



**ALBERNI VALLEY EAST
SIDE BYPASS STUDY**

Prepared for:
City of Port Alberni

Prepared by:
Stanley Consulting Group Ltd.

January 19, 1998

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4 February, 1998
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City of Port Alberni
Engineering Department
4850 Argyle Street
Port Alberni, BC
V9Y 1V8

Attention: Ken Watson, City Engineer

Dear Ken:

Reference: Alberni Valley East Side Bypass Route Study – Dated February 98

Attached is our final submission of the referenced report. We have incorporated final comments received from the Ministry of Transportation and Highways (MoTH), Alberni-Clayoquot Regional District, and the City of Port Alberni. Twenty copies have been prepared and submitted as requested.

It is our understanding that you will be presenting the report to the City Council after which a public open house may be held, pending direction from Council. Stanley will participate in an open house as per our original Work Program, if requested to do so. We will require some advance notice in order to finalize any presentation materials required by the City.

On behalf of the Project Team, I wish to express our sincere appreciation for the assistance and cooperation received from the City, Region, and MoTH during completion of this study report.

Sincerely,

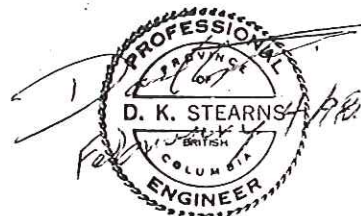
STANLEY CONSULTING GROUP LTD.

David Stearns, P.Eng.
Senior Transportation Engineer

Enclosure

cc: Tony Brcic, Stanley Consulting Group Ltd. - Nanaimo
John Schnablegger, Stanley Consulting Group Ltd. - Surrey

(watson06.doc\2118600)



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EXECUTIVE SUMMARY

The City adopted the Alberni Valley Transportation Network Plan in 1981. This plan is also referenced in the Official Community Plan dated October, 1993 (Map 8, Section 3); refer to **Figure 1.1** in the report. The future road network includes a concept for a major road along the east boundary of the City. This road is referred to as the *Alberni Valley East Side Bypass (Bypass)* and would extend northward from Bamfield Road to Cherry Creek Road north of Johnson Street (Highway No. 4). Cherry Creek Road would ultimately connect to a future Highway No 4 Bypass around the north end of the City. The Regional District of Alberni-Clayoquot also adopted the Alberni Valley Transportation Network Plan in 1981 and was an active participant in this study.

In anticipation of various development proposals along the east side of the City, a study was initiated to determine an optimum route and property requirements for the Bypass. This would allow the City and the Region to protect this property as development takes place.

This study included the following work program:

- Developing study base maps using digital mapping data obtained from aerial photography (digital mapping data was developed under a separate City contract);
- Completing a strategic review of design constraints and issues within the study area, which included meeting with key stakeholders;
- Generating feasible Bypass alignments within the study area;
- Completing an evaluation of Bypass alignment options;
- Obtaining general public input to the study by conducting an open house; and
- Finalizing recommendations for the preferred Bypass alignment option and identification of property requirements.

The Study Work Program did not include a comprehensive review of the Alberni Valley Transportation Network Plan adopted in 1981. Therefore, issues regarding the schedule for implementation of the Bypass versus other road network improvements were not dealt with in this report.

Design constraints were identified through a number of site visits and through consultation with select stakeholder groups. Site investigations were conducted to assess physical, environmental, geotechnical, and heritage constraints. Optional alignments for the Bypass were then developed and evaluated.

Planning and design considerations were identified and incorporated into the generation of optional Bypass alignments. Design criteria was established through discussion with the City administration and the BC Ministry of Transportation and Highways. It was generally agreed that the results of this study would potentially set a precedence for other transportation network links.

The evaluation process used to establish a preferred route involved consideration for typical “accounts” included in a Multiple Accounts Evaluation (MAE). The various alignment options were subdivided into logical segments. Each segment was then evaluated giving consideration to the most important accounts. The Preferred Alignment was then developed by incorporating each preferred segment.

Figures 5A to 5D, Section 5.0, in this report provides details of the Preferred Alignment. Right-of-way requirements were developed by considering probable cut and fill toes for the ultimate Bypass form. A conservative approach was also employed when considering cross sectional requirements. This approach allows the City of Port Alberni to implement measures to protect the Bypass corridor as development proceeds. It should be noted that base mapping created from aerial photographs was used as the basis of determining cut and fill toes. Therefore, the rights-of-way established are not considered acceptable for legal boundaries. It would be desirable for the City to complete a Preliminary Design of the preferred alignment. This would involve field survey and detailed analysis of geometric requirements. An alternative would require field survey and accurate identification of right-of-way requirements in future development proposal submissions.

It is recognized that the implementation of the Bypass would likely be done in stages subject to community and traffic demands. The results of this study should; therefore, be considered as a long term strategy for protecting the integrity of the preferred Bypass alignment. The final outcome of specific development proposals may require refinement of the preferred alignment or cross sections detailed in this study.

1.0 INTRODUCTION

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1.0 INTRODUCTION

1.1 BACKGROUND

The City of Port Alberni and the Regional District of Alberni-Clayoquot have experienced a growing demand for development on lands to the east of current City boundaries. Provincial approval has been received by the City to expand the City boundaries eastward to accommodate this demand. It is desirable for growth to take place in harmony with long term road network requirements; thereby minimizing long term costs to the City and optimizing the climate for encouraging growth.

The City and the Region adopted the Alberni Valley Transportation Network Plan in 1981. This plan is also referenced in the Official Community Plan dated October, 1993 (Map 8, Section 3); **Figure 1.1**. The future road network includes a concept for a major road along the east boundary of the City. This road is referred to as the *Alberni Valley East Side Bypass (Bypass)* and would extend northward from Bamfield Road to Cherry Creek Road north of Johnson Street (Highway No. 4). Cherry Creek Road would ultimately connect to a future Highway No 4 Bypass around the north end of the City.

In anticipation of various development proposals along the east side of the City, a study was initiated to determine an optimum route and property requirements for the Bypass. This would allow the City to protect this property as development takes place.

1.2 STUDY AREA

The area studied is shown on **Figure 1.2**. The area is generally defined by the Bamfield Road, the existing east City boundary, Highway No. 4, and a line approximately parallel to the east City boundary located approximately one kilometre east of the boundary.

ROAD NETWORKS

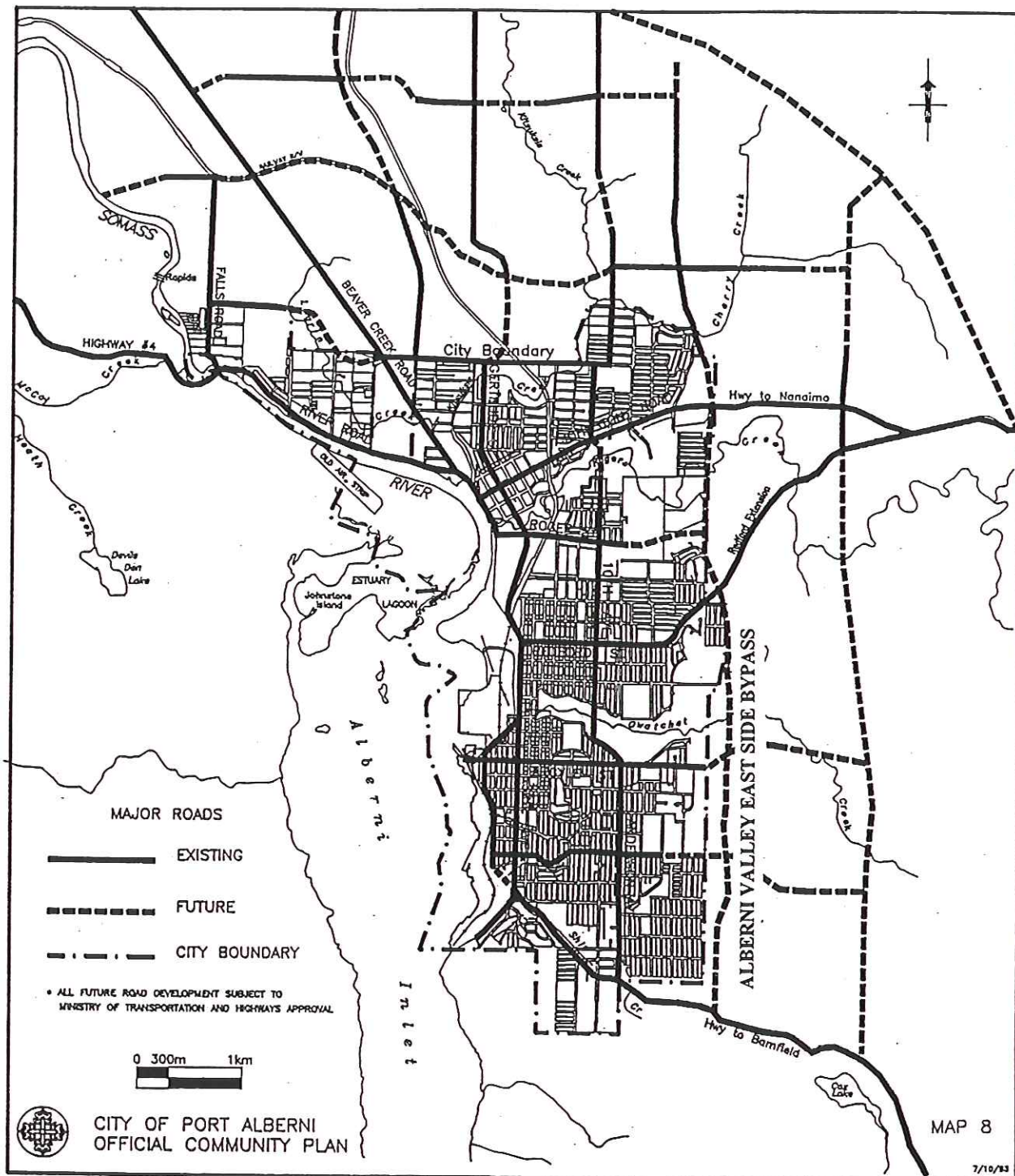
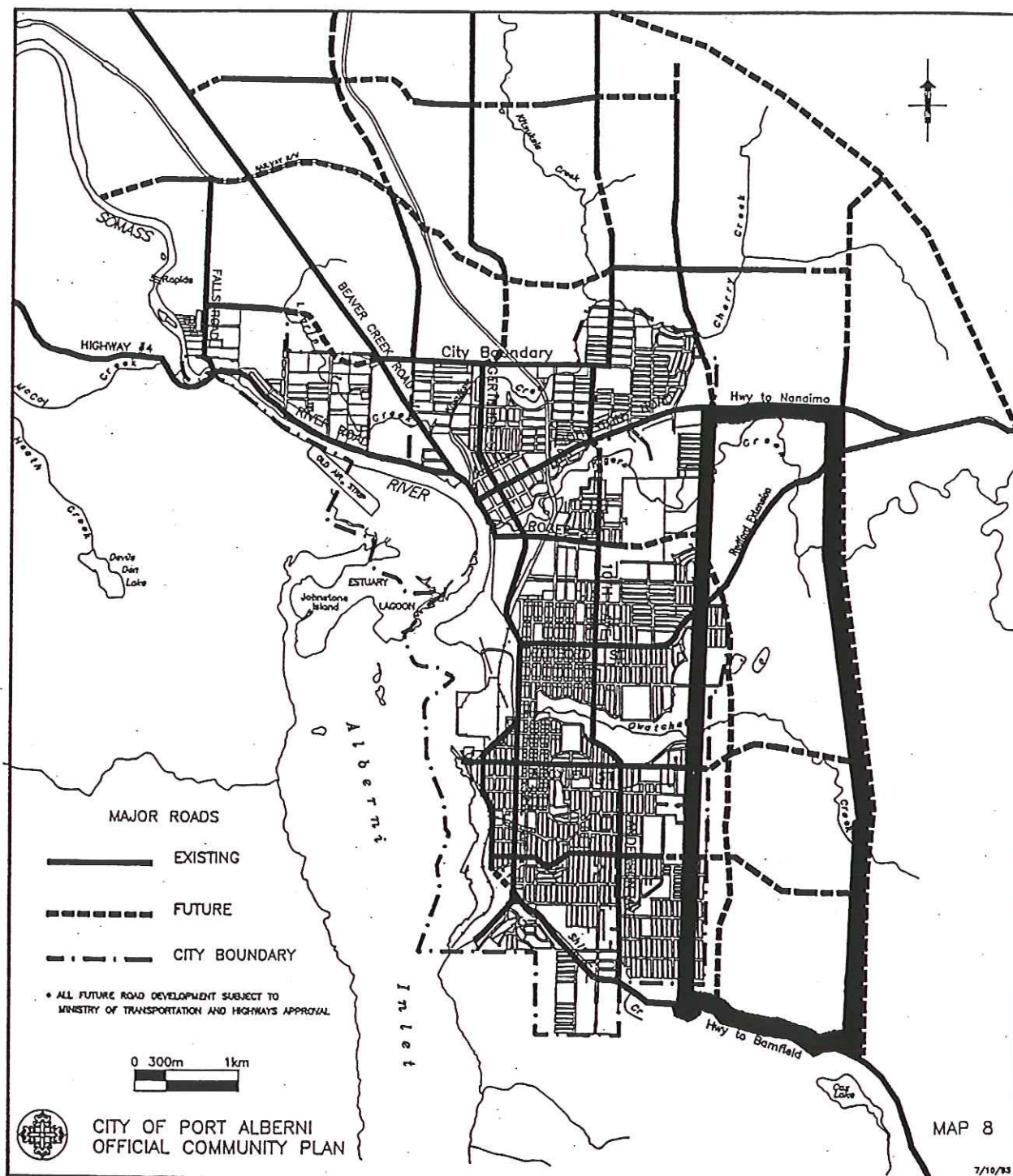


FIGURE 1.1



**FIGURE 1.2
STUDY AREA**

Alignment options were generated for the Bypass within the study area; however, issues and constraints outside the area were considered when completing the evaluation process. For example, the appropriate road service function for Cherry Creek Road immediately north of Highway No. 4 was considered

1.3 STUDY SCOPE

This study included the following work program:

- Developing study base maps using digital mapping data obtained from aerial photography (digital mapping data was developed under a separate City contract);
- Completing a strategic review of design constraints and issues within the study area, which included meeting with key stakeholders;
- Generating feasible Bypass alignments within the study area;
- Completing an evaluation of Bypass alignment options;
- Obtaining general public input to the study by conducting an open house; and
- Finalizing recommendations for the preferred Bypass alignment option and identification of property requirements.

The Study Work Program did not include a comprehensive review of the Alberni Valley Transportation Network Plan adopted in 1981. Therefore, issues regarding the schedule for implementation of the Bypass versus other road network improvements were not dealt with in this report. It is reasonable to assume that an update of the road network plan would not affect the outcome of this study because the network link within the study area complies with a desired major road network scheme (Ref: Transportation Association of Canada Manual of Geometric Design Standards For Canadian Roads).

This study did not include development of a Transportation Model; therefore, a comprehensive analysis of traffic requirements was not completed. Traffic

information included in the report titled Study of Major Road Crossing of Rogers Creek dated June 1980, discussion with select stakeholders, and the adopted Transportation Network Plan were used as the basis for establishing the appropriate service function for the Bypass. However, this data was not suitable for operational level analysis.

1.4 STUDY OBJECTIVES

This study may be thought of as part of a design process which involves a number of distinct phases. Typical design phases include:

Phase 1	Road System Needs Analysis
Phase 2	Transportation Corridor Identification
<i>Phase 3</i>	<i>Route Definition</i>
Phase 4	Preliminary Road Design
Phase 5	Functional Road Design
Phase 6	Detailed Road Design
Phase 7	Tender and Construction Documents Preparation

This study primarily focused on the Route Definition phase of the process. However, some functional design work was completed to establish intersection requirements and property requirements. For example, detailed survey was undertaken along Redford Road in the vicinity of the proposed West Coast Hospital site. This was done to coordinate the main hospital access with potential Bypass/Redford intersection locations.

Objectives of the route study included:

- Optimize road safety and transportation mobility;

- Maximize public/stakeholders participation;
- Minimize environmental disruption;
- Minimize disruption to heritage features;
- Minimize construction costs;
- Maximize development potential; and
- Define property requirements for future protection.

2.0 STUDY AREA CONDITIONS & ISSUES

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2.0 STUDY AREA CONDITIONS & ISSUES

2.1 ROADS AND TRAFFIC

The City and the Region adopted the Alberni Valley Transportation Network Plan in 1981. This plan is also referenced in the Official Community Plan dated October, 1993 (Map 8, Section 3). Refer to **Figure 1.1** in Section 1.0 of this report.

The future road network includes a concept for a major road along the east boundary of the City. This road is referred to as the *Alberni Valley East Side Bypass (Bypass)* and would extend northward from Bamfield Road to Cherry Creek Road north of Johnson Street (Highway No. 4). Cherry Creek Road would ultimately connect to a future Highway No 4 Bypass around the north end of the City. To date, none of the Bypass has been constructed. The road network plan also identifies a future bridge crossing over Rogers Creek at 10th Avenue.

A report titled Study of Major Road Crossing of Rogers Creek was prepared for the City in 1980 by N. D. Lea Associates Ltd. (Lea Report). This study involved the development of a “manual” transportation model for the City using a gravity based analysis. The primary objective of the modelling exercise was to identify which of two Rogers Creek crossings, 10th Avenue or 21st Avenue [Bypass], should be selected and what the appropriate timing for construction should be. *This issue is outside the scope of the current study*; however, the following are some key relevant points:

- The crossings are to be designed for a four-lane urban road; ultimate configuration;
- A 70 km/h design speed was utilized;

- The extensions of 10th and 21st Avenues north of Johnston Road were incorporated into the study. Ian Avenue and Cherry Creek Road were considered as possible routes for these extensions;
- An origin/destination (O&D) study was completed using questionnaires. Of the 3,810 questionnaires distributed, approximately 42% were returned. The results of the O&D study were used to assist with calibration of a trip table used in the transportation model;
- The zones established for the transportation model did not incorporate areas outside the City of Port Alberni boundaries [i.e. Greenridge Trailer Park, Sahara Heights, Arrowview Heights, proposed West Coast Hospital, and the Burde street development, etc.];
- The one-way P.M. peak hour flow across Rogers Creek was forecast to the year 2001. It was concluded that this traffic flow could be accommodated with the existing bridges [comprehensive intersection traffic analysis was not completed]. The limiting factor was the intersection of Gertrude/Stamp/Roger and to a lesser extent the intersection of Gertrude/Johnson. Approximately 21% of the traffic would utilize a bridge at 21st Avenue [Bypass]; and
- Construction of a new bridge at 10th Avenue produced the most favourable result for improving travel times and load distribution *[This statement was based on the zone model and gravity based analysis employed. A model encompassing areas outside the City boundaries and recent development proposals would produce results which assign a greater volume of traffic to the 21st Avenue bridge crossing. It is also noted that conclusions reached were not based on a multiple accounts analysis including a financial performance review].*

The current study does not include a comprehensive review of traffic and travel patterns. This was not required because limited link connection options (corridor options) were available for analysis. This is not the case north of Highway No. 4.

While the existing bridge crossings may be accommodating the traffic volumes experienced, discussions with various stakeholders suggested a strong desire to improve the mobility across Rogers Creek. It was also emphasized during these meetings that traffic is using the Sahara Heights access as a means of short cutting between Redford Road and Rogers Street.

Implementation of the Bypass would trigger changes to traffic volumes currently experienced on the existing road network. For example, traffic volumes on 10th Avenue would be expected to decrease. Traffic congestion currently experienced at the Johnson Street/Stamp Avenue intersection should be relieved to some extent. Accurate assessments of the effects of the Bypass on the existing road network were not within the scope of this study.

The ultimate laning for the Bypass facility was assumed in order to allow the City to protect future property requirements. Discussions regarding phasing implementation of the Bypass are, in part, based on traffic analysis included in the Lea Report.

It is evident from the Lea Report that the Alberni Valley East Side Bypass would serve a significant volume of City traffic and traffic originating/destined from/to outside the City boundaries. Therefore; the service function should favour traffic mobility rather than access to adjacent lands. Access to adjacent properties should be gained indirectly from collector roads crossing the Bypass.

The adopted road network plan does not include details of road classifications; therefore, *a cursory review of the road system was undertaken in order to establish the intended service function of the Bypass.*

- The Alberni Valley East Side Bypass (Bypass) will serve as an arterial road within the overall City/Region road network.
- The Bypass could also serve as a north-south designated truck route. The City currently does not have such a route. Furthermore, existing north-south routes

would involve residential and commercial areas which may not be receptive to a designated truck route passing through their area.

The Bypass can be characterized as a divided arterial roadway. Design criteria for this road class are discussed in Section 3 of this report.

Highway No. 4, Redford Road, and Bamfield Road would also be characterized as arterial roads.

Other cross road streets including Rogers Street and Argyle Street would be characterized as undivided collector streets. Their intended service function would be to provide a reasonably high level of traffic mobility as well as access to adjacent lands.

2.2 LAND USE

The existing and future land use plans are included in the Official Community Plan (OCP) dated October, 1993. The study area is predominantly outside of existing City boundaries and falls within the jurisdiction of the Regional District Alberni-Clayoquot. Map A-2 of the OCP illustrates proposed Future Land Use. The study area shown on **Figure 1.2** involves the following land uses :

- Commercial (adjacent to Highway No. 4);
- Industrial (south of the Alberni Mall);
- Parks and Natural Area (Rogers Creek & Owatchet Creek);
- Possible Urban Expansion area noted as Demonstration Forest (Adjacent to the City's east boundary); and
- Residential (along Anderson Avenue)

2.3 ENVIRONMENTAL

Note: *Figures 2.3A to 2.3D at the end of this section may be referenced for Environmental discussions following.*

2.3.1 Methods

The following details Triton Environmental Consultants Ltd's (Triton) Study Methodology for the assessment which included an overview of site resources and the assignment of habitat sensitivities to fish and wildlife habitats within the study area. The assessment was comprised of 3 phases, namely a background information review, field reconnaissance, and an analysis of habitats considering the effects of proposed Bypass routing and construction on identified and potential fish and wildlife resources.

2.3.1.1 Background Information Compilation and Review

The collection and review of existing background information pertinent to the study area and regional fish and wildlife species and species use was part of the first phase of the project. Available environmental reports, databases and resource mapping for the study area including but not limited to forest cover maps, wildlife capability surveys, federal/provincial Fish Inventory Summary System (FISS) data, and consultants reports were acquired and reviewed. Aerial photographs, forest cover and topographic maps were reviewed. Staff from the Ministry of Environment, Lands and Parks (MoELP), the Department of Fisheries and Oceans (DFO), the City, members of the Log Train Trail Committee, and stakeholders familiar with the study area were interviewed in order to gather additional information. Lists of known occurrences of rare, endangered or threatened vertebrate species, plant species and plant communities were obtained from the MoELP Conservation Data Centre's (CDC) provincial database. This information was combined with Triton's local knowledge to provide a basis for the overview of resources sustained by the study area.

The review of background information, forest cover maps, topographic maps and aerial photographs allowed natural resource features of the study area to be pre-typed keying in on study area features such as topography, vegetation communities, water features and special habitat features. Field checking of pre-typed habitat polygons was conducted to provide a general description of the vegetation communities and physical characteristics of each habitat type which may be potentially affected by proposed alignment options.

2.3.1.2 Field Reconnaissance

Field reconnaissance was conducted July 10, 14 and August 11, 1997 in order to describe riparian corridors, forest stands and wetlands which may be affected by proposed bypass route options within the study area. The survey included a comprehensive description of physical features, vegetation and associated wildlife values. Attributes of each associated watercourse including: channel morphology, flow character, bank composition and stability, and substrate composition were described to provide background information and form a basis for habitat mitigation/compensation scenarios.

Additional field assessment included the verification of forest stand polygons delineated as part of the background information review. Forest polygons were field checked in order to provide a qualitative description of the wildlife resources sustained by the study area.

All field work was conducted by a two person crew. Transects were followed using compass bearings and general locations were determined using hip chain measurements. Typical habitat units were photographed. Plant species that define the community type were identified and cover classes were assigned based on visual estimates. Stand structure elements and the structural stage were recorded within forested communities and riparian zones. Other conditions (if applicable) that were recorded within the various assessment sites included:

- slope gradient, position and shape;

- special features (geologic, mineral licks, nest sites, etc.);
- surface water features;
- drainage patterns and flooding potential;
- wildlife trees;
- diameter-at-breast height tree measurements; and
- forage abundance and availability.

Evidence of wildlife utilization was recorded within each habitat unit and along transects. Evidence included but was not limited to direct observations, calls, tracks, game trails, scat, browsed and grazed vegetation, bones, feathers, nests, nest cavities and woodpecker holes.

2.3.2 Results

2.3.2.1 Overview of Background Information

Red and Blue Listed Species

Vascular plant and wildlife species of management concern are identified on provincial conservation status lists developed by B.C. Environment in conjunction with the Conservation Data Centre (CDC). The CDC ranking for wildlife species, plant species and plant communities includes two categories, the Provincial List and the Provincial Rank. The Provincial List utilizes a colour-coding system to rank the status and management priorities for species and communities at risk. The List includes Red-listed species, considered rare, endangered or threatened and Blue-listed species which are considered vulnerable. It should be noted that Provincial status does not infer legal responsibility for management or protection of species on the list. Following is a breakdown and brief description of the status criteria used in developing these lists.

Red-listed Species/Communities

Red-listed species are candidates for legal designation as threatened or endangered:

- Threatened Species - any indigenous species of fauna or flora that is likely to become endangered in British Columbia if the factors affecting its vulnerability do not become reversed.
- Endangered Species - any indigenous species of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its British Columbia range.

Blue-listed Species/Communities

Blue-listed species are considered to be vulnerable or sensitive and could become candidates for the red-list:

- Vulnerable Species - any indigenous species of fauna or flora that is particularly at risk in British Columbia because of low or possibly declining populations.

The CDC provided tracking lists of Red and Blue listed vascular plant and wildlife species that have been observed and recorded within the Port Alberni Forest District. Nine records of species of management concern were obtained from the CDC's main and botany databases.

From the CDC's main database, records included one Blue listed vertebrate species, the Vancouver Island Ermine (*Mustela erminea anguinae*). However, the recording of this species is historical and dated from the 1940's.

Plant species from the main database included a historical record (1916) of the Red listed branching montia (*Montia diffusa*) and a more recent record (1974) of the Blue listed California tea (*Psoralea physodes*). The CDC stated that the mapping precision of the area in which California tea was located is such that it has the potential to occur along the proposed east side bypass route. Species occurrences are mapped at

the 1:50,000 scale and recent entries are assigned UTM coordinates to verify their locations.

The botany database of “Extant and Historic (<1950) Rare Native Vascular Plant Element Occurrence Records for Port Alberni” includes 6 of the nine records obtained from the CDC. These records are not expected to occur within the study area, however, they and their siting locations have been included in Table I.

Table 1
Extant and Historic Rare Native Vascular Plant Element Occurrence Records
for Port Alberni, BC

Species	Listing	Year Collected	Locality
<i>Aster curtus</i>	Red	1983	Spruce Street, Port Alberni
<i>Castilleja ambigua</i>	Red	1975	Somass River Est.
<i>Githopsis specularioides</i>	Red	1996	4.5 km NE of downtown Port Alberni
<i>Githopsis specularioides</i>	Red	1982	Port Alberni Railway Trestle
<i>Lilaea scilloides</i>	Blue	1982	Somass Delta
<i>Mitella caulescens</i>	Blue	1983	Port Alberni

2.3.2.2 Overview of Information obtained from Stakeholders /Special Interest Groups

Interviews with stakeholders and special interest groups provided a wide range of information regarding the recreational use, fish and wildlife utilization, and potential habitat utilization within the study area.

Recreational values in the area of and surrounding the Log Train Trail which extends north and south of Burde Street appear to be high. The length of the trail is approximately 25 km and is used extensively by local hikers and tourists for bicycling, hiking, mushroom picking, bird watching, and a variety of other outdoor activities. A high number of wildlife observations have been made by local hikers

and include black bear, black-tailed deer, Roosevelt elk, cougar, and many species of songbirds, waterfowl and raptors. A pair of Barred Owls are believed to breed in the area between Dry Creek and two large wetland/pond complexes.

The two wetlands are currently the subject of a fisheries enhancement proposal to provide access for rearing coho salmon through existing beaver dams which act as upstream migration barriers. (Brian Tutty, DFO pers. comm.).

The Alberni Salmon Enhancement Society conducted a mapping and inventory program of Dry Creek which was proposed to be completed at the end of June, 1997 (Darrell Riggetts pers. comm.). Fisheries information from their inventory to date in mid June determined that the creek sustains fish throughout its length and provides habitat for coho salmon, and cutthroat and steelhead trout.

2.3.2.3 Review of Relevant Environmental Reports

A preliminary environmental assessment of a 58 ha proposed development site located north and south of Burde Street was conducted by D.A. Blood and Associates Ltd. for Saveway Forest Systems Ltd. (Ref.). Environmental features described for the site included two large wetlands (Redford (2 ha) and Detention (3 ha) ponds) and Dry (Owatchet) Creek. The wetlands included habitat features such as treed nesting islands for waterfowl and a number of wildlife trees (snags) along their banks. Beaver (*Castor canadensis*) dams occur at each wetland outlet resulting in ponding and high water levels. Riparian vegetation within the Dry Creek valley was confirmed as a second-growth conifer-deciduous stand with a well established, species rich understory consisting of both shrubs and herbs. This zone (Dry Creek riparian) provides a wildlife travel corridor, bank stability, erosion control, shading, and large woody debris. Wildlife observations from all three areas included but were not limited to four species of woodpeckers, twelve songbird species, eight waterfowl species, black-tailed deer, black bear, marten, beaver, Pacific treefrog and garter snakes.

2.3.2.4 Field Reconnaissance Results

Rogers Creek

Rogers Creek was characterized by channel widths of 16 to 20 m and a channel gradient of 2 percent. Channel habitat characteristics included a substrate comprised primarily of small and large cobbles and boulders with occasional gravel and silt. Crown closure was estimated at 50 percent. Instream habitats were described as runs and riffles with occasional deep pools. The right bank of the creek was extremely steep, consisting of a thin layer of unstable fine soil over bedrock. The left bank consisted mostly of fines and ravine slopes varied from gentle to steep. Water levels along these banks appeared to reach a maximum height of 1.5 metres. The valley width was visually estimated at 60 m, however measurements were difficult to determine due to impeding vegetation.

Within the gravel and cobble substrate two reds were apparent and juvenile salmonids were visually observed during the survey. Background information gathered for the project suggested that these fish were either coho salmon or steelhead trout.

Riparian areas were dominated by red alder (*Albus rubra*) and bigleaf maple (*Acer macrophyllum*) in the mature canopy with minor amounts of Douglas-fir (*Pseudotsuga menziesii*). Pacific yew (*Taxus brevifolia*) was also observed. Understory vegetation was well developed and dominated by sword fern (*Polystichum munitum*), oceanspray (*Holodiscus discolor*) and snowberry (*Symphoricarpus albus*). Other shrub species included red huckleberry (*Vaccinium parvifolium*), trailing blackberry (*Rubus ursinus*), red elderberry (*Sambucus racemosa*) and Pacific ninebark (*Physocarpus capitatus*). Common herb species were species included licorice fern (*Polypodium glycyrrhiza*), common horsetail (*Equisetum arvense*), wall lettuce (*Lactuca muralis*), cow parsnip (*Heracleum lanatum*), Pacific water-parsley (*Oenanthe sarmentosa*), maiden hair fern (*Adiantum pedatum*), sweet-scented bedstraw (*Galium triflorum*), ladyfern (*Athyrium filix-femina*) and Cooley's hedge-nettle (*Stachys cooleyae*).

Wildlife observations along the steep right bank included a deer trail that extended down to the creek. Along this trail a deer kill, likely from a cougar, was observed. The scent of another kill was evident along the trail.

Tributary A

Tributary A drains into Rogers Creek and extended upstream for approximately 80 to 100 metres where it begins as a stormwater outfall. It was a narrowly confined tributary with a 1 to 2 m channel width and substrates comprised of angular gravels and large boulders. Riparian vegetation was moderately developed with Douglas-fir comprising the main canopy species. Understory species consisted of salmonberry, stink currant (*Ribes bracteosum*), sword fern, bracken fern (*Pteridium aquilinum*), Hooker's fairybells (*Disporum hookeri*), and youth-on-age (*Tolmiea menziesii*).

Wolf Creek

Wolf Creek expressed a variable channel ranging from 2.0 to 15.0 metres. Gradients were typically low. Substrates consists of fines and gravels. Bank height ranged from 0.5 to 0.75 m and consisted of fine textured soils. Beaver dams and ponds with well established instream vegetation were present along Wolf Creek within the study area. Woody debris within the creek was present but never common. Two back channel pools were observed adjacent to the right bank within 10 to 15 metres of the creek. Slough sedge was the most common vegetation within the pools, and skunk cabbage occurred occasionally. One juvenile salmonid was observed within the creek. Coho salmon have been observed along the entire length of Wolf Creek up to it's headwaters (Judy Hillaby - Fisheries Consultant, pers. comm.).

Young to mature red alder and mature Douglas-fir dominated both banks of the creek resulting in 70 percent crown closure. Mature Douglas-fir dominated the forest within 10 m from the creek. Some young bigleaf maple, grand fir, Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) were also present. The understory layer of the right bank was low to moderately developed with sword fern the most prevalent species. Other species included trailing blackberry, red

huckleberry, salal (*Gaultheria shallon*), bracken fern, common horsetail, youth-on-age and grasses. Skunk cabbage (*Lysichiton americanum*) was somewhat common within the creek and along both banks. The left bank understory was well developed with a dense layer of salmonberry (*Rubus spectabilis*) and sword fern. Sweet scented bedstraw, lady fern, trailing blackberry, licorice fern, pacific nine bark and grasses also occurred along the left bank.

Instream vegetation was comprised of floating-leaved pondweed (*Potamogeton natans*), hedgenettle, water parsley, skunk cabbage, bulrush (*Scirpus* spp.) and cascara (*Rhamnus purshiana*).

Wolf Creek Headwaters

Two sites were assessed at the mapped location of the headwaters of Wolf Creek. The first site was located 137 m south of Burde Street immediately adjacent to the Saveway Forest Systems Ltd. Development boundary road and the second site was located approximately 287 m south of Burde Street. Habitats were typically ephemeral wetlands with no defined channel. The immediate area surrounding the wetland was composed of hardwood logging slash including bigleaf maple and red alder. A forest canopy within the riparian zone was not well developed but included red alder (5-10 percent forest cover). Juvenile maple trees were present growing on residual tree stumps. Shrubs and herbs included salmonberry, sword fern, lady fern, hardhack (*Spiraea douglasii*), water parsley, buttercup (*Ranunculus* spp.), bulrush spp., trailing black currant (*Ribes laxiflorum*), Himalyan blackberry (*Rubus discolor*) and trailing blackberry.

Dry Creek

Dry Creek was characterized by a steep sloped ravine composed of bedrock walls. Ravine slopes were comprised of bedrock and fines and some slumping and unstable slopes were observed. Channel width ranged from 6 to 9 metres and instream habitats were described as runs and riffles with intermittent deep bedrock pools and boulder riffle complexes with step pool habitats. Stream substrates included cobbles and

boulders with some exposed bedrock. Gradients ranged from 3 to 5 percent. Large organic debris was estimated at 10 percent within the channel. Fish species observed included juvenile cutthroat trout within pools and side channel areas.

Riparian vegetation was composed of mature Douglas-fir, bigleaf maple, red alder and some western redcedar. The conditions of the forest canopy allowed a well established understory to develop consisting of salmonberry, ocean spray, salal, sword fern, lady fern and common snowberry. Riparian herbs were very diverse and included licorice fern, maidenhair fern, wall lettuce, sweet-scented bedstraw, Cooley's hedgenettle, marsh skullcap (*Scutellaria galericulata*), three-leaved foamflower (*Tiarella trifoliata*), youth-on-age, lady fern and hooker's fairybells.

Upstream portions of Dry Creek, located at the most easterly proposed road crossing, were typified by steep embankments and forested slopes. Instream substrate were comprised of cobble/boulder complexes with intermixed gravels. The creek was partially confined with the left bank consisting of a bedrock wall and the right bank flat for 15 m from the creek before extending into a forested slope. The channel widths were 8 to 10 m and stream gradient was 5 percent. Bank height ranged from 0.25 to 1.5 m and consisted of bedrock on the left bank and fines on the right bank. Riffle habitat types were most common, however bedrock/cobble pools were also present. Crown closure over the creek was 50 to 60 percent.

Direct fish observations were not made at this site, however, approximately 15 to 20 adult fish were observed within a large pool 314 m downstream and no fish barriers were apparent between the two locations.

The mature riparian canopy was predominantly bigleaf maple with lesser amounts of Douglas-fir. Western redcedar and western hemlock were observed in the subcanopy. The understory maintained a high species diversity and was composed of both shrubs and herbs. These species included sword fern as the dominant understory species as well as a mix of salmonberry, red huckleberry, stink currant, foamflower, vanilla leaf (*Achlys triphylla*), western trillium (*Trillium ovatum*), hedgenettle, trailing

blackberry, broad-leaved starflower (*Trientalis latifolia*), sweet-scented bedstraw, youth-on-age, maidenhair fern, licorice fern, lady fern and a variety of grass species.

Tributary I

Tributary I forms a confluence within the upstream section of Dry Creek. The creek was confined with slope gradients of 60 percent on the right bank and 130 percent on the left bank. The width between these slopes was estimated to be 60 metres. The creek sustained a 2.5 m channel width with a bedrock/boulder/cobble substrate. Runs and riffles were the dominant habitat conditions and small pools existed but appeared rare. Bank heights consisted of exposed bedrock or bedrock covered in a layer of fine soil. Coarse woody debris within the creek was estimated at 15 to 20 percent. A 3 to 4 m fall was located 75 m downstream of this site, 25 m upstream from the confluence with Dry Creek. The fall is expected to impede the passage of fish to upstream sections of this tributary.

Riparian vegetation was composed of mature bigleaf maple associated with young to mature Douglas-fir. The canopy provided a crown closure estimated at 75 percent, thus providing substantial shading to the creek. Both slopes to the creek sustained a high abundance of sword fern indicating rich soil conditions. Maidenhair fern, sweet-scented bedstraw, dull Oregon grape (*Mahonia nervosa*), red huckleberry, vanilla leaf, foamflower, broad-leaved starflower, licorice fern and sedges were interspersed throughout the understory layer.

Wildlife observations included an adult black bear located within 20 m from the creek site. The bear did not appear to leave the area as it was observed on two separate occasions (2 hour interval). Deer trails were common within the area of the assessment and further downstream.

Tributary J

Tributary J drains from the south into the upstream portion of Dry Creek. Two falls approximately 4 to 5 m in height were located 48 m upstream on Tributary J. These

falls are suspected barriers to anadromous fish. At the assessment site where the third bypass route/stream crossing has been proposed, the creek substrates were a complex of boulders, cobbles and gravels and the gradient of the creek was measured at 3 percent. Stream bank heights ranged from 0.25 to 0.5 m and both banks were similarly composed of fines with traces of imbedded gravels. The slopes on either side of the channel had a smooth to rolling humped topography. Valley width was estimated at 50 metres, but was difficult to ascertain. Channel width was 4 m. Run and riffle habitats dominated the creek, with few pools. Large woody debris was uncommon. Crown closure was high (70%) providing optimal shade conditions over the creek.

Riparian zones were comprised of a mature Douglas-fir canopy. An occasional bigleaf maple was present along the creek. Subcanopy tree species were also predominantly Douglas-fir with some western redcedar. The understory layer was well established and exhibited high species diversity. It was typified by herbaceous species but shrub species were also common. Common herbs were sword fern and vanilla leaf. Other herbs included sweet-scented bedstraw, foamflower, bracken fern, maidenhair fern, sedges and grasses. The shrub layer included salmonberry, red huckleberry, oceanspray, common snowberry, dull-Oregon grape, trailing blackberry and twinflower (*Linnaea borealis*).

Tributary K

Tributary K drains into the downstream portion of Dry Creek. The assessment site location was at 425 m upstream from the road/stream crossing on Hillgrass Road. The channel of this creek was quite narrow with a width of 2.0 m. Boulders, small and large cobbles and bedrock were the predominant substrates forming boulder, riffle/run fish habitats. Stream gradient was 3 percent. The confining stream banks consisted of fines, gravels and boulders. The right slope held a 50 percent slope gradient, the left slope was 35 percent and the valley width was visually estimated to be 40 m. Vegetation on these slopes was well developed, exhibited high species diversity and provided optimal bank stability.

Mature Douglas-fir was abundant on both slopes within the riparian zones. Red alder was occasionally observed within this canopy. The subcanopy layer was underdeveloped consisting of western hemlock and some red alder. Each slope exhibited well established understory layers with high cover values for both herbs and shrubs. Herbaceous species included those common in nutrient rich soils high in organic material. The most abundant herbs included sword fern and vanilla leaf. Other species were wall lettuce, mountain sweet-cicely (*Osmorhiza chilensis*), western trillium, sweet-scented bedstraw, foamflower, maidenhair fern, bracken fern and youth-on-age near stream banks. Shrub species were predominantly red huckleberry, twinflower, black twinberry (*Lonicera involucrata*) with traces of salal, salmonberry, trailing blackberry, evergreen huckleberry and stink currant.

Ship Creek

Ship Creek is located near the south end of the study area. It drains in an east/west direction into Port Alberni Inlet. At the time of the survey, water levels were extremely low. Within the study area, Ship Creek had a low gradient with substrates predominated by cobbles and gravel with occasional boulders and patches of fines. Pools were common along the banks of the creek and undercut banks were observed intermittently. Instream vegetation was estimated at 15% and overstream vegetation was abundant (30-50%). The riparian canopy was comprised predominantly of broadleaf maple and red alder. Riparian shrubs included salmonberry, black twinberry, and trailing blackberry. Herbs were abundant and included common horsetail, skunk cabbage, water parsley, reed canarygrass, creeping buttercup and wall lettuce.

Fish species presence and utilization of Ship Creek has not been recorded with the study area. An ongoing fish presence study within Port Alberni being conducted by the Port Alberni Salmon Enhancement Society may clarify the use of Ship Creek by fish species.

2.3.3 Conclusions and Recommendations

Fish and wildlife resources that will be potentially affected by the construction of the Bypass include fish and riparian habitats at stream crossing locations, wildlife habitat and movement, rare vegetation and soils. The proposed Alberni Valley East Side Bypass will require the clearing of second growth forested habitats and stream crossings at major streams (Dry and Rogers creeks) and minor streams and tributaries.

Instream construction activities have the potential to impact aquatic communities by affecting water quality, and by the disturbance of aquatic habitats directly through physical alteration or indirectly through the generation of suspended sediments and their subsequent deposition on fish habitat. Encroachments with the Fisheries Sensitive Zone (FSZ) as defined in the "Land Development Guidelines for the Protection of Aquatic Habitat" (Chilibeck, 1993), are considered impacts by the environmental agencies. Impacts to habitats which support fish populations or supply food or water to fish bearing streams require adherence to the Department of Fisheries and Oceans (DFO) "no net loss" fish habitat policy. It will therefore be imperative that design options endeavour to minimize the extent of direct and indirect impacts to the FSZ through proactive design and construction planning.

Bypass routing has the potential to affect wildlife and their habitats both directly and indirectly. Impacts include stress due to increased human access, habitat alteration and destruction, the creation of barriers to wildlife movement and direct mortalities. Appropriate planning which will include construction scheduling and the implementation of mitigation measures will help alleviate the impacts to critical wildlife habitats.

2.3.3.1 Major Stream Crossings

The proposed Alberni Valley East Side Bypass will require the crossing of two large stream systems, namely Dry and Rogers creeks. Prior to the design of crossing structures, detailed habitat inventories should be conducted at each stream crossing location to determine the most appropriate crossing structure option. Crossing

structure selection will be constrained by local topography, fish habitat, fish use and the potential for increased sedimentation.

Crossing of Dry Creek west of the Saveway development property and Rogers Creek will likely be constrained by local topography. Both Dry and Rogers creeks are fish bearing to points upstream of the study area. These creeks are canyonized, creating the need for crossing structures that minimize the need for large fills within the top of bank area and stream flood plain. Bridge crossing structures will likely be required at these locations. Use of bridges will minimize impacts to fish habitat within the canyon and will minimize requirements for habitat mitigation and compensation. Bridge designs should endeavour to minimize endfills and avoid impacts to salmonid spawning habitats should a pile supported structure be considered. Habitat mitigation will likely be restricted to the planting of riparian vegetation impacted by endfills for freespan structures. Bridge drainage designs should intercept stormwater flows and direct them to treatment systems prior to discharge into the flood plain of Dry or Rogers Creek.

Alignment route options should endeavour to cross these creek sections at narrow canyon sections. At present, the northernmost alignment option indicates crossing of a minor, steep tributary (Tributary A) at approximately 0+400m. Locating crossing locations upstream or downstream of this area on Rogers Creek would eliminate the need to infill this small stormwater drainage tributary. Although fish do not use this drainage, it does contribute water and fish food to Rogers' Creek immediately downstream. The preferred option would be to locate the beginning of the Bypass either east or west of its present location.

A proposed crossing of Dry Creek along the eastern alignment option may be topographically constrained resulting in the need for a bridge structure. Should a culvert crossing be considered, the maintenance of fish passage and minimization of impacts to salmonid spawning habitat will need to be addressed in project designs. Adult fish were observed immediately downstream of this site and barriers to fish passage were not observed from the observation point to the proposed crossing point.

Crossing structures should endeavour to maintain existing spawning habitat and to minimize impacts to fish and riparian habitat within the Fisheries Sensitive Zone.

2.3.3.2 Pond Wetland Complexes

Two large wetlands with important fish and wildlife habitat values were identified within the Saveway Forest Systems Ltd. Development property. Proposed routing options will likely bypass these habitats, therefore direct impacts to fish, wildlife and their habitats are not expected in the pond/wetland area. Should proposed alignments directly affect habitats within the ponds, the development of habitat mitigation and compensation schemes will need to be considered.

A small watercourse which drains the easternmost pond will require crossing under one of the proposed alignment options. Crossing options should be designed which will allow for access to juvenile salmonids. As the juvenile salmonids are more sensitive to gradient barriers than adult fish, crossing structures should consider fish passage as a primary constraint. Crossing options at this location (2+400) will require an impact assessment and an analysis of habitat losses and gains prior to approval by environmental agency personnel.

2.3.3.3 Wolf Creek

Proposed alignments may require either crossing Wolf Creek at 2+100 and again immediately upstream at 2+400 or the crossing of Wolf Creek at 2+100 and continuing parallel to the east side of the upstream reaches of Wolf Creek, including its headwaters from 2+300 to 3+100. Both of these options will require detailed habitat impact assessments to determine the loss of fish habitat from crossing structures, or from encroachment into the Fisheries Sensitive Zone as defined by the Land Development Guidelines (15 m from top of bank or high water mark). Stream crossings will be required to maintain fish passage as coho salmon have been observed as far upstream as it's head waters.

Extensive fills may be required for parallel options resulting in unmitigable impacts. Environmental agency personnel will require a detailed accounting of habitat losses and likely require habitat compensation if impacts are realized. Although the upstream portions of Wolf Creek may not sustain fish population, they are considered valuable for their water and fish food inputs. Proposed alignments which parallel Wolf Creek should be located as far from the top of bank of the creek as possible. Retaining structures along the toe of slope of proposed earthworks may need to be considered. Extensive mitigation should be expected for options which require relocation of Wolf Creek. Erosion and sediment control measures will need to be adequately designed and strictly adhered to during construction in these locations.

2.3.3.4 Other Stream and Tributary Crossings

A number of other stream and tributary crossings will be required along the East Side Bypass route including Tributary I (tributary to Dry Creek), Tributary J (tributary to Dry Creek), Tributary L and Ship Creek (southern end of study area). Crossing options along these streams and tributaries are not likely constrained by topography as they are not contained within gullies or canyons. Tributaries I and J likely do not sustain fish species at their crossing locations as a result of barriers to fish passage in the form of falls, located downstream of proposed crossing locations. Tributaries K and L likely do not sustain fish near crossing locations or adjacent to the proposed alignment. These systems do however contribute water and nutrients to downstream fish bearing systems. A more detailed inventory to determine the presence or absence of fish will ultimately drive designs for crossing structures. Sound design planning will endeavour to maintain fish passage and to minimize impacts to real or potential fish habitat. Detailed bio-inventories at each location will likely be a requirement of the environmental agencies to quantify habitat impacts and to determine fish use at each location and immediately downstream.

Ship Creek potentially sustains fish populations within the study area. Fish use within the study area will need to be determined prior to the approval of stream crossing structures. As the creek is not constrained by topography, crossing structures

that maintain fish passage and minimize impacts to fish habitat with the FSZ will be required for Ship Creek.

2.3.3.5 General Design and Construction Considerations

In general, highway design and construction should be guided by the “Land Development Guidelines for the Protection of Aquatic Habitat” (Chilibeck 1993). The provincial Ministry of Transportation and Highways has developed environmental design and construction guidelines, for roadways some of which are outlined below. Prior to the design of final earthworks and road grades, bio-inventories of fish habitat and detailed impact assessments will be required for crossing locations to determine habitat losses and gains. A heron/raptor nest survey, following MoELP survey protocols, will be required along the final alignment option to ensure that nests are not directly impacted by proposed construction.

2.3.3.6 Erosion and Sediment Control

Erosion control measures that include both permanent and temporary structures should be incorporated at the earliest practical time in the construction phases of the project. Temporary measures should be applied on a site specific basis, as necessary during construction.

Large cut and fill areas should attempt to minimize slope length which will require extensive treatment to control erosion and sediment runoff. Detailed designs for long cut and fill slopes may require cross ditching, the control of runoff by permanent and strategically placed rills and flow interception structures to decrease runoff velocity.

2.3.3.7 Clearing and Grubbing

Clearing and grubbing should extend only to the designated limits of the project area. If possible, ground disturbance should be minimized in the vicinity of watercourses. Clearing and grubbing within the designated FSZ should proceed only upon authorization from appropriate environmental agency personnel. MoELP will likely request that clearing and grubbing operations take place outside of the bird nesting

season (May-July) to avoid impacts to nesting birds along the ultimate alignment. It is an offence under the provincial Wildlife Act to disturb birds in the act of nest building or to disturb nests with eggs or fledglings.

FIGURES 2.3A – 2.3D LEGEND

HIGH (H):

Fish and wildlife habitats that sustain or have the potential to sustain significant fish and wildlife values. Impacts should be avoided or mitigated through sound design and route selection. Specific habitat types may require habitat compensation if impacts are unavoidable during construction.

Habitat Types:

Pond/Wetland Complexes: Identified as sustaining high wildlife values. Also potential habitat for coho salmon rearing. Proposed routes should endeavor to avoid direct impacts to these habitats.

Major Creek Crossings (Rogers, Dry, Wolf): These streams sustain populations of coho salmon and cutthroat trout. They are characterized by deep ravines with valley widths greater than 100 m from top of bank to top of bank. Crossing locations will require route options that minimize impacts to riparian vegetation and flood plain areas. Culvert designs, which would require excessive filling, will likely not be approved by environmental agency personnel. Habitat compensation will be required for impacts to the flood plain (footings) and riparian vegetation impacts.

MEDIUM (M):

Fish and wildlife habitats which sustain wildlife and biodiversity values or site characteristics that make them sensitive to disturbance. Sound design and construction practices should be sufficient to mitigate impacts to these habitats.

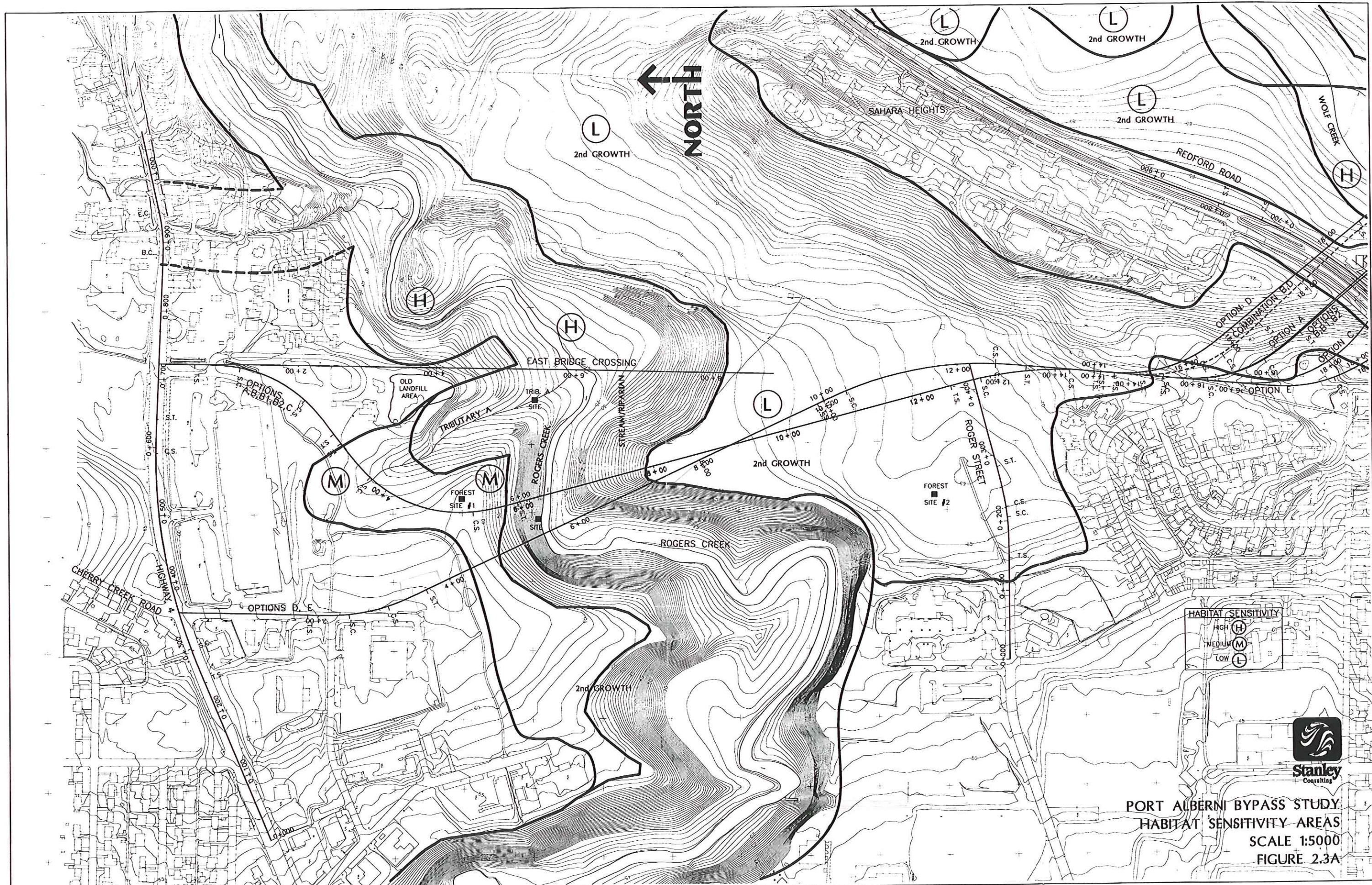
Habitat Types:

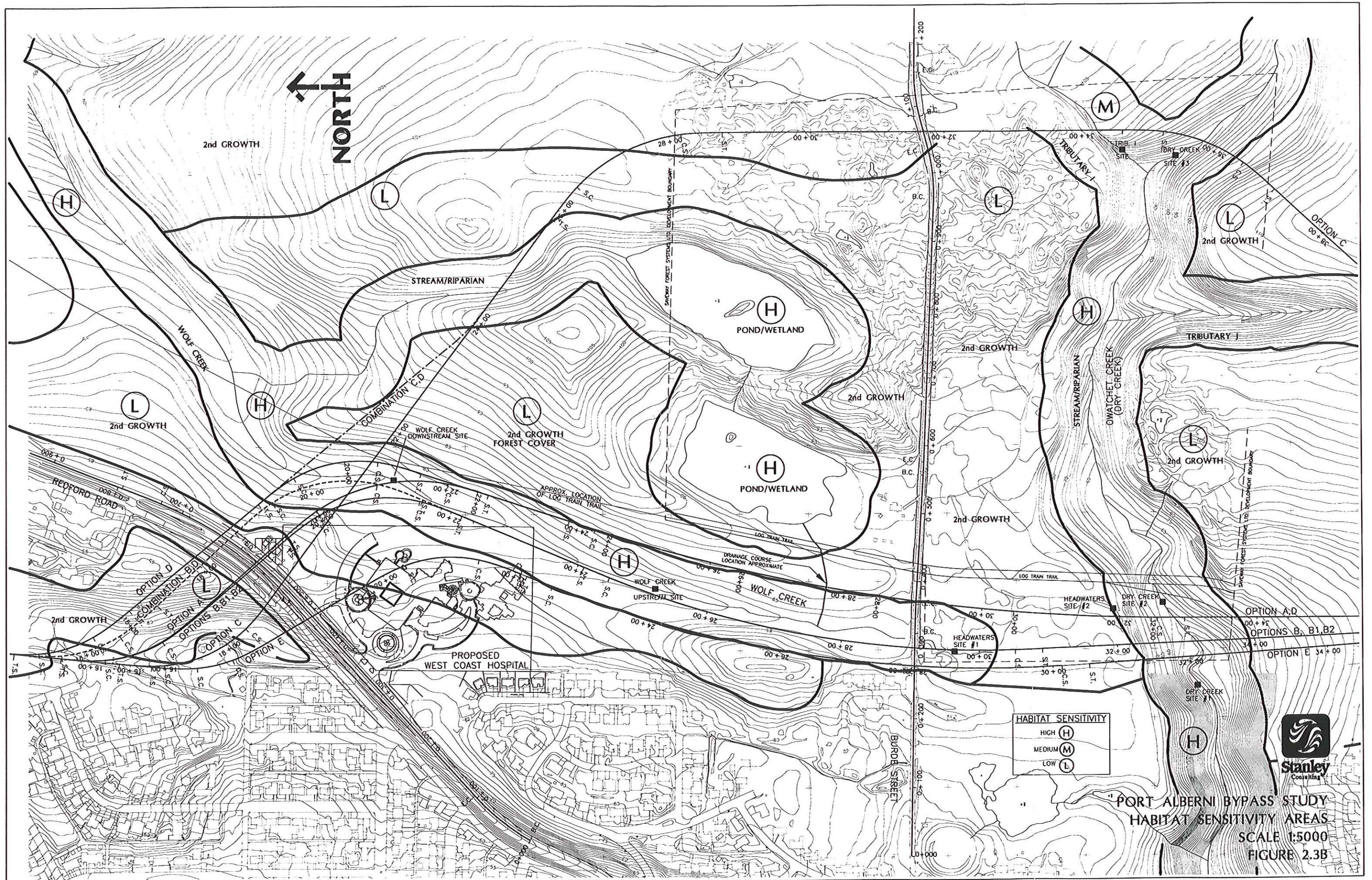
Creek and Tributary Crossings: Crossings of smaller creeks, tributaries and ephemeral channels that likely do not sustain fish at proposed crossing locations. These systems have value as they contribute nutrients and fish food to downstream areas. Streams also function as wildlife corridors for small and large mammals. Culvert design options could be considered at these locations. Environmental agency personnel will require minimization of impacts through design mitigation, habitat restoration and potential habitat compensation.

Forested Habitats: Second growth forested areas were represented by mixed canopy, nutrient rich, fresh to moist sites. Abundant shrub and herb cover provides habitat for wildlife species. Forested stands on flatter grades exhibited evidence of strongly fluctuating water tables, suggesting soils may be saturated during winter periods. Forest stands on steeper grades may require excessive cut and fill. Bypass designs should endeavour to maintain natural drainage. An MoELP heron/raptor nest survey should be conducted prior to selection of final route corridors.

LOW (L):

Habitats which do not sustain significant fish and wildlife values. Bypass design should follow MoTH Environmental Design and Construction guidelines to minimize impacts to fish and wildlife habitat.









HABITAT SENSITIVITY	
HIGH	(H)
MEDIUM	(M)
LOW	(L)



PORT ALBERNI BYPASS STUDY
 HABITAT SENSITIVITY AREAS
 SCALE 1:5000
 FIGURE 2.3D

2.4 GEOTECHNICAL AND HYDROLOGICAL

Note: *Figures 2.4A to 2.4D at the end of this section may be referenced for Geotechnical and Hydrological discussions following.*

AGRA Earth & Environmental Limited conducted a review of the geotechnical and hydrological conditions within the study area. The following summarizes the results of investigative work.

2.4.1 Feasibility of Proposed Creek Crossing

2.4.1.1 Rogers Creek

The proposed crossing at Rogers Creek is considered geotechnically feasible. Setback distances, potential depth of pilings and detailed bridge design for the crossing will require general and more detailed geotechnical investigations of soil, rock and groundwater and the provision of specific recommendations.

Steep bedrock and colluvial slopes in exposed, weathered rock indicate that the long-term stability of abutment locations may be a key factor in determining the optimal crossing location and engineering design. Bedding in sedimentary rocks underlying the area is generally shallowly dipping, but has developed steep slopes along the creek canyon walls.

2.4.1.2 Dry Creek

The proposed crossing is considered geotechnically feasible at the location indicated in the optional route plans. As with the Rogers Creek crossing, investigation of geotechnical conditions, especially the long-term stability of the valley slopes, will need to be assessed. Geotechnical issues to be addressed will include: establishment of setback distances for abutments, bearing capacity and settlement of abutments and foundations and stability of potential cuts.

The proposed middle alignment nearest the log train trail, while having a narrower canyon, may require a bridge of similar length to the westernmost crossing. This is because of the near vertical south canyon walls. Crossing of Dry Creek at a higher point in the reach may allow a simple fill and culverting approach to be used instead of construction of a bridge. Terrain and drainage requirements would be significant considerations should this alternative approach to the crossing be adopted.

2.4.2 Cut And Fill Areas

2.4.2.1 Cut and Fill in Surficial Deposits

Surficial deposits of various types, including compact till, sand and gravel and gravelly clay occur extensively across the area. Some deposits of till are expected to be upwards of 3 m to 4 m thick. This material will be excavated and potentially placed as fill where required, e.g. south of the new hospital and towards the south end of the proposed alignments. Cuts in these materials are anticipated to be simple and easily managed.

It is expected that the majority of the excavated materials can be used as general fill, but some of the tills, particularly the very gravelly or cobblely tills and finer grained tills, may not be suitable for fill without additional processing.

2.4.2.2 Cut and Fill in Bedrock

In the event that the eastern route alignment (near the reservoirs) is selected, significant cuts into bedrock should be anticipated for the southernmost section adjacent to the two reservoirs north of Ship Creek. A till mantle of 1 m thickness and perhaps greater, occurs over bedrock in this area. Preliminary visual observations indicate that joint orientations in bedrock appear to be favourable for the relatively steep cuts needed to maintain the proposed 6% grade in this section. Confirmation of overburden thicknesses and rock discontinuities critical to establishing stable cut slopes would require additional geotechnical investigation.

In the event that serious consideration is given to the eastern route (involving significant rock cuts), it would be prudent to conduct preliminary geotechnical exploration at an early stage to determine the nature and condition of the cut materials.

2.4.3 Potential Borrow Areas

2.4.3.1 Sand and Gravel Deposits

Glacial and post-glacial sand and gravel deposits are present along the proposed alignments. The post-glacial sand and gravel deposits are predominantly confined to active stream channels and, thus, are essentially inaccessible for construction purposes. Preliminary geotechnical assessment of the various optional routes suggests that the quantities of these materials are very limited. Consequently, it is unlikely that adequate amounts of these materials can be procured from along the alignment(s) for use as road sub-base. These and additional sources of borrow should be identified.

2.4.3.2 Till And Other Surficial Materials

It should be stressed that the fine grained glacial tills are moisture sensitive. Therefore, for practical construction, their use as general engineered fill for road embankment construction could be limited to the drier summer months and a contractor knowledgeable in handling fine grained soils and till soils. Moisture conditioning (i.e. drying /wetting) should be expected if the till is to be reused.

2.4.4 Hydrological Conditions

2.4.4.1 Creeks And Surface Drainage

The major creeks (Rogers and Dry Creeks) along the proposed alignments were discussed in previous sections. Other small streams and poorly drained areas and swamps along the alignments have been identified (refer to Geotechnical Constraints Plan). The smaller creeks can likely be accommodated by the placement of fill and

installation of appropriately sized culverts following standard engineering practices (i.e. B.C. Highway Engineering Design Manual).

Immediately south of the proposed hospital site, a stream known informally as Wolf Creek has been identified as a fisheries sensitive zone (FSZ). The crossing of this stream and installation of culverts, therefore, must follow all applicable guidelines for the protection of sensitive habitats (Refer to the Land Development Guidelines for the Protection of Aquatic Habitat, 1993).

Lakes and swamps can be generally avoided by the proposed routes, however, swampy areas of varying dimensions can be expected to be encountered along sections of the alignment. Soft soils and organic material in these areas may require excavation or specific fill prescriptions. Preservation of wetland areas and natural drainage courses should be a priority when considering fill options. Extensive use of culverts is anticipated for these areas.

2.4.5 Potential Geological Hazards

2.4.5.1 Slope Instabilities/Potential Landslides

Review of small scale (1:20,000) aerial photographs and observations made during the site inspection did not reveal any large bedrock or surficial slope instabilities along the proposed alignments. Instances of slope ravelling and shallow slope movements in surficial soils and on colluvium covered bedrock slopes were evident at the two main creek crossings.

2.4.5.2 Earthquakes

Historic earthquakes are known to have affected the Port Alberni area, such as the 1946 M 7.3 event, suspected to be linked to movement on the nearby Beaufort fault. Potential ground accelerations should be accommodated in the design for all bridges and structures.

A peak ground acceleration of 0.231 for the 10% probability in 50 years earthquake is estimated for the Port Alberni area based on acceleration factors provided by Natural Resources Canada, Pacific Geoscience Centre.

2.4.5.3 Other Hazards

Severe flooding in Rogers Creek and Dry Creek channels is expected over longer time scales (50 to 100 years). Seasonal high water and flooding will need to be considered when investigating locations for footings or pilings within stream channels or valley bottoms, if required.

2.4.6 Conclusions

- Based on preliminary site geotechnical reconnaissance, the crossings of Rogers and Dry Creeks appear to be geotechnically feasible. Further detailed geotechnical exploration, assessment and design is required at both crossings.
- Crossing Dry Creek at a point higher in the reach can be considered as an alternative to a bridge crossing lower in the drainage course.
- No major slide areas were identified from aerial photographs or by site reconnaissance.
- Cuts within surficial materials are expected to be of limited extent and relatively conventional. A potentially significant cut in bedrock in the south may be expected if the eastern route alignment (near the reservoirs) is selected. Based on a cursory inspection, joints and fractures appear to be favourable to steep cuts.
- A site geotechnical reconnaissance has not been conducted over much of the eastern route.
- Sand and gravel deposits, suitable for general fill and possibly as a source for sub-base, occur in the centre and southern sections of the proposed alignments,

although in limited quantities. A complete assessment of aggregate resources has not been conducted.

2.4.7 Recommendations

The following recommendations are presented based on the preceding information:

- subsurface exploration, assessment and analysis should be carried out at the proposed bridge crossings to determine a suitable setback for the abutments and to provide geotechnical parameters for design;
- in the event that the eastern alignment (near the reservoirs) of the southern portion of the route is selected, or given serious consideration, subsurface exploration, assessment and analysis should be carried out to determine the nature and condition of the cut materials, and to determine cut stability requirements;
- geotechnical exploration and assessment should be conducted along the preferred alignment to determine the nature and condition of the subsoils and ground water along with the potential for reuse of materials. Recommendations should be provided for pavement design; and
- a sand and gravel borrow source study should be conducted to establish appropriate and viable sources of road aggregate.



NEAR PROPOSED HOSPITAL
- PROMINENT RIDGE IN RNE ORIENTATION
- APPEARS TO BE WEATHERED TILL OR OUTWASH DEPOSITS
- CHECK SUBSOIL CONDITIONS NEAR THE HOSPITAL TO CONFIRM
- APPROXIMATELY 25-30% (TOP 10m); GRADUALLY DECREASING TO LEVEL AT BASE
- NO EVIDENCE OF SIGNIFICANT SLOPE MOVEMENT

GENERAL COMMENTS
- NO INDICATIONS OF POTENTIAL STABILITY PROBLEMS
- RELATIVELY STEEP CUTS THROUGH SOIL PROBABLE
- ANTICIPATE RELATIVELY STEEP CUTS CAN BE ACHIEVED IN THIS AREA

NEAR SPCA
- ENCOUNTERED FILL (END APPROXIMATELY AT ROAD CROSSING; INCLUDES TRIBUTARY)

GENERAL COMMENTS
- FILL MAY REQUIRE REMOVAL

ROGERS CREEK - SOUTH BANK
- STEEP BANK BEGINS APPROXIMATELY 50m FROM CREEK
- FIRST 10-15m APPROX. 30° (BEDROCK SURFACING)
- BROKEN SUB ANGULAR ROCK FRAGMENTS
- NEAR VERTICAL FOR 5m
- TOP 10m APPROX. 40°-45°
- NUMEROUS SUB ANGULAR AND SUB ROUNDED COBBLES AT SURFACE

GENERAL COMMENTS
- LARGER SET-BACKS MAY BE REQUIRED ON THE SOUTH BANK

BETWEEN TRIBUTARY AND ROGERS CREEK
- BOGGY AREAS

GENERAL COMMENTS
- SIGNIFICANT FILL MAY BE REQUIRED FOR CROSSING

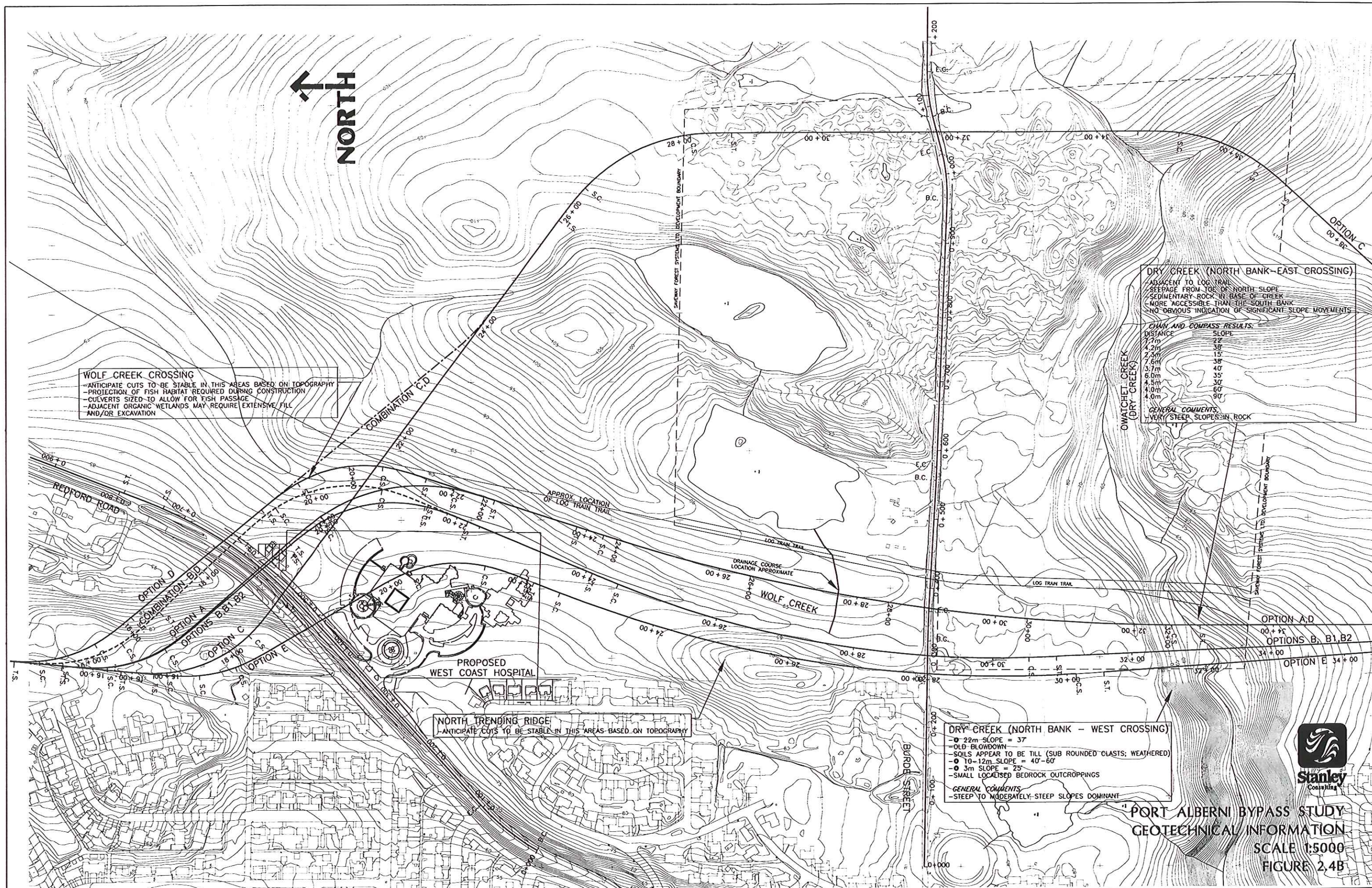
ROGERS CREEK
- BASE OF CREEK VALLEY WIDE AND FLAT
- SEDIMENTARY BEDROCK EXPOSED IN STREAM BANKS
- IGNEOUS COBBLES AND Boulders IN STREAM BASE
- OCCASIONALLY FLOWING NEAR THE BASE OF THE STEEP SLOPES FURTHER
DOWNSTREAM AND UPSTREAM OF THE PROPOSED CROSSING LOCATIONS

GENERAL COMMENTS
- GOOD FOUNDATION CONDITIONS FOR PIERS

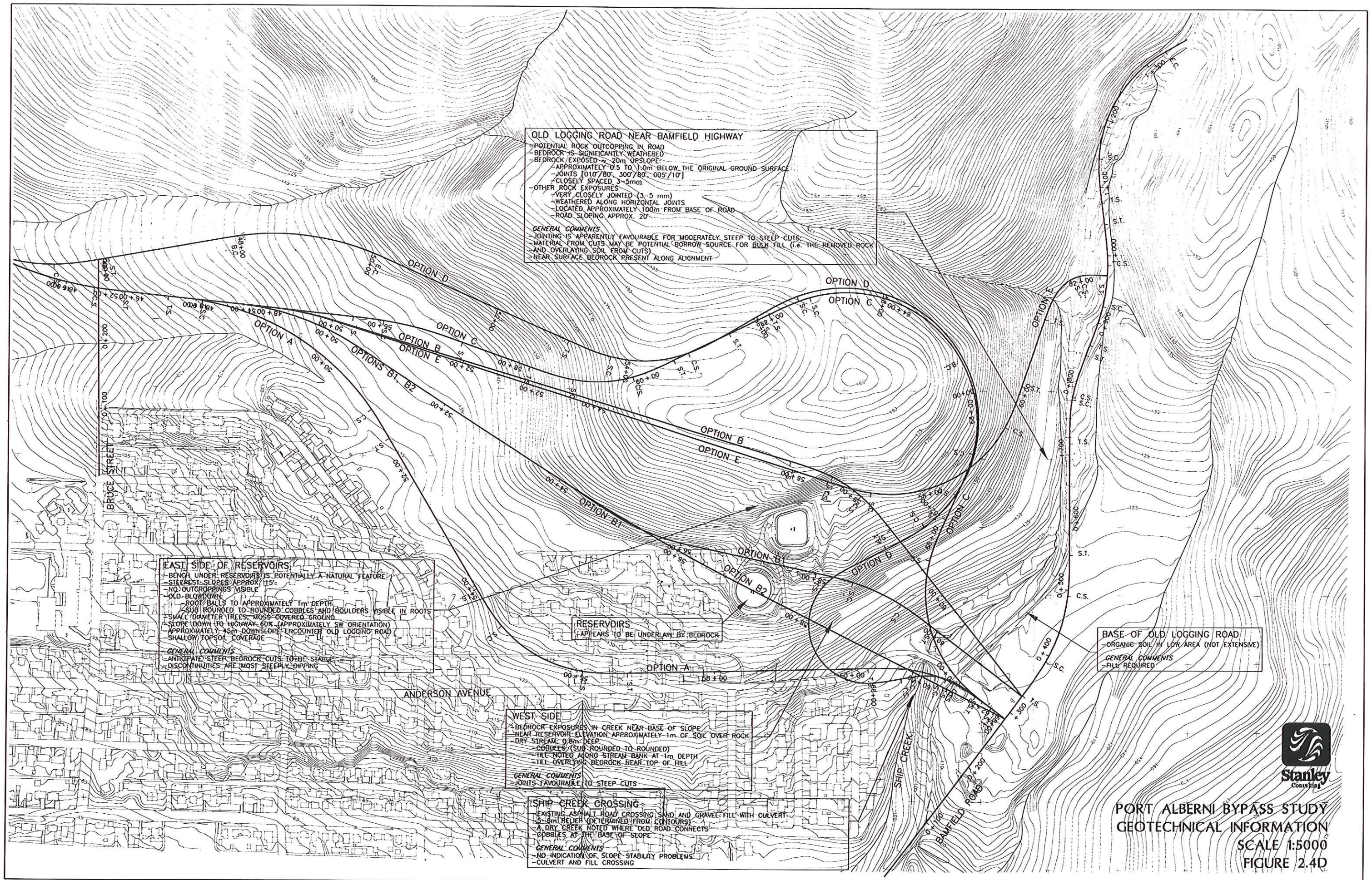
ROGERS CREEK - NORTH BANK
- 9m SLOPE = 28°
- UPPER SLOPE IN WEATHERED TILL
- 15.4m SLOPE = 38-40°
- HIGHLY WEATHERED SEDIMENTARY ROCK AT BREAK IN SLOPE (BOTTOM OF THIS PORTION)
- 28m SLOPE = 45-47°
- 10m SLOPE = 39-45°
- JOINT SETS
- MODERATELY DIPPING (032°/55° - 0.05m SPACING)
- NEAR VERTICAL (220°/80° - 0.025 - 0.05m SPACING)
- SHALLOW (043°/08° - 0.025 - 0.05m SPACING AND 3-10m SPACING)

GENERAL COMMENTS
- MODERATELY STEEP TO STEEP SLOPES; ROCK WITH COLLUVIAL VENEER
- LONG TERM STABILITY ASSESSMENT REQUIRED









Note: *Figures 2.5A to 2.5D at the end of this section may be referenced for Heritage discussions following.*

2.5.1 Introduction and Background

The following outlines the results of an Archaeological Overview Study conducted by The Bastion Group Heritage Consultants of Duncan, BC.

An Archaeological Overview Study "...is intended to identify and assess archaeological resource potential or sensitivity within a proposed study area. Recommendations concerning the appropriate methodology and scope of work for subsequent inventory and/or impact assessment studies are also expected" (from B.C. Archaeological Impact Assessment Guidelines, B.C. Archaeology Branch, Min. of Small Business, Tourism and Heritage). An archaeological overview study normally involves documentary research and consultations with local First Nations groups and individuals. A field reconnaissance component is also often included.

2.5.2 Scope and Nature of Archaeological Overview Study

The scope of the archaeological overview study included the following tasks and activities:

- a detailed review of both published and un-published archaeological and ethnographic reports relating to First Nations history and culture in the Alberni Valley area;
- a search of the Provincial Archaeological Inventory records, maintained by the B.C. Archaeology Branch in Victoria, for information regarding previously documented archaeological sites in the Port Alberni area;
- consultations with representatives of the Tseshaht and Opetschesaht First Nations at Port Alberni to make them aware of the proposed bypass project and to obtain

information regarding any documented "traditional use" areas that might be present within the proposed bypass corridor;

- consultations with staff at the Alberni District Historical Society Archives, as well as the Port Alberni Museum, regarding possible records of archaeological sites or other cultural heritage sites or features within the bypass corridor;
- a meeting with Mr. Frank Stini of the Log Train Trail Society; and
- a one day field reconnaissance of the bypass corridor to assist in determining areas which may have archaeological site potential.

Prior to initiating the above tasks, information regarding the nature and location of the proposed bypass project was reviewed. This included a set of detailed route plans, various descriptive information and a verbal outline by means of a Project Team meeting.

2.5.3 First Nations Context and Archaeological Site Potential

As indicated in the introductory section, the proposed bypass project lies within the traditional aboriginal territory of the Tseshah and Opetschesah First Nations of Port Alberni. More specifically, the bypass route lies within so-called overlapping traditional territories of these two groups in that both have registered land claims that encompass this area. The Tseshah are said to have moved to the Port Alberni area "comparatively recently", while the Opetschesah are said to be "longtime residents of the Alberni Valley" (McMillan and St. Claire, 1982). However, for the purpose of the present study, we strongly recommend that any future consultations between the proponents and/or planners of the bypass project with local First Nations groups, include both the Tseshah and the Opetschesah, regardless of the validity of either group's claims to traditional use and occupation. We also note that both of the First Nations contacted, expressed a keen interest in the proposed bypass project and indicated that they wished to be directly consulted about the project, as planning progresses.

From information obtained from our review of archaeological and ethnographic literature pertaining to the Alberni Valley area, both the Opetschesaht and the Tseshaht have maintained villages and seasonal camps within the Alberni Valley. These have been situated primarily on large water bodies such as Alberni Inlet, the Somass River and Sproat and Great Central Lakes. Smaller camps and temporary occupation sites were situated away from water and at higher elevations in association with various inland natural exploitation activities such as hunting, plant gathering, berry picking and various forest utilization practices. The proposed bypass corridor does not contain any areas which are associated with known village or camp sites, nor are there any documented archaeological sites along the present alignment route and no archaeological deposits were observed during our brief field reconnaissance in mid August. It should also be noted that no archaeological sites have been documented for any location within the Alberni Valley with corresponding geophysical attributes to the proposed highway corridor. This may be a result of the general lack of systematic archaeological inventory work in areas away from lakes, rivers and tidewater where the majority of documented archaeological sites occur. However, it may also be a reflection of the nature of archaeological resources in higher elevations which tend to be small and widely distributed over large areas as well as the lack of systematic field inventory work in these areas.

Assuming that the proposed bypass corridor did not support any permanent village or large encampments during pre-historic times (pre-European contact times), what sorts of archaeological, or other physical remains of cultural activity might be expected? Undoubtedly the area was utilized for its forest resources. In particular, cedar trees would have been utilized for bark, wood for the construction of dwellings, canoe manufacture and a host of other uses. Bark stripping, plank removal from living trees and dug out canoe trees can be identified from "cultural modification" scarring. The remaining scarred trees and "aboriginal logged stumps" can be identified by means of a systematic examination of remaining cedars and/or old stumps. Culturally Modified Trees (CMT's) are the most common aboriginal heritage feature found by archaeological field workers in coastal areas of B.C., today.

Other, more obscure physical evidence of past land use and/or occupation within the bypass corridor include buried archaeological deposits associated with ancient (Holocene period) beach terraces from a time when sea levels were higher than at the present time. A limited number of such sites have been found on the Queen Charlotte Islands and at other locations in coastal British Columbia, dating to around 8-9,000 years ago. There is some potential for such sites to be found along the proposed bypass in areas adjacent to streams which bisect old beach deposits at elevations of around 15 to 25 meters above present sea level. Finally, there may be evidence within the bypass corridor of traditional First Nations trapping activity. This would be in the form of the remains of dead-fall traps.

2.5.4 Archaeological Potential Areas

A set of plans for the proposed Bypass route have been provided with this report on which have been plotted a number of areas that are deemed to have archaeological site potential. Most of these areas correspond to terrace systems or ridges which are associated with stream crossings or which occur near wetlands or small lakes. All such areas should be subjected to a "detailed archaeological assessment" level field examination prior to finalizing preliminary and detailed design plans. This work would need to be carried out under a Permit, issued by the B.C. Archaeology Branch, and should be carried out in consultation with the two local First Nation groups. The nature and scope of this work should include the following:

- a detailed archaeological ground examination of all existing ground and sub-surface exposures;
- additional systematic examination of sub-surface deposits, by means of soil probe and shovel tests at 3 - 5 meter intervals within all archaeological potential areas; and
- "evaluative test excavations" within the boundaries of any archaeological site that may be found in the course of the above procedures.

The above work must be carried out prior to any clearing and grubbing work within the bypass corridor. It is also recommended that eventual grubbing and other ground altering activities that may be associated with the construction stage of the project in areas which have been deemed to have a high potential for buried archaeological deposits be monitored by a qualified archaeologist in order to facilitate additional inspection of sub-surface deposits.

Although the proposed bypass corridor contains very little evidence of first-growth timber, particularly red cedar stands, and no CMT's were observed during our August field reconnaissance, it is our opinion that there is some potential for culturally modified trees to be present within the highway corridor. It is therefore recommended that a detailed examination be made of mature trees within the right-of-way, with particular attention paid to red cedar trees, prior to any clearing activity.

2.5.5 Conclusions and Recommendations

We have indicated that the proposed Port Alberni East Side Bypass project does not conflict with any presently documented archaeological site locations or known aboriginal traditional use areas. However, we have indicated that some sections of the Bypass corridor contains areas which are deemed to have a potential for containing buried archaeological remains. There is also a potential for finding culturally modified trees within most of the corridor, as presently proposed. A detailed archaeological impact assessment project should be carried out within selected corridor sections as indicated on the Heritage figures at the end of this section prior to the clearing and grubbing stage of project development. The scope and nature of the impact assessment project should follow that outlined in the B.C. Archaeology Branch's Archaeological Impact Assessment Guidelines.

With regard to the various bypass route options as presently conceived (at the south end of the project and in the centre portion), the most easterly alignment is preferred in each case from an archaeological potential impact point of view since this routing removes the Bypass from a series of terrace systems at lower levels which have archaeological site potential.

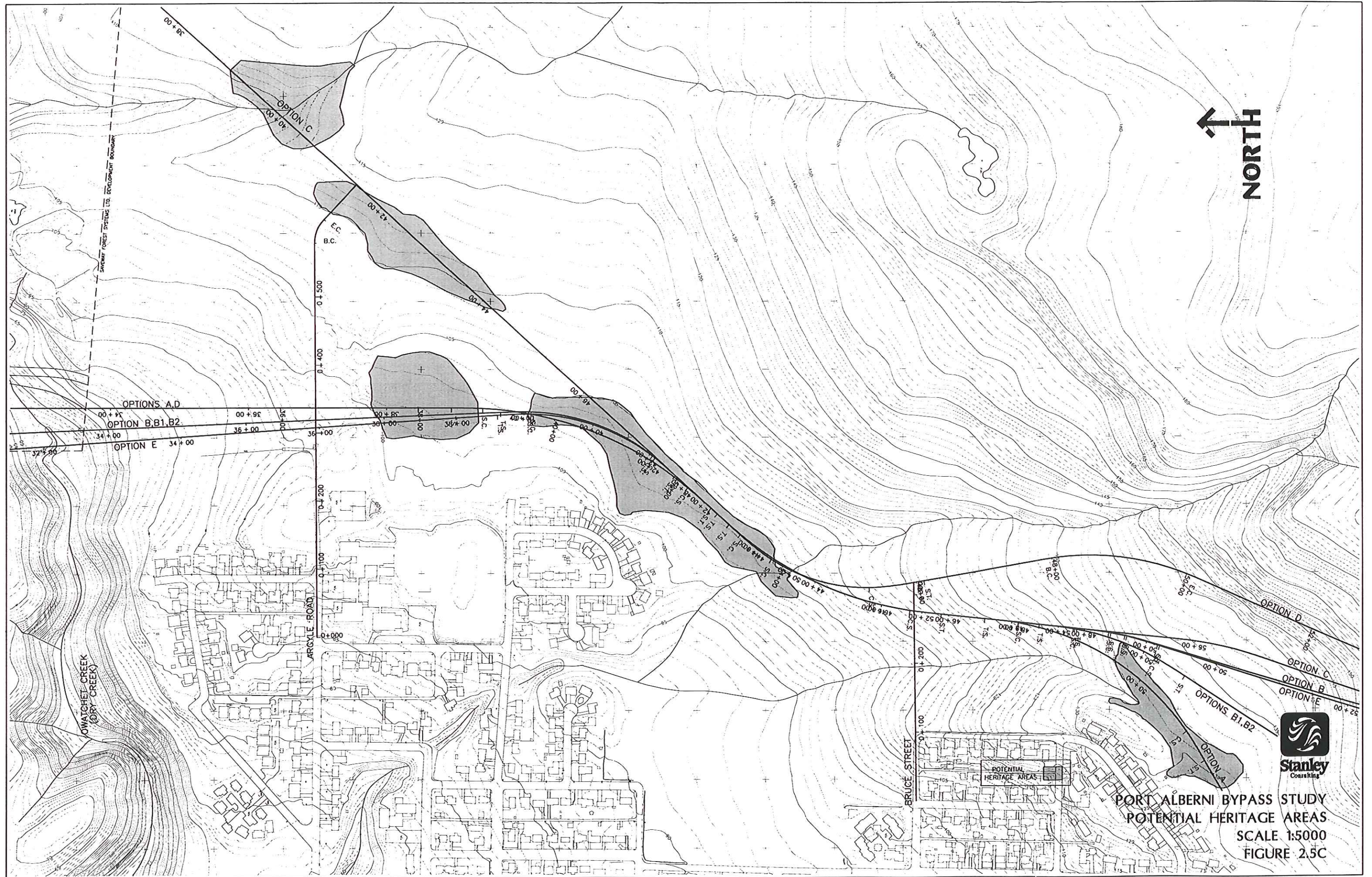
The two Alberni Valley First Nations groups, the Opetschesaht and the Tseshaht Indian Bands, should be fully consulted during the ongoing planning, design, and construction process for the bypass project. Both groups have expressed a keen interest in the project and have requested separate information meetings regarding the proposed bypass as it evolves.



PORT ALBERNI BYPASS STUDY
POTENTIAL HERITAGE AREAS
SCALE 1:5000
FIGURE 2.5A







PORT ALBERNI BYPASS STUDY
POTENTIAL HERITAGE AREAS
SCALE 1:5000
FIGURE 2.5C

2.6 UTILITIES

Drawings developed during this study were submitted to the applicable utility authorities to obtain input regarding potential impact. Typically, utility authorities require Functional or Detailed design level drawings in order to accurately assess relocation requirements. These design levels were not within the scope of this assignment. However, feedback was received from the following authorities:

2.6.1 BC Hydro

All optional alignments traverse the major transmission power line extending between Redford Road and Highway No 4. Mapping used for the study identified the transmission line but individual towers were not located. Therefore, it has been assumed that at least one transmission tower would require adjustment. An alternative would be to adjust the preferred alignment during the Functional and Detailed Design phases as necessary. **Field survey and detailed design should be completed as part of proposed developments to accurately assess the preferred Bypass alignment and cross section requirements.**

Other BC Hydro facilities may be impacted in the vicinity of Burde Street. Local adjustments to toes may be required to avoid existing facilities. Relocation of poles may also be necessary.

2.6.2 Centra Gas

Centra Gas operates a 3 inch distribution line along Highway No 4. Relocation of this line will depend upon detailed cross section requirements. It is assumed that relocation will be necessary.

A main transmission crossing exists at the Centra Gas station near Redford Road. All optional alignments will impact the line. It is assumed that line protection will be required due to the proposed fills in this area.

The preferred alignment is located with sufficient clearance to the Centra Gas station near Redford Road to avoid relocation of the station.

A 3 inch distribution line also exists in the vicinity of Redford Road. It is assumed this line will be relocated.

2.6.3 BC Tel

No information was received from BC Tel; however, it is anticipated that all affected lines can be relocated. An estimated cost for relocation has been considered in the Engineer's estimate; **Appendix A.**

2.6.4 City Utilities

City utilities are identified and discussed in following sections of this report.

2.7 DESIGN CONSTRAINTS AND ISSUES

Note: Figures 2.7A to 2.7D at the end of this section may be referenced for Road Alignment Option discussions following.

An inventory of design constraints and issues was completed during the early stages of this study. Environmental, heritage, geotechnical, hydrographic and topographic constraints were compiled and summarized in the preceding. These constraints were considered during the generation of Bypass alignment options and during the evaluation process.

The following is a summary of major design issues associated with generation of optional alignments reviewed in this study:

2.7.1 Highway No. 4 to Redford Road

The extension of the Bypass north of Highway No. 4 (Johnston) was outside the scope of this study. However, the location of the Highway No. 4/Bypass intersection was influenced by the existing service function of Cherry Creek Road immediately north of Highway No. 4. Cherry Creek Road may be characterized as a residential local road and; therefore, would not be compatible with the Bypass road class. The social impact to existing residents would be significant if the Bypass were aligned with the existing Cherry Creek Road. Therefore, optional intersection locations were reviewed east of the mall at Broughton Avenue.

Agricultural lands north of Highway 14 will be affected whether the Bypass is located on the west or east side of the mall. If located west of the mall, additional right-of-way will be required to accommodate the Bypass and a potential frontage Road. If located east of the mall, the Bypass will sever a small triangle of agricultural land, however, the need for a frontage Road is eliminated.

There would be a significant impact to businesses west of the mall if the Bypass were located west of the mall. The existing road corridor would have to be widened and indirect access developed (direct access is undesirable).

Road alignments north of the Highway No 4 were not detailed in this study.

Optional locations of a bridge crossing at Rogers Creek was influenced by the topography and geology of the area. Work completed by N. D. Lea during 1980 provided the basis for the preferred bridge location. The bridge location was also affected by the presence of an old landfill site located just south of the animal shelter facility. It was noted that a bridge crossing directly south of the Alberni Mall would be shorter than alternative locations to the east because of topography.

Options on the west side of the mall will require a longer bridge crossing. The only way to overcome this would be to introduce two sharp reverse curves for substandard design speeds.

Various utilities including the BC Hydro power line (between Redford and Highway No. 4) and the Centra Gas "gate station" affected the alignment options. An effort was made to cross the BC Hydro power line (towers) at an angle which would reduce the impact to the line. The base mapping used in this study did not accurately locate all power line towers; therefore, the cost estimate includes provision for moving/adjusting one tower.

2.7.2 Redford Road to Owatchet Creek (Dry Creek)

It is desirable to establish the angle of intersection between two roads as close to 90° as possible. This reduces the conflict areas inherent with all at-grade intersections. Reduction of these areas improves traffic operational characteristics and reduces the probability for accidents to occur. Therefore, horizontal alignments at Redford were influenced by the desire to establish good intersection geometry.

The proposed West Coast Hospital on Redford Road was considered to be "in place" (construction was described as imminent). Bypass alignment options near the Hospital site were influenced by the location of the main Hospital access. The distance between the main access and the Redford/Bypass intersection is critical to ensure acceptable operational characteristics. Also, environmental mitigation features

were required at this location due to the proximity of the Hospital and the adjacent Wolf Creek.

Some of the road alignment options at Redford Road are routed through an existing residential property. These alignments were established to ensure adequate clearance between the Centra Gas “gate station” north of Redford Road as well as ensuring adequate clearance between the Hospital and the Bypass. Alignments east of the residential properties encroach on the Log Train Trail south of Redford Road.

Stanley also reviewed an alignment option for consideration by the City of Port Alberni in the event that the Hospital construction does not proceed. The road alignment can be improved and the impact on Wolf Creek can be reduced in the event the hospital does not proceed, therefore, the City should review the preferred alignment in this report (combined B, D Option; Figure 2.7B) in the event that hospital construction does not take place.

The Log Train Trail extending northward from approximately the east terminal of Argyle Street northward to Redford Road was considered to be a valuable heritage feature. Bypass alignment options were influenced by the location of this trail.

Wolf Creek is considered to be a “High” sensitive area; however, it is feasible to mitigate the impact on this creek by westerly road alignment options. This would be accomplished by reconstructing the creek and incorporating extensive mitigation features (i.e. re-build the stream).

Saveway Forest Systems Ltd. initiated an application for preliminary approval of a major residential subdivision. The proposed subdivision along Burde Street is illustrated on **Figure 2.7B**. While efforts were made to minimize disruption to this subdivision, the controlling constraints in this area were environmental in nature as well as proximity to existing development.

All alignments were influenced by the presence of two ponds north of Burde Road. These ponds are considered to be “High” sensitive areas. The small watercourses

extending northward from the easterly pond is also consider a High sensitive area. Therefore, optional alignments on the east side of the Saveway Forest Systems Ltd Development would require open bottomed culverts (arch pipes) or bridges.

Westerly bridge crossings at Owatchet Creek (Dry Creek) were of similar cost for all applicable road alignment options. Crossing options to the east also involved "High" sensitive areas; therefore, encroachment into riparian zone of the stream would not be accepted. In other words a bridge structure would be required. It was noted that an easterly bridge crossing near Arrowsmith Heights would be longer than near the Log Train Trail crossing.

2.7.3 Owatchet Creek (Dry Creek) to Bruce Street

Building construction was underway at the east end of Argyle Street (built up limit). This construction influenced the location of the Argyle/Bypass intersection. It would have been desirable to locate the intersection further south due to the grade leading southward from Owatchet Creek (Dry Creek). However, this would have involved an intersection on a horizontal curve, therefore, the intersection is located on a steep grade just south of the horizontal curve.

Streams in this area were generally avoided or crossed at approximately 90°. Also there was an attempt to locate the Bypass with a wide green space buffer between existing residential properties and the Bypass corridor.

Generally there are few design constraints in this area.

2.7.4 Bruce Street to the Bamfield Road

Topographic constraints north of Bamfield Road (south terminal of study) presented a major constraint for establishing reasonable road geometry. A number of options were reviewed in this area as shown in **Figure 2.7D**.

Design criteria for the Bypass road class includes a maximum grade of 6%. Therefore, it was necessary to establish alignments options which presented

evaluation tradeoffs between construction cost, intersection proximity along the Bamfield Road, achievement of Bypass objectives related to desired travel pattern.

The evaluation section of this report provides more detail about the attributes of each alignment option considered in this area.



PORT ALBERNI BYPASS STUDY
ALIGNMENT OPTIONS
SCALE 1:5000
FIGURE 2.7A







PORT ALBERNI BYPASS STUDY
ALIGNMENT OPTIONS
SCALE 1:5000
FIGURE 2.7D

2.8 MAJOR BRIDGE CROSSINGS

2.8.1 Rogers Creek Bridge Crossing

2.8.1.1 Site Conditions

The proposed westerly alignments of the Rogers Creek Crossing are close together, so the site description would apply to either alignment. The East Bridge Crossing Alignment (noted on **Figure 2.7A**), was also considered, however as the bridge crossing was significantly longer (520 m), this alternative was not considered further as a possible alignment for structures.

Rogers Creek is situated in a deep, steep sided valley. Heavy vegetation exists on the slopes, consisting of a mixture of bush, deciduous and coniferous trees. The north bank is quite steep, approximately 2H:1V at alignment option A and approximately 1H:1V at alignment option B. The south banks are less steep, approximately 3H:1V at both alignments. The distance between valley edges is approximately 230 m at the roadway profile for alignment A - C and 310 m at the roadway alignment D and E. The valley is approximately 30-35 m deep at the roadway profile. At each alignment there is a flatter area between the creek and the toe of the south slope.

The N. D Lea & Associates Report dated June 1980 indicates sandstone bedrock at up to 12 m. deep at the tops of the slopes and 6 m. or less at the creek level.

2.8.1.2 Structure Considerations

Because of the steep valley north side, piers on the slope would be very difficult and expensive to construct. The flatter area south of the creek could accommodate a pier. Access for pier construction is attainable from the south side. The large trees on the banks and approaches would have to be removed to accommodate the structure.

There are really only two alternatives for span consideration; a single span across the entire valley, or a two span structure with a pier close to the south slope toe. Because

of the long span from the north bank to south of the river, there would not be a significant benefit to provide more, shorter spans on the south side.

Further structural considerations are based on a two span structure as a single span structure will cost significantly more than the two span alternative.

The bridge would be designed to CAN/CSA S6-88, Design of Highway Bridges, or the new edition of the Canadian Highway Bridge Design Code which is due to be published in the spring of 1998. Seismic design would be in accordance to the Code and ATC-6, Seismic Design Guidelines for Highway Bridges.

2.8.1.3 Structure Alternatives

Following are possible structure alternatives with a discussion of each alternative.

- a) Culvert - A culvert could result in an economical crossing, but environmental and fisheries considerations rule out this choice. With 2H:1V side slopes, the total fill width at the valley bottom would be approximately 140 m. to 150 m. This would destroy much of the trees, etc. and is not environmentally acceptable. The structure of this length would not be tolerable on a fish bearing stream.
- b) Cast-in-place Concrete Girders - This type of construction is normally an economically competitive type of structure, however would not likely be competitive for this high a structure. The falsework on the steep slopes would be difficult and expensive to construct, as well as requiring major disturbance of the slopes which would not be environmentally desirable
- c) Precast Concrete Girders - Because of the weight of the long girders required, handling and erection of this type of a girder would not make this alternative feasible.
- d) Precast Concrete or Cast-in-place Concrete Segmental Girders - Construction of this type of structure would be feasible and would be economical if constructed in

conjunction with the Owatchet Creek crossing. Utilizing the forms and erection equipment available from other past projects would add to the economy.

- e) Structural Steel Girders - Because of the long spans and lighter weight of steel construction, this would likely be the most practical and economical structure type. The steel girders would be completed with a concrete deck for the roadway. Another advantage of the lighter steel structure is that it could be assembled on the valley sides and launched across the valley. This would not require any temporary supports in the valley slopes for girder splices. As the structure is on a tangent and constant grade, this method of construction is very feasible.

2.8.1.4 Construction Costs

Further design on the various alternatives to refine construction cost comparisons is beyond the scope of this report. Structure costs are based on unit costs of recently constructed similar types of structures on the Inland Island Highway. Further study to determine the cost comparison of structure types to make a selection could be done at a future stage.

The costs are based on a roadway width of 21.2 m out to out of barriers. This is comprised of a .4 m wide outside barrier, a 1.5 m outside shoulder, and two 3.7 m lanes on each side plus 2.6 m in the center for shoulders and a median barrier.

Based on a current unit cost of \$1600/sq/m., the resulting cost is \$7.8 M for alignments A - C and \$10.5 M for alignment D and E. This should be considered within an accuracy of +/- 25% at this stage.

2.8.2 Owatchet (Dry) Creek Bridge Crossing

2.8.2.1 Site Conditions

The proposed alignments A, B, B2, D and E of the Dry Creek Crossing are close together, so the site description would apply to either alignment. Alignment C, far to the east, was also considered, however as the bridge crossing was significantly longer

(360 m), this alternative was not considered further as a possible alignment for structures.

Dry Creek is situated in a valley that is similar to Rogers Creek, except the side slopes are not as steep. The distance between valley edges is approximately 220 m at the roadway profile for alignment A and D and approximately 240 m at the roadway profile for alignment B - B2. Road fill are considered at the south end to shorten the bridge length. The north bank is approximately 1.5H:1V at the both alignment options. The south banks are much less steep, approximately 4H:1V at alignment option A and D and approximately 2H:1V at alignment option B - B2. At each alignment, there is a flatter portion at the floor, approximately 60 m to the south of the creek. The valley is approximately 30 m deep at the roadway profile for each alignment.

There is no indication of the geotechnical makeup of the foundation material, however it is reasonable to assume the conditions would be similar to those at Rogers Creek.

2.8.2.2 Structure Considerations

Because the valley slopes are much shallower than for Rogers Creek, it is feasible to construct piers on the slopes, so a multi-span structure with shorter spans would be the most economical.

2.8.2.3 Structure Alternatives

Following are possible structure alternatives with a discussion of each alternative.

- a) Culvert - As for Rogers Creek, a culvert structure would be long, resulting in major fill in the valley and would not be a feasible alternative.
- b) Cast-in-place Concrete Girders - This type of construction is normally an economically competitive type of structure, however would not likely be competitive for this high a structure. The falsework on the slopes would be

difficult and expensive to construct, as well as requiring major disturbance of the slopes which would not be environmentally desirable

- c) Precast Concrete Girders - With a shorter, multi-span structure, this alternative would be economically viable.
- d) Precast Concrete or Cast-in-place Concrete Segmental Girders - Construction of this type of structure would be feasible and would be economical if constructed in conjunction with the Rogers Creek crossing. Utilizing the forms and erection equipment available from other past projects would add to the economy.
- e) Structural Steel Girders - This alternative would be economically comparable with a precast or segmental structure.

2.8.2.4 Construction Costs

Further design on the various alternatives to refine construction cost comparisons is beyond the scope of this report. Structure costs are based on unit costs of recently constructed similar types of structures. Further study to determine the cost comparison of structure types to make a selection could be done at a future stage.

The costs are based on a roadway width of 21.2 m out to out of barriers. This is comprised of a .4 m. wide outside barrier, a 1.5 m outside shoulder, and two 3.7 m lanes on each side plus 2.6 m. in the center for shoulders and a median barrier.

Based on a current unit cost of \$1200/sq/m., the resulting cost is \$5.6 M for alignment A and D and \$6.1 M for alignment B - B2. This should be considered within an accuracy of +/- 25% at this stage.

3.0 PLANNING & DESIGN CONSIDERATIONS

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3.0 PLANNING & DESIGN CONSIDERATIONS

3.1 PLANNING AND STUDY OBJECTIVES

The City's Official Community Plan (OCP) dated October 1993 contains general planning objectives for transportation infrastructure within the City of Port Alberni:

- To provide the citizens of Port Alberni uniform levels of infrastructure service in a cost effective manner;
- To provide the highest possible quality of services, public safety and convenience of travel, within financial constraints; and
- To plan infrastructure installation in a manner to accommodate anticipated growth and development within the city with consideration of future expansion.

In addition to general infrastructure objectives, specific transportation policy statements are contained in Section 3.2 of the OCP. Map 8 in this section of the OCP also provides a concept plan for future major roads in the Port Alberni area. Work contained in this study complies with the specified policy statements and the long term road network plans.

The City of Port Alberni evolved from two separate communities; Alberni (North Port) and Port Alberni (South Port). Rogers Creek is a natural barrier to travel between these areas. North/south travel is currently accomplished by bridge crossings at Victoria Quay, Gertrude Avenue, and Redford Road (via Maebelle). While the capacity of these crossings will likely continue to accommodate the vehicle travel demand (Reference: N. D. Lea Report – Study of Major Road Crossing of Rogers Creek), it is evident from discussions with stakeholders that a strong desire exists to improve the mobility across Rogers Creek. The Alberni East Side Bypass (Bypass) would provide a bridge over this barrier; thereby, improving north/south travel mobility.

It should be noted that the existence of two central business districts (CBD), North Port and South Port, can be seen as part of a positive community planning strategy that is sought after by some other communities in British Columbia. Two CBD's limits total travel distance within the City and encourages travel by other modes such as bicycles. The introduction of a bridge at 10th Avenue would address the majority of travel pattern desires (Reference: N. D. Lea Report – Study of Major Road Crossing of Rogers Creek); however, the potential long term affects on the two CBD's should be considered in more detail. The financial performance of the network should be reviewed giving consideration to multiple accounts.

Construction of a Bypass bridge (21st Avenue) across Rogers Creek does not preclude construction of a bridge at 10th Avenue (or visa versa). Construction of the Bypass bridge rather than the 10th Avenue bridge may produce better network financial performance. Further analysis would be required to confirm this.

An ideal road network is comprised of a hierarchy of road classes. Each road class is intended to serve a specific purpose (specific part of a trip). The highest road classes such as freeways, expressways, parkways, and arterials are intended to provide a high degree of travel mobility. Local residential streets, lowest road class, are intended to provided a high standard of land access. Collector roads provide an equal weighting of importance to mobility and land access. Logically, road classes are connected together in a manner which provides a balance between mobility and land access within a community. The proposed Alberni Valley East Side Bypass location along the east boundary of the City conforms to a desired spatial distribution for arterial streets/parkways.

The interconnection and route continuity of various types of road classes are indicators of road network efficiency and overall safety. Incompatible uses of roads increases the traffic accident rate and increases travel costs to road users. For example, a local residential street should not serve as a link forming part of a City bypass route with an intended service function of high mobility. Therefore, it is important for the City to protect the long term road network plan in order to avoid

situations where there is no choice but to incorporate incompatible road uses within the road network. It should be noted that Bypass route options at the Bamfield Road terminal have already been compromised by development and topographic constraints.

The desired road class for the Alberni Valley East Side Bypass is an **Arterial**. Its primary road service function is to provide a high standard of mobility for road users between various areas within the City. The Bypass would logically connect to:

- higher road classes such as the proposed Highway No. 4 bypass around the north end of the City (major arterial, parkway, expressway);
- equivalent road classes such as Redford Road (arterial); and
- lower road classes such as Burde Road (collector).

Land access should be achieved indirectly by providing a limited number of intersections with collector class roads. Direct land access should be discouraged in order to preserve the intended service function of the Bypass.

The desirable road classification characteristics for the Bypass would be as follows (Reference: Transportation Association of Canada, U.A - 15):

- Primary service function is to facilitate traffic movement.
- The traffic flow character would favour mobility by employing partial access control.
- The design would facilitate a relatively large volume of vehicles (up to 20,000 vpd). Large trucks would be accommodated.
- The traffic flow would be characterized by uninterrupted flow except at signalized intersections.

- The average running speed would favour mobility with a posted speed of 60 km/h. The design speed will be 70 km/h.
- The ideal interconnectivity with the existing City road network would be via arterial and collector cross roads. Intersection spacing would be 400 m or greater.
- Express and local transit buses would be accommodated. Bus bays (3.0 m) would be employed at bus stops.
- Separate cycling paths would be desirable; however, lane widenings would be incorporated at intersections or other areas where separate paths are not feasible.
- Sidewalks will be provided in the vicinity of intersections and along high pedestrian traffic areas. Separate pedestrian pathways are desired at other locations.
- On street parking would not be provided.

The right-of-way width would typically be 30 m to 40 m except at locations where additional rights-of-way are needed to facilitate the design (e.g. intersections).

It should be noted that assumptions have been incorporated into this study with regard to specific road classes for connecting roads. A formalized road classification plan was not available for this study.

3.2 DESIGN CRITERIA

The City's design manual (City Engineer's Standards) indicates that "special" designs are required for major roads. Therefore, design criteria for the Bypass has been established using typical design standards and practice. It is understood that the criteria adopted for the Bypass may set a precedent for other similar arterial roads within the City.

Design components for roads can be grouped into road system features:

- Longitudinal features (vertical and horizontal alignment);

- Cross sectional features (cross slopes, ditch widths, superelevation etc.);
- Intersections (channelization, turning radii, control devices etc.);
- Interchanges (ramps, types, etc.); and
- Roadside features (park & ride stations, tourist information centres etc.)

The design elements for these road features should be compatible with the intended road service function. In other words higher standards are used for higher class roads. Many of the standards are based on an appropriate design speed for the road class; therefore, establishing the appropriate design speed is an important aspect of determining applicable design criteria.

The Urban Supplement to the Geometric Design Guide for Canadian Roads, April 1995, provides typical characteristics for urban arterial roads. The suggested design speed for a minor arterial is 50-70 km/h and 60-100 km/h for major arterial roads. The design speed selected for the Alberni Valley East Side Bypass is 70 km/h. Given the use of signalized at-grade intersections, the anticipated average running speed during off-peak hours would be 40-60 km/h. The suggested posted speed would be 60 km/h.

Design vehicles are used to establish acceptable operational characteristics. Large trucks would be anticipated on an arterial road. Their trips would generally entail movement of goods between industrial and commercial areas or would entail access to higher class roads for inter-regional travel. Therefore, the design vehicle utilized in this study is a tractor semi-trailer (TS7). The minimum turning radius for this vehicle is 14.5 m; low speed.

Table 3.0 summarizes key design elements used in this study.

3.3 ACCESS MANAGEMENT

The degree of travel mobility (traffic flow interruption) is directly related to the interference caused by intersections along the roadway. Each simple at-grade

Table 3.0

Alberni Valley East Side Bypass Study				
Basic Design Criteria				
Standard	Arterial	Source **	Collector	Source
• Design Speed	70 km/h	TAC A.5.7	60 km/h 70 km/h desired	TAC A.5.7
• Design Vehicle	WB15		WB15	
• Cross Section				
• lane	3.5 - 37 *	C.2.2d / U.C. - 15	3.5 m	C.2.2d / U.C. - 15
• curb lane	3.5 + 0.4 = 3.9 at intersections		3.9	
• curb	0.6		0.6	
• sidewalk	2.0 m	U.C.8b)	2.0 m	U.C.8b)
• boulevard	3.0 m	U.C.7	3.0 m	U.C.7
• shoulder (composite)	3.0 (2.5 + 0.5)	MoTH 430		
• foreslope	3:1 rural / 4:1 urban		4:1 urban	
• ditch bottom	1.0 m (minimum)			
• backslope	1.5:1 (minimum)			
• median	6.0 m	MoTH modified		
• Longitudinal vertical				
• crest	110 m SSD 22 min. K 270 m DSD 135 K (380 mm)	U.B.22	85 m SSD 15 min. K 230 DSD 100 k (380 mm)	U.B.22
• sag	110 SSD 25 min. K 15 K (comfort)		85 m SSD 20 min. K 10 K (comfort)	
• grade	5% (6% max.) 9% (max.) mountainous	JB.4.1 and MoTH	6% (max.) 10% (max.) mountainous	B.4.1 and MoTH
• horizontal				
• e_{max}	6%	U.B.1	Pending topography and mainline grade 0.2% - 0.4%	U.B.1
• min. radius	330 (e_{max} = 6%) reverse crown 190 (e_{max} = 6%) superelevated	U.B.3.1 U.B.3.1	185 (e_{max} = 4%) reverse crown 130 (e_{max} = 4%) superelevated	U.B.3.1 U.B.3.1
• spiral length	A = 110 for 190 m		A = 85 for 130 m	
• Intersections				
• spacing	200 m min.	U.D.2	60 m	U.D.2
• minor road approach grade	3% max. 0.5% min.	U.D.2 c)	5% max. low volume	U.D.2c)
• within intersection	4% max.	U.D.2	4% max.	U.D.2
• minor road tangent	20 m	U.D.5.1	20 m	U.D.5.1
• angle of intersection	70° - 110°			
• superelevation	4%	Table U.D.5.2	4%	Table U.D.5.2
• sight triangle	110 m	U.D.6.1	85 m	U.D.6.1
• DSD	270 m		230 m	
• control distance	stop/signals		stop/signals	
• departure (left turn)	275 m	U.D.6.3	235 m	U.D.6.3
• flared				
• straight	21:1 taper 58 m taper 1000 = R	U.D.9.1	18:1 taper 32 m taper 750 = R	U.D.9.1
• reverse	42 m B.T. for 3.0 m lane 60 B.T. 220 m radius		36 m B.T. for 3.0 m lane 50 B.T. 150 m radius	

Notes: * 3.7 m lanes were used for purposes of establishing right-of-way boundaries.
 ** Source is TAC unless otherwise indicated.

intersection inherently involves a number of conflict areas where two vehicles may attempt to occupy the same space at the same time. As the complexity of an intersection increases, the number of conflict areas also increases. If two vehicles attempt to enter a conflict area, an accident will occur unless one or both of the drivers undertake evasive action. The severity of accidents increases as the average running speed on a facility increases. Therefore, it is highly desirable to establish an access management plan which is compatible with the intended service function of a road facility. It should also be noted that inappropriate use of traffic control devices on certain road classes may increase the traffic accident rate.

The number of intersections along the Alberni Valley East Side Bypass should be limited with a minimum spacing of 400 meters. The following roads were identified as connecting roads in the Major Street Network Plan:

Bamfield Road forms the south terminus of the Bypass. Bamfield Road could ultimately serve as a major arterial road forming part of the alternative highway system linking the Cowichan Valley, the Alberni Valley, and the Comox Valley. Therefore, allowance for an intersection between two four-lane roads should be considered as a long term strategy. A segment of Bamfield Road should be realigned to develop improved geometry at the intersection.

Bruce Street would provide improved mobility to the south end of the City. Northbound drivers would be able to avoid the majority of slow moving traffic experienced along 10th Avenue. Connection of this street could be considered optional depending on the desires of local residents. Completion of a transportation study would be necessary to assess changes to travel patterns and estimated traffic impacts to the local neighbourhood. Bruce Street (east of 10th Avenue) would have to be upgraded from a local road to a collector road.

Argyle Street would provide direct access to the south central business district. The school development at the east end of Argyle Street is largely shielded from traffic due to the topography and building setting. Argyle would be classed as a collector road (or a minor arterial).

Burde Street is an established collector road which parallels Owatchet Creek and serves residential neighbourhoods east of the City. The distance between Argyle Street and Burde is approximately 800 m which complies with desired spatial distribution of intersections. Burde Street would be classed as a minor collector road.

Redford Road is an established arterial road which connects Highway No 4 to the geographic centre of the City. It also provides indirect access to the Port Alberni Mill.

Roger Street provides a connection to Victoria Quay and serves the North Island Community College facilities. It also provides access to numerous City sports playing fields and grounds. Connection of this street to the Bypass will eliminate short cutting which currently involves the Sahara Heights access. The volume of traffic expected on Rogers Street can not be accurately estimated without the benefit of a transportation study. However, traffic safety measures could be employed if deemed necessary to account for the pedestrian/vehicle mix. It should be noted that the distance between the Redford Road and Rogers Street intersections complies with minimum spatial guidelines. Sections of Rogers Street are being upgraded by the City to conform with its collector road status.

Johnson Street (Highway No. 4) would become a major arterial/arterial intersection. This intersection would form one of the major transportation nodes in the City.

Intersections north of Johnson Street were not addressed in this study.

Development and analysis of a transportation model was not within the scope of this study. A “what if” analysis was, therefore, not undertaken to determine the effects of tradeoffs between the proposed intersections listed (i.e. proposed revisions to the adopted Transportation Network Plan). For example, the effects of deleting an intersection at Bruce Street was not assessed. A general rule of thumb with respect to access management is to eliminate access wherever possible.

Note: The location of the Bypass within the Study area would not be generally affected by decisions about intersecting roads. Also, there are few road corridor options to consider. In other words there are a limited number of links available. This is not the case north of Highway No. 4 (e.g. Cherry Creek Road is not the only corridor link available).

4.0 ROAD ALIGNMENT OPTIONS

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4.0 ROAD ALIGNMENT OPTIONS

4.1 INTRODUCTION

Three primary components of vehicular transportation (including cyclists) must be considered:

- The **Road** physical plant;
- The **Driver** characteristics; and
- The **Vehicle** characteristics.

These components form a system in which each component influences the other. For example, road design characteristics will influence driver behaviour. A classic example is where drivers tend to increase speed on road facilities which incorporate a “safe feeling” driving environment. Conversely, drivers will tend to reduce speed when faced with narrow openings, which is the basis of many Traffic Calming strategies. Therefore, a basic requirement of road design is to ensure the physical road characteristics are compatible with the intended road **Service Function**.

As discussed in Section 3.0 of this report, the intended service function of the Alberni Valley East Side Bypass (Bypass) is an **Arterial** which will ultimately link a future Highway No. 4 Bypass north of the City to the Bamfield Road south of the City. Mobility is the most important attribute of the Bypass.

Road design involves a three-dimensional problem where all design features and applicable design elements must be coordinated within an environment of internal and external constraints and influences. Section 2.0 of this report provides an overview of constraints and issues which influenced the generated road alignment options. Section 3.2 of this report summarizes the various design elements considered when generating optional road alignments.

A multitude of Bypass alignment options were generated during the course of this study. Through an iterative screening process involving public input, five options (Options A through E) were detailed for evaluation. Combinations of these options are possible; therefore, the evaluation of alignments is broken into sections (each section is generally shown on separate figures). These Options are shown on **Figures 4A to 4D** at the end of this section.

4.2 EVALUATION

***Note:** Figures 2.7A to 2.7D may be referenced for Road Alignment Option discussions which follow.*

Evaluation of optional road alignments can become a complex process incorporating a Multiple Accounts Evaluation (MAE) process. Typical accounts considered, in a MAE process are summarized **Table 4**.

Table 4
Multiple Account Evaluation Performance Measures

Indicator	Type	Description and Source
Financial Account		
Capital Cost	Quantitative	Total cost of design and construction of network modifications. Expressed as net present value.
Operating Cost	Quantitative	Average annual operating costs associated with modifications expressed as net present value. Operating costs associated with existing infrastructure including maintenance and rehabilitation costs expressed as net present value.
Customer Service Account		
Route Travel Time	Quantitative	Minutes over total route (CONTRAM).
Route Time Saved	Quantitative	Difference in travel time (CONTRAM).
Value of Time Saving	Quantitative	NPV of travel time saving (MicroBencost).
Safety	Quantitative	Collision reduction by vehicle class multiplied by collision unit costs.
Vehicle Operating Cost	Quantitative	Operating costs by vehicle class (CONTRAM/MicroBencost).
Emergency Response Support	Qualitative	Degree of change in accommodation of emergency vehicles.

Table 4
Multiple Account Evaluation Performance Measures

Indicator	Type	Description and Source
Spare Capacity	Quantitative	The degree of capacity reserve available (CONTRAM).
Network Connectivity	Qualitative	Degree of mobility accommodated between major activity centres along the corridor (CONTRAM).
Goods Movement Accommodation	Quantitative	The change in accommodation of goods movement vehicles as a class (CONTRAM/MicroBencost).
Mobility Accommodation	Qualitative	The extent to which overall mobility is affected (CONTRAM).
Reliability	Qualitative	The consistency of service quality to be anticipated (function of spare capacity and degree of saturation) (CONTRAM).
Environmental Account		
Reduced NO _x	Quantitative	Change in emission (annual) (CONTRAM/MicroBencost).
Reduced Particulate	Quantitative	Change in particulate (annual) (CONTRAM/MicroBencost).
Reduced CO ₂	Quantitative	Change in emission (annual) (CONTRAM/ MicroBencost).
Noise	Quantitative/ Qualitative	Reduced peak period noise levels (CONTRAM/MicroBencost)/
Energy Use	Quantitative	Change in fuel consumption (annual) (CONTRAM/MicroBencost).
Water Pollution	Quantitative	Change in stream discharge (CONTRAM/ MicroBencost).
Health	Quantitative	Change in health costs due to emission reduction (CONTRAM/ MicroBencost).
Social Account		
Development Potential	Qualitative	Assessment of development potential in the corridor.
Community Severance	Qualitative	Change in barrier effects.
Congruity with land Use Plans	Qualitative	Degree of support for local land use plans.
Land Use Implications	Qualitative	Description of significant and irreversible land use implications.
Transportation Integration	Qualitative	Degree of integration with lower tier transportation systems.
Economic Development		
Network Connectivity	Qualitative	Degree of connectivity between commercial nodes (CONTRAM).
Efficiency Effects	Quantitative	Route Savings Costs (CONTRAM/ MicroBencost).
First Year Rate of Benefit Ratio	Quantitative	Sum of benefits accrued after construction divided by sum of all costs incurred to date (CONTRAM/MicroBencost).

Table 4
Multiple Account Evaluation Performance Measures

Indicator	Type	Description and Source
Sustainable Employment	Quantitative	Direct and indirect employment induction.
Payback Period	Quantitative	Number of years until capital recouped through flow of benefits(CONTRAM/MicroBencost).
Location Consideration	Qualitative	The degree of impedance in accommodating development.
Congruity with Economic Plans	Qualitative	Degree of support for provincial, regional, and local economic development plan objectives.

A multiple accounts evaluation methodology was not possible within the resources of this study NOR WAS SUCH A STUDY REQUIRED to establish the preferred Bypass alignment option. A modified MAE was used by considering dominant accounts for each logical segment of the Bypass.

4.2.1 Highway No. 4 to Redford Road

- The location of the intersection at Highway No. 4 is the first design feature to evaluate. The dominant evaluation account which must be considered to establish a recommendation is the Social Impact to residents along Cherry Creek Road. Limiting access to the Bypass is also an important factor to consider if the Cherry Creek Road intersection location is used. All other evaluation accounts are generally equal.

If the Cherry Creek Road intersection location is utilized, the quiet residential character along Cherry Creek Road immediately north of Highway No. 4 will dramatically change. It should be noted that Cherry Creek Road is serving as a collector road. The Bypass will ultimately be a four lane divided arterial which is intended to carry a significant volume of traffic. Direct access to the Bypass from residential properties is highly undesirable; therefore, a frontage road would be required. However, the geometric design of a frontage road and the location of intersections with the Bypass would be difficult to establish.

Businesses west of the mall would be significantly impacted if the Bypass were located west of the mall. Additional right-of-way would be required and direct access would not be desired.

Both intersection options (Cherry Creek Road and Broughton Avenue) will involve disruption to Agricultural Land Reserve property north of Highway No. 4. Also the bridge crossing at Rogers Creek for Options D and E would be longer than other options to facilitate acceptable horizontal alignment geometry.

It should be noted that Options A to C do not require relocation of the SPCA facilities.

An intersection at Broughton Avenue is the preferred location.

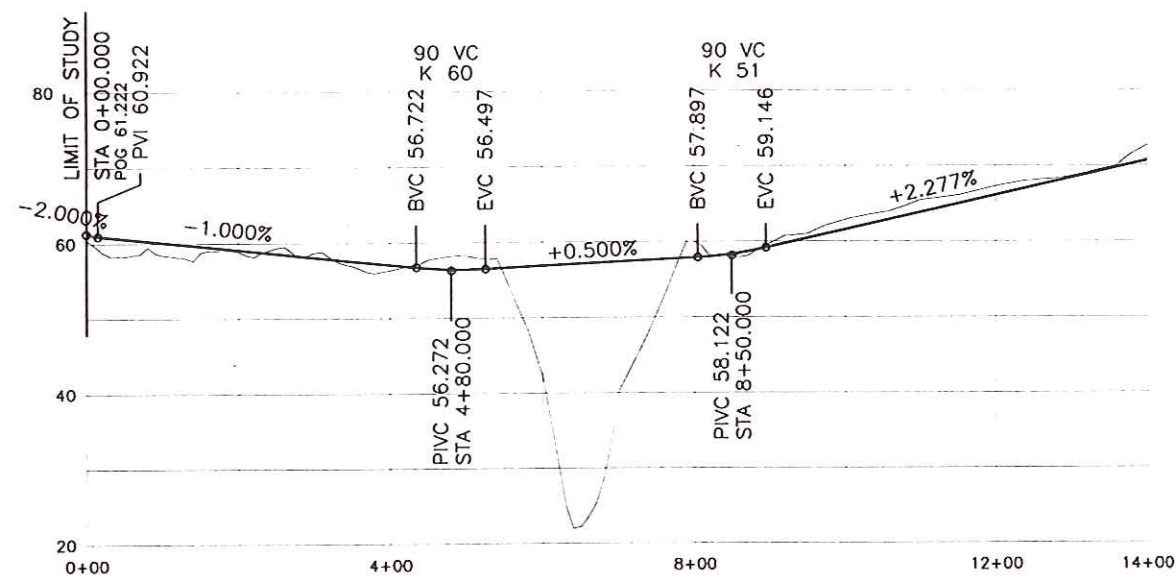
- Two basic road alignment options are available to cross Rogers Creek (Options: East bridge crossing and Option A to E). The predominant evaluation account driving the recommendation for the preferred crossing location is the capital cost of the bridge.

The length of the bridge at the westerly location for Options A through to C will be approximately 230 metres (approx. \$7.8M). The length of the bridge at the East Bridge location will be approximately 520 metres (approx. \$17.6M). The length of the bridge for Options D and E (connection to Cherry Creek Road) will be approximately 310 metres (approx. \$10.5M). Vertical profiles for these locations are shown in **Figure 4.1**.

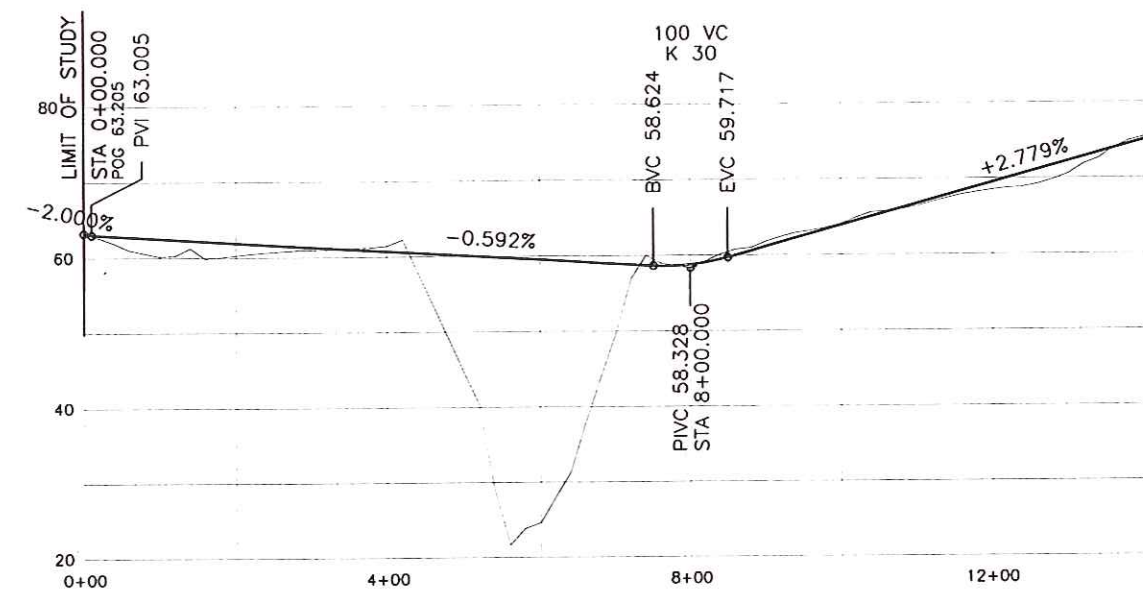
The preferred bridge location is the westerly location (east of the mall) for Options A through to C.

4.2.2 Redford Road to Owatchet Creek (Dry Creek)

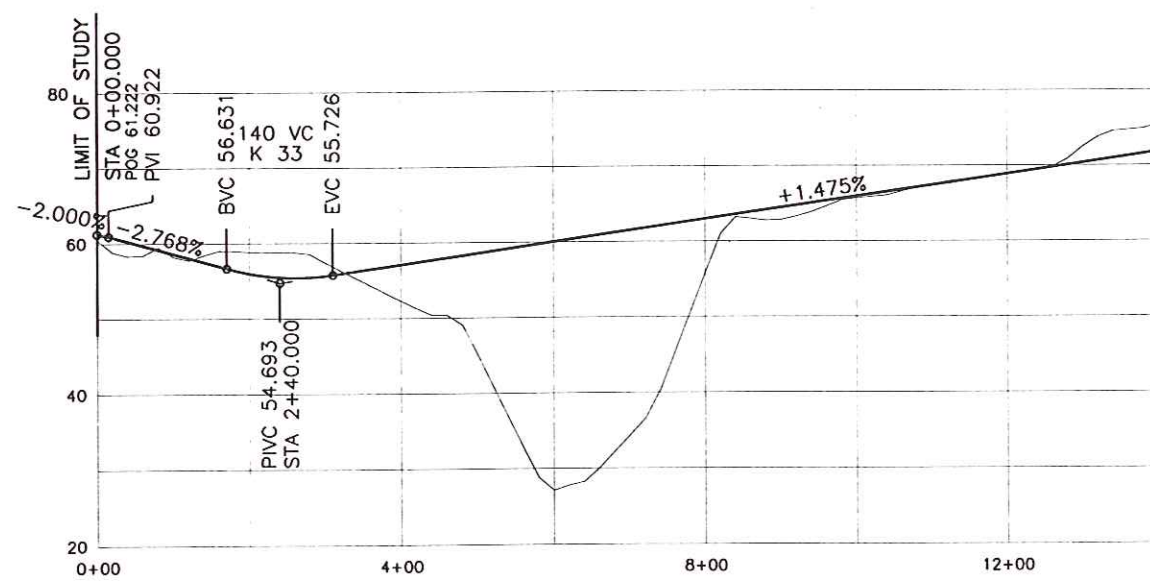
- Operational requirements (geometric design) at the intersection with Redford Road are the predominant evaluation account. A secondary account is the



OPTION A



OPTION D



EAST BRIDGE CROSSING



PORT ALBERNI BYPASS STUDY
PROFILES AT ROGERS CREEK
SCALE 1:10 000
FIGURE 4.1

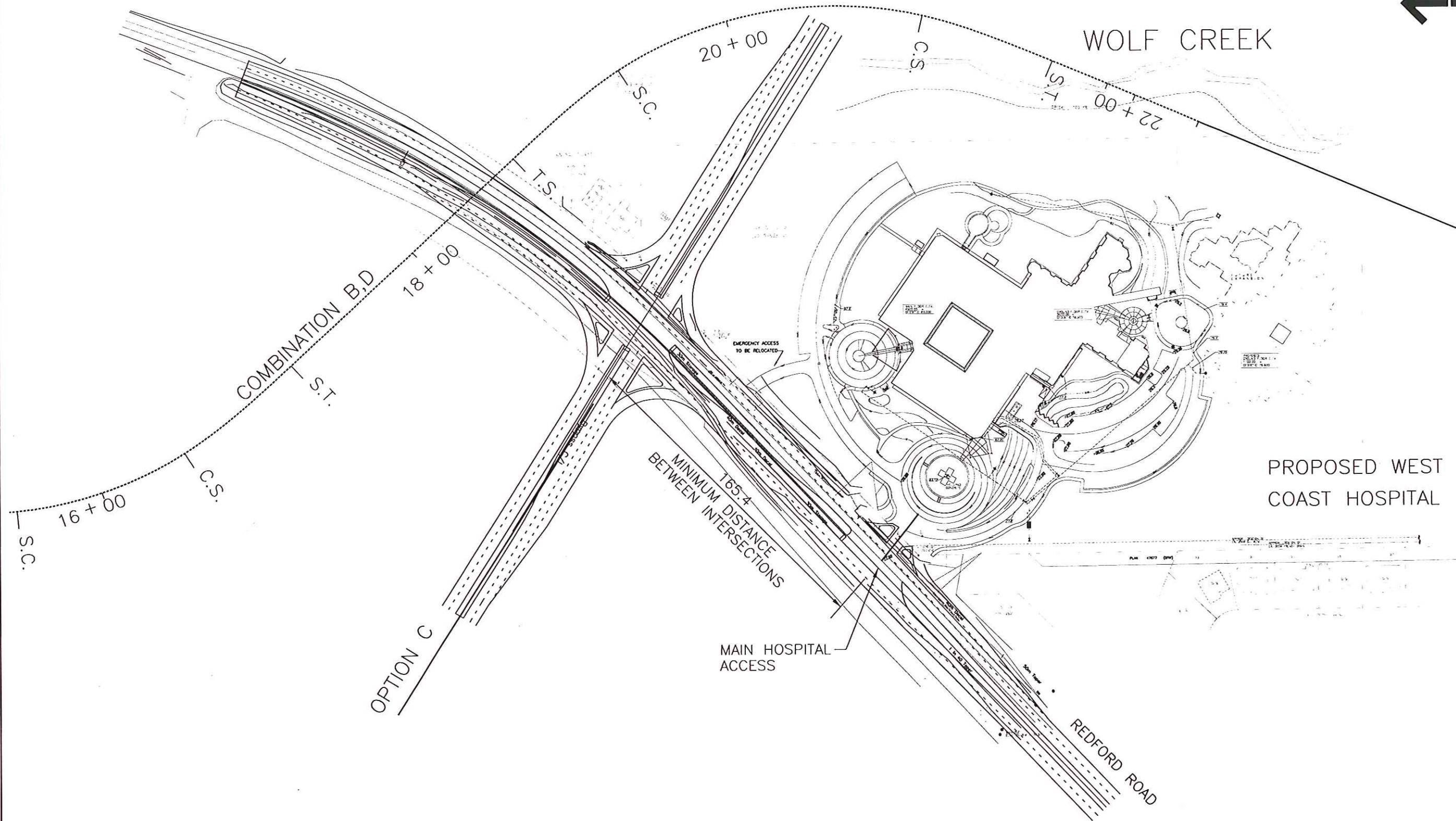
property cost associated with purchase of existing residential properties if Options A, B, B1, and B2 are selected. All other accounts are similar.

There must be sufficient separation between the main West Coast Hospital intersection and the Bypass intersection with Redford Road. Preliminary designs (including field survey) and Functional designs were completed to determine the minimum intersection spacing, refer to **Figure 4.2**. Option C, Figure 2.7B is representative of the minimum spacing required.

Options C and E, Figure 2.7B would require minor adjustments to ensure adequate separation between the Centra Gas Station and the Bypass. A variation of Option E would be preferred in the event that construction of the West Coast Hospital does not proceed. At the time of writing this report, construction of the hospital was considered imminent.

Option C, Figure 2.7B encroaches on the Hospital as the alignment is shifted to avoid the Centra Gas Station. Therefore, utilization of Option C or a combination of Option C and Options A to D was ruled out. In other words the location of the Bypass/Redford Road intersection between the main hospital access and the residential property access was ruled out.

The dominant account to be considered when evaluating Options A - B2 and Option D, Figure 2.7B is capital cost. It would be necessary to procure the existing residential property (approx. \$200,000) to accommodate Options A - B2. An intersection with Redford Road at the Option D crossing is less desirable than at the Options A - B2 crossings due to operational characteristics. However, procurement of the residential property can not be justified on the basis of operational characteristics alone. Other considerations would include the viability of retaining one property "squeezed" between the Bypass and the Hospital. It should be noted that access to the residential property would be restricted to right in/right out movements. For purposes of this report, it is recommended that the City protect sufficient right-of-way to allow for Options A - B2.



PORT ALBERNI BYPASS STUDY
HOSPITAL ACCESS CONCEPT
SCALE 1:2000
FIGURE 4.2

The preferred intersection location at Redford Road is at the combination of Options B and D, Figure 2.7B and Figure 4.2. A variation of Option B-B2 is preferred if the residential property is procured by the City. A variation of Option E is preferred if the West Coast Hospital construction does not proceed. The City should monitor development activity in the area.

- There are two general routes between Redford Road and Owatchet Creek, an easterly route which passes near Arrowsmith Heights and a westerly route adjacent to the built-up limits of the City. Routes between these options are not acceptable due to environmental impact associated with the water ponds.

The easterly route, Option C, would cross Wolf Creek, the Log Train Trail, the tributary extending north from the east pond, and the tributary draining into Dry Creek. Stream crossings must be accomplished in a manner which maintains access for fish. Granular embankment fill would likely be acceptable within the wetted perimeter of the streams and open bottom arch culverts would likely be acceptable for fish accessibility (approx. \$200,000). Severing the Log Train Trail is considered to be highly undesirable given the heritage and social value of the trail. A pedestrian/bicycle underpass/overpass would be desirable in order to accommodate the Bypass crossing (approx. \$700,000). The easterly route would be more costly due to the increased length of the Bypass (approx. 600 metres, \$900,000). A longer bridge on a horizontal curve at the Dry Creek crossing would also be required (an increase of \$0.5M). There would also be an ongoing road user cost associated with travel cost. Environmental mitigation costs associated with Options A-B2 & D, westerly routes, are estimated at approximately \$300,000. This would involve reconstruction of Wolf Creek. The total cost increase would exceed \$1,800,000 for Option C.

Road alignment options adjacent to the City's built up limit are preferred. Increased costs associated with easterly routes are not considered justifiable.

- An attempt was made to avoid disruption to the developable land south of Burde Street (Saveway Forest Systems Ltd.) which is illustrated by Option E. This was

not considered feasible due to required separation between the buildings near Burde Street and the disruption to the trunk water main south of Burde Street.

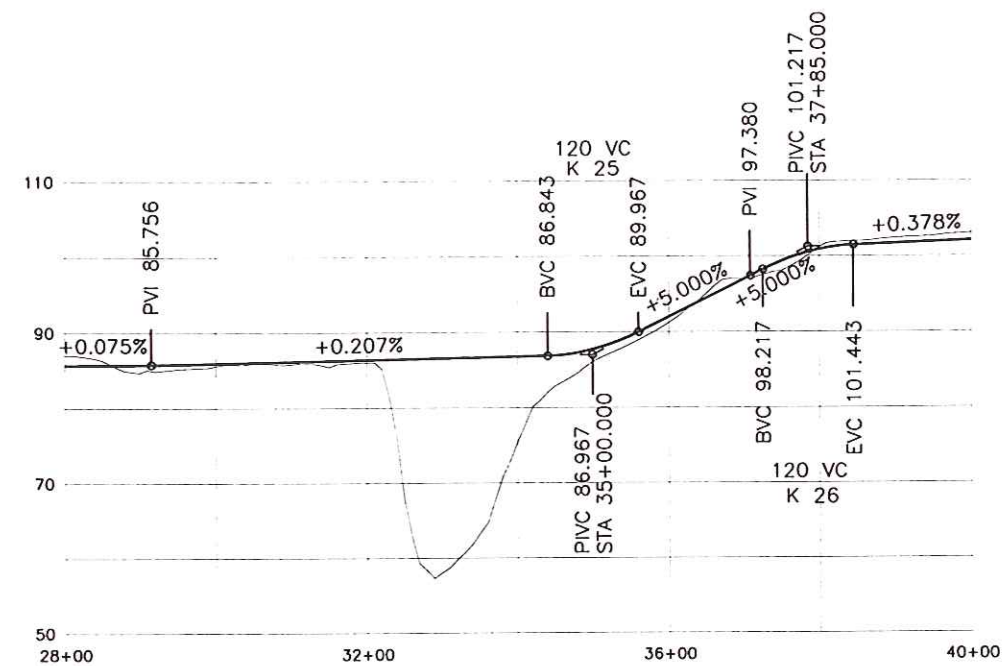
- Options A and D were developed to minimize disruption to Wolf Creek although two creek crossings would be necessary. These alignments would increase the impact on the Log Train Trail and unnecessarily increase disruption to developable land south of Burde Street.
- A bridge crossing at Owatchet Creek (Dry Creek) is similar for Options A, B-B2, D, and E (approximate cost \$5.6M to \$6.1M). Refer to **Figure 4.3** for bridge crossing profiles for Option A and Option C.
- Options B-B2 improve the separation between the buildings at Burde Street and minimize the disruption to the developable property south of Burde Street.

In view of the preceding, a combination of Options D and B-B2 (Option Combo B & D, Figure 2.7B) is the preferred route. The preferred route will have a significant impact on Wolf Creek; however, the impact can be mitigated. A variation of Option E would be the preferred route in the event that the hospital construction does not proceed because the impact to Wolf Creek can be minimized.

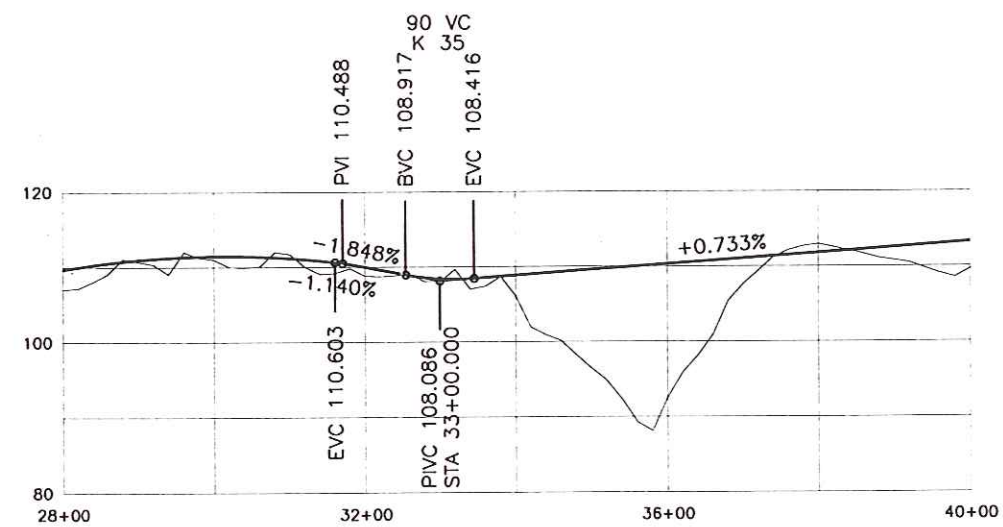
4.2.3 Owatchet Creek (Dry Creek to Bruce Street)

- In addition to the preceding discussion regarding Option C, it should be noted that the Argyle Road extension would be longer (greater capital cost) if Option C were to have been selected as the preferred option.
- All other options (A, B-B2, D, and E) are similar.

All options, excluding C, are preferred.



OPTION A

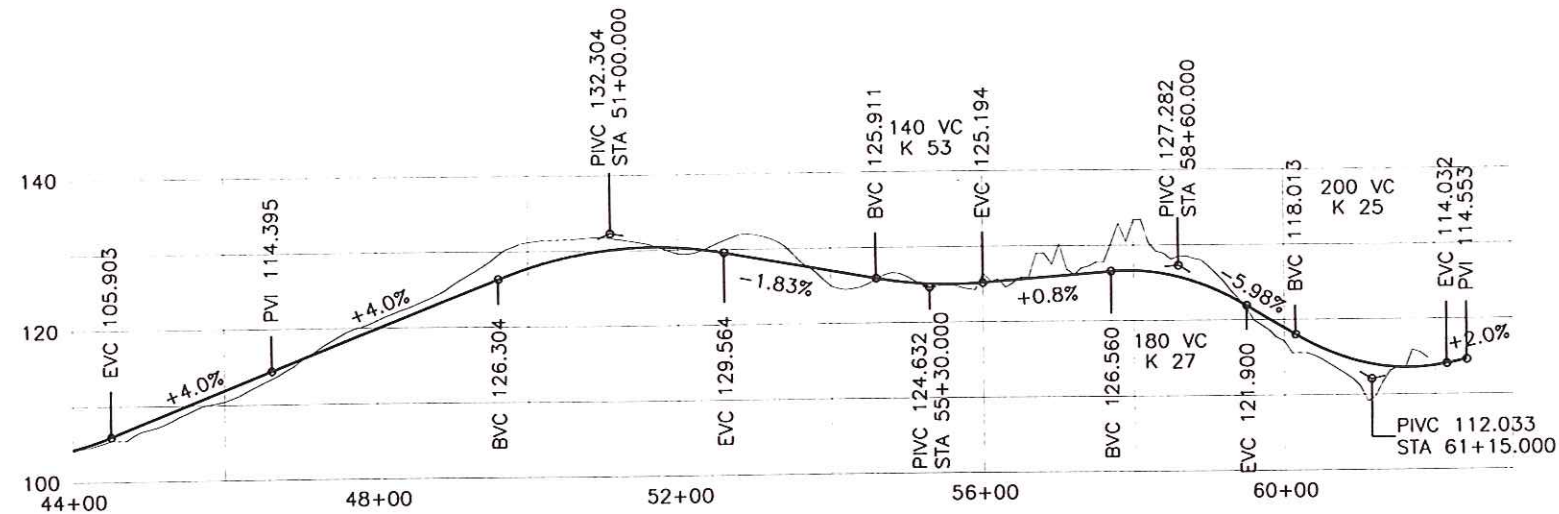


OPTION C

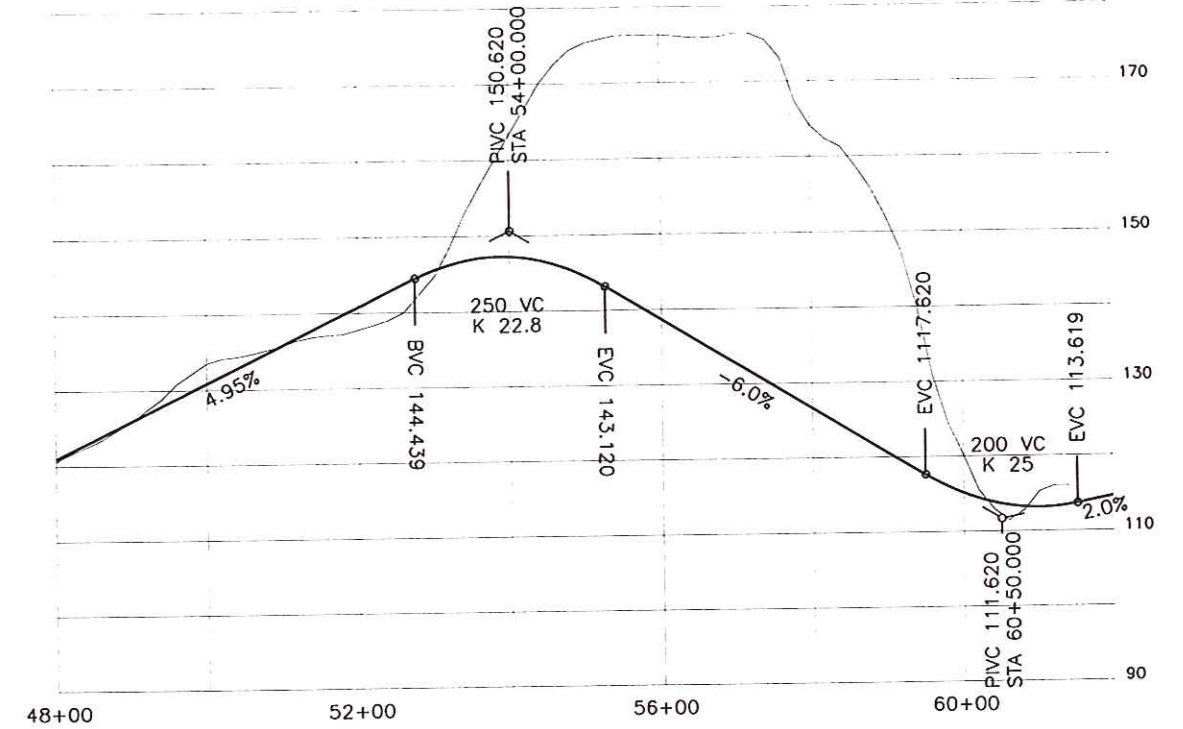


4.2.4 Bruce Street to Bamfield Road

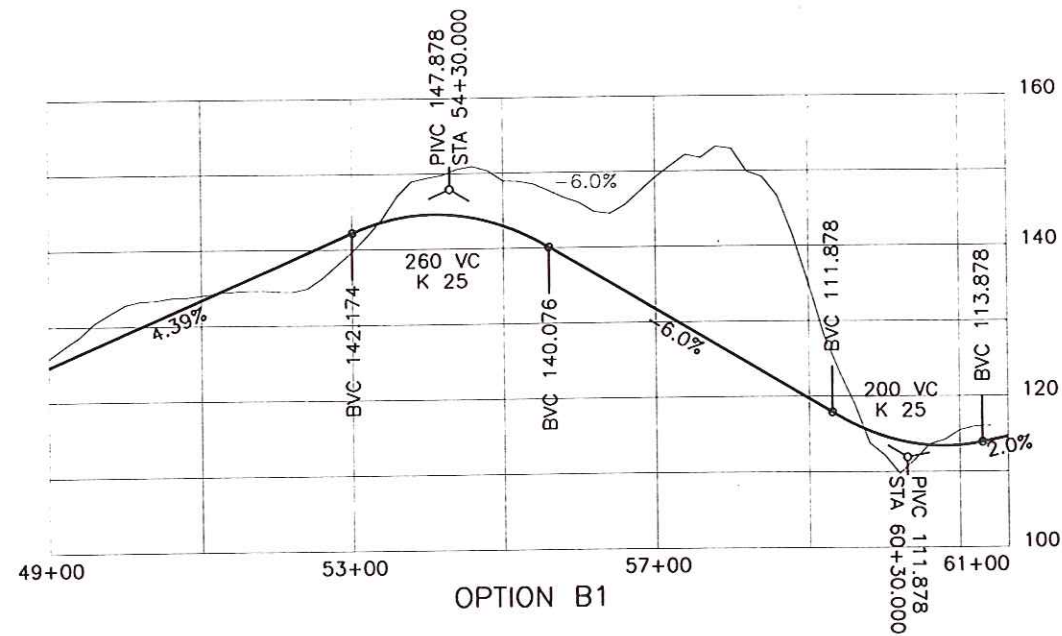
- Three evaluation accounts dominate this area; social, geometric design and capital cost.
- There are three general routes for the Bypass in this area; along Anderson Avenue (Option A), west of the mountain (Options B to B2 and E), or east of the mountain (Options C and D). Variations within these routes are possible. Seven options were generated for review.
- The design criteria limits the maximum road gradient to 6%. Vertical profiles for all options were developed; refer to **Figures 4.4A and 4.4B**. Also it is desirable to maintain an intersection with Bamfield Road as close to 90° as possible. A 150 metre tangent leading to the intersection is also desirable.
- Option A, along Anderson Avenue, is geometrically superior; however, the ultimate cross section in this area (four lane undivided along Anderson Avenue) would disrupt eight residential properties (approx. \$1,600,000). Similar to Cherry Creek Road, the Bypass is generally incompatible with residential land use. Therefore, it would be desirable to construct a frontage road to service properties on the west side of Anderson Avenue. Excavation cost would be approximately \$600,000.
- Option B avoids disruption to the local neighbourhood; however, a significant volume of rock excavation would be required (approx. 1,007,400 m³, \$12.1M). The depth of excavation would exceed 30 metres at some locations and involve rock excavation.
- Options B1 & B2 were developed in an effort to reduce the amount of excavation associated with Option B. Option B1 involves approximately 200 metres of roadway where the rock excavation exceeds 20 metres (approx. 350,000 m³, \$4.2M). Option B2 involves approximately 500 metres of roadway where the rock excavation is approximately 10 metres (approx. 400,000 m³, \$4.8M).



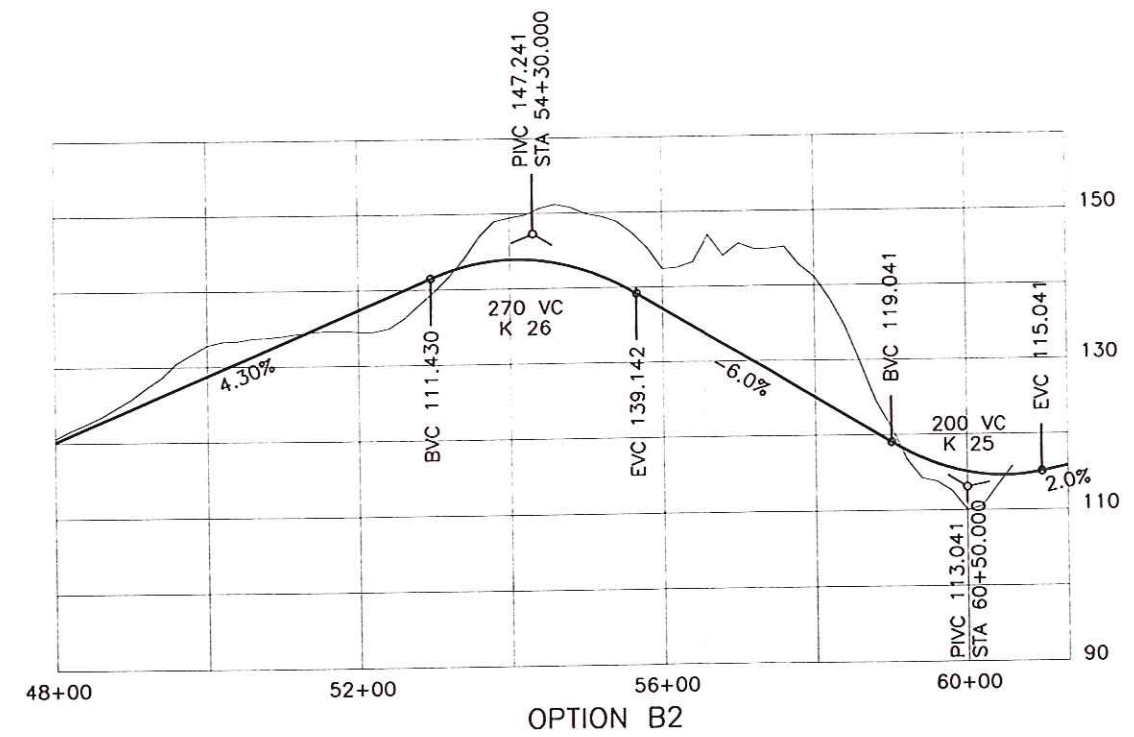
OPTION A & P



OPTION B



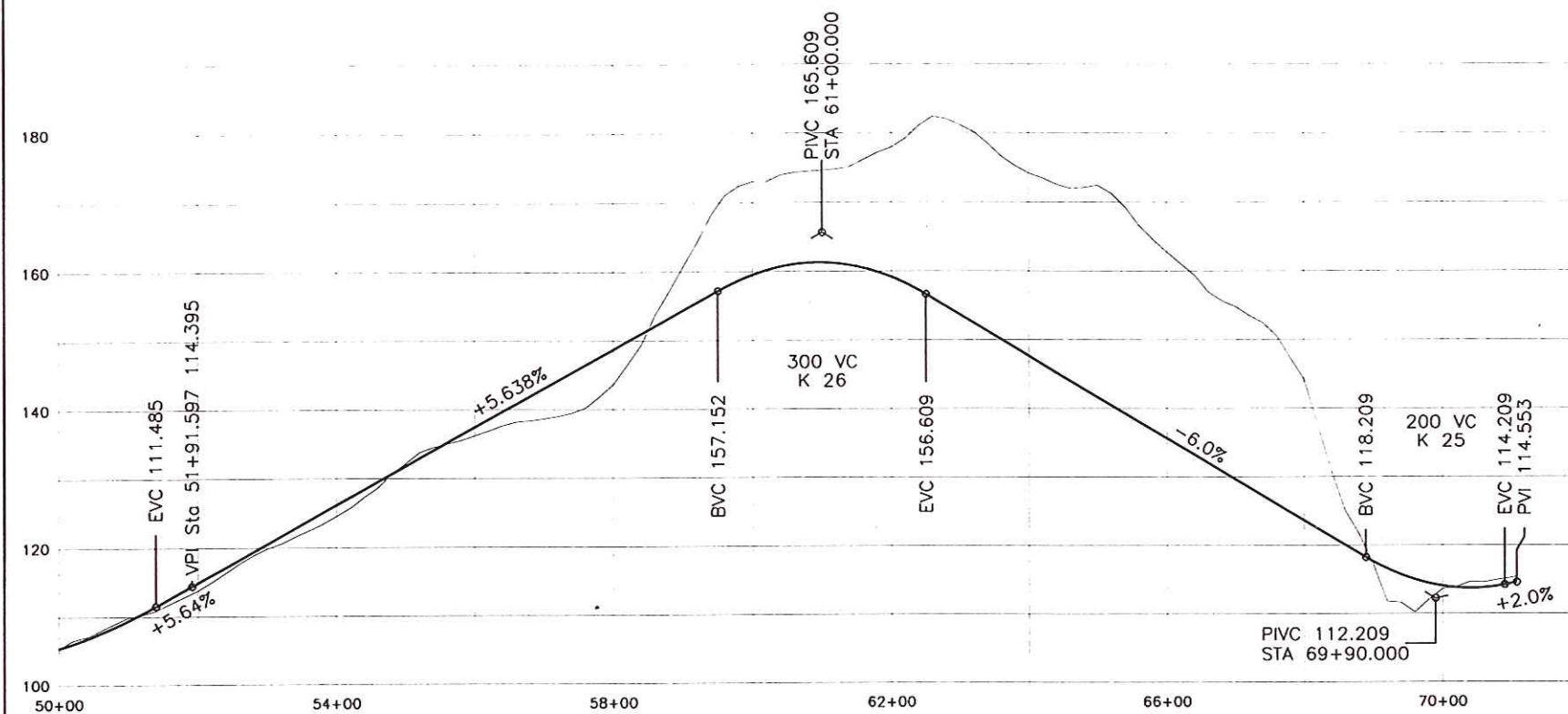
OPTION B1



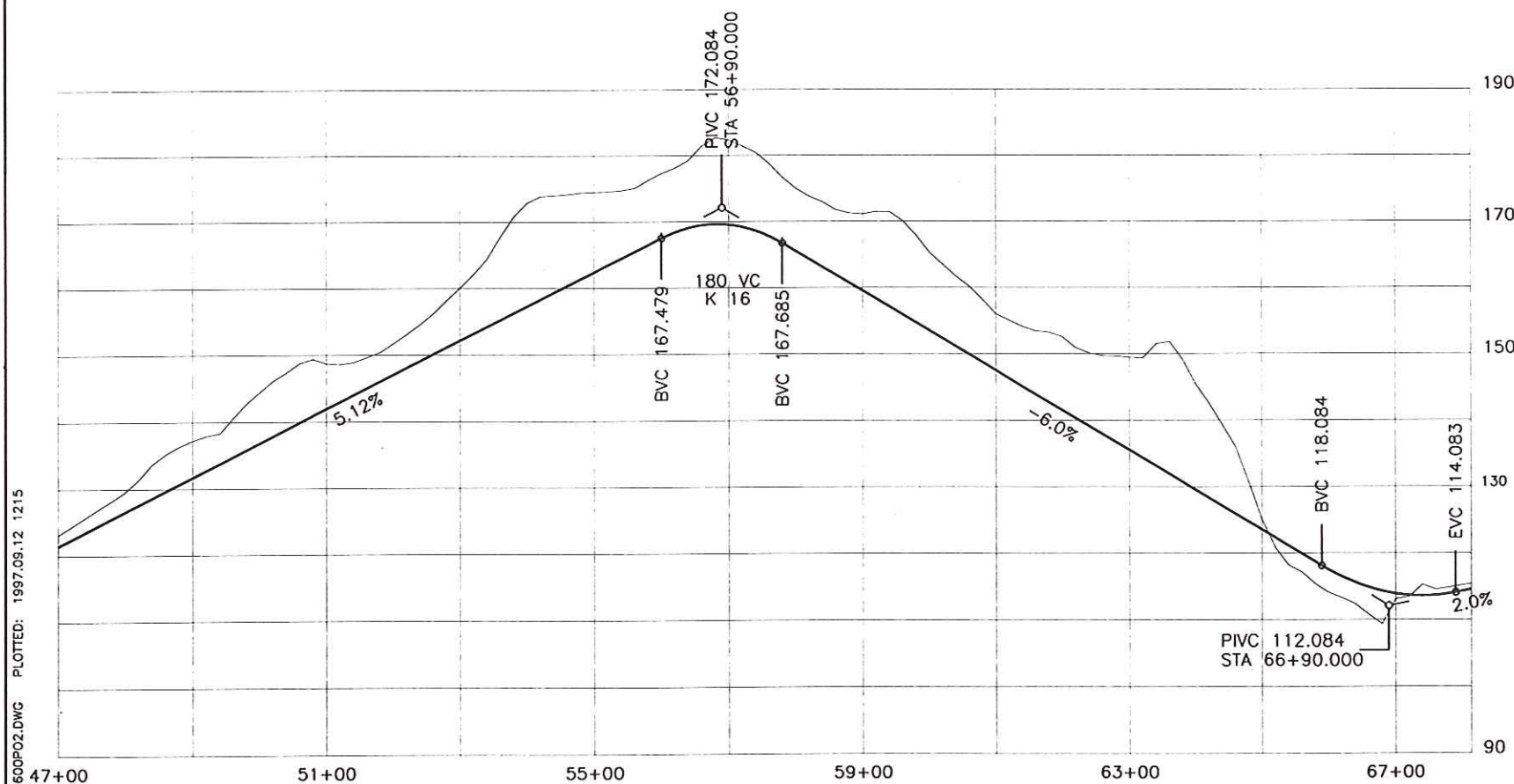
OPTION B2

PORT ALBERNI BYPASS STUDY
PROFILES AT BAMFIELD ROAD
SCALE 1:10 000
FIGURE 4.4A

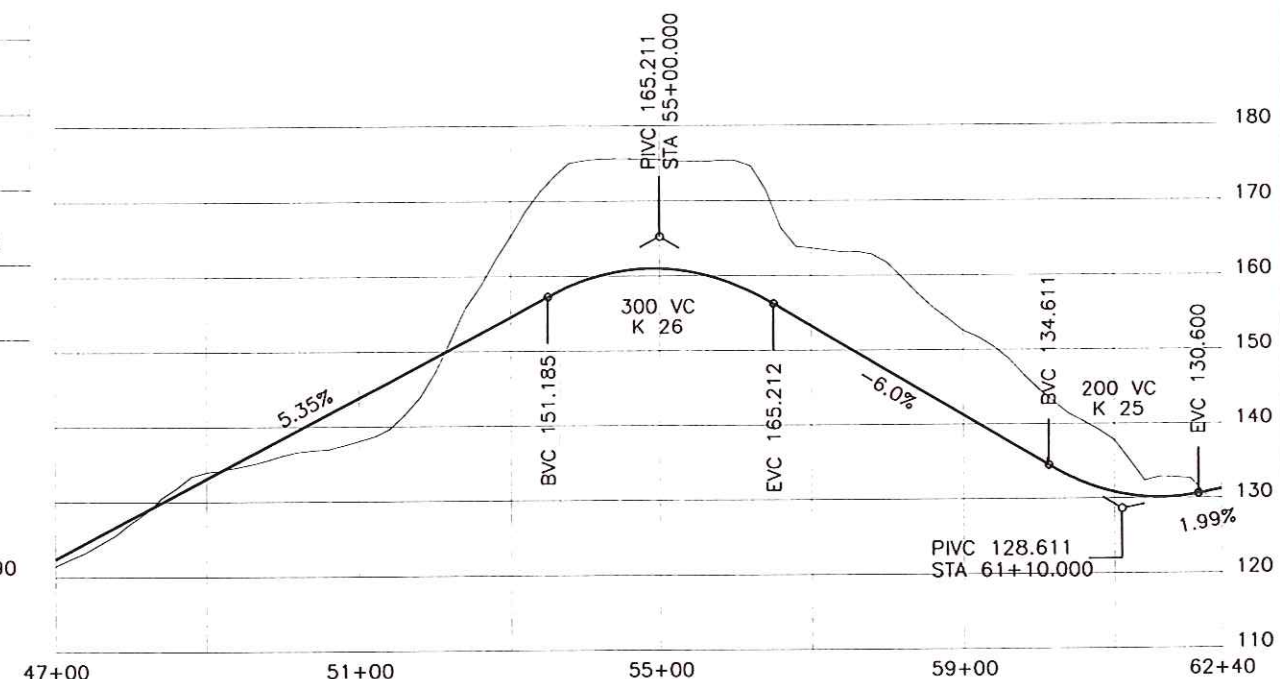




OPTION C



OPTION D



OPTION E

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PORT ALBERNI BYPASS STUDY
PROFILES AT BAMFIELD ROAD
SCALE 1:10 000
FIGURE 4.4B

Both of the alignments, B1 & B2, involve relocation of the lower water reservoir (\$1.70M). Option B1 would also require relocation of the upper reservoir (\$2.8M). Option B2 would affect four residential properties (approx. \$750,000).

- Option C, east side of the mountain, avoids disruption to the local neighbourhood and reservoirs. Option C also involves a significant rock excavation, 20 metres for a distance of approximately 500 metres (approx. 956,600 m³, \$11.5M).
- Option D is similar to Option C; however, the excavation volume is less. This option involves approximately an 8 metre rock excavation for approximately 1,000 metres (approx. 657,400 m³, \$7.9M).
- Option E locates the intersection with Bamfield Road further east. This option also involves a realignment of Bamfield Road similar to previous options. Also, this option involves approximately 5 metres excavation for 500 metres and 20 metres for 200 metres (approx. 225,300 m³, \$2.7M). This option does not achieve a desirable tangent distance leading to the intersection.
- All options, except Option A, involve steep road grades (Maximum 6%) leading to a major intersection. While technically acceptable, this geometry should be avoided when possible to reduce operational problems during slippery weather conditions.
- Another factor which affects selection of the preferred alignment relates to anticipated traffic growth. A transportation model was not developed as part of this study; however, it is reasonable to assume that the traffic volumes at the south end of the Bypass will be relatively low. This would especially be true until inter-regional highway links are revised (e.g. three valley highway link). It; therefore, would be difficult to rationalize a large expenditure to construct the south end of the Bypass on new location (i.e. Options B-E) until traffic demand warrants it. It should be noted that it may be 30 years plus before traffic volumes would warrant

an exceptionally large capital investment. This could be confirmed through traffic modelling.

- Considering assumptions about traffic volumes it would be reasonable to stage construction of the Bypass. Initially, the Argyle Street and Bruce Street connecting roads would likely serve as acceptable links to the south end of the City. This would require improvements along Anderson Avenue, especially between Neill Street and Bamfield Road including the intersection at Bamfield Road; **Figure 4.4A and 4.4B**. The final section of the Bypass between Bruce Street and Bamfield road could be constructed at a future date.
- Given the additional costs associated with Options B-E, the mitigating costs along Anderson Avenue to facilitate a four-lane arterial road, the assumptions about traffic growth, and the superior grade along Anderson Avenue, **the preferred option is Option A**.
- It should be noted that another staging option exists with Option A. The segment between Bruce Street and Anderson Avenue could be constructed as a means of alleviating traffic volumes on Bruce Street. A “T” intersection could be constructed at Anderson Avenue as part of this stage. The remaining segment of the Bypass to Bamfield Road could be constructed at a later date.
- Irregardless of the staging options, the City should protect the long term feasibility of Option A as development pressures take place.

4.3 CONCLUSIONS

The study objectives were summarized in Section 1.0. The most important study objective is to identify property requirements for the Alberni Valley East Side Bypass. This will enable the City to protect the feasibility of the preferred Bypass route. There has already been some development which has negatively affected the future cost of the Bypass; most notably at the south end along Anderson Avenue.

Figures 5A-5D in Section 5.0 of this report, provide details of the preferred alignment. The preceding evaluation process used to establish the preferred route has included some subjective assessment of evaluation accounts; however, a high confidence level exists with the evaluation results. Many of the design constraints severely limited the number of alignment options available for study, thus the preferred alignment became clear.

It should be noted that subsequent design work is expected to refine the preferred alignment. For example, the Functional and Detailed Design phases will be based on field survey. This likely will result in minor adjustments to the preferred alignment described herein. Therefore, property requirements have been conservatively established, especially in the vicinity of Redford Road.

All connecting roads were similar for each Bypass option. Obviously alignments further east involved a greater length of connecting road. Intersection locations have been reviewed and are considered technically feasible. Functional and Detailed Design phases will likely result in additional construction staging strategies.

5.0 PREFERRED ROAD ALIGNMENT AND RIGHT-OF-WAY

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5.2 PLANS AND PROFILES	5.3
5.3 ENGINEER'S ESTIMATE	5.3

5.0 PREFERRED ROAD ALIGNMENT AND RIGHT-OF-WAY

5.1 DESCRIPTION

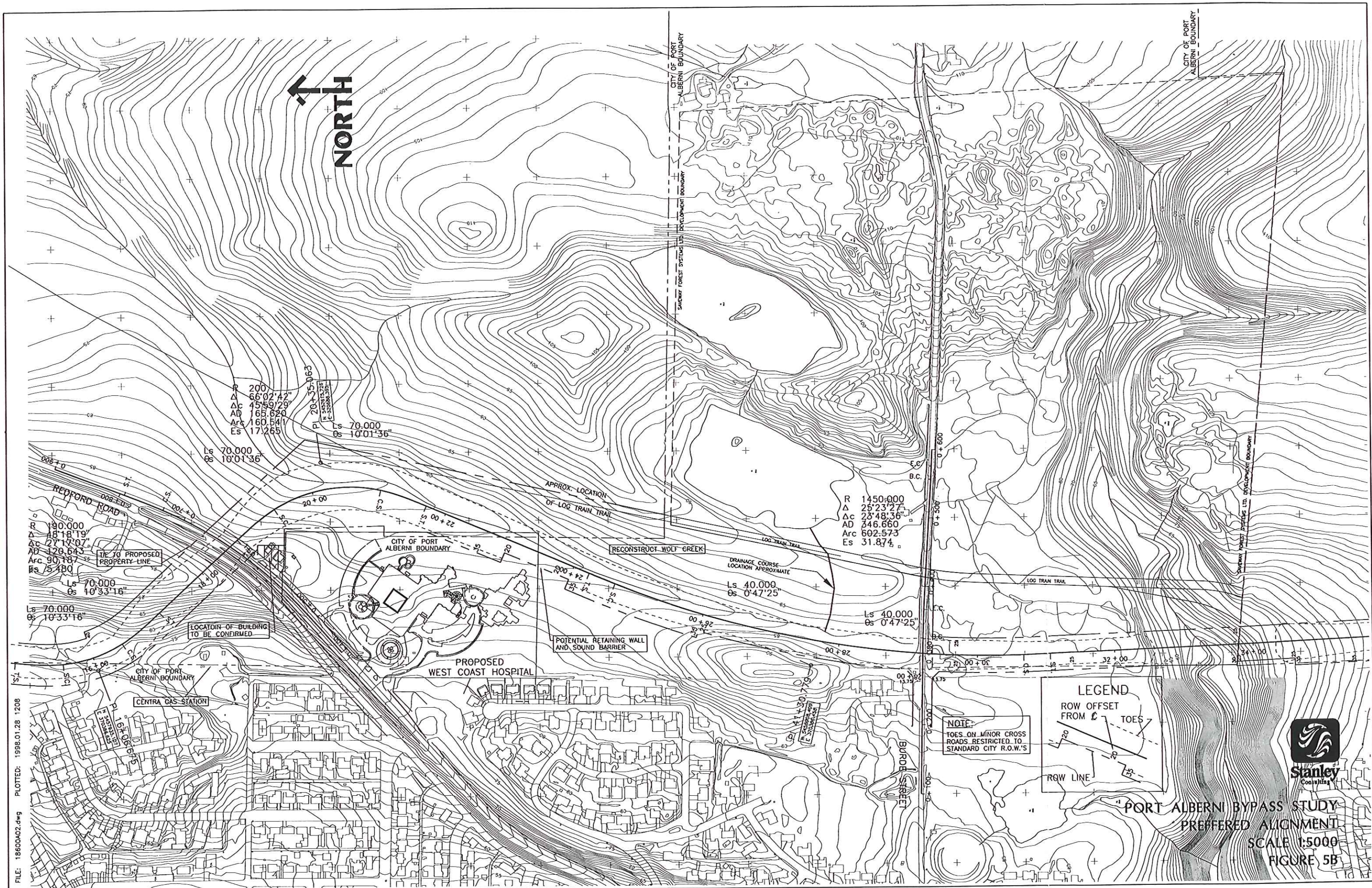
The final preferred Alberni Valley East Side Bypass (Bypass) alignment developed during this study was established by combining road segments from the various road options generated and evaluated (i.e. the best of each section was used). **Figures 5A-5D** provide details of the preferred alignment including right-of-way requirements.

Figures 5E-5G provide details of the vertical profiles for the preferred Bypass alignment and for the connecting roads. **Figure 5H** provides details of the recommended typical cross sections for the Bypass and connecting roads.

As was discussed in Section 1.4 of this report, the Alberni Valley East Side Bypass study is part of an overall design process which incorporates a number of phases. The *Route Definition* phase was the primary focus of this study. This involved the following:

- accumulation of background data;
- development of appropriate design criteria;
- development of aerial photography based mapping;
- identification of design constraints and issues through public consultation with select stakeholders, field investigations, and literature searches;
- generation of optional Bypass road alignment;
- initial screening of options;
- evaluation of remaining road alignment options;

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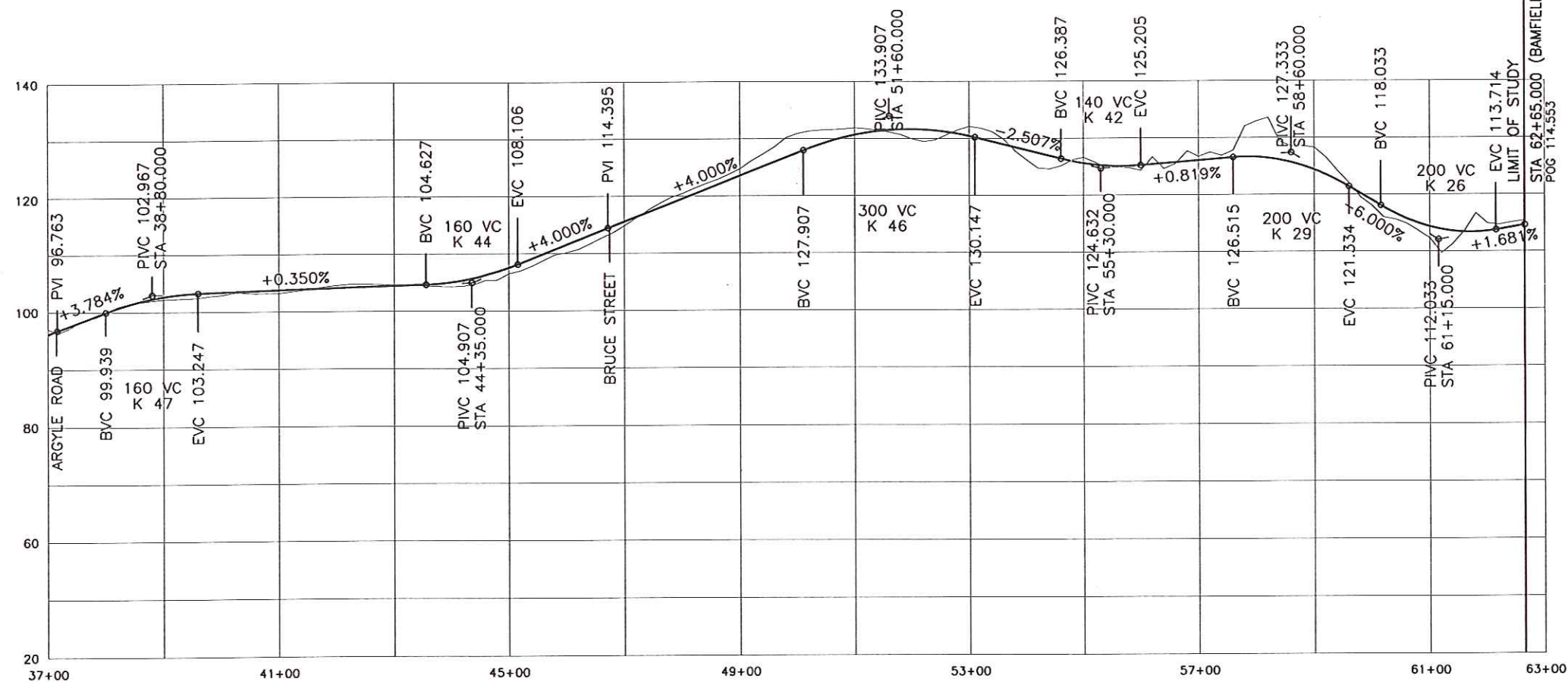
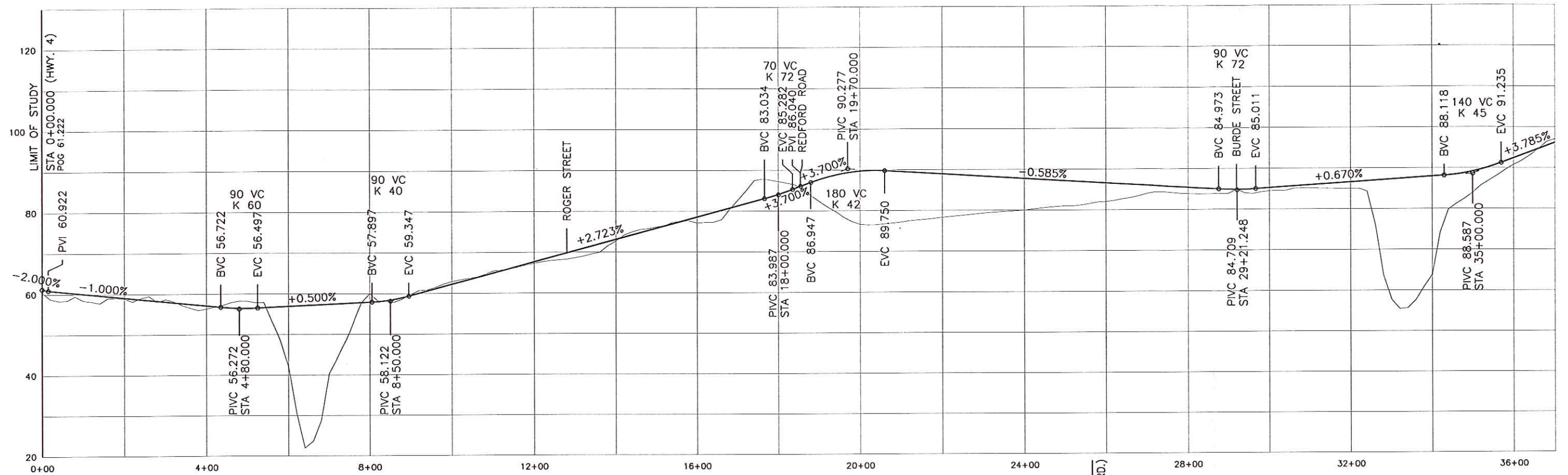
LEGEND
ROW OFFSET FROM C
TOES
ROW LINE

NOTE:
TOES ON MINOR CROSS
ROADS RESTRICTED TO
STANDARD CITY R.O.W.'S

PORT ALBERNI BYPASS STUDY
PREFERRED ALIGNMENT
SCALE 1:5000
FIGURE 5B



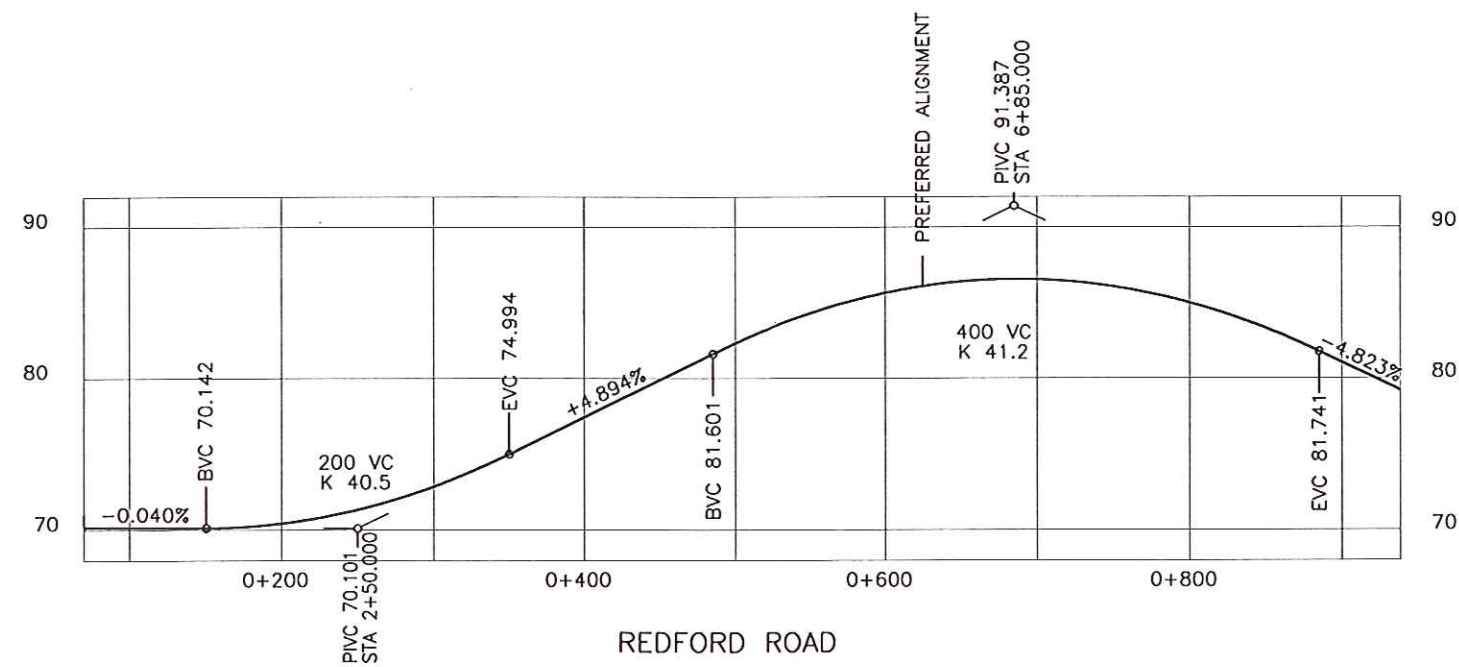
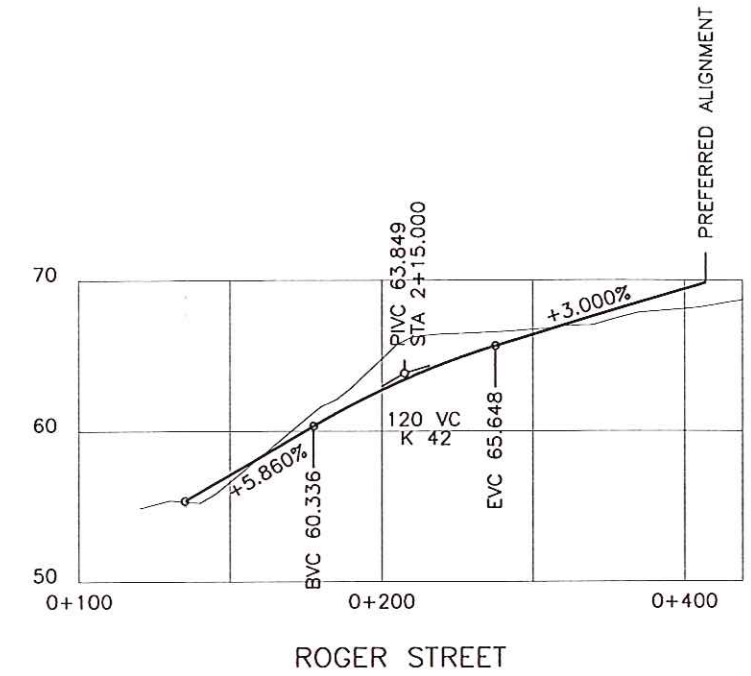
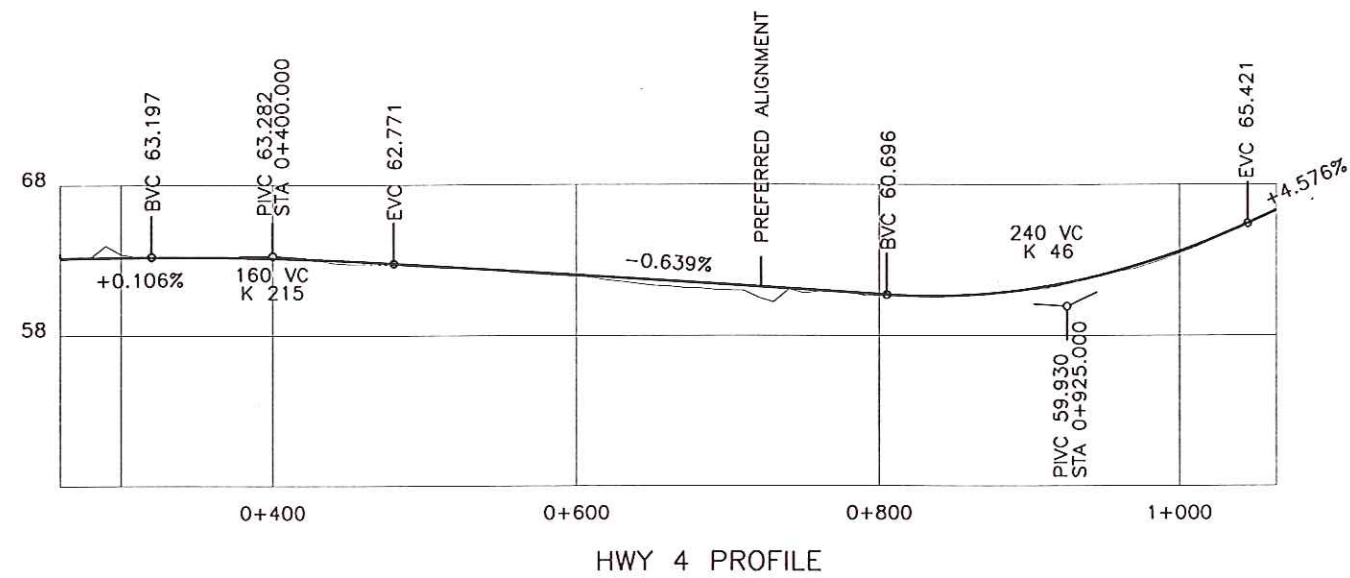
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PREFERRED OPTION

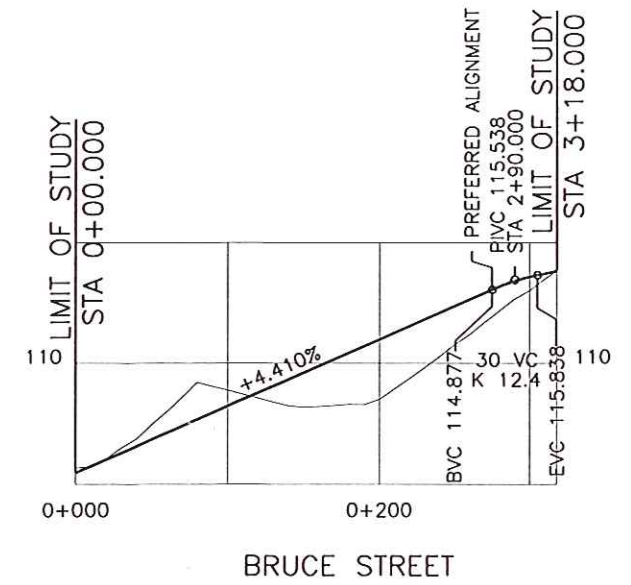
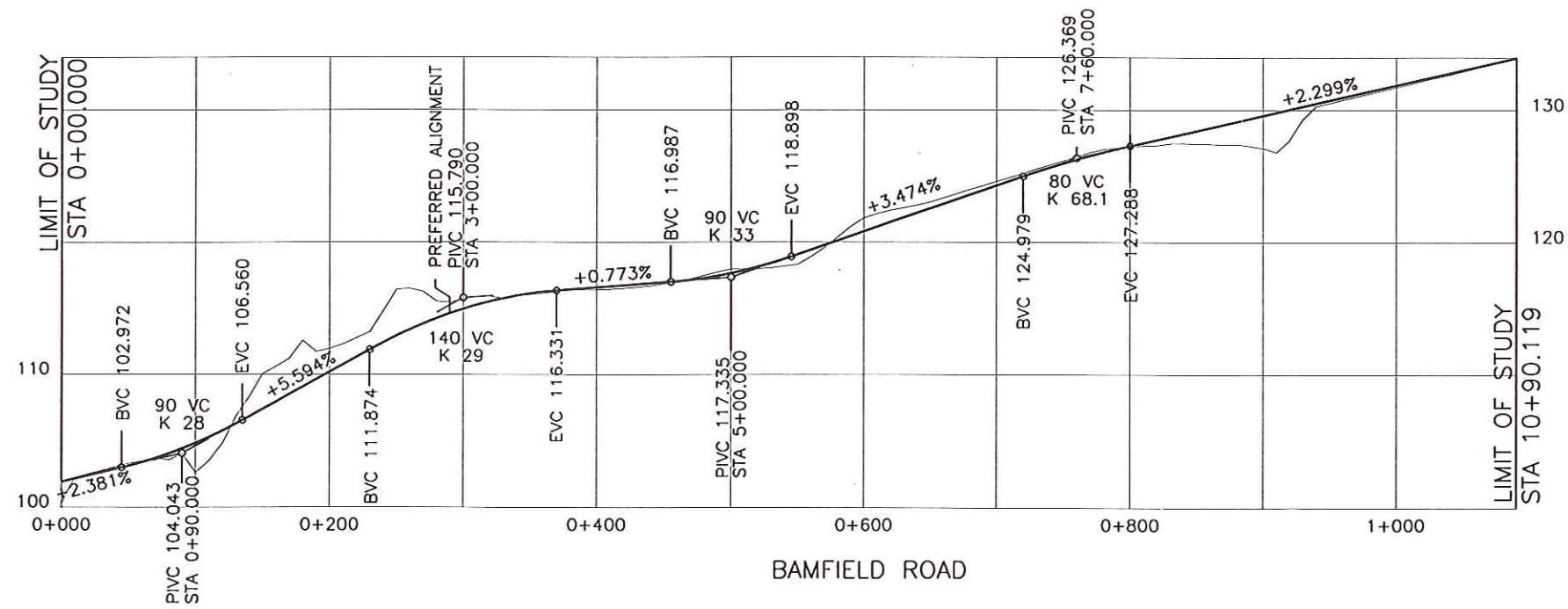
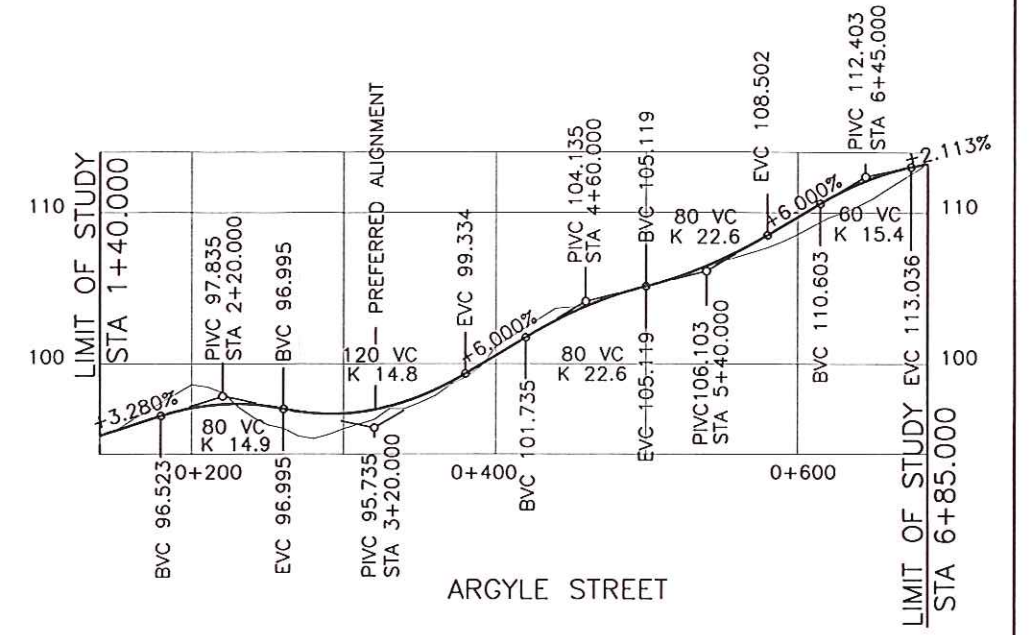
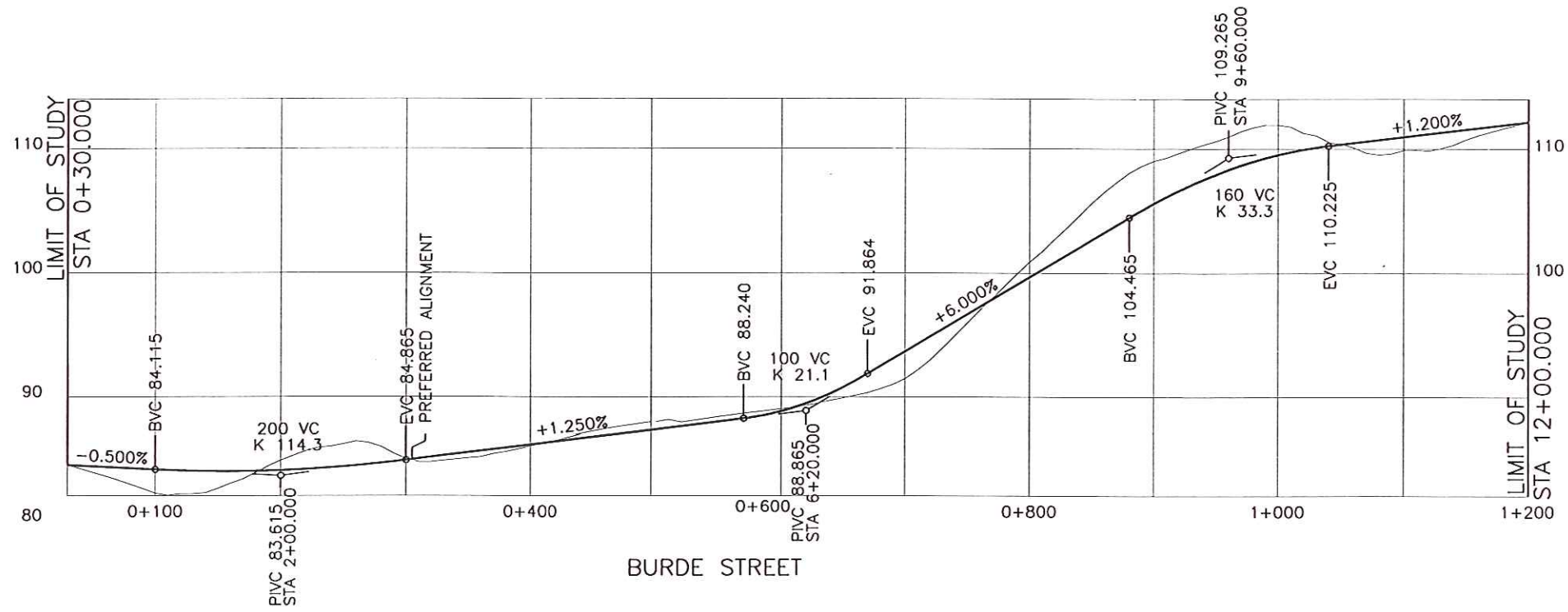


PORT ALBERNI BYPASS STUDY
PREFERRED ALIGNMENT
SCALE 1:10 000
FIGURE 5E

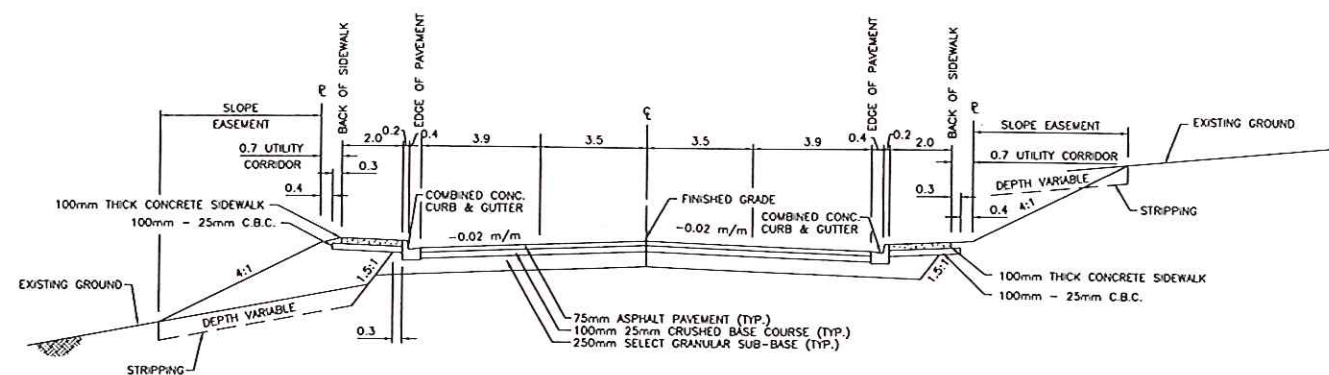


PORT ALBERNI BYPASS STUDY
SIDE ROAD PROFILES
SCALE 1:5000
FIGURE 5F

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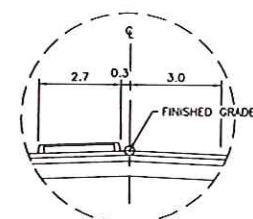


PORT ALBERNI BYPASS STUDY
SIDE ROAD PROFILES
SCALE 1:5000
FIGURE 5G

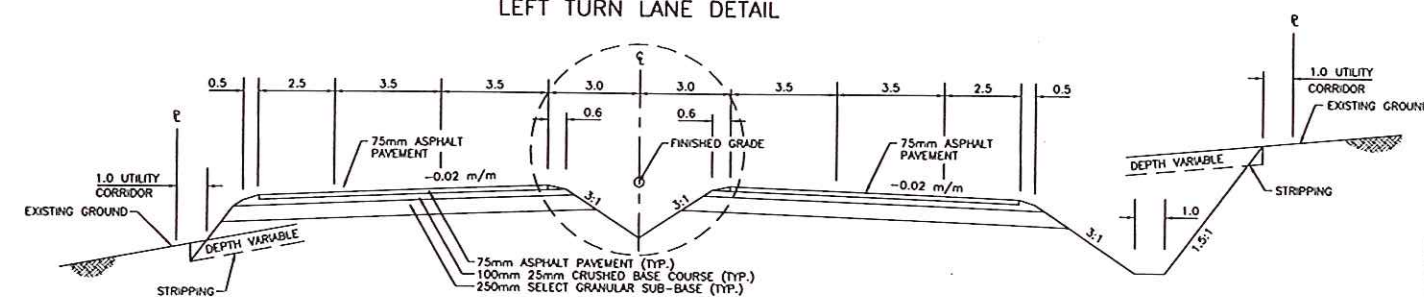


URBAN COLLECTOR UNDIVIDED - CURB AND GUTTER OPTION
O.M. CUT & FILL, PAVEMENT AND GRAVEL DETAILS
ALBERNI VALLEY EAST SIDE BYPASS

N.T.S.

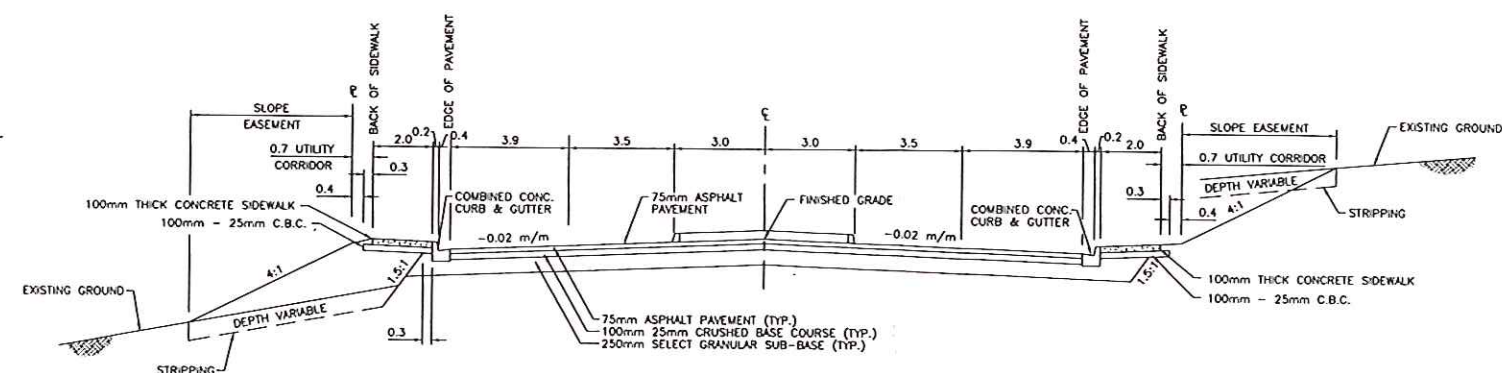


LEFT TURN LANE DETAIL



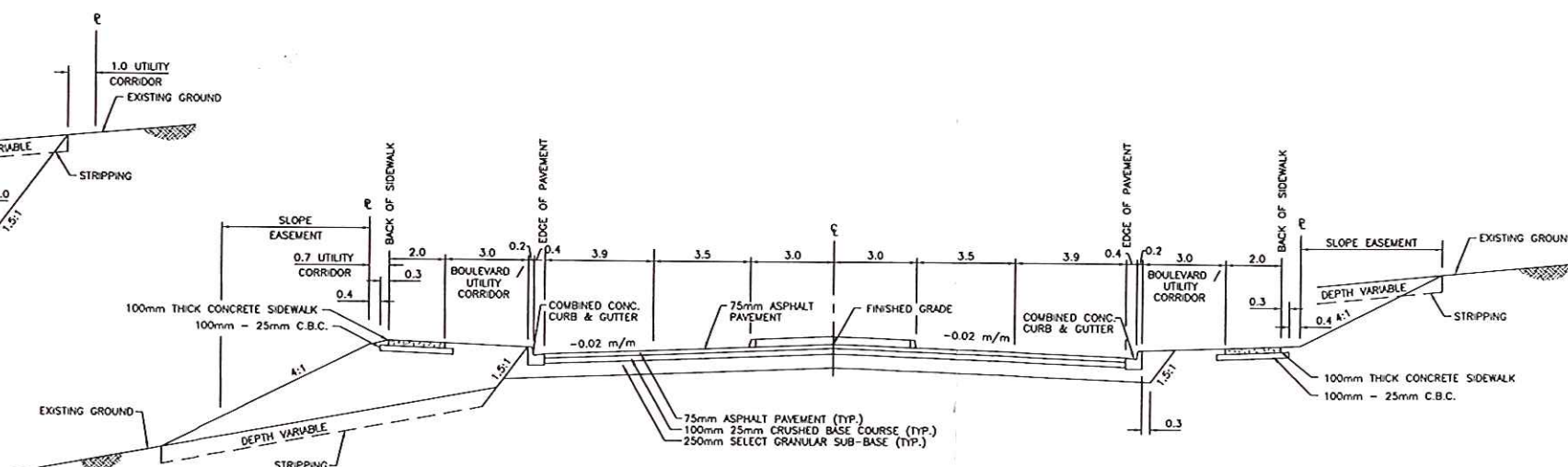
ARTERIAL HIGHWAY DIVIDED - OPEN SHOULDER OPTION
O.M. CUT & FILL, PAVEMENT AND GRAVEL DETAILS
ALBERNI VALLEY EAST SIDE BYPASS

N.T.S.



URBAN ARTERIAL DIVIDED - CURB AND GUTTER OPTION
O.M. CUT & FILL, PAVEMENT AND GRAVEL DETAILS
ALBERNI VALLEY EAST SIDE BYPASS

N.T.S.



URBAN ARTERIAL DIVIDED - CURB AND GUTTER WITH BOULEVARD OPTION
O.M. CUT & FILL, PAVEMENT AND GRAVEL DETAILS
ALBERNI VALLEY EAST SIDE BYPASS

N.T.S.



- development of the preferred alignment; and
- development of right-of-way requirements and cost estimates for the preferred alignment.

It is anticipated that subsequent phases of the design process including detailed design will inevitably involve refinement of the preferred Bypass alignment as presented herein. Therefore, a conservative approach to developing right-of-way requirements was employed.

Aerial photography was used to develop the base mapping used in this study. This is typical of Route Definition studies and it is recognized that subsequent phases of design, which employ field survey based mapping, often requires refinement of alignments. This is another reason that right-of-way requirements were developed in a conservative manner.

The study objectives listed in Section 1.4 generally focus efforts towards optimizing a road alignment giving consideration to design constraints and issues. Public consultation efforts incorporated into this study involved individual meetings with a large number of select stakeholders. The information obtained during these meetings was invaluable to the outcome of the study. It is very rare to establish a road alignment with full agreement from all parties affected. However, it is important to recognize that as development takes place in the absence of a protected road corridor, the ultimate impact of constructing a road dramatically increases. Conversely, it is very expensive to procure property far in advance of construction.

The City of Port Alberni has elected to adopt a reasonable approach whereby right-of-way requirements are identified and protective measures are initiated as required. Some sections of the Bypass may not be detailed and constructed for many years into the future; therefore, **it is recommended that field survey be undertaken as part of development applications to verify localized topography and Bypass cross section requirements.**

5.2 PLANS AND PROFILES

Plan drawings were developed by extracting applicable areas of base mapping provided by the City (Nadir Mapping Corporation).

Horizontal road alignment options were derived using the EMXS Surface Compiler Road Design System (EMXS). Horizontal alignment points of intersection (PI's) were located using Universal Transverse Mercator (UTM) projection coordinates included in the base mapping drawings.

Ground profiles were generated for each road alignment option by developing a digital terrain model from the three dimensional contour lines contained in the base mapping. Design profiles were then developed using the EMXS system.

Toes of cut and fill slopes were developed by "passing" a series of cross section templates along the horizontal and vertical alignments. The cross section templates used were "intelligent" templates developed using EMXS template programming. It should be noted that the width of driving lanes were increased to 3.7 m to ensure a conservative determination of toe locations. This was done to ensure that property definition lines would account for inaccuracies associated with the base mapping and level of design.

Right-of-way boundaries were developed by assessing cut and fill slope toes and then adding adequate widths for road maintenance purposes and environmental mitigation requirements, etc.

5.3 ENGINEER'S ESTIMATE

The engineer's estimate, included in **Appendix A**, was developed giving consideration to typical road construction unit rates and typical contract items. **The engineer's estimate does not include property costs. A 30% factor was applied to account for construction contingencies.**

Earth quantities were developed by using typical earth shrinkage factors within the EMXS system. Paving quantities were derived by assuming a typical pavement structure. Clear and grub areas were derived from the EMXS system. All other quantities were manually derived from the plan drawings.

It should be noted that a significant volume of embankment fill is required between Redford Road and Burde Street (approximately 315,000m³). This is partly due to the location of the alignment being over top of Wolf Creek (i.e. Wolf Creek is to be reconstructed). However; the greatest factor relates to the profile along Redford Road. The Preferred Bypass vertical alignment at the Redford Road intersection requires a large fill immediately south of Redford Road (approximately 15m). It was assumed that the current profile along Redford Road would be retained. This provided the worst case scenario with respect to right-of-way requirements.

It is recommended that the profile be re-evaluated along Redford Road as part of the Functional and Detailed design phases. A net savings may be achieved by reconstructing a section of Redford Road. This, however, would impact the existing Sahara Heights access and the proposed access to the West Coast Hospital.

Implementation phasing strategies were not detailed within this study. It is recommended that the City consider development of a Transportation Model which includes operational analysis features before finalizing construction phasing strategies. Development of a model could be undertaken as further route studies are considered for north of Highway No. 4. Typical strategies include:

- Phased implementation of laning (e.g. two lane roadway by constructing northbound lanes first);
- Phased implementation of segments of the Bypass (e.g. Redford Road to Highway No. 4 first);
- Phased implementation of traffic control devices (e.g. stop signs first); and

- Phased construction of pavement structures (e.g. planned pavement rehabilitation);

The Engineer's cost estimate, **Appendix A**, is considered to be a **Class D estimate**.

The accuracy is within +/- 30%.

APPENDIX A ENGINEER'S ESTIMATE

SCHEDULE 1
SCHEDULE OF APPROPRIATE QUANTITIES AND UNIT PRICES - ENGINEERS & SURVEYORS

PROJECT No.
CONTRACT No.
COMMITMENT No.

Alberni Valley East Side Bypass
Highway No 4 to Bamfield Road

ITEM No.	DESCRIPTION	NEAT LINE ESTIMATE				MOST LIKELY ESTIMATE			WORST CASE ESTIMATE		
		UNIT OF MEASURE	NEAT LINE QUANTITY	UNIT PRICE	EXTENDED AMOUNT	ML FACTOR	MOST LIKELY QUANTITY	EXTENDED AMOUNT	WC FACTOR	WORST CASE QUANTITY	EXTENDED AMOUNT
SECTION 1 - GENERAL											
1.01	MOBILIZATION	L.S.	1	1.00	1,021,029.00	1	1	1,116,096.00		1	1,173,483.00
1.02	PROVISION FOR TRAFFIC THROUGH THE WORK	L.S.	1	1.00	15,000.00	1	1	15,000.00		1	15,000.00
TOTAL SECTION 1					\$1,036,029.00			\$1,131,096.00			\$1,188,483.00
SECTION 2 - GRADING											
2.01	CLEARING AND GRUBBING AND REMOVALS										
2.01.01	Clearing	ha	30.0	7,000.00	210,000.00	1.00	30.0	210,000.00	1.17	35.0	245,000.00
2.01.02	Grubbing	ha	30.0	6,000.00	180,000.00	1.00	30.0	180,000.00	1.17	35.0	210,000.00
2.01.03	Remove and Dispose Concrete Curb and Gutter	m	15.0	40.00	600.00	1.00	15.0	600.00	1.00	15.0	600.00
2.01.04	Remove and Dispose Asphalt Curb	m	10.0	40.00	400.00	1.00	10.0	400.00	1.00	10.0	400.00
2.01.05	Remove and Dispose Concrete Road Barrier	m	5.0	15.00	75.00	1.00	5.0	75.00	1.00	5.0	75.00
2.01.06	Remove and Dispose Concrete	m2	12.0	25.00	300.00	1.00	12.0	300.00	1.00	12.0	300.00
2.01.07	Remove and Dispose Concrete Culverts	m	30.0	30.00	900.00	1.00	30.0	900.00	1.00	30.0	900.00
2.01.08	Remove Existing Catchbasin and Plug Lead	each	1.0	550.00	550.00	1.00	1.0	550.00	1.00	1.0	550.00
2.01.09	Remove Fence (Various Types)	m	50.0	100.00	5,000.00	1.00	50.0	5,000.00	1.00	50.0	5,000.00
2.02	ROADWAY & DRAINAGE EXCAVATION										
2.02.02	Type "D" Excavation	m3	503,900	5.00	2,519,500.00	1.01	510,000	2,550,000.00	1.09	550,000	2,750,000.00
2.02.03	Organic Stripping	m3	44,186	4.00	176,744.00	1.13	50,000	200,000.00	1.36	60,000	240,000.00
2.02.04	Waste Type "D" Excavation	m3	1,000	10.00	10,000.00	2.00	2,000	20,000.00	5.00	5,000	50,000.00
2.03	CUTTING, RIPPING, REMOVAL AND RECLAMATION OF EXISTING PAVEMENT										
2.03.01	Pavement Cutting, variable depth	m	100	7.00	700.00	1.00	100	700.00	1.00	100	700.00
2.03.02	Pavement Removal and Disposal	m2	50	15.00	750.00	1.00	50	750.00	1.00	50	750.00
2.04 GRANULAR MATERIALS											
2.04.01	Select Granular Sub-base	m3	38,743	12.00	464,916.00	1.03	40,000	480,000.00	1.16	45,000	540,000.00
2.05.03	25 mm Well Graded Base Course	m3	142,822	15.00	2,142,330.00	1.02	145,000	2,175,000.00	1.05	150,000	2,250,000.00
2.06 FOUNDATION EXCAVATION											
2.06.02	Type "D" Foundation Excavation	m3	500	12.00	6,000.00	4.00	2,000	24,000.00	4.00	2,000	24,000.00
2.07 CORRUGATED STEEL CULVERTS											
2.07.01	600 mm dia. CSP, 1.6 W.T.	m	30	100.00	3,000.00	1.00	30	3,000.00	1.00	30	3,000.00

**SCHEDULE 7
SCHEDULE OF APPROXIMATE QUANTITIES AND UNIT PRICES - ENGINEER'S ESTIMATE**

PROJECT No.
CONTRACT No.
COMMITMENT No.

Alberni Valley East Side Bypass
Highway No 4 to Bamfield Road

ITEM No.	DESCRIPTION	UNIT OF MEASURE	NEAT LINE ESTIMATE			MOST LIKELY ESTIMATE			WORST CASE ESTIMATE		
			NEAT LINE QUANTITY	UNIT PRICE	EXTENDED AMOUNT	M.L. FACTOR	MOST LIKELY QUANTITY	EXTENDED AMOUNT	W.C. FACTOR	WORST CASE QUANTITY	EXTENDED AMOUNT
2.08	CONCRETE PIPES										
2.08.01	Concrete Pipe, 200 dia.	m	150	180.00	27,000.00	1.00	150	27,000.00	1.00	150	27,000.00
2.08.02	Concrete Pipe, 675 dia.	m	150	240.00	36,000.00	1.00	150	36,000.00	1.00	150	36,000.00
2.08.03	Concrete Pipe, 750 dia.	m	50	240.00	12,000.00	1.00	50	12,000.00	1.00	50	12,000.00
2.09	CATCH BASINS AND MANHOLES										
2.09.01	Concrete Manhole, 1200 mm dia.	each	2	3,000.00	6,000.00	1.00	2	6,000.00	1.00	2	6,000.00
2.09.04	CB 0.9x750 mm dia. with single grate and frame	each	10	1,100.00	11,000.00	1.00	10	11,000.00	1.00	10	11,000.00
2.09.05	CB 0.9x750 mm dia. with double grate and frame	each	2	1,500.00	3,000.00	1.00	2	3,000.00	1.00	2	3,000.00
2.10	SANITARY SEWER										
2.10.01	100 mm dia. perf. PVC pipe	m	30	45.00	1,350.00	1.00	30	1,350.00	1.00	30	1,350.00
2.12	CONCRETE SANDBAGS										
		each	200	10.00	2,000.00	1.25	250	2,500.00	1.25	250	2,500.00
2.13	RIPRAP										
2.13.01	Class 10	m ³	100	50.00	5,000.00	5.00	500	25,000.00	5.00	500	25,000.00
2.13.02	Class 25	m ³	100	55.00	5,500.00	1.50	150	8,250.00	1.50	150	8,250.00
2.15	WATERMAINS										
2.15.01	Watermain, PVC 150 mm dia. CL150	m	25	65.00	1,625.00	1.00	25	1,625.00	1.00	25	1,625.00
2.15.02	Steel Casing with Casing Spacer, 300 mm dia.	m	60	210.00	12,600.00	1.00	60	12,600.00	1.00	60	12,600.00
2.15.03	Gate Valves	each	1	800.00	800.00	1.00	1	800.00	1.00	1	800.00
2.15.05	Fire Hydrant	each	6	3,000.00	18,000.00	1.00	6	18,000.00	1.00	6	18,000.00
2.15.06	Flushout	each	2	600.00	1,200.00	1.00	2	1,200.00	1.00	2	1,200.00
2.18	UTILITY LINE PROTECTION										
		m	30	110.00	3,300.00	1.00	30	3,300.00	1.00	30	3,300.00
TOTAL SECTION 2					5,868,140.00			6,029,900.00			6,490,900.00
SECTION 3 - PAVING											
3.01	SPRAY PRIMER AND TACK COAT	litre	170,000	0.11	18,700.00	1.03	175,000	19,250.00	1.18	200,000	22,000.00
3.02	ASPHALT PAVEMENT	m ³	9,350	55.00	514,250.00	1.07	10,000	550,000.00	1.60	15,000	825,000.00
3.04	CONCRETE CURBS										
3.04.01	Island and Median Curb	m	500	60.00	30,000.00	1.00	500	30,000.00	1.00	500	30,000.00
3.04.02	Concrete Curb and Gutter	m	1,000	45.00	45,000.00	1.00	1,000	45,000.00	1.00	1,000	45,000.00
3.04.03	Extruded Concrete Curb (Supply and Place) (250 mm base width)	m	1,000	20.00	20,000.00	1.00	1,000	20,000.00	1.00	1,000	20,000.00
3.05	CONCRETE SIDEWALK	m ²	500	35.00	17,500.00	1.20	600	21,000.00	1.20	600	21,000.00
3.08	CONCRETE DRIVEWAY	m ²	50	40.00	2,000.00	2.00	100	4,000.00	2.00	100	4,000.00
3.07	CONCRETE SIDEWALK AND ISLAND RAMPS	m ²	78	40.00	3,120.00	1.28	100	4,000.00	1.28	100	4,000.00
3.07	TRAFFIC ISLANDS AND TREATMENT	m ²	200	30.00	6,000.00	1.25	250	7,500.00	1.25	250	7,500.00

SCHEDULE 7
SCHEDULE OF APPROXIMATE QUANTITIES AND UNIT PRICES - ENGINEER'S ESTIMATE

PROJECT No.
CONTRACT No.
COMMITMENT No.

Alberni Valley East Side Bypass
Highway No 4 to Bamfield Road

ITEM No.	DESCRIPTION	UNIT OF MEASURE	NEAR LINE ESTIMATE			MOST LIKELY ESTIMATE			WORST CASE ESTIMATE		
			QUANTITY	UNIT PRICE	EXTENDED AMOUNT	QTY	QUANTITY	EXTENDED AMOUNT	WC FACTOR	QUANTITY	EXTENDED AMOUNT
3.05	DRAINAGE OUTLETS AND DRAINAGE CURB										
3.05.01	Paved Outfalls	each	6	300.00	1,800.00	1.00	6	1,800.00	1.00	6	1,800.00
3.05.02	Piped Outfalls	each	6	300.00	1,800.00	1.00	6	1,800.00	1.00	6	1,800.00
3.05.03	Asphalt Drainage Curb	each	30	20.00	600.00	1.00	30	600.00	1.00	30	600.00
3.06	PRECAST REINFORCED CONCRETE BARRIER										
3.06.01	CBN-1H (Drawing 11-SP323)	each	10	22.00	220.00	1.00	10	220.00	1.00	10	220.00
3.06.02	CLB-1 (Drawing 11-SP323)	each	10	22.00	220.00	1.00	10	220.00	1.00	10	220.00
3.06.03	CTB-1 (Drawing 11-SP323)	each	10	22.00	220.00	1.00	10	220.00	1.00	10	220.00
3.06.04	CRB-M (Drawing 11-SP323)	each	50	22.00	1,100.00	1.00	50	1,100.00	1.00	50	1,100.00
3.06.05	CRB-F (Drawing 11-SP323)	each	10	22.00	220.00	1.00	10	220.00	1.00	10	220.00
3.06.06	CTB-2 (Drawing 12-SP323)	each	2	22.00	44.00	1.00	2	44.00	1.00	2	44.00
3.06.07	CMB-M (Drawing 13-SP323)	each	50	22.00	1,100.00	1.00	50	1,100.00	1.00	50	1,100.00
3.06.08	CMB-F (Drawing 14-SP323)	each	10	22.00	220.00	1.00	10	220.00	1.00	10	220.00
3.06.09	CDB-1 (Drawing 16-SP323)	each	50	22.00	1,100.00	1.00	50	1,100.00	1.00	50	1,100.00
3.07	ADJUST CATCHBASIN FRAMES AND GRATES (Provisional Item)	each	2	250.00	500.00	1.00	2	500.00	1.00	2	500.00
3.08	TEMPORARY PAVEMENT MARKINGS										
3.08.01	Temporary Pavement Markings (Provisional Item)	m	30	2.00	60.00	1.00	30	60.00	1.00	30	60.00
3.08.02	Eradicate Pavement Markings (Provisional Item)	m	30	3.25	97.50	1.00	30	97.50	1.00	30	97.50
3.09	REMOVAL OF EXISTING ASPHALT CURB	m	10	6.00	60.00	1.00	10	60.00	1.00	10	60.00
TOTAL SECTION 3					665,931.50			710,111.50			987,661.50
SECTION 5 - ELECTRICAL											
5.01	CONCRETE BASES										
5.01.01	Type A Concrete Bases	each	10	350.00	3,500.00	1.00	10	3,500.00	1.00	10	3,500.00
5.01.02	Type C Concrete Bases	each	6	450.00	2,700.00	1.00	6	2,700.00	1.00	6	2,700.00
5.01.03	Type L Concrete Bases	each	4	1,500.00	6,000.00	1.00	4	6,000.00	1.00	4	6,000.00
5.01.04	Controller Bases for Type S Cabinet	each	4	750.00	3,000.00	1.00	4	3,000.00	1.00	4	3,000.00
5.01.05	Type L Adapters	each	4	500.00	2,000.00	1.00	4	2,000.00	1.00	4	2,000.00
5.02	JUNCTION BOXES										
5.02.01	Relocate Junction Box	each	1	120.00	120.00	1.00	1	120.00	1.00	1	120.00
5.03	CONCRETE JUNCTION BOXES AND VAULTS										
5.03.01	Concrete Junction Boxes	each	6	800.00	4,800.00	1.00	6	4,800.00	1.00	6	4,800.00
5.04	CONDUIT										
5.04.01	1" R.P.V.C. Conduit	m	30	3.50	105.00	1.00	30	105.00	1.00	30	105.00
5.04.02	2" R.P.V.C. Conduit	m	30	6.50	195.00	1.00	30	195.00	1.00	30	195.00
5.04.03	1 3/4" Rigid Steel Conduit	m	30	9.90	297.00	1.00	30	297.00	1.00	30	297.00
5.05	TRENCHING AND BACKFILLING										
5.05.01	Trenching and Backfilling (All Materials)	m	100	14.00	1,400.00	2.00	200	2,800.00	2.00	200	2,800.00
5.06	25 mm WELL GRADED BASE COURSE AGGREGATE	m3	500	30.00	15,000.00	1.20	600	18,000.00	1.20	600	18,000.00
5.07	REMOVAL OF EXISTING UNDERGROUND EQUIPMENT	L.S.		1.00	5,000.00			5,000.00			5,000.00
5.08	SIGNAL POLES										
5.08.01	Pole	L.S.	1	15,000.00	15,000.00	1.00	1	15,000.00	1.00	1	15,000.00

SCHEDULE 1
SCHEDULE OF APPROXIMATE QUANTITIES AND UNIT PRICES - ENGINEER'S ESTIMATE

PROJECT No.
CONTRACT No.
COMMITMENT No.

Alberni Valley East Side Bypass
Highway No 4 to Bamfield Road

ITEM No.	DESCRIPTION	UNIT OF MEASURE	NEAT LINE ESTIMATE			MOST LIKELY ESTIMATE			WORST CASE ESTIMATE		
			NEAT LINE QUANTITY	UNIT PRICE	EXTENDED AMOUNT	M.L. FACTOR	MOST LIKELY QUANTITY	EXTENDED AMOUNT	W.C. FACTOR	WORST CASE QUANTITY	EXTENDED AMOUNT
5.09	LUMINAIRE POLES										
5.09.01	Relocate Luminaire Pole	each	10	300.00	3,000.00	1.00	10	3,000.00	1.00	10	3,000.00
5.10	SERVICE EQUIPMENT										
5.10.01	100A - Overhead Drop Service (Service No. 1)	L.S.	1	1,000.00	1,000.00	1.00	1	1,000.00	1.00	1	1,000.00
5.11	WIRING										
5.11.01	Underground Wiring	L.S.	1	1,000.00	1,000.00	1.00	1	1,000.00	1.00	1	1,000.00
5.12	DETECTOR LOOPS										
5.12.01	Diamond Detector Loops	each	4	350.00	1,400.00	1.00	4	1,400.00	1.00	4	1,400.00
5.12.02	Quadrupole Detector Loops	each	6	450.00	2,700.00	1.00	6	2,700.00	1.00	6	2,700.00
5.13	FLASHER LUMINAIRE ON POLES										
5.13.01	Flasher Luminaire on Pole (1 Sign)	each	4	200.00	800.00	1.00	4	800.00	1.00	4	800.00
5.13.02	Flasher Luminaire on Pole (2 Signs)	each	2	250.00	500.00	1.00	2	500.00	1.00	2	500.00
5.14	REMOVAL OF EXISTING ELECTRICAL EQUIPMENT										
5.14.01	Removal of Existing Electrical Equipment	L.S.	1	500.00	500.00	1.00	1	500.00	1.00	1	500.00
5.15	SIGN POLES										
5.15.01	Advance Warning Sign A1 (TE-94062-9)	L.S.	1	3,000.00	3,000.00	1.00	1	3,000.00	1.00	1	3,000.00
5.15.02	Advance Warning Sign A2 (TE-94062-9)	L.S.	1	6,000.00	6,000.00	1.00	1	6,000.00	1.00	1	6,000.00
5.16	SIGNS										
5.16.01	One Post Signs	each	30	130.00	3,900.00	1.00	30	3,900.00	1.00	30	3,900.00
5.16.02	Two Post Signs	each	15	200.00	3,000.00	1.00	15	3,000.00	1.00	15	3,000.00
5.16.03	One Post Signs to Concrete Median Barrier	each	6	100.00	600.00	1.00	6	600.00	1.00	6	600.00
TOTAL SECTION 5					\$86,517.00			\$90,917.00			\$90,917.00
SECTION 6 - PROVISIONAL SUMS											
6.01	REMOVAL OF DANGER TREES	PS	1	1,000.00	1,000.00	1.00	1	1,000.00	1.00	1	1,000.00
6.02	REDUCE MOISTURE CONTENT OF EXCAVATED MATERIALS	PS	1	3,000.00	3,000.00	1.00	1	3,000.00	1.00	1	3,000.00
6.03	SCREENING TOPSOIL	PS	1	5,000.00	5,000.00	1.00	1	5,000.00	1.00	1	5,000.00
6.04	INCREASED COMPACTION	PS	1	6,000.00	6,000.00	1.00	1	6,000.00	1.00	1	6,000.00
6.05	REGRADE AREA	PS	1	5,000.00	5,000.00	1.00	1	5,000.00	1.00	1	5,000.00
6.06	MODIFICATIONS ON SITE	PS	1	5,000.00	5,000.00	1.00	1	5,000.00	1.00	1	5,000.00
6.07	PROJECT SECURITY	PS	1	1,000.00	1,000.00	1.00	1	1,000.00	1.00	1	1,000.00
6.08	Adjust Existing Municipality Utilities to New Grades	PS	1	2,000.00	2,000.00	1.00	1	2,000.00	1.00	1	2,000.00
TOTAL SECTION 6					28,000.00			28,000.00			28,000.00
SUMMARY:											
SECTION 1 - GENERAL					1,036,029.00			1,131,096.00			1,188,483.00
SECTION 2 - GRADING					5,868,140.00			6,020,900.00			6,430,900.00
SECTION 3 - PAVING					665,931.50			710,111.50			987,861.50
SECTION 4 - BRIDGE CONSTRUCTION					13,800,000.00			15,500,000.00			15,900,000.00
SECTION 5 - ELECTRICAL					86,517.00			90,917.00			90,917.00
SECTION 6 - PROVISIONAL SUMS					28,000.00			28,000.00			28,000.00
SUB-TOTAL CONTRACT WORK					\$21,464,617.50			\$23,481,014.50			\$24,839,181.50
30% Contingency Allowance					6,126,178.55			6,695,578.55			7,040,903.55
TOTAL CONTRACT WORK					\$27,590,796.05			\$30,176,593.05			\$31,880,085.05
B. WORK BY CITY (or Contractor)											
1. Hydroseeding	ha	28	3,500.00	9,800.00	1.00	28	9,800.00	1.00	28	9,800.00	
2. Road Marking	km	15.0	2,000.00	30,000.00	1.00	15.0	30,000.00	1.00	15.0	30,000.00	
3. Stimsonite Reflectors	each	100	30.00	3,000.00	1.00	100	3,000.00	1.00	100	3,000.00	
4. Engineering - Design	L.S.	1	575,000.00	575,000.00	1.00	1	575,000.00	1.00	1	575,000.00	
5. Engineering - General Engineering	L.S.	1	25,000.00	25,000.00	1.00	1	25,000.00	1.00	1	25,000.00	
6. Engineering - Construction Inspection	L.S.	1	30,000.00	30,000.00	1.00	1	30,000.00	1.00	1	30,000.00	
SUB-TOTAL WORK BY CITY					\$172,800.00			\$172,800.00			\$172,800.00

SCHEDULE 7
SCHEDULE OF APPROXIMATE QUANTITIES AND UNIT PRICES - ENGINEER'S ESTIMATE

PROJECT No.
CONTRACT No.
COMMITMENT No.

Alberni Valley East Side Bypass
Highway No 4 to Bamfield Road

ITEM No.	DESCRIPTION	NEAR LINE ESTIMATE			MOST LIKELY ESTIMATE			WORST CASE ESTIMATE			
		UNIT OF MEASURE	NEAR LINE QUANTITY	UNIT PRICE	EXTENDED AMOUNT	M.L. FACTOR	MOST LIKELY QUANTITY	EXTENDED AMOUNT	W.C. FACTOR	WORST CASE QUANTITY	EXTENDED AMOUNT
C.	MATERIALS SUPPLIED BY CITY (or Contractor)										
1.	AC-8 Asphalt (5.5% of Item 3.02)	tonne	1,157	225.00	260,325.00	1.07	1,237	278,325.00	1.60	1,856	417,600.00
2.	RM-20 Primer	L	170,000	0.30	51,000.00	1.03	175,000	52,500.00	1.18	200,000	60,000.00
3.	Concrete Barriers										
a)	CBN-1H (Drawing 1-SP323)	each	10	70.00	700.00	1.00	10	700.00	1.00	10	700.00
b)	CLB-1 (Drawing 1-SP323)	each	10	120.00	1,200.00	1.00	10	1,200.00	1.00	10	1,200.00
c)	CTB-1 (Drawing 9-SP323)	each	10	120.00	1,200.00	1.00	10	1,200.00	1.00	10	1,200.00
d)	CRB-M (Drawing 10-SP323)	each	50	140.00	7,000.00	1.00	50	7,000.00	1.00	50	7,000.00
e)	CRB-F (Drawing 11-SP323)	each	10	140.00	1,400.00	1.00	10	1,400.00	1.00	10	1,400.00
f)	CTB-2 (Drawing 12-SP323)	each	2	130.00	260.00	1.00	2	260.00	1.00	2	260.00
g)	CMB-M (Drawing 13-SP323)	each	50	150.00	7,500.00	1.00	50	7,500.00	1.00	50	7,500.00
h)	CMB-F (Drawing 14-SP323)	each	10	150.00	1,500.00	1.00	10	1,500.00	1.00	10	1,500.00
i)	CDB-1 (Drawing 16-SP323)	each	50	150.00	7,500.00	1.00	50	7,500.00	1.00	50	7,500.00
j)	Bridge Parapet Transition (Dwg. 2784-2)	each	8	150.00	1,200.00	1.00	8	1,200.00	1.00	8	1,200.00
k)	Temporary Barrier	m	500	50.00	25,000.00	1.00	500	25,000.00	1.00	500	25,000.00
4.	Electrical	L.S.	1	15,000.00	15,000.00	1.00	1	15,000.00	1.00	1	15,000.00
	SUB-TOTAL MATERIALS				\$318,785.00			\$409,215.00			\$647,895.00
D.	OTHER WORK										
	Environmental Mitigation (includes Wolf Creek)				300,000.00			350,000.00			360,000.00
	Landscaping				10,000.00			15,000.00			20,000.00
	Utilities				1,500,000.00			2,000,000.00			2,000,000.00
	Rogers Creek Bridge (See Summary Section 4.0)				7,800,000.00			8,000,000.00			8,200,000.00
	Owatschek Creek Bridge (See Summary Section 4.0)				6,000,000.00			7,500,000.00			7,700,000.00
	SUB-TOTAL OTHER WORK (excludes Bridges)				\$1,818,000.00			\$2,365,000.00			\$2,340,000.00
	TOTAL				\$30,474,379.65			\$33,615,618.05			\$35,326,925.05

Total Length = 6.625
 Cost per km (Includes Bridges) = \$4,599,906.27
 Cost per km (Excludes Bridges) = \$1,891,981.74

\$5,074,068.12
\$2,032,556.69

\$5,332,366.05
\$2,212,366.05