B. C. HYDRO

HAT CREEK PROJECT
1980 ENVIRONMENTAL FIELD PROGRAMMES

THERMAL GENERATION PROJECTS DIVISION

MARCH 1982

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SECTION 1.0 - INTRODUCTION

Numerous environmental studies related to the proposed Hat Creek thermal powerplant development have been conducted over the past five years to define environmental conditions in the region. Some of these studies have been continued to provide more detailed background data. The studies continued during 1980 at the Hat Creek site included the following:

1. surface water and groundwater monitoring programmes to better define existing conditions,

2. leachate studies to provide a longterm assessment of the characteristics of leachates from waste coal materials, and

3. meteorological and air quality monitoring programmes to establish background weather and air quality data.

The environmental trace element studies to determine trace element concentrations naturally present in the terrestrial and aquatic environments in the vicinity of Hat Creek were completed in 1979 and were not continued in 1980.

During 1977 an extensive reclamation test programme was initiated using materials from the Bulk Sample Program. The land reclamation tests were designed to assess, on a large scale, the revegetation potential of various coal waste and overburden materials and to evaluate other variables pertinent to the successful revegetation of these waste materials. In 1978 and 1979 the results of the reclamation programme were assessed and modifications were made to improve or expand the tests. In 1980 the reclamation programme was continued and a new test was added to expand the revegetation test programme.

The amount of precipitation in the Hat Creek valley during 1980 was exceptional. The rainfall was the highest on record since 1961 and the snowfall was the second lowest since 1961. This abnormal precipitation influenced the 1980 results, as well, and will likely affect the 1981 results of the continuing environmental field studies at Hat Creek.

This report presents the results of the reclamation and environmental studies during 1980. Data from previous years are also presented and compared to the 1980 results. Similar reports were prepared in 1978 and 1979. Detailed descriptions of the field test plots and the sampling and analytical procedures followed in the environmental studies are presented in these reports[2,3,4] and are not repeated in detail in this 1980 report.

SECTION 2.0 - REVEGETATION PROGRAMMES

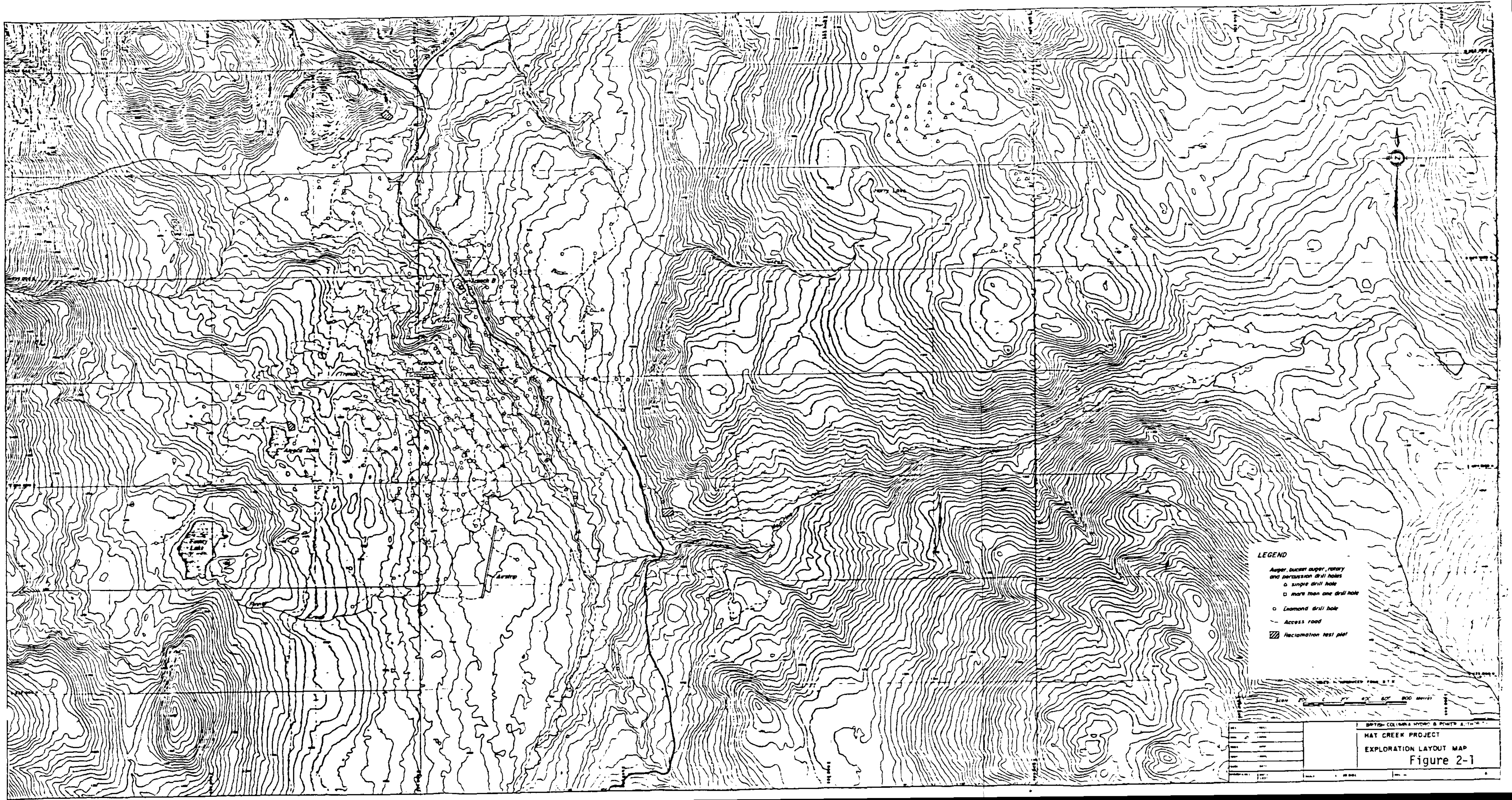
2.1 INTRODUCTION

Detailed exploration of the Hat Creek coal deposits was undertaken during 1974 to 1978. The exploration involved an extensive drilling programme and excavation of three test trenches to extract a bulk sample of coal for testing and to examine slope stabilities. Reclamation of land areas disturbed by the exploration was commenced in 1974 and is continuing. No major exploration work has been done since the end of 1978. All areas except those still in use, such as access roadways and camp facilities, have been reclaimed. Special revegetation test plots were established in 1977 using overburden and coal waste materials obtained from the Bulk Sampling Programme. The revegetation programme is designed to provide large scale field data for rehabilitation of waste materials during operation of the coal mine.

The revegetation test programme during 1980 included application of fertilizer on various test plots; visual surveys of the revegetated areas and test plots in April, June and September; nutrient analyses of vegetation samples collected from the Aleece Lake test plots, and establishment of a special garden where 21 varieties of grasses and shrubs were planted. In this section the 1980 revegetation test programme is described and the results of the three visual surveys and the vegetation analyses are presented. The locations of the revegetated areas and the test plots are shown in Fig. 2-1.

2.2 FERTILIZER ADDITIONS

The soils and waste materials used in the revegetation programme were analysed for plant nutrients and physical and chemical characteristics


LEGEND
Auger, bucket auger, rotary and percussion drill holes
single drill hole
more than one drill hole
Diamond drill hole
Access road
Reclamation test plot
Harry Lake
Airstrip
BRITISH COLUMBIA HYDRO & POWER AUTHORITY
HAT CREEK PROJECT
EXPLORATION LAYOUT MAP
Figure 2-1

in 1977 when the test plots were established. Further analyses of the soils for plant nutrients were carried out in 1978 and 1979. In the spring of each year fertilizer additions were made based on the results of the soils analyses. In April 1980, fertilizer was applied to the test plots using a cyclone hand broadcaster. The amounts of fertilizer applied were the same as that applied in 1979, as shown in Table 2-1.

A summary of the fertilizer additions made to the test plots since 1977 is presented in Table 2-2. In 1979 and 1980 lime was applied, at a rate of 2250 kg/ha, to a 15 m x 15 m test plot on top of the coaly waste pile at Trench A.

In 1979, a five year test program designed to assess the length of time that maintenance fertilizer must be applied for the establishment of abundant, self-sustaining vegetation was started. Five test areas where different fertilizer application schedules could be evaluated were established. These areas include; the 3140 (baked clay) and 3120 (gritstone) dumps at Trench A, the large gravel dump at Trench B, the colluvium parent material at the Houth Meadows test area, and the bentonitic clay dumps at Trench C. At each of the five areas, five plots of approximate equal area were designated, as shown in Figs. 2-2, 2-3, 2-4 and 2-5.

In 1977 and 1978 the dumps at Trench A were fertilized. The gravel pile at Trench B and the Houth Meadow colluvium were fertilized in 1977 but not in 1978. The Trench C areas were fertilized only in 1978. In 1979 segments numbered 1 at each location were not fertilized and others received the recommended fertilizer additions. In 1980 segments numbered 1 and 2 were not fertilized and the remaining three segments were fertilized. After five years these plots will have received maintenance fertilizer additions for a period ranging from one to seven years.

TABLE 2-1

1980 FERTILIZER ADDITION RATES ON RECLAMATION TEST AREAS

Test Area Description	Fertilizer Additions* (kg/ha)			
	11-48-0-0	46-0-0-0	0-0-62-0	0-0-0-21
Aleece Lake				
Colluvium	47	62	0	0
Glacial Gravel	47	62	0	0
Baked Clay	93	51	0	0
Gritstone	163	34	0	16
Bentonitic Clay	93	51	0	16
Coal Waste	47	62	0	0
Carbonaceous Shale	93	51	0	0
Fly Ash	42	23	84	0
Houth Meadows				
Gravel Slopes	47	62	0	16
Parent Material	280	6	0	16
Medicine Creek				
Till	47	62	0	16
Trench A				
3160' Carbonaceous Shale	47	62	0	0
3140' Baked Clay	47	62	0	16
3120' Gritstone	47	62	0	16
Coaly Waste	117	45	0	0
Trench B				
Gravel	140	40	0	16
Subsoil	140	40	0	16
Topsoil	93	50	0	16
Trench C	16-20-0-0			
Bentonitic Clay	112	34	0	16

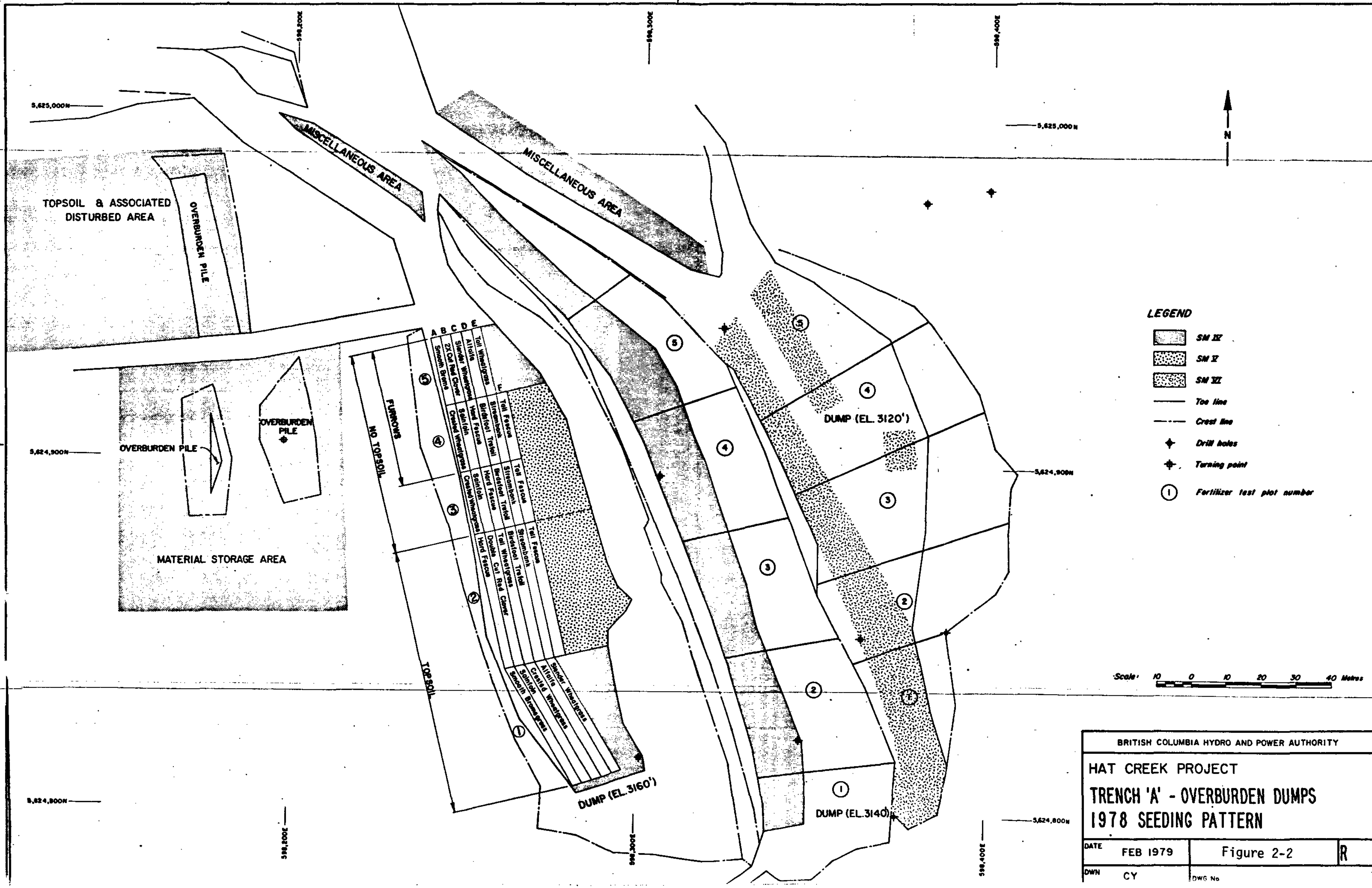
*Numbers indicate percent by weight of N, P_2O_5, K_2O and Boron respectively.

TABLE 2-2

SUMMARY OF SEEDING AND FERTILIZER ADDITIONS ON TEST PLOTS

Year	Trench A 3160	Trench A 3140	Trench A 3120	Trench A Coaly Waste	Trench B Gravel	Trench B Topsoil	Trench B Subsoil	Trench C All dumps	Aleece Lake Plots	Slope Plots
1977	S/F	S/F	S/F	S/F	S/F	S/F	S/F		S/F	S/F
1978	S/F	S/F	S/F	F	F	-	-	S/F	F	-
1979	F	F	F	F	F	F	F	F	F	F
1980	F*	F*	F	F	F*	F	F	F*	F	F*

S Seeded
F Fertilized
* Portions of these dumps are being used for a 5 year program to assess the long term requirement for maintenance fertilizer.



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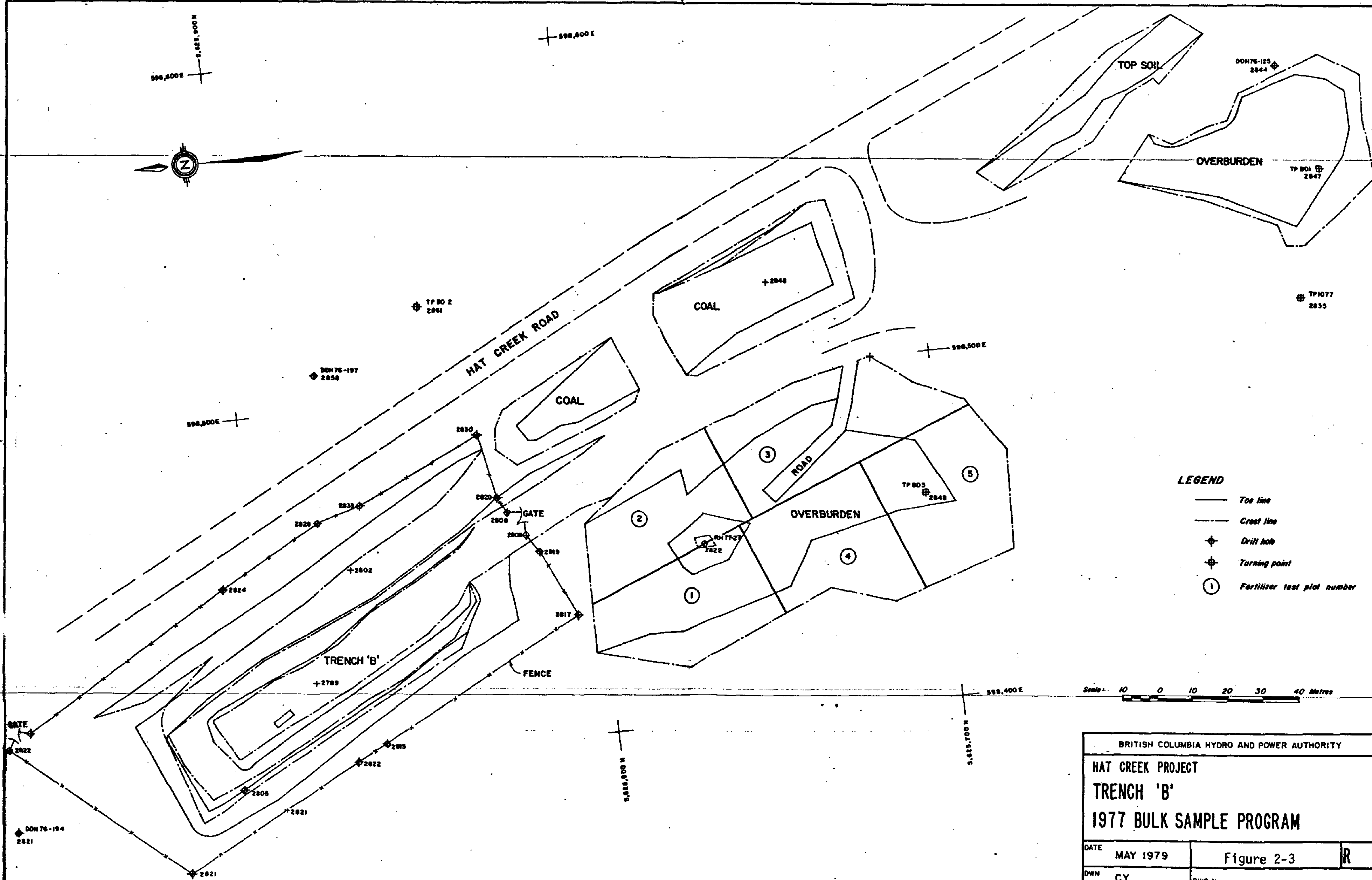
HAT CREEK PROJECT

TRENCH 'A' - OVERBURDEN DUMPS
1978 SEEDING PATTERN

DATE FEB 1979	Figure 2-2	R	
DWN CY	DWG No		



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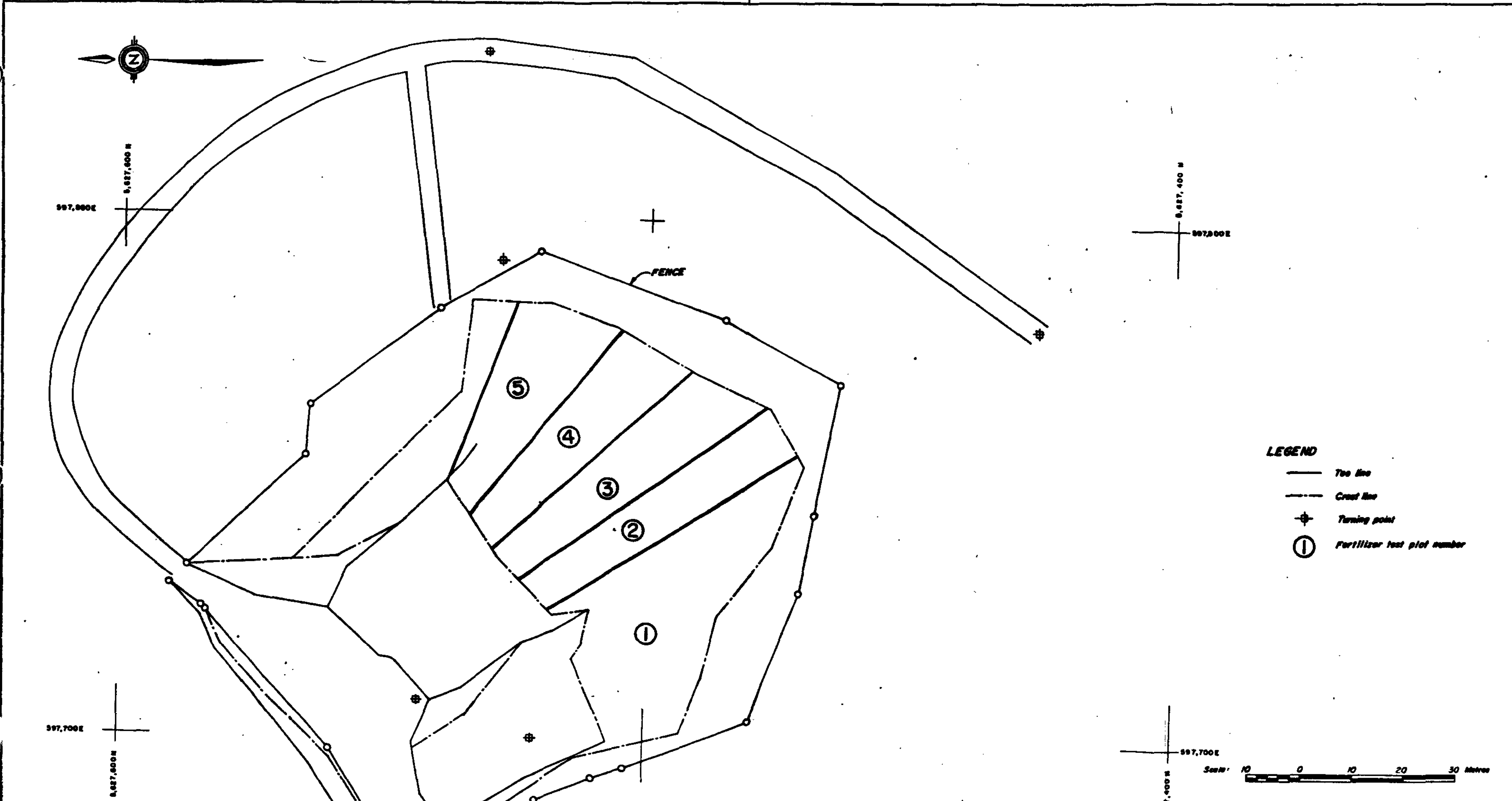
TRENCH 'B'

1977 BULK SAMPLE PROGRAM

DATE MAY 1979 | Figure 2-3 | R

DWN CY | DWG No



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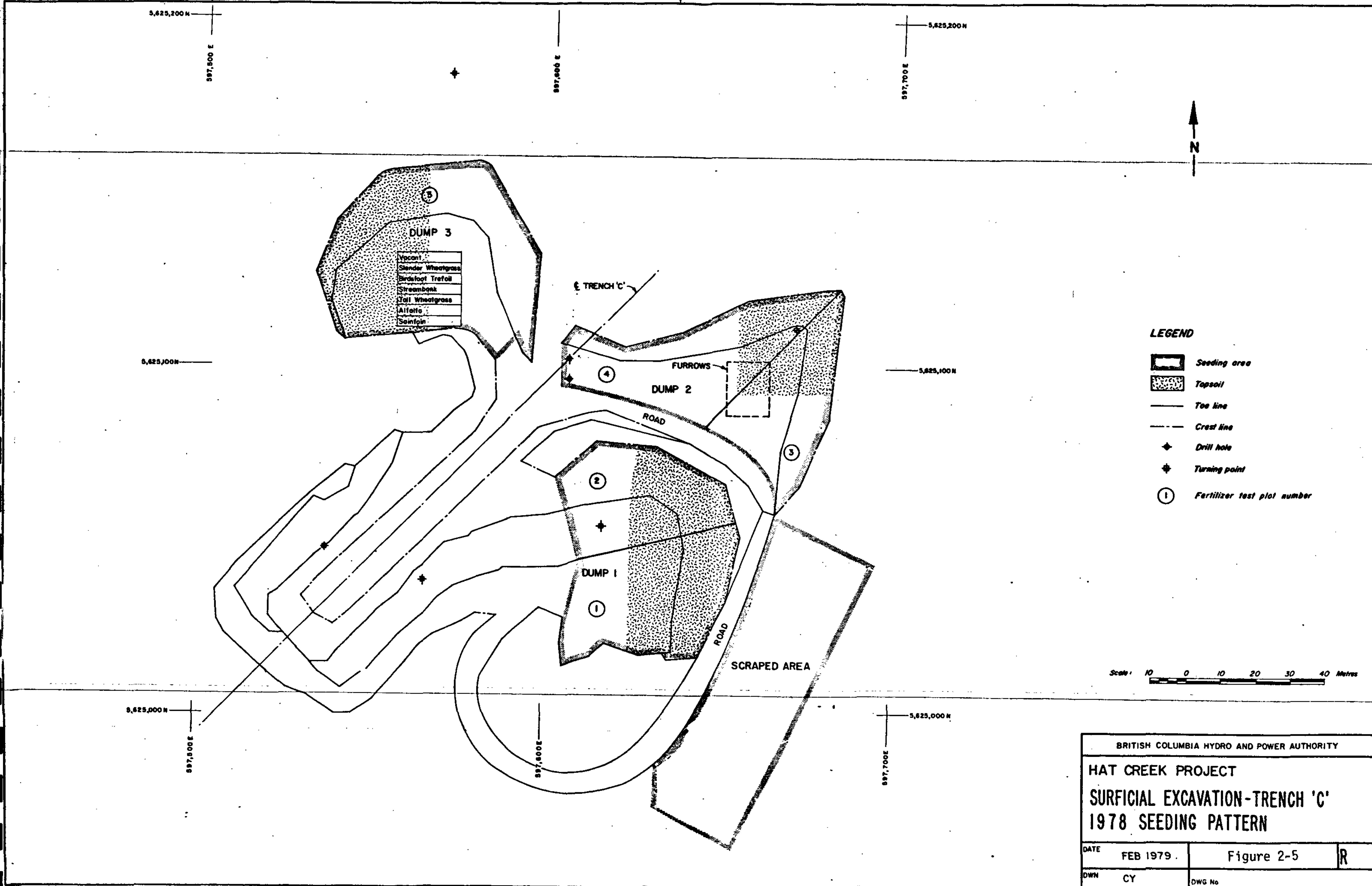
HOUTH MEADOWS

REVEGETATION TEST PLOTS

DATE MAY 1979	Figure 2-4	R



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SURFICIAL EXCAVATION-TRENCH 'C' 1978 SEEDING PATTERN

DATE FEB 1979. | Figure 2-5 | R

DWN CY | DWG No

The maintenance fertilizer addition tests are assessed during the vegetation surveys and the results are reported in section 2.3, Vegetation Surveys.

2.3 VEGETATION SURVEYS

(a) Introduction

Qualitative assessments of vegetation growth on the test areas at Hat Creek were made three times during 1980. Surveys were carried out in early spring and fall to evaluate growth and changes during the growing season. An additional survey, in which plant cover, species composition and plant condition were recorded, was conducted in June. The results of the June survey were used to assess the overall progress of the reclamation tests at Hat Creek over the past three years since planting in 1977. This assessment is the subject of a report entitled "Revegetation Potential of Waste Materials" prepared by Monenco Consultants Pacific Ltd.[1]

The results of the spring and fall surveys and a summary of the June survey results are presented in this report. The detailed results of the June survey, which include nutrient analyses of plant material from selected plots, are presented in the Monenco report.[1]

In 1980 the total precipitation, measured at the I. Lehman ranch, was 358 mm, about 13 percent above the normal level of 317 mm. During the spring and summer rainfall was considerably above normal. In June rainfall totalled over 110 mm. This abnormally high level of moisture created excellent conditions for plant growth.

In the spring and fall visual surveys plant cover was estimated using four ranges: 0 to 25, 26 to 50, 51 to 75 and

76 to 100 percent coverage. Species composition are rough estimates with native species referred to collectively as weeds. Plant conditions were noted where appropriate.

The results of the visual surveys are summarized in the following sections. Photographs of many of the test plot areas are included for reference.

(b) Aleece Lake Test Plots[2]

In general all of the Aleece Lake test plots showed good growth during the 1980 growing season. Of note was the poor performance of sainfoin, the legume in Seed Mix II. This may have been due to competition with other species. Rodent activity was evident on almost all plots, particularly on the topsoiled portions. However, evidence of rodents was not observed on the bentonite clay plot.

(i) Colluvium

Seed Mix I - In early spring plant cover on the topsoiled portions of the plot was clearly less than on the bare material. However, by fall both halves of the plot showed essentially the same uniform cover of between 75 and 100 percent. Vegetation was dominated by crested wheatgrass with $\leq$ 5 percent alfalfa. As indicated in previous reports this is attributed to the early competition from fall rye with which these species were seeded. Canada bluegrass remained essentially absent.

Seed Mix II - There was almost no difference between topsoiled and non-topsoiled halves both showing 100 percent cover in both spring and fall. Vegetation was about half slender wheatgrass and half Russian wild rye. Sainfoin, which was prolific in 1979 was almost absent this year; presumably it was outcompeted by the grasses.

Seed Mix III - There was essentially 100 percent cover with approximately half streambank wheatgrass and half smooth bromegrass. Legumes were absent except for the odd red clover plant on the perimeter of the plot.

General - Weeds were present but in small numbers on the topsoiled half of the plot, they did not appear to affect the agronomics. The degree of plant maturity and size of grasses of Seed Mix I and II was less than expected. This could be due to excessive competition or browsing by animals. The latter is clearly a possibility as a large number of deer droppings were noted on the plots.

(ii) Baked Clay

Seed Mix I - Overall cover improved from 50 to 75 percent in the spring to 100 percent in the fall. Alfalfa was present in minor amounts about the edges of the plot. Crested wheatgrass was the only grass present and accounted for most of the cover.

Seed Mix II - As with Seed Mix I the cover improved from 50 to 75 percent to 100 percent during the year. Slender wheatgrass accounted for the majority of this but good productivity and cover was also exhibited by Russian wild rye and sainfoin.

Seed Mix III - Streambank wheatgrass and smooth bromegrass both showed good cover with the former doing particularly well on the topsoiled half of the plot. Cover improved during the year although the topsoiled portion showed less

Photo 1. Aleece Lake - Baked Clay April 1980.

Photo 2. Aleece Lake - Baked Clay September 1980.

than 100 percent in the fall. Legume was present only about the plot perimeter.

(iii) Glacial Gravel

Seed Mix I - No major changes in cover were noted during the year with 75 to 100 percent cover on the non-topsoiled portion and 50 to 75 percent on the topsoiled area in September. Grass dominated in both cases although alfalfa showed improved performance in terms of size and maturity during the year especially on the bare material.

Seed Mix II - Cover improved towards 100 percent during the year with Russian wild rye the dominant species present. Sainfoin showed excellent performance accounting for about 30 percent of the cover.

Seed Mix III - This plot improved from the spring assessment of 50 to 75 percent cover to 75 to 100 percent cover in September. Grasses, streambank and smooth brome, dominated, the former better on the topsoil portion and the latter better on the non-topsoil side of the plot. Legume was present in limited quantities about the plot perimeter. Plants were mature.

(iv) Gritstone (Sandstone, Claystone)

Seed Mix I - This plot showed improved cover during the year with the topsoiled half approaching 100 percent cover by September. Crested wheatgrass accounted for almost all of this cover, alfalfa with 2 to 5 percent cover made up the balance.

Seed Mix II - Cover improved substantially over the year with 100 percent cover in the fall on the topsoiled portion.

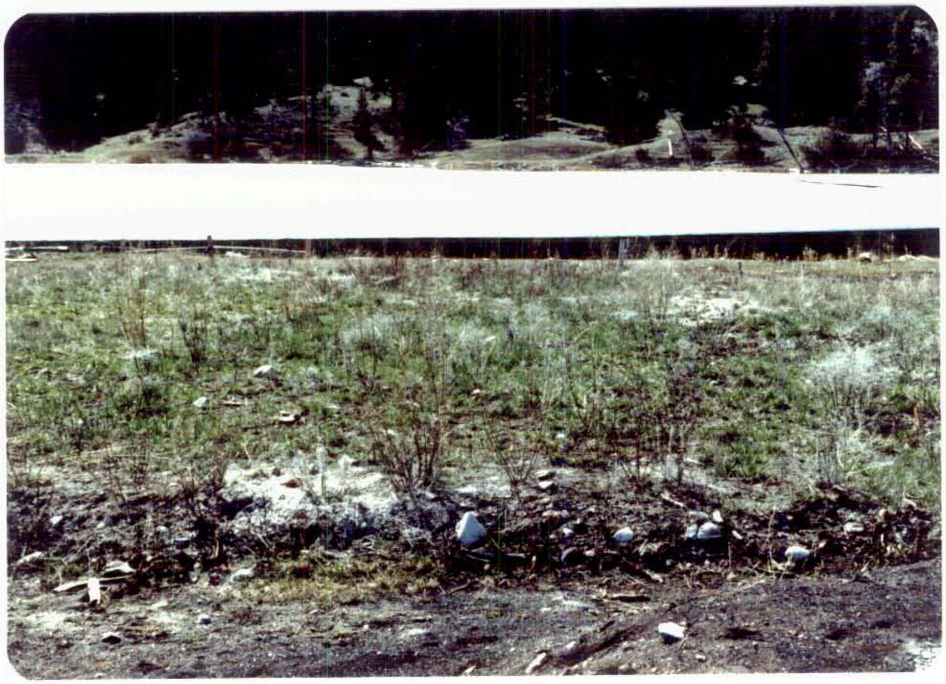


Photo 3. Aleece Lake - Gritstone April 1980.

Photo 4. Gritstone September 1980.

Sainfoin was affected by the increased competition provided by slender wheatgrass and Russian wild rye. In the spring the legume appeared in abundance but by September it represented less than 5 percent of the vegetation cover. The two grasses were present in approximately equal quantities.

Seed Mix III - This portion of the plot showed clearly the advantage of even a thin layer of topsoil. Approximately 50 percent cover was present with many patchy areas on the non-topsoiled section while on the topsoiled half cover was close to 100 percent. The double cut red clover was present in small quantities at the plot edges. The two grasses, streambank and smooth brome were present in about equal quantities.

(v) Bentonitic Clay

Seed Mix I - The non-topsoil portion showed patchy cover of about 25 percent comprised almost exclusively of crested wheatgrass. The plants appeared healthy with a good level of maturity. The presence of topsoil was beneficial, cover was in the 50 to 75 percent range and uniform.

Seed Mix II - Overall cover did not change appreciably during the year. On the non-topsoil portion of the plot cover was approximately 25 percent and patchy. Vegetation consisted mostly of grasses with about 5 percent sainfoin. Plants appeared healthy and about half of the plants were mature. With topsoil the cover became more uniform and averaged about 75 percent. A similar species mix to that on the non-topsoil side was evident.

Seed Mix III - Cover on the topsoil portion improved slightly during the year to 75 percent with streambank wheatgrass dominating. Without topsoil, cover was patchy and

Photo 5. Aleece Lake - Carbonaceous Shale April 1980.

Photo 6. Aleece Lake - Carbonaceous Shale September 1980.

averaged about 50 percent. Grasses showed good maturity on both halves of the plot. Legume, double cut red clover, was essentially absent.

(vi) Carbonaceous Shale

Seed Mix I - Vegetation was essentially absent from the non-topsoiled portion of the plot while on the topsoiled half patchy growth of crested wheatgrass to an overall cover of 25 to 50 percent was present.

Seed Mix II - Non-topsoil side was bare of vegetation. Patchy growth ranging from 0 to 75 percent cover was present with topsoil. Dense patches the grasses on the topsoil showed good growth, although they had a low level of maturity. The patchy cover may be partially due to different thicknesses in the surface layer of topsoil. Sainfoin was present (<5%) only on the topsoiled portion of the plot.

Seed Mix III - Moisture appeared to have collected in a depression on the non-topsoil portion of the plot and resulted in a good catch of streambank and smoothbrome. Plants near this depression appeared healthy. The balance of the non-topsoil portion of the plot was bare. With topsoil the cover was 25 to 50 percent and more uniform. It was mostly streambank wheatgrass.

(vii) Coaly Waste

Seed Mix I - Without topsoil growth was patchy with overall cover to 25 percent comprised almost exclusively of crested wheatgrass; one large Canada bluegrass plant was present. Plants were relatively large in the fall and showed good maturity. With topsoil, cover increased to 50 to 75 percent and showed similar size and maturity to the non-topsoil area. Only crested wheatgrass was present.

Seed Mix II - Improved cover from previous years was evident although no major improvement was noted during the 1980 growing season. On the non-topsoil plot overall cover was about 25 percent although a large number of bare spots existed. With topsoil, cover improved both in uniformity and density to 25 to 50 percent. Slender wheatgrass dominated the vegetation with Russian wild rye and some sainfoin also present. Plants generally showed good maturity.

Seed Mix III - Vegetation on the non-topsoil portion of the plot improved slightly during the growing season less than 25 percent and patchy. With topsoil, cover was more uniform and averaged approximately 50 percent during the year. Streambank wheatgrass was the dominant species present with smoothbrome amounting to less than 10 percent of the cover.

(viii) Fly Ash

Seed Mix I - Cover improved on the non-topsoil side from 25 to 50 percent in the spring to 50 to 75 percent by fall. On topsoil, the vegetative cover remained at the same level throughout the year, 50 to 75 percent. Crested wheatgrass was the only species present on the bare materials, while on topsoil, alfalfa accounted for 5 percent of the cover. The grass exhibited reddish stems, possibly due to magnesium deficiency, and the legumes were chlorotic.

Seed Mix II - The non-topsoil portion of the plot was very poorly covered, less than 25 percent and patchy. Vegetation was present in clumps, mostly Russian wild rye, some of which appeared healthy while others were stunted. With topsoil, the cover was greatly improved, 75 to 100 percent, again

Photo 7. Aleece Lake Fly Ash - April 1980.

Photo 8. Aleece Lake Fly Ash - September 1980.

dominated by Russian wild rye. Sainfoin was present particularly around the edges of the plot. On both sides the Russian wild rye showed excellent maturity.

(c) Slope Test Plots

(i) Houth Meadows

22° Slope - Reclamation of the topsoiled half of the test plot continued to be less successful than the bare material. In early years native species, the seeds of which were transported with the topsoil, provided excessive competition to the agronomics seeded. This situation appeared to be changing, in 1980 crested wheatgrass accounted for 90 percent of the cover present on the lower portion of the topsoiled plot. On the upper slope, native weed still accounted for 80 percent of the cover. In both cases overall cover was less than 50 percent. Alfalfa was present but only in small numbers.

Without topsoil, cover and species diversity is much improved. The grass:legume ratio was approximately 1:1 (crested wheatgrass:alfalfa) and cover was up to 75 percent. Erosion was not evident.

26° Slope - The topsoiled plot showed marked improvement from 1979 with weeds accounting for less than 20 percent of the cover on both lower and upper slopes. Of the agronomic species planted crested wheatgrass was by far the most successful. Alfalfa was present but in limited quantities.

Without topsoil reclamation was excellent, 75 to 100 percent cover with close to a 1:1 grass:legume mix on both upper and lower slopes. On the upper slope there was a slight dominance of alfalfa. The plots displayed good improvement during the 1980 growing season.

30° Slope - Both halves of the plot showed improvement during the year. On the topsoil side the lower slope showed about 50 percent cover in the fall, up from less than 25 percent in the spring. Grass:legume ratios were approximately equal with only a 5 percent contribution to total cover from weeds. Reclamation of the upper slope with topsoil was poor although improvements did take place during the growing season. Weeds accounted for 90 percent of the ground cover.

Without topsoil reclamation was satisfactory with up to 50 percent overall aerial cover. Plants were uniformly distributed and weeds were not significant. Grass and legumes were present in approximately equal proportions.

General - Overall the slope plots at Houth Meadows showed good reclamation on the bare material. Improvements were evident on the topsoil where the seeded agronomics were overcoming the competition from weed species. Nevertheless the non-topsoil slopes remained superior. Rodent activity and browsing occurred throughout the slopes which may have accounted for the indications of lower than expected plant maturity. Slopes showed no signs of waterborne erosion even though rainfall was greater than normal particularly in June.

Parent Material - The harrow seeded area of parent materials at Houth Meadows exhibited excellent reclamation cover which improved from about 50 percent in the spring to essentially 100 percent by fall. Crested wheatgrass and alfalfa were present at about 2:1 ratio. The grasses exhibited purplish stems, possibly indicative of phosophorus deficiency.

Topsoiled Area

Photo 9. Houth Meadows Test Area April 1980.

Photo 10. Houth Meadows Test Area September 1980.

On the hydro seeded area, where in previous years alfalfa dominated, crested wheatgrass developed very well during 1980. The grass:legume ratio was 1:2 in the fall. Cover was essentially complete and similar to the harrow seeded area.

(ii) Medicine Creek

22° Slope - An increase in cover and an improvement in legume (alfalfa) development occurred during the year. Cover averaged about 50 percent with less on the upper slope and more on the lower slope. Crested wheatgrass was dominant but Canada bluegrass was present in minor quantities.

26° Slope - This slope showed excellent improvement over the year, progressing from approximately 25 percent to 50 to 75 percent cover. Legume development was limited especially on the upper half of the plot where it made up less than 20 percent of the vegetation. The dominant species was crested wheatgrass.

30° Slope - This slope displayed excellent reclamation with cover, in the fall, of 50 to 75 percent, improved from the spring assessment of 25 to 50 percent. Crested wheatgrass was the dominant species, alfalfa was present in minor amounts (5%) especially on the upper slope. Some fall rye was present presumably as a result of self-seeding.

General - The Medicine Creek slopes showed no signs of waterborne erosion. Rodent activity and browsing was extensive throughout the test area. Lower slopes generally exhibited a better catch and productivity of legume. A rust-type fungal infection was evident on crested wheatgrass and fall rye. This was manifest as oversized, black seeds on the spikes.

Photo 11. Trench A - 3160 Dump - Furrowed Area 4 - September 1980.

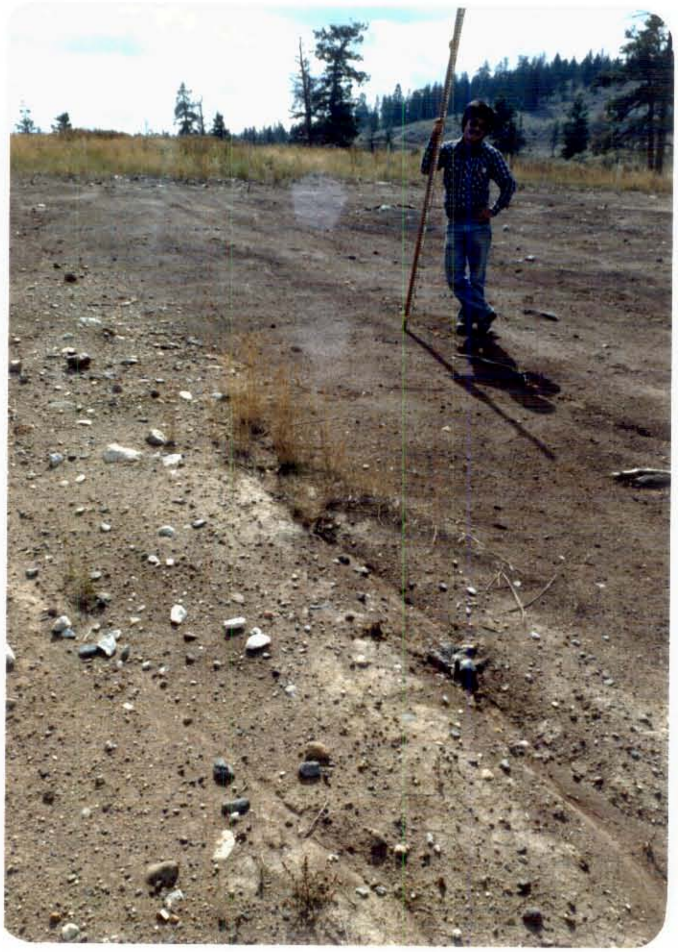


Photo 12. Trench A - 3160 Dump - Area 3 - September 1980.

(d) Trench A

(i) 3160 Carbonaceous Shale Dump

3160 Dump Surface - The carbonaceous shale dump surface was divided into five areas and reseeded in 1978. The areas and the seeding pattern are shown in Fig. 2-2.

Areas 4 and 5 were furrowed prior to seeding to provide improved moisture retention. Growth in the furrows was excellent and it seemed to be expanding along the furrows. The fine texture of the carbonaceous shale resulted in the progressive filling in of the furrows; however, this did not appear to have reduced plant growth in the furrows. Individual species sown have not developed in such a manner to warrant individual assessments.

Area 3 was seeded without any surface treatment, no topsoil or furrows. It was essentially devoid of vegetation except for the odd weed or where water had eroded a channel and grasses and growing in the channel.

Areas 1 and 2 were topsoiled (15 cm) prior to seeding but no furrows were created. In these two areas weeds developed rapidly and have provided appreciable competition to the agronomics. Relative abundance of agronomics and weeds, overall cover and cover type are shown in Table 2-3. Area 2 had fewer weeds and better growth of agronomics than Area 1 although no reason for this was evident. Growth on these areas showed a major improvement during 1980.

3160 Dump Face - The area graded to 26° showed poor growth during 1980 probably due to the erosion of this very fine textured and hydrophobic material. Large areas were essentially devoid of cover although those plants present

TABLE 2-3

SEPTEMBER SURVEY OF GROWTH AT TRENCH A 3160 DUMP SURFACE

Species	Cover %	Cover Type	Agronomics %	Weeds %
Area 1				
Hard Fescue	0-25	Uniform	5	95
Double Cut Red Clover	25-50	Patchy	<1	~100
Tall Wheatgrass	25-50	Uniform	60	40
Birds Foot Trefoil	50-75	Patchy	0	100
Streambank Wheatgrass	50-75	Uniform	10	90
Tall Fescue	50-75	Patchy	<5	95
Area 2				
Smooth Bromegrass	50-75	Patchy	80	20
Sainfoin	25-50	Patchy	50	50
Crested Wheatgrass	50-75	Uniform	80	20
Alfalfa	25-50	Patchy	25	75
Slender Wheatgrass	50-75	Uniform	80	20

Photo 13. Trench A - 3140 Dump Surface April 1980.

Photo 14. Trench A - 3140 Dump Surface September 1980.

were large and displayed good maturity. Germination seemed to be the major problem with this material rather than any inherent toxicity.

The area left at its natural angle of repose of about 34° showed much better results. Erosion was not as much a problem since some coarse material present stabilized the surface. Cover approached 100 percent with an approximately 1:1 grass:legume mix. The upper quarter of the dump, which is carbonaceous material, was essentially bare.

(ii) <u>3140 Baked Clay Dump</u>

<u>3140 Dump Surface</u> - This dump displayed excellent reclamation with 100 percent cover. Growth during the year was excellent. The relative abundance of the agronomic species was as follows: smooth bromegrass 30 percent, crested wheatgrass 30 percent, slender wheatgrass 25 percent, sainfoin 10 percent and alfalfa 5 percent. All species showed good maturity and productivity. However, grazing by deer was extensive, particularly on the legumes.

<u>3140 Dump Face</u> - The baked clay dump face also showed very good reclamation. The area sloped to 26° had 100 percent cover, the area left at its natural angle of repose had 50 to 75 percent cover. Grass:legume ratio, that is crested wheatgrass:alfalfa, on the 26° slope was greater than on the natural dump, 3:1 and 1:1 respectively. Both areas showed good plant maturity and biomass production. There was evidence of rodent activity and grazing by wildlife.

(iii) 3120 Baked Clay and Gritstone Dump

3120 Baked Clay Dump Surface - This area showed very good reclamation with 50 to 75 percent cover. The species mix was as follows: tall wheatgrass 80 percent, streambank wheat grass 10 percent, slender wheatgrass 5 percent and alfalfa 5 percent. Birdsfoot trefoil was absent. The alfalfa present was mostly at the edge of the area.

3120 Gritstone Dump Surface - This area had improved cover and biomass productivity although there were still substantial areas without vegetation. The overall cover was less than 25 percent. Crested wheatgrass dominated with the balance, which was less than 10 percent, alfalfa.

3120 Gritstone Dump Face - Reclamation on the slope graded to 20° was satisfactory with cover of 25 percent to 50 percent. Alfalfa was present but not abundant. On the 30° slope, vegetation was present predominantly along the equipment tracks. As with the 20° slope the vegetation was almost exclusively crested wheatgrass. The free dumped slope 38° was starting to fill in, although, overall cover remained poor at less than 25 percent. Again crested wheatgrass was the dominant species present.

(iv) Coaly Waste Pile

On the surface of the coaly waste pile the cover was patchy although there was improvement during the year. Overall cover in the fall was less than 25 percent. The slopes, particularly the north facing one, was much improved with cover to 50 percent in some areas. Biomass production was good and the vegetation appeared to be healthy.

Photo 15. Trench B - Gravel Pile September 1980.

(e) Trench B

(i) Topsoil Pile

Vegetation on the topsoil pile was dominated by weeds. However, crested wheatgrass had progressed and accounted for up to 15 percent of the vegetation, a marked improvement over previous years. Overall cover was approximately 100 percent.

(ii) Subsoil Pile

This subsoil area showed excellent reclamation, 100 percent cover and good biomass production. Crested wheatgrass was the dominant species at 85 percent while alfalfa at 10 percent and Canada bluegrass at less than 5 percent made up the vegetation cover. This was one of the few areas where Canada bluegrass was found.

(iii) Gravel Pile

The harrow seeded area continued to display more complete reclamation than the hydro seeded area. Cover on the harrow seeded area was 75 to 100 percent with few bare patches. Biomass productivity was excellent. The proportion of alfalfa to crested wheatgrass was approximately 1:2. On the hydro seeded area, alfalfa showed excellent productivity and accounted for 55 percent of the vegetation. Overall cover was uniform in the range 50 to 75 percent.

(f) Trench C - Bentonitic Clay

The three waste dumps at Trench C were seeded and fertilized in the fall of 1978. In 1979 the three dumps were divided into five areas for the long term fertilization tests. The Trench C areas and the seeding pattern are shown in Fig. 2-5.

(i) Dump 1 Surface

Initial patchy growth on the topsoiled area improved greatly during the year and had 50 to 75 percent cover by fall. Some patches still remained. Species diversity was good, tall wheatgrass did particularly well and alfalfa showed good establishment.

Cover also improved on the bare material although many patches remained. Growth was good on the area surfaced with baked clay (for vehicle traction). Legumes were stunted and generally chlorotic as were some of the grasses. Overall cover was less than 25 percent.

(ii) Dump 1 Slopes

Patchy cover was present on the topsoiled slope with overall cover of less than 25 percent. The plants present were large. On the non-topsoiled slopes cover was not as good as the topsoiled area. Improvement occurred over the year. Tall wheatgrass showed good growth while legumes did not.

The relative abundance of agronomics and weeds on the Dump 1 plots are shown in Table 2-4.

(iii) Dump 2 Surface

Surface preparation before seeding at Dump 2 included the ploughing to create furrows to improve water collection. On both topsoil and non-topsoil areas the furrows proved most effective in promoting plant growth. Cover on the topsoil was uniform and approached 50 percent. Legumes success was limited while tall wheatgrass was the most successful of the grasses. On the bare material growth was essentially restricted to the furrowed areas. Overall cover was less than 25 percent. In the furrows the vegetation showed good growth and the grasses were dominant.

(iv) Dump 2 Slopes

The non-topsoiled portion of the dump faces showed unexpected good growth, cover was 50 to 75 percent with excellent growth of both tall wheatgrass and alfalfa. On the topsoiled slopes there were many large patches without any vegetation.

The relative abundance of agronomics and weeds on the Dump 2 plots are shown in Table 2-5.

(v) Dump 3 Surface

The surface was seeded with individual agronomic species and with a seed mix. The individual species results are summarized in Table 2-6.

The area at Dump 3 that was seeded with Seed Mix VI showed mixed results. On the topsoiled area reclamation was excellent. Uniform cover approaching 100 percent was evident with the vegetation dominated by grasses. On the non-topsoil area, which previously had been essentially barren, several species appeared to be established. Plants were not as productive as on the topsoil but were in reasonable good condition. The overall cover was less than 25 percent.

(vi) Dump 3 Slopes

The topsoiled slopes did not do as well as the surface with topsoil. Vegetation was present in patches but where present there was good biomass production. Without topsoil growth was very patchy. In both areas the overall cover was less than 25 percent.

Photo 16. Trench C Dump 2 September 1980.

TABLE 2-4

SEPTEMBER SURVEY OF GROWTH AT TRENCH C DUMP 1

Species	Relative Plant Abundance - %		
	Surface		Slopes
	Topsoil	No Topsoil	Topsoil
Tall Wheatgrass	40	50	40
Streambank Wheatgrass	15	30	15
Slender Wheatgrass	10	10	15
Alfalfa	25	10	10
Birdsfoot Trefoil	0	0	0
Weeds	10	0	20

TABLE 2-5

SEPTEMBER SURVEY OF GROWTH AT TRENCH C DUMP 2

Species	Relative Plant Abundance - %			
	Surface		Slopes	
	Topsoil	No Topsoil	Topsoil	No Topsoil
Tall Wheatgrass	40	55	50	50
Streambank Wheatgrass	20	20	10	10
Slender Wheatgrass	20	20	10	10
Alfalfa	10	5	5	30
Birdsfoot Trefoil	0	0	0	0
Weeds	10	0	25	0

TABLE 2-6

SEPTEMBER SURVEY OF GROWTH AT TRENCH C DUMP 3 SURFACE

Species	Relative Abundance - % Agronomics	Weeds	Cover %	Comments
With Topsoil				
Sainfoin	100	0	25 to 50	Good catch. Uniform cover. Some chlorosis.
Alfalfa	100	0	50 to 75	Similar to Sainfoin but better cover.
Tall Wheatgrass	100	0	75 to 100	Excellent growth and maturity. Very uniform cover.
Streambank Wheatgrass	100	0	75 to 100	Similar to Tall Wheatgrass.
Birdsfoot Trefoil	Absent	0	-	-
Slender Wheatgrass	100	0	<25	Patchy. In centre plants were stunted but much better at front and back of plot. Good maturity.
Without Topsoil				
Sainfoin	5	95	<25	Plants were stunted and chlorotic but growth was better than last year.
Alfalfa	85	15	<25	Similar to Sainfoin but with even less cover.
Tall Wheatgrass	100	0	<25	Plants were stunted and brown. Cover was less than 10 percent.
Streambank Wheatgrass	100	0	<25	Similar to Tall Wheatgrass
Birdsfoot Trefoil	Absent	-	-	-
Slender Wheatgrass	100	0	<25	Very few plants. Plants were stunted and dried out. Cover was less than 5 percent.

TABLE 2-7

SEPTEMBER SURVEY OF GROWTH AT TRENCH C DUMP 3

Species	Relative Plant Abundance - %			
	Surface		Slopes	
	Topsoil	No Topsoil	Topsoil	No Topsoil
Tall Wheatgrass	50	50	25	70
Streambank Wheatgrass	20	25	25	10
Slender Wheatgrass	20	25	25	10
Alfalfa	20	<5	25	10
Birdsfoot Trefoil	0	0	0	0
Weeds	0	0	0	<5

The relative abundance of agronomic and weeds on the surface and sloped areas of Dump 3, that were planted with Seed Mix VI, are shown in Table 2-7.

(g) Drill Sites

Reclamation of exploration drill sites and roads was completed in the fall of 1978.

During September 1980, 12 drill sites that were disturbed in different years were selected and the progress of reclamation evaluated.

In most instances reclamation has progressed well with drill sites in better condition than the surrounding native vegetation. Details of those drill sites inspected and photographs of some of the sites are given below. Data on ground cover, species and cover type are provided along with general comments concerning the reclaimed sites and surrounding area.

Drill Hole	Cover %	Relative Plant Abundance - %	Comments
DDH 76-121	25 to 50 Patchy	Tall Wheatgrass 10 Crested Wheatgrass 5	Better growth than in surrounding but could be improved.
DDH 76-128 (see Photo 17)	25 to 50 Patchy	Crested Wheatgrass 10 Smooth Brome 5 Alfalfa 10 Native Species 75	Only slightly better than surrounding native cover. Plants in good condition.
DDH 76-166 (see Photo 18)	25 to 50 Uniform	Smooth Brome 20 Crested Wheatgrass 10 Streambank 5 Alfalfa 5 Native Species 60	Good mix of agronomic and native species. Legume not abundant.

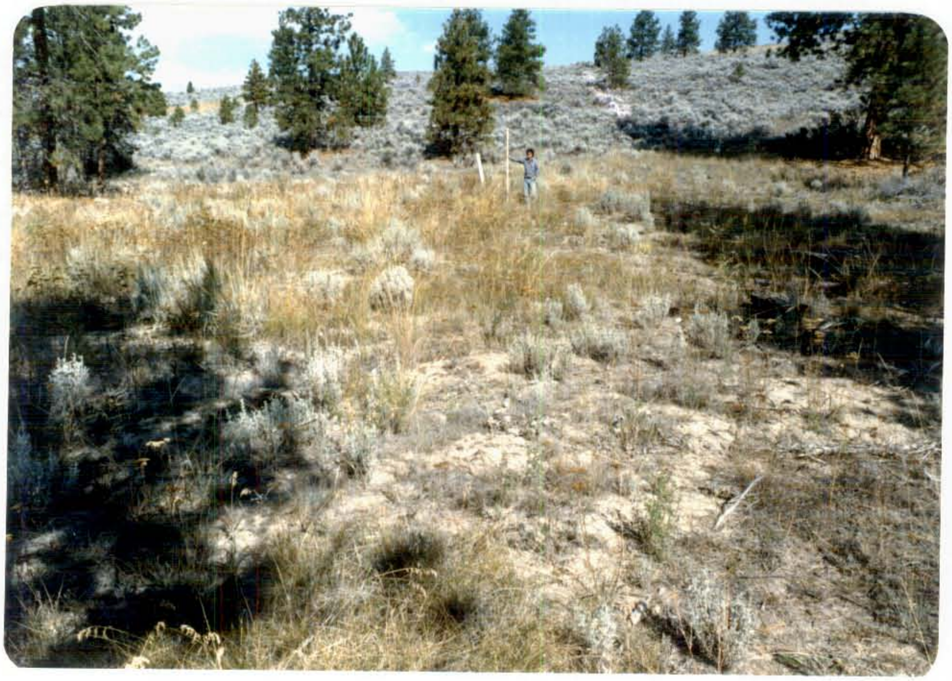


Photo 17. DDH76-128 September 1980

Photo 18. DDH 76-166 September 1980

Drill Hole	Cover %	Relative Plant Abundance - %	Comments
DDH 76-815	50 to 75 Mostly Uniform	Crested Wheatgrass 30 Alfalfa 30 Smooth Brome 20 Tall Wheatgrass 10 Native Species 10	Good grass/legume mix. Plants large and in good condition. Good reclamation.
RH 77-23	50 to 75 Uniform	Crested Wheatgrass 15 Streambank 5 Smooth Brome 5 Alfalfa 5 Native Species 70	Grasses and legume suffering from competition from native species. This rotary hole was not greatly disturbed during drilling hence large native species content.
DDH 77-226	50 to 75 Mostly Uniform	Crested Wheatgrass 15 Smooth Brome 20 Alfalfa 10 Native Species 55	Good mix of native and agronomic species. Plants in good condition.
DDH 77-251 (see Photo 19)	75 to 100 Uniform	Crested Wheatgrass 15 Slender Wheatgrass 60 Smooth Brome 5 Fall Rye <5 Alfalfa 10 Native Species 10	Excellent reclamation although legume growth was poor.
DDH 77-845	75 to 100 Mostly Uniform	Crested Wheatgrass 70 Smooth Brome 20 Alfalfa 10 Native Species <5	Good biomass production and maturity shown by both grass and legume.
DDH 78-261	75 to 100 Uniform	Crested Wheatgrass 80 Fall Rye <5 Alfalfa 15 Native Species <5	Good reclamation. Better than surrounding area.
DDH 78-262 (see Photo 20)	75 to 100 Mostly Uniform	Crested Wheatgrass 80 Alfalfa 15 Fall Rye Not Present Native Species 5	Good reclamation.

Photo 19. DDH 77-251 September 1980.

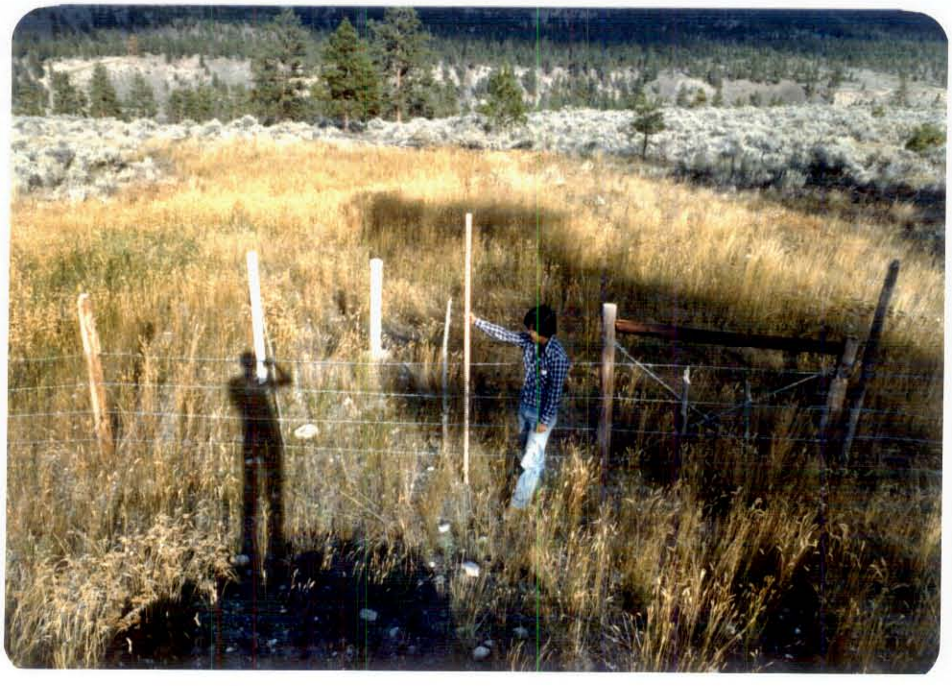


Photo 20. DDH 78-262 September 1980.

Drill Hole	Cover %	Relative Plant Abundance - %	Comments
DDH 78-266	100 Uniform	Crested Wheatgrass 15 Smooth Brome 25 Slender Wheatgrass 15 Alfalfa 10 Native Species 20	Good reclamation. Legumes showed lower biomass production than grasses.
DDH 78-287	75-100 Uniform	Crested Wheatgrass 40 Smooth Brome 40 Alfalfa 200 Native Species Not Present	Good reclamation. Biomass productivity high. Patches due to disturbances by vehicles.

2.4 VEGETATION EVALUATION PLOTS

In April of 1980 a test area was established at Hat Creek in which all species of grasses and legumes used at Hat Creek could be grown and collected for preparation of museum samples. The area was located between the B.C. Hydro house trailer and the road, about 5 m north of the camp well (BAH77-01). This location was selected because it was close to the B.C. Hydro trailer (office), the soil appeared to be of good quality and there was water available for irrigation.

In mid April a 9 m x 9 m area was scarified using a backhoe, roto-tilled and then worked by hand to remove weeds, roots and large rocks. Twenty-five 1 m x 1 m square test plots raised about 20 cm above normal ground level were constructed in the 9 m x 9 m area and it was fenced with barbed wire to keep out grazing animals. The plots were fertilized with monoammonium phosphate (11-48-0), urea (46-0-0) and borate 68 (0-0-0-21) at rates of 140, 40 and 16 kg/ha respectively.

Each test plot was planted with a single species. The grasses and legumes were sown to achieve a uniform seed distribution of about 2150 seeds/m². Cuttings of willow and root cuttings from rose and poplar were also planted. Three cuttings each of rose and poplar were planted immediately following sampling. A further three cuttings of each were stored in water for approximately 40 days and then planted out. The plots were weeded weekly and watered as required throughout the growing season.

The planting program for the vegetation evaluation plots is shown in Table 2-8.

During 1980, all of the grass and legumes germinated and grew well. The roses and willows also grew well. Only one of the six poplar cuttings grew. Vegetation samples were collected by Acres Consulting Services Limited on 8 July and 17 September. These were dried and preserved as museum samples in a booklet entitled "Reclamation Species Descriptions and Samples" prepared for B.C. Hydro by Acres Consulting Services Limited. No quantitative sampling to evaluate growth, biomass production or nutrient levels were carried out in 1980. The growth on these plots during 1980 is shown in the photographs in this section.

TABLE 2-8

VEGETATION EVALUATION PLOTS

Plot No.	Plant	Seeds/g	Seeding Rate g/m²	Date Planted 1980
1	Crested Wheatgrass (Nordan)	385	5.6	25 April
2	Alfalfa (Drylander)	469	4.6	25 April
3	Canada Bluegrass	5512	0.4	25 April
4	Fall Ryegrass	40	54.0	3 May
5	Slender Wheatgrass	353	6.1	25 April
6	Russian Wild Ryegrass	375	5.7	25 April
7	White Clover	1000	2.2	25 April
8	Sainfoin (Melrose)	40	54.0	25 April
9	Smooth Bromegrass (Manchar)	275	7.8	3 May
10	Streambank Wheatgrass (Sodar)	375	5.7	25 April
11	Canada Bluegrass (Reuben's)	5512	0.4	25 April
12	Double Cut Red Clover	606	3.5	25 April
13	Hard Fescue (Durar)	1245	1.7	25 April
14	Tall Fescue (Altar)	400	5.4	25 April
15	Birdsfoot Trefoil (Cascade)	1036	2.1	25 April
16	Tall Wheatgrass (Altar)	174	12.1	25 April
17	Creeping Red Fescue	1356	1.6	3 May
18	Mixed Blossom Sweet Clover	578	3.7	25 April
19	Willow	Six stem cuttings		9 June
20	Wild Rose	Three root cuttings		26 April
		Three root cuttings		9 June
21	Poplar	Three root cuttings		26 April
		Three root cuttings		9 June

SECTION 3.0 - WATER QUALITY MONITORING

3.1 INTRODUCTION

Since 1977 several water quality monitoring programmes have been started to provide background data and to monitor possible effects of the mining activities on surface and groundwater quality in the Hat Creek area. During 1980 the following water quality monitoring programmes were conducted:

1. Surface Water Quality - samples were collected at five stations that were monitored in previous surveys.

2. Hat Creek Water Level - the level of water in Hat Creek adjacent to Trench B and in the Trench B excavation itself were measured throughout the year. The groundwater levels in drill holes near Trench B were also measured. Both of these monitoring programmes were started in the fall of 1979.

3. Groundwater Quality - groundwater samples were collected from three wells that were sampled in previous years and from one well which had not been sampled previously.

4. Coliform Survey - samples were collected monthly from two stations in Hat Creek and from the B.C. Hydro camp well and analysed for total and faecal coliforms. This programme was initiated in the fall of 1979 and continued through 1980.

5. Coal Waste Leachates - determination of the volumes and chemical characteristics of leachates from the two specially prepared coal waste piles was continued during 1980. Selected daily leachate samples were sent for detailed physical-chemical analyses.

6. Surface Water Mercury Levels - in May 1980 monthly sampling of Hat Creek and the Bonaparte River was commenced to obtain samples for low level mercury analyses.

The procedures and results of the water quality monitoring programmes completed during 1980 are presented in this section. Where possible the current data is compared to that obtained in previous years.

3.2 SURFACE WATER

Surface water sampling has been carried out since 1977 to establish background water quality information in the Hat Creek area. During 1980 surface water samples were collected at five stations, three in Hat Creek, and in Medicine Creek and Aleece Lake. The locations of the sampling stations are as follows:

Hat Creek Station 1 -	Immediately east of Hillman house.
2 -	Upstream of Trench B adjacent to the bunkhouses.
3 -	Approximately 0.5 km downstream of Trench B - upstream of the Hat Creek Road bridge.
Medicine Creek -	Approximately 6 km upstream of its confluence with Hat Creek.
Aleece Lake -	Near centre of lake ~70 m from North shore. Radiochemical samples taken through ice ~7 m from shore.

Hat Creek stations 1 and 3 and Medicine Creek were sampled in previous years whereas Hat Creek station 2 was last sampled in 1977. The Aleece Lake station was a new sampling station established in 1980.

The water quality samples were collected from various stations by B.C. Hydro personnel in July, October and November. The samples were filtered and preserved in the field as required (following procedures detailed in the report by Beak Consultants Limited, May 1978[5]) and analysed at the B.C. Hydro research and development laboratory in Surrey. The radiochemical parameters were determined by Chemex Labs Ltd., North Vancouver.

The results of the surface water quality monitoring programme for 1980 and previous years are presented in Tables 3-1 to 3-5. As expected the surface water quality in Hat Creek and Medicine Creek has not changed significantly from that found in the previous surveys.

During the freshet in May and June, samples were obtained from Hat Creek and Medicine Creek for suspended solids and other analyses. Samples were collected from Hat Creek at its confluence with Anderson Creek, at the Highway 12 Hat Creek Road junction and from Medicine Creek about 1 km from the confluence with Hat Creek. Further samples were also collected on 12 August when the turbidity in Hat Creek was noticably increased. The samples were collected by B.C. Hydro personnel and frozen until delivered to the B.C. Hydro research and development laboratory for analyses.

The results of the solids surveys are presented in Table 3-6. The concentrations of suspended solids in Hat Creek were substantially higher than during the same period in 1979. This reflects the higher flows in Hat Creek during the 1980 freshet (peak flow 9.55 m^3/s on 7 June 1980, measured at Upper Hat Creek); in 1979 the peak flow was only 1 m^3/s. The high levels of suspended and dissolved solids on 12 August were caused by increased runoff after a short period of heavy rainfall.

3.3 HAT CREEK WATER LEVEL

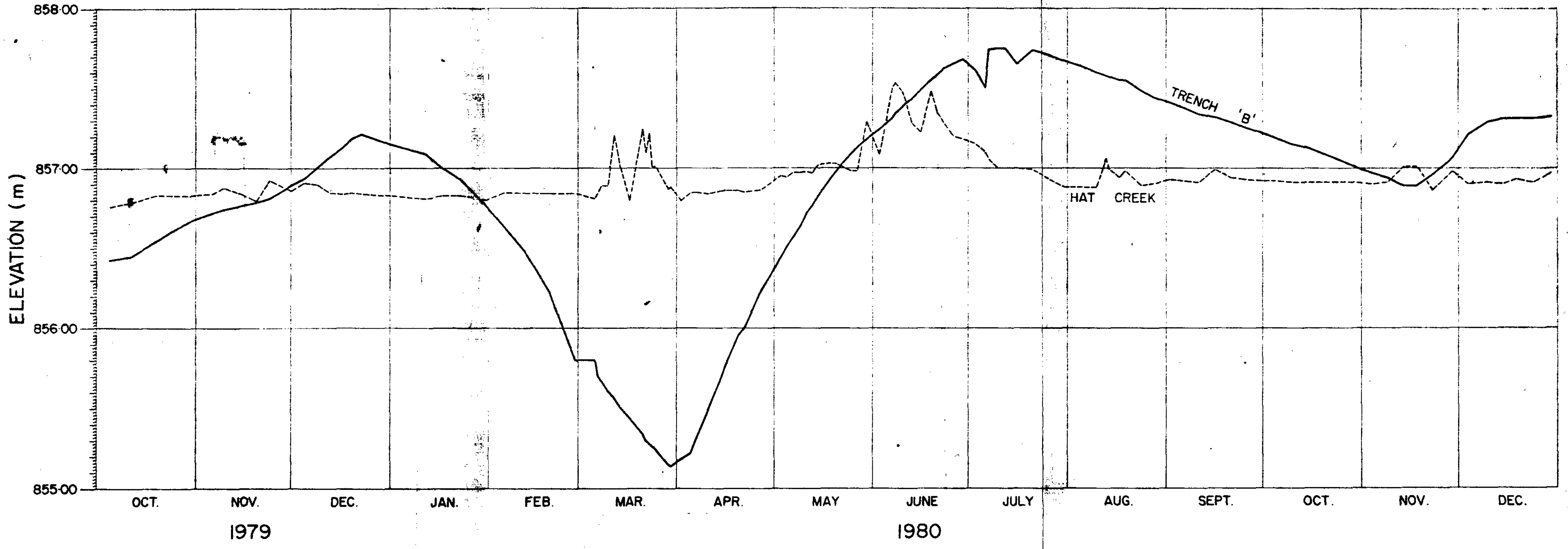
In October 1979 a monitoring programme was initiated to compare the water levels in Hat Creek and in the Trench B excavation which is adjacent to the creek. It was suggested that the flow in Hat Creek may be reduced by this excavation. This programme was continued during 1980.

Two measurement stakes were installed, one at the south end of Trench B in the middle of the excavation and the other on the west side of Hat Creek, directly west of the trench stake. The stakes were calibrated from a known benchmark. Water level readings were taken periodically during the year. When there was ice cover water level readings were taken through the ice.

The results of the water level monitoring are presented in Fig. 3-1 and in Table 3-7. The data indicate that the water levels in Hat Creek and the adjacent Trench B excavation move independently. The water level in Trench B varied over a range of about 2.5 m. The Hat Creek water level varied less than 0.8 m during the year.

The levels of groundwater in drill holes in the area of Trench B were also monitored during 1980. These results are shown in Tables 3-8 and 3-9.

The level of water in the Trench B excavation followed closely the level of groundwater found in nearby drill holes. The level of groundwater in drill hole R77-28, which is between the excavation and Hat Creek followed the water level in Hat Creek more closely and was probably influenced more by the creek than local groundwater. Analyses of the groundwater levels seems to indicate that water in the Trench B excavation is influenced by an aquifer which lies on the east side of the valley and south of the excavation, which slopes to the north-northwest. This aquifer may intersect with Hat Creek downstream of the excavation area.



B. C. HYDRO

HAT CREEK PROJECT

1980 ENVIRONMENT FIELD PROGRAMS
WATERLEVELS OF TRENCH 'B'
AND HAT CREEK

FIGURE 3 - 1

TABLE 3-1

SURFACE WATER QUALITY ANALYSES - HAT CREEK STATION NO. 1

Date of Sampling / Parameter Dissolved Total CATIONS (Mg/l)	HAT CREEK STATION #1							
	13/6/79		13/7/80			19/10/80		
	Diss.	Total	Diss	Total	Trivalent	Diss	Total	Trivalent
Aluminum (Al)	0.044			<0.1		<0.1	<0.2	
Arsenic (As)		<0.005		<.005 Diss	<.00		<.005	<.005
Cadmium (Cd)	<0.005			<0.01		<0.01	<0.02	
Calcium (Ca)	56		29.5			47.7		
Chromium (Cr)	<0.01		<0.01			<0.01	<0.01	
Copper (Cu)	<0.005		0.040			.013	.017	
Iron (Fe)	<0.01		0.07			.05	.12	
Lead (Pb)	<0.01		<0.01			<0.01	<0.02	
Lithium (Li)	0.004			.003		.004	.004	
Magnesium (Mg)	20		18.7			17.1		
Mercury (Hg)(ug/l)	<0.25	<0.25						
Molybdenum (Mo)	0.002			<0.02		<0.02	<0.04	
Nickel (Ni)	<0.01		<0.01			<0.01	<0.01	
Potassium (K)	3.2		2.33			1.92		
Selenium (Se)	<0.003		<0.001			<.001	<.001	
Sodium (Na)	27		14.2			13.2		
Strontium (Sr)	0.29		0.25			.029	.030	
Vanadium (V)	0.003			<0.1		<0.1	<0.2	
Zinc (Zn)	<0.005			.066		.005	.195	
Manganese (Mn)	0.02		0.011			.006	.010	

Table 3-1 cont'd

Date / Parameter Dissolved Total CATIONS (Mg/1)	HAT CREEK STATION No. 1 26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/7/77	20/7/77	4/8/77	14/9/77	19 / 10 / 77		29 / 11 / 77		1 / 5 / 78		7 / 6 / 78		B.C.Hydro Lab. 7 / 6 / 78		23 / 8 / 78	
	Diss.	Diss.	Diss.	Diss.	Diss.	Diss.	Diss.	Diss.	Diss.	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total
Aluminum (Al)	*	*	*	*	*	*	*	*	*	<0.1	0.060	0.077	0.080	0.030	7.8	0.051	7.2	0.04	15.8	0.008	0.13
Arsenic (As)	*	*	*	*	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05		<0.005	<0.005
Cadmium (Cd)																					
Calcium (Ca)	42	59	60	37	57	60	60	56	58	64	64	60		45	52	24	29	24.5	32.8	65	65
Chromium (Cr)	*	*	*	*	*	*	*	*	*	<0.010	<0.010	<0.010	<0.010	<0.010	0.020	<0.010	<0.010	<0.01	0.09	<0.010	<0.010
Copper (Cu)	*	*	*	*	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	0.033	<0.005	0.024	0.016	0.024	<0.005	<0.005
Iron (Fe)	0.018	0.019		0.029	0.022	0.020	0.014	0.014	0.030	0.023	0.065	0.031	0.074	0.057	12	0.076	8.6	0.083	15.2	0.022	0.17
Lead (Pb)																					
Lithium (Li)	0.010	0.005	0.004	0.003	0.004	0.004	0.005	0.004	0.002	0.004	0.004	0.005	0.005	0.004	0.006	0.001	0.004	0.001	0.006	0.004	0.004
Magnesium (Mg)	13	21	21	12	15	22	19	17	19	18	18	6		19	21	6.0	7.5	8.1	11.3	21	21
Mercury (Hg)(µg/1)	*	*	*	*		*	*	0.25	*	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.32			0.3	0.35
Molybdenum (Mo)																					
Nickel (Ni)														0.014	0.054	<0.010	0.018	0.012	0.028		
Potassium (K)																		1.2	2.08		
Selenium (Se)	*	*	0.005	*	0.003	*	*	*	*	<0.003		<0.003		<0.003	<0.003	<0.003	<0.003			<0.003	<0.003
Sodium (Na)	14	24	25	15	21	20	22	23	22	21	22	23		17	18	7.4	7.4	7.0	9.48	26	28
Strontium (Sr)	0.24	0.30	0.30	0.13	0.18	0.31	0.24	0.25	0.29	0.24	0.24	0.25	0.28	0.26	0.27	0.095	0.14			0.32	0.37
Vanadium (V)	*	0.002	0.011	*	*	0.001	0.001	0.006	0.006	0.003	0.003	<0.003	<0.003	<0.003	0.019	0.002	0.021	<0.002	<0.002	0.003	0.003
Zinc (Zn)	0.008	0.005	*	0.010	*	*	0.024	0.036	0.006	<0.005	0.007	0.019	<0.005	0.007	0.055	0.012	0.031	0.049	0.061	0.006	0.006
Manganese (Mn)										0.011	0.012	0.010	0.012					0.01	0.36		
Silica (Si as SiO_2)																		11.9	200.9		
Titanium (Ti)																		<0.1	1.25		
Barium (Ba)																		0.13	0.14		
* Denotes <NDC																					

Table 3-1 cont'd

Date (Mg/l) / Parameter Dissolved Total ANIONS, ORGANIC, CALCULATED VALUES	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/7/77	20/7/77	4/8/77	14/9/77	19 / 10 / 77		29 / 11 / 77		1 / 3 / 78		7 / 6 / 78		B.C.Hydro Lab. 7 / 6 / 78		23 / 8 / 78	
NAT CREEK STATION No. 1										Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total
Boron (B)	*	0.2	*	*	0.1	*	*	*	*	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	0.053		<0.10	<0.10
Chloride (Cl)	0.78	1.2	1.0	0.63	0.88	0.99	1.0	1.3	1.2		0.78		0.92		1.3		0.30		0.32		1.4
Fluoride (F)	0.088	0.120	0.107	0.090	0.107	0.112	0.118	0.118	0.101		0.059		0.039		0.121		0.071				0.12
Sulfate (SO_4)	41	56	65	34	44	68	52	45	41		51		47		50		23		9.3		70
Total-Kjeldahl-Nitrogen (N)																					
Nitrate-Nitrogen (NO_3 - N)																					
Nitrite-Nitrogen (NO_2 - N)																					
Total-Orthophosphate-Phosphorus (P)																					
Dissolved-Total-PO_4-Phosphorus (P)	Diss. 0.030	Diss. 0.056	Diss. 0.054	Diss. 0.051	Diss. 0.083	Diss. 0.049	Diss. 0.032	Diss. 0.045	Diss. 0.049	0.026		0.024		0.041		0.029		<0.05		0.027	
COD																					
TOC	15	10	17	19	24	34	26	17	6		5		14		33		10				6
Phenol																					
Total Hardness($CaCO_3$)	158	234	236	142	204	240	228	210	223		234		216		191		84.5		88.0		249
Total Alkalinity($CaCO_3$)	149	220	230	149	198	236	241	250	234		235		220		197		87		80		240
BOD_5																					
D.O.																					
% Saturation																					

* Denotes <MDC

Table 3-1 cont'd

HAT CREEK STATION NO.1

(mg/L) Parameter Diss. (D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES / Date of Sampling	13/6/79		13/7/80		19/10/80	
	Diss.	Total	DISS	TOTAL	DISS	TOTAL
Boron (B)	<0.1		<0.1		<0.1	
Chloride (Cl)	2.4			1.62		0.68
Fluoride (F)	0.099			0.077		0.094
Sulfate (SO_4)	55			25		33
Total-Kjeldahl-Nitrogen (N)						
Nitrate-Nitrogen (NO_3 -N)	0.03			0.03 unpres		<0.01
Nitrite-Nitrogen. (NO_2 -N)	<0.005			<0.005 unpres		<0.005
Total-Orthophosphate-Phosphorus (P)						
Dissolved-Total PO_4 Phosphorus (P)	0.042			0.014		<0.004
COD						
TOC	10			35		<2
Phenol						
Total Hardness($CaCO_3$)	222			158		190
Total Alkalinity($CaCO_3$)		232		138		179
BOD_5						
D.O.						
% Saturation						

Table 3-1 cont'd

Date / Parameter Dissolved Total PHYSICAL DATA (Mg/1)	HAT CREEK STATION No. 1													BCH Lab.							
	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/7/77	20/7/77	4/8/77	14/9/77	19/10/77	29/11/77	1/5/78	7/6/78	7/6/78	23/8/78	13/6/79	13/7/80	9/10/80			
pH (units)	7.9	8.5	8.4	8.3	8.4	8.4	8.5	8.6	8.4	8.3	8.2	8.4	8.0	8.1	8.3	8.5	7.9	8.3			
Specific Conductance (μmhos/cm @ 25° C)	370	490	520	350	440	547	520	520	508	506	485	436	190	170	557	516	270	328			
True Color (Pt-Co Units)																	8	5			
Turbidity (NTU)															1.8		0.67	0.99			
Temperature (°C)																					
Total residue	323	362	383	288	313	383	351	353	359	327	320	567	354	224	385	360	208	205			
Filtrable residue	253	360	367	253	306	378	349	353	346	324	316	286	138	158	381	352	170	200			
Non-filtrable residue	70	2	16	35	7	5	2	<1	13	3	4	281	216	65.5	4	8	38	5			
Fixed total residue																					
Fixed filtrable residue																					
Fixed non-filtrable residue																					

TABLE 3-2

SURFACE WATER QUALITY ANALYSES - HAT CREEK STATION NO. 2

Date of Sampling (mg/L) Parameter Dissolved (D), Total (T) - CATIONS	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/8/77	20/7/77	4/8/77	14/9/77	19/10/77 Diss.	19/10/77 Total	29/11/77 Diss.	29/11/77 Total	13/7/80 DISS	13/7/80 TOTAL	TRIVALENT
	HAT CREEK STATION NO. 2															
Aluminum (Al)		*	*	*	*	*	0.015	*	*	<0.010	0.060	0.026	0.026		<0.1	
Arsenic (As)		*	*	*	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<.005		<.00
Cadmium (Cd)															<0.01	
Calcium (Ca)		59	60	45	57	61	60	57	61	64	64	60		28.7		
Chromium (Cr)		*	*	*	*	*	*	*	*	<0.010	<0.010	<0.010	<0.010	<0.01		
Copper (Cu)		*	*	*	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	0.019		
Iron (Fe)		0.025	0.026	0.029	0.026	0.020	0.012	0.014	0.025	0.023	0.065	0.019	0.060	0.07		
Lead (Pb)														<0.01		
Lithium (Li)		0.005	0.004	0.004	0.004	0.004	0.005	0.005	0.003	0.004	0.004	0.004	0.004		.002	
Magnesium (Mg)		20	21	12	15	22	19	17	18	18	18	16		18.3		
Mercury (Hg)(ug/l)		*	*	*	*	*	*	0.0038	*	<0.25	<0.25	<0.25	<0.25			
Molybdenum (Mo)															<0.02	
Nickel (Ni)														<0.01		
Potassium (K)														2.31		
Selenium (Se)		*	0.004	0.006	*	*	*	0.003	0.006	<0.003		<0.003		<0.001		
Sodium (Na)		24	24	16	19	20	20	22	22	21	22	23		14.2		
Strontium (Sr)		0.29	0.30	0.20	0.18	0.32	0.24	0.30	0.30	0.24	0.24	0.24	0.28	0.25		
Vanadium (V)		0.002	*	*	*	0.002	0.001	0.003	*	0.003	0.003	<0.003	0.003		<0.1	
Zinc (Zn)		0.009	0.024	*	0.010	*	0.018	0.010	0.014	<0.005	0.007	0.015	0.007		.066	
Manganese (Mn)										0.011	0.012	<0.010	<0.010	0.012		

* Denotes <MDC

Table 3-2 cont'd

(mg/L) Parameter Diss. (D), Total (T) ANIONS, ORGANIC, *CALCULATED VALUES* / Date of Sampling	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/8/77	20/7/77	4/8/77	14/9/77	19-10/77 Diss.	19-10/77 Total	29/11/77 Diss.	29/11/77 Total	13/7/80 DISS	13/7/80 TOTAL
			RAT CREEK STATION NO. 2												
Boron (B)		*	*	*	0.1	*	0.1	*	*	<0.1	<0.1	0.1	0.1	<0.1	
Chloride (Cl)		1.3	1.2	0.70	0.94	1.1	0.90	1.1	1.0		0.86		0.92		0.76
Fluoride (F)		0.110	0.110	0.081	0.110	0.111	0.120	0.120	0.098		0.088		0.075		0.082
Sulfate (SO_4)		56	61	35	49	62	46	43	44		52		45		28
Total-Kjeldahl-Nitrogen (N)															
Nitrate-Nitrogen (NO_3 -N)															0.03 unpres
Nitrite-Nitrogen (NO_2 -N)															<0.005 unpres
Total-Orthophosphate-Phosphorus (P)															
Dissolved-Total PO_4 Phosphorus (P)		0.050	0.064	0.060	0.066	0.046	0.033	0.049	0.032	0.026		0.026			0.013
COD															
TOC		6	22	22	24	22	30	17	4		8		14	28	
Phenol															
Total Hardness($CaCO_3$)		230	236	162	204	240	228	212	226		234		216		149
Total Alkalinity($CaCO_3$)		222	228	157	196	237	246	251	241		238		225		157
BOD_5															
D.O.															
% Saturation															
* Denotes <MDC															

Table 3-2 cont'd

Date of Sampling / Parameter / PHYSICAL DATA (mg/L)	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/8/77	20/7/77	4/8/77	14/9/77	19/10/7	29/11/7	13/7/80									
	HAT CREEK STATION NO. 2																				
pH (units)		8.5	8.4	8.3	8.4	8.5	8.5	8.5	8.4	8.4	8.2	7.9									
Specific Conductance (µmhos/cm @ 25° C)		460	520	360	440	546	530	520	515	516	491	278									
True Color (*Pt-Co Units*)												43									
Turbidity (NTU)												0.75									
Temperature (°C)																					
Total residue		359	381	275	308	380	355	362	353	333	328	250									
Filtrable residue		357	369	255	302	372	351	362	343	333	324	178									
Non-filtrable residue		2	12	20	6	8	4	<1	10	<1	4	72									
Fixed total residue																					
Fixed filtrable residue																					
Fixed non-filtrable residue																					

TABLE 3-3

SURFACE WATER QUALITY ANALYSES - HAT CREEK STATION NO. 3

Date of Sampling (mg/L) Parameter Dissolved (D), Total (T) - CATIONS	HAT CREEK STATION NO. 3																				
	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/7/77	20/7/77	3/8/77	14/9/77	19/10/77		29/11/77		1/5/78		7/8/78		23/8/78		13/6/79	
										Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total
Aluminum (Al)	*	*	*	*	*	*	0.015	0.25	*	<0.010	0.032	<0.010	0.020	0.039	4.3	0.067	8.9	0.008	0.27	0.005	
Arsenic (As)	*	*	*	*	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Cadmium (Cd)																				<0.005	
Calcium (Ca)	45	60	59	39	57	61	60	57	57	65	65	60		47	49	24	31	65	65	58	
Chromium (Cr)	*	*	*	*	*	*	*	*	*	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.01	
Copper (Cu)	*	*	*	*	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	0.017	<0.005	0.032	<0.005	<0.005	0.005	
Iron (Fe)	0.012	0.032	0.032	0.021	0.028	0.018	0.010	0.010	0.026	0.025	0.064	0.030	0.056	0.064	6.0	0.074	11	0.023	0.29	0.03	
Lead (Pb)																				<0.01	
Lithium (Li)	0.011	0.005	0.004	0.004	0.004	0.005	0.005	0.005	0.003	0.004	0.004	0.004	0.004	0.003	0.004	0.001	0.004	0.004	0.004	0.004	
Magnesium (Mg)	15	20	21	12	15	21	19	17	18	18	18	15		19	20	6.0	8.5	20	20	20	
Mercury (Hg)(ug/l)	*	*	*	*	*	*	*	*	*	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.35	0.37	0.30	0.45
Molybdenum (Mo)																				0.002	
Nickel (Ni)														0.015	0.033	0.010	0.023			<0.01	
Potassium (K)																				3.3	
Selenium (Se)	0.004	0.004	*	*	0.003	*	*	*	0.005	<0.003		<0.003		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	
Sodium (Na)	14	24	25	14	19	20	21	23	22	21	21	23		18	20	6.2	6.2	26	27	28	
Strontium (Sr)	0.26	0.29	0.31	0.20	0.18	0.34	0.24	0.26	0.30	0.24	0.24	0.23	0.28	0.26	0.28	0.10	0.16	0.36	0.37	0.31	
Vanadium (V)	*	0.001	*	*	*	0.003	*	0.004	*	0.006	0.006	<0.003	<0.003	<0.003	0.012	0.002	0.027	0.003	0.003	0.004	
Zinc (Zn)	*	0.008	0.011	0.005	0.021	*	0.084	0.010	0.007	0.010	0.010	0.022	0.010	0.008	0.029	0.008	0.071	0.007	0.010	0.007	
Manganese (Mn)										<0.005	0.007	<0.010	0.010							0.01	

* Denotes <MDC

Table 3-3 cont'd

Hat Creek Station No. 3

Parameter (mg/l) Dissolved (D), Total (T) - CATIONS \ Date of Sampling	19/10/80 DISS	TOTAL	TRIVALENT
Aluminum (Al)	<0.1	0.5	
Arsenic (As)	<.005		<.005
Cadmium (Cd)	<0.01	<0.02	
Calcium (Ca)	49.3		
Chromium (Cr)	<0.01	<0.01	
Copper (Cu)	.017	.076	
Iron (Fe)	.04	.13	
Lead (Pb)	<0.01	<0.02	
Lithium (Li)	.003	.003	
Magnesium (Mg)	17.4		
Mercury (Hg)(ug/l)			
Molybdenum (Mo)	<0.02	<0.04	
Nickel (Ni)	<0.01	<0.01	
Potassium (K)	1.94		
Selenium (Se)	<.001	<.001	
Sodium (Na)	13.4		
Strontium (Sr)	.29	.30	
Vanadium (V)	<0.1	<0.2	
Zinc (Zn)	<.005	.072	
Managanese (MN)	.005	.014	

Table 3-3 cont'd

(mg/L) Parameter Diss.(D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES \ Date of Sampling	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/7/77	20/7/77	3/8/77	14/9/77	19/10/77		29/11/77		1/5/78		7/6/78		23/8/78		13/6/79	
	HAT CREEK STATION NO. 3									Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss	
Boron (B)	*	*	*	*	*	*	*	*	*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.1	
Chloride (Cl)	0.95	1.3	1.3	0.70	0.85	0.94	0.85	1.1	0.88		0.82		0.92		1.4		0.42		1.5	1.4	
Fluoride (F)	0.088	0.107	0.113	0.082	0.117	0.108	0.120	0.122	0.091		0.086		0.079		0.123		0.078		0.12	0.107	
Sulfate (SO_4)	35	56	64	34	42	66	50	41	41		52		45		50		23		67	56	
Total-Kjeldahl-Nitrogen (N)																					
Nitrate-Nitrogen (NO_3 -N)																				0.03	
Nitrite-Nitrogen (NO_2 -N)																				<0.005	
Total-Orthophosphate-Phosphorus (P)																					
Dissolved-Total PO_4 Phosphorus (P)	0.030	0.045	0.062	0.052	0.078	0.055	0.038	0.048	0.042	0.029		0.029		0.006		0.024		0.025		0.038	
COD																					
TOC	19	6	16	20	32	28	28	12	5		12		16		22		12		2		7
Phenol																					
Total Hardness ($CaCO_3$)	174	232	234	147	204	239	228	212	216		236		212		226		84.6		245		227
Total Alkalinity ($CaCO_3$)	158	219	230	153	196	237	247	248	229		237		223		227		91		239		231
BOD_5																					
D.O.																					
% Saturation																					
* Denotes <MDC																					

Table 3-3 cont'd

(mg/L) Date of Sampling / Parameter Diss. (D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES	19/10/80		Hat Creek Station No. 3																		
	DISS	TOTAL																			
Boron (B)	<0.1																				
Chloride (Cl)		0.59																			
Fluoride (F)		0.092																			
Sulfate (SO_4)		33																			
Total-Kjeldahl-Nitrogen (N)																					
Nitrate-Nitrogen (NO_3 -N)		0.07																			
Nitrite-Nitrogen (NO_2 -N)		<0.005																			
Total-Orthophosphate-Phosphorus (P)																					
Dissolved-Total PO_4 Phosphorus (P)		0.025																			
COD																					
TOC		5																			
Phenol																					
Total Hardness ($CaCO_3$)		193																			
Total Alkalinity ($CaCO_3$)		180																			
BOD_5																					
D.O.																					
% Saturation																					

Table 3-3 cont'd

Date of Sampling / Parameter	HAY CREEK STATION NO. 3																				
PHYSICAL DATA (mg/L)	26/4/77	11/5/77	24/5/77	8/6/77	22/6/77	5/7/77	20/7/77	3/8/77	14/9/77	19/10/77	29/11/77	1/5/78	7/6/78	23/8/78	13/6/79	9/10/80					
pH (units)	7.9	8.5	8.4	8.3	8.4	8.6	8.5	8.6	8.4	8.4	8.2	8.4	7.9	8.3	8.5	8.3					
Specific Conductance (μmhos/cm @ 25° C)	380	410	530	360	446	540	530	520	498	516	497	444	200	552	520	327					
True Color (Pt-Co Units)																15					
Turbidity (NTU)														2.8		0.90					
Temperature (°C)																					
Total residue	336	355	385	270	308	378	352	362	337	329	331	412	447	383	355	218					
Filtrable residue	258	350	367	236	300	371	349	360	328	329	328	296	152	376	345	213					
Non-filtrable residue	78	5	18	34	8	7	3	2	9	<1	3	116	295	7	10	5					
Fixed total residue																					
Fixed filtrable residue																					
Fixed non-filtrable residue																					

TABLE 3-4

SURFACE WATER QUALITY ANALYSES - MEDICINE CREEK

(mg/L) Parameter Dissolved (D), Total (T) / Date of Sampling — CATIONS	MEDICINE CREEK 21/5/77 D	27/7/77 D	6/8/77 D	13/9/77 D	18/10/77 D	27/4/78 D	6/6/78 D	BCH Lab 6/6/78 D	21/8/78 D	11/6/79 D	19/11/80 DISS	19/11/80 TOTAL	19/11/80 TRIVALENT
Aluminum (Al)	<0.010										<0.01	0.3	
Arsenic (As)	<0.005										<.005		<.005
Cadmium (Cd)	<0.005										<0.01	<0.02	
Calcium (Ca)	61	57	61	58	60	31	29	28.5	60	62	38.8		
Chromium (Cr)	<0.010									<0.01	<0.01	<0.01	
Copper (Cu)	<0.005										.019	.019	
Iron (Fe)	0.021									0.04	.07	.36	
Lead (Pb)	<0.010										<0.01	<0.02	
Lithium (Li)	0.003										.002	.002	
Magnesium (Mg)	29	20	21	24	23	19	10	12.5	23	23	27.3		
Mercury (Hg)(µg/l)	0.5												
Molybdenum (Mo)	<0.020										<0.02	<0.04	
Nickel (Ni)											0.01	0.01	
Potassium (K)		2.5	2.2	2.3	1.6	2.2	0.81	0.7	1.5		1.49		
Selenium (Se)	<0.003										---	<.001	
Sodium (Na)	14	12	12	11	9.0	11	2.5	2.5	13	10	7.9		
Strontium (Sr)	0.44										---	.31	
Vanadium (V)	<0.005										<0.1	<0.2	
Zinc (Zn)	0.009									<0.005	<.005	.057	
Silica (SiO_2) Dissolved Total		0.5	2.0	5.2	10.7	12.1	10.9		12.93	13			
Silica Dissolved Molybdate Reactive						11.9	10.8		12.0	13			
Manganese (Mn)											.039	.057	

Table 3-4 cont'd

MEDICINE CREEK

Date of Sampling / Parameter / PHYSICAL DATA (mg/L)	8/6/79	10/6/79	11/6/79	12/6/79	14/6/79	16/6/79	18/6/79	19/11/80
pH (units)	8.5	8.4	8.3	8.5	8.6	8.6	8.6	8.1
Specific Conductance (µmhos/cm @ 25° C)	618	616	491	620	613	616	621	362
True Color (Pt-Co Units)								---
Turbidity (NTU)								---
Temperature (°C)								
Total residue	416	407	316	420	408	423	424	270
Filtrable residue	411	401	312	415	405	419	419	262
Non-filtrable residue	5	6	4	5	3	4	5	8
Fixed total residue								
Fixed filtrable residue								
Fixed non-filtrable residue								
Settleable Matter (by weight) mg/L			<1					

Table 3-4 cont'd

(mg/L) Parameter Diss.(D), Total(T) ANIONS, ORGANIC, CALCULATED VALUES \ Date of Sampling	21/5/77 D	27/7/77 D	6/8/77 D	MEDICINE CREEK 13/9/77 D	18/10/77 D	27/4/78 D	7/6/78 D	BCM Lab 7/6/78 D	21/8/78 D	11/6/79 D	19/11/80 DISS	19/11/80 TOTAL
Boron (B)	<0.1										<0.1	
Chloride (Cl)	0.50	0.35	0.20	0.26	0.16	0.80	0.24	0.35	0.44	0.5		0.50
Fluoride (F)	0.122											0.127
Sulfate (SO_4)	40	20	18	15	16	18	13	6.3	23	13		13
Total-Kjeldahl-Nitrogen (N)	0.26											
Nitrate-Nitrogen (NO_3 -N)	0.04											0.18
Nitrite-Nitrogen (NO_2 -N)	<0.0010											<0.005
Total-Orthophosphate-Phosphorus (P)	0.010											
Dissolved-Total PO_4 Phosphorus (P)												0.031
COD	10											
TOC	27					22	20		5	10.9		6
Phenol	<0.002											
Total Hardness($CaCO_3$)	272					156	114	118	245	250		---
Total Alkalinity($CaCO_3$)	188	255	263	262	256	169	111	110	260	268		242
BOD_5												
D.O.												
% Saturation												
Phenolphthalein Alkalinity ($CaCO_3$)		5.9	4.9	7.3	4.8					0		

Table 3-4 cont'd MEDICINE CREEK

Parameter / Date of Sampling — PHYSICAL DATA (mg/L)	21/5/77	27/7/77	6/8/77	13/9/77	18/10/77	27/4/78	7/7/78	BCH Lab 7/7/78	21/8/78	13/05/79	15/5/79	17/5/79	19/5/79	23/5/79	25/5/79	27/5/79	29/5/79	31/5/79	2/6/79	4/6/79	6/6/79
pH (units)	8.4	8.5	8.5	8.5	8.5	7.8	7.9	8.0	8.2	8.5	8.6	8.6	8.6	8.6	8.5	8.6	8.7	8.7	8.2	8.6	8.5
Specific Conductance (µmhos/cm @ 25° C)	550	470	500	482	473	338	220	200	500	479	480	539	560	586	602	606	604	603	556	596	603
True Color (Pt-Co Units)	10																				
Turbidity (NTU)	0.30					18	32		1.1												
Temperature (°C)	7																				
Total residue	361							212											389	400	396
Filtrable residue	359	304	322	318	297	218	158	164	337	308	319	355	369	385	399	404	407	408	368	396	389
Non-filtrable residue	2					109	72	48.1	<1	16	15	11	10	10	5	4	2	2	21	4	7
Fixed total residue	261																				
Fixed filtrable residue	260																				
Fixed non-filtrable residue	1																				
Settleable Matter (by weight) mg/L						79	44	103.1													

TABLE 3-5

SURFACE WATER QUALITY ANALYSES - ALEECE LAKE

Date of Sampling (mg/L) Parameter Dissolved (D), Total (T) - CATIONS	ALEECE LAKE 18/10/80			17/11/80		
	DISS	TOTAL	TRIVALENT	DISS	TOTAL	TRIVALENT
Aluminum (Al)	<0.1	<0.2		<0.01	---	
Arsenic (As)	<.005		<.005	<.005		<.005
Cadmium (Cd)	<0.01	<0.02		<0.01	---	
Calcium (Ca)	27.4			20.6		
Chromium (Cr)	<0.01	<0.01		<0.01	---	
Copper (Cu)	.027	.028		.028	---	
Iron (Fe)	.02	.06		.02	---	
Lead (Pb)	<0.01	<0.02		<0.01	---	
Lithium (Li)	.008	.008		.006	---	
Magnesium (Mg)	35.2			36.5		
Mercury (Hg)(ug/l)						
Molybdenum (Mo)	<0.02	<0.04		<0.02	---	
Nickel (Ni)	<0.01	<0.01		<0.01	---	
Potassium (K)	9.73			9.80		
Selenium (Se)	<.001	<.001		<.001	---	
Sodium (Na)	36.7			37.8		
Strontium (Sr)	.35	.36		.38	---	
Vanadium (V)	<0.1	<0.2		<0.1	---	
Zinc (Zn)	.009	.195		.012	---	
Manganese (Mn)	.026	.027		<0.005	---	

Table 3-5 cont'd

(mg/L) Parameter Diss. (D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES / Date of Sampling	ALEECE LAKE 18/10/80 DISS	18/10/80 TOTAL	17/11/80 DISS	17/11/80 TOTAL
Boron (B)	<0.1		<0.1	
Chloride (Cl)		1.62		2.72
Fluoride (F)		0.151		0.186
Sulfate (SO_4)		67		73
Total-Kjeldahl-Nitrogen (N)				
Nitrate-Nitrogen (NO_3 -N)		0.04		0.06 unpres
Nitrite-Nitrogen (NO_2 -N)		<0.005		<0.005 unpres
Total-Orthophosphate-Phosphorus (P)				
Dissolved-Total PO_4 Phosphorus (P)		<0.004		0.029
COD				
TOC		13		---
Phenol				
Total Hardness($CaCO_3$)		216		---
Total Alkalinity($CaCO_3$)		224		234
BOD_5				
D.O.				
% Saturation				

Table 3-5 cont'd

ALEECE LAKE

Parameter \ Date of Sampling PHYSICAL DATA (mg/L)	18/10/80	7/11/80
pH (units)	8.0	8.2
Specific Conductance (µmhos/cm @ 25° C)	469	490
True Color (Pt-Co Units)	30	---
Turbidity (NTU)	1.4	---
Temperature (°C)		
Total residue	322	no sample
Filtrable residue	308	385
Non-filtrable residue	14	no sample
Fixed total residue		
Fixed filtrable residue		
Fixed non-filtrable residue		

TABLE 3-6

SURFACE WATER SOLIDS SURVEYS

Location and Parameter	Date of Sampling[1] 1980 May 2	May 14	May 29	June 6	June 10	August 12
Hat Creek at Highway 12						
pH	7.8	8.0	8.4	8.7	8.2	8.1
Conductivity - µmhos/cm	226	195	181	126	142	296
[2]Suspended solids - mg/L	42	53	54	319	184	273
[3]Dissolved solids - mg/L	244	212	188	134	144	209
Total solids - mg/L	286	265	242	453	328	482
Hat Creek at Anderson Creek						
pH	7.9	8.0	8.7	8.9	8.3	8.0
Conductivity - µmhos/cm	222	210	238	166	140	302
Suspended solids - mg/L	28	15	29	6	22	368
Dissolved solids - mg/L	231	233	257	191	162	214
Total solids - mg/L	259	248	286	197	284	582
Medicine Creek						
pH	7.9	7.8	8.5	8.2	7.6	7.7
Conductivity - µmhos/cm	329	370	313	309	362	438
Suspended solids - mg/L	92	54	72	149	44	77
Dissolved solids - mg/L	286	322	266	274	314	287
Total solids - mg/L	378	376	338	423	358	364
Hat Creek flow at Medicine Creek - m^3/s	0.56	0.94	0.92	9.5	7.2	1.6

1 Samples were frozen following collection.
2 Suspended solids is now commonly called non-filterable residue.
3 Dissolved solids is now commonly called filterable residue.

3.4 GROUNDWATER

On 13 July and 21 October water samples were collected from groundwater wells No. 2 and 3 near Trench B. The wells had been pumped out the previous day. The samples were preserved in the field and sent to the B.C. Hydro research and development laboratory in Surrey for analyses. Some of the samples were quite muddy and were very slow filtering. On 18 October a sample of water in the Trench B excavation was collected, preserved and sent for analyses. On 17 November, samples were collected from a well at the Steele Bros. limestone plant which is located beside Highway 12 about 4 km west of the Hat Creek - Highway 12 junction. This sample was taken from a tap after the water had run for about five minutes. This well had not been sampled previously in the B.C. Hydro monitoring programme. On 17 November water samples for radiochemical analyses were collected from groundwater wells No. 2 and 3 and from Trench B. The radiochemical samples were sent to Chemex Labs Ltd. for analyses. On 18 November samples for cyanide analyses were collected from groundwater wells No. 2 and 3, the Steele Bros. well and from Trench B. The cyanide samples were sent to the B.C. Hydro lab for analyses. All of the sampling was carried out by B.C. Hydro personnel.

The results of these analyses are presented in Tables 3-10 to 3-13. The 1980 results for groundwater wells No. 2 and 3 and Trench B were similar to the previous analyses.

3.5 COLIFORM SURVEY

In 1979 a programme was initiated to monitor background levels of coliform bacteria in Hat Creek and in the B.C. Hydro camp water supply well. This monitoring program was continued during 1980. Monthly samples were collected from three station; two surface water stations in Hat Creek near the Lehman ranch and near the B.C. Hydro trailer at Highway 12 and a groundwater sample from the B.C. Hydro camp well.

TABLE 3-7

HAT CREEK - TRENCH B WATER LEVEL MONITORING

Date	Elevation Trench 'B' (m)	Elevation Hat Creek (m)	Difference (Hat Creek - Trench B)	Remarks
1979				
04/10	856.425	856.760	+0.335	
11/10	856.449	856.786	+0.337	
19/10	856.545	856.828	+0.283	
24/10	856.615	856.831	+0.216	
29/10	856.669	856.833	+0.164	
05/11	856.722	856.839	+0.117	ice on creek edges
09/11	856.745	856.879	+0.134	ice : 75% creek
14/11	856.765	856.845	+0.080	ice : 90% creek, 10% trench
19/11	856.787	856.789	+0.002	ice : 60% trench
23/11	856.818	856.924	+0.106	ice : 50% trench
30/11	856.889	856.860	-0.029	ice : 100% creek, 95% trench
04/12	856.949	856.909	-0.040	ice : 100% creek, 97% trench
08/12	856.998	856.900	-0.098	ice : 85% trench
12/12	857.072	856.848	-0.224	ice : 97% trench
16/12	857.138	856.838	-0.300	ice : 99% trench
20/12	857.187	856.843	-0.344	ice : 95% trench
23.12	857.217	856.840	-0.377	ice : 100% creek, 98% trench
1980				
07/01	857.149	856.829	-0.320	ice : 100% creek, 99% trench
11/01	857.089	856.812	-0.277	ice : 100% creek, >99% trench
16/01	857.006	856.829	-0.177	ice : 100% creek, >99% trench
22/01	856.928	856.829	-0.099	ice : 100% creek, 100% trench
30/01	856.770	856.801	+0.031	ice : 100% creek, 100% trench
05/02	856.630	856.846	+0.216	
11/02	856.489	856.842	+0.353	
19/02	856.228	856.841	+0.613	
27/02	855.8	856.841	+1.04	
05/03	855.8	856.810		
06/03	855.700	-		
07/03	855.670	856.890	+1.220	ice : 100% creek, 100% trench
09/03	855.611	856.889	+1.278	ice : 98% creek, 100% trench
11/03	855.562	857.200	+1.638	creek overflow on ice
12/03	-	857.114		
13/03	855.509	857.066	+1.557	
16/03	855.440	856.799	+1.359	ice : 99% creek, 100% trench
20/03	855.341	857.240	+1.899	creek overflow on ice
21/03	855.300	857.100	+1.800	
22/03		857.220		
23/03		857.038		
24/03	855.247	857.070	+1.823	
28/03	855.151	856.871	+1.720	ice : 70% creek, 100% trench
29/03	855.139	856.878	+1.739	ice : 30% creek, 100% trench
01/04	855.180	856.800	+1.620	ice : 5% creek, 98% trench
04/04	855.222	856.840	+1.618	ice on creek edges only
06/04	855.312	856.850	+1.538	ice : 95% trench
10/04	855.512	856.840	+1.328	ice : 0% creek
13/04	855.665	856.855	+1.190	ice : 25% trench
15/04	855.772	856.860	+1.088	ice : 0% trench
19/04	855.958	856.860	+0.902	
21/04	856.044	856.850	+0.806	
26/04	856.231	856.860	+0.629	

TABLE 3-7 - (Cont'd)

Date	Elevation Trench 'B' (m)	Elevation Hat Creek (m)	Difference (Hat Creek - Trench B)	Remarks
1980				
02/05	856.435	856.950	+0.515	creek silty
04/05	856.510	856.945	+0.435	turbid
06/05	856.576	856.970	+0.394	turbid
08/05	856.632	856.935	+0.303	clearing
10/05	856.715	856.975	+0.260	turbid
12/05	856.765	856.970	+0.205	turbid
13/05	856.799	857.010	+0.211	very muddy
14/05	856.829	857.022	+0.193	very muddy
18/05	856.942	857.030	+0.088	very muddy
20/05	856.995	857.025	+0.030	turbid
22/05	857.045	857.005	-0.040	clearing
24/05	857.085	856.980	-0.105	
26/05	857.130	856.980	-0.150	
29/05	857.18	857.29	+0.11	
02/06	857.24	857.08	-0.16	
06/06	857.31	857.50	+0.19	very muddy
07/06	857.34	857.53	+0.19	very muddy
09/06	857.378	857.48	+0.102	very muddy
10/06	857.401	857.43	+0.029	very muddy
12/06	857.426	857.28	-0.146	very muddy
15/06	857.488	857.22	-0.268	turbid
18/06	857.55	857.48	-0.070	turbid
20/06	857.58	857.35	-0.230	turbid
22/06	857.622	857.28	-0.342	turbid
25/06	857.648	857.20	-0.448	clearing
28/06	857.682	857.18	-0.502	
02/07	857.61?	857.15	-0.46	
05/07	857.50?	857.10	-0.40	
06/07	857.741	857.055	-0.686	
09/07	857.749	857.000	-0.749	
11/07	857.750	857.000	-0.750	
15/07	857.65?	857.00	-0.65	
20/07	857.741	856.985	-0.756	
25/07	857.711	856.927	-0.784	
30/07	857.669	856.88	-0.789	
04/08	857.638	856.875	-0.763	springs still flowing,
09/08	857.601	856.88	-0.721	(creek very muddy),
12/08	857.579	857.055	-0.524	above the water line,
13/08	857.574	856.985	-0.589	but do not offset losses
16/08	~857.55	~856.94		
18/08	857.545	856.975	-0.570	
23/08	857.482	856.890	-0.592	
27/08	857.441	856.900	-0.541	
01/09	857.405	856.930	-0.475	
05/09	857.379	856.920	-0.459	
10/09	857.338	856.905	-0.433	
15/09	857.317	856.985	-0.332	
20/09	857.289	856.941	-0.348	
25/09	857.246	856.929	-0.317	
30/09	857.218	856.923	-0.295	
04/10	857.191	856.919	-0.272	
09/10	857.157	856.913	-0.244	
14/10	857.127	856.913	-0.214	
19/10	857.089	856.913	-0.176	
23/10	857.060	856.905	-0.155	
29/10	857.008	856.908	-0.100	

TABLE 3-7 - (Cont'd)

Date	Elevation Trench 'B' (m)	Elevation Hat Creek (m)	Difference (Hat Creek - Trench B)	Remarks
1980				
03/11	856.968	856.902	-0.066	
08/11	856.936	856.905	-0.031	
13/11	856.889	857.005	+0.116	ice : 80% creek, 40% Trench B
17/11	856.894	857.008	+0.114	
22/11	856.962	856.861	-0.101	ice : 95% HC, 60% TB
28/11	857.067	856.980	-0.087	ice : 98% HC, 95% TB
03/12	857.215	856.900	-0.315	ice : 98% HC, 99% TB
09/12	857.291	856.906	-0.385	ice : 99% HC, 100% TB
14/12	857.308	856.895	-0.413	ice : <80% HC, 99% TB
18/12	857.308	856.930	-0.378	ice : <70% HC, 95% TB
23/12	857.310	856.905	-0.405	ice : <80% HC, 99% TB
29/12	857.323	856.970	-0.353	ice : <30% HC, 93% TB
				Hat Creek rose 27/12 after very warm weather and rain.

TABLE 3-8

GROUNDWATER LEVELS (m) IN DRILL HOLES NEAR TRENCH B

Hole Date	R25 (1)*	(2)	(3)	R26 (1)	(2)	R27 (1)	(2)	(3)	R28 (1)	(2)	(3)
1979											
Oct	855.6	855.5	855.4	857.4	857.4	858.4	858.3	858.2	857.2	856.1	856.7
Nov	855.7	855.6	855.5	857.6	857.6	858.4	858.4	858.3	857.3	856.1	856.9
Dec	856.0	855.8	855.9	858.0	858.0	858.5	858.5	858.5	857.3	856.2	857.1
1980											
Jan	855.8	855.6	855.7	857.5	857.5	858.5	858.3	858.2	857.2	856.2	856.9
Feb	855.1	855.0	855.2	856.7	856.7	858.5	857.9	857.9	857.0	856.0	856.4
Mar	854.3	854.1	854.5	855.8	855.8	858.1	857.2	856.6	856.8	856.0	855.9
Apr	854.7	854.6	854.7	857.1	857.0	857.9	857.7	857.4	857.0	856.0	856.3
May	855.8	855.7	855.8	858.1	858.0	858.1	858.3	858.4	857.3	856.2	856.9
Jun	856.6	856.5	856.6	858.8	858.7	858.4	858.8	859.0	857.5	856.5	857.4
Jul	856.7	856.6	856.6	858.7	858.7	858.6	858.9	859.1	857.5	856.5	857.5
Aug	856.5	856.4	856.4	858.4	858.4	858.7	858.8	858.9	857.4	856.4	856.9
Sep											
Oct	856.1	856.0	856.0	857.9	857.9	858.6	858.6	858.6	857.4	856.3	857.1
Nov	855.9	855.7	855.7	857.6	857.6	858.6	858.4	858.4	857.3	856.2	856.9
Dec	856.0	855.9	855.9	858.1	858.1	858.6	858.6	858.6	857.4	856.3	857.1

* (1), (2) and (3) are piezometer in each well.

TABLE 3-9

GROUNDWATER LEVELS (m) IN DRILL HOLES IN AREA OF TRENCH B

Hole / Date	156	160 (1)	160 (2)	168	282	290 (1)	290 (2)	817	TB	HC
1979										
Oct	865.7	859.7	866.7	864.2	864.8	865.7	859.8	863.4	856.6	856.8
Nov	865.6	859.6	866.7	864.7	864.8	865.7	859.7	863.4	856.8	856.9
Dec	865.4	859.6	866.7	865.8	864.8	865.9	859.9	863.3	857.2	856.8
1980										
Jan	865.3	859.6	866.6	864.3	864.8	865.8	859.8	863.3	856.9	856.8
Feb	865.1	859.5	866.6	863.4	864.7	865.8	859.7	863.3	856.2	856.8
Mar	865.0	859.5	866.5	863.1	864.6	865.7	859.6	863.3	855.2	857.1
Apr	864.8	859.5	866.5	864.5	864.6	865.7	859.7	863.3	856.0	856.9
May	864.7	859.5	866.5	866.0	864.6	865.7	859.8	863.3	857.1	857.0
Jun	864.7	859.4	866.4	867.0	864.6	865.9	860.0	863.2	857.6	857.2
Jul	864.6	859.4	866.4	866.3	864.6	865.9	860.1	863.2	857.7	856.9
Aug	864.5	859.4	866.3	865.7	864.5	865.9	860.1	863.2	857.5	856.9
Sep										
Oct	864.3	859.3	866.3	864.8	864.5	865.8	860.0	863.2	857.2	856.9
Nov	864.2	859.3	866.2	864.4	864.4	865.9	859.9	863.2	857.0	856.9
Dec	864.0	859.3	866.1	866.4	864.6	866.0	860.1	863.2	857.2	856.9

TABLE 3-10

GROUNDWATER ANALYSES - TRENCH B

(mg/L) Parameter Dissolved (D), Total (T) - CATIONS / Date of Sampling				TRENCH B - GROUNDWATER										B.C.Hydro Lab.						
	21/6/77	6/7/77	19/7/77	4/8/77	14/9/77	20 / 10 / 77		30 / 11 / 77		1 / 5 / 78		8 / 6 / 78		8 / 6 / 78		22 / 8 / 78		18/10/80		
						D	T	D	T	D	T	D	T	D	T	D	T	DISS	TOTAL	TRIVALENT
Aluminum (Al)	*	*	0.025	*	*	0.014	0.020	<0.010	0.035	0.020	0.080	0.013	0.048	<0.02	<0.02	0.010	0.038	<0.1	<0.2	
Arsenic (As)	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05		<0.005	<0.005		<.005	<.005
Cadmium (Cd)																		<0.01	<0.02	
Calcium (Ca)	71	56	60	59	67	67	67	61		61	63	60	62	67	70	49	49	48.4		
Chromium (Cr)	*	*	*	*	*	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.01	<0.01	<0.010	<0.010	<0.01	<0.01	
Copper (Cu)	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.006	0.004	<0.005	<0.005	.020	.028	
Iron (Fe)	0.009	0.012	0.022	*	0.014	0.016	0.024	<0.010	0.022	0.024	<0.068	0.023	0.049	0.11	0.17	0.008	0.032	.02	.07	
Lead (Pb)																		<0.01	0.03	
Lithium (Li)	0.004	0.004	0.005	0.004	0.004	0.005	0.005	0.005	0.005	0.003	0.001	0.003	0.003	0.002	0.003	0.003	0.003	.004	.005	
Magnesium (Mg)						17	17	16		18	18	18	18	24.5	24.5	13	13	17.3		
Mercury (Hg)(µg/l)			*	0.20	*	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.27	0.28			0.35	0.45	15.0		
Molybdenum (Mo)																		<0.02	<0.04	
Nickel (Ni)										0.014	0.016	<0.010	<0.010	0.008	0.008			<0.01	<0.01	
Potassium (K)														2.5	2.5			2.29		
Selenium (Se)	0.003	*	0.003	*	0.004	<0.003		<0.003		<0.003	<0.003	<0.003	<0.003			<0.003	<0.003	<.001	<.001	
Sodium (Na)	21	19	20	26	26	25	25	25		22	23	22	24	24.5	24.5	21	22	16.5		
Strontium (Sr)	0.23	0.26	0.24	0.25	0.32	0.23	0.23	0.24	0.28	0.25	0.25	0.40	0.44			0.23	0.24	.27	.27	
Vanadium (V)	*	*	0.002	0.003	*	0.003	0.003	<0.003	0.004	<0.003	<0.003	0.003	0.003	<0.002	<0.002	0.005	0.005	<0.1	<0.2	
Zinc (Zn)	0.012	*	0.009	0.047	0.007	0.016	0.016	0.021	0.011	0.013	0.062	0.012	0.015	0.061	0.034	0.005	0.005	.009	.112	
Manganese (Mn)						<0.005	0.007	<0.010	<0.010					0.004	0.006			.014	.006	
Si (Si_2)														16.6	16.6					
Barium														0.17	0.17					
Titanium														<0.1	<0.1					
Uranium (U)																		0.0004	0.0008	
* Denotes MDC																				

TABLE 3-10
Cont'd

(mg/L) Date of Sampling Parameter Diss.(D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES	TRENCH B - GROUNDWATER 21/6/77	6/7/77	19/7/77	4/8/77	14/9/77	20 / 10 / 77 D	20 / 10 / 77 T	30 / 11 / 77 D	30 / 11 / 77 T	1 / 5 / 78 D	1 / 5 / 78 T	8 / 6 / 78 D	8 / 6 / 78 T	B.C.Hydro Lab. 8 / 6 / 78 D	B.C.Hydro Lab. 8 / 6 / 78 T	22 / 8 / 78 D	22 / 8 / 78 T	18/10/80 DISS	18/10/80 TOTAL		
Boron (B)	*	*	*	*	*	<0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.054		<0.10	<0.10		<0.1		
Chloride (Cl)	1.4	1.1	1.3	1.3	1.1		1.0		1.2		3.1		2.4		2.55		1.1		0.55		
Fluoride (F)	0.142	0.099	0.102	0.143	0.112		0.135		0.108		0.114		0.11				0.12		0.120		
Sulfate (SO_4)	44	56	48	46	58		56		51		74		82		6.3		44		33		
Total-Kjeldahl-Nitrogen (N)																					
Nitrate-Nitrogen (NO_3 -N)																			0.07		
Nitrite-Nitrogen (NO_2 -N)																			<0.005		
Total-Orthophosphate-Phosphorus (P)																					
Dissolved-Total PO_4 Phosphorus (P)	0.032	0.024	0.026	0.026	0.025	0.098		0.095		0.006		<0.003		<0.05		<0.003			0.020		
COD																					
TOC	31	83	95	11	4		12		11		22		< 2				13		<2		
Phenol																					
Total Hardness($CaCO_3$)	243	206	220	213	246		237		218		226		224		256		176		198		
Total Alkalinity($CaCO_3$)	222	218	229	236	257		245		228		227		241		228		198		191		
BOD_5																					
D.O.																					
% Saturation																					
* Denotes <MDC																					

TABLE 3-10

Cont'd

Parameter / Date of Sampling — PHYSICAL DATA (mg/L)	TRENCH B - GROUNDWATER 21/6/77	6/7/77	19/7/77	4/8/77	14/9/77	20/10/77	30/11 1977	1/5/78	8/6/78	BCH Lab 8/6/78	22/8/78	8/10/80									
pH (units)	8.0	7.9	7.8	8.0	8.0	8.0	7.8	8.3	8.2	8.2	8.2	8.2									
Specific Conductance (µmhos/cm @ 25° C)	510	499	530	540	603	542	516	547	560	490	432	349									
True Color (Pt-Co Units)												3									
Turbidity (NTU)											0.75	0.47									
Temperature (°C)																					
Total residue	387		38846	361	380	347	349	314	376	370	285	226									
Filtrable residue	339	340	346	357	376	345	348	310	375	370	285	226									
Non-filtrable residue	48		31500	4	4	2	1	4	1	<0.5	<1	0									
Fixed total residue																					
Fixed filtrable residue																					
Fixed non-filtrable residue																					
Settleable Matter										47.5											

TABLE 3-11

GROUNDWATER ANALYSES - WELL NO. 2

Date of Sampling (mg/L) Parameter Dissolved (D), Total (T) - CATIONS	7/6/77	21/6/77	6/7/77	20/7/77	20/10/77		30/11/77		8/6/78		22/8/78		GROUNDWATER WELL NO. 2 12/06/79		12/7/80			21/10/80			
					Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	DISS	TOTAL	TRIVALENT	DISS	TOTAL	TRIVALENT	
Aluminum (Al)	*	*	0.010	0.030	<0.010	0.68	0.010	0.40	0.013	0.28	0.009	0.30	0.005			<0.1		<0.1	0.3		
Arsenic (As)	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<.005		<.00	<.005		<.005	
Cadmium (Cd)																<0.01		<0.01	<0.02		
Calcium (Ca)	64	75	65	66	79	79	59		57	57	59	59	66		48.0			40.6			
Chromium (Cr)	*	*	*	*	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.01		<0.01			<0.01	<0.01		
Copper (Cu)	*	*	*	*	<0.005	<0.005	<0.005	<0.005	0.012	0.019	<0.005	0.006	0.006		0.026			.028	.028		
Iron (Fe)	0.034	0.024	0.035	0.13	0.026	0.44	0.011	0.42	0.015	0.28	0.015	0.31	<0.01		0.08			.04	.28		
Lead (Pb)															<0.01			<0.01	<0.02		
Lithium (Li)	0.003	0.004	0.005	0.004	0.004	0.004	0.003	0.003	0.002	0.002	0.003	0.003	0.004			.003		.004	.005		
Magnesium (Mg)	15	15	16	16	17	17	13		14	14	14	15	17		26.6			18.5			
Mercury (Hg)(ug/l)	*	*	*	*	<0.25	<0.25	<0.25	<0.25	0.27	0.32	0.37	0.37	0.26		0.6						
Molybdenum (Mo)																<0.02		<0.02	<0.04		
Nickel (Ni)									<0.010	<0.010			<0.01		0.01			<0.01	<0.01		
Potassium (K)															2.94			2.37			
Selenium (Se)	0.006	0.005	*	0.004	0.004		0.003		<0.003	<0.003	<0.003	<0.003	<0.003		<0.001			<.001	<.001		
Sodium (Na)	18	18	18	18	18	19	20		16	17	33	33	29		21.8			21.1			
Strontium (Sr)	0.20	0.21	0.28	0.23	0.24	0.24	0.19	0.21	0.31	0.32	0.24	0.27	0.27		0.33			.30	.30		
Vanadium (V)	*	*	*	0.001	0.003	0.003	<0.003	0.003	0.002	0.004	0.006	0.006	0.004			<0.1		<0.1	<0.2		
Zinc (Zn)	*	0.014	0.008	0.041	<0.005	0.011	0.032	0.007	0.005	0.010	0.011	0.029	<0.005			.011		.006	.048		
Manganese (Mn)					0.085	0.092	0.012	0.026					0.05		0.012			.031	.074		
Uranium (U)															0.0003	----		<0.0002	0.0009		
* Denotes <MDC																					

TABLE 3-11

Cont'd

(mg/L) Parameter Diss. (D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES / Date of Sampling	7/6/77	21/6/77	6/7/77	20/7/77	20/10/77		30/11/77		8/6/78		22/8/78		GROUNDWATER WELL NO. 2 14/06/79		12/7/80		21/10/80				
					Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	Diss.	Total	DISS	TOTAL	DISS	TOTAL			
Boron (B)	*	*	*	*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.10	<0.10	<0.1		0.1		<0.1				
Chloride (Cl)	1.7	1.4	1.3	1.3		1.0		0.88		1.4		1.4	1.9			1.58		1.03			
Fluoride (F)	0.104	0.128	0.135	0.146		0.140		0.107		0.14		0.18	0.152			0.153		0.139			
Sulfate (SO_4)	38	45	54	48		120		61		57		41	64			58		39			
Total-Kjeldahl-Nitrogen (N)																					
Nitrate-Nitrogen (NO_3 -N)													0.17			0.10 unpres		0.05			
Nitrite-Nitrogen (NO_2 -N)													<0.005			<0.005 unpres		<0.005			
Total-Orthophosphate-Phosphorus (P)																					
Dissolved-Total PO_4 Phosphorus (P)	0.032	0.033	0.043	0.009	0.12		0.015		0.017		0.020		0.028			0.015		0.032			
COD																					
TOC	27	32	24	50		12		22		10		<2		4		30		7			
Phenol																					
Total Hardness($CaCO_3$)	222	249	228	231		267		201		200		205	235			237		---			
Total Alkalinity($CaCO_3$)	229	232	231	241		200		179		208		232		253		238		224			
BOD_5																					
D.O.																					
% Saturation																					
* Denotes <MDC																					

TABLE 3-11

Cont'd

Date of Sampling / Parameter / PHYSICAL DATA (mg/L)	7/6/77	21/6/77	6/7/77	20/6/77	20/10/77	30/11/77	8/6/78	22/8/78	14/06/79	GROUNDWATER WELL NO. 2 12/7/80	21/10/80
pH (units)	7.6	7.4	7.4	7.6	7.4	7.7	7.6		7.7	7.4	7.7
Specific Conductance (µmhos/cm @ 25° C)	510	520	531	540	582	460	470	514	578	490	402
True Color (Pt-Co Units)										2	---
Turbidity (NTU)							1.8	2.5		0.43	---
Temperature (°C)											
Total residue	354	370	409	387	404	318	317	358	374	353	320
Filtrable residue	330	346	340	349	389	304	310	350	368	351	318
Non-filtrable residue	24	24	69	38	15	14	7	8	6	2	2
Fixed total residue											
Fixed filtrable residue											
Fixed non-filtrable residue											
* Denotes <MDC											

TABLE 3-12

GROUNDWATER ANALYSES - WELL NO. 3

Parameter (mg/L) Dissolved (D), Total (T) - CATIONS / Date of Sampling	7/6/77	21/6/77	6/7/77	20/7/77	4/8/77	30 / 11 / 77		8 / 6 / 78		22 / 8 / 78		12/6/79		12/7/80			21/10/80				
	GROUNDWATER WELL No. 3																				
						D	T	D	T	D	T	D	T	DISS	TOTAL	TRIVALENT	DISS	TOTAL	TRIVALENT		
Aluminum (Al)	*	*	*	0.057	*	0.17	1.1	0.32	16	0.027	40	0.009			<0.1		<0.1	9.8			
Arsenic (As)	*	*	*	*	*	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<.005		<.00	<.005		<.005		
Cadmium (Cd)												<0.005					<0.01	<0.01			
Calcium (Ca)	260	260	230	250	230	310		290	290	300	320	56		180			188				
Chromium (Cr)	*	*	*	*	*	<0.010	<0.010	<0.010	0.023	<0.010	<0.010	<0.01		0.01			0.01	0.04			
Copper (Cu)	0.007	*	*	*	*	0.006	0.014	0.024	0.087	0.020	0.095	<0.023		0.057			.047	.068			
Iron (Fe)	0.060	0.081	0.23	0.25	0.19	0.039	2.6	0.19	11	0.025	23	<0.01		0.17			.07	7.1			
Lead (Pb)												<0.01		0.07			<0.01	0.03			
Lithium (Li)	0.064	0.063	0.067	0.007	0.055	0.060	0.060	0.12	0.11	0.15	0.15	0.11			.104		.108	.102			
Magnesium (Mg)	81	83	85	88	65	97		110	110	100	120	97		160			134				
Mercury (Hg)(µg/l)	*	*	*	*	0.63	<0.25	<0.25	0.45	0.57	0.36	0.59	0.26	0.49	0.7							
Molybdenum (Mo)												0.003			<0.02		<0.02	<0.04			
Nickel (Ni)								0.010	0.034			0.01		0.05			0.04	0.06			
Potassium (K)												18		25.0			17.6				
Selenium (Se)	*	*	*	*	*	<0.003		0.006	<0.003	<0.003	<0.003	<0.003		<0.001			<.001	<.001			
Sodium (Na)	360	380	400	440	340	460		450	460	580	580	550		560			551				
Strontium (Sr)	0.72	0.70	2.1	0.99	1.8	1.1	1.1	1.5	0.98	1.9	1.9	2.4		2.80			2.88	3.24			
Vanadium (V)	*	*	0.008	*	0.003	0.005	0.006	0.004	0.029	<0.01	0.070	0.001			<0.1		<0.1	<0.2			
Zinc (Zn)	0.024	0.016	0.012	0.13†	0.10	0.18	0.018	0.031	0.063	0.017	0.088	0.016			.054		.016	.339			
Manganese (Mn)						0.40	0.40					<0.01		0.017			.028	.161			
Uranium (U)														0.0013	---		0.0013	0.0044			
* Denotes MDC																					
† Contamination Suspected																					

TABLE 3-12

Cont'd

Parameter (mg/L) Diss. (D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES / Date of Sampling	GROUNDWATER WELL No. 3																
	7/6/77	21/6/77	6/7/77	20/7/77	4/8/77	30 / 11 / 77		8 / 6 / 78		22 / 8 / 78		12/ 06 / 79		12/7/80		21/10/80	
						D	T	D	T	D	T	D	T	DISS	TOTAL	DISS	TOTAL
Boron (B)	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.66	0.87	0.69	0.81	0.3		0.7		0.2	
Chloride (Cl)	7.4	7.5	7.3	7.4	7.7		7.8		20		11	11			13.8		5.75
Fluoride (F)	0.105	0.134	0.134	0.133	0.135		0.127		0.12		0.11	0.119			0.120		0.115
Sulfate (SO_4)	1400	1300	1360	1280	1300		3800		1500		1800	1700			1900		1300
Total-Kjeldahl-Nitrogen (N)																	
Nitrate-Nitrogen (NO_3 -N)												1.5			0.09 unpres		0.08
Nitrite-Nitrogen (NO_2 -N)												<0.005			0.027 unpres		0.016
Total-Orthophosphate-Phosphorus (P)																	
Dissolved-Total PO_4 Phosphorus (P)	0.038	0.035	0.046	0.034	0.048	0.024		0.018		0.013		0.035			0.025		0.069
COD																	
TOC	97	102	101	80	61		28		70		95		91	78			39
Phenol																	
Total Hardness ($CaCO_3$)	983	991	924	987	842		1173		1180		1161	1024			1140		---
Total Alkalinity ($CaCO_3$)	464	506	538	572	586		458		562		646		277		551		551
BOD_5																	
D.O.																	
% Saturation																	

TABLE 3-12

Cont'd

Parameter / Date of Sampling	GROUNDWATER WELL No. 3										
PHYSICAL DATA (mg/L)	7/6/77	21/6/77	6/7/77	20/7/77	4/8/77	30/11/77	8/6/78	22/8/78	12/6/79	12/7/80	21/10/80
pH (units)	7.8	7.3	7.2	7.3	7.3	7.8	7.8	7.3	7.9	7.4	7.6
Specific Conductance (umhos/cm @ 25° C)	3000	3000	2970	3030	3030	3380	3600	3815	3730	3200	2920
True Color (Pt-Co Units)										62	---
Turbidity (NTU)								560		5.7	---
Temperature (°C)											
Total residue	2871	2877	2845	2851	2846	3246	3770	3364	4350	3400	4000
Filtrable residue	2710	2730	2700	2690	2740	3050	3280	3185	3150	2800	2300
Non-filtrable residue	161	147	132	161	106	196	490	179	1200	600	1700
Fixed total residue											
Fixed filtrable residue											
Fixed non-filtrable residue											

TABLE 3-13

GROUNDWATER ANALYSES - STEELE BROS. WELL

STEELE BROS. GWW

Date of Sampling / (mg/L) Parameter Dissolved (D), Total (T) - CATIONS	19/11/80 TOTAL	TRIVALENT	19/11/80 DISS
Aluminum (Al)	<0.2		<0.01
Arsenic (As)	<.005	<.005	
Cadmium (Cd)	<0.02		<0.01
Calcium (Ca)			82.7
Chromium (Cr)	<0.01		<0.01
Copper (Cu)	.080		.041
Iron (Fe)	.05		.04
Lead (Pb)	<0.02		<0.01
Lithium (Li)	.005		.005
Magnesium (Mg)			64.6
Mercury (Hg)(ug/l)	0.5		
Molybdenum (Mo)	<0.04		<0.02
Nickel (Ni)	<0.01		<0.01
Potassium (K)			3.66
Selenium (Se)	<.001		---
Sodium (Na)			11.3
Strontium (Sr)	.47		---
Vanadium (V)	<0.2		<0.1
Zinc (Zn)	.009		.129
Manganese (Mn)	<0.005		<0.005
Silver (Ag)	<0.01		<.005
Cobalt (Co)	<0.02		<0.01
Antimony (Sb)	<0.2		<0.1
Uranium (U)	0.0046		---

TABLE 3-13

Cont'd

Date of Sampling / Parameter			STEELE BROS. GWW																		
PHYSICAL DATA (mg/L)	19/11/80																				
pH (units)	8.1																				
Specific Conductance (µmhos/cm @ 25° C)	640																				
True Color (Pt-Co Units)	---																				
Turbidity (NTU)	---																				
Temperature (°C)																					
Total residue	580																				
Filtrable residue	556																				
Non-filtrable residue	24																				
Fixed total residue																					
Fixed filtrable residue																					
Fixed non-filtrable residue																					

TABLE 3-13

Cont'd

Date of Sampling (mg/L) Parameter Diss. (D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES	19/11/80 DISS				STEELE BROS. GWW																
Boron (B)	<0.1																				
Chloride (Cl)	5.98																				
Fluoride (F)	0.141																				
Sulfate (SO_4)	183																				
Total-Kjeldahl-Nitrogen (N)																					
Nitrate-Nitrogen (NO_3 -N)	0.26																				
Nitrite-Nitrogen (NO_2 -N)	<0.005																				
Total-Orthophosphate-Phosphorus (P)																					
Dissolved-Total PO_4 Phosphorus (P)	0.033																				
COD																					
TOC	<2																				
Phenol																					
Total Hardness($CaCO_3$)	---																				
Total Alkalinity($CaCO_3$)	271																				
BOD_5																					
D.O.																					
% Saturation																					
NH_3 (as N)	0.39																				

This well is in an aquifer about 12 m deep. The samples were collected in special sterile bottles supplied by the South Central Health Unit. The samples were sent to the Health Branch in Vancouver for analyses.

The results of the total and faecal coliform tests on Hat Creek samples are presented in Table 3-14.

Coliform bacteria were not detected in any of the monthly samples from the camp well.

The coliform levels in Hat Creek were variable but were generally higher during the warmer months. The December 1980 sample, which had higher coliform levels than normal at the station near Highway 12, may have been affected by runoff into the creek as temperatures were above freezing the week the sample was collected. The variable coliform levels in Hat Creek probably result from runoff from livestock grazing areas throughout the valley. According to provincial and other drinking water standards the waters of Hat Creek are not acceptable for human consumption without treatment.

3.6 WASTE COAL LEACHATES

During the Bulk Sample Program in 1977 two leachate collectors, made of plastic liners and perforated pipes, were placed on sloped ground near the Trench A excavation. A large pile of coaly waste material, which covers about 1050 m^2, was placed on one leachate collector and low grade coal, covering about 280 m^2, was placed on the other collector. Since 1978 the volume and physical-chemical characteristics of leachate from these two waste material piles has been determined. This monitoring programme was continued during 1980. From the spring thaw in March until December the daily volume of leachate was measured and pH and conductivity were determined. An unpreserved sample of leachate from the coaly waste pile was collected and sent for analyses on 8 July. On 20 October a second sample of coaly waste pile leachate was

TABLE 3-14

HAT CREEK COLIFORM SURVEY RESULTS

Date	Coliform Count - MPN/100 mL			
	Near Lehman Ranch		Near Highway 12	
	Total	Faecal	Total	Faecal
1979				
14 Oct	79	49	27	8
19 Nov	16	16	16	16
1980				
22 Jan	23	23	23	13
19 Feb	33	17	33	7
16 Mar	2	<2	5	2
14 Apr	46	21	17	7
19 May	170	110	140	140
16 Jun	79	79	170	79
14 Jul	130	49	110	70
18 Aug	-	-	240	130
17 Sep	79	33	350	79
21 Oct	34	11	22	8
17 Nov	17	11	17	5
17 Dec	33	23	240	23

collected and preserved before it was sent for analyses. These samples were analysed at the B.C. Hydro research and development laboratory in Surrey. The volume of leachate from the low grade coal pile was not sufficient to provide samples for detailed analyses (see Table 3-17).

The daily volume of leachate that flowed from each waste pile and the pH and conductivity of the leachate are presented in Table 3-15. Leachate began to flow from the coaly waste pile during the spring thaw in early April 1980. The daily volume of leachate collected during April, May and June was relatively constant at about 30 L/d. Near the end of June the daily volume of leachate from the coaly waste pile began to increase and reached a peak in mid July when over 100 L/d was collected. This increase is probably related to the abnormally high rainfall that occurred in early June and continued through most of the month. The monthly rainfall in June 1980 was almost five times the normal level. From mid July until the end of the year the leachate volume gradually decreased. Unlike previous years the leachate did not stop with the onset of freezing temperatures. During December about 40 L/d was collected. However, the early winter was mild with above freezing temperatures and rain during December.

The total volume of leachate collected from the coaly waste pile during the year was 14 300 L, more than ten times the volume collected during 1979. This volume represents over four percent of the precipitation which fell on the pile during the year. In 1979, the volume of leachate collected from the coaly waste pile was about 0.9 percent of the volume of rain which fell onto the pile. The reasons for this large increase are not evident. The pH and conductivity of the leachate were relatively constant throughout the year and were similar to values measured during 1979. The average 1979 and 1980 data are shown in Table 3-16. The leachate was clear and yellow in colour as it was in previous years.

TABLE 3-15

LEACHATES FROM COALY WASTES AND LOW GRADE COAL PILES

Date		Coaly Waste			Low Grade Coal		
Feb 1980	Rain mm	Volume mL	pH	Conductivity µmhos/cm	Volume mL	pH	Conductivity µmhos/cm
1							
2							
3							
4		0			0		
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15		0			0		
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26	1.4						
27	2.6	Bucket			0		
28	0.4	Over-					
29		turned			2 500	3.60	-
Feb.	4.4	?			2 500		

COMMENTS: Feb 26, 27, 28 : overnight temperatures about 0°C and daytime temperatures above freezing.

TABLE 3-15 - (Cont'd)

Date		Coaly Waste			Low Grade Coal		
March 1980	Rain mm	Volume mL	pH	Conductivity µmhos/cm	Volume mL	pH	Conductivity µmhos/cm
1		?			0		
2		0			2 300	3.60	
3		0			0		
4		0			0		
5		50	-	-	2 000	3.85	
6		0			20	-	
7		trace			trace	-	
8		0			0		
9		0			20	-	
10		0			120	3.70	
11		0			150	3.65	
12		0			20	-	
13		0			trace	-	
14		0			0		
15		0			0		
16		0			0		
17		0			0		
18		0			0		
19		0			0		
20		0			20	-	
21		0			150	3.80	
22		trace			470	3.75	
23		trace			550	3.70	
24		0			120	3.90	
25		0			50	-	
26		0			20	-	
27		0					
28		0			430	3.75	
29		160	3.65	-	120	3.80	
30		0			0		
31	2.0	0			0		
			3.65			3.75	
March	2.0	210			6560		

TABLE 3-15 - (Cont'd)

Date April 1980	Rain mm	Coaly Waste Volume mL	pH	Conductivity µmhos/cm	Low Grade Coal Volume mL	pH	Conductivity µmhos/cm
1		0			0		
2		0			0		
3		0			0		
4		0			0		
5	1.8	4 900	3.60		1 110	3.70	
6		7 700	3.60		100	3.70	
7		8 300	3.80		70	-	
8	0.4	10 500	3.70		100	3.65	
9		10 550	3.80		80	4.10	
10		12 400	3.95		70	3.90	
11		14 400	3.95		50	-	
12		16 400	3.95		50	-	
13		18 650	4.05		50	-	
14		20 000	4.00		50	-	
15		22 000	3.90		50	-	
16		>21 700	3.90		40	-	
17		>22 000	4.00		30	-	
18		27 200	3.90		30	-	
19		27 650	4.00		40	-	
20	0.4	>28 100	4.05		50	-	
21		31 150	4.15		50	-	
22		31 550	4.10		50	-	
23		32 050	4.15		50	-	
24		31 950	4.15		55	-	
25		32 650	4.20		50	-	
26		29 350	4.15		40	-	
27		28 700	4.10		30	-	
28	2.4	32 300	4.15		30	-	
29		31 700	4.15		30	-	
30		31 550	4.15		30	-	
			3.98			3.81	
April	5.0	>585 400			2 335		

COMMENTS: > indicates that the collection bucket overflowed and the exact volume could not be determined.

TABLE 3-15 - (Cont'd)

Date May 1980	Rain mm	Coaly Waste Volume mL	Coaly Waste pH	Coaly Waste Conductivity µmhos/cm	Low Grade Coal Volume mL	Low Grade Coal pH	Low Grade Coal Conductivity µmhos/cm
1		31 800	4.10		30	-	
2		32 100	4.10		30	-	
3		31 600	4.10		30	-	
4		32 150	4.10		30	-	
5		31 350	4.10		30	-	
6		31 300	4.05		40	-	
7		29 350	4.00		30	-	
8		30 050	4.05		30	-	
9	4.6	30 350	3.90		30	-	
10		30 050	3.95		40	-	
11	1.0	29 000	3.90		30	-	
12	0.2	27 900	3.95		30	-	
13	1.2	28 350	3.95		45	-	
14	4.0	28 000	3.95		45	-	
15	2.6	33 700	3.90		30	-	
16		34 650	3.90		160	3.85	
17	0.2	34 600	3.90		200	3.85	
18		26 900	3.95		190	4.35	
19		26 350	3.60		180	4.20	
20		26 850	3.80		170	4.45	
21		26 100	3.80		150	4.50	
22	1.4	26 350	4.05	6 200	140	4.20	4 900
23	0.4	26 150	3.80	6 000	130	3.80	4 280
24		24 900	3.75	5 500	110	3.70	4 460
25	3.0	24 350	3.65	6 000	100	3.90	4 760
26	0.4	24 850	3.65	5 200	90	3.60	3 830
27	7.0	22 450	3.80	5 200	80	3.90	2 780
28	1.6	26 050	3.90	5 200	90	3.90	3 160
29	2.4	25 350	3.90	5 100	70	-	-
30		26 100	3.90	5 300	60	-	-
31	9.6	25 100	3.85	4 900	50	-	-
			3.91	5 460		4.02	4 030
May	39.6	884 150			2 470		

COMMENTS: > Collection bucket overflowed.

TABLE 3-15 - (Cont'd)

Date		Coaly Waste			Low Grade Coal		
June 1980	Rain mm	Volume mL	pH	Conductivity µmhos/cm	Volume mL	pH	Conductivity µmhos/cm
1	0.6	23 650	3.85	5 600	530	3.85	3 080
2	5.4	24 800	3.85	5 500	1 810	3.90	3 190
3	11.0	23 850	3.85	5 600	1 180	3.85	3 180
4	22.0	23 900	3.85	5 600	4 620	3.90	2 980
5	6.2	-	-	-	12 800	3.85	3 090
6	4.4	23 250	3.90	5 100	12 710	3.80	3 050
7	1.5	24 900	3.90	4 900	>14 900	3.90	3 420
8	2.2	25 150	3.85	5 000	9 400	3.85	3 400
9		22 650	3.90	4 700	3 020	3.90	3 230
10		23 300	3.80	5 200	2 140	3.75	3 420
11		>14 300	3.90	4 830	1 570	3.85	3 150
12		>21 000	3.80	5 100	1 330	3.80	4 070
13		22 450	3.75	5 200	1 060	3.80	3 620
14	3.4	22 800	3.80	5 000	850	3.90	4 020
15		23 350	3.70	5 200	770	3.70	4 020
16	26.8	23 250	3.75	5 100	700	3.70	3 700
17	3.0	>17 500	3.55	5 000	14 700	3.60	3 090
18		27 400	3.65	5 100	17 400	-	-
19		32 050	3.60	5 200	5 650	-	-
20		30 500	3.55	5 300	5 500	3.60	3 280
21	12.0	31 850	3.60	5 200	3 300	3.60	3 480
22	3.6	35 750	3.70	5 100	2 300	3.65	3 480
23		36 200	3.75	5 200	1 850	3.70	3 310
24		37 850	3.75	5 100	1 550	3.70	3 510
25	1.8	39 150	3.70	5 400	1 250	3.65	3 880
26	1.2	40 300	3.80	5 100	1 100	3.70	3 230
27	0.2	41 400	3.80	5 300	860	3.70	3 710
28	4.6	43 050	3.70	4 720	670	3.60	3 210
29	2.0	48 250	3.85	5 100	310	3.75	3 780
30		51 200	3.90	5 100	2 020	3.80	3 140
			3.77	5 160		3.76	3 420
June	111.9	>890 000			>127 940		

COMMENTS: > Collection bucket overflowed.

TABLE 3-15 - (Cont'd)

Date July 1980	Rain mm	Coaly Waste Volume mL	Coaly Waste pH	Coaly Waste Conductivity µmhos/cm	Low Grade Coal Volume mL	Low Grade Coal pH	Low Grade Coal Conductivity µmhos/cm
1		>55 000	3.90	5 000	1 040	3.75	3 780
2		>55 000	4.05	5 200	990	3.75	3 880
3		64 000	4.00	5 300	740	3.80	3 800
4		63 250	4.05	5 200	760	3.75	3 730
5		>40 000	4.00	5 300	520	3.70	3 820
6		>56 000	4.00	5 600	600	3.75	4 050
7		>63 000	3.90	5 100	570	3.75	3 750
8		>78 000	3.75	4 890	540	3.60	3 700
9		81 200	3.75	5 200	520	3.60	3 630
10	3.4	83 700	3.80	5 200	480	3.60	3 920
11	1.2	85 500	3.80	4 870	480	3.60	3 570
12	0.2	89 200	3.95	5 000	440	3.70	3 620
13	1.8	89 700	3.80	6 200	390	3.70	4 400
14		91 200	3.90	5 000	370	3.70	3 690
15	0.6	93 200	4.10	6 000	350	3.65	3 910
16	2.8	93 000	3.90	5 800	340	3.70	4 050
17		101 000	3.95	6 100	270	3.70	4 100
18	5.4	91 300	3.95	6 000	210	3.70	4 170
19		95 200	3.95	5 700	280	3.70	4 370
20		92 100	3.95	5 400	240	3.75	4 390
21		94 800	3.80	5 700	200	3.65	4 200
22		93 400	3.80	5 600	190	3.60	4 460
23		93 500	3.75	5 800	180	3.65	4 710
24		93 700	3.80	6 100	160	3.60	4 690
25		92 500	3.75	5 900	150	3.60	4 960
26		92 400	3.80	5 700	150	3.70	4 700
27		93 100	3.70	5 700	140	3.60	4 280
28		91 400	3.75	5 300	130	3.65	4 340
29		91 100	3.85	5 600	110	3.60	4 420
30		90 400	3.80	5 200	90	3.60	4 180
31		85 600	3.90	5 600	70	3.60	4 030
			3.88	5 490		3.67	4 110
July	15.4	>2 572 450			11 700		

COMMENTS: > Collection bucket overflowed.

TABLE 3-15 - (Cont'd)

Date		Coaly Waste			Low Grade Coal		
Aug 1980	Rain mm	Volume mL	pH	Conductivity µmhos/cm	Volume mL	pH	Conductivity µmhos/cm
1		91 800	3.90	5 400	60	3.70	3 600
2	7.8	93 000	3.85	5 300	60	3.75	4 340
3		90 900	3.85	5 500	7 600	3.65	3 960
4	6.4	91 000	3.80	5 700	2 750	3.60	4 080
5	2.2	86 500	3.80	4 490	1 670	3.60	3 590
6		87 000	3.80	5 900	1 100	3.65	4 270
7		85 000	3.80	5 500	800	3.60	4 000
8	0.2	85 600	3.85	4 980	680	3.60	3 620
9	3.0	85 000	3.75	5 200	670	3.60	4 040
10	1.2	83 400	3.80	5 300	610	3.65	3 930
11	1.4	81 900	3.75	7 100	560	3.60	4 980
12	0.2	81 500	3.80	6 000	490	3.60	4 320
13	0.2	80 400	3.70	5 600	470	3.55	3 980
14		80 900	3.70	5 600	400	3.55	4 410
15	0.4	82 900	3.80	6 000	340	3.55	4 380
16	2.0	74 800	3.80	6 000	310	3.70	4 250
17	4.4	77 600	3.80	5 900	290	3.60	4 530
18		76 500	3.80	5 900	310	3.60	4 480
19		76 000	3.75	5 600	250	3.60	4 550
20		76 200	3.75	5 900	180	3.65	4 250
21		75 800	3.70	7 000	150	3.60	5 200
22		74 700	3.70	6 000	130	3.60	4 720
23		74 400	3.70	5 900	110	3.60	4 620
24		74 300	3.75	5 300	90	3.60	3 790
25		73 200	3.75	5 700	70	3.60	4 110
26		73 100	3.70	5 800	60	3.70	3 920
27	6.2	73 400	3.75	5 100	40	3.70	-
28	T	73 300	3.80	5 900	30	3.65	-
29	0.6	71 900	3.80	5 800	90	3.65	4 160
30	0.6	70 600	3.80	5 800	90	3.70	4 010
31	1.6	72 900	3.80	5 900	70	3.70	4 300
			3.78	5 720		3.63	4 220
Aug	38.4	2 475 500			20 530		

COMMENTS:

TABLE 3-15 - (Cont'd)

Date Sept 1980	Rain mm	Coaly Waste Volume mL	Coaly Waste pH	Coaly Waste Conductivity µmhos/cm	Low Grade Coal Volume mL	Low Grade Coal pH	Low Grade Coal Conductivity µmhos/cm
1	4.0	71 900	3.80	6 000	50	3.70	
2	5.2	70 900	3.70	5 200	40	3.70	
3		71 200	3.70	5 100	450	3.55	4 090
4		70 300	3.75	5 300	520	3.60	3 820
5		70 400	3.70	4 310	350	3.60	3 490
6	1.6	69 400	3.80	5 500	250	3.65	4 380
7		69 300	3.65	5 800	170	3.55	4 250
8		69 000	3.70	6 200	130	3.75	4 910
9		68 800	3.65	6 000	90	3.65	4 920
10		68 800	3.65	6 200	70	3.60	4 760
11	5.8	68 700	3.70	6 000	50	3.80	
12	6.8	68 000	3.75	6 100	250	3.70	4 410
13	5.8	65 900	3.75	6 000	2 640	3.70	4 530
14	0.2	67 700	3.75	6 000	4 210	3.70	4 410
15		67 600	3.75	6 200	2 310	3.65	4 560
16		67 100	3.65	6 200	1 400	3.65	4 530
17		66 500	3.60	6 800	1 010	3.60	4 930
18		66 400	3.60	6 200	770	3.60	4 550
19		65 600	3.65	5 900	650	3.60	4 240
20		65 700	3.65	5 400	510	3.60	4 010
21		65 700	3.60	5 600	410	3.60	4 230
22		65 100	3.70	5 400	320	3.65	4 000
23		64 800	3.70	5 200	280	3.65	3 880
24		64 900	3.70	5 200	230	3.60	3 980
25		65 100	3.60	5 000	210	3.55	3 820
26		64 600	3.65	6 400	140	3.60	4 610
27		62 800	3.65	6 300	130	3.60	4 720
28		64 200	3.65	6 200	120	3.65	4 420
29		65 600	3.65	6 200	100	3.60	4 530
30		62 900	3.65	6 300	80	3.60	4 780
			3.68	5 807		3.64	4 360
Sept	29.4	2 014 900			17 940		

COMMENTS:

TABLE 3-15 - (Cont'd)

Date Oct 1980	Rain mm	Coaly Waste Volume mL	Coaly Waste pH	Coaly Waste Conductivity µmhos/cm	Low Grade Coal Volume mL	Low Grade Coal pH	Low Grade Coal Conductivity µmhos/cm
1		63 800	3.70	6 100	70	3.70	-
2		63 400	3.65	5 900	50	3.65	-
3		63 700	3.60	5 800	40	3.65	-
4		63 500	3.65	4 800	30	3.65	-
5		63 100	3.60	6 800	20	-	-
6		63 300	3.65	6 100	20	-	-
7		63 000	3.60	6 200	20	-	-
8	5.2	63 100	3.60	5 800	20	-	-
9		62 800	3.65	4 930	10	-	-
10		62 200	3.60	5 200	50	3.70	-
11	1.0	62 600	3.60	5 300	40	3.70	-
12		63 000	3.60	5 300	40	3.75	-
13	0.6	62 400	3.60	5 400	30	3.70	-
14		61 800	3.60	5 800	20	-	-
15		62 000	3.60	5 300	10	-	-
16		61 700	3.60	5 100	T	-	-
17	1.4	62 000	3.60	5 400	0		
18		61 400	3.60	5 700	0		
19	1.8	61 000	3.60	5 600	0		
20	3.0	61 200	3.60	5 300	0		
21	1.8	61 000	3.60	5 300	0		
22		61 100	3.60	5 500	0		
23		60 700	3.60	5 500	0		
24		60 400	3.55	5 500	0		
25		60 200	3.60	5 300	0		
26		60 000	3.60	5 500	0		
27		59 800	3.60	5 400	0		
28		59 700	3.60	5 500	0		
29		59 600	3.60	5 600	0		
30		59 600	3.55	5 600	0		
31	0.2	59 100	3.55	5 600	0		
			3.60	5 553		3.68	
Oct	15.0	1 912 200			470		

COMMENTS: T - Trace

TABLE 3-15 - (Cont'd)

Date Nov 1980	Rain mm	Coaly Waste Volume mL	Coaly Waste pH	Coaly Waste Conductivity µmhos/cm	Low Grade Coal Volume mL	Low Grade Coal pH	Low Grade Coal Conductivity µmhos/cm
1	T	58 800	3.55	5 500	0		
2		58 400	3.60	5 600	0		
3	1.0	58 100	3.60	5 600	0		
4	T	57 900	3.55	5 800	0		
5	0.6	58 000	3.55	5 700	0		
6	3.0	57 700	3.50	5 000	0		
7		57 500	3.55	5 300	0		
8		57 200	3.55	5 400	0		
9		57 300	3.55	5 200	0		
10		57 200	3.60	5 100	0		
11		57 100	3.60	5 100	0		
12		>54 000	3.60	5 200	0		
13		>54 000	3.60	5 400	0		
14		>54 700	3.60	5 300	0		
15		>54 300	3.60	5 600	0		
16		>53 400	3.60	5 800	0		
17		>53 700	3.55	5 300	0		
18		>53 200	3.50	5 600	0		
19		53 600	3.60	5 700	0		
20	3.4	53 900	3.55	5 700	0		
21		53 100	3.55	5 600	0		
22		>52 400	3.50	5 500	0		
23		>50 200	3.55	5 800	0		
24		>54 300	3.55	5 800	0		
25		>54 100	3.60	5 700	0		
26	4.0	>54 200	3.60	5 800	0		
27	1.0	>54 900	3.60	5 600	0		
28		50 700	3.60	5 800	0		
29		51 200	3.60	5 500	0		
30		>51 500	3.60	5 400	0		
			3.57	5 513			
Nov	13.0	>1 646 600					

COMMENTS: 28 cm of snow accumulated during month.
> Collection bucket overflowed.

TABLE 3-15 - (Cont'd)

Date		Coaly Waste			Low Grade Coal		
Dec 1980	Rain mm	Volume mL	pH	Conductivity μmhos/cm	Volume mL	pH	Conductivity μmhos/cm
1		48 000	3.60	5 200	0		
2		45 000	3.55	5 500	0		
3		41 000	3.50	5 800	0		
4		39 000	3.50	6 200	0		
5		39 000	3.55	6 300	0		
6		49 000	3.55	7 100	0		
7		37 000	3.55	6 700	0		
8		40 000	3.55	5 800	0		
9		48 700	3.55	6 100	0		
10		42 400	3.60	5 800	0		
11		43 400	3.60	5 200	0		
12		42 400	3.55	5 200	0		
13		43 200	3.55	5 400	0		
14		45 200	3.55	5 500	0		
15		46 100	3.50	5 700	0		
16		45 600	3.55	5 800	0		
17		45 700	3.55	5 800	trace	-	-
18		47 200	3.50	5 800	0		
19		47 600	3.55	5 800	0		
20		47 100	3.60	5 800	0		
21		N.D.	N.D.	N.D.	0		
22		45 000	3.55	5 800	0		
23		43 000	3.50	6 100	0		
24		41 800	3.60	5 600	0		
25		45 800	3.80	6 100	0		
26	10.0	43 200	3.60	5 800	0		
27		N.D.	N.D.	N.D.	0		
28		44 000	3.65	4 210	0		
29		46 500	3.65	4 210	100	3.75	7 500
30	T	44 700	3.55	5 200	180	3.65	7 200
31	1.0	43 600	3.65	4 870	1 050	3.80	4 340
			3.57	5 669		3.73	6 347
Dec	11.0	>1 300 000			1 330		

COMMENTS: Snow accumulated to 30 cm to 7 December and then melted. On 31 December there was 16 cm of snow accumulation.

N.D. - No date.

TABLE 3-16

AVERAGE CHARACTERISTICS OF COAL WASTE LEACHATES

Year	Rainfall mm	Coaly Waste Volume mL	Coaly Waste pH --	Coaly Waste Conductivity µmhos/cm	Low Grade Coal Volume mL	Low Grade Coal pH --	Low Grade Coal Conductivity µmhos/cm
1979	130	1 245	3.9	∿5 500	66	3.9	--
1980	300	14 300	3.8	5 550	194	3.7	4000

The results of physical-chemical analyses of the leachates from the coaly waste pile are presented in Table 3-17. The trace metals and other cations showed a general increase in the 1980 results. Copper, lead and zinc levels were significantly higher than in previous years.

In 1980 the samples were analysed at the B.C. Hydro research and development laboratory and by Beak Consultants Limited in previous years. A comparison of surface water analytical results for these two laboratories was carried out in 1978. The results from the two laboratories compared favorably, although the B.C. Hydro results tended to be higher than those from Beak. In 1979 and 1980 commercial fertilizers were added to the revegetation test plot on the coaly waste pile. The cation concentrations in the leachate may have been influenced by these chemical additions.

During March daytime temperatures were often above freezing and leachate from the smaller low grade coal pile began to flow in March, one month earlier than from the coaly waste pile. The volume of leachate from the low grade coal pile generally followed the level of rainfall more closely than the larger coaly waste pile. The daily volume of leachate from the low grade coal pile was very high during the heavy rains in June. The flow of leachate stopped in mid-October when freezing temperatures occurred, except for a small amount during the warmer temperatures in December. The total volume of leachate

TABLE 3-17

ANALYSES OF LEACHATES FROM COALY WASTE PILE

(mg/L) Parameter Dissolved (D), Total (T) - CATIONS / Date of Sampling	28/4/78	9/6/78 Diss.	9/6/78 Total	23/8/78 Diss.	23/8/78 Total	24/5/79 Diss.	24/5/79 Total	24/8/79 Diss	24/8/79 Total	27/8/79 Diss	27/8/79 Total	8/7/80 DISS	8/7/80 TOTAL	8/7/80 TRIVALENT	20/10/80 DISS	20/10/80 TOTAL	20/10/80 TRIVALENT
				SURFACE WATER - COAL WASTE LEACHATE													
Aluminum (Al)	2.9	3.4	3.3	9.7			24	8.2		7.3			<0.1		24.0	24.7	
Arsenic (As)	<0.005	<0.005	<0.005	<0.005			0.007		0.007		0.008	<.005		<.00	<.005		<.005
Cadmium (Cd)							<0.005	<0.01		<0.01			0.03		0.01	0.03	
Calcium (Ca)	760	720	720	800			800	500		460		460			508		
Chromium (Cr)	<0.010	<0.010	<0.010	<0.010			<0.01	<0.02		< 0.02		0.04			0.02	0.03	
Copper (Cu)	0.034	0.034	0.034	0.044			0.025	0.016		0.012		0.088			.115	.115	
Iron (Fe)	0.30	0.13	0.37	0.38			0.56	0.10		0.09		0.43			.40	.40	
Lead (Pb)							<0.01	< 0.02		<0.02		0.19			.11	.15	
Lithium (Li)	0.17	0.19	0.13	0.24			0.26	0.09		0.09			.388		.321	.347	
Magnesium (Mg)	580	570	570	550			550	440		420		940			635		
Mercury (Hg)(ug/l)	<0.25	<0.25	<0.25				<0.25		<0.25		<0.25						
Molybdenum (Mo)							0.050	0.006		0.010			<0.04		<0.02	<0.04	
Nickel (Ni)	0.10	0.052	0.053				0.098	0.080		0.084		0.17			0.17	0.18	
Potassium (K)	30			20			27	12		12		34.7			26.7		
Selenium (Se)	<0.003	<0.003	<0.003	<0.003			<0.003	<0.003		<0.003		<0.001			<.001	<.001	
Sodium (Na)	240	190	190	190			170	130		130		165			132		
Strontium (Sr)	1.8	3.5	1.5	3.6			2.3	1.3		1.1		4.77			4.20	4.24	
Vanadium (V)	0.042	0.033	0.018	<0.04			0.23	0.020		0.018			<0.2		0.1	<0.2	
Zinc (Zn)	0.057	0.089	0.089	0.13			0.17	0.12		0.11			.153		.293	1.41	
Beryllium								<0.0003		<0.0003							
Manganese								2.4		2.2		6.72			6.84	7.02	
Uranium								0.00020		0.00010		0.0070			0.0100	0.0110	
Thorium								0.32		0.18							

TABLE 3-17

Cont'd

(mg/L) Date of Sampling Parameter Diss.(D), Total (T) ANIONS, ORGANIC, CALCULATED VALUES	SURFACE WATER - COAL WASTE LEACHATE														
	28/4/78	9/6/78		23/8/78		24/ 5 / 79		24 / 8 / 79		27 / 8 / 79		8 / 7 / 80		20 / 10 / 80	
		Diss.	Total	Diss.	Total	Diss	Total	Diss	Total	Diss	Total	DISS	TOTAL	DISS	TOTAL
Boron (B)	0.2	0.2	0.23	0.44			0.2	0.2		0.3		*2.2		*1.6	
Chloride (Cl)	15		15		11	10		5.4		5.5			10.6		8.42
Fluoride (F)			0.097		0.096	0.238		0.209		0.250			0.34		0.43
Sulfate (SO_4)	3800		4300		2900	5600		2300		1900			3300		3000
Total-Kjeldahl-Nitrogen (N)															
Nitrate-Nitrogen (NO_3 -N)						450		380		420			220 unpres		82
Nitrite-Nitrogen (NO_2 -N)						0.090		<0.003		<0.003			0.298 unpres		0.042
Total-Orthophosphate-Phosphorus (P)															
Dissolved-Total PO_4 Phosphorus (P)			<0.003	0.010		<0.003		<0.003		0.003			<0.004		0.059
COD															
TOC			395		430				257		290		---		292
Phenol															
Total Hardness($CaCO_3$)	4290		4140		4261				3100		2900		5020		---
Total Alkalinity($CaCO_3$)	56		23		<0.5				<0.5		<0.5		<0.5		<0.5
BOD_5															
D.O.															
% Saturation															

* Carmine method,
others Curcumine method

TABLE 3-17

Cont'd

Parameter / Date of Sampling		SURFACE WATER - COAL WASTE LEACHATE																			
PHYSICAL DATA (mg/L)	28/4/78	9/6/78 Diss.	9/6/78 Total	23/8/78	24/5/79	24/8/79	27/8/79	8/7/80	20/10/80												
pH (units)	5.6		5.2	4.3	4.0	4.1	3.9	4.2	4.0												
Specific Conductance (μmhos/cm @ 25° C)	7100		7500	7080	6830	5490	5580	6000	5520												
True Color (Pt-Co Units)								270	---												
Turbidity (NTU)			32	4.0		30	33	2.6	---												
Temperature (°C)																					
Total residue			9231	8097	8510			8900	7700												
Filtrable residue	8190		8960	8058	7210	6130	6320	8700	7100												
Non-filtrable residue	22		271	39	1300	263	260	200	600												
Fixed total residue																					
Fixed filtrable residue																					
Fixed non-filtrable residue																					

collected during the year was 194 L, about three times that collected during 1979. This volume was about 0.2 percent of the rainfall that fell on the pile, the same ratio that was recorded in 1979.

The average pH and conductivity of the leachate from the low grade coal pile were 3.7 and 4000 μmhos/cm respectively. The leachate was clear and colourless as in previous years. Physical-chemical analyses were not carried out on the leachate from the low grade coal pile during 1980.

3.7 MERCURY SAMPLING

Mercury is an important trace element with respect to potential environmental contamination. The minimum detectable concentration (MDC) in the procedure normally used for analysis of the Hat Creek environmental programme water samples is 0.25 μg/L. During 1980 selected surface water samples were analysed using a more sensitive analytical procedure that had a MDC of 0.05 μg/L. Commencing in May, monthly samples were collected for special mercury analyses.

Samples were collected from two sites; in Hat Creek about 2 km upstream of the confluence with the Bonaparte River, and in the Bonaparte River about 2 km upstream of Hat Creek. The samples were collected and preserved by B.C. Hydro personnel using special equipment and preservatives supplied by the provincial Ministry of the Environment, Environmental Laboratory in Vancouver. The samples were taken 7.5 to 15 cm below the surface. Total samples were preserved with 6 percent potassium dichromate and 6 percent concentrated sulphuric acid. Samples for dissolved mercury analyses were filtered through 0.45 micron filters before preserving chemicals were added. The samples were analysed at the Ministry of the Environment laboratory in Vancouver.

The results of these mercury analyses are presented in Table 3-18. Only five of the 32 samples analysed had mercury concentrations that were greater than 0.05 μg/L, the MDC, and those five were close to the MDC. All four of the November samples had mercury levels greater than the MDC. Though whether this observation is real or an artifact of sampling and/or analytical procedure is in doubt. Overall, the results show that the mercury concentrations at these locations in Hat Creek and the Bonaparte River are very low.

TABLE 3-18

SURFACE WATER MERCURY ANALYSES

Date Sampled 1980	Mercury Concentration in μg/L			
	Hat Creek		Bonaparte River	
	Total	Dissolved	Total	Dissolved
12 May	*	*	*	*
11 June	0.07	*	*	*
13 July	*	*	*	*
11 August	*	*	*	*
15 September	*	*	*	*
14 October	*	*	*	*
18 November	0.06	0.06	0.05	0.05
17 December	*	*	*	*

* less than the minimum detectable concentration (MDC) of 0.05 μg/L.

SECTION 4.0 - METEOROLOGICAL AND AIR QUALITY MONITORING

In 1974 B.C. Hydro established a network of meteorological stations in the Hat Creek region to collect data for the initial project development studies. Since 1977 additional meteorological and air quality monitoring stations have been established to better define and document local atmospheric conditions. Collection of this information was continued during 1980 by the Environmental Services Section, Operations Group. An inventory of the meteorological and air quality monitoring program is presented in Table 4-1. These data, which are collected by B.C. Hydro and various consultants, have been reduced, varified and assembled by the Environmental Services group and are available from their files.

TABLE 4-1

B.C. HYDRO METEOROLOGICAL AND AIR QUALITY INVENTORY

NO.	STATION NUMBER	STATION NAME	LATITUDE ° '	LONGITUDE ° '	ELEVATION m	PERIOD OF RECORD BEGIN YR MO	END YR MO	HOURLY WEATHER	CLIMATE REPORT	TEMP-DRY BULB	TEMP-DEW POINT	TEMP-DIFF.	HUMIDITY	PRECIPITATION	RATE/RAINFALL	WIND-DIR.&SPD	WIND-BIVANE	WIND-U.V.W.	VISIBILITY	PRESSURE-BARO.	SUNSHINE	EVAPORATION	SNOW COURSE	SO_2	O_3	NO_x	CO	PARTICULATE	DUSTFALL	SULPHATION	FLUORIDATION	CORROSION
	HAT CREEK - METEOROLOGICAL																															
1	116531	Highway 12	50 50	121 33	760	1974 11		X		X			X			X																
						1977 06																						X				
						1979 07																							X	X		X
						1979 08																									X	
2	116532	Junction	50 48	121 36	838	1974 11		X		X			X			X																
						1977 05																						X				
						1979 07																							X	X		X
						1979 08																									X	
3	116533	Marble Canyon	50 49	121 38	853	1974 11		X		X			X			X																
						1979 07																							X	X		X
						1979 08																									X	
4	116534		50 46	121 35	960	1974 11	1979 05	X		X			X			X																
						1979 07																							X	X		X
						1979 08																									X	
5	116535	Airstrip	50 45	121 37	1006	1974 11	1977 10	X		X			X			X																
6	116536	Cornwall Mountain	50 45	121 27	2027	1975 03		X		X			X			X																
						1977 01																	X									
						1979 07																							X	X		X
						1979 08																									X	
7	116537	Trachyte Hills	50 47	121 32	1400	1974 12	1979 05	X		X			X			X																
						1978 02	1978 07	X		X	X			X																		
8	116538	Pavilion Mountain	50 59	121 42	2088	1975 02	1979 05	X		X			X			X																
						1977 11		X		X			X			X																
						1979 08																							X	X	X	X
	116541	Hygrothermograph A	51 45	121 35	969	1974 12	1975 03	X		X			X																			
	116542	Hygrothermograph B	51 46	121 34	1067	1974 12	1975 03	X		X			X																			
	116543	Hygrothermograph C	51 46	121 34	1195	1974 12	1975 03	X		X			X																			
	116544	Hygrothermograph D	51 46	121 33	1295	1974 12	1975 03	X		X			X																			
	116545	Hat Creek Climate Station	50 45	121 35	899	1974 11		X	X	X			X	X																		
	HAT CREEK - AIR QUALITY TRAILERS																															
	1	Plant Site	50 47	121 32	1460	1978 07		X		X	X	X		X	X																	
						1978 08														X												
						1979 07																							X	X		X
						1979 08																									X	
						1979 09																X										
		10m Tower	50 47	121 32	1470	1978 07		X		X	X																					
						1978 08		X								X																
		100m Tower	50 47	121 32	1560	1978 07		X		X	X					X																
	2	Valley Trailer	50 45	121 36	975	1977 08		X		X	X					X			X									X				
						1977 10		X																	X	X						
						1977 11		X						X										X								
						1978 07		X													X											
						1979 07																							X	X		X
						1979 08																									X	
	3	Mobile	50 49	121 20	466	1977 05																						X				
						1977 08		X		X	X					X			X													
						1977 10		X																X	X	X	X					
						1979 07																								X		X
						1979 08																							X		X	
	HAT CREEK - MISCELLANEOUS																															
		A. Parke's Ranch				1976 07	1977 11	X		X	X										X											
		Merry Lake	50 47	121 33	1372	1977 01																	X									
		Hydro Camp				1977 05	1977 11																					X				
		Milner's Ranch				1977 04																						X				
		Pavilion	50 55	121 49	1235	1978 01																	X									

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