BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK PROJECT

PRELIMINARY ENGINEERING

COMPOSITE REPORT

September 1978

Copy No. 9

HAT CREEK PROJECT

PRELIMINARY ENGINEERING

COMPOSITE REPORT

Composite Report		
Appendix A	-	Mining
Appendix B	-	Powerplant
Appendix C	-	Offsite Facilities
Appendix D	-	Coal Quality and Handling
Appendix E	-	Environmental Work
Appendix F	-	Project Organization and Support Functions

ACKNOWLEDGMENTS

The information in this report and accompanying appendices has been prepared by the Hat Creek Project Team - a multidisciplinary team comprising B.C. Hydro and outside consultants' personnel including:

Cominco-Monenco Joint Venture	-	Mining
Ebasco Services of Canada Ltd. - Environmental Consultants	-	Environmental
Golder Geotechnical Consultants Ltd.	-	Geotechnical (Mining)
Integ-Ebasco Joint Venture	-	Powerplant
Sandwell & Company Ltd.	-	Water Supply
Toby Russell Buckwell & Partners	-	Project Architects

B.C. Hydro:

- Comptroller's Division
- Computer and Management Systems Division
- Hydroelectric Design Division
- Industrial Relations and Personnel Division
- Legal Division
- Metro Vancouver Division (Electrical Operations)
- Operations Engineering Division
- Properties Division
- Public and Customer Relations Division
- Purchasing and Supply Division
- System Design Division
- System Engineering Division
- Thermal Division

The report has been produced and coordinated by the Thermal Division.

HAT CREEK PROJECT

PRELIMINARY ENGINEERING

COMPOSITE REPORT

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HAT CREEK PROJECT

PRELIMINARY ENGINEERING COMPOSITE REPORT

SYNOPSIS

As a future source of power, B.C. Hydro is considering conventional coal-fired electrical generation as a cost-competitive, well-proven technology for converting some of British Columbia's abundant coal reserves into electrical energy. This report describes the preliminary engineering of a base scheme for Hat Creek which indicates that development of this first major coal-fired thermal plant in British Columbia can be consistent with both sound management of the coal resource and protection of the environment.

The proposed Hat Creek generating station would utilize only a part of the very large sub-bituminous coal deposit in the upper Hat Creek Valley, located 200 km (125 mi) northeast of Vancouver. The project would add 2240 MW of installed capacity to the integrated B.C. Hydro system, at a capital cost of $1297 million in 1978 dollar terms including associated transmission facilities.

PROJECT DESCRIPTION

Coal mining would be by truck-shovel combination in an open pit, with conveyor delivery to the surface. Over the 35-year minimum economic life of the powerplant, 350 Mt (385 million tons) of blended coal would be supplied and 450 Mm^3 (589 million yd^3) of waste material would be removed from the pit. The crushed and blended fuel delivered to the powerplant would average 12.8 MJ/kg (5500 Btu/lb) heating value, 27.0 percent ash and 25 percent moisture, with a low (0.4 percent) sulphur content typical of western coals. Delivery to the powerplant

PROJECT DESCRIPTION - (Cont'd)

on a plateau 410 m (1345 ft) above the valley floor would be by a two-stage overland conveyor 4.2 km (2.6 mi) long. Mine waste material, also transported by conveyors, would be stored behind engineered embankments. Staged reclamation of disturbed land areas would proceed as the mine was developed.

The powerplant would comprise four 560 MW (500 MW net) boiler/turbine/generator units, using a single four-flue stack and two natural-draft hyperbolic cooling towers. The predicted operating regime is essentially base load with ability to supply some peaking capacity to B.C. Hydro's predominantly hydroelectric generation system. At full load, the daily fuel consumption would be 43 000 t (47,300 tons); the resulting 12 000 t (13,200 tons) per day of ash would be sluiced to a settling pond. To maintain required ambient air quality levels under the forecast, infrequent and short term adverse weather conditions, a Meteorological Control System would be used, involving measures such as load reduction and the use of extra low sulphur coal.

Makeup water for the closed circuit cooling system would be supplied to the station reservoir through an 800 mm (32 in) diameter pipeline over a distance of 24 km (15 mi) from the Thompson River. Initial power from the Hat Creek generating station would feed into an already built 500 kV transmission line passing within 300 m (985 ft) of the powerplant. Subsequently, only the cost of an additional 35 km (22 mi) circuit to Kelly Lake would be directly chargeable to the project.

COSTS

The capital costs in 1978 dollars for the Hat Creek generating station, including offsite facilities, are estimated to total

COSTS - (Cont'd)

$1285 million. Associated transmission capital costs would add $11.8 million.

Based on the estimated capital and operating costs of the mine, plus royalties of 3 1/2 percent on the mine selling price, the fuel cost would be $8.13/t ($7.38/ton) of blended coal.

The powerplant annual fixed operating costs in 1978 dollars are estimated to be $127 million at a 65 percent lifetime annual capacity factor. The addition of the above fuel cost plus variable operating and maintenance charges and capacity factor adjustment result in an estimated energy cost of 19.4 mills/kWh.

SCHEDULE

A master schedule to meet a first unit in-service date of 1 January 1986 has been used for the preliminary engineering base plan of 4 x 500 MW (net) units and the related cash flow estimates in this and supporting reports.

(N.B. The preliminary estimate of licensing time in this base schedule has recently been superseded by a significantly more conservative planning allowance of 48 months. Consequently, under current B.C. Hydro imposed constraints which preclude contract awards prior to completion of all hearing appeals, the earliest first unit in-service date changes to 1 October 1987.)

PROJECT ORGANIZATION

A project team, employing matrix project management techniques, has carried out the conceptual design and preliminary engineering phases of the project. Extension of this project team approach, based

PROJECT ORGANIZATION - (Cont'd)

on the Thermal Division with other seconded B.C. Hydro members and major consultants, is recommended for the remaining licensing, final design, procurement, construction and commissioning phases. The Policy Steering Committee and Board of Review would continue in their roles as presently constituted.

LICENSING

Licensing requirements for the project are extensive: eight provincial and two federal statutes may apply. To date no progress has been made on coordinated legislation to minimize required duplication of effort and duration of the licensing period.

The Pollution Control Act contains procedures anticipated to be the most demanding, and the latest 48-month planning allowance for licensing is predicated on a hearing and two appeals. Under this Act, final pollution control "Standards" will only be set out in the permit after site-specific examination.

In the absence of official guidelines for coal-fired power-plants, the project has been designed to meet criteria advocated in B.C. Hydro's brief to the Pollution Control Board Inquiry in January, 1978. The project will generally follow the Guidelines for Coal Development issued by the Environment and Land Use Committee in March 1976.

ENVIRONMENTAL FACTORS

After more than 2 years of intensive study by resource specialists, no environmental impacts have been identified that would rule out development of the project.

ENVIRONMENTAL FACTORS - (Cont'd)

However, four factors predominate as issues that may significantly affect licensability, project economics and protection of the environment: Air Quality (sulphur dioxide emissions and mine area dust), Water Resources (run-off and seepage from mine operations), Aquatic Environment (fish mortality), and Land Usage (loss of range/crop land and potential vegetation injury). Control and mitigation measures have been investigated in each case, and the project would be designed and operated to meet all license and permit requirements.

SOCIAL FACTORS

Public concern with this first major coal-fired generating station in British Columbia is expected to be greater than with hydro-electric projects. Interest in maintaining high ambient air quality would be shared by the public and B.C. Hydro.

Socio-economic impacts such as pressure on housing and community services could be mitigated through regional and local planning, and offset by the resulting increased economic activity in the area. It is difficult to predict what measures would be appropriate to mitigate impacts on the adjacent native Indian bands because of the special legal status of their reserves.

PRINCIPAL AREAS OF CONCERN

Non-technical facets of the project constitute the principal areas of concern and are primarily influenced by factors external to B.C. Hydro:

1. Possible variance between air quality, liquid effluent and solid waste objectives used in preliminary design and the yet to be announced results of the January 1978 Pollution Control Board inquiry.

PRINCIPAL AREAS OF CONCERN - (Cont'd)

2. Anticipated delays in completing an equitable settlement with local native Indian bands.

3. Great uncertainty as to the time and effort required to prepare and present the project case at the various hearings and appeals.

4. Potential complications in establishing labour bargaining units and jurisdictions owing to the undefined relationship of mine development to the construction and operating unions traditionally employed on B.C. Hydro projects.

CONCLUSIONS

The Hat Creek project is technically and environmentally feasible.

Although the Pollution Control Board are still preparing pollution control objectives for coal-fired thermal plants in British Columbia, environmental protection embodied in the preliminary engineering design would meet and generally be better than the objectives and standards prevailing in the rest of Canada and many other parts of the world.

Of the principal areas of concern described in this report, uncertainty surrounding licensing time and procedures is the most critical relative to the project schedule.

Effective introduction of coal-fired electrical generation into British Columbia will require changes to the legislation, procedures and practices previously established for hydroelectric projects.

SECTION 1.0 - INTRODUCTION

This report describes the proposed Hat Creek Project at the conclusion of the Preliminary Engineering Design and Environmental Studies. It presents for the first time all aspects of the current base scheme for the project in a composite report, covering major engineering works for the mine, powerplant and offsites areas and detailed environmental studies, with other support aspects necessary for successful development of such a major project.

The report describes a four-unit 2000 MW (net) powerplant and mine complex which has generating units scheduled to progressively enter service between January 1986 and January 1989. Major project features are highlighted and problem areas identified with suggested approaches to mitigative solutions. The report also refers to on-going work, making some recommendations for future work and, where possible, proposes organizational arrangements for proceeding with subsequent phases of project development.

The report and its appendices with the supporting cost estimates, schedules, investigative reports, preliminary designs and assessments, forms the basis on which to proceed to the licencing and final design phases.

To allow the extensive environmental studies to start early enough to meet their required early-1979 completion date, tentative project descriptions were prepared in the fall of 1977. As a result of subsequent design refinements, the environmental impact assessments presented in this report do not cover all aspects of the current base scheme described in other sections of this report. Extension of the environmental impact assessments to cover the subsequent design refinements would be carried out during the pre-licensing period and onward as is normal in fossil-fired projects.

During the licensing phase, concurrent final design and environmentally-acceptable and cost-effective improvements to the present base scheme would continue to be explored and adopted as appropriate.

To deal with the uncertainty surrounding the length of the eight prerequisite license applications and subsequent possible appeal processes, the schedules presented in this report are based on the best informed estimates of licensing durations that were available in early 1978. A longer alternative licencing period has recently been formulated and adopted for planning purposes. Its ramifications on the project schedule are discussed in Section 5.0. While no construction is scheduled in advance of construction authorization, to maintain the January 1986 first-unit in-service date it may be necessary to call for tenders and make provisional award of contracts for design and fabrication of the boilers and turbine-generators before exhaustion of all appeal processes. This is normal practice for fossil-fired projects and is necessary to obtain firm data from suppliers to allow civil and structural design work to proceed concurrently with major equipment supply.

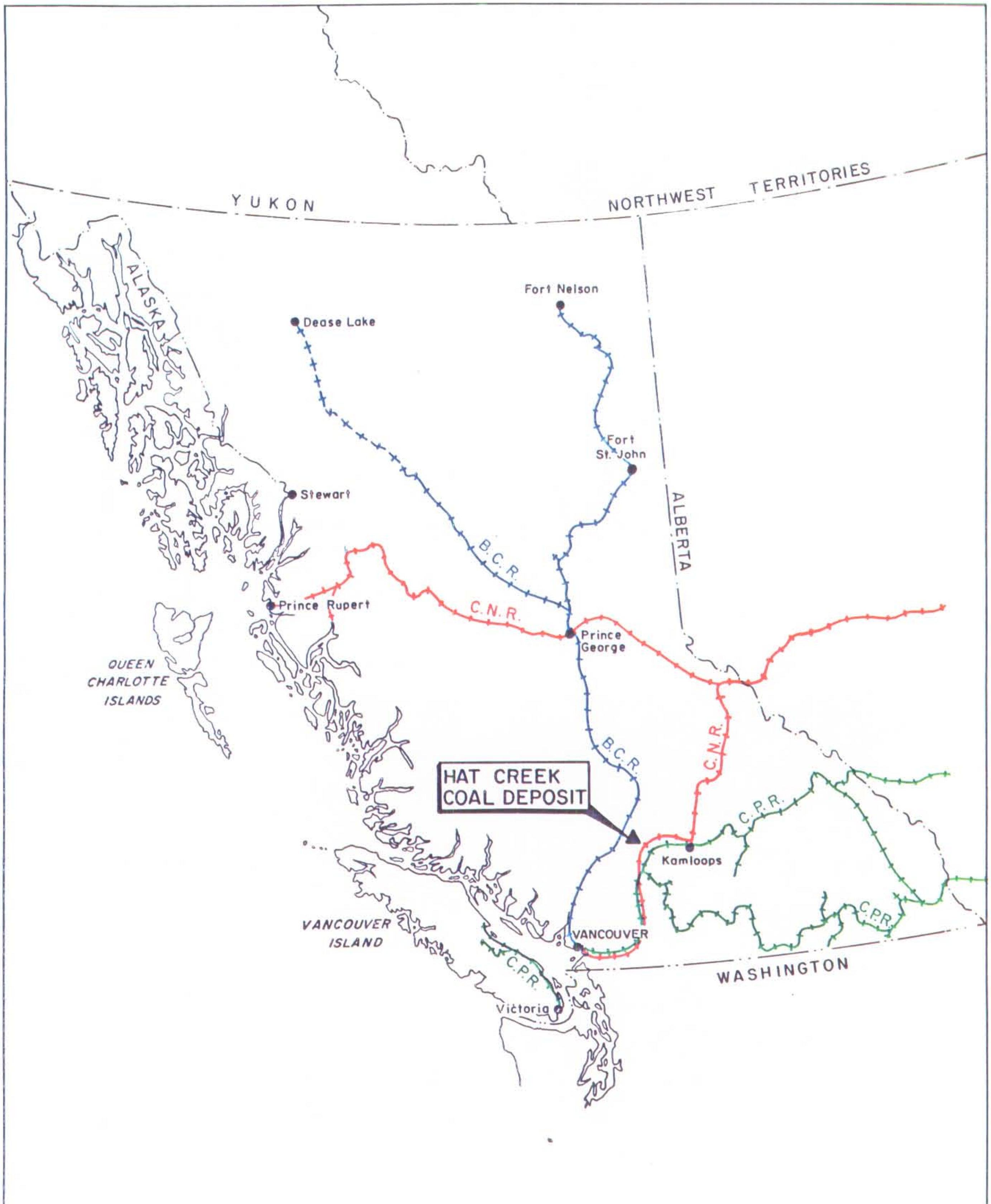
The appendices to this report describe the following six major aspects of the project in greater detail:

A. Mining.
B. Powerplant.
C. Offsite Facilities.
D. Coal Quality and Handling.

E. Environmental Work.

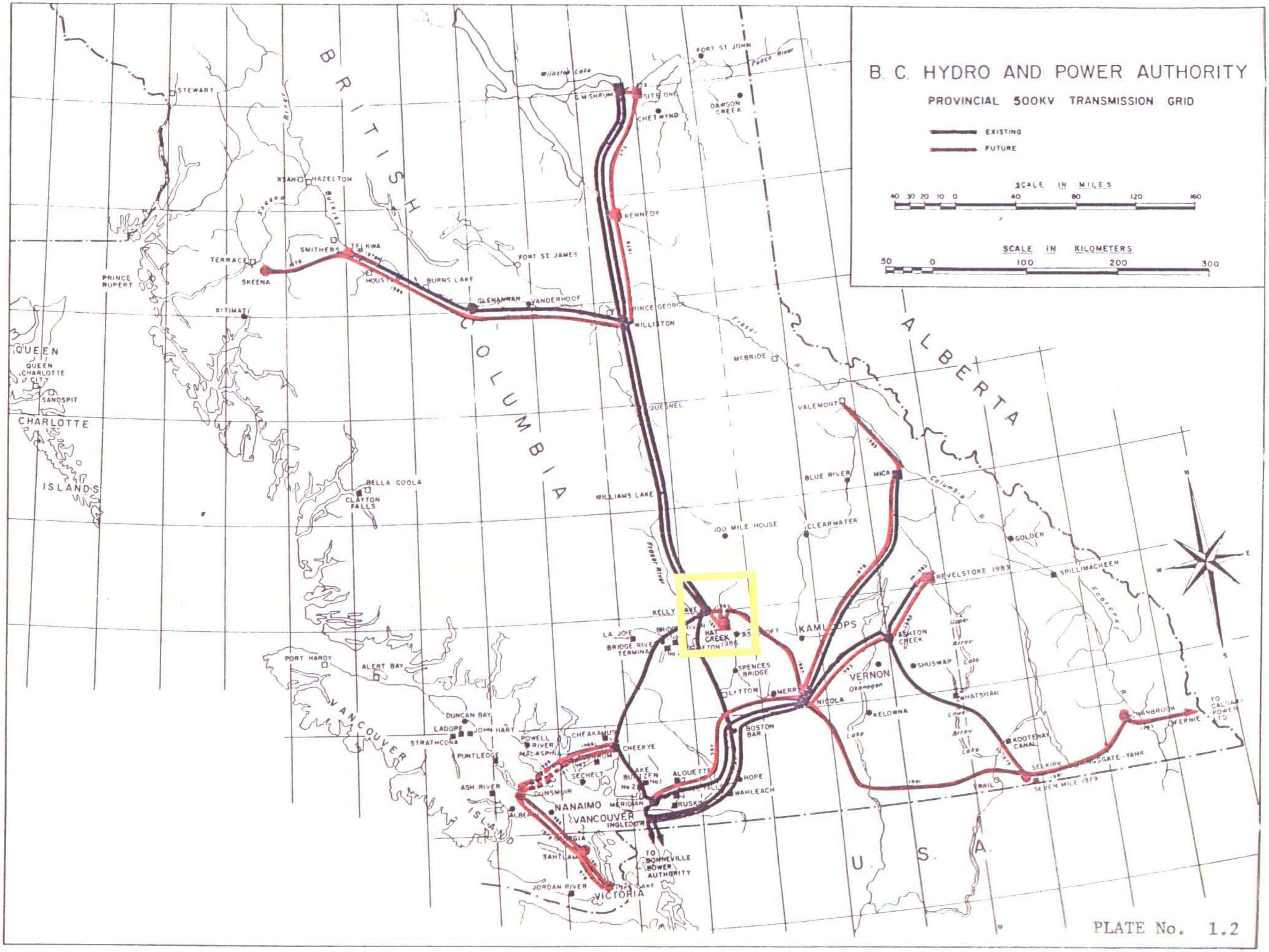
F. Project Organization and Support Functions.

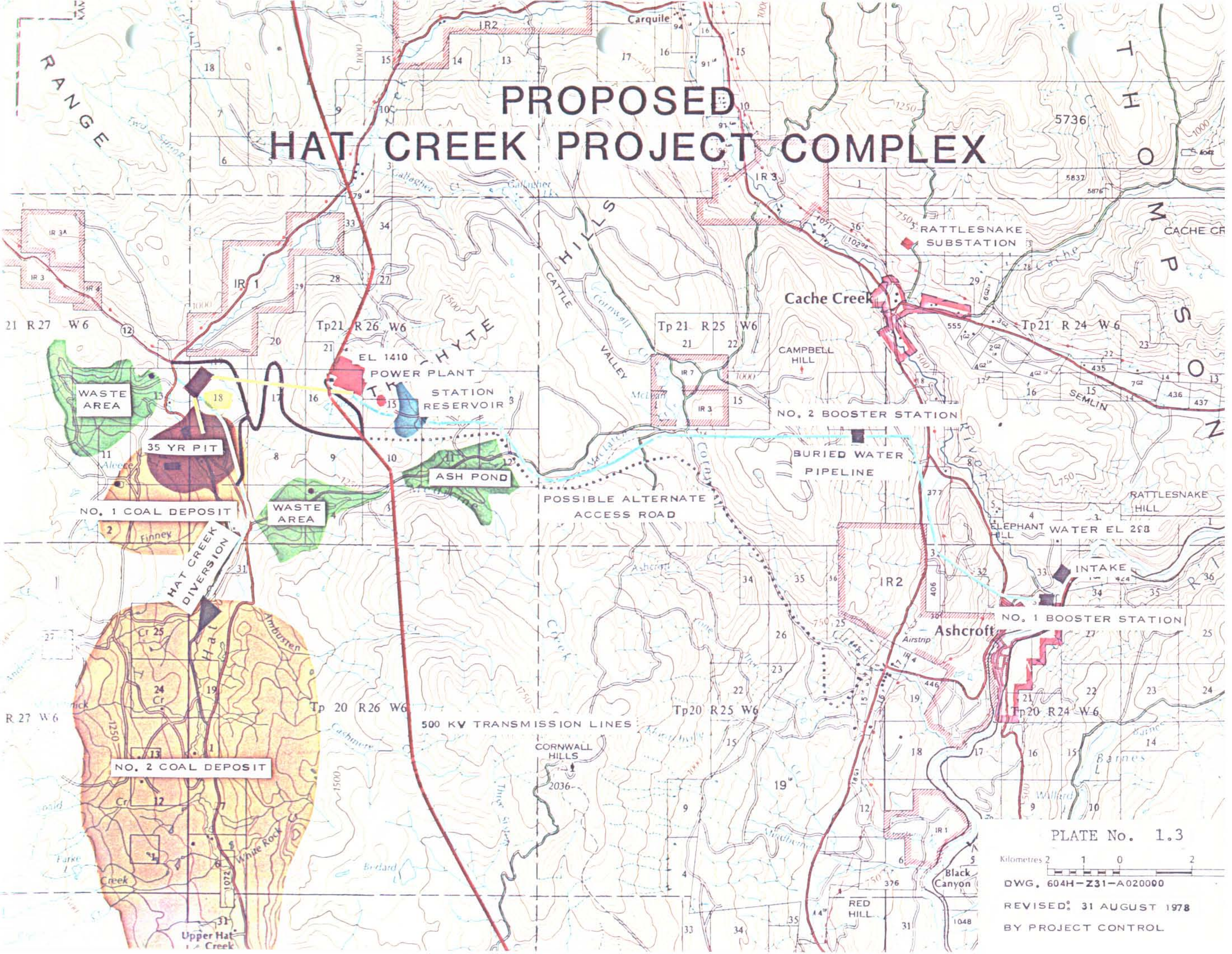
These appendices have been prepared primarily by the respective consultants and the contents reflect their wide diversity of subject experience and style.



LOCATION OF HAT CREEK COAL DEPOSIT

PLATE No. 1.1


B. C. HYDRO AND POWER AUTHORITY
PROVINCIAL 500KV TRANSMISSION GRID
EXISTING
FUTURE
SCALE IN MILES
40 30 20 10 0 40 80 120 160
SCALE IN KILOMETERS
50 0 100 200 300
BRITISH COLUMBIA
ALBERTA
U. S. A.
QUEEN CHARLOTTE ISLANDS
VANCOUVER ISLAND
STEWART
FORT ST. JOHN
Peace River
Williston Lake
G.M. SHRUM
SITE ONE
CHETWYND
DAWSON CREEK
HAZELTON
KENNEDY
TERRACE
SKEENA
SMITHERS
TELKWA
BURNS LAKE
FORT ST. JAMES
PRINCE RUPERT
GLENANNAN
VANDERHOOF
KITIMAT
WILLISTON
McBRIDE
QUEEN CHARLOTTE CITY
SANDSPIT
QUESNEL
VALEMONT
BELLA COOLA
CLAYTON FALLS
BLUE RIVER
MICA
WILLIAMS LAKE
100 MILE HOUSE
CLEARWATER
GOLDEN
REVELSTOKE 1983
SPILLIMACHEEN
Fraser River
Columbia R.
Kootenay
KELLY LAKE
LA JOIE
BRIDGE RIVER TERMINAL
HAT CREEK 1986
KAMLOOPS
ASHTON CREEK
PORT HARDY
ALERT BAY
SPENCES BRIDGE
VERNON
Okanagan
SHUSWAP
LYTTON
NICOLA
KELOWNA
WHATSHAN
DUNCAN BAY
LADORE
JOHN HART
STRATHCONA
POWELL RIVER
CHEAKAMUS
CHEEKYE
BOSTON BAR
KOOTENAY CANAL
CRANBROOK
FERNIE
TO CALGARY POWER LTD.
PUNTLEDGE
SECHELT
ALOUETTE
HOPE
SELKIRK
KINGSGATE - YAHK
ASH RIVER
DUNSMUIR
WAHLEACH
TRAIL
SEVEN MILE 1979
NANAIMO
MERIDIAN
RUSKIN
VANCOUVER
INGLEDOW
SAHTLAM
TO BONNEVILLE POWER AUTHORITY
JORDAN RIVER
VICTORIA
PLATE No. 1.2


PROPOSED
HAT CREEK PROJECT COMPLEX
RANGE
THOMPSON
CATTLE HILLS
CATTLE VALLEY
EL 1410
POWER PLANT
STATION RESERVOIR
WASTE AREA
35 YR PIT
NO. 1 COAL DEPOSIT
WASTE AREA
HAT CREEK DIVERSION
ASH POND
POSSIBLE ALTERNATE ACCESS ROAD
NO. 2 BOOSTER STATION
BURIED WATER PIPELINE
RATTLESNAKE SUBSTATION
Cache Creek
CACHE CR
CAMPBELL HILL
RATTLESNAKE HILL
ELEPHANT HILL
WATER EL 298
INTAKE
NO. 1 BOOSTER STATION
Ashcroft
Airstrip
NO. 2 COAL DEPOSIT
500 KV TRANSMISSION LINES
CORNWALL HILLS
2036
Upper Hat Creek
Black Canyon
RED HILL
Carquile
Tp21 R26 W6
Tp 21 R25 W6
Tp21 R24 W6
Tp 20 R26 W6
Tp20 R25 W6
Tp20 R24 W6
21 R27 W6
R 27 W6
SEMLIN
PLATE No. 1.3
Kilometres 2 1 0 2
DWG. 604H-Z31-A020000
REVISED: 31 AUGUST 1978
BY PROJECT CONTROL


HOUTH MEADOWS WASTE AREA
LOW GRADE COAL STOCKPILE AREA
MINE SURFACE FACILITIES (EL. 1000)
POWER PLANT (EL. 1410)
TRACHYTE HILLS
STATION RESERVOIR Max El. 1372
OPEN PIT NO. 1
HAT CREEK
MEDICINE CREEK WASTE AREA
WET ASH DISPOSAL POND Max El. 1279.5
PIT RIM DAM
Finney Lake
Aleece Lake
Harry Lake
Finney Creek
Finney Creek Diversion
Existing Airstrip
Existing Hat Creek Road
Existing Highway No. 12
Indian Reserve
Saddle Dam
Reservoir Dam
Discharge Structure
Spillway
North Canal
South Canal
Ash Pond Dam
500 KV Line (To Nicola)
60 KV Line
Project Access Road
Powerplant Access Road
Buried Make-up Water Pipeline from Thompson River
Project Access Road (Tentative) from Ashcroft Manor
35 Years pit outline
CORNWALL HILLS
NOTE: PRODUCED FROM D.T.M.
Scale 200 0 200 400 600 800 Metres
PLATE No. 1.4
BRITISH COLUMBIA HYDRO & POWER AUTHORITY
HAT CREEK PROJECT
PROJECT LAYOUT MAP
SCALE 1:10 000
DWG No. 604H-Z31-X020001 R2
REVISION DATE - AUG 17/78

SECTION 2.0 - PROJECT HISTORY AND BACKGROUND

2.1 EARLY HISTORY

The Hat Creek coal deposits are not a new discovery. Located in the interior plateau of British Columbia approximately 40 km (25 mi) west of the town of Ashcroft, the presence of coal was first reported by Dr. G.M. Dawson of the Geological Survey of Canada in 1877, and later in 1894. Various outcroppings of coal were evident along the banks of Hat Creek where overburden had been removed by erosion.

By 1925 three shallow shafts, two short adits and several drill holes were completed to mine the coal. No further work was done until 1933 when, for a period of 9 years, a few hundred tons of coal were produced from the property and sold locally. Due in part to the large quantity of inherent clay and clay partings in the coal mined, these early attempts to market the fuel were unsuccessful.

In 1957 Western Development and Power Ltd., a subsidiary of the B.C. Electric Co., optioned the property and excavated a number of trenches and drilled 15 new holes. A report completed in 1960 stated that "...coal of a type suitable for firing a thermal power station exists in great quantities in the Hat Creek area. Sufficient reserves have been proven in and adjacent to a Crown Grant area to provide fuel for a 2000 MW station at 85% load factor for a period of about 30 years...". The report envisaged a semi-outdoor powerplant consisting of eight 250 MW generating units. The use of natural draft cooling towers was proposed with water taken from the Bonaparte River for the first 1000 MW and from the Bonaparte and Thompson rivers for the 2000 MW stage.

2.1 EARLY HISTORY - (Cont'd)

Following the acquisition of the B.C. Electric Co. by the provincial government in 1962, the ownership of the Hat Creek coal property passed to the B.C. Hydro and Power Authority. No further exploration was done at Hat Creek until mid-1974.

2.2 PROJECT WORK SINCE 1974

Coal licences covering most of the upper Hat Creek Valley were obtained by B.C. Hydro in 1974 and 35 drill holes were completed in the northern end of the valley. The drilling under the direction of Dolmage Campbell and Associates confirmed the earlier 1957/59 proven and probable reserves sufficient to sustain 2000 MW of thermal generation for a minimum of 35 years. In addition, further exploratory drilling in the remainder of the valley resulted in the discovery of a second deposit south of Anderson Creek, estimated to contain in excess of 1.5 Gt (1.7 billion tons) of coal.

B.C. Hydro's work with the aid of outside consultants greatly expanded in mid-1974 when results from the No. 1 Deposit drillings became available and since that time progress has been made on four broad fronts: Mining; Powerplant; Offsite Facilities; Environmental Work, as follows:

(a) Mining

Conceptual design work, commenced in September 1975 by Powell-Duffryn National Coal Board Consultants Ltd. (PD-NCB) recommended an open pit truck/shovel mining operation for Hat Creek. It was suggested that future work be concentrated in the No. 1 Deposit.

Cominco-Monenco Joint Venture began mining preliminary engineering studies, supported by additional geotechnical, geological and benefication investigations in May 1977. These studies investigated alternative mining systems and approaches to developing the deposit and reaffirmed a truck/shovel mining system. This system is described in Section 3.2 of this report.

A Bulk Sample Programme supervised by the Thermal Division during 1977 provided 6300 t (7000 tons) of coal for a burn test in Alberta, and valuable data on mining, handling and storage of the coal and waste materials.

(b) Powerplant

Feasibility studies of the Hat Creek powerplant were carried out by the System Design Division from May 1974 to July 1975. Various combinations of unit sizes were included in their report No. 104 issued in July 1975.

Conceptual design by Integ-Ebasco was finalized in January 1977 recommending a station consisting of four 500 MW (net) units. Coincident with this study, Ebasco Services of Canada Ltd. - Environmental Consultants (ESCLEC) conducted a site selection study and recommended the proposed powerplant site location at Harry Lake.

Preliminary engineering by Integ-Ebasco further developed the conceptual design and the resulting base powerplant arrangement described in Section 3.3 of this report.

(c) Offsite Facilities

Offsite facilities, including water supply and ash disposal, were considered in the System Design Division feasibility study reported in Sub-section 2.2(b) above.

2.2 PROJECT WORK SINCE 1974 - (Cont'd)

Conceptual design studies were initiated in the latter part of 1975. Swan Wooster Co. Ltd. concluded a study of the transportation alternatives for several thermal plant sites in June 1976. A water supply study by Sandwell and Co. Ltd. and a study of the diversion of Hat Creek by Monenco Consultants Pacific Ltd. were both finalized in January 1977.

The preliminary engineering phase assignments, reported in Section 3.4, commenced in 1977 and have been extended to include the following studies:

Cooling Water Supply	Sandwell and Co. Ltd.
Water Reservoir and Ash Disposal Embankments	Hydroelectric Design Division
Creek Diversions	Hydroelectric Design Division
Project Access Road	Department of Highways and Hydroelectric Design Division
Equipment Offloading Facilities	Thermal Division
Airstrip	Transport Canada
Transmission Lines	System Design Division and Ian Hayward & Associates
Single Labour Construction Camps	H.A. Simons (International) Ltd.

(d) Environmental Work

Environmental studies of the Hat Creek Project have been in progress since mid-1974, when a preliminary environmental impact study by B.C. Research and Dolmage Campbell and Associates

2.2 PROJECT WORK SINCE 1974 - (Cont'd)

Ltd. was started. Further thermal plant site investigations and detailed environmental impact assessments were initiated following completion of this report in August 1975.

Additional work initiated prior to the detailed environmental studies included:

1. A programme of meterological and air quality monitoring commenced in the winter of 1974/75.

2. A Hat Creek regional economic impact assessment, completed in 1976.

3. Fish and wildlife surveys by the Provincial Fish and Wildlife Branch.

4. Waterfowl surveys by Ducks Unlimited.

5. Preliminary archeological investigations by the Provincial Heritage Conservation Branch.

In June 1976, Detailed Environmental Studies commenced involving more than 20 companies, including a coordinating consultant, Ebasco Services of Canada Ltd. - Environmental Consultants (ESCLEC). The terms of reference for these studies were circulated and revised until August 1977. Land, water, socio-economic and air quality resources groups were defined.

Environmental findings from these studies have and are influencing the development of the engineering design and selection of preferred project alternatives, a prime example being in the selection of the Harry Lake powerplant site over a mine-mouth site.

2.2 PROJECT WORK SINCE 1974 - (Cont'd)

The Detailed Environmental Studies will be consolidated in an Environmental Impact Assessment Report (EIAR), authored by ESCLEC, which will be a key reference document for B.C. Hydro's project Environmental Impact Statement (EIS).

SECTION 3.0 - PROJECT DESCRIPTION

3.1 SITE DESCRIPTION

(a) Location

The upper Hat Creek and Thompson River valleys lie principally within the Thompson plateau of British Columbia.

The upper Hat Creek Valley is the site of the Hat Creek coal deposits (Plate 1-3). The valley lies midway between Ashcroft and Lillooet, 200 km (125 mi) northeast of Vancouver, British Columbia. The site is accessible by car or by small aircraft from nearby points or from Vancouver. All three major railways in British Columbia pass near the site. The nearest points are Ashcroft, 21.7 km (13.5 mi) to the east, on the Canadian National and Canadian Pacific Railways, and Pavilion, 19.3 km (12 mi) to the northwest, on the British Columbia Railway.

(b) Physiography

The Thompson River, near Ashcroft, flows through a deeply incised river valley. Fluvial sand, gravel and silt form terraces which rise abruptly from river level at 275 m (900 ft) elevation, to the broad, commonly undulating part of the Thompson valley above 450 m (1500 ft) elevation. Landslides are common along the banks of the Thompson River particularly where till overlies silt. These banks become particularly unstable when the silt is saturated by snowmelt or flood irrigation.

The Trachyte and Cornwall hills, west of the Thompson River valley, are covered by a gravelly veneer which thickens

3.1 SITE DESCRIPTION - (Cont'd)

toward the north. Outcrops are generally scarce, but they are locally abundant. Bordering the upper Hat Creek Valley the hills are covered with a veneer of glacial till and there are scattered outcrops.

The upper Hat Creek Valley ranges from 825 to 1250 m (2700 to 4100 ft) in elevation. The valley is flanked by the Clear Range on the west which rises steeply to over 230 m (7600 ft) and by the Trachyte and Cornwall hills on the east. Surficial deposits in the valley consist of hummocky glacial material, forming a thick blanket of till, but reduced to a thin veneer on hill tops and steep slopes. Locally, bedrock is exposed through the veneer. On the east side of the valley, north of Medicine Creek and in the valleys of the larger tributary creeks, there are fluvial and glaciofluvial sands and gravels; some of these deposits are overlain by glacial till.

There are numerous outcrops on the sides of the valley; however, there are few outcrops near the bottom. A slope of rock debris has formed below volcanic outcrops east of the No. 1 Deposit. In the southeast there are bluffs of limestone; limestone outcrops are also numerous along the northern limit of the upper Hat Creek Valley. On the western margin of the valley outcrops of granitic and volcanic rocks are common.

(c) Upper Hat Creek Geological Setting

The upper Hat Creek Valley is largely underlain by tertiary strata that form a basin-like structure whose boundaries conform to the valley walls, at elevations of 300 m (1000 ft) or more above the valley floor. The basin lies northsouth along the valley of upper Hat Creek for a length of about 25 km (15 mi) and an average width of about 5 km (3 mi). The valley sides at higher

3.1 SITE DESCRIPTION - (Cont'd)

elevations are underlain by terraces of volcanic rocks that apparently represent erosional remnants of volcanic deposits that once covered the valley.

Most of the sedimentary rocks are poorly indurated and generally poorly cemented; therefore, they are incompetent and have low compressive strengths. Technically many of them are better described as semi-consolidated sands, silts and clays.

A prominent feature of the tertiary bedrock underlying upper Hat Creek Valley is the presence of major, regional, steeply-dipping block faults. The principal known faults cross the north end of the valley in an east-northeast direction. The No. 1 Deposit is known to be located between block faults in the north end of the valley.

The Hat Creek No. 1 Deposit consists of a thick complex series of alternating coal and sedimentary rockbeds located in a topographic and structural depression in the upper Hat Creek Valley. Coal measures and intercalated sediments were deposited in a basin formed by faulting.

The upper portion of the No. 1 Deposit contains a higher proportion of alternating layers of coal and waste than does the lower portion which is somewhat cleaner and contains fewer partings.

From near surface in the northeast corner and plunging southward, No. 1 Deposit extends over a strike length of about 2000 m (6500 ft) with a maximum width of about 1500 m (4500 ft). The maximum aggregate thickness is in the order of 450 m (1500 ft), under a cover of overburden and waste ranging in thickness from 1 to 150 m (3 to 500 ft) within the proposed pit area.

3.2 MINING

(a) Introduction

Preliminary engineering design studies completed by CMJV for the development of an open pit coal mine in the Hat Creek No. 1 Deposit as detailed in Appendix A.

The major features of the project would be:

1. An open pit mine which at the end of 35 years production would cover an area of 3 km (2 mi) by 2.5 km (1.5 mi) and extend 265 m (870 ft) below the average valley elevation.

2. Waste disposal areas at Houth Meadows and Medicine Creek linked to the mine headworks by overland conveyors.

3. A coal crushing, stockpiling and blending facility.

4. An overland conveyor connecting the mine to the powerplant.

5. An administration and maintenance complex.

(b) Geology

The geological interpretations and coal reserve estimates of the Hat Creek coal deposit were based on the following data, most of which were obtained during the period 1974 to 1978.

1. 207 diamond drill holes on a 150 m (500 ft) grid spacing with a total length of approximately 54 000 m (180,000 ft).

2. Auger samples for washability testing and pilot scale burn tests.

3.2 MINING - (Cont'd)

3. Bulk trench samples for plant scale burn tests, as well as further washability and bulk wash test programmes.

4. Geophysical surveys including down-the-hole electrologs which have been recorded for more than 90 percent of the holes drilled since 1974.

Plate 3-4 shows the location of drill holes and trenches in the No. 1 Deposit.

(i) Stratigraphy

The coal bearing section belongs to the Hat Creek Formation of the Eocene Epoch. It is overlain predominantly by claystone, siltstone beds of the Medicine Creek Formation and underlain by the Coldwater Formation consisting of mixed detrital material. During the Pleistocene Epoch these beds were subjected to glaciation and subsequently overlain by glacial material. Based on examination of the lithology and coal quality, six broad zones were recognized which were further subdivided into 14 subzones. Two of these subzones are essentially waste and coaly shale units while the remaining 12 represent coal of varying qualities. Typical geological cross sections in the west-east and north-south directions are shown on Plates 3-5, 3-6 and 3-7.

(ii) Structure

The Hat Creek Formation in No. 1 Deposit outcrops at the north end of the valley. The basic structure consists of two synclines separated by an anticline, plunging at 15° to 17° towards the south-southwest. It is truncated on the south and east by

3.2 MINING - (Cont'd)

steeply dipping faults (Plate 3-8). Due to rapid facies changes towards the southern and western limits, the coal quality sharply deteriorates in this direction.

(iii) Coal Reserves

At each drill hole the composite coal quality (including partings) was determined for each subzone. Coal quality between drill holes was interpolated using a modified inverse distance squared procedure.

Plate 3-9 summarizes the in-situ proven and probable pit reserves totalling 720 Mt (790 million tons) above the 9.3 MJ/kg (4000 Btu/lb) cut-off grade. Corresponding marginal reserves are estimated to be 83 Mt (91 million tons) between 7.0 and 9.3 MJ/kg (3000-4000 Btu/lb), 16 Mt (18 million tons) of which are contained within the proposed 35-year pit.

The parameters used in estimating the proven and probable reserves are as follows:

1. An in-situ moisture content of 25 percent was estimated.

2. A regression equation relating specific gravity of coal to ash content was developed:

   SG coal = 1.1704 + (.009577 x percent ash on a dry basis)

3. Cut-off grades employed:

Coal	-	> 9.3 MJ/kg (4000 Btu/lb)
Low-grade coal	-	7.0 to 9.3 MJ/kg (3000 to 4000 Btu/lb)
Waste	-	< 7.0 MJ/kg (3000 Btu/lb)

(c) Mine Planning

A technically feasible mining plan has been developed to deliver 350 Mt (385 million tons) of coal to the powerplant over 35 years.

The principal objectives to be met in developing the mining plan were:

1. Provide for the safety of men and equipment, with particular attention to the stability of pit wall slopes and waste embankments.

2. Supply a sufficient quantity of consistent blended coal over a minimum of 35 years to meet the powerplant requirements at minimum cost to the total thermal/mine project over the same period.

3. Maintain reasonably constant annual total volume of material movement.

4. Maximize the utilization of the coal resource without jeopardizing the future extraction of the remaining coal reserves.

(i) Mining System

The proposed mining scheme is a shovel/truck system working 15 m (50 ft) high benches to feed into unloading stations located over the central conveyor

3.2 MINING - (Cont'd)

system as shown on Plate 3-10. This approach to pit development allows the mining of an average grade of coal and a constant annual quantity of material over the 35-year life with sufficient and continuous exposure of the better-grade D zone coal necessary for coal blending.

A northern exit from the mine would be used for the three conveyor systems for waste, coal and construction material/low grade coal, respectively. A crushing, sampling and blending facility is located adjacent to the mine services area close to the northern pit exit from which blended coal would be delivered to the powerplant by overland conveyor. Conveying and spreading systems would dispose of waste in the Houth Meadows and Medicine Creek dump areas. A separate low-grade coal stockpile would be used to store material ranging from 7.0 to 9.3 MJ/kg (3000 to 4000 Btu/lb), dry basis, for future use.

A series of incremental pits were designed to obtain sufficient suitable coal to satisfy powerplant requirements while at the same time maintaining a practical and economic stripping ratio. Plate 3-11 shows a mine development cross section.

(ii) Mining Quantities

The following quantities were computed for the proposed pit development:

3.2 MINING - (Cont'd)

A. Coal

Total coal mined over 35 years	350 Mt (385 million tons)
Peak annual quantity (Years 7 to 15)	11.4 Mt (12.6 million tons)

B. Waste Materials

Total over 35 years	450 Mm^3 (589 million yd^3)
Peak annual quantity (Year 22)	17.5 Mm^3 (22.9 million yd^3)

C. Total Materials

Peak annual quantity (Year 22)	24.7 Mm^3 (32.3 million yd^3)
Average stripping ratio	1.3 m^3 waste/t coal (1.5 yd^3 waste/ton coal

(iii) Coal Quality

The mean and standard deviations for proximate, ultimate and ash analyses were developed for each of the four major coal zones, (A, B, C and D). The boiler fuel specification, (Plate 3-12) was then developed by weighting each zone in the proportions to be mined in the 35-year pit. The values presented in the fuel specification are weighted mean values and the ranges are plus or minus one standard deviation.

The average quality of blended coal supplied to the powerplant over the life of the project on a dry basis would be:

2.3244 Btu/lb. = 1 Joule/gram

3.2 MINING - (Cont'd)

Heating value	17.0 MJ/kg (7327 Btu/lb)
Ash	36.3%
Sulphur	0.48%

The run of mine (ROM) coal moisture content has been estimated to average 25 percent.

Minor fluctuations from these values would be experienced during different mining periods.

(iv) Pit Slopes

The following slope angles have been adopted for the mine design of the final pit walls based on the investigations and recommendations of the geotechnical consultant, Golder Associates:

Surficials (other than slide debris)	25^{o}
Slide debris	16^{o}
Waste rocks	20^{o}
Coal	25^{o}

These slopes would only be reached when the pit walls are excavated to their final design.

The dynamic slopes employed during the development of the pit were based on the following guidelines.

1. To minimize bench instability along bedding planes, when the dip is out of the mining face, the benches should preferably be aligned such that they are not parallel with the strike of the beds but rather make an angle of at least 20^{o} with that direction.

2. Dynamic slopes of 30° are considered to be acceptable in strong bedded material where the bench alignment follows the above guideline.

3. In the event the dip of the bedding is less than 30° and out of the face, and the strike of the bedding is parallel to or within 20° of the face alignment, the dynamic slopes should be reduced to the slope of the bedding. This precaution is not necessary where the dip of the bedding is less than 20°.

4. Dynamic slopes of 30° in weak waste materials are considered to have adequate short-term stability up to a period of 1 or 2 years.

Recommended slopes for the final pit walls and the dynamic slopes are shown graphically on Plate 3-13.

(v) Waste Disposal

Two major areas have been selected for the disposal of mine waste materials. Houth Meadows, to the northwest of the pit, would be the principal waste disposal area and is planned to receive approximately 70 percent of the waste to be removed. The remaining waste material would be stored in Medicine Creek valley southeast of the pit. Waste would be placed exclusively in Houth Meadows during the first 15 years of operation. Thereafter an increasing proportion would be deposited at Medicine Creek. Neither area is currently planned to be utilized to its ultimate capacity because the swell factors of the materials to be stored are subject to

3.2 MINING - (Cont'd)

confirmation in actual practice. It may prove possible to store all the waste materials in Houth Meadows.

Plate 3-14 shows the slopes and the design criteria used for the construction of the waste dumps. These include:

1. Waste slopes not greater than 10 horizontal to 1 vertical, where dump materials exceed crest height by 80 m (262 ft) or less, and 20 horizontal to 1 vertical, where greater than 80 m (262 ft).

2. Using the graph in Plate 3-14, which shows the relationship of bench height versus angle of repose of dumped Coldwater waste rock, the spreader was designed to deposit material 20 m (66 ft) below floor level operating at a minimum of 5 m (16 ft) from the crest. In addition the spreader will deposit material to a maximum of 15 m (50 ft) above its occupied floor level.

(d) Mine Development

The major activities to be undertaken prior to mining operations include:

1. Construction of creek diversion works (see Section 3.4, Offsites).

2. Implementation of the overall area drainage plan, shown on Plate 3-15, to protect the mining operation from major flood damage while preserving the necessary continuity and quality of the existing natural drainage system in accordance with

3.2 MINING - (Cont'd)

existing environmental guidelines. Major aspects of this plan include:

a. Drainage of lakes on the southwest perimeter of the pit to improve the stability of the west slide areas.

b. Drainage within the mine area by directing adjacent ditches; surface runoff; and leachate from waste dumps, coal storage areas and other surface facilities to sedimentation lagoons.

c. Three waste water treatment systems: a sedimentary lagoon system, a sewage treatment plant and a water recycling system.

3. Removal and stockpiling of all usable topsoil, which would be needed for future reclamation work.

4. Clearing of vegetation would be done as required immediately in advance of operations.

(e) Mining Operations

Plate 3-16 summarizes the mining equipment required at peak capacity. A fleet of support equipment complements the major mining equipment as well as performing functions such as topsoil removal, road construction and maintenance, pit cleanup, bench preparation, dump construction, conveyor moving and equipment servicing in and around the mine.

Plate 3-17 is a system flow sheet which demonstrates how the major equipment would be employed for excavation and in-pit transportation of materials as well as for waste and coal handling operations.

3.2 MINING - (Cont'd)

The total manpower to operate the Hat Creek mine would peak at 1005 from a pre-production low of 749.

(i) Excavation and In-pit Transportation of Materials

1. Where necessary coal and waste materials would be drilled and blasted. Provision has been made for blasting 50 percent of the coal and 10 percent of the waste materials.

2. Coal and waste materials would be excavated using 16.8 m^3 (22 yd^3) electric shovels and loaded into 136 t (150 ton) waste trucks and 109 t (120 ton) coal trucks for hauling to the central conveyor ramp.

3. At the central conveyor ramp coal and waste would be crushed to minus 305 mm (12 in) size and loaded onto one of three parallel conveyors for transportation to the pit-rim distribution point. Each conveyor would be 1200 mm (48 in) wide and have a peak carrying capacity of 5000 t/hr (5500 tons/hr) waste or 3200 t/hr (3500 tons/hr) of coal.

4. At the distribution point the materials would be divided into three streams and transferred to the appropriate outgoing conveyor.

   The three streams would be:

a. Waste.

b. Lowgrade coal.

c. Coal.

(ii) Waste Handling

Waste would consist of three categories of material:

1. Granular surficials.

2. Waste rock (claystone, siltstone and other weak rocks).

3. Waste coal (coal with a heating value less than 7.0 MJ/kg, 3000 Btu/lb).

The waste materials would be transferred to one of two conveyors for transport to the waste disposal area. Each conveyor would feed a stacker to place the material according to a predetermined sequence.

Granular surficial materials would be used to construct an engineered waste retaining embankment. The other weaker materials would be placed behind the embankment.

(iii) Low Grade Coal Handling

Low grade coal has a heating value between 7.0 and 9.3 MJ/kg (3000 and 4000 Btu/lb), and cannot be blended with "coal" and still produce a satisfactory fuel for the powerplant, but for which some alternate future use may be found.

Low grade coal would be transferred from the distribution point to a crusher where it would be reduced to minus 50 mm (2 in) size before transportation to the low grade stockpile area where it would be spread and compacted. The crushing and compaction of low grade coal will be necessary to prevent spontaneous combustion.

(iv) Coal Handling

In order to provide a consistent fuel to the powerplant from a variable deposit special measures are required:

1. The mine must be developed to ensure availability at all times of a range of coals that can be blended to meet the quality specifications.

2. Provision must be made to enable the available range of coals to be blended.

Coal would be transferred from the distribution point to a two stage crushing station and reduced to minus 50 mm (2 in).

The crushed coal would be conveyed to the blending yard, where a pile containing 1 weeks' powerplant supply would be constructed in layers. When the pile is completed coal would be reclaimed using bridge mounted bucketwheel reclaimers, loaded onto a conveyor and transported via the overland conveyor to the powerplant. The stacking and reclaiming procedure would effectively smooth out the short term fluctuations that occur in coal quality over the 1-week period.

Two blending piles are planned with one being built while the other is being reclaimed. Additional storage space would be provided for high heat value/low sulphur coal to ensure the ability of the powerplant to meet MCS operating requirements and to improve the quality of the blend if required. An overflow area would be available to provide additional emergency storage.

(f) Architectural Aspects of the Mine Structures

The layout of the mine buildings has been studied and a concept developed with concern for organization.

For this concept offices, labs and 'clean' areas generally will be separated and located to provide good pedestrian circulation internally as well as a convenient relationship with yards, repair areas, etc. This office-lab complex would act as the focal point at the approach to the mine installation. Private vehicles would approach the administrative area from the access road without passing through the workshop/warehouse area, while heavy vehicles from the mine and blending area would have direct access to the heavy duty areas. Plate 3-18 shows the general arrangement of the mine service area.

The grouping of buildings has concern for distant viewing, particularly from a vistors' lookout suggested for the Harry Lake area some 3 km (2 mi) east of the mine service area.

3.2 MINING - (Cont'd)

A steel frame structural system utilizing preformed steel faced sandwich panels would accommodate all the building types in the mine installation and relates directly to the treatment of the power plant structures, in form, materials, and the use of colour. Those structures vulnerable to the movement of heavy equipment (repair bays, etc.) would be provided with cast-in-place walls from grade to door head height, with steel framed and steel panel cladding for the superstructure.

The layout of storage yards and laydown areas would be designed to take advantage of the natural grades by utilizing cuts and screening mounds to define and conceal them.

It is intended to provide architectural input into the design of ancillary structures, conveyors, equipment, etc. to maintain the principles outlined above.

3.3 POWERPLANT

(a) General

The following description together with basic flow diagrams provides details of the major equipment and systems for the proposed Hat Creek powerplant. It is a summary of Integ-Ebasco's Station Design Manual (SDM) sheets, cost estimate and project specification covered by Appendix B of this report. These documents contain the results of the preliminary engineering work now being completed. During this phase of the work prospective suppliers of the major items of powerplant equipment have provided valuable information for various engineering studies.

Many secondary systems which do not significantly affect the estimated costs or the powerplant layout have not been studied in detail in the preliminary engineering stage.

From a technical standpoint the Hat Creek powerplant is considered ready for release into the final design phase of the work.

(b) Operating Regime

The predicted operating regime for the powerplant is for base load operation with the ability for two-shift and peaking capability in supplying power to a predominantly hydroeletric system. Further details are noted in the latest edition of the Operating Regime Document included in Section 12.0 of this report.

To permit continued powerplant operation under short-term adverse weather conditions a meteorological control system (MCS) is proposed to maintain ambient air quality levels. The basic mode of operation under MCS would be to reduce or redistribute load on the powerplant.

If system conditions do not permit unit load adjustment or total plant load reduction a switch to low sulphur coal would be made.

(c) Site Selection and Orientation

The powerplant site is at an elevation just over 1400 m (4600 ft) on a high, relatively flat plateau on the east side of the upper Hat Creek Valley as indicated on Plate 1-4. Most of the site is lightly forested. The prime reason for the high elevation site some 4 km (2.5 mi) away from the mine is the improved dispersion of stack gases.

3.3 POWERPLANT - (Cont'd)

Plate 3-21 provides details of the powerplant site layout and key plan. Dominant powerplant features will be:

1. The main powerplant building 90 m (295 ft) high x 290 m (950 ft) long.

2. A 244 m (800 ft) high single station stack.

3. Two natural draft hyperbolic cooling towers 134 m (440 ft) high and 102 m (335 ft) diameter.

Plates 3-1 and 3-19 illustrate the powerplant's location relative to the remainder of the project, and a view from the west.

Other powerplant site features would include a station reservoir to the east and an ash pond in the Medicine Creek valley. The main circulating water pumphouse would be adjacent to the cooling towers due south of the main powerplant building. Underground conduits would link to the reservoir. The switchyard would be located west of the powerplant. Space for possible future flue gas cleaning equipment has been allowed behind the stack. Coal would be delivered via an overland conveyor from the mine terminating at a transfer house at the south boundary of the powerplant site.

(d) Main Building Layout

Four 560 MW (gross) turbine generating units would be installed 13 m (42 ft) above grade on the operating floor level and arranged in-line along the length of the turbine hall. Units 2 and 4 would be "mirror images" of 1 and 3.

Two control rooms, one between each pair of operating units would be located in the turbine hall auxiliary bay.

Except for the main boiler feed pumps, the majority of the turbine generator auxiliary equipment would be located below the operating floor level.

Preliminary designs from prospective boiler suppliers have enabled the boilerhouse to be reasonably defined. Hat Creek's low grade coal requires that this structure be unusually high. The boilerhouse enclosure would consist of two main towers each housing two units. The remainder of the main building (auxiliary bay and turbine hall) would be a continuous structure.

Cold side electrostatic precipitators and induced draft fans would be located outside the boilerhouse.

(e) Steam System

Plate 3-23 shows the basic steam/feed system. The main components proposed for the steam system are as follows:

(i) Turbine Generators (4 x 560 MW)

Turbine - tandem compound 3600 rpm, 16.55 MPa (2400 psig), 538°C/538°C (1000°F/1000°F) single stage reheat; full arc admission; four cylinder; high pressure, intermediate pressure and two double flow low pressure exhausts; seven extractions for feedwater heating; one 100 percent steam driven boiler feed pump.

3.3 POWERPLANT - (Cont'd)

Generator - 3-phase, 3600 rpm; 60 Hz; nominally rated 560 MW at 0.85 pf; water cooled stator; hydrogen cooled rotor.

A number of desirable turbine generator design and operating features were brought into focus during 1977 discussions with manufacturers. These included:

1. Separate HP and IP cylinders to better assure that the machines would meet the base load operational requirements and allow the boilers some tolerance in reheat/superheat steam temperature deviations. Such machines would also provide robustness to withstand the more formidable two-shift operational requirements.

2. Partial sliding pressure operation.

3. Provision for the addition (if required later) of a steam by-pass.

4. Full arc admission.

Such features commonly used in Europe, facilitate rapid loading and unloading of the steam turbines and lessen consequential stresses which decrease the machine's operating life.

(ii) Boilers

Preparing the specifications for, and subsequently selecting, designing, erecting, commissioning and operating suitable boilers, is the key to a successful powerplant at Hat Creek. Considerable attention has been given, and further work continues, on this vital aspect.

Close liaison with consultants and suppliers and the results of the burn test programmes have enabled the following main boiler parameters to be established:

Number of boilers	4 (one per generating unit)
Maximum continuous steam output (each)	488.3 kg/s (3,875,000 lb/hr)
Pressure at Super-heater outlet	17.6 MPa (2550 psig) at 540.5°C (1005°F)
Feedwater temperature	252°C (485°F)
Air heater gas outlet temperature (corrected)	149°C (300°F)
Overall efficiency (MCR)	82%
MCR fuel consumption (datum fuel)	450 t/hr (495 tons/hr) each boiler
Coal feeders	gravimetric type 0.9 m (36 in) wide
Pulverizers	8 per unit (4 each side) 7 adequate in "worn" condition for MCR output with datum coal. North American type pulverizer (ring/roll).
Firing	Opposed or tangential
Furnace	Open or divided. Balanced draft. Heat release 18.2 x 10^6 KJ/hr/m^2 to be under 1.6 x 10^6 Btu/hr/ft^2) of floor area. Basket slope 55°. Basket opening 1.2 m (4 ft) minimum

3.3 POWERPLANT - (Cont'd)

Unit Arrangement	Simple tower or close-coupled arrangement. Horizontal convection surfaces. Balanced flue gas flow ensured across the unit. Flue gas velocity through convection surfaces maximum 13.6 m/s (45 ft/s). Tentative furnace gas exit temperature maximum 1204^{o}C (2200^{o}F). No gas recirculation system
Circulation	Natural or controlled
Sootblower	Steam - with shields
Economizer	Plain horizontal tubes
Air heater	Rotary type with special design for high fly-ash burden. Two secondary air, one primary air. Vertical shafts
Precipitator	Two cold electrostatic precipitators (in parallel) per unit
Fans	2 forced draft, 2 induced draft, 2 primary air all electric motor driven

Burn tests were carried out in 1976 at CCRL Ottawa and in 1977 on a 32 MW unit at the Battle River plant of Alberta Power Ltd. Results of these tests were included in the review establishing the above boiler parameters and the proposed boiler fuel specifications.

Discussions were held with the boiler supplier and others re the large units at the Centralia plant of Pacific Power and Light where difficult low-grade coal with several similar characteristics to Hat Creek coal has been burned for approximately 7 years.

Each major boiler supplier has reviewed Hat Creek coal and boiler design requirements three times as conceptual and preliminary studies have proceeded.

Based upon the above proposed 560 MW Hat Creek boilers the burning of blended raw datum coal is viable.

Coal quality factors and coal handling systems for the project are described fully in Appendix D and are summarized in Sub-sections 3.5 and 3.6 herein. Plate 3-26 indicates the basic powerplant coal handling scheme.

(f) Feedwater/Condensate System

Plate 3-23 herein shows the basic feedwater/condensate system. Feedwater heating would be accomplished in a seven stage system consisting of two high pressure and four low pressure horizontal shell and tube heaters, and one direct-contact deaerating feedwater heater with storage capacity.

Cooling tower/cooling system/turbine generator optimization studies have resulted in the selection of dual pressure condensers with cooling water flowing in series through the two condensers to produce an average turbine back pressure of 10.15 kPa (3 in Hg) absolute under design summer conditions.

Other major items of the feedwater/condensate system would be:

1. A single 100 percent capacity steam turbine driven main boiler feed pump per generating unit.

2. A single 100 percent electric motor driven booster feed pump located on the suction side of the main pump to eliminate cavitation.

3. For very low unit loads and to top up the boilers on shut-down, each pair of generating units would share the services of two 10 percent capacity electric feed pumps.

(g) Cooling Water System

The basic powerplant cooling water system (Plate 3-25) would be of the closed circuit type utilizing natural draft cooling towers drawing makeup water from the station reservoir. The main tower and pump parameters would be:

(i) Cooling Towers

Type - Hyperbolic, natural draft, counterflow.

Number - Two (for 2240 MW installed) with each tower handling the heat rejection from two 560 MW generating units.

Performance at ambient conditions and MCR steamflow to all turbines:

Design ambient conditions:	Wet bulb	13.9°C (57°F)
	Relative humidity	60%
Heat rejected to each tower at design point		1506 MW 5423 GJ/hr (5145 MBtu/hr)
Design approach to wet bulb		12.8°C (55°F)
Water entering 1st stage condenser at design point		26.7°C (80°F)
Water leaving 2nd stage condenser at design point		45.6°C (114°F)

3.3 POWERPLANT - (Cont'd)

Design cooling range	18.9°C (66°F)
Design water flow to each cooling tower	18 930 L/S (300,000 USgpm
Maximum cooling tower water flow as percentage of design water flow	150%
Minimum continuous heat load for winter conditions (without bypass) as percentage of heat rejected to each tower at design point	25%
Capacity of bypass system as percentage of design flow	100%
Relation between directions of air flow and circulating cooling water flow	Counterflow
Cooling tower shell	Reinforced concrete hyperbolic shells: 134 m high (440 ft) 102 m dia. (335 ft)
Cooling tower fill material	Non-combustible

(ii) Circulating Water

No. of circulating water pumps	4
Capacity of each circulating water pump	9463 L/S (150,000 USgpm)

(h) Waste Disposal System/Water Balance

The powerplant site selection study indicated that, because of the rate of evaporation compared to natural precipitation in the Hat Creek area, the project could be designed for zero liquid discharge. As a result preliminary engineering has proceeded with this target. All powerplant effluents and wastes would be contained. Any occasional discharges to surface waters would first be treated to acceptable quality levels. Cooling tower blowdown and other effluents would be collected for use in the ash sluicing system. Plate 3-27 shows the present powerplant water balance.

Studies are continuing on the water balance effects of an alternative ash disposal system in which ash would be disposed of, in conjunction with some of the mine waste, in the lower Medicine Creek valley.

Chemicals, lubricating oils, fuel oils and liquids other than water, whether mixing with water or not, would encounter containing structures and devices to separate and retrieve such substances and discharge the residual water for reuse.

A separate system to collect and handle storm drain water would ensure that these are not contaminated prior to discharge to existing water courses.

(j) Ash Systems

The base scheme ash removal system would convey bottom ash and fly ash from the powerplant by sluicing through pipelines to an ash pond in upper Medicine Creek some 3 km (2 mi) from and 180 m (590 ft) below the plant site. The pond may be designed to keep bottom ash and fly ash separate for future reclamation of fly ash should it be required for other industrial uses.

As continuous bottom ash removal from the boilers would be a crucial operating factor in burning raw Hat Creek coal, additional emergency bottom ash disposal facilities, for a few days' full load capacity, would be provided as close to the boiler house as possible. The details of the ash removal system from below the boiler furnace is under study.

At full load with typical coal, the 2000 MW (net) plant would produce about 12 000 t/day (13,200 tons/day) of ash of which about 3000 t (3300 tons) would be bottom ash and 9000 t (9900 tons) fly ash (Plate 3-29). The ash handling and disposal systems would be, therefore, of unusually high capacity. When mine waste disposal plans are finalized the extent to which ash disposal may be correlated with mine and other waste disposal will be reviewed. Considerable capital and operating cost savings may result and environmental impacts may be lessened by adopting the dry ash disposal scheme referred to in Sub-section 3.3(h).

Potential uses of Hat Creek ash are under study.

(k) Air Quality

Plate 3-22 shows the main atmospheric emissions from the powerplant when burning datum coal. Of particular concern in the powerplant's ability to maintain ambient air quality levels are stack emissions of:

- Sulphur dioxide (SO_2)
- Oxides of nitrogen (NO_x)
- Particulates
- Trace elements

The Hat Creek base scheme powerplant air quality protection features would include:

3.3 POWERPLANT - (Cont'd)

1. A high stack 244 m (800 ft), with four separate flues for maximum plume rise.

2. Cold side electrostatic precipators for particulate removal.

3. Special design features in the boilers to inhibit NO_x production so that permit emission levels will not be exceeded.

4. A space allocation for future installation of flue gas cleaning or sulphur reduction equipment should it be needed.

Hat Creek flue gases before cleaning would have high particulate loading due to the high ash content of the coal. From the CCRL and Battle River tests including precipitator tests it appears that fly ash would have high electrical resistivity characteristics between 10^9 and 10^{12} Ωcm. Size and shape of fly ash particles, however, indicate feasible application of cold electrostatic precipitators.

The alternative of fabric filter type dust collectors, baghouses, is considered attractive and this would be pursued in the final design phase of the work.

Discussions with manufacturers of electrostatic precipitators, and baghouses, indicate that for Hat Creek particulate removal could be done with available equipment and result in stack emissions within mandatory requirements.

Emission data and design considerations such as suitable linings for the four-stack flues have been based upon gas temperatures compatible with the use of cold electrostatic precipitators.

Normally trace element emissions/discharges are not a problem for coal-fired powerplants. The test programme at Battle River was used to analyze trace element content and behaviour in the boiler and precipitator. Practical data from other coal-fired plants is now being assembled. Appendix E covers the trace element, and other environmental study work in detail.

(l) Controls and Instrumentation

Two plant control rooms, one for Units 1 and 2 and one for Units 3 and 4, would be provided on the operating floor level.

The Units 1/2 control room would be designated the master control room and all station common services would be controlled from this room. In addition all 500 kV switching, under the direction of System Control at Burnaby Mountain, would be controlled from the master control room.

(m) Auxiliary Fuel System and Auxiliary Boilers

Fuel oil would be used for ignition and warmup of the main 560 MW boilers as well as for the auxiliary boilers. The latter would provide steam for essential services, such as building heating, when the main boilers were out of service.

Natural gas is desirable and remains as a possible auxiliary fuel.

Study is proceeding on the use of an auxiliary pulverized coal system for ignition and stabilization in order to minimize the use of oil (or gas) as auxiliary fuel.

3.3 POWERPLANT - (Cont'd)

(n) Water Treatment

The powerplant water treatment facilities (Plate 3-24) would be conventional and include.

- boiler feedwater pre-treatment
- boiler water dosing and control
- condensate polishing in the feedwater system
- circulating water/cooling tower treatment

(o) Fire Protection System

Two 1900 m^3 (2480 yd^3) permanent elevated outdoor storage tanks adjacent to the powerhouse would provide fire protection and water for construction purposes. Wells in the area would be the temporary source of water. On completion of construction these tanks would revert to only a fire service system for the powerplant and its immediate surroundings and be fed from the station reservoir. To ensure reliable delivery of fire service water the pumping installation would comprise one full duty electrically driven fire pump and one full duty diesel engine driven fire pump.

(p) Civil and Structural Work

(i) Site Conditions

The powerplant site is on a gently sloping area northeast of Harry Lake, allowing ample space for auxiliary equipment layout. If station expansion should be considered in the future, sufficient space is available. Bedrock is at very shallow depths over most of the site 0.5 m (1.5 ft) and consists of fractured mylonitic and graphitic phyllite.

3.3 POWERPLANT - (Cont'd)

(ii) Powerplant Main Buildings

The powerplant main building foundations would be reinforced concrete spread footings and mats. The boilers would be top-supported with the boiler support steel designed to also carry the building loads. Lateral restraint against wind, earthquake and general stability loads would be provided by bracing in the vertical and horizontal planes.

In general, structural steel connections would be bolted, using friction-grip bolts to facilitate fast erection and provide high tolerance to load reversals during the life of the powerplant.

Turbine-generator reinforced concrete foundations would be designed so that operating frequencies of vibration would not produce excessive resonant deflections in the foundations.

The powerhouse main building would be clad with insulated panels.

(iii) Circulating Water System

The makeup water pumphouse would be situated at the powerplant reservoir. A reinforced concrete intake structure would include a culvert designed to accommodate about 16 m (50 ft) of drawdown. Buried pipes would deliver the makeup water to the basins of the cooling towers.

A reinforced concrete hyperbolic shell, asbestos cement packing and reinforced concrete basins are proposed for the two natural draft cooling towers which would be designed for extreme wind and ice conditions.

(iv) Stack

The proposed four-flue stack would consist of a reinforced concrete outer shell, 244 m (800 ft) high, and ranging in diameter from 30 m (100 ft) at the base to 23 m (75 ft) at the top. There would be four steel liners about 7 m (25 ft) diameter. The stack would be equipped with an elevator, ladder, access platforms, aviation warning lights and flue gas sampling ports.

(v) Meteorological Criteria for Civil Design

Based on short term records for wind, snow, rain and temperature, correlations and extrapolations were made with National Building Code of Canada Design Data for Ashcroft, Cache Creek, Kamloops and Lillooet, to produce preliminary civil design data for extreme conditions.

The 100 m (330 ft) high meteorological mast now erected near the powerplant site will provide more data on meteorological conditions for the final design stage of the work.

(q) Architectural Aspects of the Powerplant

Plate 3-20 shows the powerplant architectural site plan. Architectural aspects will be correlated to ensure aesthetic quality and compatibility with local conditions.

3.3 POWERPLANT - (Cont'd)

Preliminary studies completed include the following recommendations:

1. The proposed location of the cooling towers permits the development of a landscaped area immediately inside the entrance gate separating the cooling towers from the power-plant. The spacing from the face of the cooling towers to the face of the power building would permit a suggested fore-court capable of accommodating the proposed guardhouse/tourist centre facility, and would be in scale with the elements of the plant.

2. The administration and service building would be adjacent to but acoustically separated from the main building. The workshop would be located directly adjoining the powerplant, permitting level access from auxiliary bay basement.

3. The location of the approach and service roads within the plant have been proposed as shown.

4. A visitors' centre and parking are proposed adjacent to the guardhouse.

Recommendations regarding location of conveyors and treatment of conveyor enclosures, transfer structures and other site buildings would be made later.

(r) Electrical

(i) 500 kV and 60 kV System

Plate 3-28 shows the basic electrical one line diagram. The powerplant would be connected to the 500 kV line from Kelly Lake to Nicola Substation. The first line would be routed into Hat Creek approximately 9 months ahead of first steam to set.

The open type 500 kV switchyard would be arranged so that power from any of the four turbine generators may be fed to the system from any of four transmission lines.

A 60 kV switchyard would be established at the southeast corner of the 500 kV switchyard and would supply various project auxiliary loads including the mine, startup and standby transformers, makeup water pumphouse at the reservoir and ash sluicewater pumphouse. Power for this switchyard would be drawn through two 100 percent 500 kV/60 kV 3-phase stepdown station transformers.

(ii) Main Transformers

The main unit transformers would be three single-phase water-cooled units connected to the generator by natural air-cooled isolated-phase rigid bus.

(iii) Startup and Standby Transformers

Four 60 kV/6.9 kV 3-phase transformers would be provided for station startup and standby services on a two for two units basis.

(iv) Station Electrical Power Distribution

The high voltage distribution system for the powerplant would be at 6.9 kV.

The medium voltage distribution system for loads less than 150 kW (200 hp) would be at 600 V.

3.3 POWERPLANT - (Cont'd)

(v) Emergency Power System

Upon loss of normal ac supplies 125 dc batteries (two per generating unit) would supply power for an orderly shutdown of the units.

Four 600 kW diesel generator sets (one per generating unit) would supply essential station services during prolonged loss of ac power. Startup of the diesel generator and transfer of supply from normal to emergency would be automatic, with provision for manual return to normal ac supply.

3.4 OFFSITES PROJECT DESCRIPTION

(a) General

Brief descriptions are given below of those parts of the offsite facilities which have been active in the preliminary engineering phase and reported in greater detail in Appendix C.

The offsite facilities are a vital and varying support feature of the overall project. Their environmental impacts are prominent and ongoing work in certain areas is necessary.

(b) Cooling Water Supply

A system would be required to supply the makeup cooling water needed for evaporative cooling at the powerplant. The system would comprise:

1. Pier-type intake structure and pumphouse just north of Ashcroft in the Thompson River.

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

2. High pressure pumphouse near intake.

3. Second high pressure pumphouse west of Trans-Canada Highway (half of total head).

4. Pipeline and related equipment from the intake at Ashcroft to a reservoir near the powerplant.

5. Pumps, motors, power supply, etc.

The system would be capable of delivering water continuously at a rate of 1580 L/s (25,000 USgpm) to the reservoir near the powerplant. As the working range of the reservoir would cover about 70 days of maximum makeup requirement at 78 percent of full load, there would be flexibility in the withdrawal of water from the Thompson River.

Summary of System Parameters:

Maximum flow rate of water from the Thompson River discharged to the station reservoir (equivalent to 1.4 percent of lowest recorded flow)	L/s USgpm	1580 25,000
Elevation difference	m ft	1083 3553
Total pipeline length	km mi	23.5 14.6
Pipe diameter	mm in	800 32
No. of booster pumping stations		2
No. of booster pumps in each station		4
Installed power of each booster pump	kW hp	3600 4800

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

No. of low-lift intake pumps in intake structure		5
Installed power of each intake pump	kW	170

Some of the more important makeup system features which have been evaluated in detail include:

1. Preferred location for the intake.

2. Various types of intake structure, including model studies to demonstrate the suitability of the proposed structure to the authorities having jurisdiction relating to fish.

3. System configuration and pumping stages.

4. The pipeline route.

5. Means to control water hammer.

6. Means to remove suspended material in the river water to reduce wear on the high pressure pumps.

(c) Water Supply and Ash Disposal Reservoirs

(i) Water Supply Reservoir

The water supply reservoir would be situated in a small valley southeast of the powerplant. The reservoir would be formed by a main dam at the south end of the valley and a small saddle dam at the north end.

The criteria for the water supply reservoir would be as follows:

Maximum normal reservoir level		-	El. 1372.0 (4500 ft)
Minimum reservoir level		-	El. 1356.0 (4448 ft)
Drawdown range		-	16.0 m (52 ft)
Live storage		-	7.5 x $10^6 m^3$ (1980 x 10^6 US gal)
Dam crest		-	El. 1374.0 (4508 ft)
Main Dam	- maximum height	-	47.0 m (154 ft)
	- crest length	-	790.0 m (2592 ft)
Saddle Dam	- maximum height	-	17.0 m (56 ft)
	- crest length	-	230.0 m (750 ft)

Site investigations at the two damsites indicate no particular foundation problems and the recommended modified homogeneous cross-sections were selected, therefore, on the basis of construction material availability. The total earthfill requirements for the two embankments would be approximately 1.7 Mm^3 (2.2 million yd^3) with over 90 percent of this volume in the main dam. Although no overflow would normally occur spillway facilities with a discharge capability equivalent to the maximum Thompson River supply pipeline capacity would be provided.

(ii) Ash Disposal Reservoir/Pond

The ash disposal reservoir/pond would be located in upper Medicine Creek valley. Fly ash and bottom ash would be delivered to the disposal area as an aqueous slurry. A water-tight embankment would be required to store all ash from 35 years of operation of the powerplant.

As for the water supply dams no significant foundation problems are anticipated and the modified homogeneous dam cross section was selected again on the basis of construction material availability. Rather than constructing the ash dam in four stages as originally planned, three stages have now been adopted, thus eliminating a comparatively small and costly fourth stage. Data on the three embankment stages are summarized as follows:

		Stage 1	Stage 2	Stage 3
Date completed		1985	1996	2006
Crest elevation	(m)	1250	1264	1275.6
	(ft)	4100	4147	4185
Crest length	(m)	385	435	490
	(ft)	1263	1427	1608
Maximum height	(m)	56	71	83
	(ft)	184	233	272
Cumulative dam volume	(Mm^3)	2.0	3.5	4.3
	(Myd^3)	2.6	4.6	5.6
Reservoir storage volume	(Mm^3)	29	60	98
	(Myd^3)	38	78	128

Runoff handling facilities for the ash disposal reservoir would comprise a total of about 11.6 km (7.2 mi) of perimeter canal located immediately above the ultimate ash pond level of El. 1273.5. Because of the perpetual need for these canals, they would be designed with a capacity sufficient for the probable maximum flood.

(d) Creek Diversions

Development of an open pit mine in the middle of the Hat Creek Valley would require the diversion of Hat and Finney creeks around the proposed excavations. Several alternatives were reviewed for this diversion and the canal scheme selected for preliminary design.

The proposed Hat Creek diversion canal scheme would comprise a 16 m (53 ft) high headworks dam on Hat Creek immediately downstream of Anderson Creek, a 6375 m (4 mi) long lined canal on the east side of the valley and a 1930 m (1 mi) long discharge conduit to return the flow to Hat Creek downstream of the pit. Inflows downstream of the canal headworks would be intercepted by a 13 m (43 ft) high earthfill dam near the pit rim and would be pumped up to the canal.

The headworks dam would be a zoned earthfill embankment having a concrete canal intake structure on the east abutment.

The canal would be located generally along the 975 m (3200 ft) contour in order to avoid the steep bluffs east of the pit and to minimize infringement of the pit perimeter. The canal would be sealed with impervious fill and plastic sheeting. The design capacity would be 18 000 L/s (636 cfs), with a maximum capacity of 27 000 L/s (954 cfs), which represent the 100-year and 1000-year floods respectively.

Including a service road on the uphill side and an access road on the downhill side, the overall width of the canal would vary from about 36 to 60 m (120 to 200 ft). With development of open pit No. 1 beyond the 12-year stage, pit infringement would require realignment of the canal, or replacement of a portion of the canal by a tunnel some 1400 m (4600 ft) in length.

From the end of the diversion canal, which would be expanded and deepened slightly to provide a sedimentation basin, the diversion flows would pass through a conduit intake structure and some 1930 m (6330 ft) of buried conduit, then discharge into an energy dissipating outlet works and flow via a short length of excavated open channel back to Hat Creek. The overall drop from the canal to Hat Creek would be about 155 m (509 ft).

Runoff from Finney Creek would be intercepted and diverted to the Hat Creek diversion scheme at the headworks dam.

(e) Project Access Road

(i) General

Two alternatives are being considered for road access to the project; use of the existing Highway 12 or construction of a new road from Highway 1 at Ashcroft Manor via Cornwall, MacLaren 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 power-plant near Harry Lake.

New road would be two-lane, paved and designed to 80 km/h (50 mph) Department of Highways standards suitable for a 300 t (330 ton) lowbed transporter. The maximum grade would be 8 percent.

The usual signs, guard rails and white lines would be provided throughout the length of the road. Spur roads would be provided for access to the various installations.

It is assumed that the main access road would become a public road, owned and maintained by the Department of Highways following construction of the project.

(ii) Cornwall Creek Route

The Cornwall Creek route would commence from the west side of Highway 1 (Trans-Canada Highway) near Ashcroft Manor and proceed up Cornwall and MacLaren creeks and along the north side of Medicine Creek, past the powerplant site. It would then continue down past the mine mouth area and join Highway 12 at the north end of the Hat Creek Valley. The length of new road would be about 31 km (19.5 mi) from Ashcroft Manor to Highway 12. The project complex map (Plate 1-3) shows the western half of the proposed route.

(iii) Highway 12 Route

The Highway 12 route would utilize the existing Highway 12 road from its origin on Highway 97 to its junction with the Hat Creek Valley road, a distance of approximately 20 km (12 1/2 mi). From this point 10 km (6 mi) of new road would be required to provide access to the powerplant. This latter section would be identical to the western part of the Cornwall Creek route.

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

(iv) Comparison of Alternative Routes

The main advantages of the Cornwall Creek alternative would be:

1. The route would not pass directly through any Indian Reserves.

2. It would provide a shorter access route to the project from Cache Creek, Ashcroft and Vancouver.

3. Traffic from the project would not have to travel through Cache Creek to reach the Trans Canada Highway.

The main advantages of the Highway 12 route would be:

1. A direct construction cost saving over the Cornwall Creek route of about $10 million.

2. The route would require much less land for new right-of-way and would as a result have less environmental impact.

3. It would provide a more direct and shorter access route between the project and the provincially owned BCR railhead facilities at Clinton.

A decision on the route for the project access road would have to be made prior to the project license application.

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

(f) Equipment Offloading Facilities

During the construction phase, most of the material and equipment for the project would be shipped from the suppliers by rail. The nearest rail line at Ashcroft is some 32 km (20 mi) from the project site. The distance and terrain make it uneconomical to construct a spur line into the Hat Creek project site. Consequently, all rail shipments would be moved by road from the convenient point on the railway.

The offloading facilities required would consist of a level area adjacent to the railway approximately 3 ha (7 1/2 acres) in size, a 350 m (1150 ft) rail spur, a 300 t (330 ton) unloading crane and a lowbed truck of similar capacity. The offloading area would be fenced and used as an interim storage yard for materials and equipment. A firm site has not been selected and the three major railways would be asked to submit proposals for the required facilities.

(g) Airstrips

At the commencement of the preliminary design phase it was recognized that the existing temporary airstrips in the Hat Creek Valley and at Ashcroft would not be suitable for the air traffic that would be generated by the Hat Creek project. Therefore, if a new airstrip was not constructed closer to Hat Creek, all project air traffic would have to land at Kamloops airport which is approximately 1 1/2 hours drive from the site. Furthermore the existing Ashcroft airstrip would not be suitable to meet the future needs of the local communities. It was therefore concluded that possible airstrip sites that would satisfy both community and project needs should be investigated in preliminary design. The decision on whether or not to provide an airstrip as part of the project facilities would not be made until the decision is made to proceed with the Hat Creek project.

If an airstrip were provided it would have a Class C runway suitable for the daylight operation of most executive-type jet aircraft. There are two potential sites, both of which would satisfy the project need for an airstrip relatively close to the Site.

(i) Site A

Site A is located on a terrace on the Cameron Ranch property at El. 625 (2050 ft) approximately 14 km (9 mi) south of Cache Creek and 1 1/2 km (1 mi) west of Highway 1. It is the closest site to the proposed Cornwall Creek route for the project access road. The runway would be 1500 m (4900 ft) long and 30 m (98 ft) wide. It would not be possible to extend the runway beyond 1500 m and the site would not be suitable for instrument flight rules because of the approach/takeoff slope angles. The project complex map shows the proposed location.

(ii) Site C

Site C is located on the Semlin Ranch property at El. 520 (1706 ft) adjacent to Highway 1 and approximately 4 km (2 1/2 mi) east of Cache Creek. Transport Canada advise that this site could be developed for a 1500 m (4900 ft) visual flight runway and could be extended to 1800 m (5900 ft). Also 900 m (2950 ft) of the runway would meet the requirement for instrument flight rules. Therefore there is a potential for limited night operation with this site.

The distances from both airstrips to the local communities and the project would be as follows:

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

		DISTANCE			
		Kilometres From Site		Miles From Site	
		A	C	A	C
To Ashcroft		9	15	6	9
Cache Creek		14	4	9	2 1/2
Powerplant:	via Cornwall Creek	22	37	14	23
	via Highway 12	58	48	36	30
Mine :	via Cornwall Creek	30	45	19	28
	via Highway 12	47	37	29	23

Both sites would be relatively close to the existing communities. Site C would be closer to Cache Creek. Site A would be closer to the project if the Cornwall Creek route were adopted for the project access road. Site C on the other hand would be closer to the project if Highway 12 were used for project access.

(h) Transmission Lines

(i) 500 kV Transmission Lines

Ian Hayward & Associates' report on the corridor for the 500 kV lines between Nicola and Kelly Lake, including the loop to Hat Creek switchyard has been discussed at public meetings and with governmental resource agencies. It has been accepted. Route selection within the corridor is proceeding. The project layout map (Plate 1-4) shows the route selected for the 500 kV lines past the Hat Creek powerplant site.

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

(ii) Mine Supply and Powerplant Construction Power 69 kV Lines

Site construction supply would be tapped from the existing 60 kV Carquille to Seton line at Highway 12. A short single-circuit line would feed a 60/12.6 kV substation to be established east of the mine area. The substation would eventually be used for the permanent electrical supply to the mine.

Two overhead lines would transmit the construction electrical power from the main substation up to the powerplant site and these lines would be used eventually for the permanent 60 kV supply from the powerplant to the mine and overland conveyor system.

(iii) Makeup Water Pumphouse 69 kV Power Supply and Distribution

Electrical power for the pumping system would be supplied from the proposed Rattlesnake Substation near Cache Creek. The electrical system would consist of transmission lines feeding incoming supply substations located at No. 1 and No. 2 booster stations, power distribution and motor control centres, and nine unit substations located along the pipeline. A 69 kV pole line would extend south from the Rattlesnake Substaion to a point where it would split into two 69 kV pole lines to the incoming supply substations located at the booster pumping stations.

(i) Construction Camps

During the construction phase of the project, camps would be provided by B.C. Hydro for the construction workforce for the powerplant and the mine. Because of different labour jurisdictions and travel distances, separate camps would be required for the powerplant and the mine.

The powerplant construction camp would be located on sloping ground on the west of the construction site, and would be within walking distance of work areas. The camp would require an area of approximately 500 by 310 m (1640 by 1020 ft) and would provide facilities for up to 1820 single men.

The mine camp would be located northeast of the mine in a pine forest which would screen the camp from the new project access road, powerline and conveyor right-of-way. The mine camp would require an area of approximately 300 by 200 m (985 by 656 ft) and provide facilities for up to 500 single men.

Both camps would consist of a centrally-located kitchen/cafeteria complex, with a recreational hall nearby. Bunkhouses would be located around this complex and each camp would be surrounded by an access road with parking facilities. The space between camp units would be 8 to 10 m (25 to 30 ft) to provide fire breaks and privacy. Camp services - water, electric power, sanitary sewers and telephone services would be designed to function with the optimum camp development or with only the core of the camp installed. Additional residential units could be added and removed as required by the manpower schedule. Water supply for the camps (and the powerplant construction needs) would be obtained from wells in the Hat Creek Valley and pumped to storage near the camps.

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

(j) Residential Facilities

Specific areas have not been studied for potential "townsites". Some 250 permanent powerplant staff and up to 1000 mining and related services personnel would eventually be employed on the project.

The potential for, and problems of, adding population to the adjacent towns and villages are addressed in Appendix E.

(k) Tourist Facilities

It has been assumed that the Hat Creek project would generate considerable public interest, and it is expected that tourist facilities would be provided.

Plate 3-31 shows a proposed visitor's centre adjacent to the powerplant and two possible lookouts.

(l) Architectural Aspects - Offsite Facilities

The relationships of the water supply system from Thompson River, water intake structure and booster pump stations to their immediate surroundings would be given precedence over their relationship to the other more remote structures in the powerplant and mining facilities.

For the water intake structure, Plate 3-30, the architectural concept would be directed toward recalling in form, colour, and texture, the cliffs in the immediate background. This would be accomplished by the use of textured precast panels, moulded and coloured to match the natural cliff face.

The high pressure pumping station would also be designed to blend in colour and texture with its immediate surroundings,

3.4 OFFSITES PROJECT DESCRIPTION - (Cont'd)

once again through the use of precast, precoloured concrete panels. The building would be located to provide a switchyard area at an intermediate elevation between building and natural cliff face, providing visual screening of the switchyard equipment from the surrounding area.

The clarifier and clear well would be located on the upper bench, partially screened by landscaped berms moulded to tie in with the surrounding terrain. Care would be taken to balance cut and fill.

The intermediate pumping station west of the Trans-Canada Highway would be similar in treatment to the main pumping station, using form materials and grading to blend into the landscape.

Overall, the architectural concept would be directed toward integrating the manmade elements with their natural surroundings.

3.5 COAL QUALITY

(a) General

The quality of the coal to be supplied as boiler fuel has a major impact on the design and economics of both the mine and the powerplant. Because of the wide range of variability of the coal in the Hat Creek No. 1 Deposit, it is possible to produce a number of fuels of different quality. To form a basis for the selection of the datum fuel the following objectives were established:

3.5 COAL QUALITY - (Cont'd)

1. The boiler fuel must be within design capability for conventional North American boilers and pulverizers.

2. A consistent quality of coal within specified tolerance limits must be supplied in the quantities required by the powerplant as the datum fuel.

3. Maximize utilization of the resource.

4. Minimize adverse environmental impacts.

5. Minimize the cost of energy generated which requires a careful balancing of capital and operating cost factors between the mine and the powerplant.

(b) Investigations

An extensive programme of investigations was conducted to establish the parameters for the selection of the datum fuel:

(i) Mining

1. The cut-off grade was established at 9.3 MJ/kg (4000 Btu/lb), on a dry basis. A category of low-grade coal was established for material between 7.0 and 9.3 MJ/kg (3000 and 4000 Btu/lb) which would be stockpiled for possible future use.

2. Several mining sequences were evaluated to produce a consistent quality of coal over the life of the project.

3. A coal blending scheme was developed to reduce short-term fluctuations in quality of coal mined.

3.5 COAL QUALITY - (Cont'd)

(ii) Coal Beneficiation

1. Extensive laboratory testing of the washability and size consist characteristics was performed on six 5 t (6 ton) augered samples of coal.

2. Pilot scale washing tests were performed, in 1976 by Birtley Engineering and in 1977 by Energy, Mines and Resources, using two different processes to provide verification of the laboratory results.

3. The costs and efficiency of several possible beneficiation processes were evaluated.

4. Tailings production and treatment tests were conducted during the 1977 pilot-scale washing tests at the Western Research Laboratory of Energy, Mines and Resources in Edmonton, Alberta.

(iii) Combustion Studies

1. Three raw and three washed coal samples from the 1976 bucket-auger program were tested in the pilot-scale boiler at the Canadian Combustion Research Laboratory in Ottawa, Ontario.

2. A 6300 t (7000 ton) bulk sample from surface trenches was burned under closely monitored conditions in a 32 MW unit at the Battle River plant in Alberta.

(iv) Summary of Results

1. A practical mining and blending plan was developed to produce 350 Mt (385 million tons) of coal over

35 years at an average calorific value of 17.0 MJ/kg (7327 Btu/lb) on a dry basis with 36.3 percent ash, 0.48 percent sulphur. As received moisture is estimated to be 25 percent.

2. Hat Creek coal can be beneficiated and blended to produce a range of different fuels up to 20.9 MJ/kg (9000 Btu/lb) dry basis.

3. The quantity and method of disposal of tailings from any coal beneficiation process present a major problem. The only potentially acceptable method of treating the tailings would require confirmation by pilot plant centrifuge tests prior to final design.

4. Coal averaging 15.2 MJ/kg (6524 Btu/lb), with 43.0 percent ash, dry basis, and a received moisture of 21.8 percent burned satisfactorily in the Battle River tests and no material handling problems were encountered.

5. Important boiler and ancillary equipment design data was obtained during the bulk burn test.

(c) Evaluation of Alternatives

There are basically three different products that have been considered as powerplant fuel. These are:

1. Blended run-of-mine coal at 17.0 MJ/kg (7327 Btu/lb) on a dry basis.

3.5 COAL QUALITY - (Cont'd)

2. A partially beneficiated A, B and C zone coal blended with raw D zone coal to produce fuel at approximately 18.4 MJ/kg (7900 Btu/lb) on a dry basis.

3. A fully beneficiated A, B and C zone coal blended with raw D zone coal to produce fuel at approximately 20.9 MJ/kg (9000 Btu/lb) on a dry basis.

The key factors to be weighed in selecting the optimum fuel for the powerplant are reviewed in the light of the objectives previously stated in Sub-section 3.5(a).

(i) Calorific Value of Product

The higher calorific value products are lower in ash content and are also better from a powerplant design, efficiency and operation point of view; but not to the extent that a significant change in basic powerplant design could be anticipated. All the fuels are considered to be within the heating value/ash limits of current North American designs.

(ii) Resource Utilization

Resource utilization measures the percentage of the resource that will be burned after allowance for mining and process losses. Any processing reduces the degree of resource utilization.

(iii) Tailings Production

Larger tailings production increases the degree of reliance on a relatively unproved dewatering process for which there is no acceptable alternative. Any process that washes fine coal significantly increases the quality of tailings.

3.5 COAL QUALITY - (Cont'd)

(iv) Sulphur Content

Some reduction in sulphur content can be achieved by beneficiation. This reduction would not change the powerplant design but could adversely affect the performance of the electrostatic precipitators in the present base scheme.

(v) Moisture Content

The difference in the moisture content of the fuels is not large, but increased moisture has the potential to increase coal handling problems and reduce the heating value of as received coal.

(vi) Additional Mining Quantity

An additional quantity of coal must be mined to compensate for process losses.

(vii) Costs/Benefits

Capital and operating costs for the alternative beneficiation schemes were developed and the additional mining costs estimated. Only the benefits of the partial washing scheme have been evaluated. The additional costs of beneficiation significantly outweighed the benefits.

Further beneficiation cost/benefit studies are recommended.

(d) Recommended Datum Fuel

It is recommended that blended run-of-mine coal be adopted as the datum fuel for boiler design and mine planning for the following reasons:

3.5 COAL QUALITY - (Cont'd)

1. The calorific value of 17.0 MJ/kg (7327 Btu/lb) on a dry basis, is within the design capability of North American boiler and pulverizer manufacturers.

2. A consistent quality of coal with minimal variations can be supplied to the powerplant provided proper planning and control is exercised in the mine.

3. The level of resource utilization is better than the alternatives evaluated.

4. The environmental impacts are known and appear acceptable. The impacts of the alternatives have not been assessed.

5. The use of blend run-of-mine coal is expected to produce the lowest energy cost and, with appropriate attention to powerplant design features, good plant availability.

(e) Datum Fuel Parameters

The Boiler Fuel Specification will provide the information required for boiler and pulverizer design. The data required to prepare this specification has been developed for the recommended datum coal based on the completed mine plan utilizing the full range of analytical and test results available.

Datum Fuel Parameters - Summary

Calorific Value	-	dry basis	17.0 MJ/kg (7327 Btu/lb)
	-	as received	12.8 MJ/kg (5495 Btu/lb)
Ash content	-	as received	27.3 percent
Moisture content	-	as received	25.0 percent
Weight of as-received coal/heating value			78.3 kg/GT (182.0 lb/MBtu)
Weight of ash/heating value			21.4 kg/GJ (49.7 lb/MBtu)
Weight of moisture/heating value			19.6 kg/GJ (45.5 lb/MBtu)

3.5 COAL QUALITY - (Cont'd)

The complete data for proximate, ultimate and ash analyses are presented in Appendix D together with an analysis of the size distribution of the product to be delivered to the powerplant from both the blending and dead storage piles.

3.6 COAL HANDLING

(a) General

The overall project coal handling system must ensure availability of coal of adequate quantity and quality in the boiler silos to meet all operating needs.

Open pit No. 1 would provide coal for the 2000 MW powerplant, located 4 km (2 1/2 mi) east and 550 m (1800 ft) higher than the pit surface. The high ash content, the predominance of clay in the ash, and the Hat Creek climate variations must be considered in the overall system design.

The coal handling system is based upon the mine being responsible for delivering a datum blended raw coal to the powerplant.

(b) Basic Operations

The overall coal handling system has been divided into three basic operations:

Operation 1 - Mining, processing, blending and storage (located in the mine facility area).

Operation 2 - Reclaiming from the blending piles, quality control, loading and delivery to the powerplant perimeter (all within the mining facilities).

Operation 3 - The powerplant receiving, storage and handling system.

In operation 1, truck/shovel mining and primary crushing would be followed by conveyor delivery to the mine surface facilities. Secondary crushing would precede stocking out of minus 50 mm (2 in) coal in blending/storage piles, one of which would be built up while the other one is being reclaimed.

Operation 2 would reclaim coal from one of the blending piles, add high quality coal from a separate storage pile when necessary, and load coal of the required quality and quantity onto the overland conveyor system for delivery to the powerplant. It is anticipated that normally coal of datum quality could be prepared by blending in the main blending/storage piles without addition of high quality coal.

Operation 3, at the powerplant, would include receiving coal from the overland conveyor, filling the boiler silos and moving the coal to or from the powerplant site live or dead storage facilities.

Appendix D, "Coal Quality and Handling", reviews these concepts in detail.

(c) Project Coal System Operations

The three basic operations would be reasonably flexible in their individual areas subject to meeting the current overall planned production and delivery. Planned production would evolve from the scheduled power production programme for the current period. The predicted consumption and throughput in operation 3 at the powerplant would be advised to operation 1 and 2 at the mine so that they could plan, produce and deliver accordingly.

3.6 COAL HANDLING - (Cont'd)

Normal production and coal flow from the mine would be direct to the silos on each boiler at a rate equal to boiler consumption. Provision would be made for imbalances and abnormal conditions in each of the three operations, and for suitable stocking-out to and drawing down from the storage facilities at the powerplant.

At full station load daily consumption of datum coal would be approximately 42 300 t (46,500 tons). Based upon this delivery, and filling the silos in 18 hours out of 24, a normal maximum flow rate in the filling system of 2500 t/hr (2750 tons/hr) has been tentatively set.

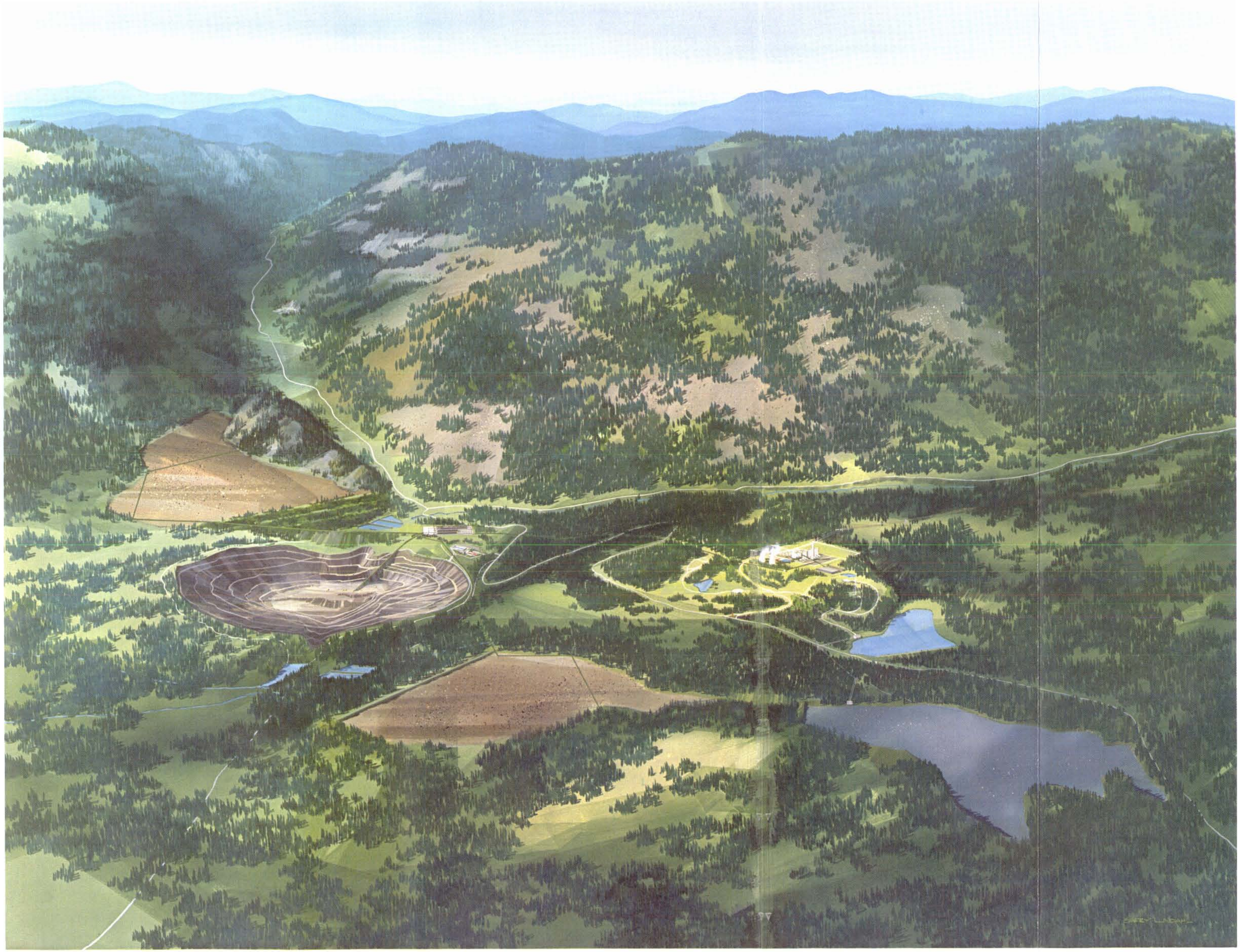
Provision for promptly delivering lower sulphur coal to the powerplant silos, should it be required for the Meteorological control system (MCS) proposed for SO_2 reduction, is included in the coal handling system design.

(d) Low Grade Coal Facilities

The blended raw datum coal for the powerplant is based upon a mine cutoff of 9.3 MJ/kg (4000 Btu/lb), dry basis. Run-of-mine coal between 7.0 and 9.3 MJ/kg (3000 and 4000 Btu/lb) would be delivered to separate low grade storage piles for possible future use other than in the powerplant.

(e) Future Work

The project coal handling system has been developed in conceptual outline only and considerable detailed work must follow in the various component and operational areas.



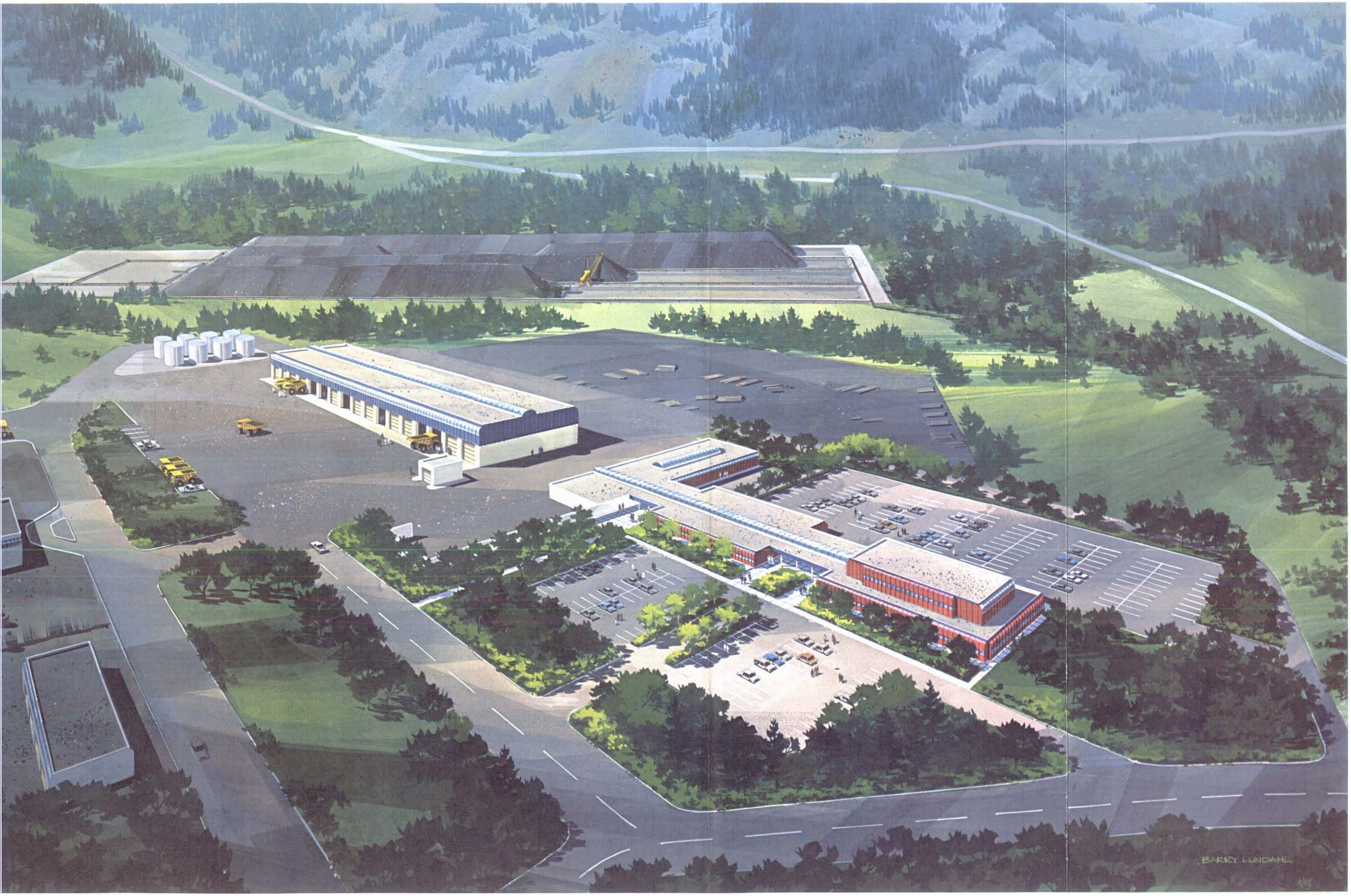
VIEW FROM SOUTH EAST

BRITISH COLUMBIA HYDRO & POWER AUTHORITY

HAT CREEK PROJECT

TOBY RUSSELL BUCKWELL & PARTNERS ARCHITECTS

PLATE NO. 3.1



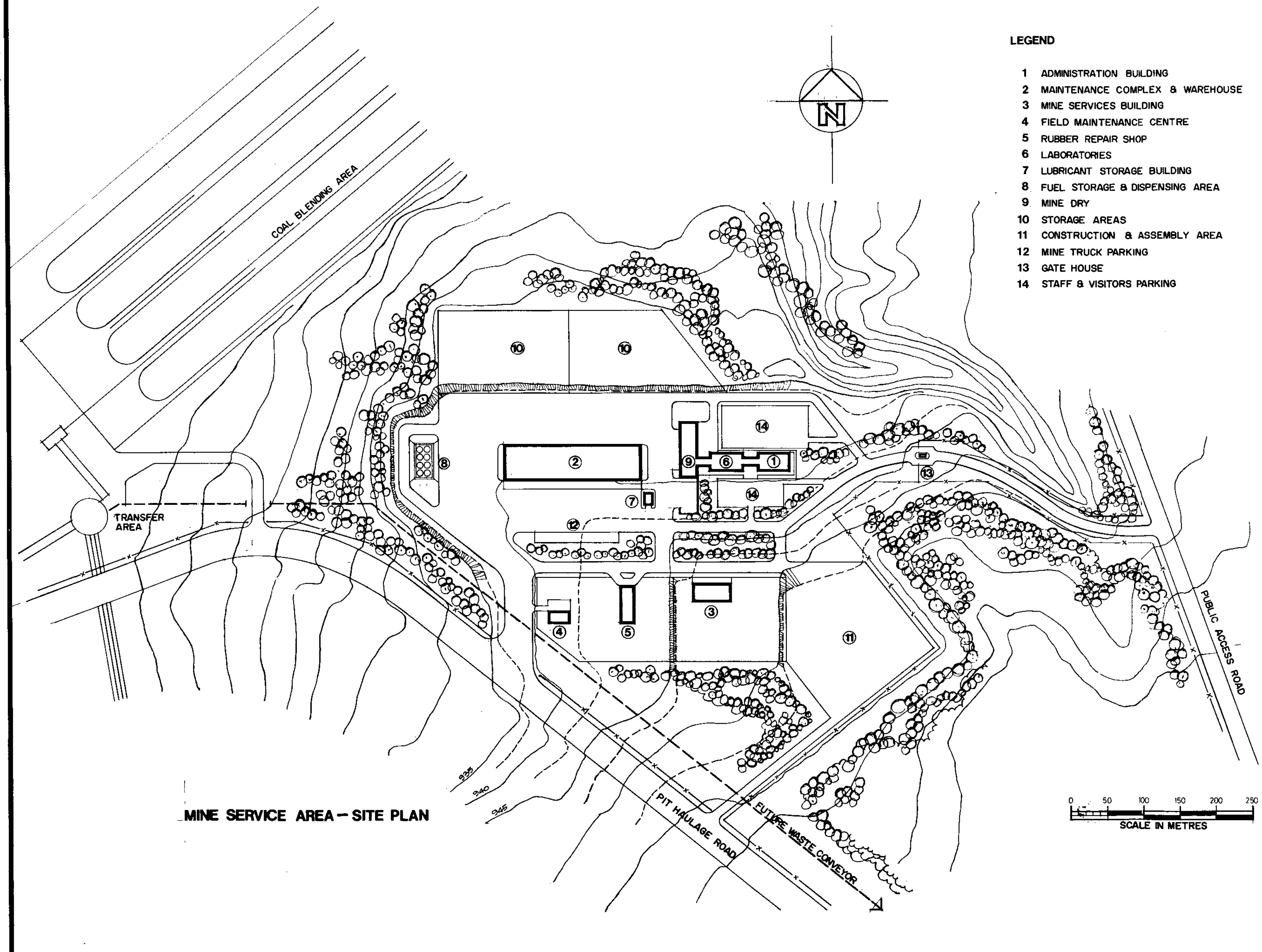
MINE SERVICE AREA FROM SOUTH EAST

COLUMBIA HYDRO & POWER AUTHORITY

HAT CREEK PROJECT

TOBY RUSSELL BUCKWELL & PARTNERS ARCHITECTS

PLATE NO. 3.2



LEGEND

1 ADMINISTRATION BUILDING
2 MAINTENANCE COMPLEX & WAREHOUSE
3 MINE SERVICES BUILDING
4 FIELD MAINTENANCE CENTRE
5 RUBBER REPAIR SHOP
6 LABORATORIES
7 LUBRICANT STORAGE BUILDING
8 FUEL STORAGE & DISPENSING AREA
9 MINE DRY
10 STORAGE AREAS
11 CONSTRUCTION & ASSEMBLY AREA
12 MINE TRUCK PARKING
13 GATE HOUSE
14 STAFF & VISITORS PARKING

MINE SERVICE AREA – SITE PLAN

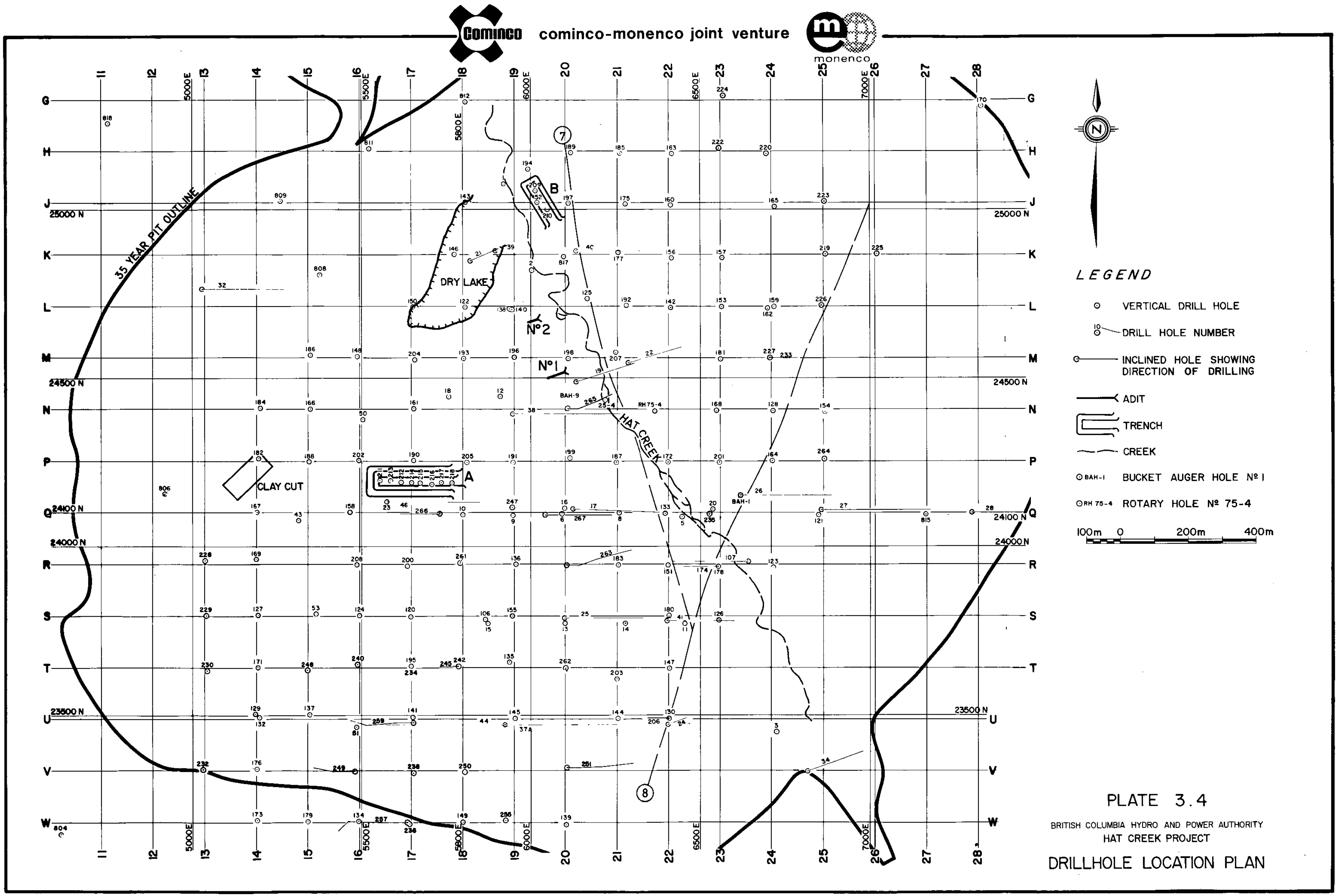
TOBY RUSSELL BUCKWELL & partners architects

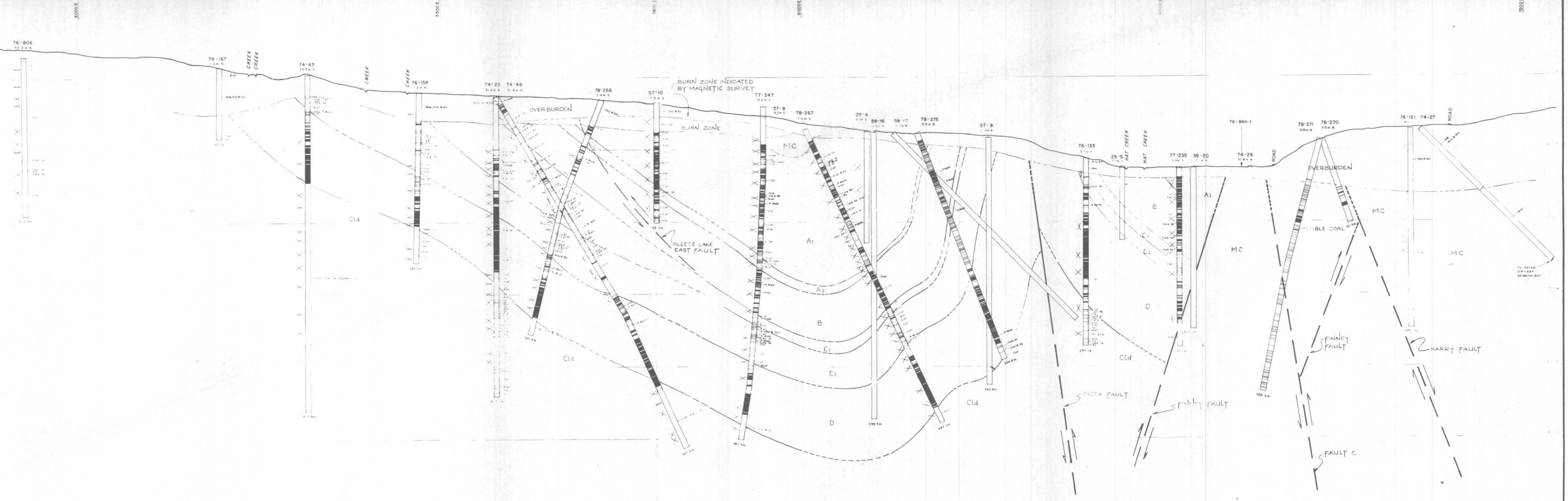
DATE JULY 1978

BRITISH COLUMBIA HYDRO & POWER AUTHORITY

HAT CREEK PROJECT

PLATE NO. 3.3


Cominco
cominco-monenco joint venture
monenco
35 YEAR PIT OUTLINE
DRY LAKE
CLAY CUT
HAT CREEK
Nº 1
Nº 2
A
B
25000 N
24500 N
24100 N
24000 N
23500 N
5000E
5500E
5800E
6000E
6500E
7000E
LEGEND
VERTICAL DRILL HOLE
DRILL HOLE NUMBER
INCLINED HOLE SHOWING DIRECTION OF DRILLING
ADIT
TRENCH
CREEK
BUCKET AUGER HOLE Nº 1
ROTARY HOLE Nº 75-4
100m 0 200m 400m
PLATE 3.4
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
DRILLHOLE LOCATION PLAN



LEGEND

Pleistocene — OVERBURDEN: unconsolidated alluvium, colluvium, till, lacustrine deposits, glacial outwash

Miocene — VOLCANICS: basalt, andesite, dacite, rhyolite

Eocene — MC: MEDICINE CREEK FORMATION: claystone, siltstone, sandstone

HC: HAT CREEK FORMATION: coal, claystone, siltstone, conglomerate, carbonaceous shale, sandstone, marl

Sub Zone and Thickness

A1	170 — 200m	C1	5 — 80 m
A2	20 — 50m	C2	60 — 120 m
B	50 — 80m	D	60 — 130 m

Cld: COLDWATER FORMATION: claystone, siltstone, conglomerate, sandstone, shale

Geological Symbols

- Fault confirmed, inferred
- Contact confirmed, inferred
- Relative movement
- Indicated bedding attitude

Colour Code

Blk	COAL < 30 % Ash; +19,750 kJ/kg (db)
Or	COAL 30 — 40 % Ash; 19,750 — 16,250 kJ/kg (db)
Blu	COAL 40 — 60 % Ash; 16,250 — 9,250 kJ/kg (db)
Gr	Coaly shale and/or carbonaceous shale
Yel	Claystone, siltstone, conglomerate, shale, sandstone, marl, petrified wood
Pk	Burn zone

Abbreviations

Blds	Boulders.	Mdst	Mudstone.
Carb. Sh.	Carbonaceous Shale.	P. Wood	Petrified Wood.
Cg	Conglomerate	Slst	Siltstone.
Cl	Clay.	Slty Gvl	Silty Gravel.
Clst	Claystone	Snd	Sand.
Gvl	Gravel	Ss	Sandstone.
Ls	Limestone.		

DES / RECD
DWN E.L. / APPD
CHKD E.L. / APPD
INSP / APPD
SUBD / DATE
MICROFILMED

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

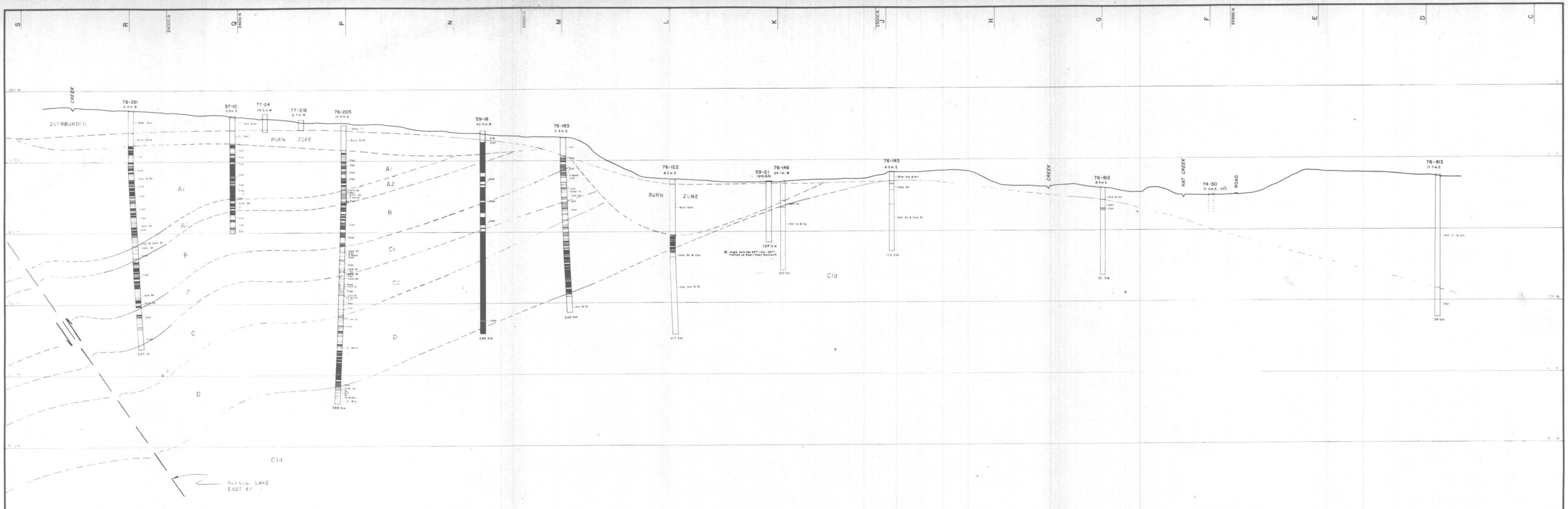
THERMAL DIVISION MINING DEPARTMENT

HAT CREEK PROJECT

SECTION Q

SCALE 1:1500

Plate 3-5 R



LEGEND

Pleistocene

OVERBURDEN: unconsolidated alluvium, colluvium, till, lacustrine deposits, glacial outwash.

Miocene

VOLCANICS: basalt, andesite, dacite, rhyolite.

Eocene

MC — MEDICINE CREEK FORMATION: claystone, siltstone, sandstone.

HC — HAT CREEK FORMATION: coal, claystone, siltstone, conglomerate, carbonaceous shale, sandstone, marl.

Sub Zone and Thickness:

A1	170 — 200m.	C1	5 — 80 m.
A2	20 — 50m.	C2	60 — 120m.
B	50 — 80m.	D	60 — 130m.

Cld — COLDWATER FORMATION: claystone, siltstone, conglomerate, sandstone, shale.

Geological Symbols

Fault: confirmed, inferred.

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Relative movement.

Indicated bedding attitude.

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Blk	COAL: < 30 % Ash; +19,750 kJ/kg(db)
Or	COAL: 30 — 40 % Ash; 19,750 — 16,250 kJ/kg(db)
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Pk	Burn zone.

Abbreviations

Blds.	Boulders.	Mdst.	Mudstone.
Carb. Sh.	Carbonaceous Shale.	P. Wood	Petrified Wood.
Cg.	Conglomerate.	Sltst.	Siltstone.
Cl.	Clay.	Slty Gvl.	Silty Gravel.
Clst.	Claystone.	Snd.	Sand.
Gvl.	Gravel.	Ss.	Sandstone.
Ls.	Limestone.		

DES		RECD	
DWN	S W	APPD	
CHKD		APPD	
INSP		APPD	
SUBD		DATE	
MICROFILMED		DIST'N CODE	

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

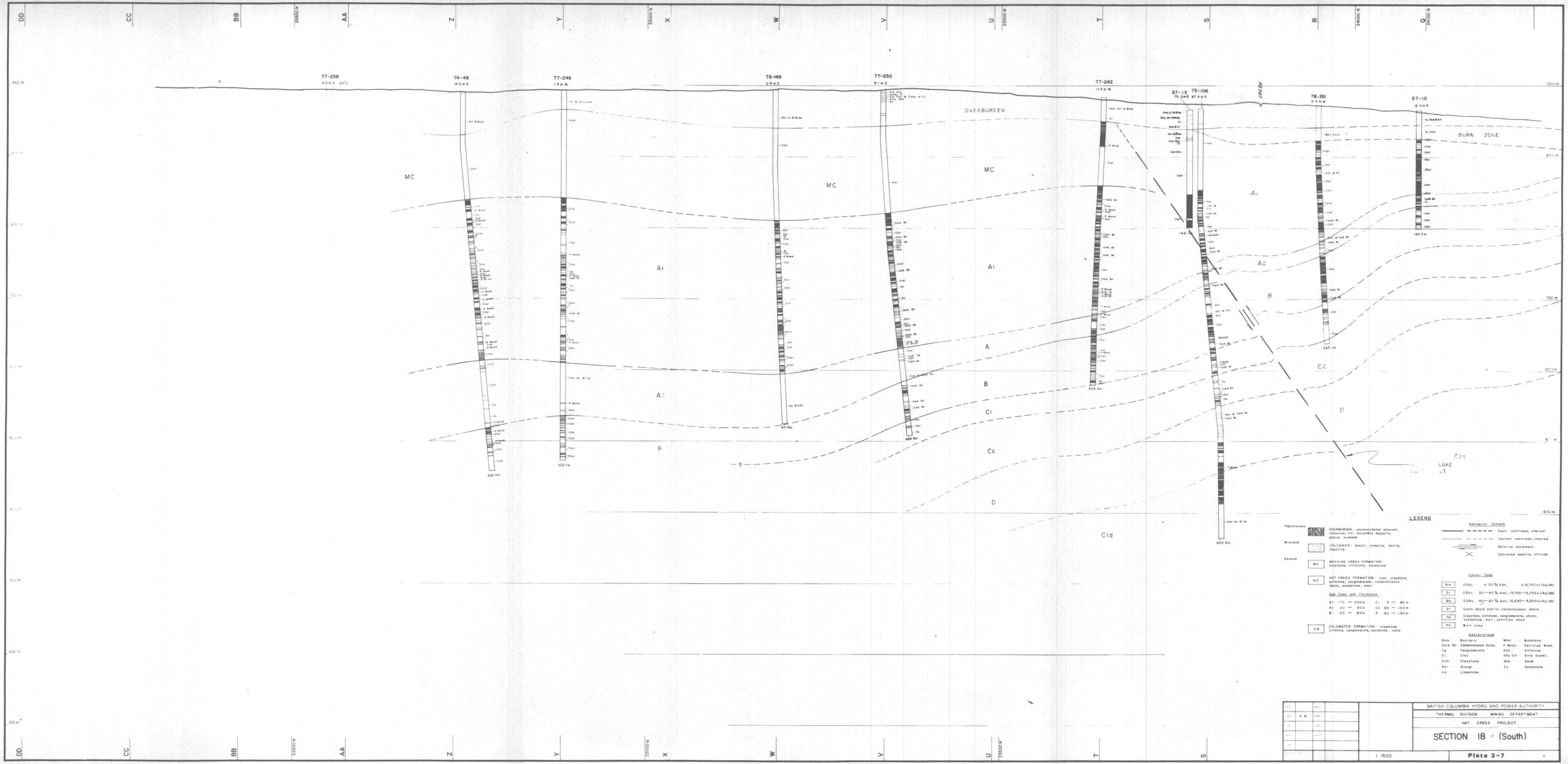
THERMAL DIVISION MINING DEPARTMENT

HAT CREEK PROJECT

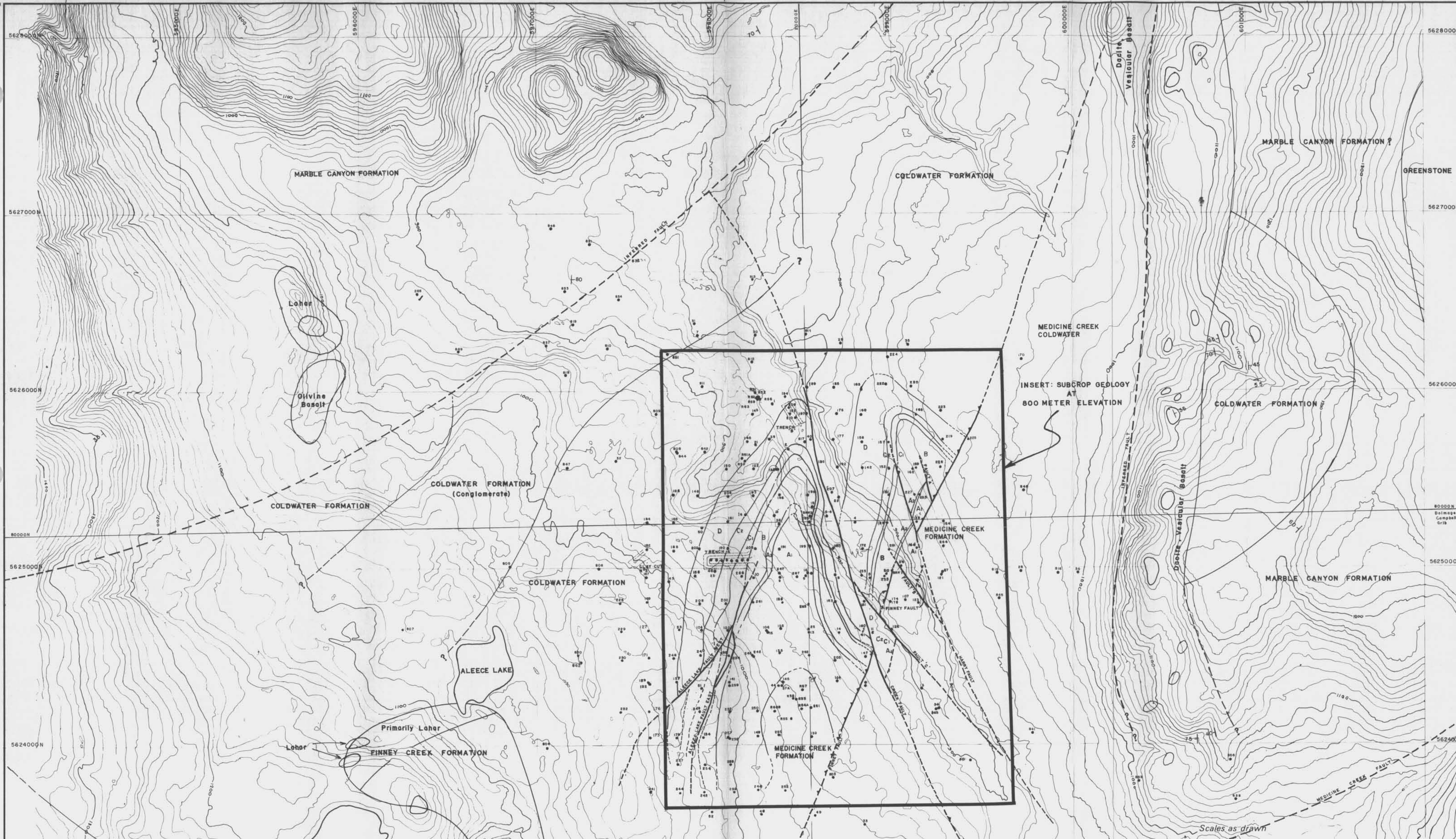
SECTION 18 (North)

SCALE 1:1500

DWG No. **Plate 3-6** R



DD
CC
BB
22500 N
AA
Z
Y
23000 N
X
W
V
U
23500 N
T
S
R
24000 N
Q
24100 N
77-258
74-48
77-246
76-149
77-250
77-242
57-15
75-106
78-261
57-10
CREEK
OVERBURDEN
BURN ZONE
MC
A1
A2
A
B
C1
C2
D
Cld
LAKE
400 m
700 m
LEGEND
Pleistocene
OVERBURDEN: unconsolidated alluvium, colluvium, till, lacustrine deposits, glacial outwash.
Miocene
VOLCANICS: basalt, andesite, dacite, rhyolite.
Eocene
MC
MEDICINE CREEK FORMATION: claystone, siltstone, sandstone.
HC
HAT CREEK FORMATION: coal, claystone, siltstone, conglomerate, carbonaceous shale, sandstone, marl.
Sub Zone and Thickness:
A1 170 — 200m. C1 5 — 80 m.
A2 20 — 50m. C2 60 — 120 m.
B 50 — 80m. D 60 — 130 m.
Cld
COLDWATER FORMATION: claystone, siltstone, conglomerate, sandstone, shale.
Geological Symbols
Fault: confirmed, inferred.
Contact: confirmed, inferred.
Relative movement.
Indicated bedding attitude.
Colour Code
Blk COAL: < 30 % Ash; +19,750 kJ/kg (db)
Or COAL: 30 — 40 % Ash; 19,750 — 16,250 kJ/kg (db)
Blu COAL: 40 — 60 % Ash; 16,250 — 9,250 kJ/kg (db)
Gr Coaly shale and/or carbonaceous shale.
Yel Claystone, siltstone, conglomerate, shale, sandstone, marl, petrified wood.
Pk Burn zone.
Abbreviations
Blds. Boulders.
Carb. Sh. Carbonaceous Shale.
Cg. Conglomerate.
Cl. Clay.
Clst. Claystone.
Gvl. Gravel.
Ls. Limestone.
Mdst. Mudstone.
P. Wood. Petrified Wood.
Slst. Siltstone.
Slty Gvl. Silty Gravel.
Snd. Sand.
Ss. Sandstone.
S.W.
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
THERMAL DIVISION MINING DEPARTMENT
HAT CREEK PROJECT
SECTION 18 (South)
1:1500
Plate 3-7



DES		RECD	
DWN		APPD	
CHKD		APPD	
INSP		APPD	
SUBD		DATE	11. 2. 1978
MICROFILMED		DIST'N CODE	

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

THERMAL DIVISION MINING DEPARTMENT

HAT CREEK PROJECT

BED ROCK GEOLOGY
No. 1 DEPOSIT

SCALE 1:10,000 | DWG No **Plate 3-8** | R

REFERENCE DRAWINGS | REFERENCE DRAWINGS | REVISIONS | REVISIONS

PLATE 3.9

In Situ Proven and Probable Pit
Reserves in No. 1 Deposit

	Million Tonnes*	Million Tons	% of Total	MJ/kg	Calorific Value (Btu/lb)	Ash Content (%)	Sulphur Content (%)
PROVEN PIT RESERVES							
35-year pit reserves cut-off > 9.3 MJ/kg (4000 Btu/lb), undiluted, dry basis.							
Zone A-1 } A-2	77.5	85.3	22.5	13.0	5613	47.8 / --	0.72 / --
B-1	57.2	62.9	16.6	17.1	7373	35.6	0.68
C-1 } C-2	60.4	66.4	17.6	14.1	6061	44.4	0.44
D-1	149.1	164.0	43.3	21.3	9147	24.5	0.31
Total	344.2	378.6					
Weighted Average				17.5	7515	35.1	0.49
PROBABLE PIT RESERVES							
beyond 35-year pit, calorific value cut-off > 9.3 MJ/kg (4000 Btu/lb), undiluted dry basis.							
Zone A	139.5	153.5	37.4	12.1	5227	50.0	0.69
B	66.8	73.5	17.9	14.7	6310	43.6	0.72
C	31.6	34.8	8.5	12.0	5157	51.1	0.43
D	134.9	148.4	36.2	20.1	8627	27.9	0.30
Total	372.8	410.2					
Weighted Average				15.4	6645	40.9	0.53
TOTAL PROVEN + PROBABLE PIT RESERVES							
Calorific value cut-off 9.3 MJ/kg (4000 Btu/lb), undiluted, dry basis.							
Zone A	217	239	30.3	12.5	5365	49.2	0.70
B	124	136	17.3	15.8	6800	39.9	0.70
C	92	101	12.8	13.4	5750	46.7	0.42
D	284	312	39.6	20.7	8900	26.1	0.31
Total	717	788					
Weighted Average				16.4	7060	38.0	0.51

*Specific gravities used to compute tonnages reflect in situ moisture. The average in situ moisture is 25% for the total in place reserves.

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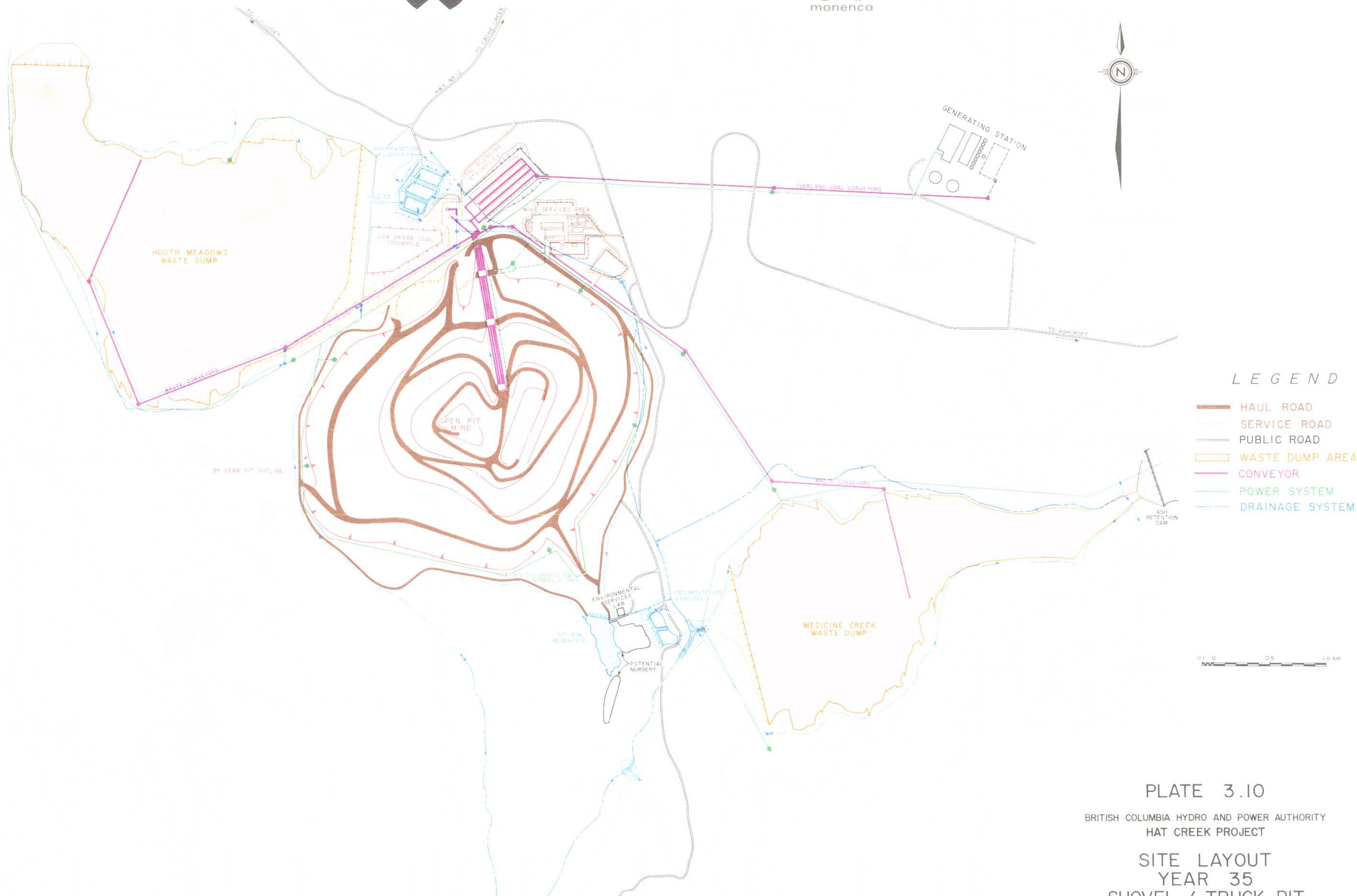

PLATE 3.10

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

SITE LAYOUT
YEAR 35
SHOVEL / TRUCK PIT

cominco-monenco joint venture

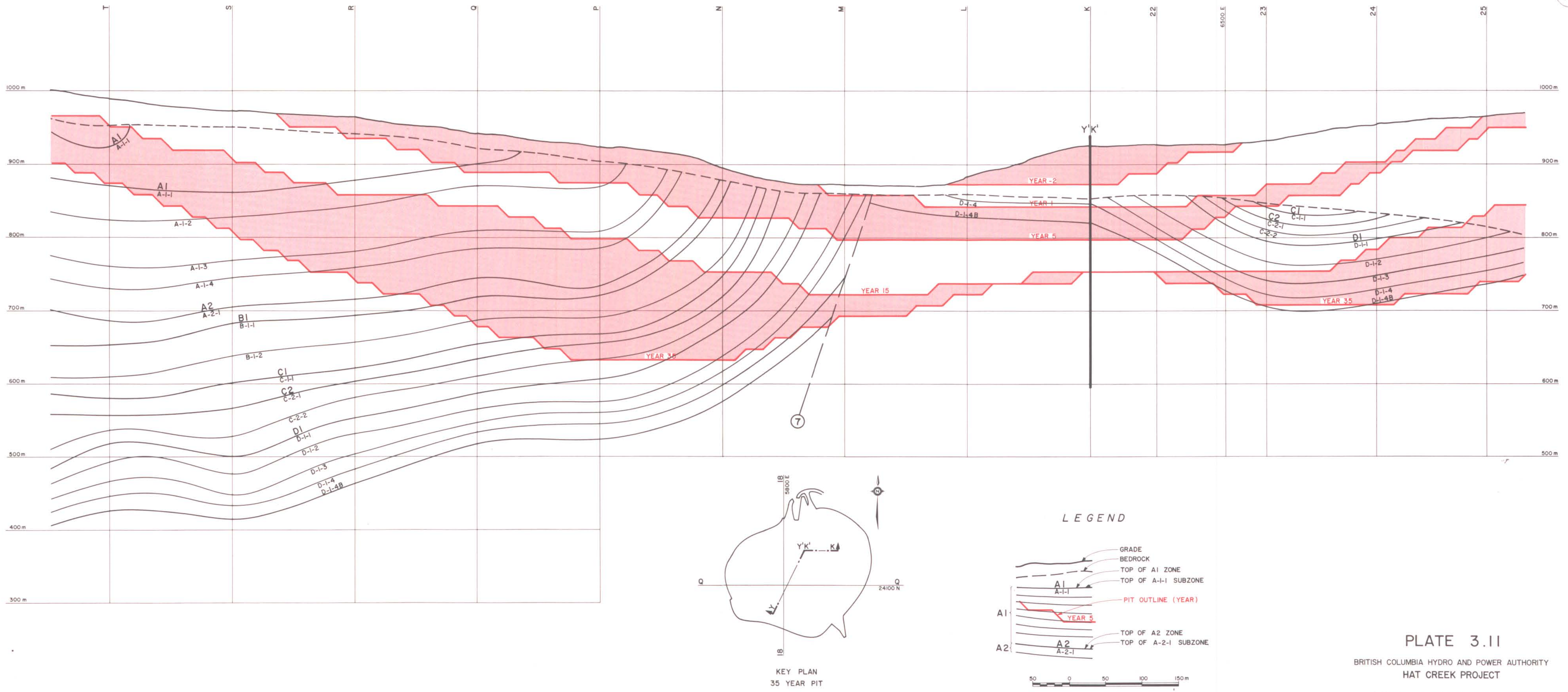

PLATE 3.11

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK PROJECT

MINE DEVELOPMENT CROSS SECTION

PLATE 3-12

BOILER FUEL SPECIFICATION DATA

	WEIGHTED AVERAGE	STANDARD DEVIATION
Ultimate Analysis		
% Carbon	43.90	±1.49
% Hydrogen	3.74	±0.56
% Nitrogen	0.89	±0.15
% Oxygen	14.58	±1.44
% Sulphur (dry basis)	0.48	±0.25
% Chlorine	0.03	±0.02
% Ash (dry basis)	36.30	±1.80
Calorific Value (dry basis)	7327 Btu/lb	±300
	17 043 kJ/kg	±700
% Moisture (run-of-mine)	25.0	±10.0
Ash Analysis (% dry ash)		
SiO_2	53.72	±6.02
Al_2O_3	28.85	±5.01
CaO	2.63	±1.99
MgO	1.41	±0.65
Fe_2O_3	7.62	±4.97
K_2O	0.52	±0.21
Na_2O	1.18	±0.51
Mn_3O_4	0.11	±0.13
V_2O_5	0.05	±0.03
P_2O_5	0.29	±0.30
SO_3	1.82	±0.90
TiO_2	0.92	±0.26
Undetermined	0.88	±0.94
Proximate Analysis (dry basis)		
% Ash	36.30	±1.80
% Volatile Matter	32.20	±4.17
% Fixed Carbon	31.40	±4.20
Carbon Dioxide (dry basis)	1.77	n.d. (not determined)
Water Soluble Alkalies		
as Na_2O	0.24	n.d.
as K_2O	0.03	n.d.
Ash Fusion Temperatures		
Reducing Atmosphere:		
Initial Deformation	1330°C	±200°
Ash Softening (H=W)	1325	
Ash softening (H=1/2 W)	1340	
Fluid	1400+	

Approximately 8.6% of the average fuel indicates an I.D.T. $<$ 1200°C.

Approximately 4.2% of the average fuel indicates an I.D.T. $<$ 1150°C.

	WEIGHTED AVERAGE	STANDARD DEVIATION
Oxidizing Atmosphere:		
Initial Deformation	1340°C	±200°
Ash Softening (H=W)	1350	
Ash Softening (H=1/2 W)	1360	
Fluid	1400+	
Hardgrove Grindability Index	50	±10

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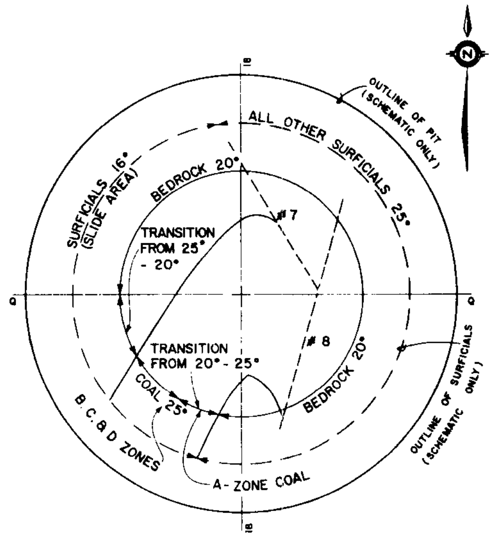
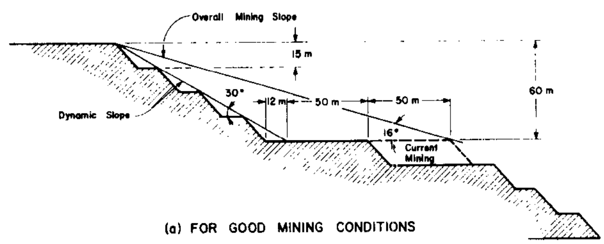


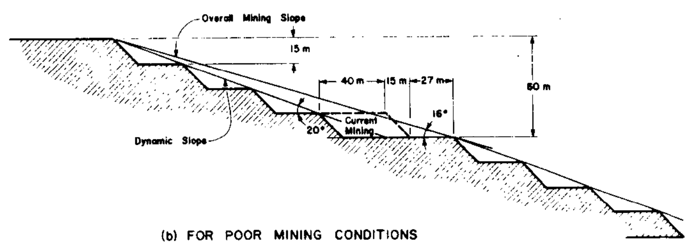
35 YEAR PIT SLOPE ANGLES

RECOMMENDED EXPANDED PIT TO 450m ASL SLOPE ANGLES

35 YEAR PIT SLOPE ANGLES



(a) FOR GOOD MINING CONDITIONS



(b) FOR POOR MINING CONDITIONS

DYNAMIC SLOPE X SECTION

PLATE 3.13

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

PIT SLOPES

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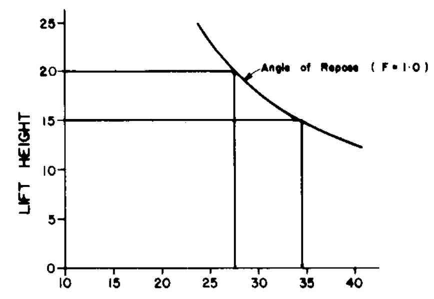
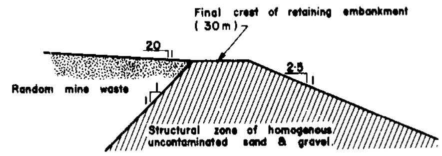
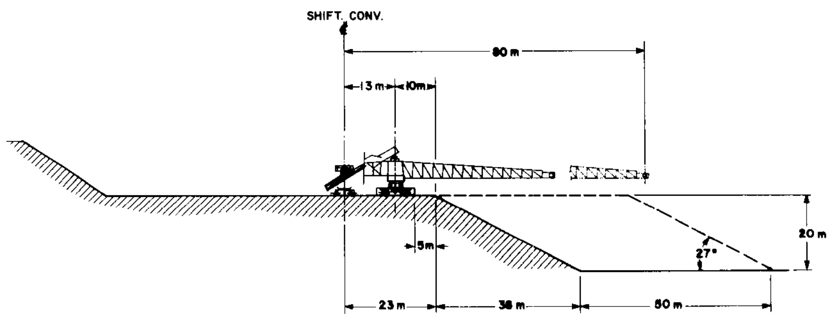


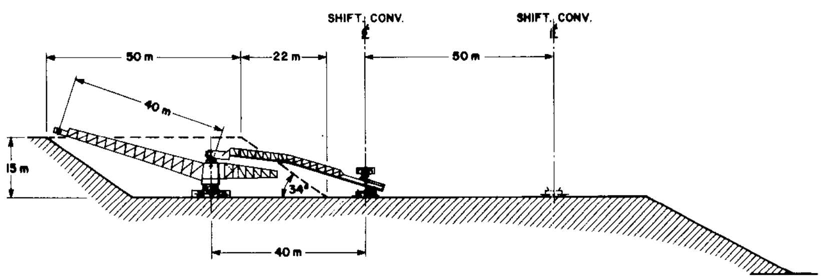
(a) WASTE MATERIAL ANGLE OF REPOSE



WASTE EMBANKMENT SLOPE ANGLES



(b) SPREADER POSITIONED TO DEPOSIT WASTE BELOW THE SHIFTABLE CONVEYOR



(c) SPREADER POSITIONED TO DEPOSIT WASTE ABOVE THE SHIFTABLE CONVEYOR

PLATE 3.14

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

WASTE DUMP SLOPES

Type	Discharge rate	Grade	Dimension			
			w	b	h	t
A	< 1m³/s	1·0 – 5·0 % < 0·6%	2·0 2·0	0·25 0·25	0·45 0·55	0·5 max 0·25
B	1 – 2m³/s	0·5 – 5·0 % < 0·4%	4·0 4·0	0·5 0·5	0·6 0·8	0·7 max 0·5
C	2 – 5m³/s	0·2 – 5·0 % < 0·2%	4·0 5·0	0·5 0·5	0·8 1·2	1·0 max 0·5

PLATE 3.15

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK PROJECT

MINE DRAINAGE PLAN

PLATE 3-16

Summary of Mining Equipment
End of Year 17

Hat Creek Project Mining Report 1978

Item	Number
Shovels 16.8 m^3 bucket capacity	7
Trucks 109-tonne	9
136-tonne	18
32-tonne	10
Scrapers 24 LCM	6
Graders	6
Dozers track	17
wheeled	2
Front-end loaders 11.5 m^3	2
5.4 m^3	3
1.5 m^3	3
Drills - Auger, Rotary, Rotary Percussion	3
Blasting Truck	1
Compactors	4
Gradall	1
Backhoe 1 m^3	1
Water Wagon	3
Mobile crusher	1
Mobile cranes 5 to 90-tonne	6
Mobile service vehicles	21
Light vehicles	130
Truck unloading stations	2
Crawler mounted waste spreaders	2
Rail mounted stackers	2
Bridge type bucketwheel reclaimers	2
	Length
Mine conveyors	2490 m
Coal transfer conveyors in preparation area	3290 m
Overland coal conveyors to generating plant	4000 m
Low-grade coal transfer conveyors	355 m
Waste conveyors	15 500 m

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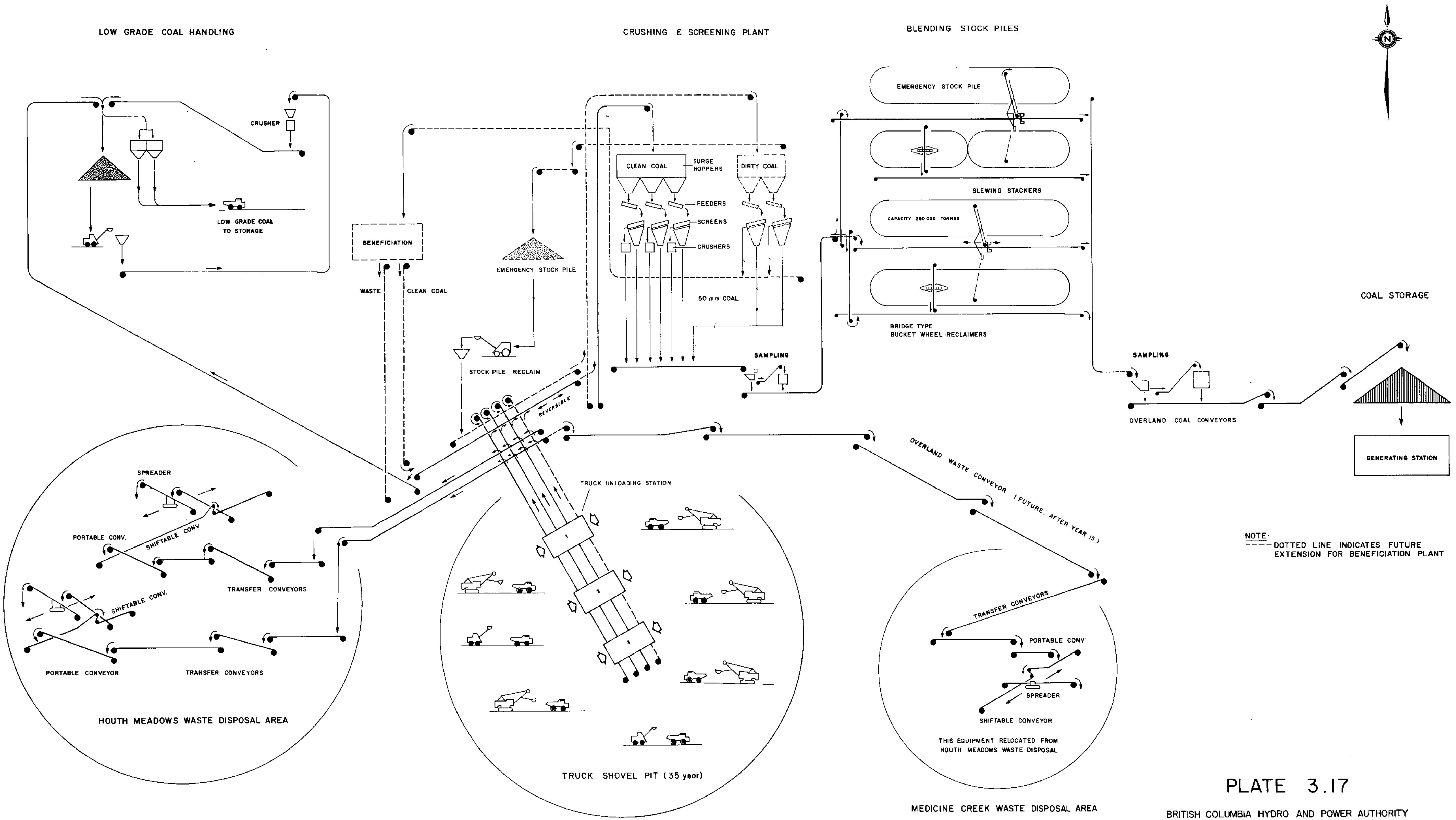

PLATE 3.17

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

SYSTEM FLOW SHEET

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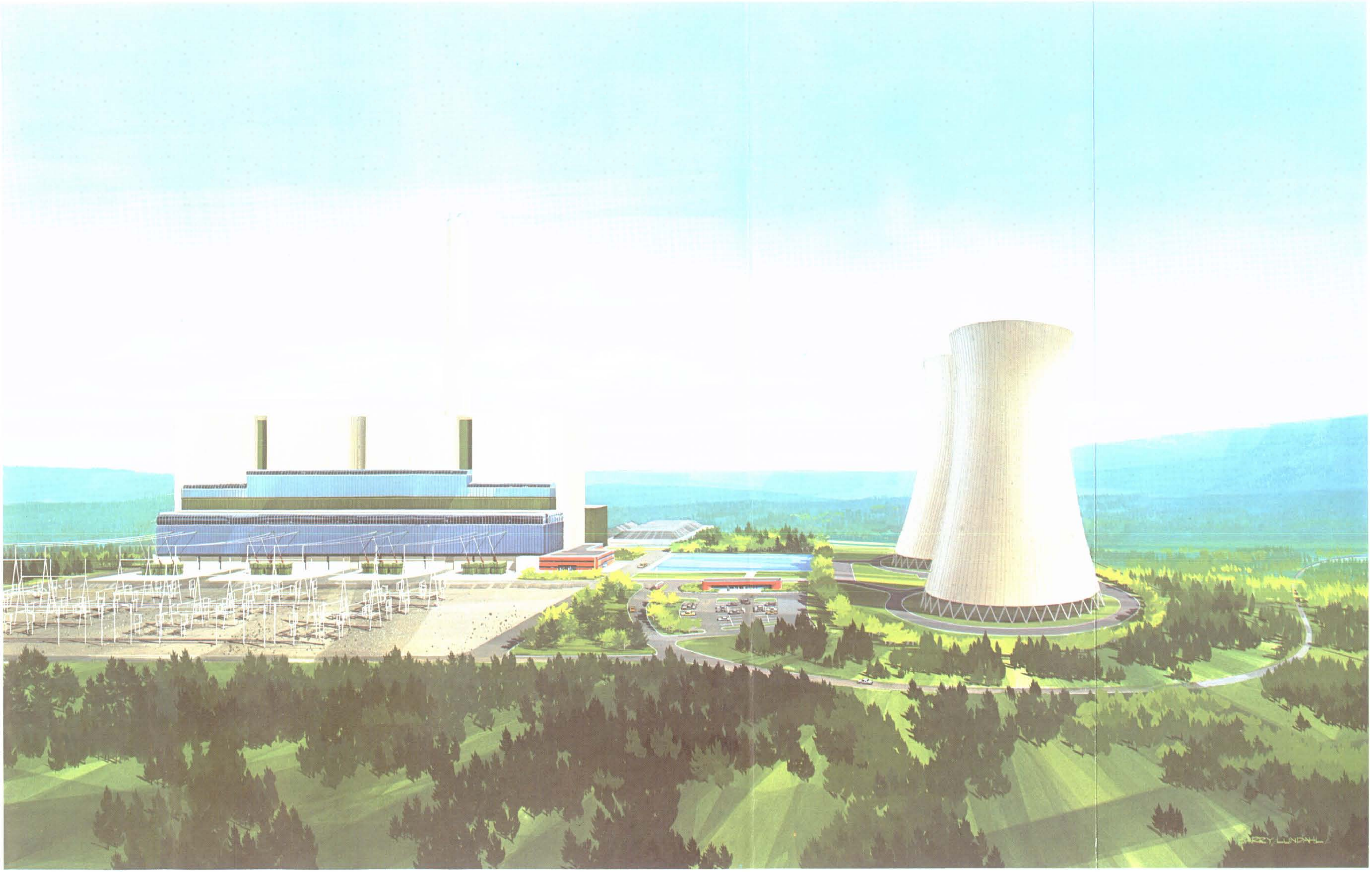
LEGEND

1. ADMINISTRATION BUILDING
2. MAINTENANCE COMPLEX & WAREHOUSE
3. MINE SERVICES BUILDING
4. FIELD MAINTENANCE CENTRE
5. RUBBER REPAIR SHOP
6. LABORATORY
7. LUBE STORAGE BUILDING
8. FUEL STORAGE & DISPENSING AREA
9. MINE DRY
10. STORAGE AREAS
11. CONSTRUCTION STORAGE AREA
12. TRUCK READY LINE
13. GATEHOUSE
14. FIRE TRUCK / AMBULANCE GARAGE

PLATE 3.18

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

MINE SERVICE AREA GENERAL ARRANGEMENT



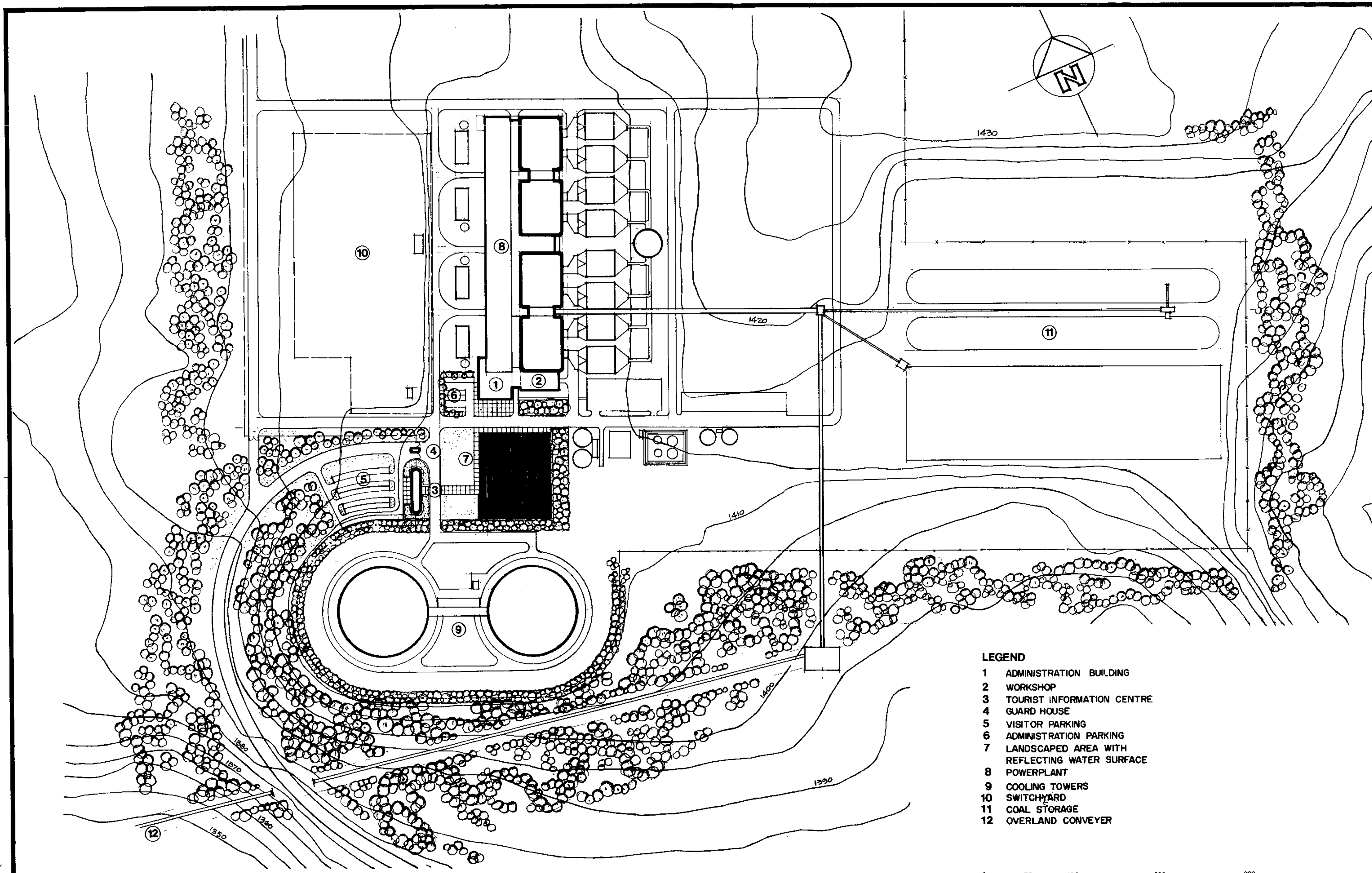
POWERPLANT FROM WEST

BRITISH COLUMBIA HYDRO & POWER AUTHORITY

HAT CREEK PROJECT

TOBY RUSSELL BUCKWELL & PARTNERS ARCHITECTS

PLATE NO. 3.19



LEGEND

1 ADMINISTRATION BUILDING
2 WORKSHOP
3 TOURIST INFORMATION CENTRE
4 GUARD HOUSE
5 VISITOR PARKING
6 ADMINISTRATION PARKING
7 LANDSCAPED AREA WITH REFLECTING WATER SURFACE
8 POWERPLANT
9 COOLING TOWERS
10 SWITCHYARD
11 COAL STORAGE
12 OVERLAND CONVEYER

0 50 100 200 300
SCALE IN METRES

POWERPLANT SITE PLAN

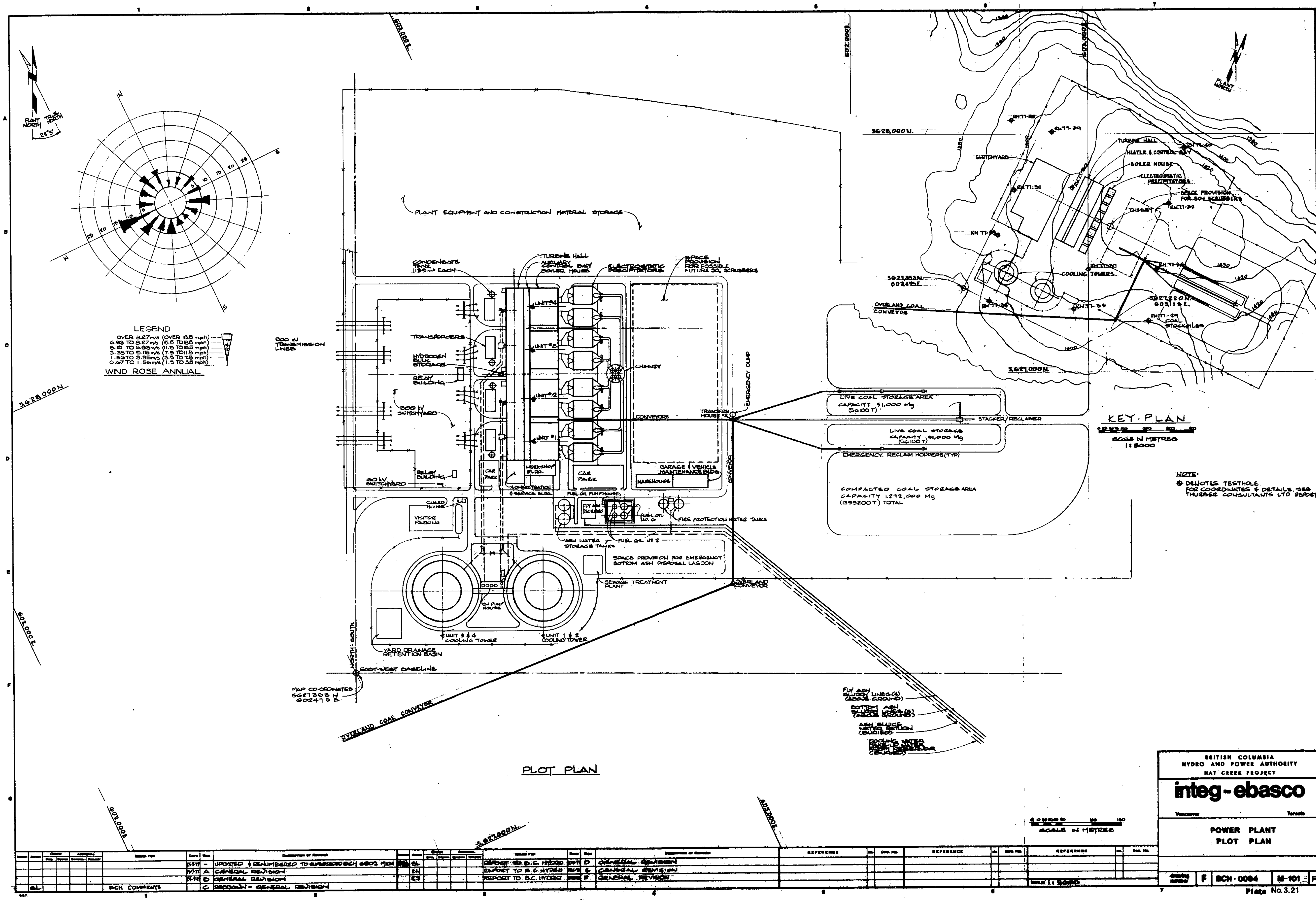
TOBY RUSSELL BUCKWELL & partners architects

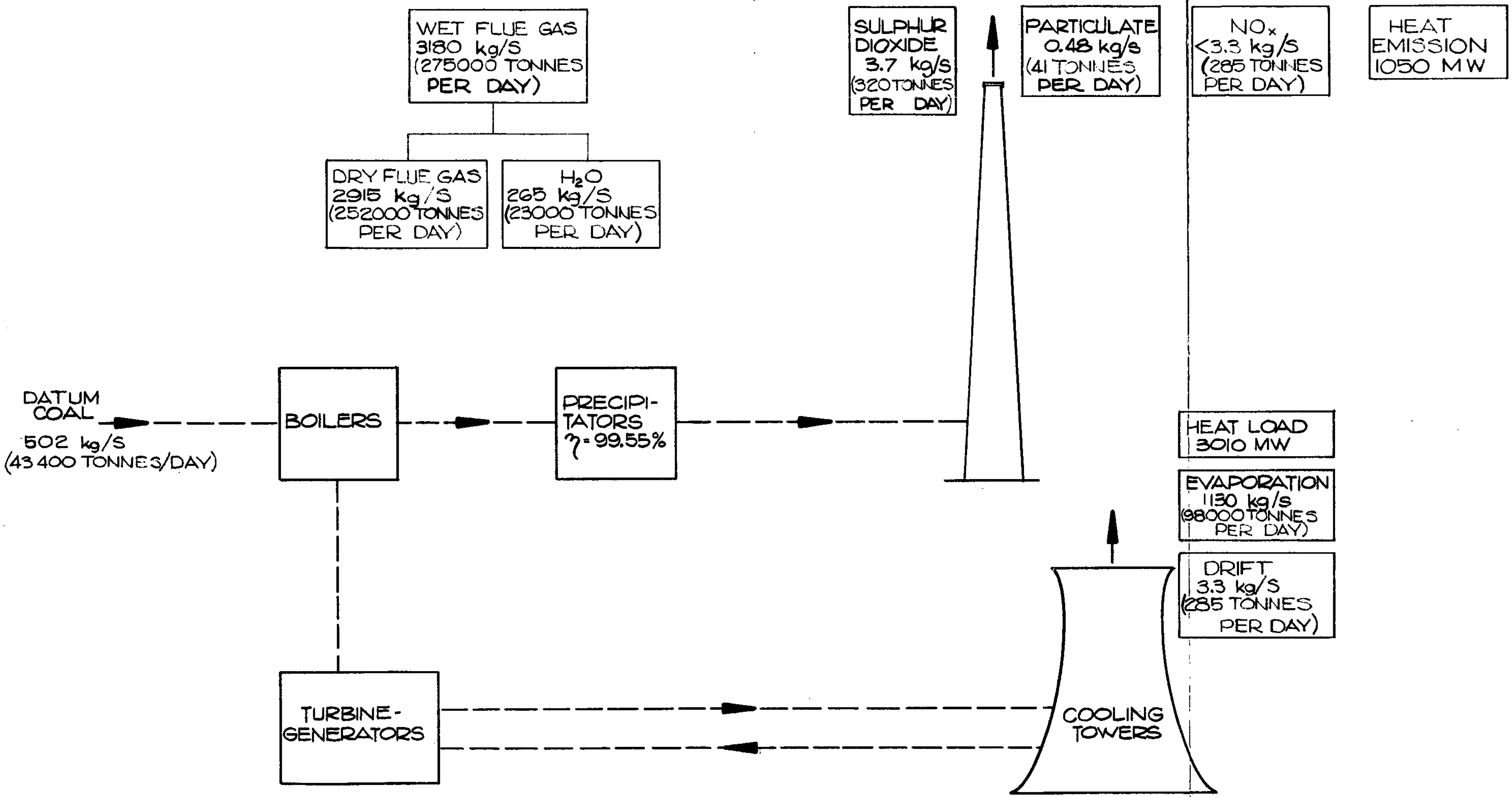
DATE JULY 1978

BRITISH COLUMBIA HYDRO & POWER AUTHORITY

HAT CREEK PROJECT

PLATE NO. 3.20


PLANT NORTH
TRUE NORTH
25°5'
LEGEND
OVER 8.27 m/s (OVER 18.5 mph)
6.93 TO 8.27 m/s (15.5 TO 18.5 mph)
5.15 TO 6.93 m/s (11.5 TO 15.5 mph)
3.35 TO 5.15 m/s (7.5 TO 11.5 mph)
1.56 TO 3.35 m/s (3.5 TO 7.5 mph)
0.67 TO 1.56 m/s (1.5 TO 3.5 mph)
WIND ROSE ANNUAL
5,628,000 N
602,000 E
603,000 E
PLANT EQUIPMENT AND CONSTRUCTION MATERIAL STORAGE
CONDENSATE TANK 1135 m³ EACH
TURBINE HALL
AUXILIARY CONTROL BAY
BOILER HOUSE
ELECTROSTATIC PRECIPITATORS
SPACE PROVISION FOR POSSIBLE FUTURE SO2 SCRUBBERS
500 kV TRANSMISSION LINES
TRANSFORMERS
HYDROGEN BULK STORAGE
RELAY BUILDING
500 kV SWITCHYARD
60 kV SWITCHYARD
UNIT #4
UNIT #3
UNIT #2
UNIT #1
CHIMNEY
CONVEYORS
TRANSFER HOUSE #2
EMERGENCY DUMP
CONVEYOR
CAR PARK
WORKSHOP BLDG.
ADMINISTRATION & SERVICE BLDG.
GARAGE & VEHICLE MAINTENANCE BLDG.
WAREHOUSE
FUEL OIL PUMPHOUSE
FLY ASH FACILITIES
FUEL OIL NO. 6
FIRE PROTECTION WATER TANKS
ASH WATER STORAGE TANKS
FUEL OIL NO 2
SPACE PROVISION FOR EMERGENCY BOTTOM ASH DISPOSAL LAGOON
SEWAGE TREATMENT PLANT
OVERLAND CONVEYOR
GUARD HOUSE
VISITOR PARKING
CW PUMP HOUSE
UNIT 3 & 4 COOLING TOWER
UNIT 1 & 2 COOLING TOWER
YARD DRAINAGE RETENTION BASIN
NORTH-SOUTH
EAST-WEST BASELINE
MAP CO-ORDINATES 5627353 N 602476 E
OVERLAND COAL CONVEYOR
LIVE COAL STORAGE AREA CAPACITY 51,000 Mg (56100 T)
STACKER/RECLAIMER
LIVE COAL STORAGE CAPACITY 51,000 Mg (56100 T)
EMERGENCY RECLAIM HOPPERS (TYP)
COMPACTED COAL STORAGE AREA CAPACITY 1,272,000 Mg (1399200 T) TOTAL
FLY ASH SLURRY LINES (4) (ABOVE GROUND)
BOTTOM ASH SLURRY LINES (2) (ABOVE GROUND)
ASH SLUICE WATER RETURN (BURIED)
COOLING WATER MAKE-UP WATER FROM RESERVOIR (BURIED)
PLOT PLAN
SCALE IN METRES
5,627,000 N
5628,000 N.
SWITCHYARD
TURBINE HALL
HEATER & CONTROL BAY
BOILER HOUSE
ELECTROSTATIC PRECIPITATORS
SPACE PROVISION FOR SO2 SCRUBBERS
CHIMNEY
COOLING TOWERS
OVERLAND COAL CONVEYOR
5627,353 N. 602476 E
5627,220 N. 603115 E.
COAL STOCKPILES
5627,000 N.
KEY PLAN
SCALE IN METRES 1:5000
NOTE:
DENOTES TESTHOLE. FOR COORDINATES & DETAILS SEE THURBER CONSULTANTS LTD REPORT
UPDATED & RENUMBERED TO SUPERSEDE BCH 6802 M101
GENERAL REVISION
GENERAL REVISION
REDRAWN - GENERAL REVISION
BCH COMMENTS
REPORT TO B.C. HYDRO
REPORT TO B.C. HYDRO
REPORT TO B.C. HYDRO
GENERAL REVISION
GENERAL REVISION
GENERAL REVISION
REFERENCE
BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
integ-ebasco
Vancouver
Toronto
POWER PLANT
PLOT PLAN
F
BCH-0064
M-101
F
Plate No. 3.21



FIGURES REPRESENT FLOWS AT 100%
STATION LOAD AND DESIGN CONDITIONS.
(WET BULB TEMP. 13.9°C, DRY BULB TEMP. 18.3°C)

Design	Drawn	Check	Appd	Issued for	Date	Rev
	B.S.			B.C.H. REPORT	JULY 5 1978	0
	E.S.			B.C.H. REPORT	AUG 1978	A

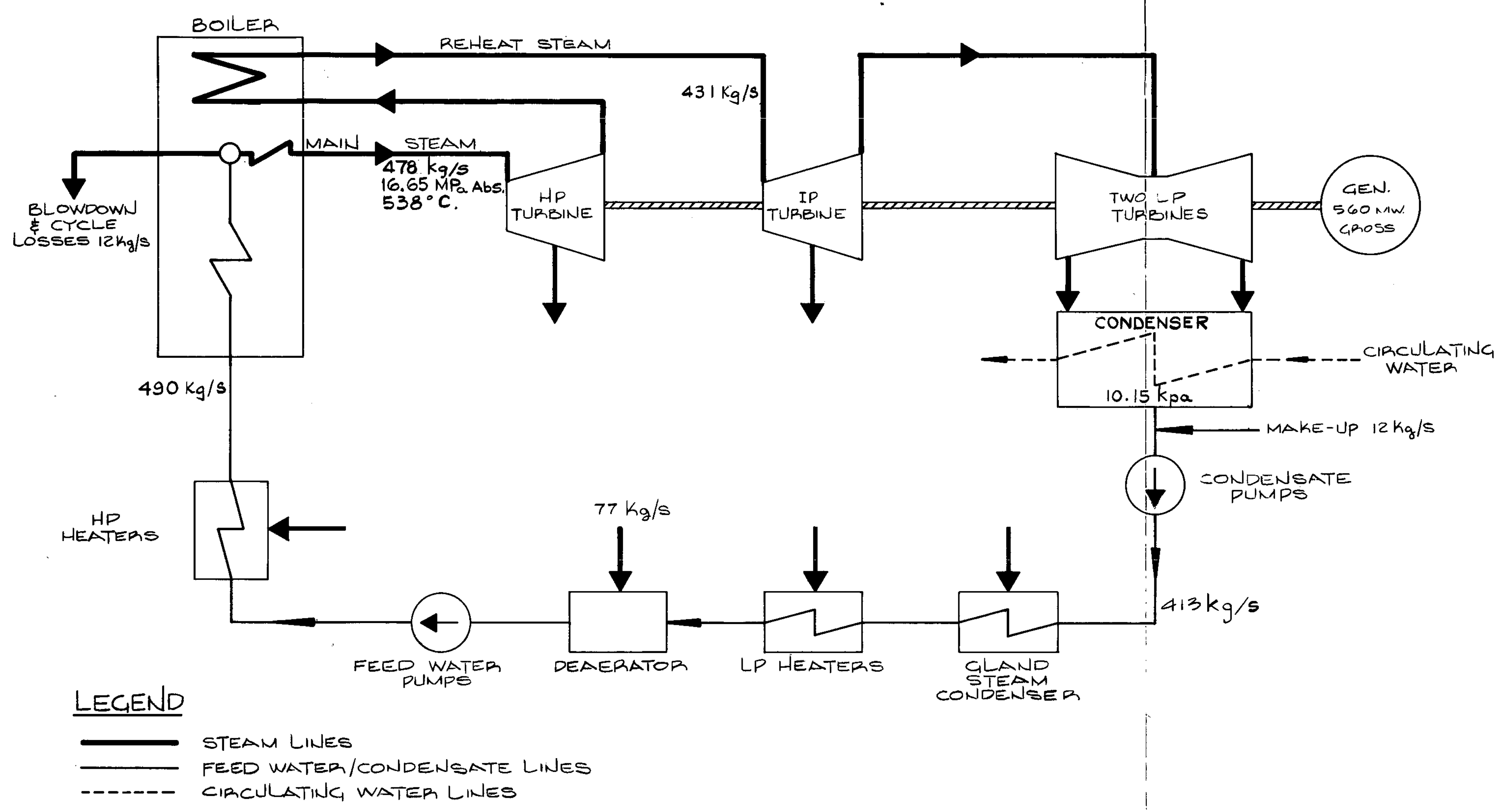
BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

integ - ebasco
Vancouver Toronto

POWER PLANT
EMISSIONS TO ATMOSPHERE
BASIC FLOW DIAGRAM

B	BCH-0064	SK-119	A

Plate No. 3-22



FIGURES REPRESENT FLOWS AT 560 MW. GROSS OUTPUT AND DESIGN CONDITIONS.

Design	Drawn	Check	Appd	Issued for	Date	Rev
	TGH			B.C.H. REPORT	23-6-78	
	BMS			B.C.H. REPORT	4-7-78	A
	V.B.			B.C.H. REPORT	7-8-78	B

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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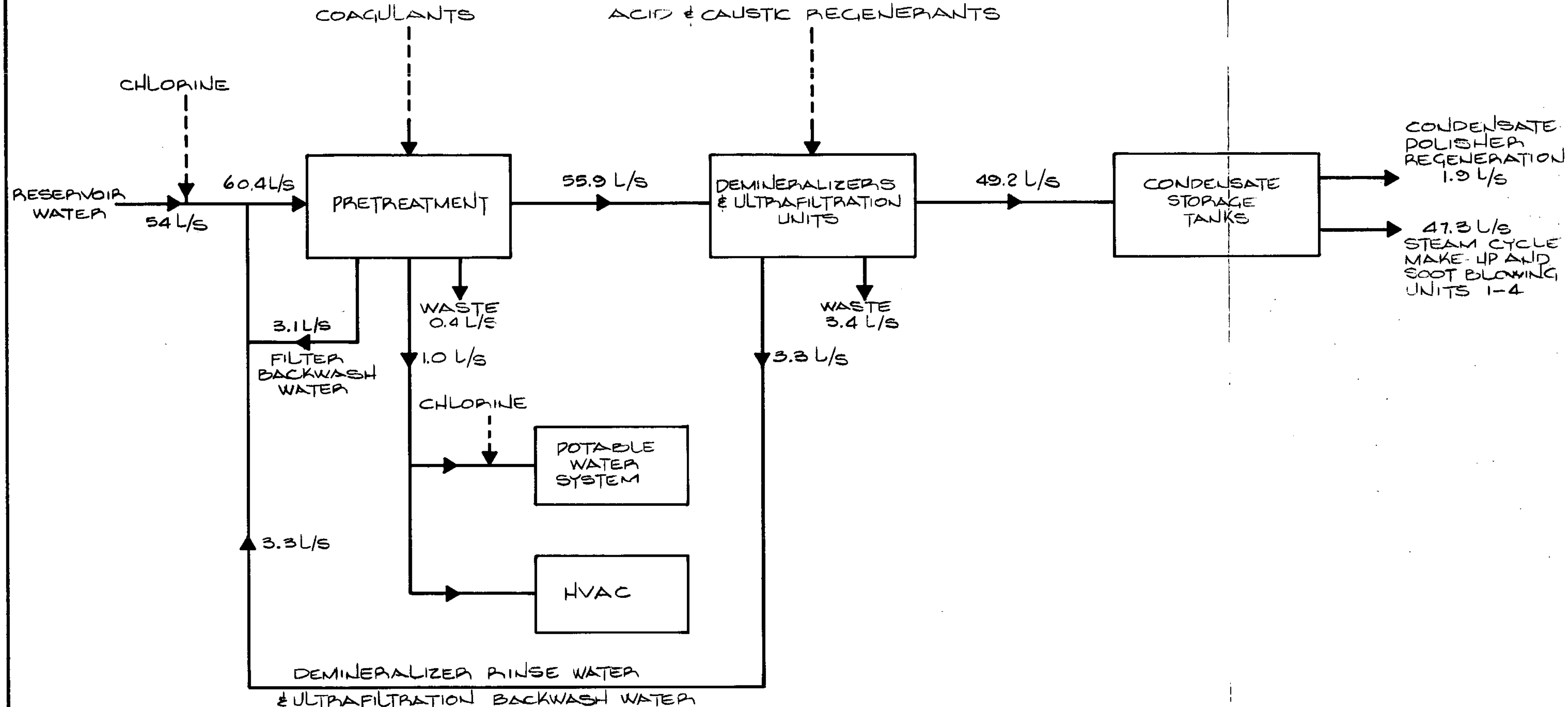
Vancouver Toronto

POWER PLANT
STEAM, FEED & COND. SYSTEM
BASIC FLOW DIAGRAM

B | B.C.H. 0064 | SK. 120 | B

Plate No.3-23



FIGURES REPRESENT AVERAGE FLOWS AT
100% STATION LOAD CONDITIONS (4×560 MW. GROSS OUTPUT)

Design	Drawn	Check	Appd	Issued for	Date	Rev
	TGH			B.C. H. REPORT	23-6-78	

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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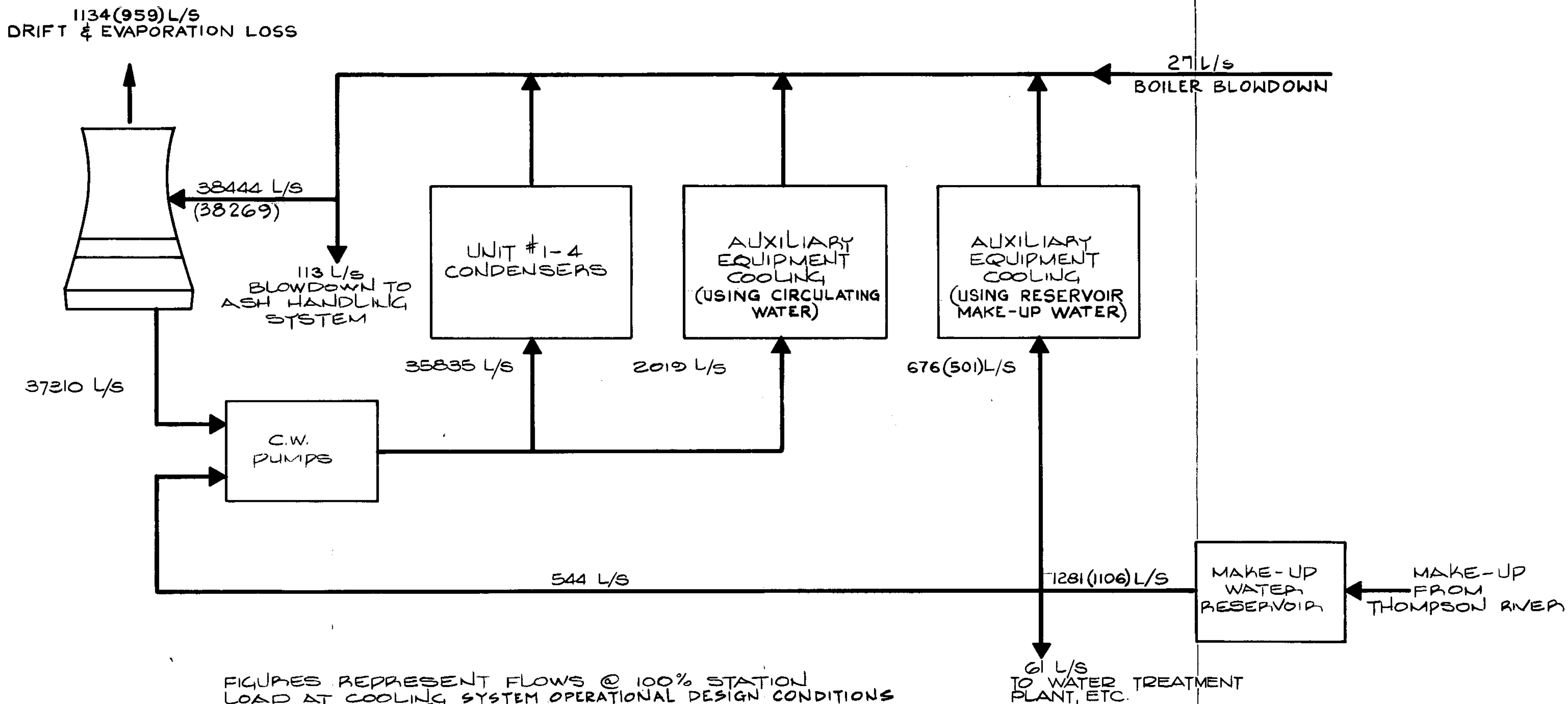
Vancouver Toronto

POWER PLANT
WATER TREATMENT SYSTEM
BASIC FLOW DIAGRAM

B BCH. 0064 SK.121

Plate No.3-24



FIGURES REPRESENT FLOWS @ 100% STATION
LOAD AT COOLING SYSTEM OPERATIONAL DESIGN CONDITIONS
[WB(13.9°C) DB(18.3°C)]

FIGURES IN BRACKETS REPRESENT FLOWS @ 100% STATION
LOAD AT AVERAGE ANNUAL METEOROLOGICAL CONDITIONS

Design	Drawn	Check	Appd	Issued for	Date	Rev
	TGH			BCH REPORT	23-6-78	
	BMS			B.C.H. REPORT	4-7-78	A
	V.B.			B.C.H. REPORT	7-8-78	B

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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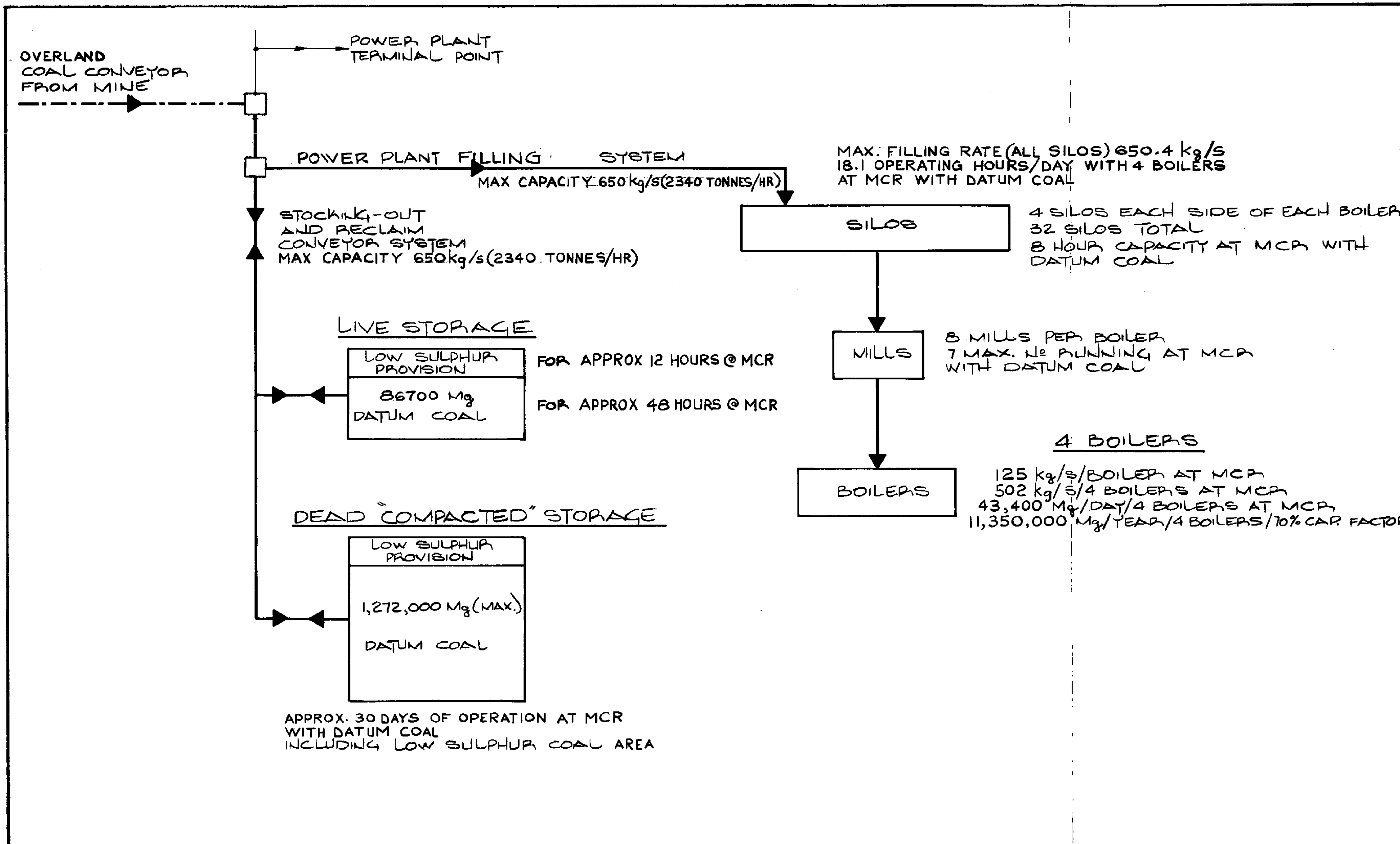
Vancouver Toronto

POWER PLANT
C.W. & COOLING WATER SYSTEM
BASIC FLOW DIAGRAM

B | B.C.H. 0064 | SK 122 | B

Plate No 3-25



Design	Drawn	Check	Appd	Issued for	Date	Rev
	TGH					
	V.B.			BCH. REPORT	AUG 1978	A

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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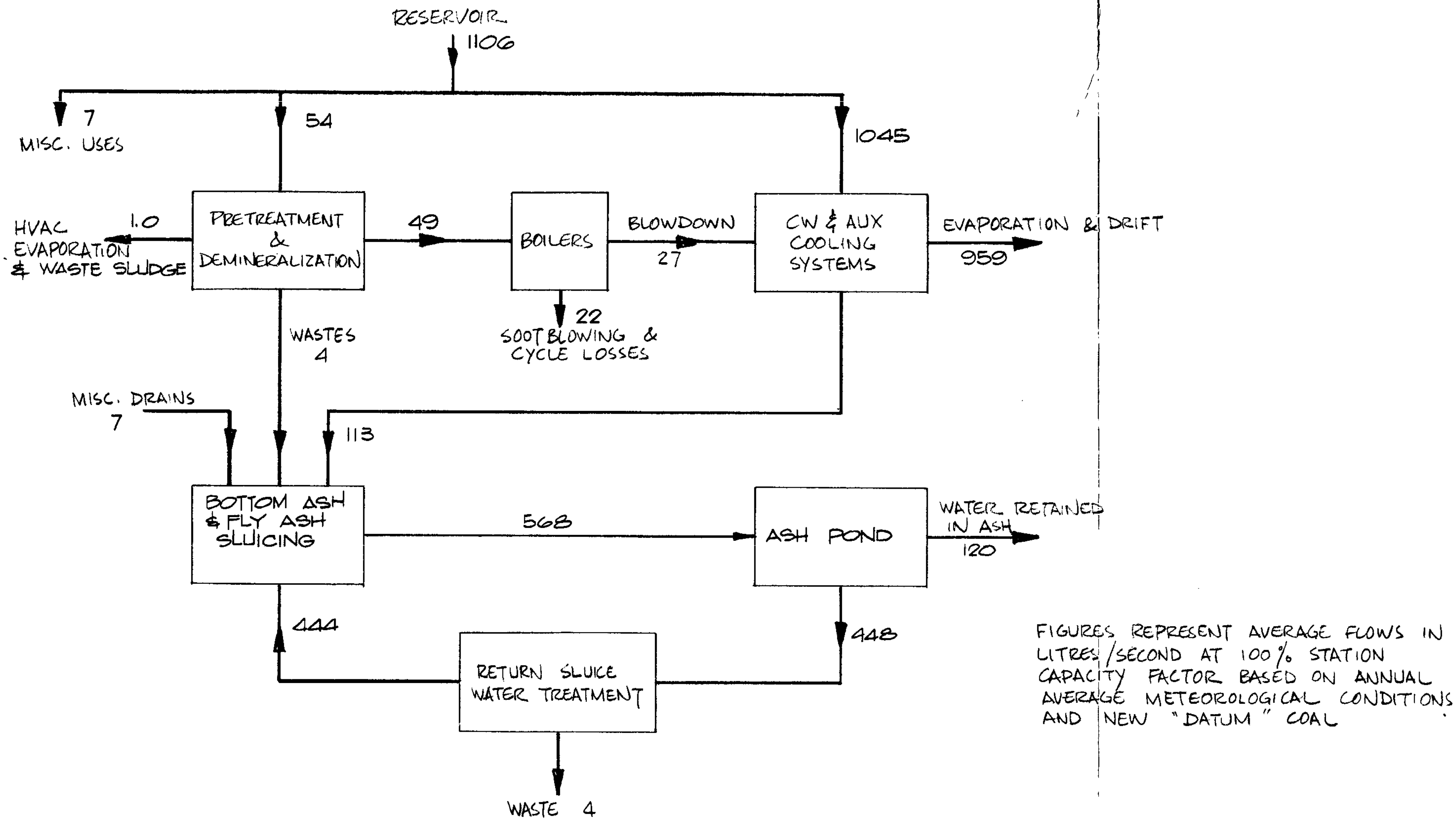
Vancouver Toronto

POWER PLANT
COAL HANDLING SYSTEM
BASIC FLOW DIAGRAM

B | BCH. 0064 | SK. 123 | A.

Plate No 3-26



Design	Drawn	Check	Appd	Issued for	Date	Rev
				B.C.H. REPORT	23-6-78	
	BMS			B.C.H. REPORT	4-7-78	A

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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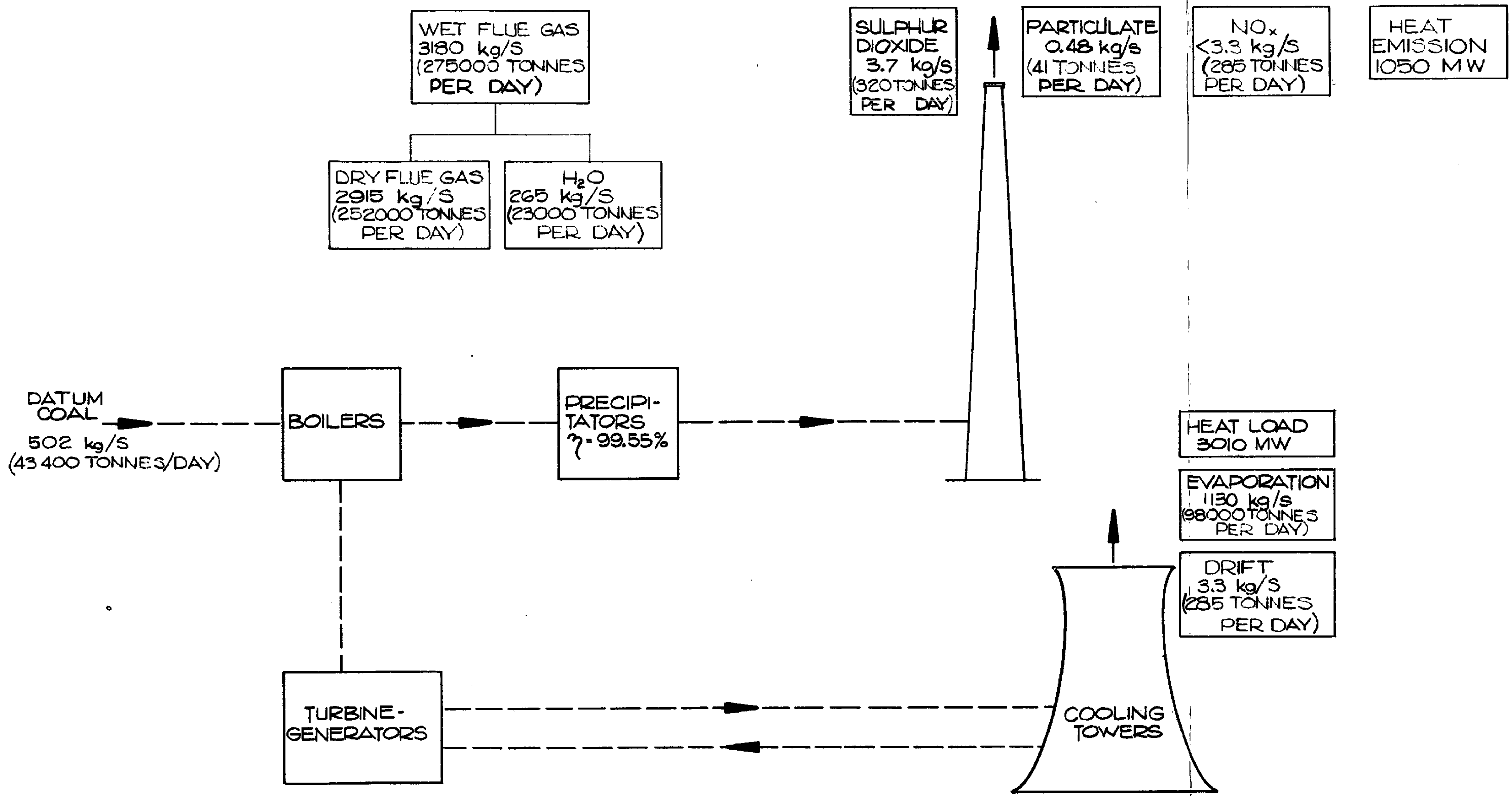
POWER PLANT
BASIC WATER BALANCE

B | BCH 0064 | SK 124 | A

Plate No 3-27



FIGURES REPRESENT FLOWS AT 100%
STATION LOAD AND DESIGN CONDITIONS.
(WET BULB TEMP. 13.9°C, DRY BULB TEMP. 18.3°C)

Design	Drawn	Check	Appd	Issued for	Date	Rev
	B.S.			B.C.H. REPORT	JULY 5 1978	0
	E.S.			B.C.H. REPORT	AUG. 1978	A

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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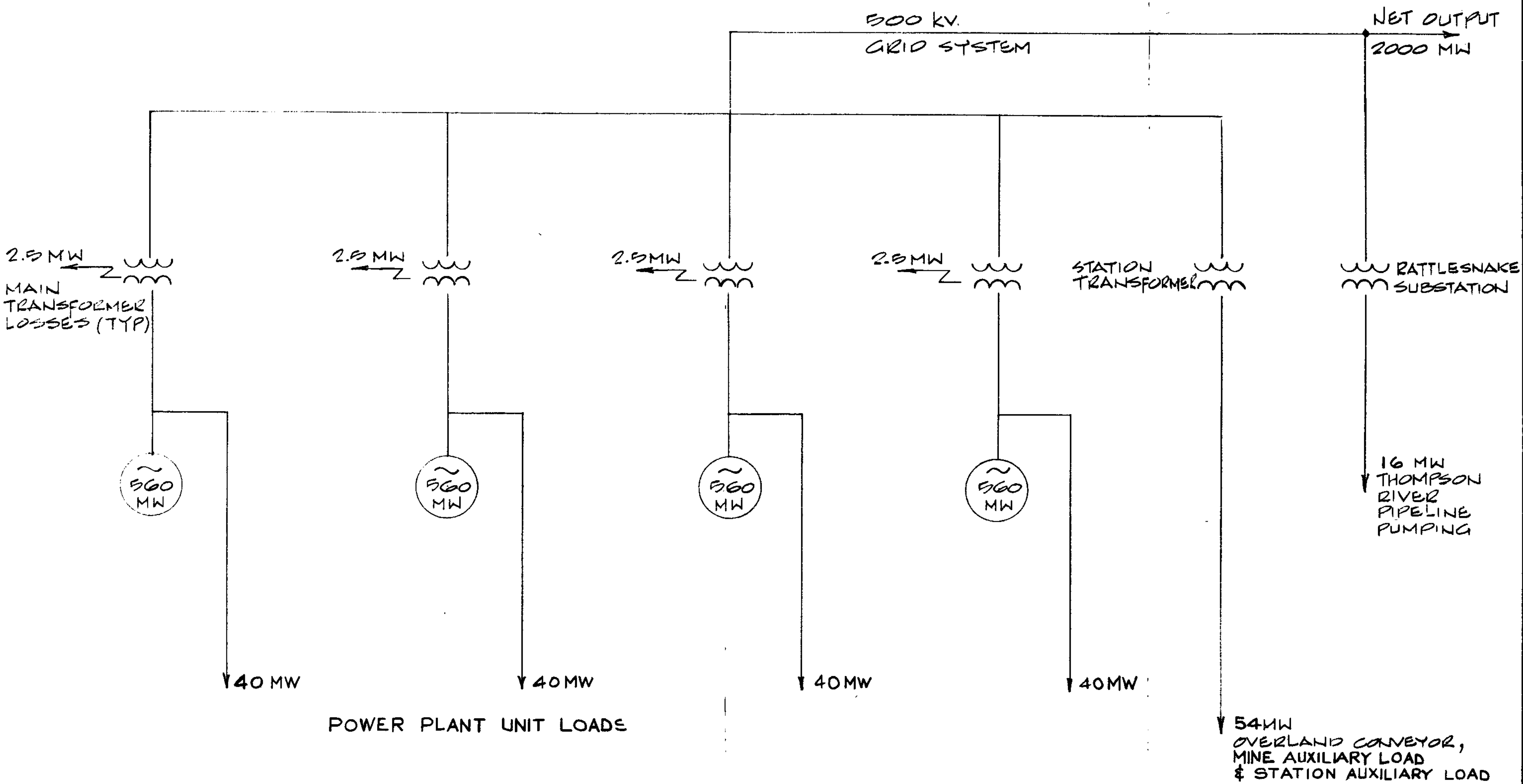
Vancouver Toronto

POWER PLANT
EMISSIONS TO ATMOSPHERE
BASIC FLOW DIAGRAM

B	BCH-0064	SK-119	A

Plate No. 3-22



OUTPUTS & AUXILIARY LOADS BASED ON AVERAGE ANNUAL CONDITIONS

Design	Drawn	Check	Appd	Issued for	Date	Rev
	EN			BCH REPORT	23-6-78	
	V.B.			BCH REPORT	7-8-78	A

BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

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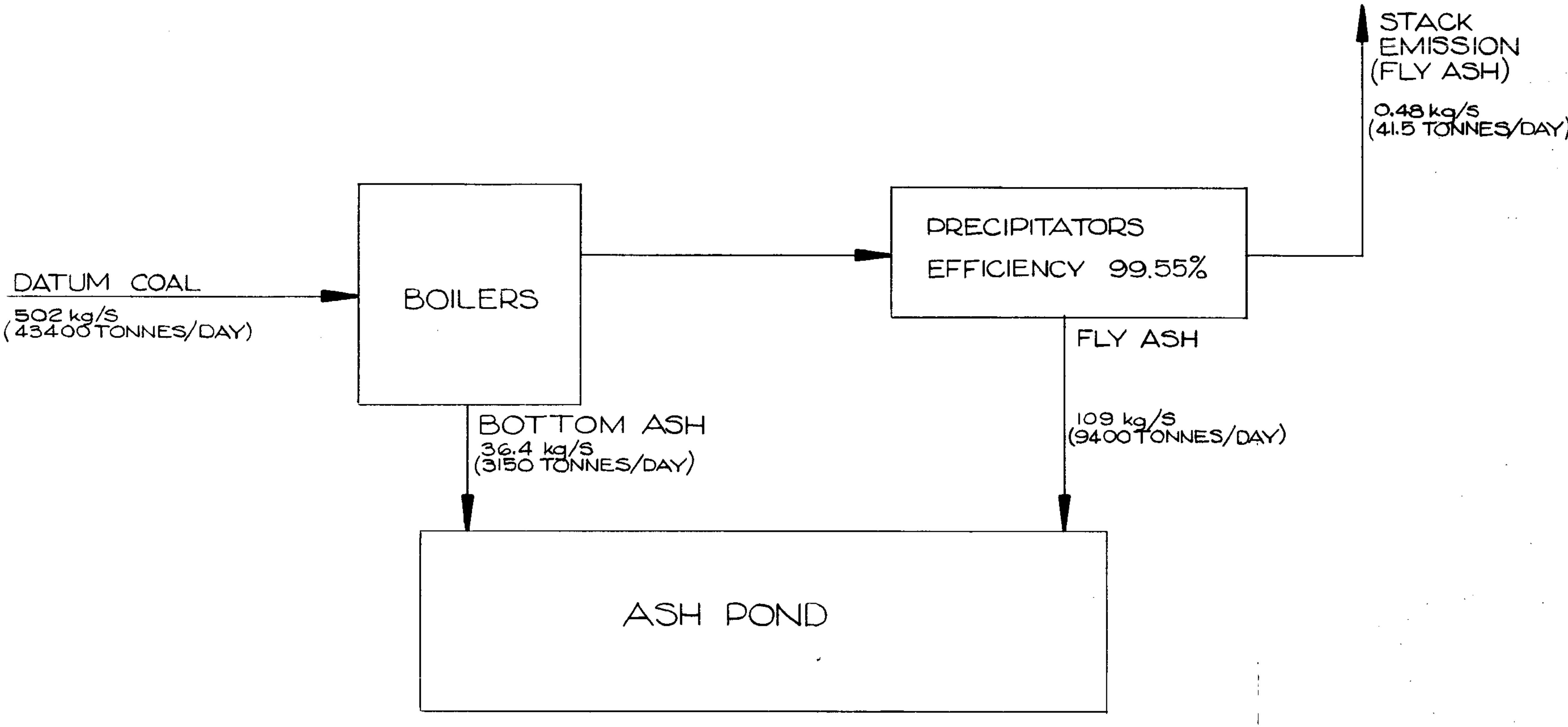
Vancouver Toronto

POWER PLANT
ELECTRICAL POWER
BASIC FLOW DIAGRAM

B | BCH 0064 | SK 125 | A

Plate No 3-28



NOTE :-
FIGURES REPRESENT FLOWS AT 100%
STATION LOAD AT DESIGN CONDITIONS

Design	Drawn	Check	Appd	Issued for	Date	Rev
	JGM			BCH REPORT	23-6-78	
	BMS			BCH REPORT	4-7-78	A
	KES			BCH REPORT	22-8-78	B

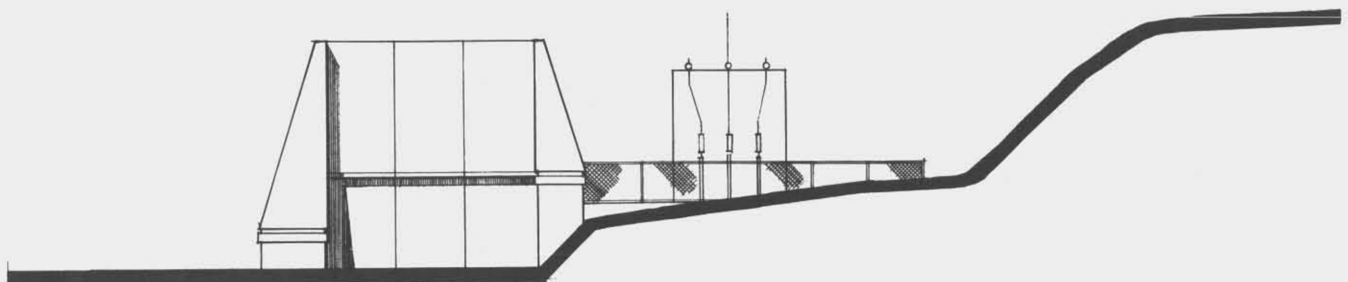
BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

integ - ebasco
Vancouver Toronto

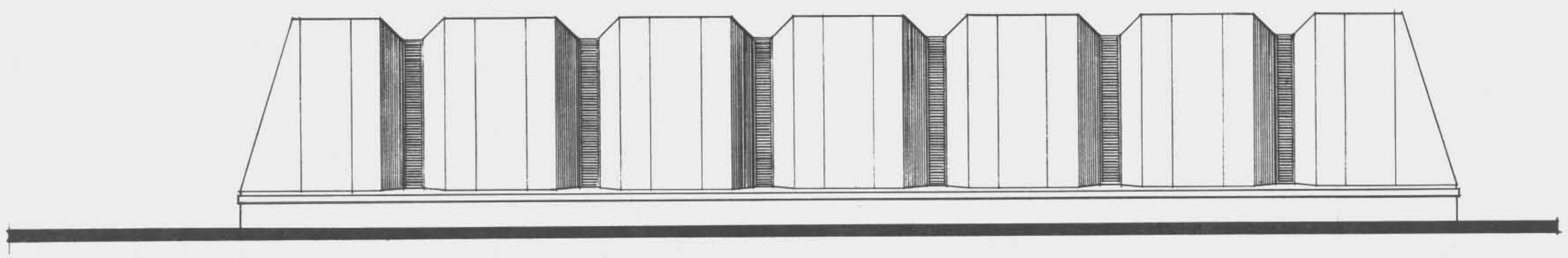
POWER PLANT
ASH HANDLING SYSTEM
BASIC FLOW DIAGRAM

B BCH-0064 SK 126 B

Plate No 3-29

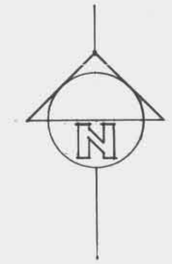


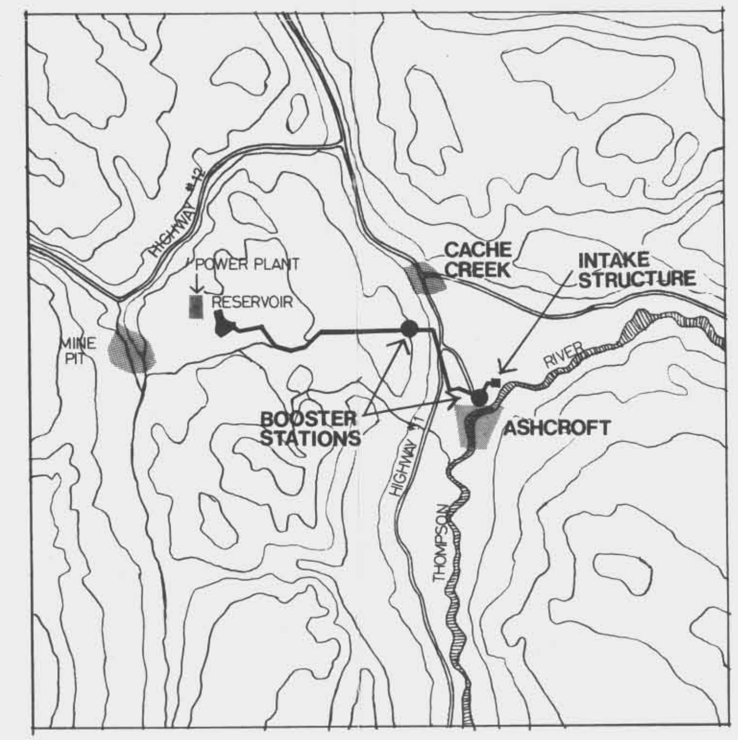
SIDE ELEVATION



FRONT ELEVATION

BOOSTER STATION





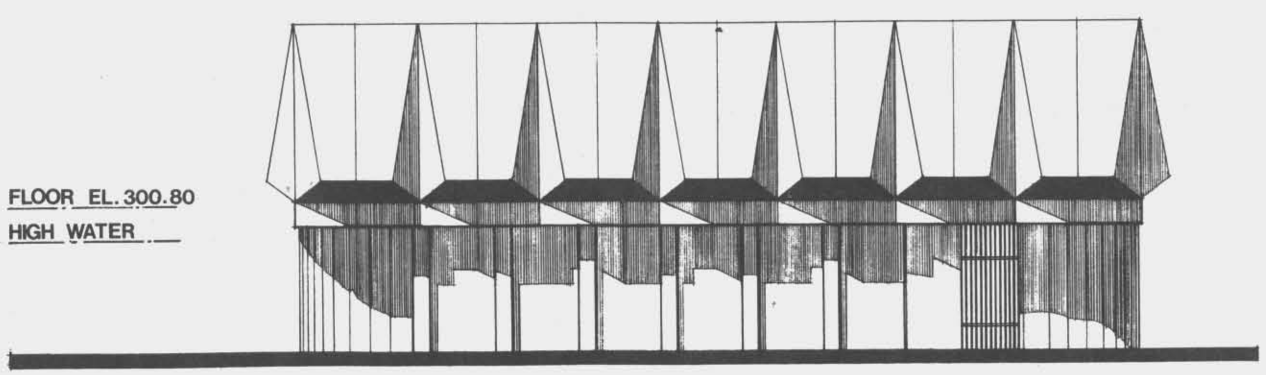
LOCATION PLAN

0 5 10 15

SCALE IN KILOMETRES

FLOOR EL. 300.80

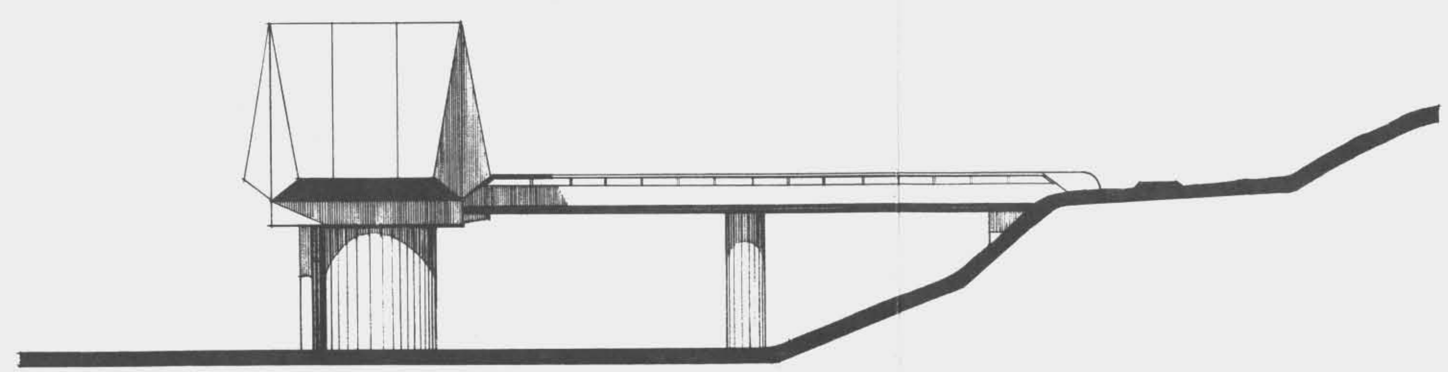
HIGH WATER



LOW WATER

SOUTH ELEVATION

INTAKE STRUCTURE



EAST ELEVATION

COOLING WATER SUPPLY STRUCTURES

0 5 10 15 20

SCALE IN METRES

TOBY RUSSELL BUCKWELL & partners architects
1650 ALBERNI STREET VANCOUVER BC CANADA TELEPHONE 682-6881

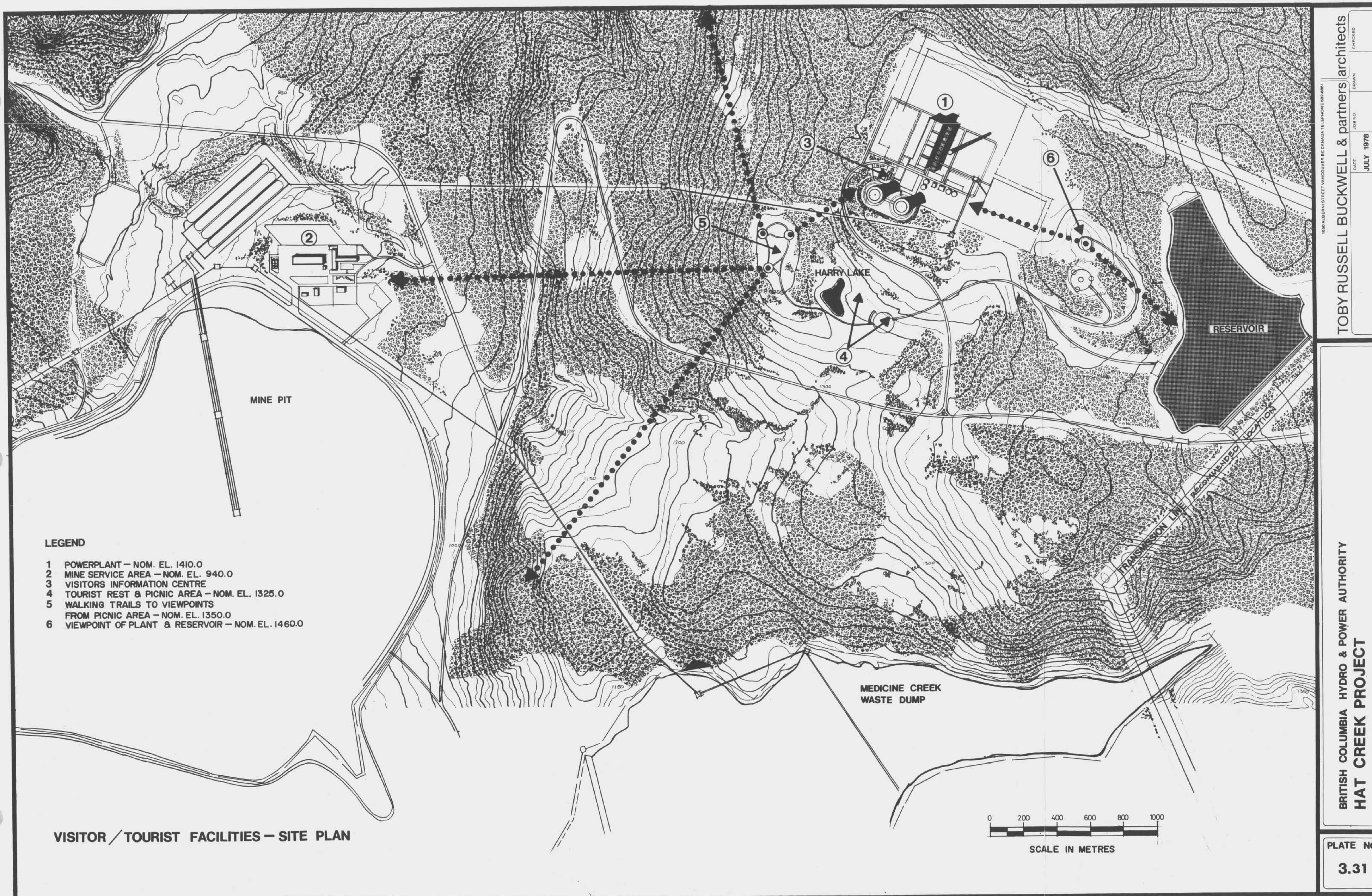
DATE JULY 1978 | JOB NO | DRAWN | CHECKED

BRITISH COLUMBIA HYDRO & POWER AUTHORITY

HAT CREEK PROJECT

PLATE NO. 3.30

BCIL 5497D - T.R.B.



VISITOR / TOURIST FACILITIES — SITE PLAN

SECTION 4.0 - PROJECT COSTS

The capital cost estimates presented in Sections 4.1 and 4.2 cover only those items of equipment and systems considered within the industry as thermal generating station costs. Included are all costs associated with design, procurement and construction of the powerplant and its auxiliary equipment, offsite facilities and transmission.

Costs associated with construction and operation of the open pit mine, including offsite facilities items concerning creek diversions and the mine construction camp are reported in Section 4.5. These costs form the basis for calculation of the cost of coal.

In Section 4.6 the capital and fuel costs are integrated with other estimated project component costs to determine the cost of energy.

4.1 GENERATING STATION CAPITAL COSTS

The estimated capital cost of the Hat Creek Thermal Generating Station is $1285 million (September 1978 dollars). Details are shown on Table 4-1.

Tables 4-2 and 4-3 summarize the powerplant and offsite facilities costs reported in Appendices B and C respectively.

Cash flow for the project commencing in fiscal year 1978-79 is shown on Table 4-4. Expenditures prior to fiscal year 1978-79 for engineering, environmental work, mine exploration and land acquisition totalling $29.3 million are not included in the above capital cost total.

4.2 TRANSMISSION AND SUBSTATION COSTS

Initial transmission requirements for Hat Creek would be met by looping into a 500 kV line passing within 300 m (985 ft) of the Hat Creek powerplant. This line will have been built in 1983 between Kelly Lake and Nicola for the Revelstoke project.

A 35 km (22 mi) circuit would however, be required from the powerplant to Kelly Lake with the addition of Unit No. 2 at Hat Creek. The estimated capital cost of this circuit, including termination and switching at Kelly Lake is $11.8 million. A breakdown of these costs and cash flow is shown in Table 4-5.

4.3 BASIS FOR CAPITAL COST ESTIMATES

(a) Powerplant

Integ-Ebasco's capital cost estimate revisions reflecting the status of engineering as of July 1978 form the basis of the powerplant cost estimates.

Pricing for major items of equipment have been based on suppliers quotations. Material quantities were established from available SDM sheets, drawings and diagrams supplemented with information and costs from similar units designed by the consultant.

All costs were reported at September 1978 levels and assumed Canadian and/or U.S.A. origin. An exchange rate of 89 cents U.S. per Canadian dollar was applied where applicable.

Major qualifications and factors assumed in the compiling of the powerplant estimates included:

4.3 <u>BASIS FOR CAPITAL COST ESTIMATES</u> - (Cont'd)

1. Construction labour 37 1/2 hour work week.

2. $15/day subsistence allowance and fringe benefits.

3. Provincial sales tax at 7 percent on equipment and materials only.

4. Cost of engineering services for final design plus assistance by the consultant during construction, inspection and start-up.

(b) Offsite Facilities

The Hydroelectric Design Division's capital cost estimates supplemented by details from consultants preliminary design reports form the basis for the offsite facilities costs indicated herein. The costs reported in Appendix C at September 1977 price levels have been adjusted to conform to the basic powerplant costs described in Sub-section 4.3(a) above, as follows:

1. Corporate overhead subtracted.

2. Water supply estimates escalated 8 1/2 percent to September 1978 price levels - as advised by Sandwell & Co.

3. The remainder of the offsite facilities estimates escalated at 7 3/4 percent to September 1978 price levels consistent with the approved B.C. Hydro published inflation rate table.

The following qualifications and factors relate to the offsite facilities capital cost estimates:

4.3 BASIS FOR CAPITAL COST ESTIMATES - (Cont'd)

1. The estimates for the cooling water supply, water and ash reservoir embankments, Hat Creek diversion and the single labour camp are considered to have a reliability generally consistent with preliminary design.

2. The cost of the access road and the airstrip would be dependent to a large extent on the amount of rock excavation required. Since no site surveys or subsurface exploration was undertaken, the estimated costs for these items must be considered feasibility stage estimates.

3. As no site has yet been selected for the equipment offloading facilities its cost must be considered an order of magnitude estimate.

4.4 CAPITAL COST EXCLUSIONS

The generating station capital cost estimates exclude the following items:

1. Plant furnishings including furniture, laboratory equipment and workshop equipment and tools.

2. Special premiums for construction labour.

3. Expenses incurred for start-up, other than those included for start-up personnel included in equipment purchases.

4. Training of operating staff.

5. Casualty insurance and bonds.

4.4 CAPITAL COST EXCLUSIONS - (Cont'd)

6. Taxes other than provincial sales tax.

7. B.C. Hydro overhead.

8. Interest during construction.

9. Allowance for inflation.

10. Licensing expenses.

4.5 FUEL COST-MINING

The estimated capital and operating costs of the Hat Creek mine are estimated at $567.8 million* and $1823 million respectively. These costs, (expressed in 1978 dollars), span a 6-year pre-production period, a 35-year production period and a 10-year post-production reclamation period. Supplemented by annual mine production figures and the range of average coal calorific values as reported in Appendix A plus royalties amounting to 3 1/2 percent of the selling price of the coal, these capital and operating costs discounted at 4 percent result in a fuel cost of 63.7 ¢/GJ (67.1 ¢/MBtu) equivalent to $8.13/t ($7.38/ton).

4.6 AVERAGE ENERGY COST

The Hat Creek powerplant average energy cost, based upon a lifetime capacity factor of 65 percent is 19.4 mills/kWh. This energy cost includes:

1. Average annual fixed charges.

---

* $548.4 million mine capital cost plus $19.5 million offsite facility cost for mine construction camp and Hat/Finney Creek diversions.

4.6 AVERAGE ENERGY COST - (Cont'd)

2. Fuel cost.

3. Variable operating and maintenance costs.

The following paragraphs briefly describe the computations summarized in Tables 4-6, 4-7 and 4-8.

(a) Average Annual Fixed Charges

The average annual fixed charges for the 2000 MW (net) powerplant at Hat Creek are summarized in Table 4-6.

Net interest during construction (Item 4) at 11.1 percent has been added to the powerplant direct capital cost and 5 percent B.C. Hydro overhead. The net interest during construction rate is based upon the use of a 4 percent annual net interest rate computed from a 10 percent financial interest rate and 5.75 percent annual inflation. The resulting annual capital costs computed at this net interest rate are real costs at 1978 price levels, which will inflate at 5.75 percent annually throughout the project lifetime. Total powerplant costs, as shown in Table 4-6, are thus about $1500 million at 1978 price levels, including corporate overhead and net interest during construction, but excluding transmission costs.

The annual capital costs shown in Item 6 of Table 4-6 are based on a 4 percent net interest rate, and 1.36 percent annual sinking fund depreciation over the project's 35-year lifetime. These annual charges are again at 1978 price levels and will inflate throughout the project lifetime. Total fixed annual operation and maintenance charges of 3.41 percent in Item 7 include 1.45 percent for fixed operation and maintenance, 0.36 percent for administration and general expenses, 0.25 percent for insurance, 4.6 AVERAGE ENERGY COST - (Cont'd)

1.00 percent for school taxes and 0.35 percent for normal interim replacement costs.

The annual transmission costs shown in Item 8 of Table 4-6 and fully detailed in Table 4-7 are based on total direct transmission costs of $11.8 million associated with the Hat Creek powerplant. The addition of 5 percent for corporate overhead and 4 percent for net interest during construction raises total transmission costs to $12.9 million. Annual charges on this transmission project include 4 percent for net interest, 0.83 percent for sinking fund depreciation over a 45-year lifetime, 1.0 percent for school taxes, and 0.95 percent for other fixed annual operating costs. Resulting total annual transmission costs are about $0.9 million annually at 1978 price levels.

The total annual fixed costs of the 2000 MW powerplant at Hat Creek would be approximately $127.2 million. Generating 11 388 GWh/yr at a 65 percent average annual capacity factor, the average annual fixed cost of energy would be 11.1 mills/kWh.

(b) Fuel Cost

The fuel cost is estimated at 7.3 mills/kWh based upon a net station heat rate of (10,930 Btu/kWh) and fuel price of 63.7 ¢/GJ (67.1 ¢/MBtu) as reported in Section 4.5.

(c) Variable Operating and Maintenance Costs

Incremental operating costs in Table 4-8 include a normal variable operating and maintenance cost of 0.55 mills/kWh, this value being the current North American utility industry average for coal-fired generating stations.

4.6 <u>AVERAGE ENERGY COST</u> - (Cont'd)

To complete the computation of average energy cost for the project a capacity factor adjustment cost has been added to allow for the fact that Hat Creek would generate energy at a 65 percent average annual capacity factor, whereas other hydro projects in the B.C. Hydro system against which it will be compared usually operate at about a 55 percent capacity factor. There is therefore less generating capacity associated with the energy produced by the Hat Creek than there would be with a comparable hydro project generating the same amount of energy at a 55 percent capacity factor. The cost of adding hydro peaking capacity with no energy at some future date to balance the higher capacity factor of Hat Creek thermal generation has therefore been computed, and added as a capacity factor adjustment cost to the average energy cost.

The total average energy cost of Hat Creek would consequently be about 19.4 mills/kWh, as shown in Table 4-8. This cost is at 1978 price levels, and would inflate at about 5.75 percent annually throughout the project lifetime.

TABLE 4-1

HAT CREEK THERMAL GENERATING STATION
CAPITAL COST

		$\$ \times 10^6$
1.	Site acquisition - see note (b)	3.6
2.	Site preparation	9.5
3.	Powerplant see note (c)	819.7
4.	Offsites: access road and airstrip	18.8
5.	Offsites: water supply and reservoir	46.1
6.	Offsites: ash dam	10.1
7.	Offsites: 60 kV transmission, equipment off-loading, powerplant construction camp	15.5
8.	Coal and ash handling	34.2
9.	Air quality control equipment	106.0
10.	Switchyard	17.9
11.	Total direct construction cost	1081.4
12.	Indirect construction costs	49.2
13.	Contingencies	95.1
14.	Total specific construction cost	1225.7
15.	Engineering fees - see note (d)	59.1
16.	Total cost	1284.8
17.	Specific cost based on 2240 MW installed	\$573.6/kW
18.	Specific cost based on 2000 MW net output	\$642.4/kW

Notes:

(a) Excluded from the summary cost table are:

- fees for construction insurance and bonds
- corporate overhead
- interest during construction

(b) Item 1 does not include $4,984,000 spent prior to present fiscal year 1978/79.

(c) Item 3. The main components of the powerplant capital costs are:

	$\$ \times 10^6$
Major civil work (includes concrete, structural steel, buildings, circulating water system)	201.8
Turbine generators	125.8
Steam generators (boilers)	247.9
Mechanical equipment	129.7
Electrical equipment	114.5
TOTAL	819.7

Table 4-2 provides a powerplant cost breakdown in greater detail.

(d) Item 15 does not include cost of engineering studies, environmental studies, drilling and development activities, etc. allocated and spent 1977/78 and earlier amounting to $24,287,000.

TABLE 4-2

POWERPLANT
SUMMARY OF CAPITAL COSTS

	$ x 10^3
Site improvements	5,226
Earthwork and piling	17,673
Circulating water system	27,465
Concrete	26,187
Structural steel	102,700
Buildings	27,713
Turbine generator	125,816
Steam generator and accessories	247,871
Mechanical equipment	55,516
Coal and ash handling	34,227
Piping	54,747
Insulation and lagging	12,998
Instrumentation	13,625
Electrical equipment	89,989
Painting	6,475
Switchyards 500 kV	13,620
60 kV	4,310
Main transformer	10,876
Air quality control system	105,960
Total direct construction cost	982,994
Indirect construction cost	46,183
Contingencies	81,318
Total specific construction cost	1,110,495
Engineering fees	49,805
Total cost	1,160,300

TABLE 4-3

OFFSITE FACILITIES
SUMMARY OF CAPITAL COSTS

		$\$ \times 10^6$
1. Powerplant		
Site preparation		4.3
Access road		15.9
Cooling water supply		37.2
Reservoir		8.9
Ash dam		10.1
Transmission (60 kV)		1.1
Equipment offloading		1.6
Powerplant construction camp		12.8
Airstrip		2.9
	Total direct construction cost	94.8
	Indirect construction cost	3.0
	Contingency	13.8
	Total specific construction cost	111.6
Engineering		9.3
	Total cost	120.9
2. Mine		
Hat/Finney Creek diversion		10.4
Mine construction camp		4.1
	Total direct construction cost	14.5
	Indirect construction cost	-
	Contingency	2.9
	Total specific construction cost	17.4
Engineering		2.1
	Total cost	19.5

TABLE 4-4

HAT CREEK THERMAL GENERATING STATION
CASH FLOW
$ \$ \times 10^6 $

Project Facility	Totals	Fiscal Years 1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
Land acquisition	3.6	2.8	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1			
Offsite Facilities													
Roads/airstrip	25.9	0.4	0.9	13.4	11.2								
Water supply/reservoir	61.5		1.1	3.1	4.7	14.8	27.5	10.8					
Ash dam	13.7				0.7	0.5	4.3	8.2					
60 kV transmission	1.2	0.1	0.3				0.2	0.4		0.1	0.1		
Other facilities	18.6		0.2	5.9	4.7	1.0	4.5	2.2	0.1				
Offsites Subtotal	120.9	0.5	2.5	22.4	21.3	16.3	36.5	21.1	0.1	0.1	0.1		
Powerplant													
Unit 1	399.3	0.3	1.4	10.0	26.0	67.0	115.0	139.8	37.8*	2.0			
Unit 2	252.0	0.1	0.4	3.0	8.0	22.0	37.0	58.0	100.0	21.5*	2.0		
Unit 3	263.6	0.1	0.3	0.5	3.0	15.0	26.0	43.0	63.0	90.0	20.7*	2.0	
Unit 4	245.4	0.1	0.3	0.5	3.0	9.0	14.0	16.0	31.0	67.0	84.0	18.5*	2.0
Powerplant Subtotal	1160.3	0.6	2.4	14.0	40.0	113.0	192.0	256.8	231.8	180.5	106.7	20.5	2.0
Cash Flow	1284.8	3.9	5.0	36.5	61.4	129.4	228.6	278.0	232.0	180.7	106.8	20.5	2.0

* In-service dates

Unit 1 - 1 January 1986
Unit 2 - 1 January 1987
Unit 3 - 1 January 1988
Unit 4 - 1 January 1989

TABLE 4-5

HAT CREEK PROJECT
TRANSMISSION CAPITAL COST
AND CASH FLOW
$\$ \times 10^3$

Item	Fiscal Years					Totals
	82/83	83/84	84/85	85/86	86/87	
500 kV Transmission Line	6	17	97	3668	5118	8906
Kelly Lake Substation		20	140	1400	1300	2860
TOTALS	6	37	237	5068	6418	11 766

TABLE 4-6

HAT CREEK THERMAL GENERATING STATION
AVERAGE FIXED COSTS (65% Capacity Factor)

	Description	Cost $\$ \times 10^6$
1.	Powerplant direct capital cost	1,284.8
2.	B.C. Hydro overhead at 5 percent	64.2
3.	Subtotal	1,349.0
4.	Net interest during construction (11.1 percent of Item 3)	149.7
5.	Total powerplant cost	1,498.7
6.	Annual capital costs (5.36 percent of Item 5)	80.3
7.	Annual fixed operating and maintenance costs (3.41 percent of Item 3)	46.0
8.	Annual transmission costs*	0.9
9.	Total annual fixed costs	127.2
10.	Average energy at 65 percent C.F.	11,388 GWh/yr
11.	Average fixed cost Item 9/Item 10	11.1 mills/kWh

* Annual transmission costs see Table 4-7.

TABLE 4-7

HAT CREEK PROJECT
ANNUAL TRANSMISSION COSTS

	Description	Cost $ x 10^6$
1.	Transmission capital cost	11.8
2.	B.C. Hydro overhead at 5 percent	0.6
3.	Subtotal	12.4
4.	Net interest during construction (4 percent x Item 3)	0.5
5.	Total transmission cost	12.9
6.	Annual capital cost (4.83 percent of Item 5)	0.62
7.	Annual fixed operating and maintenance (1.95 percent of Item 3)	0.24
8.	Annual transmission cost	$0.86 x 10^6

TABLE 4-8

HAT CREEK THERMAL GENERATING STATION
AVERAGE ENERGY COST (65% Capacity Factor)

Description	Cost
Average fixed cost	11.1 mills/kWh
(Item 11 Table 4-6)	
Average fuel cost:	
Cost of coal (at 63.7c/GJ; 67.1c/MBtu Station heat rate 11.5 MJ/kWh; 10,930 Btu/kWh)	7.3
Incremental Operating Costs:	
Variable operation and maintenance	0.55
Capacity factor adjustment cost	0.43
Total average energy cost	19.38 mills/kWh

TABLE 4-9

ENERGY COST AT VARIOUS CAPACITY FACTORS
mills/kWh

Capacity factor	40	65 (average)	78
Powerplant energy cost	26.04	18.95	17.15
Capacity factor adjustment	-0.6	+0.43	+0.92
Total energy cost	25.54	19.38	18.07

SECTION 5.0 - SCHEDULE

5.1 MASTER SCHEDULE

The Master Schedule for the project (Plate 5-2) is a computerized Critical Path Method (CPM) plot of the key activities in the major work areas, to meet a first unit in-service date of 1 January 1986. It is based on the Milestone Dates, including preliminary licensing estimates, shown in Plate 5-1 for the base plan of four 500 MW (net) units, as used for preliminary engineering and the cash flows in this and supporting reports.

B.C. Hydro constraints bar any tender invitations prior to the hearings verdict and any contract awards or major site work before completion of appeals and construction authorization. The earliest tenders called would be for the turbine-generators, access road and boilers, with contract awards for the first two immediately following construction authorization.

Site work would start with offsite facilities: the access road, mine substation and the powerplant construction camp.

The "critical" path, which in this schedule actually has considerable float, would be the manufacture, delivery, erection and boil-out of the steam generator and related systems. For Unit No. 1, a final commissioning period of 6 months has been allowed between first steam-to-set and commercial service.

The mine construction and development schedule, to stockpile coal for boiler light-off by early 1985, is not critical, even with a winter break allowance.

5.2 NEW LICENSING SCHEDULE

New, more detailed estimates of the times required for hearings, appeals and approval confirm that the preliminary estimate of the licensing period in the above base schedule is overly optimistic. The revised estimates were not incorporated into the base schedule as the Consultants' reports and cost estimates were too far advanced. For this Report, it was considered better that the costs and schedules agree, and the anticipated changes be addressed separately.

The new "best possible" estimate totals 34 1/2 months (maximum) instead of the previous 15 months from Application for License to Construction Authorization, but the "planning allowance" now proposed involves a much more conservative estimate of 48 months for licensing. On the latter basis, while no major construction would be scheduled in advance of full construction authorization, it would be necessary to make provisional T/G and boiler contract awards before completion of the first appeal process in order to maintain the January 1986 first unit in-service date. Alternatively, if all awards were held until after completion of all appeals, a first unit in-service date of October 1987 would result.

HAT CREEK PROJECT
BASE SCHEDULE
MILESTONE DATES

Completed

Powerplant Feasibility Report	July 1975
Preliminary Environmental Impact Report	August 1975
Preliminary Mining Reports	March 1976
Decision by Board to Proceed with Preliminary Engineering	December 1976
Completion of Conceptual Design Reports	end January 1977
Start of Preliminary Engineering	March 1977
Bulk Sample Program including Bulk Burn Test	May - August 1977
Progress Report to Board of Directors	29 November 1977
PCB Hearing	10 - 14 January 1978

PCB Decision - New Guidelines	1 July 1978
Completion of Preliminary Engineering Reports for Major Blocks	by 31 July 1978
Environmental Impact Assessment Report (ESCLEC) - Final Draft	31 July 1978
Preliminary Engineering Composite Report completed	31 August 1978
Report to Board of Directors	September 1978
Environmental Impact Statement (B.C. Hydro) - Final	15 November 1978
Decision by Board to Proceed to Hearings and Release of EIS	1 December 1978
First Licence Application	1 January 1979
Start of Public Hearing (assuming single hearing for entire project)	1 April 1979
Constructors Agreement Required	1 June 1979
Hearing Verdict	1 August 1979
T/G Tender Invitation	1 August 1979
Boiler Tender Invitation	15 January 1980
Hearing Appeals Completed - Cabinet Final Decision - Treasury Board Approval & Construction Authorization	by 1 April 1980
T/G Award	1 April 1980
Boiler Award	15 September 1980
Construction Starts - Offsites and Site Preparation	Spring 1980
- Powerplant	Spring 1981
- Mine	Spring 1982
Mine Producing and Stockpiling for One Boiler	February 1985
Boiler Light-off	April 1985
First Steam to Set	1 July 1985
Unit No. 1 Commercial Service	1 January 1986
Units No. 2/3/4 Commercial Service	January 1987/88/89

7 April 1978

Plate 5-1

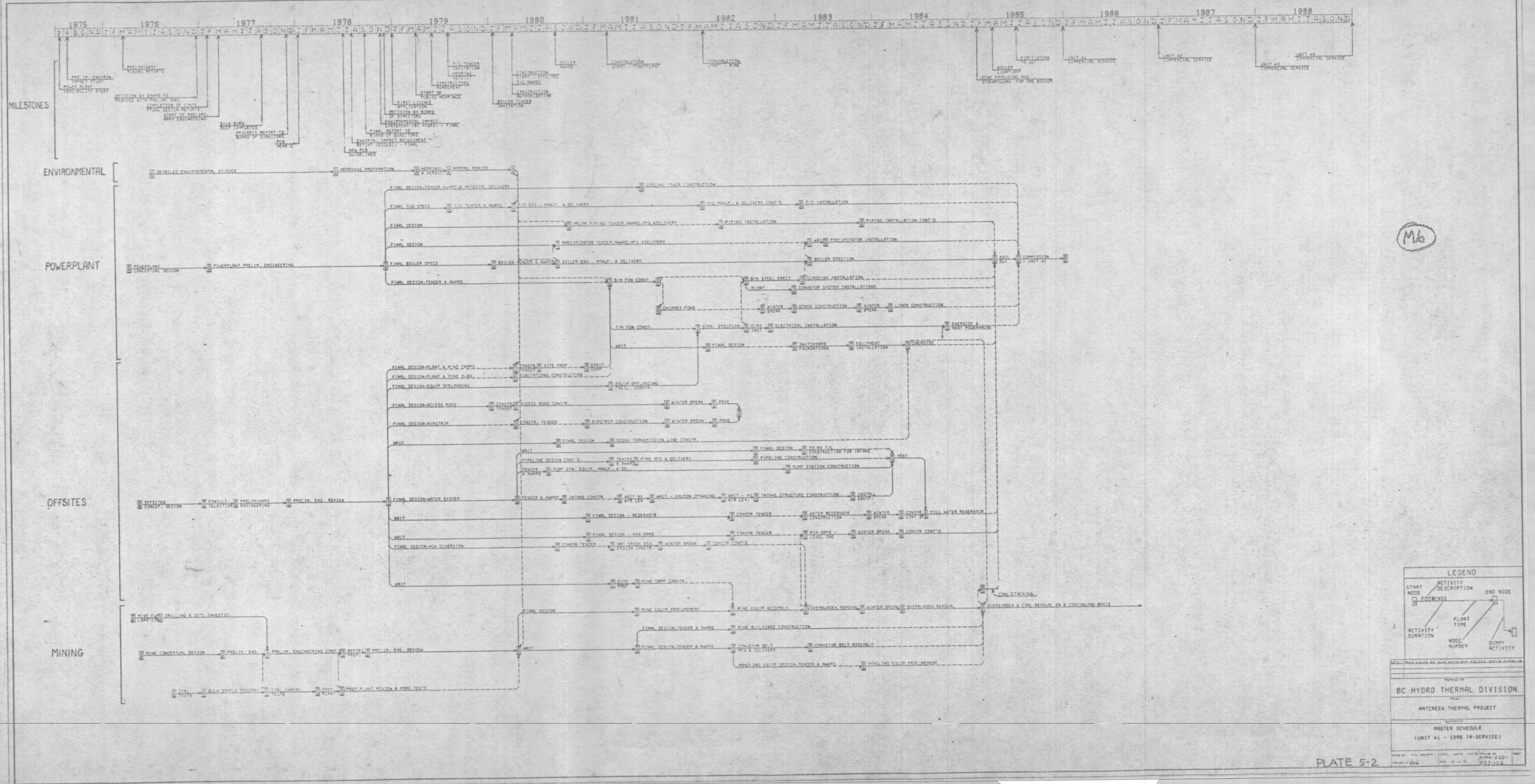

1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
MILESTONES
ENVIRONMENTAL
POWERPLANT
OFFSITES
MINING
LEGEND
START NODE
ACTIVITY DESCRIPTION
END NODE
FLOAT TIME
ACTIVITY DURATION
NODE NUMBER
DUMMY ACTIVITY
BC HYDRO THERMAL DIVISION
HATCREEK THERMAL PROJECT
MASTER SCHEDULE
(UNIT #1 - 1986 IN-SERVICE)

PLATE 5-2

SECTION 6.0 - PROJECT ORGANIZATION AND SUPPORT FUNCTIONS

6.1 INTRODUCTION

Matrix project management techniques, employed on an experimental basis for the preliminary engineering phase of the project, have resulted in effective coordination of the wide range of required specialist skills. Therefore, extension of the present project team approach is recommended for the remaining licensing, final design, construction and commissioning phases.

Considerable work has already been accomplished by seconded representatives who were brought into the project team early to contribute their experience and expertise from the following support areas: Commmunity Relations, Computer Sciences, Environmental Services, Accounting and Finance, Labour Relations, Legal, Materials Management, Electrical Operations, Personnel and Properties.

6.2 PROJECT ORGANIZATION

(a) Present Organization

Development of the proposed Hat Creek project is primarily the responsibility of a multi-discipline team moulded around the Thermal Division of the Engineering Group. The overall project organization shown on Plate 6-1, consists of a 7-man Policy Steering Committee, chaired by the Vice President of Engineering; a 6-man international Board of Review; a small Licensing Core Group; and the Project Team, including suitably qualified major Consultants in the mining, powerplant, offsites and environmental areas.

6.2 PROJECT ORGANIZATION - (Cont'd)

(b) Future Organization

Several alternative organizational structures are being considered for managing the licensing, final design, construction, commissioning and operation phases of the project. The main theme of the future organization would be a unified approach to project management and control, with clearly defined accountability and commensurate authority. Since certain key personnel, such as the Construction and Plant Operation Managers, are yet to be hired; organization for the later phases beyond design can be considered only in general terms.

1. The Policy Steering Committee and the Board of Review would be retained as at present.

2. To ensure effective coordination of all project activities affecting the critical licensing process, it is recommended that licensing be integrated with the other Project Team responsibilities.

3. The Project Team has operated successfully during preliminary engineering. While there are areas where changes may be beneficial, it is intended that this experiment with project management matrix organization would be continued and expanded.

4. Suitably qualified major consultants would be used to carry out the final design of all major work.

5. Construction would be controlled by a B.C. Hydro Construction Manager reporting to the Project Manager. Site staff may be supplied by B.C. Hydro consultants, or a combination of the two.

6.2 PROJECT ORGANIZATION - (Cont'd)

Construction would be packaged into contracts of the most suitable type: supply, supply and supervise, supply and erect, or construct/erect only. A prime objective would be appropriate concentration of responsibility.

6. Commissioning would be controlled by a Commissioning Manager, reporting to the Project Manager and recruited in time to be involved with detailed design of the powerplant and offsite facilities. It may be advantageous to approach the powerplant consultant for such a person, or use someone destined for a senior operating position in the Hat Creek Generating Station.

7. Plant operation would be carried out by Electrical Operations. It is considered mandatory that key operating staff be appointed early to ensure consistent and continuous input to design, construction and commissioning.

8. Environmental monitoring and protection would be coordinated and controlled by the Project Team Environmental Member, who would work closely with the Construction and Plant Operation Managers. A site environmental group would be developed to carry out on-going monitoring and ensure implementation of environmental protection measures.

6.3 SCHEDULING

Schedules are one of the principal tools of project control. A wide variety of types and levels is required to meet changing needs as a project progresses through the various phases of work. To date, emphasis has been placed on the first two levels of overall scheduling and on detailed schedules for current work. In the later phases of the

6.3 SCHEDULING - (Cont'd)

project, variations of most of the existing schedules would continue to be used, but the number and detail required would increase greatly to control final design, procurement, construction and commissioning.

6.4 FINANCIAL ACCOUNTING AND COST CONTROL

While accounting systems and procedures used on the project would follow established corporate guidelines, certain activities have been delegated to the Accounting and Finance Team Member by Plant Accounting to increase the effectiveness and speed of cost control procedures.

In addition to the corporate accounting systems to record and monitor costs and commitments, a Construction Cost Control System would be developed with faster response and reporting. A Mining Cost Control System would also be developed to provide effective cost and production data for mine management.

A much more detailed code of accounts than normal would be used to provide the best possible basis for cost control. The code would also be used in the project filing and drawing reference systems.

Accounting policies for pre-production and development costs, and coal inventories have been established.

6.5 MATERIALS MANAGEMENT

Materials Management brings about greater efficiencies and more effective controls by grouping together those departments involved with material supply. Procedures have been developed for procurement, transportation, and contract administration activities, specifically including those for quality control and expediting.

6.6 ENVIRONMENTAL

A comprehensive environmental assessment, monitoring and protection programme would be developed for the pre-construction, construction and operation phases. Plans for decommissioning of the powerplant and reclaiming of the mine area would also be proposed. An organizational outline has been prepared.

6.7 OPERATIONS

Electrical Operations has been involved early in the project to take advantage of its experience and expertise, particulary in areas affecting plant reliability and maintenance. Practical input has been continual through the conceptual and preliminary design stages; this participation provides past and current experience to avoid plant layout and equipment problems.

6.8 OTHER SUPPORT AREAS

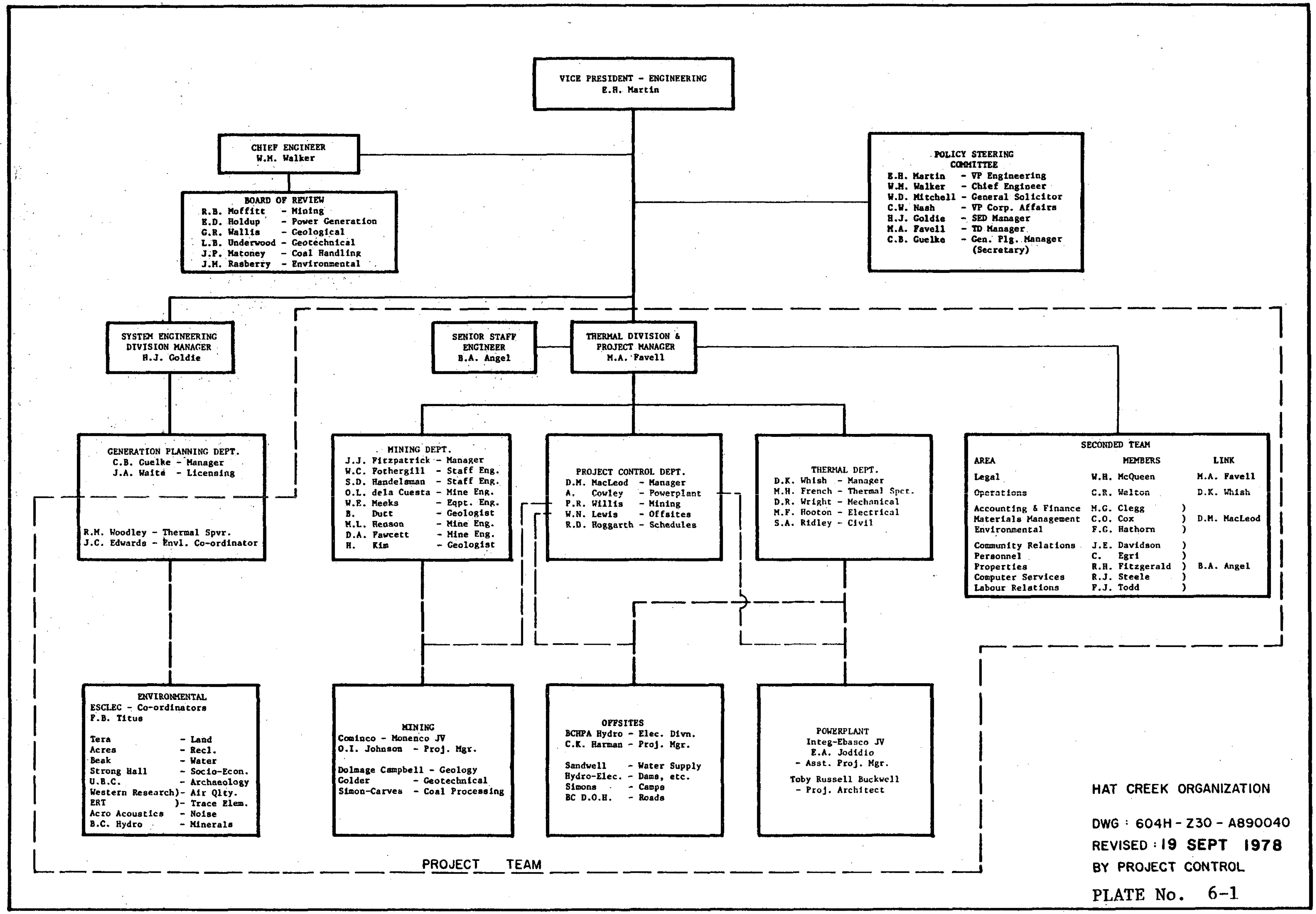
Computer Sciences Department has developed a Digital Terrain Model (DTM) for the project area from aerial photography and has been especially helfpul in mapping, scheduling, mining and air quality data bases, and analyses.

Labour Relations is investigating potential construction/ operations jurisdictional problems, which are complicated by this being B.C. Hydro's first proposed mining operation.

Land acquisition has been carried out by the Properties Division to ensure that project development could proceed as soon as the necessary approvals and licences are received. Proper management of this land during the interim is maintained through leasing arrangements and close cooperation with the Ministries of Agriculture and Forestry.

6.8 OTHER SUPPORT AREAS - (Cont'd)

Public and Customer Relations Division has drawn extensively on its resources to provide information to the public as part of B.C. Hydro's open planning process. Included have been information bulletins, news releases, reports, open houses and meetings with groups and agencies having interest in the project.



HAT CREEK ORGANIZATION

DWG : 604H - Z30 - A890040

REVISED : 19 SEPT 1978

BY PROJECT CONTROL

PLATE No. 6-1

SECTION 7.0 - LICENSING CONSIDERATIONS

7.1 INTRODUCTION

The nature and scope of statutory obligations presently being met and those anticipated to be required on the complex Hat Creek Project, should it proceed to the licensing stage, are set out in this Section.

Coordinated legislation to rationalize the variety of statutory hurdles would assist licensing but to date such an approach has not been fruitful.

The Pollution Control Act contains procedures anticipated to be the most demanding of time and resources. Two cases for Hat Creek under that Act are set out in this Section to provide an estimate of licensing time. The Pollution Control Act refers to "Objectives" which are informative only. Final "Standards" governing pollution levels would only be determined in the permits issued by the Director of the Pollution Control Branch as a consequence of site-specific examination.

7.2 GUIDELINES FOR COAL DEVELOPMENT

In working towards anticipated licensing of the proposed Hat Creek Project, B.C. Hydro has generally complied with the procedures set out in the guidelines for coal development issued by the Environment and Land Use Committee in March 1976. Although these guidelines are specifically written for coal mining and processing, B.C. Hydro is also applying them to the powerplant and offsite facilities.

7.2 GUIDELINES FOR COAL DEVELOPMENT - (Cont'd)

Draft reports currently being completed for the detailed assessment studies required under Stage II of the Guidelines will be presented to the Coal Guidelines Steering Committee for circulation to the government agencies having jurisdiction over various aspects of licensing. It is expected that these agencies will provide review and comment. An approval in principle from the Coal Guidelines Steering Committee may assist B.C. Hydro in the event that it decides to apply for licenses for the project.

7.3 POLLUTION CONTROL OBJECTIVES FOR MINING, MINE-MILLING AND SMELTING INDUSTRIES OF BRITISH COLUMBIA

In March of 1977, the Director of the Pollution Control Branch announced a public inquiry to review the pollution control objectives for the mining, mine-milling and smelting industries of British Columbia. Submissions from interested parties, including B.C. Hydro, were submitted by 1 September 1977 and the Inquiry was held 10-14 January 1978 by the Pollution Control Board.

The Pollution Control Branch extended the topics discussed at the Inquiry to include pollution-related aspects of large coal-fired powerplants. B.C. Hydro prepared a brief on coal-fired powerplants, but on mining aspects, supported the brief prepared by the B.C. Mining Association, of which B.C. Hydro is a member.

The results of the Inquiry, expected to be handed down later in 1978, will be of fundamental importance in establishing certain air quality, liquid effluent and solid waste objectives which will serve as basic objectives for planning future projects, in particular Hat Creek.

However, it must be noted that such objectives would not constitute absolute "Standards" for the Hat Creek Project. The permits issued by the Director of the Pollution Control Branch, following public hearings or otherwise, would contain the specific "Standards" for the plant.

7.4 APPLICABLE STATUTES

For the presentation to the Energy Committee of Cabinet held 18 January 1977, B.C. Hydro prepared a list of regulatory statutes which were concerned with environmental or land use matters, or both, and contained provisions on hearings (either mandatory or discretionary), or appeals to orders or decisions made under such statutes. The Legal Division has reviewed those statutes and their regulations from time to time to advise of any amendments which might affect the hearing or appeal procedures. Two significant amendments to the subject matter of the list are:

1. The Heritage Conservation Act which came into force as of 22 September 1977.

2. The Land Commission Act, now renamed as the Agricultural Land Commission Act, S.9, was repealed and substituted for. An application to exclude land in a land reserve now requires a prior public hearing S.9(1) and a decision of the Commission under S.9(2) and S.9(3) is appealable to the Environment and Land Use Committee and if leave to appeal is denied then leave to appeal may be sought from the Minister of the Environment.

The best estimate of provincial statutes and regulations applicable to the Hat Creek Project is now as follows:

7.4 APPLICABLE STATUTES - (Cont'd)

Statute	Hearing	Appeal
Coal Act	None	S.31 Lt-Gov I/C appeal from Minister
Coal Mines Regulation Act	S.8(5) mandatory re: reclamation report	None
Environment and Land Use Act	S.4 discretionary public inquiry	None
Heritage Conservation Act	None	None
Land Act	S.56 discretionary re: application	S.56(3) Ministerial appeal, then S.56(4) B.C. Supreme Court on law alone
Agricultural Land Commission Act	S.9(1) mandatory re: application by municipality, Reg. district, or Commission, to exclude. S.9(2) discretionary by Commission re: application by owner to exclude.	S.9(7) ELUC S.9(8) Minister of Environment
Pollution Control Act	S.3 discretionary Board inquiry S.13(4) discretionary re: permit S.14 Board or Directors Inquiry on any matter at their discretion (public or private inquiry)	S.12 Board appeal then Lt-Gov I/C appeal or B.C. Supreme Court
Water Act	S.9 (2) discretionary re: license	S.38 Lt-Gov I/C appeal

The federal statutes which may be applicable to the project are concerned with fisheries and navigable waters and contain no provisions for hearings or appeals.

7.5 LICENSING ESTIMATE

Time estimates prepared for licensing the Hat Creek Project are set out below.

Certain difficulties in connection with these estimates are:

1. Hydro has no direct experience to serve as a guide for mine and thermal plant licensing. Analogous precedents from other projects and simple examination of the applicable statutes have been used to arrive at the time estimates.

2. The size and complexity of the project have led to an accumulation of material on detailed environmental studies which is without parallel in the experience of B.C. Hydro. It is anticipated that this material will be so massive that the intervenors may insist upon extensive review time. The tribunals themselves may make this same request.

3. There is uncertainty whether one or more authority which has jurisdiction in a matter related to the project may be prepared to relax its statutory powers given under its act and thereby join other agencies and comprehensively hear all or part of the project issues. The procedures set down for most of these authorities are not uniform; hearings in some instances are mandatory, in others are discretionary, and in some cases are not required. Appeal procedures, where they occur, are similarly variable.

4. In the event of multiple hearings, whether they be concurrent or sequential, the logistics of organizing and preparing evidence will likely pose serious manpower problems. The seriousness of these problems may, in fact, make multiple hearings totally impracticable.

7.5 LICENSING ESTIMATE - (Cont'd)

Certain assumptions were also required in order to prepare the time estimates:

1. The basic assumption is that the governing hearing will be the Pollution Control Act hearing. The rationale for using this hearing is that the issues are most complex, the time requirements most extensive, and the appeal procedures most involved.

2. There is a possibility that concurrent hearings on minor matters would occur simultaneously and the results from such hearings may not necessarily await nor depend upon the outcome of the Pollution Control Act hearing.

3. Recent experience gained on the Revelstoke hearings, by the Comptroller and the Cabinet under the Water Act, and on the Burrard Thermal hearing, by the Pollution Control Board under the Pollution Control Act, has been utilized where possible and this experience is shown on the licensing time estimate set out in Table 7-1.

4. All information has been used to establish two cases:

    - best possible
    - planning allowance

    A planning allowance of 48 months is suggested as the guide at this time, as compared with the earlier 15-month estimate used in preliminary engineering and for the master schedule.

5. Alternate appeal procedures are available to appellants following the administrative appeal to the Pollution Control Board. These alternates are:

7.5 <u>LICENSING ESTIMATE</u> - (Cont'd)

a. Appeal to the Lieutenant-Governor-in-Council.

b. Appeal to the Supreme Court of British Columbia.

The time that may be consumed on such appeals is rather similar although the appeal to the Lieutenant-Governor-in-Council has the possibility of being the longer.

TABLE 7-1

HAT CREEK PROJECT

LICENSING ESTIMATE (MONTHS)
(Based on Pollution Control Act)

	BTGS*	REVELSTOKE	HAT CREEK	
	(Ref. only)	(Ref. only)	Best Possible	Planning Allowance
1. Hearing				
Time from application to hearing		7 1/2	6	8
Hearing (concurrent minor hearings)		1	3	4
Time to decision		1 1/2	6	8
		10	15	20
2. Administrative Appeal to Board				
Filing notice of appeal	1 1/2-2		1	2
Time from notice to appeal	2		4	6
Appeal	2 days		1	2
Time to decision	3/4		4	6
	4 3/4		10	16
3A. Appeal to Lt-Governor-in-Council				
Filing notice of appeal		1	1 1/2	2
Time from notice to appeal		4 1/2	3	4
Appeal		1/2	1	1
Time to decision		3 1/2	4	6
		9 1/2	9 1/2	13
OR				
3B. Alternate Appeal to Supreme Court				
Filing notice of appeal			1	1
Time from notice to trial			4	6
Trial			1/2	1
Time to decision			1	2
			6 1/2	10
4. TOTALS				
Hearing alone (1)		10	8	20
Hearing and administrative appeal (1 and 2)		19 1/2	25	36
Hearing and administrative appeal and further appeal (1, 2 and 3)			31 1/2 - 34 1/2	46 - 49

* Burrard Thermal Generating Station.

SECTION 8.0 - PROJECT ENVIRONMENTAL FACTORS

8.1 INTRODUCTION

After more than 2 years of intensive study by a multi-disciplinary team of resource specialists, it is concluded that no environmental impacts have been identified that would preclude the orderly development of the 2000 MW Hat Creek project. However, this Section highlights major environmental factors that may affect one or more of the following:

1. Licensability of the Project.

2. Project economics.

3. Public health and socio-economic interests.

Impacts of project components on the environment were considered in the environmental selection of preferred alternatives for developing the project description in Section 3.0. While many of the environmental and engineering tradeoffs that went into the project design are not formally described here, Appendix E presents a more detailed environmental review.

In conducting the environmental studies, the consultants utilized a common impact assessment methodology to facilitate consistent resource evaluation. Primary, secondary and tertiary impacts of construction, operation and decommissioning of the project were presented for site specific, local and regional study areas. This included a quantitative or qualitative assessment of significant beneficial and adverse impacts. To fully appreciate the results of the

8.1 INTRODUCTION - (Cont'd)

consultants' reports requires familiarization with the specific assumptions and data base used. For prediction of impact, the methodology involved the development of two scenarios; the "most probable case" and the "worst case". It should be noted that most significant impacts occur only in the "worst case" scenario even though a very conservative approach was taken in the development of assumptions related to the "most probable case".

This Section also comments on the project specific role of mitigation and compensation measures.

8.2 MAJOR ENVIRONMENTAL FACTORS

The more significant environmental impacts predicted for the proposed Hat Creek development can generally be categorized as:

1. Degradation of ambient air quality within 25 km of the plant and subsequent localized effects on vegetation.

2. Direct land alienation.

3. Socio-economic pressures due to population-induced effects as a result of the project labour force.

Each of the descriptions that follow serve to emphasize the environmental issues made evident in the impact assessment (Appendix E Section E2.0).

(a) Thermal Plant Emissions

(i) Acid Rain

Both public and government interests have expressed concern regarding the possible impacts of acid precipitation from the Hat Creek powerplant. This concern centres around the possibility of flue gas contaminants causing precipitation pH reductions and thereby reducing pH levels in water and snow courses downwind of the plant. The technical understanding of long-range transport of thermal station emissions and long-term accumulation of intermittent acid precipitation is limited.

The land resource consultants[8*] have concluded that within the local study area, because of high buffering capacity of the soils, there would be no vegetation impact due to acid precipitation. Their assessment is based on the air quality consultant's[27] estimate that pH changes would occur intermittently for short periods. pH changes beneath the plume would be more prevalent within about 20 km (13 mi) of the plant than at long range 25 to 100 km (15 to 60 mi) distances. Natural wind variability would preclude serious acidification of precipitation due to project emissions.

Analysis of available data suggests that water quality degradation on regional water bodies and stream courses as a result of long-range transport of air contaminants would not exceed acceptable levels. Measurable water quality changes could occur.

Monitoring schemes related to acid rain have been proposed by independent[39] and government[38] groups

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* Superscripts in this Section refer to reference reports listed numerically in Appendix E.

8.2 MAJOR ENVIRONMENTAL FACTORS - (Cont'd)

as well as B.C. Hydro's consultants. Appendix E, Section E3.0 deals with proposed environmental monitoring and protection.

(ii) Sulphur and Nitrogen Oxides

Potential injury to vegetation due to gaseous fumigation by SO_2 and NO_2 has been predicted to occur in the upper elevations of Cornwall Peak, the Clear Range west of the powerplant, the southern end of the Pavilion Range*[8] and additional areas such as Arrowstone Hills. The land resource consultants[7,8] have concluded, on the basis of very conservative assumptions, that some plant species within areas totalling 330 km^2 (127 mi^2) could be affected to some degree by SO_2 and NO_2 emissions from a 244 m stack operating under MCS. Smaller areas would be affected if a taller stack or a FGD system were to be used. Consultants have suggested monitoring schemes to check operational effects of the project on vegetation. No adverse human health impact is predicted from SO_2 or NO_2 emissions.

(iii) Trace Elements

Impacts of trace elements have been a subject of interest to project planners since work began on the preliminary environmental studies. The air quality consultant has concluded[27,33] that no ambient air concentrations of trace elements are expected to approach short or long-term guideline values as listed in the Pollution Control Branch objectives for the Mining, Minemilling and Smelting Industries.

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* This description also applies for both the 366 m stack with FGD case and the 366 m stack with MCS case except that the additional areas such as Arrowstone Hills would be little affected.

8.2 MAJOR ENVIRONMENTAL FACTORS - (Cont'd)

Flourine in the form of gaseous hydrogen fluoride (HF), has been reported as potentially injurious to sensitive tree species at extremely low concentrations. Wide variations in research data of the percent of fluorine released in gaseous form from the burning of coal have resulted in cautious reporting of fluoride impacts by the Hat Creek forestry consultants. Again, consultants have recommended monitoring of fluoride emissions[7,10]. No adverse human health impact is predicted from gaseous fluorine, or other trace elements.

(b) Dust Loading from Mining Activities

The air quality consultant[27] concludes that "mining activities are expected to substantially reduce visibility on a local scale within the Hat Creek Valley". For example, one area affected would be the Indian reserve 3 km (2 mi) north of the mine pit. The consultant also states that; "emissions from the mine are predicted to reduce the annual average visibility range by about a factor of four near the north boundary of the mine site and by no more than a factor of two beyond 5 km (3 mi) from the mine. More severe short-term visibility reductions beyond the project site limits will occassionally occur". This could produce excursions of total suspended particulates (TSP) in excess of both short-term and annual guidelines. The coordinating consultant has suggested that fugitive dust from "mining activities could reduce visibility in the valley within a few kilometers of the mine under restrictive meteorological conditions".

8.2 MAJOR ENVIRONMENTAL FACTORS - (Cont'd)

It should be recognized that a conservative approach to assessing mine TSP was utilized. The air quality consultant states that; "concentrations beyond a few hundred meters from the mine are expected to be overestimated in the predictions". Furthermore, the mine design upon which the aforementioned impacts were projected differs somewhat from that presented in Appendix A. With the experience gained from excavating the 6300 t (7000 ton) bulk sample, the modified mine design is being studied to determine its potential TSP level, and what mitigative design changes and remedial measures in operation of the mine would bring the dust levels within the Pollution Control guidelines. Thus the restricted visibility referred to by the environmental consultants would be improved to an acceptable level.

(c) Water and Fisheries Resources

Impacts on surface and groundwater resources and in particular impacts on the Thompson River fisheries resource are expected to be issues at a project license hearing.

The hydrology consultants[19] advise that "while the project would not seriously affect the total groundwater resource, the pit excavation and dewatering would cut the valley alluvial aquifer and significantly reduce the flow in its northern end". They further suggest that "most of the water from dewatering would be returned to the creek". This water would be directed to lagoons for settlement prior to discharge to Hat Creek. Also, "impacts on groundwater resources would be restricted to an area within a radius of about 7 km (4 mi) from the centre of the pit". With the present design some erosion and sedimentation damage could occur within the proposed drainage system during the life of the project. A study of the necessary mitigative changes in the design has been initiated. Drainage from the proposed waste dump, coal stockpile area and ash disposal sites would result in some seepage into the ground water systems in these areas. Where dissolved solids or metal ions could potentially contaminate ground water, impermeable liners or treatment facilities would be required. Any impacts on ground water quality would be confined to the immediate area of the disposal sites.

The present design would cause an increase in the summer water temperature in Hat Creek downstream of the diversion canal which is expected to adversely affect the resident fish population. A study of the necessary mitigative changes in the design of the diversion canal has been initiated. Temporary habitat modification due to siltation during construction activities would be expected to contribute to impacts on Hat Creek and the Bonaparte River fish populations.

Of public concern would be the impact of the water intake on the Thompson River water and fish resources. The intake has been specifically designed with participation by Federal Fisheries, to minimize impingement of salmon fry on the intake screens. The powerplant reservoir would have sufficient storage for extended shutdown of the intake operation during critical juvenile fish migration periods. The quantity of water withdrawn would be small in comparison to the overall river flow, less than 0.05 percent, and fish losses are expected to be negligible. Any withdrawal of water and subsequent potential fish loss from one of British Columbia's most productive salmon rivers will come under public and political scrutiny before approval is granted.

(d) Land Alienation

Development of the project would require both temporary (reversible) and permanent (irreversible) alienation of land which is important wildlife habitat, significant or potentially

8.2 MAJOR ENVIRONMENTAL FACTORS - (Cont'd)

significant agricultural land and land which is useful to a lesser degree for forestry production. Some wildlife habitat along 7 km (4 mi) of Hat Creek would be lost in construction of the diversion scheme and opening of the mine. Vegetation damage as described in Sub-section 8.2(a)(ii) above would be generally confined to chronic effects on a few species at higher elevations within 25 km (15 mi) of the plant site.

Land aliented by the project activities and facilities would total approximately 37 km^2 (14 mi^2). The mine and associated waste dumps would alienate 18.4 km^2 (7.1 mi^2) of range and 4.98 km^2 (1.92 mi^2) of cropland. Plant construction would alienate 4.24 km^2 (1.64^2) of grazing land. The cattle herd size for beef production in the Hat Creek Basin is projected to be about 6 percent less with the project. However, good range management production could replace this loss.

(e) Employment and Income

With the construction of the full 2000 MW facility requiring up to 7 years and a peak labour force of about 3000, the project would become one of the most labour-intensive in the province. In addition, a permanent mine, thermal plant and offsite operating staff of about 1250 persons would be required over the 35-year life of the project.

Expenditures by the work force and their families would generate additional commerce within the surrounding communities of Cache Creek and Ashcroft. A maximum of about 115 construction jobs would be expected to be filled by local residents with approximately 60 permanent operating positions filled by the regional work force. Local residents could be expected to fill

8.2 MAJOR ENVIRONMENTAL FACTORS - (Cont'd)

about half of the regional operating total. Construction jobs would significantly reduce unemployment in the construction trades at the regional level. The project could cause considerable shifting in mining manpower as workers switch to the Hat Creek project for greater job security and proximity to residences in the Ashcroft/Cache Creek area. Careful planning could turn employment opportunities into local advantage. Local acceptance of the project would be significantly enhanced if positive opportunity could be developed.

An economic boom would be generated in the region during project construction, but the normal post-construction downturn would be mitigated by the permanent settlement of a large operating work force.

(f) Impact on Local Communities

A number of both positive and negative impacts resulting from the project have been identified. Those that may be of concern are described as follows:

1. A few of the 30 or 40 people resident in the Hat Creek Valley could be affected by the noise, dust and traffic during construction.

2. The local communities would experience rapid population growth for a 5 to 6-year period. If the majority of workers were to settle in Cache Creek, the village could experience an annual growth rate of up to 30 percent for 2 to 3 years. Municipalities would be under great pressure to expand physical infrastructure, housing and other services. They

have the space and capability to do this but serious disruptions and bottlenecks could be avoided only if local governments were given adequate time to plan for, and carry out, service expansions.

3. Unless compensation is provided, local taxpayers could experience a sharp rise in property tax in the first 4 years of the project. Long-term taxes could increase somewhat as population thresholds are reached requiring the municipalities to pay a greater share of some servicing costs such as policing.

4. Pavilion Lake and possibly Loon Lake would tend to become areas of permanent, rather than summer recreational settlement.

5. Short-term inflation, primarily related to land prices, would occur in the local area.

6. The south Thompson bridge in Ashcroft may become so congested as to warrant replacement.

Consultants[24] have proposed means of overcoming these concerns and have identified areas where B.C. Hydro could contribute through mitigation or compensation.

Cooperation from the municipal and regional governments in combination with the past experience gained by B.C. Hydro could provide timely planning schemes to offset or reduce anticipated project impacts. Socio-economic study results are continuing to provide access for the community and regional planners to the multiplicity of community infrastructure inventories generated by

8.2 MAJOR ENVIRONMENTAL FACTORS - (Cont'd)

the detailed environmental studies. This would effectively reduce the lead time in obtaining action/reaction to project socio-economic impacts. Based on the current schedule, however, local governments are about 1 year behind in land use planning and development to accommodate project impacts.

(g) Native Indians

Impacts of the project on Native Indians were studied as part of the overall socio-economic assessment. The close proximity of Indian Reserve lands to several project components makes Indians one of the groups most affected by localized impacts such as noise, dust and aesthetic change.

8.3 MITIGATION AND COMPENSATION

Clearly defined opportunities for mitigation and compensation generally demonstrate the success (or failure) of environmental impact and engineering optimization studies. Mitigation measures for the Hat Creek Project are actions taken in the planning, design, construction, operation or decommissioning of the project which would lessen adverse impacts on values associated with resources affected by the project. Benefit/ cost assessments of intra-project alternatives (i.e. measures) are working tools for implementing mitigation decisions. Many mitigative decisions have already been incorporated in the project descriptions presented in Section 3.0.

Formal benefit/cost assessment in many cases was foregone in favour of informal engineering and environmental trade-offs or optimizations. Other mitigation measures have been suggested by the environmental consultants for implementation during future phases of the project. These would be subjected to the same scrutiny and evaluation as were the measures already incorporated.

8.3 MITIGATION AND COMPENSATION - (Cont'd)

Compensation expenditures for resource losses associated with the Hat Creek Project may be considered when mitigation measures do not fully take care of the impacts. These will be carefully evaluated in light of the policy developed by B.C. Hydro on compensation and mitigation. A separate report evaluating the various measures proposed by the environmental consultant is being considered. Mitigation and compensation proposals would be made at licence hearings following preliminary negotiations with government agencies. B.C. Hydro would propose in the Environmental Impact Statement a preferred mitigated project and suggest which compensation expenditures are appropriate.

8.4 FUTURE WORK

Several tasks are planned or in progress to close information gaps in preparation for project licensing (to maintain an October 1987 first unit in-service date). These include but are not limited to:

1. Position papers covering important engineering decisions which affect the environmental impacts, including stack height and cooling tower selection.

2. Investigation of numerical modelling techniques for estimating plume dispersion and mine dust emissions.

3. Review of mine dust TSP predictions based on mitigative changes in the mine design and remedial measures in the mine operating plan.

4. Additional trace element analysis to confirm background levels of flourine in the local study area.

5. Reassessment of the most probable impacts of air quality on vegetation.

8.4 FUTURE WORK - (Cont'd)

6. Investigation of acid precipitation chemistry and impact of acid rain on hydrology and soils.

7. Discussions with resource agencies on compensation and mitigation for resource impacts.

8. Formal benefit/cost analysis of intra-project design options.

9. An assessment of integrated resource management planning in the Hat Creek area.

Some of the tasks are for direct input to the EIS and others would be required as backup for public hearings and license applications.

8.5 CONCLUSION

Provided that the preferred air quality control and cooling tower options are accepted for licensing by the responsible government agency, additional mitigation and compensation expenditures for the base scheme (or the alternatives described in Section 3.0) are not expected to be large or to materially affect project economics.

SECTION 9.0 - MAJOR SOCIAL FACTORS

There are three major social factors that could have an important impact on project licensing and final design.

Before these factors are addressed, it should be noted that the Hat Creek Project would be publicly discussed in the current debate of matters relating to this province's energy policy. Recently during information meetings about specific projects, B.C. Hydro planners have been drawn into policy-related discussions on issues such as whether and when further generation projects are required, how load forecasting is done and whether electrical energy should be exported. During licensing procedures for the next B.C. Hydro generation project (and the Hat Creek Project is no exception), these issues will continue to be vigorously discussed.

9.1 COAL-FIRED GENERATING PLANT

The first social factor which should be recognized is that the Hat Creek Project proposal represents the first major coal-fired thermal generating plant in British Columbia. It is therefore expected that the public would approach the proposal with a certain degree of apprehensiveness due to unfamiliarity with such a plant and its operations. In addition, the standards or guidelines set by the provincial government for licensing Hat Creek would be new and untested in British Columbia, further increasing public uncertainty.

9.2 AIR QUALITY

The second factor to consider is the wide public concern for air quality. The recent public reaction to B.C. Hydro's attempts to

9.2 AIR QUALITY - (Cont'd)

acquire oil-fired testing and operating permits for the Burrard Thermal plant supports this suggestion. The possible presence and effects of acid rain, sulphur dioxide and trace elements such as arsenic and fluorine would probably be of great interest at both the local and provincial level.

9.3 SOCIO-ECONOMIC FACTORS

The third point to note is that many of the impacts identified by the socio-economic consultants would be mitigated through regional and local planning. For example, pressures would be felt on the communities' housing, medical and educational facilities. Several communities are involved e.g. Cache Creek, Ashcroft and possibly Clinton, and it would be important to deal equitably with all. A sub-committee of the Thompson Nicola Regional District, which is composed of directors from all communities and unorganized areas near Hat Creek, was set up to deal with the project and could be valuable in this regard. In considering B.C. Hydro's responsibilities to these communities, it should be noted that the Hat Creek Project's workforce profile over time is different from that for hydroelectric dam projects: the minimum 35-year operating phase of the mine and generating plant would require a large labour force which would be permanently resident in the area. This would mean that the typical boom syndrome associated with construction of hydroelectric projects would be largely avoided.

A final social factor to be considered with the Hat Creek Project concerns Native Indians. Both by virtue of proximity to the project and special legal status related to reserves, it is difficult to predict what measures could be taken to mitigate impacts on the bands. Further, if discussions with the bands extend over a long period, no mutually acceptable solution may be reached within the present project time frame.

9.4 SUMMARY

The communities near the Hat Creek Valley, with the exception of the Native Indian bands, have indicated their support for the proposal on the assumption that the project would increase the economic activity in the area. This support is conditional upon actions taken by B.C. Hydro and the provincial government to ensure that adequate measures are taken to safeguard the environment.

SECTION 10.0 - PRINCIPAL AREAS OF CONCERN

Principal areas of concern are restricted to the following non-technical factors which are conditioned primarily by influences external to B.C. Hydro.

10.1 POLLUTION CONTROL OBJECTIVES

There could be possible variance between the air quality, liquid effluent and solid waste objectives used in design of the project's powerplant and offsite facilities, and the soon to be announced results of the January 1978 public inquiry into Pollution Control Objectives. If these objectives are more stringent than those advocated in B.C. Hydro's brief to the Inquiry, commensurate changes may have to be made to the project design as part of the prelicensing activity.

10.2 NATIVE INDIANS

The potential impact of anticipated delays in completing a settlement with local Native Indian bands is an area of concern. Difficulty has been encountered in maintaining contact with the bands although occasional joint meetings have been held since 1974. Joint studies were attempted but the bands decided to undertake their own federally-funded study. So far there have been no results from this study.

10.3 LICENSING PERIOD

There is great uncertainty as to the time and effort required to prepare and present the case for the project at the anticipated eight applications or hearings required to obtain the prerequisite licenses to proceed. Best informed estimates of hearings and appeals under the Pollution Control Act - presently thought to be the most

10.3 LICENSING PERIOD - (Cont'd)

demanding of time and resources - range from 15 to 20 months without appeals, and 34 1/2 to 49 months for hearings and consecutive appeals to both the Board and the Supreme Court. In the event of extensive appeals, it may not be possible to maintain the 1986 first unit in-service date unless some major contracts are awarded while the decision on an appeal is still pending.

10.4 LABOUR BARGAINING UNITS

In formulating an approach to establishing labour bargaining units for the project, the mine, which is new to B.C. Hydro, would be a complicating factor. Alternatives are under study, but the matter of mine development and its relationship to the construction and operating unions involved in previous B.C. Hydro projects remains uncertain. The ultimate form and scope of project bargaining units would, to a large degree, be determined by the wishes of a majority of the worker group, tempered to some extent by current Labour Relations Board policies constraining fragmentation of such units. This situation underlines the necessity to develop objectives and a plan to achieve those objectives as soon as possible following project approval.

SECTION 11.0 - CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSIONS

It is technically and environmentally feasible to develop the proposed open pit coal mine and operate the associated conventionally fired 2000 MW thermal generating station for a minimum working life of 35 years.

In 1978 dollar terms, the capital costs for the powerplant, offsite facilities and the associated transmission lines are estimated to total $1297 million. The fully capitalized cost of coal supplied to the powerplant is $8.13/t ($7.38/ton).

Using these costs in conjunction with a 65 percent lifetime annual capacity factor the powerplant, the cost of electrical energy supplied to the transmission system, including interest and degradation, is 19.4 mills/kWh.

While pollution control objectives for coal-fired thermal plants in British Columbia are still in the course of preparation by the Pollution Control Board, environmental protection can be provided for this project to meet and generally be better than pollution control objectives for coal-fired thermal plants which are consistent with established objectives and standards prevailing in the rest of Canada and many other parts of the world.

There are four principal areas of concern described in this report which are restricted to non-technical factors conditioned primarily by influences external to B.C. Hydro. Of these factors, the uncertainty as to the time and procedures required to obtain the necessary licences and permits, is the most critical to maintaining the scheduled first unit in-service date.

11.2 RECOMMENDATIONS

In assessing ways of serving future power requirements, B.C. Hydro must consider conventional coal-fired thermal generation plants as a cost-competitive, well-developed technology for converting some of British Columbia's abundant coal resources into electrical energy.

Because coal-fired thermal plants are new to B.C. Hydro, a Thermal Division was established in 1975 to investigate and develop such future projects. However, it is becoming increasingly evident that B.C. Hydro as a whole must go further and, with the Provincial Government, accept that the proven and familiar legislation, procedures and practices established for hydroelectric projects, will have to be changed to effectively accomplish the introduction of coal-fired electrical generation.

Such changes are recommended as necessary to ensure compatibility with government policy and public consensus, and would follow well-proven and established practices in the many world-wide locations in which coal-fired electrical generation exists with a tradition of social acceptability and reliable performance.

SECTION 12.0 - REFERENCE DOCUMENTS

HAT CREEK PROJECT

POWER PLANT

PREDICTED OPERATING REGIME

UNITS 1-4 (4 x 560 MW GROSS)

1) GENERAL

(a) Start-up

The four coal-fired units will be identical and are scheduled for commercial service 1 January 1986, 1 January 1987, 1 January 1988, and 1 January 1989, respectively.

(b) Lifetime

Each unit is assumed to have a working lifetime of 35 years.

Year 1 is 1985/6 (Note that Fiscal Years are used - April 1 to March 31).

(c) System

The units will supply a predominantly hydro-electric generating system which, just before the first Hat Creek unit goes into service, will be of 10,672 MW total installed capacity, 9438 MW of which is hydro. By 1990/1 it is expected that Hat Creek will supply 18% of the system peak load and 22% of the system energy load.

(d) Mine

The adjacent open pit mine, from which all coal will come, will have production rate set by predicted coal requirements scheduled in advance. Coal storage facilities will allow for unbalances between station consumption and mine production.

(continued)

1) GENERAL cont'd

(e) Make-up Water System

Make-up water has to be pumped from the Thompson River to the station. A reservoir at the station will allow make-up pumping to be scheduled independently of daily load. Make-up water pumps are fed from the system rather than directly from the Hat Creek units.

(f) Minimum Load

Normal minimum continuous load per unit is 30% of M.C.R. The units will be capable of operation at this level without auxiliary fuel.

(g) Capacity Factor

All capacity factors quoted in this document have been calculated as a percentage of net output, i.e. 500 MW on a unit basis or 2000 MW on a plant basis.

2) OPERATING MODES

(a) Availability

During the early period of unit in-service the availability of the units is expected to progress as shown in the table below:-

Year	Availability (%)	
	Annual	Monthly
1	65	71
2	70	76
3	75	82
4 and thereafter	78	85

Each unit is expected to be unavailable for one month due to annual maintenance.

(continued)

2) OPERATING MODES cont'd

(b) Annual Operation

For the purpose of describing the annual operation of the project, the unit lifetimes have been divided into four distinct periods, an initial five-year maturing stage followed by three 10-year stages. During all stages of the plant's life, the units should be able to operate in the base load mode; however, the actual capacity factor to which the units are operated will depend on the water conditions in the system's hydro plants. The following table illustrates plant usage during the initial in-service years:- (Note: each unit has a six-month "Commissioning Period" prior to commercial in-service date.)

PLANT USAGE

Fiscal Year Apr - Mar	Maximum (GWH)	Minimum (GWH)	Average (GWH)	Average (C.F.%)
Year 1 1985/6	767	551	1635 (incl. 876 Commissioning)	69
2 1986/7	3671	2218	3269 (" 1314 ")	60
3 1987/8	6798	4185	5865 (" 1314 ")	60
4 1988/9	10116	6546	8832 (" 1314 ")	61
5 1989/90	12767	8149	11404	65

The variation in plant usage due to various water conditions for the three 10-year stages is illustrated below:-

Capacity Factor (%)	Probability (%) of Operating at Given Capacity Factor: Years 6-15	Years 16-25	Years 26-35
78	30	15	5
72 - 78	20	20	5
62 - 72	10	25	30
54 - 62	30	20	25
47 - 54	10	10	15
37 - 47	-	10	15
33 - 37	-	-	5
Average C.F. for period:	70	65	55

Calculation of a weighted average for the various periods results in a lifetime average capacity factor of 65%.

(continued)

2) OPERATING MODES cont'd

(c) Monthly Operation

If unit energy production is reduced due to high water conditions, there is a lower probability of cutback during the October to March period than during the April to September period. Maintenance on units generally will be performed during the summer period. Typical monthly operating plans for various water conditions are illustrated in Figure 1.

(d) Daily Operation

At all times during the units' lives it is conceivable that Hat Creek will be operated at relatively low capacity factors (during high water conditions). This type of operation is likely to be more frequent in the later stages of the unit's life. For this reason the units must be suitable for the following types of operation:-

(i) Two Shift: In this, the unit will be shut down overnight.

(ii) Weekend Shutdowns: In this, the unit will be shut down Friday night and re-started Monday morning and will operate in the "Base Load" or "Cycling" mode for the remainder of the week.

(iii) Peaking or Cycling: In this, the unit will be operated at the top of the system load-duration curve to meet peak demand. In this mode frequent re-starts and load changes will occur. Also, a unit may be held in-service as "spinning reserve" ready for rapid loading.

Typical daily operating patterns for the various types of operation are shown in Figure 2.

(continued)

2) OPERATING MODES cont'd

(e) Continuous M.C.R. Operation

The power plant equipment will be capable of continuous operation for periods of up to six months at maximum continuous rating on all four units, if called upon.

Equipment specifications for the specific major items of equipment will list the operating regime in detail for that item of equipment.

Mining/Mixing/Blending/Coal Delivery system shall also allow for the above full-load coal demand in their equipment and production planning.

3) STARTS

Each unit is estimated to experience the following starts in its lifetime:-

400	Cold Starts	(Unit off the line for more than 72 hours)
700	Warm Starts	(" " " " " 12 to 72 hours)
2300	Hot Starts	(" " " " " less than 12 hours)

4) M.C.S. CONDITIONS

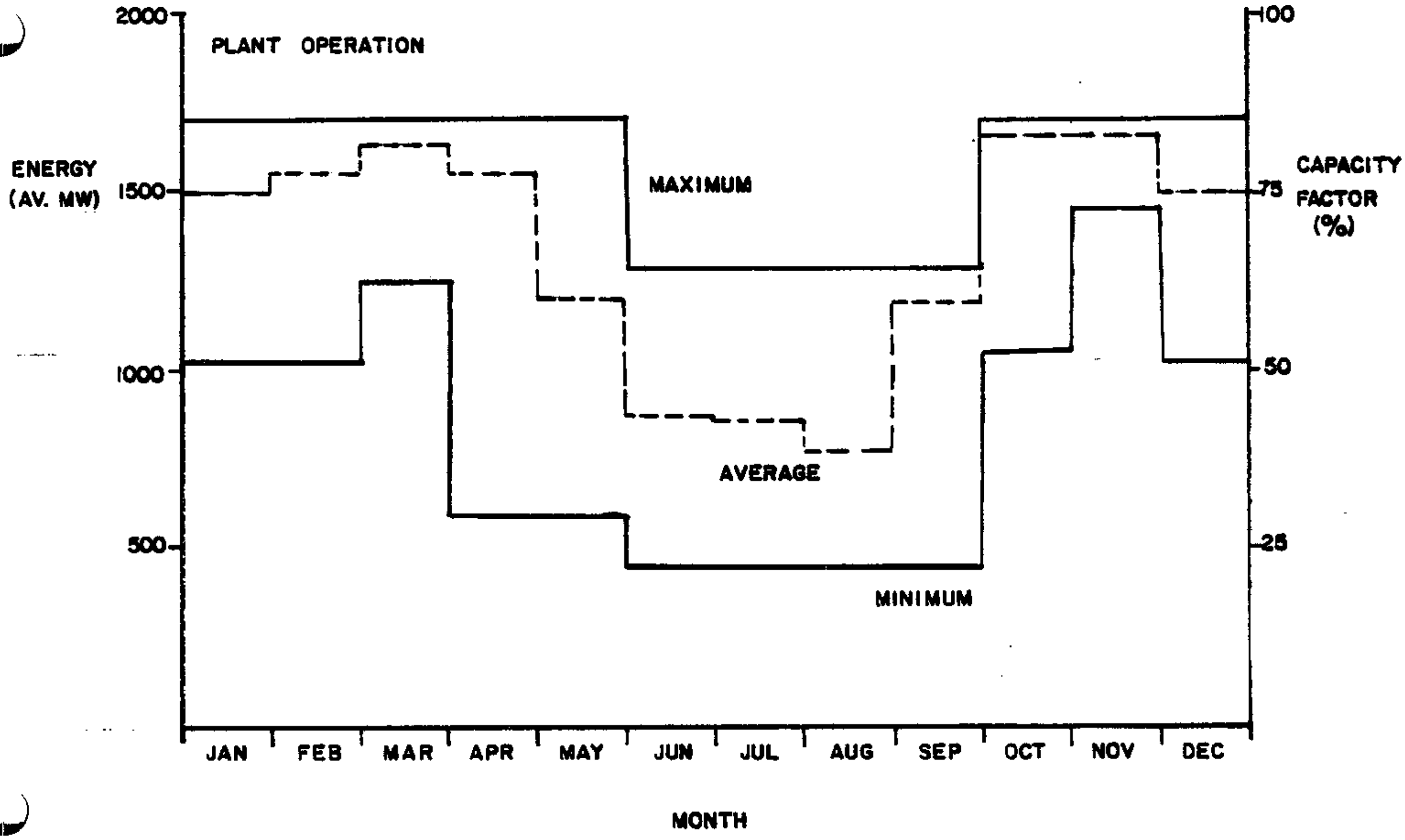
To allow operation to meet ambient air quality target levels when certain adverse weather conditions may prevail for short periods an M.C.S. (Meteorological Control System) will be used.

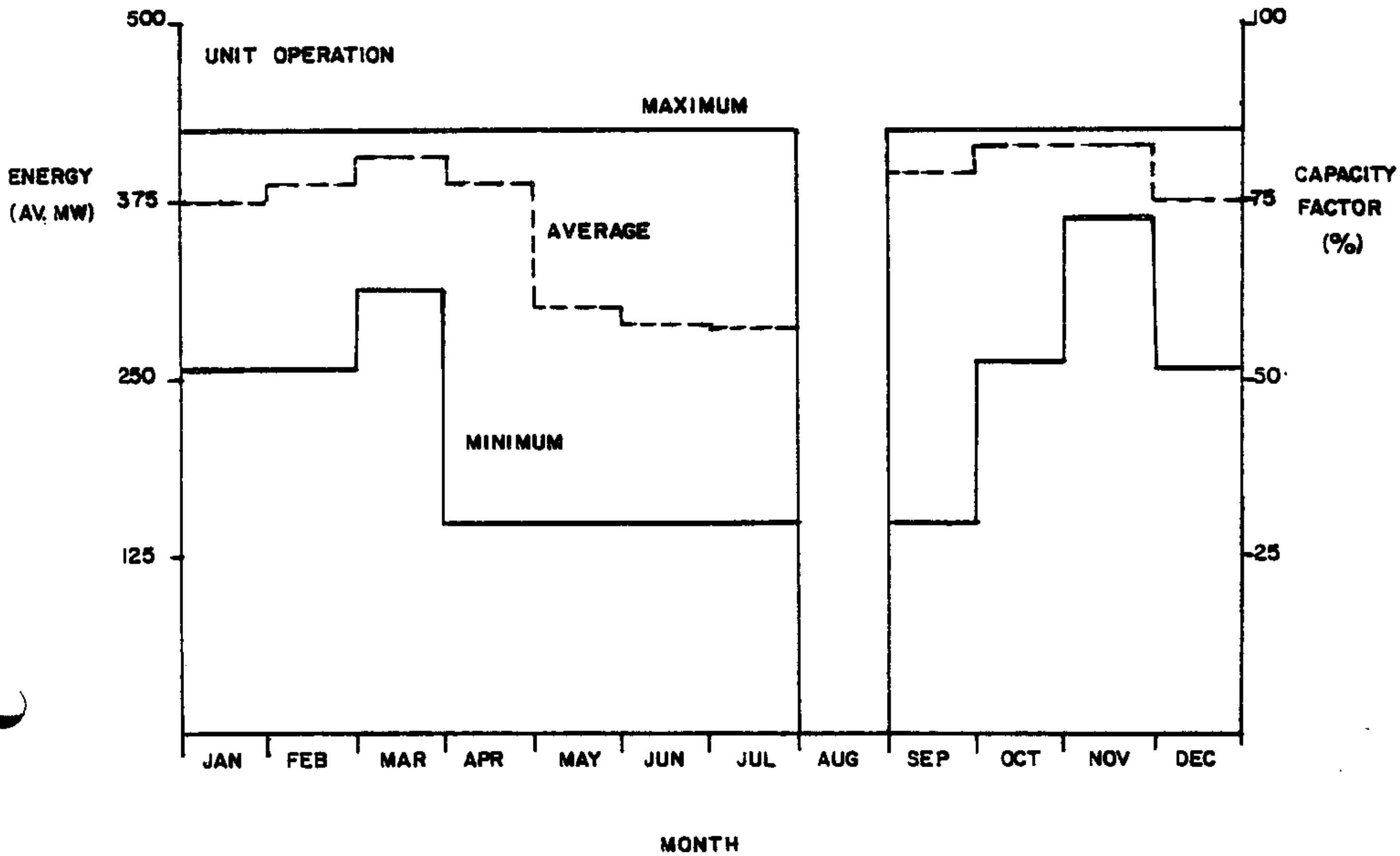
Unit loading proportions of station load and total station output may be adjusted during the use of the M.C.S. system. The use of alternative coal (low sulphur) is also a possibility to meet adverse temporary conditions.

The basic method planned if the M.C.S. system has to be applied is to reduce load on the power plant. If system conditions do not permit load reduction then a switch to lower sulphur coal would be made. In general fuel switching would only be employed during the winter months.

MONTHLY OPERATION

FIGURE 1

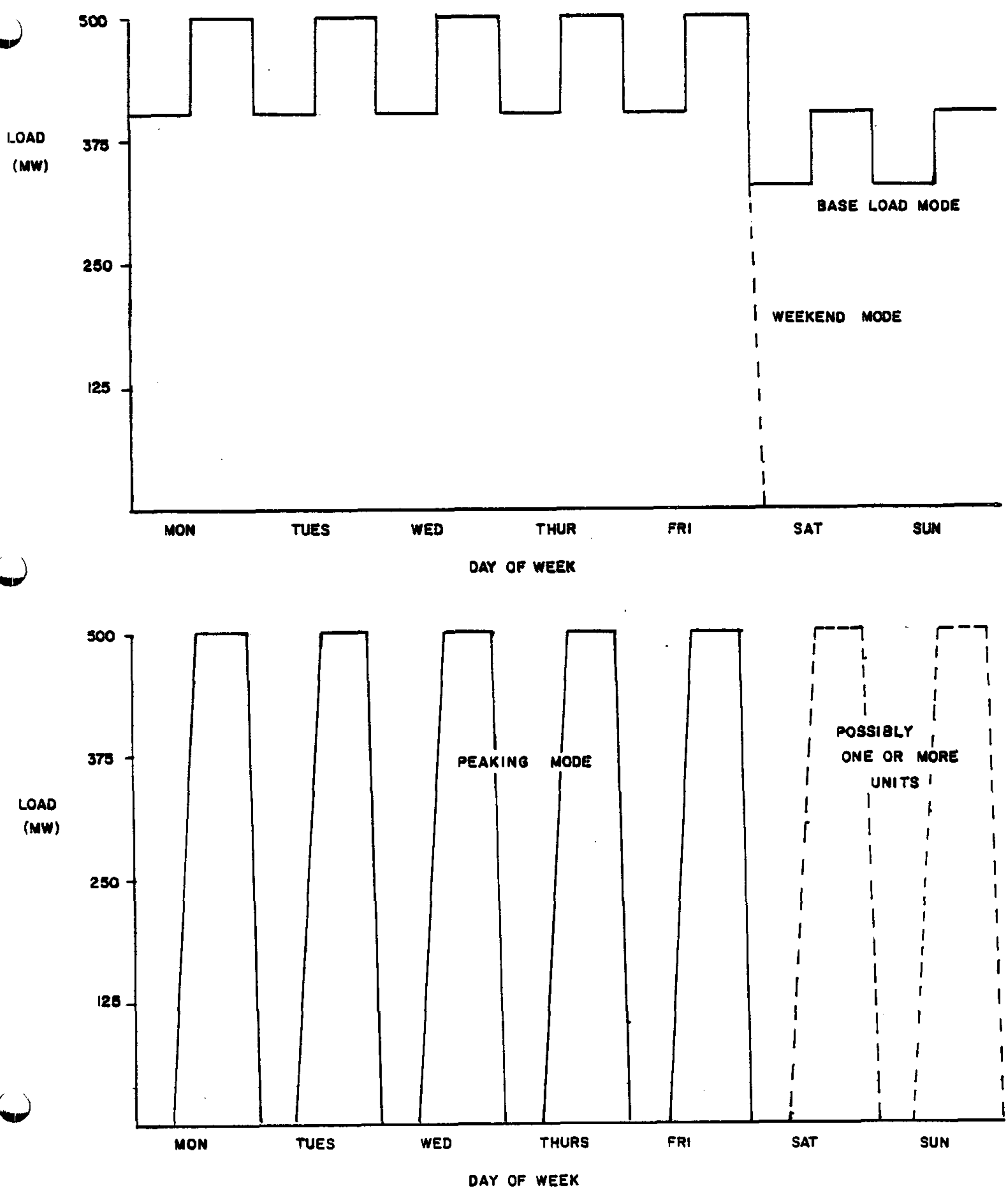




DAILY OPERATION

(PER UNIT BASIS)

FIGURE 2



HAT CREEK PROJECT

POCKET FACTS

(METRIC UNITS)

Generation Station Capacity	:	2240 MW (gross) 2000 MW (net)
Unit Size	:	4 x 560 MW (gross) 4 x 500 MW (net)
Commercial Operation Dates	:	1st Unit - 1 January 1986 2nd Unit - 1 January 1987 3rd Unit - 1 January 1988 4th Unit - 1 January 1989
Location	:	200 km NE of Vancouver, 25 km W of Cache Creek, British Columbia.
Site	:	Upper Hat Creek Valley. Powerplant adjacent to Harry Lake, at El. 1410. Coal mine at head of valley, 4 km from powerplant. El. 915. Total area approx. 3700 ha of which open pit No. 1 area 770 ha, powerplant site 92 ha, reservoir 67 ha, ash pond 660 ha.
Estimated Workforce	:	Construction (peak) 2950 Powerplant operation 250 Mine operation 1000
Coal/Ash Quantities	:	Datum powerplant fuel - max. consumption 43 000 t/day (4 units operating) 12.8 MJ/kg (wet basis); 25% H_2O/27% ash/0.4% S. Ash disposal 12 000 t/day. 35-year consumption of coal approx. 350 Mt.
Coal Mine Features No. 1 Deposit	:	Total minable reserves 720 Mt. Open pit 3 km x 2.5 km x 265 m deep below the average valley elevation. Overall stripping ratio 1.3 m^3 waste/t coal. Total waste removed over 35 years - 450 Mm^3. Total coal removed over 35 years - 350 Mt. Mining by truck and shovel method (16.8 m^3 shovel, 136 t waste trucks, 109 t coal trucks). Mining benches 15 m wide.

Coal Mine Features - No. 1 Deposit - (Cont'd)	Pit slope angle varies from 16^{o} to 25^{o}. Coal blending/mixing facility adjacent to mine. Coal delivery by belt conveyor.
Powerplant Features :	4 unit station for base load with two-shift operating capability. Turbine generators - 4 x 560 MW gross, single shaft, 3600 rpm, tandem compound, four flow, single reheat operating at 16.5 MPa $538^{o}C/538^{o}C$. Steam generators - 4 x 488 kg steam/'s capacity. Eff. 82%, balanced draft, 17.6 MPa and $540^{o}C$ superheat outlet conditions. Pulverized coal fired. Stack - single, four flue concrete, 244 m high. Closed circuit dual pressure condenser cooling water system with two natural draft hyperbolic cooling towers for four units and a make-up fresh water reservoir on site. One 100% steam turbine-driven boiler feed pump and booster pump per unit. Air Quality Control System incorporating cold side electrostatic precipitators, efficiency 99%+.. (Space allowed for future installation of flue gas de-sulphurization equipment if required).
Water Supply System :	24 km long buried water supply pipeline from Thompson River near Ashcroft to the plant reservoir. Capacity 1580 L/s, Static head 1083 m. Intake pumphouse and two high-pressure pumphouses.
Project Major Consultants:	Powerplant Conceptual Design (1976) Powerplant Preliminary Engineering Phase I (1977/78)) Integ-Ebasco Joint Venture Mine Conceptual Design (1976) - PD-NCB & Wright Engineers Mine Feasibility Study (1977/78) - Cominco-Monenco Joint Venture

Project Major Consultants: (to date) - (Cont'd)	Offsite Facilities Preliminary Engineering (1977)	- BCHPA H.E.D.D.
	Water Supply System, Conceptual & Preliminary Engineering (1976-78)	- Sandwell
	Hat Creek Diversion Conceptual (1976)	- Monenco
	Preliminary Engineering (1977/78)	- BCHPA H.E.D.D.
	Transportation (1976)	- Swan Wooster
	Construction Camps (1977)	- H.A. Simons
	Access Road (1977)	- B.C. Dept. of Highways
	Site Selection Study (1976)	- Envirosphere (now ESCLEC)
	Detailed Environmental Studies (1976/78)	- ESCLEC (Coordinators)
	Land Resources	- Tera
	Waste Disposal	- Acres
	Hydrology/Fisheries	- Beak
	Socio-Economic	- Strong Hall
	Air Quality/Trace Elements	- ERT
	Noise	- Aero Acoustics
	Alternate Uses of Hat Creek Coal	- Stone & Webster
	Project Advisory Architect	- Toby, Russell, Buckwell Architects

PROJECT CONTROL
THERMAL DIVISION
20 September 1978

HAT CREEK PROJECT

POCKET FACTS
(Imperial Units)

Generation Station Capacity	:	2240 MW (gross) 2000 MW (net)
Unit Size	:	4 x 560 MW (gross) 4 x 500 MW (net)
Commercial Operation	:	1st Unit - 1 January 1986 2nd Unit - 1 January 1987 3rd Unit - 1 January 1988 4th Unit - 1 January 1989
Location	:	125 mi NE of Vancouver, 15 mi W of Cache Creek, British Columbia.
Site	:	Upper Hat Creek Valley. Powerplant adjacent to Harry Lake at El. 4650. Coal mine at head of valley, 2 1/2 mi from powerplant. El. 3000. Total area approx. 8200 ac of which open pit No. 1 area 1900 ac, powerplant site 230 ac, reservoir 170 ac, ash pond 1630 ac.
Estimated Workforce	:	Construction (peak) 2950 Powerplant operation 250 Mine operation 1000
Coal/Ash Quantities	:	Datum powerplant coal - max. consumption 47,000 tons/day (4 units operating) 5500 Btu/lb (wet basis); 25% H_2O/27% ash/0.4% S. Ash disposal 13,200 tons/day. 35-year consumption of coal approx. 385 million tons.
Coal Mine Features No. 1 Deposit	:	Total minable reserves 790 million tons. Open pit 2 mi x 1.5 mi x 870 ft deep below the average valley elevation. Overall stripping ratio 1.5 yd^3 waste/ton coal. Total waste removed over 35 years - 585 million yd^3. Total coal removed over 35 years - 385 million tons.

Coal Mine Features No. 1 Deposit - (Cont'd)	:	Mining by truck and shovel method ($22\ yd^3$ shovel, 150 ton waste trucks, 120 ton coal trucks). Mining benches 50 ft wide. Pit slope angle varies from 16^o to 25^o. Coal blending/mixing facility adjacent to mine. Coal delivery by belt conveyor.
Powerplant Features	:	4 unit station for base load with two-shift operating capability. Turbine generators - 4 x 560 Mw gross, single shaft, 3600 rpm, tandem compound, four flow, single reheat, operating at 2400 psig $1000^oF/1000^oF$. Steam Generators - 4 x 3.875 million lb steam/hour capacity. Eff. 82% balanced draft 2550 psig and 1005^oF superheat outlet conditions. Pulverized coal fired. Stack - single, four flue concrete, 800 ft high. Closed circuit dual pressure condenser cooling water system with two natural draft hyperbolic cooling towers for four units and a make-up fresh water reservoir on site. One 100% steam turbine-driven boiler feed pump and booster pump per unit. Air Quality Control System incorporating cold side electrostatic precipitators, efficiency 99%+. (Space allowed for future installation of flue gas de-sulphurization equipment if required).
Water Supply System	:	15 mi long buried water supply pipeline from Thompson River near Ashcroft, to the plant reservoir. Capacity 25,000 USgpm. Static head 3550 ft. Intake pumphouse and two high-pressure pumphouses.
Project Major Consultants: (to date)		Powerplant Conceptual Design (1976); Powerplant Preliminary Engineering Phase I (1977/78)) Integ-Ebasco Joint Venture Mine Conceptual Design (1976) - PD-NCB & Wright Engineers

Project Major Consultants: (to date) - (Cont'd)	Mine Feasibility Study (1977/78)	- Cominco-Monenco Joint Venture
	Offsite Facilities Preliminary Engineering (1977)	- BCHPA H.E.D.D.
	Water Supply System, Conceptual & Preliminary Engineering (1976-78)	- Sandwell
	Hat Creek Diversion Conceptual (1976)	- Monenco
	Preliminary Engineering (1977/78)	- BCHPA H.E.D.D.
	Transportation (1976)	- Swan Wooster
	Construction Camps (1977)	- H.A. Simons
	Access Road (1977)	- B.C. Department of Highways
	Site Selection Study (1976)	- Enviroshpere (now ESCLEC)
	Detailed Environmental Studies (1976/78)	- ESCLEC (Coordinators)
	Land Resources	- Tera
	Waste Disposal	- Acres
	Hydrology/Fisheries	- Beak
	Socio-Economic	- Strong Hall
	Air Quality/Trace Elements	- ERT
	Noise	- Aero Acoustics
	Alternate Uses of Hat Creek Coal	- Stone & Webster
	Project Advisory Architect	- Toby, Russell, Buckwell Architects

PROJECT CONTROL
THERMAL DIVISION
20 September 1978

SECTION 13.0 - GLOSSARY

CCRL	Canadian Combustion Research Laboratories
CMJV	Cominco-Monenco Joint Venture
ESCLEC	Ebasco Services of Canada Ltd - Environmental Consultants
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
FGD	Flue Gas Desulphurization
Gt	Giga tonnes
HP	High pressure
IP	Intermediate pressure
MPa	Megapascal
MCS	Meteorological Control System
MCR	Maximum Continuous Rating
M	Mega or million
No_x	Nitrogen Oxides
PCB	. Pollution Control Board
PD-NCB	Powell-Duffryn National Coal Board Consultants Ltd.
ROM	Run-of-mine
SG	Specific gravity
SDM	Station Design Manual
SO_2	Sulphur dioxide
TSP	Total suspended particulate
T/G	Turbine-generator