North Coast LRMP

Background Report

An Overview of Water Based Log Handling on the North Coast of British Columbia

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Disclaimer

This report was prepared by Triton Environmental Consultants Ltd., as background information on water-based log handling in the North Coast LRMP area. The information in this report was collected from a wide range of sources and was reviewed by government staff for accuracy and completeness. The final product is presented as the professional judgment of the authors and does not necessarily reflect the view of the Province.

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Executive Summary

Water-based log handling is a crucial component of coastal BC logging operations. The remote location of the timber and the mountainous terrain characteristic of the region prohibit cost effective land based transportation of logs from harvest sites to sorting and processing centers. The environmental implications of water-based log handling are well documented. Historic practices often resulted in persistent fish and wildlife habitat damage, related to site selection and the operational phases of log handling. Current site selection and operational procedures are heavily regulated and seek to minimize environmental impacts in and around the operating areas. This is achieved through:

- careful site selection, targeting deep water, steeply sloping, unproductive aquatic locations,
- careful site design, addressing potential impacts to all resources in proposed operational areas,
- an extensive referral process, addressing all resource issues at proposed water-based log handling facilities, including those raised by the general public,
- the implementation of specific, environmentally responsible operational conditions, set by federal and provincial regulatory agencies and executed by licensees,
- the continued refinement of water-based log-handling procedures.

Although many of the impacts associated with the operational phases of water-based log handling are well understood others are not, and have been identified as knowledge gaps. It was noted for example, that quantative assessments of the impacts of water-based log handling operations are lacking. Detailed inventories and fisheries and bird resources on the North Coast are also lacking, making assessments of the impact of water-based log handling on these resources very difficult. Further, it was noted that the historic impacts of resource exploitation, including those affecting First Nations are not well known. Finally, the following environmental knowledge gaps were identified;

- the effects of deep water accumulations of bark and woody debris on species diversity,
- the effects of log boom shading on aquatic vegetation,
- the influence of current on bark and woody debris accumulation, and
- the variation in colonization success of newly placed rock in intertidal areas.

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1.0 Definitions and Descriptions Relevant to Water-Based Log Handling

Water-Based Log Handling

Water-based log handling refers to the movement and storage of logs in water, and includes activities such as dumping, booming, storage and sorting.

Log Dumping

Log dumping is the process of moving logs from dry land into the water. This is achieved with a variety of different methods and/or equipment, including: skidways (slides), vertical hoist apparatuses, self - dumping barges and helicopter drop logging. The location at which logs on land are placed into the water is called the ***log dump***. Conventional log dumps employ traditional dumping methods such as skidways.

Log Booming

Log booming is the process of collecting logs in the water, to be stored or transported to processing centers and points of export. The collected logs are called ***log booms***. Log booms are towed as flat rafts, sometimes consisting of single logs, but more typically as log bundles. Log bundles are groups of logs bound together with steel cables. Log booms are contained in the water by ***boomsticks***, made of floating logs that are chained together in a rough hexagonal shape. Boomsticks prevent log bundles or loose logs from escaping the log boom during towing.

Log Transportation

Log transportation is the process of towing or barging logs to sort yards, processing centers, or to points of export. Tugboats are used to tow booms over short distances and barges over longer distances. Barges used for log transportation can also be self-propelled.

Log Storage

Log storage is the storing of log booms, at log dumps, sort yards and processing sites. Log booms are generally stored close to the shoreline at sufficient depths to prevent them from grounding during low tide.

Log Sorting

Log sorting is the process of separating logs of similar grade, species and size. Sorting takes place in the water or on land.

Dolphins

Dolphins are mooring posts located in relatively shallow water. Log booms can be attached to dolphins for storage.

Skidway

A skidway is a slide used to dump logs on land into the water. Historically skidways were made entirely of wood. Modern skidways are typically made entirely of metal.

Vertical Hoist Log Dumping

Vertical hoist log dumping involves lifting logs or log bundles on land and lowering them into the water. Examples of vertical hoist methods include A-Frames and cranes.

SBFEP

SBFEP refers to the Small Business Forest Enterprise Program, administered by the Ministry of Forests.

Epifauna

Epifauna are organisms that live on the surface of the substrate in a body of water.

Infauna

Infauna are organisms that live in the substrate of a body of water, commonly a soft sea floor.

Benthic Organisims

Benthic organisms, also known as benthos, live at sea or lake bottoms.

Fucus

A genus of brown algae.

2.0 Introduction

Water-based log handling is an important component of coastal logging operations. Much of the timber harvested on the North Coast is moved into the water, where it is transported to sort yards, mills and shipping ports for further manufacturing or export. Transportation in the water is crucial on the North Coast, because the remote location of the timber, and the mountainous terrain preclude the cost effective transportation of logs on land. Building roads in remote mountainous areas to transport entire harvests to processing locations is generally not feasible.

Water-based log handling is a significant resource management issue on the North Coast, because the associated operational phases can impact on potential fish, wildlife, First Nations and recreation values in operational areas. Impacts associated with the underwater accumulation of woody debris are of particular concern, and can result in changes to on site habitat and water quality, and the smothering of benthic organisms (benthos). At large scale operations, aquatic debris accumulations and escaped logs can pose a safety issue for recreational boaters. First Nations archaeological resources can be destroyed or alienated by both upland and tidal development associated with water-based log-handling facilities.

The purposes of this report are to:

- provide an overview of current water-based log handling practices on the North Coast,
- examine resource management issues associated with water-based log handling on the North Coast, and
- summarize knowledge gaps associated with water-based log handling on the North Coast.

2.1 Description

In coastal British Columbia, water-based log handling frequently occurs in marine waters and lakes, and occasionally in tidal rivers. Water-based log handling includes the following activities:

- log dumping,
- log booming,
- log transportation,
- log storage,
- log sorting.

Specific water-based log handling facilities include: log dumps, log sorts and log storage areas. Although these facilities can be located separately, they often occur together. For example, many log dumps have attached dry land log sorts, and all require some form of temporary storage on the water. Log dumps are typically located in marine waters, close to the mouth of the watershed in which a given licensee is logging. Timber harvested in the watershed is transported by truck to the log dump, where log bundles or individual logs are

then dumped into the water. These logs are then organized into log booms, and transported to offsite sort yards and mills, by tug and/or barge.

3.0 Historic and Current Water-Based Log Handling Practices

3.1 Historic Water-Based Log Handling Practices on the North Coast

Historic site selection and operational procedures were substantially different prior to the 1980's and often resulted in significant and persistent, biophysical changes to marine and tidal river habitats in North America.

3.1.1 Historic Site Selection Procedures

Historically, site selection of water-based log handling facilities was primarily a function of cost and convenience. On the North Coast specifically, log dumps were often associated with the largest, level piece of land close to the ocean (*Bob Cuthbert, pers.com*). On the South Coast in particular, log-handling operations were often located in estuaries. This proximity to freshwater systems provided protection against wave action and allowed for the relatively simple transportation and storage of logs. The freshwater influx also resulted in reduced infestation and subsequent destruction of wood by teredos (*Bankea setacea*), a marine clam which bores into, and feeds on wood.

3.1.2 Historic Operational Procedures

Traditional log dumping, transportation and storage methods are still in use, but have been refined to mitigate and/or avoid adverse environmental impacts. The following section provides a brief description of historical dumping, transportation and storage methods.

Vertical Hoist Methods

Vertical hoist methods are still in use, however specific operations such as A-frames are now less common on the North Coast. A-frames lift logs or log bundles located on land, and lower them into the water. Although A-frames have fallen out of favour, they are still used occasionally on the North Coast, and were used as recently as 1999 in Kemano.

Skidways

Skidways are still commonly used at log dumps on the North Coast to move logs on land into the water. Historically, skidways were constructed of wood, and loose logs were pushed down the skidway into shallow receiving waters.

Log Transportation and Sorting

Historically logs were often sorted in the water, corralled into flat rafts (comprised of single, loose logs), and then towed to storage and/or processing facilities. Flat rafts were stored at processing centers until they could be pulled apart, typically in the water, and the individual logs moved onto land.

Log Storage

Historically, log rafts consisting of single, loose logs contained by boomsticks, were often stored in shallow water close to the shoreline, where they were subject to grounding at low water.

3.1.3 Environmental Impacts of Historic Water-Based Log Handling Practices

Site Selection Procedures

The presence of log handling operations in environmentally sensitive areas such as estuaries, often had serious implications for adjacent flora and fauna, as documented in studies by (Conlan and Ellis, 1979) and (Jackson, 1986). Operational procedures in the shallows of estuaries and other sensitive marine environments resulted in the physical destruction of flora and fauna, as well as associated habitat degradation and loss.

Historic Operational Procedures

Historic log dumping, sorting and storage procedures often resulted in substantial accumulation of bark in upland and wetted operational areas, as well as physical damage to shoreline and shallow water habitats.

Vertical Hoist Methods

High drop speed was historically an issue at A-frame operations, as it resulted in increased bark loss and damage to the shoreline in shallow receiving waters. Lost bark accumulated in receiving waters and resulted in:

- the physical smothering of marine organisms and habitats (Summary Report of the Steering Committee, 1981), and
- the degradation of on site water quality through the decomposition of accumulated woody debris, causing reduced dissolved oxygen levels and the formation of toxins such as hydrogen sulfide (Brownlee et al., 1981).

Additionally, repeated impacts associated with dropping logs in shallow waters, resulted in physical damage to shoreline sediments, marine organisms and habitats.

Hand Logging

In the 1800's shoreline trees were often felled by hand, either directly into the water, or onto the shoreline, where they were rolled into the water and floated to receiving mills (Sedell and Duval, 1985). This typically occurred without shoreline protection measures.

Skidways

Historically skidways were made of parallel logs, positioned perpendicular to the shoreline. Because the sliding surface of skidways was comprised of wood, the friction caused by pushing the logs down the skidway often resulted in substantial bark loss. Additionally, bark loss occurred when the slope of the skidway exceeded 60%. The steep slope of the slide resulted in the high-energy impact of logs as they hit the water, causing increased bark loss**.**

Dumping in shallow water also resulted in the destruction of habitat and organisms on the shoreline.

Log Sorting

Water sorting was more common prior to the 1980's and involved repeated, vigorous contact with logs by log dozers (boom boats), which increased the introduction of woody debris in the water (Sedell and Duvall, 1985). Propeller wash from log dozers also caused on-site turbulence, disturbing substrates in shallow waters and spreading accumulated woody debris over a larger area (Brownlee et al., 1981).

Log Storage

Log storage in shallow waters often resulted in the grounding of logs at low water, causing the destruction of plants and organisms, epifauna and infauna. The further reduced wave action, associated with the calming influence of stored log booms also resulted in decreased sediment flushing and increased sedimentation, which subsequently resulted in chemical and physical habitat changes. Log storage in shallow waters also resulted in the shading of aquatic plants, resulting in reduced productivity, and a subsequent reduction in faunal productivity.

Log Driving

Historically log driving was used to transport logs to mills. Typically, log driving consisted of floating logs downstream in loose aggregations, under the power of stream flow (Sedell and Duval, 1985). River improvements were often required to facilitate log driving and included the following changes to freshwater systems:

- blocking off sloughs, swamps and low meadows to ensure that both logs and water were kept in the main channel,
- blasting and/or removal of boulders, rocks, leaning trees, sunken logs or obstructions of any kind which might result in log jams during the driving seasons,
- widening of stream channels, and the
- use of splash dams and periodic releases of water to provide sufficient flows for log driving (Sedell and Duval, 1985).

Log driving and associated river improvements resulted in physical damage to streambeds and banks through erosion and gouging. Further, these activities prevented fish from spawning and also resulted in egg mortalities through scouring and/or silting (Sedell and Duval, 1985).

3.2 Current Water-Based Log Handling Planning and Practices on the North Coast

Current water-based log handling methods are the result of continued refinement of methodology and increased regulation on behalf of federal and provincial agencies. A discussion of the application procedure is provided below to highlight the required planning

process. This process is designed to prevent or mitigate many of the historical environmental problems associated with log handling. A brief discussion of the Log Transfer Facility (LTF) permitting process in Alaska is provided in section 3.5 for comparison purposes.

3.2.1 The Foreshore Lease Application Process

Licensees are required to submit detailed lease applications to the British Columbia Assets and Lands Corporation (BCAL), and are required to provide the following information as part of their lease application:

- Detailed design plans for the proposed facility,
- Detailed mapping of the proposed operational area, and the
- Results of dive surveys carried out in the proposed operational area.

When BCAL receives an application for a water-based log handling facility, BCAL initiates an extensive referral process, which includes the following agencies and organizations:

- Department of Fisheries and Oceans (DFO)
- Ministry of Water, Land and Air Protection (MWLAP)
- Ministry of Forests (MOF)
- Canada Coast Guard (Navigable Waters Protection Act)
- Canadian Wildlife Service (CWS)
- First Nations
- Ministry of Small Business, Tourism and Culture (MSTC)
- Local Municipalities
- Regional Districts

The above organizations provide input, make recommendations or stipulate specific operational conditions, within their jurisdiction. BCAL rejects or approves applications based on input received through this referral process. It should be noted that lease applications for well established log handling sites, can be submitted directly to DFO. Upon receipt of such an application, the DFO initiates a referral process including government agencies and potentially impacted First Nations (*David Harper, pers.com*).

Public Involvement in the Foreshore Lease Application Process

BCAL advertises water-based log handling foreshore lease applications in local papers and the BC Gazette for 2 consecutive weeks, inviting public input regarding the applications. If warranted, public meetings are held to identify and address public concerns regarding specific foreshore lease applications. BCAL may reject specific foreshore lease applications if significant public concern is demonstrated.

Foreshore Lease Applications For Designated Use Areas (DUA's)

The lease application process is consistent for pristine areas and those with previous use, except where the licensee makes a lease application for a Designated Use Area (DUA). DUA's are created by BCAL at the request of the Ministry of Forests. Establishing a DUA is a means of pre approving the use of certain areas for specific purposes, such as log handling. Proposed DUA's are subject to an extensive referral process, in which government agencies and non-government organizations provide input and set conditions regarding the proposed DUA. Licensees pursuing leases within established DUA's, must make an application to BCAL. Licensee applications for land use within an established DUA, are not subject to the referral process, nor are they publicly advertised, because these processes are completed as part of the creation of the DUA for which they are making a lease application.

3.3 The Referral Process of the Foreshore Lease Application

A variety of federal and provincial government organizations provide input into the foreshore lease application process. The purpose of their involvement is to identify and protect on site and nearby resource values, or to minimize impacts to specific resources where they cannot be avoided. Potential conflicts with fish and wildlife resource values, marine navigation, First Nations traditional use and archaeological sites are addressed through the BCAL application and referral process. The jurisdiction(s) of each government agency, and their concerns and involvement in the foreshore lease application process, are summarized in Table 1 and described in further detail below.

3.3.1 Federal Government Agencies Participating in the Referral Process

The Department of Fisheries and Oceans, Coast Guard and the Canadian Wildlife Service provide input into the BCAL foreshore lease application process, and the nature of each agency's input, is related to its jurisdiction.

Table 1. Summary of Federal and Provincial Agencies Participating in the Foreshore Lease Referral Process.

Agency	Jurisdiction or Mandate	Issues of Concern	Conditions or Recommendations Set By Agency
Department of Fisheries and Oceans (DFO)	resources within the water column	impacts on fisheries resources and habitats	**Conditions**: Use of clean blast rock for foreshore infilling, proper storage of fuel and contaminants, minimum log storage and dumping depths, containment and removal of woody debris at log handling facilities.
Navigable Waters	Marine navigation	impacts on safe marine navigation	**Conditions**: Implementation of safe boating regulations and the marking of construction equipment in or on a waterway, at log handling facilities.
Canadian Environmental Assessment Agency (CEAA)	To ensure that all potential impacts are considered/ reviewed prior to a foreshore lease approval	impacts to socio-economic and environmental values	**Recommendations**: CEAA makes recommendations relevant to the proponent's proposed activities.
Canadian Wildlife Service (CWS)	wild bird conservation	impacts on birds and bird habitat	**Recommendations**: Identifies preferred alternative sites, where the potential for bird habitat damage exists
Ministry of Water, Land and Air Protection (MWLAP)	Resources on the shoreline and upland terrain	impacts on fisheries and wildlife resources and habitats	**Conditions**: Use of proper marine storage techniques, specific dumping methods at specific flow levels, approved debris containment procedures. MELP also has regulations regarding the conditions of trees prior to watering.
Ministry of Small Business, Tourism and Culture (MSTC)	archaeological resources	impacts on archaeological values	**Conditions**: Where archaeological values are identified at a proposed log handling facility, an impact assessment must be carried out by a qualified archaeologist.

Department of Fisheries and Oceans

Under the Fisheries Act, the DFO has decision-making authority for the conservation and protection of fish and fish habitat supporting Canadian fisheries (DFO, 1999). Under this mandate, the DFO sets conditions for water-based log handling operations that are relevant to the protection of habitat on site, and in the vicinity of log dumps, storage and sorting sites. Conditions set by DFO relate to a wide range of operations, which may impact on fisheries values at log handling facilities. Examples of such conditions include the following:

- The use of clean blast rock, (free from pollutants) for infilling of foreshore slopes at log dumps, (authorized by DFO as per section 35(2) of the Fisheries Act),
- The proper storage of fuel and contaminants during operations,
- The acceptable minimum depths for dumping and storing of logs,
- The containment and removal of woody debris resulting from log handling on site, and
- The use of operational work windows, related to on site tide levels and life history events for fish species such as herring (*Joy Hillier, pers. com*).

Further conditions set by DFO relate to the location, size and building schedule of compensatory habitat, where DFO has identified the need for a licensee to build such habitat. DFO may also stipulate that the annual monitoring of compensatory habitat be conducted by a recognized professional acceptable to DFO. Water-based log-handling site and operations approvals, as well as decisions regarding the need for compensatory habitat, are made in the context of DFO's "No Net Loss" principal. The objective of this principal is net gain of fisheries habitat, through habitat conservation, restoration and development. Very generally, habitat conservation objectives are achieved through:

- Locating proposed developments in areas where damage to higher value habitats can be avoided,
- Reducing impacts of proposed developments by implementing mitigation procedures, such as building around sensitive habitats, and
- Constructing compensatory habitat where impacts to habitat cannot be avoided and where doing so is in the public interest.

Canadian Coast Guard

Under the Navigable Waters Protection Act, the Canadian Coast Guard is responsible for marine navigation on a national scale, and reviews water-based log handling lease applications for potential impacts by proposed facilities on marine navigation. Navigable waters also makes suggestions regarding boating safety, which include the marking of construction equipment located in, or on, a waterway.

Canadian Wildlife Service

The CWS has the mandate of bird conservation on a national scale, and reviews water–based log handling applications for potential impacts on birds and bird habitat. Potential impacts to bird habitat associated with the development and operations of proposed facilities are identified and outlined for BCAL and the licensee, by the CWS. Preferred alternative

locations of log handling facilities are indicated by CWS, where the potential for bird habitat damage exists at a particular site (*Andrew Robinson, pers. com).*

3.3.2 Provincial Government Agencies Participating in the Referral Process

Ministry of Water, Land and Air Protection

The Ministry of Water, Land and Air Protection (MWLAP) and the Ministry of Small Business, Tourism and Culture (MSTC) also provide input into the leasing process. MWLAP is responsible for the protection of upland terrain and the seabed, and reviews applications on a site-specific basis. MWLAP has also compiled a set of general marine storage and dump clauses, addressing preferred:

- log storage and dumping methods,
- debris containment procedures,
- log dump locations relative to flow levels,
- conditions of trees prior to watering, and
- fuel storage methods in the proposed working area

These clauses are included in referral packages created by the MELP and are summarized in Appendix 1.

Ministry of Small Business, Tourism and Culture, Archaeology Branch

The MSTC is responsible for the protection of archaeological sites and features, under the Heritage Conservation Act. Information regarding existing archaeological values at potential water-based log handling facilities is collected by BCAL from the MSTC during the referral process. If significant archaeological values are identified at a potential site, BCAL is expected to hire an archaeologist to conduct an impact assessment. These impact assessments are followed by the collection of representative samples of data on site. Once this phase has been completed, a permit authorizing the destruction of the remaining archaeological values on site is issued to the licensee, as per section (12) of the Heritage Conservation Act. (*Ray Kenney, pers. com*).

3.4 The Role of the Canadian Environmental Assessment Agency (CEAA) in the Foreshore Lease Application Process

Foreshore lease applications for water-based log handling facilities are now frequently subject to review by the Canadian Environmental Assessment Agency (CEAA), the center of expertise for federal environmental assessments in support of sustainable development. A CEAA review of a water-based log handling foreshore lease application, is triggered where proposed facilities may disrupt or impede navigation (section 5, (1A) of the Navigable Waters Protection Act), or where fish habitat may be harmfully altered, disrupted or disturbed (section 35(2) of the Fisheries Act). CEAA requires an examination of the potential cumulative effects of proposed log handling facilities, and initiates a multi-agency referral

process including the provincial, federal and municipal governments (*Linda Sullivan, pers. com*). The general public are involved in a CEAA review, which is conducted in addition to the BCAL foreshore lease referral process.

3.4.1 A Brief Description of the CEAA Review Process

The CEAA process is managed by a responsible authority. The Coast Guard is the responsible authority where impacts to navigation may occur as a result of proposed development, while the DFO is the responsible authority where impacts to fish and fish habitat may occur. The proponent (licensee) is required to provide the responsible authority with a project description, which the responsible authority forwards to relevant government agencies for review. Typically, the collection of additional on site biological information is required after the project description has been submitted. Once all data are compiled, an Environmental Impact Statement (EIS) is produced, and the lease application is then rejected or accepted, depending on the content of the EIS. In some cases, a rejected proposal will be reviewed by an independent panel, selected by the Minister of the Environment. However if the responsible authority determines that a proposed facility will result in significant adverse affects, a review of the rejected proposal can be denied (*Linda Sullivan, pers co*m).

3.5 The Log Transfer Facility Permitting Process of the State of Alaska

The state of Alaska requires licensees to obtain a minimum of 4 permits for log transfer facilities (LTF's). Similar to the foreshore lease referral process of BC, the granting of these permits is subject to a multi-agency review process. The 4 permits are granted by federal and state agencies, including the:

- Environmental Protection Agency (EPA),
- US Army Corps of Engineers,
- Alaska Department of Environmental Conservation (ADEC), and the
- Alaska Department of Natural Resources (DNR).

Permits granted by the DNR, are subject to review by the Alaska Coastal Management Program (ACMP), which includes an assessment by the Alaska Department of Fish and Game (DFG). As in BC, Alaskan licensees are typically not permitted to operate in protected areas, such as National Parks or critical wildlife habitats, and are expected to address issues such as sensitive habitats, through siting criteria. Conditions regarding acceptable bark accumulations, bark and oily sheen monitoring are built into log transfer facility permits, just as conditions regarding fuel management and woody debris monitoring and containment are built into the foreshore lease agreements with the licensees of BC.

A unique feature of the Alaska permitting process is the identification of specific maximum acceptable levels of debris and bark accumulation at log transfer facilities. Such accumulations must not exceed 1.0 acre (0.4046863ha) in area and 10 cm in depth – at any point in the zone of accumulation. Where such excessive accumulations exist, remedial measures sanctioned by the Alaska Department of Environmental Conservation must be

implemented. A more detailed discussion of the permitting process of the state of Alaska is provided in Appendix 3.

3.6 Licensees With Water-Based Log Handling Operations on the North Coast

Major licensees currently operating on the North Coast include:

- International Forest Products (Interfor)
- Boyle and Dean Logging Ltd.
- Thomson Industries
- Triumph Timber Ltd.

Small Business companies currently operating on the North Coast include, but are not limited to the following companies:

- Linwood Homes Ltd.
- Lima Harbour Construction
- Terrace Pre cut mill Ltd.
- Arrowhead Forest Products

The allowable annual cut of the each major licensee and the entire small business sector are summarized in Table 2.

Table 2. The Allowable Annual Cut Licensees Currently Operating on the North Coast

Company Name	Allowable Annual Cut (m^3)
Interfor	226,000
Boyle and Dean	22,000
Thomson Industries	30,000
Triumph Timber	153,377
Small Business Forest Enterprise Program (SBFEP)	149,082

3.7 Current Site Selection and Operations at Water-Based Log Handling Facilities on the North Coast

Current site selection and operations at log handling facilities on the North Coast were determined from conversations with licensees, the Ministry of Forests and the Forest Engineering Research Institute of Canada (FERIC).

3.7.1 Site Selection and Design

Conversations with licensees indicated that companies intentionally avoid productive foreshore habitats when identifying potential water-based log handling sites. Specifically, unproductive, steeply sloping rocky shorelines associated with deep waters, were identified as preferred sites for water-based log-handling facilities, by both licensees and the DFO.

As part of the BCAL application process, licensees are required to conduct dive surveys at proposed water-based log handling sites. The dive surveys are conducted by recognized experts in the field, acceptable to the DFO, and provide data regarding water depths, on site and nearby habitat values and flora and fauna in the proposed operational areas. These surveys are used by DFO to set conditions in foreshore lease agreements, and to make decisions regarding the need for compensatory habitat.

Proposed facility designs are reviewed for potential environmental impacts and recommendations made where necessary. Reviews of facility designs can include assessments of the following proposed features:

- dumping method,
- debris containment procedures,
- on site log storage locations,
- on site log sorting locations where applicable, and
- on site floating camp locations.

Proposed log dumping and storage methods are evaluated with respect to the potential for adverse impacts to the shoreline. Plans for controlling the introduction of woody debris, and preventing the introduction of contaminants such as oil and gas are also reviewed, and the

effectiveness of proposed debris containment procedures in the watered dumping area is also assessed. Proposed floating camps are evaluated in terms of proximity to potentially valuable habitats and specifications regarding sewage holding capability and depth of effluent discharge.

3.7.2 Site Preparation

Upland modification is generally required at log dumps. The extent and nature of upland modification required is determined by the specific dumping method used. For example, water drop helicopter dumping operations tend to require minimal upland development, while skidway operations typically require blasting of upland areas, road building and some modification of the foreshore, such as infilling. Direct load to barge operations also require upland clearing, road building, and some infilling of the foreshore at barge ramp/tie up areas, to accommodate safe loading and unloading. Generally speaking, less modification of the shoreline is required at a direct load to barge dump than a skidway dump. Crane operations require standard upland development procedures including blasting and road building, but usually do not require shoreline modifications such as infilling.

3.7.3 Log Dumping Methods

A variety of dumping methods with operation specific procedures, have been used on the North Coast. These methods include:

- vertical hoist methods (including cranes),
- direct load to barge,
- helicopter dumping, and
- skidways (slides).

Conversations with the licensees and the Ministry of Forests, indicate that the use of skidways (slides) to move logs into the water is the most common log dumping method in use on the North Coast, with skidways used at 100% of some licensee's conventional log dumps (*Drew McKay, pers.com*). The use of skidways over alternative methods is largely a function of cost. Crane and barge operations for example, can be prohibitively expensive. The use of helicopter dumps over other methods is often logistically impossible, as helicopters can only carry large loads like logs, or log bundles over short, 1.0-2.0 km distances.

Vertical Hoist Methods

Vertical hoist methods such as cranes and A-Frames, are not commonly used on the North Coast. Cranes situated in the upland working area, lift log bundles on land and place them in the water. A-frames work in conjunction with trucks and consist of a pulley system attached to 2 logs bound together in an A formation. Log bundles are loaded into the A-frame, which swings the bundles out and over the ocean and then lowers them into the water (*Shawn Hedges, pers. com).*

Direct Load to Barge

Direct Load to barge is also uncommon on the North Coast, but is used at over 10% of SBFEP operations (*Kevin Hill, pers.com*). Direct load to barge operations vary in specific

methodology, but can include the use of cranes or front-end loaders to load either single logs - or log bundles into a barge. Generally, logs are trucked into the upland section of the log dump and are moved directly into the barge. In some situations however, logs are trucked into the dumpsite and stockpiled on land, if the receiving barge is not yet in the working area. This would occur for example, when the barge is in transit to the log dump. Barges are much more expensive than the traditional tugboat transportation method, especially if the barge has to go any significant distance.

Water Drop Helicopter Logging

Helicopter dumping is common on the North Coast, with helicopter logging comprising an estimated average of 20% of logging operations in a given year. A variety of different sizes of helicopters are used in helicopter logging operations and the size of the aircraft, determines the weight and size of logs, or multiple pieces of timber that it can carry. Logs are attached to a helicopter by a ground crew, or with the use of a remote control grapple system operated by the helicopter pilot. Once the logs are attached, the helicopter flies to the drop pocket (located in the water), and drops the logs or bundles, typically at a depth of 10-m chart datum in marine waters and a minimum depth of 20-m in lakes. The drop pocket is referred to as the drop zone, and is double lined with boomsticks to contain logs and woody debris generated by dumping. Some water sorting may occur in conjunction with helicopter logging.

Skidways

Modern skidways are typically constructed entirely of metal, with slopes ranging from 30%-75% on the North Coast. A relatively smaller number of metal and log skidways are used on the North Coast, and are comprised of steel runners situated on top of parallel logs positioned on the slope. As recently as 2000, a skidway constructed entirely of wood, with 2-3 parallel logs wired together was used in Goat Harbour (*Bob Cuthbert, pers com).* Floating metal skidways have been recently introduced on the North Coast (*Brad Taylor, pers. com*) and consist of a pivot on the shore at the upland end, while the offshore end floats free in the water. The offshore end of the skidway is pushed into the water as the log bundle descend the skids.

At a skidway operation, logs are typically trucked into the upland operational area, bundled, placed on the skids with a loader and released. The log bundles then slide into the water. In some cases, loaders are used to push logs off a truck, onto the skidway, where the logs then slide into the water. Helicopters can also be used to transport logs to a road, where they are loaded onto a truck and transported to the log dump.

Log Transportation

Logs are transported from log dumps to central sorting areas and processing centers. They are typically transported in bundles, as opposed to flat rafts, to prevent the loss of individual logs during transport. Tugboats are well suited to towing log booms over short distances to sorting and processing centers. However, logs are generally barged over longer distances, and are also shipped to foreign markets. Barges can be towed or self- propelled. Smaller

barges on the North Coast have a capacity of 5,000 to 12,000 m^3, but larger barges travelling to Vancouver have approximate capacities of 150,000 tonnes (*Bob Cuthbert, pers.com*)

3.7.4 Log Storage

Logs are stored on the surface of the water at dumping operations, sorting and processing centers. On the North Coast, on site storage at log dumps is designed to occur at sufficient depths to prevent the grounding of the log bundles at low tide. When stored in deep water, log booms are held in place with anchors, can buoys and boom chains attached to boomsticks surrounding the log bundles. In more shallow water, booms can be held in place by chains attached to dolphins.

3.7.5 Log Sorting

Log sorting on the North Coast is typically carried out on land at dry land sorts. Although proposed water sorts were noted on Small Business development plans, they are uncommon on the North Coast. Licensees currently operating on the North Coast sort logs at their own dry land facilities at log dumps, tow logs to centralized dry land sorts like those in Prince Rupert, Port Edward and Ridley Island, and/or barge logs to lower mainland sorting facilities. Logs sorted in the upland sections of log dumps are sorted, scaled and bundled on land and then dumped into receiving waters. Logs towed to centralized sorts are bundled without being sorted, dumped into the water at log dumps and are then taken to centralized sorts. At the sorting facility the bundles are broken apart, the logs are dewatered and sorted on land. Once sorted, logs at central sorts in Prince Rupert, for example, can be watered and barged to the lower mainland for mill processing and export. Logs barged to sorting facilities, can be also removed from the barge with a front-end loader and placed on land. This prevents watering of the logs prior to sorting. Additionally, some dry land sorts unload barges with cranes, which are capable of moving entire bundles, also preventing watering of the logs prior to sorting.

3.7.6 Site Deactivation

Site deactivation and decommission procedures are site specific and generally have the goal of returning the operating area to conditions present in surrounding natural areas. Such procedures are outlined in foreshore lease agreements, and are determined through the BCAL referral process. In addition, formal deactivation projects are completed through the Watershed Restoration Program (WRP) and include site prescriptions and referrals.

Deactivation procedures vary depending upon the type of dumping method used at a log dump. For example, deactivation of a skidway log dump involves:

- road deactivation, including sediment control measures,
- removal of the skidway,
- removal of woody debris that has accumulated immediately below the slide,
- removal of infill materials and re-contouring of the slope where required,
- removal of floating woody debris, and
- grass seeding of exposed areas

The removal of foreshore infilling may not be required where it is shown to provide productive habitat. *Fucus* species for example, can colonize clean angular infill and provide important spawning habitat for herring.

Site deactivation at a helicopter log dump involves:

- removal of logs lining the drop pocket, and
- removal of floating woody debris.

Site deactivation at vertical hoist dumps, like crane operations involves:

- road deactivation in the upland portion of the operation to prevent sedimentation,
- removal of floating woody debris, and
- grass seeding of exposed areas.

Additional, general deactivation measures, suggested by Environment Canada, include the removal of dead heads, submerged woody debris, anchors and dolphins. Licensees are expected to consult with DFO prior to removing sunken woody debris.

3.8 Current and Alternative Water-Based Log Handling Practices Which Address Resource Management Issues

Current water-based log handling practices are the result of continued refinement of site selection criteria and operational procedures, with the goal of minimizing impacts to on site environmental, archaeological and social values. The use of more environmentally responsible handling methods has both positive and negative economic consequences for licensees. The implications of current and alternative handling methods designed to mitigate resource impacts are summarized below.

3.8.1 Site Selection

Historically, site selection of water-based log handling facilities was primarily a function of cost and convenience. As knowledge of non-forestry resources increased within the forest industry, and new environmental regulations and guidelines were developed by relevant government agencies, site selection procedures changed. Current site selection is a function of cost, and the identification and management of all resource values at a given site. This includes the identification of potential First Nations, fisheries, wildlife values at specific locations, prior to on site development of water-based log handling facilities.

As previously stated, dive surveys documenting flora and fauna, substrate and habitat types present in the proposed operational area must be completed by recognized professionals and submitted to DFO. Primarily because of potential conflicts with fish and fish habitat, licensees generally attempt to locate water-based log handling facilities in areas with marginal or poor fisheries values. Examples of such areas are moderate to steeply sloping rocky shores, with limited habitat complexity. It should be noted that DFO would reject a proposed site if it were planned in an area with sensitive habitat, such as eelgrass beds (*David Harper, pers.com*). First Nations fisheries and archaeological values are addressed in the BCAL referral process, through contact with specific First Nations, DFO and the

Archaeology Branch of the Ministry of Environment, Lands and Parks. Archaeological impact assessments and data recovery expeditions may be required, in the event that archaeological values will be destroyed by proposed development (*Ray Kenney, pers. com*).

3.8.2 Operational Procedures

Log dumping, transportation and storage methods have changed over time, to address the issues of habitat alteration and loss within operational areas.

Skidways

Modern skidways at conventional log dumps are primarily made of metal. The introduction of woody debris into the wetted operational area is greatly reduced through the use of metal, as opposed to wood, because the metal sliding surface is smoother and results in reduced bark loss when log bundles are dumped. The use of floating skidways further reduces bark loss and accumulation at the dumpsite, by reducing the speed of the log bundles as they hit the water.

Current skidway dumps can require shoreline infilling to ensure that the skidway is as close to the water as possible. In recent years however, licensees have tried to minimize and even eliminate the use of infill at log dumps. Infilling must be authorized by the DFO, as per section 35(2) of the Fisheries Act and where it is required, the use of clean blast rock as opposed to fill comprised of smaller particles is often stipulated in foreshore leases. The use of clean blast rock results in less sedimentation and when maintained on site, can provide structural habitat for marine flora and fauna, which may have been absent prior to development. Maintaining infill at log dumps post operations can be prescribed by DFO, where doing so will result in habitat creation or improvement.

Skidways are the most commonly used log dumping method on the North Coast. They can be re used and despite the somewhat substantial upland and foreshore development, skidways are the least expensive dumping method currently available.

Direct Load to Barge

Direct load to barge operations typically result very little introduction of woody debris in the operational area, as logs are moved directly from land, by crane for example, into a barge. As such, logs are never placed in the water and the potential for debris production and accumulation is largely eliminated. On site log storage problems are also eliminated using direct load to barge, as logs are never stored in the water. Direct load to barge operations, also require less shoreline infilling. The environmental benefits of direct load to barge are clear, as comparatively little habitat disturbance results. However, direct load to barge operation costs can be prohibitive, due to the high charge out rates of the limited number of tug and barge operators on the North Coast. Direct load to barge systems can be feasible if they are of short duration. For example, if a barge can be loaded, moved to a sort yard or processing facility and return to the dump-site within 1 day, then the costs may not be too high. However, if the same process takes 3-6 days, the costs can become unmanageable. When the barge is offsite, log loading stops and downtime results.

Helicopter Drop Zones

Helicopter water drop zones are generally short lived (up to 2 weeks) and require minimal foreshore development. However, logs are not always dumped in bundle form at helicopter drop zones, which increases the potential for woody debris introduction. Drop speed can also be an issue at helicopter drop zones, because logs hit the water directly as opposed to sliding into the water over a skidway. Excessive drop speed can result in increased bark loss and subsequent accumulation in receiving waters. Entire log losses have been noted at helicopter drop zones (White, 1999), which would result in the eventual accumulation of woody debris on site. Generally, helicopter drop zones are located 10-m at chart datum minimum depth in marine waters and at 20-m minimum depth in lakes. The purpose of dropping logs at these depths is to avoid physical damage to the tidal and littoral zones. Helicopter logging can be an expensive operation and the use of helicopter drop zones is limited by distance. The accepted limit of travel in helicopter operations is 1-2 km. Beyond this distance, the operation is generally not feasible.

Crane Operations

Crane log dumps, in which cranes are used to lower log bundles into the water at a controlled speed, result in less introduction of woody debris on site. Like skidway operations, they require site preparation and road building, but do not require the same amount of foreshore infilling (*Bob Cuthbert, pers.com*). Because of the controlled dumping speed and reduced shoreline development, less site disturbance results from a crane operation. However, similar to direct load to barge, crane operations are expensive and are not favoured by licensees.

Fuel and Contaminant Storage Guidelines for Water-Based Log Handling Operations

Additional environmental precautions implemented at log dumps include the controlled storage of fuels, oil and other potential contaminants necessary to the operation of machinery on site. In order to prevent marine or lake contamination, such contaminants are stored upland, away from the water. Guidelines for fuel storage are outlined in:

- CCME Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products (1993), and
- CCME Environmental Code of Practice for Above Ground Storage Tank Systems Containing Petroleum Products (1994).

Tanks located on federal land may have to be registered in accordance with the *Registration of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands*, under the Canadian Environmental Protection Act.

Floating Camps

Environment Canada sets conditions regarding the storage, control of debris and use of timber preservatives at floating camps housing staff at log dumps. As a result, environmental impacts associated with floating camps are minimized.

Timber preservatives are to be applied prior to the installation of treated wood at a floating camp. This time lag permits the total absorption of preservatives, preventing subsequent leaching into the water. Floating camps are to be designed and stored so that no part of the facility grounds at low water. Debris control measures are to be incorporated and the disposal of demolition materials must be carried out upland. Further, the disposal of preservative treated lumber via burning is not permitted. A summary of the Environment Canada Guidelines for Log Storage and Handling is provided in Appendix 4.

3.8.3 Log Bundling, Sorting, Transportation and Storage

Log Bundling

The dumping of logs as bundles, as opposed to individual logs, decreases woody debris entering the water at log dumps. Log bundling has the additional advantage of reducing the number of escaped logs at a dumping operation, resulting in fewer sunken logs and eventual decaying woody debris on site. Log bundling is also economically beneficial to the licensees, as fewer logs are lost than if logs were dumped in loose groups.

Log Sorting

Water sorting is now uncommon on the North Coast. Logs are typically sorted at dry land facilities located upland of log dumps or at central sort yards on the North Coast and processing centers on the South Coast. Water sorting with log dozers results in the introduction of woody debris into the water. Dry land sorting precludes the entry of woody debris in the water via sorting, and is therefore the preferred method.

Log Transportation

Barging logs as opposed to towing them in rafts via tug, reduces the amount of woody debris and lost logs entering the water. Barges can be towed or self propelled and used for short and long distances.

Log Storage

Log storage, either as bundles, or as loose single logs, in shallow waters can have serious implications for shoreline substrates, as well as inter-tidal plant and animal communities. At low water, logs that are stored too close to the shoreline can be grounded, resulting in substrate compaction and the destruction of individual animals and plants. Substrate compaction resulting from log grounding can be persistent (White 2001), reducing plant and animal productivity over time.

In recognition of this problem, log bundles are often stored offshore at sufficient depths to prevent low water grounding. No added costs were identified in association with deeper water log storage. In addition, logs stored on the water are contained in boomsticks, which prevent loose logs or bundles from escaping.

3.8.4 Site Deactivation

In order to mitigate long term impacts associated with water-based log handling facilities, site deactivation procedures including the removal and disposal of floating and upland woody debris, the removal of infill (where required by DFO) and the re-contouring of the slope are implemented. As previously stated, site deactivation procedures are prescribed by the regulatory agencies and are built into foreshore lease agreements.

3.8.5 Habitat Compensation

Habitat compensation is required by DFO, where habitat loss will occur as a result of water-based log handling operations. Decisions regarding the type and amount of habitat compensation to be built are site specific, and are made in the context of DFO's "no net loss" principal. The amount of compensatory habitat a licensee is required to build is based on whether or not is it the same as, different from, or of higher quality than the original habitat lost. Additional considerations include the time it takes for compensatory habitat to become productive. Compensation measures may include, but are not limited to the following:

- the use of new rock fill to replace lost intertidal habitat,
- the construction of intertidal marsh, and
- the installation of artificial reefs.

Similar to infill left behind at skidway dumps, new rock fill and artificial reefs are colonized by marine flora and fauna, providing three dimensional habitat and feeding zones for a wide variety of marine organisms. Intertidal marsh can provide important rearing habitat for juvenile fish species, as well as nesting habitat for songbirds and waterfowl.

Licensees are responsible for the construction and environmental monitoring costs associated with compensatory habitat. As a condition of the resulting authorization under section 35 (2) of the Fisheries Act, licensees are required to ensure that environmental monitoring is carried

out during and after construction, for a prescribed length of time. The results of post construction habitat monitoring are used to determine the need for improvement of compensatory habitat, also carried out by the licensee.

3.9 Current and Anticipated Water-Based Log Handling Facilities on the North Coast

3.9.1 Current Water-Based Log Handling Facilities on the North Coast

Log dumps are the most common water-based log-handling facility on the North Coast. There are a total of 26 active conventional log dumps on the North Coast, and the data for individual licensees is summarized in Table 3.

Table 3. Active Conventional Log Dumps on the North Coast

Licensee	*Log Handling Facility Type*	*Number of Active Facilities on the North Coast*
Boyle and Dean/Thomson Industries	Conventional log dump	1
Interfor	Conventional log dump	6
SBFEP	Conventional log dump	15
Triumph Timber	Conventional log dump	4

Helicopter drop zones are also common on the North Coast, but are more temporary in nature than conventional dumps. Interfor currently has 45-helicopter drop zones under permit, including 30 lake sites and 15 ocean sites. The lifespan of these drop zones is typically a maximum of 2 weeks and the use of helicopter drop zones is approved by DFO directly.

Log dumps vary with respect to dumping methods used on site. However, they also differ in size and duration of use. The size and duration of use of a log dump is related to the volume of timber to be watered at a specific operation. Boyle and Dean have used a small 15 m x 20 m log dump at Halfway Creek, where logs were dumped via skidway with a crane that either lifted logs and placed them into the water, or pushed logs off trucks, onto the skidway (*Bob Cuthbert, pers.com*). Larger dumps sometimes have associated sorting areas, or even multiple skidways. The SBFEP Kennedy dump/sort, is 100 m x 40 m. The multiple skidway operation in Triumph Bay is 70 m x 30 m and a private log dump on Porcher Island is 28 m x 65 m. The approximate average size of log dumps on the North Coast is 45 m x 25 m (*Bob Cuthbert, pers.com*).

The duration of use of log dumps in the North Coast, ranges widely from 1-30 years, depending on the related volume of timber harvested. Log dumps at smaller drainages are generally in use for 1-2 years, while larger drainages can require active log dumps for 15 to 30 years. Log dumps on the North Coast are not active year round, in part because of severe

winter conditions. Licensees have indicated log dump activity for roughly zero to eight months of the year.

The duration of use of a log dump is also associated with the rate of timber harvest in a given drainage. SBFEP for example, may only be active for 1 season in 4, and may remove 10-50% less timber than a major licensee would in the same area (*Kevin Hill, pers.com*). Log and lumber market conditions have a direct impact on the volume of timber harvested and watered through a log dump, which in turn effects the duration and intensity of use of a log dump.

The number of proposed locations of new log handling facilities is summarized in Table 4. A total of 43 conventional dumps, 72 heli drop zones, 17 water sorts and 6 dry land sorts are proposed. It should be noted that these numbers were derived from development plans and conversations with licensees, and that they do not reflect the total number of facilities licensees expect to receive approval for. Licensees expect to build a fraction, perhaps only $1/5^{th}$ of facilities indicated on development plans. As such, Table 4 does not indicate the total number of water-based log handling facilities that will be constructed on the North Coast.

Table 4. Summary of Proposed Log Dumps on the North Coast.

Licensee	***Log Handling Facility Type***	***Number of Log Dumps***
Boyle and Dean/Thomson Industries	Conventional log dump	1
Interfor	Conventional log dump	20
Interfor	Heli drop zone	54
SBFEP	Conventional log dump	18
SBFEP	Heli drop zone	18
SBFEP	water sort	17
SBFEP	dry sort	6
Triumph Timber	Conventional log dump	4

3.4.1 Future Development of Water-Based Log Handling Facilities on the North Coast

While specific pre-existing log dumps are reactivated for use on the North Coast, the development of new log dumps is expected to proceed at the rate of 1 per year, for the entire SBFEP and for each of the major licensees. Theoretically, the development of new dumps and subsequent storage areas should not be required in approximately 30 years time, when first pass old growth harvest will be complete (*Bob Cuthbert, pers com*).

4.0 Resource Management Issues Related to Water-Based Log Handling on the North Coast

4.1 Marine Resource Management Issues Associated with Water-Based Log Handling

Water-based log handling can impact on marine resources in the operational phases. Site preparation, log dumping, sorting and storage procedures can result in damage to the marine environment, if protective measures are not implemented.

Impacts Associated With Site Preparation

The construction of log handling facilities generally involves shoreline modification, which can result in marine habitat alteration or loss through the covering and/or infilling over shoreline habitat. In some cases however, modification can create more productive habitat than previously existed on site. Shoreline modifications resulting in habitat creation include the use of clean blast rock for shoreline infilling. Clean blast rock can be colonized by marine flora and fauna when the facility is not in use.

Impacts Associated With Log Dumping

The impact of log bundles hitting the submerged substrate at the foot of the log dump, during the dumping phase, can result in the loss of benthic marine life and compaction of the substrate. Organisms can be crushed under the impact of log bundles, leading to a reduction of animal and plant life in the areas of contact. Severe compaction of the substrate on site can render it useless to marine bottom dwelling animals, well after logging operations have ceased (Sedell et al. 1991).

Woody Debris Accumulation

The accumulation of woody debris during the dumping phase can result in the loss of marine life and reduced productivity. Bark deposits generally have a negative impact on marine benthic invertebrates, causing reductions in species diversity, abundance and biomass (e.g. Samis et al., 1999; Jackson, 1986). Such impacts can persist at inactive sites for decades.

Woody debris accumulations negatively impact on benthic marine invertebrates through smothering, and the degradation of water quality. Benthic filter feeding animals (such as clams) are buried by woody debris accumulations and subsequently "choke" on fine wood particles. They ingest wood particles that cannot pass through their digestive tracts, preventing them from further feeding. Water quality within the zone of debris accumulation becomes degraded due to ongoing decay processes and creatures living in the surface layer of bottom sediments cannot survive, leading to a lack of prey for larger marine creatures such as bottom feeding fish and crabs (Sedell, 1991; Williamson et al., 2000). Additional water quality issues are associated with the extensive mats of white bacteria, and/or biogenic precipitates, derived from the bacteria associated with wood decay (Williamson at al., 2000;Gray and Head, 1999).

The areal extent of debris accumulation varies, likely according to factors such as energy environment at the log dump and volume of wood handled. Data from six BC sites show that the area of woody debris impact can vary from 0.05 ha to 0.42 ha. in water depths above 20 meters. The area of impact at log transfer facility sites in Alaska varies from 0 to 2.75 ha. Table 5 presents relevant data from the North Coast, while Table 6 presents relevant data from log transfer facilities in Alaska.

Table 5. Woody Debris at Log Dumps in Northern BC.

Site	***Years Since Last Use***	***Volume of wood dumped (m^3)***	***Depth of Woody Debris[2] (cm)***	***Extent of Woody debris[3] (m)***	***Total Area Affected[4]*** ***(ha)***	**Area Affected Acutely[4]** ***(ha)***	***Tidal Flushing***
Kitkiata Inlet	1[5]	327,022	0 to 20	50+	0.15	0.03	moderate
Ochwe Bay	4	311,404	up to 40	65	0.42	0.13	moderate
Chapple Inlet	4	229,700	0 to 75	50+	0.24	0.18	Poor
Chambers Creek	0	88,000	5 to 50	50+	0.25	0.03	moderate
Steamer Passage	0	41,000	10 to 20	55	0.2	0.003	Strong
Marion Creek	1	30,000	0 to 15	15	0.05	0.016	good

Notes: 1. This is the number of years since the dump was last used counting back from the time of the assessment.
2. This is the depth of accumulated woody debris within the affected area at the log dump.
3. This is the distance from the log dump at which woody debris, which was of sufficient quantity that it could be reasonably assumed to be having a biological impact, was observed
4. The total area affected includes all areas where there is wood mulch, even if it is thin (<5 cm) or intermittent. The area acutely affected is where there is continuous wood mulch >5 cm deep.
5. This site was active from 1987 through 1990 (when 291 347 m^3 was dumped) and again in 1997 (when 35 675 m^3 was dumped).

Sources: White (1995, 1997, 1998a, 1998b, 1999a & 2000a); Presented with permission.

Table 6. Woody Debris at Log Transfer Facilities in Alaska

Site	*Years of Use*	*Facility Type*	*Volume of Wood (m3)*	*Mean Depth of Woody Debris (cm)*	*Area of Woody Debris (ha)*
Blind Slough	1983	beaver slide	235,833	0	0
Corner Bay	1974-79	beaver slide	117,917	15	0.64
Deep Bay	1981	lift-off	235,833	41	1.94
Hollis	1954-62; 1967	lift-off	705,142	24	0.41
Kina Cove	1954-59	lift-off	82,542	3	0.8
Margaret Bay	1960-70	lift-off	294,792	13	0.97
Mud Bay	1967-73	lift-off	330,167	35	0.67
Nakwsina Sound	1961-64	lift-off	87,258	0	0
Neets Bay	1954-60	beaver slide	141,500	21	0.32
Rodman Bay	1961-64	lift-off	330,167	20	0.85
Saginaw Bay	1961-81	lift-off	471,667	18	1.23
St. John Harbour	1982	lift-off	707,500	31	2.75
Woodpecker Cove	1982	lift-off	82,542	15	0.08

Accumulated woody debris can also move down slope from log dumps, impacting on marine life in deep water beyond the operational area. A recent deepwater investigation of woody debris accumulations in Alaska indicated that bark and woody debris accumulations, can cause reductions in species diversity and abundance up to 70 m depth. Using a manned submersible, bark and woody debris accumulations, and species and numbers of individual organisms were recorded along 6 transects near log handling facilities and 3 transects in control areas. Bark accumulations were noted up to 40 m depth on 6 dives and up to 70 m depth on 3 dives. Significantly reduced species richness was noted in all bark-dominated habitats (Kirkpatrick et al., 1998).

Log Escapement

Escaped or lost logs associated with log dumping and transportation can also result in woody debris accumulation in operating areas. Although submerged logs may provide initial habitat diversity, they ultimately decay to woody debris. Studies have suggested that large pieces of woody debris can, for a time, increase faunal diversity on site by providing otherwise unavailable substrates. For example, large pieces of woody debris can provide elevated surfaces for filter feeders such as plumose anemones, as well as cover for epifauna such as

coonstripe shrimp (*Pandalus danae*) and food for teredos (e.g. Conlan and Ellis, 1979). Williamson et al. (1999) noted several species on logs above sand/mud substrates, that would be unexpected in sand/mud substrates alone. Despite these initial advantages however, logs eventually decay and contribute to on site wood and bark accumulations, resulting in the well-documented reduction in faunal and floral diversity. Many logs have "escaped" from water-based log handling operations in the past and have impacted and/or altered the high/supra tidal habitat in some parts of coastal BC. The logging industry has succeeded in reducing the rate of "escape," but has not eliminated it entirely, as fresh logs were noted in high inter-tidal marshes, in a recent foreshore fish habitat assessment (White, 2000b).

Sinkers, or escaped sunken logs, can also occur in operational areas. Historic water-based log handling resulted in the losses of many logs, sometimes in relatively confined areas. Losses in these confined areas sometimes resulted in habitat alteration on the bottom of the receiving waterbody, with subsequent decreases in productivity. (*Eric White, pers. com*). One example of this type of log loss was noted in Clio Bay, where a deep-water video survey documented on the order of 10, 000 logs on the bottom of the bay (Bornhold and Harper, 2000) - sometimes in piles up to 10 meters high (*B. Bornhold, pers. com., 2001*).

There is also evidence of ongoing log losses associated with helicopter logging. In Ochwe Bay, White (1999a) noted several large logs with attached polypropylene chokers floating upwards in the bay at a helicopter drop zone. Postoperative foreshore assessments have identified logs on the sub-tidal foreshore in front of log dumps and examples of this are found at log dumps in Nasoga Gulf, Farrant Island, Captain Cove, Work Channel Kildala Arm. These operations are of varying sizes and have different operators, so it would appear that the problem is systemic rather than specific to one or two operators.

Impacts Associated With Log Storage

Storing log bundles directly against steep shorelines allows them to rub against the shoreline, resulting in the destruction of inter-tidal life at the points of contact. These losses are generally not universal within the zone of impact, as inter-tidal life in the hollows and crevices within the shoreline are protected from contact with log bundles. Shorelines impacted by shallow water log bundle storage, should recover naturally once the rubbing is eliminated. This recovery is facilitated by the presence of healthy inter-tidal life in the hollows and crevices of the shore, which would act as "seed" sources for re-colonization.

Shade under semi-permanently moored log booms or stringers, can cause reductions in seaweed abundance, with subsequent potential reductions in the marine invertebrate fauna relying on the seaweed. All seaweeds depend on sunlight for energy and growth and some, like the bull kelp (*Nereocystis lutleana*), are particularly shade intolerant (Carefoot, 1977). Shading under log booms could reduce seaweed growth if those areas are used semi-permanently, or are in use for most of the growing season (i.e. April to September). A reduction in seaweed under semi-permanently stored boom stringers was noted qualitatively in outer Kildala Arm (White, 2001d). A similar reduction was noted along the shore of a long-term boom ground in Clio Bay, south of Kitimat (White, 2000b). Generally however, quantitative data are lacking.

4.2 Wildlife

Water-based log handling operations have the potential to impact on wildlife populations through human disturbance, habitat alteration or alienation, and changes to prey abundance.

Noise and activity associated with water-based log handling facilities, may result in avoidance or abandonment of habitats near or within operational areas by wildlife. Blasting and road construction associated with site preparation for example may result in avoidance of operational areas by upland songbirds and game birds, as well as small and large mammals. Operations in the water, such as log dumping, may discourage the use of on site aquatic habitats by waterfowl, semi aquatic mammals and marine mammals. Reductions in benthos, shellfish, or finfish resources, resulting from water-based log-handling practices, may also impact on wildlife by reducing the available prey base.

Log booms in areas with limited human disturbance are used as haul outs by river otter (*Lutra canadensis*), harbour seal (*Phoca vitulina*) and sea lion. Harbour seal in particular favour log booms, as they provide protection against land predators (Duval, et al., 1980). River otter sometimes fish from log booms, while sea lions sometimes seek protection from winter winds behind beached logs (Duval et al., 1980).

4.3 First Nations

First Nations fisheries and archaeological values can be impacted by water-based log handling. Eulachon (*Thaleichthys sp.*), crab, ground and shellfish in particular can be affected. The Haisla have indicated that eulachon are very sensitive to noise (*John Scott, pers.com*), which is unavoidably associated with site preparation and operations at log handling facilities. Bark accumulation at storage and dumping sites can impact on traditional groundfish, shellfish and crab fisheries. Further impacts to fisheries values can be associated with tug boat sea bed scouring, which can result in physical habitat disturbance, and failed sewage storage at floating camps, which can potentially result in compromised water quality.

Archeological sites such as fish weirs, shell middens and upland features such as culturally modified trees (CMT's) may also be affected. Steps are taken in the site selection and BCAL application processes, to eliminate potential conflicts with First Nations values at potential log handling sites. These steps include documenting fisheries and archaeological values at a given site, and making the subsequent decision to move forward with proposed development, or abandon the site in favour of another.

4.4 Recreational Use

Recreational activities that can be affected by water-based log handling operations include:

- Boating
- Diving
- Marina development

Recreational diving is limited on the North Coast and marina development is largely restricted to Prince Rupert and Port Edward harbours. As such, these activities are rarely impacted by water-based log handling operations on the North Coast.

Boating

Water-based log handling can have both positive and negative impacts on boating activity. On the South Coast, log booms have been shown to provide temporary moorage to boaters using areas with few to no naturally occurring anchorages (Summary Report of Steering Committee, 1981). Concurrently however, loose logs and woody debris associated with water-based log handling have also created safety hazards for boaters, resulting in part from collisions (Summary Report of Steering Committee, 1981). These hazards have been reduced through the use of dry land sorts, bundle booming, log salvage and the transportation of logs via barge, which have reduced the amount of woody debris and loose logs in the water.

On the North Coast, many well-protected anchorages are too small, shallow or constricted to accommodate water-based log handling operations. Additionally, water-based log handling operations are typically located in deep water, with steeply sloping shorelines that provide limited suitable anchorage. As such, the potential for conflicts between water-based log-handling faculties and recreational boaters, is currently minor on the North Coast.

4.5 Aquaculture and Commercial Fishing

4.5.1 Aquaculture

The North Coast is poised for growth in the aquaculture sector. Beginning in 1997, BC Fisheries in conjunction with First Nations, established 27 experimental aquaculture sites on the North Coast (*Bill Heath, pers.com*). Species such as oysters, (*Crassostrea gigas*), scallops and manila clams (*Venerupis phillippinarum*), were grown at these experimental sites in order to determine the feasibility of aquaculture on the North Coast. The experiments demonstrated that aquaculture is feasible in the North Coast marine environment.

Currently, one full production aquaculture facility, (an oyster farm on Porcher Island), is in operation on the North Coast (Tamblyn and Horn, 2001). An additional abalone (*Haliotis sp*) farming license has been granted for the North Coast, but the facility is not yet in operation. Roe-on kelp farming is conducted on the North Coast by the Metkatla, Gitga'at, Lax Kw'alaams and Hartley Bay bands (*Hannah Horn, pers.com*), and one kelp farm has been proposed for the area.

Conflicts between aquaculture and water-based log handling have been documented for the South Coast and were primarily associated with the production and containment of woody debris. In one study, small particles of woody debris floated into sea pens and were eaten by fish used to feeding on matter floating on the surface of their pens (*Bill Heath pers. com*). Fish ingesting woody debris can develop "bloat syndrome" and die. Additionally, escaped woody debris has the potential to move into marine farms and pose boating safety hazards (*Bill Heath pers. com)*. Conflicts associated with site selection also exist. Aquaculturists prefer to use sheltered marine areas, also favoured by developers of water-based log handling facilities.

4.5.2 Commercial Fishing

Prawn Fishery

The BC Prawn Fishermen's Conservation Society, based in Powell River BC, was contacted regarding potential impacts of water-based log handling to commercial prawn fishing operations. The organization noted that their gear can sometimes catch on boom chains if they venture too close to log booms while fishing, but that this was a minor and avoidable problem. Two prawn fishermen have indicated that " the fishing is good" in areas where log booms have recently been removed (*Kim Mikkelsen, pers.com*).

Geoduck Fishery

Mike Featherstone, of the Underwater Harvesters Association, was contacted for information regarding the potential impacts of water-based log handling to commercial geoduck fishing operations. Although he had no specific information for the North Coast, he did provide examples of impacts that have been noted on the South Coast. He indicated that access to geoduck beds can be obstructed by log booms, which can pose a safety hazard to divers and vessels working in the vicinity of the booms. Additionally, he indicated that the accumulation of woody debris underwater can pollute geoduck beds, causing changes to the taste and colour of the clams, and even mortality under extreme circumstances.

5.0 Knowledge Gaps

Knowledge gaps regarding water-based log handling on the North Coast were identified by licensees and federal and provincial agencies. Additional knowledge gaps were identified through the investigation of resource management issues associated with water-based log handling.

5.1 Operational Issues

Knowledge gaps with respect to operational issues are associated with the lack of empirical or quantitative assessments of impacts associated with log dumps. The following is a summary of questions raised by interviewees, which are relevant to log dumps and operational phases of water-based log handling on the North Coast:

- What are the large-scale impacts of log dumps and are current levels of development and operations within scientifically, socially and economically acceptable levels?
- What is the correct interpretation of the "No Net Loss" principal, as it relates to development?
- Does infilling in non-critical intertidal or subtidal habitat, or the use of a log dump warrant a CEAA process, which is felt to duplicate the BCAL application process?
- What is the true nature of impacts associated with log dumps? For example, what is the true nature of impact to a 0.2ha area of marginal habitat, in an inlet that is 2,000 ha in size?

5.2 Fisheries

Detailed inventories of fisheries resources, including sensitive habitats and clam bed locations on the North Coast are lacking. Addressing the issue of cumulative impacts of water-based log handling on marine resources is problematic, in part because of this lack of inventory of marine resources. Currently, inventories of marine resources at specific proposed log dump locations are obtained through dive surveys. The extent and true nature of the impacts of water-based log handling operations on commercial fishing activity on the North Coast are also not well understood. Further, the success of operational conditions, designed to protect marine resources and set out in foreshore lease agreements, is not well understood.

5.3 Wildlife

Detailed inventories of bird use and bird habitats on the North Coast are lacking. The range of bird species, the locations of significant bird habitats (including deep-water marine feeding zones) and the densities of birds on the North Coast are not well known (*Sean Boyd*,

pers.com). As such, the impacts of water-based log handling on birds and bird habitat on the North Coast are unknown.

5.4 First Nations

The issues of ownership and jurisdiction over the harvest of resources, and the ability of resources to provide for First Nations at pre-contact levels, (or prior to historic management practices) were identified as knowledge gaps relevant to First Nations concerns (*John Scott, pers. com*). In addition, impacts of the historic exploitation of resources, including those affecting First Nations are not well understood.

5.5 Environmental Impacts of Woody Debris Accumulation

Deep Water Accumulations

The nature and environmental impacts of deep-water accumulations of woody debris are not well known and require further investigation. Investigation of potential deep-water impacts from woody debris should be completed to clarify what impacts are being incurred and what the implications of those impacts are. This issue is significant because the logging industry may be open to charges of impacting deep-water commercial fisheries, such as the prawn or crab fisheries, if there are no data to the contrary. Such investigations should include the evaluation of the sea bottom below helicopter drop zones.

Any investigation of this nature must include a control area - i.e. a deep-water assessment in an inlet where there has not been any logging. Natural landslides and mass wasting events have carried woody debris into some inlets. Preliminary habitat assessments have found pre-existing accumulations of woody debris on delta faces in watersheds where there has been no logging for many years.

The Relationship Between Currents and Woody Debris Deposition

The critical current conditions causing woody debris deposition are unknown. It was noted that "clean" sorts, like North Coast Timber, are located in high current areas and that facilities located in deeper waters, at lower current areas, would be expected to demonstrate increased debris accumulation (*Remi Odense, pers.com*).

5.6 Environmental Impacts of Shading

The impacts of shading on inter-tidal and sub-tidal seaweeds are not well documented and warrant further assessment.

5.7 Failed Colonization of Rock in Tidal Areas

In some cases, colonization of rock placed in intertidal areas has failed, or has colonized at a slower rate than at other sites. The factors inhibiting colonization of newly placed inter-tidal rock in areas where a lack colonization has been observed, are not well known and warrant further assessment.

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Ennis, G.	Department of Fisheries and Oceans, Vancouver, BC, May 2001
Harper, D.	Department of Fisheries and Oceans, Vancouver, BC,March 2001
Heath, B.	Ministry of Agriculture, Food and Fisheries, Sustainable Economic Development Branch, Courtenay, BC, March 2001
Hill, K.	Ministry of Forests, Prince Rupert, BC, March 2001
McKay, D.	International Forest Products, Terrace, BC, March 2001
Mikkelsen, K.	BC Prawn Fishermen's Conservation Society, Powell River, BC, March 2001
Scott, J.	Ministry of Forests, Prince Rupert, BC, March 2001
Sullivan, L.	Department of Fisheries and Oceans, Vancouver, BC, May 2001
Taylor, B.	International Forest Products, Terrace, BC, March 2001
Vanderstar, L.	Ministry of Environment, Lands and Parks, Smithers, BC, March 2001

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Appendix 1. Summary of Marine Log Dump and Storage Clauses Provided by the Ministry of Water, Land and Air Protection

Marine Log Dump And Storage Clauses

L1

The primary effects of log handling on the marine and estuarine aquatic environments are the physical changes from shading, grounding, and scouring by logs, debris accumulations, reduced current and wave action, scour from tugboat propellers and the chemical effects of leachates and reduced dissolved oxygen in water and sediment.

L2

The most vulnerable of the estuarine and marine nearshore resources and habitats to log handling and storage are marshes and areas of emergent or marine vegetation, shellfish and crustacean beds, herring spawning sites, and productive salmonid rearing areas including estuarine and marine littoral areas.

L3

Dry land handling and sorting is preferred to water handling and sorting, although the location of dry land facilities should not be adjacent to marine sensitive zones such as estuaries, salt marshes, herring spawning beds, or shellfish beds. Habitat Protection requests the proponent investigate an alternative marine or dry land log sort as the proposed marine location is in a sensitive marine zone. In general, dry land log sorts are less environmentally destructive as long as they are not adjacent to sensitive marine zones.

L4

Violent dumping of logs into water is discouraged as this is the major cause and point source of debris. Easy let-down devices should be employed for placing logs in the water, thereby reducing bark separation and the generation of other wood debris.

L5

Positive bark and wood debris controls, collection, and disposal methods should be employed at log dumps, marine storage sites, and other handling zones. This should be required for both floating and sinking particles. Log dumps should not be located in rapidly flowing waters or other water zones where debris controls cannot be effective.

L6

Accumulations of bark and other debris on the land and docks around dump sites should be kept out of the water.

Appendix 2. Summary of Contacts Regarding Water-Based Log Handling on the North Coast of BC

Contact Name	*Company, Agency or Organization Name*	*Address*
Rod Fowler	Boyle and Dean Logging Thomson Industries	Box 220 3974 Old Lakelse Lake Road, Terrace, BC V8G 4A6
Drew McKay	International Forest Products Ltd. (Interfor)	3712 Highway 16 East, Terrace BC V8G 5J3
Shawn Hedges	SBFEP North Coast	125 Marketplace, Prince Rupert, BC, V8J 1B9
Dino Dianah	Skeena Sawmills	PO Box 10, 5330 Highway 16 West, Terrace, BC, V8G 4A3
Sean Kenmuir	Triumph Timber	Box 220 3974 Old Lakelse Lake Road, Terrace, BC V8G 4A6
Andrew Robinson		
Stephanie Hazlitt	Canadian Wildlife Service (CWS)	5421 Robertson Road, Delta, BC
Sean Boyd		
Ken Brock		
Dale Gueret		
Uriah Orr	Department of Fisheries and Oceans (DFO)	228-417 Second Avenue West, Prince Rupert, BC V8J 1G8
Joy Hillier		
David Harper		
Gordon Ennis	Department of Fisheries and Oceans (DFO)	300-555 West Hastings St, Vancouver , BC.
Linda Sullivan		
Hal Nelson	Environment Canada	224 West Esplanade, N. Vancouver, BC, V7M 3H7
Leah Johnstone	British Columbia Assets and Lands Corporation (BCAL)	PO Box 5000, 3726 Alfred Avenue, Smithers, BC, V0J 2N0

Appendix 2. Summary of Contacts Regarding Water-Based Log Handling on the North Coast of B.C., continued.

Len Vanderstar	Ministry of Water, Land and Air Protection, (MWLAP)	PO Box 5000, 3726 Alfred Avenue, Smithers, BC, V0J 2N0
Bill Heath	Ministry of Agriculture, Food and Fisheries, Sustainable Economic Development Branch	2500 Cliffe Avenue, Courtenay, BC, V9N 5M6
Bob Cuthbert	Ministry of Forests (MOF)	125 Marketplace, Prince Rupert, BC, V8J 1B9
Kevin Hill	Ministry of Forests (MOF)	125 Marketplace, Prince Rupert, BC, V8J 1B9
John Scott	Ministry of Forests (MOF)	125 Marketplace, Prince Rupert, BC, V8J 1B9
Baron Carswell	Ministry of Agriculture, Food and Fisheries	PO Box 9359 STN PROV GOVT, Victoria, BC, V8W 9M2
Marv Clark	Forest Engineering Research Institute of Canada	Vancouver, BC
Ray Kenney	Ministry of Small Business, Tourism and Culture	Victoria, BC
Mike Featherstone	Underwater Harvesters Association	Whistler, BC
Dan Larsden	Underwater Harvesters Association	Coquitlam, BC
Kim Mikkelsen	BC Prawn Fishermen's Conservation Society	Powell River, BC
Dave Sturdevant	Department of Environmental Conservation (DEC)	410 Willoughby Avenue, Suite 303, Juneau, AK, 99801-1795

Appendix 3. Detailed Discussion of the LTF Permitting Process in the State of Alaska.

Permits Required

Water-based log handling facilities in the state of Alaska are called Log Transfer Facilities (LTF). Licensees are required to hold a minimum of 4 permits for log transfer facilities, which are granted by both federal and state agencies.

LTF permits fall into two classes, Pre 1985 and Post 1985, and have different application requirements. The Federal Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC), grant General Permits, which authorize the discharge of bark and wood debris from LTF's. Pre 1985 facilities are automatically provided with a general permit from the EPA, but are required to obtain a general permit from the ADEC. Post 1985 facilities are required to obtain general permits from both the EPA and ADEC. The federal US Army Corps of Engineers and the Alaska Department of Natural Resources also grant permits for LTF's. The US Army Corps of Engineers grants permits for structures built in waters and for the placement of fill material in waters or wetlands. One or both of these permits must be obtained for LTF's. The Department of Natural Resources issues permits and leases for use of state lands, including all waters and submerged lands. Permits issued by the DNR, are subject to a review by the Alaska Coastal Management Program (ACMP), a state coordinating agency which reviews federal and state permit applications for LTF's. The Alaska Department of Fish and Game (DFG), which manages fish and wildlife resources in Alaska also participates in the ACMP review process of proposed LTF's and the DEC permitting of LTF's. (http://www.state.ak.us/dec/dawq/waterpermits/ltf/ltffactsheet.htm)

Location Restrictions

Post 1985 permits exclude LTF development in the following areas:

- Protected waters
- State Game Sanctuaries
- Critical Habitat Areas
- State Parks
- National Parks
- National Historic Landmarks
- National Wildlife Refuges
- National Wilderness Areas
- Impaired Waters
- Steller's sea lion haul outs
- Rookeries
- Waters surrounding Kodiak and Afnogak Islands – if affecting Steller's eider
- Waterbodies in which bark accumulation already exceeds 1.0 acre in area and 10 cm in depth – at any point.

Additional siting criteria are derived from the Alaska Timber Force Guidelines, which address the issues of operational proximity to fish spawning and rearing habitat, site productivity, bark dispersal, sensitive habitats and log storage and rafting procedures.

Monitoring Requirements

Daily monitoring for oily sheen must be conducted at LTF's. If present, oily sheen must be documented, corrected and reported to the EPA within 24 hours. Annual bark monitoring is required for all pre and post 1985 permit facilities. Bark accumulations exceeding 1.0 acre (0.4046863 ha) in area and 10cm in depth – at any point in the operating area, are deemed unacceptable and require the implementation of ADEC sanctioned remedial procedures. Pre 1985 permit LTF's are required to submit the results of annual bark surveys if the LTF is expected to transfer 15 million board feet (mmbf or 35,375 m3) of timber or more within 5 years, and if the LTF is located at depths of <60 feet (18.288m) MLLW (mean lower low water – the equivalent of chart datum). Post 1985 permit LTF's are required to submit annual bark surveys if the LTF is expected to transfer 15mmbf (35,375 m3) or more over the duration of the General Permit and if the LTF is located in waters less than 60 feet (18.288m) deep MLLW. Bark survey methods are specified through the permitting system and the results of bark surveys must be submitted to the EPA, DEC and DNR within 60 days of completion. All LTF's must submit annual operations reports. Facilities must also maintain monitoring records and reports required by the permit and application data for a minimum of 5 years (http://www.state.ak.us/dec/dawq/waterpermits/ltf/ltffactsheet.htm).

Appendix 4. Environment Canada Guidelines for Log Storage and Handling.

General log handling operations have the potential to cause serious impacts to the local environment through the aquatic deposition of large amounts of secondary woodwaste (i.e.. bark. chips, etc.). Deposition of woodwaste can smother aquatic plants, benthic invertebrates and fish egg/alevins and also reduce the living space for juvenile fish Additionally, the decomposition of woodwaste and associated leachate reduces dissolved oxygen, increases acidity and produces toxic hydrogen sulphide and methane gases. Impacts at industrial log handling sites include an overall decrease in species diversity, abundance and biomass of the invertebrate community (i.e., food organisms for fish and water birds); the net result is often an area of significantly reduced fish and wildlife productivity.

To reduce the amounts of woodwaste introduced into the environment through log handling activities, and to direct the impacts to less sensitive areas we recommend the following as a general guideline:

(a) Storage areas should be off-set from any watercourse in mouth or wetland by at least 100 metres. Marshy areas, deltas, river and creek mouths, and areas of critical and valuable importance as fisheries and wildlife habitat, should be offset

(b) Log handling and sorting should take place on land as opposed to water,

(c) Logs should not be dumped or stored where grounding[1] particularly on sensitive areas, will occur;

(d) The free-fall violent dumping of logs should not be allowed to occur, since this is the major cause of loose bark and other debris. Easy let-down devices such as A-frames and stiff leg derricks should be used wherever it is technically feasible.

(e) Steel dumping bunks could be used for small, temporary log dumps. Logs should be bundled on dry land and methods for containing, collecting and disposing of bark and wood debris should be carefully applied.

(f) Log bundles should not be allowed to ground on the foreshore.

(g) Accumulations of wood debris on the land and docks around the dump sites should be kept out of the water.

(h) Upon site abandonment, the site should be rehabilitated to its original condition including removal of dead heads and sunken woody debris which is deemed unfavourable. Anchors and dolphins should also be removed. The Department of Fisheries and Oceans (OFO) should be consulted prior to removal of submerged wood debris.

With respect to helicopter drop zones, Environment Canada has previously discussed this issue with the Ministry of Forests as well as several helicopter logging operators. There was a consensus, which is still supported by Environment Canada that the following criteria should apply to such areas.

1. Drop zones should be located in a minimum of 70ft. (21.34m) of water.

2. Operators of aerial logging operations should recognize the importance of marshy areas, deltas, and the area around the mouths of Class 1 streams, as having a critical and valuable importance as fisheries and wildlife habitat. Where such areas are present adjacent to a drop/log storage zone, a buffer of not less than 100 metres (330 ft.) should be maintained between the above types of area and the active area of the logging operations.

3. Operators of aerial logging operations should recognize the importance of the foreshore in general as productive fish and wildlife habitat. In this regard, all activities must be carried out in a way that precludes the tidal grounding of any floating component on the foreshore.

4. Care should be taken to ensure that sewage disposal is adequate to prevent contamination to nearby waters. Land disposal of sewage is the preferred option, examples of this being pit privy, chemical/incinerator toilets, holding tanks (48 hour retention time) or septic tank and tile field located well away from the foreshore.

5. Any fuel stored or used on the site is to be contained and transferred as required in a manner that minimizes the risk of accidental spillage of fuel into the aquatic environment and appropriate clean-up materials are to be kept on hand to allow clean up of any spillage which may occur.

6. Operators of fuel storage facilities must be prepared for emergency incidents that result in unauthorized discharges. During an emergency there is no time to plan strategy, locate equipment, identify contacts, etc. These must be predetermined and contained in a contingency plan. The plan must be accurate and specific, be located as to allow for immediate reference and all facility personnel must be aware of their responsibilities in the plan. The plan should be updated annually at minimum and complimented with regular training and exercising. There are numerous documents available to assist in the development of a contingency plan including:

   - Guidelines for Industry Emergency Response Contingency Plans, BC Ministry of Environment$_1$ Lands and Parks; and
   - Emergency Standards for Industry - A National Standard for Canada, Canadian Standards Association (CANIGSA-Z731 -M91). Please contact Paul Ross, Emergencies Section, Environment Canada, (604) 666-6950 if you have further questions regarding the above.

7. Facilities with fuel storage can pose a significant threat of spillage to the marine environment. All such facilities should be designed, operated and maintained in accordance the CCME Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products (1993) and the CCME Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products (1994).

   These documents can be obtained from:

   Manitoba Statutory Publications Distribution Centre
   Lower Level,
   200 Vaughn Street
   Winnipeg, Manitoba, R3C ITS
   Telephone: (204) 94~664; Fax: (204) 945-7172

   As well, tanks located on federal lands may have to be registered in accordance with the Registration of Storage Tank Systems for Petroleum Products and Allied Petroleum Products on Federal Lands Regulations under the *Canadian Environmental Protection Act.*

8. No dredging or filling of the foreshore is to be involved unless specifically authorized in writing by the Department of Fisheries and Oceans and other agencies having jurisdiction.

Regarding any float camp proposal, Environment Canada typically attaches the following additional conditions to such facilities:

i. Any timber preservatives used are to be applied in the dry for a sufficient time prior to installation of treated timbers to allow complete absorption of preservative and prevent leaching into the water. A minimum of 45 days is generally required to satisfy this criterion.

ii. The facility shall be designed and located so as to preclude tidal grounding of any floating component on the foreshore.

iii. Effective debris control measures are to be maintained at all times in connection with the operation of this facility.

iv. All demolition materials are to be disposed of upland in an authorized manner. In this regard. It should be noted that burning of preservative treated timber is not permitted. Whenever possible, recycling of materials is encouraged.

v. All Department of Fisheries and Oceans concerns are to be fully addressed.