009544

HAT CREEK PROJECT

Public Information Bulletin No. 3

March 1979

CONTENTS

		PAGE
1.	INTRODUCTION	1
2.	STATUS OF THE PROJECT	1
3.	ENVIRONMENTAL STUDIES	2
4.	MINING	6
5.	POWERPLANT	9
6.	OFFSITE FACILITIES	10
7.	COMMUNITY RELATIONS	13
8.	LAND ACQUISITION	14
9.	APPROVALS PROCESS	15
10.	ALTERNATE USES OF HAT CREEK COAL	16
	MAP	

1. INTRODUCTION

The purpose of this bulletin is to provide information on the progress to date of B. C. Hydro's planning associated with the development of a proposed 2000 megawatt coal-fired thermal electric generating station at Hat Creek Valley, 194 kilometres (120 miles) north-east of Vancouver. Because the studies are not yet complete to point where B. C. Hydro may apply for licences to proceed with the project, the information in this bulletin is subject to change.

Inquiries regarding the Hat Creek studies should be addressed to:

Community Relations Department
B. C. Hydro
970 Burrard Street
Vancouver, B. C.
V6Z 1Y3

2. STATUS OF THE PROJECT

Substantial progress was made since issue of Bulletin No. 2 in March 1977, as B. C. Hydro continued investigation of the Hat Creek coal deposit. Work, which is described later in greater detail, included the following:

- An expanded drilling programme was completed to further define the distribution and quality of coal and the extent of the deposit.
- A test burn of a bulk sample was carried out to determine the handling and combustion characteristics of the coal.
- Work continued on the engineering studies for the mine, power-plant and related facilities.
- A consultant completed a study on Alternative Uses of Hat Creek Coal.
- Other consultants' detailed environmental reports have been reviewed by B. C. Hydro staff.

The project's preliminary engineering study phase has been completed and, together with assessments of environmental and socio-economic impact, will provide most of the information necessary for B. C. Hydro's Directors to determine whether the project should proceed to the licence application phase.

Recently Hydro's Board of Directors deferred a decision on the Hat Creek proposal for some months because:

(i) The electric load forecast has moderated to the extent that more time can be allowed for the studies underway, and

(ii) Hydro has been still awaiting the definition of air quality objectives from the Pollution Control Board which are essential to the design of the proposed power plant.

3. ENVIRONMENTAL STUDIES

(i) Preliminary Environmental Study

Environmental studies were initiated in July 1974 when B. C. Research and Dolmage Campbell & Associates were engaged to undertake a preliminary environmental impact study. Their report, which was submitted in August 1975 and became a public document, recommended that more detailed studies and evaluations of impacts be carried out.

(ii) Detailed Environmental Studies - Terms of Reference

In early 1976, draft terms of reference for the detailed environmental studies were prepared and circulated to various Provincial government agencies, Environment Canada, and several special interest groups. After consideration of the comments that resulted from the draft, and incorporation of refinements as the studies progressed, the final terms of reference were published in August 1977. In June 1976, the various studies were assigned to several consulting firms, and a Coordinating Consultant, Ebasco Services of Canada Limited; Environmental Consultants, was selected to provide scheduling, cost control and reporting functions to B. C. Hydro.

The detailed environmental studies were divided into five subgroups. Each subgroup is made up of closely related studies, and reports from each of the five subgroups will serve as references or appendices to a comprehensive report by the coordinating consultant. The following tabulation outlines the topics included in the studies:

A. Land Resources Subgroup

- A1 - Physical Habitat and Range Vegetation
- A2 - Wildlife
- A3 - Forests
- A4 - Agriculture
- A5 - Recreation
- A6 - Solid Waste Disposal, Coal Storage and Land Reclamation

B. Water Resources Subgroup

B1 - Hydrology, Drainage and Water Quality and Use
B2 - Fisheries and Benthic Fauna
B3 - Water Intake

C. Socio-Economic Subgroup

C1 - Impacts on Human Society
C2 - Impacts on Community Services and Infrastructure
C3 - Resources Evaluation for Provincial, Environmental and Regional Accounts
C4 - Archaeological and Historic Sites

D. Air Quality Subgroup

D1 - Meteorological and Air Quality Equipment
D2 - Ambient Air Quality
D3 - Epidemiology (Health)
D4 - Climatic Assessment Study
D5 - Meteorological Control Potential

E. General Subgroup

E1 - Noise
E2 - Minerals and Petroleum
E3 - Trace Elements
E4 - Aesthetics

Since the award of the studies in June 1976, the scope and timing of the work has been continually updated and revised as the project developed and requirements became more clearly defined.

(iii) Detailed Environmental Studies - Sequence of Work

For more than a year the consultants were involved in resource inventory work to determine the current status of resources in the Hat Creek area. This included field measurements and sampling and was followed by interpretation and presentation of data in a manner consistent with the Terms of Reference. Projections were made of the changes that might occur in the area without the mine and generating station. The consultants' efforts were then concentrated on assessing the effects of the construction, operation and decommissioning of the project on the local and regional surroundings. Emphasis was placed on participation by the enviornmental consultants in developing satisfactory compromises between environmental constraints and engineering or economic requirements.

(iv) Detailed Environmental Studies - Some Preliminary Conclusions

In their reports the consultants discussed the potential environmental impacts of the project on air, land, water, socio-economic and other resources. Some of these potential impacts are:

- Direct land alienation within the Hat Creek Valley and at the water intake site.
- Potential sulphur dioxide impacts on vegetation at higher elevation.
- Intermittent pH reductions in precipitation due to hydrogen ion loading (natural wind variability would preclude widespread acidification).
- Possible forest production losses due to land clearing and sulphur dioxide and fluoride emissions.
- Possible decrease in forage production and subsequently the beef cattle industry due to land alienation and stack emissions.
- Short-term local area population increase of approximately 6000 during construction and permanent increase of approximately 4000 during operation. (These figures include population influx in addition to the project work force.)
- Increased local and regional employment and expansion and diversification of commercial, recreational and cultural facilities.
- Localized effects on groundwater regime due to open-pit mining.
- Loss of natural Hat Creek stream channel due to diversion of creek around the open pit.
- Visual impact on the north end of the Hat Creek Valley along Highway 12 to Marble Canyon.

B. C. Hydro will address these and other impacts in mitigation and compensation proposals should a decision be made to seek approval for the project.

Several consultants' reports identified areas which warranted additional investigation that B. C. Hydro has acted upon. For example, supplemental work has been initiated on trace element

analysis, effects of long-range transport of powerplant emissions and the implications of acid precipitation and mine dust control, to more explicitly define the potential for environmental impacts.

(v) Detailed Environmental Studies - Air Quality

(a) Meteorological Studies

In November 1974, B. C. Hydro started a meteorological programme with the installation of eight unattended weather stations in the Hat Creek Valley. These supplemented an existing wind instrument and an Environment Canada climate station. Air quality monitoring was started in 1977 to measure existing air quality conditions.

Meteorological studies were conducted during the winter and summer of 1975 to obtain information on the temperature and wind profiles in the lower atmosphere at Hat Creek. Additional information was obtained from tracking constant-volume balloon flights, which approximated the path of powerplant stack plumes from potential thermal plant sites.

Atmospheric diffusion and plume dispersion characteristics were studied through the use of gas tracers released from aircraft. These studies were conducted in the winter, spring and summer of 1976 to simulate the actual operation of a powerplant from an air quality perspective.

A meteorological tower has been constructed near the proposed Harry Lake powerplant site. In addition, a number of monitoring trailers have been stationed in and around the valley.

Meteorological data have been made available to the design engineers and environmental consultants. The meteorological studies have been integrated into the air quality portion of the detailed environmental studies.

(b) Air Quality

The modelling results for air quality have indicated that a single tall stack at least 244 metres (800 feet) high is desirable for the Hat Creek powerplant. This, combined with occasional switching to a premium quality of coal would ensure the achievement of acceptable air quality levels. During infrequent adverse weather conditions, specially stockpiled lower sulphur fuel would be burned and/or powerplant load would be reduced.

4. MINING

(i) Test Burn

In the spring and summer of 1977, some 6,300 tonnes (7,000 tons) of coal from two test trenches at Hat Creek were transported by rail to the Battle River Powerplant of Alberta Power Ltd.

Burning and other tests carried out there demonstrated that typical Hat Creek coal can be handled, pulverized and burned in a 32 megawatt commercial-scale powerplant unit. The fuel used in the test-burn ranged in heating value from 10,500 kJ/kg (4,500 Btu/lb) with 38 per cent ash, to 14,000 kJ/kg to (6,000 Btu/lb) with 25 per cent ash, at a moisture content of 20 per cent.

Despite much of the ash content of the coal being in the form of sticky clays, there were no significant handling problems, even though two inches of rain fell while the coal was stockpiled at Battle River.

The Hat Creek coal required less power to grind than Battle River coal and its combustion characteristics appeared similar in nature.

The high proportion of ash in Hat Creek coal did not cause any serious boiler problems. Although a certain amount of slagging did occur on the furnace walls, it was satisfactorily dealt with by the existing cleaning devices.

Ash handling was the largest problem, due to the fact that the test unit had been designed to handle a much smaller percentage of ash.

Generally speaking, the test burn at Battle River demonstrated the feasibility of burning Hat Creek coal. It also provided important data to powerplant designers, particularly on cleaning flue gases with electrostatic precipitators.

(ii) Test Trenches

The excavation of the two trenches not only accomplished the prime objective of obtaining the bulk sample, but also provided information with respect to the mining and geological characteristics of the coal and overburden in the deposit.

The excavation and related work was treated as a pilot scale mining operation to provide data to help develop a full-scale project mining plan.

This excavation work verified that both the overburden, coal and waste materials can be dug by machine without blasting, except for isolated pockets of boulders. The economic advantages and disadvantages of blasting will have to be studied further during the detailed design stage.

The trenches were excavated with relatively steep walls to permit evaluation of slope stability to guide design of safe slopes for the mine.

Temperature monitoring of stockpiles indicated that Hat Creek coal, like other western coals, is relatively reactive and subject to spontaneous combustion if it is stored in stockpiles without proper compaction.

Information on the crushing characteristics, range and variation of particle sizes of Hat Creek coal was obtained as part of the test programme.

Both trenches were geologically mapped to provide helpful information for interpreting exploratory diamond drill hole data.

Environmental impacts of the test excavations were restricted to the immediate areas of the trenches and related (waste and coal storage) areas. There were no significant project related alterations to air or water quality, except for localized temporary effects. Monitoring instruments indicated no increase in ambient suspended particulate which could be attributed to this programme.

(iii) Mine Planning

A preliminary engineering mining design has been completed to augment the conceptual design carried out in 1976 - 77.

The objective of the preliminary engineering studies is to provide a mine design which fully and clearly defines the scope of the project and provides reliable estimates of capital and operating costs for such a development. A final preliminary engineering report will establish the technical and economic feasibility of the mining project and will provide the basis for project planning and controlling the detailed design, mine development and construction.

The mining studies have been appropriately integrated with the parallel development of the powerplant preliminary engineering design.

The final project design will incorporate optimum combinations of mining equipment and methods based on the updated knowledge that is available from previous conceptual studies, recent development drilling programmes and the bulk sample programme. For example, in previous studies, the mining systems evaluated employed shovel-truck-conveyor combinations. In the most recently completed mining studies, the application of bucket-wheel excavators of a type developed for lignite mines in Germany, has also been studied.

The mining studies to date have also considered the means by which a consistent quality of coal can be delivered to the powerplant. The Hat Creek coal occurs with considerable localized variation in heating value and other characteristics. Waste bands of varying thicknesses which are interspersed throughout the deposit cause further complications.

There are a number of approaches which allow delivery of a consistent fuel to the powerplant, including:

(a) Selective Mining - Selective mining is an excavation technique which involves the separate extraction of some of the larger waste bands which would be disposed of along with other waste materials.

(b) Coal Washing (or Beneficiation) - Coal washing is applied successfully to many coals around the world. The processes used rely on the gravity separation of the heavier waste materials (ash) from the coal, thereby raising the heating value of the washed coal. Coal washing operates most effectively where the coal and waste occur in discrete bands.

Tests conducted on the Hat Creek coal to date, indicate that although there are discrete bands of waste and coal, most of the coal is intimately mixed with waste material, which makes gravity separation (washing) more difficult.

(c) Coal Blending - The third approach to providing a consistent powerplant fuel is aimed at reducing the variability over time. This would be achieved by carefully selecting which accessible areas should be mined at a given time and mixing the coal from these areas to provide a consistent blend. This could be accomplished by a coal blending system which places different grades of coal in a layered stockpile and then recovering it so that the layers are mixed to produce the required blend.

5. POWERPLANT

(i) Location

To provide improved dispersion of flue gases, the power station would be on high ground on the north side of Medicine Creek, near Harry Lake, some 4 kilometres (2.5 miles) northeast of Open Pit No. 1. The ground level at the power plant is about 1,400 metres (4,600 feet) above sea level. Ground level at the top of Open Pit No. 1 is approximately 915 metres (3,100 feet) above sea level.

(ii) Boilers

The containing structure for a Hat Creek boiler would be about 90 metres (300 feet) high, 60 metres (200 feet) wide and 46 metres (150 feet) deep. Essentially, the boiler is a large water-cooled furnace followed by numerous banks of tubes containing steam and/or water, to which additional heat is transferred by the hot combustion gases leaving the furnace. At full load each boiler would consume about 450 tonnes (500 tons) per hour of Hat Creek coal to produce 1760 tonnes (1940 tons) per hour of high pressure steam. A single tall stack, with separate flues for each boiler, would discharge cleaned combustion gases to the atmosphere.

(iii) Turbine Generators

High pressure steam from the boilers would drive turbines which in turn drive electric generators. Each generator would deliver 500 megawatts of power after the supply of "in-plant" auxiliary power has been taken off. Four generators of this size could supply the present Lower Mainland electrical demand.

(iv) Condensers

A condenser at the turbine exhaust changes the steam to water after most of its useful energy has been expended. The water is then returned to the boiler to be re-heated into steam. A condenser requires large quantities of cold water flowing through it to condense the exit steam. In providing cooling for the condenser, the cooling water itself is warmed up and the heat it has gained must be dissipated.

(v) Cooling Towers

At Hat Creek, the cooling water heat would be dissipated in two large natural draft cooling towers where heat would be transferred, mainly by evaporation, to a stream of air flowing through drops of cooling water as they rain down through the towers. The cooled water would then be recycled to the condensers.

Some of the cooling water would evaporate to the atmosphere, and it would therefore be necessary to add some make-up water to replace it. A local reservoir, containing an approximate two-month supply of make-up cooling water, would be supplied with water pumped from the Thompson River.

(vi) Emissions

The power plant would be designed to ensure acceptable control of emissions within the terms of all Pollution Control Branch permits which would have to be obtained to operate the plant. Three major flue gas contaminants which would be dealt with are sulphur dioxide, particulate matter and oxides of nitrogen. For details, see Public Information Bulletin No. 2, issued in March 1977.

6. OFFSITE FACILITIES

These are project services which do not form an integral part of either the mine or powerplant.

(i) Water Supply System

The supply of make-up cooling water to the powerplant is the major offsite facility. From an intake and pumphouse on the Thompson River, a pipeline would take water about 21 kilometres (13 miles) to a reservoir near the powerplant. The system would have an average peak capacity of 1580 litres (348 gallons) per second, but would operate at a lower average flow.

Intake - The intake would be located on the west bank of the Thompson just upstream of the point where it is joined by the Bonaparte River. Designed with concern for fish protection, the intake would be a midstream pier-type structure housing five pumps.

Booster Pumping Stations - The system would include two identical booster pumping stations--one located at the Bonaparte junction near the intake and including water clarification facilities and the other above Boston Flats, about 1.6 kilometres (1.0 mile) west of Highway 1. Each pumphouse would contain four 3580 kW (4,800 hp) pumps. Additional facilities would include clarifier and clearwell tanks at the Bonaparte Station and an equalizing tank at the Boston Flats Station.

Pipeline - The welded steel pipeline would be 800 millimetres (31.5 inches) in diameter and about 21 kilometres (13 miles) long. The pipe would be buried 2 metres (6.5 feet) below ground. Surge tanks, air and drain valves would be located as required along the pipeline.

Reservoir - A cooling water storage reservoir would be constructed in Upper Medicine Creek, a natural ravine near the powerplant. An earthfill embankment would be required to create this reservoir; a main dam 55 metres (180 feet) high by 340 metres (1,115 feet) long.

(ii) Creek Diversions

Diversion works would be required to channel Hat Creek around the pit and mining facilities.

A 16 metre (53 foot) high headworks dam south of the Open Pit would divert the flow into a 4 metre (13 foot) deep canal some 6.4 kilometres (4 mile) in length along the east side of the valley, to a buried conduit nearly 2 kilometres (1.2 miles) in length to convey the flow back to Hat Creek downstream of the pit site.

Two smaller dams near the edge of the pit would divert ground drainage water around the pit.

(iii) Ash and Mine Waste Disposal

For the preliminary design study, a scheme was adopted to discharge both bottom and fly ash in slurry form to an ash pond in upper Medicine Creek. An alternative dry ash disposal scheme, in conjuction with mine waste disposal in middle and lower Medicine Creek, has now been proposed.

Drainage canals surrounding the pond would intercept and divert runoff water. The combined dump would be progressively covered with top soil and seeded during the 35 year life of the project to produce a revegetated valley.

(iv) Project Access Road

Two alternatives are still being considered for the main road access to the project, namely: (1) use of the existing Highway 12, and (2) the construction of a new road from Highway 1 at Ashcroft Manor via Cornwall, McClaren and Medicine Creek Valleys. Common to both alternatives would be the need for a new road between the mine in Hat Creek valley and the powerplant near Harry Lake.

All new roads would be two-lane paved roads designed to 80 km/h (50 mph) Department of Highways standard.

(v) Airstrip

B. C. Hydro is considering the location and costs for an airstrip in the vicinity of Ashcroft and Cache Creek. However, no decision has been made on whether or not an airstrip would be a component of the project.

(vi) Transportation Facilities

Most equipment and supplies required for the project would be transported by rail to an unloading point located on one of the nearby main lines. Unloading facilities there would have to be capable of lifting the very heavy loads typical of such project equipment. Delivery from the railhead to the project would be by road vehicles.

(vii) Construction Camps and Housing

Should the project receive the prerequisite licences and permits to proceed, the construction work force is estimated to peak at 3,000 and subsequently the permanent mine and powerplant operating staff would reach approximately 1,200 when the mine and four generating units could be in service.

(a) Construction Camps - Two separate construction camps would be provided to house the project's single labour construction work force. One camp would be located adjacent to the powerplant and have a peak capacity of about 1800 people. Another camp with a peak capacity of about 500 people would be located on a bench above the east side of the mine in the Hat Creek Valley.

Both camps would be designed to modern standards and would obtain their water supply either from wells or Hat Creek. Sewage from the camps would receive full biological treatment and would be disposed of in accordance with the requirements of the Pollution Control Branch.

Both camps would be removed following the construction phase of the project.

(b) Permanent Housing - A separate B. C. Hydro townsite is not planned at this time.

(viii) Tourist Facilities

Visitor facilities would be provided by B. C. Hydro for the large number of visitors who would undoubtedly wish to see the project as it progresses through the various phases of construction and later to see it in operation.

7. COMMUNITY RELATIONS

From the early planning stages, B. C. Hydro has followed a policy of communicating with the public. The purpose of the Community Relations programme is to develop a dialogue with those who may be affected by, or concerned about, the potential impacts of the Hat Creek development so that issues of local and general public concern can be identified at an early stage of planning.

In this respect, since 1974, efforts have been made by B. C. Hydro to involve both the public and government departments in the planning process. Liaison has been established with (1) residents of the Hat Creek Valley, (2) local Indian Bands, (3) civic leaders of five local communities, (4) the Regional District of Thompson-Nicola, (5) environmental groups, (6) the provincial Environmental Land Use Committee Secretariat, (7) Provincial Government Regional Resource agencies, (8) certain Provincial Social Service Departments, and (9) Environment Canada. In four years over 40 information meetings have been held with government agencies, public interest groups, Indian bands, community groups and other organizations.

In addition to the above meetings, "Open House" information meetings were held in six local communities in the spring of 1977 with the purpose of providing interested members of the public with information on the proposed project.

In late 1975 the Regional District of Thompson-Nicola created special Hat Creek committees on both the elected and administrative levels. These will provide a framework by which local people can work closely with B. C. Hydro in assessing and planning for community and regional impacts in a coordinated way during the planning period.

During the summers of 1977 and 1978 a Site Information Office was opened at the junction of Highway 12 and the Hat Creek Valley road, to respond to information requests from the public.

Most concerns which have been expressed by the community are related to air quality issues and the anticipated socio-economic impacts resulting from population increases. It is intended that these concerns will be respectively addressed through proper project design, including adequate environmental safeguard measures, and through local and regional planning.

8. LAND ACQUISITION

B. C. Hydro is engaged in the acquisition and leasing of land in the Hat Creek area. The general policy and practice of Hydro's land aquisition programme is a matter of legitimate public interest and has been the subject of numerous discussions at meetings and in correspondence.

The policy and practice may be summarized as follows: -

(i) Where so requested by a land owner, Hydro will purchase property at fair market value, which:

(a) lies wholly within the Hat Creek Valley;

(b) lies within an area defined as likely to be required for a transportation purpose;

(c) is held as part of a single holding with land within (a) or (b) above and cannot be separated from it without payment of significant compensation for severance or disturbance.

(ii) The order of events in such cases is:
- request by owner;
- appraisal by B. C. Hydro;
- negotiations regarding terms of purchase;
- concluded agreement.

It should be noted that the appraisal binds neither party; it is a means of arriving at agreement on fair market value.

No account is to be taken of any depreciation in land value caused by the Project itself. For this reason, comparable sale prices are sought outside the area of influence of the prospect of the Project.

(iii) As a matter of business prudence, B. C. Hydro considers from time to time the advisability of acquiring land which is placed on the market by the owner. The criterion for decision in such cases is:

(a) whether the land is likely to be needed for project purposes should the project go ahead, and if so;

(b) whether, as a business proposition, the investment can be justified.

In such cases, B. C. Hydro makes an offer for the property either directly or through an agent, in accordance with normal business practice.

It would not be prudent for B. C. Hydro to discuss publicly the details of such acquisition, since this knowledge might be useful to speculators or competitors and might defeat the purpose of the acquisition.

(iv) Hydro leases land acquired and not likely to be required in the near future. Leases are offered in the first instance to the former owner and if not desired by him, by public advertisement or other business method. The objective is to secure proper management of the land in the interim period. Close co-operation is maintained with the Ministries of Agriculture and Forestry regarding proposed leases.

(v) So far as B. C. Hydro is concerned, all negotiations for sale and leasing are confidential to the vendor or lessee.

(vi) Hydro will seek to dispose of any land eventually found to be surplus to project requirements.

9. APPROVALS PROCESS

In working towards preparation for possible licensing of the proposed Hat Creek Project, B. C. Hydro is being guided by the procedures set out in the Guidelines for Coal Development as issued by the Provincial Government's Environment and Land Use Committee in March 1976. Although these Guidelines are specifically written for coal mining and processing, B. C. Hydro is also using them for the powerplant and off-site facilities.

B. C. Hydro is currently completing reports for the detailed assessment studies as set down by Stage II of the Guidelines. Certain reports in draft form have been presented to the Coal Guidelines Steering Committee of the Environment and Land Use Committee for circulation to the government agencies having jurisdiction over various aspects of licensing. It is expected that these agencies will review and provide comment on the draft reports.

Unlike hydroelectric projects, where B. C. Hydro has had a familiarity with the formal project application process as required by the Water Act, large-scale coal-fired powerplants have not previously been constructed in the province and the various formal approvals required are quite cumbersome.

In the case of the Hat Creek Project, the air emmission permit, mine reclamation permit and water licence represent some of the more important approvals.

In British Columbia, pollution control objectives are developed for various industries which provide for flexibility in application of the Pollution Control Act. The objectives, which are periodically

reviewed by the Pollution Control Board, are used by applicants for general guidance in preparing specific projects for permit applications. The permit issued by the Pollution Control Branch defines the specific limitations or regulations which apply to each project.

B. C. Hydro participated in the January 1978 inquiry conducted by the province's Pollution Control Board. This inquiry into the pollution control objectives for the mining, mine-milling and smelting industries included review of appropriate emission and ambient objectives for coal-fired powerplants. The final powerplant objectives to be adopted by the Board are expected to be published during 1979.

The detailed environmental studies of the project comprise more than 30 volumes of reports (approximately 8000 pages). A condensed environmental impact statement (EIS) will be authored by B. C. Hydro, to accompany licence applications, if the decision is made by B. C. Hydro to proceed with the project. This statement would include a description of the project, highlight the impacts, present a benefit-cost analysis of project component alternatives and present B. C. Hydro's plans for mitigation and compensation of impacts. The EIS document would be available to the public at the time of application for government approval.

10. ALTERNATE USES OF HAT CREEK COAL

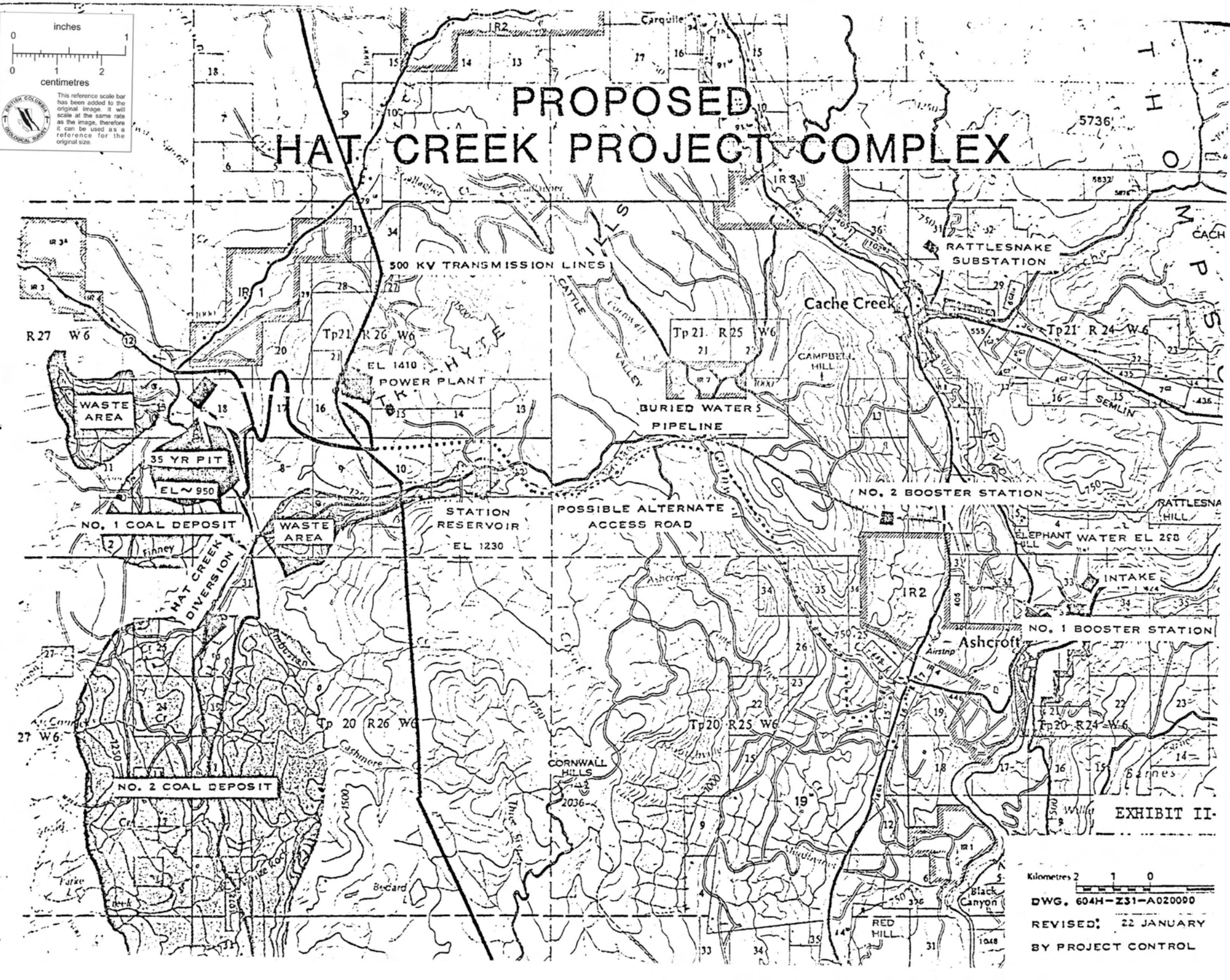
Consultants studying alternate uses for Hat Creek coal have concluded that gasification is the only potentially economically-viable alternative to electrical power generation at the present time.

A report prepared for B. C. Hydro by Stone & Webster Canada Ltd. states that while production of methanol, ammonia for nitrogenous fertilizers, and other liquid derivatives is technically feasible, poor markets rule out these alternatives for the near future. However, methanol might become an attractive alternative if it is adopted as a gasoline additive, with a vast increase in world demand, the report says.

Possible production of upgraded solid products such as coke or activated carbon is not technically feasible because of the very high inherent ash of the coal.

The report comments: "The use of Hat Creek coal for effluent treatment . . . . has recently been publicized in British Columbia and Alberta," but "the possibility of the coal finding wide use in water treatment or effluent purification is considered remote."

The consultants recommended additional studies to further refine the balance of advantages between steam-electric power production and other uses of Hat Creek coal.


inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
PROPOSED
HAT CREEK PROJECT COMPLEX
500 KV TRANSMISSION LINES
RATTLESNAKE SUBSTATION
Cache Creek
Tp21 R24 W6
Tp21 R25 W6
Tp21 R26 W6
EL 1410
POWER PLANT
CAMPBELL HILL
BURIED WATER PIPELINE
WASTE AREA
35 YR PIT
EL~950
NO. 1 COAL DEPOSIT
WASTE AREA
STATION RESERVOIR
EL 1230
POSSIBLE ALTERNATE ACCESS ROAD
NO. 2 BOOSTER STATION
ELEPHANT HILL
WATER EL 2
INTAKE
NO. 1 BOOSTER STATION
Ashcroft
HAT CREEK DIVERSION
Tp 20 R26 W6
Tp20 R25 W6
Tp20 R24 W6
CORNWALL HILLS
2036
NO. 2 COAL DEPOSIT
RED HILL
Black Canyon
Kilometres 2 1 0
DWG. 604H-Z31-A020090
REVISED: 22 JANUARY
BY PROJECT CONTROL
EXHIBIT II

Hat Creek file E. Macgregor

The Coal Association of Canada
29th Canadian Conference on Coal

Edmonton, Alberta
October 2-4, 1977

COAL RESOURCE OF THE HAT CREEK VALLEY AND PLANS FOR ITS UTILIZATION

Presentation by:

E. H. Martin, P.Eng.
General Manager for Engineering
British Columbia Hydro and Power Authority

Presentation by Mr. E. H. Martin to the
Canadian Conference on Coal in
Edmonton - October 2-4, 1977

COAL RESOURCE OF THE HAT CREEK VALLEY AND PLANS FOR ITS UTILIZATION

Introduction

B. C. Hydro supplies the majority of the electricity in British Columbia. We also distribute natural gas in the more densely populated parts of the province. Our interest in coal is as a raw material for producing electricity or substitute natural gas.

At present our electricity is provided mainly by hydro-electric generation; but hydro-electric schemes generally require more initial capital than do fossil-fired thermal power stations. We are continually reviewing the costs and advantages and disadvantages of the alternative ways of producing electrical power.

One alternative is coal. In British Columbia, we have huge reserves of coal that have scarcely been touched. Some coal is better used for metallurgical purposes. At Hat Creek, which has to be one of the thickest coal zones in the world, and probably represents the largest coal resource in such a small area, we are considering an initial development for thermal generation of electricity.

This presentation will include a brief history of the Hat Creek coal deposit and a description of the estimated extent of the deposit and its known properties. The studies that are being conducted by B. C. Hydro, or by other agencies on its behalf, are discussed. There is a review of the possible alternative uses of the coal and a word about the mining method under consideration.

Location

The Hat Creek deposit is about 190 kilometres northeast of Vancouver, about 22 kilometres west of the nearest town, Ashcroft, or 20 kilometres, west of Cache Creek on the Trans-Canada Highway. The B. C. Railway to the west and the main CPR and CNR lines to the east are about 18 and 20 kilometres away respectively.

History

Near the mouth of Hat Creek, until comparatively recently, stook a large rock. It was indented with several hat-like cavities. According to Indian legend, three giants contested their strength by pushing their heads against the rock to see which could make the deepest impression. The first two giants did not manage very well, but the third succeeded in forcing his head in up to his shoulders. The hat shapes left by the giants gave the name to the creek and hence to the coal deposit.

The interior of B. C. was given its first prominence when gold was discovered in 1858. The Cariboo Road, from Yale to the gold-fields, was built between 1861 and 1865 and passed by the rock with the hats. The first settler in the Hat Creek Valley arrived about this time, and probably observed the exposed coal seams by the creek.

In 1877 a geologist working for the Canadian Geological Survey, George Mercer Dawson, visited the valley. He reported on the coal in the Geological Survey Report of Progress for 1877-78. After a further visit, he reported again in the Annual Report of the Geological Survey for 1894.

Some development work began on the deposit in 1889. Mr. Finney, a local rancher, sank a 38 metre shaft in 1893 and sold coal locally for a short period.

The next activity began in 1923 when a Chinese syndicate started a more ambitious operation, planning to use the nearby Pacific Great Eastern Railway to ship the coal to the coast. This railway line is now the B. C. Railway. The syndicate ran out of funds before much was accomplished. The Clear Mountain Coal Company Ltd. took over and shipped three car loads of the coal, but the marketing of it in Vancouver proved a failure and the company went into bankruptcy. Early in 1925 the Hat Creek Coal Company acquired the property, drove tunnels and bored some holes. No further work was done on the deposit until 1933.

From 1933 until 1942, a few hundred tons of coal were mined each year and sold locally. This activity ceased because of World War II, and was not renewed.

In the mid-fifties, the B. C. Electric Company Limited asked its geological consultant, Dr. Victor Dolmage, if he could recommend a coal property in southern British Columbia that might be amenable to large-scale mining to support a major thermal power generating plant. Dr. Dolmage had previously examined the Hat Creek coal property for its owners, the Wilson family of Vancouver, and had noted the widespread occurrence of thick coal in a few scattered drill holes, and the structures exposed in the mine that suggest unusually thick coal layers. Accordingly, he recommended the Hat Creek property and, in 1957, it was optioned to Western Development and Power Limited, a subsidiary of B. C. Electric Company Limited. The area of the exposed portion of the Hat Creek coal deposit was explored by reconnaissance diamond drilling and trenching during 1957 and 1959. This work indicated that the deposit was of sufficient size and the coal of sufficient calorific value to be of interest as a major potential source of fuel for the generation of thermal power; therefore, the property, consisting of one coal Crown grant and two adjoining leases, was purchased by B. C. Electric.

Following expropriation of B. C. Electric by the Provincial Government, the ownership of the coal property passed to the B. C. Hydro and Power Authority and no further work was done on it until 1974 when the current program of more definitive investigation was begun.

Extent of the Deposit

The Hat Creek Valley is approximately 26 kilometres in length and 5 to 7 kilometres wide. It runs roughly north-south, rising from 850 metres above sea level at the north end to 1220 metres at the south end. Coal deposits have been traced by drilling and gravity surveying under the entire 26 kilometre length of the valley and have been estimated to be 10 to 15 billion tonnes. This has to be one of the thickest coal zones in the world and probably represents the largest coal resource in such a small area.

Exploration has been concentrated in two areas: No. 1 Deposit, the original discovery deposit at the north end of the valley; and No. 2 Deposit, about 3 kilometres south of No. 1.

No. 1 Deposit could provide coal for a 2000 MW generating station for 35 years using openpit mining with a pit no deeper than 185 metres. The No. 2 Deposit would last for 55 years using the same mining parameters.

During 1976 the No. 1 Deposit was drilled on a 153 metre grid. The distance from top to bottom of coal is over 600 metres, and the width of the deposit is about 1.6 kilometres. Through the centre of the deposit there is a fairly simple continuous structure, whereas on the fringes of the deposit there is more faulting and discontinuity. In the north the deposit lies very close to the surface, but dips to the south under an increasing layer of overburden.

Origin of the Coal

The Hat Creek coal deposit is about 40 million years old, originating in the Eocene epoch of the Tertiary period of geologic time. During this period the Rocky Mountains were formed by a compression in the earth's surface. We theorize that at Hat Creek there was tension causing a subsidence, very steady and gradual, in the floor of the valley. A wet bog condition existed over millions of years and, always slowly sinking, produced the organic material that became compressed to form coal.

The Hat Creek deposit is low grade coal with highly variable physical and chemical properties. It is ranked as Sub-bituminous B using the PARR formula, but appears to be on the border between Sub-bituminous and Lignite type A. It has a high ash content, a reasonably low sulphur content, and an average calorific value at 20% moisture of around 13,920 KJ/kg (6000 Btu/lb.).

Some average values for the "as received" coal are:

Equilibrium moisture content	22.5%
Ash content	32.5%
Volatile matter	23.8%
Fixed carbon	21.2%

It is found that 13.4% of the volume of the coal is clay; the stickiness of the clay (such as bentonite) may cause difficulties in coal handling and beneficiation.

The average sulphur content is 0.4% in the "as received" coal.

This is low grade coal, but it compares favourably with coals of even lower rank and grade that have been found economic for use in other parts of the world.

Bulk Sample Burn Test

As I have said, the characteristics of the Hat Creek coal deposits vary widely. The properties of the fuel obviously will affect the design of the boilers, precipitators and coal handling equipment. So, during the summer this year, B. C. Hydro has excavated two test trenches. About 6000 tonnes of the lowest quality of coal that would be consumed in the Hat Creek generating station were crushed, prepared, and shipped to the Battle River Power Plant of Alberta Power Limited for burn tests. One trench was about 25 metres deep x 80 m x 300 m, the other 12 metres deep x 50 m x 90 m. Results of the burn tests will be known in November 1977.

Plans

We are planning to develop an openpit mine, with a conveyor system to carry the coal to a generating station well above the valley bottom. The design would include a reservoir and cooling towers, an ash pond and waste disposal areas.

Openpit Mine

PD-NCB Consultants Limited have completed mining feasibility studies on the No. 1 and No. 2 deposits. The mining method adopted in the studies included the use of 12 cubic metre shovels and 150 tonne trucks. Mining benches would be 12 metres high and wide enough for two trucks to pass. A conservative pit slope angle of about 16 degrees was used. The pit depth was limited to about 185 metres.

Drilling and blasting would probably be minimal because most of the rock and all of the coal are soft enough to be either directly excavated by shovels or ripped by bulldozers.

The amount of overburden and waste rock that would have to be handled has been estimated assuming a project life of 35 years, thus:

Overburden	323 million tonnes
Waste Rock	782 million tonnes

Uses may be found for some of this, especially the sand and gravel. But calculations have been done on the assumption that all of the overburden and waste rock will have to be stacked near the mine. Dumps up to 90 metres high with 25° slopes are planned. It is hoped that dumps can be completed and reclaimed separately as mining proceeds so that the "live dump" area will be relatively small. Similarly, the pit area will be reclaimed when mining is complete. Vegetation will be planted on relatively flat surfaces, and the pit will either become a lake or will be filled with waste from the No. 2 Deposit if that deposit is mined.

B. C. Hydro Studies

As well as the Bulk Sample Burn Test, B. C. Hydro has been gathering information from engineering, economic, environmental and social points of view. This accumulation of knowledge will probably be the fullest compendium of information yet put together in advance of any power project in Canada.

There are three questions that these studies have to answer:

1. The need for more electrical power generation.
2. Is Hat Creek the best alternative?
3. Is electrical generation a good use of the Hat Creek resource?

The first two questions are the subject of other considerations, but the third question is relevant to this presentation.

Alternative Uses for Hat Creek Coal

B. C. Hydro has commissioned a study to identify and evaluate major uses of Hat Creek coal. Some of the preliminary conclusions are:

The potential for sale of Hat Creek coal is low due to high transportation costs (~ 1¢/t km), high ash content, and availability of better quality thermal coal elsewhere.

Combustion for process heat generation is technically and economically feasible but there is no suitable market in the area.

The production of upgraded solid products from Hat Creek coal, such as char and activated carbon, is not technically feasible because of the very high inherent ash content. The high ash content and the complete absence of coking properties also render production of metallurgical coke or formed coke technically not feasible. Again, high ash plus high oxygen content make solvent refining technically infeasible. Direct conversion of Hat Creek coal to nitrogenated and ammoniated products (fertilizers, soil conditioners, etc.) is technically impractical and economically unattractive.

High ash, moisture and oxygen content, and low tar yield make production of coal liquids from Hat Creek coal by pyrolysis and solution/hydrogenation technically impractical and economically unattractive.

The production of synthesis gas and liquid hydrocarbons from it is technically feasible and a range of products is capable of being fully marketed. The economics seem unattractive at present and depend upon the future price of naturally derived products.

Methanol from synthesis gas while technically feasible and economically acceptable faces an uncertain market situation. Currently, the annual world demand for methanol is about 8 million tonnes but any alteration in present usages, such as its use as a gasoline additive, would vastly increase world demand. On the other hand, the open market would be greatly reduced should Middle East flare gas be converted in large quantities to methanol. Thus, for methanol there is a large potential but no assured market.

The use of Hat Creek coal as a chemical feedstock for production of benzenes and phenols as major products (~400,000 tonnes/year) would encounter a most difficult market situation. Only as a by-product, (~45,000 tonnes), e.g. from an SNG plant, could these chemicals find a market.

The production of ammonia and nitrogen fertilizers while technically feasible and economically attractive, faces a very unsatisfactory world market situation in which ample capacity into the 1990's seems a certainty. Production of a million tonnes per year of ammonia, for example, from 3 million tonnes of Hat Creek coal would double current Canadian production of ammonia.

SNG could not successfully compete with natural sources on the market today but in the future the production of SNG from Hat Creek coal seems technically and economically feasible, and the market for the product and by-products seems good. The economic estimates based on a selling price of SNG of $3/GJ would allow the price of feedstock coal to be about $10/tonne, which compares favourably with the presently estimated mining cost of Hat Creek coal of about $8/tonne in 1981.

The generation of electricity using Hat Creek coal in conventional pulverized fuel boilers seems technically feasible and economically attractive. The economic analysis would allow the price of feedstock coal to be about $19/tonne. This compares favourably with the mining cost of Hat Creek coal of $8/tonne and opportunity cost of coal in SNG production of $10/tonne in 1981. It is thus evident that electricity generation from the Hat Creek coal could be economically attractive and a viable alternative to the other uses considered, including gasification.

It should be noted that the uses indicated above are not necessarily mutually exclusive and the construction of a thermal generating plant, far from excluding alternate uses, could well provide the catalyst for their development should the economic climate become favourable.

Where Are We At?

The Burn Test results are being reviewed. Our consultants' final Environmental Impact Assessment Report is nearing completion. B. C. Hydro's Board of Directors then have to make some major decisions. If they recommend going ahead with the project, the first steps will be the Licence Applications followed by Public Hearings.

The plant as presently envisaged would be a 2000 MW plant, made up of four 500 MW generating units, but remember please, this is only a proposal at present. Everything I have discussed today may come about - or maybe, like the Chinese syndicate and the Clear Mountain Coal Company, B. C. Hydro may leave no evidence of its interest in the Hat Creek coal except a few test diggings.

6 September 1977

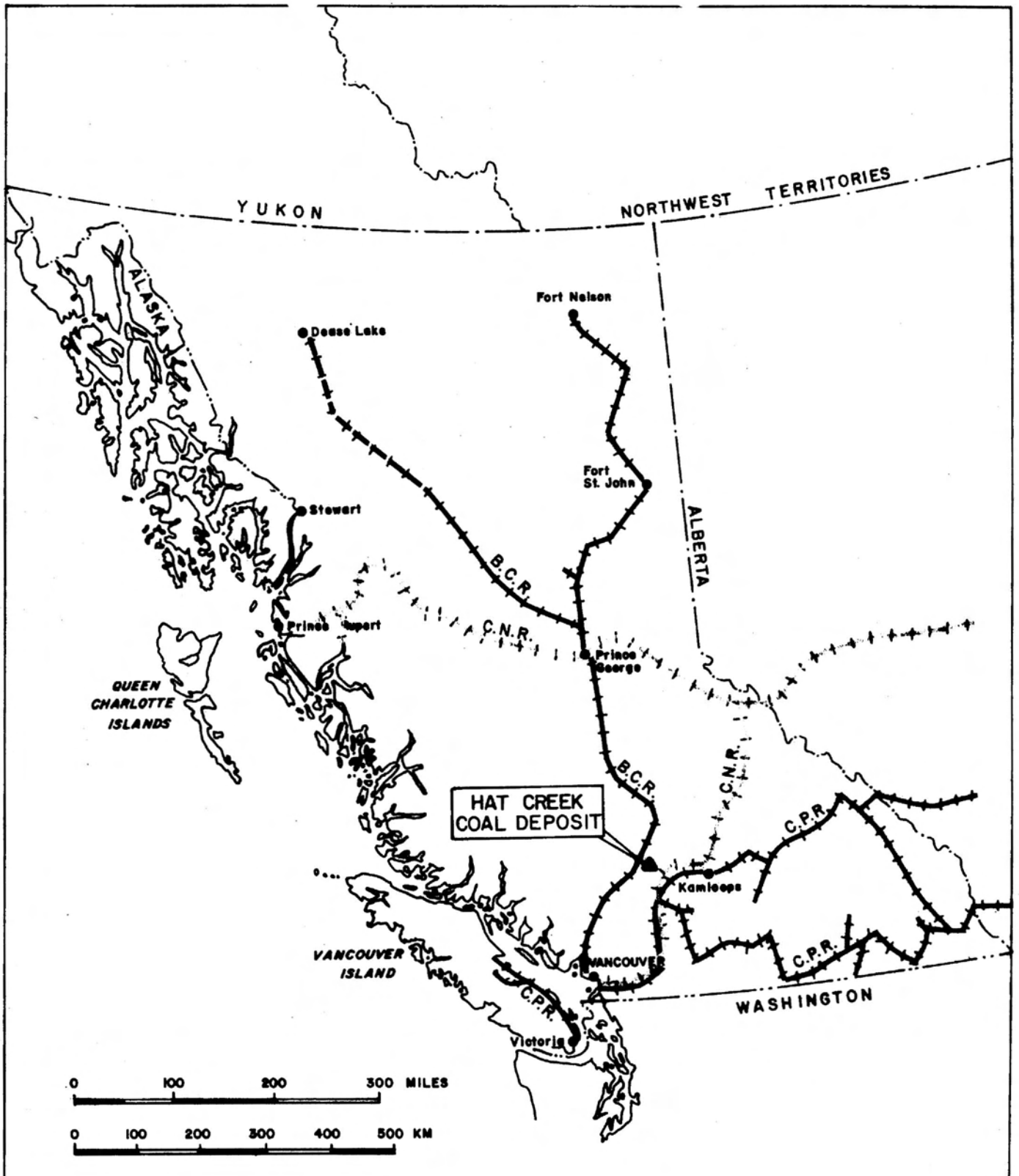
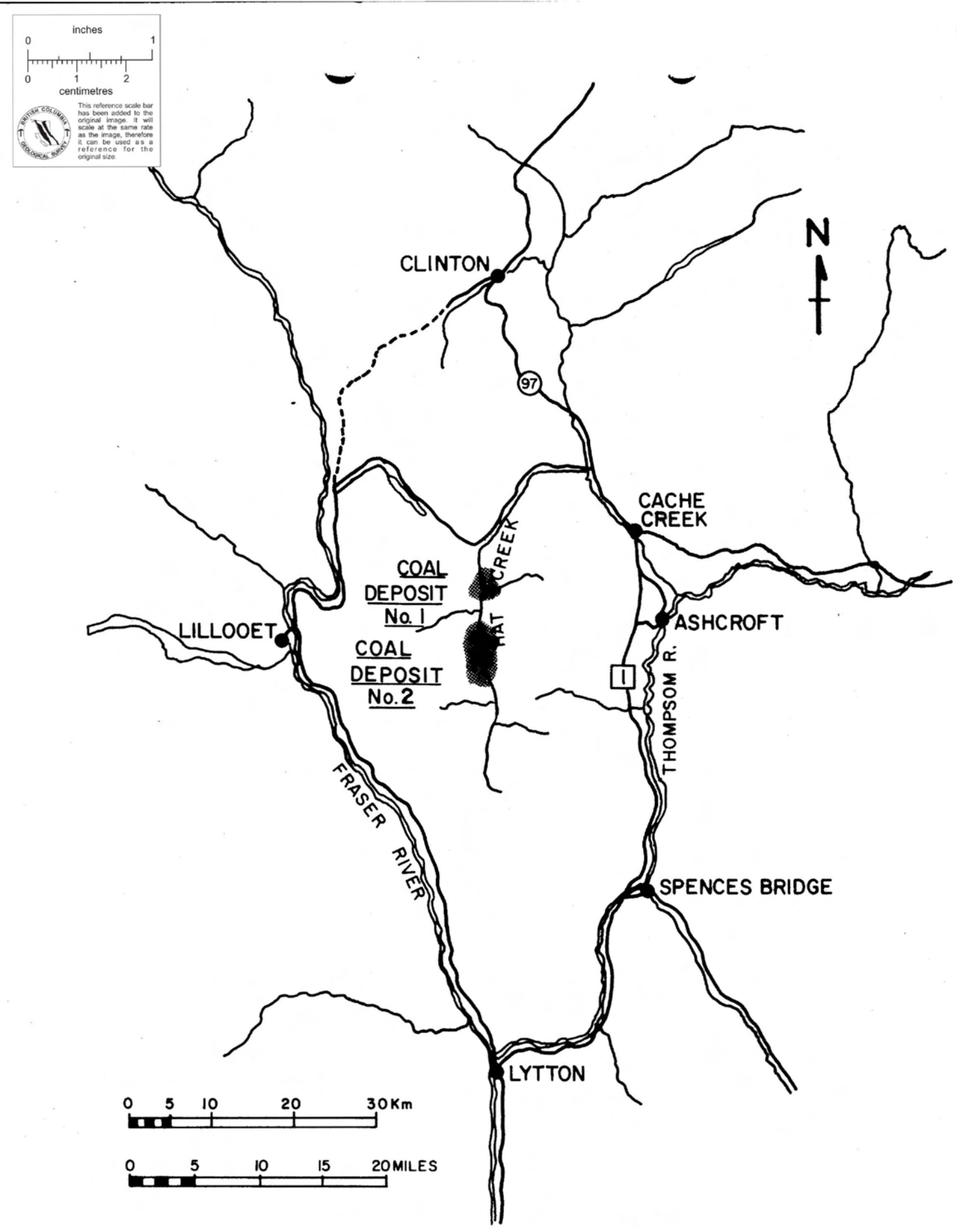


FIGURE I

LOCATION OF HAT CREEK COAL DEPOSIT



HAT CREEK VALLEY AREA

FIGURE 2

FIGURE 3

HAT CREEK COAL
No. 1 DEPOSIT
CROSS-SECTION 78,000 N

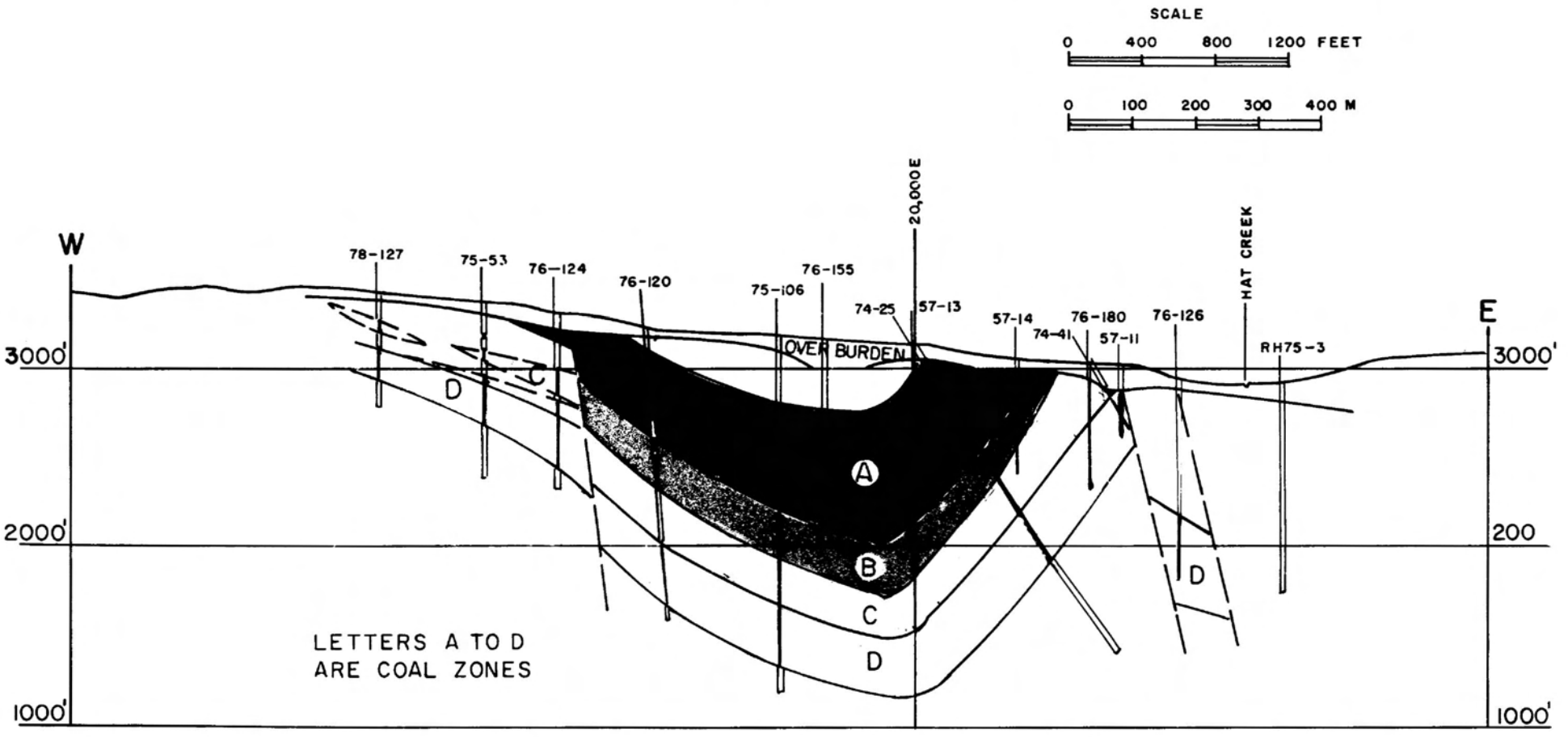


FIGURE 4

HAT CREEK COAL

No. 1 DEPOSIT

LONGITUDINAL (N-S) SECTION

19,500 E

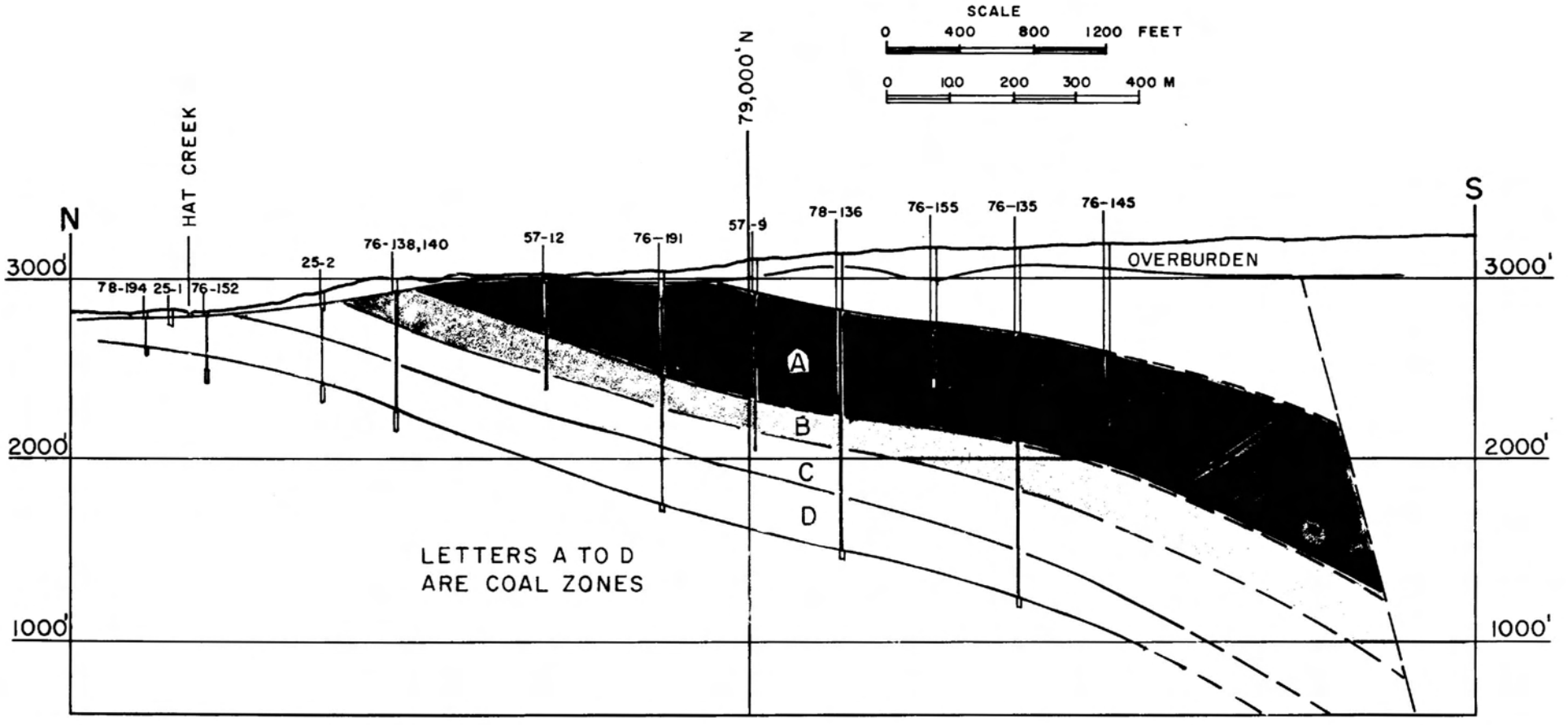
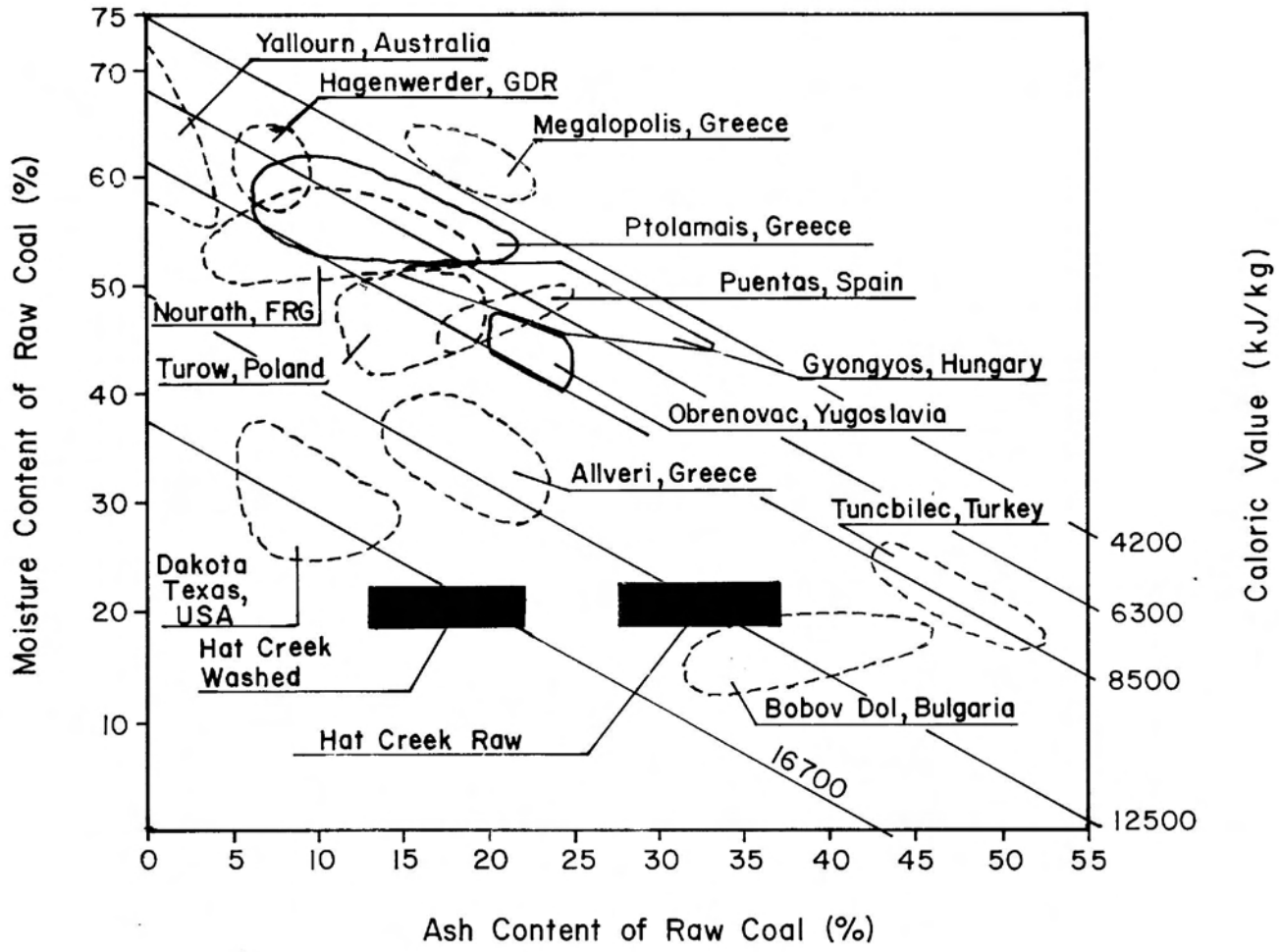


FIGURE 5

RANGE OF PROPERTIES OF LOW RANK, LOW GRADE COALS USED IN THE WORLD WITH HAT CREEK VALUES SUPERIMPOSED



QUICK FACTS

about B.C. Hydro's proposed

HAT CREEK PROJECT

Two vast coal deposits beneath Hat Creek Valley have been explored by diamond drilling, and are estimated to contain at least two billion tons of coal suitable for a commercial power plant, but not for coking to manufacture steel. The possibility of other uses is still under study.

HYDRO'S PROPOSAL is to excavate coal from the Number One deposit at the north end of the valley through an open pit mine, and to build a 2,000-megawatt coal-fired generating station three miles to the east, near Harry Lake. The quantity of coal which could be mined by the open pit method would operate such a plant for 35 years, and much coal would remain in the ground until new technology for its use was developed.

HYDRO IS TO DECIDE BY THE END OF THIS YEAR WHETHER OR NOT TO SEEK REGULATORY APPROVAL TO PROCEED WITH THE PROJECT.

MAJOR FEATURES would include:

- A large open pit mine, tapered to a depth of 600 feet after 35 years operation.
- A system of conveyor belts to carry coal to the power plant, rock and waste soil to disposal sites, and ash to other areas.
- The power plant, at a higher elevation to assist in the dispersal of stack gases, feeding electricity to Hydro's power transmission system at 500,000 volts.
- A canal to divert Hat Creek around the open pit mine.
- A cooling water storage reservoir near the power plant, supplied by a buried pipeline from a pumphouse on the Thompson River.
- Tourist and visitor facilities, during construction and after.

THE 1977 PROGRAM

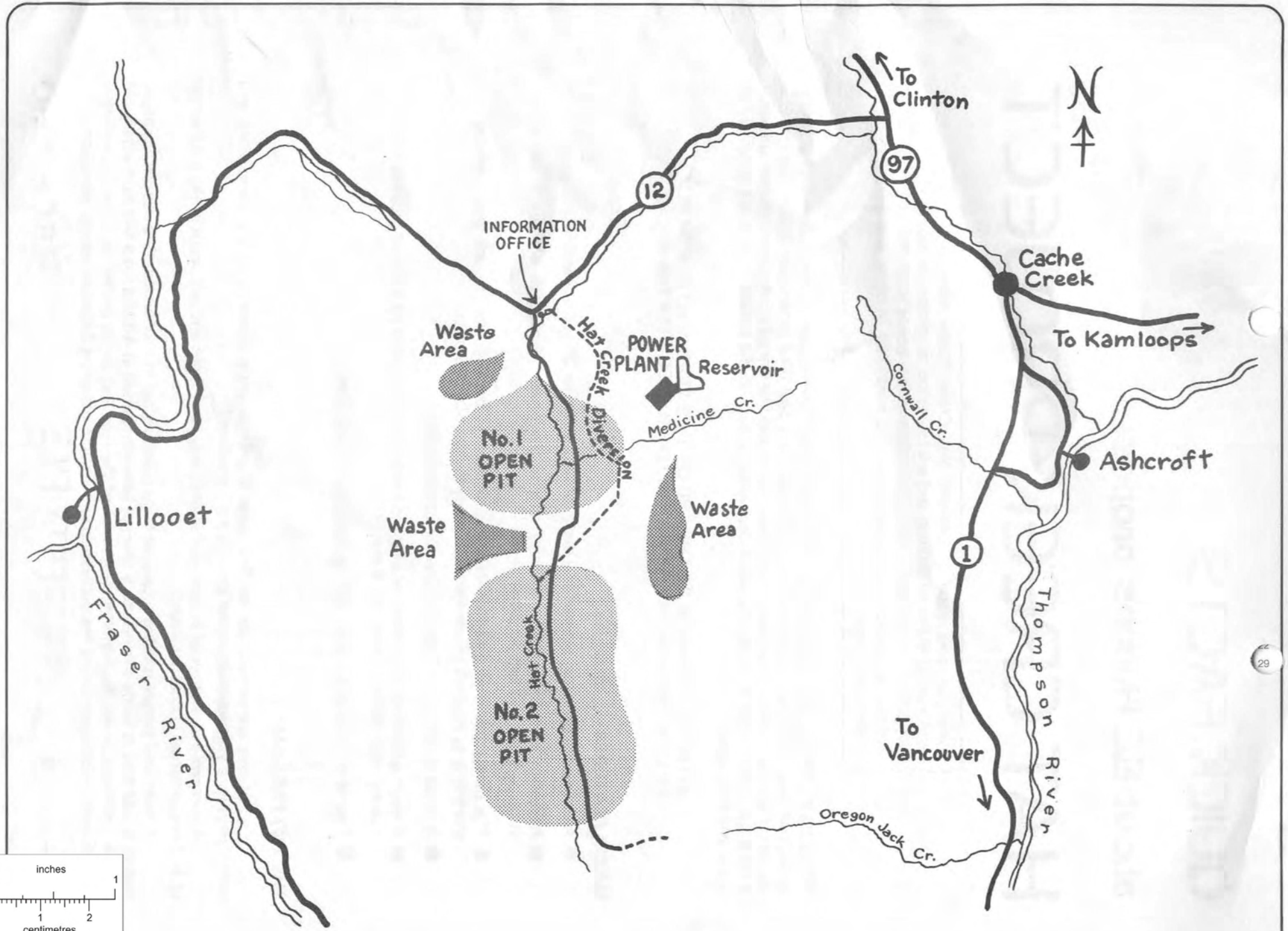
Consultants are working on the first stage of preliminary engineering of the mine, plant, and other facilities, a step necessary to assist in Hydro's decision.

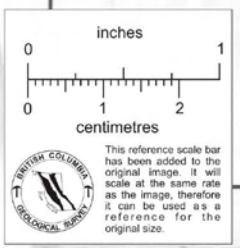
Environmental and social impact studies are being carried out and will result in the publication of an Environmental Impact Statement.

A bulk coal sample is being excavated from two trenches in the Number One deposit. Approximately 6,000 tons is being shipped to a thermal generating plant in Alberta for a test burn which will provide information on the handling properties of the coal and on its performance in a commercial plant. Experience gained during the excavation will assist in designing full-scale mining operations.

Summer, 1977

B.C. HYDRO


To Clinton
N
97
12
INFORMATION OFFICE
Cache Creek
To Kamloops
Waste Area
Hot Creek Diversion
POWER PLANT
Reservoir
Medicine Cr.
Cornwall Cr.
No. 1 OPEN PIT
Ashcroft
Lillooet
Waste Area
Waste Area
1
Fraser River
Hot Creek
No. 2 OPEN PIT
Thompson River
To Vancouver
Oregon Jack Cr.


inches
0
1
0
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
BRITISH COLUMBIA GEOLOGICAL SURVEY

PRELIMINARY GEOLOGICAL INTERPRETATION

OF THE HAT CREEK COAL BASIN

INTRODUCTION

This report is intended as a brief informal outline of the Hat Creek coal basin preliminary to a more detailed report to be published in G.E.M. 1975. The descriptions and interpretations offered are based on direct field observations by the writer during the period June 17th to July 20th, 1975, and information supplied in older reports by the Geological Survey of Canada, and B.C. Hydro.

PHYSIOGRAPHY AND ENVIRONS

The valley formed by the upper reaches of Hat Creek, site of the coal deposits, is a northerly-trending topographic and structural depression 14 miles long and 2 to 3 miles wide. This is an open basin bounded by the rugged Clear Range on the west and Cornwall Hills on the east. Relative relief is marked with slopes rising from Hat Creek, near Marble Canyon at the north end of the valley, elevation approximately 2,700 feet, to the encircling ridges and peaks with elevations in excess of 6,500 feet.

The area forms part of the Interior Dry Belt with annual precipitation usually less than 13 inches, combined rain and snow. Temperatures have been recorded in excess of 100 degrees Fahrenheit for brief periods during mid-summer.

Low areas on the valley floor and south-facing slopes at higher elevations are extensive grass covered forming ideal cattle country. Summit areas and north-facing slopes have forests of pine

and fir of sufficient quality and density to support logging operations.

The numerous small lakes and ponds in the area, while picturesque, are usually stagnant and not considered drinkable. Tourists enroute to the nearby Pavilion Lake - Marble Canyon recreation area are not advised to drink from Hat Creek because of a high coliform count in this water (no doubt owing to the large resident cattle population).

Wildlife is abundant. Grouse, deer, and yellow bears are commonly seen, although hunters and sportsmen are not generally welcomed by local ranchers.

GLACIAL HISTORY

It is evident that the valley was overridden by at least two and possibly several Pleistocene ice sheets. The most recent advance originated in the Coast Mountains and moved easterly at 117 degrees, according to striae measurements, depositing much gravel and clay. Except for the coal beds now exposed at the north end of the valley, bedrock is rarely seen on the valley floor. Reconnaissance drilling shows that the average till cover is 170 feet thick.

The soils of Hat Creek valley are characteristically clay-rich. In many areas these clays have unusual swelling properties when water saturated suggesting the presence of bentonite - a type of clay formed by the decomposition of volcanic ash. Indeed in several places bands of volcanic ash are clearly visible intercalated in the glacial deposits.

The consequence of this clay-rich mantle is evident in the area immediately north of the proposed No. 1 pit, where two large active landslides have been identified. A second active landslide area is located farther south in the vicinity of White Rock Creek.

The bright yellow and reddish soils, conspicuous at several points in the valley, are residual and not glacial in origin. These are often found near coal seams and appear to be the cindery residue of burnt coal. There is evidence that much, if not all, of the exposed coal in the Hat Creek valley has been superficially burnt in prehistorical times.

GENERAL GEOLOGY

The general geology of the Hat Creek area is shown on the accompanying map.

Cover rocks of Tertiary and Cretaceous age, consisting of coal, and sedimentary and volcanic formations, rest with marked unconformity on a Paleozoic basement of metamorphosed carbonate and greenstone beds.

The soft, easily eroded coal and shaly formations are mostly on the floor of the valley whereas the resistant volcanic rocks and basement formations are found on the valley slopes and ridge crests.

Although extensive glacial deposits have hampered geological investigation to date, much stratigraphic information has been provided from drilling the "cover rocks". The most important relations revealed by this work shows that the coal is almost everywhere overlain

by a thick claystone sequence which in turn is overlain unconformably by a variety of volcanic rocks including lahars, and dacite, basalt, rhyolite, and trachyte lavas.

Owing to the great thickness of the claystone and coal, often in excess of 2,500' feet, few drill holes have penetrated below the main coal horizon. A thick succession of intermixed sandstones, conglomerates, and shales, found lateral to the coal formation, are thought to underlie the coal. In any case, andesitic volcanic rocks of the Kamloops Group (Eocene) and Spences Bridge Group (Cretaceous), exposed peripherally in the valley, most certainly form the base of the "cover rock" succession.

STRUCTURE

The general structure of the Hat Creek basin is simple. The central zone of the valley, underlain mainly by coal and sedimentary formations, has been down dropped forming a graben. Apparently this has been achieved principally by downward movement on a series of north-south tension faults trending subparallel to the direction of regional maximum stress. Locally the walls of the graben have been off-set somewhat by a series of northwest and northeast-striking conjugate shear faults. An important system of easterly-trending gravity faults cutting across the basin is evidently of recent origin being superimposed on the main graben structures.

COAL RESERVES

No. 1 Pit

The proposed No. 1 open pit is adjacent to the original dsicovery on Hat Creek near the north end of the valley. Here the main near-surface coal reserve covers approximately 290 acres. The area has been thoroughly drilled yielding intersections of coal formation ranging from several hundred to over one thousand feet. The geological insitu measured reserves of 500 million tons (to 2,000 feet above sea level) of coal are not expected to change by more than 20 per cent with further drilling. Indicated reserves of additional 130 million tons are calculated and these or a part thereof should move into the measured category with the drilling currently taking place.

Determining the actual economically recoverable reserves requires considerably more drilling than has been done to date. Designing a mining plan calls for detailed knowledge of the geometry of the deposit, location and planar orientation of all major faults, competency of the rocks in the pit walls, and variations in coal quality. Thus it is still not possible to calculate economically recoverable reserves of coal from the deposit. If the deposit can only be mined to 2,500 feet above sea level, calculations based on data from 21 holes gives reserves of only 200 million tons. Drilling for coal deeper than the 2,000-foot level is not likely as further pursuit of the coal formation in this area is made difficult by the displacement of beds by major faults and the down dip burial of coal under the claystone formations.

No. 2 and No. 3 Pits

A second major near-surface coal occurrence was recently discovered to the south near the mid point in the valley. This is a sinuous 12,000-foot long band of coal paralleling the axis of a large negative gravity anomaly. Initial drilling has indicated a thickness of about 1,700 feet of coal, the beds dipping 20 to 30 degrees passing

westerly under the claystone formation. The band has been cut and displaced near the centre point by a fault.

This deposit is now being divided into north and south areas as the proximity of a large ridge on the east side would likely necessitate the development of two separate pits. These areas are shown on the accompanying map. The drilling to date has been chiefly exploratory and hence only indicated and inferred resources of 500 million tons each have been assigned to the deposit. At least another 50 to 75 holes will be necessary to delimit the reserves to a measured status. Potential within the bounds of presently known geology exists for development of reserves beyond that already in the indicated and inferred categories.

Other Areas

The major economic deposits of coal within the Hat Creek basin appear to have been discovered. The ultimate coal potential of the basin is well delineated by the negative gravity contours. However, coal outside the above noted pit areas appears to be deeply buried. The testing of these areas may not be of great importance at the present time.

The accompanying map shows the position of diamond-drill holes to July 20 - Nos. 75 - 77. The positions of recently completed holes, Nos. 75 - 78 to 75 - 106 have not been recorded and the core not yet examined. Much of this new drilling has been in the vicinity of No. 2 deposit.

Footnote

The number of drill holes required to prove specific deposits can be determined using Stein's equation (see attached reprint). For example, 21 holes assigned to the No. 1 deposit proved more than adequate at the 95-per-cent confidence level in establishing an average thickness of 338 feet of coal to the 2,500-foot elevation level. The calculations suggest that one hole to every 15 or 20 acres is sufficient.

November 14, 1975

B. N. Church

R. Gilchrist

ESTIMATED RESERVES OF No. 1 PIT AREA

(ABOVE THE 2,500 FT. ELEVATION)

Hole No.	Cover Thickness (ft.)	Coal Formation Thickness (ft.)
25 - 2	0	350
25 - 4	25	330
25 - 5	10	300
57 - 8	60	450
57 - 9	130	450
57 - 10	175	350
57 - 11	150	250
57 - 12	100	450
57 - 13	110	500
57 - 14	100	490
57 - 15	380	175
59 - 16	20	350
59 - 18	50	425
59 - 20	50	300
74 - 26	50	310
74 - 39	50	300
74 - 43	200	280
74 - 46	400	310
74 - 48	480	200
74 - 50	76	325
74 - 53	400	200
	3,196	7,095
Averages	152	338

Reserve Area..... 12,500,000 ft.^{2} (287 acres)

Volume of Coal Formation ..... 4,225,000,000 ft.^{3}

Reserve in tons of coal formation ..... 205, 546,000 tons

(Assumed specific gravity of coal - 1.56)

APPENDIX

PLATE 1 ORIGINAL COAL DISCOVERY LOCALITY ON HAT CREEK, NORTH END OF THE VALLEY (No. 1 RESERVE)

PLATE 2 PLEISTOCENE GRAVEL BEDS OVERLYING NO. 1 COAL RESERVE

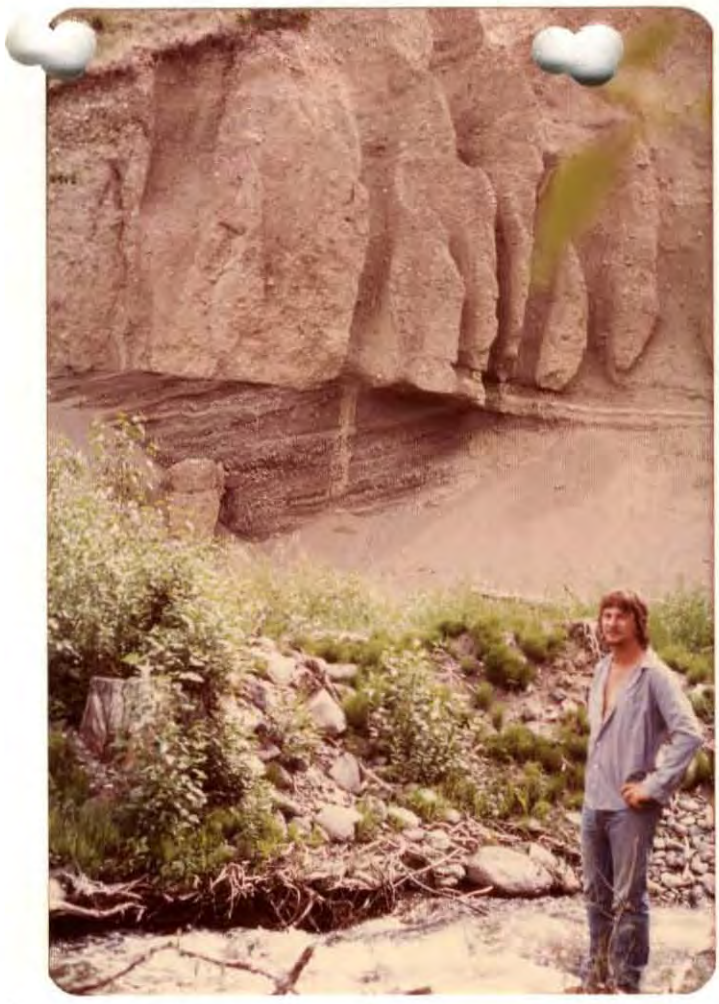


PLATE 3 TILL RESTING UNCONFORMABLY ON GLACIOFLUVIAL GRAVEL

PLATE 4 OVERGRAZING = GULLY EROSION ? (NOTE SEAM OF WHITE VOLCANIC ASH IN ERODED TILL)

PLATE 5 LAHAR IN VOLCANIC FORMATION ABOVE COAL

PLATE 6 D.W. COATES ENTERPRISE LTD. DRILL EQUIPMENT AT SITE NEAR SOUTH END OF VALLEY

PLATE 7 PANORAMA LOOKING NORTHEAST AT NORTH END OF NEW COAL ZONE (No. 2 RESERVE - LEFT EDGE OF PHOTO)

PLATE 8 SOUTH END OF NEW COAL ZONE BELOW WHITE ROCK BLUFF, TOP CENTRE, VIEW LOOKING EASTERLY ACROSS HAT CREEK VALLEY

PLATE 9 A TYPICAL UPLAND MEADOW WITH ABUNDANT PURPLE LARKSPUR (DELPHINIUM) - CONSIDERED VERY POISONOUS TO GRAZING STOCK

PLATE 10 SCENIC SOLITARY TIMBER HAS LITTLE COMMERCIAL VALUE BECAUSE OF WIND SPLITS AND PITCH SATURATION.

MEMORANDUM FROM A. Sutherland Brown

H. Horn,
Associate Deputy Minister,
Chairman of the Coal Task Force.

THE DEPARTMENT OF
MINES AND PETROLEUM RESOURCES
PARLIAMENT BUILDINGS, VICTORIA, BRITISH COLUMBIA V8V 1X4

DATE Nov. 14/75
File - C-5a

RE: PRELIMINARY GEOLOGICAL INTERPRETATION OF THE HAT CREEK COAL BASIN.

Herewith the first part of the preliminary geological interpretation of the Hat Creek coal basin by Dr. B.N. Church, including geological map. The second part by Gilchrist to follow later this afternoon.

A. SUTHERLAND BROWN,
Chief Geologist, Geological Division,
Mineral Resources Branch.

ASB/jr

Encl: Report

PROPERTY FILE

PRELIMINARY GEOLOGICAL INTERPRETATION

OF THE HAT CREEK COAL BASIN

INTRODUCTION

This report is intended as a brief informal outline of the Hat Creek coal basin preliminary to a more detailed report to be published in G.E.M. 1975. The descriptions and interpretations offered are based on direct field observations by the writer during the period June 17th to July 20th, 1975, and information supplied in older reports by the Geological Survey of Canada, and B.C. Hydro.

PHYSIOGRAPHY AND ENVIRONS

The valley formed by the upper reaches of Hat Creek, site of the coal deposits, is a northerly-trending topographic and structural depression 14 miles long and 2 to 3 miles wide. This is an open basin bounded by the rugged Clear Range on the west and Cornwall Hills on the east. Relative relief is marked with slopes rising from Hat Creek, near Marble Canyon at the north end of the valley, elevation approximately 2,700 feet, to the encircling ridges and peaks with elevations in excess of 6,500 feet.

The area forms part of the Interior Dry Belt with annual precipitation usually less than 13 inches, combined rain and snow. Temperatures have been recorded in excess of 100 degrees Fahrenheit for brief periods during mid-summer.

Low areas on the valley floor and south-facing slopes at higher elevations are extensive grass covered forming ideal cattle country. Summit areas and north-facing slopes have forests of pine

and fir of sufficient quality and density to support logging operations.

The numerous small lakes and ponds in the area, while picturesque, are usually stagnant and not considered drinkable. Tourists enroute to the nearby Pavilion Lake - Marble Canyon recreation area are not advised to drink from Hat Creek because of a high coliform count in this water (no doubt owing to the large resident cattle population).

Wildlife is abundant. Grouse, deer, and yellow bears are commonly seen, although hunters and sportsmen are not generally welcomed by local ranchers.

GLACIAL HISTORY

It is evident that the valley was overridden by at least two and possibly several Pleistocene ice sheets. The most recent advance originated in the Coast Mountains and moved easterly at 117 degrees, according to striae measurements, depositing much gravel and clay. Except for the coal beds now exposed at the north end of the valley, bedrock is rarely seen on the valley floor. Reconnaissance drilling shows that the average till cover is 170 feet thick.

The soils of Hat Creek valley are characteristically clay-rich. In many areas they clays have unusual swelling properties when water saturated suggesting the presence of bentonite - a type of clay formed by the decomposition of volcanic ash. Indeed in several places bands of volcanic ash are clearly visible intercalated in the glacial deposits.

The consequence of this clay-rich mantle is evident in the area immediately north of the proposed No. 1 pit, where two large active landslides have been identified. A second active landslide area is located farther south in the vicinity of White Rock Creek.

The bright yellow and reddish soils, conspicuous at several points in the valley, are residual and not glacial in origin. These are often found near coal seams and appear to be the cindery residue of burnt coal. There is evidence that much, if not all, of the exposed coal in the Hat Creek valley has been superficially burnt in prehistorical times.

GENERAL GEOLOGY

The general geology of the Hat Creek area is shown on the accompanying map.

Cover rocks of Tertiary and Cretaceous age, consisting of coal, and sedimentary and volcanic formations, rest with marked unconformity on a Paleozoic basement of memamorphosed carbonate and greenstone beds.

The soft, easily eroded coal and shaly formations are mostly on the floor of the valley whereas the resistant volcanic rocks and basement formations are found on the valley slopes and ridge crests.

Although extensive glacial deposits have hampered geological investigation to date, much stratigraphic information has been provided from drilling the "cover rocks". The most important relations revealed by this work shows that the coal is almost everywhere overlain

by a thick claystone sequence which in turn is overlain unconformably by a variety of volcanic rocks including lahars, and dacite, basalt, rhyolite, and trachyte lavas.

Owing to the great thickness of the claystone and coal, often in excess of 2,500 feet, few drill holes have penetrated below the main coal horizon. A thick succession of intermixed sandstones, conglomerates, and shales, found lateral to the coal formation, are thought to underlie the coal. In any case, andesitic volcanic rocks of the Kamloops Group (Eocene) and Spences Bridge Group (Cretaceous), exposed peripherally in the valley, most certainly form the base of the "cover rock" succession.

STRUCTURE

The general structure of the Hat Creek basin is simple. The central zone of the valley, underlain mainly by coal and sedimentary formations, has been down dropped forming a graben. Apparently this has been achieved principally by downward movement on a series of north-south tension faults trending subparallel to the direction of regional maximum stress. Locally the walls of the graben have been off-set somewhat by a series of northwest and northeast-striking conjugate shear faults. An important system of easterly-trending gravity faults cutting across the basin is evidently of recent origin being superimposed on the main graben structures.

COAL RESERVES

No. 1 Reserve

The proposed No. 1 open pit is adjacent to the original discovery on Hat Creek near the north end of the valley. Here the main near surface coal reserve covers approximately 290 acres. The area has been thoroughly drilled yielding intersections of coal formation ranging from several hundred to over one thousand feet. Calculations based on data obtained from 21 holes indicates slightly more than 200 million tons determined to base elevation of 2,500 feet (calculations attached). Additional calculations, on fewer drill penetrations, suggest that about twice this tonnage can be realized by extending mining downward to base elevation of 2,000 feet.

Further pursuit of the coal formation in this area is made difficult by the displacement of beds by major faults and the down dip burial of coal under the claystone formations.

No. 2 Reserve

A second major near surface coal occurrence was recently discovered to the south near the mid point in the valley. This is a sinuous 12,000-foot long band of coal paralleling the axis of a large negative gravity anomaly. Initial drilling has indicated a thickness of about 1,700 feet of coal, the beds dipping 20 to 30 degrees passing westerly under the claystone formation. The band has been cut and displaced near the centre point by a fault.

The calculation of tonnage in this deposit awaits further drill results to establish the breadth of the zone. There seems to be general consensus, however, that the volume of coal here well surpasses the No. 1 deposit. The quality also appears to be superior with only 15 to 25 per cent clay admixture.

OTHER POTENTIAL

The ultimate coal potential of Hat Creek basin is well delineated by the negative gravity contours. Unfortunately much of the coal is surely deeply buried.

The accompanying map shows the position of diamond drill holes to July 20 - No. 75 - 77. The positions of recently completed holes, No's. 75 - 78 to 75 - 106 have not been recorded and the core not yet examined. Much of this new drilling has been in the vicinity of No. 2 deposit.

Many additional holes are required to complete the testing of the gravity anomaly zone.

Footnote

The number of drill holes required to prove specific deposits can be determined using Stein's equation (see attached reprint). For example, 21 holes assigned to the No. 1 deposit proved more than adequate at the 95 per cent confidence level in establishing an average thickness of 338 feet of coal to the 2,500-foot elevation level. The calculations suggest that one hole to every 15 or 20 acres is sufficient.

November 14th, 1975 B. N. CHURCH

ESTIMATED RESERVES OF No. 1 PIT AREA

(ABOVE THE 2,500 FT. ELEVATION)

Hole No.	Cover Thickness (ft.)	Coal Formation Thickness (ft.)
25 - 2	0	350
25 - 4	25	330
25 - 5	10	300
57 - 8	60	450
57 - 9	130	450
57 - 10	175	350
57 - 11	150	250
57 - 12	100	450
57 - 13	110	500
57 - 14	100	490
57 - 15	380	175
59 - 16	20	350
59 - 18	50	425
59 - 20	50	300
74 - 26	50	310
74 - 39	50	300
74 - 43	200	280
74 - 46	400	310
74 - 48	480	200
74 - 50	76	325
74 - 53	400	200
	3,196	7,095
Averages	152	338

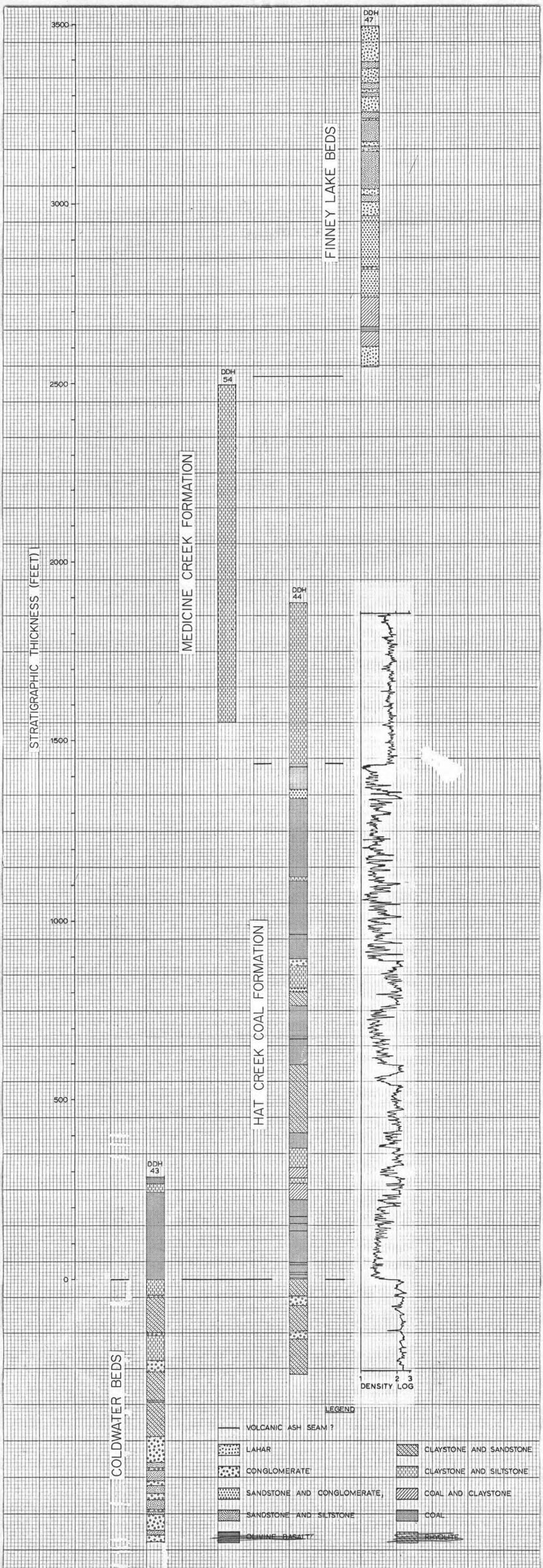
Reserve Area..... 12,500,000 ft.^{2} (287 acres)

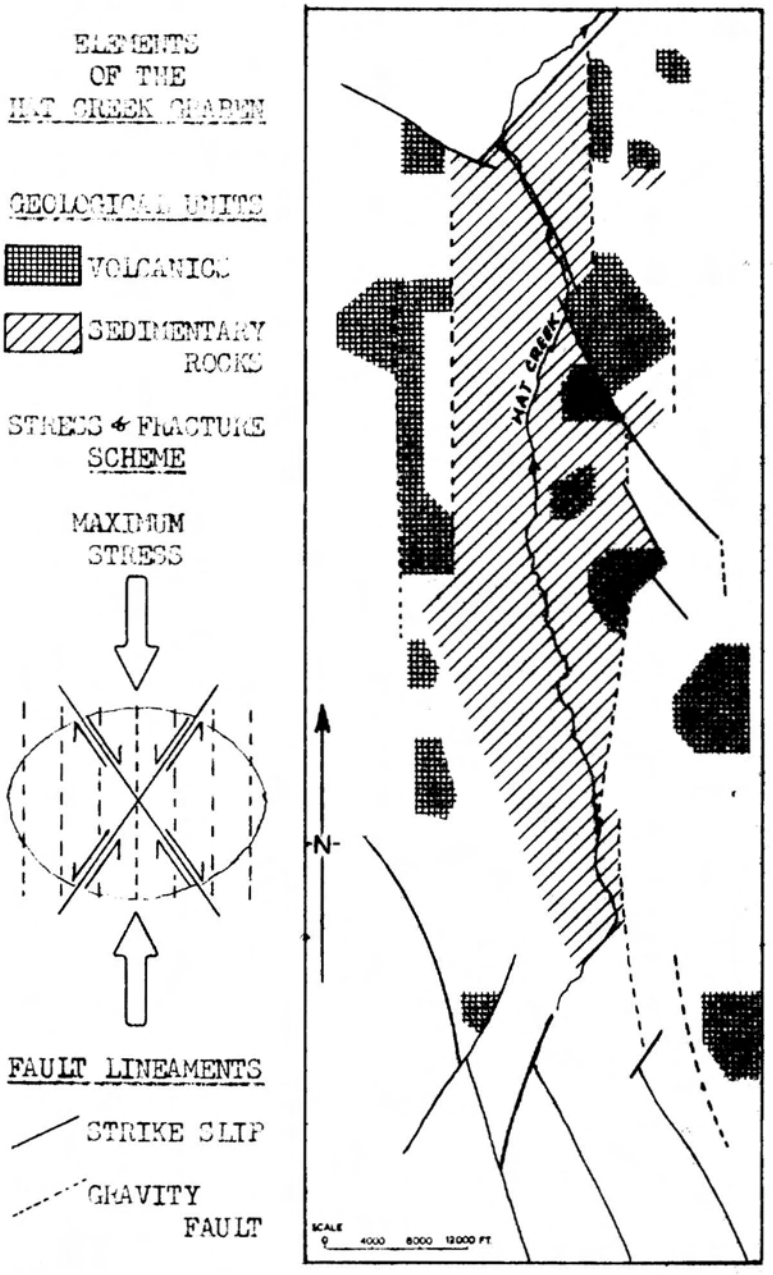
Volume of Coal Formation ..... 4,225,000,000 ft.^{3}

Reserve in tons of coal formation ..... 205, 546,000 tons

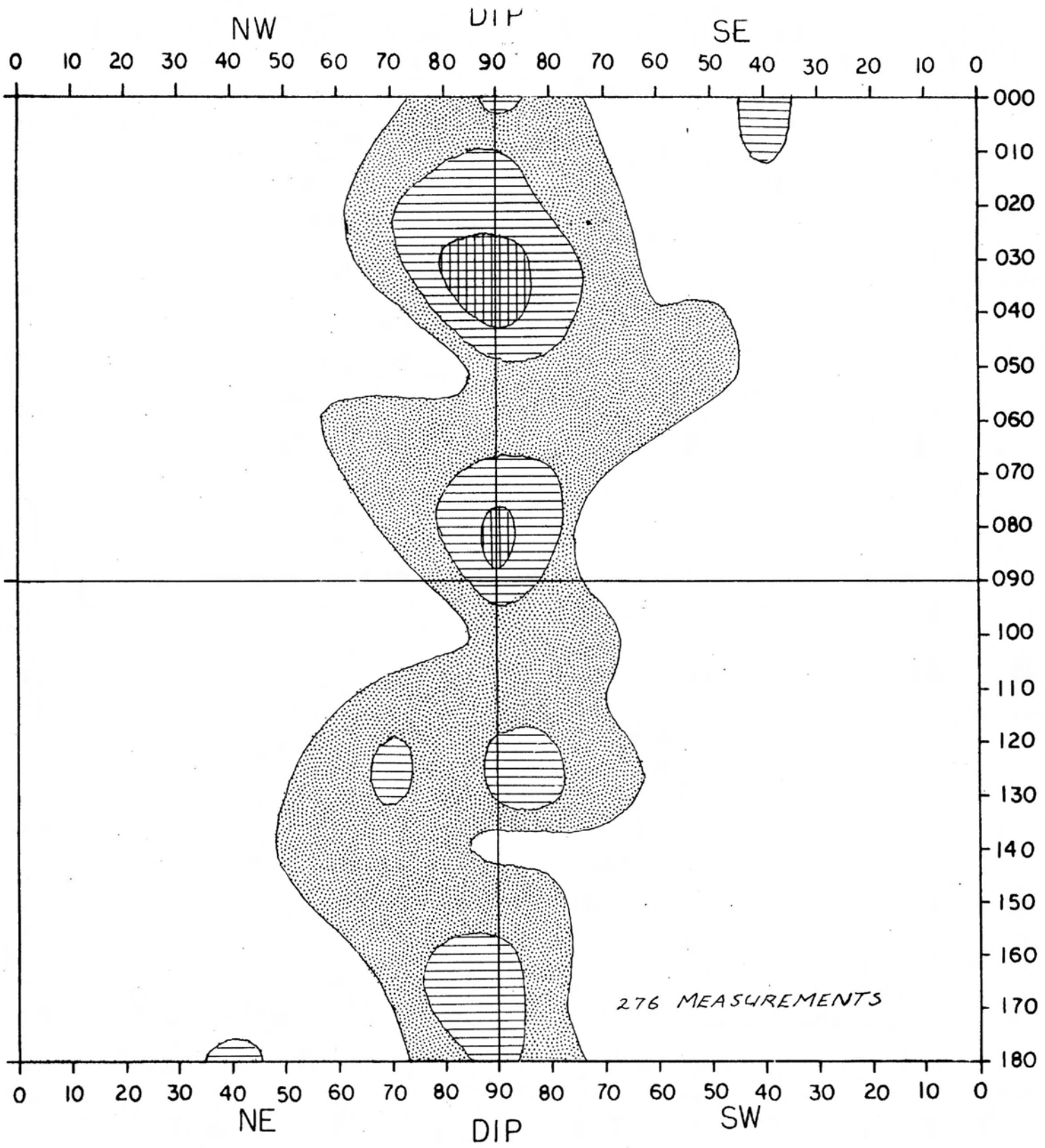
(Assumed specific gravity of coal - 1.56)

CHURCH 2 Drill Section of the Hat Creek Coal Measures and Accompanying Strata





CHURCH Fig 3 Possible Stress Scheme Relating Faulting to Graben Development in the Hat Creek Area



Fracture Frequency Plot for the Hat Creek Area

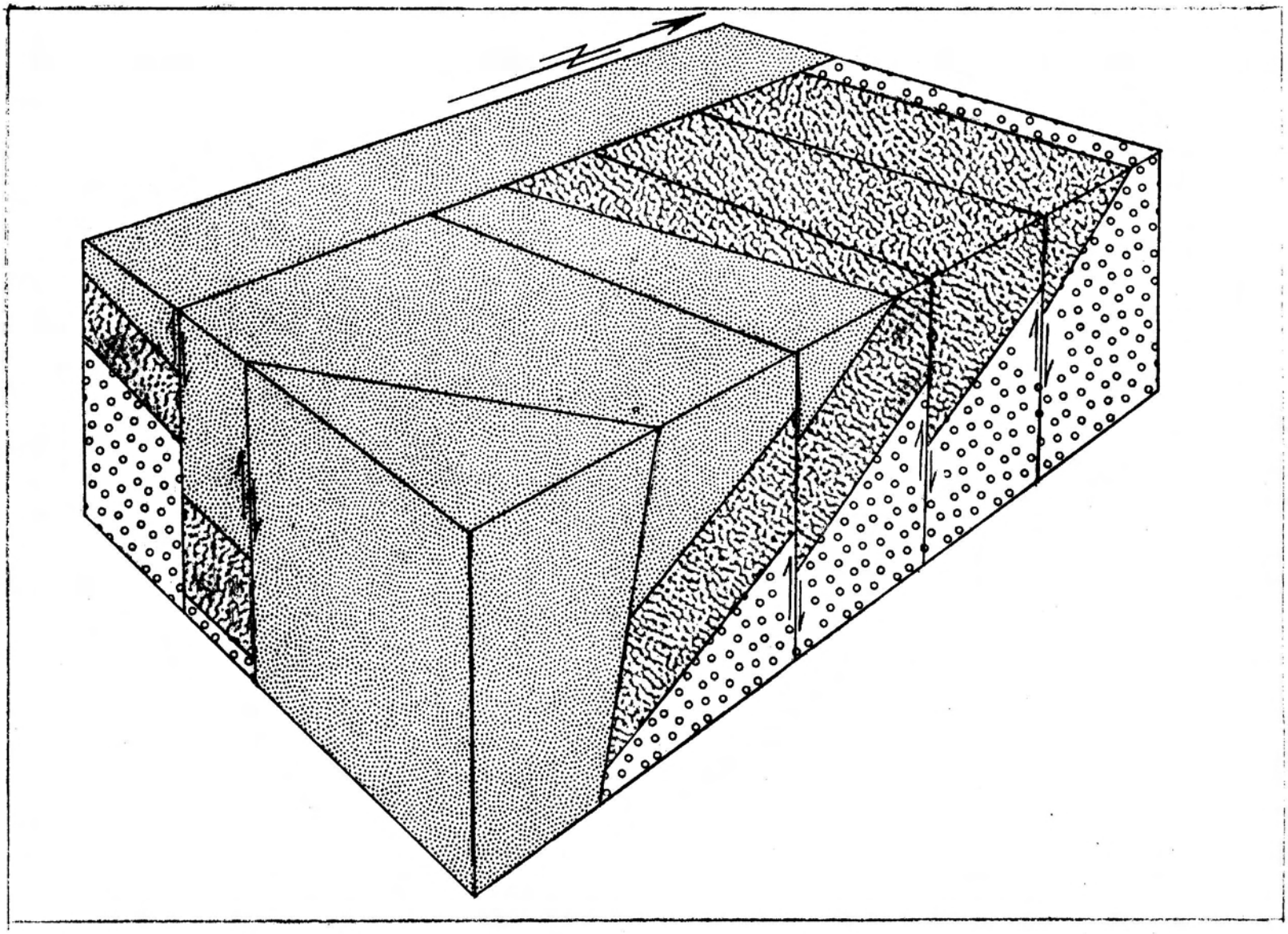
FIGURE 4

FRACTURE FREQUENCY

VERY FREQUENT

LESS FREQUENT

INFREQUENT

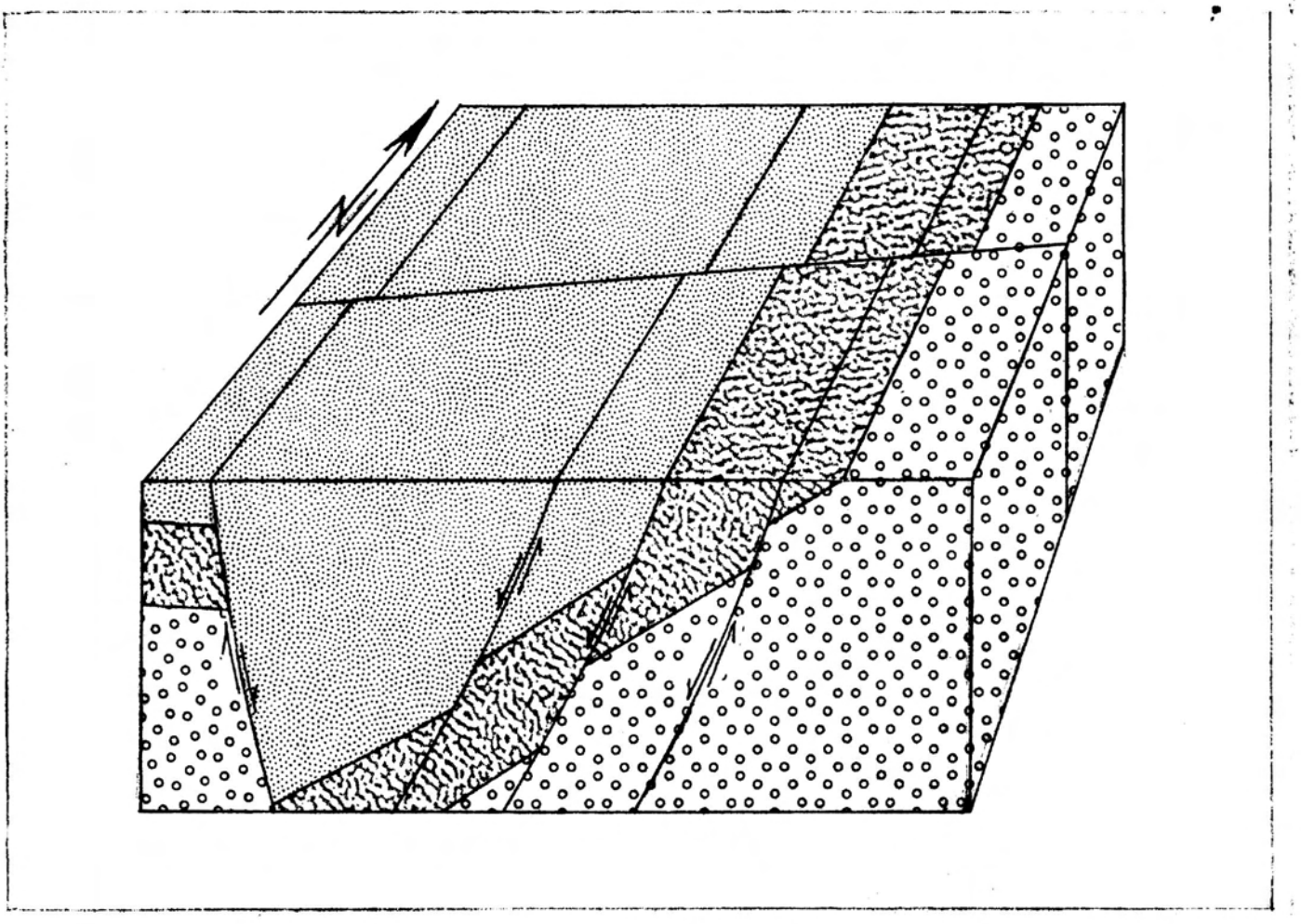


MEDICINE CREEK FORMATION

HAT CREEK COAL FORMATION

COLDWATER BEDS

CHURCH 5A Structural Model of No. 1 Coal Reserve



MEDICINE CREEK FORMATION

HAT CREEK COAL FORMATION

COLDWATER BEDS

CHURCH 5B Structural Model of No. 2 Coal Reserve

Oxides Recalculated to 100:-												
SiO_2	57·07	57·92	55·97	76·07	66·14	51·16	67·96	57·74	75·58	75·41	50·66	46·98
TiO_2	0.19	0·98	0·86	0·69	0·59	1·29	0·54	1·01	0·04	0·06	1·58	0·86
Al_2O_3	37·14	34·42	29·67	14·60	17·13	20·35	16·55	18·59	14·34	14·31	14·88	25·86
Fe_2O_3	0·37	2·45	7·62	2·00	3·29	5·02	2·73	4·12	0·33	0·38	1·44	14·06
FeO	0·67	0·11		2·80	0·79	4·04	0·55	2·57	0·34	0·28	0·26	0·36
MnO	—	0·02	—	0·12	0·07	0·19	0·01	0·09	0·04	0·04	0·16	0·19
MgO	1·36	0·89	1·44	0·94	1·38	3·74	0·49	3·10	0·52	0·14	0·84	1·97
CaO	2·21	1·04	2·74	0·83	4·09	9·72	3·08	6·09	1·05	1·05	8·33	8·70
Na_2O	0·62	0·84	1·15	0·93	4·65	3·72	4·60	4·55	3·34	4·19	2·95	0·50
K_2O	0·37	1·33	0·55	1·02	1·87	0·77	3·49	2·14	4·42	4·14	0·90	0·52
	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	00·00	100·00
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Oxides as Determined:-												
$+H_2O$	9·60	0·00	—	4·43	0·68	0·69	0·50	0·30	0·74	0·36	0·48	0·50
$-H_2O$	6·15	8·60	—	5·48	1·16	1·42	0·71	0·59	2·01	0·27	0·34	0·29
CO_2	5·44	0·07	—	3·61	0·16	0·30	0·16	0·14	0·07	0·30	0·16	0·30
P_2O_5	4·99	0·55	0·24	0·34	0·32	0·53	0·25	0·30	0·15	0·18	0·37	0·39
S	0·04	0·04	0·75	0·08	0·02	0·01	0·01	0·01	0·02	0·02	0·01	0·02
SrO	1·015	0·065	—	0·011	0·075	0·097	0·077	0·099	0·034	0·019	0·054	0·021
BaO	1·220	0·046	—	0·040	0·069	0·024	0·107	0·079	0·123	0·089	0·016	0·048
R.I.					1·518	1·578	1·507	1·545	1·488	1·486	1·604	

Key to Analyses

1 - Hat Creek Coal Formation, tonstein band in coal, Hole 74-141

2 - Hat Creek Coal Formation?, tonstein from Dry Lake area

3 - Hat Creek Coal Formation, average coal ash, McCullough p. 7

4 - Medicine Creek Formation, mudstone, Hole 34-356'

5 - Spences Bridge Group, dacite from ridge 2 miles north of Porks Lake

6 - Spences Bridge Group, feldspathic basalt, south of Blue Earth Creek

7 - Kamloops Group, dacite, 1½ miles east of south end of Marble Canyon.

8 - Kamloops Group, andesite, west of Bedard Lake

9 - Kamloops Group, rhyolite, below and immediately west of White Rock Bluff.

10 - Kamloops Group, rhyolite from Trachyte Hills

11 - Kamloops Group?, olivine basalt, 1½ miles northwest of White Rock Bluff

12 - Cinders from burnt coal (pseudo scoria deposit) south side of Dry Lake gulch

Results of Drilling, 1974-1975

HOLE NO.	GRID CO-ORDINATES NORTH	GRID CO-ORDINATES EAST	OVERBURDEN	TOTAL LENGTH	BEDS TO CORE AXIS	REMARKS
74-23	79125	17425	231	1355	55°	MOSTLY HAT CREEK COAL FORMATION?
74-24	76950	21000	212	386	15°	MEDICINE CREEK FORMATION
74-25	77900	19975	102	2072	90°	COMPLETE SECTION OF HAT CREEK COAL FORMATION AND SOME COLDWATER BEDS
74-26	79200	21700	59	1513	30°	HAT CREEK COAL FORMATION FAULTED
74-27	79000	22400	431	1501	15°	MEDICINE CREEK FORMATION
74-28	79000	24000	225	1469	75°	MEDICINE CREEK FORMATION & COLDWATER BEDS? , FAULTED.
74-29	83350	20675	283	1359	70°	MEDICINE CREEK FORMATION?
74-30	83500	19150	160	1092	?	FINNEY LAKE BEDS OVERLYING MEDICINE CREEK FORMATION
74-31	83700	18000	222	664	45°	FINNEY LAKE BEDS
74-32	81175	16475	304	1750	45°	MOSTLY COLDWATER BEDS , SOME MEDICINE CREEK FORMATION , FAULTED
74-33	74400	20925	227	1370	45°	MEDICINE CREEK FORMATION
74-34	76500	22350	109	998	60°	MEDICINE CREEK FORMATION
74-35	83275	21900	395	932	55°	MEDICINE CREEK FORMATION
74-36	79000	25000	302	967	45°	FINNEY LAKE BEDS
74-37A	76950	19450	166	2186	60°	MEDICINE CREEK FORMATION ON FAULTED HAT CREEK COAL FORMATION.
74-38	79925	19500	64	2085	60°	HAT CREEK COAL FORMATION
74-39	81525	19400	33	1441	45°	HAT CREEK COAL FORMATION AND COLDWATER BEDS , FAULTED.
74-40	81500	20075	91	1318	35°	MEDICINE CREEK FORMATION
74-41	77950	20950	170	357	60°	HAT CREEK COAL FORMATION?

HOLE NO.	GRID CO-ORDINATES NORTH	GRID CO-ORDINATES EAST	OVERBURDEN	TOTAL LENGTH	BEDS TO CORE AXIS	REMARKS
74-42	72700	17100	46	532	35°	COLDWATER BEDS AND HAT CREEK COAL FORMATION? , FAULTED
74-43	78950	17425	90	1526	45°	BASE OF HAT CREEK COAL FORMATION ON COLDWATER BEDS
74-44	76950	19450	164	2318	86°	COMPLETE SECTION THROUGH HAT CREEK COAL FORMATION , UPPER & LOWER CONTACTS
74-45	73075	18075	91	1151	45°	MEDICINE CREEK FORMATION AND HAT CREEK COAL FORMATION? , FAULTED.
74-46	79125	17425	41	1813	50°	SECTION THROUGH HAT CREEK COAL FORMATION & SOME MEDICINE CREEK FORMATION , FAULTED
74-47	72075	16000	53	1001	75°	FINNEY LAKE BEDS
74-48	74550	19100	200	1747	60°	MEDICINE CREEK FORMATION ON HAT CREEK FORMATION , FAULTED?

Hole No.	Grid Coordinates		Overburden	Total Length	Beds To Core Axis	Remarks
	North	East				
75-49	74500	20,050	130	1277	65°	MEDICINE CREEK FORMATION
75-50	79950	18100	76	1032	75°	LOWER PART OF HAT CREEK COAL FORMATION FAULTED AGAINST MEDICINE CREEK FORMATION
75-51	76950	18000	162	1616	50°	ALMOST COMPLETE SECTION OF HAT CREEK COAL FORMATION AND TOP OF COLDWATER BEDS
75-52	74600	18150	102	1004	65°	FAULTED SECTION OF HAT CREEK COAL FORMATION ABOVE COLDWATER BEDS ?
75-53	78050	17600	102	999	60°	LOWER SECTION OF HAT CREEK COAL FORMATION ABOVE COLDWATER BEDS?
75-54	65489	21266	53	1000	80°	MEDICINE CREEK FORMATION
75-55	64825	17?00	104	1000	60°	MEDICINE CREEK FORMATION
75-56	34800	25700	146	590	60°	FAULTED MEDICINE CREEK FORMATION AND HAT CREEK COAL FORMATION
75-57	2?600	25900	369	1549	75°	HAT CREEK COAL FORMATION
75-58	17500	24750	161	643	20°	FAULTED FINNEY LAKE BEDS
75-59	23800	22500	42	1438	45° & 60°	MEDICINE CREEK FORMATION ABOVE FAULTED SECTION OF HAT CREEK COAL FORMATION
75-60	48000	22750	258	1948	65°	MEDICINE CREEK FORMATION ABOVE HAT CREEK COAL FORMATION
75-61	40700	24450	161	1320	70°	MEDICINE CREEK FORMATION ABOVE HAT CREEK COAL FORMATION
75-62	55250	21?00	150	1679	20°	HAT CREEK COAL FORMATION
75-63	60155	23054	270	1000	45°	MEDICINE CREEK FORMATION
75-64	57527	22479	200	490	30°	MEDICINE CREEK FORMATION
75-65	56297	24335	240	790	25°	MEDICINE CREEK FORMATION ABOVE FAULT ZONE
75-66	55087	14655	111	135	?	FAULT ZONE

Hole No.	Grid Coordinates		Overburden	Total Length	Beds To Core Axis	Remarks
	North	East				
75-67	55197.	15736	78	715'	?	FINNEY LAKE BEDS
75-65	53350	21550	140	1843	30°	FAULT REPETITION OF HAT CREEK COAL FORMATION WITH MEDICINE CREEK FORM. ABOVE
75-64	55770	19738	110	1337	50°	MEDICINE CREEK FORMATION
75-70	51254	19788	141	1250	65°	MEDICINE CREEK FORMATION
75-71	55295	17411	268	1001	85°	MEDICINE CREEK FORMATION
75-72	29750	20100	151	856	85°	MEDICINE CREEK FORMATION
75-73	50850	22525	125	1940	30°	HAT CREEK COAL FORMATION
75-74	48025	24500	282	2232	60°	HAT CREEK COAL FORMATION WITH POSSIBLE FAULT REPETITION
75-75	21850	26425	260	395	75°	MEDICINE CREEK FORMATION
75-76	21500	25500	92	1300	80	MEDICINE CREEK FORMATION
75-77	59714	20655	106	1546	55	HAT CREEK COAL FORMATION

Plates

CHURCH 1 Unconformable Pleistocene deposits on Hat Creek

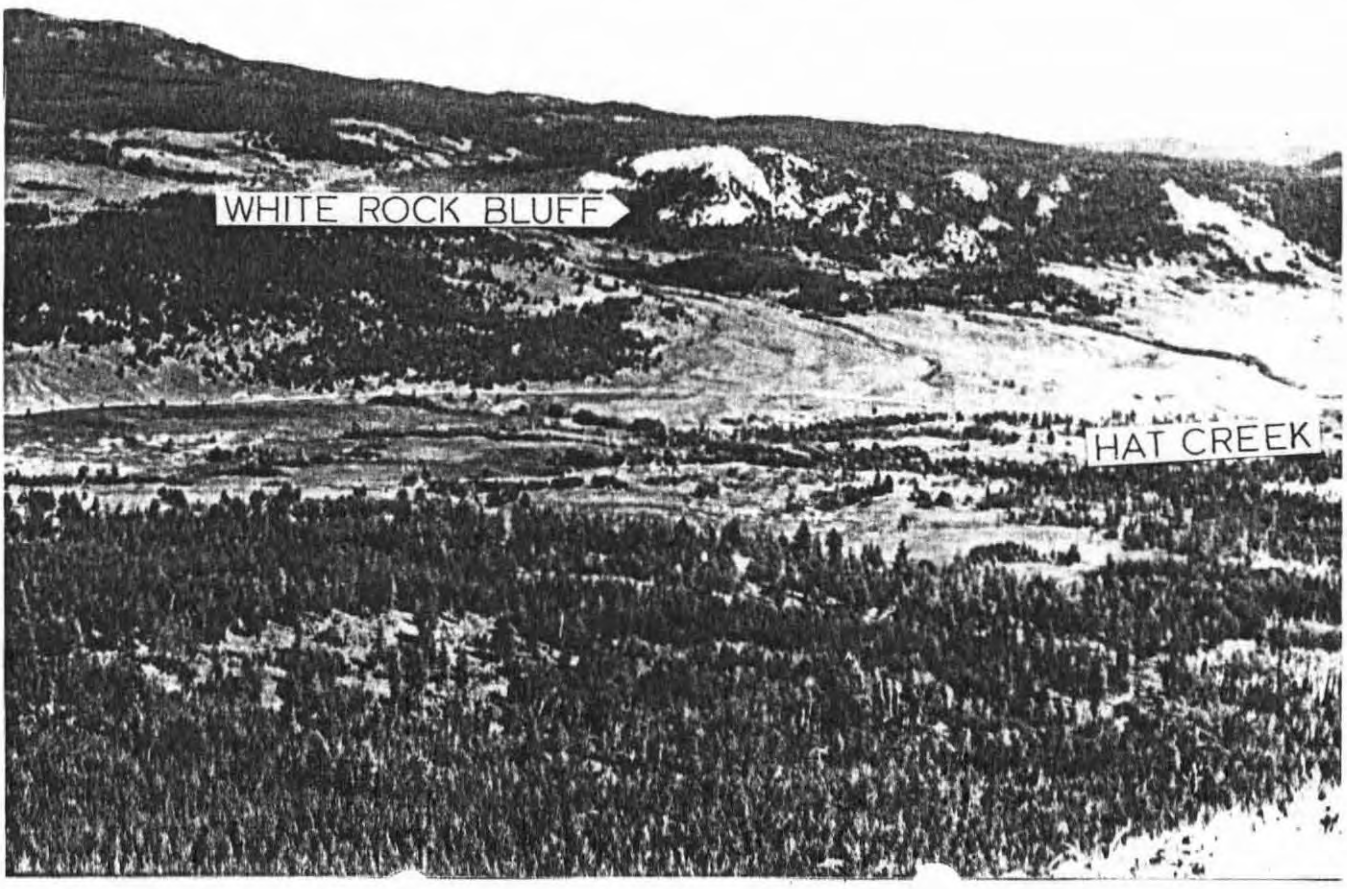
CHURCH 2 Original coal discovery zone on Hat Creek

CHURCH 3 View looking easterly across Hat Creek valley to No. 2 Coal Reserve below White Rock Bluff

CHURCH 4 Lahar deposit in Finney Lake Beds, south of Medicine Creek

CHURCH 1 Unconformable Pleistocene deposits on Hat Creek

CHURCH 2 Original coal discovery zone on Hat Creek



CHURCH 3 View looking easterly across Hat Creek valley to No. 2 Coal Reserve below White Rock Bluff

CHURCH 4 Lahar deposit in Finney Lake Beds, south of Medicine Creek