	A3W5	" "
1·3	TD-42	A3C5	" "
2·2	TD-43	A3W6	Carb. shaly coal ash.
3·0	TD-44	A3C6	Shaly coal
5·5	TD-45	A3W7	Clst silty some carb.
2·8	TD-46	A4C1	Coal shiny platy.
·9	TD-47	A4W1	Coal sheared earthy
3·8	TD-48	A4C2	Mixed coal & shaly coal.
1·2	TD-49	A4W2	" "
2·4	TD-50	A4C3	
5·9	TD-51	A4W3	Clst. olive grey.
3·6	TD-52	A4C4	Coal & shaly coal.
4·8	TD-53	A4W4	Fine ss silty clst. creamish white
9·2	TD-54	A4C5	Mixed good coal, carb and shaly coal.
·7	TD-55	A4W5	Clst.
4·5	TD-56	A4C6	Mixed coal & shaly coal.
·8	TD-57	A4W6	Carb. clst.
5·5	TD-58	A4C7	Mainly coal some carb.
3·5	TD-59	A4W7	Clst. locally weak carb.
1·8	TD-60	A5C1	
1·8	TD-61	A5C2	
·5	TD-62	A5W2	Carb. clst.
2·7	TD-63	A5C3	Coal, massive limonitized.
·6	TD-64	A5W3	Clst. weakly carb.
3·6	TD-65	A5C4	
1·5	TD-66	A5W4	Clst. grades to carb. clst.
3·5	TD-67	A5C5	Shaly coal & carb. clst. ash 0·2 m
1·0	TD-68	A5W5	Carb. clst.
1·9	TD-69	A5C6	Shaly coal
1·1	TD-70	A5W6	Carb. clst.
1·8	TD-71	A5C7	Coal. massive weakly clayey.
1·2	TD-72	A5W7, C8, W8	Carb. clst.
3·6	TD-73	A5C9	Coal, lustrous platy
8·7	TD-74	A6	Partial including some O.B.

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FIGURE 2

CHANNEL SAMPLE PLAN

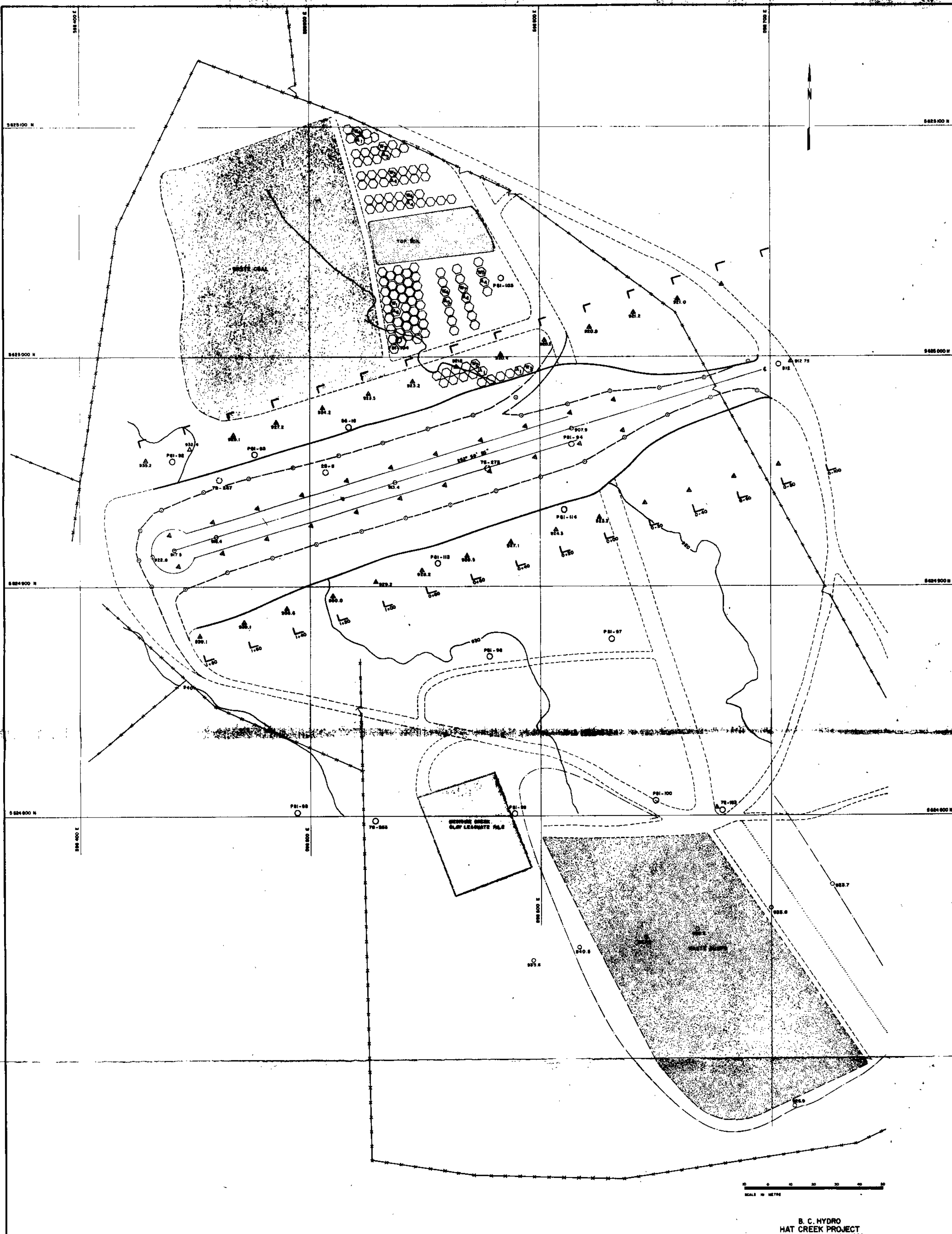

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FIGURE 3

TRENCH D
LAYOUT PLAN

DATE: OCTOBER 1982 SCALE 1:500

Photo 1: Channel sampling prior to mining the coal.

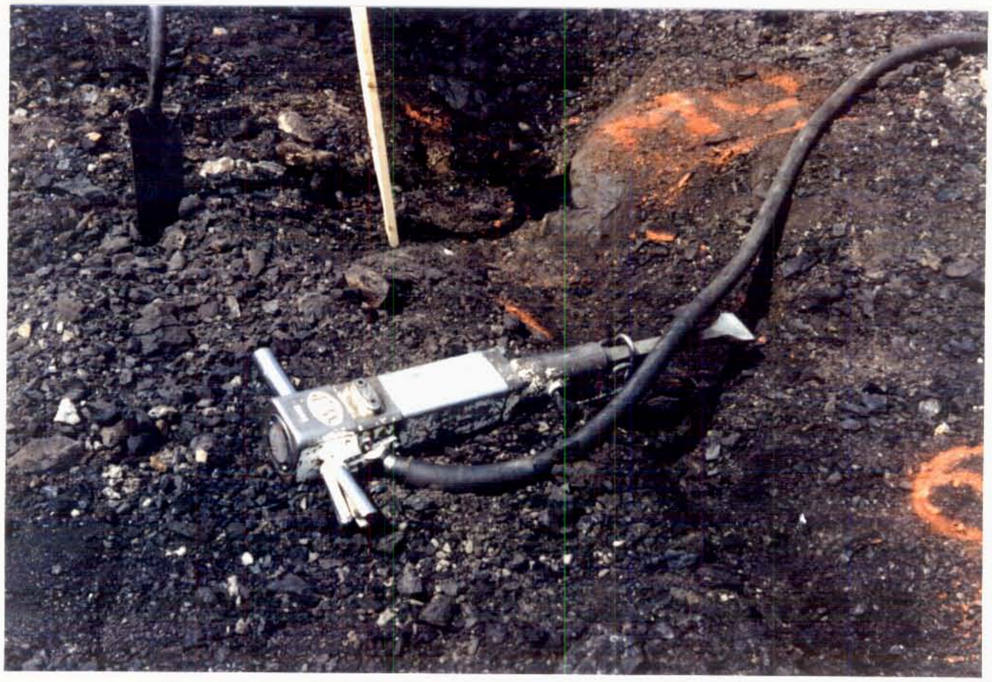


Photo 2: Hydraulic percussion hammer for channel sampling.

bedrock contact with the bottom of the glacial overburden was at 3° to 6° to the east.

A ramp decline entrance was made from the (east) main access road at 10 percent down to the required depth at the B1 coal subzone contact. A sump was dug with the backhoe at this lowest point, and drainage ditches were cut along each side wall.

(c) Equipment Performance

The coal slot excavation was done by backhoe digging (P&H 418), front end loader (cat 966-4 yard) loading and two 12 yard diesel dump trucks (Photo No. 3). The glacial till was very tough and hard to dig making progress slow until the trench entered the B1 zone coal which was softer and easier to dig. The A6 waste clay was also easy to dig (Photo No. 4) as were all the clay parting subzones. However, the backhoe did have trouble with the petrified wood which broke up into large boulders after digging around it (Photo No. 4).

(d) Water

As the coal slot advanced further west, water seepage was encountered in the coal seams which dipped at 65° west. This water accumulated on the working face floor and soon the rubbertired equipment turned the coal/clay material into a soft sticky "peanut butter". It was then found preferable to let the backhoe do the loading of the diesel trucks and to dispense with the front end loader except for cleanup (Photo Nos. 5 and 6).

(e) Coal Cut and Sampling

The width of the slot trench was 11 m at the top and 10 m at the bottom. A 2 m wide cut on the south side was selectively excavated

Photo 3: East end ramp completed - Starting the coal cut - P&H 418 hydraulic excavator, 966 loader, two 12-yard dump trucks.

Photo 4: Petrified wood or carbonate boulders from the A-zone coal slot.

Photo 5: Front end loader loading trucks in the slot.

Photo 6: Backhoe loading the dump trucks from on top.

across each subzone of coal for the crusher sample (Photo Nos. 7 and 8), and then the balance taken out for the stockpile in the coal yard where it was packed down by a tractor-dozer (Photo No. 9). This selective mining or separation of the wastebeds over 2 m wide proved to be relatively easy and testimony to the success can be seen in the stockpiles of each separated waste zone placed in rows on the north side of the trench (Photo No. 10). Minor waste partings (less then 2 m width) were purposely left in with the coal subzones grouped for the blended bulk sample for wash testing. It was apparent in the mining that lesser widths of waste parting could be separated without too much loss of coal.

(f) Medicine Creek Claystone

At the extreme west end, the contact between the top A1 coal subzone and the overlying Medicine Creek claystone Formation was exposed, and the trench slot was advanced a further 20 m into it (Photo No. 11). This clay was easy digging because it was above water table and therefore dry. Five drums of this Medicine Creek clay (approximately 2000 pounds) were shipped to Hazemag, U.S.A. at Union Town, Pennsylvania for crushing and handling tests.

(g) Trench D - Dimension and Details

Overall Dimensions:	Total Length - 265 m
	Average Top Width - 60 m
	Average Depth - 15 m

(h) Volumes of Materials

Overburden:	72 268 bcm
Coaly Waste:	48 179 bcm
Coal Slot Trench:	7 677 bcm

Photo 7: Excavating the 2 m x 2 m sample cut.

Photo 8: Cutting the 2 m x 2 m coal sample across the subzone.

Photo 9: An ROM coal pile compacted by tractor-dozer in the coal yard.

Photo 10: Each clay parting >2 m wide placed in separate row piles.

2.6 STOCKPILING

Run-of-mine coal and waste was trucked from the pit and placed in separate stockpiles according to the subzone groupings developed in the mining plan. Mine design criteria specified that the minimum thickness which could be mined separately was 2 m. Table 2-1 shows the composition of the resulting stockpiles and the estimated quantities of each.

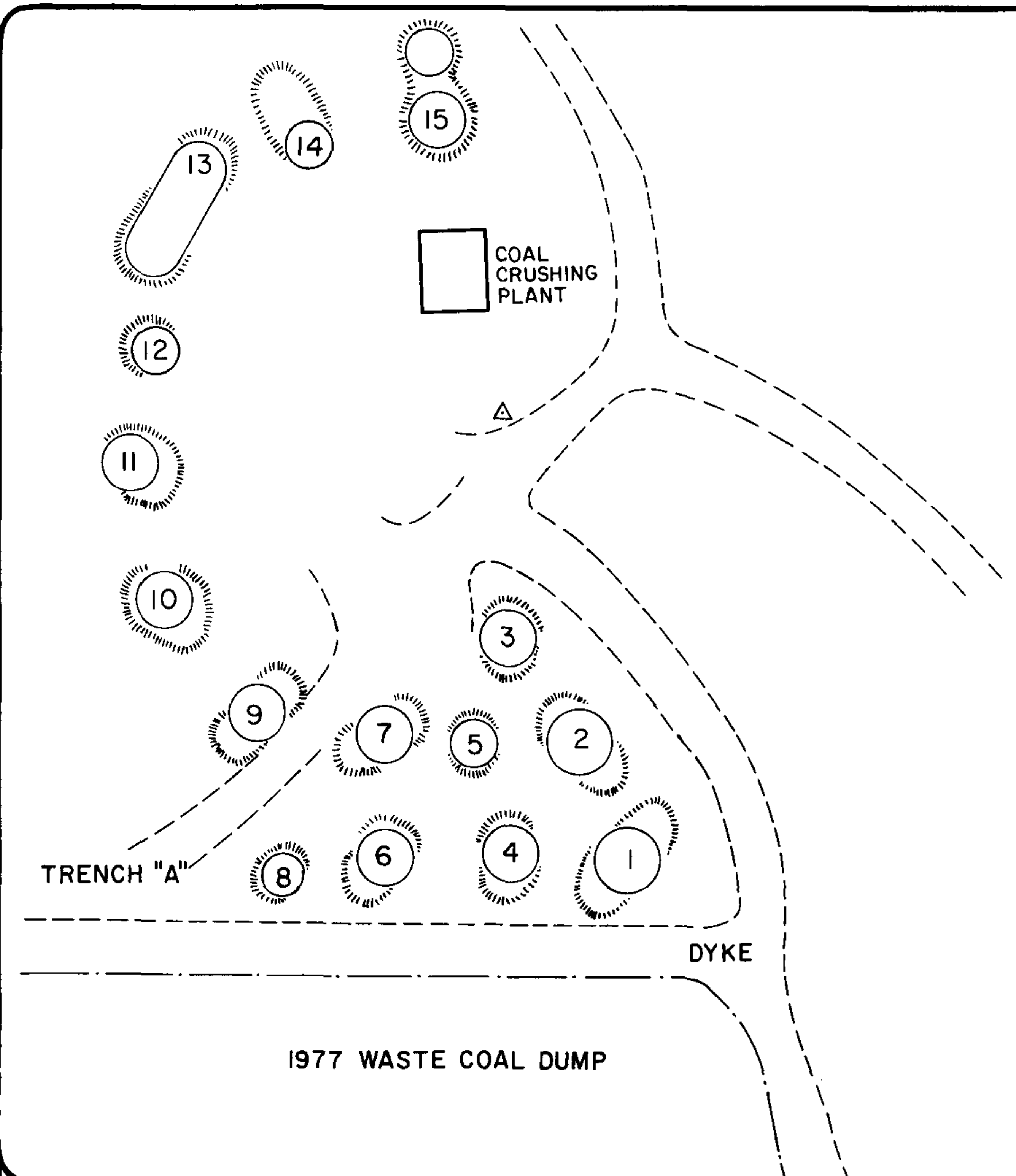
Coal stockpiles were carefully contoured and compacted using a tractor-dozer in order to prevent spontaneous combustion. Pipes were installed in all ROM stockpiles in order to monitor heating, but no significant temperature rises have been observed to date. Fig. 3 shows the location of the various waste piles and Fig. 4 the coal piles stockpiled on the site.

The crushed coal stockpile was deliberately left uncompacted to observe spontaneous combustion. Fine damp coal within 1 m of the surface of the pile heated to 80°C plus within the first 6 weeks. A small backhoe was used to dig into the pile and although the fine coal was "steaming" no fires had started. The entire pile was contoured and compacted with a tractor-dozer and has subsequently cooled. These observations of heating in uncompacted stockpiles confirmed the observations from the 1977/78 bulk sample programs.

2.7 CRUSHING

The run-of-mine coal from the 2 m x 2 m sample cut contained excessively large lumps of coal, claystone and carbonate. In some areas of harder coal (e.g. A_1C_1-A_1C_2) the largest lumps of coal measured 2 m across, necessitating some degree of crushing prior to sampling and shipping.

The crushing device employed in the 1977 bulk sampling program was a 7-foot diameter Bradford Breaker with 1¼ inch screen openings. This crusher apparently rejected some of the harder coal along with the



1. "B" ZONE COAL
2. A_4C_7 & A_4C_6
3. A_4C_5
4. A_5C_2 & A_5C_9
5. A_4C_4
6. A_5C_4
7. $A_3W_1 \sim A_3C_6$
8. A_1C_4
9. $A_4C_1 \sim A_4C_3$
10. $A_2C_2 \sim A_2C_5$
11. A_1C_3

RUN-OF-MINE (R.O.M.) (items 1–11)

12. TRENCH "D" "B_1" ZONE 1982
13. "B" ZONE TRENCH "A" 1977
14. "A" ZONE BLEND PILE 1982
15. "D" ZONE TRENCH "B" 1977

CRUSHED (items 12–15)

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HAT CREEK PROJECT
MINING FIELD PROGRAM 1982

FIGURE 4

TRENCH D COAL PILES

TABLE 2-1

SUBZONE STOCKPILES - ESTIMATED QUANTITIES

Subzones	Estimated Quantity (tonnes)
A_1C_1-A_1C_2	326
A_1W_2	112
A_1C_3	46
A_1W_3	122
A_1C_4	110
A_1W_4	192
A_2C_1-A_2C_5	619
A_3W_1-A_3C_6	523
A_3W_7	176
A_4C_1-A_4C_3	298
A_4W_3	208
A_4C_4	60
A_4W_4	154
A_4C_5-A_4C_7	444
A_4W_7	93
A_5C_1-A_5C_4	277
A_5W_4	51
A_5C_5-A_5C_9	336
A_6	-
B_1	-
TOTAL	4147

petrified wood when operated with the rejects chute open. Consideration was given to modifying this crusher (by opening the holes to 6 inches) for the 1982 program, but the idea was discarded as impractical because of inadequate sampling access.

A portable jaw crusher was rented from Nelson Machinery in Savona and transported to the site in June. The crusher, which was originally built for crushing gravel, was adjusted to its maximum jaw opening to produce a nominal 15 cm topsize. Once on site the crusher was set up on a base of logs and the existing coal conveyor was relocated to feed raw coal from the existing hopper. The ROM coal was loaded into the hopper using either the 966 or the 922 loader. Large lumps of material were retained by the 12 inch opening grizzly located on top of the feed bin and had to be crushed by hand or with the loader bucket.

Production rates through the crusher were estimated to be 80 to 100 t/h on average. Some reduction in the rate was noticed when hard or wet coal was being crushed. Minor plugging occurred when extremely wet feed conditions persisted, but this was largely due to the inability of the crusher conveyor to move the material from below the crushing chambers. Wet clays tended to stick to the return idlers on both conveyors causing both tracking and traction problems. The majority of the coal fed to the crusher was dry creating a moderate dusting problem at the point where the coal dropped from the feed conveyor into the crusher.

A total of 772.6 t of coal was crushed from the mining operation. Various subzones were mined separately in the trench, crushed separately and then placed into the composite sample pile. Approximately 175 t of coal was removed from this composite sample pile and recrushed in order to obtain two representative 10 t samples and one site laboratory sample.

Upon completion of the coal crushing operation, the entire system was carefully cleaned so that a small limestone sample could be processed.

The crusher jaws were adjusted to 8 cm opening and approximately 15 t of limestone rock were crushed. The crushed limestone rock was replaced in 45-gallon drums for shipment to an offsite testing facility.

2.8 SAMPLING

The sample plan developed from the geophysical logging and channel sampling described in Section 3.4 above, resulted in the inclusion of the following subzones in the 2 m x 2 m sample cut:

Subzone	Estimated Quantity (tonnes)
A_1C_1-A_1C_2	81.6
A_1C_3	11.4
A_1C_4	27.6
A_2C_1-A_2C_5	154.8
A_3W_1-A_3C_6	130.8
A_4C_1-A_4C_3	74.4
A_4C_4	15.0
A_4C_5-A_4C_7	111.0
A_5C_1-A_5C_4	69.2
A_5W_4	12.8
A_5C_5-A_5C_9	84.0
TOTAL	772.6

Each subzone grouping listed above was mined, stockpiled, crushed and sampled separately. Samples were collected from the discharge point of the crusher product conveyor by placing a 5-gallon pail in the path of the falling coal. A plank was installed parallel to the conveyor so that the pail could be placed immediately under the conveyor headpulley (Photo No. 12). The sampling interval was normally every three minutes except for subzones A_1C_3, A_1C_4, A_4C_4 and A_5C_4. The sampling interval

Photo 11: Excavating the Medicine Creek clay at the west end Trench D.

Photo 12: Taking the periodic coal cut laboratory samples.

for these smaller subzones was decreased in order to collect a minimum of two 45-gallon drums of material from each subzone.

The samples representing the various subzone groups were placed in plastic lined 45-gallon drums and stored near the crusher. A flat surfaced sample preparation pad 8 feet x 16 feet was constructed and covered with galvanized tin sheeting. The stored subzone samples were dumped onto the pad and processed as time permitted during the crushing operation. The process for preparing the -15 cm samples for delivery to the site laboratory involved hand crushing through an 8 cm screen, partially air drying the sample, then hammer mill crushing to -6 mm (the 5 inch x 7 inch Holmes laboratory hammer mill crusher was installed near the sample preparation pad for this purpose). The -6 mm material was then coned and quartered until a 15 to 20 kg laboratory sample resulted. The rejects from the coning and quartering were replaced in plastic lined 45-gallon drums to provide retain samples. Where several drums were retained from one subzone group, care was taken to ensure that each drum was representative on its own.

The bulk of the crushed coal was trammed away from the crusher using either the 2 cubic yard or the 4 cubic yard front end loaders. The material from all of the subzones was stacked into one long windrow type of pile. The windrows were formed by dumping front end bucket loads on a long line and then dumping successive loads on top of the first line. Each bucket load was placed beside the last one in order to form representative cross-sections through the pile. When all of the A-zone bulk samples had been crushed and combined, two slices were taken at right angles to the windrow to extract a smaller 175 t sample. The 175 t was estimated by loading two 12-yard dump trucks with three full loader buckets in each and then weighing the trucks at Steel Brothers. Each loader bucket was calculated to weigh 3.35 t, therefore requiring 52 buckets for 175 t.

The 175 t sample was recrushed and 155 t of it was stored in a separate pile. While this coal was passing through the crusher system 20 t was taken out and placed in plastic lined 45-gallon drums. A small tractor with a 1 cubic yard bucket was used to sample approximatley 1200 pounds of coal every 3 minutes (Photo No. 13). With the crusher operating at 100 t/h, this resulted in 101 drums of coal being filled. Two representative samples were taken for the site laboratory by sampling every three minutes with the 5-gallon pail. The two samples represented the two "slices" taken from the large windrow pile.

The 101 drums were separated into two samples of 50 and 51 drums respectively, and were shipped offsite on flat deck trucks (Photo NO. 14). The 155 t sample was loaded into "B" train style end dump using the 4 cubic yard front end loader. The "B" train trucks, owned by Arrow Transport, hauled the coal to Ashcroft and dumped it on a specially prepared concrete pad. The coal was loaded into bottom hopper rail cars for shipment to Homer City, Pennsylvania.

2.9 ENVIRONMENTAL PROTECTION

(a) Planning

Environmental protection planning was conducted concurrently with the development of the study program. Early interactions with engineering enabled modifications to be made to achieve environmental goals namely:

1. Ensure that sensitive areas were protected and that land disturbances and habitat alienation were minimized.

2. Ensure an effective drainage control plan was implemented to prevent sedimentation and contamination of Hat Creek.

Photo 13: Taking sample cuts with the small backhoe bucket.

Photo 14: Loading sample drums on transports.

3. Ensure that dust emissions would be controlled.

4. Ensure that groundwater from the trench was contained by the drainage control system.

5. Ensure that all disturbed areas were rehabilitated and reclaimed to a stable condition where necessary.

This program provided a good opportunity to gather more information on environmental protection and rehabilitation practices and to carry out specific on-site testing.

An environmental field officer was assigned to ensure that these measures were implemented. During the planning stages, field examinations determined the nature of the land to be used and allowed for the development of site specific requirements. Close liaison with the contractors and engineering staff was maintained so that environmental concerns were addressed as work progressed. Daily monitoring and inspecting during the excavation allowed the officer to ensure that acceptable standards were being maintained.

(b) Site Preparation

Land and habitat alienation were the major environmental impacts in the excavation of Trench D. The total area disturbed by the trench waste disposal areas and roads was approximately 5.7 ha of vegetation of the sagebrush-bluebunch wheatgrass association. This area provided cover and forage for cattle, deer, rodents, coyotes and birds. The entire ground cover was cleared and grubbed, the vegetation being removed and piled for burning.

Topsoil was scraped from both the trench proper and from the waste disposal area. This was stockpiled for future use in reclamation. The carbonaceous material waste dump was not prestripped to ensure that the area retained its compaction and thus reduced any leachate migration.

(c) Excavation of Trench D

Three general materials were removed from Trench D: overburden, A-zone coal and Medicine Creek claystone. Each soil material encountered was sampled and characterized for reclamation potential. Assistance in classifying waste materials was obtained from a specialized consultant. The topsoil was identified as a loess deposit and was stockpiled for later reclamation use. The overburden materials included glacio-fluvial silts and gravels, ablation till and basal till. These were found to be similar in basic properties such as pH and salinity and were therefore placed in a single waste disposal area.

Carbonaceous materials were placed in a specially prepared separate dump. Care was taken to provide suitable drainage control works.

A small amount of Medicine Creek claystone was excavated late in the program. This was stockpiled separately.

Samples of all waste materials were sent for soils analysis to the B.C. Ministry of Agriculture.

During the overburden removal, a dust level study was undertaken. This study was designed to determine dust concentrations at various distances from the excavation activities and to evaluate methods of control. Traffic on haul roads proved to be the primary cause of dust and water sprayed on roads was most effective in its control.

(d) Drainage

Plans were instituted to ensure that all drainage from the work area would be contained on site and not discharged. The trench was excavated to form a sump to collect all runoff from the area. The access road around the lower (east) perimeter of the work area was constructed to direct drainage into the trench as were ditches surrounding the carbonaceous waste dump. Slopes were recontoured to minimize erosion and facilitate drainage.

Small amounts of groundwater were encountered in the trench. Of particular note was the water emanating from the coal zone. There are apparently many different sources of water in the coal interbeds as determined by the analytical results. Although much of the water appeared suitable for discharge, according to Pollution Control Board objectives some samples demonstrated high acid levels and very high total dissolved solids concentrations. All of this groundwater was retained in the trench.

(e) Leachate Test Piles

To obtain realistic estimates of the quality of leachate from overburden materials two leachate collection piles were created. These involved underlaying the waste material with plastic in order to collect the leachate. Piles were established using:

1. a mix of tills and silty clays, and

2. a sample of Medicine Creek claystone.

(f) Reclamation

Miscellaneous areas adjacent to the east pit perimeter road were scarified by rake and minor indentations across the slope were created as water bars. The areas were then seeded with the seed mix in Table 2-2. A general purpose 13-16-10 fertilizer was used. The areas were harrowed following the spreading of seed and fertilizer.

The excavation of Trench D provided the opportunity for additional reclamation testing. However, the basic intent of the effort was to demonstrate the ability to reclaim all waste piles to productive use. Seed mixes and dump surface materials were selected based on the testing results and experience obtained over the past 5 years. Steep slopes were recontoured to lessen grades on the overburden waste dump and coaly waste dump.

The overburden waste dump was fertilized based on results of the soil analyses done by the Ministry of Agriculture. The dump was then divided into four equal plots to test four different seed mixes (Table 2-3). After broadcasting seed and fertilizer the area was harrowed.

The carbonaceous waste dump was surfaced (15 cm) with topsoil previously scraped from the trench. A small area was left without topsoil to provide limited testing. The same four seed mixes were used (see Table 2-3).

Two discrete waste material dumps were created, one of silty clay material and the other of Medicine Creek claystone. The latter was also the leachate collection pile. These materials had not yet been specifically encountered and were tested by seeding with rows of single seed species.

TABLE 2-2

RECLAMATION SEED MIX AND FERTILIZER ADDITIONS

Species	Compostion (% by weight)	Application Rate (kg/ha)
Nordan Crested Wheatgrass Agropyron cristatum var. Nordan	29	7.25
Manchar Bromegrass Bromus inermis var. Manchar	27	6.75
Drylander Alfalfa Medicago sativa var. Drylander	24	6.00
Streambank Wheatgrass Agropyron riparium var. Sodar	20	5.00
TOTAL	100%	25 kg/ha
N - P - K 13 - 16 - 10 fertilizer	-	120 kg/ha

TABLE 2-3

REVEGETATION SEED MIX

Species	Compostion (% by weight)	Application Rate (kg/ha)
Nordan Crested Wheatgrass Agropyron desertorun var. Nordan	29	7.25
Manchar Brome Bromis inermis var. Manchar	27	6.75
Drylander Alfalfa Medicago media var. Drylander	24	6.0
Streambank Wheatgrass Agropyron riparium var. Sodar	20	5.0
TOTAL	100	25.0 kg/ha

Fertilizer (13-16-10 or 11-48-16) was applied at a rate of 120.0 kg/ha

SECTION 3.0 - GEOLOGY

The selection of a site for an excavation into A-zone coal (Trench D) was the main objective of the 1981 Field Investigations. The final location was selected because the entire sequence of A-zone coal could be exposed with the least overburden removal.

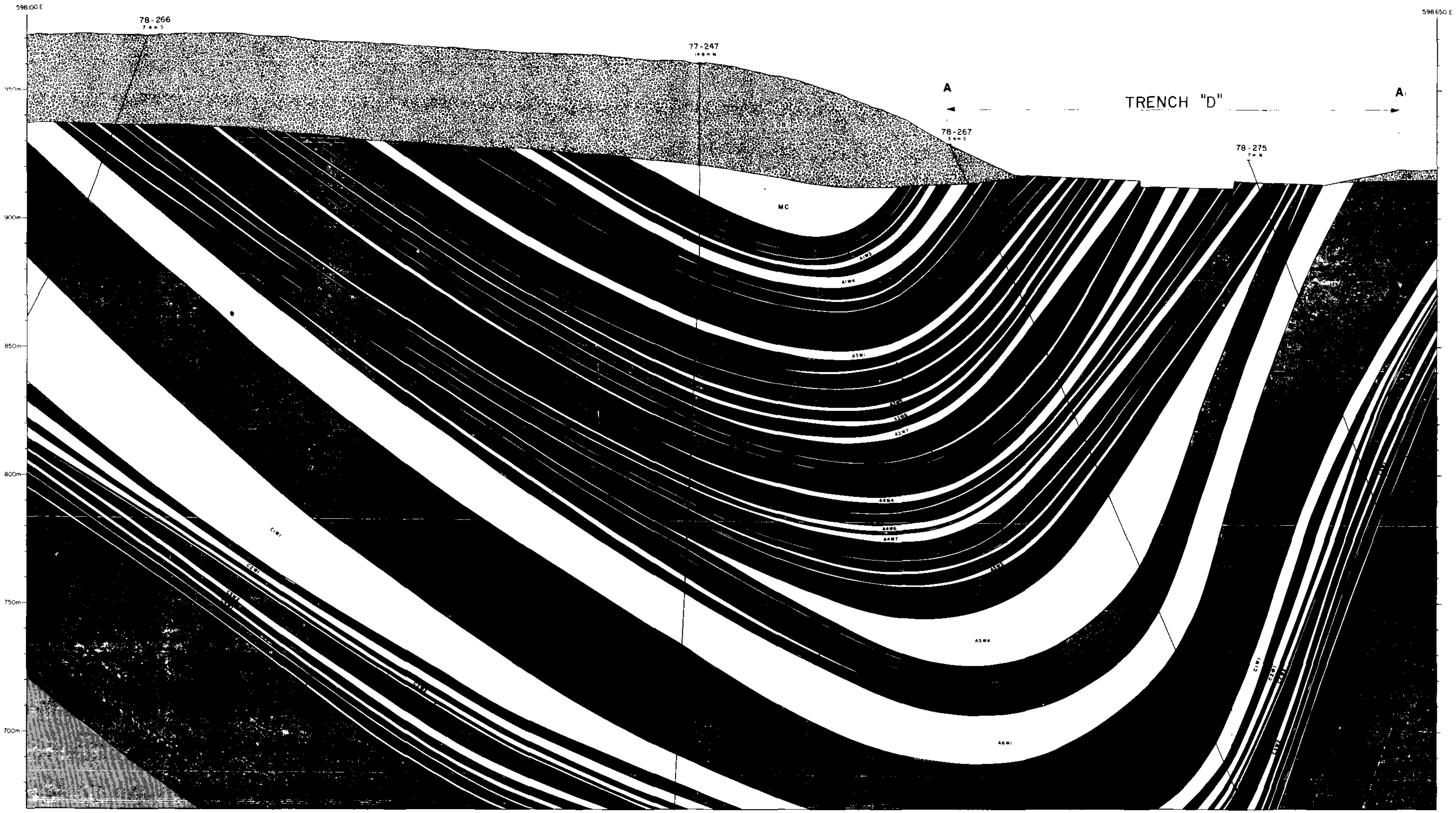
The trench is located on the east limb of the Hat Creek syncline between the synclinal axis and the Creek fault and just south of Section Q, see Fig. 5 (cross section). The trench was excavated from east to west perpendicular to the beds which are striking N17°E.

3.1 STRATIGRAPHY

(a) Upper Bench

The upper bench was essentially overburden removal. Completion of this bench exposed most of the A-zone coal stratigraphic sequence. Medicine Creek claystone was exposed at the west end of the trench. As shown on Fig. 6 the trench floor was about 90 percent A-zone, 8 percent surficials and 2 percent Medicine Creek claystone. The south wall was 50 percent A-zone and 50 percent overburden. The north wall was 95 percent surficials and 5 percent A-zone. The west end wall was 100 percent surficials with Medicine Creek claystone at the base of the wall. The east end of the trench is open.

Overburden in the trench consisted mainly of glacial till, lacustrine clay, and glacio-fluvial sand and gravel beds. The overburden soil was composed of soft, brown, plastic, silty clay spotted with white gypsum crystals. There were several thin beds



LEGEND

- OVERBURDEN – clay, silt, gravel and boulders
- MEDICINE CREEK FORMATION – bentonitic claystone and siltstone
- HAT CREEK FORMATION WASTE BEDS – mainly claystone and siltstone with intercalated coal
- HAT CREEK FORMATION COAL BEDS – mainly coal with intercalated siltstone and claystone
- COLDWATER FORMATION – siltstone, claystone, sandstone, conglomerate, minor coal

10m 0 10 20 30 40 50m

SCALE IN METRE

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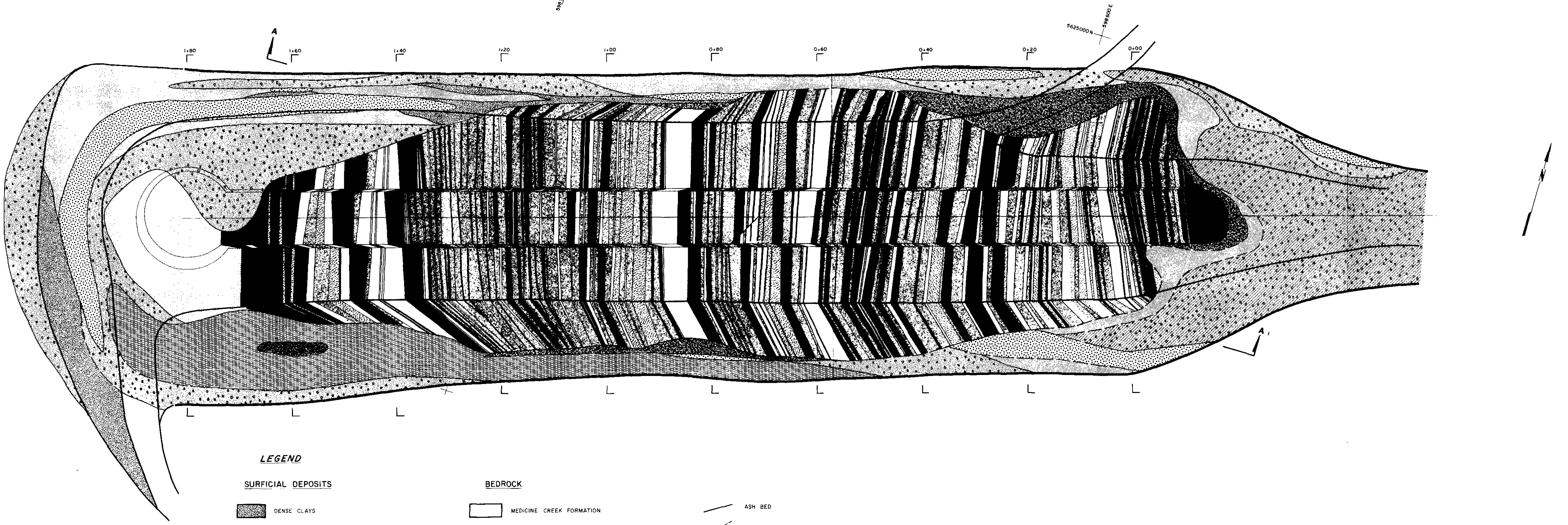
FIGURE 5

GEOLOGICAL CROSS SECTION "Q" CUTTING ACROSS TRENCH "D"



LEGEND

SURFICIAL DEPOSITS

- DENSE CLAYS
- TILL – Dense clays with angular to subangular gravels and boulders (unstratified)
- LOOSE SILTS AND CLAYS
- LOOSE SILTS AND CLAYS WITH SUBANGULAR TO SUBROUNDED PEBBLES, GRAVELS AND BOULDERS.
- GLACIO FLUVIAL BED – Clean sands with rounded to subrounded pebbles, gravels and cobbles.
- LACUSTRINE SILTS

BEDROCK

- MEDICINE CREEK FORMATION
- OXIDIZED COAL MIXED WITH SOILS
- WASTE BEDS CONSISTING OF CLAYSTONE, SILTSTONE, FINE GRAINED TO MEDIUM GRAINED SANDSTONE.
- CARBONACEOUS CLAYSTONE
- SHALY COAL, DARK GREY EARTY LOOKING, GENERALLY THINLY BEDDED TO LAMINATED
- MASSIVE COAL, BLACK TO DARK GREY, LUSTROUS, VISIBLE VITRAINS, OCCASIONALY PLATY AND THICKLY BEDDED

- ASH BED
- FAULT

Note: For cross section A – A' refer to dwg. Fig. 5

10 0 10 20 30 m.

Scale in metre
Date: Dec. 1982

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FIGURE 6

TRENCH D
GEOLOGICAL PLAN

of lacustrine clay developed due to local ponding which were interlayered with a variety of glacial fluvial sands, and gravels. Over much of the trench area the bedrock was blanketed by a dense basal till. Slickensides on the basal till bedrock contact show the direction of glaciation to be N88°E.

(b) <u>Lower Bench</u>

The lower bench exposed the total sequence (158 m) of A-zone coal with about 15 m of B-zone coal at its lower contact, to the east and 25 m of Medicine Creek Formation at its upper contact, to the west. The coal generally strikes at N17°W and dips at 60°SW (see Fig. 7, Trench D Wall Geology).

The A-zone coal consists of 58 interbeds of coal and waste. The waste bands vary from claystone to a coarse sandstone. Many of the waste beds are carbonaceous to coaly. Some of the coal beds have minor claystone seams. Most of the interbed contacts are gradational but some are sharp. The 27 waste beds vary from 0.3 to 8.5 m thick with nine greater than 2 m thick in true thickness.

The numerous waste beds in A-zone are due to the periodic flooding or sediment influx from the southwest that inundated the peat accumulation. The result was a rapid facies change to the southwest with a lowering of coal quality and a thickening of waste partings. Trench D is located at the eastern end of the facies change where the coal quality increases and the waste parting thickness is reduced. This does not mean, however, that the run-of-mine coal found in Trench D is higher quality than the average A-zone coal. The waste partings which in Trench D are found to be small (less then 2 m) tend to increase in thickness to the southwest, and consequently, can be selectively mined out, upgrading the run-of-mine coal.

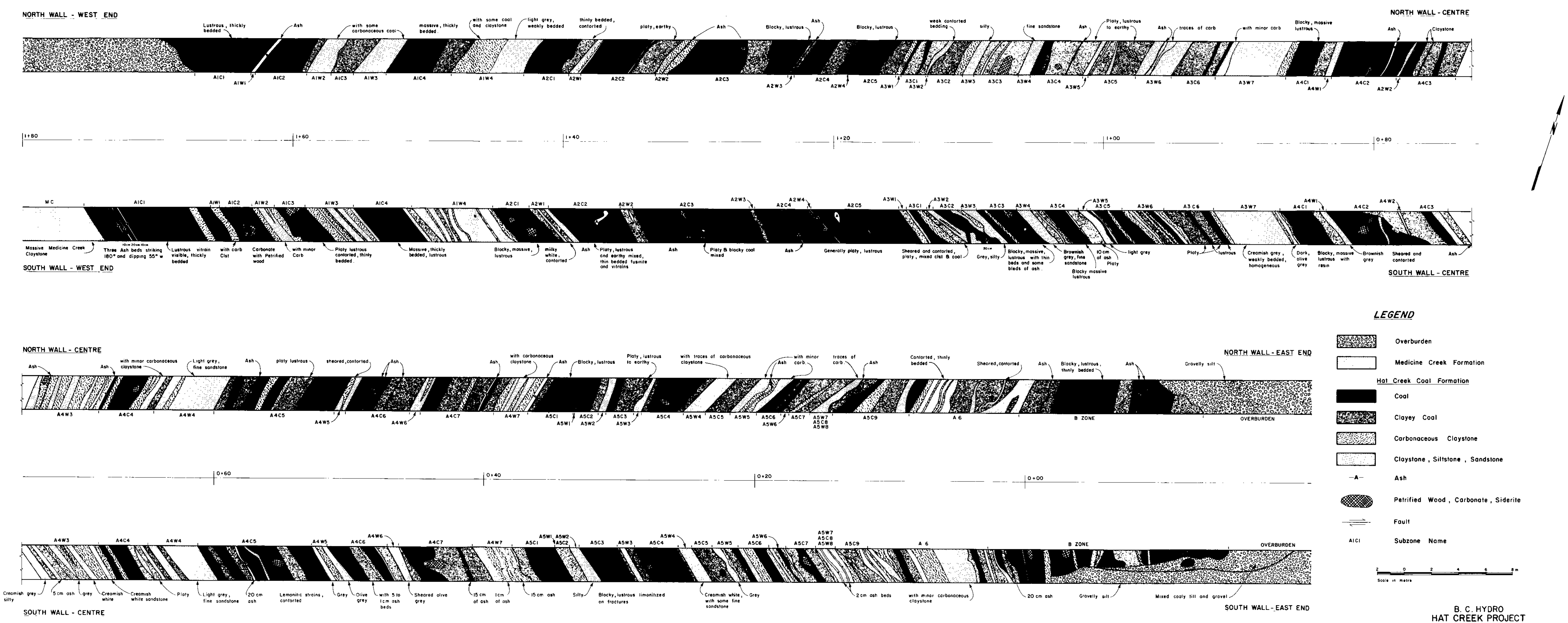

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FIGURE 7.
TRENCH D - WALL GEOLOGY

Some of the coal immediately below overburden is highly weathered and oxidized. The oxidation extends as much as 2 to 3 m into the coal in places. Much of the coal has not been oxidized. This is probably due to an impervious layer of basal till which covers most of the coal. It appears that where the dense basal till is 0.2 m or greater in thickness there is no evidence of oxidation.

Several carbonate boulders were found within the coal. These carbonates, which were also intersected by numerous drill holes in the deposit, are deposited in pods or lenses within the coal rather than in distinct blanket layers.

Stumps of petrified wood ranging from 0.5 m to 1.5 m in diameter were uncovered throughout the excavation.

More than 40 ash beds varying from 0.02 to 0.35 m thick are contained within the A-zone coal measures. Most of the ash beds make excellent marker bands, which will be useful for determining stratigraphic locations in future mining operations.

Some leaf fossils were found within the coal and claystone interbeds.

The Medicine Creek Formation consists of a uniform succession of bentonitic claystone and siltstone formed in a lacustrine environment. The sharp paraconformable contact of the Medicine Creek Formation with the coal measures indicate a rapid facies change from moor (marsh) to lacustrine depositional conditions. The Medicine Creek claystone from Trench D was put on a leachate pile just west of the Trench D overburden dumps.

3.2 STRUCTURE

The main structure of the No. 1 Deposit is characterized by broad synclinal feature, the Hat Creek Syncline. Trench D is located on the eastern limb of the Hat Creek Syncline. The local structure in Trench D is marked by widespread folding and faulting (Fig. 7). The widespread tectonic activity is demonstrated by the variable dip, 38° to 72°, and strike N20° to N0°W, of the coal beds. Although the beds are locally deformed the general trends are remarkably uniform and lend no problems to selective mining.

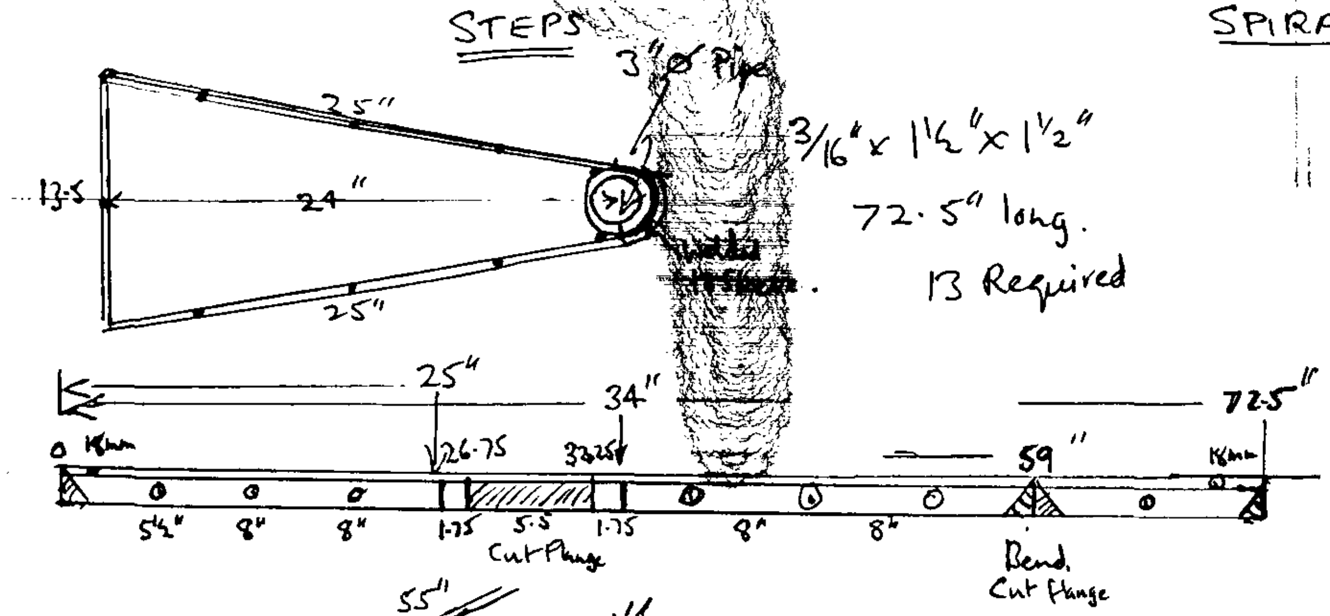
The overall pit walls, 45° on the upper bench, 60° on the lower bench, maintained their stability during excavation. The west end wall in the Medicine Creek Formation failed shortly after its completion.

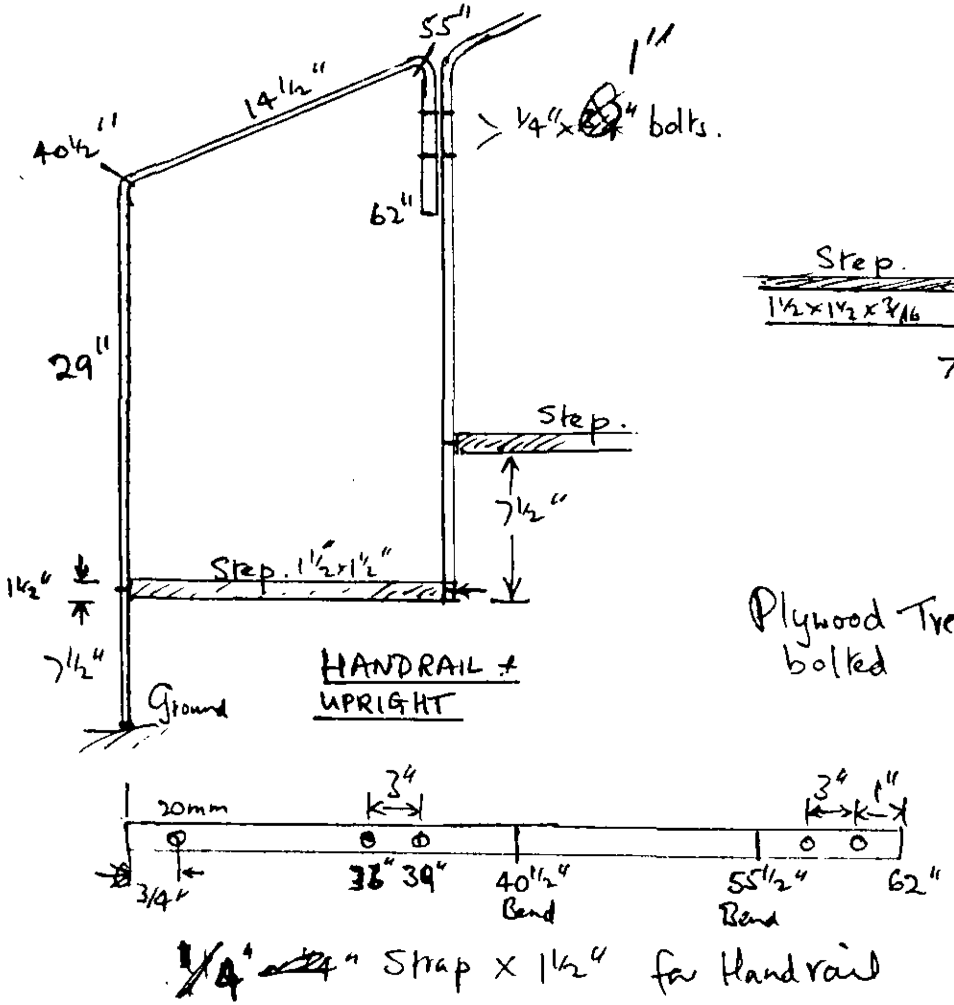
3.3 HYDROLOGY

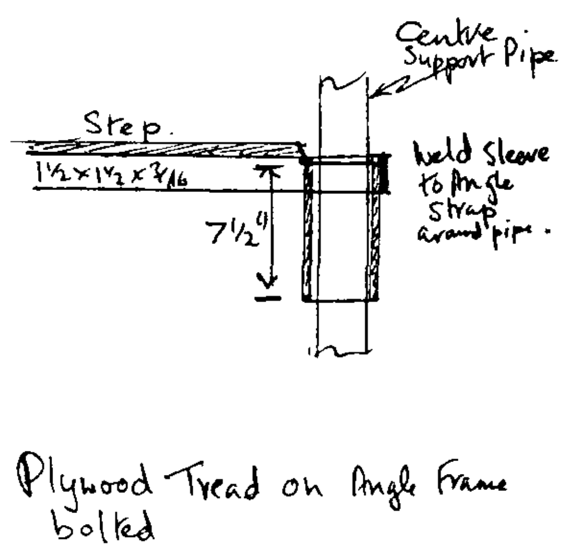
Water was encountered at numerous locations while excavating Trench D. The amount of water at each location was generally very small but there was usually enough to allow periodic sampling. There were several pockets of water that dried up as the lower bench was excavated past them. The lower excavation apparently drained these pockets. The water is contained in small pockets under pressure trapped locally in the individual interbeds. Evidence of this is the fact that the pH of the water from locations as close as 20 m apart varied from 3.5 to 8 and when certain zones were mined the water squirted out under pressure.

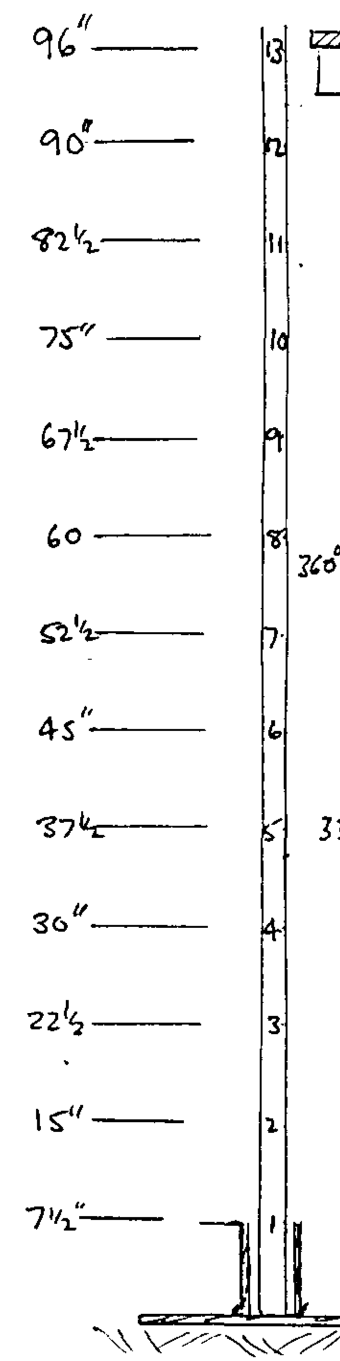
SPIRAL STAIRCASE FOR "FOLLY"

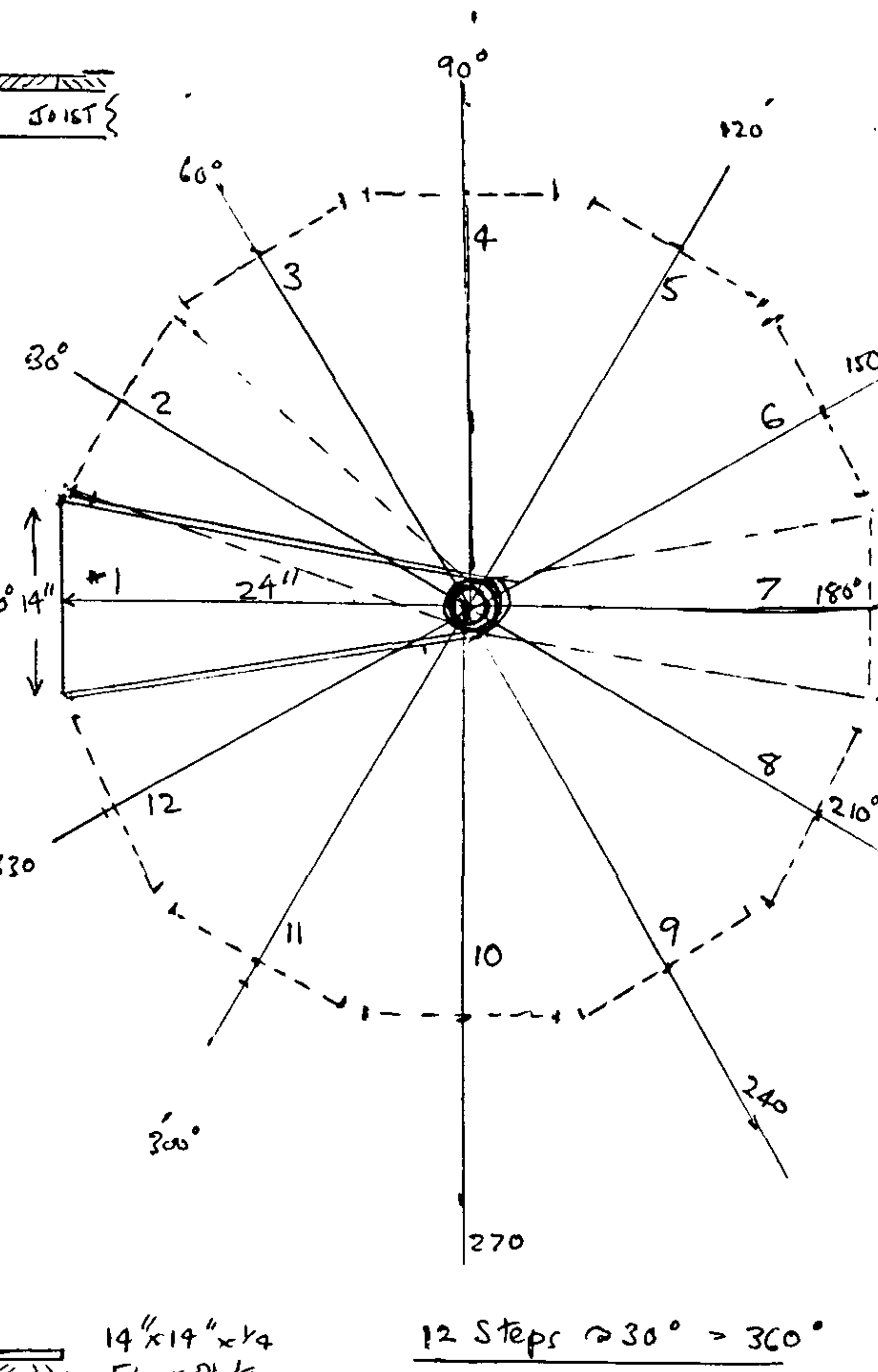
W. Fothergill Eagle Bay B.C.











SECTION 4.0 - COAL QUALITY

4.1 SITE LABORATORY

The coal testing laboratory at Hat Creek was originally set up in 1977 to monitor the quality of coal mined from different sections of Trenches A and B. The normal time lag of about 2 to 3 weeks which the commercial laboratories required was unacceptable because by that time the coal had already been mined and blended into one pile. The cost to operate a site laboratory was also cheaper than the prevailing rates at that time.

The laboratory capabilities included the determination of moisture, ash, heating value and sulphur. Sample preparation and screening down to -200 mesh were carried out in the Hillman House complex. The analytical testing unit was mounted on a mobile trailer so that it could be moved from temporary exploration sites to permanent mine site if required.

The laboratory was reactivated for the 1982 Trench D program in order to analyse various quality control samples taken during the trench excavation. Two BCIT chemical technology graduates, Gary Faar and Naomi Matsuda were hired to run the laboratory. The training of these technologists and standardization of laboratory procedures was provided by Elias Ayoub of Chemical and Geological Laboratories, Edmonton.

In 2 weeks, the laboratory attained high degree of reproducibility of data and reliability consistent with other commercial laboratories.

All the proximate, thermal value determinations and sulphur analyses for the Trench D program were conducted at the Site Laboratory. Periodically, round robin samples were sent to commercial laboratories in

Vancouver, and the differences in values were well within the permissible ASTM limits for specific tests.

The laboratory was shut down at the conclusion of the program at the end of August 1982.

4.2 COMPARISON OF CHANNEL SAMPLES AND BULK SAMPLES

Each channel sample taken represented a discrete geological entity or subzone from the previously developed AxCx and AxWx subzone classification scheme. In Trench D, there were 56 subzones which were prominent enough to be channel sampled.

The bulk samples represented an attempt to mine the various subzones in accordance with certain mine design criteria. Mining subzones were made up of a group of geological subzones between mineable partings. The mine design criteria specified that the minimum mineable thickness of parting was 2 m. The laboratory samples taken from the mining subzones consisted of a minimum of 20 increments (40 pounds per increment). The laboratory sample for the 150 t A-zone bulk sample contained 35 increments (40 pounds per increment).

Table 4-1 shows a summary of the comparison between the channel samples and the bulk sample data for the A-zone representative sample. It can be seen that the channel sample data has excellent correlation with the bulk sample data for the entire zone. The overall impacts of mining dilution and mining loss appear to cancel out in this instance. Table 4-2 indicates that dilution did not occur at every coal/parting contact. In some cases where, the channel sample ash is greater than the bulk sample ash, the mining operation must have been stopped before the parting contact had been reached. Table 4-3 lists the sources of mining dilution and their estimated quantities.

TABLE 4-1

COMPARISON OF CHANNEL SAMPLES AND BULK SAMPLES
SUMMARY
(ALL RESULTS REPORTED AS DRY-BASIS)

	Ash %	Total Sulphur %	Calorific Value (Btu/lb)
Channel Samples- Calculated A-zone Composite	39.8	0.76	6680
Subzone Bulk Samples- Calculated A-zone Composite	40.6	0.75	6600
A-zone Bulk Sample- Representative Sample from 150 t Coal Preparation Sample	40.9	0.72	6630

TABLE 4-2

COMPARISON OF CHANNEL SAMPLES AND BULK SAMPLES (ALL RESULTS REPORTED AS DRY-BASIS)

Channel Samples					Calculated Composite Values			Bulk Samples			
Subzone	Sample Length[*1] (m)	Ash %	Total Sulphur %	Calorific Value Btu/lb	Ash %	Total Sulphur %	Calorific Value Btu/lb	Mining Subzone	Ash %	Total Sulphur %	Calorific Value Btu/lb
A_1C_1	10.1	31.2	1.04	8150							
A_1C_2	3.5	18.9	1.06	9860	28.0	1.04	8590	A_1C_1-A_1C_2	26.3	1.02	8750
A_1C_3	1.9	43.4	1.00	6330	43.4	1.00	6330	A_1C_3	38.6	0.92	7000
A_1C_4	4.6	25.3	1.27	8870	25.3	1.27	8870	A_1C_4	36.3	1.11	6760
A_2C_1	2.2	27.6	1.74	8560							
A_2W_1	1.2	73.2	1.25	2030							
A_2C_2	6.4	38.0	0.97	7050							
A_2W_2	1.0	54.0	0.10	2130							
A_2C_3	5.6	32.7	0.60	7770							
A_2W_3	1.3	26.2	0.52	8440							
A_2C_4	4.0	27.5	0.57	8480							
A_2C_5	3.7	23.1	0.74	8090	34.9	0.81	7180	A_2C_1-A_2C_5	33.1	0.89	7630
A_3W_1	0.9	46.9	0.54	5710							
A_3W_2	1.3	62.6	0.46	3280							
A_3C_2	2.0	41.3	0.87	6730							
A_3W_3	0.7	80.5	0.16	970							
A_3C_3	3.8	36.2	0.79	7390							
A_3W_4	1.1	69.6	0.62	2480							
A_3C_4	3.8	48.6	0.57	5450							
A_3W_5	2.0	62.0	0.53	3110							
A_3C_5	2.1	45.3	0.55	5700							
A_3W_6	1.4	49.7	0.93	5320							
A_3C_6	2.7	49.1	0.80	5410	51.0	0.65	5070	A_3W_1-A_3C_6	52.0	0.65	4970
A_4C_1	3.9	23.7	0.79	9100							
A_4W_1	0.4	58.0	0.35	3940							
A_4C_2	5.05	37.3	0.65	7120							
A_4W_2	0.25	42.5	0.64	6540							
A_4C_3	2.8	36.1	0.70	7160	31.5	0.70	7700	A_4C_1-A_4C_3	36.8	0.71	7200
A_4C_4	2.5	43.0	0.64	6540	43.0	0.64	6540	A_4C_4	48.4	0.65	5590
A_4C_5	8.8	32.9	0.57	7760							
A_4W_5	0.9	72.8	0.30	1690							
A_4C_6	3.5	45.6	0.62	5880							
A_4W_6	0.5	64.1	0.38	2950							
A_4C_7	4.5	42.8	0.50	6200	41.4	0.54	6460	A_4C_5-A_4C_7	41.4	0.56	6490
A_5C_1	2.0	27.5	0.67	8420							
A_5C_2	1.8	38.8	0.61	7010							
A_5W_2	0.5	75.7	0.25	1450							
A_5C_3	2.9	23.8	0.98	8860							
A_5W_3	1.0	69.5	0.48	2290							
A_5C_4	3.0	28.2	1.37	8550	36.3	0.86	7210	A_5C_1-A_5C_4	37.0	0.71	7130
A_5W_4	1.6	85.0	0.02	10	85.0	0.02	10	A_5W_4	74.2	0.31	1630
A_5C_5	3.8	43.5	0.73	6140							
A_5W_5	1.0	64.0	0.41	3200							
A_5C_6	1.9	47.9	0.90	5950							
A_5W_6	0.8	44.0	0.97	6280							
A_5C_7	1.8	39.7	0.85	6910							
A_5W_7											
A_5W_8	2.1	67.4	0.32	2730							
A_5C_8											
A_5C_9	2.6	28.4	1.31	8490	47.5	0.77	5700	A_5C_5-A_5C_9	50.8	0.67	5200

[*1] Note: Apparent thickness - actual dip varies from 60° to 72°.

CR36

TABLE 4-3

MINING DILUTION IN THE "A" ZONE BULK SAMPLE

Mining Subzone	Length (m)		Channel Sample Composite Ash % (db)		Bulk Sample Ash % (db)		Estimated Dilution (m)
A_1C_1-A_1C_2	13.6		28.0		26.3		Nil
A_1W_2	3.5		55.5				
A_1C_3	1.9		43.4		38.6		Nil
A_1W_3	3.8		78.1				
A_1C_4	4.6		25.3		36.3		0.9 m
A_1W_4	6.0		76.1				
A_2C_1-A_2C_5	25.2		34.9		33.1		Nil
A_3W_1-A_3C_6	21.8		51.0		52.0		0.5
A_3W_7	5.5		84.4				
A_4C_1-A_4C_3	12.4		31.5		36.8		1.3
A_4W_3	6.5		68.0				
A_4C_4	2.5		43.0		48.4		0.4 m
A_4W_4	4.8		83.8				
A_4C_5-A_4C_7	18.2		41.4		41.4		Nil
A_4W_7	2.9		76.1				
A_5C_1-A_5C_4	11.2		36.3		37.0		
A_5W_4	1.6	26.8	85.0	46.0	74.2	47.9	2.1
A_5C_5-A_5C_9	14.0		47.5		50.8		
A_6			56.1		Not Sampled		

The sulphur contents for the bulk samples and the channel samples are directly comparable. High sulphur areas identified by the channel samples were also found in the corresponding bulk samples.

4.3 ROM ASH AND CALORIFIC VALUE PREDICTIONS

The ability to predict ROM coal quality values from exploration data depends on the following factors:

1. Degree of lithological and structural complexity in the deposit.

2. Accuracy and frequency of exploration data.

3. Accuracy of the structural and coal quality model.

4. Ability of the mine design criteria to represent the proposed mining scheme, i.e. minimum mining thickness, dilution, mining loss, slope stability, blending cycles, etc.

The original Trench D plans were to simulate full scale mining operations in order to establish practical mine design criteria. A hydraulic shovel with a 3 to 5 m^3 bucket was to be employed to dig 6.5 m deep benches. This would have provided realistic data on dilution, mining loss, face slope stability and minimum mining thickness. Budget constraints, however, necessitated the use of a less expensive machine. A backhoe with a 2 m^3 bucket was used and bench heights were reduced to 2 m to reduce quantities. These changes eliminated the opportunity to collect realistic quantitative data, but the following qualitative observations were made:

1. <u>Colour</u> - Partings vary in colour over a range from creamish-white to blackish-brown.

2. <u>Contact</u> - The contact between coal and waste varies between a sharp, clean breaking separation and a gradual transition.

3. <u>Hardness</u> - The waste partings varied from sandstone to claystone, but all were softer then the coal bands.

Experience gained in mining Trench D indicated that more comprehensive mine design criteria will be required to accurately predict ROM quality characteristics. Different selective mining criteria will be required depending on such factors as the inclination of the seam in the face, parting colour, parting contact sharpness and bench orientation.

4.4 SULPHUR FORMS

The distribution of sulphur forms in the subzones of A-zone (Trench D) were analyzed at B.C. Hydro's site laboratory. The form sulphur tests were run on samples with high sulphur content >0.9 percent (db) (Table 4-4). The sulphur form distribution in the washed coal and the wash water will be studied during the Homer City washing tests to indicate any sulphur reduction due to washing.

A review of the sulphur data shows that in some cases the organic sulphur content of the high ash coal were >60 percent of the total sulphur. This is contrary to the earlier established trends where the organic sulphur increases with increasing carbon content of the coal. In other words, high heating value coals should normally have higher organic sulphur than the low heating value coals.

The results of the sulphur form testing in Trench D will be incorporated into a sulphur form study of the whole deposit which is currently underway. The results of this study will better define the relationships between sulphur forms and carbon content or heating value.

TABLE 4-4

SULPHUR FORMS IN A-ZONE
TRENCH D

Lab No.	Subzone	Thickness (m)	Ash %	Total 'S'	Form Sulphur: Organic (as % of total sulphur)	Form Sulphur: Pyritic (as % of total sulphur)	Form Sulphur: SO_4 (as % of total sulphur)
5039	A_1C_1	10.1	31.15	1.04	0.69 (66.3%)	0.33 (31.7%)	0.02 (2.02%)
5040	A_1C_2	3.5	18.85	1.06	1.05 (99%)	-	0.01 (1%)
5041	A_1C_3	1.9	43.41	1.00	0.75 (75%)	0.23 (23%)	0.02 (2%)
5044	A_1C_4	4.6	25.34	1.27	1.25 (98.4%)	0.00 -	0.02 (16%)
5046	A_2C_1	2.2	27.60	1.74	1.38 (79.3%)	0.29 (16.7%)	0.07 (4.0%)
5048	A_2C_2	6.4	37.97	0.97	0.92 (94.8%)	0.03 (3.1%)	0.03 (2.1%)
5050	A_2C_3	5.6	32.67	0.58			
5052	A_2C_4	4.0	27.46	0.57			
5053	A_2C_5	3.7	23.10	0.74			
5056	A_3C_2	2.0	41.32	0.86	0.82 (95.4%)	0.02 (2.3%)	0.02 (2.3%)
5058	A_3C_3	3.8	36.18	0.79			
5060	A_3C_4	3.8	48.64	0.57			
5062	A_3C_5	2.1	45.27	0.55			
5064	A_3C_6	2.7	49.07	0.80			

TABLE 4-4 - (Cont'd)

Lab No.	Subzone	Thickness (m)	Ash %	Total 'S'	Form Sulphur: Organic (as % of total sulphur)	Form Sulphur: Pyritic (as % of total sulphur)	Form Sulphur: SO_4 (as % of total sulphur)
5066	A_4C_1	3.9	23.70	0.79			
5068	A_4C_2	5.05	37.31	0.65			
5070	A_3C_3	2.8	36.14	0.70			
5072	A_4C_4	2.5	42.98	0.97	0.45 (46.4%)	0.49 (50.5%)	0.03 (3.1%)
5074	A_4C_5	8.8	32.94	0.57			
5076	A_4C_6	3.5	45.56	0.62			
5078	A_4C_7	4.5	42.80	0.50			
5083	A_5C_3	2.9	23.78	0.98	0.83 (84.7%)	0.13 (13.3%)	0.02 (2.0%)
5085	A_5C_4	3.0	28.23	1.37	0.88 (64.2%)	0.46 (33.6%)	0.03 (2.2%)
5087	A_5C_5		43.53	0.73			
5089	A_5C_6	1.9	47.86	0.89	0.53 (59.6%)	0.35 (39.3%)	0.01 (1.1%)
5091	A_5C_7	1.8	39.66	0.84	0.64 (76.2%)	0.19 (22.6%)	0.01 (1.2%)
5092	A_5C_8	2.1	67.36	0.32			
5093	A_5C_9	2.6	28.38	1.31	0.80 (61.1%)	0.48 (36.6%)	0.03 (2.3%)

SECTION 5.0 - COAL PREPARATION

Previous coal preparation test work was conducted on 1977 bulk samples taken from B and D-zone coals. One of the major objectives of the 1982 Trench D program was to perform pilot scale coal preparation tests on a sample which represented the entire A-zone coal sequence. Two major test facilities, EPRI's Coal Cleaning Test Facility in Homer City, Pennsylvania and KHD's BATAC Jig Test Facility in Bochum, West Germany, were selected to receive the bulk samples described in Section 3.8 of this report.

5.1 HOMER CITY TEST PROGRAM

The Electric Power Research Institute (EPRI), is the research and development arm of the United States electric utility industry. The Coal Cleaning Test Facility (CCTF) located near Homer City, Pennsylvania is owned by EPRI and operated under contract by Kaiser Engineers. The CCTF has been in operation for 1 year and has processed numerous thermal coals for member utilities. Laboratory analyses for samples taken at the CCTF are performed at the Homer City Coal Laboratory (HCCL), which is part of the Homer City Thermal Power Station owned by Penelec. The laboratory employs a staff of 50 people and is one of the best equipped coal laboratories in the United States.

The EPRI test facility was selected to perform the pilot scale test on the A-zone bulk sample for the following reasons:

1. The CCTF is the only test facility in North America with fully automatic sampling capability and commercial scale test equipment.

2. Tailings generated during the test runs could be processed in an Arus Andritz belt filter press under closely controlled conditions.

3. The laboratory associated with the CCTF was capable of performing exhaustive tests on the samples taken during the pilot plant runs.

4. The cost of the work at Homer City was extremely low because of EPRI's willingness to cost-share (the Phase II work scope total cost was estimated to be $100,000, but B.C. Hydro's share was only $70,000).

The pilot plant tests at Homer City were planned in two separate phases.

Phase I was comprised of a 1-hour plant run on a 10 t sample which was shipped in advance of the main 150 t sample. The objective of Phase I was to ensure that the CCTF could process Hat Creek coal from a material handling standpoint. The coal was crushed to 3/8 inch x 0 and processed in the two stage water only cyclone circuit. The -28 mesh tailings were processed in a Bird Solid Bowl because it was the only machine available for that purpose at the time. As anticipated, the Bird performance was very poor in terms of both cake moisture and centrate clarity. This confirmed the need for a continuous belt filter press to dewater the tailings thickener underflow.

Phase II was made up of two separate pilot plant test runs. Test 1 was basically the same flowsheet as Phase I except that the -28 mesh material was processed in a 1 m wide Arus Andritz continuous belt filter press. In Test 2 the coal was crushed to -3/4 inch and the 3/4 inch x 28 mesh raw coal was processed in the heavy media cyclone circuit. The -28 mesh material was pumped to a classifying cyclone and separated into 28 mesh x 100 mesh and 100 mesh x 0 size fractions. The 28 mesh x 100 mesh material was dewatered using the Bird Screen Bowl Centrifuge and the 100 mesh x 0 material using the Arus Andritz continuous belt filter press (a full description of the Phase II program is contained in Appendix A - Hat Creek Project-Phase II Work Scope, prepared for EPRI by Kaiser Engineers of Pennsylvania).

The Phase II tests were completed on 30 September 1982 and although no confirming laboratory results were available at the time of this writing, the following observations were made:

(a) Rail Car Unloading

A rail strike in the U.S. rail system prevented the rail cars from reaching the Coal Cleaning Test Facility (CCTF). The coal was unloaded at Stearns-Roger's Bi-Gas research station and trucked the last 10 miles to the CCTF.

The coal was unloaded through the bottom-hopper doors into a receiving bin below the tracks and conveyed to a transfer chute for loading into the trucks. The coal did not free flow from the rail cars and a crew of labourers with picks and shovels was required to loosen it enough to permit flow. When the coal did flow it "rat holed" requiring constant shovelling to keep it flowing.

(b) Raw Coal Handling at CCTF

No major problems were encountered in crushing and handling the Hat Creek raw coal. Some minor hangups were observed in the raw coal bins confirming that the critical arching dimensions must be preserved in order to attain mass flow.

(c) Pilot Plant Washing

No major operational problems were encountered during either test run. Minor plugging occurred in the Bird Centrifuge discharge chute during Test 2 but the problem was overcome by increasing the moisture in the Bird product. No clay contamination was observed in the heavy media circuit and clarifying water clarity was maintained throughout both tests. Wet sticky plant rejects were conveyed out of the plant and the belt scrapers prevented clay buildup on the return idlers.

(d) Tailings Dewatering

The thickener underflow from each test run was dewatered using a 1 m wide Arus Andritz continuous belt filter press. In Test 1 the filter press performed at "normal" capacity and produced a readily handleable filter cake along with excellent clarity on the recycle water. In Test 2 the capacity was reduced by approximately 20 to 30 percent, but the filter cake and water clarity were similar to Test 1.

(e) Summary

Initial observations of the Homer City pilot plant tests indicate the following:

1. Hat Creek coal can be washed successfully in a heavy media cyclone circuit at approximately 75 percent recovery and 22 percent product ash.

2. Tailings generated during washing of Hat Creek coals can be dewatered in a continuous belt filter press.

3. Materials handling problems with wet rejects materials can be overcome with proper design.

Laboratory tests on the samples collected during the two plant runs are being analyzed at Homer City Coal Laboratory and this work should be completed by 11 January 1983. The results from the tests will be incorporated into a report which will be submitted to B.C. Hydro in a draft form on 12 January 1983. It is anticipated that a cost estimate for a plant to treat Hat Creek coals can be completed with the aid of Kaiser Engineers in Oakland, California by 22 December 1982.

5.2 BATAC TESTS

The Batac jig has been reported to provide efficient separation in cases with difficult run-of-mine coal and with large quantities of clays. If applicable to Hat Creek coal, the Batac jig offers a number of advantages over a heavy media system. It has high capacity, saves space in the plant, requires less ancillary pumps and sumps, and is significantly lower cost to operate. The capital costs of the Batac jig is the same as for a heavy media system.

The Batac jig was developed in West Germany, by Humboldt Wedag and exhibits two fundamental differences when compared to the standard jig design. First, the water vibrations are initated from a series of air chambers under the jig bed, not from one point located laterally beside the jig. This permits the jig to be built wider, with resultant larger input capacity. Secondly, the movement of water, contrary to the conventional jig, is regular all along the Batac jig bed because the distance to be covered by the water is equal length at any point. This fact, when coupled with the delicately sensitive air valve and discharge control, results in similar efficiency to a heavy media system.

A 10 t sample ((51) 45-gallon drums) of A-zone coal was shipped to KHD's laboratory in Bochum, West Germany. Budget constraints reduced the KHD test program from a complete investigation of 150 mm x 0 washability characteristics, dewatering, tailings handling and jig test to two stage jigging tests on 10 mm x 0.5 mm raw coal. Basic raw coal data, including washability data, will be forwarded to KHD from Homer City.

The 10 t sample arrived in Germany 12 October 1982 and test work will commence on 1 November 1982 when the test date is available. It is anticipated that a report will be available from KHD approximately 15 January 1983.

SECTION 6.0 - COSTS

The costs for the Trench D program can be divided into two separate categories; indirect and direct. The indirect costs include B.C. Hydro staff costs for supervision and administration, catering and camp costs for housing personnel on site, office maintenance, truck rentals, etc. These costs were common to all of the various programs operated at the site between 1 May and 30 September 1982 and have not been accounted for separately for Trench D.

The Trench D direct costs include all of the contractors charges from initial surveying to final bulk sample testing. These costs have been divided into four categories and are listed as follows:

Mining	$	BCM	Unit Cost/BCM
Surveying (Surveyor and Helper)	12,145		
Site Preparation and Extra Work	5,638		
Overburden Shipping (Sanders)	153,232	120,448	1.29
Coal Slot Cost	31,294	7,677	4.07
Shift Boss - Supervisor	2,960		0.38
Geophysical Logging	1,244		
TOTAL	206,513	128,125	1.61

Coal Crushing	$
Plant and Equipment	16,610
Crushing Labour (PLC)	17,850
Sampling - Materials	4,530
Assay Lab. - Labour	19,520
Sample Drums	2,100

Sample Shipment

Arrow Transport (150 t Ashcroft)	1,730
Signal Trucking (10 t Homer City, Pa.)	4,302
Motorways (2 t Uniontown, Pa.)	678
Consolidated Freightways (10 t W. Germany)	4,927
CPR (150 t Homer City, Pa.)	20,120

Sample Testing

EPRI (Homer City) Washing	70,000
Batac Jig (KHD Humbold - Wedag)	24,000
Hazemag U.S.A. - Medicine Creek Clay	N/A
H. Colijn, Monroeville, Pa.	N/A

TOTAL PROGRAM DIRECT COSTS $392,880

SECTION 7.0 - RECOMMENDATIONS AND CONCLUSIONS

7.1 GEOLOGY

1. Although the beds are locally deformed, the general trends are remarkably uniform and can be readily correlated in terms of zones and subzones.

2. Geophysical traces produced by winching the natural gamma probe along freshly exposed surfaces of coal and waste are directly comparable to the traces produced by conventional downhole logging.

3. Oxidation occurs to 2 to 3 m depths at some locations, but no oxidation is evident where the coal is overlain by more than 0.2 m of dense basal till.

4. Petrified wood and carbonate boulders occur in pods or lenses rather than in discrete layers or horizons.

5. Ash beds will provide useful marker bands for determining stratigraphic locations during actual mining.

7.2 MINING

1. The only overburden materials which created digging problems were hard basal tills and carbonate rock.

2. In all cases, the partings encountered were softer and easier to dig than the coal beds.

3. Selective mining proved to be straight forward to the 2 m minimum set forth in the previous mine design criteria. It is recommended, however, that further mining tests be carried out in Trench D prior to the purchase of production equipment. The test should be performed with a 3 to 5-yard hydraulic shovel working from east to west with at least 6.5 m bench height. This would provide quantitative selective mining data.

4. Water which accumulated on the working face floor of the trench turned the coal/clay material into soft sticky "peanut butter" making it impossible to work with rubbertired equipment.

5. A similar mining test to that recommended in (3) above should be conducted in C-zone coal at a locaton below the water table. Mining conditions and selective mining requirements could be radically different in saturated strata and could require a totally different mine design.

7.3 COAL QUALITY

1. Channel samples provide an excellent tool for predicting ROM quality when they are taken in conjunction with geophysical logs.

2. Mining in Trench D did not produce quantitative data regarding mine design criteria for predicting ROM quality characteristics from drill core data. Mining tests as described in Section 7.2 (3) above will be required in order to generate this data.

3. It was observed that mine design criteria should be expanded in order to more accurately predict run-of-mine quality. Future detailed coal quality estimates should account for such factors as seam attitudes in the coal face, bench orientation, parting colour and parting contact sharpness.

4. Although Trench D is located at the eastern portion of the facies change the ROM ash of 40.9 percent (d.b.) is near the average for the deposit.

7.4 COAL PREPARATION

1. The coal washing tests at Homer City proved that Hat Creek A-zone coal can be washed in a heavy media cyclone plant. Laboratory results were unavailable at the time of this writing but the tests indicate that approximately 75 percent yield can be achieved in the heavy media cyclone circuit with a product ash of <25 percent.

2. The tailings thickener/clarified water curcuit can be successfully controlled through careful application of suitable flocculants.

3. Both 28 mesh x 0 and 100 mesh x 0 tailings can be dewatered using an Arus Andritz continuous belt filter press. The filter cake from either size range of material is conveyable, but the throughput rate for the 100 mesh x 0 material was reduced by approximately 30 percent.

4. Wet sticky 3/4 inch x 100 mesh plant rejects can be conveyed if the conveying system has an adequate belt scraper design.

5. Special considerations will be required in storage bin designs to ensure that "bridging" and "rat-holing" does not occur.

APPENDIX A

B.C. HYDRO - HAT CREEK PROJECT - PHASE II WORK SCOPE

PREPARED FOR EPRI BY KAISER ENGINEERS OF PA., INC.

B.C. HYDRO

HAT CREEK PROJECT

PHASE II

WORK SCOPE

September, 1982

Prepared for

Electric Power Research Institute

by

Kaiser Engineers

of Pennsylvania, Inc.

TABLE OF CONTENTS

B.C. HYDRO

HAT CREEK PROJECT

PHASE II WORK SCOPE

I. INTRODUCTION

The first phase of this Hat Creek project was conducted September 15, 1982. In Phase I, a preliminary plant test run of approximately 50 minutes was carried out to evaluate the handleability of the various material streams that occur during processing. This test run demonstrated that the plant was capable of handling the Hat Creek coal from a material handling stand point. As anticipated, the solid bowl centrifuge was not the desired equipment for dewatering this type of fine refuse, but the thickener and clarified water circuits were shown to have adequate capacity.

A compressed work schedule requested by BC Hydro necessitated that Phase II work commence prior to the completion of the laboratory work on Phase I.

In the absence of detailed washability information, two different test runs are proposed for Phase II. This document outlines the test objectives and describes the proposed flowsheets and evaluation procedures for each of these test runs.

II. TEST OBJECTIVES

The BC Hydro - Hat Creek Phase II test program is designed to accomplish the following five(5) objectives:

- o Provide washabiltiy information of the raw coal for future use by BC Hydro.

- o Operate the plant under two different circuit flowsheets to determine material balance and efficiencies of separation of the water only cyclone and the heavy media cyclone circuits.

- o Operate the Arus-Andritz test belt filter press to determine the dewatering capability on both 28M x 0 (0.6mm x 0) and 100M x 0 (0.15mm x 0) size fractions.

- o Produce a bulk sample of clean coal for future use by BC Hydro.

- o Subject the run of mine raw coal and clean coal to laboratory tests to provide pertinent combustion data.

III. TEST PROGRAM

To achieve the test objectives, the Phase II work of the Hat Creek program has been divided into two tests.

In Test 1, approximately 60 tons of raw coal will be subjected to a plant test run. The water only cyclone circuit will be employed to clean 3/8" x 0 (9.4mm x 0) plant feed. The 28M x 0 (0.6mm x 0) size fraction from the primary cyclone overflow will be fed to the tailings thickener for eventual processing in the Arus-Andritz belt filter press.

In Test 2, approximately 80 tons of raw coal will be processed in the heavy media cyclone circuit. A 14"(355mm) classifying cyclone will be utilized to separate the raw 28M x 0 (0.6mm x 0) material into 28M x 100M (0.6mm x 0.15mm) and 100M x 0 (0.15mm x 0) size fractions. The 100M x 0 (0.15mm x 0) fractions will be directed to the tailings thickener for final processing in the Arus-Andritz belt filter press.

1. Flowsheet

Test 1

The flowsheet (Figure 1) for Test 1 of Phase II test program requires the 6-in x 0 (150mm x 0) as received raw coal to be crushed to a 3/8-in x 0 (9.4mm x 0) product size.

The crushed 3/8-in. x 0 (9.4mm x 0) raw coal will be delivered at 10 TPH to the plant to be processed in the two-stage water only cyclone circuit.

The material discharged from the feed conveyor will be slurried, and pumped to the two-stage water only cyclone circuit. The cyclone circuit consists of a 14"(355mm) primary water only cyclone and an 8" (203mm) secondary water only cyclone. The overlow of the 14"(355mm) primary cyclone will report to a fine clean coal sieve bend and screen with the underflow being pumped to the secondary cyclone. The overflow of the 8" (203mm) cyclone will report back as eventual feed to the primary cyclone and the underflow will report to the fine refuse screen.

The clean coal screen oversize (3/8" x 28M, 9.4mm x 0.6mm) reports to the basket centrifuge for final dewatering. The thru material (-28M, -0.6mm) of both the fine clean coal and refuse screens report to the 17' (5.2M) static thickener.

The thickener underflow will be withdrawn periodically and collected in the storage tank. The use of the storage tank offers the opportunity to optimize the flowrates of both the thickener underflow and the belt filter press. Once the 60 ton plant run has been completed, the thickened 28M x 0 (0.6mm x 0) tailings will be fed to the belt filter press at a sufficient rate required for steady state operations.

Test 2

The flowsheet (Figure 2) for test 2 of Phase II requires the 6" x 0 (150mm x 0) as-received raw coal to be crushed to minus 3/4" (19mm).

The crushed 3/4" x 0 (19mm x 0) raw coal will be fed to the plant at 20 TPH to be processed in the heavy media circuit.

The material entering the plant will be deslimed on a 3' x 12' (0.9m x 3.6m) vibrating screen at 28M (0.6mm). The coarser size fraction, 3/4" x 28M (19mm x 0.6mm), will report to a sump where it will be mixed with media and delivered via a variable speed pump to a 14" diameter (355mm) heavy media cyclone (HMC). The products of the heavy media cyclone will be drained and rinsed on two 3' x 10' (0.9m x 3.0m) vibrating screens. The refuse will report to the plant refuse conveyor and the clean coal will be dewatered in a basket centrifuge, then discharged onto the plant clean coal conveyor.

The through product of the deslime screen, 28M x 0 (0.6mm x 0) will flow to the fine coal sump to be delivered via a variable speed pump to a 14"(355mm) diameter classifying cyclone. The classifying cyclone will separate the 28M x 0 (0.6mm x 0) raw coal into 28M x 100M (0.6mm x 0.15mm) and 100M x 0 (0.15mm x 0) size fractions. The 28M x 100M (0.6mm x 0.15mm) size fraction in the cyclone underflow will report to the

18" x 42" (0.46m x 1.07m) Bird Centrifuge to be dewatered and discharged onto the plant refuse conveyor. The 100M x 0 (0.15mm x 0) size fraction in the cyclone overflow will be fed to the tailings thickener.

The mode of operation for the tailings thickener and the Arus-Andritz belt filter press will be the same as for Test 1. The dewatered 100M x 0 (0.15mm x 0) size fraction will be transported in containers to a storage pile outside the test plant.

2. Measurements and Sampling

Prior to crushing the 150 ton bulk sample, a 6" x 0 (150mm x 0) raw coal sample (41001B) will be extracted. The other proposed sample points for each test are as follows:

Test 1

Sample Name	CCTF Sampler No.
Plant Feed	41003A
Deslime Screen Underflow	41005
Primary WOC O'flow	41007B
Secondary WOC U'Flow	41011B
Fine Refuse Screen Oversize	41019B
Thickener Feed	41046B
Agitator Tank Underflow	41047B
Clarified Water	41050B
Plant Clean Coal Product	41051A
Belt Filter Press Cake	N/A

Belt Filter Press Effluent	N/A

In addition to the samples collected during the test, the following plant variables will be recorded.

Plant Feed Rate (TPH)

Fine Coal Pump Flowrate (GPM)

Primary WOC Feed Pressure (PSI)

Secondary WOC Pump Flowrate (GPM)

Secondary WOC Feed Pressure (PSI)

Thickener Flocculant Dosages & Type (ml/min)

Circulating Clarified Water pH

An operations log will be maintained and it will identify any unusual occurrences regarding handling or dewatering of the Hat Creek coal.

Test 2

Sample Name	CCTF Sampler #
Plant Feed	41003A
Deslime Screen Oversize	41004
Deslime Screen Underflow	41005
Clean Coal D & R Screen Product	41037
Refuse D & R Screen Product	40140
Thickener Feed	41046B
Agitator Tank Underflow	41047B
Bird Centrifuge Cake	41048B
Clarified Water	41050B
Belt Filter Press Cake	N/A
Belt Filter Press Effluent	N/A
Circulating Heavy Media	N/A

In addition to the samples collected during the test, the following plant variables will be recorded:

Plant Feed Rate (TPH)

Heavy Media Cyclone Feed Pump Flowrate (GPM)

Heavy Media Cyclone Feed Pump Pressure (PSI)

Heavy Media Gravity (gm/cc)

Classifying Cyclone Feed Pump Flowrate (GPM)

Classifying Cyclone Feed Pump Pressure (PSI)

Circulating Clarified Water pH

Thickener Flocculant Dosages and Type (ml/min)

An operations log will be maintained and will identify any unusual occurrances regarding handling on dewatering of the Hat Creek coal.

3. Laboratory Analyses

The samples collected during test 1 and 2 will be forwarded to the Homer City Coal Laboratory (HCCL). The analytical test requirements for each sample are detailed in the Appendix.

4. Testing Schedule

The major activities of the Phase II test program and the anticipated time frame are listed in the following tabulation:

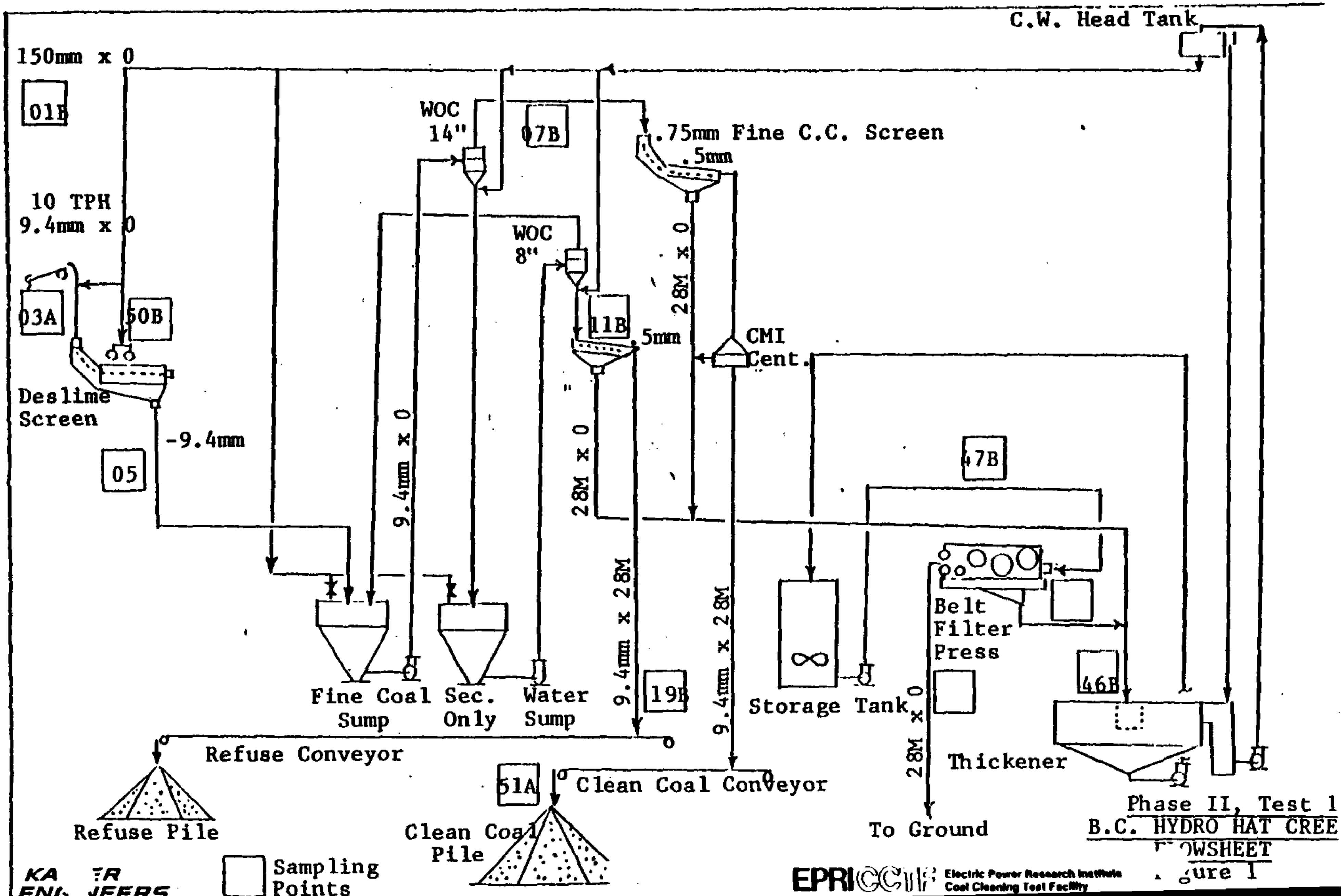
Receive 150 ton coal sample	Week of 9-20-82
Plant Run Test 1	9-27-82
Plant Run Test 2	9-29-82
Laboratory Analyses	9-29-82 to 11-1-82
Submit Draft Phase II Report	12-1-82

Submit Final Phase II Report 12-13-82

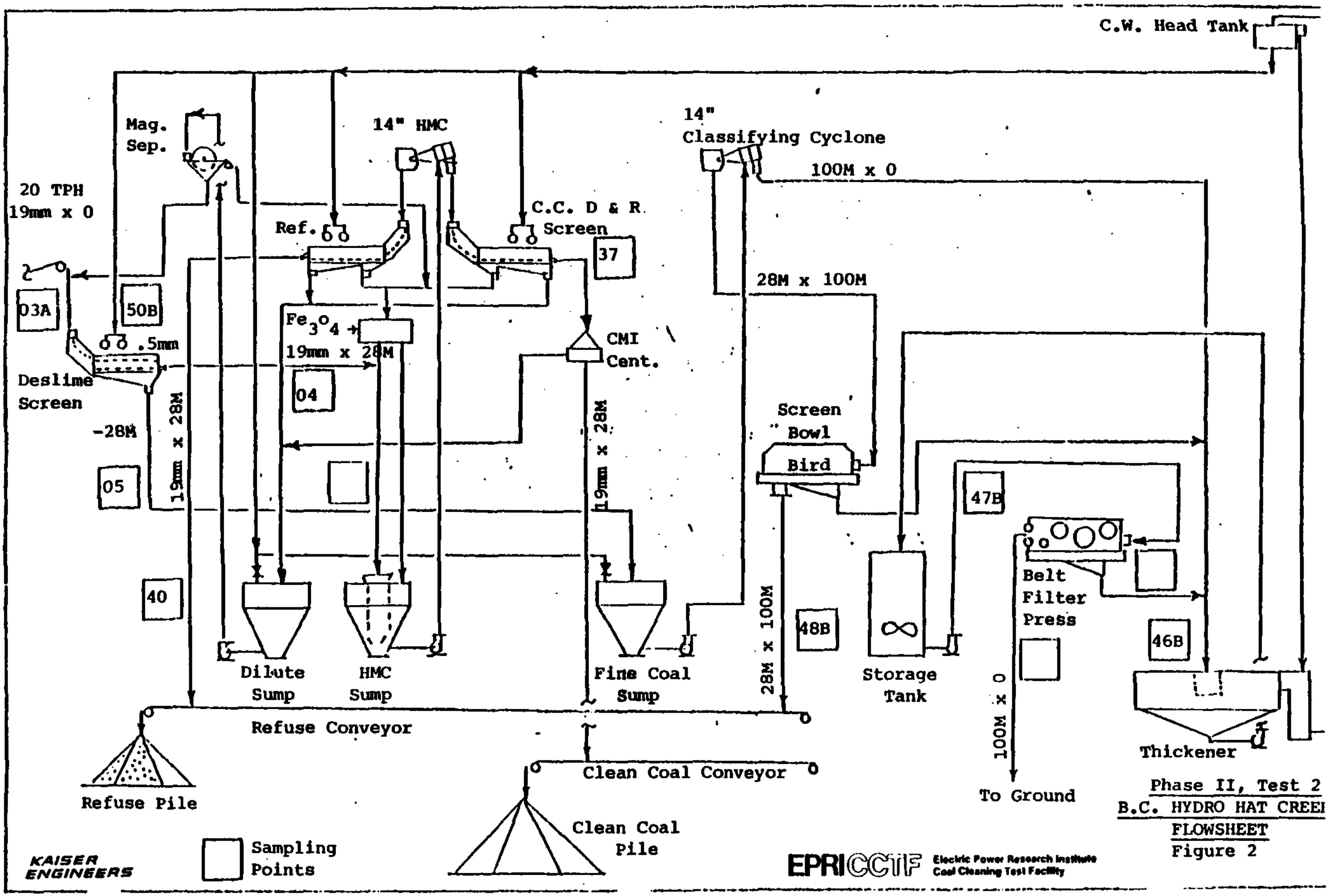
IV. REPORT

EPRI will provide BC Hydro with a report covering the Phase II test program as completed at the CCTF for the Hat Creek Project. This report will be prepared by the CCTF Operations Contractor, Kaiser Engineers of Pennsylvania, Inc. The report will include all laboratory analyses, results, documentation of material handling characteristics of the feed and product stream, evaluation of the plant performance and engineers comments regarding the processing of Hat Creek coal.

It is anticipated that the report on the Phase II test program will be issued to BC Hydro in draft form on December 1, 1982 and in final form on December 13, 1982.



Phase II, Test 1
B.C. HYDRO HAT CREE
FLOWSHEET
Figure 1



Phase II, Test 2
B.C. HYDRO HAT CREEK
FLOWSHEET
Figure 2

EPRI CCTF Electric Power Research Institute Coal Cleaning Test Facility

B.C. Hydro

Phase II

Plant Run Time Measurements

TEST 1

1. Raw Coal Storage Bin Feeder Totalizers (Short Tons) (Beginning and End)
2. Fine Coal Pump Delivery Rate (GPM) (every 15 min.)
3. Primary Water Only Cyclone Feed Pressure (PSI) (every 15 min.)
4. Secondary Water Only Pump Delivery Rate (GPM) (every 15 min.)
5. Secondary Water Only Cyclone Feed Pressure (PSI) (every 15 min.)
6. Clarified Water pH (every 15 min.)
7. Flocculent Types and concentrations
8. Flocculent Dose Rates to the Thickener (ml/min.)
9. Flocculent Dose Rate to the Belt Press (GPM)
10. Bages of Lime used
11. Clean Coal Weigh Feeder Totalizer (short tons) (Beginning and End)
12. Time to fill Belt Press Cake Hopper (sec.)
13. Weight of full Belt Press Cake Hoppers (lbs.)

TEST 2

1. Raw Coal Storage Bin Feeder Totalizers (short tons) (Beginning and End)
2. Heavy Media Pump Delivery Rate (GPM) (every 15 min.)
3. Heavy Media Cyclone Feed Pressure (PSI) (every 15 min.)
4. Circulating Heavy Media Specific Gravity (every 15 min.)
5. Type of magnetite used.
6. Bags of magnetite added.
7. Fine Coal Pump Delivery Rate (GPM) (every 15 min.)
8. Classifying Cyclone Feed Pressure (PSI) (every 15 min.)
9. Clarified Water pH (every 15 min.)
10. Flocculant Types and Concentrations
11. Flocculent Dose Rates to the Thickener (ml/min.)
12. Flocculent Dose Rates to the Belt Press (GPM)
13. Bags of Lime used.
14. Clean Coal Weigh Feed Totalizer (short tons) (Beginning and End)
15. Time to fill Belt Press Cake Hoppers (sec.)
16. Weight of full Belt Press Cake Hoppers (lbs.)

EPRI CCTF Electric Power Research Institute Coal Cleaning Test Facility

BC Hydro

Phase II

Sample Points

Sample Point	CCTF Sample #	Type	Frequency(min)
Run of Mine Raw	41001B	Stopped Belt	4 min.30 sec.
	TEST 1		
Plant Feed	41003A	Auto.Cross Stream	3 min.
Deslime Screen U'flow	41005	Auto.Cross Stream	2 min.
Primary WOC O'flow	41007B	Manual	6 min.
Secondary WOC U'flow	41011B	Manual	6 min.
Plant Clean Coal	41051A	Auto.Cross Stream	3 min.
Fine Ref.Screen Oversize	41019	Auto.Cross Stream	3 min.
Thickener Feed	41046B	Manual	6min(timed)
Clarified Water	41050B	Manual at Deslime Sprays	30min(timed)
Agitator Tank U'flow	41047B	Manual	3min(timed)
Belt Press Cake	N/A	Manual	3min(timed)
Belt Press Effluent	N/A	Manual	3min(timed)
	TEST 2		
Plant Feed	41003A	Auto.Cross Stream	3 min.
Deslime Screen Oversized	41004	Auto.Cross Stream	2 min.
Clean Coal D&R Product	41037	Auto.Cross Stream	2 min.
Refuse D&R Product	41040	Auto.Cross Stream	2 min.
Circulating Heavy Media	N/A	Manual at Central Box	30min(timed)
Deslime Screen U'flow	41005	Auto.Slurry Divt.	2 min.
Bird Cent.Cake	41048	Auto.Cross Stream	6 min.
Thickener Feed	41046B	Manual	6min(timed)
Clarified Water	41050B	Manual at Deslime Sprays	30min(timed)
Agitator Tank U'flow	41047B	Manual Slurry Diverter	3min(timed)
Belt Press Cake	N/A	Manual	3min(timed)
Belt Press Effluent	N/A	Manual	3min(timed)

APPENDIX

LABORATORY ANALYSIS

SPECIFICATION

LABORATORY ANALYSIS
FOR PHASE II

B.C. Hydro

Sampler Name:	Run of Mine Raw Coal
Sampler Number:	41001B
Sampler Type:	Manual (Stopped Belt)
Frequency:	Forty Increments (7 min., 30 sec.; 39 feet)
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Fixed Carbon Volatile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Ash Fusion Temperatures (Oxidizing and Reducing) Bulk Density Hardgrove Grindability Index Chlorine Free Swelling Index
Wet Screen Analysis:	6" (150mm), 3/4" (19mm), 3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm)
Recombine to:	+6" x 3/4" (+150mm x 19mm) 3/4" x 3/8" (19mm x 9.4mm) 3/8" x 28M (9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0)
Cummulative Float/Sink each Recommbination:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00, 2.10, 2.17. Do not F/S the one(1) -100M (-0.15mm) fraction. Perform Ash Sulfur(Leco), and BTU/lb. on each fraction
Mathematical Composites:	+6" x 3/8" (+150mm x 3/8") 3/8" x 100M (9.4mm x 0.015mm) +6" x 100M (+150mm x 0.015mm) +6" x 28M (+150mm x 0.6mm)

Note: This is subbituminous coal: All screening must be wet and all F/S done on cummulative.

LABORATORY ANALYSIS

B.C. Hydro

FOR PHASE II Test 1

Sample Name:	Plant Feed
Sampler Number:	41003A
Sampler Type:	Automatic Cross Stream
Frequency:	3 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash
Wet Screen Analysis:	NONE
Recombination:	NONE
Float/Sink Analysis:	NONE

Note: This is subbituminous coal: all screening must be wet.

* Save one 55 gal. drum of head sample for BC Hydro

LABORATORY ANALYSIS

B.C. Hydro

FOR PHASE II a

Sample Name:	Primary WOC Overflow
Sampler Number:	41007B
Sampler Type:	Manual
Frequency:	6 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm)
Recombination:	+3/8" x 28M (+9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00, 2.10, 2.17. Do not F/S the 100M x 0 (0.15mm x 0) Perform ash on each fraction.
F/S Mathematical Composite:	+3/8" x 100M (+9.4mm x 0.15mm)

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sample Name:	Secondary WOC Underflow
Sampler Number:	41011B
Sampler Type:	Manual
Frequency:	6 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	3/8" (9.4mm, 28M (0.6mm), 100M (0.15mm)
Recombination:	+3/8" x 28M (+9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00, 2.10. Do not F/S the 100M x 0 (0.15mm x 0) Perform ash on each fraction.
F/S Mathematical Composite:	+3/8" x 100M (+9.4mm x 0.15mm)

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sample Name:	Plant Clean Coal Product
Sampler Number:	41051A
Sampler Type:	Automatic Cross Stream
Frequency:	3 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Fixed Carbon Volatile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Ash Fusion Temperature (Oxidizing and Reducing) Bulk Density Hardgrove Grindability Index Chlorine Free Swelling Index
Wet Screen Analysis:	3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm)
Recombine to:	+3/8" x 28M (9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0) Perform ash, sulfur (Leco) and BTU/lb.on each size fraction.
Float/Sink:	NONE

*Save one 55 gal. drum of head sample for BC Hydro

LABORATORY ANALYSIS

B.C. Hydro

FOR PHASE II Test 1

Sample Name:	Deslime Screen Underflow
Sampler Number:	41005
Sampler Type:	Automatic Slurry Diverter
Frequency:	2 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Sulfur (Leco) Heating Value Specific Gravity of Solids
Wet Screen Analysis:	3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm)
Recombination:	+3/8" x 28M (+9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00, 2.10, 2.17. Do not F/S the 100M x 0 (0.15mm x 0) Perform ash, sulfur (Leco) and BTU/lb. on each fraction.
F/S Mathematical Composite:	+3/8" x 100M (+9,4mm x 0.15mm)

Note: This is subbituminous coal: all screening must be <u>wet</u> and all F/S done on cummulative.

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sampler Name:	Fine Refuse Screen Oversize
Sampler Number:	41019B
Sampler Type:	Automatic Cross Stream
Frequency:	3 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Fixed Carbon Volatile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Bulk Density Hardgrove Grindability Index Specific Gravity of Solids
Wet Screen Analysis:	3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm)
Recombine to:	+3/8" x 28M (9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0) Perform ash, sulfur (Leco) and BTU/lb. on each fraction.
Float/Sink:	NONE

*Save one 55 gal. drum of head sample for BC Hydro

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sampler Name:	Thickener Feed
Sampler Number:	41046B
Sampler Type:	Manual Slurry Diverter
Frequency:	6 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Solids Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	100M (0.15mm), 200M (0.075mm)
Recombination:	As screened Perform ash of each fraction.
Float/Sink Analysis:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sampler Name:	Agitator Tank Underflow
Sampler Number:	41047B
Sampler Type:	Manual Slurry Diverter
Frequency:	3 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Solids Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	100M (0.15mm), 200M (0.075mm)
Recombination:	As Screened Perform ash on each fraction.
Float/Sink Analysis:	NONE

LABORATORY ANALYSIS

B.C. Hydro

FOR PHASE II Test 1

Sample Name:	Clarified Water
Sampler Number:	41050B
Sampler Type:	Manual at Deslime Screen Sprays
Frequency:	30 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Suspended solids (ppm) % Disolved Solids (ppm)
Screen Analysis:	NONE
Recombination:	NONE
Float/Sink Analysis:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sample Name:	Belt Filter Press Cake
Sampler Number:	N.A.
Sampler Type:	Manual at Belt Filter Press
Frequency:	3 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Solids Total Moisture Ash Fixed Carbon Volitile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Bulk Density Specific Gravity of Solids
Wet Screen Analysis:	100M (0.15mm), 200M (0.075mm)
Recombination:	As Screened Perform ash, sulfur (Leco) and BTU/lb. on each fraction.
Float/Sink Analysis:	NONE

* Save one 55 gal. drum of head sample for BC Hydro

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 1

Sample Name:	Belt Filter Press Effluent
Sampler Number:	N.A.
Sampler Type:	Manual at Belt Filter Press
Frequency:	3 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Suspended Solids (ppm) % Disolved Solids (ppm) Ash Specific Gravity of Solids
Screen Analysis:	NONE
Recombination:	NONE
Float/Sink Analysis:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Plant Feed
Sampler Number:	41003A
Sampler Type:	Automatic Cross Stream
Frequency:	3 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Sulfur (Leco) Heating Value
Wet Screen Analysis:	3/4" (19mm), 3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm
Recombination:	+3/4" x 3/8" (+19mm x 9.4mm) 3/8" x 28M (9.4mm x 0.6mm) 28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00, 2.17 Do not F/S the 100M x 0 (0.15mm x 0) Perform ash, sulfur (leco), and BTU/lb. on each fraction.
F/S Mathematical Composite:	+3/4" x 28M (+19mm x 0.6mm) +3/4" x 100M (+19mm x .15mm)

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

* Save one 55 gal. drum of head sample for BC Hydro

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Deslime Screen Oversize
Sampler Number:	41004
Sampler Type:	Automatic Cross Stream
Frequency:	2 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash (non-magnetic) Specific Gravity of Solids
Wet Screen Analysis:	3/4" (19mm), 3/8" (9.4mm), 28M (0.6mm), 100M (0.15mm)
Recombination:	+3/4" x 3/8" (+19mm x 9.4mm) 3/8" x 28M (9.4mm x 0.6mm) 28M x 0 (0.6mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00 Do not F/S the 28M x 0 (0.6mm x 0) Perform ash on each fraction.
F/S Mathematical Composite:	+3/4" x 28M (+19mm x 0.6mm)

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Clean Coal D & R Screen Product
Sampler Number:	41037
Sampler Type:	Automatic Cross Stream
Frequency:	2 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash (Non-magnetic) Fixed Carbon Volatile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Ash Fusion Temperatures (Oxidizing and Reducing) Bulk Density Hardgrove Grindability Index Chlorine Specific Gravity of Solids (non-magnetic)
Wet Screen Analysis:	3/4" (19mm, 3/8" (9.4mm), 28M (0.6mm)
Recombine to:	+3/4" x 3/8" (+19mm x 9.4mm) 3/8" x 28M (9.4mm x 0.6mm) 28M x 0 (0.6mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00 Do not F/S the -28M (0.6mm) fraction. Perform ash, sulfur (Leco), and BTU/lb. on each fraction.
F/S Mathematical Composite:	+3/4" x 28M (+19mm x 0.6mm)

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Refuse D & R Screen Product
Sampler Number:	41040
Sampler Type:	Automatic Cross Stream
Frequency:	2 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash (non-magnetic) Fixed Carbon Volatile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Bulk Density Hardgrove Grindability Index Specific Gravity of non-magnetic Solids
Wet Screen Analysis:	3/4" (19mm), 28M (0.6mm)
Recombine to:	+3/4" x 28M (+19mm x 0.6mm) 28M x 0 (0.6mm x 0)
Cummulative Float/Sink Analysis:	1.30, 1.40, 1.50, 1.60, 1.70, 1.80, 1.90, 2.00 Do not F/S the -28M (0.6mm) fraction. Perform ash, sulfur (leco) and BTU/lb. on each fraction.

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

* Save one 55 gal. drum of head sample for BC Hydro

LABORATORY ANALYSIS

B.C. Hydro

FOR PHASE II Test 2

Sample Name:	Circulating Heavy Media
Sampler Number:	N/A
Sampler Type:	Manual
Frequency:	30 min.
Head Analysis:	% Solids % Magnetics
Screen Analysis:	NONE
Recombination:	NONE
Float/Sink:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Deslime Screen Underflow
Sampler Number:	41005
Sampler Type:	Automatic Slurry Diverter
Frequency:	2 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	28M (0.6mm), 100M (0.15mm)
Recombination:	+28M x 100M (0.6mm x 0.15mm) 100M x 0 (0.15mm x 0) Perform ash on each fraction.
Cummulative Float/Sink Analysis:	NONE

Note: This is subbituminous coal: all screening must be wet and all F/S done on cummulative.

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Bird Centrifuge Cake
Sampler Number:	41048B
Sampler Type:	Manual (Grab)
Frequency:	6 min.
Head Analysis:	Gross Sample Weight Air Dry Moisture Total Moisture Ash Fixed Carbon Volitile Matter Sulfur Forms Heating Value Ash Constituents Ultimate Analysis Bulk Density Specific Gravity of Solids
Wet Screen Analysis:	28M (0.6mm), 100M (0.15mm)
Recombine to:	+28M x 100M (+0.6mm x 0.15mm) 100M x 0 (0.15mm x 0) Perform ash, sulfur (leco) and BTU/lb. on each fraction.

Note: This is subbituminous coal: all screening must be wet

* Save one 55 gal. drum of head sample for BC Hydro

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Thickener Feed
Sampler Number:	41046B
Sampler Type:	Manual Slurry Diverter
Frequency:	6 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Solids Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	100M (0.15mm), 325M (0.045mm)
Recombination:	As Screened Perform ash on each fraction
Float/Sink Analysis:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Agitator Tank Underflow
Sampler Number:	41047B
Sampler Type:	Manual Slurry Diverter
Frequency:	3 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Solids Total Moisture Ash Specific Gravity of Solids
Wet Screen Analysis:	100M (0.15mm), 200M (0.075mm)
Recombination:	As Screened Perform ash on each fraction
Float/Sink Analysis:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Clarified Water
Sampler Number:	41050B
Sampler Type:	Manual at Deslime Screen Sprays
Frequency:	30 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Suspended Solids (ppm) % Disolved Solids (ppm)
Screen Analysis:	NONE
Recombination:	NONE
Float/Sink Analysis:	NONE

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Belt Filter Press Cake
Sampler Number:	N.A.
Sampler Type:	Manual at Belt Filter Press
Frequency:	3 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Solids Ash Fixed Carbon Volitile Matter Total Moisture Sulfur (Leco) Heating Value Ash Constituents Ultimate Analysis Bulk Density Specific Gravity of Solids
Wet Screen Analysis:	100M (0.15mm), 200M (0.075mm)
Recombination:	As Screened Perform ash, sulfur (Leco) and BTU/lb. on each fraction
Float/Sink Analysis:	NONE

* Save one 55 gal. drum of head sample for BC Hydro

B.C. Hydro

LABORATORY ANALYSIS

FOR PHASE II Test 2

Sample Name:	Belt Filter Press Effluent
Sampler Number:	N.A.
Sampler Type:	Manual at Belt Filter Press
Frequency:	3 min., start new sample each hour
Head Analysis:	Gross Sample Weight % Suspended Solids (ppm) % Disolved Solids (ppm) Ash Specific Gravity of Solids
Screen Analysis:	NONE
Recombination:	NONE
Float/Sink Analysis:	NONE