APPENDIX A:

TERRESTRIAL ASPECTS

Prepared for:

NORTHCOAST ENVIRONMENTAL
ANALYSIS TEAM

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TERRESTRIAL REPORT

APPENDIX A

NEAT

CHAPTER A3 cont'd

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This Appendix was prepared by the following members of NEAT under the supervision and coordination of Mr. H. Urhahn, (Tera Environmental Resource Analyst Ltd.):

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Archaeology	-	R. Inglis (National Museum of Man, seconded to the B.C. Provincial Archaeologist)
Wildlife	-	W.G. Smith P.W. Martin
Plant Ecology	-	J. Pojar (Tera Consultants)
Forestry	-	D.J. Norris (Reid, Collins & Associates Ltd.)
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INTRODUCTION

The terrestrial report will cover aspects of the physical and natural environment which are land-based. Within the terms of reference of the complete study, it was decided that the terrestrial report would include landform, geology, surficial geology, soils, vegetation, forestry, wildlife, archaeology and engineering geology. Aspects of hydrology and freshwater ecology are components of the aquatic section.

General, geologic and physiographic descriptions as they pertain to the aquatic sections, such as the Skeena River Delta formation and sedimentation patterns, are described so as to be useful to the aquatic group.

This terrestrial appendix is organized in two main parts. Part 1 describes the existing environment, starting with the physical base (geology and soils) through vegetation and forestry as independent entities and as habitat, to wildlife which use that habitat, and finally the archaeological description of the people who utilize the environment described.

Part 2 evaluates these physical and biological factors to designate areas suitable for development over the entire Tsimpsean Peninsula, and at the specific sites designated for further study at the end of Phase I (Port Simpson, Ridley Island, Kitson Island, and Fairview Point).

The information contained in this Appendix is condensed and summarized. Detailed back-up data, individual working maps, and so forth, have been retained in the NEAT archives and are available for viewing with the approval of the joint federal/provincial steering committee.

All information within this terrestrial report has been geared to a port development such as bulk loading and concentrate handling, and their access needs. It should be understood that raw data presented have been subjected to compilation and analysis which is "port-specific" but can with further refinement be used for suitabilities such as recreation, urban suitability and larger industrial installations, as well as resource utilization in the forest and mining sectors.

The break between physical and natural components is somewhat artificial and more for report convenience. It should be stressed that the physical aspects discussed are not engineering limitations but the "substrate" for the natural system. However, this does not mean that the physical components and their subsequent physical suitability for port development cannot be used by the engineering group.

Introduction cont'd

Specific components of the terrestrial system such as surficial geology and soils suffered from complete lack of existing information. Original field work was necessary to compile the regional and site-specific inventories. The vegetation component suffered the same limitation as there had been no survey undertaken previous to this assignment. The waterfowl and wildlife components to this terrestrial section relied heavily on discussions with the conservation officer and biologists of the provincial government as well as original field work.

STUDY METHODS

The terrestrial data bank was established using field reconnaissance, review of existing information and photo interpretation as the main tools. In particular, the descriptions of the physical and biological components of landform, geology, soils and vegetation were based on air-photo interpretation with ground checks.

Specific methods used were as follows:

Bedrock Geology

A preliminary field reconnaissance and a review of the existing mapped information at 1" = 4 miles was plotted on a scale of 1:100,000. Subsequent airphoto interpretation with ground checks of critical geological boundaries refined the previously plotted geology. In this way,the bedrock geology and structural geology of the total study area was plotted.

Surficial Geology

Since no data were available on this component, an initial field reconnaissance established the rough surficial categories which were to be used on the regional map. Airphoto interpretation was checked during two subsequent field trips in order to establish the surficial geology of the total study area at 1:100,000. In addition, existing snowslides, rock slides and debris slides were plotted on the regional surficial geology map.

Soils

No site-specific data were available for soils. A review of soil information from southern Alaska, the Queen Charlottes and northern Vancouver Island was used as a guideline for field reconnaissance. The surficial geology and vegetation were related to the possible soil types on the Tsimpsean Peninsula. An initial field reconnaissance established the preliminary soil categories which subsequently were plotted using airphoto interpretation at a scale of 1:100,000.

Study Methods cont'd

Soil profiles were extrapolated in the field from road cuts, eroded slopes, uprooted trees, and other areas with soil exposure. A transect normal to the coastline was conducted at the four highest ranked port options. The ground transect enabled a check of the air-photo interpretation and then established a soils map at a scale of 1:100,000 for the total study area.

Vegetation

No site-specific information was available for vegetation and the preliminary vegetation categories and associations were established on the basis of the field reconnaissance. Subsequent air - photo interpretation with ground checks established a regional vegetation map at a scale of 1:100,000.

All of the above information was cross-checked with the use of an overlay system to establish the physical and biological composite. In addition, the four highest ranked port options were mapped in more detail, using the same categories as established for the regional maps. The site-specific detail was mapped at 1:10,000 for all components from slope to vegetation.

Forestry

Forest cover maps at a scale of 1" = ½ mile were obtained from the B.C. Forest Service, Mapping Branch, and were reduced to a scale of 1" = 1 mile.

Map Area Statements, Map Volume Statements and Volume Over Age Curve indices were also obtained for the study area which is located wholly within the Hecate Public Sustained Yeild Unit (PSYU).

The location of the alternative sites and associated rights-of-way were obtained from the engineering drawings provided by Swan Wooster Engineering Co. Ltd. and plotted on the 1" = 1 mile maps.

The forest cover types were identified and listed from the forest cover map and then verified from the air during a one day reconnaissance flight. Timber quality based on pathological indicators (visible from the air), visible sweep and tree height were also checked. Acreages of each forest type found within the alternate port sites and right-of-way were then estimated.

Study Methods cont'd

Volumes per acre for each forest cover type were obtained from the Map Volume Statements. These volumes are based on trees in excess of 9.1 inches diameter Breast Height, to a 4.0 inch top, at close utilization standards and less decay only.

The proposed port sites, rights-of-way, productive forest sites, low site forests and non-productive forest sites were replotted on a 1:100,000 scale map.

Wildlife

Wildlife evaluations in the Prince Rupert study area included two weeks of field studies in September, a one day flight in November to observe the number and distribution of wintering waterfowl, interviews with locally informed people, and a search of published literature. Information from these sources was interpreted and prepared by W.G. Smith and P.W. Martin, the wildlife study team of N.E.A.T.

Field studies consisted mainly of site inspections throughout the study area by boat and car, and a flight over the entire coastal and much of the coastal plain portions of the study area. Interviews were conducted with numerous individual members of the public, the local Conservation Officer, the former Regional Wildlife Biologist in the area, local representatives of the Federal Fisheries Service, and a former member of the Prince Rupert S.P.E.C. club. Some information was obtained from members of the indian community at Port Simpson and an executive member of the Prince Rupert Rod and Gun club. Literature repsecting wildlife in the Prince Rupert area is scarce indeed, and most of that found to have local significance was from British Columbia Provincial Museum publications and from Alaska Department of game. Records on hunting activity and same harvest data were obtained from B.C. Fish and Wildlife Branch sources.

SHORTCOMINGS OF THE TERRESTRIAL DATA

All data collected by the terrestrial group for comparison of all port options is confined to the study period of September to November. For the wildlife and waterfowl aspects, this does not include all of the seasonal activities of these animals. This deficiency is aggravated by the lack of published information on wildlife in the Prince Rupert area. For this reason, several major judgements respecting the status of wildlife and waterfowl species, their habitat requirements and the resultant port impact, had to be made.

Specific waterfowl and wildlife shortcomings are:

(a) The spring migration of waterfowl to the study area should be observed to determine species composition and areas of feeding and resting habitat. More detailed knowledge of numbers and distribution of black brant, white-fronted geese and mew geese, should be obtained.

(b) Winter habitat and distribution of deer under various weather conditions should be documented in order to accurately define the critical winter ranges. Present designation of winter range is founded on judgement, a process not adequate for determining local variation in the importance of winter ranges and the extent of their use by deer.

(c) More detailed information respecting the utilization of Flora Bank by waterfowl and marine bird species is needed to better appreciate the significance of primary impact of the causeway as well as the potential pollution by oil, coal dust and abestos.

(d) A more detailed inventory of the nesting populations of Canada geese, sandhill crane, and other dabbling ducks should be established.

(e) An inventory of bald eagle eyries within potential port sites should be conducted.

(f) Documentation of peregrine eyrie sites should be conducted in the early spring period together with an examination of the alcid population nesting on Lucy and Rachael Islands.

Reflecting the sources of information and deficiencies, the wildlife portion of the study represents the best judgement of the authors presented as a series of conclusions rather than a rigourous scientific evaluation. It is our opinion that this approach is sufficient for the purposes of this phase 2 report, and will permit an informed selection of sites. A better documented field study is assumed to be part of the phase 3 evaluation of the selected site.

PART I

DESCRIPTION OF THE ENVIRONMENT

CHAPTER A1 PHYSIOGRAPHY OF THE STUDY AREA

A1.1 GENERAL DESCRIPTION

The study area encompasses the Tsimpsean Peninsula and some of the outer islands. The geographic boundary follows Work Channel, Lachmach River, to the mouth of Khyex River. It then swings southwest along the Skeena River to Marcus Passage, below De Horsey Island. From here the boundary swings northwest directly to Rachael Island and Lucy Island, where it turns northeast to the mouth of Work Channel. The total study area consists of 380 square miles of land and 355 square miles of tidal water.

The Tsimpsean Peninsula belongs to that area in British Columbia called the Coastal Trough, which extends the whole length of British Columbia and includes areas such as Puget Sound, Dixon Entrance and southeastern Alaska. In particular, the Tsimpsean Peninsula belongs to the Hecate Depression, between the Queen Charlotte Islands and the mainland.

The Coast Mountains form their own area, and belong to the Kitimat Ranges. These form abrupt boundaries to the east and south of the Tsimpsean Peninsula.

In the centre of the study area is Kaien Island with the City of Prince Rupert. The city fronts on the only fjord within the Tsimpsean Peninsula. The city is joined to the mainland by highway and railway which reach tidewater via the Skeena River Valley.

The Tsimpsean Peninsula consists of three main physiographic units. They are the coastal lowlands; the central uplands, which form the spine of the peninsula; and the coastal mountains, which border the eastern part of Work Channel. (Map 741-A1)

The change from the coastal lowlands including the outer islands to the Coast Mountains is gradual. The central upland reaches heights of 3000 feet and the Coast Mountains 5000 feet. The general grain of lineament of the Tsimpsean Peninsula runs from northwest to southeast as exemplified by Tuck Inlet, Work Channel and the east shore of Port Simpson Harbour. This same northwest trend divides these physiographic units - the coastal lowlands, central uplands and the Coast Mountains - into broad linear belts.

General Description cont'd

The Coastal Lowland has an average elevation of 250 feet with some hills reaching 1500 feet. The terrain is generally gentle with a ridge and swale micrc-topography. Steep slopes are associated with the ridge tops and are a prominent feature on Digby and Ridley islands. The Slope Map averages slopes not exceeding 30% and does not take into consideration the micro-topography.

Within the coastal lowlands the drainages show a poorly developed pattern which, as the land rises and leads to the central uplands, shows more prominent trends primarily in the northwest - southeast alineament. Stream gradients are low and streams are interrupted by frequent shallow lakes. The dominant water recharge is from forest bogs.

The Coastal Upland shows a moderately rugged terrain, consisting of rounded hills reaching heights of up to 3000 feet. The central upland shows predominantly slopes in excess of 30%. It does not display the ridge and swale micro-topography of the coastal lowlands. The rounded mountains are dissected by many glaciated valleys with broad cirques at the head of the valleys. The drainage is not random but controlled by a northwest-southeast alineament. Stream gradients are gentle in the hanging valleys and the cirques, and rapidly increase before reaching tidewater and the coastal lowland.

The valley walls of these glaciated valleys are frequently oversteepened with sometimes valley walls exposed to bedrock.

The Coast Mountains display the most rugged topography, reaching heights of 5000 feet adjacent to Work Channel. They form the backdrop to the Tsimpsean Peninsula and determine the morphology of Work Channel and the Skeena River. The Coast Mountains display a prominent alineament in a northwest-southeast direction, frequently interrupted by en echelon faults at right angles. For example, Work Channel parallels the major coast mountain trend and occupies an eroded fault zone which separates the Tsimpsean Peninsula from the mainland. In contrast, the northern and southern boundaries of the study area, the Skeena River and Portland Canal, occupy a major fault pattern at right angles to Work Channel which has been subsequently eroded by the waters of the Skeena and Nass rivers.

General Description cont'd

The only land less than 30% in slope within the Coast Mountains is found in the broad U-shaped valleys and on the alluvial fans of smaller drainage networks. In general, there is a severe lack of level land within the Coast Mountains as is demonstrated by the topography at the head of Work Channel.

A1.2 GENESIS OF THE TSIMPSEAN PENINSULA

The Tsimpsean Peninsula is the transition zone between the Hecate Lowland and the Coast Mountains. During geologic history, the Hecate Trough subsided and the Coast Mountains rose. Such differential stress played the major part in the uplift of the eastern portion of the Tsimpsean Peninsula and the relative stasis of the western lowlands. The oldest rocks recorded on the Tsimpsean Peninsula are the metamorphic sediments found in the coastal lowlands. They are up to 350 million years old and belong to the Upper Paleozoic. Progressively younger metamorphic rock is found adjacent to Work Channel, approximately 250 million years old.

Within the Coastal Trough-Coastal Mountain fault line intruded, during the Cretaceous and Lower Tertiary, a number of small plutonic stockworks. The southern portion of the Tsimpsean Peninsula, the Ecstall Pluton, formed 100 million years ago. The same rock can be found on Kinahan Island and some dikes are found on the northern part of Ridley Island. These intrusives have been forcefully injected, creating small scale uplifts in the metamorphic rocks on the Tsimpsean Peninsula.

Accompanying this turbulent geologic history are major fault zones. The classic example is Work Channel, a straight fault zone which intersects with the Portland Canal Fault and Skeena River fault at right angles. Therefore, the Tsimpsean Peninsula is bounded by faults.

During the ice age, approximately 9 to 10 thousand years ago, the Kitimat Range ice sheet was one of the larger ice accumulations within the Cordilleran ice fields. During the largest extent of this ice cap it flowed east and west. The Tsimpsean Peninsula was subjected to a slow, westerly-moving ice sheet which was estimated to be several thousand feet thick. It was this ice cap and its movement which created the rounded mountain tops of the Kitimat Range to the east.

Genesis of the Tsimpsean Peninsula cont'd

With the gradual melting of the Kitimat Range ice sheet, the ice thinned until it formed large mountain and valley glaciers. It is estimated that this stage of the glacial history occurred approximately 7000 years ago. During this period the Skeena Valley, Work Channel, Tuck Inlet and Prince Rupert Harbour were gouged out by the ice. The direction of movement conformed to present day valleys and fjords such as the Skeena River. The glaciers continued northwesterly into Chatham Sound where they merged with the major ice flow out of Portland Inlet to flow into Dixon Entrance.

Further warming trends and wasting of the valley glaciers and mountain glaciers created remnant cirque glaciers. It is this latter process which has determined the makeup of the landform on the Tsimpsean Peninsula. The spine of the central upland shows numerous remnant cirques whose mouths are at approximately 1200 to 1500 feet above present sea level. The cirque walls then rise to heights 2500 to 2800 feet. The valleys which originate from the cirques then drop through fairly steep river gradients to tide water. Valley shape is that of a hanging glacial valley with glacial debris filling the valley bottom.

The large valley glacier which moved northwest down Chatham Sound created the flat gentle plain of the coastal lowland, and scoured its northwest trending ridge and swale micro-topography.

During the wasting of the ice mass, the land mass rebounded in relation to sea level and it is estimated that in the Prince Rupert area the land has risen approximately 200 to 250 feet in the past 10 thousand years.

The rebound of the land relates directly to the nature of the emerging coastline. In the bays along the outer coast, old beach ridges can be traced for a few hundred yards into the lowlands. Estimates of adjacent Alaska territories showed a rise of approximately 25 feet in the past 2000 years in the land mass relative to the sea level.

Because the coastal lowland consists of relatively soft rocks, not resistant to wave erosion, we find large rocky headlands, approximately 50 to 100 feet above sea level and long halfmoon shaped beaches. The gentle relief forms large flat expanses of intertidal beach and

Genesis of the Tsimpsean Peninsula cont'd

large shallows adjacent to the coastline. Such coasts are rare in British Columbia because they offer such large expanses of subtidal shallows.

In contrast, the more resistant metamorphic rocks found in the central upland manage to survive the erosive action of ice and water and show a differential erosion pattern created by mountain glaciers and cirque glaciers.

The Skeena, which forms the southern boundary of the Tsimpsean Peninsula, is one of the ancient rivers of British Columbia. It has survived the uplift of the Cordillera and with the aid of the last ice sheet, gouged a deeply eroded U-shaped valley. This broad valley has been filled with sand and silt of the Skeena River after the ice was wasted. The rapid sedimentation has reached Marcus Passage and Kitson Island. The delta front is located between Kitson Island and Kennedy Island.

The Skeena River has formed a complex delta because of the presence of Smith Island, De Horsey and Kennedy Island, which have divided the flow of the Skeena within relatively narrow channels. No broad delta front such as the Fraser delta can be recognized.

A1.3 THE GEOLOGY (SEE ARCHIVES: GEOLOGY MAP)

The discussion of the genesis of the Tsimpsean Peninsula has introduced some of the chronology of rocks encountered. In the following section, we will discuss the physical properties of rock and their relationship to land use opportunities. The oldest rocks are found in the coastal lowland and consist of metamorphic rock including slate and composite schists. These rocks show tightly folded bedding planes and arerelatively soft. These rocks can be excavated with the aid of heavy machinery without blasting. There is, however, some variation in resistance to erosion among the slates and schists which created the micro-topography so characteristic of the coastal lowlands. The more resistant rockmakes up the ridges and softer rock the depressions.

Younger rocksgrade into meta-sediments of the almandend, amphibolite facies encountered on Ridley, Lelu, Kaien islands and Port Simpson. These meta-sediments are steeply dipping towards the east and are tightly folded. The more resistant rocks, mainly quartzite and some hornblende schists, create a steeply ridged micro-topography on the north shore of Prince Rupert Harbour and in the Port Simpson region. In contrast, the softer schists are located in gentle depressions. In other words, the micro-topography becomes more rugged although the macro-topography is moderate in this rock series.

Progressively younger rocks are found in the gneiss series on the central upland which makes up the backbone of the Tsimpsean Peninsula. These rocks are resistant to ice and water erosion and require blasting techniques for excavation. The majority of this rock is found at the Port Simpson Harbour site, and similar rock is found in the Melville Arm area.

The remaining rocks are much younger, poorly metamorphosed gneiss, diorite and hornblende gneiss and they are located along portions of Work Channel and the southern end of the Tsimpsean Peninsula, Smith Island and De Horsey Island. These rocks are massive and resistant to erosion and display the same properties as the gneisses.

The injected intrusive rocks occur on Kinahan Island and on the southern tip of the Tsimpsean Peninsula. These are Cretaceous quartz-monzonite plutons, which have intruded into the meta-sediments. This rock is massive, coarse-grained and resistent to erosion. Evidence of a dike stockwork can be found at the northern tip of Ridley Island, presumably from the Kinahan Island pluton. The only importance in this dike system on Ridley is that these rocks are far more resistant and massive than the schists surrounding them and may possibly provide opportunities for rock anchors, not generally found in the softer meta-sediments. At the Port Simpson site, the foliated gneisses are massive enough to be suitable for proper rock anchor locations.

A1.4 THE STRUCTURAL GEOLOGY (SEE ARCHIVES: GEOLOGY MAP)

As mentioned, the Tsimpsean Peninsula bespeaks a turbulent geological history. The Hecate Lowland subsided, while the Kitimat Range uplifted. The boundary between these two activities is on the Tsimpsean Peninsula. Major planes of weakness have created fault zones such as Portland Canal, Skeena River, Work Channel and smaller secondary fault and fracture patterns are evident throughout the peninsula. The region

The Structural Geology cont'd

displays deep faults through which the Cretaceous and Tertiary intrusives, such as the Ecstall pluton at the southern tip, have reached the earth's surface.

In addition, the wasting of the ice sheet and the rebound of the land have added additional stress on the earth's crust. It is suggested that at present the Tsimpsean Peninsula has reached equilibrium. The last major earthquake was recorded in 1929 with its epicentre in the Hecate Strait.

A1.5 SURFICIAL GEOLOGY (SEE ARCHIVES: SURFICIAL GEOLOGY MAP)

The gradual warming trend during the past 10 thousand years has created conditions leading to the wasting of the Cordilleran ice sheet on the Tsimpsean Peninsula. During this process different types of ice erosion have lead to different types of surficial deposits. The wasting Cordilleran ice sheet flowed down the Skeena River Valley and northwest along Chatham Sound to meet with even larger ice flows down Portland Canal. During the recession of this ice sheet, the ocean water floated the tongues of the wasting ice mass. This created a water column below the ice sheet and deposited thin till on the coastal lowlands. At the same time, larger boulders carried by the ice were dropped, due to the melting process, and embedded themselves in the fine clayey matrix of the till. This material is generally very thin and found in depressions below the organics in the coastal lowlands.

The ice sheet was wasted to form valley glaciers and mountain glaciers. The glacial deposits changed to channel and recession deposits, of which remants are only found in the Lachmach River valley. The study region is characterized by a general lack of glacial recession deposits because many of them are masked by resorted river deposits.

No glacio-marine veneer or glacial lacustrine deposits are evident in the study area. The most dominant surficial deposits are colluvium (200 square miles) generally less than 5 feet thick, which may increase in thickness at the base of mountain slopes. Second most common is the exposed rock with less than three feet of overburden (132 square miles). The exposed rocks are generally associated with the oversteepened valley walls of glaciated valleys or with mountain tops which are in excess of 2000 feet above sea level.

Surficial Geology cont'd

For convenience, the organic deposits in excess of 5 feet in thickness were mapped as surficial deposits even though they may blanket glacial till and impervious bedrock. They are mainly located in the coastal lowland on gentle topography. They are the third largest unit of the surficial geology (32 square miles).

Some of the larger streams on the Tsimpsean Peninsula have resorted the thicker colluvium at the base of slopes and the glacial till to form mountain stream deposits and stream deposits of lowstream and deltaic natures. Alluvial deposits are not extensive, only 7 square miles, and confined to lower reaches of streams generally situated in the central upland of the Tsimpsean Peninsula.

Along the river channel of the Skeena River, extensive floodplain deposits and deltaic deposits are present. Because of the confinement of the river within relatively steep mountain flanks, right to Smith Island and Kennedy Island, the channel deposits are relatively coarse. Only in embayments, such as at the Khyex River, Inverness Passage and Flora Bank, do we find silt deposits of lowstream and deltaic nature. The true delta front is located at Kitson Island, derived from sediments from Inverness Passage and between Kennedy Island and Smith Island, derived from sediments from Marcus Passage.

In addition to steep slopes, it is in the surficial deposits that we find the serious limitations to port development. The organic and fine silt deposits show poor foundation and bearing strength as well as poor stability and internal cohesion. They are easily eroded.

A1.6 THE SOILS (SEE ARCHIVES: SOIL MAP)

Soils in the study area are roughly 8000 years old. They have developed as a function of climate, topography, parent material and time. Because rainfall is very high, and temperatures are cool with little range between summer and winter temperature, climate is one of the overwhelming controlling factors in soil formation. Next, in order of importance as soil-forming factors on the Tsimpsean Peninsula are drainage and slope.

Soils can then be grouped according to the land unit they belong to. Within the coastal lowlands the majority of soils are

The Soils cont'd

organics due to the gentle topography and poor drainage characteristics. In the central uplands, with more rugged, moderate topography, the soils grade into thin organics and on well drained slopes into podzol. Within the central uplands, podzols and thin organics are the two dominant soils. Above 1500 feet mean sea level, montane soils develop which generally show less decomposed organic horizons.

Special soils, not very abundant in the study area, are associated with major stream courses and are the regosols which are drained, oxidized mineral soils, generally in the coarse parent material of stream deposits.

The finer sediments of the Skeena River show the development of soils which are reduced chemically. These are gleysols and occur beneath marsh vegetation. Some gleysols are confined to small embayments along the outer coast such as Big Bay and Venn Passage.

Among the organic soil series a special soil group occurs, the folisols, which are dry, undecomposed organic soils less than 4 feet thick. They consist generally of moder and are located on islands or headlands on the outer coast.

To understand the dominant soils a brief description follows. The organics fall into two dominant soil groups; the mesic-fibrisols and the lithic-fibrisols. The mesic-fibrisols are the open bog soils which have undecomposed sphagnum in the top horizon and partially decomposed organic material in their middle and lower horizons. These soils exceed 5 feet in thickness and are associated with the open raised bogs of the coastal lowlands.

The lithic-fibrisols are soils which show generally undecomposed organics and are not more than 5 feet thick. Both the top and bottom horizons are undecomposed and are associated with forest bog associations such as lodgepole pine - yellow cedar and the blanket bogs of higher elevations. Besides the poorly-drained organic soils, we find podzols on the steeper, better-drained portions of the Tsimpsean Peninsula. The podzols consist of humo-ferric podzols which are drained mineral soils with a relatively undecomposed top horizon. These soils have a

The Soils cont'd

well-developed podzolic B-horizon which is easily recognized by its rust brown colour. These soils are associated, in general, with productive forest lands.

The brunisols in the study area are found at higher elevations, generally above 2000 feet. These soils have an organic top horizon and in contrast to the podzols fail to have a rust brown lower horizon indicating oxidized conditions. They, however, are acidic. Some of the brunisols grade into lithic-brunisols which are only 4 to 8 inches thick over the bedrock surface.

A1.7 SEISMICITY

The seismicity lies in zone 3, as suggested by the Building Code of Canada. By definition, the possibility of earthquake occurrence is high. Different unconsolidated surface materials perpetuate quakes at different rates. Special mention should be made of the Flora Bank sands and silts which will amplify quake activity and are unstable.

A1.8 PHYSICAL HAZARDS (SEE ARCHIVES: SURFICIAL GEOLOGY MAP)

The assessment of the physical environment of the Prince Rupert area includes an appraisal of landslide hazards.

Landslide scars are conspicuous features on hillsides throughout the area and are clearly indicated on the airphotos which were available for study. They are plotted on the regional Surficial Geology Map.

A preliminary study of these slides reveals that they are exclusively debris slides with characteristics closely related to the topography, climate and geology of the Prince Rupert area.

A1.8.1 Debris Slides in the Prince Rupert Area

Debris slides occur throughout the area on slopes of 30 degrees or more. The characteristic scar appears as an arrowhead pointed up the slope.

Physical Hazards cont'd

The slides apparently start as a small slide on the steep slope and sweep a wider and wider path as they move down. The slide debris consists of a few feet of topsoil and weathered rock together with the forest cover.

In areas of hard massive and resistant rocks the surface of the slide is swept clean and the debris consists almost completely of wood. In areas of more friable rock the slide surface is not swept clean and the debris includes a higher percentage of mineral soil and broken rock.

These debris slides move rapidly and the momentum depends on how high on the slope the slide started and the volume of moving material. The debris comes to rest on flatter ground at the toe of the slope. Depending on the momentum of the slide and the topography at the bottom of the steep slope, the debris may move out a variable amount. The maximum distance appears to be less than 1000 feet and the minimum may be as little as 100 feet.

Once the slide has occurred and removed all the potentially unstable material from the slide path, no further slide will occur in exactly the same path until the forest cover is re-established. Presumably after fifty to a hundred years a slide scar will be completely covered by a mature forest and will again be susceptible to sliding.

These slides are commonly associated with minor drainage channels which occur every hundred yards or so on steep slopes. A major slide may be triggered by a very small local slide or obstruction which interferes with normal drainage.

Although most of these slides occur without any human intervention, it is obvious that they can easily be precipitated by construction activities.

The date and character of the movement for most of the slides is unknown. The following paragraphs describe two slides which are known in more detail.

Prince Rupert Slide

About noon on November 22, 1957, a debris slide swept down the slope of Mount Oldfield southeast of Prince Rupert and buried several houses with loss of seven lives. The slide started about 900 to 1000 feet up the slope and was about 900 feet wide and up to 50 feet deep

Physical Hazards cont'd

when it reached the base of the slope. It was estimated by an eyewitness that the slide came to rest about four minutes after he first saw trees moving on the slope. The eyewitness said he looked up and saw trees beginning to slide. Then it gathered speed and started to roll like a big carpet getting bigger as it came. Trees some three feet in diameter were snapped in two.

The writer climbed up the slide track during the summer of 1958. The rock surface was swept bare and judging from the depth of the scarp at the edge of the slide, only six feet or so of material had been removed. The debris at the toe of the slide appeared to consist largely of tree trunks, branches and roots in a tangled mass and only ten percent or so of mineral soil.

Rainfall records at Digby Island show precipitation of 2.8 inches on November 21 and 2.6 inches on November 22, the day on which the slide occurred.

When the site was again visited in 1974 the slide path was still clearly visible but a second growth of small deciduous trees covered the area. It was clear that vegetation has been re-established within a few years after the slide came down.

Phelan Slide

On December 5th, 1959, in the late afternoon or early evening, a slide occurred which derailed several freight cars which were standing on the railway siding at Phelan.

The movement started as a small slide about 1000 feet above the railway track on the middle slopes of Mount MacDonald. The slide progressed down the slope peeling off a thin mantle of topsoil and tree cover. By the time the slide reached the bottom of the slope a fairly large volume of timber and soil had been incorporated in the slide and the momentum carried this material across the flatter lower slope for a distance of about 500 feet into Inverness Passage.

The slide path is clearly visible on airphotos taken in 1963 and the present condition of the area is visible today. An area of the slope west of the slide has been logged off since 1963. Significant amount of new growth has been established on the slide track since 1959.

Physical Hazards cont'd

Rainfall records at Digby Island show precipitation of 2.9 inches on December 4th and 1.6 inches on December 5th.

A1.8.2 Climatic Conditions for Debris Slides

The Prince Rupert area is noted as an area of heavy rainfall. For four slides where the date of the slide is known, Table 1 shows the precipitation on the day of the slide and on the preceding day. This table suggest that rainfall in excess of four inches in forty-eight hours is a prerequisite for the occurrence of debris slides in the Prince Rupert area. Records indicate that on an average about once a year, rainfall in a forty-eight hour period exceeds four inches. It appears that this type of slide will not develop until the mantle above the bedrock is saturated. Conceivably during long continued periods of heavy rain, excess pore pressures develop at the contact between the bedrock and the mantle. Weather conditions during the weeks preceding a 48-hour storm may also be a factor.

It appears that during extended periods of heavy precipitation large areas of the mantle on steep bedrock slopes reach a condition of incipient instability. However, the slides which actually occur are distributed throughout the area in a random fashion. Therefore, in addition to the general conditions there must be some local triggering mechanism.

Natural triggering mechanisms could include intense local winds to overturn trees and so start a slide or intense local rainfall from an unstable cell within the general air-mass of the storm. Either of these mechanisms would account for the apparently random distribution of debris slides precipitated by any one storm or for the absence of debris slides during a storm which would otherwise be expected to precipitate slides.

The existing CN line is subject to this slide hazard at various localities between the Khyex River and Prince Rupert. The proposed line through the valley of Lachmach River and along Work Channel would also be subject to this hazard.

Highway 16 is subject to this hazard along the Skeena, along the west side of Ganble Creek, near Prudhome Lake and where it is located between the north slope of Mount Stewart and the shore of Morse Basin.

Table 1

SLIDE	DATE	RAINFALL		
		DAY OF SLIDE	DAY BEFORE	TOTAL
Prince Rupert	November 22, 1957	2.6"	2.8"	5.4"
Phelan	December 5, 1959	1.6"	2.9"	4.5"
Tyee	October 24, 1972	4.1"	0.7"	4.8"
Sunnyside	October 15, 1974	3.0"	3.6"	6.6"

Physical Hazards cont'd

The proposed route of the highway from Prince Rupert to Port Simpson may be subject to this hazard where it is located along the west shore of Prince Rupert Harbour, and Tuck Inlet, and in some areas north of Georgetown Lake. The degree of hazard would depend to some extent on the exact location chosen for the highway.

Of the proposed port facilities only Fairview is subject to the hazard of debris slides which could occur on the slope of Mount Hayes. The hazard may also be aggravated by the presence of an access road to the microwave tower on Mount Hayes together with some logging activity on the slopes east of Fairview docks.

A1.9 MINING AND MINERAL POTENTIAL

The source material for the mining and mineral potential comes from the British Columbia Department of Mines and Petroleum Resources. The information is taken directly from the mineral deposit-land use map whose purpose is: an appraisal of mineral potential to be used as an aide in evaluation and overall land use studies. It shows the location and extent of regions in which mining activities exist or can be expected. The classification is based on two parameters, probability of occurrence and the size of the deposit.

Probability of occurrence is rated on a class system from 1 to 5. Class 1 shows the highest probability of commercial mineral occurrence and the existence of commercial ore bodies. Class 5, in contrast, includes regions which are geologically unlikely of being mineralized. The size categories are expressed in letters from A to C. A are large deposits valued at more than $500 million to C which are small deposits valued at 0.5 to 500 million dollars.

Within the study region, the probability of mineral occurrence is rated at 3 (moderate potential for mineralization). Usually Class 3 areas contain localized mineralization of somewhat higher potential or are adjacent to similar environments of higher potential.

Size evaluation shows a likelihood of small deposits with moderate likelihood of occurrence.

Mining and Mineral Potential cont'd

Within the study area only one commercial mineral deposit is present. This occurs on Smith Island and consists of limestone. About 13 thousand tons of limestone was shipped in 1950 and 1951 but quality is marginal. This limestone was used for pulp digestion and no subsequent exploitation took place.

The highest mineral potential is located on Porcher Island southwest of the study area. Gold, silver and some copper is confined to vein type deposits. These small localized occurrences are all insular and not expected to change the future transportation requirements within the study area.

As yet unexploited deposits of sand and gravel occur along the outer coast. The largest sand and gravel deposit is Tugwell Island at the western portion of Venn Passage. The entire island consists of coarse beach material.

Minor occurrences of unconsolidated sand and gravel occur along the outer coast in the form of raised beach lines. They extend from Tugwell Island north to Pearl Harbour.

The largest source of sand and gravel is derived from the Skeena River itself. The easternmost boundary of the study area shows the Skeena to be still in tidal influence. The sediment load of the river at this point consists of coarse sand which downstream gradually grades into finer sands. The channel banks, as well as quiet backwaters, display silt and mud. In order to obtain coarse river gravels, it is necessary to proceed ten miles upstream from the study area. Here lack of tidal influence shows sufficient gravels for construction materials.

The delta front located between Kitson Island and the western margin of Smith Island consists mainly of medium grained sands. This material can be used as land fill if dredged.

In summary, the only commercial deposits of significance located within the study area are construction aggregates. The largest suitable deposit is Tugwell Island consisting of beach materials.

Mining and Mineral Potential cont'd

The environmental ramifications of extraction of these materials have not been considered. It should be pointed out however, that the study area shows general scarcity of unconsolidated deposits on the Tsimpsean Peninsula due to the removal of most unconsolidated deposits by glaciers.

A small limestone deposit on Smith Island has not been exploited since 1951 when it was used as material for pulp digestion at CanCel.

CHAPTER A2 VEGETATION AND FORESTRY

A2.1 VEGETATION

The vegetation of the Tsimpsean Peninsula is typical of the growth that clothes the rugged coasts of northern British Columbia and southeastern Alaska. It belongs to the Coastal Western Hemlock zone, wet subzone, of Krajina (1965). The plant cover is a complex of forest, muskeg, and maritime and montane communities.

A2.1.1 Lowland Forests

The dense, evergreen forest that covers most of the well-drained lowlands in the study area is part of the so-called Pacific Coast Conifer Forest (Heusser, 1960), which stretches from southern Alaska to northern California. This closed coastal forest is composed of varying amounts of western hemlock, Sitka spruce, red cedar and red alder. At higher elevations mountain hemlock, Pacific silver fir, and yellow cedar become more prevalent. The shrub and herb layers in the dark forest interior are poorly developed. However, bryophytes and lichens enshroud the tree trunks and branches, and form a thick, spongey cover over the decaying humus, rotten fallen timber, and other organic litter on the forest floor.

The two commonest forest types, hemlock-cedar (10) (all bracketed numbers refer to those numbers in the plant species list, Annex A2) and cedar-hemlock (11), may be distinguished on the basis of their dominant trees. However, the flora of the two types is similar, typically including shrubs such as blueberry, false azalea, salal and red huckleberry, various ferns, and forbs such as false lily-of-the-valley, foam flower, dwarf dogwood and twayblade orchid.

The Sitka spruce - sea spray forest type (12) occurs in a narrow strip along the most exposed reaches of the mainland coastline (eg., commonly between Big Bay and Duncan Bay). As well, it covers the more exposed offshore island (eg., Lucy and Rachael islands). Occurrence of this forest type has been shown to be related to the intensity of ocean spray (Cordes, 1972). In places, the forest is almost pure Sitka spruce, but western hemlock and red cedar are common associates. Salal is by far the dominant shrub; red elderberry, salmonberry, red huckleberry and false azalea are also common. False lily-of-the-valley is the characteristic forb, while Nootka bluejoint

Vegetation cont'd

is the commonest grass. Bryophytes and lichens form a particularly well-developed epiphytic and ground cover. The epiphytic licorice fern is frequent in moss cushions on the trees.

Riparian forest communities (13) are found on floodplains and terraces along rivers and larger streams. Trees are large and fairly well spaced, the canopy and understory are partially open, and the ground cover lush. This forest type is analogous to the "meadow forest" of Day (1957). Tree species include Sitka spruce, western hemlock, red alder, red cedar, and western crabapple. Typical shrubs are blue currant, red elderberry, devil's club, false azalea, and salmonberry. Various ferns, grasses, sedges and forbs such as sweet cicely, enchanter's nightshade, skunk cabbage, false lily-of-the-valley, yellow violet, buttercup and twisted stalk are abundant. The trees are draped with epiphytic bryophytes, lichens and the licorice fern, but bryophyte and lichen ground cover is relatively sparce.

Although much of the timber in the study area is non-merchantable, some logging has gone on. Newly logged sites are invaded by pioneer and weed species. The successional vegetation (14) which develops varies in composition according to the differential success of the invaders, and the stage of their regeneration. Common species are red and Sitka alder; seedlings and saplings of western hemlock, red cedar, and Sitka spruce; mountain ash, salal red elderberry and blueberry shrubs; bracken and oak fern; fireweed, trailing bramble, chickweed, madder, and various grasses, sedges and rushes.

A similar, alder-dominated successional forest develops along avalanche tracks. Sitka spruce is often found in the avalanche track vegetation, which grows on unstable or very steep substrata with abundant seepage water.

A2.1.2 Transitional Shrub Zone

A narrow fringe of shrub-dominated vegetation (15), frequently occurs between the foreshore (that part of the beach subject to tidal action) and the closed coastal forest. This strip is wider in sheltered sites, behind tidal marshes, and near stream mouths, but is lacking

Vegetation cont'd

along the more exposed or steeper coastlines. Typical shrubs are false azalea, salal, red huckleberry, western crabapple, red alder, Sitka alder, salmonberry, thimbleberry, blueberry, black twinberry, blue currant, red elderberry, Sitka mountain ash and devil's club. Associated species in the herb layer are false lily-of-the-valley, beach lovage, hemlock-parsley, sea-watch, Nootka bluejoint, giant vetch, yarrow, limegrass, buttercup, chocolate lily, holygrass, sea barley, hairgrass, aster, yellow paintbrush, skunk cabbage, red fescue and bentgrass.

A2.1.3 Coastal Muskeg

Much of the coastal forest is a relatively narrow band close to sea level with stringers following streams to a more continuous belt on the lower mountain slopes. Behind the timbered fringe, scurb plant boggy barrens (muskeg) dominate the flats and low slopes of poor drainage. The muskeg consists of a mosaic of raised bogs (7), blanket bogs, islands of bog forest (8) and pit ponds, pools, small lakes and rivulets (9) (see Griggs 1936; Rigg 1925, 1937; Zach 1950). Blanket bogs are normally found on undulating, rocky uplands, covering the terrain with a thin bog mantle. In this report, blanket bogs will be considered as part of the montane vegetation.

Extensive, open, raised bogs generally occur on more or less flat, low-lying land. In the study area, the bogs usually have shallow peat deposits. However, very deep peat can be locally frequent, especially in basins that once held lakes. The micro-topography of the blanket bogs is complex: hummocks with low, evergreen-leaved shrubs and stunted, "bonsai" conifers; pit ponds and pools with aquatic and semiaquatic plants; beds of sphagnum moss; numerous small rills and flushes.

The variously stunted and contorted trees of the muskeg include shore pine, yellow cedar, western hemlock and red cedar. Common shrubs are labrador tea, bog laurel, bog rosemary, bog cranberry, dwarf azalea, bog blueberry, lingonberry, sweet gale, crowberry, spreading juniper and yew. Characteristic forbs are cloudberry, sundew, burnet, goldthread, white gentian, starflower, skunk cabbage, and deer cabbage. Additional typical elements include several sedge species, cotton grass, white beakrush, tufted clubrush, and slender bentgrass. Several species of sphagnum moss are the dominant bryophytes, forming thick, spongey, water-saturated hummocks.

Vegetation cont'd

Bog forest occurs as small and large wooded islands scattered throughout the muskeg, and as the transition zone between open bog and closed coastal forest. The trees are fairly widely spaced, poor growing, and often stunted or with dead tops. Shrub cover (especially of labrador tea) is dense.

The frequent pools, pitponds, and rivulets that bead the surface of the muskeg are bordered by or contain semi-aquatic or aquatic plants. Growing in the water are yellow water lily, pond weed, bur reed and bog bean. The pools and water courses are edged with skunk cabbage, marsh marigold, amphibious rush, cotton grass, manna grass and sedges.

A2.1.4 Maritime Communities

Maritime terrestrial vegetation occurs on a variety of tidelands between the forest and the sea. It is an extremely important component of the total vegetation in the study area, not only because there are numerous large and small islands and a highly dissected mainland coastline, but also because the tidal land-water interface is often very biologically productive. The interface may take the form of beach, bluff, sill, headland, mudflat, or marsh.

The formation of sand beaches in the Prince Rupert area is limited by the nature of the topography and geology. Shingle beaches are much more extensive. The substratum consists of tide-washed coarse gravels and cobbles, some sand, and occasional large boulders.

Shingle beaches subjected to strong wave action (1a) are found on the more exposed sections of the coastline and the seaward sides of the outer offshore islands. Isolated plants of scurvy grass, sea purslane, orache, and sea rocket grow on the lower beach. The upper, more or less vegetated beach, the zone bordering the spruce-hemlock forest, has (in addition to abundant driftwood) a cover of salal, limegrass, Nootka bluejoint, beach lovage, hemlock-parsley, sea-watch, chocolate lily and giant vetch.

Shingle beaches affected by tidal action only (1b) are found at the heads of inlets and along the margins of protected bays. Vegetation zonation is particularly evident along these beaches and usually follows the pattern below:

Vegetation cont'd

(i) eelgrass zone; submerged marine aquatic.

(ii) intertidal Fucus zone.

(iii) alkaligrass - sea plantain zone; almost always covered by high tides. Additional characteristic species are scurvy grass, weablite, sea spurry, pearlwort, pickleweed, orache and sea arrowgrass.

(iv) hairgrass - sedge zone; occasionally covered by high tides. Hairgrass, Lyngbye's sedge, red fescue, bentgrass, sea barley, and Baltic rush form a turf with a thick, tough root-mat.

(v) grass - forb lush meadow; covered only by exceptionally high tides. These productive meadows are a mixture of grasses and forbs such as limegrass, Nootka bluejoint, hairgrass, bluegrass, holygrass, Pacific brome, Lyngbye's sedge, chocolate lily, bedstraw, yarrow, silverweed cinquefoil, yellow paintbrush, hemlock-parsley, beach lovage, sea-watch, aster and Pacific clover.

Sand beaches (2) are uncommon in the study area. Most are small crescent beaches that have developed between rocky headlands. The vegetation varies according to exposure to surf and on-shore winds. If any appreciable vegetation has developed, the following zonation is usually apparent:

(i) foreshore is usually barren.

(ii) driftwood zone; above foreshore, containing driftwood and other flotsam. Species that may be found include sea rocket, sea purslane, limegrass, bluegrass, yarrow, madder, sea bluebells, silver bur-sage, beach carrot, hairy cat's ear, strawberry, sheep sorrel and beach pea.

(iii) transition zone between the driftwood and adjacent forest. Species here include limegrass, Nootka bluejoint, salal, red huckleberry, holygrass, false lily-of-the-valley, woodrush, yellow paintbrush, buttercup, horsetail, Pacific clover and silverweed cinquefoil.

Vegetation cont'd

The sparse vegetation of rocky bluffs, sea stacks, sills and headlands (3) grows on rock steeply exposed from water's edge to above high tide line, where the coniferous forest forms an abrupt border. These communities vary according to the degree of their exposure to open sea and salt spray. Surf-battered rocks and pools in the littoral zone often have well-developed clumps of basketgrass (also known as surfgrass). The rocks above high tide may bear various combinations of the salt-tolerant forbs sea plantain, wooly cinquefoil, scurvy grass, pearlwort, sea purslane, hemlock-parsley, beach lovage, rusty saxifrage, madder, yarrow, hairy rockcress, sea mustard, strawberry, chocolate lily, yellow paintbrush and sea-watch, plus grasses such as red fescue, sea barley, limegrass, alkaligrass and hairgrass. The transitional shrub zone (15) is usually lacking or poorly developed above such rock vegetation.

Rocky islets supporting bird rookeries (4) usually receive fairly heavy salt spray and have heavily nitrified (though shallow) soils. Consequently, they possess a characteristic vegetation. Trees and shrubs are usually lacking, but grasses and forbs form a relatively dense, lush vegetative cover. Common grasses are limegrass, alkaligrass, red fescue, sea barley, bentgrass and hairgrass. Typical forbs are sea mustard (an indicator species for high nitrogen), sea plantain, scurvy grass, wooly cinquefoil, rusty saxifrage, pearlwort, beach lovage, hemlock-parsley, sea-watch, sea purslane, red stonecrop and false lily-of-the-valley.

Tidal marshes border the shoreline of many inlets and harbours along the coast. These marshes vary considerably in level of salinity. However, those marshes not directly influenced by the Skeena River outflow are generally of much higher salinity than those along the lower reaches of the Skeena. Though under tidal influence, the Skeena marshes probably have fresh or brackish water conditions most of the time. As the only extensive lowland meadows within the study area, the tidal marshes provide important habitat for deer, bear and waterfowl.

High salinity tidal marshes or salt marshes (5) are fronted by shingle beach or mud flats, frequently supporting eelgrass beds. The following zonation is often apparent (cf. Calder and Taylor, 1968; McAvoy, 1931; Stephens and Billings, 1967):

(i) drainage courses and brackish or saline pools. These channels and pools which dissect the lower part of the marsh support submerged beds of eelgrass and widgeon grass.

Vegetation cont'd

(ii) sedge zone; covered by most high tides. The dominant species is Lynbgye's sedge; alkaligrass, sea plantain, seablite, sea spurry, sea arrowgrass, pickleweed and saltwort are common.

(iii) hairgrass zone; on raised, vegetated terraces inundated only during extreme tides or storms. This zone is usually the most extensive, and supports a dense grass - forb meadow of hairgrass, bentgrass, sea barley, red fescue, large-fruited plantain, trailing chickweed, silverweed cinquefoil, Baltic rush, Lyngbye's sedge, sea arrowgrass, Pacific clover, Nootka bluejoint and aster.

(iv) limegrass zone; only occasionally covered by tides; adjacent to the shrub transition vegetation (15). Characteristic species here are limegrass, Nootka bluejoint, holygrass, yarrow, yellow paintbrush, beach lovage, sea-watch, hemlock-parsley, chocolate lily, bracken, large-fruited plantain and western dock.

Low salinity tidal marshes (6) occur along the lower reaches of the Skeena River and its immediate estuary (eg., delta of McNeil and Khyex rivers, flats along De Horsey Passage). Again, vegetation zonation is evident:

(i) waterstar - widgeon grass mudflat. The soft muds of the lower river flats are partially covered with mats of waterstar and beds of widgeon grass. Other semi-aquatic species here are flowering quillwort, mudwort, waterplantain and wapato (all rare species at this latitude), as well as bur reed, spike rush and buttercup.

(ii) sedge - water hemlock marsh. This is a tall-growing, wet marshland of slough sedge, water hemlock, bulrush, water parsnip, bentgrass, Baltic rush, sea-watch, silverweed cinquefoil, deer cabbage, speedwell and horsetail.

(iii) shrub - forb fringe. This zone fringes the riverbank forest. Shrubs include Sitka, peachleaf and Scouler's

<u>Vegetation</u> cont'd

willow, red alder, western crabapple and red huckleberry. The herb layer is composed of skunk cabbage, false lily-of-the-valley, slough sedge, small-fruited bulrush, hairgrass, horsetail, Canada bluejoint, sea-watch, beach lovage, chocolate lily, giant vetch, aster and water parsley.

A2.1.5 Montane Vegetation

Montane communities (16) are present at higher elevations throughout the study area. For mapping purposes, roughly any vegetation above 1500 feet has been classed montane. This is a good general rule in the area, although lowland species may occur above 1500 feet and montane plants frequently descend to near sea level, particularly along avalanche tracks and streams and in coastal bogs.

The montane and subalpine forests are dominated by mountain hemlock, with Pacific silver fir and yellow cedar as common associates. Blueberry, false azalea, copperbush and Sitka mountain ash form dense shrub thickets.

Montane communities also include blanket bogs. lush subalpine grass - sedge - forb meadows, heaths dominated by low shrubby members of the heather family, and a variety of communities that have become established on talus slopes, rock outcrops, cliffs and wet runnels.

A2.1.6 Freshwater Aquatic Vegetation

Freshwater aquatic communities (17) generally occur within muskeg vegetation. However, some of the larger lakes support submerged, floating, or emersed aquatic plants. Some of the common species are yellow water lily, bur reed, bog bean, pond weeds, amphibious rush, manna grass, cotton grass, spike-rush, waterstar, coontail, aquatic buttercup, bladderwort and sedges.

A2.2 FORESTRY

A2.2.0 The purpose of this section is to:

1 estimate the volume/acre, total volume by species, total value of the timber

2 estimate mean annual increment of the forests on each site

3 calculate the bare land values for the purposes of growing forest crops (ie., loss of tree growing capacity)

The purpose of the estimate of forest values is to provide a preliminary approximation of the relative loss of forest values on Crown and Indian Reserve land for each alternative. The valuation cannot be used as a basis for compensation. The area and volume data must be considered approximate since it is based on existing Forest Service Maps and area-volume statements and a one day field and aerial reconnaissance.

The major tree species found in the study area at elevations below 1000 feet are western hemlock (Tsuga heterophylla), western red cedar (Thuja plicata), yellow cedar (Chamaecyparis nootkatensis), Sitka spruce (Picea sitchensis), balsam (Abies amabilis), and lodgepole pine (Pinus conorta).

Of the above species, Sitka spruce tends to be the largest and soundest in this area. Western red cedar, western hemlock, yellow cedar and balsam tend to be quite decadent when they are over 150 years of age (age classes 8 and 9 - B.C.F.S.), especially on poor and low sites.

A2.2.1 Description and Evaluation of Lands Required for Alternative Port Sites

The majority of the Tsimpsean Peninsula is covered by low site and non-productive land. The reason is due mainly to high rainfall, shallow soils and poor drainage.

Low site stands, which are composed mainly of red and yellow cedar, western hemlock and lodgepole pine have low volumes per acre and produce trees which are generally unsuitable for use in sawmills (due to poor form and high defect).

Forestry cont'd

The revenue derived from these stands is low and costs of logging are high. Thus low site stands are not considered merchantable and have no commercial forestry values. Furthermore, sites classified as non-productive have no commercial value.

The information for the seven port sites with commercial forest values is summarized in the section below. Detailed information is included in Annex A-5

A2.2.2 Area Summaries

Table 2
Areas of Forest Cover (areas on Crown land except where noted)

	Mature	Immature	NSR	Total
Port Simpson				
site	-	-	-	-
railroad right-of-way	272.4			272.4
road right-of-way (crown)	174.3		2.4	176.7
road right-of-way (I.R.#2)	114.5		48.4	162.9
sub-total	561.2		50.8	612.0
Smith Island				
site	-	-	-	-
railroad right-of-way	8.0	-	-	8.0
sub-total	8.0	-	-	8.0
Kitson Island	-	-	-	-
Ridley Island				
Digby Island	45.0	3.0	-	48.0
Bacon Cove	-	-	-	-
Melville Arm	-	-	-	-
Schreiber Point	36.0	-	-	36.0
[illegible]ethic Point	58.0	-	-	58.0
Osborn Cove	7.0	25.0	-	32.0
Fairview Point	13.0	-	-	13.0

Forestry cont'd

Table 3
Areas by Site Class (areas on crown land except where noted)

	ACRES GOOD	MEDIUM	POOR	TOTAL PRODUCTIVE AREA
Port Simpson				
site	-	-	-	-
railroad right-of-way	6.0	115.2	151.2	272.4
road right-of-way (crown)	-	121.1	55.6	176.7
road right-of-way (I.R.#2)	-	53.6	109.3	162.9
sub total	6.0	289.9	316.1	612.0
Smith Island				
site	-	-	-	-
railroad right-of-way	-	-	8.0	8.0
sub total	-	-	8.0	8.0
Kitson Island	-	-	-	-
Ridley Island	-	-	-	-
Digby Island	-	-	48.0	48.0
Bacon Cove	-	-	-	-
Melville Arm	-	-	-	-
Schreiber Point	-	36.0	-	36.0
Pethic Point	-	-	58.0	58.0
Osborn Cove	-	-	32.0	32.0
Fairview Point	-	-	13.0	13.0

Forestry cont'd

A2.2.3 Volume Summary

Table 4
Volume of Merchantable Timber in Thousands of Cubic Feet (MCF)*
(Close utilization standard)

C = Red Cedar
S = Spruce
H = Hemlock
Cy = Cypress or Yellow Cedar
B = Balsam
MCF = Thousands of Cubic Feet

SITES	C	H	B	S	Cy	TOTAL
Port Simpson						
Site	-	-	-	-	-	-
Railroad R/W	774	1022	269	275	90	2430
Road Crown R/W	313	747	278	363	7	1708
Road IR #2 R/W	245	525	167	151	20	1108
Sub-Total	1332	2294	714	789	117	5246
Smith Island	24	8	10	3	6	51
Kitson Island	-	-	-	-	-	-
Ridley Island	-	-	-	-	-	-
Digby	217	108	17	87	4	433
Bacon Cove	-	-	-	-	-	-
Melville Arm	-	-	-	-	-	-
Schreiber Point	87	122	27	32	3	271
Pethic Point	183	102	44	22	15	366
Osborn Cove	3	12	-	2	8	25
Fairview Point	-	-	-	-	-	-

Forestry cont'd

A2.2.4 Appraisal

Merchantable Timber

The appraisal of merchantable timber is based on the volumes by species for each site and the values for existing stands estimated in Annex A-5. These values are current and must be revised as markets change.

Each value in the table below is a weighted total in the sense that it is the sum of the volume of each species multiplied by its corresponding stumpage values.

Table 5
Merchantable Timber Values in Dollars

Port Simpson	
site	-
railroad right-of-way	110,000
road right-of-way (crown) and road right-of-way (I.R.#2)	125,000
sub total	235,000
Smith Island	2,000
Kitson Island	nil
Ridley Island	nil
Digby Island	21,000
Bacon Cove	nil
Melville Arm	nil
Schreiber Point	12,000
Pethic Point	17,000
Osborn Cove	1,000
Fairview Point	nil

Forestry cont'd

Value of the Loss of Tree Growing Capacity

In addition to the loss of timber now on the land as noted above, there will be a loss because of the land being removed from future forest production. The actual loss would amount to the Mean Annual Increment of wood added. As calculated in Annex A-4 the annual value of such loss would be as shown below (Table 6). For all practical purposes, the tree growing capacity losses may be assumed as nil, except for Port Simpson.

Table 6
Annual Value by Port Site of the Tree Growing Capacity

Site	Value in Dollars per Year
Port Simpson	
Site	nil
railroad right-of-way	1,024
road right-of-way (crown) and road right-of-way (I.R. #2)	1,206
Sub-total	2,230
Smith Island	18
Kitson Island	nil
Ridley Island	nil
Digby Island	107
Bacon Cove	nil
Melville Arm	nil
Schreiber Point	168
Pethic Point	132
Osborn Cove	120
Fairview Point	39

CHAPTER A3 WILDLIFE

A3.0 This chapter contains a general appraisal of wildlife resources in the study area. It first discusses the wildlife by species, then by habitat types, and finally by uses and values. The assessment is based on the opinions of government officials and local residents, on published literature, and on the field evaluation of the NEAT wildlife study team.

A3.1 WILDLIFE RESOURCES

A3.1.1 Big Game Species

Mule deer (Sitka Deer), black bear, grizzly bear, wolf are the principal big game species in the study area. Mountain goat and moose may occasionally range into the eastern extremities of the study area, but are of little consequence in relation to possible port development effects.

Sitka Deer

Sitka deer is the most abundant and recreationally valuable big game animal. Deer are dispersed throughout the port study area during summer months. During winter months deer congregate along the coastal fringe.

The controlling factor on the abundance of deer is dependent upon this location, but is generally the extent and quality of winter range. In some areas, where winter range is abundant, predation by wolves is the controlling factor. In the study area, deer appear to depend on marine vegetation in the intertidal zone, and on upland vegetation in the adjacent forest fringe. For this reason sections of the study area having extensive foreshore areas supporting marine plants adjacent to timber fringes have the highest capability to sustain deer populations. The coastal forest fringe consisting of hemlock, cedar and Sitka spruce provides essential cover and food during periods of heavy snowpack. The dense canopy prevents much of the snow from reaching ground level, and during winter gales large quantities of food in the form of terminal branches and tree lichens are dislodged and fall to the groung where they become available to foraging deer.

Big Game Species cont'd

Generally, shallow bays and stream estuaries with forested backup lands comprise the most important deer winter ranges in the study area. Areas of major importance to deer include Big Bay, the fringes of Venn Passage, the coastal fringes of Digby, Kaien, Ridley and Lelu islands, and the fringe of De Horsey Passage.

Field studies revealed that small islands with wolves supported very few deer. Conversely the Kinahan Islands supported a very high density of deer in the absence of wolves. Similarly the urban portion of Kaien Island sustained a good number of deer in the absence of wolves close to settlement. In view of these observations it is believed that small islands have similar capability to support deer as the larger ones. Since wolves are readily controlled by modern control techniques the small islands are classed as potentially important deer range.

Several small stream estuaries in Tuck Inlet and Work Channel offer limited deer winter range. The remaining coastal strip in the study area is limited in its capacity to winter deer by steep and rocky shoreline, and by limited intertidal area. The capability of such areas to support deer along with remaining uplands within the study area is believed to be accurately portrayed by the Canada Land Inventory capability map. Deer populations in these areas are thus very low due to adverse snow, vegetation and other conditions indicated on the ungulate capability map.

No statistical basis for directly estimating or extrapolating deer numbers in the study area exists. On the basis of general observations and a process of informed guessing it is expected that the total deer population in the study area would approximate 400 animals. In the absence of wolves the deer population could probably be sustained at about 1000 animals.

Black Bear

Black bear occur commonly throughout the mainland and large island portions of the study area. The status of this species in the smaller islands is unknown at this time; they are believed to be erratic in such areas. The life habits of black bear in the study area have not been studied, nor are areas of particular importance to black bear known. The species probably subsists on plant materials from coastal muskeg and tidal marshes, carrion during spring and summer months, and on various fruits and spawning salmon in the late summer and fall period.

Big Game Species cont'd

Stream estuaries are of particular importance as habitat for black bear, meeting most of their seasonal needs for vegetable and animal foods. Field observation in early September revealed that black bear were concentrated along stream courses and their estuaries and in coastal muskeg areas where berries were numerous. Grasses and blueberries were the most obvious contents of bear scats at this time.

No statistical basis exists for estimating the number of black bear within the port study area. The species is common, and probably number about 400 individual animals.

Mountain Goat

Mountain goat occur in alpine and rock bluff areas along the east side of Work Channel. None are known to reside within the study area. Goat are associated primarily with alpine habitat during the summer months. Winter habitat consists of steep rocky escape terrain in locations that for various climatic reasons have lesser snow pack. Coastal inlets are noted for the presence of low elevation goat winter ranges, to sea level in some instances. It is not known if such areas exist in Work Channel, but this remains a possibility requiring specific examination during the late winter and early spring period. No data exists respecting goat numbers in the study area.

Wolves

Wolves occur throughout the study area except on small islands and close to human habitation. Reports indicate a remarkable increase in their numbers in recent years. Wolves are major predators on deer, however their increase is not likely proportional to the abundance of deer. It is expected, rather, that wolf populations are supported largely by animal life associated with the coast littoral environment. Coastal and insular populations of wolves have not been studied in detail, but it is known that they exhibit marked fluctuations in numbers. These fluctuations are caused by a combination or succession of factors. The prime factor promoting population is food supply. Disease and parasites, such as distemper and mange depress populations. It is probable that these factors operate in the study area to effect periodic fluctuations

Big Game Species cont'd

in both deer and wolf populations. While deer constitute the preferred prey of wolves, their population appears able to be maintained at unusually high numbers by alternative sources of food. Beaver, salmon, small mammals, and a host of invertebrates in the intertidal zones all contribute to a subsistence diet for wolves during periods of deer scarcity. Harbour seals have been a recorded item of prey for wolves in southeastern Alaska in similar habitat.

Wolves are great travellers but areas of preference appear to be similar to those occupied by deer, principally estuaries, shallow intertidal bays and the adjacent timber lands. The winter distribution given for deer is believed also to be a reasonable approximation of that of wolves during this time.

Grizzly Bear

Grizzly bear are fall transients to salmon spawning streams in the port study area, mainly on the east side of Work Channel. Few, if any, are resident animals in the study area although the occasional individual may occur as a transient. The species is unimportant as a game animal or as a member of the fauna within the port study area.

Coyote

Coyote are an erratic species in the study area. A single individual was observed in Tuck Inlet during field studies. (This is believed to be the first recorded in the vicinity of Prince Rupert.)

A3.1.2 Upland Game Birds

In the study area upland game birds include blue grouse and ruffed grouse. Blue grouse are associated with the margins of forest cover and the dry rocky ridges that frequently separate muskegs. Areas of seral vegetation following logging are temporarily beneficial to blue grouse. Blue Grouse are not an abundant species in the study area. No basis exists for estimating their numbers. Ruffed grouse occupy riparian habitat along stream courses, and muskeg and salt marsh edges where deciduous shrubbery prevails. The species is not abundant by comparison with populations elsewhere in the province.

A3.1.3 Migratory Game Birds

The study area is used by a variety of migratory game birds, the more important of which are Canada geese, ducks and bandtailed pigeon. Canada geese and bandtailed pigeon nest in the study area, however the limited amount of freshwater marsh habitat reduces nesting ducks to an insignificant number. Most waterfowl species occur as spring and fall migrants, and a number winter in the coastal bays and estuary areas.

Canada geese, whitefronted geese, and snow geese are spring and fall migrants. Black brant are a spring migrant. It appears doubtful that Chatham Sound is on the main coastal flyway for northern breeding waterfowl populations, and the occurance of such birds as brant, white-fronted geese, lesser Canada geese, cackling geese, pintail duck and other species appears to be erratic. Only one race of large Canada geese is a resident within the study area, nesting in the coastal muskeg habitat and wintering in lower estuaries and tidal foreshore areas. At least 400 of these geese were observed during field studies in September, mostly in the vicinity of Pearl Harbour and Big Bay. A winter count (November 21st, 1974) yielded a count of 205 of these birds in groups located at Swamp Island, Pearl Harbour and Digby Island. It is estimated on the basis of field observations that at least 500 Canada geese comprise the resident population in the study area. Whitefronted geese were observed as a fall migrant during September field studies. A group of 18 birds was observed over a two day period in marshes along the lower Skeena River. No estimate of population numbers that migrate through the study area can be made from these observations, local residents however report their presence in spring and fall. It appears unlikely that this species or snow geese winter in the study area or use the study area as a staging or feeding area to any extent.

A variety of ducks frequent the study area, mainly as migrants and wintering populations. For convenience they can be grouped as pond ducks, those that feed in shallow bays and muskeg; diving ducks, those that feed by diving for food; and sea ducks, those that frequent the marine environment of rocky shoreline, reefs and islands of the exposed coast. Few ducks nest in the study area.

Migratory Game Birds cont'd

A few mallards and mergansers nest in the stream estuaries and scattered freshwater marshes in the study area. Their numbers are insignificant. No estimate can be made of the number of ducks that migrate through the study area. Fall observations revealed that by September pond and diving ducks were congregating in the study area. Several hundred pond ducks were observed at this time in numerous tidal bays, estuaries and freshwater marshes along the Skeena River, consisting mainly of wigeon, greenwinged teal and mallard. A few hundred diving ducks were observed also in the sheltered saltwater bays and passages throughout the study area and on Flora Bank. Inlets such as Tuck Inlet and Work Channel appear to be of less importance to migrating diving ducks than are the coastal bays, reefs and banks. The most common diving ducks observed were scaup, bufflehead and goldeneye. Sea ducks were observed throughout the coastal portions of the study area in the fall, mainly in association with reefs and islets on the more exposed coast, and on Flora Bank. Species most commonly encountered were whitewinged scoter and surf scoter. A few American scoter and harlequin ducks were seen.

Winter observations (November 21st, 1974) yielded a total of 2,000 ducks counted, about half of which were mallard, wigeon and pintail. Among diving species bufflehead, goldeneye and scaup were the most abundant. Relatively few sea ducks were observed. The major concentrations of wintering waterfowl were at Pearl Harbour and Big Bay. Smaller numbers of birds were encountered in most of the shallow coastal bays and passages elsewhere in the Skeena estuary and in the inlets. Information from this single aerial count is not sufficient to estimate the wintering population of ducks in the study area. On the basis of an informed guess there are probably at least 5,000 ducks of all species and several thousand marine birds such as murres, alcids, gulls and cormorant. Areas of most importance to migrant and wintering waterfowl are those with wide beaches, eelgrass beds, sheltered channels and salt marshes.

The Pearl Harbour and Big Bay areas provide the best waterfowl habitat for all species in the study area. Tugwell Island and it's spit are reported to be a favoured resting area for black brant during spring migration.

Migratory Game Birds cont'd

Venn Passage and the islets and channels contiguous to it provide excellent diving duck habitat, as do the south coast of Digby Island and Flora Bank. In general, sections of the study area having steep rocky shoreline provide little habitat for waterfowl. The Skeena estuary has limited waterfowl capability due, it is believed, to excessive turbidity from suspended sediment. This estuary has little marsh area associated with it, and that present is influenced by wave and tide action. Several upstream tidal marsh areas are used by migrant waterfowl, but have only limited importance as nesting habitat due to tidal and freshet influences.

Bandtailed pigeon nest in second growth forest in the study area, including the city limits of Prince Rupert. This species is an early migrant from the study area, and for this reason contributes little to the game harvest.

A3.1.4 Non-game Species

About 18 species of mammals, 86 species of birds, two amphibians and a single reptile comprise this category of wildlife in the study area. Many non-game species, small mammals for example, are small or nocturnal in their habits and escape notice. Little recreational significance can be attributed to many non-game species, however, each plays a role in the function of the ecosystem and is important in this respect. Field studies were not designed to obtain detailed information on the status and ecology of most non-game species. Verbal reports and published information form the principal basis for the following comments on this group of animals in the study area.

Small Mammals

The study area supports a variety of small mammals outside the general classification of game or fur bearing animals. Few of these mammals occur in sufficient abundance to generate economic values or popular interest. A list of indiginous small mammals includes two species of shrews, three bats, one squirrel, one flying squirrel, six mice, a pack rat, a porcupine, a marmot, and a weasel. Brown rats and house mice have moved in with the advent of human occupation. No estimates of abundance can be made of these small mammals in light of available data. They all contribute to a greater or lesser degree to the food chains involving carnivorous fur bearers and raptorial birds.

Non-game Species cont'd

Reptiles and Amphibians

The only reptile recorded from the study area is the coast garter snake. These small and inoffensive snakes are rare in the coastal area and usually frequent banks of small freshwater streams and grassy areas.

The northwestern toad and British Columbia salamander have been recorded from the Prince Rupert area. Little is known of their distribution or abundance in the region. The moderate to low temperatures and acidic condition of the soils and water are not condusive to the maintenance of abundant reptile and amphibian populations.

Avian Fauna

Very little is recorded of the avian fauna of the Prince Rupert area. 86 species of birds either were observed during the field work or their presence is indicated by the literature. This variety of birds consists of three species of loons, three species of grebes, one species of cormorant, one species of heron, two species of swans, four species of geese, thirteen species of ducks, one species of eagle, two species of grouse, one species of crane, eleven species of shore birds, seven species of gulls, five species of alcids (marine diving birds), one wild pigeon, three species of crows, one species of kingfisher, and twenty species of small passerine birds. These data are incomplete and an intensive study of the avian fauna of the area would reveal many more species, particularly of migrants in passage.

The coastal muskeg forest types do not support a large variety or density of birds, most of which are only of interest to serious students of ornithology. The coast littoral and marine habitat supports the most conspicuous and popularly interesting species.

Bald eagles are a common occupant of Prince Rupert Harbour during the spring and summer months. They nest locally, and in addition to their association with the coast littoral habitat make use of offal from the fish plants for sustenance. In autumn they appear to move out to the streams to feed on spawned-out salmon. Of the five species of gulls two nest locally. The glaucous-winged gull nests on Green Islets and Inez Island and the new gull nests close to areas of fresh water.

Non-game Species cont'd

Red-throated loons nest on the muskeg lakes. Since many of these lakes are devoid of fish the parent birds fly out to the ocean to forage for fish which they transport to the young on the lakes. The young do not leave their natal lake until fully fledged. The sandhill cranes and trumpeter swans are of particular interest. Sandhill cranes nest widely but sparingly in muskeg areas of the coastal islands and probably do so on Digby Island and the Tsimpsean Peninsula. Trumpeter swans visit the area as erratic migrants when their usual wintering grounds further up the Skeena are frozen during exceptionally cold winter. Both are considered rare and endangered species and should be treated accordingly.

A3.1.5 Marine Animals

Six species of marine mammals are known to frequent the study area. Three are cetaceans and three are seals. Of these, only harbour porpoise and harbour seals are abundant.

Killer Whales

Killer whales are reported to be erratic visitors to Prince Rupert Harbour during winter months. No definite data regarding dates and numbers could be obtained but sufficiently reliable reports indicate their presence.

Dall's Porpoise

These porpoise are frequently observed in areas close to Chatham Sound and probably visit the study area intermittently.

Harbour Porpoise

Harbour porpoise appear to be residents or regular visitors to the Prince Rupert Harbour area. They are relatively inconspicuous animals and may be much more abundant than our observations indicate. They were observed off Ridley Island several times, in singles and pairs. Harbour porpoises are more estuarine in habitat preference than Dall's porpoise.

Marine Animals cont'd

Harbour Seals

Harbour seals are widespread throughout the study area and locally abundant. They were so abundant in the 1940's that they were considered a menace to the salmon populations of the Skeena drainage. Population estimates ranged from 2,000 to 2,500 for the Skeena estuary and seal control was instituted by the Federal Fisheries Department in 1944. From 1944 to 1960, 200 seals were killed annually. In 1960, a commercial outlet was found for seal skins and a heavy commercial harvest resulted for several years. The demand ceased and the harvest ceased. Very little seal hunting has been engaged in since 1965 and now the species is accorded full protection under the Federal Fisheries regulations.

The centreof the harbour seal population is on the main channels of the Skeena. The bars of Smith and De Horsey islands are favoured haulout grounds and 200 to 300 seals frequent the area. Hauling grounds of lesser importance are situated in favourable areas all the way up the Skeena to the limit of tidal influence. Seals were observed on the reefs north of Tugwell Island. Seals frequent Prince Rupert Harbour in limited numbers.

Sea Lions

Sea lions are infrequently seen in the vicinity of Prince Rupert Harbour and the Skeena estuary. Numbers congregate in the Nass estuary during eulachon runs, and are taken for food by the Nass Indians.

Fur Seals

Fur seals are regular migrants through the Hecate Strait and the occasional individual strays into the study area.

A3.2 HABITAT CLASSIFICATION OF STUDY AREA

In general terms the classification of plant communities in the study area provides an approximate measure of the important habitat for various wildlife species. A more detailed account of the botanical attributes of these plant communities is given in Chapter

Habitat Classification of Study Area cont'd

2, however, their listing here with an explanation of related wildlife species seems appropriate. In addition to these, the marine environment has been included here as two habitat types of major significance to wildlife in the study area.

Lakes and Freshwater Aquatic Communities

Beaver, otter, mink, Canada geese and several ducks are the more important wildlife species associated with this plant community, or habitat type. The lakes and freshwater habitat are used primarily as nesting habitat by ducks and geese in the study area. Otter and minks are associated as predators on fish and animals in this habitat. Amphibians and a variety of non-game species are associated with this habitat type also. Some of the more interesting examples include red-winged blackbirds, bitterns, marsh wrens, marsh hawk and herons.

Tidal Marsh Communities

Low and high salinity tidal marshes are used primarily by migrant waterfowl as feeding and nesting areas. Local non-breeding geese frequent these marshes during summer months for extended periods of time. Most of the low salinity tidal marshes extend along the banks of the Skeena River, and in some smaller stream estuaries. A major marsh of this type is located at the mouth of the Khyex River, and is one of the more important waterfowl marshes and hunting areas in the general vicinity of Prince Rupert that is accessible by road. High salinity marshes occur mainly in sheltered bays and passages throughout the study area. These marshes are used by wintering geese and pond ducks, and by many shore birds of several species. Deer, black bear, wolves, mink and eagles use these important marsh areas during winter months. A great many non-game species frequent such marshes, which usually remain ice-free due to the presence of salt water and daily tides. Along with tidal foreshore, high salinity marshes are one of the most important wildlife habitats in the study area.

Coastal Muskeg Communities

Sandhill crane, Canada geese and loons use this habitat for nesting. Sitka deer, black bear and wolf occupy the rocky ridges and other dry grounds within muskeg area. Deer make extensive use of forbs and Vaccinium spp. within muskeg areas, and black bear seek skunk cabbage in spring and blueberries and cranberries in fall in this habitat type. The coastal muskeg is an acidic environment, of low productivity compared with the coastal fringe. Although important for nesting geese and cranes, coastal muskeg is not an important habitat in the study area for most wildlife species.

Sitka Spruce Forest

Deer, bald eagle, squirrel and marten are the more important species that occupy Sitka spruce habitat Deer rely on this habitat for winter range, along with other coastal forest cover adjacent to the coastline. Squirrel and marten are permanent residents of this habitat. Eagles make use of large spruce trees as nesting sites, which are often occupied for many years in succession. Arboreal lichens in the Sitka spruce forest type are an important source of winter food for deer, along with terminal branches that are dislodged by winter storms. The dense canopy provides protection from excessive snowfall. The Sitka spruce forest type is not extensive in the study area, but is locally important to wintering deer.

Montane Forest

Deer, black bear, grizzly bear, wolf, mountain goat, blue grouse, squirrel and marten are important wildlife species in this forest type. Goat and grizzly bear are not residents within the study area however. The montane forest provides summer range for deer, black bear and wolves. Squirrel and marten are permanent occupants. Blue grouse extend their winter range into the montane forest. In general, the montane forest is of little importance in maintaining game species in the study area, and is well removed from port development sites, or their effects.

Coastal Forest

Deer, black bear, wolf, ruffed grouse, blue grouse, bald eagle, squirrel and marten are major species in this habitat. This forest is the principal summer range of deer, black bear and wolf in the study area, and sustains squirrel and marten at all times. Portions of the coast forest adjacent to the coast that are mature support deer in the winter months. Logged areas of coast forest are preferred summer habitat for deer, black bear and blue grouse. A large variety of non-game species occupy this habitat, but are of little concern with regard to probable effects of port development. The coast forest is the most extensive habitat type in the study area, only a small fraction of which would be affected by port development proposals.

Coast Littoral Zone

The coast littoral zone consists of the intertidal zone and seaward to about the ten fathom line. It contains a variety of habitat types which in turn support a variety of species of wildlife and plants. The estuarine areas, tidal mud flats and sand beaches support a host of marine plants and invertebrates which provide food for dabbling ducks, geese, shorebirds, and gulls as each tide exposes a succession of feeding areas. Wave and tidal action maintain a varied but constant circulation of water and water-borne nutrients which support a variety of fish, crustaceans and mollusks which in turn attract sea ducks, diving birds and gulls. The rugged and varied character of the coastline provides adequate areas of shelter during winter storms for all the resident birds and animals. Mink and otter frequent the intertidal zones and seals the shallows and reefs. There are approximately 60 square miles of this zone extending from Port Simpson to Kennedy Island.

The Pearl Harbour-Big Bay area covers about 9 square miles. Much of it is sheltered from the full force of wave action and the head of the bay supports salt marsh and mud flats. Wave action has built up spits and sand bars in the lee of the islands in Pearl Harbour providing a great variety of situations attractive to all types of water birds and mammals. This is one of the most productive sections of the coast littoral zone. The shoreline from Big Bay to Tugwell Island is smaller but more exposed than that of Big Bay itself. The large reefs and kelp beds of Hodgson Reefs provide excellent habitat for sea ducks, diving ducks and also seals. Tugwell Island and the sandy

Coast Littoral Zone cont'd

spit protect the entrance of Venn Passage from the winter gales, thus providing shelter. In the spring brant frequent the sand spit and shallows as feeding and gravelling areas.

The shoreline from Tugwell Island to Lima Point on the south end of Digby Island is rocky with a foreshore studded with reefs and shallows. It provides good feeding areas for sea ducks and diving birds. The shoreline of the east shore of Digby Island and Venn Passage is sheltered and has numerous small inlets which provide shelter and food for both puddle and diving ducks. The remainder of the shores of Prince Rupert Harbour are either too steep or occupied by dock facilities and are of limited value to wildlife. Gulls and eagles take advantage of offal from the fish plants and some scaup ducks frequent the vicinity of the grain elevator, presumably feeding on waste grain.

The foreshore from Kaien Island to Smith Island including Ridley Island, Lelu Island, Kitson Island and Inverness Channel to the North Pacific Cannery site covers over 6.5 square miles. The area has moderately good capabilities for diving ducks.

The area along the south shore of Smith Island and including Marcus and Inverness passages covers over 13 square miles and is one of the two main outlets of the Skeena estuary. It contains a complex of constantly changing sandbars and mudflats. The salinity of the waters varies considerably depending upon the discharge of the Skeena. It does not appear to be an area rich in resident flora and fauna, however periods of food abundance for marine birds occur with eulachon and salmon migrations. Harbour seals congregate in the area for both food and resting at these times, and certain sandbars are reported to be pupping areas also.

Table 7 provides a summary of major habitats in the study area, along with a more detailed breakdown of coast littoral zones that will be most affected by port development and operations.

Coast Littoral Zone cont'd

Table 7
Habitat types and their areas in the study area

Habitat type	Area in square miles
Lakes and freshwater habitat	7
Tidal marsh habitat	7
Coastal muskeg habitat	80
Sitka spruce forest habitat	9
Montane forest habitat	64
Coastal forest habitat	215
Coast littoral habitat (local areas below)	60
Smith Island to Kaien Island including Flora Bank	7
East shore of Digby Island and Prince Rupert Harbour from Sima Point to Schreiber Point	4
Rachael and Kinahan islands and reefs	2
West side of Digby Island to Tugwell Island	10
Tugwell Island to Tree Bluff	10
Marcus and Inverness passages	15
Devoir Pass to Tree Bluff including Port Simpson ans Big Bay	12
Total area of all major types	445

A3.3 USES AND VALUE OF WILDLIFE IN THE STUDY AREA

A3.3.0 The uses and value of wildlife are separated for this study into "consumptive" and "non-consumptive" categories. This is an arbitrary division since the benefits derived from various activities are primarily subjective in either case. Consumptive use however can more readily be defined and measured with existing data. Some information is available also respecting the economic value of consumptive wildlife use.

Non-consumptive use includes such activities as photography, viewing, serious study, collecting, and vicarious satisfactions arising from the resource. No commonly accepted definition of non-consumptive use exists at this time, nor are statistical measures of such use available in the study area, or elsewhere in the province.

Consumptive uses of wildlife in the study area include recreational hunting, trapping, guiding and consumption of wildlife for food, mostly by Indian peoples.

A3.3.1 Recreational Hunting

There are 3,000 licensed hunters in the Prince Rupert District (Hunter Sample, 1972). Most hunting effort of these licensed holders is expended in the northern interior where opportunity for success on big game is better, under more favourable conditions of access. Hunting activity in the study area is severely curtailed by low opportunity for success on big game and upland birds, by difficult cover conditions, and by the necessity of using boat transportation to most of the areas offering favourable hunting opportunity.

Game harvests in the study area cannot be accurately measured from available statistics. An approximation based on extrapolations from the Hunter Sample and on the judgment of the authors of this report is given in Table 8.

Waterfowl (ducks and geese) contribute the greatest harvest to recreational hunting, provide the largest number of hunter days and have the greatest potential to sustain recreational hunting activity in the study area. Most of the ducks of both the "pond" and "diving" groups taken by hunters are migrants. Local production of these birds is limited by the acidic condition of freshwater wetlands in the area. Although the number of geese taken by hunters is small and the areas of production of these birds is limited, the local

Recreational Hunting cont'd

Table 8
Approximate game harvest in the study area

Species	Recreational hunting	Kill for food	Total
Sitka deer	20	50	70
Black bear	10	5	15
Grizzly bear	2	-	2
Goat	5	-	5
Wolf	10	-	10
Ducks	2,000	300	2,300
Geese	75	50	125
Grouse	100	-	100
Other species	200	-	200

population of Canada geese is highly valued by hunters and general recreationists. It is estimated that about 75 locally raised birds are taken annually by hunters, and some are probably taken for food by Indian people on reserve lands. The contribution of migrant geese (mainly Canada and white-fronted geese) to hunting in the study area is not identifiable from existing data. Migrant geese probably occur mainly in the foreshore area of Big Bay and in wetlands along the Skeena River, and are not readily available to local hunters. Although the potential harvest of migrant geese would considerably exceed that of the local goose population, it is unlikely that much of this potential would be realized due to difficulty of access to areas where birds would concentrate. For this reason the local Canada geese population, though small, is believed to be an important component of the total population that seasonally occurs in the study area. The importance of the local goose population, which is locally abundant by general provincial standards, relates largely to its qualitative significance rather than the extent or potential of its consumptive use.

Deer populations in the study area sustain only a small annual kill by recreational hunters. Difficult hunting conditions and restricted access are primarily responsible for this. The use of deer for food by Indian people is not accurately known. It is believed that most of the kill for this purpose occurs on Indian reserve lands.

Recreational Hunting cont'd

Deer populations in the study area are capable of sustaining a higher level of use under more intensive management. It appears doubtful however that such measures to increase deer harvests as longer seasons, removal of the Kaien Island sanctuary and measures to control wolf numbers would be publicly acceptable. For this reason, it is expected that potential deer harvests by recreational hunting will not be realized and that deer are less important than waterfowl in providing hunting opportunity in the study area. Much of the deer population in the study area is supported on Indian lands, a further restraint in developing improved public deer hunting opportunity. Most of the deer hunting by residents of Prince Rupert occurs in the Terrace-Prince George region and on Porcher Island. This tradition will likely continue for the reasons described.

The annual kill of other game species in the study area is significant only in lending variety to hunting opportunity and satisfaction. Most of these species are taken incidentally during deer and waterfowl hunting activity. Most of these species such as black bear, grouse, goat, etc. have a limited capability to support hunting activity in the study area, and it is unlikely that more intensive management could significantly alter existing hunting preference for deer and waterfowl, or result in measurably increased use of these other animals.

The techniques for valuing hunting activity have not been fully developed, and no locally applicable data on such values exist for the study area. Table 9 gives an approximation of hunting effort in the study area, and includes a crude estimate of the value derived from this activity. The estimates of effort are based on informed judgment, and the values assigned are those published in "The Value of Resident Hunting in British Columbia, Pearse Bowden, 1972". As indicated in Table 9, the value of hunting activity in the study area is small indeed, and is probably negligible in comparison with the social benefits of locally provided hunting opportunity and non-consumptive appreciation of wildlife.

Table 9
Approximate hunting effort and its value in the study area

Species hunted	Days	Value of hunting
Deer	1200	$6,000
Waterfowl	450	$4,500

A3.3.2 Trapping

A summary of trap lines and trapping activity is given in Table 10. Some of the 16 lines recorded partially occupy lands outside of the study area, but are included in the summary given.

Table 10
Trap lines and trapping activity in the study area 1973*

Location of line	Active lines	Inactive lines	Harvest
Croosdale-Smith, Ridley-Lelu and Digby islands	2	2	25 mink
Rupert Harbour, Tuck Inlet and Moore Basin	3	-	63 marten 30 mink 16 otter 2 beaver
North Tsimpsean Peninsula, excluding Indian reserves	-	1	nil
East side of Work Channel	-	6	nil
West side of Work Channel	-	2	nil

*Data from the Prince Rupert Fish & Wildlife Branch Office

Of the 16 trap lines in the study area only 5 were active in 1973 (and in most other recent years). Information on trapping activity by Indians on reserve lands is not recorded, or available for inclusion here. It appears unlikely that any significant amount of trapping would occur on these lands, or that such activity would seriously distort the information given. On this assumption, it is obvious that trapping cannot be considered an important value of wildlife or a significant industry in the study area. Some benefits

Trapping cont'd

may be realized by the more active individual trappers. However the economic status of these individuals is not known. Potential benefits from trapping in the study area appear to be negligible also. Such benefits relate more to the many unpredictable features of trapper activity and fur marketing processes than to the potential of fur species to sustain a harvest. It appears unlikely that trapping activity will change substantially, and for this reason trapping is considered an avocational benefit to individual trappers rather than a significant form of wildlife resource use or an economic benefit to the study area.

A3.3.3 Guiding

A relatively small portion of one guiding territory lies within the study area. The hunting activity and game kill on this territory is given in Table 11, most of which occurred outside of the study area.

Table 11
Guiding data in the study area*

Year	Numbers of hunters	Game kill
1971	7	3 grizzly bear 6 black bear 1 goat
1972	3	2 grizzly bear 4 black bear
1973	9	4 grizzly bear 8 black bear 1 goat 1 wolf

*Data from the Fish & Wildlife Branch Office

Guiding cont'd

Little economic or other significance can be attributed to guiding activity within the study area. Some interest to individual guides probably exists within the study area in terms of its potential to support hunting activity. However , little or no use has been made of the portion of the territory in the port development area in past years. It is judged that guiding is a negligible concern within the study area, or in relation to port development.

A3.3.4 Non-consumptive Uses and Value of Wildlife

No clear definition of non-consumptive use and values of wildlife exists. It is generally conceded that aesthetic and scientific values are among the more important benefits of non-consumptive use of wildlife, and that one or more of these benefits are enjoyed by most individuals in society. While not an accurate portrayal of non-consumptive use of wildlife, this general definition appears workable for this study.

No measures exist in the province or in the study area of non-consumptive wildlife activity. It is judged that most people in the area derive pleasure from various wildlife-oriented experiences, and that in aggregated social terms this kind of satisfaction may exceed that of consumptive use.

Several wildlife species in the study offer notable opportunities for public enjoyment. Bald eagles occur in large concentrations during the fall and winter months in several locations in the study area, notably the Skeena estuary, Big Bay and Port Simpson. Concentrations occur in association with spawning runs of salmon, herring and eulachon. Nesting bald eagles are distributed throughout the coastline of the study area and along the lower Skeena River. Some nest within the city of Prince Rupert, offering singular viewing opportunity.

The resident population of Canada geese in the study area is a particularly attractive feature contributing to aesthetic enjoyment of the environment.

Non-consumptive Uses and Value of Wildlife cont'd

Nesting sandhill cranes in the study area have significance to the more discriminating student of natural history, and while not commonly identified by most, these birds are one of the more spectacular in flight. Their relatively rare status adds significance.

The frequent occurrence of harbour porpoise and large numbers of harbour seals in the study area, and the ease with which these animals can be viewed is an uncommon event in an urban setting. Harbour seals concentrate in large numbers on sand bars in the lower Skeena River and estuary during the period of salmon and eulachon migration. While no accurate count of their numbers exist, up to 600 have been reported at one time on sand bars off De Horsey Island.

Large numbers of marine birds are associated with tidal foreshores, reefs, roosting islets and areas of tidal disturbance in the study area. Included are several species of gulls, cormorant, shorebirds, murres, rhinocerous auklets, Cassis auklets, marbled and ancient murrelet, pigeon quillemot, parasitic jaeger, three species of loons, four species of grebes and a dozen species of diving ducks. These birds are a dominant feature of the marine environment in the study area of considerable aesthetic appeal.

Three active eyries of the rare Peregrine falcon are reported on offshore islets in the study area, in association with nesting colonies of alcid birds. It is probable that the falcon occupies the larger expanses of tidal foreshore in the study area during winter months, in association with concentrations of shorebirds. Peregrine falcon are extremely sensitive to disturbance during the incubation and early brood rearing period, and should not be disturbed by human presence at this time. The very rare status of this bird warrants exceptional protection measures.

The aesthetic appeal of wolves in the study area is uncertain. Their occurrence in close proximity to an urban area such as Prince Rupert is an unusual phenomenon, probably appealing to the more discriminating appreciator of wildlife, but a source of apprehension to most.

CHAPTER A4 ARCHAEOLOGY

A4.0 The archaeological impact study was a preliminary investigation of a 735 square mile area, directed at an inventory and evaluation of prehistoric and historic resources within the region.

The broad objectives were:

a) to gather together previously recorded archaeological and related information concerning known and potential archaeological resources of the area.

b) to obtain a comprehensive picture of site characteristics and distribution and their relationship to present, and if possible, past environments, in order to project a patterning of prehistoric occupation in the area.

c) to use the above information to determine the importance of the sites in order to assess the requirements for preservation or salvage.

Because the known pattern of prehistoric habitation of this region was along the waterways of the coastal plain, the area to be most affected by this development, it was assumed that the construction of the proposed facility and access routes would destroy a significant number of archaeological sites.

A4.1 OUTLINE OF PREVIOUS RESEARCH

Archaeological research in the northcoast area was minimal until the mid 1960's. Starting in 1907 and through to the late 1920's H.I. Smith worked intermittently in the Prince Rupert Harbour area for the National Museums of Canada. His early work was in conjunction with the railroad construction and resulted in the salvage recovery of numerous burials from prehistoric middens on Kaien Island. These were analyzed in the late 1950's by L. Oschinsky of the National Museums of Canada. Smith also excavated a site at Seal Cove but the results were never published (Archives ASC/NMM). His inventory of archaeological sites (Smith, 1909) concentrated on Kaien Island, his main interest being distracted by the rock art of the region, Tyee and Roverson Point being two prime examples (Smith, 1927).

Outline of Previous Research cont'd

The next person to conduct archaeological field work in the area was P. Drucker of the Smithsonian Institution who in 1938 conducted a major survey with test excavations along the northern coast. His 1943 report was the first published statement on midden contents. He brought attention to the deep stratigraphy of coastal sites, their excellent preservation and good skeletal samples. His site inventory concentrated on the sites in Venn Passage and on Digby Island (Drucker, 1943).

In 1954, C. Borden from the University of British Columbia conducted the second salvage excavation in the region. Assisted by James Baldwin, a local resident and archaeology student, he spent a brief period excavating the Co-op site, GbTo-10 (Calvert, 1969). Baldwin numbered and re-surveyed Drucker's site localities and added several new ones to the inventory.

In 1966, G.F. MacDonald of the National Museum of Man began a major research programme in the Prince Rupert Harbour area. The harbour region was systematically re-surveyed with many new sites added to the list. As well he undertook a broad aerial reconnaissance of the Tsimpsean area, observing or photographing likely site locations. His excavation strategy entailed an east-west transect across Tsimpsean territory from the upper Skeena River to Hecate Strait. Sites were dug at Hazelton (GhSv-2), Gitaus (GdTc-2) near Terrace, and in the Prince Rupert area, Grassy Bay (GbTc-1), Garden Island (GbTo-23), Dodge Island (GbTo-18), the Boardwalk site (GbTo-31 and GbTo-30) and GbTp-1 on Lucy Island (MacDonald, 1967, 1969a, 1969b, 1969c).

Excavation continued in 1970 under the direction of R. Inglis with four more village sites being excavated, GbTo-34, GcTo-1, GbTo-33 and GbTo-36 (Inglis, 1970, 1971, 1972, 1973, 1974). The last two were part of a major salvage programme related to the development of port facilities at Fairview Point on Kaien Island.

The 1974 survey is a continuation of this major programme to investigate the culture history of the Coast Tsimshian.

A4.2 Current State of Knowledge

The area defined by the terms of reference is part of the traditional territory of the Coast Tsimshian Indians. Before the 1834 population shift to Port Simpson in response to the establishment of the

Outline of Previous Research cont'd

the Hudson Bay Company fort, the nine tribes occupied sites in the Prince Rupert Harbour area, concentrating in Venn Passage (Duff, 1967; Beynon, 1953).

Archaeological work conducted by the Archaeological Survey of Canada, National Museum of Man, has detailed a 5000 year continuum of extensive human occupation in the Prince Rupert region.

This environmentally rich coastal area supported the semi-permanent winter villages of the Coast Tsimshiam. From this base they exploited the many local resources including shellfish, sea and land mammals, fish species, sea and migratory birds as well as a wide spectrum of flora.

In the spring, the winter villages broke up into household groups which moved from the Rupert region into temporary camps over a large territory to harvest different seasonal resources - eulachon, seaweed, salmon, berries to name a few. In the fall they once again returned to winter in their villages along the shores of the Rupert Harbour.

The archaeological work conducted to date has emphasized the winter village occupation period of the seasonal cycle, and our archaeological knowledge of the camps and activities relating to the rest of the cycle is very deficient.

A4.3 METHODS AND SOURCES OF DATA

A4.3.1 Terminology

The following terms are used frequently in the text and are defined for easy reference:

winter village: a protected area occupied in the winter months and marked by a degree of permanence. The basic food source during this period is the preserved food surpluses from the summer season, and the shellfish of the intertidal zones. The large accumulation of shells is probably the most diagnostic feature of these sites. Other features include great extent and large house structures.

Methods and Sources of Data cont'd

campsite: an area occupied for a brief period of time, usually for the exploitation of a specific economic resource. It is generally characterized by little extent or depth.

burial cave/shelter: an area, usually isolated, with prominent cliffs, where the dead were disposed of in caves, under overhangs, or on rock ledges.

stone fish trap: an extensive crescent-shaped wall of boulders situated on the intertidal area that utilizes the rise and fall of the tides to trap salmon. These features usually occur in series.

canoe skid: boulder alignments used as pathways for dugout canoes.

A4.3.2 The Archaeological Survey

Archaeological survey must begin with a general inventory of the cultural resources of the region, but as one begins to define such parameters as settlement pattern and the economic resources exploited the research can deal with problems on a finer level.

Initial survey relies upon five basic features as guides to prehistoric site distribution:

a) analogies with the known ethnographic pattern for the area - the traditional occupation and resource exploitation patterns.

b) reconstruction of environmental factors that would have affected prehistoric occupation.

c) comparison to similar cultural features from known archaeological situations in other areas.

d) continuity in areal occupation by projecting the present pattern into the past.

e) analogies with the distribution of known sites in the area.

Methods and Sources of Data cont'd

An archaeological site is a locality which exhibits some trace of past human activity as reflected in buried deposits or surficial features.

Prehistoric occupation is determined by different criteria in different environments. As the area under consideration is predominantly influenced by the coastal/maritime setting it is assumed that human occupation of this area would rely to a great extent upon utilizing the resources of the sea.

The most common physical indicators of site locations were:

a) extensive intertidal zone areas.

b) presence of intertidal zone features - canoe skids and/or fish traps.

c) shell along the upper tidal areas of the beach, usually a result of tidal erosion.

d) deposits with a greater ratio of depth to extent.

e) modification of the surface by cultural features - house pits or ridges for example. The original occupation surfaces are quickly buried under vegetational growth in this environment with a subsequent disappearance of less prominent surface indicators.

Several generalized environmental factors also affect the choice of areas for human occupation. The two basic considerations are:

a) shelter from the elements, and

b) location of food resources.

Sites are most frequently situated in small bays, or on the lee side of islands or points of land. Economic resource areas - hunting, fishing and collecting locales for various plant and animal foodstuffs - were a valuable asset and were inevitably exploited.

Many areas could be eliminated because of adverse environmental factors - rocky shoreline, muskeg hinterland, restricted intertidal zone - areas that were physically unsuitable to access, or that offered little resource potential.

Methods and Sources of Data cont'd

A4.3.3 Attributes Used to Determine Individual Site Salvage Needs

Archaeological sites are a non-renewable historical and cutural resource to Canadians and well worth safeguarding.

In 1972 the National Sites and Monuments Board declared the Venn Passage area of the Prince Rupert Harbour of national importance to our historical and cutural heritage. There are twelve winter village sites of the Coast Tsimshian within the area covered by the declaration.

Based on the criteria used to evaluate the Venn Passage area the following attributes have been chosen as guides to the ranking and evaluation of other localities in the region:

a) great temporal span

b) large and/or complex surface features

c) good organic preservation

d) great depth in the stratigraphy

e) great lateral extent

f) intertidal features

A site which has a high ranking in any three of these attributes is recommended for total protection from construction activity. A site that ranks low in the attribute listing or that has less than three of the attributes is recommended for salvage, the procedure to be followed based on individual site requirements.

Because of the strong public interest in rock art and its relative rarity in the north coast area, and the very few burial caves and intertidal fish traps located, such sites are automatically recommended for protection.

Methods and Sources of Data cont'd

Archaeological techniques of recovery and analysis are improving rapidly and future developments in the areas of field techniques and strategies and in laboratory analysis will undoubtedly produce new and important kinds of information. A site, from this point of view, should not be evaluated only in terms of its immediate contribution to the Canadian historical scene, but also in terms of its future potential in archaeological interpretation.

The designation of a site is dependent not only upon its immediate characteristics but also on its relationship to other sites within the entire area of reference.

A4.4 RESULTS

A4.4.0 A total of 123 new site localities were recorded, bringing the total in the area of reference to 193. This part will summarize the detailed annotations in "Archaeological Impact Study, Bulk Loading Facility, Environmental Assessment, Northcoast, B.C." by Richard L. Inglis, 1974 (available on request from Northcoast Environmental Analysis Team), a separate document, and evaluate the archaeological resources in terms of the proposed site development localities. (See Archaeological Map)

A4.4.1 The Archaeologic Sites

The area covered by the immediate Prince Rupert Harbour, including Dibgy and Kaien islands, the north shore of the harbour, and the shorelines of Fern Passage, Morse Basin and Wainright Basin was the population centre of the Coast Tsimshian peoples in prehistoric times.

A total of 82 sites have been recorded in this area:

1 burial cave
12 rock art sites
22 campsites
46 villages

Results cont'd

One site GbTo-49 was totally destroyed without observations made on its extent.

Within this area are four potential site locations for the bulk loading facilities:

a) Fairview

b) south end of Digby Island

c) north shore of Prince Rupert Harbour

d) Pethick Point

Fairview is the only primary consideration, the other three being secondary localities.

Access for the first two facilities would be along existing routes, access to Pethick Point and the north shore would be along the east coast of Kaien Island crossing Fern Passage in the Shawatlan region.

As this area was densely populated prehistorically, the developments are bound to affect the archaeological resources. Each locality will be looked at in specific terms.

Fairview

Two archaeological sites, GbTo-12 and GbTo-13, located on either side of Casey Point are endangered by extension of existing facilities at the Fairview site. Both sites have been partially destroyed by railroad construction in the early 1900's, but as was the case for the 1973 salvage of GbTo-33 and GbTo-36, both still contain considerable cultural material - bone, stone and shell tools, burials. Neither site is recommended for protection although adequate salvage plans must be made.

South End of Digby Island

Any facilities planned for the north or east coast of Digby Island would adversely affect winter village site locations.

Results cont'd

The north end of Digby Island is within the declared area of the National Sites and Monuments Board. There is less concentration of villages at the southern end of Digby Island, but construction will endanger five village sites, three campsites and one burial cave.

GbTo-32, located in the bay between Frederick and Philips points, is the largest site, measuring 1000 by 250 feet to a depth of approximately 14 feet. It has large and complex surface features, great extent and depth, and likely a long span of occupation. The house pit features are numerous and very distinct, a rare occurrence in the region.

GbTo-28, on the north shore of Philips Point, is a moderately sized midden, 300 by 50 feet and up to 100 feet in depth. It is similar to GbTo-32 except for its smaller size.

GbTo-14, located on Emerson Point, is a moderately sized shell midden, 300 by 150 feet with a depth up to 10 feet. The surface of the midden has been cleared and cultivated, and there is a scout camp nearby.

GbTo-27, is an undisturbed small midden, 200 by 50 feet and 3 feet in depth located on the first stream north of Emerson Point.

GbTo-15 is located on Charles Point, east of the Marine Station on Digby Island. It is a campsite, 120 by 25 feet in extent with a depth ranging to 5 feet. There is a canoe skid on the beach. This site was tested in 1938 by Drucker (Drucker, 1943), and was badly disturbed by wartime construction at the Marine Station.

GbTo-16, located on the south shore of Casey Cove west of the Marine Station, has also been badly disturbed by construction.

GbTo-45 and GbTo-46 are two minor campsites on the west coast of Digby Island. Both have been badly disturbed, and are limited in extent.

GbTo-47 is a burial cave located on the north side of Snider Point. It has been badly looted, but enough information remains for a small salvage project.

Results cont'd

Sites GbTo-32, 28, 14 and 27 are recommended for preservation. GbTo-15, 16, 45, 46, 47 should be salvaged.

North Shore of Prince Rupert Harbour

The north shore of Prince Rupert Harbour is just outside of the declared area of Venn Passage. There are five sites in this region, three of them village site localities, and two camp sites.

GbTo-1, located on De Stein Point, is a camp site measuring 100 by 15 feet to a depth of approximately 6 feet. It is undisturbed.

GbTo-25, located in the small bay between De Stein Point and Philips Cove, is a large shell midden 500 by 100 feet in extent, to a depth of approximately 12 feet. A stream cuts through the site. The midden was cleared in the last century for several cabin sites which are now abandoned.

GbTo-9, located on the west shore of the entrance to Melville Are, north of Detention Island, is the major midden in this inlet. It measures 300 by 75 feet to a depth of approximately 10 feet. A modern cabin has been built on the midden and a small garden plot cultivated.

GbTo-8, located in a large cove on the east side of Douglas Point, is an extensive midden 800 feet in length and up to 20 feet in depth. There has been little surface disturbance.

GcTo-6, located on the west side of McNichol Creek, is a small midden site, 200 by 50 feet and approximately 5 feet in depth. McNichol Creek has a large annual pink salmon run, and a smaller coho run. The site is situated to exploit this resource.

The above sites are recommended for preservation.

Access along the north shore, crossing at Tuck Narrows, threatens three other localities GcTn-1, 2 and 3.

GcTn-1 is a campsite located on both sides of Silver Creek. This creek supported major runs of pink, chum and a few coho salmon.

Results cont'd

GcTn-2 is a minor campsite located on the south shore of Tuck Point.

GcTn-3 is located on the northwest shore of Prince Rupert Harbour opposite Osborn Cove. It extends approximately 150 feet along the shoreline and 25 feet inland. There is extensive surface disturbance on areas of the site. These sites (GcTn-1,2, and 3) are recommended for salvage, the major effort deployed on GcTn-3.

Pethick Point

There are eight archaeological sites in the area of Pethick Point, one village site and seven seasonal camps. There are also reported burials along the cliffs of the east shore of Prince Rupert Harbour.

GcTn-8, located at the mouth of a small creek on the south shore of Pethick Point is a minor campsite of little extent and shallow depth.

GcTn-9, located along the south shore of David Point across Fern Passage from the Ministry of Transport, Seal Cove Base, is an extensive village site. There are five distinct house depressions at the top of a 10 to 15 foot midden rise. The site is in excellent condition.

GbTn-4 is located across the small bay from GcTn-9. The deposit of concentrated clam shell is very localized.

GbTn-5 occupies the northern point at the entrance to a large bay with extensive clam flats. The deposit is small and likely a campsite during the harvesting of the intertidal resources of the bay.

GbTn-17, located on the north point of the entrance to Shawatlan Lake, is a minor campsite.

GbTn-3 is a large campsite located on Shawatlan Bay at the northwest end of Coast Tsimshian Reserve No.4. The Shawatlan region is a major salmon spawning system.

<u>Results</u> cont'd

GbTn-20 is located across the small bight from GbTn-3. Two distinct canoe skids of probable prehistoric origin were observed on the beach.

GbTn-7 has been badly disturbed by the Shawatlan Reservoir construction. It was likely a sizeable campsite.

GcTn-9 and GbTn-3 are recommended for preservation, and further work along the cliff areas of Prince Rupert Harbour is required.

Access to the Pethick/Osborn area along the east coast of Kaien Island will threaten two sites, GbTn-1 and 10. These two sites are also endangered by proposed developments for the Heilbroner Estate (Inglis, 1974b). GbTn-1 is recommended for preservation, GbTn-10 for salvage.

The area including the north arm of Prince Rupert Harbour, Tuck Narrows and Tuck Inlet records a total of seven sites, six economic resource camps and one village site. Three of the sites have been discussed in the previous section in relation to access routes to the north shore development. Potential construction of the bulk loading facilities at Osborn Cove threaten another three of the seven sites.

GcTn-5, located at the northern limit of Osborn Cove, is a medium sized midden, 200 by 50 feet and up to 10 feet in depth. A sawmill complex was built on the site and remnants of the buildings and garbage litter the site. There appears to be little sub-surface disturbance.

GcTn-6 and 7 are two campsites at the head of Osborn Cove, utilized in the harvesting of the extensive clam resources of the intertidal zones offshore.

Adequate arrangements must be made to see that these three sites are salvaged. Access routes have been discussed previously.

Considered next is the area of Ridley, Lelu, Kitson, Smith and De Horsey Island, and the mainland opposite Porpoise Harbour and

Results cont'd

Inverness Passage. Two primary development areas, Ridley and Kitson islands, are within this area.

Few sites were located in this area. There are several physiographic and environmental factors which limit site and resource availability:

a) rugged and exposed coastlines along the western shores

b) sedimentation from the Skeena River affecting the productivity of the intertidal areas

c) low, muskeg areas along the shoreline, or a steep rise of the land from the shoreline.

Smith's reconnaissance of the area during the early decades of the 1900's recorded several midden exposures along the railroad right-of-way but these seem to have been destroyed by the development of Port Edward. Two sites have been recorded, GbTn-18 and 19.

GbTn-18, situated on the southernmost point on Kaien Island, is a small campsite, extending 50 feet on either side of the point and inland 25 feet. There is a possible house platform back of the foreshore area, but there is considerable historic disturbance to the surface.

GbTn-19, located in the northwest bay of Ridley Island, is a medium sized midden site. The deposit extends 160 feet along the shore and the same distance inland, and has a depth of approximately 4 feet. A stream runs through the middle of the site and there is a strong likelihood of organic preservation. Portions of the site have been heavily disturbed by the construction of a sewer pipeline for Canadian Cellulose.

Both sites are directly threatened by the proposed Ridley facility and are recommended for extensive salvage study. They are in a different micro-environment from the harbour sites, and should offer considerable data on the exploitation of economic resources on an exposed coastline.

Results cont'd

There are three reports of prehistoric cultural features, in the De Horsey Passage area. At the head of Osland Creek a large, unfinished cedar dugout canoe has been reported. Near the subtidal zone of the flats at the southeast entrance to the passage there are a row of wooden fish stakes, likely from a fish weir. At Osborn Point, a stone hammer was found by one of the inhabitants of Osland. This area definitely needs further study in order to verify these reports and to search for associated cultural features.

Skeena River

The area blocks off the north shore of the lower Skeena River from the mouth of the Khyex River to Gust Point. It is under the influence of the Skeena River/Pacific Ocean interface. There is little flood plain area with the mountains descending to the banks of the Skeena.

Expansion of the present access route facilities to Prince Rupert Harbour endangers two localities.

There is a reported Gitsees village site at the mouth of the Khyex River but it was not located. The report is reliable (Beynon, 1953 V.3, p.48) and more time should be set aside to systematically survey this region.

Two pictograph localities, designated Gbtl-1, are located to the east of Tyee. The most important site depicts a series of seven copper shields and a face. The second set is a combination of small circles. Both are painted in red ochre.

If and when a site is found at the Khyex it is recommended for preservation. It is the closest report site to the coast on the lower Skeena River. The pictographs are also recommended for protection.

Work Channel

This area encompasses the entire length of Work Channel from the head at Lachmach River to the entrance between Maskelyne and Father Points. A total of thirty-nine sites were located along the shores of the

Results cont'd

channel-seven major village sites, thirty-one camp sites, and one stone fish trap complex.

Eleven sites are near the railway access route to the possible Port Simpson facility.

GbTl-2, located at the head of Work Channel on the north shore of Lachmach River, is a major Gitsees campsite, measuring 75 by 50 feet. It was a seasonal camp used to exploit the salmon resources of the Lachmach River and mammal hunting in the early fall.

GbTl-3 is a fish trap complex consisting of three crescent-shaped boulder walls on the intertidal zone. The two largest traps are over 200 feet in length and rise to a height of two feet above the flats, although silting has likely covered the bases of the structures.

GbTl-4 is a campsite just north of GbTl-2 and very similar to it.

It also was utilized during the late summer salmon runs. One distinct canoe skid is apparent on the beach.

Sites GcTm-5, Gctn-11, GdTn-3, 4, 5, and GdTo-4, 5, 6 along the south shore of Work Channel are campsites utilized for the processing of the shellfish resources of the various isolated intertidal zones.

GcTm-5 is a large site, 120 by 25 feet, with minor canoe skids on the beach. An association with the large village site, GcTm-3, on the north shore of the Channel is postulated.

GdTn-4, opposite Legace Bay, is an important campsite, measuring 10 paces by 4 paces to a height of 8 feet. The matrix in the erosion face is composed entirely of whole and broken butter clam. A canoe skid fronts the site.

Results cont'd

GdTo-4, located on the south shore of Trounce Point, is an extensive campsite measuring 90 paces along the beach front by 10 paces at the greatest inland extent to a depth of 6 feet.

GdTo-6, on the northeast point of Zumtela Bay, is an extensive campsite measuring 30 by 20 paces with a midden rise 3 to 4 feet. Its use as a resource processing area has extended into historic and recent times.

All the outer sites feature localized concentrations of clam shells in the deposit and along the foreshore area.

These sites represent a part of the Coast Tsimshian economic cycle which is poorly understood in terms of resources exploited, seasonality of exploitation, time span, and tool procurement of foods. Therefore, despite the relatively minor extent of these locations in comparison to the major middens of the Prince Rupert Harbour, they are still considered of significant importance to our understanding of the regional prehistory to warrant preservation and/or adequate salvage excavations.

Port Simpson

This area included the environs of Port Simpson Harbour, Birnie Island, Finlayson Island and the east shore of Cunninham Passage. Twenty-eight sites were located - one burial cave, one fish trap complex, eight villages and eighteen camps.

The development of bulk loading facilities on the north shore of Port Simpson Harbour immediately threatens two campsite localities. However, the opening of the area as a major shipping terminal endangers sites over a much broader area than the immediate facility. Because two of the sites in the harbour have already been destroyed - GbTo-24 and 25 - the remaining sites take on increased importance.

GdTo-22, located at the west-end of the second bay east of Grassy Point, is a minor campsite occupied to exploit the extensive clam flats offshore. The site covers an area 15 by 7 paces and has a rise of 2 to 3 feet above the high water mark.

GdTo-23, on the north shore of the harbour and due north of Bath Point, is another campsite extending 30 paces along

Results cont'd

the beach front and 14 paces inland. The cultural deposit represents the top one foot of a four foot bank. There is considerable surface distrubance with quantities of historic garbage scattered around.

Stumaun Creek, GdTo-52, is a large pink salmon spawning creek which at low water forms shallow pools - natural fish traps which were undoubtedly used in prehistoric times.

GdTo-2, at the northeast of Birnie Island is the largest site in the area, measuring 165 paces along the beach frontage by 20 paces inland. The deposit is shallow, ranging from one to three feet in depth. It was utilized as a campsite through historic times.

GdTo-3, is a burial shelter located at the southwest end of Birnie Island approximately fifteen feet above sea level. The overhang is approximately 40 feet long and extends back 20 feet. The shelter has been disturbed, but there are still two mummified skeletons and quanitities of box fragments, adzed planks and cedar bark rope visible.

The cultural material likely dates to the mid- 1800's. This site should be strictly avoided.

Outer Coast & Big Bay

This area encompasses the coastline from Ryan Point north to the southern end of Finlayson Island including Big Bay, Burnt Cliff Island, Pearl Harbour and the Flat Top Islands. Thirty-one sites were located - two fish trap complexes, five village middens, and twenty-four camp facilities.

The region of Pearl Harbour and Big Bay is and likely was, a major economic resource area with three salmon streams, shellfish and waterfowl in quantity. It was heavily exploited in prehistoric times by inhabitants of the villages on Burnt Cliff Island and opposing mainland south of Lahou Creek.

In the open stretch between Venn Passage and Burnt Cliff Island are thirteen sites - two extensive middens, GcTO-27 and 37, and eleven campsites. The area was utilized for stop-overs when heading north from or returning to the Rupert Harbour village sites.

Results cont'd

As the area is not directly threatened by the proposed developments, the recommendations are left at a general level.

A diverse coastline is represented in this map - an area that was rich in economic resources and heavily exploited from prehistoric through historic times. It is of major importance and remains to be thouroughly investigated.

PART 2

ENVIRONMENTAL SUITABILITY ANAYLSIS

CHAPTER 5 EVALUATION OF PHYSICAL AND BIOLOGICAL TERRESTRIAL RESOURCES

5.1 EVALUATION OF PHYSICAL COMPONENTS

Before describing the specific port site locations, it is necessary to examine the importance or suitability of the physical terrestrial system towards locating a port facility. In order to arrive at a suitable port location, it would be desireable to understand the shear supportive capacity of the land itself.

The terrain of the Tsimpsean Peninsula relative to other areas within the province poses special problems for land use opportunities, whether they are urbanization, industrialization or transportation facilities. Unique conditions, such as extreme accumulations of organic deposits, extensive rock outcrops, (especially with regards to microtopography), high rainfall, steep slopes and a general lack of mineral soil, demand the establishment of a unique rating system to be devised to handle these conditions.

It should be stressed again that specific rating system ignores navigational considerations, and will strictly deal with the land, whether adjacent to tide water or not. Where development suitabilities occur adjacent to tide water, that area may well be ruled out by extensive shoals or other aquatic limitations.

5.1.1 Slope (See Slope Map)

A slope classification map was drawn which established categories of slope in percentage. The following slope categories were considered:

0 to 10%
10% to 30%
and 30% +

It was felt that slopes in excess of 30% would require special development practices. With regard to port development, slopes in excess of 10% would require special industrial development practices. However, for the purposes of this exercise, the following ratings were attached to the slopes:

0 to 10%	Class 3
10% to 30%	Class 2
30% +	Class 1

The adoption of a three class system was strictly for simplification purposes. Class 1 was regarded as unsuitable, Class 2 regarded as low to moderately suitable, and Class 3 as suitable.

5.1.2 Bedrock Geology (See Archives: Geology Map)

The second physical component considered was the bedrock geology and parameters were:

alluvial, sand, gravel and till	Class 3
volcanic breccia	Class 3
massive grano-diorite and quartz monzonite	Class 3
gneiss or foliated diorite and quartz diorite	Class 3
metadacite, quartz feldspar gneiss	Class 3
foliated micaceous gneiss	Class 2
micaceous schist	Class 2
slate, mica and graphitic schist	Class 2

Within the geological parameters, bedrock was evaluated as to aspects of bearing strength, foundation, workability of the rock by modern excavation techniques, as well as tendency of the rock to erode and weather. In general, hard, massive rocks were regarded as Class 3 while soft, friable rocks were regarded as Class 2. There is no unsuitable bedrock material within the study region.

5.1.3 Surficial Geology (See Archives: Surficial Geology Map)

Parameters considered in the surficial geology of the Tsimpsean Peninsula were:

Floodplain deposits; including floodplain channel deposits, deltaic deposits, deposits of lowstream and deltaic nature, and mountain stream deposits	Class 1
Beach deposits	Class 2
Colluvium, generally less than 5 feet thick which may thicken at the base of slopes	Class 3
Organic substrate in excess of 5 feet thick	Class 1
Glacial till	Class 3
Glacial, fluvial recession deposits	Class 2
Glacio-marine veneer and marine deposits	Class 2
Glacial lacustrine deposits	Class 2
Exposed rock, and rock with up to 3 feet of overburden	Class 3

Parameters considered within the surficial geology component were again foundation, bearing strength, and as well workability of the unconsolidated material. Susceptibility to erosion and weathering as well as the difficulty and/or ease with which certain material can be utilized or disposed of, were considerations. For example, organics show poor foundation and difficult disposal. They were rated as Class 1 while the ordinary colluvium found on the Tsimpsean Peninsula shows good foundation and bearing strength and easy disposal and fill characteristics.

5.1.4 Soils (See Archives: Soil Map)

Parameters considered in the soils were:

Regosols (drained oxidized mineral soils)	Class 3
Gleysols (reduced mineral soils with silt)	Class 1
Podzols (drained mineral soil)	Class 3
Fibrisols, mesic-fibrisol (open bog soils)	Class 1
Fibrisols, lithic-fibrisol (forest bog soils)	Class 1
Folisols (dry, undecomposed organics)	Class 2
Brunisols (montane soils)	Class 2

Properties of the soils considered were foundation, bearing strength, workability, as well as mode of occurence. In addition, susceptibility to erosion, and difficulty of disposal and removal were considerations. Since soils bridge the gap between the physical and natural components, considerations of uniqueness, and biochemical nutrient content were evaluated. The latter varies somewhat from the traditional physical evaluation and considers such factors as high nutrient and organic content of gleysols as well as the high oxidation-reduction of podzols. The former shows a rich substrate for plant materials, while the latter may show high nutrient loss.

5.1.5 Engineering Geology and Physical Hazards

This section concentrates on debris slides in the study area and simply notes the presence or absence of slope instability.

5.1.6 Compilation of Physical Factors

All physical components (slope, geology, surficial geology, soils, and engineering geology) have been evaluated and overlaid prior to the final overlay. The classes assigned to each parameter were then added with slope weighted against the mean of all modifying parameters. The mean number arrived at with this system created the composite class of the physical component. The following classes evolved:

3 to 2.4	Suitable
2.3 to 1.8	Low to moderately suitable
1.0 to 1.7	Unsuitable

The regional composite map of the physical parameters showed an unqualified suitability rating for urban, transportation, and port development.

5.2 EVALUATION OF BIOLOGICAL COMPONENTS

5.2.1 VEGETATION (See Archives: Vegetation Map)

The problem of evaluation of the different vegetation types has been resolved by considering vegetation per se, as an independent entity, and rating the various vegetational units according to their intrinsic properties or qualities. This exercise has been carried out for all 17 vegetation types delineated in the study area, and is presented in Table 12. Each type has been scored for 7 properties or qualities. The higher the number, the more valuable the vegetation type is.

Occurence of the vegetation type within the study area is easy to evaluate. For example, coastal forest and coastal muskeg are common types and cover large areas; tidal marshes and sand beaches are relatively uncommon and of small extent; and shingle beaches and the shrub fringe, though common, cover very small areas compared to, say, hemlock-cedar forest. Floristic diversity is merely an estimate of the richness of the flora and the equitability with which the individual plants in a community are distributed into different species. The vegetation types also differ in their structual complexity and diversity. Sand beaches have a simple vegetation compared to the complex of associations that make up coastal muskeg. Productivity estimates are straightforward. Productivity of tidal marshes is extremely high, of coastal muskeg very low. Mature coastal forest, though it may have a high biomass, generally has low productivity, particularly in the Prince Rupert area. Occurence of rare, uncommon, or endangered species (see Annex A-2) relies on the investigator's knowledge of the flora of the study area, adjacent areas, and B.C. in general. Visual impact or aesthetic value of vegetation is a necessary qualitative judgment. The direct impact of port development (ie. direct removal) is indescriminate in the effect on the vegetation. However, certain secondary disturbances such as oil spills, coal dust, waste disposal, road building, and interception or impedance of drainage will affect some vegetation types more than others.

Suitabilites

The results of this analysis can be summarized in three suitability classes:

Class 1 Unsuitable for Development

1 Shingle Beaches
4 Rookery Islands
5 and 6 High and low salinity marshes
7, 8 and 9 Coastal Muskeg
12 Sitka Spruce forest
17 Freshwater Aquatic Communities

Intrinsic Vegetational Properties and Qualities

Vegetation Unit	Occurence within the Study Area 1-4	Floristic Diversity 1-4	Vegetational Diversity within Map Unit 1-3	Productivity 1-4	Occurence of Rare or Uncommon Species 1-4	Visual Impact, Aesthetics etc. 1-4	Tolerance to Development caused Disturbance 1-4	Total 7-27
1. Shingle beaches	3	3	2	2	3	3	4	20
2. Sand beaches	4	1	1	1	3	4	4	18
3. Steep rocky beaches	2	1	1	1	2	3	2	12
4. Rookery Islands	4	3	2	3	3	3	4	22
5 High Salinity tidal marshes	4	3	2	4	2	3	3	21
6. Low Salinity tidal marshes	4	4	2	4	4	3	3	24
7,8 and 9 Coastal Muskeg	1	4	3	1	4	4	4	21
10. Hemlock-cedar	1	1	2	2	1	1	1	9
11. Cedar-hemlock	1	1	2	1	1	2	2	10
12. Sitka spruce-sea spray	4	2	2	2	2	4	3	19
13. Riparian	2	3	2	3	2	3	3	18
14. Second growth	1	3	1	3	1	1	1	11
15. Shrub zone	3	3	1	3	2	3	2	17
16. Montane vegetation	1	2	3	2	4	4	3	21
17. Freshwater aquatic	1	4	3	2	4	4	3	21

Suitability Class 1 (19-27) Unsuitable for disturbance by development
Suitability Class 2 (13-18) Low suitability for disturbance
Suitability Class 3 (7-12) Suitable for disturbance by development

Class 2 Low Suitability for Development

2 Sand Beaches
13 Riparian Forest
15 Shrub Fringe

Class 3 Suitable for Development

10 Hemlock-cedar Forest
11 Cedar-hemlock Forest
14 Second Growth Forest
3 Steep, Rocky Beach Vegetation

Impact Monitoring by Vegetation

Pollution (especially airborne) due to future development can be monitored by the terrestrial vegetation. Epiphytic bryophytes and lichens (especially lichens) are extremely sensitive to air pollutants. A system of sampling stations located at radiating intervals from sources of pollution can yield, through analysis of the epiphytic vegetation, high resolution bioassays of some common pollutants and sulfur dioxide. Vascular plants are less sensitive to pollution than nonvascular plants, but conifers are the most sensitive. Many dead or dying cedars and spruces in the vincinity of Port Edward are most probably victims of pulp mill pollution. Any significant increase in airborne pollutants is picked up and preserved by the organic deposits in sphagnum bogs. Chemical analysis of the peat and surface moss layers can yield information on the amount and chronology of pollution. The maritime vegetation will, of course, reflect any significant marine pollution.

5.2.2 FORESTRY (See Archives: Forestry Map)

Aspects of forestry are relatively simple to evaluate in terms of displacement of productive forest lands, dollar values of standing timber to be removed, as well as the value of the lost tree growing capacity. For this reason, timber types are mapped on the Tsimpsean Peninsula in three types: productive merchantable timber, non-merchantable timber and non-productive timber. The impact of the proposed bulk loading facility and displacement of timber types if directly measured by these above types where non-productive shows the least impact and the productive merchantable timber the greatest impact.

In the case of transportation corridors, particularly the rail corridor to Port Simpson, special considerations had to be given to accessibility of merchantable timber on the west shore of Work Channel. Because railway rights-of-way in this particular site make the harvest of timber more difficult, the impact was generally weighted more severe than generally attributed to straight removal of forest vegetation by the right-of-way.

5.2.3 WILDLIFE (See Archives: Wildlife Map)

Wildlife should be observed at all seasons of at least one year to properly assess their requirements and intero-relationships. As less than two months could be alloted to this assessment for the phase 2 study, considerable reliance had to be placed on the opinion of government biologists and local residents, and on habitat evolution (rather than habitat utilization). Within this framework, an attempt has been made to highlight those areas of importance as shown by the more spectacular vertebrates within the study area. To this end the habitats of ungulates were mapped with special emphasis as to the critical wintering habitat. Significant feeding areas for waterfowl, both dabbling ducks and diving ducks, were outlined as well. Those shallow littoral zones which have importance to sea mammals were noted and the offshore islands utilized by alcids.

It must be stressed however, that this particular method is an extreme simplification of the significance of the terrestrial and avian fauna within the study area. It is intended only to highlight those areas significant to the perpetuation of certain animals and will need substantial further clarification both in the field and through continued research to arrive at a meaningful model which can predict impacts of a proposed port development.

It was felt that a map showing such areas as critical wintering habitat, significant feeding grounds, breeding and staging grounds for waterfowl, as well as resting areas should be plotted to contribute to the overall evaluation of the biological components. This method pretends in no way to be complete, but is suitable for rating one port site against another.

5.2.4 ARCHAEOLOGY

Archaeological sites were plotted as to location relative to the proposed port sites and were described as to their cultural and historical significance. The salvageability of certain sites and the preservation needs for those not salvageable were highlighted.

5.2.5 COMPILATION OF BIOLOGICAL FACTORS

All the "biological" factors of vegetation, forestry, upland wildlife, waterfowl and archaeology were overlaid in order to produce the accompanying biological composite map. This map highlights the critical bilogical components of the terrestrial system.

CHAPTER A6 SUMMATION

The terrestrial environment of the Tsimpsean Peninsula encompassing a total of 380 square miles was mapped on a scale of 1:100,000 considering the following components:

Physiographic Divisions
Slope
Bedrock Geology
Surficial Geology
Soils
Vegetation
Forestry
Archeology
Waterfowl and Wildlife Habitat

In addition, descriptions were furnished of the mineral potential, structural geology, seismicity, physical hazards, and booming grounds within the study area. The archaeological inventory, although basicly a cultural component, was included in the terrestrial report.

All terrestrial physical and biological components were assessed in such a way as to compare them and compile a summary in order to understand the dynamic relationship of the terrestrial system. In summary, each component showed:

* the Tsimpsean Peninsula shows a high percentage of steep lands as well as adverse micro-relief to the establishment of access corridors and port facilities.

  all bedrock within the Tsimpsean Peninsula is hard to intermediately soft and suitable for foundations and aggregate for proposed developments

  surficial materials within the study area generally show absence of unconsolidated glacial material however concentrations of river gravels of the Skeena, and beach-derived materials (Tugwell Island) can be sources for construction aggregate

* the soils on the Tsimpsean Peninsula show high content of organic soils which if decomposed can show poor foundation characteristics and difficult disposal problems

Summation cont'd

* vegetation on the Tsimpsean Peninsula are mainly the wet coastal forest and coastal muskeg or relatively poor forest value. Some of the wetland communities show extremely high species diversity

* An assessment of debris slides in the Prince Rupert Area indicates slides on forested slopes steeper than 30 degrees they are triggered in a random pattern during periods of prolonged heavy rain. The slides vary greatly in the volume and momentum of the debris but may represent a hazard to development closer than about 1000 feet from the toe of the steep slope.

  These slides present some hazard to existing and proposed transportation routes. In some areas it may be impossible to locate roads and railways so as to completely eliminate this hazard.

  A site-specific assessment of the hazard should be made for buildings or other facilities which are located at the floor of a steep slope and which may be occupied by workmen continuously during periods of heavy rain.

* One hundred and ninety-three localities (including 123 newly located during this study) utilized for up to 5,000 years have been detailed. Seven are directly threatened by the physical structure of the bulk-loading facility at the four primary selections, and another twelve sites are threatened by access routes to those four selections. Secondary site locations could threaten a further thirty-two sites.

  It is recommended that the archaeological sites be safeguarded from destruction if at all possible, and where destruction is inevitable adequate arrangements must be made to properly salvage the material. Certain sites have been designated for "preservation", and this should be considered and absolute constraint on development.

  The coastal shell middens in the north coast area are unique in Canadian prehistory. Soils conditions are such that there is excellent preservations of organic material including bone and occasionally wood which are normally destroyed in other soil types across the

Summation cont'd

country. In consequence the middens are a great source of information on prehistoric economic resources and paleonenvironmental data.

* The following table summarizes the forest values for the eleven proposed port sites:

Table 13 FOREST VALUES

	MATURE TIMBER (DOLLARS)	IMMATURE TIMBER (DOLLARS)	TREE GROWING CAPACITY (DOLLARS PER YEAR)
1. Port Simpson			
Site	nil	nil	nil
Railroad R/W	110,000	nil	1,024
Road	125,000	nil	1,206
Sub-Total	235,000	nil	2,230
2. Smith Island			
Site	nil	nil	nil
Railroad R/W	2,000	nil	18
Sub-Total	2,000	nil	18
3. Kitson Island	nil	nil	nil
4. Ridley Island	nil	nil	nil
5. Digby Island	21,000	nil	107
6. Bacon Cove	nil	nil	nil
7. Melville Arm	nil	nil	nil
8. Schreiber Point	12,000	nil	168
9. Pethic Point	17,000	nil	132
10. Osborn Cove	1,000	5,000	120
11. Fairview Point	nil	nil	39

A timber salvage program would be required to harvest the timber on the Port Simpson rights-of-way.

None of the proposed sites will have a significant impact on the allowable annual cut in the Hecate PSYU.

* Deer are present in moderate numbers throughout the study area, and their populations are likely controlled by wolves in rural areas and by winter range near urban areas.

  The major wildlife resource of this study area is waterfowl which concentrate on the coast littoral fringe. They are not likely to be greatly affected by the minor alterations to habitat envisioned in the construction of various facilities proposed, but would be quite vunerable to oil spills and other pollution related problems. It is likely that such pollution-related impacts would greatly overshadow any more direct forms of impact which may result from port development.

Although outside the study area and immediate proximity to port locations Lucy and Rachael Island are singularly important in that they support nesting of Peal's peregrine falcon and alcid birds. These birds are exceedingly sensitive to disturbance to human activity during the incubation and early brood rearing period, and their rare status warrants effort to avoid them harm as a result of any installations for navigation or other port related activity that may occur in the future. Apart from these falcons, no other unique or endangered wildlife species are Known to occupy any of the sites proposed.

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ANNEX A-1
PLANT SPECIES LIST

1a

scurvy grass	(Cochlearia officinalis)
sea purslane	(Honkenya peploides)
orache	(Atriplex patula)
sea rocket	(Cakile edentula)
limegrass	(Elymus mollis)
Nootka bluejoint	(Calamagrostis nutkaensis)
beach lovage	(Ligustichum scoticum)
hemlock-parsley	(Conioselinum pacificum)
salal	(Gaultheria shallon)
sea-watch	(Angelica lucida)
giant vetch	(Vicia gigantea)
chocolate lily	(Fritillaria camschatcensis)
*columbine	(Aquilegia formosa)
*twisted stalk	(Streptopus amplexifolius)

1b

eelgrass	(Zostera marina)
alkaligrass	(Puccinellia pumila and Puccinellia nutkaensis)
sea plantain	(Plantago maritima)
scurvy grass	
pearlwort	(Sagina maxima)
pickleweed	(Salicornia pacifica)
orache	
sea arrowgrass	(Triglochin maritimum)
seablite	(Suaeda maritima)
sea spurry	(Spergularia marina)
hairgrass	(Deschampsia caespitosa)
Lyngbye's sedge	(Carex lyngbyei)
red fescue	(Festuca rubra)
bentgrass	(Agrostis exarata)
sea barley	(Hordeum brachyantherum)
Baltic rush	(Juncus balticus)
limegrass	
Nootka bluejoint	
bluegrass	(Poa spp.)
holygrass	(Hierochloe odorata)
Pacific brome	(Bromus pacificus)

*occasional species

Annex A-1 cont'd

chocolate lily	
bedstraw	(*Galium trifidum*)
yarrow	(*Achillea millefolium*)
silverweed cinquefoil	(*Potentilla pacifica*)
yellow paintbrush	(*Castilleja unalaschcensis*)
hemlock-parsley	
beach lovage	
sea-watch	
aster	(*Aster subspicatus*)
Pacific clover	(*Trifolium wormskjoldii*)

2

sea rocket	
sea purslane	
limegrass	
bluegrass	
yarrow	
madder	(*Galium triflorum*)
sea bluebells	(*Mertensia maritima*)
silver bur-sage	(*Franseria chamissonis*)
beach carrot	(*Glehnia littoralis*)
hairy cat's ear	(*Hypochaeris radicata*)
strawberry	(*Fragaria chiloensis*)
sheep sorrel	(*Rumex acetosella*)
beach pea	(*Lathyrus japonicus*)
Nootka bluejoint	
salal	
red huckleberry	(*Vaccinium parvifolium*)
holygrass	
false lily-of-the-valley	(*Maiantheomum dilatatum*)
woodrush	(*Luzula multiflora*)
yellow paintbrush	
buttercup	(*Ranunculus* sp.)
horsetail	(*Equisetum arvense*)
Pacific clover	
silverweed cinquefoil	

Annex A-1 cont'd

3

basketgrass	(Phyllospadix scouleri)
sea plantain	
wooly cinquefoil	(Potentilla villosa)
scurvy grass	
pearlwort	
sea purslane	
hemlock-parsley	
sea barley	
red fescue	
alkaligrass	
beach lovage	
rusty saxifrage	(Saxifraga ferruginea)
madder	
yarrow	
hairy rockcress	(Arabis hirsuta)
sea mustard	(Draba hyperborea)
strawberry	
limegrass	
chocolate lily	
yellow paintbrush	
sea-watch	
hairgrass	

4

sea mustard	an indicator of high nitrogen
sea plantain	
scurvy grass	
limegrass	
alkaligrass	
red fescue	
sea barley	
bentgrass	
hairgrass	
wooly cinquefoil	
rusty saxifrage	
pearlwort	
beach lovage	
hemlock-parsley	
sea-watch	
sea purslane	
red stonecrop	(Sedum roseum)
false lily-of-the-valley	

Annex A-1 cont'd

5

eelgrass	
widgeon grass	(Ruppia maritima)
Lyngbye's sedge	
alkaligrass	
sea plantain	
sea arrowgrass	
pickleweed	
saltwort	
seablite	
sea spurry	
hairgrass	
bentgrass	
sea barley	
red fescue	
large-fruited plantain	(Plantago macrocarpa)
trailing chickweed	(Stellaria humifusa)
silverweed cinquefoil	
Baltic rush	
Pacific clover	
Nootka bluejoint	
aster	
limegrass	
holygrass	
yarrow	
yellow paintbrush	
beach lovage	
sea-watch	
hemlock-parsley	
chocolate lily	
bracken	
western dock	(Rumex occidentalis)

6

waterstar	(Callitriche stagnalis and Callitriche anceps)
widgeon grass	
flowering quillwort	(Lilaea scilloides)
mudwort	(Limosella aquatica)

Annex A-1 cont'd

waterplantain	(*Alisma plantago-aquatica*)
wapato	(*Sagittaria latifolia*)
bur reed	(*Sparganium emersum*)
spike rush	(*Eleocharis acicularis* and *Eleocharis palustris*)
buttercup	(*Ranunculus cymbalaria* and *Ranunculus flammula*)
horned pondweed	(*Zannichellia palustris*)
slough sedge	(*Carex obnupta*)
water hemlock	(*Cicuta douglasii*)
bulrush	(*Scirpus validus*)
bentgrass	
Baltic rush	
water parsnip	(*Sium suave*)
sea-watch	
silverweed cinquefoil	
deer cabbage	(*Fauria crista-galli*)
speedwell	(*Veronica americana*)
horsetail	(*Equisetum fluviatile*)
Sitka willow	(*Salix sitchensis*)
peachleaf willow	(*Salix lasiandra*)
Scouler's willow	(*Salix scouleriana*)
red alder	(*Alnus rubra*)
western crabapple	(*Pyrus fusca*)
skunk cabbage	(*Lysichitum americanum*)
false lily-of-the-valley	
small-fruited bulrush	(*Scirpus microcarpus*)
hairgrass	
Canada bluejoint	(*Calamagrostis canadensis*)
sea-watch	
beach lovage	
chocolate lily	
giant vetch	
aster	
water parsley	(*Oenanthe sarmentosa*)
Sitka sedge	(*Carex sitchensis*)

7

shore pine	(*Pinus contorta*)
yellow cedar	(*Chamaecyparis nootkatensis*)

Annex A-1 cont'd

western hemlock	(Tsuga heterophylla)
red cedar	(Thuja plicata)
labrador tea	(Ledum groenlandicum)
bog laurel	(Kalmia polifolia)
bog rosemary	(Andromeda polifolia)
bog cranberry	(Vaccinium oxycoccus)
dwarf azalea	(Loiseluria procumbens)
bog blueberry	(Vaccinium uliginosum)
dwarf blueberry	(Vaccinium caespitosum)
lingonberry	(Vaccinium vitis-idaea)
sweet gale	(Myrica gale)
crowberry	(Empetrum nigrum)
spreading juniper	(Juniperus communis)
yew	(Taxus brevifolia)
sedges	(Carex kelloggii, livida, obnupta, pauciflora, pluriflora and sitchensis)
cotton grass	(Eriophorum angustifolium)
white beakrush	(Rhynchospora alba)
slender bentgrass	(Agrostis aequivalvis)
tufted clubrush	(Scirpus caespitosus)
common rush	(Juncus effusus)
deer cabbage	(Fauria crista-galli)
skunk cabbage	(Lysichitum americanum)
cloudberry	(Rubus chamaemorus)
sundew	(Drosera rotundifolia)
burnet	(Sanguisorba officinalis)
goldthread	(Coptis trifolia)
white gentian	(Gentiana douglasiana)
starflower	(Trientalis arctica)
bog dandelion	(Apargidium boreale)
mosses	(Sphagnum spp.)
reindeer lichens	(Cladonia spp.)

8

shore pine
yellow cedar
red cedar
western hemlock
labrador tea
salal (stunted)
sweet gale

Annex A-1 cont'd

lingonberry	
red huckleberry	
crowberry	
spreading juniper	
sedges	(*Carex obnupta* and *Carex pauciflora*)
Nootka bluejoint	
hairgrass	
common rush	
fern-leaved goldthread	(*Coptis asplenifolia*)
twinflower	(*Linnaea borealis*)
green rein orchid	(*Habenaria saccata*)
dwarf dogwood	(*Cornus canadensis*)
clubmoss	(*Lycopodium annotinum*)
false lily-of-the-valley	
deer cabbage	

9

sweet gale	
yellow water lily	(*Nuphar polysepalum*)
bog bean	(*Menyanthes trifoliata*)
amphibious rush	(*Juncus oreganus*)
bur reed	(*Sparganium angustifolium* and *Sparganium minimum*)
pond weed	(*Potamogeton natans*)
marsh marigold	(*Caltha biflora*)
manna grass	(*Glyceria occidentalis*)
cotton grass	
sedge	(*Carex livida*)

10 and 11

yew	
red elderberry	(*Vaccinium alaskaense* and *Vaccinium ovalifolium*)
blueberry	
false azalea	
salmonberry	
blue currant	(*Ribes bracteosum*)

Annex A-1 cont'd

salal	
red huckleberry	
false lily-of-the-valley	
foam flower	(*Tiarella trifoliata*)
dwarf dogwood	
oak fern	
shield fern	
deer fern	
clubmoss	
woodrush	(*Luzula parviflora*)
skunk cabbage	
fern-leaved goldthread	
twayblade orchid	(*Listera cordata* and *Listera caurina*)
twisted stalks	(*Streptopus amplexifolius*, *Streptopus roseus* and *Streptopus streptopoides*)
single delight	(*Moneses uniflora*)

12

Sitka spruce	
western hemlock	
*red cedar	
salal	
salmonberry	
red elderberry	
devil's club	
false azalea	
red huckleberry	
black twinberry	(*Lonicera involucrata*)
blue currant	
false lily-of-the-valley	
Nootka bluejoint	
sword fern	
foam flower	
woodrush	
dwarf dogwood	
licorice fern	

*occasional species

Annex A-1 cont'd

13

Sitka spruce	
western hemlock	
red alder	
western crabapple	
red cedar	
blue currant	
red elderberry	
blueberry	
red huckleberry	
devil's club	
false azalea	
salmonberry	
*yew	
*salal	
hairy ryegrass	(Elymus hirsutus)
nodding reedgrass	(Cinna latifolia)
nodding false-oat	(Trisetum cernuum)
onion grass	(Melica subulata)
sedges	(Carex laeviculmis and Carex mertensii)
sweet cicely	(Osmorhiza purpurea)
enchanter's nightshade	(Circaea alpina)
shield fern	
sword fern	
lady fern	
wood fern	(Thelypteris phegopteris)
oak fern	
Siberian miner's lettuce	
skunk cabbage	
false lily-of-the-valley	
yellow violet	(Viola glabella)
twisted stalk	(Streptopus amplexifolius)
madder	
foam flower	
Canada bluejoint	
white lettuce	(Prenanthes alata)
buttercup	(Ranunculus uncinatus)
licorice fern	(Polypodium glycyrrhiza)

*occasional species

Annex A-1 cont'd

14

red alder
western hemlock
red cedar
Sitka spruce
Sitka alder (*Alnus sinuata*)
mountain ash (*Sorbus sitchensis*)
salal
red elderberry
blueberry
bracken
oak fern
fireweed (*Epilobium angustifolium* and *Epilobium glandulosum*)
woodrush
madder
trailing bramble
sheep sorrel
velvet grass (*Holcus lanatus*)
annual bluegrass (*Poa annua*)
common rush
toad rush (*Juncus bufonius*)
chickweed (*Cerastium vulgatum*)
starwort (*Stellaria crispa*)
sedges

15

false azalea
salal
red huckleberry
western crabapple
red alder
Sitka alder
salmonberry
thimbleberry
blueberry
black twinberry
blue currant

Annex A-1 cont'd

red elderberry	
Sitka mountain ash	
*devil's club	
*willow	(Salix scouleriana)
false lily-of-the-valley	
beach lovage	
hemlock-parsley	
sea-watch	
Nootka bluejoint	
giant vetch	
yarrow	
limegrass	
buttercup	
chocolate lily	
holygrass	
sea barley	
hairgrass	
aster	
yellow paintbrush	
skunk cabbage	
red fescue	
bentgrass	

17

yellow water lily	
bur weed	
bog bean	
pond weeds	(Potamogeton spp.)
amphibious rush	
manna grass	
cotton grass	
spike-rush	
waterstar	
coontail	(Myriophyllum spicatum)
aquatic buttercup	(Ranunculus aquatilis)
bladderwort	(Utricularia spp.)
sedge	
mare's tail	(Hippuris vulgaris)

*occasional species

ANNEX A-2
RARE, UNCOMMON OR ENDANGERED PLANT SPECIES

Vegetation Type	Species and Comments
1,3,5,6,15	-chocolate lily (Fritillaria camschatcensis) though fairly frequent in the study area and along the northern coast of British Columbia, this is an uncommon species along the southern coast, and is endangered because of destruction of its habitat
2	-beach carrot (Glehnia littoralis) - uncommon -sea bluebells (Mertensia maritima) - uncommon
4	-sea mustard (Draba hyperborea) - rare -red stonecrop (Sedum roseum) - uncommon
1,2,3,5	-yellow paintbrush (Castilleja unalaschcensis) - uncommon
3,4	-wooly cinquefoil (Potentilla villosa) - uncommon
6	-flowering quillwort (Lilaea scilloides) - very rare, northernmost range extension in North America -mudwort (Limosella aquatica) - rare -waterplantain (Alisma plantago-aquatica) - rare, northernmost range extension -wapato (Sagittaria latifolia) - rare, northernmost range extension -waterstar (Callitriche stagnalis) - uncommon -slough sedge (Carex obnupta) - northern limit of range
7,17	-dwarf azalea (Loiseluria procumbens) - rare in most parts of British Columbia
7	-white gentian (Gentiana douglasiana) - uncommon
11	-western twayblade (Listera caurina) - uncommon
12	-filmy fern (Hymenophyllum sp.) - very rare
7,9,17	-a rare lichen, Siphula ceratitis, occurs in and around bog pools -several rare or uncommon lichens, mosses and liverworts occur in various habitats throughout the region, but only more intensive field study could bring them all to light

ANNEX A-3
TABLE OF B.C. FOREST SERVICE CODES

Species Symbols

Douglas-fir	F	Whitebark pine	Pa
Red cedar	C	Western larch	L
Western hemlock	H	Ponderosa pine	Py
Balsam	B	Cottonwood	Cø or Cot
Spruce	S	Aspen	A
Yellow cedar	Cy	Birch	Bi
White pine	Pw	Red alder	D
Lodgepole pine	Pl	Broadleaf maple	Mb

Age Codes

1 - 20 years	1
21 - 40 years	2
41 - 60 years	3
61 - 80 years	4
81 - 100 years	5
101 - 120 years	6
121 - 140 years	7
141 - 250 years	8
250+	9

Height Codes

1 - 35 feet	1
36 - 65 feet	2
66 - 95 feet	3
96 - 125 feet	4
126 - 155 feet	5
156 - 185 feet	6
186 - 215 feet	7
216+	8

Annex A-3 con't

Stocking Class Codes

All immature	0
High volume mature (31+ stems/ac. - 11.1"+)	1
Low volume mature (0-30 stems/ac. - 11.1"+)	2

Site Codes

Good site	G
Medium Site	M
Poor Site	P
Low Site	L
Non-productive	NP

example: SH(C) 951 -M
species - age code - height code - stocking code - site

Bracketed Species

Greater than 10%
but less than 20%
of the total estimated
volume

ANNEX A-4
SUMMARIES OF AREAS, VOLUMES AND VALUES

Forest Cover Types of Proposed Sites

Site	Species	Age, height and density codes	Site	Growth type
Port Simpson	HC(SCy)	931	Low	7
(port site only)	CCy HPL	921	Low	5
Smith Island	CH	931	Poor	5
	CCy H(B)	931	Low	5
Kitson/Lelu	CH(PLCy)	921	Low	5
Islands	CH(S)	931	Low	5
	Cy PL(CH)	912	NP	
Ridley Island	CHPL	931	Low	5
Digby Island	Cy CPL(H)	921	Low	5
	CHS	841	Poor	5
	BS	320	Poor	8
Bacon Cove	CH	921	Low	5
Melville Arm	CH	921	Low	5
Schreiber Point	HC(B)	941	Medium	7
Pethic Point	CH(S)	931	Poor	5
Osborn Cove	CPLH(Cy)	921	Low	5
	H(Cy)	931	Poor	7
	SHC	420	Poor	9 - 11
Fairview Point	SH(C)	941	Poor	9 - 11

Annex A-4 cont'd

Yield Characterisitics of Growth Types

Growth Type	Type	Present Volume/ac (cu.ft.)	Volume/ac @ Culmination Age (cu.ft.)	Mean Annual Increment @ Culmination (cu.ft./ac)	Culmination Age (years)	Remarks
5	Cedar					
	-low site	2300-9300	2125	16	137	-poor form and grade
	-poor site	7200-9600	3675	38	98	-no value, value mainly as pulp or rough saw logs
7	Hemlock					
	-low site	6500	2050	21	123	-poor form and grade
	-poor site	7500	4800	54	89	-no value, value mainly as pulp and rough saw logs
	-medium site	7500	6250	78	80	-pulp and saw log
9-11	Spruce					
	-low site	not found in the study area				
	-poor site	7600	5375	39	137	-pulp and saw log

Annex A-4 cont'd

Port Simpson - Forest Cover Types and Their Volumes on Road Right-of-way

Forest Cover	Type	Land Tenure	Acreage	Volume/ Acre (cu.ft.)	Total Volume (MCF)
CH(PLS)	841-P	Crown	33.9	9633	327
CHB	941-P	Crown	14.5	9633	140
HC(B)	941-M	Crown	4.8	7527	36
HC(S)	941-M	Crown	21.8	7527	164
HC(SCy)	841-P	Crown	4.8	7527	36
HBSC	951-M	Crown	82.4	10952	902
HS	640-M	Crown	12.1	8559	104
NSR-M		Crown	2.4	-	-
Sub-total			177.10		1709
C(HSCy)	941-M	I.R.#2	17.0	7237	123
CH(S)	941-P	I.R.#2	10.0	9633	96
CHS(B)	941-P	I.R.#2	19.4	9633	187
HCS(B)	941-M	I.R.#2	4.8	7527	36
HB(CCy)	851-M	I.R.#2	10.0	12750	128
HB(CCy)	841-P	I.R.#2	17.0	9659	164
HB(S)	951-M	I.R.#2	14.5	12750	185
HS(C)	941-P	I.R.#2	14.5	8003	116
SH	530-M	I.R.#2	7.3	10500	77
Sub-total			114.5		1112
Total			291.6		2821

Volumes are based on trees in excess of 9.1 inches DBH, less decay only, to close utilization standards

Annex A-4 cont'd

Port Simpson - Volume and Appraised Value of Mature and Merchantable Immature Timber on Road Right-of-way

In the table below, appraised value is calculated as close utilization volume of each species multiplied by its stumpage value

	C	H	B	S	Cy	Total
Cedar	447	219	43	143	21	873
Hemlock	114	1028	402	320	6	1870
Spruce		25		52		77
Total Volume	561	1272	445	515	27	2820
Appraised Value	$28,050	$50,880	$13,900	$30,900	$1,890	$125,070
					or say,	$125,000

Annex A-4 cont'd

Port Simpson - Net Value of Mean Annual Increment - Road Right-of-way (Loss of Growing Capacity)

TYPE/SITE	MEAN ANNUAL INCREMENT (MCF/AC)	ACREAGE	TOTAL MAI/YR. (MCF)	VALUE PER MCF, DOLLARS (APPENDIX 2)	ANNUAL VALUE (DOLLARS)
Cedar					
Poor	0.038	77.8	3.0	$ 60	$ 180
Medium	0.093	17.0	1.6	$ 60	$ 96
Hemlock					
Poor	0.054	36.3	2.0	$ 60	$ 120
Medium	0.078	153.2	12.0	$ 60	$ 720
Spruce					
Medium	0.125	7.3	.9	$100	$ 90
Total		291.6			$1,206

Annex A-4 cont'd

Port Simpson - Forest Cover Volumes on Railway Right-of-way

FOREST COVER	TYPE	ACREAGE	VOLUME/AC (CUBIC FT)	TOTAL VOLUME (MCF)
C	931-P	4.8	5,527	27
C(H)	941-P	7.2	7,237	52
CH	831-P	15.6	6,293	98
CH	931-P	1.2	6,293	8
CH	941-P	9.6	9,633	92
CH	951-M	3.6	10,460	38
CH(S)	931-P	7.2	6,293	45
CH(S)	941-P	7.2	9,633	69
CH(S)	951-M	10.8	10,460	113
CH(Scy)	941-P	7.2	9,633	69
CH(Cys)	931-P	27.6	6,293	174
CH(Cy)	931-P	7.2	6,293	45
CH(Cy)	941-P	18.0	9,633	173
CCy	941-P	10.8	4,769	52
CCyH	941-P	9.6	4,769	46
HC(B)	951-M	6.0	10,677	64
CH(S)	951-M	13.2	10,677	141
HCS	941-P	10.8	7,527	81
HCS(B)	851-M	24.0	10,677	256
HC(SB)	951-M	30.0	10,677	320
HB	951-M	9.6	12,750	122
HB(S)	951-M	4.8	12,750	61
HBS	951-M	7.2	10,952	79
HS(C)	951-M	4.8	10,577	51
HS(B)	951-M	1.2	10,577	13
SH	961-G	3.6	13,995	50
SH(C)	941-P	7.2	7,652	55
SHB	961-G	2.4	13,995	34
TOTAL		272.4		2,429

Annex A-4 cont'd

Port Simpson - Volume of Mature Timber on Railroad Right-of-way in thousands of cubic feet

TYPES	SPECIES					TOTAL
	C	H	B	S	Cy	
Cedar	584	231	110	88	88	1,101
Hemlock	178	749	155	107	-	1,189
Spruce	11	42	4	80	2	139
Total Volume	773	1,022	269	275	90	2,429
Appraised Value	$38,650	$40,880	$8,070	$16,500	$6,300	$110,400
					or say,	$110,000

Annex A-4 cont'd

Port Simpson - Net Value of the Loss of Tree Growing Capacity

RAILWAY RIGHT-OF-WAY

TYPE/SITE	MEAN ANNUAL INCREMENT (MCF/AC)	ACREAGE	TOTAL MAI (MCF)	VALUE/MCF (APPENDIX 2)	TOTAL VALUE DOLLARS
Cedar					
Poor	.038	133.2	5.1	$ 60	
Medium	.093	14.4	1.3	$ 60	$ 384
Hemlock					
Poor	.054	10.8	.6	$ 60	
Medium	.078	100.8	7.9	$ 60	$ 510
Spruce					
Poor	.039	7.2	.3	$100	
Good	.172	6.0	1.0	$100	$ 130
Total					$1,024

Annex A-4 cont'd

Smith Island - Port site

The port site on Smith Island is covered by CCyH(B)931-1 and thus has no commercial forestry values.

Smith Island - Mature and Merchantable Immature Values of Right-of-way

The road and/or rail right-of-way contains 8 acres of CH931-P. The total volume is 50,344 cubic feet (50 MCF) or which red cedar constitutes 47% of the volume, hemlock 16%, balsam 19%, spruce 5% and yellow cedar 13%.

The net value of the timber is estimated to be the sum of the following:

1	red cedar	24 MCF x \$ 50.00 =	\$1200
2.	hemlock	8 MCF x \$ 40.00 =	\$ 320
3	balsam	10 MCF x \$ 30.00 =	\$ 300
4	yellow cedar	6 MCF x \$ 70.00 =	\$ 420
	Total merchantable value	=	\$2360
	or approximately		\$2000

Smith Island - Loss of Tree Growing Capacity of Right-of-way

The mean annual increment (in MCF) for a poor site cedar type is .038 MCF.

The annual value of the increment that would be lost is:

.038 x 8 x \$.60 = \$18

Annex A-4 cont'd

Kitson Island - Forest Cover

Kitson Island has no forestry values since the site and right-of-way is covered by low site class forests

Ridley Island Site - Forest Cover

The Ridley site and the associated right-of-way is covered by a cedar, hemlock and lodgepole pine stand of low site. There are no commercial forest values to be lost if this site were cleared of the trees.

Digby Island - Forest Cover

The forest cover is divided into three types:

1	BS 320-P	3 acres
2	CHB 841-P	45 acres
3	CyC Pl(H) 921-L	approximately 300 acres (no values)

Digby Island - Mature Values

The volume of the CHS 841-P stand is 433,485 cubic feet (433 MCF) of which cedar comprises 50%, hemlock 25%, balsam 4%, spruce 20% and yellow cedar 1%

Thus, the value of the mature timber is estimated to be the sum of:

1	cedar(red)	217 MCF x $50.00 =	$10,850
2	hemlock	108 MCF x $40.00 =	$ 4,320
3	balsam	17 MCF x $30.00 =	$ 510
4	spruce	87 MCF x $60.00 =	$ 5,220
5	yellow cedar	4 MCF x $70.00 =	$ 280
Sub-total			$21,180
or approximately			$21,000

Digby Island - Immature Values (non-merchantable)

There are 3 acres of immature, 50-year old balsam on this site. According to the B.C. Forest Service valuation schedule this stand is worth $163/acre for a total of $489. This value is negligible and has been rounded to nil

Annex A-4 cont'd

Digby Island - Loss of Tree Growing Capacity

TYPE/SITE	MEAN ANNUAL INCREMENT (MCF/AC)	ACREAGE	TOTAL MAI (MCF)	VALUE PER (MCF)	TOTAL ANNUAL VALUE ($)
Cedar					
Poor	.038	45	1.7	$ 60	102
Balsam					
Poor	.044	3	.13	$ 40	5
Total					107

Bacon Cove - Forest Cover

The forest cover consists of CPL(CyH) 921-L and CH 921-L. There are no forest values associated with this site.

Annex A-4 cont'd

Melville Arm - Forest Cover

This area is covered in CH 921-L forest and thus has no forestry value

Schreiber Point - Forest Cover - Volume and Value

The forest cover on this site covers approximately 36 acres and is classified as HC(B) 941-M.

The total volume of the stand is 271 MCF of which cedar (red) accounts for 32% of the volume, hemlock 45%, balsam 10%, spruce 12% and cedar (yellow) 1%.

Therefore, the net value of the timber on this site is estimated to be the sum of:

1	cedar (red)	87 MCF x \$50.00 =	\$4,350
2	hemlock	122 MCF x \$40.00 =	\$4,880
3	balsam	27 MCF x \$30.00 =	\$ 810
4	spruce	32 MCF x \$60.00 =	\$1,920
5	cedar (yellow)	3 MCF x \$70.00 =	\$ 210
			\$12,170
or approximately			\$12,000

Schreiber Point - Loss of Tree Growing Capacity

The mean annual increment for hemlock, medium site is .078 MCF/ac. Therefore, the net present worth of the sum of every annual increment that would be lost to the forest industry in perpetuity is:

$$\frac{.078 \times 36 \times \$60.00}{} = \$168$$

Pethic Point - Forest Cover and Mature Value

Pethic Point has a stand of CH(S) 913-P of approximately 58 acres. The total estimated volume if 365 MCF of which cedar accounts for 50%, hemlock accounts for 28%, balsam accounts for 12%, spruce 6% and yellow cedar 4%.

Annex A-4 cont'd

The net value of this timber is estimated to be:

1	cedar (red)	182 MCF x $50.00 =	$9,100
2	hemlock	102 MCF x $40.00 =	$4,080
3	balsam	44 MCF x $30.00 =	$1,320
4	spruce	22 MCF x $60.00 =	$1,320
5	cedar (yellow)	15 MCF x $70.00 =	$1,050
Total			$16,870
or say			$17,000

Pethic Point - Loss of Tree Growing Capacity - Bare Land Values

The mean annual increment for cedar types, poor site, is .038 MCF. Therefore, the present worth of the annual increment that would be lost is:

$$\underline{.038 \times 58 \times \$60.00} = \$132$$

Osborn Cove - Forest Cover and Mature Values

The Osborn Cove site is covered by CPlH(Cy) 921-L forest with two small stands of productive timber land, H(Cy) and SHC 420-P.

The H(Cy)931-P stand covers approximately 7 acres and contains 25 MCF of which red cedar accounts for 12%, spruce 9%, and yellow cedar 30%.

Thus the value of this timber is estimated to be the sum of:

1	cedar (red)	3 MCF x $50.00 =	$150
2	hemlock	12 MCF x $40.00 =	$480
3	spruce	2 MCF x $60.00 =	$120
4	cedar (yellow)	8 MCF x $70.00 =	$560
Total			$1,310
or approximately			$1,000

Annex A-4 cont'd

Osborn Cove- Immature Value

There are 25 acres of immature forest on this site. The stand is coded as SHC 420-P, and is about 70 years old.

According to B.C. Forest Service schedule of values, this stand is worth $212/acre for a total of $5,300, or approximately $5,000

Osborn Cove - Loss of Tree Growing Capacity

The mean annual increment for hemlock and spruce types, poor site are .054 MCF and .039 MCF, per acre respectively. Therefore, the net present worth of the annual increment is:

$$(.054 \times 7 \times \$60.00) + (.039 \times 25 \times \$100.00)$$

$$= \$120$$

Fairview Point - Forest Cover

The Fairview site used to have a small stand (approximately 13 acres) of SH(C) 914-P. This stand has since been cleared.

Thus if this site were to be used, the only forestry loss would be a loss of growing capacity.

Fairview Point - Loss of Tree Growing Capacity

The mean annual increment is .039 MCF per acre per year. The total increment per year is .039 x 13 - .5 MCF of which spruce comprises 50%, hemlock 25%, cedar 20%, and other species 5%.

Therefore, the value of the total increment is the sum of:

1	spruce	.5 MCF x $.50 =	$ 25
2	hemlock	.5 MCF x $.25 =	$ 60
3	cedar	.5 MCF x $.20 =	$ 60
4	other species	.5 MCF x $.05 =	$ 1
Total			$ 39

ANNEX A-5
STUMPAGE VALUE CALCULATIONS

In this first approximation, the same procedure has been followed to appraise forest values on Crown and Indian Reserve lands. While this procedure can be expected to give a good overall approximation, the breakdown for the Indian Reserve lands is less meaningful and under no circumstances could results be used as a basis for compensation.

Log Storage

Estimated log quality in existing stands, and projected quality for second growth stands is shown below:

	Existing Stands	Second Growth
Pulp	90%	40%
#3 Sawlog or better	10%	60%

Stumpage Prices

Most timber sales in the Prince Rupert Forest District are currently being appraised at statutory minimums which is 8% of average log selling price in the Vancouver log market.

In the table below, stumpage for pulp logs is based on statutory minimum (8% of average log market value for #3 logs), and the stumpage for sawlog grades is based on published Coastal Prince Rupert average stumpage prices for May, 1974. The published prices refer to intermediate utilization sales and must be adjusted downward for close utilization sales.

Species	Pulp log Grades	Sawlog Grades
Cedar	$ 5.00	6.00
Hemlock	$ 4.00	8.00
Balsam	$ 3.00	4.00
Spruce	$ 5.00	13.00
Cypress	$ 5.00	29.00

Annex A-5 cont'd

By weighting the above prices by the expected recovery of pulp and sawlog grades, the following table of values was estimated for existing and second growth stands:

	Average Stumpage Value $/M.c.f.	
Species	Existing Stands	second Growth Stands
Cedar	$ 50.00	$ 60.00
Hemlock	$ 40.00	$ 60.00
Balsam	$ 30.00	$ 40.00
Spruce	$ 60.00	$100.00
Cypress	$ 70.00	$190.00

The above prices are used for estimating the value of close utilization volumes of existing timber and of projected second growth crops.