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SAM GOOSLY PROJECT
STAGE II: DETAILED ASSESSMENT

PREPARED FOR

EQUITY MINING CORPORATION
VANCOUVER, B.C.

September, 1976

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A REPORT FOR:

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SEPTEMBER, 1976

TABLE OF CONTENTS

Page

MAPS

DRAWINGS

TABLES

FIGURES

1.0 SUMMARY

The proposed Sam Goosly project encompasses the construction and operation of a medium sized open-pit mine and flotation mill in the Bulkley-Nechako district of west-central British Columbia. Project construction and preproduction stripping is proposed for 1976 and 1977 with full production of 4,800 TPD commencing in 1978. Operation life is presently estimated at 25 years.

The deposits are primarily copper, silver, gold and antimony with stripping ratio for total reserves of 2.1:1. The mill involves conventional flotation processes with a closed-cycle tailings pond system and an ancilliary water supply system. Flotation circuit concentrate is further treated in a roast/leach circuit prior to shipment.

Access to the project site from the nearest community, Houston, is via a new 23 mile road following the Dungate Creek Valley. During construction, the estimated peak work force of approximately 250 men will reside on-site whereas the operative work force of approximately 200 individuals will become part of the community of Houston.

Biophysically, the project site lies within an area of dissected plateau with broad open valley. Regional elevations range between 2,000 and 5,000 feet with the deposits situated at 4,300 feet. The majority of the area is forested, generally with alpine fir, Engelman spruce and white spruce. Land capability and present use focuses on cuttable timber and wildland complex with capabilities usually of moderate or low potential. Moose and deer are the predominant wildlife of the area.

The site straddles two watersheds, Buck Creek to the west and south-west and Foxy Creek to the northwest. Both systems are of relatively minor resource value with regards to magnitude of flows. Limnologically they are typical of cold, northern British Columbia water-courses with low levels of chemical constituents; the predominance of sensitive benthic invertebrates and, in sections where upstream movement is unhindered, the presence of anadromous and resident fish species.

Considering the socio-economic aspects of the project site, the nearest community is the district municipality of Houston which lies on the Yellowhead Highway about half way between Smithers and Burns Lake. Houston's history has been one of 'promise unfulfilled' since several major development proposals by various forestry and mining industries remain unrealized. In anticipation of rapid expansion, the town was recently developed to service a population of 5,000 - twice its present size. Thus local residents are eager for an industrial development that would provide alternative employment opportunities and create a more economically viable community.

The Sam Goosly project contains the potential for both positive and negative environmental impacts and, for the latter case, specific mitigative activities have been developed. Regarding land resources, increased erosion potential will require mitigation activities such as the planned winter construction of the utilities corridor and both on-site and off-site revegetation programs. Potentially major impacts on the region's water resources again relate to erosion processes and concomitant stream siltation. Mitigative measures focus upon revegetation programs and the control, diversion and treatment of surface waters. Considering air resources, scrubbers are provided in the concentrate roasting circuit and within the concentrate drying circuit a wash cycle is provided in order that residual reduced sulphur compounds are removed prior to drying.

The reclamation program will be a major mitigation measure involving research, experimental revegetation and long term reclamation. The program will, most importantly, be an on-going program of the development such that disturbed areas may be revegetated with appropriate methods and species concomitant with their becoming inactive.

It is evident that the Equity project will have major social and economic impacts on the Houston community, necessitating local expansion and mitigative measures. In particular, mitigation actions relating to available housing could be a major requirement for the municipality of Houston. A major positive aspect of the development is the expansion of the industrial base within the Houston area with the benefit of long term employment and the impact of this on the Houston economy. On the basis of recent historical developments it would appear that Houston would be receptive to a project of this nature and magnitude. Indeed the Equity project could greatly assist the community in realizing its desire to become a social and economic hub of activity within the Bulkley-Nechako region.

2.0 INTRODUCTION

An integral component of any major resource development is the preparation of an environmental impact assessment encompassing the biophysical impact and the socio-economic impact of the proposed development on existing environmental conditions. As a general rationale for the preparation of such documents, it is considered important that environmentally sensitive areas be identified and that actions are taken in the planning stages to mitigate identified adverse interactions. The foundation of the assessment is a functional integration of engineering, environment and economics.

Within Canada, provincial and federal government regulatory agencies have been formed and modified to implement policies regarding the compatibility of our environment and resource development. As a specific rationale for the preparation for environmental assessments, policy implementation has necessitated the establishment of procedures dealing with permits, approvals and evaluations from government agencies. Thus, within the framework of the Province of British Columbia this report has been prepared at the request of the Department of Mines and Petroleum Resources for distribution to other government agencies.

This report consists of three major sections: a description of the development, a description of existing environmental characteristics and an assessment of the environmental impact in light of mitigation procedures recognized and implemented. Each major section of documentation or assessment is further divided to consider firstly, the biophysical aspects and secondly, the socio-economic and community aspects.

This document is one of a series that have been presented to government agencies during 1975 and 1976 - i.e., specifically the Sam Goosly Project - Information Summary (October 1975) and the Preliminary Environmental Impact Study of the Proposed Sam Goosly Project (February 1976). With respect to the project description section, these previous submissions by Equity Mining Capital Limited have been used as major references. Where appropriate, aspects of the development have been updated or modified to reflect any recent changes and certain details presented in the previous documents are not repeated herein.

To date, licenses and permits for which Equity Mining Corporation have applied include:

DEPARTMENT OF MINES AND PETROLEUM RESOURCES

	Date applied	Proof of Advertising	Date issued
1. Notice of Intention to Apply for Mining Lease.	July 16/76		July 29/76
2. Affidavit on Application for Mining Lease.	Sept. 24/76	Sept. 24/76	
3. Sand & Gravel Reclamation Permit G 243.	Sept. 3/76		Sept. 13/76
4. Reclamation Permit for Sam Goosly Project.	March 8/76	May 14/76	
5. Environmental Impact Study Information Summary (Prospectus).			October '75
6. Preliminary Environmental Impact Study.			February '76
7. Detailed Environmental Impact Study of the Sam Goosly Project.			September '76
8. Approval of mining Plan and operating method.	March 15/76		May 3/76

DEPARTMENT OF ENVIRONMENT LANDS SERVICE

	Date applied	Property Inspection	Date issued
1. Plant Site Land Lease Application.	March 16/76	June 1976	

WATER RESOURCES SERVICE
WATER RIGHTS BRANCH

	Date applied	Proof of Advertising	Date issued
1. Application for Water License (Lu Lake).	March 29/76	NA	
2. Application for Water License (East branch of Lu Creek).	March 29/76	NA	
3. Application for a Permit Over Crown Land under Section 23 of the Water Act.	March 29/76	NA	
a) Lu Creek (Tailing Impoundment).			
b) (Unnamed Creek - Plant Site Drainage Pond).			
c) Southern Tail Pit - Run-off Drainage Pond.			
4. Acquisition of Approvals for Water Diversions.			
a) Lu Creek-Foxy Creek Diversion.	March 24/76	NA	
b) Buck Creek Diversion.	March 24/76		

	Date applied	Proof of Advertising	Date issued
5. Acquisition of Approval of the Water Act. (Access Road Culvert Details).	May 29/76	NA	
6. Acquisition of Approval (Washing Aggregate).	Aug. 31/76	NA	

POLLUTION CONTROL BRANCH

	Date applied	Proof of Advertising	Date issued
1. Application for Permit under the Pollution Control Act, 1967 (Effluent -Closed Circuit Tailing Impoundment).	March 27/76	May 14/76	
2. Application for Permit under the Pollution Control Act, 1967 (Emissions-Plant Site).	March 27/76	May 14/76	
3. Application for Permit under the Pollution Control Act, 1967 (Effluent -Sewerage Lagoon).	March 27/76	May/76	
4. Application for Permit under the Pollution Control Act, 1967 (Refuse -Domestic Garbage).	March 27/76	May 14/76	
5. Approval (Effluent-System for Aggregate Washing).	Aug. 31/76	NA	

DEPARTMENT OF FORESTS:

	Date applied	Proof of Advertising	Date issued
1. Special-Use Permit (Access Road).			May 18/76
2. Special-Use Permit (Aggregate Gravel Pit).	Aug. 26/76	NA	

3.0 DESCRIPTION OF PROJECT

The proposed Sam Goosly project is the construction and operation of a medium sized open-pit mine in west-central British Columbia (Map 1). The general operating plan (Figure 1) will include mining operations involving two open pits, a mill processing unit, and infrastructure consisting of a closed-circuit tailings pond system and a utility corridor from Houston.

Overall, the process of flow involves a mine, crushers, grinders, concentrator, and leach plant. A schematic process flow chart with particular reference to products and emissions is provided in Figure 2.

The proposed development schedule is provided on Figure 3. Provided that the necessary approvals are obtained, new road construction will commence in 1977, and shortly thereafter power line construction.

By using the existing road, the construction camp would be moved to the property and the plant site would be excavated and concrete foundations would be started by 1977. It is anticipated that the new road would be serviceable for the movement of structural steel for buildings in 1977 and in 1978. The construction pace would be increased with startup of the plant estimated to occur in mid 1978.

Production from the open-pit mine would have to commence approximately five months in advance of the plant in order to remove sufficient waste rock from the southern tail pit to ensure a constant supply of ore once the plant is operational. The overall development timing is based on the contractor's capabilities and on starting the plant during reasonable climatic conditions.

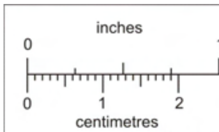
Ultimate land requirements for the proposed operation amount to approximately 1,800 acres (Figure 4). The area to be occupied by the various facilities during the first three years of production is estimated to be 815 acres:

MAP I:

LOCATION OF SAM GOOSLY DEPOSIT

SCALE

MILES 100 0 100 200 300 MILES



Facility	Acres
Pits and Bench Access Roads	85
Waste Dump and Low Grade Ore Stockpile	109
Plant Site and Construction Camp	46
Tailing	145
Initial Process Water Supply	66
Fresh Water	4
Access Road and Powerline	360
Total	815

The total area to be occupied during the probable duration of the operation is estimated to be approximately 1,800 acres:

Facility	Acres
Pits and Bench Access Roads	150
Waste Dump and Low Grade Ore Stockpile	278
Plant Site	46
Tailing and Process Water Supply	939
Fresh Water	4
Access Road and Powerline	360
Total	1,777

The sequence of events for the overall project development are currently envisioned as follows:

1976-1977	Construction and preproduction stripping
1978-1985	Production from southern tail at 3,200 TPD
1986-2001	Main zone production at 3,700 TPD
2002 onward	Production from low-grade stockpiles, underground ore or new open-pit reserves.

In conjunction with exploration, environmental studies, metallurgical research and preliminary design and feasibility studies, procedures have commenced for the application of necessary licenses and permits. To date, applications have been submitted to the Pollution Control Branch, Water Rights Branch, Department of Mines and Petroleum Resources, Forest Service and Land Service.

Aspects of environmental control have been integrated into the planning phases of the development via site surveys, discussions with government agencies and metallurgical research. Thus, an integral component of the project description is the proposed environmental control measures.

3.1 Mining

The Sam Goosly mineral deposits were discovered by Kennco Explorations (Western) Ltd. in 1968 following a regional geochemical survey. Subsequent soil sampling and geological interpretation provided the initial drill target. In 1973 the property was optioned by the present operators.

The economic metals occurring in the deposit are copper, silver and gold (Cu, Ag, and Au). Common metallic minerals in the mineralized zones are chalcopyrite (Cu, Fe), tetrahedrite (Cu, Fe, Sb) and pyrite (Fe) with minor amounts of magnetite (Fc), hematite (Fc), sphalerite (Zn), pyrrhotite (Fc), galena (Pb) and arsenopyrite (Fe, As). The principle copper mineral is chalcopyrite which accounts for approximately 60 percent of the recoverable copper. A much smaller but significant portion of the extractable copper is in the form of tetrahedrite. The tetrahedrite carries most of the recoverable silver.

Unlike most B.C. copper producers, the Sam Goosly mineralization is complex and contains a variety of elements in variable proportions. Analyses of typical composites submitted for metallurgical test work revealed the following distribution of elements:

Element	Southern Tail	Main Zone
Copper %	0.39	0.66
Silver oz/ton	4.08	4.10
Gold oz/ton	0.04	0.026
Lead %	0.08	0.045
Zinc %	0.20	0.118
Arsenic %	0.56	0.073
Antimony %	0.13	0.126
Bismuth %	0.01	0.020
Cadmium %	0.002	< 0.001
Mercury ppm	0.7	0.10
Silicate %	46.9	44.4
Sulphur %	4.4	4.47

The proposed operating plan is to commence production for the Southern Tail deposit at an average rate of 3200 TPD, increasing to 4800 TPD in year two. Production from the main zone deposit would commence during operating year seven and would go beyond year 25. Subsequent production would come from low grade stockpiles or new reserves.

The primary reasons for commencing production from the Southern Tail deposit are to take advantage of its better metallurgy compared to the main zone, good metal recoveries and the lower concentrate production costs. The commencement of mining on the Southern Tail is scheduled for 1977. Initial production will be on day shift only until operators and crew are trained. Between 1977 and 1978 about 686,000 tons of waste rock and 298,000 tons of ore will be mined. The ore will be stockpiled close to the primary crusher. Mining will continue in the southern tail zone for the first eight years of operation at a fairly constant production rate of 4.45 million tons/year or 12,500 TPD of ore and waste.

The proposed open-pit mining plans are generally comparable to existing operations in British Columbia. Thirty-three foot bench heights are planned with an overall pit slope of 1:1. A typical cross-section of the mine is provided on Figure 5. The ore will be mined by conventional open-pit mining methods utilizing shovels, trucks and bulldozers.

The stripping ratio of the Southern Tail is 2.3:1 and in the main zone 2.1:1 with an overall stripping ratio for total reserves of 2.1:1. Waste dumps would be developed on an upward slope of about 2% by dumping short and bulldozing over the edge. The outer edges would be terraced so as not to exceed a face height of 100 feet between benches. A cross-section of the waste dump is provided in Figure 6.

3.2 Processing

The principal processing facilities include primary crushing, secondary and tertiary crushing and screening, concentrating by grinding and flotation and a leaching plant. A plant layout is given in Figure 7.

Expansion of the processing facilities is planned for operating year eight coincident with a change from the Southern Tail ore-body to the main zone body in order to stabilize concentrate production. The date of expansion reflects a flow sheet change dictated by the mineralogy of the main zone ore. Because of the unusually fine grind required to liberate main zone minerals, through-put would drop by 50% if expansion to the grinding and flotation sections of the concentrator were not undertaken concurrent with main zone ore processing.

Initially, a gyratory-type primary crusher will be operated at an average of 3200 TPD. The bag-type dust collector will be provided and maintained to control dust emissions. The primary crusher is expected to operate only on eight hour shifts, but provision for 24 hour per day operation will be included. Coarse ore from the primary crusher will be reduced in size in subsequent secondary and tertiary crushers. Dust collection units in these systems will be both bag-type and wet-type depending on location. The crusher circuit will produce mill feed at about 20% plus 3/4 inch. Final grinding to approximately 55% minus 200 mesh will be performed in a single rod mill - ball mill circuit. The ground ore will then be directed to the flotation circuit.

Initially the concentrator will be operated at an average of 3200 TPD. The concentrator will be based on flotation techniques utilizing xanthate collectors, alcohol frothers and lime for pH control. It is predicted that concentrate from this facility for the southern tail and main zone will have the following grade range:

Anticipated Metal Content in Concentrate

Element	Southern Tail	Main Zone
Cu %	22	20
Zn %	3.0 - 7.0	3.9 - 5.9
Pb %	1.7 - 6.0	1.3 - 2.0
As %	2.0 - 4.8	0.3 - 0.5
Sb %	2.5 - 7.9	3.1 - 4.4
Bi %	0.30	0.2 - 0.4
S %	26.9 - 36.6	32
Si02	5.0 - 10.0	6.5
Fe	18.0 - 24.4	22.2 - 24.0

Within the concentrator facility air emissions from dust collectors and ventilation fans will occur. Mill tailings will be pumped from the concentrator as a 30 percent solids slurry. The pipeline route is such that any spillage resulting from a failure of the line would flow by gravity into the impoundment area. Plant and plant-site drainage will be directed to a collection pond equipped with a pumping installation.

The copper concentrate produced from the flotation circuits contains numerous impurities at levels higher than commonly found in British Columbia copper concentrates. In order to meet smelter specifications, concentrate roasting and leaching are necessary.

After filtering, the copper concentrate is given a neutral roast in an atmosphere of nitrogen and sulphur in order to convert arsenopyrite to a leachable form. The neutral roast was selected to avoid generating sulphur dioxide and oxides of antimony and arsenic. Roaster off-gases will be scrubbed and recycled to the roaster. Scrubber liquid effluent will be cycled to the leaching circuit. The capability of this technique has been demonstrated during pilot plant operation. The roaster is indirectly fired and thus the only air emissions will be the products of combustion from the gas furnace.

Roasted concentrate is then leached with sodium sulphide which removes most of the arsenic, antimony, mercury and some gold. The solids are filtered, dried and shipped as a copper concentrate. Dryer exhaust gases will be treated with a wet type dust collector.

Leach solution or filtrate, from the solids above, is passed to an evaporative crystallizer which separates most of the antimony and some arsenic in the form of a sodium thioantimonate/thioarsenate crystal. The crystal is retained in two six month storage bins for shipping or further processing.

Most of the mother liquor from the crystallizer is returned to the leaching circuit together with make-up sodium sulphide solution. Approximately 5% of the mother liquor is continually bled from the circuit in order to prevent an excessive buildup of antimony, arsenic, mercury and bismuth within the system. The bleed stream is acidified with concentrated sulphuric acid to precipitate these metals as insoluble sulphides which are then stored in an uncovered, impermeable residue pit.

The acidification stage is carried out in an air agitated pachuca vessel to ensure completion of the reaction. During the process, hydrogen sulphide is evolved and passes to an incinerator where it is converted to sulphur dioxide gas. The sulphur dioxide then passes to a packed tower scrubber where it is removed by means of a lime slurry which is pumped from the concentrator lime circuit. The scrubber effluent is recycled to the process while the solid material (gypsum) is sent to the residue pit. The clarified supernatant from the residue pit is directed to the tailings pond for assimilation into the recycled process water systems.

Marketing and metallurgical research will continue in an attempt to produce a saleable arsenic product, increase the antimony recovery and to recover the mercury in a saleable form. Every success in these objectives will reduce the volumes of residues.

3.3 Infrastructure

The support facilities required for a mining project at Sam Goosly include: a tailings pond, ancilliary water supply and reclamation systems and a utilities corridor from the plant site to Houston providing power and access.

3.3.1 Tailings Pond and Ancilliary Water Systems

The water supply and tailing impoundment area will be located in the immediate vicinity of the mine plant as shown on Figure 1. At the lower end of the broad open valley immediately north of the plant site a dam will be constructed reaching the ultimate height of 80 feet. The constructed pond will accommodate 33 million tons of tailings or 23 years production as currently planned. Tailings will be pumped to the impoundment area via a pipeline. An impervious till starter dam will be constructed to contain the tailings for the first 1.5 years. Dam building will be continued as required. A small dam and pumping station are planned downstream from the main tailing dam to recover and return any seepage.

The proposed tailings pond system will be a closed cycle in which concentrator process water will be reclaimed from the tailings pond. Freshwater usage is expected to be less than 500 USGPM. Fresh water use will be restricted to domestic services, cooling, steam plant and equipment seals. A water balance for the tailings and plant facilities is given in drawing 1.

The supply of makeup fresh water will be taken from the east branch of Lu Creek located to the northeast of the plant. Under normal conditions sufficient fresh water will be available from Lu Creek and Lu Lake to meet requirements. As a contingency measure to meet abnormal conditions, a small dam will be constructed near the outlet of Lu Lake to raise its water level several feet during spring run-off.

With regards to the tailing impoundment area proper, water balances developed from precipitation records, stream flow data and estimated plant requirements have shown that a minor net accumulation of water will occur in the tailings impoundment area. For this reason, diversion ditches are planned to minimize run-off water entering the system. Should a water shortfall develop due to evaporation or lower than expected run-off, the plant site drainage and pit drainage water would be added to the tailings pond system.

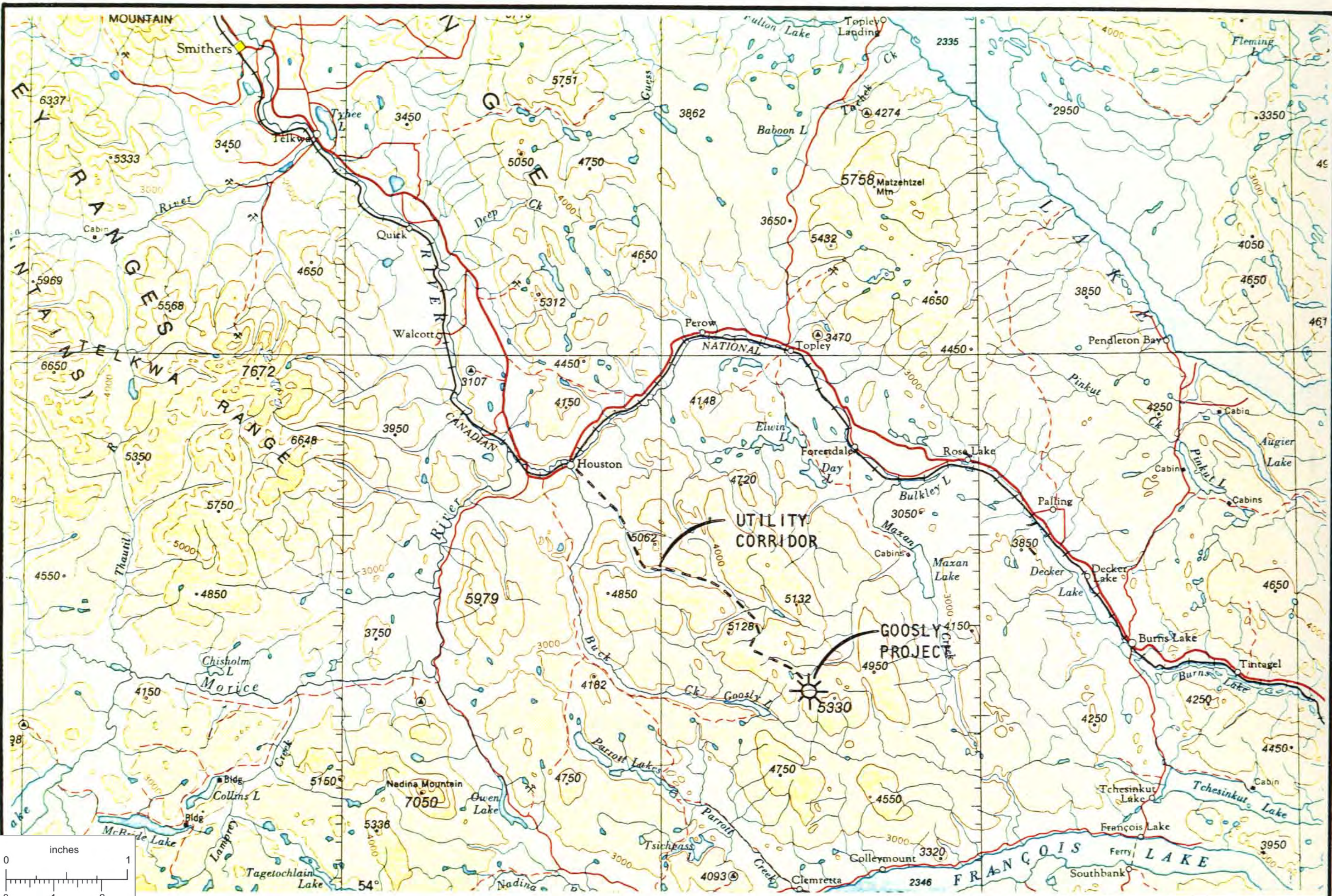
3.3.2 Utility Corridor

The proposed utility corridor will provide upgraded road access and hydro routes from Houston to the plant site. The proposed 23 mile road would follow the Dungate Creek Valley as given on Map 2. Detailed road and power line surveys were carried out over this route during the summer of 1974 and were reported as appendices in the Sam Goosly Project Information Summary (October 1975).

Current road access is via a 34 mile logging road which follows the Buck Creek Valley south of Houston. The road is a low class dirt standard with a bare minimum of gravelling. Up to mile 18.5 it is a marginal two lane road which includes two single lane bridges, beyond mile 18.5 it is generally single lane although vehicles can pass with care.

At present, a road exists along the proposed utilities corridor for the first sixteen miles. It is in poor condition and is travelled only by four-wheel drive vehicles, trail bikes and snowmobiles. At present, no road access currently exists between Klo Creek and Sam Goosly property - the last seven miles. The proposed gravel road is designed for 50 mph traffic with a 30 ft subgrade, two foot ditches. Clearing would be a minimum of 80 feet with additional clearing over most of the route as required for the hydro right-of-way. Grades throughout the route are not excessive and tangents of a mile or more are common (less than 8%). Estimated commuting time from Houston to the mine site is 30 minutes.

Initial power requirements have been estimated at 7700 kva. Subsequent expansion would increase the power consumption two or three fold. Power will be provided with a transmission line commencing at the Houston sub-station and following the proposed Dungate Creek Access road to the mine site.



MAP 2: HOUSTON ENVIRONS

BEAK	DATE	14/09/76
	PROJECT	J5058A
	DWG NO	

3.4 Social and Economic

The Sam Goosly mine is located approximately 20 miles southeast of the District Municipality of Houston, a relatively small town in the Bulkley-Nechako Region.

The proposed development of this mine will, as a result of direct employment opportunities (approximately 200 jobs) and those created through the "multiplier effect", increase Houston's present population of 2,500 by an estimated 875 over the next seven years. Although this development is not as significant as others within the region, it nevertheless will have substantial impacts in social terms on a town the size of Houston. Careful consideration of the projects' social and economic aspects is therefore warranted. These include such factors as employment, income generation, accommodation and community integration. Because the projects' two phases - construction and operation - involve quite different manpower requirements, they will be discussed separately.

3.4.1 Construction: Phase I

Employment

During the construction phase, employment opportunities in construction and operation activities will peak at approximately 270 (200 and 70 respectively).

The overall pattern of this employment will tend to approximate a bell-shaped curve as a result of intensified construction activity during the middle of Year 1. In terms of Equity Mining Corporation's direct involvement, construction activity during this phase includes construction of the plant site and ancilliary fresh and reclaimed water systems alone. It does not include construction of the tailings impoundment or proposed access route or the mine stripping and pre-production processes required to put the mine into operation. It is anticipated that these activities might add a maximum of 50 men above those involved in plant site construction.

The source of labour will be local as the supply holds and, in the case of the construction force, will be determined by hiring regulations imposed by affiliated unions. The operative force will, at this time, be composed mainly of company executives, supervisory and technical staff. These people will generally be from centers outside of the region, however some positions may be filled locally.

Income Generation

The potential income generated by the construction force is difficult to predict without specific information regarding the companies and unions involved in the various construction activities. In the case of workers employed in plant-site construction, Equity Mining Corporation expects wages (not including fringe benefits) to be in the order of $3,285,000. The operative work force will receive remuneration according to the following company guidelines:

Position	Gross Income	(a) Fringe Benefits	Total per Employee	(b) Disposable Income
Management	$28,000	$5,000	$32,000	$19,304
Supervisory	20,000	3,500	23,500	15,636
Trades	13,000	2,500	15,500	10,151

(a) Typical fringe benefits would include WCB, Silicosis and Accident, UIC, MSP Medical and Dental, Group, Accident, and Sickness Insurance, Holiday Pay, Canada and Company Pension Plans.

(b) Disposable income based on a married man with two children.

The phase one operative force will involve mainly executive and supervisory and staff. Total income generated for this group during Phase I, will be in the order of $1,500,000. ($915,000 disposable).

Accommodation

Most of the construction workers will live in the on-site camp facilities provided by Equity Mining Corporation. These will be designed to accommodate a maximum of 250 workers, and are intended to fulfill the accommodation requirements of workers associated with the construction of the new access road and tailings impoundment and the mine stripping and pre-production processes as well as plant-site construction.

Construction supervisors, workers with families, and the 70 permanent employees will likely seek accommodation in Houston, which is both the closest community to the mine site and the terminus of the new access road. A few workers may opt to live in Topley, Telkwa, Smithers, or Burns Lake, however commuting distances to these communities are generally considered restrictive. Travel distances, using the new 23-mile Dungate Creek route, are as follows:

Community	Commuting Distance (in miles)
Houston	23
Topley	36
Telkwa	53
Smithers	61
Burns Lake	67

For the purpose of this report it is assumed that the majority of permanent employees will elect to settle within the immediate vicinity of Houston.

In order to calculate the amount and kind of accommodation required by employees and their families during both phases of the project it is necessary to make assumptions regarding the nature of the incoming work force and their patterns of accommodation. These assumptions, based on information supplied by the proponent, Statistics Canada information for Houston and the Bulkley-Nechako region, and relevant studies and reports, are:

1. That Project Year 1 will be 1977.

2. That a maximum 5% of all employment opportunities created will be filled by local residents of the spouses of employees (therefore reducing overall demand for accommodation).

3. That at least 90% of the construction force will be housed in on-site camp facilities.

4. That the majority of the operative force will at commencement be single males, with a trend towards a higher percentage of married employees as the project progresses; and that the number of children per family will be minimal during the first few years, increasing towards the end of the project to the expected regional average of 1.5 (Gray, 1975).

To facilitate calculations trends have been standardized as follows:

Project Year	1	2	3	4	5	6	7
Percentage of married workers	35	40	45	50	55	60	65
Percentage of children per family	.5	.5	.75	.75	1.0	1.0	1.5

5. That the labour force:dependent population ratio will remain in the vicinity of 2:3 as indicated by the 1971 census figures for Houston (Statistics Canada, 1971) and that this ratio may be used to determine the number of dependents associated with married construction workers and secondary workers.

6. That the amount of accommodation required will be one unit for every 3.5 persons, in keeping with the current occupancy level in Houston and with predicted ratios for the Bulkley-Nechako region (Gray, 1975).

7. That the kind of accommodation required will parallel the present patterns of accommodation in Houston (i.e., 65% single family residential, 25% rental, and 10% mobile) with an adjustment made in the case of the direct work force only to allow for the higher proportion of single and transient workers as follows: 50% single family residential, 35% rental, and 15% mobile.

On the basis of these assumptions the following table may be derived:

PHASE I: HOUSING REQUIREMENTS

Construction force (less 5%)	190 (max.)
Dependents	30
Operative force (less 5%)	65
Dependents	40
On-site accommodation	250
Population requiring accommodation	155

UNITS OF HOUSING REQUIRED:	45
(Single family)	(20)
(Rental)	(15)
(Mobile)	(10)

Community Integration

During the construction phase, on-site amenities will include a cafeteria and an assembly room with pool tables, a shuffleboard and a small library. A safety crew and ambulance will be on-site at all times. It is expected that on-site workers will have a low level of integration with the community of Houston, particularly as the new Dungate Creek road will not be completed during Phase 1 and the present access road (Buck Flats) involves a 60 to 90 minute drive into Houston. Community contact will likely be limited to weekend excursions for personal shopping and entertainment.

Permanent employees, on the other hand, will integrate fully into the community, depending on it for accommodation and for the goods and services associated with every-day life.

3.4.2 Operation: Phase II

Employment

Upon completion of the construction phase approximately 130 operative workers (in addition to the 70 already on-site) will be required. A proposed expansion in year eight will involve short-term employment for approximately 30 construction workers and the creation of approximately 10 additional positions within the operative force.

The 200 employment opportunities within the operative work force are classified as follows:

Positions	Employees
Mine	43
Concentrator	21
Leach plant	21
Assaying	11
Maintenance	56
Office and warehouse	29
Other	13
Total	200

The corresponding skills required for these positions are:

Skills	Employees
Heavy equipment operators	39
Tradesmen (including 25 mechanics)	55
Mill and leach plant operators	24
Supervision and engineering	16
Office and clerical	21
Other skills	25
Unskilled	20
Total	200

During Phase II the source of labour will be determined by the availability of local workers with appropriate skills. In addition, training and apprenticeship programs in mine operation, mine rescue, and first aid will enable unskilled and semi-skilled workers to secure employment. It is expected that approximately 20 openings for women, mostly in the 'office and clerical' classification, will be available. As the minimum age requirement for mine-related jobs is 17 (18 for mining itself), the project should not deplete school enrollment, although it may provide summer employment opportunities for older students. Furthermore, as the wages to be paid to permanent employees are consistent with those of similar operations in the region, it is not expected that significant numbers of workers will be drawn from these sources.

Income Generation

Based on the remuneration guidelines previously discussed (see section 3.4.1) the Sam Goosly project may be expected to generate a total of approximately $2,750,000 per year in gross incomes and $2,100,000 in disposable incomes.

Accommodation

Permanent mine employees are expected to locate in Houston. There will be no on-site accommodation during Phase II. Equity Mining Corporation intends to encourage residence in Houston by offering employees attractive second and third mortgages, forgiven over a period of five years, to provide the initial down-payment on a home, condominium, or building lot, and thereby relieving workers of the necessity of depleting personal savings. Equity will also purchase approximately

15 homes for senior company employees and will, if necessary, aid in the financing of additional housing units. Construction of such housing will hopefully be undertaken by local developers.

According to the assumptions and formulae discussed, in Section 3.4.1 the following table of accommodation requirements may be derived:

PHASE II: HOUSING REQUIREMENTS

	Year 2	3	4	5	6	7
Construction force (less 5%)	-	-	-	-	-	-
Dependents	-	-	-	-	-	-
Operative force (less 5%)	190	190	190	190	190	190
Dependents	115	145	170	210	230	325
Total population	305	335	360	400	455	515
On-site accommodation	-	-	-	-	-	-
Population requiring accommodation	305	335	360	400	425	515
UNITS OF HOUSING REQUIRED	85	95	105	115	120	150
(Single Family)	(45)	(50)	(55)	(60)	(60)	(75)
(Rental)	(30)	(30)	(35)	(35)	(40)	(50)
(Mobile)	(10)	(15)	(15)	(20)	(20)	(25)

Community Integration

During the operative phase on-site amenities will be limited to lunchroom and coffee-bar facilities. The first aid crew and ambulance will continue to service the mine on a full time basis. It is expected that the operative force will integrate fully into the local community, depending on Houston (and to a lesser extent on Smithers and Burns Lake) for goods and services appropriate to their life style.

4

4.0 EXISTING ENVIRONMENTAL CHARACTERISTICS

Subsequent to the previous reports prepared for Equity Mining by Beak Consultants Limited, and the submission to the Department of Mines of the preliminary environmental impact study of the proposed Sam Goosly project in February of 1976, Beak Consultants Limited contacted the Resources Analysis Unit of the Environment and Land Use Secretariat (ELUS) as well as the Fish & Wildlife Branch and Regional Districts for updating on the initial Canada Land Inventory information.

The more extensive land capability information has been placed on a series of figures which specifically outline the proposed development area as well as the new utility corridor along Dungate Creek and Upper Klo Creek.

Utilizing as an overall guide the ELUC coal guidelines, the specific information available and relevant to the Goosly project has been broken down into major subdivisions, biophysical and socio-economic. Each of these major subdivisions are further divided to emphasize the relevant components of the biophysical and socio-economic settings.

A similar format subdivision into two major components will be continued into Section 5.0: Environmental Impact and Mitigation.

4.1 Biophysical

4.1.1 Land Resources

Soils and Land Forms

The Sam Goosly property is located approximately 30 miles (48 km) southeast of Houston, British Columbia, near Goosly Lake within an area of dissected plateau with broad open valleys. Regional elevations range between 2,000 and 5,000 ft. (610 and 1,525 m). The deposits are situated in an area of gentle relief at an elevation of 4,300 ft (1,310 m).

The Goosly property straddles the high point between the Buck Creek watershed and Foxy Creek (a tributary of the Maxan Creek watershed) and encompasses a variety of small streams. Several of these streams run northerly into the Foxy Creek basin and others run southerly towards Goosly Lake. The mine-mill complex will be located within both the Foxy and Buck Creek drainage areas. Both Foxy and Buck Creek flow in the Bulkley River system.

Proposed access to the Sam Goosly property is along the Dungate Creek Road. The existing road begins near Houston, B.C. (Mile 0) and ends at the point where it crosses Klo Creek (Mile 16). The road is currently in poor condition. No road access currently exists between Mile 16 and the mine-mill complex.

The proposed road to the Sam Goosly property, from Mile 0 to Mile 9, follows the lower Dungate Creek valley on the northern side of Dungate Creek, climbing 1,500 ft (457 m) at grades varying from 3 to 8%. At Mile 5, the proposed road would cross one of the Dungate Creek tributaries, and at Mile 9 would cross Dungate Creek itself.

The section of the proposed road from Mile 9 to 16 is essentially straight and flat as it traverses the broad open valley of upper Dungate and Klo Creeks. The proposed road crosses Klo Creek at Mile 16, having passed through a 3 mile section (Mile 13 to 16) of recent burned area.

The section of proposed road from Mile 16 to 20 passes through an area of dry ground and climbs steeply at grades of between 6 and 8% to Mile 19 where it reaches an elevation of 4,600 ft (1,402 m) and then descends back down into the Foxy Creek Valley. A substantial portion of this climb and subsequent descent is to circumvent a deep canyon between Miles 17.5 and 18.5. Between Miles 19 and 21, the proposed road would pass through an area of poorly-drained ground.

Between Miles 20 and 23, the road would drop slowly to the Sam Goosly property at 4,200 ft (1,280 m) elevation. The road would have modest grades and be essentially straight. At Miles 21 and 22.5, the road would cross Foxy Creek and Lu Creek, respectively.

The entire Dungate route as well as the mine site occurs in Class 7 soils which have no capability for arable culture or permanent pasture (Figure 8). The soils along most of the corridor are basal tills with severe climatic and topographic limitations.

The corridor passes through two areas where the soils would be subject to high erosion hazard and where careful management practices would have to be exercised (Figure 9). These are located in the Dungate Creek watershed, especially the upper watershed, as well as the middle Klo Creek watershed.

The majority of the Dungate corridor passes through an area of slight to moderate slope with the only area of potential concern being the upper Dungate area where the slope reaches above 30% (Figure 10).

The majority of the access corridor has only slight or moderate limitations due to the depth of soil to bedrock, with the Klo Creek and upper Dungate Creek areas having areas of less than three feet of soils. The Upper Dungate Creek area is the only area where exposed bedrock occurs (Figure 11).

Along the Dungate corridor poorly drained soils occur only in the Upper Klo Creek drainage with the rest of the route being either well-drained or moderately-well-drained (Figure 12).

Along the Dungage route the climax vegetation is generally alpine fir and Engelman spruce with white spruce occurring in the Upper Dungate drainage and along the Buckley Valley. The majority of the area is densely forested (Figure 13). Details on climate are contained in the section on Air Resources, especially precipitation and winds. The portion of the Dungate route and the Upper Dungate Creek to the mine has less than 30 frost-free days with the area dropping down into Buckley Valley increasing to 50 and 70 frost-free days respectively. The bulk of the area from a climatic standpoint is not suitable for agriculture crops (Figure 14).

Land Capability and Present Use

The existing information from the Resource Analysis Unit has been summarized into a single figure (Figure 15) which shows the generalized present land use within the Dungate utility corridor and surrounding the mine site. The majority of the area is in forest production with the next most important area being a wild land complex including all natural or semi-natural vegetation. The final component, agricultural use, is restricted to the Bulkley Valley.

Within the utility corridor, there are essentially two areas where the forest resource has been consumed, one in the vicinity of

Goosly Lake and to the south and west of the mine site which has been cut. The other is in the Middle Klo Creek drainage which was burned in a forest fire.

Of the seven land use capabilities suggested by the Environmental Land Use Secretariat, only three are of importance to the specific project and its proposed utility corridor.

1. Recreation

   The recreational potential of the corridor and the mine site is very low being Class 5 and 6 (Figure 16). The major advantage to this area would be increased access through the development of the utility corridor up Dungate Creek which would then allow access to the Upper Klo Creek drainage.

2. Forestry

   The access corridor goes through a mixture of Class 3, 4 and 5 from the forestry standpoint (Figure 17). The majority of the Dungate access route goes through areas of limited yield forestry with productivity ranging from 31 to 50 cu. ft/acre annually for the main commercial species. In the Dungate Creek drainage, the route is in an area of moderate limitation with a productivity of 71 to 90 cu.ft/acre/year.

3. Wildlife

   The Dungate access route, once it leaves the main Bulkley Valley, provides extensive summer range for moose and deer (Figure 18). The Upper Dungate Creek, Klo Creek Meadows and the burn on Klo Creek are used by moose as a late fall range. Snow depth severely limits the availability and hence use of these areas by wintering moose. As snow depths increase in the fall, the moose migrate late into either the Buck Creek or Bulkley Valleys.

   Mountain goats have been reported on Dungate Mountain to the north and east of Dungate Creek.

   The whole area is considered as having severe limitations for the production of waterfowl with the majority, save the Klo Creek Meadows, having such severe limitations that no waterfowl are produced (Figure 19).

4.1.2 Water Resources

Two watersheds encompass the region's water resources: Buck Creek and Foxy Creek. Both systems are minor components of the major regional water resource : the Bulkley River.

The Buck Creek system lies west and south-west of the development and includes Buck Creek, Goosly Lake, Klo Creek and Dungate Creek. Buck Creek itself joins the Bulkley River at the District Municipality of Houston.

The Foxy Creek system, the smaller of the two, lies northwest of the development and includes Lu Lake, Lu Creek and Foxy Creek. Foxy Creek itself joins Maxan Creek near Maxan Lake. Maxan Creek in turn enters the Bulkley system proper at Bulkley Lake.

The location of the regional water resources is displayed on Figure 22 and all other figures of similar format. The local sub-components of the Buck and Foxy systems are displayed on Figure 21.

Water Quantity

Due to the relatively minor resource value of the Buck and Foxy systems no long term historical flow records are available from the Water Survey of Canada. At the request of Equity Mining Corporation two flow monitoring stations (Figure 21) were established in 1974: Foxy Creek (#08EE015) and Lu Creek (#08EE016). Flow records from May 1974 to September 1975 are displayed in Figure 20. The units used are U.S. gallons x 10^6 per day (10^6 USGPD = 1.55 CFS).

Both creeks exhibit very similar flow regimes with the major proportion of annual flow occurring during freshet - May and June. For the remainder of the year flows are relatively low and constant.

Little information relating to the groundwater resources of the development area exists although the presence of artesian flows has been noted in two drill holes during the exploration phase of the development. One is located in the Buck system ("Camp" Creek) and the other in the Foxy system (Lu Creek).

To date, the major water license application on the Foxy Creek system is that of Equity Mining Corporation requesting approximately 500 IGPM (500 IGPM = 1.34 cfs) from the upper Foxy Creek area (Lu Lake).

Water Quality

The water quality of the Buck and Foxy Creek systems has been documented during the past three years by Beak Consultants and Environment Canada (EPS). Sampling points are denoted on Figure 21. To date the following water quality surveys have been conducted:

Date	Source	Comments
14 July 1973	EC (EPS)	primarily trace elements
25 July 1973	Beak	comprehensive
10 October 1973	Beak	comprehensive
13 October 1973	EC (EPS)	primarily trace elements
26 July 1974	EC (EPS)	comprehensive
May, June 1975	Beak	turbidity, non-filterable residue
12 May 1976	Beak	comprehensive

These surveys do not encompass the exact same water quality parameters. Nevertheless, the environmental rationale for each survey was identical and hence basic water quality parameters including trace elements have been well documented for the region. All results available to date are given in Appendix II. A summary of the available data by watershed is provided in Tables 1 and 2.

Both watersheds exhibit a number of similar physico-chemical characteristics and are in many ways typical of cold, northern British Columbia watercourses. Dissolved oxygen levels are close to saturation, pH is close to neutrality, nutrients are present in low levels and trace element concentrations are generally below or near levels of detection. Antimony, arsenic, chromium, lead, manganese, molybdenum, mercury, nickel and silver were not detected.

Dissolved iron levels fluctuated considerably within each watershed and were higher in the Buck Creek system. Mean values for the Buck and Foxy Creek systems were 0.22 mg/l and 0.09 mg/l respectively. At certain Buck Creek stations, specific samples exceeded the level "A" standard for iron (0.3 mg/l) set by the Pollution Control Branch for mine and mill effluents. All other recorded parameters in both systems were below level "A" standards.

Turbidity and non-filterable solids in the regions watercourses appear to be generally low in absolute levels and to exhibit minimal seasonal fluctuations. To date increased levels have been detected in two areas (cf. Table 3). Within the Buck Creek system the "Camp" Creek watershed encompasses the Sam Goosly exploration area and an area of recently cut timber (cf. Figure 15). The elevated fill level for "Camp" Creek may reflect exploration or logging activities. The elevated mean spring level shown for Lower Foxy Creek, near the confluence with Maxan Creek, most probably reflects erosion processes in Foxy Creek Canyon located between the Upper and Lower Foxy Creek areas.

The water quality of the two artesian wells in the area is considerably different than that of the natural watercourses (cf Appendix). The artesian flow within the Buck Creek system exhibited high iron and filterable residue levels. In addition arsenic and zinc levels were elevated in conjunction with lower pH. The concentration of these latter two elements was nevertheless below the Pollution Control Branch level "A" requirements of 0.50 mg/l and 0.05 mg/l respectively. No effect of this well on the Buck Creek system has been observed. The artesian flow within the Foxy Creek system had an exceedingly high filterable residue level and may account for slight differences in filterable residue levels noted in the headwater tributaries of Foxy Creek.

Benthos

Studies focusing on the benthos communities of water systems associated with the Equity development were undertaken by Beak Consultants Limited (Beak, 1974) and EPS (Hallem & Kussat, 1974). Beak established six stations near the Goosly property and sampled these in July and October 1973 (Figure 21). Data generated from these two survey periods function as baseline information for the structure of invertebrate communities prior to industrial development. Comparable surveys were performed by EPS at 11 stations during the months of July and October, 1973 (Figure 21).

Invertebrates living in or on bottom sediments have been used as indicators of adverse changes in aquatic environments because they display varying degrees of sensitivity to degradation in water quality (Hynes, 1958; Wilhm & Dorris, 1966 and 1968; Cairns & Dickson, 1971). Natural benthic communities are relatively stable or exhibit some predictability regarding oscillations in structure and composition. This phenomenon coupled with their respective sensitivities enables the use of benthic fauna as a biological measure of water conditions. Benthic invertebrate data enable the analysis of alternations in water quality over time. The existence of a given community at a given point in time is representative of water quality prior to (in terms of weeks or months) and during sampling periods. It is for this reason that biological sampling is undertaken in conjunction with chemical analyses which are considered time specific.

Since benthic organisms exhibit varying degrees of sensitivity to changes in the conditions of an aquatic environment, Beak (1965) has categorized benthos into three groups: those typical of clean water (pollution sensitive organisms - Group 3), moderately polluted waters (moderately tolerant of polluted waters - Group 2), or heavily polluted waters (pollution tolerant organisms - Group 1). This tolerance index is based not only on published scientific literature but also on years of practical experience in pollution studies.

The Group 3 organisms contain aquatic larval stages of insects which are sensitive to adverse changes in water quality and are the first to disappear if conditions deteriorate. Included in Group 3 are the mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera) and others. These organisms require clean water conditions such as high concentrations of dissolved oxygen, relatively swift currents, low turbidity and relatively low concentrations of toxic materials. Group 2 consists of a number of organisms such as leeches (Hirudinea), midges (Diptera), water mites (Hydracarina) clams (Pelecypoda) and others. These can tolerate a moderate amount of water quality degradation to varying degrees according to individual tolerance.

Group 1 organisms are tolerant of some toxic conditions and low concentrations of oxygen and will survive in an area where less tolerant organisms would be eliminated. Within this group, for example, are the Oligochaeta.

Although these groups are not rigid, it has been found for wide application that they form a useful classification in environmental studies.

The results of studies performed by Beak and EPS are summarized in Table 4 and Tables 5 and 6 respectively. Beak employed an abundance index for each major taxonomic order observed. Data collected by EPS were tabulated according to familial groups which Beak re-organized to illustrate "Groups" by order only. Data from

EPS are total numerical counts of three samples at each of the eleven stations.

Data interpretation by Beak and EPS resulted in essentially the same conclusions. In both survey programs, Group 3 (Ephemeroptera and Plecoptera) and Group 2 (Diptera) predominated sampled substrates. Beak did not observe any Group 1 organisms in the benthic samples; however, EPS collected a total of eleven organisms (Group 1) from the eleven sampling stations in July 1973 and one organism in October. The sampling periods of July and October resulted in comparable results for Group 3 organisms (i.e., July mean number per station = 133; October mean number per station = 123). A preponderance of Group 2 invertebrates was noted in July (mean number of organisms per station = 183) as compared to October (mean number of organisms per station = 67).

The representation of Groups 3 and 2 in EPS samples were of such a magnitude as to generate the ultimate conclusion that watercourses associated with the Goosly property were typical of undisturbed high altitude streams consisting of good water quality. The numbers of invertebrates collected would appear to indicate that adequate populations were available to provide a good source of food for resident fishes.

Fisheries

Two major water systems are associated with the Equity development. These include Buck and Maxan Creeks with their respective tributary systems.

Dungate and Klo Creeks and Goosly Lake drains into Buck Creek. Falls situated on Buck Creek approximately 6 miles upstream from Houston hinder movement of fish upstream. However, this barrier can be traversed during periods of high water. Fish species that have been found in Buck Creek are summarized in Table 7. Escapement records compiled by the Federal Fisheries & Marine Service for anadromous species entering Buck Creek date back to 1928. Relative abundance figures for resident species have not been determined. Table 8 summarizes the annual escapement surveys since 1948 with data from 1928 and 1929. Spawning areas for these species are scattered from the Bulkley River confluence to the impassable falls on Buck Creek. The Federal Fisheries & Marine Service have not observed steelhead in Buck Creek, however the B.C. fish and Wildlife Branch indicated that minor populations frequent this system.

The first major tributary of Buck Creek is Dungate Creek. Approximately 1 - 1.5 miles upstream from its confluence with Buck Creek, falls prohibit passage of fish further upstream. Consequently fish have not been recorded above this point. Below the falls, fish species comparable to Buck Creek have been observed (cf. Table 7). Relative abundance of populations in Dungate have not been established. The B.C. Fish & Wildlife Branch have indicated that the lower reaches of Dungate (below the falls) provide spawning and rearing habitat for trout and possibly salmon, however, use versus availability of habitat has not been ascertained.

Klo Creek the major tributory of Buck Creek supports large scaled suckers, prickly sculpins, largenose dace and rainbow trout. Documentation of the relative abundance of these species has not been undertaken. Fish habitat in the area of the proposed bridge crossing was considered good.

In August 1968, the B.C. Fish & Wildlife Branch collected a gill net sample from Goosly Lake. The catch included 74 redside shiners (*Richardsonius balteautus*), 49 peamouth chub (*Mylocheilus caurinum*), 22 longnose suckers, 12 rainbow trout, 8 largescaled suckers, 7 mountain white fish and 1 kokanee salmon (*O. nerka*). Inlets to Goosly Lake are seasonal and do not provide suitable spawning habitat. The outlet into Buck Creek was deemed as good spawning habitat. The presence of kokanee salmon may indicate limited use of Goosly Lake for spawning.

The Environment Protection service performed trace analyses on the fish tissue collected from two locations on Buck Creek. (Hallam & Kussat, 1974). Table 9 summarizes metal concentrations for copper, zinc and cadmium. Peamouth chub and rainbow trout were the fish species employed in the tissue analyses. The tests were also performed to ascertain the concentration of various chlorinated hydrocarbon pesticides. Over 9 separate pesticides were considered in these analyses. No pesticide residues were detected in any of the tissue samples.

Lu Lake, Foxy Creek and Maxan Lake empty into Maxan Creek. Maxan Creek supports a resident fish population consisting primarily of 7 species. These include redside shiner, squawfish, peamouth chub, largescaled sucker, longnose sucker, prickly sculpin, mountain white fish, rainbow trout and dolly varden char. Relative abundance figures in Maxan Creek are not available. Escapement of anadromous species compiled by the Federal Fisheries & Marine Service is presented in Table 10.

Maxan Lake was sampled in September 1973. Gill netting results are presented in Table 11. In addition to those species listed, rainbow trout and dolly varden char probably inhabit Maxan Lake although they were not collected (B.C. Fish & Wildlife Branch).

Foxy Creek was sampled approximately 1.5 miles from its confluence with Maxan Creek. Small rainbow trout and dolly varden char were collected. These data indicate that lower Foxy provides spawning and rearing habitat for these species. Two barriers exist along Foxy Creek which prevent migration of fish further upstream. These include a log jam approximately 5 miles upstream from the confluence with Maxan Creek and two falls approximately 15 miles upstream. No fish were observed or sampled above these locations on Foxy Creek.

Lu Lake was found to be barren of resident fishes (B.C. Fish & Wildlife Branch).

Data on recreational fishing in the water systems considered above are sparse; however, the B.C. Fish & Wildlife Branch indicated that there is limited use of Goosly Lake, Maxan Lake and Buck Creek. Success rates within each of these areas are not available.

4.1.3 Air Resources

The plant site is approximately two miles north east of Goosly Lake which is located in the north west/south east valley of Buck Creek. The site is at the 4,200 foot MSL level with mountain peaks in excess of 5,000 feet two miles to the east and four miles to the northwest of the plant. The general region of the plant is in the rain shadow of the Coast Mountains and Hazelton Mountains and is sheltered from the north by the Babine and Bait Ranges. The result of this topography is a relatively dry climate and generally light winds through the year.

Broad climatic characteristics with respect to precipitation are given in Figure 22. The plant, mine and utility corridor are predominately located in an area of 25 - 30 inches of precipitation annually. Spring and summer rainfall average 12 - 15 inches annually and snowfall averages 120 - 150 inches annually. Precipitation levels decline in the lower levels of the region's valleys. For example, precipitation data for nearby stations, Burns Lake - Decker Lake and Nadina River, indicate only about 20 inches of precipitation annually. This is comprised of 12 inches rainfall during the spring, summer and fall and 70 - 75 inches snowfall during the winter. Measureable precipitation occurs on 32% of days at Burns Lake - Decker Lake and 35% of days at Nadina River. Evaporation data for the Houston area indicate that evaporation from exposed water surfaces averages about 21 inches annually. (The National Atlas of Canada). The evaporation rate would be slightly less at the plant site due to elevation differences.

The nearest available anemometer records are for Burns Lake, approximately 25 miles ESE. While it is not known how representative of the plant area these records may be due to elevation and exposure differences, the data does provide a partial understanding of the region's air resources. Winds prevail from the south east, particularly in the fall, winter and spring, while in the summer they also prevail from the north west (Figures 23 and 24). Most significant is the very high frequency of calms. The display of percentage frequency of calms by hour shows that calms are frequent at all times, but particularly overnight and in the early morning in summer (Figure 25).

A recent study of ground based inversions in B.C. valleys (Emsley, 1976) gives the seasonal percentage frequencies for the area at two times of the day, late afternoon and early morning:

	% Frequency of inversions			
	Winter	Spring	Summer	Fall
P.M.	45	20	20	40
A.M.	65	70	80	65

Thus, early morning inversions are frequent in all seasons, but particularly in summer. Data on the strength and duration of the inversions are unavailable at this time.

4.2 Social and Economic Aspects

The district municipality of Houston is situated on the Yellowhead Highway about half-way between Smithers and Burns Lake in the Bulkley-Nechako region of B.C. Its recent history has been one of 'promise unfulfilled': several development proposals by various forestry and mining concerns have gone unrealized. In anticipation of promised social and economic expansion, the Houston community has developed the infrastructure and service capacity requisite for a population approximately twice its present size. The initial cost of this endeavour, coupled with continuing losses as a result of under-utilization have weakened the municipal budget considerably. This, in combination with the recent recession in the forestry industry and the concomitant softening of the regional and provincial economies, has engendered an atmosphere of quiet desperation in the town of Houston. Virtually every citizen is aware of the community's need for a new source of employment and economic activity.

The following discussion of Houston's present social, economic, and physical aspects provides some insight into the potential opportunities and problems that may be associated with future development.

4.2.1 Population

The 1971 census figures indicate that Houston had a population of 2,232. As of January 1976, Houston's estimated population was 2,500. Of this, the vast majority are Caucasian, of American or European descent. There are very few native Indians, and the closest reserve, at Topley, is over 30 miles away.

According to Gray (1975), Houston's population structure parallels the regional pattern with a high proportion (46%) of 0-19 year olds and a slight predominance of males (55%). It is anticipated that these proportions will diminish as the population increases, becoming 32% and 50% respectively, by 1991. Gray's population estimates for Houston, based on the age specific cohort-survival method and assuming no net migration, are as follows:

Year	Population
1971	2,232
1976	2,470
1981	2,671
1991	3,065

4.2.2 Employment

Unemployment is currently somewhat higher in the region west of Prince George than in the rest of B.C. Seasonal fluctuations in employment create a considerable degree of economic instability (workers and businessmen alike are hesitant to settle and invest in the area) which engenders additional employment problems. Houston's 1,500-man labour force has suffered considerably from the instability of employment. In 1973/74, the closure of Bradina Mine and Northwood's decision to return to a single-shift operation left many workers unemployed. Northwood's re-commencement of double-shift operations in January 1976 has helped to alleviate unemployment in the Houston area, however there is still a surplus of unskilled labour.

4.2.3 Economy

Over the past three years, Houston's municipal budget has been in the order of $900,000. Approximately 2/3 of its revenue is acquired through taxation and its largest expenditures are on administration, street and other municipal maintenance, and recreation and community services. As the Noranda Group of companies maintains substantial real estate holdings within the community as Bulkley Valley Forest Industries Limited and employs a large percentage of the local labour force at the Northwood Pulp Ltd. sawmill and the Bell Copper Mines, its impact on the municipal economy is substantial. Indeed Houston is virtually dependent on Noranda, and in particular on Northwood Pulp Ltd. Thus the recent softening of world lumber markets has, through its effects on Northwood's operations, had a decided effect on the municipal economy as well as on local employment.

4.2.4 Housing Development

According to a report by P.S. Ross & Partners (1975), Houston's 1974 Housing Inventory was as follows:

Type of Accommodation	Number of Units
Single family dwellings	411
Duplex suites	10
Fourplex suites	4
Town house condominiums	36
Apartment suites	100
Townhouse suites (rental)	69
Mobile homes	73
Total	703

A review of current listings (February 1976) with North Country Realty in Houston indicates that there are presently 5 homes, ranging from $14,000 to $30,000; 30 townhouse condominiums, approximately $20,000 each; several residential lots, approximately

$5,000 per lot; and at least one commercial property on the market. In addition there are approximately 35 lots (ranging from $6,500 to $8,000) in a new subdivision south of Hillside Drive, on the real estate market.

Rental (unfurnished) accommodation in Houston varies in price according to type as follows:

Type of accomodation		Price per month
Apartments:	bachelor	$123
	one bedroom	$142-158
	two bedroom	$160-176
Townhouses:	three bedroom	$199-204
	four bedroom	$212-217

There were no vacancies in January, 1976 although it is expected that some will be vacated later in 1976 as tenants relocate to homes under construction.

There are two trailer courts in the central area of Houston and one on the outskirts of town. The 'Ambassador' has 132 serviced lots, of which 62 are presently occupied, and an additional 200 undeveloped lots. Its 1976 rates are as follows:

Lot Type	Monthly Rental
Paved pad and drive	$54.00 & $11.25 municipal charges
Gravel pad and drive	$44.25 & $11.25 " "
Double lot	$59.00 & $11.25 " "

The 'Houston Trailer Court' has approximately 35 lots, of which 20 are occupied and 'Gerry's Trailer Court' (west of Houston) provides 40 lots, of which 30 are occupied. Rates at these two courts are slightly lower than those of the 'Ambassador.'

Hotel and motel accommodation in Houston is limited as a result of a fire which destroyed a 22-unit motel in 1975. The 'Houston Hotel' has 30 units, of which over half are new (1971) double rooms with baths. The remainder are single rooms, mostly without baths, in the older section of the hotel. Rates range from $13.65 for a single room and $17.85 for a double room (with double occupancy). In addition, the hotel offers monthly rates from $84.00 and is currently providing a number of Northwood's second-shift workers with accommodation. Ancilliary facilities include a tavern (150 seats), lounge (60 seats), cafeteria (100 seats) and dining room. The hotel normally has vacancies, but may become full during the summer tourist season.

The Idylwild Motel has a total of 22 rooms: 8 singles, 12 doubles and 2 family rooms, all with bath. Six of the rooms have kitchenette facilities. Rates are from $14.00 for a single, $17.00 for a double, and $21.00 for a family room. Ancilliary facilities include a lounge (75 seats), cafeteria (100 seats), and dining room (50 seats). The motel is generally fully occupied, mostly by government employees and businessmen, but does provide accommodation for tourists during the summer season.

Plans for a new 30 unit motel are currently underway and it is anticipated that construction will commence in 1976.

4.2.5 Services

Educational

Houston is in the Smithers School District (#54) and has an elementary school, a secondary school, an independent school, and a school for disabled children. The elementary school has a design capacity of 500, and a present enrollment of 450 students from Grades 1 to 6. There are 19 staff members including the principal. School facilities include a gymnasium and a large field with an adventure playground. The building is used daily by the community kindergarten and weekly by adult education, Boy Scouts, Girl Guides, and other community groups. A new 4 classroom elementary school will be constructed this year on property adjacent to the secondary school.

The secondary school presently houses a total of 275 students (grades 7-12) with a design capacity of 500. Enrollment is expected to diminish slightly in 1977 as grade 7 students are relocated in the new elementary school. The high school, built in 1970, has a gymnasium and auditorium, but no cafeteria facilities. It is equipped with industrial education, science, and home economics laboratories and provides excellent facilities for sports, including a 400-metre track and a large playing and football field. There are 22 teachers on staff, including the principal. The school offers a full range of programs (Arts & Science, Industrial, Commercial, and Community Relations), has an excellent sports program, and a wide variety of clubs and extra-curricular activities.

The Christian Independent School has an enrollment of approximately 100 students and is located in the main part of town bordering Highway 16. The Jack and Jill School for disabled students has an enrollment of 5 to 6 students and one full-time teacher. Both of these schools are funded through donations and government grants.

Recreation/Entertainment

Houston's recreational amenities tend to be oriented towards active physical sports. Nevertheless, there is a reasonable assortment of establishments providing quiet recreational facilities. These include the pub, lounges, and restaurants of the local hotels, the Legion Hall and lounge, and the new (1971) recreation center, which offers six lanes of bowling, six pool tables, a 260 seat movie theatre, and a small cafeteria. Although there is no cabaret or nightclub in town, the Idylwild Motel lounge has live entertainment on weekends.

Sports facilities include an indoor ice arena (1971) with a regulation ice surface and a seating capacity of 800, and a newly constructed three sheet curling rink. On the outskirts of town is a nine hole golf course and a small ski hill with rope-tow facilities. Ski enthusiasts may also enjoy good skiing at Hudson's Bay mountain near Smithers, which is within an hour's drive of Houston. Snowmobiling is a popular winter sport, and almost 100 vehicles are registered for road use with the government agent. At least as many again are probably used for recreational purposes only, and on fine weekends as many as 50 to 60 snow-mobilers may be found at the Dungate Meadows. Horseback riding is prevalent throughout the region and there are a number of stabling facilities within easy driving distance of Houston.

Perhaps the most popular local sports are hunting and fishing. During the last two seasons, local residents accounted for 600 of the 610 hunting licenses issued locally and 900 of the 1,100 angling licenses. American residents also patronize the Houston area during hunting season. Hunting is confined generally to moose, mountain goat, caribou, and grizzly bear, which are sought in areas accessible by logging road. River fishing is more popular than lake fishing, and the plentiful stocks of steelhead, coho, and spring salmon in local rivers ensure a good day's catch. The Morice River is especially favoured by canoeists, hikers, and picnickers as a result of its natural beauty and easy accessibility. Naturalists, backpackers and outdoor enthusiasts enjoy a multitude of mountain, lake and river environments within the region, and several parks offer overnight camping facilities.

Commercial

Although square footage data for retail and service outlets in Houston is not readily available, it may be assumed that the new shopping mall, constructed in 1970 when Houston's population was expected to double within 5 to 10 years, ensure an abundance of retail space. The mall includes a Post Office, Liquor Store, Super-Value, two banks, a dozen or more shops, and municipal and general offices. There are also a number of retail and service outlets scattered along Highway 16, including a co-op store (building supplies, etc.), grocery store, men's wear and sporting goods shop, department store, realty company, several trucking companies, and eight gas stations. Houstonites are accustomed to travelling to Burns Lake and Smithers for some goods and services, and the hour's drive is certainly not unreasonable on a monthly, or even semi-monthly basis.

Health

Although Houston has no hospital, it is served by a Health and Human Resources Center which provides emergency medical facilities, public and mental health programs. The current staff includes two doctors, two nurses, one lab and x-ray technician, one public health nurse, one social worker, one financial assistant, and a part-time psychologist. The center does include two beds, but patients requiring hospitalization are generally sent to the 53-bed hospital in Burns Lake or the 75-bed regional hospital in Smithers. As there is no resident general practitioner in Houston, most Houstonites commute to Smithers or Burns Lake for routine medical attention. The local ambulance services Houston, Rose Lake, (32 miles east) and Quick Hill (26 miles west).

Complete dental services are offered by a resident practitioner who now sees approximately 1,500 recall patients from Houston, Granisle, Topley, Quick, Telkwa, and Burns Lake. Dental services are also available in Smithers and Burns Lake.

Cultural

Like most northern communities, Houston has relatively few cultural amenities. A modest library and an informal arts and crafts center offer some media for cultural exchange. In addition, there are a surprisingly large number of clubs and groups which engage in or sponsor cultural activities.

The Houston library, built as a centennial project in 1969, was designed for a community of 1,000. It is currently open three hours a day, five days a week. A large variety of books are available, from paperback novels to books of a highly technical nature, and an inter-library loan system ensures fulfillment of most requests. The community plans to include larger library facilities in their new municipal offices, which should be constructed in 1977/78.

Located in the shopping mall, the 'S.C.R.A.P.' center offers an information and referral service, an arts and crafts program, and a drop-in center. It is funded partly through grants from the Department of Human Resources and partly through revenues received in the sale of arts, crafts, and second-hand goods. Citizens interested in drama, ballet, and music generally travel to Smithers or Terrace to attend performances, although a stage and auditorium are included in the community hall.

There are eight churches in Houston, representing nine denominations, including Anglican, Baptist, Catholic, Christian Reform, Pentecostal, and United. Congregations are fairly active and weekly services are held in most churches. Several churches sponsor women's and youth groups and take an active part in community affairs.

Law Enforcement

Six R.C.M.P. officers (two with mobile units) are responsible for law enforcement in Houston, Rose Lake, and Quick Hill. Because Houston is a training center for the R.C.M.P., staff levels are often higher on a per capita basis than elsewhere in the region. Officers contacted during the course of this study indicated no special law enforcement problems other than those minor difficulties associated with transient work forces.

Houston does have court offices and members of the judiciary in Smithers are available on a weekly basis. The community probation officer is located in Burns Lake, less than an hour's drive from Houston.

Fire Protection

Houston's fire protection system is well developed, with hydrants throughout the central community along the water mains. One fire truck, and two tank-trucks with a capacity of 2,200 gallons are manned by a 25-man volunteer force which services only the municipality of Houston.

4.2.6 Community Land Use and Infrastructure

Houston's municipal acreage is unusually large (17,472 acres), though less than a tenth of this (approximately 1,200 acres) is included in the central development core and subject to zoning regulations. There is no official land use map of this area, but a map of current land uses based on field notes, 1975 aerial photographs, and the official zoning map has been prepared by Beak (Figure 26). There is a good deal of vacant land within the central core that is presently zoned for residential, commercial and industrial development. One major aspect the community faces in ensuring the orderly development of this land is that much of it is held by Bulkley Valley Forest Industries.

Land for schools, parks, and public amenities is adequate in terms of acreage, but generally under-developed, with the notable exceptions of the ice and curling arenas and the recreation center. The municipality has recently acquired a 70-acre parcel of land south of the secondary school which it intends to develop as parkland.

Current land use patterns reflect the orderly development of a central commercial-industrial core and an outer ring of single-family and multiple dwellings. Problems relating to non-conforming uses within the community are minimal and may be easily mitigated as development proceeds.

Houston's infrastructure has recently been developed, during a period of predicted growth, to service a community of 6,000. Its water system draws on two deep wells within the nucleus of the settlement. One is serviced by an electric pump which operates approximately 20 hours per day at 200 gallons per minute, and the other 'back up' well is serviced by a diesel pump that operates from one to three days per week (depending on demand) at 400 gallons per minute. The pumps force water through the system into a half million gallon reservoir above the town. The system has a two-way flow, and the reservoir is kept filled to provide an emergency supply of water. The system services the entire community area.

The sewer system involves a network of 8-12" lines which service over half of the community (Figure 26). Two aerated lagoons are located in the 'industrial zone'. These lagoons discharge directly into the Bulkley River.

Municipal garbage is collected weekly (domestic) and tri-weekly (commercial) by a privately contracted firm. It is hauled to a sanitary landfill of 2½ acres about 1½ miles south of the municipal center. The landfill may be expanded to four acres.

Houston is serviced by a 138,000 volt B.C. Hydro line, with a local distribution voltage of 25,000. To date there have been no major problems or interruptions in service. In-town lines are generally above ground, although in new subdivisions they are buried. Pacific Northern Gas pipelines service the entire community (Figure 26), and most residents rely on gas for home heating.

The major transportation artery in Houston is the Yellowhead Highway (16) which runs almost through the center of town, splitting the older residential from more recently developed areas. Traffic along this corridor is relatively light, but truck traffic represents a high proportion of the volume. Municipal roads are generally gravel-surfaced, although the Mountainview Subdivision and sections of the 'downtown' area, including Butler Avenue and 10th and 11th streets are paved with curbs and gutters. All areas are equipped with street lighting.

CN rail services the community daily, with three time per week passenger service. Vancouver passengers must travel to Jasper, changing trains and continuing on through Prince George to Houston, a rather circuitous trip requiring almost 36 hours (fare $35.50). Greyhound busses travel twice daily from Vancouver through Prince George and on to Houston and Smithers. From Vancouver the trip takes approximately 20 hours (fare $28.90).

The closest airfields are at Smithers and Burns Lake where daily flights connect passengers with Vancouver and general northern communities. It is expected that Houston's 3,500 ft gravel strip will receive M.O.T. licensing in mid 1976, at which time Harrison Airways has indicated it will commence service.

Houston residents receive three radio stations: the C.B.C. (Prince Rupert, 1320), CFBU (Smithers, 1450), and CFPR (Prince Rupert, 860). CFBU covers Houston news and advertisements as well as regional news. Television reception is limited to one channel, CFTK from Terrace, which has a 65% CBC content. The transmission lines are above ground and are therefore subject to frequent disturbances due to adverse weather conditions. In general, the reception is only fair and is often interrupted during storms.

The Lakes District News/Houston Today weekly newspaper has a circulation of approximately 800, and carries items of local and regional interest. In addition, the Prince George Citizen and the Vancouver Sun and Province newspapers are available in Houston although they arrive on the day following their release in these centers.

4.2.7 Regional Infrastructure

The Bulkley-Nechako region lies in the central northern part of British Columbia, a rugged sparsely populated area which only now as a result of increasing forestry and mining activities, is developing in both social and economic terms. Since 1941 the region's population has increased by 3½ times, yet in 1971, with a population of approximately 27,000 it still represented only 1% of the province's total.

The majority of the region's population inhabits the various settlements along the Yellowhead Highway (16) which runs east-west from Prince George through Vanderhoof, Burns Lake, Fraser Lake, Houston, Telkwa, and Smithers (the regional center) on to Terrace and Prince Rupert. A lesser corridor runs north from Vanderhoof to Fort St. James. Several secondary roads run north and south linking smaller communities to the main access route. The Canadian National Railway and 138,000 volt B.C. Hydro lines service almost all of the communities in the area. Daily air services connect Prince Rupert, Smithers and Prince George to Vancouver and the lower mainland, and less frequent commercial and charter services operate between Vancouver and the smaller centers of the region such as Burns Lake and Vanderhoof. Local airlines provide inter-community services on a demand basis.

Radio stations operate out of Smithers, Terrace, Prince George, and Prince Rupert, carrying both local and CBC programs. Reception is generally good. Cable television is not available, and only one channel is receivable under favourable weather conditions.

Smithers, the region's center, provides a broad array of commercial, medical, educational and cultural services and amenities. Subcenters such as Burns Lake, Houston, and Fort St. James are endowed with modern shopping facilities and adequate medical, educational, and cultural facilities to meet normal day-to-day requirements.

Because of recent rapid population growth, a good deal of the housing within the region has been built within the last 15 years, and is equipped with modern conveniences such as built-in appliances, and wall-to-wall carpeting. Most of the settled communities are serviced with underground sewer water and natural gas systems and aboveground electricity. In rural areas septic tanks and wells are more common.

The way of life tends, like the supporting landscape, to be rough and ready; and most residents 'live off the land', either directly, as farmers or ranchers, or indirectly, as employees of forestry and mining concerns. Leisure-time activities too are land and resource based, including such pastimes as hunting, more cultural and educational opportunities are being developed and, in the light of these, family life in the region is becoming increasingly attractive.

5

5.0 ENVIRONMENTAL IMPACT AND MITIGATION

Upon completing the project description and the documentation of the existing environment a bio-physical environmental impact matrix was developed to document the major interactions between the development and the natural environment (Figure 27).

Equity Mining Corporation together with their mining and environmental consultants reviewed the suggested environmental impact matrices from the Environment and Land Use Secretariat's coal guidelines. Since the off-site and mine site activities essentially interact with very similar environmental factors a single environmental impact matrix was developed.

The order of the environmental factors is such that it corresponds with the discussion in Section 4. It was assumed that there must be at least one interaction between a proposed activity and a listed environmental characteristic in order for either the activity or the environmental characteristic to remain in the matrix.

Axes of the matrix were assessed by a terrestrial biologist, an environmental engineer and an environmental chemist. These assessments were than integrated and discussed prior to the completion of the finalized environmental impact matrix.

Regarding the socio-economic interactions of the development, an in-text matrix of existing characteristics, impacts and the need for expansion and/or mitigative measures is provided as a summary of the impact and mitigation discussions in section 5.2.7.

5.1 Biophysical

5.1.1 Land Resources

Off site Activities

On the bases of the information presented in Section 4 there are three areas in the Dungate Corridor where the road construction activities will have moderate but temporary negative impacts on the physical land resources. The first area in question (Figure 28) is in the upper Dungate Creek area where severe slopes, shallow soils and a moderate to high erosion potential will have to be accommodated in the road design. The second area is further along the Dungate road where it crosses the Klo Creek system near the Klo Creek Meadows. Shallow top soils and moderate to high potential erosion potential are areas of potential environmental impact. As a mitigation action to counter this potential erosion impact, seeding is planned for cut/fill surfaces as an integral part of the utility corridor construction program. Thirdly, the Lu Lake Meadows have poorly drained soils, thus a moderate impact is anticipated during the road construction. Overall negative impacts related to physical land resources will be mitigated by the planned winter construction of the Dungate Corridor.

For the land capability and present use (Figure 29), the development of the utility corridor as well as expansion of the Houston town site will have major positive impacts on urbanization of the existing town site. The Dungate Creek road would expand the existing access route to the timber resources in upper Dungate/Klo Creek areas. Logging activities are currently taking place on the first nine miles of the route. Recreation will be impacted positively as the new road will increase access to the alpine meadows of Klo Creek as well as Upper Dungate areas. Both of these areas are used during the winter time fairly extensively by snowmobilers.

With wildlife there are a series of minor negative interactions of the utility corridor. Ungulate populations may be affected as increased hunter access could increase hunting pressure on the moose population of Upper Dungate and Klo Creek. Fish and Wildlife have expressed concern regarding increased hunting pressure, and have indicated that certain management techniques such as closing hunting on a half mile of either side of the proposed road would effectively counteract potential adverse effects. Effective communications with the Fish and Wildlife Branch will be maintained such that sufficient lead-time is provided to implement required management techniques prior to the opening of the Dungate Creek route.

Potentially negative interactions also exist between ungulates and traffic flow during the winter months. Specifically, ungulates can become trapped in the plowed roadway and be unable to avoid car and truck traffic. Should such an impact occur, run-offs through the snowbanks shall be established on the roadway at regular intervals as a mitigating measure.

Mine Site Activities

With the construction of the plant and mine a series of localized major negative impacts with the land resources will be realized. Stripping of the overburden, the construction of the dam for the mine water supply, and the construction of the tailings lagoon will all have major negative impacts on the soils of the region. Although the impacts are negative they are short termed as once the construction activities have been completed the impact on the soils will be over. The clearing of the construction site as well as construction of the tailings lagoon will have a major negative impact on the vegetation of the area as it will be removed. Removal/clearing operations will include logging in the tailings pond area once the tree line is reached. Subsequent revegetation upon project termination will assist in mitigating the vegetation losses.

The operation of the mine will create a waste dump which will have a major negative impact on the existing land forms as well as increase the opportunity for erosion potential in the area of the dump.

Revegetation of the waste dumps will have major positive impacts on both soils and erosion potential and should be carried out as soon as feasible. Overall, the revegetation will have a major positive impact on the vegetation of the area, especially if native species are utilized in the revegetation schemes.

5.1.2 Water Resources

The water resources of the region contain physical, chemical and biological components. These components, namely water quantity, water quality, benthos and fisheries, are closely interrelated and interdependent. A development activity which interacts with any one of these limnological characteristics of the existing environment will interact to some degree with the others as well. For example, a potentially major negative aspect of the development is the siltation of streams with increased levels of suspended solids and turbidity. Siltation appears overtly to affect water quality but could in fact affect benthos and fisheries as well. Thus, development activities which relate to the potential siltation of streams are discussed in the context of three environmental characteristics: water quality, benthos and fisheries.

Off-site Activities

Interactions between the natural water resources and off-site project activities focus upon the possible introduction of sand, silt and clays to streams by the construction and operation of the utilities corridor and the potentially negative implications thereof.

Regarding the limnologically sub-component, water quality, cut and fill operations offer a potentially major negative impact. The potential short-term impact during utility corridor construction will in part be mitigated by the planned period of activity: the winter months during which erosion processes due to running water are at a minimum. For the long-term, operational impact, seeding of exposed surfaces will be undertaken.

Inadequate culvert and overall drainage practises of the utility corridor could also affect water quality. Mitigative measures include careful consideration to and design of stream parallel offsets, ditch grade, and culvert spacing and diameters.

Regarding benthos, and considering more specific locales and water systems, an increase in the silt load of a stream could ultimately create unfavourable conditions for invertebrates whose respiratory processes involve external gill structures. These Group 3 invertebrates are sensitive to any changes in ambient conditions resulting from suspended residues. The abrassive nature of fine sediments on gill tissues and the simple suffocating effect of high sediment loads could result in high mortality of Group 3 benthos. The ultimate result would be a shift in structure whereby communities would be dominated by organisms more tolerant to such unfavourable conditions and ultimately lowering community diversity values.

The utilities corridor would exert the most pressure on aquatic environments during its construction phase. Both the Foxy-Maxan and Buck watersheds have the potential of being affected by increased sediment loads. However, the Foxy-Maxan system is not traversed by the corridor to the same extent at the Buck Creek watercourses. The corridor parallels a significant portion of Dungate Creek and also intercepts Klo Creek. The possibility of increasing sediment levels is relatively high for Dungate Creek and Buck Creek below its confluence with Dungate. This is resultant primarily to the physical characteristics of the Upper Dungate Creek area, that is: 30% + slope, shallow soils and moderate to high erosion potential.

Klo Creek plus Buck Creek below its confluence with Klo may also receive increased sediments, but probably not to the same degree as below the Dungate confluence. Overall, the potential of sediment input to Klo Creek is less than to Dungate Creek although there are factors of shallow top soil and moderate to high erosion potential in the Klo Creek area.

The Foxy-Maxan system is traversed by the utilities corridor for a short stretch near the mine site. Impacts in this locale associated with corridor construction and operation are secondary to those of the mine-site activities. Thus, impact discussions on the Foxy-Maxan system are provided in the Mine-Site Activities section. Included therein are also fisheries impact discussions.

The ultimate biological result of higher residue levels in the aquatic systems would be a decline in sensitive benthic forms with their replacement by more tolerant organisms. This phenomenon would precipitate a less complex, less diverse community of invertebrates. Regarding mitigation activities, road construction techniques that are commensurate with the guidelines established by the cooperation of engineering and forestry disciplines are recommended. Conscious efforts on the part of construction crews to minimize stream bed disturbances would contribute significantly to the maintenance of an undisturbed aquatic system.

In summary, major off-site activity impacts on water resources relate primarily to the erosion processes and stream siltation. Mitigation measures focus upon adequate control of run-off water and revegetation programs.

Mine Site Activities

Interactions between the natural water resources and mine site activities focus, as with off-site activities, upon the possible introduction of deleterious materials to the region's watercourses. Aspects of water quantity are also involved as related to the plant's water supply.

The required rate of fresh water make-up of 500 IGPM (~1 cfs) from Lu Creek is of similar magnitude to Lu Creek's expected summer and fall flows. Flows in Foxy Creek are generally two to four times greater. Thus, continuous direct withdrawal would potentially cause a major flow regime alteration by the reduction of creek flows during periods of low, natural flows. As a mitigative measure storage facilities will be provided at Lu Lake with the construction of a high water level control dam. This action will allow storage of water for plant use throughout the year from the non-critical freshet period of high flows and thereby not seriously affect the flows of Lu and consequently Foxy Creeks during periods of low, natural flows. On an annual basis, net consumptive usage of water from the Foxy Creek watershed will total approximately 200 - 300 x 10^6 USG or approximately 10 - 20% of total annual flow of the watershed upstream from the confluence of Lu and Foxy Creeks. The negative impact of this consumption will be minor due to the time period in which it is withdrawn.

Potentially major negative impacts on water quality, and by inference possibly other limnological characteristics such as benthos and fisheries, could occur during the construction phase due to land resource modifications and subsequent erosion by water. Specific activities of note are stripping, stockpiling and tailings pond construction. Mitigation actions against the potential impairment of water quality primarily involve good drainage control with treatment and/or emergency facilities. Diversion ditches protecting the southern tail deposit, plant site, tailings pond and access road are planned as a means of minimizing water access to exposed land surface (Figure 32). In addition, drainage lagoons are proposed for runoff from the plant site and pit waters. Such mitigative measures will be applicable not only to the construction phase but also to the operational phase.

Operationally, water quality impairment could relate to siltation, tailings, sewage or acidic drainage. Mitigative measures to handle siltation problems have been discussed as they relate to the construction phase. Additional activities during the operation phase would include seeding of cut and fill areas and the implementation of an overall revegetation program for the development. Regarding tailings, the major mitigation taken involves the establishment of a closed-cycle system coupled with a secondary seepage dam downstream from the main tailings dam. Domestic sewage will receive conventional secondary treatment prior to disposal in a tile bed.

Regarding acidic drainage, samples of ore and tailings were tested for acid producing potential. This characteristic is important in determining whether drainage water from the mine site will constitute a potential problem. The tests subsequently indicated that the potential for acid generation does exist.

Pyrite is present in substantial amounts in both the Main Zone and the Southern Tail while pyrrhotite is absent from the Southern Tail. Most of the sulphide minerals mined at the site will pass through the ore treatment process and the uneconomic pyrite and pyrrhotite will be sent directly to the tailings pond where they will be retained indefinitely. Only a minimal amount of sulphide minerals is expected to be retained in the overburden and waste rock dump areas.

Since the tailings pond will be an impermeable structure with a closed circuit water system to the process plant, any acid generated from the oxidation of sulphides will be retained within the system. Should acid generation occur within the tailings pond, the problem becomes one of internal process operation and procedures for neutralizing the acid within the system would be taken.

To ensure that any sulphide minerals present in the overburden and waste rock dump areas do not constitute a hazard to the environment from acid generation, mitigative measures have included diversion of natural watercourses to circumvent the waste dump, control of runoff from the waste dump surface such that it is directed towards the mine rather than over the dump face and the establishment of a water quality monitoring programme of seepage water from the dump area.

It is not, however, anticipated that acid generation will constitute a problem from this source since the quantity of sulphide minerals in the dump areas will be minimal. In addition, the climate at the Sam Goosly mine site does not favour the formation of acid mine waters. The low rainfall and cold temperatures for a greater part of the year do not assist the acid-producing bacteria in oxidizing the sulphide minerals. The low rainfall deprives the bacteria of water which is needed to complete the acid-generating reaction while cold temperatures retard the activity of the bacteria, thus minimizing acid production.

After considering the relevant factors which are required for acid mine waters to constitute a pollution problem, it is anticipated that the impact on the environment will be negligible provided that the monitoring programme for water seeping from the waste dumps is correctly implemented. Should problems occur in these areas from acid generation then mitigating procedures could be carried out to prevent acid mine waters from entering nearby watercourses.

Benthos, and fish populations, may also be affected by mine-site activities. Considering specific watersheds, the tailings pond area has the potential of increasing the silt load of the Foxy-Maxan Creek system. As the progression is made downstream from the project towards Bulkley Lake, the absolute negative impact would be lessened resulting from increased dilution by waters from Maxan Lake. The magnitude of the negative response would ultimately be a function of the amount of sediment released. A portion of the benthos resource will nevertheless be lost at the precise site of the tailings pond since this section of Lu Creek will become dysfunctional. The length of stream lost is small in comparison to the overall Foxy-Maxan system.

The plant and mine areas could impact the Buck Creek system. However, any increased sediment load may not impart environmental effects beyond Goosly Lake in the Buck Creek watershed since Goosly Lake could function as a settling basin for suspended residues.

Overall, mitigation measures discussed as they related to water quality are applicable also to the benthos resource. Indeed, with appropriate precautions and housekeeping procedures implemented during construction and operation, the effect of the mine site on benthic communities inhabiting the two main watersheds would be minimal or non-existent.

Considering fisheries, the third component of the water quality, benthos, and fisheries trio, Buck Creek and Maxan Creek with their respective tributary systems support limited resident and migratory fish populations. Escapement of anadromous species, primarily coho salmon, into Buck and Maxan Creeks has been relatively low with no spawners observed for the majority of years dating back to 1948. The natural barriers in Dungate and Foxy Creeks have prevented migration of anadromous species beyond these points. Resident species were not found to inhabit these reaches which are closest to the development.

In areas that do support some resident populations, relative numbers were low. Limited recreation fishing has occurred in Goosly and Maxan Lakes and Buck Creek and success rates are not known. In general, the fishery resource of the water systems associated with the utilities corridor and mine site per se is not considered a major resource of the area.

With the concerted efforts to mitigate impacts by minimizing the input of particulate matter, runoff and seepage into the watersheds during the construction and operational phases of the mine and utilities corridor, the fisheries resource of Buck Creek and Foxy-Maxan Creeks should not be adversely affected. In addition, the high mobility of fish enables escapement from an area exhibiting infavourable ambient conditions. This fact further lessens the degree of potential impact since avoidance behaviors can be executed to remove the organism from zones of severe impact.

In summary, major mine-site activity impacts on water resources relate to erosion processes and potential acid water generation. Mitigation measures focus upon revegetation programs and the control, diversion and treatment of surface water.

5.1.3 Air Resources

Off-site Activities

Interactions between the natural air resources and off-site project activities will in most instances be of a minor negative type. Vehicular flow over the utility corridor will produce conditions of dust, noise and combustion emissions but the level of importance of such interactions is low. Within populated areas elevated dust and noise levels could produce some concern but mitigative measures such as regular street cleaning could be considered.

A potentially major negative impact exists with regards to preparation of the townsite. A considerable amount of construction will take place within the boundaries of Houston during the initial years of the development and few effective mitigative measures exist for the noise and dust levels associated with such activities. Nevertheless, the impact will be of a short-term, transient nature and may indeed be perceived by Houston to be of an ambivalent rather than negative type.

Mine Site Activities

As with off-site activities, mine site activities interact with the air resources in a generally minor way. Elevated noise and dust levels during construction will be evident with short-term mitigation of the latter impact being provided by water-tank trucks.

Stack emissions from the operating plant possess potentially major negative interactions with air quality. Airborne pollutants could be subject to limited horizontal and vertical transport, considering the analyses of meteorological conditions at nearby Burns Lake, and hence increased local concentrations are possible. In addition, while the air pollution potential of the general area is low (Figure 30) with regards to topographic considerations, a severe air pollution potential exists in Foxy Canyon to the northeast of the project site.

Major mitigative measures have been taken such that gaseous and controlled particulate emissions from the project will meet or exceed guidelines established by the provincial government. Reduced sulphur compounds have required especial considerations. In the concentrate roasting circuit scrubbers are provided to mitigate the potentially major negative impact and within the concentrate drying circuit, a wash cycle is provided in order that residual reduced sulphur compounds are removed prior to drying. Overall, the most noticeable impact of the project site activities in air quality will be the vapor plumes associated with the loss of heat and water through the plant's stacks.

5.1.4 Reclamation

The reclamation program should provide major positive impacts with both land and water resources of the region. Indeed, the reclamation program is in itself a major mitigation activity and has been briefly referred to in the land and water resources sections, 5.1.1 and 5.1.2 respectively.

The program would be staged over the life of the mine and would include research and definition of objectives, experimental revegetation and long term reclamation. A general discussion of the program is contained herein. A more detailed report regarding reclamation will be submitted by Equity Mining Corporation under separate cover with regards to the reclamation permit.

The research and definition of objectives would be conducted with the assistance of consultants and with the aid and consultation of provincial and federal resource departments. The first phase of research would be to expand the data base presently available with respect to natural vegetation, water quality, fish and wildlife and soil analysis for those areas where disturbance is likely. A second phase of research would be conducted during the preproduction period and during initial operation and would include research into the characteristics of mine and mill waste products in order to determine their potential as a grooth medium for plant life.

Experimental revegetation would be conducted with the ultimate objective of determining optimum revegetation procedures which would return as much of the distrubed areas to as productive, or conceivably to a more productive state than currently exists. Experimental work would include both aerial and surface seeding, studies of fertilizer application and the study of plant growth under various conditions.

Since, with the exception of tailing dam faces little can be accomplished on reclamation of tailing area surfaces during active operation, experimental revegetation will be conducted on test plots of tailing to determine appropriate mixtures of fertilizers, grasses and legumes for ultimate reclamation.

As portions of the disturbed area become inactive, they will be reclaimed. The reclamation procedure would be based on the results of the research and experimental revegatation previously described.

The mine waste dump area will be terraced and ultimately smoothed along the down dip side in order to prevent slumping subsequent to reclamation. Rock volumes and road access routes are being studied in order to ensure that the necessary lower terraces can be laid at the appropriate time.

Conservation efforts will be directed towards minimizing the area disturbed bed and conserving materials excavated which may have future use or value. Topsoil will be conserved, whenever feasible, for possible use in reclamation of disturbed areas. Low grade stockpiles will include rock which is well below current cutoff grades. The low grade rock will be segregated according to grade and stored in areas convenient for retrieval should technical improvements or economic conditions change to the point where such rock becomes ore.

The major portion of the areas disturbed will ultimately be reclaimed. A substantial portion of the land will be returned to its present or similar use while other areas, such as the lower portions of the pits, will become small lakes. A breakdown of the anticipated ultimate reclamation is as follows:

Facility	Similar to Existing	Different Land Use	Partial Reclamation	Total Acreage
Pits and Bench Access Roads	30%	50%	20%	150
Waste Dump Area	90%	-	10%	278
Plant Site	60%	-	40%	46
Tailing Impoundment	95%	-	5%	939
Fresh Water	100%	-	-	4
Utilities Corridor	-	-	100%	360
Totals (weighted average)	69%	4%	27%	1,777

In summary, reclamation will be an on-going program of the development such that disturbed area may be revegetated with appropriate methods; species concomitant with their becoming inactive.

5.2 Socio-Economic and Community Impact

The magnitude of the Sam Goosly project in relation to the community of Houston ensures that its physical, social, and economic impacts on the community will be significant. The tenor of these impacts, and whether they are deemed detrimental, beneficial, or ambivalent, is more difficult to predict. Such predictions involve not only subjective judgments and assumptions, but also a consideration of probable initiatives that will be taken by the community itself to direct growth and development in such a manner that potential benefits are maximized and potential disbenefits minimized.

The following discussion of the Sam Goosly project's impact on Houston addresses itself primarily to the identification of major impacts and secondarily to the evaluation of both their positive and negative aspects. In some cases mitigative actions are suggested, but it should be emphasized that the onus of ensuring that the physical, social, and economic impacts of the Goosly project on

Houston contribute to the overall well-being of the community rests with the community itself. In anticipation of project approval, municipal officials should begin now to assess its probable impacts, establish community priorities, and devise a set of development policies and guidelines to ensure that their interests are served.

5.2.1 Population

In conjunction with the influx of mine-related employees and dependents, Houston can expect a more gradual influx of secondary workers (and dependents) associated with the induced employment generated by both the mining operation itself and by more general commercial and service activities. This phenomenon is known as the 'multiplier effect', and has been studied and documented on both a regional and a project-specific basis. For community planning and design purposes, employment multipliers are utilized to calculate the probable number of induced employment opportunities that will be created (generally on a local basis) by a new project. These multipliers take into consideration such factors as regional employment, labour force, and family patterns; local facilities and services; and the nature of the project under consideration, including the kinds of workers required, duration of employment, location of housing, etc.

For the purposes of this study 0.2 and 0.4 have been considered as appropriate employment multipliers for the construction and operation phases respectively. As previously established, the work force: dependent population ratio is assumed to be in the order of 2:3. The size of the secondary work force and its associated dependent population is therefore:

Year	1	2	3	4	5	6	7
Construction force[1]	200	-	-	-	-	-	-
Secondary force	40	-	-	-	-	-	-
Operative force[1]	70	200	200	200	200	200	200
Secondary force	50	140	140	140	140	140	140
Total secondary force	90	140	140	140	140	140	140
Total secondary force (less 5%)	85	130	130	130	130	130	130
Secondary force dependents	130	195	195	195	195	195	195

1. Full force figures (not those adjusted to reflect employment opportunities filled by local residents) are utilized to determine the number of secondary employment opportunities associated with direct employment.

Adding these figures to the primary work force and dependent figures previously calculated, the following table is derived:

Estimated population Increases, By Year

	Year 1	2	3	4	5	6	7
Construction force	190	-	-	-	-	-	-
Dependents	30	-	-	-	-	-	-
Operative force	65	190	190	190	190	190	200
Dependents	40	115	145	170	210	230	325
Secondary force	90	130	130	130	130	130	140
Dependents	130	195	195	195	195	195	210
Total	545	630	660	685	725	745	875

Assuming Year 1 is 1977, these increases have been added to estimated base population figures (Figure 31). The predicted 1983 population is in excess of 3,600, virtually a 50% increase over its present level (Figure 31).

5.2.2 Labour Force

As the mine itself will not be in full operation during the first phase, employment opportunities will be somewhat restricted. The policies and practices of both the construction company and the various unions involved will determine the number and kind of opportunities available. Induced economic activity should help to ease local unemployment, especially in the construction and service trades.

The 340 or more employment opportunities associated with the second phase of the project represent a substantial increase over present levels. Direct mine-oriented employment for unskilled as well as skilled workers through company sponsored and Canada Manpower training programs will hopefully diminish the regional surplus of unskilled labourers. Secondary employment opportunities will also be created for both skilled and unskilled workers during the second phase of the project. Indeed the large number of jobs to be created greatly exceeds the current labour force's ability to fill them and hence the predicted influx of workers.

More generally, the addition of a primary source of employment and the variety of secondary jobs created will help to create a climate of greater economic and social stability. Workers who are presently forced to leave the area because of seasonal fluctuations in employment, job dissatisfaction, or simply the dearth of job opportunities available will find it easier to settle and remain within the region. This in turn will encourage increased investment at all levels of the regional economy, and greater stability in the labour force.

5.2.3 Income

While the bulk of the wages earned by construction workers during Phase I will likely be spent outside of the region, some increase in the commercial sectors of the local economy may be expected.

The disposable income of mine-related workers alone is expected to exceed \$2.5 million per year and that of the secondary work force on the order of \$1.5 million per year. According to the 1972 Census data (Statistics Canada, 1972) these incomes may contribute to the local economy as follows:

Sector of Economy	Percentage of Disposable Income	Potential Value (1976 dollars)
Food	20	800,000
Shelter (including household goods, furniture, and equipment)	27	1,080,000
Personal items (including clothing, medical and health care, cigarettes and alcohol)	16	640,000
Transportation and travel	14	560,000
Recreational and cultural pursuits and miscellaneous	8	320,000
Taxes	15	600,000
Total	100	4,000,000

Corporate spending by both Equity Mining Corporation and the affiliated construction company may also help to stimulate the Houston economy, particularly in the sectors of food and building supplies, although major purchases will likely be made from suppliers outside of the region.

Revenues acquired through taxation as a result of the project will benefit all three levels of government. Corporate and personal income taxes, sales taxes, and import duties will be applicable to both the operation and to the various economic activities it generates. The District Municipality of Houston will receive a substantial proportion of tax revenues, their exact magnitude depending on agreements negotiated between Equity, Houston, and the provincial government. As legislation regarding the taxation of mining companies is currently under review, estimations of potential tax revenues cannot be made at this time.

The Goosly project and associated activities will augment municipal revenues considerably. Outlays for housing construction and expansion of necessary service and infrastructure components will undoubtedly be recouped by the community in a very short time. The possible reluctance of the community to appropriate large amounts of the municipal revenue to preparatory construction could result in short-term shortages of housing and services. This problem should be considered by the proponent, the community and the provincial government, and appropriate agreements reached to ensure an adequate supply of funding for preparatory activities.

5.2.4 Community Land-Use and Infrastructure

Probable impacts on both community land-use and infrastructure are postulated on the basis of amount and location of housing required, not on population increases *per se*. These requirements have already been calculated for the direct employees and dependents. (Sections 3.4.1 and 3.4.2). Based on the same formulae and assumptions, the corresponding housing requirements for the secondary work force and dependents may be calculated as follows:

Year	1	2	3	4	5	6	7
Secondary workers and dependents	220	325	325	325	325	325	325
Units of housing required	60	95	95	95	95	95	95
(Single family)	(40)	(65)	(65)	(65)	(65)	(65)	(65)
(Rental)	(25)	(20)	(20)	(20)	(20)	(20)	(20)
(Mobile)	(5)	(10)	(10)	(10)	(10)	(10)	(10)

Adding the above figures to the housing requirements of direct employees and dependents we derive the following table:

Total Housing Requirements

Year	1	2	3	4	5	6	7
Units of housing required	105	180	190	220	210	215	245
Single family	60	110	115	120	125	125	140
Rental	30	50	50	55	55	60	70
Mobile	15	20	25	25	30	30	35

From these predicted housing requirements, it is possible to construct an overall housing schedule, as follows:

Year	1	2	3	4	5	6	7	Total
Single family	60	50	5	5	5	-	15	140
Rental	30	20	-	5	-	5	10	70
Mobile	15	5	5	-	5	-	5	35
Total	105	75	10	10	10	5	30	245

Evidently the pressure for housing construction will be greatest during the first two years of the project. As Houston presently has only five houses on the market and virtually no rental accommodation available, its immediate ability to meet this housing demand is severely limited. There are, however, three potential sources of accommodation which should be considered and developed accordingly. These are:

1. Thirty three- and four-bedroom condominium townhouses in the Mountainview subdivision, presently owned by Northwood Pulp Limited. These might be purchased from Northwood (by Equity, the construction company, and/or the municipality of Houston) for subsequent resale or rental to incoming workers.

2. Thirty-five serviced lots south of Hillside Avenue, owned by Westpoint Construction Limited. Construction of both single family and multiple dwellings may commence immediately, pending appropriate financing arrangements.

3. One hundred lots for mobile homes, over 70 of which are in the central Houston area.

These sources could if developed immediately provide sufficient accommodation for the population increase expected during Year 1. It is unlikely however, that real estate development servicing and housing construction will be able to proceed quickly enough to fulfill complete demand in the short term. Temporary deficiencies in accommodation may be alleviated through monthly rental arrangements with the local hotel and motel, and through increased short-term mobile home accommodation (there is presently a surplus of serviced lots). Excessive reliance on mobile units may have the detrimental effect of promoting a transient lifestyle and instability within the labour force and the community as a whole.

To ensure the timely availability of housing for the incoming population in Year 2, additional parcels of land should be acquired and serviced as soon as possible. The large parcels of land south of Hillside Avenue (District Lot 333), west of Hungerford Drive (District Lot 622A) and south of East Valley Road (Rem. Bk. 5, Plan 2012, District Lot 619) are possible choices for future housing development. These parcels have the potential for well over 300 building lots, which is more than adequate for both phases of operation.

Development of the indicated parcels of land for housing is in keeping with present land-use patterns and allows for expansion of the central service core. Indeed the areas are sufficiently removed from either industrial- or commercial-zoned areas that no conflicts of use need arise. Estimates of the potential number of building lots within the parcels take into account the trend to larger lot sizes as in the Mountainview subdivision and the land required for neighbourhood parks, in keeping with the community's established rural aspect. A major emphasis during the coming years then, should be on the formulation and implementation of strict development guidelines which will protect those values considered most important to Houston residents.

It is critical that housing development and construction commence as soon as possible. This may require external assistance such as the financing of local contractors (in advance of construction) or the introduction of larger contracting concerns which have the working capital required to undertake such a housing project.

As a result of construction activities and the increased resident population the volume of municipal garbage will likely double by 1982, requiring a roughly proportionate expansion of disposal services. The present 4-acre landfill area should be able to accommodate the increase in volume.

Increased residential power demands will require expansion of present hydro and gas services. New lines and pipes should be installed underground in conjunction with housing development. A major hydro line will be required to service the mine itself, and will likely be constructed along the Dungate Creek Corridor during Phase I.

Transportation and communication networks will experience substantial increases in usage. Traffic volume on both Highway 16 and local arterial and secondary roads may be expected to increase fairly dramatically, perhaps necessitating the installation of stop-lights at major intersections. Assuming that the local airstrip receives M.O.T. licencing and regular air service commences in the near future, rail and bus service will not require expansion.

Radio, television, and newspaper services will require expansion to meet the needs of growing local and regional population. Hopefully new radio stations will be added in the near future. Of more immediate concern is the introduction of cable television services into the region. Such action would enhance not only the communications network, but also the social and cultural aspects of life in a relatively isolated community such as Houston.

5.2.5 Community Services

During Phase I, two distinct impacts on commercial services will occur. One will involve the weekend pressure exerted by on-site workers for goods and services of a personal nature: drugs and toiletries, clothing, cigarettes, alcohol, car-oriented services, and recreational amenities. In particular the local pub, lounges, and restaurants may expect a substantial increase in patronage. Increased weekend pressure on recreational and entertainment facilities as a result of the large construction force will probably be shared by other regional centers such as Burns Lake and Smithers, where these facilities are more abundant. The impact of permanent employees, indirect workers, and their dependents, on the other hand, will tend to generate an even increase in demand for all goods and services during Phase 1.

In view of the recent expansions in Houston's commercial and recreational sectors, these added pressures should not present significant problems. Increases in the goods and services provided will obviously be necessary, but expansion of the actual facilities should not be required during Phase I.

During the operative phase of the project the increased demand for goods and services will be keenly felt. The virtually immediate 25% increase in resident population during Year 2 will exert relatively sudden pressures on all sectors of the economy. According to a recent publication (Statistics Canada, 1971) Houston will probably require major expansion in retail outlets of food, clothing and accessories, hardware, and home furnishings. The present reliance on Smithers and Prince George to supply some goods and services will undoubtedly continue. This trend, along with Houston's current over-development in the retail sector, will enable local merchants to assess and provide for additional community needs without excessive pressure. There are presently several vacant lots and a number of older establishments that could be removed to facilitate commercial expansion, however, planning guidelines must be formulated to ensure orderly development.

Education

The number of incoming school children is likely to be in the order of 50 to 100 students in the first few years of the project. Assuming the construction of the new elementary school by September of 1978 at the latest, this influx should require only the addition of three or four staff members. However, by 1983 the 0-19 year old population will likely approach 300 (Gray, 1975), 250 or more of which may be school-age children. Present education facilities are clearly unable to accommodate such an increase in enrollment. Even the proposed new elementary school will not provide sufficient facilities, especially considering enrollment increases as a result of natural population growth. It is probable that another four classrooms (in addition to those planned) will be required at the elementary level by 1990. Secondary school facilities should be adequate to cope with projected increases although capacity enrollment levels may be reached during the 1990's. For the more immediate future, cafeteria facilities, shared by the adjacent secondary and elementary schools, may be warranted, particularly in view of the schools' removal from the town center. According to design capacities, expansions of other facilities, such as laboratories, should not be required at this time. An increase in the variety and scope of educational programs and activities, particularly at the secondary level, will probably occur in conjunction with the addition of the 6 to 10 new staff members who will be required during Phase II. In general the educational atmosphere should become healthier and more dynamic for students and teachers alike as a result of predicted growth within the system.

Recreational Amenities

As previously mentioned, Houston's most pressing need, in terms of recreation, is for more and more varied entertainment facilities. The projected 40% increase in population associated with Phase II of the Equity operation and the number of single transient workers that will be included in this increase will tend to aggravate the current situation. An independent restaurant-cabaret and a coffee-house for young adults might help to provide more adequate facilities for all members of society.

Active recreational facilities, such as the recreation center, ice arena, and curling rink, will likely become fully utilized over the next few years. The development of new facilities, such as a swimming pool or gymnasium complex would help to relieve this pressure and would add to the recreational diversity of the community.

Houston's projected population growth over the next seven years will be sufficiently large to affect regional recreational patterns as well as local ones. Hunting and fishing pressures will increase fairly dramatically, not only as a result of the increased local population, but also as a result of the greater number of tourists that will be attracted by the more highly developed town facilities. Although it may expose new areas and populations to hunting and fishing pressures, the Dungate Creek access route to the mine, could help to disperse these pressures within the Houston vicinity. Thus the aesthetic values associated with these sports might not be appreciably altered despite increased activity.

Local and regional parks officials recognize that the predicted population increase may warrant the creation of local parks, particularly a campground to service both residents and tourists. Both the Morice River and Owen Lake, which have outstanding recreational and aesthetic values, are being considered for potential park development. Increased participation in winter sports such as skiing and snow-mobiling will probably result, over the years, in the development of more local and regional facilities for these activities. In the immediate future, Houston's small ski hill and Smithers' Hudson's Bay mountain should be able to cope with added skiers. Dungate meadows will probably remain a popular spot for snow-mobile enthusiasts, and the possible new access route should not interfere with this activity.

Health

Houston's health facilities will experience a considerable increase in pressure as a result of the expanded population. While the Health and Human Resources Board may continue to provide emergency medical services, day-to-day medical requirements will warrant the addition of at least one resident doctor. This might diminish the current reliance on Burns Lake and Smithers practicioners for routine medical attention, generating a gradual demand for additional local practicioners. Finished office space is now available within the new shopping mall, and there should be no lack of space in the near future, as present municipal offices are vacated. Regional hospital facilities may require expansion, particularly if other projects are commenced during this period. Despite the services of an on-site first-aid crew and ambulance for mine employees, the community of Houston may also require an additional ambulance at this time. The 30 minute driving time between the mine and the community limits the value of the company's ambulance in emergency situations.

Increased demand for dental services may warrant the addition of both professional staff and new equipment, however the present practice has sufficient space to accommodate such expansion.

Cultural Amenities

The increased pressure on Houston's cultural amenities will probably necessitate their expansion, particularly in the case of local library facilities which are already inadequate. Reliance on Smithers and Terrace for cultural events will undoubtedly continue although population increases may warrant the establishment of music, drama, arts and crafts programs, sponsored by either the community or the local school board. Such growth will tend to occur spontaneously, Cultural opportunities offered by artists and artisans within the region should be considered as possible contributions to the Houston community.

Law Enforcement

As law enforcement currently presents little difficulty in Houston despite the semi-transient nature of the work force associated with the Northwood mill, it is likely that the relative peacefulness will continue regardless of anticipated growth. Local R.C.M.P. officials recommend that a close liaison between themselves and company officials be established at project commencement and that a strict policy of no firearms on site be maintained. The logistics of policing the large construction force some 20 miles from town may necessitate the immediate addition of an officer and mobile unit, and further additions may be required to police the larger resident population and the associated increase in vehicular traffic. Assessments of force requirements are made yearly, adjusting manpower and equipment according to need.

5.2.6 Social Considerations

As construction and operation activities are 23 miles removed from the nearest community, environmental disturbances will have a minimal social impact. The 1,400 acres of land occupied by the operation will not be available for recreational purposes, but as neither the Goosly property nor the area immediately surrounding it are currently used to any significant extent for recreational, hunting, or fishing purposes, the social value associated with this loss is negligable. The greatest impact will be of a visual nature: disruptions of land forms will continue throughout the duration of the operative. Air and water pollution during both phases have been assessed, and it is expected that local fish and wildlife populations, the recreational pursuits contingent upon these, and the values associated with them, will not be adversely affected. Noise created by weekly blasting will be audible within a maximum five-mile radius, and should therefore have negligeable social impact.

Construction of the new Dungate Creek road will cause some socio-environmental effects especially in so far as it provides increased public access to hitherto isolated areas. The unpredictable nature of the potential recreational and wildlife effects associated with increased access precludes any estimation of its net social value. Residents will tend to assess the new route according to their own life style and environmental ethic.

A more clear cut social liability generated by construction activity will be the increase in traffic volume within the community. During the first phase an average of two to four trucks per day, ranging from small pick-ups to large tandems, plus the vehicles driven by mine employees will travel to and from the mine site. During the second phase traffic will become somewhat more regular. It is expected that 75 tons of concentrate will be hauled daily, necessitating an average of four or five round trips made by 20-ton tandem trucks from the mine site to Topley Landing. Dungate Creek vehicular traffic will likely turn from Highway 16 onto Butler

Avenue, continuing south to Riverbank Drive and Omineca Way. A major disadvantage to this route is that it passes through both the elementary school zone and an established residential area. An alternate route, which would avoid the vicinity of the school, might be developed by constructing a new road extending east from 11th Street to meet Omineca Way.

Complete avoidance of residential areas would necessitate the construction of considerably more new road surfaces, however, the social benefits and costs of this alternative should be carefully considered before a final decision is made. If the route is to pass through residential areas, appropriate measures would be taken to ensure the safe crossing of school children and a minimum of disturbance to local residents with such mitigative actions as pedestrian crossings and lights, time restrictions on transport activities and noise screens. It may also be necessary to upgrade the quality of local roads to accommodate the increased traffic volume and weight.

5.2.7 Summary

From the preceding discussion, it is evident that the Equity project will have major social and economic impacts on the Houston community, necessitating local expansion and mitigative measures. A summary matrix indicating major and minimum impact of the various elements of the local and regional communities, major and minor expansion required to these elements, and mitigative measures required, is given on the following page.

As previously mentioned the potential benefits and disbenefits of community impacts will be determined to a large extent by the community itself. On the basis of recent historical developments as identified by Stranger and through discussions with members of the Houston community during the course of the study, it would appear that Houston will be receptive to a project of this nature and magnitude. Indeed the Equity project could greatly assist the community in realizing its desire to become a social and economic hub of activity within the Bulkley-Nechako region.

	Local Impact	Regional Impact	Local Expansion Required	Mitigative Measures Required
Population	X	0		0
Labour Force				
Skilled	X	X		
Unskilled	0	0		
Economy	X	0	X	0
Housing	X	0	X	X
Land Use	X	0	X	0
Communication	0	0	0	
Transportation	0	0	0	
Services/ Commercial	0	0	0	
Education	0	0	X	
Health	0	0	0	
Law Enforcement	0	0	0	
Culture/ Entertainment	X	0	X	
Recreation	0	0	0	0
Social-Env. Aspects	0	0		0

X - Major
0 - Minor

6

6.0 CONCLUSIONS AND RECOMMENDATIONS

The construction phase of the Sam Goosly project will have the major negative environmental impact, especially on the utility corridor and mine site. The negative impact associated with site preparation and construction activities in the city of Houston will be largely offset by the long term benefits of increased utilization of already developed services in the community.

Within the utility corridor there is only one area of major concern, that where the access route will move up through upper Dungate Creek before it comes out onto the Klo Creek Meadows. From a physical standpoint soil depth above bedrock and erosion potential in this area are high. However, with careful road construction techniques emphasizing road location, placement and maintenance of culverts being employed by the contractor, it is anticipated that these potential negative impacts will be at least transitory if not non-existant.

The impact on the biophysical environment in the mine site will be those associated with the clearing of the mine site. However, once the site has been cleared and the new building constructed on it, and taking into consideration the amounts of similar habitats in the overall area, the long term impact of development of the mine site is considered minimal.

On wastes, processes and emissions from the processing plant, impact are considered minimal however more long term in view of the long life of the proposed mine and mill complex. The potential does not exist should a problem occur in the tailings lagoon for those tailings to get into the Foxy Creek watershed which in its lower reaches are known to have fish present. It is anticipated that adequate design criteria will be included in the design of this tailings pond to minimize this potential impact.

The waste dump will have a major impact on those areas where the material is placed. However, reclamation and revegetation plans are such that in the long term the impact of these dumps should be minimal.

Major positive aspects of the development are the expansion of the industrial base within the Houston area with the benefit of long term employment and the impact of this on the Houston economy. The new access corridor will in addition to serving the mine provide people living in the Houston area with improved access into this area for both winter and summer recreational pursuits.

It is concluded that the Sam Goosly development will in the overview have minor negative biophysical impacts and major positive social and economic impacts considering the limited utilization of the area at the present time for any other significant use with the possible exception of some forestry potential, the development of a mine, mill and utility corridor complex should be encouraged.

7

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A

APPENDIX

Water Quality Data

WATER QUALITY DATA

Beak Consultants Limited

Table I: Chemical Analyses/Water Quality

Station

	1 Upper Foxy		2 Lower Foxy		3 "Camp" Creek		4 Upper Buck		5 Goosly Lake		6 "Burnt" Creek		7 "Eagle" Creek		8 Lower Buck	
	Summer[a]	Fall[b]	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall[d]
Temp. (°C)	7.8	0.0	13.0	3.8	11.0	2.8	10.5	2.2	16.0	7.2	9.5	3.0	8.8	1.6	12.5	4.5
Diss. Oxygen	10.2	11.9	9.2	11.1	10.2	12.1	9.4	10.7	8.3	7.8	10.4	10.8	9.2	11.1	9.0	10.4
Total Solids	64	108	65	97	111	221	66	116	59	100	96	104	86	121	95	94
Diss. Solids	56	106	57	92	104	189	60	110	48	90	92	98	80	115	88	90
Susp. Solids	8	2	8	5	7	32	6	6	11	10	4	6	6	6	7	4
pH	6.8	7.0	7.0	7.0	7.0	7.0	7.0	7.1	6.8	7.1	6.9	7.2	6.9	7.2	6.9	7.0
turbidity	1.0	1.0	2.0	1.0	14.0	3.4	3.0	3.0	2.0	1.0	2.0	1.0	3.0	4.5	1.0	1.0
cyanide	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver[c]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Arsenic[c]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper[c]	0.009	0.014	0.011	<0.005	0.009	0.014	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoride[c]	<0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	<0.1	0.2
Iron[c]	0.08	0.10	0.08	0.10	0.09	0.06	0.49	0.54	0.18	0.22	0.18	0.02	0.22	0.34	0.09	0.22
Mercury[c]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Lead[c]	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Antimony[c]	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Zinc[c]	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Flow (cfs)	13	12	11	20	1.0	1.0	5.0	5.0	-	-	<0.2	<0.2	<0.2	<0.2	16	2.5

a July 25, 26, 1973
b October 10,11, 1973
c dissolved metals
d location changed in fall survey

Beak Consultants Limited

385 Shell Road
Richmond/British Columbia
Canada/V6X 2W2
Telephone (604) 273-1601
Telex 04-507893

Client: Equity Mining Corporation
908 - 1111 W. Hastings
Vancouver, B.C.
V6E 2J3

Attention: Mr. E. Holt

Report of analysis:

Project: J5058
Date received: 14 May 1976
Date analyzed:
Number of samples: 6/8

Sample reference	8961	8962	8963	8964	8965	8966
pH	7.4	6.3	7.1	7.2	7.4	7.1
Filtrable Residue	1660	994	82	86	97	59
Nonfiltrable Residue	6	6	21	14	4	<1
Total Residue	1666	1000	103	100	101	59
Turbidity *	20	13	22	13	2.7	1.0
Total Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Arsenic	<0.005	0.043	<0.005	**	<0.005	<0.005
Total Copper	<0.005	<0.005	0.017	0.009	<0.005	<0.005
Total Iron	1.5	15	1.8	1.0	0.21	0.12
Total Lead	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Total Silver	<0.010	<0.010	0.010	<0.010	<0.010	<0.010
Total Zinc	<0.005	0.42	0.017	0.005	0.008	0.005

Ref: 8961 Artesian #53
8962 Artesian #128
8963 Station 3 - Lower Camp Creek
8964 Station 4A - Buck Creek below confluence
8965 Station 1B - Lu Creek
8966 Station 1A - Upper Foxy above confluence

* The results are reported in NTU's (equivalent to JTU and FTU)
** Result to follow

All results expressed as ppm except
pH unless otherwise stated.
1 ppm = 1 mg/l = 1 lb/100,000 Imp. gal.

Beak Consultants Limited

385 Shell Road
Richmond/British Columbia
Canada/V6X 2W2
Telephone (604) 273-1601
Telex 04-507893

Client Equity Mining Capital

Report of analysis:

Project: J5058

Date received: 14 May 1976

Date analyzed:

Number of samples: 2/8

Sample reference	8967	8968				
pH	7.1	6.7				
Filtrable Residue	96	77				
Nonfiltrable Residue	3	1				
Total Residue	99	78				
Turbidity	3.4	1.4				
Total Antimony	<0.05	<0.05				
Total Arsenic	<0.005	<0.005				
Total Copper	0.014	<0.005				
Total Iron	0.41	0.32				
Total Lead	<0.020	<0.020				
Total Silver	<0.010	<0.010				
Total Zinc	0.019	0.005				

Ref: 8967 Station 3A - Upper Camp Creek
8968 Station 3B - Little Camp Creek

All results expressed as ppm except
pH unless otherwise stated.
1 ppm = 1 mg/l = 1 lb/100,000 Imp. gal.

WATER QUALITY DATA

Environment Canada (EPS)

TURBIDITY, CONDUCTIVITY AND RESIDUE CONTENT OF THE WATERSHED ADJACENT TO THE GOOSLY DEVELOPMENT - JULY 26, 1974

Station Number	Turbidity F.T.U.'s	Conduct µmho/cm	Total Res. mg/l ±2.5	Filterable Res. mg/l ±2.5	Non-Filterable Res.* mg/l ±2.5
1	2.6	160	109	109	<2.5
2	2.5	73	42	42	<2.5
3	4.4	280	168	168	<2.5
4	15.0	55	481	481	<2.5
5	2.2	280	188	183	5.0
6	3.4	88	66	66	<2.5
7	1.8	110	63	63	<2.5
8	9.1	200	135	135	<2.5
9	9.5	170	121	121	<2.5
10	4.2	130	95	95	<2.5
11	3.5	82	69	69	<2.5

* Obtained by subtraction-detection limit = 2.5 mg/l

< Indicates less than the detection limit

BIONUTRIENT CONTENT OF THE WATERSHED ADJACENT TO THE GOOSLY DEVELOPMENT - July 26, 1974

Station Number	TPO_4 mgP/l ±.005	NO_3 mgN/l ±.005	NO_2 mgN/l ±.005	SO_4 mg/l ±.005
1	.023	<.01	<.005	-
2	.019	<.01	<.005	<5
3	.013	<.01	<.005	91
4	.015	<.01	<.005	<5
5	.052	<.01	<.005	10
6	.015	<.01	<.005	<5
7	.029	<.01	<.005	13
8	.020	<.01	<.005	52
9	.017	<.01	<.005	43
10	.027	<.01	<.005	10
11	<.01	<.01	<.005	<5

< Indicates less than the detection limit

Heavy Metal Analysis for July 14th and October 13th, 1973.

Metal	Date (1973)	Sample Site No. 1	2	3	4	5	6	7	8	9	10	11
Cu	July 14	.01	<0.01	<0.01	.01	0.01	<0.01	.01	.02	.04	.01	<0.01
	Oct. 13	<0.03	<0.03	<0.03	0.55	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Pb	July 14	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Oct. 13	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Zn	July 14	<0.01	<0.01	.03	<.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01
	Oct. 13	<0.06	<0.06	0.07	0.77	0.07	<0.06	0.05	<0.06	<0.06	<0.06	<0.06
Fe	July 14	.76	.24	.92	.52	.40	.62	.36	---	.33	.96	.61
	Oct. 13	0.21	0.14	2.50	57.0	2.90	0.11	0.11	1.30	0.47	0.89	0.30
Ni	July 14	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
	Oct. 13	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
Mo	July 14	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Oct. 13	---	---	---	---	---	---	---	---	---	---	---
Cd	July 14	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
	Oct. 13	---	---	---	---	---	---	---	---	---	---	---
Ca	July 14	38.0	19.0	3.8	3.2	28.0	9.8	17.0	8.1	15.0	12.0	8.6
	Oct. 13	18.0	3.9	51.0	10.0	31.0	10.0	24.0	12.0	22.0	13.0	8.3

All values expressed as mg/ℓ unless otherwise indicated.

Continued --

Metal	Date (1973)	Sample Site No.										
		1	2	3	4	5	6	7	8	9	10	11
Mg	July 14	5.1	6.0	3.1	2.3	7.9	6.0	7.7	3.6	7.4	8.2	7.1
	Oct. 13	3.50	1.50	4.80	4.40	6.50	3.20	6.30	3.80	6.50	5.00	3.40
Mn	July 14	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06
	Oct. 13	---	---	---	---	---	---	---	---	---	---	---
Cr	July 14	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Oct. 13	---	---	---	---	---	---	---	---	---	---	---
Ag	July 14	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
	Oct. 13	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Sb	July 14	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Oct. 13	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Hg	July 14	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ
	Oct. 13	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ	<0.8 μg/ℓ
As	July 14 Oct. 13	Nitric Acid interferes with As test.										

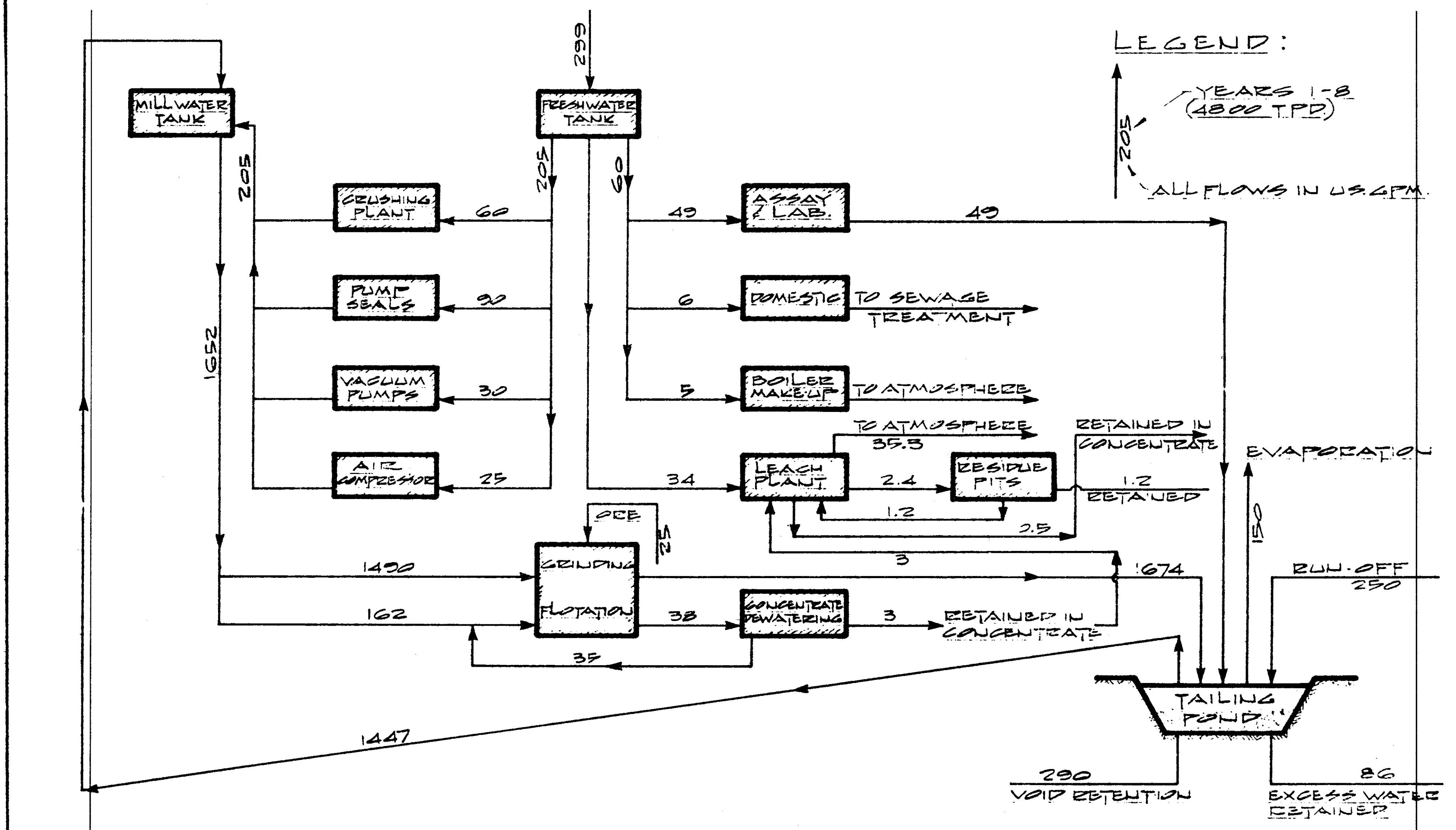
All values expressed as mg/ℓ unless otherwise indicated.

TOTAL AND DISSOLVED METAL ANALYSES - JULY 26, 1974

Station Number		Cd ppm ±0.01	Cr ppm ±0.02	Cu ppm ±0.01	Fe ppm ±0.03	Mo ppm ±0.1	Pb ppm ±0.02	Zn ppm ±0.01
1	Total	<0.01		0.01	0.34		0.02	0.05
	Dissolved	<0.01	<.02	<0.01	0.15	<0.3	<0.02	<0.01
2	Total	<0.01		0.02	0.20		0.02	0.03
	Dissolved	<0.01	<.02	<0.01	0.09	<0.3	<0.02	<0.01
3	Total	<0.01		0.05	0.18		<0.02	0.04
	Dissolved	<0.01	<.02	0.01	<0.03	<0.3	<0.02	<0.01
4	Total	<0.01		0.08	0.31		0.02	0.07
	Dissolved	<0.01	<.02	<0.01	0.14	<0.3	<0.02	<0.01
5	Total	<0.01		0.04	1.6		0.02	0.08
	Dissolved	<0.01	<.02	0.01	0.43	<0.3	<0.02	0.03
6	Total	<0.01		0.03	0.23		0.02	0.02
	Dissolved	<0.01	<.02	<0.01	<0.03	<0.3	<0.02	<0.01
7	Total	<0.01		0.03	1.3		0.04	0.01
	Dissolved	<0.01	<.02	0.02	0.37	<0.3	<0.02	<0.01
8	Total	<0.01		0.07	0.76		<0.02	0.05
	Dissolved	0.02	<.02	0.02	0.05	<0.3	<0.02	<0.01
9	Total	<0.01		0.02	0.80		<0.02	0.02
	Dissolved	<0.01	<.02	<0.01	0.16	<0.3	<0.02	<0.01
10	Total	<0.01		0.03	0.87		0.03	0.04
	Dissolved	<0.01	<.02	0.01	0.44	<0.3	<0.02	<0.01
11	Total	<0.01		0.02	0.50		0.02	0.02
	Dissolved	<0.01	<.02	<0.01	0.17	<0.3	<0.02	<0.01

< Denotes less than the dection limit

DRAWINGS



DSGN.	DRAWN	CHECK	APPR	ISSUED FOR	DATE	REV	DESCRIPTION OF REVISION
JMB	Th.v.E	[illegible]	[illegible]		18/[illegible]/76		
	Th.v.E		W.P.	ENVIRONMENTAL IMPACT STUDY	23/8/76		TONNAGE & FLOWS REVISED

EQUITY MINING CORPORATION
SAM GOOSLY PROJECT HOUSTON B.C.

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

GENERAL WATER BALANCE ADDENDUM - A -

SCALE: ——

DRAWING No. 1 B 742 611 FIG. VII-6

REV. A

TABLES

BEAK
J5058A

TABLE 1: Water Quality Summary
Buck and Foxy Creek Systems

PARAMETER	BUCK CREEK MEAN	BUCK CREEK RANGE	BUCK CREEK N	FOXY CREEK MEAN	FOXY CREEK RANGE	FOXY CREEK N	DETECTION LIMIT
Temperature	-	0 - 16	28	-	0 - 13	10	
Dissolved Oxygen	10.7	7.8 - 13	22	11.3	9.2 - 13	7	
pH (median)	7	6.7 - 7.2	16	7	6.8 - 7.4	7	
Total Residue	119	63 - 481	24	90	42 - 168	9	
Filterable Residue	113	48 - 481	24	87	42 - 168	9	
Sulfate	18	<5 - 52	8	48	<5 - 91	2	<5
Conductivity	123	55 - 280	8	171	73 - 280	3	
Turbidity	3.2	1 - 15	39	3.3	1 - 14	15	
Calcium	14.5	3.2 - 28	16	22	2.8 - 51	6	
Cyanide	*	*	12	*	*	4	<0.005
Magnesium	5.6	2.3 - 8.2	16	4	3.1 - 6.0	6	
Total Phosphate	0.023	0.01 - 0.052	8	0.018	0.012 - 0.023	3	
Nitrate - N	*	*	8	*	*	3	<0.01
Nitrite - N	*	*	8	*	*	3	<0.005

* Not detectible

Results in mg/l unless otherwise stated

SOURCE: Beak Consultants & Environment Canada (EPS)

BEAK J5058A

TABLE 2: Trace Element Summary
Buck and Foxy Creek Systems

PARAMETER	BUCK CREEK MEAN	BUCK CREEK RANGE	BUCK CREEK N	FOXY CREEK MEAN	FOXY CREEK RANGE	FOXY CREEK N	DETECTION LIMIT[2]
Antimony[1]	*	*	12	*	*	4	<0.025
Arsenic[1]	*	*	12	*	*	4	<0.01
Cadmium[1]	0.01	<0.01 - 0.02	8	*	*	3	<0.01
Chromium[1]	*	*	8	*	*	3	<0.02
Copper[1]	0.01	<0.01 - 0.014	20	0.01	<0.01 - 0.014	7	<0.01
Fluoride[1]	0.18	<0.1 - 0.2	12	0.15	<0.1 - 0.2	4	<0.1
Iron[1]	0.22	<0.03 - 0.54	20	0.09	<0.03 - 0.15	7	<0.03
Lead[1]	*	*	20	*	*	7	<0.02
Manganese	*	*	8	*	*	3	<0.06
Molybdenum[1]	*	*	8	*	*	3	<0.3
Mercury	*	*	28	*	*	10	<0.0008
Nickel	*	*	16	*	*	6	<0.06
Silver[1]	*	*	12	*	*	4	<0.01
Zinc[1]	0.01	<0.01 - 0.03	20	*	*	7	<0.01

* Not detectible

1 Dissolved metal concentration
2 Where analyses were performed under different analyticla conditions, the highest detection limit has been reported.

Results in mg/l unless otherwise stated

SOURCE: Beak Consultants & Environment Canada (EPS)

TABLE 3: Non-Filtrable Residue - Seasonal Summary[1]
Buck and Foxy Creek Systems

	"CAMP"[2]	BUCK	UPPER FOXY	LOWER FOXY
SPRING[3]	4	8	5	29
SUMMER[4]	7	7	8	8
FALL[4]	32	7	2	5

1 Concentration expressed as mg/l; mean values
2 Tributary of Buck Creek
3 Multiple survey
4 Single survey

SOURCE: Beak Consultants

BEAK J5058A

Table 4: Summary of benthic invertebrate data for stations near the Goosly property, July and October 1973 (Beak, 1974). Abundance Ratings were employed as the expression of numerical abundance*.

STATION	JULY 1973 Ephemeroptera†	Plecoptera†	Diptera§	OCTOBER 1973 Ephemeroptera	Plecoptera	Diptera
1 Upper Foxy Creek	3	3	2	3	3	2
2 Lower Foxy Creek	3	2	1	3	3	3
3 "Camp" Creek	3	3	2	3	2	2
4 Upper Buck Creek	3	3	2	3	1	2
6 "Burnt" Creek	3	3	2		Absent	
8 Lower Buck Creek	3	2	2	3	3	2

* Index:

3 = Abundant

2 = Moderately Abundant

1 = Few

† = Group 3 (Intolerant)

§ = Group 2 (Facultative)

BEAK J5058A

Table 5: Relative abundance of benthic invertebrates collected from stations near the Goosly property in July 1973. (Hallem & Kussat, 1974). Each value is the total of three samples taken from each station.

	SAMPLING SITE NO.										
	1	2	3	4	5	6	7	8	9	10	11
GROUP 3 ORGANISMS											
Ephemeroptera	66	50	81	19	2	66	19	-	56	24	391
Trichoptera	6	17	3	-	1	5	2	-	-	-	1
Plecoptera	27	17	22	2	2	19	-	-	5	18	285
Coleoptera	24	30	-	-	-	1	-	-	1	4	189
Megaloptera	4	-	-	-	-	-	-	-	5	-	-
Lepidoptera	-	-	-	-	-	-	-	-	4	-	-
TOTAL	127	114	106	21	5	91	21	-	71	46	866
GROUP 2 ORGANISMS											
Diptera - Chironimidae	139	183	25	69	41	71	37	102	20	73	730
Other Diptera	47	11	18	25	9	1	2	2	20	23	241
Nematoda	-	2	-	-	-	6	1	-	-	8	2
Gastropoda	-	6	-	-	-	-	-	-	-	1	3
Crustacea	5	4	-	-	-	-	-	-	2	27	5
Arachnida, Hydracarina	-	5	16	-	1	7	-	2	6	12	2
Hydrozoa	-	3	-	-	-	-	1	-	-	-	1
TOTAL	191	214	59	94	51	85	41	106	48	144	984
GROUP 3 ORGANISMS											
Oligochaeta	1	-	-	-	-	-	1	1	-	4	3
Polychaeta	-	-	-	-	-	-	1	-	-	-	-
TOTAL	1	-	-	-	-	-	2	1	-	4	3

BEAK
J5058A

Table 6: Relative abundance of benthic invertebrates collected from stations near the Goosly property in October 1973 (Hallem & Kussat, 1974). Each value is the total of three samples taken from each station.

	SAMPLING SITE NO.										
	1	2	3	4	5	6	7	8	9	10	11
GROUP 3 ORGANISMS											
Ephemeroptera	72	105	59	1	-	12	12	-	45	210	38
Trichoptera	8	7	2	-	-	3	-	9	-	-	-
Plecoptera	127	147	51	-	-	30	3	-	78	35	147
Coleoptera	3	4	-	-	1	-	-	-	-	-	146
TOTAL	210	263	112	1	1	45	15	9	123	245	331
GROUP 2 ORGANISMS											
Diptera - Chironomidae	17	82	9	31	3	105	3	31	3	42	249
Other Diptera	6	14	-	2	2	16	16	27	48	27	8
Gastropoda	-	-	-	-	-	-	-	-	-	-	1
TOTAL	23	96	9	33	5	121	19	58	51	69	258
GROUP 1 ORGANISMS											
Oligochaeta	-	-	-	-	-	-	-	-	-	-	1
TOTAL	-	-	-	-	-	-	-	-	-	-	1

TABLE 7: Fish species found in Buck Creek (B.C. Fish & Wildlife Branch)

Chinook Salmon *(Onconhynchus tshawytscha)*
Coho Salmon *(O. kisutch)*
Pink Salmon *(O. gorbuscha)*
Steelhead Trout *(Salmo gairdnerii)*
Dolly varden Char *(Salvelinus malma)*
Rocky Mountain Whitefish *(Prosopium williamsoni)*
Prickly Sculpin *(Cottus asper)*
Squawfish *(Ptychocheilus sp.)*
Longnose Sucker *(Catostomus catostomus)*
Large Scale Sucker *(C. macrocheilus)*
Longnose Dace *(Rhinichthys cataractoe)*

BEAK
J5058A

TABLE 8: Escapement data or numbers of individuals observed entering the Buck Creek system (Fisheries & Marine Service)*

YEAR	STEELHEAD	COHO	PINK	CHINOOK
1928	L	L	N.O.	N.O.
1929	L	L	N.O.	N.O.
1948	N.O.	L	N.O.	N.O.
1949	N.O.	L	N.O.	N.O.
1951	N.O.	300	N.O.	N.O.
1952	N.O.	M	N.O.	N.O.
1953	N.O.	300	N.O.	N.O.
1954	N.O.	N.O.	N.O.	N.O.
1955	N.O.	60	N.O.	N.O.
1956	N.O.	50	N.O.	N.O.
1957	N.O.	50	N.O.	N.O.
1958	N.O.	200	N.O.	N.O.
1959	N.O.	200	N.O.	N.O.
1960	N.O.	200	N.O.	N.O.
1961	N.O.	N.O.	N.O.	N.O.
1962	N.O.	500	N.O.	N.O.
1963	N.O.	400	N.O.	N.O.
1964	N.O.	600	N.O.	N.O.
1965	N.O.	200	N.O.	N.O.
1966	N.O.	200	N.O.	N.O.
1967	N.O.	200	100	N.O.
1968	N.O.	200	N.O.	N.O.
1969	N.O.	300	N.O.	N.O.
1970	N.O.	300	N.O.	50
1971	N.O.	300	N.O.	N.O.
1972	N.O.	N.O.	N.O.	25
1973	N.O.	N.O.	N.O.	N.O.
1974	N.O.	N.O.	N.O.	N.O.
1975	N.O.	150	N.O.	N.O.

* N.O. = None Observed
L = Light
M = Medium

BEAK
J5058A

TABLE 9: Heavy Metal Analyses of Fish Tissues Collected from Buck Creek (Hallan & Kussat, 1974)

METAL	CONCENTRATION (ppm) WET	DRY
Copper	2.6	11.0
Zinc	21.0	92.0
Cadmium	0.34	1.5

TABLE 10: Escapement data on Number of Individuals Observed Entering Maxan Creek (Fisheries & Marine Service)*

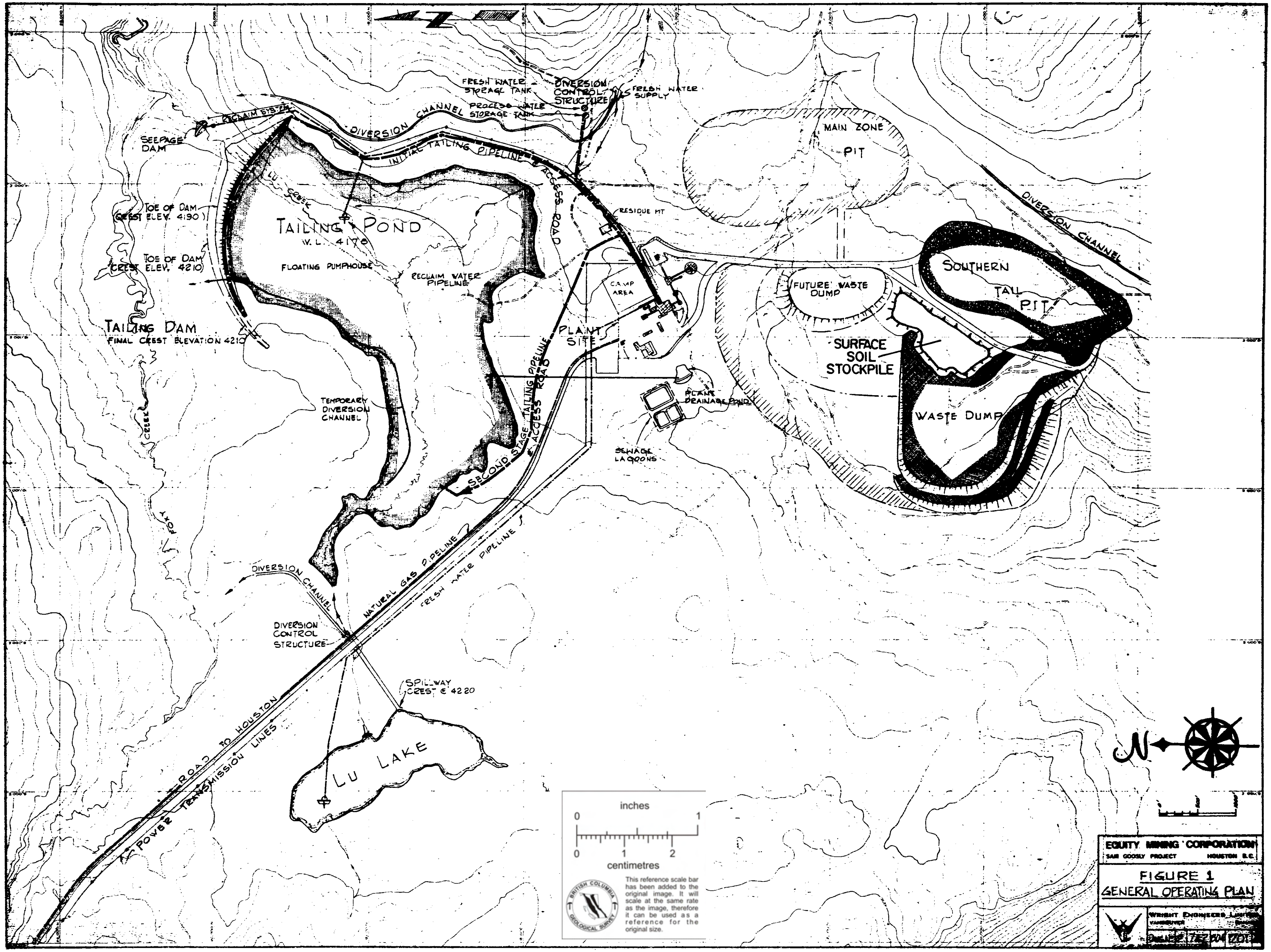
YEAR	COHO	SOCKEYE
1965	100	N.O.
1966	200	N.O.
1967	N.O.	N.O.
1968	400	N.O.
1969	500	200
1970	N.O.	N.O.
1971	300	300
1972	70	N.O.
1973	N.O.	N.O.
1974	N.O.	N.O.
1975	N.O.	N.O.

* N.O. - None Observed

TABLE 11: Gill Netting Results of Maxan Lake, September 1973 (B.C. Fish & Wildlife Branch)

SPECIES	NUMBER
Mountain Whitefish	1
Largescaled Sucker	4
Longnose Sucker	3
Prickly Sculpin	1
Redside Shiner	10
Squawfish	15
Peamouth Chub	22

FIGURES


FRESH WATER STORAGE TANK
DIVERSION CONTROL STRUCTURE
FRESH WATER SUPPLY
PROCESS WATER STORAGE TANK
RECLAIM SYSTEM
DIVERSION CHANNEL
SEEPAGE DAM
INITIAL TAILING PIPELINE & ACCESS ROAD
MAIN ZONE PIT
LU CREEK
TOE OF DAM (CREST ELEV. 4190)
TAILING POND
W.L. 4178
RESIDUE MT
DIVERSION CHANNEL
TOE OF DAM (CREST ELEV. 4210)
FLOATING PUMPHOUSE
RECLAIM WATER PIPELINE
CAMP AREA
SOUTHERN TAIL PIT
FUTURE WASTE DUMP
TAILING DAM
FINAL CREST ELEVATION 4210
PLANT SITE
SURFACE SOIL STOCKPILE
TEMPORARY DIVERSION CHANNEL
SECOND STAGE TAILING PIPELINE & ACCESS ROAD
PLANT DRAINAGE POND
WASTE DUMP
SEWAGE LAGOONS
FOXY CREEK
DIVERSION CHANNEL
NATURAL GAS PIPELINE
FRESH WATER PIPELINE
DIVERSION CONTROL STRUCTURE
SPILLWAY CREST © 4220
ROAD TO HOUSTON
POWER TRANSMISSION LINES
LU LAKE
N
inches
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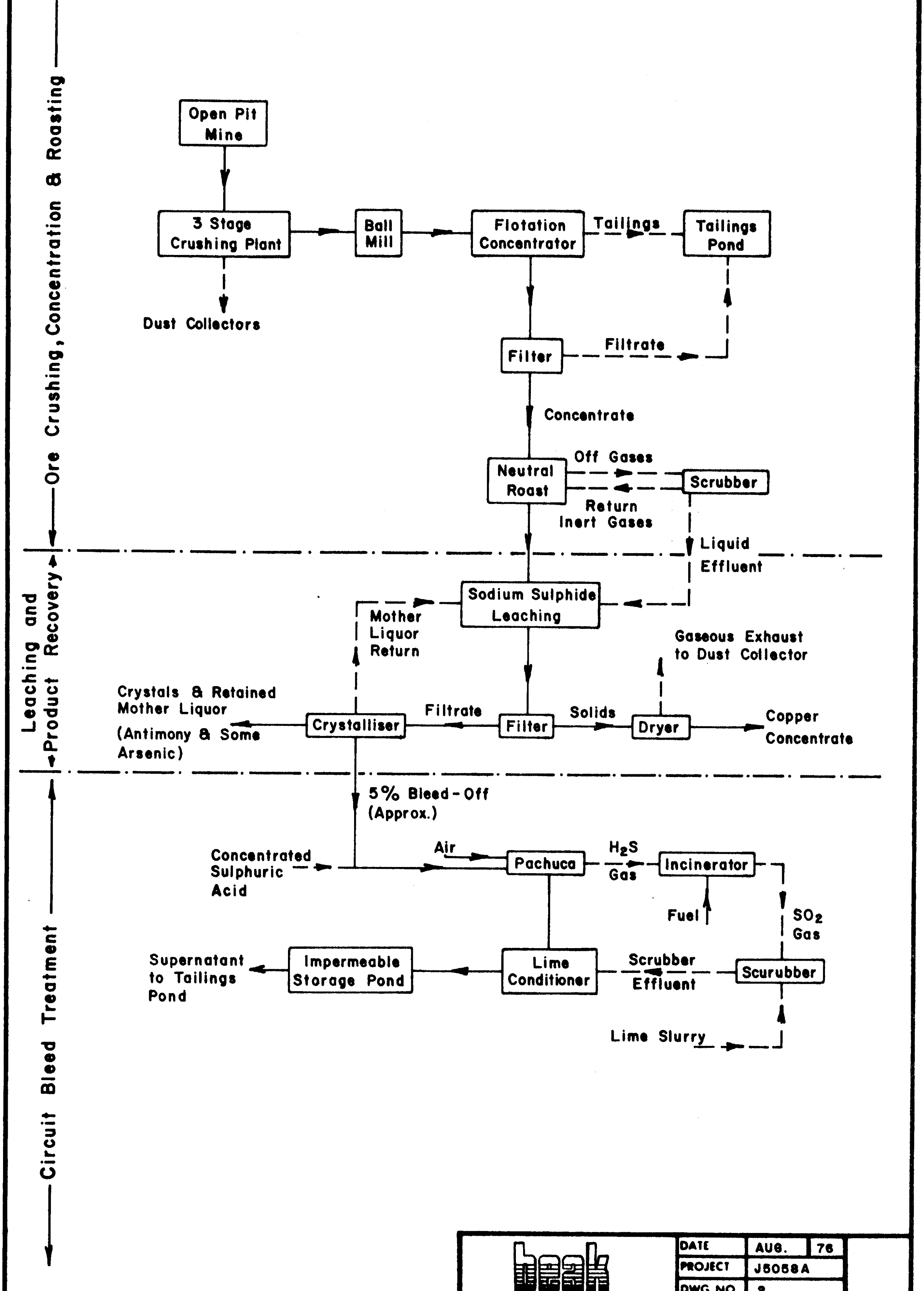
1
2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.
BRITISH COLUMBIA GEOLOGICAL SURVEY
EQUITY MINING CORPORATION
SAM GOOSLY PROJECT
HOUSTON B.C.
FIGURE 1
GENERAL OPERATING PLAN
WRIGHT ENGINEERS LIMITED
VANCOUVER

— PROCESS FLOW DIAGRAM —



SAM GOOSLY PROJECT

HISTORY & PROPOSED DEVELOPMENT SCHEDULE

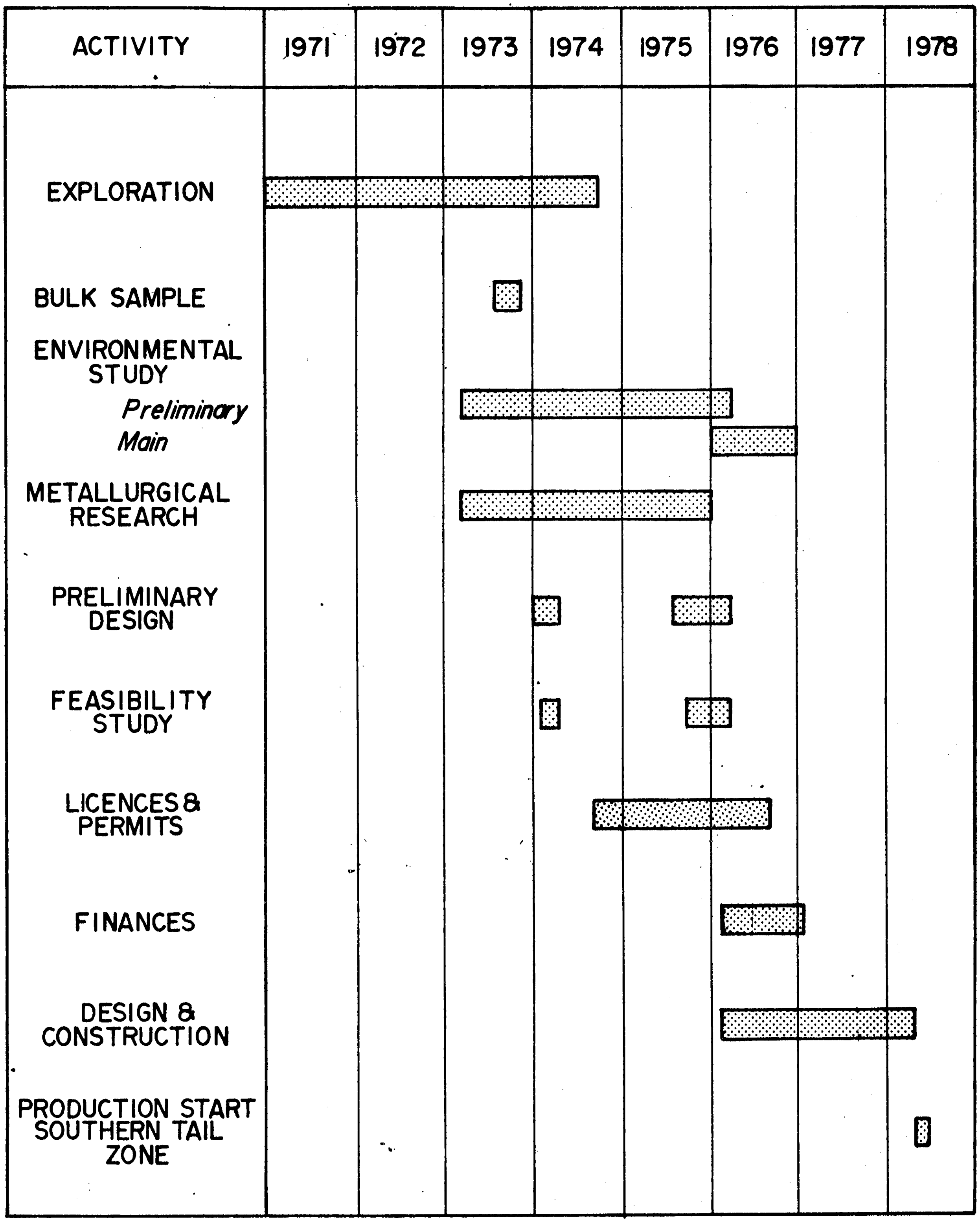
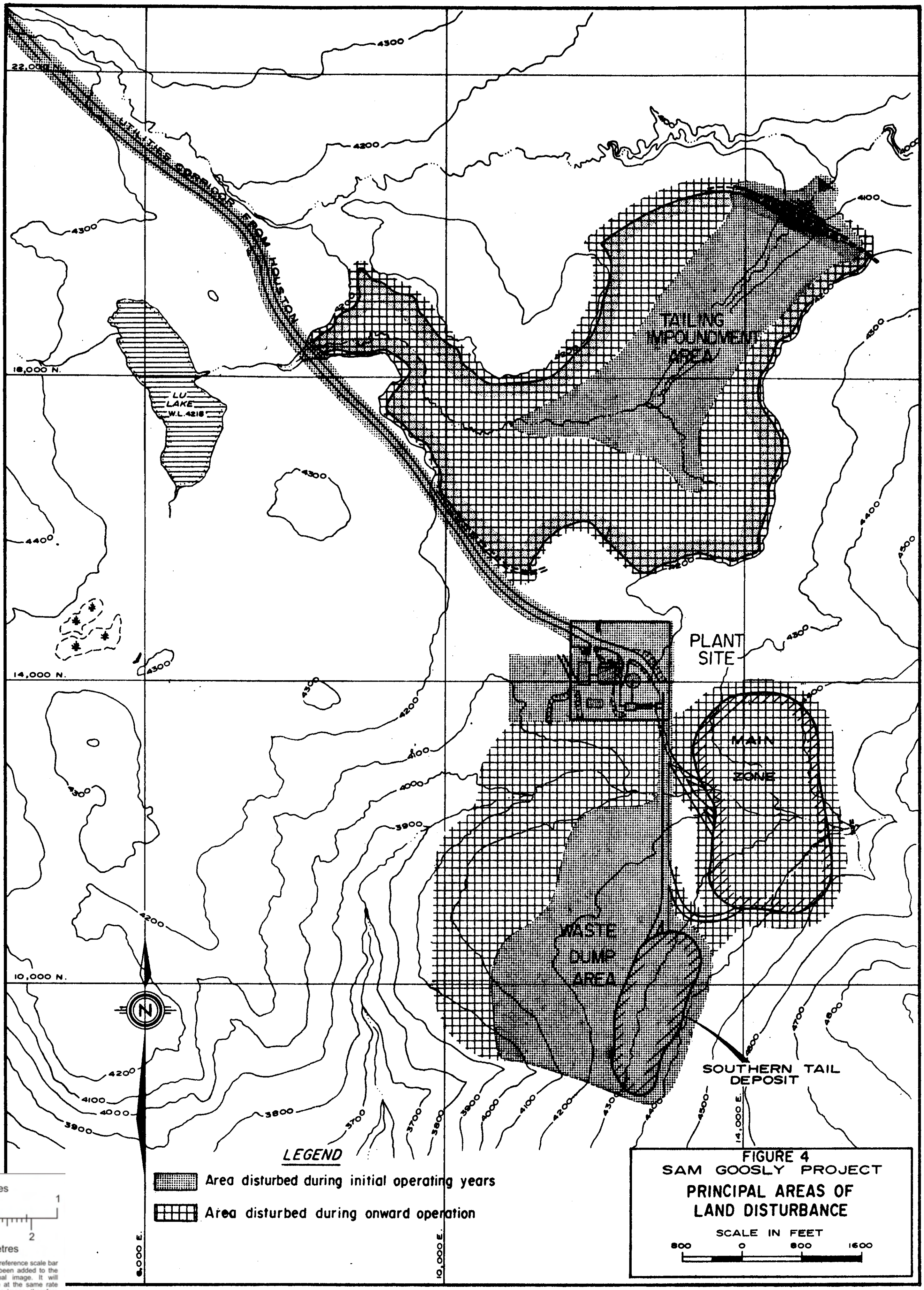


FIGURE 3


UTILITIES CORRIDOR FROM HOUSTON
TAILING IMPOUNDMENT AREA
LU LAKE W.L. 4218
PLANT SITE
MAIN ZONE
WASTE DUMP AREA
SOUTHERN TAIL DEPOSIT
22,000 N.
18,000 N.
14,000 N.
10,000 N.
6,000 E.
10,000 E.
14,000 E.
LEGEND
Area disturbed during initial operating years
Area disturbed during onward operation
FIGURE 4
SAM GOOSLY PROJECT
PRINCIPAL AREAS OF LAND DISTURBANCE
SCALE IN FEET
800 0 800 1600

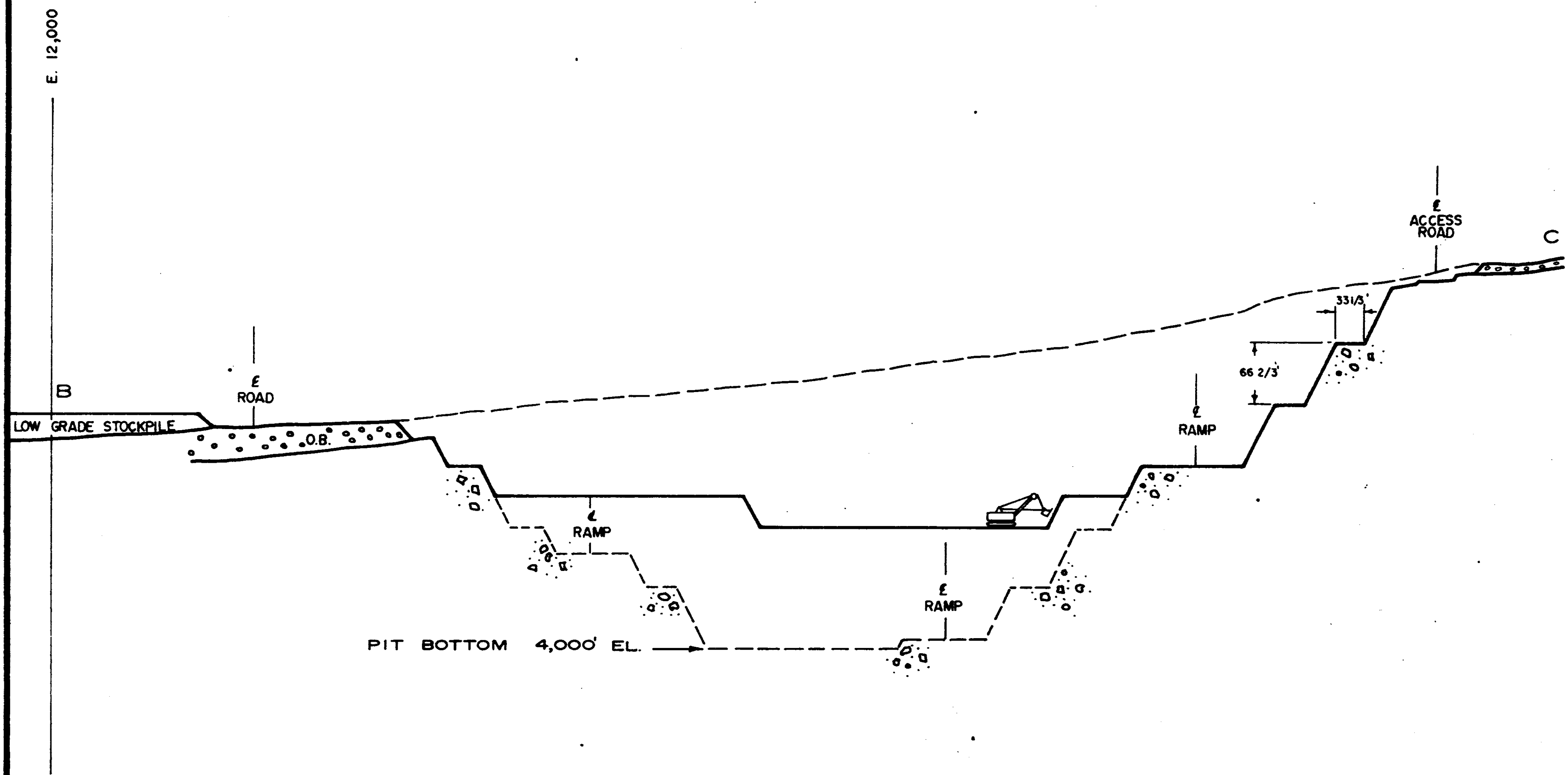
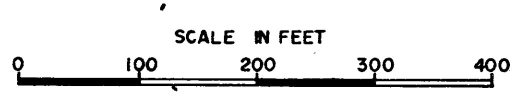
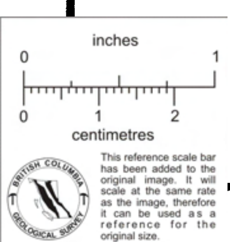


FIGURE 5:

SECTION THROUGH SOUTHERN TAIL OPEN PIT. MINE LOOKING NORTHEAST





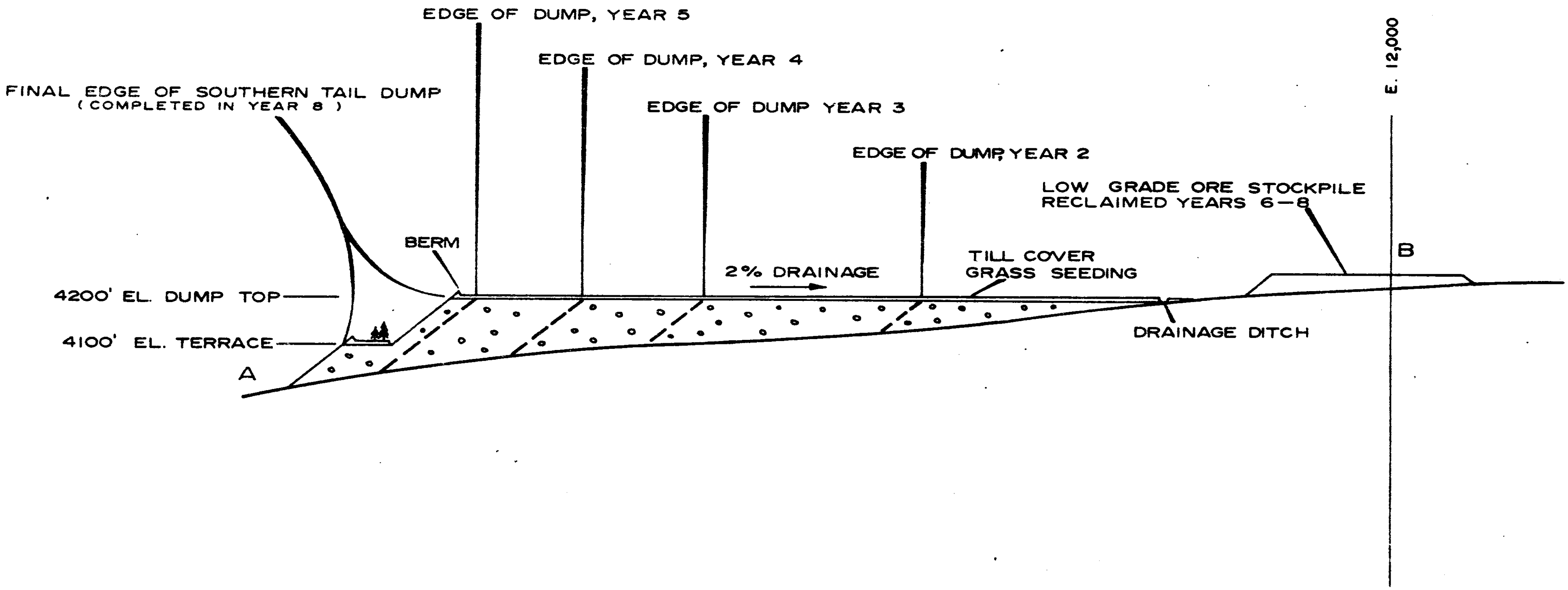
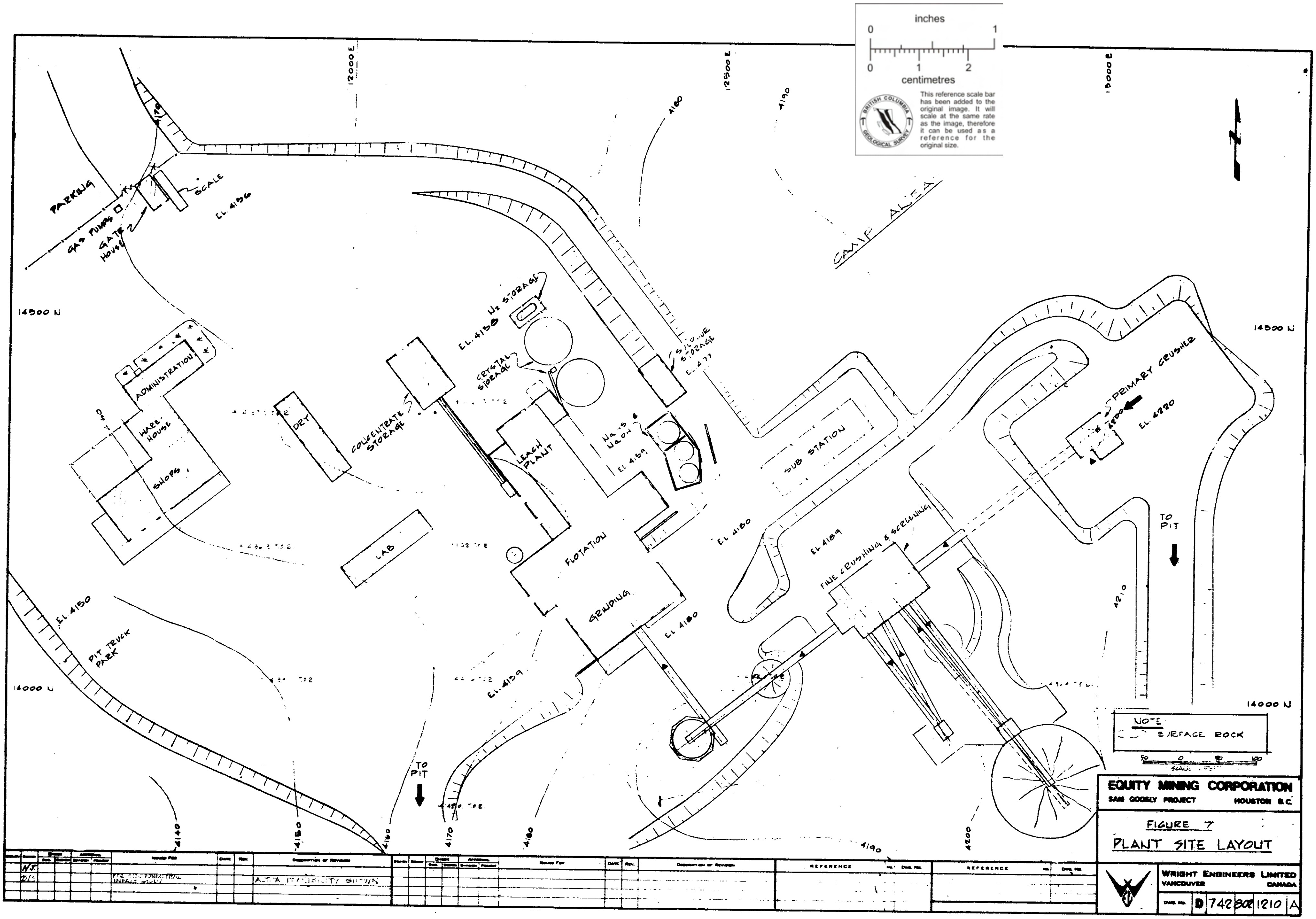


FIGURE 6:

SECTION THROUGH WASTE DUMP LOOKING NORTHERLY

SCALE IN FEET

0 100 200 300 400 500 600



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BRITISH COLUMBIA GEOLOGICAL SURVEY
12000 E
12500 E
13000 E
14500 N
14000 N
PARKING
GAS PUMPS
GATE HOUSE
SCALE
EL. 4156
CAMP AREA
ADMINISTRATION
WARE-HOUSE
SHOPS
DRY
LAB
CONCENTRATE STORAGE
CRYSTAL STORAGE
LEACH PLANT
FLOTATION
GRINDING
SUB STATION
PRIMARY CRUSHER
EL. 4220
FINE CRUSHING & SCREENING
EL. 4189
EL. 4180
EL. 4159
EL. 4150
PIT TRUCK PARK
TO PIT
NOTE:
SURFACE ROCK
EQUITY MINING CORPORATION
SAM GOOSLY PROJECT
HOUSTON B.C.
FIGURE 7
PLANT SITE LAYOUT
WRIGHT ENGINEERS LIMITED
VANCOUVER
CANADA
D 742808 1210 A

* CLASS 1 — SOILS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS IN USE FOR CROPS.

The soils are deep, are well to imperfectly drained, hold moisture well, and in the virgin state were well supplied with plant nutrients. They can be managed and cropped without difficulty. Under good management they are moderately high to high in productivity for a wide range of field crops.

* CLASS 2 — SOILS IN THIS CLASS HAVE MODERATE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE MODERATE CONSERVATION PRACTICES.

The soils are deep and hold moisture well. The limitations are moderate and the soils can be managed and cropped with little difficulty. Under good management they are moderately high to high in productivity for a fairly wide range of crops.

CLASS 3 — SOILS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES.

The limitations are more severe than for Class 2 soils. They affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. Under good management they are fair to moderately high in productivity for a fair range of crops.

CLASS 4 — SOILS IN THIS CLASS HAVE SEVERE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES, OR BOTH.

The limitations seriously affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. The soils are low to fair in productivity for a fair range of crops but may have high productivity for a specially adapted crop.

CLASS 5 — SOILS IN THIS CLASS HAVE VERY SEVERE LIMITATIONS THAT RESTRICT THEIR CAPABILITY TO PRODUCING PERENNIAL FORAGE CROPS, AND IMPROVEMENT PRACTICES ARE FEASIBLE.

The limitations are so severe that the soils are not capable of use for sustained production of annual field crops. The soils are capable of producing native or tame species of perennial forage plants, and may be improved by use of farm machinery. The improvement practices may include clearing of bush, cultivation, seeding, fertilizing, or water control.

CLASS 6 — SOILS IN THIS CLASS ARE CAPABLE ONLY OF PRODUCING PERENNIAL FORAGE CROPS, AND IMPROVEMENT PRACTICES ARE NOT FEASIBLE.

The soils provide some sustained grazing for farm animals, but the limitations are so severe that improvement by use of farm machinery is impractical. The terrain may be unsuitable for use of farm machinery, or the soils may not respond to improvement, or the grazing season may be very short.

CLASS 7 — SOILS IN THIS CLASS HAVE NO CAPABILITY FOR ARABLE CULTURE OR PERMANENT PASTURE.

This class also includes rockland, other non-soil areas, and bodies of water too small to show on the maps.

0 — ORGANIC SOILS (Not placed in capability classes).

Goosly Project

◆◆◆◆◆ Utilities Corridor

0 Miles 2

SUBCLASSES

Excepting Class 1, the classes are divided into subclasses on the basis of kinds of limitation. The subclasses are as follows:

SUBCLASS C: adverse climate – The main limitation is low temperature or low or poor distribution of rainfall during the cropping season, or a combination of these.

SUBCLASS D: undesirable soil structure and/or low permeability – The soils are difficult to till, absorb water slowly or the depth of the rooting zone is restricted.

*SUBCLASS E: erosion damage – Past damage from erosion limits agricultural use of the land.

*SUBCLASS F: fertility – Low natural fertility due to lack of available nutrients, high acidity or alkalinity, low exchange capacity, high levels of calcium carbonate or presence of toxic compounds.

SUBCLASS I: inundation – Flooding by streams or lakes limits agricultural use.

SUBCLASS M: moisture – A low moisture holding capacity, caused by adverse inherent soil characteristics, limits crop growth. (Not to be confused with climatic drought).

*SUBCLASS N: salinity – The soils are adversely affected by soluble salts.

SUBCLASS P: stoniness – Stones interfere with tillage, planting, and harvesting.

SUBCLASS R: shallowness to solid bedrock – Solid bedrock is less than three feet from the surface.

*SUBCLASS S: soil limitations – A combination of two or more subclasses D, F, M and N.

SUBCLASS T: adverse topography – Either steepness or the pattern of slopes limits agricultural use.

SUBCLASS W: excess water – Excess water other than from flooding limits use for agriculture. The excess water may be due to poor drainage, a high water table, seepage or runoff from surrounding areas.

SUBCLASS X: minor cumulative limitations – Soils having a moderate limitation due to the cumulative effect of two or more adverse characteristics which individually would not affect the class rating. (This subclass is always used alone and only one class below the best possible in a climatic subregion).

CONVENTIONS

Large arabic numerals denote capability classes.
Small arabic numerals placed after a class numeral give the approximate proportion of the class out of a total of 10. Letters placed after class numerals denote the subclasses, i.e. limitations.

*Denotes class or subclass not present on this map.

EXAMPLES

An area of Class 4 land with topography and stoniness limitations is shown thus: 4^{T}_{P}

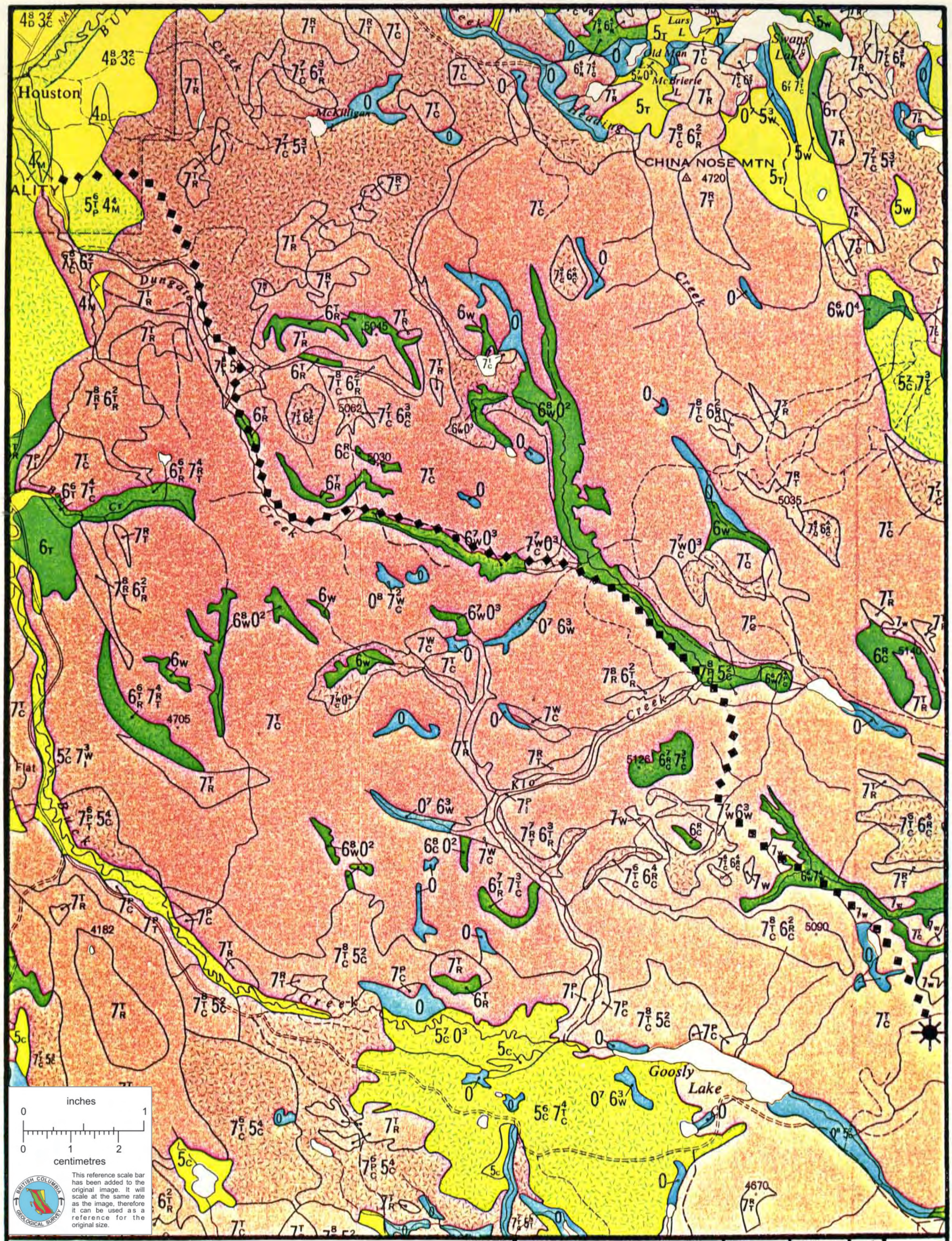
An area of Class 2 with topographic limitation, and Class 4 with stoniness limitation, in the proportions of 7:3 is shown thus: $2^{7}_{T}4^{3}_{P}$

N.B. The color used for a complex area is determined by the first digit of the symbol. Generally the dominant class appears first in a complex symbol. However, in complexes of two arable classes (1-4) and one non arable class (5-7), the arable classes are shown first if they total one half or more of the map unit.

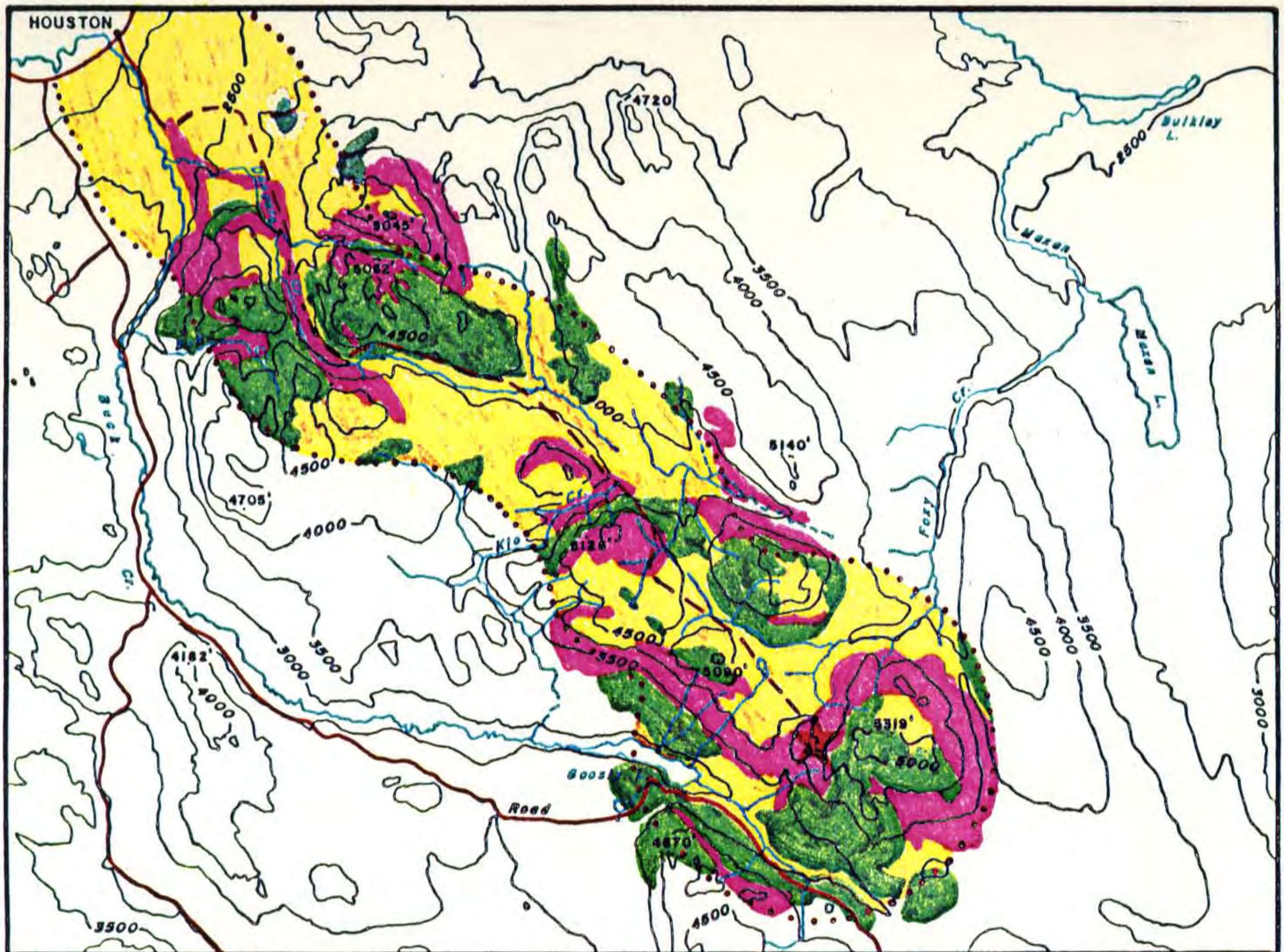
This pattern is overprinted on the color in complex areas, except those having ratios of 8:2, 8:1:1 and 9:1.

Figure 8

SOIL CAPABILITY - AGRICULTURE



Soil Capability for Agriculture	beak	DATE	JULY 76
		PROJECT	J5058A
		DWG NO	



LEGEND

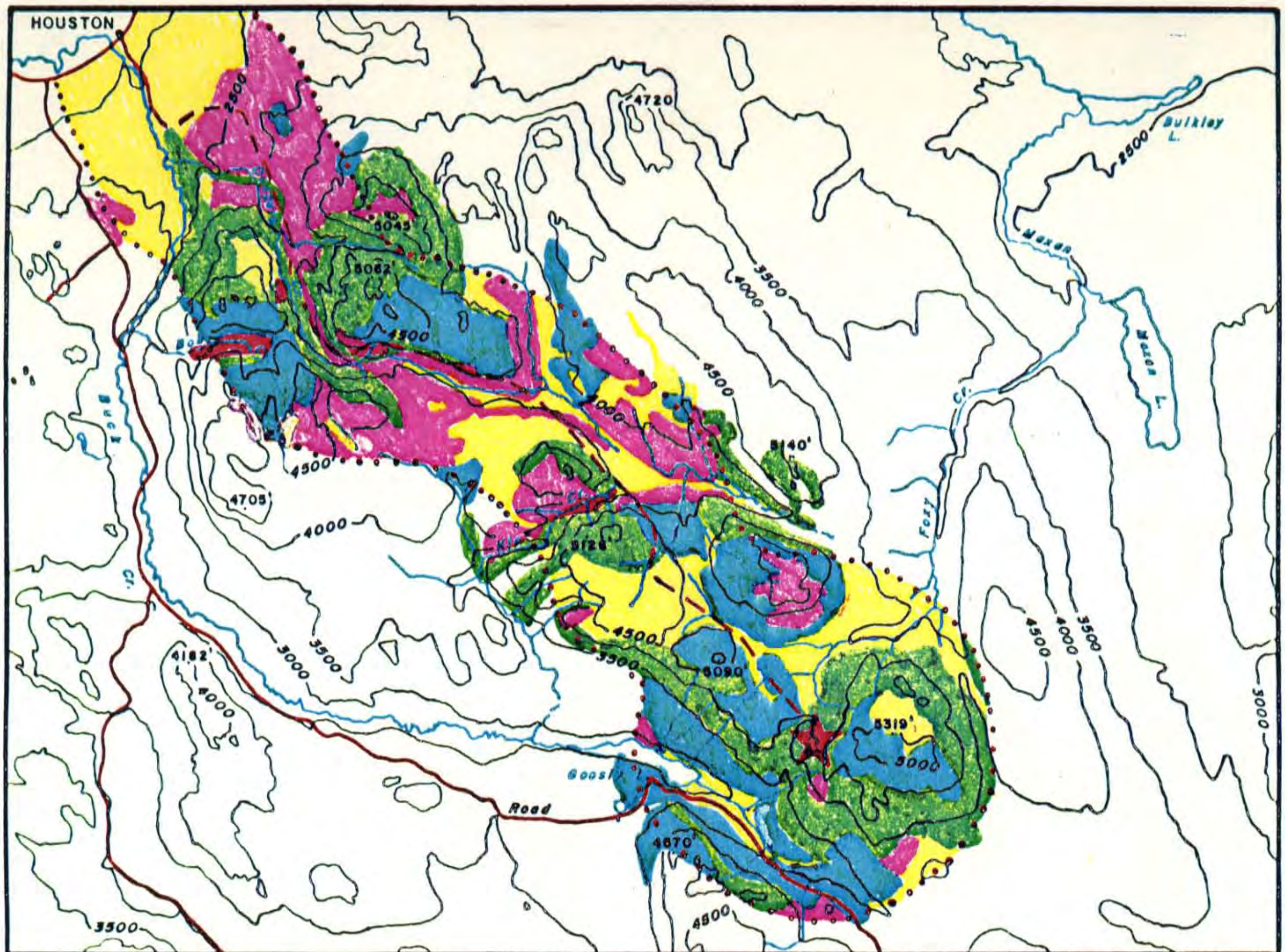
- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

Scale : 0 — 2 — 4 Miles

FIGURE 9: SOIL EROSION HAZARD

- (yellow) No to slight erosion hazard. No special consideration to minimize soil erosion hazard - topography generally less than 30%
- (green) Soils have moderate sheet, rill and gully erosion hazard - topography generally from 20-50%, but includes areas of silts and fine sands from 8-20% - special consideration should be given to road location, placement and maintenance of culverts
- (magenta) Soils subject to high sheet, rill and gully erosion hazard - topography generally greater than 50% - careful management practice should be emphasized on road location, placement and maintenance of culverts

beak	DATE	JULY 76
	PROJECT	J5058A
	DWG NO	



LEGEND

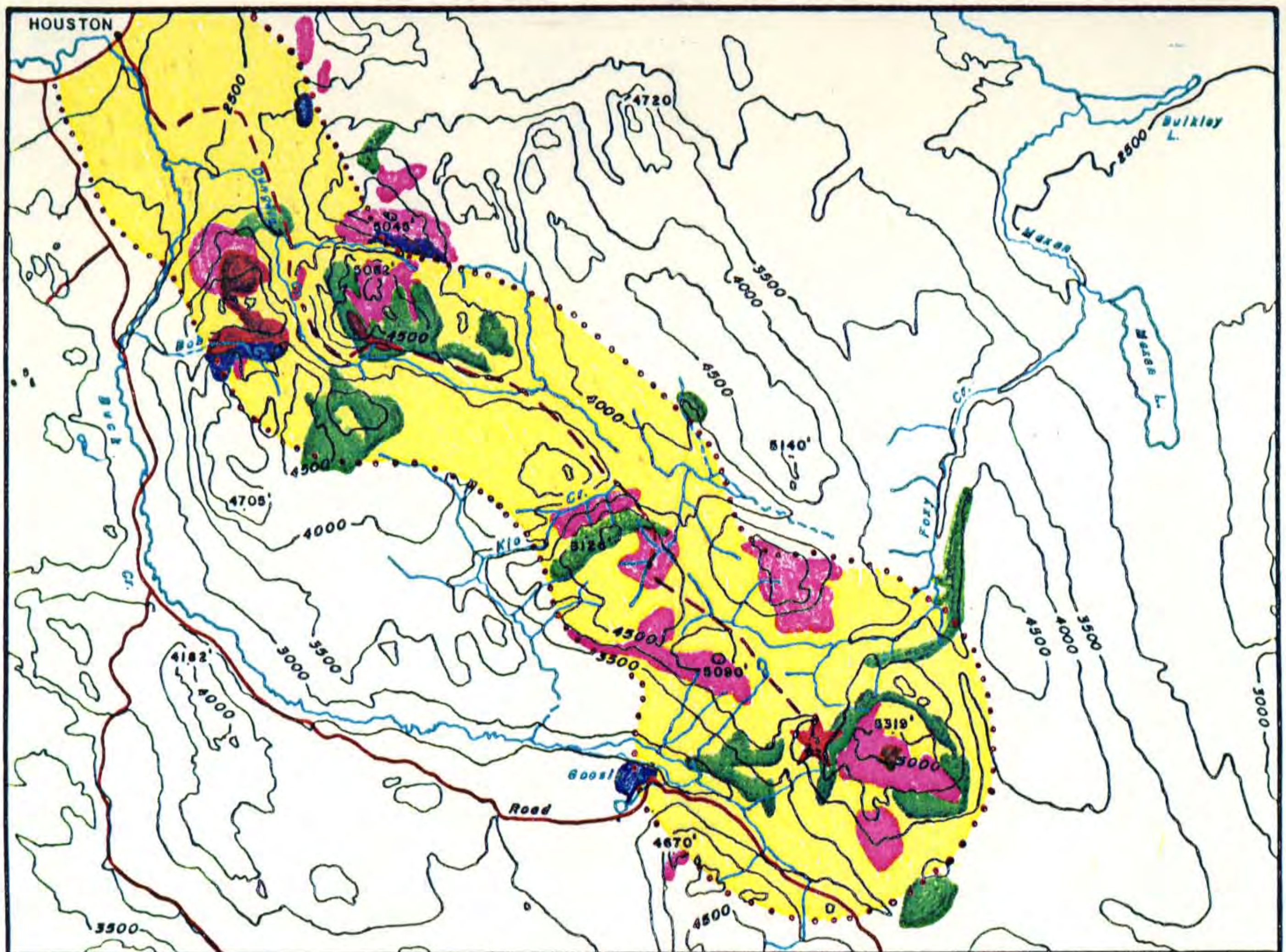
- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

Scale: 0 — 2 — 4 Miles

FIGURE 10: SLOPE

- 0-9%; Slight
- 9-15%; Slight
- 15-30%; Moderate
- 30-60%; Severe
- 60+% ; Severe

beak	DATE	JULY 76
	PROJECT	J5058A
	DWG NO	



LEGEND

Existing Roads

Utilities Corridor

Zone of Analysis

Goosly Project

Scale : 0 2 4 Miles

FIGURE 11: DEPTH TO BEDROCK

Deep soils; slight limitation (6 feet plus)

Deep soils with 20-30% shallow inclusions; slight limitation (6 feet plus)

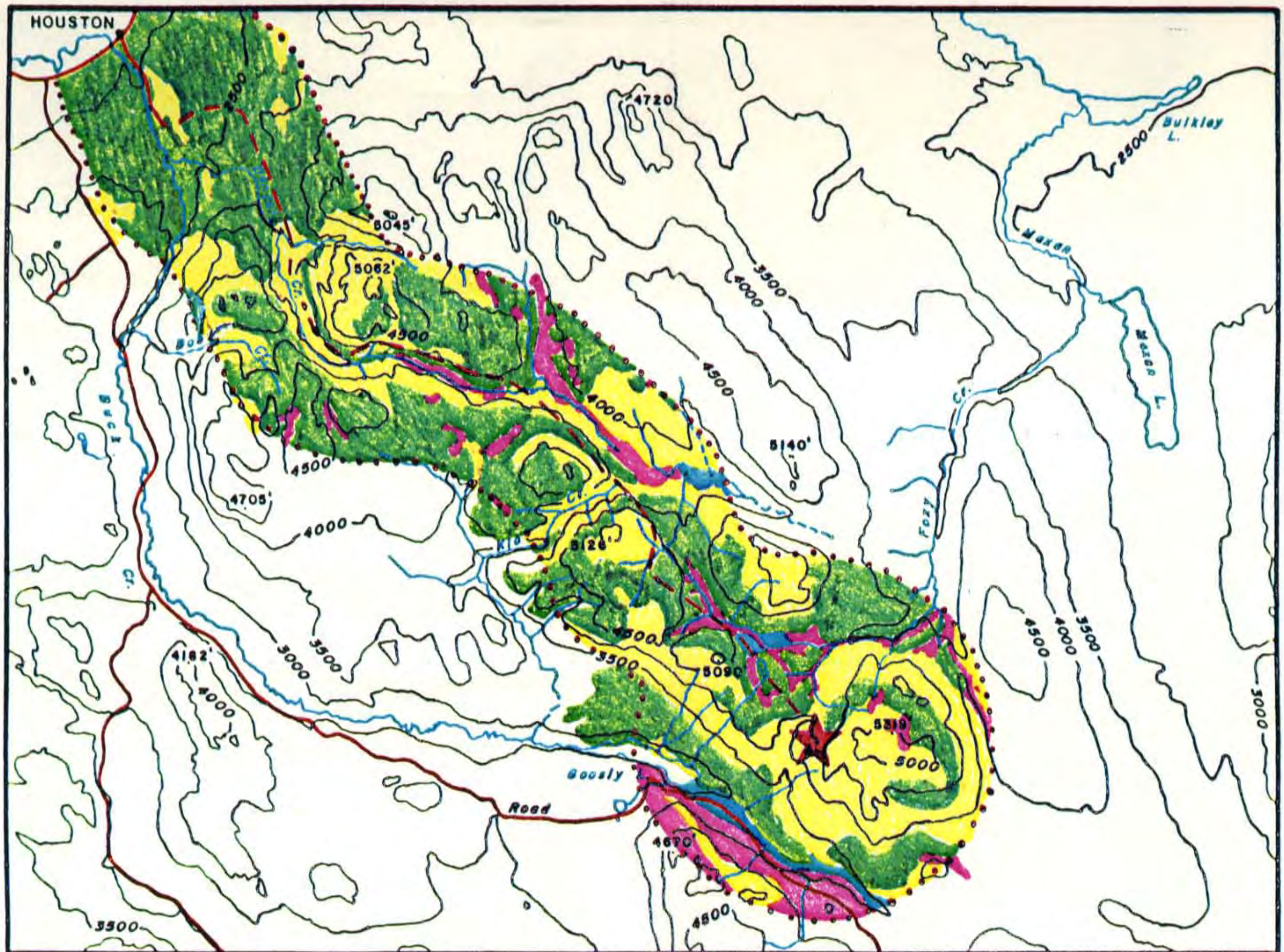
Deep soils with 40% shallow inclusions; moderate limitation (3-6 feet)

Shallow soils with 20-30% deep inclusions; severe limitation (0-3 feet)

Exposed bedrock; severe limitation

beak

DATE	JULY 76
PROJECT	J5058A
DWG NO	



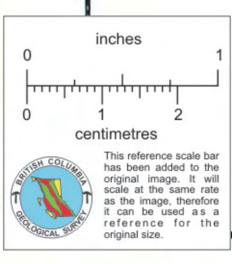
LEGEND

- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

Scale : 0 2 4 Miles

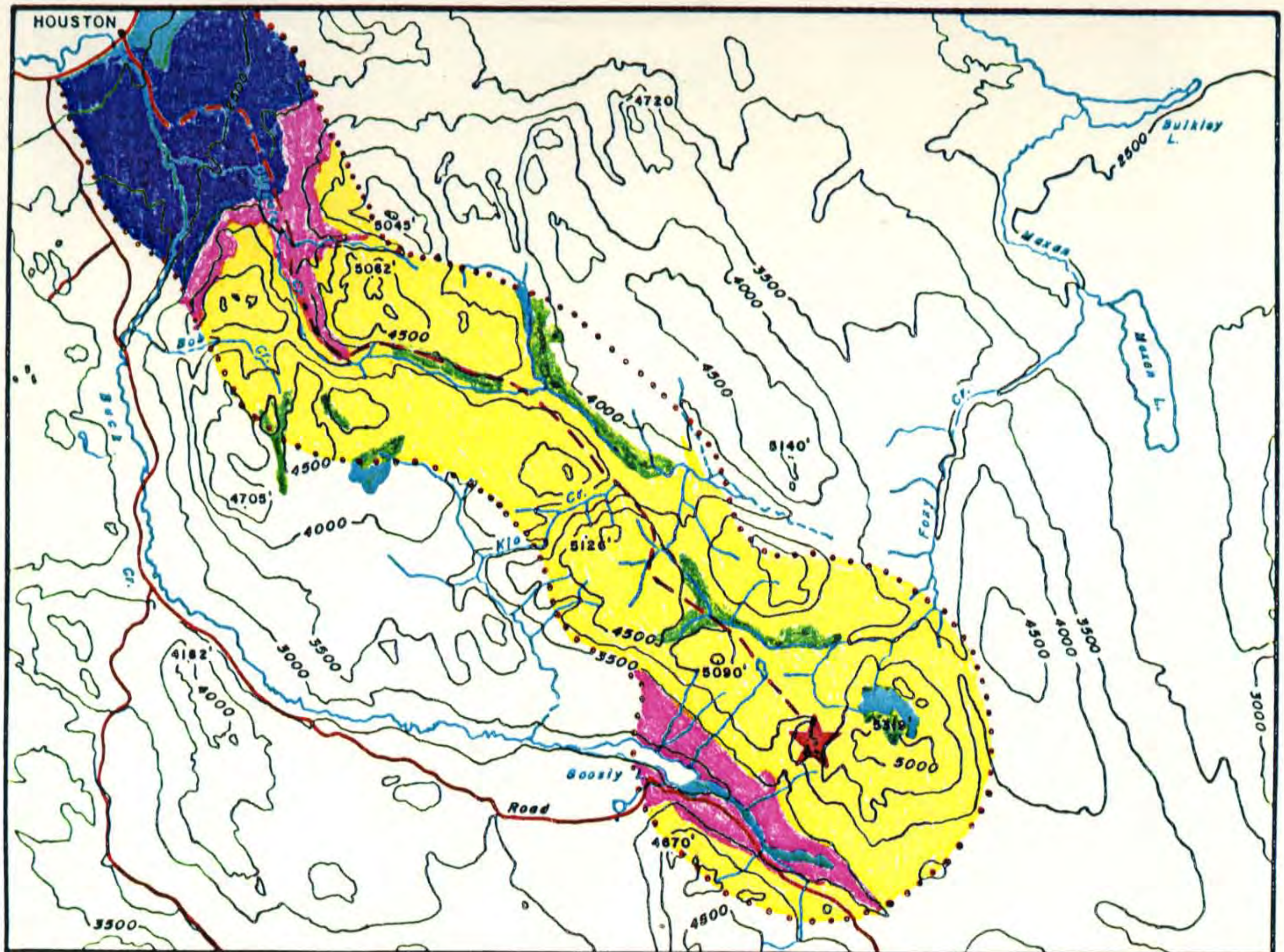
FIGURE 12: WETNESS

- Rapid, well drained
- Slow permiability, moderately well drained, imperfectly drained
- Gleysols, poorly drained, very poorly drained soils
- Organic, areas subject to flooding



beak

DATE	JULY	76
PROJECT	J5058A	
DWG NO		



LEGEND

- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

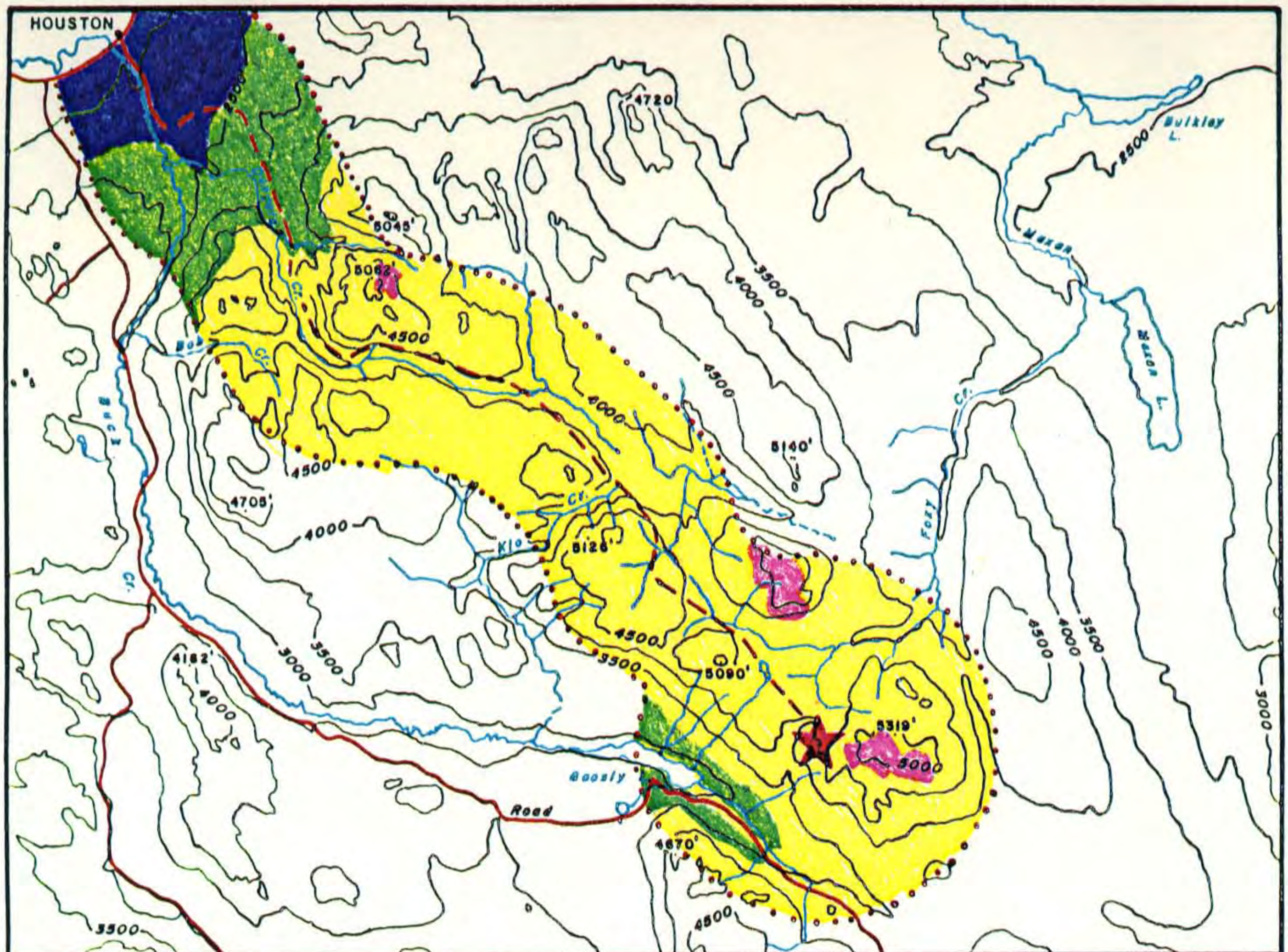
Scale : 0 2 4 Miles

FIGURE 13: BROAD FOREST ZONATION

- Mature climatic climax, Alpine Fir, Eglemann Spruce, densely forested
- Mature climatic climax, White Spruce, densely forested
- Mature climatic climax, White Spruce, Hybrid Spruce (Englemann and White), densely forested
- Mature edaphic climax, Black Cottonwood, White Spruce, densely forested
- Mature edaphic climax, Bog Treed, Bog Shrubs

beak

DATE	JULY 76
PROJECT	J5058A
DWG NO	



LEGEND

- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

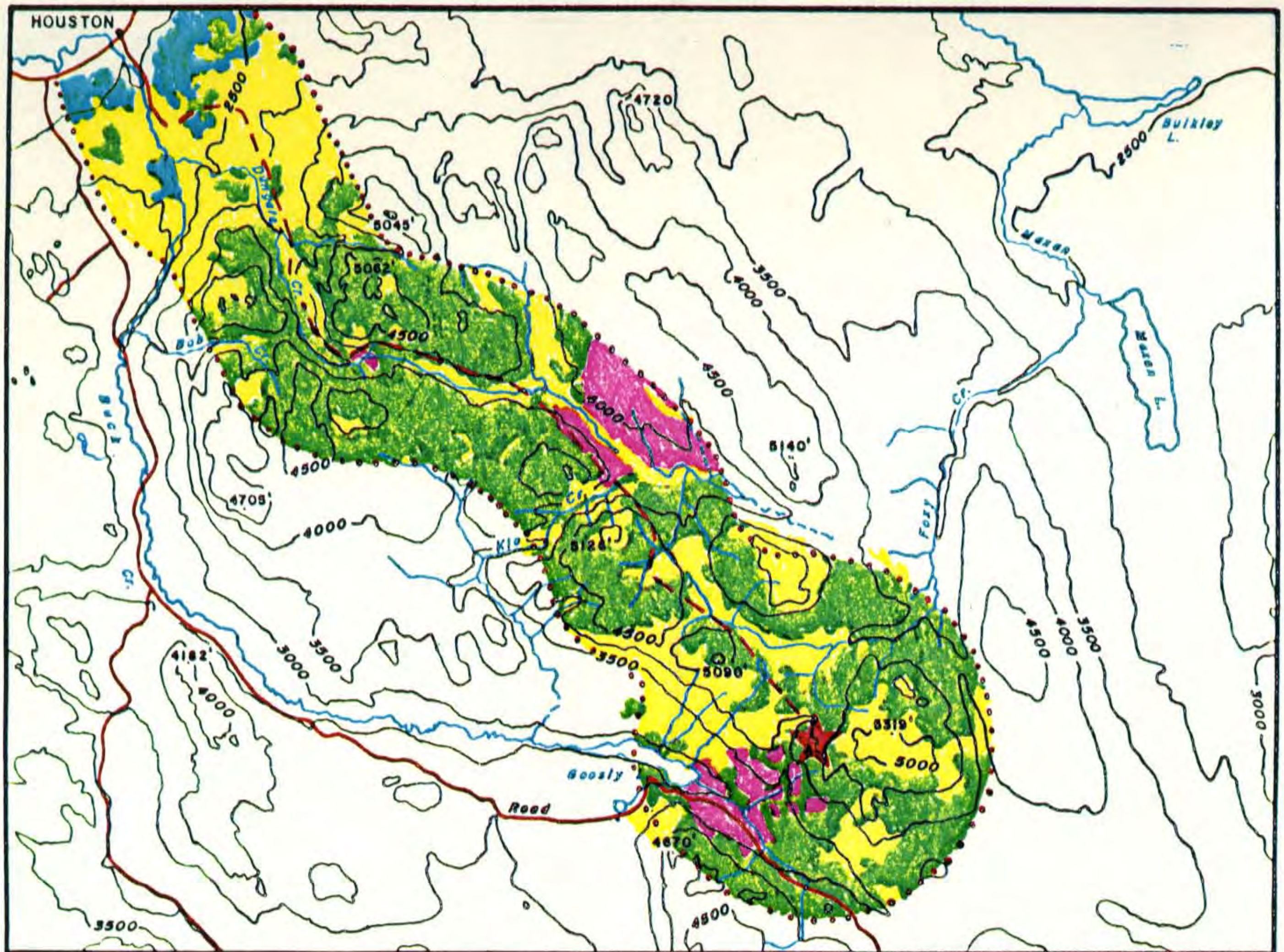
Scale: 0 — 2 — 4 Miles

FIGURE 14: CLIMATE CAPABILITY FOR AGRICULTURE

- (blue) July temperatures 61-62°F; 60-70 frost-free days; "cool-loving" vegetables; small fruits in favored local sites
- (green) 30-50 frost-free days; forage crops only
- (yellow) Less than 30 frost-free days; crops limited to native browse species; not suitable for agricultural crops; limited potential for agriculture
- (pink) Frost-free days variable, normally less than 30; no potential for agriculture

beak

DATE	JULY 76
PROJECT	J5058A
DWG NO	



LEGEND

- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

Scale : 0 2 4 Miles

FIGURE 15: GENERALIZED PRESENT LAND USE

Each category contains at least 70% of any given type

Cuttable timber

Cut and/or burnt since 1960

Wildland complex; includes all natural or semi-natural vegetation not covered by other classifications (i.e. immature timber, rock, sandbars, non-productive and alpine forests, marshes, open range, meadows, minor water bodies, etc.)

Agriculture; rangeland, unimproved and improved pasture, cropland and intensive use such as truck and poultry farms

beak	DATE	JULY 76
	PROJECT	
	DWG NO	

* **CLASS 1** LANDS IN THIS CLASS HAVE VERY HIGH CAPABILITY FOR OUTDOOR RECREATION.

Class 1 lands have natural capability to engender and sustain very high total annual use based on one or more recreational activities of an intensive nature. Class 1 land units should be able to generate and sustain a level of use comparable to that evident at an outstanding and large bathing beach or a nationally known ski slope.

CLASS 2 LANDS IN THIS CLASS HAVE A HIGH CAPABILITY FOR OUTDOOR RECREATION.

Class 2 lands have natural capability to engender and sustain high total annual use based on one or more recreational activities of an intensive nature.

CLASS 3 LANDS IN THIS CLASS HAVE A MODERATELY HIGH CAPABILITY FOR OUTDOOR RECREATION.

Class 3 lands have natural capability to engender and sustain moderately high total annual use based usually on intensive or moderately intensive activities.

CLASS 4 LANDS IN THIS CLASS HAVE MODERATE CAPABILITY FOR OUTDOOR RECREATION.

Class 4 lands have natural capability to engender and sustain moderate total annual use based usually on dispersed activities.

CLASS 5 LANDS IN THIS CLASS HAVE MODERATELY LOW CAPABILITY FOR OUTDOOR RECREATION.

Class 5 lands have natural capability to engender and sustain moderately low total annual use based on dispersed activities.

CLASS 6 LANDS IN THIS CLASS HAVE LOW CAPABILITY FOR OUTDOOR RECREATION.

Class 6 lands lack the natural quality and significant features to rate higher, but have the natural capability to engender and sustain low total annual use based on dispersed activities.

* **CLASS 7** LANDS IN THIS CLASS HAVE VERY LOW CAPABILITY FOR OUTDOOR RECREATION.

Class 7 lands have practically no capability for any popular types of recreation activity, but there may be some capability for very specialized activities with recreation aspects, or they may simply provide open space.

Goosly Project

Utilities Corridor

0 Miles 5

SUBCLASSES

Subclasses indicate the kinds of features which provide opportunity for recreation. They are, therefore, positive aspects of land and do not indicate limitations to use. Features may be omitted from a unit, either because of the imposed three-feature limit, or because their presence was unknown or unconfirmed.

The degree to which these features are judged capable, collectively, of generating and sustaining use for recreation, determines the class. The sequence in which they are listed indicates the order of their significance. Subordinate features may be relatively insignificant and the class of a unit should not be interpreted to indicate the capability of a secondary or tertiary feature.

The subclasses are:

SUBCLASS A—Land providing access to water affording opportunity for angling or viewing of sport fish.

SUBCLASS B—Shoreland capable of supporting family beach activities. In high class units this will include family bathing. In Classes 4 and 5, the activities may be confined to dry land due to cold water or other limitations.

SUBCLASS C—Land fronting on and providing direct access to waterways with significant capability for canoe tripping.

* SUBCLASS D—Shoreland with deeper inshore water suitable for swimming or boat mooring or launching.

SUBCLASS E—Land with vegetation possessing recreational value.

SUBCLASS F—Waterfall or rapids.

SUBCLASS G—Significant glacier view or experience.

* SUBCLASS H—Historic or pre-historic site.

SUBCLASS J—Area offering particular opportunities for gathering and collecting items of popular interest.

SUBCLASS K—Shoreland or upland suited to organized camping, usually associated with other features.

SUBCLASS L—Interesting landform features other than rock formations.

SUBCLASS M—Frequent small water bodies or continuous streams occurring in upland areas.

SUBCLASS N—Land (usually shoreland) suited to family or other recreation lodging use.

SUBCLASS O—Land affording opportunity for viewing of upland wildlife.

SUBCLASS P—Areas exhibiting cultural landscape patterns of agricultural, industrial or social interest.

SUBCLASS Q—Areas exhibiting variety, in topography or land and water relationships, which enhances opportunities for general outdoor recreation such as hiking and nature study or for aesthetic appreciation of the area.

SUBCLASS R—Interesting rock formations.

SUBCLASS S—A combination of slopes, snow conditions and climate providing downhill skiing opportunities.

* SUBCLASS T—Thermal springs.

SUBCLASS U—Shoreland fronting water accommodating yachting or deep water boat tripping.

SUBCLASS V—A vantage point or area which offers a superior view relative to the class of the unit(s) which contain it, or a corridor or other area which provides frequent viewing opportunities.

SUBCLASS W—Land affording opportunity for viewing of wetland wildlife.

* SUBCLASS X—Miscellaneous features with recreational capability.

SUBCLASS Y—Shoreland providing access to water suitable for popular forms of family boating.

SUBCLASS Z—Areas exhibiting major, permanent, non-urban man-made structures of recreational interest.

CONVENTIONS

Large arabic numerals denote capability classes.

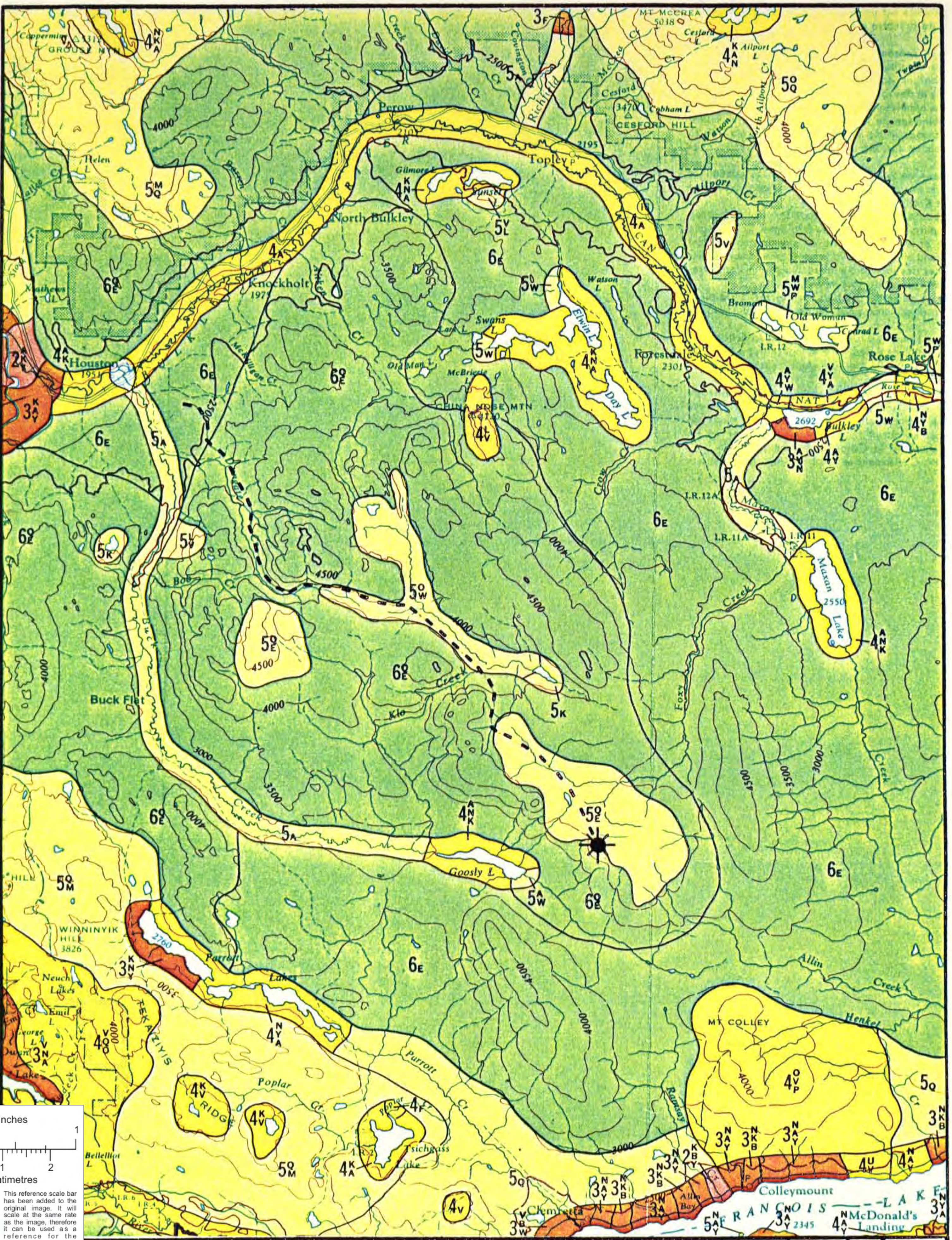
Upper case letters denote subclasses.

There may be area distortion due to scale limitations, particularly in the case of corridor-shaped units.

* Denotes class or subclass not present on this map.

Figure 16

LAND CAPABILITY - RECREATION



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centimetres

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BRITISH COLUMBIA GEOLOGICAL SURVEY

Land Capability - Recreation	beak	DATE	JULY 76
		PROJECT	J5058A
		DWG NO	

*** CLASS 1** — LANDS HAVING NO IMPORTANT LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS.

Soils are deep, permeable, of medium texture, moderately well-drained to imperfectly drained, have good water-holding capacity and are naturally high in fertility. Their topographic position is such that they frequently receive seepage and nutrients from adjacent areas. They are not subject to extremes of temperature or evapotranspiration. Productivity will usually be greater than 111 cubic feet per acre per year.

When required this class may be subdivided on the basis of productivity into classes 1 (111 to 130), 1a (131 to 150), 1b (151 to 170), 1c (171 to 190), 1d (191 to 210), and by 20 cubic foot classes thereafter, as necessary.

CLASS 2 — LANDS HAVING SLIGHT LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS.

Soils are deep, well-drained to moderately well-drained, of medium to fine texture and have good water-holding capacity.

The most common limitations (all of a relatively slight nature) are: adverse climate, soil moisture deficiency, restricted rooting depth, somewhat low fertility, and the cumulative effects of several minor adverse soil characteristics.

Productivity will usually be from 90 to 110 cubic feet per acre per year.

CLASS 3 — LANDS HAVING MODERATE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS.

Soils may be deep to somewhat shallow, well to imperfectly drained, of medium to fine texture with moderate to good water-holding capacity. They may be slightly low in fertility or suffer from periodic moisture imbalances.

The most common limitations are: adverse climate, restricted rooting depth, moderate deficiency or excess of soil moisture, somewhat low fertility, impeded soil drainage, exposure (in maritime areas) and occasional inundation.

Productivity will usually be from 71 to 90 cubic feet per acre per year.

CLASS 4 — LANDS HAVING MODERATELY SEVERE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS.

Soils may vary from deep to moderately shallow, from excessive through imperfect to poor drainage, from coarse through fine texture, from good to poor moisture holding capacity, from good to poor structure and from good to low natural fertility.

The most common limitations are: moisture deficiency or excess, adverse climate, restricted rooting depth, poor structure, excessive carbonates, exposure, or low fertility.

Productivity will usually be from 51 to 70 cubic feet per acre per year,

CLASS 5 — LANDS HAVING SEVERE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS.

Soils are frequently shallow to bedrock, stoney, excessively or poorly drained of coarse or fine texture, may have poor moisture holding capacity and be low in natural fertility.

The most common limitations (often in combination) are: moisture deficiency or excess, shallowness to bedrock, adverse regional or local climate, low natural fertility, exposure particularly in maritime areas, excessive stoniness and high levels of carbonates.

Productivity will usually be from 31 to 50 cubic feet per acre per year.

CLASS 6 — LANDS HAVING SEVERE LIMITATIONS TO THE GROWTH OF COMMERCIAL FORESTS.

The mineral soils are frequently shallow, stoney, excessively drained, of coarse texture and low in fertility. A large percentage of the land in this class is composed of poorly drained organic soils.

The most common limitations (frequently in combination) are: shallowness to bedrock, deficiency or excess of soil moisture, high levels of soluble salts, low natural fertility, exposure, inundation and stoniness.

Productivity will usually be from 11 to 30 cubic feet per acre per year.

CLASS 7 — LANDS HAVING SEVERE LIMITATIONS WHICH PRECLUDE THE GROWTH OF COMMERCIAL FORESTS.

Mineral soils are usually extremely shallow to bedrock, subject to regular flooding, or contain toxic levels of soluble salts. Actively eroding or extremely dry soils may also be placed in this class. A large percentage of the land is very poorly drained organic soils.

The most common limitations are: shallowness to bedrock, excessive soil moisture, frequent inundation, active erosion, toxic levels of soluble salts, and extremes of climate or exposure.

Productivity will usually be less than 10 cubic feet per acre per year.

✱ Goosly Project

◆◆◆◆◆ Utilities Corridor

0 Miles 2

SUBCLASSES

Except for Class 1, subclasses indicate the kind of limitation for each class. The subclasses are as follows:

CLIMATE

Denotes a significant adverse departure from what is considered the median climate of the region, that is, a limitation as a result of local climate; adverse regional climate will be expressed by the class level.

SUBCLASS A – droughty or arid conditions as a result of climate.

SUBCLASS C – a combination of more than one climatic factor or when it is not possible to decide which of two or more features of climate is significant.

SUBCLASS H – low temperatures, that is too cold.

SUBCLASS U – exposure.

SOIL MOISTURE

Denotes a soil moisture condition less than optimum for the growth of commercial forests but not including inundation.

SUBCLASS M – soil moisture deficiency.

SUBCLASS W – soil moisture excess.

SUBCLASS X – a pattern of "M" and "W" too intimately associated to map separately.

SUBCLASS Z – a pattern of wet organic soils and bedrock too intimately associated to map separately.

PERMEABILITY AND DEPTH OF ROOTING ZONE

Denotes limitations of soil permeability or physical limitation to rooting depth.

SUBCLASS D – physical restriction to rooting by dense or consolidated layers, other than bedrock.

SUBCLASS R – restriction of rooting zone by bedrock.

SUBCLASS Y – intimate pattern of shallowness and compaction or other restricting layers.

OTHER SOIL FACTORS

Denote factors of the soil which, individually or in combination, adversely affect growth.

SUBCLASS E – actively eroding soils.

SUBCLASS F – low fertility.

SUBCLASS I – soils periodically inundated by streams or lakes.

SUBCLASS K – presence of perennially frozen material.

SUBCLASS L – nutritional problems associated with high levels of carbonates.

SUBCLASS N – excessive levels of toxic elements such as soluble salts.

SUBCLASS P – stoniness which affects forest density or growth.

SUBCLASS S – a combination of soil factors, none of which, by themselves would affect the class level but cumulatively lower the capability class.

TREE SPECIES INDICATORS

The species which can be expected to yield the volume associated with each class are shown as part of the symbol. Only indigenous species adapted to the region and land are shown. Where only one species indicator is shown in a complex it applies to all classes.

tA .... Trembling Aspen
aIF .... Alpine Fir
lP .... Lodgepole Pine
bS .... Black Spruce
wS .... White Spruce

CONVENTIONS

Large arabic numerals denote capability classes.

Small arabic numerals placed after a class numeral give the approximate proportion of the class out of a total of 10. Letters placed after class numerals denote the subclasses, i.e., limitations. Letters placed below large arabic numerals denote tree name abbreviations.

*Denotes class not present on this map.

EXAMPLES

An area of Class 4 land with soil moisture deficiency and white spruce indicator species: 4_{M} (*wS*)

An area of Class 4, with moisture deficiency and Class 5 with a soil depth limitation, in the proportion of 8:2 and white spruce and trembling aspen indicators species: $4^{8}_{M}5^{2}_{R}$ (*wS* *tA*)

N.B. The colour used for a complex area is determined by the first digit of the symbol. The dominant class appears first in a complex symbol.

This pattern is overprinted on the colour in complex areas except those having ratios of 8:2, 8:1:1, and 9:1.

Figure 17

LAND CAPABILITY – FORESTRY

Land Capability - Forestry

beak

DATE	JULY 76
PROJECT	J5058A
DWG NO	

SUBCLASSES

With the exception of Class 1, the classes are divided into subclasses according to the nature of the limitations, which determine the class. In most cases the limitations do not affect the animals themselves, but rather the ability of the land to produce suitable food and cover plants. For convenience the subclasses are placed in two main groups: those relating to climate and those relating to inherent characteristics of the land.

CLIMATE

The following are used to denote significant climatic factors that may affect either the animals or the ability of the land to produce suitable food and cover.

* SUBCLASS **A**: aridity — Drought or aridity that adversely affects the habitat.

SUBCLASS **C**: climate — A combination of climatic factors acting to reduce favorable habitat, and the production and survival of ungulates.

SUBCLASS **Q**: snow depth — Excessive snow depth that reduces the mobility of ungulates and availability of food plants.

* SUBCLASS **U**: exposure or aspect — Special climatic factors, such as exposure to prevailing winter winds, that adversely affect the animals or their habitat.

LAND

The following subclasses are used to denote significant characteristics of land that limit its usefulness for producing suitable food and cover. Some may also have a slight adverse effect on the animals.

* SUBCLASS **F**: fertility — Lack of nutrients in the soil for optimum plant growth.

* SUBCLASS **G**: landform — Poor distribution or interspersion of landforms necessary for optimum ungulate habitat.

* SUBCLASS **I**: inundation — Excessive water level fluctuation or tidal action that adversely affects the habitat or survival of ungulates.

* SUBCLASS **M**: soil moisture — Poor soil moisture, either excessive or deficient.

* SUBCLASS **N**: adverse soil characteristics — Excessive salinity, lack of essential trace elements, or abundance of toxic elements in the soil.

SUBCLASS **R**: soil depth — Restriction of the rooting zone by bedrock or other impervious layers.

* SUBCLASS **T**: adverse topography — Either steepness or flatness of the land.

UNGULATE INDICATOR SPECIES

Species of ungulates for which capability ratings are assigned are shown by the following symbols:

* *A* . . . . Antelope	* *E* . . . . Elk
C . . . . Caribou	*G* . . . . Mountain goat
D . . . . Deer (white-tailed deer, Columbia black-tailed deer, mule deer)	*M* . . . . Moose
	* *S* . . . . Mountain sheep

CONVENTIONS

Large arabic numerals denote capability class.

Small arabic numerals placed after class numeral or special class symbols indicate the approximate proportion (in tenths) of the complex that is represented by that class. The dominant class appears first in the symbol.

Small upper case letters placed after class numeral or special class symbols denote the subclasses, i.e., limitations.

Upper case italic letters placed beneath the class numeral denote ungulate species.

* Denotes class, subclass or ungulate species not present on this map.

EXAMPLES

An area of Class 5 land with topography and soil fertility limitations to deer production is shown: $\underset{D}{5^{T}_{F}}$

An area of which 70% is Class 4 for deer with limitations due to snow depth and topography and 30% is class 3 wintering area for elk and moose with slight limitations due to snow depth. $\underset{D}{4^{7}_{QT}}\ \underset{EM}{3W^{3}_{Q}}$

An important wintering area for deer and mountain sheep of which 60% is Class 1 and 40% is Class 2 with slight limitation due to exposed bedrock is shown: $\underset{DS}{1W^{6}}\ \underset{DS}{2W^{4}_{R}}$

N.B. The color used on the complexed area is determined by the first digit of the symbol.

This pattern is overprinted on the color in complexed areas when the dominant class is less than 80% of the complex.

* **CLASS 1** LANDS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS TO THE PRODUCTION OF UNGULATES.

Capability on these lands is high. They provide a wide variety and abundance of food plants and other habitat elements.

CLASS 1W Lands in this special class are Class 1 areas that are winter ranges on which animals from surrounding areas depend.

* **CLASS 2** LANDS IN THIS CLASS HAVE VERY SLIGHT LIMITATIONS TO THE PRODUCTION OF UNGULATES.

Capability on these lands is high but less than Class 1. Slight limitations are due to climatic or other factors.

CLASS 2W Lands in this special class are Class 2 areas that are winter ranges on which animals from surrounding areas depend.

CLASS 3 LANDS IN THIS CLASS HAVE SLIGHT LIMITATIONS TO THE PRODUCTION OF UNGULATES.

Capability on these lands is moderately high, but productivity may be reduced in some years. Slight limitations are due to characteristics of the land that affect the quality and quantity of habitat, or to climatic factors that limit the mobility of ungulates or the availability of food and cover.

CLASS 3W Lands in this special class are Class 3 areas that are winter ranges on which animals from surrounding areas depend.

CLASS 4 LANDS IN THIS CLASS HAVE MODERATE LIMITATIONS TO THE PRODUCTION OF UNGULATES.

Capability on these lands is moderate. Limitations are similar to those in Class 3, but the degree is greater.

CLASS 5 LANDS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS TO THE PRODUCTION OF UNGULATES.

Capability on these lands is moderately low. Limitations are usually a combination of two or more of climate, soil moisture, fertility, depth to bedrock or other impervious layer, topography, flooding, exposure, and adverse soil characteristics.

CLASS 6 LANDS IN THIS CLASS HAVE SEVERE LIMITATIONS TO THE PRODUCTION OF UNGULATES.

Capability on these lands is very low. Limitations are so severe that they are easily recognized; for example, soil depth may be negligible or climatic factors so extreme that ungulate populations are severely reduced.

CLASS 7 LANDS IN THIS CLASS HAVE LIMITATIONS SO SEVERE THAT THERE IS NO UNGULATE PRODUCTION.

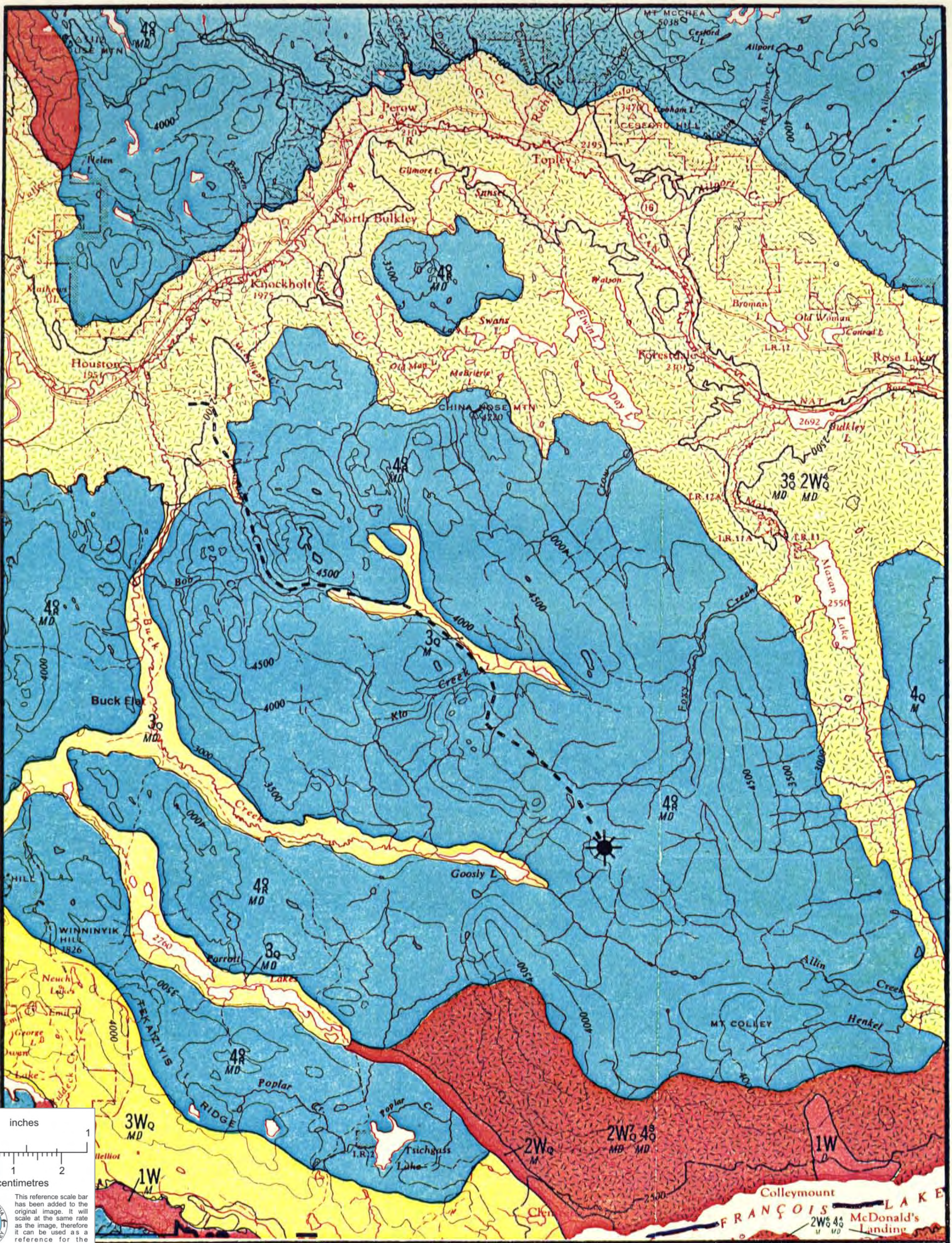
Goosly Project

- - - - - Utilities Corridor

0 Miles 5

Figure 18

LAND CAPABILITY - UNGULATES



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BRITISH COLUMBIA GEOLOGICAL SURVEY

Land Capability - Ungulates

beak

DATE	JULY 76
PROJECT	J5058A
DWG NO	

* **CLASS 1** LANDS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS TO THE PRODUCTION OF WATERFOWL.

Capability on these lands is very high. They provide a wide variety and abundance of important habitat elements; rolling topography is well suited to the formation of wetlands. Predominant water areas on these lands are both shallow and deep permanent marshes, and deep, open water areas with well-developed marsh edges.

* **CLASS 1S** Water areas in this special class are Class 1 areas that also serve as important migration stops.

* **CLASS 2** LANDS IN THIS CLASS HAVE VERY SLIGHT LIMITATIONS TO THE PRODUCTION OF WATERFOWL.

Capability on these lands is high but less than Class 1. Slight limitations are due to climate, fertility, or permeability of the soils. Topography tends to be more undulating than rolling; a higher proportion of the water areas than in Class 1 are small temporary ponds or deep, open water areas with poorly developed marsh edges.

* **CLASS 2S** Water areas in this special class are Class 2 areas that also serve as important migration stops.

* **CLASS 3** LANDS IN THIS CLASS HAVE SLIGHT LIMITATIONS TO THE PRODUCTION OF WATERFOWL.

Capability on these lands is moderately high, but productivity may be reduced in some years because of occasional droughts. Slight limitations are due to climate or to characteristics of the land that affect the quality and quantity of habitat. These lands have a high proportion of both temporary and semipermanent shallow marshes poorly interspersed with deep marshes and bodies of open water.

* **CLASS 3S** Water areas in this special class are Class 3 areas that also serve as important migration stops.

* **CLASS 3M** Lands in this special class may not be useful for waterfowl production, but are important as migration or wintering areas. This class has no subclasses.

CLASS 4 LANDS IN THIS CLASS HAVE MODERATE LIMITATIONS TO THE PRODUCTION OF WATERFOWL.

Capability on these lands is moderate. Limitations are similar to those in Class 3, but the degree is greater. Water areas are predominantly temporary ponds, or deep, open waters with poorly developed marsh edges, or both.

CLASS 5 LANDS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS TO THE PRODUCTION OF WATERFOWL.

Capability on these lands is moderately low. Limitations are usually a combination of two or more of the following factors: climate, soil moisture, permeability, fertility, topography, salinity, flooding, and poor interspersion of water areas.

CLASS 6 LANDS IN THIS CLASS HAVE SEVERE LIMITATIONS TO THE PRODUCTION OF WATERFOWL.

Capability on these lands is very low. Limitations are easily identified. They may include aridity, salinity, very flat topography, steep-sided lakes, extremely porous soils, and soils containing few available minerals.

CLASS 7 LANDS IN THIS CLASS HAVE SUCH SEVERE LIMITATIONS THAT ALMOST NO WATERFOWL ARE PRODUCED.

Capability on these lands is negligible or nonexistent. Limitations are so severe that waterfowl production is precluded or nearly precluded.

SUBCLASSES

With the exception of Class 1, and special Class 3M, the classes are divided into subclasses according to the nature of the limitations that determine the class. The following subclasses are used to denote significant limiting factors that may affect either the waterfowl or the ability of the land to produce suitable habitat conditions.

* SUBCLASS **A**: aridity — The limitation is an arid condition of the land or the susceptibility of the land to periodic droughts, which results in low pond water levels or premature drying of marshes in the breeding season.

SUBCLASS **B**: free-flowing water — The limitation is usually due to fast or excess water flow, which inhibits development of marsh habitat along the stream edge. It may also be due to a lack of flow through low-lying land, which results in habitat of poor quality.

SUBCLASS **C**: climate — A combination of adverse climatic factors may act to reduce favorable habitat and the production and survival of waterfowl.

SUBCLASS **F**: fertility — The limitation is insufficient nutrients in the soil and water for optimum plant growth.

* SUBCLASS **G**: landform — Poor distribution or interspersion of marshes or basins may be a limiting factor of the land and may prevent the development of optimum waterfowl habitat.

* SUBCLASS **I**: inundation — The limiting factor is excessive water level fluctuation or tidal action, which adversely affects the habitat or the nesting success of waterfowl.

SUBCLASS **J**: reduced marsh edge — The limitations are topographic features that adversely affect development of optimum marsh conditions along the edge of water areas.

* SUBCLASS **M**: soil moisture — Poor water-holding capacity of soils, which adversely affects the formation and permanency of water areas.

* SUBCLASS **N**: adverse soil and water characteristics — Excessive salinity, alkalinity, acidity, lack of essential trace elements, or abundance of toxic elements may limit the development of plant and animal communities essential for waterfowl production.

* SUBCLASS **R**: soil depth — Restriction of the rooting zone by bedrock or other impervious layers may limit development of suitable plant communities.

SUBCLASS **T**: adverse topography — Either steepness or flatness of the land may limit the development or permanency of wetlands.

SUBCLASS **Z**: water depth — Excessively deep or shallow waters limit the development of optimum waterfowl habitat.

CONVENTIONS

Large arabic numerals denote capability class.

Small arabic numerals placed after class or special class symbols indicate the approximate proportion (in tenths) of the complex represented by that class. The dominant class appears first in the symbol.

Small upper-case letters placed after class or special class symbols denote the subclasses, i.e., limitations.

* Denotes class or subclass not present on this map.

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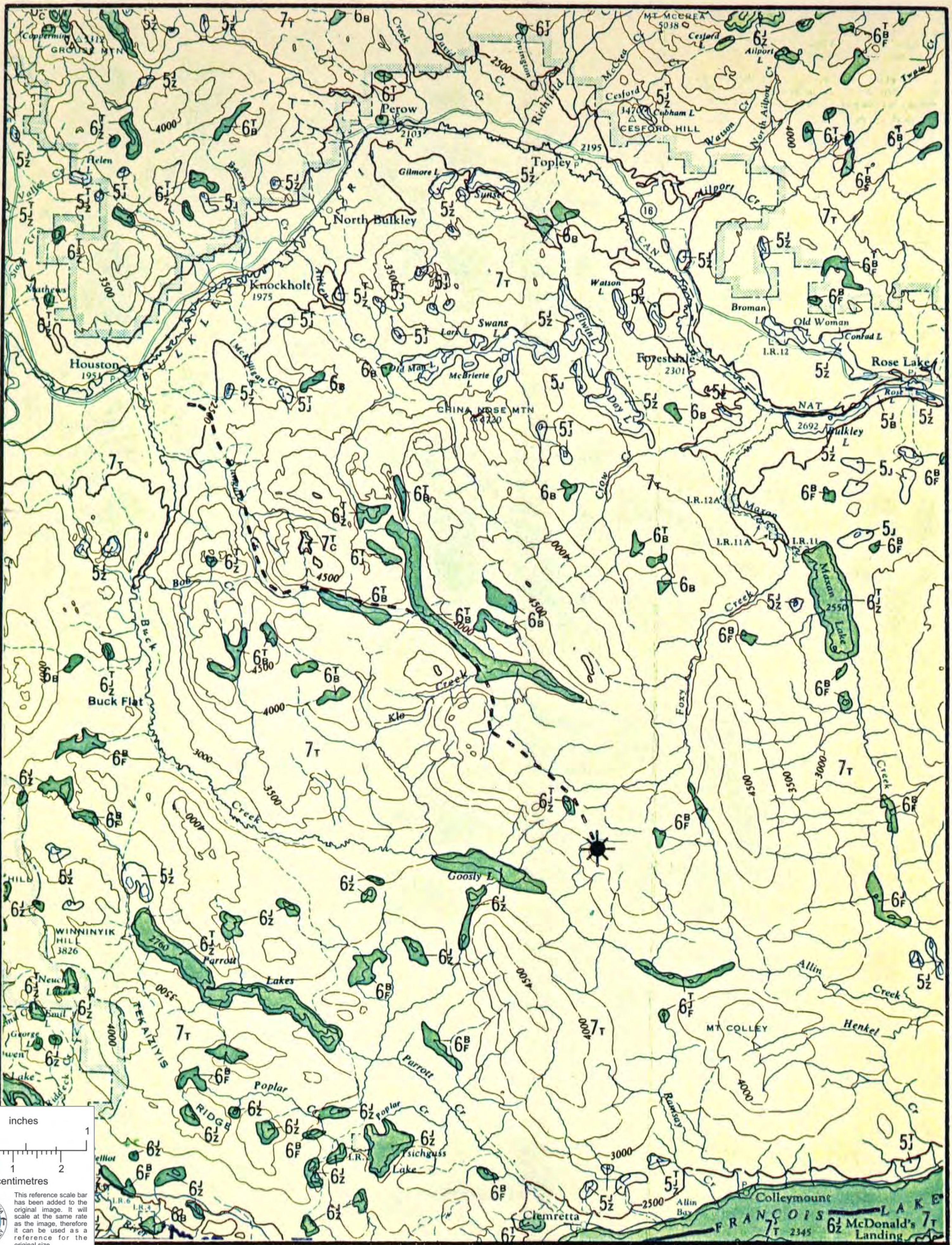
- - - - - Utilities Corridor

0 Miles 5

Figure 19

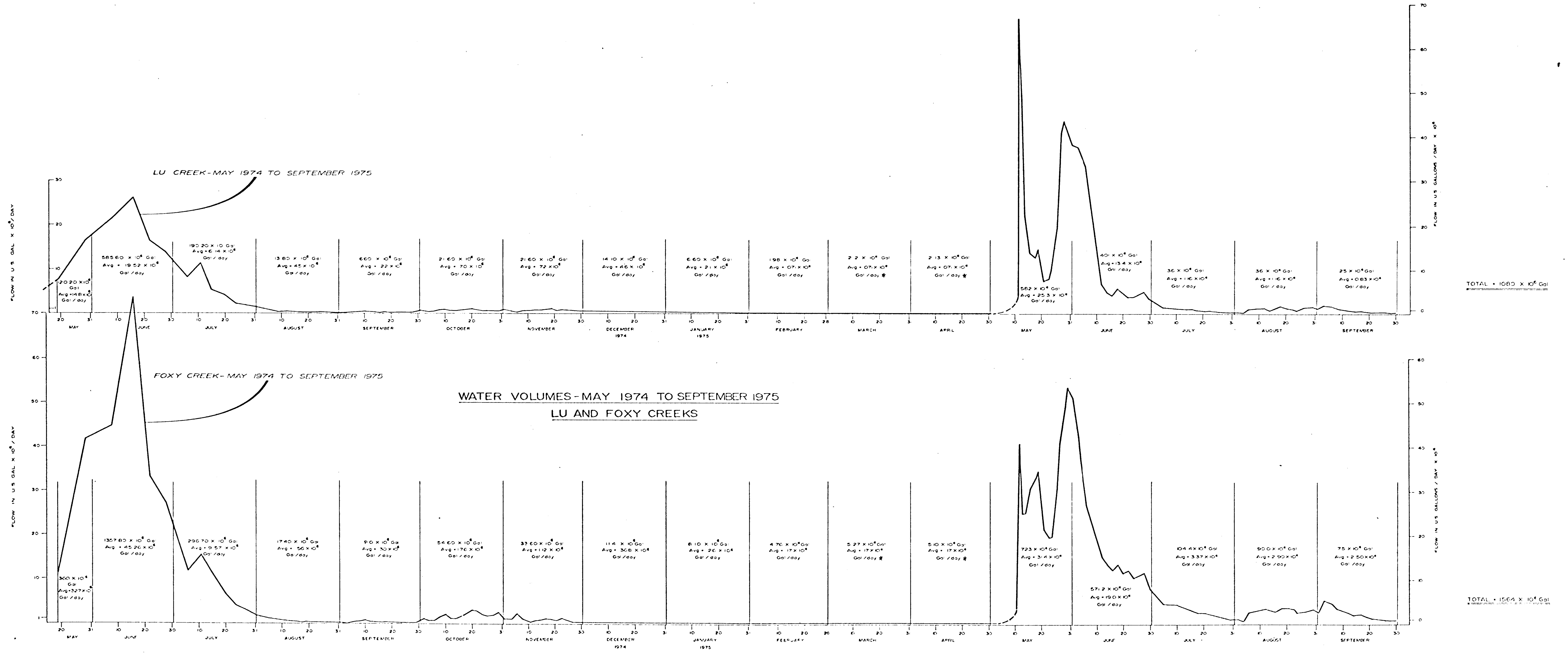
LAND CAPABILITY - WATERFOWL



Land Capability - Waterfowl

beak

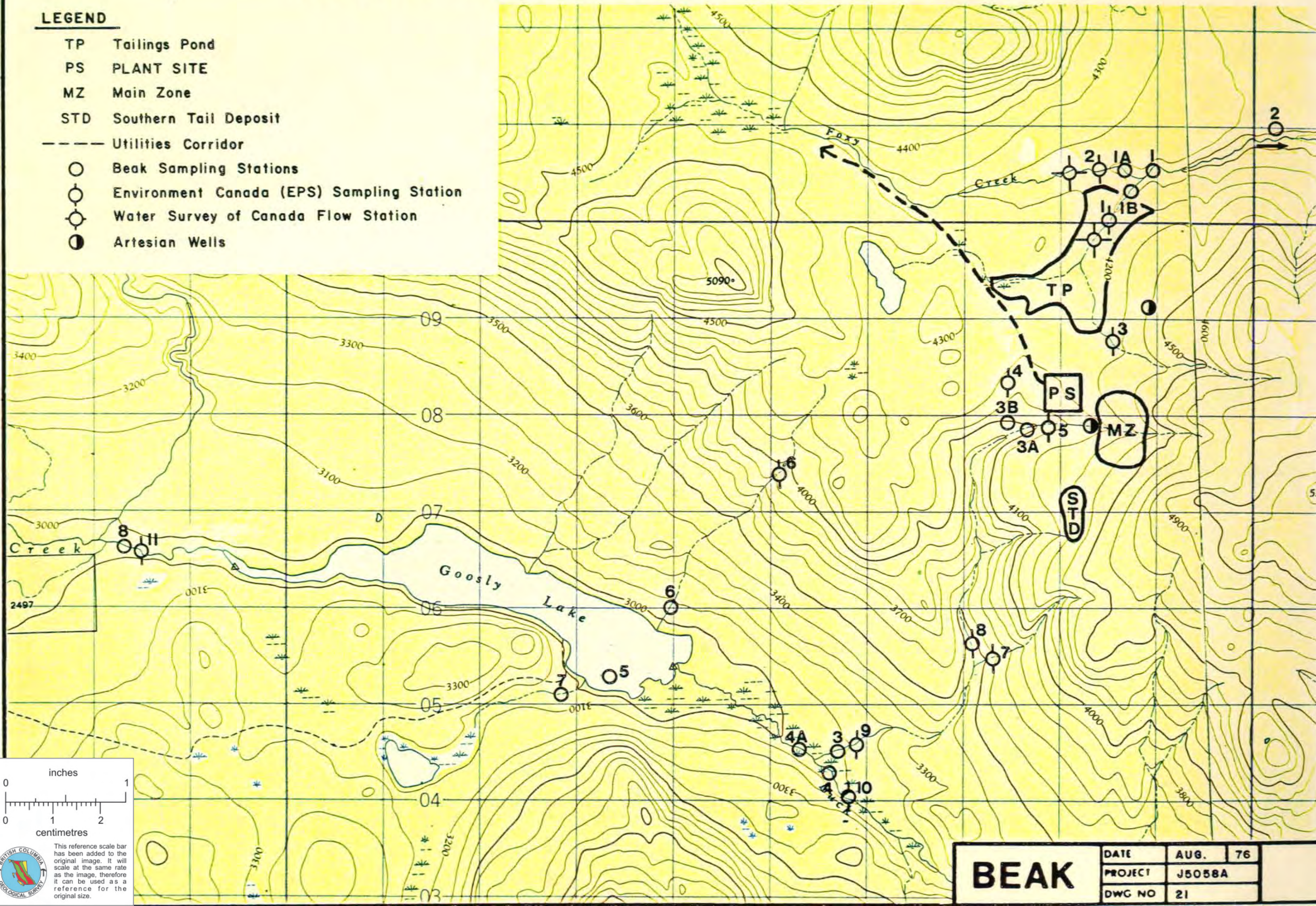
DATE	JULY 76
PROJECT	J5058A
DWG NO	

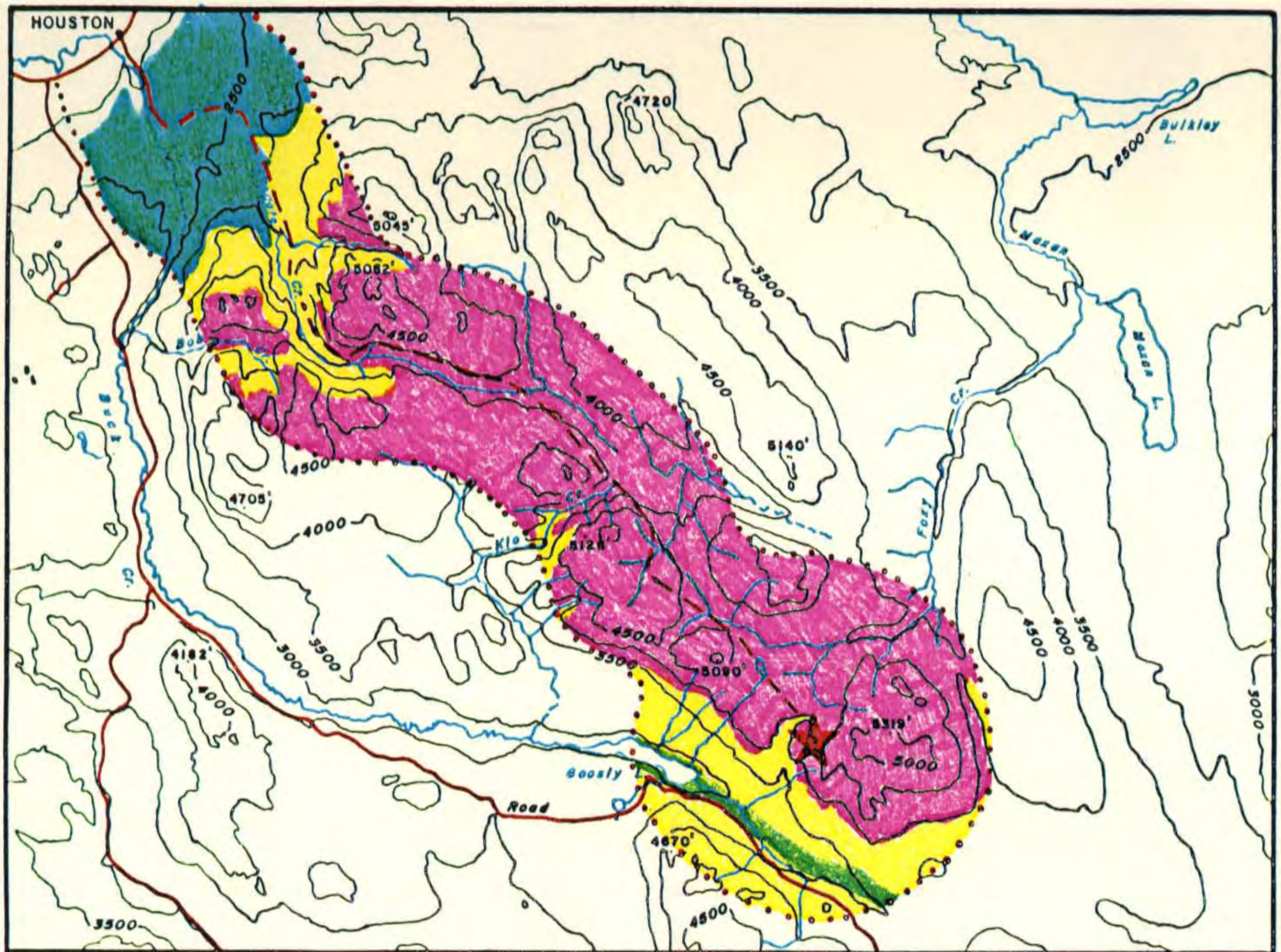


* No data, discharge assumed to be the same as February

FIGURE 20: WATER VOLUMES - LU & FOXY CREEK

SAMPLING STATIONS OF ENVIRONMENTAL SURVEYS





LEGEND

— Existing Roads

— — Utilities Corridor

• • • • Zone of Analysis

★ Goosly Project

Scale : 0 — 2 — 4 Miles

FIGURE 22: CLIMATE

A = Annual precipitation, in inches
B = May-September precipitation, in inches
C = November - March snowpack, in inches
D = Maximum snowpack, in inches
E = Frequency of summer rainfall >0.6 inches, in days
F = Frequency of winter snowfall >6.0 inches, in days
G = Potential evapotranspiration, in inches
H = Evaporation from open water, in inches

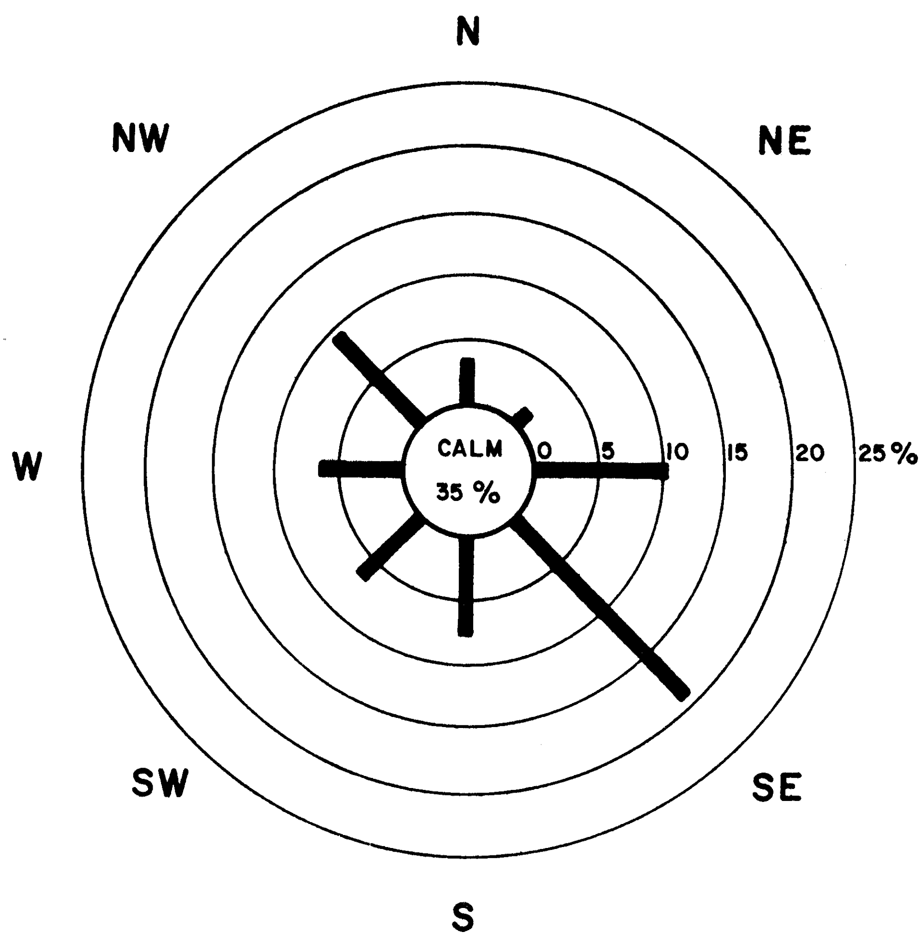
(Blue) A = 18-25; B = 7-12; C = 80-120; D = 20-40; E = 2-5; F = 2-6; G = 17-18; H = 22.1-23.4

(Green) A = 20-25; B = 8-12; C = 80-120; D = 20-40; E = 2-5; F = 2-5; G = 16-17; H = 20.8-22.1

(Yellow) A = 20-25; B = 9-12; C = 80-120; D = 40-60; E = 2-5; F = 5-10; G = 16-17; H = 20.8-22.1

(Magenta) A = 25-30; B = 12-15; C = 120-150; D = 40-60+; E = 5-10; F = 10+ G = 15-; H = 19.5-20.8

beak		
	DATE	JULY 76
	PROJECT	J5058A
	DWG NO	



—ANNUAL WIND ROSE FOR BURNS LAKE, B.C—

DATE	AUG.	76
PROJECT	J5058A	
DWG. NO.	23	

	J	F	M	A	M	J	J	A	S	O	N	D
N	4	3	4	2	5	4	4	3	5	4	2	4
NE	2	2	1	1	3	2	2	1	2	1	1	1
E	11	9	10	9	6	6	7	9	13	13	19	11
SE	18	23	21	23	16	12	12	16	19	21	26	22
S	5	8	7	14	8	9	9	9	8	6	5	3
W	3	4	6	10	11	11	7	9	4	5	3	2
W	4	4	7	8	11	11	10	7	7	6	4	4
NW	9	8	9	7	14	16	13	9	11	9	5	8
CALM	44	39	35	25	28	29	36	38	31	35	35	44
MEAN SPEED	4.7	4.7	5.6	7.0	6.1	5.9	5.6	5.2	5.4	5.5	5.5	4.0

FIGURE 24: Burns Lake, B.C. - Percentage Frequency Wind Direction (and Calms) and Mean Wind Speed by Months

SOURCE: Environment Canada (AES)

DATE	AUG.	76
PROJECT	J5058A	
DWG. NO.	24	

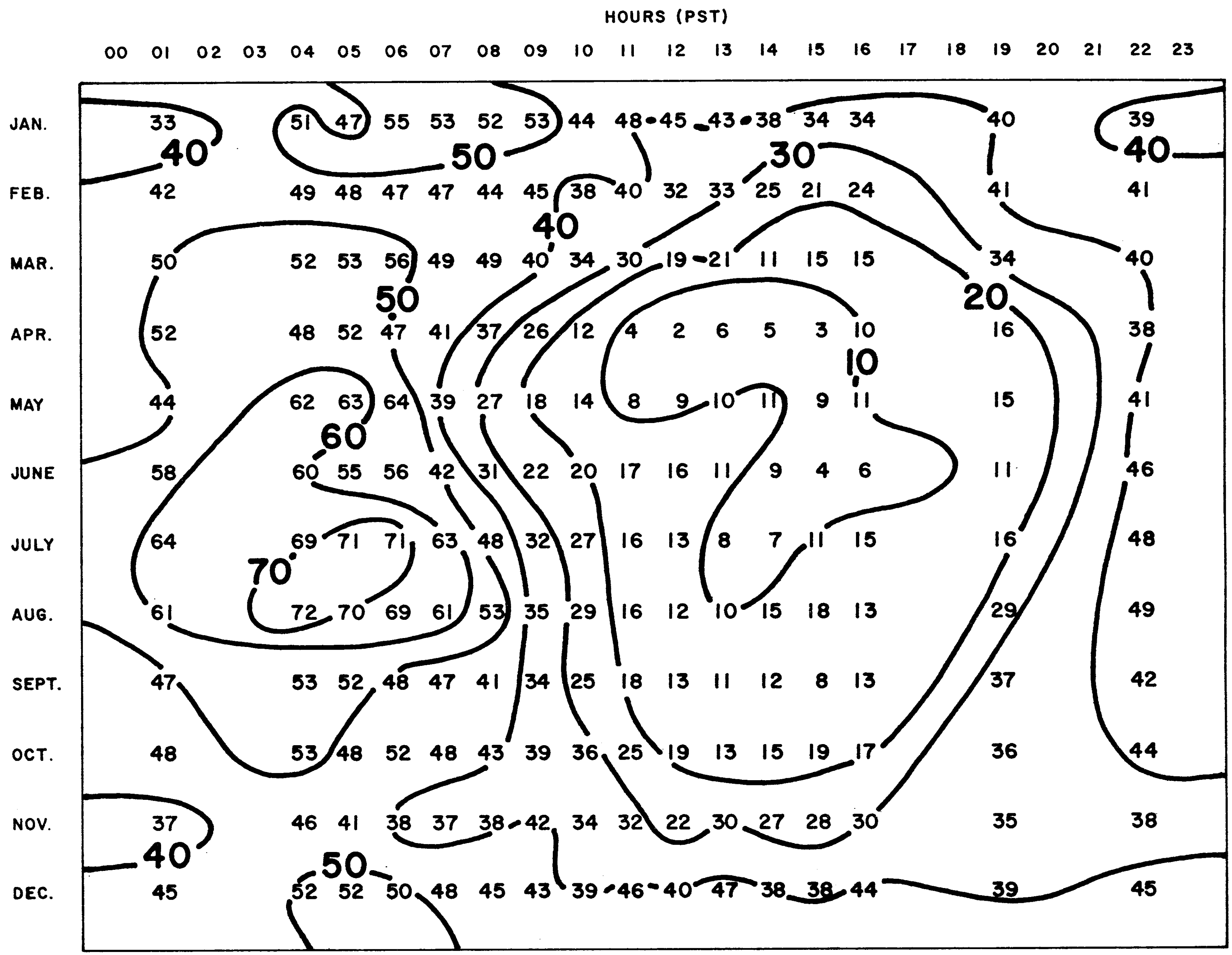


FIGURE 25: Burns Lake - Percentage Frequency Calm Winds by Hour and Month (1969-1972)

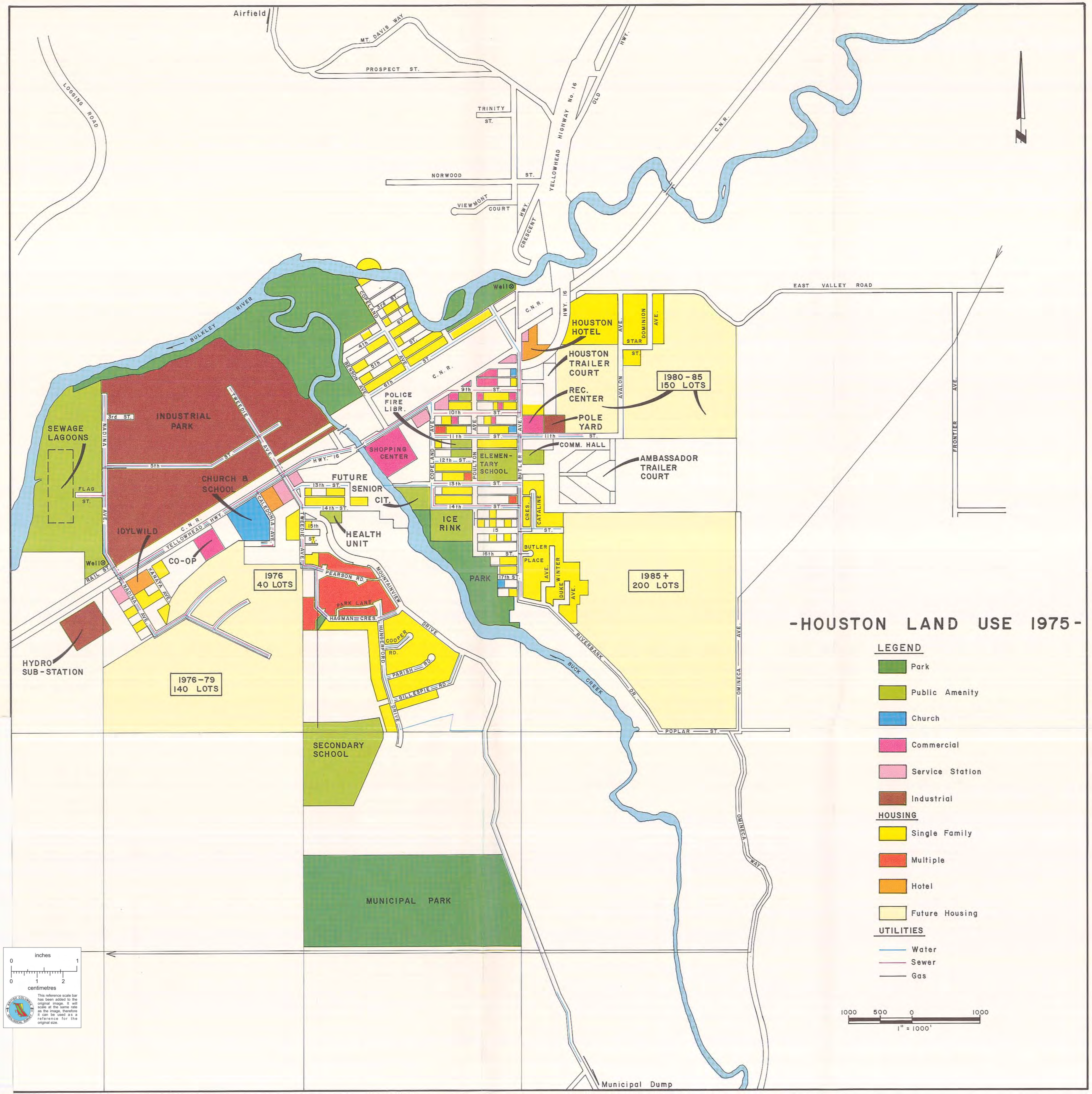
SOURCE: Environment Canada (AES)

BEAK

DATE	AUG. 76
PROJECT	J5058A
DWG NO	25

FIGURE 26

HOUSTON LAND USE 1975



-HOUSTON LAND USE 1975-
LEGEND
Park
Public Amenity
Church
Commercial
Service Station
Industrial
HOUSING
Single Family
Multiple
Hotel
Future Housing
UTILITIES
Water
Sewer
Gas
1000 500 0 1000
1" = 1000'
Airfield
MT. DAVIS WAY
PROSPECT ST.
TRINITY ST.
NORWOOD ST.
VIEWMONT COURT
CRESCENT HWY.
YELLOWHEAD HIGHWAY No. 16
OLD HWY.
C.N.R.
LOGGING ROAD
BULKLEY RIVER
EAST VALLEY ROAD
FRONTIER AVE.
Well
HOUSTON HOTEL
HOUSTON TRAILER COURT
REC. CENTER
POLE YARD
COMM. HALL
AMBASSADOR TRAILER COURT
1980-85 150 LOTS
1985+ 200 LOTS
1976 40 LOTS
1976-79 140 LOTS
DOMINION AVE.
STAR ST.
AVALON AVE.
POLICE FIRE LIBR.
SHOPPING CENTER
ELEMEN-TARY SCHOOL
FUTURE SENIOR CIT.
HEALTH UNIT
ICE RINK
PARK
CHURCH & SCHOOL
INDUSTRIAL PARK
SEWAGE LAGOONS
IDYLWILD
CO-OP
HYDRO SUB-STATION
NADINA AVE.
FLAG ST.
RAIL ST.
KANATA AVE.
TWEEDIE AVE.
CALEDONIA AVE.
COPELAND AVE.
BENSON AVE.
POULTON AVE.
BUTLER AVE.
CATALINE CRES.
BUTLER PLACE
WINTER AVE.
DUKE AVE.
PEARSON RD.
MOUNTAINVIEW DRIVE
PARK LANE
HAGMAN CRES.
HUNGERFORD RD.
COOPER RD.
PARISH RD.
GILLESPIE RD.
RIVERBANK DR.
BUCK CREEK
POPLAR ST.
OMINECA AVE.
OMINECA WAY
SECONDARY SCHOOL
MUNICIPAL PARK
Municipal Dump
inches
centimetres
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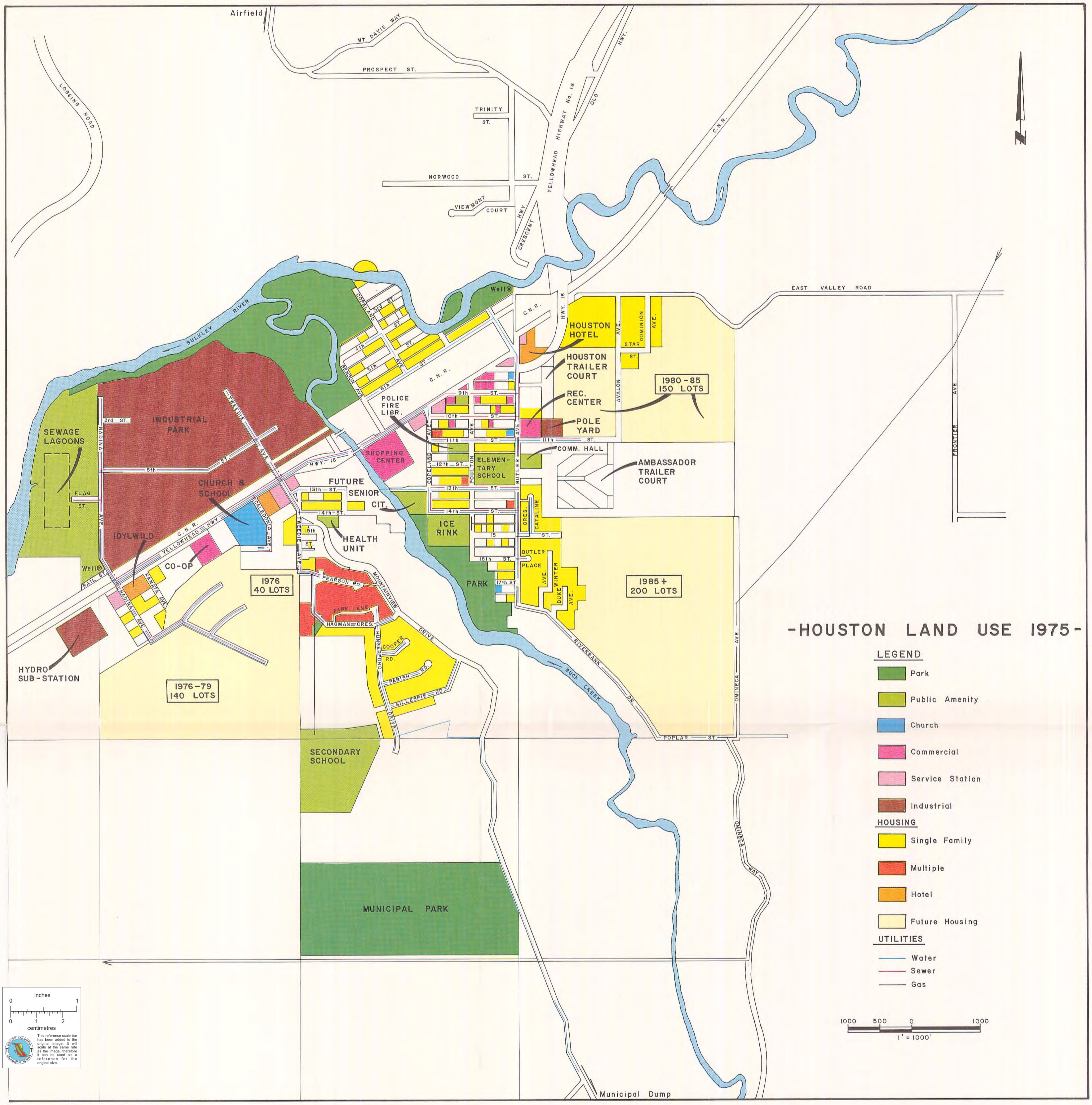
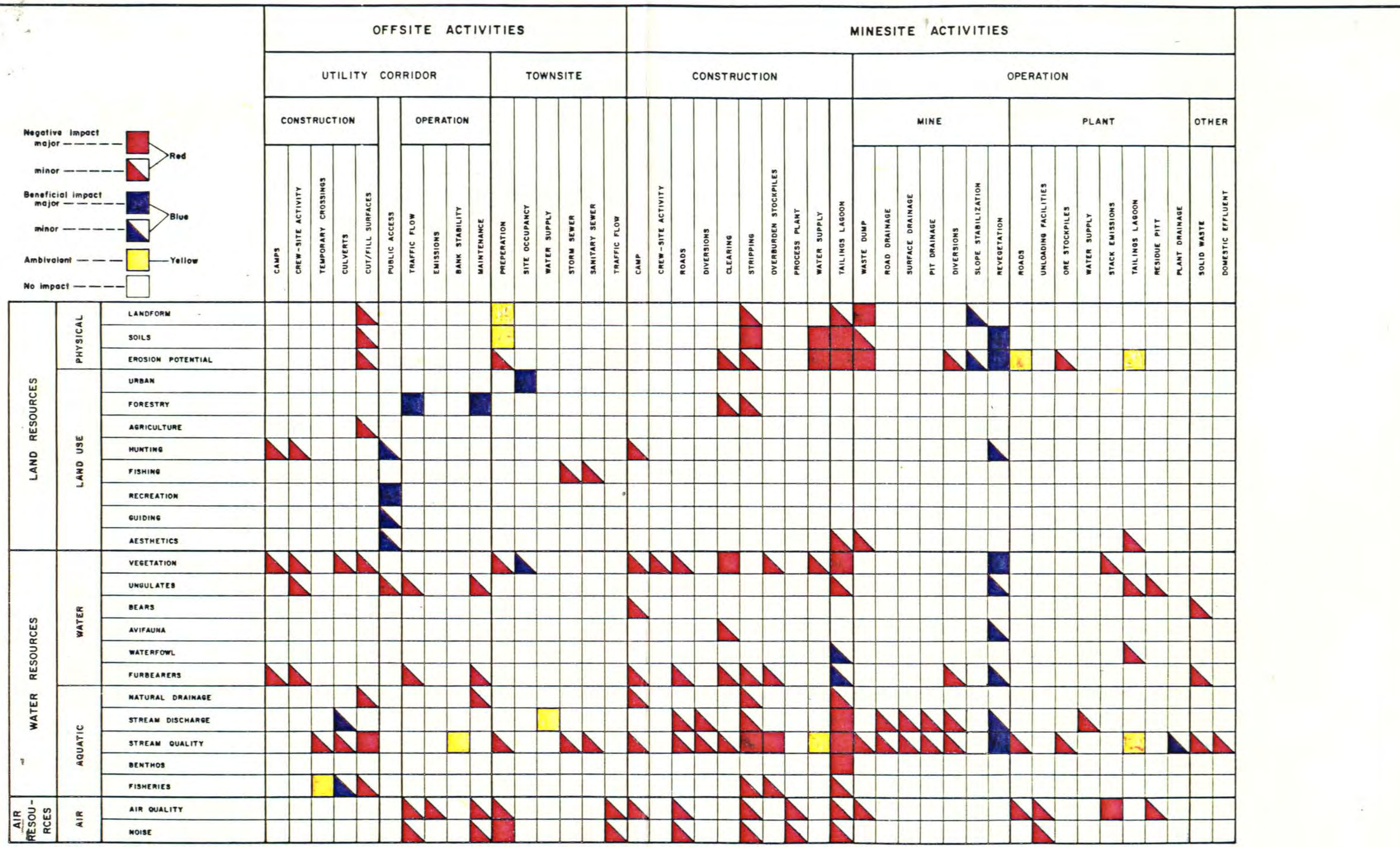
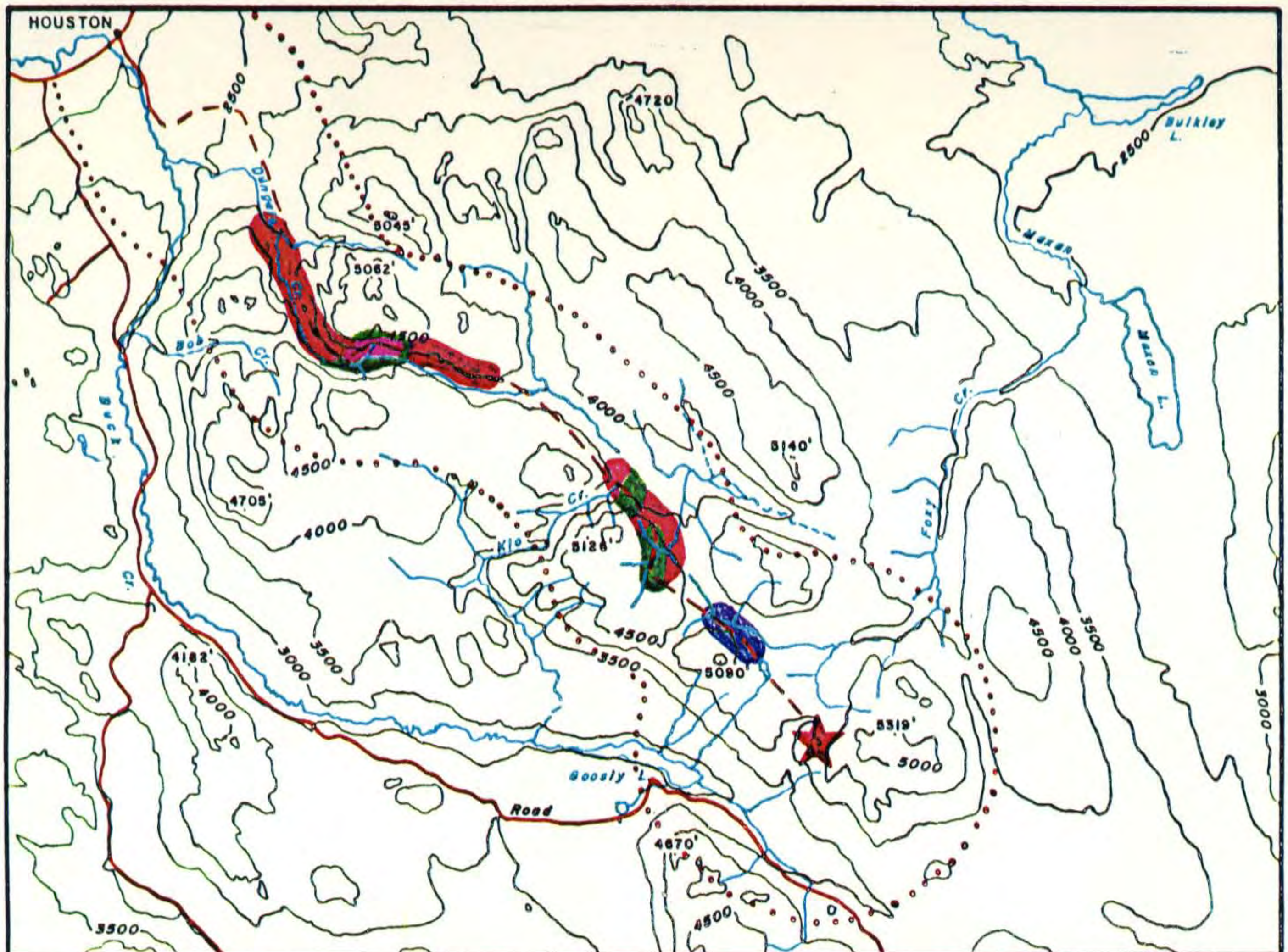

-HOUSTON LAND USE 1975-
LEGEND
Park
Public Amenity
Church
Commercial
Service Station
Industrial
HOUSING
Single Family
Multiple
Hotel
Future Housing
UTILITIES
Water
Sewer
Gas
1000 500 0 1000
1" = 1000'
Airfield
MT. DAVIS WAY
PROSPECT ST.
TRINITY ST.
NORWOOD ST.
VIEWMONT COURT
CRESCENT HWY.
YELLOWHEAD HIGHWAY No. 16
OLD HWY.
C.N.R.
LOGGING ROAD
BULKLEY RIVER
EAST VALLEY ROAD
FRONTIER AVE.
SEWAGE LAGOONS
INDUSTRIAL PARK
3rd ST.
5th ST.
NADINA AVE.
TWEEDIE AVE.
FLAG ST.
CHURCH & SCHOOL
IDYLWILD
CO-OP
Well
RAIL ST.
KANATA AVE.
CALEDONIA AVE.
HYDRO SUB-STATION
1976 40 LOTS
1976-79 140 LOTS
SHOPPING CENTER
POLICE FIRE LIBR.
FUTURE SENIOR CIT.
HEALTH UNIT
PEARSON RD.
PARK LANE
HAGMAN CRES.
MOUNTAINVIEW DRIVE
COOPER RD.
PARISH RD.
GILLESPIE RD.
HUNGERFORD DRIVE
SECONDARY SCHOOL
MUNICIPAL PARK
COPELAND AVE.
BENSON AVE.
4th ST.
5th ST.
6th ST.
9th ST.
10th ST.
11th ST.
12th ST.
13th ST.
14th ST.
15th ST.
16th ST.
17th ST.
POULTON AVE.
ELEMEN-TARY SCHOOL
ICE RINK
PARK
BUTLER AVE.
BUTLER PLACE
CATALINE CRES.
WINTER AVE.
DUKE AVE.
HOUSTON HOTEL
HOUSTON TRAILER COURT
REC. CENTER
POLE YARD
COMM. HALL
AMBASSADOR TRAILER COURT
STAR ST.
DOMINION AVE.
AVALON AVE.
1980-85 150 LOTS
1985+ 200 LOTS
RIVERBANK DR.
BUCK CREEK
POPLAR ST.
OMINECA AVE.
OMINECA WAY
Municipal Dump
inches
0 1
0 1 2
centimetres
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.



BEAK	DATE	AUG.	76
	PROJECT	J5058A	
	DWG NO	27	



LEGEND

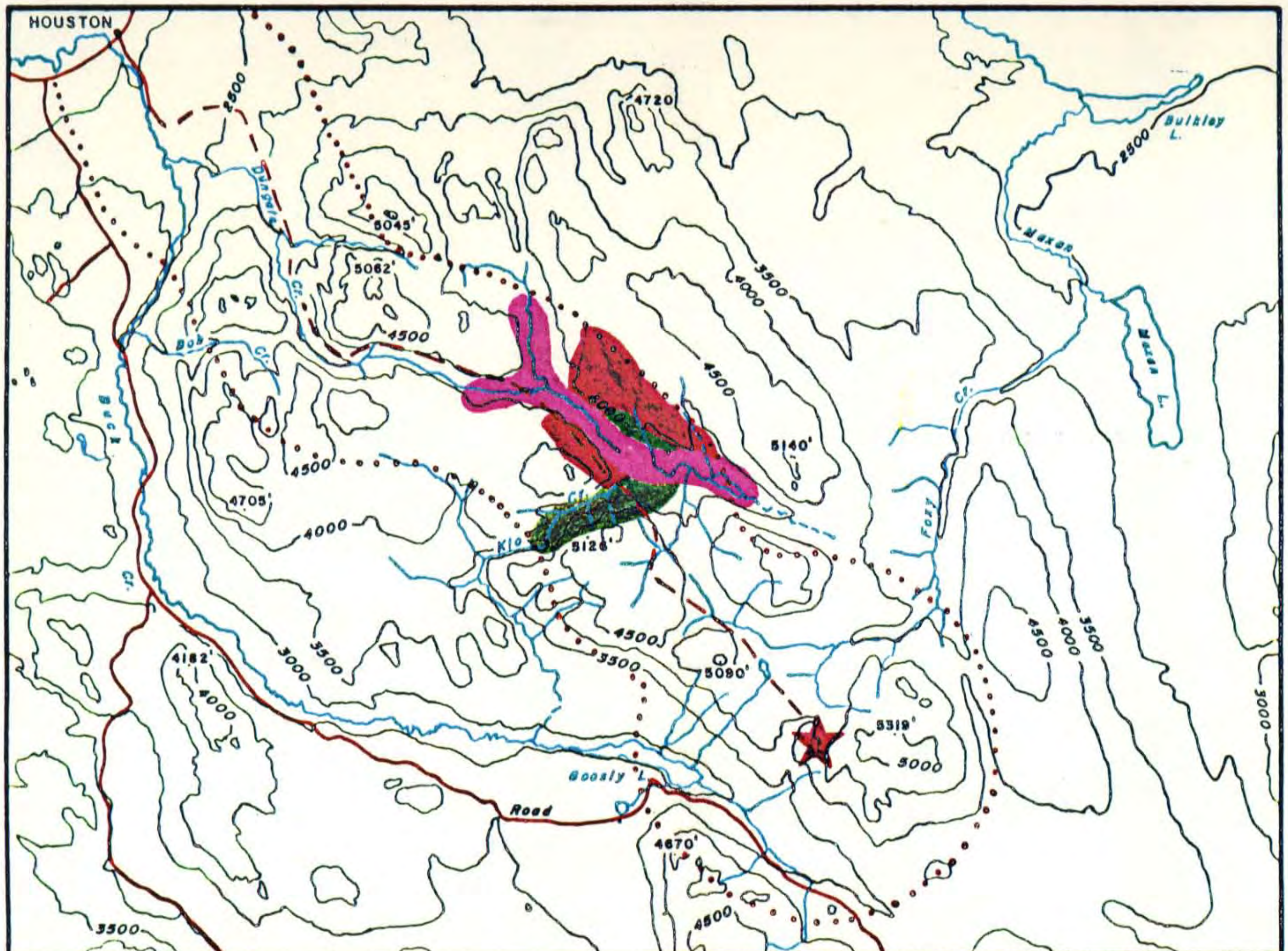
- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

Scale : 0 2 4 Miles

FIGURE 28: PHYSICAL SETTING: ENVIRONMENTAL IMPACT SUMMARY

- Slope severe; 30% +
- Wetness; poorly drained
- Depth to bedrock <3'
- Soil erosion; moderate - high

beak		
	DATE	AUG. 76
	PROJECT	J5058A
	DWG NO	



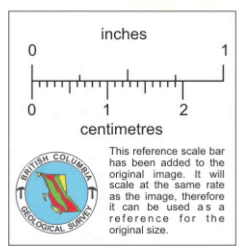
LEGEND

- Existing Roads
- Utilities Corridor
- Zone of Analysis
- Goosly Project

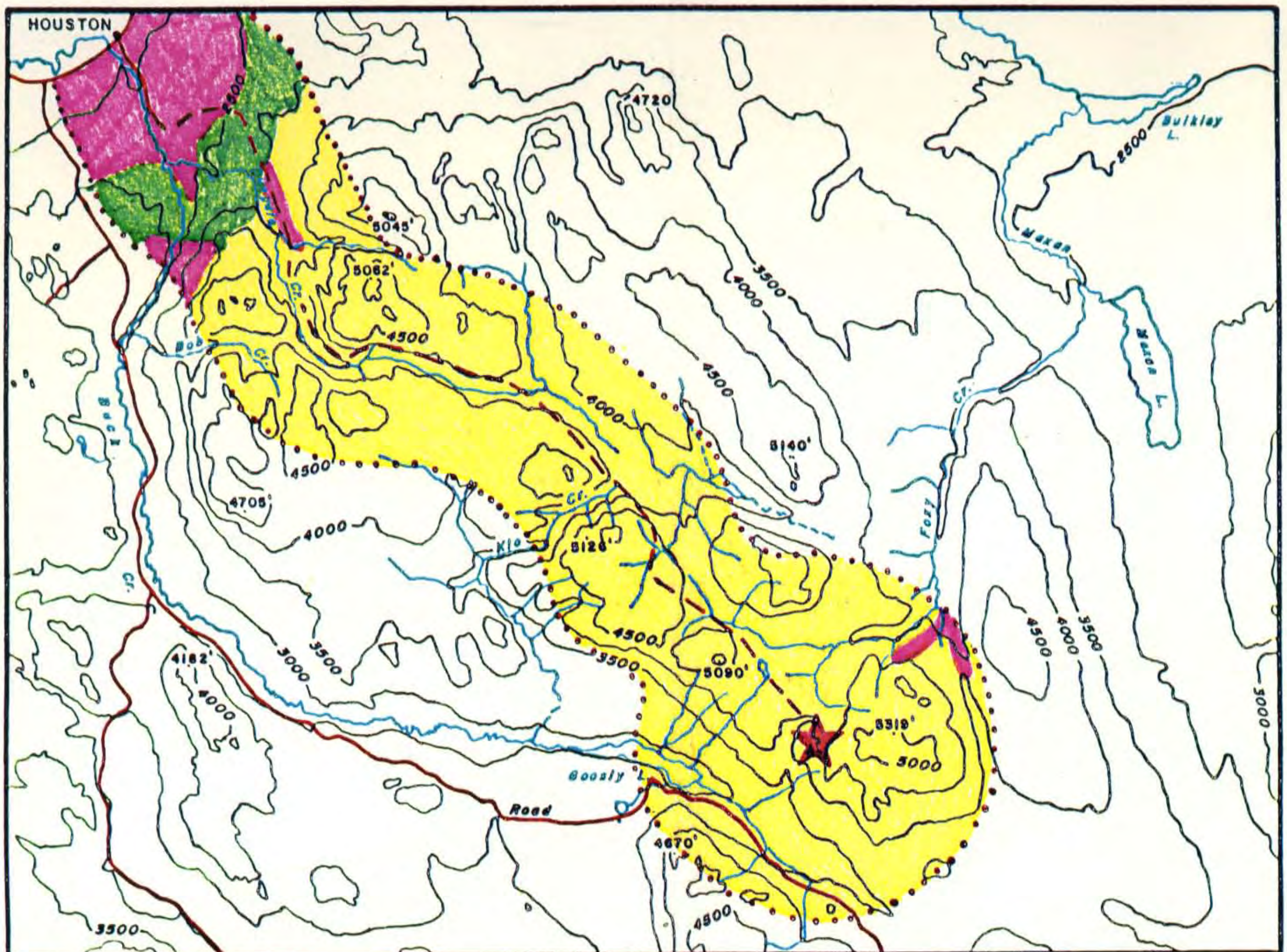
Scale : 0 2 4 Miles

- Recreational Use
- Forestry
- Wildlife

FIGURE 29: LAND USE - ENVIRONMENTAL IMPACT SUMMARY



beak	DATE	AUG. 76
	PROJECT	J5058A
	DWG NO	



LEGEND

Existing Roads
Utilities Corridor
Zone of Analysis
Goosly Project

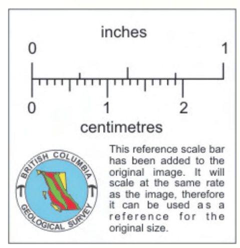
Scale: 0 2 4 Miles

Low

Moderate

Severe

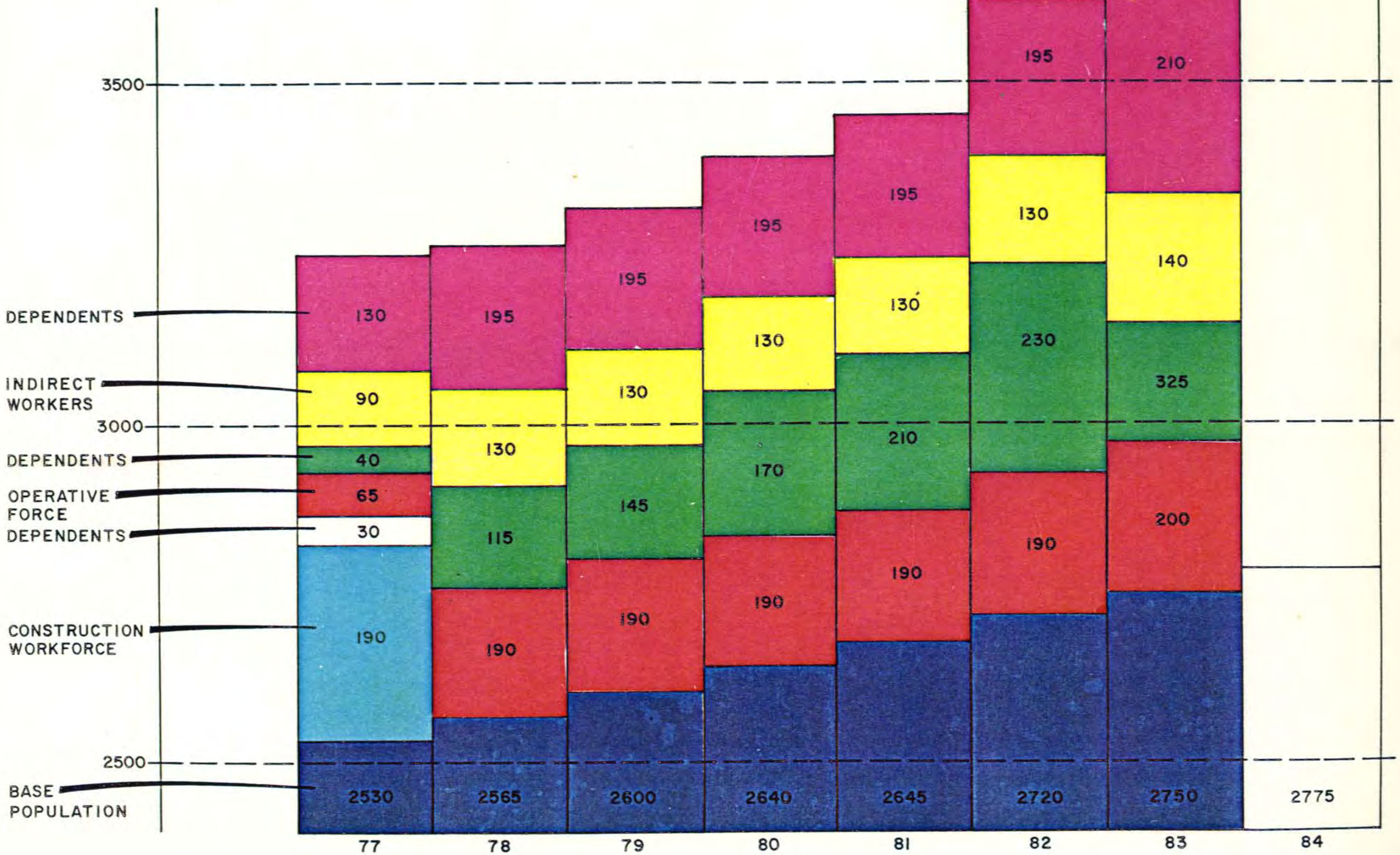
FIGURE 30: AIR POLLUTION POTENTIAL



beak

DATE	JULY 76
PROJECT	J5058A
DWG NO	

PROJECTED POPULATION INCREASE : HOUSTON B.C.
(ASSUMING EQUITY YEAR I = 1976)



BEAK	DATE	AUG.	76
	PROJECT	J5058A	
	DWG NO	31	

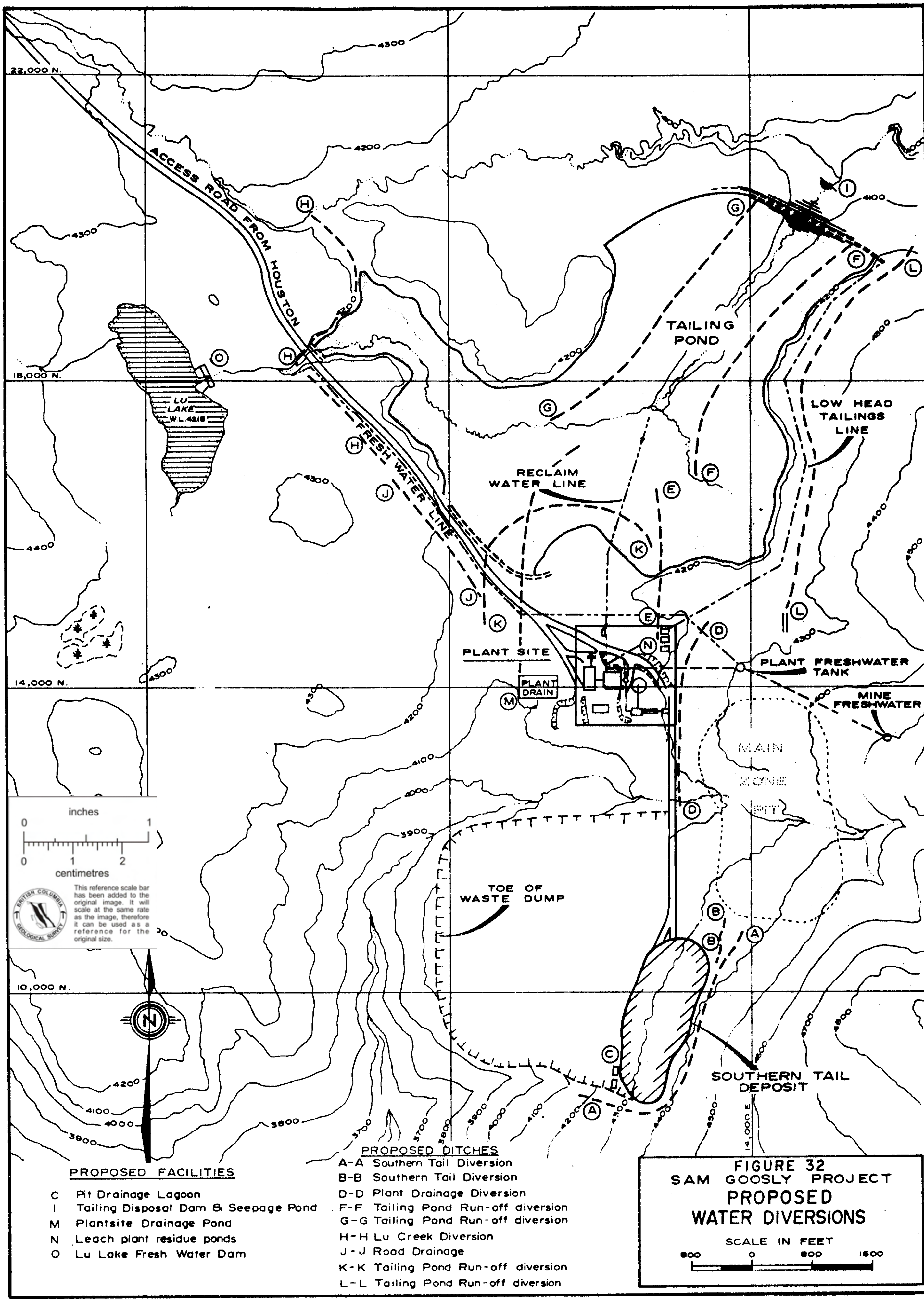


FIGURE 32
SAM GOOSLY PROJECT
PROPOSED WATER DIVERSIONS