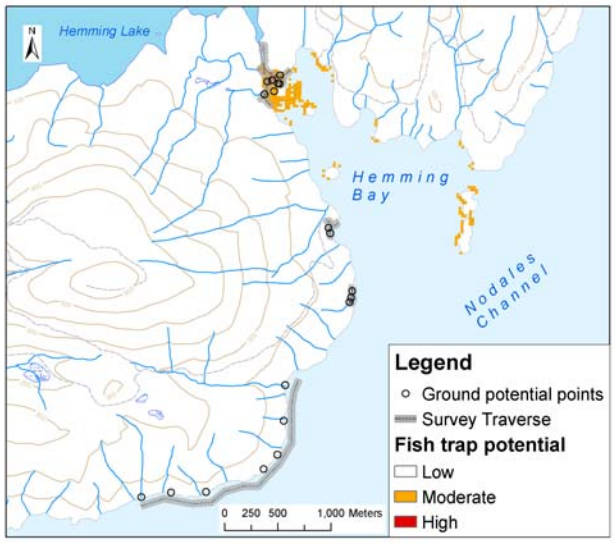
Permit 2007-048:
Campbell River Forest District
Archaeological Overview Assessment

Prepared for:
Campbell River Forest District,
Ministry of Forests and Range



Submitted to:
The Da'naxda'xw First Nation
The Hamatla Treaty Society
The Homalco First Nation
The Klahoose First Nations
The Mamalilikula-Qwe'Qwa'Sot'Enox Band
The Namgis First Nation
The Sliammon First Nation
The Tlowitsis Tribe
The Qualicum First Nation
The Mowachat/Muchalaht First Nations
The K'omoks First Nation
and
The Archaeology Branch



In partial fulfilment of:
Permit 2007-048

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Management Summary

This Archaeological Overview Study is mainly concerned with producing an updated Archaeological Potential Model and mapping for the area. Seven models were created using sophisticated data analysis and model building tools. Ground truthing confirmed the general accuracy of the models and allowed some fine-tuning.

These include CMTs, Shell Midden/Habitation, Fish Trap, Pictograph, Petroglyph, and Trench Embankment/Refuge. The models were created after extensive analysis of site type correlation with known sites, and building models using tools to measure model efficiency. In addition to many variables typically used in model building, several innovative variables were also used. These include the use of custom terrain modelling features, a measure of shoreline crenellation, and a measure of fetch from prevailing storm winds. The models are performing probably as well as can be obtained with present data, although new knowledge of site locations, especially in inland areas, would require some changes. Two principal new data sources could substantially improve the models: a more detailed digital elevation model (DEM); and shorezone mapping.

As part of the ground-truthing, site locations were corrected for about one-quarter of the sites in the eastern district. However, it was found that another quarter of the sites were too poorly recorded to be sure of even their location. Additional recorded sites missing from the provincial inventory came to light during this process that resulted in 19 new CMT sites added to the provincial registry.

Ground truthing visited a number of diverse locations, recording over two hundred ground truthing points and recorded 21 new archaeological sites and revisited three previously recorded ones. The new sites included CMTs, shell middens, a rockshelter burial, an historic graveyard, a fish weir, an intertidal lithic, clam gardens, and intertidal rock features.

The project increased the inventory of registered CMT sites in the Forest District by a third.

<u>Recommendations:</u>

The distribution of yellow cedar CMTs should be investigated with ground truthing or preliminary field reconnaissance of stands with a high (>20%) content of yellow cedar.

The large rivers inland of the coast and large lakes over 100 ha have had little archaeological investigation to date. This present study and the Baseline 2004 study examined small amounts of such areas (and all have returned negative results to date), but parts of these areas still retain potential.

The 25% of previously recorded sites that are too poorly recorded to be confidently mapped are a real problem for the long-term management of archaeological sites in the district. A series of inventories concentrating on shorelines is recommended to improve the quality of the registered inventory and find a great many previously undiscovered sites.

Several First Nations expressed interest in attending a training workshop on using the models in GIS or Google Earth format. This had been proposed for a second stage of the project, to occur in the new fiscal year.

For most models, including the 'old growth CMT model', areas with moderate to high potential should be at a minimum reviewed by an archaeologist. PFR or AIA followup is expected to be appropriate for many such areas.

For areas with low potential for other models, but moderate or high potential in the "Veteran CMT" model, detailed cruise plot or other means by forestry professionals should be used to determine if veteran or snag western redcedar or yellow cedar are present in the development area. The Veteran CMT model is considered to be more of a 'checklist' than a guide to where field assessment is likely required. However, a substantial number of CMTs have been found in such areas.

In use, the midden model should be considered somewhat conservative along marine shorelines (with moderate potential often meaning high potential), and the size of polygons of higher potential can be expected to be slightly enlarged by review. In river valleys where the midden model shows moderate to high potential, office review using more detailed elevation mapping would be appropriate prior to conducting any archaeological field work. Unless there is historical or traditional use evidence for a habitation, relatively low locations in the flood plain should be considered low potential.

The areas investigated by this study (particularly shorelines) where nothing was found cannot be considered thoroughly inventoried. In fact, the discovery of extensive shell midden deposits at the revisit of a site within a recent AIA area (where only a tiny midden was previously recorded) suggests that even AIA results should not automatically be regarded as final.

It was clear from the amount of recent development in the area, some of it obviously having impacted archaeological sites, that archaeological impact assessments are often not being required of non-forestry coastal developments in the area. It is recommended that the Archaeology Branch approach local governments to include archaeological resource management in the development or building permit process. An initiative to undertake this has recently started; it is clear that this is very much needed.

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Introduction

The Campbell River Forest District (CRFD) contracted Millennia Research Limited (Millennia) to update archaeological predictive models in the eastern portion of the CRFD. The work was not intended to be a full-blown Archaeological Overview Assessment as these have been completed previously in large parts of the district. However, many parts of a typical overview were conducted, including components of background research of previous archaeological work, digital site location corrections, and ground truthing field work. Several First Nations took part directly or indirectly in the study.

The work began with the award of contract in mid-December 2006. Data gathering and background research took place in the remainder of December and early January, and January and February were taken up with analysing data, creating draft models and applying for a permit. Preliminary field reconnaissance ground-truthing was conducted in mid-March. Several meetings with First Nation representatives occurred during this time. The field results were analysed, site inventory forms prepared, models updated, and the report prepared in late March.

Millennia Research Limited undertook most of the work directly. Millennia has extensive experience in archaeological predictive modelling, and has developed in-house analytical and modelling software aids and a unique approach to modelling terrain features with archaeological potential. Most of the GIS work took place using Millennia's facilities; some high-end terrain modelling algorithms and large-format plotting was subcontracted to Timberline Natural Resources Group.

Study Area

The study area for this project consists of the eastern portion of the Campbell River Forest District (Figure 1) from just south of Knight Inlet to Comox and Courtenay, including Johnstone Strait and northern part of the Strait of Georgia. To the east it extends to and includes Quadra Island, and to west it includes Strathcona and Schoen Lake Provincial Parks. It covers an approximate area of 1,153,480 ha in total.

The study area comprises a number of biogeoclimatic zones (Figure 2), and ecosections (Figure 3). From south to north, the ecosections include the Nanaimo Lowland, the Outer Fjordland, the Leeward Island Mountains, and the Northern Mountain Islands. Biogeoclimatic zones include, from low elevation to high, the Coastal Western Hemlock, Mountain Hemlock, and Alpine Tundra zones . The entire study area is north of the Coastal Douglas Fir zone, that remarkably dry band that closely correlates with the 'natural area' defined by Mitchell (1971) as the Gulf of Georgia with its associated archaeological sequence.

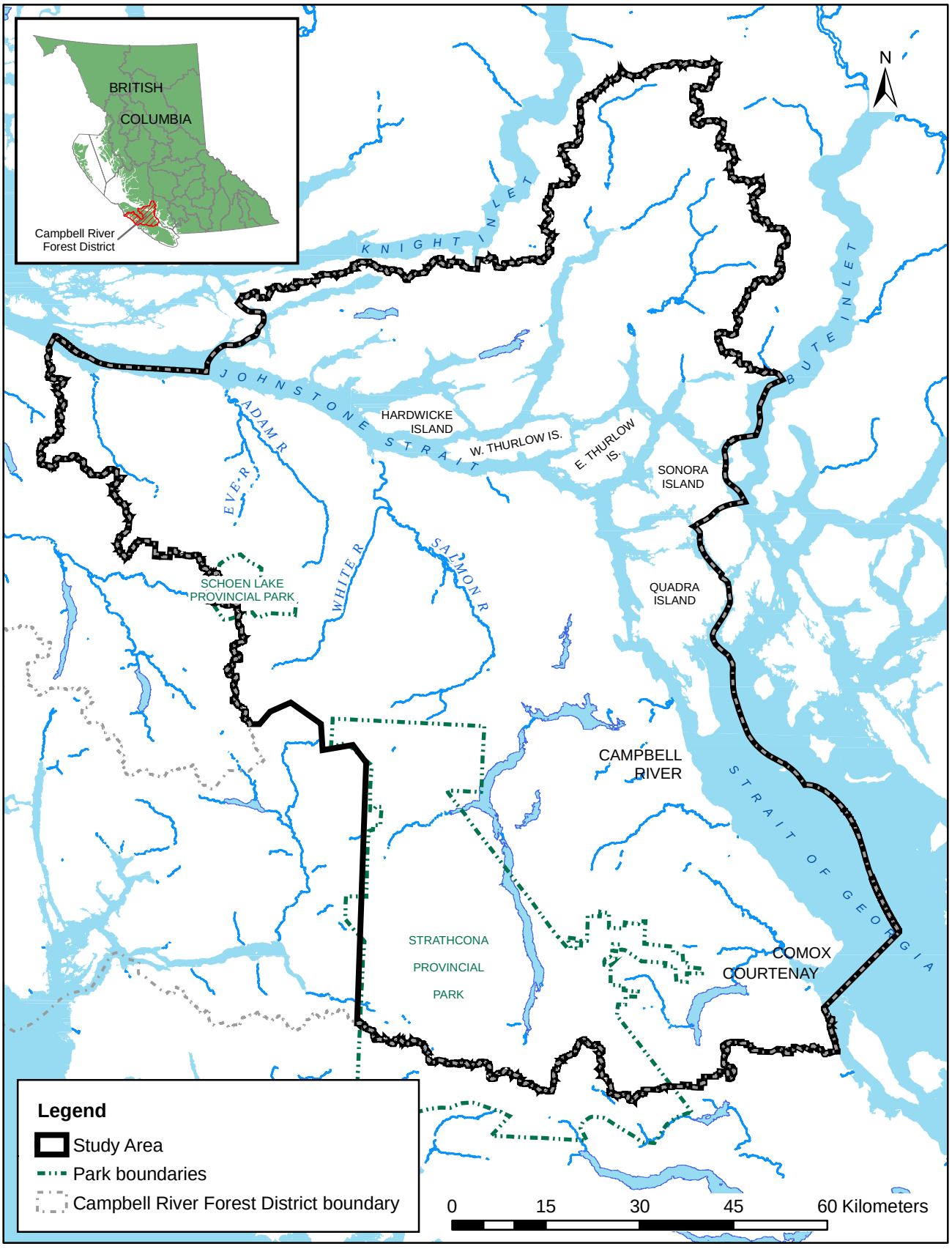


Figure 1. Study area.

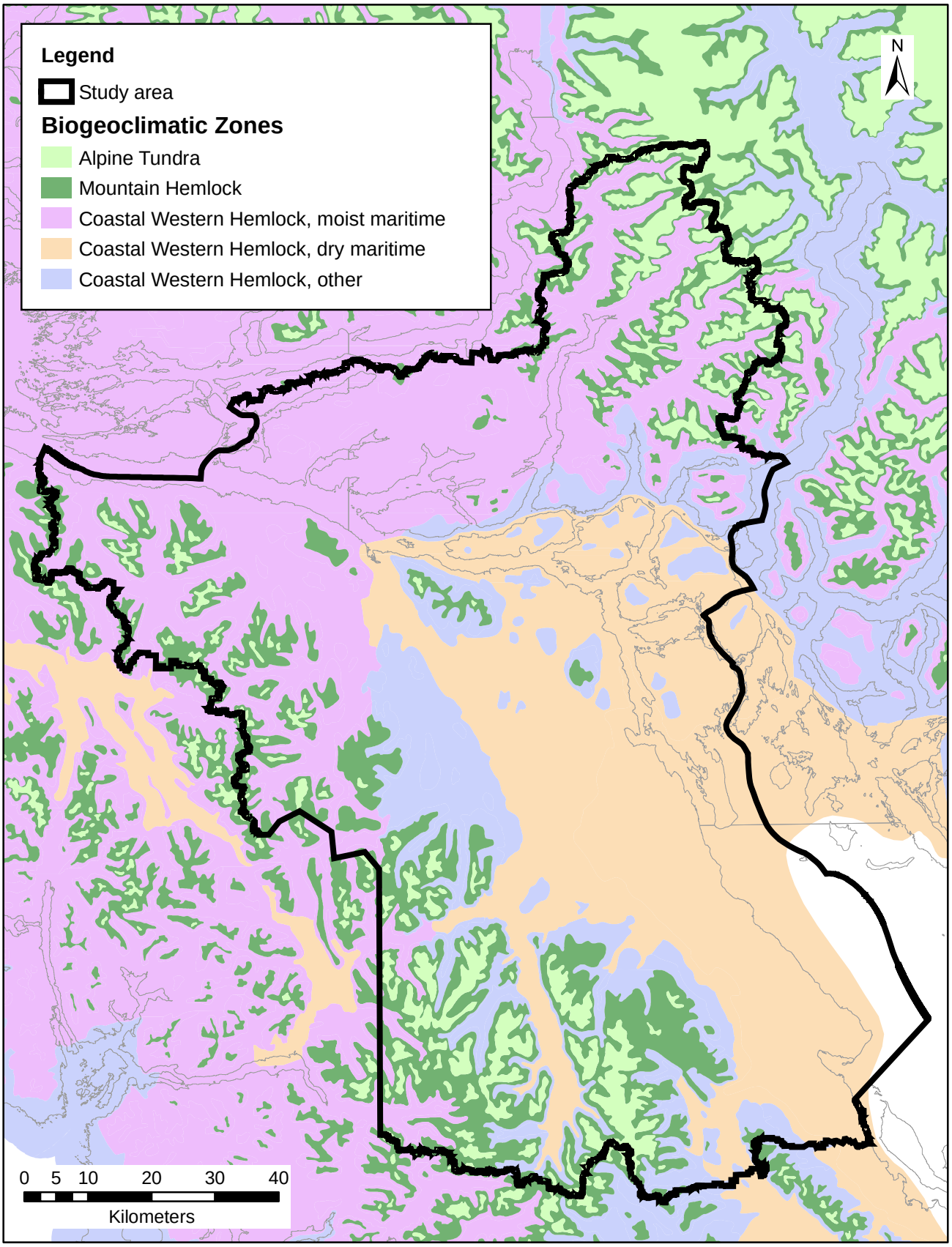


Figure 2. Biogeoclimatic zones.

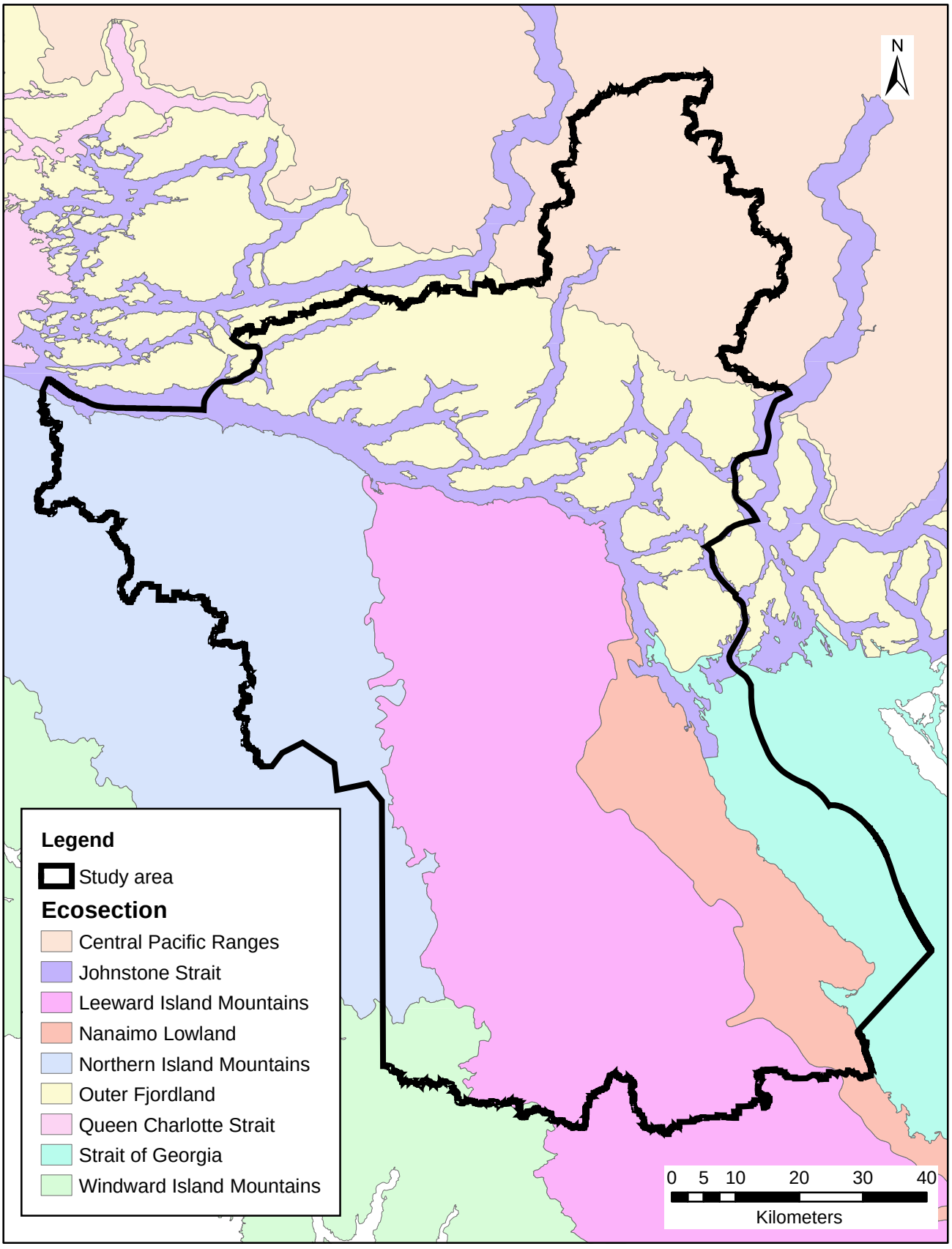


Figure 3. Ecosections.

First Nations

The study area is within the traditional territories of the Campbell River, Kwiakah, and Cape Mudge First Nations (all part of the Hamatla Treaty Society), the Mamalilikulla Qwe-Qwa'Sor'Em First Nation, Namgis First Nation, Da'naxda'xw First Nation, as well as the K'omox, Homalco, and Klahoose First Nations, the Tlowitsis First Nation, and Qualicum and Sliammon First Nations (Figure 4). Several of these groups have only a minor overlap between the study area and their declared traditional territories. In some cases, the First Nation requested that A detailed discussion of the First Nations of the study area is beyond the scope of this report. Several overviews of the ethnography of the First Nations of Vancouver Island in the study area are available (Bouchard, et al. 1993; Codere 1990; Kennedy and Bouchard 1990; Wilson, et al. 1992). Wilson, et al. 1992 is particularly useful as it provides a brief summary of each group's language and history, including (where appropriate) the sequence of movements from village to village from late precontact to modern times.

The Qualicum and Sliammon First Nations are in the extreme south of the study area and the only Salishan speakers. The remainder of the First Nations are Kwakwala speakers (although the K'omox were originally Salishan speakers but have gradually become Kwakwala speakers). Salishan place names are found to the Salmon River and just beyond. Kwakwala speakers aggressively expanded their territory southward in response to warfare and other pressures in the early historic, but pre-colonial, time period (Bouchard, et al. 1993: 101-102; Schaepe 2006: 677).

Previous Archaeological Research

The Strait of Georgia has a relatively well-known cultural sequence derived from a great many archaeological investigations. However, the northern Strait remains much less investigated than those areas to the south and there are indications that the archaeological record is slightly different in the two areas (Eldridge 1987; Mitchell 1985). A distinction continues to be made in archaeological discussion today (Schaepe 2006). In the main part of the study area, from Campbell River north along Johnstone Strait, comparatively little study has occurred. Early archaeological investigation in the northern area consisted mostly of broad-area inventories of rock art (Hill 1985, 1994; Hill 1973; Lundy 1974), starting with the Barrows' work in the 1930s. In the late 1960s and early 1970s, Mitchell (1974; 1969) conducted large-scale shoreline inventory of hundreds of sites through the study area and vicinity. The quality of the locational information, condition, dimensions, internal features, and so forth on all these early surveys was poor by modern standards.

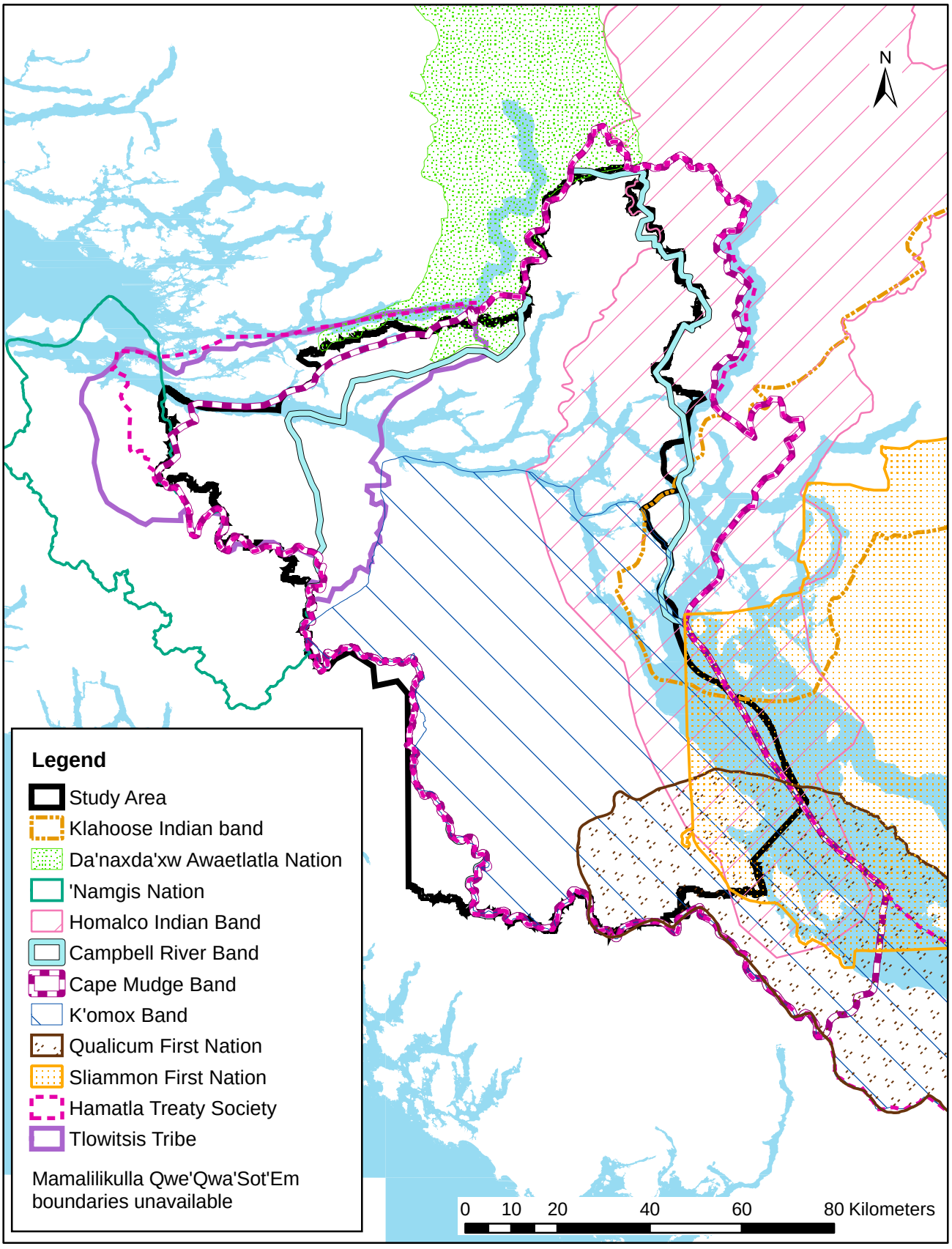


Figure 4. First Nations traditional territories.

Very little archaeological excavation has previously occurred in the northern area, other than very limited testing at a few sites and as yet unreported fieldschool excavations at the Hkusam site at the mouth of the Salmon River. More major excavation has occurred to the northwest of the study area, in the Port Hardy area (e.g., Carlson 1979). A general consensus regarding the archaeological sequence for the Johnstone Strait area is as follows, drawn from (Carlson 1990; Matson and Coupland 1995; Mitchell 1990):

Table 1. Culture-history sequence for Johnstone Strait.

Culture Type	**Age**	**'Diagnostic' Artifacts**
Old Cordilleran culture: Pebble Tool Tradition	>5000 BP	Flaked cobbles and pebbles, leaf-shaped flaked stone points
Obsidian	2500-5000 BP	Leaf shaped flaked stone points Rare formed flake tools Abundant obsidian microflakes Hammerstones Irregular Abraders Composite toggling bone harpoons Simple bone points and bipoints Ulna tools Mussel shell celts and knives
Queen Charlotte	2500 BP – contact	Flat-topped hand mauls Ground stone celts Shaped abraders Stone discs Unilaterally barbed bone harpoons and points Composite toggling bone harpoons Ulna awls Whalebone bark beaters Bone spindle whorls Bone blanket pins Mussel shell celts and knives

Systematic Overviews and Inventories

Inventories in the last few decades have generally been more intensive having a smaller study areas or more focussed goals than the early archaeological surveys. For example, an inventory of the Robson Bight Ecological Reserve was undertaken in 1988 by Eldridge (Eldridge, et al. 1988) and resulted in the registry of several shell middens, a fish trap, and historical remains. Many CMTs were also recorded, but were not included in the inventory at the time. As part of the project, a detailed ethnographic study of the locality was undertaken with elders from Comox, Fort Rupert, and Alert Bay (Bouchard 1988).

A general overview of the different regions of Vancouver Island was completed in 1992 by IR Wilson Consultants Ltd (Wilson, et al. 1992). This study briefly examined the intensity and distribution of previous surveys compared to archaeological site distribution and noted data gaps.

Golder Associates (Golder Associates Ltd., et al. 1998) completed a major overview and modelling project for the Central Coast LRMP. Models for coastal and interior/CMT distribution were created, but no ground truthing was undertaken.

Arcas Consulting Archeologists Ltd (Arcas Consulting Archeologists Ltd. 2002) undertook to create an updated model for TFL 47. The Arcas models used sophisticated environmental "TEM" mapping to try and improve model performance. This yielded disappointing results, and the models were revised in 2005, apparently yielding much better results without TEM data (Arcas Consulting Archeologists Ltd. 2005). As part of their study, they undertook ten days of ground truthing surveys; six days in 2002 and four days in 2005. It is unclear from the report how many archaeological sites were revisited or discovered during this work, and no site inventory forms appear to have been submitted.

Baseline Archaeological Services Ltd undertook a major archaeological inventory for selected locations distributed over TFL 39 Blocks 2 and 5 (Engisch, et al. 2004) for Weyerhaeuser Company. During a total of 20 days of fieldwork, 22 areas were examined and two previously recorded sites were revisited. A significant new site component, a wood stake fish trap, was added to one of the previously recorded sites. Twenty-two new archaeological sites were found, mostly CMTs, but also including two shell middens and an isolated lithic. The Baseline study was significant in that it targeted archaeological survey of a number of inland areas, which represent a major data gap for the region. In particular, inland small and medium sized lakes, generally less than 100 ha in size, were surveyed. Inland riverine terraces were also examined. No sites were found in these inland areas, but anecdotal information regarding standing plank-stripped trees and petroglyphs at the headwaters of some drainages was obtained following fieldwork.

Clam Gardens

Clam gardens are a relatively recently identified feature of Northwest Coast archaeology. Clam gardens were identified by John Harper, marine geologist, in a 1995 study of the shoreline of the Broughton Archipelago (Harper, et al. 1995). Harper found nothing in the way of published ethnographic information regarding the clam garden features although elders retained oral history regarding their use. It is this lack of information in the ethnographic record, coupled with their relative invisibility at anything other than low tides, which kept clam gardens unknown in the context of archaeological survey. Recent work by Harper and avocational archaeologist Judith Williams has brought the importance of clam gardens to the forefront of current archaeological research (Williams 2006).

We learned from crew members that the Hamatla Treaty Society has commissioned archaeologists to conduct an inventory of clam gardens and fish traps in the study area, but the results are not public.

Previous Archaeological Potential Models

Golder modelled a very large area, consisting of the Central Coast Land and Resource Management Plan area, but the model overlaps only in the northern part of the present study area (Figure 5). More recently, Arcas Consulting Archaeologists Ltd. created a model of the TFL Forest Ltd. Johnstone Strait operation area. The model was initially created in 2002, and was revised in 2005. This model covers only a portion of the current study area (Figure 5), and the revised 2005 model has slightly different boundaries from the initial 2002 model.

Predictive modelling has become a specialized topic of study for archaeologists (Brandt, et al. 1992; e.g., Eldridge and Anaya 2005; Eldridge and Mackie 1993; Hudak, et al. 2001; Kohler 1985; Petrie, et al. 1995; Warren 1990; Westcott and Brandon 2000). In BC, two basic approaches have been used; inductive modelling and deductive. Inductive modelling searches for patterning in known site and 'non-site' locations and uses these patterns to predict site locations. Sometimes these are expressed as formal probability surfaces where the probability of finding a site is expressed for each pixel; other times the area is ranked into potential classes. This is the approach used by both Millennia and Golder. Arcas used a 'deductive' modelling process. Deductive modelling draws from known or expected behaviour of humans, especially from ethnographic information. Geological processes and mapping can also be incorporated to give appropriate time depth to the model. In fact, the process of developing the two types of models are not that different, and aspects of one can be used in the other. The Millennia modelling strategy is discussed below.

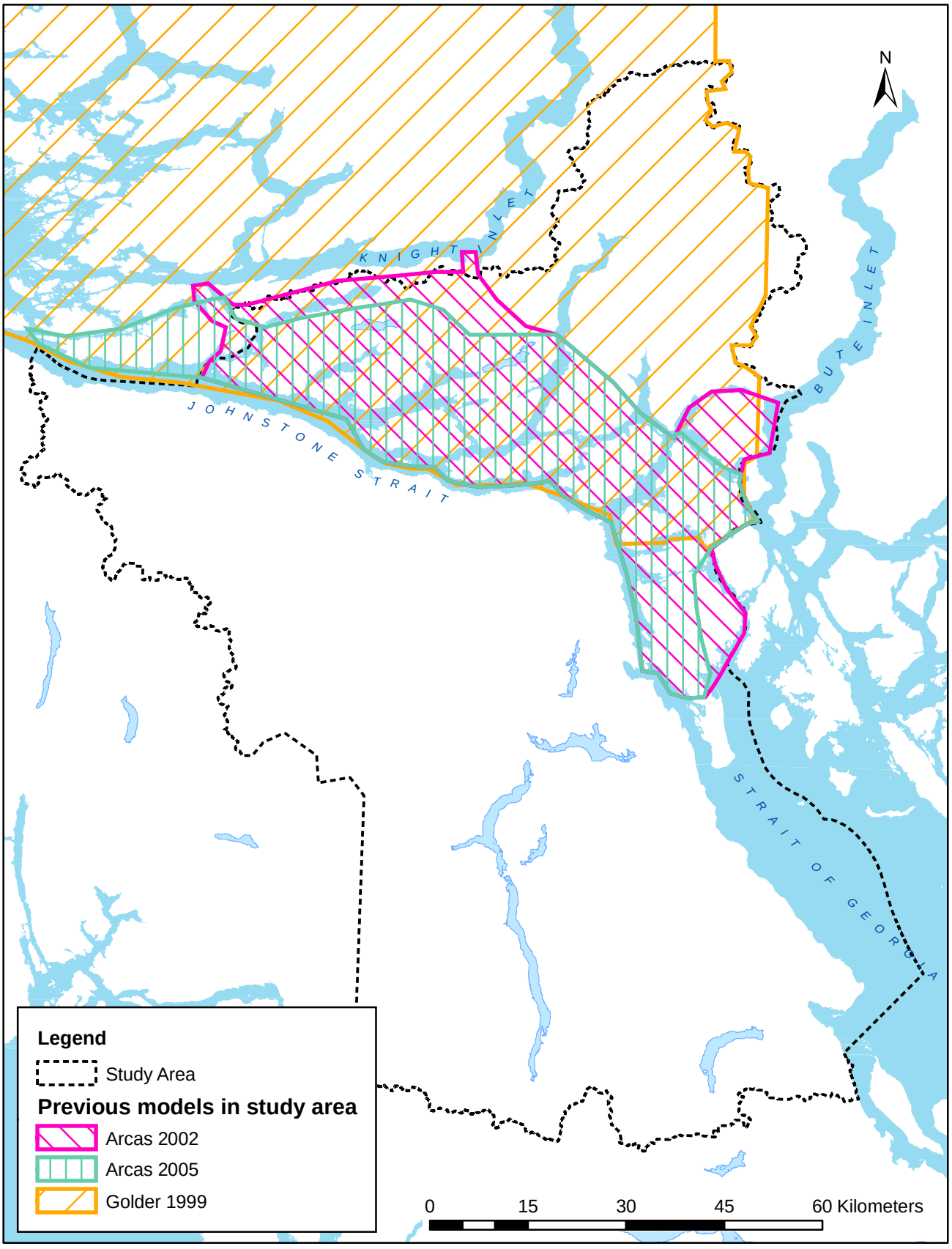


Figure 5. Area of current study area covered by previous models.

Methodology

Site Corrections

As a first stage in the creation of an archaeological potential model, the accuracy of known archaeological site mapping was evaluated. This was done by selecting a representative sample of sites within the study area. The correct locations of these sites were determined using sophisticated methods (see below), and the mapping of the sites was corrected where necessary. The new locations were compared to the old locations, and differences were then measured to determine the amount of error in the original mapping. The measurements were summarized and analyzed, and the results of this analysis were extrapolated to estimate the scope of errors in the mapped locations of the entire population of archaeology sites in the study area. From this, decisions can be made on whether the error is enough to affect the results of the model.

Within the Campbell River Forest District East study area, there are a total of 435 archaeology sites, which are primarily distributed along the coastline. Of these 435 sites, a sample of 100 sites was selected to be corrected. It was our starting hypothesis that earlier recorded sites would tend to be less accurately located than more recently recorded sites. In order to test this, the initial sample of 100 sites was systematically selected by choosing every fourth site from a list sorted by the site polygon creation date. However, this led to a change in the sample.

There were several sites which had actual mapped dimensions much smaller than their recorded dimensions. Because the model development was to be based on analysis of the spatial relationship between sites and other mapped features, it was important that no only the site location be correct, but also the actual dimensions and shape. Large sites will contribute more points to the overall sample than small ones. For small sites, the boundary shape is not particularly important from our perspective. So the sites that the text dimensions suggested should be greater than $25m^2$ were prioritized. These numbered about 20.

The other reason for modifying the sample was because the entire systematically chosen sample could not be corrected in the budgeted time. However, some of the rectified site maps included multiple sites not all of which were part of the initial sample. These sites were also corrected, as the site-map rectification (the most time-consuming portion of site correcting) had already been completed. Therefore, the end sample was neither purely systematic nor random. However, looking at the database and map of the corrected and uncorrected sites, the corrected sites are well distributed spatially and temporally, giving a representative sample of the entire population of sites. There may be some weighting towards less accurately mapped sites, due to the addition of the sample of sites with incorrect dimensions.

Correct locations were identified using orthophotos, TRIM data (streams, roads, coastline etc.), and any other relevant data available to rectify the original site maps. Digital format (scanned) site maps were imported into the GIS, and resized, rotated, and shifted. The site map would first be resized to the correct scale, and then rotated to match feature orientation. Features that were present in both the site map and in the base TRIM line and orthophoto layers, such as coastline, streams, and roads, were then used to position the site map correctly. The site

boundaries were then redigitized directly from the rectified site map. In some instances, the sites were correctly mapped, and did not need to be redigitized. In many cases, however, the site locations were mapped incorrectly, and the sites were relocated, or in some cases the locations were correct but the size of the site was incorrect. The distance between the original mapping and the corrected mapping ranged up to 1000m. In addition, the sizes of the mapped sites were often incorrect, again ranging from a few metres to 900m. Figure 6 shows the number of corrected sites that were altered in location, size, both location and size, or neither location nor size.

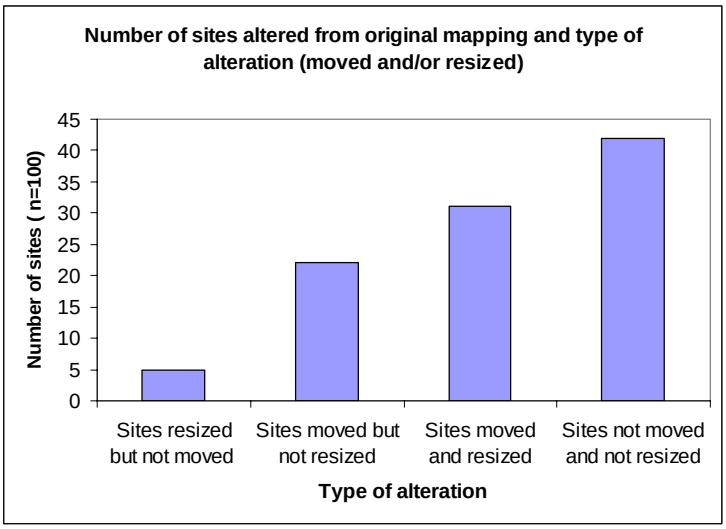


Figure 6. Number of sites altered in location and size.

Most of the errors in the original mapping are probably due to the methods used to digitize site locations. Many of the older site maps were poor, and made it difficult to accurately locate the site for digitizing. Some of these maps were simple, undetailed, small-scale sketch maps. In these cases, the site form description of the location of the site sometimes supplemented the site map enough to locate the site accurately, but often was inadequate. Most of these sites were therefore not redigitized, as the locations mapped by the Archaeology Branch appeared as correct as we would be able to get it with the limited information available. These sites contribute to the final column in Figure 6, of "sites not moved and not resized".

With advances in technology, including GPS and sophisticated mapping software, and more professional archaeological fieldwork, site maps have generally improved in quality. It would be expected, then, that more recently entered sites would be more accurately mapped in the provincial database than older sites. However, it was found that even recently entered sites sometimes had large errors in their mapped locations. An example of such a case is found with the group of sites comprising CMTs of the well-known "Hotel Block" EcSl-17 to EcSl-21. The Hotel Block contains a high density of rare CMT types such as standing plank-stripped trees, and its clearly high significance led to logging plans being permanently deferred even at a time when CMTs were not protected by provincial legislation (Eldridge 1991b). At the time, not only were the CMTs not protected by law, but the Archaeology Branch was not including the sites in its inventory as they were not recognized as archaeological at the time. Therefore, the sites were not registered at the time of the initial formal study. The sites were only recently added to the inventory, during an Archaeological Inventory Study by Baseline Inc. (Engisch, et al. 2004), when the sites were added on the basis of forest company mapping of the original Eldridge maps overlaid on orthophotos.

Sites EcSl-17 to EcSl-21 are all located in the same area, and with the exception of EcSl-21, are all included on the same site map. EcSl-21 has its own map, but it matches the other site map, and was likely created at the same time. The original "hardcopy" site map for EcSl-17 to EcSl-20 is a very good one, and even included a base layer colour orthophoto. Figure 7 shows the original site map rectified by Millennia, using the TRIM line features and TRIM orthophoto to match recognizable features. The original site map was first sized to the correct scale, and then shifted to match features. As shown in Figure 7, the bends in the road were easy to match, as were the streams, allowing the map to be rectified with a very high degree of accuracy. The sites were then digitized from the rectified site map (the yellow lines in Figure 7 are the redigitized site boundaries).

When the sites had been redigitized correctly, the locations were compared to the locations where the sites had been originally mapped. Figure 8 shows the corrected site locations in comparison to the original site locations. There is a very large amount of error in the originally digitized locations of these sites. The locations are not only wrong, but the scale is also wrong. This error in scale contributes both to different sizing of the sites, but is also the reason that the northernmost site, EcSl-21, is off by 345 m, while the southernmost, EcSl-17, is off by 745 m (as shown on the figure by the green lines connecting centroid to centroid). Therefore, errors in mapping of archaeology sites cannot be considered confined to older mapped sites with poor site maps.

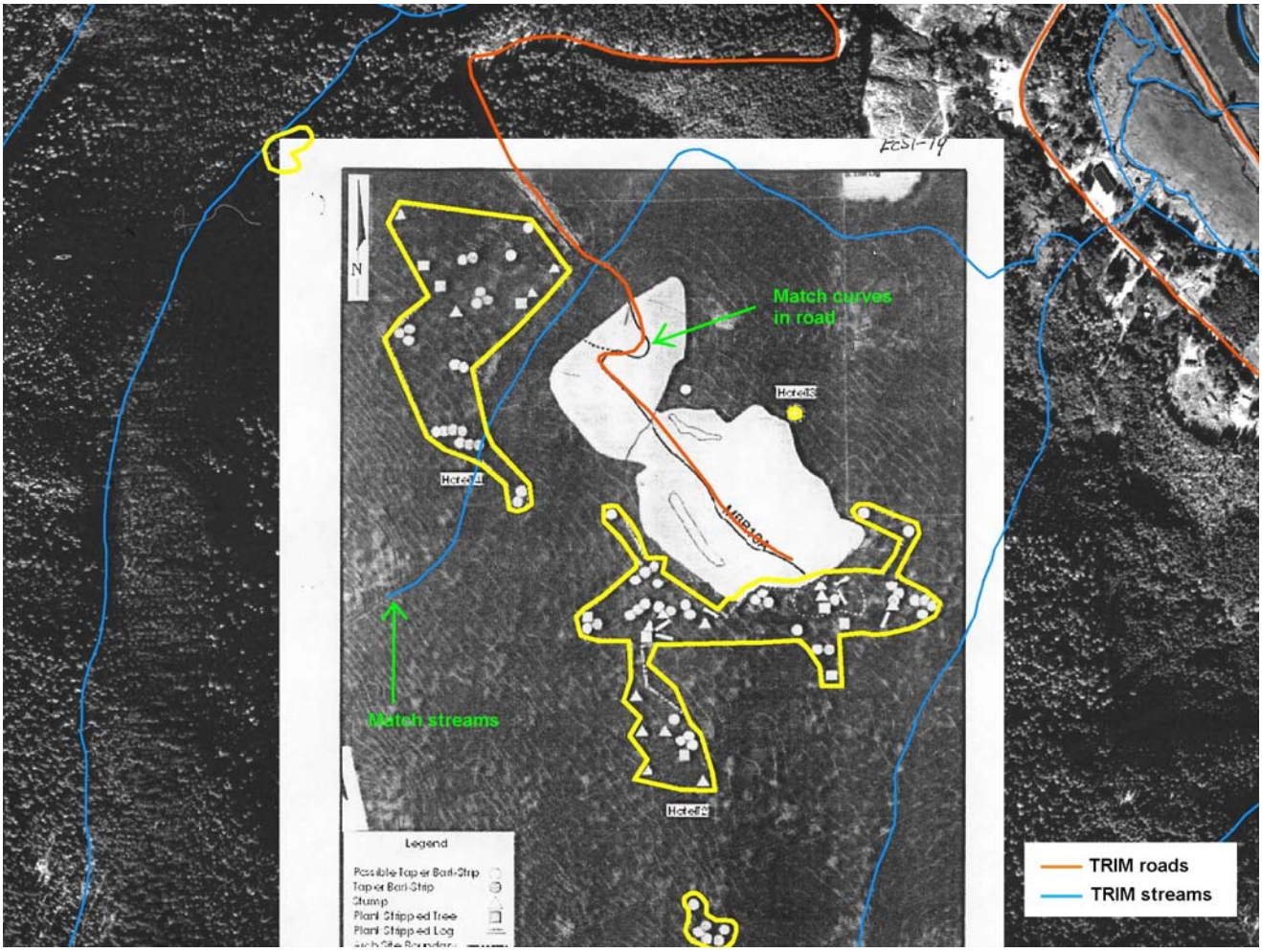


Figure 7. Rectified original Hotel Block site map for sites EcSl-17, 18, 19, and 20, and digitized corrected site polygons.

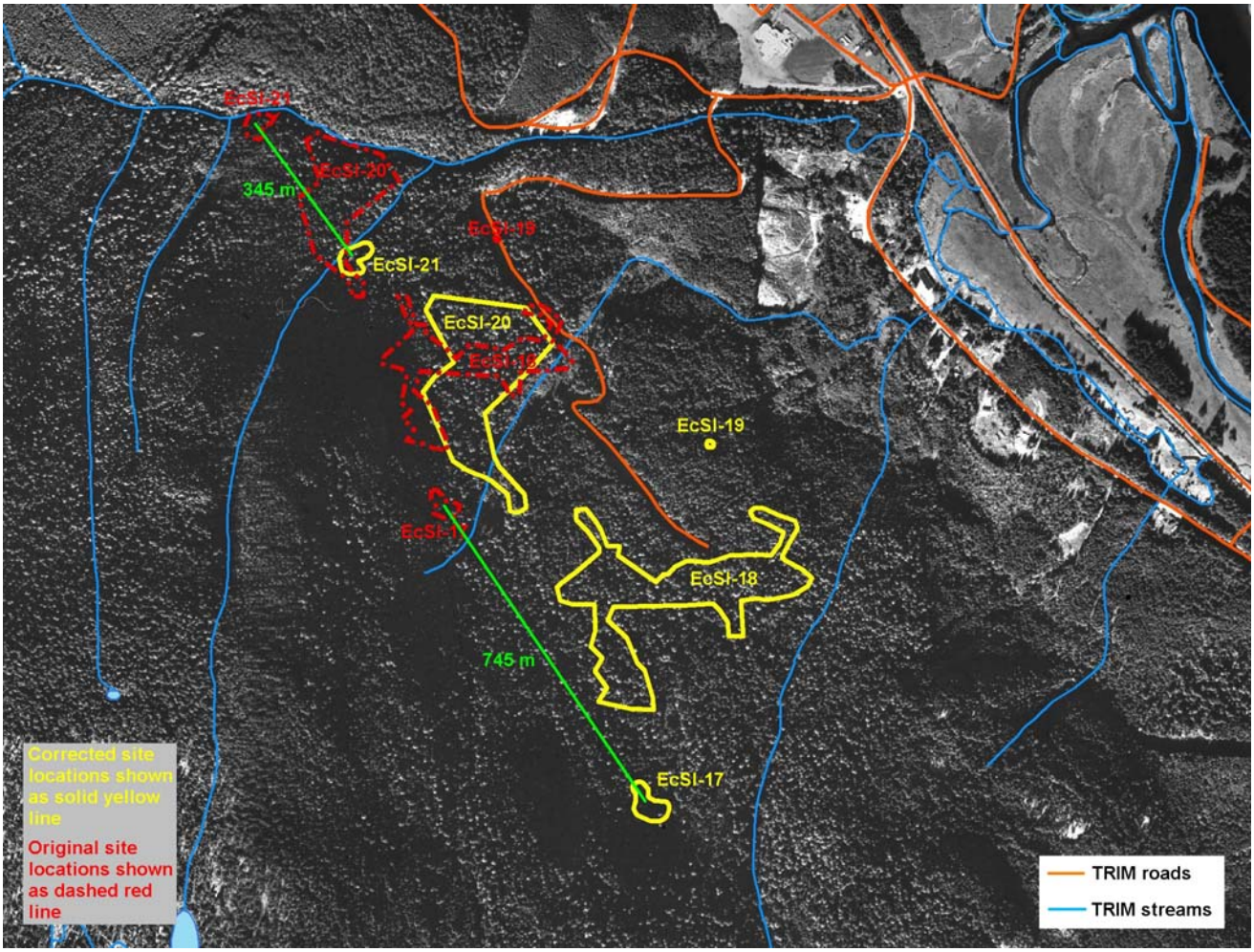


Figure 8. Original mapped site locations and corrected locations of Hotel Block sites EcSl-17 to EcSl-21.

Another instance of poor digitizing is the case of site EdSk-9. Not only were the original 1988 site maps for this site fairly good, but the location was described in detail in the site form. However, the site (described to be ~ 900m long) was mapped as a small circle, about 1km away from where it should have been located (Figure 9).

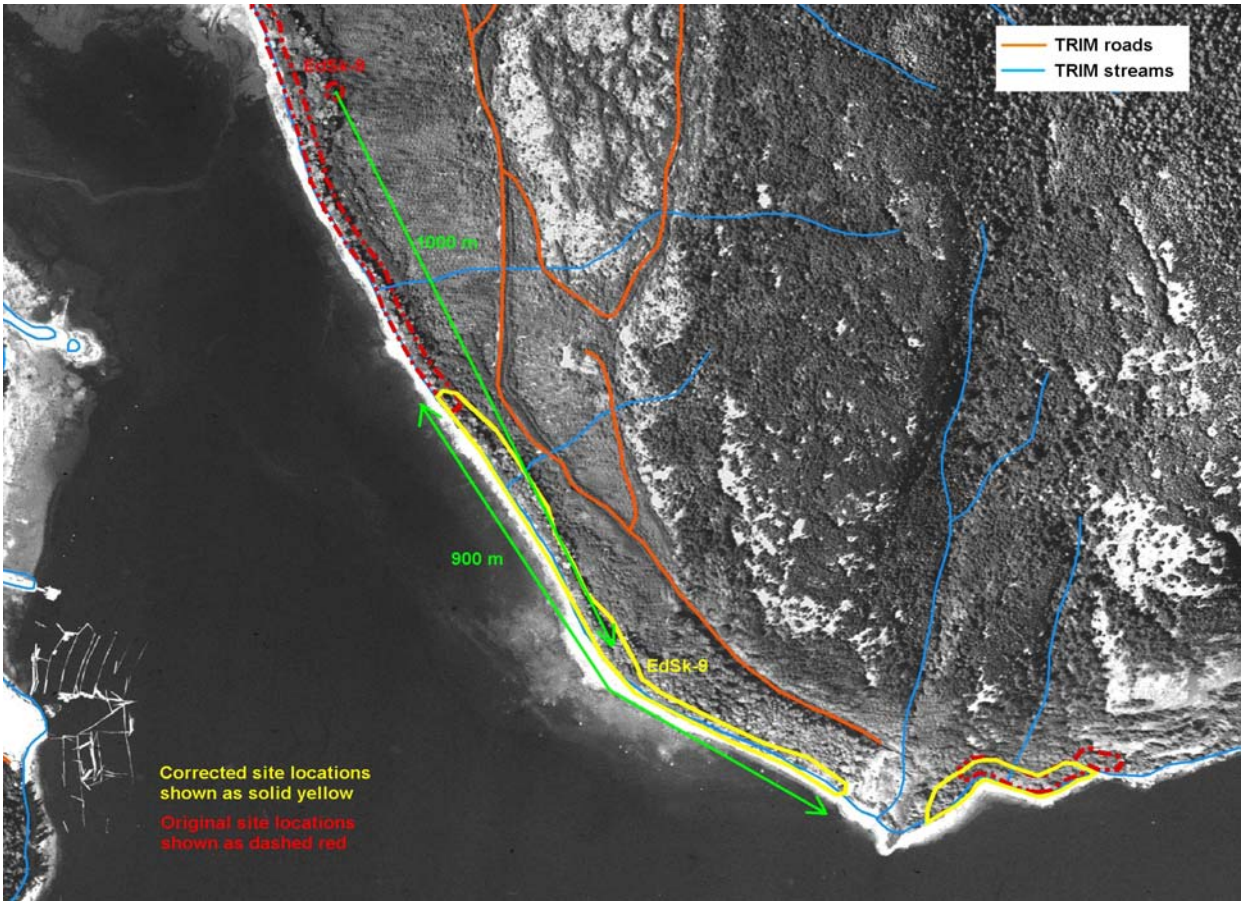


Figure 9. Errors in mapping of site EdSk-9.

These are some of the more extreme examples however; most of the sites after being corrected had changed location by 100m or less. Figure 10 summarizes the centroid to centroid error in distances. Most of the sites did not change location; however, a number of sites (indicated by the area above the line on the first column of the graph) were not moved only because of a lack of a detailed site map or description. Many of the site maps were small-scale, sketch maps, without scales, north arrows, and without detail. The sites were considered mapped correctly if they matched the general location indicated on the site map and the site form. In these cases, the only way to determine the accurate location would be to revisit and verify the site location.

The majority of sites changed size (as opposed to location) by less than 100m (Figure 11). Size is based on the longest dimension given in the original site description or measured from a site map, compared to that of the originally digitized site polygon.

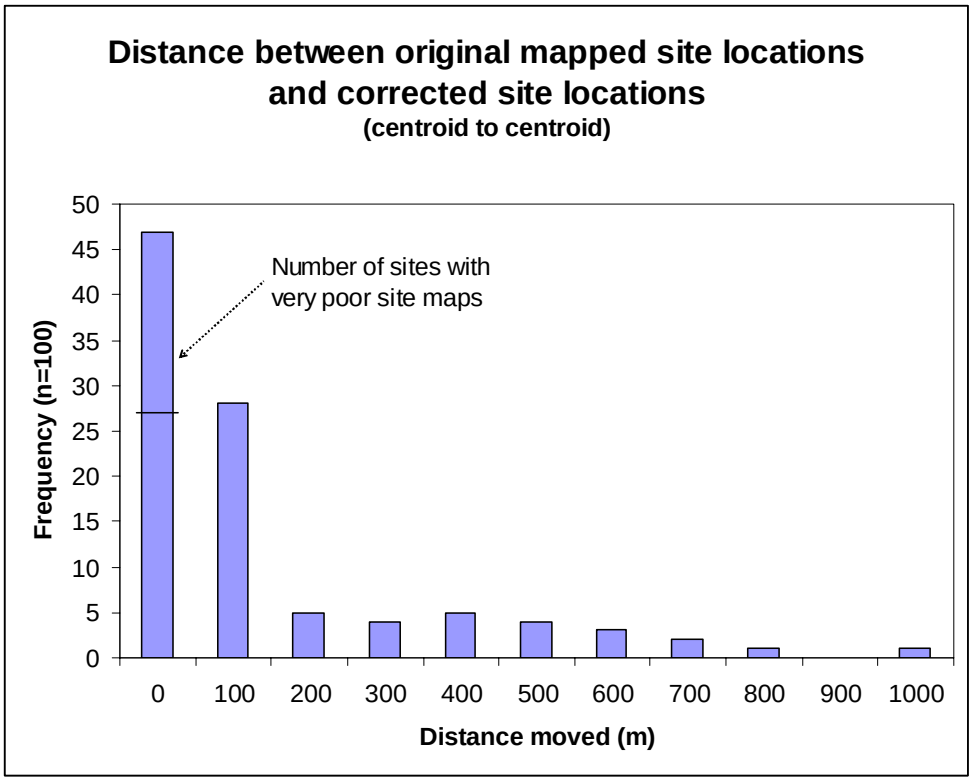


Figure 10. Distances between corrected and original site locations.

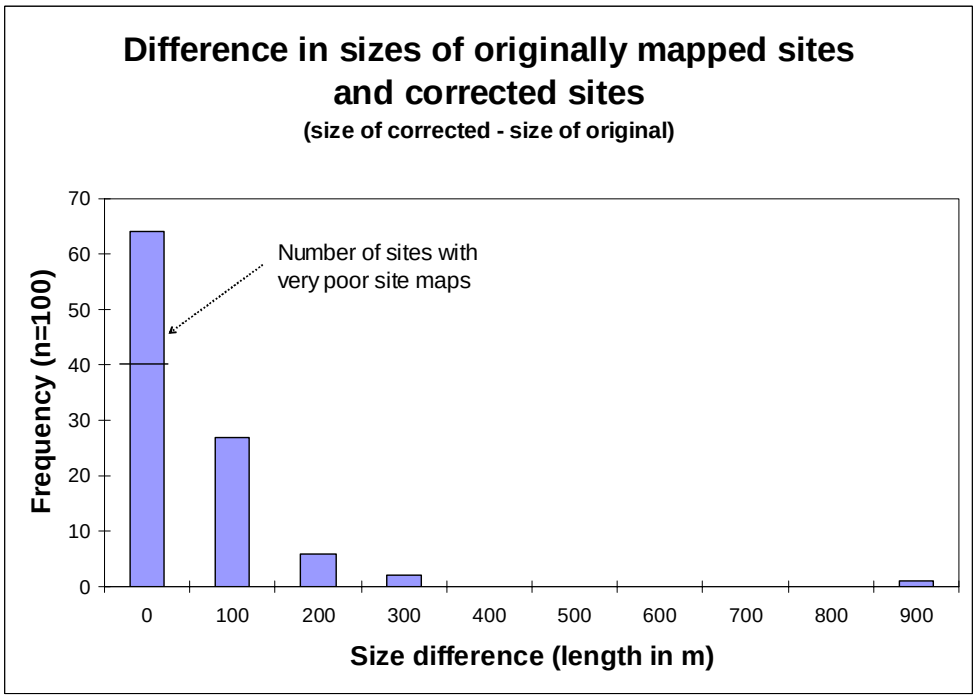


Figure 11. Size changes between corrected and original site size.

There are several conclusions that have arisen from this analysis. About ¾ of the sites are mapped with less than 100m error. Half of these may actually be in error, but cannot be improved with existing information. About ¼ of the sample has serious errors of over 100m. Therefore, extrapolating these numbers to the entire population of 435 sites, the starting total number of sites with serious errors is estimated to be about 110. However, 25 of these have been corrected with this exercise, leaving about 85 with substantially incorrect locations (approximately 20% of the sites). We also biased our sample slightly by correcting sites with known inconsistencies between polygon size and reported site dimensions; so the residual sites may be slightly better in quality. However, another quarter of the sites have uncertain locations in which original recording descriptions and maps were so poor that only site revisits can confirm or correct the site locations. Archaeological sites are very non-randomly distributed and often require a set of conditions to all be present for them to be present. A random error in site mapping, therefore, will strongly tend to have a location that is lower potential, with a less favourable location in regards to site potential. Therefore, if we are able to detect patterns in the data comparing site points to random locations, the pattern is likely to be present DESPITE the errors in location mapping, not because of the errors. **We conclude that the overall sample is sufficiently good to proceed with modelling**. However, by being cognizant of these errors, we can also evaluate apparent errors in predictive modelling. "Misses" where the model does not capture a known site point can be examined using a selection of the uncorrected sites to determine if the 'miss' is due to model performance, or due to mismapping of the site.

Additional Sites from the 'Lost Generation' of CMTs

During the site checking, we became aware of a number of sites that, like the Hotel Block, had been recorded and studied in detail in the late 1980s but were missing from the Provincial Registry as a result of provincial policy as discussed above. These included studies from Robson Bight (Eldridge, et al. 1988) and Newcastle Ridge (Eldridge and Eldridge 1988). An additional site at Hotel Block that had been overlooked when the sites were incorporated in the inventory was also added. In total, 19 sites were added to the inventory from these old sources.

First Nation Liaison and TUS Datasets

First Nation Liaison occurred through a number of letters, e-mails, phone calls, and meetings. Beginning February 15, phone calls were made to all the First Nations, to introduce the project and ensure our list of forestry or cultural contacts were correct.

The Qualicum and Sliammon First Nations both declared that they had a peripheral interest in the main study area (the parts of the Forest District north of Campbell River) as their traditional territories were mainly outside the district. The Qualicum's territory within the Forest District is predominantly private land. The Sliammon requested that they be kept informed of the progress and results of the study but deferred direct participation to Vancouver Island based First Nations (Maynard Harry personal communication 2007). The Namgis First Nation also stated that they had only a small part of their traditional territory in the study area. The Qualicum and Namgis also asked that they be kept informed of results, but did not require

further direct input. The Klahoose forestry representative was unavailable to meet due to a relatively long absence.

No direct contact was made with a few groups; for instance, the Mamalilikulla Qwe'Qwa'Sot'Em returned no calls or e-mails, as a hereditary chief had died. The Da'naxda'xw could not be reached by telephone, despite repeated attempts.

An information meeting was held in Campbell River on March 23 and all First Nations were invited, via email and fax, to attend. The Homalco and Tlowitsis met directly, and K'omox representatives conferred by telephone. The general project and ways to incorporate the models into existing referral systems were discussed, as well as arrangements to incorporate First Nations staff or equipment in ground truth surveys.

One subject of discussion was the initial analysis results of comparing a sample of Traditional Use Information with archaeological site locations. The District provided spatial data for Traditional Use Sites, partly derived from previous Traditional Use Site studies to which they had access, and partly gleaned through particular information provided during meetings with District staff. The data was incomplete, distributed predominantly in the southern part of the district, and had not been subject to substantial quality control. Nevertheless, it was used as a test of the type of data that often contributes to AOAs. The TUS data unexpectedly showed a NEGATIVE correlation with archaeological sites; that is, the average distance of a TUS to a random location was less than the average distance to an archaeological site. If traditional use sites tended to be located at the same location or even near archaeological sites the opposite would be true. The TUS data was then filtered to remove place names that referred to dangerous locations where people were unlikely to spend time, or landmarks potentially just used for navigation. The same pattern of a negative correlation persisted. This is quite contrary to common sense, which would suggest that there is an obvious correlation between the two data sets. Ken Smith, representative for the Tlowitsis First Nation, considered it likely that at least some of the TUS data could be mis-mapped, perhaps due to the difficulties some elders find in working with maps rather than being on the water or land itself, or perhaps through a lack of error checking. We hoped to obtain additional TUS data to see if a different pattern might emerge from new sources, but due to confidentiality rules, none of the First Nations were able to meet with our request.

The Hamatla Treaty Society, representing three separate First Nations, declined to take part in the study. As part of their review of the permit application, they outlined a number of concerns with the project itself and with the project approach and scope; they therefore asked the Archaeology Branch to withhold issuance of the permit. Several of the HTS points were made in regard to the possible use of the model by licensees following completion of the study, particularly in light of the new Forest Stewardship Plan. These concerns were beyond what Millennia Research, a private consulting company, could address. In any case, existing archaeological potential models are available for parts of the District, and could be used by the companies to make decisions regarding the need for archaeological studies.

Concerns regarding the approach and scope of the project primarily related to funding for and participation in fieldwork. The HTS also felt that, since Millennia had not contacted them

regarding the project before the proposal was written, their policies with respect to archaeological studies were not addressed and funds had not been allocated for their involvement. Millennia and the HTS have worked together on a number of previous projects and we were therefore aware of their general archaeological policies and had budgeted accordingly. The HTS were also concerned that there was not adequate field time to ground-truth the model; the District subsequently increased the fieldwork budget to allow for more field time. With respect to the fieldwork itself, the HTS also were concerned that the permit application did not state that ancestral remains would remain undisturbed. This was, however, clearly stated in the permit application. Finally, the HTS requested that the Campbell River Museum act as repository for any collected artifacts, a request which was addressed through revision to the permit application. Despite these changes and assurances, the HTS did not participate in the study.

Several First Nations expressed an interest in participating in a GIS training workshop for use of the model. This had been proposed as a follow-up for the next fiscal year.

Predictive Modelling

Preliminary models have been created for the study area. Ten site types were originally modelled for: Midden, Lithics, CMT (culturally modified tree), Cairns, Pictograph, Petroglyph, Fish (traps and weirs), Trench (Trench Embankment or Refuge sites), Shelter (Rock Shelters), and Clam (Clam Terraces). These were later reduced to eliminate ones with poor performance or where too little data on known site locations was present. The datasets and methods used in the creation of the models, an analysis of previous modelling in the study area, and some of the limitations of the models are discussed below.

Datasets

Modelling was based on TRIM data – including streams, lakes, wetlands, and coastline, – a DEM with 25m cells, Forest Inventory data compiled by the Campbell River Forest District from provincial and major licensee data, stream inventory data, and FISS streams (Fisheries Information Summary Systems). In addition, we acquired a dataset of clam bed locations in the study area from Fisheries and Oceans Canada. We also generated other variables based on the DEM and TRIM data. Timberline Natural Resource Group (Timberline) was contracted to run Millennia's custom scripts on the DEM data, to create several new datasets. The AML script uses a rectangular moving window to identify topographic variables from the DEM by evaluating the cells surrounding a central cell. Moving windows used for this evaluation were a 9 by 9 cell rectangle, a 25 by 1 cell horizontal rectangle, and a 1 by 25 cell vertical rectangle. The statistics calculated for each cell include the sum of all cells with relative elevation values higher than the central cell ("positive"), the sum of all cells with relative elevation values lower than the central cell ("negative"), and the number of cells with relative elevation values higher than the central cell ("positive count"). The positive and negative were calculated using both the 25 by 1 horizontal and vertical windows, while the 9 by 9 square window was used to calculate positive and positive count. The 25 by 1 results were combined by taking the maximum value of the horizontal and vertical for each cell.

A measure of coastline complexity was also created as a spatial dataset and used in the analysis. This proved to be a fairly significant factor in the locations of several site types. Also, to attempt to test the effects of weather on the location of sites, a measure of fetch (up to 20km) was calculated for the coastline. While this variable was not highly significant, it did help to improve the models somewhat. Both these last drew directly on comments about the importance of protection from weather noted several times in the Arcas report (Arcas Consulting Archeologists Ltd. 2002, 2005).

Coastline complexity was determined by first converting the coastline of the study area to points with 50m spacing. These points were then buffered to 1000m, and the resulting buffer layer was spatially joined to the points layer. This operation assigned a "count" value to each resulting buffer polygon. The count value indicates how many of the coastline points are located within each buffer polygon. Where the coastline is more complex, there would be a greater number of points within the buffer polygon (Figure 12); where the coastline is fairly straight, there would be relatively few points within the buffer. Each buffer polygon was then converted back to centroid points, creating a layer of points along the coastline at 50m spacing with a numeric value which essentially describes the coastline complexity at that point. illustrates how coastline complexity is calculated. Two coastal points are highlighted and their buffers and "count" values shown. Note the northeastern buffered point in an area of more complex coastlines, with lots of bays and islands, has a count of 150, while the southwestern one is on a relatively straight coastline and has a lower count of 46.

Fetch was calculated using the same initial layer of points at 50m spacing along the coastline. A guideline was first created from one point in the array, at the distance and direction desired. For this analysis, the directions used were North, North-northeast, Northeast, East-northeast, East, East-southeast, Southeast, and South-southeast. This was designed to capture the significant storms of the region, those with winds in the southeast quadrant, and winter outflows from the north through east. The analysis was initially done to a fetch length of 10km, due to computer limitations. The entire layer of points was copied and selected, then the one point from which the guideline had been drawn was dragged to the end of the guideline. This moved the entire copied array of points so that each copied point was located 10km and the fetch angle away from its originating point. Each initial point had a unique ID, which was copied to the copied layer. Using an ArcMap extension, XTools, lines were created connecting points with the same ID. This created a layer of lines extending from each initial coastline point at the fetch angle and length. This layer of lines was then clipped to the ocean, to remove portions of the line that intersected land, and the length of the lines calculated for the resulting layer. The points were then joined to the closest segment of line. Where the line ID and the point ID didn't match, the points were assigned a fetch of 0.01 (0 being used as a default NULL value in later analysis). If the distance from the point to the line was greater than 5m, it was also assigned a fetch of 0.01 (i.e. the line was interrupted by at least 5m of land from the point). For the remaining points, the fetch was calculated by using the length of the closest line with the same ID.

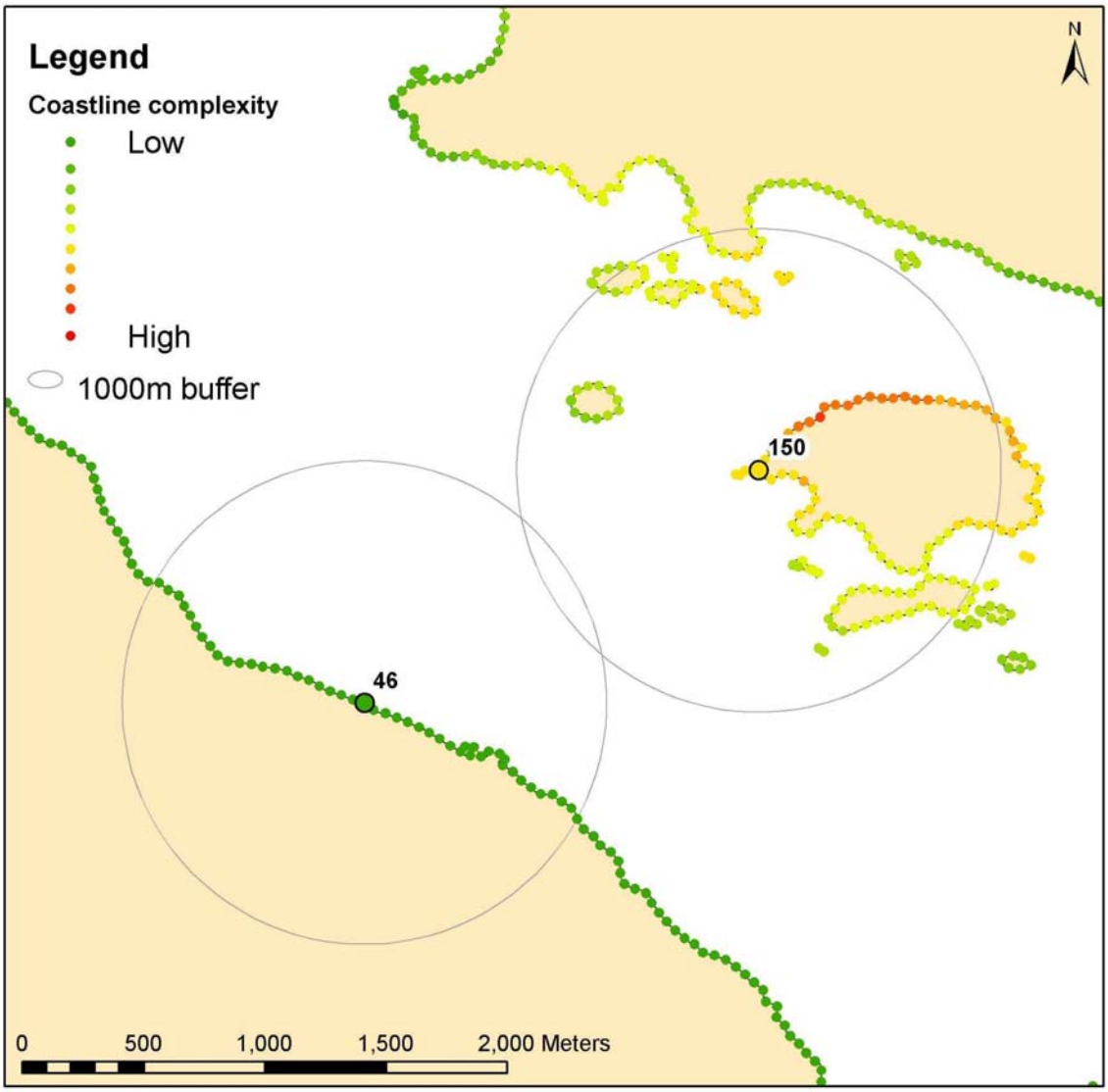


Figure 12. Calculation of coastline complexity.

Following the calculation of the 10km fetch, any points which had a fetch length of 10km were then selected, and a 20km fetch was calculated for this subset, using the same methods as described above. Because the analysis was working on a smaller set of points than the initial set, we were able to complete a 20km fetch analysis on these points. The final array of coastline points therefore had fetch lengths assigned ranging up to 20km. Each point had a fetch length for each direction, and then was also assigned the maximum fetch of all directions (Figure 13).

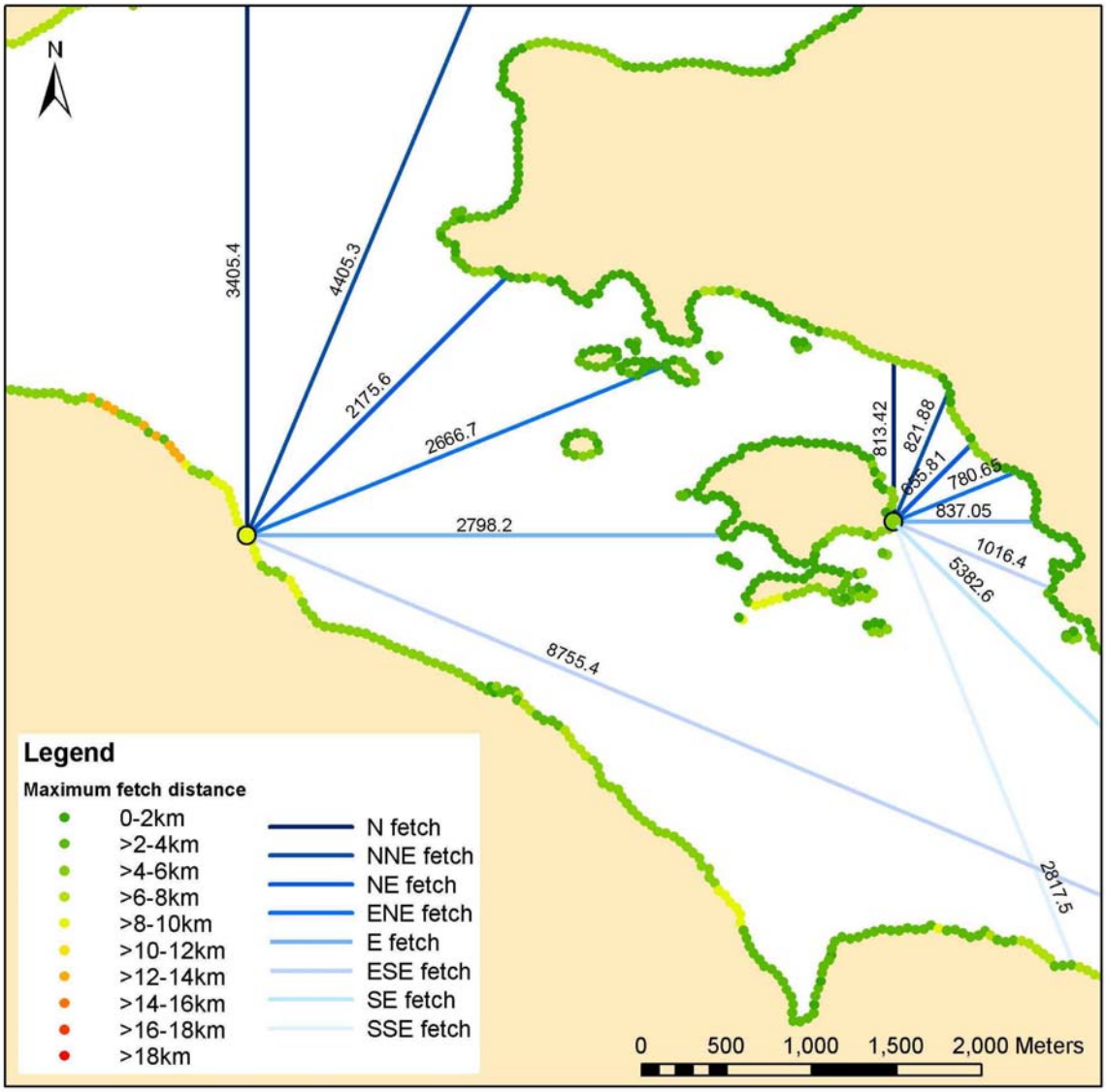


Figure 13. Calculation of coastline fetch.

Preliminary modelling

There are several steps involved in the building of the preliminary models. These steps include:

- Reviewing previous models
- Identification of the major site types
- Assignment of typology fields to the site polygons
- Conversion of site polygons and overall land base to point array format for modelling

- "Near-to" analyses to define the distance of modelling factors (e.g. rivers, lakes etc.) to the points, and insertion of the distance variables into the attribute table
- Identification of terrain variables (from the DEM)
- Executing Millennia's "Buffer" program on the points databases to analyze significance
- Inputting the significant factors into Millennia's "Model" program as a preliminary model, and iteratively running the "Model" program to refine the model, comparing model performance through Kvamme's Gain Statistic
- Building, analyzing, and further refining the model in the GIS

Each step will be discussed in detail below. Review of previous models is discussed separately below.

After the correction of the sample of archaeology sites, as reported on January 15, a new "archaeology site" layer was created which contained both corrected and uncorrected sites. The site typologies were then assigned by querying the "typology" field of the RAAD database of archaeological sites. There are a number of site types represented within the study area. The site types which were used for the analysis include:

- Midden
- Lithics
- CMT (culturally modified trees)
- Fish (fish traps and weirs)
- Petroglyphs
- Pictographs
- Clam (clam gardens and clamming stations)
- Trench (trench embankments, fortifications, and refuges)
- HR Cairns (human remains/burial cairns)
- HR Shelter (human remains/burial rock shelters)
- HR Islet (human remains/burial islets)
- HR Midden (human remains found in midden)
- Skid (canoe skids)

Sites which were historic, with no pre-contact elements were excluded from the modelling.

The typology field given in the RAAD database is a long string field, and therefore difficult to use in analysis (the "typology" column in Figure 14). Therefore, in order to be able to model for each site type, an attribute field for each main site type was created in the archaeological sites' attribute table (Figure 14). Each site was given a value of 1 or 0 in for each site type, based on the results of a query on the typology field. For instance, sites which had the keywords "midden" or "shell" in the typology field were assigned a value of 1 in the "Midden" field. In some cases, other attribute fields were searched when the typology field was incomplete or undefined for a site. Many of the sites had more than 1 typology, as seen in the final row of Figure 14, where the site includes both shell midden and trench (refuge) features.

TYPOLOGY	MIDDEN	CMT	FISH	PICTO	PETRO	CLAM	LITHICS	CAIRNS	SHELTER	TRENCH	TOTAL
PRECONTACT,Ceremonial/Religious Feature,Rock Art,Pictograph	0	0	0	1	0	0	0	0	0	0	1
PRECONTACT,Human Remains,Burial	0	0	0	0	0	0	0	0	1	0	1
PRECONTACT,Human Remains,Burial	0	0	0	0	0	0	0	0	1	0	1
PRECONTACT,Human Remains,Burial	0	0	0	0	0	0	0	0	1	0	1
PRECONTACT,Cultural Material,Subsurface,Shell Midden	1	0	0	0	0	0	0	0	0	0	1
PRECONTACT,Cultural Material,Subsurface,Shell Midden	1	0	0	0	0	0	0	0	0	0	1
PRECONTACT,Cultural Material,Subsurface,Shell Midden|PRECONTACT,Habitation Feature,Refuge	1	0	0	0	0	0	0	0	0	1	2

Figure 14. Example of typology string and typology fields assignments.

Following the assignment of typology, the polygon archaeology sites layer (Figure 15a) was converted to raster format, with a cell size of 25 metres (Figure 15b). This layer was then converted to points, resulting in an array of points at 25m spacing within each site (Figure 15c). For sites which were less than 25m^2, a single centroid point was created and added to the point array. The points were then assigned the attributes of the site polygon in which they were contained. Following this, a simple program was run to randomly select and delete points from any site which contained more than 25 points, so that no site contained more than 25 points (Figure 15d). This was done in order to prevent weighting of the sample used to build the model towards very large sites. The selection of multiple points from an archaeological site is necessary to represent variability in large sites, and to weight larger sites more than small sites; but it does introduce redundancy with spatial autocorrelation (Kvamme 1988). Effectively, we have a cluster sample. Cluster sampling violates the principals of simple random sampling that many statistical tests of association require, and the results of tests need to be either adjusted or interpreted with caution (Kish 1965). The Chi-square values produced by our 'Buffer' program need to be interpreted with this in mind.

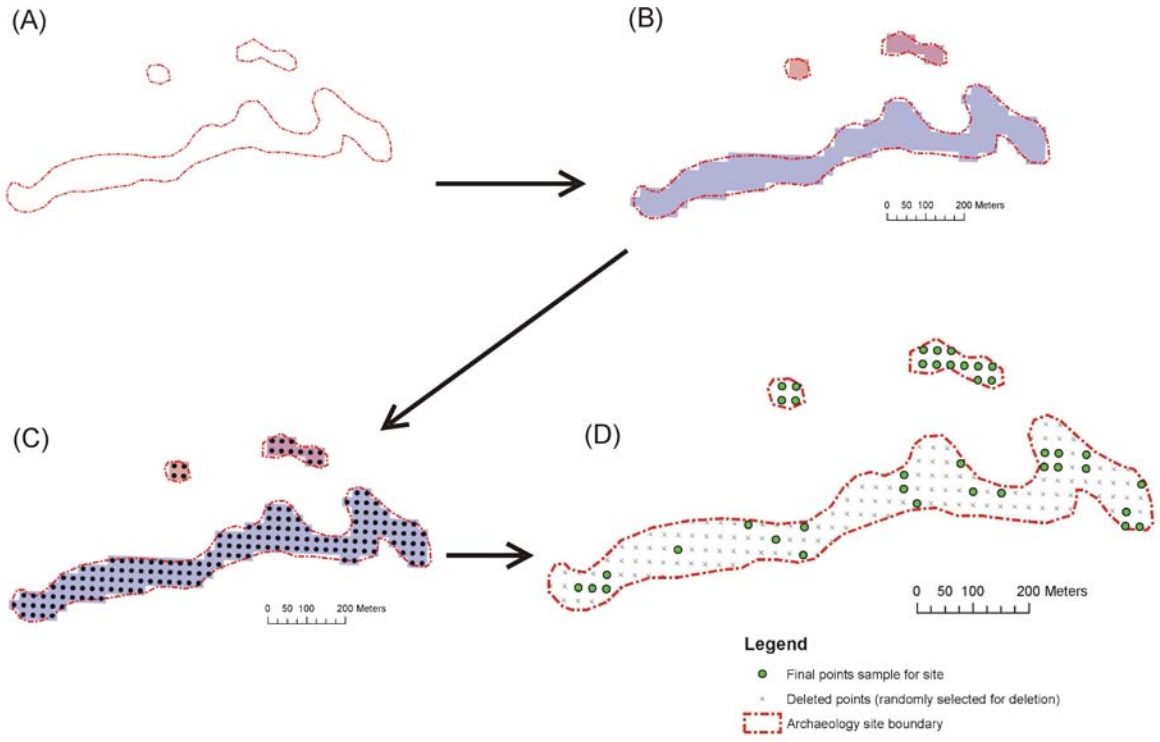


Figure 15. Creation of points sample for sites.

A point array from the overall land base was also created to provide a random land sample. The land base was converted into a raster with 1000m cells, which was then converted to points. This created an evenly spaced grid of points at 1000m spacing over the entire land base. However, the point array had relatively few points along the coast, while more than half of the site points were located within 100m of the coast (Table 2). Another raster was created within 100m of the coast, at 500m spacing, and converted to points to weight the sample slightly towards the coast. Also, so that intertidal sites could be modelled for, a 500m raster was created within 100m of the coast on the ocean side. These points were all combined into one file, to act as sample for the land base. Points located within water features such as lakes and rivers were removed. The land-base point array (referred to as "grid" points) and the sites point array were then combined into one large database, and the points identified in a field in the database as type "SITE" or type "GRID". The final sample sizes of points used for the analysis and modelling include 13733 grid points, 812 of which are land based and within 100m of the coast, with another 527 located in the intertidal. There are a total of 2346 site points. There were 61 variables analysed for significance, though not all of these variables were used in the modelling.

Table 2. GRID and SITE point sample sizes.

	# of GRID points	**# of SITE points**
Initial sample total	~12900	2346
Initial sample within 100m of coast (without any intertidal points in the GRID sample)	226	1431 (includes intertidal sites)
Revised GRID sample total	13733	2346
Revised GRID sample within 100m of coast (land-based)	812	1190
Revised GRID sample in the intertidal	527	241
Combined intertidal and 100m from coast sample (revised)	1339	1431

The next major step was to determine the unique sets of variables that define the location of each site and grid point. Distances to features such as rivers, lakes, and wetlands were calculated for each point using a spatial join. The distance was added to a field in the database which was named for the analysis layer (for instance, the field "Chinook" contained values that described the distance of each point to the nearest Chinook-bearing stream). If the point was located in a polygon feature, it was given a distance of 0. In the case of the forest inventory data, each point was assigned the value of the forest inventory polygon within which it was located. For instance, a field "Age Class" was created, and each point was assigned the age class of the forest inventory polygon in which it was located. Where there was no forest inventory data available, the default value was 0.

The DEM terrain variables – including slope, aspect, and elevation range, "positive", "negative", and "positive count" – were then identified for each point. The points in the array were converted to a raster with a cell size of 25m and a cell value of 1. This raster was combined

with the DEM raster using map algebra to multiply the values of overlying cells. This created a new raster with cells containing the DEM values for the location of the points. This layer was converted to points, which was joined to the original point database, and the DEM values assigned to the initial point database. This was done for each DEM based layer. The end result from the "near-to" and "identity" analyses was the creation of a database containing values that describe the unique relationship of each point to a variety of variables, which could then be statistically analysed.

Statistical analysis to determine factors that are predictive of the location of archaeology sites was done using Millennia's existing "Buffer" program. The program was first modified for this specific project, by adding in each site type as a filter, allowing for analysis of each site type rather than for sites as a whole, as was done in previous models. The "Buffer" program analyzes and compares the number of site points within a certain distance of a feature (within a buffer), to the number of random land points within that distance of the feature. For DEM variables, it compares the number of site points within a certain range of the variable, to the number of random land points within that range. Each time the program is run, it prompts for certain inputs, which include the variable to be analyzed, a start point, end point, and buffer size. For example, when running the program on lake features, the "lakes" variable was inputted, the start point set as 0 (i.e. distance to a lake = 0m), the end point set as 2000m and the buffer size set as 100m. The program then compares the number of sites that were 0 to 100m away from lakes, to the number of grid points within the same distance. Then it compares the numbers at 100 to 200m away from lakes, and so on, until it reaches the end point. The program then provides output statistics for each "buffer" distance, as well as providing a Chi Square statistic to evaluate the significance of a bias in either direction. The significance level is generally overstated, since the site sample is drawn from a cluster, rather than a simple random sample (Kish 1965).

The buffer program was usually run more than once for each variable, using different start and end points, and different buffer sizes, depending on which variable was being analyzed and what the results of previous analyses were. Combinations of variables were also tested. Any buffers or ranges towards which site points were significantly more skewed than the overall land base were then entered into the "Model" program. The significant variables differed for each site type, so a separate model was created for each site type. Some variables were further filtered to exclude those areas distant from the coast, if the variable was confined to the coast, such as clam beds. This made the analysis more meaningful. Another result of the "Buffer" program was identifying site types which would not be modelled. The site type "HR Islet" had a very small sample size, too small to accurately measure significance, and was therefore excluded from modelling. However, the "HR Islet" sites was checked at a later stage in modelling, to confirm that the known sites were being captured in other site models (they were, in "Trench" or "Rockshelter" models). "Skid" and "HR Midden" were also removed, as examination of the database showed they would be captured in the "Midden" model.

A preliminary formula for each site type was created using the significant variables generated by the "Buffer" program. This formula was then incorporated into the "Model" program, copying and modifying the program for each site type. The program gives each point a value of 1 or -1 for each significant factor, which cumulatively gives each point an "expect" value. The higher the expect value, the more factors that are captured, and therefore the higher

the potential for finding that particular site type. For example, in the case of the "midden" site type, the areas within 100m of a large river were significant for finding midden sites, as was the area within 100m of clam beds, and areas with a slope lower than 20 degrees (among other significant variables listed in Appendix A.) Therefore, for example, a location which was 50m to a large river, and 75m to a clam bed, and on a 10 degree slope would have a higher "expect" value, and therefore higher potential for midden, than, for instance, a location which was on a 30 degree slope and 150m away from a clam bed and a large stream.

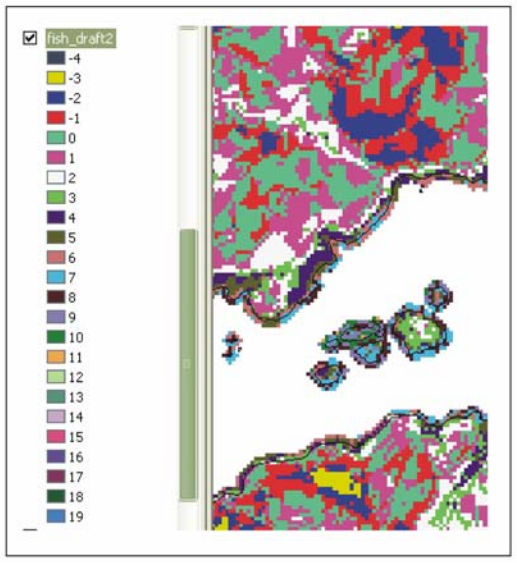
Once the "expect" values for each site type have been assigned to each point, the program then uses the Kvamme's Gain Statistic (Kv Gain) to test how well the models are working. Ideally, site points would all have very high expect values, while grid points would have low expect values. This would indicate that the model was doing a good job of predicting the locations of existing archaeology sites, while at the same time minimizing the area of land with high potential. Kvamme's Gain Statistic compares the percentage of sites captured to the percentage of the overall land area for each expect value. The formula for the Kv Gain is: 1- (% land/% sites). For high expect values, the ideal Kvamme's Gain is close or equal to 1. At the low end of the expect values, it is ideal to have a large negative Kvamme's gain. Once the initial model for each site type was run, the formulas were modified by adding in variables that were less significant, to see if the Kvamme's Gain numbers improved. This was done several times for each site type to test different combinations as well as individual variables, to see if the models could be improved. Once each model achieved the best possible performance, or there were no more variables to test, it was built in the GIS to be assessed spatially.

Once the formulas were defined, the model was built using map algebra from the Spatial Analyst extension of ArcGIS. Each buffer of a vector feature (e.g. streams) was converted to raster, using a 25m cell size. Then each layer was converted to binary – for instance, if the formula specified that there was higher potential within 100m of a Chinook-bearing stream, and then all Chinook streams were buffered to 100m, the buffers converted to raster, and the raster classed as 1 for all cells within the buffer, and 0 for all other cells. Then, the raster layers were added up using map algebra, so that areas where more than 1 layer had a value of 1 would become cumulatively higher potential. The result of this addition was a single raster with a range of values, which can then be associated directly to the Kvamme's Gain results in the model, and the raster can then be classified into levels of potential based on the Kv gain (Figure 16). Figure 16a shows the GIS model for the "Fish Trap" type on the left, with the complete range of values produced by the map algebra. The statistical model (the output from the model program) is shown to the right.

One of the last steps in the process of building the final models was to determine the cut points used to define the classes of potential. This is done to balance the risk of surveying many areas where no sites are actually found, with only surveying the highest potential lands and missing many sites that occur in lands with lower potential ratings. Figure 16b shows a possible classification of the fish trap model into high and moderate potential. A fairly high Kv Gain was used as the cutoff for the high potential, while a lower, but still positive Kv Gain was used for the moderate potential. Using these classification cut points, "high" captures 34.7% of the sites in 5.3% of the coastal/riverine land base, for an overall Kv Gain of 0.85. The cut off points can be changed, however, right up to the last stages of modelling.

The raster models were then clipped to remove areas of the model within water features. The models for site types located in the intertidal (Fish, Clam, and Midden) were allowed to extend 50m into the ocean. All other models were clipped to the coastline.

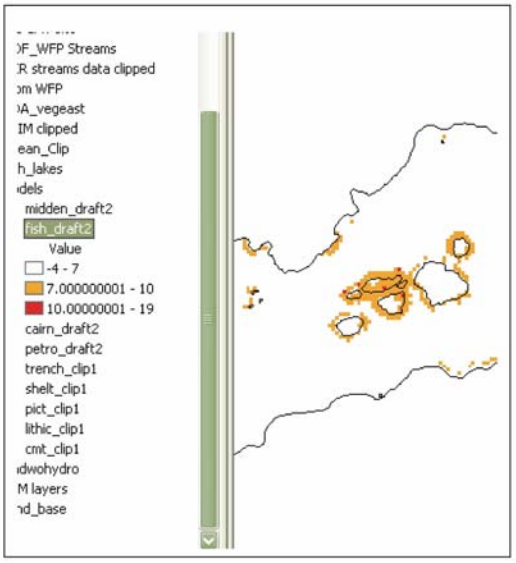
(A)



*** Fish ***

		sites	grid	Kv Gain
exp_Fish	-1:	0.0	0.6********	
exp_Fish	0:	0.0	4.6********	
exp_Fish	1:	0.0	5.2********	
exp_Fish	2:	0.0	5.6********	
exp_Fish	3:	0.0	6.3********	
exp_Fish	4:	0.6	8.5	-13.40
exp_Fish	5:	0.6	11.0	-17.77
exp_Fish	6:	0.0	12.6********	
exp_Fish	7:	10.6	12.3	-0.16
exp_Fish	8:	21.8	12.6	0.42
exp_Fish	9:	16.5	10.0	0.39
exp_Fish	10:	15.3	5.4	0.65
exp_Fish	11:	13.5	2.0	0.85
exp_Fish	12:	2.4	1.6	0.34
exp_Fish	13:	0.6	0.9	-0.61
exp_Fish	14:	2.9	0.5	0.84
exp_Fish	15:	1.2	0.3	0.77
exp_Fish	16:	0.0	0.0********	
exp_Fish	17:	0.6	0.0	1.00
exp_Fish	18:	5.9	0.0	1.00
exp_Fish	19:	7.6	0.0	1.00
exp_Fish	20:	0.0	0.0********	

(B)



*** Fish ***

		sites	grid	Kv Gain	
exp_Fish	-1:	0.0	0.6********		
exp_Fish	0:	0.0	4.6********		
exp_Fish	1:	0.0	5.2********		
exp_Fish	2:	0.0	5.6********		
exp_Fish	3:	0.0	6.3********		
exp_Fish	4:	0.6	8.5	-13.40	
exp_Fish	5:	0.6	11.0	-17.77	
exp_Fish	6:	0.0	12.6********		
exp_Fish	7:	10.6	12.3	-0.16	
exp_Fish	8:	21.8	12.6	0.42	↓
exp_Fish	9:	16.5	10.0	0.39	moderate
exp_Fish	10:	15.3	5.4	0.65	
exp_Fish	11:	13.5	2.0	0.85	↓
exp_Fish	12:	2.4	1.6	0.34	
exp_Fish	13:	0.6	0.9	-0.61	high
exp_Fish	14:	2.9	0.5	0.84	
exp_Fish	15:	1.2	0.3	0.77	
exp_Fish	16:	0.0	0.0********		
exp_Fish	17:	0.6	0.0	1.00	
exp_Fish	18:	5.9	0.0	1.00	
exp_Fish	19:	7.6	0.0	1.00	
exp_Fish	20:	0.0	0.0********		

Figure 16. Comparison of GIS model with raw scores and classified model.

Analysis of previous models

Two previous models overlap with parts of the Campbell River Forest District, east portion. Golder Associates Ltd completed a model of the Central Coast LRMP in 1999 (Golder Associates Ltd., et al. 1998). Both coastal and CMT models were created. The Forest District now considers the model of rather low resolution (Call for Proposals for present study). Another part of the District was modelled by Arcas in 2002, for TFL Forest Limited. Arcas revised the model in 2005. The Arcas model consists of two types of potential - non-CMT potential, and CMT potential. Although this modelled area was excluded from the present study deliverable, and the terms of a data sharing agreement do not allow the results to be released, the overlap area was included in analysis to assist in model development and compare model performance. Kvamme's Gain (or 'Kv Gain') was used as a measure to compare the models. Kv Gain is a simple formula: 1-%land area/%site captured. In actuality, it can be quite time-consuming to ensure that all the variables are kept the same, particularly when the areas of each model are different.

Table 3 is presented for comparative purposes. It presents the results of the current study in summary; the detailed results form a separate section. The Golder model where it overlaps our study area has 5.5% of the land base in High or Moderate potential for CMTs. There are currently 46 CMT sites recorded in this modelled area. Of these, 0 are in High potential, and 4 are in Moderate potential. Together, these represent 8.7% of the known sites, and at 5.5% of the land overall, this represents a Kvamme's Gain of 0.36, a relatively poor performance.

The Golder model for other site types is generally confined to ocean and large lake shorelines. The total area captured by moderate and high potential is 3.3%. This model captures 117 of the 157 known non-CMT sites in High potential; and 67 in moderate potential. Together, the two classes capture 85% of the known CMTs, for a Kvamme's Gain of 0.96. This is apparently a very good model (and the Kv Gain for High potential would calculate out as even higher); although if the land base is restricted to the area where non-CMT sites are actually expected (as we did during our modelling) the Gain will be substantially less. Nevertheless, it is clear that the non-CMT model performs much better than the CMT model.

Kvamme's Gain was used interactively during the Millennia model development; however, it was usually filtered to one or more conditions, so the statistic was normally calculated for a portion of the area (for instance, all areas with old growth, or all areas within a certain distance of the shoreline), rather than the gross total area. For rough comparison, we have provided the following table, where the total land base has been used in each. The values of land are calculated slightly differently (for instance, lake area was included in the overall land area in the calculation of the Golder model but not the Millennia model; if deleted, it would increase the % land and decrease the Kv Gain in the Golder model slightly). The Golder and Millennia non-CMT models are overall quite similar; the 6% improvement in site capture and the 0.5% decrease in land area in the 2007 Millennia model is only enough to slightly increase the overall Kv Gain. A much larger Kv Gain difference would be evident if the land area was restricted to areas near shore, and if the Millennia models for different site types were considered separately, but this was not considered sufficiently important to undertake such fine-resolution comparison.

Table 3. Comparison of model performance for Golder 1999 and Millennia 2007.

	Golder 1999	Millennia 2007
Old Growth CMT		
% land H&M	n/a (moderate incl. younger stands)	1.5%
% CMT sites	n/a	27%
Kv Gain	n/a	0.94
% land H only	0.7%	0.5%
% CMT sites	0%	24%
Kv Gain	Non calculable (divide by 0)	0.98
All CMTs		
% land H&M	5.5%	13%
% CMT sites	8.7%	80%
Kv Gain	0.36	0.84
All Other Site Types		
% land H&M	3.3	2.8
% Other Sites	85%	91%
Kv Gain	0.96	0.97

Ground Truthing

Locations were chosen for ground truthing based on a number of criteria:

- the client stated that the main interest was in the CMT model, so testing this (in particular, the 'old growth' model) was emphasised in the fieldwork;
- some areas were identified by First Nations where they were interested in having field work undertaken. Other areas were selected based in part on research of aboriginal place names;
- previously unexamined locations that contained areas of high potential for a variety of site types. For instance, Hemming Bay on East Thurlow Island showed high potential for several of the models, yet there were no recorded archaeology sites there;
- previously unexamined areas that showed a range of high, moderate and low potential;
- previously recorded archaeological sites that had poor, or inadequate site maps;
- inland areas of CMT potential which were relatively easily accessible were also identified for field visits;
- TFL 47 was avoided, since this was the subject of a separate recent AOA (Arcas Consulting Archeologists Ltd. 2002, 2005) and technically was not part of the study area;
- access formed a major part of area selection; all areas were accessed by either road (mostly along mainlines) or boat. Not all of the areas identified for possible ground truthing could be visited in the allotted time and due to a lingering deep snow pack.

The areas where ground truthing occurred are shown in Figure 17.

In some cases, areas chosen for ground-truthing proved too difficult to access and alternatives were chosen in the field. This was facilitated by driving or boating with a laptop computer running GIS and loaded with all map and model layers, connected to a GPS with real-time tracking and auto-panning enabled. Particular models could be examined on-the-fly and ground truthing foot survey done without hardcopy maps.

The goal of ground truthing fieldwork was to assess archaeological potential in separate areas of the forest district using field observations and limited subsurface examination. Survey coverage was judgemental and primarily involved pedestrian survey along shorelines and in forested areas.

Each surveyed area was logged using hand-held GPS (WAAS capable, 3m accuracy). Additional waypoints were also provided. Logs were downloaded at the end of the day to a hard drive.

Subsurface testing was undertaken on an extremely limited basis. Auger and probe tests were conducted at periodic locations near recorded sites or in areas of high potential for subsurface cultural deposits. The goal of subsurface auger and probe testing was to establishing the presence or absence of archaeological deposits for assessing the accuracy of the recorded site boundaries incorporated into the model. Systematic shovel testing was not conducted in any of the examined areas.

Shoreline locations were visually inspected for shell midden, intertidal artifacts, fish traps, trench embankments, rock alignments, pictographs, petroglyphs, clam gardens, canoe runs, cairn features, lithics, and wet sites.

The forested portion of the survey examined mature trees for evidence of cultural scars. Suitable landforms (e.g., rockshelters and bluffs) were inspected for cultural materials and/or cultural modification. A survey crew ranging from three to five individuals generally followed a 50-75m traverse with the exception of particularly steep hillsides or dense understory. Intertidal survey was more intense, with crewmember survey tracks overlapping in many cases.

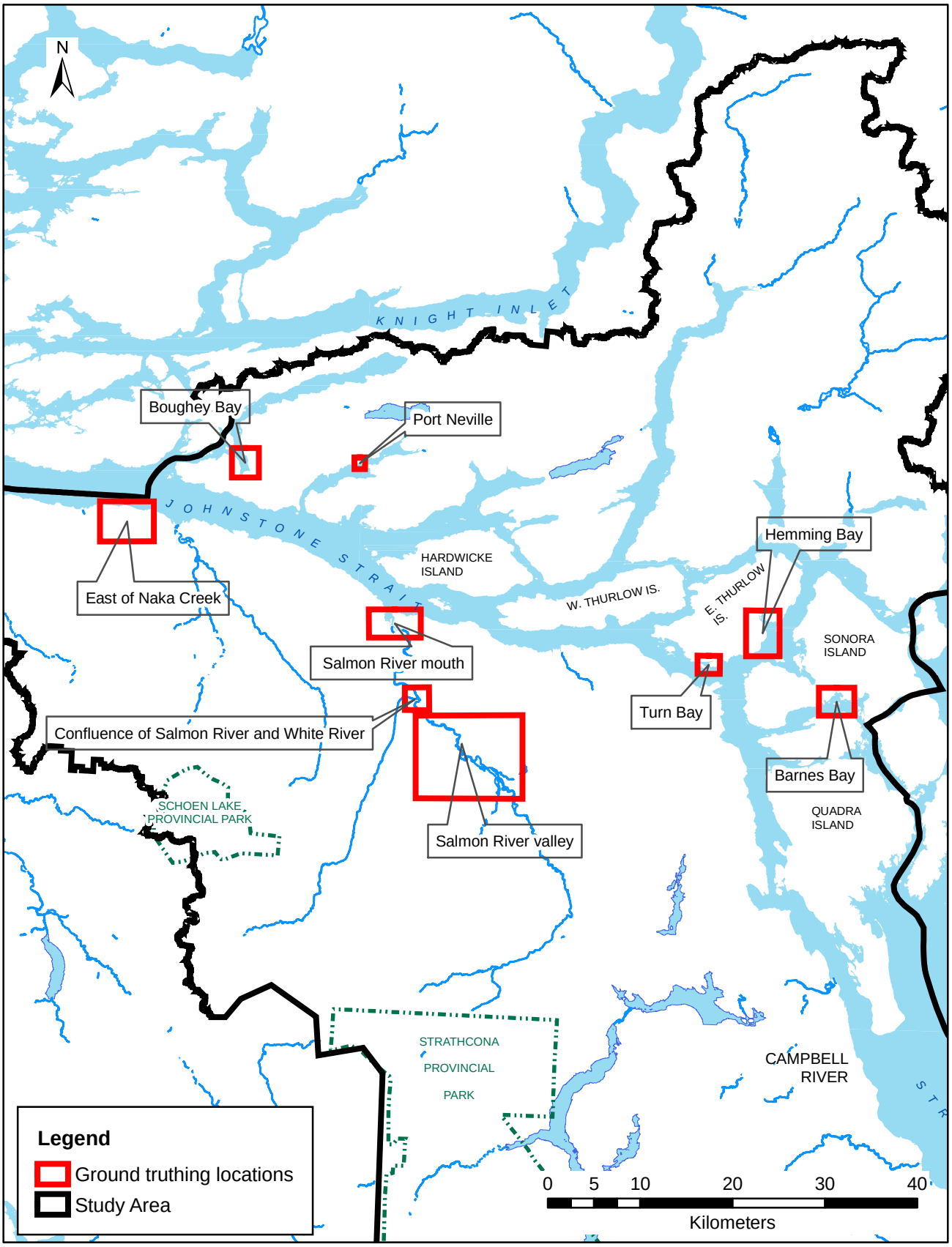


Figure 17. Ground truthing locations.

Results

Ground Truthing Results

Ground Truthing Introduction

The goal of the work was to test the model, not necessarily to systematically identify sites and determine site boundaries. As such the work completed cannot be considered an inventory. Site-specific recommendations should be considered preliminary and incomplete. Further, the low level of systematic subsurface testing sometimes makes it difficult to formally establish and confirm individual site boundaries or to evaluate the integrity and significance of individual sites or locations.

The following field observations are summarized by individual locations and listed by ground truthing points at each locality. Each section summarizes the location, description, criteria, results and recommendations for assessing archaeological potential in the areas explored. Detailed assessments of potential for multiple site-types for each ground potential point within each examined area are listed in Appendix D.

Salmon River Mouth and Graveyard Point Headland (Ground Truthing points 121-140)

Location and Description

This survey area is located along the eastern portion of the Salmon River mouth, which enters Johnstone Strait on northeastern Vancouver Island. The area comprises the eastern shoreline of the lower Salmon River, Graveyard Point and the forested area inland of the Graveyard Point headland (Figure 18). The area is directly east of the modern town of Sayward across Salmon Bay. Access is by gravel road east of the river towards the former landing at Port Hkusam (Duncan and Harding 1979).

The surveyed area comprises several environment types: the protected shoreline and exposed intertidal area of the lower Salmon River estuary; the steeply sloping headland surrounding Graveyard Point; and the steep forested area east of the lower Salmon River (Figure 20). The lower estuary contains mudflats, grasslands, and side channels. The shoreline of Graveyard Point is rocky with pocket beaches. Forest cover is composed of western redcedar, hemlock and Douglas-fir situated in steep terrain with rocky outcrops. The area bordering the access road to Port Hkusam and west towards the Hkusam Village (EcSl-007) is dominated by alder, hemlock and young Douglas-fir.

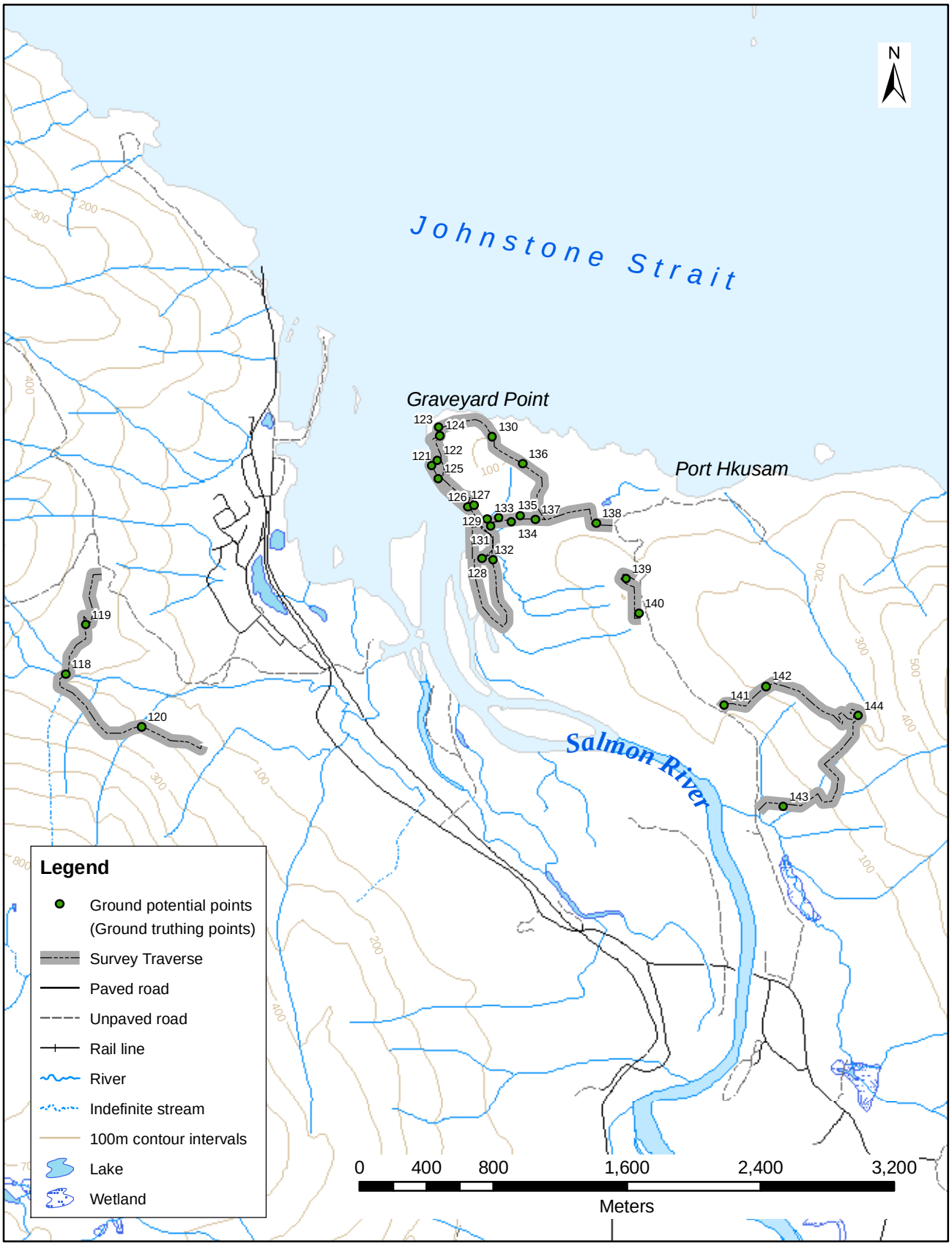


Figure 18. Ground truthing results and survey coverage, Salmon River Mouth.

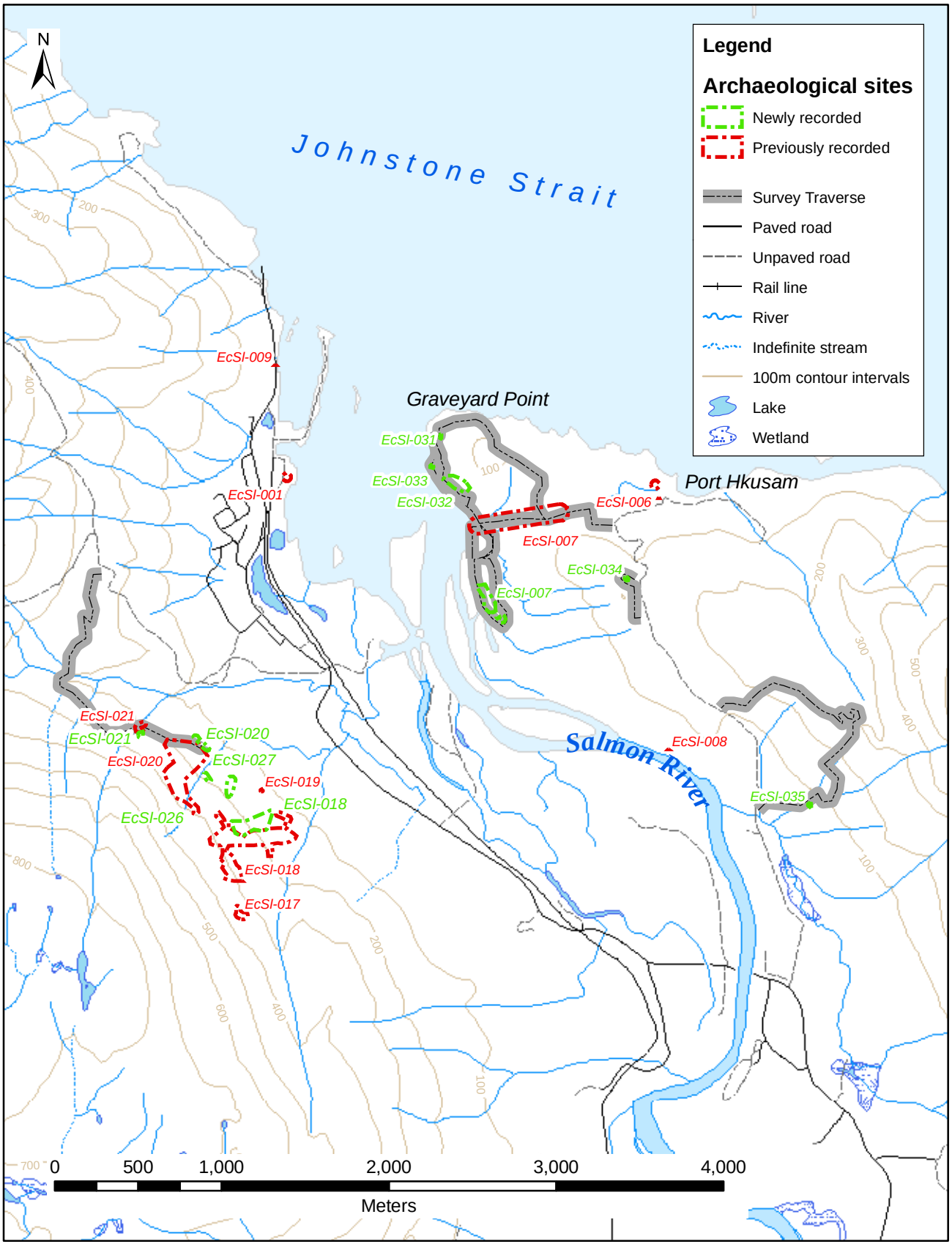


Figure 19. Survey coverage and identified archaeological sites, Salmon River Mouth.

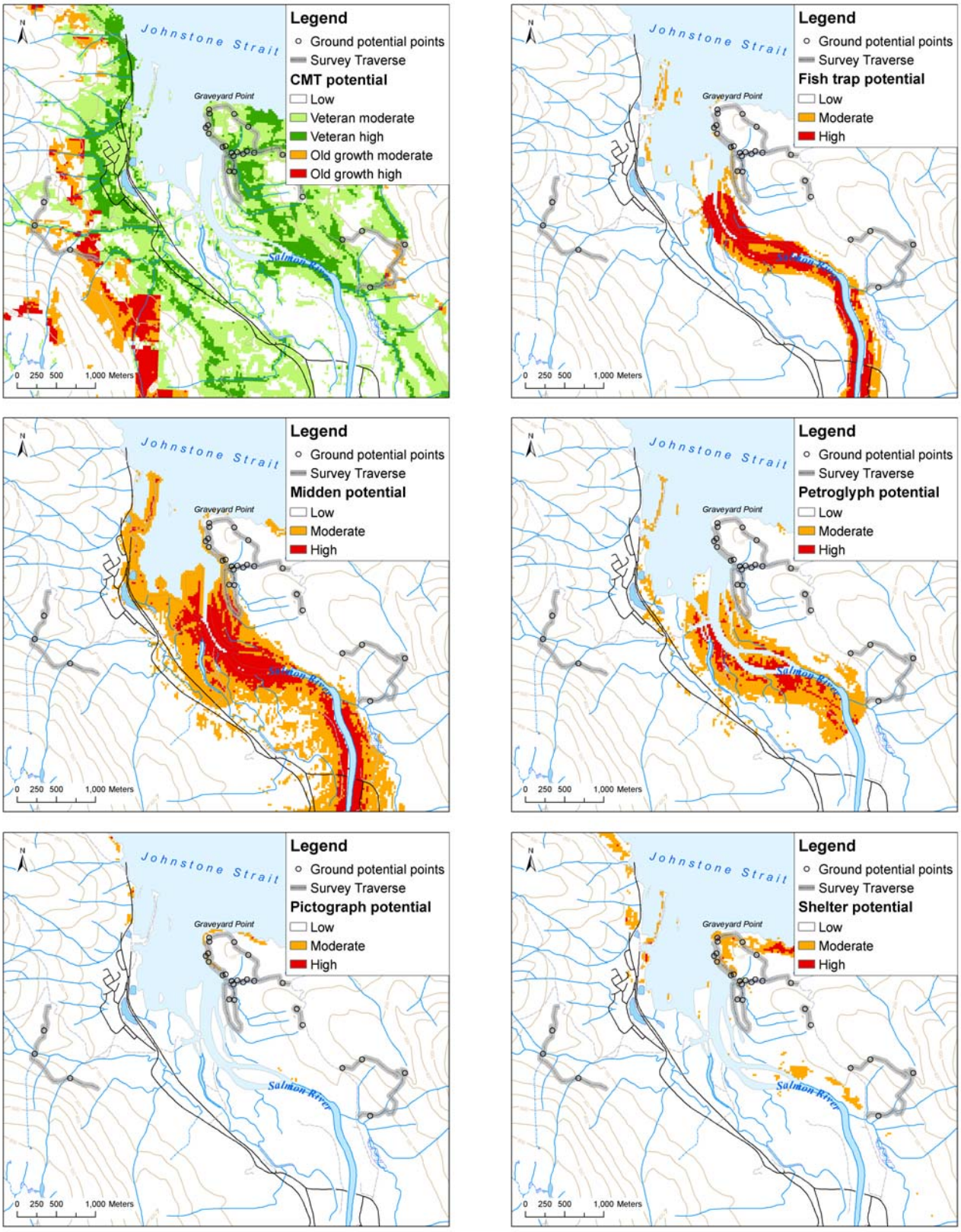


Figure 20. Archaeological potential models, Salmon River mouth.

Criteria

This area was selected for investigation due to its location within Salmon River Indian Reserve #4 and the low number of recorded sites given the extensive aboriginal use recorded during the historic era (Duncan and Harding 1979; Ham 1987). The relatively undisturbed nature of the shoreline, the presence of old growth cedar and the ease of access was also taken into consideration in choosing this locale.

The Hkusam village site (EcSl-007) was an area selected to revisit, as it is area of significance and concern for the K'omoks First Nation and is near the area of proposed woodlot. It also was convenient to visit on an initial work day to calibrate the crew members to various potential features.

Coverage

The Salmon River survey coverage included the eastern shoreline of the Salmon River and forested portions of the Graveyard Point headland residence (Figure 18). The survey began at the deteriorated access road to Port Hkusam, just north of a small creek near a modern residence. The field crew consisted of Morley Eldridge and Iain McKechnie (Millennia Research Limited), and Alan Mitchell and Charlie Johnstone (K'omoks First Nation) and judgmental survey was conducted

The shoreline survey area includes the eastern shore of the Salmon River mouth from the Hkusam village site (EcSl-007) north to the Graveyard point headland. Due to steep terrain at the head of Graveyard Point (50-90% slope), the survey headed eastwards over the ridge-top back to the access road. The survey crew generally covered a 75m traverse. Auger and probe tests were conducted in a single location south of the main Hkusam village site (Figure 25). Auger test were not conducted on near the previously excavated Hkusam Village site or along Graveyard Point due to the sensitive nature of deposits associated with the historical burial area (Figure 32 and Figure 34).

Results

A total of five archaeological sites were recorded or revisited during fieldwork in this area (Figure 19):

- A cluster of bark-stripped CMTs was identified west of the access road near the height of land south of Port Hkusam (EcSl-034, Figure 35).
- The previously recorded Hkusam Village site (EcSl-007) was revisited and the site location was corrected (Figure 21).
- The historic burial ground location on Graveyard Point was also recorded as a site (EcSl-032, Figure 33).
- A canoe-run was identified along on the shoreline of Graveyard Point (EcSl-033, Figure 29).
- A rockshelter burial was identified at Graveyard Point (EcSl-031, Figure 26).

A significant portion of the forested area between the Port Hkusam access road and EcSl-007 has been previously logged.

Hkusam Village (EcSl-007) site revisit

EcSl-007 is located on the east side of the Salmon River mouth, south of Graveyard Point and across the estuary from the town of Sayward (Figure 19 and Figure 25). The site is situated along a narrow forested slightly raised landform. An old river channel forms the eastern border of the site but is blocked by historic-era dykes and is now a grassy marsh. The dykes were built in the 1890s according to Linda Hogarth (2007, personal communication).

K'omoks field assistant Alan Mitchell participated in the Xw esam Ethnographic and Archaeological Project which took place at the site in 2002 as part of the North Island College Archaeology Field School. Alan recalled the extensive excavation process that recovered historic shell midden deposits with artifacts and features. He noted that members of the excavation crew camped near the site on weekends out of concern for unscrupulous artifact collectors. Field school instructors Linda Hogarth (Campbell River Museum) Eric Forgeng (now Archaeology Branch), and James Anderson (North Island College) have been contacted regarding site details but reports of the excavations are not yet complete

Direct field observations demonstrate that the site location is incorrectly plotted in the provincial database. The site was erroneously shown to be approximately 500 m to the north and incorrectly oriented 90 degrees to the shore (Figure 25). Rather than situated on a narrow treed islet in the estuary, the site was mapped as on the main island. An updated site location based on GPS field recording verified with orthophotos has been submitted to the Archaeology Branch. This was not a site selected for correction during the earlier phase of the project, so this error had not come to light.

The field crew spent an hour inspecting the area, examining the intertidal zone for exposed artifacts, wet site deposits, fish weir stakes, and evidence of recent disturbance. The downstream end of the site has historic intertidal debris and features that correlates with the upland furthest north house depressions. The site contains numerous house outlines surrounded by shell midden ridges. Some of the houses are very large, up to 17 x 12 m in size. Numerous house locations contained evidence of recent disturbance by artifact collectors and archaeological excavation units, tarps, and piles of backdirt and historic material from the North Island College archaeological excavations (Figure 24)

The upstream end of the house platforms also correlates with the limit of historic intertidal debris. A few isolated cedar posts or half-posts still stand near a dyke slightly further upstream end. The function of these posts is unknown. However, additional cultural materials were found even further south. Another forested area approximately 70m south of the village and across a historic-era dyke was briefly inspected for subsurface deposits (Figure 25). Fire cracked rock was observed in a three throws and animal burrows and two probes and an auger test were conducted in this location. The probe tests were negative for cultural deposits (>50cm of humic) but the single auger test encountered fire-cracked rock at 30cm depth. Also at this locations was refuse, apparently from the 2002 site guardians camp identified by Alan Mitchell. The fire-broken rock and buried dark soils are probably from a habitation; there is oral history about an ‘older village’ adjacent to the Hkusam site (L. Hogarth, personal communication 2007)

and this may be the remains of this older village. The extent of the buried deposit was not established.

Three or more apparently aligned wood stakes occur in the intertidal zone at the downstream end of the village (Figure 22). Although the right size for fish-weir stakes, it seems these filled a different function as they were so widely spaced. Similar-sized stakes occurred in small rectangles, about a metre and a half square, and associated with clusters of boulders in the beach fronting the centre of the village. These could have formed small wharf structures: they are not visible in the 1881 photo (Figure 21).



Figure 21. Photograph of the Hkusam village (EcSl-007) in 1881. Photographer Edward Dossetter. BC archives accession number: 198604-012.



Figure 22. Charlie Johnson (K'omoks First Nation) showing aligned wooden stakes visible in beach in north end of site EcSl-007 View looking north.



Figure 23. Close up of axe-sharpened wooden stake.



Figure 24. House depression at EcSl-007 showing excavation unit stakes, ground tarps with backdirt, and partially open excavation units from archaeological investigations of house depression at north end of site. View looking west.

Rockshelter at Graveyard Point (EcSl-031)

Reconnaissance of the Graveyard Point headland identified a rockshelter burial site (Figure 28). This location is clearly different from the historic graveyard, which is over 200 m to the south. The rear of the rockshelter appears to be nearly perfectly dry. The shelter contained several thin cedar boards inside the rockshelter drip-line (Figure 26 and Figure 27). The boards appear to be from one or more kerfed and steamed bentwood boxes. Two boards showed perforations that were likely pegged or sewn corners. These boards appear to have been disturbed and scattered by relic hunters. Two isolated boards at the south end of the shelter are partially outside the drip-line further indicating disturbance. Two clusters of large rocks form 1.5m diameter cairns at the northern end of the rockshelter. These probably weighted burial box lids originally. A single adult human vertebra was observed in the vicinity of the cedar boards but no additional human remains were visible. Due to the sensitive nature of this site, the survey crew did not enter the drip-line to inspect the remains or disturb the ground surface. The crew were careful to step only on rocks or tree roots in the vicinity of the rockshelter.

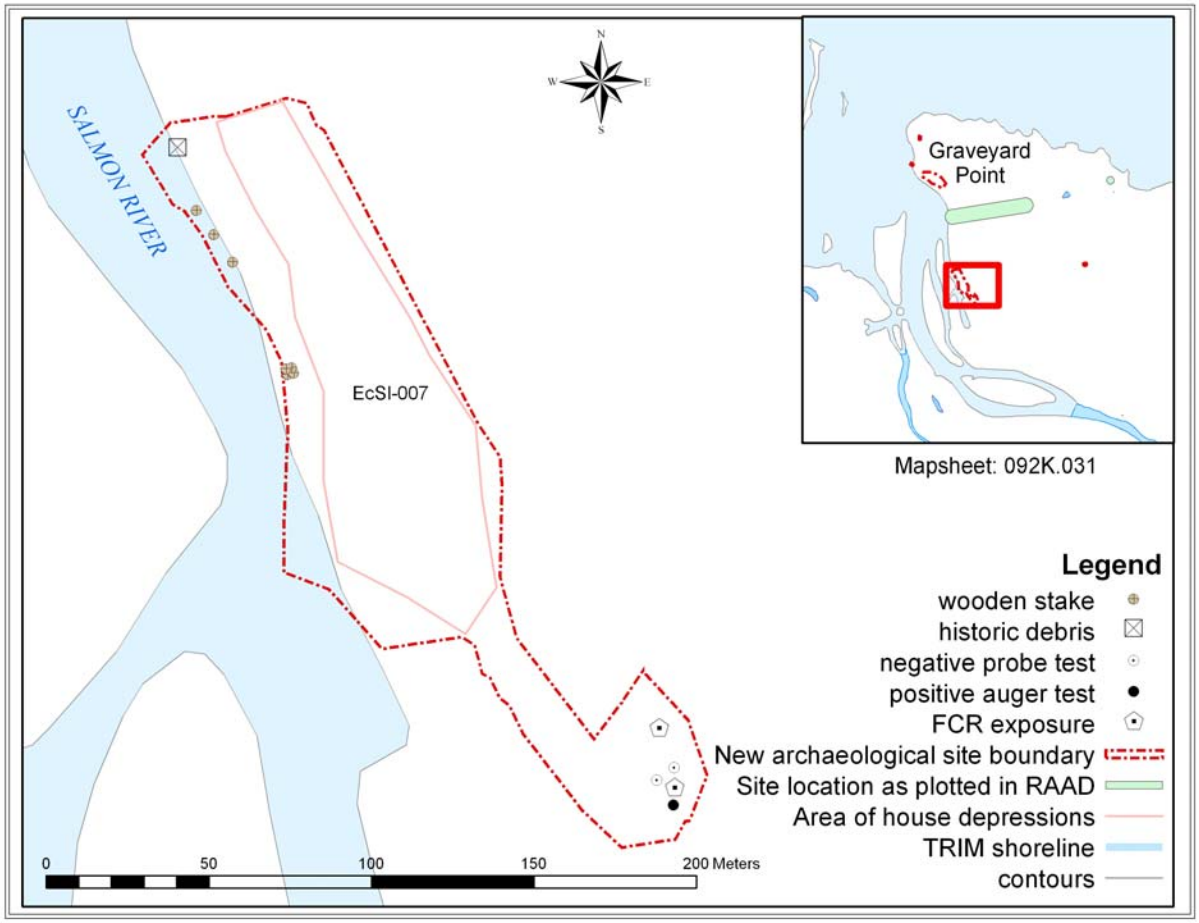


Figure 25. Revised site map of the Hkusam village (EcSl-007), lower Salmon River.



Figure 26. Photo of rockshelter EcSl-031 looking south.



Figure 27. Cedar bentwood box plank with notched and perforated end.

No CMTs were observed in the predominantly old growth forest along the shoreline of the Graveyard Point headland in the immediate vicinity of the rockshelter. The lack of CMTs and commercial logging may reflect respect of the site as a burial area.

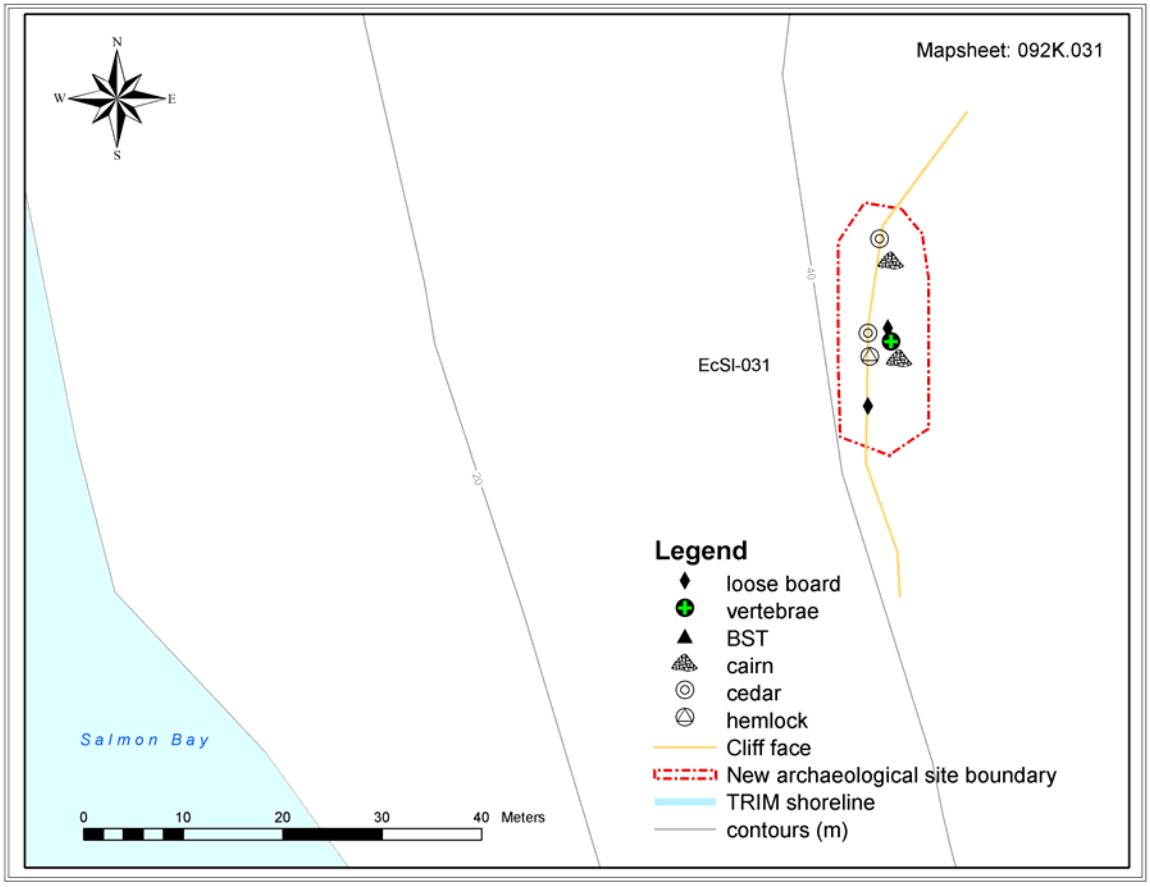


Figure 28. Rockshelter site EcSl-031.

Canoe run(s) at Graveyard Point (EcSl-033)

Shoreline inspection of a northwest-facing beach on Graveyard Point identified two possible canoe runs in the intertidal zone (Figure 19 and Figure 31). The canoe run(s) consist of small to large boulders arranged in two semi-linear formations (Figure 29 and Figure 30). The southern line is well defined. The boulders along the northern side of the site are more irregular. Auger testing was not conducted in the forested area directly behind the site due to the potential to inadvertently disturb human burials. This beach may be the closest landing to the burial rockshelter.



Figure 29. Canoe-run (EcSl-033) on Graveyard Point looking south up the Salmon River estuary.



Figure 30. Another view of canoe run at EcSl-033.

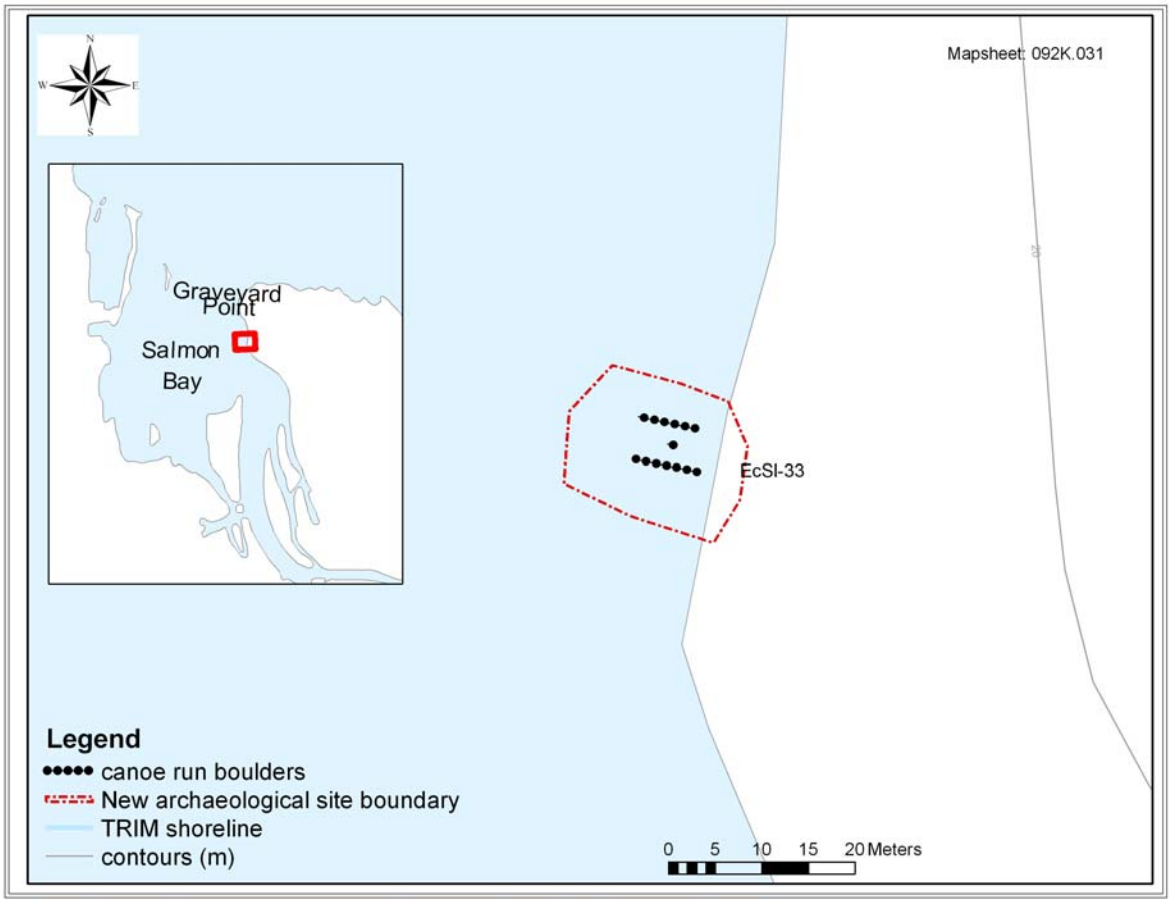


Figure 31. Canoe run site EcSl-033.

Graveyard location (EcSl-032)

The area of the historically recorded burial ground on Graveyard Point (for which Graveyard Point is likely named) is located north of the village site (Figure 19). Although no direct evidence of the site was observed during a brief reconnaissance of the area, the site location has been mapped on the basis of historic photos (Figure 32 and Figure 33) and a rectified survey map of the Indian Reserve Commission recorded sometime in the late 19th century (Indian Reserve Commission Ottawa 1876-1907). The map specifies the location of the graves. More information could likely be found in the surveyor's notes. Subsurface testing was not conducted in this area due to its sensitivity.

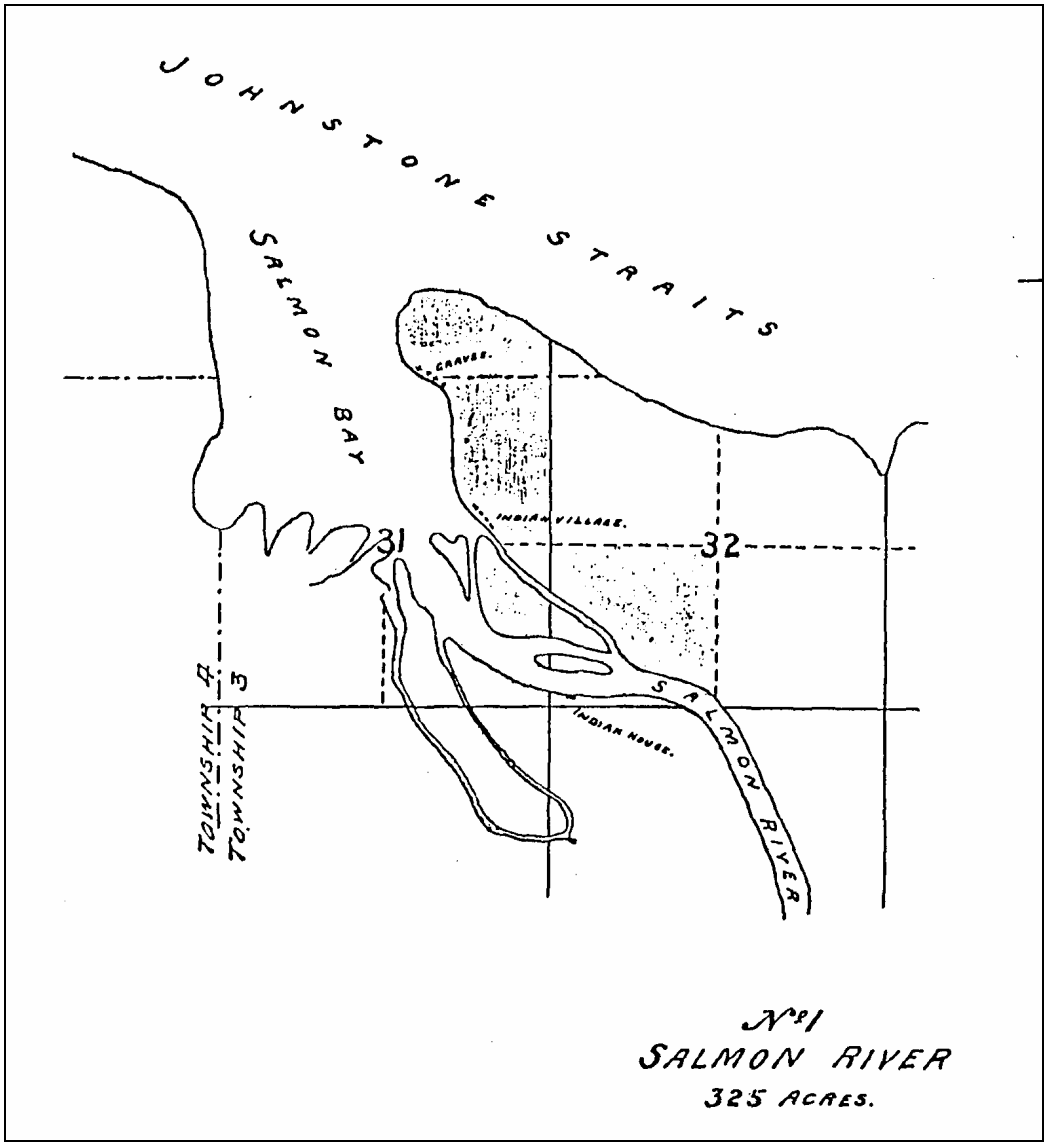


Figure 32. Historic map of Salmon River mouth showing Hkusam village, a house location south of the village, and the grave site (Indian Reserve Commission Ottawa 1876-1907).



Figure 33. Memorial figures and grave houses, Graveyard Point (ca. 1881). Photograph by Edward Dossetter (BC Archives accession number 198604-012).

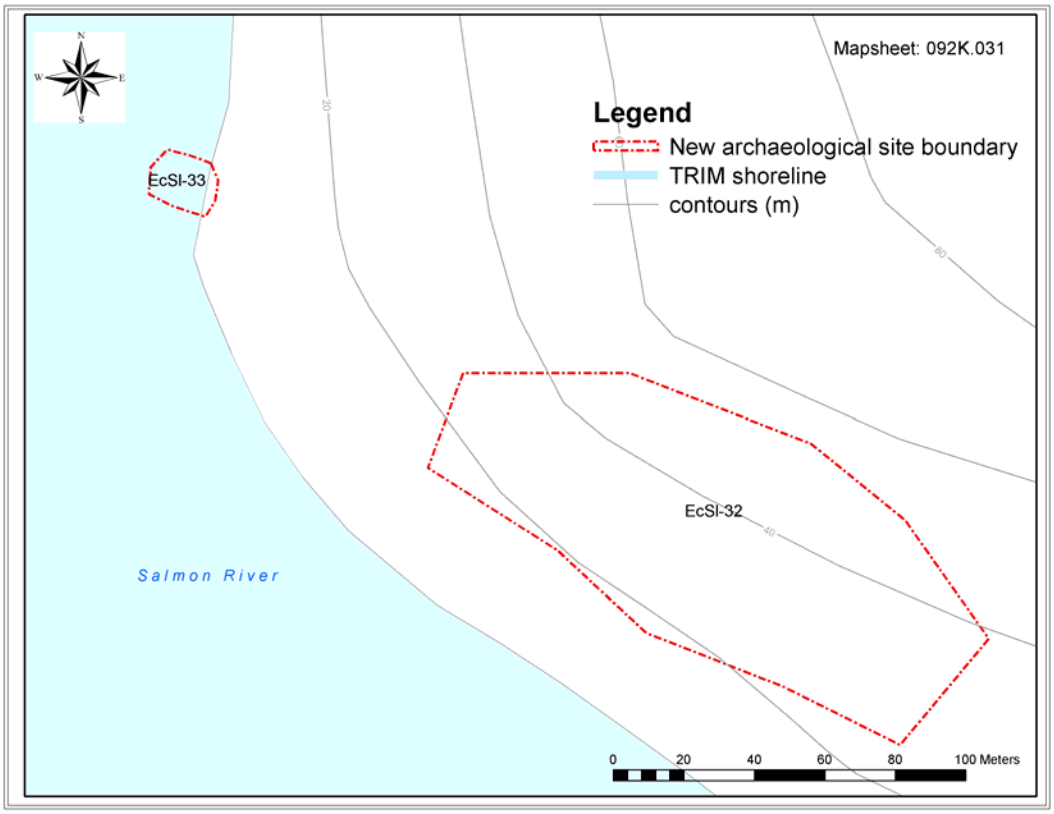


Figure 34. Graveyard location (EcSl-032) and canoe run site (EcSl-033).

CMT site EcSl-034

A cluster of five taper bark-stripped western redcedar CMTs was identified in a relatively steep gully (60% slope) above the north side of the access road to Port Hkusam slightly east of the ridge line dividing watersheds of the Port Hkusam side from the Salmon River proper (Figure 19 and Figure 35). These trees are veterans in an otherwise logged area. They are relatively small diameter trees and two of them are dead snags about 25 cm dbh. The taper strips were all on the uphill side. Due to the lack of time, the area was not examined in detail but no further CMTs were noted during a short reconnaissance uphill.

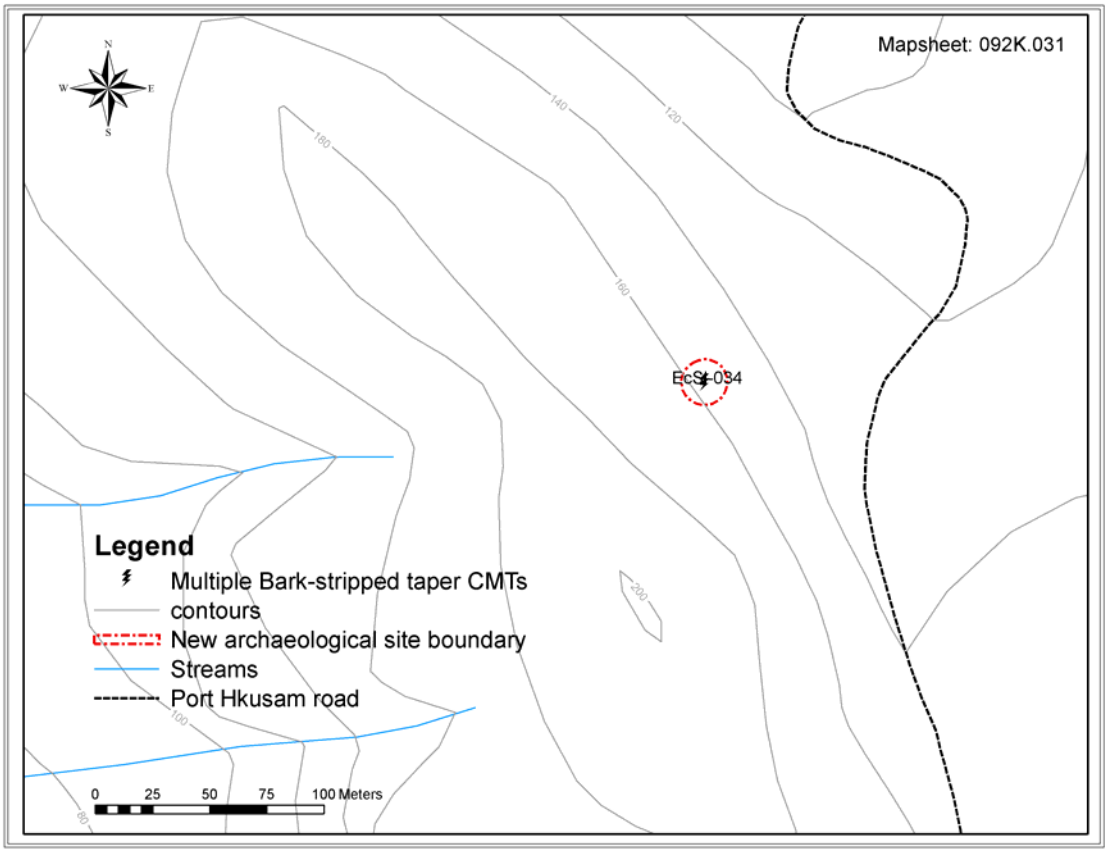


Figure 35. CMT site EcSl-034.

Discussion and Recommendations

Hkusam Village EcSl-007

The reports from field school investigations will probably detail recommended further archaeological work at this site. It is clearly an important site and much of the surrounding shoreline has considerable archaeological potential. Disturbance and vandalism appear to be an ongoing problem. If future developments are to occur in the vicinity of this site, a full AIA is strongly recommended.

Burial rockshelter EcSl-031

This site appears to have been subject to disturbance as evidenced by the mixed rock and box remains. This site was not investigated thoroughly due to its sensitive nature. Total avoidance of the site is strongly recommended. The gazetted name "Graveyard Point" clearly marks the general location as a cemetery and there is little left for looters to collect.

Canoe run EcSl-033

Should future development be planned for the area, a full AIA is recommended.

Graveyard EcSl-032

The location of this historical recorded graveyard was not closely examined in the field but was located using historic maps and photos. Further archaeological and archival research is required to determine the precise extent and location of the features. Copies of the surveyors notebooks could provide additional spatial and other information. Total avoidance of the area is recommended.

Proposed Woodlot east of the lower Salmon River (Ground Truthing points 141-143)

Location and Description

A forested area on a 50-70% slope east of the lower Salmon River was surveyed on March 10th (Figure 19). The area east of the Port Hkusam access road in a proposed woodlot. This area is within the CWH xm sub-zone. Survey included a traverse from valley bottom to ridge top, and returned down to meet the road to Port Hkusam (Figure 19, points 141-143). This area contained older second growth stands composed primarily of mature Douglas fir, balsam, and hemlock, but also contained veteran old-growth western redcedar. A narrow fringe of old-growth occurred alongside a recent clearcut near the ridge-top (point 144 in Figure 18). Within the clearcut on the ridge-top, springboard notched stumps were observed among the stumps of recently logged second growth.

Criteria

The area was chosen for survey due to it status as a proposed Woodlot, the presence of forest cover identified as old-growth, and the presence of areas modelled as high potential for CMTs. CMTs and rockshelters were the only expected site types. The survey traverse crossed a variety of microenvironments yet was at an elevation that would not have significant snow cover during fieldwork.

Coverage

The field crew consisted of Morley Eldridge and Iain McKechnie (Millennia Research Limited), and Charlie Johnstone and Alan Mitchell (K'omoks First Nation) who conducted the survey along a 75m wide traverse. A portion of the survey was conducted in single file due to the steepness of the slope.

Results

One bark stripped taper cedar CMT was identified during the hillside ascent near the confluence of two small creeks (EcSl-035, Figure 36). A brief reconnaissance in all directions

suggested that no other archaeological remains were present in the vicinity. On the initial ascent of the hillside, Douglas fir appears to have been selectively logged, possibly during a time when cedar prices were low. Veteran cedars, cedar snags, and Douglas-fir stumps were present throughout, with the cedar concentrating along creeks. The terrain was very steep in places with some rock bluffs that required climbing. No rockshelters were observed along the traverse.

Near the end of the traverse, just above the access road, several large old-growth cedar had large creases potentially indicative of fully enclosed bark-strips (point 141). Lack of additional evidence of cultural modification precluded positive identification and further investigation.

Results from this portion of the survey indicate that veteran western redcedar and cedar snags may occur in areas that have been previously logged. Cedar was largely restricted to areas near creeks. The area identified as old growth at the top of the ridge appears to be misclassified. Rather, the area contained springboard-notched stumps from an old clearcut.

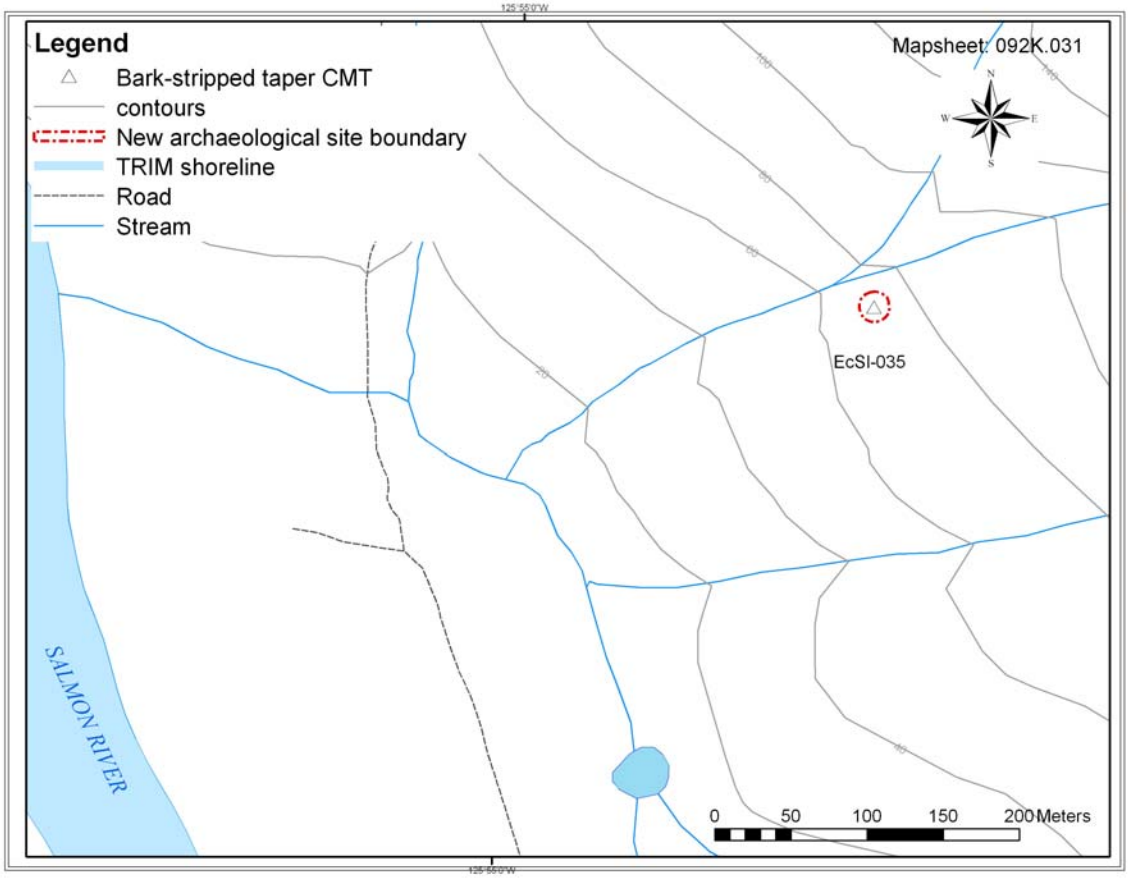


Figure 36. CMT site EcSl-035. See Figure 19 for general site location.

Discussion and Recommendations

Portions of the surveyed area include forest cover classified as old growth, which appears to misclassified, at least in the parts seen. However, areas of older second growth were found to have moderate to high potential for CMTs, as it appears that cedar were selectively retained at the time of initial commercial harvest. Therefore, additional CMT inventory work would be appropriate prior to woodlot or other forestry operations commencing.

Hotel Block, Salmon River Mouth (Ground Truthing points 118-120).

Location and Description

A forested area above downtown Sayward adjacent to the cluster of CMT sites located in Hotel Block (containing sites EcSl-017, 018, 019, 020, 021) (Eldridge 1991b), was briefly examined on the afternoon of March 13th. The northern part of the traverse was through moderately sloped second growth hillside. Parts of this stand had also been surveyed during the Baseline inventory (Engisch, et al. 2004). The southern section mostly consisted of very steep gullies and crossed a major stream. Old growth occurred in patches in the gulleys and then is continuous in the Hotel Block area.

Criteria

This area was selected for reconnaissance due to the nearby presence of a large number and variety of CMT types.

Coverage

The survey consisted of a single narrow traverse by three people. In most locations the coverage was about 20 m wide, widening to 35 m in the southern part.

Results

The old-growth portions of this forested area contains many taper bark stripped CMTs, some just outside the boundaries of the known sites. Taper and multiple taper bark-stripped western redcedar were observed along the hillside (Ground Truthing points 118-120) but were not recorded. They became more common closer to the Hotel Block. The Hotel Block itself is well known for its varied feature types including several standing plank-stripped trees (Eldridge 1991b). The traverse ended at the previously recorded sites, including an undercut western redcedar with tool marks (Figure 37 and Figure 38).

Discussion and Recommendations

This area is well established containing numerous known CMT sites. It was noted that the lower slopes appeared to be drier with little sign of even veteran cedar. The biogeoclimatic division between wetter and drier subzones is drawn right along this slope, with all the CMT sites being in (or very close to) the wetter CWH vm1 subzone.

Further inventory uphill of the recorded sites is recommended. In contrast, the previously logged area on the north of the stream was chainsaw logged. No veteran cedars were observed and the potential for CMTs is very low here. This corroborates the findings of Baseline (Engisch, et al. 2004).



Figure 37. Revisited plank stripped and undercut CMT with tool marks in Hotel Block.



Figure 38. Close of CMT with tool marks in Hotel Block.

Above confluence of the Salmon & White Rivers (Ground Truthing points 8-13)

Location and Description

This area is an elevated forested slope containing several unnamed drainages northeast of the confluence of the Salmon and White Rivers (Figure 39). This area occurs within the CWH xm sub-zone. The surveyed area contained large stands of old-growth at higher elevations. Second growth was present at the lower slope, predominately Douglas-fir and hemlock along benches separated by bluffs above the Salmon River.

Criteria

This area was chosen for survey due to its status as an established woodlot (Woodlot License W2029), and areas modelled as high potential for CMTs in old-growth. CMTs and rockshelters were the only expected site types. The survey traverses crossed a variety of environments yet was low enough elevation to not have significant snow cover. Access was from the Island Highway. See Appendix D and Figure 40 for detailed results of the expected and actual archaeological potential for this area.

Coverage

A crew of four (Alan Mitchell, Charlie Johnson, Iain McKechnie, and Morley Eldridge) conducted the survey along a single traverse. The initial portion of the survey was conducted in single file due to the steepness of the slope. The remainder covers a 75m wide swath.

Results

The upper area contained abundant old growth consisting of large Douglas-fir along the two benches running north of the creek (Figure 39). Cedar trees tended to be smaller and perhaps younger and were concentrated along ephemeral streams. Some larger, old cedar snags were present but were heavily burnt. No CMTs or rockshelters were observed along the surveyed area.

Discussion and Recommendations

This portion of the survey encountered no CMTs despite the presence of large old growth western redcedar relatively close a major river and at low elevation (<200m). The east side of the river at this location is in the drier CWH xm subzone and this has a noticeable effect on the size, density, and distributions of western redcedar. There is some potential for CMTs in this woodlot, but it is a moderate rather than a high potential. Despite being adjusted downward for the drier microclimate, the model continues to show high potential pixels amongst moderate potential. Systematic coverage, particularly along the base of the two benches observed north of the creek (points 8-10). The preliminary reconnaissance of this survey area needs to be augmented by further survey.

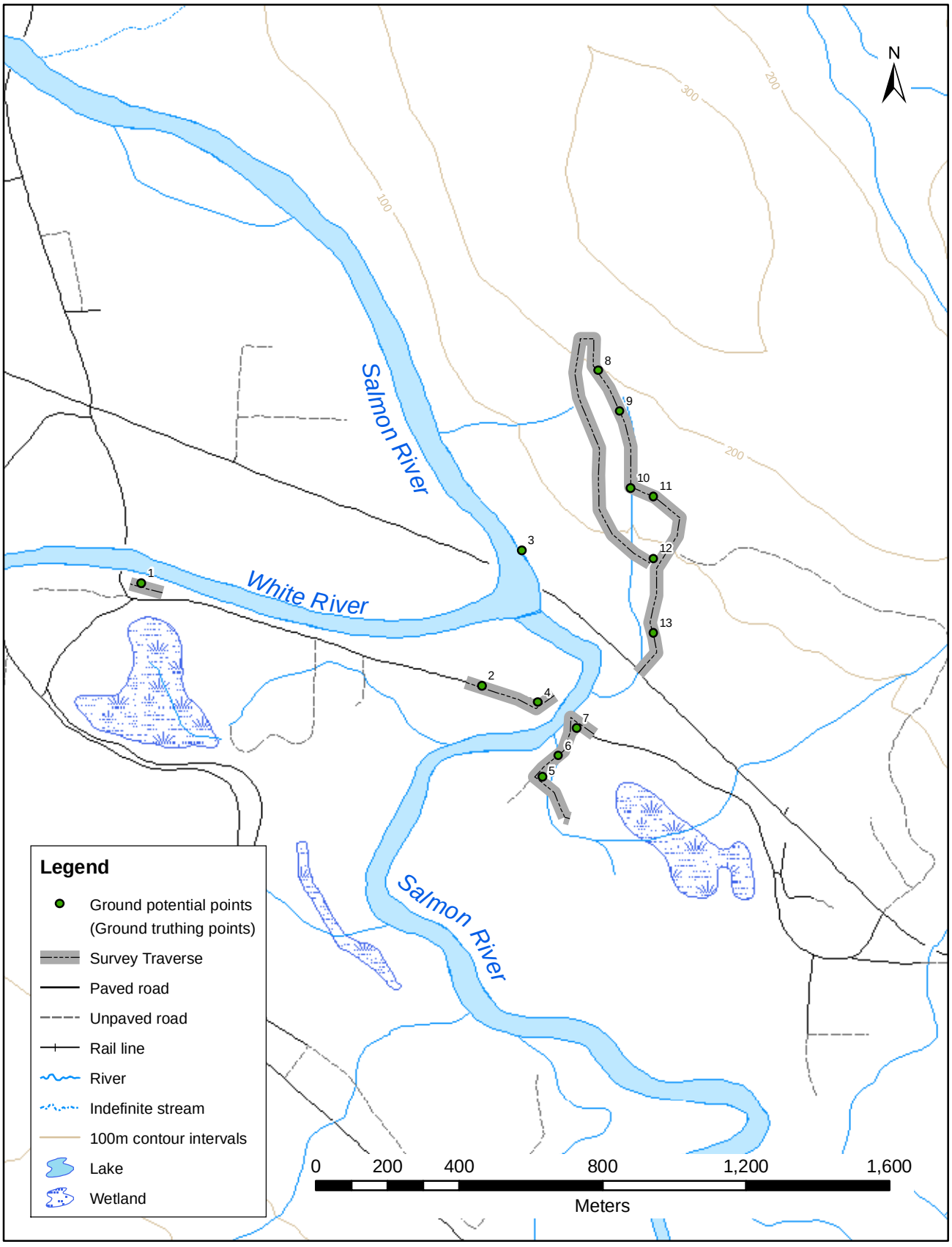


Figure 39. Ground truthing results and survey coverage, confluence of Salmon River and White River.

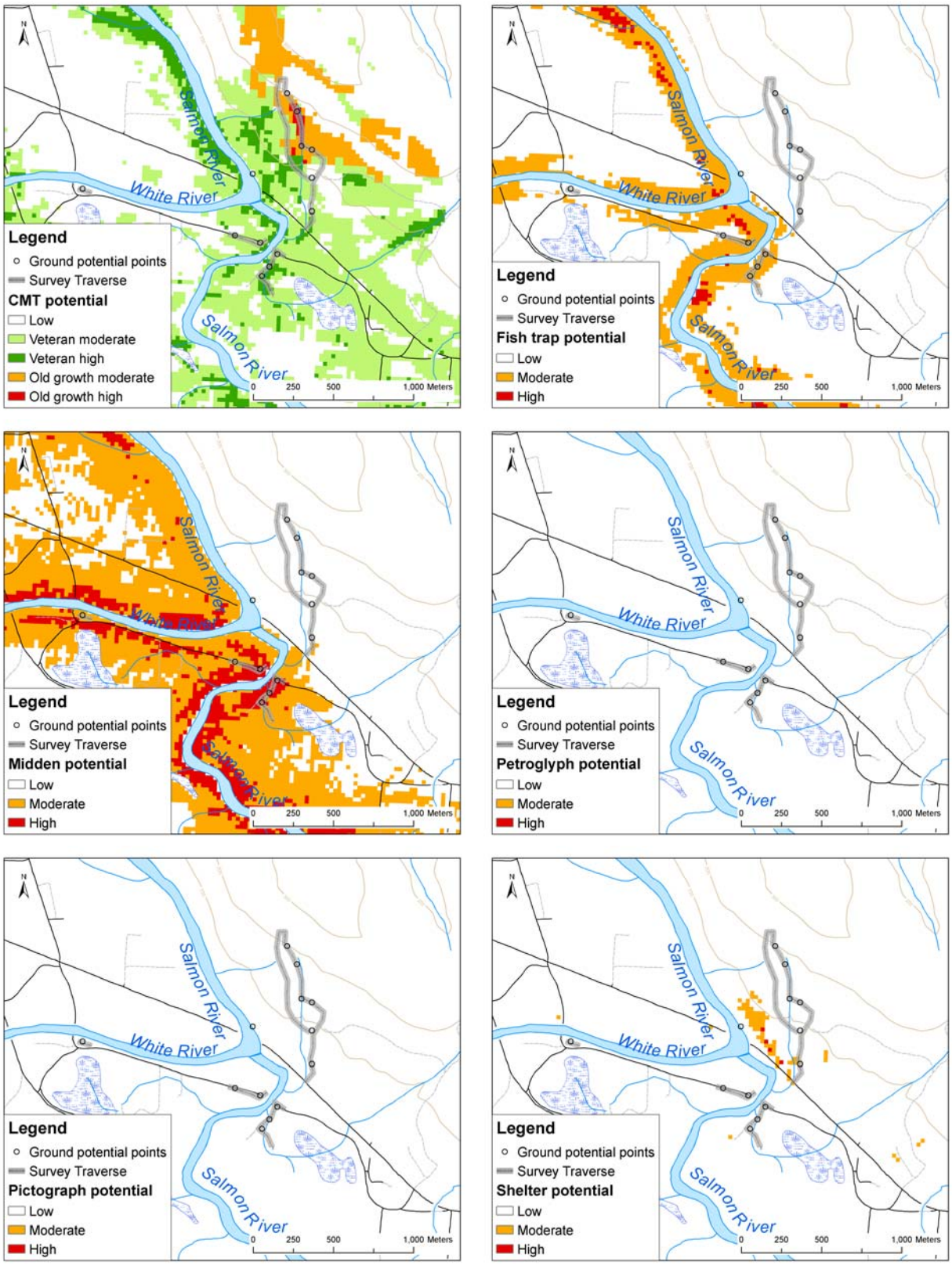


Figure 40. Potential models for the confluence of Salmon River and White River.

Collingwood Point, Port Neville (Ground Truthing points 157-169)

Location and Description

Port Neville is a relatively small coastal inlet located on the BC mainland in eastern Johnstone Strait. The coastal portion is in the CWHvm1 biogeoclimatic subzone. Survey was conducted along the western shore and a forested area above Collingwood Point, located two-thirds of the way up the inlet at a narrows across from Hanatsa Point (Figure 41).

Collingwood Point is an exposed bedrock outcrop bordered by a gravel beaches. To the west along the shoreline has a flat narrow bench with a gently sloping south facing hillside behind. A recent clearcut is situated approximately 50-100m from the shoreline. Previous archaeological investigations of the area have recorded EdSl-009. Originally, the site consisted of a petroglyph at the point, recorded by the Barrows in 1933. An AIA of a proposed cutblock TS A75911 Block 3 was undertaken by Baseline under permit 2003-390 (Grant 2003). Unfortunately the report in both hardcopy and CD formats is missing from the Archaeology Branch, and there is no indication of the level of effort undertaken at this site. However, according to the site form, during the AIA a shell midden was found in a tree throw exposure on a raised bench, measuring a metre square, and this was added to the nearby petroglyph site. Site revisits subsequent to the initial recording have been unable to relocate the petroglyph. Two other shell midden sites on either side of Collingwood Point (EdSl-008 and EdSm-017) are located in the general vicinity but were not revisited.

Criteria

This area was selected for investigation due to its location outside the TFL but in Port Neville, and due to the existence of nearby place names recorded by Boas (Boas 1934) and Bouchard and Kennedy (Eldridge, et al. 1988), and previously recorded sites (Figure 42). This area is reported to have old growth forest cover above the recent cutblock and the predictive model shows high potential for habitation sites and fish traps along the shoreline (Figure 43). A place name given by Chief Charlie Matilpi (the Matilpi tribe amalgamated with the Tlowitsis in the 19th century) identifies Collingwood Point as *Gwélyadi*, translated as 'abalone place' (Eldridge, et al. 1988: 132). Coincidentally, a recent northern abalone (*Haliotis kamtschatkana*) shell was found on the beach during intertidal survey by assistant Gina Thomas (Tlowitsis First Nation). Hanatsa Point, directly across the inlet from Collingwood Point is also identified by Charlie Matilpi as *Hánets'*, translated as "canoe submerged from clam overload" (Eldridge, et al. 1988: 132). This implies the area was exceptionally productive for shellfish.

Coverage

Shoreline and forestry survey coverage was judgemental. A crew of three conducted the survey (Gina Thomas, Iain McKechnie, and Morley Eldridge). The shoreline was inspected for shell midden deposits, intertidal artifacts, and petroforms. Auger and probe tests were conducted at periodic locations in the forested shoreline adjacent to site EdSl-009 and on a 15m terrace uphill from the originally mapped site. Surface exposure was good in the recently logged cutblock and along the shoreline. Petroglyph survey coverage was generally poor. The sandstone

exposed along the intertidal area wraps around the point were not investigated due to the lack of time. Another petroglyph site (EdSl-001) (or, possibly, the same one with confused records) is located approximately 170m east of Collingwood Point but lack of time precluded investigation of the remainder of the foreshore and intertidal bedrock ramps.

Results

EdSl-009 revisit

The survey found that EdSl-9 is significantly larger than previously documented (Figure 46). Two tree throw exposures containing fire-broken rock, littleneck and butter clam, bay mussel, and acorn barnacle were found. The elevation to these deposits was measured as 15 m above high tide line using a clinometer and laser rangefinder. These and several positive augers or probes enlarged the upper shell midden to 20 metres across (Figure 44).

Along the shoreline forming the western side of the point, a large bench of previously unrecorded midden at least 50 m long and 10 to 15 m wide was found. This midden was up to 75 cm deep and large enough to potentially represent house remains.

Additional pocket middens were found at the head of the small bay to the west and due to proximity, have been included in the enlarged EdSl-9. A low but level and well-drained shoreline continues to the west with a high potential for additional midden sites here.

Two taper bark-stripped cedar trees were also found amongst the midden deposits at EdSl-9 (Figure 45).

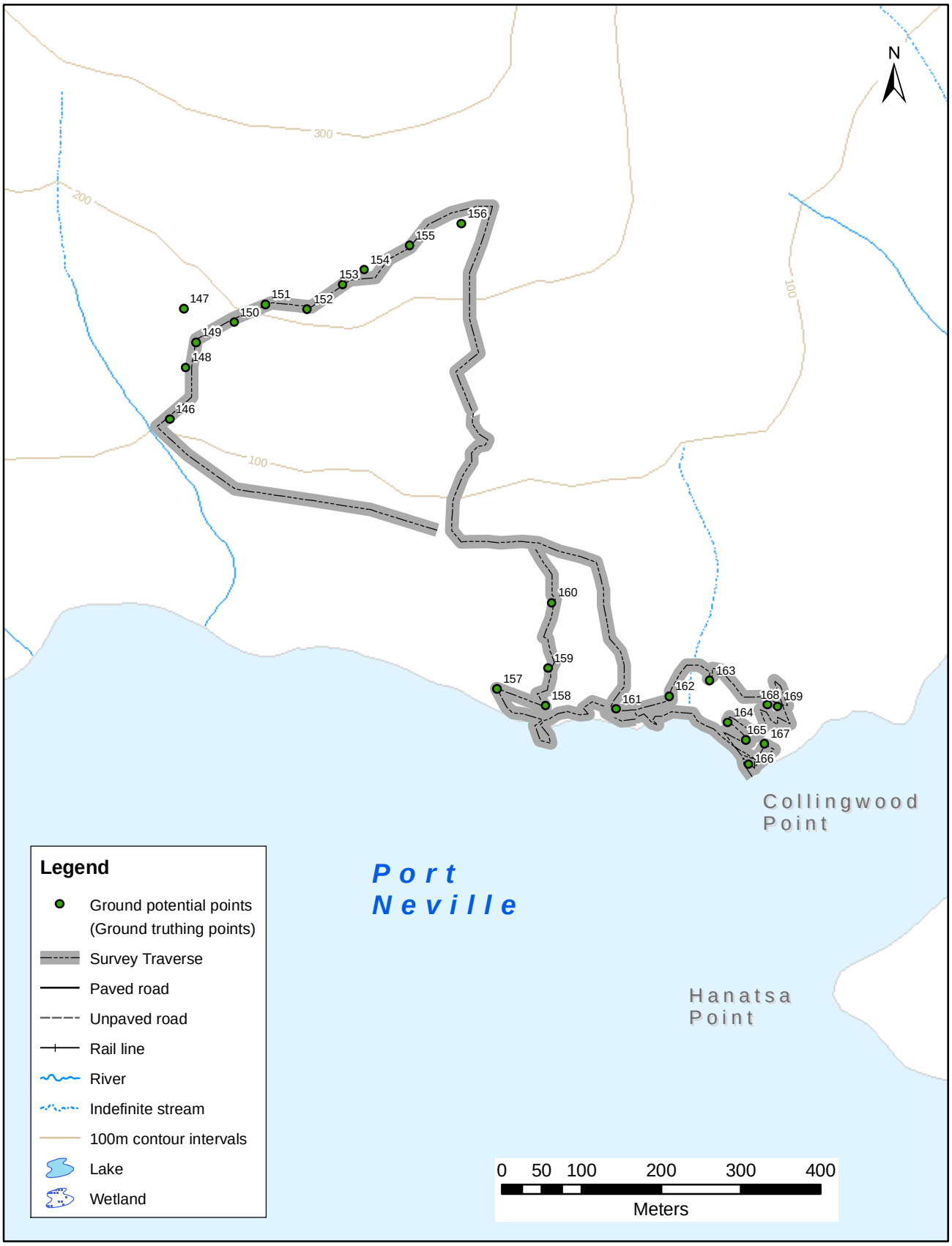


Figure 41. Ground truthing results and survey coverage, Port Neville.

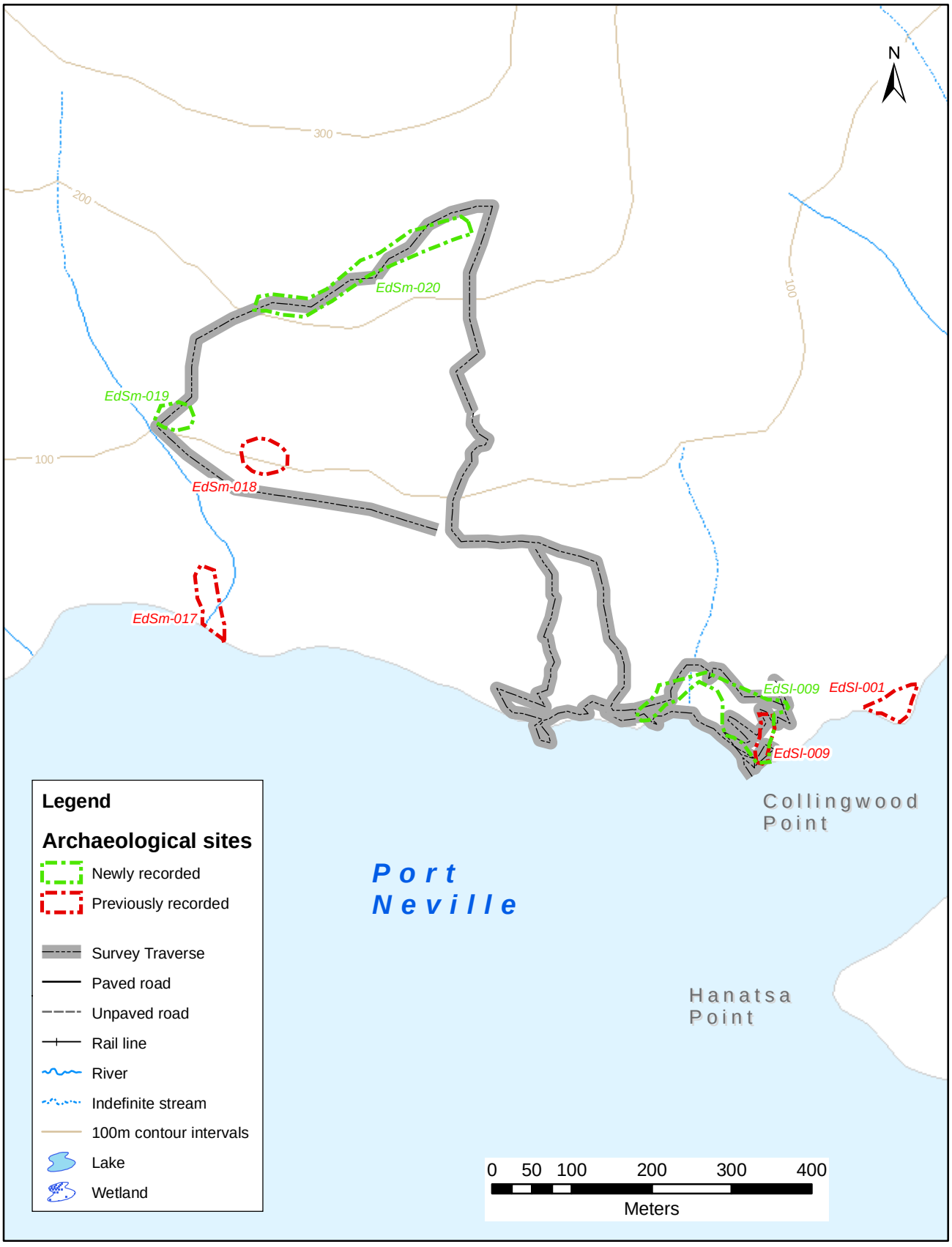


Figure 42. Survey coverage and identified archaeological sites, Port Neville.

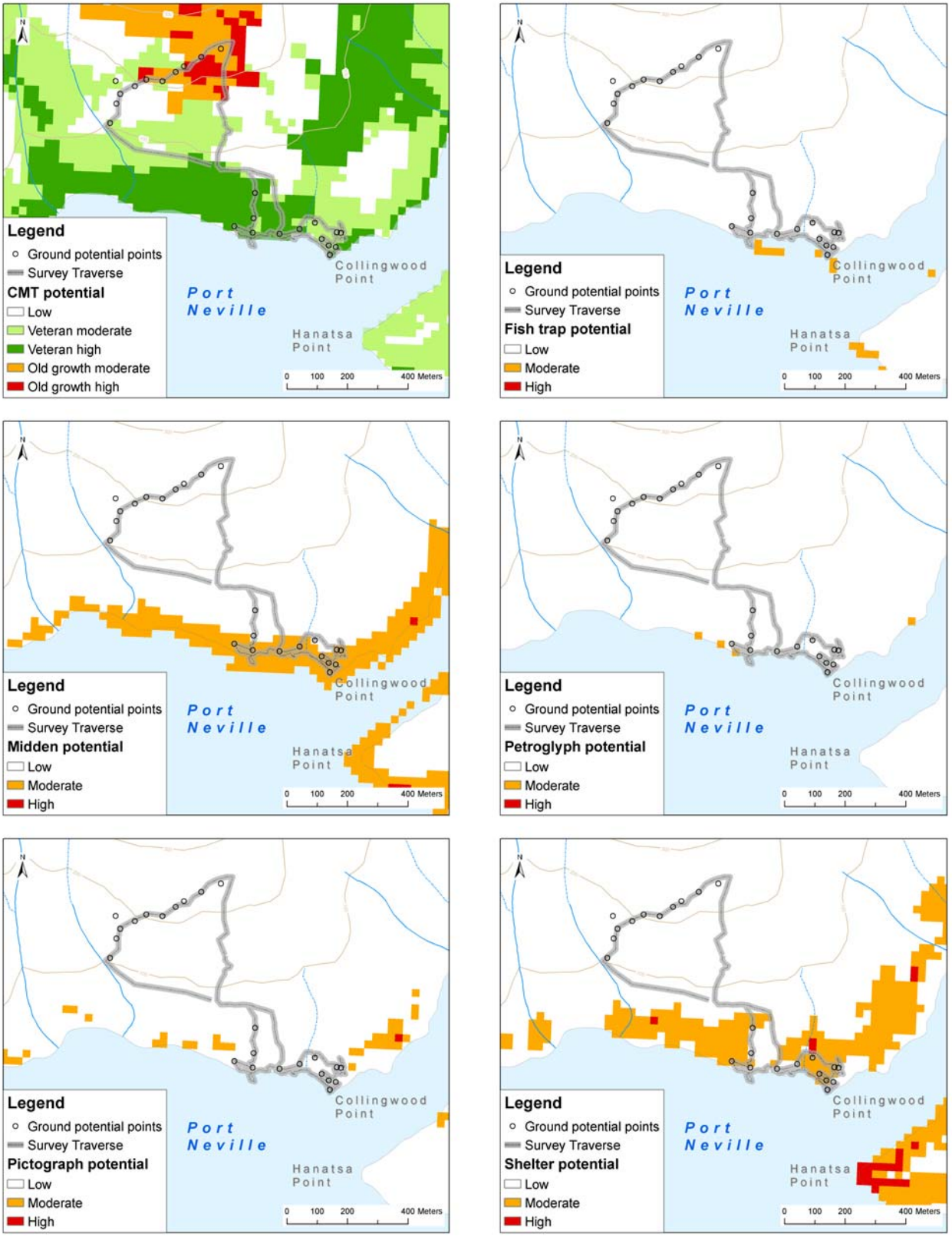


Figure 43. Potential models for Port Neville.

Discussion and Recommendations

The site boundary of EdSl-009 is significantly larger than previously reported. Systematic subsurface testing of the deposits along this portion for the shoreline is recommended in order to precisely define site boundaries in relation to nearby sites EdSl-008 and EdSm-017. The current shape of the revised EdSl-009 site boundary is based on limited subsurface observations and two CMTs. However, it is likely that additional shell middens are present further west along the shoreline.

The presence of midden deposits on a terrace 15m above sea level may be also be significant to interpreting the settlement structure and/or antiquity of human occupation in the area as this may reflect a special activity area separated from the main habitation area or, possible but unlikely, date to a time when sea levels where significantly higher than today.

As noted, it is likely that additional shell midden deposits will occur to the west, and the petroglyphs along this shore remain uncertain as to their location. The midden at 15 m elevation could be associated with higher sea levels; more likely, though, it represents special activity areas spatially separated from the main midden. The remaining fringe of forested shoreline on either side of Collingwood Point should also be surveyed for the presence of CMTs as well as similar areas in and around Port Neville.



Figure 44. Shell midden tree throw exposure on 15m terrace above EdSl-009.



Figure 45. Bark stripped CMT (MR2) associated with EdSl-009 (note visible scar crusts).

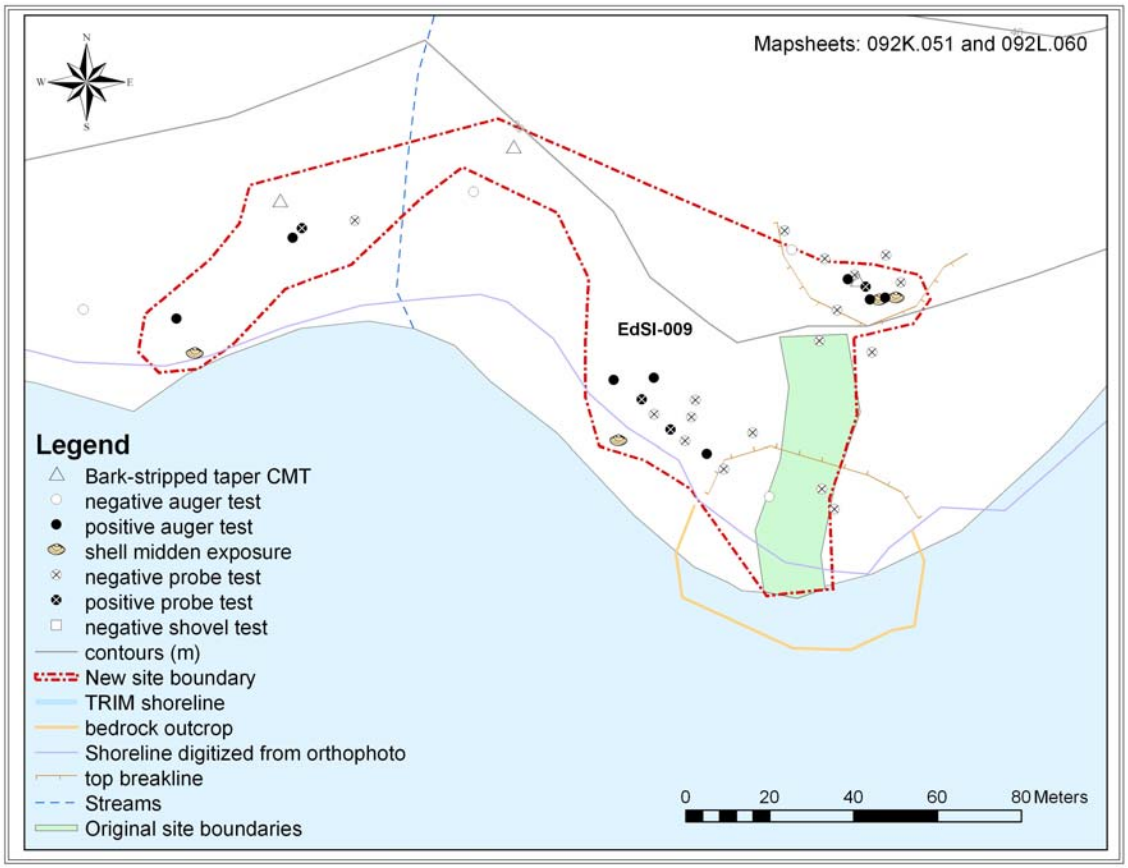


Figure 46. Revised site map of EdSl-009, Collingwood Point, Port Neville.

Above Collingwood Point, Port Neville (Ground Truthing points 146-156)

Location and Description

The survey conducted in the forested area above Collingwood Point is in old growth cedar and Douglas-fir, above a recently logged block. Previously recorded site EdSm-018 is located in a small leave patch within the block; our survey began at a bridge crossing a major creek just to the west (Figure 41). Heavy handlogging was evident from the young stand of trees and dense springboard-notch stumps located along the creek and along an unmapped tributary that flows from the northeast, paralleling our track. Old growth occurs between the creek and the new cutblock below.

Criteria

The area was selected due to the general proximity to the shoreline, the presence of areas identified as old-growth and modelled as high and moderate potential for CMTs, and previously recorded archaeological sites (EdSm 18) as well as a shell midden along the shoreline (EdSl-009). Aboriginal place names in the vicinity also exist for Collingwood Point and Hanatsa Point

(see previous section). Expected site types, potential models, and ground truth ratings are shown in Appendix D and Figure 43). CMTs and rockshelters were the only expected site types.

Coverage

A crew of three conducted the survey in a single traverse (Gina Thomas, Iain McKechnie, and Morley Eldridge).

Results

The area contains many CMTs in varying density. Dense bark-stripped CMTs were encountered in patches between 140-230m asl. Post field mapping distinguishes these as two sites: EdSm-019 and EdSm-020 (Figure 48 and Figure 49).

EdSm-019

This CMT site is situated on a steep (90%) slope above the east side of the creek (Figure 48). The site contains a dozen or more western redcedar CMTs. One notable multiple bark-stripped example shows a small area of metal toolmarks on a dry face (Figure 47). The toolmarks predate the bark-strip, as the chopped area grew small scar lobes that were then stripped as part of a large strip. The reason for the original chopping, which did not penetrate the wood deeply, was not evident. Full attribute recording was done for most of the CMTs here, but it became evident that there would not be sufficient time to record them all fully and conduct reconnaissance over a larger area. Other CMT recording was limited to noting their location.

EdSm-020

Similar to EdSm-019, this nearby CMT site contains a cluster of CMTs containing high densities of taper bark stripped western redcedar. CMTs in this site are arranged along a bench feature above 200m (Figure 49). A lower density of scattered CMTs occurred on the more open, better drained parts of the slope.

Evidence of aboriginally logged CMTs was not observed at either site

Discussion and Recommendations

Field observations indicate that concentrated areas of CMTs occur in what appear to be wetter microenvironments. In contrast, adjacent areas also contain cedar but it is seldom bark-stripped. These patches occurred on slightly drier substrates. This 'patchy' distribution may reflect a preference for cedar bark obtained from specific micro-environments or cedar stands. Although these largely empty areas are useful in the arbitrary splitting of the features into sites (currently set by the BC Archaeology Branch Inventory Section at 100 m apart maximum to be included in the same site), study of the CMTs should examine the distribution of individual features across the whole landscape.

Due to lack of time, this area was not systematically surveyed. However, based on the observed density of CMTs in the few examined areas, it is likely that dozens more CMTs are located in this area. An AIA should precede any future logging.

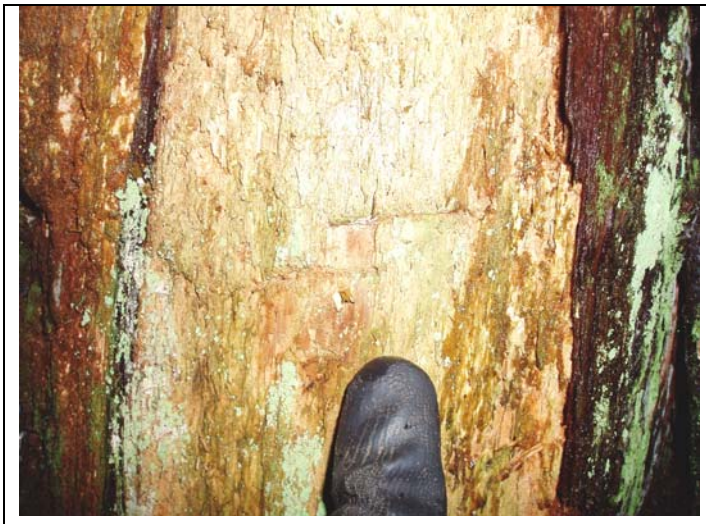




Figure 47. Bark stripped CMT with metal tool marks (MR11) at site EdSm-019 above Collingwood Point (~170m elevation).

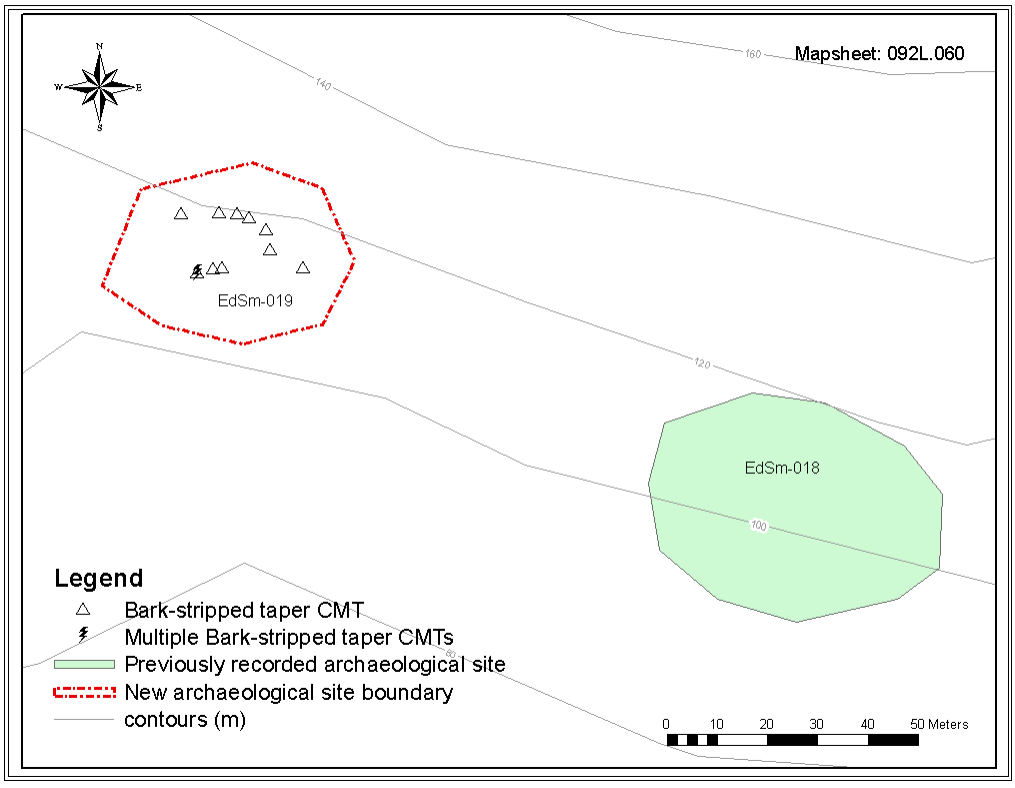


Figure 48. CMT sites EdSm-019 and EdSm-018, Port Neville.

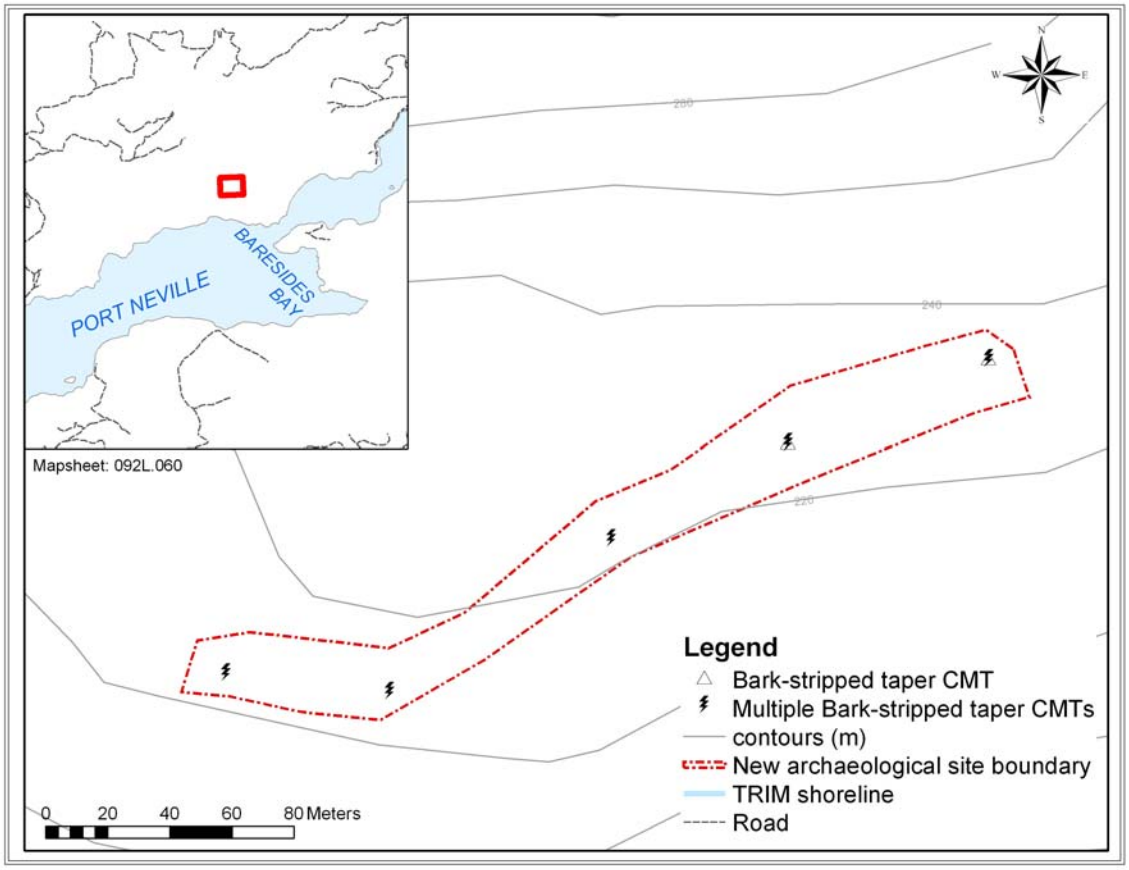


Figure 49. CMT site EdSm-020.

Snow Mountain, Boughey Bay (Ground truthing points 17-20, 22-23, 29, and 34-51)

Location and Description

Boughey Bay is located in Havannah Channel on the BC mainland side of Johnstone Strait at the southern entrance to Call Inlet. The areas surveyed included lower elevations of the west-facing slope of Snow Mountain (150-250m) (Figure 50, Figure 53) The terrain is generally 50-70% slope with a broad bench at 150-200m. Old growth areas have a high number of western redcedar with old burn scars.

Criteria

The area chosen for forestry survey was due to the recorded presence of old growth at moderately high elevation (150-250m), the high potential for CMT sites shown on the model and the relative ease of boat access (Figure 52). An area near the shoreline was also identified by the late Chief Charlie Matilpi as *Tlígas*, translated as "a place to make dugout canoes" (Eldridge, et al. 1988: 133).

Coverage

Survey coverage of the lower western slope of Snow Mountain was conducted with a crew of three (Gina Thomas, Iain McKechnie, and Morley Eldridge) and generally followed a 50m traverse with the exception of particularly steep hillsides or dense understory. Areas of old growth were judgementally surveyed with the goal of assessing the forest condition and general densities of CMTs. Previously commercially harvested forests were inspected for veteran cedar. CMTs and rockshelters were the only expected site types in the region. No subsurface testing was conducted in this area.

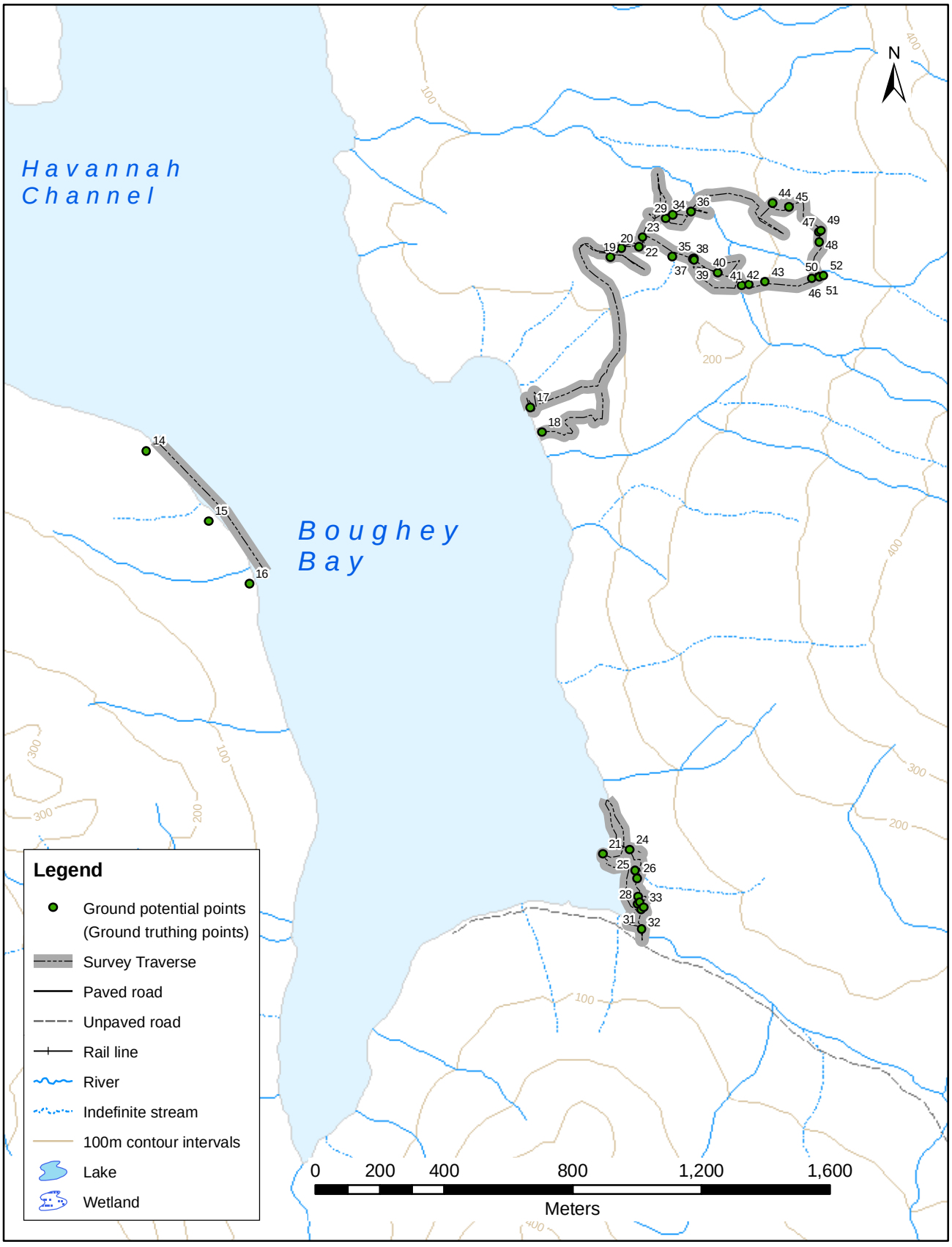


Figure 50. Ground truthing results and survey coverage, Boughey Bay.

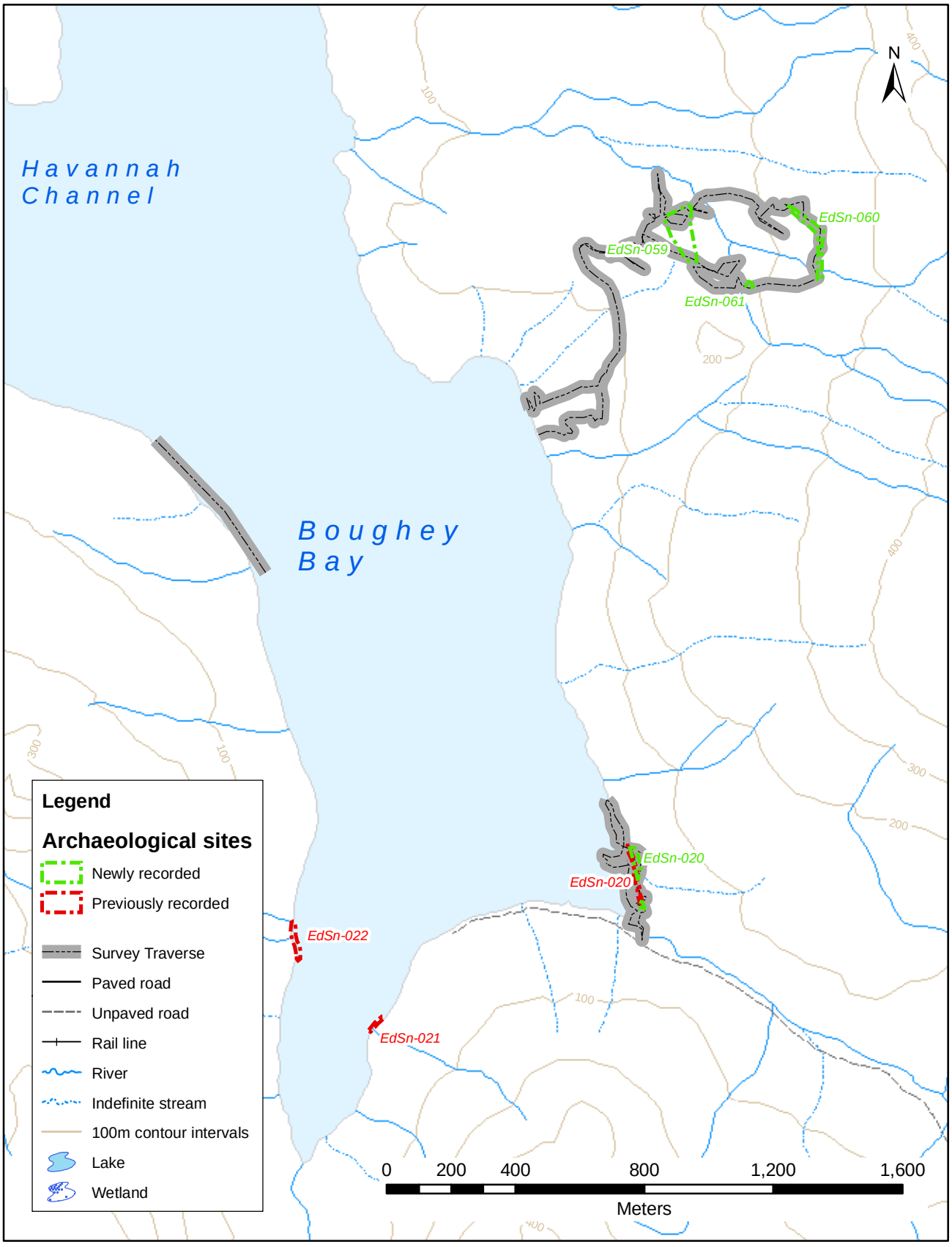


Figure 51. Survey coverage and identified archaeological sites, Boughey Bay.

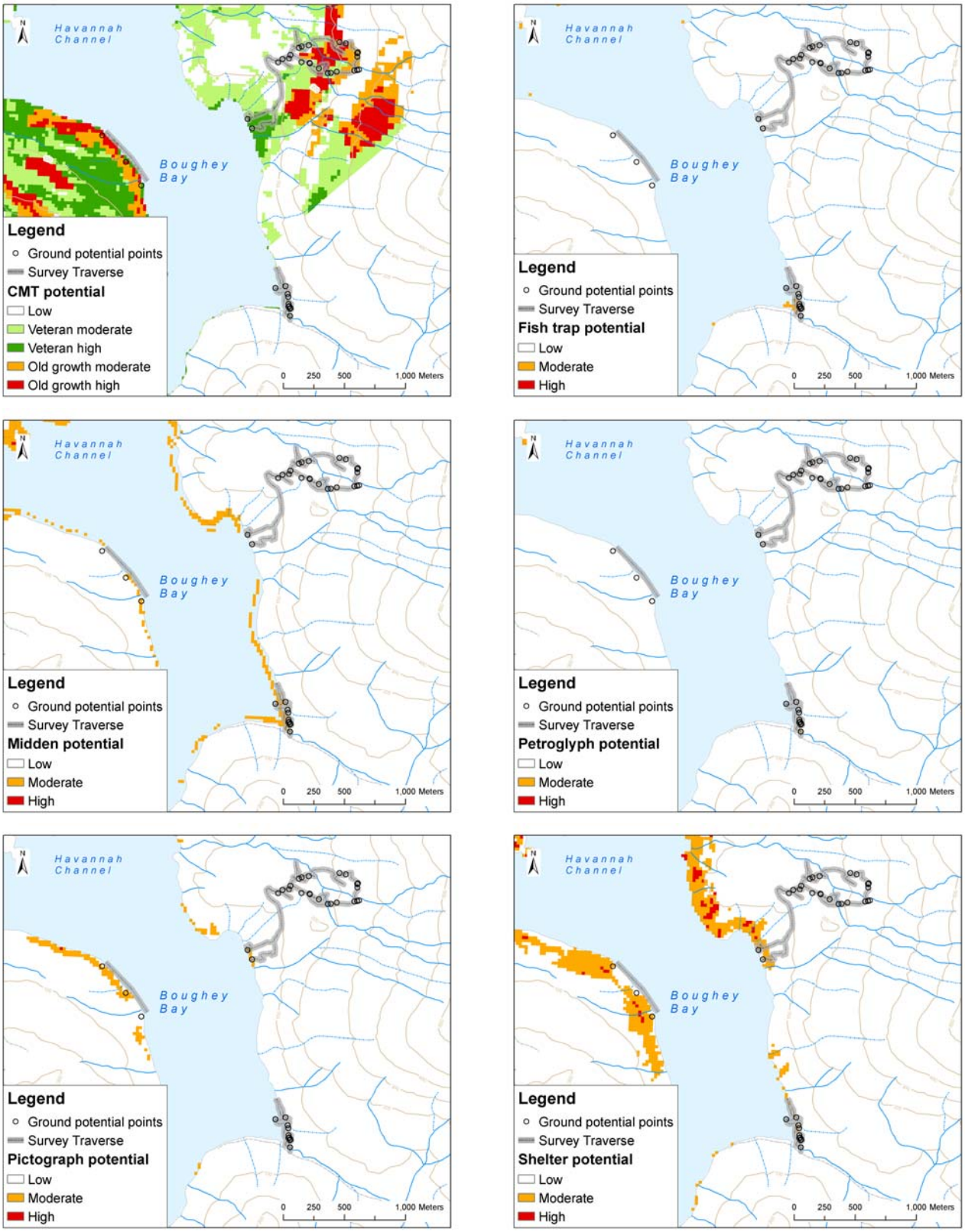


Figure 52. Potential models for Boughey Bay.

Results

Two aboriginally logged stumps were found amid old springboard-notched logging and bark-stripped western redcedar CMTs were observed within the forested portion of the higher elevation area surveyed (Figure 55). A few yellow cedar were observed above 200m but none was stripped. Three CMT sites were defined: EdSn-059, 060, and 061 (Figure 51, Figure 55). The lower parts of the traverse were through dense regeneration immature stands from cutblocks perhaps 20 years old. No veteran cedar or large old stumps were seen in these areas.

EdSn-059

Two aboriginally logged stumps (MR13 and MR14) were encountered on a large bench near a meandering creek at 160m elevation. Both stumpshad large nursing trees and were noticeably more decayed than the nearby springboard-notched stumps. The size of the nursing trees was also much larger than those on the springboard-notched stumps and a nursing tree on one of the aboriginally logged stumps had a bark strip scar (Figure 54). All these features combined with a lack of springboards notches on the stumps themselves to indicate that the features were aboriginal rather than commercial. One of the stumps had an associated log. Although the log had been partly sawn into shake-bolts in the recent past, enough remained to show that the log was originally unmodified. No associated log could be found for the other stump. A closed canopy and level ground meant that visibility was excellent in this area, and the crew examined most of the old stumps on the west side of the creek without finding other aboriginal logging features. Two other taper bark-stripped small diameter cedar snags were found on the bench near the stumps, with a cluster of three taper stripped trees found at the south end of the site.

EdSn-060, -061

Taper bark-stripped western redcedar were found at modest density on the hillside above the aboriginal logging. Five CMTs were spread across 300 m at the 230 m elevation (EdSn-060) (Figure 55). A single CMT was found on the return leg just above the creek and bench containing EdSn-059.

Discussions and Recommendations

Based on the field observations, this portion of the survey demonstrated the presence of CMTs within previously handlogged stands containing spring-board notched stumps. Future archaeological work conducted in the area should take into account the possibility that CMTs may occur in old second growth especially considering the place name for this area is ‘a place to make dugout canoes’ (Eldridge, et al. 1988: 133) and the presence of aboriginally logged stumps the possibility exists that CMTs exist in this area. Taper bark-stripped cedar occur in at least modest numbers; more may once have been present, but the mountainside has had one or more wildfires that may have destroyed the features. The CMTs appear to be occurring where the fire burned with low intensely.



Figure 53. West slope of Snow Mountain, Boughey Bay. Area surveyed includes the older second growth on bench at the left-centre of the image and old growth at centre right (note dead tops).

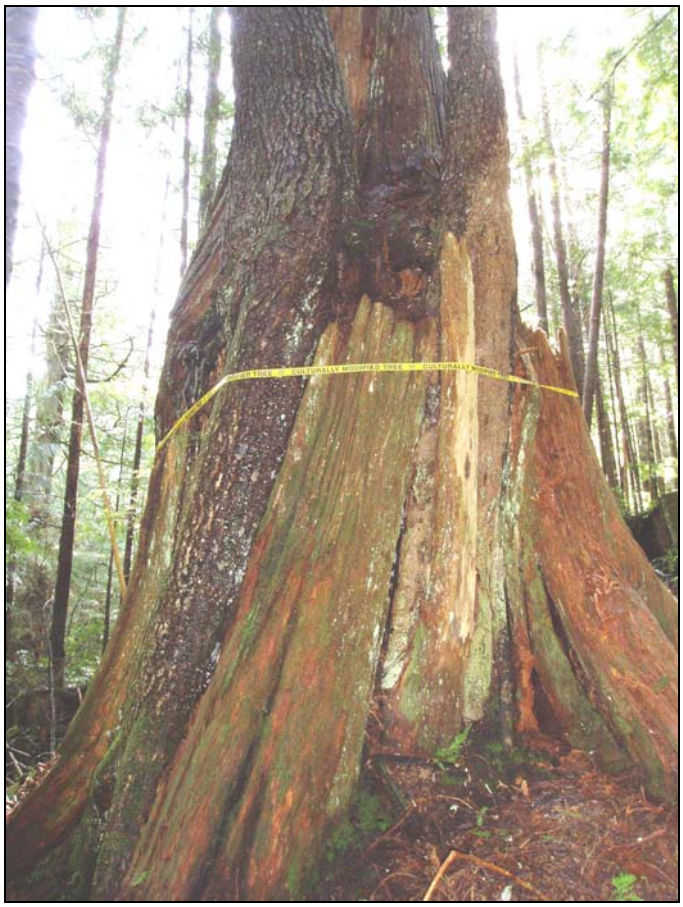


Figure 54. Aboriginally logged stump (MR13) at site EdSn-059 with culturally modified nursing tree at 160m elevation on Snow Mountain.

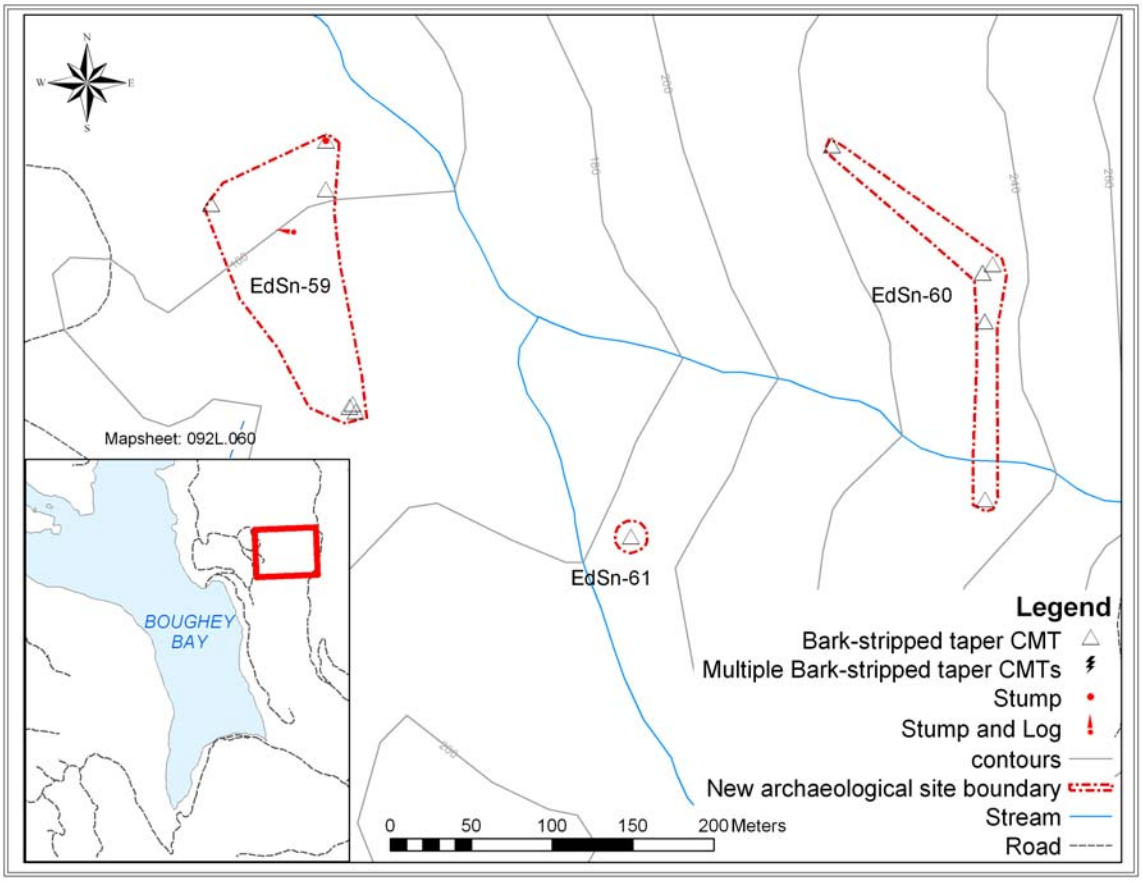


Figure 55. CMT sites EdSn-059, 060, 061 on the western slope of Snow Mountain, Boughey Bay.

Boughey Bay Shoreline (Ground truthing points 14-16, 21, 24-28, and 31-33)

Location and Description

This portion of the survey covered the north western shoreline, and river mouth area at the southeast corner of Boughey Bay, including a site revisit to EdSn-020 (Figure 50). Boughey Bay is a steeply sided forested inlet with two river drainages entering into the southern arms of the bay. The river valley at the head of this portion of the bay has been heavily logged in past decades and a logging camp was situated there.

The lower elevations of most of the inlet were logged in the early 20th century.

Criteria

Shoreline survey was at the mouth of a river identified by Boas (Boas 1934, map 15) as *Wak!āla,* translated as "noise of the river". Boas also notes the presence of a "salmon trap"

(*Me$^{\acute{e}}$wa*) near the southern bank of the river that drains into the southwestern arm of the bay (Boas 1934, map 15). Previous survey by Mitchell and Turnbull (1967) identified a shell midden site (EdSn-020) at this location (Figure 51). The purpose of a site revisit was to attempt to identify additional site types in the vicinity and evaluate the accuracy of the reported site location and dimensions. Many of the site forms comprise the quarter of the District's site's recorded in the 1960s and 1970s that are generally too poorly described to allow accurate mapping. A revisit to a sample of these was desired. Although several are located in the bay, there was only time to visit one of these.

Along the north western shoreline of Boughey Bay, where it joins Havannah Channel, there is high potential for CMTs in both the old growth and veteran CMT models.

Coverage

Shoreline survey was conducted along the intertidal area east of the river mouth and within 25m of the shoreline for the length of site EdSn-20. Auger tests were conducted at periodic intervals to assess site presence and dimensions. Different site types expected in the area include shell midden habitation sites, defensive sites, intertidal fish trap sites, and CMT sites. See Appendix D and Figure 52 for detailed results of the expected and actual archaeological potential for this area.

The north western section of shoreline was observed from the boat, due to lack of time for ground survey.

Results

EdSn-020

Shoreline survey concentrated on site EdSn-020. Surficial observations suggest that boundaries of EdSn-020 as recorded by Mitchell and Turnbull (1967) and mapped in RAAD by the Archaeology Branch were accurate (Figure 58). The northern extent of the midden deposits was relocated at the position plotted by Mitchell and Turnbull while auger tests to the south indicated that southern extent of the site is just 20m further south than originally mapped. Abandoned logging equipment and supplies are scattered throughout the site including two abandoned pickup trucks. A former road runs the length of the site deeply cutting into midden in some areas and filling in with midden in others (Figure 57). An area of disturbed midden at the northern end of the site (Figure 56) has several large boulders (1-2m across) sitting on top of midden deposits. These appear to have been pushed there by heavy equipment. Due to time constraints, it was not possible to investigate the condition of deposits in any further detail.

North western shoreline (Ground Truthing points 14-16)

Several points were observed from the boat on the return trip after leaving EdSn-20, at an area where we had intended to conduct ground survey but couldn't due to lack of time. Ground Truthing Points 14 to 16 are in a shoreline area modelled as high potential in the Old Growth model. Careful observation of the tree canopy from the boat suggested that there was no old

growth cedar along this part, as no 'dead top' cedar crowns could be seen. It appeared to be older second growth that is not correctly age-typed in the forest inventory.

Discussions and Recommendations

The archaeological work conducted in the general area suggests undiscovered archaeological remains are likely. In particular, intertidal areas along the southeast and southwest corner of Boughey Bay probably contain fish traps. Although marine charts suggest the area has been used for log booming, these are named locations of "salmon traps" (Boas 1934, map 15).



Figure 56. Disturbed shell midden exposure in an old roadbed at the northern end of site EdSn-020.



Figure 57. Photo of Gina Thomas (Tlowitsis First Nation) at EdSn-020 looking south along the road running the length of the site.

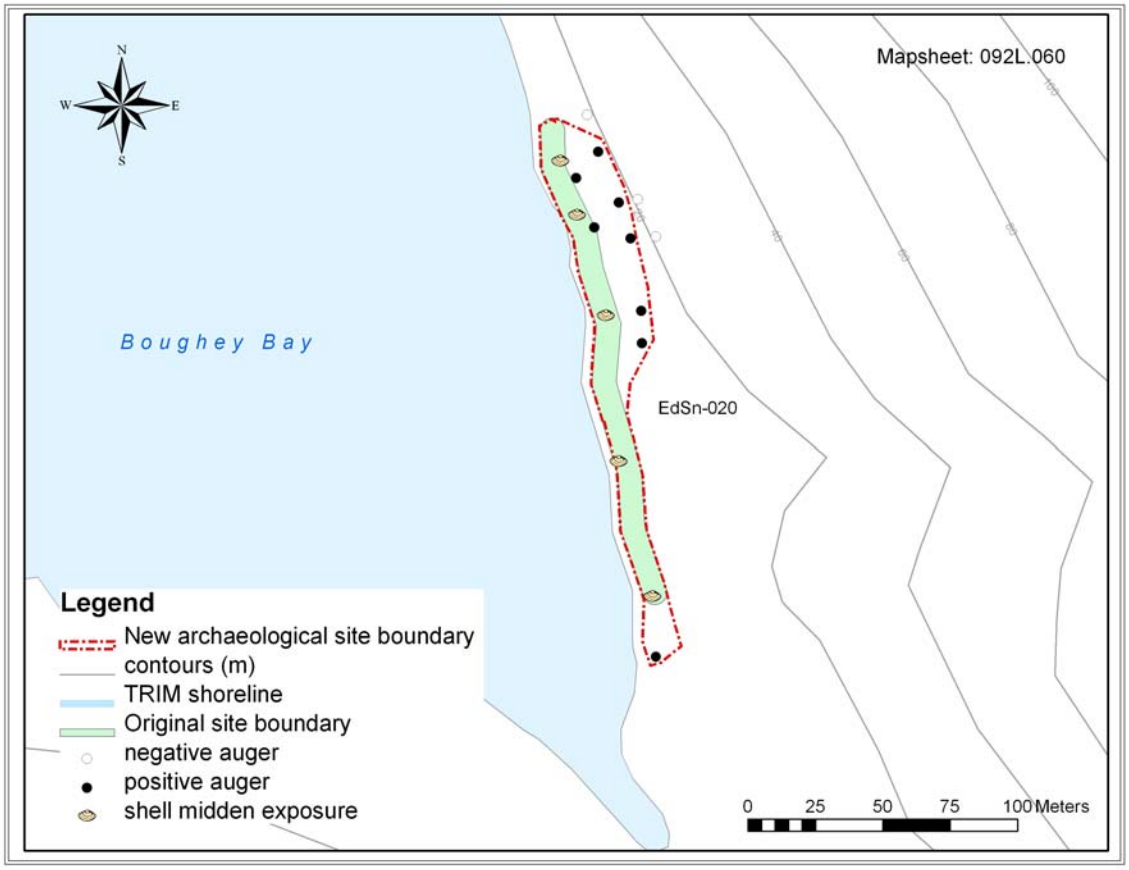


Figure 58. Revised site map of shell midden site EdSn-020, southeast Boughey Bay.

Port Harvey Pictographs

EdSn-005 and EdSn-049

While just outside the study area, two known pictograph sites (EdSn-005 and EdSn-049) were briefly revisited on the evening of March 11th during a trip back to accommodations in Port Harvey. EdSn-005 is located on a western facing bluff of a small island in the middle of the entrance to Port Harvey on West Cracroft Island (Figure 59). The site contains no noticeable evidence of vandalism (Figure 60). However the recorded rock art site EdSn-049 on the western side of the channel, on 'Mist Bluff', has evidence of vandalism in the form of spray paint. This site is also in an area where log booms are temporarily stationed, as the rock face has bolts inserted for cable ties, and painted large numbers probably relate to log-boom operation. This location should be considered for further evaluation and possible graffiti removal. Due to the time of the visit at sunset, no photos of the site adequately show the site condition.



Figure 59. General location of pictograph site EdSn-005.



Figure 60. Pictograph site EdSn-005.

Naka Creek (Ground Truthing points 53-86)

Location and Description

The area surveyed on March 13th included five localities at roadside locations accessible from the Naka Creek mainline logging road northwest of the Eve River and southeast of the Naka Creek drainage (Figure 61).

Locality 1 – (Ground Truthing points 79-86). The first location surveyed was a ridge and knoll and adjacent small creek containing a small patch of old-growth including a high percentage of western redcedar at approximately 175m above sea level. Generally smaller trees are found on the ridge and larger trees on the sides and bottom of the creek.

Locality 2 – (Ground Truthing points 69-78). The second area surveyed was a 60-110%, north-facing slope below the road overlooking a west flowing drainage. This area contained large old-growth cedar with open understory and blowdown at approximately 150m above sea level.

Locality 3 – (Ground Truthing points 64-68). The third area surveyed was located in large old-growth western redcedar north of the road. Particularly large cedar were observed along a small drainage near the Naka Creek mainline Below the old growth cedar was a bench containing almost pure hemlock. The area was bounded on the west by another hemlock stand, a narrow strip along the edge of a recent logging block. Much of Locality 3 is shown as second growth; this is true of the hemlock bench but not of the area near the road.

Locality 4 – (Ground Truthing points 55-63 and 53). The fourth area surveyed was located above the road at 130m elevation on gently sloping ground at the base of a bluff. The area included old growth western redcedar, some of which were particularly large.

Locality 5 – (Ground potential point 54). The fifth and final area surveyed was located at higher elevation (400m), almost 2 km inland, in an area adjacent to a recent clearcut. Western redcedar, hemlock and balsam were region containing primarily western redcedar, hemlock and spruce.

Criteria

These locations were chosen for investigation as they were accessible by road and contained areas identified as pockets of old growth relatively close to shore (<1km), except for Locality 5 that was just under 2 km from shore. Locality 4 is about 1 km northeast of a cluster of taper bark-stripped western red cedar comprising two sites on Naka Creek. EcSo-1 consists of two bark-stripped trees recorded by Sources consultants for a proposed block in 2002 under permit 2002-93. EcSo-2 consists of 111 taper bark-stripped trees recorded by Baseline under permit 2005-82. The two sites almost share a boundary, with only 10 m separating them, and it is unclear why two separate sites were registered. Two kilometres southeast of Locality 1, and one kilometre southeast of a number of Locality 5, a number of aboriginal logging and bark-stripping sites were recorded by the Baseline (Engisch, et al. 2004). Another site in this area is EcSn-1, recorded by Arcas in 1995, with aboriginal logging and taper bark-stripped red and yellow cedar trees at high elevation. The landmark Newcastle Block study area is about 12 km to the east (Eldridge and Eldridge 1988; Mobley and Eldridge 1992).

The only expected site type in these five localities was CMTs (Figure 63).

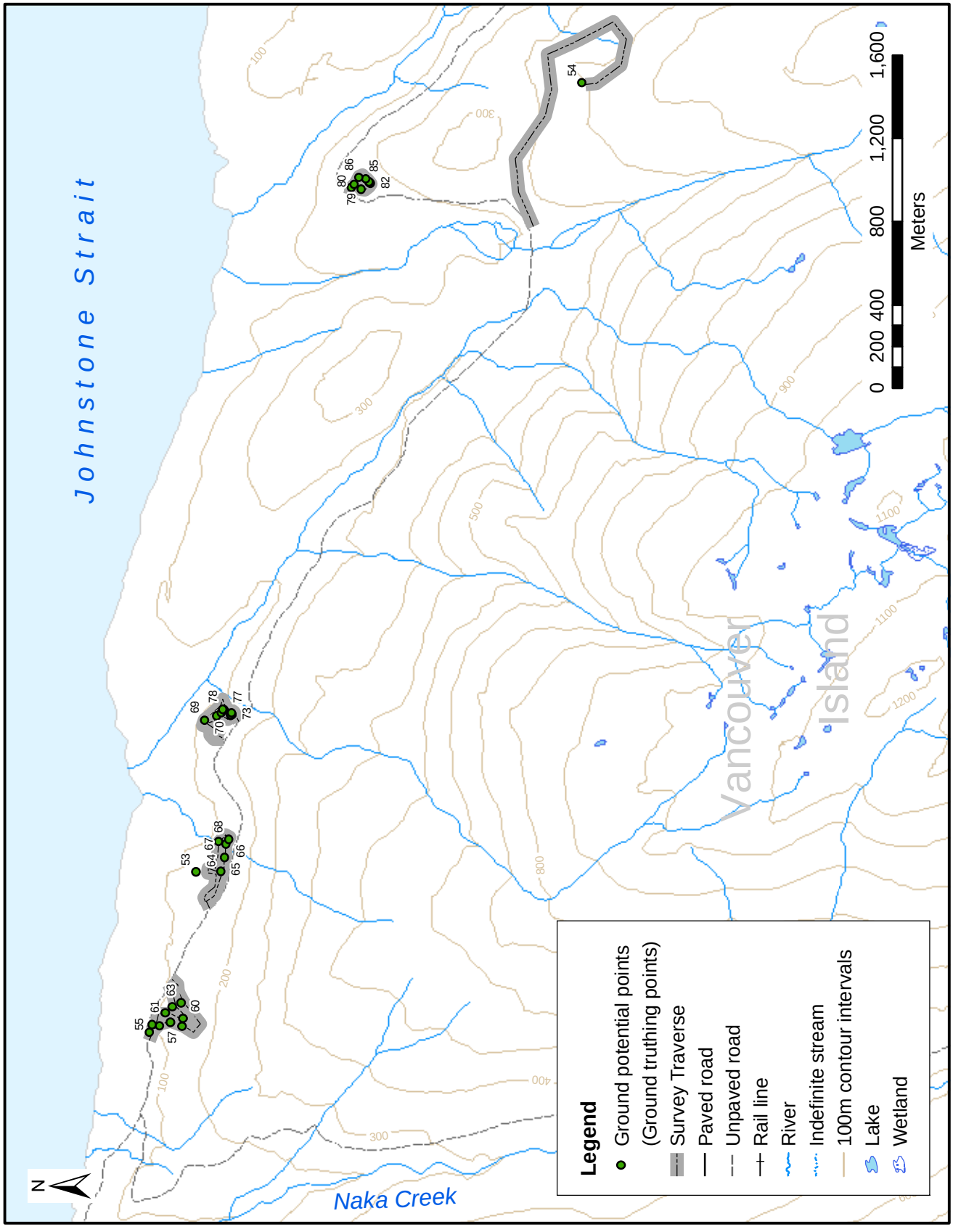


Figure 61. Ground truthing results and survey coverage, east of Naka Creek.

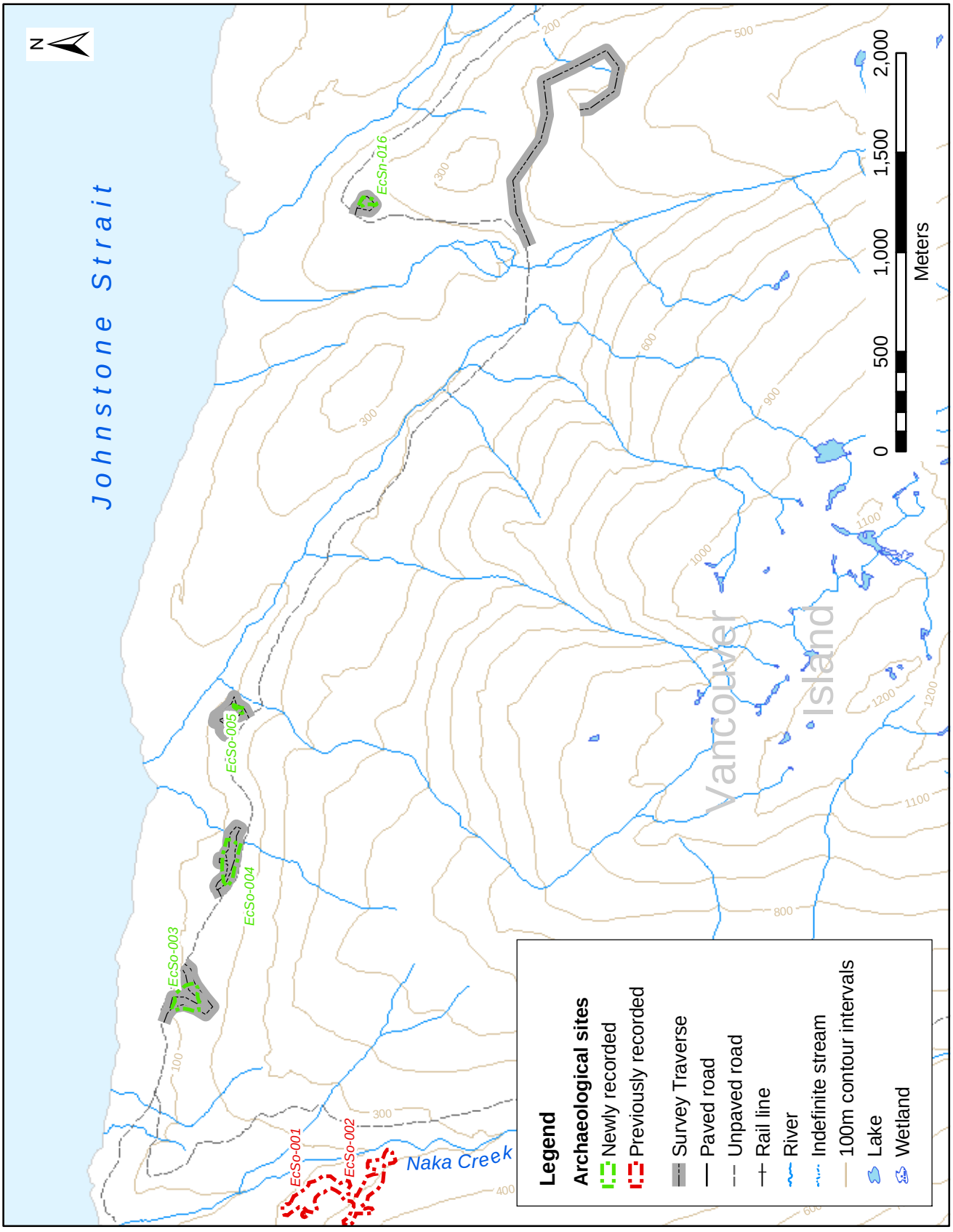


Figure 62. Survey coverage and identified archaeological sites, east of Naka Creek .

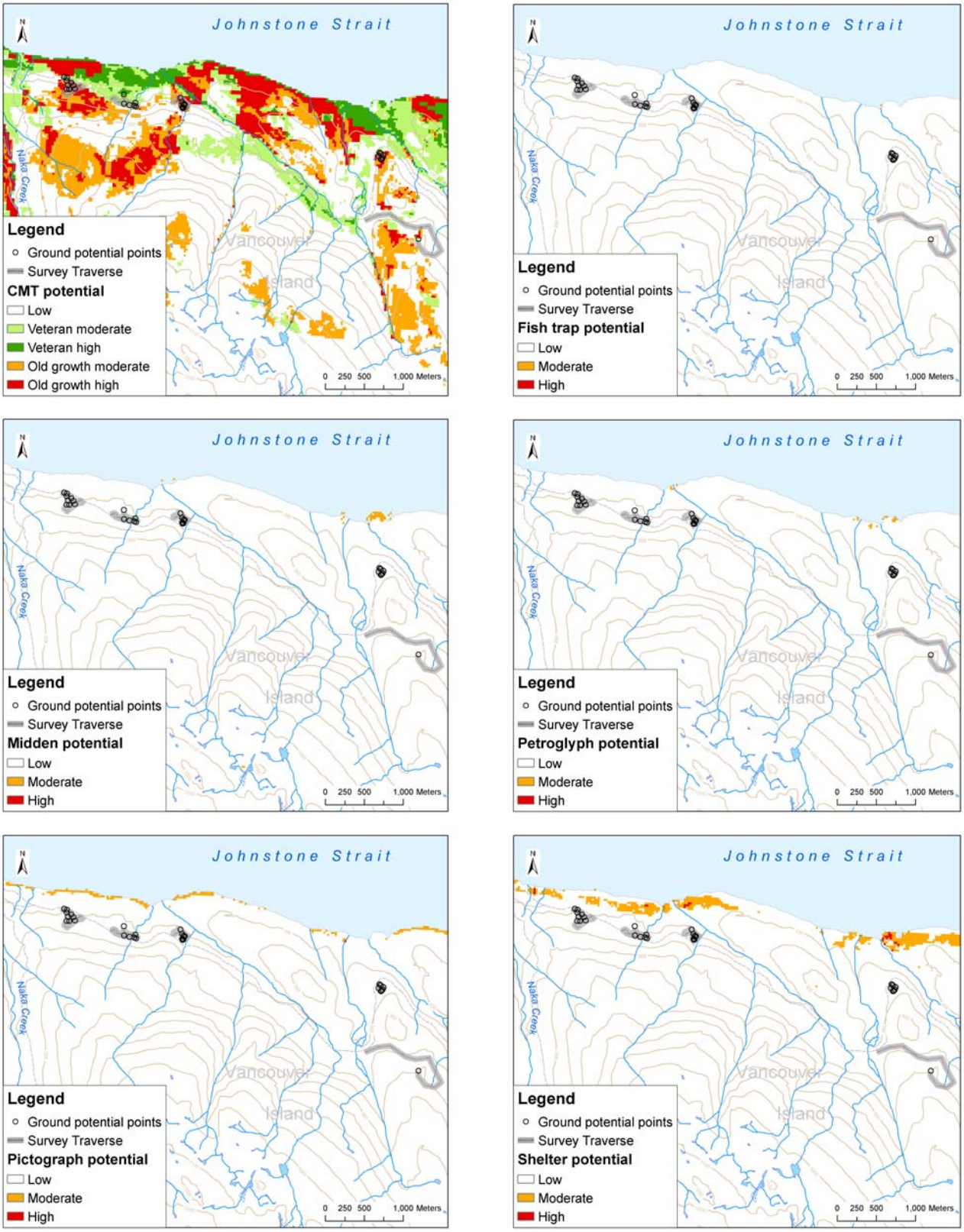


Figure 63. Potential models for the area east of Naka Creek.

Coverage

Judgemental survey was conducted in each forested area with a crew of three (Morley Eldridge, Iain McKechnie, and Gina Thomas). Coverage was generally 30-50m along traverses. Mature trees were visually inspected for cultural scars and suitable landforms (e.g., rockshelters and bluffs) were inspected for cultural materials and/or cultural modification.

Results

Several of the areas examined contained abundant CMTs. Due to the time constraints and the goals of the fieldwork, few individual trees were recorded with full attribute data. Rather, the relative presence and feature types were noted and locations plotted with GPS (Figure 62). Notable results include an aboriginally logged stump with tool marks at 150m asl in a very rugged area.

Locality 1, EcSn-016 (Figure 65) – Notable at this site was a concentration of dense taper bark-stripped western redcedar in a minor stream gulley bottom and sites. Contrasting with this was an absence of CMTs on the ridge line and on a rocky knoll, despite the presence of cedar trees here. The cedar here were scarred, but due to natural causes. Combined with similar observations in other localities, it is clear that cedar growing on dry microsites was seldom being selected for bark harvesting, even in the wetter CWH vm1 environment. Cedar was also present, but bark-stripping notably less common than on the slightly steeper ground, in a flatter part of the stream bed where drainage was poor. Many of the CMTs had multiple bark-strips. No other CMT types or cultural features were observed.

Locality 2, EcSo-005 (Figure 66) – The site contained numerous bark-stripped trees and an aboriginally logged stump on a steep, north-facing slope. The aboriginally logged 'barber chair' stump (MR22) has tool marks and is surrounded by tall dense salal in a natural blowdown area approximately 150m above sea level (Figure 64). A narrow bench west of this site contains a low density of CMTs amongst large hemlock. Much of the forest on this bench has blown down. The site location is steep, with a precipitous drop to the shore far below. The finding of an aboriginally logged tree here was therefore a surprise, as it must have been very difficult to move the log controllably downhill.

Locality 3, EcSo-004 (Figure 67) – EcSo-4 contains numerous small to large (0.50-2m dbh) bark-stripped cedar CMTs amidst massive old-growth western redcedar, spruce, and Douglas-fir. A particularly large cedar stump observed near the Naka Creek mainline contained a single springboard notch, and was the only springboard-notched stump seen in the vicinity. Although the tree may have been logged aboriginally it was assumed to be commercial based on the springboard notches. The trees in and to the east of the creek were very large, but contained no obvious cultural scars and there was no evidence of aboriginal logging.

Locality 4, EcSo-003 (Figure 68) – EcSo-4 contained abundant taper bark-stripped cedar, many of them with multiple scars. Also present here are a stand of very large, completely unmodified cedar. These stand in contrast to the heavy bark-stripping at other areas nearby.

Locality 5 – This higher elevation location was only briefly inspected. No CMTs or cultural features were observed in this area. Some scarred cedar could not be confidently assigned to either a cultural or natural origin, and these were not recorded. Seedling yellow cedar were observed, but no older yellow cedar, although it is likely that these grow nearby. Both aboriginal logging and bark-stripped red and yellow cedar have been found nearby at a similar elevation and even further inland by Arcas Associates (EbSn-1 siteform).

Discussion and Recommendations

Four of the five surveyed localities contained a high density of bark-stripped CMTs. The fifth area did not, but the surveyed area was too small to discount the possibility that unrecorded CMTs occur nearby. This continues to show the pattern of intensive bark-stripping in the immediate area found by Baseline at Naka Creek, EcSo- 2, to the east during the Baseline inventory (Engisch, et al. 2004) and by a 1995 Arcas AIA. Furthermore, it reinforces the intensive character of aboriginal forest use of this entire stretch of Johnstone Strait shoreline first noted in the Newcastle Block (Mobley and Eldridge 1992). Several of the other originally conclusions regarding CMT distribution presented in reports and publications on Newcastle appear to be supported, including the inland distribution of aboriginal logging and the presence of stands of unmodified trees amongst dense harvesting, considered to possibly represent owned stands 'reserved' for future generations (Mobley and Eldridge 1992). The intensive bark harvesting over such a large area conceivably could have resulted in shortages of cedar bark. This general area, at least within a kilometre or two from the shore, is best viewed as a cultural landscape in late precontact times.

The aboriginal logging and bark-stripped cedar trees at nearby EcSn-1 were dated after harvesting (information from siteform). Together with the 100 dated trees at the Newcastle Block these are some of the only dated CMTs in the region. Yellow cedar at EcSn-1 were found to be stripped in AD 1846 and 1858 (two scars), and in 1850 and 1904. One tree was stripped at two different dates. Nursing trees on different aboriginal stumps germinated in 1857 and 1858. A western redcedar was taper stripped in 1565. This is extends to more recent time the dating range found in the Newcastle Block, where bark-stripping spanned the years 1467 to 1847, after which all bark stripping and aboriginal logging ceased. Directly dated aboriginally logged features at Newcastle dated 1750 to 1800, with nursing trees germinating from the 1830s to the 1880s. The dates from these areas give a temporal context to the intensive use evident from the CMT density and distribution. The CMTs date to a span of several hundred years, and the same areas and often the same individual trees are harvested on multiple occasions.

In the areas subject to inventory during the current study, detailed inventory would be needed to define the specific distribution of the CMT features.



Figure 64. Aboriginally logged barberchair stump (MR22) at site EcSo-005. Toolmarks under the moss shown at right.

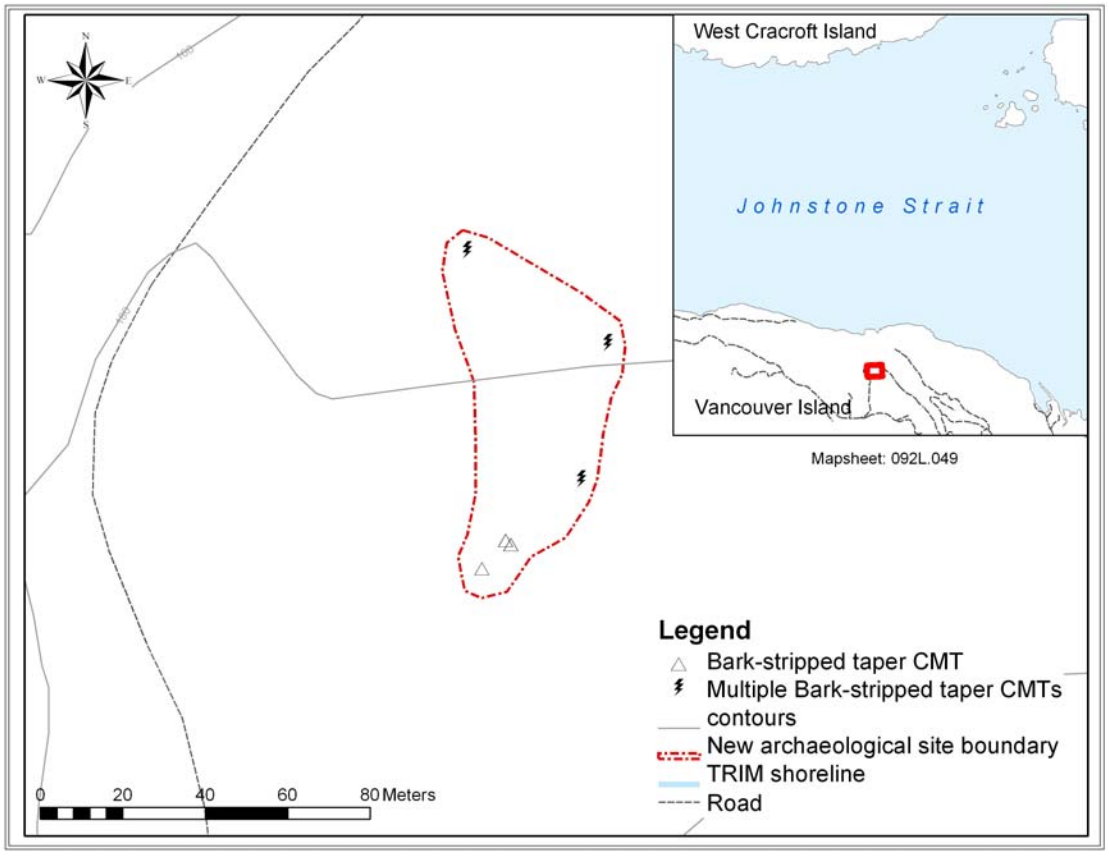


Figure 65. CMT site EcSn-016.

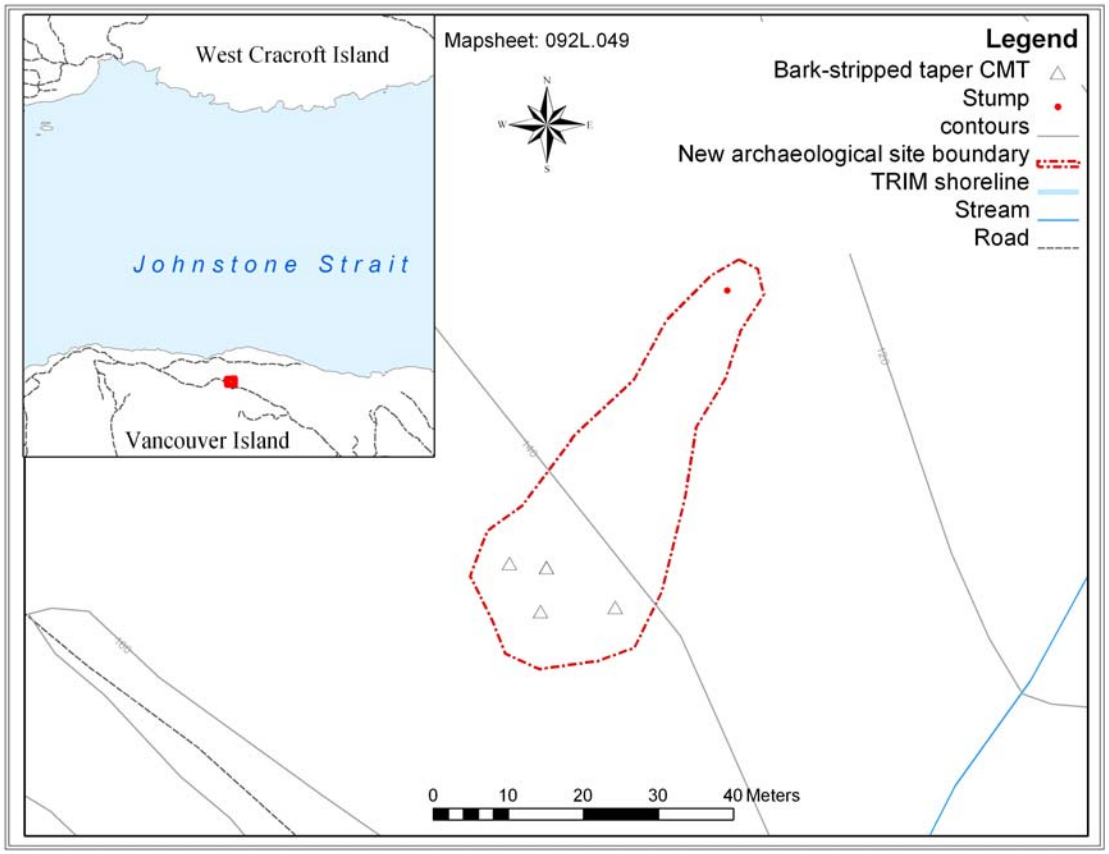


Figure 66. CMT site EcSo-005.

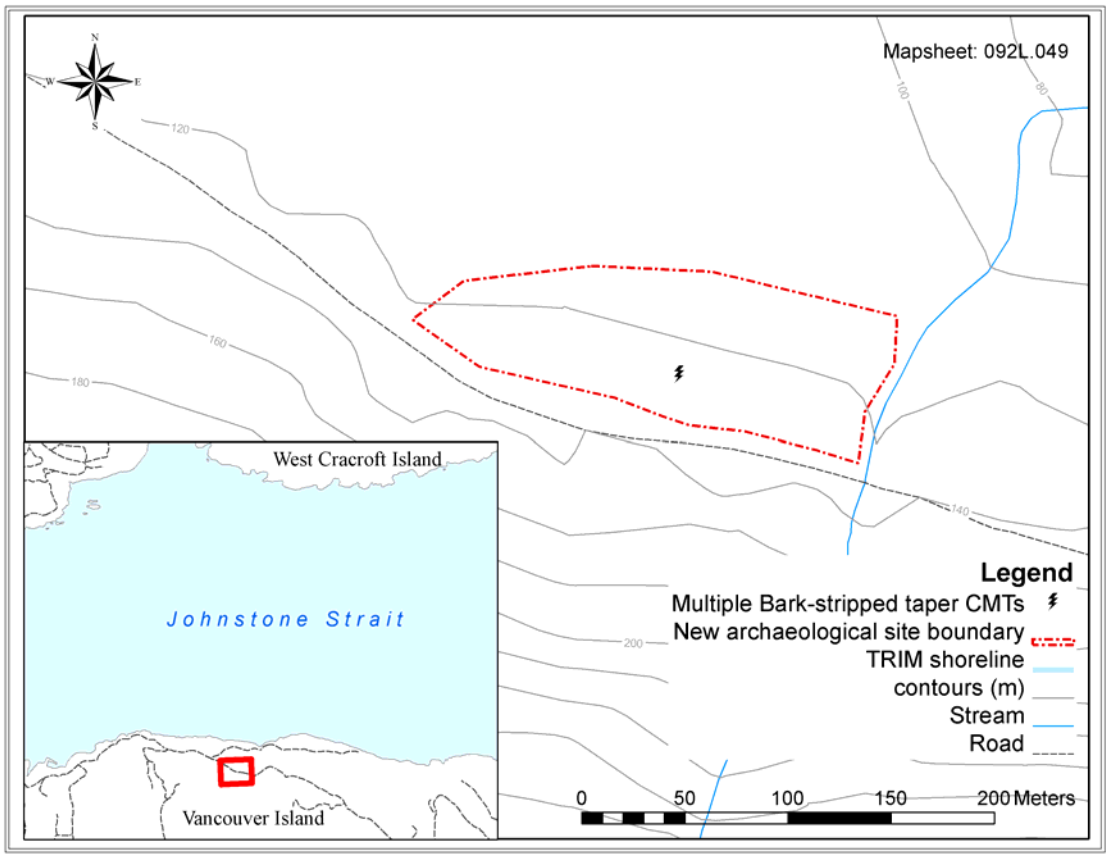


Figure 67. CMT site EcSo-004.

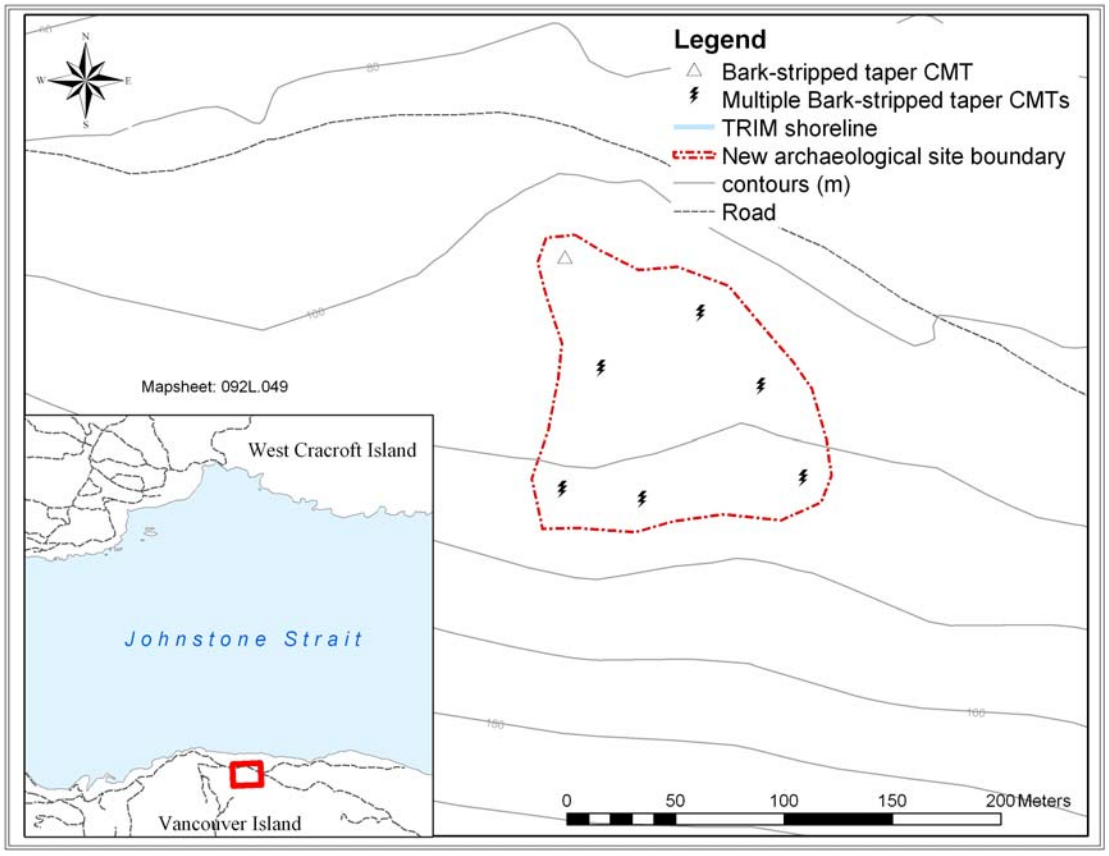


Figure 68. CMT site EcSo-003.

Salmon River Valley (Ground Truthing points 2-7 and 170-177)

Location and Description

The area surveyed includes portions the Salmon River valley for approximately 13km southeast above the confluence of the Salmon and White Rivers (Figure 69). The examined areas were accessed by road along the Salmon River. Terrain consisted of low relief fluvial terraces and floodplain on both sides of the Salmon River (Figure 71). The heavy logging and, in the lower stretches, the farming over the past century have changed the overall landscape. Areas examined were primarily second or third growth forest variously consisting of alder, balsam, hemlock, Douglas-fir, and cedar. Some portions of the steeply sided river valley have potential for veteran old-growth CMTs but these areas were not examined.

Criteria

The goal of was to evaluate the effectiveness of the predictive model for identifying habitation sites and fish trap locations (Figure 70). It is notable that no archaeological sites have been recorded above the confluence of the Salmon and White Rivers despite ethnographic information that suggests upriver sites are likely (Bouchard 1990: 8-9 referenced in Eldridge 1991). We chose to explore this area in order to evaluate site potential by identifying stable landforms which might or might not be identified using the currently available digital elevation model. Judgemental survey was conducted with a crew of three (Morley Eldridge, Iain McKechnie, and Gina Thomas).

Coverage

The river valley portion of the survey was judgemental and conducted by truck. Where visible from the road, river channels were inspected for evidence of fish traps, habitation sites, and artifacts. Cut-bank exposures were examined for cultural deposits. It was hoped that an examination of a large number of road cuts could provide a sample of terrace margins from a wide range of the Holocene. Unfortunately, almost all road cuts were found to be heavily vegetated and were not suitable for this purpose. Surface exposure was generally good among recently logged areas. No subsurface testing was conducted. See Appendix D and Figure 70 for detailed results of the expected and actual archaeological potential for this area.

Results

The model identifies high potential for habitation sites and fish traps in areas along the valley bottom on both sides of the Salmon River (Figure 70). Field reconnaissance of the area shows that much of the landscape consists of low-lying, boggy terrain which would not generally be suitable for habitation. In contrast, limited areas with raised landforms would be better suited to temporary habitation but these areas do not reliably show up using the currently available digital elevation data. Examination of the DEM values at one point on the Salmon River about 300m upstream from its confluence with the White River correctly show a raised landform on the east bank of the river; but the elevation values were identical on the opposite bank, which in actuality is low-lying and recently fluvially active. Another location at the southern end of the survey area demonstrated the same circumstance. Field observations indicate such environmental differences are critical to determining site locations in these environments.

Discussion and Recommendations

Few examined areas of the Salmon River contain high potential for fish weir locations as this portion of the river is likely too fluvially active for fish weirs to preserve. Greater potential exists in the slower flowing side channels, where the majority of habitation sites would have been located. CMT potential is low in this heavily logged portion of the valley. To further define site types and locations in this complex landscape, it is recommended that higher resolution elevation data (e.g., LIDAR – Light Detection and Ranging) be used to better define high potential medium sized and micro-landforms.

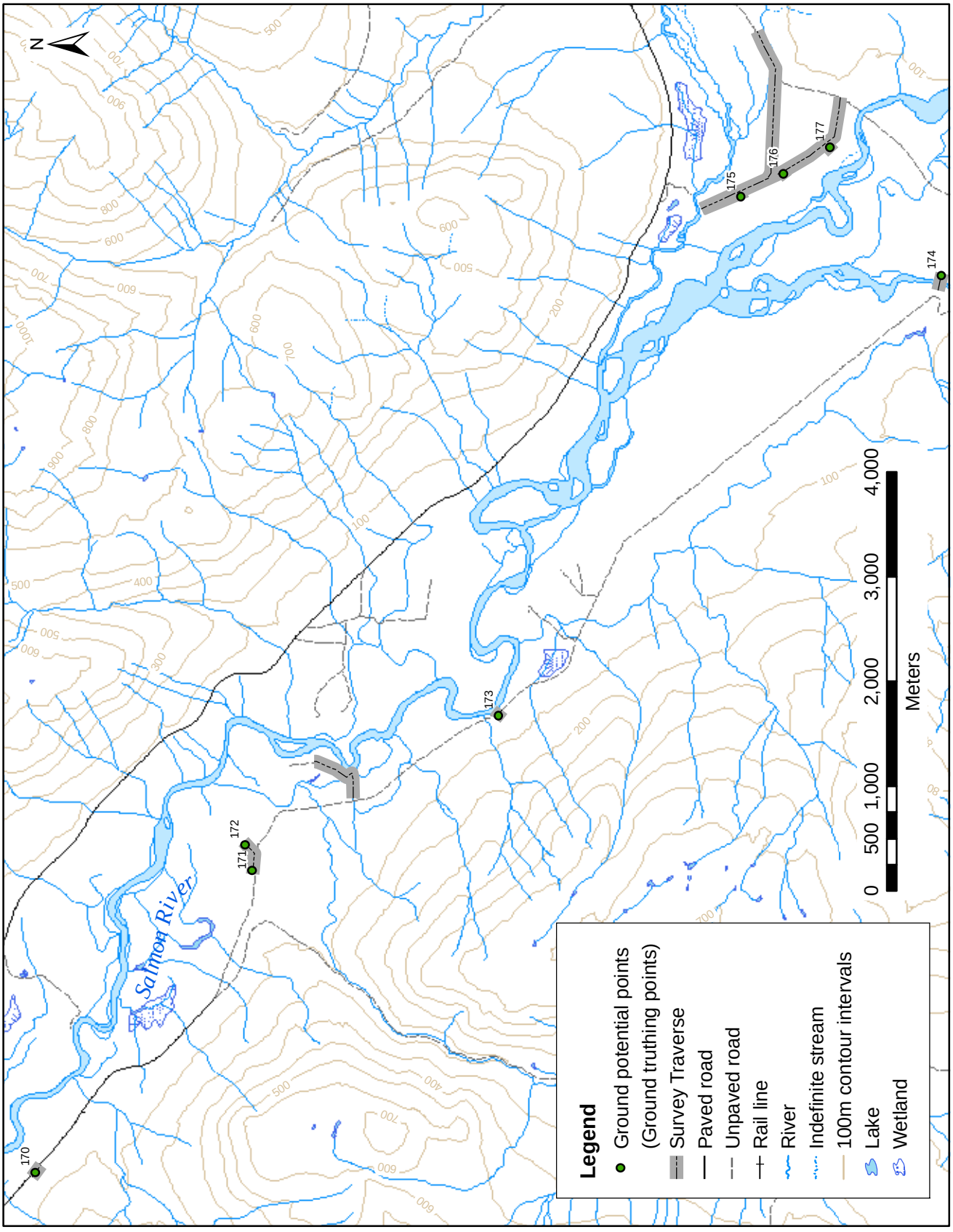


Figure 69. Ground truthing results and survey coverage, Salmon River Valley.

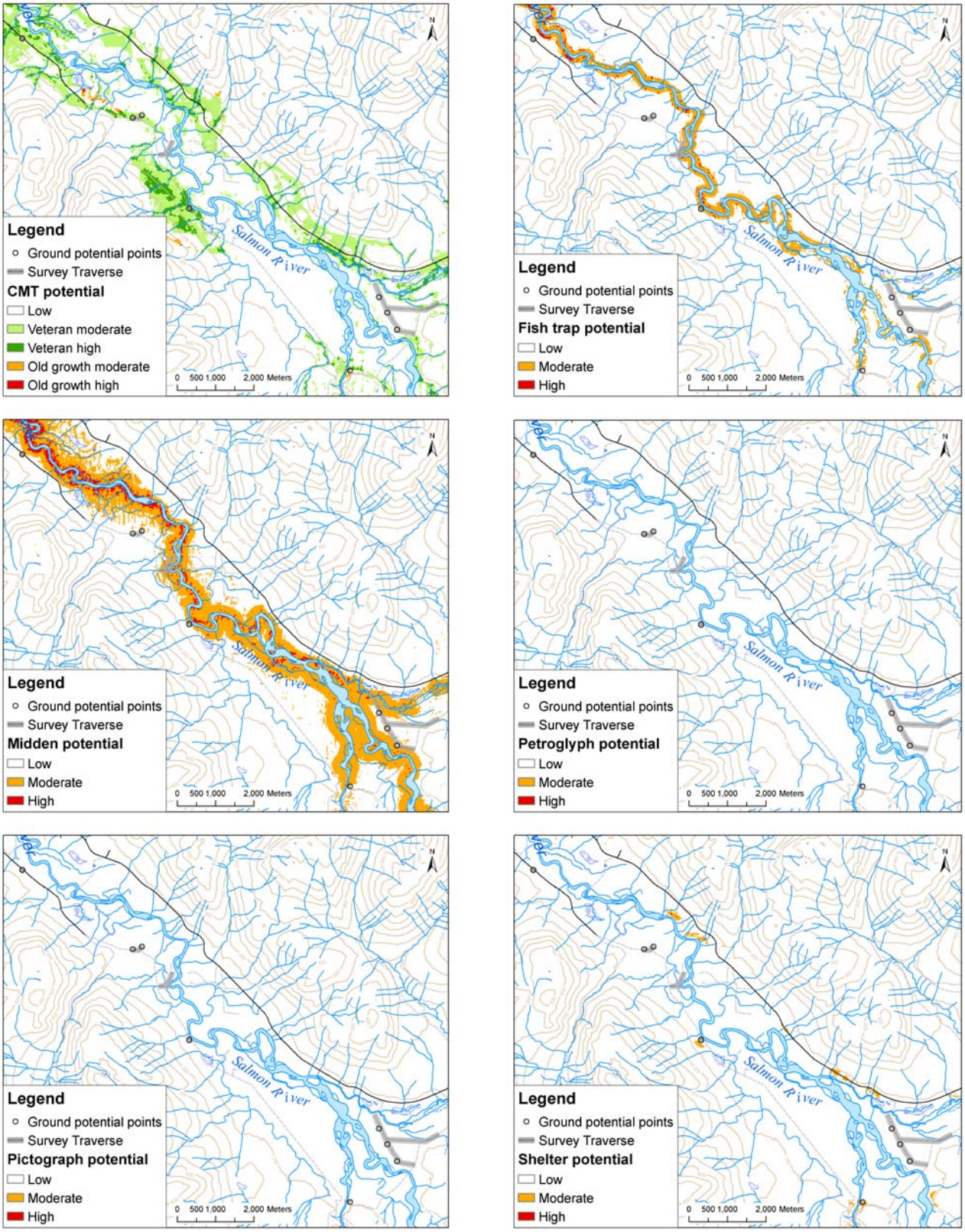


Figure 70. Potential models for the Salmon River valley.



Figure 71. View of low-lying fluvial terrain and recently logged second-growth forest looking north in the Salmon River valley.

Hemming Bay, East Thurlow Island (Ground Truthing points 87-106)

Location and Description

The northwest corner of Hemming Bay on the eastern side of East Thurlow Island was selected for model ground truthing. Two similar sized streams drain into the same location at the northwest end of Hemming Bay from Hemming Lake (21m asl). The western stream is listed as fish bearing and the eastern stream as non-fish bearing. There are several small islets near the mouth of these creeks, creating a sheltered intertidal area near the creek mouths. Shoreline locations to the south and west of Hemming Bay on East Thurlow Island were also examined. The area was assessed by a 27ft aluminium boat, which limited the suitable landing locations (Figure 72). The tides for this day were a low of 0.7m at 11:15 am and a high of 3.7m at 3:15pm.

The majority of the shoreline of south and west of Hemming Bay consists of steep rocky outcrops with similar intertidal zones. Few locations are suitable for landing a canoe or boat.

The general forest cover of the shoreline of Hemming Bay consisted of western redcedar, Douglas-fir, alder and hemlock with a dense understory of salal in places. Most of the more accessible, flatter locations appeared to be heavily disturbed due to previous

logging, as was evidenced by a predominance of alder in these locations. The northwest portion of Hemming Bay, which has many small islets, is too shallow for a deep-hulled boat. The six small islets shown on the TRIM maps are actually four islets – the largest of which is joined to the East Thurlow Island by a tombolo. The other islets have rocky, narrow, and shallow passages between them. The islets appear to have not been logged and are predominantly forested by stunted Douglas-fir and western redcedar. Some shore pine is present in the more exposed areas of the islets.

Criteria

This area was chosen for survey due to its predicted high potential for numerous site-types (See Appendix D and Figure 74) and the total lack of recorded sites in the area. The fish-bearing stream in the sheltered portion of Hemming Bay shows high potential for fish traps and other intertidal features. This area was investigated at low tide. The flatter landforms adjacent to the shoreline increased the potential for finding habitation features, and the rock bluffs were shown as having a high potential for rock art features. No CMTs were predicted in the old-growth model, but there was high potential for CMTs in the veteran model for the area; however, a concentration on non-CMT models was desired as these had not been thoroughly tested elsewhere. Site types expected in Hemming Bay also included fish traps. See Appendix D for detailed results of the expected and actual potential.

Coverage

The survey crew consisted of Jo Brunsden and Iain McKechnie of Millennia Research Limited, Christine Roberts of the Campbell River Indian Band, and Lloyd Paul of the Homalco Tribe. Harold Harry of the Homalco Tribe accompanied by photographer Guy Baechler did not participate in the field survey but accompanied the field crew in the boat and provided additional information about the study area. In the northwest portion of Hemming Bay, appropriate footwear and rising tides restricted survey of the western side of the bay, and this area was only surveyed by two crewmembers.

Results

Four archaeological sites were identified during survey of Hemming Bay: Two clam harvesting terraces; one shell-midden; and one intertidal petroform feature (Figure 75).

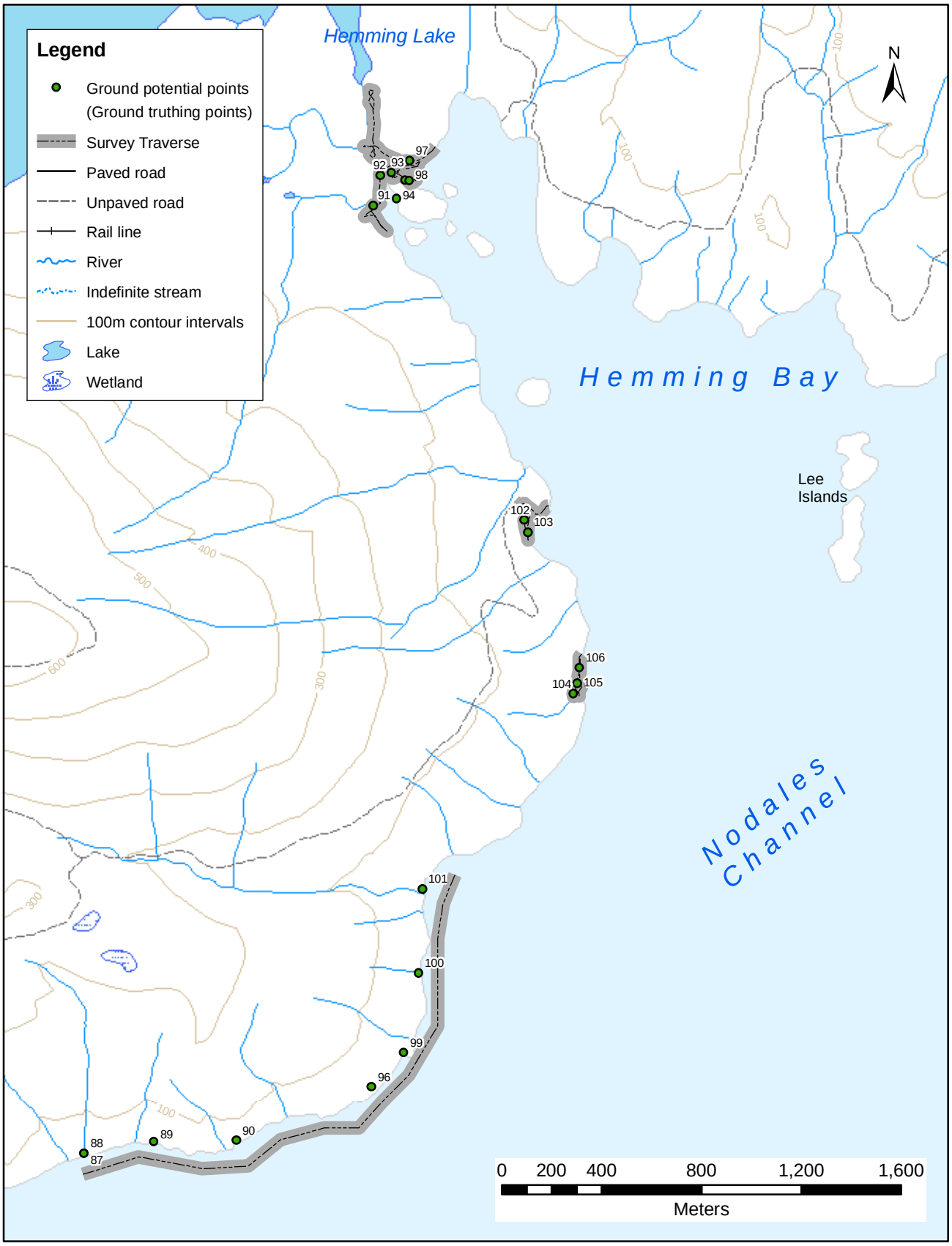


Figure 72. Ground truthing results and survey coverage, Hemming Bay, East Thurlow Island.

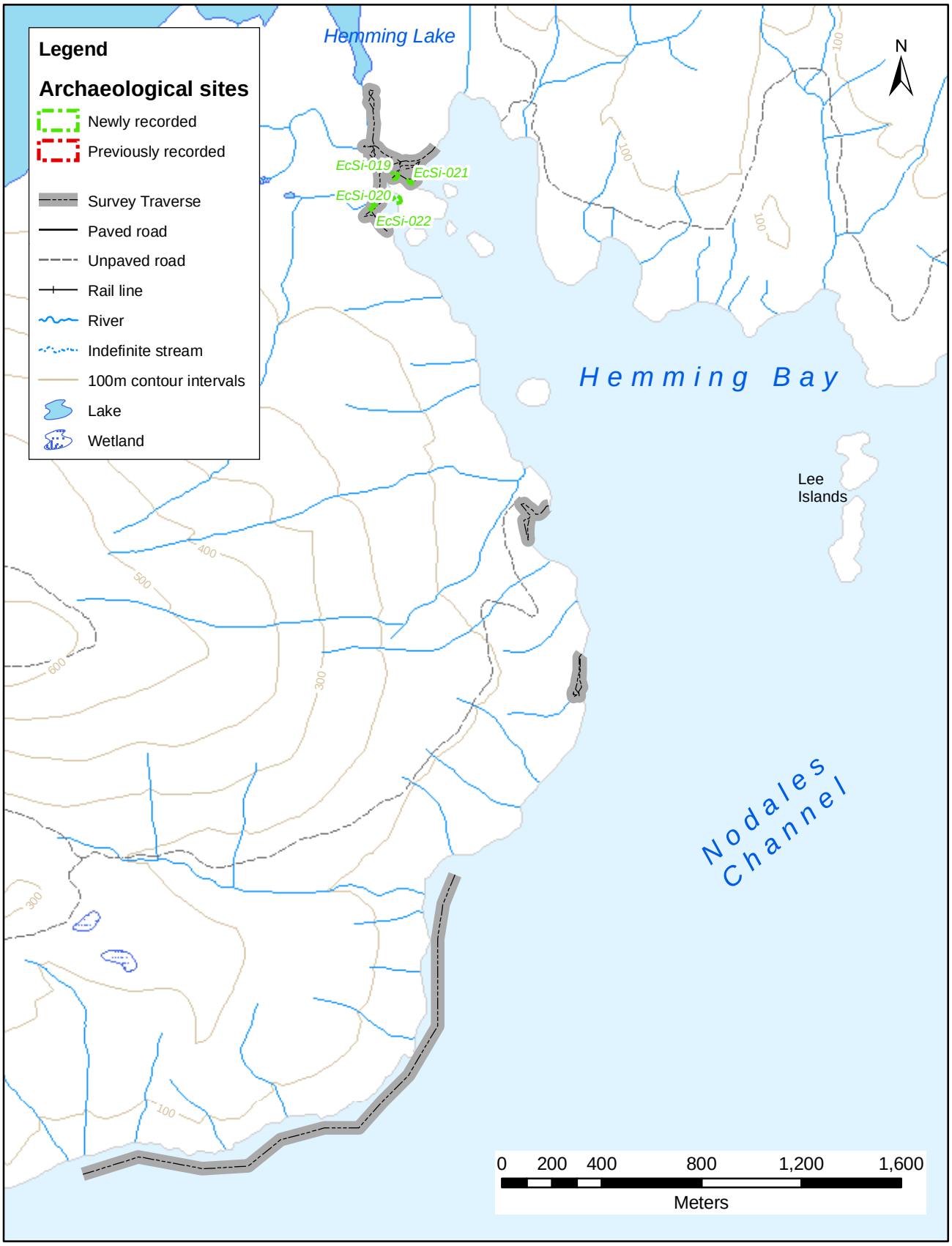


Figure 73. Survey coverage and identified archaeological sites, Hemming Bay, East Thurlow Island.

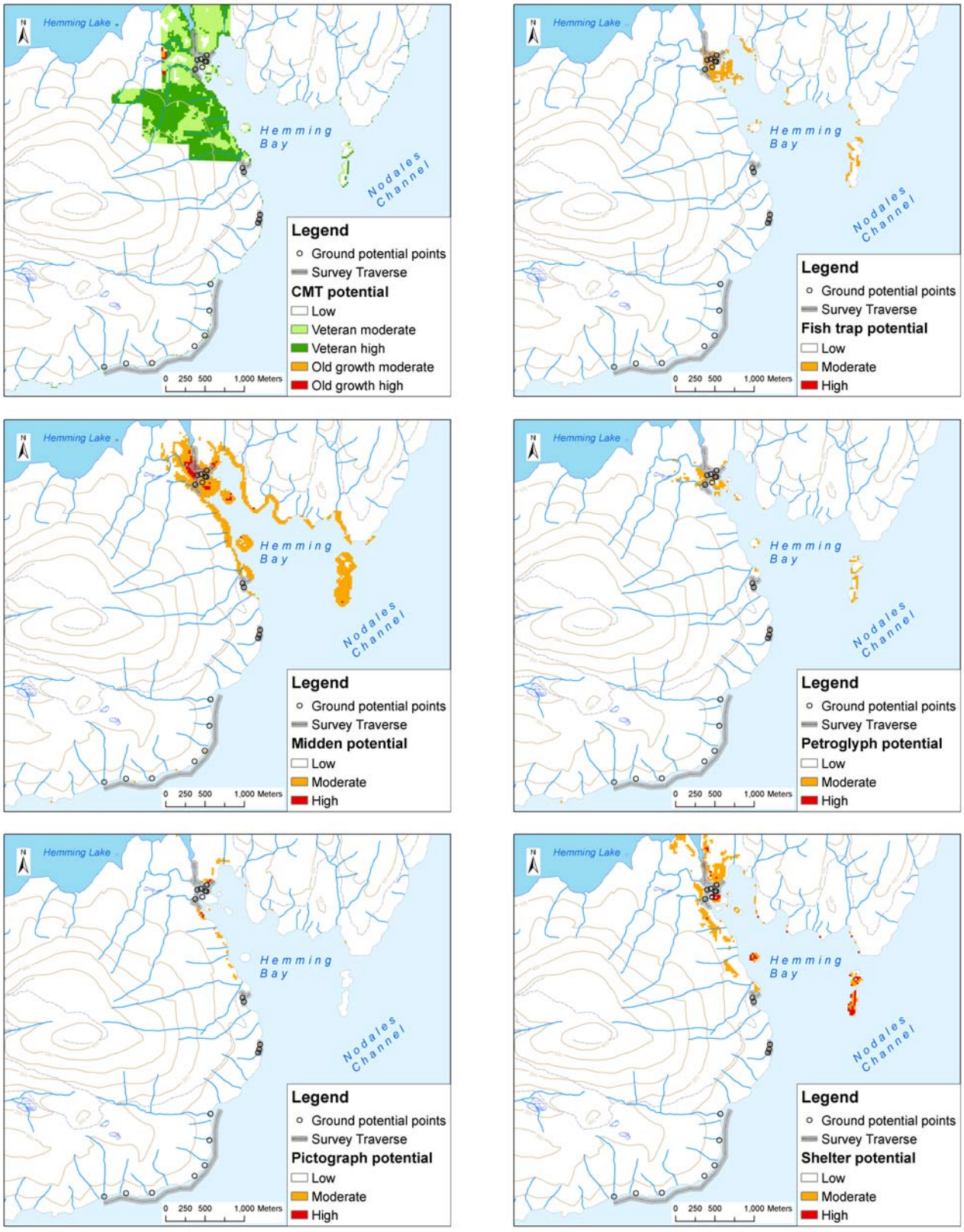


Figure 74. Potential models for Hemming Bay.

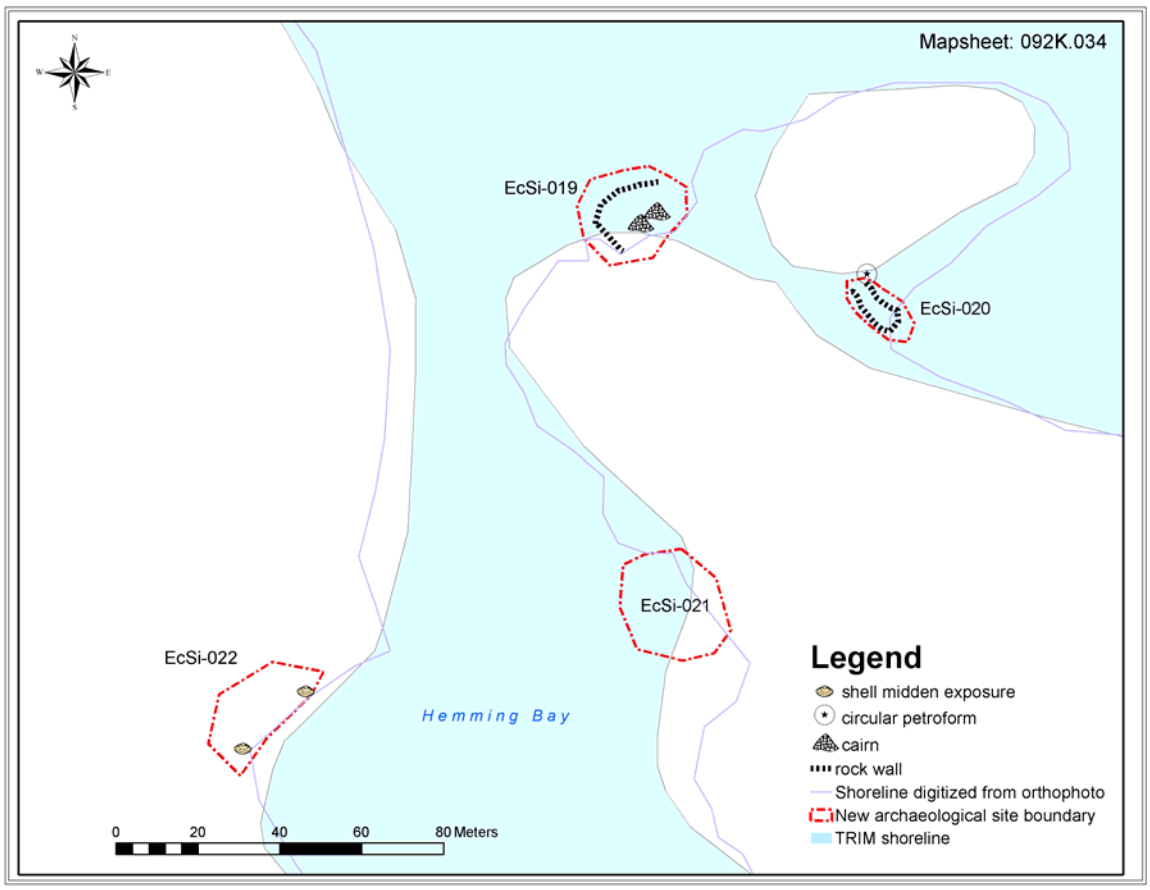


Figure 75. Archaeological site locations in northwest Hemming Bay, East Thurlow Island

Shoreline southwest of Hemming Bay (Ground Truthing points 87-99, 100 and 101)

On the way to Hemming Bay, the survey crew examined the shoreline south and west of Hemming Bay. Portions of this area visible from the water were assessed for rock shelter and rock art potential. The shoreline consisted of steep rocky outcroppings, varying in slope and vegetation (Figure 76). Areas with potential for rock shelters were not observed from the boat. Rock art potential was high on a few vertical bedrock faces but no petroglyph or pictograph features were observed. The majority of the shoreline was rocky with series of bluffs and slopes of up to 130% (Figure 72).



Figure 76. Example of rocky shoreline to the south and east of Hemming Bay

Shoreline to the southwest of Lee Islands, Hemming Bay, East Thurlow Island (Ground Truthing points 104-106)

The crew disembarked on a rocky bluff north of a small rocky beach (Figure 77). The beach was thoroughly examined for evidence of cultural alteration or lithics, but none was identified. The landform behind the beach consisted of a steep rocky hillside with vegetation predominantly western redcedar and hemlock with dense patches of salal in places. Several older cedar and fir stumps showed the area had been commercially logged. At the southern end of the small beach at an elevation of approximately 15m was a moderate sized granitic rock overhang (Figure 78). This feature was approximately 5m x 5m and up to 1.5m deep in places. The back wall of the shelter had water flowing down the face. The ground surface of the shelter was inspected with flashlights and was heavily saturated. Cultural remains were not observed on the surface of the shelter and the wet conditions suggests it was not suitable for habitation or burial. Small spalls of roof-fall were scattered throughout the shelter.



Figure 77. Length of small rocky beach on the southwest side of Hemming Bay looking north. Lloyd Paul in foreground.



Figure 78. Small rock overhang identified above southern end of small beach. Iain McKechnie in foreground.

The landform between the rock overhang and the beach was very steep (approximately 110%) and surface exposure was good. No subsurface testing was conducted (see points on Figure 72 for survey transects and rock shelter location). The shoreline north of this point was visually inspected from the boat at slow speeds and is steep and rocky with low potential for any site type.

Shoreline due west of Lee Islands (Ground Truthing points 102 and 103)

Another possible area with potential for shoreline archaeological sites was identified due west of the Lee Islands in outer Hemming Bay on East Thurlow Island. A small beach surrounded by gently sloping landforms was searched (Figure 79). Vegetation consisted predominantly of hemlock and immature redcedar with dense patches of salal. The beach was heavily disturbed by logging and alder concentrated along an old road leading to the beach. A beach cleared of boulders using a bulldozer was most likely associated with log booming ground (Figure 80). Seven auger and probe tests were made beside the road with no evidence of cultural remains.



Figure 79. Small beach due west of Lee Islands looking west.



Figure 80. Evidence of beach boulder clearance on small beach due west of Lee Islands. Looking south.

Clam Garden Site EcSi-019 (Ground Truthing points 93, 96, and 97)

East of the small islets in the northwest end of Hemming Bay, a low tide allowed the crew to walk between the cliff face and the islets. This area is comprised of biogenic sand and had few rocks, and appeared to be a productive shellfish harvesting location (Figure 81). Signage in numerous locations indicated that the entire northwest portion of Hemming Bay was private property belonging to 'Hemming Bay Community' and therefore the survey was limited to the intertidal zone.



Figure 81. Large expanse of beach sediments between islet and cliffs (left) with biogenic sand and few rocks (Lloyd Paul shown at southern end)

Christine Roberts stated that she remembered recording a clam garden in Hemming Bay with John Harper (Christine Roberts, personal communication March 2007). This site is not registered with the Archaeology Branch. Christine was able to assist in the positive identification of two clam garden features in Hemming Bay.

EcSi-019 was identified on the north end of the largest islet in the northwest corner of Hemming Bay. The clam garden consists of a cobble and boulder terrace paralleling the shore to the north end of the site, with a small area (approximately 10m x 8m) cleared of rocks above the rock wall (Figure 82). The relatively low tide enabled the field crew to see the clam terrace rock wall beneath the water. The cleared clam terrace area is heavily silted behind the wall (as is the purpose of these features) Two small cobble-cairns of unknown function were noted at the south end of the cleared terrace (Figure 75). Although well sheltered, there is a strong current as it is near the confluence of the two creeks.



Figure 82. EcSi-19 Clam garden feature looking west. Note clearly defined area of clearance and cairn feature in foreground.

North of EcSi-019 (Ground Truthing points 92 and 93)

From EcSi-019, the survey continued along the north edge of the bay along a small, recently cleared trail in the intertidal zone to a large log dump area at the confluence of the two creeks (Figure 84). This area shows heavy disturbance with roads, a log dump, and partially eroded culverts present (Figure 83). Subsurface archaeological potential in this area is high, but no subsurface testing was conducted due to its location on private property. Survey continued to the north of the log dump along the eastern-most creek examining surface exposures and determining the level of disturbance. No evidence of cultural remains were identified, but the archaeological potential remains high. The majority of the area has been logged, but a few veteran trees are still present. The intertidal logging disturbance does not appear to have extended up the creek.



Figure 83. Log Dump and disturbance at northwest end of Hemming Bay – looking north

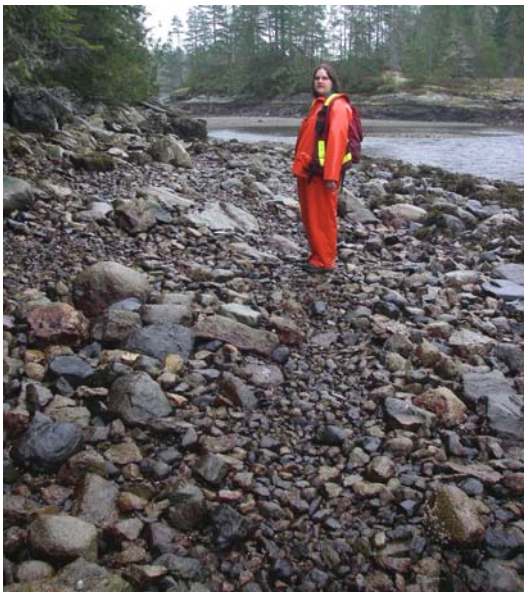


Figure 84. Christine Roberts on small cleared trail around the north side of Hemming Bay - looking south towards EcSi-019

Clam Garden Site EcSi-020 (Ground potential point 94)

Survey continued south from the two creeks along the rocky western shoreline of northern Hemming Bay (Figure 75). At a small dock west of the largest of the islets, the view was clear to the large islet, and the tide still low enough to see the intertidal zone clearly on the beach there. A small clam garden terrace was identified on the western side of the larger of the islets. This feature was approximately 75m away but was easily identified due to the clear absence of rocks in one area, with a lower rock ridge and rocks piled to the sides of the clearing. This site could not be directly accessed due to the deep water, but has an estimated size of 10m x 10m (Figure 85).



Figure 85. EcSi-020 as seen from the adjacent shore (EcSi-022)

Shell Midden Site EcSi-022 (Ground potential point 91)

The Community of Hemming Bay has a small private boat dock and a collection of cabins and storage facilities in the low-lying area to the west of the largest islet (Figure 87). From the intertidal zone, shell was noted in road and path exposures. The eroding shoreline exposed shell midden starting approximately 10cm below the current surface, extending up to 50cm deep (Figure 86). To the south of the site is a small creek, and the midden does not appear to continue south of this point. The site appears to be somewhat disturbed, but intact portions most likely still remain. The site vegetation consists predominantly of alder with immature western redcedar, hemlock and spruce. The area surrounding the community buildings appears to have been commercially logged in the early 20th century, as springboard notches are present in stumps (Figure 75).



Figure 86. Whole and crushed clam shell evident in midden eroding from shoreline at EcSi-022.



Figure 87. General site photo looking north from intertidal zone. Evidence of Hemming Bay Community habitation visible.

Intertidal Petroform Feature EcSi-021 (Ground potential point 98)

An intertidal petroform feature approximately 8m x 3m is present on the largest islet (Figure 75). The feature consists of a small cleared area on the rocky beach, starting in the upper intertidal zone curving down and to the west in the mid-intertidal. The uppermost end is open (Figure 88). The function of this feature could not be identified. As the lower end is closed, and the feature curves, it would not have been suitable as a canoe run, and its position in the upper- to mid-intertidal zone would not have made it a ideally located fish trap. This feature was thought not to be of modern origin. At the northeast end of the petroform is a circular petroform, which is thought to be modern, possibly a fire pit (Figure 89). The site was surrounded by bedrock and no subsurface testing was conducted on the backshore due to its location on private property. No cultural materials were identified in the natural exposures along the shoreline.



Figure 88. Intertidal petroform feature looking south (EcSi-020)



Figure 89. Small circular petroform feature in upper intertidal zone; probably modern fire pit

Summary

It appears that clam terraces were built in even very small locations. This is particularly interesting in this part of the study area due to the extreme tides and currents present, and the implications for use of these sites. The observed rapid change in tide level means that these areas are only easily accessible for short periods of time. During the winter months, most low tides occur at night. Clam harvesting seasons varied from region to region, but clam meat is generally considered to be best when harvested during the winter (Keen 1975). This would have meant that the clam gardens in these channels would have had to be accessed with some difficulty and danger, and the small size of them implies intensive use and modification of almost every available niche in the 4intertidal zone.

The survey methods employed in this portion of the study area were not sufficient to identify all expected site types. The restricted access from private property in the northwest corner of Hemming Bay severely limited survey for certain site types. Due to the strong current of the creek and rising tide, sediment deposits in north western Hemming Bay are thick and may well cover additional intertidal features. Ground potential proved to be similar to predicted potential for most of the site-types. The major disagreement between predicted and actual potential for northern Hemming Bay was caused by the anthropogenic constructed log dump. This area was predicted to have high habitation potential, and was determined to have low potential in the field.

Time constraints limited survey for the southwest portions of Hemming Bay.

Recommendations

Further archaeological work in the area is strongly recommended if development is planned. Further archaeological work would include the definition of archaeological site EcSi-022, the subsurface testing of the surrounding level landforms, and interior traverses to identify any CMT or rockshelter sites. It is recommended that if impacts are to occur in the intertidal zone, survey be conducted at low tide to determine the presence of fish trap or clam garden features. Subsurface testing of the intertidal zone may be valuable in determining the presence of buried archaeological features.

Barnes Bay, South Sonora Island (Ground Truthing points 178-204)

Location and Description

Barnes Bay and surrounding areas on southern Sonora Island were selected for model ground truthing. Portions of a small-unnamed bay to the east of Barnes Bay and Nutcracker Bay to the west of Barnes Bay were also included in this portion of the survey. The use of a 27ft aluminium boat limited the number of suitable landing locations (Figure 90).

Steep rocky shorelines and a predominant forest cover of western redcedar, Douglas-fir, hemlock and alder characterize the area. Many small creeks drain into Barnes Bay and surrounding areas, and some are fish bearing. Most of the flatter, more accessible areas have been impacted heavily by logging activity, including the construction of roads and log dumps.

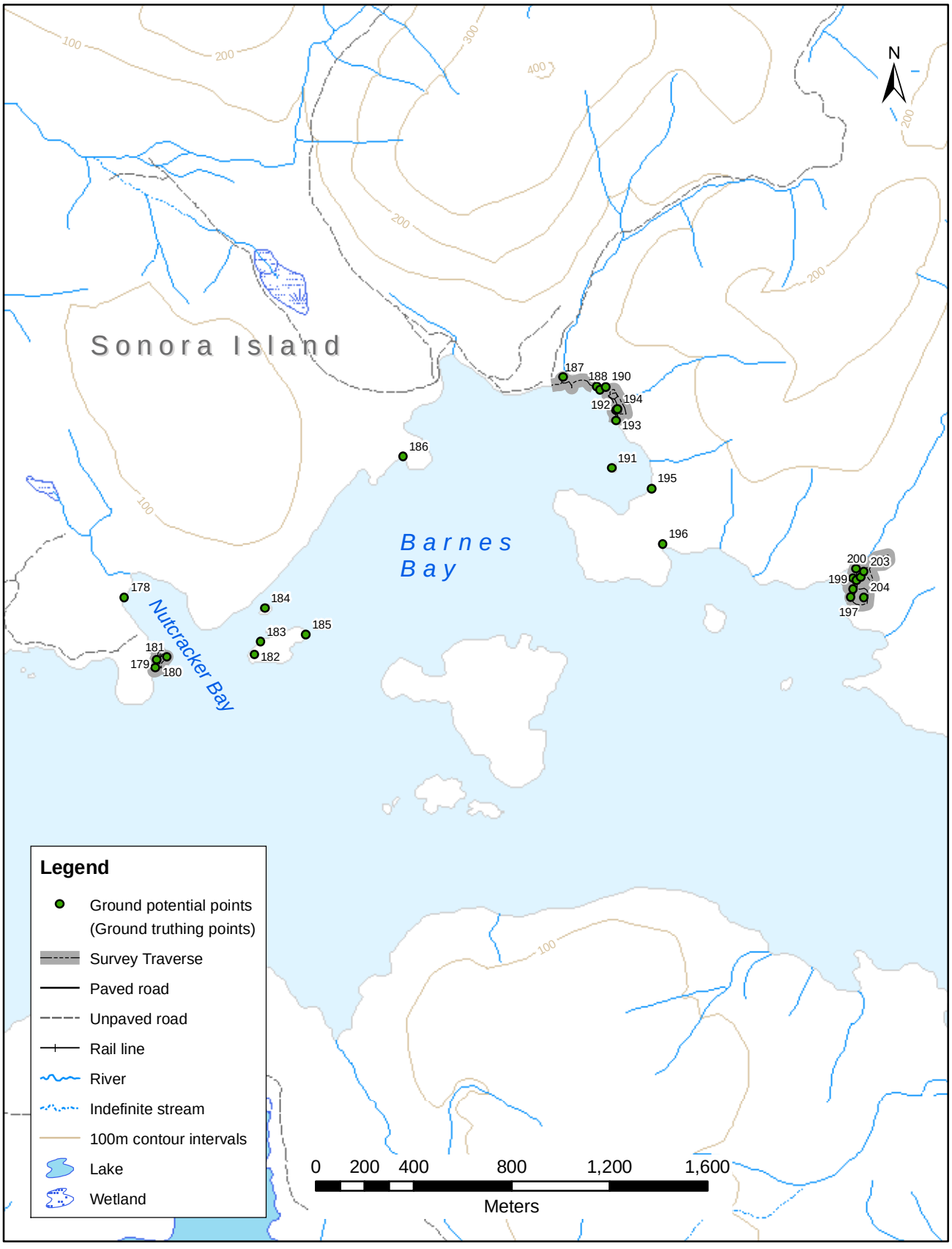


Figure 90. Ground truthing results and survey coverage, Barnes Bay, Sonora Island.

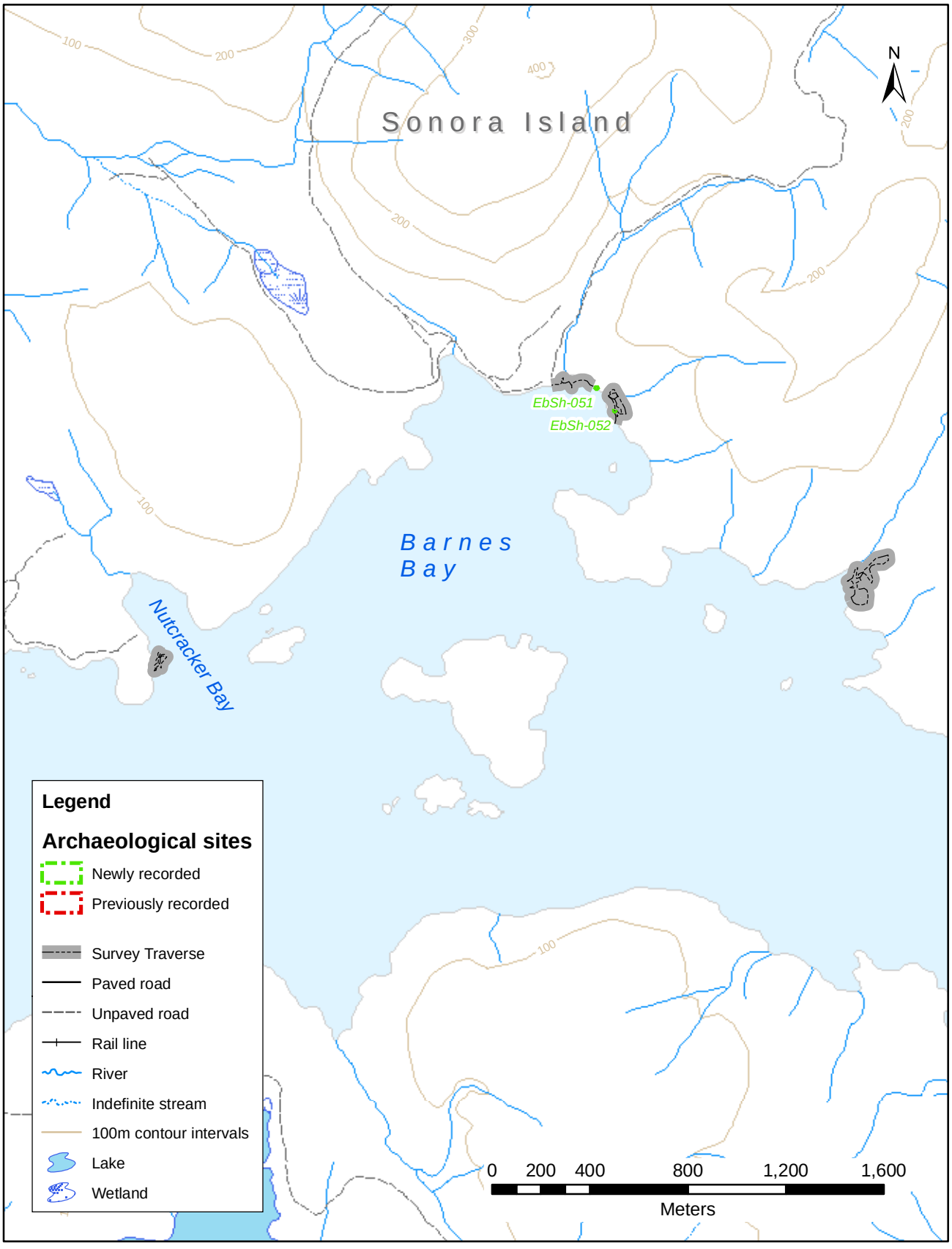


Figure 91. Survey coverage and identified archaeological sites, Barnes Bay, Sonora Island.

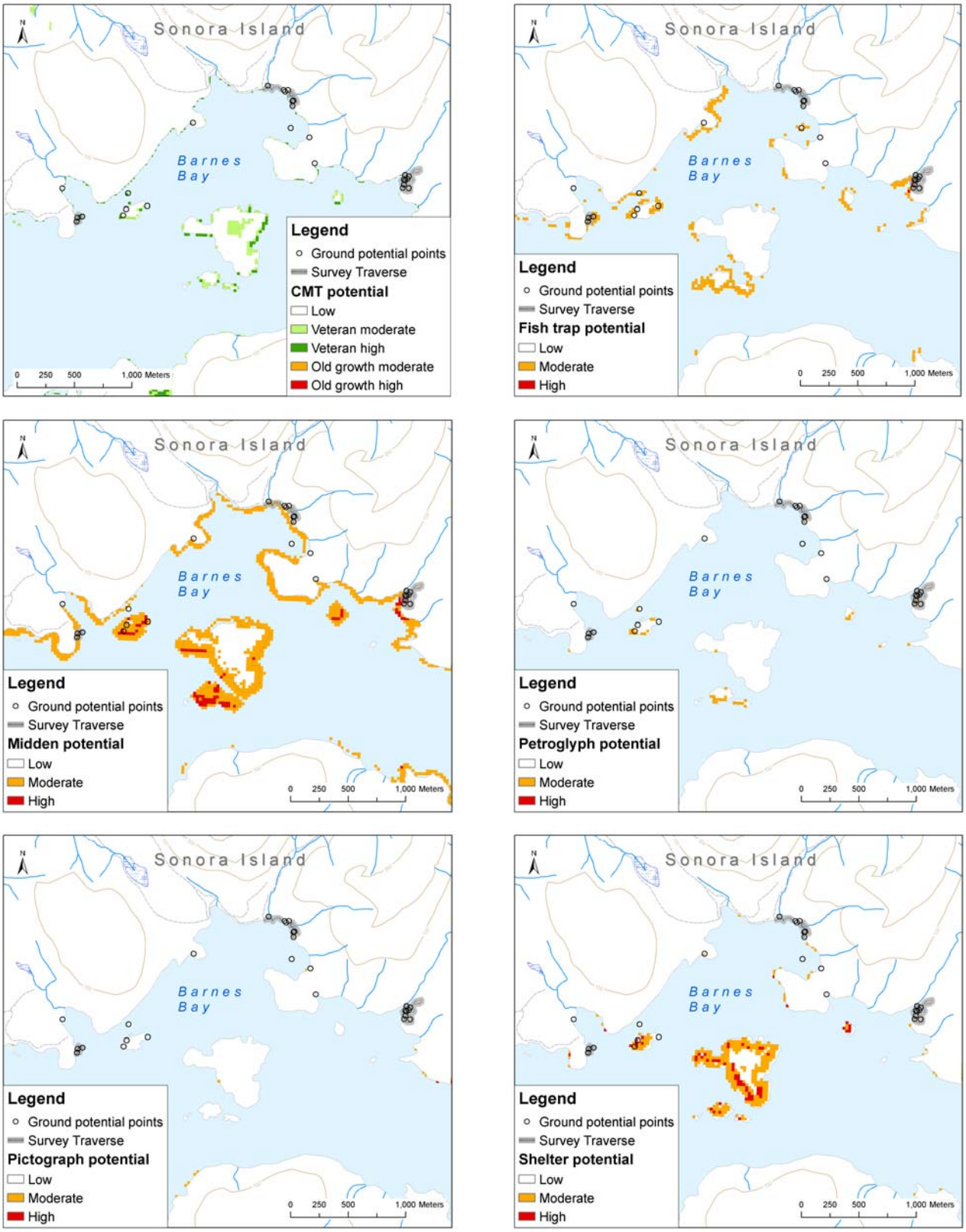


Figure 92. Potential models for Barnes Bay.

Criteria

This area was selected for survey due to the lack of previously recorded archaeological sites in the area and the predicted high potential for finding many site types in shoreline contexts. Site types expected in the area include shell midden habitation sites, defensive sites, intertidal fish trap sites, and CMT sites. See Appendix D and Figure 92 for detailed results of the expected and actual archaeological potential for this area.

Coverage

The survey crew consisted of Jo Brunsden and Iain McKechnie of Millennia Research Limited, Christine Roberts of the Campbell River Indian Band, and Lloyd Paul and Harold Harry of the Homalco Tribe. The goal of this portion of the fieldwork was to verify the shoreline predictions from the potential model, while also noting potential for all expected site types. The field crew were spaced at a distance of no more than 10m apart in areas considered to be of high archaeological potential. Shovel and auger tests were conducted according to the methodology outlined above.

Results

Two archaeological sites were identified in Barnes Bay: one disturbed shell midden and one isolated surface find (Figure 91).

Small unnamed bay to the east of Barnes Bay (Ground Truthing points 197-204)

Mapping information provided by the Campbell River Forest District showed that this area was Crown land. The area east of Barnes Bay has been heavily disturbed by the construction of two houses, outbuildings, and gardens and it appears that the original landforms have been altered significantly. Exposures in the vicinity of the houses and the garden were thoroughly inspected and do not show any evidence of cultural remains (Ground Truthing points 197 and 204) (Figure 93, Figure 94). The intertidal zone adjacent to the developed area also shows evidence of being recently disturbed, by removal of boulders to allow for water pipe placement. No evidence of precontact modification of intertidal features is visible.



Figure 93. To the east of Barnes Bay, looking north. Note heavy disturbance to original landform.



Figure 94. Heavy disturbance in intertidal zone in small bay east of Barnes Bay.

To the west of the houses was a large creek, which was too wide and deep to cross; subsequently survey was not conducted west of the creek. Between the creek and the houses was a relatively undisturbed landform with an undulating top at 25m elevation and a steep slope down to the shore and creek (Figure 95). The landform was approximately 50m wide x 25m deep and was bounded to the north by a moderate slope out on the east by an overgrown road. East of the road is a heavily cleared area with houses. A total of 15 auger tests and 5 shovel tests were conducted north of this area, with the general stratigraphy consisting of 0-15cm dark silty humic layer with some charcoal, and 15-25cm of medium brown silty sand with 10% angular pebbles (Ground Truthing points 201, 202 and 203). These layers were underlain by bedrock at varying depths. The vegetation consisted of western redcedar, Douglas-fir, spruce and alder. There was little to no understorey and surveyors were in visual contact with each other at all times.

No evidence of cultural remains was identified during the subsurface testing of this area. From this point, the survey was continued by boat along the shoreline to the west into Barnes Bay.



Figure 95. Landform tested to the west of the heavily disturbed area, alder in background defines overgrown road.

Shoreline to the east of Barnes Bay (Ground potential point 196)

This area was examined from the boat and was generally steep and rocky with few suitable places for landing. There were no rockshelters visible, and the potential for rock art was low due to the moderate slope of the shore. Strong tides and fast currents limited the ability of the crew to disembark. A small low-lying neck of land exists between Barnes Bay and the small bay to the east (Figure 96). This area could not be landed at (Figure 97). The landform visible from the boat appeared to be flat and well drained, although alder indicated disturbance. The boat went as near to shore as possible on both sides of this neck of land, and surveyors examined the intertidal zone beneath the boat for evidence of cultural modification. No cultural remains were identified.

Barnes Bay: EbSh-051 and EbSh-052 (Ground Truthing points 192-195)

Pedestrian survey of Barnes Bay was conducted with a focus on the shoreline. The crew were dropped off near the eastern end of the bay surveyed the intertidal zone and immediate shoreline heading east. A fish farm and former logging operation in the bay appears to have caused some disturbance to the surrounding area with the attachment of anchor cables and freshwater pipes.



Figure 96. Small cove to the east of Barnes Bay (Ground potential point 196)



Figure 97. General shoreline to the southeast of Barnes Bay

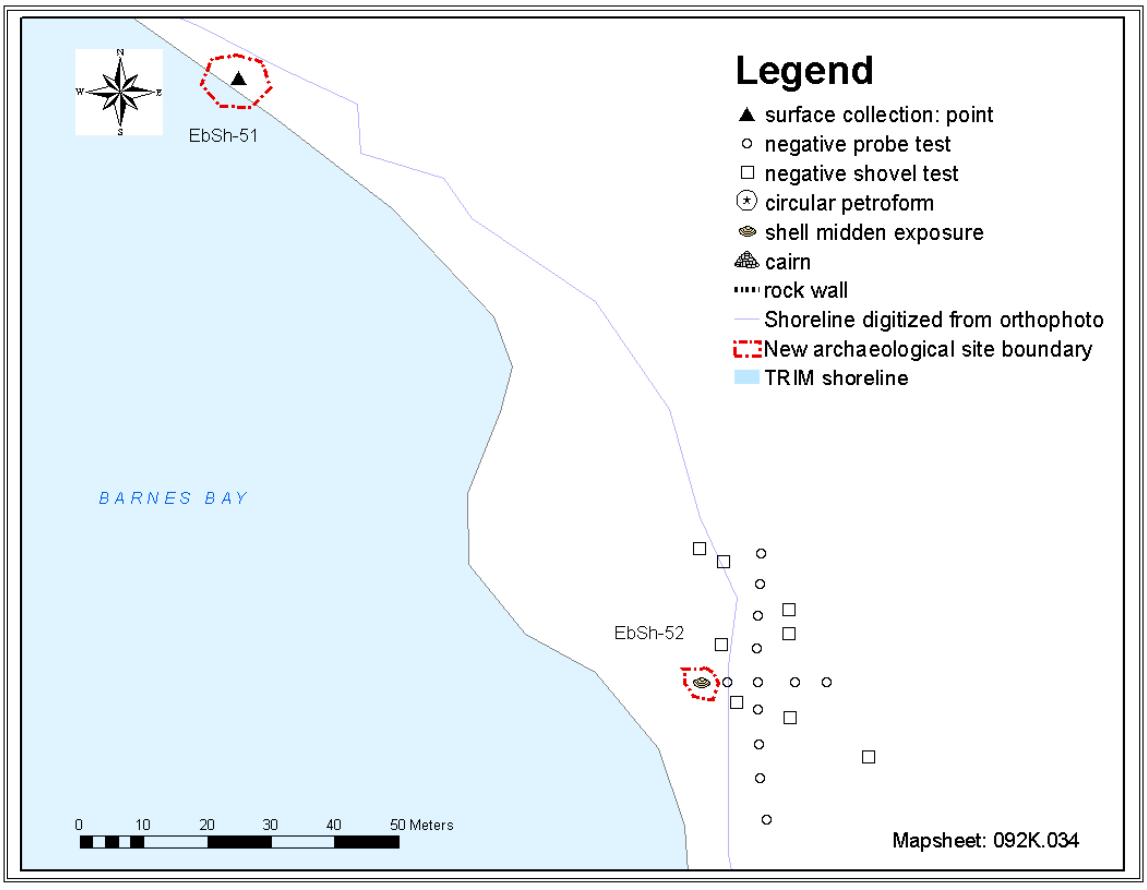


Figure 98. Site maps for EbSh-051 and EbSh-052

EbSh-052 is a small-disturbed shell midden site located in a collapsed portion of bank in the upper intertidal zone of eastern Barnes Bay (Figure 98). Deposits are very shallow and appear to be completely disturbed (Figure 99). Crushed shell and FCR was visible in the exposure, but depths could not be estimated. The bank itself appears to have been heavily disturbed by road building and logging (Figure 100). The road has long since been abandoned but not deactivated and the collapsed culverts have caused flooding and erosion of parts of the road and alteration of stream channels. A total of 12 probe tests and 8 shovel tests were made and a thorough visual inspection of the intertidal zone was conducted. No further cultural remains were identified. The midden consists of approximately 25cm of mixed crushed shell and FCR in dark black silty sand. The original location of this midden is unknown and no more was found on the surrounding landforms, which were thoroughly inspected. The shoreline was tested approximately every 10m to the western end of the bay.



Figure 99. Disturbed stratigraphy of shell midden site EbSh-052



Figure 100. General site location for EbSh-052. Note heavy disturbance in background. Shell midden exposure found in clump of eroded bank at top of intertidal zone.

EbSh-051 (Ground Truthing points 187-190)

This site is located approximately 120m northwest of EbSh-051 in the intertidal zone of Barnes Bay (Figure 103). The point is made from reddish jasper (Figure 101, Figure 102). The point appears to have been broken from a larger artifact and reworked. The tip may be original, and is finely worked on both faces with small pressure flakes. The proximal end has split obliquely across the face, leaving a large flake scar on one face. Further down on this face are the scars of large expanding soft-hammer flakes. The point has been roughly reworked to make a slightly contracting stem. One lateral side of the point has been worked mainly unifacially on the broken face with a series of flakes that terminated in step fractures; this process has left a fortuitous open notch on one side, but apparently not an intentional one. The other proximal margin has two or three small flakes removed or broken away, but is otherwise unmodified from the break. The other face has 'nibbled' steeply retouched stem margins.

Points generally similar to this are most common in the Marpole and Strait of Georgia periods in the southern Strait of Georgia. The exotic material and fine quality of original knapping suggests it may have been traded from the interior.



Figure 101. Red jasper point, EbSh-051



Figure 102. Other side of red jasper point



Figure 103. EbSh-051 general site photo looking west. Note heavy alder indicating disturbance along shoreline.

Shoreline of Barnes Bay heading southwest into Nutcracker Bay (Ground Truthing points 178-186)

A road that parallels most of the shoreline from Barnes Bay west to Nutcracker Bay has heavily modified the original rocky shoreline through blasting, with blast rock or alder backing much of the shoreline. All small bays with more hospitable shorelines were examined from the boat for evidence of intertidal cultural features. Haro Island in south Barnes Bay was examined for cultural remains from the boat (Figure 104). As no suitable boat-landing places were visible, pedestrian survey could not be conducted (Ground Truthing points 182-185). Few suitable canoe-landing places were visible either. The shoreline of Haro Island was steep and rocky with the surrounding currents being strong and dangerous. These characteristics would make the island suitable for a fortified refuge, however. The "trench" model has high potential for refuge sites on this island. The lack of canoe landings was probably not an issue: Baseline found one defensive site with no canoe landing for 900 m during their inventory (Engisch, et al. 2004: 54,108).



Figure 104. North end of Haro Island

Nutcracker Bay was briefly examined from the boat although fish farm cables prevented close examination of much of the shoreline. A newly built road was visible from the boat and appears to parallel the shoreline. The northwest portion of Nutcracker Bay (Ground potential point 178) appears to be flatter than the surrounding landforms although pedestrian survey could not be conducted due to lack of suitable boat landings.

At the southern end of Nutcracker Bay is a small rocky intertidal point (Ground Truthing points 179-181). None of the unusual rock formation features here could be positively identified as cultural in origin. The flat-topped point of land had few large rocks and consisted of primarily biogenic sand (Figure 105). This flat-topped area was approximately 25m long and 10m wide, but its location at the high tide line would make it unsuitable for clam mariculture based on current knowledge on clam growth preferences. To the north of the point is a small beach with little to no rocks (Figure 106). It is possible that the clearing was cultural, but no low-tide terrace was evident and it was not recorded as a site. It is possible that this beach shows evidence of cultural modification, but no positive identification could be made in the field.

Summary

One example of disagreement between the draft model potential and ground potential was a small exposed islet in the eastern side of Barnes Bay (Ground potential point 191). This small islet was predicted as having high potential for habitation and fish trap features, but was assessed in the field as being too exposed and low-lying with no fresh water source or large vegetation to be suitable for a midden (Figure 107). The model was subsequently revised to remove very small islets. For several of the models in Barnes Bay, man-made "anthropogenic" landforms showed potential where there was none. The level, slightly raised nature of these features, often occurring in sheltered locations, mimics the location of several types of archaeological site.



Figure 105. Small flat-topped landform in upper intertidal zone in southern Nutcracker Bay.



Figure 106. Possible culturally modified beach looking north into Nutcracker Bay, not recorded as a site.



Figure 107. Small islet in Barnes Bay with low archaeological potential for predicted site types.

Lack of suitable boat landing spots and time restricted the amount of pedestrian survey and subsurface testing. The subsurface testing in eastern Barnes Bay was intensive (approximately every 10m for 200m of shore), however conceivably there could be undiscovered cultural deposits underlying roads or blast-rock piles. The testing and surface exposure examination in the small bay to the east of Barnes Bay would have been sufficient to identify any shell midden had it been present.

Recommendations

Further archaeological work is strongly recommended in all areas surveyed should development take place. The shorelines of Barnes Bay and Nutcracker Bay have already been heavily impacted and archaeological sites may have already been disturbed. No interior traverses were completed in any of these areas and further archaeological work is recommended for these locations.

Turn Bay, southwest East Thurlow Island (Ground Truthing points 107-117)

Location and Description

The northeast portion of Turn Bay, located on southwest East Thurlow Island, was predicted as having high archaeological potential for fish trap sites (Ground Truthing points 107-117). A small stream drains into the bay from the northeast creating a large flat intertidal area. The survey was conducted on foot (Figure 108).

This large and shallow bay was visited near to low tide and is surrounded by generally low-lying landforms. A recently built road has been constructed along the north side of the bay, and there is also evidence for a log boom and log sort facility. Recently logged areas are visible approximately 20m away from the high tide line to the north of the bay. The remaining forest cover consists predominantly of immature western redcedar, hemlock and Douglas-fir, with some spruce in the lower-lying areas. The area to the south and east of the bay was logged historically, as there are springboard notched stumps. The intertidal zone in the northeastern portion of the bay is estuarine and consists of a large sand flat with a shallow stream channel bisecting it (Figure 111). The stream channel is filled with angular cobbles in some places and silty sand elsewhere. Further to the east, a low-lying marsh borders the stream channel.

Criteria

This area was chosen for survey due to its predicted high potential for fish trap sites and the fact that no sites have been previously recorded in this area. Habitation, rockshelter, rock art and CMT sites were also expected in Turn Bay (Figure 110). See Appendix D for details on predicted and actual archaeological potential for this location.

Coverage

The survey crew consisted of Jo Brunsden and Iain McKechnie (Millennia Research Limited), Christine Roberts (Campbell River Indian Band), Lloyd Paul and Harold Harry (Homalco Tribe). Time was limited for this portion of the field survey, as the boat had a prior engagement. Field crew were spaced at a distance of no more than 10m apart in the low-lying portion of the bay, and survey traverses often overlapped in the streambed. Subsurface probing was conducted as described above.

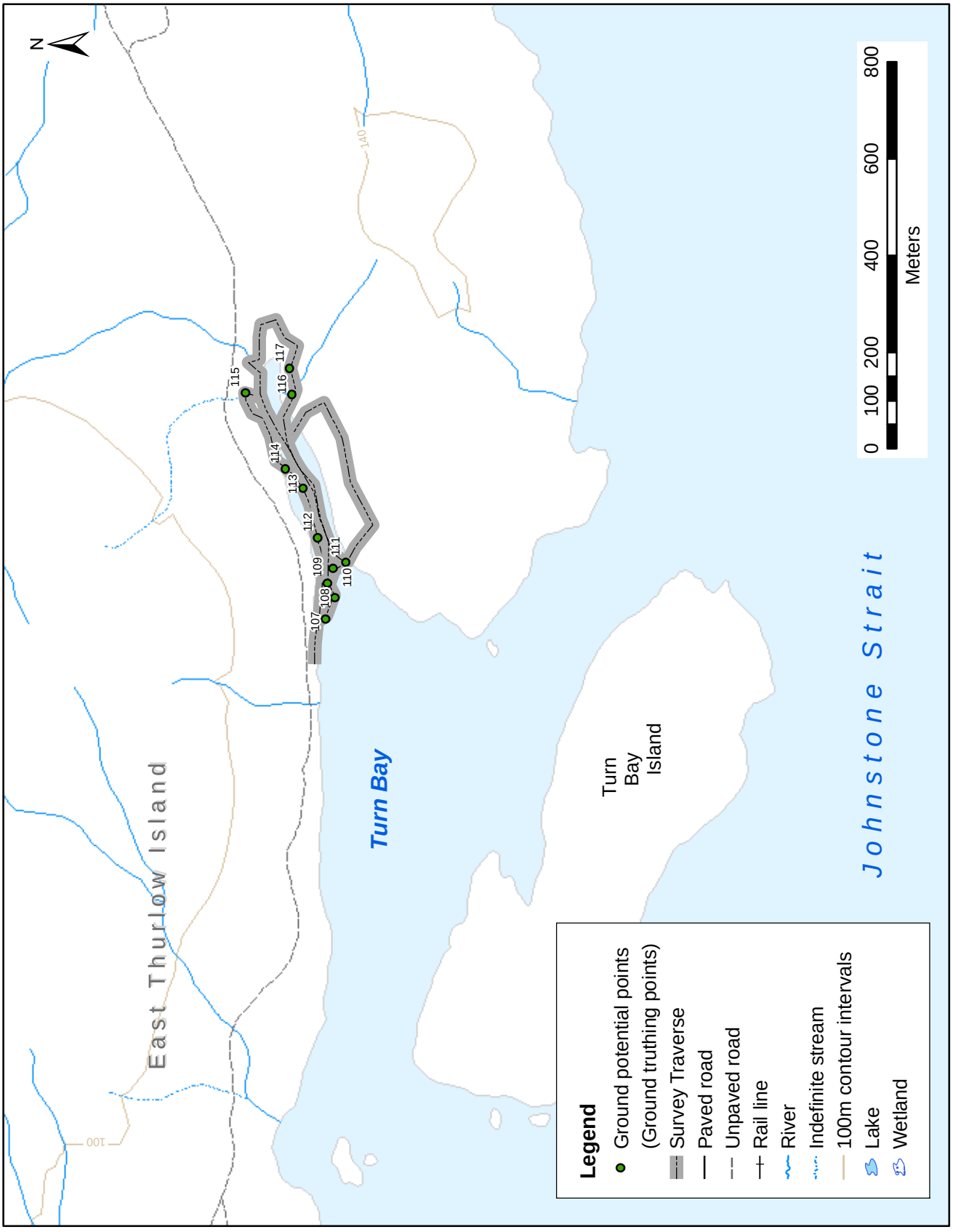


Figure 108. Ground truthing results and survey coverage, Turn Bay, East Thurlow Island.

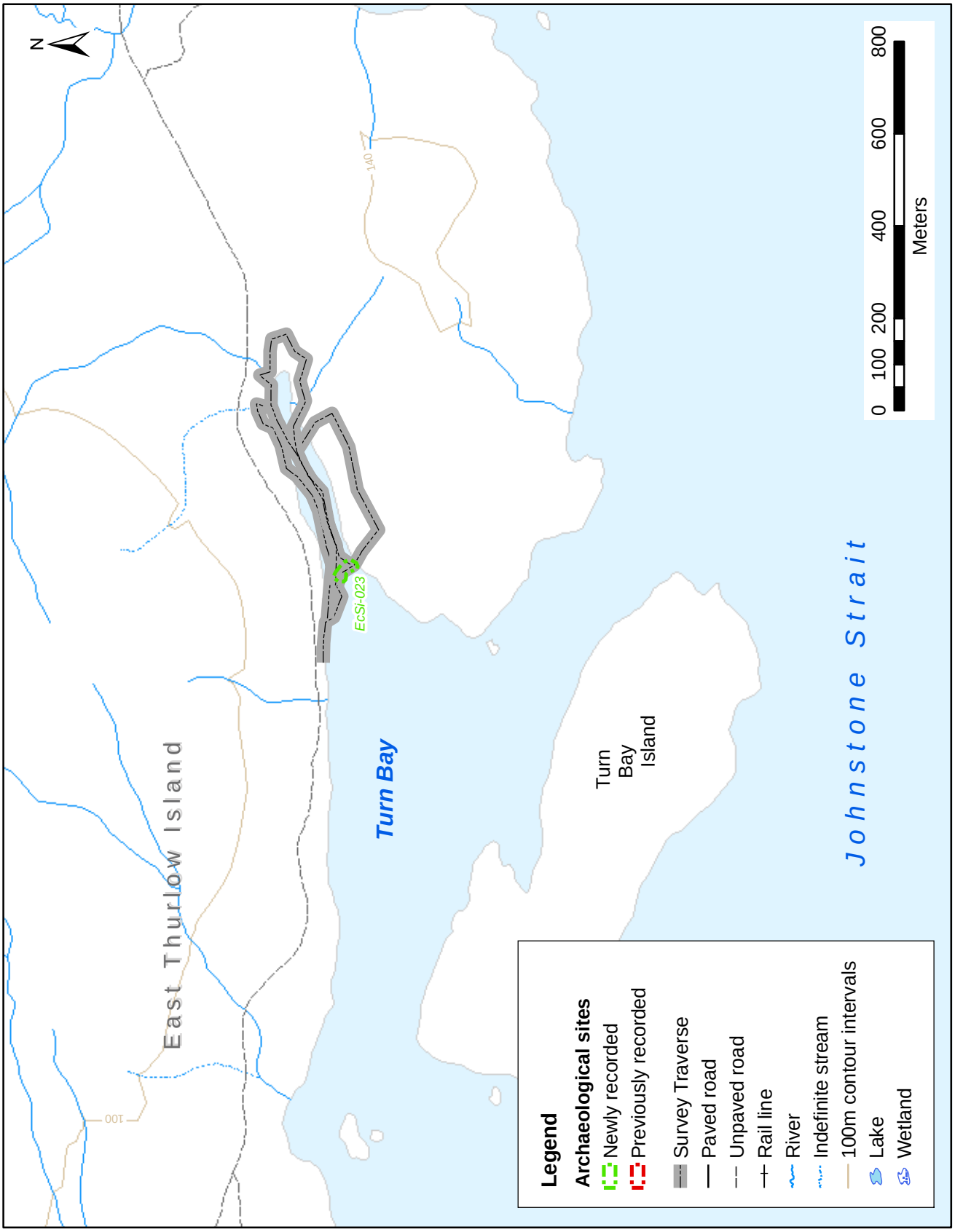


Figure 109. Survey coverage and identified archaeological sites, Turn Bay, East Thurlow Island.

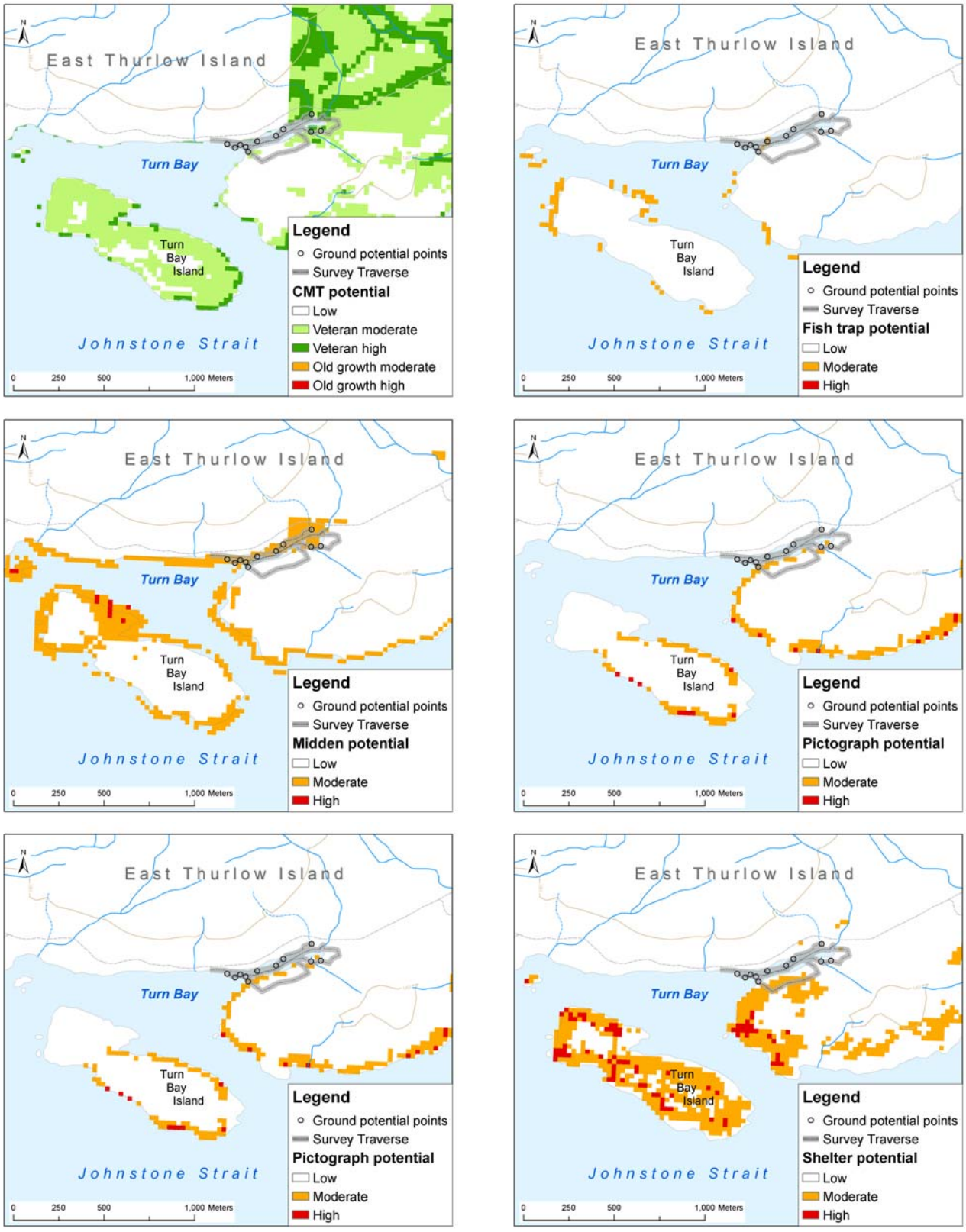


Figure 110. Potential models for Turn Bay.



Figure 111. View of Turn Bay Estuary looking west to Turn Bay Island

Results

One fish weir was identified in the intertidal estuary of Turn Bay (Figure 112, Figure 113 and Figure 109).

EcSi-023

EcSi-023 is located at the western end of the estuary in Turn Bay. The site is a small fish weir consisting of rounded and angular cobbles and boulders, and is approximately 12m long and 30cm wide (Figure 113). The rock wall feature appears to continue to the south and curves around back to the east but is poorly defined (Figure 114). The function of this portion of the feature is unknown and its location on a relatively steep slope in the upper intertidal zone and arrangement appears to make it unsuitable as a fish trap. No similar configurations could be found in Stewart's *Fishing* (Stewart 1977). No evidence of wood stakes was visible at the time of survey. Three small piles of rock in the intertidal zone adjacent to the northern end of the fish weir were found. The function of these 'cairns' is unknown. It is possible that the fish weir feature extends further to the north and has been buried by deep fluvial sediments.

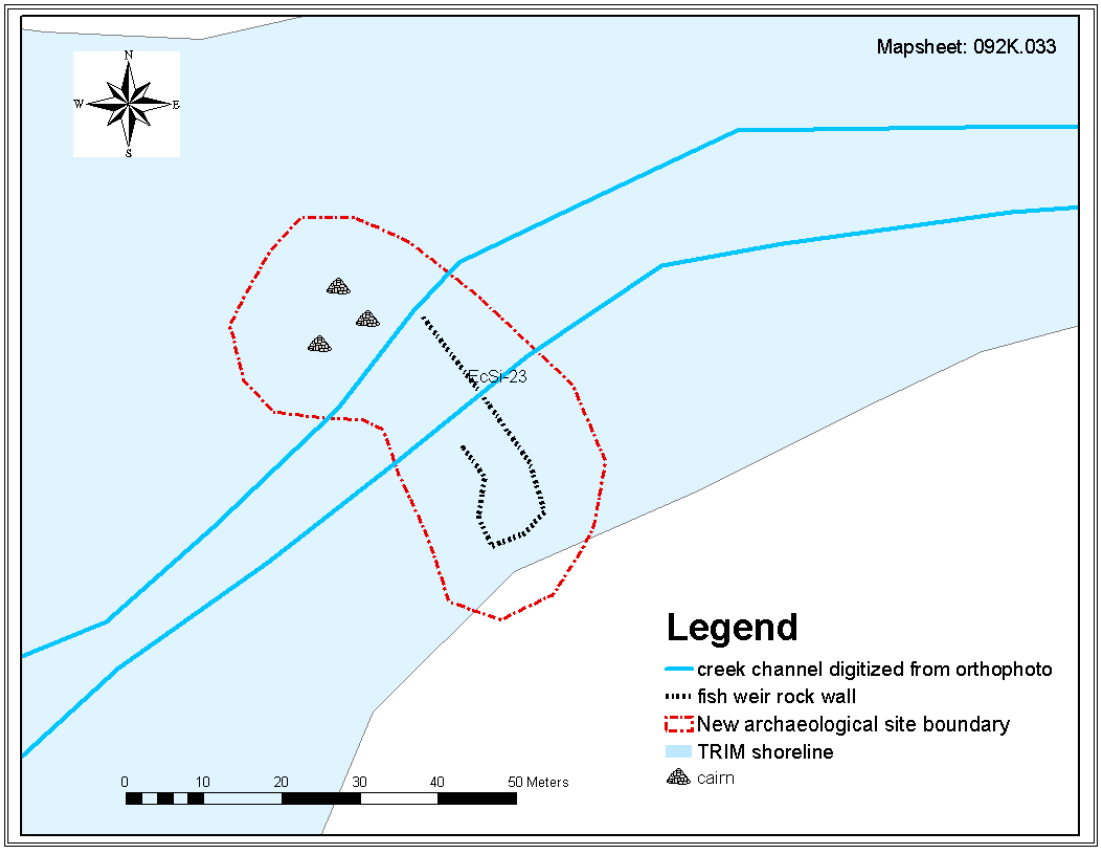


Figure 112. EcSi-023 site map. See Figure 109 for general site location.



Figure 113. Fish weir at EcSi-023



Figure 114. Upper intertidal section of fish weir petroform feature.

No further cultural remains were identified in the surveyed portions of Turn Bay. The land around the bay was generally flat and level, but semi-saturated and therefore unsuitable for habitation (Figure 115). Three auger tests were conducted in slightly raised hummocky areas considered to be of slightly higher archaeological potential, but no cultural remains were identified (Ground Truthing points 116 and 117).



Figure 115. Low-lying saturated landforms in the eastern end of Turn Bay

Summary

The survey methods employed in this portion of the study area were sufficient for the identification of fish trap sites (Figure 110). Due to time constraints, survey for other site-types was extremely limited, but logging activity seen in the area would limit CMT potential, and the lack of suitable landforms would limit habitation potential.

Recommendations

Further archaeological work is recommended if development will impact the intertidal zone in Turn Bay. An Archaeological Impact Assessment should also precede impacts to any well-drained, level landforms. Subsurface testing of the intertidal zone may be valuable in the identification of buried archaeological features.

Modelling results

Appendix A presents the buffers and ranges for all variables used in all the models. Appendix B contains the output of the buffer program runs and Appendix C contains the output from the model program runs. As Appendices B and C total over a thousand pages, they are provided in digital CD format only. Appendix D provides the ground truthing points listing all criteria rated for ground potential assessment and the potential itself for each model. Matches of model and ground assessments are given as two-letter designations, with the model always coming first; e.g., HM in the midden column would mean the location modelled as high for middens and rated moderate for middens in the ground truthing; LH in the petroglyph column would mean the location modelled as low for this site type but was rated high in the field. During analysis/report writing, it was discovered that the majority of the apparent mismatches (e.g., LH for middens) were between 0.5 and 20 metres from a higher modelled pixel; the difference is well within GPS error and 1:20,000 map scale error. These apparent significant mismatches could have been eliminated by attaching the highest model rating within one pixel of each ground truth point, but the discovery was made too late to re-do the analysis.

The initial model results were fairly good, but were improved through "tweaking" of modelling factors. The results of the ground-truthing provided additional data to further refine and improve the models. In particular, the addition of the clam bed data significantly improved the Midden, Fish, and Cairns models. Paradoxically, the "clam" model did not perform well, and was worsened by the addition of the clam bed data. This is due to the small sample of registered clam terrace sites in the provincial registry. The other current models are performing reasonably well, as indicated by the Kv Gains.

Not all models continued through to the final product and some were greatly limited in scope. Upon consideration of the draft models, it was decided to remove the "cairns" model entirely. This model appeared to be performing well (based on the statistical analysis), however, the actual sample size was quite small, and several of the sites which had been used in this model were not definite burial cairns, but were labelled "earthwork features, mounds" in the typology. The locations of these sites did not have enough distinguishing characteristics to model for them. For instance, several of the mounds were located on relatively flat, featureless terrain, and were not located near rivers or other water features. When the model was built spatially, the entire area near Comox and Courtenay was classed as high potential, making the model ineffective. The clam model was also removed, as the lack of recorded sites and the discrepancies between the mapped clam bed locations and the mapped clam garden sites were too great to model for clam sites effectively.

Table 4 provides a summary of the final model performance. The final model adjustments were developed only in GIS, and the %land and Kvamme gains are reported for the entire study area, not the restricted zone of shoreline (where that is appropriate) as reported in Appendices 2 and 3. The Kv Gains are correspondingly higher in Table 4 than in the appendices.

Table 4. Performance of various models, final versions.

Model	N=sites	% land H	% land M	% sites H	% sites M	Kv H	Kv M	Kv combined
Fish Trap	19	0.19	0.44	26	32	0.99	0.98	0.99
Midden	259	0.20	2.3	27	63	0.99	0.96	0.97
Petroglyph	25	0.03	0.3	12	40	0.99	0.99	0.99
Pictograph	31	0.01	0.16	16	45	1.0	1.0	1.0
Rock shelter	11	0.09	(0.7)	27	(55)	1.0	(1.0)	1.0
Trench Embankment Refuge	7	0.008	0.04	29	14	1.0	1.0	1.0
CMT (Old Growth)	99	0.5	1.0	24	3	0.98	0.67	0.94
CMT (combined OG and Vet models)	99	3.0	10	51	29	0.94	0.65	0.84

Each model is discussed below, with an emphasis on discussing the ground truthing results.

CMT Model

It was determined that the CMT model should be split into two main parts. One part would be an old growth model, and the other part would be a veteran tree model. The old growth model was applied in areas where (using the Forest Inventory dataset) the age class was greater than 150 years, and where yellow cedar or western redcedar were present (in any of the SPC1, 2, 3… fields in the forest inventory data). The veteran CMT model considers the fact that a large number of CMTs are recorded in areas not classified as old growth in forest inventories. The veteran model was applied in all areas other than 'old growth'. Both of these models were then limited to within 3km of the coast, or 1km of large rivers, or 1km of large lakes (over 200ha). The veteran CMT model was then further modified so that where there was no forest inventory data, the cut points could be lowered to allow for the absence of some of the variables used in creating the model (e.g. volume class, site index). These were then all combined back into one model, with the values for the veteran CMT model ranging from 1 to 14 where there is no forest cover data, from 100 to 115 for the CMT model where there is forest cover data, and from 1000 to 1015 for the old growth model. Original scores of 0 or less were rounded up to 1 in

the old growth model. Values of 0 indicate areas beyond which no CMTs have been recorded, and where potential is presumed to be low. Areas covered by ocean or water polygons are classified as "null". For each model, cutpoints were given to classify the range into low, moderate, and high potential.

Table 3 and Table 4 provide a summary of the performance of the CMT model against known sites. The High potential class in the 'old growth' model captures almost a quarter of all known CMTs in only one half of one percent of the land base. Given that two-thirds of the recorded CMTs occur in areas since logged, or in areas mapped as second growth, or in private lands where there is no forest inventory, this is a very good outcome.

The ground truthing also showed the old growth CMT model to be generally accurate. Of 42 ground truthing points in old growth, 30 scored as high potential in the model. Some 26 of these were in agreement as high potential during ground inspection. Four were classed as moderate potential in the field; these were in the drier biogeoclimatic subzone where cedar was confined to wet microenvironments and was often younger or badly burnt. Eleven points were modelled as moderate potential; only two were in agreement as moderate (again in dry microenvironments), while eight were classified as high potential (and CMTs were found at all these), and one was ground-classified as low potential, as there was old growth but cedars were absent. A ground-truth point was recorded in Low potential for old growth. This was rated as moderate potential on the ground, due to the presence of old cedar snags in creek beds. However, all the cedar snags were heavily burnt, and the potential for actually identifying CMTs in that location could also be considered low.

For the Veteran CMT model, there were 11 ground truthing points classified as high in the model; of these, one matched the ground potential, five were assessed as "moderate" (and CMTs were found on vets in some of these areas; they were moderate due mainly to the commercial logging). Five were classified as "low" on the ground, due to clearcutting. In the veteran Moderate model potential there were 53 ground truthing points: seven were ground-assessed as high, 21 as moderate, and 24 as low. The high potential were mostly in oldgrowth stands inventoried as younger, while the ones classed as low potential were either in areas heavily disturbed or totally lacking cedar. The moderate potential areas generally had a scattering of veteran cedar or cedar snags.

One change that has not been undertaken in the veteran model is to decrease potential in any areas logged during the 1960s and later. At about this date, large-scale clearcutting became the norm, with all snags and non-merchantable trees felled for safety. This lowers the potential for CMTs to have survived previous commercial cuts. This could be included in a future update of the model.

The CMT model was applied within 3 km of the coast and 1 km of major rivers and large lakes. Beyond these cut-off distances, CMTs occur extremely rarely. A very few CMTs have been recorded between 3 km and 3200 m inland (and away from major rivers) and none are recorded further than 3200 m. Yellow cedar, whose bark was as a more valuable resource for certain uses (especially clothing) than redcedar, and whose presence was undoubtedly a major reason for use of high elevation forests, occurs plentifully within the modelled area. Yellow

cedar is a particular concern that could not be addressed in the fieldwork; see recommendations later in this report.

The ground truthing results suggest that the old growth model performs rather better than the known site results in Table 4 suggest, especially with 'moderate' rated lands. However, it should be recognized that a relatively large number of these points occur in the CWH vm1 division, where CMT potential was generally much higher than in the drier subzone.

The Veteran model for 'moderate' potential appears to have relatively poor performance, and indeed in Table 4 it has the lowest Kv score of all. However, this model is recommended to be treated differently in use. Recommendations for use of the CMT model – especially the Veteran model, which is a departure from previous approaches – are given below in a separate section.

Midden model

The lithics model was dropped due to the heavy overlap with the midden model and a lack of confidence due to the very small number of recorded lithic sites. The midden model incorporates shell middens and lithics. The midden model is also limited to the 3 km coastal and 1 km main riverine zones. Again, undoubtedly unrecorded habitation sites must occur outside this zone, but there is no compelling argument for predicting their locations using presently available mapped data.

Table 4 shows the midden model to be performing very well against known sites, with 90% of known shell midden sites captured in the combined high and moderate potential classes. Note that sites as polygons are more likely to intersect higher potential areas than are individual points as were taken in the ground truthing.

Of the ground truthing points, only two were rated as high in both the model and ground truthing. Of the ground truth high potential points, 25 had been modelled as moderate potential and 11 were modelled as low potential. The relatively large number of points rated high in the field but modelled as low initially caused a concern that the model was performing poorly. However, checking the GIS showed that almost all of these points are immediately beside cells modelled as moderate or high (Figure 116). So, although the percentage of mismatched points appear to suggest that the midden model is missing a substantial area of high potential, in fact, most of the mismatched points are within a few metres of being 'correct' and therefore within tolerances of the mapping. Two of the points in Figure 116 (the farthest right turquoise point and the farthest north) are far enough away to be considered 'misses'. In both these locations, there was a well-drained level terrace at 10-15 m elevation, which is not evident in the TRIM DEM, and the areas are modelled as relatively steep hillside. In fact most of the minor mismatches also occur in areas where the DEM shows too steep a slope to be included in the model.

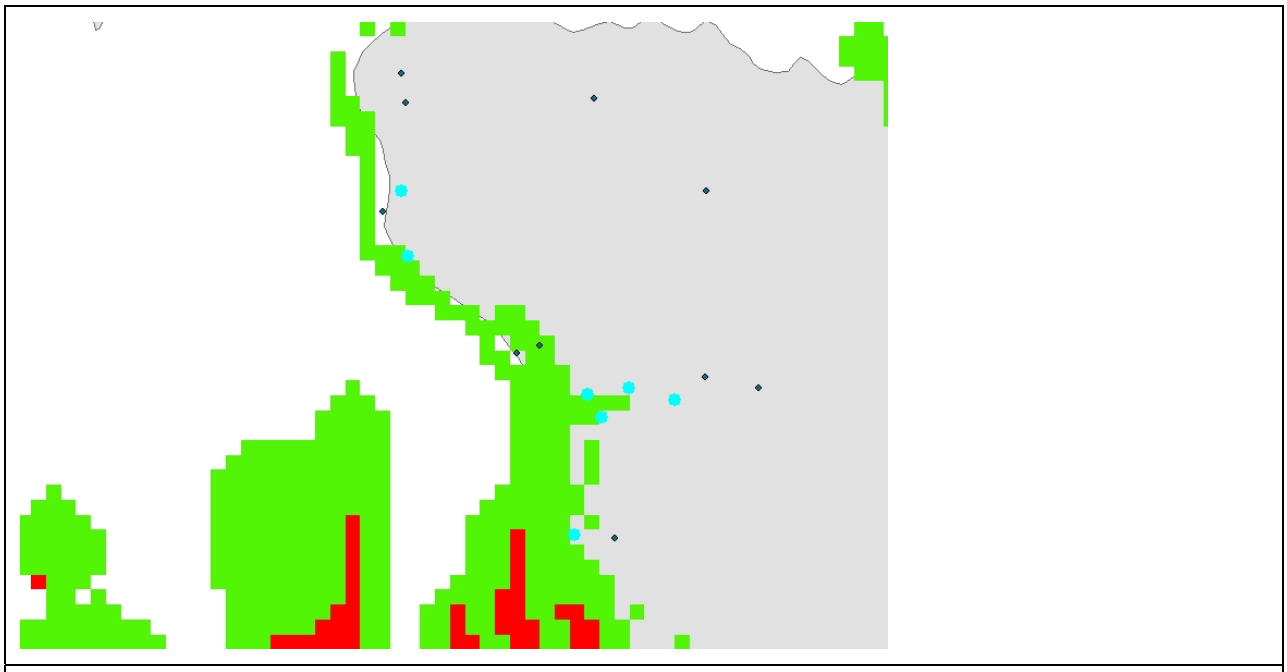


Figure 116. Ground truth points "H" for midden, but modelled "L".

Ground truth points “HL” are turquoise. Note that five of these shown are immediately beside areas modelled as moderate (green). Those less than 1 pixel away from the green are essentially “HM” and do not constitute a significant failing of the model.

Of areas ground truthed as moderate for middens, 20 matched the model and eight had been modelled as low, the latter generally being immediately beside moderate potential. A couple of points fall along steep shorelines where a small bench combined with a pocket beach created moderate potential; again, the DEM is not accurate enough to pick up such features. Another eight were modelled as high. The “MH” difference was not considered significant.

Of the ground truthing locations rated as low for middens, three points were modelled high. These tended to be on places not suitable for regular habitation, but which rated highly for defensive sites (rare locations which were not tracked in the analysis). The defensive site “trench embankment/refuge” model performs well to capture the small sample of known sites (Table 4). Another 20 ground truthing low potential locations were modelled as moderate potential, again tending to be either in intertidal zones or (in a reversal from some of the high ground potential mismatches) where steep slopes were not recognized as such on the DEM. The largest number of all matches, 88, matched low in both the predictive model and ground potential for midden.

The midden model is working very well, considering both the ground truthing results and the performance against known sites. If anything, the ground truthing results suggest that modelled moderate potential is generally rated as high in the field. The poorest performance is in the major river valleys, where active, or recently active fluvial erosion and deposition cannot be distinguished from the slightly raised, more stable landforms where archaeological sites are more likely. Indeed, the DEM in these areas created considerable frustration in these valleys during the fine-tuning phase, as in some areas the DEM correctly identified raised landforms; but

these were outnumbered where it either failed to identify them, or identified areas as raised landforms which were in fact low (including one knife-edged ridge with a stream running along the crest, Figure 117).

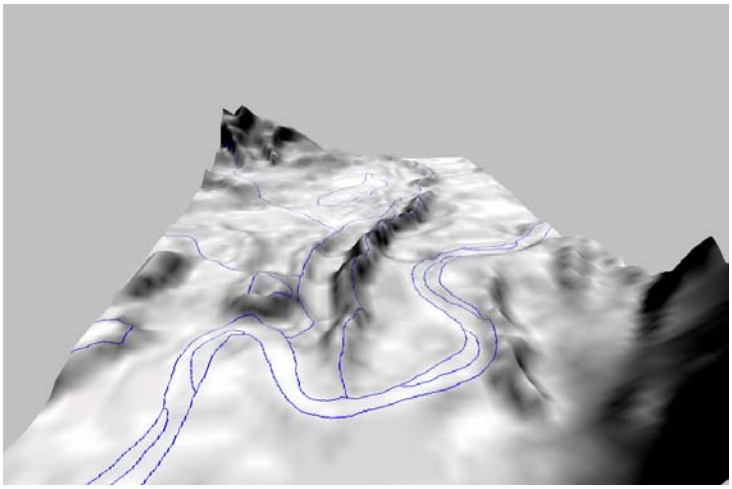


Figure 117. TRIM DEM showing creek running down ridge crest in floodplain (centre). Relief exaggerated 5 times.

Significant improvements in the model could be obtained with a higher resolution DEM and digital shoreline classification mapping.

Trench model

The trench model incorporates both trench embankments and refuge sites. Refuge sites will often have shell midden associated, but the locations will have difficult access or other characteristics that make the midden model poor at capturing them. Refuge sites are rare relative to most other site types, with only seven in the district; because of their rarity no systematic assessment potential for this type points was made during ground truthing. However, two locations noted in the field as being suitable for refuge sites were at locations with high "Trench" model predictions. Table 4 shows that just under half the known refuge sites are captured in this model. An eighth site is also reported to be a refuge site (Engisch, et al. 2004:54, 108) but appears in the provincial inventory typology only as a midden and CMTs. This was discovered too late for inclusion in the database. The model shows no high or moderate potential at this location which is notable for having no canoe landing locations and the closest beach is 900 m away. Again, a more accurate DEM would greatly facilitate modelling for this site type.

Shelter model

The shelter model tries to find very steep locations in association with other features that might be associated with human use. Both human remains buried in rockshelters and rockshelters used as human habitations are modelled for. This model was restricted to areas

within 3 km of the ocean or 1 km from large lakes and major rivers. Rockshelters probably occur outside this zone, especially in subalpine settings; but none are known and there was insufficient knowledge of other attributes to include the model in these areas. The sample of known sites is quite low.

Table 4 shows that the model for rockshelters is performing very well, with 82% of the known sites captured in 0.7% of the land area. However, it was decided to restrict the model to areas of high potential only, which captured 27% of the known sites in only 0.09% of the land. The reasons for this are due to ground truthing and further checking of known site locations.

During ground truthing, five points were assessed as high potential for rockshelters. One of these rated moderate and the remainder low in the model. Except for one feature, where the DEM does not define a bluff, the remainder are all directly adjacent to high potential pixels (four of the points, including the 'moderate' one) and the difference is within mapping and GPS tolerances. So, although the attribute table suggests that ground truthing showed the model to perform poorly, in actuality it performs quite well. The ground truthing found 156 locations to be low potential. The model predicted one of these as high, 26 as moderate and matched the great majority, 129 as low. Ground truthing rated 40 locations as having moderate potential for rockshelters. Of these, 37 were modelled as low, and three as moderate. However, 'moderate' field observation of potential for rockshelters generally meant that steep bluffs occurred where rockshelters might be expected in a general way, but none were seen (in which case it would have rated high in the ground truth log).

During final model assessment, several 'mismatched' known sites occurring in low potential were examined that had not been corrected during the earlier portion of the study. All of the misses were due to mismapping, and all those checked actually appear to occur in high potential.

In conclusion, the ground truthing results and the known site locations suggests that the modelled high potential for rockshelters is accurate, as is the low. The moderate potential class was removed from the final model.

Fish Trap model

The fish trap model is based on 19 recorded sites. The model captures almost 60% of these.

Out of 25 points ground truthed as 'high' potential, 15 are in locations modelled as low. Five of these are adjacent to moderate potential; one is on what is now land but was previously a river channel; and the rest are in estuaries or intertidal zones currently modelled as 'low'. About half of these scored '7' on the model, and the model cutpoint could be moved down by one point to capture these, but other factors suggest that better options are available. Virtually all these locations are classed as 'ocean' in the TRIM data, and the intertidal areas have been modelled by extrapolating the on-shore DEM into what TRIM sees as undifferentiated water. Errors occur where deep water is actually present close to the shoreline (and the potential is actually low but

is modelled high or moderate), and where extensive intertidal flats extend beyond where the model allows (producing the opposite error, and responsible for the ground truthing mismatches).

Ground truthing did show that the extensive areas up the major rivers modelled as having high or moderate potential for fish traps usually were actually low potential. This was principally due to active channelling and river energy that is too high to expect fish traps to survive. In most of the main river channel of the Salmon River upstream of the estuary, fish traps would not survive. However, if built in backchannels or one of the low energy fetches of the rivers, or if the main channel migrated sideways during fish trap use, woodstake fishtraps could survive. Bouchard and Kennedy suggest that upstream sites (meaning either villages or camps with fish traps) are likely on the Salmon River (Wilson et al. 1992:28) and this probably holds for other major salmon rivers.

A very large number of ground truth points (154) matched low potential; obviously, these are mostly in areas away from rivers or shoreline.

A high resolution DEM would likely provide the accuracy and detail necessary to correlate stream slopes with chances of fish trap survival. The current model is also hampered by the lack of shorezone mapping of intertidal areas. In its present form, the fish model should be considered minimal in estuaries or on gravely beaches and adjacent areas of the same landform should be considered to have potential. In upstream areas, the model should be used as a guide, but not relied upon for decision making. In terms of map reading, in upstream areas the river itself can have potential; where the river touches higher potential, the potential model should be taken to continue into the river. The model should be revised to use the newly-available shorezone mapping (see recommendations).

Petroglyph model

The petroglyph model performs quite well against known sites, with over 50% of the sites captured in high and moderate potential, and very high Kvamme's Gain (Table 4).

The petroglyph model did not perform as well in the ground truthing. Four points were recorded as high potential; all were low in the model, with one being adjacent moderate potential. Of 38 moderate potential ground ratings, 29 were modelled low and the remainder matched moderate model potential. Low/Low matches were the majority, at 152. In contrast, the majority of the known sites are captured in the model. This suggests that our field rating of petroglyph potential may have not reflected the actual distribution of these rather unusual sites. They generally occur on sandstone ramps in the study area. No inland petroglyphs are known, although Baseline (Engisch, et al. 2004) reports anecdotal information that petroglyphs occur near the headwaters of some drainages.

Shorezone geological mapping would greatly improve the model.

Pictograph model

Pictographs are generally located on overhanging cliff faces. Table 4 shows that over three-quarters of the 31 known sites are captured in the model. Seven ground truth points were assessed as high potential. These had all been modelled as low potential, but all except two are adjacent to moderate or high potential pixels. One was a field recording error (it should have been classified as low and would have then matched the model). One high potential ground truth site, a cliff above the Salmon River, was missed by the model. In summary, the pictograph model performs well. Again, a better DEM and shorezone mapping would further improve the model.

Model limitations

There are a few limitations to the current draft of the model, primarily due to the availability of data. The forest inventory data is not complete for the entire study area, so the CMT model, which is heavily based on this data, is not as accurate as it could be in places. Approximately 15 of the recorded CMT sites are located in areas which have no Forest Inventory data. Shoreline type and bathymetric data would likely be very useful in improving the model for intertidal site types.

Significant improvements in all the models could be obtained with a higher resolution DEM, while digital shoreline classification mapping and detailed bathymetry would help with many. Digital elevation models allow modelling for specific landforms, but there is a great deal of difference in the quality of DEMs. The following gives a graphic example of the differences expected. Figure 118 shows a view using TRIM's DEM; Figure 119 shows the same area (in southern Vancouver Island) viewed with LiDAR data. In the left view, the TRIM shows the general trend of the landscape and the largest features can be made out; but in the right view, the detail is so much clearer both for the overall landscape and details within it. The differences are similar to the view experienced by a very shortsighted person putting on prescription glasses. The terrain modelling component of the present study has been done using the equivalent of the left DEM; we could do much better using the DEM on the right. Consider, for example, the likely comparative success for modelling terrain features like very steep bluffs with rockshelter potential at their base.

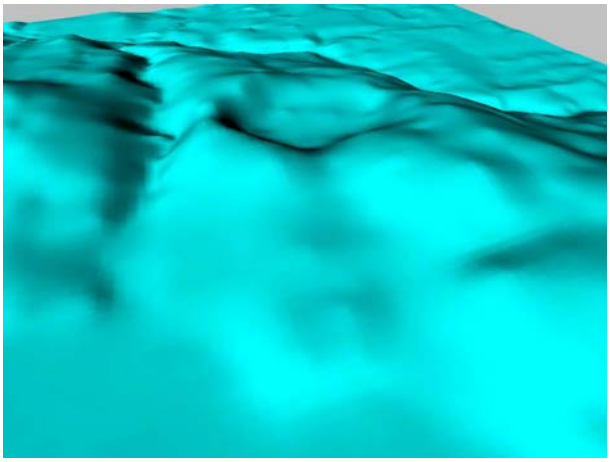


Figure 118. Small lake and nearby terrain; three-dimensional view of TRIM DEM.

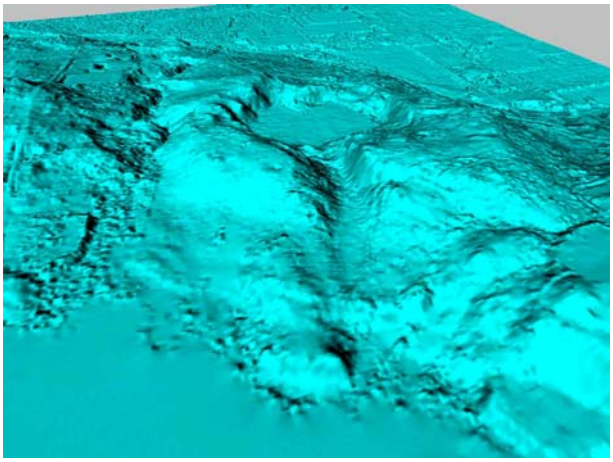


Figure 119. Same area viewed at same scale using LiDAR DEM.

LiDAR is not the only source of better quality DEMs. Figure 120 and Figure 121 show the difference between TRIM DEM and a DEM obtained using the same technology as TRIM, but with higher accuracy and precision. While not quite as detailed as LiDAR, it is still quite good at showing small terrain features that are invisible in TRIM and which are important for creating an accurate archaeological potential model.

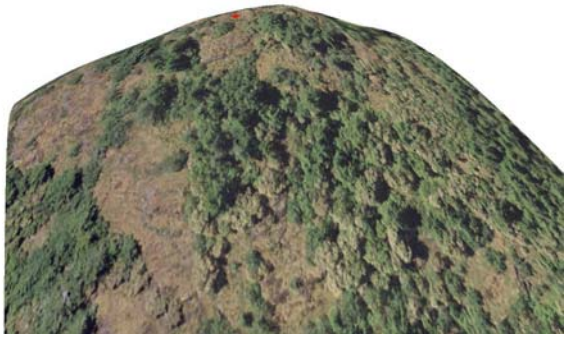


Figure 120. Colour orthophoto draped over TRIM DEM.

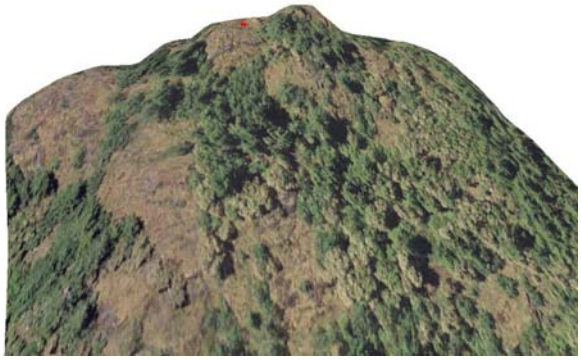


Figure 121. Colour orthophoto draped over custom air-photo stereo pair DEM.

Geological and biological shorezone classification mapping has been conducted along some 35,000 km of the province's shorelines (e.g., Harper, et al. 2005); however, the availability of this mapping in digital format is still limited. Coincidentally, in the last few weeks of the project, digital versions became available for the entire study area (John Harper, Coastal and

Ocean Resources Inc. 2007, personal communication). All the models along the shoreline could be improved by having this data layer and some, like fishtrap modelling, could be greatly improved.

No ground truthing was able to be completed in areas of high elevation, where yellow cedar is often found, due to deep snow cover. As noted above, yellow cedar was particularly valuable and in other parts of coastal BC, stands of yellow cedar with reasonably easy access from the coast were often heavily stripped. Only five of the previously recorded CMT sites recorded in the present study area have yellow cedar in the forest inventory data. One of these, EdSh-3, is noted as having 22 stripped yellow cedar, and the forest inventory shows 54% of the trees here are yellow cedar. EcSm-11, 20 and EcSn-5 are essentially coastal and have only 3%, 6% and 9% yellow cedar respectively. No mention of yellow cedar is found in the archaeological site records for these three sites. Another site, EdSm-16, has no specific mention of yellow cedar in the site form but hundreds of CMTs were noted during a brief reconnaissance in a more inland area mapped as 20% yellow cedar. It seems likely that stripped yellow cedar are present. Added to these are the nearly 100% bark-stripping of yellow cedar trees along a ridge at EcSp-18 and 19, recorded in 1988 but added to the database during this project. The sites with a higher percentage of yellow cedar, EdSh-3, EdSm-16, and EcSp-18 and 19 suggest, in combination with information from nearby Forest Districts, that there may be a substantial data gap with perhaps many more stripped yellow cedar than are presently recorded. If this is so, then there is a subsequent question regarding how far inland they can be expected. One survey of high elevation, inland yellow cedar at Mt. Washington found no CMTs (Eldridge 1991a). The Baseline inventory (Engisch, et al. 2004) included several lakes at 400 to 700 m elevation and 7 km or more from the coast; although yellow cedar was present at several, no CMTs were found in any of these locations. These observations of both positive and negative findings suggest that the 3 km/1 km cutoff for CMTs is close to accurate.

Summary

Seven predictive models were created for the Campbell River Forest District East portion. These include CMTs, Shell Midden/Habitation, Fish Trap, Pictograph, Petroglyph, and Trench Embankment/Refuge. The models were created after extensive analysis of site type correlation with known sites, and building models using tools to measure model efficiency. In addition to many variables typically used in model building, several innovative variables were also used. These include the use of custom terrain modelling features, a measure of shoreline crenellation, and a measure of fetch from prevailing storm winds. The models are performing probably as well as can be obtained with present data, although new knowledge of site locations, especially in inland areas, would require some changes.

As part of the ground-truthing, site locations were corrected for about one-quarter of the sites in the eastern district. However, it was found that another quarter of the sites were too poorly recorded to be sure of even their location. Additional recorded sites missing from the provincial inventory came to light during this process that resulted in 19 new CMT sites added to the provincial registry.

Ground truthing visited a number of diverse locations, recording over two hundred ground truthing points and recorded 21 new archaeological sites and revisited three previously recorded ones. The new sites included CMTs, shell middens, a rockshelter burial, an historic graveyard, a fish weir, an intertidal lithic, clam gardens, and intertidal rock features.

Recommendations

All models could be substantially improved by a more accurate and precise digital elevation model than that provided in TRIM. If better sources become available, they should be incorporated in the model, even if this is piecemeal.

Shorezone mapping would greatly improve the site models for those sites that concentrate along the coastline. Digital shorezone mapping for this area has very recently become available and should be incorporated in a fine tuning of these models.

The distribution of yellow cedar CMTs should be investigated with ground truthing or preliminary field reconnaissance of stands with a high (>20%) content of yellow cedar. The stands should be distributed both within the present CMT model limits (3 km of coastlines and 1 km from double-line rivers and lakes larger than 200 ha) and a moderate distance further inland.

The large rivers inland of the coast and large lakes over 100 ha have had little archaeological investigation to date. This present study and the Baseline 2004 study examined small amounts of such areas, but overall these still retain potential. Examination of road-cuts along major river systems, as undertaken in this study in a small way, should be expanded as a quick way of examining large areas.

Several First Nations expressed interest in attending a training workshop on using the models in GIS or Google Earth format. This had been proposed for a second stage of the project, to occur in the new fiscal year.

For most models, including areas with 'old growth model' CMT potential areas with moderate to high potential should be at a minimum reviewed by an archaeologist. PFR or AIA followup is expected to be appropriate for most such areas.

For areas with low potential for other models, but moderate or high potential in the "Veteran CMT" model, detailed cruise plot or other means by forestry professionals should be used to determine if veteran or snag western redcedar or yellow cedar are present in the development area. If all snags are heavily burnt, potential should be considered low and an archaeologist is not needed to consider the need for further work unless there is a determination that there is indeed veteran cedar or dead cedar snags with little fire scarring. Large cedar stumps lacking springboard notches (and not felled with chainsaws) should also be considered to indicate archaeological potential. The Veteran CMT model is considered to be more of a 'checklist' than a guide to where field assessment is likely required. However, the potential should neither be discounted too readily, for a significant portion of the CMTs found during this study were found in areas modelled by the Veteran CMT model.

In use, the midden model should be considered somewhat conservative along marine shorelines (with moderate potential often meaning high potential), and the size of polygons of higher potential can be expected to be slightly enlarged, so areas bordering high or moderate potential on shorelines should also be considered to be potentially high. Most of such areas are included in the higher potential categories of other models in any case. In river valleys, office review using more detailed elevation mapping would be appropriate prior to conducting archaeological field work. Even low areas in fluvially active locations cannot be written off entirely, as the location of the historic village of Hkusam at the mouth of the Salmon River reveals, along with early historic mapping showing another "Indian House" across the channel from Hkusam, on low estuarine flats. However, the chances for preservation of such sites are low especially upriver, where channel meanders will tend to destroy such sites over the long term. The same holds for fish traps. So, unless there is historical or traditional use evidence for a habitation, relatively low locations in the flood plain should be considered low potential.

The areas investigated by this study where nothing was found (particularly shorelines) cannot be considered thoroughly inventoried.

The 25% of previously recorded sites that are too poorly recorded to be confidently mapped are a real problem for the long-term management of archaeological sites in the district. Part of this problem is the confusion over rock art sites recorded during the 1930s to 1970s; it seems that the same site often has two or more site locations with Borden Numbers, and notes on all regarding the confusion and inability of brief revisits to clarify the situation. A series of inventories concentrating on shorelines is recommended to improve the quality of the registered inventory and find a great many previously undiscovered sites.

It was clear from the amount of recent development in the area, some of it obviously having impacted archaeological sites, and comparing this to the archaeological inventory attribute data, that archaeological impact assessments are often not being required of non-forestry coastal developments in the area. It is recommended that the Archaeology Branch approach local government to incorporate archaeological resource management with development and building permit systems. An initiative to do this has been started by the Archaeology Branch this year (D. Glaum, personal communication 2007).

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Appendix A

Significant factors used to build models

*Each factor counts for 1 point in the model, unless otherwise noted, or where marked with a * (a point was subtracted from the model for these values)*

	Midden	CMT	Pictograph	Petroglyph	Fish	Trench	HR - Shelter
Coast (metres)	100	700	100	100	100	100, *>100	100
Coastline straightness (low # = straighter)	*60, >140-160	80		80	*60, >120-140	*60, >140-160	*60, 80
Chinook				300	200		
Chum	200			400	200		
Coho	400			300	200		
Cutthroat					200		
Pink	100			400	200		
Sockeye				300	200		
Steelhead		200		300	200		
NonClassified Lakes		*200					
L3 Lakes		200					
L2 Lakes							
L1 Lakes		100			100		
L1 Lakes over 200Ha	100 (= 2 pts)						100 (= 2 pts)
Fish Lakes (FISS)	100						
S5-S6 Streams			*100	*200	*300		
S2-S4 Streams				*100			*100
S1-S4 Streams			*200				*400
S1 Streams	100			200	100		
DblLine Rivers	100						
Clam beds	100			100	100		
Wetlands					*300		
Maximum Fetch (of N, NNE, NE, ENE, E, ESE, SE, SSE)	2000				2000		
DEM Data							
Negative 25	<-400	-400->-600	*<-200, -600--800	<-400	-<600	-100->-300	<-400
Range 25 by 1 (max)	<50	*<10, 100-200	<100	10-<20	20-<30	20-<60	<200
Range 9 by 9	<20	*<10, 10-100	*<50, 50-100	<30	10-<20	<40	
Aspect (degrees)	*330-<30, 150-<210	0-<60	120-<150	*<30, 30-<60, 150-<210	*<30, 270-<300		210-<240
Elevation	<20	<400	<30	<20	<30	<30	<100
Positive 9 by 9	<600	<300	<300	<600	<600	200-<800	*<300, 2100-2400
Positive 25 by 1 (max)	<200	<1000	<500	<200	<200	<200	
Positive count 9 by 9	<10 (this value removed from model within 700m of a double line river)	<10, *10-<60	<10		<20	60-<80	50-<60, 70-<80
Slope	<20	<30	*<20, 20-40	<15	<20	<15	*<10, 10-<20
Shore slope for intertidal sites				<10	<10		
Forest Inventory Data*							
Site Index		37-38, 21-22	13-14				
Forest Age Class		26-28					
Forest Volume Class		16, 20, *8					
Species 1		5,6					
Species 2		5					
Species 3		7,13					
Combinations							
Coast and S1 Streams	*>200						*>200
Coast and S1 Streams and L1 Lakes			*>100				
Coast and Double-line rivers					*>100		
Positive count 9 by 9 (where range 9 by 9 <= 20 and slope <= 20)	>50 (this factor added only within 700m of double line rivers)						
Notes	1	2	3	4		5	6

(1) Islands of 0.3 Ha or less were removed from model

(2) Models were limited to 3km from the coast, OR 1km from a double line river, OR 1km from a large (L1) lake. Within biogeoclimatic zones CWH xm1 and xm2, the following was added into the Old Growth and Veteran CMT model: Definite and indefinite (excluding double line) rivers buffered to 25m and limited to areas with a positive count <= 60, OR where the positive count was <= 15. For the Vet model (without inventory data), the OR statement with the positive count <= 15 was excluded.

(3) Model limited to areas within 100m of lakes or 100m of the coast

(4) Model limited to areas wihtin 1000m of the coast

(5) Islands of 0.2 Ha or less were removed from model

(6) Limit to high potential

***Forest Inventory Data Classification Systems**

Species Codes		
CLASS	**CODE**	**NAME**
1	AC	Balsam poplar/black cottonwood
2	B	Balsam
3	BA	Amabilis fir
4	BG	Grand fir
5	CW	Western red cedar
6	DR	Red alder
7	FD	Douglas fir
8	H	Hemlock
9	HM	Mountain hemlock
10	HW	Western hemlock
11	MB	Broadleaved maple
12	PL	Lodgepole pine
13	S	Spruce
14	SS	Sitka spruce
15	YC	Yellow cedar (cypress)
16	PW	Western white pine
17	BL	Alpine fir
18	E	Birch
19	VB	Bitter cherry
20	AT	Aspen
21	EP	Common paper birch
22	LW	Western larch
23	T	Yew
24	TW	Western yew
25	PY	Yellow pine
26	SE	Englemann spruce

Age Class		
From (years)	**To (years)**	**Class**
0	0	0
1	5	1
6	10	2
11	15	3
16	20	4
21	30	5
31	40	6
41	50	7
51	60	8
61	70	9
71	80	10
81	90	11
91	100	12
101	110	13
111	120	14
121	130	15
131	140	16
141	150	17
151	160	18
161	170	19
171	180	20
181	190	21
191	200	22
201	210	23
211	220	24
221	230	25
231	240	26
241	250	27
251	12000	28

Volume Class		
From (cubic meters)	**To (cubic meters)**	**Class**
0	0	0
1	50	1
51	100	2
101	150	3
151	200	4
201	250	5
251	300	6
301	350	7
351	400	8
401	450	9
451	500	10
501	550	11
551	600	12
601	650	13
651	700	14
701	750	15
751	800	16
801	850	17
851	900	18
901	950	19
951	1000	20
1001	1050	21
1051	1100	22
1101	1150	23
1151	1200	24
1201	1250	25
1251	1300	26
1301	1350	27
1351	1400	28
1401	1450	29
1451	15000	30

Site Index

Site index classes are the height in meters that the trees on a site will reach by the time they are 50 years old. The 45m class includes all heights greater than and equal to 45m. Site index is an indicator of the productivity (fertility) of the land (soil / site / moisture).

Appendix D

Ground truthing points and assessment of potential

ID	COMMENTS	NEAR RIVER	NEAR OCEAN	LOCAL TOPOGRAPHY	MAJOR TOPOGRAPHY	CLIFFS	STABILITY	HISTORIC DISTURBANCE	OLD GROWTH	OLD CEDAR	CMT POTENTIAL	FISH TRAP	MIDDEN	ROCK SHELTER	PICTOGRAPH	PETROGLYPH	CMT MODEL	FISH MODEL	MIDDEN MODEL	PETRO MODEL	PICTO MODEL	SHELTER MODEL	TRENCH MODEL	CMT MATCH	MIDDEN MATCH	SHELTER MATCH	PETRO MATCH	PICTO MATCH	FISH MATCH
Confluence of Salmon River and White River																													
1	stable terrace above river near modern residence	h	m	h	h	l	m	m	l	l	l	l	m	l	l	l	5	6	9	0	0	2	4	LL	MM	LL	LL	LL	LL
2	featureless low spot, flood plain	h	m	l	h	l	l	l	l	l	l	m	m	l	l	l	8	5	8	0	0	2	4	HL	MM	LL	LL	LL	LM
3	steep cliff into river	h	m	h	h	h	h	h	l	l	l	l	l	m	h	l	0	7	5	0	0	4	3	LL	LL	LM	LL	LH	LL
4	low river bank (much lower than opposite side of river)		m					m	l	l		m	l				7	9	12	0	0	3	6	ML	HL	L	L	L	MM
5	narrow causeway between highpoints on oxbow, high potential for older sites on terrace edges	h	m	h	h	l	m	m	l	l	l	l	h	l	l	l	8	10	11	0	0	1	4	HM	HH	LL	LL	LL	ML
6	narrow causeway between highpoints on oxbow, high potential for older sites on terrace edges	h	m	h	h	l	m	m	l	l	l	l	h	l	l	l	8	9	12	0	0	1	4	HL	HH	LL	LL	LL	ML
7	deep silt & clay in river cutbank, red soil at top, high terrace this side of river low opp side	h	m	h	h	l	m	m	l	l	l	l	m	l	l	l	7	9	12	0	0	2	6	ML	HM	LL	LL	LL	ML
8	old growth D-f cedar in creek but smaller younger than D-f, occas totally burnt c snags	h	m	h	h	l	h	h	h	m	m	l	l	l	l	l	1006	-2	0	0	0	2	0	LM	LL	LL	LL	LL	LL
9	old growth D-f cedar in creek but smaller younger than D-f, occas totally burnt c snags	h	m	h	h	l	h	h	h	m	m	l	l	l	l	l	1009	-1	2	0	0	-2	2	HM	LL	LL	LL	LL	LL
10	old growth D-f cedar in creek but smaller younger than D-f, occas totally burnt c snags	h	m	h	h	l	h	h	h	m	m	l	l	l	l	l	1009	-1	2	0	0	1	2	HM	LL	LL	LL	LL	LL
11	old growth D-f cedar absent	h	m	h	h	l	h	h	h	l	l	l	l	l	l	l	1008	0	3	0	0	1	2	ML	LL	LL	LL	LL	LL
12	second growth regen, but easier ground than near river	h	m	h	h	l	h	l	l	l	l	l	l	l	l	l	106	0	3	0	0	2	2	LL	LL	LL	LL	LL	LL
13	second growth, steep bluffs	h	m	l	h	h	h	l	l	l	l	l	l	m	l	l	106	3	5	0	0	5	1	LL	LL	MM	LL	LL	LL
Boughey Bay																													
14	steep slope with OG, no visible BST observed from boat	l	h	l	l	h	m	h	h	h	h	l	l	m	l	m	1009	3	5	7	6	5	4	HH	LL	MM	LM	ML	LL
15	steep slope with OG, no visible BST observed from boat	l	h	l	l	h	m	h	h	h	h	l	l	m	l	m	1009	2	5	5	6	4	4	HH	LL	LM	LM	ML	LL
16	steep slope with OG, no visible BST observed from boat	l	h	l	l	h	m	h	h	h	h	l	l	m	l	m	10	2	7	6	3	5	4	HH	ML	MM	LM	LL	LL
17	previously logged 2nd growth, moderate to steep slope near small drainage	l	h	m	l	m	l	m	l	l	l	l	l	m	m	m	109	3	5	5	6	4	3	HL	LL	LM	LM	MM	LL
18	previously logged 2nd growth, moderate to steep slope near small drainage	l	h	m	l	m	l	m	l	l	l	l	l	m	m	m	109	1	5	5	6	4	3	HL	LL	LM	LM	MM	LL
19	2nd growth, regen near road, vet springboard stumps	l	h	m	m	l	m	l	l	l	m	l	l	l	l	l	105	-1	2	3	0	2	3	LM	LL	LL	LL	LL	LL
20	vet springboard stumps near old logging road, heavy canopy cover	l	h	m	m	l	m	l	l	l	m	l	l	l	l	l	105	0	2	3	0	1	4	LM	LL	LL	LL	LL	LL
21	intertidal high fish trap potetial	h	h	h	h	l	m	m	l	l	l	h	l	l	l	m	0	0	0	0	0	0	0	LL	LL	LL	LM	LL	LH
22	regen in old road, no potential	l	h	m	m	l	l	l	l	l	l	l	l	l		l	105	-1	2	2	0	1	4	LL	LL	LL	LL	L	LL
23	vet springboard stumps along slow moving creek, gently sloping area	m	h	m	m	l	m	l	l	l	m	l	l	l	l	l	105	0	3	3	0	1	5	LM	LL	LL	LL	LL	LL
24	north end of midden deposits, disturbed bulldozed?	h	h	h	h	l	h	m	l	l	m	l	h	l	m	m	8	2	7	7	5	5	4	HM	MH	ML	LM	LM	LL
25	auger test, 5-30cm black silty loam with abundant shell exposed to 30 cm, appears intact	h	h	h	h	l	h	m	l	l	l	l	h	l	l	l	8	3	4	5	5	5	2	HL	LH	ML	LL	LL	LL
26	auger test, 5-20 cm, black greasy silt w/charcoal, water saturated	h	h	h	h	l	h	m	l	l	l	m	h	l	l	l	7	2	7	8	5	5	4	ML	MH	ML	LL	LL	LM
27	abandoned trucks & historic debris, gravel road constr likely disturbed localized site evidence	h	h	h	h	l	h	l	l	l	l	l	h	l	l	l	0	8	8	0	0	0	0	LL	MH	LL	LL	LL	ML
28	south end of site as determined from beach	h	h	m	h	l	m	m	l	l	l	h	h	l	l	h	0	9	8	0	0	0	0	LL	MH	LL	LH	LL	MH
29	oldgrowth cedar on slope, BST CMT observed on 25m C	l	h	m	m	l	h	l	h	h	m	l	l	l	l	l	106	1	3	6	0	-1	5	LM	LL	LL	LL	LL	LL
30	auger test, 5-25cm black greasy silty loam with abundant shell just north of creek drainage	h	h	h	h	l	h	m	l	l	l	m	h	l	l	l	9	9	9	9	3	6	4	HL	MH	ML	ML	LL	MM
31	auger test, dark black sitlty loam with trace shell, south end of site deposits	h	h	h	h	l	h	m	l	l	l	h	h	l	l	m	9	9	10	9	3	4	4	HL	MH	LL	MM	LL	MH
32	intertidal river cutbank, lots of historic garbage	h	h	h	h	l	m	m	l	l	l	h	h	l	l	m	9	7	9	9	3	3	4	HL	MH	LL	MM	LL	LH
33	boggy area with possible wet site potential, also may have been cleared for pasture/orchard?	h	h	h	h	l	m	l	l	l	l	m	h	l	l		9	7	10	9	3	4	4	HL	MH	LL	M	LL	LM
34	vet springboard stumps surrounding Aboriginally logged stump	m	h	m	m	l	m	l	l	l	m	l	l	l	l	l	106	2	3	4	0	-2	4	LM	LL	LL	LL	LL	LL
35	clearcut southfacing slope	l	h	l	l	l	l	l	l	l	l	l	l	l	l	l	108	2	3	2	0	0	2	ML	LL	LL	LL	LL	LL
36	relatively steep slope with bedrock outcrops, lots of slash and burned out cedars	l	h	m	m	m	l	l	l	m	m	l	l	m	l	l	106	2	3	4	0	-2	3	LM	LL	LM	LL	LL	LL
37	BST CMT (alive)	l	h	m	m	l	h	h	h	h	h	l	l	l	l	l	106	0	1	2	0	0	4	LH	LL	LL	LL	LL	LL
38	BST CMT snag	l	h	m	m	l	l	h	h	h	h	l	l	l	l	l	106	0	1	2	0	0	4	LH	LL	LL	LL	LL	LL
39	BST CMT snag w/ nice scarcrust	l	h	m	m	l	h	h	h	h	h	l	l	l	l	l	106	0	1	2	0	0	4	LH	LL	LL	LL	LL	LL
40	2nd growth with old springboard stumps	m	h	m	m	m	m	m	l	l	m	l	l	l	l	l	107	1	3	4	0	0	3	MM	LL	LL	LL	LL	LL
41	old commercial logging by stream	m	h	m	m	l	l	l	l	l	m	l	l	l	l	l	107	2	2	2	0	1	2	MM	LL	LL	LL	LL	LL
42	BST snag halfway down slope, old commercial logging by stream just below	m	h	m	m	l	m	m	m	m	m	l	l	m	l	l	107	1	1	1	0	1	1	MM	LL	LM	LL	LL	LL
43	sloping ridge with some commerical logging with burnt out vet cedars	l	h	m	m	l	m	m	l	m	m	l	l	l	l	l	107	0	0	0	0	1	1	MM	LL	LL	LL	LL	LL
44	ridgetop some CY, none stripped but some Redcedar stripped	l	h	m	m	m	h	h	h	h	h	l	l	l	l	l	1009	0	0	1	0	-1	2	HH	LL	LL	LL	LL	LL
45	WP 59, BST CMT cedar snag, burned out C common	l	h	m	m	l	h	h	h	h	h	l	l	m	l	l	1009	-1	1	0	0	-1	2	HH	LL	LM	LL	LL	LL
46	strip of OG, burnt, early commerical logging below	l	h	m	m	l	m	m	m	m	m	l	l	l	l	l	105	1	1	2	0	1	2	LM	LL	LL	LL	LL	LL
47	BST CMT 1 strip	l	h	m	m	l	h	h	h	h	h	l	l	l	l	l	1008	-1	0	0	0	1	1	MH	LL	LL	LL	LL	LL
48	BST CMT w 2 strips in OG patch some early commercial logging, some old burned out vet C	l	h	m	m	l	m	h	m	m	h	l	l	l	l	l	1008	-2	0	0	0	1	2	MH	LL	LL	LL	LL	LL
49	BST CMT C 4 strips	l	h	m	m	l	h	h	h	h	h	l	l	l	l	l	1007	-1	0	0	0	0	1	MH	LL	LL	LL	LL	LL
50	fringe of OG	l	h	m	m	l	m	m	m	m	m	l	l	l	l	l	105	0	1	0	0	1	2	LM	LL	LL	LL	LL	LL
51	BST probable strip on downhill, snag	l		m	m	l					m		l				105	0	1	0	0	1	2	LM	LL	L	L	L	L
52	recently clearcut	l	h	m	m	l	l	l	l	l	l	l	l	l	l	l	105	0	1	0	0	1	2	LL	LL	LL	LL	LL	LL

ID	COMMENTS	NEAR RIVER	NEAR OCEAN	LOCAL TOPOGRAPHY	MAJOR TOPOGRAPHY	CLIFFS	STABILITY	HISTORIC DISTURBANCE	OLD GROWTH	OLD CEDAR	CMT POTENTIAL	FISH TRAP	MIDDEN	ROCK SHELTER	PICTOGRAPH	PETROGLYPH	CMT MODEL	FISH MODEL	MIDDEN MODEL	PETRO MODEL	PICTO MODEL	SHELTER MODEL	TRENCH MODEL	CMT MATCH	MIDDEN MATCH	SHELTER MATCH	PETRO MATCH	PICTO MATCH	FISH MATCH
East of Naka Creek																													
53	All hemlock-balsam and D.Fir in previously logged flat	l	h	h	h	l	h	m	l	l	m	l	l	l	l	l	103	0	1	4	0	-2	2	LM	LL	LL	LL	LL	LL
54	scarred cedar possible CMTs not recorded	l	l	m	m	l	h	h	h	h	h	l	l	l	l	l	101	-1	-1	0	0	1	0	LH	LL	LL	LL	LL	LL
55	exposed rocky bluff, open and exposed, few trees, much different than upslope	l	h	l	m	m	h	h	h	l	m	l	l	m	l	l	107	0	-1	2	0	-1	2	MM	LL	LM	LL	LL	LL
56	CMT, BST on bench with slow moving stream	l	h	h	h	l	h	h	h	h	h	l	l	l	l	l	1008	0	0	2	0	-2	2	MH	LL	LL	LL	LL	LL
57	massive OG C near stream at base of bluff, fewer visible BST	l	h	h	h	m	h	h	h	h	h	l	l	m	m	m	1009	-3	-1	2	0	-1	1	HH	LL	LM	LM	LM	LL
58	exposed rocky bluff, open and exposed, few trees, much different than upslope	l	h	l	m	m	h	h	h	l	m	l	l	m	l	l	108	0	-1	1	0	-1	2	MM	LL	LM	LL	LL	LL
59	dense C BST CMT's on small bench below bluff,	l	h	h	h	m	h	h	h	h	h	l	l	m	m	m	1009	0	0	3	0	0	2	HH	LL	LM	LM	LM	LL
60	massive OG C near stream at base of bluff, fewer visible BST	l	h	h	h	m	h	h	h	h	h	l	l	m	m	m	1009	-2	-2	1	0	-1	1	HH	LL	LM	LM	LM	LL
61	OG with more hemlock, BST C still common	l	h	h	h	l	h	h	h	h	h	l	l	l	l	l	1009	0	0	3	0	0	2	HH	LL	LL	LL	LL	LL
62	Dense BST CMTs C	l	h	h	h	l	h	h	h	h	h	l	l	l	l	l	1010	-2	-1	0	0	0	1	HH	LL	LL	LL	LL	LL
63	Dense BST CMTs C	l	h	h	h	l	h	h	h	h	h	l	l	l	l	l	1010	-2	-1	0	0	0	1	HH	LL	LL	LL	LL	LL
64	dense BST CMT's	m	h	h	h	m	h	h	h	h	h	l	l	m	l	l	108	-3	-1	0	0	0	1	MH	LL	LM	LL	LL	LL
65	massive gunbarrel C around creek	m	h	h	h	m	h	h	h	h	h	l	l	m	l	l	107	-2	-1	1	0	-1	1	MH	LL	LM	LL	LL	LL
66	massive gunbarrel C around creek	m	h	h	h	m	h	h	h	h	h	l	l	m	l	l	107	-2	-1	0	0	0	0	MH	LL	LM	LL	LL	LL
67	massive gunbarrel C around creek	m	h	h	h	m	h	h	h	h	h	l	l	m	l	l	108	-1	-1	0	0	0	1	MH	LL	LM	LL	LL	LL
68	isolated large C stump springboard notched maybe AL but not recorded, presumed commercial	m	h	h	h	m	h	h	h	h	h	l	l	l	l	l	1009	-3	-1	1	0	-1	1	HH	LL	LL	LL	LL	LL
69	hemlock common, narrow flat bench, clearcut below	m	h	m	m	m	m	h	m	m	h	l	l	m	m	l	1010	0	0	3	0	0	0	HH	LL	LM	LL	LM	LL
70	hemlock common, narrow flat bench, clearcut below	m	h	m	m	m	m	h	m	m	h	l	l	m	m	l	1009	2	0	2	0	-1	0	HH	LL	LM	LL	LM	LL
71	unrecorded BST, single strip, unrecorded	m	h	m	m	m	h	h	h	h	h	l	l	l	l	l	1009	0	0	3	0	-1	0	HH	LL	LL	LL	LL	LL
72	unrecorded BST, C	m	h	m	m	m	h	h	h	h	h	l	l	l	l	l	1009	0	0	3	0	-1	0	HH	LL	LL	LL	LL	LL
73	old growth C, dense BS to creek and down slope	m	h	m	m	m	h	h	h	h	h	l	l	m	l	l	1009	-2	0	3	0	-1	0	HH	LL	LM	LL	LL	LL
74	MR 20 BST x2	m	h	m	m	m	h	h	h	h	h	l	l	m	l	l	1009	0	0	3	0	-1	0	HH	LL	LM	LL	LL	LL
75	hemlock common, narrow flat bench, clearcut below	m	h	m	m	m	m	h	m	m	h	l	l	m	m	l	1009	1	0	2	0	-1	0	HH	LL	LM	LL	LM	LL
76	MR 21 BST C 40 deg slope	m	h	m	m	m	m	h	h	h	h	l	l	l	l	l	1009	-2	0	3	0	-1	0	HH	LL	LL	LL	LL	LL
77	MR 22 aboriginally logged barber stump, large cedar no discernable toolmarks	m	h	m	m	m	h	h	h	h	h	l	l	l	l	l	1008	0	0	2	0	-1	0	MH	LL	LL	LL	LL	LL
78	hemlock common, narrow flat bench, clearcut below	m	h	m	m	m	m	h	m	m	h	l	l	m	m	l	1008	0	0	2	0	-1	0	MH	LL	LM	LL	LM	LL
79	on plateau past bluff edge, OG Cedar along dry ridgetop	l	l	l	l	m	h	l	h	h	h	l	l	l	l	l	1009	1	1	4	0	0	3	HH	LL	LL	LL	LL	LL
80	exposed dry ridgetop, Sml OG Cedar no visible CMT's BS	l	l	m	m	m	m	l	h	h	m	l	l	l	l	l	1010	-1	0	2	0	0	3	HM	LL	LL	LL	LL	LL
81	OG w/ cedar BST x2 right beside road	m	h	m	m	l	m	h	h	h	h	l	l	l	l	l	1009	1	1	4	0	0	3	HH	LL	LL	LL	LL	LL
82	MR 19, C BST CMT 40 deg slope	l	l	m	m	l	h	h	h	h	h	l	l	l	l	l	1010	1	0	3	0	-1	2	HH	LL	LL	LL	LL	LL
83	MR 17 OG C BST CMT 2 strips from NE and S side	l		m	m	m					h		l				1010	1	0	3	0	-1	2	HH	LL	L	L	L	L
84	MR 18 OG C BST CMT 2 strips from NW and SE side	l	l	m	m	l	h	h	h	h	h	l	l	l	l	l	1010	1	0	3	0	-1	2	HH	LL	LL	LL	LL	LL
85	dense BST CMT's three recorded in this area, found along both sides of short draw	l	l	m	m	m	h	h	h	h	h	l	l	l	l	l	1009	1	0	3	0	0	2	HH	LL	LL	LL	LL	LL
86	dense CMTs till bluff above road	l	l	m	m	m	h	h	h	h	h	l	l	m	l	l	1009	1	0	3	0	0	2	HH	LL	LM	LL	LL	LL
Hemming Bay																													
87	exposed cliff faces with moderate rockart potential, moss covered and not vertical	l	h	l	m	h	h	l	m	l	l	l	l	m	m	m	11	2	7	5	4	3	2	HL	ML	LM	LM	LM	LL
88	exposed cliff faces with moderate rockart potential, moss covered and not vertical	l	h	l	m	h	h	l	m	l	l	l	l	m	m	m	11	2	7	5	4	3	2	HL	ML	LM	LM	LM	LL
89	overhanging cliff face with high potential	l	h	h	h	h	h	l	l	l	l	l	l	m	h	h	0	3	6	6	4	4	3	LL	LL	LM	LH	LH	LL
90	exposed cliffs with moss, lowmoderate rock art potential/survivability	l	h	l	m	m	h	l	l	l	l	l	l	m	m	m	11	2	7	6	4	4	2	HL	ML	LM	LM	LM	LL
91	midden deposits on flat bench near modern dock	h	h	h	h	l	h	m	l	l	h	m	h	l	l	m	10	9	10	9	4	3	5	HH	MH	LL	MM	LL	MM
92	steep rocky bluff bordering shoreline, visible springboard notched stumps	h	h	l	h	m	l	m	l	l	l	h	m	l	l	m	0	9	11	10	5	3	7	LL	HM	LL	MM	LL	MH
93	clam garden feature, fine sediments with lower rock alignment, associated cairns, sharp lines	h	h	h	h	l	h	l	l	l	l	h	l	l	l	m	0	10	8	0	0	0	0	LL	ML	LL	LM	LL	MH
94	clam garden feature, on pocket beach	h	h	h	h	l	h	h	l	l	l	h	m	l	l	m	0	10	9	0	0	0	0	LL	MM	LL	LM	LL	MH
95	leveled delta, blast rock present, water pipes present	h	h	h	h	l	m	l	l	l	l	m	m	l	l	l	0	8	8	12	3	3	7	LL	MM	LL	ML	LL	MM
96	steep broken cliff face, low rock art potential	l	h	l	l	h	l	l	m	l	l	l	l	l	l	l	9	-2	5	6	10	3	2	HL	LL	LL	LL	HL	LL
97	tombolo bench between river and bay with high midden potential, some modern water pipes present	h	h	h	h	l	m	h	l	l	l	l	h	l	l	m	0	9	10	9	4	5	6	LL	MH	ML	MM	LL	ML
98	rock alignment fish trap feature approx 12m long associated with modern rock cairn	h	h	h	h	l	h	m	l	l	l	h	m	l	l	m	0	8	9	12	3	3	7	LL	MM	LL	MM	LL	MH
99	tiny pocket beach where it would be possible to land a canoe, might be a defensive location	l	h	h	m	l	m	l	m	m	l	m	h	l	m	m	10	2	7	7	5	2	3	HL	MH	LL	LM	LM	LM
100	steep hillside abutting semiprotected beach w narrow bench, moderate habitation potential	l	h	h	m	m	m	m	m	m	m	m	m	m	l	l	10	1	5	5	3	4	3	HM	LM	LM	LL	LL	LM
101	small delta beach, likely used as log sort, moderate potential for habitation, did not go ashore	m	h	h	m	m	m	m	l	l	m	m	h	m	m	m	10	2	6	5	6	4	2	HM	LH	LM	LM	MM	LM
102	heavily logged, lots of young C but no CMTs	l	h	m	m	l	l	l	l	l	m	l	l	m	l	l	8	3	6	4	1	3	5	HM	LL	LM	LL	LL	LL
103	expanse of coarse sands gravels, lack of boulders, high potential for fish traps rock alignments etc	h	h	h	h	l	h	h	l	l	l	h	l	l	l	l	0	5	6	6	3	5	4	LL	LL	ML	LL	LL	LH
104	cobble beach in front of heavily logged road and landing area	l	h	h	m	l	l	l	l	l	l	m	m	l	m	m	108	1	4	4	3	3	3	ML	LM	LL	LM	LM	LM
105	narrow pocket beach with boulders, moderate fish trap/clam garden potential	l	h	l	m	m	h	h	m	m	m	h	h	l	l	l	0	1	5	4	8	2	2	LM	LH	LL	LL	HL	LH
106	narrow pocket beach with boulders, moderate fish trap/clam garden potential	l	h	l	m	m	h	h	m	m	m	h	h	l	l	l	0	3	5	6	7	4	3	LM	LH	LL	LL	ML	LH
Turn Bay																													

ID	COMMENTS	NEAR RIVER	NEAR OCEAN	LOCAL TOPOGRAPHY	MAJOR TOPOGRAPHY	CLIFFS	STABILITY	HISTORIC DISTURBANCE	OLD GROWTH	OLD CEDAR	CMT POTENTIAL	FISH TRAP	MIDDEN	ROCK SHELTER	PICTOGRAPH	PETROGLYPH	CMT MODEL	FISH MODEL	MIDDEN MODEL	PETRO MODEL	PICTO MODEL	SHELTER MODEL	TRENCH MODEL	CMT MATCH	MIDDEN MATCH	SHELTER MATCH	PETRO MATCH	PICTO MATCH	FISH MATCH
107	intertidal sandy sediments, ideal fish trap potential, none observed	h	h	h	h	l	m	m	l	l	l	h	l	l	l	l	0	6	9	0	0	0	0	LL	ML	LL	LL	LL	LH
108	intertidal sandy sediments, ideal fish trap potential, none observed	h	h	h	h	l	m	m	l	l	l	h	l	l	l	l	0	5	8	0	0	0	0	LL	ML	LL	LL	LL	LH
109	intertidal sandy sediments, ideal fish trap potential, none observed	h	h	h	h	l	m	m	l	l	l	h	l	l	l	l	0	5	8	0	0	0	0	LL	ML	LL	LL	LL	LH
110	rock alignment fish trap, running from sediment laden north side of stream south into boulder circle	h	h	h	h	l	m	m	l	l	l	h	m	l	l	m	0	7	7	0	0	0	0	LL	MM	LL	LM	LL	LH
111	rock alignment fish trap, running from sediment laden north side of stream south into boulder circle	h	h	h	h	l	m	m	l	l	l	h	m	l	l	m	6	5	6	6	7	4	4	ML	LM	LL	LM	ML	LH
112	cobbles and boulders in sandy silt, large possible stone axe recovered here - not artifactual	h	h	h	h	l	m	h	l	l	l	h	m	l	l	l	0	8	7	0	0	0	0	LL	MM	LL	LL	LL	MH
113	location of another possible rock alignment, much less distinct than one further downstream	h	h	h	h	l	m	h	l	l	l	h	m	l	l	l	0	6	8	0	0	0	0	LL	MM	LL	LL	LL	LH
114	location of another possible rock alignment, even much less distinct than ones further downstream	h	h	h	h	l	m	h	l	l	l	h	l	l	l	l	0	5	7	7	6	2	4	LL	ML	LL	LL	ML	LH
115	microlandform raised approx 50-75cm above river level, high habitation potential	h	h	h	h	l	m	h	m	l	l	m	m	l	l	l	8	5	9	6	1	0	5	HL	MM	LL	LL	LL	LM
116	auger test, 0-50cm silty humic, water saturated, large OG with lots of 'leaning' trees	h	h	h	h	l	m	h	h	h	m	m	m	l	l	l	109	3	7	3	5	2	4	HM	MM	LL	LL	LL	LM
117	boggy area OG, C present, hummocky terrain, high habitation potential	h		h	h	l		h	h	h	m		h				108	4	8	5	5	2	5	MM	MH	L	L	L	L
Salmon River mouth																													
118	steep creek gulley with a few cedar vets	m	m	l	m	m	m	l	m	m	m	l	l	l	l	l	102	-1	0	0	0	-2	0	LM	LL	LL	LL	LL	LL
119	previously logged bench	m	m	m	m	l	h	l	l	l	l	l	l	l	l	l	101	0	2	0	0	2	2	LL	LL	LL	LL	LL	LL
120	encountered previously recorded CMT site	m	m	m	m	m	h	h	h	h	h	l	l	l	l	l	101	-4	-2	0	0	-1	0	LH	LL	LL	LL	LL	LL
121	possible canoe run on stable shoreline, no auger testing due to burial location nearby	h	h	h	h	l	h	m	l	l	l	h	m	l	l	h	0	7	6	0	0	0	0	LL	LM	LL	LH	LL	LH
122	nice well-drained bench or terrace above beach near headland burials once here or near	h	h	h	h	m	h	m	l	l	l	l	h	m	m	l	7	2	4	3	6	4	3	ML	LH	LM	LL	MM	LL
123	nice rockshelter, no evidence of HR or pictographs	h	h	h	h	h	h	h	h	l	m	l	l	h	h	l	6	2	4	4	4	6	2	MM	LL	MH	LL	LH	LL
124	at burial rockshelter	h	h	h	h	h	h	h	h	m	m	l	l	h	h	l	8	2	3	3	3	4	1	HM	LL	LH	LL	LH	LL
125		h		l	l	l	l	l			l		h				7	5	6	5	6	5	4	ML	LH	M	L	M	L
126	log booms, steep gravel bank, generally flat terrace above, logged	h	h	l	h	l	m	l	l	l	l	l	m	l	l	l	0	6	6	5	2	5	5	LL	LM	ML	LL	LL	LL
127	on narrow terrace, logged but near ocean with cliff +-20m upslope	h	h	h	h	m	m	l	l	l	l	l	h	l	l	l	7	3	7	5	2	5	5	ML	MH	ML	LL	LL	LL
128	within known site, raised micro-landform, logged during aboriginal habitation	h	h	h	h	l	h	h	l	l	l	l	h	l	l	l	7	8	6	7	4	3	7	ML	LH	LL	LL	LL	ML
129	near to river and ocean, moderately well drained terrace approx 2m above hightide	h	h	h	h	l	l	l	l	l	l	l	h	l	l	l	7	3	5	3	2	5	5	ML	LH	ML	LL	LL	LL
130	mod steep above v. steep gully, nice old growth C, onlhy fire scars	h	h	l	h	h	h	h	h	h	m	l	l	h	h	l	7	-2	1	1	0	4	0	MM	LL	LH	LL	LH	LL
131	near to river and ocean, moderately well drained terrace approx 2m above hightide	h	h	h	h	l	l	l	l	l	l	l	h	l	l	l	8	2	6	4	0	3	4	HL	LH	LL	LL	LL	LL
132	possible wetsite location, upstream from historic dyke,	h	h	m	h	l	h	l	l	l	l	h	m	l	l	l	9	2	5	5	0	0	4	HL	LM	LL	LL	LL	LH
133	near to river and ocean, poor drainage behind dry terrace approx 2m above hightide	h	h	h	h	l	m	l	l	l	l	l	h	l	l	l	6	0	5	3	0	4	3	ML	LH	LL	LL	LL	LL
134	near to river and ocean, moderately well drained terrace approx 15m above hightide Probed X4	h	h	h	h	l	h	l	l	l	l	l	h	l	l	l	8	0	2	1	0	1	1	HL	LH	LL	LL	LL	LL
135	poorly drained and logged yet the EcSl 7 site is incorrectly plotted as going up this drainage	h	m	l	m	l		l	l	l	l	l	l	l	l	l	10	1	4	3	0	-2	3	HL	LL	LL	LL	LL	LL
136	second growth mostly D-f, some H, occas burnt-out C snags	h	h	l	h	l	h	l	l	l	l	l	l	l	l	l	6	1	2	3	0	1	4	ML	LL	LL	LL	LL	LL
137	poorly drained and logged yet the EcSl 7 site is incorrectly plotted as going up this drainage	h	m	l	m	l		l	l	l	l	l	l	l	l	l	9	1	1	1	0	0	2	HL	LL	LL	LL	LL	LL
138	logged with lots of roads	h	h	l	m	l	h	l	l	l	l	l	l	l	l	l	6	-4	-2	0	0	1	1	ML	LL	LL	LL	LL	LL
139	cedar vet CMTs	h	h	l	h	l	h	l	l	l	h	l	l	l	l	l	107	-2	0	2	0	1	1	MH	LL	LL	LL	LL	LL
140	steep cliff with potential for rockshelters (none occur)	h	h	h	h	h	h	l	l	l	l	l	l	h	l	l	106	-2	1	3	0	2	2	LL	LL	LH	LL	LL	LL
141	cedar vets - poss crease CMTs, not recorded as CMTs	h	h	l	h	l	h	l	l	l	h	l	l	l	l	l	109	1	2	3	0	0	1	HH	LL	LL	LL	LL	LL
142	second growth hillside, some big cliffs nearby	h	h	l	h	l	h	l	l	l	l	l	l	l	l	l	107	-1	1	2	0	1	1	ML	LL	LL	LL	LL	LL
143	cedar vets burnt, no cultural scars. Old C, D-f has been logged	h	h	m	h	l	l	l	l	l	m	l	l	l	l	l	8	-1	1	0	0	3	1	HM	LL	LL	LL	LL	LL
144	cedar vet snags - but all burnt, old springboard notched stumps	h	h	l	h	l	h	l	l	h	m	l	l	l	l	l	107	0	0	0	0	-1	2	MM	LL	LL	LL	LL	LL
Port Neville																													
145	cliff into water - but rock type right here not good for Picto/Petroglyph, still OK potential	l	h	h	h	h	h	l	l	l	l	l	l	h	h	l	0	7	8	0	0	0	0	LL	ML	LH	LL	LH	LL
146	steep with dense CMTs, bordering 2nd growth along stream to N (unmapped TRIM)	l	h	h	h	m	h	m	h	h	h	l	l	m	l	l	107	-3	0	1	0	-1	0	MH	LL	LM	LL	LL	LL
147	clearcut few vets old commercial springboard. Narrow strip along ck. V. steep further down	l	h	m	h	m	h	l	l	l	m	l	l	l	l	l	106	-3	-1	0	0	0	0	LM	LL	LL	LL	LL	LL
148	steep, old growth but large D-f, C are small and unstripped	l	h	h	h	m	h	l	h	m	h	l	l	m	l	l	105	-3	0	1	0	-1	0	LH	LL	LM	LL	LL	LL
149	old growth with C	l	h	m	h	l	h	h	h	h	h	l	l	l	l	l	106	-3	0	1	0	-1	0	LH	LL	LL	LL	LL	LL
150	no CMTs this stretch, D-f, probably dry microclimate	l	h	m	h	l	h	h	h	l	m	l	l	l	l	l	106	-3	0	1	0	-1	0	LM	LL	LL	LL	LL	LL
151	CMTs on larger cedar on bench	l	h	m	h	l	h	h	h	h	h	l	l	l	l	l	1008	-3	0	2	0	-1	0	MH	LL	LL	LL	LL	LL
152	wpt 50, dense CMTs on bench	l	h	h	h	l	h	h	h	h	h	l	l	l	l	l	1008	-3	0	2	0	-1	0	MH	LL	LL	LL	LL	LL
153	no CMTs this stretch, D-f, probably dry microclimate	l	h	h	h	l	h	h	h	l	m	l	l	l	l	l	1008	-2	1	2	0	0	0	MM	LL	LL	LL	LL	LL
154	wpt 52, cluster CMTs on bench	l	h	h	h	l	h	h	h	h	h	l	l	l	l	l	107	-1	0	2	0	0	1	MH	LL	LL	LL	LL	LL
155	iso large CMT mostly H & D-f, probably dry microclimate	l	h	h	h	l	h	h	h	m	m	l	l	l	l	l	1009	-1	1	2	0	0	0	HM	LL	LL	LL	LL	LL
156	iso BST CMT on large C	l	h	h	h	l	h	h	h	m	m	l	l	l	l	l	1008	-1	1	2	0	0	0	MM	LL	LL	LL	LL	LL
157	nice bench, midden expected even where negative, 2nd growth	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	110	3	8	8	3	5	4	HM	MH	ML	LL	LL	LL
158	nice bench, midden expected even where negative, 2nd growth	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	109	4	8	7	3	2	6	HM	MH	LL	LL	LL	LL
159	gentle slope well behind beach, recent cutblock	l	h	m	h	l	h	h	l	l	l	l	l	l	l	l	109	2	7	7	4	5	4	HL	ML	ML	LL	LL	LL
160	gentle slope well behind beach, recent cutblock	l	h	m	h	l	h	l	l	l	l	l	l	l	l	l	109	-1	4	4	0	5	2	HL	LL	ML	LL	LL	LL
161	nice bench, probably patches of midden all along, most tests neg 2nd growth	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	110	5	10	7	3	2	5	HM	MH	LL	LL	LL	LL

ID	COMMENTS	NEAR RIVER	NEAR OCEAN	LOCAL TOPOGRAPHY	MAJOR TOPOGRAPHY	CLIFFS	STABILITY	HISTORIC DISTURBANCE	OLD GROWTH	OLD CEDAR	CMT POTENTIAL	FISH TRAP	MIDDEN	ROCK SHELTER	PICTOGRAPH	PETROGLYPH	CMT MODEL	FISH MODEL	MIDDEN MODEL	PETRO MODEL	PICTO MODEL	SHELTER MODEL	TRENCH MODEL	CMT MATCH	MIDDEN MATCH	SHELTER MATCH	PETRO MATCH	PICTO MATCH	FISH MATCH
162	cmt MR3,4, shell midden in 2nd growth	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	109	5	9	6	2	4	4	HM	MH	LL	LL	LL	LL
163	cmt MR2, wpt40, 27m from shore near midden exposure vit 2nd growth	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	108	5	5	3	3	5	3	MM	LH	ML	LL	LL	LL
164	n end of extended midden on bench EdSl-9, logged 30s	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	108	5	8	5	1	5	3	MM	MH	ML	LL	LL	LL
165	s end extended midden on bench, EdSl-9, logged 30s	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	108	5	9	7	1	5	6	MM	MH	ML	LL	LL	LL
166	nice sandstone bedrock, perfect for petroglyphs, non seen (only W end point examined)	l	h	h	h	l	h	l	l	l	l	l	l	l	h	h	110	6	9	7	4	2	5	HL	ML	LL	LH	LH	LL
167	elevated knoll at point, no midden found, shell midden nearby	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	108	5	9	7	1	5	6	MM	MH	ML	LL	LL	LL
168	cmt #MR1 BSt snag and midden in probe W of CMT 2nd growth vet	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	108	2	7	5	1	5	3	MM	MH	ML	LL	LL	LL
169	second bench of shell midden 15.5 m above HHW cutblock bdy 35 m uphill midden also midden 8 m E	l	h	h	h	l	h	m	l	l	m	l	h	l	l	l	108	3	7	5	1	5	3	MM	MH	ML	LL	LL	LL
Salmon River Valley																													
170	slope to river, low potential	h	m	l	l	m	m	m	l	l	l	l	l	l	l	l	107	1	2	0	0	2	2	ML	LL	LL	LL	LL	LL
171	cutbank with gravel knoll, microlandform	h	m	h	m	l	m	m	l	l	l	l	m	l	l	l	6	2	3	0	0	0	6	ML	LM	LL	LL	LL	LL
172	low boggy terrain, thrid growth alder logging area	h	m	l	m	l	l	l	l	l	l	m	m	l	l	l	7	6	7	0	0	0	6	ML	MM	LL	LL	LL	LM
173	higher slope to south, some Cedar	h	m	m	l	m	m	m	m	m	m	l	l	m	l	l	8	8	6	0	0	4	2	HM	LL	LM	LL	LL	ML
174	narrown high bench above narrow point in river model shows low habitation potential	h	m	h	m	l	m	m	l	l	m	m	m	l	l	l	108	7	7	0	0	4	3	MM	MM	LL	LL	LL	LM
175	low refelief flooplain recently clear cut 2nd growth, lots of ground exposure	h	m	l	m	l	m	l	l	l	l	l	l	l	l	l	105	2	4	0	0	0	3	LL	LL	LL	LL	LL	LL
176	low refelief flooplain recently clear cut 2nd growth, lots of ground exposure	h	m	l	m	l	m	l	l	l	l	l	l	l	l	l	104	4	6	0	0	0	3	LL	LL	LL	LL	LL	LL
177	low refelief flooplain recently clear cut 2nd growth, lots of ground exposure	h	m	l	m	l	m	l	l	l	l	l	l	l	l	l	105	4	6	0	0	0	3	LL	LL	LL	LL	LL	LL
Barnes Bay																													
178	cobble beach with moderate habitation potential, much less disturbed than bay to east	m	h	h	h	l	h	h	l	l	l	m	m	l	l	l	0	7	7	6	4	3	4	LL	MM	LL	LL	LL	LM
179	high clam garden petroform potential, cleared of medium cobbles, boulders	l	h	h	h	l	h	h	l	l	l	h	l	l	l	m	0	9	10	8	4	5	7	LL	ML	ML	LM	LL	MH
180	high clam garden petroform potential, cleared of medium cobbles, boulders	l	h	h	h	l	h	h	l	l	l	h	l	l	l	m	0	7	9	0	0	0	0	LL	ML	LL	LM	LL	LH
181	high clam garden petroform potential, small area 3x5m cleared of medium cobbles, boulders	l	h	h	h	l	h	h	l	l	l	h	l	l	l	m	0	9	0	8	4	3	0	LL	LL	LL	LM	LL	MH
182	small island w/ exposed bedrock & little sediment, low habt pot, mod burial loc or fish station	l	h	l	m	l	h	l	m	m	l	l	m	l	l	m	104	5	11	10	2	6	9	LL	HM	ML	MM	LL	LL
183	only area to land canoe, possible fish trap potential did not inspect closely	l	h	m	l	l	m	l	l	l	l	m	l	l	l	m	105	6	8	5	2	7	7	LL	ML	HL	LM	LL	LM
184	exposed bedrock, high current area	l	h	l	l	l	m	l	l	l	l	l	l	l	l	m	8	8	0	9	5	3	0	HL	LL	LL	MM	LL	ML
185	small island with exposed bedrock little habitation potential but model says high, swift currents	l	h	l	m	l	h	h	m	m	l	l	l	l	l	m	0	9	11	0	0	0	0	LL	HL	LL	LM	LL	ML
186	cobble beach with not recently logged on rocky bluff	l	h	m	l	l	h	m	l	l	l	m	m	l	l	m	108	7	8	8	3	6	8	ML	MM	ML	LM	LL	LM
187	heavily disturbed shoreline, roadbuilding, blasting, logging etc.	h	h	h	h	l	l	l	l	l	l	m	l	l	l	l	0	5	9	7	5	2	5	LL	ML	LL	LL	LL	LM
188	isolated projectile point found on beach!	m	h	h	h	l	m	m	l	l	l	m	m	l	l	l	7	3	7	4	5	3	4	ML	MM	LL	LL	LL	LM
189	modern midden exposure adjacent to blast rock from road building	m	h	m	h	l	h	l	l	l	l	l	m	l	l	l	7	6	7	4	4	1	4	ML	MM	LL	LL	LL	LL
190	old logging road	l	h	l	m	l	h	l	l	l	l	l	l	l	l	l	8	3	8	4	3	2	4	HL	ML	LL	LL	LL	LL
191	barren bedrock, low potential for habitation, etc fish farm trash storage area	l	h	l	m	l	h	l	l	l	l	l	l	l	l	m	5	6	0	7	4	3	0	LL	LL	LL	LM	LL	LL
192	buldozed isolated midden, surrpunded by logging debris nearby an abandoned road	m	h	h	h	l	h	l	l	l	l	m	m	l	l	l	8	4	7	3	1	2	4	HL	MM	LL	LL	LL	LM
193	cobble and berock beach, moderat fish trap potential, abundant fish farm loggin trash	m	h	h	h	l	h	m	l	l	l	m	m	l	l	m	0	6	7	0	0	0	0	LL	MM	LL	LM	LL	LM
194	auger test location 0-10 duff, 10-30cm compact sands (road base?)	m	h	h	h	l	h	l	l	l	l	l	m	l	l	l	108	4	7	3	1	3	4	ML	MM	LL	LL	LL	LL
195	heavily logged & disturbed, steeply sloping cobble beach	l	h	h	h	l	h	l	l	l	l	l	m	l	l	l	106	6	6	3	3	5	3	LL	LM	ML	LL	LL	LL
196	pocket beach with large cobbles	l		m	h	l					l						106	5	9	8	3	5	6	LL	M	M	L	L	L
197	bedrock outcrop w/ petroglyph potential	h	h	m	m	m	h	m	l	l	l	l	l	l	l	m	6	8	11	9	3	5	6	ML	HL	ML	MM	LL	ML
198	steep bluff area, low potential despite being close to creek no feasible way to cross creek	h	h	l	m	m	m	m	m	l	m	l	l	m	l	l	0	9	10	0	0	0	0	LM	ML	LM	LL	LL	ML
199	bach with gravels and sand, some rock alignments but likely modern, lfish trap potential high	h	h	m	m	l	m	m	l	l	l	h	m	l	l	l	0	8	10	0	0	0	0	LL	MM	LL	LL	LL	MH
200	small flat bench above river 2 probes, no shell	h	h	h	h	l	h	m	l	l	m	l	h	l	l	l	7	6	10	8	1	5	6	MM	MH	ML	LL	LL	LL
201	auger test, silty humic to 50cm	h	h	m	h	l	m	m	l	l	m	l	m	l	l	l	7	9	11	9	4	3	6	MM	HM	LL	ML	LL	ML
202	auger test on terrace above river 2nd growth, logged but moderate habitation potential	h	h	m	h	l	m	m	l	l	m	l	m	l	l	l	7	7	11	9	4	3	6	MM	HM	LL	ML	LL	LL
203	auger test on bench 1m sediment with sandy humic silt w angular rock lots of hemlock	h	h	m	m	l	m	m	l	l	m	l	m	l	l	l	6	8	11	8	1	5	6	MM	HM	ML	LL	LL	ML
204	cleared area modern residence, high potential for habitation but disturbed, no midden observed	h	h	h	h	l	h	m	l	l	l	l	h	l	l	l	6	7	8	6	0	6	4	ML	MH	ML	LL	LL	LL

NOTES:
(1) "MATCH" fields indicate the match between the modelled potential and potential as assessed during ground truthing (with modelled potential first and ground potential second). For instance, a modelled potential of high, where the ground assessed potential was moderate, would be indicated as "HM"
(2) "HISTORIC DISTURBANCE" rates as high (h) where there is low historic disturbance, and low (l) where there is high disturbance
(3) "MODEL" fields indicate the modelled potential using, where the numeric values indicate how many "points" each location received during modelling (see Appendix A for factors contributing to each model)
(4) The CMT model is broken into 3 models: CMT Old Growth Yellow Cedar and Western Red Cedar (model values from 1001 to 1015), CMT Veteran where Forest Inventory data was available (model values from 101 to 115), and CMT Veteran where Forest Inventory data was not available (model values from 1 to 14)